Dec. 13, 1966 S. A. RADLEY 3,291,190

GASEOUS FUEL BURNERS

Filed Aug. 28, 1963 3 Sheets-Sheet 1

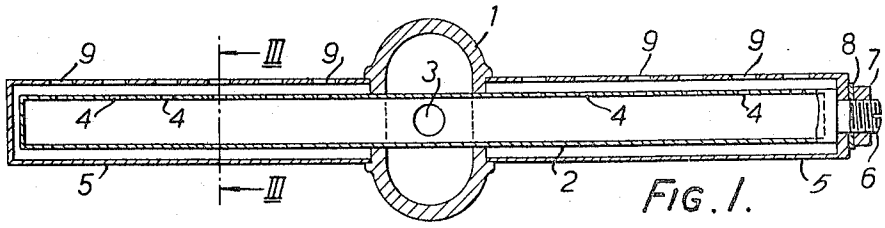

FIG. 1.

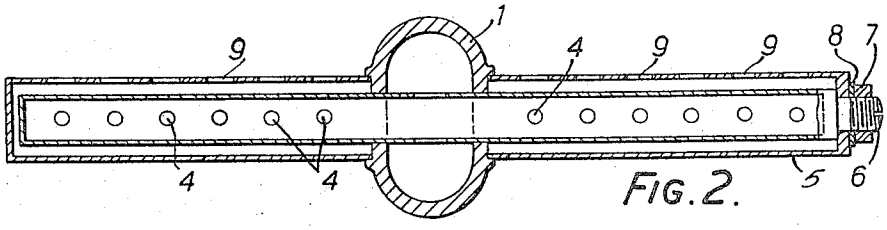

FIG. 2.

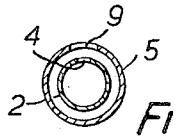

FIG. 3.

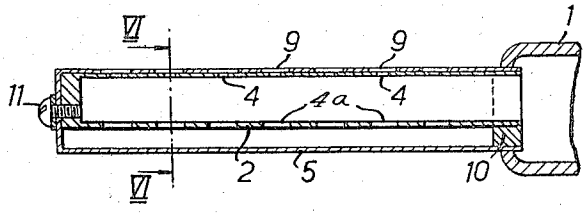

FIG. 4.

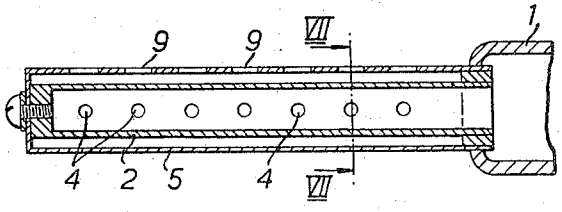

FIG. 5.

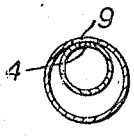

FIG. 6.

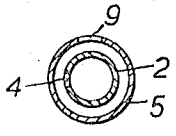

FIG. 7.

INVENTOR
S. A. Radley
By Holcombe, Wetherill & Brisbin
ATTORNEY

Dec. 13, 1966 S. A. RADLEY 3,291,190

GASEOUS FUEL BURNERS

Filed Aug. 28, 1963 3 Sheets-Sheet 2

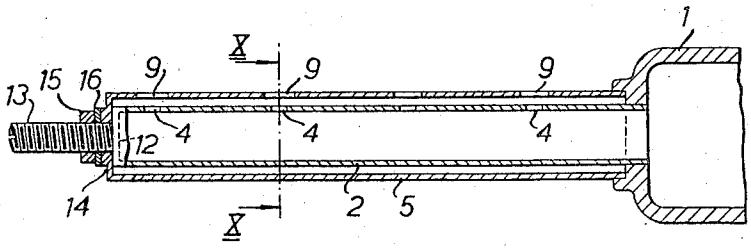

FIG. 8.

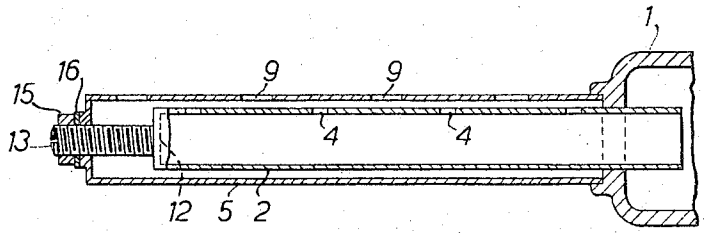

FIG. 9.

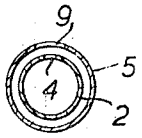

FIG. 10.

INVENTOR
S. A. Radley
By Holcombe, Wetherill & Brisebois
ATTORNEYS

Dec. 13, 1966 S. A. RADLEY 3,291,190

GASEOUS FUEL BURNERS

Filed Aug. 28, 1963 3 Sheets-Sheet 3

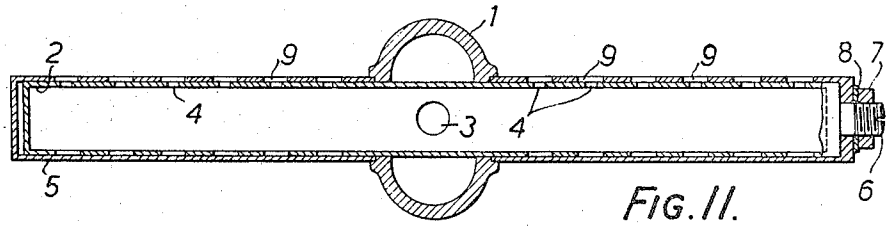

FIG. 11.

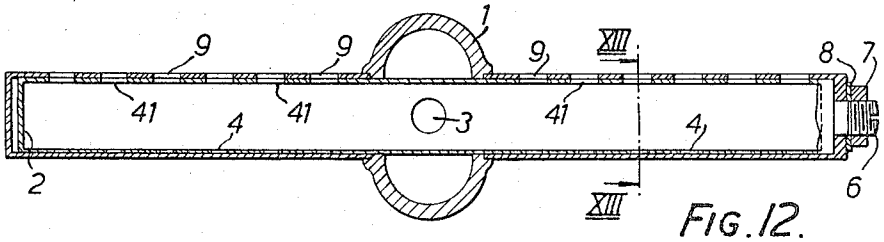

FIG. 12.

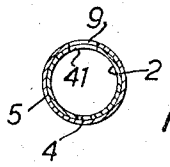

FIG. 13.

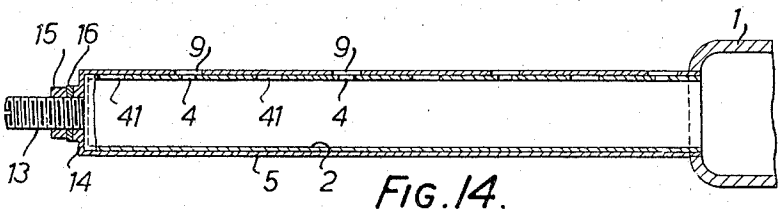

FIG. 14.

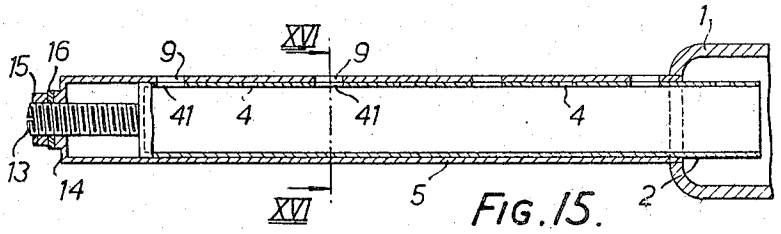

FIG. 15.

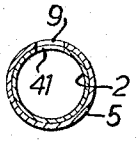

FIG. 16.

INVENTOR
S. A. Radley
By Holcomb, Dethmers & Bruinsma
ATTORNEYS

United States Patent Office 3,291,190 Patented Dec. 13, 1966

3,291,190

GASEOUS FUEL BURNERS

Stewart Albert Radley, Elstree, England, assignor to Radiation Limited, London, England, a British company

Filed Aug. 28, 1963, Ser. No. 305,133
Claims priority, application Great Britain, Aug. 30, 1962, 33,389/62
2 Claims. (Cl. 158—117)

This invention relates to burners for fuel in gaseous form which, however, may be stored in other than gaseous form, for example, as a pressurised liquid.

The invention in particular relates to gaseous fuel burners of tubular form which have burner orifices formed therein. The diameters of the orifices are related to the calorific value, among other things, of the gaseous fuel used and there are becoming used gaseous fuels having widely differing calorific values. For example, town's gas, or coal gas, has a compartively low calorific value, butane has a comparatively high calorific value, and natural gas and propane have calorific values falling between those of town's gas and butane. The cross-sectional area of the burner orifices, required for satisfactory operation of the burner, varies inversely with the calorific value of the fuel and a burner tube designed for use with one fuel may not be satisfactory for use with a different fuel.

It is an object of this invention to provide a gaseous fuel burner suitable for operation with fuels having different calorific values and specific gravities.

According to the present invention, a gaseous fuel burner comprises an outer tube having a set of burner orifices and an inner tube within the outer tube the inner tube being adapted to be coupled to a source of gaseous fuel and also having at least one set of burner orifices whose spacing is the same as, but whose orifice size is different from, that of the set of orifices in the outer tube and in which the inner tube is movable relatively to the outer tube so as to bring into and out of registration the set of orifices in the outer tube and a set of orifices in the inner tube.

Preferably, the orifices of the outer tube have larger cross-sectional areas than corresponding orifices of the inner tube. The inner tube may be mounted for axial movement within the outer tube but preferably is rotatably mounted therein.

In one arrangement, embodying the invention, a header tube for supplying gaseous fuel to the burner has a plurality of transverse drillings through which extend, on either side of the header tube, inner burner tubes, of circular cross section. The inner tubes pass through the walls of the header in substantially gas tight manner and are arranged to be capable of rotation or longitudinal movement. Each inner tube may have one or more apertures, in the region which is within the header tubes, for supply of gaseous fuel to the inner tube. The inner tube has burner orifices of relatively small cross-sectional area at spaced intervals along its length.

Also attached to the header in a gas-tight manner and surrounding the inner tube are outer tubes carrying burner orifices usually of larger cross sectional area than those of the inner tube.

Embodiments of the invention will now be described in greater detail with reference to the accompanying drawings of which:

FIGS. 1 and 2 show in diagrammatic form only sections of a first embodiment with one member thereof in different positions,

FIG. 3 is a section on line III—III of FIG. 1,

FIGS. 4 and 5 show in diagrammatic form only sections of a second embodiment with one member thereof in different positions,

FIGS. 6 and 7 are respectively, sections on line VI—VI and VII—VII of FIGS. 4 and 5,

FIGS. 8 and 9 show in diagrammatic form only sections of a third embodiment with one member thereof in different positions,

FIG. 10 is a section on the line X—X of FIG. 8,

FIGS. 11 and 12 show in diagrammatic form only sections of a fourth embodiment with one member thereof in different positions,

FIG. 13 is a section on the line XII—XII of FIG. 11,

FIGS. 14 and 15 show in diagrammatic form only sections of a fifth embodiment with one member thereof in different positions, and

FIG. 16 is a section on the line XVI—XVI of FIG. 15.

Referring first to FIGS. 1, 2 and 3, there is shown a header tube 1 of somewhat oval transverse cross-section and whose side walls are apertured to receive an inner burner tube 2. The inner burner tube 2 having each end stopped extends on both sides of the header tube 1 in which it is rotatably mounted in substantially gas-tight manner. The inner tube 2 is apertured as indicated at 3 to permit gas flow to tube 2 from tube 1, the size of the aperture or apertures if more than one is provided being appropriate to the gas flow required. The inner tube also has orifices 4 at spaced intervals over those parts of its length outside the header tube 1.

On each side of the header tube 1, outer tubes 5 with one end stopped are secured at the other end in gas-tight fashion to the header tube 1 surrounding inner tube 2. As can be seen, the inner diameter of the tube 5 is greater than the outer diameter of the tube 2 and since the inner and outer tubes are co-axial there is thus formed between the tubes an annular space whose dimensions are dealt with later.

At one end (the right-hand end as seen in FIGS. 1 and 2), the inner tube is formed with a shank 6 which passes through an aperture in the end wall of the appropriate outer tube 5 and is screw-threaded only over that part projecting beyond that end wall. The inner tube 2 is held against longitudinal movement and in a desired angular position relative to the outer tube 5 by means of a lock-nut 7. There is a leak-preventing washer 8 interposed between the lock-nut 7 and the end wall of the outer tube 5.

In most cases, a single fixing such as that described is sufficient for the inner tube but if necessary a collar may be formed at the other end of the inner tube and engaged with appropriate supporting means on the outer tube. Alternatively, some other form of location means may be provided to hold that other end of the inner tube centrally with respect to the outer tube.

The outer tube 5 has burner orifices 9 whose size is the maximum required for the lowest calorific value gas with which the burner is intended to be used.

The spacing between the orifices 4 is the same as that between the orifices 9 so that the orifices can be brought into alignment or registration as shown in FIGS. 1 and 3 by rotating the inner tube 2 and locking it. When the orifices are in registration as shown in FIGS. 1 and 3, gaseous fuel fed to the header tube 1 passes via aperture 3 to orifices 4 where it burns off. The spacing between the inner and outer tubes is such that the flames actually seat on the inner orifices 4.

If now the inner tube is turned into and locked in the position shown in FIG. 2, or even 180° from the FIG. 1 position, in which the orifices 4 and 9 are not in registration, gas passes via apertures 3 and orifices 4 into the annular space between the inner and outer tubes and burns off at the orifices 9, the flames seating on these orifices.

Both inner and outer tubes of the embodiment just described are of circular transverse cross-section (i.e. the cross-section in a plane normal to the axis of the tube) but it will be appreciated that this is not an essential condi-

tion. Provided that there is adequate clearance between the inner and outer tubes transverse cross-sections of other shapes, for example square or oval, might be used, provided also that the shape permits the requisite orifice registration.

In the burner shown in FIGS. 4, 5, 6 and 7, the inner tube **2** and outer tube **5** extend on one side only from a header tube **1** and the inner tube is eccentrically mounted with respect to the outer tube. The inner tube is supported at one end in a bearing member **10** and at the other by means of a screw **11** with a gas-tight washer which screws into the end wall **12** of the inner tube and serves also to lock that tube in a desired angular position. The connections of inner and outer tubes **2**, **5** with the header are, respectively, substantially gas-tight and completely gas-tight so that gas from header **1** gains access first to the interior of the tube **2**. The burner shown in FIGS. 4–7 functions in a manner similar to that described above with reference to FIGS. 1–3. Registration of the orifices in the inner and outer tubes as shown in FIG. 4 imparts the flame control to the orifices **4** whilst rotation of the inner tube to the position shown in FIG. 5 imparts control to the orifices **9**. It will be evident that, if desired, an additional set of different-sized orifices **4***a* can be provided on inner tube **2**, diametrically opposite the orifices **4** so that either set can be brought into registration with the orifices in the outer tube.

FIGS. 8, 9 and 10 show an embodiment of the invention corresponding in operation with the embodiment described above with reference to FIGS. 1, 2 and 3 but in which the inner and outer tubes **2** and **5** extend on one side only of a header tube **1** and in which the inner tube **2** is movable longitudinally with respect to the outer tube **5**. As in FIG. 1, the outer tube **5** has a set of orifices **9** and the inner tube **2** a set of orifices **4** whose spacing is the same as that of the set of orifices **9**. The inner and outer tubes are again of circular transverse cross-section, are co-axial and are separated from one another by an annular space.

Extending from an end wall **12** of the inner tube **2** is a threaded shank **13** which projects through a threaded boss on the end wall **14** of the outer tube **5** and which carries a lock nut **15** on its projecting part. Between the lock nut and the end wall **14** is a leak preventing washer **16**.

In FIG. 8, the sets of orifices **4** and **9** are in registration and combustion is determined by the orifices **4** on which the gas flames seat. After loosening the lock nut **15** the inner tube can be moved by screwing shank **13** to a position shown in FIG. 9 in which the sets of orifices are midway between orifices **9**. As an alternative, the orifices **4** may be orientated at 180° away from the orifices **9** at any intermediate position. In the position shown in FIG. 9, combustion is controlled by the orifices **9** in which the gas flames seat. It will of course be understood that the header tube **1** is of a size such that it can accommodate that part of tube **2** which projects into the header tube on movement of tube **2** to the right. Moreover, the connection beween the inner tube **2** and the header tube **1** is substantially gas-tight so that gas passes from header tube **1** into the interior of inner tube **2**.

The embodiment of the invention as shown in FIGS. 11, 12 and 13 is also generally similar to that described above with reference to FIGS. 1, 2 and 3 except that the inner tube **2** has an outside diameter such that there is effectively no clearance between the inner and outer tubes. Further, the inner tube **2** may have a number of sets of different sized orifices **4**, **41**, etc., whose spacing is the same as that of the orifices **9** in the outer tube **5**. Thus, by rotating the inner tube **2** after having first loosened the lock nut **7**, a particular set of orifices can be brought into registration with the orifices **9**. The size of the orifices in the inner tube **2** are selected in accordance with the different calorific values and specific gravities of the gas with which the burner is to be used.

An alternative embodiment shown in FIGS. 14, 15 and 16 employs longitudinal movement to bring the sets of orifices into registration, the operation being generally similar to that described above with reference to FIGS. 8, 9 and 10. The general construction of the burner shown in FIGS. 14–16 is similar to that of the burner described above with reference to FIGS. 8–10, the differences lying in the mounting of the inner tube within the outer tube and in the diameter of the inner tube.

The inner tube **2** has, in the embodiment shown, two sets of orifices **4**, **41** formed in a single line, the spacing between adjacent orifices in the line being one half of the spacing of the orifices **9** in the outer tube **5**. Thus, the spacing between the orifices **4** and that between the orifices **41** is the same as the spacing between the orifices **9**.

With the inner tube **2** in the position shown in FIG. 14, the orifices **9** register with the orifices **4** which control the combustion of gas issuing therefrom.

FIG. 15 shows a different position of the inner tube **2** in which the latter has been moved to the right as seen in the figure thereby bringing orifices **41** into registration with orifices **9**. In that position combustion is controlled by the orifices **9**. The pitch of the thread on shank **13** is so chosen to produce the requisite longitudinal movement and angular movement to bring orifices **9** and **41** into accurate registration.

Again, more than two sets of different size orifices may be formed in the inner tube **2** of the embodiment shown in FIGS. 14–16 and, if desired, some of the sets of orifices may be spaced circumferentially around the inner tube due allowance being made for the traverse resulting from the pitch of the thread so that the latter may have to be moved longitudinally and rotated to bring a particular set of orifices into registration with the orifices **9** in the outer tube **5**.

Although tubes of circular transverse cross-section are used in the embodiments shown in FIGS. 14–16, cross-sections of other shapes, for example square, may be used provided only longitudinal movement of the inner tube is employed so that the threaded boss as described above cannot be used.

The inner and outer tubes used in the embodiments of the invention described above will normally be formed from stainless steel sheet but other metals may be used instead.

Normally a gaseous fuel burner will comprise a header tube from which extend several inner and outer tubes, the number depending on the heat output required.

Again, although all the embodiments described above are the so-called "neat" gas burners, it will be understood that the orifices **9** in the tube **5** or the operative orifices in the inner tube **2** may act as injectors for aerated burners employing mixing heads. Such burners are well known and the design of the mixing head may take any one of any well known forms.

I claim:

1. A gaseous fuel burner comprising in combination an outer tube, a set of burner orifices in said outer tube, a coaxial inner tube within the outer tube and defining with said outer tube an annular space therebetween, said inner tube being adapted to be connected to a source of gaseous fuel, and at least one set of orifices in said inner tube whose spacing is the same as that of the orifices in the outer tube but whose orifice size is different from that of the orifices in said outer tube and in which the inner tube is movable relatively to the outer tube in such manner as to bring into and out of registration the set of orifices in the outer tube and a set of orifices in the inner tube.

2. A gaseous fuel burner comprising in combination an outer tube, a set of burner orifices in said outer tube and an inner tube within the outer tube, the inner tube being adapted to be connected to a source of gaseous fuel, and at least one set of orifices in said inner tube whose spacing is the same as that of the orifices in the outer tube but whose orifice size is different from that of the orifices in said outer tube, in which the inner tube is

movable relatively to the outer tube in such manner as to bring into and out of registration the set of orifices in the outer tube and a set of orifices in the inner tube, and in which the inner tube has an end wall having a shank which projects through an aperture in an end wall of the outer tube and is screw threaded over the projecting part, the inner tube being located in position by means of a lock nut screwed over the projecting part.

References Cited by the Examiner

UNITED STATES PATENTS

169,161	10/1875	Fouch	158—117 X
312,976	2/1885	Cowles	158—56

1,034,304	7/1912	Runnion	158—117
1,069,860	8/1913	Dale	158—117 X
1,172,295	2/1916	La Moy	158—117
2,257,605	9/1941	Hartley	158—117 X

FOREIGN PATENTS

19,327	8/1882	Germany.
6,794	1903	Great Britain.

JAMES W. WESTHAVER, *Primary Examiner.*

FREDERICK L. MATTESON, JR., *Examiner.*

H. B. RAMEY, *Assistant Examiner.*