March 3, 1970 J. P. D. HAKLUYTT 3,498,544

OIL FUEL BURNING APPARATUS

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Fig 1

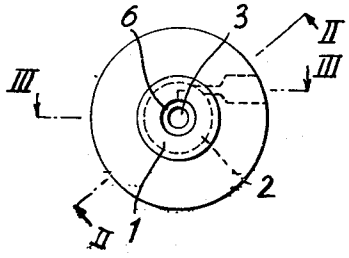
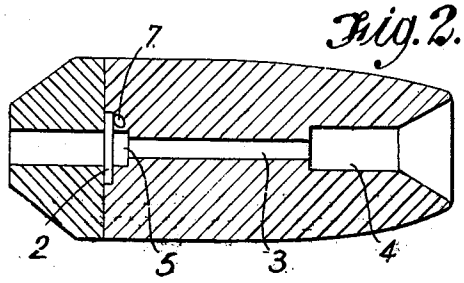


Fig. 2.



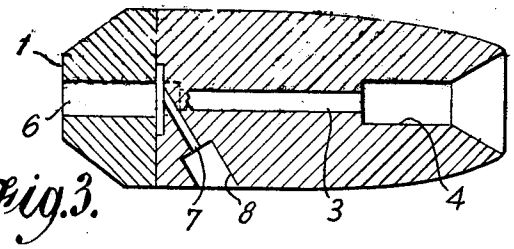


Fig. 3.

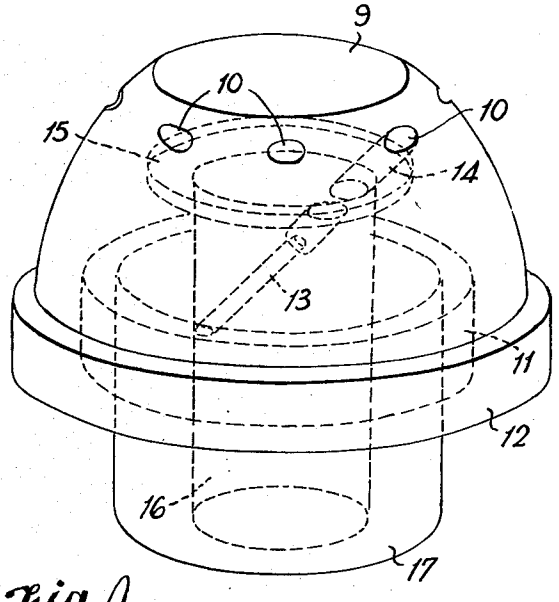


Fig. 4.

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OIL FUEL BURNING APPARATUS

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Fig. 5.

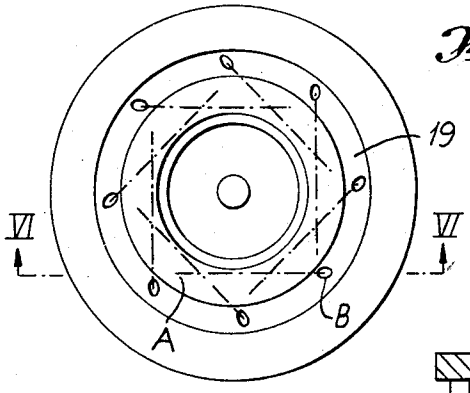


Fig. 6.

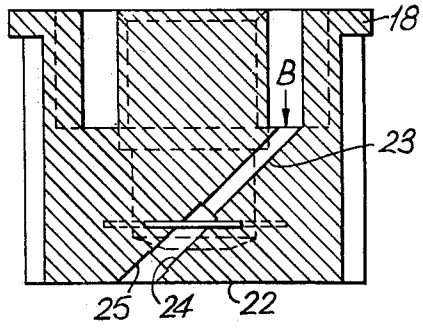


Fig. 7.

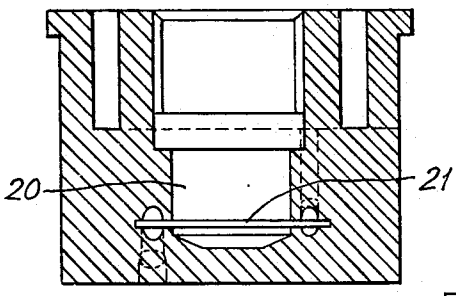
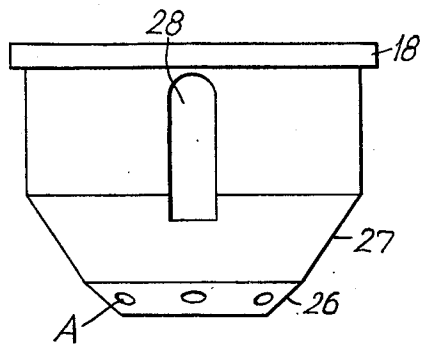


Fig. 8.



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OIL FUEL BURNING APPARATUS

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Int. Cl. B05b 7/10
U.S. Cl. 239—404 6 Claims

ABSTRACT OF THE DISCLOSURE

A head for a fuel oil spray burner in which fuel oil is atomised by a second fluid such as steam is arranged with at least one fuel jet fed from a fuel supply passage, the atomising fluid, preferably steam, being introduced to the fuel jet through a passage in the form of an annular chamber formed in the head, the two fluids being mixed before ejection from the head in a mixing chamber at an outer portion of the, or each, jet passage. Where a plurality of jets are provided these are preferably symmetrically arranged around the axis of the head and the annular chamber is common to all the jets which may be arranged to be generally convergent or divergent or to impinge upon one another.

This invention relates to oil fuel burners and more particularly to jet spray burners in which liquid fuel is atomised by the use of a second fluid.

In the case of atomisers where, for example, fuel oil is atomised by steam or air, it is understood that fouling of the atomiser surface occurs as a consequence of oil accumulations which carbonise. Such fouling leads inevitably to shut-down for cleaning purposes since the deterioration of atomisation associated with the fouling and blockage is cumulative and unacceptably serious. It is considered that the accumulation of fouling due to oil carbonisation is governed principally by the temperature of the surface and by the area thereof presented to the radiation sources. In the one case, the temperature should be minimised and, in the other, the area should be minimised.

To meet these requirements a design of atomiser has been described in the specification accompanying co-pending patent application Ser. No. 634,335, now Patent No. 3,452,933. That design had been devised with the following objects in view:

(a) To reduce the size of the atomiser face and to shape the atomiser head profile in such a way that the location of the breakaway of the boundary layer is changed and thereby cooling may be improved,

(b) To reduce the "bluff body" effect of the atomiser head diameter by fairing the head so that the vertical recirculation, with its axial zone of low pressure, may be minimised,

(c) To discharge the fuel spray most advantageously, with respect to the zone of recirculation, for the purpose of mixing,

(d) To provide the maximum cooling effect which is to be derived from the two fluids at the atomiser face where said cooling is required in order to keep the surface temperature below a certain point, above which carbonisation may occur and below which, it may not.

A two-fluid atomiser involves the introduction of separate fluids to the burner head and various proposals have been made for leading the two fluids into their respective paths so as to cause emission of jets of the fuel oil from the burner head and in the known arrangements of burner complicated drillings have been necessary. It is

an object of the present invention to provide a modified form of burner which is simpler to manufacture.

In a spray burner in accordance with the invention, the jet passage is associated at its inner end with a supply passage for feeding one fluid and at a region intermediate its ends with an annular zone through which the second fluid is to be supplied, an outer portion of the jet passage forming a fluid mixing chamber wherein the two fluids are to be mixed before being discharged from the burner.

The jet passage will normally be straight and along the axis of the burner head.

A spray burner in accordance with the invention may comprise a plurality of jet passages arranged in a burner head and the intermediate portions may then be arranged to be associated with a common annular zone through which the second fluid is to be supplied. In this arrangement the inner ends of the jet passages are preferably associated with a second common annular zone through which the one fluid is to be fed.

The jet passages in the multi-jet head will normally be straight and their axes may be in planes containing the axis of the head, in which case the jets will probably be arranged to impinge against each other to produce a divergent spray pattern.

In one form of multi-jet head according to a feature of the invention the axes of the jets are arranged, as in the arrangement of jets disclosed in the specification of the above-numbered co-pending application, to be skewed, relative to each other so as to provide the desirable divergent spray pattern; in this arrangement, however, the spray pattern may be obtained without impingement of the jets one upon another.

In another form of burner in accordance with the invention, the common annular zone for the supply of the second fluid is in the form of a very narrow annulus extending co-axially with the burner axis and the jet passages are arranged to pass through this thin annular zone at intermediate positions so that the issuing jets are convergent. Such a head may, for example, be formed by the well-known investment casting methods.

Preferably the said annular zone is used to supply atomising fluid and the said supply passage to supply the fuel; also the inner end of the jet passage is preferably arranged to be of smaller diameter than the outer end, the passage opening to larger diameter before passing through the annular zone. Then, if the atomising fluid is pressurised steam, the fuel emerges from the smaller diameter as a jet and is surrounded by steam. The effect of this latter arrangement is that the walls of the mixing chambers are not wetted by the fuel and the formation of large droplets of fuel is less likely to occur and may, in fact, be prevented entirely.

In order that the invention may be more fully understood, particular arrangements of burner head will now be described by way of example with reference to the accompanying drawings of which:

FIGURES 1, 2 and 3 show a burner of the single jet type, FIGURE 2 being a view on the line II—II of FIGURE 1 and FIGURE 3 being a view on the line III—III of FIGURE 1,

FIGURE 4 shows a multi-jet burner of one form, and FIGURES 5 to 8 inclusive are illustrative of a method of forming a burner similar to the form shown in FIGURE 4. FIGURE 5 shows a view from the fluid supply end of a blank, partly machined, for the burner, FIGURE 6 a section on the line VI—VI in FIGURE 5, FIGURE 7 a section on the line VII—VII in FIGURE 6 and FIGURE 8 a side elevation of the finished form of burner.

In order that the invention may be more fully understood, one arrangement of burner head will now be de-

scribed by way of example with reference to the accompanying drawing.

Referring to FIGURES 1, 2 and 3, the burner (or atomiser) head is faired-off to a face **1** of comparatively small area. The body of the head is made in two parts as indicated in FIGURES 2 and 3, secured together as by brazing and the one part is formed with a recess **2** before the parts are secured together. Fuel porting **3** is provided in the head, the supply end of this porting communicating with a bore **4** for receiving the end of a fuel supply pipe (not shown) in the burner to which the head is attached. The outer end of the fuel porting feeds into a larger diameter bore **5** that extends through the recess **2** and forms a mixing chamber **6**. The recess **2** is then an annular zone for the supply of atomising fluid to the mixing chamber. Atomising fluid, such as steam, is led to the burner through a pipe (not shown) which is secured within a side bore **7** leading to the porting **8** which opens into the annular zone of recess **2**.

Fuel oil fed to the portion **3** passes through the annular zone **2** as a fine jet and atomising fluid from the annular zone surrounds this jet so that the fuel oil enters the mixing chamber **6** surrounded by atomising fluid; the wall of the mixing chamber is, therefore, not wetted by the fuel oil. Mixing takes place between the oil and the atomising fluid as they pass through the mixing chamber and the mixture emerges from the head in a spray pattern as required, the dimensions of the portings **3** and **7** of the annular zone and of the mixing chamber being chosen to suit the conditions required. In particular, the diameter and axial depth of the annular zone **2** are to be such as to provide an assured distribution of atomising fluid to the mixing chamber around the periphery of the jet. It will be evident also that its axial depth may have to be limited in some way so that it is appropriate for the jet of fuel issuing from the porting **3**. A further bore (not shown) can be introduced at outlet from the mixing chamber, as a small arbouring, if desired for calibration purposes.

In the arrangement of multi-jet burner head shown in FIGURE 4, there is a fairing-off of the body to a face **9** of comparatively small area and grouped around the face are a number of discharge orifices **10**, each of which forms an outlet for an atomised spray jet. Fuel is fed to an annular chamber **11** which is formed in the face of the fixing flange **12** by which the head is held in the burner. Fuel supplied to the chamber **11** emerges through inclined portings **13** into mixing chambers **14** in which the fuel is first surrounded by atomising fluid entering the mixing chamber from the annular passage **15**; mixing of the fuel and atomising fluid then takes place to enable the fuel to emerge from one of the orifices **10** as a spray. Each system of fuel porting and mixing chamber, of which only the one is shown for the sake of clarity, behaves substantially as the single system in the arrangement of single jet sprayer described above with reference to FIGURES 1, 2 and 3, the annular passage **15** being common to all systems in the multi-jet arrangement. Calibrating arbouring may, of course, be provided also in the multi-jet arrangement. The annular passage **15**, in the arrangement illustrated, is fed from a central feed passage **16**, the head being formed with an axial extension **17** to enable the fuel and atomising fluid feeds to be separated for convenient attachment of the head to the burner.

The inclination of the axes of the jets is used advantageously to induce rotational velocity with benefit to the efficiency of the process of mixing the fuel spray with combustion air in the air register with which the burner may be used in a boiler or other heating installation.

It will be appreciated that the diameters of the gallery **16** and of the annular passage **15** as well as the axial depth of the latter should be such as to provide an assured supply and of adequate distribution of the atomising fluid to each mixing chamber around the whole periphery of the jet system in the chamber; as has been stated above in connection with the arrangement of FIGURES 1, 2 and 3, it will be evident also that there may need to be some limitation of axial depth of the annular passage in order that it should be appropriate for the jet of fuel issuing from the fuel porting.

The arrangement of the spray orifices comparatively close together and the small area of the face **1** of the head assist in overcoming the disadvantage hitherto met of accumulation of deposits due to oil carbonisation at the face. Also as mentioned above, the fact that the mixing chamber walls are not wetted by liquid fuel assists in the prevention of large droplets of fuel which might result from such wetting, these droplets tending to be carbonised at exit from the orifices.

FIGURES 5, 6 and 7 illustrate a method of machining a form of head similar to that shown in FIGURE 4, FIGURE **5** being a view in the direction of the arrow V in FIGURE 6, and it will be seen that it is first necessary to provide a cylindrical blank having a flange **18**; the material will be that best suited in respect to use and of machining and will probably be of steel but possibly of brass, the use of any other alternative, however, not being ruled out.

The annular passage **19** and the gallery **20** are formed to the desired dimensions, the outer end of the gallery being opened up and internally threaded to enable a pipe for the atomising fluid feed to be secured to the head. The annular passage **21** is suitably milled into the wall of the gallery.

The drillings are made in the face **22** of the blank to the diameter of the fuel portings **2** to break into the base of the annular passage as shown for example, at B. The number, diameter and inclination of the portings will depend upon the performance required by the burner and details such as these are discussed in the specification of the co-pending application referred to above. These drillings will of course be positioned also to break through the annular passage **21**.

Thereafter the drillings will be opened up from the face **22** to the diameter of the mixing chambers **24**, these further drillings being carried through to the other side of the annular passage as shown. Finally, the outer ends are drilled to the dimensions of the arbours **25** which, in the finished form shown in FIGURE 8, form the orifices, such as indicated at A associated with entry B, in the chamfer **26** superimposed on the chamfer **27** to simulate a fairing-off of the head. Slots **28** milled at 120° intervals provide for use of a C-spanner or the like for screwing the head on to the atomising fluid feed pipe.

It will be evident that, in either the multi-jet heads above described, the fuel oil and atomising fluid feeds may be changed over so that the fuel oil is fed through the annular passage. Although in such arrangement the advantage of non-wetting of the mixing chamber walls with liquid fuel is lost, there may be burner applications where wetting will not be so disadvantageous.

If wetting is not considered to be a disadvantage in any particular application, it is envisaged according to a further feature of the invention that the annular passage may be so dimensioned and/or positioned that the breakthrough of the second fluid porting(s) is not symmetrical; in other words, the portings may, for example, simply break into the edge of the annular passage.

It will be evident that the head can be so formed that, whereas in the designs illustrated in FIGURES 4 and 5 to 8 the axes of the fuel sprays are convergent, there is, alternatively, either impingement of the sprays on the axis of the head, or divergence of the spray axes. Certainly, by use of the convergent or divergent design of head in accordance with the invention, a presentation of transit paths in the general spray pattern for combustion air from the outside of the axisymmetric flame to the inside may be obtained which will be conducive to the promotion of flame stability.

Other points and variations within the general concept of the invention will be evident to those skilled in the art.

I claim:

1. A head for a fuel oil spray burner in which the fuel oil is atomised by means of a second fluid, at least one jet passage in said head for one fluid, said jet passage being associated at its inner end with a supply passage for the one fluid and at a region intermediate its end with an annular zone in the head through which the second fluid is to be supplied, the said jet passage passing through this annular zone and communicating therewith about substantially its entire periphery such that the second fluid surrounds the one fluid as the one fluid passes through the said annular zone, an outer portion of the said jet passage forming a fluid mixing chamber where the two fluids are to be mixed before being discharged from the head.

2. A head for a fuel oil spray burner as claimed in claim 1, wherein there is only one jet passage axially situated in a generally cylindrical body and the supply passage for said jet passage is axially situated at one end of said body.

3. A head for a fuel oil spray burner as claimed in claim 1, comprising a plurality of jet passages, each jet passage being at an inclination to a plane containing the axis of the head and said jet passages being substantially symmetrically disposed around said axis.

4. A head for a fuel oil spray burner as claimed in claim 1, comprising a plurality of jet passages, each jet passage being at an inclination to a plane containing the axis of the head and said jet passages being substantially symmetrically disposed around said axis and the axes of the jet passages being generally convergent.

5. A head for a fuel oil spray burner as claimed in claim 1, comprising a plurality of jet passages substantially symmetrically disposed around the axis of the head, the axis of each jet passage being substantially in a plane parallel to the said axis of the head.

6. A head for a fuel oil spray burner as claimed in claim 1, comprising a plurality of jet passages substantially symmetrically disposed around the axis of the head, the axis of each jet passage being substantially in a plane containing the said axis of the head and the axes of the jet passages being generally convergent.

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EVERETT W. KIRBY, Primary Examiner

U.S. Cl. X.R.

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