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LIQUID-FUEL COMBUSTION CHAMBER

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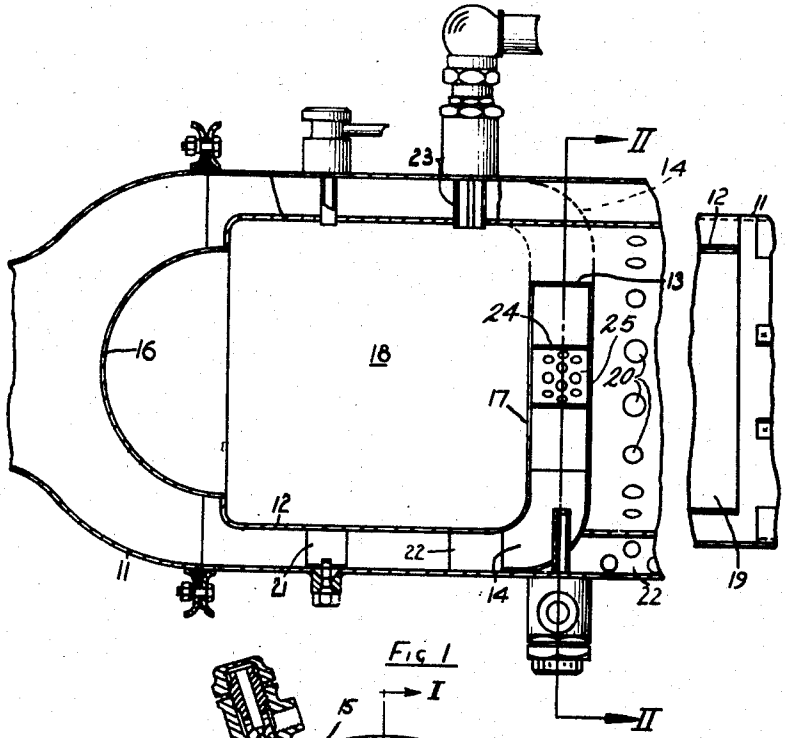


Fig 1

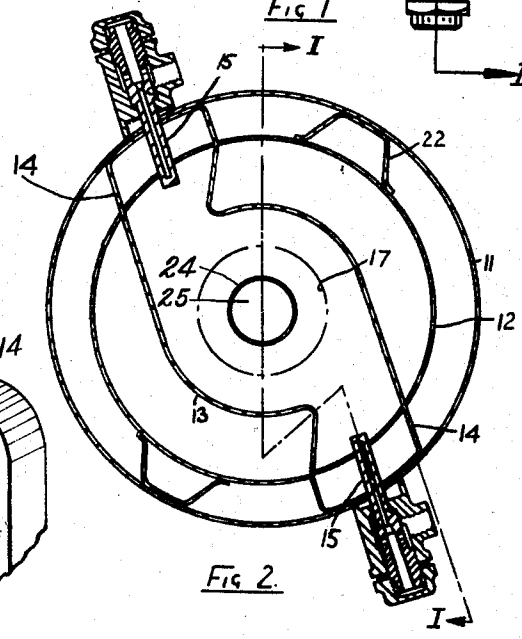


Fig 2.

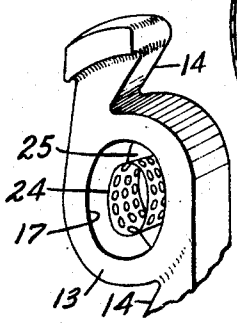


Fig 2a.

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LIQUID-FUEL COMBUSTION CHAMBER

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4 Claims. (Cl. 158—28)

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This invention relates to a liquid-fuel combustion apparatus, and particularly to a heavy-fuel combustion apparatus for an internal-combustion turbine plant, though the use of the combustion apparatus is in no sense restricted thereto.

Our main object is to provide means whereby to ensure rapid and very complete combustion.

A further object is to provide a combustion-initiating chamber, in which injected fuel and primary air are mixed, which is pre-heated by a burning mixture. Preferably, the arrangement is such that the mixture of injected fuel and primary air emerges from the combustion-initiating chamber through a sharp-edged orifice (so as to provide turbulence) into an enclosure whence it is returned externally to heat the combustion-initiating chamber before being mixed with the diluent air.

A further object is to provide a liquid-fuel combustion apparatus which incorporates at least two combustion-initiating chambers acting in series into each of which a portion of the fuel and primary air is supplied, the arrangement being such that the burning mixture from the first chamber serves for vapourizing the fuel and heating the air of the next chamber. Preferably, the mixture from the first and/or the second chamber emerges through a sharp-edged orifice.

In any of these constructions the combustion-initiating chamber may be cylindrical, the primary air being led tangentially thereto.

By raising the temperature of the combustion-initiating chamber (or of the second combustion-initiating chamber, as the case may be) before ignition takes place, the speed of chemical combination of the fuel and air (which varies approximately as the square of the absolute temperature) is increased. Furthermore, the effect of the fuel being vapourized in suspension in the air assists in ensuring efficient mixing of the fuel and air, whilst the increased vigour of the chemical action provides increased turbulence thereby increasing the chance of each particle of fuel finding the necessary oxygen. By this means very complete combustion can be obtained with a relatively-small combustion apparatus.

For a better understanding of these and other objects and advantages of the invention attention should be directed to the following description in which reference is made to the accompanying diagrammatic drawings, wherein:

Figure 1 is a fragmentary longitudinal section through one form of combustion apparatus according to the invention, the section being mainly on the line I—I of Figure 2;

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Figure 2 is a cross-section taken mainly on the line II—II of Figure 1; and

Fig. 2a is a perspective detail of the combustion-initiating chamber.

In the construction of Figures 1 and 2, as applied to a combustion apparatus for an internal-combustion turbine plant, the compressed air is led along a tube 11 axially within which is disposed a thimble-like member 12 containing in its interior, approximately mid-way of its length, a combustion-initiating chamber. This is conveniently a hollow cylinder 13, coaxial with the thimble-like member 12, provided with two tangential inlets 14, 14 for primary air collected from the main air stream passing between the thimble-like member and the tube 11, and the fuel may be injected into the inlets, as shown at 15, 15, or into the interior of the combustion-initiating chamber. An apertured cylinder 24 is arranged centrally in the hollow cylinder 13, being conveniently carried by the wall 25. On its face adjacent the closed end 16 of the thimble-like member, the closed end 16 being towards the flow of compressed air, the cylinder 13 is provided with a sharp-edged orifice 17 through which the burning fuel and primary air passes, turning round in the space 18 between the combustion-initiating chamber and the closed end 16 of the thimble-like member to impinge against and pass round the sides of the combustion-initiating chamber, thereby to pre-heat it, before emerging from the open end 19 of the thimble-like member to join the diluent air, which is in the form of an annulus surrounding the thimble-like member. Openings 20 may be provided in the thimble-like member to admit additional air from tube 11 for completing combustion.

We have found that the forward speed of the gases at the center of the vortex in the combustion-initiating chamber 13 is low, as a result of which the flame base tends to rest on the base wall 25, thereby causing over-heating. The object of providing the perforated tube 24 is to destroy the vorticity of the gases within it, thus increasing the forward speed of the gases and keeping the flame base from the wall 25. In addition, the tube 24 increases the velocity of the gases leaving the combustion-initiating chamber and assists in giving better mixing.

Where the thimble-like member 12 and the said tube 11 are mechanically connected to one another, as at 21, 22, or where any part passes between them, such as the igniter 23, a stream-

lined fairing may be provided in a manner well understood.

In this way the self-heated combustion-initiating chamber serves for pre-heating the swirling primary air and injected fuel and for vapourizing the latter, and the sharp-edged exit orifice 17 serves for introducing turbulence to increase the mixing of the fuel and air, so that very rapid and complete combustion is obtained.

Obviously, if desired, a second combustion-initiating chamber could be mounted further along the combustion apparatus, and obviously, in practice, use may be made of several such combustion apparatus, for example, a dozen, acting in parallel.

In this way we pre-heat the subsequent combustion-initiating chamber or chambers so as to raise the fuel and air mixture to a high temperature before ignition takes place, thereby ensuring rapid and very complete combustion.

What we claim as our invention and desire to secure by Letters Patent of the United States is:

1. A liquid fuel combustion apparatus for an internal combustion power plant including a tube for supplying compressed air to the apparatus, a cylindrical thimble-like member positioned coaxially within said tube with its closed end directed towards the flow of compressed air through said tube, a cylindrical drum-like part of heat conductive material constituting a combustion-initiating chamber positioned coaxially within and spaced from the cylindrical wall of said thimble-like member, means for supplying primary air from said tube to said combustion-initiating chamber, and means for supplying liquid fuel under pressure to said chamber, said combustion-initiating chamber having, in its end wall facing the closed end of said thimble-like member, an aperture concentric with the axis of said chamber providing a sharp-edged outlet orifice into said member for producing turbulence in the burning mixture to facilitate its complete combustion within said member, and the closed end of said member deflecting, in

counter-flow, the burning mixture externally around the combustion-initiating chamber to heat the same.

2. A liquid fuel combustion apparatus according to claim 1 in which the combustion-initiating chamber has tangentially disposed inlets for leading the primary air thereinto.

3. A liquid fuel combustion apparatus, according to claim 1, having in the combustion-initiating chamber a coaxial perforated tube supported from the wall which is opposite said orifice.

4. A liquid fuel combustion apparatus, according to claim 1, having in the combustion-initiating chamber a coaxial perforated tube supported from the wall which is opposite said orifice, said tube being of substantially the same axial length as said combustion-initiating chamber and of smaller diameter than said orifice.

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