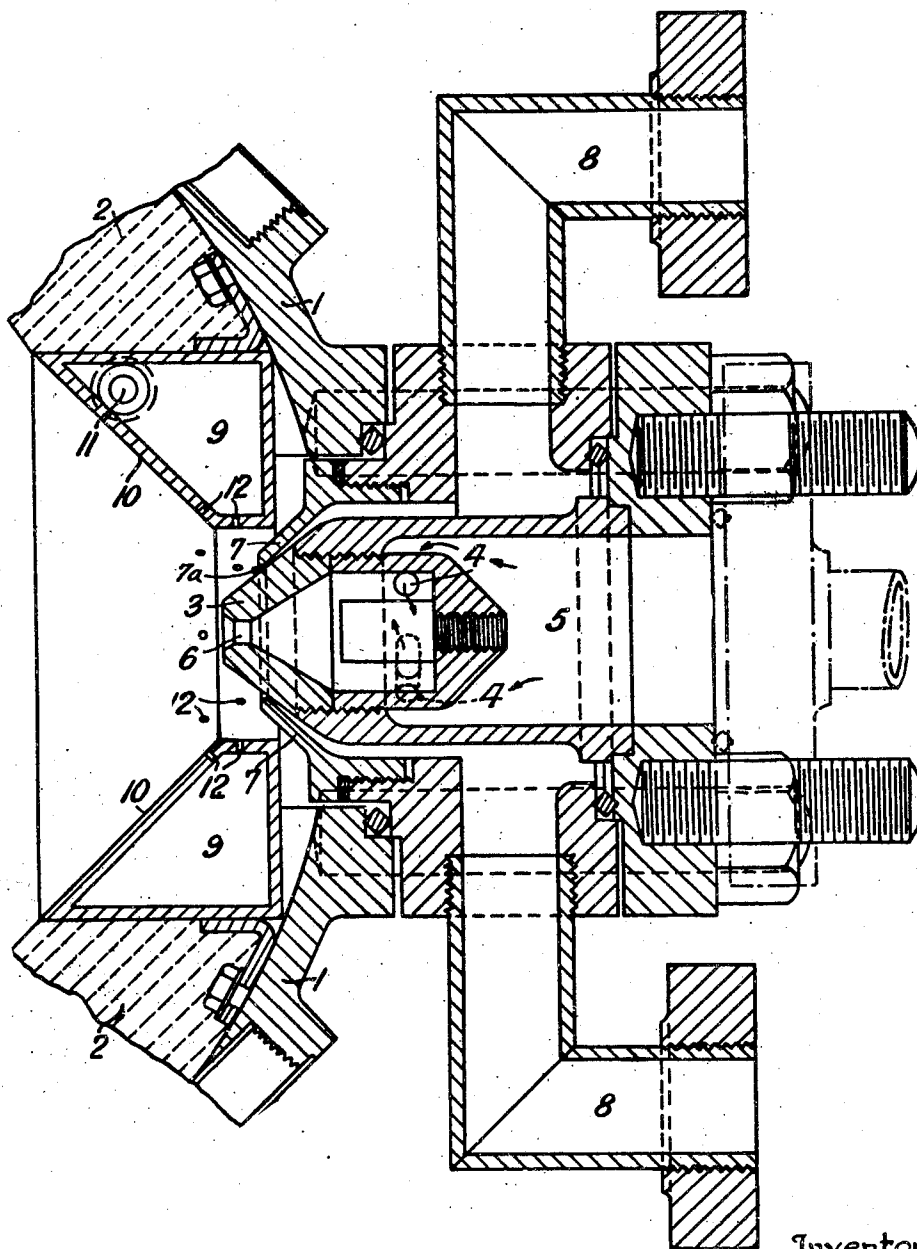


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LIQUID-COOLED NOZZLE ARRANGEMENT FOR COMBUSTION
CHAMBERS OF JET PROPULSION APPARATUS
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LIQUID-COOLED NOZZLE ARRANGEMENT
FOR COMBUSTION CHAMBERS OF JET
PROPULSION APPARATUSIsaac Lubbock, Great St. Helens, London, Eng-
land, assignor to The Asiatic Petroleum Com-
pany Limited, London, EnglandApplication July 7, 1943, Serial No. 493,800
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3 Claims. (Cl. 60-46)

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This invention relates to jet propulsion apparatus having a combustion chamber in which a liquid fuel is burnt with an oxidant in liquid form such as liquid oxygen, liquid air, liquefied nitrogen peroxide, nitric or perchloric acid or the like.

According to the invention a central spraying nozzle for the fuel is combined with an annular outer nozzle for the liquid oxidant.

The central spraying nozzle for the fuel is preferably of the well-known form embodying a vortex chamber fed under pressure to give an open spray while surrounding it is an annular passage carrying the oxidant and in virtue of the setting of the annular gap providing metering means to ensure the correct proportions of fuel to oxidant. The outer annular passage preferably tapers inwards across the outer face of the fuel nozzle to give a spray which by itself forms a node first in front of the centre of the fuel nozzle, expanding again from this node to form a cone of spray. When the two fluids are ejected simultaneously the two sprays interact to give intimate mixing and hence sufficiently rapid combustion for the very high rates involved. Moreover, the oxidant flowing over the inner fuel nozzle keeps it cool against the flame radiation.

Additional cooling means may be provided by a cooling medium such as water, passed through passages or a coil in or about the head in which the nozzles are mounted. Such cooling medium may be discharged into the combustion chamber to intermingle with the flame products.

The cooling means is preferably devised so that the cooling medium will pass over a surface to be cooled in the vicinity of the combustible ingredients discharged from the nozzle, at a far higher speed than that equivalent to the quantity of cooling medium which is discharged into the combustion chamber if the fluid were fed in an ordinary manner. For this purpose the cooling medium is introduced tangentially at a high velocity by passing it through a constriction into a jacket mounted within the combustion chamber so as to surround a space immediately in advance of the nozzle. The jacket may be of substantially triangular form in cross section so that the cooling surface is disposed substantially in the form of a cone, the cooling medium being introduced tangentially at high velocity into an apex of the triangular cross sectional form of the jacket corresponding to the wider part of the cone so that the cooling medium in the jacket will rotate with a high velocity. Orifices in the narrow part of the cone are provided

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for the passage out of the jacket of a predetermined amount of cooling medium to enter a combustion chamber in the region of the nozzle and to intermingle at that point with the flame products.

The invention is illustrated by way of example in the accompanying drawing which is a sectional elevation of the head of a combustion chamber in which a liquid fuel is burnt with an oxidant in liquid form.

Referring to the drawing, 1 indicates the head of the shell of the combustion chamber proper. 2 indicates refractory lining within the combustion chamber shell. The parts 1 and 2 are shown broken away. The combustion chamber may be constructed generally as described in British Patent No. 578,007.

To the head of the combustion chamber proper is fixed the nozzle and its associated inlet ducts. The nozzle comprises the central spray nozzle 3 into which the liquid fuel is fed tangentially at 4 to produce a vortex in the known manner. The fuel inlet to the nozzle is from the duct 5 and the outlet from the nozzle into the combustion chamber is through the opening 6.

Surrounding the central nozzle 3 is an outer member 7 which leaves an annular passage 7a between it and the central nozzle which can be varied in cross section by the adjustment of the member 7 which is screw-threaded for that purpose as shown. This annular passage is provided for the introduction of the liquid oxidant which is supplied through the inlets 8.

Fitted within the combustion chamber and surrounding the front of the nozzle is a jacket 9 for a cooling medium such as water. This jacket is substantially triangular in cross section as shown so that a conical cooling surface 10 is exposed to the space in which the flame products are generated. The cooling medium is introduced at high velocity into the jacket through the tangential port 11 which is located at the remote corner of the triangular cross sectional form of the jacket corresponding to the wider part of the conical cooling surface. The cooling medium in the jacket is thereby rotated at high speed. The openings 12 in the narrower portion of the cone provide for the discharge of cooling medium into the combustion chamber to intermingle with the flame products.

By virtue of the high velocity of rotation of the cooling medium within the jacket, and notwithstanding the limited quantity which is discharged into the combustion chamber, a high rate of cooling is provided whereby the nozzle is enabled

to withstand the extremely high temperatures involved.

I claim:

1. In apparatus of the class described for burning a liquid fuel with a liquid oxidant in a combustion chamber, the combination of a central spraying nozzle for admitting the liquid fuel to said chamber, an outer nozzle for admitting liquid oxidant to said chamber, a jacket mounted within said chamber so as to surround a space in front of the nozzles and being of substantially triangular form in cross section so that the cooling surface is disposed substantially in the form of a cone, means for introducing the cooling medium tangentially at high velocity into an apex of the triangular cross sectional form of the jacket corresponding to the wider part of the cone so that the cooling medium in the jacket will rotate with a high velocity, orifices in the narrow part of the cone being provided for the passage out of the jacket of a predetermined amount of cooling medium to enter the combustion chamber in the region of the nozzle and to intermingle at that point with the flame products.

2. In apparatus of the class described for burning a liquid fuel with a liquid oxidant in a combustion chamber, the combination of a central nozzle for admitting the liquid fuel to said chamber comprising a vortex chamber fed under pressure to provide an open spray, an outer nozzle forming an annular passage around said central nozzle for admitting liquid oxidant to said chamber, a jacket mounted within said chamber so as to surround a space in front of the nozzles and being of substantially triangular form in cross section so that the cooling surface is disposed substantially in the form of a cone, means for introducing the cooling medium tangentially at high velocity into an apex of the triangular cross sectional form of the jacket corresponding to the wider part of the cone so that the cooling medium in the jacket will rotate with a high velocity, orifices being provided in the narrow part of the cone for the passage out of the jacket of a predetermined amount of cooling medium to enter the combustion chamber in the region of the nozzles and to intermingle at that point with the flame products.

3. In apparatus of the class described for burning a liquid fuel with a liquid oxidant in a combustion chamber, the combination of a central nozzle for admitting the liquid fuel to said

chamber comprising a vortex chamber fed under pressure to provide an open spray, an outer nozzle forming an annular passage around the central nozzle for admitting liquid oxidant to said chamber, said annular passage tapering inwardly toward its outlet to said combustion chamber to provide a convergent spray of oxidant directed on the spray of fuel from said central nozzle, a jacket mounted within said chamber so as to surround a space in front of the nozzles and being of substantially triangular form in cross section so that the cooling surface is disposed substantially in the form of a cone, means for introducing the cooling medium tangentially at high velocity into an apex of the triangular cross sectional form of the jacket corresponding to the wider part of the cone so that the cooling medium in the jacket will rotate with a high velocity, orifices being provided in the narrow part of the cone for the passage out of the jacket of a predetermined amount of cooling medium to enter the combustion chamber in the region of the nozzles and to intermingle at that point with the flame products.

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