Sept. 19, 1961 A. M. FISH 3,000,184

COOLED INJECTOR

Filed Aug. 14, 1956 3 Sheets-Sheet 1

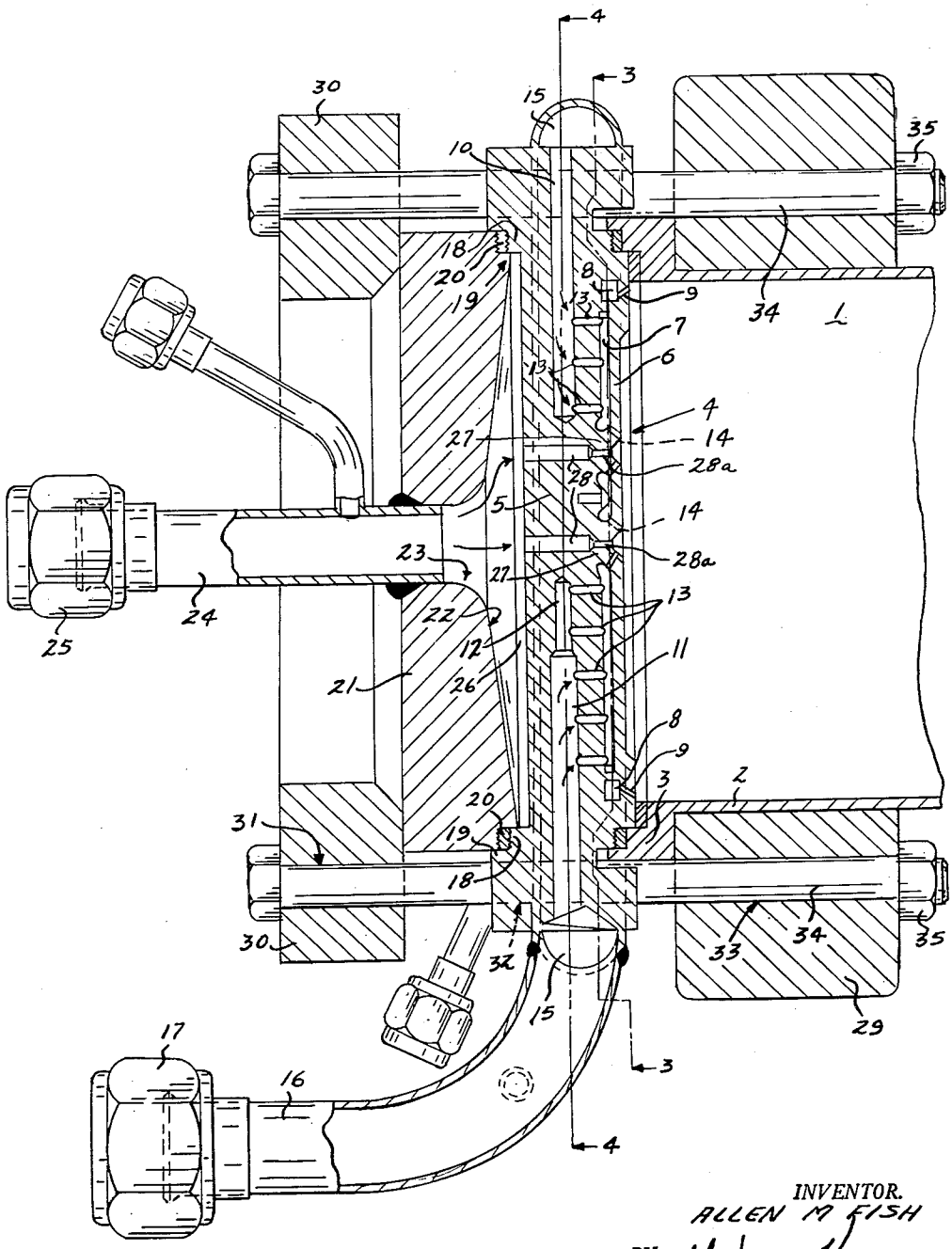


Fig-1

INVENTOR.
ALLEN M FISH
BY Wade Kenney
Charles H. Hague
ATTORNEYS

Sept. 19, 1961 A. M. FISH 3,000,184

COOLED INJECTOR

Filed Aug. 14, 1956 3 Sheets-Sheet 2

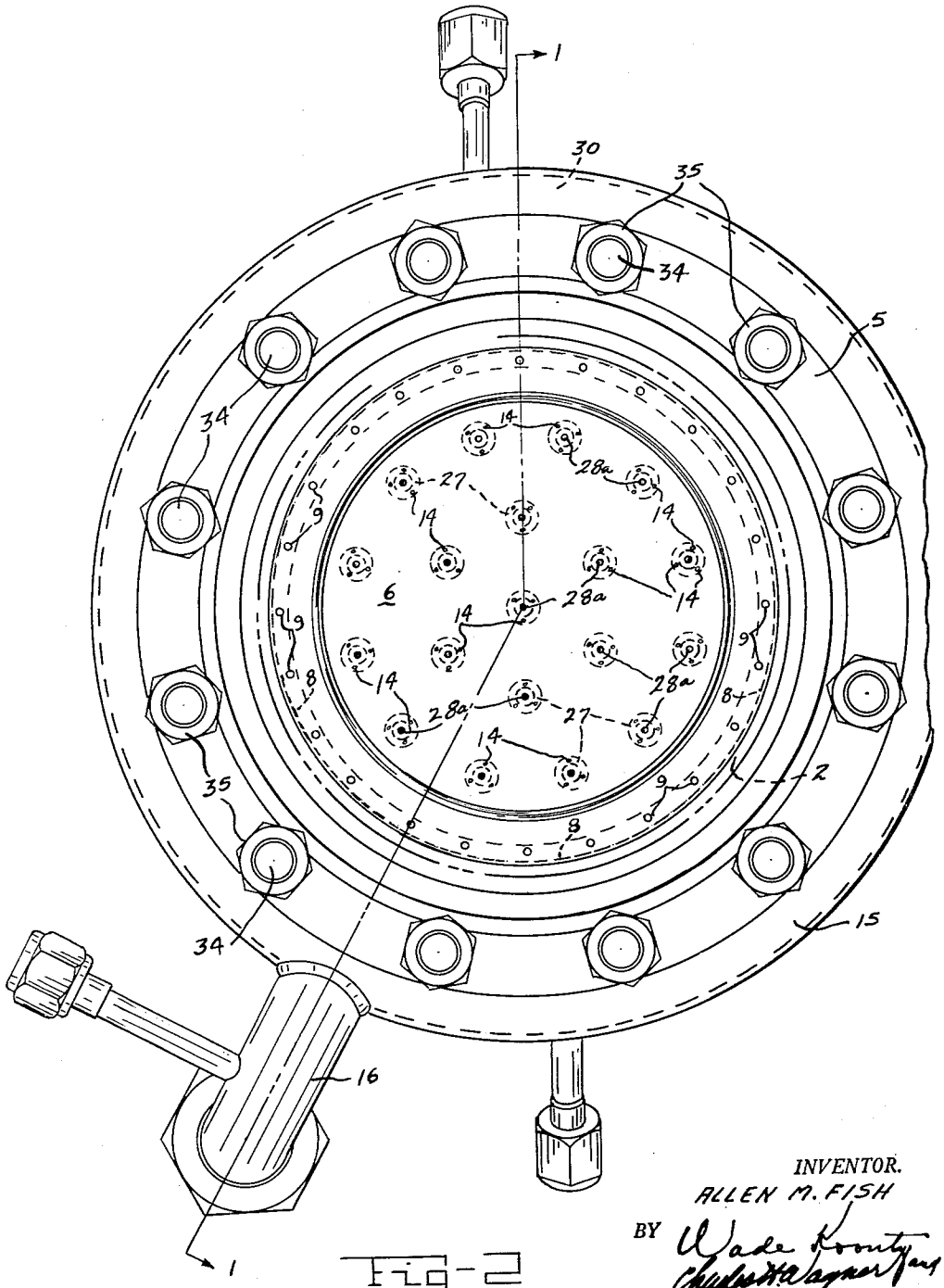


Fig-2

INVENTOR.
ALLEN M. FISH
BY Wade Kountz
Charles H. Wagner Jr.
ATTORNEYS

Sept. 19, 1961 A. M. FISH 3,000,184

COOLED INJECTOR

Filed Aug. 14, 1956 3 Sheets-Sheet 3

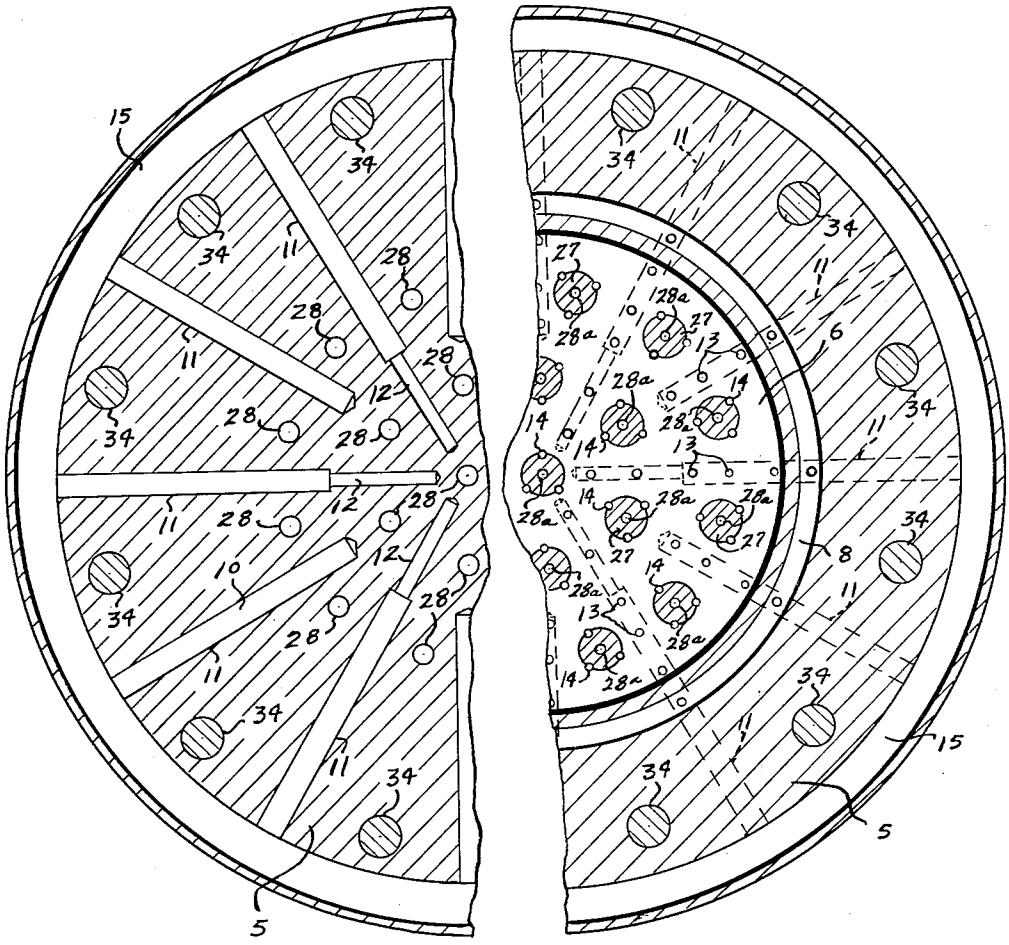


Fig-4

Fig-3

INVENTOR.
ALLEN M. FISH
BY Wade Kenney and Charles H. Wagner
ATTORNEYS

United States Patent Office 3,000,184 Patented Sept. 19, 1961

3,000,184
COOLED INJECTOR

Allen M. Fish, Sacramento, Calif., assignor to the United States of America as represented by the Secretary of the Air Force

Filed Aug. 14, 1956, Ser. No. 604,054
8 Claims. (Cl. 60—39.74)

This invention relates to rocket motors and more particularly to rocket motor propulsion devices utilizing liquid fuel propellants and oxidizers, having for one of its objects the provision of improved liquid propellant and coolant circulation means for controlling the temperature of the head or front wall of the combustion chamber to prevent the rapid deterioration and burning out of the same during excessive and long operations at high temperatures.

A further object is the provision of a combustion chamber for rocket motors of the fuel and oxidizer type in which the head of the combustion chamber is provided with a thin wall face plate that forms part of the combustion chamber and incorporates a multitude of coolant inlets distributed substantially uniformly over a coolant passageway in rear of the plate to provide a multitude of small jets facing the rear of this plate to impinge a coolant against the hottest spots of the plate and then cause the coolant to travel at high velocity across the hot plate and through orifice holes into the combustion chamber.

A further object is the provision of a combustion chamber having a head closure comprising a strong substantial backing plate and a relatively thin face plate disposed in closely spaced parallel relation in front of the backing plate to form the closure for the rear end of the combustion chamber in which the face plate is supported by said backing plate in a plurality of uniformly spaced areas throughout its surface with fuel and coolant oxidizer inlet apertures extending through said areas for directing fuel and coolant oxidizer in impinging relation in front of said areas in the combustion chamber to provide combustion fuel spray jets, and including conduit means for impinging a coolant against the rear surface of the face plate intermediate said areas to control the temperature of the face plate during the combustion of the fuel and oxidizer introduced in the combustion chamber of said jets.

A further object includes the provision of radial passages formed in the backing plate and communicating passages at right angles thereto facing the rear of the face plate, together with an intake manifold surrounding the periphery of said backing plate in communication with the radial passages for introducing a coolant fuel constituent therethrough into said radial passages.

A further object includes a fuel supply chamber in rear of the backing plate and passages extending forwardly from said chamber through said backing plate and said face plate intermediate the uniformly spaced areas into communication with the combustion chamber and intermediate the outlets of said oxidizer discharge passages.

A further object includes an annular passage formed in said backing plate and surrounding said face plate at the periphery thereof formed with inlet jets inclining outwardly toward the inner wall of the combustion chamber for directing a coolant constituent into the combustion chamber toward the inner wall thereof at the periphery of the face plate.

Other objects and advantages of the invention will become apparent from the following description and accompanying drawings in which like reference characters refer to like parts in the several figures.

Drawings

FIGURE 1 is a fragmentary longitudinal sectional view through the inner or front end of a rocket combustion chamber, parts being broken away.

FIGURE 2 is a plan view of the construction shown in FIGURE 1 but with the cylinder or shell of the combustion chamber and the clamping rings and gaskets omitted.

FIGURE 3 is a fragmentary half sectional view taken about on the plane indicated by line 3—3 in FIGURE 1; and

FIGURE 4 is a fragmentary half sectional view taken about on line 4—4 of FIGURE 1, clamping rings being omitted.

In the drawing the reference numeral 1 denotes a combustion chamber or cylinder generally, having a shell or cylindrical wall 2 and a seating or anchor flange portion 3 at the front end.

The head or inner end of the combustion chamber shell 2, as indicated at 4 generally, and as shown in the drawing is in the form of a cored casting comprising a backup plate portion 5 and a comparatively thin face plate portion 6, spaced in front of the backup plate substantially as shown to leave a flat, somewhat thin disc shaped cavity 7 which is almost coextensive with the front or closed end of the combustion chamber 1.

An annular coolant passage 8 is also formed in the end closure 4 surrounding the flat circular or disc shaped chamber 7 and provided with a plurality of jet orifices or apertures 9 inclining outwardly into the combustion chamber adjacent to and toward the inner wall and base of the cylindrical shell 2.

Intermediate the front and rear faces of the backup plate portion 5 are a plurality of radial coolant fuel or oxidizer supply conduits 10 and 11. The conduits 11 extending nearer to the center of the backup plate portion have reduced diameter conduit extensions 12. A plurality of small lateral passages 13 extend rearwardly from the radial conduits as shown in a direction directly toward the forward face of the face plate 6 for directing the coolant fuel constituent or oxidizer against the back of the face plate 6.

The coolant fuel constituent then travels at high velocity in all directions across the front or inner surface of the face plate 6 to diagonal passages 14 which extend through the face plate 6 into the combustion chamber 2. The coolant is supplied to the radial passages 10 and 11 by an annular conduit or manifold 15 which surrounds the periphery of the backing plate 5 as shown. A supply conduit 16 having the conventional coupling means 17 connects the manifold 15 with a source of coolant fuel supply such as a high pressure pump and appropriate control means therefor, not shown.

The backup plate 5 is formed with an annular flange or rib 18 and shoulder 19 carrying a sealing gasket 20 on which is seated a heavy fuel plate 21 formed with a dished interior 22 and a communicating central fuel supply passage 23 is connected to a fuel supply conduit 24, having the conventional coupling or union fitting 25 for connection to a source of fuel supply and control and gauge means not shown. The space between the backup plate 5 and the dished portion 22 of the fuel plate 21 forms a fuel supply manifold or chamber 26 directly behind the backup plate 5, surrounded by the sealing gasket 20.

The backup plate has a plurality of annular webs or bosses 27 in the chamber 7 as shown best in FIGURE 3 to universally support the back of the backup plate 6 at a plurality of spaced points throughout its combustion chamber area, the diagonal passages 14 inclining from the periphery of these bosses 27 toward central axes of the bosses, said central axes being perpendicular to the face plate.

Fuel supply conduits 28, disposed perpendicular to the face plate 6, extend through the center of each of the bosses 27 from the fuel cavity or chamber 26 into the

combustion chamber 2, for directing the fuel component of the fuel directly into the combustion chamber 2 at a plurality of points distributed over the rear wall or face plate 6 of the combustion chamber while the inclined coolant passages for the fuel constituent or oxidizer projects or sprays this material into the combustion chamber toward the central fuel sprays from the openings or apertures 28a to form the fuel oxidizer combustion or spray jets 28a in the combustion chamber.

The combustion chamber 2, combustion chamber head, including the unitary face plate 6 and backup plate 5 and the fuel plate 21 are held tightly in assembled relation, by an annular ring 29 surrounding the combustion chamber tube 2 in abutting relation with the flange 3 and an annular clamping ring 30 through which the fuel conduit 24 extends, the ring 30 bearing against the periphery of the fuel plate 21, the peripheral portions of the rings 29 and 30 and that of the plate 5—6 between the radial coolant delivery passages 10 and 11 being provided with aligned openings 31, 32 and 33 through which the tie bolts 34 extend, the bolts having nuts 35 threaded thereon so that tightening of the nuts 35 draws the plates and combustion chamber flanges tightly together on the gaskets substantially as shown in FIGURE 1.

Having thus described my invention and advantages thereof, I do not wish to be limited to the exact details herein disclosed, otherwise than as set forth in the accompanying claims.

I claim:

1. In a combustion chamber head for rocket fuel motors adapted to be supplied with a fuel and a coolant oxidizer liquid, a relatively thin face plate for closing one end of a combustion chamber, a backup plate disposed in back of said face plate in closely spaced parallel relation to said face plate, said backup plate having a plurality of circumferentially spaced substantially radially passages extending from the periphery of the backup plate toward its center, manifold means extending around the periphery of said face plate connecting said radial passages at the outer ends thereof, means for introducing said coolant oxidizer liquid into said manifold, said backup plate formed with lateral passages extending from said substantially radial passages forwardly into the space between said backup and face plates for directing the coolant oxidizer liquid into impinging engagement with the inner surface of said face plate next to said back-up plate.

2. Apparatus as claimed in claim 1, in which the backup plate and face plate are formed with a plurality of spacer web elements disposed in spaced relation to each other between the adjacent surfaces of the face and backup plates for supporting the face plate from the backup plate at a plurality of comparatively small spaced areas within its periphery, against the combustion chamber pressure, and formed with fuel inlet passages extending through said areas from the front or forward surface of the backup plate to the rear or combustion chamber surface of the face plate, and a plurality of inclined coolant passages extending from the space between the backup and face plates through the front or combustion chamber face of the face plate in surrounding relation to the said areas and said fuel inlet passages.

3. In a liquid fuel rocket motor having liquid fuel and oxidizer supply means, a combustion chamber, a fuel and oxidizer face plate closing the front end of said chamber, flange means on the combustion chamber bearing against the rear surface of the face plate, a fuel plate bearing against the front face of said face plate formed with a fuel delivery cavity therein facing said face plate and connected to said liquid fuel supply means, a clamping ring engaging the outer periphery of said fuel plate, a clamping ring surrounding said combustion chamber and engaging the said flange means thereon, tie bolt means connected between the first and second mentioned clamping rings for tightening said combustion chamber flange means and said fuel plate into sealing contact with the opposite faces of said face plate and gasket means between said clamping rings and said face plate to prevent fuel and combustion chamber leakage, a plurality of fuel delivery passages through said face plate and extending from said cavity into the combustion chamber in spaced apart relation, said face plate being formed with an annular flat cavity adjacent the combustion chamber face to include and surround said fuel delivery passages in isolated relation from the passages, coolant oxidizer jet passages inclining inwardly toward each other in surrounding relation to said fuel delivery passages to form fuel and oxidizer inlet jets at substantially equal spaced points over the area of the combustion chamber face of said face plate, and a plurality of coolant discharge passages extending from said annular flat cavity substantially into said face plate substantially perpendicular to said flat cavity in out-of-alignment relation with said oxidizer passage, radial coolant supply passages in communication with said coolant discharge passages, whereby the incoming coolant oxidizer impinges the back of the combustion side of the wall of said flat cavity intermediate said fuel delivery passages to cool the combustion chamber side of said face plate.

4. Apparatus as claimed in claim 3 in which said coolant introducing radial passages extends inwardly from the periphery of the face plate intermediate the wall of said cavity remote from the combustion chamber and the outer wall of the face plate most remote from the combustion chamber, said passages disposed in communication with said coolant discharge passages, and manifold means disposed in communication with said inwardly extending passages at said periphery for supplying a coolant to said inwardly extending passages.

5. A combustion chamber face plate assembly as claimed in claim 4, including an annular chamber formed in said face plate and surrounding the periphery of said cavity, means for introducing a coolant into said annular chamber, and a multitude of closely spaced coolant discharge conduits inclining outwardly toward the inner wall of the combustion chamber adjacent its flanged portion in communication with the interior of said annular chamber for directing a coolant against the interior wall of the combustion chamber adjacent said flanged portion of said combustion chamber.

6. An injector assembly cooled face plate for liquid fuel rocket motor combustion chambers, comprising a relatively thick substantially disc shape injector plate formed with coolant oxidizer supply passages extending substantially radially inward from its periphery toward its central axis, and formed with a relatively thin annular flat cavity extending from its center to adjacent its periphery, to be coextensive relative to the end area of the combustion chamber and formed with a thin substantially flat wall facing the combustion chamber, a plurality of small annular backup webs formed between the adjacent flat walls of the cavity in substantially uniformly spaced relation throughout the back of the combustion chamber exposed wall of said injector plate, fuel injection passages extending through said injector plate, passing centrally through each of said backup webs from the outer face through the combustion chamber face of said injector plate, for directing liquid fuel into the combustion chamber in each of said spaced apart areas, small coolant jet delivery conduits connected at one end to said substantially radial coolant supply passages and directed toward the back of said thin flat wall out of register with said backup webs whereby the coolant is first directed radially through the radial passages, thence laterally into the annular flat cavity intermediate said spaced apart areas to impinge the rear of the front face of said cavity to cool the combustion chamber face, and inclined a plurality of coolant jet openings surrounding each of said fuel injection passages and annular backup webs in communication with said thin cavity at their inner ends and the inclined discharge jets inclined toward said fuel outlet jet and the axis of said fuel injection passages;

whereby the coolant is caused to travel across the cavity and the back of thin face plate portion between said areas and out of said inclined coolant jet openings to cool said thin face plate and supply fuel and coolant into the combustion chamber, and fuel and coolant supply means for supplying fuel to said fuel passages and a coolant to said inwardly extending coolant supply passages.

7. Apparatus as claimed in claim 6 in which the fuel supply means includes a fuel plate disposed in sealing contact with the face of the injector plate remote from the combustion chamber, and formed with a central fuel inlet conduit and a fuel cavity facing the injector plate and surrounding the fuel inlet ends of said fuel injection passages, and clamping means retaining said fuel plate in sealing engagement with said injector plate.

8. Apparatus as claimed in claim 7 in which the coolant oxidizer supply means comprises an annular manifold chamber formed in the periphery of the injector plate disposed in communication with said inwardly extending substantially radial passages and includes means for introducing a coolant oxidizer into said annular manifold.

References Cited in the file of this patent

UNITED STATES PATENTS

2,703,962	Olson	Mar. 15, 1955
2,753,687	Wissley et al.	July 10, 1956

FOREIGN PATENTS

731,739	Great Britain	June 15, 1955