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TWO-LIQUID COMBUSTION CHAMBER FOR ROCKET APPARATUS

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Fig. 1

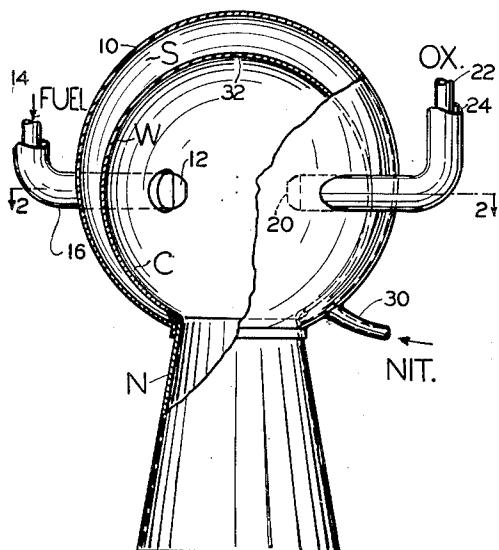


Fig. 2

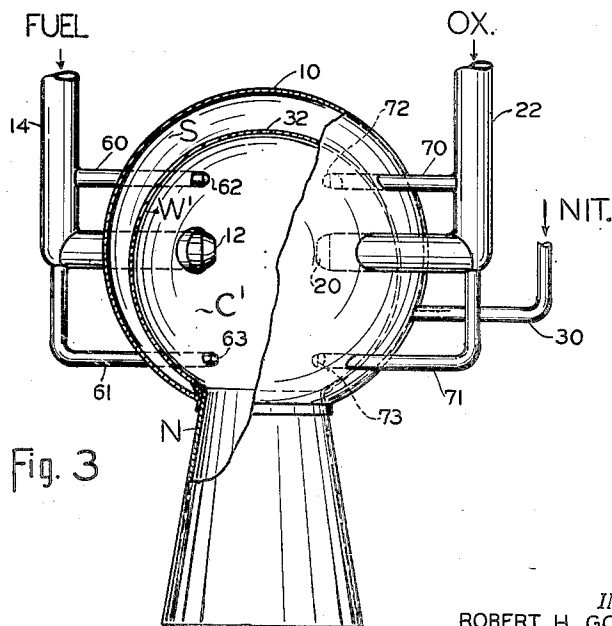
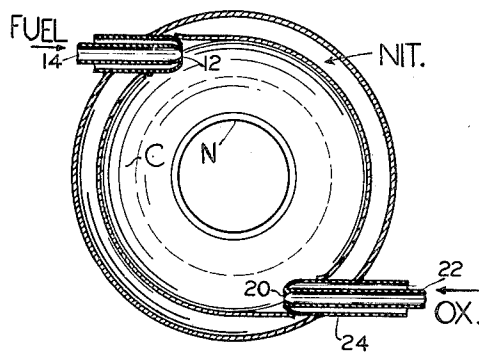


Fig. 3

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TWO-LIQUID COMBUSTION CHAMBER FOR  
ROCKET APPARATUSRobert H. Goddard, deceased, late of Annapolis,  
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3 Claims. (Cl. 60—39.66)

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This invention relates to a combustion chamber as used in rocket apparatus and of the general type in which the combustion gases formed in an enclosed combustion area by combustion of two different liquids are ejected through an open discharge nozzle.

In order to save weight, it is desirable that such combustion chambers have very thin metal walls, but the combustion temperatures are commonly very high, and provision is necessary for cooling such thin walls.

It is the general object of this invention to introduce combustion liquids to such a combustion chamber in such manner that the thin metal wall of the chamber will be protected by superposed films of combustion liquids covering the inner surface thereof.

An enclosing jacket space is also provided about said combustion chamber, and an inert fluid, such as nitrogen, may be supplied to this jacket space under such pressure as to offset the pressures developed in the combustion chamber. Additional localized cooling films may also be provided for any areas which tend to become overheated.

The invention further relates to arrangements and combinations of parts which will be hereinafter described and more particularly pointed out in the appended claims.

Preferred forms of the invention are shown in the drawing, in which

Fig. 1 is a side elevation, partially in section, and disclosing a preferred form of the invention;

Fig. 2 is a sectional plan view, taken along the line 2—2 in Fig. 1; and

Fig. 3 is a view similar to Fig. 1 but showing a modified construction.

Referring to Figs. 1 and 2, combustion apparatus is shown involving a combustion chamber C having a thin metal wall W, an open discharge nozzle N, and an outer casing 10 enclosing a jacket space S.

A feeding nozzle 12 projects tangentially into the combustion chamber C and is supplied with gasoline or other liquid fuel under pressure through a feed pipe 14. The pipe 14 is preferably surrounded by an outer tube 16 spaced from the pipe 14 to enclose an insulating air space.

A second feeding nozzle 20 is supplied with liquid oxygen or some other liquid oxidizer under pressure through a feed pipe 22, and the pipe 22 is preferably surrounded by an outer tube 24 enclosing a space which may be filled with liquid oxygen to protect the liquid oxygen in the feed pipe 22 and feeding nozzle 20 from vaporization, which might develop gas-lock.

As the combustion liquids are supplied through the feeding nozzles 12 and 20 under substantial pressure and in tangential directions, the liquids will be dispersed in more or less distinct and superposed liquid films, which films will cover the inner surface of the combustion chamber wall W and will thus protect the thin chamber wall from the high combustion temperatures.

An inert fluid, such as nitrogen, may be supplied to the jacket space S through a pipe 30 and under such pressure as will offset the pressures developed by combustion in the combustion chamber C. The pressures on the inner and outer surfaces of the chamber wall W may thus be substantially equalized, so that the thin wall has to resist only a very slight unbalanced pressure.

A small bleed opening 32 at the top of the chamber wall W will permit limited circulation of the inert liquid through the jacket space S, but the amount of fluid escaping through the hole 32 will be too small to have any objectionable effect on combustion.

With this very simple construction, the cooler parts of the combustion mixture are kept close to the inner surface of the wall W, the alternate layers of the liquids will facilitate intimate mixing without the violent recoil which occurs on engagement of large masses of the separate liquids, and the gradual advance of the liquids toward the axis of the combustion chamber will rapidly preheat and evaporate any still unmixed and unevaporated combustion liquids. This preheating and evaporation is found to take place very rapidly. The spherical form of the combustion chamber resists distortion and gives maximum volume for a given weight.

If it is found in operation that certain portions of the combustion chamber still tend to overheat, the construction shown in Fig. 3 may be adopted. The construction in Fig. 3 is essentially the same as that shown in Fig. 1, except for the provision of branch pipes as 60 and 61 connecting the gasoline feed pipe 14 to additional tangential feed nozzles 62 and 63 in the upper and lower portions of the combustion chamber C', and branch pipes 70 and 71 which similarly connect the oxygen feed pipe 22 with additional tangential nozzles 72 and 73 disposed in the planes of the nozzles 62 and 63 respectively.

In this way, the cooling film within the wall W' of the combustion chamber C' may be built up to additional thickness in areas where the films from the feeding nozzles 12 and 20 might be of less thickness or otherwise inadequate.

The construction herein described is of very

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simple and reliable construction and is found to be well adapted for its intended purposes.

Having thus described the invention and the advantages thereof, it will be understood that the invention is not to be limited to the details herein disclosed, otherwise than as set forth in the claims, but what is claimed is:

1. In rocket apparatus, a combustion chamber of substantially spherical shape and having a thin sheet-metal wall, means to introduce a stream of liquid fuel at one side of said chamber and in a tangential direction and adjacent the side wall of said chamber, and means to introduce a stream of liquid oxidizer at a relatively separated point in said combustion chamber and in the same tangential direction and also adjacent the side wall of said chamber, and said two supply means being in the same plane normal to the combustion chamber axis and substantially at the point of greatest diameter.

2. The combination in rocket apparatus as set forth in claim 1, in which additional streams of liquid fuel and liquid oxidizer are supplied tangentially to said chamber and in planes at each side of the main supply plane but spaced therefrom.

3. In rocket apparatus, a combustion chamber of substantially spherical shape and having a thin

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sheet-metal wall, means to introduce a stream of liquid fuel at one side of said chamber and in a tangential direction and adjacent the side wall of said chamber, and means to introduce a stream of liquid oxidizer at a diametrically opposite point in said combustion chamber and in the same tangential direction and also adjacent the side wall of said chamber, whereby superposed films of liquid fuel and liquid oxidizer are formed, which films produce a combustion mixture and also protect the side wall of said chamber from excessive heat.

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*Executrix of the last will and testament of Robert H. Goddard, deceased.*

#### References Cited in the file of this patent

##### UNITED STATES PATENTS

| Number    | Name     | Date           |
|-----------|----------|----------------|
| 1,827,246 | Lorenzen | Oct. 13, 1931  |
| 2,097,255 | Saka     | Oct. 26, 1937  |
| 2,482,262 | Goddard  | Sept. 20, 1949 |
| 2,520,751 | Zucrow   | Aug. 29, 1950  |
| 2,526,219 | Goddard  | Oct. 17, 1950  |
| 2,526,222 | Goddard  | Oct. 17, 1950  |
| 2,544,419 | Goddard  | Mar. 6, 1951   |