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APPARATUS FOR FEEDING A LIQUID FUEL, A LIQUID OXIDIZER AND WATER TO A COMBUSTION CHAMBER ASSOCIATED WITH ROCKET APPARATUS

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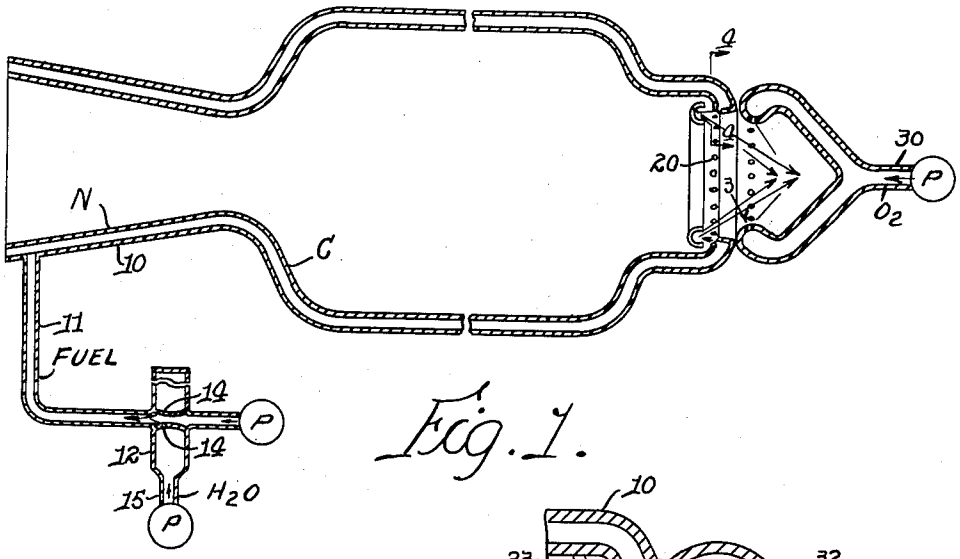

Fig. 1.

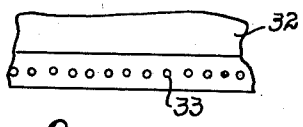

Fig. 3.

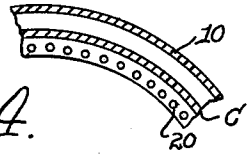

Fig. 4.

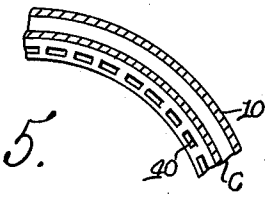

Fig. 5.

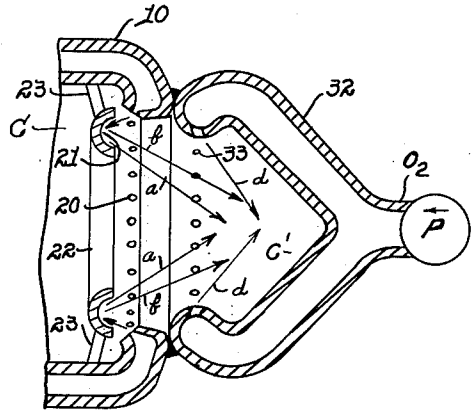

Fig. 2.

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APPARATUS FOR FEEDING A LIQUID FUEL, A LIQUID OXIDIZER AND WATER TO A COMBUSTION CHAMBER ASSOCIATED WITH ROCKET APPARATUS

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4 Claims. (Cl. 60—39.46)

This invention relates to combustion chambers as used in rockets and rocket craft, and relates more particularly to devices for feeding liquid fuel to such a combustion chamber.

It is at times desirable to add a small proportion of water to the gasoline or other liquid fuel before it is fed to the combustion chamber but the presence of this water tends to retard ignition.

Accordingly, it is the object of the present invention to provide means to separate the fuel and water as the intermingled liquids fed to the ignition point and in such manner that the oxidizing agent will engage and combine with the separated fuel before said oxidizing agent can be engaged and diluted by the separated water.

A further object of the invention is to provide a deflecting device in a combustion chamber by which intermingled liquid fuel and water will be separated in accordance with their different specific gravities.

A preferred form of the invention is shown in the drawing, in which

Fig. 1 is a longitudinal sectional view of a combustion chamber embodying the invention;

Fig. 2 is an enlarged sectional elevation of certain parts shown in Fig. 1;

Fig. 3 is a detail view, looking in the direction of the arrow **3** in Fig. 1;

Fig. 4 is a detail sectional view, taken along the line 4—4 in Fig. 1; and

Fig. 5 is a view similar to Fig. 4 but showing a slight modification.

Referring to Fig. 1, a combustion chamber C is shown, having a nozzle portion N and enclosed within a jacket casing **10**. Liquid fuel, as gasoline, is supplied under pressure to the casing **10** through a pipe **11**. The liquid fuel receives a certain proportion of water as it passes through an annular casing **12** having feed openings **14** and supplied with water under pressure through a pipe **15**.

At the front or closed end of the combustion chamber the jacket casing **10** is contracted as shown in Fig. 2 and a plurality of feed openings **20** are provided, through which jets of intermingled fuel and water are projected against the sharply concave side surface of an annular deflecting ring **22**, mounted on spaced ribs or supports **23** within the combustion chamber.

Liquid oxygen or other suitable oxidizing liquid is fed under pressure through a pipe **30** to the outer end of the jacket space between a chamber extension C′ and its jacket casing **32**. The inner or rear end of the casing **32** is welded or otherwise permanently secured to the adjacent end of the jacket casing **10**, and a plurality of feed openings **33** are provided for the liquid oxygen, said feed openings being inclined forwardly and toward the chamber extension C′.

When the intermingled gasoline and water are injected under pressure against the concave annular side surface **21** of the deflector ring **22**, there is a very abrupt change

in direction of the intermingled liquids and the deflecting effect is such that the water is projected inward along the lines of the arrows *a* while the lighter gasoline is more easily deflected and is projected along the lines of the arrows *b*. At the same time the liquid oxygen is projected into the chamber extension C′ along the lines of the arrows *d*.

Satisfactory operation requires that the liquid pressure be high enough to eject the intermingled liquids at the velocity necessary to produce the described and definite deflecting and separating action, and of course the pressure must substantially exceed the vapor pressure in the combustion chamber.

It will be evident from Fig. 2 that the liquid oxygen, proceeding along the lines of the arrows *d*, will intercept the gasoline or other liquid fuel entering along the lines of the arrows *b* before the oxygen can be engaged by the water entering along the lines of the arrows *a*. The liquid oxygen and liquid fuel are thus intermingled in such manner that they may be easily vaporized and ignited, while the water is thereafter absorbed by the combustion gases and by any partially consumed liquids or vapors as they are ejected from the chamber extension C′ and are projected into the combustion chamber C where further and more complete combustion takes place.

For most effective operation, the liquids are supplied to the deflector **22** only in such quantities as will form a relatively thin film on the annular concave side surface of the deflector ring. Under some operating conditions, however, this film may be more effectively formed if the small circular feed openings **20** for the intermingled fuel and water are replaced by elongated openings or slots as shown at **40** in Fig. 5.

By this simple addition of a concavely recessed annular deflecting ring, prompt ignition and complete combustion of the liquid fuel is greatly facilitated.

Having been thus described, 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 a combustion chamber of rocket type, means to inject intermingled liquid fuel and water under pressure in excess of the combustion chamber pressure, a deflector ring mounted within said chamber and in the path of the injected liquids and having a sharply concave annular surface engaged by said liquids and effective to deflect the fuel and water by relative deflection along diverging conical paths, and additional means to inject a liquid oxidizer along a path which intercepts the cone of liquid fuel before it intercepts the cone of separated water.

2. In a combustion chamber of rocket type, a jacket enclosing said chamber and having forwardly and inwardly directed feed openings adjacent its closed end portion, means to feed intermingled liquid fuel and water to said jacket and to inject said liquids into said chamber through said openings under pressure in excess of the combustion chamber pressure, a deflecting device mounted within said chamber and in the path of the intermingled injected liquids and engaged by said liquids and effective to separate the fuel and water by relative deflection into concentric forwardly directed cones, with the fuel cone outside of the water cone, and means to inject jets of a liquid oxidizer to said chamber, which jets are intercepted by said fuel cone before being intercepted by said water cone.

3. In a combustion chamber of rocket type, a jacket surrounding said chamber and enclosing a jacket space, means to inject intermingled liquid fuel and water from said jacket space to said chamber under pressure in excess of the combustion chamber pressure, deflecting means mounted within said chamber and in the path of the injected liquids and engaged by said liquids and effective to

separate the liquid fuel from the water by relative deflection and to direct said separated liquids forward along separate paths into an extension of said chamber, and means to inject a liquid oxidizer along a path in which it engages and intercepts said liquid fuel in said extension to form a relatively pure combustible mixture before said liquid oxidizer engages and intercepts the separated water.

4. In a combustion chamber of rocket type provided with two sets of feed openings adjacent its closed end portion, means to inject intermingled liquid fuel and water through one set of feed openings under pressure in excess of the combustion chamber pressure, means to inject a liquid oxidizer through the other set of feed openings, and deflecting means in said chamber effective to separate the liquid fuel from the water and to project said liquid fuel into the path of the liquid oxidizer as said oxidizer enters said chamber and before said oxidizer engages the

separated water, and said deflecting means comprising an annular ring mounted within said chamber in the path of the intermingled fuel and water and having a sharply concave annular side surface engaged by said intermingled liquids.

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