June 7, 1955 R. H. GODDARD 2,709,890

MECHANISM FOR INTERMITTENT FEEDING OF COMBUSTION LIQUIDS
TO A COMBUSTION CHAMBER IN PROPULSION APPARATUS
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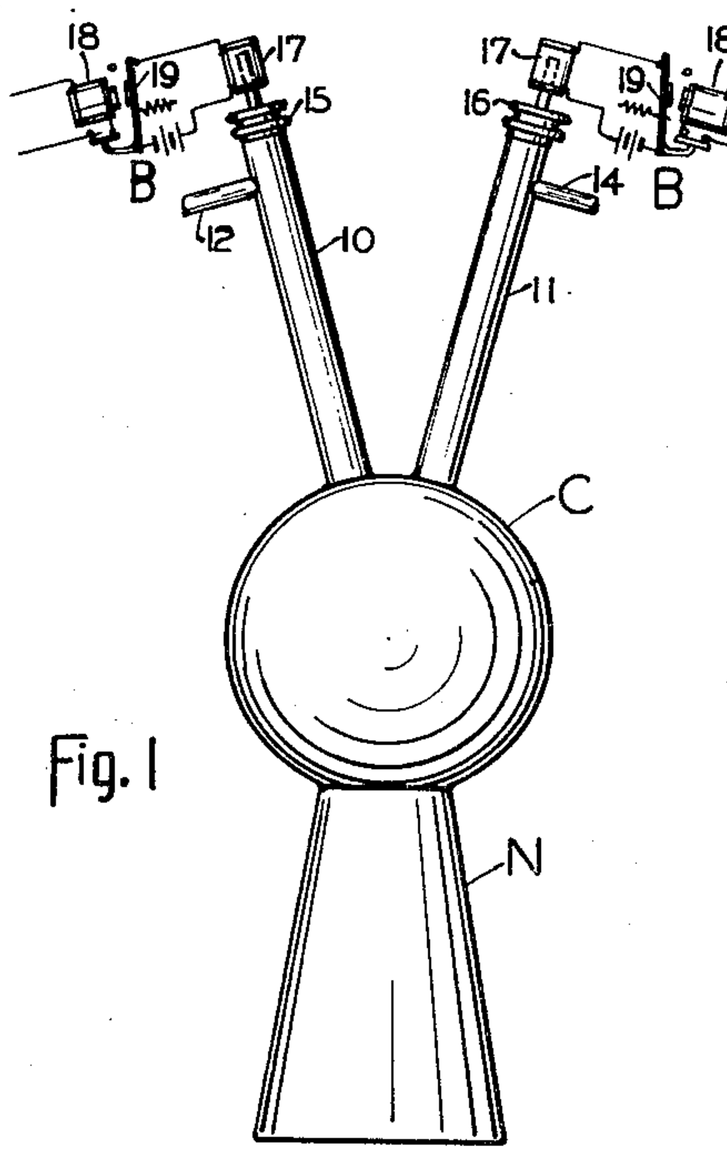

Fig. 1

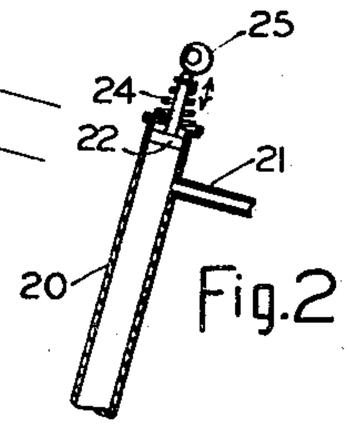

Fig. 2

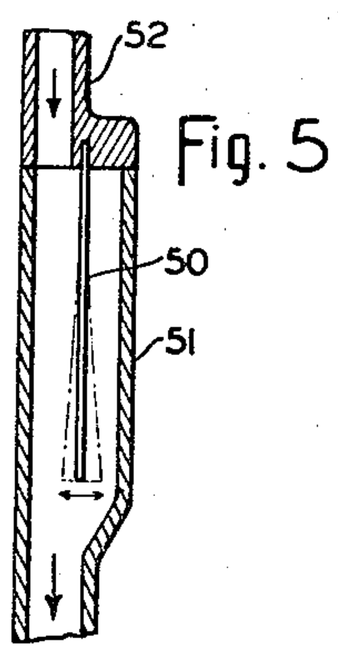

Fig. 5

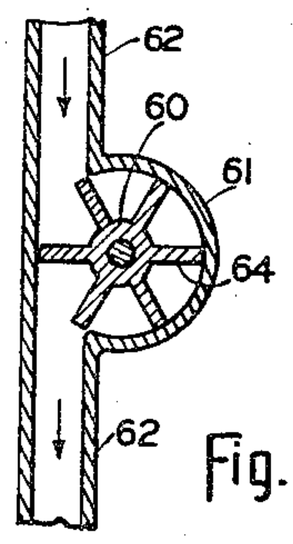

Fig. 6

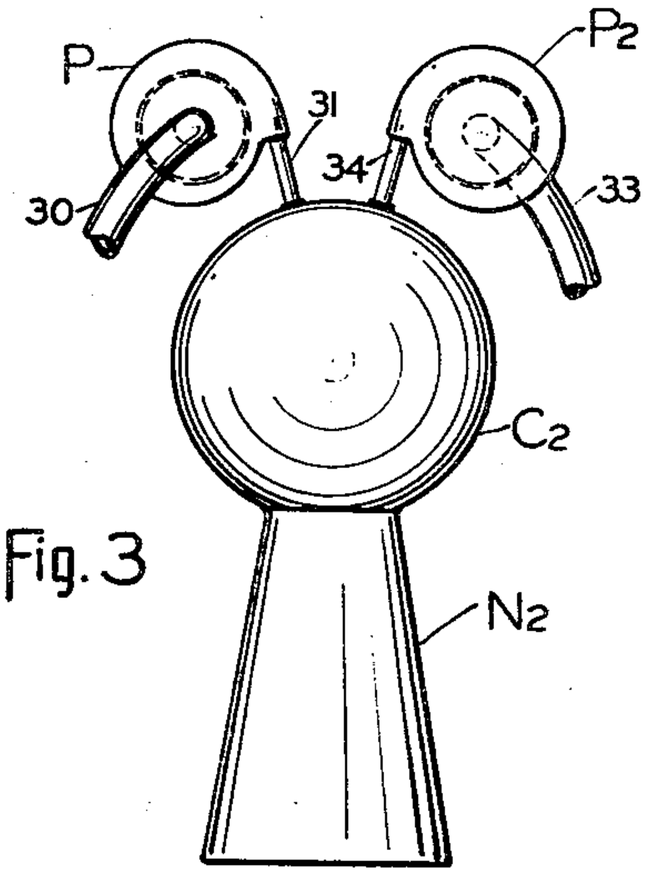

Fig. 3

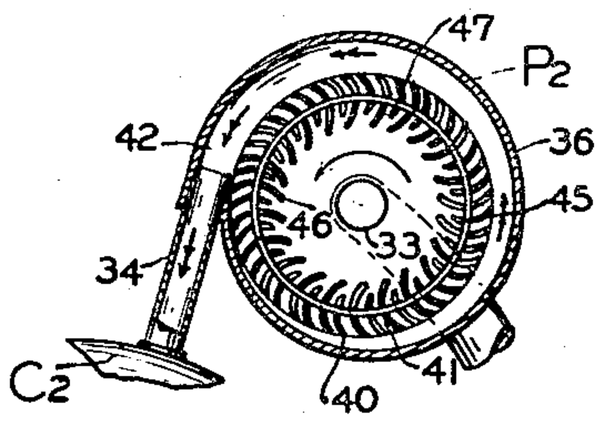

Fig. 4

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MECHANISM FOR INTERMITTENT FEEDING OF COMBUSTION LIQUIDS TO A COMBUSTION CHAMBER IN PROPULSION APPARATUS

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Application March 26, 1952, Serial No. 278,712

1 Claim. (Cl. 60—35.6)

This invention relates to propulsion apparatus of the type in which a combustion chamber continuously discharges its exhaust gases through a rearwardly-open discharge nozzle. When such a combustion chamber is used in aircraft, limitations of weight make it obviously essential that maximum power be developed from the combustion liquids, such as gasoline and liquid oxygen.

This maximum power development depends quite largely on providing a very intimate mixture or intermingling of the combustion liquids. To the attainment of this desired result, means is herein provided for intermittent or pulsating feeding of each of the combustion liquids.

If the flow interruptions are extremely rapid, the general effect is that of continuous flow, but each stream of liquid tends to break up into many small drops which mix much more easily than when the liquids are fed uniformly and thereby tend to form separate films or layers.

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

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

Fig. 1 is a front elevation of mechanism for providing intermittent or pulsating liquid feed;

Fig. 2 is a partial sectional elevation of a modified construction;

Fig. 3 is a front elevation of a construction in which the pulsating waves are produced by turbine action;

Fig. 4 is an enlarged sectional view of one of the turbines shown in Fig. 3;

Fig. 5 is a sectional view indicating the production of waves in the liquid stream by a vibrating reed; and

Fig. 6 is a sectional view showing the interruption of feed as produced by a rapidly rotating bladed rotor.

Referring to Fig. 1, the combustion chamber C is shown as provided with an open discharge nozzle N, both of any usual construction. Feed tubes **10** and **11** are connected into the otherwise closed end of the combustion chamber, and the tube **10** may receive a liquid oxidizer, as oxygen, through a supply pipe **12**, while the tube **11** similarly receives a liquid fuel, as gasoline, through a supply pipe **14**.

At their outer ends, the tubes **10** and **11** are closed by bellows members **15** and **16**. A solenoid **17** may be associated with each bellows member **15** or **16**, and the solenoid current may be rapidly interrupted by a magnetic relay **18**, which operates a make-and-break switch **19** of any usual type. With this construction, the combustion liquids will be fed under pressure through the pipes **12** and **14** to the tubes **10** and **11**, and will be rapidly interrupted or caused to pulsate by the alternate expansion and contraction of the bellows members **15** and **16**.

The flow of the liquids to the combustion chamber then also assumes an interrupted or pulsating form which is found to substantially facilitate the breaking-up of the liquid streams into many fine drops.

If the length and diameter of the tubes **10** and **11** are properly selected, standing waves may be produced in the tubes, and the pulsating effect may thus be magnified.

In Fig. 2, the tube **20**, corresponding to the tube **11** previously described, receives a combustion liquid under pressure through a supply pipe **21** and is provided with a piston **22** at its outer end. This piston may be intermittently pressed inward against a spring **24** by a rotated cam or eccentric **25**. The pulsations thus produced are similar in effect to those produced by the construction shown in Fig. 1.

In Fig. 3, a combustion chamber C2 is provided with a nozzle N2, both of usual construction, and one combustion liquid, as oxygen, is supplied to the chamber C2 through a supply pipe **30**, turbine pump P and tube **31**, while the other liquid, as gasoline, is supplied from a pipe **33** through a turbine pump **P2** and tube **34**.

The detailed construction of the turbine pump **P2** is shown in Fig. 4, in which a volute casing **36** eccentrically encloses a stator **40** comprising a plurality of fixed vanes **41**.

Liquid from the pipe **33** is supplied at the axis of a rotor **45**, preferably provided with a series of long vanes **46** and interposed short vanes **47**. The vanes or partitions **41**, **46** and **47** are of such thickness and spacing that the moving vanes substantially but momentarily close the passages between the stationary vanes **41**.

Consequently, the pressure of the liquid fed through the pipe **34** to the cylinder C2 is alternately increased and decreased as the vanes **46** and **47** pass the openings between the stationary vanes **41**. If the rotor **45** is rotated at a relatively high speed, the rate of pressure interruption or pulsation will be correspondingly high.

In Fig. 5, a vibrating reed **50** is mounted in a recessed portion **51** in a supply pipe **52**. As liquid under pressure flows through this recess, as indicated by the arrows, the reed **50** will be set in vibration and will produce correspondingly rapid variations in the flow of the liquid out of the recessed portion **51**. An interrupted or pulsating flow is thus very simply obtained and with no moving parts except the vibrating reed.

In Fig. 6, a similar result is obtained by rotatably mounting a rotor **60** in an enlarged portion **61** of a supply pipe **62**. The rotor is provided with blades **64** which have close clearance in the casing portion **61** and also in the adjacent part of the pipe **62**.

As liquid under pressure flows through this device in the direction of the arrows, the rotor **60** will be rotated at a speed definitely related to the rate of travel of the liquid, and the blades **64** will produce irregularities or slight interruptions in the flow, so that a pulsating effect is produced.

With each of the constructions herein shown and described, the main purpose of the invention is attained by providing an interrupted or pulsating flow of both liquids to the combustion chamber, at which they arrive in the form of small drops or are otherwise broken up for more effective mixing.

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 claim, but what is claimed is:

In combustion mechanism for propulsion apparatus, a combustion chamber, means to feed a liquid fuel under pressure to said combustion chamber, means to feed a liquid oxidizer under pressure to said combustion chamber, and separate and additional means to impress a pulsating pressure variation on each of said liquids while under otherwise normal and continuous feeding pressure, said additional means comprising a volute casing, a bladed stator within said casing, a bladed rotor within said stator, means to supply a liquid under pressure to

the interior of said rotor and means by which said rotor is rotated by said liquid, and the thickness of the blades in said rotor and stator being substantially equal to the spaces between said blades, so that the periods of liquid flow and flow interruption are substantially equal and each of extremely brief duration.

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