March 14, 1950 R. H. GODDARD 2,500,537

MOVABLY MOUNTED AUXILIARY VANES FOR ROTATING COMBUSTION CHAMBERS

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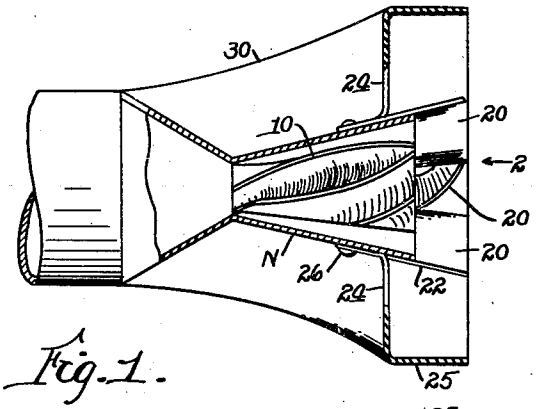

Fig. 1.

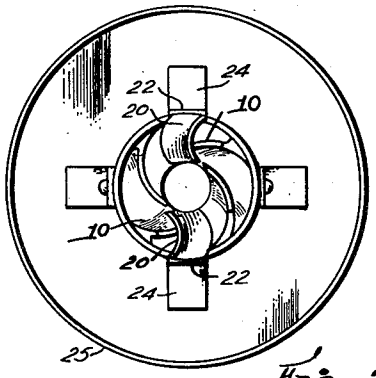

Fig. 2.

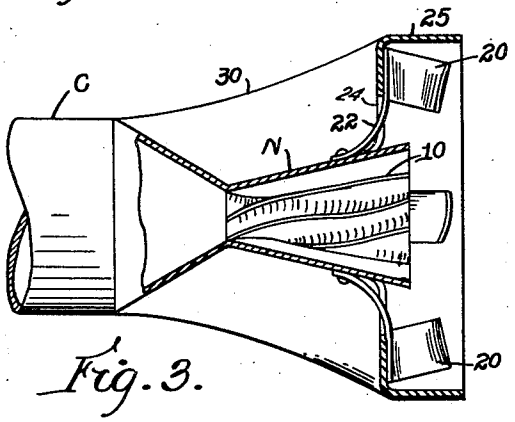

Fig. 3.

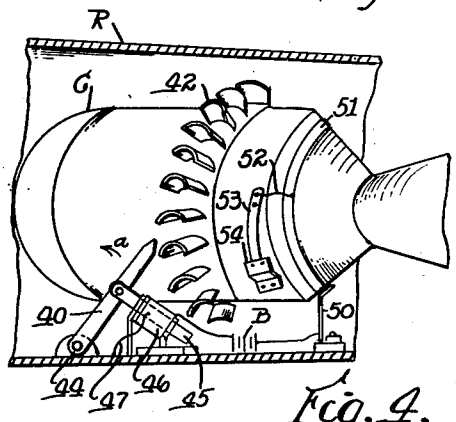

Fig. 4.

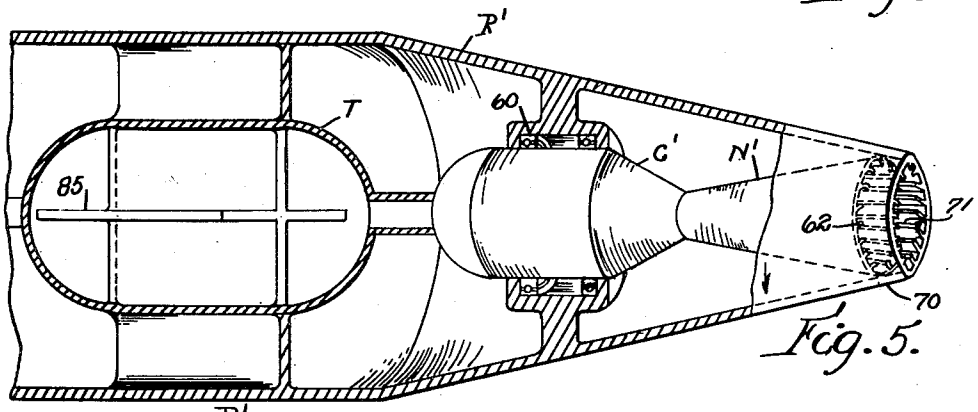

Fig. 5.

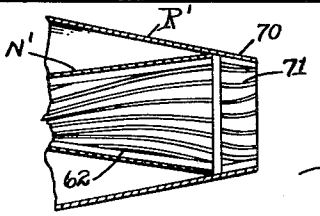

Fig. 6.

INVENTOR.
Robert H. Goddard, Dec'd.
Esther C. Goddard, Executrix.
BY
Chas. T. Hawley
ATTORNEY.

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2,500,537

MOVABLY MOUNTED AUXILIARY VANES FOR ROTATING COMBUSTION CHAMBER

Robert H. Goddard, deceased, late of Annapolis, Md., by Esther C. Goddard, executrix, Worcester, Mass., assignor of one-half to The Daniel and Florence Guggenheim Foundation, New York, N. Y., a corporation of New York

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3 Claims. (Cl. 60—35.6)

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This invention relates to combustion chambers as used in propulsion apparatus, and relates more particularly to combustion chambers which are mounted for rotation in flight.

It is an important object of the present invention to provide auxiliary means for starting rotation of the combustion chamber, and means for cutting out the auxiliary starting means when rotation is under way.

A further object is to provide auxiliary means utilizing discharged combustion gases to increase the speed of rotation of the chamber until a predetermined speed is reached, and therefore automatically becoming inoperative.

Another feature of the invention relates to the provision of means to counteract the gyroscopic effect of the rotating combustion chamber.

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 of certain parts of a rotating combustion chamber, partly in section and embodying this invention;

Fig. 2 is an end view, looking in the direction of the arrow 2 in Fig. 1, but with certain parts omitted for clearness;

Fig. 3 is a view similar to Fig. 1 but showing the auxiliary vanes in high-speed and inoperative position;

Fig. 4 is a partial perspective view showing auxiliary means for starting rotation of the combustion chamber;

Fig. 5 is a sectional side elevation of a modified construction in which both the combustion chamber and the rocket craft rotate but in opposite directions; and

Fig. 6 is a partial longitudinal section of the construction shown in Fig. 5.

Referring to Figs. 1, 2 and 3, a combustion chamber C is shown which is provided with the usual rearwardly extending nozzle N through which the combustion gases are discharged. Spirally disposed vanes 10 are mounted in the nozzle N, which vanes are preferably hook-shaped as shown in end view in Fig. 2.

When the combustion chamber is in full operation and developing full power, the vanes 10 continuously rotate the chamber C at the desired speed, but the chamber is rather slow in picking up speed when first started. Accordingly, auxiliary vanes 20 are provided which are positioned rearward of the nozzle N and which are aligned

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with the nozzle opening when the chamber is at rest, as shown in Figs. 1 and 2.

The vanes 20 are curved to correspond with the curvature of the vanes 10 and assist in building up rotational speed and in the same direction of rotation. The vanes 20 are mounted on flat spring arms 22 which extend through slots 24 in a casing 25 and which are firmly secured to the nozzle N, as by rivets 26.

The springs 22 are of such strength and thickness that the vanes 20 will be swung outward by centrifugal force to the position shown in Fig. 3 when the chamber C has been brought up to a desired speed of rotation. The vanes 20 are thereafter inoperative and the chamber continues to rotate at the desired speed by the rotational effect of the vanes 10 in the nozzle N.

The casing 25 encloses the vanes 20 in all positions and reduces air resistance. A streamlined outer casing 30 may be added to further reduce air resistance, if the combustion chamber is not enclosed in the casing of a rocket craft R as shown in Fig. 4.

Auxiliary apparatus is also shown in Fig. 4 by which the combustion chamber C may be initially started to rotate from a position of rest. For this purpose, a small powder rocket or a compressed air nozzle 40 is mounted to discharge a fluid at high speed against an annular series of vanes 42 mounted on the outside of the chamber C. These vanes are preferably curved as indicated, so that the fluid is reversed in direction, and so that increased power is thus obtained therefrom.

The device 40 is intended for operation only to start rotation of the chamber, and it is desirable to discontinue the operative effect of the device 40 as soon as the chamber C is rotating at the relatively low speed at which the vanes 10 and 20 can take over and continue.

The device 40 is accordingly pivoted at 44 and is provided with a solenoid plunger 45 extending through a solenoid coil 46. One terminal of the coil is grounded on the casing of the craft R by a wire 47, and the other terminal of the coil is connected through a battery B to a brush or contact 50 which continuously engages an insulated commutator ring 51 connected by a wire 52 to a leaf spring 53 mounted on but insulated from the combustion chamber C.

When rotation of the combustion chamber comes up to a predetermined speed, the spring 53 swings outward under centrifugal force and engages a bracket 54 supported by and grounded on the chamber C. When this contact is made,

the solenoid circuit is completed and the device 40 is swung outward as indicated by the arrow *a*, so that the stream of air, gas or vapor flowing therefrom no longer engages the turbine blades 42. The production of excessive rotative speed for the combustion chamber is thus avoided.

Under certain operating conditions, it may be necessary to neutralize the gyroscopic effect of the rotating combustion chamber. For this purpose the construction shown in Figs. 5 and 6 may be used. A combustion chamber C' is mounted in bearings 60 in a rocket craft R' and is provided with the usual nozzle N'. Spiral vanes 62 are provided in the nozzle N', and the combustion chamber is rapidly rotated thereby within the craft R' as previously described.

In order to neutralize the gyroscopic effect, provision is made to rotate the rocket craft R' and fuel tank T in the opposite direction to the chamber C' and at a speed just sufficient to neutralize the more rapid rotation of the chamber.

For this purpose, the rear end portion 70 of the rocket craft casing is extended as indicated in Figs. 5 and 6 and is provided with a plurality of short angularly disposed vanes 71 which are substantially in line with the vanes 62 in the nozzle N' but which are disposed at a reverse angle. Consequently, the combustion gases discharged through the nozzle N' will engage the vanes 71 after leaving the nozzle and will rotate the craft R' in the opposite direction.

The neutralizing effect of such opposite rotation will be increased if the load of fuel in the tank T also partakes of this rotation, and for this purpose longitudinally disposed baffle plates 85 may be mounted in the tank T but with clearance at each end, so that all portions of the fuel may be accessible for use.

Provision is thus made for initially starting the combustion chamber in rotation, for continuing such rotation by the action of the combustion gases discharged from the rotating chamber, and for accelerating the building up of a desired speed of rotation by auxiliary vanes which become inoperative at a predetermined speed of rotation.

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 propulsion apparatus, a combustion chamber having an open rearward discharge nozzle, means to rotatably support said combustion chamber, spiral vanes in said nozzle with which the discharging combustion gases coact to rotate said chamber, and auxiliary vanes movably mounted on and beyond the open rear end of said nozzle to provide additional starting torque and said vanes being displaceably by centrifugal force to inoperative position on attainment of a predetermined speed of rotation.

2. In propulsion apparatus, a combustion chamber having an open rearward discharge nozzle, means to rotatably support said combustion chamber, spiral vanes in said nozzle with which the discharging combustion gases coact to rotate said chamber, and auxiliary vanes mounted on and beyond the open rear end of said nozzle to provide additional starting torque, and said auxiliary vanes being mounted to move radially outward and out of the gas stream under centrifugal force and to thereby become inoperative at a predetermined speed.

3. The combination in propulsion apparatus as set forth in claim 2, in which the auxiliary vanes are mounted on spring arms fixed to said nozzle and which arms yield under centrifugal force and thereby permit said vanes to move outward when the predetermined speed is attained.

ESTHER C. GODDARD,
Executrix of the Last Will and Testament of Robert H. Goddard, Deceased.

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