May 16, 1950 R. H. GODDARD 2,507,970

GAS-OPERATED MEANS FOR DRIVING ROTATING COMBUSTION CHAMBERS

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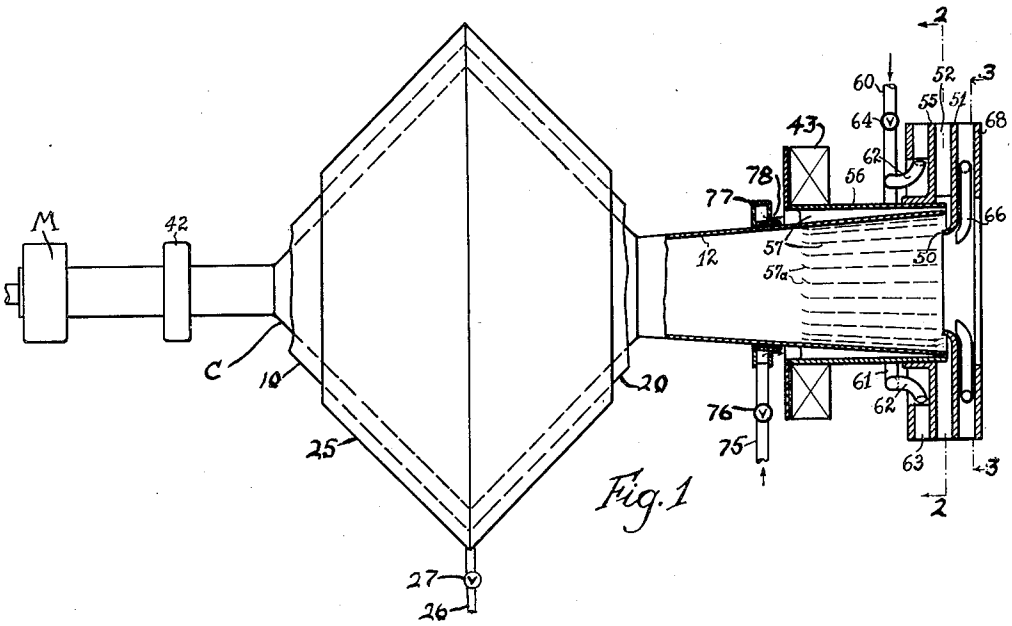


Fig. 1

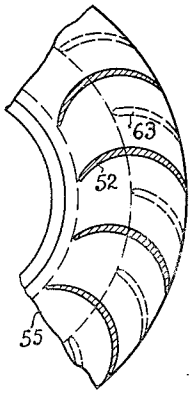


Fig. 2

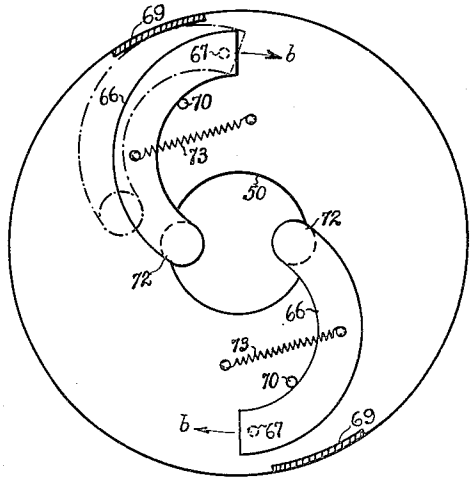


Fig. 3

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## GAS-OPERATED MEANS FOR DRIVING ROTATING COMBUSTION CHAMBERS

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

Original application October 23, 1943, Serial No. 507,416, now Patent No. 2,479,829, dated August 23, 1949. Divided and this application March 19, 1949, Serial No. 82,442

6 Claims. (Cl. 60—35.6)

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This invention relates to improved means for starting and driving a rotatable combustion chamber adapted for use in rockets and other rocket-type propulsion apparatus.

This invention is a division of the prior application of Robert H. Goddard, Serial No. 507,416, filed October 23, 1943 and issued as Patent No. 2,479,829.

An important object of the invention is to provide improved means engaged by a portion of the discharged combustion gases and operative to continuously rotate the combustion chamber.

Another feature of the invention relates to the provision of an externally-powered turbine device for starting purposes.

A further object of the invention is to provide improved auxiliary starting devices for quick pick-up, together with means for rendering said devices inoperative on the attainment of a predetermined speed.

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

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

Fig. 1 is a front elevation of a rotating combustion chamber, with the parts embodying this invention shown in section; and

Figs. 2 and 3 are sectional end elevations, taken along the lines 2—2 and 3—3 in Fig. 1 respectively.

Referring to Fig. 1, a double conical combustion chamber C is shown mounted in bearings 42 and 43 and provided with a motor M for starting purposes. The chamber C is enclosed by jackets 10 and 20 through which combustion liquids are supplied, and the jacket 20 is enclosed in an outer jacket 25 to which gas under pressure may be supplied through a pipe 26 and valve 27. An outwardly tapered nozzle 12 is directly connected to the chamber C and is rotatable therewith.

As the combustion gases are discharged from the nozzle 12, an outer and cooler portion of the gases is engaged by the inturned lip 50 of a disc 51. The disc 51 is connected by a plurality of vanes 52 (Fig. 2) to a second disc 55 which is firmly supported on a sleeve 56. The sleeve 56 is connected to the nozzle 12 by a series of vanes 57 having curved entrance portions 57a.

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As the rotating combustion gases engage the lip 50 and are directed outward, they react with the curved vanes 52 to keep the chamber C and associated parts in continued rapid rotation. The bearing 43 may be mounted on the sleeve 56.

For starting purposes, gas under pressure may be supplied through a pipe 60 (Fig. 1), annular connection 61 and stationary nozzles 62 to react against relatively short curved vanes 63 (Figs. 1 and 2) mounted on the disc 55 at the opposite side from the vanes 52. A valve 64 controls the admission of gas through the pipe 60. This turbine construction for initial starting may be used in addition to the motor M or in substitution therefor. After the chamber C is in full operation, the valve 64 may be closed.

As an aid to quick pick-up, two or more starting nozzles 66 (Figs. 1 and 3) are pivoted at 67 between an outer disc 68 and the outer face of the disc 51. The two discs are connected by segmental portions 69 (Fig. 3) which also act as outer stops for the nozzles 66. Pins 70 mounted in the discs 68 and 51 act as inner stops.

At their inner ends, the nozzles 66 have side inlet openings 72, directed toward the chamber C and positioned to receive portions of the exhaust gases as they are ejected at high speed through the nozzle 12. The gases which enter the side openings 72 pass outward through the curved nozzles 66 and are discharged as indicated by the arrow *b* (Fig. 3), thus producing a further reaction which tends to increase the speed of rotation of the combustion chamber and associated parts.

Springs 73 (Fig. 3) normally hold the starting nozzles 66 in inward position against the stop pins 70. As the speed of the chamber increases, the inner ends of the nozzles 66 are swung outward by centrifugal force to the inoperative positions shown in dotted lines in Fig. 3, where they are shielded between the discs 51 and 68.

It is desirable to reduce the temperature of the gases collected by the disc 51 and flowing outward along the vanes 52. For this purpose, water is supplied through a pipe 75 and valve 76 (Fig. 1) to a casing 77 having an annular outlet 78. Water is thus supplied to the axial passages between the rotating vanes 57 in the annular space between the nozzle 12 and the nozzle casing 56. This water acts to lower the temperature of the

rear end of the nozzle **12** and at the same time the water is turned into steam which mingles with that portion of the exhaust gases which is diverted by the lip **50** and thus directed outward against the vanes **52**.

The devices and constructions herein described have been found effective and reliable for starting and continuously rotating a rotatable combustion chamber and for providing a quick pick-up as soon as combustion gases are discharged through the rearwardly open nozzle.

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 a rocket type combustion apparatus, a combustion chamber, means to rotatably support said chamber, a discharge nozzle rotatable with said chamber, an annular plate mounted at the discharge end of said nozzle and rotatable therewith but spaced therefrom and having an inner annular lip positioned in the path of the outflowing combustion gases, and a set of propelling vanes fixed to the inner side of said plate and in the path of the diverted gases, and said gases reacting with said vanes to rotate said combustion chamber.

2. The combination in a combustion apparatus as set forth in claim 1, in which a second set of vanes is mounted to rotate with said discharge nozzle and in which fixed means is provided to direct streams of compressed gas against said latter vanes to effect initial rotation of said chamber.

3. In a rocket type combustion apparatus, a combustion chamber, means to rotatably support said chamber, a discharge nozzle rotatable with said chamber, and pick-up means for said chamber associated with said discharge nozzle and comprising curved auxiliary nozzles transversely disposed at the end of said discharge nozzle and rotating therewith, said auxiliary nozzles having inner side openings normally positioned in the path of the out-flowing gases and facing said gases and having outer end openings through which the diverted portions of said gases are tangentially discharged.



4. The combination in combustion apparatus as set forth in claim 3, in which the auxiliary nozzles are pivotally mounted, and in which the inner ends of said nozzles are swung out of the gas stream by centrifugal force as the speed of rotation increases.

5. In a rocket type combustion apparatus, a combustion chamber, means to rotatably support said chamber, a discharge nozzle rotatable with said chamber, and pick-up means for said chamber associated with said discharge nozzle and comprising gas-diverting devices mounted at the outer end of said nozzle and normally positioned for engagement by the exhaust gases, and yielding means to hold said devices in normal engaging position, and said devices being mounted for movement under centrifugal force to non-engaging position on attainment of a predetermined speed of chamber rotation.

6. In a rocket type combustion apparatus, a combustion chamber, means to rotatably support said chamber, a discharge nozzle rotatable with said chamber, an annular plate mounted at the discharge end of said nozzle and rotatable therewith but axially spaced therefrom and having an inner annular lip positioned in the path of the outflowing combustion gases, a second annular plate mounted nearer said combustion chamber, a set of propelling vanes mounted between said plates and secured thereto, a sleeve mounted on said nozzle but radially spaced therefrom by a plurality of interposed and axially extended vanes, and means to inject cooling water into said sleeve and between said vanes at the ends thereof nearer the combustion chamber, said sleeve supporting said discs and propelling vanes, and steam developed in said sleeve and between said vanes being discharged rearward into the diverted gases flowing radially outward between said plates.

ESTHER C. GODDARD,

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

No references cited.