May 29, 1951 R. H. GODDARD 2,555,084

MEANS FOR DEFLECTING AXIAL FLOW IN A COMBUSTION CHAMBER FOR PROPULSION APPARATUS

Filed Oct. 2, 1947

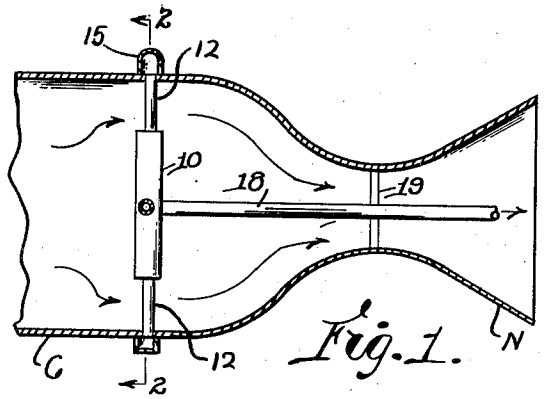


Fig. 1.

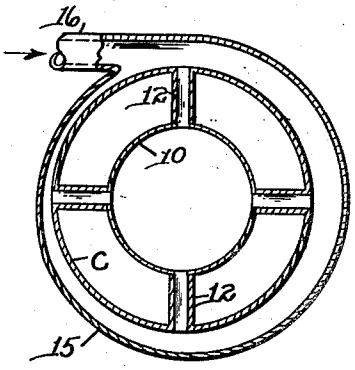


Fig. 2.

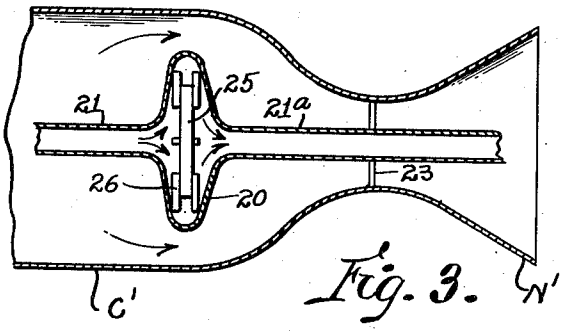


Fig. 3.

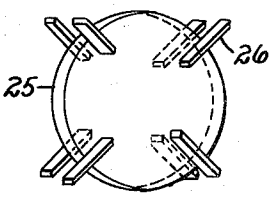


Fig. 4.

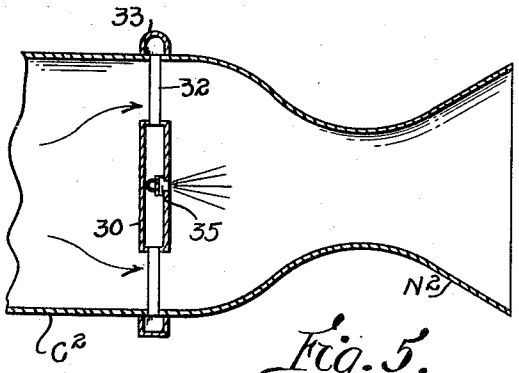


Fig. 5.

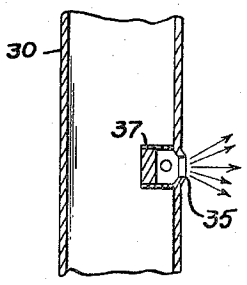


Fig. 6.

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

Patented May 29, 1951 2,555,084

UNITED STATES PATENT OFFICE

2,555,084

MEANS FOR DEFLECTING AXIAL FLOW IN A COMBUSTION CHAMBER FOR PROPULSION APPARATUS

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

Application October 2, 1947, Serial No. 777,470

1 Claim. (Cl. 60—35.6)

1

This invention relates to combustion chambers as used in aircraft propulsion apparatus. Such chambers commonly comprise a substantially cylindrical body portion and a rearwardly expanding discharge nozzle.

The combustion fluids in such a combustion chamber, comprising intermingled liquids and combustion gases, move rearward at relatively low speed adjacent the chamber and nozzle walls but at relatively high speed along the combustion chamber axis where the gases are hotter and less dense and where they consequently move with less resistance. Such rapid axial flow of the combustion fluids utilizes the heat and kinetic energy to poor advantage and is correspondingly inefficient.

It is the general object of this invention to provide means to communicate the heat and kinetic energy of the hot and rapidly moving axial fluids to the cooler and more slowly moving fluids adjacent the chamber and nozzle walls.

To the accomplishment of this general object, a deflecting device is mounted within the combustion chamber by which straight axial flow is prevented and by which the velocities of the fast-moving and the slow-moving fluids are averaged. Means is also provided for liquid-cooling of the deflecting devices, and for effecting more complete combustion of the combustion gases.

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 partial sectional elevation of a combustion chamber and nozzle embodying this invention;

Fig. 2 is a transverse sectional elevation, taken along the line 2—2 in Fig. 1;

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

Fig. 4 is a perspective view of the deflecting device shown in Fig. 3;

Fig. 5 is a view similar to Fig. 1 but showing a second modification; and

Fig. 6 is an enlarged partial section of the deflecting device shown in Fig. 5.

Referring to Figs. 1 and 2, a combustion chamber C is shown as provided with a rearwardly expanding discharge nozzle N. The chamber C is substantially cylindrical and is provided with a hollow disc-like deflecting device 10 axially supported in the chamber C by radiating pipes 12 which extend through the wall of the chamber

2

C and which communicate with a manifold or volute 15 having an intake pipe 16 (Fig. 2).

A discharge pipe 18 may be connected to the center of the disc 10 at the rear or discharge side thereof, and may be axially supported by vanes or ribs 19. Any suitable cooling liquid, such as water, is supplied to the deflecting device through the intake pipe 16 and radiating pipes 12, and this water in a more or less gaseous condition is discharged through the pipe 18 into the outwardly directed blast of combustion fluids, with which it is then intermingled.

The deflecting disc 10 effectively prevents straight axial rearward flow of the combustion fluids and causes the fluids to be outwardly displaced as indicated by the arrows in Fig. 1. Such outward displacement causes the faster-moving axial fluids to be intermingled with the more slowly-moving fluids adjacent the outer wall of the chamber C, so that the entire body of fluids discharged through the nozzle N flows at an averaged speed substantially below the normal speed of axial discharge.

It is well known that the speed of the liquids or gasses in a combustion chamber and of the gases in the associated nozzle is much less near the wall than near the axis of symmetry, being, in fact, zero in contact with the wall. The velocity along the axis is, of course, a maximum, and when this velocity is high much of the energy of the propellant escapes without supplying a proportionately great reaction or thrust, for the reason that mechanical kinetic energy depends upon the square of the velocity, whereas the thrust depends only upon the first power of the velocity. The discharge of all of the combustion gases at an averaged and substantially reduced speed thus avoids much of the waste of kinetic energy which is encountered with gases discharged at excessive and very high speeds.

In Fig. 3, a similar combustion chamber C' and nozzle N' are shown, but the deflecting device comprises a hollow structure 20 formed as an enlargement at an intermediate point in a pipe 21 having a rear end portion 21*a*. The pipe 21 may extend through the closed or front end of the combustion chamber C' and receive a supply of water or other cooling liquid from any suitable source. The pipe portion 21*a* extends along the axis in the nozzle N', as in the construction previously described, and may be supported by braces or vanes 23.

A disc 25 is mounted in the center of the enlarged pipe portion 20 and is axially positioned therein by a plurality of radiating ribs 26 (Fig.

4). The cooling liquid is thus deflected outward around the disc **25** and again inward into the discharge pipe portion **21***a*, thus effectively cooling all surfaces of the deflecting device which comprises the enlarged portion **20** and the supporting pipe portions **21** and **21***a*.

In Fig. 5, a construction is shown which is quite similar to that shown in Fig. 1. A combustion chamber C2 is provided with a nozzle N2, and a deflecting device **30** in the form of a hollow disc is axially supported in the chamber C2 by radiating pipes **32** connecting to a manifold or volute **33** to which water is supplied as in the construction shown in Fig. 2.

Instead, however, of conducting the steam and water vapors to the rear of the nozzle N2 as shown in Fig. 1, a spray opening **35** is formed in the discharge side of the deflecting device **30**. The spray opening **35** is covered at its inner side by a perforated cap **37** which prevents direct and unobstructed out-flow from the hollow disc **30** but produces a discharge spray.

The cooling liquid used in this construction is preferably liquid oxygen. The liquid and gaseous oxygen discharged through the port **35** is intermingled with the combustion gases discharged through the nozzle N2 and effects more complete combustion thereof.

In all forms of the invention, the primary object of the invention, namely, to average the flow of the faster-moving axial fluids with the slow-moving peripheral gas stream, is effectively accomplished.

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 a combustion chamber having a body portion with a circumferential side wall and having an open rearward nozzle portion, that improvement which comprises a hollow gas deflector having a transversely-extended outer casing which is axially positioned in said body portion and which is substantially spaced radially from said circumferential side wall and which is positioned wholly within said body portion and which is substantially spaced axially forward from the entrance of said nozzle portion, an axially-disposed pipe extending lengthwise along said body portion and said nozzle portion and supporting said deflector and also conducting a cooling liquid to and away from said deflector, said pipe having supporting vanes in said nozzle portion and said nozzle portion being entirely unobstructed by said deflector and except by said pipe and vanes, and means in said deflector supported in spaced relation to the outer casing thereof and effective to divert said cooling liquid against the outer casing of said deflector.

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

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
228,250	Eaton	June 1, 1880
324,828	Gassett	Aug. 25, 1885
974,458	Backstrom	Nov. 1, 1910

OTHER REFERENCES

Astronautics, published March 1944, page 12.