Aug. 12, 1952 R. H. GODDARD 2,606,421

MIXING TARGET FOR COMBUSTION CHAMBERS HAVING MEANS TO RETARD RADIAL OUTWARD MOVEMENT

Filed May 11, 1946

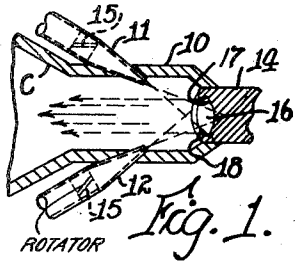


Fig. 1.

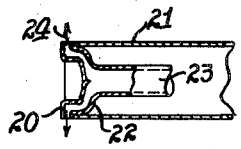


Fig. 2.

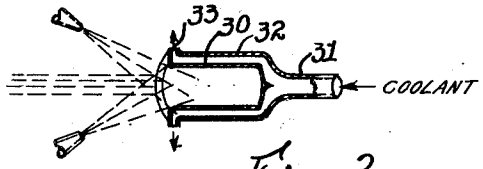


Fig. 3.

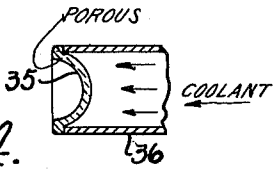


Fig. 4.

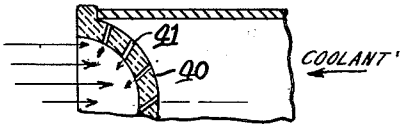


Fig. 5.

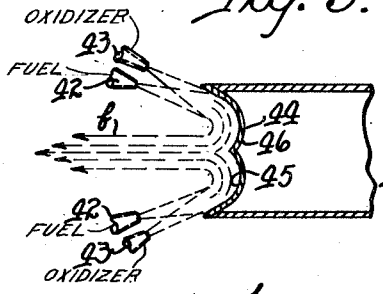


Fig. 6.

Fig. 7.

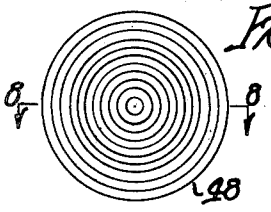


Fig. 10.

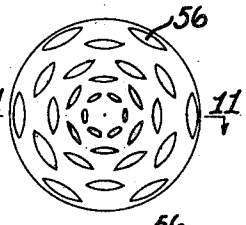
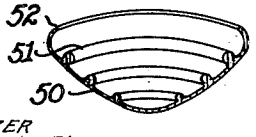


Fig. 9.



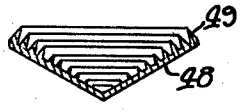


Fig. 8.

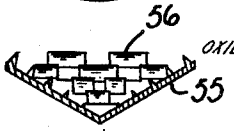


Fig. 11.

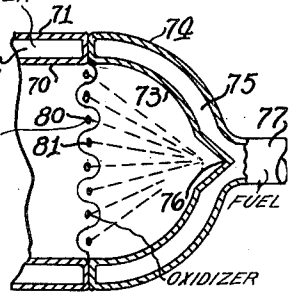


Fig. 15.

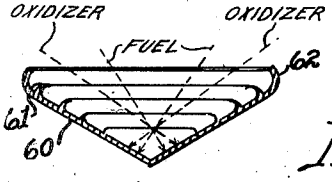


Fig. 12.

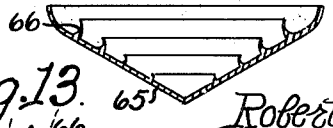


Fig. 13.



Fig. 14.

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MIXING TARGET FOR COMBUSTION CHAMBERS HAVING MEANS TO RETARD RADIAL OUTWARD MOVEMENT

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5 Claims. (Cl. 60—39.69)

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This invention relates to a combustion chamber particularly adapted for use in rocket propulsion apparatus and of the type in which the combustion elements are projected under pressure toward a closed or inner end portion of the combustion chamber.

The provision of a target area at the closed end of a combustion chamber causes the drops or sprays of combustion liquids striking the target to be flattened out and to be superposed in the target area, thus becoming much more thoroughly mixed than where two open sprays merely intersect and only partially intermingle.

It is the general object of this invention to provide an improved target construction by which more effective mixing of the combustion elements is caused to take place.

To the attainment of this object, a target construction is provided which retards the radial outward spreading of the drops or sprays away from the target area and which thereby attains even more thorough mixing and intermingling of the combustion liquids.

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 drawings, in which

Fig. 1 is a partial sectional side elevation of a combustion chamber having one form of improved target construction embodied therein;

Figs. 2 and 3 are sectional side elevations of modified and jacketed target members;

Fig. 4 is a partial sectional side elevation of a porous target member;

Fig. 5 is a similar view of a target member having fine perforations for coolants;

Fig. 6 is a partial sectional elevation of a member having an annular target area;

Fig. 7 is an end elevation of a modified target member;

Fig. 8 is a transverse sectional view, taken along the line 8—8 in Fig. 7;

Fig. 9 is a sectional view similar to Fig. 8 but showing a further modification;

Fig. 10 is an end view of another form of target member;

Fig. 11 is a transverse sectional view, taken along the line 11—11 in Fig. 10;

Figs. 12 and 13 are transverse sectional views of additional modifications;

Fig. 14 is an enlarged detail view of a portion of the structure shown in Fig. 13; and

Fig. 15 is a partial longitudinal section of a

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jacketed combustion chamber and target member.

Referring to Fig. 1, portions of a combustion chamber C are shown having an inner end extension 10 provided with nozzles 11 and 12 through which streams of combustion liquids may be projected against a target member 14. The nozzles 11 and 12 are preferably provided with inner helical guiding members or rotators 15 by which the liquids will be given a rotating or whirling motion as they are injected under pressure against the target 14.

The operative face of the target 14 is provided with a target recess 16 preferably having a concave impact surface 17 and also having an annular overhanging edge portion 18 which retards outward spreading of the combustion liquids on impact with the target surface 17. Thorough and effective mixing of the combustion liquids accordingly takes place in the target recess 16. The intermingled and ignited combustion elements pass into the combustion chamber C as indicated by the arrows in Fig. 1, the combustion process being completed in the chamber C.

In Fig. 2 a target member 20 is shown mounted on a tubular support 21 and provided with a jacket 22 supplied with a cooling liquid through a pipe 23. The liquid thus supplied, after engaging and cooling the target 20, passes out through slots or openings 24 to any suitable waste or discharge. With this construction, the target member is effectively cooled and may be made of relatively thin sheet metal.

In Fig. 3 a somewhat similar construction is provided for cooling a target member 30 which is of very substantial depth. This type of target member allows the larger drops to engage the emerging stream of mixed liquids for a considerable distance before they strike the inner end of the target member. The emerging stream of mixed combustible elements is narrower and more sharply defined than when produced by a target of the type shown in Fig. 2. A cooling liquid is supplied through a pipe 31 to the jacket casing 32 and flows out through openings 33 to a waste or discharge, all as previously described.

In the construction shown in Fig. 4, the target member 35 has a substantially semi-spherical target surface and is formed of porous material, such as a porous metal or oxide, so that coolant supplied through the tubular support 36 will effectively cool the target member 35 and will be discharged to the combustion chamber through the pores of the target member.

In Fig. 5 a similar target member 40 is provided

with fine perforations 41 obliquely disposed with respect to the axis of the combustion chamber, so that the cooling liquid will enter the chamber somewhat tangentially and so that the combustion liquids engaging the target will be prevented from passing in a direct line therethrough.

In Fig. 6 effective intermingling is produced by introducing two different combustion liquids, as a liquid fuel and a liquid oxidizer, through nozzles 42 and 43 to the peripheral portion of the target member 44 which has a generally concave target surface 45 but which is also provided with an outwardly projecting axial portion 46, so that the intermingled combustion liquids are projected along the axis as indicated by the arrows *b* and do not intersect the sprays projected from the nozzles 42 and 43.

In Figs. 7 and 8 a target member is shown in which special provision is made for retarding outward spread of the liquids engaging the target surface. The target member 48 is provided with annular ridges 49 disposed as shown in Fig. 8 and gradually decreasing in height toward the axis. This variation in height permits the drops or sprays to spread out more rapidly in the central portion and to be increasingly retarded as they approach the periphery.

In Fig. 9 a target member 50 is shown in which the annular ridges 51 are rounded in section to better resist high temperature, by reason of their increased cross section and by their avoidance of sharp edges. An overhanging lip portion 52 is also provided, similar to the overhanging portion 18 shown in Fig. 1 and previously described.

In Figs. 10 and 11 a quite similar target member 55 is shown, except that the annular ridges previously described are replaced by annular series of spaced elongated projections 56, alternately disposed in adjacent series.

Fig. 12 is a modification of the construction shown in Figs. 7 and 8 and shows a target member 60 having annular ridges 61 of inwardly curved cross section, so that outward spreading of the combustion liquids is additionally retarded. The target member 60 also has an overhanging outer edge portion 62 similar to the edge portion 52 in Fig. 9 and the edge portion 18 in Fig. 1 and the outer edge portions are curved inward or towards the axis.

Fig. 13 shows a further modification of the construction shown in Figs. 7 and 8, with the target member 65 provided with annular ridges 66 of curved and hooked section, and with the hooked edges directed outwardly and away from the axis, as more clearly shown in Fig. 14. This construction is designed to facilitate the thorough mixing and intermingling of the combustion liquids by the formation of vortices between the ridges, as indicated by the arrows in Fig. 14.

In all forms of the invention as above described, it will be evident that special provision has been made for retarding the outward travel of the drops or sprays of combustion liquids after they engage the target surface.

In Fig. 15 a combustion chamber is shown having a cylindrical body portion 70 enclosed by a casing 71 providing a jacket space 72. The closed inner end portion of the chamber has a semi-spherical end wall 73 and a casing 74 enclosing a jacket space 75. The wall 73 has an axial conical target recess 76. One combustion liquid, as fuel, is supplied under pressure to the jacket space 75 by a feed pipe 77 and another combustion liquid as an oxidizer is supplied under pressure to the jacket space 72 by a similar feed pipe not shown. The liquids are fed along converging lines through feed openings 80 and 81 and intermingle in and adjacent the target recess 76. The adjacent parts of the body and end portions of the chamber meet along a sinuous section, as shown in Fig. 15, so that the openings 80 and 81 may all be in the same plane and at the same distance from the point of convergence.

Having thus described certain preferred forms of the invention, 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. A mixing target for a combustion chamber comprising a conically-recessed closed end wall having a plurality of concentric ridges projecting substantially normal from the inner and concave face of said wall, and said ridges being effective to retard radial outward displacement of combustion liquids directed against said closed wall of said mixing target and adjacent the axis thereof, and said ridges increasing in height from the axis outward.

2. A mixing target for a combustion chamber comprising a conically-recessed closed end wall having a plurality of concentric ridges projecting substantially normal from the inner and concave face of said wall, and said ridges being effective to retard radial outward displacement of combustion liquids directed against said closed wall of said mixing target and adjacent the axis thereof, and said ridges being interrupted to provide staggered spaced retarding projections.

3. A mixing target for a combustion chamber comprising a conically-recessed closed end wall having a plurality of concentric ridges projecting substantially normal from the inner and concave face of said wall, and said ridges being effective to retard radial outward displacement of combustion liquids directed against said closed wall of said mixing target and adjacent the axis thereof, and said ridges increasing in height from the axis of said wall outward and being of curved and hooked cross-section.

4. A mixing target for a combustion chamber comprising a conically-recessed closed end wall having a plurality of concentric ridges projecting substantially normal from the inner and concave face of said wall, and said ridges being effective to retard radial outward displacement of combustion liquids directed against said closed wall of said mixing target and adjacent the axis thereof, and said ridges increasing in height from the axis of said wall outward and being of curved and hooked cross section and with the hooked edges thereof directed outward and away from the axis of said target.

5. A mixing target for a combustion chamber comprising a conically-recessed closed end wall having a plurality of concentric ridges projecting substantially normal from the inner and concave face of said wall, and said ridges being effective to retard radial outward displacement of combustion liquids directed against said closed wall of said mixing target and adjacent the axis thereof, and said ridges increasing in height from the axis of said wall outward and being of curved and hooked cross section and with the hooked edges thereof directed inward and toward the axis of said target.

ESTHER C. GODDARD,

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

(References on following page)

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
166,803	Oyston	Aug. 17, 1875
229,344	Watkins	June 29, 1880
316,581	Stratton	Apr. 28, 1885
1,502,045	McCarry	July 22, 1924
1,509,448	Skinner	Sept. 23, 1924
2,058,823	Pigott	Oct. 27, 1936
2,085,800	Goddard	July 6, 1937
2,100,143	Mock	Nov. 23, 1937
2,259,011	Taylor	Oct. 14, 1941
2,511,992	Quick	June 20, 1950

FOREIGN PATENTS

Number	Country	Date
284,289	Great Britain	Oct. 11, 1928
522,313	Great Britain	June 14, 1940
633,667	Germany	Aug. 3, 1936
729,926	France	May 3, 1932
850,399	France	Sept. 11, 1939

OTHER REFERENCES

"Astronautics," Journal of The American Rocket Society, Number 33 of March 1936, pages 8 and 12.

"Rocket Problems," page 71, book by Lasser (1931).

"Aviation," January 1944, page 148.