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ROTATING, FEEDING, AND COOLING MEANS FOR COMBUSTION CHAMBERS

2,536,600

Filed Feb. 7, 1948

2 Sheets-Sheet 1

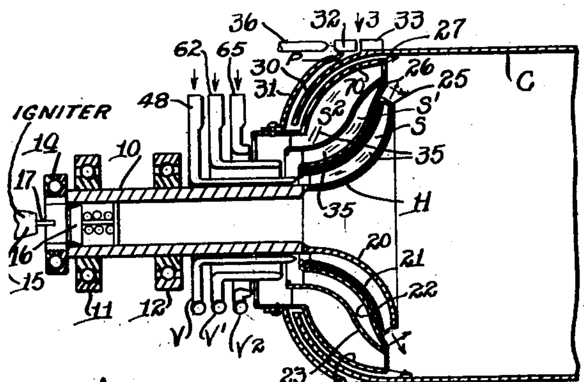

Fig. 2.

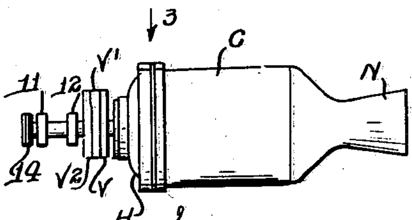

Fig. 1.

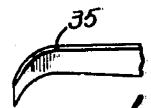

Fig. 4.

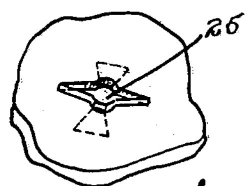

Fig. 5.

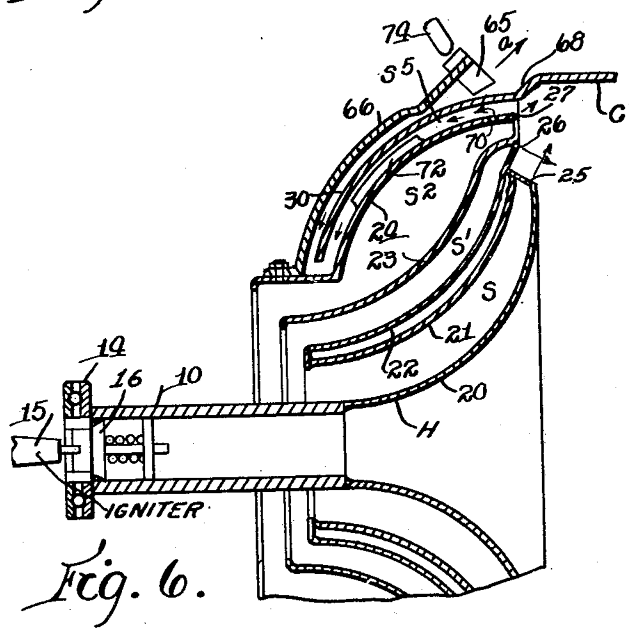

Fig. 6.

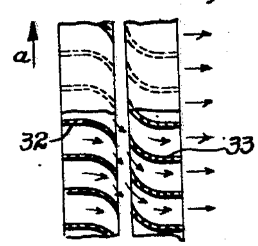

Fig. 3.

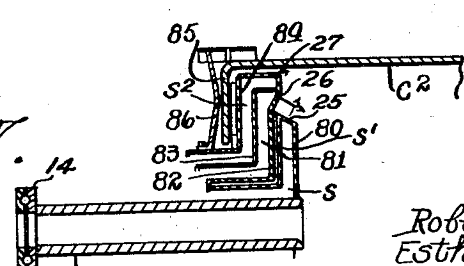

Fig. 7.

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ROTATING, FEEDING, AND COOLING MEANS FOR COMBUSTION CHAMBERS

Filed Feb. 7, 1948 2 Sheets-Sheet 2

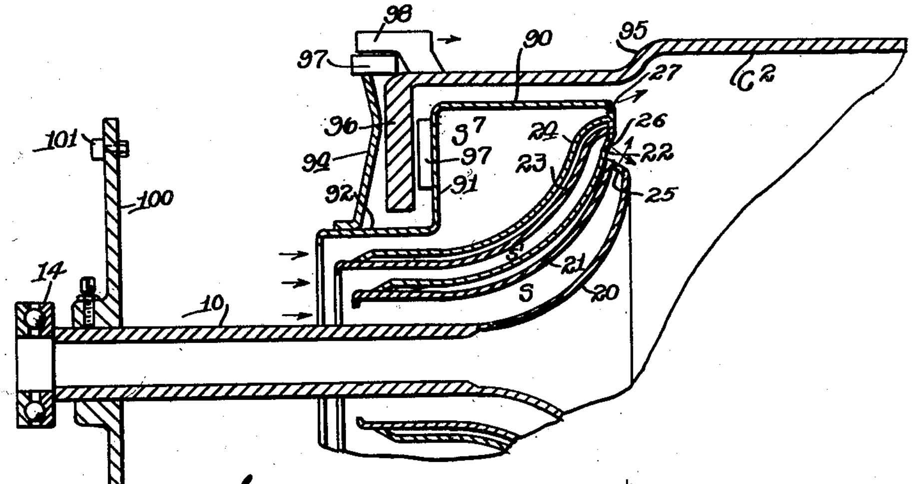

Fig. 8.

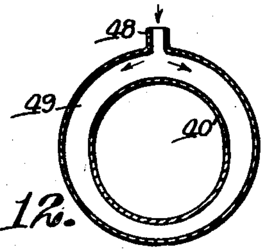

Fig. 12.

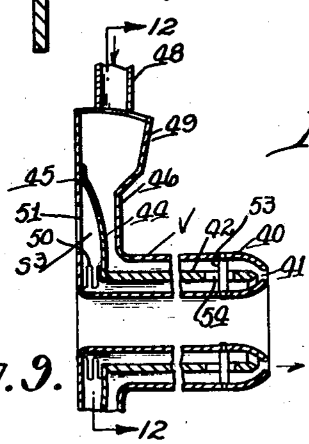

Fig. 9.

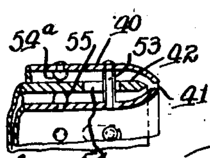

Fig. 10.

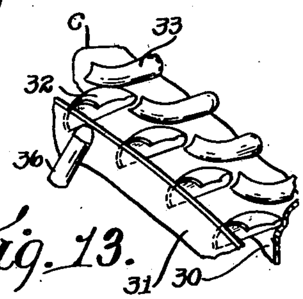

Fig. 13.

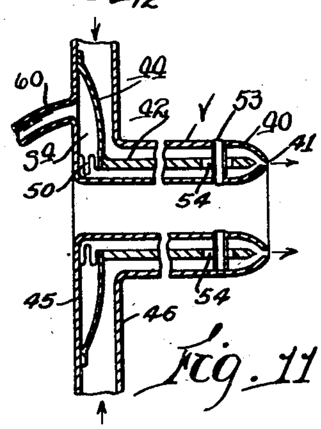

Fig. 11.

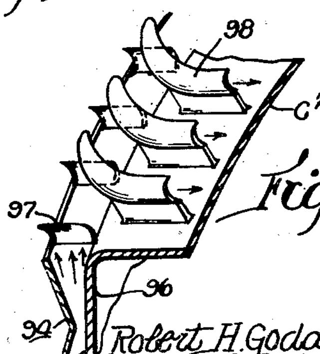

Fig. 14.

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UNITED STATES PATENT OFFICE

2,536,600

ROTATING, FEEDING, AND COOLING MEANS FOR COMBUSTION CHAMBERS

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Application February 7, 1948, Serial No. 7,016

2 Claims. (Cl. 60—44)

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This invention relates to combustion chambers of the general type disclosed in Figs. 16 to 23 of prior Goddard Patent No. 2,395,403 issued February 26, 1946, and in which a rotating feeding head is provided for a stationary combustion chamber and nozzle.

It is the general object of the present invention to provide improved devices for feeding the combustion liquids, for cooling the combustion chamber and associated parts, and for actuating the rotating parts.

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 side elevation of a combustion chamber embodying this invention;

Fig. 2 is a partial longitudinal sectional elevation of the combustion chamber shown in Fig. 1;

Fig. 3 is a detail view, partly in section, and looking in the direction of the arrow 3 in Figs. 1 and 2;

Fig. 4 is a partial perspective view of a guiding vane to be described;

Fig. 5 is a detail view showing a special feed slot or opening;

Figs. 6, 7 and 8 are partial sections similar to Fig. 2 but showing modified constructions;

Fig. 9 is a partial sectional elevation of an annular valve construction;

Figs. 10 and 11 are partial sectional elevations of modified valve constructions;

Fig. 12 is a sectional end view of a volute for liquid feeding purposes taken substantially along the line 12—12 in Fig. 9 but with certain parts omitted; and

Figs. 13 and 14 are enlarged detail perspective views showing the turbine blade arrangements of Figs. 2 and 8 respectively.

Referring to Fig. 1, combustion apparatus is shown comprising a stationary combustion chamber C having a discharge nozzle N associated therewith. The combustion chamber C also has a rotatable feeding head H, more clearly disclosed in Fig. 2.

The head H is assembled on an axially-disposed tube 10 having supporting bearings 11 and 12 and an end thrust bearing 14. An igniter 15 may be provided, by which a flame may be projected into the chamber C to start combustion. A check valve 16 normally closes the open end of the tube 10 but may be opened by a stud 17 as

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the igniter 15 is manually advanced to operative position.

The head H comprises a series of substantially concentric but convex partitions 20, 21, 22, 23 and 24, all supported by and rotatable with the tube 10. These parts define annular liquid spaces S, S' and S2.

The space S is designed to receive liquid oxygen, which is sprayed into the chamber through feed openings 25 which may be of the special design shown in Fig. 5 to produce flat sprays. The space S' is designed to receive a liquid fuel, as gasoline, which is similarly sprayed through openings 26. The space S2 is designed to receive a cooling liquid, as water, which is sprayed through openings 27 to engage the stationary wall of the chamber C in a tangential direction.

The end 30 of the chamber C is extended in segmental spherical form and is fixed in spaced relation to the casing member 24 which defines the outer wall surface of the water space S2. An additional casing member 31 is mounted outside of the segmental end wall 30 and in spaced relation thereto and supports a series of turbine blades 32, which are positioned adjacent a second series of stationary blades 33.

A small proportion of the combustion gases in the combustion chamber C escape through the narrow annular passages inside and outside of the chamber end portion 30, and these gases engage the blades 32, which are curved as indicated in Figs. 3 and 13. The feeding head H is thus rotated in the direction of the arrow a in Fig. 3.

The combustion gases escaping from the blades 32 are engaged by fixed blades 33 on the chamber C and are redirected axially, so that their remaining propulsive force is added to that of the gasses escaping through the nozzle N.

Vanes or partitions 35 are mounted in the spaces S, S' and S2 to hold the casing members in fixed spaced relation and also to pick up and outwardly direct the liquids supplied to these annular spaces. The inner ends of the blades 35 are preferably curved as shown in Fig. 4.

The casing 31 (Fig. 2) is slidably mounted relative to the end portion 30 of the chamber C, so that the space between the parts 30 and 31 may be varied to control the proportion of combustion gases utilized for rotating the feeding head H. The space between the parts 30 and 31 is preferably reduced at the point P to increase the speed of the gases as they approach the blades 32. Gas under pressure may be supplied through one or more nozzles 36 for starting purposes. An air space is provided between the casings 21 and 22 to prevent freezing of the liquid fuel in the space S'.

The several liquids are fed to the spaces S, S' and S2 through annular nozzle and valve members V, V' and V2, indicated diagrammatically in Fig. 2 and more in detail in Figs. 9, 10 and 11.

The details of construction of the valve V which controls the feed of liquid oxygen to the space S are shown in Fig. 9. The valve comprises a double-walled annular tube or sleeve 40 having an end slot 41 which may be closed by an annular valve member 42 mounted within the sleeve 40 and having its outer end beveled and adapted to enter and close the slot 41.

The valve member 42 is supported on a diaphragm 44 which is mounted between flanges or discs 45 and 46 extending outward from the inner and outer walls of the valve sleeve 40 and which is secured at its periphery to the flange 45. A pipe 48 supplies liquid oxygen under pressure through a volute 49.

The opening between the free inner edge of the diaphragm 44 and the inner face of the flange or disc 45 is closed by an annular bellows member 50, and a hole 51 vents the space S3 enclosed between the parts 44, 45 and 50.

The diaphragm 44 is resilient and is so shaped and proportioned that it normally forces the valve member 42 into the slot 41 and thus closes the valve V. When it is desired to admit liquid oxygen to the combustion chamber C, the pressure in the supply pipe 48 is increased, thus withdrawing the valve member 42 and permitting flow through the annular slot 41.

The inner and outer walls of the sleeve 40 are held in spaced relation by cross-pins 53 which extend through slots 54 in the annular valve member 42. These slots 54 also provide communication between the valve spaces inside and outside of the valve member 42. Guidepins 54*a* and 55 (Fig. 10) may be provided to guide the valve member 42 as it slides toward and away from the end slot 41. The construction of the valve V' for gasoline and V2 for water is similar to the construction of the valve V, except for differences in diameter and in axial length which are necessary to permit nesting as shown in Fig. 2. The valve V' receives gasoline or other liquid fuel through a pipe 62 and the valve V2 receives water or other cooling liquid through a pipe 65.

If the liquid oxygen is maintained continuously under pressure, the construction shown in Fig. 11 may be adopted, in which liquid or gas under pressure is supplied through a pipe 60 to the space S4 outside of the diaphragm 44. This pressure is normally sufficient to overcome the pressure of the liquid oxygen and to close the valve V. When it is desired to feed oxygen, the pressure in the pipe 60 and space S4 is temporarily reduced by any suitable control valve, not shown. Otherwise, the construction and operation is as previously described in detail in connection with Figs. 9 and 10.

In the construction shown in Fig. 6, the parts are substantially as disclosed in Fig. 2, with the exception that the turbine blades 65 on the rotating outer casing 66 are curved to discharge outwardly in the direction of the arrow *a*, and fixed blades on the wall of the chamber C' are omitted. The wall of the chamber C' is also outwardly enlarged as indicated at 68 to provide additional space in chambers where a relatively large amount of water is injected through the openings 26.

Additional spray openings 70 may be provided into the space S5 between the end casing members 24 and 30, so that the hot combustion gases may be additionally cooled. The rate of flow of these gases may also be controlled by providing radial vanes 72 on the rotating casing member 24. These vanes will tend to slow down the flow of combustion gases through the space S5 by centrifugal force and the centrifugal force will also retard inward movement of any drops of unevaporated combustion liquid found in said space. The usual starting nozzle is shown at 74. All of the features not specifically described will be understood to be the same as in Fig. 2.

The construction shown in Fig. 7 is similar to that previously described, except that the end casing members 80 to 86 of the chamber C2 are disposed substantially in diametral planes, rather than in the form of the semi-spherical segments shown in Figs. 2 and 6. This construction is somewhat more compact than that shown in Figs. 2 and 6, but otherwise operates substantially as previously described.

In Fig. 8 the rotary support 10 and rotary feeding head members 20 to 24 are as shown and described in connection with Fig. 2 and provide similar annular spaces S and S' for liquid oxygen and liquid fuel. The water space S7 is, however, of substantially increased cross section, and is enclosed by a casing member having an outer cylindrical portion 90, an end disc 91 and an inner cylindrical portion 92 on which the outer disc 94 is supported.

The wall of the chamber C2 may be inwardly contracted at 95 as in Fig. 6 and is provided with a relatively heavy end flange 96 disposed in a diametral plane. Vanes 97 may be mounted on the disc portion 91 adjacent the chamber end wall portion 96 and function as previously described to slow down the travel of the combustion gases.

Turbine blades 97 are mounted at the outer edge of the end disc 94 and the combustion gases are discharged outward against fixed blades 98 by which they are directed rearward. The construction and operation of the blades 97 and 98 is shown in perspective in Fig. 14.

In Fig. 8 there is also shown a blank disc 100 on which weights 101 may be selectively mounted to accurately counterbalance the entire rotating head.

With all forms of the apparatus herein disclosed, highly efficient provision is made for feeding combustion liquids through a rotating head to a stationary combustion chamber and for effectively cooling all surfaces exposed to high combustion temperatures.

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 combustion apparatus, a non-rotating combustion chamber having a segmental end portion, a feeding head rotatably mounted at one end of said chamber and having inner and outer segmental feeding head portions located respectively within and without the segmental end portion of said fixed combustion chamber but spaced therefrom to form a first contracting but thereafter expanding tortuous passage for a portion of the combustion gases produced in said combustion chamber, said passage opening at one end into said combustion chamber and being open to the atmosphere at the other end, an annular set of turbine blades mounted on said rotatable feed-

ing head and engaged by said portion of said combustion gases, means to supply combustion liquids and a cooling liquid to said rotatable feeding head and to feed said liquids to said combustion chamber, and said inner segmental feeding head portions having spaced walls and a closed inner end and receiving said cooling liquid and having a series of ports adjacent said inner end and adjacent said combustion chamber and through which parts a portion of said cooling liquid is discharged into that portion of the combustion gases whch is traversing the contracting portion of said tortuous passage.

2. The combination in combustion apparatus as set forth in claim 1, in which a plurality of vanes are mounted on and rotate with said feed-

ing head and extend into the contracting portion of said tortuous passage and retard inward travel of unevaporated drops of said cooling liquid with the combustion gases.

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

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

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Number	Name	Date
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