May 29, 1951 R. H. GODDARD 2,555,082

LIQUID OXYGEN AND FUEL FEEDING APPARATUS
UTILIZING OXYGEN FOR SCAVENGING
Filed Nov. 2, 1946

Fig. 1.

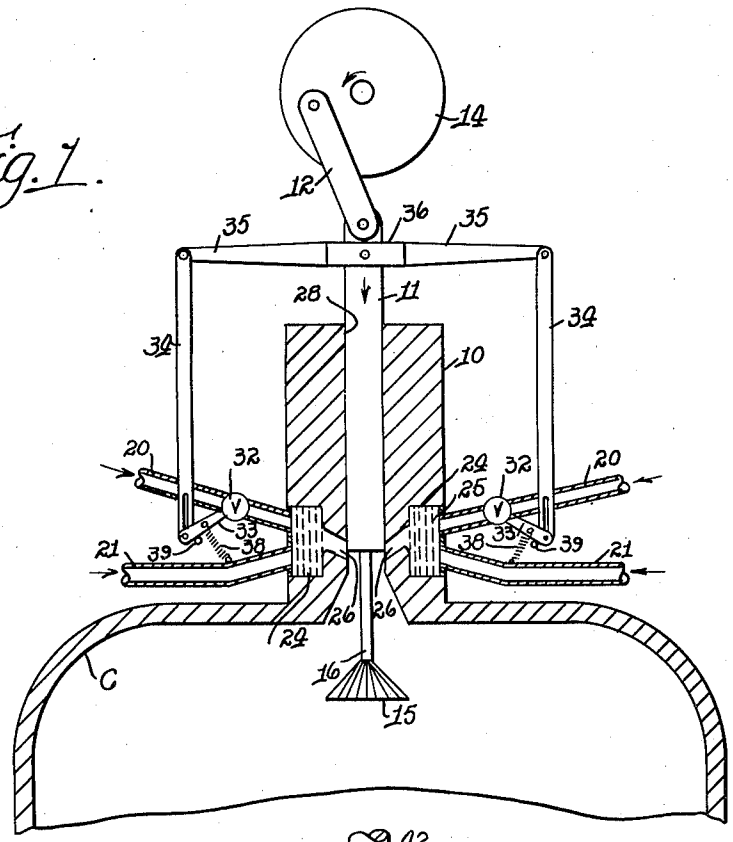
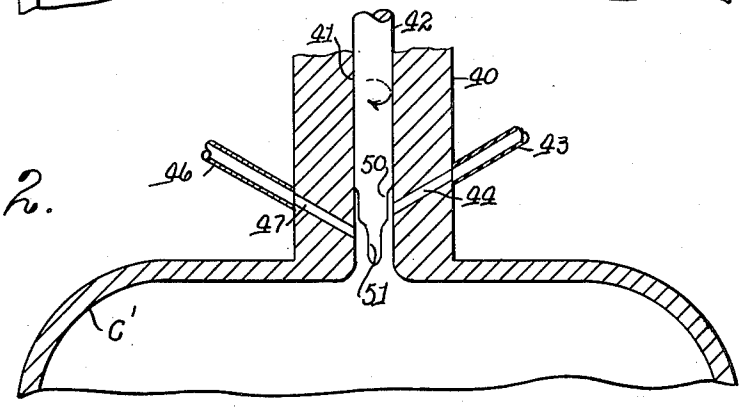


Fig. 2.



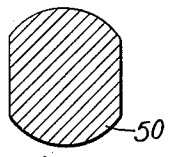


Fig. 3.

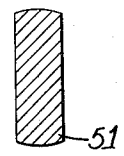


Fig. 4.

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

Patented May 29, 1951 2,555,082

UNITED STATES PATENT OFFICE

2,555,082

LIQUID OXYGEN AND FUEL FEEDING APPARATUS UTILIZING OXYGEN FOR SCAVENGING

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 November 2, 1946, Serial No. 707,352

9 Claims. (Cl. 60—44)

1

This invention relates to combustion chambers particularly adapted for use in rocket apparatus and other jet-propelled constructions and in which separated charges or plugs of a detonating mixture of liquid fuel and liquid oxygen are fired in rapid succession. The separated charges may be produced by rapidly and repeatedly opening and closing the valve in the main feed line to the detonating chamber.

It is the general object of the present invention to prevent the possibility of flash-back into any small amount of explosive mixture which may remain in the space immediately behind the main valve as the valve is closed or opened.

A further object of the invention is to provide a construction in which the supply of liquid fuel is shut off before the supply of liquid oxygen.

To the accomplishment of these general objects in the preferred form, auxiliary valves are provided in the fuel supply pipes, together with actuating connections such that the auxiliary valves are opened just after the main valve is opened and are closed just before the main valve is closed.

In a modified form, a single and specially designed rotating valve member accomplishes the same sequence of operations.

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

Two forms of the invention are shown in the drawing, in which

Fig. 1 is a partial sectional elevation of a detonating chamber having a preferred form of the invention applied thereto;

Fig. 2 is a partial sectional elevation of a detonating chamber which embodies a modified form of the invention;

Fig. 3 is a transverse sectional view of the valve portion 50 shown in Fig. 2; and

Fig. 4 is a transverse sectional view of the valve portion 51.

Referring to Fig. 1, the detonating combustion chamber C is provided with an upward extension or hub 10 in which a main valve plunger 11 is reciprocated by a link 12 connected to a rotating crank disc 14. A spreader 15 is mounted on a rod 16 extending downward from the plunger 11.

Liquid fuel, as gasoline, is supplied under pressure through fuel feed pipes 20, and liquid oxygen is supplied under pressure through feed pipes 21. The pipes 20 and 21 open into closed recesses 24 each containing several wire gauze discs 25.

2

The recesses 24 are connected by feed passages 26 to the cylindrical passage 28 in which the main valve plunger 11 is reciprocated. When the plunger 11 is in its lowest position, the passages 26 are closed, and when the plunger is in its raised position, the passages 26 are open.

Shut-off valves 32 are provided in the fuel supply pipes 20, and the actuating arms 33 of the valves 32 have pin-and-slot connections to links 34 suspended from cross arms 35 which extend outward from a collar 36 fixed to the plunger 11 and vertically reciprocated therewith. Springs 38 normally hold the valves 32 closed, with the arms 33 engaging stop pins 39.

The operation of the improved feeding apparatus is as follows:

Liquid fuel and liquid oxygen are supplied under pressure to the pipes 20 and 21 respectively. The valves 32 are closed when the plunger 11 is at or near its lowest position and in which position detonations occur. As the plunger 11 rises, the passages 26 are uncovered and a brief initial flow of liquid oxygen takes place through the recesses 24 and the passages 26 before the fuel valves 32 are opened by continued upward movement of the plunger 11 and links 34. Fuel is then admitted, mixing takes place within the meshes of the wire gauze discs in the recesses 24, and the resultant detonating mixture is injected into the chamber C.

As the plunger 11 thereafter moves downward, the springs 38 act to close the valves 32. This closing movement is completed when the parts are in the position shown in Fig. 1 and just before the passages 26 are fully closed.

As the oxygen supply pipes 21 remain open briefly after the valves 32 are closed, liquid oxygen will enter the recesses 24 and passages 26 and will force out any remains of explosive mixture before the plunger 11 completely closes the passages 26.

Detonation then takes place, due to the residual heat in the combustion chamber, but there is no explosive mixture left in the passages 26 or recesses 24, so that there is no possibility of flash-back during the detonation or as the plunger 11 begins its upward travel. Safe operation of the detonating chamber is thus attained. Any usual igniting device, such as a sparkplug, may be provided for initial operation.

In the construction shown in Fig. 2, the detonating combustion chamber C' is provided with an upward extension or hub 40 having an axial opening 41 in which a valve member 42 is continuously rotated by any usual power means (not

shown). Liquid fuel under pressure is fed through a pipe 43 to a passage 44, and liquid oxygen is fed under pressure through a pipe 46 to a passage 47.

The valve member 42 is slabbed off or has partitions of stock removed on opposite sides to leave a relatively wide valve portion 50 and a relatively narrow portion 51. The fuel feed passage 44 is opposite the upper and wider valve portion 50 and the oxygen feed passage 47 is opposite the lower and narrower valve portion 51.

With the valve rod 42 in the position shown in Fig. 2, both passages 44 and 47 are open and a detonating mixture will be formed in the lower part of the axial passage 41 and will flow into the detonating chamber C'. As the valve member 42 rotates, the wider valve portion 50 will first close the fuel passage 44, and somewhat later the narrower valve portion 51 will close the oxygen passage 47, at which time detonation will take place.

As the oxygen passage 47 is closed later and opened earlier than the gasoline passage 44, the lower portion of the axial opening 41 will be supplied with liquid oxygen to mingle with and eject any remaining gasoline before the detonation takes place, and more liquid oxygen will be admitted before the fuel feed passage 44 is again opened. Safe operation of the detonating chamber C' is thus insured, as with the form shown in Fig. 1 and previously described.

In both forms of the invention, the preliminary shutting off of a substantial part of the liquid supply reduces the pressure in the recesses 24 and feed passages 26, or in the feed passages 44 and 47, which also reduces the danger of flash-back.

Selected form of the invention having been thus described, 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 combination apparatus having a combustion chamber with an upward extension open to said chamber and forming a mixing recess and means to provide a detonating mixture of liquid fuel and liquid oxidizer in successive separate charges for said recess, that improvement which comprises separate supply means for liquid fuel and for liquid oxidizer, a main valve controlling injection of said mixed charges to said recess, auxiliary valve means for the fuel supply, and connections between said auxiliary valve means and said main valve through which said auxiliary valve means is opened later and closed sooner than said main valve.

2. In combustion apparatus having a combustion chamber with an upward extension open to said chamber and forming a mixing recess and means to provide a detonating mixture of liquid fuel and liquid oxidizer in successive separate charges for said recess, that improvement which comprises separate supply means for liquid fuel and for liquid oxidizer, a main valve controlling injection of said mixed charges to said chamber, auxiliary valve means for the fuel supply, lost-motion connections between said auxiliary valve means and said main valve through which said auxiliary valve means is opened later than said main valve and is allowed to close sooner than said main valve, and a spring to close said auxiliary valve means.

3. In combustion apparatus having a combustion chamber with an upward extension open to said chamber and forming a mixing recess to receive liquid fuel and a liquid oxidizer, that improvement which comprises separate means to supply said liquid fuel and said liquid oxidizer, main valve means controlling the injection of both said liquid fuel and said liquid oxidizer to said mixing recess, additional valve means controlling the injection of said liquid fuel to said mixing recess, and a connection from said additional valve means to said main valve means by which the movements of the main valve means and of the additional valve means are coordinated and by which said additional valve means is closed to shut off the supply of liquid fuel to said mixing recess before said main valve means shuts off the supply of liquid oxidizer to said mixing recess.

4. The combination in combustion apparatus as set forth in claim 3, in which said additional valve means is effective to admit liquid oxidizer to the mixing recess for the next charge before admitting liquid fuel to said mixing recess for said next charge.

5. In combustion apparatus having a combustion chamber with an upward extension open to said chamber and forming a mixing recess and means to provide liquid fuel and a liquid oxidizer in successive separate charges for said recess, that improvement which comprises separate supply means for liquid fuel and for liquid oxidizer, a rotated main valve which is cylindrical but which is cut-away at each side thereof to provide spaced and relatively broad peripheral portions controlling the liquid fuel and further cut-away to provide adjacent and relatively narrow spaced peripheral portions controlling the liquid oxidizer, and said apparatus having separate feed passages for said fuel and said oxidizer opposite said broad and narrow portions of said main valve respectively and positioned to be closed and opened alternately by said peripheral portions said broad portion adapted to close the fuel passage before the narrower portion closes said oxidizer passages whereby flash-back is prevented.

6. The combination in combustion apparatus as set forth in claim 5, in which said valve portions are relatively positioned to effect admission of the oxidizer ahead of the fuel and shutting-off of the fuel ahead of the oxidizer for each charge.

7. In combustion apparatus having a combustion chamber with an upward extension open to said chamber and forming a mixing recess, and rotated valve means to provide a detonating mixture of liquid fuel and liquid oxidizer in successive separate charges for said mixing recess, that improvement which comprises separate supply means for liquid fuel and for liquid oxidizer, and said rotated valve means having a relatively broad valve portion effective on rotation to alternately and successively admit and shut off the supply of fuel to said mixing recess and having another and relatively narrow valve portion effective on simultaneous rotation to admit and shut off the supply of oxidizer to said recess, and said rotated valve means thereby effecting the admission of fuel for shorter periods than the admission of oxidizer when said valve means is rotated and shutting off the fuel passages before the oxidizer passages to prevent flash-back.

8. In combustion apparatus a combustion chamber and means to provide a detonating mixture of liquid fuel and liquid oxidizer in successive separate charges for said chamber, said combustion chamber having an upward extension with an axial admission passage, a main valve plunger slidable in said axial passage, closed

mixing recesses in said extension, feed openings from said recesses to said axial passage controlled by said plunger, separate pipes to supply liquid fuel and liquid oxidizer to each of said recesses, auxiliary valves in the fuel supply pipes only, and valve-actuating means including connections between said auxiliary valves and said main valve plunger effective to open the auxiliary fuel valves after the main valve uncovers said feed openings and to close said auxiliary fuel valves before the main valve closes said feed openings.

9. The combination in combustion apparatus as set forth in claim 8, in which each recess is provided with a plurality of layers of fine wire gauze through which both liquids pass to facilitate mixing of said liquids.

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
1,042,076	Breuer	Oct. 22, 1912
1,164,064	Brown	Dec. 14, 1915
1,400,264	Charles	Dec. 13, 1921
2,283,863	Achterman	May 19, 1942
2,409,036	Goddard	Oct. 8, 1946

FOREIGN PATENTS

Number	Country	Date
412,478	France	July 13, 1910
386,908	Great Britain	Jan. 26, 1933
522,935	Great Britain	July 1, 1940