

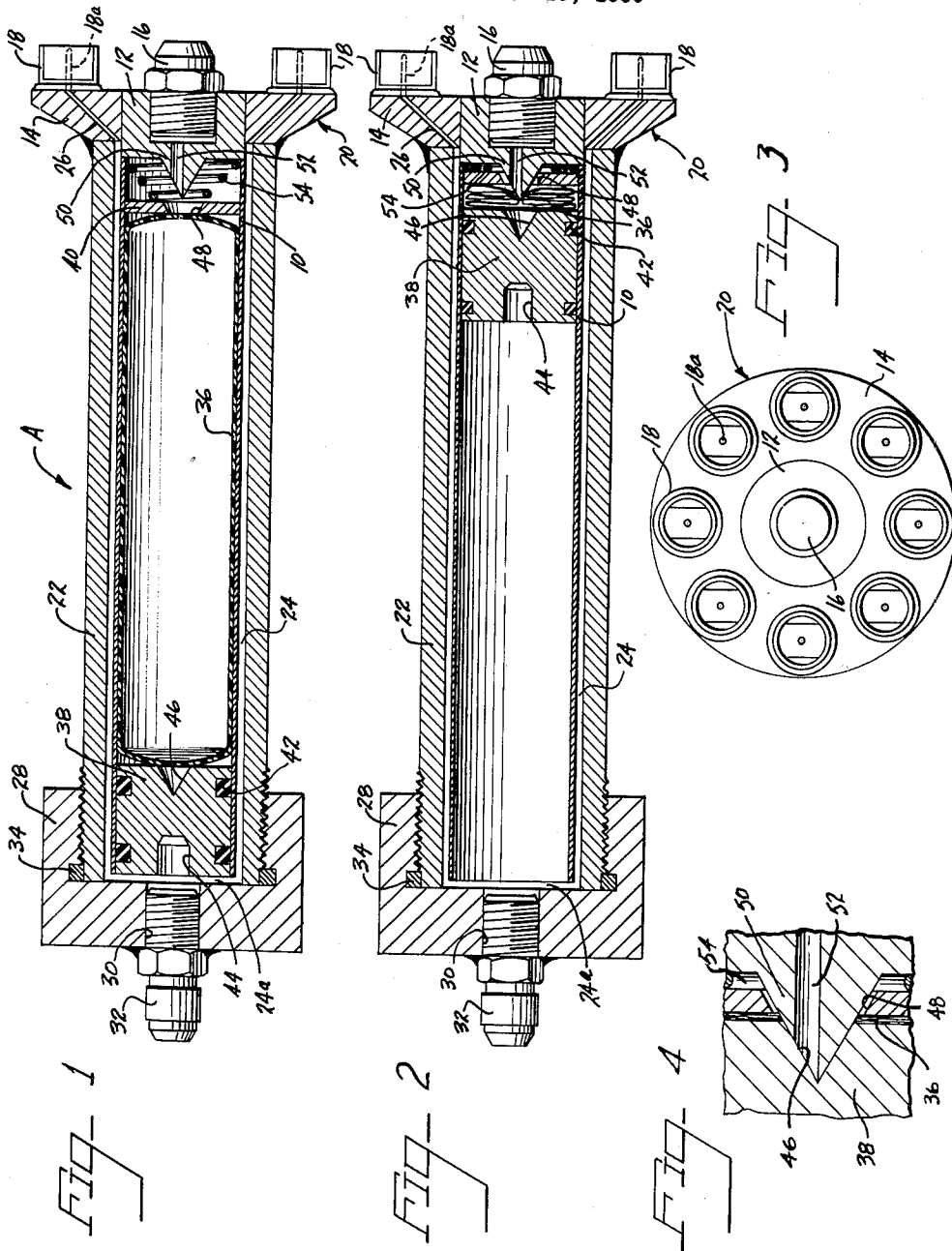
Feb. 12, 1963

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3,077,078

INJECTOR CHAMBER CONSTRUCTION

Filed Oct. 13, 1959



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INJECTOR CHAMBER CONSTRUCTION

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Filed Oct. 13, 1959, Ser. No. 846,166

4 Claims. (Cl. 60—39.48)

The present invention relates broadly to rocket engines and the like, and is more particularly concerned with a new and improved device for essentially simultaneously introducing fuel and oxidizer into reaction chambers of various types.

This application is a continuation-in-part of application Serial No. 731,513 filed April 28, 1958.

Reaction chambers, rocket motors and the like employing a bipropellant ignition system, and wherein an oxidizer is employed for hypergolic ignition, necessarily require a system for delivering the oxidizer to the injector under pressure. Several arrangements have been utilized or proposed for this purpose; however, many devices known to the art are unduly complicated and subject to frequent malfunctions.

It is accordingly a primary aim of the present invention to provide a device of relatively simple and extremely reliable construction for simultaneously introducing fuel and oxidizer into a reaction chamber.

Another object of the invention lies in the provision of a starting device for rocket engines and the like, having as one feature thereof the control of oxidizer injection by propellant pressure.

Another object of this invention is to provide an injector chamber construction wherein the oxidizer is initially contained therein in pre-packaged form, resulting in the advantages of handling ease and improved storability.

A further object of the instant invention lies in the provision of an improved rocket engine injector which is suitable for various sizes and classes of reaction units, and is further possessed of the advantages of relatively light weight and re-usability.

A still further object of the present invention is to provide a reaction chamber starting mechanism so constructed as to prevent any portions thereof from entering the combustion chamber.

Other objects and advantages of the invention will become more apparent during the course of the following description, particularly when taken in connection with the accompanying drawings.

In the drawings, wherein like numerals designate like parts throughout the same:

FIGURE 1 is a sectional view of an exemplary injector chamber construction in a loaded condition and prior to actuation;

FIGURE 2 is a view similar to FIGURE 1, and showing the position of parts after rupture of the oxidizer container and subsequent to injection of the oxidizer into the combustion chamber;

FIGURE 3 is an end view of the starting device of this invention, and illustrating the structural features of the injector head; and

FIGURE 4 is a detailed sectional view showing the position of certain parts upon completion of oxidizer injection.

Briefly stated, a starting device constructed in accordance with the principles of this invention comprises a pair of concentrically spaced casings provided therebetween with an annular passage communicating at one end with ports in an injector head mounting the casings. Connecting with the ports are fuel nozzles communicating with the reaction chamber. Provided within the inner casing is a puncturable container for oxidizer, and one

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form of container is a plastic bag. The bag is backed at one end by a slidable member movable upon the introduction of propellant, and the opposite end of the bag may bear against an apertured slidable plate member, the opening of which may receive a spike portion formed on the inner surface of the injector head. When propellant is introduced into the starting device, the slidable member is moved axially to direct the plastic bag containing oxidizer against the spike portion to puncture the plastic bag, whereupon during continued movement of the slidable member the oxidizer is directed through an oxidizer port in the injector head to mix simultaneously with propellant fed through the fuel ports and nozzles of the injector head. If desired, the apertured plate member may be resiliently urged away from the spike portion on the injector head, and in addition, the slidable member backing the plastic bag may have a recess formed therein mating with the spike portion to block the oxidizer port upon full axial travel of the slidable member.

Referring now to FIGURE 1, there is illustrated a starting device or injector chamber, designated in its entirety by the legend A and shown with parts thereof in position prior to the simultaneous ejection of fuel and oxidizer therefrom. The injector chamber A in its preferred form comprises an inner tubular casing 10 welded or otherwise secured at one end to a spike member 12 connected to an injector member 14, the spike member having a nozzle portion 16 and the injector member a plurality of nozzle portions 18. As employed herein, the expression "injector head" refers to the parts 12—18, and the injector head is designated generally in the drawings by the numeral 20.

The inner casing 10 is surrounded in concentrically spaced relation by an outer tubular casing 22 to define therewith an annular passage 24 communicating at one end with generally axially and radially extending bored openings or ports 26 in the injector member 14. In the arrangement shown, eight of such ports are provided and said ports communicate with the propellant or fuel nozzles 18; however, it is of course appreciated that the number and size of the ports 26 and nozzles 18 may be varied to meet particular conditions.

The nozzles 18 are passaged at 18a to communicate with the ports 26 in the injector member 14, and the nozzles 18 may take any one of a number of different forms known to the art. As will now be described, fuel is injected from the passages 18a in the nozzles 18 essentially simultaneously with injection of oxidizer from the nozzle 16, and an essentially simultaneous ignition takes place in a reaction chamber, rocket engine or the like (not shown) positioned in communication with the injector chamber A comprising this invention.

Threadably received upon the opposite end of the tubular housing or casing 22 is a cap member 28 provided with an axial opening 30 into which is threaded or otherwise located a fuel inlet fitting 32 connected with a pressurized fuel source (not shown). It may be noted at this point that the inner casing 10 is of relatively lesser length than the outer housing to provide a radial passage 24a in communication with the fuel inlet opening 30 and with the annular passage 24. As is the practice in the art, seal means 34 assures a fluid tight relationship between the casing 22 and the cap member 28.

When the injector chamber A is in a loaded or active condition, an oxidizer container 36 is housed within the inner tubular member 10. The container 36 is preferably formed of a substantially inert plastic material, and in work performed to date Kel-F sheet is suitable. Other materials may in particular applications be preferred, and the important advantage obtained from a puncturable container 36 is that the oxidizer may be handled

with considerably greater ease and the bag construction substantially facilitates oxidizer storage.

The container or bag 36 is of course of sealed construction when located in the manner of FIGURE 1, and said bag is backed or bottomed at one end against a slid-
5 able piston member 38 and bottoms at its opposite end against a slidable apertured plate member 40. The piston member 38 is generally cylindrical, and is formed with annular grooves thereon to receive seal means 42. The piston member may be tapped at one end as at 44,
10 and at its opposite end the slidable member has formed therein a generally conical recess 46.

The slidable plate member 40 is provided with a tapered central opening 48 of sufficient diameter to be received about a spike portion 50 formed on the inner surface of the spike member 12 forming a part of the injector head 20. The spike portion 50 may be seen to be contoured to generally the configuration of the conical recess 46 in the piston 38, so that when the piston is fully advanced to the right as viewed in FIGURE 1, a passage 52 in the spike member 12 is essentially closed to terminate oxidizer flow.

The slidable plate member 40 may be resiliently urged away from the spike portion 50 by spring means or the like 54, and as is apparent, the passage 52 in the spike portion 50 communicates with the oxidizer nozzle 16.

Operation of the starting device A of this invention may be described as follows. The oxidizer bag 36 is introduced into the casing 10 in bottoming relation with the plate member 40 by removal of the piston member 38 and cap member 28. The parts are then assembled as in FIGURE 1, and fuel is caused to flow through the inlet fitting 32 and into the passage 30. Since the fuel is admitted under pressure, travel of the piston or slidable member 38 is initiated and simultaneously fuel is directed into the radial passage 24a and annular passage 24. Continued movement of the piston member 38 compresses the plastic bag 36 and moves said bag and slidable member 40 in the direction of the spike portion 50, until said spike portion punctures the end wall of the bag 36.

The bag interior is then in communication with the opening 48 in the plate member 40 and in communication with the axial passage 52 in the spike member 12. Continued piston travel forces oxidizer within the bag 36 through the named passages, and simultaneous with injection of the oxidizer from the nozzle 16, fuel is injected from the passages 18a in the fuel nozzles to combine with the oxidizer and cause a hypergolic ignition. Continued travel of the piston occurs after initial ignition until the entire quantity of oxidizer is exhausted, at which time the slidable plate member 40 is received about the spike portion 50 and the conical recess 46 in the piston member 38 bears against said spike portion to close the axial passage 52 therein against further oxidizer flow. A possible leakage of oxidizer is thereby precluded, and flow of fuel through the annular passage 24 and through the passages 26 and 18a then continues uninterrupted. As is appreciated, the presence of the punctured fuel bag into generally the folded or pleated condition of FIGURE 2 provides an effective seal means between the piston member 38 and spike portion 50. Accordingly, it is not necessary in order to terminate oxidizer flow that the spike portion be completely received in the conical recess 46, as is shown in FIGURE 4. In the latter view it may be noted that the passage 52 in the spike portion 50 is essentially blocked off by the conical recess 46; however, as noted, the ruptured bag in generally pleated condition functions as a seal by, in effect, providing a curtain across the passage 52 in the manner of FIGURE 2.

It may now be seen that there is herein provided a starting device comprising a minimum number of easily formed parts, assuring continued reliability of the structure disclosed. The structure of this invention features

a prepackaging of the oxidizer in a readily punctured bag, and the advantages accruing therefrom are ease of handling and improved storability. Equally importantly, as contrasted with a known structure in which a diaphragm normally closing the oxidizer nozzle is fractured, there is no possibility of fragments being discharged into the combustion chamber on other portions of the system. Further, the injector chamber disclosed may be employed with propellants and oxidizers of various compositions, and while satisfactory results have been obtained by applicant in the ignition of hydrazine and nitric acid, the invention is not limited thereto.

Various changes and modifications may of course be effected in the procedures and structures herein disclosed without departing from the novel concepts of the present invention.

I claim as my invention:

1. A fuel and oxidizer injector for rocket engines and the like, comprising a tubular housing having an inner tubular casing concentrically spaced from said housing and defining an annular fuel flow passage between said housing and said casing, a plurality of nozzles connected to one end of said housing and in communication with said annular fuel flow passage, an apertured spike member mounted on said one end of the housing and projecting into the inner casing, said inner casing adapted to receive a collapsible, foldable and readily puncturable sealed oxidizer bag, said apertured spike in confronting relation to said bag, a piston member received in the opposite end of said casing and backing said bag, a fuel inlet mounted on the opposite end of said housing and having a passage therein communicating with the housing interior and directing fuel to said annular fuel flow passage and against said piston member and driving one end of the bag against the spike member to release oxidizer for flow through the aperture in the spike member while fuel is flowing through said nozzles, the bag when essentially completely folded and collapsed being received between the piston and spike member for sealing the aperture in the spike member to prevent oxidizer flow there-through.

2. A fuel and oxidizer injector for rocket engines and the like, comprising a tubular housing having an inner tubular casing concentrically spaced from said housing and defining an annular fuel flow passage between said housing and said casing, a plurality of nozzles connected to one end of said housing and in communication with said annular fuel flow passage, an apertured spike member mounted on said one end of said housing and projecting into the inner casing, said inner casing adapted to receive a collapsible, foldable and readily puncturable sealed oxidizer bag, an apertured plate member between said bag and said spike member, resilient means between said plate and spike member urging said bag away from the spike member, said apertured spike in confronting relation to said bag, a piston member received in the opposite end of said casing and backing said bag, a fuel inlet mounted on the opposite end of said housing and having a passage therein communicating with the housing interior and directing fuel to said annular fuel flow passage and against said piston driving one end of the bag against the spike member while moving the apertured plate member against the spike member and compressing the resilient means to release oxidizer for flow through the aperture in the spike member, the bag when essentially completely collapsed being received between the piston and spike member for sealing the aperture in the spike member to prevent oxidizer flow there-through.

3. A fuel and oxidizer injector for rocket engines and the like, comprising a tubular housing having a tubular inner casing concentrically spaced from said housing to define an annular fuel flow passage therebetween, said inner casing receiving a collapsible, foldable and readily puncturable sealed oxidizer bag, an injector head mounted on one end of said housing and provided with fuel flow

and oxidizer flow passages therein, said injector head being formed with an inwardly extending spike portion thereon and said fuel flow passages being in communication with the annular fuel flow passage, an apertured plate member between one end of said bag and said spike portion, spring means encircling said spike portion and bottoming at opposite ends against said plate member and the injector head and urging one end of said bag away from the spike portion, a driven member backing the oxidizer bag and being slidably movable within the inner casing receiving said bag and a fuel inlet at the opposite end of the housing communicating with the annular flow passage and with the interior of said housing and directing fuel against the driven member to move the same and drive one end of the bag against the spike portion, thereby puncturing said bag and moving the apertured plate member against the spike portion and compressing the spring means to inject oxidizer from the oxidizer flow passage simultaneous with injection of fuel from the fuel flow passages, the bag when essentially completely collapsed being received between the driven member and injector head for sealing the oxidizer passage in the injector head to prevent oxidizer flow therethrough.

4. A fuel and oxidizer for rocket engines and the like, comprising a tubular housing having a tubular inner casing concentrically spaced therefrom to define an annular fuel flow passage therebetween, said inner casing receiving a collapsible, foldable and readily puncturable sealed oxidizer bag, an injector head including a spike member attached to one end of said housing and being formed with a central and axially extending oxidizer flow passage therein, said injector head further including an annular fuel injector member connected to the spike member and provided with generally radially and axially extending fuel flow passages in communication with the annular fuel

flow passage, an apertured plate member between one end of said bag and said spike member, a coiled spring encircling said spike member and bottoming at opposite ends against said plate member and the injector head and urging one end of said bag away from the spike member, a driven member backing the oxidizer bag and being slidably movable within the inner casing receiving said bag, said driven member being formed at its backing end with a conical recess for receiving the spike member to close the oxidizer passage therein when the driven member has completed its travel, and a fuel inlet at the opposite end of the housing communicating with the annular flow passage and with the interior of said one casing and directing fuel against the driven member to move the same and drive one end of the bag against the spike portion, thereby puncturing said bag and moving the apertured plate member against the spike member and compressing the spring means to inject oxidizer from the oxidizer flow passage simultaneous with injection of fuel from the fuel flow passages, the bag when essentially collapsed being received between the driven member and spike member for sealing the oxidizer passages in the spike member to prevent oxidizer flow therethrough.

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