Feb. 6, 1951 R. H. GOODARD 2,540,665

MECHANISM FOR COAXIAL FEEDING OF TWO COMBUSTION LIQUIDS TO A COMBUSTION CHAMBER

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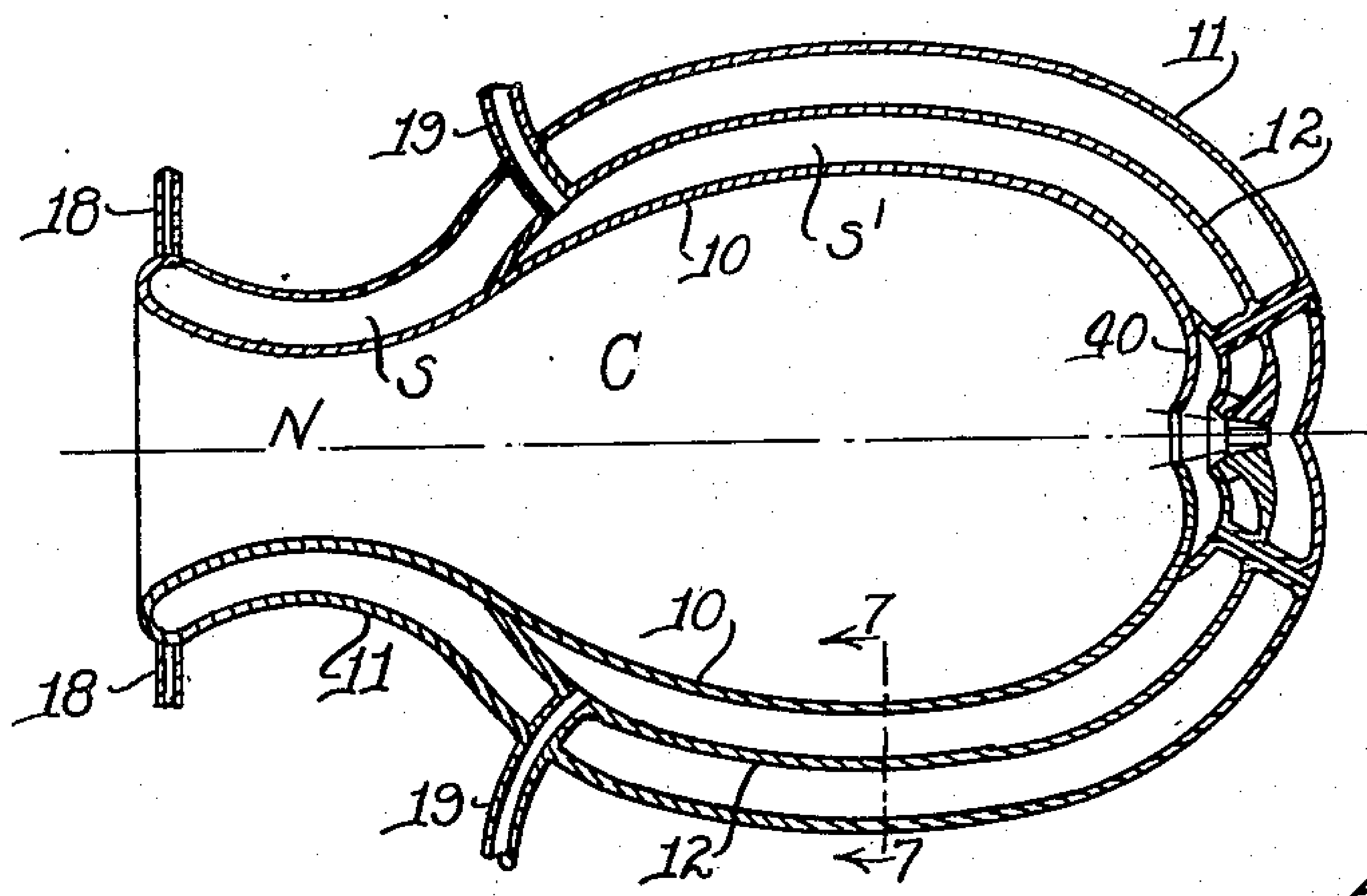

Fig. 1.

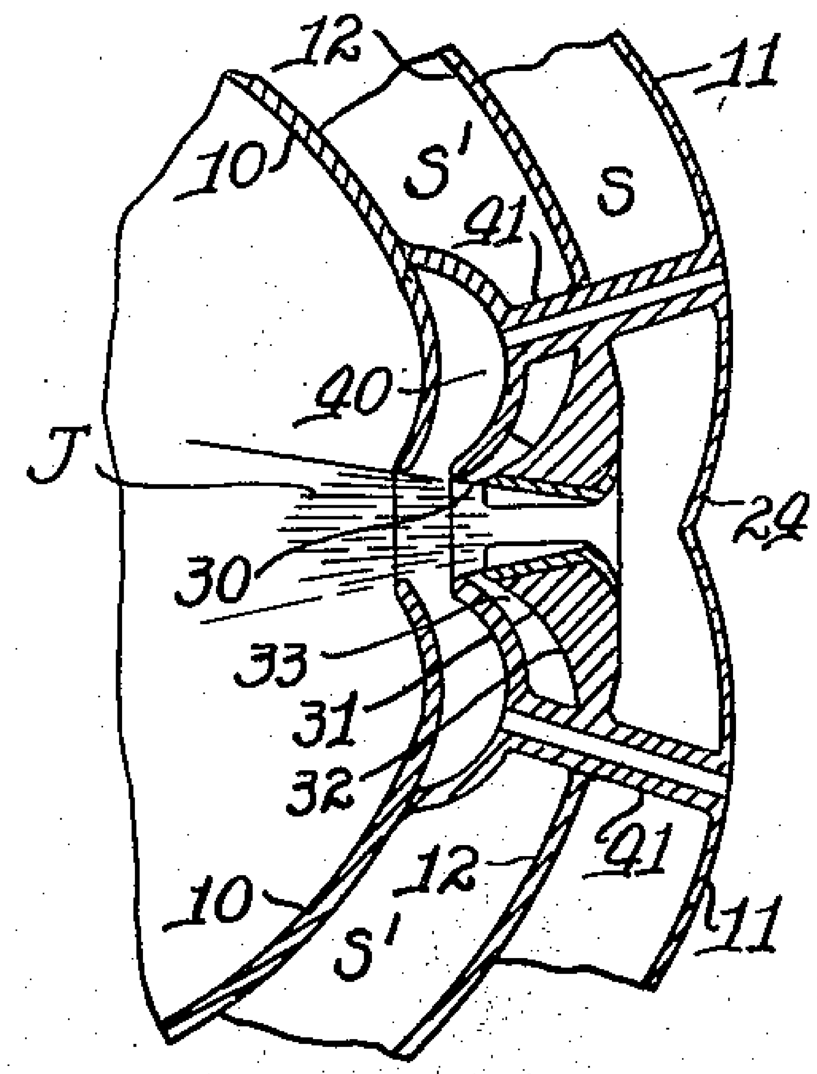

Fig. 2.

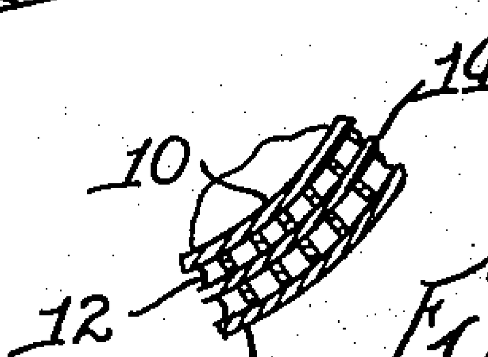

Fig. 7.

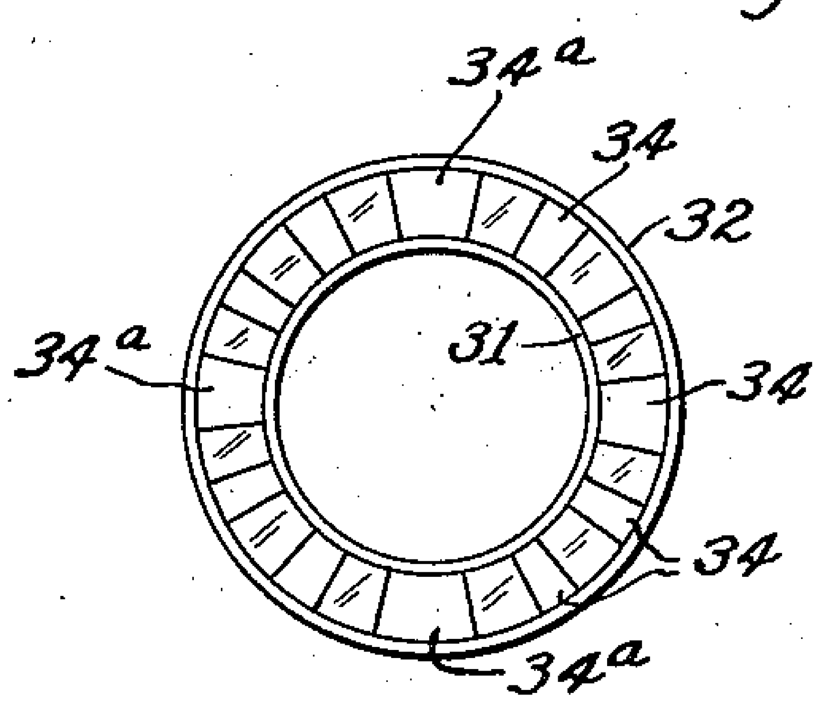

Fig. 3.

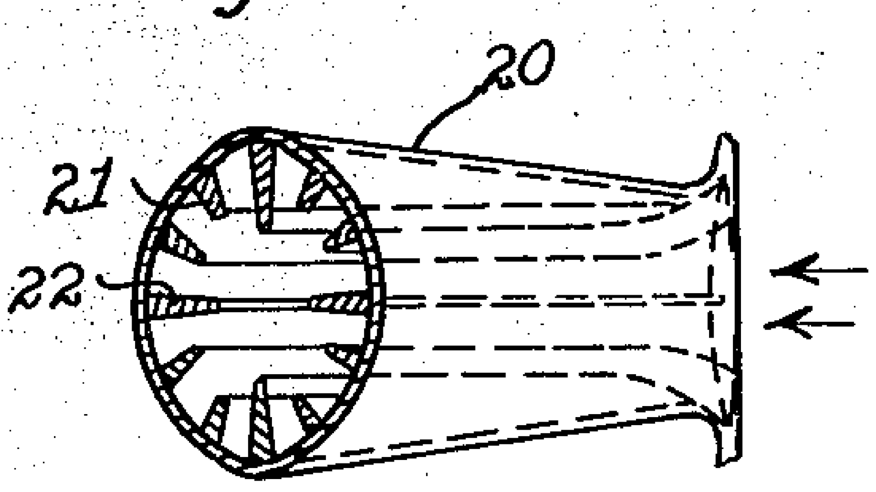

Fig. 4.

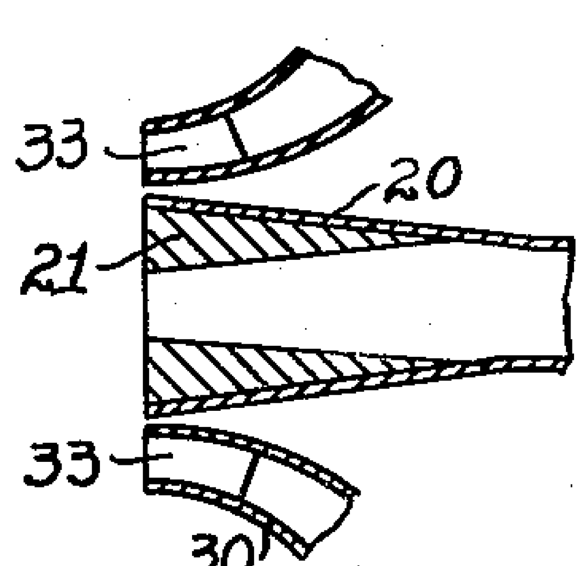

Fig. 5.

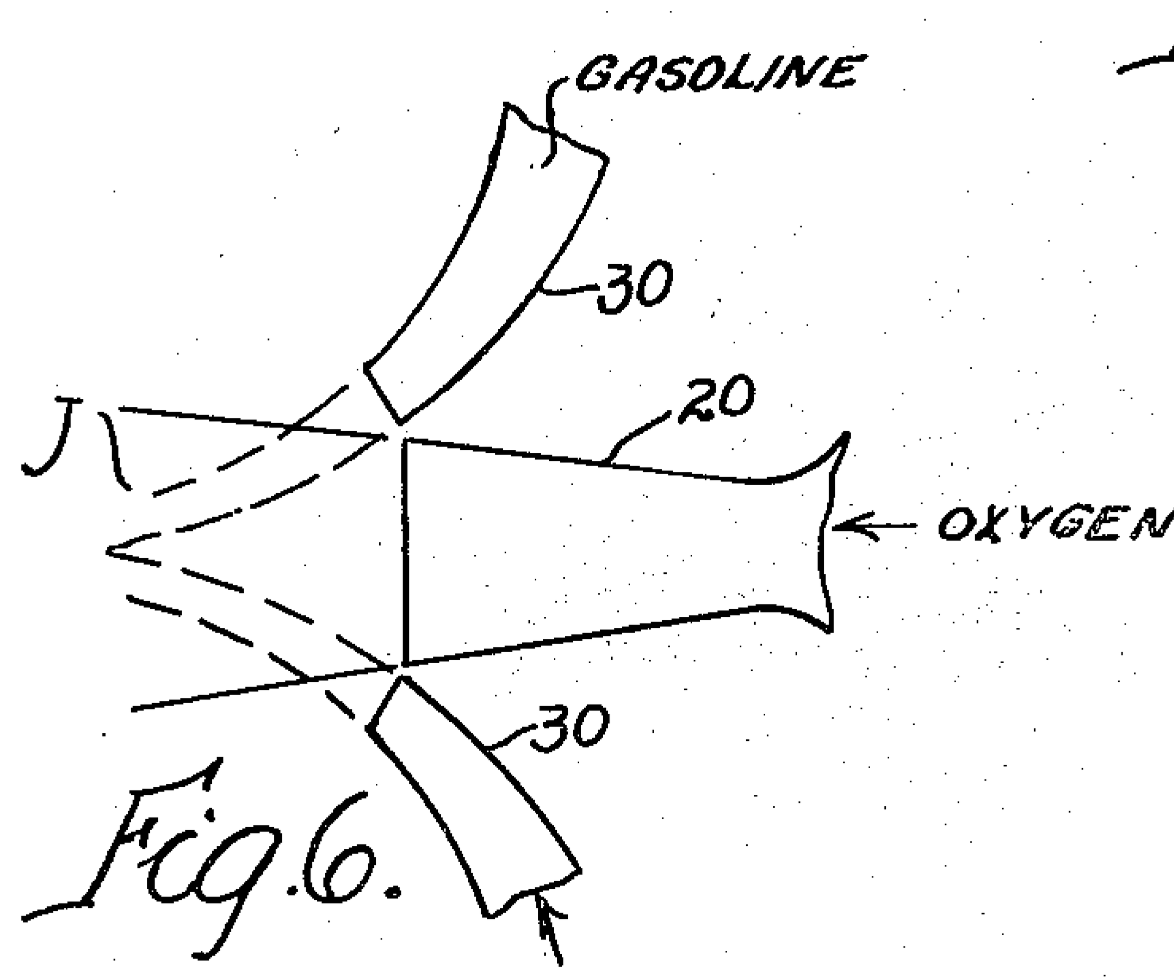

Fig. 6.

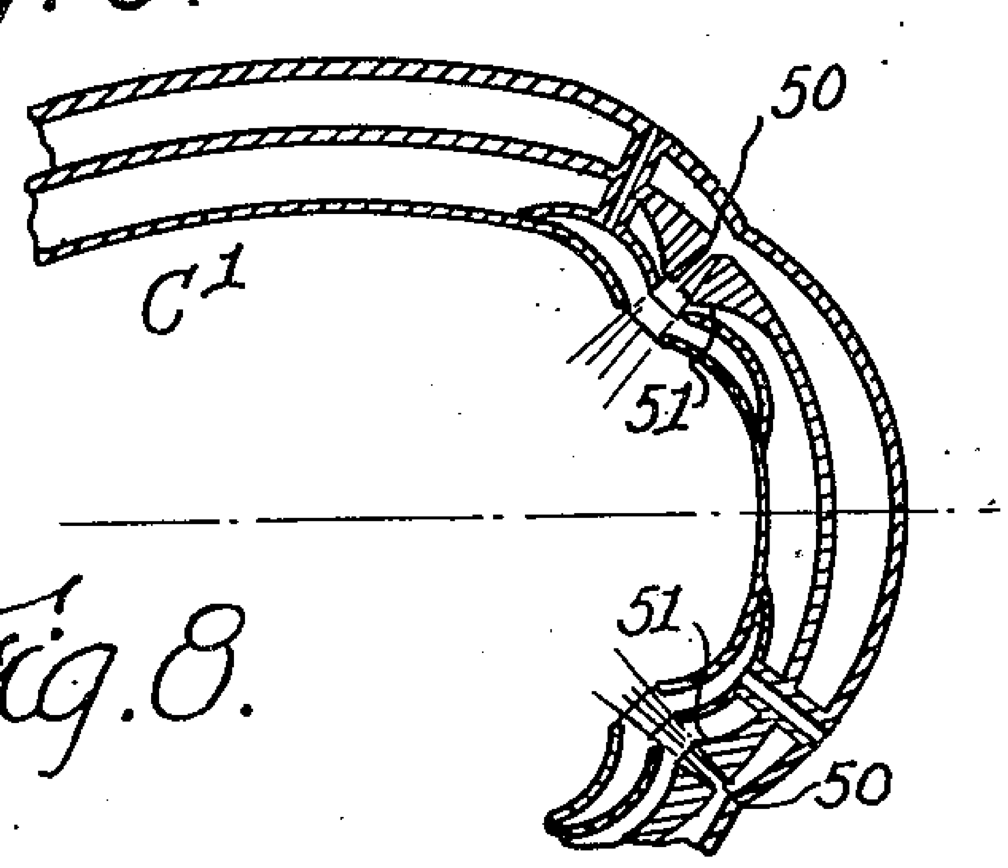

Fig. 8.

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2,540,665

MECHANISM FOR COAXIAL FEEDING OF TWO COMBUSTION LIQUIDS TO A COMBUSTION CHAMBER

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4 Claims. (Cl. 60—44)

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This invention relates to a combustion chamber having provision for delivery thereto of a combustible liquid fuel and a liquid oxidizing agent such as liquid oxygen. The invention further relates to a combustion chamber to which two combusion liquids are delivered coaxially.

It is the general object of the invention to provide improved means by which two combustion liquids may be delivered to a combustion chamber coaxially and in an annular series of successively alternated areas. More specifically, the invention relates to a construction in a combustion chamber which provides for alternating feed areas of high density and low density for one combustion liquid and also provides for delivering portions of a second combustion liquid to the areas of low density.

The invention also 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 drawing, in which

Fig. 1 is a sectional side elevation of a combustion chamber embodying the invention;

Fig. 2 is an enlarged sectional side elevation of certain parts shown in Fig. 1;

Fig. 3 is a front view of the outlet portion of the gasoline feed member, with certain associated parts omitted for clearness;

Fig. 4 is a partial perspective view of certain delivery or nozzle parts, partly in section;

Fig. 5 is an enlarged vertical sectional fragmentary view of the parts shown in Figs. 3 and 4 (assembled);

Fig. 6 is a diagrammatic view indicating the paths of delivery of the two liquids;

Fig. 7 is a detail sectional view, taken along the line 7—7 in Fig. 1; and

Fig. 8 is a partial sectional side elevation of a combustion chamber showing a modified construction.

Referring to Figs. 1 to 7, a combustion chamber C having a nozzle portion N is shown, said chamber having an inner side wall 10, an outer wall 11, and an intermediate wall 12. These walls are securely held in fixed spaced relation by partitions 14 (Fig. 7) positioned in radial planes about the periphery of the combustion chamber. The casing members 10, 11 and 12 are formed of steel or some other metal of high tensible strength and the partitions 14 are preferably of some metal having high heat conductivity, such as copper, bronze or some other suitable alloy.

Reference to Fig. 1 will show that a jacket space S is enclosed around the nozzle portion N between the casing walls 10 and 11 and around the chamber C between the walls 11 and 12. The walls 10 and 12 also enclose a jacket space S' around the chamber C and within the jacket space S.

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One or more feed pipes 18 supply liquid oxygen to the outer jacket space S, and one or more feed pipes 19 similarly supply gasoline or other liquid fuel to the inner jacket space S'. The liquid oxygen cools the nozzle portion N of the combustion chamber and the oxygen may be partially vaporized by the heat thus received. Additional heat is received from the gasoline in the inner jacket space S'. The gasoline may likewise be partially vaporized by the heat in the combustion chamber.

At its rear end, the outer or oxygen jacket space S connects with the outer end of an oxygen feeding nozzle 20, preferably located in the axis of the combustion chamber C and expanding toward the combustion chamber.

The nozzle 20 is provided with inwardly projecting ribs or vanes 21 and 22 (Fig. 4), all of these vanes being preferably wedge-shaped in cross section and the vanes 22 extending nearer to the axis of the nozzle 20 than the vanes 21. The spaces between the vanes have approximately parallel limiting side surfaces, due to the wedge-shaped cross section of the vanes.

As the liquid or partially vaporized oxygen is delivered under pressure through the nozzle 20, the stream of oxygen is broken up by the vanes 21 and 22 to present portions of high density corresponding to the spaces between the vanes and portions of very low density intervening between the high density portions. The low density portions induced by the longer or deeper vanes 22 extend closer to the axis of the oxygen stream, so that the stream throughout its length has high and low density portions in approximately the same ratio. The flow of oxygen to the nozzle 20 is assisted by a deflecting cone 24 (Fig. 2).

The inner jacket space S' is connected to an annular member 30 (Figs. 2 and 3) having inner and outer walls 31 and 32 and intervening partitions or vanes 33 which provide gasoline delivery passages 34 (Fig. 3) which correspond in angular position to the positions of the vanes 21 and 22 and which consequently correspond to the portions of low oxygen density. The passages 34a, which correspond in position to the longer or deeper vanes 22, are of increased width so as to supply extra gasoline for the deeper portions of low oxygen density.

The relative directions of the oxygen and gasoline streams is indicated diagrammatically in Fig. 6, where it appears that the spaced streams of gasoline delivered through the annular member **30** are angularly projected into the striated stream of oxygen projected through the nozzle **20**, the combined streams forming a composite jet J of alternated portions of gasoline and liquid oxygen which enters the chamber C at high velocity, due to the pressure in the supply pipes from which the liquid oxygen and gasoline are fed.

An annular space **40** may be provided adjacent the entrance portions of the nozzle **20** and member **30**, and this annular space may be connected to the atmosphere by tubes **41** (Fig. 2), so that a limited amount of air may be drawn into the jet J of combustion materials. This may be desirable to effect more complete combustion.

Preferably the speed of the gasoline jet portions is the same as the speed of the oxygen jet portions and both speeds are relatively high, so that there is little or no mixing of the two materials before they enter the chamber C. Combustion cannot take place until the stream has fully entered the combustion chamber, since the components must be raised to ignition temperature before combustion can begin.

Immediately after the stream or jet J enters the chamber C, combustion takes place for the following reasons: First, the heat of the chamber raises the temperature of the laminated mixture to the ignition point. Second, the speed of the laminated jet is very suddenly reduced on entering the chamber, and the jet is compressed as it encounters the gaseous pressure developed in the chamber. This sudden stopping of the jet and compression of the mixture generates heat which additionally raises the temperature of the mixture. Third, the mechanical energy produced by the sudden stopping of the high speed stream or jet causes strong turbulence and effective intermingling of the combustion elements.

Consequently, the stream or jet J while in the form of very thin alternate layers of oxygen and gasoline or other liquid fuel will not ignite in the short time in which these layers are in contact before they enter the combustion chamber. These layers are, however, quickly and thoroughly mixed and raised in temperature as soon as they enter the chamber C, with resulting intense and very rapid combustion.

In Fig. 8 the invention is shown as applied to a combustion chamber C' which is rotatably mounted as disclosed in the prior Goddard Patent No. 2,395,114, issued February 19, 1946, in which one or more pairs of nozzles **50** and annular members **51** may be provided. These are preferably symmetrically located with respect to the axis of the chamber and preferably deliver their laminated streams to a common axial point.

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 that what is claimed is:

1. In a combustion apparatus, a feeding device for one combustion liquid comprising a tubular nozzle of circular cross section and having inwardly projecting vanes of different radial lengths, a coaxial annular feeding device for a second combustion liquid and having partitions opposite the spaces between said vanes and having intervening spaces opposite said vanes, and annular means to add air to said jet.

2. In a combustion apparatus, feeding mechanism comprising a tubular nozzle of circular cross section and having internal and axially extended vanes, and an annular feeding device coaxially disposed with respect to said nozzle, said feeding device comprising inner and outer spaced annular casing members and said device having an annular series of spaced feed openings, and each of said feed openings being positioned in axial alignment with one of said vanes.

3. In a combustion apparatus, a feeding device for one combustion liquid comprising a tubular nozzle of circular cross section and having inwardly projecting vanes of different radial lengths, and a coaxial annular feeding device for a second combustion liquid, said feeding device comprising inner and outer spaced annular casing members and said device having partitions opposite the spaces between said vanes and having intervening spaces opposite said vanes.

4. In a combustion apparatus, a feeding device for one combustion liquid comprising a tubular nozzle of circular cross section and having inwardly projecting vanes of different radial lengths, and a coaxial annular feeding device for a second combustion liquid, said feeding device comprising inner and outer spaced annular casing members and said device having partitions opposite the spaces between said vanes and having intervening spaces opposite said vanes, and the spaces between said partitions which are opposite the deeper vanes being of greater circumferential width.

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

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