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REACTION MOTOR POWER PLANT WITH AUXILIARY POWER PRODUCING MEANS

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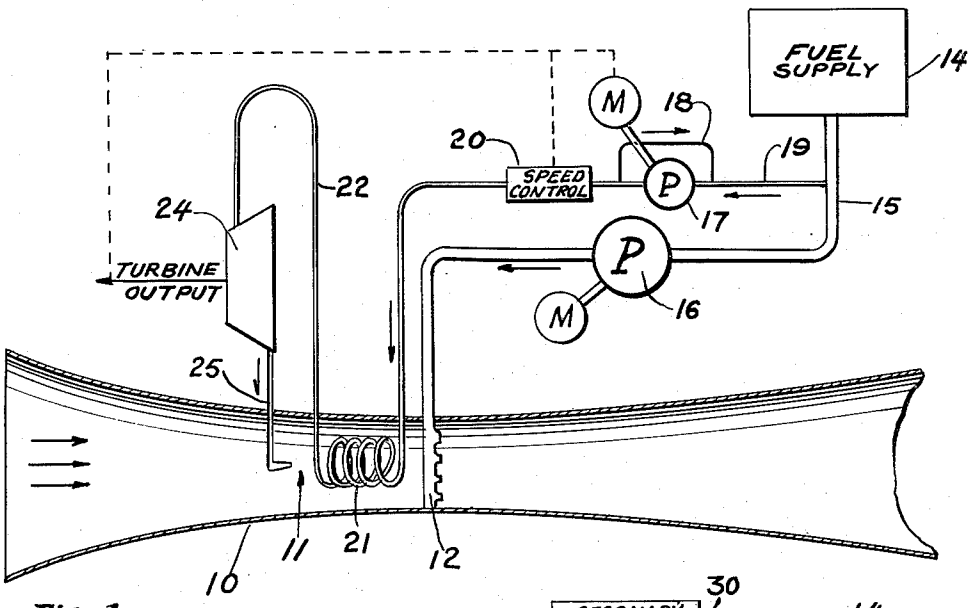


Fig. 1

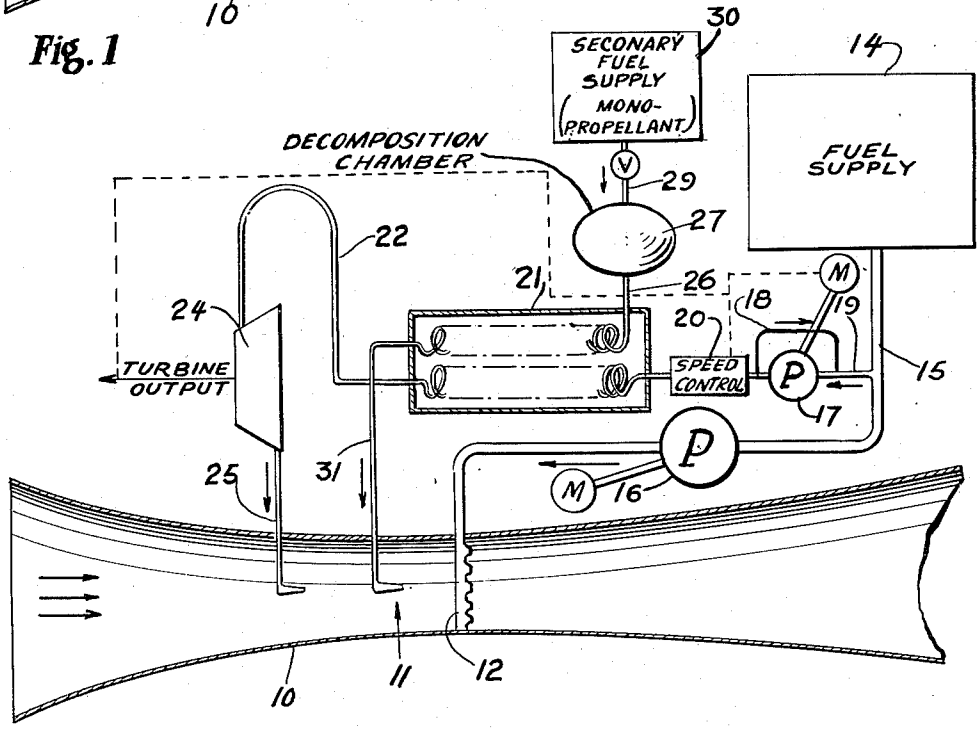


Fig. 2

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REACTION MOTOR POWER PLANT WITH AUXILIARY POWER PRODUCING MEANS

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This invention relates to reaction motors such as jet engines and rocket motors, and, more particularly, to a method of and a system for producing auxiliary power in connection with such motors.

Heretofore, in the production of auxiliary power for the operation of fuel pumps, hydraulic pumps, air compressors, generators and the like, it has been customary to draw the fuel required for the production of such power from an auxiliary supply or from the main fuel supply for the production of motive power. In either instance, the fuel used for the production of auxiliary power did not contribute to the production of motive power along with the main fuel supply, wherefore, in addition to the main fuel supply necessary for the generation of motive power, such systems necessitated the provision of a heavy, space consuming amount of auxiliary fuel stored together with the main fuel supply or separately thereof. Another difficulty heretofore inherent in certain types of reaction motors has been the lack of reliability in starting and in sustaining combustion.

Accordingly, an object of the present invention is to overcome the foregoing difficulties and disadvantages.

Another object is to provide an auxiliary power system for reaction motors wherein that portion of fuel which is used for the production of auxiliary power is also employed for the production of motive power.

Another object is to provide a continuous pilot flame to insure ignition of the main fuel supply in the combustion zone and to minimize the possibility of flame-outs.

Another object is to provide such a system wherein a portion of the fuel supply is vaporized under pressure, is expanded to provide auxiliary power and is burned to provide motive power.

Another object is to provide such a system wherein auxiliary power is generated with only a negligible weight and space penalty for fuel therefor.

A further object is to provide such a system which is simple and compact in construction and efficient and reliable in operation.

A still further object is to provide a method of producing such auxiliary power for a reaction motor.

Other and further objects of the invention will be obvious upon an understanding of the illustrative embodiment about to be described, or will be indicated in the appended claims, and various advantages not referred to herein will occur to one skilled in the art upon employment of the invention in practice.

Preferred embodiments of the invention have been chosen for purposes of illustration and description and are shown in the accompanying drawing, forming a part of the specification, wherein:

FIG. 1 is a schematic view of a system illustrating one embodiment of the invention, and

FIG. 2 is a schematic view of a system illustrating another embodiment of the invention.

Referring to the drawing in detail, and more particularly to FIG. 1 thereof, there is shown a reaction motor **10** of the ram jet type including a combustion zone **11** and conventional fuel injectors **12** for the delivery of fuel to the combustion zone. The fuel is pumped to the injectors from a receptacle or tank **14** through a main fuel supply conduit **15** by a pump **16**.

The auxiliary power system comprises a source of fuel such as a tank **14**, a fuel pump **17** provided with a return flow line **18**, a speed control mechanism **20**, a heat exchanger **21** and a turbine **24**.

The speed control **20** may be any conventional apparatus for controlling the flow of fuel through the conduit **19** to maintain the desired turbine speed, and in this embodiment of the invention, the heat exchanger **21** consists of a coiled conduit disposed within the combustion zone **11**.

In operation, fuel is delivered from the tank **14** through the conduit **15** and the injectors **12** into the combustion zone **11** where it is burned to provide motive power in the usual manner.

In accordance with the invention, fuel from the tank **14** is also conducted by the conduits **15** and **19** to the pump **17**, where it is placed under a desired head of pressure, through the speed control mechanism **20** and to the heat exchanger **21** in the combustion zone **11** where sufficient heat is absorbed to vaporize the fuel. In its vaporized state, the fuel is then delivered to the turbine **24** by the conduit **22**. The vaporized, pressurized fuel is expanded in the turbine to operate the same to produce auxiliary power and is then delivered, still in its vaporized state, through the conduit **25**, to the combustion zone **11** where it is burned to provide motive power and to supply heat to the heat exchanger **21**.

The return flow line **18** serves to return a portion of the fuel from the downstream side of the pump **17** to the supply side thereof in case the pump delivers more fuel than the speed control **20** allows to pass.

Referring to FIG. 2 of the drawing, there is illustrated a system similar to that of FIG. 1, except that the heat for effecting vaporization is not derived from the combustion zone **11**.

The pump **16** delivers fuel from the tank **14** through the conduit **15** to the injectors **12** and the auxiliary pump **17** delivers fuel from the conduit **15** through the connecting conduit **19**, the speed control **20**, the heat exchanger **21**, the conduit **22** and the turbine **24**, and the conduit **25** to the combustion zone **11**. The pump **17** is provided with a return flow line, as described heretofore.

The heat required to effect vaporization of the fuel is supplied to the heat exchanger **21** through a conduit **26** connecting the same with a decomposition chamber **27** which in turn is connected by a valved conduit **29** to a pressurized secondary fuel receptacle **30** for containing a suitable mono-propellant fuel.

In operation, fuel is supplied to the injectors **12** in the usual manner, and fuel from the same source is also pressurized by the pump **17** and vaporized in the heat exchanger **21**, expanded in the turbine **24** and delivered to the combustion zone **11** where it is burned to provide motive power. In the present embodiment, heat for effecting vaporization of the fuel is provided by permitting the pressurized mono-propellant fuel to flow from the receptacle **30** through the valved conduit **29** to the chamber **27** where it is decomposed to generate heat. The hot products of decomposition are then delivered through the conduit **26** to the heat exchanger **21**, to vaporize the fuel to be supplied to the turbine **24**, and thence through a conduit **31** to the combustion zone where they are burned to provide motive power.

In order to start the unit illustrated in FIG. 1, a portable heater may be inserted into the combustion zone **11** to provide heat for the vaporization of the fuel in the heat exchanger and the auxiliary devices such as the pump **17** may be temporarily operated by external power. As soon as sufficient fuel is vaporized to operate the turbine **24**, the portable heater and the external power supply

may be removed. Alternatively, a supply of pressurized, burnable gas may be injected into the conduit **22** to operate the turbine **24**. The discharge of such gas into the combustion zone **11** may be ignited to provide heat for the vaporization of sufficient fuel to operate the turbine, whereupon the supply of pressurized burnable gas may be removed.

To start the unit illustrated in FIG. 2, it is merely necessary to provide a temporary source of external power for operation of the fuel pump **17** while decomposition of the secondary fuel is commenced by allowing the same to flow into the chamber **27** and heating the chamber, or by providing a suitable catalyst therein to promote decomposition of the fuel. The external power for the pump **17** may be removed when the turbine is in operation and providing auxiliary power and the external heat or the catalyst may be removed when the decomposition becomes self-sustaining.

From the foregoing description, it will be seen that the present invention provides a simple and compact auxiliary power system for reaction motors which is efficient and reliable in operation and wherein that portion of the fuel which is used to provide auxiliary power is also used to supply motive power with only a negligible weight and space penalty therefor. It will also be seen that the present invention provides a pilot flame to insure ignition of the main fuel supply and to minimize the possibility of flame-outs.

In addition to providing auxiliary power, the present system may be used as a starter. For example, where the reaction motor is of the turbo-jet type, the turbine may be employed to drive the main air compressor until sufficient air is provided in the combustion zone to support combustion of the main fuel supply after which the turbine may be disengaged from the compressor.

As various changes may be made in the form, construction and arrangement of the parts herein, without departing from the spirit and scope of the invention and without sacrificing any of its advantages, it is to be understood that all matter herein is to be interpreted as illustrative and not in any limiting sense.

We claim:

1. In a power plant, the combination of a source of liquid fuel, a reaction motor having a combustion zone wherein liquid fuel is burned, means for delivering a major portion of the fuel from said source to said motor and injecting the same into said zone wherein it is ignited to provide motive power, fuel throttling means, means for pressurizing a minor portion of the fuel and conducting the same from said source to said throttling means, means connected to said throttling means for vaporizing the throttled fuel, auxiliary power producing means connected to said vaporizing means to be driven by the expansion of the vaporized fuel, said throttling means being operated by said auxiliary power means, and means for conducting the expanded vaporized fuel from said power producing means to said motor and injecting the same into said zone concurrently with the first mentioned injected fuel and into the path thereof wherein it is ignited to provide additional motive power and a pilot flame for the first mentioned injected fuel.

2. Apparatus according to claim 1, wherein said fuel vaporizing means includes a second source of fuel, means for decomposing fuel from said second source to produce heat, heat exchanger means for transferring heat from the decomposed fuel to said minor portion of the fuel from said first source, and means for conducting the products of decomposition of the second fuel from said heat exchanger means and injecting the same into said zone to provide additional motive power.

3. In a power plant, the combination of a source of liquid fuel, a reaction motor having a combustion zone wherein liquid fuel is burned, means for delivering a major portion of the fuel from said source to said motor and injecting the same into said zone wherein it is ignited to provide motive power, means for withdrawing a minor portion of the fuel from said source and pressurizing the same, means in fluid flow communication with said pressurizing means for throttling the pressurized fuel, means in fluid flow communication with said throttling means for vaporizing the throttled fuel, auxiliary power producing means in fluid flow communication with said vaporizing means and driven by the expansion of the vaporized fuel, said pressurizing means and said throttling means being operated by said auxiliary power means, and means for conducting the expanded vaporized fuel from said auxiliary power means to said motor and injecting the same into said zone concurrently with the first mentioned injected fuel and into the path thereof wherein it is ignited to provide additional motive power and a pilot flame for the first mentioned injected fuel, said vaporizing means being positioned to receive heat from the combustion of said vaporized fuel.

4. In a power plant, the combination of a source of liquid fuel; a reaction motor having a combustion zone wherein liquid fuel is burned; means for delivering a major portion of the fuel from said source to said motor and injecting the same into said zone wherein it is ignited to provide motive power; fuel vaporizing means; means for delivering a minor portion of the fuel from said source to said vaporizing means; auxiliary power producing means connected to said vaporizing means to be driven by the expansion of the vaporized fuel; and means for conducting the expanded vaporized fuel from said power producing means to said motor and injecting the same into said zone concurrently with the first mentioned injected fuel and into the path thereof wherein it is ignited to provide additional motive power and a pilot flame for the first mentioned injected fuel, said fuel vaporizing means including a second source of fuel, means for decomposing fuel from said second source to produce heat, heat exchanger means for transferring heat from the decomposed fuel to said minor portion of the fuel from said first source, and means for conducting the products of decomposition of the second fuel from said heat exchanger means and injecting the same into said zone to provide additional motive power.

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