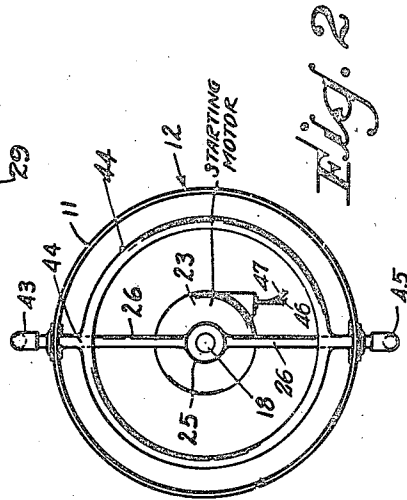
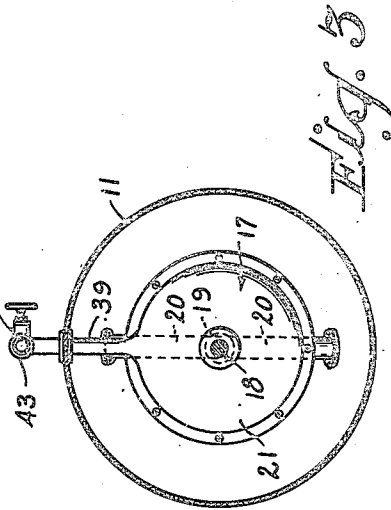
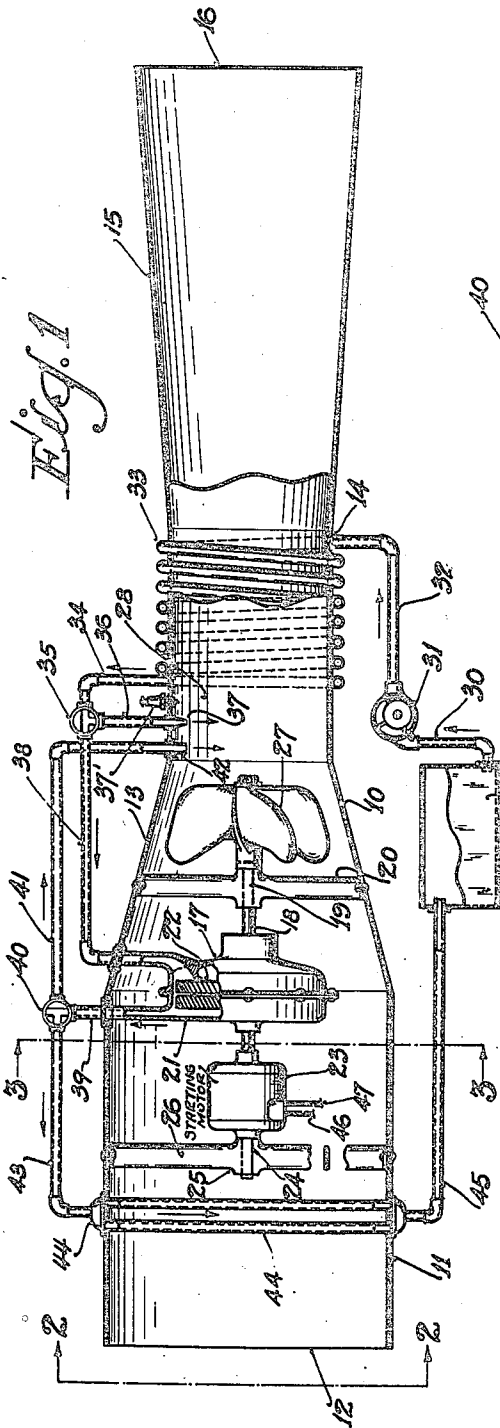


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JET ENGINE, INCLUDING A COMBUSTION CHAMBER TO WHICH
GASEOUS FUEL IS DELIVERED UNDER PRESSURE
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JET ENGINE, INCLUDING A COMBUSTION CHAMBER TO WHICH GASEOUS FUEL IS DELIVERED UNDER PRESSURE

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This invention relates to a method and means of producing power, and particularly pertains to a jet propelled engine and method of operating the same.

It is common practice to provide jet engines which embody the use of a compressor, ignition chamber, and a turbine. The products of combustion from the ignition chamber flow to the turbine and thus produce excessive heat in the turbine. It is the principal object of the present invention, therefore, to provide a jet propulsion power unit in which a combustible fuel may be vaporized and used as the propelling force for air moving means prior to its ignition period, so that the air moving unit will be maintained in a cool condition, and in which structure the combustion action takes place in the discharge throat of the jet tube and in the rear of the air moving unit, thus obtaining the flexibility of control of the present-day jet engine and the low temperature operation and high speed efficiency of an engine embodying the athodyd principle.

The present invention contemplates the provision of an outer tubular housing providing a continuous longitudinal passageway, the forward end of which is open to form an air induction throat and the rear portion of which provides a restricted tubular throat of the Venturi type having a rear eduction opening through which air and products of combustion from the engine may be discharged at high velocity.

The invention is illustrated by way of example in the accompanying drawing in which:

Figure 1 is a view in central longitudinal section showing the jet propulsion power unit embodying the present invention.

Fig. 2 is an end view showing the induction end of the power unit, as viewed on the line 2—2 of Fig. 1.

Fig. 3 is a view in transverse section through the power unit in advance of the turbine, as seen on the line 3—3 of Fig. 1.

Referring more particularly to the drawing, 10 indicates the outer tubular housing or jet tube of a jet propulsion engine embodying the present invention. The housing includes a cylindrical induction section 11 formed with an unrestricted open induction end 12. The opposite end of said section continues in a frusto-conical section 13 which forms a restricted throat for a purpose to be hereinafter described. The small end of the frusto-conical section 13 continues in a cylindrical section 14 of uniform diameter to which an eduction tube 15 is connected. The tube 15 is outwardly tapered, the taper being considerably

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longer than that of the frusto-conical section 13 and being of a lesser degree. The end of the tube 15 is open and unrestricted and forms an eduction mouth 16. Considering the entire housing section without regard to the equipment associated therewith, it will be seen that if air is caused to travel longitudinally through the housing 10 it will pass through the induction opening 12 in relatively large volume and will be restricted as it flows into and through the cylindrical section 14, thus increasing the velocity flow of the air and gases of combustion so that the force of expulsion at the eduction end 16 of the tube 15 will be sufficient.

Mounted transversely of the base section of the frusto-conical portion 13 of the housing is a turbine 17. This turbine is of the conventional steam jet type having a fixed outer housing and a rotor therein. The rotor is mounted upon a driven shaft 18 which extends longitudinally and centrally of the housing 10 and is supported in a central bearing 19 carried by radial arms 20. Attention is directed to the fact that the turbine 17 is not a specially designed turbine to receive burned gases but is of the type usually employed when steam is used as the motive fluid. In fact, it is not necessary to provide a turbine made of special metals which will satisfactorily resist high temperature, since the temperatures of the gases passing through the turbine 17 will be at relatively low temperature and fully within the range of safe operation without being of special construction. The driven shaft 18 passes entirely through the housing 21 of the turbine and serves as a mounting for the rotor 22. The shaft 18 is fitted with a starting motor 23 which is disposed in advance of the turbine and gives the power unit its initial impetus prior to full automatic operation within the unit. The motor 23 has a forward shaft 24 seated within a bearing 25. The bearing 25 is carried on radial arms 26 within the portion 11 of the housing 10.

Mounted at the forward end of the driven shaft 18 and beyond the bearing 19 is an air blower 27. This blower is so designed as to cooperate with the frusto-conical wall section 13 of the housing in forcing the air rearwardly and into the eduction tube 15. The restricted cylindrical portion 14 of the housing provides a combustion chamber 28 within which fuel may be burned. It is contemplated that the fuel which is to be used in the engine of the present invention is in liquid phase while in storage and is then converted to vapor phase for introduction into the combustion chamber 28 and into the turbine 17. Liquid fuel for

use with the jet propulsion engine here shown may be carried in a storage tank 29. This tank is fitted with a fuel pipe 30 leading to one side of a fuel pump 31. The fuel pump may be driven by any source of power. The opposite side of the fuel pump 31 is fitted with a fuel pipe 32 which leads to a vaporizing coil 33. This coil is wrapped around the cylindrical portion 14 of the housing with its convolutions leading to the forward end of the housing. The coil thus produces a helical tubular boiler within which the liquid fuel may be heated by the gases passing through the portion 14 of the housing and will be thus vaporized. A gaseous fuel pipe 34 connects with the last convolution of the tubular boiler coil 33 and leads to a two-way valve 35. When this valve is set in one direction a connection will be made to a fuel feed pipe 36 which extends through the wall of the housing portion 14 and is fitted with a jet nozzle 37 so that fuel which passes through the boiler coil 33 in the initial stage of operation will be directly introduced into the combustion chamber. Initial ignition of the fuel discharged from the pipe 36 into the combustion chamber 28 may be brought about by a suitable igniter, such for example as the spark plug 37'. This plug will be connected in a suitable ignition circuit not shown in the drawing.

When the valve 35 is moved to a position where the flow of fuel from the fuel pipe 34 to the fuel pipe 36 is interrupted a flow of fuel will be established from the fuel pipe 34 to a gas pipe 38. This pipe leads to the induction side of the housing 21 of the turbine 17. The opposite side of this housing is fitted with an exhaust pipe 39 which leads to a two-way valve 40. One side of the two-way valve 40 is connected to a gaseous fuel supply pipe 41. This pipe leads to and extends through the wall of the restricted cylindrical portion 14 of the engine housing, as indicated at 42, where it will discharge gaseous fuel into the combustion chamber 28 in the rear of the fan 27. When the two-way valve 40 is moved to its other position flow of gaseous fuel from the pipe 41 will be established through the valve 40 to a return pipe 43. The return pipe 43 connects to one side of a condenser 44. This condenser may be of any desired type or design. Here, however, it is shown as being in the form of an annular conduit which is embraced by the enlarged cylindrical portion 11 of the housing. It is obvious that since this condenser is on the entering end of the tubular housing 10 it will be subjected to the cooling action of air which passes into the mouth 12 and along the wall 11 as well as the air which passes on the outside of the wall 11 and impinges against the wall of the condenser 44. The normal temperature of the atmosphere is sufficiently low to cause the gaseous fuel which passes into the condenser to be converted from vapor phase to liquid phase so that it may be drained off through a drain pipe 45 leading to the storage tank 29.

In operation of the engine with which the present invention is concerned electricity is delivered to the motor 23 from a suitable source of supply through the conductors 46 and 47. The motor 23 is of the motor-generator type so that when it is not utilized for its motive power it may be used as a generator if desired. As the motor rotates the shaft 18 will be driven and this in turn will drive the rotor 22 of the turbine as well as the fan 27. The fan will act to draw air through the induction end 12 of the tubular housing, around the turbine, and then force it

into the combustion chamber 28. At this same time the fuel pump 31 will be driven and will force liquid fuel through the pipe 32 to the boiler coil 33. During the initial period of operation it is obvious that the fuel passing through the coil 33 will not be sufficiently heated to produce its vaporization. Thus, when the valve 35 is adjusted to establish communication between pipes 34 and 36 a jet of fuel will be forced from the nozzle 37 into the combustion chamber 28 and will be ignited by the spark plug 37'. As the fuel burns within the combustion chamber the boiler coil 33 will be heated gradually so that eventually the liquid entering the boiler coil 33 will be converted to vapor phase before it reaches the outlet pipe 34. When this condition arises the burner will of course be self-generating so that the spark plug or ignition device 37' may be interrupted in its operation, and so that the valve 35 may be adjusted to close the pipe 36 and to establish a flow of fuel vapor from the pipe 34 to the pipe 38. The pressure of the fuel vapor will act upon the rotor 22 of the turbine 17 to drive the same. This will then drive the shaft 18 and will make it possible for the motor-generator 23 to be driven so that electricity for any desired purpose may be obtained from the generator. The exhaust gases from the turbine pass through the pipe 39 to the valve 40 and under normal conditions are led through the pipe 41 to the discharge nozzle 42 within the combustion chamber 28. It will be recognized that the highest temperature prevailing within the turbine 17 will be the maximum temperature of the fuel gases generated within the boiler coil 33, and that such temperatures will not be detrimental to a steam turbine of conventional design and construction. The discharge of fuel gases from the turbine into the combustion chamber 28 will support the combustion of fuel which had been initiated in the chamber 28. The fan 27 will then force the burning fuel rearwardly and outwardly through the jet propulsion nozzle 15 and will create sufficient impulse force to drive the engine forwardly.

In the event that it is desired to stop the engine the valve 40 may be manipulated to interrupt the flow of gaseous fuel from the pipe 39 through the valve 40 to the pipe 41 and to direct this fuel from pipe 39 through the valve 40 to the pipe 43. The gaseous fuel will then enter the condenser 44, where it will be converted to liquid phase and will drain through the pipe 45 to the storage tank 29. Thus, any vapors which are generated within the boiler coil 33, after fuel supply to the combustion chamber 28 has been interrupted, will migrate through the piping system to the condenser and return to the storage tank in liquid phase.

It may be found desirable to drive the blower fan 27 at a higher speed than the speed at which the turbine 17 rotates, however this is not essential.

While I have shown the preferred form of my jet propulsion power unit, and the method of operating the same, it is to be understood that various changes in the combination of the parts of the structure and a rearrangement of the steps of the operation may be made by those skilled in the art, without departing from the spirit of the invention as claimed.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. A jet propulsion power unit comprising a

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tubular housing having a cylindrical induction end of relatively large diameter and an eduction end of relatively small diameter forming a continuous passageway from end to end thereof with a restricted throat section intermediate its ends, a fluid pressure turbine disposed within said passageway relatively near the induction end and having its axis concentric with the longitudinal axis of the tubular housing, a blower fan driven by said turbine and longitudinally aligned therewith, said fan being disposed between the turbine and the eduction end of the tubular housing and designed to move air through the housing toward the eduction end thereof, said blower being disposed in the advance portion of said restricted throat, a combustion chamber formed at a point in said restricted throat between the blower and the eduction end of the tubular housing, a heating coil circumscribing said combustion chamber whereby heat incident to the combustion of fuel in said combustion chamber will be imparted to said heating coil, a liquid fuel storage tank, a conduit connecting said storage tank with said heating coil, a pump positively circulating liquid fuel from said storage tank to said heating coil, a pipe connecting the heating coil with the induction side of the turbine, and a pipe leading from the eduction side of the turbine to the combustion chamber whereby the fuel vapors generated within the heating coil may be delivered to the turbine to motivate the same and to thereafter be exhausted from the turbine into the combustion chamber.

2. The structure of claim 1 including an auxiliary fuel pipe connected with the heating coil and extending into the combustion chamber, and valve means acting to alternately deliver fuel from the heating coil directly into the combustion chamber through said auxiliary pipe or indirectly while passing through the turbine.

3. The structure of claim 1 including a condenser associated with the induction end of the tubular housing, a connection between the eduction side of the turbine and said condenser, a drain connection between the condenser and the storage tank, and a valve optionally controlled to alternately direct the fuel vapor from the eduction side of the turbine to the combustion chamber or to the condenser.

4. A jet propulsion power unit, comprising a tubular housing adapted to be mounted upon an object to be propelled with the longitudinal axis of said housing extending substantially parallel to the proposed path of travel of the object, said housing comprising a tubular cylindrical air induction section having an open end, a frusto-conical section connected therewith and forming a rearwardly tapering side wall to produce a restricted throat in longitudinal alignment with the open end of the housing, a restricted throat section continuing therefrom and having an outwardly flaring side wall terminating in an eduction opening of lesser diameter than the induction opening, a fluid turbine mounted upon

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the longitudinal axis of the tubular housing and at the forward end of the tapered throat section, said turbine being of a diameter to permit free flow of air around the turbine and between its circumference and the side walls of the housing, a shaft extending through the turbine and carrying the turbine rotor, a motor generator mounted upon the forward end of said shaft, a blower fan mounted upon the rear end of said shaft, said blower operating in the restricted throat formed by the tapered section of the housing, means for rotatably supporting said shaft within the housing, a combustion chamber within the restricted throat section of the housing, a heat exchanger associated with the wall of the housing along the restricted throat area whereby air and gases passing through the housing may impart heat to said heat exchanger, a liquid fuel supply tank, a supply conduit leading therefrom to the heat exchanger, a power driven pump mounted at a point in said conduit, a conduit leading from the heat exchanger to the induction side of the turbine, a two-way valve at a point in said conduit, an auxiliary conduit connected with said two-way valve structure and leading to the combustion chamber, a jet nozzle on the discharge end thereof, a conduit leading from the eduction side of the turbine to the combustion chamber, whereby exhaust gases from the turbine will be delivered to the combustion chamber, the discharge end of said conduit and the jet nozzle being disposed in the path of travel of air moved by the blower fan, and fuel ignition means disposed within the combustion chamber.

5. The structure of claim 4 including a condenser circumscribing the cylindrical wall at the induction end of the housing and being in heat exchange relation therewith whereby air passing through the housing and therearound will tend to lower the temperature of the condenser structure, a conduit connecting the condenser with the exhaust gas conduit leading from the turbine, a two-way valve which may be operated to alternately deliver exhaust gases from the turbine to the combustion chamber or the condenser, and a drain pipe leading from the condenser to the fuel supply tank.

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