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PERTAINING TO INTERNAL COMBUSTION AIRCRAFT MOTORS.

APPLICATION FILED NOV. 6, 1917.

1,375,931. Patented Apr. 26, 1921.

Fig. 1,

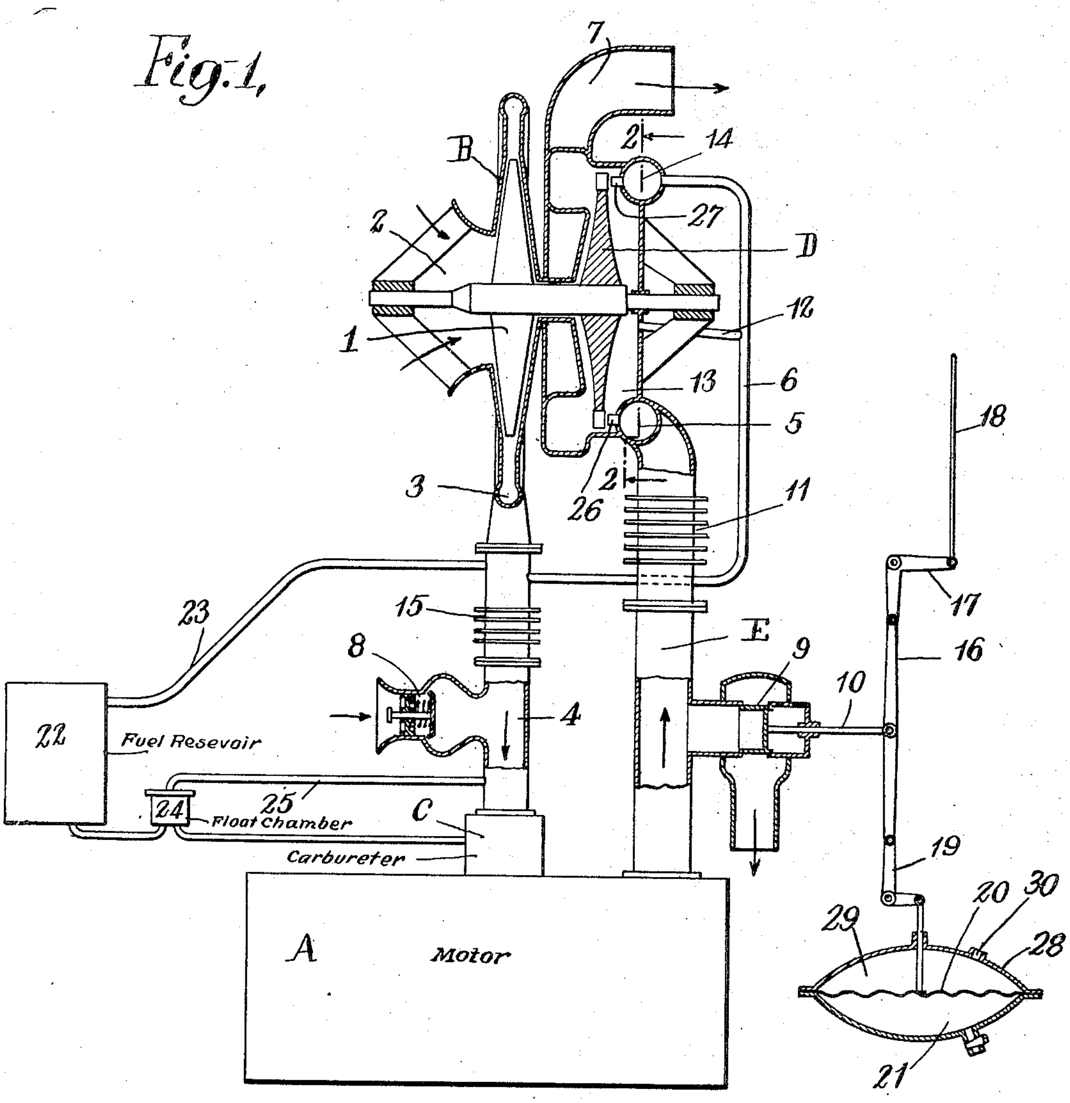
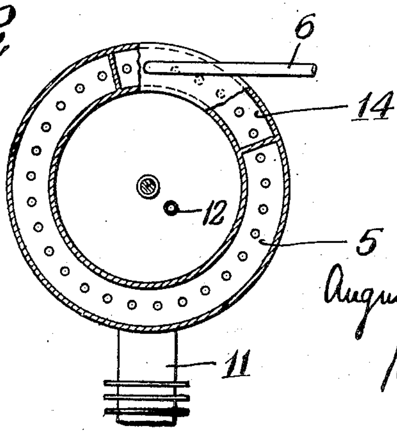


Fig. 2,



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PERTAINING TO INTERNAL-COMBUSTION AIRCRAFT-MOTORS.

1,375,931. Specification of Letters Patent. Patented Apr. 26, 1921.

Application filed November 6, 1917. Serial No. 200,514.

To all whom it may concern:

Be it known that I, AUGUSTE CAMILLE EDMOND RATEAU, a citizen of the Republic of France, and a resident of Paris, France, have invented certain Improvements Pertaining to Internal-Combustion Aircraft-Motors, of which the following is a specification.

My invention relates to internal combustion motors, such as gasolene, alcohol, petroleum and gas motors and has for its object the provision of means whereby the power of such motor may be increased, and more specifically, whereby it may be operated with efficiency where the atmosphere is rarefied, as for example on an aeroplane flying at a great elevation. More specifically my invention contemplates means whereby the power of the motor may be maintained at any desired constancy while operating an aeroplane at varying elevations.

To these ends I provide an air compressor located in the air intake passage of the motor, whereby air under compression may be supplied to the combustion chamber and to such other parts of the motor as should be maintained at the same pressure as that of the air entering the combusion chamber. This air compressor is operated by power remaining in the exhaust gases of the motor, and utilized in driving a turbine located in the exhaust passage of the motor.

My invention more specifically includes means for operating the motor independently of the air compressor and turbine, and a means for suitably cooling the compressed air and the turbine, and means for automatically regulating the operation of the turbine when a more or less constant power, regardless of the degree of rarefication of the atmosphere, is desired. My invention will be better understood from the more detailed description of the apparatus shown in the drawings as illustrating one embodiment of my invention.

Referring to said drawings,

Figure 1 is a diagrammatic illustration of an internal combustion motor of the type employing a carbureter and embodying my invention.

Fig. 2 is a detail illustrating the means I prefer for cooling the turbine wheel.

A indicates diagrammatically the portion of the motor containing the cylinder or cylinders which may be of any known type, single or double acting. C represents the carbureter of a motor using a liquid form of fuel. 4 represents the air intake passage of the motor, and E the exhaust passage of the motor. 22 represents the fuel reservoir, and 24 the usual float chamber controlling the passage of fuel from the fuel reservoir to the carbureter. The parts thus far described are representative of any combustion motor using liquid as a source of fuel, the air sucked in through the passage 4 mixing with the fuel in carbureter C. The combustion takes place in the cylinder or cylinders in box A and the hot gases pass out to the atmosphere through the passage E.

In the intake passage 4 is included a centrifugal fan having rotatable blades 1, so that the air from the atmosphere may be sucked in through the passage 2 and compressed by the fan and discharged into fan casing B, which communicates with an air passage 4 leading to the carbureter. As it is desirable that the fuel reservoir 22 and float chamber 24 should be maintained at the same pressure as that at the carbureter, I supply pipes 23 and 25 respectively leading from the air passage 4 to the said fuel reservoir and float chamber.

Upon the same shaft as the blades 1 of the fan is a turbine wheel D adapted to rotate in a casing 13, which casing is in communication with the passage 7 leading to the atmosphere. A channel 5 is in communication with the exhaust passage E of the motor whereby the exhaust gases entering said passage can operate the turbine wheel by passing through the nozzles 26. The passage 5 as shown in Fig. 2 is not a complete ring, as I prefer to form the chamber 14 in said passage for a purpose hereinafter set forth.

Considering the operation of the motor thus far described, the power of the exhaust gases, most of which is ordinarily lost, and which is developed within the cylinder or cylinders of the motor, is utilized to drive the turbine D and through it the blades 1 of the air compressor, thus supplying compressed air to the passage 4 and from that passage to the carbureter and thence to the cylinder or cylinders. The power of a combustion motor depends upon its speed of rotation and upon the density of the air entering the motor and therefore is roughly proportional to the air density. The power of the motor is therefore increased proportionally to such increased pressure, and a compression of the air from one atmosphere to one and one-half atmospheres by means of the fan will increase the power of the motor substantially fifty (50%) per cent. over what it would be if my invention were not applied to it. This means for example that if an aeroplane is at such a height as to be surrounded by an atmospheric pressure only seven-tenths (7/10) of that found at the sea level, that a motor equipped with a gasolene turbo fan in accordance with my invention, and which compresses the air to the extent above indicated, will operate with the same power as the same motor without my invention would develop at sea level. I have selected a degree of compression as an example which I have found to be entirely practicable, but I do not intend to indicate that the amount of the compression may not be increased very much more.

In some cases it will be desirable to cool the compressed air especially if the compression is high. For example the air might increase in temperature 65 degrees centigrade for an increase of compression of sixty (60%) per cent., which might interfere with the proper operation of the carbureter especially where light gasolene is used. I have shown for this purpose radiator 15 on the intake passage located between the fan discharge and carbureter.

In some cases it will also be necessary to provide means for cooling the exhaust gases or cooling the turbine or both, for in some combustion motors, especially aeroplane motor, the exhaust gases leave the motor at a very high temperature. Where the temperature is only in the neighborhood of 600 degrees centigrade it will generally be found that the expansion in the nozzles will lower the temperature of the gases sufficiently to prevent injury to the turbine, but with higher temperature this lowering of temperature by expansion in the nozzles will not be sufficient. I have shown a radiator 11 on the exhaust pipe between the motor and the channel 5 of the turbine, and in some cases this may be sufficient means for avoiding injury to the turbine. I prefer, however, when the temperature of the exhaust gases is high, to cool the turbine in the manner shown in the drawings wherein a pipe 6 carries compressed air from the intake passage 4 passing some of the compressed air through the branch 12 into the casing 13 of the turbine and passing compressed air also into the chamber 14 through nozzles 27 upon a sector of the turbine wheel. In this manner the buckets or blades of the wheel are alternately subjected to the hot gases and relatively cold compressed air and the wheel takes an intermediate temperature.

While I have shown in the drawings an arrangement whereby all of the exhaust gases produced from the motor are discharged into the passage leading to the turbine, it will be understood that any portion thereof may be so discharged, while the remaining portion is discharged direct in the atmosphere. For example, in motors having a number of cylinders, some of the cylinders could discharge to the turbine and some direct to atmosphere.

The provision of my turbo fan, when operated by the exhaust gases as described, does not lessen the power that can be utilized by the motor for its primary purpose, because the expansion of the exhaust gases is more than sufficient to drive the fan with such power as to raise the pressure of the air to the desired extent, and the turbine is benefited by the high pressure prevailing in the cylinders at the end of the expansion in them, which makes possible an increase in power generation as the pressure of the atmosphere into which the turbine exhaust diminishes and the power required for compressing the charge forming air increases.

I have found that a very small turbo fan weighing from twenty to forty pounds and from twelve to eighteen inches in length and width can be operated at a speed of 20,000 revolutions per minute and upward and effect the purpose of my invention when applied to aeroplane motors.

I have also arranged my motor so that it need not be dependent upon the turbo fan for successful operation, but can operate as an ordinary combustion motor in case of any defect or breakage in the turbo fan, or in case it is desired for any reason to operate the motor with a lower power. To this end the intake passage 4 is provided with valve 8 arranged to close when the pressure within the passage is higher than the atmospheric pressure, but which opens the passage to the atmosphere whenever the pressure within the passage falls below that of the atmosphere. I have also provided a valve 9 adapted, when open, to provide direct communication between the exhaust passage E and the atmosphere, and I can manually control this valve in any suitable way, as by connecting a rod 10 to the valve 9 and moving said rod through the pivoted member 16, bell crank 17 and rod 18. Whenever the rod 18 is moved upward sufficiently, this valve 9 is moved outward and the exhaust gases pass directly to atmosphere without first passing through the turbine.

I have also so arranged my motor that when desired, the motor may be operated at a constant development of power whatever the pressure of the surrounding atmosphere. Thus it may be desired that an aeroplane be operated with a motor of constant power whatever the elevation of the aeroplane. I effect this purpose by connecting pivoted member 16, which operates the valve 9, to a bell crank 19 connected to diaphragm 20 within a casing 28. The diaphragm divides the chamber into two compartments 21 and 29. The compartment 21 contains air at, for example, sea level pressure. The compartment 29 connects through the passage 30 with the surrounding atmosphere. As the surrounding atmosphere becomes rarer the diaphragm 20 will be forced upwardly moving the bell crank lever 19 around its pivot so gradually closing the valve 9. It will be obvious that the manually controlled rod 18 can be placed at a position that will definitely close valve 9 whatever be the position of diaphragm 20, or that will definitely open the valve 9 whatever be the position of the diaphragm 20, or that will enable the upward movement of the diaphragm 20 from its normally central position to cause the valve 9 to gradually throttle the flow of gases at that point and finally shut them off altogether. It will be noted that by this control the motor may be started, if desired, when the aeroplane is on the ground without any operation of the turbo compressor and the aeroplane can be raised to any desired level before the turbo compressor is automatically started.

In the case of gas motors, as distinguished from motors using a liquid fuel, and in which the gas is generally received at about atmospheric pressure, it will be desirable to provide a second fan to compress the combustible gas, which second fan may be driven by the same turbine or by a separate turbine, also actuated by the exhaust gases of the motor.

While I have described in detail and illustrated in the drawings one specific embodiment of my invention, showing it in a form as now preferred by me, I do not desire to be limited to the specific details as herein set forth, since my invention is broader than such specific embodiment, as pointed out by the appended claims.

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

1. The method of compensating for changes in atmospheric pressure resulting from changes in altitude in the charge forming operation of an internal combustion aircraft motor, which consists in expanding the exhaust motor gases into the atmosphere to thereby develop kinetic energy in amount increasing as the atmospheric pressure decreases and employing this energy in compressing atmospheric air and delivering it to the air inlet of the motor at a pressure exceeding that of the atmosphere at the aircraft altitude.

2. The combination with an internal combustion aircraft motor of means for compressing the air supplied to the motor air inlet to a pressure above that of the atmosphere at the aircraft altitude comprising a turbo blower having its motive fluid inlet connected to the motor exhaust outlet and its motive fluid exhaust open to the atmosphere, and having its blower inlet open to the atmosphere and its blower outlet connected to the motor air inlet.

3. The combination with an internal combustion aircraft motor, of means for maintaining an approximately constant air pressure at the motor inlet as the altitude of the motor varies comprising an air compressor having its inlet open to the atmosphere and its outlet connected to the motor air inlet, and a turbine driving said compressor and having its inlet connected to the motor outlet and its exhaust open to the atmosphere.

4. The combination with an internal combustion aircraft motor of means for compressing the air supplied to the motor air inlet to a pressure above that of the atmosphere at the aircraft altitude comprising a turbo blower having its motive fluid inlet connected to the motor exhaust outlet and its motive fluid exhaust open to the atmosphere, and having its blower inlet open to the atmosphere and its blower outlet connected to the motor inlet, and means for cooling the air compressed before its delivery to the motor air inlet.

5. The combination with an internal combustion aircraft motor of means for compressing the air supplied to the motor air inlet to a pressure above that of the atmosphere at the aircraft altitude comprising a turbo blower having its motive fluid inlet connected to the motor exhaust outlet and its motive fluid exhaust open to the atmosphere, and having its blower inlet open to the atmosphere and its blower outlet connected to the motor air inlet, and means for controlling the pressure of the air at the motor inlet comprising a by-pass for discharging more or less of the exhaust gases from the combustion motor to the atmosphere without passing through the turbine.

6. A combustion motor having an air compressor in its intake passage, a turbine driving the same and located in the exhaust passage of the motor and a valve in said exhaust passage adapted to control the operation of said turbine, said valve being controlled responsively to the pressure of the atmosphere.

7. A combustion motor having an air compressor in its intake passage, a turbine driving the same and located in the exhaust passage of the motor and a valve in said exhaust passage opening said passage to the atmosphere, said valve being controlled responsively to the pressure of the atmosphere.

8. In a combustion motor, an air compressor in the intake passage of the motor, a turbine driving the same and operated by the exhaust gases of the motor, and passages

connecting the compressed air passage with the casing of the turbine and with nozzles adjacent to the turbine wheel.

9. In a combustion motor, an air compressor in the intake passage of the motor, means for driving the same, and means for introducing air from the surrounding atmosphere directly into the compressed air passage upon failure of the compressor to maintain the air compressed therein.

10. In a combustion motor, an air compressor in the intake passage thereof, means for operating the same, and a valve in said passage on the motor side of the compressor opening the passage to atmosphere when the pressure in the passage falls below that of atmosphere.

11. In a combustion motor, an air compressor in the intake passage thereof, means for operating the same from the power of the exhaust gases of the motor, means for cooling said operating means and means for controlling the flow of the gases to atmosphere to control the operation of said compressor.

12. In a combustion motor, an air compressor in the intake passage of the motor, a turbine driving the same and located to receive exhaust gases from the motor, means for cooling said turbine, a valve in the passage between the motor and the turbine adapted to open up the passage to atmosphere, and means for controlling said valve.

13. In a combustion motor, an air compressor in the intake passage of the motor, a turbine driving the same and located to receive exhaust gases from the motor and controlling means for said turbine comprising a valve, a member connected to the same, automatic means for controlling the position of said member and independently movable manual means for also controlling the position of said member.

14. In a combustion motor, an air compressor in the intake passage of the motor, a turbine driving the same and located to receive exhaust gases from the motor and controlling means for said turbine comprising a valve, a member connected to the same, automatic means adapted to vary the position of said member according to the pressure of the surrounding atmosphere and independently movable manual means for also controlling the position of said member.

15. In a combustion motor, an air compressor in the intake passage of the motor, a turbine driving the same and located to receive exhaust gases from the motor and controlling means for said turbine comprising a valve, a member connected to the same, automatic means for controlling the position of said member and independently movable manual means adapted to move the member to positions definitely closing and opening said valve whatever the action of the automatic means and also to a position where the operation of the automatic means will determine the operation of said valve.

16. In a combustion motor, an air compressor in the intake passage of the motor, a turbine driving the same and located to receive exhaust gases from the motor and controlling means for said turbine comprising a valve, a member connected to the same, automatic means adapted to vary the position of said member according to the pressure of the surrounding atmosphere and independently movable manual means adapted to move the member to positions definitely closing and opening said valve whatever the action of the automatic means and also to a position where the operation of the automatic means will determine the operation of said valve.

17. In a combustion motor, an air compressor in the intake passage of the motor, a driving means therefor operated by the exhaust gases of the motor, and valves in the intake and exhaust passage adapted to connect said passages to atmosphere.

18. A combustion motor including a carbureter, a float tank, a fuel reservoir, an air compressor between intake of the motor and the carbureter, connections leading compressed air to the float tank and fuel reservoir, a turbine driven by the exhaust gases of the motor, a valve adapted to open an independent intake from atmosphere, and a valve adapted to open an independent passage for the exhaust to atmosphere.

19. A combustion motor, such as an aeroplane motor, for use at different atmospheric pressures, said motor having an air intake passage with an air compressor therein, a turbine driven by the exhaust gases of the motor and exhausting to the surrounding atmosphere for driving the air compressor, and means for controlling the operation of said turbine responsively to the pressure of the surrounding atmosphere.

20. In a combustion motor, a turbine adapted to be driven by the exhaust gases from the engine, means whereby the said gases may be discharged without driving said turbine, means for cooling the exhaust gases before they reach the turbine, and an air compressor in the motor intake driven by said turbine.

21. In a combustion motor, a turbine adapted to be driven by the exhaust gases from the motor, means whereby said gases may be discharged without driving the turbine, an air compressor driven by the turbine and means for cooling the turbine.

In testimony whereof, I have signed my name to this specification.

AUGUSTE CAMILLE EDMOND RATEAU.