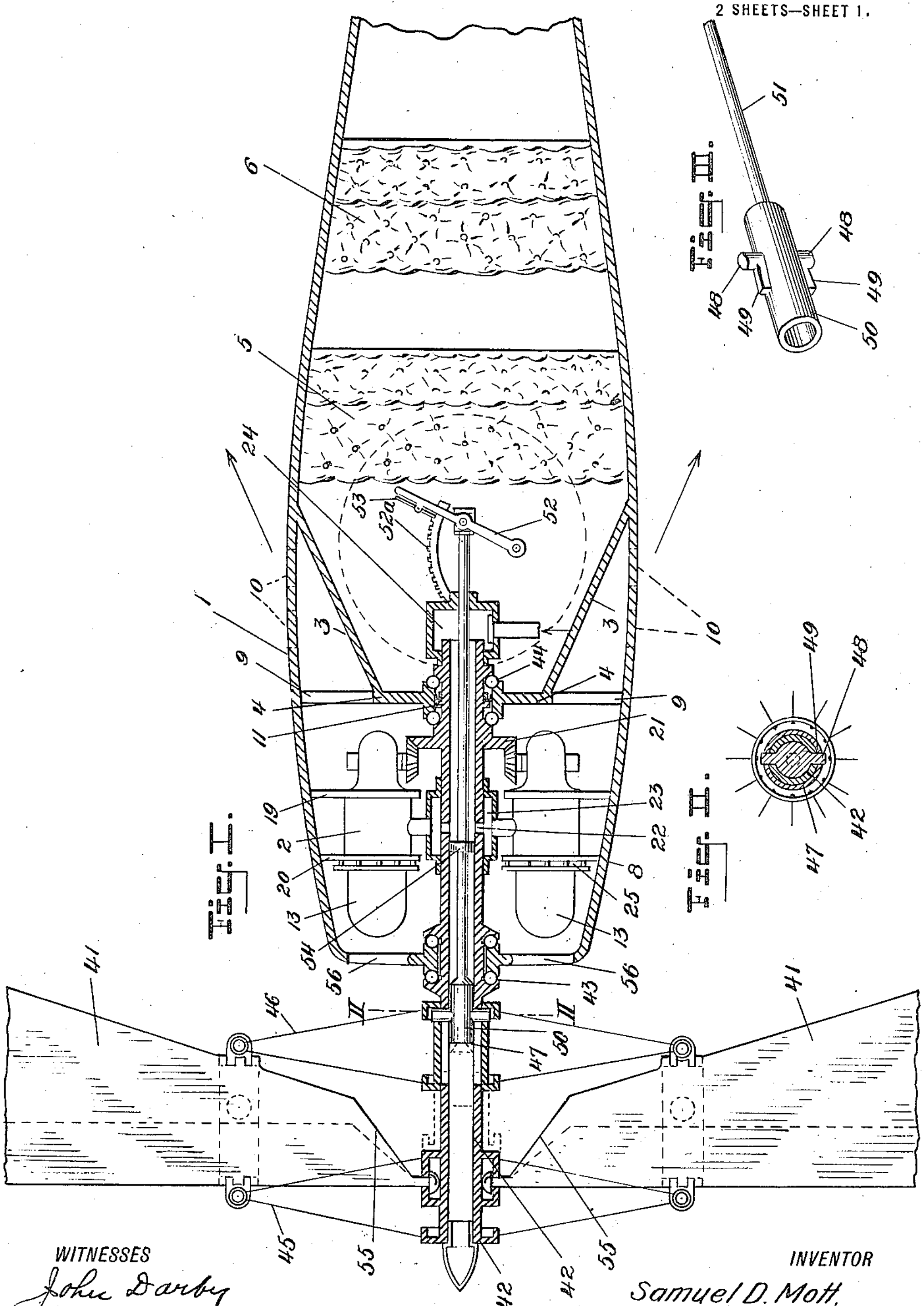
S. D. MOTT.
AEROPLANE.
APPLICATION FILED DEC. 13, 1915.

1,407,293. Patented Feb. 21, 1922.

2 SHEETS—SHEET 1.



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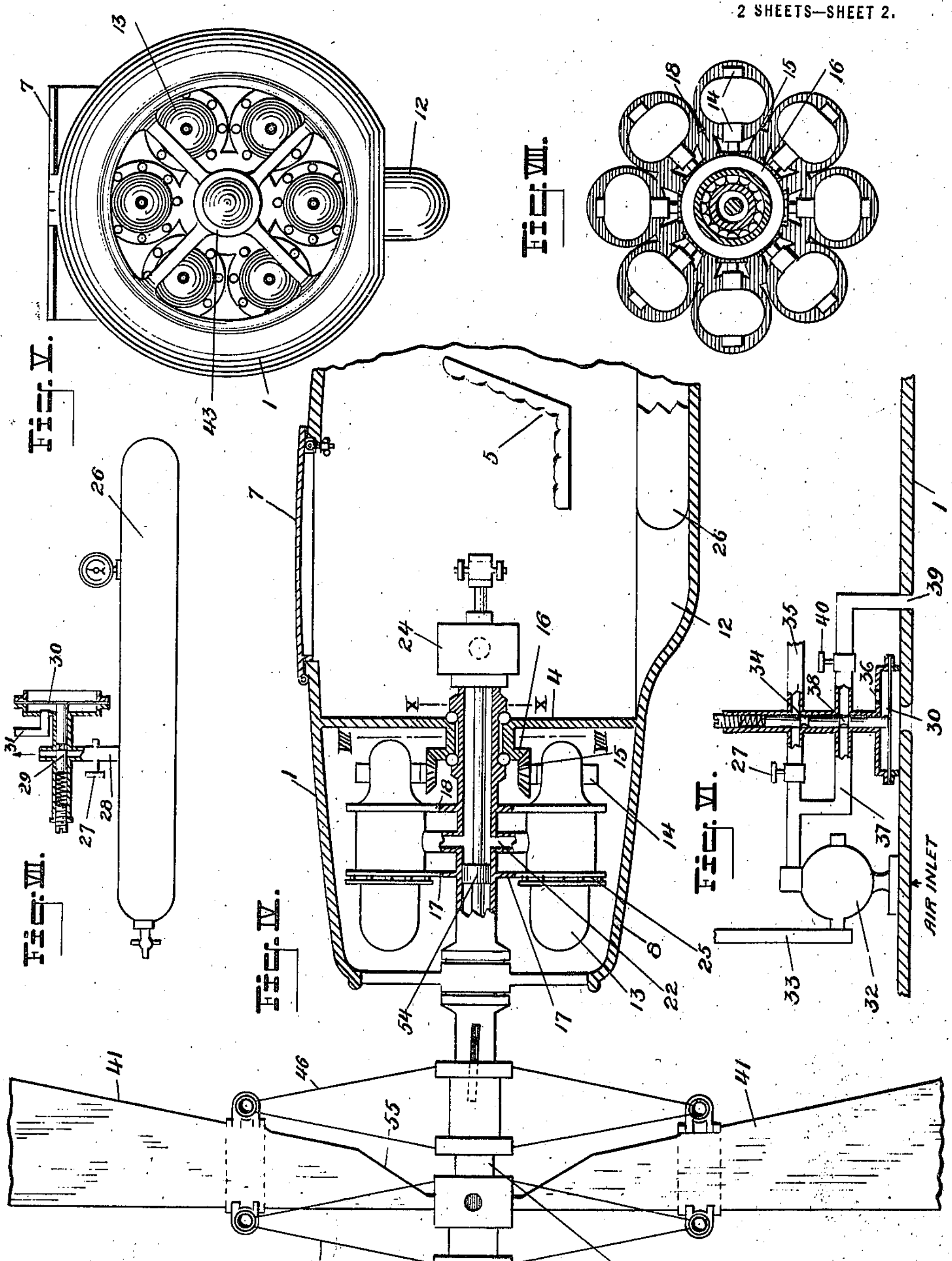

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UNITED STATES PATENT OFFICE.

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AEROPLANE.

1,407,293. Specification of Letters Patent. **Patented Feb. 21, 1922.**

Application filed December 13, 1915. Serial No. 66,466.

To all whom it may concern:

Be it known that I, SAMUEL D. MOTT, a citizen of the United States, resident of and whose post-office address is 130 Autumn Street, in the city of Passaic, county of Passaic, and State of New Jersey, have invented certain new and useful Improvements in Aeroplanes, of which the following is a description, reference being had to the drawings, forming a part hereof.

My invention relates to aeroplanes, and more particularly to features of construction which, in some respects, are radical and intended to meet conditions which the constantly more extended use of the same will present. As, for example, the practical operation of aeroplanes is rapidly reaching a point when flying in extreme altitudes will be undertaken and eventually become usual. For extreme altitude operations, various factors enter into consideration which in the early stage of the commercial art have been immaterial or negligible. High altitudes may involve a rapid rise and rapid fall, which means a rapid change of atmospheric presure. With the change of atmospheric pressure or rarification of the air, the resistance to the propeller changes. The varying pressure in turn has its effect upon the motor.

The long heralded and much discussed extreme voyaging in aeroplanes, includes, preferably, the factor of negotiating high altitudes where most advantageous atmospheric conditions are available, and as this in turn involves the contemplated advantage of reduced air resistance, thereby greatly increasing speeds of aeroplanes and by the material increase in speed, it is generally conceded that the long journeys, such as inter-continental, will eventually be accomplished. By the increased speed the time of long voyages is reduced in inverse ratio, and with the reduction in time for a given trip the risk and hazard are proportionately reduced.

To preserve normal working capacity of the operator under such trying conditions, is one object of my invention; while various other objects will be apparent from a thorough appreciation of my invention, there may be mentioned the means of increasing the speed in spite of the reduced propeller blade resistance at increased altitudes, and a general combination of construction as a whole to meet the conditions which can now be in a measure foreseen, and which will be realized as problems to be commercially solved as soon as the rapid advance in the art makes possible practical attempts.

As a particular embodiment of my invention serving to more fully set forth the same, I will herein specifically describe and show the essential parts in an aeroplane in the accompanying drawings, in which:

Fig. I is a plan view of a section of the front portion of the fuselage of an aeroplane with engine and propeller.

Fig. II is a section at II—II, Fig. I.

Fig. III is a perspective of the propeller pitch control sleeve.

Fig. IV is a vertical section of the front portion of a fuselage showing in part the propellers and also the engine and other mechanism.

Fig. V is a front view of the fuselage, propellers being omitted.

Fig. VI is a view of the pressure-maintaining apparatus, in part section.

Fig. VII is an air supply mechanism apparatus, part in section.

Fig. VIII is an end view of the motor at section VIII—VIII.

My invention is intended to meet the problems presented by the conditions above indicated. While men could not live, nor engines operate under water without protection and without constructions and arrangements which have made the present submarines possible, the basis of my invention will lay the foundation for the construction of aeroplanes in which men can live and operate without inconvenience, and engines and other apparatus can suitably operate at high altitudes and under the severe conditions imposed by the rapid development in the use of flying machines.

I provide an enclosure in the fuselage, or have the fuselage completely enclosed, to be airtight, and by means of regulated air supply, provide a substantially normal density of air to be maintained at all levels. Internal pressure of the air surrounding the aviators may be automatically kept at constant pressure from the sea level to the highest obtainable altitudes, with ventilation and maintenance of accustomed temperature. This may involve the use of compressed air or oxygen, for emergency or otherwise. The engine or such parts as required may be maintained subject to the normal or constant pressure and temperature, as well as, for instance, the carburetor or mixture inlet for the internal combustion engine. By means of a diaphragm regulated air supply, a pump operated by the engine can be controlled to pump outside air into the closed space, which can be thus regulated to afford ample air for occupants and engine, while in cases it may be desirable to use separate means for air supply for the occupants and the engine. While the exhaust would be in the rarified medium, proportioned to the altitude of flight, the difference of pressure at the carburetor and air resistance to the exhaust will involve increased efficiency of the engine and may involve changes in dimensions with the development of motors, for the particular purpose.

Various other features will coordinate the main factors changed to meet the extreme conditions in the problem involved, which in part will be referred to hereafter. Among these may be mentioned the use of a keel to nullify the gyroscopic effect or tendency for the reaction on the fuselage which may be accentuated by giving the keel an adjustable or variable position.

In the drawings, the fuselage 1, shown in part in Fig. I, in horizontal section on the axis of the motor shaft, has an engine 2 located in front, partitions 3, abutting a bulk-head 4, with seats 5 and 6, the rear of the fuselage shown broken away, being enclosed to leave any desired space for operators or passengers. The hatch 7 may be in any suitable place for convenience for ingress and egress, and secured in a manner and by means proper to meet the conditions of pressure involved. The bow 8 of the fuselage, shown in the particular form as containing and housing the engine, is separated from the occupant's compartment by the bulk-head 4, which is cut away, or has openings at 9, to permit passage of air and exhaust from the engine compartment rearward. The exhaust is deflected by the partitions 3—3, and is passed out of the sides through suitable openings in the skin or shell of the fuselage, at 10, as indicated by the arrows. A suitable airtight or semi-airtight joint 11, would serve to prevent leakage of air through the shaft opening in the bulkhead, so that the loss of air from the closed chamber would be only through the carburetor and into the engine, unless the air for the carburetor is drawn from the outside by carrying the supply pipe to a suitable position, or by having a separate air pump for the engine supply, in which case the occupant's compartment would have air regulation to suit their requirements, and the requirements for leakage or otherwise. I may embody a keel 12, which may be formed in the shell or skin of the fuselage, or might be a dependent compressed air tank, should such be used and require replacement, in which case their attachment on the outside affords a convenience, or their attachment to a separate compartment open to the outside and separated from the closed occupant's compartment, except for the air pipe connection, will in cases afford advantages for convenience and safety.

The engine 2, has the six cylinders 13—13, which have their axes parallel to the main shaft, each having a small crank shaft housed in the projections 14, with a bevel pinion 15, while the bevel pinions of all the cylinders engage with the stationary bevel gear 16, as shown in Figs. IV and VIII. In this arrangement the stationary gear 16, affords a reaction for the bevel pinions on the cylinders, thereby turning the cylinders around the axis of the main shaft, to which shaft they are attached by framing 17—18, thereby driving the shaft by the reaction of the pinions on the stationary bevel gear. The form of engine shown, and its internal construction, is more particularly described in my application for Letters Patent, Serial No. 63,710, filed November 27, 1915,—but any suitable engine may be used to meet the conditions of space that may be involved in any particular aeroplane.

The engine, as shown in Fig. I, has the cylinders supported by brackets or framing 19—20, holding the cylinders 13, stationary, and in this arrangement the reaction bevel gear 21, is mounted on the drive shaft which turns in suitable bearings, thereby driving the propeller shaft by the bevel gear.

The drive shaft in either case is hollow, and has openings 22 to permit the explosion mixture to pass into the supply manifold 23, or, as shown in Fig. IV, to pass directly into the respective cylinder inlet ports. The mixture passes from the carburetor, not shown, into the supply box 24, which is stationary, and by suitable airtight joints affords the proper connection to the hollow shaft or the port passage through the shaft. Any suitable means of engine regulation may be used, as well as various other details. The exhaust from the cylinders, in the construction shown in Fig. I, is at 25, while in the arrangement shown in Fig. IV, when the cylinders revolve, the exhaust may be located only on the outer semi-circle of the cylinders, since the exhaust is aided by the centrifugal force. The exhaust emitted into the engine chamber will, by the action of the air currents, be carried through the openings 9, in the bulk-head 4, and through openings 10 in the skin or shell, will pass away. The relation of parts owing to variation in dimensions, may obviously be such that the exhaust will be carried out in a varying manner, the proximity of the bulk-head, or the presence of several bulk-heads being a matter of individual design, when the particular requirements of any proposed construction are met.

A compressed air or oxygen cylinder 26 may be located in the keel, or any other suitable place as shown in Fig. IV, and has a controlling valve comprising the connecting pipe 28 and the valve 27, and the automatic valve 29, attached to the diaphragm 30, which diaphragm is actuated by change of the relative pressures in the compartment and the outside air, one side of the diaphragm being open to the one pressure, and a pipe 31 communicating to the other side of the diaphragm the pressure of the other medium.

When flying at those altitudes at which it is desired that the device should act to maintain the normal pressure in the compartment, the diaphragm will be subjected, upon the inside, to the normal pressure communicated from the compartment and, on the outside, to a lesser pressure owing to the rarefication of the atmosphere depending to a greater or less degree upon the altitude of the machine and owing to the superior force acting upon the inside the diaphragm will be held tense or biased and in position to allow the valve to maintain itself in closed position. As will be obvious, the superior force upon the interior of the diaphragm will be supplemented to some extent by the backing spring shown acting upon the valve stem and capable of adjustment as to its force by the adjusting screw working in the rear end of the barrel carrying the spring.

Upon decrease of the normal pressure within the compartment due to leakage or otherwise, it is obvious that the lessening of the pressure against the inside of the diaphragm will result in the movement of the same in a direction to shift the valve so as to open the same and allow air under pressure to be supplied to the compartment until the normal pressure is attained. When this has been reached the diaphragm will be again moved to cause to flex in a direction opposed to the external pressure upon it and so that the valve may move back to the position shown under the influence of the backing spring or otherwise and the supply of air to the compartment will be cut off.

It is obvious that the movement of the diaphragm in a direction to open the valve when the pressure in the compartment falls below normal is assisted by the pressure of the rarefied atmosphere upon the external face thereof and to a less degree of course when the machine is flying at increased or very high altitudes where the rarification of the atmosphere is greater. Hence a greater fall of normal pressure within the compartment might be required before the valve will open. The adjusting screw acting upon and compressing the spring affords an adjustment of the action for this change since, by turning back the screw and lessening the pressure opposing the restoration of the diaphragm towards normal position, the lessening of the pressure on the exterior of the diaphragm will be compensated.

As shown in Fig. VI, an air pump 32, driven by suitable connection 33, from the engine shaft, or by an independent engine, pumps air through the valve 34 into the pipe 35 leading to the closed compartment, the passage of air being made possible when the diaphragm 30 moves upward a predetermined amount, due to reduction in pressure on the upper side of the diaphragm which is open through the passage 36 to the closed chamber. When in the position shown in Fig. VI the air supply to the closed chamber is cut off and the pump or fan 32 pumps through the passage 37, and the by-pass valve 38, and pipe 39, back into the atmosphere outside the shell. Valve 40 serves to voluntarily close the by-pass pipe.

The driving means of the aeroplane is the propeller, the blades 41 of which are rotated by the shaft 42, supported in the bearings 43—44, and driven by the motor 2.

The propeller shown is a variable pitch propeller, and in Fig. I it is illustrated with the blades in a position of maximum pitch, with dotted lines to show the minimum pitch position, while in Fig. IV the blades are shown in a position of intermediate pitch. While the propeller is of variable pitch, the variation in pitch may be changed while the aeroplane is in flight, by means of gradual change entirely accessible and capable of operation by the operator while controlling the aeroplane. This is accomplished in the particular form shown, by having the blades of the propeller supported by one edge, part way out from the hub to the tip, by wheel structure 45, the rim of which is secured to the edge of the propeller by a hinge or other suitable joint, and the hub of which is affixed to or integral with the shaft 42. The other edge of the propeller blades is attached to another wheel structure 46, having a hub 47 which is slidable on the shaft from the position shown in Fig. I, to the dotted position there shown, and when slid or moved longitudinally on the shaft it is also rotated slightly so that the hinged connection between its rim and the edge of the propeller blade 41, moves the edge of the blade slightly rotarily and longitudinally, to change the inclination of the blades with respect to the axis of the shaft, or, in other words, to change the pitch of the propeller. The particular means of effecting such change of pitch is more particularly described in my separate application Serial No. 63,710 filed November 27, 1915, and therein claimed.

The combination of a variable pitch propeller adjustable during flight, is so interrelated with other features of the invention herein described, that the combination of the correlating or cooperating functions effected by the combination of such propeller with the other elements, will be herein claimed.

The method of operating the change of pitch by movement of the hub 47, involves the sliding of the hub by means of lugs 48, with helical feathers 49, on a shaft bolt 50, moved by the adjusting rod 51, actuated by the lever 52, with suitable fixed fulcrum and collar engaging the end of the rod 51, while the handle of the lever is held in any desired position of adjustment by means of the sector 52^a and the pawl 53, symbolically shown, or any other suitable means of lever locking. While the shaft 51 passes through the hollow centre of the driving shaft 42, which forms a passage for the explosive mixture, a collar and airtight joint 54, are provided as a stop for the gases, while still permitting, by a suitable joint, the reciprocation of the rod 51.

The form of variable pitch propeller and adjusting means shown, is, generally speaking, the same as that covered by the separate application above cited, except that in the other application two hubs of the blade supporting wheels are shiftable, whereas in this application one of said hubs is rigidly attached to the shaft, and the other hub and blade supporting wheel 46 is shiftable alone, thereby simplifying the construction and adjusting means. The blades 41 in the present case, are attached at their hub into a hub on the drive shaft substantially in the same transverse plane as that passing through the swivels or joints connecting the edge of the propeller blades with the rim of the fixed supporting wheel.

By providing the main rotative supports for the blades some distance away from the shaft or midway between the hub and blade tips, so that the necessary blade strength to transmit the driving torque is away from the hub, it is possible to cut away the inner end of the propellers, as shown at 55, and likewise minimize the size or diameter of the shaft and hub parts, so that air will flow past the propeller immediately around the shaft, thereby admitting air to the engine space through the openings 56, for purposes of cooling the engine and to form a current to carry off the exhaust in an advantageous manner. Such arrangement of blades likewise permits the elimination of a bulk of material at the hub where its linear rotary velocity is ineffective for propelling purposes, and, on the other hand, affords a strong rotary support at a point approaching the centre of resistance of the propeller blade, and in any event at a radius far greater than can be made effective by any support in the nature of an ordinary hub, or, in other words, a hub now usual in practice.

While describing a particular embodiment of construction and combination, the nature of my invention is of such a character that a wide variation and numerous changes and modifications may be made, and would of necessity be made in designing different sizes of aeroplanes and aeroplanes intended to be of maximum efficiency under specific conditions of use.

The completely closed space while forming a protection for operators or passengers, will, of course, have suitable windows, and may have trap doors for purposes of manipulation and operations which might be found essential in flight. In larger sizes, such as aeroplanes of great horse-power which are this day contemplated, separate space for engines and engine tenders would require the complete enclosing of the engine, or all such parts as require attention by the engineer, as inspection of bearings, adjustments of parts, while in operation and constant watching. Furthermore, the complete enclosing is desirable where oiling operations have bearings or other parts that will be influenced by variation in air pressure.

With the contemplated development of aviation, the rising to heretofore unnegotiated altitudes will involve material reduction in air resistance permitting proportionately increased speed, provided the propelling power can be made effective. To make the propelling power effective involves the fact that with the rarer medium at high altitudes, the resistance of the air for reaction of the propeller blades would be reduced, and to offset this the pitch of the propeller blades will, with the same engine speed or propeller shaft speed, proportionately increase the driving effort of the propeller. Furthermore, with the rarer medium, in high altitudes, the speed of the aircraft must be increased in order that the upward reaction on the planes or wings of the machine, will be sufficient to sustain the aeroplane at the desired altitude. By my invention the combination of means for increasing the propelling effort at will of the operator, in an aeroplane capable of being operated at the high altitude where such compensation becomes necessary, will, it can now be seen, give results which in a sense are the solution of the extreme altitude flight, and accordingly permit high increase in speed, and as well the increased speed with the same engine power by making the power of the engine more effective in the rarer medium, where the resistance to the aeroplane is proportionately reduced.

It is unnecessary in the drawings showing a particular embodiment, to illustrate the planes or wings, as these may be of great variety, and in design, form and extent will conform to proven practice, and conditions that may hereafter develop. On the other hand, extremely light aircraft may be used, and in the general shape as shown in my application, a craft approaching the point of buoyancy might be designed to embody some of the features of my invention or the combination of some of the elements, although my invention is more particularly intended for heavier-than-air machines.

While increased propelling effort may be attained by increased engine and propeller speed, reliability of the engine being the first desideratum, attempts to vary engine speed are relatively impractical, and, furthermore, if increased excessively introduce elements of gyroscopic effect, as well as other objections, so that thought along such lines has indicated a lack of possibility for the solution of high altitude flight.

The gyroscopic effect, however, may be involved to some degree in the extreme development of the aircraft for which my invention is applicable, and a keel formed on the bottom of the fuselage may be used to offset this action, while other means of compensation can likewise be applied.

Various modifications and developments in detail will be made in the future embodiment of my invention, without departing from the spirit of the invention herein claimed. The shape of the fuselage, as illustrated in this embodiment, is in section of stream line or fish-shape, with an engine and engine mounting permitting the same, which has its advantages compared with the shapes heretofore used in some cases of which the advantage of shape is offset by arrangement of motor or a large bow resistance due to bulky construction of propeller centre or engine attachment, or in many other ways.

Without limiting myself to the particular embodiment herein shown and described, what I claim and desire to secure by Letters Patent is:

1. An aeroplane adapted for flying in high altitudes having an air-tight enclosed space for the aviator, a diaphragm exposed on the one side to the air pressure in said enclosed space and on the other or external side to the pressure of the surrounding atmosphere, means controlled by said diaphragm for maintaining constant pressure of air within said space and manual means for adjusting the action of the diaphragm to compensate for changes of altitude and pressure on the external face thereof.

2. An aeroplane adapted for flying at high altitudes having an air-tight enclosed space for the aviator, a valve controlling the admission of air to said space, a diaphragm subjected to the opposing pressures of the air within the space and the surrounding atmosphere and a spring acting on said diaphragm and manually adjustable to compensate for variations in the pressure of the surrounding atmosphere with changes of elevation.

3. An aeroplane adapted for flying in high altitudes having an air-tight enclosed space of a size sufficient to house and permit freedom of movement of the aviator and containing the controlling mechanism for the aeroplane, a valve controlling the admission of air from the exterior to the enclosed space, a diaphragm subjected to the opposing actions of the air within the space and the surrounding atmosphere for controlling the action of the valve and means for adjusting the action of the diaphragm to compensate for changes of altitude and pressure on the exposed outer face of the diaphragm.

4. An aeroplane adapted for flying in high altitudes having an air-tight enclosed space for the aviator and for the engine controlling means, an engine forward of said space and separated therefrom by an air-tight wall, a hollow engine shaft communicating with the enclosed space and means for supplying a combustible mixture to the engine through said hollow shaft.

5. An aeroplane adapted for flying in high altitudes having an air-tight enclosed space for housing the aviator and containing the controlling mechanism for the aeroplane and the carburetor of the engine while the exhaust and moving parts of the engine are exterior to said enclosed space and exposed to the atmosphere and a valve controlling the passage of air to said enclosed space for maintaining a constant pressure therein, a diaphragm controlling the action of said valve exposed on the one side to the internal pressure of said space and on the other to the action of the surrounding atmosphere and means for regulating the operation of the diaphragm for changes of altitude and pressure upon the outside thereof.

6. In an aeroplane adapted for flying in high altitudes, an air-tight enclosed space for the aviator, an engine forward of said space and mounted upon a hollow shaft, a variable pitch propeller having an axis of rotation coincident with that of the engine and means passing through said hollow shaft and controllable in the enclosed space for adjusting the pitch of the propeller.

7. In an aeroplane adapted for flying in high altitudes, an air-tight enclosed space for the aviator, means in said space for maintaining a constant air pressure therein independent of the speed of the aeroplane, a propeller, means for varying the action of said propeller to make effective the propelling power applied thereto by increasing the reaction of said propeller on the enveloping air, an engine mounted on a hollow shaft forward of the enclosed space and carrying

said propeller and means passing from said enclosed space through said hollow shaft for regulating the adjustment of the propeller.

8. An aeroplane adapted for flying in high altitudes comprising an air-tight enclosed space for the aviator and means for maintaining a constant pressure of air therein, an engine forward of said space and exposed to the action of the air surrounding the machine as it flies and separated from said space by a wall, a propeller mounted on the engine shaft co-axially therewith, a hollow shaft mounted in said wall and means enclosed in said shaft and connected with the propeller at one end and with operating means within the enclosure at the opposite end for regulating the reaction of the propeller upon the enveloping air.

In testimony whereof, I have signed my name to this specification, in the presence of two subscribing witnesses, this 10th day of December 1915.

SAMUEL D. MOTT.

Witnesses:
HERMANN F. CUNTZ,
H. MUCHMORE.