B. KOLEROFF.

PROPELLING APPARATUS.

APPLICATION FILED MAY 24, 1919.

1,362,997. **Patented Dec. 21, 1920.**

FIG. 1.

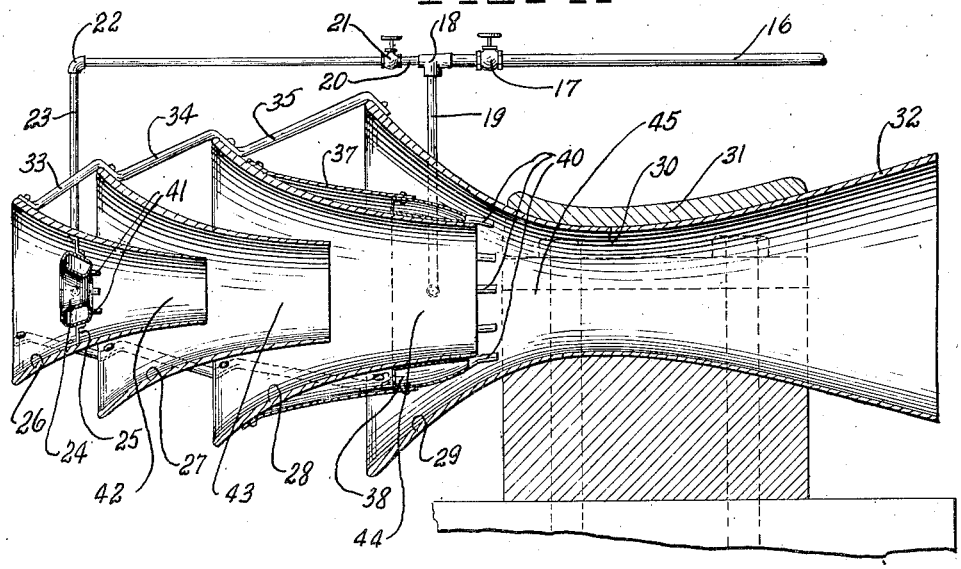


FIG. 2.

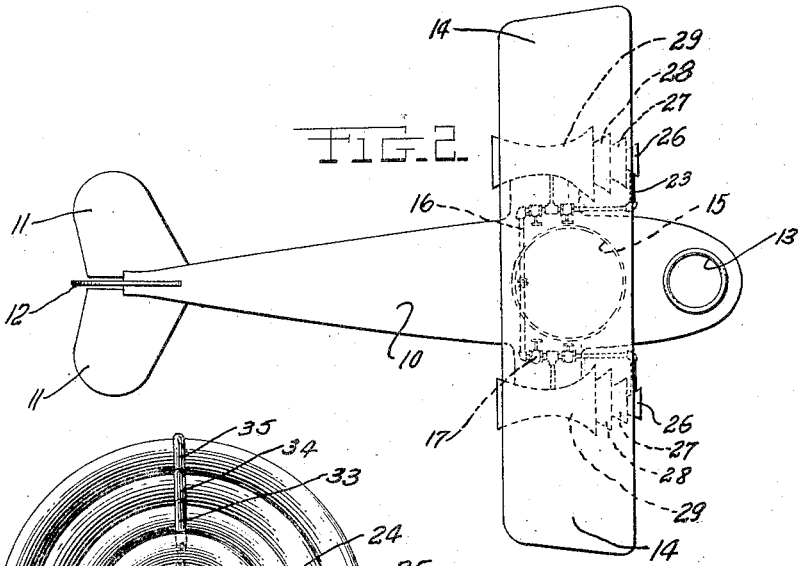
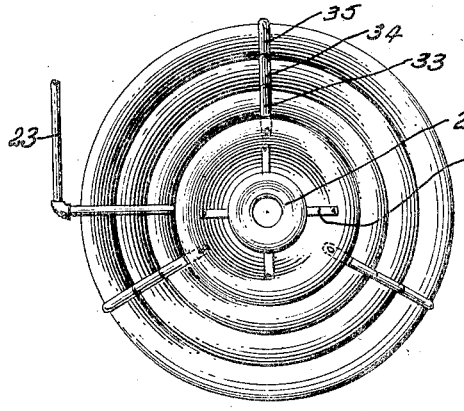


FIG. 3.



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UNITED STATES PATENT OFFICE.

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PROPELLING APPARATUS.

1,362,997. Specification of Letters Patent. Patented Dec. 21, 1920.

Application filed May 24, 1919. Serial No. 299,622.

To all whom it may concern:

Be it known that I, BORIS KOLEROFF, a citizen of the Russian Republic, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Propelling Apparatus, of which the following is a specification.

This invention relates to the application of a new principle in the propulsion of flying machines, this principle consisting in utilizing the reaction generated by jets of a gaseous substance discharged from the apparatus through specially provided nozzles, this reaction being increased by proper entrainment of the outside air.

The entrainment of the air prevailing within the apparatus by the jets of the gaseous substance is due to viscosity and is responsible for creation of a continuous vacuum in the apparatus. Because of this partial vacuum the outside air is drawn into the apparatus through specially provided guiding surfaces, which impart to the motion of the outside air a direction coinciding with that of the jets.

The addition of momentum of the outside air and the actuating jets of gas in accordance with the law of conservation of momentum will increase the total momentum of the discharged gas and air mixture and therefore will increase also the reactive force exerted upon the apparatus and equal to this momentum.

The energy required for the entrainment of air is supplied from the kinetic energy of the actuating gas jets discharged through the nozzles.

The apparatus does not contain any movable elements such as propeller, motor parts, etc.

This principle is embodied in the new construction, consisting in a combination of different parts, described below and shown on the accompanying drawings, forming the essential features of this disclosure and where—

Figure 1 is a longitudinal section view taken through a single motor element made in accordance with the invention.

Fig. 2 is a top plan view showing a conventional type of flying machine and indicating one of the possible applications of this invention.

Fig. 3 is a front view of the motor element shown on Fig. 1.

Referring to the drawing, a conventional type of flying machine is indicated generally by the number 10, the same being provided with horizontal rudders 11 and vertical rudders 12, while at the front is an observation chamber 13, wings 14, extending equally at both sides of the flying machine as is usual.

As one of the possible realizations of the invention in practice, the drawing shows the location of the two motor elements on both sides of the flying machine. Starting with the container 15, holding or generating gas, air, steam or any mixture of gaseous substances under high pressure, follows the pipe 16, regulated by the valve 17, this pipe being provided on its continuation with a tee 18, from which a branching off pipe 19 leads to the rear annular container 38 directly feeding the rear set of nozzles 40. The straight pipe 20 starting from the tee 18 is controlled by a separate valve 21 and ends in an elbow 22, from which a pipe 23 leads to the front annular container 24, having a stream line form, and feeding the front set of nozzles 41. The container 24 is located inside the front guiding surface 26 and fastened by brackets 25 at some distance from the outer end of this guiding surface, the remaining (inside) part of this surface forming the first mixing or entraining chamber 42. The front guiding surface 26 projects into the second guiding surface 27 to a certain depth of the latter, thus forming in the remaining (inside) part of the surface 27 the next mixing chamber 43. The mixing chambers 44 and 45 are formed in the same way by the narrow (inside) parts of the guiding surfaces 28 and 29.

All these guiding surfaces are succeedingly increasing in their dimensions, having a conical and slightly curved shape and being arranged substantially as shown on Fig. 1.

The last guiding surface 29, through its narrow end 30, provided with a suitable support 31, is directly connected with the diffuser 32.

All these guiding surfaces 26, 27 and 28 are rigidly connected by a plurality of support bars 33, 34 and 35 to the outer end of the guiding surface 29 in such a way that all these conically shaped surfaces have the same axial direction. The rear annular container 38, feeding the nozzles 40, is adjacent with its inside surface to the guiding surface 28 while its outer surface is connected at its

front end to an annular surface 37, shaped in such a way as to afford a smoother admission of air to the rear set of nozzles 40.

A plurality of strong jets of gas, discharged with great velocity from the rear set of nozzles 40, will entrain air by viscosity in the mixing chamber 45 and create there a continuous vacuum. This vacuum will be sustained also in all other mixing chambers 44, 43 and 42, which are directly connected with chamber 45. On account of this vacuum inside the apparatus the air will be drawn into it from the outside and will enter the mixing chambers 42, 43, 44 and 45 in an axial direction through spaces left between the guiding surfaces. The latter may vary in number. The air will be led toward the actuating gas jets, in a direction coinciding with these jets and will acquire a certain velocity and therefore also a momentum before being actually entrained by the jets. The momentum of the air, already drawn in by the action of nozzles 40, will still be increased through entrainment by the front set of nozzles 41. This increase of momentum will take place in all mixing chambers and the whole mass of air and gas with this increased momentum will enter the chambers 45. There a further increase will take place due to addition of momenta: 1st of the gas jets from the nozzles 40, and 2nd of the air drawn in between the guiding surface 29 and the annular surface 37, until finally the total mixture is discharged through the diffuser 32. A certain amount of kinetic energy is lost by the mixture while leaving the diffuser as it has to overcome the difference between the atmospheric pressure outside the apparatus and the vacuum inside of it, this amount being approximately equal to that acquired by the air before its entrainment by the gas jets. Therefore the loss of energy by the jets takes place only in the mixing chambers. This loss is due to the entrainment process (excluding the loss due to friction) and is determined by difference in velocities of the jets and entering air. The degree of vacuum in the apparatus and therefore also the velocity of the entering air, will depend upon the proper choice of dimensions for the mixing chambers.

The use of more than one set of nozzles (not necessarily two) will increase the velocity of the entering air. The use of the diffuser will serve the same purpose by increasing to a certain extent the vacuum in the apparatus.

As the velocity of the entering air increases, the difference in velocities between air and actuating gas jets will decrease, and as this difference decreases the efficiency of the apparatus will rise.

The principle of the apparatus as described above can be embodied in a number of different ways in practical construction. I have already stated that the number of nozzle sets as well as the number of guiding surfaces may vary. The body of flying machine itself may be constructed as a single large motor element, drawing in the air sidewise and discharging the mixture from the rear. Finally the guiding surfaces can be drawn out along the wings of the flying machine and the apparatus placed inside these wings. Accordingly the arrangement of nozzles may be changed from an annular to one in a straight line, with a suitable rearrangement of the guiding surfaces. In this case the wings would become the seat not only of a lifting force but of a forwardly directed thrust as well.

While I have explained the use of my invention in connection with a flying machine, it will be obvious that the apparatus may be employed for propelling other movable bodies, or for simply imparting motion to a body of air or other fluid, and I desire the term "propelling device" occurring in the appended claims to be given an interpretation broad enough to cover these various applications.

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

1. A propelling device comprising a plurality of tubular members arranged in tandem fashion and spaced at their adjacent ends to allow fluid to be entrained, and nozzles arranged to discharge jets within different members to act successively on the fluid passing through said members.

2. A propelling device comprising members presenting air guiding surfaces and inclosing a mixing chamber therewithin, and successively arranged sets of nozzles arranged in the direction of the axis of the apparatus, and means for causing a gas to be discharged through the said nozzles.

3. A propelling device comprising members presenting air guiding surfaces and inclosing a mixing chamber therewithin, and successively arranged sets of nozzles arranged in the direction of the axis of the apparatus, and means for causing a gas to be discharged through the said nozzles and a diffuser for discharging the final mixture into the atmosphere.

4. A propelling device comprising a plurality of tubular members arranged in tandem fashion and spaced at their adjacent ends to form an opening allowing fluid to be entrained, and nozzles arranged both in advance and in the rear of the said opening to act successively on the fluid passing through said members.

5. A propelling device comprising a series of annular air conducting members partially nested one within the other, annular

sets of nozzles arranged in tandem in said members, and means for discharging gas from said nozzles.

6. A propelling device comprising a series of longitudinally flared annular air conducting members partially nested one within the other with their large ends facing forwardly, a series of annularly arranged nozzles in the forward one of said members, a second series of nozzles arranged in a rear one of said members, and means for discharging gas from said nozzles.

7. A propelling device comprising a series of longitudinally flared annular air conducting members having their large ends facing forwardly, said members being partially nested within one another whereby a series of mixing chambers are formed at the rear of the various members, and means for introducing jets of gas into different ones of said members.

8. A propelling device comprising a series of longitudinally flared annular air conducting members having their large ends facing forwardly, said members being partially nested within one another whereby a series of mixing chambers are formed at the rear of the various members, and means for introducing jets of gas into different ones of said members the rear end of the rear one of said members being outwardly flared to form a diffuser.

9. A propelling device comprising a series of funnel shaped annular air conducting members nested partially one within the other said members being of progressively larger size from the front to the rear one thereof, an annularly arranged series of nozzles within the front member, an annularly disposed series of nozzles within the rear member, and means for supplying gas to each of said series of nozzles.

In testimony whereof I have affixed my signature.

BORIS KOLEROFF.