P. SKOUSES.

JET PROPULSION.

APPLICATION FILED JUNE 9, 1908.

982,540. Patented Jan. 24, 1911.

3 SHEETS—SHEET 1.

Fig. 1.

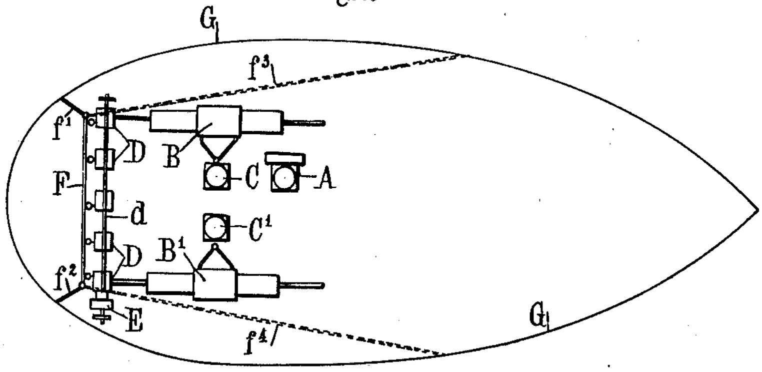


Fig. 8.

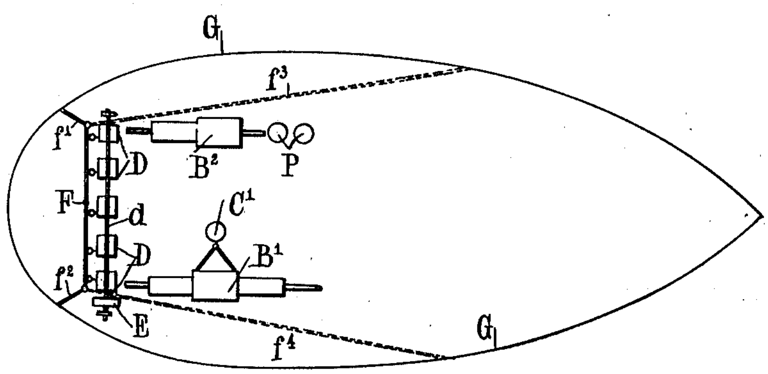
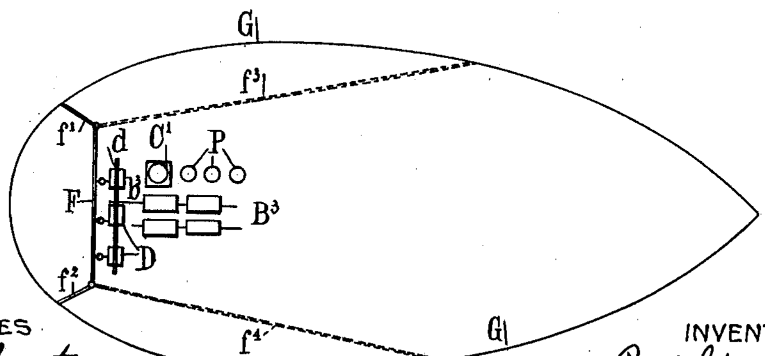


Fig. 9.



WITNESSES

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3 SHEETS—SHEET 2.

Fig. 4.

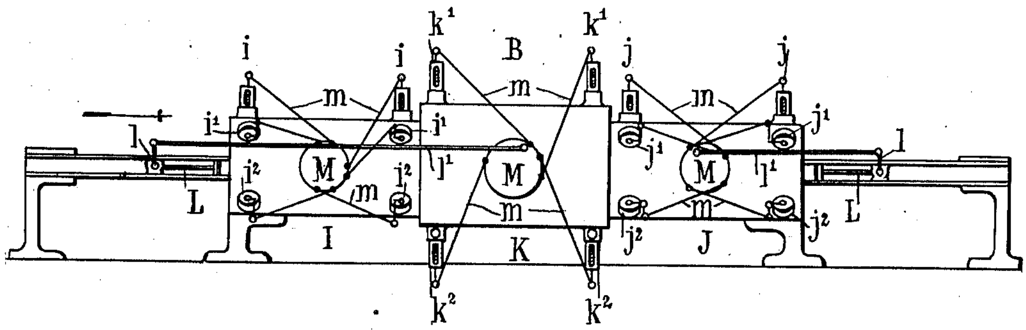


Fig. 2

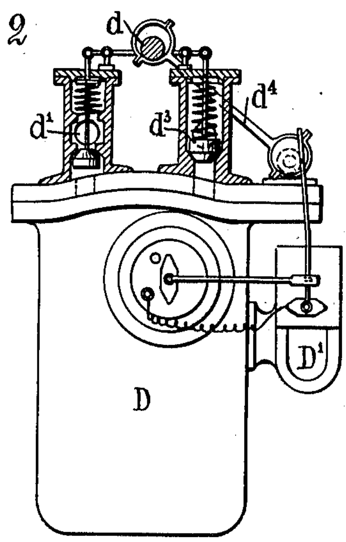
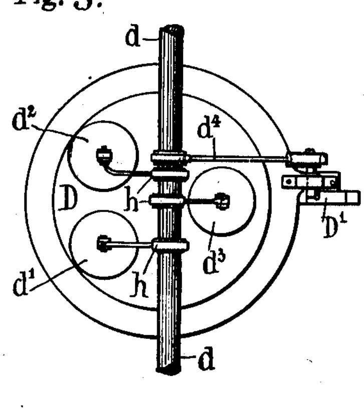


Fig. 3.



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3 SHEETS—SHEET 3.

Fig. 5

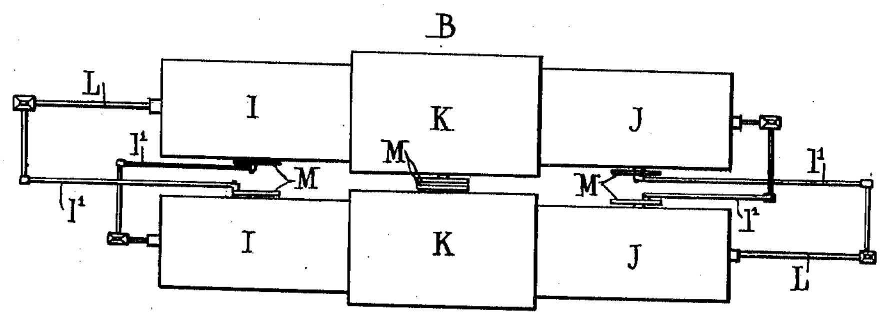


Fig. 7

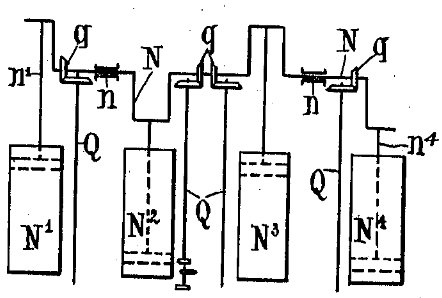


Fig. 7ᵃ

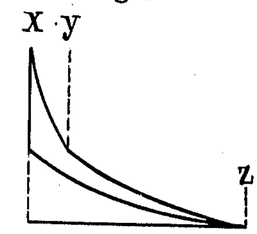


Fig. 7ᵇ

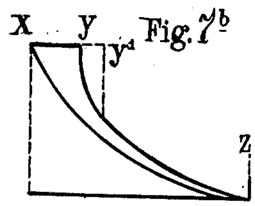
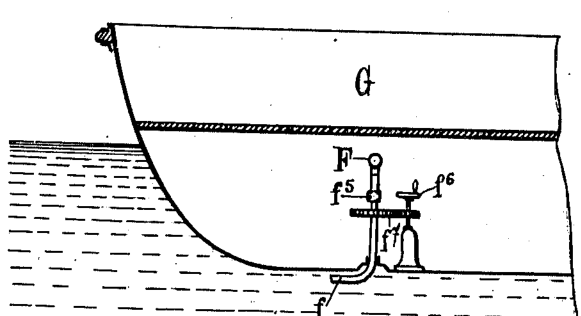


Fig. 6.



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JET PROPULSION.

982,540. Specification of Letters Patent. Patented Jan. 24, 1911.

Application filed June 9, 1908. Serial No. 437,727.

To all whom it may concern:

Be it known that I, PAUL SKOUSES, a subject of the King of Greece, residing in Athens, Greece, proprietor, have invented certain new and useful Improvements in Jet Propulsion, of which invention the following is a full, clear, and exact description.

The principle underlying the propulsion of navigable vessels by hydraulic reaction has been long known and numerous applications thereof have been made. In such applications the motive force utilized on the vessel works centrifugal or piston pumps which draw in water from the front of the vessel and expel it at the rear thereof and the reaction of this water as expelled into the sea produces the movement of the vessel. According to this invention, instead of producing this reaction by expelled water, the pressure derived from the explosion of gases is utilized therefor. Ordinary gas engines are worked by the pressure of the explosion of gas; in apparatus according to this invention however a motor that may be termed a gas engine ceases to work as such after the compression of the explosive mixture, the mixture after such compression being ignited and the compressed gases produced by the explosion discharged through suitable pipes into the sea, thus producing the reaction necessary to movement. In this way notable economy is secured. A vessel which, to move at a given speed, would require an engine of one hundred horse power would, under such conditions, only require an engine necessary to produce the compression of the mixture the work produced by the explosion of which would be equal to one hundred horse power, so that there are secured economy in price, weight and space occupied, besides the consequent increased facility of manipulation. Propulsion by reaction has other advantages; for example, a propeller screw is no longer necessary; a vessel so propelled can move with equal ease in either direction without the necessity of turning around in order to present its forward end to the direction of motion. By causing the gases to escape from two pipes, one on each side, the rudder may be dispensed with, a condition which, concurrently with the absence of the screw, obviates frequent causes of grounding. With such an engine moreover a vessel is capable of moving more readily from one position to another.

In order that the invention may be clearly understood reference will now be made to the accompanying illustrative drawings which show diagrammatically several constructional arrangements of apparatus embodying the invention.

Figure 1 is a diagrammatic plan view of a vessel adapted to be driven by the exhaust from an exploder; Figs. 2 and 3 are respectively an elevation and a plan of a battery of exploders; Fig. 4 is a diagrammatic elevation of a compressor motor having three cylinders mounted in tandem; Fig. 5 is a plan of a modified compressor motor comprising six cylinders; Fig. 6 is an elevation partly in section of a modified arrangement of reaction pipes; Fig. 7 is a diagrammatic elevation of a modified form of motor; Figs. 7^a and 7^b are diagrams of the work of the four cylinder motor shown in Fig. 7 and working respectively as an explosion motor and a Diesel motor; Fig. 8 is a diagrammatic plan of a vessel adapted to be driven by the exhaust from a hydrocarbon motor; and Fig. 9 is a similar view of a modified arrangement.

In the first arrangement, see Fig. 1, the motive force employed is the explosion of poor gas derived from a gas producer A and compressed by a motor gas compressor B into a gas accumulator C under a pressure of about 20 (twenty) atmospheres; a second compressor B^1 for air forces air at the same pressure into an air accumulator C^1. The explosion takes place in a battery of exploders D of which one is shown separately in Figs. 2 and 3. These exploders are fed with a mixture of gas and air from the respective accumulators C and C^1 through admission valves d^1 and d^2 respectively; the pressure of the mixture is reduced by means of suitable reducing valves to about six atmospheres and its composition consists of one part gas and five parts air. A motor E drives a shaft d which controls the distribution of air and gas to the exploders and, by means of the eccentric d^4, also drives the magnetos D^1 which ignite the mixture. The products of the explosion escape through the exhaust valve d^3 which is actuated by the same shaft d and enter the main or collecting pipe F which supplies the pipes f^1, f^2, f^3, f^4 (Fig. 1) through which the gases of the explosion are caused to react upon the water and produce the movements of the vessel. The pipes f^1, f^2, f^3, f^4 may be fitted with stop cocks or valves whereby they may be so controlled or combined as to obtain the different desired movements of the vessel G. When for example the tubes f^3 and f^4 are closed and the tubes f^2, f^1 are open the vessel will move forwardly and in the reverse case it will move backwardly; rotary movements are obtained by the combination of the tubes f^1, f^4, or f^2, f^3. It is thus possible to replace the rudder by these pipes, an arrangement which offers great advantages, since the rudder is a frequent and very prominent cause of serious accidents in navigation. The different exploders do not work simultaneously but one after the other. There is thus obtained a continuous action and shocks in the propulsion of the vessel are avoided. This successive action is obtained by the displacement of the angles at which the cams h, which work the valves of the exploders, are keyed on the shaft d, Figs. 2 and 3.

In place of the four tubes f^1, f^2, f^3, f^4, a single rotating tube f may be employed, see Fig. 6. This tube is connected to the main pipe F of the reaction gases, by a spherical joint or knuckle f^5 of well known construction, which does not in any way hinder the rotary movement of the tube f. This rotary movement is produced by gear wheels f^7 and a hand wheel f^6 which is actuated at will by the engineer. This arrangement also permits of the rudder being dispensed with and the different desired movements of the ship being obtained.

The motor compressor B, see Fig. 4, comprises three cylinders mounted in tandem; the two extreme cylinders I and J are motor cylinders and the middle cylinder K is a compressor cylinder. The motor cylinders I J are provided on each side with two admission valves i, i^1, j, j^1 for gas and air, and with an exhaust valve i^2, j^2 for the products of the explosion; the compressor cylinder K has only one gas or air admission valve k^1, if it is a gas or air compressor, and one exhaust valve k^2 for the gas or compressed air which passes to the accumulator. The pistons of the three cylinders I, J, K are mounted on a common piston rod L which has a to and fro rectilinear movement imparted to it. The phases of action are reversed in the two motor cylinders so that there is always a motor movement. Supposing for example, that the piston rod L moves from left to right, (see the arrow Fig. 4) if there is the admission into the left hand end of the left hand motor cylinder I, there will be compression upon the right hand face of the piston of the same cylinder, explosion and expansion in the left hand end of the right hand motor cylinder J and exhaust at the right hand end of such cylinder and conversely; in this way a flywheel may be dispensed with.

The method employed for operating the distribution valves of the cylinders I, J, K, is diagrammatically indicated in Fig. 4 where it will be seen that disks M are actuated by tappets l on the common piston rod and links l^1; valve actuating levers m connecting the disks M to the different valves. The starting of the motor compressor is effected by means of compressed air derived from the accumulator.

Fig. 5 shows a compressor motor B having six cylinders formed in two groups of three cylinders each mounted in tandem. Each group comprises two motor cylinders constituted by the outside cylinders I and J, and one intermediate compression cylinder K. The arrangement of the admission and exhaust valves in the different cylinders is the same as in Fig. 4 and in each group the pistons of the three cylinders in tandem are mounted, as hereinbefore described, on one common piston rod L. As the working phases in the motor cylinders are crossed there is always a motor movement per group of cylinders, or two movements per stroke, one in the opposite direction to the other.

The motor B shown in Figs. 4 and 5 may be arranged so as to avoid the use of the exploders. For this purpose it suffices to make the intermediate cylinders K motor cylinders and to admit an explosive mixture thereto. This mixture is fired and the products of the combustion escape immediately after the explosion to react upon the water without the intermediation of exploders; it is necessary that there should be in the cylinder a difference in the angles of keying of the unclicking tappets. The motors of this arrangement may likewise work on the principle of gas motors or else according to the principle of Diesel motors.

Another arrangement for avoiding the use of exploders is indicated diagrammatically in Fig. 7. It comprises a motor composed of four cylinders N^1, N^2, N^3, N^4 the pistons of which act upon a common shaft N which is mounted to rotate in bearings n. This shaft is cranked for the cylinder piston rods at the middle N^2 and N^3 and at its extremities, it is provided with cranks connected to rods n^1 n^4. Q are the distribution rods of each cylinder worked by the main shaft N through gearing q. The angles at which the cranks are keyed are such that the four strokes succeed each other symmetrically in the four cylinders. Fig. 7 shows the cylinder N^1 at the end of its suction stroke, the cylinder N^2 is at the end of its compression stroke, the cylinder N^3 at the end of its expansion stroke and the cylinder N^4 at the end of its expulsion stroke. The dimensions of the fly wheel may thus be reduced to a minimum. The motor shown in Fig. 7 may work according to the principle of either explosion motors, combustion motors, or Diesel motors.

Fig. 7^a is a diagram of the four cylinder motor of Fig. 7 working after the principle of explosion motors. This diagram differs from that of an ordinary explosion motor, in that the exhaust valve is opened by means of the distribution rod, immediately after the explosion. From x to y there is a sudden fall of pressure, the gases issuing from the cylinder to exercise their pressure upon the water. At y the valve will be closed and the pressure reduced to such a value that it can accomplish sufficient work to compress the explosive mixture in the cylinder where compression takes place and to overcome the passive resistances. The expulsion of the gases takes place on the fourth stroke by another exhaust valve likewise worked by the distribution rod and communicating with the atmosphere.

Fig. 7^b shows a diagram of the motor working on the principle of Diesel motors; the arrangement is analogous to that just described.

In the second arrangement, see Fig. 8, the explosive gases are derived from some suitable hydrocarbon, such as petrol for example, contained in reservoirs P and forced by a petrol compressor B^2 into the exploders D at a pressure of 30 (thirty) atmospheres. The exploders are previously filled with air at the same pressure derived from an air accumulator C^1 which is fed by an air compressor B^1. As, at the pressure of 30 (thirty) atmospheres petrol ignites automatically, the exploders are not fitted with magnetos. The distribution of fluid to and from the exploders is effected as in the first described arrangement.

The third arrangement, see Fig. 9, is much simplified. Air derived from an air accumulator C^1 enters into petrol reservoirs P at a pressure of 6 (six) atmospheres and is then delivered by means of injectors into the exploders D where explosion is caused by means of magnetos; the use of a petrol compressor is thus dispensed with. The pressure of the air in the accumulator C^1 may be from 50 to 60 (fifty to sixty) atmospheres and it is reduced by suitable reducing valves. Furthermore, the use of a motor E employed in the preceding arrangements is also dispensed with and the shaft d which operates the distribution valves of the exploders is actuated by a rack b^3 on the rod of the air compressor B^3. This air compressor is a duplex compressor with four motor cylinders and two compressing cylinders.

Apparatus embodying the principle upon which the arrangements hereinbefore described are based may also be applied to submarine boats and to the propulsion of automobile torpedoes, such propulsion being obtained by the reaction of the exploded gases.

For the purpose of obtaining gases in a compressed form without the use of compression machines there may be employed carbid of calcium to which is added, for the purpose of furnishing the atmospheric air required by the explosive mixture, oxylith yielding pure oxygen, which is preferable to air. At the moment of launching the torpedo, or when it is desired to move the submarine, it suffices, to produce the reaction, to put the necessary water into the compartment containing the mixture of carbid of calcium and oxylith in suitable proportions. As is heretofore known that to regulate the speed of this reaction of the carbid of calcium and the oxylith, saccharose can be added to the first and soda to the second of these ingredients. In such an arrangement the torpedo has not to carry any motor mechanism but only the pressure regulator, thereby increasing the simplicity of the torpedo construction and facilitating its easy manipulation.

Finally the same principle of reaction by the explosion of explosive gases can also be applied to aerial navigation by the aid of aerostats which would work like rockets, and to the raising of water, and to any other application of compressed air.

What I claim is:

1. In driving means for vessels, a plurality of explosion chambers, independent accumulators for gas and air with passages leading to each of said chambers, means for compressing gas and air in said accumulators at a relatively high pressure, and means for admitting said gas and air at reduced pressure to said explosion chambers, in combination with a common exhaust passage into which said chambers open and forwardly and backwardly directed passages branching from said exhaust to the exterior of said vessel, substantially as and for the purpose described.

2. In driving means for vessels, a plurality of explosion chambers, independent accumulators for gas and air with passages leading to each of said chambers, means for compressing gas and air in said accumu-

lators at a relatively high pressure, and means for admitting said gas and air at reduced pressure to said explosion chambers, in combination with a common cam shaft controlling the inlets to said chambers, a common exhaust passage into which said chambers open and forwardly and backwardly directed passages branching from said exhaust to the exterior of said vessel, substantially as and for the purpose described.

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

PAUL SKOUSES.

Witnesses:

LOUIS HEINOIS,

PAUL ARCHICON.