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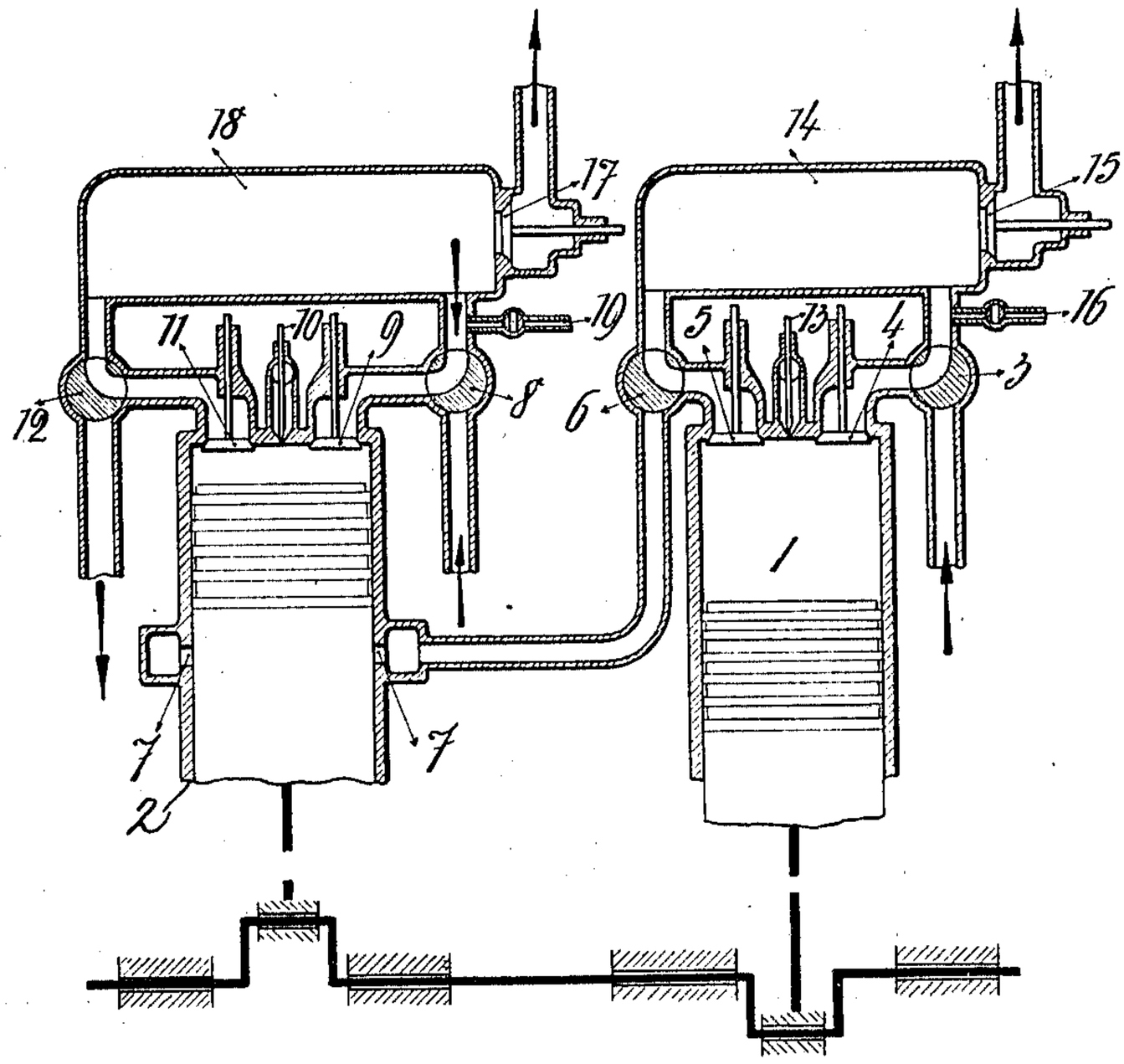
COMBUSTION ENGINE PLANT FOR SUBMARINE CRAFT.

APPLICATION FILED NOV. 9, 1906.

970,153. Patented Sept. 13, 1910.



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COMBUSTION-ENGINE PLANT FOR SUBMARINE CRAFT.

970,153. Specification of Letters Patent. **Patented Sept. 13, 1910.**

Application filed November 9, 1906. Serial No. 342,757.

To all whom it may concern:

Be it known that I, PAUL WINAND, engineer, a subject of the King of Belgium, resident at 1 Sudermannstrasse, Cologne-on-the-Rhine, Germany, have invented certain new and useful Improvements in Combustion-Engine Plants for Submarine Craft; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

In submarine boats it is important in order to save room and weight to produce the power required by means of an engine having the smallest possible dimensions.

Inasmuch as, for operating combustion engines during submersion of the boat, the atmospheric air is replaced by oxygen or by substances rich in oxygen which are kept or prepared under a pressure higher than that of the atmosphere, there is advantage in using engines working on the two-stroke cycle or engines working on the four-stroke cycle in the cylinders of which greater combustible charges are introduced than correspond to the amounts taken by the cylinders under atmospheric pressure. In this way a greater power than with the ordinary four-stroke cycle engine is obtained and furthermore the air pump, otherwise needed for introducing the required amount of air, is dispensed with since the required substances are taken from their receivers under pressure. When working at the surface, and therefore with atmospheric air, some of the cylinders of such an engine are used in carrying out my invention as air pumps for feeding to the other cylinders the amount of air required and the use of special air pumps is thus dispensed with. In this case the power required is usually less than when working during submersion.

It is true that a four-stroke cycle engine might be operated without an air pump, the air being drawn in from the atmosphere directly by the pistons of the engine; in such a case however the pressure due to compression would be less and the economy of fuel less than when using some of the cylinders as air pumps. Moreover the power obtained would be less since the cylinders used as pumps will take in air at every revolution while in the working cylinders the pistons will likewise draw in air in the usual fashion. As compared with one of the ordinary kind, an engine working as above described, that is with a larger charge than that which would fill the cylinder under atmospheric pressure works with less economy of fuel, although with more power, if the pressure of the compression is the same in both. Now as the power needed for cruising speed is considerably less than that for the speed required in action, I arrange some of the cylinders to work in the ordinary way with a high rate of compression and with the best economy attainable, in order to use them at cruising speed as well when running during submersion as when running at the surface. The other cylinders are arranged to work as above with a larger charge, filling the cylinders at a higher pressure, and they are used for obtaining a higher rate of speed. When running during submersion both this set of cylinders and the other set may be working at the same time and thus the highest rate of power and of speed may be obtained if desired. When running at the surface *i. e.* with air, the cylinders of the first set, or some of them, are used as air pumps for the other set, when a higher rate than the cruising speed is desired. The power thus attainable is naturally less than that attainable when working under exclusion of the atmospheric air. This however is an advantage as a high rate of speed is not practicable with a submarine craft running at the surface.

In applying this method to engines working on the two-stroke cycle, special air pumps may be needed when working with atmospheric air if it is desired to reduce as much as possible the difference between the power attainable at the surface and that attainable when during submersion, because for a given size of cylinder the amount of air needed is twice as large as for cylinders working on the four-stroke cycle. Nevertheless there will generally be an advantage in using besides the special air pumps some of the cylinders as air pumps. It will also be of advantage to have as above one set of the cylinders operated with a pressure of charge before compression equal or nearly equal to the atmospheric pressure, in order

to use them with the best economy for the cruising speed and to have another set of cylinders operated with a pressure of charge higher than the atmospheric to be used for obtaining higher speeds. When working at the surface the first set is supplied with air by a special pump for the cruising speed, while the other set is not in operation. For the highest speed the other set is supplied with air furnished simultaneously by the first set, which then act as air pumps and by the special air pump. The latter is thus assisted in its action by the first set of cylinders of the engine.

The accompanying drawing illustrates the application of my invention to a combustion engine of the four cycle type.

At full output and when working with air, cylinder 2 serves as the working cylinder and cylinder 1 as the air pump or charging pump. In such case, the piston of cylinder 1 draws in air through the two-way cock 3 and the valve 4, and, on the return stroke, forces it through the valve 5 and two-way cock 6 to the cylinder 2, into which it enters through the ports 7, when the piston of cylinder 2 approaches the outermost limit of its stroke. In the meantime, the piston of cylinder 2 has drawn in air through the two-way cock 8 and valve 9, which air at this juncture fills the cylinder, under atmospheric pressure. To this air is added that which is forced in through the ports 7 by the piston of cylinder 1, so that the cylinder 2 is filled with air under a pressure higher than that of the atmosphere. The combustible enters through the valved port 10 either simultaneously with or later than the air, and the exhaust gases escape from the cylinder 2 through the valve 11 and two-way cock 12. At decreased output, the cylinder 1 may alone operate. This is effected by reversing the two-way cock 6 and admitting the combustible through the valved port 13. The exhaust gases will then escape through the receptacle 14 and valve 15.

At full load, and when atmospheric air is excluded, both cylinders serve as working cylinders. At decreased load, either the one or the other cylinder may serve as the working cylinder. In the latter case, for instance, cylinder 1 may serve as the working cylinder while cylinder 2 runs entirely idle. In this event, oxygen is admitted through the pipe 16 and receptacle 14; the cock 6 is so set that residual gases from the cylinder may enter the receptacle through the valve 5, and the cock 3 is so set that a mixture of residual gases and oxygen may enter the cylinder from the receptacle through the valve 4. A portion of the residual gases is not returned to the cylinder, but escapes through the valve 15, which is so loaded that the cylinder 1, after the suction stroke, is filled with a mixture having atmospheric pressure, which takes the place of the air that would otherwise be drawn in. For increased output, the cylinder 2 is brought into operation, and its mode of operation is entirely analogous to that of cylinder 1.

The loading of the valve is, of course, so chosen, that the mixture of residual gases and oxygen, admitted through 8 and 9, at the end of the outstroke of the piston, fills the cylinder at the same pressure as that of the air when the cylinder was working with air.

It will be understood that the specific construction of the individual parts *per se* shown in the drawing, is not claimed herein, but only the general combinations set forth in the claims, the specific construction of the individual parts being presented in the drawing merely as illustrative of many others that might be employed for the same purposes in the combinations claimed.

What I claim is:

1. A combustion engine plant for submarine craft, comprising a multiple cylinder combustion engine, a pressure receptacle for storing under pressure an artificial oxygenating element, connections for establishing and cutting off the supply of such artificial oxygenating element to the explosive charge, and connections for admitting atmospheric air to one of the multiple cylinders and for pumping it therefrom into the charge of the other cylinder; substantially as described.

2. A combustion engine plant for submarine craft, comprising a multiple combustion engine, a pressure receptacle for storing under pressure an oxygenating element, connections for supplying the explosive charge to one of the cylinders at a pressure of the charge before compression equal or nearly equal to that of the atmosphere and for cutting off the supply to the other cylinder so that the engine may operate at reduced power (as, for instance, at cruising speed), and connections for supplying air to the second cylinder, when a greater amount of power is desired and pumping air therefrom into the explosive charge of the first cylinder at a pressure of the charge before compression greater than that of the atmosphere; substantially as described.

3. A combustion engine plant for submarine craft, comprising a multiple cylinder combustion engine, connections for supplying fuel to the several cylinders thereof, connections for supplying atmospheric air to said cylinders, connections for supplying under pressure an artificial oxygenating element thereto, a connection between individual cylinders, and cut-offs for all of said connections; whereby the several cylinders may all operate conjointly as expolosion

cylinders either with air or with the artificial oxygenating element as the oxidizer for the fuel, and whereby, when operating with air any individual cylinder may serve as an air pump to convey air under compression into the explosion chamber of any other cylinder; substantially as described.

In testimony whereof I have affixed my signature, in presence of two witnesses.

PAUL WINAND.

Witnesses:
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