E. R. GILL.

REACTION ENGINE.

APPLICATION FILED JAN. 22, 1906. RENEWED MAR. 7, 1908.

999,776. Patented Aug. 8, 1911.

Fig. 1.

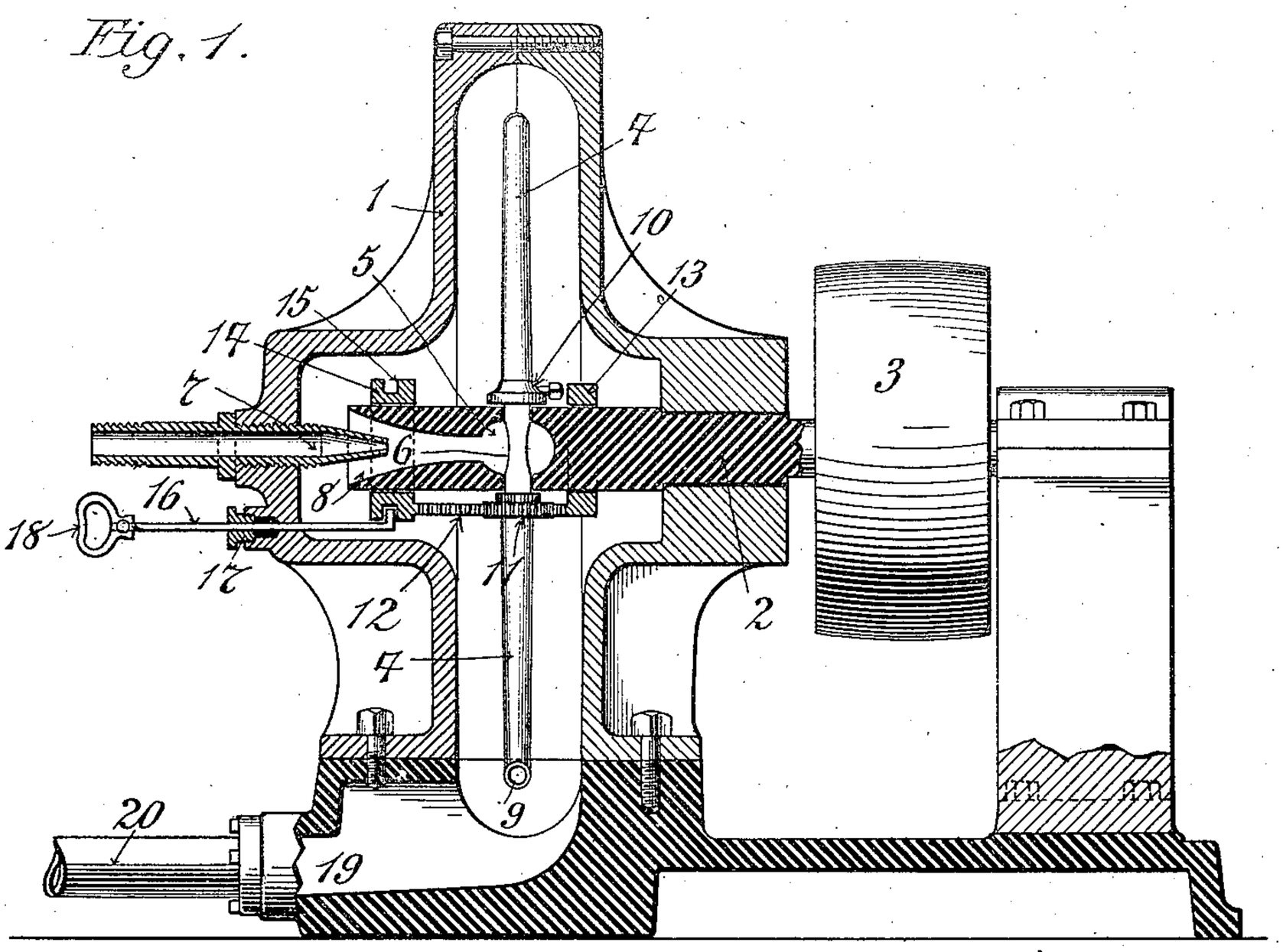


Fig. 3.

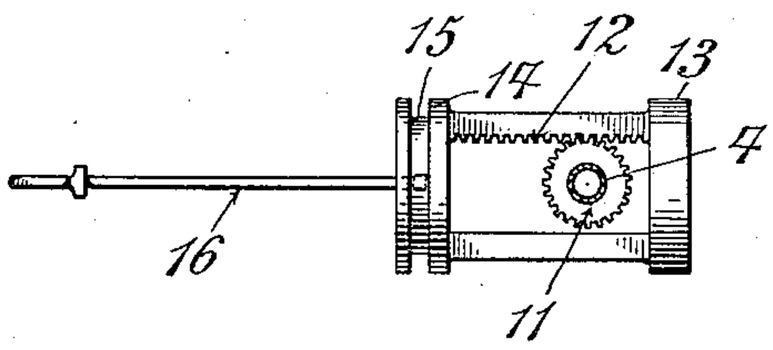
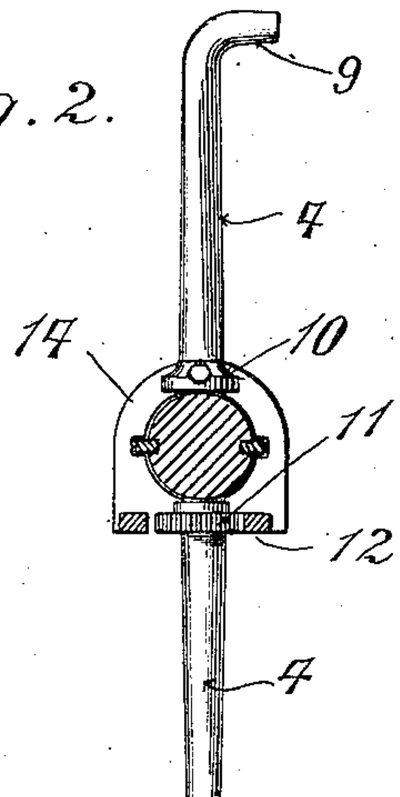


Fig. 4.

Fig. 2.



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REACTION-ENGINE.

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To all whom it may concern:

Be it known that I, EDWIN R. GILL, a citizen of the United States, residing in Yonkers, county of Westchester, and State of New York, have invented a certain new and useful Improvement in Reaction-Engines, of which the following is a specification.

The principal objections hitherto incident to use of the reaction type of heat engine are—first, the necessity of running at impracticably high speed to obtain commercial efficiency; second, the necessity of using a stuffing box which, if made properly tight, impedes the action of the engine to a serious extent and third, the difficulty of producing a reversible engine.

The present invention has relation to an improved form of heat engine, for steam or other appropriate elastic fluids, which, while operating on the principle of reaction shall be free from all three of the objections above mentioned.

In order to run the engine at a practicable speed, I convert the energy of high velocity and pressure in an initial fluid jet of small volume into the energy of a large volume of elastic fluid moving with relatively low velocity. This is accomplished without appreciable loss, by utilizing the low velocity gases immediately after the conversion takes place, so that the heat of impact between gases may be available. The means employed for accomplishing the conversion of form taken by the energy of the fluid also serves the further end of doing away with all stuffing boxes whatever. Instant reversibility is simply and reliably secured by the use of reaction nozzles of such a nature and so located that they may be turned through an angle of 180 degrees thus immediately reversing the rotary effect of the escaping fluid.

It is to be understood that this invention has relation to engines using any appropriate elastic fluid, whether steam, hot air, or any other gas.

The details of the device as hereinafter described are given as illustrative examples and it is not intended to point these out as essentials of the invention.

In the accompanying drawings, Figure 1 is a central section of one form of engine embodying my invention, Fig. 2 is a side view of the shaft and reaction nozzles thereof, Fig. 3 is a detailed plan view of a portion of the reversing device shown in Fig. 1, and Fig. 4 is a side view of a preferred form of nozzle.

The maximum of efficiency corresponds to a velocity of the rotating periphery equal to that of the issuing fluids while the maximum output of mechanical work corresponds to a speed one half as great as that of the fluid. It is obvious therefore, that by supplying the working fluid through a properly proportioned aspirator, the fluid velocity can be cut down, to such a point as to get the desired output of efficiency at practicable speeds.

The reaction nozzles in which the conversion into work takes place are made larger than the feeding nozzle in the proportion of the difference of velocity between the live fluid which leaves the feeding nozzle and the active fluid in the reaction nozzles.

In the particular embodiment of this device which is herein shown, the outer casing of the engine, is shown, at 1, the main driving shaft at 2, and the main driving pulley at 3. The details of these features may be indefinitely varied, and indeed, where a condensing engine is not desired the casing may be dispensed with entirely.

The reaction nozzles are shown at 4, and as many of these may be used as desired. I find two nozzles placed diametrically to be suitable, and, as shown, these may form each a continuation of the other, the center of the pair, passing through the chamber 5 at the hub of the engine which in the particular form herein illustrated, is hollowed out in the main shaft itself. Within the chamber 5 the middle of the pair of reaction nozzles is provided with two oppositely placed elongated apertures 6, which admit the working fluid to the nozzles. The live working fluid is fed through a finely choked feeding nozzle 7, and is directed into an entrance passage 8, leading to the chamber 5 of such a shape and position as is suitable for the purposes of an injector or aspirator. The cross section shown in the drawing will be found a correct one.

The outer extremities of the reaction nozzles are turned into the plane of revolution of the engine, and are preferably shaped so that the fluid issues at substantially a right angle to the radial portion of each reaction nozzle. This is shown at 9 in Fig. 2. Being bent in opposite directions, the two members of the pair coöperate. It is obvious

that any proper form of reaction nozzle may be used so long as the exit opening in each nozzle is so placed that the reaction of the fluid issuing therefrom will be rendered effective.

The direction in which the engine will rotate will of course depend upon the directions of the bent tips 9. By revolving an entire pair of nozzles at its middle, the bent ends can be instantly reversed in direction, thus reversing the engine without use of valves or other means for controlling the mode of fluid supply. While this mode of reversal has the advantage of exceedingly prompt action, it is nevertheless carried out without rigid shock. This follows from the fact that, in the process of reversal, the reaction nozzles act first, with a gradually increasing departure from the plane of operation until they make a right angle therewith, with an effect equal to zero, after which they are brought gradually into the plane of rotation again, but pointed in the opposite direction to that which they have just left.

The turning of the two nozzles for reversing the engine may be accomplished by a variety of devices which will occur to one skilled in the art, and that shown in the drawings will be found suitable among others. Here the shoulders 10 and 11 are fitted upon the nozzles where they enter the chamber 5 and outside of the same. These shoulders prevent longitudinal movement of the nozzles with respect to the shaft 2. For purposes of reversal, one of the shoulders, as 11 takes the form of a gear wheel which is engaged by the rack 12. This rack is carried by two sleeves 13 and 14 which are mounted upon the main shaft 2 on opposite sides of the nozzles and are so arranged as to be capable of sliding longitudinally upon said shaft. One of these sleeves, as 14, is preferably provided with a peripheral groove 15 into which there projects the inner end of an operating rod 16 sliding through a stuffing box 17 and provided with a handle 18. When the rod 16 is pushed inward, the rings will carry the rack 12 with them, thus turning the gear wheel 11 and the nozzles with it. On pulling the handle 18 outward again the nozzles are once more reversed, but oppositely.

The casing 1 is provided with an opening 19 which, for condensing engines, is connected with the condenser by means of a pipe 20. Where a condenser is used, the inert fluid is the exhaust fluid remaining in the casing. When a non-condensing engine is used, the inert fluid is provided by the atmosphere.

One of the advantages incident to use of elastic fluids in the manner described is that the heat of the mixture delivered to the reaction nozzles can be converted without material loss into useful work. This is accomplished by allowing the fluid to expand by the action of its own temperature within the reaction nozzle and in that portion of the nozzle which is turned out of the radial line and wherein the reaction effect is rendered operative. For this purpose I prefer to employ reaction nozzles which increase gradually in diameter from the point at which they depart from the radial line outward as shown at 9 in Fig. 4. Where this construction is employed, the gases will be expanded down to the pressure of the atmosphere or, in condensing engines, to the condenser pressure, and during expansion they will do work upon the nozzle walls. This not only utilizes the initial heat but also diminishes loss of energy by utilizing the heat of friction and of eddies or interfering currents within the nozzles.

Many changes may be made in the construction of this device without departing from the scope of this invention, and I am not to be understood as limiting myself to the details herein shown and described.

What I claim is—

1. A reaction engine comprising a main shaft, a single pair of reaction nozzles passing through the same and having properly placed openings near their extremities, and means for revolving said pair of nozzles upon their common axis, substantially as described.

2. A reaction engine comprising a main shaft, a chamber thereon, a single pair of reaction nozzles passing through said chamber and provided with an inlet aperture within said chamber and means for revolving said nozzles on their common axis, substantially as described.

3. A reaction engine comprising a pair of reaction nozzles a gear wheel thereon, a rack engaging said gear wheel and means for reciprocating said rack, substantially as described.

4. A reaction engine comprising a main shaft, a pair of reaction nozzles carried thereby, a gear wheel on said nozzles, two sleeves capable of sliding on said shaft, a rack carried by said sleeves and engaging said gear wheel and means for sliding said sleeves and rack on said shaft, substantially as described.

5. A reaction engine comprising a main shaft, a chamber therein, a pair of reaction nozzles passing through said chamber and provided with an aperture within said chamber and means for rotating said reaction nozzles, substantially as described.

6. A reaction engine comprising a casing, a main shaft entering one side thereof, an aspirator opening axially entering the end of said shaft and leading to a chamber within said shaft, a pair of reaction nozzles passing through and communicating with

said chamber, means for revolving said nozzles and a feeding nozzle entering the opposite side of said casing and directed into said aspirator opening, substantially as described.

7. A reaction engine of the class described comprising an outer casing, a revoluble main shaft entering the casing on one side, said shaft being hollow and open at the end opposite that where it passes into said chamber, means for transmitting power from said shaft outside of said casing and on that end of the shaft opposite to the opening therein, a fixed feeding nozzle placed substantially in the axial line of said shaft and arranged to discharge into the open end thereof, and reaction tubes carried by said shaft and communicating at their inner ends with the hollow therein so as to receive working fluid from said feeding nozzle, substantially as described.

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