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H. ZOELLY.

EXPLOSIVE TURBINE.

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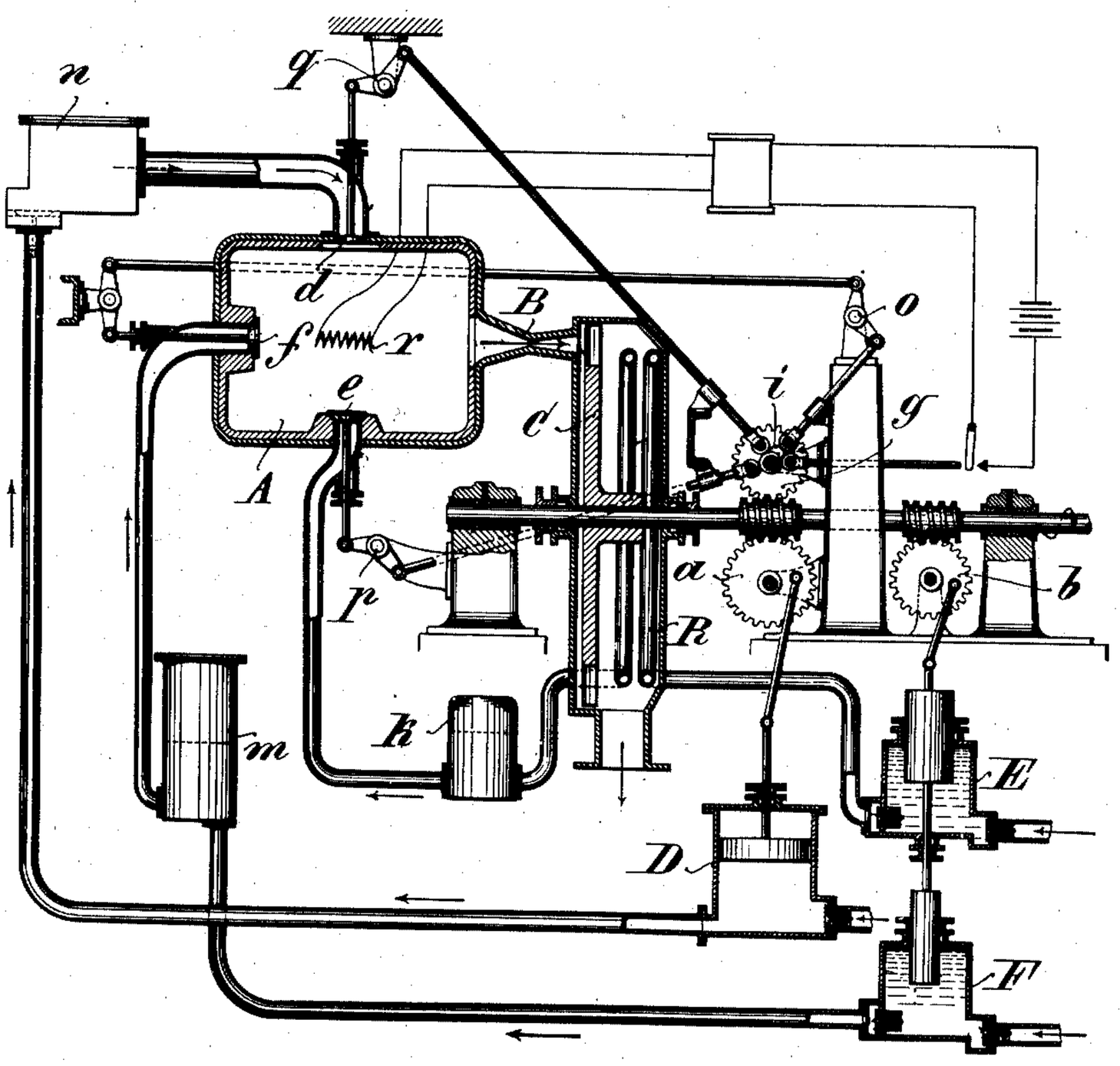

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EXPLOSIVE-TURBINE.

No. 864,821. Specification of Letters Patent. Patented Sept. 3, 1907.

Application filed May 22, 1905. Serial No. 261,583.

To all whom it may concern:

Be it known that I, HEINRICH ZOELLY, of Zurich, a citizen of Switzerland, and whose post-office address is No. 58 Rämistrasse, Zurich, Switzerland, have invented new and useful Improvements in or Relating to Explosion-Turbines and in the Methods of Working or Operating the Same, of which the following is a specification.

In the working of explosion gas turbines hitherto used a suitable gas mixture is caused to expand in a closed chamber *i. e.*, at a constant volume and after the highest pressure is reached, is conveyed through the turbine. The expansion is continued until a pressure is attained corresponding to that in the turbine casing, after which the chamber is closed and recharged. This method has the drawback that the pressure medium is supplied to the turbine, running at a constant speed, at very varying pressures, so that towards the end of the expansion the energy of the fuel mixture is insufficiently utilized at the nozzles, owing to a too small fall of pressure and at the wheels owing to the velocity of the gas being too small, thereby causing loss of efficiency.

The object of the present invention is to overcome these drawbacks. The gases, compressed to a certain pressure, and the air necessary for the combustion are fed into the explosion chamber just at the moment at which the gases expanding therein have attained equal pressure so that they are driven out of the chamber at constant pressure. In order to prevent premature ignition the air valve is allowed to open slightly earlier than the gas valve so that an isolating cushion is formed between the new and the old charge. After the chamber is nearly filled with fresh mixture the gas inlet valve is closed and the mixture is ignited without however the outlet to the turbine being closed. This ignition owing to the extremely short duration of the explosion, takes place almost as if a constant volume prevailed. After the maximum pressure is reached steam obtained by the vaporization of water by the heat given off by the turbine is introduced under a pressure equal to the explosion pressure whereby a "full pressure period" is obtained, as in steam engines with expansion before the cut off of the steam admission and the temperature of the fuel mixture is reduced to such an extent that the subsequent expansion in the nozzle produces temperatures which cause no harm to the blades. After a portion of the whole mixture has escaped during the full pressure period, expansion follows, which however is only continued up to compressor pressure, after which, when the latter is reached, the inlets open again and fresh mixture at compressor pressure is introduced in order to repeat the described operation.

The characteristic feature of the new mode of working is in the first place the explosion upon the admission to the turbine being open, owing to the rise of pressure and temperature the explosion signifies an increase in the thermal efficiency; the absence of closing devices in front of the nozzle renders the process operative in practice, as such closing means would not be practicable in this particular case in view of the high temperatures and velocity of flow prevailing. A second feature is the interruption of the expansion at compressor pressure by admitting a charge of fresh mixture thereby providing a very favorable proportion of maximum to minimum pressure in the explosion chamber. While for instance with an exhaust turbine working at 20 atmospheres (300 lbs) and under ordinary working conditions, the proportion of the expansion falls from 20 to 1, this relation according to the new mode of working at say, for instance, 5 atmospheres (75 lbs) only varies between the limits of 20, and 20÷5=4, atmospheres. The expansion nozzle therefore operates at pressures which are considerably less remote from a mean pressure for which the nozzle is built, than in the present process and consequently the mean efficiency in the nozzle as well as the efficiency in the wheel are considerably higher than usual. To this may be added, thirdly, the introduction of steam under explosion pressure so that for a given period the mixture must pass out at full pressure. Thus the energy derived from the steam is more advantageously utilized than is possible in any of the known gas turbine processes.

It is obvious that instead of gases, liquid or solid fuels can be used, suitably introduced into the explosion chamber.

In the accompanying drawing a turbine for working under this new process is diagrammatically shown.

A is the explosion chamber, B the expansion nozzle, and C the turbine wheel. Air, water and fuel are compressed by the pumps D, E, F respectively through the conduits and air or collecting chambers *n*, *m*, *k*, and conveyed to the explosion chamber. From the pump E the water is first conducted through a coil R, heated by the exhaust and is here vaporized before passing to the explosion chamber A.

The controlling valves or members *d*, *e*, *f* allow of the introduction at suitable moments of the various media and are operated by a suitable device. The latter is indicated diagrammatically by worm wheels *g*, *a*, *b*, the cam *i* and the levers *o*, *p*, *q*.

r is the ignition device.

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

1. In a gas or fuel explosion turbine the combination with the explosion chamber and the turbine; of an always open expansion nozzle; pumps for compressing the air, steam and fuel; admission valves for these media to the

explosion chamber, and means for controlling the same whereby the air and fuel are supplied to said chamber at the time when the pressure therein has dropped to be equal to the pressure of the compressor pumps; an ignition device; and means for controlling the ignition—substantially as and for the purpose specified.

2. In a gas or fuel explosion turbine the combination with the explosion chamber of an expansion nozzle in constant communication with the explosion chamber, turbine wheel, valves for admitting air, steam and fuel to the explosion chamber, steam generator heated by the exhaust of the turbine, pumps for compressing the air, steam and fuel and means for controlling the admission of the various media to the explosion chamber and for controlling the ignition, substantially as and for the purpose specified.

3. In a gas or fuel explosion turbine the combination with the explosion chamber of an always open expansion nozzle, admission valves for the various media to the explosion chamber, pumps for compressing the various media, an ignition device, and means adapted to open the air admission valve slightly in advance of the gas-admission valve, substantially as and for the purpose specified.

4. In a gas or fuel explosion turbine the combination with the explosion chamber of the always open expansion nozzle, admission valves for the various media to the explosion chamber, pumps for compressing the various media, ignition device and means adapted for igniting the explosive mixture immediately in advance of the admission of the compressed steam to the explosion chamber, substantially as and for the purpose specified.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

HEINRICH ZOELLY.

Witnesses:
CARL GROSS,
JOSEPH SIMON.