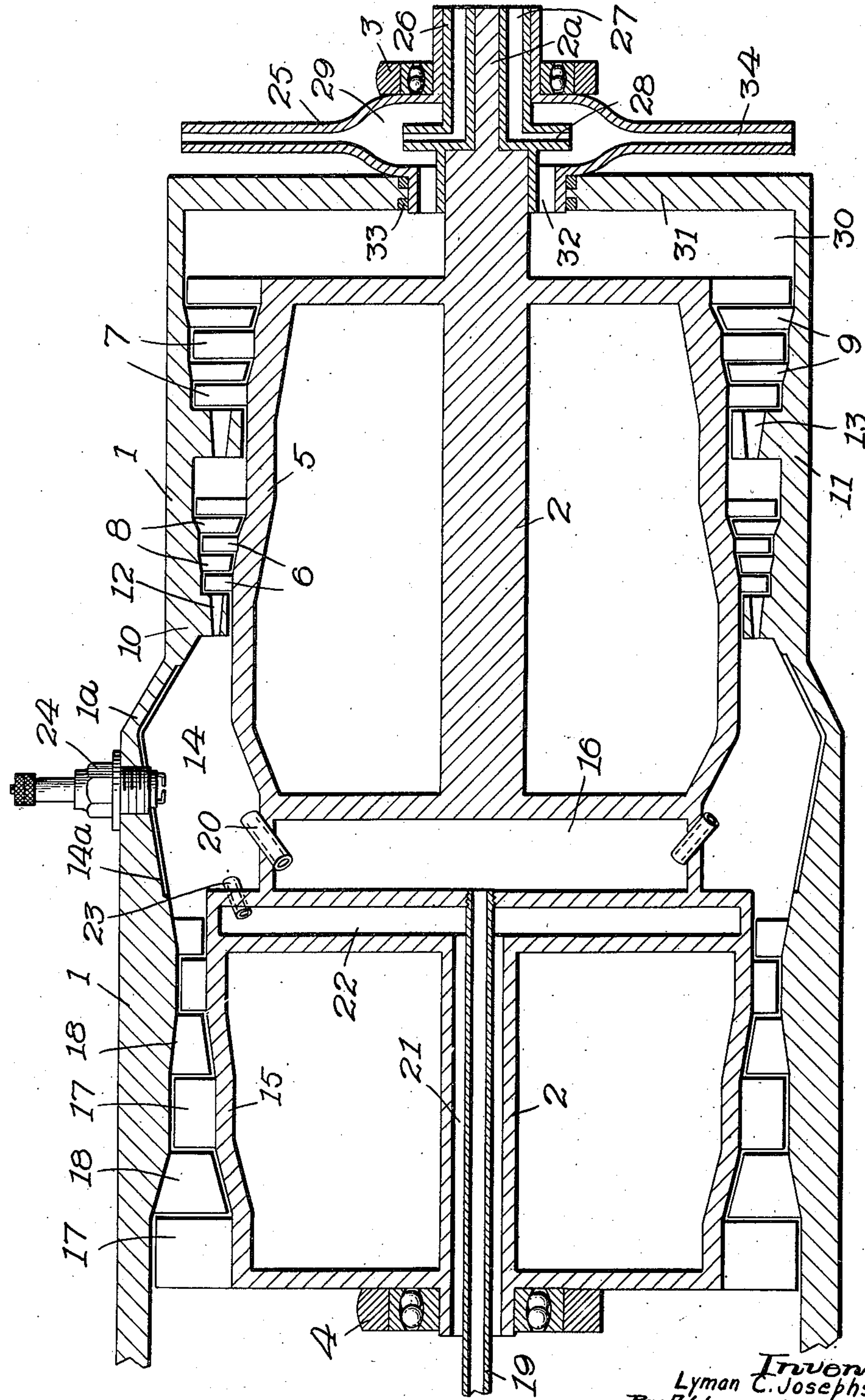
L. C. JOSEPHS, Jr.
INTERNAL COMBUSTION TURBINE.
APPLICATION FILED SEPT. 25, 1919.

1,418,444. **Patented June 6, 1922.**



Inventor
Lyman C. Josephs, Jr.
By Attorney
Owen W. Kennedy

UNITED STATES PATENT OFFICE.

LYMAN C. JOSEPHS, JR., OF FLUSHING, NEW YORK.

INTERNAL-COMBUSTION TURBINE.

1,418,444. Specification of Letters Patent. Patented June 6, 1922.

Application filed September 25, 1919. Serial No. 326,407.

To all whom it may concern:

Be it known that I, LYMAN C. JOSEPHS, Jr., a citizen of the United States, residing at Flushing, in the county of Queens and State of New York, have invented a new and useful Improvement in an Internal-Combustion Turbine, of which the following, together with the accompanying drawings, is a specification.

My invention relates to internal combustion engines of the rotary type, more commonly known as gas turbines.

The object of my invention is to provide an internal combustion turbine that is extremely simple in construction and embodies certain novel features of design and principles of operation not heretofore employed in engines of this class.

Internal combustion or gas turbines, as heretofore constructed, have usually comprised a bladed or vaned rotor element adapted to be driven by the impact or reaction of gases resulting from the combustion of an explosive mixture in suitable combustion chambers. Among the practical difficulties encountered in the commercial development of this type of turbine has been the injurious effects of the hot gases upon the turbine blades, for it has been found that the extremely high temperature and corrosive action of the hot gases tend to destroy the most resistant material. This has necessitated the use of various means for cooling the turbine blades, such as the provision of water jackets, or the use of steam acting directly on the rotor, independently of the gases of combustion. In addition, the high pressures employed have resulted in the use of relatively heavy parts in order to provide the requisite strength and durability. A further inherent defect of previous gas turbines, resulting from the use of high pressures, has been the amount of energy required to compress the air that makes up a large part of the explosive mixture, and which must be supplied to the combustion chambers at high pressure. As a result, it has often been found necessary to provide separate air compressing and steam generating units as part of the auxiliary equipment of a gas turbine, thereby increasing the complication of the machine, as a whole, and rendering its application in small units impracticable.

By my invention, I propose to substantially eliminate the above described difficulties by providing a new type of self-contained turbine unit, that is equally as well adapted to be embodied in small units as in large. My proposed turbine operates on a semi-fluid mixture composed partly of steam, or other vapor, and partly of gases formed from the products of combustion of the fuel from which the necessary heat units are supplied. The steam, or other vapor, is formed directly in the combustion chamber, and the temperature of the resulting mixture is not high enough to injure the rotor. I further provide a turbine operating at a relatively low pressure, in which the air entering into the explosive mixture is delivered in sufficient quantity by a turbo-blower mounted directly on the rotor shaft adjacent to the combustion chamber, thereby eliminating the auxiliary compressor.

The single figure of the accompanying drawing is a transverse sectional view of a turbine embodying my invention.

Referring to the drawings, the turbine comprises a hollow cylindrical casing 1, within which is centrally located a shaft 2, rotatably supported at its ends in bearings 3 and 4. The right-hand portion of the shaft 2 is surrounded by a hollow cylindrical spider 5, around the periphery of which are mounted a plurality of sets of blades or vanes 6 and 7, the number of sets of blades being determined by the number of stages which it is desired to have in the turbine. The inner periphery of the casing 1 is provided with a plurality of sets of guides 8 and 9 arranged alternately between the blades 6 and 7, as is customary in turbine practice. The casing 1 is further provided with inwardly extending annular projections 10 and 11, within which are formed a plurality of nozzle openings 12 and 13, respectively terminating adjacent to the blades 6 and 7. The casing 1 is somewhat enlarged beyond the projection 10, as shown at 1^a, to provide a combustion chamber 14 between the inner periphery of the casing 1 and the outer periphery of the spider 5. The chamber 4 is generally frusto-conical in form, with its smallest cross section adjacent to the nozzle openings 12. The chamber 14 is provided with a lining 14^a of heat-resistant material, such as nickel steel.

The left hand portion of the shaft 2 is surrounded by a hollow cylindrical spider 15 similar to the spider 5, but separated therefrom by a chamber 16, the purpose of which will be hereinafter described. A plurality of blades or vanes 17 are provided upon the outer periphery of the spider 15 and a plurality of stationary guides 18, carried by the casing 1, are arranged alternately between the blades 17. The blades 17 and the guides 18 together constitute the several stages of a turbo-blower that is adapted to deliver air to the combustion chamber 14. The portion of the shaft surrounded by the spider 15 is hollow, and a pipe 19, centrally located within the shaft 2, is connected to the chamber 16, which will be hereafter known as the fluid chamber. One or more nozzles 20 are provided around the periphery of the chamber 16 and are respectively inclined toward the opposite end of the combustion chamber 14. The pipe 19 is of such diameter that an annular passage 21 is left between the pipe 19 and the inner wall of the shaft 2. The passage 21 connects with a space 22 located between the adjacent walls of the chamber 16 and of the spider 15. One or more nozzles 23 are peripherally arranged around the space 22 outside the nozzles 20, angularly displaced with respect to the same. The nozzles 23 are also inclined with respect to the nozzles 20 so that their paths of delivery will converge at a point beyond the middle of the combustion chamber 14. An ignition device 24 projects within the casing 1 about the middle of the combustion chamber 14. The ignition device 24 is here shown as being of the electric jump-spark type, although it is to be understood that any other suitable ignition device, such as a hot tube, may be employed.

The right hand end of the rotor is provided with a condenser which generally comprises a casing 25 adapted to rotate with the shaft 2, the bearing 3 supporting one end of the casing 25. A sleeve 26 surrounds a reduced portion 2^a of the shaft 2 and is provided with a passage 27 and a plurality of radial jets 28 opening into an annular condensing space 29 within the casing 25. The condensing space 29 communicates with a discharge chamber 30, located between the spider 5 and the end wall 31 of the casing 1, by means of a passage 32. An air-tight seal 33 is provided between the end wall 31 and the condenser casing 25. The chamber 29 is surrounded by a plurality of radial discharge jets 34 which open to the outside atmosphere.

Having thus described the various parts of my turbine, the operation thereof is as follows:—The passage 21 is first connected to a source of fuel supply, it being understood that the fuel may be either in liquid form, such as gasoline, or it may be in the form of a pulverized solid, such as powdered carbon. The passages between the vanes 17 are open to air at atmospheric pressure. In order to start the turbine, the shaft 2 is rotated by any suitable external means, such as a starting motor, and the ignition device 24 is energized. As the shaft 2 rotates, air is delivered by the blades 17 to the combustion chamber 14 and, at the same time, fuel in atomized or finely powdered form is delivered by the nozzles 23 under the influence of centrifugal force. The blast of air delivered by the turbine blades 17 mixes with the fuel delivered by the nozzles 23 to form an explosive mixture which is ignited by the device 24. As soon as the combustion is under way, the pipe 19 is connected to a source of water or any other readily vaporizable fluid, whereupon the nozzles 20 deliver the fluid in atomized form to the chamber 14. The gases resulting from the combustion of the mixture of fuel and air immediately convert the atomized fluid delivered by the nozzles 20 into superheated steam at a comparatively low pressure. The mixture of vapor and combustion gases then passes out of the chamber 14 through the nozzles 12 and impinges upon the several sets of turbine blades 6 and 7 at high velocity, whereby its kinetic energy is converted into useful work at the shaft of the rotor. The angular displacement of the nozzles 20 and 23 is such that the flame tends to travel around the combustion chamber 14 in a generally spiral form, and the atomized fluid is introduced into this flame at points where the combustion is most complete. It is evident that flame propagation and formation of fluid vapor in the combustion chamber is continuous after the first few turns of the starting motor and that the turbine will run so long as it is supplied with fuel.

The question of regulation in my improved turbine is extremely simple, in the entire absence of any auxiliary control devices usual with turbines. It is apparent that when the nozzle sizes have once been determined to supply the proper proportions of fuel and water to support good combustion, the operation of the turbine can readily be controlled by simply varying the amounts of fuel and water supplied to the nozzles from the chambers 16 and 22.

As the waste gases pass from the turbine stage into the condenser casing 25, a continuous stream of water is delivered centrifugally by the jets 28 into the condensing space 29, where the waste gases are condensed and together with the condensing water are ejected centrifugally at atmospheric pressure through the jets 34. The condensed fluid may then be returned to the turbine, in any suitable manner, to be used again.

From the foregoing it is apparent that an internal combustion turbine constructed in accordance with my invention is extremely simple and entirely self-contained, inasmuch as the turbine blades, the combustion chamber, and the turbo-blower for the air supply are all inclosed within a single casing, and all moving parts are mounted on a single shaft rotating within the casing. The provision of a plurality of jets adapted to simultaneously deliver atomized fuel and fluid by centrifugal force insures a continuous supply to the turbine as soon as the rotor begins to turn, while the arrangement of jets so that atomized fluid will be introduced into the combustion gases at points where the combustion is most complete insures its immediate conversion into vapor. The continuous transfer of heat from the combustion gases to the fluid insures that the resulting vapor mixture will not be hot enough to damage the turbine blades. The amount of energy consumed by the turbo-blower is small in comparison to the useful work performed by the turbine, and this energy loss can always be kept at a low figure by so designing the blower that just enough air will be delivered to the combustion chamber to properly support combustion therein.

It is obvious that my turbine is particularly well adapted to produce power in units small enough to be used for the propulsion of motor vehicles and it possesses many advantages over the present type of reciprocating internal combustion engine, owing to its extreme simplicity and lightness of construction, absence of reciprocating parts, and its ability to use almost any type of fuel. The power required for starting the turbine should not be much greater than that required for the usual type of internal combustion engine of the same capacity.

The construction of an internal combustion turbine operating upon the above described principles represents a distinct improvement in the art of producing power. Considered fundamentally, my invention consists in burning a combustible media in the presence of a non-combustible media, within a combustion space, followed by a transfer of heat between the media, and their expansion together to perform useful work. The practical embodiment of my invention in an engine results in an internal combustion turbine which will operate successfully at low pressures and low temperatures, in direct contrast to the high pressures and high temperatures heretofore employed in gas turbines. This difference in operation is due to the fact that my improved turbine employs a propelling medium of considerable density, due to its large content of fluid vapor, which possesses enough kinetic energy to drive the rotor without the development of high pressure within the combustion chamber. On the other hand, a turbine employing only the light gases of combustion as its propelling medium, must necessarily develop much higher pressures within its combustion chamber in order to perform the same amount of work as my improved turbine.

While I have shown my invention in its simplest and preferred form, it is not so limited, but it is obvious that it is susceptible of various structural modifications without departing from the scope of my invention. I desire, therefore, that only such limitations be placed thereon as come within the scope of the appended claims.

I claim,

1. In an internal combustion turbine, the combination with sources of fuel and a vaporizable non-combustible medium, and a combustion chamber, of a rotor having a plurality of nozzles for delivering the fuel and the non-combustible medium to said chamber by centrifugal force.

2. In an internal combustion turbine, the combination with sources of fuel and a vaporizable non-combustible medium, and a combustion chamber, of a rotor having a blower and a plurality of nozzles thereon for simultaneously delivering air and the fuel and non-combustible medium in atomized form to said chamber.

3. In an internal combustion turbine, the combination with a rotor and a combustion chamber, of a plurality of containers carried by said rotor and provided with nozzles adapted to deliver fuel and a vaporizable medium to said chamber by centrifugal force.

4. In an internal combustion turbine, the combination with a rotor and a combustion chamber, of a plurality of nozzles and a blower arranged on said rotor for simultaneously delivering air, a vaporizable medium and fuel in atomized form to said chamber.

5. In an internal combustion turbine, the combination with sources of fuel and a non-combustible medium and a combustion chamber, of a rotor operating in said chamber and adapted to deliver the fuel and the non-combustible medium to said chamber in converging streams.

6. In an internal combustion turbine, a combustion chamber and a bladed rotor operating therein and provided with a plurality of nozzles opening into said chamber at different angles for delivering converging streams of fuel and a vaporizable medium into said combustion chamber.

7. In an internal combustion turbine, the combination with a combustion chamber and sources of a combustible medium, a combustion supporting medium, and a noncombustible medium, of a rotor adapted to deliver said media to said chamber in converging streams.

LYMAN C. JOSEPHS, Jr.