No. 845,622. PATENTED FEB. 26, 1907.

A. DU SHANE.

GAS TURBINE ENGINE.

APPLICATION FILED JUNE 13, 1904.

Fig. 1.

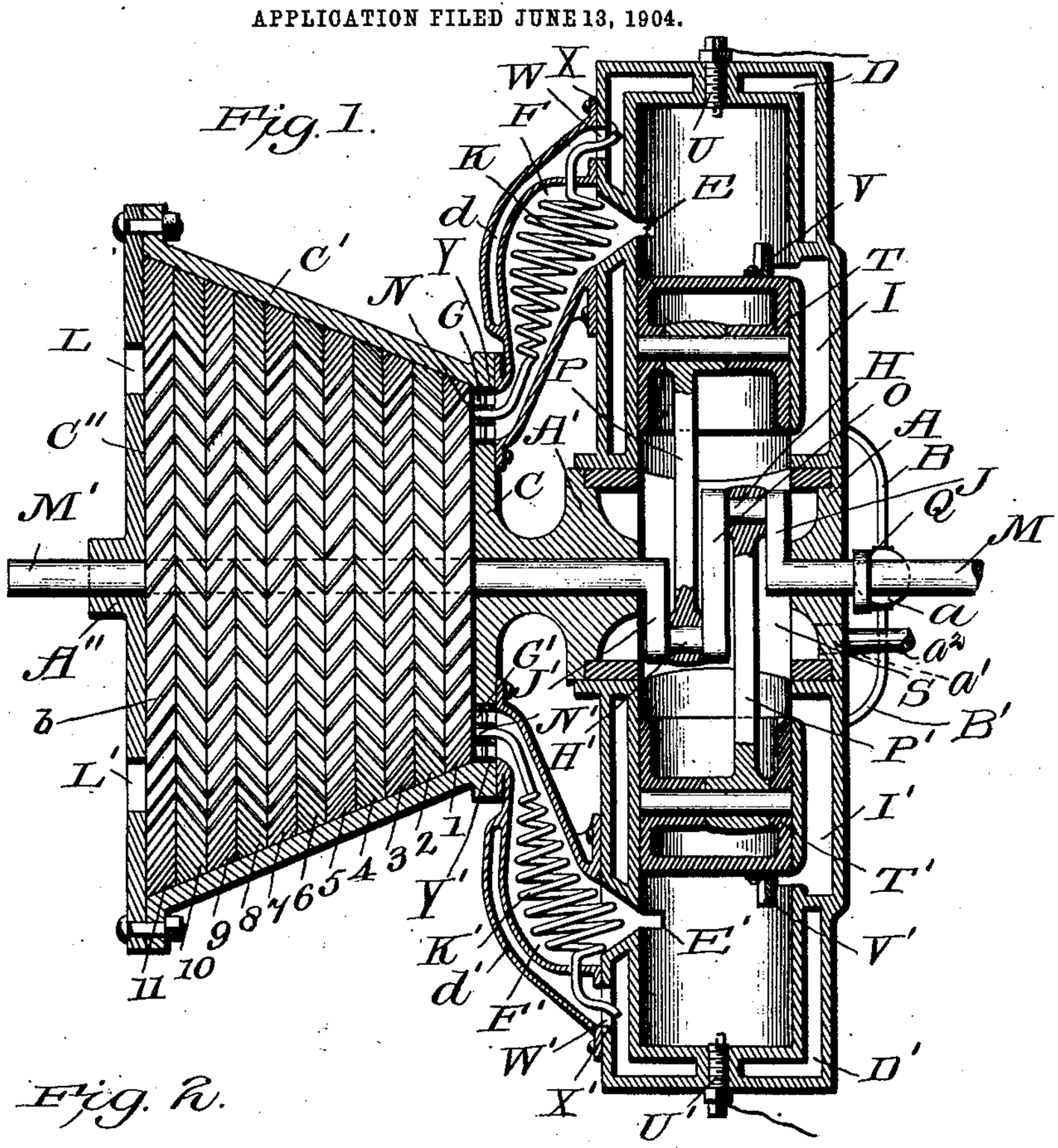


Fig. 2.

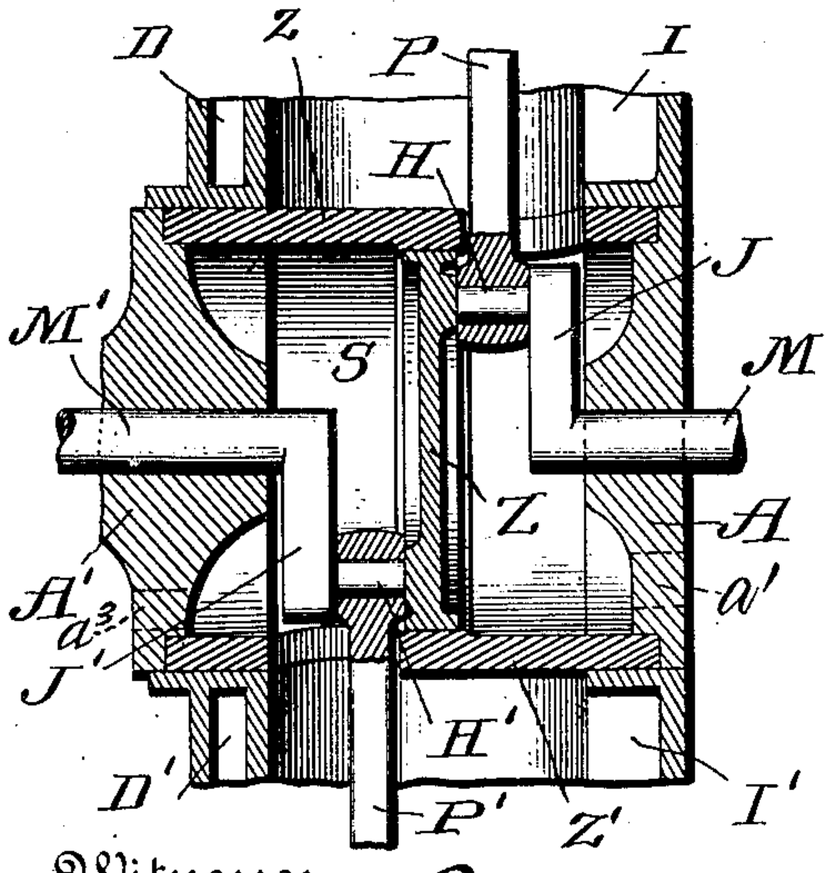
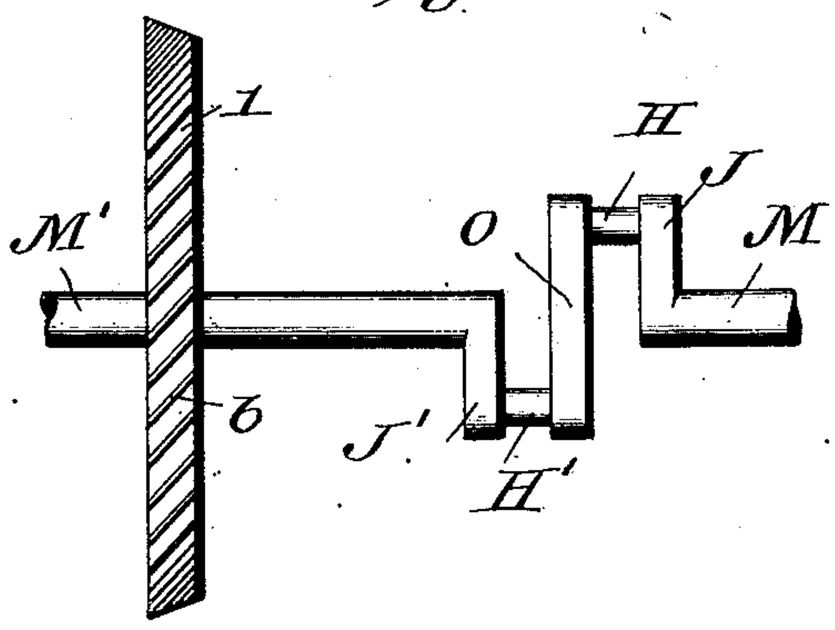


Fig. 3.



Witnesses
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UNITED STATES PATENT OFFICE.

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GAS TURBINE-ENGINE.

No. 845,622. Specification of Letters Patent. Patented Feb. 26, 1907.

Application filed June 13, 1904. Serial No. 212,416.

To all whom it may concern:

Be it known that I, ANDREW DU SHANE, a citizen of the United States, residing at South Bend, in the county of St. Joseph and State of Indiana, have invented certain new and useful Improvements in Gas Turbine-Engines; 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.

This invention relates to internal-combustion engines, more particularly to such engines combined with a turbine or rotary engine mounted on the driving-shaft of said combustion-engine and so connected thereto as to be enabled to receive and utilize the waste products of combustion which are generally exhausted to the atmosphere.

Another object of the invention is to combine with a jacketed internal-combustion engine having a rotary engine mounted on its driving-shaft means for circulating the cooling liquid through said jacket and means for utilizing a portion of the heat in the waste products of combustion to transform the liquid delivered from the jacket or other source through a suitable heating coil or boiler and to inject the same in the form of steam to the inlet-port of the rotary engine.

Further objects of the invention will hereinafter appear; and to these ends the same consists of a combined internal-combustion engine, boiler, and rotary engine embodying the features of construction, combinations of elements, and arrangement of parts having the general mode of operation substantially as hereinafter described and claimed in the specification.

One embodiment of the invention, which is the preferred form as at present known, is shown in the accompanying drawing, wherein like reference characters denote like parts throughout the several views, in which—

Figure 1 shows a central sectional view in plan of the entire apparatus. Fig. 2 shows a sectional view of a modified form of crank-shaft and its seat in the combustion-engine casing, and Fig. 3 shows a detail of the crank-shaft shown in Fig. 1 with one of the rotary-engine-driving sections mounted thereon.

Referring to the drawing, M M′ denotes a crank-shaft mounted in suitable bearings A and A′, the latter of which may be cast with a circular plate C at its outer end carrying a cylindrical casing C′, which is closed at its other end by a suitable plate or cover C″, which has provided centrally thereof a third bearing A″ for the shaft M M′.

The particular form of internal-combustion engine to be used is immaterial, but a construction that has been found convenient, economical, and practicable will now be described.

The drawing shows a two-cycle gas-engine provided with two cylinders, cranks, and pistons, although it is obvious that there may be more than one pair of cylinders, if desired, according to the power to be generated. These cylinders are formed of castings oppositely disposed with respect to the bearings A A′, to which they are attached by any suitable means, and they may be in line or set at an angle to each other, as is most convenient with respect to the space in which the apparatus is to be erected. The inner open ends of these oppositely-disposed cylinders are connected by any suitable form of casing surrounding the cranks and forming thereabout a chamber S. Conveniently located in the wall of the chamber S is a port a', connecting said cylinder—for instance, by means of the pipe a^2—with the usual controlled source of fuel-supply.

The shaft M M′ is provided with crank-pins H H′ set at one hundred and eighty degrees by mounting the same between the ends of separate oppositely-extending side webs J J′ and a continuous central web O. From the crank-pins H H′ extend piston-rods P P′, terminating in pistons T T′.

The cylinders are provided with suitable ignition devices U U′, those in the drawing being intended to illustrate jump-spark electric sparkers, intake-ports I I′, leading from chamber S to the explosion-chambers in the outer ends of the cylinders, exhaust-ports E E′ so located that the exhaust takes place earlier than is ordinarily the custom and substantially diametrically opposite the intake-ports, and inclosing water-jackets D D′, which may be divided into one or more compartments, as is desired. On the outer face of each piston T T′ are mounted baffle-plates or deflectors V V′ adjacent the outer ends of intake-ports I I′.

The exhaust-ports are so positioned that an early exhaust is obtained, so that the heated gases of combustion which are retained in the explosion-chamber at considerable pressure and heat will not work against

a disadvantageous leverage of the crank-shaft, but will readily escape for use in other connections, as hereinafter described.

Water is forced into the lower portions of the jackets D D′ through connecting-pipes B B′ by a force-pump *a*, operated by any suitable means, as a cam Q on the crank-shaft, and outlets from the upper portions of the jackets are provided at W W′, so that the revolution of shaft M M′ will create a continuous circulation of water, cold water entering through pipes B B′ and heated water or steam, or both, finding an exit at W W′.

The rotary engine employed may be of any convenient type; but the preferred form is shown in the drawing and embodies the principle of the turbine with fixed and movable blades carrying steam-buckets at their peripheries. As here shown eleven such blades are used; but the number is proportional to the size of the internal-combustion engine selected. The odd-numbered blades are mounted to rotate with the shaft M M′, and the even-numbered blades are fast to the casing C′, the shaft rotating in centrally-arranged apertures therein. Each blade is provided with angularly-disposed peripheral vanes *b*, those on the fixed blades being reversely arranged with relation to those on the movable blades.

The blades increase in diameter outwardly to allow for expansion of the driving fluid and the casing C′ is therefore made, preferably, in the form of a conical frustum, its smaller end being adjacent the internal-combustion engine. Plate C is provided with intake-ports G G′, one for each exhaust-port of the combustion-engine, and plate C″ is provided with suitable outlet or exhaust ports L L′.

The exhaust-ports E E′ are each surrounded by one end of casings F F′, respectively, the other ends of said casings surrounding intake-ports G G′, respectively, thus forming passages for conveying the waste products of combustion from the internal-combustion to the rotary engine. These casings F F′ are partially or wholly surrounded by auxiliary water-jackets *d d′*, connected to the main jackets through the openings W W′.

Within the casings F F′ are water-pipes K K′, respectively, preferably coiled so as to provide as great a length as possible within the casings. Ends X X′ of these pipes pass through water-tight joints in the casing-wall and project into water-jackets D D′ through openings W W′, while ends N N′ are held within intake-ports G G′ by any suitable means, as by being inserted in the hubs of spiders Y Y′.

In operation, assuming the jackets D D′ to be filled with water, the internal-combustion engine is started in the usual manner and the cycle continues as follows: An explosive mixture is admitted to chamber S by the forward stroke of the pistons T T′, which is compressed by the return of said pistons, as in the usual operation of a two-cycle engine. As the pistons pass exhaust-ports E E′ the products of combustion escape into casings F F′ and thoroughly heat the coils K K′ by passing against and between them, which coils at about this time have a small quantity of hot water from the upper portions of jackets D D′ forced into them by the action of cam Q on pump *a*. This water is further heated in its passage through the coils K K′ and is converted into steam, which passes out of the coils at N N′ and impinging upon the vanes *b* of the rotary engine-blades and in conjunction with the expansive force of the exhausting gases drives the blades and assists in turning the shaft during the forward portion of the stroke. In the meantime a fresh charge has passed through ports I I′ and into the explosion-chamber, baffle-plates V V′ tending to prevent a mixture of the fresh and exploded charges until ports E E′ are again closed, which fresh charge is exploded at the proper time, and the cycle thus continues. The revolution of the rotary engine-blades is also assisted by the exhaust products of combustion, which after heating coils K K′ pass through said engine and out of exhaust-ports L L′, having also thoroughly heated the various blades *b* during its passage past and against them. The more complete conversion of the heated water into steam will be effected by being brought into direct contact with the heated gases as they are conjointly injected into the inlet-ports of the turbine. Should the conversion into steam be still incomplete, however, the contact of the fluid with the heated blades will be effective to the desired end.

When it is desired to run the engine at a high rate of speed, it becomes necessary to provide an additional bearing between the crank-pins, and to gain this the modified construction of crank-shaft shown in Fig. 2 is used. As there shown, the continuous web O is enlarged and constructed in the form of a disk Z, and the engine-frame is extended internally, as shown at *z* and *z′*, to form a suitable bearing therefor. This construction divides chamber S into two parts and necessitates the use of two port-openings a' a^3.

Obviously some features of this invention may be used without others, and the same may be embodied in widely-varying forms without departing from the spirit thereof, and I do not, therefore, limit myself to the exact details shown and described; but

What I claim is—

1. The combination with a gas-engine having a cooling-jacket therefor, of a turbine, a conduit between the exhaust-port of the gas-engine and intake-port of the turbine, and a separate conduit passing through said first

conduit and forming a communication between said cooling-jacket and turbine intake-port.

2. The combination with an internal-combustion engine of a turbine mounted on the crank-shaft thereof, a casing connecting the exhaust-port of the combustion-engine with the intake-port of the turbine, a coiled pipe within said casing having an open end at said intake-port, and means for forcing water into said pipe, substantially as described.

3. The combination with an internal-combustion engine and jacket therefor, of a turbine mounted on the crank-shaft thereof, a casing connecting the exhaust-port of the combustion-engine with the intake-port of the turbine, a steam-generator within said casing connecting said jacket with said intake-port, and means for producing a circulation of the cooling liquid through said jacket and generator, substantially as described.

4. The combination with an internal-combustion engine and jacket therefor, of a turbine mounted on the crank-shaft thereof, a casing connecting the exhaust-port of the combustion-engine with the intake-port of the turbine, a steam-generator within said casing connecting said jacket with said intake-port, and means controlled by said crank-shaft for producing a circulation of the cooling liquid through said jacket and generator, substantially as described.

5. The combination with an internal-combustion engine, and jacket therefor of a turbine mounted on the crank-shaft thereof, a casing connecting the combustion-engine exhaust-port with the turbine intake-port, said jacket provided with an inlet and an outlet, a conduit between said jacket-outlet and turbine-intake passing through said casing, and means for forcing said jacket-water into said conduit, substantially as described.

6. The combination with an internal-combustion engine and jacket therefor, of a turbine mounted on the crank-shaft thereof, a casing connecting the combustion-engine exhaust-port with the turbine intake-port, said jacket provided with an inlet and an outlet, an auxiliary casing about said outlet, a coiled pipe within said casing one end entering said outlet and the other the turbine-intake, and means for forcing water through said jacket into said coiled pipe, substantially as described.

In testimony that I claim the foregoing invention as my own I have hereto affixed my signature in the presence of two witnesses.

ANDREW DU SHANE.

Witnesses:

JAMES M. BRODBECK,

HARRY G. SCHOCK.