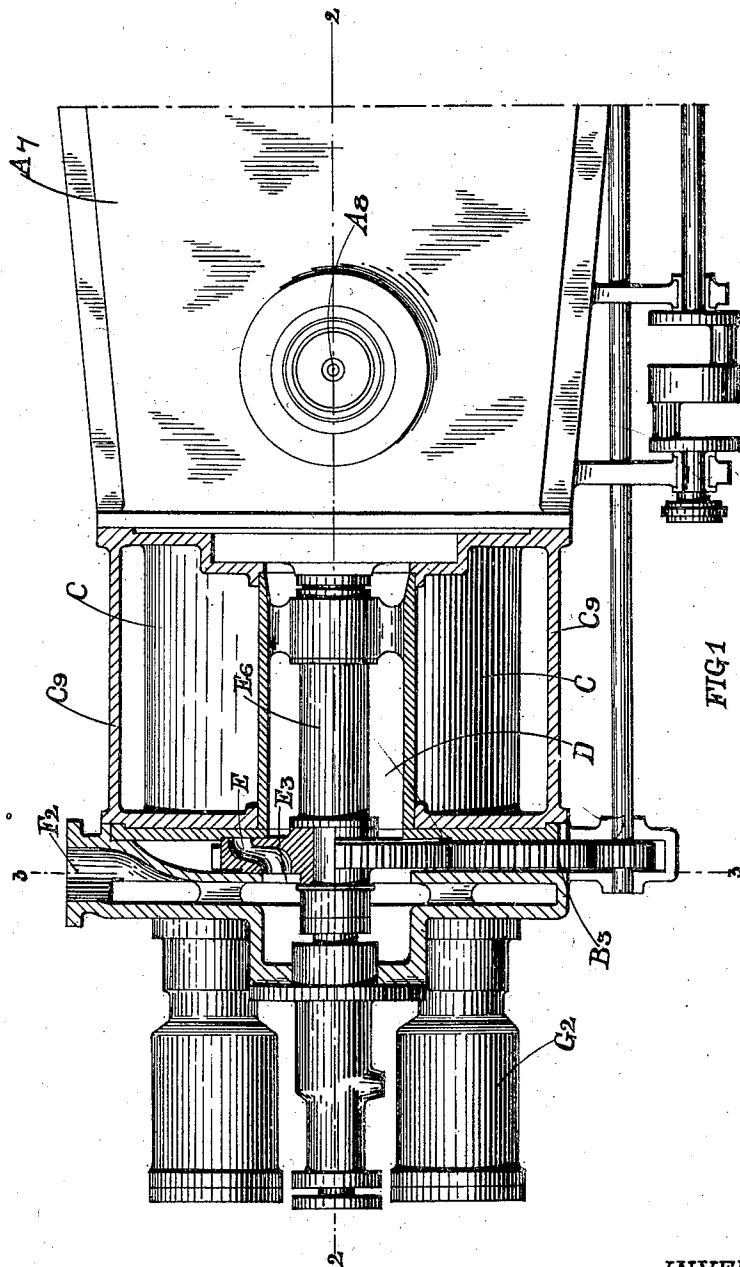


H. S. JOHNSON.
INTERNAL COMBUSTION TURBINE.
APPLICATION FILED MAR. 9, 1920.

1,421,087.

Patented June 27, 1922.

4 SHEETS—SHEET 1.



WITNESSES:

E. L. Tolson

INVENTOR:

Herbert Stone Johnson

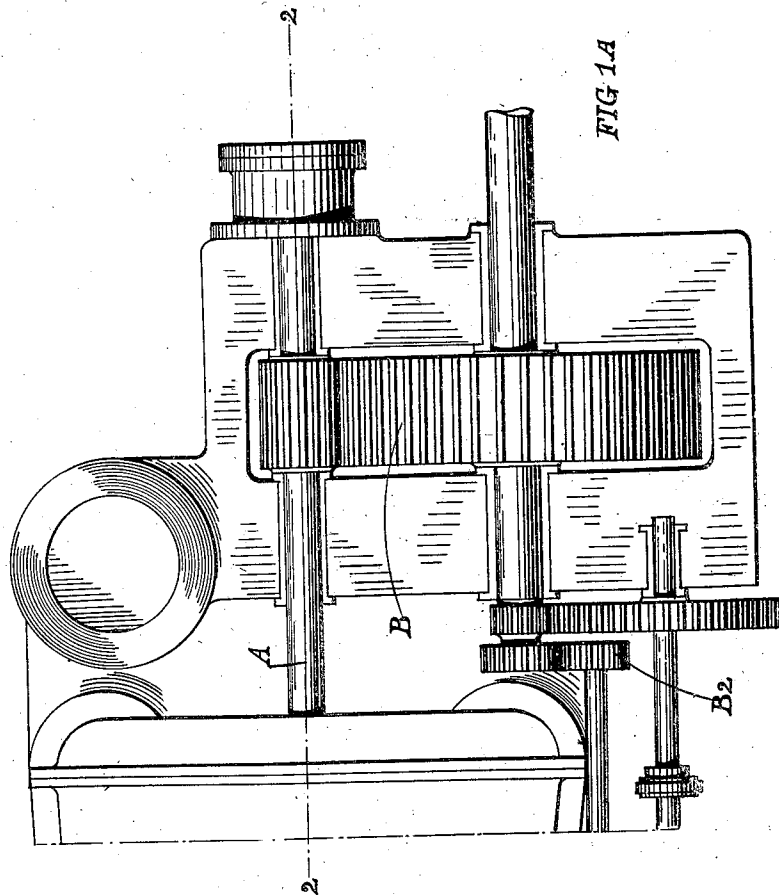
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Herbert Stone Johnson
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4 SHEETS—SHEET 2.



WITNESSES:

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1,421,087.

4 SHEETS—SHEET 3.



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4 SHEETS—SHEET 4.

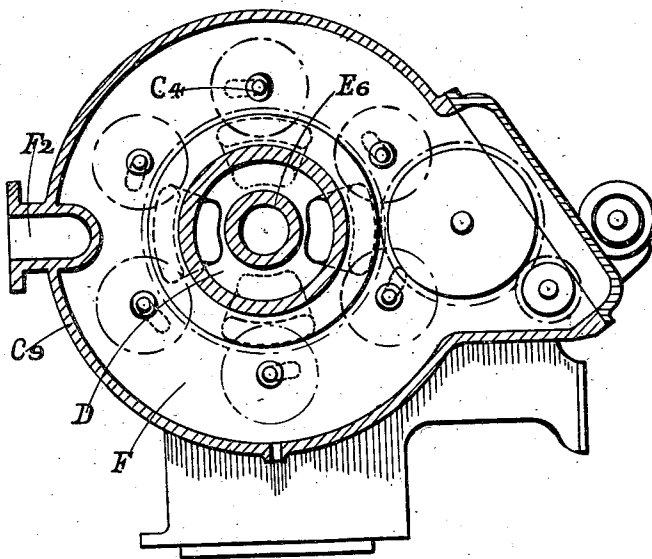


FIG 3

WITNESSES:

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ATTORNEYS

UNITED STATES PATENT OFFICE.

HERBERT STONE JOHNSON, OF NUNEATON, ENGLAND.

INTERNAL-COMBUSTION TURBINE.

1,421,087.

Specification of Letters Patent. Patented June 27, 1922.

Application filed March 9, 1920. Serial No. 364,432.

To all whom it may concern:

Be it known that I, HERBERT STONE JOHNSON, a subject of the King of England, residing at Nuneaton, in the county of Warwick, England, have invented certain new and useful Improvements in Internal-Combustion Turbines, of which the following is a specification.

This invention relates to internal combustion turbines of the type in which is used a plurality of cylinders each provided with a reciprocally moving piston and with a combustion chamber in communication with the turbine nozzle, the aforesaid piston acting to induce, to compress, and to assist in the discharge of the working gases into the turbine.

It is one of the objects of the present invention to actuate the aforesaid pistons, without the aid of cranks, connecting-rods, or the equivalent, and to provide simple valve mechanism by means of which the various operations of the cycle can be carried out. Other important features will be apparent from the description which follows.

In carrying out this invention, one end of each cylinder constitutes a pump which is separated from a combustion chamber at the other end by a piston by means of which the working charge is drawn in to the pump and after compression therein is delivered to the combustion chamber at the other end for ignition and supply to the turbine, in the process reacting upon the piston and causing it to compress a charge already drawn in at the pump end and to deliver it to a receiver common to all the pumps and combustion chamber. The piston is thereafter returned to the commencing end of its working stroke by means of a resiliently yielding thrust member which is operatively connected to the main piston and is loaded by its recoil action. In this way part of the energy evolved during combustion, is first stored and is thereafter re-stored by causing the working-piston to return to the commencing end of its stroke, thereby expelling through the turbine the remaining burnt products contained in the cylinder, and at the same time drawing in a new charge in the pump. In this manner the several pistons are operated without the necessity of employing linkwork operatively connected to the turbine shaft.

The distribution of the working fluid is

conveniently carried out by means of rotary valves operatively connected to the turbine shaft, which latter also actuates the ignition gear and a distributing valve for compressed air whereby the pistons can be set in motion initially to start the cycle of operations.

The manner of carrying out the invention is illustrated in the accompanying drawings, in which—

Figure 1 is a plan view, partly in section on a central horizontal plane, shewing one half of the turbine, the other half being shewn in Figure 1^A.

Figure 2 is a sectional side elevation on the line 2—2 of Figure 1, and

Figure 3 is a transverse section on the line 3—3 of Figure 1.

Like letters indicate like parts throughout the drawings.

The turbine shaft A of the rotor A² contained in the turbine casing A³, extends beyond the end of the latter, and cylinders C are equally spaced around it with their axes arranged parallel to the shaft-axis A. In the space between the shaft A and the cylinders C is a chamber D constituting a receiver, at whose ends are rotating disc-valves E, E² which extend over ports C², C³ in the ends of the cylinders. These valves E, E² are secured upon the shaft A⁰ which is co-axial with the rotor shaft A, and is operatively connected to the latter by the gearing B, B² and B³, and are spaced apart by a sleeve whose function will hereafter be explained.

Of these rotating valves, that indicated at E puts each cylinder at the pump end alternately in communication with a charge-induction chamber F and with the receiver D, ports E³, E⁴ being provided in the valve for this purpose; the other E² places the receiver D by way of a transfer passage E⁵ in communication with the working-end of the cylinder, and after ignition of the mixture therein uncovers a jet orifice C⁴ by means of its radial flange E⁷ constituted by a ring around the valve which overlies the orifice and which though shown integral with the valve may be merely attached thereto through which the working-charge acts on the turbine blades A⁴ in the known manner and thereafter leaves the turbine casing by way of the exhaust passage A⁵.

Each piston C⁵ of the cylinders C is con-

connected by a piston-rod C^6 extending fluid-tight through the pump-end of the cylinder to the piston G of an auxiliary cylinder G^2 constituting a resiliently yielding thrust member in the form of a dashpot provided with a closed annular chamber G^3 in which air is compressed as the pistons G and C^5 move outwardly during the firing-stroke such air entering the chamber G^3 by way of the port G^4 . Subsequent expansion of this air, after the explosion pressure has fallen sufficiently to permit it, causes the piston C^5 to be returned to its inner position for the next firing-stroke. Thus the reciprocations of the pistons C^5 are caused to take place without the aid of linkwork or other operative connection to the turbine shaft and during these movements the charge is drawn in at the pump end of the cylinder C and compressed into the receiver D .

To prevent the piston C^5 striking the ends of the cylinder, air is trapped at the outer end of the auxiliary cylinder G^2 in the known manner, but the other end of the latter, remote from the closed chamber G^3 forms a subsidiary dashpot which communicates with the atmosphere by a vent G^5 until the piston G covers the vent, trapping takes place at this end also. In the latter process some of the trapped air may be delivered by way of a conduit G^6 containing an appropriately loaded non-return valve G^7 , to the firing end of the cylinder C to impinge on the spark-plug electrodes normally inserted through aperture K but not shown and cool them.

For starting purposes, ports C^7 are provided in the firing end of each cylinder whereby compressed air is led into each in succession, just after the transfer port C^3 and jet orifice C^4 have closed.

In starting up, the compressed air drives the piston C^5 along its firing stroke (i. e., in the direction to the left in Figures 1 and 2) causing the cylinder contents at the pump end to be delivered into the receiver D and at the same time compressing air in the auxiliary cylinder G^2 . Rotational movement of the turbine by manual or other means then causes the motive air to be cut off and the rotating valve E^2 after admitting the contents of the receiver D to the working end of the cylinder uncovers the jet orifice C^4 and allows them to pass into the turbine casing A^3 , and to impinge on the rotor blades A^4 thus keeping the rotor in motion. Thereupon the compressed air in the auxiliary cylinder G^2 returns the piston C^5 to the inner end of the cylinder and causes the pump to draw in a charge from the induction chamber F whose supply port is at F^2 . The next admission of motor air actuates the piston C^5 to compress and deliver this charge to the receiver D , whence, by the

passage E^5 in the valve E^2 , it enters the working end of the cylinder C , is ignited, and again the piston C^5 is driven outwardly along its working stroke, the jet orifice C^4 is opened and the contents of the cylinder operate on the turbine blades to actuate the rotor. The piston is thereafter returned as before and the cycle of operations is repeated.

This cycle of operations is carried out by each cylinder in succession, and preferably opposite pairs of cylinders act in unison to give a balanced torque on the rotor.

Non-return valves C^8 control the ports C^7 for the entry of the compressed air for starting and are loaded somewhat below the normal compression pressure attained previous to ignition, so that when each cylinder is in operation and the compression pressure is "piled up" in the receiver against it, motive air automatically ceases to enter.

The usual non-return inlet valve may be applied to the closed chamber of the auxiliary cylinder or dashpot G^2 to provide for air lost by leakage therefrom.

The cylinders and receiver may be formed integrally or otherwise with a casing C^9 constituting water jackets for each thus forming a neat and simple arrangement.

An important feature of the invention is the manner of preventing binding of the valves E , E^2 on the ends of cylinders. The latter may attain a higher temperature than the sleeve E^5 forming a distance piece between the two rotary valves and situated in the relatively cool receiver D . This sleeve may be of a metal such as aluminium, having a higher coefficient of expansion than the cylinder metal, thereby compensating for the effects of the difference of temperatures aforesaid. By this means the valves E , E^2 can be held against their port-faces without binding thereon, the valve E and also the sleeve E^5 being for this purpose movable endwise on the turbine shaft A . The valve thus movable is resiliently pressed against the sleeve end by a spring washer E^7 backed by lock-nuts E^8 . These valves E , E^2 being of equal diameter are balanced against end-pressure upon their valve-faces.

To cool the turbine and utilize otherwise waste heat, its casing A^3 is surrounded by a jacket A^7 and water is fed in the space thus constituted, from the exhaust end of the turbine. Steam generated in the jacket is delivered by a valve A^8 and an appropriate nozzle A^9 to act both on the turbine blades and to cool them. The interior of the rotor A^2 may be similarly cooled by admitting water therein through a central longitudinal conduit A^{10} in the shaft A and a lateral passage A^{11} in the rotor hub. Any steam formed within the rotor is delivered on the turbine blades for the purpose just

mentioned by way of an aperture A¹² in the periphery of the rotor. This aperture A¹² is directed axially of the turbine upon the adjacent stationary blades A¹⁴ in the turbine casing. The inflow of water by the conduit A¹⁰ may be regulated by any convenient automatic or other valve.

Any appropriate form of ignition gear may be employed such for example as a magneto operatively connected to the turbine shaft.

What I claim as my invention and desire to secure by Letters Patent of the United States is:—

1. In an internal combustion turbine, a plurality of cylinders each having a combustion chamber communicating with a fluid delivery nozzle of said turbine and spaced around the end wall of its casing with their axes parallel to the rotational axis of said turbine, pistons adapted to move reciprocally in each of said cylinders, pump chambers in each cylinder constituted by the ends remote from the combustion chambers, passages connecting said pump chambers with a mixture-supply source and with the combustion chambers, rotating valves at each end of the cylinders co-axially mounted in reference to the turbine shaft and operatively connected to it and controlling said passages, those at the pump ends alternately connecting the pumps with the mixture-supply source and with the passage to the combustion chamber; those at the other ends alternately connecting the combustion chambers with the aforesaid passages from the pump ends and controlling also the discharge from the combustion chamber into the turbine nozzles, and resiliently-yielding thrust members operatively connected to each piston aforesaid, substantially as set forth.

2. In an internal combustion turbine as claimed in claim 1, rotating fluid-control valves constituted by discs extending, one over the pump ends and the other over the combustion chamber ends of the cylinders, one valve fixed on a rotating valve shaft; the other valve rotationally fast but endwise free on said shaft, and spaced from the fixed valve by a distance piece of a material whose co-efficient of expansion by heat is greater than that of the material of the cylinders; and a resilient thrust member adapted to press the endwise-displaceable valve on its seating, substantially as set forth.

3. In an internal combustion turbine as claimed in claim 1, a subsidiary dashpot, a conduit connecting the compression chamber of the subsidiary dashpot with the combustion chamber end of its associated cylinder,

and a non-return valve situated in said conduit, substantially as set forth.

4. In an internal combustion turbine according to claim 1, a water-injection conduit extending axially into the turbine rotor shaft, a lateral passage connecting the interior of the rotor with said conduit, and a valve controlling the fluid delivered through the aforesaid conduit, substantially as set forth.

5. In an internal combustion turbine according to claim 1, ports in each combustion chamber for the entry of a compressed fluid at starting, each port provided with a non-return valve, substantially as set forth.

6. In an internal combustion turbine, a plurality of cylinders each having a combustion chamber communicating with a fluid delivery nozzle of said turbine and spaced around the end wall of its casing with their axes parallel to the rotational axis of said turbine, pistons adapted to move reciprocally in each of said cylinders, pump chambers in each cylinder constituted by the ends remote from the combustion chambers, passages connecting said pump chambers with a mixture-supply source and with the combustion chambers, rotating valves at each end of the cylinders co-axially mounted in reference to the turbine shaft and operatively connected to it and controlling said passages, those at the pump ends alternately connecting the pumps with the mixture-supply source and with the passage to the combustion chamber; those at the other ends alternately connecting the combustion chambers with the aforesaid passages from the pump ends and controlling also the discharge from the combustion chamber into the turbine nozzles, and resiliently-yielding thrust members operatively connected to each piston aforesaid, a conduit connecting the compression chamber of a subsidiary dashpot with the combustion chamber end of its associated cylinder, and a non-return valve situated in said conduit, a receiving chamber constituted by the space enclosed by the cylinders and by the rotating disc valves, said receiver forming a common chamber for the reception of the mixture delivered by the several pumps to the respective combustion chambers, substantially as set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

HERBERT STONE JOHNSON.

Witnesses:

WILLIAM ERNEST HALFORD,
ALBERT EDWARD MARRIOTT.