No. 861,329. PATENTED JULY 30, 1907.

A. STODOLA.

EXPLOSION GAS TURBINE.

APPLICATION FILED JULY 3, 1905.

3 SHEETS—SHEET 1.

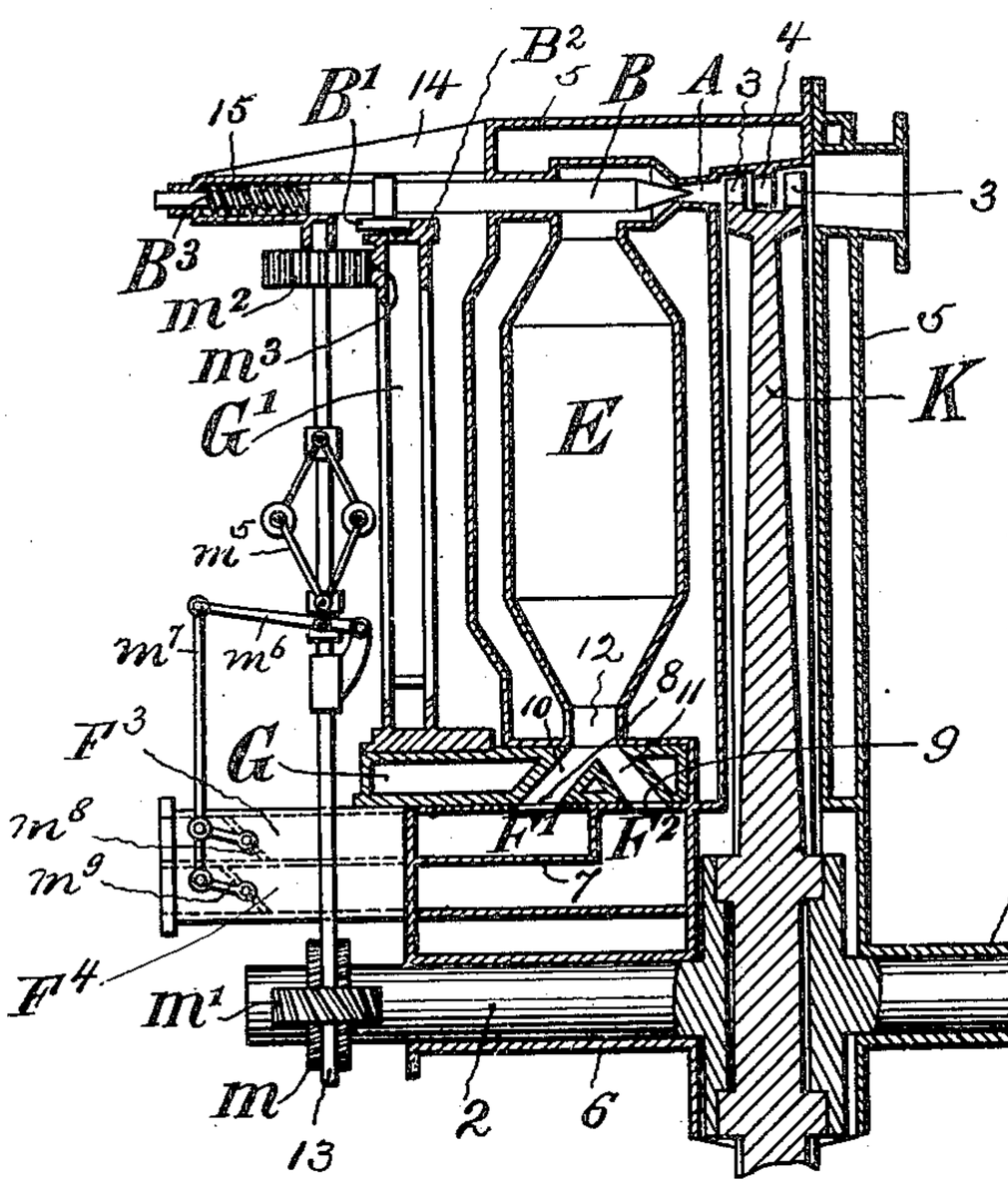


Fig. 1

Fig. 2a

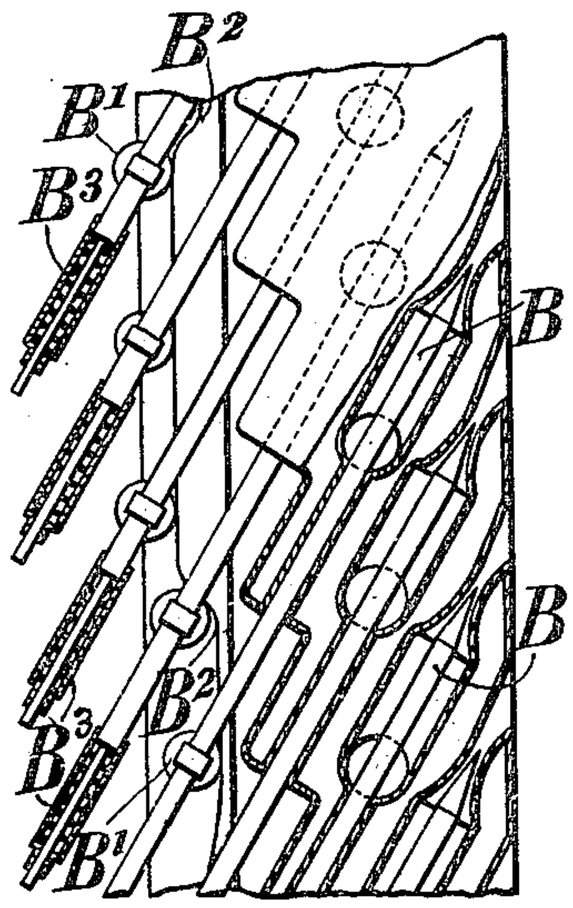


Fig. 1a

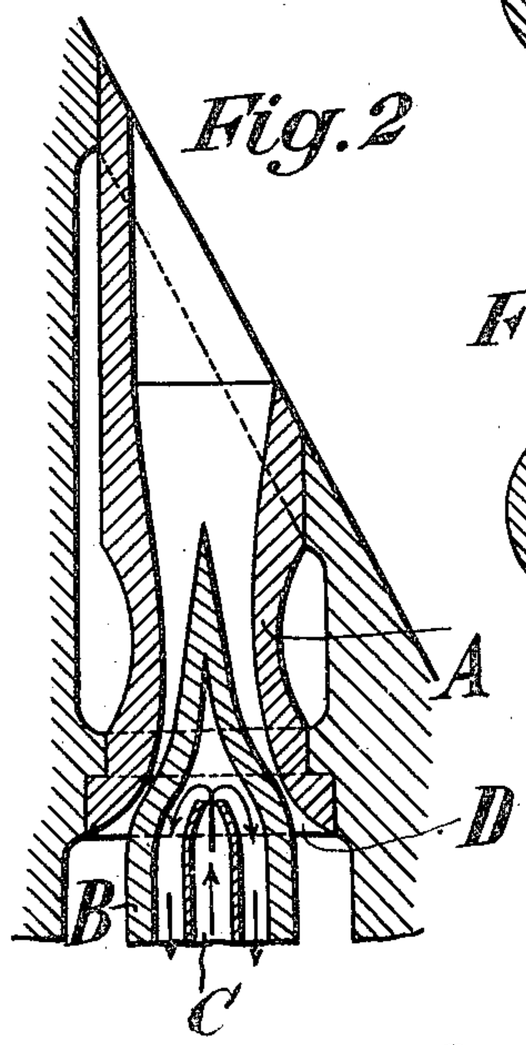


Fig. 2

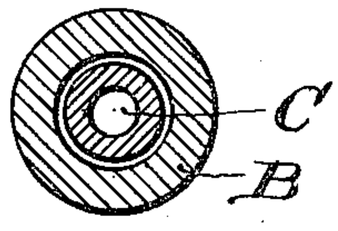
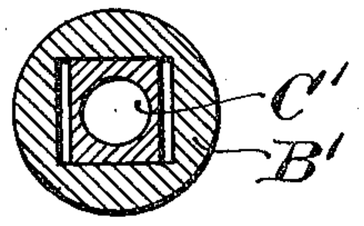


Fig. 2b



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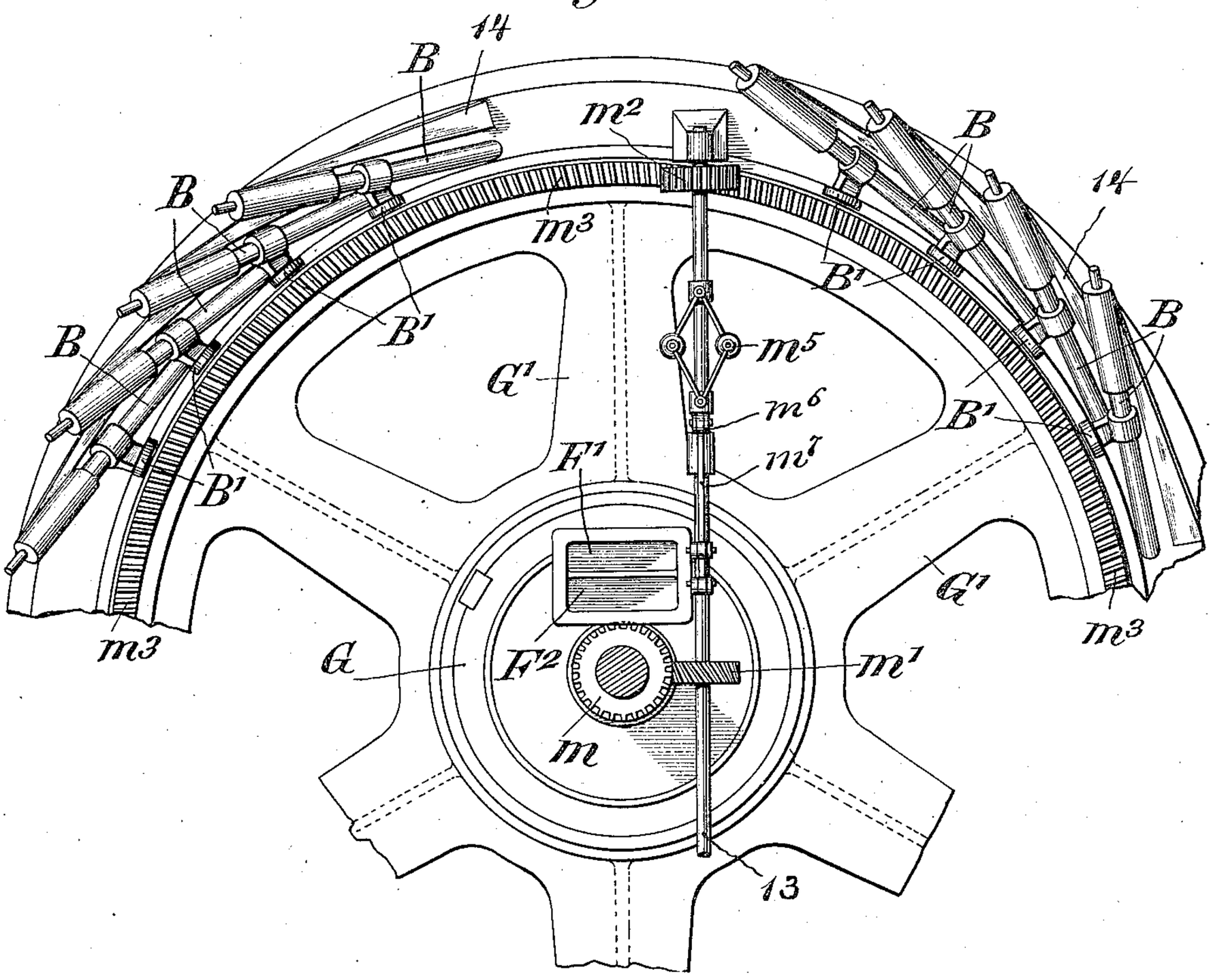
3 SHEETS—SHEET 2.

Fig. 3



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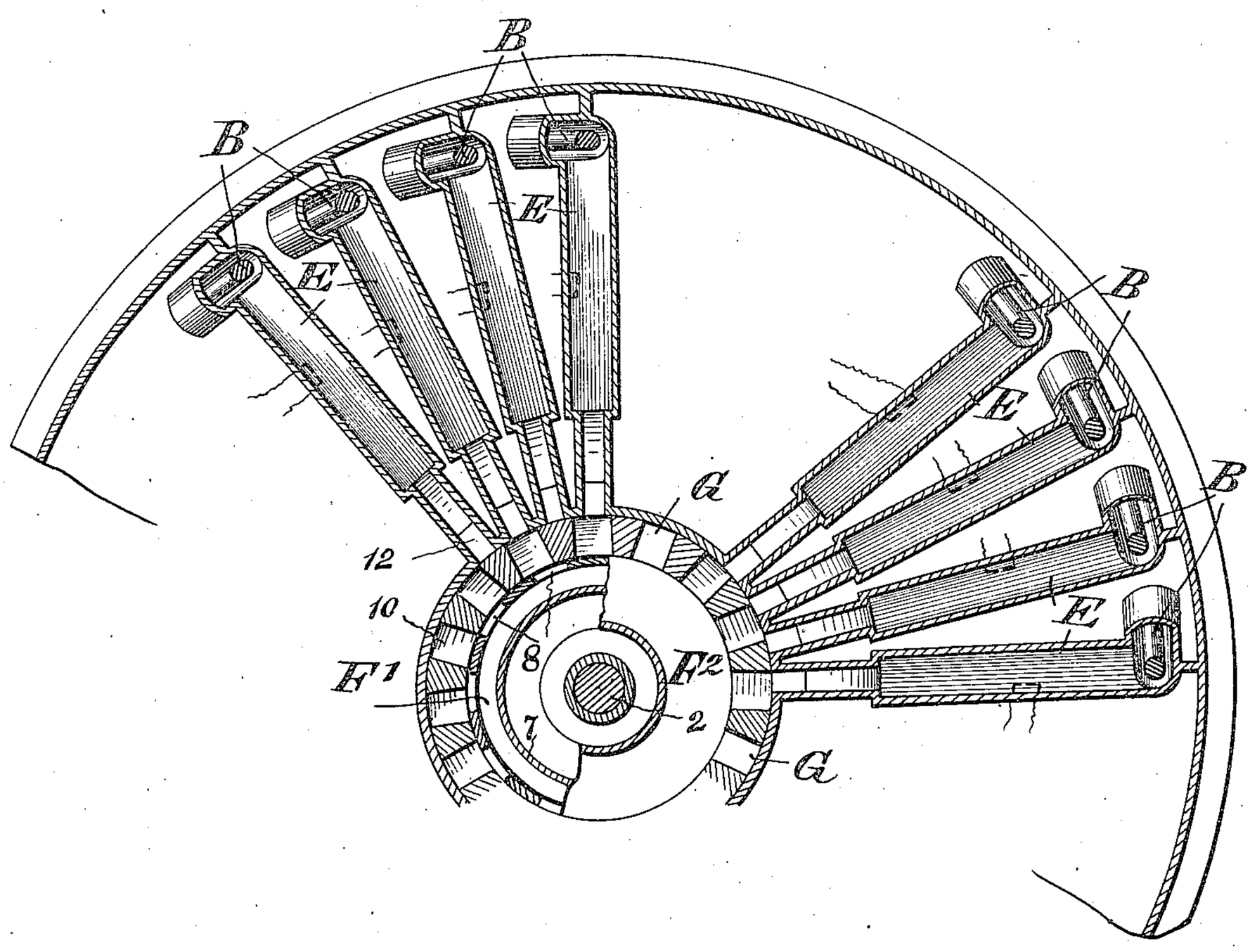
3 SHEETS—SHEET 3.

Fig. 4



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UNITED STATES PATENT OFFICE.

AUREL STODOLA, OF ZURICH, SWITZERLAND, ASSIGNOR TO THE FIRM OF AKTIENGESELLSCHAFT DER MASCHINENFABRIKEN VON ESCHER, WYSS & CO., OF ZURICH, SWITZERLAND.

EXPLOSION GAS-TURBINE.

No. 861,329. Specification of Letters Patent. Patented July 30, 1907.

Application filed July 3, 1905. Serial No. 268,218.

To all whom it may concern:

Be it known that I, AUREL STODOLA, a subject of the King of Hungary, residing at Zurich, in the Republic of Switzerland, have invented new and useful Improvements in Explosion Gas-Turbines, of which the following is a specification.

My invention relates to explosion gas turbines, and has for its object the novel construction and arrangement of parts hereinafter specifically described and claimed.

Explosion gas turbines in which there is a jet of gas acting on the turbine wheel are not usually regulable, as the pressure at the end of the nozzle varies with the pressure in the explosion chamber, and the turbine consequently operates with a bad efficiency.

My invention is designed to obviate this disadvantage by positively varying the area or cross section of the passage through the nozzle by an axially moved and cooled spindle or core in the nozzle, so that the ratio of the area of cross section of the effective opening or passage through the nozzle to the greatest cross section or area of the passage at the mouth of the nozzle at every instant has the value, which according to Zeuner's theory is necessary in order to render possible the proper expansion from the pressure for the time being in the expansion chamber, to the constant pressure in the turbine casing.

Referring to the drawings, in which like parts are similarly designated—Figure 1 is a vertical section of the upper part of a turbine. Fig. 1ª is a developed plan, partly in section, of the stationary nozzle ring. Fig. 2 is a longitudinal central section through a nozzle. Figs. 2ª and 2ᵇ are cross sections of nozzles. Fig. 3 is a partial front elevation of Fig. 1, and Fig. 4 is a vertical section through several explosion chambers.

The turbine wheel K is mounted on shaft 2, and is provided on its periphery with blades 3, here shown as two sets of blades, one set on each side of the middle stationary blades 4 on the casing 5. The shaft 2 is mounted in bearings 6 on the casing 5, said bearings concentric with the stationary air and gas supply chambers F′ and F² preferably but not necessarily constructed as concentric cylindrical chambers separated from each other by a partition 7, Figs. 1 and 4, and provided with ports 8 and 9 respectively, and entrances F³ and F⁴. On the outer chamber F′ and also extending over the chamber F² is a cylindrical valve G provided with ports 10 and 11 arranged in pairs that are designed to simultaneously come into register with the stationary ports 8 and 9 of the air and gas chambers F′ and F² respectively, and these ports 10 and 11 simultaneously discharge into the inlet 12 of one of several explosion chambers E at the upper ends of which are nozzles A presented to the blades. The cylindrical valve G is keyed or otherwise rigidly connected to a cam wheel G′ provided with a toothed ring m^3 and a cam B².

On the shaft 2 is mounted a gear or worm wheel m driving a wheel m' mounted on a spindle 13 which carries a similar wheel m^2 at its upper end meshing with and driving the toothed ring m^3 the cam wheel G′ and the valve G connected thereto. The spindle 13 has mounted upon it a ball governor m^5 that operates a lever m^6 that raises and lowers a rod m^7 that rocks the pivoted valves m^8 and m^9 controlling the entrance of air and gas to the respective chambers F′ and F².

Mounted in brackets 14 projecting from the casing 5 are cases 15 in which are mounted the outer ends of the spindles B that are surrounded by coil springs B³ urging said spindles into the nozzles A. On each spindle B is mounted an anti-friction roller B′ within the path of the cam faces B² on the cam wheel G′, as clearly shown in Figs. 1 and 1ª, said cam during its rotation withdrawing the conical ends of the spindles from the nozzles A against the pressure of their springs.

The nozzles may be circular or rectangular in section, as shown in Figs. 2ª and 2ᵇ, and the hollow spindles B may be cooled by water conveyed by pipe C to their interior, as shown in Fig. 2, said water being preferably conveyed under pressure through a round pipe C, Figs. 2 and 2ª, or a square pipe Cᵇ, Fig. 2ᵇ, to the spindle most likely to be burned out. In the positions shown in the drawings the narrowest cross-section between the casing of each spindle or core and the nozzle wall is in the form of a small annular space at D, Fig. 2, and the nozzles enable an expansion from the highest pressure to that of the atmosphere. The explosion chambers operate successively and are independent of one another, or they may be operated in groups, as desired. The spindles B preferably do not completely close the nozzles A, being held from completely closing them by the cam B² on wheel G′.

Immediately after the explosion the spindles B are substantially in the position shown in Fig. 2, and immediately thereafter the cam B² on cam wheel G′ gradually withdraws the spindles to enlarge the annular space in accordance with the decrease of pressure in the explosion chamber the area of opening thereof being in accordance with the theory of Zeuner, and when the pressure in the explosion chamber has decreased, the spindle B is again permitted to assume its normal position.

I claim—

1. In a turbine, an explosion chamber to produce gas pressure, a nozzle connected thereto having a contracted portion, a spindle to control the same and means operated by the turbine to move the spindle from the nozzle in

accordance with the gas pressure in the explosion chamber.

2. In a turbine, an explosion chamber, a nozzle leading therefrom in which the energy of the motive fluid is converted into velocity, a hollow spindle to partially close the nozzle, means to supply a cooling fluid to the interior of the nozzle, and means operated from the turbine to move the spindle from the nozzle in accordance with the decrease of pressure of the motive fluid in the explosion chamber.

3. In a turbine, an explosion chamber, a nozzle leading therefrom, a hollow spindle partially closing said nozzle, said hollow spindle supplied with a cooling liquid, a spring to urge the spindle into its normal position, and a driven cam on the turbine to actuate said spindle and withdraw it from the nozzle in accordance with the decrease of pressure in the explosion chamber.

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

AUREL STODOLA.

Witnesses:

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