May 9, 1933. M. SEDLMEIR 1,908,066

NOZZLE FOR GAS TURBINES

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Fig. 1

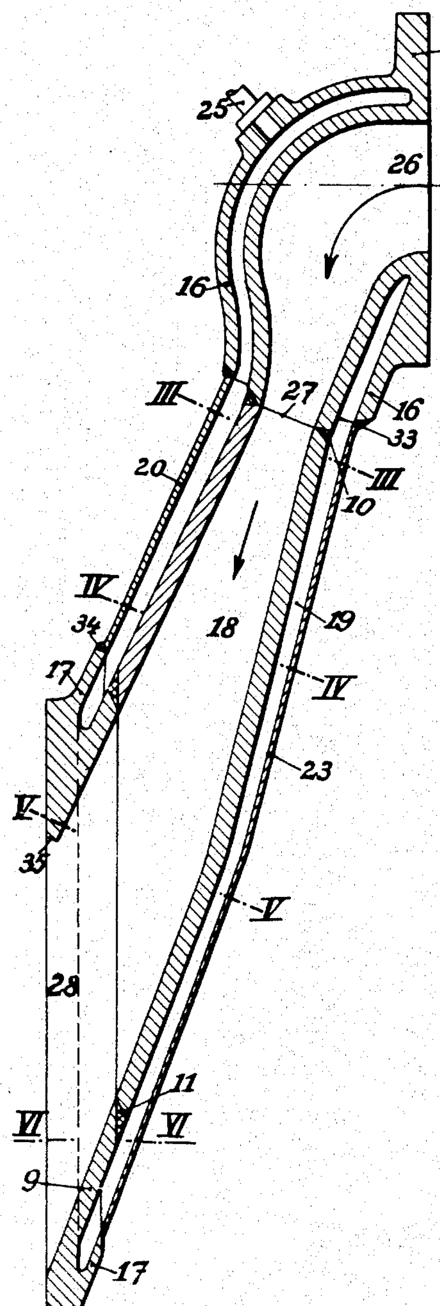


Fig. 2

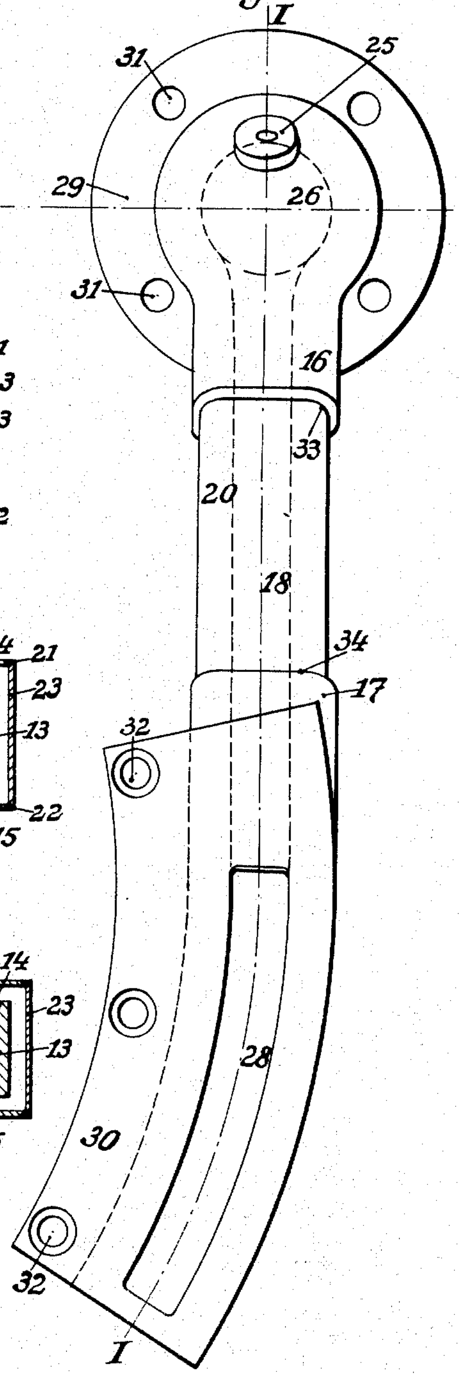


Fig. 3

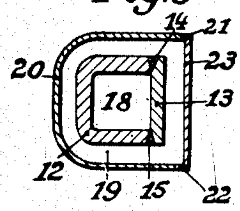


Fig. 4

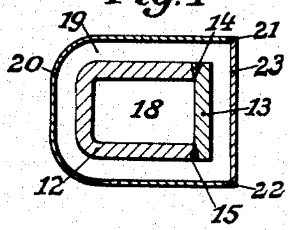
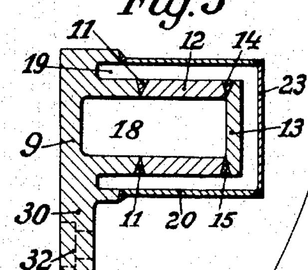


Fig. 5



Inventor
Michael Sedlmeir
By Joseph Hirschman
Attorney

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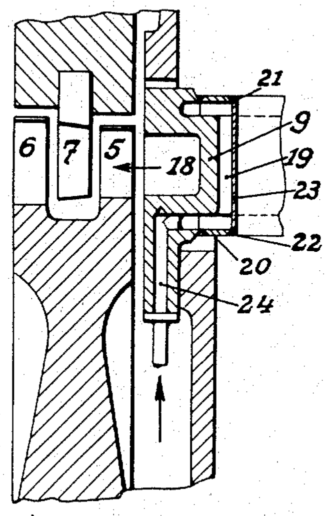
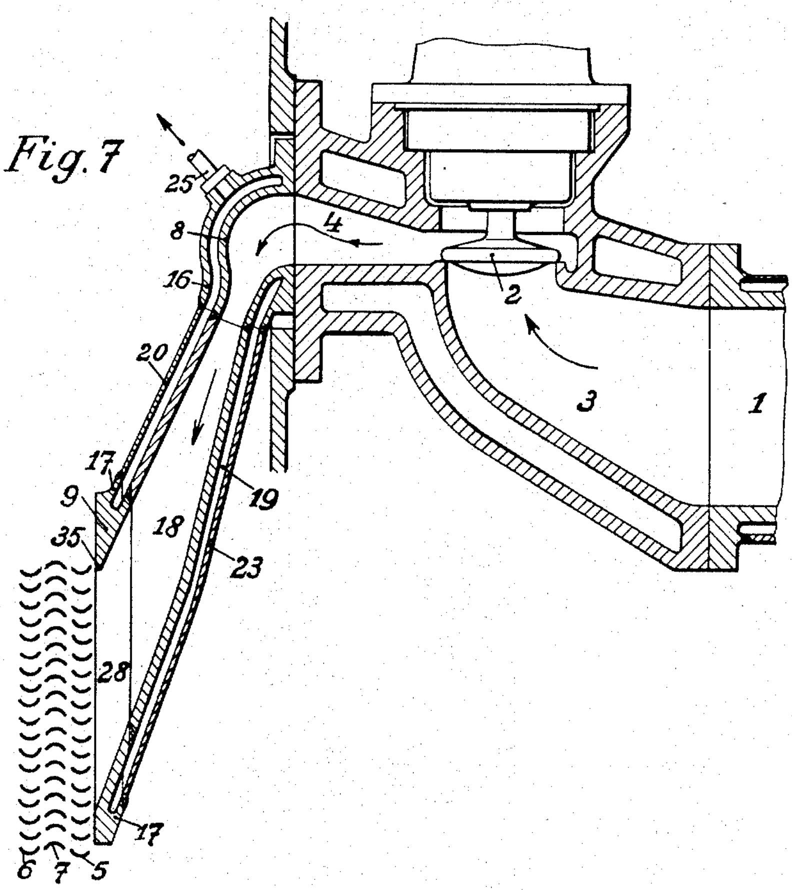


Fig. 6

Fig. 7



Inventor
Michael Sedlmeir
By Joseph Hirschman
Attorney

Patented May 9, 1933 1,908,066

UNITED STATES PATENT OFFICE

MICHAEL SEDLMEIR, OF MULHEIM-ON-THE-RUHR, GERMANY, ASSIGNOR TO HOLZWARTH GAS TURBINE CO., OF SAN FRANCISCO, CALIFORNIA, A CORPORATION OF DELAWARE

NOZZLE FOR GAS TURBINES

Application filed August 7, 1930, Serial No. 473,742, and in Germany August 22, 1929.

My invention relates to nozzles for conducting a fluid medium of such high temperature as to necessitate the employment of a cooling jacket about such nozzles; and more particularly to nozzles of the expansion type for conducting to a turbine rotor the gases generated in the explosion chamber of an explosion turbine.

It is one of the objects of the present invention to simplify the manufacture of a nozzle of the above-mentioned type and to provide a nozzle of superior efficiency and reliability. It is also an object of the invention to provide a sectional nozzle whose central portion is formed of pressed metal so that machining thereof is rendered unnecessary while at the same time greater accuracy is secured. Other objects and advantages will appear from the following description and the features of novelty will be pointed out in the claims.

In the acompanying drawings is shown by way of example a preferred embodiment of the invention. In said drawings, Fig. 1 is a longitudinal section through the nozzle along the line I—I of Fig. 2; Fig. 2 is a view of the nozzle in elevation from the outlet end thereof; Figs. 3, 4 and 5 represent transverse sections taken along the lines III—III, IV—IV, and V—V, respectively, of Fig. 1; Fig. 6 is a section along the line VI—VI of Fig. 1 and shows also the adjoining turbine parts; and Fig. 7 shows my improved nozzle in association with an explosion chamber and the rotor of an explosion turbine.

My improved nozzle is of particular advantage in combustion gas turbines and will be described in connection with such an apparatus. In such turbines, as is now well understood in the art, gases under high temperature and pressure may be generated within combustion chambers 1 (of which only one is indicated in Fig. 7 of the drawings) forming part of a gas turbine, such as an explosion turbine of the constant volume type. In this latter type of turbine, the explosion chambers are periodically charged with an explosive mixture which is exploded therein, by means not shown on the drawings, the nozzle valve 2 of each chamber being periodically opened to permit the gases to discharge from the outlet end 3 of the chamber into a nozzle channel 4. From the latter the gases flow into the gas nozzle by which they are directed against the rotor of a turbine, such rotor comprising, for example, two rows of blades 5, 6, between which are located stationary reversing blades 7.

The gases entering the nozzle are of very high temperature, so that the nozzle must be provided with a cooling jacket to prevent destruction thereof. With gas nozzles of the de Laval type, wherein the nozzle first diminishes in cross-section from the inlet end thereof to the throat section, and then increases in cross-section from such throat toward the outlet end, the latter being preferably curved to correspond to the circle along which the rotor blades lie, the provision of such cooling jacket presents many serious difficulties. When the nozzle body is formed as a single casting with as much as possible of the jacket cast integral with it, the danger exists, particularly with the larger and more complicated castings, that all of the core is not removed, so that local overheating and burning out is liable to occur when the nozzle is in use. It is also very difficult to machine the inner walls of the nozzle casting along which the hot gases flow so as to reduce friction losses.

In accordance with the present invention, I overcome these difficulties and gain certain important advantages by forming the nozzle inlet and outlet sections as separate parts, while the central section, whose form determines the velocity and pressure relations of the gas flowing therethrough, and is therefore the most critical part of the nozzle, I form of pressed metal, so that it possesses a smooth interior surface and thus reduces the energy losses due to friction. Machining of the interior of the nozzle is thus rendered unnecessary, while greater accuracy in the dimensions of the critical parts of the nozzle, such as the cross-sectional area of the throat portion, can be attained than in casting.

As shown in the drawings, the nozzle comprises an inlet section 8, an outlet section 9, and a middle section which is joined to the end sections as by welding, as shown at 10, 11. The middle section is formed of a pressed sheet metal part 12 of U-shaped cross-section and a closure plate 13 welded thereto as shown at 14, 15. The smooth surface of the plate from which the part 12 is produced is not injured during the pressing operation, so that no machining of the middle section is necessary after it is formed, so that the cost of manufacture is reduced.

The inlet and outlet sections of the nozzle are provided with jacket sections 16, 17 which extend in the direction of the nozzle axis and are connected by welding, as shown at 33, 34, with a middle jacket or shell, so that there is formed a cooling space 19 which extends for substantially the whole length of the gas passageway 18 of the nozzle. The middle cooling jacket section may, like the middle section of the nozzle body, be formed of a U-shaped part 20 and a cover plate 23 welded to the part 20 at 21, 22 (Figs. 3, 4 and 5).

The cooling medium, such as water, may enter the cooling space 19 at the outlet end of the nozzle through a conduct 24 (Fig. 6) and is withdrawn by conduit 25 (Fig. 1) at the inlet end of the nozzle.

The end sections 8 and 9 of the nozzle may be of cast steel, while the middle portion may be made of a metal or alloy adapted to be welded with steel, such as nickel-copper-iron alloys or wrought iron plate. Because of the efficient cooling of the nozzle body by the aid of the cooling jacket, the inner walls of the nozzle need be only strong enough to withstand the pressure of the gases flowing through the nozzle, so that wrought iron plate offers a very satisfactory structural material.

The inlet 26 of the nozzle is of circular form, the inlet section rapidly diminishing in cross-section to the throat 27 which is in the region of the welding seam 10. From the throat 27 the nozzle gradually increases in cross-section to the sector-shaped outlet 28. The shorter or upper nozzle wall is preferably cut away in advance of the outlet, as shown at 35, in order to avoid the presence of too much metal between the cooling space 19 and the inner surface of such wall. The end castings 8 and 9 are provided with flanges 29 and 30, respectively, having openings 31 and 32 to receive fastening means whereby the nozzle may be fixed to the turbine frame.

Variations may be resorted to within the scope of the appended claims without departing from the spirit of the invention. For instance, the parts 12 and 20 need not be made of U-form but may be given other shapes.

I claim:

1. A jacketed nozzle suitable for use with explosion chambers, preferably in gas turbines, comprising separately cast inlet and outlet sections and a middle section formed of sheet metal with a smooth surface and connected with the inlet and outlet sections along lines transverse to the axis of the nozzle, the inlet section terminating in the vicinity of the throat of the nozzle, the inlet and outlet sections having jackets integral therewith, and a jacket of sheet metal surrounding the middle section and connected with the first mentioned jackets.

2. A nozzle suitable for use in explosion gas turbines, comprising a body portion having separately formed inlet, outlet and middle sections, said middle section comprising a sheet metal part of U-shape and a closure plate connected therewith, and a cooling jacket about said sections.

3. A nozzle suitable for use in explosion gas turbines, comprising a body portion having separately formed inlet, outlet and middle sections and a cooling jacket about said sections, the portion of said jacket about the middle section comprising a sheet-metal part of U-shape and a closure plate connected therewith.

MICHAEL SEDLMEIR.