

No. 739,191.

PATENTED SEPT. 15, 1903.

P. KUGEL & V. GELPKE.

STEAM TURBINE.

APPLICATION FILED MAR. 30, 1903.

NO MODEL.

2 SHEETS—SHEET 1.

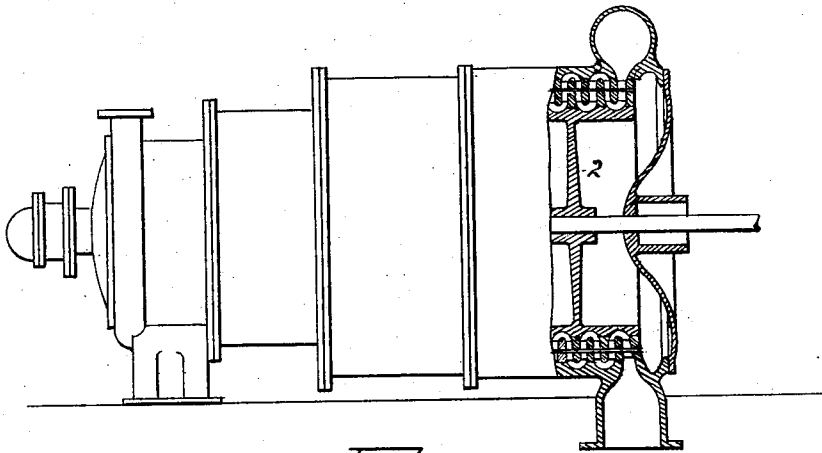


Fig. 1.

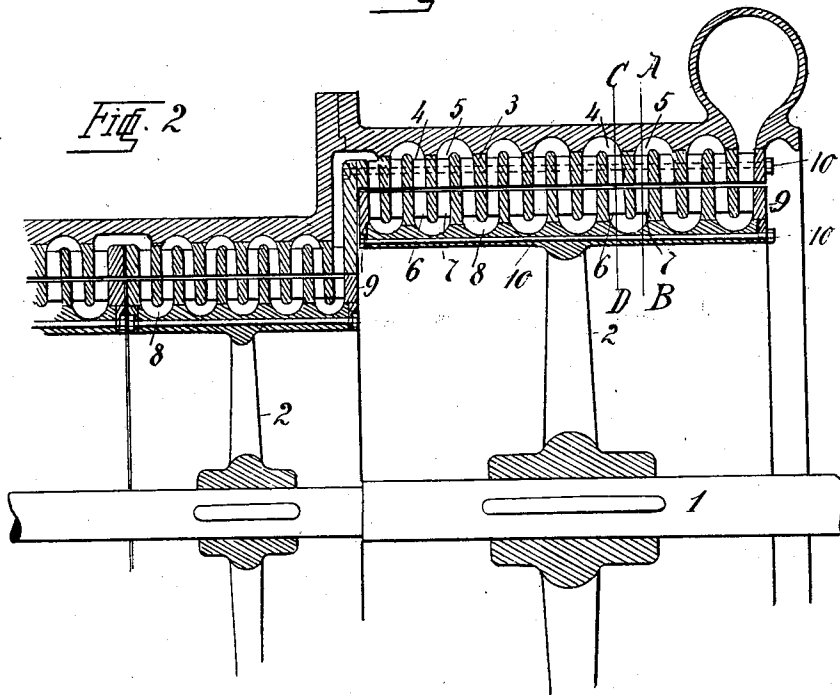
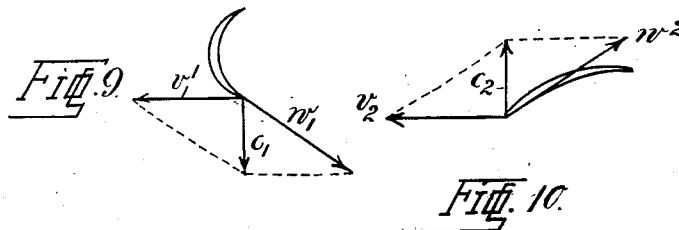


Fig. 2.



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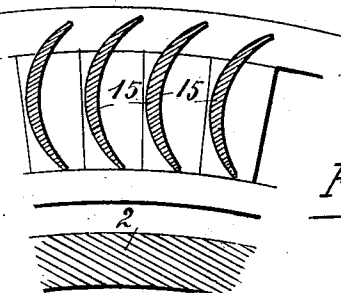
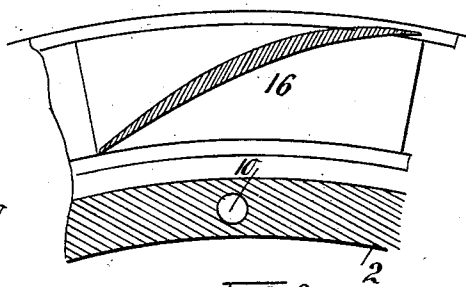
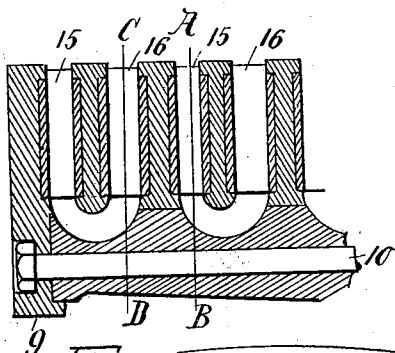
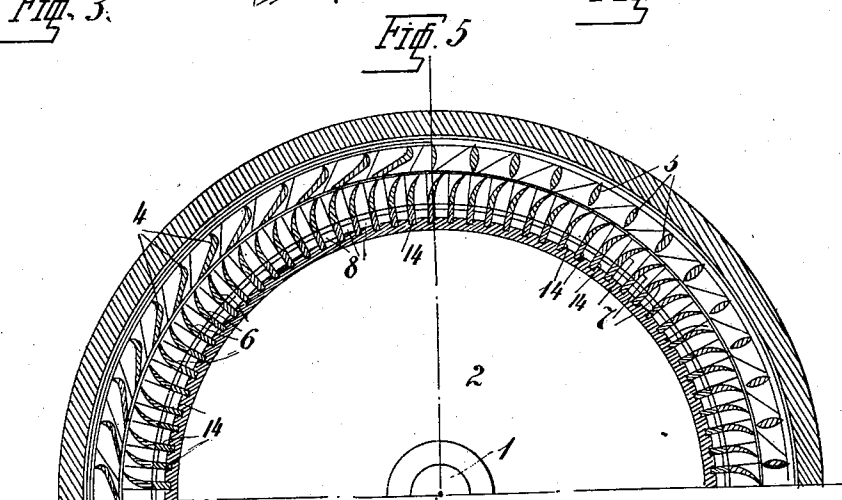
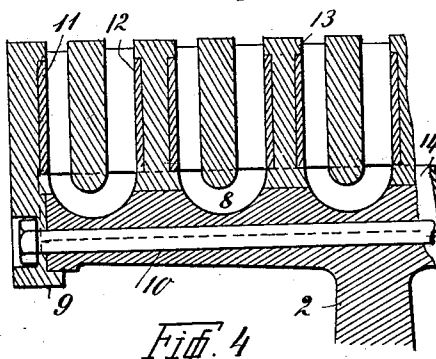
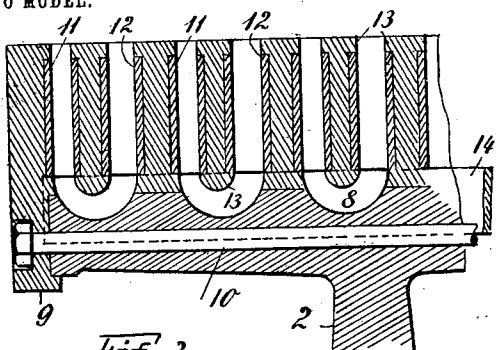
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2 SHEETS—SHEET 2.

NO MODEL.



Witnesses:  
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# UNITED STATES PATENT OFFICE.

PAUL KUGEL AND VICTOR GELPKE, OF ZÜRICH, SWITZERLAND.

## STEAM-TURBINE.

SPECIFICATION forming part of Letters Patent No. 739,191, dated September 15, 1903.

Application filed March 30, 1903. Serial No. 150,232. (No model.)

*To all whom it may concern:*

Be it known that we, PAUL KUGEL and VICTOR GELPKE, engineers, citizens of the Republic of Switzerland, and residents of Zürich, Switzerland, have invented new and useful Improvements in Steam or Gas Turbines with Radial Inward Flow, of which the following is a specification.

This invention relates to improvements in steam or gas turbines with radial inward flow, the construction of which is improved in such a manner that the driving medium makes a U-shaped way and is conducted in such a manner that it repeatedly strikes the vanes. In the accompanying drawings, Figure 1 represents a turbine partly in front view and partly in section. Fig. 2 is an axial section showing the arrangement of the blades and vanes. Figs. 3 and 4 are vertical sections showing the blades and vanes of slightly-modified construction. Fig. 5 is a section on line A B of Figs. 2 and 4, showing in the left half the active blades and vanes and in the right half the inactive blades and vanes. Fig. 6 shows in an axial section a modified construction of the running wheel. Fig. 7 shows the active vanes in radial section on line A B of Fig. 6. Fig. 8 is a radial section on line C D of Fig. 6, showing a modified construction of the inactive vanes. Figs. 9 and 10 are diagrams showing the velocity of the driving medium.

The improved steam-turbine comprises, as usual, the running wheels 2, keyed to the shaft 1, and the directrices 3, surrounding the running wheels. The running wheels 2, as well as the directrices 3, have blade-rims composed of alternating sets of active and inactive sets of blades and vanes 6 7, respectively. Each pair of sets is connected at the bottom by a U-shaped channel 8.

The active blades 4, as well as the inactive blades 5 of the directrices and the vanes 6 7 of the running wheels, consist of single blades, which are kept in place by end plates 9, connected through long horizontal screws 10.

Each set of active or inactive blades or vanes can be made in one piece, as shown in Fig. 2, or separately, as shown in Figs. 3 and 4, in which latter case a certain number of rings 11 and 12 are required to keep the single vanes in place. The vanes shown in Fig. 4

are held between the rings 11 12 by means of lateral projections 13.

As shown in Fig. 3, two or more rows of vanes can be made in one piece and secured in place by rings. The blades 4 5 of the directrices are secured in place in the same manner as hereinbefore described with reference to the vanes of the running wheels. In the U-shaped channels 8 cross-pieces 14 are provided between the consecutive blades or vanes, so that each pair of active or inactive blades or vanes is separated from the next pair by such cross-pieces 14, whereby, so to say, separate buckets are formed, in which each flow of steam is securely guided, so that it cannot get into the next following bucket. The cross-pieces 14 further serve for increasing the stability of the whole construction. The space between the surfaces of the running wheels 2 and the directrices 3 is thus reduced to a minimum and an easy fitting of the blades and vanes is obtained.

This improved steam-turbine operates as follows: The steam first strikes the active blades and is then conducted on to the corresponding active vane and through the U-shaped channel to the corresponding inactive vane, and from there to the inactive blade, and from thence through the U-shaped channel of the directrix to the next active blade, from thence to the active vane, and so on.

As it is very essential for the efficiency of the turbine to make the driving medium pass through the U-shaped channels with as little speed as possible, so as to prevent the loss of energy which is required for overcoming the resistance in the curvature, the kinetic energy must be taken out of each quantity of driving medium on the active vane before the driving medium gets to the U-shaped channel. This is obtained in the improved construction shown in Figs. 6, 7, and 8 by placing the active vanes 15 not at a right angle to the tangent, but at an acute angle, as shown in Fig. 7. The cross-pieces 14 are dispensed with. The active vanes 16 are placed at an acute angle to the tangent, as shown in Fig. 8. In this improved construction the driving medium exerts practically all its kinetic energy on the active vanes 16, as can be seen from the diagrams shown in Figs. 9 and 10. The driving medium leaves the active vane

- with the relative velocity  $w$ , Fig. 9, and combines with the velocity of periphery  $v$  to the absolute velocity  $c$ , with which velocity it passes through the U-shaped channel, strikes the inactive vane, Fig. 10, and combines again with the velocity of periphery  $v$  to the relative velocity  $w$ , with which velocity  $w'$  it slides along the surface of the inactive vane and leaves the running wheel.
- 10 Having fully described our invention, what we claim, and desire to secure by Letters Patent, is—
1. Improved steam or gas turbine, comprising in combination running wheels fixed to the main shaft, directrices surrounding the running wheels alternating sets of active and of inactive blades on the rim of the directrices, alternating sets of active and inactive vanes on the rim of the running wheels, U-shaped channels in the running wheels and directrices respectively below and above the vanes and blades connecting one active set with its corresponding inactive set, cross-pieces in the U-shaped channels for separating one pair of blades and vanes from the following, substantially as described and shown and for the purpose set forth.
  2. Improved steam or gas turbine, comprising in combination running wheels fixed to the main shaft, directrices surrounding the running wheels alternating sets of active and of inactive blades on the rim of the directrices, alternating sets of active and inactive vanes on the rim of the running wheels, said sets of blades and vanes being made each in one piece, U-shaped channels in the running wheels and directrices respectively below and above the vanes and blades connecting one active set with its corresponding inactive set, cross-pieces in the U-shaped channels for separating one pair of blades and vanes from the following, substantially as described and shown and for the purpose set forth.
  3. Improved steam or gas turbine, comprising

ing in combination running wheels fixed to the main shaft, directrices surrounding the running wheels alternating sets of active and inactive blades on the rim of the directrices, alternating sets of active and inactive vanes on the rim of the running wheels, said sets of blades and vanes being composed of single blades and vanes, rings between the several blades or vanes of one set, end plates at the end of each set, long horizontal screws connecting the end plates of each set, lateral projections of the blades and vanes entering corresponding recesses of the rings, U-shaped channels in the running wheels and directrices respectively below and above the vanes and blades connecting one active set with its corresponding inactive set, cross-pieces in the U-shaped channels for separating one pair of blades and vanes from the following, substantially as described and shown and for the purpose set forth.

4. Improved steam or gas turbine, comprising in combination running wheels fixed to the main shaft, directrices surrounding the running wheels alternating sets of active and inactive blades on the rim of the directrices, alternating sets of active and inactive vanes on the rim of the running wheels, the active vanes and the inactive vanes being placed at an acute angle to the tangent, U-shaped channels in the running wheels and directrices respectively below and above the vanes and blades connecting one active set with its corresponding inactive set, substantially as described and shown and for the purpose set forth.

In testimony whereof we have hereunto set our hands in presence of two subscribing witnesses.

PAUL KUGEL.  
VICTOR GELPKE.

Witnesses:

A. LIEBERKNECHT,  
A. CUMINS.