B. LJUNGSTRÖM.

TURBINE.

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962,088.

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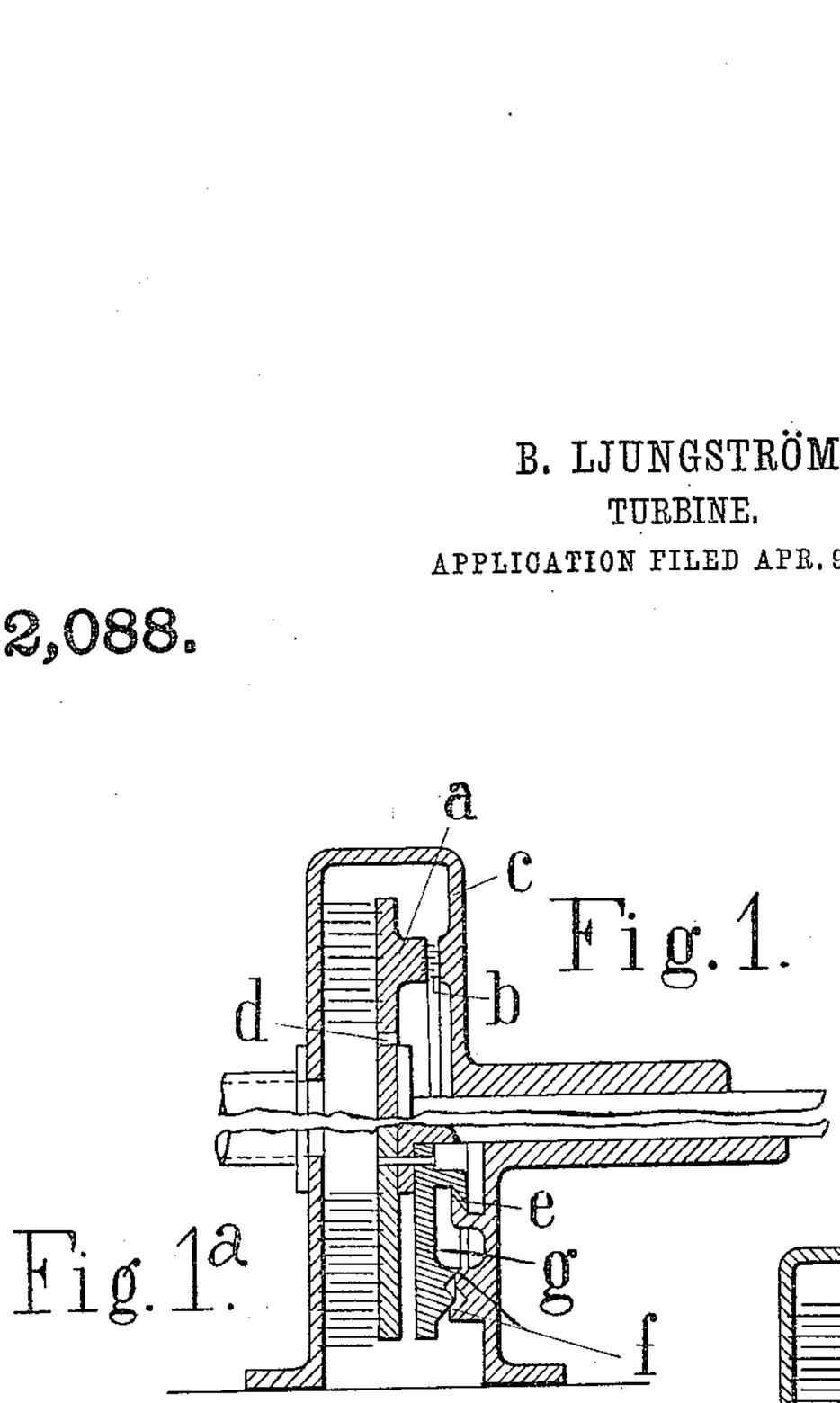

Fig. 1.

Fig. 1a.

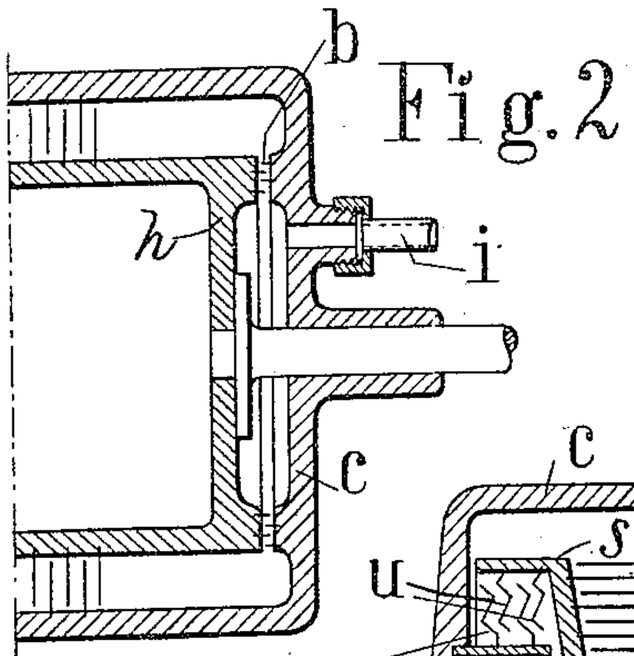

Fig. 2

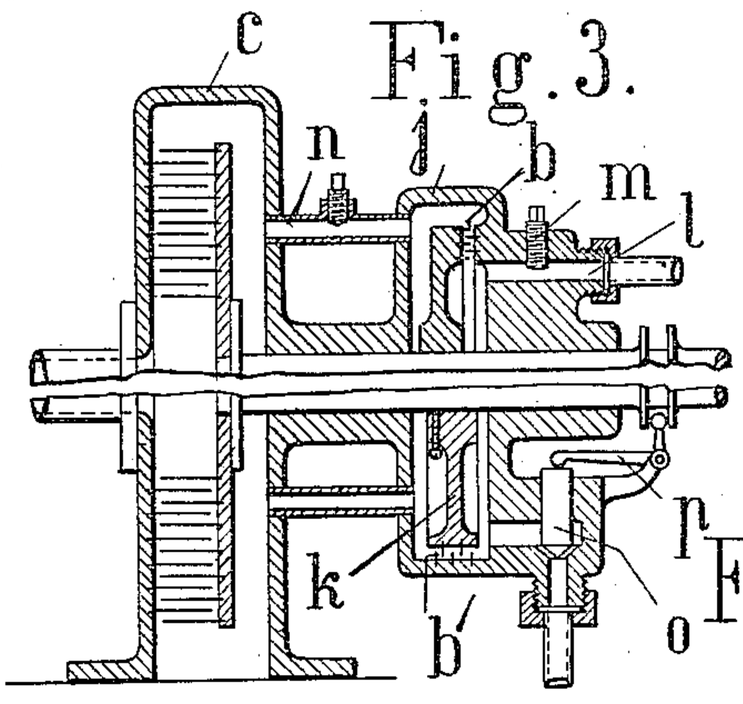

Fig. 3.

Fig. 3a.

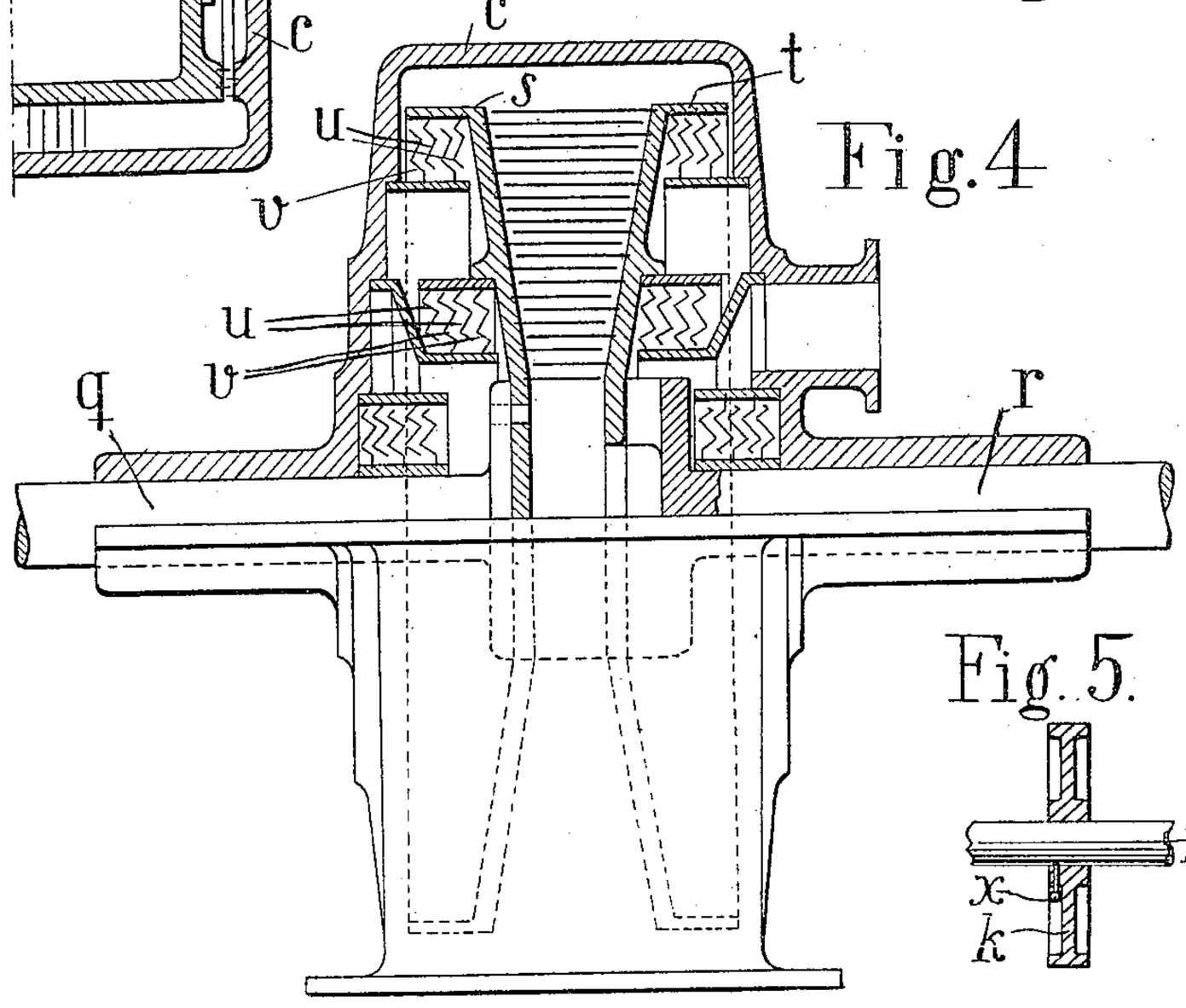

Fig. 4

Fig. 5.

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UNITED STATES PATENT OFFICE.

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TURBINE.

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To all whom it may concern:

Be it known that I, BIRGER LJUNGSTRÖM, a subject of the King of Sweden, residing at 8 Fleminggatan, Stockholm, Sweden, have invented certain new and useful Improvements in Gas-Turbines; 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, reference being had to the accompanying drawings, and to letters or figures of reference marked thereon, which form a part of this specification.

This invention relates to an arrangement for the automatic balancing of the axial pressure caused by the driving medium and imparted to the rotating parts of a gas turbine which carry the vane series. These pressures will, especially in radial turbines, be very high and can on account thereof not be taken up by cam bearings. Said axial pressures are according to this invention balanced by means of pistons connected to the parts carrying the vanes and acted upon by the driving medium in such a manner that the pressure acting upon the pistons is automatically suited to the working pressure acting upon the parts carrying the vanes. These pistons are tightened by means of ring shaped baffling devices. The annexed drawing does not in any case show more than one piston for one rotating vane series, although several pistons naturally may be arranged on the same shaft.

Figure 1 is a vertical section through one embodiment of the invention; Fig. 1[a] is a view similar to Fig. 1, slightly modified; Fig. 2 is a vertical section through another embodiment; Fig. 3 is a vertical section through a third embodiment; Fig. 3[a] is a view similar to Fig. 3, slightly modified; Fig. 4 is a side elevation, partly in section, of a fourth embodiment, and Fig. 5 discloses the means for effecting adjustment of the baffle plates.

The baffling devices communicating with an inlet for the driving medium consist, in the embodiment shown in Fig. 4, of ring chambers disposed adjacent each other and connected by narrowed channels. These ring chambers are suitably formed by means of corrugated rings placed close to each other and which rings have a part connected to the device carrying the vanes, and this part consequently rotates relatively to the other part of the baffling rings which is secured to the turbine casing or to a part secured to the casing.

The invention is of special importance in case of using one or two ring shaped baffling devices in order to attain a varying throttling of the driving medium. Such an arrangement will be most simple in radial turbines with two systems of vanes rotating in opposite directions.

The baffling rings consist according to Figs. 1–3 of concentric cylinders or ring shaped plane disks threaded in each other and concentric to the shaft and to each other and connected partly with a rotating part and partly with the turbine casing. In radial turbines with inlet for the driving medium at one side of the turbine casing and with the shaft projecting from the other side of the casing it is necessary to have only one ring shaped baffling device in as far as an inlet for the driving medium leads to one side of the piston from the inlet side of the turbine wheel or from the pressure conduit which inlet is adapted to be throttled in a certain manner.

In order to make it possible to place a sufficient number of baffling rings on the outside and inside of the piston area, so that the entire device becomes of reasonable dimensions with a sufficiently great piston area the baffling rings may suitably be made according to the multiple principle.

The cylindrical baffling rings *b* are according to Fig. 1 located on the turbine disk *a* carrying the vanes, the baffling rings engaging between the said rings being secured to the turbine casing *c*. The baffling device communicates with the pressure chamber of the turbine casing through a channel *d*. When an increased pressure in the pressure chamber moves the turbine disk and the shaft to the right, the passage of the pressure medium through the baffling device will be throttled and the pressure in the said device against the other side of the turbine disk working as a piston will therefore in-

crease and finally overcome the aforesaid pressure, whereby the turbine disk is brought back to its original position while at the same time the baffling passages increase.

In the form shown in Fig. 1a, there is a plate *g* carried by the turbine disk *a*, which plate is provided with baffle members co-operating with like members on the casing *c*. This manner of adjacently disposing these baffle elements provides an irregular and narrowing channel *f* which serves the purpose intended.

In the axial turbine shown in Fig. 2 one part of the baffling rings *b* is secured to the drum *h* carrying the vanes, the other part being secured to the turbine casing *c*. The baffling device communicates with an inlet pipe *i* and works in the same manner as the device shown in Fig. 1.

The baffling device and the piston are in Fig. 3 arranged in a special casing *j* communicating with the turbine casing *c*, one part of the baffling device *b* being placed on a disk *k* secured to the shaft and serving as a piston and the other part being located on the casing *j*. As shown in the figure, a throttling device *m* may be arranged in an inlet pipe *l* opening into the baffling device. Such a device may also be placed in a pipe *n* connecting the casing *j* with the turbine casing *c*.

Fig. 3a shows the manner in which a throttle valve or slide may be automatically acted upon by means of a lever *p* mounted on the shaft, thus when the shaft is moved to the right the valve *o* increases the inlet to the disk *k* and to the baffling device b^1, and reduces the same on the movement of the shaft in the opposite direction. In this figure also the baffling devices b^1 are in the nature of flat disk rings.

The two turbine wheels *s t* carrying vanes are in Fig. 4 mounted on separate shafts *q* and *r* and rotate in opposite directions. The baffling devices consist of folded or corrugated rings *u v* connected partly with the turbine wheels and partly with parts secured to the inner wall of the turbine casing *c*. As shown in the drawing, the baffling devices at each turbine disk are divided into two groups working according to the multiple system, whereby I obtain the greatest possible piston area on the outside of the turbine disks between the groups which piston area works against the axial pressure between the turbine disks. The balancing pressure required will consequently be lower, whereby the leakage through the outermost baffling device will be more reduced than is the case when higher balancing pressure and smaller piston area are employed. The baffling devices are furthermore secured on special rings located on the rotating or on the fixed part. If the axial position of these rings is altered by means of set screws or in another manner, an adjustment of the axial position of the turbine disk as well as an adjustment of the interspaces in the baffling devices may be obtained.

The baffling plates may be secured to the shaft and the pistons by set screws *x* whereby relative adjustment between said plates is effected.

Having thus described my invention, what I claim is:—

1. In fluid pressure turbines, the combination of a vane-carrying rotating part, a concentric annular pressure chamber between it and a fixed part, and baffling devices at the outer and inner periphery of said chamber, the distances in the said inner baffling device being varied to correspond with the axial movements of the vane-carrying rotating part.

2. In fluid pressure turbines, the combination of a vane-carrying rotating part, a concentric annular pressure chamber between it and a fixed part, and baffling devices at the outer and inner periphery of said chamber, the distances of the said outer and inner baffling devices being varied to correspond reversely to the axial movements of the vane-carrying rotating part.

3. In fluid pressure turbines, the combination of a rotating part, a concentric annular pressure chamber between it and a fixed part and baffling devices at the outer and inner periphery of said chamber, varying differently to correspond with the axial movements of the rotating parts, said baffling devices being partly arranged on rings.

4. In fluid pressure turbines, the combination of a rotating part, a concentric annular pressure chamber between it and a fixed part and baffling devices at the outer and inner periphery of said chamber varying differently upon the axial movements of the rotating parts, said baffling devices partly projecting from rings, loosely arranged in the turbine casing.

5. In fluid pressure turbines, the combination of a rotating part, a concentric annular pressure chamber between it and a fixed part and baffling devices at the outer and inner periphery of said chamber varying differently upon the axial movements of the rotating parts, said baffling devices partly projecting from rings, loosely arranged in the turbine casing and adjustably secured thereto.

6. In fluid pressure turbines, the combination of a rotating part, a concentric annular pressure chamber between it and a fixed part and baffling devices at the outer and inner periphery of said chamber varying differently upon the axial movements of the rotating parts, said baffling devices partly pro-

jecting from rings, loosely arranged in the turbine casing and adjustably secured thereto in axial direction.

7. In fluid pressure turbines, in combination with a rotating part, a concentric annular pressure chamber between it and a fixed part and baffling devices at the outer and inner periphery of said chamber varying differently upon the axial movements of the rotating parts, said baffling devices partly projecting from rings, loosely arranged in the turbine casing and adjustably secured thereto by means of bolts.

In testimony, that I claim the foregoing as my invention, I have signed my name in presence of two subscribing witnesses.

BIRGER LJUNGSTRÖM.

Witnesses:

CARL FRIBERG,

E. RÅBERG.