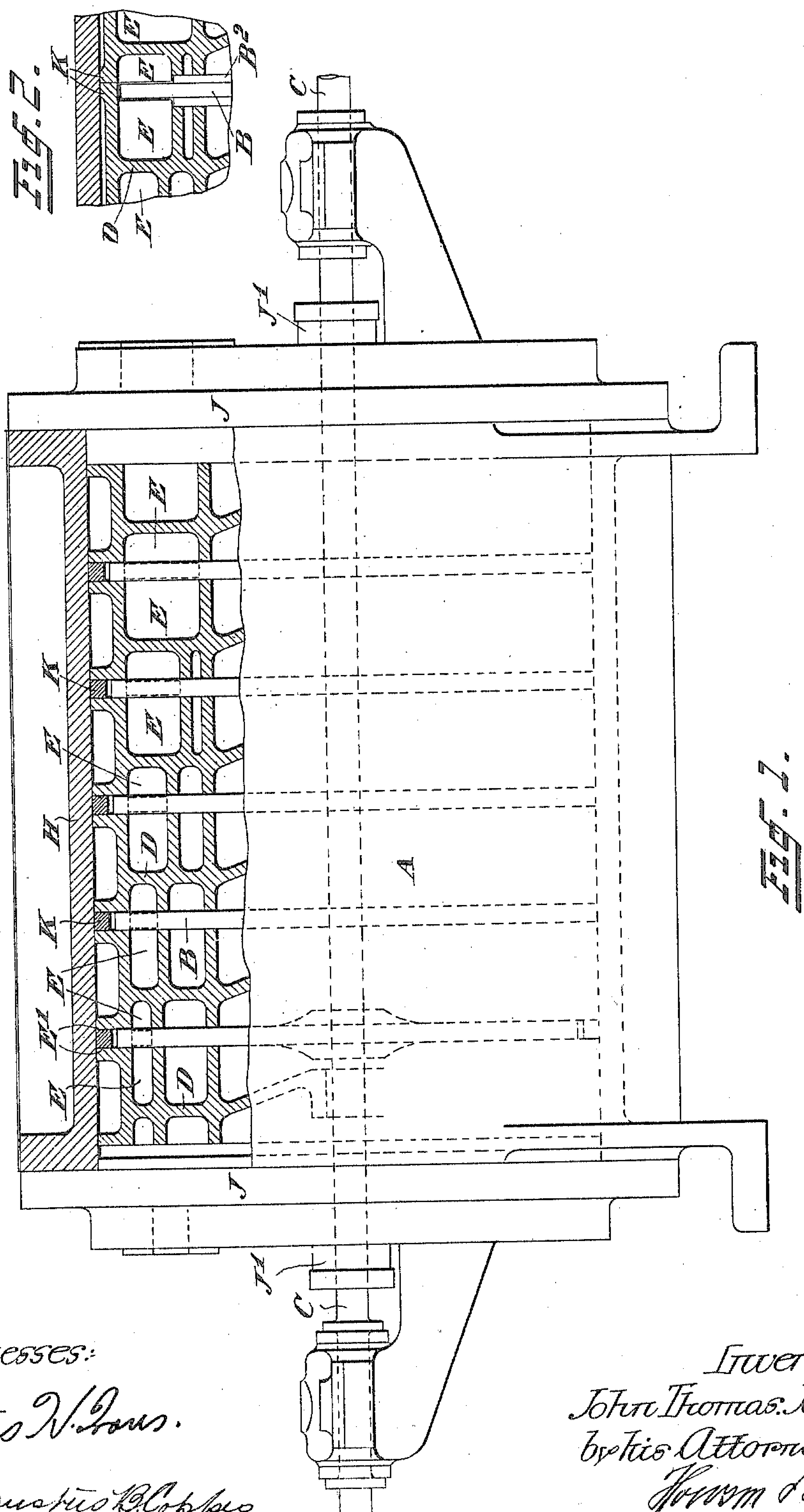
No. 817,067. PATENTED APR. 3, 1906.

J. T. JENNINGS.

TURBINE.

APPLICATION FILED JAN. 14, 1905.

4 SHEETS—SHEET 1.



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Augustus B. Coppes

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4 SHEETS—SHEET 2.

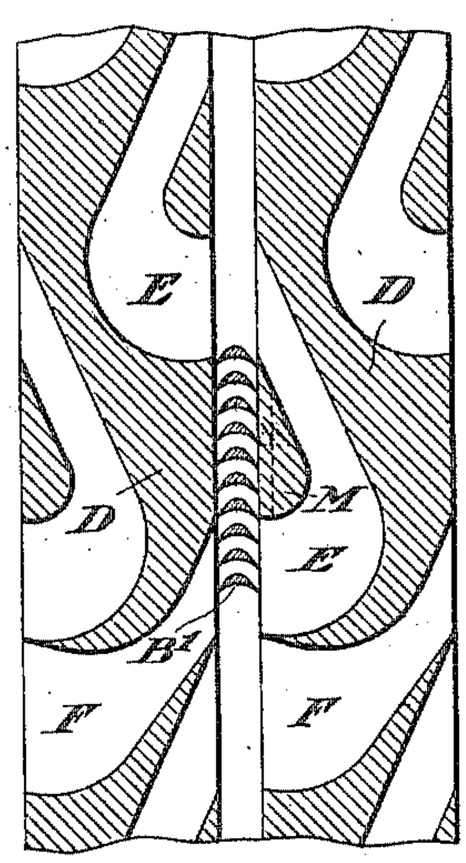


Fig. 3.

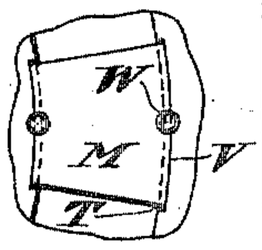


Fig. 6.

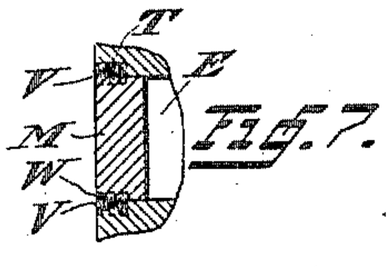
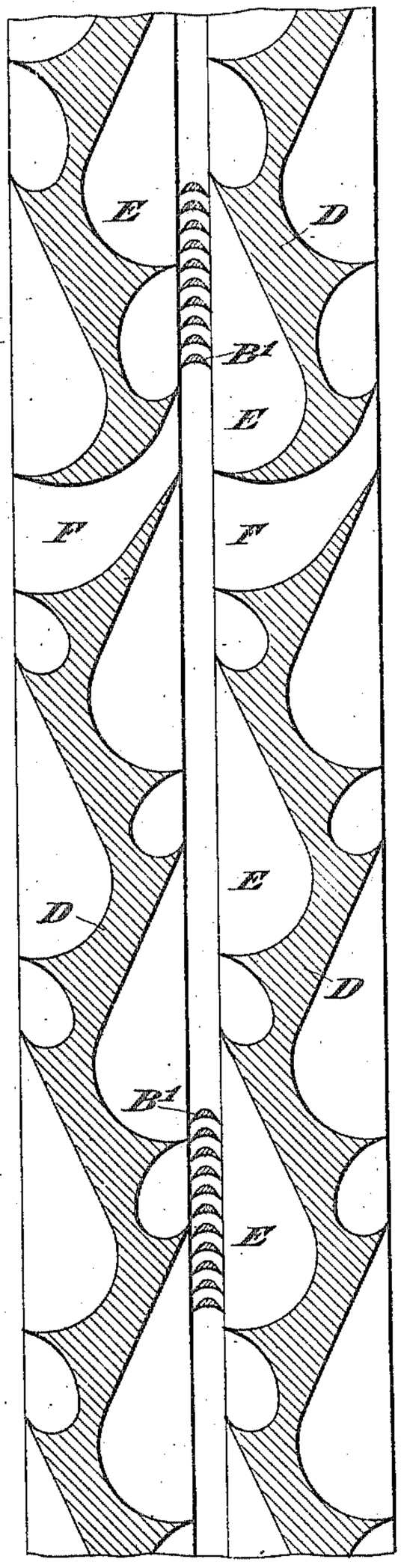


Fig. 7.



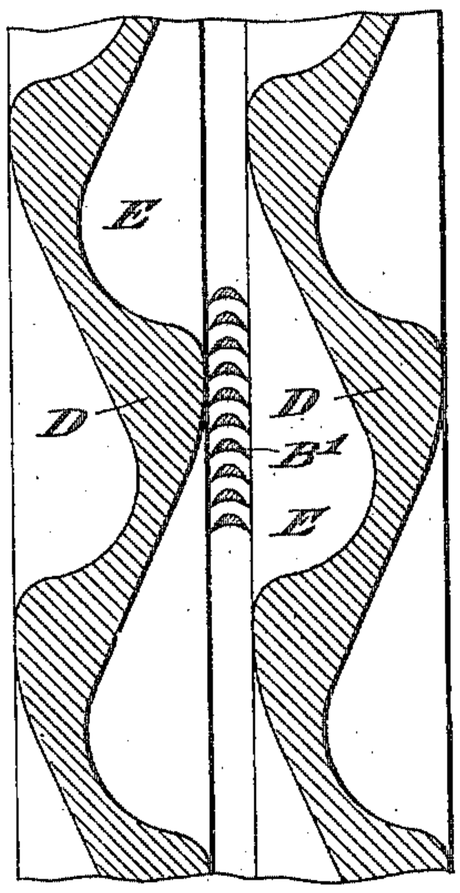


Fig. 4.

Fig. 5.

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4 SHEETS—SHEET 3.

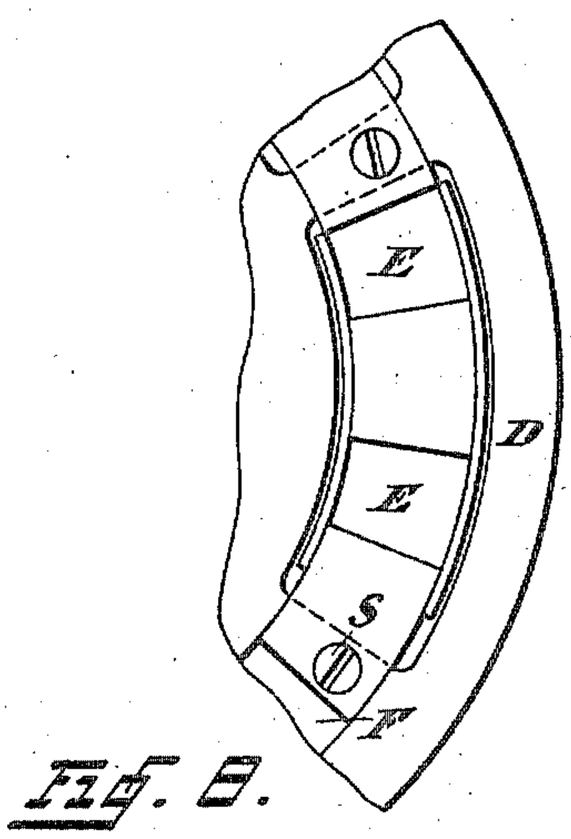

Fig. 8.

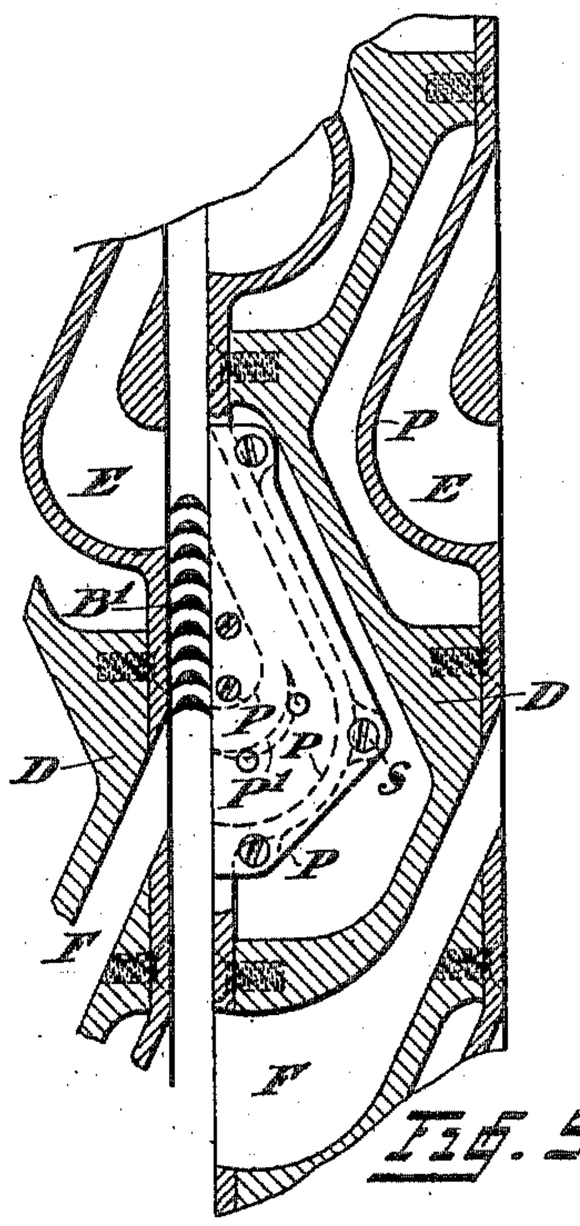

Fig. 9.

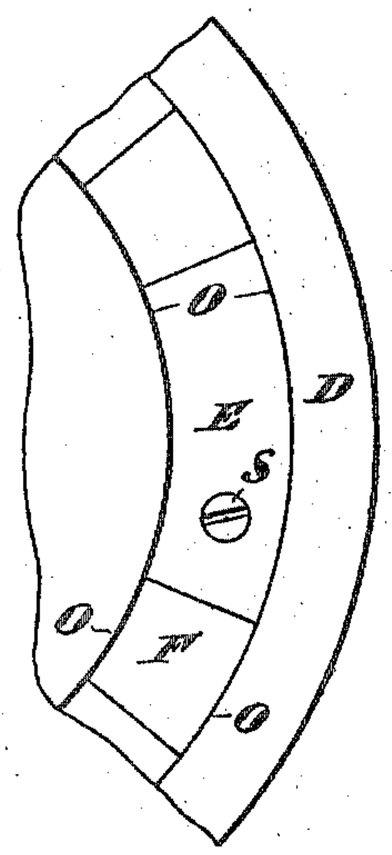

Fig. 10.

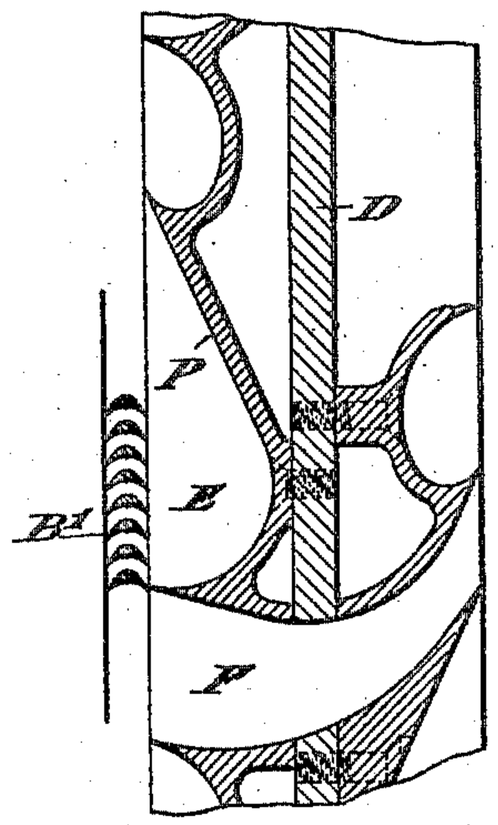

Fig. 11.

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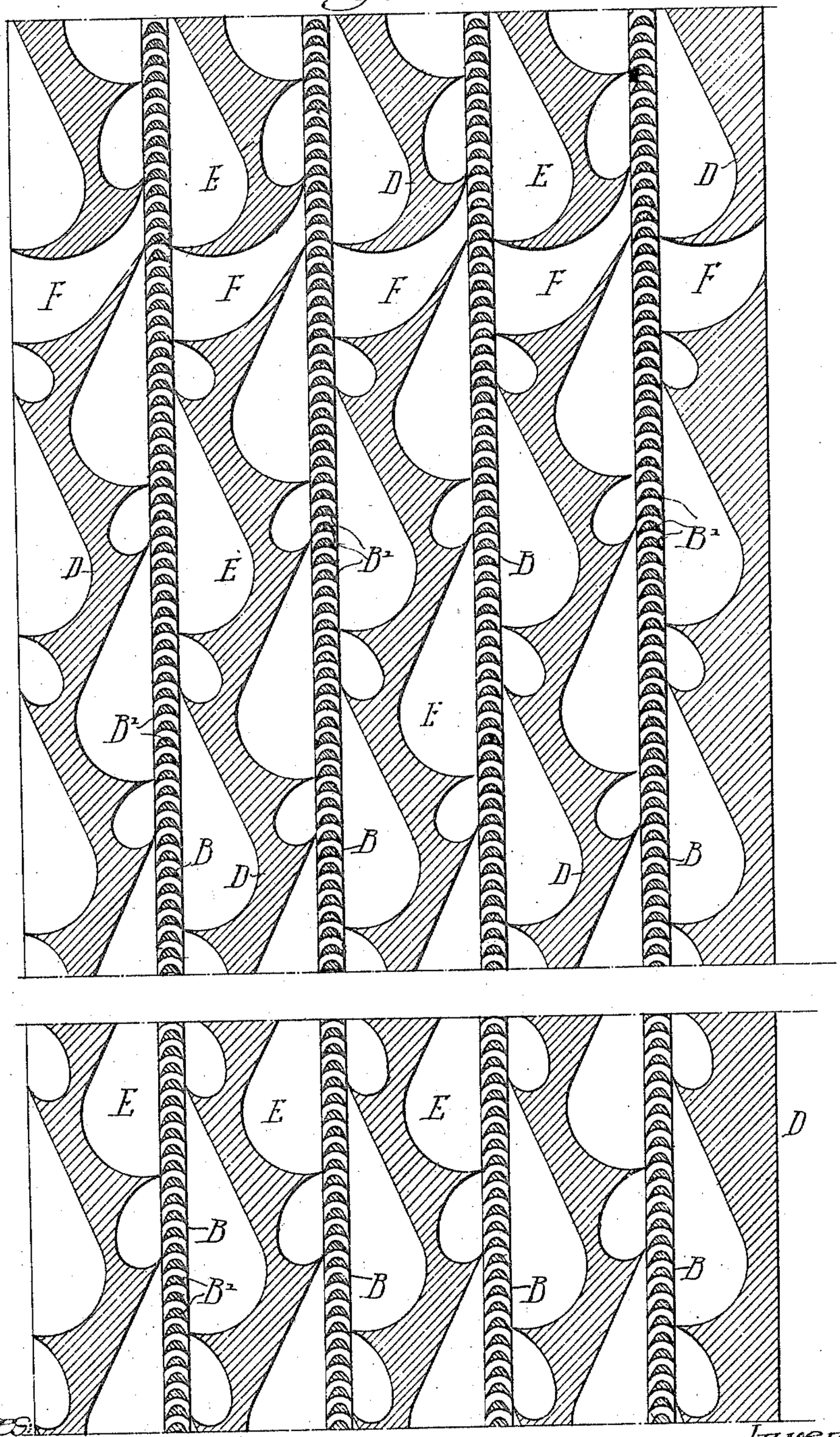
4 SHEETS—SHEET 4.

Fig. 12.



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UNITED STATES PATENT OFFICE.

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TURBINE.

No. 817,067. Specification of Letters Patent. Patented April 3, 1906.

Application filed January 14, 1905. Serial No. 241,057.

To all whom it may concern:

Be it known that I, JOHN THOMAS JENNINGS, a subject of the King of Great Britain and Ireland, whose postal address is 190 Pershore road, Kings Norton, near Birmingham, in the county of Worcester, England, have invented certain new and useful Improvements in and Relating to Turbines Actuated by Steam, Air, or the Like, of which the following is a specification.

This invention relates to improvements in turbines actuated by steam, air, or the like, and has for its object the construction of turbines in such a manner as to obtain a comparatively low velocity of rotating parts and of working fluid without great complexity or multiplicity of parts and with economy in the consumption of the working fluid.

In describing my invention in detail reference is made to the accompanying sheets of drawings, similar letters indicating similar parts, in which—

Figure 1 represents an arrangement of a turbine as hereinafter described and suitable for steam used non-condensingly. Fig. 2 represents a form of guide-plate with the distance-ring cast on one face of each guide-plate, as hereinafter described. Figs. 3, 4, and 5 are part angular sections through the working steam-spaces of guide-plates. Figs. 6 and 7 show part elevation and part axial section of guide-plate shown in Fig. 3, showing a method of securing the center pieces and hereinafter referred to. Fig. 8 shows part elevation, and Fig. 9 part angular section, of a special construction of guide-plate. Fig. 10 shows elevation; Fig. 11, an angular section of another form of guide-plate, and Fig. 12 is a diagrammatic development of an angular section through the guide-disks and vane-wheels of the turbine illustrated in Fig. 1.

In carrying out my invention I construct a turbine A, having one or more rings of radially-projecting vanes B concentrically secured in any convenient manner in the direction of rotation with the turbine-shaft C and arranged in one or more series. These mounted rings of vanes or vane-wheels B may be arranged in gradually-increasing diameters to allow greater area for the expansion of the steam, or each series may be all of the same diameter at the tips of the vanes, as shown in Fig. 1, the area of the steam-flow being increased by decreasing the diameter of the vane-disks, their periphery corresponding to the root of the vanes.

On either side of each vane-wheel B is a disk or plate D, which guides the steam-flow to and from the vane-wheels B, those disks lying between two vane-wheels having guide channels or passages E for the steam on both their faces and all having a port or ports F to allow the steam to pass through the whole series of vane-wheels. The guide-plates D and vane-wheels B are preferably contained in one or more casings H, having suitable end covers J with stuffing-boxes J′, through which passes the turbine-shaft C, said boxes being secured in a suitable manner to the casing or to the end covers to prevent them from turning. The spaces between the end covers J, casing H, and stuffing-boxes J′ are made as nearly as possible steam-tight, except, of course, at the ports.

The portions E and E′ of each of the circular disk-like spaces P, lying between each pair of guide-plates D, which is occupied by the working fluid and the vanes, is annular in form, occupying the outer portion of the said spaces, but with both side faces of guide-plates D suitably shaped, corrugated, or channeled to form the spaces or channels E in the angular direction, which, as the general direction of the flow of the fluid is angular, is arranged to give the said working fluid a sinuous course, partly angular and partly axial, crossing and recrossing through the ring of vanes B, which are centrally in the plane of this annular space, and work is done each time of crossing by giving up the kinetic energy generated by the expansion of such working fluid in the guide-channels E. The said annular spaces are made as nearly steam-tight as possible. As the steam-jets strike the vane-wheels B on both sides and the vanes B′ are preferably of equal-sided section, there is practically no unbalanced thrust on the side faces of the said wheels. They are therefore allowed to freely move axially on the shaft C, and at the roots of the vanes B′, and where necessary at the tips, are made of just the required width to be a running fit in the space E′ between the guide-faces.

Distance-rings K are arranged between each pair of guide-plates, all being held together by the high-pressure steam which enters through the port L in end cover J, or, if preferred, through casing H. If desired, the casing H and guide-plates D may be arranged in halves, or the said casing may be dispensed with, the guide-plates being bolted to one another and to the end covers J.

Fig. 2 shows a form of guide-plate D with the distance-ring K cast on one face of each guide-plate and also shows the guide-plates arranged to suit a vane-wheel with its inner or vaneless portion B^2 wider than the vanes in vane-ring B and without a ring round the tips of the vanes.

Figs. 3, 4, and 5 show part angular sections of various forms of guide-plates D, such sections being taken through the working steam-spaces E and vanes B′, such guide-plates having thereon different forms of steam channels or passages E for efficiently guiding the steam. The said channels may be produced in any suitable manner and may be lined with sheet metal, if desired, in order to obtain a smooth surface.

Figs. 6 and 7 show part elevation and part axial section of guide-plates D, as shown in Fig. 3, giving a method of fastening the center pieces M by means of recesses T in the outer and inner periphery of the guide-channels E and projections V on center pieces M, the whole being secured when finally adjusted by screws W.

Fig. 8 shows part elevation, and Fig. 9 part angular section, giving details of construction of a form of guide-plate D in which the metallic surfaces P, guiding the steam, are formed separately, such surfaces or guides being attached to the frame of the guide-plate D by means of screws S or in any other convenient manner. The said guide-buckets or walls of channels E may be castings or stamped, hammered, rolled, or otherwise formed. One of the guide-buckets is shown with a guide-vane P′, and one or more of the same may be fitted in each guide-bucket in any suitable manner when desired to assist in diverting the steam-flow with little loss of energy.

Fig. 10 shows elevation, and Fig. 11 angular section, of a portion of another form of guide-plate. In this form the inner and outer walls O of the steam-channels E are parts of the guide-plate casting D, the shaped surfaces P of the channels only being formed separately and secured to the guide-plate in any suitable manner.

Either of the methods of construction shown in Figs. 8, 9, 10, and 11 may be adopted in producing any of the forms of guide-channels E shown in Figs. 3, 4, and 5, and each complete ring of the said guide-channels may be made in one or more pieces, as desired.

In operation steam or the like enters at one end of the casing H or end cover J through port L and passes through one or more ports F in the first guide-plate D, entering the annular space between the first and second guide-plates D. Such steam or the like is caused by the first guide-plate to strike the face of the first ring of vanes B′ at a suitable angle and speed, passing therethrough between the vanes B′ and being deflected thereby, so that it leaves them at a very much lower speed, giving up the greatest part of the difference in momentum as power through the shaft C. On leaving the ring of vanes B′ the steam is deflected by the second guide-plate in the direction of rotation and made to again enter the first set of vanes at a suitable angle and speed, as before. The steam thus passes through the vanes B′, comes in contact with the first guide-plate, and is again deflected in the direction of rotation and made to pass through the vane-ring and again come in contact with the second guide-plate, and if there is only one port F in the first guide-plate the steam or the like makes approximately a complete circuit of the annular space between the guide-plates D, crossing and recrossing the path of vanes B′ until it has nearly completed such circuit. It is diverted by the second guide-plate and led through a port F into the second annular space. The same action takes place in this space (which will be larger than the first in the manner before explained to allow for expansion) as in the first space, and then the steam leaves the same and goes through a port into the third space, and so on through the whole series of annular working spaces, driving the vanes onward by the power developed by expansion each time such fluid crosses the said vanes.

The passages in the guide-plates D are all arranged to give a suitable area for the volume of fluid passing through them and the vane-rings B, which area will of course increase proportionately in each successive annular space with the increase of volume of steam. The expansion of the fluid goes on through the series of operations until exhaust-pressure is reached.

What I claim as my invention is—

1. A turbine consisting of a casing, a shaft extending therethrough, a series of vane-wheels on said shaft having radially-projecting vanes, disks fixed to the casing and respectively projecting between successive pairs of the vane-wheels, and a disk for the vane-wheel at each end of the series, there being passages in the faces of each pair of disks adjacent to a vane-wheel formed to cause motive fluid to alternately pass from one side to the other of the vane-wheel in a substantially circumferential direction, with another passage through each of the disks between the vane-wheels, said passages being placed to conduct motive fluid from one vane-wheel to the next after it has passed completely around the same, substantially as described.

2. The combination in a turbine, of a casing having an inlet and an outlet for motive fluid, and a series of disks carried in said casing and spaced to have annular chambers between them, the adjacent faces of each pair

of disks being provided with a circular line of recesses, with vane-wheels within said annular chambers, and a shaft carrying said wheels, said passages being formed to cause a current of motive fluid to pass alternately from one side to the other of the vane-wheel in a generally circumferential direction and finally to pass to the next adjacent vane-wheel and to the passages in the disks thereof, the vanes of the first vane-wheel and the corresponding faces of the disks being of less radial dimensions than those of the next vane-wheel, substantially as described.

3. The combination of a substantially cylindrical casing, a shaft extending therethrough, a series of disks in said casing spaced apart to form a series of annular chambers, each of said disks having series of passages in its two faces, a series of vane-wheels mounted in the annular chambers between successive disks, and a shaft carrying said vane-wheels, there being a passage through each disk whereby successive vane-wheel chambers are connected, substantially as described.

4. The combination in a turbine, of a casing, a shaft extending therethrough, there being a vane-wheel on the shaft, disks each having a face adjacent to said wheel and provided with recesses whereby motive fluid is conducted circumferentially around the disk and caused to flow alternately from one side thereof to the other, certain of said passages having in them center pieces for directing the motive fluid, said center pieces being independent of the material of the disks, substantially as described.

5. The combination in a turbine, of a casing having a shaft, a vane-wheel carried by said shaft, and a structure on each side of said vane-wheel and each provided with a circular line of recesses formed in its face adjacent to the wheel, with removable pieces in said recesses forming channels to direct motive fluid from a source of supply circumferentially around said wheel and to cause it to flow alternately from one side to the other thereof, substantially as described.

In witness whereof I have hereunto set my hand in the presence of two witnesses.

J. T. JENNINGS.

Witnesses:

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JOSEPH P. KIRBY.