A. H. BECKMAN.

STEAM TURBINE.

APPLICATION FILED JUNE 18, 1908.

912,061.

Patented Feb. 9, 1909.

4 SHEETS—SHEET 1.

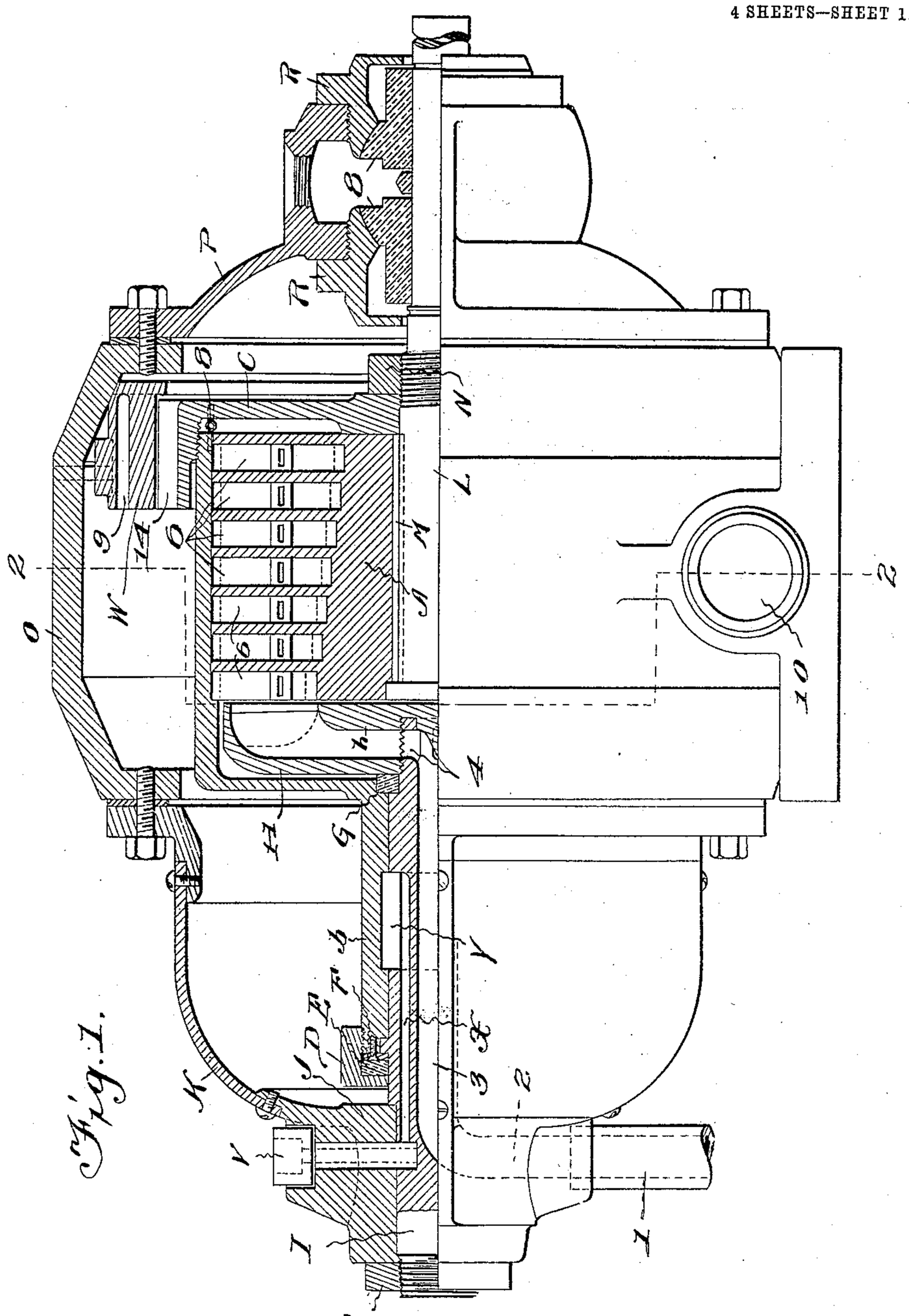

Fig. 1.

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4 SHEETS—SHEET 2.

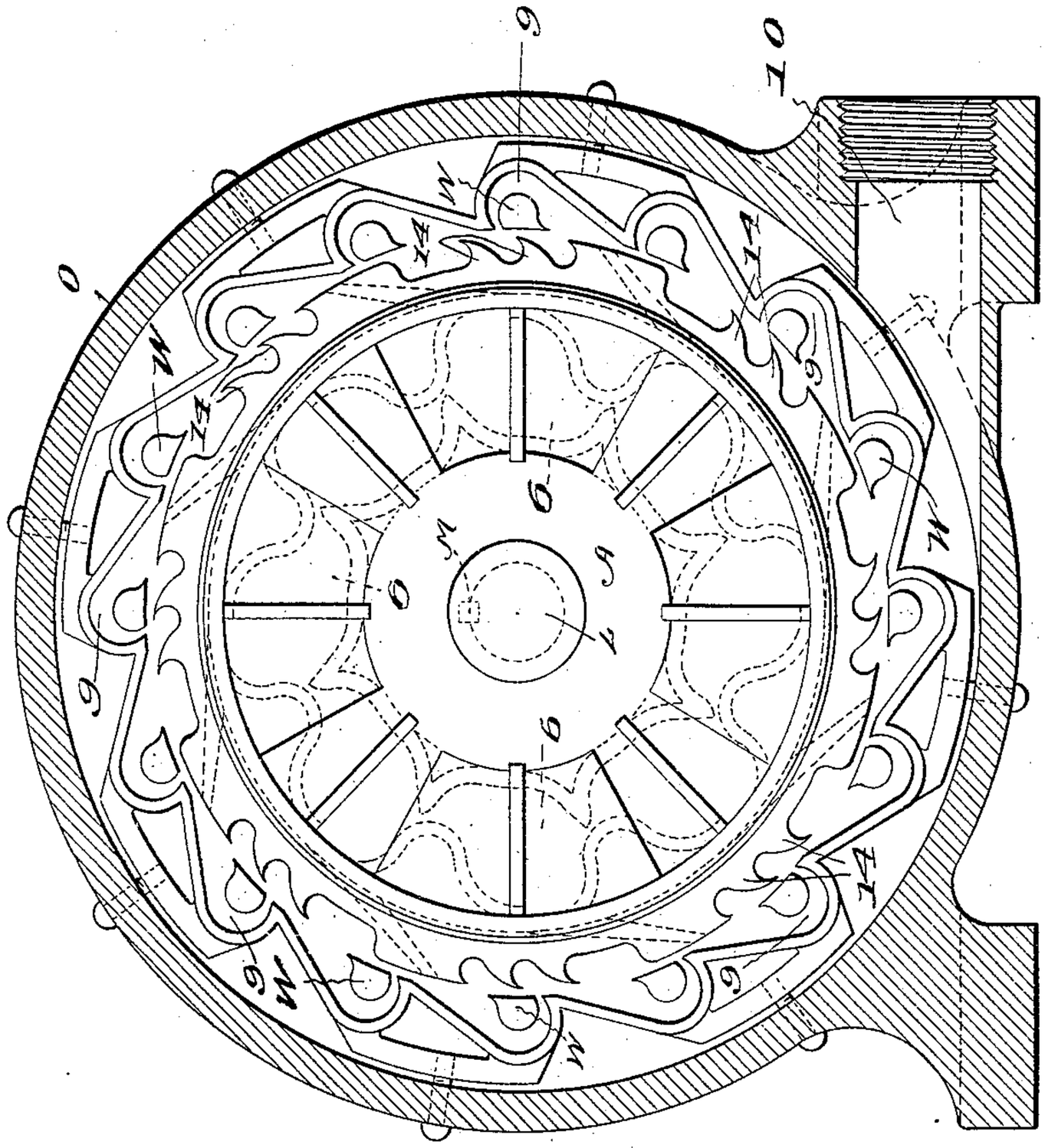

Fig 2.

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4 SHEETS—SHEET 3.

Fig. 6.

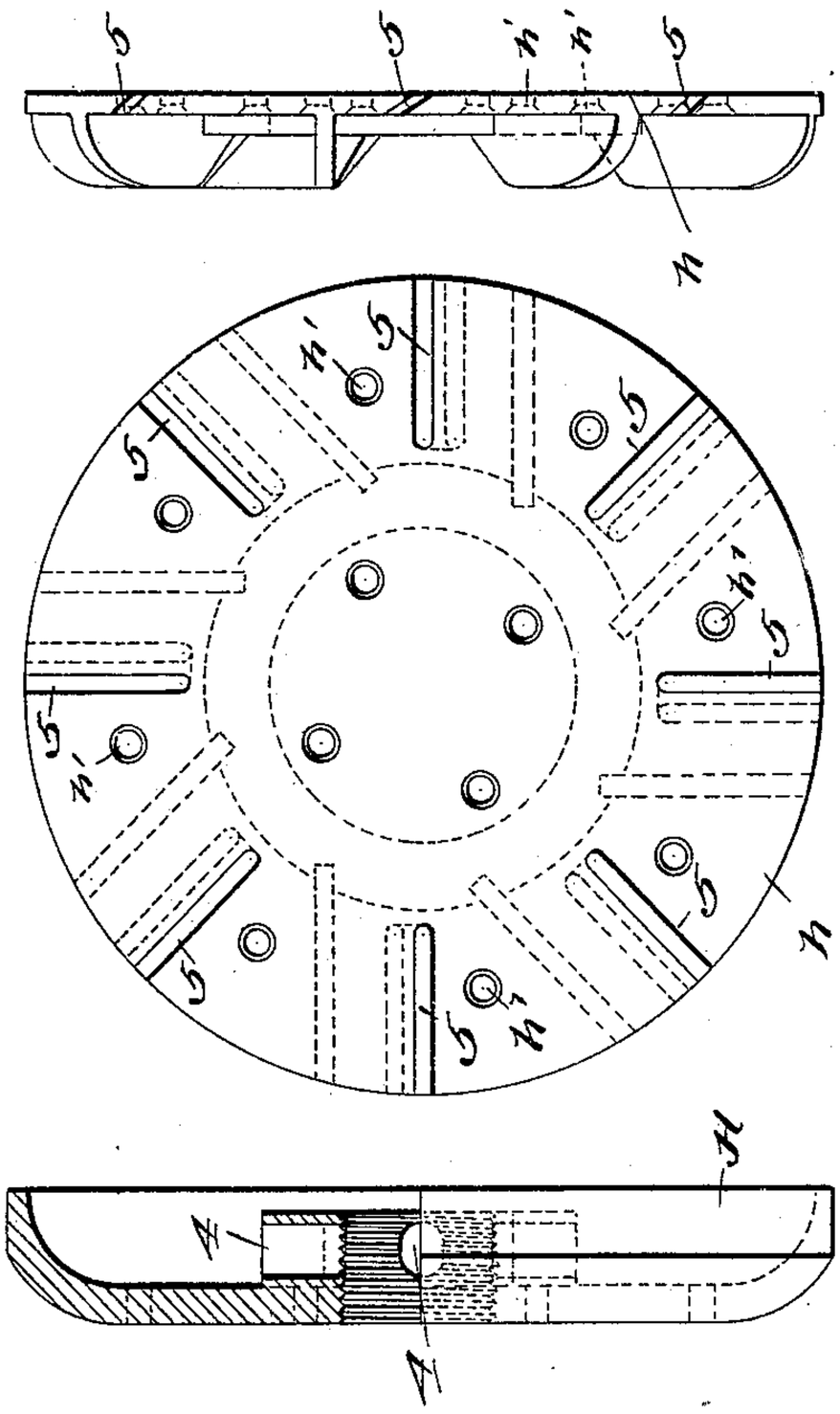
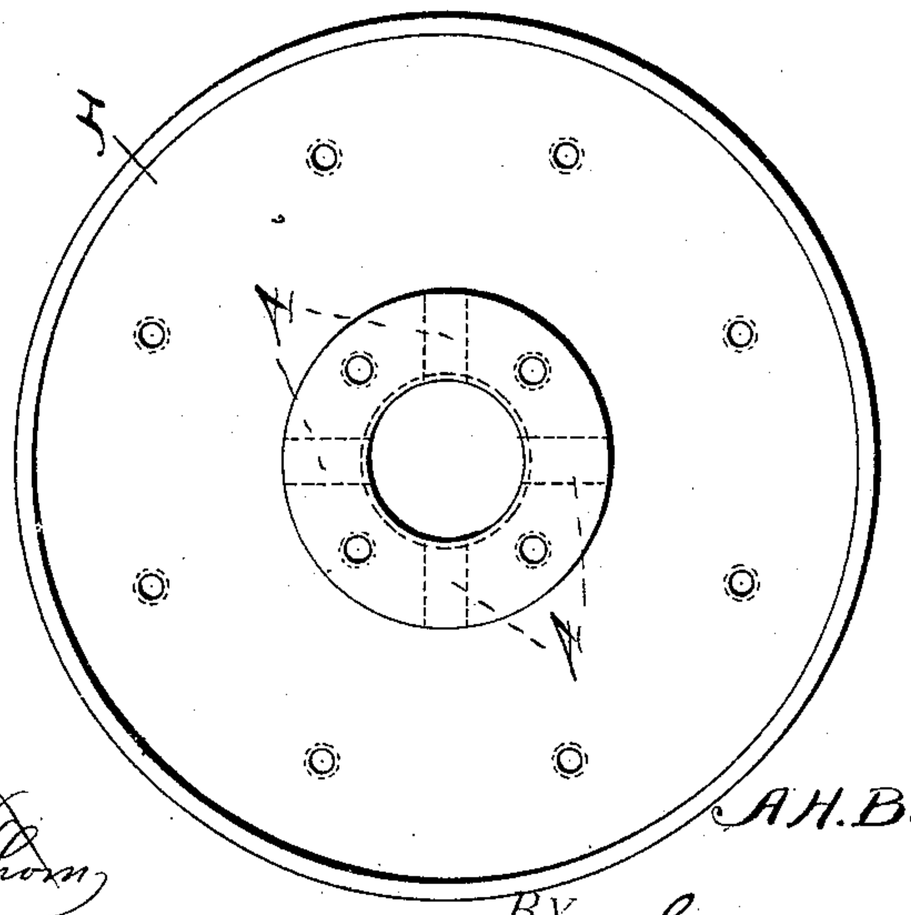


Fig. 5.

Fig. 4.

Fig. 3.



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4 SHEETS—SHEET 4.

Fig. 8.

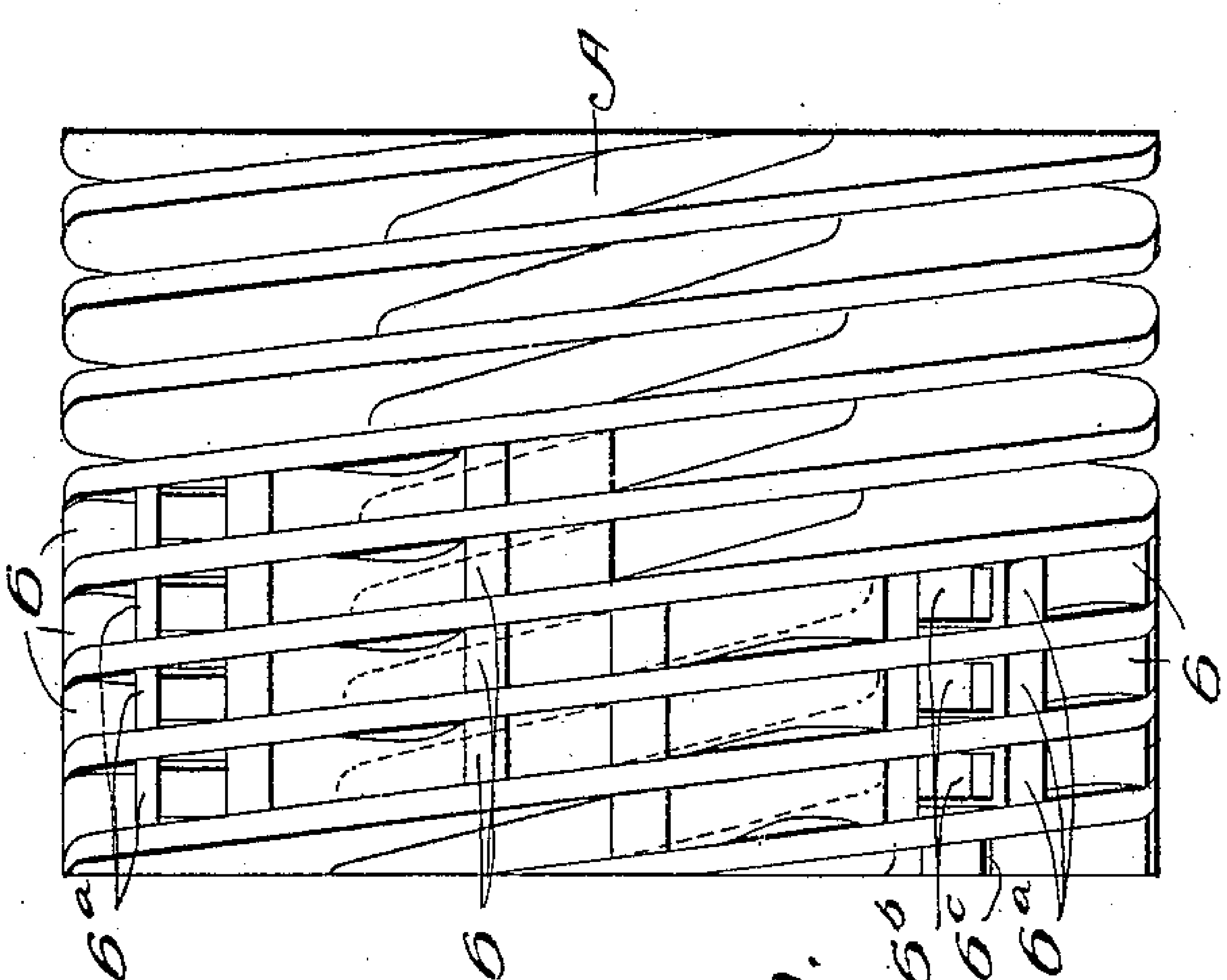


Fig. 9.

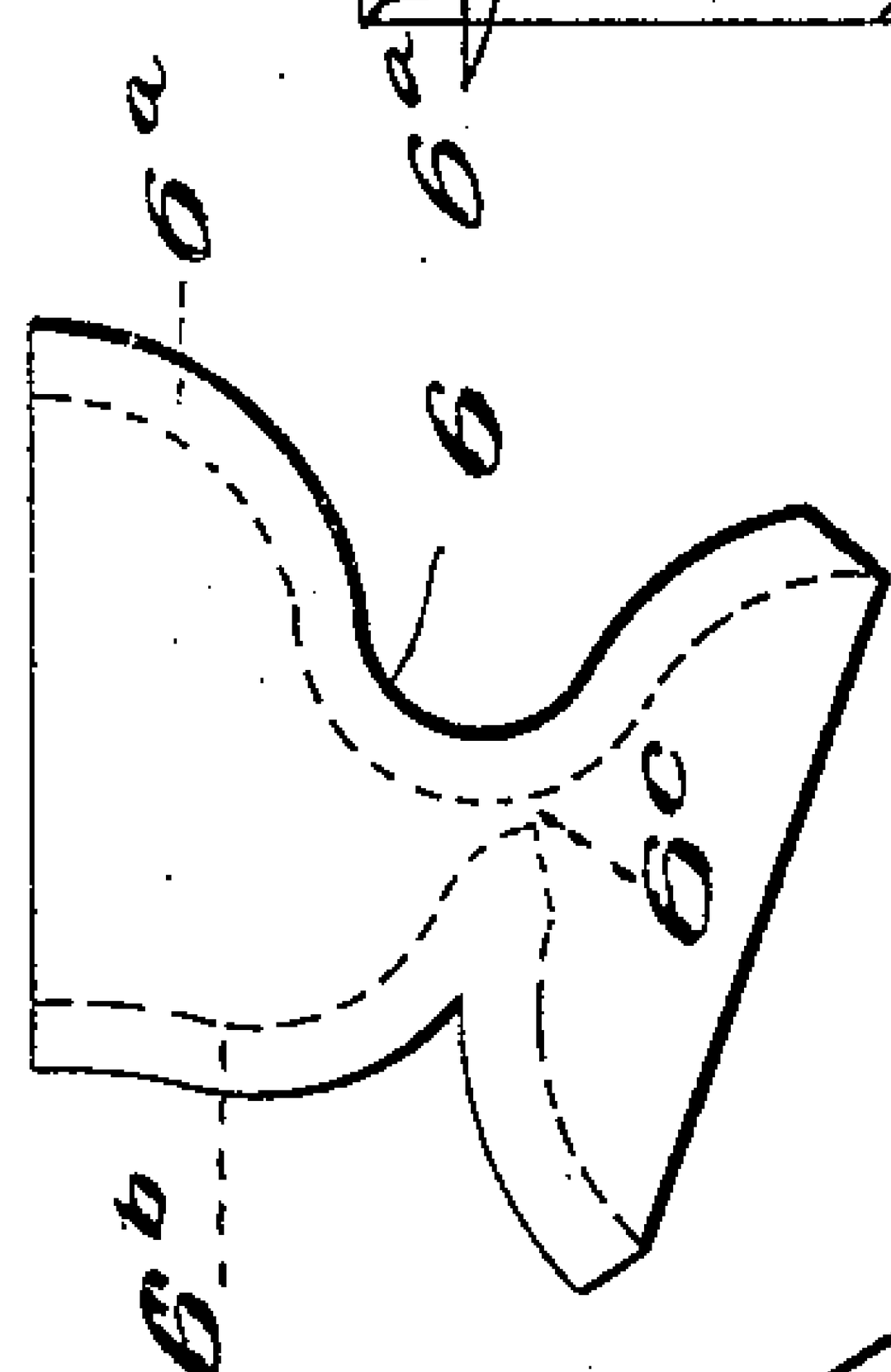


Fig. 10.

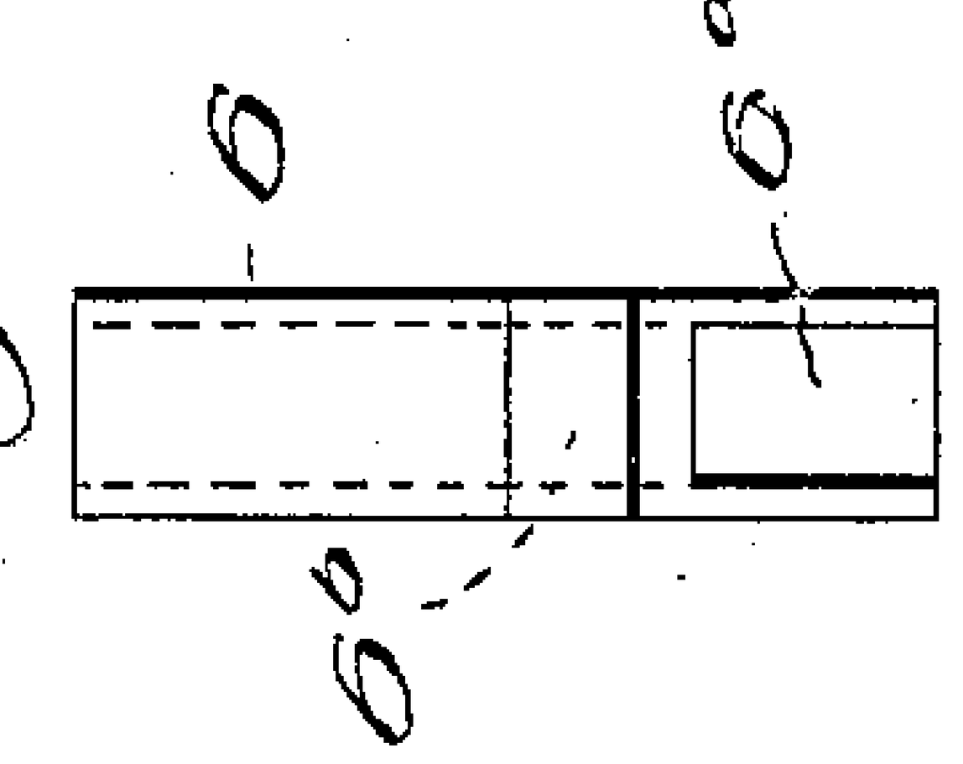
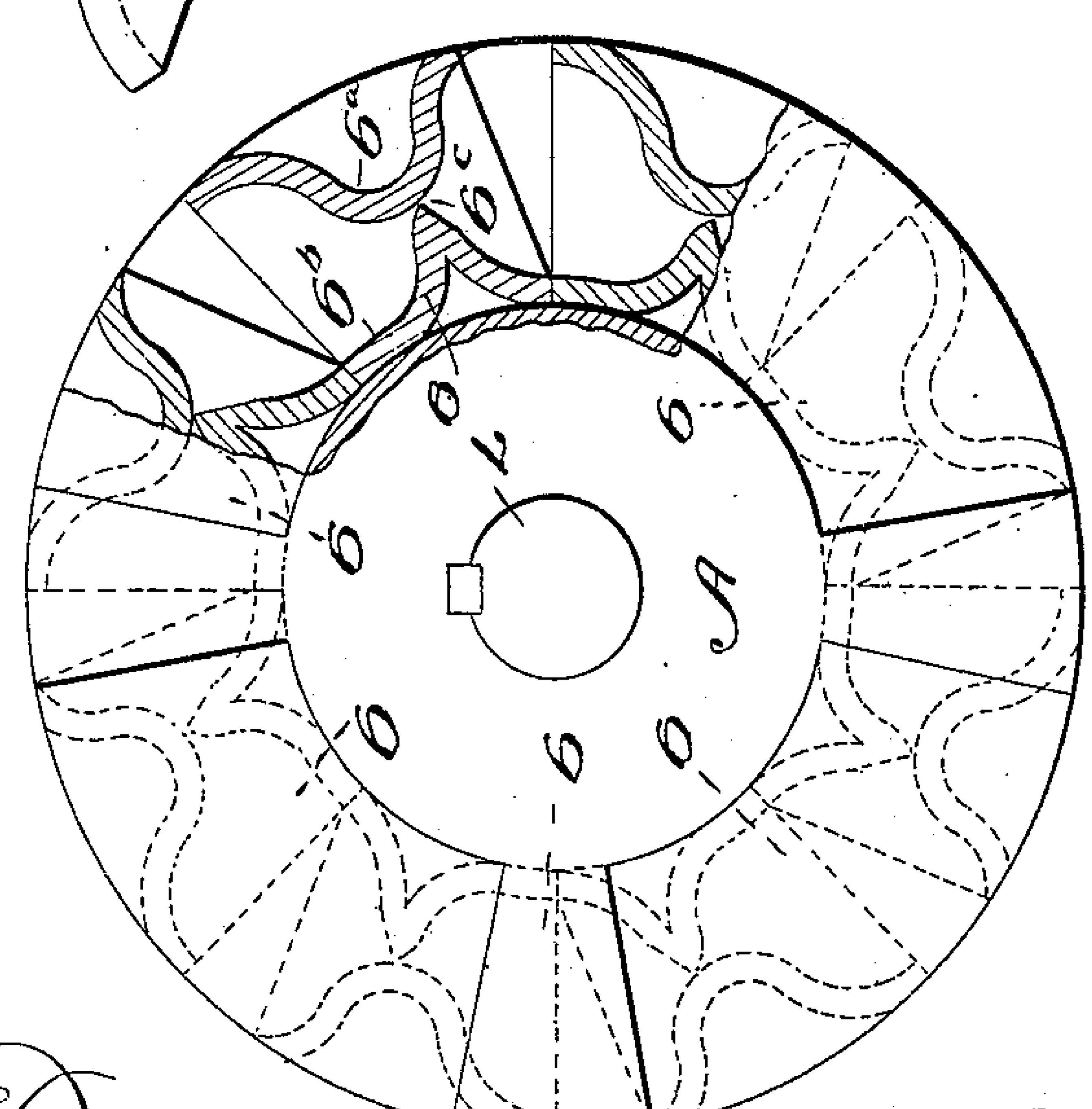


Fig. 7.



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UNITED STATES PATENT OFFICE.

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STEAM-TURBINE.

No. 912,061. Specification of Letters Patent. Patented Feb. 9, 1909.

Application filed June 18, 1908. Serial No. 439,248.

To all whom it may concern:

Be it known that I, AUGUST H. BECKMAN, a citizen of the United States, residing at Madison, in the county of Dane and State of Wisconsin, have invented certain new and useful Improvements in Steam-Turbines, of which the following is a specification.

This invention relates to that class of steam turbines having axial flow, and includes a casing, and a rotor therein having buckets extending around the same and arranged in a series (four as shown) of parallel spirals, forming a quadruple screw so arranged that the steam passes from one to the next in succession until it reaches an end chamber from which it passes through ports to curved reversing passages from which it impinges on blades projecting from the periphery of the rotor at the outlet end thereof, and thence to exhaust.

The invention is illustrated in the accompanying drawings, in which—

Figure 1 is a side elevation, half in section, of the machine. Fig. 2 is a cross section on line 2—2 of Fig. 1. Figs. 3 and 4 are details in plan and section of the steam chest casing. Figs. 5 and 6 are details in plan and edge view of the port piece which fits in the steam chest casing and completes the chest. Figs. 7 and 8 are details in end view (partly in section) and side elevation of the rotor. Figs. 9 and 10 are details of one of the buckets.

Referring specifically to the drawings, O indicates an outer circular casing, closed at the ends by hollow heads J and P, secured by cap bolts Q. This casing contains the rotating and other parts. The quadruple screw rotor A contain the buckets 6, fixed by a key M and clamp nut N to the end of the power shaft L which is mounted in and extends through bearings S in a gland R in the head P of the outer casing. The rotor has a shell or casing B thereon, and an end plate C screwed on the shell. The casing B is extended at the inlet end to form a sleeve *b* which turns on a stud I mounted in the support J, and the stud is held fast by the lock nut T. The stuffing box D, containing metal packing E and a thrust ring F, is screwed on the end of the sleeve *b*, a packing ring G being also interposed between the rotor casing and the steam chest H. The end plate C of the rotor is provided at its periphery with a series of blades 14 located opposite to the curved and tapered reversing passages 9 in a ring W which is fixed by screws to the outer casing O. The ring C is also provided with a series of inclined nozzles 8, through which steam flows from the rotor to the passages 9.

The bearing stud I is bored to allow the passage of steam to the steam chest H located between the end of the rotor A and the end of its casing B, and said chest has a face plate *h* provided with a series of slots 5 forming nozzles leading to the rotor buckets. The steam chest is screwed in the inner end of the stud I, and the nozzle plate is set in and fixed to the chest by countersunk screws in the holes h^1. The bearing stud is also drilled to form an oil passage X from the supply at V to the oil well Y, supplying lubricant to the long bearing between the sleeve *b* and the stud.

The steam enters through steam pipe 1 to the opening 2 in the stud support J, and passes on to bore 3 in the stud I and then enters the annular steam chambers 4 in the steam chest from which it passes through the nozzles 5 into the spirals of the rotor A. It travels along or in said spirals through the buckets 6, which are formed of curved partitions set in grooves in the rotor drum. The grooves increase in depth from the beginning to the end, to allow expansion, and the shape of each succeeding bucket accordingly changes, the change being made in the inner curve or wall, the outer wall being the same in every bucket. The steam follows up the succeeding buckets in each spiral until it reaches the end and then passes out into the chamber 7 from which it flows through the nozzles 8 in the end plate C to the passages 9 in which its direction of flow is reversed and directed against the blades 14 on the end plate, operating by impact thereon, and then passes into the exhaust chamber inclosed by the outer casing and finally exhausts therefrom through the exhaust port 10. The passages 9 and blades 14 are so arranged that alternate ones are engaged at the same time.

The admission of steam through the bearing stud I gives a short and direct path to the steam chest, and the number of nozzles in the chest is twice the number of spirals and thus prevents any dead point of the rotor. The number of spirals may be increased or decreased as desired, and so may the number of buckets in each spiral.

The arrangement and shape of the buckets

is such that the steam is deflected from one to the other, thus giving a constant speed to the rotor for a given pressure of steam. The outer wall or partition of the buckets is indicated at 6^a and the inner wall at 6^b, and they are so shaped that the port or passage 6^c from one bucket to the next directs the steam toward the concavity of the outer wall whence it is deflected toward the projections on the inner wall, and thence through the port to the next bucket. As stated, the depth of the spirals and the size of the buckets increase from the beginning to the end, giving a greater area and tending to equalize the pressure due to the expansion of the steam. And the outer ring of passages and blades finally utilize the remaining velocity of the steam.

As shown in Figs. 9 and 10 each bucket is a light casting and may be made up either as one piece or in halves. They will have a light force fit in the grooves in the rotor drum, and will be sweated in, or they may be held by pins or otherwise.

Various modifications may be made in the construction, and no limitation is implied by reason of the particular structure shown.

I claim:

1. In a turbine the combination of a rotor having a spiral groove with inner and outer walls, said walls being curved in and out toward and from each other to form a series of buckets with contracted passages therebetween, the passages being inclined toward the periphery to deliver the fluid against the concave surface of the outer wall of the successive buckets, and means to cause a flow of fluid through the buckets.

2. In a turbine the combination of a rotor having a spiral groove with inner and outer walls, the walls being curved in and out toward and from each other, to form a series of buckets with contracted passages therebetween, the passages being inclined outwardly toward the concavity of the outer wall, and said outer wall being curved inwardly toward the concavity of the inner wall to cause a rebound of the fluid toward and onto said inner wall, whereby the fluid impinges on both walls, and means to cause a flow of fluid through said buckets.

3. In a turbine, a rotor comprising a drum having a spiral passage therein of gradually increasing depth from the beginning to the end, the passage being alternately expanded and contracted on radial lines to form a succession of buckets.

4. In a turbine, in combination, an outer casing, a supporting stud in one end thereof having a steam passage through the same, a steam chest at the inner end of the stud, having a ring of nozzles, and a rotor in the casing, arranged to receive fluid pressure from the nozzles, and having a bearing sleeve which turns on the stud.

5. In a turbine, in combination, an outer casing, a shaft in one end thereof and a concentric bearing stud in the other, a rotor on the shaft and having a bearing on the stud, and a steam chest on the inner end of the stud, having nozzles arranged to deliver fluid to the rotor, the stud having a passage therein, to the chest.

6. In a turbine, in combination, an outer casing, a shaft in one end thereof, a bearing stud in the other, an annular steam chest on the inner end of the stud, having a ring of nozzles directed axially, the stud having a passage for fluid leading to the chest, and a rotor mounted on the shaft and having a series of buckets arranged to receive fluid from the nozzles, the outer wall of the rotor being extended to inclose the chest and form a sleeve bearing on the stud.

7. In a turbine, in combination, an outer casing, a rotor therein having fluid passages therethrough formed with buckets to receive fluid pressure and outlets at the end of said passages, peripheral blades on the rotor, and means in the casing to deliver the fluid from the outlets with impact to the blades.

8. In a turbine, in combination, an outer casing, a rotor therein, means to apply fluid pressure to the rotor, the rotor having outlets for the fluid at the end and also having projecting blades, and a fixed ring within the casing extending around the rotor and having recurved passages arranged to receive the fluid and to deliver the same with impact against the blades.

9. In a turbine, in combination, an outer casing, a rotor therein having a series of fluid passages with pressure receiving devices therein, the passages being open at opposite ends to form inlets and outlets respectively for the fluid, the outlets being inclined with respect to the circumference of the rotor, a series of blades around the rotor at the outlet end thereof, and a ring fixed to the casing and having a series of recurved passages therein, the ends of the passages being opposite the outlets and the blades respectively and adapted to receive the fluid from the outlets and deliver the same with impact to the blades.

In testimony whereof I affix my signature in presence of two witnesses.

AUGUST H. BECKMAN.

Witnesses:
JOHN OLLIS,
HERBERT S. SIZGELKO.