(No Model.)

3 Sheets—Sheet 1.

E. G. LIBBY.

TURBINE.

No. 563,194. Patented June 30, 1896.

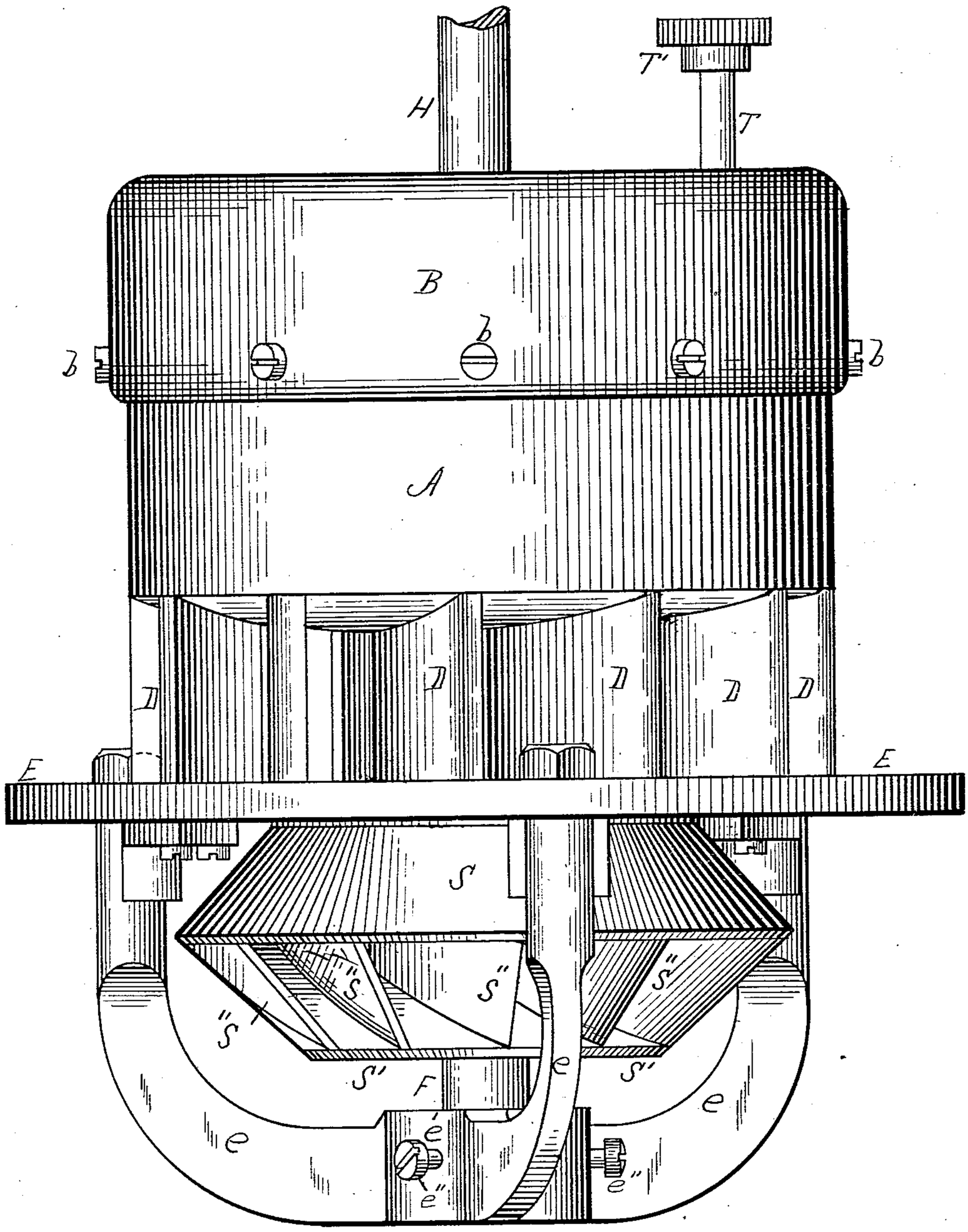

Fig. 1.

WITNESSES
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(No Model.)

3 Sheets—Sheet 2.

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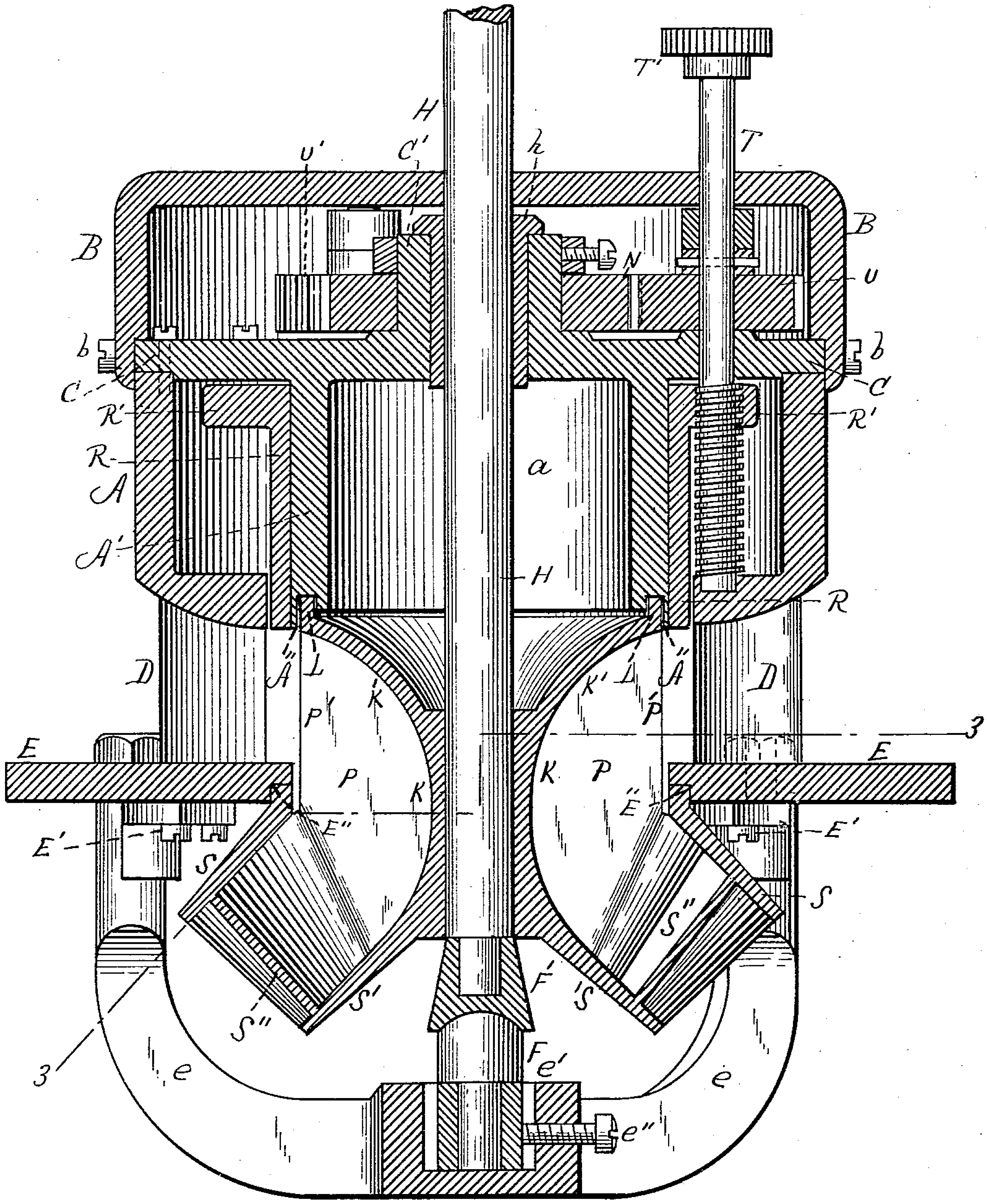

Fig. 2.

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(No Model.) 3 Sheets—Sheet 3.

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TURBINE.

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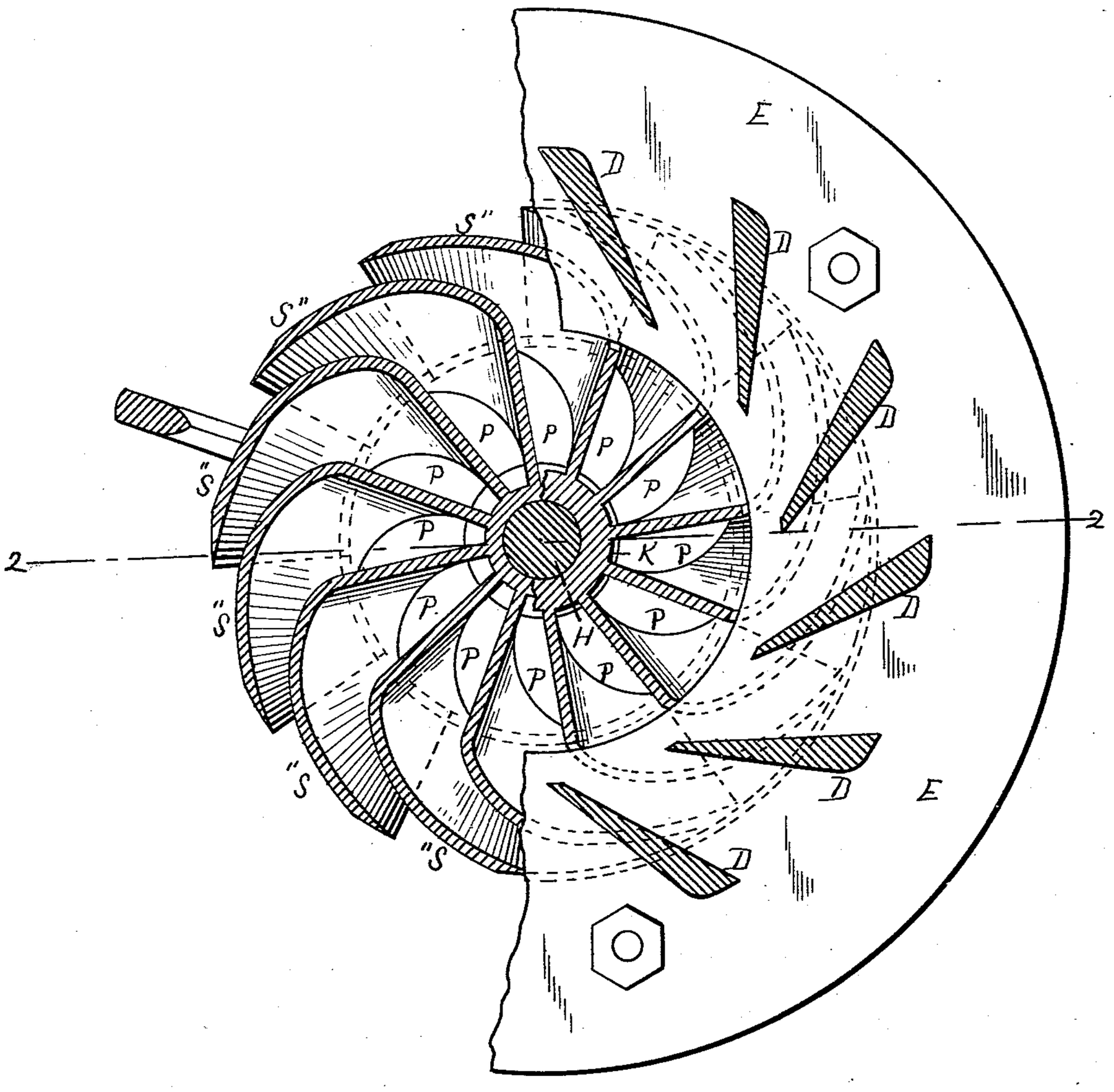

Fig. 3.

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UNITED STATES PATENT OFFICE.

ELBRIDGE G. LIBBY, OF EVERETT, MASSACHUSETTS.

TURBINE.

SPECIFICATION forming part of Letters Patent No. 563,194, dated June 30, 1896.

Application filed February 3, 1896. Serial No. 577,823. (No model.)

To all whom it may concern:

Be it known that I, ELBRIDGE G. LIBBY, a citizen of the United States, residing in Everett, in the county of Middlesex and State of Massachusetts, have invented new and useful Improvements in Turbines, of which the following is a specification.

This invention relates to an improved construction of turbines; and it has for its principal object to discharge the water through the buckets in an absolutely straight line, or in as nearly a straight line as the action of gravity will allow, said line being at a downward and outward angle, and hence to produce a higher degree of velocity and greater discharge of a solid body of water. In other words, it is intended that the water should discharge through the rotating buckets in lines which make no deflection or turn whatever other than the slight downward deflection from a straight line produced by gravity as the force of the water becomes exhausted.

The improvement also provides means for preventing the water from working up from the wheel into the central chamber within the inner casing, and thereby weighting the wheel and producing additional pressure upon the step which supports the vertical shaft communicating the power.

The nature of the invention in detail is fully described below, and illustrated in the accompanying drawings, in which—

Figure 1 is an elevation of a turbine embodying my invention. Fig. 2 is a central vertical section taken on line 2, Fig. 3. Fig. 3 is a section taken on line 3, Fig. 2.

Similar letters of reference indicate corresponding parts.

A represents the outside casing, and B a cap or housing bolted at *b* to said casing.

C is the crown-sheet or covering of the case, from which extends downward the cylindrical inner case A′, which is cast with or bolted to said crown-sheet, and is provided on its under edge with the annular groove A″, for the purpose below described. Extending downward from the outside casing A to the plate E are the guides D, integral with said casing and set substantially tangentially, as shown in Fig. 3, said plate E being integral with said guides and constituting the lower portion of the case. This plate, which is substantially circular in form, has bolted to it at E′ a spider *e*, which supports centrally and adjustably, by means of the socket *e′* and set-screws *e″*, the step F. This step F, which is preferably of wood and not new in this invention, is convex on its upper surface and supports the concave lower end of the sleeve or cup F′, which receives and is rigidly secured to the lower end of the vertical shaft H, which transmits the power. The upper portion of this shaft has its bearings in the sleeve *h* intermediate of said shaft and the hub C′, extending up from the crown-sheet C.

K is the hub of the water-wheel, keyed on the shaft H, and extending up into the flaring portion K′, (constituting the upper portion of the buckets,) such portion K′ being provided with the upwardly-extending annular flange L, which projects into the annular groove A″ in the under edge of the inner casing or cylinder A′. This arrangement is for the purpose of preventing the water from working up into the chamber *a* within said cylinder and thus pressing down upon the water-wheel and hence pressing the shaft H upon the step, thereby producing undue friction at that point and consequently affecting injuriously the amount of power transmitted by the shaft.

P P are the buckets, P′ being, in each instance, the mouth or inlet. These buckets consist of the upper crown-plate S and the lower crown-plate S′, said plates extending over and under, respectively, all the buckets, and constituting upper and lower walls common to all, the side walls or partition-walls S″ curved, as shown in Fig. 3, and dividing the buckets from each other and the upper portions K′ above mentioned. By means of the curvatures and inclinations of these side walls S″, the curvature of the portion K′ and K, and the angle at which the parallel portions S′ and S are set, the passage through each bucket describes, when the bucket is at rest, an arc which is much more than ninety degrees, and is, in fact, nearly one hundred and eighty degrees, that is to say, nearly a half-circle. Moreover, as the lower crown-plate S′ is smaller in diameter than the upper crown-plate S, the lower portion of each bucket is narrower than the upper portion thereof, by reason of the walls S″ approaching

each other toward their lower ends. Hence the major portion of the volume of water discharged from the outer end of the bucket is above the center thereof. The result is that the water enters the mouth P′ of the bucket at a point nearer the shaft, or nearer the axis around which the bucket revolves, than the point at which the water is discharged. In other words, supposing the center of the volume of water discharged from each bucket to be, say, one-third of the distance down from the crown-plate S, the center of the discharge is at a greater distance from the axis of the water-wheel than the center of the mouth or inlet of the bucket. The effect of this, and of the curvature described, and of the length of the arc constituting the vertical curvature of the bucket is that the water which is guided into the buckets by guides D discharges in absolutely straight lines as the buckets revolve, said lines radiating at downward and outward angles, and being deflected only by gravity when the force of the water is exhausted. Thus the friction is reduced to a minimum, and the results are great velocity, a large amount of discharge, and a discharge which is in a solid mass, that is to say, not disintegrated nor split nor spread into spray.

R represents the annular gate for checking or regulating the flow of water into the buckets. This gate slides vertically between the cylinder A′ and the base of the outer casing A, (see Fig. 1,) and is operated by means of, say, three screws extending at equidistant points through the correspondingly-threaded flange R′. One of these screws is shown at T in Fig. 2, and extends up above the cap B and is provided with a hand-wheel T′. A gear-wheel U is fast on the plain portion of said screw and engages with a gear-wheel V, which is loose on the hub C′. The other two screws (which need not extend above the cap) are provided with gear-wheels, one of which is shown at U′, and which engage with the central or intermediate gear V. Thus rotating the hand-wheel T′ communicates rotation to all the screws and lowers or raises the gate, as described.

The upper crown-plate S fits and moves, as the wheel rotates, in the annular groove E″ in the plate E.

Having thus fully described my invention, what I claim, and desire to secure by Letters Patent, is—

1. In a turbine of the character described, the water-wheel, comprising the hub K; outwardly-flaring upper portion K′; the downwardly-extending and outwardly-flaring lower crown-plate S′ constituting the floor or lower wall of the buckets; the upper crown-plate S constituting the upper wall of the buckets and set substantially parallel with the lower crown-plate, said plates S, S′ being set on straight lines and with their outer ends even, that is to say, on a line at right angles with the lines of direction of said plates, and the upwardly-flaring curved partitions S″ extending from the upper to the lower crown-plate and constituting the sides of the buckets, whereby the body of water is held solid and its velocity preserved at its discharge, substantially as described.

2. In a turbine of the character described, the water-wheel, comprising the hub K; outwardly-flaring upper portion K′; the downwardly-extending and outwardly-flaring lower crown-plate S′ constituting the floor or lower wall of the buckets; the upper crown-plate S constituting the upper wall of the buckets and set on a straight line and substantially parallel with the lower crown-plate, and the upwardly-flaring curved partitions S″ extending from the upper to the lower crown-plate and constituting the sides of the buckets, the water-passage in each of said buckets produced by the above-named parts, describing an arc which is greater than one hundred and eighty degrees, and the outlet of each bucket pointing at a downward and outward angle and with its major portion at a point farther from the axis of the water-wheel than the inlet thereof, substantially as set forth.

ELBRIDGE G. LIBBY.

Witnesses:
HENRY W. WILLIAMS,
A. N. BONNEY.