No. 827,995. PATENTED AUG. 7, 1906.

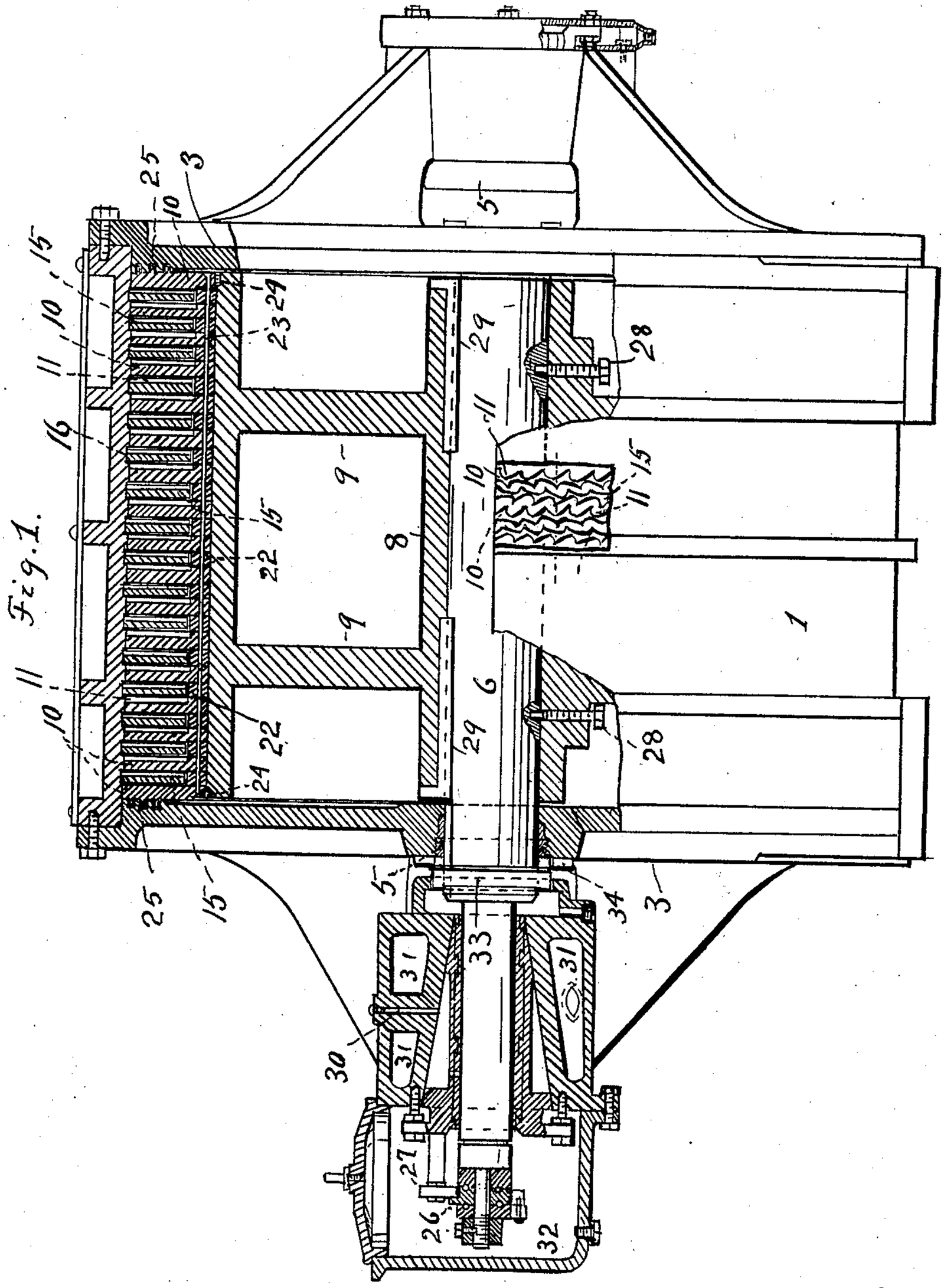
E. F. PRALL.

TURBINE ENGINE.

APPLICATION FILED MAR. 21, 1906.

3 SHEETS—SHEET 1.

Fig. 1.




Witnesses

C. M. Catlin.

Jno. E. Burch.

Inventor

Edgar F. Prall,

By Benj. R. Catlin

Attorney

No. 827,995. PATENTED AUG. 7, 1906.

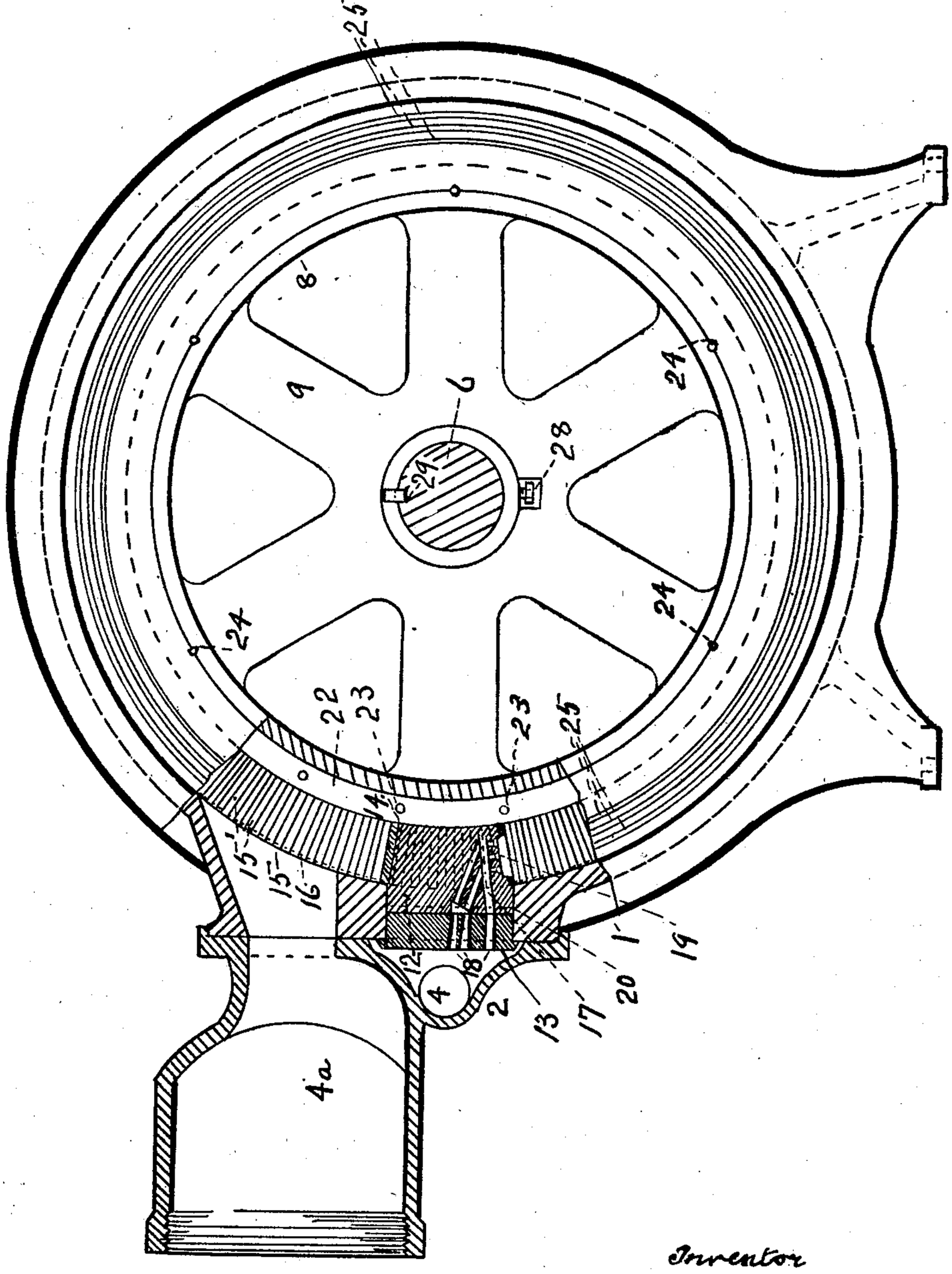
E. F. PRALL.

TURBINE ENGINE.

APPLICATION FILED MAR. 21, 1906.

3 SHEETS—SHEET 2.

Fig. 2.




Witnesses
C. M. Catlin.
Jno. E. Burch.

Inventor
Edgar F. Prall,
By Benj. R. Catlin
Attorney

No. 827,995. PATENTED AUG. 7, 1906.

E. F. PRALL.

TURBINE ENGINE.

APPLICATION FILED MAR. 21, 1906.

3 SHEETS—SHEET 3.

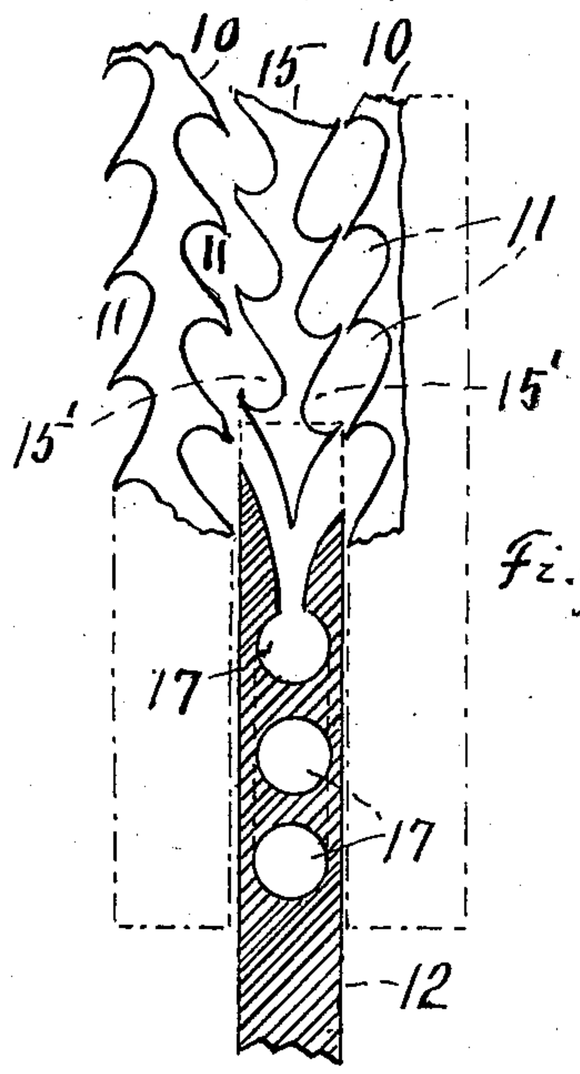



Fig. 3.

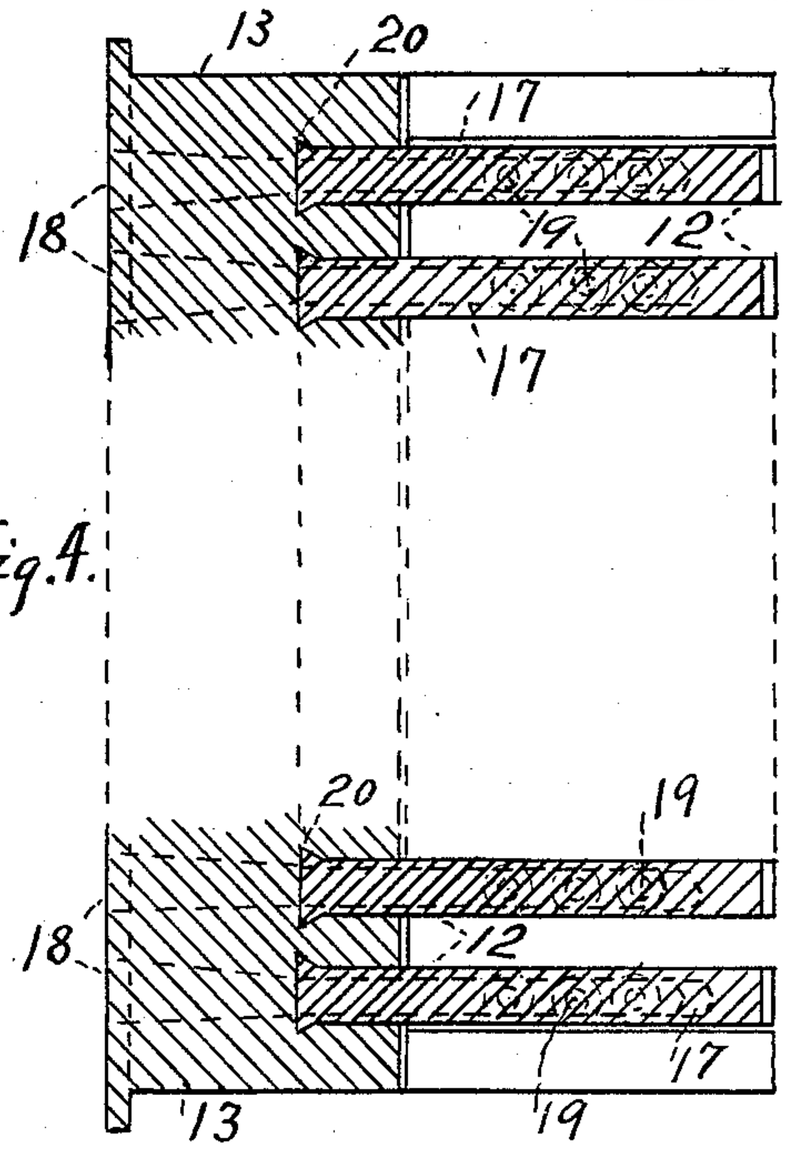



Fig. 4.

Fig. 5.

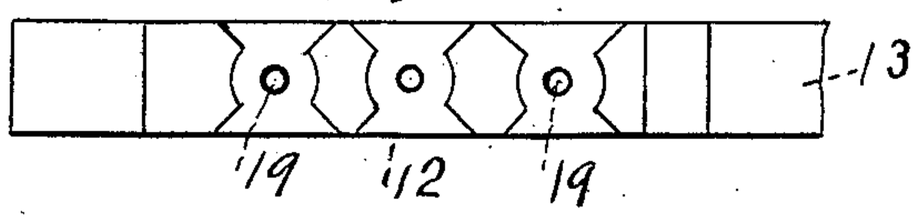
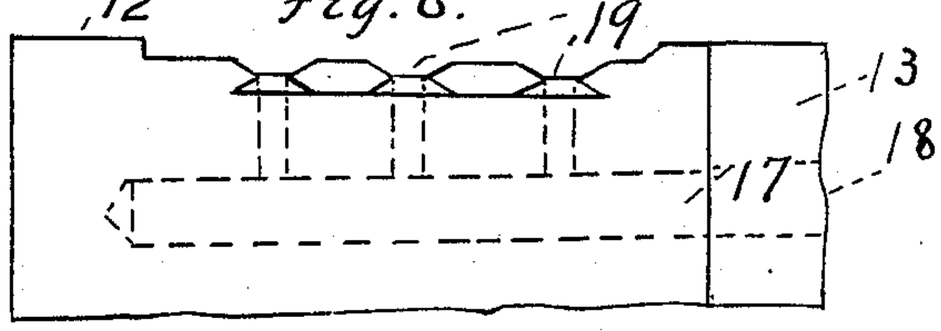



Fig. 6.




Witnesses

C. M. Catlin

Jno. E. Burch.

Inventor

Edgar F. Prall.

By Benj. R. Catlin

Attorney

# UNITED STATES PATENT OFFICE.

EDGAR FREDERICK PRALL, OF NEW YORK, N. Y.

## TURBINE-ENGINE.

No. 827,995. Specification of Letters Patent. Patented Aug. 7, 1906.

Application filed March 21, 1906. Serial No. 307,209.

*To all whom it may concern:*

Be it known that I, EDGAR FREDERICK PRALL, a citizen of the United States, and a resident of New York city, in the county of New York and State of New York, have invented certain new and useful Improvements in Turbine-Engines, of which the following is a specification.

The invention relates to impact or turbine engines, and has for its object to increase their efficiency and economy of manufacture; and it consists in the construction hereinafter described and pointed out.

In the accompanying drawings, which illustrate the invention and form a part of the specification, Figure 1 is a partial vertical section of the machine. Fig. 2 is a partial cross-section through the steam-chest and an abutment-block, the near head being omitted. Fig. 3 is an enlarged longitudinal broken section showing a fixed abutment, a bucket-ring or running wheel, and an interposed fixed abutment or bucket-ring. Fig. 4 is a longitudinal section of the abutment-block and abutments. Figs. 5 and 6 are side views of an abutment at right angles to each other, showing the relation of the steam ports and nozzles.

Numeral 1 denotes a cylinder or casing closed by a head 3.

2 indicates a steam-chest, 4 an inlet, and $4^a$ an exhaust.

5 denotes bearings including a stuffing-box for a shaft 6. To this shaft is fixed by screws or other means a hub 8, having webs or spokes 9. To this hub are fixed by any suitable means the disks, rings, or runners 10, having on their proximate faces buckets or fluid-deflecting surfaces 11, adapted to receive the impact of steam, gas, or other fluid.

Each bucket, curved as shown and substantially in the form of a parabola, has two oppositely-situated faces arranged to produce the greatest deflection of the steam, as hereinafter described.

12 denotes a stationary abutment fixed to the abutment-block 13, which is rigidly fixed to the cylinder. The abutments 12 are fitted into the opening 14, cut out of the stationary deflecting-ring 15 in such manner as to expand said deflector-ring into the grooves 16, situated in the interior of the cylinder, whereby said stationary deflector-ring is held immovably in position.

The abutments 12 have holes 17 bored into them to permit steam to pass from holes 18 in the abutment-block to the nozzles 19, arranged to communicate with the buckets.

The abutments 12 are connected to the abutment-block 13 by dovetail grooves 20. By this arrangement steam is delivered to all the nozzles through the various abutments simultaneously from the steam-feeding chest 2 and will be expanded from the nozzles against the revolving buckets on each side of said abutments. These buckets are out on both sides of the revolving disks and formed in such manner as to cause the steam to be deflected and discharged from said buckets in a direction opposite that of the movement of the wheel, it being desirable that the greatest possible angle of deflection may be obtained in order to produce the greatest impact force upon each revolving bucket-wheel.

In order to insure the best results from the repeated impacts of steam in the series of moving buckets and reaction on the stationary buckets 15′ on the ring abutments 15, both series of buckets are formed substantially as represented and so that steam acting upon the moving buckets is thereby deflected directly backward into the abutment-buckets and in manner as to react from said latter buckets successively against the moving buckets. The buckets of both series are in section approximately of the form of half an oval, the moving one being directed backwardly and the stationary ones forwardly. Their form is such that when the apices or highest parts of their inclosing walls are adjacent, the series on one to the series on the other they inclose a space a section of which has the form of an oval the longer axis of which approximates parallelism with the plane of movement of the running buckets.

It will be noted that in the situation represented in Fig. 3 the fixed and moving rings and their respective buckets are so disposed that steam is entering on the left side and the proximate walls of the fixed buckets, which are directed in the plane of the axes of opposite movable buckets in manner to direct steam along the nearest side of the running

bucket, and thus avoid interference with reaction from the short side of the former bucket against the proximate fixed bucket.

The number of impacts which can be made by steam on each revolving runner or wheel will be determined by the diameter of the wheel and the number of buckets cut upon the runners, and it will be seen that hundreds of deflections and reactions may be utilized before the final discharge of the steam from an engine of comparatively small dimensions. In constructing these bucket-rings from steel plates they will be made of a uniform thickness and will be cut on both sides down to a point as near to the hub as required to insure the desired depth of the channels or steamways. The base of the runner will not, however, be cut to its bottom. Smaller rings 22 are placed upon the hub to separate the runners equal distances apart. These rings and runners are forced upon the hub and held securely together by means of rods 23, driven through holes in the runners, and division-rings at short intervals around the periphery. The whole body thus held together is secured to the drum or hub by screws 24 at short intervals around the periphery of the drum.

"Walls of Troy" 25, dovetail grooves, or other tongue-and-groove devices are cut upon the last runner and upon the cylinder-head at each end of the engine, which will largely prevent the leakage of steam. The centrifugal force of the steam also tends to prevent it from passing through such grooves.

The revolving drum and its runners will be held rigidly in position by means of the ball-bearing device 26, that connects the shaft directly to the cylinder by means of a yoke 27. There is no end thrust, and the purpose of said ball-bearing and yoke connection is to effectually prevent the revolving part coming in contact with the stationary parts. The hub or drum is securely attached to the shaft by screws 28 and feathers 29.

The journals are properly lubricated through oil-hole 30, and water may be circulated through openings 31 around the journals. Oil can be kept in the box 32 for lubricating the ball-bearings 26.

33 is a thimble for centering the shaft by means of lugs 34.

Having thus described the invention, what I claim is—

1. In an engine, the shaft, the fixed cylindrical casing, a wheel fixed to said shaft and revolving with it, a series of buckets cut on said wheels shaped to discharge the steam in a backward direction from the line of motion of the wheel, a series of oppositely-situated stationary buckets to receive steam from the running wheel and change its direction back into buckets of the same running wheel, an abutment situated in and terminating the steamway, said abutment having an admission-port adapted to direct steam against the bucket-faces, and an exhaust-port leading out through the casing, substantially as described.

2. A stationary wheel having deflectors or buckets and held in a groove in the cylinder of a turbine-engine between two oppositely-situated revolving bucket-wheels, said wheels being separated to permit the expansion of its periphery into said groove by the introduction of a fixed abutment terminating the steamway, said abutment having an admission-port adapted to direct steam or other fluid against a bucket-face, and an exhaust-port leading out through the casing, substantially as described.

3. In a turbine-engine, the abutment-block having a series of abutments held therein by dovetail grooves and provided with steam-ports to admit steam through said abutment-block so as to communicate with admission-port in the abutments adapted to direct steam against a bucket-face, substantially as described.

4. In a turbine-engine, an abutment-block provided with dovetail grooves, and abutments fixed in the grooves, said block and abutments having connecting steam-ports.

5. In a turbine-engine, an abutment-block provided with dovetail grooves, and abutments fixed in the grooves, said block and abutments having connecting steam-ports, and rotating bucket-wheels, the abutment-ports being arranged to direct steam into said buckets.

6. In a turbine-engine, an abutment-block provided with dovetail grooves, and abutments fixed in the grooves, said block and abutments having connecting steam-ports, and rotating bucket-wheels, the abutment-ports being arranged to direct steam into said buckets, curved reaction buckets on the abutments, the buckets on the wheels being similar to those on the abutments and oppositely disposed.

7. In a turbine-engine, an abutment having an inlet-port and provided on each side with similar reaction-buckets, in combination with running bucket-wheels provided with similar buckets on their proximate faces adjacent the abutment, said abutment-buckets on opposite sides of the abutment being situated successively in advance of each other, whereby steam is admitted from the abutment-port alternately on opposite sides of the abutment.

8. An abutment provided with a series of reaction-buckets on its opposite sides shaped substantially as shown and having lips or apices pointing forwardly, combined with

running wheels having a series of similar buckets of practically the same size and form with lips pointing backwardly, whereby when the lips of one series are closely adjacent the lips of the other steam-spaces of approximately oval outline are inclosed and reaction in the direction of the wheel movement produced by steam admission.

Signed at New York city, in the county of New York and State of New York, this 5th day of March, A. D. 1906.

EDGAR FREDERICK PRALL.

Witnesses:
JULIA L. PRALL,
L. M. PRALL.