No. 827,141. PATENTED JULY 31, 1906.

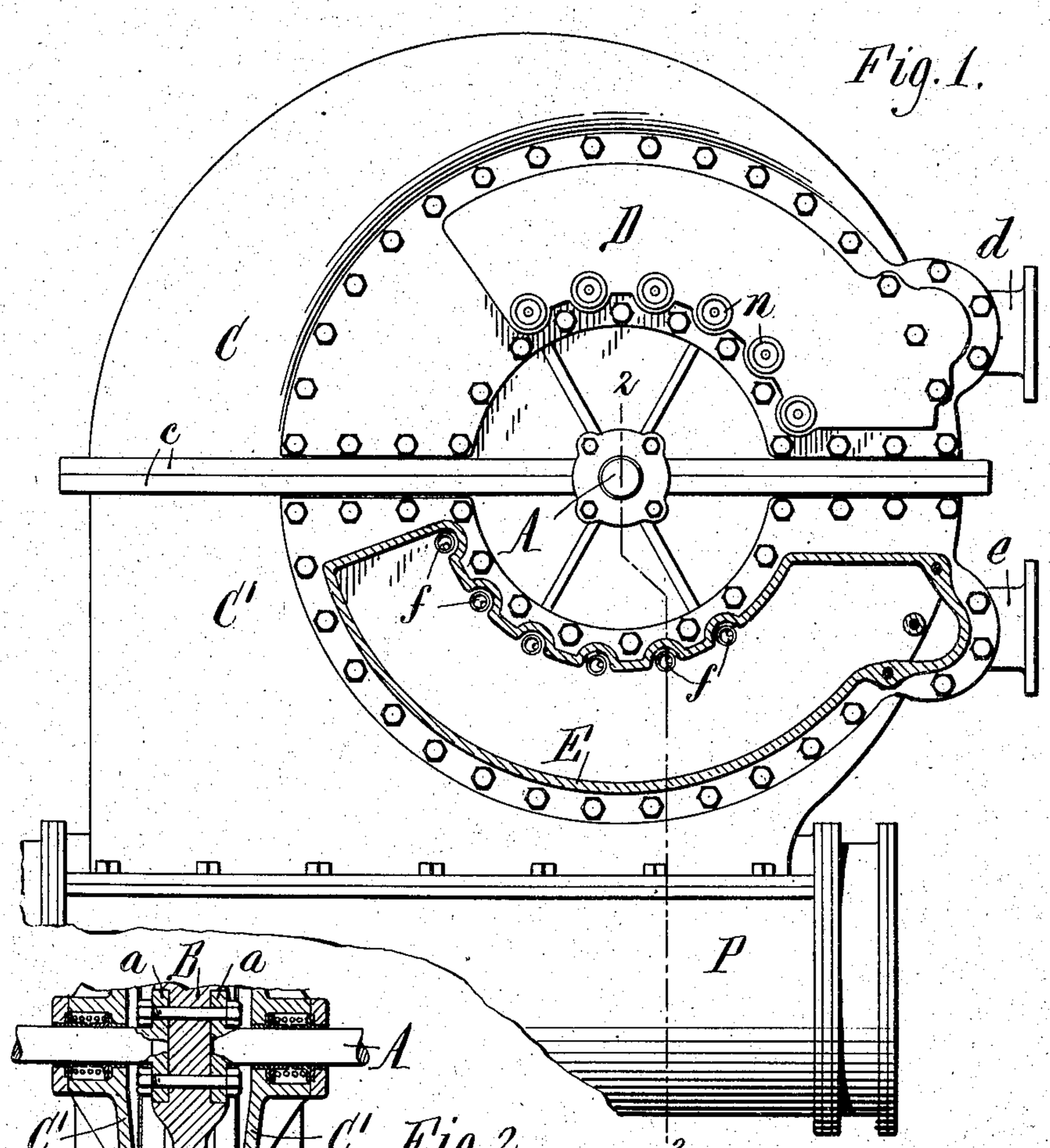
J. H. O. BUNGE.

TURBINE.

APPLICATION FILED MAY 6, 1905.

3 SHEETS—SHEET 1.

Fig. 1.



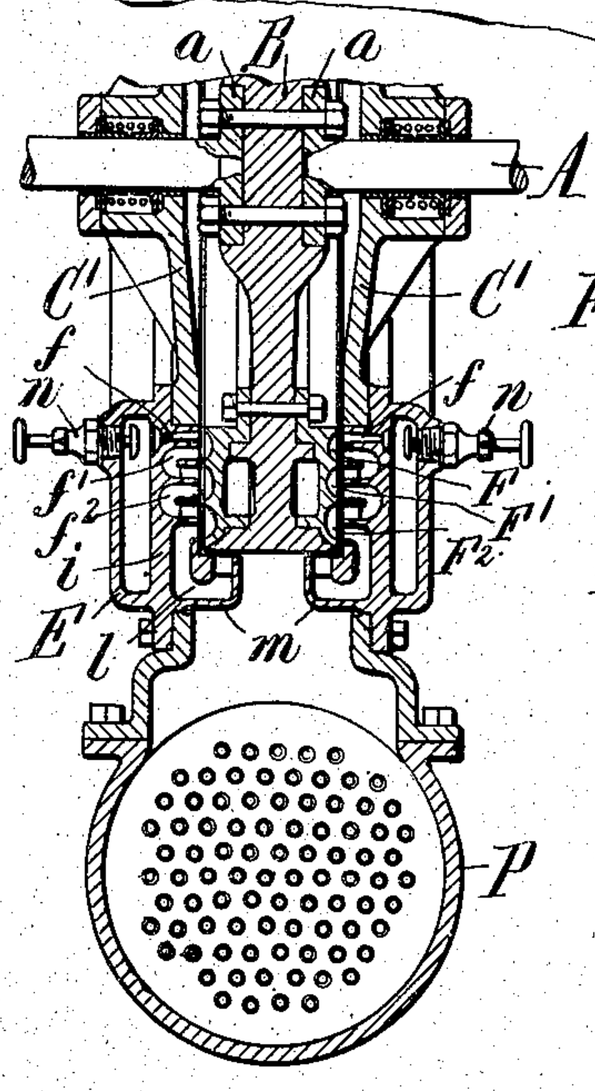


Fig. 2.

Fig. 3.

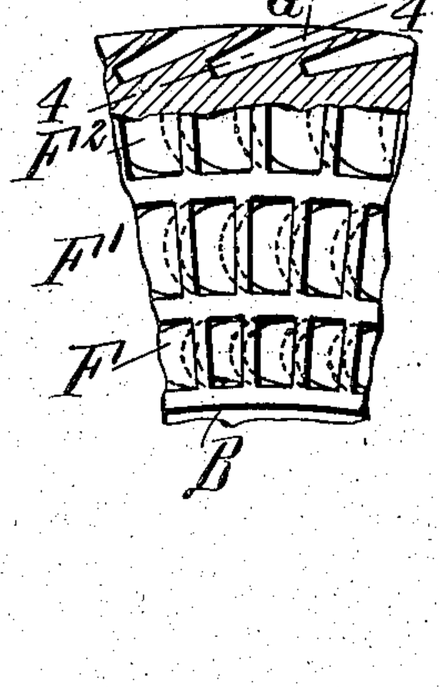
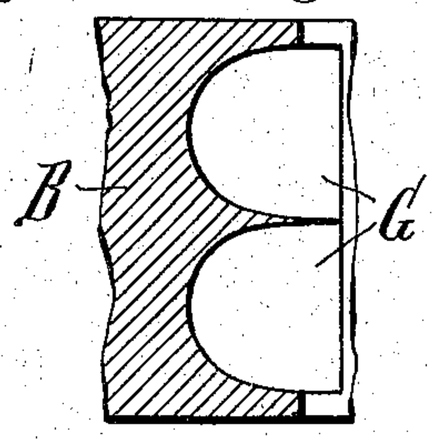


Fig. 4



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3 SHEETS—SHEET 2.

Fig. 5.

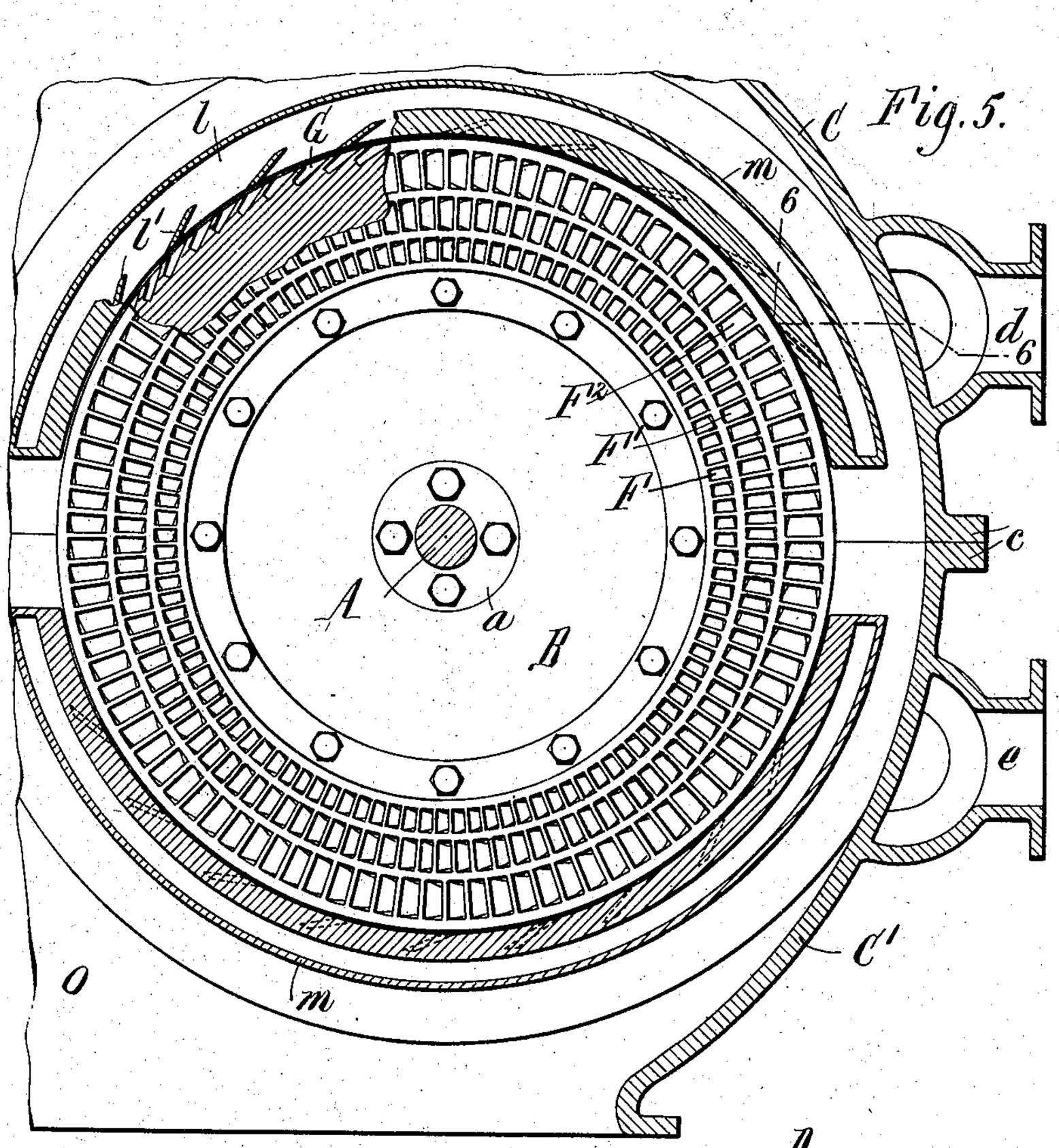
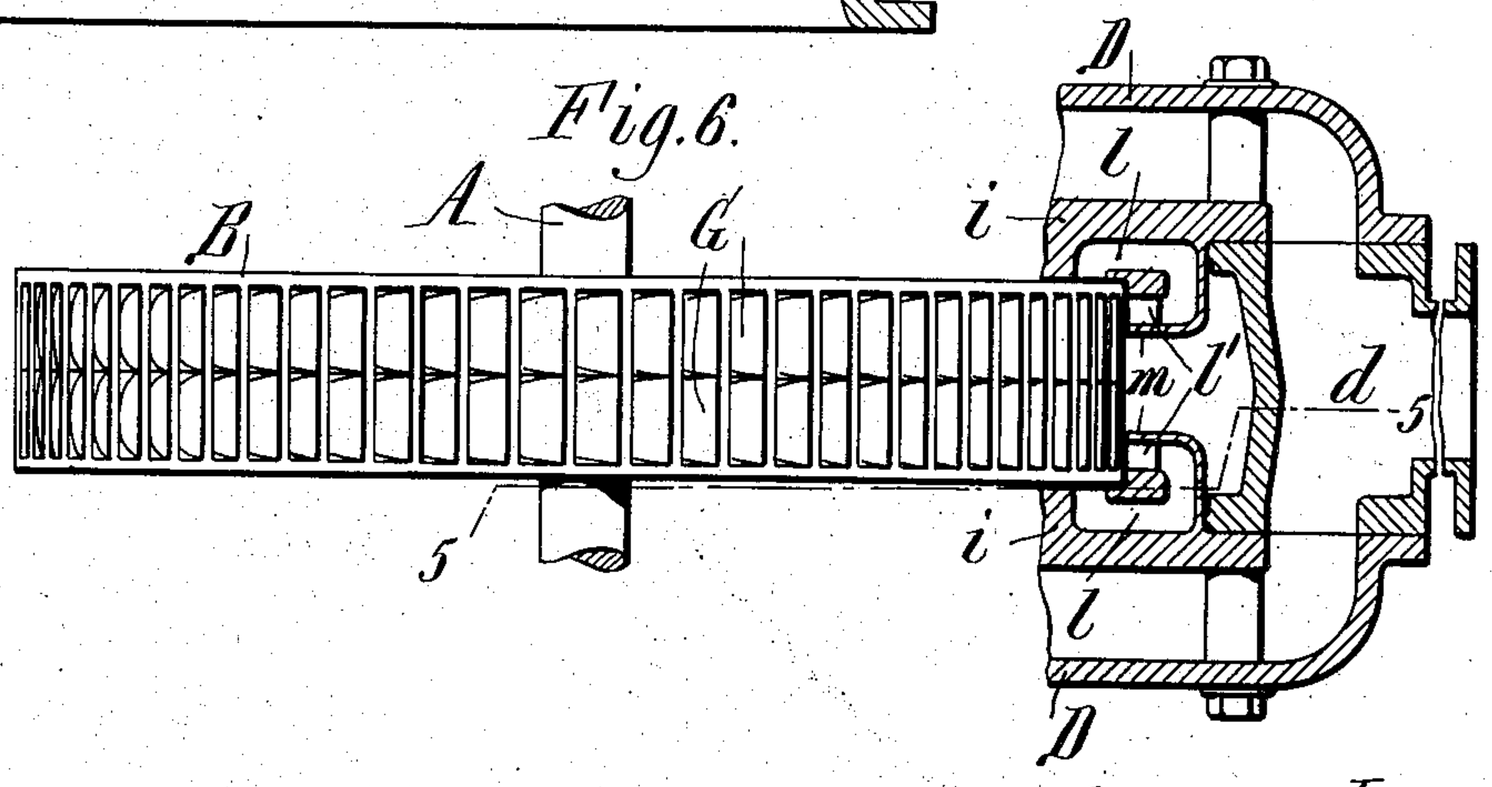


Fig. 6.



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3 SHEETS—SHEET 3.

Fig. 7.

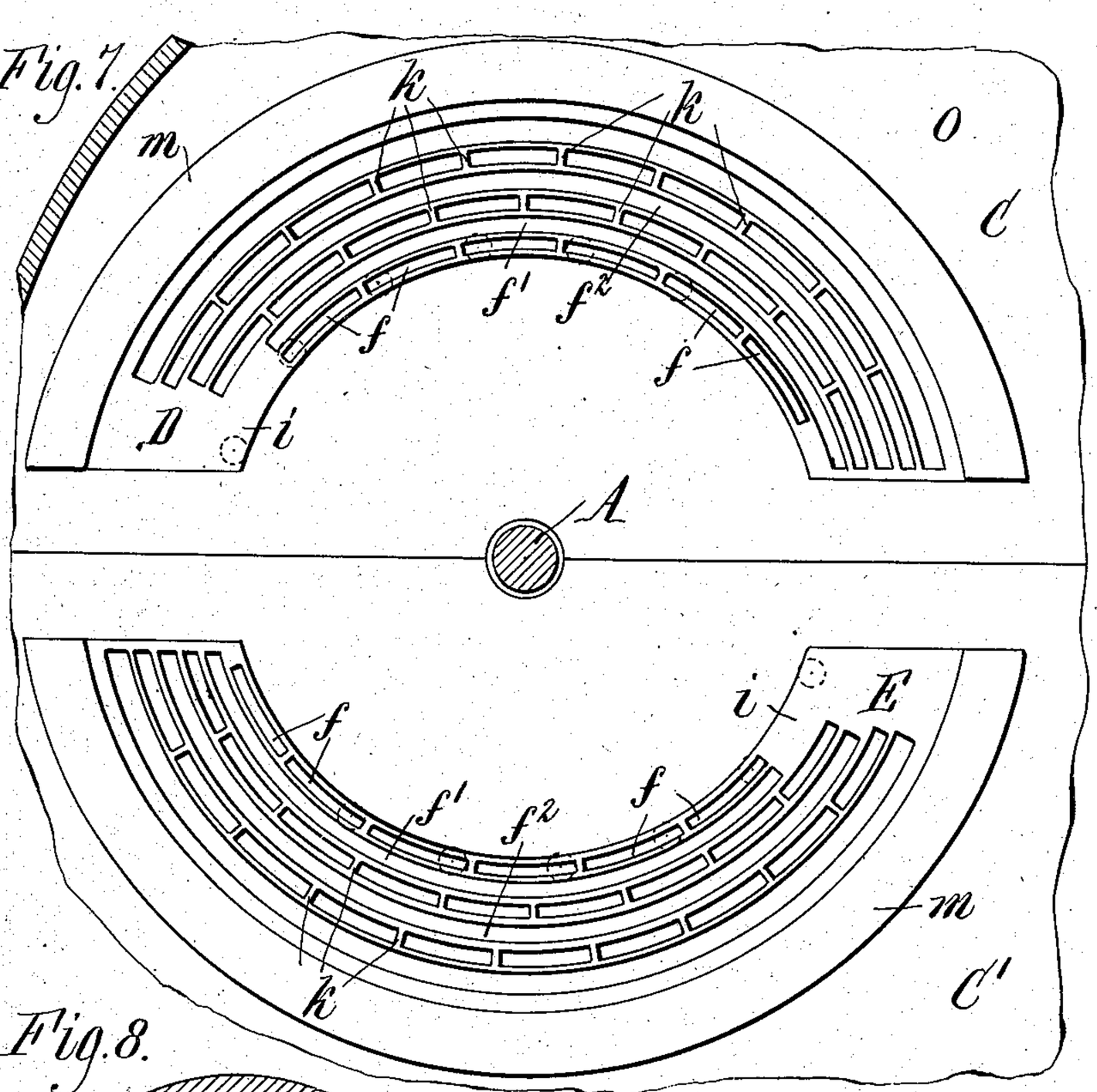


Fig. 8.

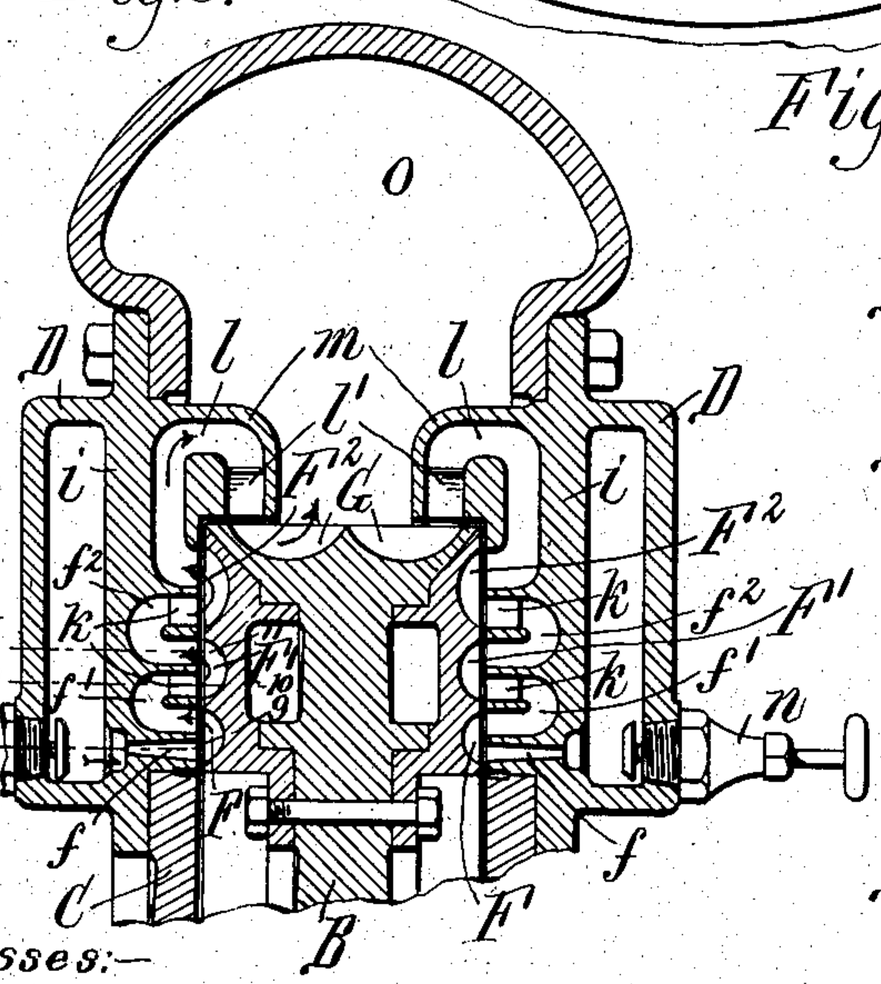


Fig. 9.

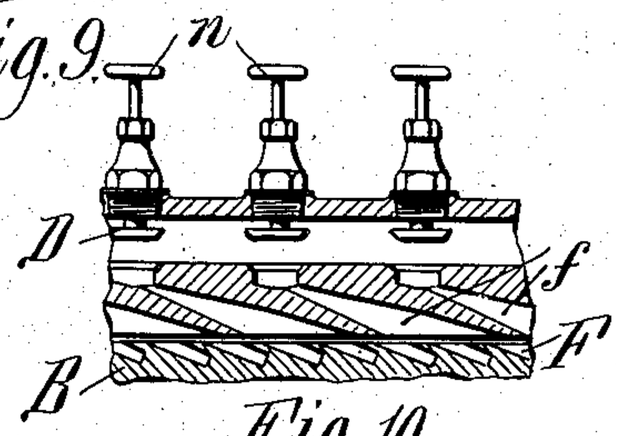


Fig. 10.

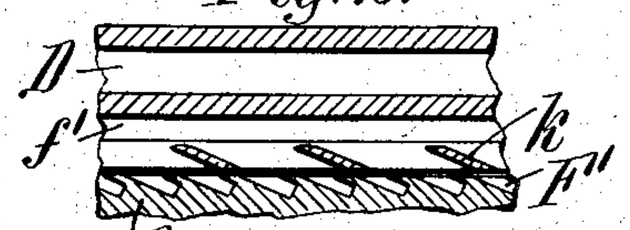
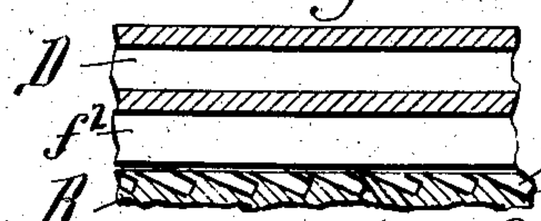


Fig. 11.



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UNITED STATES PATENT OFFICE.

JULIUS H. O. BUNGE, OF BUFFALO, NEW YORK.

TURBINE.

No. 827,141. Specification of Letters Patent. Patented July 31, 1906.

Application filed May 6, 1905. Serial No. 259,084.

To all whom it may concern:

Be it known that I, JULIUS H. O. BUNGE, a subject of the Queen of the Netherlands, residing at Buffalo, in the county of Erie and State of New York, have invented a new and useful Improvement in Turbines, of which the following is a specification.

This invention relates to that class of turbines which are actuated by the impact of an elastic fluid under pressure, usually steam, and in which the turbine-wheel is provided at its sides and at its periphery with devices which receive the impact.

The object of this invention is to improve the construction and arrangement of the impact-receiving devices and the devices by which the steam or other elastic fluid is directed against the wheel and exhausted therefrom with a view of producing a turbine which is simple, compact, and durable in construction, economical in consumption of steam, highly efficient in operation, and free from end thrust.

This improved turbine comprises, briefly stated, a wheel which has two rows of buckets side by side in its peripheral face and also rows of buckets in its side faces, nozzles which deliver the steam primarily to the side buckets, and passages which receive the steam escaping from the side buckets and conduct the steam to the outer portions of the rows of peripheral buckets, while the adjacent inner portions of the rows of peripheral buckets are free for the escape of the exhaust therefrom.

In the accompanying drawings, consisting of three sheets, Figure 1 is a side elevation of the improved turbine, partly in section. Fig. 2 is a vertical transverse section of the lower portion of the turbine in line 2 2, Fig. 1. Fig. 3 is a fragmentary side elevation of the turbine-wheel, partly in section and on an enlarged scale. Fig. 4 is a section through a pair of the peripheral buckets in line 4 4, Fig. 3. Fig. 5 is a sectional side elevation showing the turbine-wheel partly in section and showing parts of the casing and steam-chests, the section through the latter being taken in line 5 5, Fig. 6. Fig. 6 is a plan of the turbine-wheel and a horizontal section through the casing in line 6 6, Fig. 5. Fig. 7 is an elevation showing the inner faces of the steam-chests. Fig. 8 is a vertical transverse section through the upper portion of the turbine wheel and casing on an enlarged scale. Figs. 9, 10, and 11 are horizontal sections through one of the steam-chests and its passages in lines 9 9, 10 10, and 11 11, Fig. 8, respectively.

Like letters of reference refer to like parts in the several figures.

A represents the horizontal turbine-shaft, which is preferably made in two sections arranged in line and each having at its inner end a head or disk *a*, Fig. 2.

B represents the turbine-wheel, which is secured to the shaft, preferably, as shown, by being arranged between the disks *a* and bolted thereto. The wheel B is arranged in a casing which is preferably composed of an upper part C and a lower part C′, joined by horizontal flanges *c*. This casing is provided with steam-chests on both sides, and such chests are preferably provided on both the upper and lower parts of the casing, as shown, D representing the upper chests and E the lower chests. The upper chests are provided with an inlet *d* and the lower chests with an inlet *e* for the steam. The wheel B is provided, as shown, in each side face, near its periphery, with several concentric rows of buckets, three rows F F′ F² being shown, and in its peripheral face with two rows of buckets G, arranged side by side. These buckets preferably increase in size from the innermost row of side buckets F to the peripheral row of buckets G in such proportion as the successive degrees of expansion and velocity of the steam require.

Each steam-chest is provided with one or more steam-nozzles *f*, Figs. 8 and 9, which deliver the steam against the innermost row of side buckets F. These nozzles diverge toward the wheel to cause the proper expansion of the steam and are arranged obliquely in the direction in which the wheel rotates, as shown in Fig. 9, the buckets F to which they direct the steam being similarly inclined. These nozzles are arranged to deliver the steam against the inner half of each bucket, leaving the outer half free for the escape of the steam therefrom, as shown in Fig. 8.

The inner wall *i* of each steam-chest is provided with a U-shaped steam-passage *f*′, Fig. 8, which receives the steam escaping from the outermost portion of the innermost row F of side buckets and delivers such steam to the innermost portion of the next outer or intermediate row F′ of side buckets, and with a similar U-shaped steam-passage *f*², which conducts the steam in like manner from the intermediate row of buckets F′ to the outermost row of side buckets F². The delivery

portions of the steam-passages f' f^2 are provided with oblique partitions k, Figs. 8 and 10, which direct the steam properly against the buckets. Each steam-chest is further provided in its inner wall with a steam-passage l, which receives the steam from the outermost portion of the outermost row of side buckets F^2 and conducts the steam to the outermost portion of the corresponding row of peripheral buckets G, leaving the innermost portion of the peripheral buckets free for the exhaust. The outer or peripheral portion m of each steam-chest overlaps the outer portion of the peripheral face of the wheel, and the delivery portion of each passage l is formed in this overlapping part of the steam-chest, Figs. 2, 5, and 8. The delivery portion of the passage l is provided with oblique partitions l', which properly direct the steam against the peripheral buckets. The inlet and outlet openings of the steam-passages f f' and l are segmental in shape and correspond with the respective rows of buckets, as represented in Fig. 7.

Each bucket has preferably the form of a broad and shallow pocket or recess which extends from the surface of the wheel at an oblique angle into the wheel and which has its bottom rounded or concave in the direction of the width of the bucket, as represented in Figs. 3 and 4. The rounded or concave bottom permits the steam to pass through the bucket from the inlet to the outlet side thereof without obstruction. These buckets are readily cut in the wheel by means of rotary milling-tools.

Each steam-chest is preferably provided in its outer wall with a separate valve n, Figs. 8 and 9, for each nozzle f, so that any individual nozzle or any desired number of nozzles can be closed, if desired, thereby permitting the steam-supply to be regulated without throttling the steam.

The casing is provided with an exhaust-passage O, which extends around the peripheral face of the wheel to a greater or less extent and communicates between the peripheral portions m of the steam-chests with the adjacent inner portions of the two rows of peripheral buckets G, so as to receive the exhaust-steam therefrom. The exhaust-steam is preferably conducted from the passage O directly to a condenser P, Figs. 1 and 2, or is otherwise discharged in any suitable manner.

The steam passes through the peripheral buckets from their outer to their inner portions and emerges into the exhaust-passage from both sides of the annular ridge which separates the two rows of peripheral buckets. There is therefore little or no tendency of the steam to wear out the buckets. Any wear which may occur in these buckets by the action of the steam will tend to keep the ridge between the two rows of buckets clear and sharp. A free and steady escape of the exhaust-steam is insured at all times and whirling of the steam and the loss in efficiency resulting therefrom when the steam is directed against the ridge and emerges from the outer halves of the buckets are avoided.

The operative area of the wheel is comparatively large and located very advantageously at and near the periphery of the wheel, the steam acts in several stages of expansion and its energy is gradually absorbed by the successive rows of buckets in a very advantageous manner, the wheel runs without end thrust as the pressures on its sides are balanced, and the width of the wheel and the distance between the bearings of the shaft are comparatively small, rendering the turbine very compact. The number of rows of side buckets may be reduced or increased, as circumstances may require.

I claim as my invention—

1. The combination of a turbine-wheel having its peripheral face provided with rows of buckets arranged side by side, and supply-passages for the elastic motive fluid which direct the fluid to the outer portions of the rows of buckets and leave the adjacent inner portions of the buckets free for the exhaust, substantially as set forth.

2. The combination of a turbine-wheel having its peripheral face provided with rows of buckets arranged side by side, passages which direct the elastic motive fluid to the outer portions of the rows of buckets and leave the adjacent inner portions of the buckets free, and an exhaust-passage covering the adjacent inner portions of said rows of buckets, substantially as set forth.

3. The combination of a turbine-wheel having buckets in its side faces and having its peripheral face provided with rows of buckets arranged side by side, nozzles which direct the motive fluid to the side buckets, passages which conduct the fluid escaping from the side buckets to the outer portions of the peripheral buckets, and an exhaust-passage which covers the inner portions of the peripheral buckets, substantially as set forth.

4. The combination of a turbine-wheel having side buckets and having its peripheral face provided with buckets formed by recesses extending obliquely into the wheel from the surface thereof and having their bottoms concave in the direction of their width, nozzles which direct the motive fluid against the side buckets, and passages which direct the fluid from the side buckets to the peripheral buckets, substantially as set forth.

5. The combination of a turbine-wheel having its side faces and its peripheral face provided with concentric rows of buckets formed by recesses extending obliquely into the wheel from the surface thereof and having their bottoms concave in the direction of their width, nozzles which direct the motive

fluid against the inner portion of the innermost row of buckets, passages which receive the fluid from the outer portion of the innermost row of side buckets and conduct the fluid to the next outer row of side buckets, and passages which conduct the fluid from the outermost row of side buckets to the peripheral buckets, substantially as set forth.

6. The combination of a turbine-wheel having buckets in its side faces and in its peripheral face, a casing surrounding the wheel, chests secured to said casing, and nozzles and passages within the chests for directing the motive fluid to the side buckets and from the latter to the peripheral buckets, substantially as set forth.

7. The combination of a turbine-wheel having concentric rows of buckets in its side faces, an inclosing casing, and a chest detachably secured to said casing and having in its inner wall a nozzle which directs the motive fluid to the innermost row of buckets, and passages which receive the fluid from the innermost row of buckets and direct it to the next outer row of buckets, substantially as set forth.

8. The combination of a turbine-wheel having its peripheral face provided with rows of buckets arranged side by side, chests which overlap the outer portions of said buckets and are provided with passages for the motive fluid leading to the outer portions of said buckets, and an exhaust-passage which is arranged between the overlapping portions of said chests, substantially as set forth.

9. The combination of a turbine-wheel having buckets in its side faces and rows of buckets arranged side by side in its peripheral face, an inclosing casing, chests secured to said casing and provided with nozzles which direct the motive fluid to the side buckets and with outer portions which overlap the peripheral face of the wheel and which are provided with passages for conducting the fluid from the side buckets to the outer portions of the rows of peripheral buckets, and an exhaust-passage which communicates with the space between the overlapping portions of the chests and with the inner adjacent portions of the peripheral buckets, substantially as set forth.

Witness my hand this 3d day of May, 1905.

JULIUS H. O. BUNGE.

Witnesses:
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