(Model.) 3 Sheets—Sheet 1.

# J. C. LANSING.

## TURBINE WHEEL.

No. 480,929. Patented Aug. 16, 1892.

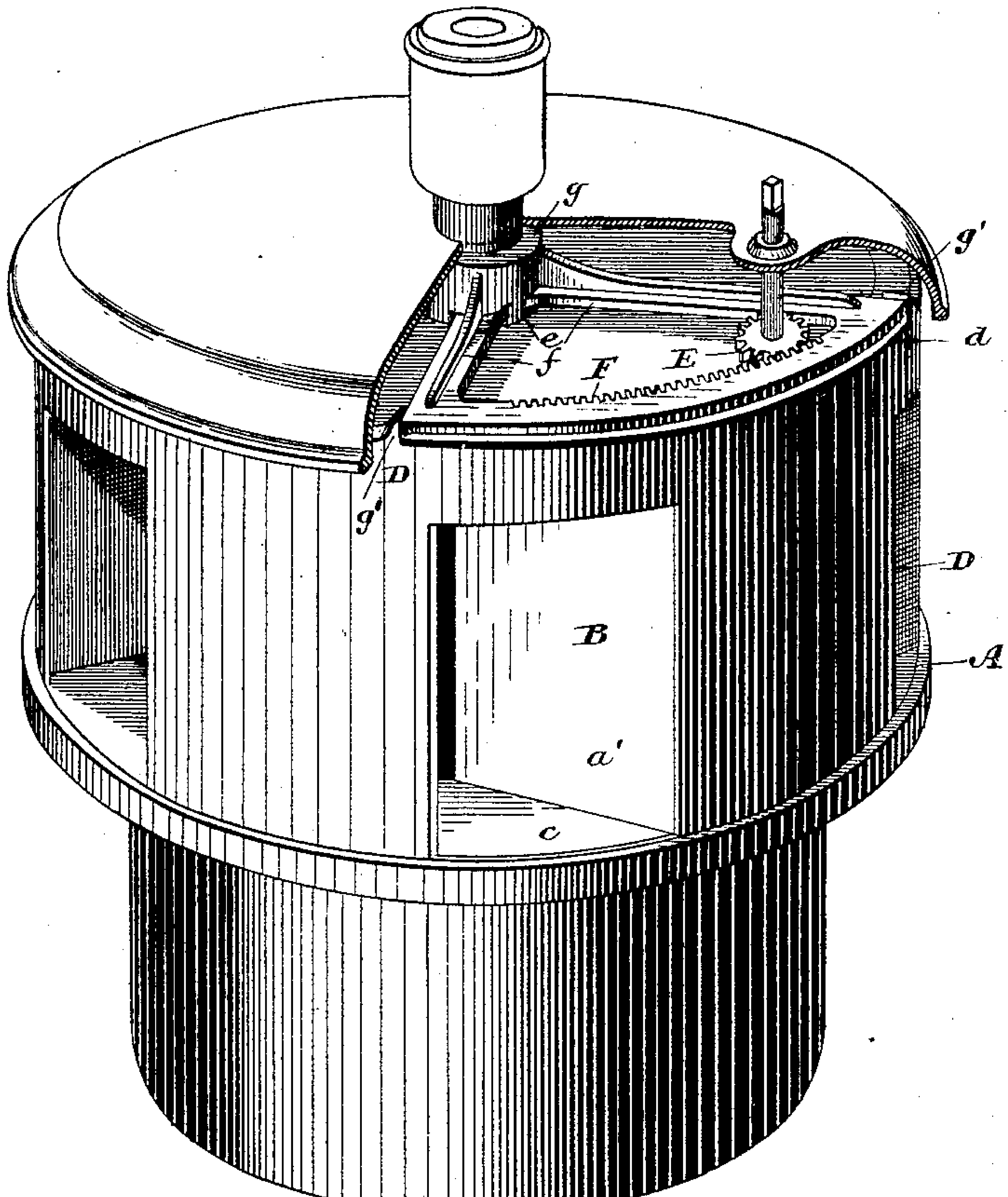


Fig. 1.

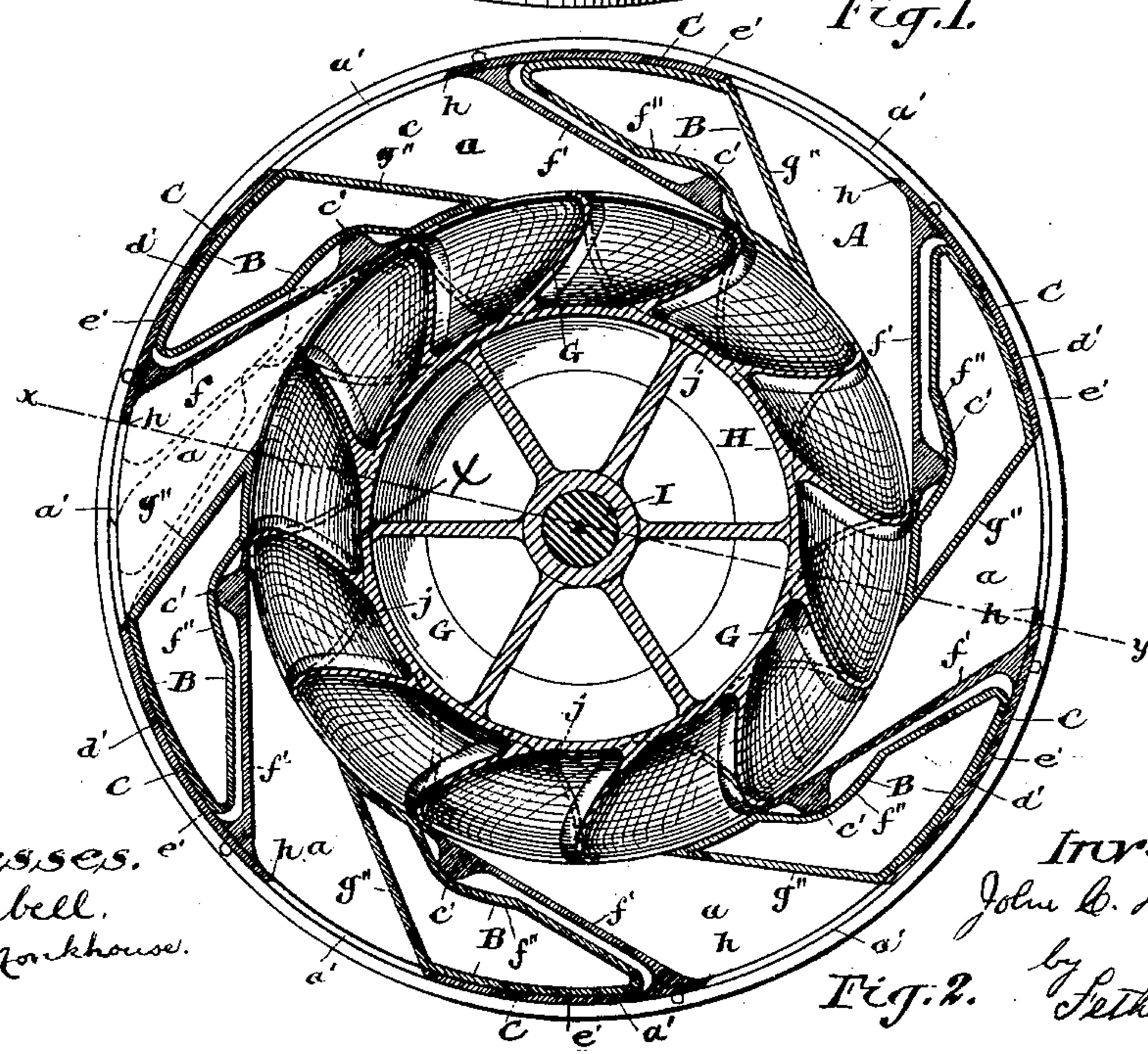


Fig. 2.

Witnesses.
L. P. Abell.
A. B. Monkhouse.

Inventor.
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Attys

(Model.)

3 Sheets—Sheet 2.

J. C. LANSING.

TURBINE WHEEL.

No. 480,929.

Patented Aug. 16, 1892.

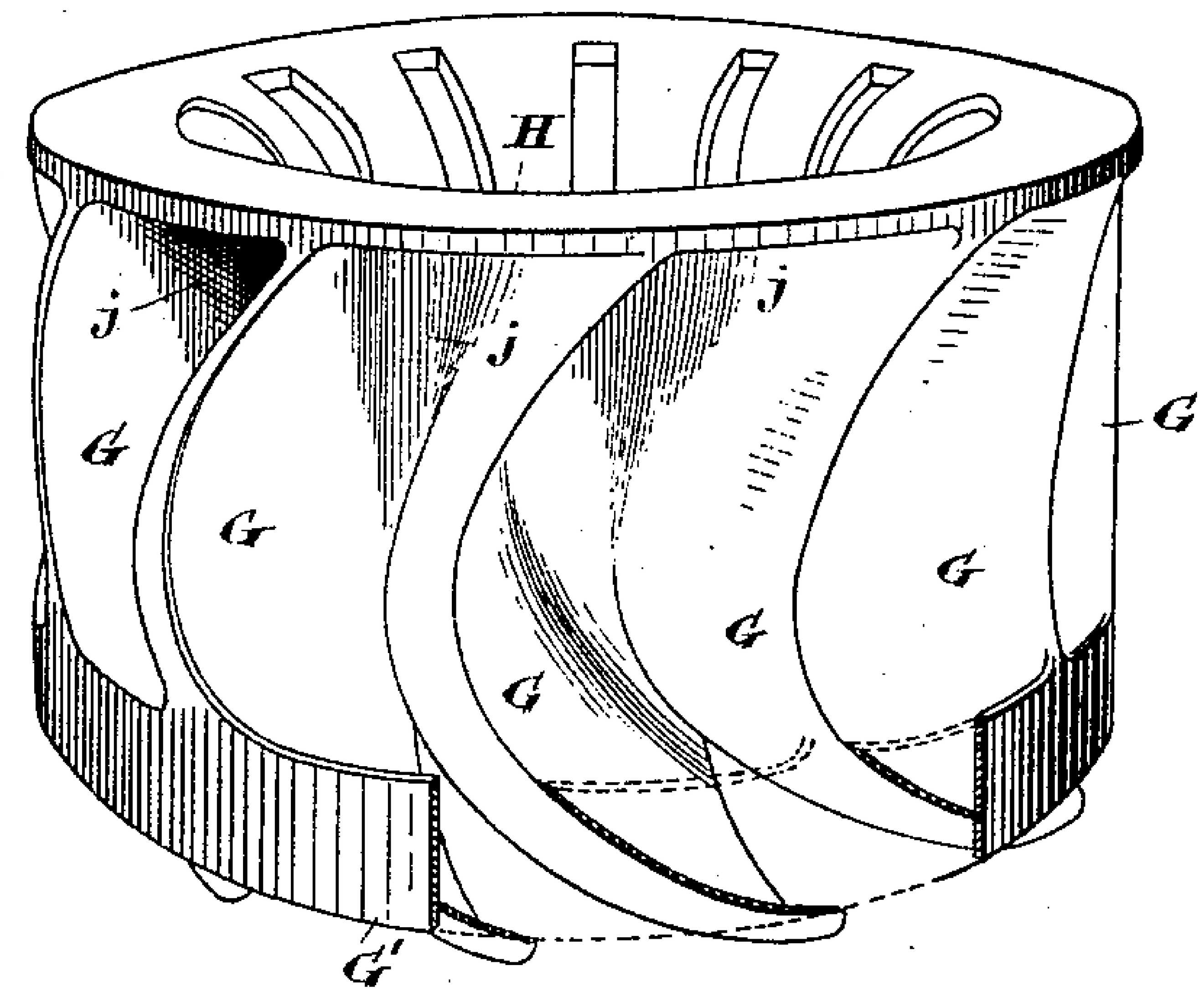

Fig. 3.

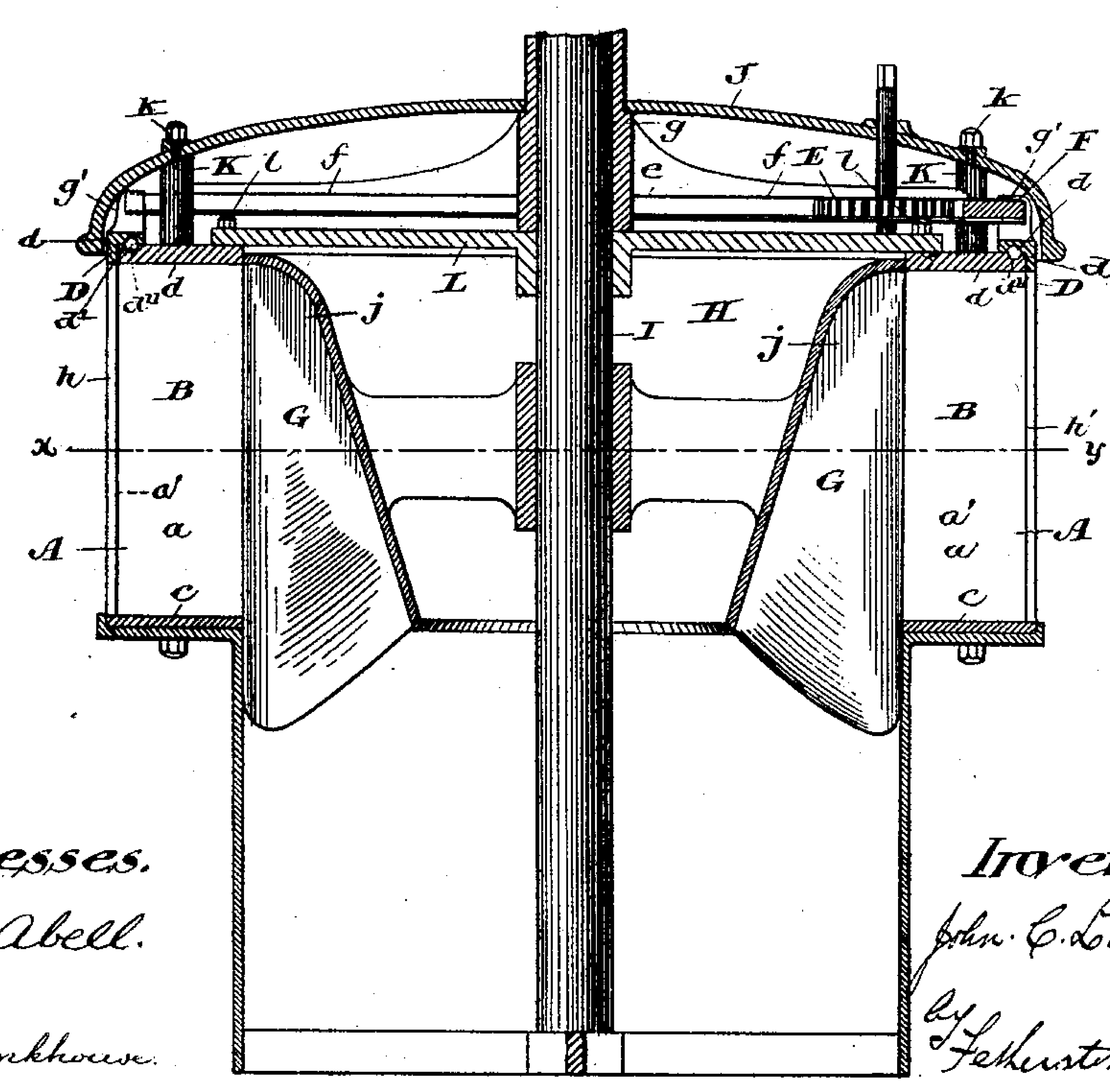

Fig. 4.

Witnesses.

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(Model.)

3 Sheets—Sheet 3.

# J. C. LANSING.

## TURBINE WHEEL.

No. 480,929. Patented Aug. 16, 1892.

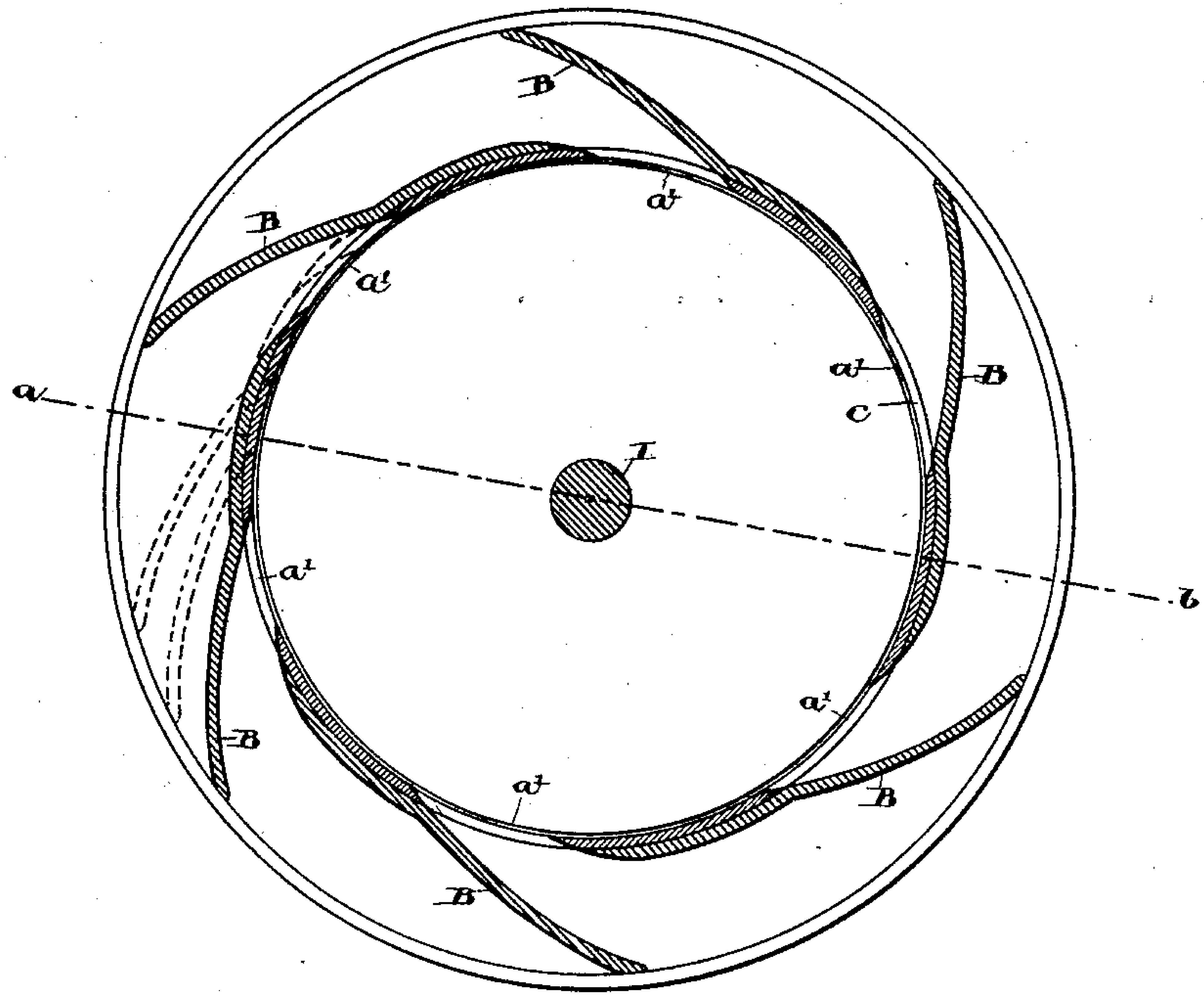


Fig. 5.

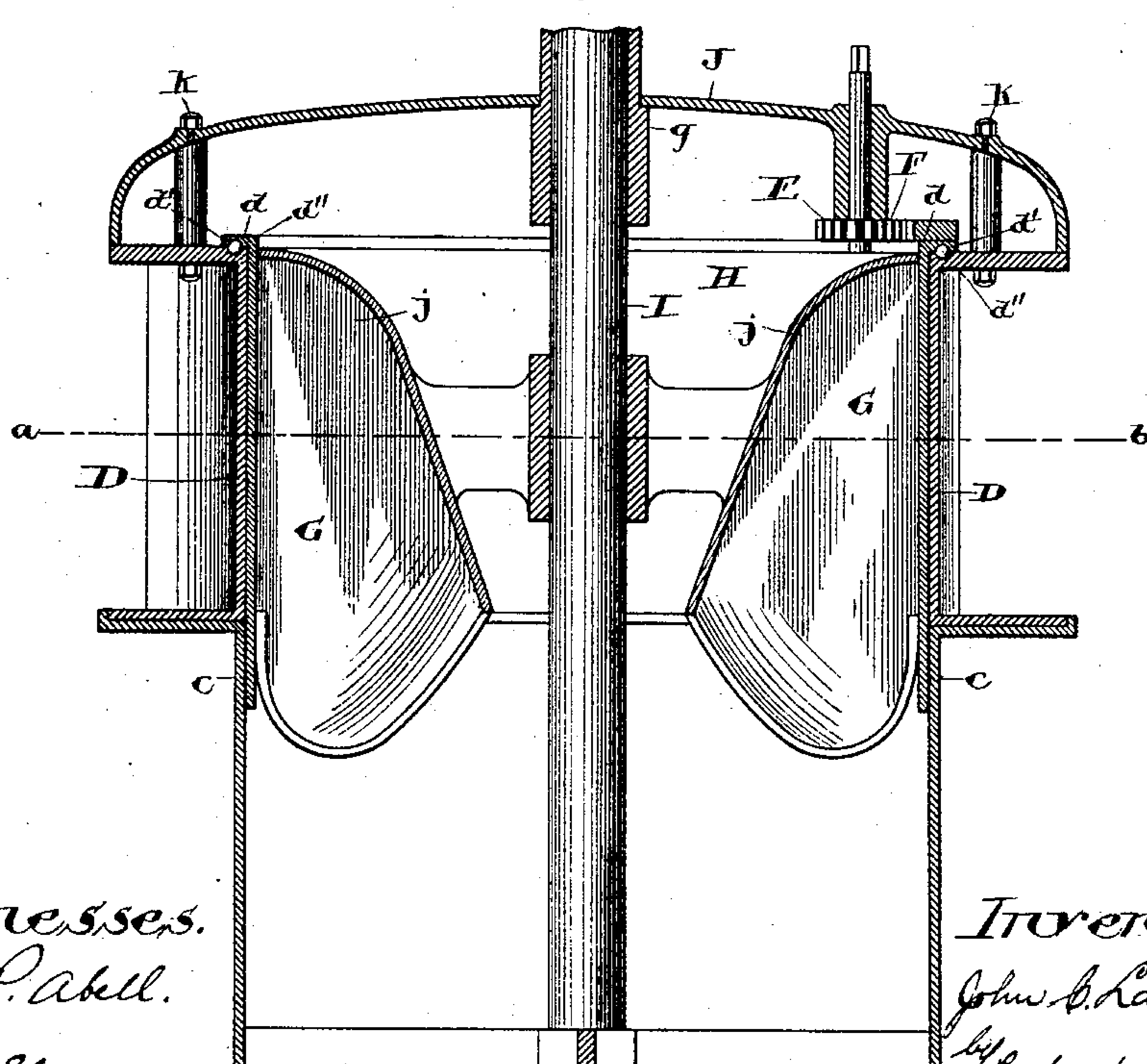


Fig. 6.

Witnesses.
Lewis P. Abell.
H. G. Young.

Inventor:
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Attys

# UNITED STATES PATENT OFFICE.

JOHN CHARLES LANSING, OF SHELBOURNE, CANADA.

## TURBINE WHEEL.

SPECIFICATION forming part of Letters Patent No. 480,929, dated August 16, 1892.

Application filed November 23, 1891. Serial No. 412,826. (Model.) Patented in Canada February 21, 1891, No. 36,207.

*To all whom it may concern:*

Be it known that I, JOHN CHARLES LANSING, carriage-builder, of the village of Shelbourne, in the county of Dufferin, in the Province of Ontario, Canada, have invented certain new and useful Improvements in Turbine Wheels, (for which I have obtained Letters Patent in Canada, dated February 21, 1891, No. 36,207,) of which the following is a specification.

The object of the invention is, first, to design a turbine wheel in which the full effect and power due to the velocity and dead-weight or head of water will be secured, and, secondly, to provide regulating-gates which when they are being opened or closed, respectively, diminish or increase the length of the chute, so as to always direct the water to the outer end of the bucket or periphery of the wheel and yet offer but a minimum of resistance when being opened or closed, no matter under what head of water the turbine is running; and it consists, essentially, of a wheel having a series of buckets radiating from its center, each bucket of which extends from outside to inside back from the radial line, passing through the outer end of the bucket in the opposite direction to that in which the wheel revolves, except at the top, which is flared in the direction in which the wheel revolves; and from top to bottom has its upper portion curved downwardly and onwardly from the top, so as to recede in the direction in which the wheel revolves, while the lower portion of the bucket continues the curve in the opposite direction, the cross-section of the bucket at the top being slightly concaved and the concave and width gradually increased from the top to the bottom, the outer end of which forms part of a strengthening-ring, while the bottom edge extends beneath each succeeding bucket, and, secondly, of regulating-gates, substantially V-shaped in form, connected to a spider, the arms of which extend from a loose sleeve on the shaft and are secured in the outer edge of the ring, a toothed quadrant being formed between two of the said arms, with which quadrant a spur-pinion is caused to mesh to operate the said gates. The other wing of each gate when being opened or shut follows the outer curve of the three-sided stationary guides, which curve forms part of the periphery of the circle of the casing, while the end of the inner wing of each gate follows the inner face of the guide, which helps to form one side of the chute when the gate is partially closed, the other side of the chute being formed by the third side of the guide, the whole being constructed and arranged in detail in the manner hereinafter more particularly explained.

Figure 1 is a perspective outside view of my improved turbine wheel. Fig. 2 is a sectional plan of same on the line *x y*, Fig. 4. Fig. 3 is a perspective outside view of the wheel partially broken away to show the form of the buckets. Fig. 4 is a vertical cross-section on the line *x y*, Fig. 2. Fig. 5 is a sectional plan and an alternative form of gate on the line *a b*, Fig. 6, with the wheel removed. Fig. 6 is a vertical cross-section of the said alternative form on the line *a b* in Fig. 5.

The principal defect of most turbines with complete admission is the imperfection of the arrangements for working with less than the normal supply. With most forms of turbine the efficiency is considerably reduced when the regulating-gates are partially closed; but it is exactly when the supply of water is deficient that it is most important to get out of it the greatest possible amount of work. The imperfections of the regulating arrangements are, therefore, from a practical point of view, a serious defect, and it is these imperfections which I have striven and, from a practical experience, have in a maximum measure overcome by invention, besides forming a wheel the buckets of which are the most efficient of any of which I am aware. The efficiency of the regulating-gates and wheel I have compared side by side with those of the most approved forms of turbines in existence before my invention and find that my form eclipses them, inasmuch as there is a much greater amount of power produced, both at whole gate when the chutes are open to their fullest extent and at half-gate when the chutes are partially closed, on account of the arrangement of the gates and buckets in the manner hereinafter explained.

In the drawings like letters of reference indicate corresponding parts in each figure.

A is the outer casing of the wheel, and B three-sided stationary guides forming part tof he casing A.

C are the regulating-gates, which are secured at the top and bottom to two rings *d* and *c*, or form part of the same, and thus constitute one solid ring-gate D, with openings *a'*, corresponding to the width of the mouths of the chute *a*.

The ring-gate D is operated by the spur-pinion E, which meshes with a quadrant F, connecting two of the outer arms *f* of the spider *e*, which is secured to the sleeve *g*, which is loose on the shaft I. The ends of the arms *f* of the spider *e* are secured between lugs *g'* on the ring *d* of the ring-gate D. When it is desired to open or close the gates C, the spur-pinion E is turned till the desired position of the gate is reached. The mouths of the chute *a* are located opposite to each other and are shaped as shown in Fig. 2. The curved face *d'* of each guide B forms part of the periphery of the circle of the casing. The face *d'* is followed by the outer wing *e'* of each gate C when the ring-gate D is being opened or closed. At the time the ring-gate D is closed the curved face *d'* of the guides B is exposed to the action of the water and cleansed from any sand or other foreign matter which might tend to produce friction and prevent the free working of the regulating-gates C.

It will be noticed on reference to Fig. 2 that the outer end of each outer wing *e'* extends a slight distance past the outer end of each inner wing or side *f'*, so that when the gates are closed, as shown by dotted lines in this figure, the outer end of the outer wing *e'* laps over the face *d'* and the face of the wing or side *f'* abuts the other side *g''* of the chute. Consequently a complete and doubly secure shut-off is provided. It will also be noticed that a knife or beveled edge *h* is formed at the outer end of each wing *e'*, so as to cut away any weeds or foreign matter which might interpose and prevent the free closing of the gates.

*c'* is a boss extending from top to bottom of the inner wing of each gate C at its inner end, as shown. When the ring-gate D is being opened or closed, this boss *c'* follows the concentric curved face of the side *f''* of the guides B, and the length of the chute *a* on this side is consequently respectively diminished or increased. The third side *g''* of each guide B meets the side *f''* at the edge of the wheel-space and forms the other side of the chute *a*. It follows from this construction that the volume of the water both at whole gate or at half-gate is directed not only against precisely the same point in the wheel, but against the same amount of bucket or wheel surface, for by reference to the position of the side *f''* when at half-gate, as indicated in Fig. 2 by dotted lines, it will be seen that the inner mouth of the water-passage measured along the curved edge of the wheel-space remains practically the same width as at full-gate—that is, the amount of bucket-surface exposed to the current of water, whether at full or half gate, is practically the same, notwithstanding the fact that the wing *f'* has approached the side *g''* of the stationary guide and decreased the width of the passage as measured directly across it.

In order to provide for the easy adjustment of the ring-gate D, I form a groove *d''*, in which I place a series of balls *d'''*, thus forming a ball-bearing on which the ring-gate will revolve.

G are a series of buckets radiating from the center of the wheel and forming part of the ring H, which is suitably connected to the shaft I. Each bucket G, as shown in cross-section in Fig. 2, extends from outside to inside at the lower portion back from the radial line in the opposite direction from that in which the wheel revolves, except at the top *j*, where it flares out from outside to inside forward of the same radial line in the direction in which the wheel revolves, or reversely from the direction of the lower portion. This form of top prevents any lodging of water at the top of the back of the bucket, and consequently there is no retarding of the wheel from this source. This form of the extreme top of the bucket is shown in Fig. 2 by the curved dotted lines, and in Fig. 3 at the points marked *j*, the object being to round out or cut off the corners or sharp acute angle which would otherwise be left at *x*, Fig. 2, corresponding to that at the lower part of the bucket, it being desirable at the latter point in order to properly direct the water.

The peculiar form of the bucket from top to bottom is further exhibited in Fig. 3, in which it will be noticed that the bucket is in cross-section slightly concaved at the top and gradually made more so till it reaches the bottom of the bucket, and is curved lengthwise from the top to the center of the bucket, so as to recede in the direction in which the wheel revolves and also utilize the natural spurting velocity of the water, while from the center to the bottom it is curved lengthwise in the opposite direction, the outer end of the bottom of the bucket being extended to the radial line beneath the next succeeding bucket, as shown. G' is a strengthening-ring, which forms part of the side or flange of the bottom of each bucket.

After repeated experiments I find in practice that the form of the bucket from top to bottom, as above described, has the effect of throwing the force of the water against the outer portion of the buckets, or, in other words, close to the periphery of the wheel, where it operates with the most power, thus utilizing to the greatest extent possible the spurting velocity and dead-weight or head of the water. I also find that not the smallest quantity of water can pass through the wheel without acting upon it, which fact accounts for the great power of the wheel.

On reference to Figs. 5 and 6, which exhibit an alternative form of my ring-gate D and of my chute $a$, it will be seen that instead of placing the ring-gate on the outside of the casing I secure it within a space between the inner side of the casing and the wheel or buckets D, which space is designed to receive it and permit of its free adjustment. The chutes $a$ are in these figures formed of the stationary guides B, extending from the outside of the casing to the inner edge of the casing, where they are concentric with the inner edge of the casing and leave openings corresponding in size to the openings $a'$ in the ring-gate D. When the ring-gate is adjusted so as to bring the opening $a'$ opposite to the openings at the inner ends of the chutes, the wheel is at full-gate. When the gate is adjusted so as to bring the edge of the side of the opening $a'$ midway across the opening at the inner end of the chute, the wheel is at half-gate, and when the solid portion of the ring-gate is brought directly across the opening at the inner mouth of the chute the gate is closed. In order to adjust the ring-gate D, I provide, as shown in Figs. 1 and 4, a pinion E and a quadrant F, which I form along with or attach to the upper ring $d$ of the ring-gate D.

It will be seen from the form of the chute $a$ that a solid volume of water is delivered against the buckets G and carried through the wheel. It will also be seen that as the water is delivered at all points simultaneously a series of independent streams act on the buckets opposite each chute, and consequently the greatest effect possible is derived from the wheel.

J is a dome resting in the center on the sleeve $g$ of the spider $e$ and at the outer ends on the standards K, to which it is secured by bolts $k$, as shown. The standards K form part of the ring $d$ of the casing A. L is the top plate, which is secured by the bolts $l$ to the ring $d$ of the casing A.

Although I show six chutes $a$, it will be understood, of course, that more or less may answer my purpose without affecting the principle of my invention.

From the peculiar construction of the gates C it will be apparent that but a minimum of resistance is offered in opening or closing the gates, no matter under what head of water the wheel is running, and consequently very little power will have to be exerted to move the ring-gate D.

A further advantage in construction lies in the fact that by removing the dome and top plate the wheel may be withdrawn from the top and not from the bottom, which is at present the common and I may say a most inconvenient way of removing the wheel. The rising action of the water produced by the peculiar form of buckets also materially lessens the pressure of the bottom of the central shaft upon the step.

What I claim as my invention is—

1. A turbine having a wheel contained within the casing provided with a series of buckets, the lower portion of each bucket of which extends from outside to inside back from the radial line, passing through the outer end of the bucket in the opposite direction to that in which the wheel revolves, the top, however, being flared in the direction in which the wheel revolves, substantially as specified.

2. A turbine having a wheel contained within the casing provided with a series of buckets, the lower portion of each bucket of which extends from outside to inside back from the radial line, passing through the outer end of the bucket in the opposite direction to that in which the wheel revolves, the top, however, being flared in the direction in which the wheel revolves, and the bucket being also constructed lengthwise, with the upper portion curved downwardly and inwardly, so as to recede in the direction in which the wheel revolves and the lower portion continuing the curve in the opposite direction, the cross-section of the bucket at the top being slightly concaved and the concavity and width gradually increased from top to bottom, substantially as and for the purpose specified.

3. A turbine having a wheel contained within the casing A, provided with a series of buckets G, having the upper portion curved downward and inward, so as to recede in the direction in which the wheel revolves and the lower portion continuing the curve in the opposite direction, in combination with the chutes $a$, designed to direct the water against the upper receding portion of the buckets G, from which it sweeps down and is carried through the wheel, substantially as and for the purpose specified.

4. In combination, the casing, the wheel thereon having a series of buckets G, the guides B of the casing with spaces between them forming the chutes $a$, said guides having curved sides $d'$ and the sides $f''$ and $g''$, converging at the edge of the wheel-space, the ring-gate D, and the gates G, carried thereby, said gates having the curved wings $e'$, adapted to the face of the guide, and the wings $f'$, adapted to bear alternately on the sides $f''$ and $g''$ of the guides, the inner ends of the wings $f'$ bearing against the side $f''$, substantially as described.

5. In combination, the casing, the wheel therein having a series of buckets G, the guides B of the casing with spaces between them forming the chutes $a$, said guides having the curved side $d'$ and the sides $f''$, with a curved portion $c'$, the ring-gate D, provided with the gates C, said gates having the curved wings $e'$, adapted to the face $d'$ of the guides, and the wings $f'$, adapted to sides $f''$ and bearing against the curved part thereof, substantially as described.

6. In a turbine, the casing, the wheel therein, the shaft I therefor, the ring-gate D for

controlling the openings of the chutes, the toothed quadrant F, the lugs $g'$ on the ring-gate for holding the quadrant in place, and the pinion engaging the quadrant, substantially as described.

7. In a turbine, the casing, the wheel, the shaft therefor, the covering or dome J, the standards K, and the bolts for supporting and holding the dome, the top ring $d$, and the top L, held thereto by the bolts $l$, substantially as described.

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BLANCHE BOYD.