(No Model.) 2 Sheets—Sheet 1.

W. W. TYLER.

WATER WHEEL.

No. 459,969. Patented Sept. 22, 1891.

Fig. 2.

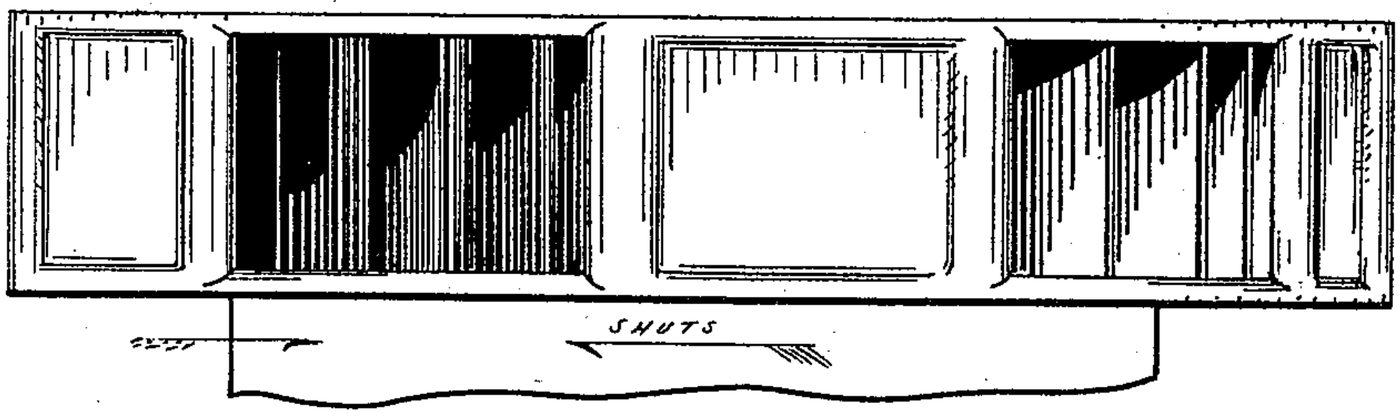
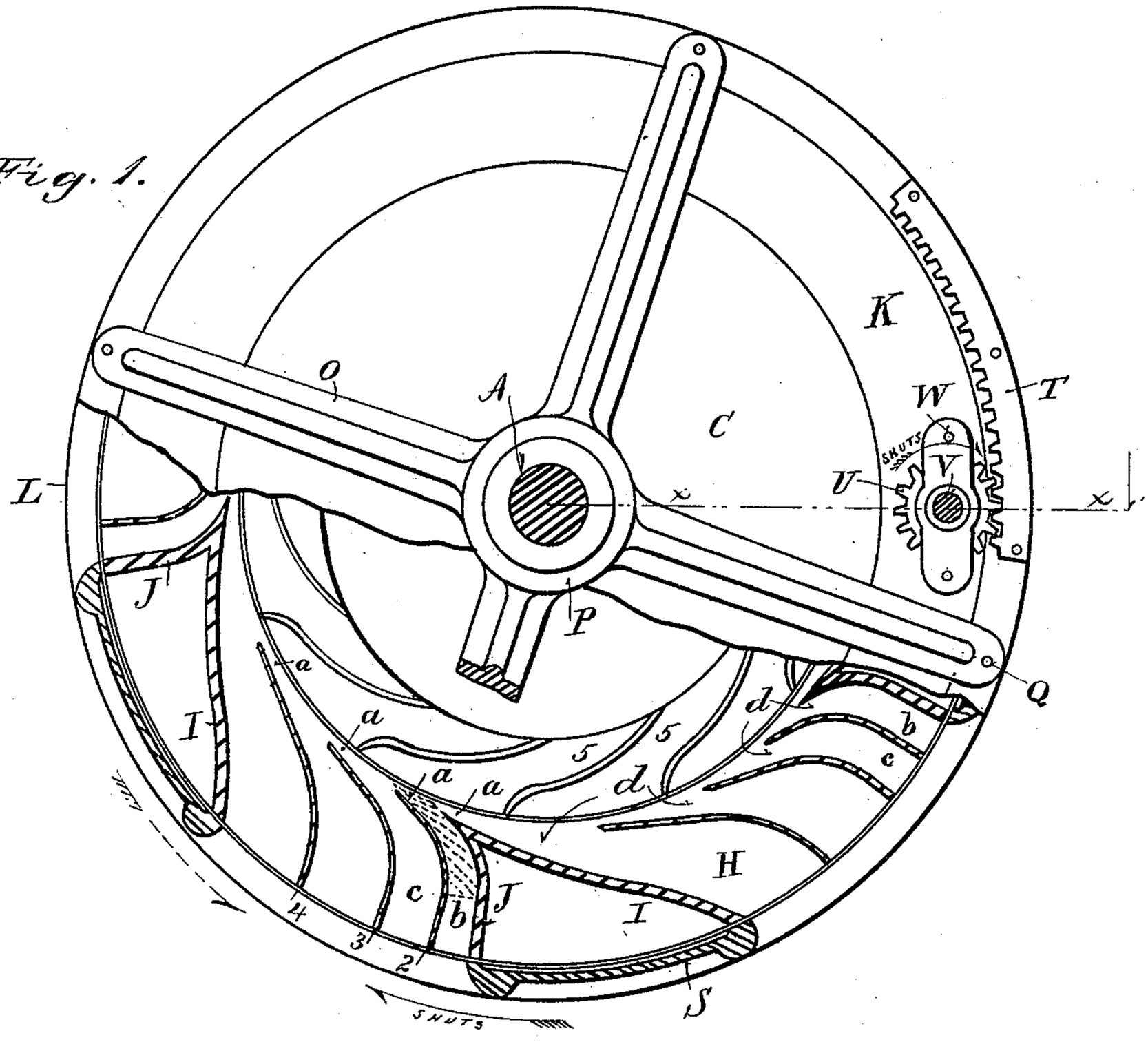


Fig. 1.



WITNESSES:

H. M. Plaisted

Warren O. Hill,

INVENTOR

William W. Tyler,

BY H. A. Toulmin

HIS ATTORNEY.

(No Model.) 2 Sheets—Sheet 2.

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Fig. 4.

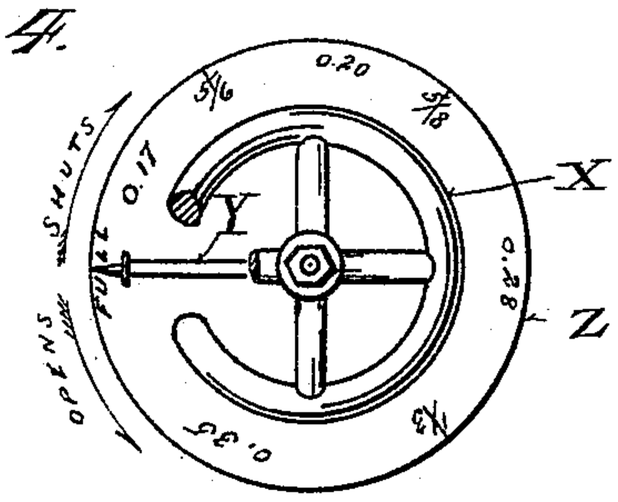
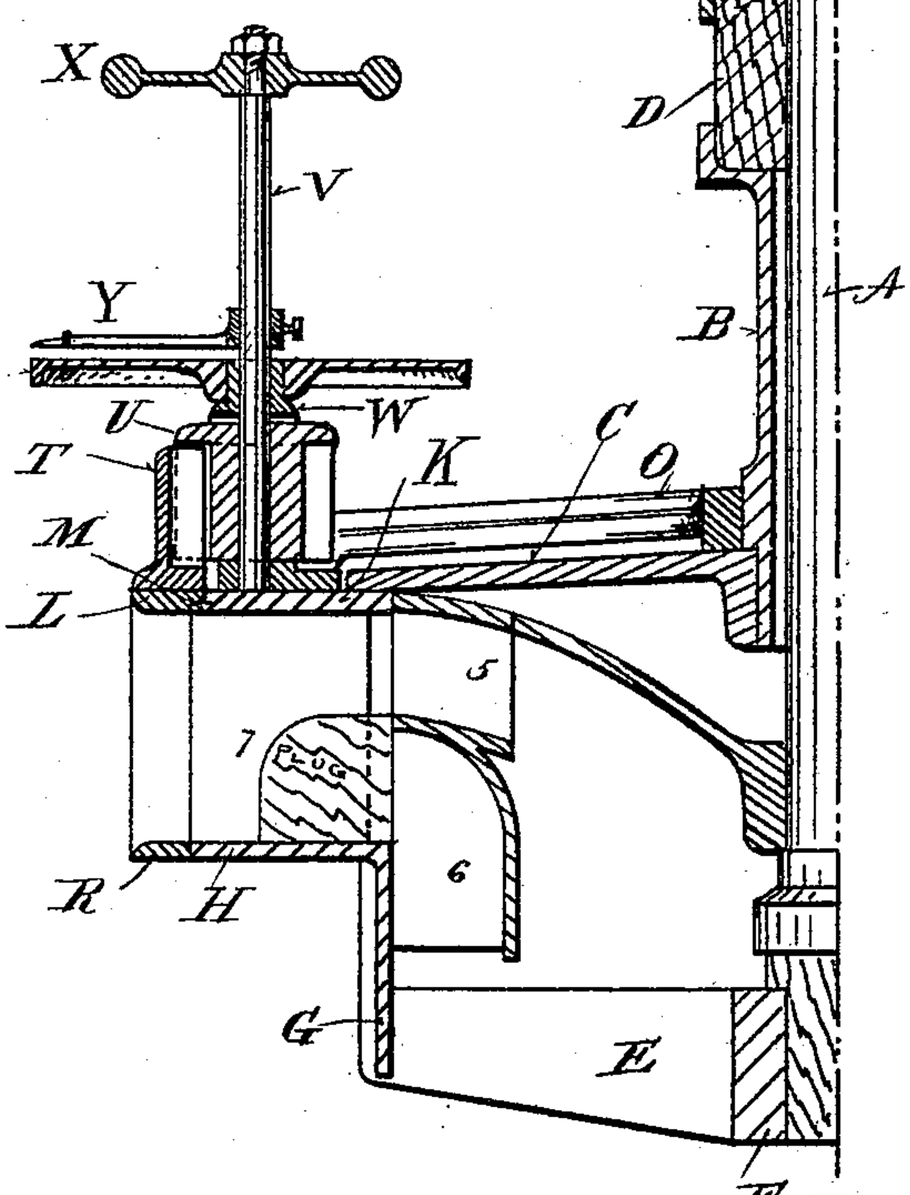


Fig. 3.



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UNITED STATES PATENT OFFICE.

WILLIAM W. TYLER, OF SPRINGFIELD, OHIO, ASSIGNOR TO THE JAMES LEFFEL & COMPANY, OF SAME PLACE.

WATER-WHEEL.

SPECIFICATION forming part of Letters Patent No. 459,969, dated September 22, 1891.

Application filed October 8, 1890. Serial No. 367,423. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM W. TYLER, a citizen of the United States, residing at Springfield, in the county of Clark and State of Ohio, have invented certain new and useful Improvements in Water-Wheels, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to certain new and useful improvements in turbine water-wheels.

My improvements have reference to the provision of a series of chutes in the wheel-casing of progressive sizes, running from a small to a large or larger chute, each chute being larger than the preceding chute commencing with the smallest and going toward the largest in connection with a suitable gate adapted to cut off the water from one or more or all of said chutes, whereby the amount of water admitted to the wheel may be regulated according to the head or quantity of water available and according to the power desired to be developed by the wheel; have reference to the combination of a casing with said chutes and such gates, and with a turbine wheel having two tiers of buckets from either of which water may be cut off by blocking or otherwise obstructing so much of one or more of said chutes as leads to the tier desired to be cut off, whereby the apparatus may be further adjusted to the supply of water available and to the amount of power desired to be developed; have reference to the provision of annular or partially-annular water-space between the discharge ends of the chutes and the periphery of the wheel or the entering ends of the buckets in combination with said graduated sizes of chutes, and have reference to certain matters of detail hereinafter appearing.

In the accompanying drawings, forming a part of this specification, and on which like reference-letters indicate corresponding parts, Figure 1 represents a partial plan and partial sectional view of a water-wheel entire embodying my improvements; Fig. 2, a detail side elevation of the gate structure, showing the webs of the chutes beyond it; Fig. 3, a vertical sectional view in a radial direction from the shaft of one-half of the structure shown in Fig. 1, the section being on the line $x\,x$ of said figure and in the direction of the arrow; and Fig. 4, a detail plan view of the dial, the pointer, its shaft, and the hand-wheel, such devices being used to determine which and how many of the chutes are closed or how much of the chute area is open to the passage of the water.

The letter A designates a shaft designed to be mounted as usual and having about it a column B, supported by the top or plate C of the casing and itself assisting to support a follower-block D for maintaining the shaft A in position. The lower part of the casing is formed of spiders E, having a hub portion F. To the outer ends of the spiders is secured an annular vertical plate G of the casing proper, to which is connected, preferably by being cast therewith, an annular horizontal plate or rim H. At intervals round and upon this plate H are cast or otherwise secured rim-connecting partition-walls I and J, which serve to separate the groups of chutes and to form respectively one wall of the last and first chute of two respective groups. These partition-walls I and J also serve instead of the usual posts to support and connect the upper annular horizontal plate K. Thus a casing is formed within which the wheel is to rotate.

The space between the partition-wall J and the partition-wall I of any two of the partitions is divided off into chutes by vertical webs. The web 2, with a partition-wall J, forms the first chute. The webs 2 and 3 form the second chute. The webs 3 and 4 form the third chute, and the web 4 and partition-wall I form the fourth chute of the series. The location of the web 2 with respect to the partition-wall J is such as to make the first chute the smallest of the series. The location of the third web with respect to the second web is such as to make the second chute the next larger in size. The location of the fourth web with respect to the third web makes the third chute somewhat larger than the second chute, and the location of the partition-wall I with respect to the web 4 makes the last or fourth chute progressively larger than the third chute. The relative size of these chutes may vary in different wheels for different purposes or to be used under different circumstances. By this pro-

vision of progressively larger chutes from the first to the last of the series and by the provision of a suitable gate, hereinafter described, the amount of water admitted to the wheel may be regulated with the greatest degree of nicety and with the desired graduation. If the head of water be large and full power be desired, all of the chutes will be opened. If a small amount of power only be desired, then one or more of the chutes may be closed, and inasmuch as the supply of water is but slightly diminished by closing, say, the first or first and second chutes the reduction is graduated and not suddenly lessened or increased, according to whether such chutes are opened or closed. It will also be observed that the lengths of the webs and the lengths of the chutes are progressively longer, as well as the widths of the chutes progressively greater. This preserves the proper proportion of the width of the chutes to the length of the chutes, so as to obtain the proper shape of the webs to direct and yet not impede the water.

Referring to the gates, the letter L designates a ring or belt supported in part by being shouldered to fit the corresponding shoulder of the plate K, as seen at M in Fig. 3, and otherwise supported by the spider-arms O, whose hub P fits over the columns B and rests upon the top plate C of the casing. Rivets or bolts Q serve to connect the ring L with the spider-arms O, as seen in Fig. 1. A similar ring R embraces the plate H of the casing and is connected to the ring L by the walls S, which constitute the gates, as seen particularly in Fig. 1. In order to adjust the gates with respect to the chutes, so as to lap over one or more of them, I attach a short rack T in the segment of a circle. I actuate the rack by a pinion U, carried by a shaft V, mounted in a yoke W, secured to the plate K of the casing. The shaft carries a hand-wheel X and a pointer U, beneath the latter of which is mounted a dial Z. (See Fig. 4.) This dial-plate is graduated, so as to indicate, in connection with the pointer, how many and which of the chutes are open or closed, as the case may be. There are as many gates S as there are groups of chutes, and each gate is adapted to stand across and close all of the chutes of a group.

Referring now to another part of my invention—namely, the provision of a continuous space between the outside of the wheel or the entering ends of the buckets and the discharge ends of the chutes—it will be seen that the webs 2 3 4 and the partition-walls I and J terminate outside of the inner edge of the plate H. This leaves a space which, together with the open discharge ends of the chutes, forms the annular space. The water projected to the wheel through the chutes will thus circulate in a belt entirely around the wheel and will not be cut off or divided at the time of entering the buckets of the wheel into separate and distinct streams, as would be the case if the webs were extended beyond the inner edge of the plate H and close to the periphery of the wheel or entering ends of the buckets. By the provision of this annular space it will be understood that the water being present in an annular belt around the wheel will enter every bucket, so that no bucket escapes uncharged, even though one or more, save all, of the chutes of each group be closed. To illustrate this, let it be supposed that the gates are adjusted to close the first and second chutes of a group marked *b c*. Now the water passing from the third and the fourth chutes will unite and pass on to or opposite the discharge ends of the closed chutes *b c* of the next groups. This occurring with each group still maintains the annular belt of water or regular feed, and therefore the buckets passing the chutes *b c* will receive water as though such chutes *b c* were open, though in a less quantity. Thus the water fed to the buckets is continuous, and is maintained to all of the buckets, as distinguished from being intermittent by being cut off from any of the buckets at any point in the circle. This is of highest importance in obtaining the full power of a water-wheel, because the fundamental problem is to maintain a continuous and uniform feed, as distinguished from even a mere violent intermittent feed, wherein the buckets are fed at intervals around the circle, as distinguished from every point.

I have so far not described any particular form of wheel and wish it understood that any approved type of turbine wheel may be used in carrying out my invention so far described. To obtain a further result, however, than that mentioned, and a valuable one in practice, I prefer to use a turbine wheel having two tiers of buckets. The wheel on the market known as the "Leffer wheel" is the kind I refer to. From Fig. 3 of the drawings it will be seen that this wheel is mounted upon the shaft A, and has upper buckets 5 with a central downward discharge and lower buckets 6 with a downward discharge. Now, the further result referred to is that of being able to not only graduate the water as regards the number of chutes and as regards the quantity admitted by the respective chutes, but to graduate the quantity needed and the power developed by employing either one or both tiers of the buckets. To do this I close up so much of one or more of the chutes as leads to one of said buckets. I do not confine myself to any particular means for this purpose, but prefer the use of plugs of wood or metal or other suitable material adapted to enter a chute and fit snugly therein, as suggested at 7 in Fig. 3, wherein a plug stands in a chute and cuts off the delivery direct of water into the lower tier of buckets. In this manner but one tier of buckets may be used, or both tiers by removing the plug. Thus, also, the graduations of the water hereinbefore referred to, by means of adjusting the

gate across one or more of the graduated chutes, may be employed in connection with but one tier of buckets or with both tiers of buckets.

From the foregoing the results and functions of my improvements will be readily understood and the advantages be obvious to those skilled in the department of mechanics to which they relate. It will also be observed that the chutes vary in length as well as width and that the longer chutes are the widest chutes, whereby the proportion of the area of the discharge end to the length and the proper curvature thereof is preserved, so that the discharge of the water and its deflection from a radial to a tangential direction are accomplished without obstructing it. The progressive difference in width of the discharge ends of the chutes will best be observed by noticing the space designated by *d*.

While it is preferred to close off the chutes, beginning with the smallest one and going toward the largest, still it will not be outside of the contemplation of my invention to reverse this order of closing the gates.

Referring to Fig. 4, it will be understood that when the pointer Y is opposite the designation 5 6 this amount or proportion of the aggregate of chute area is open for the passage of water. When opposite 5 8, this amount or proportion of chute-area is open to the passage of the water, and so on around the dial. The webs 2, 3, and 4 are preferably curved in the outer part and approaching a straight line in the inner part, as shown in Fig. 1, so as to insure the easy and proper change of direction of the water. By the graduation of the chutes hereinbefore referred to the proper quantity of water to be admitted to the wheel is under perfect control, and hence the annular space is kept properly filled, but at no time cramped and overfilled or partially emptied. Thus the graduated chutes and the annular space unite in securing the proper quantity and the proper use of such quantity.

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

1. In a water-wheel, the combination, with a wheel proper, a case, and gates, of a series of chutes of different areas, whereby only a small part of the water will be shut off from the wheel when the first one or two of the chutes are closed, said gates being adapted to close one or more of said chutes.

2. In a water-wheel, the combination, with a wheel proper, a case, and gates, of a series of webs and a series of rim-connecting partition-walls I J, substantially as described, said walls and said webs forming chutes, the chutes being of progressively-different areas from minimum to maximum, whereby a small part of the water progressively will be shut off from the wheel when the first one or two chutes are closed, said gates being adapted to close one or more of said chutes.

3. In a water-wheel, the combination, with a wheel proper, a case, and gates, of chutes of progressively-increasing areas from minimum to maximum and terminating at their discharge ends outside of the periphery of the wheel or entering ends of the buckets to leave an annular water-space, said gates being adapted to close one or more of said chutes.

4. In a water-wheel, the combination, with a wheel proper having two tiers of buckets, a casing, and chutes of varying sizes from maximum to minimum within the said casing, of plugs adapted to fit the said chutes, respectively, and cut off the direct delivery of water therefrom to one tier of said buckets.

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

WILLIAM W. TYLER.

Witnesses:

H. M. PLAISTED,

WARREN HULL.