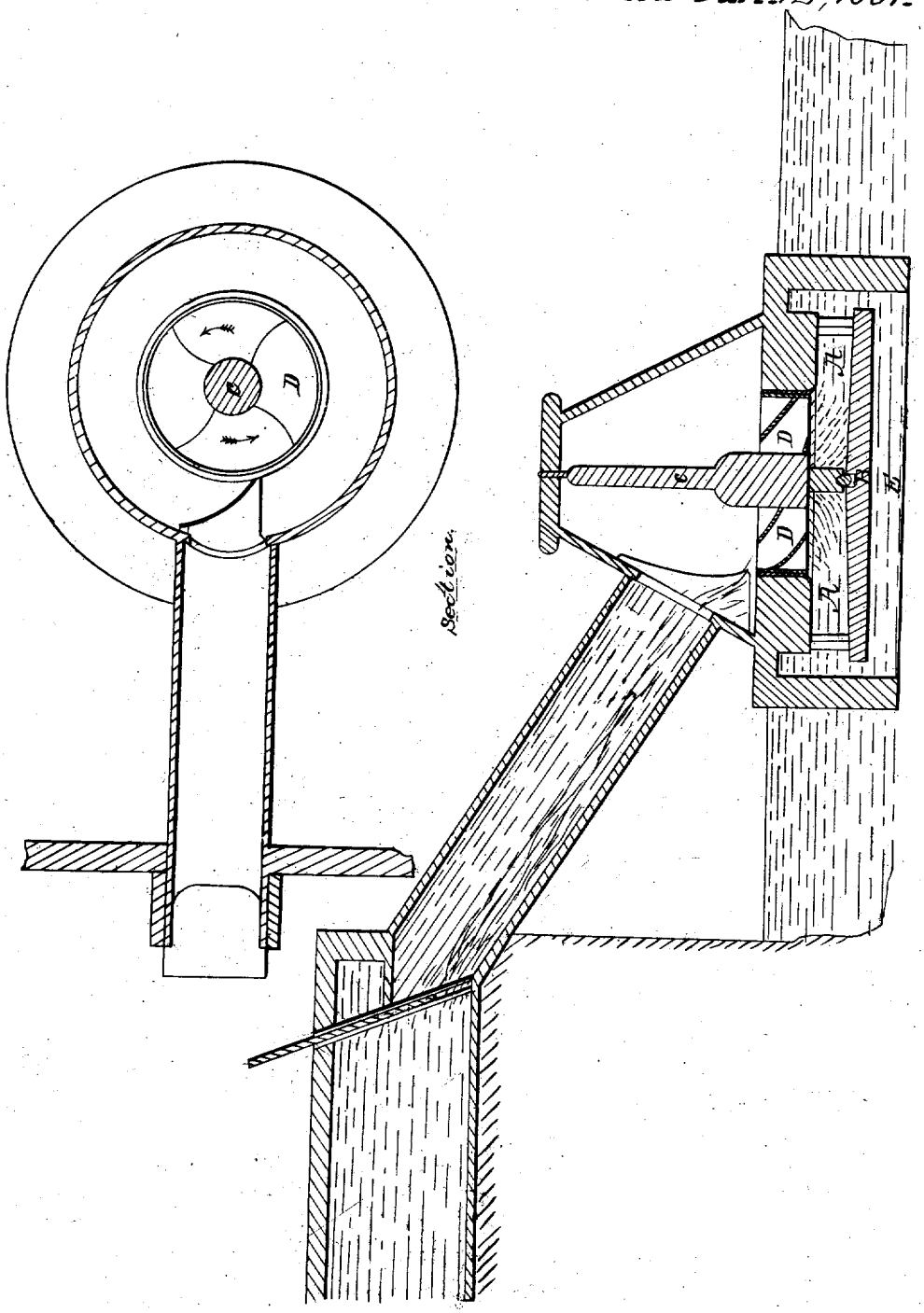
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W. Kendall,

Water Wheel,

Patented Jan. 12, 1831.

No Printed Specification Available



N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

Jan 12 1881

William Kendall Fairfield Maine.

Miller Patent X 6336

The schedule referred to in these Letters Patent and making part of the same containing a description in the words of the said William Kendall himself of his improvement in the mode of applying Water to Mill wheels.

To all persons to whom these presents shall come. William Kendall of Fairfield in the County of Somerset and State of Maine Millwright sends greeting. Be it known that I William Kendall have made a new and useful discovery or invention in the application of water whilst acting upon Mill wheels which I call the Lyttleton principle, that is after the water has performed the full measure of its first action upon the wheel by pressure, or rather by reaction the water in passing the wheel has been reduced nearly equal to that from a gate under the same head the effect of this velocity of the water is still continued by this invention to act upon the same wheel by causing its force to be expended in removing the atmospheric pressure from the lower or opposite side of the oblique buckets and openings of the wheel, which pressure never exceeds, yet always is equal to the weight or head of water of 33 1/3 feet, or fifteen pounds to the square inch; this pressure becomes proportionately diminished according to the head of water used; by causing the water from the wheel to pass off, between two plain surfaces, with a fixed space, a proper degree larger than the body of water in motion naturally descends. this space becoming an increased area it extends from the wheel, and does not require to be extended further than to allow its outer end measure of opening to be sufficient to discharge the quantity of water expended by the wheel at the rate of from two to six feet per second as the quantity of water may require; this discharge in all cases must be laid below the surface of the water that the air may be prevented from entering within. this shall be the depth of the wheel

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wheel if not an error diffusion and will be better explained after explaining the common notion of science as it stands at the present time. In which wheels or water acting by its gravity they have the advantage of producing effects greater and greater, as the cells for holding & retaining all the water in which its motion becomes sensibly diminished, get it is not in my power to obtain more effect from them, than is obtained by following the judicious rules, directed by Chevalier Borda when their effects are estimated at two thirds of the power applied, the requisite strength and expense is proportionally increased, if we use beyond this diminishing one we increase the other in the same geometrical progression.

The next case is where one half the velocity is multiplied by three quarters of its greatest load, or rather nothing by persuasion under that which are variously made, and in these most perfect forms their effects are rated at 2/3 of the power applied, here from an application of your invention, by adding three buckets of about one third the width of the acting column of water, and increasing the number in that ratio their effect become increased; a suggestion of this principle as applicable to Hamilton's which was published in 1818, intending for that purpose it should be given the advantage in pressure action of the buckets of the buckets. But I have to clear that from a reaction of water resulting from reaction that may arise from a weight of water like the wheel by placing it near the upper part of a confined passage, but from velocity or its force of percussion when applied by any invention which obtains. Reaction wheels are those which move by reaction of the water, their effects have been estimated by the same rules as undershot wheels; this principle of reaction of fluids in confined vessels in some time, but only from one of their bellies dispersed having an oblique issue like today Hadow's notion given at the title of Barker applied it to mechanical purposes from an essay at the end of a bellows arm, and after him applied to a circular vessel to return water by Jones Downey & Bridges & Ridley by this the whole end and hence and many passages for with obtained where no other reaction could be applied, [illegible] of water

[illegible]

valuable principle actuated only by Economy is wholly abandoned in the late edition of his work alleging that they (the wheels) have not succeeded the expectations entertained of them &c. This is reasonable and accords to the result of a perfect system be considered the wheels they have generally made a considerable waste of water in a short time after built & little use required, much of this may be given of the difficulty in reconciling the maintenance of the shaft with the changing position from the working of the gudgeon, the unsteadiness of the wheel in other parts, causing its working rings nearly the space between it and the stream, making an allowance by every particle that is drawn within by the water, & since this part is contended with in wheels of any construction, but the assurance that the wheel will support a perfect circle and that the shining is smaller and in that part where the velocity of the water is great and the circle direction to make waste or retain the particles to cause additional energy.

From all reasons where the quantity of water which issues from the wheel is increased with the velocity of the wheel, and also the velocity of the water is increased when the motion of the wheel is diminished by its load.

Some ingenuity presumed that he will be excused from making a more particular investigation, by saying that in 1786, he gave the common construction wheel to produce form of buckets by making them thin of a good addition, instead of afford expense, this was an improvement as there was left room of resistance against the backside of the buckets, they being only bossed, difficult to give a preference to the discharging water shortly after; this became under a patent from a professional scheme and presume never explained the principle, neither has it ever been explained with respecting how they discharge the water as clear from the shaft the buckets seem between two rims, with the shaft connected to one, that the wheel which I have no objection and objected to any invention have buckets not three at right angles with the former which gives

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See Plate 111. The water may be seen to act upon it by pressure from the back of the head, but it is only by reaction that the wheel moves.

This wheel which I have considered for ease in making and permanency of its parts may be represented as a glancing view, that which was formerly called a tub wheel except it has no arms, the buckets entering the shaft and are supported in the rim, they lie very flat and very thin, their edges which outward have the water, are made sharp by their obliquity they do not overlap one another, and the space between them all is called the throat, or opening of the wheel, they decline about three or four inches to a foot of their width, for a wheel of four feet diameter with seven buckets their width becomes about 15 inches at the shaft and two feet at the rim; their rim there required to be about two inches and a deep groove cut round one inch below the buckets, and two inches above the piping a feather edge bar of iron through with this edge resting against, and fair with the bucket as a rib to it, each bucket being dove tailed into the shaft the other end bent down after one and being dove tailed into the shaft the other end bent down and supported under a hoop which binds the rim and bucket, which thus a concave form at its upper side, and is nearly flat at its bottom, it has a shaft for its support commonly of half the diameter of the wheel, two elliptical mortices are made small portions of the wood are left to support its shoulders. The buckets being slit to fit the same, if the buckets were wholly of iron, plate or cast iron made smooth it would be better although as it is required that the wheel should be always under water, it is not subject to decay still for high heads, the buckets should be made wholly of metal, with just proportion fair & smooth, as they become very small, because one of such wheels will be required. The next is the gudgeon, so much difficulty has attended this point in the common reaction wheel as to render me reluctant to their use, and although the wheels of my construction, have lost weight from their reduced size, still an improvement in them can yet be made, and that the wheel may be raised or lowered adjusting it for the draught by the screw. Therefore gudgeons for the wheels are made of wood or to be easily managed about the wheel, it

[illegible] made of any convenient length, say five feet and from four
to five inches square or somewhat square. This should be shod
with a thin plate of iron at each of its sides for its support. It is
also supported by iron hooks driven at each of its corners. Upon
which bearing stands a frame of timber, as in the figure annexed. It
consists of two pieces of timber, each about three inches square,
and of such length as may be sufficient for the breadth of the shaft
and working. The pieces of the above bearing pieces, standing thus
far asunder as the square and eight sides, with the said up-
right bearing on the same round; one side [illegible] the gudgeon standing
in a mortise about three inches. This mortise is not obliquely and
so large as to admit the gudgeon readily as the weight of the shaft
is removed from the said bearing, and for its security in moving
commonly on pieces of wood is properly screwed from
the bearing, and more secured. The bearing for this gudgeon is
upon is commonly cast iron about one inch thick with a
projecting edge to rest upon the wood, which is a floor or rather
a platform, made as much as round, and about beyond the rim
of the wheel forming the lower part of the trough. The middle of this
bearing is filled for the bearing to hang upon its edge, the round
surrounds its bottom. A small round hole is made at one side
of the middle of the box, and the wood is scooped away from its bottom,
with a large hole continued down through, that the water may ride
For the moving part it has circular grooves of the proportion of half
an inch deep for five inches face. This circular is [illegible]
to [illegible] necessary to inhale the water below the surface. This
system will not wholly apply to [illegible] for weight shafts and for wheels
over two feet in diameter, referring to common pictures for gudgeons
when above, and to observe the above principle. Combining to describe
bearings and pictures for applying the [illegible] principle. The wheel is now
disposed to stand upon its [illegible] with the lower part of it immer-
sed about the platform as to give no opening between them equal
to three that of the opening of the wheel. This may vary in some
cases

cases, as for small wheels with high heads (fig. 1 represents) the inside of the lower corner of the iron is sometimes ground off between the brackets, and the lower part of the bracket projects about 2 inches the edge of the iron, this space between them, and the platform level the bottom of the wheel, the head of the wheel, the space between the bracket and head is about one fifth more than the diameter of that part of the opening above. This is done to make room for the draught, for raising the draught beyond the wheel, pushing further the material excavated the wheel and extends with circular sweep and level bottom, for common use about one foot; as for example, if the level in the head is 6 inches the tunnel; and the bracket 6 inches feet diameter, with a perfect opening. Then radius 2 X 3 = 6 feet the space required under the iron which is 18 feet in circumference, and the 4 feet 8 X 12 = 48. which divided by the iron 12 in = 4 inches for its height above the head, and allowed discharge entering one foot beyond the wheel, and discharge or discharge half a square more, that is six feet, and the head 3 1/2, square half a square more still to be added for the discharging space, which is now 9 feet, and 9 ÷ 2 = 4 1/2 or 4 1/2 square long at the opening of the wheel; which having from feet head or 18 feet velocity through it, then 6 1/2 by 4 1/2 = 35 feet per second, equal to a head rather less than two inches load. This application. The extension of the draught may sufficient for heads from six to 30 feet, so may easily be extended. That merely nothing is that small wheels have more than simple, inverse advantage from their want of the draught, in respect to the head lost, water the head can be raised, and even if not for so many natural forces to direct the water entered, the draught might be turned more to accumulate great part of the force within the same position. But even these from its natural course, as also in the application. This shows the principle demonstrating that if sufficient power of the water is

is lifted under a head of water of 25½ feet and meets below the surface its gate then having the pressure 20 53 lbs when shut, and if the gate is half opened it will then have the same pressure on the half gate, that it had on the whole surface, whilst it was shut for when the gate is half drawn the concussion of the issuing water expells the incumbent water from the lower side and produces a vacuum there, and if this half gate is allowed to move onward through the penstock, with half the natural velocity of the water, (or 13 feet per second) which is the same velocity with which it gives to ½ of the head 33½ + 2 = 5½ that is 5½ feet, it would then have the pressure exerted upon it, equal to ½ of that which it had before it moved, which is ½ of 20 53 lbs or 15 6½ lbs, moving this with half the velocity of the water, whilst the opening remained at half of 20 53 or 10 43 lbs, and if this gate was laid inclining to represent the float of the wheel, we shall apply this principle with the same effect the above may suffice to shew the reason why the wheel requires double resistance to stop its motion, than the whole amount of pressure removed by its openings, that is one half of the opening for the wheel, with this application produces equal effects to that which was established for the common float wheel, with the same opening, produces double effect, or in as the explained, the water acts upon the wheel by its whole head, whatever may be its velocity in directing it into the floom (surrounding the wheel) its motion should be the same, way which the wheel may move, as from the opening being directed to that side of the shaft to give this motion round the shaft, and if the wheel is within a penstock where the water descends to it such pictures as described should be affixed to its sides to give the direction, this exactly prevents a whirlpool which would otherwise destroy the action, and also have other prejudicial effects, for preventing a whirl of water on the side of the vein a separate diaphragm is placed before the working timber and

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and containing the time of the wheel its circumference containing
perpendicular, and having thin wrought iron plates nailed on to
extend nearer to the centre than the buckets. The wheel is sup-
posed to be turned by the motion in that part. The wheel
should have a small diameter merely sufficient to give the
requisite quantity of water, that is to say that the buckets must
surface and weight with increased velocity as the centrifu-
ging, all tend to diminish friction, and the water addition
of much power, yet some inconvenience it is to the building
because more flat for convenience, having one wheel of good
form, the diameter of another, with different openings, may
be found from the square of the diameter of the former
number by the proportion of their openings may be the square
root of the product of the diameter of the required wheel, to apply
different powers with different heads; the quantity of water
or rather the power reduced, must be estimated by concentra-
tion, such as that of a millstone of four feet diameter, requiring
100 lbs to be constantly exerted at a point two feet from its centre
where the velocity is 20 feet per second, therefore 100 × 20 = 2000 lbs
lbs is raised one foot per second by that power, and for two pairs
it would be 4000 lbs, one foot high per sec. and the weight of
a cubic foot of water is 62½ lbs, which by the whole head in feet
gives the pressure on one foot of surface, or opening removed
and from this foot, more or less, as the opening of the wheel may be,
to which add half as much more for the maximum load. this
being multiplied by half the velocity of the water per second in
feet, gives the effect, and in the comparison of the above
the velocity of the water per second divided by 8, gives the
square root of the head & the square root of the head × 8 is the
velocity per second in feet. Then if the wheel had a feet
head applied with 1 feet opening its effect would be the
proportion 62½ = to 250, add ½ and × by 2, the opening, the
product is 1000 = 4 millstones, and its velocity of action

being

being 48 inches or 11 feet circumference it revolves 8 per second or 480 per minute, or in 1 hour 28800 the artificial pressure is equal to 99 lbs the square foot of opening in the bucket, which multiplied by the head in feet, the product is the maximum load of the wheel, and this multiplied by half the velocity per second, gives the effective number of lbs, that can be raised one foot per second example if 33 ft head, was applied to this wheel, then 99 lbs. X by 2 = 198 lbs X by 33 ft = 6534 lbs, the maximum pressure, at the centre of the buckets, which being X by ½ the velocity per second = 22 feet, gives 143748 lbs, that can be raised 1 ft. this divided by 6600, gives near 22 millstones, or if divided by 330, it shows the horse power. And if it was required to construct a wheel with this head, to be equal to the power of the above, 30 part of that opening = 288 inches, i.e. = 2 inches, and deep as 12 inches diameter for this opening from the last wheel, 2 inches by ½ = 1 inch = to 60/30, the square feet being 4/6 of a foot or = to 8 inches for the diameter of the wheel, here four buckets would be proper of riveted plate, measuring about 9 inches on the circle of the wheel, which may be supported by a hoop made of plate about 2 inches wide and ¼ thick, a ledge projecting above the buckets, about ½ of an inch, this hoop should be turned fair, especially within to receive the edges of the buckets by lineal hoops, to enter properly within, to secure the buckets for preventing waste of water, the opposite part is secured to the framework, as the wheel is supposed to sit within one, and should be extend through the sides of the same observing that the shafting become 4 or 5 inches diameter, for the support of the wheel, and the pulleys fast, or keyed, if the gearing to be connected are fast or loose within may be followed, and the arms formed to allow an easier transfer of water to the circumference. The maximum load 1733 24/36 lbs. and here allows 12 inches per second, or 720 per minute, is for swift gearing with common cogs, and the motion is generally swift, with this application, although we should reduce the driving wheel to six

six or seven inches diameter, it will often be difficult to gear from this, it may seem right to describe a new form of gear which I have introduced for saving expense, and preventing friction by making thinner cogs with wide wearing, for the common wheel or gear requires 23 pair of joints for setting in each leg; having two rivets which cannot well possibly to mortise- ment. Whereas the spur wheel is made wholly from large timbers, which is formed into sectional parts of the circle of the wheel say 12, 15, 24 &c, pieces to have alike edge and number of cogs, on the end of each sectional piece. These pieces are made wide at the great width to receive; and also about two inches to each rim, when turned off for meeting the other wheel, that it may not jut from the pitch circle. A proportional part of them extend into the shaft as usual having a shoulder at their inner edge which end is also fitted by the saw, that it may be strained to fill the mortise. The other parts are merely dowelled upon these; and the wheel is secured by the iron hoop on each side; these hoops are let into the wood several inches from the outer edge of the wheel, and are drawn by a span and key. 216 cogs with one inch space may be had with 18 pieces; that is 12 cogs on each, or if 24 pieces 9 cogs on each. and for bevel gear observe the same principle, but there the grain of the wood becomes the same way with that of the shaft, and the wheel is secured to arms which are movable when new cogs are required to be cut upon the same wheel, whilst the other allowance of adding a proportional piece between the pair or joints to enlarge its diameter for the same purpose. The substance of the hoop may vary with the size of the wheels as from five eighths to one inch square, that is must bear a heavy strain, in small wheels or where the driving wheels are made of iron. The inner ring should be half the thickness of the wooden cog in its bearing intent; the design to increase the number and surface of the cogs by making them

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certain mechanism which is done by turning off and ____ work allowing the teeth to be spaced between Pins & the auger is used for cutting the work.

Claim I have endeavoured to explain the principle, and how to use the invention when an additional artificial pressure is applied to the wheel increasing its effects by friction; which is call the Hydraulic principle, where the power of percussion of water as well as gravity is applied to expel the atmospheric pressure, which declares many inventions, when applied to mill wheels; also the wheel and parts for applying the same according to this my specification.

Witnesses
Arthur Davis 2
Samuel Maisdale

William Hindall

Engd
Chas 7

[1052 hb]