S. L. BERRY.

TANGENTIAL IMPULSE WATER WHEEL.

APPLICATION FILED NOV. 16, 1908.

1,012,799. Patented Dec. 26, 1911.

Fig. 1.

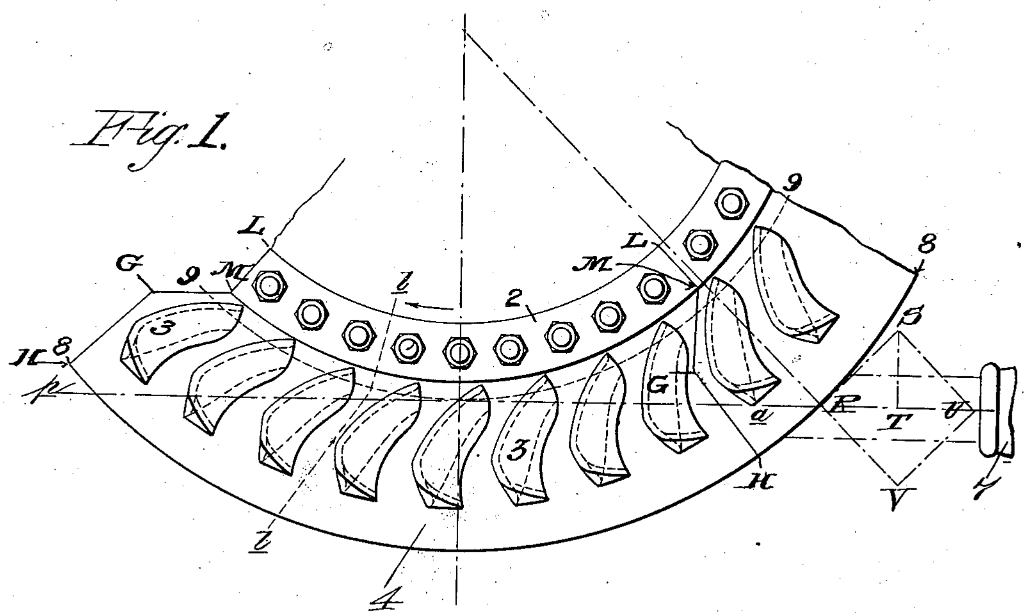
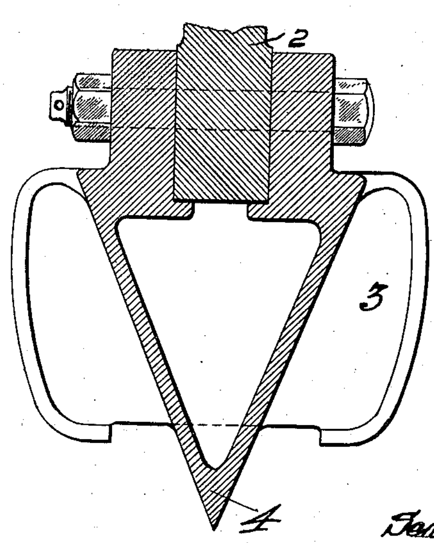


Fig. 2.



Witnesses.

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TANGENTIAL-IMPULSE WATER-WHEEL.

1,012,799. Specification of Letters Patent. Patented Dec. 26, 1911.

Application filed November 16, 1908. Serial No. 462,882.

To all whom it may concern:

Be it known that I, SENECA LUCIEN BERRY, a citizen of the United States, residing at Sunnyvale, in the county of Santa Clara and State of California, have invented new and useful Improvements in Tangential-Impulse Water-Wheels, of which the following is a specification.

My invention relates to tangential impulse water-wheels in which a jet of water under high velocity from a nozzle is designed to impinge upon a circumferential series of buckets to drive the wheel.

The object of the present invention is to obtain greater efficiency, especially when using large volumes of water, than is now possible by the wheels ordinarily in use. This desired increased efficiency I obtain by so constructing the buckets and arranging them with respect to the water jet, that the splitter edges of the buckets will be normal to the direction of relative flow of the water entering the moving buckets, whereby the line of the stream will not be deflected toward or away from the axis of the wheel on striking the buckets, but the reversal of the stream in the buckets will take place in a plane which passes through the axis of the stream and which is parallel to the axis of the wheel.

The invention consists of the parts and the construction and combination of parts as hereinafter more fully described and claimed, having reference to the accompanying drawings, in which—

Figure 1 is an elevation of a part of a wheel showing the principle of the invention. Fig. 2 is a section on 1—1, Fig. 1.

2 represents the rim of a wheel of any suitable description to which the buckets 3 are applied.

My buckets are double buckets having their cups or pockets arranged in pairs on each side of a central continuous dividing wedge or splitter 4, the sides of which splitter are continuous with the inner sides and bottoms of the cups or pockets. Preferably there are a plurality of pairs of pockets or cups cast integral, the dividing line between two bucket sections or any group of integrally cast buckets being indicated by the irregular line L—M—G—H.

The splitter edge of the buckets is disposed in the plane of the center line of the jet issuing from nozzle 7; this center line being indicated at p. The splitter edge divides the stream equally, one-half going to one side of the wheel, the other half to the other, the divided stream being received into the pockets and discharged laterally therefrom.

The position of the nozzle 7 with respect to the splitter 4 is important as affecting the efficiency of the wheel; and the relationship existing between the nozzle and the splitter edge and buckets constitutes the essence of this invention: In other words the hydraulic feature of the invention is in the formation of the splitter edge with respect to the water jet issuing from the nozzle 7, so that the "relative flow line" (represented by V—R) is normal to the splitter edge. By employing a double bucket with a wedge-shaped splitter whose edge is at all times normal to the relative flow line of the jet when the bucket is passing through the jet, the stream will be received, reversed and discharged with a minimum deflection of its path from the line of the water column, thus allowing the wheel to run at the correct speed to utilize most fully the force of the jet.

One of the serious faults of wheels of this type previously made, is that there is a great difference in the conditions governing the reception, reversal and discharge of the various parts of the stream taken care of by each bucket. Part of the water discharges near the point of entrance and part at a considerable distance along the stream line. It is proposed to correct this as far as it may be by the arrangement of the splitter and nozzle shown so that a greater part of the water will follow the ideal stream path. In order to clearly understand the principle involved, it is necessary to distinguish between the "absolute" and the "relative" direction and velocity of flow of the water. These terms and their applicability to water-wheels are explained in all complete treatises on hydraulics, and may be briefly stated as follows: The "absolute" direction and velocity of the water is its direction and velocity in relation to the earth, while the "relative" direction and velocity is its direction and velocity as they would appear when viewed from the moving bucket.

Referring to Fig. 1, the line p represents the center line of the jet of water, which meets the circle 8—8 (or perimeter of the continuous splitter edge 4 and known as the "outer circle") at R, and is tangent to the circle 9—9 known as the "pitch circle." Let the line R—T, of any length, represent the direction and velocity of a point on the bucket located on the pitch circle 9—9 at the instant it reaches the tangent line *p*; draw the line T—S at right angles to said line *p*, cutting the line R—S which is tangent to the circle 8—8 at R, at the point S. Then it will be found, by well-known principles of geometry, that the ratio of the line R—S to the line R—T will be the same as the ratio of the radius of the outer circle 8—8 to the radius of the pitch circle 9—9, and the line S—R will represent the direction and velocity of the entering lip at the point R. As the absolute velocity of the parts of the bucket situated on the pitch circle is usually made one-half of the absolute velocity of the water, the line U—R is made equal to twice T—R and represents the absolute direction and velocity of the water. Completing the parallelogram by connecting points S and U, drawing U—V parallel to S—R and R—V parallel to S—U, the line R—V, will represent the direction and velocity of the water relative to the bucket moving under the conditions given. The line V—R, therefore, expresses the "relative" flow of the water to the bucket, and the moving bucket receives water from the jet, the center line of which is the line *p*, in the same way that it would were the bucket stationary and the jet center line placed on the line V—R.

As shown in Fig. 2 the inner walls of the pockets converge wedge-shape to the splitter edge 4 and this splitter is so disposed to the nozzle that the stream may reach the bottom of the buckets with the least possible deflection toward or away from the axis of the wheel; the reversing and discharging curves being shaped to perform their functions with a minimum of deflection of the water toward or away from the axis of the wheel and to prevent excessive spreading of the water, the final surfaces being arranged to discharge the water to clear the following bucket. The shape of the buckets is generally immaterial, except that the splitter edge is made substantially wedge-shape, as shown in Fig. 2, with the base of the wedge running into, and in connection of, the bottom of the pockets on each side of the splitter; the divergent splitter surfaces forming the inner walls of the pockets. In designing water-wheels with buckets having the splitter edge normal to the "relative" direction of flow of the water, I have found that when the splitter edge is continuous, as here shown at 8—8, the pitch radius *i. e.*, the radius of the circle 9—9 tangent to the center line *p* of the stream is 0.707 of the outer radius, *i. e.*, the radius of the circle 8—8. This results in a free running impulse water-wheel, of a capacity more nearly approaching the regular types of turbines and with all the advantages of the tangential impulse wheels. As the position of the nozzle changes, the diagram changes, and the shape of the splitter edge of the buckets changes in conformity therewith. Thus, as here shown, the axis of the nozzle has been brought nearer the center of the wheel until the splitter edge has moved toward the circumference of the wheel, and at the critical point has become coincident with the circumference itself. If on the other hand the nozzle were moved farther from the center of the wheel, the splitter edge for each bucket would depart from a true circle and assume the position represented in the companion case of applicant Ser. No. 577312. Understanding that the line V—R represents the "relative" direction of flow of the jet, when the nozzle is so arranged that the radius of the circle 9—9 tangent to the jet center line *p* is 0.707 of the radius of the outer circle 8—8, the edge of the splitter on passing through the stream will be normal to this "relative" flow line V—R. The advantage of this construction is that by my arrangement of the splitters and nozzle, I avoid undesired deflection of the stream on hitting the buckets. Another advantage is that this wheel will take equally well single circular jets, multiple circular jets, and rectangular streams around a part or all of the circumference. Another advantage is that tangential wheels as made at present, must have multiple streams applied at considerable distances apart, while the construction of my wheel permits the application of water around the entire circumference, the same as in ordinary turbines, and retains all the advantages of the free running impulse wheel.

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

1. The combination with a hydraulic nozzle, of an impulse water-wheel having a circumferential series of double buckets, said buckets having a central continuous splitter wedge-shape in cross section, the edge of said splitter and said nozzle being constructed and arranged to cause said edge to be constantly normal to the relative flow line of the entering stream.

2. The combination with a hydraulic nozzle, of an impulse water-wheel having a circumferential series of double buckets, said buckets having a central continuous splitter wedge-shape in cross section, the edge of said splitter and said nozzle being constructed and arranged to cause said edge to be constantly normal to the relative flow line of the entering stream, the radius of the circle which is tangential to the axial line of

the nozzle, being approximately 0.707 of the outer radius of the wheel.

3. An impulse water-wheel having a series of circumferentially arranged double buckets said buckets having a continuous splitter with the pitch radius of the wheel approximately 0.707 of the outer radius.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

SENECA LUCIEN BERRY.

Witnesses:

ANNA ELIZABETH BERRY,

JOHN FAULDS.