Abstract

Said dispensing assembly (1), for a Pelton turbine wheel (R), includes a dispensing pipe (20), having the shape of a torus portion, and a plurality of injection pipes (31-35) that are distributed around the site of the wheel (R) so as to inject water into the buckets. Each injection pipe (31-35) is connected to the dispensing pipe (20). The dispensing assembly (1) comprises at least one auxiliary pipe (310-340, 350) that includes an outlet (340.2, 350.2), connected to the inner portion of an injection pipe (31-35), and an inlet (340.1, 350.1), directly connected to the dispensing pipe (20) upstream from said corresponding injection pipe (31-35), between the inlet of said injection pipe (31-35) and the inlet (340.1, 350.1) of the preceding injection pipe (31-35) in the water flow direction.

CLAIMS

1. A dispensing assembly (1), to supply a Pelton turbine wheel (R) with water, the dispensing assembly (1) comprising:

– a dispensing pipe (20) globally having the shape of a torus portion whereof the axis of revolution is substantially parallel to the axis of rotation (Y) of the wheel (R);

– a plurality of injection pipes (31-35) that are distributed around the site of the wheel (R), the injecting pipes (31-35) being arranged so as to inject water into the buckets of the wheel (R), each injection pipe (31-35) being connected to the dispensing pipe (20);

– at least one auxiliary pipe (310-340, 345, 350);

the dispensing assembly (1) being characterized in that the auxiliary pipe (310-340, 345, 350) comprises an outlet (340.2, 345.2, 350.2) connected to the inner portion of an injection pipe (31-35) and an inlet (340.1, 345.1, 350.1) directly connected to the dispensing pipe (20) upstream from said corresponding injection pipe (31-35), between the inlet of said injection pipe (31-35) and the inlet (340.1, 345.1, 350.1) of the preceding injection pipe (31-35) in the water flow direction.

2. The dispensing assembly according to claim 1, characterized in that it comprises an auxiliary pipe for at least one injection pipe, said auxiliary pipe extending near the equatorial plane of the dispensing pipe.

3. The dispensing assembly (1) according to claim 1, characterized in that it comprises two auxiliary pipes (340, 345) for at least one injection pipe (34), said two auxiliary pipes (340, 345) respectively extending on either side of the equatorial plane (P_{20}) of the dispensing pipe (20).

4. The dispensing assembly (1) according to claim 3, characterized in that said two auxiliary pipes (340, 345) extend symmetrically relative to the equatorial plane (P_{20}) of the dispensing pipe (20).

5. The dispensing assembly (1) according to one of the preceding claims, characterized in that at least one injection pipe (31-35) comprises an upstream portion (341, 351) with a convergent shape and in that at least one auxiliary pipe (310-340, 345, 350) outlet (340.2, 345.2, 350.2) is connected to the corresponding injection pipe (31-35) downstream of said upstream portion (341, 351) with a convergent shape.

6. The dispensing assembly (1) according to any of claims 1 to 4, characterized in that a so-called inlet angle ($A_{340.1}$; $A_{345.1}$) formed, in a meridian plane ($P_{340.1}$) comprising an inlet (340.1, 345.1, 350.1) of an auxiliary pipe (310-340, 345, 350), between the radial direction ($R_{340.1}$) perpendicular to the axis of rotation (Y) and the segment (O_{20}–340.1) connecting said auxiliary pipe (310-340, 345, 350) inlet (340.1, 345.1, 350.1) to the median axis (C_{20}) of the dispensing pipe (20), is comprised between 0° and 90°.

7. The dispensing assembly (1) according to any of claims 1 to 4, characterized in that a so-called outlet angle formed, in a plane (VII-VII) orthogonal to the injection direction and comprising an auxiliary pipe (310-340, 345, 350) outlet (340.2, 345.2, 350.2), between the equatorial plane (P_{20}) of the dispensing pipe (20) and the segment connecting said auxiliary pipe (310-340, 345, 350) outlet (340.2, 345.2, 350.2) to the median axis (X_{342}) of the corresponding injection pipe (31-35), is comprised between 0° and 45°.

8. The dispensing assembly (1) according to any of claims 1 to 4, characterized in that at least one auxiliary pipe (310-340, 345, 350) has the shape of a cylinder with a circular base.

9. The dispensing assembly (1) according to any of claims 1 to 4, characterized in that the downstream end (I_{35}) of the dispensing pipe (20) is extended by an end injection pipe (35) connected to at least one auxiliary pipe (310-340, 345, 350) whereof the inlet (340.1, 345.1, 350.1) is situated on the outer portion of the dispensing pipe (20) and whereof the outlet (340.2, 345.2, 350.2) is situated on the inner portion of the end injection pipe (35).

10. A Pelton turbine comprising a wheel (R), said turbine being characterized in that it comprises a dispensing assembly (1) according to any of claims 1 to 4.

Dated this 8/6/2012

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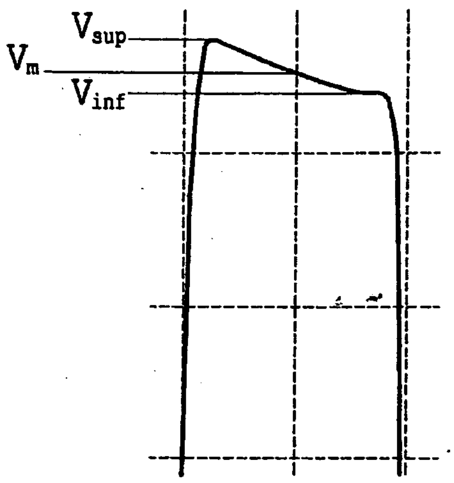

Fig.1

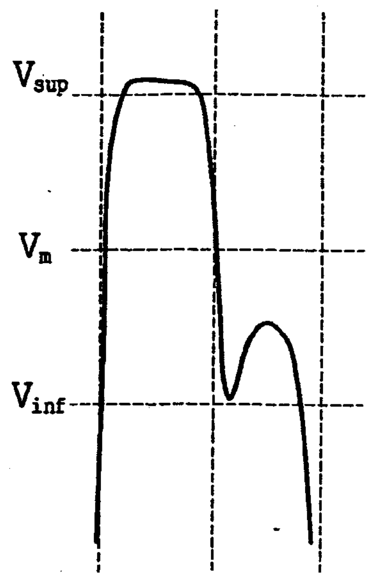

Fig.2
PRIOR ART

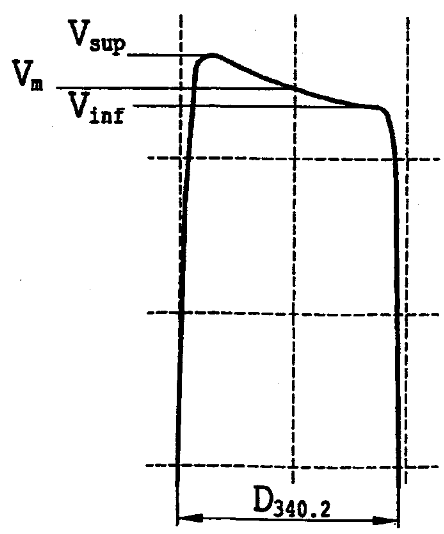

Fig.3

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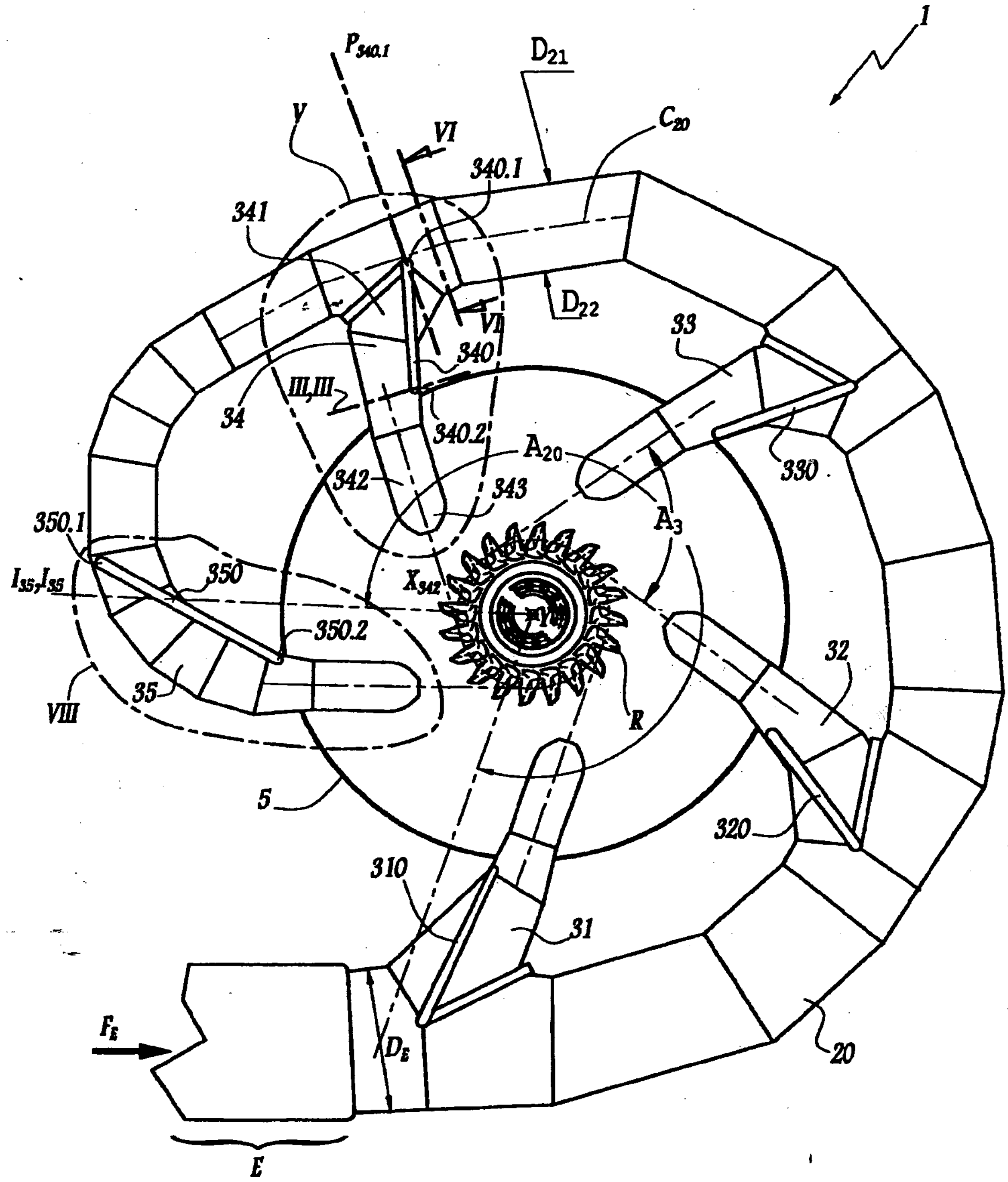

Fig.4

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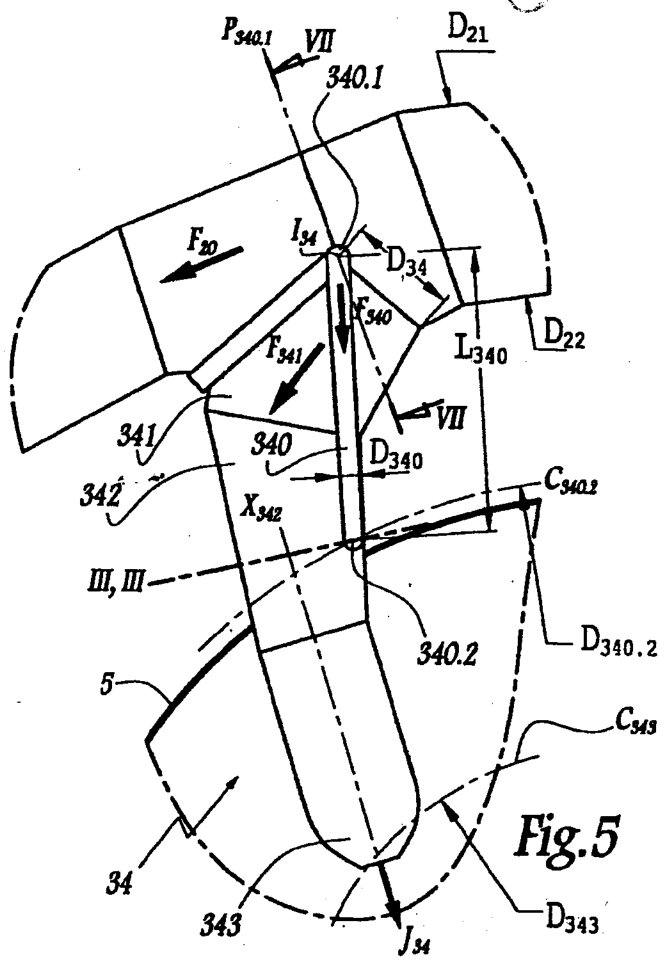

Fig.5

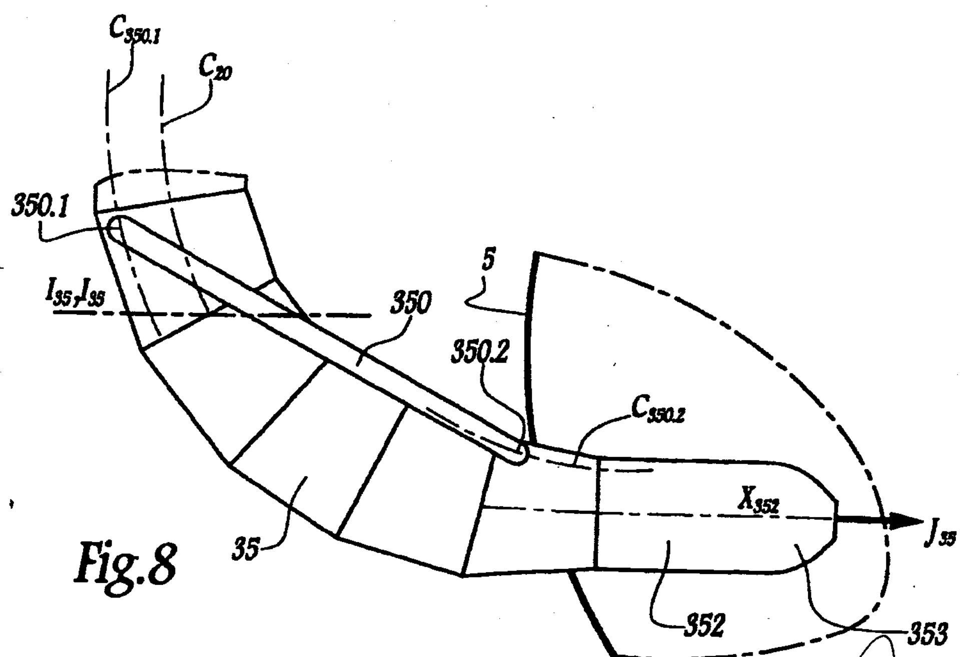

Fig.8

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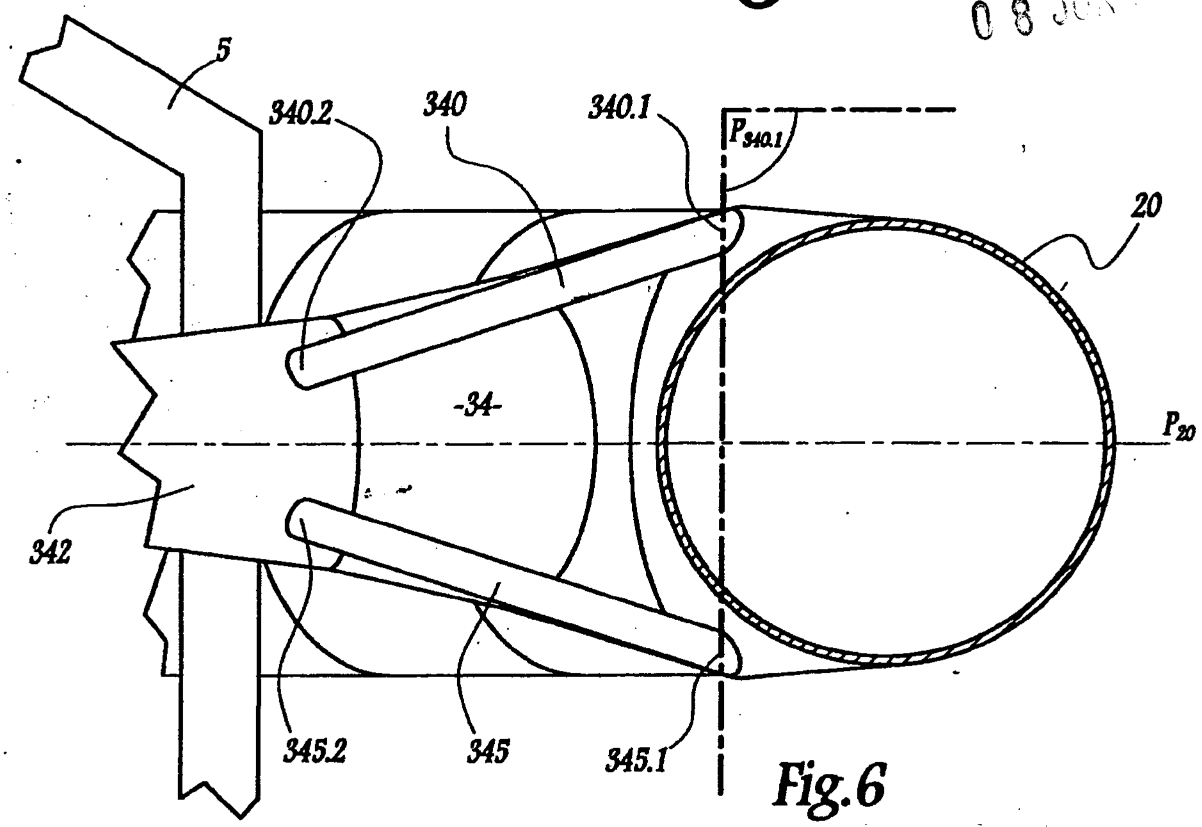

Fig.6

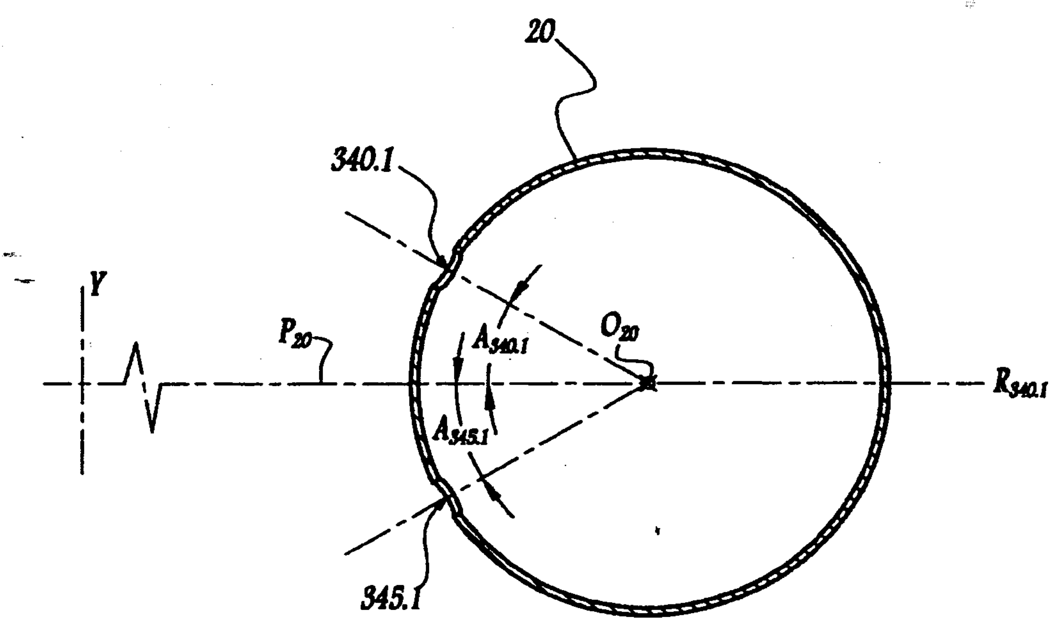

Fig.7

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DISPENSING ASSEMBLY FOR A PELTON TURBINE WHEEL, AND PELTON TURBINE COMPRISING SUCH A DISPENSING ASSEMBLY

The present invention relates to a dispensing assembly to supply a Pelton turbine wheel with water. The present invention also relates to a Pelton turbine comprising such a dispensing assembly.

To supply a Pelton turbine wheel with water, it is known to implement a dispenser comprising a dispensing pipe, substantially in the shape of a torus portion, and a plurality of injection pipes distributed around the site of the wheel so as to inject jets of water into its buckets. The dispensing pipe channels the water toward each injection pipe. Each of the injection pipes is connected to the dispensing pipe, with the result that the flow of water is locally distributed between the dispensing pipe on the one hand, and one of the injection pipes on the other.

In a dispensing assembly of the prior art, the dispensing pipe and each injection pipe have tubular shapes with cylindrical sections. The water that flows therein follows curved paths, along which it is subject to centrifugal accelerations. These centrifugal accelerations generate a pressure gradient between the inner wall and the outer wall of the curvature of an injection pipe. The water situated near the inner and outer walls is subject only slightly or not at all to the centrifugal acceleration, as its flow speed near these walls is low or nonexistent. As a result, the pressure gradient generated in the region of the injection pipe causes a circulation of liquid along the walls between the outer curve radius and the inner radius. The water that flows primarily along the injection pipe therefore has secondary flows transverse to the longitudinal direction of the injection pipe.

Figure 1 shows a profile of speeds measured upstream of an intersection between the dispensing pipe and an injection pipe. This “upstream” speed profile is globally uniform. Figure 2 shows a speed profile measured in the injection pipe, along a plane transverse to the primary direction of the injection pipe and downstream of the intersection with the dispensing pipe. This “downstream” speed profile has a pronounced dissymmetry due to the aforementioned secondary flows. More specifically, this dissymmetry or the deviation between the average speed V_m on the one hand and the minimum speed V_{inf} or maximum speed V_{sup} on the other hand is approximately 50% of the value of the average speed V_m. However, such a dissymmetry of the speed profile causes a deformation of the jet of water coming from the injection pipe, which reduces the kinetic energy available to actuate the wheel of the Pelton turbine.

FR-A-2 919 355 describes a Pelton machine comprising a dispensing pipe and several injection pipes mounted bypassing the dispensing pipe. This Pelton machine also comprises auxiliary pipes whereof the shared inlet is connected to a manifold forming the inlet of the dispensing pipe. The outlet of each auxiliary pipe is connected to the dispensing pipe upstream of an associated injection pipe.

However, the Pelton machine of FR-A-2 919 355 has drawbacks of the same nature as those previously mentioned. Furthermore, the structure of the auxiliary pipes complicates the construction of the dispensing assembly.

The present invention in particular aims to resolve these drawbacks, by proposing a dispensing assembly making it possible to maximize the conversion of the kinetic energy of the water into mechanical energy of the wheel.

To that end, the invention relates to a dispensing assembly, to supply a Pelton turbine wheel with water, the dispensing assembly comprising:

– a dispensing pipe globally having the shape of a torus portion whereof the axis of revolution is substantially parallel to the axis of rotation of the wheel;

– a plurality of injection pipes that are distributed around the site of the wheel, the injecting pipes being arranged so as to inject water into the buckets of the wheel, each injection pipe being connected to the dispensing pipe;

– at least one auxiliary pipe.

The dispensing assembly is characterized in that the auxiliary pipe comprises an outlet connected to the inner portion of an injection pipe and an inlet directly connected to the dispensing pipe upstream from said corresponding injection pipe, between the inlet of said injection pipe and the inlet of the preceding injection pipe in the water flow direction.

The water flowing in the auxiliary pipe(s) makes it possible to balance the profile of the flow speeds in the dispensing pipe and in the corresponding injection pipes. Owing to the invention, an injection pipe projects a weakly dispersed drop of water, with low secondary flow speeds that are reduced relative to the prior art.

According to other advantageous, but optional features of the invention, considered alone or according to all technically allowable combinations:

- the dispensing assembly comprises an auxiliary pipe for at least one injection pipe, said auxiliary pipe extending near the equatorial plane of the dispensing pipe;
- the dispensing assembly comprises two auxiliary pipes for at least one injection pipe, said two auxiliary pipes respectively extending on either side of the equatorial plane of the dispensing pipe;
- said two auxiliary pipes extend symmetrically relative to the equatorial plane of the dispensing pipe;
- at least one injection pipe comprises an upstream portion with a convergent shape and in that at least one auxiliary pipe outlet is connected to the corresponding injection pipe downstream of said upstream portion with a convergent shape;
- a so-called inlet angle formed, in a meridian plane comprising an inlet of an auxiliary pipe, between the radial direction perpendicular to the axis of rotation and the segment connecting said auxiliary pipe inlet to the median axis of the dispensing pipe, is comprised between 0° and 90°;
- a so-called outlet angle formed, in a plane orthogonal to the injection direction and comprising an auxiliary pipe outlet, between, the equatorial plane of the dispensing pipe and the segment connecting said auxiliary pipe outlet to the median axis of the corresponding injection pipe, is comprised between 0° and 45°;

- at least one auxiliary pipe has the shape of a cylinder with a circular base;
- the downstream end of the dispensing pipe is extended by an end injection pipe connected to at least one auxiliary pipe whereof the inlet is situated on the outer portion of the dispensing pipe and whereof the outlet is situated on the inner portion of the end injection pipe.

Furthermore, the present invention relates to a Pelton turbine comprising a wheel, said turbine being characterized in that it comprises a dispensing assembly as described above.

The invention will be better understood, and its advantages will also emerge, in light of the following description, provided solely as a non-limiting example and done in reference to the appended drawings, in which:

- figure 1 is a diagram of a speed profile measured upstream of an intersection between an injection pipe and a dispensing pipe of a dispensing assembly of the prior art, as described above;

- figure 2 is a diagram similar to figure 1 of a speed profile measured in an injection pipe of a dispensing assembly of the prior art, along a plane transverse to the primary direction of the injection pipe and downstream of the intersection with the dispensing pipe, as described above;

- figure 3 is a diagram similar to figure 2 of a measured speed profile, following the radial line III-III in figure 4 or 5, in an injection pipe of a dispensing assembly according to the invention, at the same level as the speed profile illustrated in figure 2;

- figure 4 is a top view of a dispensing assembly according to the invention;

- figure 5 is a larger-scale view of detail V of figure 4;

- figure 6 is a cross-section in plane VI in figure 4;

- figure 7 is ,a cross-section of a portion of the dispensing assembly of figure 4 along plane VII of figure 5; and

- figure 8 is a larger-scale view of detail VIII of figure 4.

Figure 4 illustrates a dispensing assembly or dispenser 1 intended to supply a Pelton turbine wheel R, known in itself, with water. The wheel R globally has a symmetry of revolution along an axis Y, which forms an axis of rotation around which the wheel R is intended to rotate. The axis Y is perpendicular to the plane of figure 4.

An inlet pipe E brings the dispenser 1 a stream of water that is symbolized by an arrow F_E. The inlet pipe E is situated upstream of the dispenser 1. In this application, the terms "upstream" and "downstream" refer to the general flow direction of the water, from the inlet pipe E to the wheel R.

The dispenser 1 comprises a dispensing pipe 20 and several injection pipes 31, 32, 33, 34 and 35 formed by direct tappings, from the dispensing pipe 20, toward the wheel R. The flow of water F_E entering the dispensing pipe 20 leaves through the injection pipes 31 to 35. Each injection pipe 31 to 35 then discharges a jet of water, J_{34} and equivalent, toward the buckets of the wheel R. Then, the water is collected by a housing 5 before being discharged through at least one outlet pipe (not shown).

As shown in figure 4, the dispensing pipe 20 globally has the shape of a torus portion whereof the axis of revolution is parallel to the axis Y. The term "portion" indicates that the torus extends "in a circle" over a narrowing torus angle A_{20} smaller than 350°. In the case at hand, the torus angle A_{20} is approximately 280°. In other words, the dispensing pipe 20 is in the form of an "open" torus.

The dispensing pipe 20 comprises several elementary dispensing segments. The elementary dispensing segments are juxtaposed along an arc of circle defined by the torus angle A_{20}. Each elementary distribution segment is arranged between two respective injection pipes 31 to 35.

Each injection pipe 31 to 35 is connected to the dispensing pipe 20. Thus, part of the flow of water coming from the inlet pipe E is bypassed toward each injection pipe 31 to 35 by the dispensing pipe 20. The water therefore flows from the dispensing pipe 20 toward each injection pipe 31 to 35.

72°, in the example of figure 4. The angle separating two consecutive injectors depends on the number of injectors and could therefore be different from 72°.

Each injection pipe 31 to 35 is arranged so as to inject water into the buckets in the wheel R, which makes it possible to rotate the wheel R around its axis Y. The dispenser 1, the wheel R and the inlet pipe E together form a hydraulic machine of the Pelton turbine type.

The structure of the injection pipe 34 is described below in more detail, relative to figure 5. This description can be transposed directly to the injection pipes 31, 32 and 33, as they are similar to the injection pipe 34.

The injection pipe 34 comprises an oblique portion 341, a rectilinear segment 342 and a nozzle 343. The rectilinear segment 342 is arranged downstream of the oblique portion 341 and upstream of the nozzle 343.

The oblique portion 341 performs a bypass function, as it forms the tapping of the injection pipe 34 on the dispensing pipe 20. Each oblique portion 341 or equivalent constitutes a bypass segment connecting the respective dispensing pipe 31 to 34 on the dispensing pipe 20, so as to collect part of the flow of water flowing into the dispensing pipe 20. Each oblique portion 341 or equivalent defines an upstream portion with a convergent shape for the respective injection pipe 34. More specifically, the oblique portion has a convergent tapered shape.

The adjective "oblique" indicates that the flow direction in the oblique portion 341, which is symbolized by an arrow F_{341} in figure 5, is inclined relative to the local direction of the flow in the dispensing pipe 20 at the injection pipe 34, this local direction being symbolized by an arrow F_{20} in figure 5.

The rectilinear segment 342 performs a channeling function, as it channels the water from the oblique portion 341 to the nozzle 343. The longitudinal direction X_{342} of the rectilinear segment 342 is tangent to a circumference of the wheel R taken at the center of the buckets, i.e. whereof the diameter forms the Pelton diameter of the wheel R. According to an alternative that is not shown, each injector is provided without an oblique portion and is made up of a rectilinear portion and a convergent portion directly connected to one another.

The nozzle 343 performs a discharge function, as it discharges a jet of water J_{34} toward the buckets of the wheel R. A mechanism (not shown) is mounted on the dispenser 1 so as to actuate a needle (not shown) of the nozzle 343 and equivalent nozzles of the other injection pipes 31, 32, 33 and 35. In the jet of water J_{34}, the flow speeds extend essentially along the longitudinal direction X_{342}, as detailed hereafter.

Furthermore, the dispensing assembly 1 comprises auxiliary pipes, five of which are visible in figure 4 with references 310, 320, 330, 340 and 350. The structure and operation of the pipe 340 are described hereafter in more detail, relative to figures 5 to 7. This detailed description can be transposed directly to the auxiliary pipes 310, 320 and 330, as the latter are similar to the auxiliary pipe 340. The structure and operation of the auxiliary pipe 350 are also described hereafter in more detail, relative to figure 6.

The auxiliary pipe 340 comprises an outlet 340.2 that is connected to the inner portion of the injection pipe 34, as shown in figure 4 or 5. The auxiliary pipe 340 comprises an inlet 340.1 that is connected to the dispensing pipe upstream of the injection pipe 34. In the example of the figures, the inlet 340.1 of the auxiliary pipe 340 is directly connected upstream of the injection pipe 34.

The terms "inlet" and "outlet" refer to the flow direction of the water in an auxiliary pipe, such as the auxiliary pipe 340 for which the flow of water is symbolized by an arrow F_{340} in figure 5. In the example of figures 4 to 8, the terms “inlet” and “outlet” respectively designate a single inlet opening and a single outlet opening.

The adverb "directly" means that the inlet of an auxiliary pipe is located between the inlet of the injection pipe to which the outlet of that auxiliary pipe is connected and the inlet of the preceding injection pipe in the flow direction of the water. In other words, the inlet of an auxiliary pipe is connected to the portion of the dispensing pipe situated between the two injection pipes whereof the inlets are closest upstream of the outlet of that auxiliary pipe.

The auxiliary pipe 340 extends rectilinearly between the inlet 340.1 and the outlet 340.2. The auxiliary pipe 340.2 has a cylindrical shape with a circular base. The circular base of the auxiliary pipe 340 has a diameter D_{340}. The diameter D_{340} depends on the geometry of the dispensing pipe 20.

The flow, with a relatively high rate F_{340}, makes it possible to effectively offset the pressure gradient generated by the injection pipe 34 by centrifugal acceleration.

The inlet 340.1 is positioned here at the intersection I_{34}. More specifically, the inlet 340.1 is connected to the dispensing pipe 20 near the intersection I_{34}. This position of the inlet 340.1 makes it possible to use the high pressure available at the divergent portion of the divergent dispensing pipe 20.

In this application, the adjectives "inner" and “outer” refer to the curvature of the piece to which they pertain. In other words, the adjectives “inner” and “outer” respectively designate the convex region and the concave region that border that piece, such as the dispensing pipe or an injection pipe. Thus, for the injection pipe 34, the inner edge is located on the right in figure 4 and the outer edge is located on the left in figure 4.

"Transverse" designates a section or a plane transverse to the primary flow direction of the water at that section or plane. The transverse section of a curved piece, such as the dispensing pipe 20, is therefore perpendicular to a direction locally tangent to the curvature of that piece.

Furthermore, the outlet 340.2 is connected to the inner part of the injection pipe 34 downstream of the oblique portion 341, which forms an upstream portion with a convergent shape for the injection pipe 34. Since the oblique portion 341 is convergent, the pressure decreases, as the fluid accelerates.

In the example of figures 4 to 6, the outlet 340.2 is positioned outside the housing 5, which facilitates the mounting of the auxiliary pipe 340, as it is not necessary to pierce the housing 5. According to one alternative not shown, one or more auxiliary pipe(s) pass through the housing.

In the meridian plane $P_{340.1}$ passing through the inlet 340.1, i.e. in the plane between figure 7, the position of the inlet 340.1 on the circumference of the dispensing pipe 20 is determined by a so-called inlet angle $A_{340.1}$, which is a geometric angle, but not an oriented angle. The meridian plane $P_{340.1}$ is qualified as “meridian” because it comprises the axis Y.

As shown in figure 7, in the meridian plane $P_{340.1}$, the inlet angle $A_{340.1}$ is formed between the radial direction $R_{340.1}$, which is perpendicular to the axis Y and the segment connecting the inlet 340.1 to the median axis C_{20} of the dispensing pipe 20 that is visible in figure 4 and that intersects the plane $P_{340.1}$ of figure 7 at the center O_{20} of the dispensing pipe 20. In other words, the inlet angle $A_{340.1}$ is the angle at the center O_{20} formed between the inlet 340.1 and the equatorial plane P_{20}. The equatorial plane P_{20} is perpendicular to the axis Y and parallel to the plane of figure 4 ; it is qualified as "equatorial" because it forms a plane of symmetry for the globally torus shape of the dispensing pipe 20.

In the example of figures 4 to 6, the inlet angle $A_{340.1}$ is 30°. In practice, the inlet angle $A_{340.1}$ is comprised between 0° and 90°.

In a plane passing through the outlet 340.2 and orthogonal to the longitudinal direction X_{342}, such as the plane containing the radial line III-III in figure 4 or 5, the position of the outlet 340.2 is determined by a so-called outlet angle, which is a geometric angle but not an oriented angle. The outlet angle is formed between the equatorial plane P_{20} of the dispensing pipe 20 and the segment connecting the outlet 340.2 to the median axis of the injection pipe 34, in this case the longitudinal direction X_{342}.

In the example of figures 4 to 7, the outlet angle is 40°. In practice, the outlet angle is comprised between 0° and 45°.

Furthermore, in the example of figures 4 to 8, each injection pipe 31 to 35 is connected to two auxiliary pipes. As shown in figures 6 and 7, the dispensing assembly 1 comprises, for the injection pipe 34, two auxiliary pipes 340.1 and 345.1 that respectively extend on either side of the equatorial plane P_{20}.

The auxiliary pipe 345 extends symmetrically to the auxiliary pipe 340 relative to the equatorial plane P_{20}. The geometric description of the pipe 340 can therefore be transposed to the pipe 345. The inlet 345.1 of the auxiliary pipe 345 is positioned at the inlet 340.1 along the axis Y. Likewise, the outlet 345.2 of the auxiliary channel 345 is positioned at the outlet 340.2 along the axis Y.

Furthermore, the inlet angle and the outlet angle characterizing the auxiliary pipe 345 are respectively identical to the inlet angle and the outlet angle that characterize the auxiliary pipe 340.

Figure 8 illustrates the end injection pipe 25 that extends the downstream end of the dispensing pipe 20. The end injection pipe 25 differs from the injection pipes 31 to 34, as it does not form a tapping or a bypass from the dispensing pipe 20. In other words, all of the water flowing in the downstream end of the dispensing pipe 20 leaves through the end injection pipe 35.

The end injection pipe 35 is also connected to two auxiliary pipes, one of which is visible in figure 8 with reference 350. The inlet 350.1 of the auxiliary pipe 350 is situated on the radially outer part of the dispensing pipe 20. In other words, the radius of the circle $C_{350.1}$ centered on the axis Y and on which the inlet 350.1 is located is larger than the radius of the circle C_{20} that defines the median axis of the dispensing pipe 20, i.e. the major radius of the torus portion.

The outlet 350.2 of the auxiliary pipe 350 is situated on the radially inner portion of the end injection pipe 35. In other words, the radius of the circle $C_{350.2}$ centered on the axis Y and on which the outlet 350.2 is located is smaller than the radius of the median axis C_{20}.

Such positions of the inlet 350.1 and the outlet 350.2 contribute to optimize the compensation of the centrifugal acceleration exerted on the water flowing in the end injection pipe 35, which generates a uniform profile of the speeds measured in the end injection pipe along a plane transverse to the longitudinal direction X_{352} of the rectilinear segment 352.

Furthermore, the dispensing pipe 20 ends at a meridian plane I_{35} visible in figure 4 or 8. The plane I_{35} marks a limit of the torus angle A_{20}, i.e. the downstream end of the dispensing pipe 20. In other words, the plane I_{35} forms the intersection between the dispensing pipe 20 and the end injection pipe 35.

The diagram of figure 3 illustrates the "downstream" profile of the speeds measured in the injection pipe 34 along the radial line III-III, i.e. at the outlet 340.2 or at the same level as the speed profile illustrated in figure 2. The deviation between the average speed V_m on the one hand and the minimal speed V_{inf} or maximal speed V_{sup} on the other hand is approximately 8% of the value of the average speed V_m. This speed profile is therefore substantially uniform.

The geometric parameters defined above, such as inlet and outlet angles, therefore make it possible to determine an auxiliary pipe that contributes to optimizing the compensation of the centrifugal acceleration exerted on the water flowing in the respective injection pipe 31 to 35, which generates a relatively uniform profile of the speeds measured in the injection pipe along a plane transverse to the longitudinal direction X_{342} of the rectilinear segment 342.

A dispensing assembly according to the present invention therefore makes it possible to reduce kinetic energy losses in the flow of water inside each injection pipe 31 to 35, therefore to increase the rotational mechanical energy transmitted to the wheel R, which improves the overall output of the hydraulic machine. A Pelton turbine according to the invention has an improved overall output.

According to one alternative not shown, one or more auxiliary pipe(s) comprise a plurality of inlet openings and/or outlet openings connected to a shared segment of the auxiliary pipe. The set of inlet openings and the set of outlet openings are respectively designated using the terms “inlet” and “outlet.”

According to one alternative not shown, each auxiliary pipe has a curved shape.

According to one alternative not shown, each auxiliary pipe can have a cylindrical shape with a non-circular base or a non-cylindrical shape, for example a prismatic shape.

According to one alternative not shown, all of the injection pipes of a dispensing assembly according to the invention are not connected to an auxiliary pipe, but only some of them.

According to still another alternative not shown, one or more injection pipes of a dispensing assembly according to the invention are connected to a single auxiliary pipe.

According to one alternative not shown, one or more injection pipes of a dispensing assembly according to the invention are connected to more than two auxiliary pipes, for example four.