W. M. WHITE.

DISCHARGE CHAMBER FOR WATER WHEELS.

APPLICATION FILED FEB. 28, 1916.

1,264,728.

Patented Apr. 30, 1918.

2 SHEETS—SHEET 1.

Fig. 2.

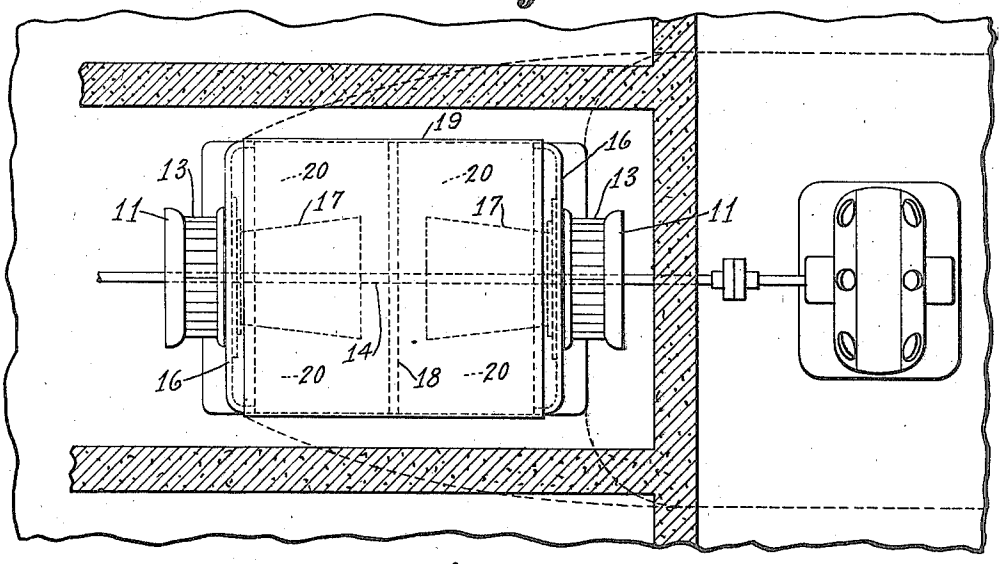


Fig. 1.

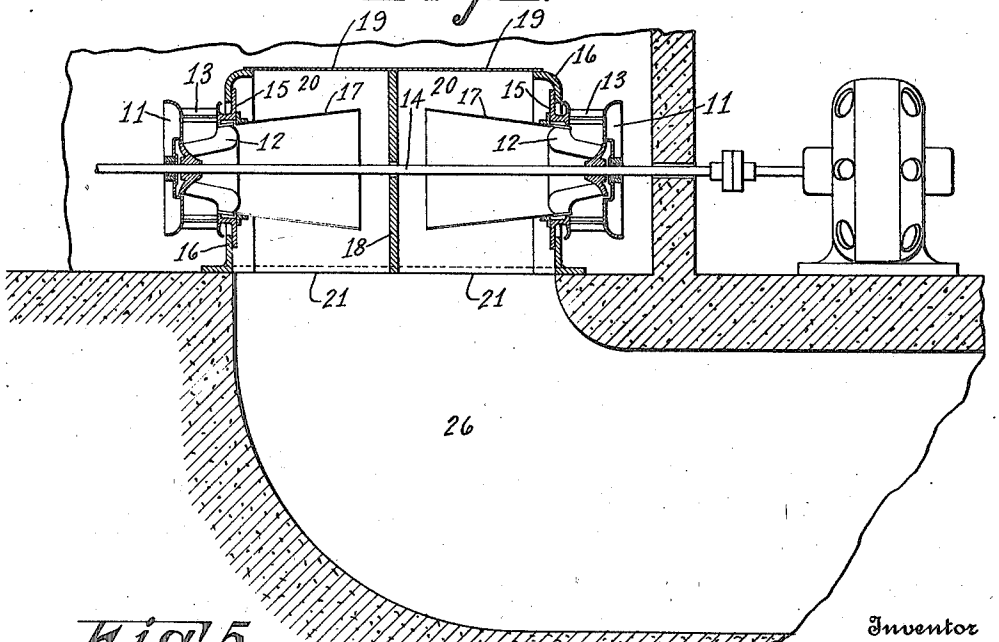
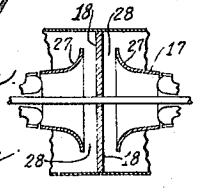


Fig. 5.



Witnesses

C. H. Roesner.

G. F. Murray.

Inventor

William M. White

By G. G. Linthicum

Attorney

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2 SHEETS—SHEET 2.

Fig. 4.

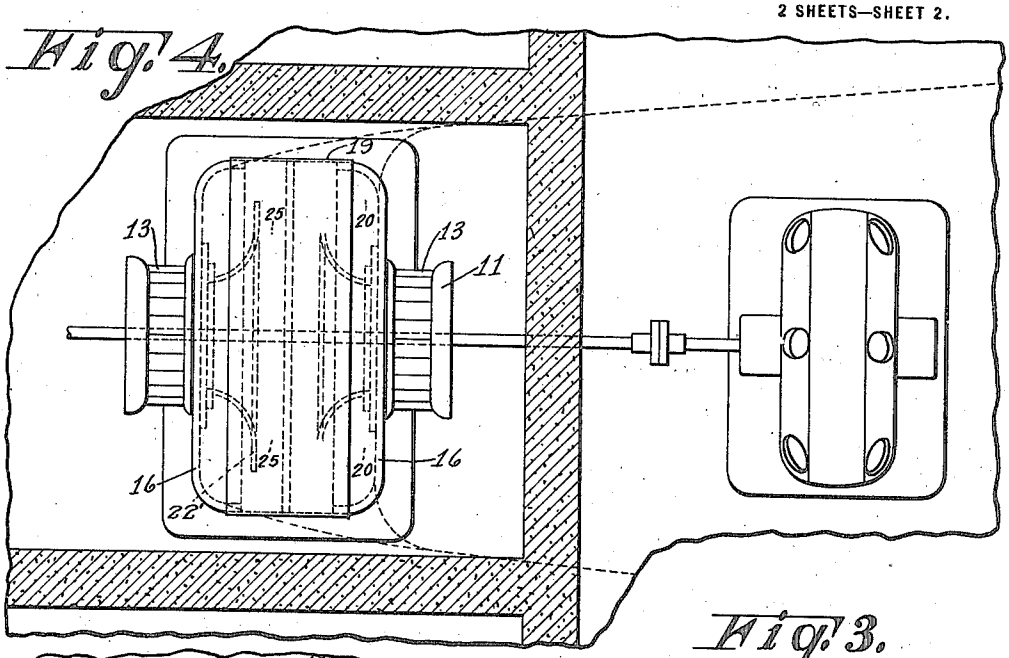
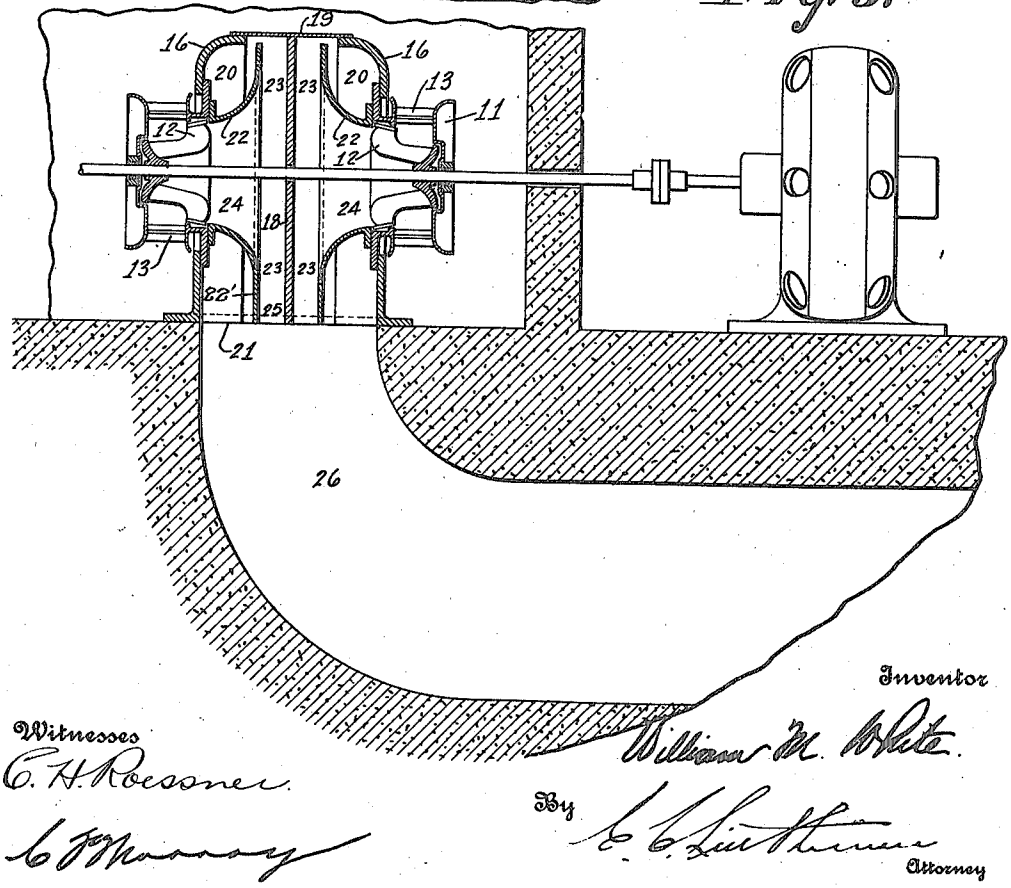


Fig. 3.



Witnesses

C. H. Roessner.

E. F. Mooney

Inventor

William M. White.

By E. E. Lee Thurmon

Attorney

UNITED STATES PATENT OFFICE.

WILLIAM M. WHITE, OF MILWAUKEE, WISCONSIN.

DISCHARGE-CHAMBER FOR WATER-WHEELS.

1,264,728. Specification of Letters Patent. Patented Apr. 30, 1918.

Application filed February 28, 1916. Serial No. 80,850.

To all whom it may concern:

Be it known that I, WILLIAM M. WHITE, a citizen of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented certain new and useful Improvements in Discharge-Chambers for Water-Wheels, of which the following is a specification.

One object of the invention is to provide an efficient discharge chamber for water wheels coaxially mounted and oppositely disposed to each other.

A further object of the invention is to provide for the regain of pressure from velocity within symmetrical conduits disposed concentrically about the axis of two coaxially mounted oppositely disposed water wheels.

Another object of the invention is to provide a center discharge chamber for said oppositely disposed water wheels having a construction suitable for high efficiency and accommodated to shortest distance between the runners of said water wheels.

Another object of the invention is to provide a suitable discharge chamber for accommodating the water discharged from two coaxially mounted, oppositely disposed water wheels embodying conoidal chambers disposed substantially symmetrically about the axis of and located at the discharge of each of the two said coaxially mounted water wheels, said conoidal chambers being of slightly increasingly greater capacity in the direction of flow than that required to accommodate a free hydraucone, as described in my co-pending application, Serial No. 38,373, dated July 6, 1915. Reference is also made to my co-pending application Serial No. 83,259 filed March 10, 1916.

The invention consists of the several features hereinafter set forth, and is more particularly defined by claims at the conclusion hereof.

In the drawings;

Figure 1 is a transverse vertical section through two water wheels coaxially mounted, oppositely disposed, fitted with a form of center discharge chamber, embodying the invention.

Fig. 2 is a horizontal plan view of Fig. 1.

Fig. 3 is a transverse vertical section through two coaxially mounted, oppositely disposed water wheels and center discharge chamber embodying hydraucone regainers disposed at the discharge of each of the water wheels.

Fig. 4 is a plan view of Fig. 3.

Fig. 5 is a vertical section showing a modification wherein a pair of water wheels are shown having the discharge ends of the tubes flared outwardly.

Before entering into a detailed description of the invention I shall describe briefly the usual form of center discharge chamber for coaxially mounted, oppositely disposed twin water wheels, and describe briefly some of the results of my experiments relating to my invention.

The usual construction of center discharge chambers for coaxially mounted, oppositely disposed twin water wheels consists of two elbows, each connecting with one of the twin runners, and the discharge ends of the elbows are merged into one conduit, or chamber, usually circular at its outlet, thus providing a common outlet for the water passing through both wheels. The elbows are usually made of increasing cross sectional area in the direction of flow in an attempt to regain pressure energy from kinetic energy contained in the water discharged at high velocity from the water wheel runners.

I have found by experiments that an elbow of increasing capacity throughout its length in the direction of flow is an exceedingly poor device for the regain of pressure energy from kinetic energy contained in the water flowing at high velocity into the entrance of the elbow, and experiments have shown that when the water issues from the discharge end of an elbow, constructed with increasing cross sectional area in the direction of flow, it issues therefrom at widely different velocities throughout the cross section of its discharge end. This is true of an elbow of constant cross sectional area throughout its length, but the variation in velocity is augmented in the case of an elbow of increasing capacity in the direction of flow.

It is well known that a conduit of increasing capacity in the direction of flow, with straight axis, will regain pressure energy from the kinetic energy of water flowing at high velocity into the entrance of such conduit, when the velocity throughout the stream flow at entrance is approximately

uniform, and especially when any variation in the stream flow is symmetrical about the axis of the tube.

It is evident that the velocities of the discharge water from a water wheel are substantially symmetrical about its axis and therefore a regaining section with a straight axis in line with the axis of the runner may be advantageously employed. In order to permit of the use of straight axis regainers so that their functions will not be impaired and so that they may be used in connection with a common discharge chamber occupying a small space as compared to the usual elbow construction, I make use of a deflecting surface within the chamber.

I have found by experiments that a deflecting surface may be set opposite to the end of such regaining conduit and may be disposed near to the end of the conduit and form an annular outlet between the end of the regaining conduit and the deflecting surface, without disturbing the regaining effect of such conduit, and I have further found that by placing the deflecting surface in proper relation to the regaining conduit a slight increase of the regaining effect of the combination is obtained.

I am using and combining the results of these experiments in the construction of a center discharge chamber for two coaxially mounted water wheels, and providing for regain of pressure from velocity within conduits preferably disposed substantially symmetrically about the axis of the water wheels.

Referring now more particularly to the drawings, it will be noted that in Fig. 1 two water wheels 11 having runners 12 and guide vanes 13 are mounted upon a common shaft 14. The bases 15 of the water wheels are connected to the dome head 16 of the center discharge chamber. It will be noted that discharge conduits 17, increasing in capacity in the direction of flow, are connected with each of the water wheel runners 12, 12 at the discharge end thereof, and that they discharge the water directly into the body of the chamber.

There is preferably disposed transverse to and adjacent the end of each of the conduits a deflecting plate 18 shown on the drawing common to both. It is not essential that one deflecting surface be used as two surfaces independent of each other, located properly with reference to each of the discharge ends of the conduits, would serve equally well.

It will be noted that the walls of the enveloping chamber 19 surround the conduits 17, 17 connecting with the water wheel runners, and that passages 20, 20 are formed between the outer surface of the conduits, and the walls of the enveloping chamber. The enveloping chamber is provided with a side outlet 21, Fig. 1. It is not essential whether one or more outlets are provided.

The water discharged from the runners at high velocity is caused to be decreased in velocity in the conduits 17, 17 of increasing capacity in the direction of flow connecting with each runner 12, 12 with consequent regain of pressure. The water discharged from the ends of the conduits is deflected by the deflecting surfaces 18, 18 from axial to radial in all directions, and by reason of the passageways 20, 20 between the conduits 17, 17 and enveloping chamber 19 is caused to flow over and around the discharge conduits to the outlet at the ends of the conduits 21 from the center discharge chamber to change the direction of flow of the water and permit the conduits 17, 17 to carry out their functions within a shorter distance between the runners than was necessary in devices heretofore employed.

Modern efficient water wheels of medium and large capacity discharge the water from the runner at relatively high velocity. This high velocity contains kinetic energy. By transforming this kinetic energy into pressure energy it is conserved, with the result that greater efficiency of the power development is obtained. By embodying discharge conduits increasing in capacity in the direction of flow having axes coincident with the axis of the shaft, I provide for efficient conversion of the high velocity of the water discharged from the water wheel into pressure energy, and by employing deflecting surfaces to change the water discharged from said conduits from axial to radial, and to gather such water in the chamber surrounding and inclosing the discharge conduits, I am enabled to bring the water wheels closely enough together to obtain a rational and inexpensive construction.

In order to obtain a more compact construction and at the same time a more efficient means for the conversion of the kinetic energy of the water into pressure energy, I connect with each of the water wheels 11, as shown in Fig. 3, two flared tubes, or hydraucone regainers 22, 22 and dispose adjacent the ends of the flared tubes deflecting surfaces 18, 18, and thus form between said flared tubes 22, 22, and such deflecting surfaces 18, 18, a conoidal chamber. The water discharged at high velocity from the runners, 12, 12, impinges against the surfaces of a deflecting plate 18, 18 respectively, is changed from axial to radial and is discharged from the conoidal chamber through the annular openings 23, 23, 23, 23 and is collected within the enveloping chamber wall 19, 19, constructed to form passageways between the outside of the flared tubes 22, 22 and the walls 16, 19 of the enveloping chamber, and a portion of the water flowing

through said annular openings is accommodated by flowing over, back of, and around the flared tubes 22, 22.

When a free circular jet of water is caused to impinge upon a flat surface placed at right angles to the axis of the jet, the water forms itself into a conoidal shape at point of contact with the plate, and is discharged from the base of such conoidal shape radially in all directions along the deflecting surface. That portion of the stream of enlarged section at point of contact with the plate, I have termed a "hydraucone".

I have performed experiments which show that the water issuing from the base of a free "hydraucone" is at the same velocity as the water entering the apex of the hydraucone.

Referring now to the action of the water in the conoidal chambers 24, 24, the water issuing from each runner is a jet of circular cross section, and when impinging against the plate 18, tends to form the shape of a free hydraucone.

The flared conduits 22, 22, connecting with the runners 12, 12 are constructed to form a conoidal chamber between the walls of the flared tubes 22, 22 and the plates 18, 18 of slightly increasingly greater capacity in the direction of the flow of the water, than that required to conform to the shape of a free hydraucone, and by reason of the increasingly greater capacity, the water is decreased in velocity at the discharge from the annular openings 23, 23 around the bases of the conoidal chambers, from what it was when discharged from the runner, and I find that such change in velocity results in an increase of pressure at the discharge from the annular opening over what it was at the discharge from the runner. I have termed the combination of the flared tube and the deflecting surface disposed adjacent thereto a "hydraucone regainer". For a fuller and more complete description of the utility and novelty thereof reference is made to Patent No. 1,223,843, granted to me April 24, 1917, for apparatus for utilizing the hydraucone action of water.

For a further regain of pressure from the kinetic energy in the water discharged from the annular openings 23, 23 at the base of the hydraucone, there may be provided an outwardly extending portion 22' forming a passageway 25, shown on the left hand conduit in Fig. 3, radial in extent, and of increasing capacity in the direction of flow. A portion of the energy of the water due to discharging from the runner at high velocity is transformed into pressure, first, in the conoidal chamber, and second, in the radially extended passage, is then collected by the surrounding chamber 19 and a portion of the water is accommodated through the passageways 20, 20 between the outside of the flared tubes, and the surrounding walls of the enveloping chamber and is caused to discharge from the outlet 21 of the enveloping chamber.

By reference to Figs. 1 and 3, it will be noted that the discharge from the center discharge chamber connects with a conduit 26 which may be preferably of increasing capacity in the direction of flow for still further decreasing the velocity with some increase of pressure.

It is usual to connect a discharge conduit constructed with increasing capacity in the direction of flow to the outlet of a center discharge chamber as previously described, in an attempt to regain pressure from the velocity of the water issuing therefrom, but I have found by experiments that proper regaining effect is not obtained in such discharge conduit when the water entering such conduit is flowing at widely varying velocities throughout the stream, which is the case of the discharge from such center discharge chamber having the form of elbow above described leading thereto. A more complete analysis of the action of water flowing in a conduit of increasing capacity in the direction of flow at varying velocities throughout the stream will be found in my co-pending application Serial No. 22,232, filed April 19th, 1915.

With the discharge chamber above described the water flowing through the outlet of said chamber passes therethrough at velocities which are substantially equal and symmetrical about the axis of the tube or conduit connected at the discharge end of the chamber, and this makes it possible to secure efficient regaining effects with various kinds of regaining sections communicating with the outlet of the discharge chamber.

I may regain the energy discharged from the runners of two coaxially mounted, oppositely disposed water wheels by connecting with each runner 12, 12 conduits 17, 17, the edges of the flared ends of which terminate short of the inclosing casing, Fig. 5, increasing in capacity in the direction of flow and flare the ends 27, 27 of said conduits and dispose transversely and near to the discharge ends of the conduits deflecting surfaces, 18, 18, disposed to form conoidal chambers, as described, between the flared ends 27, 27 of the said tubes and said plates 18, and also extend radially the flared portion of the conduit 27 to provide, between said radial portion and said plate, a passage 28 radial in extent of increasing capacity in the direction of flow for a still greater reduction of velocity for further increase of pressure. The modification shown in Fig. 5 discloses flaring discharge conduit 17, 17, the edges of which terminate short of the sides, bottom and top of

the casing. This is a modification over the arrangement shown in Fig. 3.

In the above specification I have referred to twin water wheels, but the wheels need not necessarily be of the same capacity, nor even of the same type.

I have mentioned an annular outlet for the discharge of the water from the conical conduits and conoidal chambers, but I do not limit myself to a continuous annular opening; by annular opening, under this specification, I mean an opening of essentially greater dimension circumferentially than axially, and especially such an opening as will permit the water to be discharged radially to the axis of the water wheels and permit of reasonably close proximity of the ends of the conduits and said conoidal chamber, and at the same time accommodate the water discharged from the water wheels.

In the drawings I have shown the hydraucone chamber with a flat plate for an impinging surface, but such impinging surface need not necessarily be flat, but is preferably concentric with the axis of the entering stream. The shape of the free hydraucone may be different depending upon the particular form of base used. I make the walls of the chamber to a shape which provides an inclosed conoidal chamber and preferably of slightly increasingly greater capacity in the direction of flow than that required to conform to the shape of the free hydraucone which would tend to form on impact with the particular form of base used. Some beneficial effect is obtained when the walls of the inclosing chamber are such as to provide an outlet from the conoidal chamber of greater capacity than the inlet at the apex, even though the walls be not made of slightly increasingly greater capacity throughout the entire length of the conoidal chamber.

The invention thus exemplifies a discharge chamber for a pair of coaxially mounted, oppositely disposed water wheels provided with regaining means for regaining pressure from velocity from the water passing from the wheels into the chamber and with means for changing the direction of flow of the discharge water from the wheel from axial to radial within a short axial distance whereby an efficient, compact, regaining discharge chamber is provided.

It will be understood that the constructions herein shown are capable of other modifications and such modifications as are within the scope of my claims I consider within the spirit of my invention.

I do not claim specifically in this application a device for converting velocity head into pressure head embodying a water wheel runner having an open space immediately therebeneath and a deflector across said space leaving a free passage from the wheel to the center of the deflector, nor a deflector projected across said space and arranged substantially at right angles to the rotative axis of the runner as these are claimed in my copending application No. 769,791, entitled "Hydraulic regainers." Nor do I claim the method of operating water wheels which consists in passing an amount of water through a wheel in excess of the amount required for the maximum efficiency of the wheel, nor by passing an amount of water through the wheel by reason of excess speed at excess of the amount required for the maximum efficiency of the wheel. Nor by operating discharge water wheels by means of utilizing energy of discharged water to produce an effective head. Nor by utilizing the centrifugal force of the whirl of the body of water at the discharge of the water wheel, the same being included in my copending application No. 774,528, for "method of increasing head." Nor do I claim a pressure regaining section surrounding the initial regaining section and conoidal deflecting chamber connecting said regaining sections together, this and modifications having been included in my copending application Serial No. 86,388, entitled, "Return regainer."

I do not claim herein the inventions as described above but show several elements in common for the purpose of clearness and explanation. I therefore do not intend to dedicate to the public, matter herein shown but not claimed which matter is in common with the above referred to copending applications and which is therein fully described and claimed.

I claim:

1. The combination, with a pair of oppositely disposed coaxially mounted water wheels, of regaining devices communicating with the discharge outlets of said wheels, a common discharge chamber inclosing said devices, and means within the chamber for abruptly changing the direction of flow of the water from axial to radial for regaining pressure from velocity in said chamber.

2. The combination, with a pair of coaxially mounted, oppositely disposed water wheels, of a common discharge chamber for said wheels, means for regaining pressure from velocity from the water passing from the wheels into said chamber, and a member disposed within the chamber and provided with deflecting surfaces, each surface being disposed adjacent said regaining means, and substantially radial to the axis of the wheels.

3. The combination, with a pair of coaxially mounted oppositely disposed water wheels, of a common discharge chamber for said wheels, and means within said chamber for utilizing the hydraucone action of water

whereby pressure may be regained from velocity with good effect.

4. The combination, with a pair of coaxially mounted oppositely disposed water wheels, of a common discharge chamber for said wheels, regaining sections at the inlets for discharging the water directly into the main body of the chamber, and means within said chamber for changing the direction of flow of the water from axial to substantially radial in all directions without decreasing the efficiency of the device as a regainer.

5. The combination with two coaxially mounted, oppositely disposed water wheels discharging toward each other, of conduits connecting with the water wheel runners, the discharge ends of said conduits being flared outwardly, deflecting surfaces disposed transversely and adjacent to the discharge ends of said conduits, and a discharge chamber for said conduits inclosing said surfaces, whereby the water discharged at high velocity from the runners may be deflected from axial and discharged radially in all directions.

6. The combination, with two coaxially mounted, oppositely disposed water wheels discharging toward each other, of conduits connecting with the water wheel runners, the discharge ends of said conduits being flared outwardly, deflecting surfaces disposed transversely and adjacent to the ends of the discharge conduits, and a chamber inclosing said conduits and surfaces, the walls of said inclosing chamber constructed to form a passageway for the water between the walls of the inclosing chamber and the outside of the walls of said conduits, whereby the water discharged at high velocity from the runner may be reduced in velocity with regain of pressure in the conduits, may be deflected from axial and discharged radially in all directions, may pass over, around and behind said flared portion, and may be discharged through said passageways to the outlet from the inclosing chamber.

7. The combination, with two coaxially mounted, oppositely disposed water wheels discharging toward each other, of conduits comprising hydraucone regainers connecting with the water wheel runners, and a discharge chamber for said regainers.

8. The combination, with two coaxially mounted, oppositely disposed water wheels discharging toward each other, of hydraucone regainers including conduits connecting with the water wheel runners, and being substantially symmetrically disposed about the axis of the wheels, and a discharge chamber for said regainers.

9. The combination, with two coaxially mounted, oppositely disposed water wheels discharging toward each other, of hydraucone regainers communicating with the discharge ends of said wheels and provided with outwardly extending portions forming radially extending passages of increasing capacity in the direction of flow, and a discharge chamber inclosing said regainers.

10. The combination, with two coaxially mounted, oppositely disposed water wheels discharging toward each other, of hydraucone regainers communicating with the discharge ends of said wheels and provided with outwardly extending portions forming radially extending passages of increasing capacity in the direction of flow, said regainers being substantially symmetrically disposed about the axis of the wheels, and a discharge chamber inclosing said regainers.

11. The combination, with a pair of coaxially mounted, oppositely disposed water wheels, of a common discharge chamber for said wheels provided with an outlet, means for regaining pressure from velocity from the water passing from the wheels into said chamber, a partition member disposed within said chamber in a plane transverse to the axis of said wheels and provided with deflecting surfaces disposed adjacent said regaining means, and a regaining conduit communicating with the outlet to said chamber.

Signed at Chicago, Ill., this 24th day of February, 1916.

WILIAM M. WHITE.

Witnesses:
T. D. BUTLER,
CHAS F. MURRAY.