The invention relates to a new and useful improvement in turbine wheel systems.

One object of the invention is to provide a sluiceway with a plurality of turbine wheels in series and a plurality of deflecting walls whereby the current will be guided in a tortuous course in such manner that the full force of the current will strike the blades of each wheel on the far side of the wheel just before the discharge, so that the blades will not have to push the dead water half way around as is usually the case; also to arrange the series of deflecting walls in such manner that after the water has been operative in the manner above described on one wheel, and discharged, the current will again be deflected and be operative on the blades of the next wheel in the series just before the discharge.

Another object of the invention is to provide an auxiliary independent current or stream to augment the current which has already passed through a previous wheel.

Other features of the invention will be more particularly set forth hereinafter.

In the drawings, Fig. 1 is a plan view, partly in diagram, and broken away at each end, of a system embodying the invention showing a single longitudinal series of water wheels.

Fig. 2 is a plan view, partly in diagram, and broken away at each end, showing a system with two parallel series of water wheels in one general sluiceway.

The apparatus is more especially intended to be installed in tide water, and open to the tide water at each end so that it will be operative whether the current is flowing in one direction with the inflow of the tide or in the reverse direction with the ebb of the tide. The invention is adapted, however, to be employed in a sluiceway in which the current flows only in one direction, as in a river or a canal fed from a river or pond.

Referring now to the drawings, in Fig. 1 there is shown a sluiceway having two parallel side walls 1, 2, through which flows a current of water.

Mounted in said sluiceway are a longitudinal series of water wheels, preferably turbine wheels mounted to rotate on a vertical axis. For illustration, a series of four wheels are shown which, for convenience of reference in describing the invention, are designated a, b, c and d. The series may be extended to include as many wheels as desired. It is not deemed necessary to show the water wheels, except in diagram, as the present invention does not relate to the construction of the wheel itself. The inner circle 4 indicates the periphery of the hub of each wheel, and the concentric outer circle 5 indicates the periphery of the path described by the sweep of the blades. The full width of the sluiceway between the two side walls 1, 2, is considerably greater than the diameter of the wheel, and the wheels are located intermediate the said walls so that there is a space on each side of the wheels.

The wheels are also spaced at some distance apart from each other, in longitudinal series. On one side of the series of wheels, there are a series of deflecting walls 6, 6a and 6b which are curved, as viewed in plan, being bowed outwardly from the longitudinal median line through the axes of the wheels toward the adjacent side wall 1, but not extending entirely to the side walls.

One end of each of said curved walls starts at a point adjacent the periphery of one of the wheels at the median line of the sluiceway, if the wheels are located in the middle of the sluiceway (or at any rate, in a line parallel with the side wall of the sluiceway drawn through the axis of the wheel), and extends a sufficient length to partially embrace two adjacent wheels.

There is provided a series of curved wall sections 7, 7a and 7b parallel with the curved deflecting walls 6, 6a, 6b, to form auxiliary curved passages for the water to alternate wheels, in addition to the central current.

There is a passage 8 between the adjacent ends of the curved wall sections 6, 6a, and a passage 8a between the adjacent ends of the walls 6b and 6c, and so on between the adjacent ends of the walls of any extension of the series.

On the opposite side of the series of wheels from the curved deflecting walls 6, 6a, 6b, there are a series of curved deflecting walls 9, 9a, each of which partially embrace two adjacent wheels, but in alternating relation to the walls 6, 6a, 6b; that is, the wall 6a embraces the wheels b, c, the wall 9 embraces the wheels a, b, and the wall 9a embraces the wheels c, d.

A series of curved wall sections 10, 10a, cooperate with the guide wall sections 9, 9a, to form passages to the wheels which are al-
ternate to the wheels which are fed by the passages formed by the walls 6, 6', and 6" and their cooperating walls 7, 7', and 7".

In operation, we will assume that the current is flowing from the right toward the left, as viewed in Fig. 1. The water in the middle of the channel will strike the wheel a, the first in the series, between the wall sections 6, 9, on that half of the wheel which is on the side toward the wall 6, while the wall 9 will wand off the current from the other half of the wheel. The direct force of the current will come against the blades of the wheel through the throat 12 at different points on the way from the proximate end of the wall 9 to the further end of the wall 6, just before the discharge point of the water from the wheel.

After the water escapes past the wheel a, the curved wall 6 and the rotation of the wheel a will give the current a deflection toward the concave face of the wall 9 which will deflect the current through the throat 13 against the wheel b on the side toward the wall 9, and the wall 6" will prevent the current from acting on the opposite side of the wheel. The wheel b will rotate in the reverse direction from the wheel a.

An auxiliary current will come in through the passage between the walls 6 and 7 and thence part of it will pass through the passage 8 between the converging proximate ends of the walls 6 and 6" and unite with the current which passes through the wheel a already described.

The water which passes through the wheel b will in turn be deflected by the curved wall 6" to act upon the wheel c, and an auxiliary current which passes through the passage 17 between the walls 9 and 10 will augment the current which passes through the wheel b. The wheel c will rotate in the reverse direction to wheel b.

It will be readily understood that wheel d will be driven in a similar manner to wheel b. The system may be extended to include as long a sluiceway as and many wheels as desired.

In the system shown in Fig. 2, the principle is the same as that shown in Fig. 1, but is adapted for two longitudinal series of wheels in one broad channel. The deflecting walls for the wheels a, b, c and d in one series are curved oppositely to those for the wheels a', b', c', and d' in the parallel series, so that the wheel a will rotate in the opposite direction from the wheel a', and the same is true as to the succeeding wheels in the two series.

In the middle of the channel which flows between the two series there are placed a series of combination deflecting members to split the current and deflect a portion to one series and a portion to the other series. The two converging members 14, 14' cooperate respectively with the walls 9 and 9' in a manner which will be easily understood from the description of the system shown in Fig. 1. The walls 15, 15' cooperate with the walls 9 and 9', and the walls 16 and 16' cooperate with the walls 9 and 9" respectively.

It is obvious that the system is adapted for use in connection with tide water where the current flows alternately in one direction and then in the other. This is true whether the single series, as shown in Fig. 1, is employed, or the double series, as shown in Fig. 2. When the current reverses direction, the wheels will all rotate in the same direction as that in which they rotated before the change in direction of the current. It is obvious that the walls 62 and 101, 63 and 102, 64 and 103 form an auxiliary channel in the same way as the two sets of walls 6, 7, etc., on the opposite side of the sluiceway.

What I claim is:

1. In combination with a sluiceway, a plurality of turbine wheels mounted therein in a series in the longitudinal direction of the sluiceway and spaced apart from each other, a plurality of deflecting walls on opposite sides of the series of wheels so arranged that the space between the proximate ends of the deflecting walls on one side will come opposite one of the deflecting walls on the opposite side, the two ends of each deflecting wall extending respectively to the periphery of the circle described by the blades of one of two adjacent wheels.

2. In combination with a sluiceway, a plurality of turbine wheels mounted therein in a series in the longitudinal direction of the sluiceway and spaced apart from each other, a plurality of deflecting walls on opposite sides of the series of wheels so arranged that the space between the proximate ends of the deflecting walls on one side will come opposite one of the deflecting walls extending respectively to the periphery of the circle described by the blades of one of two adjacent wheels, the contact point of one end being on the near side and the contact point of the other end being on the far side of the respective wheels.

3. In combination with a sluiceway, a plurality of turbine wheels mounted therein in a series in the longitudinal direction of the sluiceway and spaced apart from each other, a plurality of deflecting walls on opposite sides of the series of wheels so arranged that the space between the proximate ends of the deflecting walls on one side will come opposite one of the deflecting walls on the opposite side, and deflecting walls outside of each series of said deflecting walls spaced apart therefrom in such manner as to form channels for auxiliary currents.

4. In combination with a sluiceway, a plurality of turbine wheels mounted therein in a row longitudinally of the sluic-
way, said wheels being spaced apart from each other and set with their axes in vertical position, a plurality of curved deflector walls in the sluiceway on opposite sides of the series of wheels so spaced and disposed that the concave sides of the walls face toward the wheels, one of said deflector walls partially embracing two adjacent wheels, the two ends of said wall extending respectively to the peripheries of the circles described by the sweep of the blades and one of said curved walls on the opposite side of the sluiceway partially embracing one wheel of said first two wheels and a third wheel.

5. In combination with a sluiceway a plurality of turbine water wheels mounted therein in a row longitudinally of the sluiceway, said wheels being spaced apart from each other and set with their axes in vertical position, a plurality of curved deflector walls in the sluiceway on opposite sides of the series of wheels so shaped and disposed that the concave sides of the walls face toward the wheels, one of said curved walls partially embracing two adjacent wheels, the two ends of said wall extending respectively to the peripheries of the circles described by the sweep of the blades and one of said curved walls on the opposite side of the sluiceway partially embracing one wheel of said first two wheels, and a third wheel, and curved deflector walls outside of and parallel with said embracing walls and spaced apart therefrom in such manner as to form a channel for an auxiliary current.

6. In combination with a sluiceway a plurality of turbine water wheels mounted therein with their axes in vertical position, said wheels being arranged in a series in the longitudinal direction of the sluiceway and spaced apart from each other, the sluiceway being of a width greater than the diameter of the wheels to provide a substantial width of clear channel on both sides of the row of wheels, a longitudinal series of curved deflecting walls on each side of the row of wheels, each of said walls having its concave face toward the wheels, each of said walls partially embracing two adjacent wheels, there being a space between the proximate ends of the adjacent concave walls in each longitudinal series, the open spaces between the proximate ends of the concave walls in one series, coming opposite one of the concave walls in the other series.

7. In combination with a sluiceway, a plurality of turbine wheels mounted therein with their axes in vertical position, and deflecting walls so constructed and arranged that the current will be guided to act directly upon the blades of each wheel in the series on the far side of the wheel just before the discharge from the wheel, the water after being discharged from one wheel being guided by deflecting walls to the blade adjacent the outlet of the next wheel, and a channel for an auxiliary current with guides for directing portions thereof to unite with the current which has passed through one wheel to jointly act on a following wheel.

8. In combination with a sluiceway, a plurality of parallel rows of turbine wheels mounted therein, each row being in the longitudinal direction of the sluiceway, deflecting walls so constructed and arranged that the current will be guided to act directly upon the blades of each wheel in the series on the far side of the wheel just before the discharge from the wheel, the water after being discharged from one wheel being guided by deflecting walls to the blade adjacent the outlet of the next wheel, and a channel for an auxiliary current with guides for directing portions thereof to unite with the current which passed through one wheel to jointly act on the following wheel, and a channel between two parallel rows of wheels having therein deflecting members to split the current and direct a portion thereof to the wheels in one row and a portion to the wheels in the other row.

In testimony whereof I affix my signature.

FRANK M. ZOTTOLI.