G. B. FRENCH.

HYDRAULIC MOTOR.

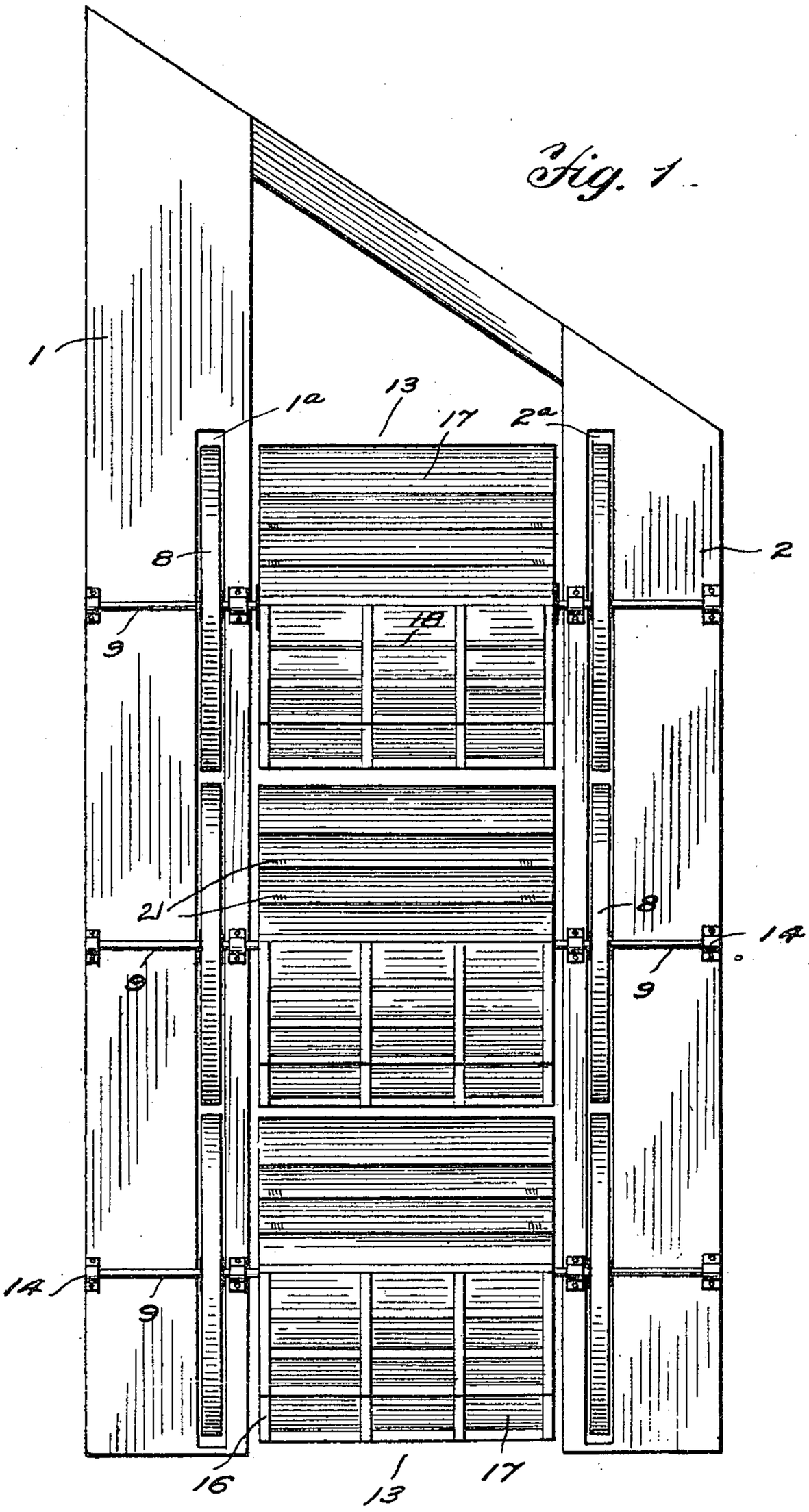
APPLICATION FILED MAY 15, 1908.

960,876.

Patented June 7, 1910.

4 SHEETS—SHEET 1.

Fig. 1.



Witnesses

R. C. Claflin

V. C. Brower.

Inventor

George B. French

By Edson Bros

Attorneys

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4 SHEETS—SHEET 2.

Fig. 2

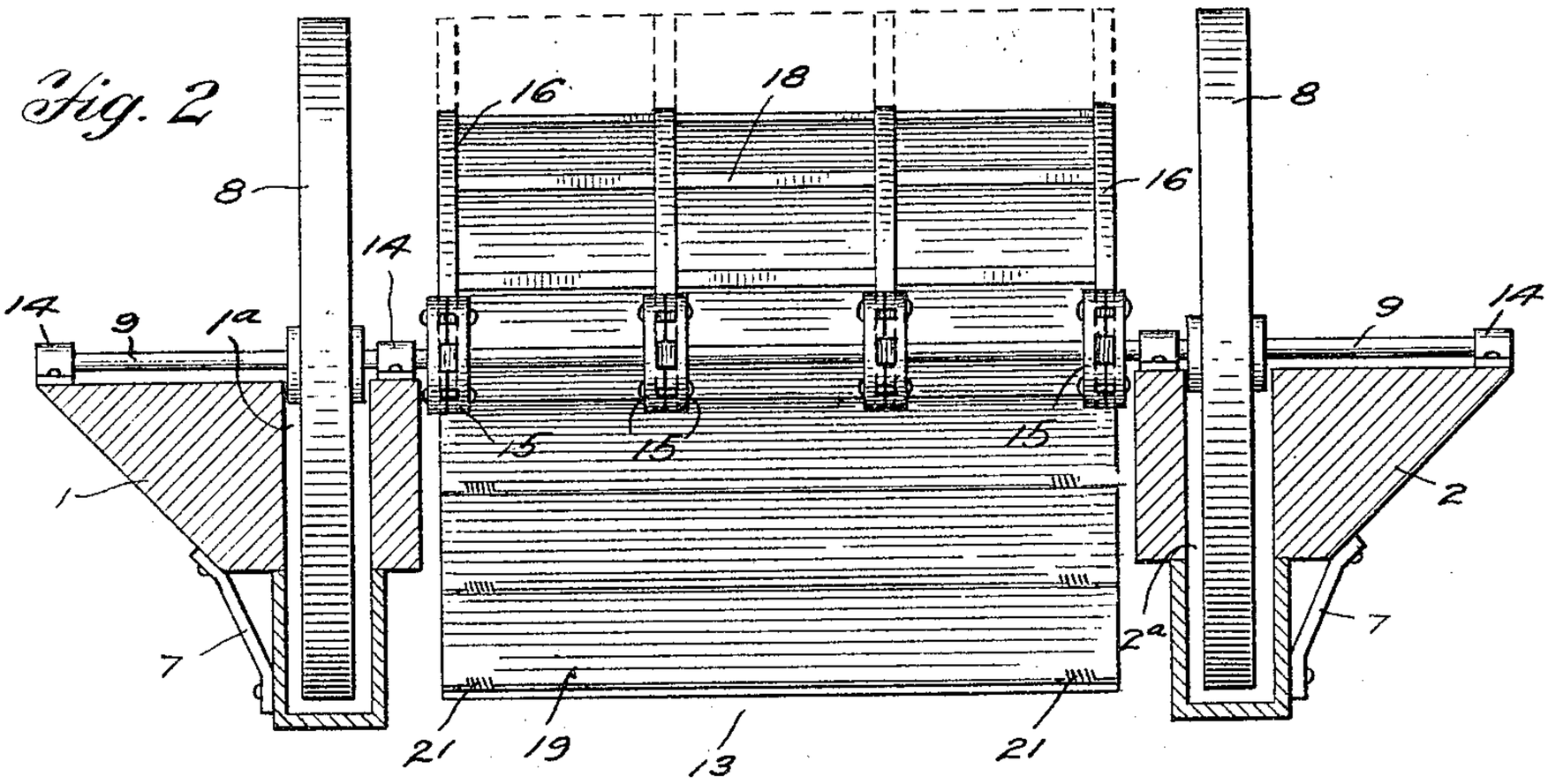
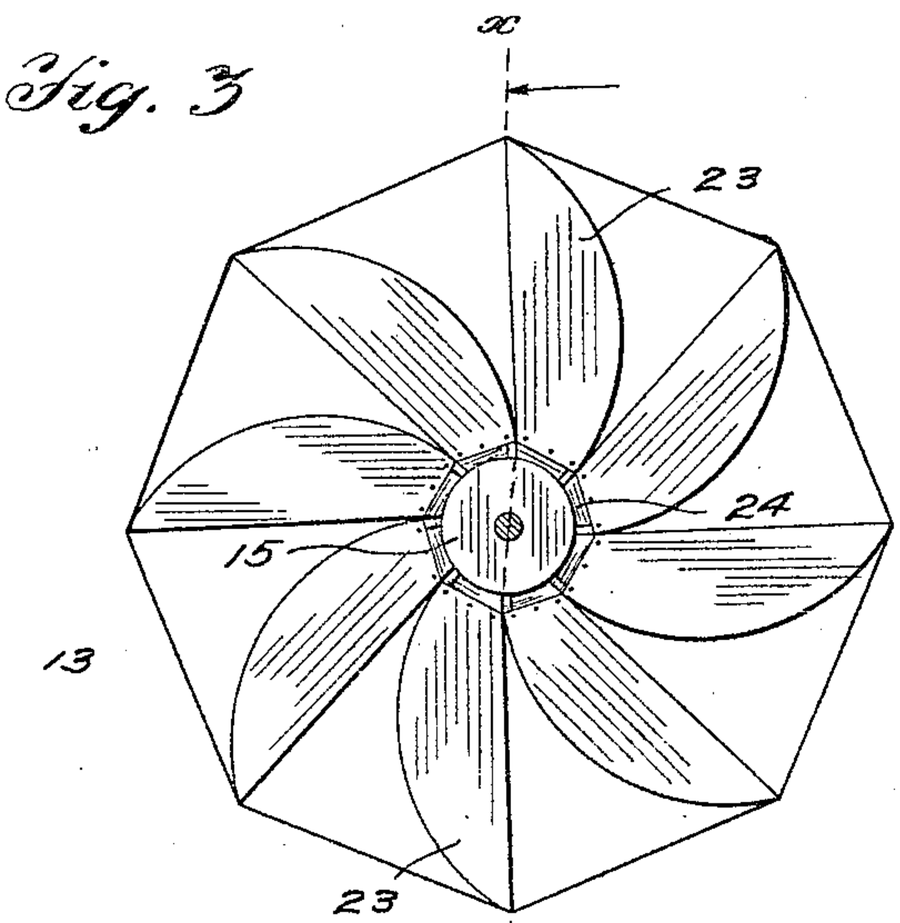


Fig. 3



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4 SHEETS—SHEET 3.

Fig. 4

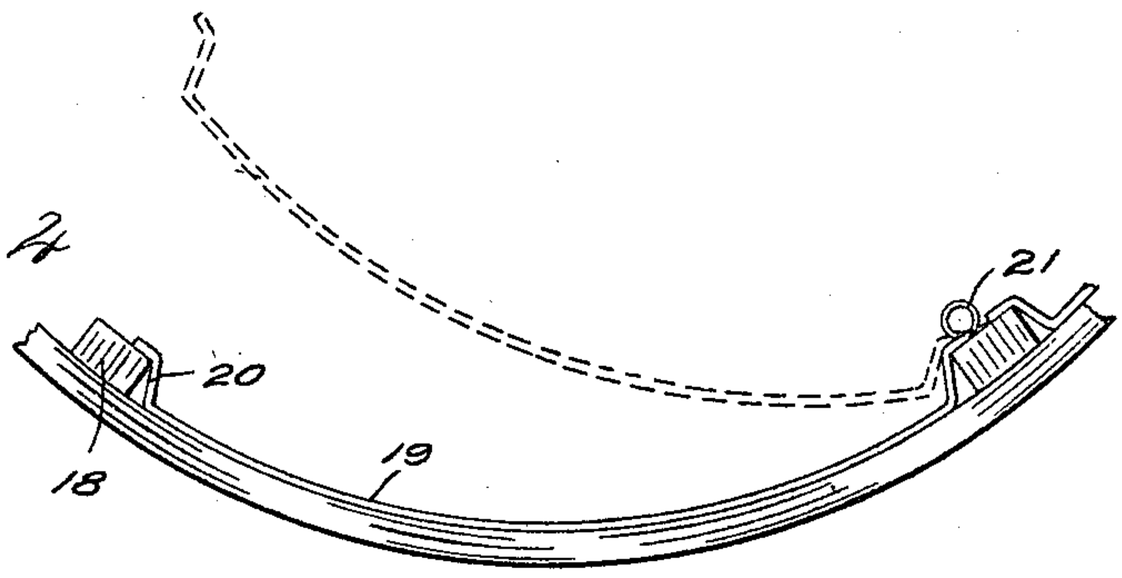


Fig. 5

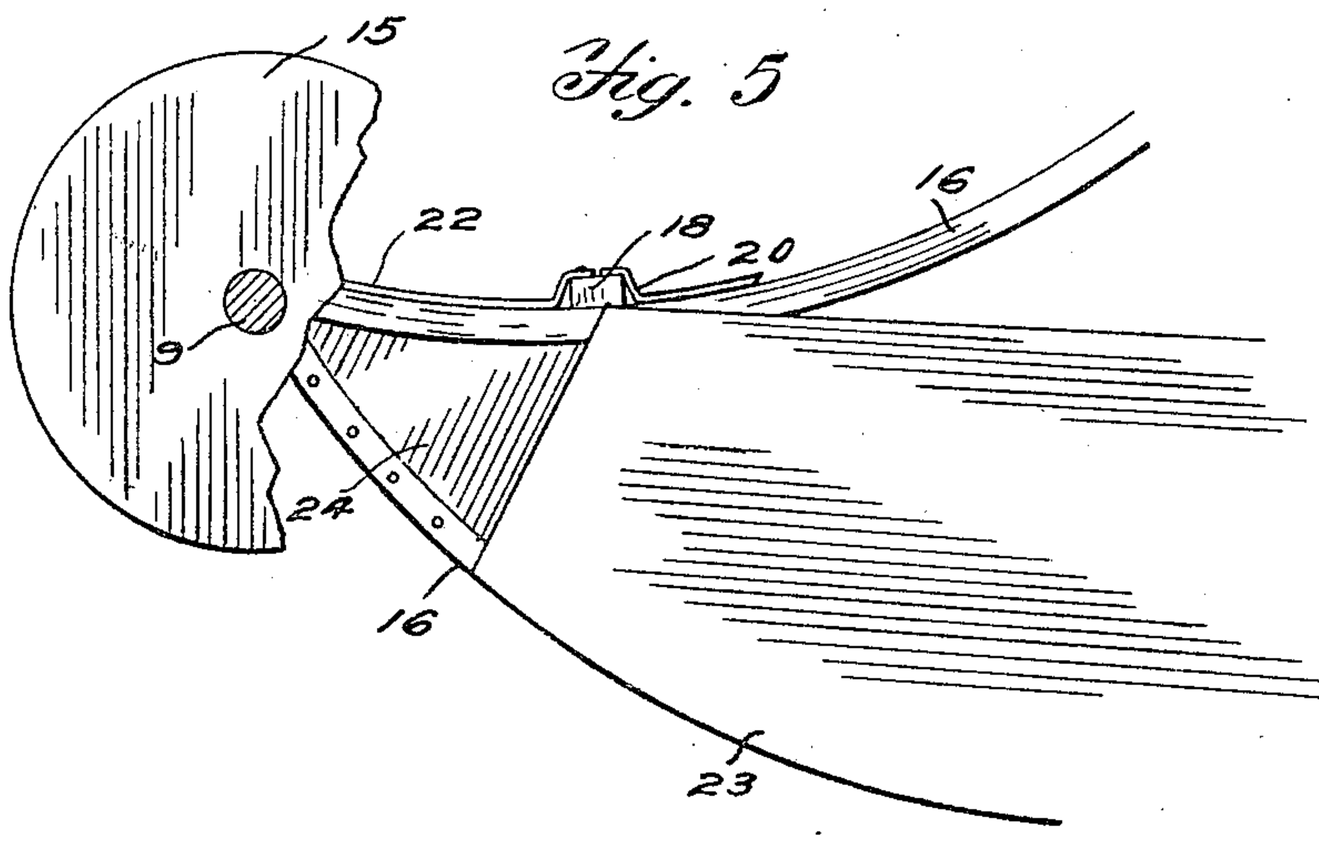
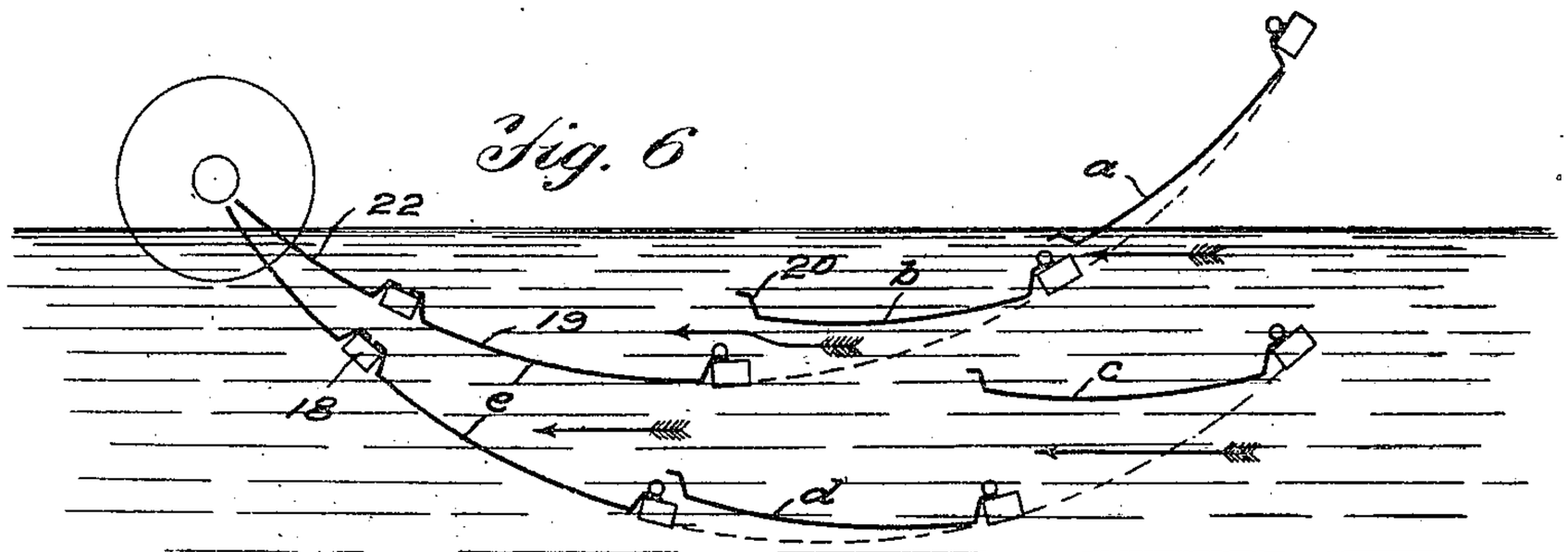


Fig. 6



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4 SHEETS—SHEET 4.

Fig. 8

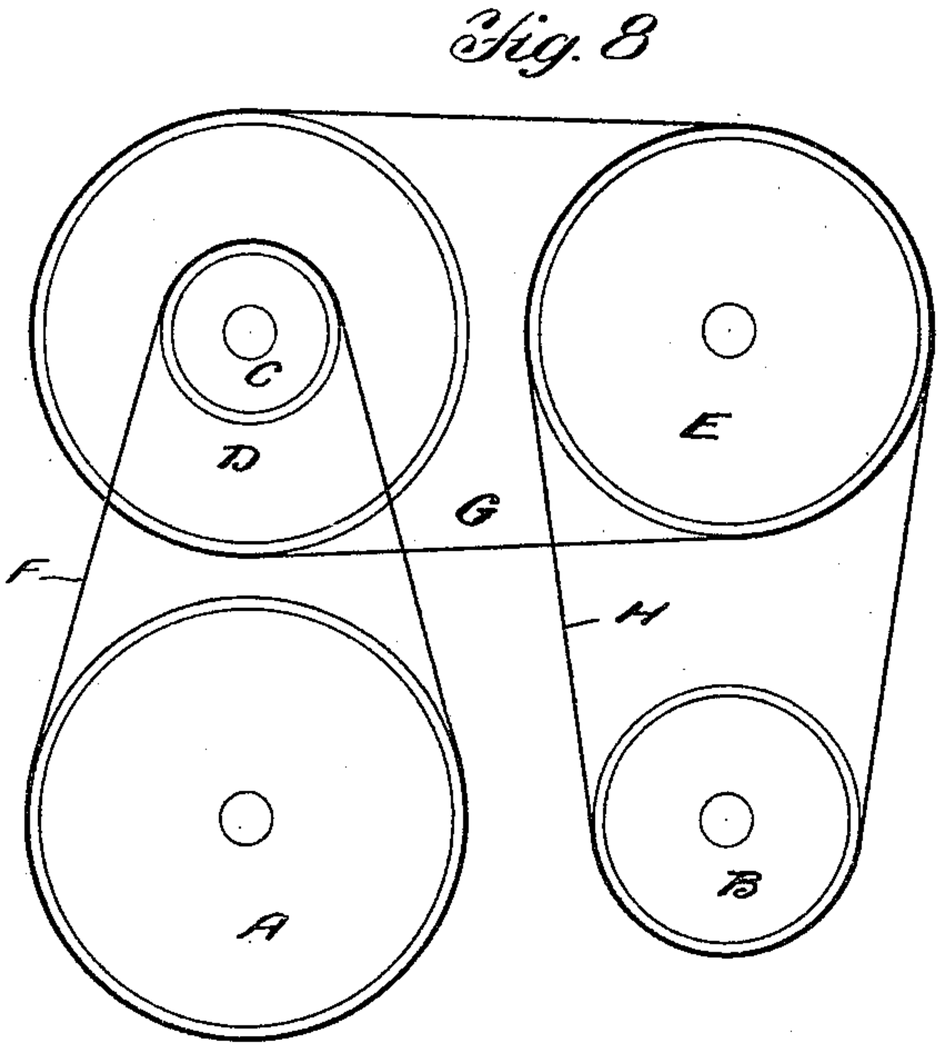
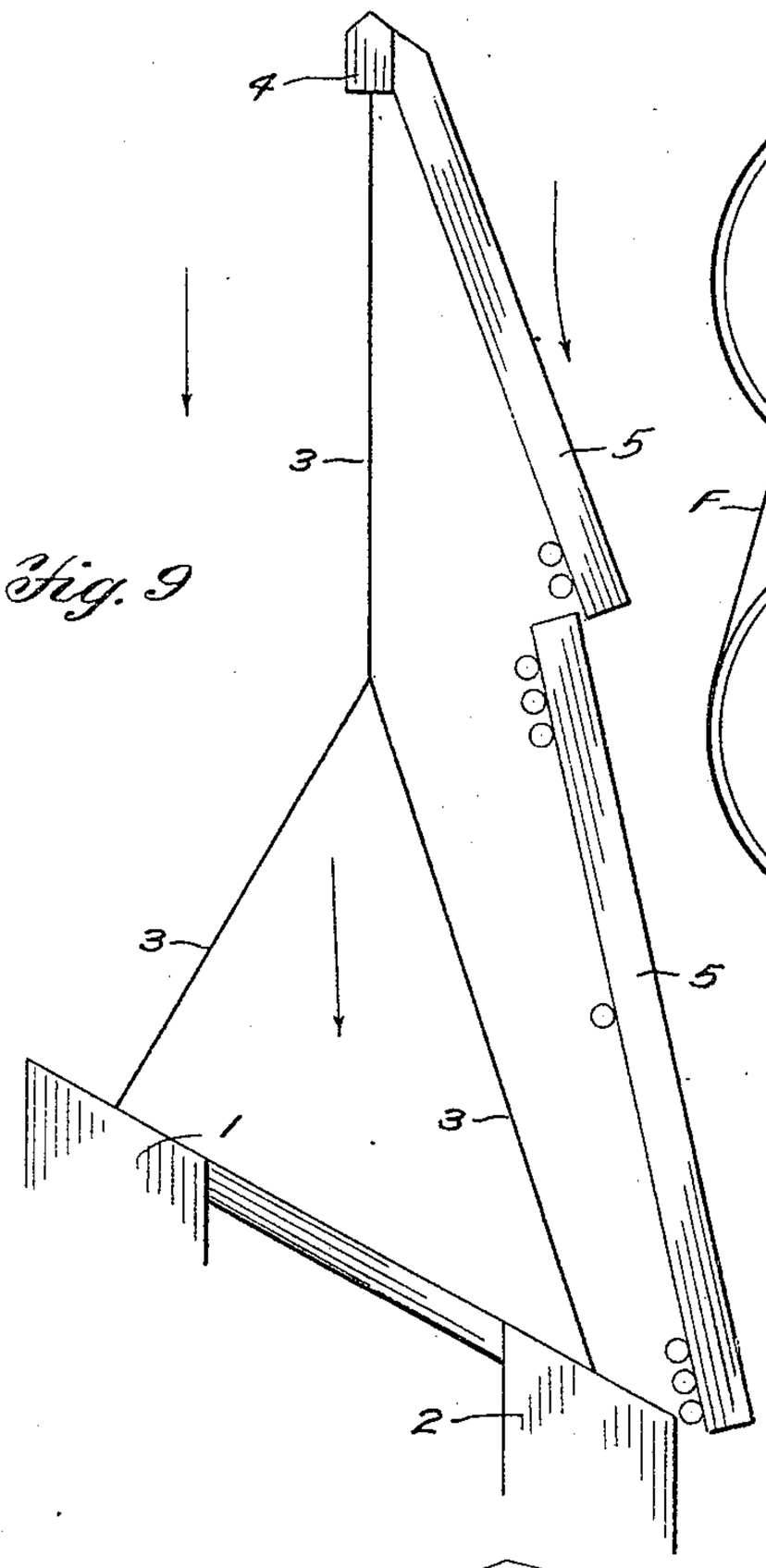


Fig. 9



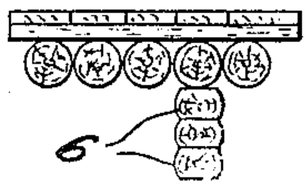
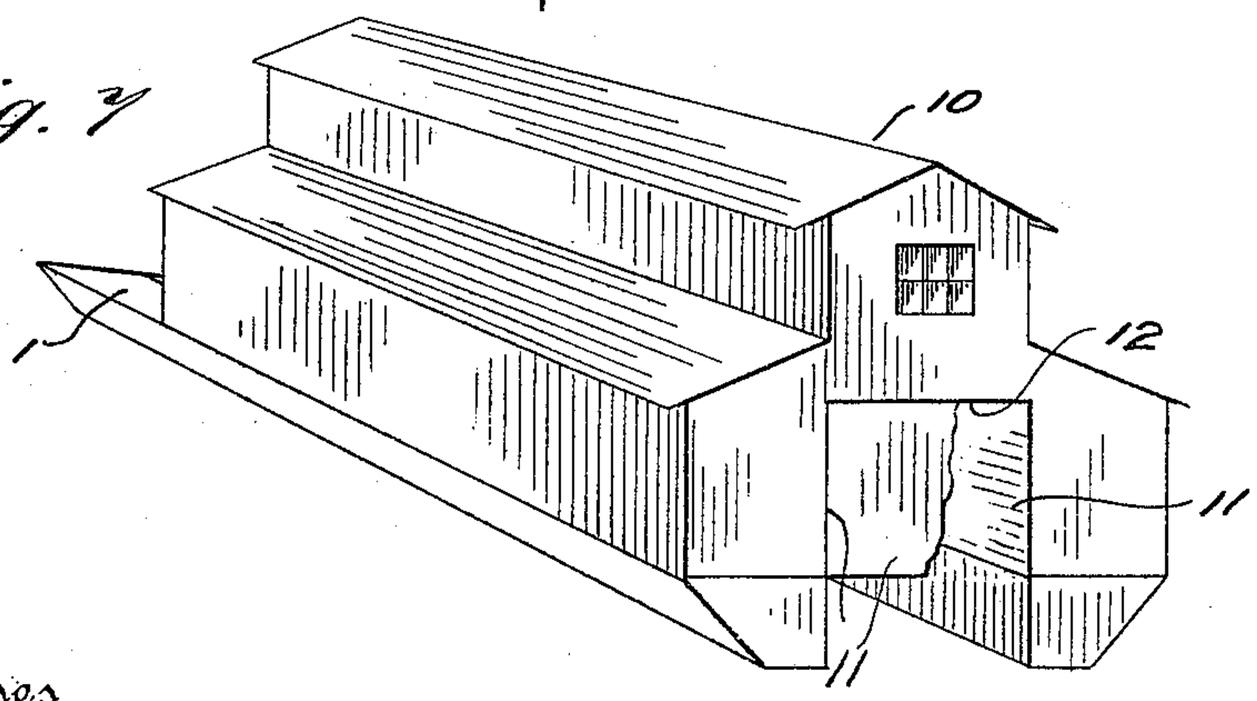


Fig. 10

Fig. 7



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Attorneys

UNITED STATES PATENT OFFICE.

GEORGE B. FRENCH, OF FREMONT, NEBRASKA.

HYDRAULIC MOTOR.

960,876. Specification of Letters Patent. Patented June 7, 1910.

Application filed May 15, 1908. Serial No. 433,108.

To all whom it may concern:

Be it known that I, GEORGE B. FRENCH, a citizen of the United States, residing at Fremont, in the county of Dodge and State of Nebraska, have invented certain new and useful Improvements in Hydraulic Motors; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to hydraulic motors and especially to that class relating to current wheels which are adapted to be arranged in a stream to receive the action of the current. Its main object is to provide means whereby the blades or floats of a current wheel may successively become immersed in and raised from the current without creating a water vacuum above the float while becoming immersed nor an air vacuum under the float while being raised from the current, and practically without aid from the floats preceding or succeeding it.

It is obvious that in the operation of a hydraulic motor having concavo-convex floats, shrouds, air tight and water tight partitions, and its axle near the surface, its floats, while becoming successively immersed, must overcome the force of the current upon its convex surface and the weight of water displacement its immersion would create, and that the force expended to overcome this current and this displacement must come from the preceding floats already immersed and receiving the force of the current. It is also obvious that such floats, when emerging from the water, may encounter, by suction or otherwise, an air vacuum or a tendency to create an air vacuum, under its concave surface, and that the force which creates such vacuum or such tendency must come from the floats succeeding the float which is emerging from the water and which are already immersed and receiving the force of the current. The force necessary to overcome the effect of this current, and this displacement, and this vacuum or tendency to a vacuum would lessen the energy expended by the floats upon the axle, and thus lessen the transmissible energy expended upon the driving wheels through the axle or shaft and to that extent lessen the power and usefulness of the motor.

My invention has for one object to minimize the expenditure of this wasted energy.

Other objects of the invention are to protect the motor and provide means for transmitting power from the blades or floats to a dynamo or other machine without changing the direction of motion and without the use of gears whereby a maximum amount of power is secured with a minimum liability of disaster to the motor from ice, floods, drift wood and other floating objects. Said motor is simple, strong, durable and efficient for the purposes for which it is designed for all seasons of the year.

The invention consists essentially in providing the blades or floats of a current wheel with valves which are automatically opened and closed respectively, as they reach the surface of the stream and become immersed therein.

The invention also consists in mounting drive wheels directly on the shafts which carry the blades or floats and providing means for transmitting power from said drive wheels to the shaft of a dynamo or other machine.

The invention consists further in providing means for protecting the motor from drift wood and other floating objects and in the features of construction and combinations of parts hereinafter described and specified in the claims.

The present invention is designed as an improvement on the motor shown and described in my United States Patent No. 856,858, dated June 11, 1907.

In the accompanying drawings, illustrating the preferred embodiment of my invention: Figure 1 is a plan view of the motor and its supports showing a series of current wheels or impellers. Fig. 2 is a cross section thereof. Fig. 3 is an end view of one of the current wheels. Fig. 4 is an enlarged broken view of a portion of one of the blades or floats showing one of the valves closed in solid lines and open in dotted lines. Fig. 5 is an enlarged broken detail view showing one of the valves, of modified construction, which are arranged around the shaft between the converging ends of the outer arms and at the inner extremities of the shrouds. Fig. 6 is a diagrammatic view showing the various positions of the valves in the faces of the blades or floats as the latter enter and

become immersed in the stream. Fig. 7 is a perspective view illustrating how a power house may be built over the motor. Fig. 8 is a diagrammatic view showing means for transmitting power from the main drive wheel to the shaft of a dynamo or other machine. Fig. 9 is a plan view illustrating a preferred method of protecting the entrance to the motor by rafts, etc., and Fig. 10 is an enlarged end view of one of the rafts.

In practicing my invention, I build a flat boat or shallow pontoon 1, the upper end of which is diagonal to the direction of the current which it is desired to utilize and a similar pontoon 2 somewhat shorter than 1. These pontoons are built with their outer sides and both ends sloping from the plane of their flat bottoms to the top of the frame work and with their inner sides perpendicular to the plane of their bottoms. Said pontoons are properly held in place with their inner sides parallel at a distance apart slightly greater than the width of the motors by cables 3 attached to the timbers of their upper ends and to a pier 4 built for that purpose higher up the stream (see Fig. 9). I also erect slightly above the upper diagonal end of the pontoons one or more booms or rafts 5, the purpose of which is to guard the pontoons and motors from floating ice, drift and flood wood and debris. Two or more logs or pieces of long timber 6, (Fig. 10) flattened on two sides, are bolted together and one or more logs or pieces of timber of equal length are bolted or otherwise properly secured to these and sunk by ballasting or weighting so that they will be wholly immersed while the former will float in the water and thus prevent debris from passing under the rafts.

Built into each of the pontoons or attached near to their inner sides are wheel pits 1^a, 2^a mostly submerged and extending nearly the length of the pontoons below their diagonal portions. Said pits are somewhat wider than the width of the rim of the driving wheels and extend from the deck of the pontoons to a depth somewhat greater than one half of the diameter of the driving wheels and somewhat less than the depth of the current at low water mark in which the pontoons are designed to be placed. These pits may be built of cast or malleable cast iron or galvanized sheet iron, or of steel plates, or from the same material of which the pontoons are built. Preferably they should be built into the pontoons so as to be water tight and they should be substantially braced toward the outside as at 7, Fig. 2. Said braces may serve to protect the pits from floating ice and other debris which finds its way under the pontoons. The principal function of said pits is to provide a space in which the drive wheels 8, mounted on the motor shafts 9, may revolve but they also have a secondary function which is to assist the shrouds on the water wheels, which will be presently described, in holding the current against the motors.

I am aware that flat boats or pontoons constructed in the manner I have described with wheel pits projecting below the plane of their bottoms and not in the center thereof and of unequal lengths would not float level with the current on account of the unequal distribution of the weight of their displacement. I obviate this by extending the shafts 9 over the entire width of the pontoons and the difference in displacement between the longer and shorter pontoons I equalize by more heavily ballasting the forward end of the longer pontoon.

As illustrated in Fig. 7, a building 10 may be constructed upon the pontoons 1 and 2 and serve as a power house and to prevent by artificial heat whenever necessary the formation of ice in and upon the motor and the machinery driven thereby.

I am aware that a current of ice-cold water running through the power house and dripping from the motors would require artificial heat to keep the temperature above 32° F., but this would be very largely offset by the continual agitation of the water and by the construction of removable partitions 11 and ceiling 12 which restrict the space directly over the motors in which heat would have to be supplied.

Arranged between the inner sides of the pontoons are a plurality of motors or impellers 13 with their shafts 9 journaled in bearings 14, each shaft extending the entire width of the pontoons 1 and 2, and of the space between them. Each shaft preferably has four bearings one upon each outside and one upon each inside edge of each pontoon as shown in Fig. 2. These bearings are so arranged that the shafts 9 will be but slightly raised above the surface of the current to the end that the motor floats or blades may receive practically the entire force or impact of the current. Said shafts have hubs or disks 15 preferably cast in two sections, each having formed therein half the groove space necessary to let in the inner ends of arms 16 presently described. Said disks are bolted together and are preferably shrunk on to said shafts after the said arms are disposed therein.

Each of the motors or water wheels comprises a series of radial concavo-convex arms 16, preferably of steel and quadrangular in cross section, and a series of radial blades or floats 17 of coincident convexity with said arms. The hubs or disks 15 to which the inner ends of the arms 16 are secured are disposed and secured at equal distances along the shaft 9. Upon said

arms there are secured iron or steel rods or ribs 18 arranged at equal distances along said arms and extending parallel with the shaft 9 the full length of the blades or floats. To the outside edge of this rib, that is, the edge farthest from the shaft, metallic plates or valves 19 are properly secured preferably by rivets. Said valve plates are of coincident convexity with the arms 16 and have their side edges bent or stepped as at 20 to fit upon the ribs 18 as best illustrated in Fig. 4. By stepping the valves in this way, they are given a pan-shape, the stepped portion constituting the rim. This formation of the valves adds to their efficiency because the rim or stepped portion acts as an obstruction to the current as will be readily appreciated from an inspection of Fig. 6. The outer side edge of each valve plate is hinged to one of the ribs while its other or inner side edge and both ends are free to open and close with the action of the current. Coiled springs 21 are applied to the hinges to hold the valves normally closed. Said valve plates are preferably made of galvanized sheet iron and constitute practically the entire surface of the floats or blades which receive the force of the current.

In Fig. 6, I have illustrated diagrammatically the operation of the valves of each blade as it enters and becomes immersed in the stream or current. When a valve comes in contact with the surface of the water and begins to become immersed therein, it begins to open gradually without causing backwater, by reason of the force of the current against its convex face. The valve continues to open as it descends until it reaches a horizontal position. The current then begins to act upon its concave face to gradually close said valve which is accomplished as soon as it has gone deep enough to permit the current to get a good sweep against its concave face. In Fig. 6 the valve *a* is shown just beginning to open as it enters the stream. The valve *b* is farther open while the valve *c* is wide open. Valve *d* is partially closed and valves *e* have reached a depth where they receive the action of the current on their concave faces, and are accordingly closed. In like manner to that just described, every valve of every blade of the water wheel will successively meet the current, open and close and become subject to the action of the current whereby it will perform its proper function in transferring its share of the kinetic energy of the current to the shaft 9. When a blade is emerging from the water it is evident that, were it water tight and air tight upon its three sides, it would encounter a resistance by suction or otherwise, of an air vacuum under its concave side, or a tendency to such, which would lessen its transmissible power and thus lessen its usefulness. The valves shown in Fig. 6 would, upon a very light air pressure, open against this vacuum or tendency thereto, and thus relieve this resistance. So when every blade successively emerges from the current. Thus, by the operation of these valves, viz: the pressure of the current upon their convex sides as the blades successively enter the water, opening them; the pressure of the current upon their concave sides when the blades become immersed, closing them; and the air pressure upon their convex sides as the blades successively emerge, from the water, opening them; preventing water vacuums and air vacuums and the tendency to such vacuums, and water displacements, practically the entire kinetic energy of the current which comes against the blades is transferred to the axle and through it to the driving wheels.

It is obvious that valves such as I have described could not become operative upon the portion of each blade or float between the shaft 9 and the first rib 18, that is the one disposed nearest to said shaft, because the space is restricted. Furthermore, such valves are unnecessary there because the outer edges of a plate secured at this point would become immersed practically as soon as the edge nearest to the shaft. I, therefore, fill this space with a strip 22 of galvanized sheet iron or other suitable material secured rigidly to the ribs and arms, giving it the same convexity as said arms.

Connected up with the lateral or extreme side arms are shrouds or plates 23, the function of which is to hold the current against the blades or floats and to brace the arms. Said shrouds close the ends of the blades on the concave sides thereof as shown in Fig. 3. To the extent of the width of the strips 22, the shrouds may be supplied with valve-plates 24 which may be secured along their outer edges and free at their inner converging edges as illustrated in Fig. 3. If preferred or desired, said valve-plates 24 may be secured along one converging edge, as shown in Fig. 5, leaving their outer edges and other converging edges free. Each valve-plate opens inwardly from the pressure of the water upon its outer face as the blade to which it is secured enters the stream and the valves 19 are opened. The force of the current upon the inside of the blade after it is submerged closes said valve-plate against the hub or disk 15 as the valves 19 are closed.

Fig. 8 illustrates one method by which motion may be transmitted from the drive wheels on the shaft 9 to a dynamo or other machine. In this figure A designates the drive wheel, B a pulley on the dynamo shaft and C, D and E pulleys mounted on intermediate shafts. The drive wheel A and pulley C are connected by a belt F, the pulleys

D and E by the belt G and the pulleys E and B by the belt H. By means of a simple system of pulleys, such as this, the power derived from my hydraulic motor may be conveniently utilized without much loss by friction and without changing the direction of motion.

I claim:

1. In a hydraulic motor of the character described, a water wheel comprising an axle arranged slightly above the surface of a flowing stream, and radial blades having valves therein which strike the surface of the stream in a substantially flat or horizontal position and are opened thereby as each blade becomes successively submerged, said valves being automatically closed by the kinetic energy of the stream as the respective blades are immersed.

2. In a hydraulic motor of the character described, a water wheel comprising an axle arranged slightly above the surface of a flowing stream, and radial concavo-convex blades having valves therein which strike the surface of the stream in a substantially flat or horizontal position and are opened thereby as each blade becomes successively submerged, said valves being automatically closed by the kinetic energy of the stream as the respective blades are immersed.

3. In a hydraulic motor of the character described, a water wheel comprising an axle arranged slightly above the surface of a flowing stream, and radial blades having valves therein which strike the surface of the stream in a substantially flat or horizontal position and are opened thereby as each blade becomes successively submerged, said valves being automatically closed by the kinetic energy of the stream as the respective blades are immersed, and means to hold said valves closed when not in the water.

4. In a hydraulic motor of the character described, a water wheel comprising an axle arranged slightly above the surface of a flowing stream, and radial concavo-convex blades having valves therein which strike the surface of the stream in a substantially flat or horizontal position and are opened thereby as each blade becomes successively submerged, said valves being automatically closed by the kinetic energy of the stream as the respective blades are immersed, and means to hold said valves closed when not in the water.

5. In a hydraulic motor of the character described, a water wheel comprising an axle arranged slightly above the surface of a flowing stream, and radial blades having valves therein which strike the surface of the stream in a substantially flat or horizontal position and are opened thereby as each blade becomes successively submerged, said valves being automatically closed by the kinetic energy of the stream as the respective blades are immersed, and springs applied to said valves for holding them closed when not in the water.

6. In a hydraulic motor, of the character described, a water wheel comprising an axle arranged slightly above the surface of a flowing stream, and radial concavo-convex blades having valves therein which strike the surface of the stream in a substantially flat or horizontal position and are opened thereby as each blade becomes successively submerged, said valves being automatically closed by the kinetic energy of the stream as the respective blades are immersed, and springs applied to said valves for holding them closed when not in the water.

7. In a hydraulic motor of the character described, a water wheel comprising a horizontal axle arranged slightly above the surface of a flowing stream, and radial blades formed of radial arms and ribs connecting said arms and arranged parallel to the axle, and valves, each hinged to one of said ribs and adapted to close upon another rib, said valves being adapted to strike the surface of the stream in a substantially flat or horizontal position whereby they are opened as each blade becomes successively submerged, said valves being automatically closed by the kinetic energy of the stream as the respective blades are immersed.

8. In a hydraulic motor of the character described, a water wheel comprising a horizontal axle arranged slightly above the surface of a flowing stream, and radial concavo-convex blades formed of radial arms and ribs connecting said arms and arranged parallel to the axle, and valves, each hinged to one of said ribs and adapted to close upon another rib, said valves being adapted to strike the surface of the stream in a substantially flat or horizontal position whereby they are opened as each blade becomes successively submerged, said valves being automatically closed by the kinetic energy of the stream as the respective blades are immersed.

9. In a hydraulic motor of the character described, a water wheel comprising a horizontal axle arranged slightly above the surface of a flowing stream, and radial blades formed of radial arms and ribs connecting said arms and arranged parallel to the axle, and valves, each hinged to one of said ribs and adapted to close upon another rib, the free edge of each valve being stepped where it engages one of the ribs for the purpose specified, said valves being adapted to strike the surface of the stream in a substantially flat or horizontal position whereby they are opened as each blade becomes successively submerged, said valves being automatically closed by the kinetic energy of the stream as the respective blades are immersed.

10. In a hydraulic motor of the character described, a water wheel provided with radial blades adapted to be successively submerged, each blade comprising radial arms, ribs secured to said arms, and a sheet metal valve hinged to one of said ribs and having its free edge stepped to engage another rib when closed.

11. In a hydraulic motor of the character described, a water wheel comprising a horizontal axle arranged slightly above the surface of a flowing stream, and radial blades formed of radial arms and ribs connecting said arms and arranged parallel to the axle, and valves, each hinged to one of said ribs and adapted to close upon another rib, said valves being adapted to strike the surface of the stream in a substantially flat or horizontal position whereby they are opened as each blade becomes successively submerged, said valves being automatically closed by the kinetic energy of the stream as the respective blades are immersed, and springs applied to said valves for holding them closed when not in the water.

12. In a hydraulic motor of the character described, a water wheel comprising a horizontal axle arranged slightly above the surface of a flowing stream, and radial blades formed of radial arms and ribs connecting said arms and arranged parallel to the axle, and valves, each hinged to one of said ribs and adapted to close upon another rib arranged nearer the axle, said valves being adapted to strike the surface of the stream in a substantially flat or horizontal position whereby they are opened as each blade becomes successively submerged, said valves being automatically closed by the kinetic energy of the stream as the respective blades are immersed.

13. In a hydraulic motor of the character described, a water wheel comprising a horizontal axle arranged slightly above a flowing stream, and radial blades made up of radial arms and ribs connecting said arms and arranged parallel to the axle, the surfaces of said blades consisting of valves each hinged to one rib and adapted to close upon another, said valves being adapted to strike the surface of the stream in a substantially flat or horizontal position, whereby they are opened as each blade becomes successively submerged, said valves being automatically closed by the kinetic energy of the stream as the respective blades are immersed.

14. In a hydraulic motor of the character described, a water wheel provided with radial blades adapted to be successively submerged shrouds arranged between the lateral edges of said blades, and valves in said shrouds for the purpose specified.

15. In a hydraulic motor of the character described, a water wheel provided with radial blades adapted to be successively submerged, shrouds arranged between the lateral edges of said blades, and valves in said shrouds adjacent to the axle of the wheel for the purpose specified.

16. In a hydraulic motor of the character described, a water wheel provided with radial blades adapted to be successively submerged, valves in said blades, shrouds arranged between the lateral edges of said blades, and valves in said shrouds, for the purpose specified.

17. In a hydraulic motor of the character described, the combination, with two pontoons, each having a wheel pit constructed therein and extending below the surface of the water, of a water wheel hung between said pontoons with its axle arranged near the surface of the water, and drive wheels mounted on the axle of said water wheel and arranged in said pits.

18. In a hydraulic motor of the character described, the combination, with two pontoons, each having a wheel pit constructed therein, and extending below the bottoms of said pontoons well into the water, of a water wheel hung between said pontoons with its axle arranged near the surface of the water, and drive wheels mounted on the axle of said water wheel and arranged in said pits.

19. In a hydraulic motor of the character described, the combination, with two pontoons, each having a wheel pit constructed therein which extends below the bottoms of said pontoons well into the water, braces on the outer sides of said pits for the purposes specified, of a water wheel hung between said pontoons with its axle arranged near the surface of the water, and drive wheels mounted on the axle of said water wheel and arranged in said pits.

20. In a hydraulic motor of the character described, the combination, with two pontoons of unequal length, each having a wheel pit constructed therein which extends below the bottoms of said pontoons well into the water, of a water wheel hung between said pontoons, said water wheel being mounted on a shaft which is arranged near the surface of the water and extends entirely across both pontoons, and drive wheels also mounted on said shaft and arranged in said pits.

21. In a hydraulic motor of the character described, the combination, with two pontoons of unequal length, having their upper ends oblique on the same line, each pontoon having a wheel pit constructed therein which extends below the bottoms of said pontoons well into the water, of a water wheel hung between said pontoons, said water wheel being mounted on a shaft which is arranged near the surface of the water and extends entirely across both pontoons, and drive wheels also mounted on said shaft and arranged in said pits.

22. In a hydraulic motor of the character described, the combination, with two pontoons, of a water wheel hung between said pontoons, a closed housing built over said pontoons and water wheel and having partitions and a ceiling constructed immediately over said wheel for the purposes described and means to close the ends of the chamber formed by said partitions and ceiling down to the water's edge.

23. In a hydraulic motor of the character described, the combination, with two pontoons, of a water wheel hung between said pontoons, a pier, cables connecting said pontoons to said pier and floating rafts anchored in position extending from said pier to the outside one of said pontoons to guard the motor, each of said rafts having timbers attached underneath it and extending down into the stream and weights serving to hold said rafts partially submerged, all for the purposes specified.

24. In a hydraulic motor of the character described the combination, with two pontoons, each having a wheel pit constructed therein, of a water wheel hung between said pontoons, drive wheels mounted on the shaft of said water wheel and arranged in said pits, a housing built over said pontoons and water wheel, and means in said housing for transmitting power from said drive wheels without changing the direction of motion.

25. In a hydraulic motor of the character described, a water wheel comprising an axle arranged near the surface of a flowing stream and radial concavo-convex blades having valves therein which strike the surface of the stream and are opened thereby as each blade becomes successively submerged said valves being automatically closed by the kinetic energy of the stream as the respective blades are immersed, and shrouds at the edges of said blades forming lateral closures for the concave sides thereof, said valves being automatically opened to release the air vacuum as the blades are successively raised from the stream.

In testimony whereof, I affix my signature, in presence of two witnesses.

GEORGE B. FRENCH.

Witnesses:.
IRVING MCKENNAN,
ELINOR WILLIAMS.