G. WESTINGHOUSE.

DYNAMOMETER.

APPLICATION FILED NOV. 30, 1907.

1,050,186.

Patented Jan. 14, 1913.

4 SHEETS—SHEET 1.

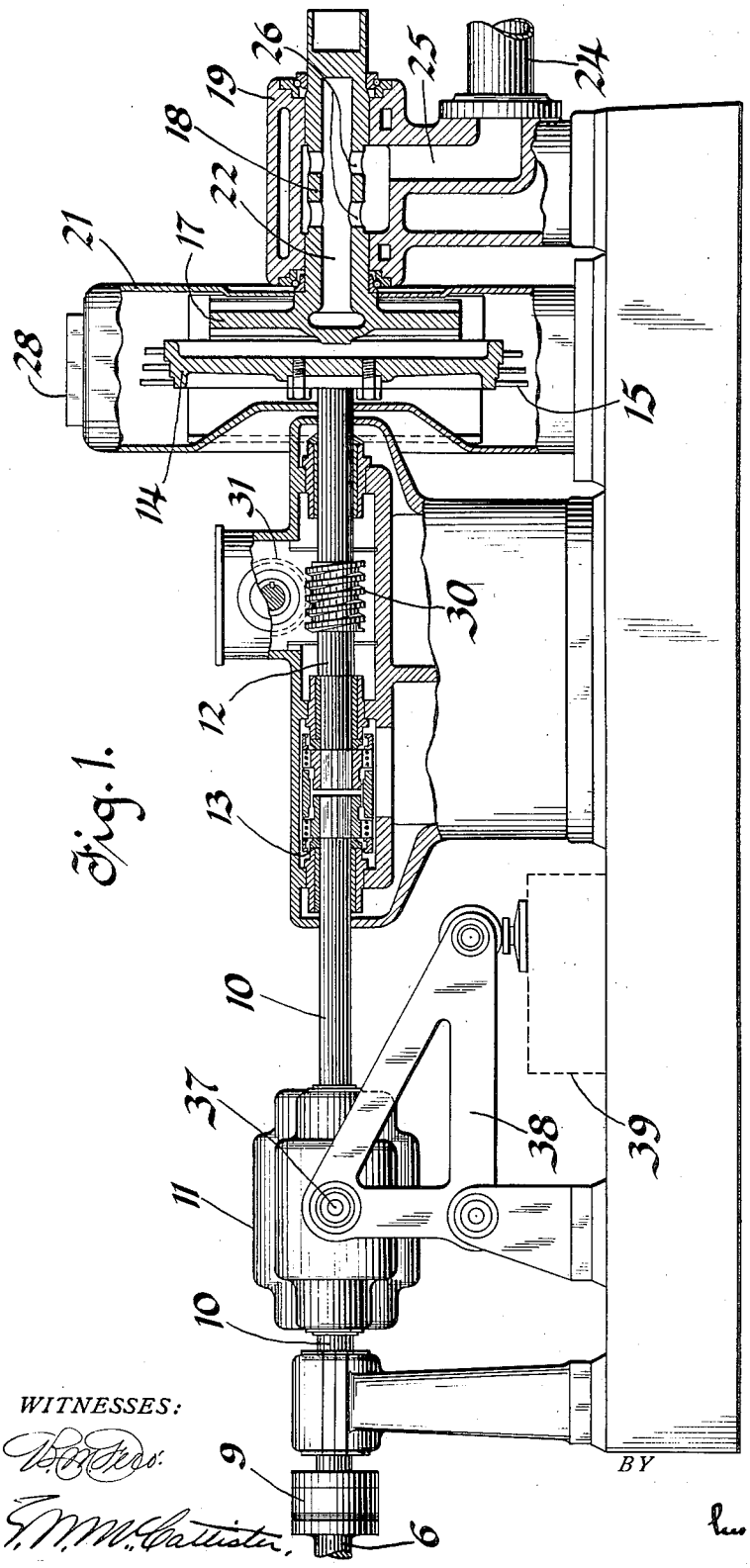

Fig. 1.

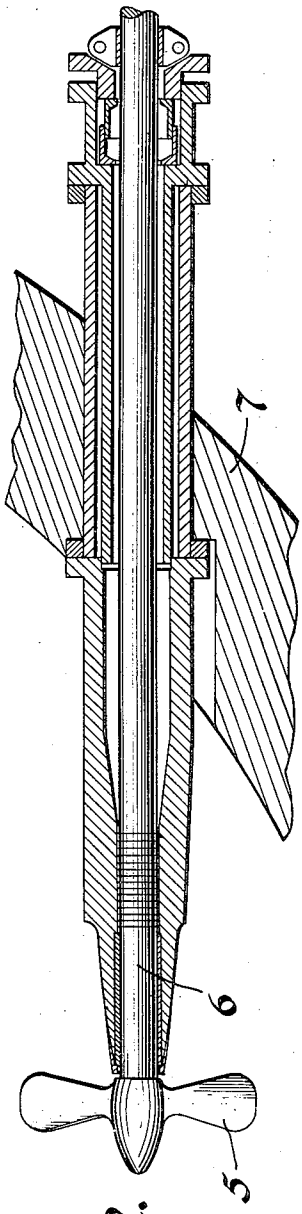

Fig. 2.

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4 SHEETS—SHEET 2.

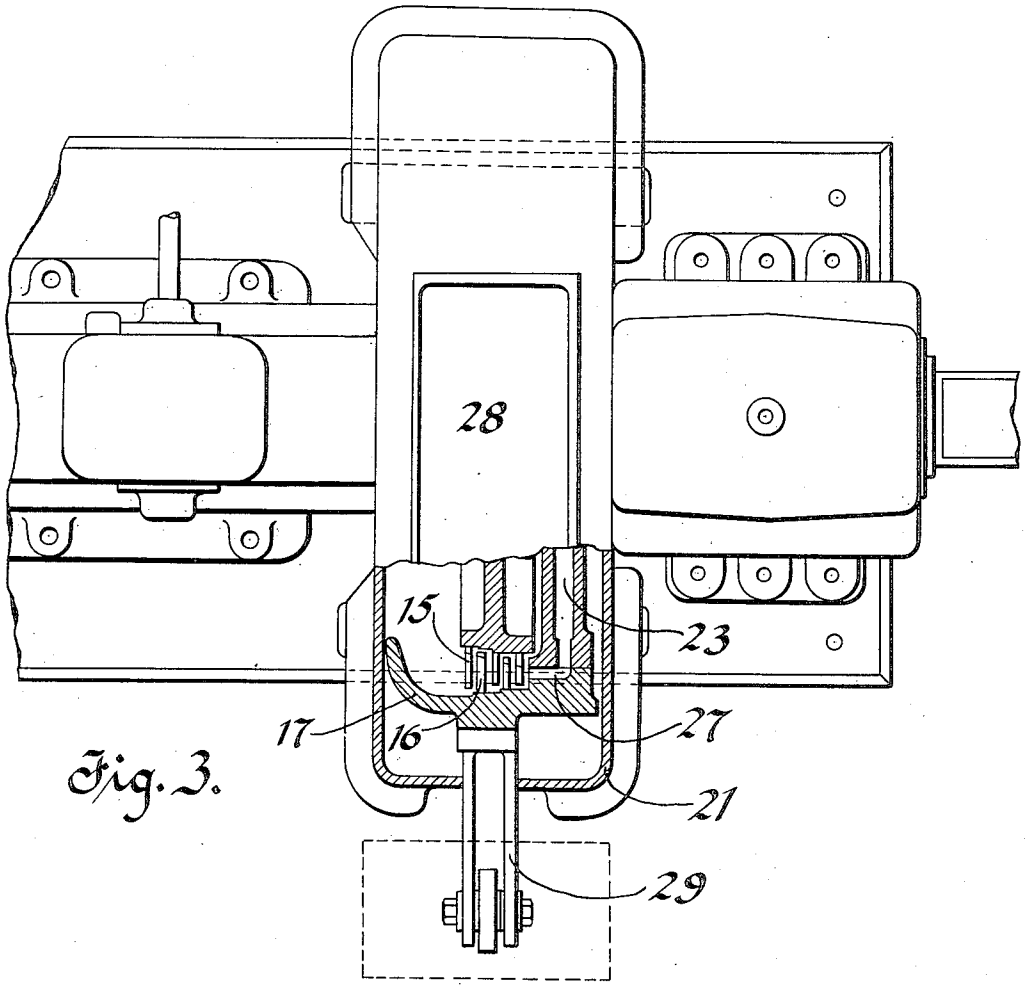

Fig. 3.

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4 SHEETS—SHEET 3.

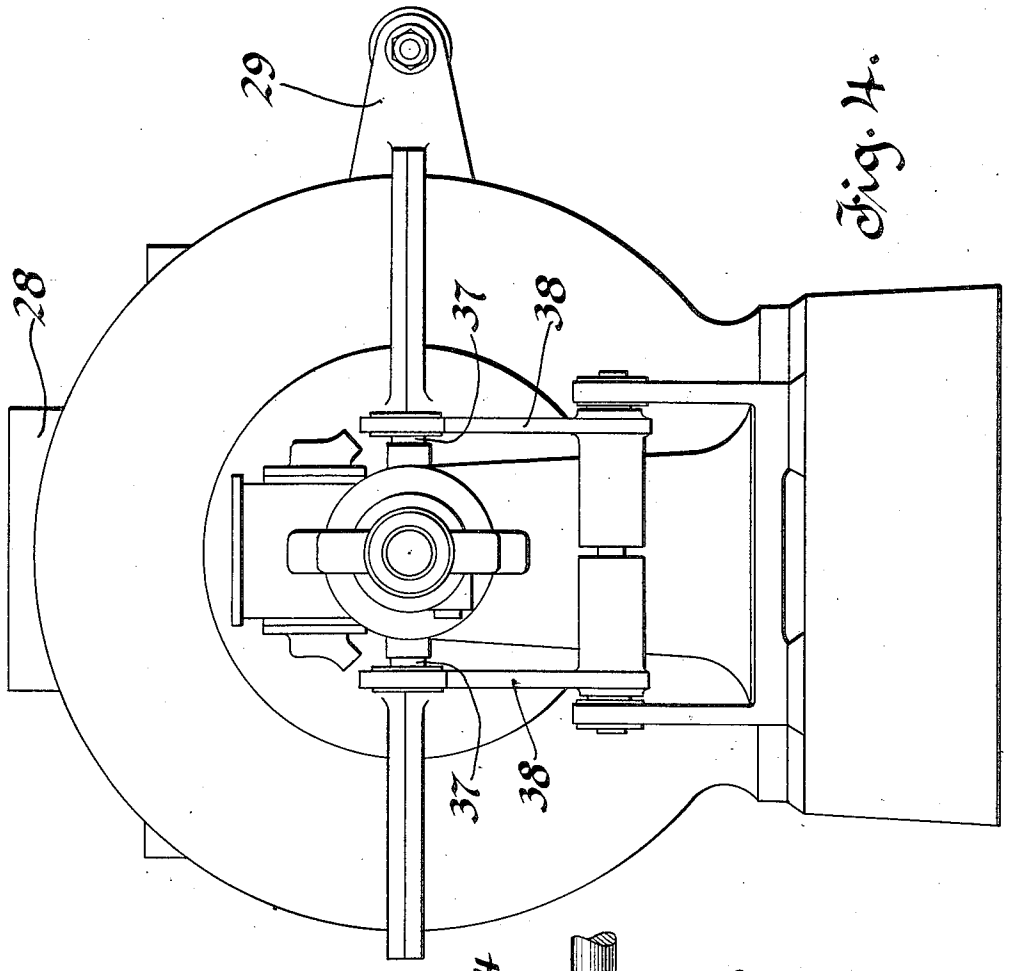

Fig. 4.

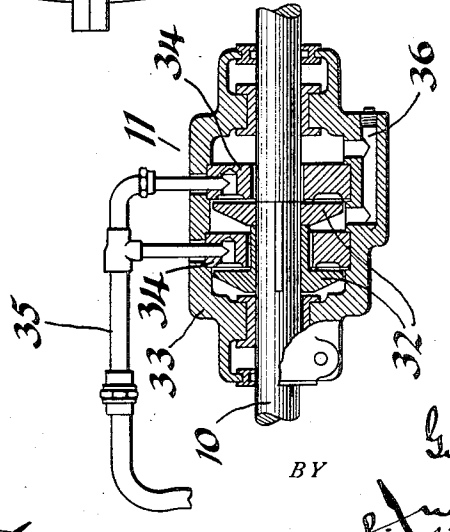

Fig. 5.

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4 SHEETS—SHEET 4.

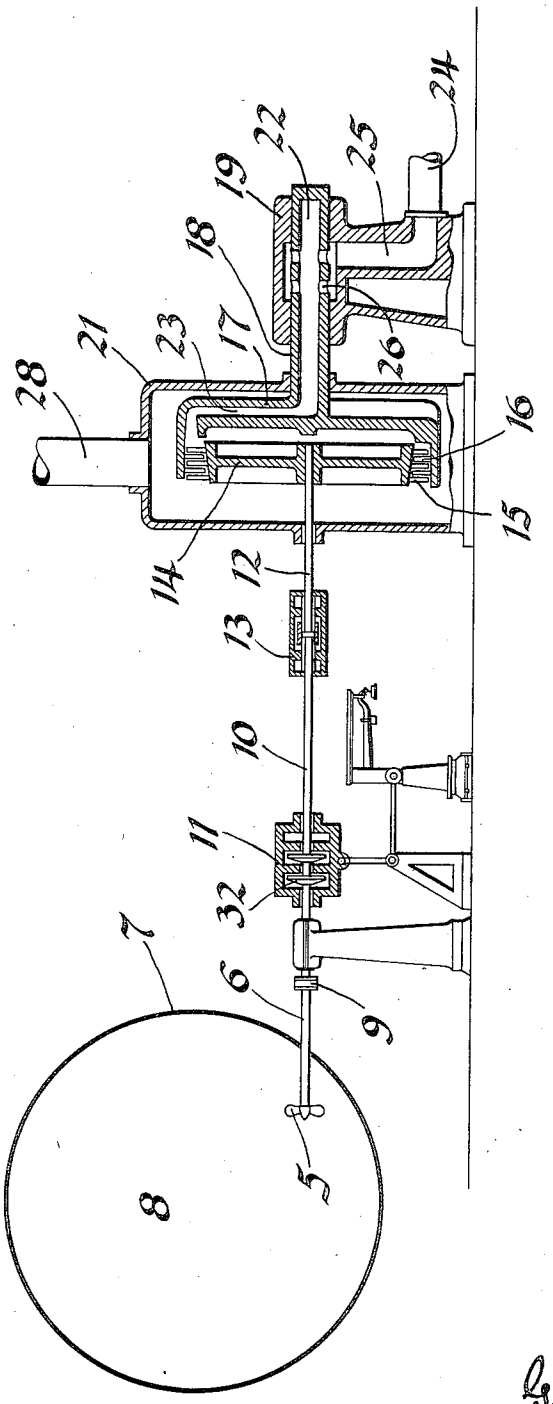

Fig. 6.

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UNITED STATES PATENT OFFICE.

GEORGE WESTINGHOUSE, OF PITTSBURGH, PENNSYLVANIA.

DYNAMOMETER.

1,050,186. Specification of Letters Patent. Patented Jan. 14, 1913.

Application filed November 30, 1907. Serial No. 404,572.

To all whom it may concern:

Be it known that I, GEORGE WESTINGHOUSE, a citizen of the United States, and a resident of Pittsburgh, in the county of Allegheny and State of Pennsylvania, have made a new and useful Invention in Dynamometers, of which the following is a specification.

This invention relates to propellers and more particularly to a method of ascertaining the efficiency of propellers as propelling or power transmitting agents and it also relates to the apparatus for carrying out my method.

Briefly, my method of testing a propeller to determine the efficiency consists in submerging the propeller to be tested in a circular tank, ascertaining the velocity of the liquid leaving the propeller, the speed and longitudinal thrust of the propeller and the power delivered to the propeller.

The apparatus with which I carry out the steps of the above outlined method forms a part of my invention and a preferred form is disclosed in the drawings accompanying this application and forming a part thereof.

In the drawings, Figure 1 is a partial longitudinal section of apparatus embodied in my invention; Fig. 2 is a continuation of Fig. 1 and shows the propeller in connection with a fragmental section of the walls of the circular tank; Fig. 3 is a partial plan view of Fig. 1, a part of which is broken away for convenience of illustration; Fig. 4 is an end view of the apparatus shown in Fig. 1; Fig. 5 is a section of a thrust bearing employed in my invention; and, Fig. 6 is a diagrammatic view of the apparatus of my invention, the tank being shown in plan.

A propeller 5 is secured to a longitudinal shaft 6 which projects through the cylindrical wall 7 of a circular tank 8. The shaft 6 is suitably packed and journaled and projects through the wall of the tank in such a way that the propeller in running in the ahead direction sets up currents in the liquid contained within the tank, which are approximately parallel to the cylindrical wall of the tank. With such an arrangement the liquid circulates around the tank and its velocity can easily be measured, by any suitable means, as for example, a paddle wheel placed in the tank and rotatable by the current, said paddle wheel being supplied with a suitable indicator in an obvious manner. The propeller is always supplied with a sufficient amount of liquid and the tendency is not as in a rectangular tank to move the liquid away from the propeller toward the opposite end of the tank.

The shaft 6 is connected by means of suitable coupling 9 to a shaft 10 which is journaled in suitable bearings and which is provided with a thrust bearing 11 to be hereinafter described. The shaft 10 is connected to a shaft 12 by means of a flexible joint 13 which permits of relative longitudinal motion between the shafts 10 and 12 and which is so arranged that the longitudinal thrust of one shaft will not be transmitted to or affect the operation of the other shaft.

The shaft 12 overhangs its bearings and the rotor 14 of a turbine is rigidly mounted on the overhanging portion. The turbine rotor is provided, as is customary, with a plurality of rows of moving blades 15 which coöperate with rows of vanes 16 which are mounted on a casing 17 which partially incloses the rotor element 14.

The casing 17 is provided with a centrally-located and laterally-projecting spindle 18 which is journaled in a pillow block 19 and which is so arranged that the casing is capable of rotating about its axis. A casing 21 incloses both the rotor element 14 and the casing 17 and is mounted on the frame portion of the apparatus.

Motive fluid is admitted to the turbine through a passage 22 formed in the spindle 18 and radially-extending passages 23 formed in the casing 17; and motive fluid is delivered to the passage 22 by a pipe 24, a passage 25 formed in the pillow block and ports 26 which extend radially through the walls of the spindle 18. Each radially-extending passage 23 communicates at its outer end with a fluid nozzle 27 which delivers fluid to the coöperating blades and vanes of the rotor element 14 and casing 17. The stationary casing 21 is provided with an exhaust port 28 and the casing 17 is open at one side to permit of an unrestricted flow of motive fluid from the last row of moving blades to the exhaust.

An arm 29 is integrally formed with or rigidly secured to the casing 17 and projects through a slot formed in the casing 21. This arm is adapted to be supported, in any suitable way, upon the platform of scales which may be utilized in determining the

power delivered to the propeller by the turbine by weighing the reactive torque turning moment of the casing 17.

A worm 30 is provided on the shaft 12 and meshes with a worm wheel 31 which, because of its reduced speed, is adapted to drive apparatus for determining the speed of the turbine rotor and consequently of the propeller 5.

Any type of turbine may be used for driving the propeller, or the turbine may be replaced by any motor in which the element, ordinarily termed the stationary element, may be utilized in determining the torque or turning moment of the rotary element.

The propeller in its operation transmits a longitudinal thrust to its mounting shaft which it is necessary to determine in computing the efficiency of the propeller. For this reason the shafts 6 and 10 of the apparatus are longitudinally shiftable through their bearings and the thrust bearing 11 and means for weighing the thrust of the propeller are provided. In Fig. 5 a longitudinal section of the thrust bearing is shown. Disks 32 are keyed to the shaft 10 and are inclosed within a casing 33. Disks 34 are mounted on the casing 33 and coöperate with the disks 32 in transmitting the longitudinal thrust of the propeller from the shaft 10 to the casing 33. A system of piping 35 is so connected as to deliver oil, under pressure, between the coöperating disks 32 and 34. A port 36 is provided at the bottom of the casing for draining of the same or permitting of a circulation of oil through the bearing if it is found desirable. With such an arrangement the rotating disks 32 transmit the thrust of the propeller through a thin film of oil to the disks 34 and through the disks of the casing 33. Pins 37 are screwed into the casing 33 and coöperate with a suitably fulcrumed lever 38, which transmits the thrust of the propeller to the platform 39 of scales utilized for weighing the thrust.

With such an apparatus the propeller 5 may be driven at any suitable speed, the speed ascertained by means of apparatus driven by the worm wheel 31, the power delivered to the propeller ascertained by means of reactive force of the stationary element of the driving agent, the longitudinal thrust of the propeller accurately ascertained by means of the thrust bearing 11 and the coöperating parts, and the velocity of the liquid within the tank may be made apparent.

While I have shown a preferred form of apparatus, I do not wish to limit myself to that shown, as the method may be carried out by other means and still fall within the spirit and scope of my invention.

What I claim is:

1. A propeller testing apparatus comprising a circular tank in which the propeller is submerged, an agent for driving said propeller, means for ascertaining the power delivered to the propeller by measuring the reactive force of the stationary element of said agent, means for measuring the longitudinal thrust of the propeller, and means for measuring the velocity of the liquid in the tank.

2. A propeller testing apparatus comprising a circular tank in which the propeller to be tested is submerged, whereby arcuate currents are set up in the tank, a turbine for driving the propeller, a rotatably mounted casing for said turbine, means for measuring the arcuate currents in said tank, means for measuring the reactive force of said casing to ascertain the power delivered by said turbine, and means for measuring the longitudinal thrust of said propeller.

3. A propeller testing apparatus comprising a circular tank in which the propeller to be tested is submerged, whereby arcuate currents are set up in the tank, a turbine for driving said propeller, and means for ascertaining the power delivered by said turbine by weighing the reactive force of the vane carrying element of said turbine, means for measuring the velocity of the arcuate currents in the tank, and means for measuring the longitudinal thrust of said propeller shaft.

4. A propeller testing apparatus comprising a circular tank in which the propeller to be tested is submerged, whereby arcuate currents are set up in the tank, a motor for driving said propeller and means for ascertaining the power delivered by said motor by indicating the reactive force of the stationary element of the motor, means for measuring the velocity of the currents in the tank, and means for measuring the longitudinal thrust and the speed of the propeller.

In testimony whereof, I have hereunto subscribed my name this twelfth day of November. 1907.

GEO. WESTINGHOUSE.

Witnesses:
JNO. S. GREEN,
CHARLES W. McGHEE.