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F. RAY.

MULTISTAGE CENTRIFUGAL, TURBINE, OR LIKE PUMP.

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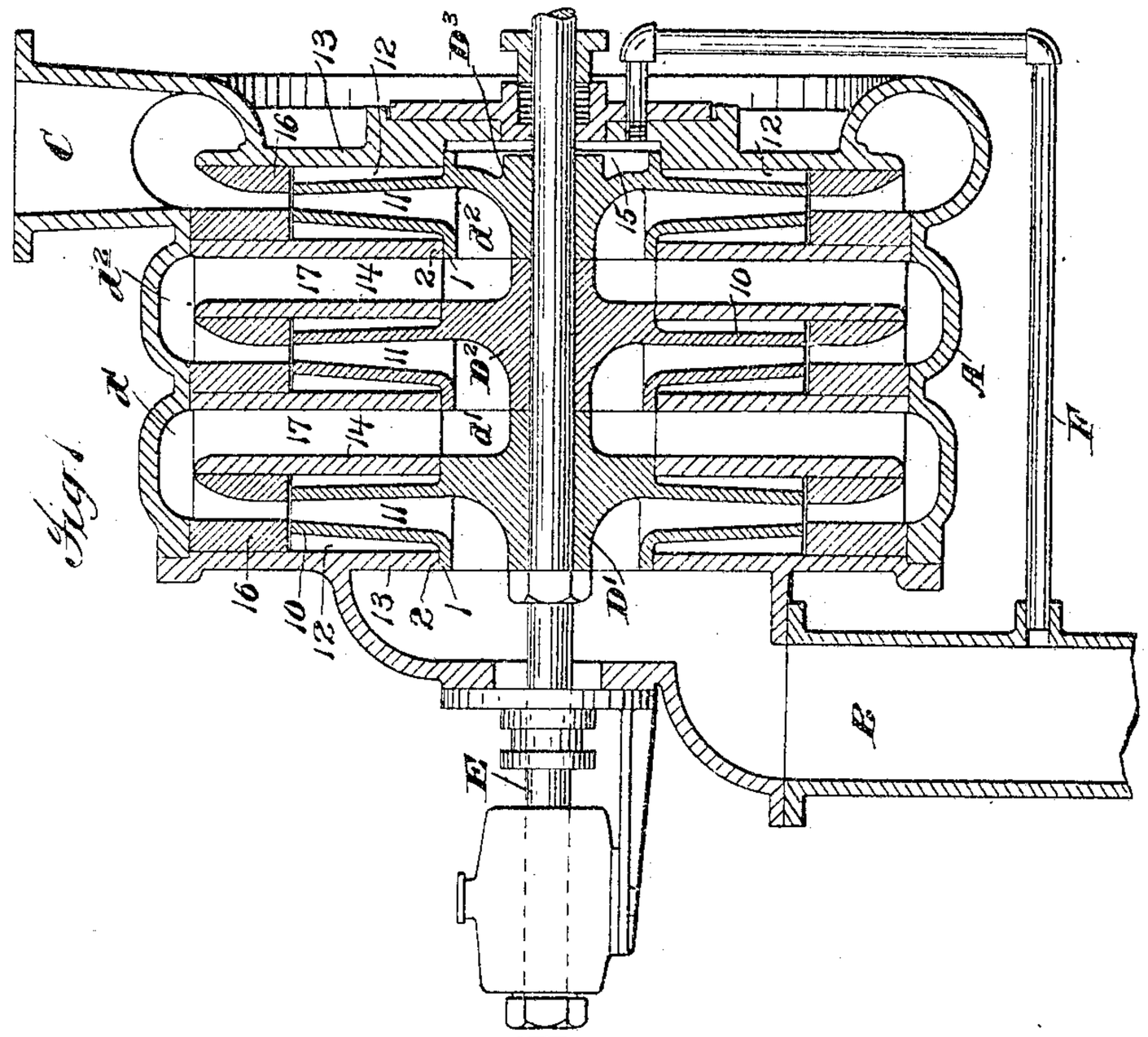

Fig. 1.

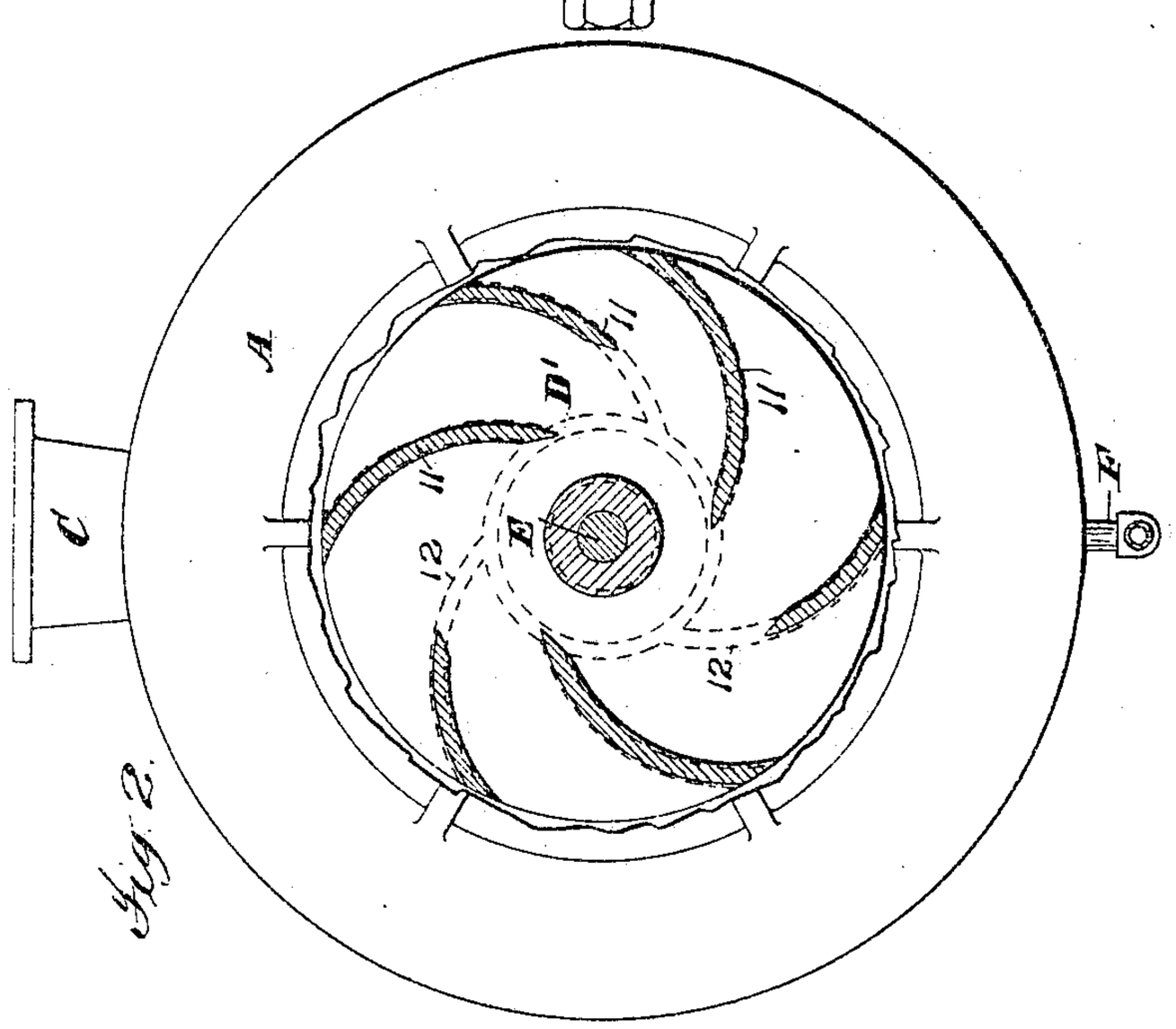

Fig. 2.

Witnesses
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No. 782,272. Patented February 14, 1905.

UNITED STATES PATENT OFFICE.

FREDERICK RAY, OF EAST ORANGE, NEW JERSEY, ASSIGNOR TO HENRY R. WORTHINGTON, OF NEW YORK, N. Y., A CORPORATION OF NEW JERSEY.

MULTISTAGE CENTRIFUGAL, TURBINE, OR LIKE PUMP.

SPECIFICATION forming part of Letters Patent No. 782,272, dated February 14, 1905.

Application filed April 30, 1904. Serial No. 205,680.

To all whom it may concern:

Be it known that I, FREDERICK RAY, a citizen of the United States, residing at East Orange, county of Essex, and State of New Jersey, have invented certain new and useful Improvements in Multistage Centrifugal, Turbine, or Like Pumps, fully described and represented in the following specification and the accompanying drawings, forming a part of the same.

This invention relates to an improved centrifugal, turbine, or like pump of that class having a plurality of inclosed impellers arranged in series and known as "compound" or "multistage" pumps; and the invention consists in an improved construction by which efficient balancing of the pump-pressures is secured.

In accordance with the present invention the successive impellers are not separated by the usual fixed diaphragms at the hub; but the hubs of the successive impellers are provided with suitable balancing-surfaces on the delivery side, so that the delivery-pressure acts in opposition to the suction-pressure on the hub of each impeller, the surfaces subjected to pressure on the delivery and suction sides of the impellers being preferably substantially the same. The delivery-pressure of the last impeller of the series is preferably not applied to its hub; but the pressure upon the last impeller is preferably partially balanced so as to balance the suction-pressure on the first impeller and secure the complete balancing of the shaft carrying the series of impellers, which may be done by a pipe connecting the suction of the first impeller with the balancing-chamber at the rear side of the last impeller. The impellers are provided with flanges or shoulders forming running-joints with the inner edges of the casing or diaphragms on the suction and delivery sides of the impellers, and outside vanes on the opposite side walls of the impellers are preferably used to prevent leakage past the running-joints into the balancing-spaces at the hubs, although this feature may be omitted.

For a full understanding of the invention a detailed description of a construction embodying all the features of the same as applied in their preferred form to a common type of centrifugal or turbine pump will now be given in connection with the accompanying drawings, forming a part of this specification, and the features forming the invention will then be specifically pointed out in the claims.

In the drawings, Figure 1 is a central section of the pump, taken longitudinally of the axis, a multistage pump having three impellers being shown. Fig. 2 is an end view looking to the right in Fig. 1 with the casing and suction broken away to show the end impeller.

Referring to the drawings, A is the pump-casing, having the suction B and delivery C and having the three impellers D' D^2 D^3, which are carried by the driving-shaft E. These impellers D' D^2 D^3 are all of a common inclosed-impeller form—that is, having the side walls 10 and vanes 11 extending between the side walls—and these impellers are shown as having on opposite sides outside vanes 12 on the walls 10, running in chambers on the opposite sides of the impellers, these chambers preferably being closed to the impeller-space by the side walls of the impeller. As usual in this class of pumps, the first impeller D' takes its suction at the hub directly from the pump-suction B and delivers through curved annular passage d', which extends inward to the hub and forms the suction of the second impeller D^2, which in turn delivers through a similar curved annular passage d^2 to the hub and suction of the third impeller D^3. Diffusion-rings 16 are preferably used outside the impellers and fixed vanes 17 in the passages d' d^2, extending to the inner edges of the diaphragms, as usual in turbine-pump constructions. These impellers D' D^2 D^3, however, instead of being separated from their delivery-passages d' d^2 at the hub by diaphragms, so that the delivery-pressure at the hub comes upon the diaphragm and not upon the back of the impeller, are arranged to abut directly against each other, and the diaphragms 14 between the backs of the impellers and the delivery-passages d' d^2 terminate at such a distance outside the hubs, so that the pressure of the

liquid in the passages d' d^2 at the hub comes upon the rear side of one impeller and the suction side of the next impeller, thus providing balancing-surfaces at the hub on the rear or delivery side of the impellers. The end casings 13 and the diaphragms 14 between the successive impellers preferably terminate, as shown, on about the line of the interior edge of the impeller-vanes 11, and the impeller-walls 10 are provided on opposite sides with projecting flanges or shoulders 1, which form running-joints with the inner edges 2 of the end casings 13 and diaphragms 14. It will be seen that with this construction the pressure on the impellers outside the running-joints 1 2 is balanced by the opposite side walls 10 of the inclosed impellers, and the pressures at the hub in the passages d' d^2, which form the delivery-passages for the impellers D' D^2 and the suction-passages for the impellers D^2 D^3, are balanced by the surfaces on the hubs of the successive impellers within the diaphragms 14, which are subjected to the pressure of the liquid. The shaft E, carrying the impellers, therefore, is entirely balanced, except that the suction-pressure on the impeller D' is not balanced, but tends to move the shaft E to the right in Fig. 1, and this excess pressure is not counterbalanced by any pressure in the pump as thus far described. This excess pressure tending to move the shaft E and impellers to the right in Fig. 1 may be balanced by other means or in small pumps may be neglected; but preferably this pressure on the suction is balanced by a pipe connecting the suction B of the first impeller with the rear side of the last impeller. As shown in the drawings, pipe F connects the suction-pipe B with a balancing-chamber 15 on the rear side of the impeller D^3, this chamber being formed so as to provide substantially the same area of pressure-surface as that subjected to pressure on the suction and delivery sides of the other impellers.

The outside vanes 12 are preferably used for reducing the pressure toward the center and aiding in preventing leakage from the outer edge of the impellers, inward outside the impeller, and past the running-joints 1 2. While the use of these vanes is desirable, however, and their combination with the broader features of the invention forms the subject-matter of specific claims, it will be understood that these outside vanes may be omitted within the invention considered broadly. These outside vanes when used preferably extend substantially from the outer edge of the impeller to the running-joint, as shown; but the length of these vanes may be varied so long as they are of sufficient length to prevent such inward pressure at the running-joint as will cause leakage past the joint into the space at the hub of the impeller.

The invention secures a very efficient balance of a multistage centrifugal or turbine pump under different running conditions. The construction also is simpler, cheaper, and more satisfactory than constructions in which the impellers are separated by diaphragms at the hub, less running-joints being required, lessening the expense for fitting parts and reducing the danger of leakage.

It will be understood that the invention is not limited to the exact form or construction of parts in the pump shown, but that the invention is applicable generally to multistage centrifugal or turbine pumps of the inclosed-impeller type.

What I claim is—

1. In a multistage centrifugal, turbine or similar pump, the combination with a plurality of inclosed impellers having their suction at the hub on one side and balancing-surfaces on their delivery sides opposite the suction, of diaphragms between the impellers and their delivery-passages terminating outside the balancing-surfaces on the delivery sides of the impellers.

2. In a multistage centrifugal, turbine or similar pump, the combination with a plurality of inclosed impellers having their suction at the hub on one side and balancing-surfaces on their delivery sides opposite the suction, of diaphragms between the impellers and their delivery-passages terminating outside the balancing-surfaces on the delivery sides of the impellers, and means for balancing the excess of pressure on the suction side of the pump.

3. In a multistage centrifugal, turbine or similar pump, the combination with a plurality of inclosed impellers having their suction at the hub on one side and balancing-surfaces on their delivery sides opposite the suction, of diaphragms between the impellers and their delivery-passages terminating outside the balancing-surfaces on the delivery sides of the impellers, a balancing-chamber on the rear side of the last impeller, and a pipe connecting said balancing-chamber with the pump-suction.

4. In a multistage centrifugal, turbine or similar pump, the combination with a plurality of inclosed impellers having their suction at the hub on one side and balancing-surfaces on their delivery sides opposite the suction, of diaphragms between the impellers and their delivery-passages terminating outside the balancing-surfaces on the delivery sides of the impellers, flanges forming running-joints between the impellers and the casing and diaphragms, chambers on the opposite sides of the impellers outside said joints, and vanes carried by the impellers running in said chambers.

5. In a multistage centrifugal, turbine or similar pump, the combination with a plurality of inclosed impellers having their suction at the hub on one side and balancing-surfaces on their delivery sides opposite the suction, of diaphragms between the impellers and their

delivery-passages terminating outside the balancing-surfaces on the delivery sides of the impellers, means for balancing the excess of pressure on the suction side of the pump, a balancing-chamber on the rear side of the last impeller, and a pipe connecting said balancing-chamber with the pump-suction.

6. The combination with the impellers D′, D², &c., of delivery and suction passages d', d^2, &c., diaphragms 14 between the impellers and their delivery-passages, and balancing-surfaces on the delivery sides of the impellers subjected to the pressure in said passages, substantially as described.

7. The combination with the impellers D′, D², &c., of delivery and suction passages d', d^2, &c., diaphragms 14 between the impellers and their delivery-passages, and balancing-surfaces on the delivery sides of the impellers subjected to the pressure in said passages, and balancing-chamber 15 on the last impeller, substantially as described.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

FREDERICK RAY.

Witnesses:
C. J. SAWYER,
W. H. KENNEDY.