Oct. 14, 1941.

E. D. DICKINSON

2,259,126

ELASTIC FLUID TURBINE

Filed July 28, 1939

Fig. 1.

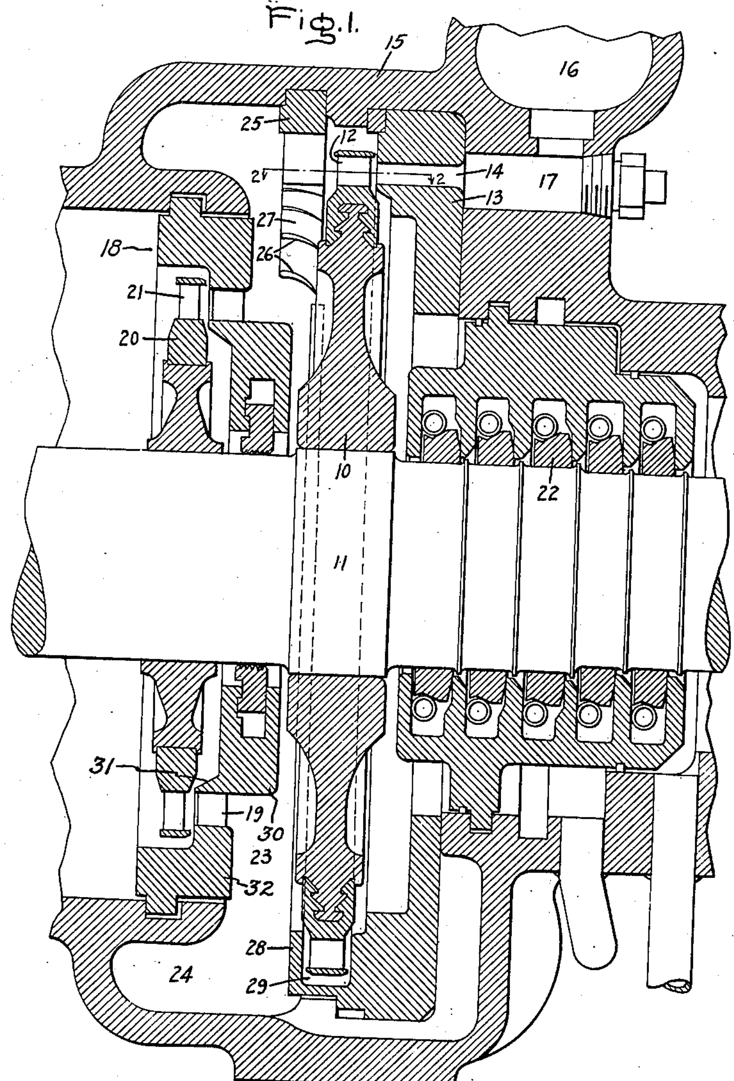
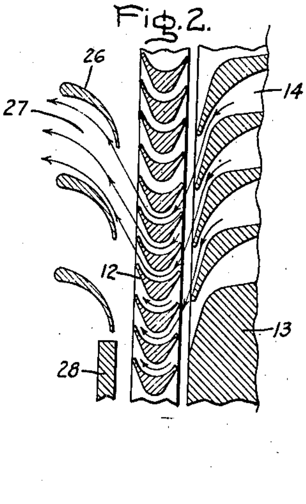


Fig. 2.



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ELASTIC FLUID TURBINE

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3 Claims. (Cl. 253—69)

The present invention relates to elastic fluid turbines of the type which include a stage having a large-diameter bucket wheel arranged to discharge elastic fluid into another stage having a nozzle diaphragm of small diameter considerably axially spaced from the aforementioned large-diameter bucket wheel. The large space thus formed between the large-diameter bucket wheel and the small-diameter diaphragm gives rise to considerable loss due to whirling. Devices in the form of dams and directing vanes have heretofore been suggested to reduce this whirling and smoothly to guide elastic fluid discharged from a large-diameter stage into a small-diameter stage. An arrangement of this kind is described in the application of D. J. Bloomberg, Serial No. 214,909, filed June 21, 1938 and assigned to the same assignee as the present application.

The object of my invention is to provide an improved construction and arrangement of turbines of the type above specified whereby loss in efficiency due to whirling of elastic fluid on its path from a large-diameter stage to a small-diameter stage is reduced.

For a consideration of what I believe to be novel and my invention, attention is directed to the following description and the claims appended thereto in connection with the accompanying drawing.

In the drawing Fig. 1 illustrates somewhat diagrammatically a sectional view of a turbine embodying my invention; and Fig. 2 is a view along line 2—2 of Fig. 1.

The multi-stage turbine in the drawing comprises a first stage with a large-diameter first bucket wheel **10** secured to a shaft **11** and having an annular row of buckets **12** and a nozzle plate **13** forming a row of nozzles **14** extending over an arc of, for example, 60°, thus constituting a partial admission arrangement for elastic fluid to the first bucket wheel **10**. The nozzle plate **13** is suitably secured to a casing **15**. The latter also forms an elastic fluid chest **16** from which elastic fluid is conducted to the nozzles **14** by a channel **17**. A second stage of the turbine includes a nozzle diaphragm **18** forming a row of nozzles **19** and supported on the casing **15** for receiving elastic fluid discharged from the bucket wheel **10** and conducting it to a small diameter bucket wheel **20** having an annular row of buckets **21**. The shaft **11** extends through the high pressure end of the casing and is sealed thereto by means of a suitable packing **22**. Details of the packing are not described because they do not form a part of this invention.

The second stage, more particularly the nozzles **19** of the nozzle diaphragm **18**, are considerably axially spaced from the bucket wheel **10** and the nozzles **19** have a diameter substantially smaller than the diameter of the buckets **12**. A large space **23** is thus formed between the bucket wheel **12** and the diaphragm **18** through which elastic fluid flows on its path from the bucket wheel **12** to the diaphragm **18**.

In order to reduce whirling of elastic fluid in the space **23** and to improve the distribution of elastic fluid discharged from the high pressure stage to the low pressure stage, particularly where elastic fluid is admitted to an arc only of the high pressure stage, I provide an annular chamber **24** surrounding one of the stages, in the present example the low pressure stage, including the diaphragm **18** and the bucket wheel **20**. This annular chamber forms in substance an axial extension of an outer portion of the space **23**. During operation, elastic fluid discharged from the passages formed between the buckets **12** flows into the opposite portion of the annular chamber **24** and is then distributed annularly in the entire chamber **24** to be conducted smoothly to the nozzles **19** of the diaphragm **18**. As a further means properly to guide the elastic fluid to the nozzles **19** of the second stage, I may provide an elastic fluid guiding and directing device **25** with a plurality of vanes **26** forming passages **27** between them for receiving fluids discharged from the passages between the bucket **12** and turning the direction of the flow of fluid axially (see Fig. 2). The guiding device **25** extends over an arc which is substantially equal to the arc of admission to the bucket wheel **12** in the present instance about 60°. The portion of the bucket wheel which in a particular instant does not discharge any fluid is shielded by a ring **28** secured to, in the present example integrally formed with, the annular nozzle plate **13**. From another viewpoint, the nozzle plate **13** forms a chamber **29** for enclosing that portion of the bucket wheel **10** to which no fluid is supplied from the nozzle plate. The purpose of the chamber **29** and the shield **28** is to prevent backflow of fluid through the passages formed by the buckets **12** and thus to reduce windage loss and leakage of fluid to the inlet side of the bucket wheel.

During operation fluid discharged from the bucket wheel **12** passes through the passages **27** formed by the guiding device **25** into the annular chamber **24** in which the fluid is distributed annularly and smoothly guided through the space **23** to the nozzles **19** of the diaphragm **18**.

The distribution chamber **24** has another important advantage, namely, it permits a reduction of the size of the space **23** between the bucket wheel **10** and the diaphragm **18** or, from another viewpoint, it permits closer spacing of the large-diameter bucket wheel **10** and the small-diameter diaphragm **18** than would be possible without such chamber **24**. This closer spacing results in shortening of the axial length of the turbine. In the present instance the closer spacing is accomplished by a special design of the diaphragm **18** which has an inner portion or disk **30** closely spaced with the bucket wheel **10** and forming a lateral projection **31** facing away from the bucket wheel **10** to which the inner ends of the nozzle partitions are secured. An outer ring **32** is secured to the outer ends of the nozzle partitions and considerably axially spaced from the bucket wheel **10**. The outer ring **32** is suitably supported on the turbine casing **15** and surrounds the bucket wheel **20**.

Having described the method of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof, I desire to have it understood that the apparatus shown is only illustrative and that the invention may be carried out by other means.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. Elastic fluid turbine comprising a casing, a first stage having a large-diameter bucket wheel, a second stage including a small-diameter diaphragm and a bucket wheel, the diaphragm comprising an inner disk closely spaced with the first stage bucket wheel and an outer ring with partitions fastened to the ring and to the disk and considerably axially spaced from the first stage bucket wheel and surrounding the second stage bucket wheel, and a plurality of guide vanes supported on the casing adjacent the diaphragm.

2. Elastic fluid turbine comprising a casing, a first stage having a large-diameter bucket wheel, a second stage including a small-diameter diaphragm and a bucket wheel, the diaphragm comprising an inner disk closely spaced with the first stage bucket wheel and having a lateral projection adjacent the second stage bucket wheel, a ring with a plurality of partitions considerably axially spaced from the bucket wheel and secured to the lateral projection and supported on the casing, and an annular chamber formed by the casing and surrounding the second stage diaphragm and bucket wheel for conducting fluid from the first stage bucket wheel to the diaphragm.

3. Elastic fluid turbine comprising a casing, a first stage having a bucket wheel and a diaphragm for conducting elastic fluid to a part only of the bucket wheel, said diaphragm forming a channel for receiving the portion of the bucket wheel to which no fluid is conducted in order to reduce windage losses, and a second stage comprising a diaphragm of a diameter considerably smaller than that of the first stage bucket wheel, the second stage diaphragm having a disk with an outer rim portion projecting laterally away from the first stage bucket wheel, a plurality of partitions having inner ends secured to said rim portion and an outer ring secured to the outer ends of the partitions and supported on the casing, the disk of the second stage diaphragm being closely spaced with the first stage bucket wheel and the partitions and the ring of the second stage diaphragm being considerably axially spaced from the first stage bucket wheel to form space for conducting fluid to the second stage diaphragm, the casing forming an annular chamber surrounding the second stage for conducting elastic fluid from the first stage to said space.

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