

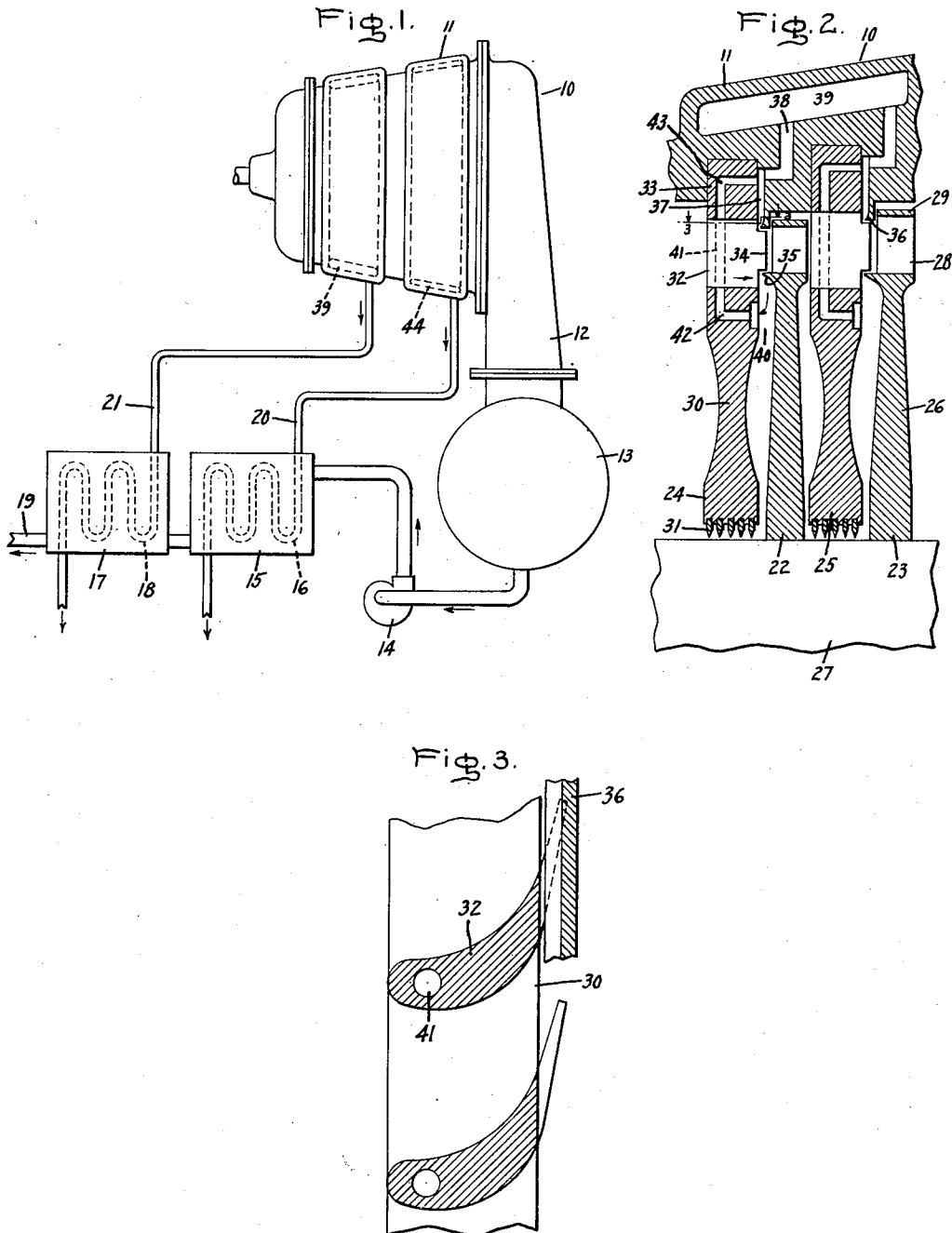
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ELASTIC FLUID TURBINE ARRANGEMENT

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ELASTIC FLUID TURBINE ARRANGEMENT

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The present invention relates to elastic fluid turbine arrangements including a preheater or preheaters for preheating fluid discharged from a turbine condenser on its path to a boiler.

An object of my invention is to provide an improved elastic fluid turbine arrangement whereby condensate discharged from the condenser is effectively and economically preheated.

Another object of my invention is to provide an improved construction and arrangement of elastic fluid turbines whereby the boundary layer of fluid in the stationary nozzle passages is effectively removed.

This is accomplished in accordance with my invention by the provision of an elastic fluid turbine having a row or rows of stationary nozzles for conducting elastic fluid to rows of buckets on a bucket wheel or wheels, which buckets have a radial height smaller than the radial height of the corresponding nozzle passages. Scoops are provided adjacent the inner and outer ends of the buckets for receiving fluid from the boundary layer and conducting it to a channel. This fluid in accordance with my invention is utilized for preheating condensate discharged from the turbine condenser.

For a better understanding 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 an elastic fluid turbine arrangement in accordance with my invention; Fig. 2 is an enlarged sectional view of a part of Fig. 1; and Fig. 3 is a sectional view along line 3—3 of Fig. 2.

The arrangement comprises an elastic fluid turbine 10 with a shell 11 and an exhaust conduit 12 connected to a condenser 13. Condensate discharged from the condenser 13 is forced by means of a condensate pump 14 to a first preheater 15 having a heating coil 16 and being connected to discharge preheated condensate into a second preheater 17 with a heating coil 18. The preheater 17 has a discharge conduit 19 for connection to an elastic fluid generator or boiler, not shown. The heating coils 16 and 18 of the preheaters 15 and 17 are connected to supply conduits 20 and 21 respectively for receiving heating fluid from the turbine.

The turbine as shown in Fig. 2 has bucket wheels 22, 23 and diaphragms 24 and 25 for conducting elastic fluid to the wheels 22, 23 respectively. Each bucket wheel has a disk 26 secured

to a shaft 27. A row of radial buckets 28 is suitably secured to the rim of the disk 26 and a shroud band 29 is fastened to the outer ends of the buckets. Each diaphragm has an inner member or disk 30 sealed to the shaft 27 by a packing 31 and a row of partitions or blades 32 secured between the rim of the disk and an outer ring 33 held on the casing 11.

During operation, elastic fluid is directed by the nozzle passages formed between the blades 32 of the high pressure diaphragm 24 towards the buckets 28 of the bucket wheel 22. The fluid discharged from the bucket wheel 22 is conducted through the nozzle passages formed by the second or low pressure diaphragm 25 to the bucket wheel 23.

The fluid flowing through the nozzle passages has maximum velocity in the central portion of these passages. The velocity decreases towards the outer portion and becomes a minimum at the walls formed by the blades, the disk 30, and the ring 33. Thus, during operation a boundary layer of relatively slowly flowing fluid is formed in each passage. This boundary layer of slowly flowing fluid does little work when conducted into the passages formed between the buckets of a bucket wheel. Therefore, in accordance with my invention, means are provided preventing at least part of the boundary layer of fluid in the stationary diaphragms from entering the rotating bucket wheels. To this end the buckets 28 of the bucket wheels have a radial length or height smaller than the radial length or height of the blades or partitions 32 of the corresponding diaphragms. The outer and inner ends of the thin outlet edges of the partitions 32 are cut away to form a shortened intermediate outlet edge 34 closely spaced with the buckets of the succeeding wheel.

The ends of the partitions extend radially beyond the ends of the corresponding buckets. From another viewpoint, the disk of the bucket wheel 22 has a larger diameter than the disk 30 of the diaphragm 31. Thus, the inner ends of the buckets are arranged along a cylindrical surface of greater diameter than that of the cylindrical surface defined by the radially inner ends of the nozzle passages.

The rim of each bucket wheel disk has a projection forming an annular scoop 35 for receiving the inner boundary layers of the nozzle passages. The scoop 35 is closely spaced with the inner, cut-away edge portions of the blades 32. Similarly the casing 11 is provided with an-

nular projections 36 closely spaced with the cut-away, outer, thin outlet edges of the blades 32 and forming scoops for receiving the boundary layers formed in the outer portions of the nozzle passages. The fluid of the outer boundary layers is conducted through a passage 37 formed between the outer ring 33 of the diaphragm and the casing 11 into a channel or channels 38 which discharges the fluid into a chamber 39 formed by the casing 11.

The inner boundary layer in the nozzle passages is received by the scoops 35 and conducted into a space 40 formed between adjacent diaphragms and bucket wheels, whence the fluid is conducted to the aforementioned chamber 39 of the casing 11. To this end the thick inlet portions of at least some of the partitions or blades 32 are provided with radial bores 41 which at their inner ends communicate through channels 42 with the space 40 and at their outer ends communicate through channels 43 with the channels 38.

During operation fluid flowing through the central portions of the nozzle passages is conducted to the bucket wheels whereas the inner boundary layer is conducted through the space 40, the channels 42, the bores 41 and the channels 43 and 38 to the chamber 39. The space 40 also receives leakage fluid flowing along the shaft. The fluid of the outer boundary layer is conducted through the passage 43 and the channel 38 to the chamber 39.

In the present arrangement the chamber 39 receives the fluid of the boundary layers from the two diaphragms 24 and 25. The chamber 39 is connected to discharge fluid into the aforementioned supply conduit 21 for preheating the condensate in the second preheater 17. A similar chamber 44 (Fig. 1) is formed to receive fluid from boundary layers of lower turbine stages and discharge such fluid into the supply conduit 20 of the first preheater 15.

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 diaphragm supported on the casing and forming a row of nozzle passages and a bucket wheel having a row of buckets associated with the nozzles and being of radial height shorter than the radial height of the nozzle passages, the inner ends of the buckets being arranged at a larger diameter than the inner ends of the nozzle passages, and means including separate scoops near the inner and outer ends of the bucket passages to prevent the inner and outer boundary layers of fluid in the

nozzle passages from entering the bucket wheel to separate the boundary layers of fluid from the remaining fluid.

2. Elastic fluid turbine comprising a casing, a diaphragm supported on the casing and forming a row of nozzles, a bucket wheel having a row of buckets associated with the nozzles and being of a radial height shorter than the radial height of the nozzle passages, the bucket wheel diameter at the inner ends of the buckets being larger than the diaphragm diameter at the inner ends of the nozzles, and means including a scoop formed on the bucket wheel adjacent the roots of the buckets for receiving the inner boundary layer from the nozzle passages, and channel means for removing said layer from the turbine.

3. Elastic fluid turbine comprising a casing forming a fluid chamber, a diaphragm having a disk, a plurality of radial partitions with inner ends secured to the disk and an outer ring supported on the casing and secured to the outer ends of the partitions, a bucket wheel having a row of buckets for receiving fluid from the diaphragm, the radial height of the buckets being smaller than the radial height of the partitions, and means forming channels for conducting fluid from the inner and outer boundary layers formed in the nozzle passages to said chamber to separate the fluid of the boundary layer from the remaining fluid and to remove the fluid of the boundary layers from the turbine, said means including the disk and the ring and radial bores through at least some of the partitions.

4. Elastic fluid turbine comprising a casing forming a fluid chamber, a diaphragm having a disk, a plurality of radial partitions with inner ends secured to the disk and an outer ring supported on the casing and secured to the outer ends of the partitions, a rotor comprising a shaft and a bucket wheel secured to the shaft disposed within the casing and spaced from the diaphragm, a packing to reduce leakage along the shaft past the diaphragm, and means for receiving leakage passing along said packing into the space between the diaphragm and the bucket wheel, said means including channels formed in the disk and the partitions and said chamber.

5. Elastic fluid turbine comprising a casing, a diaphragm having a disk with a plurality of partitions forming nozzle passages supported on the casing, a rotor having a shaft and a bucket wheel secured to the shaft disposed within the casing and arranged to receive fluid from the passages formed by the diaphragm, the bucket wheel being spaced from the diaphragm, and means including radial bores in the partitions and channels in the disk for receiving fluid from the space between the disk and the bucket wheel and for removing such fluid from the turbine.

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