

SPECIFICATION

Improvements relating to multi-stage centrifugal pumps

This invention relates to multi-stage centrifugal pumps of the kind comprising a series of two or more impellers mounted on a common shaft and with each impeller surrounded by an annular stage piece whereby liquid received centrally in one stage piece is centrifugally discharged from that stage piece by the impeller therein and conducted to the centre of a next adjacent stage piece whereafter finally the liquid is delivered from a casing which surrounds the stage pieces. It is found that in the operation of a plural or multi-stage centrifugal pump of this kind, the stage pieces expand differently compared with the surrounding casing which may be made of a different material. This has the effect of reducing and sealing tightness between the stage pieces.

A usual method of overcoming these problems in pumps of the kind referred to is to provide a sliding joint between the components, but this is susceptible to failure as a result of local corrosion or dirt deposition.

The general object of the present invention is to provide an improved alternative to the above and other established expedients which is free from their disadvantages.

In accordance with the present invention therefore a multi-stage centrifugal pump of the kind referred to is characterised by a dished or truncated conical element of which the smaller end part engages a fixed radially inner body portion of the pump and the larger end part engages an endmost stage piece, and spring means acting between a radially outer portion of the body and the smaller end part of the conical element and acting to bias it against the stage piece to maintain a fluid tight seal between this stage piece and the successive stage pieces.

Preferably the truncated conical element is spring biased by a plurality of radially disposed leaf springs of which the radially inward ends engage the truncated conical element, which may be formed with a series of circularly spaced holes.

A typical multi-stage centrifugal pump embodying the invention is illustrated in the accompanying drawings in which:

Fig. 1 is a fragmentary sectional elevation;

Fig. 2 is an inverted plan view of a casing preload cone and leaf springs shown in Fig. 1; and

Fig. 3 is an axial section through the cone and leaf springs shown in Fig. 2;

Referring mainly to Fig. 1 there is shown a multi-stage centrifugal pump comprising a lower body block 1 having a fluid inlet 2 and a fluid delivery outlet 3 and an upper body block 4. Mounted on the pump shaft 5 which extends from the lower body block 1 up through the upper body block 4 is a series of pump impellers 6 which are

surrounded by a corresponding series of stage pieces 7. These stage pieces are in turn surrounded by an enclosing tube 8.

Directly above the uppermost stage piece 7 and surrounding the shaft 5 is a frusto conical element or preload cone 9 with circularly spaced holes 9a. This cone 9 exerts pressure on the top stage piece 7 and the stage pieces beneath it by the action of a series of six equally spaced radially directed leaf springs 10.

These leaf springs have their radially inward ends located in a circular channel 9b formed in the radially inner part of the small end of the cone 9 and their radially outward ends seating on the underside of the top body block 4. At its large end, the cone 9 has a peripheral axially directed flange 9c which engages the rim of the abutting stage piece 7 so as to maintain the cone and the stage piece in axial alignment.

During differential expansion of the stage pieces 7, the leaf springs 10 are caused to deform and thus maintain a loading between the block 4 and the uppermost stage piece 7, this loading being thence applied to the various stage pieces 7 which are arranged beneath it.

CLAIMS

1. A multi-stage centrifugal pump of the kind referred to characterised by a dished or truncated conical element of which the smaller end part engages a fixed radially inner body portion of the pump and the larger end part engages an endmost stage piece, and spring means acting between a radially outer portion of the body and the smaller end part of the conical element and acting to bias it against the stage piece to maintain a fluid tight seal between this stage piece and the successive stage pieces.

2. A multi-stage centrifugal pump as claimed in Claim 1 in which the dished, or truncated conical, element is spring biased by a plurality of radially disposed leaf springs of which the radially inward ends engage the dished or truncated conical element.

3. A multi-stage centrifugal pump as claimed in Claim 1 or Claim 2 in which the dished, or truncated conical, element is formed with a series of circularly spaced holes.

4. A multi-stage centrifugal pump as claimed in any of Claims 1, 2 or 3 in which the dished, or truncated conical, element has at its large end a peripheral axially directed flange engaging the rim of the abutting stage piece so as to maintain the said element and the stage piece in axial alignment.

5. A multi-stage centrifugal pump as claimed in Claim 3 or Claim 4 as dependent on Claim 2 in which the radially inward ends of the leaf springs are located in a circular channel formed in the radially inner part of the small end of the dished, or truncated conical, element.



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A usual method of overcoming these problems in pumps of the kind referred to is to provide a sliding joint between the components, but this is susceptible to failure as a result of local corrosion or dirt deposition.

The general object of the present invention is to provide an improved alternative to the above and other established expedients which is free from their disadvantages.

In accordance with the present invention therefore a multi-stage centrifugal pump of the kind referred to is characterised by a dished or truncated conical element of which the smaller end part engages a fixed radially inner body portion of the pump and the larger end part engages an endmost stage piece, and spring means acting between a radially outer portion of the body and the smaller end part of the conical element and acting to bias it against the stage piece to maintain a fluid tight seal between this stage piece and the successive stage pieces.

Preferably the truncated conical element is spring biased by a plurality of radially disposed leaf springs of which the radially inward ends engage the truncated conical element, which may be formed with a series of circularly spaced holes.

A typical multi-stage centrifugal pump embodying the invention is illustrated in the accompanying drawings in which:

Fig. 1 is a fragmentary sectional elevation;
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surrounded by a corresponding series of stage pieces 7. These stage pieces are in turn surrounded by an enclosing tube 8.

Directly above the uppermost stage piece 7 and surrounding the shaft 5 is a frusto conical element or preload cone 9 with circularly spaced holes 9a. This cone 9 exerts pressure on the top stage piece 7 and the stage pieces beneath it by the action of a series of six equally spaced radially directed leaf springs 10.

These leaf springs have their radially inward ends located in a circular channel 9b formed in the radially inner part of the small end of the cone 9 and their radially outward ends seating on the underside of the top body block 4. At its large end, the cone 9 has a peripheral axially directed flange 9c which engages the rim of the abutting stage piece 7 so as to maintain the cone and the stage piece in axial alignment.

During differential expansion of the stage pieces 7, the leaf springs 10 are caused to deform and thus maintain a loading between the block 4 and the uppermost stage piece 7, this loading being thence applied to the various stage pieces 7 which are arranged beneath it.

CLAIMS

1. A multi-stage centrifugal pump of the kind referred to characterised by a dished or truncated conical element of which the smaller end part engages a fixed radially inner body portion of the pump and the larger end part engages an endmost stage piece, and spring means acting between a radially outer portion of the body and the smaller end part of the conical element and acting to bias it against the stage piece to maintain a fluid tight seal between this stage piece and the successive stage pieces.

2. A multi-stage centrifugal pump as claimed in Claim 1 in which the dished, or truncated conical, element is spring biased by a plurality of radially disposed leaf springs of which the radially inward ends engage the dished or truncated conical element.

3. A multi-stage centrifugal pump as claimed in Claim 1 or Claim 2 in which the dished, or truncated conical, element is formed with a series of circularly spaced holes.

4. A multi-stage centrifugal pump as claimed in any of Claims 1, 2 or 3 in which the dished, or truncated conical, element has at its large end a peripheral axially directed flange engaging the rim of the abutting stage piece so as to maintain the said element and the stage piece in axial alignment.

5. A multi-stage centrifugal pump as claimed in Claim 3 or Claim 4 as dependent on Claim 2 in which the radially inward ends of the leaf springs are located in a circular channel formed in the radially inner part of the small end of the dished, or truncated conical, element.

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6. A multi-stage centrifugal pump as claimed in any of Claims 3 to 5, as dependent upon Claim 2 in which there are six leaf springs equally spaced around the dished, or truncated conical, element.

5 7. A multi-stage centrifugal pump constructed substantially as hereinbefore described with reference to, and as shown in, the accompanying drawings.

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