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71 Applicant: **SIHI PUMPS (UK) LIMITED**
Broadheath
Altrincham, Cheshire WA14 1NB(GB)

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72 Inventor: **Blease, Raymond Owen**
12 Olive Road
Timperley, Cheshire(GB)

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74 Representative: **Barker, Rosemary Anne et al**
c/o Mewburn Ellis, 2 Cursitor Street
London EC4 1BQ(GB)

54 Method and apparatus for the production of an improved diaphragm pump.

57 The invention provides a method and apparatus for the production of an improved diaphragm pump using a cutting tool having a cylindrical body 12 and mounted on a shaft 14 which is in turn connected to drive means (not shown). A plurality of blade elements 18 are located in slots provided in the body 12 so as to provide a number of cutting edges 20. The blades are arranged alternately converging and diverging from each face of the body 12 and along its curved surface so that there are, in the illustrated

embodiment, four cutting edges 20 at each end of the body. A lower housing 30 of a diaphragm pump is held in a support frame so that the tool's cutting edges 20 are in contact with the side and lower surfaces 34, 36, 38 of a U-channel 32. In this way the surfaces of the channel are machined to a precise finish so as to minimise frictional wear on a diaphragm in contact therewith.

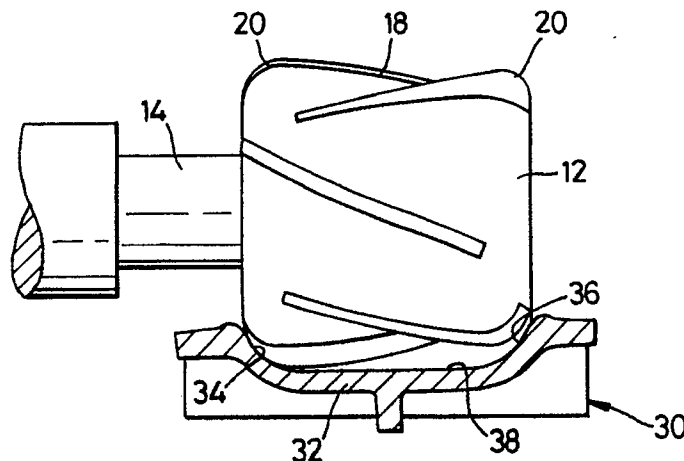


Fig. 2

EP 0 420 576 A2

A METHOD AND APPARATUS FOR THE PRODUCTION OF AN IMPROVED DIAPHRAGM PUMP

This invention relates to a method and apparatus for providing an improved diaphragm pump especially a rotary diaphragm pump of the type described in European Patents No. 0 052 679 and 0 087 823.

In European Patent 0 052 679 is described a rotary diaphragm pump operating on a principle similar to that of a peristaltic pump. In a pump according to the aforementioned patent a channel is provided within the pump body, one side of which channel is provided by a flexible membrane. The membrane is operated on by a rotating member formed with a plurality of rollers, for example three or four. These rollers compress the membrane into the U-shaped channel thereby operating on a fluid media passing therebetween in a manner of a known peristaltic pump. The length of operation of this type of pump is limited by the rate of wear of the membrane or diaphragm and several factors determine this rate.

Firstly, when the diaphragm contacts the edges of the U channel a poor surface finish on the U channel can lead to excessive frictional wear on the diaphragm which is moving in relation thereto. Furthermore if the U channel is not precisely cut with respect to the axis of rotation of the rollers operating on the diaphragm there will again be frictional contact between the diaphragm and the channel surface causing excess wear.

As the U channel of the pump is part of the pump housing itself which is usually cast, the surface generally has a certain degree of irregularity and hence is the cause of excess wear on the diaphragm where contact takes place.

It is an object of the invention to provide a method and apparatus to produce an improved diaphragm pump housing in which the diaphragm is fitted more constantly to the channel.

With this object in view the present invention provides a method of forming an improved diaphragm pump housing comprising casting a pump housing including a generally U-shaped arcuate channel, mounting said cast housing in a support frame, rotatably mounting above said housing a cutting tool, causing said cutting tool to be rotated and applied to the U-shaped channel such that the cutting tool's edges are operative to machine the U-shaped channel to a desired configuration, withdrawing said cutting tool and removing the housing from the support frame for assembly with a complementary housing and diaphragm so as to form a rotary diaphragm pump.

It will be appreciated that using this method the U-shaped channel in the lower housing is machined in relation to other machined areas of the chan-

nel and such that it is a constant distance from the axis of rotation of the rollers acting on the diaphragm. In this way the surface of the U-shaped channel where it is in contact with the diaphragm is substantially smooth and at a constant distance therefrom along the length of the channel. Contact between the diaphragm and the housing is thus minimised and wear of the diaphragm thereby reduced.

A further aspect of the invention provides a cutting tool for use with a method for providing an improved diaphragm pump housing the tool comprising a generally cylindrical member to which are attached a plurality of cutting edges.

Advantageously the cutting tool is provided with a plurality of blade elements each having a cutting edge configured so as to act on the cast housing and cut it to a predetermined configuration. To achieve this the blade elements are preferably arranged in divergent pairs and substantially parallel to the axis of rotation of the cutting member such that one end of each pair acts on a side surface of the said U channel.

In a preferred embodiment of the invention the said cutting member comprises eight blade elements arranged in four pairs, each blade element respectively diverging from its immediately adjacent element on either of its two sides.

It has been found that the better finish of the surface with which the diaphragm is in contact leads to an increased life of the diaphragm by reason of less frictional wear where it is in contact therewith.

In an advantageous modification of the cutting tool according to the invention the blade elements are so arranged that their radius of rotation about the cutting tool's axis is equal to the desired radius of the arcuate channel formed in the cast housing. It will be appreciated that in this configuration the cutting tool is ideally mounted having its axis of rotation substantially equal to that axis of rotation of the rollers which act on the diaphragm positioned above the channel. In this way the channel is cut precisely such that it is a constant distance from the rollers at all points throughout their travel.

A further aspect of the invention provides a support frame for the method of the invention, the support frame comprising clamping means for releasably retaining a diaphragm pump housing within the said support frame, displaceable mounting means for rotatably mounting a cutting tool at a predetermined distance from a housing retained in the said clamping means, the said mounting means being displaceable vertically such that a cutting tool mounted thereon may be brought into contact with

a surface of the housing which is machined.

Preferably the support frame also includes means for rotating the said cutting tool at its required rotational speed.

The invention will be described further by way of example with reference to the accompanying drawing in which:-

Fig. 1 is a perspective view of a cutting tool according to a first aspect of the invention; and

Fig. 2 is a part sectional view of a diaphragm pump housing and a cutting tool as illustrated in Fig. 1 in use.

Turning firstly to Fig. 1, a cutting tool 10 according to a first aspect of the invention comprises a generally cylindrical body 12 mounted on a shaft 14. The shaft 14 is connected to drive means (not shown) such that the cylindrical body 12 may be rotated about the shaft's axis.

A plurality of slots 16 are provided in the cylinder's exterior surface, in the illustrated example there are eight such slots, although only four visible. These slots 16 are located equidistantly around the cylinder's outer surface. The slots 16 are arranged at an angle with respect to each other so that the ends of each slot 16 respectively converge and diverge with respect to the respective ends of an adjacent slot 16.

Each of the slots 16 serves to hold a blade element 18. Each of these blade elements 18 has a cutting edge 20 at one end thereof, and the blade elements 18 are arranged in an alternating fixed spaced relationship to each other such that there are four cutting edges 20 at one end of the cylindrical body 12 and four cutting edges 20 at the other end of said cylindrical body 12.

Turning now to Fig. 2, a cutting tool 10 as illustrated in Fig. 1 is fixedly located above a lower housing 30 of a diaphragm pump (not shown) generally according to EP Patent No. 0 052 679. The lower housing 30 is fixedly held in a support frame (not shown) which serves to rigidly locate the lower housing 30 by way of clamping means (not shown) in relation to the cutting tool 10. The lower housing 30 is formed by a conventional casting process and consequently will normally have a relatively rough finish which surface could lead to excess wear occurring where said surface contacts a diaphragm of a diaphragm pump.

The housing 30 has formed within it a U-shaped channel 32 having side walls 34, 36 and a lower surface 38. It is important for operation of the type of diaphragm pump referred to that these surfaces are accurately disposed in relation to the rotational axis of a rotary member (not shown) of the pump assembly which operates on a diaphragm or membrane located over the U channel 32. Before assembly of the completed pump arrangement the lower casing 30 is therefore placed

in the support frame and a cutting tool is arranged so as to be located within the U-channel 32 as shown in Fig. 2.

In this position each of the blade elements 18 act in turn on the side and lower surfaces 34, 36, 38 of the U channel 32. Thus rotation of the tool 10 will cause those blade elements 18 to smooth or machine to a precise finish those surfaces which are in contact during operational use with the diaphragm of the pump. As the axis of rotation of the cutting tool 10 is substantially identical to that of the rotary member located within the pump housing in the finished pump assembly the surfaces of the U channel 32 are finished so as to be at a constant radius from that axis at all points along the channel 32. In this way the lower surface 38 of the channel 32 is always at a constant distance from the diaphragm and the rotary member's axis thus causing consistent operational characteristics and reducing wear on the diaphragm.

The invention is not confined to the precise details of the foregoing description and variations may be made thereto within the scope of the invention. For example, the cutting tool need not be precisely as indicated and could alternatively be in the form of a square block rotating about a central axis, the corners of the square providing the necessary cutting edges required for action on the side and lower surfaces of the U channel of the lower casing. It will be appreciated that the actual shape of the cutting tool 10 would be altered according to the precise shape and size requirement of the U channel 32 in the lower casing. Other variations are also possible.

Claims

1. A method of forming an improved diaphragm pump housing comprising casting a pump housing (30) including a generally U-shaped arcuate channel (32), mounting said case housing in a support frame, rotatably mounting above said housing a cutting tool (10), causing said cutting tool to be rotated and applied to the U-shaped channel (32) such that the cutting tool's edges (20) are operative to machine the U-shaped channel to a desired configuration, withdrawing said cutting tool (10) and removing the housing from the support frame for assembly with a complementary housing and diaphragm so as to form a rotary diaphragm pump.
2. A cutting tool for use with a method as claimed in Claim 1 the tool (10) comprising a generally cylindrical member (12) to which are attached a plurality of cutting edges (20).
3. A cutting tool as claimed in Claim 2 in which the cutting tool is provided with a plurality of blade elements each having a cutting edge configured so

as to act on the cast housing and cut it to a predetermined configuration.

4. A cutting tool as claimed in Claim 3 in which the blade elements (18) are arranged in divergent pairs and substantially parallel to the axis of rotation of the cutting member (10) such that one end of each pair acts on a side surface (34, 36) of the said U channel (32). 5

5. A cutting tool as claimed in Claim 4 in which the said cutting member comprises eight blade elements (18) arranged in four pairs, each blade element (18) respectively diverging from its immediately adjacent element on either of its two sides. 10

6. A cutting tool as claimed in Claim 4 or Claim 5 in which the blade elements (18) are so arranged that their radius of rotation about the cutting tool's axis is equal to the desired radius of the arcuate U channel (32) formed in the cast housing (30). 15

7. A support frame for a method as claimed in Claim 1, the support frame comprising clamping means for releasably retaining a diaphragm pump housing within the said support frame, displaceable mounting means for rotatably mounting a cutting tool at a predetermined distance from a housing retained in the said clamping means, the said mounting means being displaceable vertically such that a cutting tool mounted thereon may be brought into contact with a surface of the housing which is machined. 20 25

8. A support frame as claimed in Claim 7 in which the support frame also includes means for rotating the said cutting tool at its required rotational speed. 30

9. A cutting tool substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings. 35

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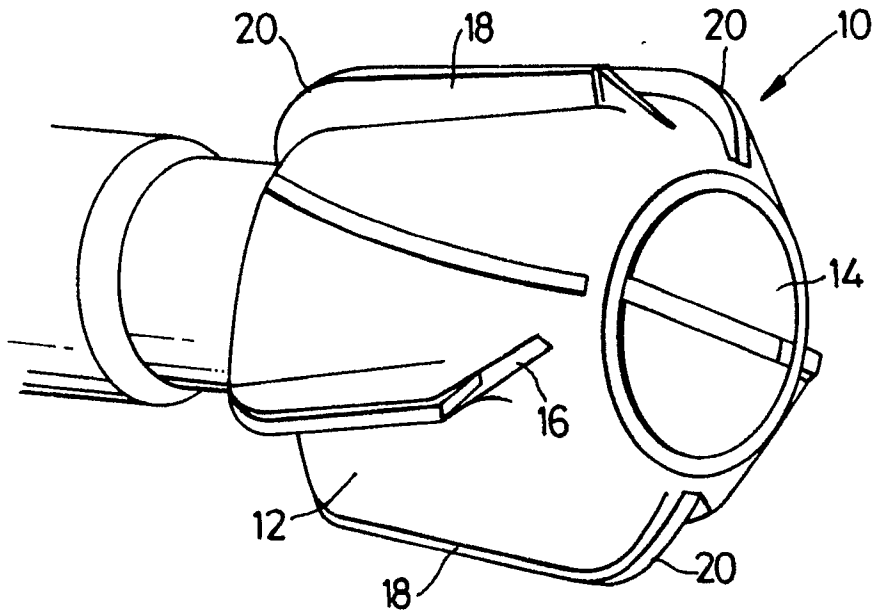


Fig. 1

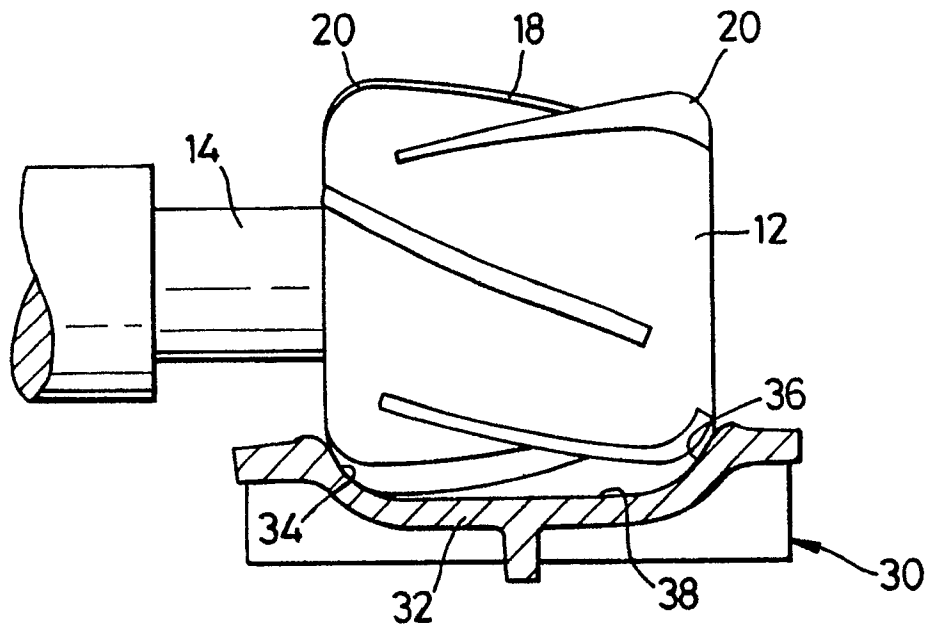


Fig. 2