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GB 2192240 A GB 1176621 A GB 0590429 A

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(54) A displacer unit, especially a piston pump

(57) A displacer unit comprises a plurality of reciprocating parts (eg cylinders or pistons) which in operation move in a repetitive sequence. The construction is so designed that the displacer or piston working strokes occur in sequence with varying phase differences which have a non-integral ratio to one another. This can be achieved, in the case of a radial piston pump arrangement, by either having the pistons/cylinders 2 at differing radial angles around the axis A of the unit or having a rotary eccentric ring (such as a cam (3, Fig 2)) with eccentric regions located at differing radial angles around the axis of the unit. By this means, the risk of excitation of noise or resonance vibrations can be greatly reduced.

Fig. 1

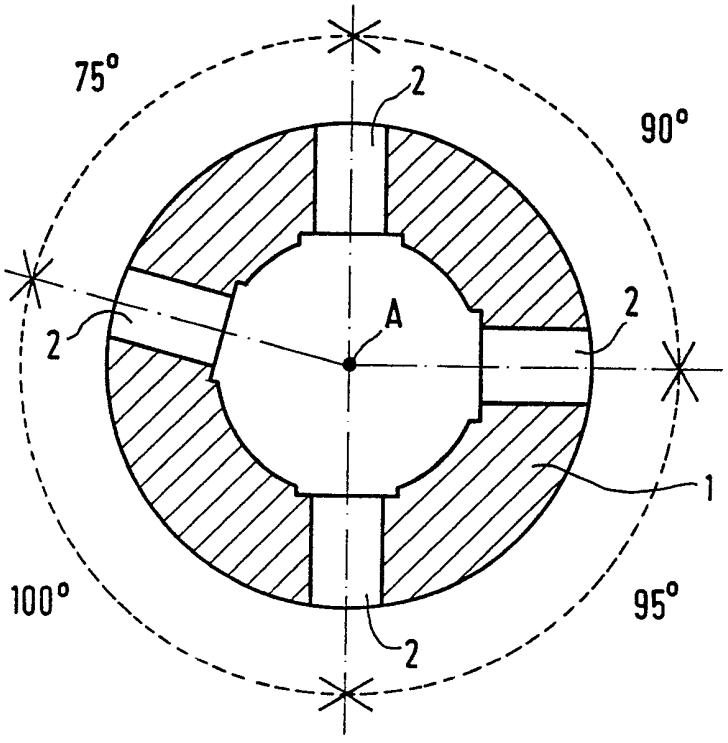

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Fig. 1

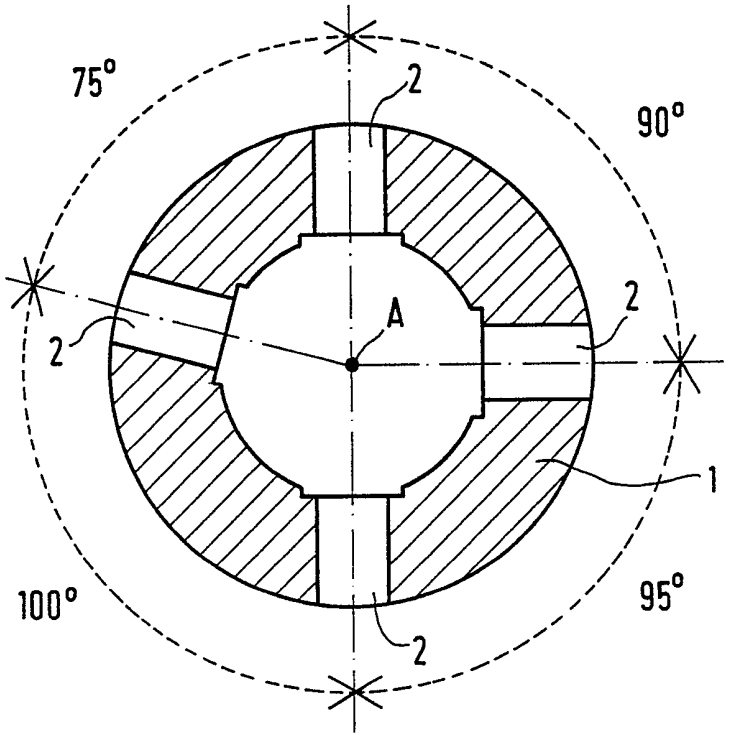
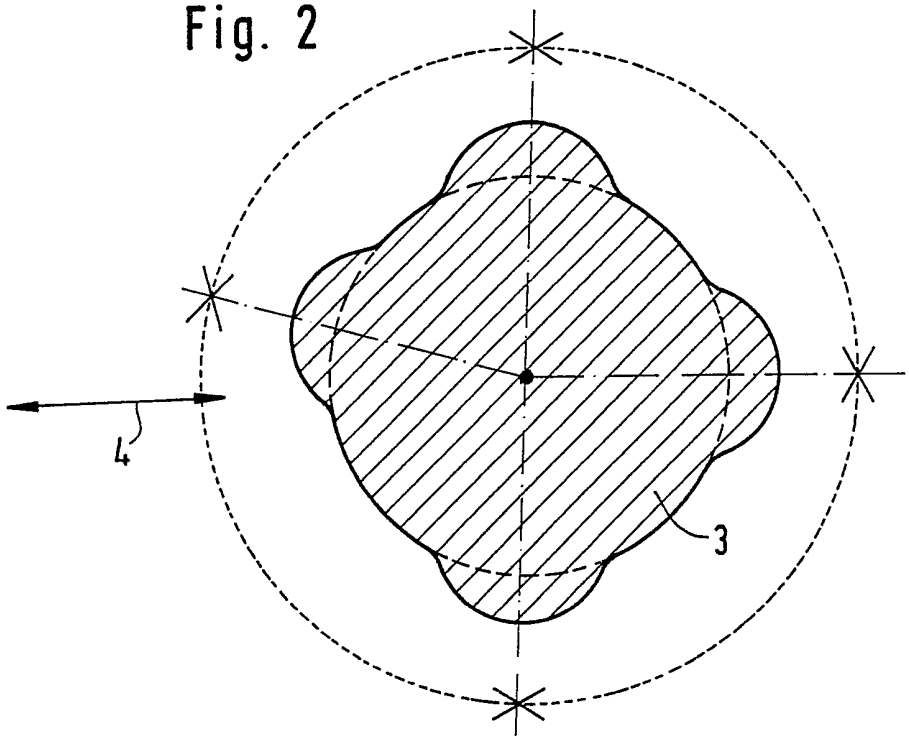


Fig. 2



A displacer unit

The invention concerns a displacer unit, particularly but not exclusively, a piston pump, with a plurality of displacers or pistons which carry out sequential displacer or piston working strokes.

In fluid and hydraulic systems of motor vehicles, pumps piston, which are usually configured as radial piston pumps, are used for supplying different consumption units. In addition to being functionally reliable, it is also important that the pump should operate with low noise in order to permit comfortable driving in the vehicle.

In the avoidance of noise, account must be taken of the fact that the pump must operate at greatly varying speeds depending on the operating conditions of the vehicle and the speed of the vehicle engine and, as far as possible, low-noise operation should be possible at all speed ranges.

In connection with the reduction of operating noise in a vehicle, it is known in principle to encapsulate units causing noise in a sound insulating manner or to arrange them in such a way that the noise cannot be transmitted, or can only be transmitted to a small proportion, to other components or sub-assemblies of the vehicle.

Nevertheless, it remains a desirable target to employ, as far as possible, such units as produce particularly low noise so that the measures mentioned above become unnecessary to the greatest possible extent.

A radial piston pump with three pistons is known from DE-B 12 07 707 which is actuated by a cam ring with five cam-shaped protrusions. Two of the pistons have the same cross-sections and are located with their axes at an angle of approximately 72° to one another whereas the other piston has approximately 1.6 times the cross-section of the two previously mentioned pistons and is located with its axis symmetrical to the piston axes of the two other pistons. Because of this arrangement, all the pistons execute their compression or suction stroke simultaneously,

i.e. all the pistons are simultaneously moved radially inwards or radially outwards. Because of the arrangement quoted and the dimensions of the pistons, the reaction torques occurring are mutually compensating, i.e. the housing of this known pump is only excited to relatively small vibrations by the pump work.

Another radial piston pump is known from US-A 24 23 701 whose pistons are actuated by a central cam wheel with three cams. In accordance with US-A 24 23 701, different piston arrangements are possible depending on the desired pump output. In one embodiment, two diametrically opposite and coaxial pistons are associated with the cam wheel. In another embodiment, the cam wheel actuates a total of four pistons which are opposite to one another in pairs, the pistons of each pair having a common piston axis. The piston axes of pistons adjacent to one another in the direction of rotation of the cam wheel form a right angle in each case. Finally, a third embodiment is shown in which the cam wheel interacts with three pistons, of which two pistons are diametrically opposite to one another and coaxial. The third piston is arranged transverse to the two previously mentioned pistons and its piston axis forms a right angle with each of the piston axes of the two other pistons.

Even though the previously known piston pumps operate, in some cases, with very little vibration, undesirable noise still appears during operation, particularly in motor vehicles.

The present invention seeks, therefore, to produce a construction which leads to a substantial reduction in noise.

According to the present invention there is provided a displacer unit with a plurality of displacers or pistons which carry out sequential displacer or piston working strokes, wherein there are varying phase differences between working strokes occurring sequentially in time, these phase differences having a non-integral ratio with one another.

The invention is based on the knowledge that an

essential cause of the noise developed by displacer units and piston pumps is that pressure pulsations necessarily appear in the pipework system connected to the displacer unit or piston pump. In the case of piston pumps, this applies particularly to the pressure pulsations on the pressure side of the pump. These pressure pulsations can lead to noise at very remote locations, particularly when natural frequencies are excited there of components or units which can vibrate. In motor vehicles, for examples, body parts can be excited to vibration relatively easily even at a large distance from a hydraulic pump if these body parts are located near fluid pipes in which pressure pulsations can occur at a critical frequency. An additional difficulty is that in motor vehicles, the pumps are usually driven directly by the vehicle engine and therefore run with varying speed depending on the particular vehicle speed. The risk that the pressure pulsations caused by the pump may have a critical frequency for some parts of the body - at least in certain speed ranges - is very great.

Because, in accordance with the invention, there are different time intervals between sequential working strokes of the displacer unit or the piston pump, and since the length of these time intervals have a non-integral ratio with one another, this arrangement at least avoids the possibility of the pressure pulsations having a frequency spectrum in which the frequencies of higher harmonics are excited in addition to the fundamental vibration frequency. What is in fact excited is a mixture of frequencies whose constituents cannot mutually amplify one another so that the formation of resonances is quite substantially limited.

The invention can fundamentally be effected in the case of very different types of displacer unit or piston pump designs. In a piston pump with cylinders arranged in line, for example, a crankshaft can be provided whose cranks can form appropriately different angles, in an axial view onto the shaft, so that the piston strokes follow sequentially with varying phase differences.

Where the pistons or displacers are driven by eccentric or cam units, these can have a multiplicity of eccentric regions or cams which are so arranged that, for a constant driving speed, they become effective as driving elements with different time intervals between them.

In a particularly preferred manner according to the invention, a piston pump is designed as a radial piston pump, at least some of the cylinders associated with the pistons being arranged at different angles relative to one another so that there are correspondingly varying phase differences between working strokes which are sequential in time.

A preferred embodiment of the invention will now be described by way of example with reference to the drawing, in which:-

Fig. 1 shows a radial section of a housing part accommodating the cylinder bores of a radial piston pump according to the invention and

Fig. 2 shows a cam wheel which is used, in a manner according to the invention, for actuating one or a plurality of pistons.

The housing part 1, shown in Fig. 1, of a radial piston pump has a total of four cylinder bores 2 in which the pump pistons (not shown) are accommodated, these being in turn actuated by an eccentric (not shown) rotating about an axis A of the housing part 1.

As may be seen from Fig. 1, the axes of the cylinder bores 2 include angles of varying magnitude with dimensions, in the example shown, of 90°, 95°, 100° and 75°. The working strokes of the pistons to be accommodated in the cylinder bores 2 correspondingly follow one another with varying phase differences and this is so even when the driving speed of the eccentric or its rotational speed remain unaltered.

In consequence, the pressure pulsations caused by the working strokes of the pistons on the pressure side of the pump follow one another at correspondingly varying time intervals so that the danger of resonance excitation is

substantially reduced. An advantage of the radial piston pump configuration shown in Fig. 1 is that its construction remains substantially unaltered and, in particular, no complicated manufacturing steps are necessary. It is sufficient for the cylinder bores 2 in the housing part 1 to be arranged in the manner shown; the other parts of the pump, and their mode of assembly, remain unaltered.

A similar result can be achieved in the case of a radial piston pump if its pistons are driven by a specially shaped eccentric such as is shown, for example, in Fig. 2. This eccentric 3 has a total of four cams which are located at different angles relative to one another, in the view along the axis of the eccentric 3, the dimensions being 90°, 95°, 100° and 75° in the example shown. If this eccentric 3 now interacts with a piston whose piston axis 4 is shown as a dashed line, the working strokes of the piston follow one another at varying time intervals.

The same also applies when the arrangement includes a plurality of pistons, even if adjacent piston axes are arranged at the same angle to one another.

Instead of an eccentric 3 which interacts with the piston or pistons by means of its external surface, it is fundamentally also possible to have an arrangement with an annular part which interacts with the piston or pistons by means of an eccentric internal peripheral surface.

CLAIMS

1. A displacer unit with a plurality of displacers or pistons which carry out sequential displacer or piston working strokes, wherein there are varying phase differences between working strokes occurring sequentially in time, these phase differences having a non-integral ratio with one another.

2. A displacer unit according to Claim 1, having a configuration as a radial piston pump, some at least of whose piston axes - viewed along the axis of the pump - include different angles.

3. A displacer unit according to Claim 1 or 2, wherein the displacer or displacers or piston or pistons interact, for their drive, with a rotating eccentric ring surface of a driving element, the ring surface having a plurality of eccentric regions which are located at varying angles to one another viewed along the axis of the driving element.

4. A displacer unit according to claim 3, wherein the driving element comprises an eccentric or cam wheel or cam ring.

5. A displacer unit substantially as described herein with reference to and as illustrated in the accompanying drawings.

`atents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

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Relevant Technical fields

(i) UK Cl (Edition K) F1W (WCV, WDC, WDD, WEC)
F1B (B1A3, B1B3, B1C3, B1D3)

(ii) Int Cl (Edition 5) F018, F03C, F04B

Search Examiner

H F YOUNG

Databases (see over)

(i) UK Patent Office

(ii) ONLINE DATABASES: WPI

Date of Search

29 OCTOBER 1992

Documents considered relevant following a search in respect of claims 1-5

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
X	GB 2192240 A (LINDE) - note lines 39-93 of page 1 and Figures 1 and 2	1
X	GB 1176621 (VEB) - note lines 10-76 of page 1 and Figure 1	1 and 2
X	GB 590429 (MESSIER) - note lines 8-64 of page 1 and see Figure 7	1 and 2

Category	Identity of document and relevant passages	Rele .t to claim(s)

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family, corresponding document.

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).

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