An operating device (1) for a valve has a regulating unit (15) acting via an inverter (21) reversing the movement direction of the regulating unit (15) upon a connecting link (outlet element 23). The inverter (21) has an inlet element (22), which is displaceable by means of the regulating unit (15) along an axis (E), with at least one tapered inlet surface (30, 31), an outlet element (23), which is also displaceable along the axis (E), with at least one tapered outlet surface (34, 35) and at least one intermediary element (24, 25) which extends vertically to the axis (E), each having two tapered intermediary surfaces (32, 33, 36, 37), the influence of the lateral force causing the first one to bear on a tapered inlet surface (30, 31) and the second one having the opposite inclination in relation to the axis (E) to bear on a tapered outlet surface (34, 35). Thus, an inverter is obtained, which only needs little space and is safely built-in. An inverter (21) of this kind can also be sold as an independent component.
FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL Albania
AM Armenia
AT Austria
AU Australia
AZ Azerbaijan
BA Bosnia and Herzegovina
BB Barbados
BE Belgium
BF Burkina Faso
BG Bulgaria
BJ Benin
BR Brazil
BY Belarus
CA Canada
CF Central African Republic
CG Congo
CH Switzerland
CI Côte d'Ivoire
CM Cameroon
CN China
CU Cuba
CZ Czech Republic
DE Germany
DK Denmark
EE Estonia
ES Spain
FI Finland
FR France
GA Gabon
GB United Kingdom
GE Georgia
GH Ghana
GN Guinea
GR Greece
HU Hungary
IE Ireland
IL Israel
IS Iceland
IT Italy
JP Japan
KE Kenya
KG Kyrgyzstan
KP Democratic People's Republic of Korea
KR Republic of Korea
KZ Kazakhstan
LC Saint Lucia
LI Liechtenstein
LK Sri Lanka
LR Liberia
LS Lesotho
LT Lithuania
LU Luxembourg
LV Latvia
MC Monaco
MD Republic of Moldova
MG Madagascar
MK The former Yugoslav Republic of Macedonia
ML Mali
MN Mongolia
MR Mauritania
MW Malawi
MX Mexico
NE Niger
NL Netherlands
NO Norway
NZ New Zealand
PL Poland
PT Portugal
RO Romania
RU Russian Federation
SD Sudan
SE Sweden
SG Singapore
SI Slovenia
SK Slovakia
SN Senegal
SZ Swaziland
TD Chad
TG Togo
TJ Tajikistan
TM Turkmenistan
TR Turkey
TT Trinidad and Tobago
UA Ukraine
UG Uganda
US United States of America
UZ Uzbekistan
VN Viet Nam
YU Yugoslavia
ZW Zimbabwe
Operating device for a valve and belonging inverter

The invention concerns an operating device for a valve, with a regulating unit acting via an inverter reversing the movement direction of the regulating unit upon a connecting link, which is connectable with the closure member of the valve, and an inverter for movement reversal.

From DE 26 19 413 C3 is known a similar operating device for thermostatically operable valves. The inverter used is a two-arm lever arranged pivotally in a valve element. The regulating unit engages with one arm. The other arm engages in a connecting link, which is arranged on the same axis as a closure member spring loaded in the opening direction and a valve pin connecting the closure member and the connecting link. An inverter of this kind has the advantage that the same regulating unit can optionally operate a heating valve closing at increasing temperature or a refrigeration valve opening at increasing temperature.

The invention is based on the task of providing an additional operating device of the kind described in the introduction.

According to the invention, this task is solved in that the inverter has:

a) an inlet element, displaceable by means of the regulating unit along an axis, with at least one tapered inlet surface,

b) an outlet element, also displaceable along the axis, with at least one tapered outlet surface,
c) at least one intermediary element, extending vertically to the axis, as well as two tapered intermediary surfaces, the influence of a lateral force causing the first one to bear on a tapered inlet surface and the second one having the opposite inclination in relation to the axis to bear on a tapered outlet surface.

When the inlet element is displaced in the direction of the closure member by the regulating unit, the at least one intermediary element guided in the transverse direction is displaced laterally. This again causes that the outlet element, which is loaded by the return spring of the closure member, moves in the direction of the inlet element. The inverter is arranged between the regulating unit and the valve pin. In that place it is well protected and only requires little space.

It is recommendable that the inlet element has two symmetrically arranged tapered inlet surfaces and the outlet element has two symmetrically arranged tapered outlet surfaces and that two symmetrically arranged intermediary elements are provided, which are pressed against each other by the lateral force. Thus, the inlet element, the intermediary elements and the outlet element are working substantially symmetrically in relation to each other, which permits a construction without fixed guides for the inlet element and the outlet element in the housing. In this connection, the valve rod is substantially loaded in the axial direction, which ensures a long lasting sealing.

Preferably, all tapered surfaces have the same or, in reflected image, the same inclination angle in relation to the axis. This gives a 1:1 reversing movement. Different reflected image embodiments of the tapered surfaces can change the amplification factor.
Advantageously, the lateral force is produced by at least one spring. For this purpose, many different springs can be used, for example, helical springs, clip springs, annular springs and the like, but also simple O-rings or elastic ribbons are applicable. Most favourable are springs surrounding both intermediary elements, thus pressing them against each other, as this unit will then locate itself centrally in relation to the other parts.

It is also recommended that the connecting link is formed by the outlet element and has a stop for a valve pin, which is spring loaded in the pressure direction. This double function of the outlet element enables even smaller dimensions.

In a preferred embodiment it is provided that the guide for the intermediary elements is arranged on a head having means for fixing on a valve housing. Thus, the inverter is positioned correctly in relation to the valve pin.

It is recommended that the head also carries the regulating unit. Thus, an integrated unit is fixed on the valve housing.

Another preferred alternative provides that the head has a holder on which an upper part containing the regulating unit can be fixed. Thus, the head can also be two-part.

It is particularly recommendable that the holder of the head corresponds to that of the valve housing. The upper part can then optionally be mounted on the valve housing direct or by way of the head carrying the inverter.

Preferably, the inverter can also be delivered as an independent component for an operating device, as de-
scribed above. Thus, the user himself can change a heating valve into a refrigeration valve on need.

In the following the invention is described on the basis of preferred embodiments in connection with the drawings, showing:

Fig. 1  a longitudinal section through an operating device according to the invention

Fig. 2  a cross section along the line A-A in Fig. 1

Fig. 3  a cross section along the line B-B in Fig. 1

Fig. 4  a longitudinal section through a modified embodiment

Fig. 1 shows an operating device 1 having an upper part 2 and a head 3. The latter is fixed on the merely intermittently drawn valve housing 4 in that fixing means 7 in the shape of a screw engage in a holder 6. Inside the valve housing further parts are shown intermittently, but not true to scale and not in the right places, namely a closure member 8, a return spring 9 and a valve pin 10, which is led out through a gland seal 11.

The upper part 2 is fixed on the head 3 in that fixing means 12 in the shape of a screw engage in a holder 13 on the head 3, which corresponds to the holder 6 on the head 3, which does not mean, however, that they are identical, but merely that with the fixing elements 5 and 12 a safe fixing is obtained.

In the upper part 2 there is a corrugated pipe 14, which is part of a thermostatically operated regulating unit 15 and is connected with a temperature sensor via a capillary
tube 16. On increasing temperature, the thermostatic medium, that is, a liquid-vapour charge or a liquid charge, transmits the movement of its front face 17 in the closing direction of the valve via a transmission element 18, which surrounds the bellows box 14 by way of a barrel-shaped extension 19 and is held against the front face 17 by means of a spring 20.

Between the transmission element 18 and the valve pin 10 an inverter 21 is arranged. The inverter has an inlet element 22 and an outlet element 23, which are displaceable along an axis E corresponding to the movement track of the regulating unit 15, and between which two intermediary elements 24 and 25 are arranged, which are pressed against each other by the springs 26 surrounding the intermediary elements, and which are displaceable on guides 27, 28 in the transverse direction, namely vertically to the axis E and thus vertically to the symmetry level dividing the inlet and an outlet elements in the middle and extending between the two intermediary elements 24 and 25. These guides 27 and 28 are arranged in the upper part of the head 3.

The inlet element 22 has two tapered inlet surfaces 30 and 31, which bear planely on first tapered intermediary surfaces 32 and 33 of the intermediary elements 24 and 25. The outlet element 23 has two tapered outlet surfaces 34 and 35 bearing planely on the second tapered intermediary surfaces 36 and 37 of the intermediary elements 24 and 25.

When the upper part 2 is fixed direct on the housing 4, the transmission element 18 acts direct upon the valve pin 10. The belonging valve closes at increasing temperature. When, however, the inverter 21 is also used, the movement conditions are reversed. The valve opens at increasing temperature.
This takes place as follows: When the inlet element 22 is pressed down by the regulating unit 16, the two intermediary elements 24 and 25 are pressed apart. This means that the outlet element 23 is pressed upward by the return spring 9, thus opening the valve more.

In the present case, the tapered inlet, intermediary and outlet surfaces have the same angle, here 45°, to the axis E or the symmetry level, respectively, which gives a movement ratio of 1:1. An angle area from 20° to 70° is recommended.

The spring 26 must be so strong that the valve is not able to act upon the system in the opposite direction via the valve pin, and that it can keep the valve closed. The best performance is reached in that the spring force is the same in both directions. This gives an automatic orientation of the parts.

The outlet element 23 has spring arms 38, and after insertion of the inverter 21 in its working position said arms engage over the inner projection 39 and hold all parts in the right places. However, the outlet element 23 can also be held in other ways, for example by means of an oblong hole suspension of the guide 28, 29.

In the embodiment in Fig. 4 corresponding parts have reference numbers increased by 100. The most essential difference is that both the inverter 121 and the regulating unit 115 are arranged in the head 103 fixed on the housing 102. This head leads direct to a movement reversal of the regulating movement of the regulating unit 115.

The material of the tapered surfaces has been chosen so that the friction between the surfaces sliding on each
other is kept as small as possible. The tapered surfaces do not have to be plane. They can, for example have the shape of a channel or be grooved, which enables an additional guiding.

5 The embodiments show regulating units with external temperature sensors. However, it is also possible to arrange the sensor in the regulating unit. Instead of the thermostatic regulating unit also other regulating units, for example with a heatable expansion material, like an electrically heatable wax cartridge, can be used.

According to the embodiment in Fig. 1, the inverter is arranged in a head forming an independent unit. Optionally, this head can be built-in or not built-in. Instead of the shown screw fitting, other connection forms can be used, for example snap connections.
Patent claims

1. Operating device for a valve, with a regulating unit acting via an inverter reversing the movement direction of the regulating unit upon a connecting link, which is connectable with the closure member of the valve characterised in that the inverter (21; 121) has:

   a) an inlet element (22; 122), displaceable by means of the regulating unit (15; 115) along an axis (E), with at least one tapered inlet surface (30, 31),

   b) an outlet element (23; 123), also displaceable along the axis (E), with at least one tapered outlet surface (34, 35), and

   c) at least one intermediary element (24, 25), extending vertically to the axis (E), as well as two tapered intermediary surfaces (32, 33, 36, 37), the influence of a lateral force causing the first one to bear on a tapered inlet surface (30, 31) and the second one having the opposite inclination in relation to the axis (E) to bear on a tapered outlet surface (34, 35).

2. Device according to claim 1, characterised in that the inlet element (22; 122) has two symmetrically arranged tapered inlet surfaces (30, 31) and the outlet element (23; 123) has two symmetrically arranged tapered outlet surfaces (34, 35) and that two symmetrically arranged intermediary elements (24, 25) are provided, which are pressed against each other by the lateral force.
3. Device according to claim 1 or 2, \textit{characterised in} that all tapered surfaces (30 to 37) have the same or, in reflected image, the same inclination angle in relation to the axis (E).

4. Device according to one of the claims 1 to 3, \textit{characterised in} that the lateral force is produced by at least one spring (26, 126).

5. Device according to one of the claims 1 to 4, \textit{characterised in} that the connecting link is formed by the outlet element (23, 123) and has a stop for a valve pin (10), which is spring loaded in the pressure direction.

6. Device according to one of the claims 1 to 5, \textit{characterised in} that the guide (27, 28) for the intermediary elements (24, 25) is arranged on a head (3; 103) having means for fixing on a valve housing (2; 102).

7. Device according to claim 6, \textit{characterised in} that the head (103) also carries the regulating unit (115).

8. Device according to claim 6, \textit{characterised in} that the head (3) has a holder (13) on which an upper part (2) containing the regulating unit (15) can be fixed.

9. Device according to claim 8, \textit{characterised in} that the holder (13) of the head (3) corresponds to that of the valve housing (2).

10. Inverter (21) as independent component for an operating device (1) according to one of the claims 1 to 9.
**INTERNATIONAL SEARCH REPORT**

**International application No.**

PCT/DK 99/00317

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC6: F16K 31/68 / G05D 23/02

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC6: F16H, F16K, G05D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE, DK, FI, NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>DE 2619413 A1 (DANFOSS A/S), 17 November 1977 (17.11.77)</td>
<td></td>
</tr>
</tbody>
</table>

\[\text{---} \]

Further documents are listed in the continuation of Box C. See patent family annex.

**Date of the actual completion of the international search**

13 Sept. 1999

**Date of mailing of the international search report**

14-10-1999
<table>
<thead>
<tr>
<th>Patent document cited in search report</th>
<th>Publication date</th>
<th>Patent family member(s)</th>
<th>Publication date</th>
</tr>
</thead>
<tbody>
<tr>
<td>DE 2619413 A1</td>
<td>17/11/77</td>
<td>DK 187477 A</td>
<td>04/11/77</td>
</tr>
<tr>
<td></td>
<td></td>
<td>FR 2350555 A,B</td>
<td>02/12/77</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GB 1573769 A</td>
<td>28/08/80</td>
</tr>
<tr>
<td></td>
<td></td>
<td>JP 52134245 A</td>
<td>10/11/77</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US 4114806 A</td>
<td>19/09/78</td>
</tr>
</tbody>
</table>