Title: MOTION TRANSMISSION DEVICE FOR MOVABLE MEMBERS OF MECHANICAL EQUIPMENT OR STRUCTURES

Abstract: Motion transmission device for movable members (5, 5') of mechanical equipment or structures, comprising a support (9) which can be rotated by suitable drive means (11, 12) and which is connected to a pair of levers (8, 8'); each of said levers (8, 8') is connected rotatably at one end to this support (9) and is connected at the other end to a member (5, 5') capable of sliding in one or the other direction on suitable guides (2, 2'); the rotary motion of the support (9) is converted into a synchronized rotary motion of each of the levers (8, 8') and therefore into an alternating linear motion of these members (5, 5').
TITLE: Motion transmission device for movable members of mechanical equipment or structures

DESCRIPTION

Background and summary of the invention

The present invention relates to a motion transmission device for movable members of mechanical equipment or structures.

As is known, various systems are present in essentially mechanical equipment or structures by means of which two operating members opposed to each other are alternately moved away from and towards each other in order to execute specific operations. These operating members are generally associated with sliding blocks or pads which slide along guides and are normally driven by means of actuators. In order to move these operating members towards or away from each other at variable speeds, it is frequently necessary to combine the actuators with complex operating and control systems; furthermore, these actuators are often very bulky, expensive and inefficient.

The object of the present invention is therefore to provide a motion transmission device for movable members of mechanical equipment or structures which, by using a single drive motor, enables the rotary motion of this motor to be converted into an alternating linear motion of any pair of operating members, thereby also allowing them to be moved away from or towards each other at variable speed if required.

This object is achieved by the present invention by means of a motion transmission device for movable members of mechanical equipment or structures according to Claim 1.

Other advantageous features of the present motion
transmission device for movable members of mechanical equipment or structures are described in the dependent claims.

By using the present motion transmission device for movable members of mechanical equipment or structures, therefore, a single drive motor can be used, and, by means of a pair of suitably shaped levers, the rotary motion of the motor is converted into linear motion of the two operating members, which pass, alternately, from a situation in which they are moved away from each other to a situation in which they are moved towards each other. Additionally, for a given speed of the motor, the speed of the operating members changes in the different stages of movement towards and away from each other, and, in particular, when the members are distant from each other, their speed of movement towards each other is relatively high, whereas, when they are close to each other, the speed of movement towards each other is relatively low.

**Brief description of the drawings**

Other features and advantages of the present invention will be made clear in the course of the following description, to be considered as a non-limiting example, which refers to the attached drawings, in which:

- Fig. 1 shows a first front view of a motion transmission device for movable members of mechanical equipment or structures, in a completely open position and with a maximum distance or gap between two movable members supported by the device;
- Fig. 2 shows a view from above of the present device of Fig. 1 in the open position;
- Fig. 3 shows a second front view of the present device in a
completely closed position and with a minimum distance or
gap between the operating members;
- Fig. 4 shows a view from above of the present device of
Fig. 3 in the closed position; and
- Figs. 5a, 5b, 5c and 5d show, in schematic views from
above, the sequence of the movement from a completely open
position, with a maximum gap or distance between the
operating members, to a completely closed position, with a
minimum gap or distance between the operating members.

Description of the preferred embodiment of the invention

With reference to the attached drawings, and with
particular reference to Figures 1 and 2 thereof, the number 1
indicates a support structure for a pair of parallel guides 2
and 2'. A pair of sliding blocks or pads 3 and 3' slides on
each of the guides 2 and 2'. The pad 3 and the pad 3'
positioned on each guide 2 and 2' are translated
simultaneously in opposite directions to each other, and are
therefore moved away from or towards each other.
Additionally, the two pads 3' placed on the right-hand side
of the device, as it appears to the viewer of the drawings, are
positioned in a position which is a mirror image of that of
the two pads 3 placed on the left-hand side relative to a
median plane M of the device. The two pads 3' located on
the right-hand side support a first essentially L-shaped plate
4', placed in a position which is a mirror image, relative to
the median plane M, of that of a second essentially L-shaped
plate 4 carried by the pair of pads 3 located on the left-hand
side of the device. Each of these plates 4 and 4' supports an
operating member which must be translated in one or the
other direction, in other words the operating member 5 and
the operating member 5'. These operating members 5 and 5'
could be, for example, heads for welding the tops and bottoms of packages for packaging machines, these heads, as is known, being generally aligned and opposed to each other and moving towards and away from each other. These operating members 5 and 5' are in positions which form mirror images relative to the median plane M of the device. Each of the plates 4 and 4' is connected by means of a plate 6 and 6', provided with a corresponding pin 7 and 7', to a first end part of a corresponding curved lever: the pin 7 is connected to the first free end part 108 of a first curved lever 8, while the pin 7' is connected to a first free end part 108' of a second curved lever 8'. These first end parts 108 and 108' of the curved levers are in diametrically opposed positions. The curved levers 8 and 8' can take the form of circular arcs, elliptical arcs, or the like, and are preferably identical. Each of these curved levers 8 and 8' comprises a second end part 208 and 208', fastened to a support plate 9, which in this case is circular. The second end part 208 of the curved lever 8 is connected to the plate 9 by means of a pin 10 about which the lever 8 can rotate, while the second end part 208' of the curved lever 8' is connected to the plate 9 by means of a pin 10' about which the lever 8' can rotate. The pins 10 and 10', and therefore the end parts 208 and 208' of the levers 8 and 8', are located in the proximity of the periphery of said plate 9 and in diametrically opposite positions relative to this plate. This support plate 9 is connected centrally to the shaft 11 of an electric motor 12, provided with a bush 13 for its support on the structure 1. In this structure 1, a cavity 14 is provided to allow the circular plate 9 to pass partially through it.

In the situation shown in Figs. 1 and 2, the present
device is shown in the open position, in other words with the operating members 5 and 5' at the maximum distance from each other. As mentioned, these operating members could be, for example, heads for welding the tops and bottoms of packages for packaging machines, and the present motion transmission device is particularly advantageous if used for translating these welding heads in one or the other direction. In the situation shown in Figures 1 and 2, the package welded at the top and bottom can pass freely through the free space left between the operating members 5 and 5', owing to the size of the distance L.

In Figures 3 and 4, the present device is shown in the closed position, in other words with the operating members 5 and 5' at the minimum distance from each other, which may ultimately be equal to zero, if for example the operating members come into contact with each other as a result of their operation. If these movable members are heads for welding the tops and bottoms of packages for packaging machines, in this situation the heads are able to weld the top of one package and the bottom of a subsequent package.

The present device can move at the desired speed from the open to the closed position, and vice versa. In order to move, for example, from the open position of Figures 1 and 2 to the closed position of Figures 3 and 4, the motor 12 is operated in such a way that the shaft 11 causes the plate 9 to rotate through about 90° in the direction of the arrow R of Fig. 1. Simultaneously with the rotation of the plate 9, there is a synchronized rotation of the curved levers 8 and 8' about the respective rotation pins 10 and 10', in the opposite direction to the direction R of the support plate 9. At the end of this rotation of the plate 9, the terminal parts 208 and
208' of the levers 8 and 8' have also rotated through 90° in the direction of the arrow R, while the end parts 108 and 108' of the levers have moved towards each other; see Figures 1 and 3 and Figures 2 and 4. In the movement from the open to the closed position, or vice versa, one of the two levers passes under the other, with the curved lever 8' passing under the lever 8 in the present case, and therefore, as is apparent, the 8 and 8' can cross each other without any mutual interference. In order to move from the closed to the open position, the motor must be operated in such a way that the plate 9 undergoes a rotation of about 90° in the direction of the arrow R' of Fig. 3, which is opposite to the direction of the arrow R of Fig. 1. As can be seen, at the end of the rotation the rotation pins 10 and 10' of the end parts 208 and 208' of the respective curved levers 8 and 8' are still in diametrically opposed positions on the plate 9.

Depending on the size and shape of the curved levers, and the distance between the corresponding movable parts, the angle of rotation imparted by the motor 12 to the plate 9 can be other than 90°.

A further advantageous aspect of the present device is that the speed at which the operating members move towards or away from each other is variable for a given rotation speed of the motor 12. Fig. 5a shows a situation similar to that of Fig. 1, with the present device in the open position and the operating members 5 and 5' associated with the two curved levers 8 and 8' at the maximum distance L. When the motor is operated in the direction of the arrow R, the curved levers 8 and 8' rotate in a synchronized way about the respective rotation pins 10 and 10', and when they have covered approximately 50% of their curved path (see Fig.
5b), in other words when they have travelled through an angle A of approximately 45°, the two operating members will have covered approximately 80% of their linear path towards each other, thus arriving at a distance L' equal to approximately 20% of the distance L in the open position. When the curved levers 8 and 8' move through a further angle B of approximately 22.5° (see Fig. 5c), the operating members 5 and 5' move towards each other by a further 10%, and therefore the new distance L'' between them will be equal to approximately 10% of the initial distance L. Consequently, the initial speed of the movement of the two operating members 5 and 5' towards each other, and also the final movement away from each other in the opposite stage, is high, whereas, when the operating members are at a sufficiently small distance, their movement towards each other becomes markedly slower, until the situation of minimum distance, or of contact in the ultimate case, is reached as shown in Fig. 5d. This aspect of the present device, in other words the fact that the operating members move at different speeds towards and away from each other for the same motor speed, may prove to be very important in some possible applications. For example, if the operating members 5 and 5' are heads for welding the tops and bottoms of packages for packaging machines, the heads will move rapidly towards each other and to the flaps of a package to be welded, whereas, when the heads are in the proximity of the flaps and come into contact with them, they slow down markedly, in such a way that sufficient time is provided for carrying out the weld. In the same way, during their movement away from each other, there is essentially a first, relatively slow, stage of detachment from the flaps of the
package, and a second, relatively fast, stage of movement away from each other, in such a way that the package can pass through the operating members when they are again in the open position. Clearly, the arrangement described above is only one of the possible multiple applications of the present motion transmission device for movable members of mechanical equipment or structures.
CLAIMS

1. Motion transmission device for movable members (5, 5') of mechanical equipment or structures, characterized in that it comprises a support (9) which can be rotated by suitable drive means (11, 12) and which is connected to a pair of levers (8, 8'), each of said levers (8, 8') being connected rotatably at one end to said support (9) and being connected at the other end to a member (5, 5') capable of sliding in one or the other direction on suitable guides (2, 2'), the rotary motion of the support (9) being converted into a synchronized rotary motion of each of said levers (8, 8') and therefore into an alternating linear motion of said members (5, 5').

2. Device according to Claim 1, characterized in that said support (9) is connected, by means of a first rotation pin (10), to an end part (208) of a first lever (8) of said pair of levers (8, 8'), and, by means of a second rotation pin (10'), to an end part (208') of a second lever (8') of said pair of levers (8, 8'), the other end part (108, 108') of each of said levers (8, 8') being connected to means (3, 3', 4, 4', 6, 6', 7, 7') for the support and translation of each of said members (5, 5').

3. Device according to Claim 1, characterized in that said levers (8, 8') are of curved shape.

4. Device according to Claim 1, characterized in that, during said rotation in one or the other direction of the support (9), said levers (8, 8') cross each other without any interference with each other.

5. Device according to Claim 2, characterized in that said first and second rotation pins (10, 10') are positioned in the proximity of the periphery of said plate (9).
6. Device according to Claim 2, characterized in that said first and second pins (10, 10') and therefore said end parts (208, 208') of the levers (8, 8') are located on said support (9) in diametrically opposite positions.

7. Device according to Claim 2, characterized in that said other end parts (108, 108') of the levers (8, 8') are connected by means of at least one pin (7, 7') to support plates (4, 4') of said operating members (5, 5'), said support plates (4, 4') being mounted on pads or sliding blocks (3, 3') which are slidable along said guides (2, 2').

8. Device according to Claim 2, characterized in that, when the support (9) is caused to rotate in a given direction (R, R'), said levers (8, 8') rotate simultaneously about said first and second pins (10, 10') in the opposite direction to said given direction (R, R').
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
INV. F16H21/44
ADD.

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)
F16H B65B

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

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

EPO-Internal, WPI Data

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>X</td>
<td>GB 2 462 882 A (RIDEHOUGH BENJAMIN JOHN [GB]; WELCH FRANCIS BERNARD [GB]; GIBSON NICHO) 3 March 2010 (2010-03-03) figures 3, 4</td>
<td>1, 8</td>
</tr>
<tr>
<td>X</td>
<td>JP 48 044179 U (UNKNOWN JAPANES PATENTEE) 8 June 1973 (1973-06-08) figures 4-7</td>
<td>1, 3, 6, 8</td>
</tr>
</tbody>
</table>

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

* Special categories of cited documents:
  "A" document defining the general state of the art which is not considered to be of particular relevance
  "E" earlier application or patent but published on or after the international filing date
  "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
  "O" document referring to an oral disclosure, use, exhibition or other means
  "P" document published prior to the international filing date but later than the priority date claimed
  "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
  "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
  "Y" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
  "R" document member of the same patent family

Date of the actual completion of the international search 23 July 2012
Date of mailing of the international search report 30/07/2012

Name and mailing address of the ISA:
European Patent Office, P.B. 5818 Patentlaan 2
NL-2280 HJ Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer
Bel z., Thomas
<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>GB 2462882 A</td>
<td>03-03-2010</td>
<td>NONE</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>JP 51017662 Y2</td>
<td>12-05-1976</td>
</tr>
</tbody>
</table>