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(71) Applicant *(for all designated States except US)*: **F.L. SMIDTH & CO. A/S** [DK/DK]; Vigerslev Alle 77, DK-2500 Valby (DK).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **FONS, Morgens, Juhl** [DK/DK]; Amollevej 26, DK-9560 Had (DK).

(74) Agent: **GILL JENNINGS & EVERY**; Broadgate House, 7 Eldon Street, London EC2M 7LH (GB).

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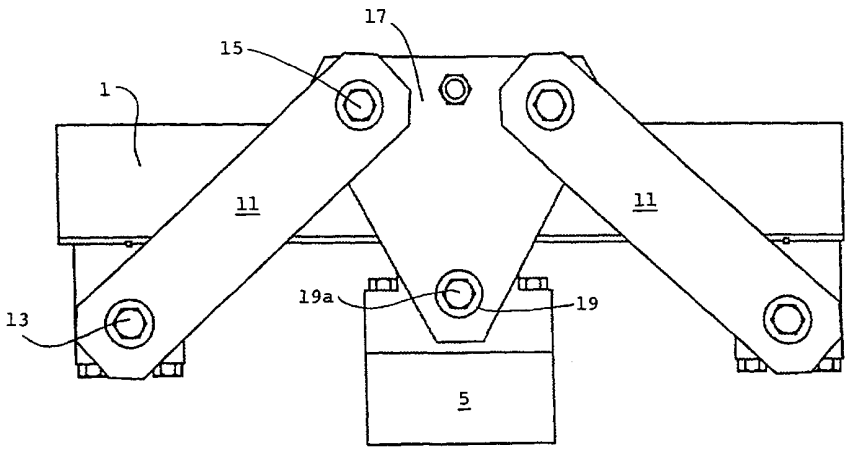
(54) Title: HEAT EXCHANGE DEVICE FOR TREATING PARTICULATE MATERIAL



(57) Abstract: A heat exchange device for treating particulate material such as cement raw materials, cement clinker or similar materials, is described which heat exchange device comprises a grate surface for supporting the material and which has means for conveying the material across the surface of the grate from the inlet of the heat exchange device to its outlet. The conveying means is moved back and forth in the direction of transport of the material and is supported by one or more carrying frames (1) which are supported in a machine frame (5) for movement substantially in the direction of transport of the material. The heat exchange device is so designed for supporting the carrying frame (1) relative to the machine frame (5) to comprise at least two kinematically determined articulated mechanisms (3) each comprising four joints. The support point (19a) connects the mechanism (3) to either the carrying frame (1) or the machine frame (5). Thus, the carrying frame (1) can be moved back and forth in a kinematically determined way within a given stroke length interval following a substantially straight line independent of the load sustained by the carrying frame.

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HEAT EXCHANGE DEVICE FOR TREATING PARTICULATE MATERIAL

The present invention relates to a heat exchange device, particularly a cooler, for treating particulate material such as cement raw materials, cement clinker or similar materials, which heat exchange device comprises a grate surface for supporting the material. Such devices have means for conveying the material across the surface of the grate from the inlet of the heat exchange device to its outlet, said conveying means being moved back and forth in the direction of transport of the material and being carried by one or more carrying frames. The carrying frame or frames are movably supported in a machine frame and connected to driving means.

Attempts have been made to support the carrying frame by means of linear guidance mechanisms allowing the carrying frame to be moved back and forth along a straight line. However, such linear guidance mechanisms have proved to be sensitive to dust, misalignment and inherent thermal forces, resulting in inadequate service life of such mechanisms.

In conventional coolers it is also known to support the carrying frames on link arms. As compared to a linear guidance mechanism, the advantage of a pendular support structure is that its service life is quite substantial due to the fact that the link arms are swivellable by means of swivel joints which may be sealed. However, the disadvantage of such carrying frame support structures is that, as is obvious, they do not follow a straight line, but, instead, follow a circular arc. In order to reduce the deviation of the movement of the carrying frame from a straight line, it is necessary, as suggested, to use long link arms. However, long link arms require a substantial height of installation in the cooler if the link arms are fixed to frame structures at the lowermost end and may also entail sealing problems if the link arms are fixed to steel at the uppermost end. Furthermore, the thermal expansion of long link arms constitutes a general problem.

From DE-A-4132475 is known a grate cooler where the carrying frame is suspended from link arms. In order to give the carrying frame a linear movement, each pendulum comprises an articulated mechanism in which one of the joints is a sliding joint to compensate for the circular arcuate movement. The disadvantage of this known solution is that the articulated mechanisms are not kinematically determined, i.e. their movement is not completley defined by their construction, therefore necessitating an external or additional means for controlling the position of the sliding joint as a function

of the angular rotation of the link arm in order to obtain a linear movement.

From WO–A-98/40683 is known a device for support of the carrying frame in a cooler or kiln in such a way that the frame is capable of being moved in reciprocating manner. The device is composed of a number of upright leaf springs which are rigidly interconnected in pairs. The disadvantage of this known device is that the curve of movement for the point of fixation depends on the vertical force which is acting upon the point. Due to the fact that the leaf springs are rigidly clamped at the ends, they are deflected in the deformed position in lazy-s shapeand the corresponding pathe of movement (or swing path) is similarly shaped and the flatness of the swing path depends on the vertical force on the springs. A greater load impact on the carrying frame and thus a greater vertical force will yield a flatter swing path. Furthermore, the total length of the leaf springs must, because of this lazy-s deflection, exceed that of a corresponding link arm support. The many leaf springs required to minimize the height of the arcuate movement will result in instability of the device in the transverse direction. Overall, from a practical point of view, this device is of little interest.

It is aim of the present invention to provide a heat exchange device in which the aforementioned disadvantages are eliminated or reduced.

This is achieved by means of a heat exchange device of the kind mentioned in the introduction, **characterised in that** the carrying frame is supported relative to the machine frame by at least two kinematically determined articulated mechanisms each comprising four swivel joints, and each being designed so that it comprises a support point which, within a given stroke length, will follow a substantially straight line, either the carrying frame or the machine frame being connected to the mechanism at the support point.

Thus, the carrying frame can be moved back and forth in a kinematically determined way within a given stroke length interval following a substantially straight line independent of the load sustained by the carrying frame.

In order to make the heat exchange device as compact as possible, it is preferred that the point of support is situated within the envelope defined by the swivel joints of the articulated mechanism.

Further, it is preferred that the point of support within the given stroke length interval is movable upward and downward within a maximum distance 0.00025 times the stroke length. At a stroke length of for example 200 mm, the point of support will thus be moving up and down a maximum of 0.05 mm.

It is further preferred that the frame defined by the articulated mechanism does not in any direction exceed the stroke length by a factor greater than 5.

According to a preferred embodiment of the invention, the heat exchange device comprises four articulated mechanisms, each articulated mechanism being fitted in the immediate proximity of each of the corners of the carrying frame.

The invention will now be described in further detail with reference to the accompanying drawings, in which:

Figure 1, is an isometric view of parts of a heat exchange device according to the invention, and

Figure 2 shows an articulated mechanism which is used in the heat exchange device shown in Figure 1.

In Fig. 1 is seen a movable carrying frame 1 which is intended for carrying conveying means (not shown) for conveying particulate material across a grate surface (not shown). The conveying means may be grate shoes which constitute part of the grate surface as described for example in DE–A-3812425, or the conveying means may be transverse girders which independently of the grate surface are moved back and forth as described for example in PCT/EP98/02012, or they may be differently configured. The particular type of conveying means does not form part of the invention. The carrying frame 1 is supported by means of four articulated mechanisms 3 from a stationary machine frame which, in the figure, is shown as a pair of beams 5. Furthermore, the movable carrying frame is connected to suitable driving means (not shown).

A simple embodiment of the articulated mechanism is shown in Figure 2. It comprises two arms 11 which are connected at one end via swivel joints 13 to the carrying frame 1 and which at their other end are connected, also by means of further swivel joints 15, to a plate 17. The plate 17 is connected at a point support 19a to the machine frame 5 via a swivel joint 19. The design of the shown articulated mechanism is such that the carrying frame follows an approximately straight line path when subjected to reciprocating movement within a given stroke length interval or range of operation. In other words, this entails that during operation the support point 19a is moved in relative terms substantially parallel to a line through the swivel joints 13.

To enhance the stability of the system, the articulated mechanisms are advantageously of a double-sided design as illustrated in Figure 1. In this case, each mechanism has two parallel plates 17a and 17b which are separated by means of a spacer 7, and which are rigidly assembled, and the arms are doubled up too. In this embodiment common swivel joints 13, 15 and 19 can be used for corresponding sides.

In the embodiment shown in Figure 1 only the swivel joints 13 and 19 are common for the two sides whereas the swivel joints 15 are individually configured for each side. Furthermore, the swivel joint 19 may advantageously be of a spherical bearing type to allow for minor deflections of the carrying frame 1. In the embodiment shown in Figure 1, the two spherical swivel joints 19c will allow for axial displacements (i.e. transversely of the carrying frame movement) whereas the two spherical swivel joints 19d are locked to prevent axial displacements.

CLAIMS

1. A heat exchange device for treating particulate material such as cement raw materials, cement clinker or similar materials, and which comprises a grate surface for supporting the material and means for conveying the material across the surface of the grate from an inlet to an outlet, back and forth in the direction of transport of the material and being supported by one or more carrying frames (1) which are supported in a machine frame (5) for movement substantially in the direction of transport of the material, **characterised in** that

the carrying frame (1) is supported relative to the machine frame by at least two kinematically determined articulated mechanisms (3) each comprising four swivel joints (13,15), and each being designed so that it comprises a support point (19a) which, within a given stroke length, will follow a substantially straight line, either the carrying frame (1) or the machine frame (5) being connected to the mechanism at the support point (19a).

2. A heat exchange device according to claim 1, wherein the point of support (19a) is disposed within the envelope defined by the swivel joints (13,15) of the articulated mechanism.

3. A heat exchange device according to claim 1 or claim 2, wherein the point of support (19a) comprises a swivel joint (19)

4. A heat exchange device according to any of claims 1 to 3, wherein, within the given stroke length interval, the support point (19a) is movable upward and downward a maximum distance 0.00025 times the stroke length.

5. A heat exchange device according to claim 4, wherein the envelope defined by the swivel joints of the articulated mechanism does not in any direction exceed the stroke length by a factor greater than 5.

6. A heat exchange device according to any of the preceding claims **which** comprises four articulated mechanisms and in that each articulated mechanism is fitted in the immediate proximity of one of the corners of the supporting frame.

7. A heat exchange device according to any of the preceding claims, wherein the articulated mecahnism comprises a pair of arms (11) having a respective swivel joint (13,15) at each end, and each arm being connected at one end to a link plate (17) by a first swivel joint (15), the support point (19a) being disposed on the link plate, the arms (11) each being connected by a second swivel joint (13) to either the machine frame (5) or the carrying frame (1) respectively.

8. A heat exchange device according to any of the preceding claims, wherein the articulated mechanisms are disposed in parallel pairs and two or more of the swivel joints (13,15) are common between the articulated mechanisms of each pair.

9. A heat exchange device according to any of the preceding claims, wherein the swivel joints on one side of the device are spherical joints.

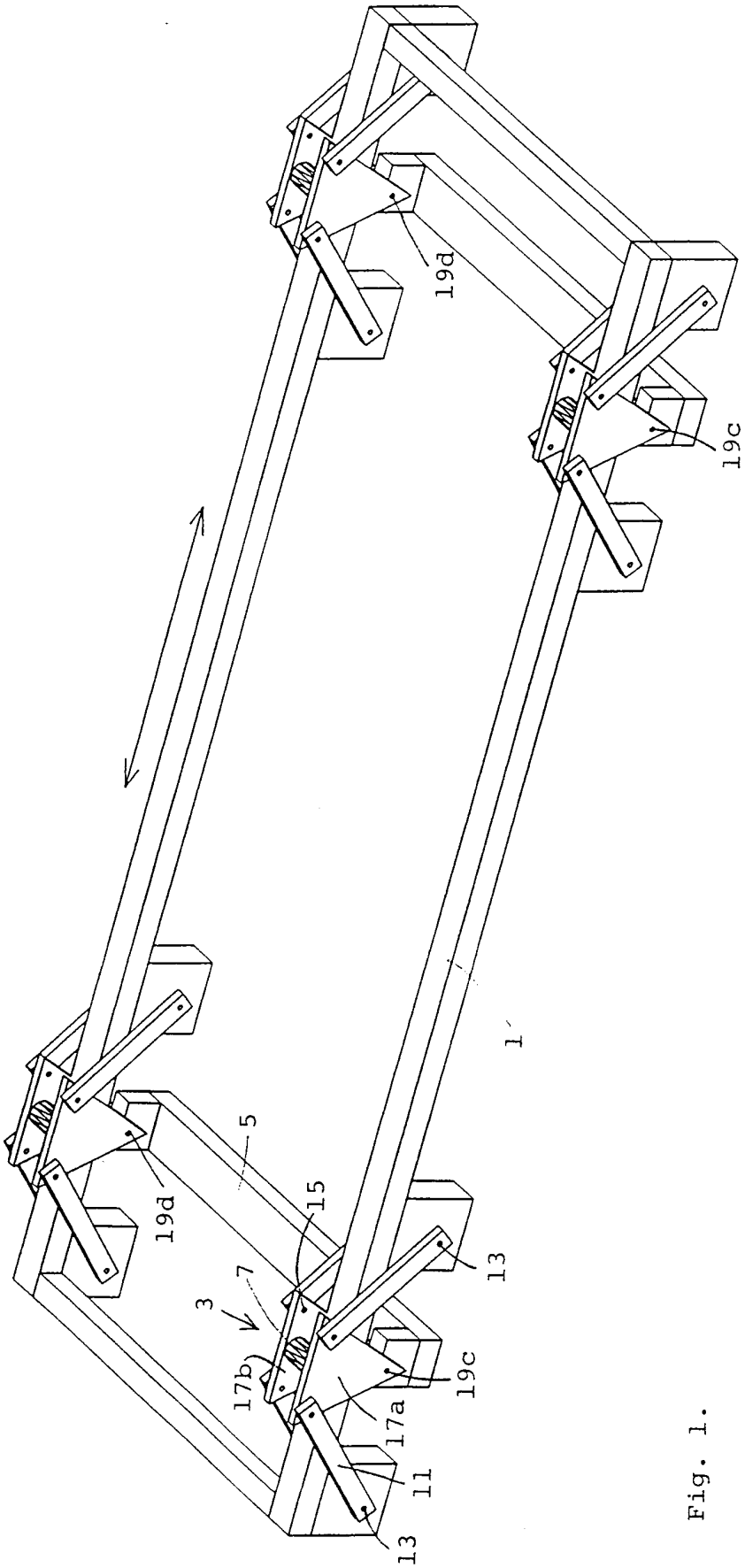

Fig. 1.

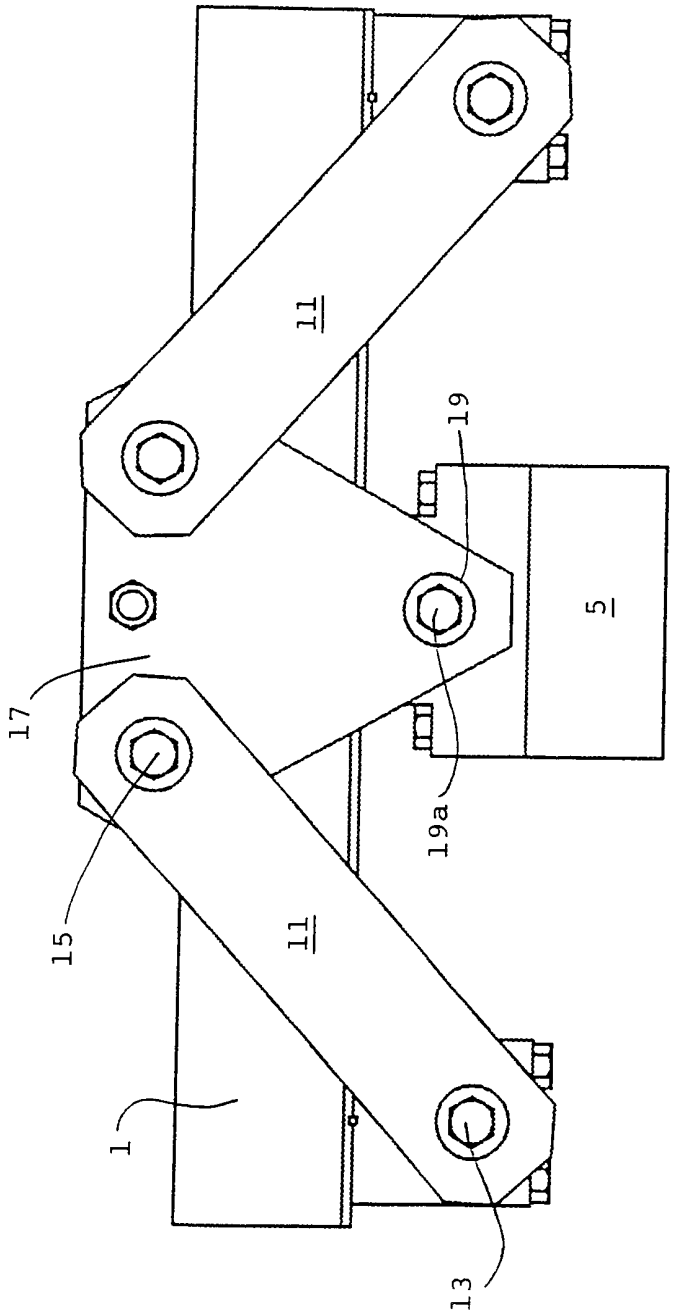

Fig. 2.

INTERNATIONAL SEARCH REPORT

Interr ıal Application No
PCT/EP 00/04462

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 F27D15/02

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)
IPC 7 F27D F27B

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 practical, search terms used)
WPI Data, EPO-Internal, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 98 40683 A (SUER ULRICH ;BMH CLAUDIUS PETERS AG (DE)) 17 September 1998 (1998-09-17) cited in the application page 3, line 33 -page 4, line 4 figure 1 -----	1-9

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in 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 document 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)

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"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 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.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13 October 2000	23/10/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Peis, S

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INTERNATIONAL SEARCH REPORT

...formation on patent family members

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PCT/EP 00/04462

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9840683 A	17-09-1998	DE 19710332 A	17-09-1998
		DE 19744903 A	15-04-1999
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