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(57) Abstract: An apparatus for washing and/or dewatering pulp comprising a first and a second press roll (102, 104), each press roll (102, 104) being permeable and rotatable about an axis of rotation (218, 218), and a vat (114, 116, 118) in which the press rolls (102, 104) are installed. The press rolls (102, 104) define a press nip (112) between them. The apparatus comprises a first pair of bearing housings (202) with bearings (204) for the first press roll (102), each bearing housing (202) of the first pair and the first press roll (102) being movable in relation to the second press roll (102, 104) to vary the press nip (112). The apparatus comprises a second pair of bearing housings (208) with bearings (208) for the second press roll (104). Each bearing housing (202) of the first pair and the opposite bearing housing (208) of the second pair are connected by an adjusting device (220; 501) which is adapted to force the first press roll (102) away from and towards the second press roll (104). The adjusting device (220; 501) is connected to at least one measuring member adapted to provide measurement values by means of which the linear load acting on the pulp in the press nip (112) is determined.
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AN APPARATUS FOR WASHING AND/OR DEWATERING PULP

Technical Field

The present invention relates to an apparatus for washing and/or dewatering pulp comprising a first press roll and a second press roll, each press roll being rotatable about an axis of rotation and having a permeable outer surface, and a vat in which the press rolls are installed. The press rolls define a press nip between them, in which press nip the pulp is pressed, and the apparatus is arranged to feed the pulp in the direction of rotation of the press rolls through the press nip. The apparatus comprises a first pair of bearing housings provided with bearings in which the ends of the first press roll are journalled, and each bearing housing of the first pair and the first press roll are movable in relation to the second press roll to vary the press nip. The apparatus also comprises a second pair of bearing housings provided with bearings in which the ends of the second press roll are journalled.

Background of the Invention

When producing cellulose-based products, a roll press is frequently used for washing and dewatering the cellulose-based pulp. The pulp is passed between two co-operating press rolls installed in the roll press, the press rolls having a perforated outer surface, a so-called mantle surface, whereby the outer surface is permeable for liquid pressed out of the pulp, and the pulp is pressed in the roll nip, or the press nip, between the press rolls, whereby liquid is pressed out of the pulp. The roll press also includes one or more washing zones prior to the press nip.

One example of such a roll press is disclosed in EP 1 035 250, where the axes of rotation of the press rolls are lying in substantially the same horizontal plane. The pulp is fed in the direction of rotation of the press rolls through the press nip and the pulp passes the press nip between the press rolls from below upwards.

In prior art roll presses, it is known to provide a press roll which is laterally movable relative to the other to vary the press nip between the press rolls. The cross-section of the press nip, or the distance between the press rolls, is one of the operating parameters which affect the quality of the washed and dewatered pulp. US 3,730,079 discloses a roll press comprising two press rolls rotatable about parallel axes, wherein one of the press rolls is laterally movable relative to
the other to vary the cross-section of the therebetween press nip. Pressing force is applied to the laterally movable press roll by a plurality of separate link systems actuated by individual fluid pressure operated actuators. Pneumatically expansible tubes or springs are provided to force the movable press roll away from the other. The object of this press is to maintain the axes of the press rolls parallel while permitting relative lateral movement of the press rolls.

The Object of the Invention

There is a need for an improved processing of pulp in an apparatus for washing and dewatering pulp comprising two rotatable press rolls, which more accurately provides pulp with the quality which is desired, and which increases the capacity of the apparatus. In order to attain an improved processing of pulp it is important to obtain a adequate determination of the linear load which acts on the pulp in the press nip and is affected by the torque of the press rolls.

In most prior art apparatus having a stationary rotatable first press roll and a rotatable second press roll which is laterally movable relative to the first press roll to vary the press nip, the lateral movement of the second press roll is attained by friction rails, normally made of a plastic material, on which the bearing housings, provided with bearings in which the laterally movable second press roll is journalled, rest and slide. The linear load is determined by measuring the load on the bearing housings of the movable second press roll. The load cells used for determining the linear load are thus situated between the sliding bearing housings and the casing housing the press rolls, often behind the sliding bearing housings in their direction of motion/sliding. During operation when the bearing housings slide back and forth on the friction rails, the friction rails are subjected to wear, and the friction between the sliding bearing housings and the friction rails is therefore not the same over time but is continuously changing. The wear on the friction rails negatively affects the determination of the linear load and is a source of errors. Consequently, the linear load can not be adequately determined.

Further, the bearing housings, the end casing members, or gables, to which the bearing housings are attached, and the region between the sliding bearing housings and the casing housing where the load cell is positioned in prior art are exposed to the heat from the vat. When there is a change in vat temperature there is also a temperature change in the region of the load cell. Thus, in prior
art, the load cell is affected by heat and temperature changes which deteriorates the performance of the load cell. This affects the determination of the linear bad and is a source of errors.

Because of poor determination of the linear load based on deteriorated performance of the load cell, the process cannot be controlled efficiently enough, and pulp having the quality which is desired cannot be produced from the roll press.

The object of the present invention is thus to provide an improved processing of pulp in an apparatus for washing and/or watering pulp comprising two rotatable press rolls.

**Summary of the Invention**

The above-mentioned object is achieved by providing an apparatus of the kind mentioned in the introductory part of the description, having the features that each bearing housing of the first pair and the opposite bearing housing of the second pair are connected to each other by an adjusting device, which adjusting device is adapted to force the first press roll away from and towards the second press roll, respectively, and that the adjusting device is connected to at least one measuring member adapted to provide measurement values by means of which the linear load acting on the pulp in the press nip is determined.

By the present invention, the at least one measuring member for measuring the forces acting on the bearing housing is situated at a position where the influence of the heat from the vat and the resulting heat changes is minimal, whereby the performance of the measuring member is radically improved and gives an accurate measurement of the forces acting on the bearing housing, and consequently, the linear load acting on the pulp in the press nip can be more accurately and efficiently determined. Hereby, the processing of pulp is efficiently improved. Further, because of the more suitable environment of the measuring member according to the present invention, the measuring member is subjected to less wear, as the heat exposure is lower and the temperature around the measuring member is kept at a more even level. However, the innovative position of the measuring member also provides for an easy and uncomplicated replacement of the measuring member if necessary.
The adjusting device is advantageously controlled by a control system, or a control device, which controls the processing of the apparatus by setting one or several variable operating parameters, which setting is based on measurements and determinations of several control parameters, inter alia the linear load. The at least one measuring member is advantageously connected to the control system, or the control device which may comprises a processing means, e.g. a CPU (Central Processing Unit).

According to an advantageous embodiment of the apparatus according to the present invention, the apparatus comprises determination means for determining the linear load based on the measurement values. When determining the linear load based on the measurement values, the determination means are adapted to take into account design parameters which are specific for the design of the overall apparatus, for example the geometry of the bearing housings, the vat pressure profile etc., or the determination means can be calibrated based on previous measurements on the apparatus.

According to advantageous embodiments of the apparatus according to the present invention, the adjusting device is directly connected, or directly attached, to the at least one measuring member.

According to another advantageous embodiment of the apparatus according to the present invention, the at least one measuring member is mounted by the adjusting device.

According to a further advantageous embodiment of the apparatus according to the present invention, the at least one measuring member comprises at least one force sensor, the adjusting device is attached to the bearing housing of one of the pairs by a first set of complementary attachment means, and said first set comprises the at least one force sensor for measuring forces acting on that set of complementary attachment means to determine the linear load acting on the pulp in the press nip.

The above-mentioned object is also attained by providing an apparatus of the kind mentioned in the introductory part of the description, having the features that each bearing housing of the first pair and the opposite bearing housing of the second pair are connected to each other by an adjusting device, which adjusting device is adapted to force the first press roll away from and towards the second press roll, respectively, that the adjusting device is attached to the bearing housing
of one of the pairs by a first set of complementary attachment means, and that said first set comprises at least one force sensor for measuring forces acting on that set of complementary attachment means to determine the linear load acting on the pulp in the press nip.

According to an advantageous embodiment of the apparatus according to the present invention, the attachment means of the first set comprise an attachment element and at least one recess which the attachment element engages, and the attachment element is provided with said at least one force sensor. Tests performed by the inventors of the present invention have shown that this position of the force sensor is especially advantageous in order to accurately determine the linear load.

According to a further advantageous embodiment of the apparatus according to the present invention, the at least one force sensor is included in a cylindrical load cell, and the attachment element is cylindrical and houses the load cell. This embodiment provides for an efficient installation of force sensors at the above-mentioned location.

According to another advantageous embodiment of the apparatus according to the present invention, the attachment element and the recess are pivotable in relation to each other. Tests performed by the inventors have shown that this arrangement of the attachment element and the recess is advantageous in order to accurately determine the linear load.

According to still another advantageous embodiment of the apparatus according to the present invention, the adjusting device is pivotally attached to the bearing housing of one of the pairs via a first pivot axis by the first set and pivotally attached to the bearing housing of the other pair via a second pivot axis by a second set of complementary attachment means, and the first and second pivot axes are displaced in relation to the axes of rotation of the press rolls.

By the arrangement where the first and second pivot axes are displaced in relation to the axes of rotation of the press rolls, the adjusting device is subjected to less stress and forces, as would be the case if the adjusting device was attached to the bearing housing via the axes of rotation, whereby the adjusting device can be less strong and have a less complicated, or less advanced, structure, and the adjusting device can thus be more light-weight and less expensive to produce.
According to yet another advantageous embodiment of the apparatus according to the present invention, each bearing housing of the first pair is pivotable about a third pivot axis which is displaced in relation to the axis of rotation of the first press roll and in relation to the first and second pivot axes, and the bearing housings of the first pair are adapted to move the first press roll in relation to the second press roll by pivoting about their third pivot axes. In addition to the source of errors because of the wear on the friction rails, the inventors of the present invention have also found that the force of the friction between the rails and the sliding bearing housing is also dependent on the vat pressure, i.e. the pressure within the vat, and other sources of errors. In prior art, a determination of the linear load which must take the friction between the friction rails and the sliding bearing housing into account b a considerable extent can not present a satisfactory and accurate enough value of the linear load. By this embodiment, the above-mentioned friction rails can be excluded, and by laterally moving the first press roll relative to the other press roll by the innovative pivoting of the bearing housings of the first press roll about the third pivot axis, the friction in connection with the movement of the first press roll to vary the press nip is in principal unchanged during long term operation, since the contact surfaces pivoting in relation to each other about the third pivot axis are not sensitive to wear, and if subjected to wear, the wear's effect on the friction between said contact surfaces is minimal. Consequently, the accuracy of the determination of the linear load based on load cells measuring the load on the bearing housings is further improved, whereby a further improved processing of pulp in an apparatus for washing and dewatering pulp is provided.

Further, since the friction rails can be excluded, there is no longer a need for repacing worn out friction rails by new friction rails, which also reduces the costs for maintenance, since no stop of the roll press is necessary because of any change of friction rails.

According to an advantageous embodiment of the apparatus according to the present invention, the adjusting device is attached to the bearing housing of the first pair by said first set of complementary attachment means. Tests performed by the inventors have shown that this position of the force sensor, i.e. in connection with the pivotable bearing housing, is advantageous in order to accurately determine the linear load.
According to another advantageous embodiment of the apparatus according to the present invention, the apparatus comprises a casing which houses said vat and the two press rolls, and each bearing housing of the first pair is pivotally attached to the casing via its third pivot axis. This pivotability attachment can be effected by a first means and a second means which are complementary to each other and pivotable in relation to each other, where the bearing housing of the first pair is provided with said first means and the casing is provided with said second means. For example, a pin can be provided on the casing and a recess can be provided in the bearing housing, which recess is complementary to and engaged by the pin. The pin and recess are pivotable in relation each other about the third pivot axis. Instead, the bearing housing could be provided with the pin and the casing could be provided with the recess.

The vat pressure tends to elevate the movable press roll in an upward direction. In prior art apparatus, the weight of the end casing members, i.e. the gables, of the apparatus, must be great so that the casing can withstand the forces of the vat pressure on the laterally movable press roll. The innovative attachment of the first press roll to the casing, advantageously to the end casing members, via the third pivot axis balances the upward force originating from the vat pressure, and the casing including the end casing members can be manufactured using less material, providing end casing members and a casing of a reduced weight which still efficiently withstand the forces originating from the vat pressure.

Further, in prior art apparatus there is a need for a strong, bulky and heavy mechanism which applies a force on the movable first press roll and its bearing housings in the direction towards the stationary press roll to counter act the force produced in the press nip which forces the movable press roll away from the stationary press roll. Further, the overall casing must be strong and heavy to handle the forces originating from the press nip. Because of the innovative attachment of the first press roll to the casing, advantageously to the end casing members, via the third pivot axis, the weight and size of said mechanism can be reduced and the weight of the casing can be further reduced. Since said mechanism and the casing of the apparatus can thus be produced using less material, providing a low-weight apparatus, the apparatus is easier to transport and install, and also less expensive to manufacture.
According to an advantageous embodiment of the apparatus according to the present invention, the adjusting device is in the form of a pneumatic or hydraulic driving device and comprises a housing adapted to contain fluid, and the at least one measuring member comprises at least one pressure sensor for measuring the pressure of the fluid provided by the housing to determine the linear load acting on the pulp in the press nip. By measuring the pressure of the fluid provided to the driving device, the linear load can be determined in an efficient way. The pressure measuring equipment can be easily mounted to the apparatus, even if apparatuses already manufactured and installed on site. The fluid can be a gas or a liquid, for example oil, but other fluids for the driving device may also be used.

According to a further advantageous embodiment of the apparatus according to the present invention, the at least one pressure sensor is adapted to measure the pressure of a fluid situated in the housing of the adjusting device. The measurement values of the pressure of a fluid situated in the housing are advantageous for determining the linear load. Alternatively, the at least one pressure sensor can be adapted to measure the pressure of a fluid situated in a fluid-carrying line which connects the housing to a fluid reservoir.

According to another advantageous embodiment of the apparatus according to the present invention, the housing houses a piston which divides the inner space of the housing into a first chamber and a second chamber, and the at least one pressure sensor is adapted to measure the pressure of the fluid of both the first chamber and the second chamber. By measuring the pressure of both the first and the second chamber, the pressure difference therebetween can be provided, which is advantageous for determining the linear load.

Alternatively, the at least one pressure sensor can be adapted to measure the pressure of a fluid situated in a fluid-carrying first line which connects the first chamber to a fluid reservoir and the pressure of a fluid situated in a fluid-carrying second line which connects the second chamber to a fluid reservoir. The apparatus may also comprise determination means adapted to determine the difference between the fluid pressure of the first line and the fluid pressure of the second line, and adapted to determine the linear load based on the pressure difference between the first and second lines.

According to yet another advantageous embodiment of the apparatus according to the present invention, the apparatus comprises determination means
adapted to determine the difference between the fluid pressure of the first chamber and the fluid pressure of the second chamber, and adapted to determine the linear load based on the pressure difference between the first and second chambers. This is an efficient way to provide a good determination of the linear load based on pressure measurement on the adjusting device.

According to still another advantageous embodiment of the apparatus according to the present invention, the adjusting device is in the form of a hydraulic driving device. By using a hydraulic driving device, an efficient control of the movable press roll and of the size of the press nip is achieved. However, also other devices for adjusting the distance between the press rolls are possible, such as devices based on electrorheology.

According to another advantageous embodiment of the apparatus according to the present invention, the first pivot axis is positioned between the axis of rotation of the first press roll and the press nip, and the second pivot axis is positioned between the axis of rotation of the second press roll and the press nip. Hereby, the longitudinal extension of the adjusting device can be reduced and thus be manufactured using even less material making it even less expensive to produce.

According to still another advantageous embodiment of the apparatus according to the present invention, where the adjusting device is pivotally attached to the bearing housing of the first pair via said first pivot axis, when the axes of rotation of the two press rolls are in the same plane which is substantially parallel to the plane on which the apparatus rests, the third pivot axis and the first pivot axis are positioned on different sides of said plane in which the axes of rotation of the two press rolls lie.

By the above-mentioned innovative attachments of the adjusting device, where the first pivot axis is displaced in relation to both the third pivot axis and the axis of rotation of the first press roll, the adjusting device is subjected to less stress and forces in relation to an adjusting device attached to the bearing housing via the axis of rotation.

By the above-mentioned displacements of the first pivot axis from the third pivot axis, a "leverage effect" is attained, whereby less force is required to force the movable first press roll towards the other stationary press roll. The longer distance between the third pivot axis and the first pivot axis, the more prominent the
"leverage effect" becomes, and the adjusting device is also subjected to less stress and forces during operation and can thus be less strong and have a less complicated, or less advanced, structure, and can thus be made of less material.

The axes of rotation of the two press rolls can be in the same plane which is substantially parallel to the plane on which the apparatus rests and, and the movable press roll is then laterally movable in relation to the other, or the axes of rotation of the press rolls can be positioned in other ways.

Further advantageous embodiments of the apparatus according to the present invention and further advantages of the apparatus according to the present invention emerge from the detailed description of preferred embodiments.

**Brief Description of the Drawings**

The present invention will now be described, for exemplary purposes, in more detail by way of embodiments and with reference to the enclosed drawings, in which:

Fig. 1 is a schematic view of an embodiment of the apparatus according to present invention;

Fig. 2 is a schematic view illustrating bearing housings of the apparatus of Fig. 1;

Fig. 3 is a schematic section view illustrating a set of complementary attachment means of a first embodiment of the apparatus according to the present invention;

Fig. 4 is a schematic view of the set of complementary attachment means of Fig. 3 seen from above; and

Fig. 5 is a schematic cut-away view illustrating an embodiment of an adjusting device of a second embodiment of the apparatus according to the present invention.

**Detailed Description of Preferred Embodiments**

Fig. 1 schematically shows an embodiment of the apparatus for washing and dewatering cellulose-containing pulp according to the present invention provided with an embodiment of the system according to the present invention schematically illustrated with blocks. The apparatus comprises a first rotatable press roll 102 and a second rotatable press roll 104, each press roll 102, 104 having a permeable outer surface 108, 108 which is perforated, i.e. provided with apertures,
whereby the outer surface 106, 108 is permeable to filtrate pressed out of the pulp. The shape of the apertures is normally circular, but any shape is possible. The press rolls 102, 104 comprise a number of filtrate channels 110 radially inwards of the outer surface 106, 108 to lead evacuated filtrate away. The two press rolls 102, 104 defines a press/roll nip 112 between them, in which press nip 112 the pulp is pressed, and are arranged to rotate in opposite directions, the left press roll 104 being arranged to rotate in counter clockwise direction and the right press roll 102 being arranged to rotate in clockwise direction. The apparatus is arranged to feed the pulp in the direction of rotation of the press rolls 102, 104 through the press nip 112. The axes of rotation of the press rolls 102, 104 being in substantially the same horizontal plane, and the apparatus is arranged to feed the pulp through the press nip 112 in a substantially vertical direction from below upwards. One of the press roll 102, 104, herein the first press roll 102, is laterally movable in relation to the other press roll 104 to vary the press nip 112 under the operation of the apparatus. The processing of the pulp in the apparatus is determined by a set of variable operating parameters which are variable during operation. The cross-section of the press nip is on of these operating parameters.

The apparatus comprises a casing 113 which includes a vat 114, 116, 118 in which the press rolls 102, 104 are installed, the vat 114, 116, 118 partly enclosing the outer surface 106, 108 of each press roll 102, 104, whereby a gap 124, 125 for each press roll 102, 104 is defined, limited by the vat 114, 118, 118 and the outer surface 106, 108 of the respective press roll 102, 104. The vat 114, 118, 118 can be pressurized and comprises a first side vat segment 114 which partly encloses the outer surface 106 of the first press roll 102, and a second side vat segment 118 which partly encloses the outer surface 108 of the second press roll 104. In the gap a vap pressure is built up during operation which tends to elevate the press rolls 102, 104 in an upward substantially vertical direction.

Said casing 113 comprises a first casing member 115 which extends between the ends of the first press roll 102 and to which the first side vat segment 114 is mounted, and a second casing member 117 which extends between the ends of the second press roll 104 and to which the second side vat segment 116 is mounted. The first casing members 115 is pivotabie about a first axis 121 and the second casing members 117 is pivotabie about a second axis 123, whereby the casing members 115, 117, together with their side vat segments 114, 118, are
movable between a closed position and an opened position for providing access to
the press rolls 102, 104. Further, the vat 114, 116, 118 comprises a central vaf
segment 118 partly enclosing the outer surface 108, 108 of the press rolls 102, 104 between the press nip 112 and the side vat segments 114, 118.

The apparatus comprises a first pulp distribution device 128 for distributing
pulp on the first press roll 102 and a second pulp distribution device 128 for dis-tributing pulp on the second press roll 104. The pulp distribution devices 128, 128 are arranged to distribute pulp to the gap 124 along the whole length of each press
roll 102, 104. The pulp distributed on the outer surface 106, 108 of the press roll
102, 104 forms a mat on the press rolls 102, 104. Herein, the pulp distribution de-
vice 126, 128 is in the form of a pulp distribution screw. However, other kinds of
pulp distribution devices are possible. The pulp distribution device 128, 128 can
also comprise several separate pulp distribution means distributed one after the
other along the longitudinal extension of the press roll 102, 104. Each pulp distri-
button device 128, 128 is connectable to a pulp supplying system via connection
means 140, 142, and the supplying system supplies pulp to each pulp distribution
device 126, 128.

The apparatus also includes a pulp transport screw (not shown), which for
example can be in the form of a pulp disintegrating screw or a shredder screw, to-
wards which the pulp which has been pressed in the press nip 112 is conveyed.
The pulp transport screw extends parallelly to the longitudinal axes of the press
rolls 102, 104, and is arranged to disintegrate the pulp and transport the pulp axi-
ally away from the press for further processing.

With reference to Fig. 2, the apparatus includes a first pair of bearing
housings 202 provided with bearings 204, in which bearings 204 the ends of the
first press roll 102 are journaled, and a second pair of bearing housings 208 pro-
vided with bearings 208, in which bearings 208 the ends of the second press roll
104 are journaled. In Fig. 2, only one of the bearing housings 202 of the first pair
and the opposite bearing housing 208 of the second pair are shown. The casing
113 of the apparatus includes two end casing members 210 (only one end casing
member is shown in Fig. 2) between which the press rolls 102, 104 are installed,
and each end casing member 210 comprises a beam 212 to which both a bearing
housing 202 of the first pair and the opposite bearing housing 208 of the second
pair are attached. The bearing housing 202 of the first pair is pivotally attached to
the beam 212 via a third pivot axis 214 which is displaced in relation to the axis of rotation 218 of the first press roll 102, and the bearing housings 202 of the first pair are adapted to move the first press roll 102 in relation to the second press roll 104 by pivoting about their third pivot axes 214. The bearing housings 206 of the second pair are fixedly attached to the beam 212. The pivotally attachment of the bearing housings 202 of the first pair to the beam 212 is effected by a pin 215 provided on each bearing housing 202 and a recess 217 provided in each beam 212, which recess 217 is complementary to and engaged by the pin 215. The pin 215 and recess 217 are pivotal in relation each other about the third pivot axis 214.

The apparatus rests on a plane, and the axis of rotation 218 of the second press roll 104 and the axis of rotation 218 of the first press roll 102 are in the same plane which is substantially horizontal and substantially parallel to the plane on which apparatus rests. The third pivot axis 214 and the axis of rotation 218 of the first press roll 102 lie in the same plane which is transverse to the plane on which the apparatus rests.

Each bearing housing 202 of the first pair and the opposite bearing housing 208 of the second pair are connected to each other by an adjusting device 220, in the form of a hydraulic driving device, more precisely a hydraulic cylinder in the disclosed embodiment. The adjusting devices 220, one provided at one end of the apparatus and the other provided at the other end of the apparatus, are adapted to force the laterally movable press roll 102 away from the stationary second press roll 104 and towards the second press roll 104 for providing a specific distance between the press rolls 102, 104 and for keeping this distance. The adjusting device 220 is pivotally attached to the bearing housing 202 of the first pair via a first pivot axis 222, which is displaced in relation to the third pivot axis 214 and the axis of rotation 218 of the first press roll 102, and pivotally attached to the bearing housing 206 of the second pair via a second pivot axis 224, which is displaced in relation to the axis of rotation 218 of the second press roll 104. The adjusting devices 220 are adapted to perform the lateral movement of the first press roll 102 by pivoting the bearing housings 202 of the first pair about their third pivot axes 214.

The third pivot axis 214 and the first pivot axis 222 are positioned on different sides of the plane in which the axes of rotation 218, 218 of the press rolls 102, 104 lie, which plane is substantially parallel to the plane on which the apparatus
rests. The first pivot axis 222 is positioned between the axis of rotation 218 of the first press roll 102 and the press nip 212, and the second pivot axis 224 is positioned between the axis of rotation 218 of the second press roll 104 and the press nip 212. The adjusting device 220 is pivotally attached to the bearing housing 202 of the first pair by means of a first set 226 of complementary attachment members, and the adjusting device 220 is pivotally attached to the bearing housing 206 of the second pair by means of a second set 228 of complementary attachment members.

In this embodiment, the complementary attachment members of the first set 228 generally correspond to the complementary attachment members of the second set 228. With reference to Figs. 3 and 4, the complementary attachment members of the first set 228 will now be described in more detail. The adjusting device 220 is provided with a first attachment member of the first set 226, which includes a circular-cylindrical attachment element 302. The bearing housings 202 of the first pair is provided with a second attachment member of the first set 228, which includes a recess 304 which is complementary to the cylindrical attachment element 302. Alternatively, the adjusting device may be provided with the recess 304, and the bearing housings 202 of the first pair may be provided with the circular-cylindrical attachment element. The attachment element 302 engages the recess 304, and the attachment element 302 and the recess 304 are pivotable in relation to each other about the first pivot axis 222.

According to a first embodiment of the apparatus according to the present invention, the attachment element 302 houses a cylindrical load cell 306 provided with several force sensors 308 for measuring forces acting on the cylindrical attachment element 302, which measurement then is used for determining the linear load acting on the pulp in the press nip 112. Hereby, a load measuring is provided, which corresponds more accurately to the force originating from the press nip and acting on the first press roll 102, which results in an improved and more effective determination of the linear load, whereby a further improved processing of pulp is provided. The above-mentioned measuring is performed at both adjusting devices 220. The toad cell 308 may be connected to a control device including a CPU and determination means adapted to determine the linear load based on forces acting on the first set 226 of complementary attachment means and measured by the
load cell 308, in view of the design of the overall apparatus, for example the geometry of the bearing housings, the vat pressure profile etc.

Fig. 5 shows a schematic cut-away view illustrating an embodiment of an adjusting device 501 of a second embodiment of the apparatus according to the present invention. The apparatus comprises two adjusting devices 501, one adjusting device 501 being provided at one end of the apparatus and the other adjusting device 501 being provided at the other end of the apparatus. The adjusting device 501 is in the form of hydraulic driving device 501 and comprises a housing 502 adapted to contain an oil-based liquid. The adjusting device 501 is provided with a circular-cylindrical first attachment element 302 and a circular-cylindrical second attachment element 504. The first attachment element 302 is adapted to be connected to one of the bearing housings 202, in a similar way as previously disclosed in connection with the first embodiment of the apparatus but without the toad cell 308, and the second attachment element 504 is adapted to be connected to the other bearing housing 206 opposite the bearing housing 202 to which the first attachment element 302 is connected. In a conventional way, the housing 502 of the adjusting device 501 houses a piston 506 which divides the inner space of the housing 502 into a first chamber 508 and a second chamber 510, and the piston 508 is axially movable in relation to the housing 502. A piston rod 512 is mounted to the piston 506 and to the first attachment element 302. In a conventio- nal way, each chamber 508, 510 is provided with a connection means 514, 518 for the inlet and outlet of pressurized oil, and each connections means 514, 516 is connected to an oil reservoir 518 via an oil-carrying line 520, 522, or conduit, and via a pump device 524 which controls the flow of the oil between the oil reservoir 518 and the chambers 508, 510. Via the connections means 514, 516, the pump device 524 axially displaces the piston 506 in relation to the housing 502 by increasing and decreasing, respectively, the oil volume of the respective chamber 508, 510. The adjusting device 501 is provided with a first pressure sensor 528 for measuring the pressure of the fluid situated in the first chamber 508 and with a second pressure sensor 528 for measuring the pressure of the fluid situated in the second chamber 510. Each pressure sensor 528, 528 is directly attached and mounted to the adjusting device 501. The apparatus includes a control device 530 including a CPU and determination means 532 adapted to determine the difference between the fluid pressure of the first chamber 508 and the fluid pressure of
the second chamber 510, The determination means 532 is adapted to determine the linear load based on the pressure difference between the first and second chambers 508, 510, in view of the design of the overall apparatus, for example the geometry of the bearing housings, the vat pressure profile etc. The control device 530 may also be adapted to control the pump device 524 and consequently the adjusting device 501. The above-mentioned measuring of the pressures is performed at both adjusting devices 501, and consequently, in this embodiment the pressure of four housing chambers is measured.

According to another embodiment of the apparatus according to the present invention, the adjusting device may be connected to both at least one toad cell and at least one pressure sensor.

By the present invention, the performance and the flexibility of a roll press are improved since the press nip can be more efficiently controlled based on a more accurate and more easy determination of the linear load, whereby the capacity of the apparatus is improved, and a desired quality of the pressed pulp is attained in an efficient way.
CLAIMS

1. An apparatus for washing and/or dewatering pulp comprising a first press roll (102) and a second press roll (104), each press roll (102, 104) being rotatable about an axis of rotation (216, 218) and having a permeable outer surface (106, 108), and a vat (114, 116, 118) in which the press rolls (102, 104) are installed, the press rolls (102, 104) defining a press nip (112) between them, in which press nip (112) the pulp is pressed, and the apparatus is arranged to feed the pulp in the direction of rotation of the press rolls (102, 104) through the press nip (112), the apparatus comprises a first pair of bearing housings (202) provided with bearings (204) in which the ends of the first press roll (102) are journalled, each bearing housing (202) of the first pair and the first press roll (102) being movable in relation to the second press roll (102, 104) to vary the press nip (112), and the apparatus comprises a second pair of bearing housings (206) provided with bearings (208) in which the ends of the second press roll (104) are journalled, characterized in that each bearing housing (202) of the first pair and the opposite bearing housing (206) of the second pair are connected to each other by an adjusting device (220; 501), which adjusting device (220; 501) is adapted to force the first press roll (102) away from and towards the second press roll (104), respectively, and in that the adjusting device (220; 501) is connected to at least one measuring member adapted to provide measurement values by means of which the linear load acting on the pulp in the press nip (112) is determined.

2. An apparatus according to claim 1, characterized in that the apparatus comprises determination means (532) for determining the linear load based on the measurement values.

3. An apparatus according to claim 1 or 2, characterized in that the at least one measuring member is mounted to the adjusting device (220; 501).

4. An apparatus according to any of the claims 1 to 3, characterized in that the at least one measuring member comprises at least one force sensor (308), in that the adjusting device (220; 501) is attached to the bearing housing (202) of one of the pairs by a first set (228) of complementary attachment means,
and in that said first set (228) comprises the at least one force sensor (308) for measuring forces acting on that set (228) of complementary attachment means b determine the linear load acting on the pulp in the press nip (112).

5. An apparatus according to claim 4, characterized in that the attachment means of the first set (226) comprise an attachment element (302) and at least one recess (304) which the attachment element (302) engages, and in that the attachment element (302) is provided with said at least one force sensor (308).

6. An apparatus according to claim 5, characterized in that the at least one force sensor (308) is included in a cylindrical load cell (306), and in that the attachment element (302) is cylindrical and houses the load cell (306).

7. An apparatus according to claim 5 or 8, characterized in that the attachment element (302) and the recess (304) are pivotable in relation to each other.

8. An apparatus according to any of the claims 4 to 7, characterized in that the adjusting device (220, 501) is pivotally attached to the bearing housing (202) of one of the pairs via a first pivot axis (222) by the first set (226) and pivotally attached to the bearing housing (206) of the other pair via a second pivot axis (224) by a second set (228) of complementary attachment means, and in that the first and second pivot axes (222, 224) are displaced in relation to the axes of rotation (216, 218) of the press rolls (102, 104).

9. An apparatus according to claim 8, characterized in that each bearing housing (202) of the first pair is pivotable about a third pivot axis (214) which is displaced in relation to the axis of rotation (218) of the first press roll (102) and in relation to the first and second pivot axes (222, 224), and in that the bearing housings (202) of the first pair are adapted to move the first press roll (102) in relation to the second press roll (104) by pivoting about their third pivot axes (214).
10. An apparatus according to claim 9, characterized in that the adjusting device (220; 501) is attached to the bearing housing (202) of the first pair by the first set (228) of complementary attachment means.

11. An apparatus according to claim 9 or 10, characterized in that the apparatus comprises a casing (113) which houses said vat (114, 118, 118) and the two press rolls (102, 104), and in that each bearing housing (202) of the first pair is pivotally attached to the casing (113) via its third pivot axis (214).

12. An apparatus according to any of the claims 1 to 11, characterized in that the adjusting device (501) is in the form of a pneumatic or hydraulic driving device and comprises a housing (502) adapted to contain fluid, and in that the at least one measuring member comprises at least one pressure sensor (528, 528) for measuring the pressure of the fluid provided to the housing (502) to determine the linear load acting on the nip in the press nip (112).

13. An apparatus according to claim 12, characterized in that the at least one pressure sensor (528, 528) is adapted to measure the pressure of a fluid situated in the housing (502) of the adjusting device (501).

14. An apparatus according to claim 12 or 13, characterized in that the housing (502) houses a piston (508) which divides the inner space of the housing (502) into a first chamber (508) and a second chamber (510), and in that the at least one pressure sensor (528, 528) is adapted to measure the pressure of the fluid of both the first chamber (508) and the second chamber (510).

15. An apparatus according to claim 14, characterized in that the apparatus comprises determination means (532) adapted to determine the difference between the fluid pressure of the first chamber (508) and the fluid pressure of the second chamber (510), and adapted to determine the linear load based on the pressure difference between the first and second chambers (508, 510).

18. An apparatus according to any of the claims 1 to 15, characterized in that the adjusting device (220; 501) is in the form of a hydraulic driving device.
### A. CLASSIFICATION OF SUBJECT MATTER

**IPC:** see extra sheet

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: D21C, D21D, D21F, B30B, BOL1, G01L

**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)**

### EPO-INTERNAL, WPI DATA, PAJ

### C. DOCUMENTS CONSIDERED TO BE RELEVANT

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**Date of the actual completion of the international search**
14 December 2009

**Date of mailing of the international search report** 12-17-2009

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International patent classification (IPC)

D21C 9/18 (2006.01)
B01D 33/067 (2006.01)
B30B 9/20 (2006.01)
D21C 9/06 (2006.01)

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