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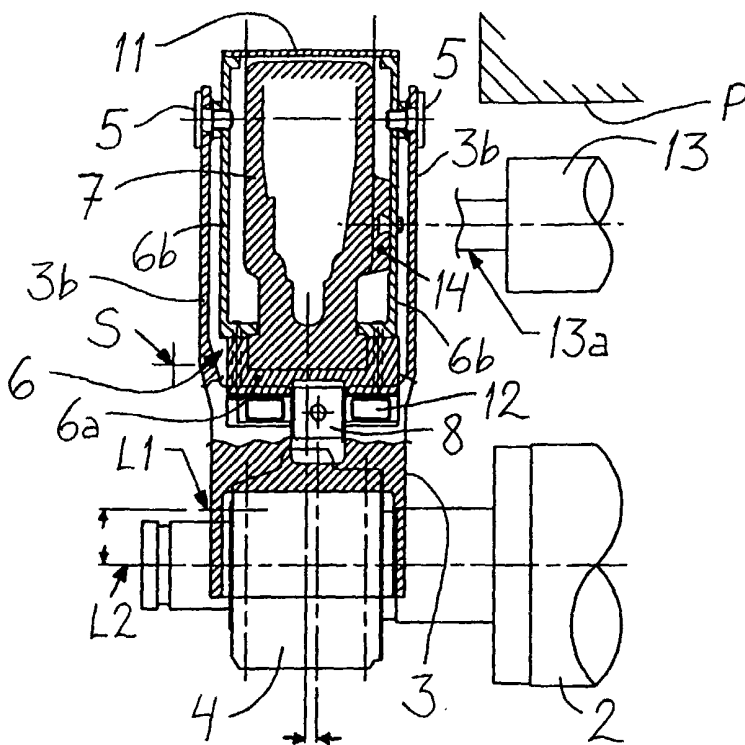
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(54) Title: CALENDER AND METHOD OF REBUILD OF A CALENDER



(57) Abstract: Calender has a supporting frame and a set of rolls attached to vertical portions of the supporting frame so as to form a stack of rolls in which adjacent rolls placed one above another form calendaring nips therebetween. The stack includes a top roll, a bottom roll and a plurality of intermediate rolls between the top roll and the bottom roll. The intermediate rolls are attached revolvingly to arms pivoted on auxiliary frames attached to vertical portions of the supporting frame. In the rebuild of a calender, auxiliary frames are attached to the vertical portions of the existing calender frame, whereafter pivotal arms for the intermediate rolls are mounted on the auxiliary frames.

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Calender and method of rebuild of a calender

Field of the invention

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The invention relates to a calender having a supporting frame and a set of rolls attached to vertical portions of the supporting frame so as to form a stack of rolls in which adjacent rolls placed one above the other form calendaring nips therebetween, the stack including a top roll, a bottom roll and a plurality of intermediate rolls between the top roll and the bottom roll. The invention also relates to a method of rebuild of a calender where the construction of an existing calender is used to provide a modernized calender.

15 Background of the invention

The set of rolls in a calender conventionally comprises a plurality of rolls which are arranged one above the other as a stack of rolls. The rolls are placed one above another and adjacent rolls in the stack are in nip contact with one another, and the paper or board web or equivalent to be calendered is arranged to run through the nips between the rolls. The rolls are journaled revolvingly on bearing housings, which in turn are normally attached to slides fitted slidably on vertical guides provided in the frame of the calender. The slides are suspended through spindle nuts on vertical lifting spindles provided in the frame of the calender. Thus, the rolls of the set of rolls are not rigidly fixed at their bearing housings to the frame of the calender, but, instead, the rolls can move in a vertical direction.

30 The mass of the bearing housings of the rolls and the auxiliary devices attached thereto, such as, fly rolls, are quite large, and as such, cause in conventional calendars the considerable drawback of distortions in the distributions of the linear loads of the nips. For this reason, calendars have started to incorporate relief devices which are supported on the slides of the rolls, on one hand, and on spindle nuts provided on the lifting spindles, on the other hand. In this manner, distortions caused by the weight of the bearing housings of the rolls and

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the auxiliary devices attached thereto in the linear load profiles between the rolls can be relieved by means of relief devices. One such arrangement has been previously disclosed, inter alia, in U.S. Pat. No. 4,901,637. The use of relief devices is previously known also from
5 conventional machine calenders, in which attempts are made to eliminate, in particular, by means of hydraulic relief cylinders, the above-mentioned effect of concentrated loads arising from the bearing housings of the rolls and from auxiliary devices.

10 New supercalenders have begun to employ polymer rolls as soft rolls instead of fiber rolls, whereupon the total height variation of the set of rolls has remained considerably smaller than in conventional supercalenders that use fiber rolls. One reason for this reduced total height variation has been the fact that variations in the diameters of soft rolls
15 have been very small because the grinding allowances of these rolls are small. This reduced total height variation has in turn led to the fact that it has been possible to omit altogether the lifting spindles and the slides associated with conventional sets of rolls in a supercalender, and it has been possible to replace this construction with a so-called pivotal set of rolls, where the intermediate rolls of the set of rolls are mounted
20 on the frame of the calender by means of articulated arms pivotally mounted on the frame. It has been possible to do so for the reason that, since variations of the total height of the set of rolls are small, the vertical distance of movement required by an individual roll is small, and because of this, irrespective of the articulated attachment mode,
25 the movements of the rolls relative to the nip level have also been very small when adjusting the height position of the roll.

One such very developed articulated set of rolls is disclosed, inter alia,
30 in U.S. Pat. No. 5,438,920, U.S. Pat. No. 5,806,415, and international application whose publication number is WO 98/50628.

The modernization of a calender having spindles to move the rolls in the direction of the stack to a multi-nip calender having pivotal arms for
35 holding the rolls involves a lot of work, because many operations have to be performed on existing constructions, such as calender frame.

Objects and summary of the invention

Accordingly, it is an object of the present invention to provide a calender which meets the demands of modern calender constructions and up-to-date multi-nip calendars by using existing calender constructions in a simple manner.

It is another object of the invention to provide a method of rebuild of a calender where the construction of an existing calender is used to provide a modernized multi-nip calender.

With a view to attaining the objects of the invention set forth above, the intermediate rolls are attached revolvingly to arms pivoted on auxiliary frames, which in turn are attached to vertical portions of the supporting frame of the old calender. With the help of auxiliary frames, all the necessary equipment for modernization can be incorporated in this frame, and the vertical portions of the old frame that has existed prior to the rebuild, that is, the vertical posts designed to carry the vertical spindles and shaped to act as guides for the bearing housings of the rolls need only be modified in view of mounting the auxiliary frames.

The auxiliary frames can be designed as profiles which in part clamp around the old guides of the frame, and, being composed of several parts, wrap around the existing vertical portions of the old calender frame. The arms supporting the intermediate roll at both ends thereof can each be pivoted to this profile to both lateral portions thereof on opposite sides of the vertical portion of the old frame. The arms can also provide a place for mounting revolvingly the inner fly rolls that have existed inside the old calender frame.

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Brief description of the drawings

Additional objects of the invention will be apparent from the following description of the preferred embodiment thereof taken in conjunction with the accompanying non-limiting drawings, in which:

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- Fig. 1 is a side view of a portion of the calender roll stack in a modernized calender,
- Fig. 2 is a front view of the same,
- Fig. 3 is a horizontal cross-section of one of the vertical portions of the frame of a modernized calender, and
- Fig. 4 is a horizontal cross-section of the frame at the height of the bottom roll.

Detailed description of the preferred embodiments

Fig. 1 shows the lower part of a calender stack showing the bottom roll 1 and two lowermost intermediate rolls 2. The intermediate rolls 2 are attached at their both ends revolvingly to arms 3, that is, each intermediate roll 2 is supported by a pair of arms 3, to which the respective bearing housings 4 of the rolls are fixed. The arms 3 are pivoted at 5 to an auxiliary frame 6, which extends vertically in the direction of the vertical portion 7 of the old frame. The auxiliary frames 6 wrap around the respective vertical frame portions 7 that exist in the old calender at both edges of the vertical calender stack. The attachment to the old frame will be described hereinafter in more detail.

Further, at each end of an intermediate roll 2, there is an actuator 8 disposed between a forwardly protruding bracket 9 of the auxiliary frame 6 and the arm 3 to provide movements of the roll 2 and to provide relief force, when necessary during the calendaring, and they are used to control the load in the calendaring nips. The actuators 8, which are preferably hydraulic cylinders, can act on the same principle as disclosed in the aforementioned U.S. Patents 5,438,920 and 5,806,415 and international application WO 98/50628.

Fig. 1 also shows a shelf 3a in each arm 3 forming a support surface under the bearing housing to make the roll change easier and safer. These support surfaces can act as a temporary support for a roll when it is fastened to the arms by its bearing housing. The bracket 9 in turn

acts as a stopper for limiting the downward pivotal movement of the arm 3 directly above it.

Fig. 2 shows one of the vertical portions of the calender frame at one edge of the stack of rolls in front view, it being understood that the construction is identical in a mirror-symmetrical manner at the opposite edge of the stack. The revolving attachment of the lowest intermediate roll 2 to the bearing housing 4 is shown entirely, whereas the ends of the bottom roll 1 and the second lowest intermediate roll 2 as well as the arm 3 carrying the second lowest intermediate roll have been omitted for showing the spacer piece 10 attached at the front side of the vertical portion 7 of the old frame at the height of the bottom roll 1 and the position of the actuator 8 at the front side of the auxiliary frame 6. As shown in Fig. 2, the auxiliary frame does not extend to the height of the bottom roll 1, but ends a short distance above the spacer piece 10 to be described in more detail hereinafter.

Fig. 3 shows the structure of the vertical portion 7 of the old frame and the auxiliary frame 6 as well as their connection to each other in horizontal cross-section. The auxiliary frame 6 is made of steel and wraps around the vertical portion 7 of the old frame by surrounding it in the form of a U-shaped assembled profile and a back plate 11 attached to the U-shaped profile. The U-shaped profile of the auxiliary frame 6 has a base portion 6a lying against the front side of the vertical portion 7 of the old frame, and two portions 6b extending therefrom to both lateral sides of the vertical portion 7 of the old frame. This U-shaped profile is assembled of three parts which clamp to the vertical guide in the front portion of the vertical post 7. The base part 6a has the form of a shallow U to which L-shaped parts 6b forming the side portions are bolted so that the guide portion where the bearing housings of the old calender have slid on is clamped between the base part 6a and the shorter sides of the L-shaped parts 6b which in the area near their free ends rest against the shoulders of the guide construction.

Fig. 3 also shows shock absorbers in the form of cushions or pads 12 being placed on the upper side of the brackets 9 protruding forwardly of the auxiliary frame 6. Each bracket 9 has a pair of these shock

absorbers disposed at both sides of the actuator 8 and designed to dampen the shock caused by a quick drop of the arm 3. The arm has two legs 3b extending in approximately parallel relationship to the side portions 6b of the auxiliary frame 6. Both legs 3b are pivoted to respective side portions 6b to make the arm 3 pivotable in vertical plane. Finally, the back plate 11 is attached to the free ends of the side portions 6b of the auxiliary frame to form a cover plate and to complete the auxiliary frame to a closed structure wrapping or enclosing completely the vertical portion 7 of the old frame. The main purpose of the back plate 11 is to stabilize the side portions 6b by connecting the side portion (side plate) 6b attached to the old fly roll mount 14 to the other side portion (side plate) 6b. The back plate also gives the frame a renewed appearance.

The spindle location of the old calender before the rebuild is denoted by letter S. The location of the threading platform between the vertical frame portions is denoted by letter P.

Further, in Fig. 3 is shown how the distance of the calender rolls from the frame can change in connection with the rebuild. The center lines of the roll 2 before the rebuild (line L1) is closer to the frame than the centerline L2 after the rebuild.

One feature of the invention is the mounting of the inner fly rolls 13 guiding the web between successive nips inside the calender frame, it being understood that the calender also comprises outer fly rolls guiding the web in positions forwardly of the calender frame. The inner fly rolls 13, previously attached to a fixed position revolvingly to the vertical portions 7 of the old frame (their previous mounting point now serving as attachment of the inner one of the auxiliary frame side portions 6b, denoted with 14 in Fig. 3), are now, with their shafts 13a shortened correspondingly, mounted revolvingly to the arms 3, at each end to the inner one of the two legs 3b of the respective arm 3. The outer fly rolls are mounted in a known manner to the bearing housings 4 of the intermediate rolls 2. It is understood that the mounting of these outer fly rolls is known to anyone skilled in the art and they are not shown. The inner fly rolls do not need readjustment when the intermediate rolls 2

are replaced with rolls of another diameter, because they will be always in a correct position with respect to the adjacent intermediate rolls 2, and they always provide essentially a constant web path length. Tearing or wrinkling of the web is thus avoided. As to the general principle of guiding the web alternately on both sides of the calender stack by means of the fly rolls, reference is made to the U.S. Patents and International Application discussed above.

Fig. 4 shows the structure of the calender frame in cross-section taken at the height of the bottom roll 1. As already mentioned hereinabove, the auxiliary frame 6 does not extend to the lowest area of the calender frame but at the height of the shaft of the bottom roll 1, it is replaced by a spacer piece 10 clamping around the front portion of the vertical portion of the old frame much in the same manner as the base part 3a of the auxiliary frame to space the old bearing housing 15 of the bottom roll 1 so that the center line of the bottom roll 1 will be aligned with the center lines of the intermediate rolls above it in a common nip plane. However, the connection of this spacer piece to the vertical portion 7 of the old frame is slidable to allow the vertical movement of the bottom roll 1 along the nip plane.

Alternatively, the auxiliary frame 6 can extend to the height of the bottom roll 1, and it can go all the way to the floor. It can act in its lower portion as the guide for the bottom roll. This lower portion of the auxiliary frame can be used in the same way as the spacer piece, that is, to space the bottom roll out to align it with the new centerlines of the intermediate rolls.

One preferred sequence of operations of a rebuild of a calender, without the intention to limit the scope of invention, is as follows:

- A. Demolition (removal of fly rolls, stack rolls, spindles, top loading cylinders and auxiliary devices), leaving the supporting frame
- B. Installation of wrap-around frame (auxiliary frame)
- C. Installation of the pivotal arms
- D. Reinstallation of the bottom roll and its bearing housings
- E. Reinstallation of the intermediate rolls, bearing housings and auxiliary devices to the pivotal arms

F. Reinstallation of the top roll with new bearing housings to the wrap-around frame (auxiliary frame).

5 It is understood that the invention is not limited to the number and type of rolls in the multi-nip calender that has been accomplished by means of the above elements. The top roll has not been studied above, but for example when the calender of the type shown is modernized, the top roll can be supported in a fixed position by attaching its supports to the upper sections of the auxiliary frames. The top loading cylinders used to apply load to the calender stack are at the same time discarded, and the bottom cylinder can be made to apply the load by providing its supports with loading cylinders. After this, the bottom loading cylinder will both load the calender stack and close the calendaring nips. All the rolls are lowered when the calender nips open except the top roll which remains in its fixed location. The top and bottom rolls are preferably deflection compensated rolls.

15 The invention is not restricted to the embodiment described above, but it can be varied within the scope provided by the appended claims. The invention can be applied to rebuild various types of existing supercalenders, especially to change spindle-operated supercalenders to supercalenders where the rolls are carried by pivotal arms. The invention is not limited to the type and number of rolls either, it being understood that variations to roll structures and number of rolls could be made in connection with the rebuild. It is not necessary to change the intermediate rolls during the rebuild, and the change of these rolls can be decided case by case. The invention is applicable to both off-line and on-line calenders having the typical multiroll construction as shown in this disclosure. Finally, the invention is not restricted to one particular loading principle, it being, however, preferred that the loading take place according to the principles known in the above-mentioned prior art, where upward load on the arms by the actuators provides more load on the top nips according to the principle known in the U.S. Patent 5,438,920 where the nip load produced by the masses of the intermediate rolls and their auxiliary equipment is substantially relieved. The various intermediate rolls can also have different loads applied to them by the actuators to compensate for unequal rigidity or deflection of

the rolls for example according to the principle known from the International Application WO 98/50628, where individual physical properties of the intermediate rolls are taken into account in the regulation of the linear loads in the calendering nips.

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Although in the preceding disclosure there has been shown a calender having the frame disposed strictly vertically at an angle of 90° to the horizontal plane, the present invention can be applied also to calenders where the frame and consequently the nip plane of the rolls is inclined at an angle to the horizontal, thus deviating from 90° . The term "vertical" used throughout the description and claims shall therefore be understood as describing any structure extending from a lower level to an upper level, either straight up or in an inclined fashion.

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Claims:

1. Calender having a supporting frame and a set of rolls (2) attached to vertical portions (7) of the supporting frame so as to form a stack of rolls in which adjacent rolls placed one above another form calendaring nips therebetween, the stack including a top roll, a bottom roll (1) and a plurality of intermediate rolls (2) between the top roll and the bottom roll, the intermediate rolls being attached revolvingly to arms (3) pivoted on auxiliary frames (6) attached to vertical portions (7) of the supporting frame.
2. Calender as claimed in claim 1, wherein the auxiliary frames (6) surround at least partly the vertical portions (7) of the supporting frame.
3. Calender as claimed in claim 1 or 2, wherein the auxiliary frames (6) are clamped to the guides in the vertical portions (7) of the supporting frame.
4. Calender as claimed in claim 2 or 3, wherein the auxiliary frame (6) includes a profile having a base portion (6a) and two side portions (6b) extending along the opposite lateral sides of the vertical portions (7) of the supporting frame.
5. Calender as claimed in claim 4, wherein the auxiliary frame (6) includes a back plate (11) attached to the free ends of the side portions (6b) to complete the auxiliary frame to a closed structure wrapping the vertical portion (7) of the supporting frame.
6. Calender as claimed in claim 4 or 5, wherein the arms (3) are connected pivotally to the side portions (6b) of the auxiliary frame (6).
7. Calender as claimed in claim 4, 5 or 6, wherein a plurality of actuators (8) is placed between the auxiliary frame (6) and the arms (3).
8. Calender as claimed in claim 7, wherein the actuators (8) are supported by brackets (9) projecting forwardly from the auxiliary frame (6).

9. Calender as claimed in any of the preceding claims, wherein fly rolls (13) designed to guide a web between two successive nips of the calender stack are mounted revolvingly on said arms (3).

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10. Calender as claimed in any of the preceding claims, wherein the arm (3) has a forward extension located underneath a bearing housing of the intermediate roll (2) to support in the form of a shelf (3a) the bearing housing.

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11. Calender as claimed in any of the preceding claims, wherein the support of the bottom roll (1) is fixed to a spacer piece (10) mounted slidably on the guide of the vertical portion (7) of the supporting frame below the auxiliary frame (6).

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12. Calender as claimed in any of the preceding claims 1 to 10, wherein the lower portion of the auxiliary frame (6) forms a guide for the support of the bottom roll (1).

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13 Method of rebuild of a calender including a supporting frame and a set of rolls (2) attached to vertical portions (7) of the supporting frame so as to form a stack of rolls in which adjacent rolls placed one above another form calendaring nips therebetween, the stack including a top roll, a bottom roll (1), and a plurality of intermediate rolls (2) between the top roll and the bottom roll (1), wherein at least the intermediate rolls (2) are detached from the supporting frame of the calender, auxiliary frames (6) are attached to the vertical portions (7) of the supporting frame, arms (3) are mounted on the auxiliary frames (6) one above another pivotally with respect to the auxiliary frame (6), and intermediate rolls (2) are mounted on the arms (3).

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14 Method as claimed in claim 13, wherein the bottom roll (1) is detached from the supporting frame and is thereafter attached slidably thereon through a spacer piece (10) attached to a support of the bottom roll (1) and slidably on a guide in the supporting frame.

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- 15 Method as claimed in claim 13 or 14, wherein actuators (8) are arranged between the auxiliary frame (6) and the arms (3) carrying the intermediate rolls (2).
- 5 16 Method as claimed in claim 13, 14 or 15, wherein the auxiliary frame (6) is mounted around the vertical portion (7) of the supporting frame to enclose it totally.

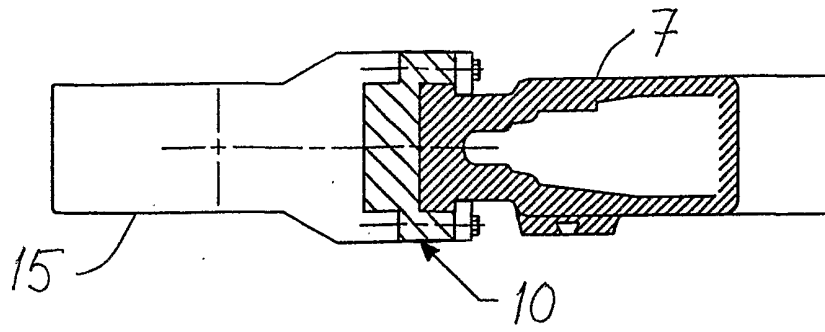


Fig. 4

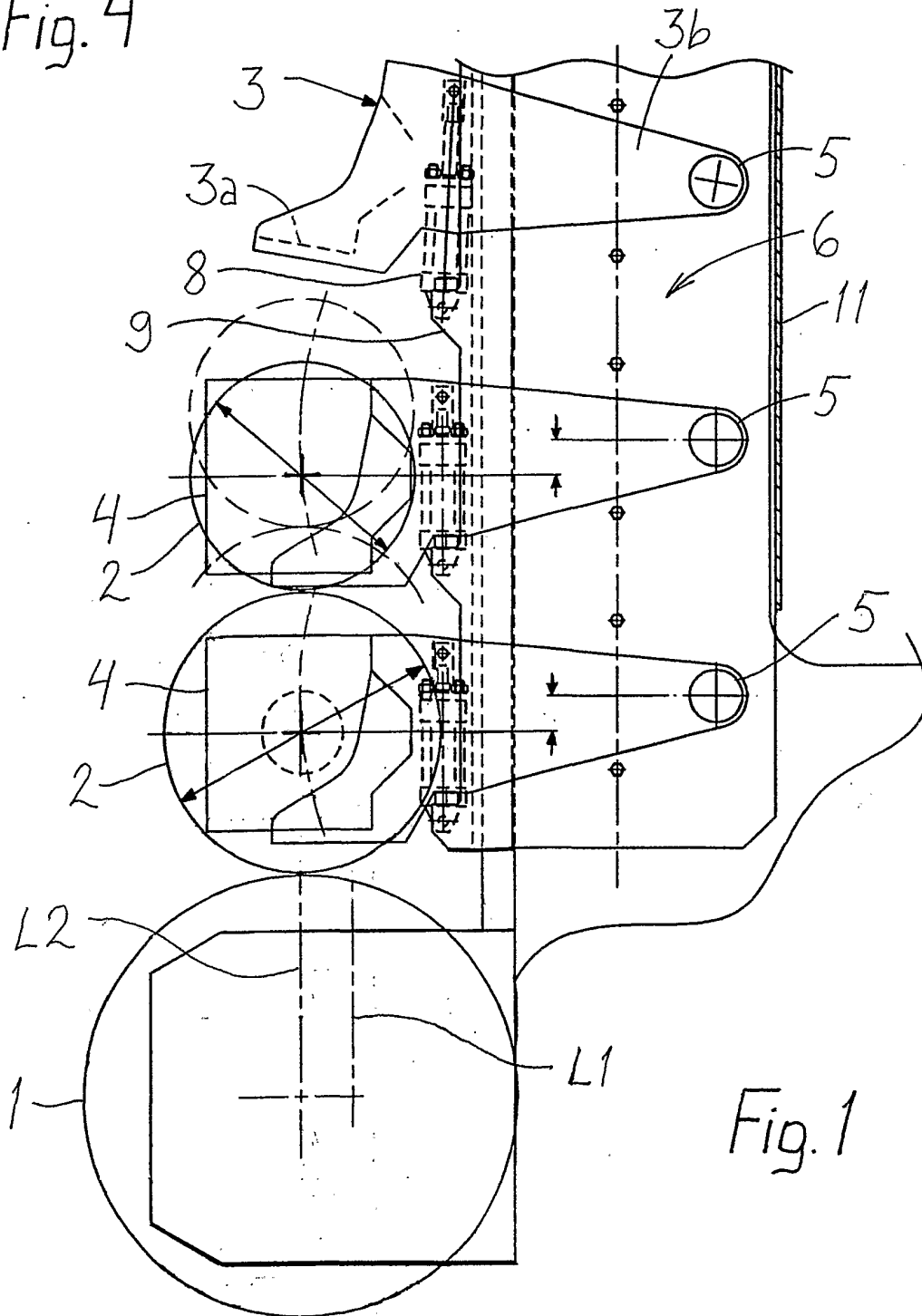


Fig. 1

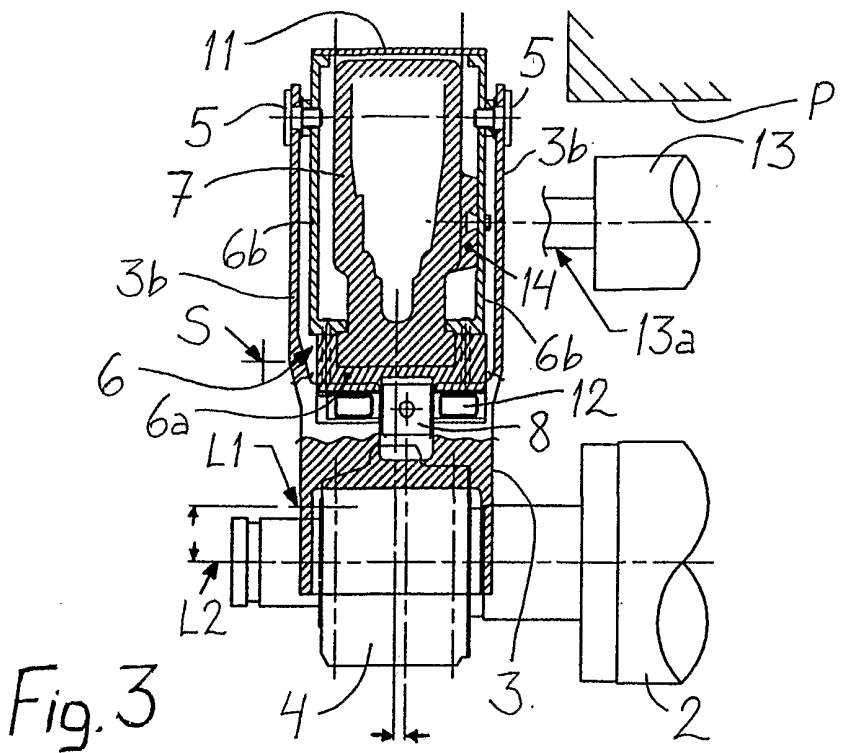


Fig. 3

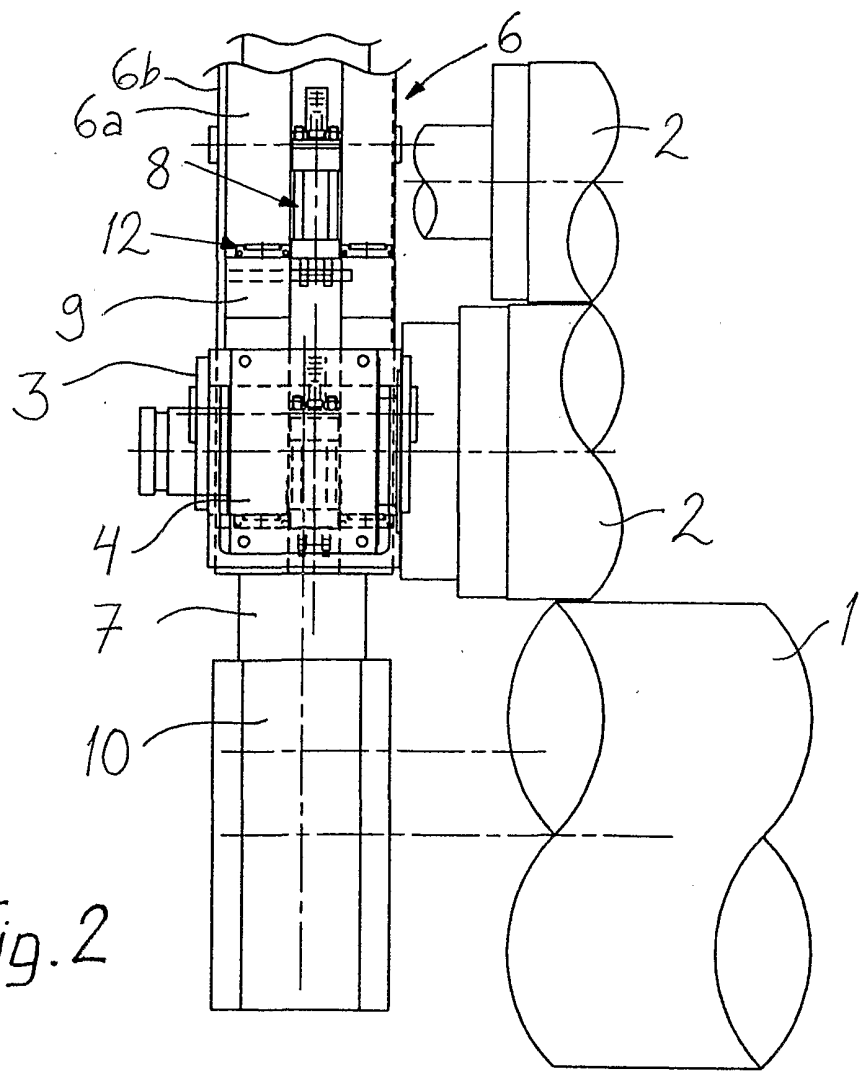


Fig. 2

INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 01/00672

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: D21G 1/00, D21G 1/02

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)

IPC7: D21G

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

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5806415 A (JUHA LIPPONEN ET AL), 15 Sept 1998 (15.09.98), column 5, line 24 - column 6, line 64	1,2,9-12
A	--	3-8,13-16
A	US 4924772 A (JÜRGEN SCHLUNKE ET AL), 15 May 1990 (15.05.90), column 6, line 60 - line 64; column 7, line 62 - line 67, figure 1	10-12

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

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INTERNATIONAL SEARCH REPORT
Information on patent family members

01/10/01

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