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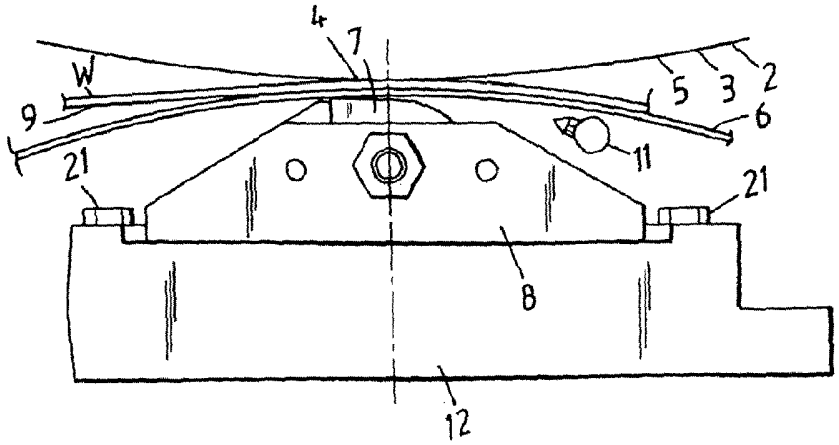
(54) Title: SUPPORT BODY, HOLDING DEVICE THEREFOR, APPARATUS WITH SAID BODA FOR TREATMENT OF A WEB, METHODS OF FORMING AN EXTENDED NIP IN THE APPARATUS AND CONTROLLING LOAD IN THE NIP



(57) Abstract: A support body (7) for an apparatus having an extended nip (N), being defined by a contact surface (13) of the support body and an opposed surface (4), the support body being elastically deformable and has its contact surface adaptable to the opposed surface in intercation with this, and comprising a pressure chamber (14; 56; 60) or several pressure chambers (40; 43; 62), said pressure chamber or each pressure chamber, respectively, is arranged to be pressurized for loading the nip via said contact surface. According to the invention the support body is provided with a holding device (8) which forms a counter support for the pressure chamber or pressure chambers except at the side facing said contact surface. The invention also relates to a holding device for such a support body and also an apparatus, e.g. a press, for the treatment of a fibre web, said apparatus having such a support body. The invention also relates to a method of forming the extended nip in said apparatus by applying a pressure in at least one pressure chamber of the support body and expanding elastically deformable side portions of the support body, and also to a method of controlling the load in the extended nip by designing the support body with several pressure chambers and setting the pressure chambers in accordance with a predetermined pattern.

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Support body, holding device therefor, apparatus with said body for treatment of a web, methods of forming an extended nip in the apparatus and controlling load in the nip

The present invention relates to a support body for an apparatus having an extended nip being defined by a contact surface of the support body and an opposed surface, said support body being elastically deformable and has its contact surface adaptable to the opposed surface in interaction with this, and comprising a pressure chamber or several pressure chambers, said pressure chamber or each pressure chamber, respectively, is arranged for being set under pressure in order to load the nip via said contact surface.

The invention also relates to a holding device for such a support body.

The invention also relates to an apparatus/press for the treatment of a fibre web, being manufactured in a paper or board machine, comprising a first structural element and a second structural element being movably arranged and has an opposed surface for interaction with the first structural element while forming an extended nip, said first structural element including a movable clothing and a support body/press body having a contact surface/press surface which together with the opposed surface defines said nip, said support body/press body being elastically deformable and has its contact surface/press surface adaptable to the opposed surface in interaction with this, and comprising a pressure chamber or several pressure chambers, said pressure chamber or each pressure chamber, respectively, is arranged for being set under

pressure in order to load the nip via said contact surface/press surface.

The invention also relates to a method of forming an extended nip in an apparatus, comprising a support body having a contact surface, wherein said nip is to be defined by said contact surface and an opposed surface, said support body being elastically deformable and has its contact surface adaptable to the opposed surface in interaction with this, and comprising a pressure chamber or several pressure chambers, said pressure chamber or each pressure chamber, respectively, is arranged for being set under pressure in order to load the nip via said contact surface.

The invention also relates to a method of controlling the load in an extended nip in an apparatus, including a support body having a contact surface, said nip being defined by said contact surface and an opposed surface, said support body, which has a plurality of pressure chambers, being deformed elastically, and the contact surface thereof being adapted to the opposed surface in interaction with this, said nip being loaded via said contact surface by pressurizing the pressure chambers.

The previously known presses with an extended press nip has a so-called press shoe, which consists of a metallic material, such as aluminium or steel, and are designed with a press surface, usually a concave press surface, whose profile is very accurately adapted to the opposed counter-pressure surface. Such a press shoe is very complicated to manufacture and therefore involves a very high cost. Due to the fact that it consists of metal, it is relatively rigid and inflexible. The press roll acting as a counter roll of such a shoe press can have a

relatively thick cylinder wall which withstands the forces from the press shoe. In accordance with another embodiment of the counter roll, it has a relatively thin cylinder wall and is provided internally with a counter-pressure system for adjustable crowning of the thin and, thus, deformable cylinder wall or shell in dependence of the forces the press shoe has to apply on the counter roll in order to obtain the desired load. Also the press shoe can be crowned in accordance with the crowning of the counter roll, and it will then be usable only in combination with this counter roll. Alternatively, the metallic press shoe can be tilted by means of hydraulic cylinders.

A Yankee cylinder has a cylinder wall or shell which is relatively thin, and which easily is deformed by impression of the press shoe when the Yankee cylinder is used as a counter roll. The deformation of the shell varies in an axial direction from the central region in a direction towards the end walls, where the impression is substantially smaller than within the central region. Therefore, the press shoe will act with a higher pressure at and in the vicinity of the end walls, resulting in an increased wear at the edges of the press felt and an irregular load profile along the press shoe, something which in its turn results in variable paper properties crosswise to the machine direction. It has been proposed to crown the shell of the Yankee cylinder by means of an internal counter-pressure system, or to arrange two or more rows of hydraulic cylinders on the underside of the press shoe for influencing the press shoe to conform to the deformed surface, in both cases in order to achieve a more uniform load profile. Both proposals, however, are complicated and expensive to carry out.

The following documents are examples of presses having extended press nips.

DE 44 05 587 and WO 02/44467 describe a press having a hydrostatic bearing, including a press shoe 3 or double press shoes 3a, 3b of the same design. A press belt 6 rotates on top of a lubricating fluid bed of the press shoe 3 with a very small friction. The press shoe, which is made of metal, has a pressure chamber 10 containing a hydraulic fluid, preferably water. A rectangular pressure-equalizing membrane 20, consisting of a suitable solid material, preferably stainless steel, is fixed on the press nip side of the press shoe. The pressure-equalizing membrane 20 has an outer edge 26, an inner edge 22, and an opening 27 that is defined by the inner edge 22. The pressure-equalizing membrane 20, thus looking like a frame, is flexible so that an edge zone 21, standing in direct contact with the hydraulic fluid, can deflect when pressure differences occur between its two sides. These pressure differences arise when hydraulic fluid happens to leak out through the press nip as a result of irregularities in the paper web and/or in the envelope surface of the counter roll. Thus, the flexible pressure-equalizing membrane 20 creates a self-adjusting nip 2, having no or only a minimum of fluid leakage. Thus, through the opening 27 in the pressure-equalizing membrane 20, the pressure fluid in the pressure chamber 10 stands in direct contact with the movable belt. The complementary addition which has been done in said WO-publication in comparison to said DE-publication is that the flexible membrane has been provided with "pinholes 25" within its free edge zone 21 in order to conduct hydraulic fluid from the pressure chamber 10 to the belt 6 for the purpose of lubricating the belt.

US 5,980,693 describes presses having a tube-shaped or inflatable loading element, but with a metal shoe between the loading element and the inside of the belt. Furthermore, this part of the shoe is constructed in order to provide a slow reduction of the pressure in nip outlet. Normally, an abrupt pressure drop is desired.

US 3,839,147 describes a shoe press having two opposed shoes. Each shoe has a metal bottom and sills, sealing against the inside of the belt. The side of the shoe facing the belt is a perforated diaphragm, which causes the pressure of the hydraulic fluid in a pressure chamber to load the inside of the belt directly. The shoe is of a rather complicated construction with various apertures and reinforcements.

US 5,951,824 describes an ordinary shoe having ordinary hydraulic loading elements. The shoe is coated with a soft and durable layer of polymer or rubber in order to reduce the risk of damages to the belt and shoe from paper wads passing through the press nip.

EP 0 575 353 describes a press having a shoe, which is loaded with bellows being arranged inside a metal cover of the shoe, wherein a belt slides around said metal cover.

US 6,334,933 describes a press having a counterpart of metal, which is provided with a plurality of pressure pockets being sealed by a metal plate and hoses, which also can contribute to loading the opposite portions of the press nip.

US 6,387,216 describes a press having an open fluid chamber, over which a belt is running and which is loading the press nip. The chamber is sealed by means of setting the belt under pressure, so that it is tightened over the edges of the chamber.

EP 1 319 744 describes a method for measuring and regulating the nip pressure in a shoe press, crosswise to and along the web, by means of measuring and continuously adapting the hydraulic static pressure in reference points above measurement holes in the press nip.

DE 30 30 233 describes an elastic slide shoe which is attached to a stand of metal. The slide shoe includes a solid body or a hollow body in the form of a hose which can be filled with a pressure medium. The hose is surrounded by an elastic belt which is attached to the metal stand. The hollow body may be divided into chambers which can be pressurized to different pressures. However, a change of pressure in the chamber or chambers does not result in a change of the loading in the nip because of the fact that the hollow body is permitted to expand laterally during every such increase of pressure.

It is an object of the invention to provide an elastic support body which, in relation to known support bodies, can be manufactured in a more simple way, without any special machining and without any major consideration to the shape of the opposed surface which it is to work against, and which can provide a loading profile in dependence of the pressure in the pressure chamber or pressure chambers in the same way or even in a better way than what is possible with a conventional support body of metal with one or more rows of pressure pockets which are closed by a running belt.

The support body according to the invention is characterised in that it is provided with a holding device arranged to form a counter support for the pressure chamber or the pressure chambers, respectively, except at the side of the pressure chamber or pressure chambers, respectively, facing said contact surface.

The holding device according to the invention is characterised in that it has a space for receiving the support body in order to form an outer counter support for all surfaces of the support body, as seen circumferentially, except its contact surface, and/or is entirely or partially embedded in the support body in order to form an inner counter support for the pressure chamber or the pressure chambers, respectively, except at the side facing said contact surface.

The apparatus according to the invention is characterised in that the support body is provided with a holding device arranged to form a counter support for the pressure chamber or the pressure chambers, respectively, except at the side of the pressure chamber or pressure chambers, respectively, facing said contact surface, whereby, in the operation of said apparatus and the support body being in a nip-forming operation position, the support body is arranged such that a change of the pressure in said pressure chamber or in at least one of said several pressure chambers produces a corresponding change of pressure in the nip with accompanying changed press curve.

The press according to the invention is characterised in that the press body is provided with a holding device arranged to form a counter support for the pressure

chamber or the pressure chambers, respectively, except at the side of the pressure chamber or pressure chambers, respectively, facing said press surface, whereby, in the operation of the press and the press body being in a nip-forming operation position, the press body is arranged such that a change of the pressure in said pressure chamber or in at least one of said several pressure chambers produces a corresponding change of pressure in the nip with accompanying changed press curve.

The method of forming an extended nip according to the invention is characterised by the steps of:

- mounting the support body in a holding device which forms counter support for a top portion and side portions of the support body;
- applying an increased pressure in said pressure chamber or in at least one of said several pressure chambers; and
- moving a top portion of the support body, exhibiting said contact surface, in a direction towards the opposed surface under the influence of said increased pressure, by means of expansion of said side portions of the support body, said side portions being elastically deformable and connected to the top portion.

The method of controlling the load in an extended nip according to the invention is characterised by the steps of:

- mounting the support body in a holding device, which forms a counter support for a bottom portion and side portions of the support body; and

- setting the pressures in the pressure chambers in accordance with a predetermined pattern to obtain a desired press curve.

The expression "nip" is to be interpreted in its broadest meaning in order to involve such a nip that is defined by a wire and support body.

In the following, the invention will be described further with reference to the drawings.

Figure 1 shows a press according to the invention with a press body according to a first embodiment.

Figure 2 shows the press nip with a press body according to Figure 1 and its holding device in magnification.

Figure 3 is a perspective view of the press body and the holding device according to Figure 2.

Figure 4 is a cross-section of the press body and the holding device according to Figure 3.

Figure 5 is a perspective view of the holding device according to Figure 3, without press body.

Figure 6 is a perspective view of the press body itself according to Figure 3.

Figure 7 is a cross-section of the press body according to Figure 6.

Figure 8 is a graph depicting the pressure curve which is obtained with the press body according to the first embodiment.

Figure 9 shows a press body according to a second embodiment.

Figure 10 is a graph depicting the pressure curve which is obtained with the press body according to Figure 9.

Figure 11 shows a press body according to a third embodiment.

Figure 12 shows a press body according to a fourth embodiment.

Figure 13 is a graph depicting the pressure curve which can be obtained with the press body according to Figure 12.

Figure 14 shows a press body according to a fifth embodiment.

Figure 15 shows a press body according to a sixth embodiment.

Figures 16 and 17 show a press body according to a seventh embodiment.

Figure 18 shows a press body according to a eighth embodiment.

The invention will be described in connection with a press for dewatering a fibre web. Naturally, in addition to the press section, the invention can be applied to any suitable apparatus for the treatment of a fibre web, e.g. an apparatus in a drying or forming section of a paper or

board machine, and in a calender for surface treatment of the fibre web.

Figures 1 and 2 show schematically portions of a press, which is arranged in the press section of a paper or board machine in order to press water out of a formed, wet fibre web. Advantageously, the invention can be used in a paper machine of the tissue machine type. The press includes a first press element 1 and a second press element 2. The press elements 1, 2 are interacting with each other in order to form an extended press nip N.

The second press element 2 includes a counter-pressure member being active in the press nip N and having a movable, endless surface 3, which forms an opposed surface or counter-pressure surface 4, which can be curved or linear, within the press nip N. In the shown embodiment of the press, the second press element 2 consists of a counter roll in the form of a press roll. The counter roll also can be a drying cylinder in a conventional drying section, or a drying cylinder in a tissue machine designated Yankee cylinder. In this case, the counter-pressure member includes the cylindrical wall 5 of the counter roll 2 the envelope surface of which forms said movable, endless surface 3, which within the extended press nip N forms said counter-pressure surface 4, which can be at room temperature or a temperature raised by means of heating. Provided that the cylinder wall 5 is thick and stable enough, it constitutes the counter-pressure member as such. In the case when the cylinder wall 5 is thin and deformable, the counter-pressure member further includes an internal supporting system (not shown), which provides the necessary counter-force.

The first press element 1 includes a movable, endless belt 6 of a flexible material, a support body 7 in the form of a press body, a holding device 8 for mounting the press body 7, a support for mounting the holding device 8, and a loading means for activating the press body 7. The movable belt 6 describes a closed loop inside of which the press body 7 and the support are located. Before the press nip N, the movable belt 6 is arranged for meeting a press felt 9 carrying a wet fibre web W which is to be dewatered when it passes through the extended press nip N. The loading means is arranged for being activated in order to influence the press body 7 during the operation of the press for obtaining pressure forces which the press body 7 exerts against the counter roll 2 via the belt 6, the press felt 9 and the web W. The press body 7 is arranged for deciding the length of the extended press nip N, as seen in the machine direction. The press body 7 has a free sliding surface 10 with which the rotating belt 6 is in sliding contact during the operation of the press, whereby the sliding surface 10 entirely or partially forms a contact surface or press surface 13, which together with said counter-pressure surface 4 defines the press nip N. A spraying device 11 is mounted upstream the press body 7 for supplying lubricant on the inside of the belt in order to form a film which reduces the friction between the rotating belt 6 and the press body 7.

In the shown embodiment of the press, the first press element 1 consists of a press roll, the shell of which forms the movable belt 6 which thus describes a substantially circular loop. In an alternative embodiment of the press (not shown), the flexible, movable belt is arranged for running in a non-circular loop, e.g. in a substantially oval loop or in a substantially triangular

loop, around the press body and one or several guide rolls. In the embodiment shown, the press roll 1 has two circular, rotatably mounted end walls (not shown), whereby the shell 6 is rigidly mounted to the peripheries of the end walls in order to rotate together with them. The shell 6 and the end walls define a closed space in which the support is located, said support including a stationary supporting beam 12 extending axially between the end walls without touching them. Also the press body 7 and its holding device 8 are extending axially between the end walls without touching them. Alternatively, the second press element 2 can be of the same or substantially the same design as the above-described first press element 1, whereby the press nip thus is formed by two press bodies according to the invention.

The press body 7 is elastically deformable and has its press surface 13 adaptable to the counter-pressure surface 4 in interaction with this. This adaptation takes place under the influence of a load being created by said loading means, on the press body 7 in a direction towards the counter-pressure surface 4 in order to load the entire press nip N correspondingly. The definition that the press body is elastically deformable does not necessarily imply that the entire press body consists of an elastic material, but should in the context of the invention be seen in a broader sense, namely that the press body has at least one functional portion consisting of an elastic material and fulfilling said definition. For practical and production-engineering reasons, and according to the most preferred embodiments the press body is in its entirety made of an elastic material (or several).

According to the invention, the press body 7 includes one or several closed pressure chambers, said pressure chamber or pressure chambers being part of said loading means. In accordance with Figure 5, the press body 7 includes a single, larger pressure chamber 14, defining an opposed press zone 15 of the press surface 13. The press body 7 and its holding device 8, being part of the press according to Figure 1, are shown in greater detail in Figures 3 and 4, whereas these two structural elements are shown separately in detail in Figures 6 and 7 and Figure 5, respectively. As is evident from Figure 5, the holding device 8 includes an elongated, beam-formed holder 22, which is form-stable and provided with an axially through-going channel 16 having a U-shaped or rectangular cross-section and being defined by two side support portions 17, 18 and a bottom support portion 19 connecting them. Opposite mounting flanges 20 are formed at the side support portions 17, 18 for detachable fixing of the holder 22 to the supporting beam 12 by means of bolts 21, as shown in Figure 2. Furthermore, it is evident from Figure 3 that the holding device includes two end plates 23 for detachable mounting to the opposed, parallel end surfaces of the holder 22 as well as two clamping plates 24 for detachable mounting on top of the side support portions 17, 18. As is evident from Figures 3 and 4, the side support portion 17, being intended to be located at the inlet of the press nip N, is provided with a recess 25 extending between the clamping plates 24 in order to expose the press body 7. One of the end plates 23 is provided with a centrally positioned connecting member 26, forming an inlet for a pressure medium in gas or liquid form, preferably hydraulic oil. The other end plate 23 is provided with a similar connecting member 27, forming an outlet for deaeration of the pressure chamber 14 when hydraulic oil is used.

Figures 6 and 7 show the press body 7, which is intended to be mounted in the channel 16 of the holder 22 and which has a cross-section being adapted to the cross-section of the channel 16, so that no play arises between opposite lateral surfaces and so that the press body 7 with its bottom surface comes to rest against the bottom surface of the channel 16. In this embodiment, the press body 7 is provided with a through-hole, which is arranged for being sealed at the ends in order to form said pressure chamber 14, having a generally rectangular cross-section. The pressure chamber 14 is defined by the two parallel side walls 28, 29, the bottom wall 30, and the top wall 31 of the press body 7. In the embodiment shown in Figures 6 and 7, the two side walls 28, 29 have the same thickness. The top wall 31 forms said free sliding surface 10, which will be facing the counter roll 2, and with which the rotating belt 6 will be in sliding contact during operation. In a cross-sectional view, the sliding surface 10 is designed with a predetermined arch-shape in order to form an initial, curved surface portion 32 having a predetermined radius, and a surface portion 33 being tangential to the curved surface portion 32 and extending up to the sharp corner 34 which the sliding surface 10 forms with the outside of the side wall 29 being fixed in the machine direction. The purpose of the curved surface portion 32 is to create a wedge between the rotating belt 6 and the curved surface portion 32 in order to make it possible to get lubricant to follow the belt 6 on its inside while forming a film between the belt 6 and the sliding surface 10. The above-mentioned corner 34 forms the outlet of the press nip N, while the inlet of the press nip N at the curved surface portion 32 becomes floating depending on the pressure prevailing in the pressure chamber 14. The press body 7 has end portions 35 which lack said sliding

surface 10, since the top wall 31 here has been made narrower, i.e. recessed and uniform. The end portions 35 enable a simple, detachable mounting in the holder 22 by means of said clamping plates 24, as is evident from Figures 2 and 3. Accordingly, in this assembly, the two connecting members 26, 27 will run into the pressure chamber 14. Cuplike sealings (not shown) are positioned in the pressure chamber 14 at the end portions 35 in order to seal internally against these, and against the end plates 23 and the connecting members 26, 27. In the shown embodiment according to Figures 1-7, the loading means includes said pressure chamber 14 and a pressure medium source 36 being connected to the pressure chamber 14 via a pipe 37 and said connecting member 26. The pressure in the pressure chamber 14 is regulated by means of suitable control devices 38.

As mentioned in the foregoing, the press body 7 is elastically deformable in order to expand, under the influence of an increased pressure in the pressure chamber 14, and bring the top wall 31 with its press surface 13 in a direction towards the counter-pressure surface 4 of the counter roll. As is evident from Figures 6 and 7, the press body 7 is made in one piece of an elastic material. The press body 7 is mounted in a starting position with its press surface 13 situated at a predetermined, touch free distance from the opposite counter-pressure surface 4. When the press is put into operation, the pressure in the pressure chamber 14 is increased in order to obtain a nip-forming operation position. The increase of pressure causes the press body 7 to expand elastically in relation to the holding device 8 in a direction towards the counter-pressure surface 4 of the counter roll 2, since the side walls 28, 29 have the freedom to stretch or expand elastically until

counter-forces arise from the counter-pressure surface 4 of the counter roll 2. These counter-forces first appear at the outlet of the press nip, i.e. just opposite the side wall 28, and then propagates successively in a direction towards the inlet of the press nip, the position of which is determined by the maximum pressure value which is pre-set for a desired load. Accordingly, during said elastic expansion of the press body 7, the top wall 31, and the rotating belt 6 abutting against the top wall 31, will be pressed in a direction towards the counter roll 2, wherein the top wall 31 is elastically deformed both in the machine direction MD and crosswise to the machine direction CD in dependence of the shape of the counter-pressure surface 4, i.e. the press surface 13 conforms to and adopts the outline of the counter-pressure surface 4, and the portion of the sliding surface 10 defining the press nip, i.e. the press surface 13, which in this case corresponds to said press zone 15, changes its form in accordance with the opposed counter-pressure surface 4 of the counter roll 2. Alternatively, the press body 7 is mounted in a first starting position with its press surface 13 situated at a touch free distance from the corresponding counter--pressure surface 4. The press body 7 and the holding device 8 are together moved from the first starting position by means of a suitable movement transmitting device to a second starting position with the press surface 13 of the press body 7 in contact or nearly in contact with the opposite counter-pressure surface 4. The pressure is then increased in the pressure chamber for attaining a nip-forming operation position and the desired pressure curve.

The press body 7, being used in the embodiments according to Figures 1-7, achieves a load profile or pressure curve as illustrated in Figure 8.

Also in the embodiment according to Figure 9, the press body 7 is made in one piece, but with the upstream side wall 28 being slightly thicker than the downstream side wall 29. Thereby, the thicker side wall 28 provides a larger resistance against elastic expansion than the thinner side wall 29, when a pressure is applied in the pressure chamber 14, implying that the pressure forces acting in the initial part of the press nip N become smaller than in the final part of the press nip, so that the load profile or pressure curve describes a more flat course, as illustrated in Figure 10. This effect can also be achieved by means of making the side walls equally thick, but of materials having different coefficients of elasticity, so that the downstream side wall becomes more elastic and more stretchable than the upstream side wall.

Figure 11 shows a press body 7 with a circular cross-section, exhibiting the form of an elastic hose which is sealed at the ends and whose internal space forms a pressure chamber 60. The channel 16 of the holding device 8 has a corresponding or substantially corresponding rounded shape, so that the rounded channel wall forms a counter support for the hose, when it is set under pressure and brought to expand so that the upper, free portion or top wall 31 is pressed out through the upwardly open channel 16, and forms a support in accordance with the principles of the invention.

Figure 12 shows a press body 7 which is similar to the one in Figure 7, but which, furthermore, is provided with two elastically deformable, longitudinal, vertical

partition walls 39 which, accordingly, are parallel to the side walls 28, 29 and are defining three smaller pressure chambers 40 being connected to the pressure medium source 36 in order to enable them to be set under different pressures p_1, p_2, p_3, independently of each other, for the regulation of the load within the nip. For example, the pressure relation can be chosen to be $p_1<p_2<p_3$, wherein the press body 7 according to this example will achieve a load profile or pressure curve describing a stepped course, as illustrated in Figure 13. Each pressure chamber 40 defines an opposed press zone 41 of the press surface 13.

Figure 14 shows a press body 7 which is similar to the one in Figure 12, but which is provided with an elastically deformable, longitudinal, vertical partition wall 61, defining two pressure chambers 62 which are connected to the pressure medium source 36 in order to be set under different pressures, independently of each other, for the regulation of the load within the nip. The partition wall 61 is relatively thick in order to be capable of withstanding the pressure it is subjected to, when such a large pressure difference is present between the two pressure chambers that a deflection of the partition wall 61 otherwise would occur.

Figure 15 shows a press body 7 which is similar to the one in Figure 14, but which is provided with a downwardly open groove 63, extending away from and through the bottom wall 30 and up through the entire partition wall, which thereby is divided into two smaller wall portions 64. The holding device 8 is designed or provided with a reinforcement wall 65, extending upwards from the bottom of the channel 16 and having a rectangular cross-section corresponding to the one of the groove 63. The

reinforcement wall 65 consists of a rigid material, e.g. by means of being formed integral with the shape--permanent holding device 8. The reinforcement wall 65 ensures that the pressures in the two pressure chambers 62 do not influence each other via the partition wall 61 when large pressure differences are present. Such a reinforcement of the partition walls can also be obtained with form-stable square profiles (not shown), for instance, which are positioned within each pressure chamber of a press body, for instance, according to Figure 12, and supporting against all surfaces of the pressure chambers, the side of the profile facing the press surface 13 having holes or apertures so that the pressure in the pressure chamber is allowed to act against the top wall 31.

Figure 16 shows a portion of a press body 7 which is similar to the one in Figure 12, but which is provided with four elastically deformable, longitudinal, vertical partition walls 39. As is evident from Figure 16, the press body 7 further is provided with a plurality of elastically deformable, transversal, vertical partition walls 42, being displaced in relation to each other and, together with the longitudinal partition walls 39, defining a plurality of cellular pressure chambers 43, which are connected to the pressure medium source 36 in order to enable them to be set under different pressures by sections or groups, independently of each other, for the regulation of the load within the nip. In the shown example, the cells 43 are arranged in two groups with different pressures p_1, p_2, wherein the pressure relation of the cell groups, for example, is $p_1<p_2$. The cells 43 of the group with the higher pressure p_2 are marked with dashed lines in Figure 17.

Figure 18 shows a press body 7 which is similar to the one in Figures 6 and 7, but which is made of two parts, enclosing a pressure chamber 56 which is similar to the one in Figures 6 and 7, and of which one part includes the two side walls 28, 29 and the bottom wall 30 of the press body, whereas the other part includes the top wall 31 of the press body, exhibiting the form of a thin layer or membrane 54, wherein the side walls 28, 29 are designed with flange portions 55 for fixing the membrane 54 along its edge portions. The press body 7 in Figure 18 functions in the same way as the one in Figures 6 and 7. The first part 28, 29, 30 consists of an elastic material. The membrane 54 can consist of any material, also material which has a low elasticity, e.g. metal, but still is deformable when expanding the side walls 28, 29 in order to cause its press surface 13 to adapt to the counter-pressure surface 4 and return to its initial position when the tensile forces in the side walls 28, 29 cease to act when reducing the pressure in the pressure chamber 56.

When the support body 7 has a plurality of pressure chambers (as those according to Figures 12 and 14) one or more pressure chambers, but not all, can be kept under atmospheric pressure, while at least one pressure chamber simultaneously has an increased or higher pressure when such a specific loading profile is desired.

The press body according to the invention has a number of essential advantages of which the following can be mentioned.

- It is self-conforming to the outline of the counter--pressure surface.

- It conforms to and follows the deformation of the counter-pressure surface.

- It avoids abnormal wear of the edges of the press felt.

- It is forgiving to e.g. a paper wad passing through the press nip.

- It can be manufactured at a very low cost.

- It can be designed for controlling the load within the entire press nip, or within successive sections of the press nip and independently of each other.

The support bodies 7 which are described above and shown in the drawings have been designated press bodies, since they are used in a press apparatus. Naturally, the same embodiments of the press body can be used in other apparatus for the treatment of a fibre web in a paper or board machine, or in a calender. When the invention is applied to e.g. a wire section, the belt 6 of the first press element 1 in Figure 1 can be replaced with a clothing, such as e.g. a wire.

The load in the nip can vary from 0 to 3000 kN/m.

The support body may have a dimension in the machine direction (width) which typically is 50-500 mm.

The desirable elastic properties of the support body are achieved by means of an elastic material, having a coefficient of elasticity which is substantially lower than that of metal, such as steel and aluminium, so that the support body, depending on the construction of the

support body, can be elastically expanded or elastically compressed. Typical hardness values of the elastic material is 50-95 Shore A. The elastic material should also give the support body a sufficient strength/hardness in order to withstand wear, but at the same time make the support body elastically deformable enough in order to obtain the desired function according to the invention. As elastic materials, plastic and rubber materials can be used, such as polymers, composite materials, which can be reinforced with e.g. glass fibres, carbon fibres or textile. At present, polyurethane is a preferred polymer.

If desired, the contact surface 13 of the support body can be covered by an exchangeable, thin wear protection (not shown), the one side edge portion of which being rigidly mounted to the upstream side of the holder, while the other side edge portion is free to follow the movement and deformation of the support body.

In the embodiments described above the holding device 8 functions as an outer counter support for all surfaces, as seen circumferentially, of the support body 7 except its contact surface 13. It can also be designed and arranged such that it functions as an inner counter support which is entirely or partially embedded in the support body at a distance from the pressure chamber or pressure chambers, respectively. Also the combination of an outer counter support and an inner counter support can be used.

C L A I M S

1. A support body (7) for an apparatus having an extended nip (N) being defined by a contact surface (13) of the support body (7) and an opposed surface (4), said support body (7) being elastically deformable and has its contact surface (13) adaptable to the opposed surface (4) in interaction with this, and comprising a pressure chamber (14; 56; 60) or several pressure chambers (40; 43; 62), said pressure chamber (14; 56; 60) or each pressure chamber (40; 43; 62), respectively, is arranged for being set under pressure in order to load the nip (N) via said contact surface (13), **characterised in** that the support body (7) is provided with a holding device (8) arranged to form a counter support for the pressure chamber (14; 56; 60) or the pressure chambers (40; 43; 62), respectively, except at the side of the pressure chamber (14; 56; 60) or pressure chambers (40; 43; 62), respectively, facing said contact surface (13).

2. A support body (7) according to claim 1, **characterised in** that, in the operation of said apparatus and the support body (7) being in a nip-forming operation position, the support body (7) is arranged such that a change of the pressure in said pressure chamber (14; 56; 60) or in at least one of said several pressure chambers (40; 43; 62) produces a corresponding change of pressure in the nip (N) with accompanying changed press curve.

3. A support body (7) according to claim 2, **characterised in** that the support body (7) is mounted in a starting position with its contact surface (13) at a touch free distance from the opposed surface (4), and

that, in pressurizing the pressure chamber (14; 56; 60) or the pressure chambers (40; 43; 62), respectively, the support body (7) is arranged to expand in order to move the contact surface (13) in the direction to the opposed surface (4) for obtaining said nip-forming operation position, the holding device (8) being arranged to form said counter support body also during said expansion of the support body.

4. A support body (7) according to claim 2, **characterised in** that the support body (7) is mounted in a first starting position with its contact surface (13) at a touch free distance from the opposed surface (4), and that the holding device (8) and the support body (7) are arranged to be moved together by means of a movement transmitting member in the direction to the opposed surface (4) to a second starting position with the contact surface (13) of the support body in contact with or nearly in contact with the opposed surface (4), and that, in pressurizing the pressure chamber (14; 56; 60) or the pressure chambers (40; 43; 62), respectively, the support body (7) is arranged to expand for obtaining said nip-forming operation position, the holding device (8) being arranged to form said counter support body also during said expansion of the support body.

5. A support body (7) according to any one of claims 1-4, including several closed pressure chambers (40; 43; 62), **characterised in**

- that each pressure chamber (40; 43; 62) defines an opposed contact zone (15; 41; 44) of said contact surface (13),
- that the support body (7) has a deformable top wall (31), which exhibits said contact surface (13) and which is arranged for being actively influenced by the

pressure in the pressure chambers (40; 43; 62), two outer, elastically deformable side walls (28, 29), being connected to said top wall (31) and arranged for expanding elastically at increased pressure in the pressure chambers (40; 43; 62) in order to displace the top wall (31), and a bottom wall (30) being connected to the two outer side walls (28, 29).

6. A support body (7) according to claim 5, **characterised in** that the two outer side walls (28, 29) have the same elasticity.

7. A support body (7) according to claim 5, **characterised in** that the two outer side walls (28, 29) have different elasticity.

8. A support body (7) according to claim 7, **characterised in** that the outer side walls (28, 29) have different thickness and/or consist of the same or different elastic materials.

9. A support body (7) according to any one of claims 1-8, **characterised in** that the continuous pressure chambers (40; 43; 62) axially through-going and being separated by partition walls (39; 61).

10. A support body (7) according to claim 9, **characterised in** that it includes at least four pressure chambers (43) being separated by longitudinal partition walls (39) and transversal partition walls (42).

11. A support body (7) according to any one of claims 5-9, **characterised in** that the pressures in the pressure chambers (40; 43; 62) are arranged for being regulated in

accordance with a predetermined pattern for obtaining a desired press curve.

12. A support body (7) according to any one of claims 9-11, **characterised in** that the partition wall (61) or at least two of the partition walls include(s) reinforcement members (65) which are arranged such that the partition wall withstands a pressure difference between two pressure chambers (62) being separated by the partition wall.

13. A support body (7) according to claim 12, **characterised in** that the reinforcement member (65) consists of a rigid material and is integrated into the partition wall or received in a corresponding groove or recess (63) in the partition wall (61).

14. A support body (7) according to any one of claims 5-13, **characterised in** that at least said outer side walls (28, 29) consist of an elastic material in the form of a polymer having a good elasticity and good strength.

15. A support body (7) according to claim 14, **characterised in** that it is made in one piece.

16. A support body (7) according to claim 1, **characterised in** that the load in the nip (N) varies from 0 to 3000 kN/m.

17. A support body (7) according to any one of claims 1-16, **characterised in** that the support body (7) has a dimension in the machine direction of 50-500 mm.

18. A support body (7) according to any one of claims 1-17, **characterised in** that the holding device (8) is an

outer counter support for all surfaces, as seen circumferentially, of the support body (7) except its contact surface (13).

19. A support body (7) according to any one of claims 1-17, **characterised in** that the holding device is an inner counter support which is entirely or partially embedded in the support body.

20. A support body (7) according to any one of claims 1-17, **characterised in** that the holding device (8) is an outer counter support for all surfaces, as seen circumferentially, of the support body (7) except its contact surface (13) and an inner counter support which is entirely or partially embedded in the support body.

21. A holding device for a support body (7) according to any one of claims 1-3, 5-17, **characterised in** that it has a space (16) for receiving the support body (7) in order to form an outer counter support for all surfaces of the support body (7), as seen circumferentially, except its contact surface (13), and/or is entirely or partially embedded in the support body in order to form an inner counter support for the pressure chamber (14; 56; 60) or the pressure chambers (40; 43; 62), respectively, except at the side facing said contact surface (13).

22. A holding device according to claim 21 for a support body (7) according to any one of claims 9-11, **characterised in** that at least one reinforcement wall (65) is arranged in said space (16) in order to extend into a partition wall (61) between two pressure chambers (62).

23. A holding device according to claim 21 or 22, **characterised in** that it is movably arranged by means of a movement transmitting member, which includes a jack, pneumatic cylinder, hydraulic cylinder or similar member, between two positions.

24. An apparatus for the treatment of a fibre web (W), being manufactured in a paper or board machine, comprising a first structural element (1) and a second structural element (2) being movably arranged and has an opposed surface (4) for interaction with the first structural element (1) while forming an extended nip (N), said first structural element (1) including a movable clothing (6) and a support body (7) having a contact surface (13) which together with the opposed surface (4) defines said nip (N), said support body (7) being elastically deformable and has its contact surface (13) adaptable to the opposed surface (4) in interaction with this, and comprising a pressure chamber (14; 56; 60) or several pressure chambers (40; 43; 62), said pressure chamber (14; 56; 60) or each pressure chamber (40; 43; 62), respectively, is arranged for being set under pressure in order to load the nip (N) via said contact surface (13), **characterised in** that the support body (7) is provided with a holding device (8) arranged to form a counter support for the pressure chamber (14; 56; 60) or the pressure chambers (40; 43; 62), respectively, except at the side of the pressure chamber (14; 56; 60) or pressure chambers (40; 43; 62), respectively, facing said contact surface (13), whereby, in the operation of said apparatus and the support body (7) being in a nip-forming operation position, the support body (7) is arranged such that a change of the pressure in said pressure chamber (14; 56; 60) or in at least one of said several pressure chambers (40; 43; 62)

produces a corresponding change of pressure in the nip (N) with accompanying changed press curve.

25. An apparatus according to claim 24, wherein the support body (7) is designed according to any one of claims 1-20.

26. An apparatus according to claim 24, **characterised in** that also the second structural element (2) includes a support body, which has a contact surface constituting said opposed surface (4), whereby both support bodies are designed according to any one of claims 1-20.

27. A press for the treatment of a fibre web (W), being manufactured in a paper or board machine, comprising a first press element (1) and a second press element (2) being movably arranged and has an opposed surface (4) for interaction with the first press element (1) while forming an extended press nip (N), said first press element (1) including a movable belt (6) and a press body (7) having a press surface (13) which together with the opposed surface (4) defines said nip (N), said press body (7) being elastically deformable and has its press surface (13) adaptable to the opposed surface (4) in interaction with this, and comprising a pressure chamber (14; 56; 60) or several pressure chambers (40; 43; 62), said pressure chamber (14; 56; 60) or each pressure chamber (40; 43; 62), respectively, is arranged for being set under pressure in order to load the nip (N) via said press surface (13), **characterised in** that the press body (7) is provided with a holding device (8) arranged to form a counter support for the pressure chamber (14; 56; 60) or the pressure chambers (40; 43; 62), respectively, except at the side of the pressure chamber (14; 56; 60) or pressure chambers (40; 43; 62),

respectively, facing said press surface (13), whereby, in the operation of the press and the press body (7) being in a nip-forming operation position, the press body (7) is arranged such that a change of the pressure in said pressure chamber (14; 56; 60) or in at least one of said several pressure chambers (40; 43; 62) produces a corresponding change of pressure in the nip (N) with accompanying changed press curve.

28. A press according to claim 27, **characterised in** that the opposed surface (4) and/or the press surface (13) is/are arranged to be heated.

29. A press according to claim 27 or 28, wherein the press body (7) is designed according to any one of claims 1-20.

30. A press according to any one of claims 27-29 with a press body (7) according to any one of claims 5-20, **characterised in** that the upstream outer side wall (28) has a smaller elasticity than the downstream outer side wall (29).

31. A press according to any one of claims 27, 28 and 30, **characterised in** that also the second press element (2) includes a press body, which has a press surface constituting said opposed surface (4), whereby both press bodies are designed according to any one of claims 1-20.

32. A method of forming an extended nip (N) in an apparatus, comprising a support body (7) having a contact surface (13), wherein said nip (N) is to be defined by said contact surface (13) and an opposed surface (4), said support body (7) being elastically deformable and has its contact surface (13) adaptable to the opposed

surface (4) in interaction with this, and comprising a pressure chamber (14; 56; 60) or several pressure chambers (40; 43; 62), said pressure chamber (14; 56; 60) or each pressure chamber (40; 43; 62), respectively, is arranged for being set under pressure in order to load the nip (N) via said contact surface (13), **characterised by** the steps of:

- mounting the support body (7) in a holding device (8) which forms counter support for a top portion (30) and side portions (28, 29) of the support body (7);
- applying an increased pressure in said pressure chamber (14; 56; 60) or in at least one of said several pressure chambers (40; 43; 62); and
- displacing a top portion (31) of the support body (7), exhibiting said contact surface (13), in a direction towards the opposed surface (4) under the influence of said increased pressure, by means of expansion of said side portions (28, 29) of the support body (7), said side portions (28, 29) being elastically deformable and connected to the top portion (31).

33. A method of controlling the load in an extended nip (N) in an apparatus, including a support body (7) having a contact surface (13), said nip (N) being defined by said contact surface (13) and an opposed surface (4), said support body (7), which has a plurality of pressure chambers (40; 43; 62), being deformed elastically, and the contact surface (13) thereof being adapted to the opposed surface (4) in interaction with this, said nip being loaded via said contact surface (13) by pressurizing the pressure chambers, **characterised by** the steps of:

- mounting the support body (7) in a holding device (8), which forms a counter support for a bottom portion

(30) and side portions (28, 29) of the support body (7); and

- setting the pressures in the pressure chambers (40; 43; 62) in accordance with a predetermined pattern to obtain a desired press curve.

34. A method according to claim 33, **characterised in** that the pressure chambers are defined by partition walls, extending both in the machine direction and crosswise to it in order to obtain groups of pressure chambers, and that the pressures in each group of pressure chambers are set independently of the pressures in the other group or groups.

35. A method according to claim 34, **characterised in** that the load in the press nip (N) is controlled independently in the machine direction and/or crosswise to the machine direction.

36. The use of a support body (7) according to any one of claims 1-20 as a press body (7) in a press apparatus in a paper or board machine.

37. The use of a support body (7) according to any one of claims 1-20 as a supporting foil for a carrying apparatus in a paper or board machine.

38. The use of a support body (7) according to any one of claims 1-20 as a reeling support in a reel-up of a paper or board machine.

Fig. 2

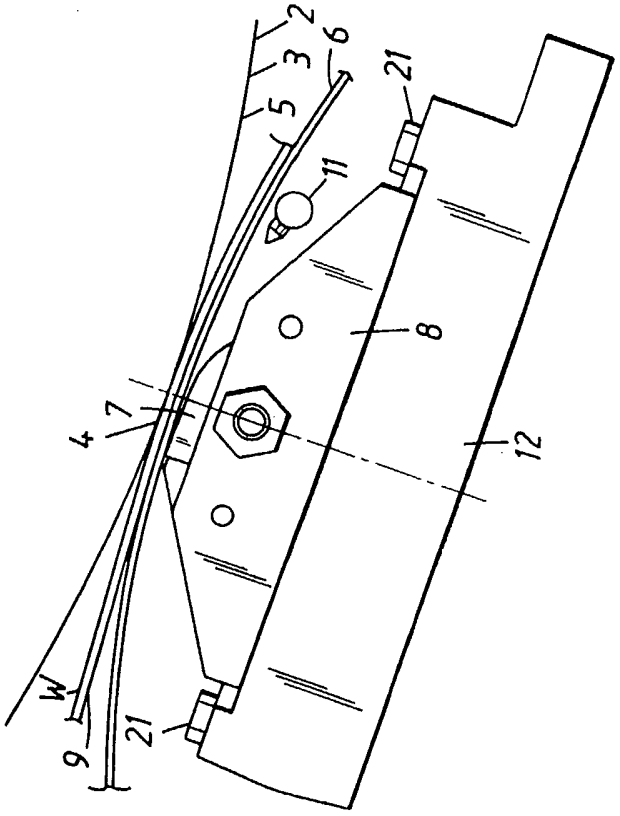
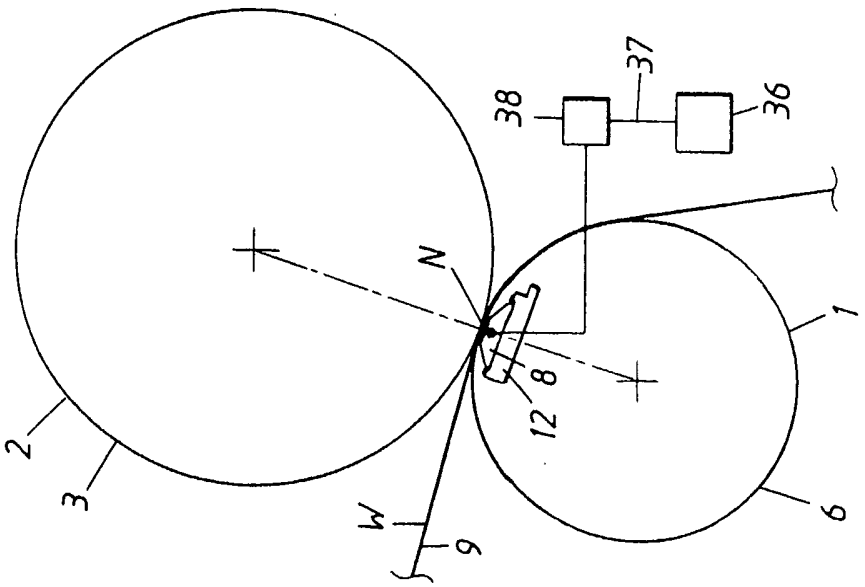


Fig. 1



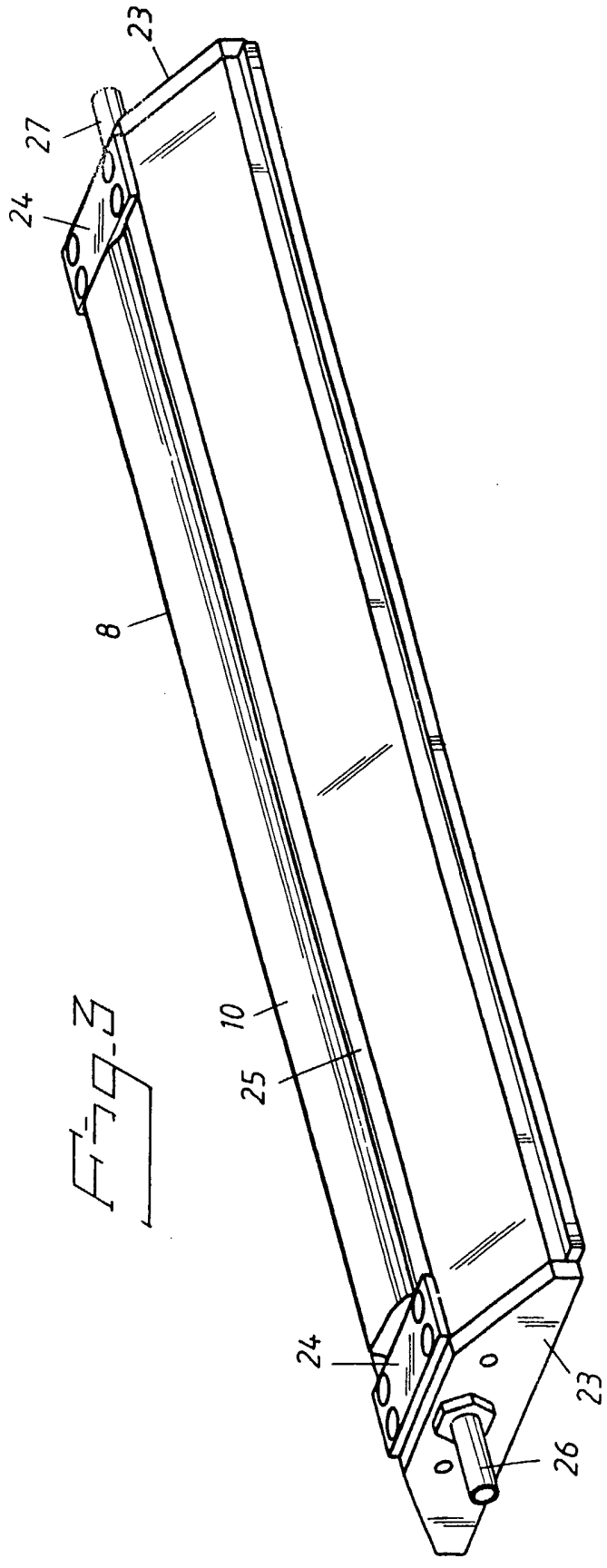


Fig. 3

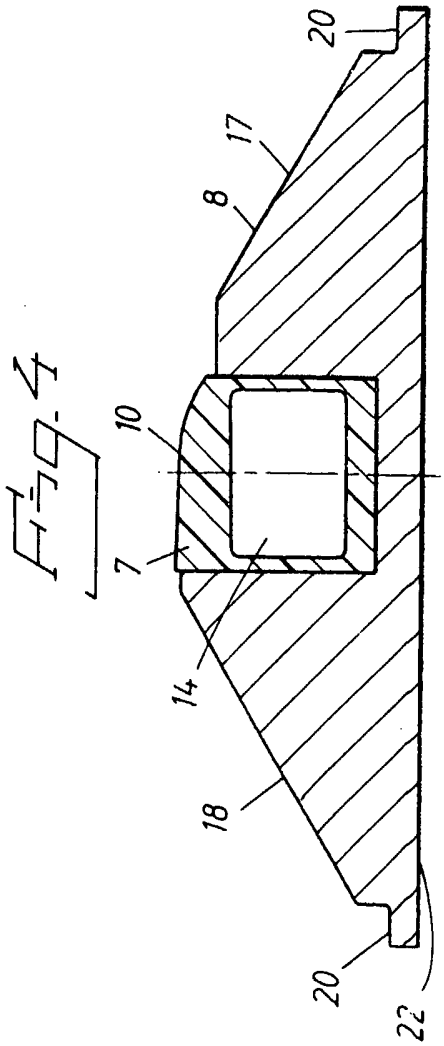


Fig. 4

Fig. 5

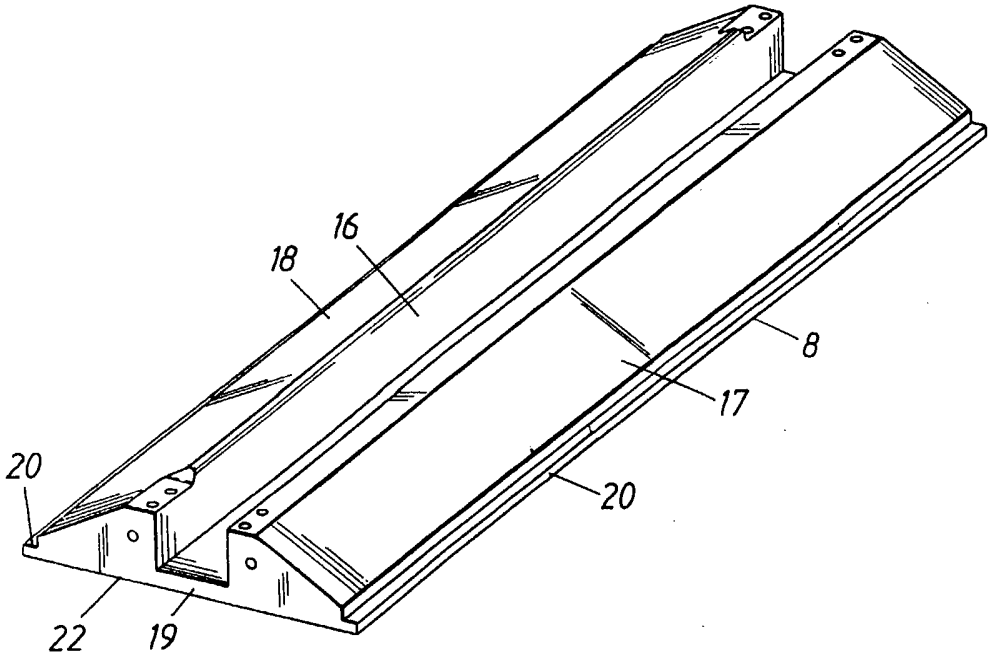


Fig. 6

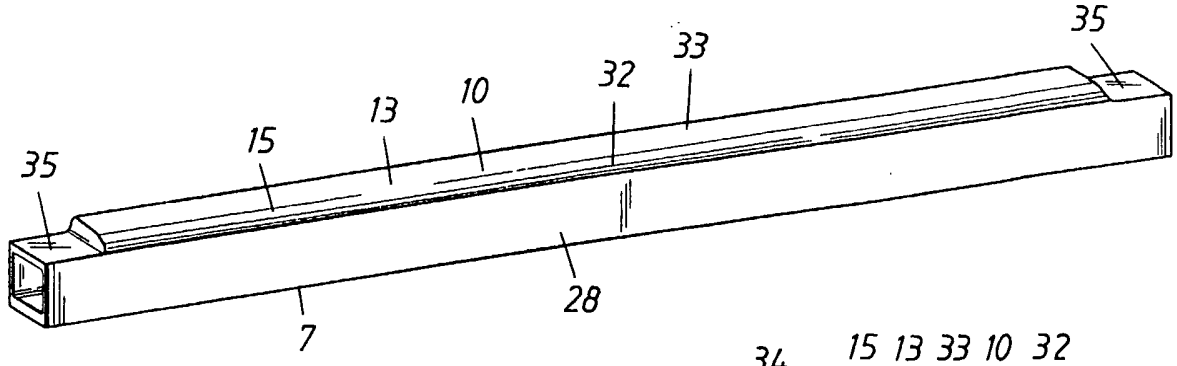


Fig. 7

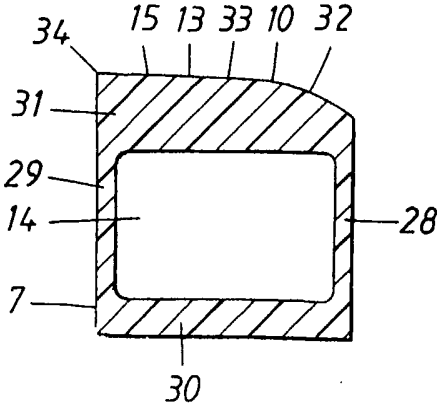


Fig. 8

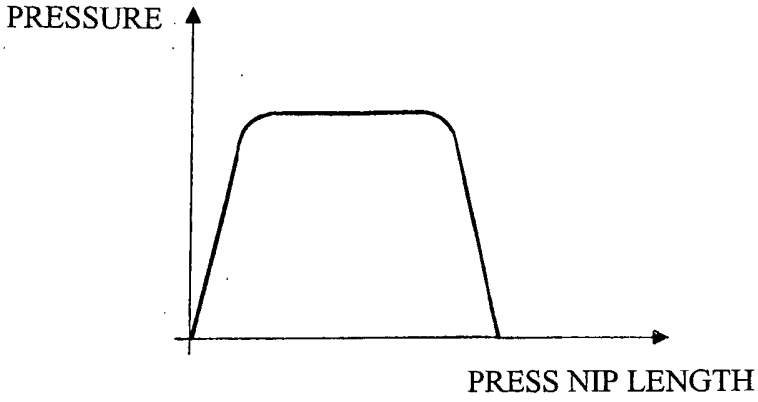


Fig. 9

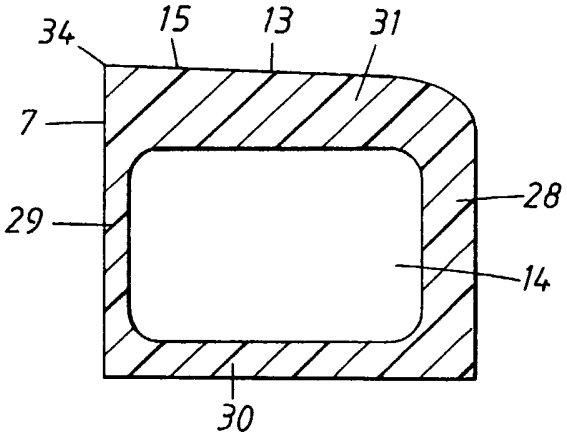


Fig. 10

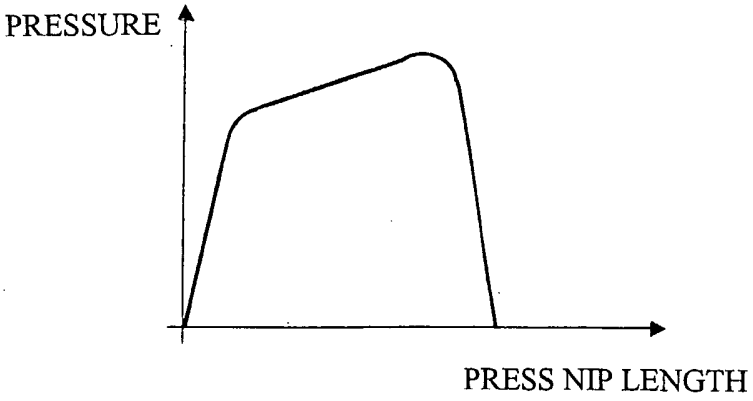


Fig. 11

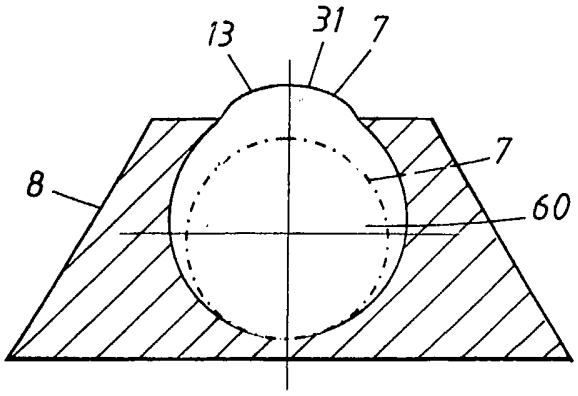


Fig. 12

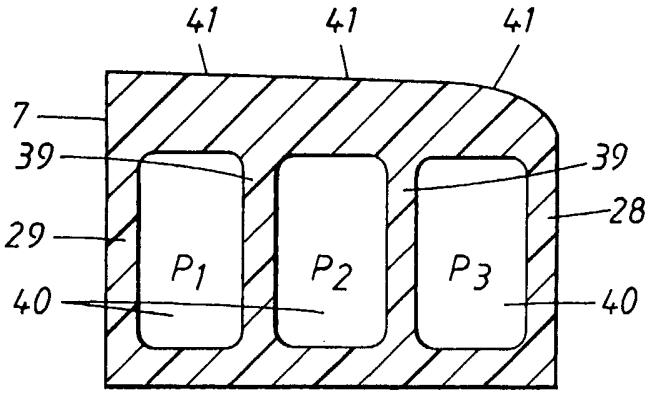


Fig. 13

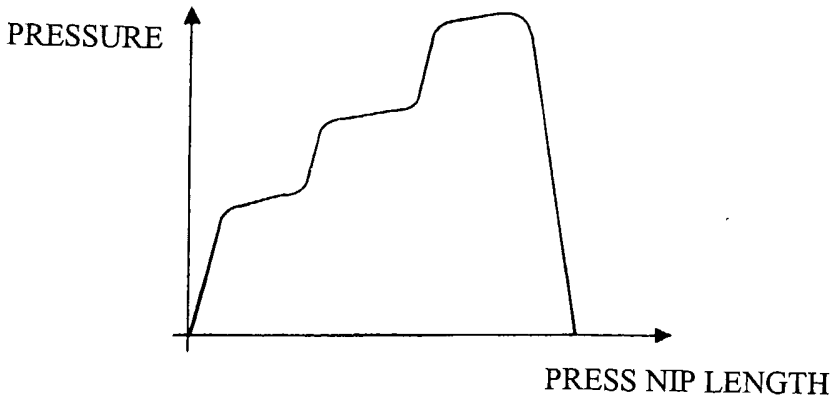


Fig. 14

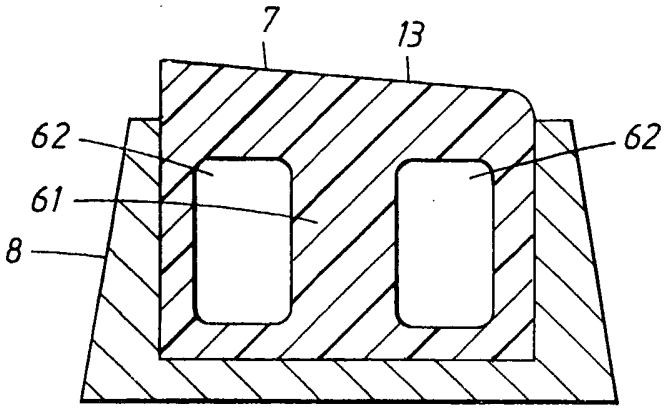


Fig. 15

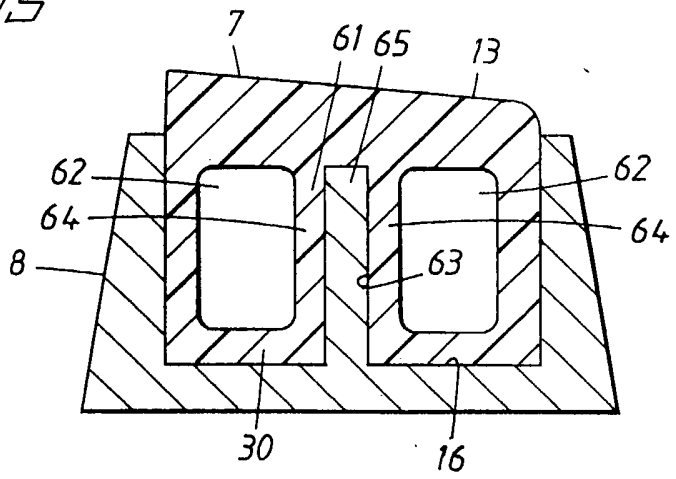


Fig. 16

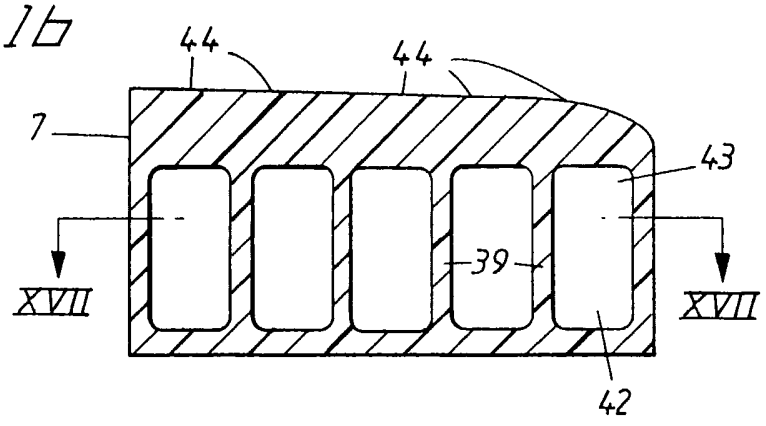


Fig. 17

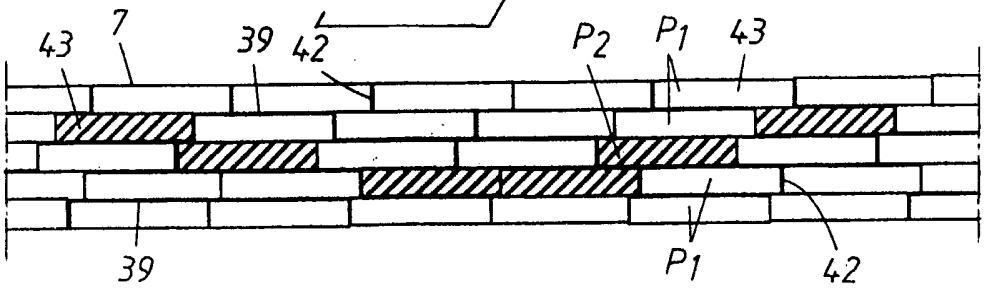
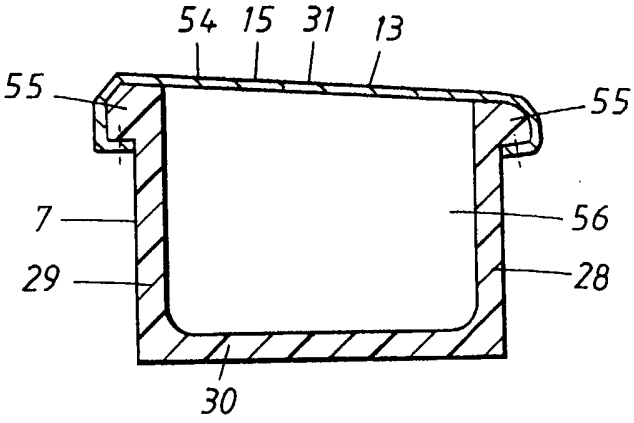


Fig. 18



INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 2004/001485

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: D21F 3/02
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: D21F, D21G

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)

WPI-DATA, EPO-INTERNAL

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 3030233 A1 (J.M. VOITH GMBH), 18 February 1982 (18.02.1982), The whole document --	1-38
A	US 5951824 A (RAJENDRA D. DESHPANDE), 14 Sept 1999 (14.09.1999), column 3, line 12 - line 16, abstract --	1-38
A	US 4468287 A (HANS DAHL), 28 August 1984 (28.08.1984), column 3, line 50 - line 57, figure 1 --	1-38
A	WO 0244467 A1 (RAJAMÄKI, TEUVO), 6 June 2002 (06.06.2002), The whole document --	1-38

[X] Further documents are listed in the continuation of Box C. [X] 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 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
21 January 2005	09 -02- 2005
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INTERNATIONAL SEARCH REPORT

International application No.
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