(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 270 806 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
02.01.2003 Bulletin 2003/01

(51) Int Cl.[7]: **D21F 1/04**, D21F 1/02

(21) Application number: **01115459.8**

(22) Date of filing: **26.06.2001**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE TR
Designated Extension States:
AL LT LV MK RO SI

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Remarks:
Amended claims in accordance with Rule 86 (2) EPC.

(54) Headbox with rotating side walls

(57) This invention relates to an improved structure of a head box for a paper making machine. The side walls (4) of a nozzle of a head box shall be movable with the rotation of a roll (1) transporting a forming wire (3) of the paper making machine. Thus, the homogeneity of produced paper can be improved.

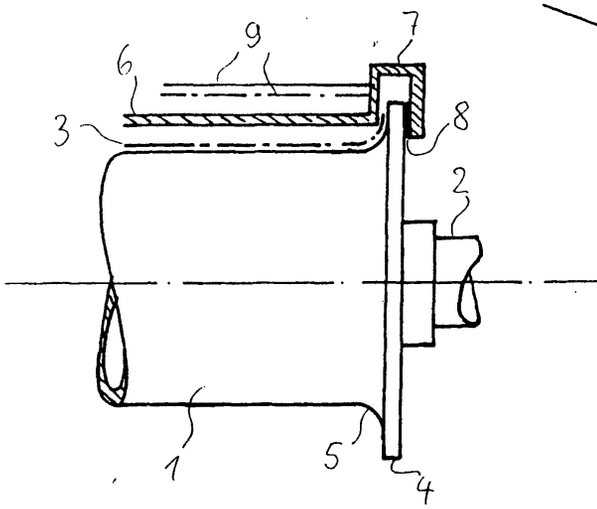

Fig.1

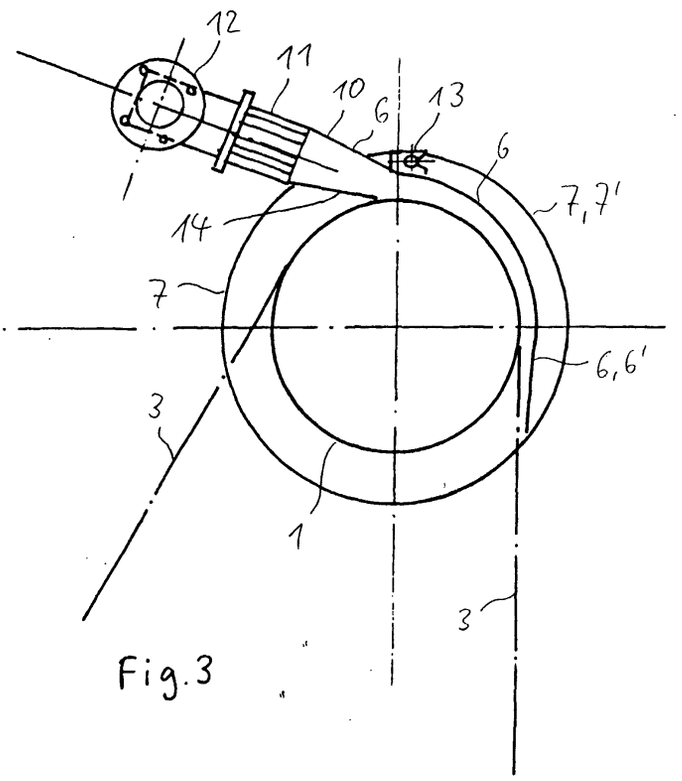

Fig.3

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Description

Technical Field:

[0001] The present invention concerns a head box being part of a paper making machine and a method of making paper with said head box.

Related Art:

[0002] It is known to produce paper by using a stock solution that is, in one step of paper making, fed on a forming wire being transported on a roll. An inlet line feeds that stock solution to a nozzle that distributes the stock solution on the forming wire. The forming wire is adapted to extract water from the stock solution as a first step of producing a layer of paper. The hydrodynamic part of the paper making machine including inlet line and nozzle is usually called head box.

[0003] The conventional technical details of such paper making machines and head boxes are well known to the expert.

[0004] Although electronic communication technologies increase in importance, the overall paper consumption is steadily increasing as well. Therefore, it is of interest to optimize the output of paper making machines. This can be done by increasing the production velocity and also by increasing the production width. Although there are improvements in the acceleration of the mechanical parts of paper making machines, the handling of the stock solution becomes more and more difficult. Namely, this relates to the homogeneity of the produced paper in the width direction, i.e. in the axial direction of the roll.

[0005] There are many prior art documents treating the construction of stock solution inlet lines and nozzles, i.e. the so called headbox. As an example, it can be pointed to US 6,004,431 being directed to a better control of the cross direction flow of stock solution by means of flow control valves.

[0006] Also US 5,833,808 is directed to the control of the edge flow of stock solution in the headbox nozzle through adjustable valves positioned in edge tubes employing fiber orientation sensors.

[0007] US 5,196,091, however, proposes to control the cross directional homogeneity by means of a stock diluting source permitting dilution of the stock solution flowing into a tube bank.

[0008] As a final example, US 6,033,527 is concerned with the improvement of the uniformity of the velocity profile of the stock solution across the nozzle opening. It is proposed to use pond sides of the nozzle that are angled inwardly. Further, columns of outer tubes of the tube bank may also be angled inwardly.

Summary of the Invention:

[0009] The present invention has the object to improve the performance of a head box for a paper making machine and a related paper making method in view of a high production velocity with a simultaneously good homogeneity of the produced paper.

[0010] According to the invention, a head box for a paper making machine is proposed, that has a stock solution inlet line for feeding stock solution, a nozzle for being fed with said stock solution by said inlet line, and for spraying said stock solution on a forming wire of said paper making machine during a rotating movement of said forming wire on a roll relative to said nozzle, wherein said nozzle has an opening to be positioned directly adjacent said forming wire being provided mutually opposed and for defining a width of said opening in an axial direction of said roll and for essentially inhibiting stock solution flowing out of said opening in said axial direction, and that is characterized in that said side walls are rotatable with said roll in said rotating movement relative to said nozzle.

[0011] Further, the invention is related to a method of making paper using such a head box, that is characterized in that said side walls are rotated with said roll in said rotating movement during paper making.

[0012] Preferred embodiments are given in the dependent claims.

[0013] The inventors have discovered that a relevant reason for non-homogeneities of the paper are based on the fact that the stock solution in the nozzle, especially at the nozzle output opening, is not as fast at the outer borders of the usually slit-formed opening as in the middle. This can be understood by the friction of the stock solution at the outer side walls at the borders. In contrast to the borders, the parts of the stock solution flowing in the middle of the nozzle come in contact only with a so-called upper lip and a so-called lower lip or with one of the lips and the surface of the roll and the forming wire. The parts of the stock solution flowing at the borders suffer from additional friction at the side walls adjacent the ends of the inner sides of the lips.

[0014] The basic idea underlying this invention is to provide a construction in which the side walls at the last part of the nozzle adjacent the opening to the roll and the forming wire are movable with the roll so that they can be moved along with the stock solution flow. Thereby, the velocity loss at the side walls can be essentially reduced and the homogeneity of the velocity profile much improved. With a better homogeneity, even higher velocities of roll and the stock solution flow are feasible in order to increase the production rate.

[0015] Certainly, additional measures to improve the homogeneity and the feasible velocity can be chosen as proposed in the prior art. However, the present invention has revealed and proposes to avoid one major source of non-homogeneities and thus offers an important contribution to the art of paper making. In order to have a simple construction with side walls moving with the roll, these side walls preferably are annular and concentric with the roll. Is has to be noted that the side walls are to

be understood as the walls being the end of the stock solution flow path in widthwise cross section, i. e. the start and the end of the slit form. However, they can be a mechanical part of the roll as well as of the nozzle or independent of both, as detailed in the following.

[0016] Further, it is to be noted that the head box as defined by the invention is to be understood in the conventional sense, i.e. as the hydrodynamic unit of the paper making machine with that line and nozzle but without the roll referred to above and in the following. However, since the movable side walls are an essential part of the invention and shall be moved with the roll in the rotating movement explained above, a head box according to the invention that shall replace a conventional head box in a paper making machine could optionally also comprise a new roll for the paper making machine. This roll could be specially adapted to the construction of the movable side walls and could also be a unit with these. Thus, a head box according to the enclosed claims is already given by a head box without roll but with side walls according to the invention. However, a set including the roll with the head box is a preferred embodiment of the invention. Finally, the invention also refers to the paper machine as a whole.

[0017] In order to have a simple construction, it is further preferred that said slit opening is defined essentially only by said movable side walls and by the so called lips of the nozzle being the border of the slit opening between the side walls and being opposed to each other. The lips are fixed with regard to the rotating movement of the roll and the side walls, of course. However, at least one of the lips can be movable in other respect, e.g. with regard to an adjustability of the distance between the lip and the forming wire. For the sake of clarity, it is to be explained that usually the flow direction of the stock solution within the nozzle is directed in a direction more or less tangential to the roll. This means that the slit form of the opening appears in cross-section perpendicular to the flow direction. However, the lower lip usually ends upstream from the upper lip so that there is an area of stock solution flow in which the channel of flow is defined also by the forming wire being transported on the roll and the roll underlying the forming wire and possibly appearing beneath the borders of the forming wire, instead of the lower lip. In this context, the opening of the nozzle to which the invention refers appears at the end of the lower lip where the first contact of the stock solution with the forming wire takes place and where movable sidewalls shall be present. However, these movable sidewalls should preferably guide the stock solution flow until the end of the upper lip. Further preferably, the movable sidewalls are annular and thus go around the complete circumference of the roll.

[0018] It is further preferred that said lips comprise side parts directly adjacent said annular side walls and sealed against the side walls in order to keep the stock solution within the nozzle as regards the direction perpendicular to the main flow direction. These side parts can be integral parts of one of the lips or separate parts mounted to the lips in a sealing manner. It is further preferred, that said side parts are at least in part positioned radially outwards of said annular side walls. This improves the possibilities for sealing between the side parts and the side walls. For illustration, it is referred to the description of the embodiments.

[0019] One advantageous choice for a sealing is a pressure water sealing fed by a pressure water conduit. The pressure water sealing has the first advantage to allow high relative velocities between the side walls and the side parts without substantial friction problems in view of temperature, power loss or durability. Second, the pressure water sealing allows to provide for some water flow from the sealing directed to the stock solution. This can be advantageous to inhibit a congestion of stock solution or solid parts of stock in the border areas of the nozzle, i.e. in the region of the side wall. When there is a small but more or less continuous water flow from the sealing to the main stock solution flow, the border areas will be kept free.

[0020] An alternative for the above mentioned sealing could comprise conventional sealing rings (e.g. of elastomers), possibly in combination with conventional bearings as roller bearings. In order to improve the sealing properties of the sealing rings, a container filled with a pressurized fluid (water, air and the like) can be used to press the sealing ring against a sealing surface.

[0021] It is preferred that the sealing rings are pressed against those sealing surfaces that shall rotate relative to the sealing itself in order to protect the above mentioned container. The container itself can be a closed container e.g. of plastic with fluid contents, but can also be a conduct that is fed by an exterior fluid source.

[0022] It has been stated before that the side walls can, but need not be parts of the roll. In a preferred embodiment, the side walls are axially movable relative to the roll in a limited manner. This can be preferred in order to compensate for some axial movements of the forming wire that regularly occur during the transport of the forming wire on the roll. This applies especially to long-wire machines or so-called Fourdrinier machines as well as to twin-wire and to inclined-wire machines. These Fourdrinier machines are a preferred application for the invention independent from the axial movability mentioned above. In case of a Fourdrinier paper making machine, the roll mentioned so far in this description is the so called breast roll.

[0023] When having axially movable side walls, the lips can be fixed relative to the side walls or relative to the roll as regards this axial movement. In the one case, the lips are moved together with the side walls in the axial direction, in the other case, there must be some free space at the connection between the lips and the side walls (or the side parts of the lips and the side walls to be precise) to compensate for the axial movement.

[0024] It is to be seen that usual forming wires are quite flexible and thus are not well adapted to exert sub-

stantial axial forces during the above mentioned axial movements. Thus, a passive movability of the side walls that is activated by the forming wire is usually not preferred in order to avoid damages or crumbling of the wire at the borders. Instead, a drive by means of an electric motor, pneumatic or hydraulic means and the like can be provided, that acts in response to signals from a position sensor detecting an axial position of the forming wire. i.e. the axial movability can be controlled in an active manner.

[0025] If the side walls are fixed to the roll it is preferred that they have tapered inward surfaces that are adapted to allow some axial movement but to inhibit excessive axial movement of the forming wire. Especially, concave tapered surfaces are preferred, where the term concave is to be understood as seen in a section along the axial direction. A forming wire can run up said tapered surfaces for some distance but is forced to increase its length in the circumferential direction of the roll thereby. Thus, a backdriving force can be created that inhibits too large axial movements. By concave surfaces, this backdriving force is rapidly increasing with the axial movement distance of the forming wire.

Description of Preferred Embodiments:

[0026] In the following, several embodiments of the invention are explained. These embodiments are preferred for individual reasons but are merely meant as illustrative examples. They shall not be understood to limit the scope of the invention.

[0027] In the drawings:

figure 1 is a schematic drawing of one side portion of a breast roll with a section through a nozzle in a head box according to the invention as a first embodiment;

figure 2 is comparable to figure 1 but shows a second embodiment;

figure 3 illustrates the first and the second embodiment by means of a side view along the axis of the breast roll;

figures 4, 5 and 6 are schematic cross sectional drawings of a third embodiment and show the structure of a nozzle in a head box according to the invention;

figure 7 shows a fourth embodiment, namely a breast roll and a section through a nozzle of a head box according to the invention; and

figure 8 is comparable to figure 3 but refers to the fourth embodiment of figure 7.

[0028] In figure 1, reference numeral 1 shows a breast roll of a Fourdrinier (long wire) paper making machine. Only the (in the sense of the figure) right portion of the breast roll is shown. 2 shows a part of an axis of breast roll 1, the axial direction being shown as a dash-dotted line in figure 1 as well as in figure 2 and 3.

[0029] A conventional forming wire is numerated with 3 and only schematically shown in section. 4 is a concentric ring on breast roll 1, being an integral part of breast roll 1 and embodying an annular movable side wall according to the invention. This side wall 4 shows a concavely tapered inward surface 5 on which forming wire 3 can run up as sketched in figure 1.

[0030] 6 is an upper lip of the nozzle of the paper making machine that is provided with a side part 7 gripping around side wall 4 in U-shape manner. A conventional sliding sealing 8 is positioned between the outer arm of side part 7 and the outer side of movable side wall 4. Sealing 8 prevents stock solution in the channel between upper lip 6, breast roll 1, side wall 4 with surface 5 and wire 3 from flowing out. It is adapted to withstand a fast relative movement between side parts 7 and side wall 4. 9 is a stabilization structure for improving the rigidity of upper lip 6 with side part 7 (and connecting the shown side part with the opposed not shown side part) and is without fundamental importance for the invention.

[0031] It can be seen that upper lip 6 and side wall 4 with surface 5 together with breast roll 1 and forming wire 3 define a channel for stock solution flow in which only upper lip 6 does not participate in the rotating movement of breast roll 1 and wire 3. Further, a limited axial movement of forming wire 3 is possible according to the concave shape of surface 5 with relatively large radius of curvature. Namely, the second side of breast roll 1 and the nozzle (parts 6, 7, 8, 9) is symmetrical. The distance between shown side wall 4 and the second non-shown side wall is somewhat larger than the width of forming wire 3 in order to allow some oscillation of wire 3.

[0032] Before a modification of this embodiment is shown along with an explanation of figure 2, reference is made to figure 3. Identical numerals refer to the same parts as in figure 1. Figure 3 is seen in the axial direction so that breast roll 1 appears as a circle. Wire 3 runs around breast roll 1 along only somewhat less than half of its circumference and spreads to other transport rolls as usual in Fourdrinier paper making machines. That run of wire 3 that is approximately vertical in figure 3 carries the stock solution away from the channel as described in connection with figure 1 and extracts water from the stock solution.

[0033] The stock solution originates from nozzle 10 that is fed by means of a manifold 11 and a header 12 of a conventional stock solution inlet line.

[0034] Downstream from manifold 11 begins nozzle 10 with upper lip 6 and a lower lip 14 shown in figure 3. It can be seen that upper lip 6 and lower lip 14 narrow the dimension of the channel for the stock solution in one direction perpendicular to the flow direction. However, in the second direction perpendicularly to the flow,

the channel is as broad as breast roll 1 (including manifold 11 and thus fed from several parallel tubes of tube bank 12).

[0035] When arriving at the circumference of breast roll 1 with lower lip 14 in a nearly tangential manner, lower lip 14 ends. Thus, the opening of nozzle 10 at breast roll 1 is situated at that end of lower lip 14. Further, upper lip 6 projects in a manner concentrical to breast roll 1 and in a nearly constant distance from the circumference of breast roll 1 for approximately a quarter of said circumference. This is in order to guide the stock solution already on wire 3 until wire 3 becomes distant from the circumference of breast roll 1. Thus, a channel is formed without lower lip 14, as can be seen in the section of figure 1.

[0036] Figure 1 shows that side walls 4 are concentrical rings around the complete circumference of breast roll 1. Thus, from a point somewhat upstream of the end of lower lip 14 down to the end of the channel (without lower lip 14) mentioned above, rotating side walls are provided. During this length, the flow of stock solution can develop a uniform velocity profile in the axial direction.

[0037] Figure 3 further shows that nozzle 10 is held by a pivoting device 13 so that namely upper lip 6 can be pivoted around the axis given at 13. This helps to adjust the height defined by upper lip 6 above wire 3 at the end of upper lip 6 and thus helps to define the thickness of the stock layer at this point.

[0038] It can also be seen from figure 3, side part 7 of upper lip 6 extends around the complete circumference of annular side wall 4 which is necessary in order to guarantee the sealing function of sealing 8.

[0039] Figure 2 shows a second embodiment and can be directly compared to figure 1. Here, the left side of breast roll 1 is shown. Identical numerals refer to similar components.

[0040] Upper lip 6' has a non-integral side part 7' being fixed to upper lip 6' by means of bolts. Side wall ring 4' shows a somewhat different circumferential surface but an analogous concave inward surface 5.

[0041] Between the modified circumferential surface of side wall 4' and an inner surface of side part 7' a pressure water sealing 15 is provided. This pressure water sealing 15 is fed by a pressure water conduit 16 feeding pressure water into a first ring space 17 distributing pressure water around the complete circumference of ring 4'. Therefrom, the pressure water is pressed though very small slits being the actual pressure water sealing 15 and connecting first inner space 17 with second ring spaces 18. These slits are directed radially and have an axial dimension of the order of 0.1 mm. This gives a good sealing effect and minimizes water consumption. From the outer second ring space 18, the sealing water flows to the exterior and can be recovered, if necessary. From the inner second ring space 18, the pressure water flows into the channel of the stock solution flow, as long as in the region of upper lip 6'. This inhibits congestions as explained earlier.

[0042] First and second ring spaces 17 and 18 have a varying volume depending on the height that is given by the adjustability of upper lip 6' (compare pivoting means 13 in figure 3).

[0043] The side view of figure 3 applies also to the second embodiment of figure 2. Also the explanations given in connection with figure 3 apply to the second embodiment. The main difference between the first and second embodiment consists in the type of sealing of the stock solution channel.

[0044] Figures 4, 5 and 6 show a third embodiment and show a left and a right side of a breast roll 1' with sectional structure of a nozzle as in figures 1 and 2 (the middle of breast roll 1' is omitted).

[0045] Breast roll 1' differs from the embodiments of figures 1, 2 and 3 in that annular side walls 4" are not an integral part of breast roll 1'. Instead, annular side walls are implemented by rings 4" that are axially shiftable relative to breast roll 1'. Therefore, a slide bush 19 is provided between each side wall ring 4" and pressed roll 1'. Additionally, elastomer sealings 20 inhibit stock solution flowing therethrough.

[0046] Further, side wall rings 4" are slideable against modified side parts 7" fixedly mounted to a stabilization and holding structure 9' (hollow section) of an upper lip 6".

[0047] Between side part 7" and side wall rings 4", again a pressure water sealing 15' with a pressure water inlet 16' is provided. Sealing 15' essentially consists in a narrow slit between a circumferential surface of each side wall ring 4" and an inner circumferential surface of respective side part 7". Pressure water flows through inlet 16' into a first ring space 17' and therefrom through sealing slits 15' to the exterior and to a second ring space 18' that is connected to the interior channel by means of inner sealing slit 15'.

[0048] A shifting movement of side wall rings 4" relative to breast roll 1' goes along with a shifting between side wall rings 4" and upper lip 6" with side part 7" because the latter are in fixed position relative to breast roll 1'. Therefore, ring spaces 17' and 18' vary in volume and can even disappear as appears from figures 5 and 6.

[0049] In order to allow said shifting movement of side wall rings 4", upper lip 6" has a width that is somewhat smaller than the distance between both side wall rings 4". This means that stock solution will flow up to inner sealing slit 15' but not beyond. Congestions will be prevented by pressure water coming therethrough.

[0050] The main difference between the third embodiment in figures 4, 5 and 6 and the first and the second embodiments is the axial shiftability of side wall rings 4" in relation to breast roll 1' and upper lip 6". The third embodiment and the second embodiment have the pressure water sealing in common.

[0051] The axial movement of side wall rings 4" is activated by a drive (not shown in figures 4, 5 and 6) that

will be explained with reference to figure 7. This drive operates in response to an optical sensor for detection of the position of forming wire 3.

[0052] Figures 7 and 8 describe a last embodiment of the invention. Figure 7 shows a view analogous to figures 1, 2, 4, 5, 6, whereas figure 8 can be compared to figure 3. Again, similar parts are given identical reference numerals.

[0053] Here, as in the third embodiment, axially movable side wall rings 4''' are mounted on a breast roll 1". Sliding keys 21 for transmitting the rotating movement and allowing an axial movement, and sealings 20' are shown. An upper lip 6''' is provided between side wall rings 4''' and slides against them during rotation of breast roll 1" and side walls 4'''. A sealing is provided there-between but not shown in figure 7.

[0054] Side wall rings 4''' are mounted at structural parts 22 of the nozzle by means of roller bearings 23. Between structural parts 22 and side wall rings 4''', an elastomer sealing ring 24 and, axially outwards of ring 24, a pressure air container ring 25 is provided (on each side naturally). Pressure air container ring 25 is adapted to press sealing ring 24 axially inwardly in order to improve its sealing properties. Parts 24 and 25 do not participate in the rotating movement, i.e. side wall rings 4''' slide against sealing rings 24.

[0055] Comparing figure 7 with figures 4, 5, and 6 reveals that in the fourth embodiment the complete set of side wall rings 4''', structural parts 22, upper lip 6''', and further, according to figure 8, lower lip 14', manifold 11' and header 12, is axially shiftable as a whole. i.e. the nozzle can be axially moved as a whole. This movability is compensated by a soft upstream connection of header 12 as seen in figure 7 at 26.

[0056] The movement of the nozzle is activated by a movement drive 27 symbolized in the lower left part of figure 7 and acting on manifold 11'. Drive 27 can be a pneumatic, hydraulic or electric motor drive. The details of a shiftable support of the nozzle are not shown but obvious to the expert.

[0057] Again, the movement of the nozzle with drive 27 is activated in response to a signal from a (not shown) optical sensor that detects the position of forming wire 3.

[0058] 28 shows another drive for driving the pivoting movement around pivoting means 13 already explained earlier for adjusting the height of upper lip 6''' above forming wire 3 at the end of upper lip 6'''. During such an adjustment movement, upper lip 6''' can slide against side wall rings 4''' because of the sliding sealing provided therebetween and mentioned earlier.

[0059] By the way, it has to be noted that manifolds 11 and 11' (being somewhat longer) and header 12 can have various advantageous structures in order to further improve the homogeneity of the paper produced. Namely, manifolds 11 and 11' can consist of single pipes of various section forms, e.g. square or circular.

[0060] The fourth and the third embodiments have in common the axial shiftability of side walls 4" and 4'''. The differences comprise i.a. pressure water sealings 15' in contrast to sealing 24, 25 and the shiftability of lips 6''' and 14' and the rest of the nozzle in contrast to the static nozzle of the third embodiment.

[0061] The first and the second embodiments, however do not have axially shiftable parts besides the usually unavoidable movements of forming wire 3' (in case of a Fourdrinier machine). The structure is somewhat more simple, however, there might be some increased wear of forming wire 3 at the borders depending on its quality.

[0062] All four embodiments produce paper with very good homogeneity. This refers especially to both the homogeneity of the fiber orientation in the paper (especially at the outer borders in the width direction) as well as the fiber distribution homogeneity. The fiber orientation is the ratio of fiber lying in a defined direction, e.g. the machine direction compared to the cross direction. The fiber distribution is the relative weight of fibers per unit area across the width of the machine. The homogeneities of both have been a problem with various machines of the prior art.

Claims

1. A head box for a paper making machine, said head box having

a stock solution inlet line (11, 11', 12) for feeding stock solution,

a nozzle (4", 4''', 6 - 6''', 14, 14') for being fed with said stock solution by said inlet line (11, 11', 12), and for spraying said stock solution on a forming wire (3) of said paper making machine during a rotating movement of said forming wire (3) on a roll (1 - 1") relative to said nozzle (4", 4''', 6 - 6''', 14, 14'),

wherein said nozzle (4", 4''', 6 - 6''', 14, 14') has an opening to be positioned directly adjacent said forming wire (3),
side walls (4 - 4''') being provided mutually opposed and for defining a width of said opening in an axial direction of said roll (1 - 1") and for essentially inhibiting stock solution flowing out of said opening in said axial direction,
said head box being **characterized in that** said side walls (4 - 4''') are rotatable with said roll (1 - 1") in said rotating movement relative to said nozzle (4", 4''', 6 - 6''', 14, 14').

2. A head box according to claim 1, wherein said side walls (4 - 4''') are annular and adapted to be concentric with said roll (1 - 1").

3. A head box according to claim 2, wherein said noz-

zle (4", 4"', 6 - 6"', 14, 14') has lips (6 - 6"', 14, 14'), at least one of which comprises side parts (7 - 7") being directly adjacent to said annular side walls (4 - 4"'), a sealing (8, 15, 15', 24, 25) being provided between said lip side parts (7 - 7") and said side walls (4 - 4"') for essentially inhibiting stock solution flowing out and for allowing a rotating movement of said side walls (4 - 4"') with said roll (1 - 1") relative to said lip side parts (7 - 7").

4. A head box according to claim 3, wherein said sealing comprises a pressure water sealing (15, 15').

5. A head box according to claim 4, wherein said pressure water sealing (15, 15') is adapted to provide some water flow from said sealing (15, 15') to said stock solution for inhibiting a stock congestion at said side walls (4, 4"').

6. A head box according to one of the preceding claims, wherein said side walls (4, 4"') are adapted to be axially movable relative to said roll (1, 1") in order to compensate for some axial movement of said forming wire (3) during said movement.

7. A head box according to claim 6, wherein said nozzle (4"', 6"', 14') is fixed to said side walls (4"') with regard to said axial movability.

8. A head box according to claim 6 or 7 with a movement drive (27) for said axial movability and with a sensor for detecting a position of said forming wire (3) in said axial direction, wherein said movement drive (27) is controllable in response to said forming wire position sensor.

9. A head box according to one of claims 3 to 8, wherein said sealing comprises sealing rings (24) and elastic pressure fluid containers (25) for pressing that sealing rings (24) against sealing surfaces.

10. A head box according to one of claims 1 to 5, wherein said side walls (4, 4') are adapted to be fixed to said roll (1) and have tapered surfaces (5) on inner sides thereof for allowing some axial movement and inhibiting an excessive axial movement of said forming wire (3) on said roll (1).

11. A head box according to claim 10, wherein said tapered surfaces (5) are concave in a section along said axial direction.

12. A head box according to one of the preceding claims adapted for a Fourdrinier or twin-wire or inclined-wire paper making machine.

13. A head box according to one of the preceding claims, comprising said roll (1 - 1").

14. A method of making paper using a head box according to one of the preceding claims and comprising the steps of

providing a stock solution inlet line (11, 11', 12) for feeding stock solution,

providing a nozzle (4", 4"', 6 - 6"', 14, 14') for being fed with said stock solution by said inlet line (11, 11', 12),

providing a forming wire (3) for receiving said stock solution from said nozzle (4", 4"', 6 - 6"', 14, 14'), for extracting water from said stock solution, and

providing a roll (1 - 1") for a rotating movement for transporting said forming wire (3),

wherein said nozzle (4", 4"', 6 - 6"', 14, 14') has an opening directly adjacent said forming wire (3),
side walls (4 - 4"') being provided mutually opposed and for defining a width of said opening in an axial direction of said roll (1 - 1") and for essentially inhibiting stock solution flowing out of said opening in said axial direction,
said method being **characterized in that** said side walls (4 - 4"') are rotated with said roll (1 - 1") in said rotating movement during paper making.

15. A paper making machine comprising a head box according to one of claims 1 - 13.

Amended claims in accordance with Rule 86(2) EPC.

1. A head box for a paper making machine, said head box having a stock solution inlet line (11, 11', 12) for feeding stock solution,
a nozzle (4", 4"', 6 -6"', 14, 14') for being fed with said stock solution by said inlet line (11, 11,' 12), and for spraying said stock solution on a forming wire (3) of said paper making machine during a rotating movement of said forming wire (3) on a roll (1 -1") relative to said nozzle (4",4"',6 - 6"', 14, 14'),
wherein said nozzle (4", 4"', 6 -6"', 14, 14') has an output opening to be positioned directly adjacent said forming wire (3),
side walls (4 -4"') being provided mutually opposed for essentially inhibiting stock solution flowing out in said axial direction
wherein said side walls (4 -4"') are rotatable with said roll (1 -1") in said rotating movement relative to said nozzle (4",4"', 6 -6"', 14, 14')
characterized in that said side walls defining a width of said output opening in an axial direction of said roll (1 -1") for inhibiting stock solution flowing out of said output opening in said axial direction.

14. A method of making paper using a head box according to one of the preceding claims and comprising the steps of

providing a stock solution inlet line (11, 11 " 12) for feeding stock solution,

providing a nozzle (4", 4"', 6 -6"', 14, 14') for being fed with said stock solution by said inlet line (11, 11" 12),

providing a forming wire (3) for receiving said stock solution from said nozzle (4", 4"', 6 -6"', 14, 14'), for extracting water from said stock solution, and providing a roll (1 -1") for a rotating movement for transporting said forming wire
(3),

wherein side walls (4 -4"') being provided mutually opposed, and

wherein said nozzle (4", 4"', 6 -6"', 14, 14') has

an output opening directly adjacent said forming wire (3),

said side walls essentially inhibiting stock solution flowing in said axial direction

wherein said side walls (4- 4"') are rotated with said roll (1 -1") in said rotating movement during paper making,

characterized in that said side walls define a width of said output opening in an axial direction of said roll (1 -1") for inhibiting stock solution flowing out of said output opening in said axial direction.

Fig.1

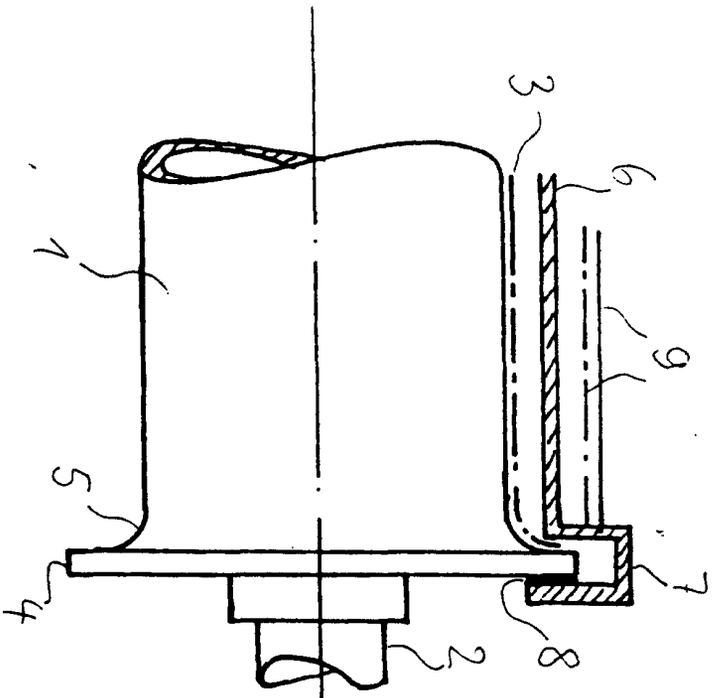
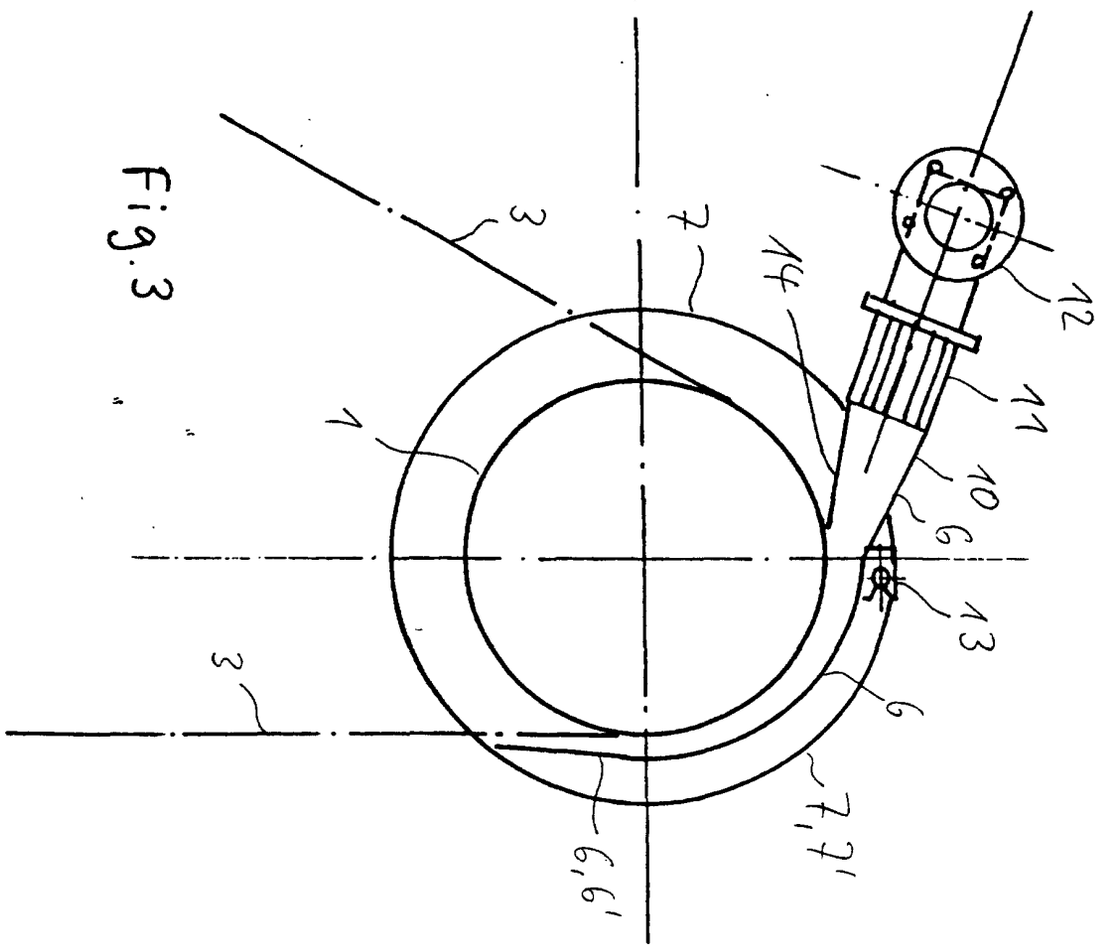


Fig.3



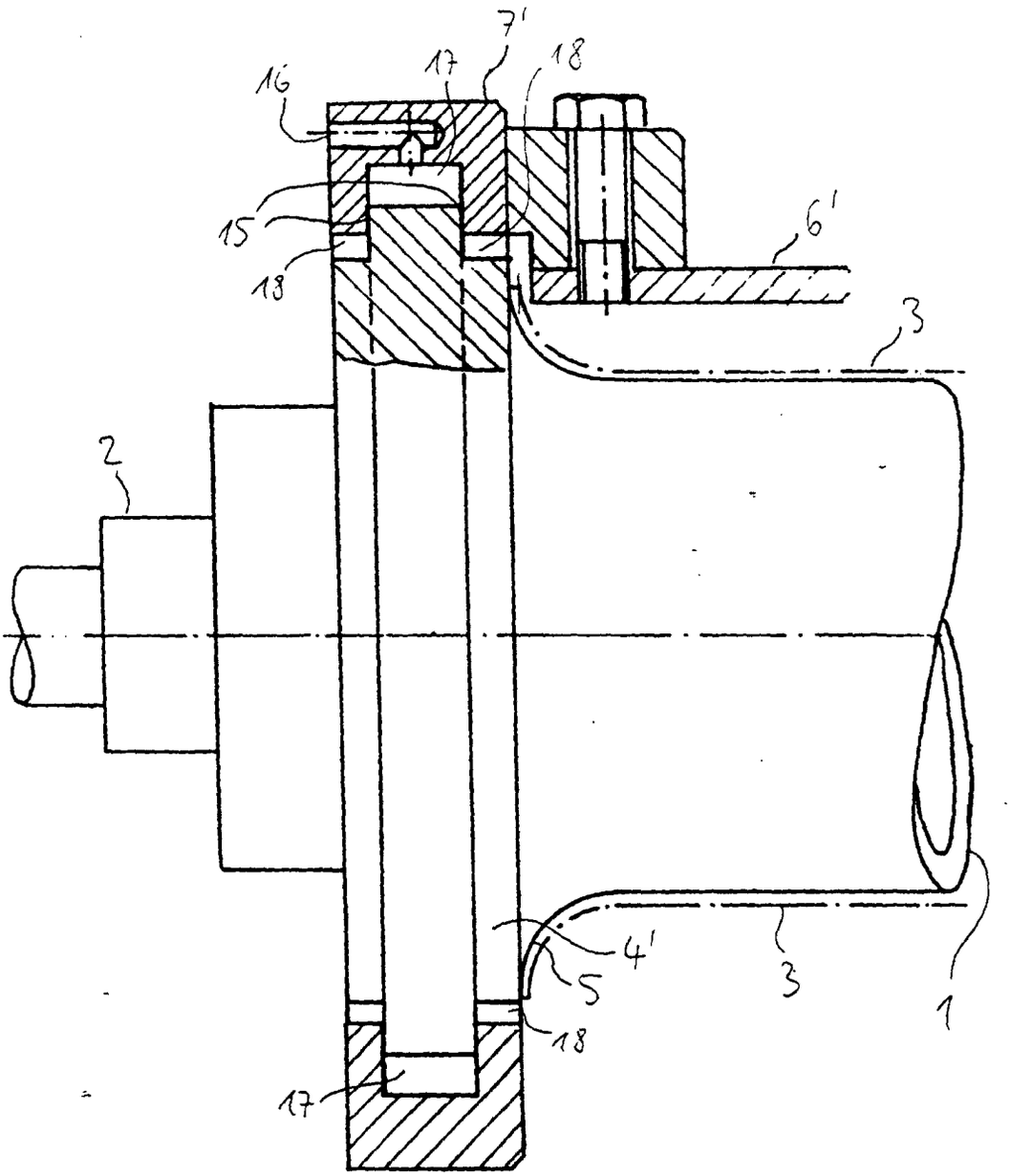


Fig.2

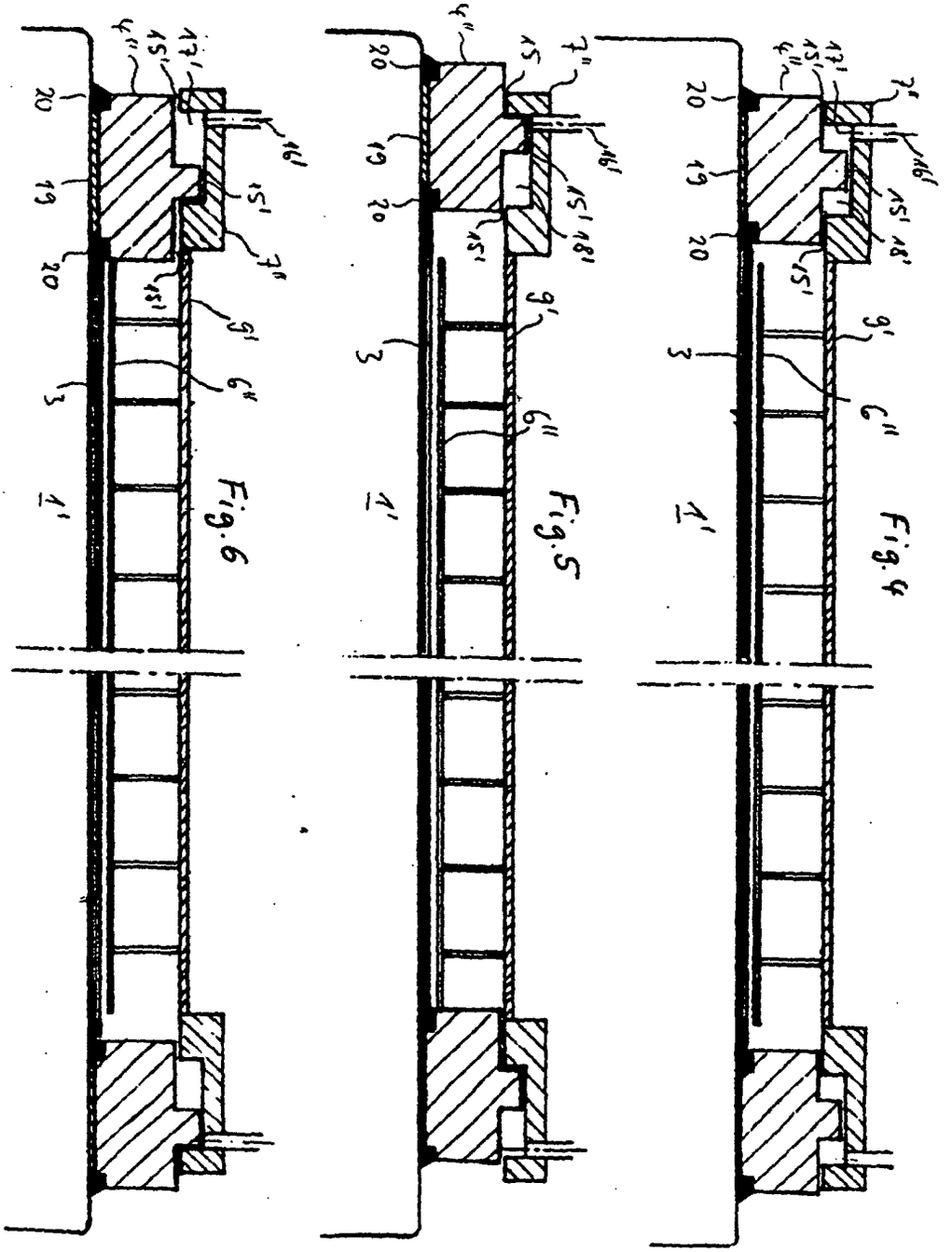


Fig.6 Fig.5 Fig.4

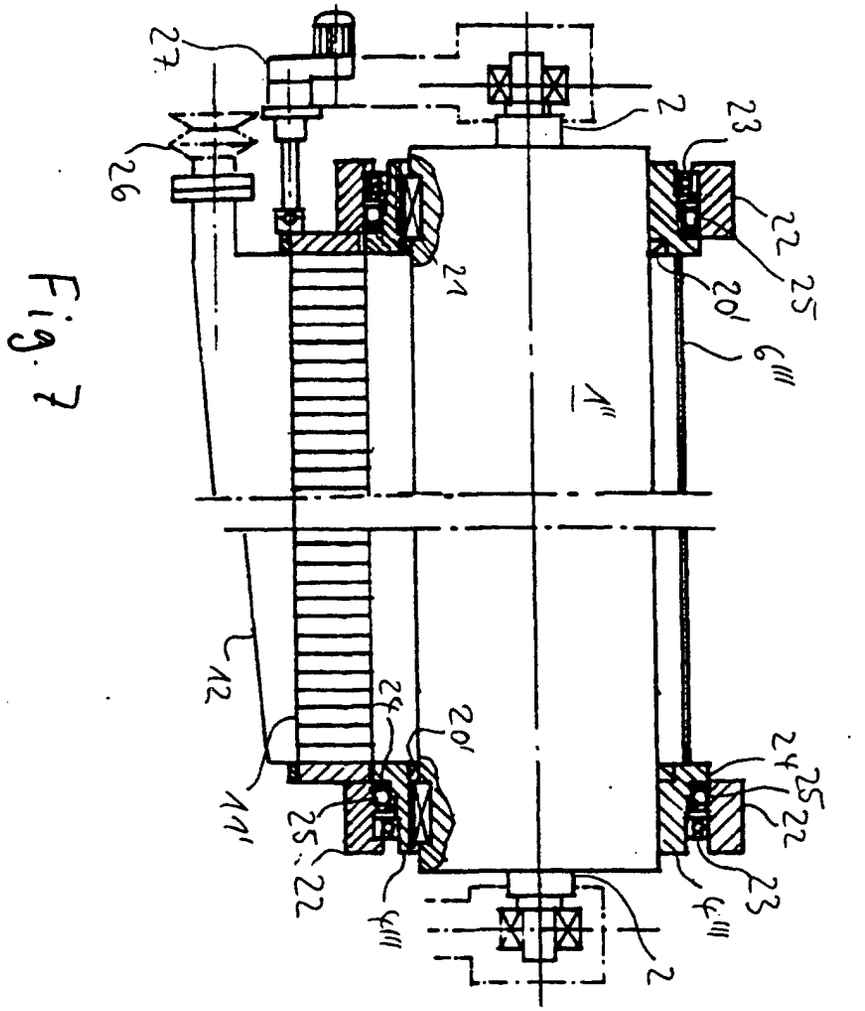

27
26
2
23
22
25
21
20'
6'''
1''
12
24
20'
24
25
22
11'
25
22
23
6'''
2

Fig. 7

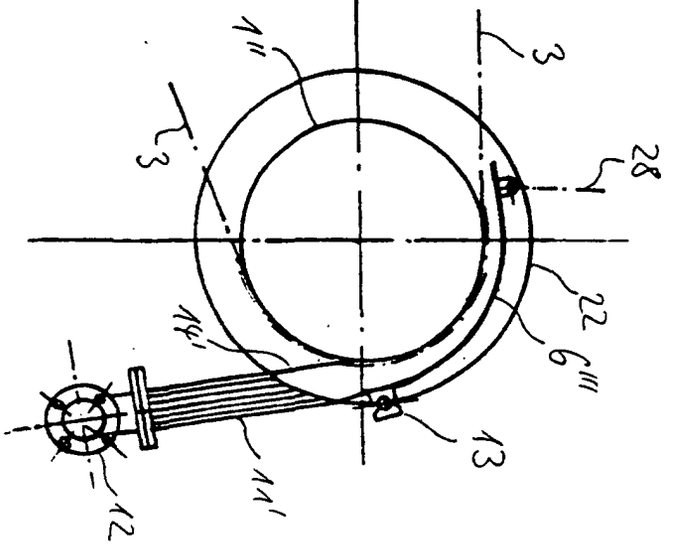

1''
3
3
28
22
6'''
14'
13
11'
12

Fig. 8

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EUROPEAN SEARCH REPORT

Application Number
EP 01 11 5459

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	27 November 2001	Helpiö, T.

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