Nov. 16, 1965 U. J. STRINDLUND 3,217,387

ROLL

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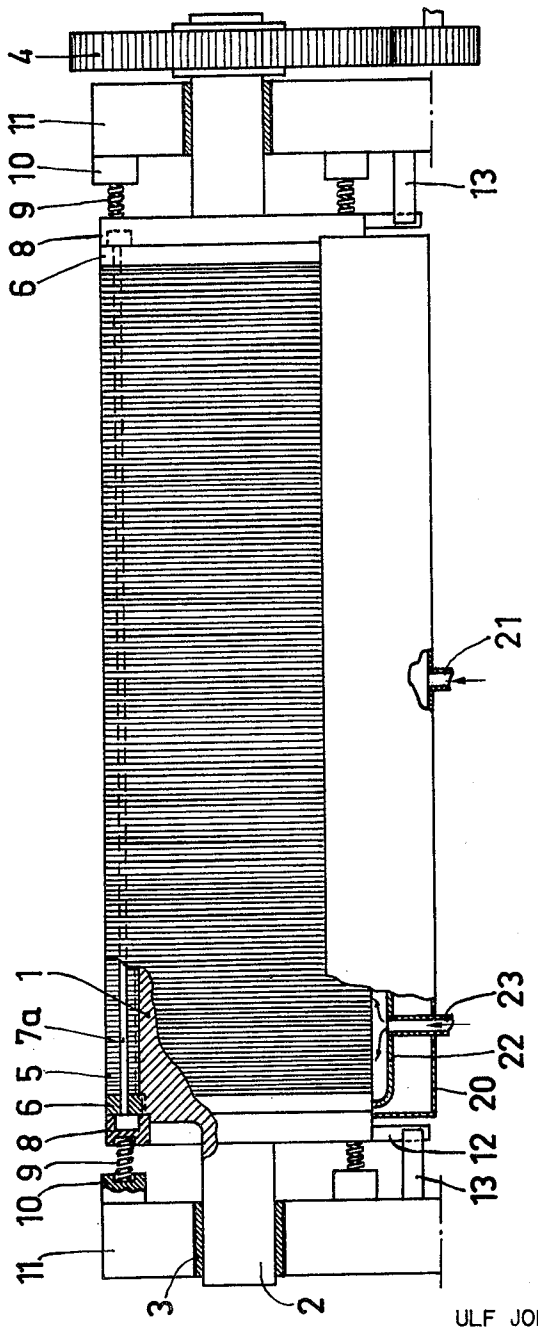
FIG.1



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Nov. 16, 1965 U. J. STRINDLUND 3,217,387

ROLL

Filed Oct. 15, 1963 7 Sheets-Sheet 2

FIG. 2

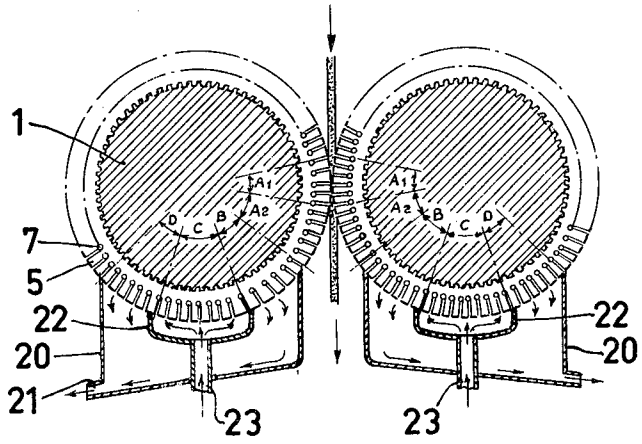


FIG. 3

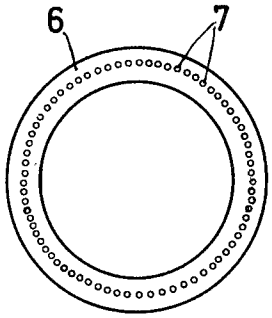


FIG. 4

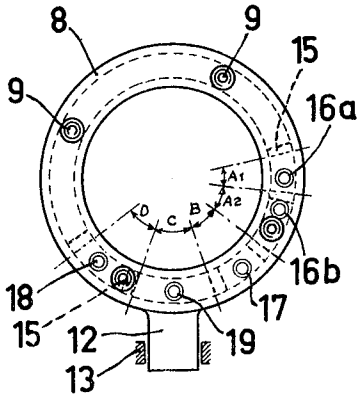
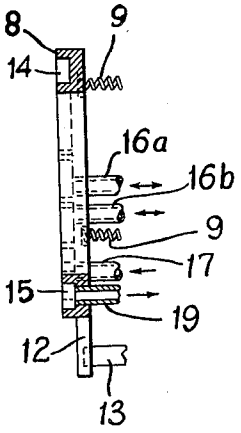


FIG. 4a



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Nov. 16, 1965 U. J. STRINDLUND 3,217,387

ROLL

Filed Oct. 15, 1963 7 Sheets-Sheet 3

FIG. 5

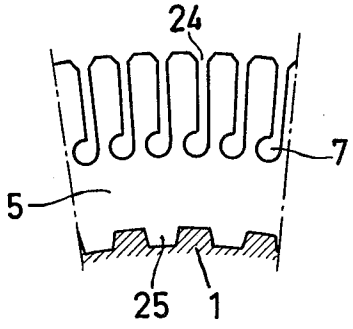


FIG. 6

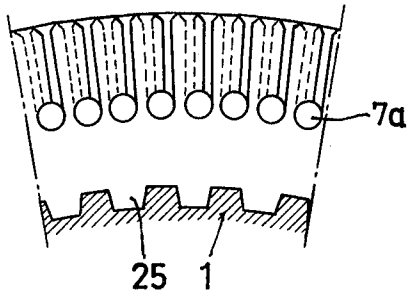
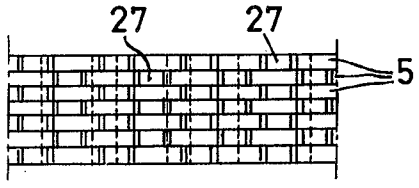


FIG. 7



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Nov. 16, 1965 U. J. STRINDLUND 3,217,387

ROLL

Filed Oct. 15, 1963 7 Sheets-Sheet 4

FIG. 8

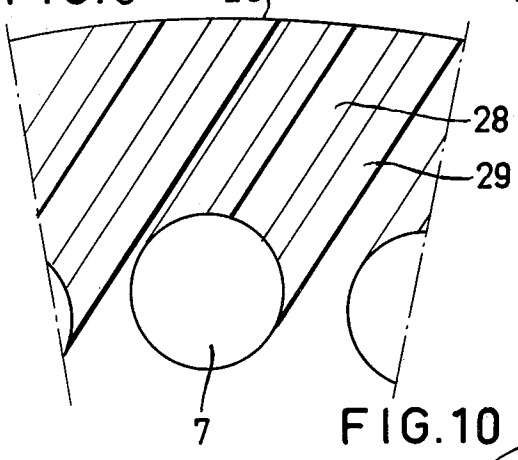


FIG. 9

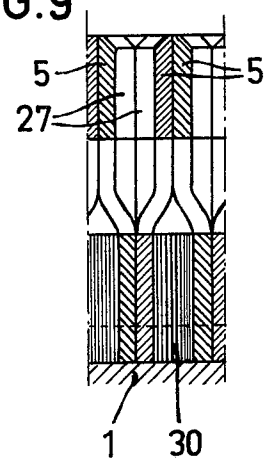


FIG. 10

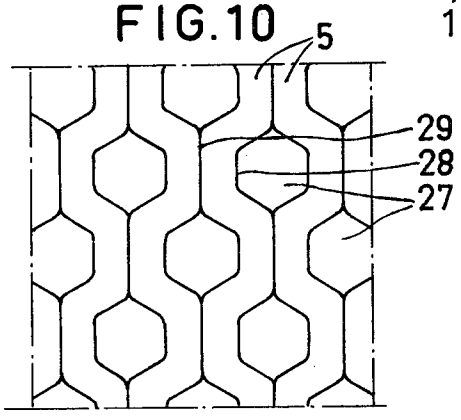
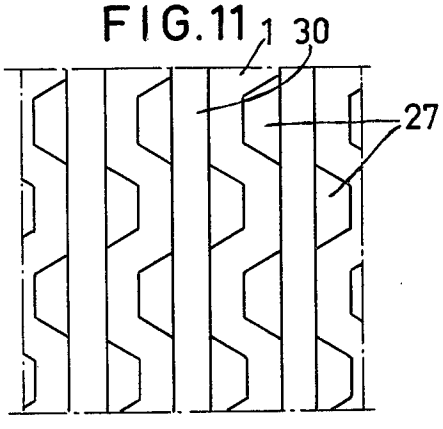


FIG. 11



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ATTORNEYS

ROLL

Filed Oct. 15, 1963

FIG.12

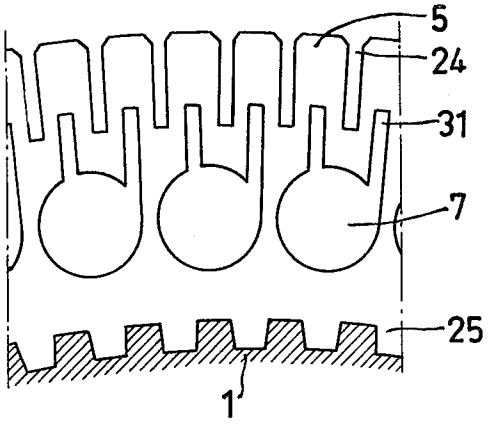


FIG.13

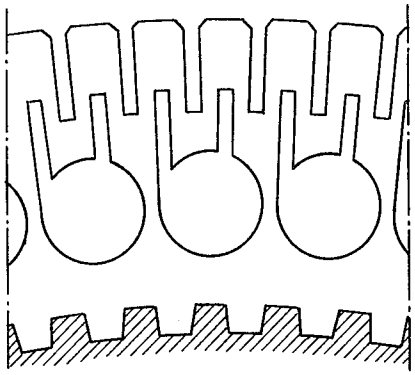


FIG.14

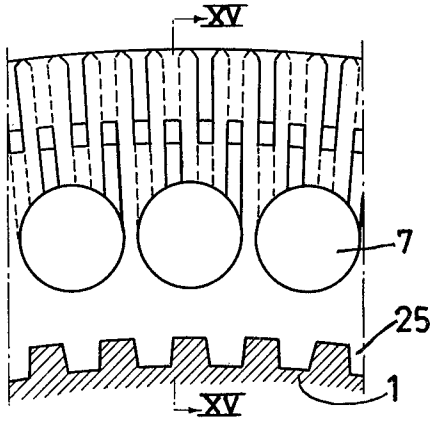
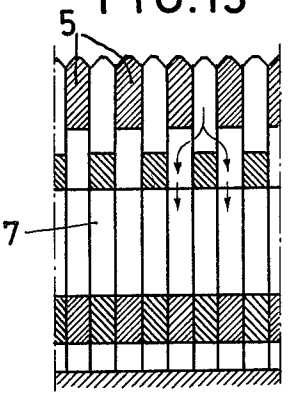


FIG.15



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Nov. 16, 1965 U. J. STRINDLUND 3,217,387

ROLL

Filed Oct. 15, 1963 7 Sheets-Sheet 6

FIG. 16

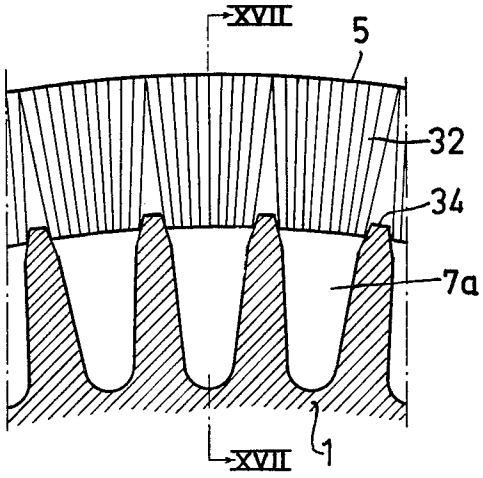


FIG. 17

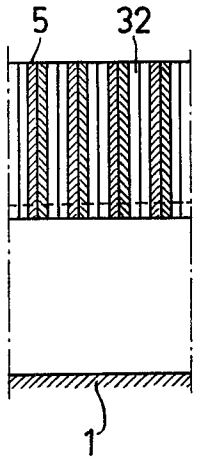


FIG. 18

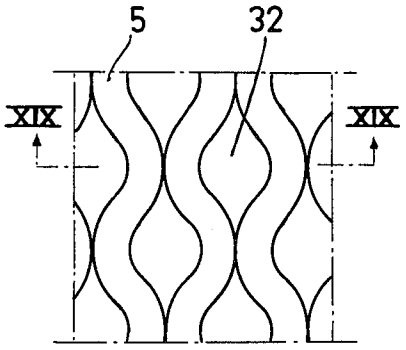
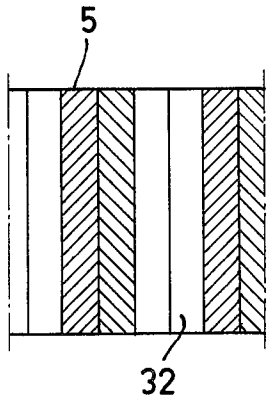


FIG. 19



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Nov. 16, 1965 U. J. STRINDLUND 3,217,387

ROLL

Filed Oct. 15, 1963 7 Sheets-Sheet 7

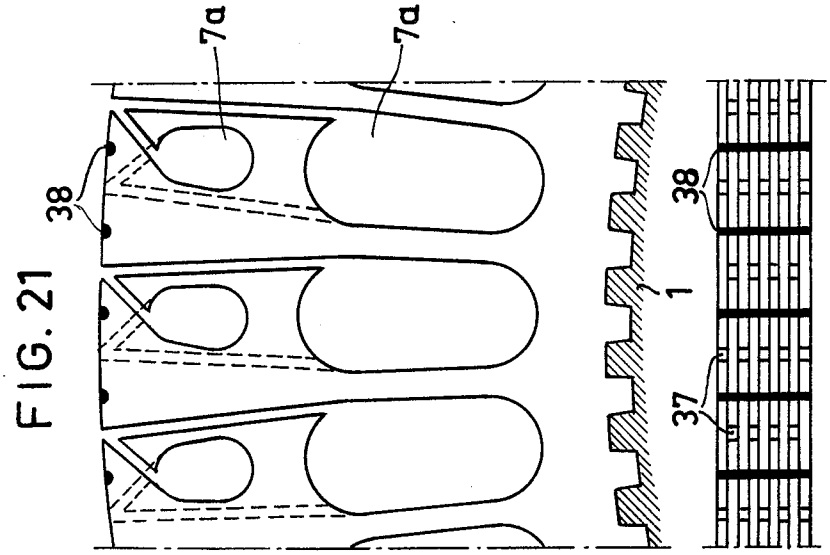

FIG. 21

FIG. 22

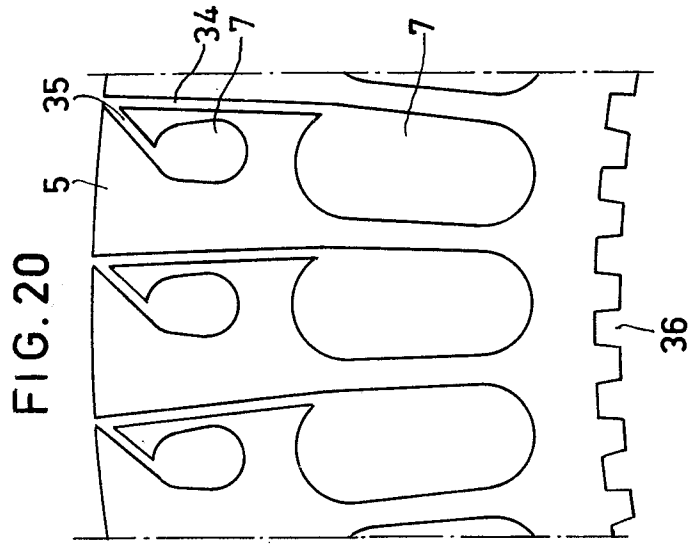

FIG. 20

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United States Patent Office 3,217,387 Patented Nov. 16, 1965

3,217,387

ROLL

Ulf Johan Strindlund, Mackmyra, Sweden

Filed Oct. 15, 1963, Ser. No. 316,212
Claims priority, application Sweden, Oct. 19, 1962, 11,255/62
7 Claims. (Cl. 29—121)

This invention relates to a roll, preferably a press roll, having on its surface a great number of openings which are connected with passages in the roll.

In the manufacture of paper, card-board or pulp the fibres are suspended in water when they are supplied to the paper machine, card-board machine or drying machine. The largest portion of the water is drained in the wirepart of the machine. From an economical point of view it is of advantage to remove by pressing as much of the remaining water as possible. This pressing is normally carried out by roller presses in the press section of the machine. The rolls comprised in such roller presses may be of iron with a grooved face (high pressure rolls) or they may press with a lower roll of iron and the upper roll covered with rubber, a textile felt provided between the rolls and running along with them (felt presses). In papermaking machines felt presses are used having their lower roll provided with a suction box which is connected to a vacuum pump.

Between two presses in the press section there are usually provided one or several steam-heated rotary cylinders adapted to increase the temperature of the fibrous web and thereby to facilitate the pressing out of the water in subsequent rolls.

The dry content obtained in the described manner (in the wet section) is about 40% in paper machines, about 45% in drying machines (paper pulp) and about 50% with high pressure presses which are now rarely employed because they render the pulp difficult to defibrate.

The amount of pressure effected by the upper roll on the fibrous web against the lower roll is in the said presses at maximum 300 kg. per centimetre of length of the roll. When the amount of pressure is made to exceed the said limit, the fibrous web splits or, as it is usually called, the web forms "crushes." Such "crushes" appear in the web after the high pressure press in the form of flockiness. Such flockings consist of fibre accumulations and fibre thinnings in the web in certain points making the web less and more transparent respectively. Flockiness is caused when the water amount (the water particles) which at high linear pressure is to be pressed out of the so-called nip of the press rolls, is enclosed in the web and in that part thereof which is located in the nip proper, so that the water is prevented from displacement in the direction of motion of the web. Due to the very high water pressure in the said nip, minor water explosions occur whereby fibers are taken along and cause the aforesaid fibre accumulations and thinnings respectively. The said explosions have probably the same direction as the web. When the amount of pressure applied is increased too much, the web breaks in the point where the pressure is applied (in the nip), due to the aforesaid crush phenomenon. The risk that water will be enclosed in the nip and cause "crushes" increases with increasing roll diameter, because the nip length increases with the roll diameter. There is, on the other hand, the requirement that in machines with large width the roll diameters must be increased, in view of the stiffness of the rolls (resistance to bending) at the high linear pressures applied. The problem is, thus, to satisfy two requirements opposing one another.

According to the invention, the said shortcomings are eliminated and at the same time dry contents exceeding

50% are obtained by using the roll as a press roll. The roll according to the invention renders it further possible to work with lower linear pressures and thus to use rolls with smaller diameter than heretofore used. This is achieved in that the water pressed out of the web penetrates into the cavities in the roll and is retained there by the vacuum applied until the web and the roll separate. Due to the possibility of immediate removal of the pressed-outer water from the nip proper, the risk of crushes is completely eliminated, and at the same time the risk of resuction of the pressed-out water is reduced.

The roll according to the invention is characterized in that it is constructed of disk elements disposed adjacent to each other about a core. In a roll of this type the disk elements may be provided with recesses forming passages in the rolls. These passages in the roll may be located completely in the disk elements and the core respectively or partially in the said disk elements and partially in the said core. The disk elements may be split open from the periphery to the recesses or, as an alternative, to a circle situated between the periphery and the passages, slots also being arranged from the passages overlapping the circle such, that the connections between the surface of the roll and the passages are formed by the slots in a disk element and the slots associated with the passages in an adjacent disk element. As an alternative, the disk elements may be folded or grooved from the periphery to the passages. The disk elements may be separate disks or an upright ribbon arranged helically along the core.

The roll according to the invention is, thus, constructed of adjacent disks or disk elements arranged about a core such that substantially axial passages are formed in the roll and connected with the great number of openings in the roll surface, in such a manner, that the openings in an axial direction along the roll are connected by connecting passages with one and the same passage in the roll. A great number of openings is to be understood such that the number of openings per disk element or disk is at least ten, perferably at least about 50 to 100. The connecting passage between the openings in the roll surface and the axial passages in the roll core or disk elements may be of any cross-section, for example circular, polygonal, such as rectangular and hexagonal. At least one of the dimensions of the connecting passages may possibly be capillary, i.e., it may be such small that water is retained in the passage by capillary force. The thickness of the disk elements is preferably of the magnitude 1–2 mm., but is in many cases smaller, especially in the case of flat disks without slots or grooves. The openings in the roll surface have preferably a length dimension which is at maximum ten times the width dimension, for example at maximum five times. The width and the length of the openings are with advantage of the same magnitude.

The disks or disk elements in a roll according to the invention may also be provided with more than one passage in connection with each opening in the roll surface. By means of such an embodiment of a roll water may be sucked from the opening to the one passage in the roll and, for example, compressed air from the other passage may ensure that the water in the first passage is really removed and not re-sucked by the web.

The roll according to the invention is described in greater detail in the following reference being had to the accompanying drawings whereof

FIG. 1 shows partly in section a roll according to the invention mounted in its stand,

FIG. 2 shows in cross-section two rolls acording to the invention mounted as a pair of press rolls,

FIG. 3 shows a lock ring for a roll according to the invention,

FIG. 4 shows an end wall for a roll according to the invention,

FIG. 4*a* is a vertical diametric section of the device of FIG. 4,

FIG. 5 shows part of a disk for a roll according to the invention,

FIG. 6 shows two disks placed adjacent to one another in a roll according to the invention,

FIG. 7 shows part of the surface of a roll according to the invention,

FIG. 8 shows on an enlarged scale another embodiment of a disk for a roll according to the invention,

FIG. 9 shows on an enlarged scale and in section a partial view of some disks according to the embodiment in FIG. 8 placed adjacent to each other,

FIGS. 10 and 11 show on an enlarged scale parts of a roll surface with disks similar to the embodiment shown in FIG. 8,

FIGS. 12 and 13 show on an enlarged scale parts of disks in a further embodiment of a roll according to the invention, the disks being identical but seen from different directions,

FIG. 14 shows the disks in FIGS. 12 and 13 mounted as in a roll according to the invention,

FIG. 15 shows a view along the line XV—XV in FIG. 14,

FIG. 16 shows in section a partial view of a roll according to the invention comprising an alternative embodiment of the disk elements,

FIG. 17 shows a view along the line XVII—XVII in FIG. 16,

FIG. 18 shows a partial view of the surface of an embodiment of a roll according to FIG. 16,

FIG. 19 shows a view along the line XIX—XIX in FIG. 18,

FIGS. 20 and 21 show on an enlarged scale parts of disks in still further embodiments of a roll according to the invention,

FIG. 22 shows part of the surface of a roll according to the invention, the disks being fixed in their position relative one another by means of weld joints.

The roll according to the invention shown in FIG. 1 comprises a core **1** of steel provided at both ends with journals **2** supported in bearings **3**. One of the journals is extended for a drive wheel **4**. The core **1** is on its outside provided with a casing of tightly abutting disks **5** of corrosion-resistant material, for example steel or a nonferrous metal. The disks **5** are on their inner edge provided with teeth fitting accurately into grooves along the periphery of core **1**. The disks **5** are thereby fixed accurately relative one another, in such a manner, that recesses **7** in the disks **5** are located directly in front of each other and, thus, form passages **7***a*, for example of circular cross-section, extending from one end of the roll to the other. Lock rings **6** mounted at the roll ends maintain the disks **5** in compressed position. Holes in the lock rings **6** correspond in number, size and position to the recesses **7** in the disks **5**.

FIGS. 1–4 show further end walls **8** pressed against the lock rings **6** by helical springs **9** which are supported on blocks **10** in the stand **11** wherein the bearings **3** for the roll are mounted. The end walls **8** are prevented from rotating with the roll by a lever **12** guided between supports **13** in the stand **11**. In the end walls **8** facing the lock rings **6** recesses **14** are provided all around the end walls, in which recesses blocks **15** are placed to form tight partitions and to separate the cavities in the circle sections A_1, A_2, B, C and D. Cavity A_1, for example, is connected with pipe connection **16***a* for high vacuum, cavity A_2 is connected with pipe connection **16***b* for low vacuum, cavities B and D are connected with pipe connection **17** and **18** for compressed air, and cavity C is connected with pipe connection **19** which preferably is an outlet. Fixed troughs **20** disposed below the rolls have outlets **21** adapted to collect and discharge water

which through the pipes **17** and **18** is blown by compressed air via the cavities B and D out of the passages **7***a* and disks **5**. There are further provided fixed cup-shaped troughs **22** in tight abutment to the casing surfaces of the rolls, said troughs **22** having pipe connections **23** adapted to blow in therethrough, for example, steam, hot or warm air into the disks **5** and passages **7***a* and further out via cavity C through the pipes **19**, so that the disks and passages are effectively cleaned from fibres and resin or resin coverings. Steam, hot or warm air may also be blown in through pipe connection **19** via cavity C into the passages **7***a* and disks **5** in order to collect blown-out impurities, such as fibres and resin, in trough **22** and discharge said impurities through pipe **23**.

FIG. 5 shows a disk **5** made of a thin sheet of corrosion-resistant material. The disk has recesses **7** and is split open **24** between the recess **7** and the periphery. The corners of the slots **24** at the periphery may be chamfered as shown. Teeth **25** provided at the inner edge of the disk fit accurately into longitudinal grooves in the core **1**. In a roll according to the invention all disks are preferably exactly alike. When mounting them on core **1**, every second disk is turned and the disks are placed together to form a package according to FIG. 6. The recesses **7** coincide exactly with each other and form a passage **7***a* extending in the longitudinal direction of the roll. By placing the disks in the aforedescribed manner a roll is obtained having its surface provided with openings **27** (see FIG. 7) which are connected by the slots **24** with the passages **7***a* formed by the tightly adjacent disks. Due to the aforesaid chamfering of the corners at the slots **24** the partition between the slots is reduced whereby the portion of the casing surface of the roll which is active, for example for suction, is enlarged.

FIGS. 8–11 show another embodiment of the disks for rolls according to the invention. The disks **5** are made of a thin sheet of corrosion-resistant material, have recesses **7** and are folded by pressing between the recesses **7** and the periphery of the disk, as it specially appears from FIGS. 10 and 11. By placing disks together which are folded by pressing from different sides, rolls with openings **27** are obtained, which openings are connected with passages **7***a* formed by the recesses **7** in the disks. When the disks are folded by pressing from different sides to form indentations **28** and ridges **29**, as shown in FIGS. 8 and 10, flat disks or intermediate sheets **30** are required. The said intermediate sheets **30** have outer diameters extending to the inner edge of the recesses **7**, as appears from FIG. 9. The roll according to the invention shown in FIG. 11 is constructed of disks which are alternating folded **1** and flat **30**. Instead of bent or folded sheets the disk **5** may consist of a plate provided with flutes or grooves, for example milled grooves.

When the folded disks are made of thick sheets, their outer edge must be chamfered. The chamfering has in this case the same function as the chamfering at the corners of the aforedescribed slotted disks.

A third embodiment of disks is shown in FIGS. 12–15. Each disk **5** is made of a thin sheet of corrosion-resistant material, such as stainless steel or a nonferrous metal, has recesses **7** and is split open at **31** both from the recess **7** to a division circle (in this case two slots per recess are shown) and from the periphery to a division circle situated closer to the centre than the firstmentioned division circle. The number of slots **31** from the recesses **7** may vary from one to, for example, three to four or more, but is preferably two. The corners of the slots **24** at the periphery are preferably chamfered. The inner edge of the disks is provided with teeth **25** fitting accurately into longitudinal grooves in the core **1**. All disks are preferably exactly alike. When mounting them on the core, every second disk is turned (see FIG. 13) and the

disks are placed together to form a package (see FIGS. 14 and 15). Thus, the recesses **7** coincide exactly with one another and form a passage *7a* extending along the roll. The slots **24** and **31** form thereby connecting passages from the roll surface to the passages *7a*. When the disks are made of thicker sheets, the outer edges must be chamfered. The object with this chamfering is the same as indicated for the aforedescribed disks.

FIGS. 16–19 show a further embodiment of a roll according to the invention. The core **1** is provided with deep grooves which form the passages *7a* in the completed roll. About the core **1** is helically mounted a disk element **5** which is folded or provided with grooves **32**. The said grooves **32** form connecting channels between the openings in the roll surface (FIG. 18) and the passages *7a* in the roll (FIG. 16).

FIGS. 20–22 show in a schematic manner a further embodiment of disks for a roll according to the invention. Each of the disks **5** is made of a thin sheet of corrosion-resistant material, such as stainless steel or a nonferrous metal, has larger and smaller recesses **7** and slots **34** and **35** from the periphery to the recesses **7**. The inner edge of the disk shows teeth **36** which fit accurately into longitudinal grooves in core **1**. The said teeth may, of course, be replaced by some other means for fixing the disks. In a roll according to the invention preferably all disks are exactly alike. When mounting them on the core **1**, every second disk is turned and the disks are placed together to form a package according to FIG. 22. Thus, the recesses **7** coincide with one another and form in the roll longitudinal passages *7a*. By arranging the disks in the aforesaid manner a roll is obtained the surface of which is provided with openings **37** (FIG. 22). The said openings are connected by the slots **34** and **35** with the passages *7a* of larger and smaller cross-sectional area formed by the tightly adjacent disks. In addition to the said teeth **36** fitting accurately into grooves in the core **1** the disks may be fixed in their relative position on the core in that on the periphery weld beads **38** are laid in the middle of each "sector," which beads provide additional connection and fixing of the disks.

The roll shown in FIGS. 20–22 operates preferably such that compressed air is directed from the larger passage *7a* (which is under pressure) through the slot **34** to the slot **35**, whereby the water found at the slots is pressed to the smaller passage *7a* (which is under vacuum). In this way the web is prevented from resucking the water which was pressed out of the nip between two rolls. This is accomplished in that the web in the nip seals against the openings **37**.

Compressed air to the larger passage *7a* and vacuum in the smaller passage *7a* is produced in known manner in that the passages are connected to a compressed air source and a device for producing vacuum respectively by a shielding device of expedient design provided at the ends of the roll.

The roll according to the invention may be employed together with a usual press roll with which it forms a roller press. It may be expedient to use an endless web of wool or artificial fibre, for example polyamide fibre, between the roll according to the invention and the fibrous web. The said endless textile web is conducted in known manner, for example, over guide rolls. In another embodiment of a roller press two rolls according to the invention may abut and be pressed against one another, a textile web as described above possibly employed for one or both of the rolls. In roller presses comprising rolls according to the invention the fibrous web may be conducted both horizontally and vertically through the nip, and in the latter case the direction may be upwards-downwards or vice versa.

Low vacuum and high vacuum may be applied or steam or air be supplied in known manner to the passages in the roll which have a definite position in relation, for example, to the nip in a roller press. The high vacuum may be applied in the nip proper, and steam may flush passages and other cavities in the roll as these passages and cavities are not in connection with the portion of the roll surface which is in contact with the fibrous web. The roll according to the invention may even be used for supplying material or heat to, for example, a fibrous web in that the material is supplied through the passages and cavities to the roll surface where this is covered by the web. The web may thereby preferably enclose a considerable part of the casing surface of the roll. It is, for example, possible to heat a fibrous web by supplying steam to it.

Due to the fact that the cavities in the roll according to the invention are adapted to receive and retain pressed-out water at the point of pressure (nip), it is possible to operate with higher linear pressures without causing the said crush phenomenon. Hereby a considerably higher dry content of the fibrous web is achieved and, as a result thereof, higher production and lower steam consumption respectively.

In view of the possibility of draining the pressed-out water from the nip proper, the invention allows operation with lower linear pressures and, thus, with press rolls of a smaller diameter, which rolls are cheaper to manufacture and procure.

Paper in ready state or pulp has usually a dry content of about 90% and the water remaining in the fibrous web after the press section is removed by passing the fibrous web in contact with steam-heated cylinders of iron or through a drying box with hot-air circulation, which box is provided with rotating rolls over which the fibrous web or pulp web is conducted (fan drying section).

The steam consumption in the drying section of a modern machine for pulp is about 1.3 tons steam per ton of 90% pulp. As 1 ton of steam produced in a modern steam boiler plant at today's fuel prices costs about SwCrs. 15:-, the costs for drying (evaporation) amount to about SwCrs. 19:- to 20:- per ton of 90% pulp.

Due to the fact that by the invention more water is removed prior to the drying section, i.e. in the wet part, the steam consumption and thus the manufacturing costs for paper and pulp are reduced. In the manufacture of pulp it is thus possible to press out water to a dry content of at least 53% compared with 45% dry content according to indicated conventional methods, which means a saving of steam by about 30%. The steam consumption is reduced from about 1.3 to about 0.9 ton per ton of 90% pulp, which corresponds to a saving of about 0.4 tons of steam (SwCrs. 15:-) per ton of pulp= about SwCrs. 6:- per ton of pulp or about SwCrs. 600,000:- per year in a plant having an annual production of 100,000 tons of pulp.

What I claimed is:

1. A press roll for squeezing a fibrous material comprising, in combination, a core, a plurality of metallic disk like members mounted on said core as a center each said disk member having a plurality of apertures extending therethrough, at least one passage extending outwardly from each said aperture to the periphery of said disk, said disks being aligned to form a plurality of axial passages each communicating directly with at least one outwardly extending passage in each disk to form at least one row of passage openings on the periphery of the roll, said row extending parallel to the axis of the roll.

2. A device as claimed in claim **1** wherein said disks are identical and wherein said outwardly extending passages are offset from a radial line extending through the center of the corresponding aperture said disks being arranged in two sets the disks of one set alternating with those of the other and the sets facing in opposite directions.

3. A device as claimed in claim **1** wherein there is a single radial passage extending outwardly from each aperture to the periphery of the corresponding disk said radial passage being offset from a radial line passing

through the center of the aperture and wherein said disks are arranged in two sets the disks of one set alternating with those of the other and the disks of the two sets facing in opposite directions to thereby form two rows of openings in the roll periphery said rows being parallel to the roll axis and communicating with a single axial passage said openings of one row being formed by the radial passages in one set of disks and those in the adjacent row being formed by the radial passages in the other set of disks.

4. A device as claimed in claim 1 wherein said outwardly extending passages comprise grooves formed in said disks extending outwardly from said apertures to the disk periphery.

5. A device as claimed in claim 1 wherein said outwardly extending passages are radial and wherein at least two outwardly extending passages extend from each aperture and wherein said radial passages extend outwardly from said axial passages and terminate at a circle of lesser diameter than the diameter of the disk and wherein additional radial passages extend inwardly from the periphery of said disk and terminate at a circle of diameter less than that of said first mentioned circle said last mentioned passages lying radially intermediate said first mentioned radial passages and wherein said disks are assembled in sets with alternating ones facing in opposite directions to thereby form passages extending from the axial passage outwardly a portion of the passage being in one disk and the remaining portion in the adjacent disk.

6. A device as claimed in claim 1 wherein at least one end plate is provided said end plate having an end groove therein which covers said axial passages, means pressing said end plate against the end one of said disks to effect a seal, means for preventing rotation of said end plate, means dividing said annular groove into sections and means for connecting individual sections to supply means for supplying fluids to said axial passages under a desired pressure.

7. A press roll for squeezing a fibrous material comprising, in combination, a core, a plurality of disk like members mounted on said core as a center, a plurality of axial passages in the press roll, at least one passage extending outwardly from each axial passage to the periphery of each disk, said disks being aligned so that the outwardly extending passageways in the disks form at least one row of passage openings on the periphery of the roll, said row extending parallel to the axis of the roll.

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