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FELT CONDITIONING APPARATUS FOR PAPERMAKING MACHINE

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FIG. 1

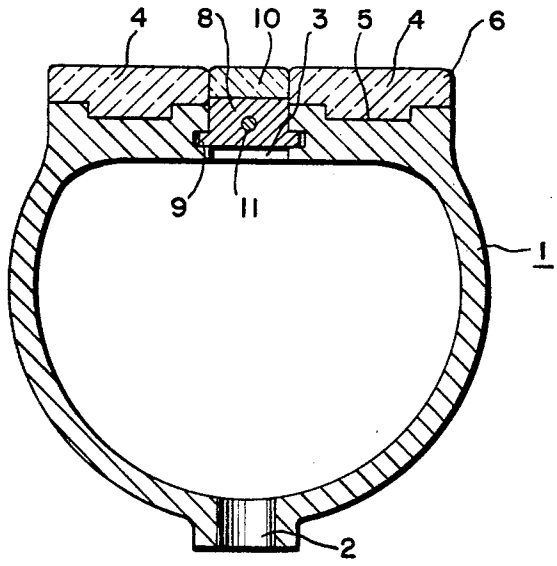

FIG. 2

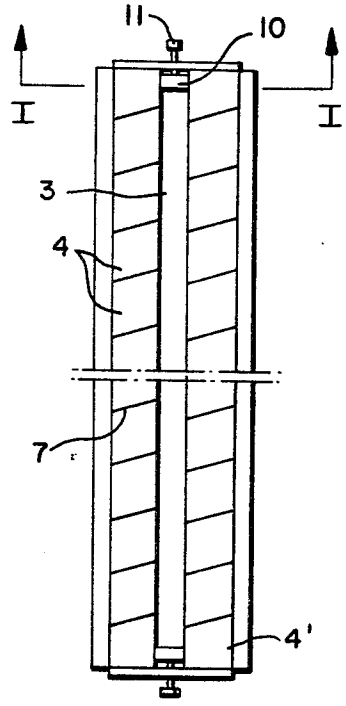

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FIG. 3

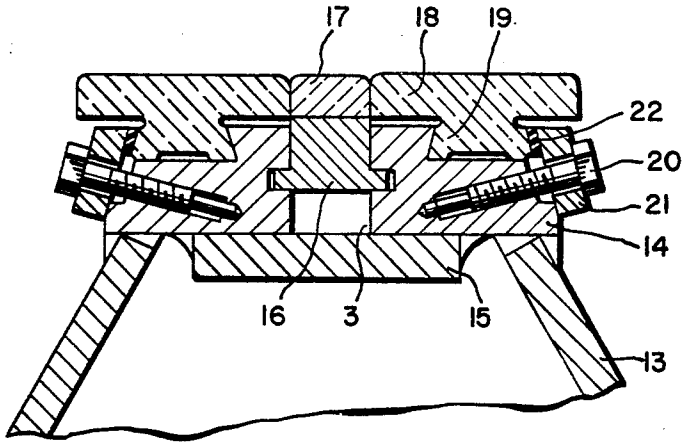
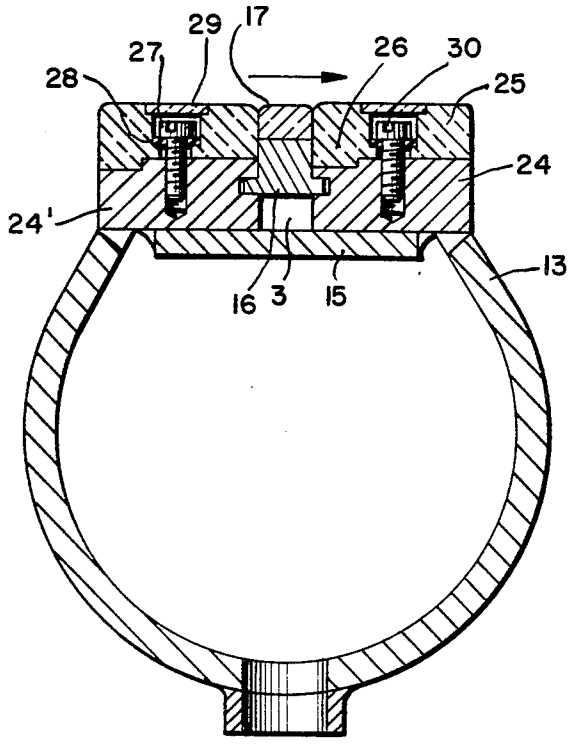


FIG. 4



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FELT CONDITIONING APPARATUS FOR PAPERMAKING MACHINE

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9 Claims. (Cl. 162—274)

ABSTRACT OF THE DISCLOSURE

A felt conditioning apparatus for a paper-making machine in which two spaced elongated bars define a suction slot and are covered with sintered, parallelogram-shaped aluminum oxide sections on their faces flanking the slot. The sintered sections are attached to the bars in such a manner that they are capable of limited relative movement.

This invention relates to papermaking machinery, and particularly to felt conditioning apparatus for use in the press section of a Fourdrinier type papermaking machine.

It is conventional to pass a press felt over a suction box which withdraws absorbed liquid from the felt, thereby restoring the permeability and absorbency of the felt for another pass between the press rolls. Known felt suction boxes may consist of an axially slotted tube connected to a vacuum line. The felt passes approximately tangentially over the slotted surface.

The known felt suction boxes are made of steel or bronze and are subjected to relatively rapid wear by the moving felt. The edges of the suction slot in the box are particularly rapidly worn, and the worn edges in turn attack the felt and are a prime source of felt degradation. The frictional wear of the metallic materials of construction conventionally employed is further accelerated by the chemical attack of acidic and other constituents in the white water which is drawn from the felt.

We have found that the useful life of press felts can be greatly increased by making at least those portions of the associated felt suction boxes which are in direct contact with the felts of sintered, dense, and very hard ceramic materials, and more specifically, to support facing plate sections of such material on a carrier structure which extends over the width of the felt to be conditioned, the several sections being juxtaposed in the direction of felt width on either side of the suction slot. The dimension of each individual section in that direction is but a fraction of the felt width, and the several sections are individually secured to the carrier structure in such a manner that they are capable of limited movement relative to each other.

Other features of the invention will become apparent to those skilled in the art as the disclosure is made in the following detailed description of preferred embodiments of the invention as illustrated in the accompanying drawings in which:

FIG. 1 shows a felt suction box of the invention in elevational section on the line I—I in FIG. 2;

FIG. 2 illustrates the suction box of FIG. 1 in plan view;

FIG. 3 shows a modified felt suction box of the invention in a fragmentary sectional view corresponding to that of FIG. 1; and

FIG. 4 shows yet another felt suction box of the invention in a sectional view as in FIG. 1.

Referring now to the drawing in detail, and initially to FIG. 1, there is seen the tubular cast iron shell 1 of a

felt suction box. A drainage nipple 2 at the lowest point of the shell 1 is connected to a vacuum line when the suction box is operated. As better seen in FIG. 2, a longitudinal slot 3 divides the flat top of the shell 1 so that two bar portions of the shell 1 extend along the two sides of the slot 3.

Facing plate sections 4 cover the two bar portions of the shell 1 practically over their entire length. A rib 5 projecting from the underside of each plate section 4 engages one of two grooves in the shell 1 which extend over the full length of the shell on either side of the slot 3. The grooves are of shallow rectangular section. The exposed top faces of the sections 4 have rounded longitudinal edges 6.

As seen in FIG. 2, the exposed faces of the plates, except for those of the longitudinally terminal plates 4', are of parallelogram shape. They are contiguously juxtaposed so that adjacent plates 4 or 4' form therebetween a joint 7 which is obliquely inclined relative to the direction of elongation of the shell 1, and relative to the direction of felt movement which is perpendicular to the length of the shell in the plane of FIG. 2.

The longitudinal ends of the slot 3 are provided in a conventional manner with bronze deckle blocks 8 having lateral ribs 9 slidably received in longitudnailly elongated recesses in the walls of the slot 3. Approximately prismatic facing plate sections 10 cover the deckle blocks 8 and have rounded edges at their exposed faces which are flush with those of the sections 4. Screws 11 are provided for shifting the blocks 8 longitudinally in the slot 3 and for thereby varying the effective length of the slot in a manner known in itself.

The facing plate sections 4, 4', 10 are secured to the supporting metal elements 1, 8 by an epoxy resin cement in a layer too thin to permit pictorial representation on the scale of FIG. 1. The engagement of the ribs 5 on the plate sections 4, 4' with the grooves of the shell 1 further secure the sections against the frictional stresses transmitted by the felt which moves over the exposed faces of the plate sections.

The sections 4, 4', 10 consist of sintered fairly pure aluminum oxide and are prepared by the method disclosed in more detail in the commonly owned copending application Ser. No. 240,735, filed Nov. 28, 1962. They contain at least 95 percent Al_2O_3 and are shaped by molding and by firing the green compacts at a temperature above 1000° C., and preferably above 1200° C.

Although other dense and very hard ceramic materials such as silicon carbide may be employed, and some of the advantages of this invention may be obtained thereby, facings of aluminum oxide are preferred and give the most consistent long felt life while undergoing very little wear. It is believed that aluminum oxide because of its chemical structure tends to retain the polar water molecules on its surface, and thus to maintain a water film at the interface of suction box and felt which acts as a lubricant.

Aluminum oxide and other ceramic products of the high hardness and density required for successfully carrying out this invention are brittle. When facings extending over the full width of a press felt are made of a unitary piece of ceramic material, the useful life of the facing and of the cooperating felt is sharply reduced. The individual plate sections individually fastened to the supporting metallic carrier are capable of sufficient relative movement to prevent the transmission of stresses other than compressive stresses to which sintered aluminum oxide and other suitable ceramic materials are highly resistant.

Modern high-speed papermaking machines have effective widths of 20 feet and more. The individual facing

plate sections employed with an elongated carrier structure extending over the full width of the machine should not have dimensions of more than 24 inches in the direction of carrier elongation. Dimensions of 8 to 16 inches in that direction have been found to be most practical in almost all instances.

Aluminum oxide sections containing less than 95 percent Al_2O_3 have a significantly shorter useful life than those made of purer material under otherwise analogous conditions. It is difficult, if at all possible, to produce sintered elements of a density approaching that of corundum from less pure raw materials. It is also believed that a very small grain size is not readily available in the presence of an excessive amount of impurities, yet is desirable.

It is believed that sintered aluminum oxide bodies of a purity lower than 95 percent contain amorphous constituents which are concentrated at the grain boundaries of the aluminum oxide and are more readily attacked by aqueous liquids so that individual crystals or grains may be loosened and ultimately dislodged from an exposed surface. The resulting rough spot is a source of felt degradation and a starting point for further destruction of the facing structure.

The surface finish of the aluminum oxide bodies affects felt life and the durability of the facings. Rather surprisingly, exposed facing surfaces of the highest possible polish do not produce the best results. It has been found most advantageous to finish the exposed surfaces in such a manner that a layer on a level 0.5 micron below the enveloping surface defined by the high points of the exposed face consists of not more than 75 percent and not less than 10 percent solid material, the remainder being occupied by voids.

Such a surface structure may be obtained directly by judicious selection of starting materials and of suitable temperatures and times in the sintering process, but is more readily produced by grinding and polishing an originally rougher surface. A secondary sintering operation or flame polishing also have been used successfully for the purpose. The end point of the smoothing operation is determined by means of a known surface analyzer having a microscopic stylus which scans the surface. The movements of the stylus are transmitted to a recorder which plots a curve. Peaks of the curve represent the high points of the scanned surface. A first line is drawn on the plot to connect these peaks, and a second line parallel to the first line interesects areas under the curve representing solid material, and areas above the curve representing voids. Smoothing of the surface is continued until the desired ratio of solid material and voids is obtained for all directions of stylus movement on the exposed face.

A surface meeting the above requirements is formed during normal operation of the felt suction box even when the surface finish of the facing plate sections originally is rougher or smoother than the optimum range. Quite surprisingly, the best surface finish is obtained quicker when the original finish was rougher than desired than with a facing that is more highly polished than is necessary for meeting the above limitations. It is thought that the full retention of the aforementioned lubricating water film is predicated on the specified surface finish. When an aluminum oxide facing is provided with such a finish before installation, a costly break-in period causing damaged felts is avoided.

Metal and aluminum oxide faces that are adhesively secured to each other, preferably by means of epoxy resin cement, are bonded more strongly if roughened prior to cement application, and it is preferred to roughen the ribs **5**, the underside of the facing section **10**, the top face of the block **8**, and as much of the corresponding surface portion of the shell **1** as is accessible prior to installing the facings **4**, **4'**, **10** by means of cement. Fastening methods other than cementing may be resorted to or may supplement cemented bonds, and modified felt suction boxes of the invention relying on such other fastening methods are shown in elevational section in FIGS. 3 and 4. When viewed in plan view, they do not materially differ from what is shown in FIG. 2.

The felt suction box shown in FIG. 3 has a trough-shaped lower part **13**, partly broken away in FIG. 3, but fully shown in FIG. 4 and connected to a suction line. Two carrier bars **14** welded to the trough-shaped part **13** extend inward of the trough opening to define therebetween a slot **3**. The longitudinally terminal portions of the bars **14** are connected by a plate **15** welded to the bars. Deckle blocks **16** are movably mounted in the slot **3** in the known manner described with reference to FIG. 1. They are covered with cemented aluminum oxide facings **17**, whereas the carrier bars **14** are protected by respective facing plate sections **18**, only one of the numerous sections associated with each carrier bar being illustrated.

A dovetail-shaped projection **19** at the underside of each facing plate section **18** engages a notch at the outer edge of the top face of each carrier bar **14**. The notch has a flat, horizontal wall which is in contact with the centrally recessed bottom face of the projection **19**, and another wall which extends obliquely upward at an acute angle to the bottom wall. The oblique wall of the bar **14** conformingly engages a corresponding wall of the projection **19**. The dimensions of the projection **19** are such that there is no direct contact between any other portion of the facing plate section **18** and the associated carrier bar **14**.

The facing plate sections are urged horizontally inward of the notches in the carrier bars **14** by two clamping devices each of which includes several screws **20** longitudinally spaced along each carrier bar **14** and threadedly engaging the same. Only one screw **20** in each bar **14** is visible in FIG. 3. The screws **20** pass through corresponding bores in an elongated clamping bar **21** one longitudinal edge of which engages an edge portion of the carrier bar **14** and is pivoted on the bar **14** when the screws **20** are tightened. A resilient spacer **22** is interposed between the other longitudinal edge of the clamping bar **21** and a side face of the projection **19** of the facing plate section **18**. When the screws **20** are tightened, the facing plate sections **18** are firmly anchored in the notches of the carrier bars **14**. The spacers **22**, which may be of cork, leather, rubber, or the like, distribute the pressure of the clamping bar **21** over the surface of the brittle ceramic facings.

The welded shell of the felt suction box shown in FIG. 4 consists of a trough **13** whose top is closed by two carrier bars **24**, **24'** except for a slot **3**, the carrier bars being connected by welded plates **15** at their two ends, and deckle blocks **16** covered by cemented aluminum oxide facings **17** being provided for adjusting the effective length of the slot **3** to the width of the felt, not itself shown, which travels over the illustrated structure in the direction of the arrow.

The two sets of aluminum oxide facing plate sections **25** which cover the carrier bars **24**, **24'** have ribs **26** on their undersides which engage conforming notches in the top faces of the associated carrier bars at the leading edges thereof. The notch in the carrier bar **24** thus is contiguous to the slot **3** whereas the notch of the carrier bar **24'** is remote from the slot.

Stepped cylindrical bores **30** in the facing plate sections **25** are coaxially aligned with threaded bores in the associated carrier bars **24**, **24'**. The stems of screws **27** threadedly engage the bores of the carrier bars, pass axially through the narrowest portion of the associated bore **30**, and carry screw heads which are received in a wider portion of the bore **30**. The orifices of the bores **30** in the exposed face of the facing plate section **25** constitute the widest axial portion of the bore. The several sections of the bore **30** define shoulders therebetween. A resilient washer **28** is interposed between one of the shoulders and the annular clamping face at the underside

of the screw head. A plate shaped plug **29** of sintered aluminum oxide is adhesively fastened to the other shoulder and fills the orifice of the bore **30** flush with the exposed face of the facing plate section.

The facing plate sections **25** are firmly secured to the supporting carrier bars **24, 24'** by the screws **27**, but a layer of epoxy resin cement may additionally be interposed between the sections and the bars. The stresses transmitted to the suction box by the moving felt are largely absorbed by the abuttingly engaged vertical faces of the ribs **26** and of the associated carrier bars.

Obviously, many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically described.

What we claim is:

1. In a felt conditioning apparatus for the press part of a papermaking machine, in combination:

(a) two elongated carrier bar means spacedly juxtaposed;

(b) facing means on each of said carrier bar means and substantially completely covering respective faces of the same,

(1) each facing means including a plurality of facing sections juxtaposed in the direction of elongation of the associated bar means,

(2) each section essentially consisting of a hard, dense, non-metallic, ceramic material,

(3) said two carrier bar means and the facing means thereon jointly defining an elongated slot extending between said carrier bar means and between said facing means.

(c) fastening means securing each section to the associated carrier bar means while permitting limited relative movement of the sections relative to each other.

2. In an apparatus as set forth in claim **1**, said material including at least 95 percent aluminum oxide.

3. In an apparatus as set forth in claim **1**, said sections consisting essentially of sintered aluminum oxide.

4. In an apparatus as set forth in claim **3**, each section consisting of not more than 75 percent and not less than 10 percent solids at a level 0.5 micron below a surface defined by the high points of a face of said plate section directed away from the associated carrier bar means.

5. In an apparatus as set fotrh in claim **3**, said fastening means including a clamping member secured to said associated carrier bar means for movement toward said section.

6. In an apparatus as set forth in claim **5**, said fastening means further including a resilient member contiguously interposed between said clamping member and said section.

7. In an apparatus as set forth in claim **5**, said clamping member being a screw having a threaded stem threadedly engaging said associated carrier bar means, and a head having an annular clamping face, said section being formed with a bore therethrough having an orifice in an exposed face of said section directed away from said carrier bar means, and having shoulder means in said bore for cooperation with said clamping face, said head being received in said bore intermediate said orifice and said shoulder means, and plug means in said orifice flush with said exposed face for closing said orifice.

8. In an apparatus as set forth in claim **3**, said fastening means including a layer of epoxy resin cement interposed between said carrier bar means and each of said sections.

9. In an apparatus as set forth in claim **3**, two juxtaposed sections defining therebetween a joint obliquely inclined relative to the direction of elongation of said carrier bar means.

References Cited

UNITED STATES PATENTS

1,977,352	10/1934	Proulx	162—374
3,250,671	5/1966	Walker	162—374

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