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LIQUID FLOW CONTROL DEVICE HAVING IMPROVED SURFACE FOR OPERATIVE ENGAGEMENT WITH RELATIVELY MOVING PAPER MACHINE FORMING WIRE

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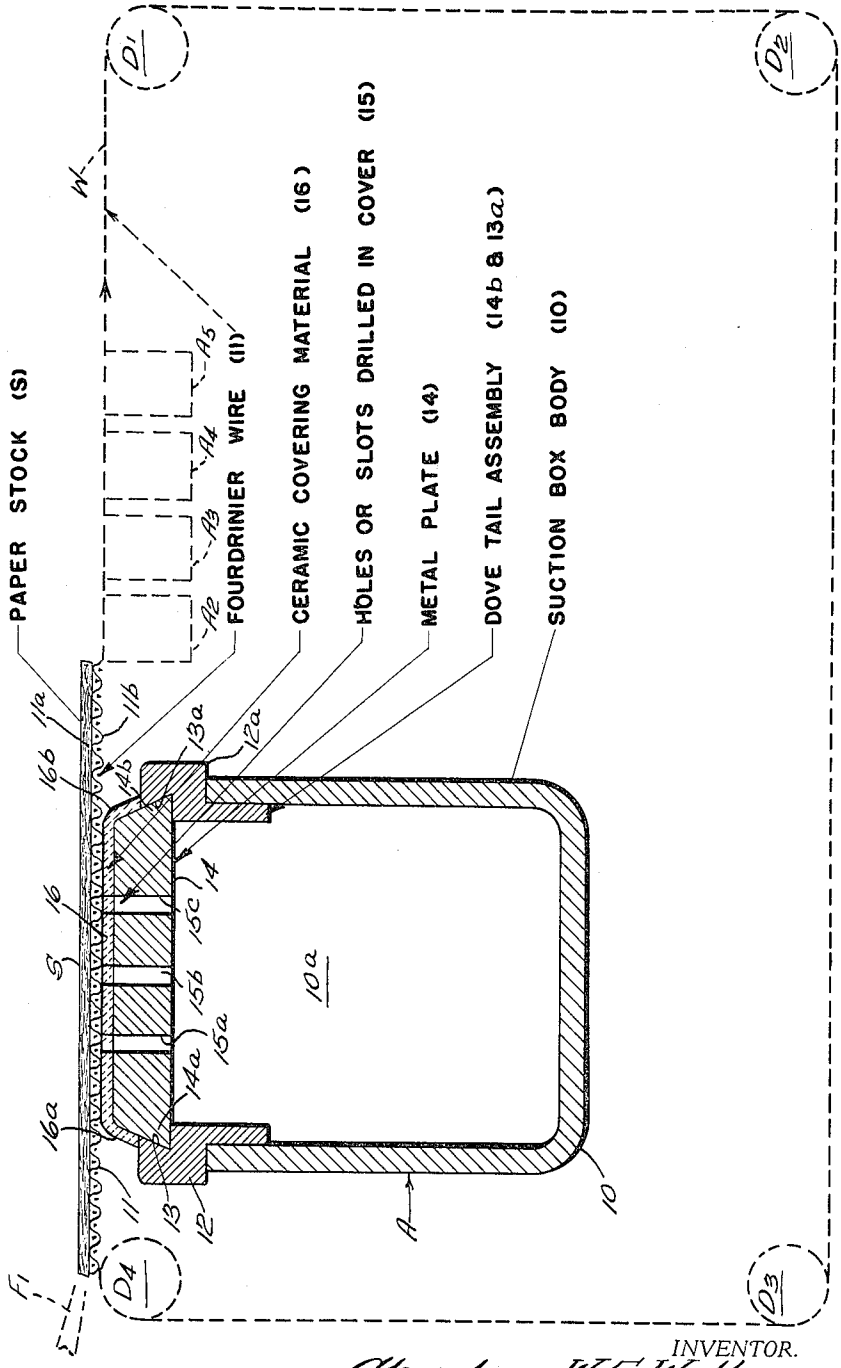

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LIQUID FLOW CONTROL DEVICE HAVING IMPROVED SURFACE FOR OPERATIVE ENGAGEMENT WITH RELATIVELY MOVING PAPER MACHINE FORMING WIRE

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This is a continuation-in-part of my application Serial No. 150,917, filed November 8, 1961, now abandoned.

The instant invention relates to paper making machines, and more particularly to parts or elements of paper making machines which are adapted to contact the forming wire moving relative thereto.

In certain paper making machines, the stock or dilute suspension of fibers is fed onto what is known as a "forming wire" which is actually a fine mesh screen; and in the Fourdrinier type machine, the forming wire is often referred to as the Fourdrinier wire. In Fourdrinier type machines, the forming wire has the structure of an endless loop of such fine mesh screen which receives paper stock on the outer periphery thereof, dewatering such stock by movement of water through the screen and past initially the outer periphery and ultimately the inner peripheral surface of the looped screen, thereby ultimately forming a moist paper web on the loop outer peripheral surface (from which the web is removed for further processing in the machine at a later stage). The forming wire travels at a relatively high speed in present-day paper machines, in the order of 1500 to 2500 feet per minute, and machines are being designed for speeds of as much as 3000 feet per minute. The forming wire, of course, comes into contact with elements such as rolls, which are rotating at a surface speed that is substantially the same as the speed of the traveling forming wire.

The forming wire also comes into contact with various elements in the paper machine which are stationary or substantially so, to the extent that there is significant relative movement between the traveling forming wire and such elements. These elements include primarily the suction box covers, although the forming wire does move relative to and in contact with various other elements on the machine, including forming boards, deflector tops and deckle straps, all of which elements or devices function to control liquid (i.e., water ordinarily) or stock flow in one way or another in a paper machine. The instant invention provides a novel structure for such elements which may come into contact with the traveling forming wire, moving relative thereto. Such structure comprises a suitable base or support material on which is securely mounted a layer of ceramic material, which ceramic material has been found to reduce the abrasive wear of the wire so as to increase the life of the wire. It will be appreciated that in the case of, for example, wooden suction box covers, the wire tends to wear away the covers, but in so doing the wire itself is subjected to abrasive wear, which is compounded by the tendency for grit and other hard abrasive materials (known to be present in stock in fine particulate form) to become embedded in the wooden box tops and function as an abrasive with respect to the wire.

The instant invention also provides a solid, smooth, mirror-finished, ceramic surface on such stationary element for contacting the solid wire that affords sliding solid-against-solid type of frictional engagement between the moving wire and the stationary element, thus decreasing the power consumption of the machine required to drive the wire.

It is also a conventional practice to remachine the suction box covers after a certain period of operation, in the case of conventional suction box covers; but the instant ceramic layer-protected box tops do not require this additional operational expense, because of their resistance to wear.

It is, therefore, an important object of the instant invention to provide an improved element for a paper machine adapted to contact a forming wire moving relative thereto.

It is a further object of the instant invention to provide an improved perforated paper machine suction box cover presenting a refractory, mirror-finished ceramic land surface for contact with a traveling forming wire surface moving relative thereto and urged thereagainst by virtue of paper stock on the opposite wire surface being subjected to a pressure differential to dewater such stock through the wire and box.

Other and further objects, features and advantages of the present invention will become apparent to those skilled in the art from the following detailed description thereof and the drawing attached hereto and made a part hereof.

The drawing attached hereto is a sectional elevational view of a suction box mounted in association with the traveling forming wire and equipped with the ceramic cover of the invention.

In the drawing, the reference numeral **10** indicates generally a suction box body of generally U-shaped cross section, which extends the full width of the paper machine and, of course, the full width of the forming wire indicated at **11**, traveling in the direction indicated by the arrowhead. The forming wire is shown herein only as a single line for simplicity, although it will be appreciated that this forming wire **11** is a fine mesh screen, usually a metal screen which is the type of screen or wire that is used most advantageously with the suction box of the instant invention.

The suction box body **10** is provided with opposed generally parallel support members **12** and **12***a* which extend the full width of the machine across the mouth **10***a* of the suction box body and present dove-tail grooves **13** and **13***a* in opposed relation at the top of the suction box body **10**. Slidably mounted in the dove-tail grooves **13**, **13***a* is a metal plate **14** which has a tapered cross section along the edges **14***a* and **14***b* thereof to conform with the shape of the dove-tail grooves **13**, **13***a*, respectively.

The metal plate **14** is perforated with drillings, slots or otherwise, but in the embodiment here shown the perforations are in the form of drillings **15***a*, **15***b*, **15***c*, etc., which form a myriad of perforations throughout the full width of the metal plate **14** for receiving water therethrough, which is collected in the suction box body **10**. The suction box body is, of course, maintained under a reduced pressure by conventional means which need not be described in detail herein, and the water collected therein is removed by conventional means such as a drop-leg or the like which also need not be described in detail herein.

The metal plate **14** functions as a base or supporting member which carries a ceramic layer **16** on the upper face thereof. The ceramic layer engages the traveling forming wire **11** carrying thereon paper stock indicated generally at S. The forming wire **11** here shown is a Fourdrinier forming wire in a conventional Fourdrinier machine; and the wire **11** moves at a relatively high rate of speed in the direction indicated by the arrow, whereas the suction box assembly, indicated generally by the reference numeral A (and including the entire body **10**, the metal plate **14** and the ceramic coating **16**, secured to the body **10** via the supporting members **12**, **12***a*) remains stationary.

Expressed in other terms, conventional to the paper machine builder, the Fourdrinier type paper machine has a traveling looped forming wire **11** with outer **11***a* and inner **11***b* peripheral forming wire surfaces and also such machine is provided with means F_1 for flowing a paper stock S onto the outer peripheral surface **11***a* of the forming wire **11**. Second means, i.e., the suction box shown at A and subsequent boxes indicated diagrammatically at A_2, A_3, A_4, A_5 in the schematic view of the drawing, are positioned within the loop of the wire **11** for moving water from the stock S through the wire **11** from the outer **11***a* to and past the inner peripheral surface **11***b* thereof to dewater the stock and form a moist paper web W on the wire **11** at the outer peripheral surface **11***a* thereof remote from such second means A, for dewatering; and the paper machine is also provided with third means indicated schematically in the drawing D_1, D_2, D_3 and D_4 as drive rolls for effecting relative movement between the traveling wire loop **11** and the aforesaid first means F_1 and second means A, A_1, A_2, etc., in the paper machine. It will also be appreciated that the aforesaid second means are indicated more specifically herein as at least one box A defining a substantially regularly recurring pattern of water receiving apertures **15***a*, **15***b*, etc., therein maintaining a pressure differential between the stock S on the wire loop outer periphery **11***a* and the wire loop inner periphery **11***b* for dewatering such stock S by water movement in the previously described direction through the wire **11** and into such water-receiving apertures **15***a*, **15***b*, etc. The box A is also provided with land areas, indicated generally by the ceramic layer **16** covering the metal layer **15**, intermediate such water-receiving apertures **15***a*, **15***b*, etc., with such land areas **16** bearing against the wire loop inner periphery **11***b* and in control of direction of the aforesaid relative movement between the forming wire loop **11** and the aforesaid second means or box A for dewatering the stock S, simply by virtue of the fact that the suction box A engages the inner periphery **11***b* of the wire **11** and thus controls its direction of movement to a certain extent. The engagement between the ceramic land areas **16** on the box A and the inner periphery **11***b* of the wire is essentially solid-to-solid engagement, as those skilled in the art will readily recognize and it is this type of engagement which has caused previous difficulties in the operation of suction boxes in the prior art paper machines either by virtue of wearing of the wood covers on the suction boxes or by virtue of grit being caused to imbed (and therefore score) the wooden box tops so that such grit in fine particulate form will function as an abrasive with respect to the wire, or wearing may result from both causes, so that both the wire and the suction box top must ultimately be replaced more often than is desirable. In the practice of the instant invention the suction box top or land areas **16** which engage the inner periphery **11***b* of the wire **11** consists substantially entirely of the mirror-finished refractory monolithic ceramic material which is described hereinbefore as being resistant to wear per se and also resistant to the previously mentioned cause of wear or abrasion on the wire, namely, the imbedding of the grit particles in the imbedding of the grit particles in the suction box top. In other words, the ceramic land areas **16** are inherently resistant to wearing by the relatively softer metal wire as well as wearing by the grit particles which are known to be comparatively hard inorganic and even ceramic materials, for the reason that the land areas **16** are mirror-finished refractory monolithic hard ceramic layers or bodies of the materials described in this specification which have inherently the aforesaid properties with respect to being hard, refractory, crystalline, monolithic, and the like. The additional feature of being mirror-finished is significant, however, because it is known by those skilled in solid-to-solid friction that when two solids are moved in engagement with each other and relative to each other the harder solid will abrade the softer solid, unless and only unless the harder solid is formed with a surface such that it will not abrade the softer solid. In this particular instance the harder solid is the ceramic mirror-finished land areas **16** and it is, of course, inherently much harder than the metallic wire, as paper-machine builders will readily recognize from knowledge of metallic forming wires and an examination of the Bradstreet patent specifically referred to hereinafter and the materials described therein. The skilled worker in the art will also recognize that the materials described in the Bradstreet patent have at least substantially the hardness of the grit particles which are generally understood to be silicon carbide or similar hard materials that break loose from the pulp making machinery and thus become incorported in the stock at an early stage in the production of the stock and are carried along with the stock to the forming wire **11** in conventional paper making.

Although specific aspects of the ceramic material or layer **16** will be described in detail hereinafter, it is sufficient to note first that the ceramic layer **16** is secured to the base plate **14** and, as here shown, conforms substantially with the top shape thereof, i.e., the layer **16** is secured to land areas only on the plate **14** and leaves the perforations **15***a*, **15***b*, etc., open. In this respect, it will be noted that at the oncoming top edge **16***a*, the ceramic coating is curved so as to present a smoothly curved surface, as contrasted to a sharp edge. Likewise, the trailing edge **16***b* of the ceramic layer **16** is curved so as to present a rounded smooth edge, rather than a sharp edge. The rounded edges **16***a*, **16***b*, and particularly, the rounded edge **16***a* at the oncoming side of the wire **11** affords a very great advantage in minimizing wear on the wire when it initially comes into contact with the ceramic top **16** for the suction box A. Actually, the ceramic coating or layer **16** is preferably applied to the base plate **14** in a relatively thin layer of about 1/16 of an inch (ranging preferably from about 0.02 inch to about 0.1 inch) so as to conform substantially with the overall shape of the top of the metal support **14**, which is also provided with rounded edges at the oncoming and off-running top side. The ceramic coating is preferably applied with heat, so that there is sintering or fusion at least at the surface of the ceramic particles and the same are sintered together and onto the metal supporting plate **14**. After such application of ceramic particles by heat to effect the formation of a monolithic layer **16** secured to the top of the metal plate **14**, it has been found particularly advantageous to polish the exposed wire-contacting top surface of the ceramic layer **16** to obtain a mirror finish thereon.

The application of the ceramic coating to the metal layer **14** is preferably carried out by spraying the metal support **14** with a suitable refractory metallic oxide using a high temperature spray gun with an oxyacetylene or oxyhydrogen flame; and it has been found that chrome oxide is particularly satisfactory for this purpose. After the ceramic coating has been so applied to the surface of the metal plate **14**, it may often be desirable to give the ceramic layer **16** a subsequent or more prolonged heat treatment to effect more complete fusion and integration of the layer **16**, to minimize porosity therein.

A particularly satisfactory method of applying the ceramic coating **16** to the surface of the metal plate **14** is described in detail in Bradstreet U.S. Patent No. 2,904,449, the disclosure of which is incorporated herein by reference. The ceramic materials employed in the practice of the invention, using the method of said Patent No. 2,904,449, are, of course, water insoluble inorganic crystalline materials which have a relatively high melting or softening point. Preferably the materials used are refractory at about 1000 to 1200° C.

The ceramic materials which may be used in the practice of the instant invention include all of those specifically referred to in said Patent No. 2,904,449, which include ilmenite, rutile, kyanite, sillimanite, bauxite and

zircon. Alumina and chromia may also be used to particular advantage.

For example, using a procedure of Example II of said Patent No. 2,904,449, for the application of a 50 to 60 mil coating of flame sprayed mullite, one obtains an excellent ceramic layer **16** on the metal base support **14**. The resulting material is polished to a mirror finish. Such flame spraying process, of course, does not involve filling or plugging of the various perforations **15***a*, **15***b*, **15***c* in the metal support **14**, so that the function of the suction box top **14–16** is retained.

The procedure of the previous paragraph is repeated using, instead of mullite, powdered chromia and the resulting ceramic coated suction box top **14, 16** is found to be particularly suitable for use in the practice of the instant invention.

It will be understood that modifications and variations may be effected without departing from the spirit and scope of the novel concepts of the present invention.

I claim as my invention:

1. A suction box cover for Fourdrinier machines comprising a perforated cover for the suction box and in contact with which is moved the Fourdrinier screen wire, said cover comprising a perforated base member and a screen wire contacting body consisting essentially of a layer of crystalline refractory metal oxide ceramic material secured to said perforated base member, said ceramic material presenting a smooth mirror finish surface to said wire.

2. A paper machine suction box cover adapted to contact a forming wire moving relative thereto comprising a base member and a cover therefor and secured thereto, said cover having perforations and land areas, the improvement in said cover consisting essentially of a layer of ceramic material refractory at 1000° C. on said cover presenting a smooth, mirror finish surface of said ceramic material for contact with said forming wire, said cover having a generally smooth transverse forward edge converging gradually with the moving wire passing over said edge and then over the cover body, said layer of ceramic material being fused to the land areas including said smooth forward edge of said cover and leaving the perforations open.

3. A perforated paper machine suction box cover comprising a base support having a myriad of perforations with land areas therebetween and a ceramic layer fused only to the land areas thereof, said ceramic layer presenting a smooth mirror finish surface for contact with a traveling forming wire moving relative thereto, and said layer being formed of monolithic hard crystalline metal oxide refractory at 1000° C.

4. In a paper machine having a rapidly traveling forming wire of fine mesh metal screen for receiving and dewatering stock thereon, a dewatering device consisting essentially of first means presenting to the traveling wire a transverse monolithic surface layer for contact therewith having a smoothly curved leading transverse edge on the side of the surface from which the wire approaches, second means mounting the first means for movement of the wire relative to said surface presented thereby, and third means connected to said first means for drawing water toward said first means from the stock and through such wire to assist in stock dewatering, said transverse monolithic surface layer with its smoothly curved leading edge consisting of a ceramic material smoothed to a mirror finish to facilitate sliding frictional engagement with the forming wire and refractory at 1000° C. so as to be wear-resistant with respect to the wire as well as grit and other foreign material.

5. In a paper machine having a rapidly traveling forming wire of fine mesh metal screen for receiving and dewatering stock thereon, a dewatering device consisting essentially of first means presenting to the traveling wire a transverse monolithic surface layer for contact therewith having a smoothly curved leading transverse edge on the side of the surface from which the wire approaches, second means mounting the first means for movement of the wire relative to said surface presented thereby, and third means connected to said first means for drawing water toward said first means from the stock and through such wire to assist in stock dewatering, said transverse monolithic surface layer with its smoothly curved leading edge consisting of a ceramic crystalline refractory metal oxide polished to a mirror finish to facilitate sliding frictional engagement with the forming wire and refractory at 1000° C. so as to be wear-resistant with respect to the wire as well as grit and other foreign material.

6. In a paper machine having a rapidly traveling forming wire of fine mesh metal screen for receiving and dewatering stock thereon, a dewatering device consisting essentially of first means presenting to the traveling wire a transverse thin monolithic surface layer for contact therewith, said layer being secured to a structural substrate material and having a smoothly curved leading transverse edge on the side of the surface from which the wire approaches, second means mounting the first means for movement of the wire relative to said surface presented thereby, and third means connected to said first means for drawing water toward said first means from the stock and through such wire to assist in stock dewatering, said transverse monolithic surface layer with its smoothly curved leading edge consisting of a ceramic material smoothed to a mirror finish to facilitate sliding frictional engagement with the forming wire and refractory at 1000° C. so as to be wear-resistant with respect to the wire as well as grit and other foreign material.

7. In a paper machine having a rapidly traveling forming wire of fine mesh metal screen for receiving and dewatering stock thereon, a dewatering device consisting essentially of first means presenting to the traveling wire a thin transverse monolithic surface layer for contact therewith, said layer being bonded to a structural metal substrate and having a smoothly curved leading transverse edge on the side of the surface from which the wire approaches, second means mounting the first means for movement of the wire relative to said surface presented thereby, and third means connected to said first means for drawing water toward said first means from the stock and through such wire to assist in stock dewatering, said transverse monolithic surface layer with its smoothly curved leading edge consisting of a ceramic crystalline refractory metal oxide polished to a mirror finish to facilitate sliding frictional engagement with the forming wire and wear-resistance with respect to the wire as well as grit and other foreign material.

8. In a paper machine having a rapidly traveling forming wire of fine mesh metal screen for receiving and dewatering stock thereon, a dewatering device consisting essentially of first means presenting to the traveling wire a transverse thin monolithic surface layer for contact therewith, said layer being secured to a structural metal substrate material and having a smoothly curved leading transverse edge on the side of the surface from which the wire approaches, second means mounting the first means for movement of the wire relative to said surface presented thereby, and third means connected to said first means for drawing water toward said first means from the stock and through such wire to assist in stock dewatering, said transverse monolithic surface layer with its smoothly curved leading edge consisting of a ceramic material smoothed to a mirror finish to facilitate sliding frictional engagement with the forming wire and refractory at 1000° C. so as to be wear-resistant with respect to the wire as well as grit and other foreign material.

9. In a paper machine having a rapidly traveling forming wire of fine mesh metal screen for receiving and dewatering stock thereon, a dewatering device consisting essentially of first means presenting to the traveling wire a thin transverse monolithic surface layer for contact

therewith, said layer being bonded to a structural metal substrate and having a smoothly curved leading transverse edge on the side of the surface from which the wire approaches, second means mounting the first means for movement of the wire relative to said surface presented thereby, and third means connected to said first means for drawing water toward said first means from the stock and through such wire to assist in stock dewatering, said transverse monolithic surface layer with its smoothly curved leading edge consisting of a ceramic crystalline refractory metal oxide polished to a mirror finish to facilitate sliding frictional engagement with the forming wire and wear-resistance with respect to the wire as well as grit and other foreign material.

10. In a paper making machine having a traveling looped forming wire with outer and inner peripheral forming wire surfaces and also provided with means for flowing a paper stock onto the outer peripheral surface thereof, second means within the wire loop for moving water from such stock through the wire from the outer to and past the inner peripheral surface thereof to dewater the stock and form a moist paper web on the wire outer peripheral surface, and third means for effecting relative movement between said traveling wire loop and the aforesaid first and second means in said paper machine, the improvement characterized by a structure for said second means comprising at least one box defining a substantially regularly recurring pattern of water-receiving apertures therein maintaining a pressure differential between stock on the wire loop outer periphery and the wire inner periphery for such stock dewatering by water movement in the direction aforesaid into said water-receiving apertures, said box being provided with land areas intermediate such water-receiving apertures bearing against the wire loop inner periphery in control of direction of the aforesaid relative movement between the forming wire loop and the aforesaid second means for dewatering the stock, said land areas presenting to and bearing against the wire loop inner periphery, for essentially solid-to-solid engagement, a mirror finished refractory monolithic hard crystalline metal oxide ceramic body, that is resistant to wear by the comparatively softer metallic forming wire screen and also resistant to wear by inherently present inorganic particulate ceramic grit particles in the stock which may be carried over the surface of such body by the forming wire in the course of dewatering the stock and operation of the machine.

11. In a paper making machine having a traveling looped forming wire with outer and inner peripheral forming wire surfaces and also provided with means for flowing a paper stock onto the outer peripheral surface thereof, second means within the wire loop for moving water from such stock through the wire from the outer to and past the inner peripheral surface thereof to dewater the stock and form a moist paper web on the wire outer peripheral surface, and third means for effecting relative movement between said traveling wire loop and the aforesaid first and second means in said paper machine, the improvement characterized by a structure for said second means comprising at least one element extending in the cross machine direction and defining both solid surface and water-receiving aperture means maintaining a pressure differential between stock on the wire loop outer periphery and the wire inner periphery for such stock dewatering by water movement in the direction aforesaid into said water-receiving apertures, said element being provided with land areas immediately adjacent such aperture means bearing against the wire loop inner periphery in control of direction of the aforesaid relative movement between the forming wire loop and the aforesaid second means and said land areas presenting to and bearing against the wire loop inner periphery, for essentially solid-to-solid engagement, a mirror finished monolithic hard ceramic body refractory at 1000° C., that is resistant to wear by the comparatively softer metallic forming wire screen and also resistant to wear by inherently present inorganic particulate ceramic grit particles in the stock which may be carried over the surface of such body by the forming wire in the course of dewatering the stock and operation of the machine.

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