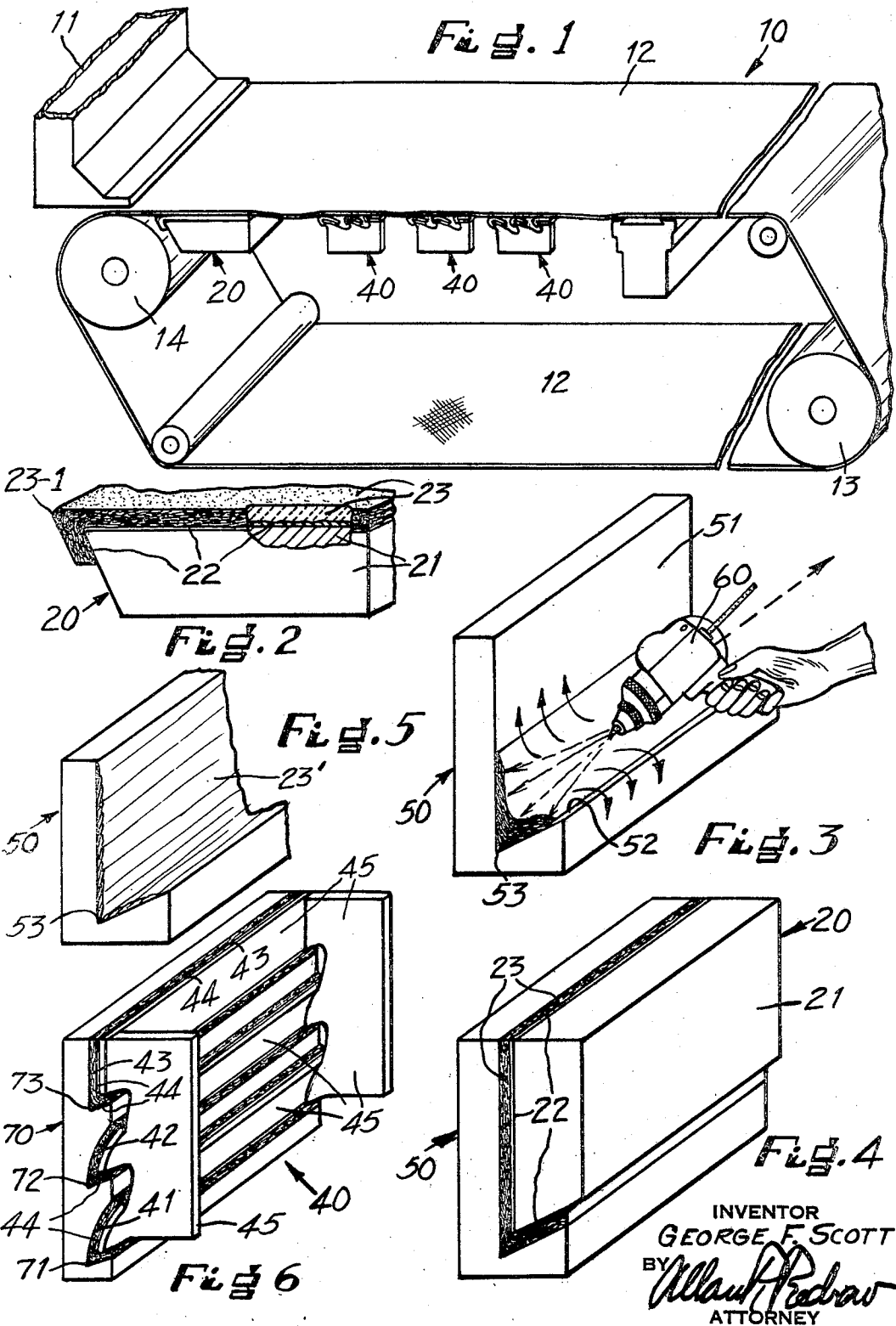


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METAL OXIDE COVERED BEARING STRUCTURES
FOR PAPERMAKING MACHINES
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2

METAL OXIDE COVERED BEARING STRUCTURES FOR PAPERMAKING MACHINES

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6 Claims

ABSTRACT OF THE DISCLOSURE

A Fourdrinier wire bearing structure having an integral preformed smooth hard porous covering mounted on a substructure and which overhangs a side thereof.

The covering comprises overlapping coatings of a refractory metal oxide material flame sprayed onto Teflon coated mold surfaces having the configuration of the finished structure and secured by a layer of resin to the substructure while retained on the Teflon coated mold surfaces.

Upon securing the substructure to the covering the mold is removed by lightly tapping it to produce a shearing force between it and the covering.

This invention relates to bearing structures and more particularly to bearing structures for use in paper making machinery.

In many industrial processes, widespread use is made of bearing structures. Such is the case in the paper industry which commonly employs the Fourdrinier process for the production of paper. In this process, paper pulp is delivered to a continuously rotating wire screen, through which water drains from the pulp to permit the formation of a web of interlocked fibers. The pulp is initially deposited from a head box onto the top side of the generally horizontally moving screen in the vicinity of a stationary forming board disposed to bear against the underside of the screen. This board prevents too great a flow of water through the screen whereby to control the initial orientation of pulp fibers on the screen. Beyond the forming board, also on the underside of the screen, are various foils which are used in scooping off the droplets of water that drain through the screen and collect on the underside thereof. Additional water removal is accomplished by suction boxes which co-operate with the underside of the screen.

The forming board, the foils and the suction boxes are all bearing structures which support the screen which tends to sag between these spaced apart supports due to the weight of the pulp on top of the screen. As such, they are subject to wear from the screen. This wear comes about because of frictional contact between the screen, and the bearing structures and because of abrasive particles in the pulp which are deposited on the screen. These particles are generated at the time the log is ground to a pulp by abrasive wheels. As the pulp is transported by the screen, some of the abrasive particles pass through the screen and come into contact with the bearing surfaces and cause considerable wear.

In order to curtail the wear that is incident to the paper making process, bearing structures can be coated by flame spraying their surfaces with a layer of ceramic or refractory oxide. The resulting coating is advantageous from the standpoint of resistance to wear, but the surface of the coating produced by the spray process as practiced heretofore is quite coarse and the process must be carefully controlled to avoid surface undulations which require extensive grinding and polishing for removal in order to realize a suitable bearing surface. In addition, in the prior art the

ceramic layer forms a mechanical bond with the base substructure, or substrate. In certain instances it has been found that as water drips or is collected from the screen, an erosive separation may occur between the substrate and its coating.

Accordingly, it is an object of the invention to achieve advantageous bearing structures for processing machines in general, and paper making machines in particular. A further object is to realize, in the absence of polishing, bearing structures with a relatively smooth molded exterior surfaced ceramic oxide covering. A related object is to achieve a ceramic oxide covering which requires a reduced degree of polishing to meet a prescribed set of standards. A still further object is to mitigate the erosive effect of fluids which come into contact with oxide covered bearing surfaces.

In accomplishing the foregoing and related object, the invention provides bearing structures with a ceramic oxide covering that extends from a structure support surface for a limited extent over a side wall to form an overhang. The overhang in part serves to counteract the tendency of erosive fluids, such as water, to cause the covering to separate from its substructure. The covering of this invention is preformed and is then bonded to a supporting substructure. The bonding material also serves to fill any voids between the preformed covering and the substructure to eliminate the undesirable effect of surface undulations which are more or less present in every flame sprayed surface.

Under some circumstances the smooth molded exterior surface of the covering in the vicinity of the overhang is disposed at an acute angle with respect to the substructure support surface advantageously less than 90° but greater than 70°. This is the case in paper making, for example, to facilitate placement of bearing structures with respect to rollers and to permit efficient removal of water passing through a Fourdrinier screen.

In configuration, the ceramic oxide covering bonded to a substructure is a composite advantageously formed by a succession of interlaced molten particles that have been frozen in situ to become overlapping coatings which begin at the corner of the overhang. Each overlapping coating is laid down so as to extend generally longitudinally with respect to the direction of motion of the item, such as a Fourdrinier screen, that will bear against the surface of the composite.

To preform the covering, a durable mold which can be finished to have a relatively smooth surface, such as one made of steel, is used. The interior surface of the mold, which is proportioned in accordance with the overall exterior surface of the bearing structure formed by the covering, is sufficiently sandblasted that the covering may be adheringly applied to it.

The covering is applied by flame spraying, refractory or ceramic rod that is placed in a holder, or gun, and melted by an oxyacetylene flame. A blast of air shears off the molten tip of the rod, forming a spark stream the individual particles of which are frozen in situ on the surface of the mold. Each interior corner of the mold is sprayed first over its entire longitudinal length beginning opposite and extending around said corner to form the described overlapping coating. Other overlapping coatings are formed by moving outwardly from the corner and making a succession of these longitudinal passes with the gun over the transverse interior surface of the mold thereby forming a layer. The results is a composite covering which may consist of multiple transverse layers of these longitudinally overlapping coatings.

Following spraying a bonding material is applied to the covering and the substructure attached. The composite structure thus formed, including the ceramic covering, is

freed from the mold by light tapping to produce a shearing force between the sprayed on surface and the mold.

To assure that the composite structure can be freed easily from the mold, it is usually desirable to apply a thin barrier film, as of Teflon, to the interior surface of the mold before spraying the ceramic oxide covering. The barrier film is sufficiently thin that it does not interfere with the initial adhesion of the ceramic layer to the interior surface of the mold. The film is sufficiently thick, however, that it bars the bonding material, by which the covering is attached to the substructure, from causing adhesion to the mold.

Other aspects of the invention will become apparent after considering several illustrative embodiments thereof taken in conjunction with the drawings in which:

FIG. 1 is a perspective view of a fragmentary paper making machine;

FIG. 2 is a perspective view of a bearing structure for the machine of FIG. 1;

FIG. 3 is a perspective view of a mold for preforming the covering of the structure in FIG. 2;

FIG. 4 is a perspective view of the composite structure of FIG. 2 in the mold of FIG. 3;

FIG. 5 is a perspective view of a mold showing the formation of a covering that is unsuitable for use with a bearing structure; and

FIG. 6 is a perspective view of a mold for a foil for a paper making machine.

Turning to the drawings, the fragmentary paper making machine 10 illustrated by FIG. 1 sets forth the context of the invention. A head box 11, containing paper pulp, is used to apply the pulp to a Fourdrinier screen 12, which rotates continuously under the motive power of a couch roll 13. In the vicinity of the head box the screen is wrapped around a free-wheeling breast roll 14. Near the breast roll 14, on the underside of the screen 12, is a forming board 20, which is a bearing structure in accordance with the invention. Beyond the forming board 20, are foils 40. It will be understood that the various forming boards 20 and foils 40 may be included in one or more units, and that where desirable, foil surfaces may be combined with one or more of the forming boards. It will also be appreciated that a complete Fourdrinier system for the making of paper includes additional components, such as supporting rollers and suction boxes which are not shown in FIG. 1.

As paper pulp is deposited upon the screen 12 from the head box 11 in the vicinity of the forming board 20, the screen develops a sag as it passes from one bearing support to another. Furthermore, beyond the initial forming board 20, in the vicinity of the foils 40 there is additional sag because of the weight of the pulp on the screen. This sag causes the screen to be drawn over the front edges of the various units 20 and 40. Consequently, these units experience significant wear which can be reduced by surface covering of ceramic oxide.

Each coated substructure desirably has a side wall that extends partially over the front side of the associated substructure, in part, to compensate for the sag of the screen 12 and, in part to reduce the possibility that water draining through the screen 12 will penetrate the underside of the covering and weaken the bond between the substructure and the covering.

As disclosed in the co-pending application of James H. Perry, Ser. No. 540,895 filed Apr. 7, 1966, now Patent No. 3,352,749, a hard ceramic coating, which is relatively impervious to the wear occasioned by the moving Fourdrinier screen 12, may be flame sprayed upon the upper surface of each substructure using the technique disclosed in U.S. Patent No. 2,707,691, issued May 3, 1955 to W. M. Wheildon, Jr. but other known flame spraying techniques may also be used. The resulting surface is eminently suitable from the standpoint of wear but, unless carefully controlled, may require a substan-

tial amount of grinding and/or polishing to achieve a suitable, and relatively drag-free finish.

However, in accordance with the present invention, an appropriate covering, including an overhang and requiring only a limited amount of polishing, can be achieved by using an auxiliary mold to form what ultimately becomes the exposed or bearing surface of the covering instead of spraying it upon the substructure.

A typical end product is the forming board 20, shown in the enlarged form in FIG. 2. The board 20 includes a basic substructure or substrate 21 which may be of any suitable material such as steel or "Micarta" which is a trade name for a rather rigid inert phenolic bonded laminated cloth product. Overlying the support surface and a portion of the side wall of the substructure 21 is a layer 22 of bonding material such as an epoxy resin. Superimposed upon the bonding material is an integral component in the form of a covering of ceramic oxide 23. The oxide covering is shown in detail to illustrate the way in which its multiple layers are formed. The first layer 23-1 starts at the corner of the forming board 20. Each successive layer is formed of overlapping coatings that extend over the length and breadth of the substructure which serves the function of the forming board. It is to be understood that the multiple layers of FIG. 2 are tightly and generally homogeneously bonded so that, for practical purposes the covering 23 is a unitary but slightly porous structure.

The multiple layers of the refractory oxide covering of FIG. 2 are formed by flame spraying the material in molten form into a mold of the kind shown in FIG. 3. The mold of FIG. 3 is a metallic block 50 whose inner surfaces 51 and 52 are designed to have the configuration of the outer surface of the covering 23 on substructure 21 for forming board 20 of FIG. 2. The general technique employed in preforming the covering 23 makes partial use of the teachings of U.S. application Ser. No. 529,348 filed Feb. 23, 1966 for producing surface coatings. A layer of a refractory metal oxide covering may be applied to the mold 50 by flame spraying the interior of the mold with an oxyacetylene fired gun 60. The configuration of the gun 60 and suitable refractory metal oxide materials for the covering are disclosed in U.S. Patent No. 2,707,691, issued May 3, 1955 to W. M. Wheildon, Jr. However, unless the refractory metal oxide is properly applied, the resultant preformed covering may have unsatisfactory properties at the corner 53. The gun 60 makes use of a stream of high velocity gases, which if not properly utilized tend to disrupt the desired formation of the covering 23 in the vicinity of the interior corner 53.

To produce a preformed covering 23 with suitable corner characteristics, the refractory metal oxide is applied as a stream of molten particles, indicated by the broken-line arrows, in a transverse layer. The transverse layer begins at the corner 53 and extends in the direction indicated by the dashed-line arrow and is composed of longitudinal overlapping coatings. In addition the length of the overhang or interior surface 52 of the mold is proportioned to take into account the angle between the overhang surface 52 and the upper surface 51. As the angle diminishes below 90°, the length of the overhang 52 decreases in order to permit the onrushing gases, indicated by solid line arrows, from the flame spraying gun to escape without causing excessive turbulence. Such turbulence interferes with the formation of a smooth corner layer extending along the transverse length of the mold. In a successful example, the included angles between the overhang region 52 and the base region 51 was 75° and the length of the overhang was 1/4".

The overall technique for applying the covering 23 in the mold involves the step of beginning the lay down of molten particles in the corner 53 and executing longitudinal strokes beginning opposite and extending around the corner, laying down for each stroke an overlapping

5

coating of molten particles frozen in situ of appreciable thickness such as is indicated at 23-1, FIG. 2. These overlapping coatings are achieved by virtue of the fact that the ceramic rod of the gun 60 is melted by an oxy-acetylene flame and a blast of air shears off molten tip of the rod, forming a spark stream of molten material which is quenched or frozen in situ on the surface being sprayed.

Before the covering 23 is deposited in the mold 50, it is advantageous to prepare the interior surface 51 and 52 by a light blasting step. This assures that the overlapping coatings will adhere to the mold 50. The grit blasting desirably produces a roughness which is just sufficient for adherence of the ceramic oxide covering in order to reduce the amount of polishing required once the covering is removed from the mold. In the example of the invention described above, 120 grit aluminum oxide for blasting the mold was found to produce a satisfactory roughness.

In addition, the composite ceramic covering 23 is porous to the extent of about 1% or greater depending on the material and method of spraying with the result that the bonding material, subsequently applied, may seep through the pores of the covering and form an additional bond between the mold and the surface of the sprayed on covering. To prevent this from happening, a release agent is advantageously applied to the interior of the mold after the sandblasting has been completed. A suitable release material has been found to be fluorinated hydrocarbons, such as polytetrafluoroethylene and related materials, one such being sold and marketed under the trade name "Teflon." The release film is desirably thin enough that it does not interfere with the adherence of the covering to the grit blasted interior surfaces of the mold. At the same time, the release film has such a composition that the small amount of bonding material 22 that seeps through the porous covering, will not adhesively bond the covering to the interior surface of the mold. A thin film of a release agent, such as can be applied with an aerosol spray, has been found to be satisfactory.

Because of the relatively smooth interior surfaces of the mold 50 a reduced thickness of covering 23 may be applied to achieve the same end result as commonly achieved by spraying the covering directly upon a substructure, since less grinding and polishing is required because of the substantially planar surface produced on the ultimate surface which becomes the exposed bearing surface. A thickness of 40 mills has been found to be satisfactory in above described example of the preferred embodiment of the invention.

Once the desired thickness of covering 23 is formed on the mold 50 as shown in FIG. 4, the substructure 21 is attached to the covering 23 while it is retained in the mold, by applying a suitable bonding material 22 to the surface of the coating 23. An epoxy resin was found to be a suitable material. The substructure 21 is pressed against the bonding material 22 until the oxide covering 23 becomes integrally mated to it. The mold 50 is then lightly tapped in a longitudinal direction to release the composite structure 20.

It has been emphasized earlier that the multiple transverse layers of the refractory oxide material begin at the corner 53 of the mold 50 in FIG. 3, and unless the formation of the multiple layers is controlled, the preformed covering may have unsatisfactory characteristics. A poorly formed covering is illustrated by FIG. 5, where a ceramic covering 23' has been formed by producing multiple layers upon the mold beginning above the corner 53. As a result the overlapping coatings are orthogonally disposed in the vicinity of the corner 53 and the covering has a tendency to chip as it is withdrawn from the mold. In addition the covering 23' tends to be less durable and less able to withstand the wear and load applied at the corner of the bearing structure.

An alternative embodiment of the invention is shown

6

in FIG. 6 wherein a mold 70 is provided for forming the multiple foil element 40 for the paper making system of FIG. 1. The mold 70 has three interior corners 71, 72 and 73, in accordance with the configuration of the foil 40 in FIG. 1. However, the depth of each of the corners 71, 72 and 73 is each proportioned to permit the formation of respective durable coverings 41, 42 and 43 produced by the preferred flame spraying process, while permitting the onrushing gases from a flame sprayer to escape without impediment. As described before, the spraying begins in the corner regions 71, 72 and 73 and extends in longitudinal coating over the transverse extent of the mold surface until the successive coverings 41, 42 and 43 are completed. Subsequently bonding material 44 is applied and the substructure 45 inserted into the mold 70. After the bond material 44 is cured, the composite unit 40 is freed from mold 70 by tapping the mold in the fashion described previously.

While the present invention has been described in connection with the fabrication of forming board and foil elements for Fourdrinier machines, it is apparent that it may be usefully exploited wherever a flat or configured bearing or other bearing surface may be required. The invention may be used for preparing the surface of a cover for a suction box such as shown in the above mentioned co-pending Perry application.

Other aspects and adaptations of the invention may occur to those skilled in the art.

I claim:

1. In a paper making machine having a traveling screen for supporting water wet pulp during the drainage of water therefrom having transversely extending bearing structures contacting said screen to control the drainage of water from said pulp, the improvement wherein each of said bearing structures comprises a substructure having a support surface and side walls, and an integral preformed refractory metal oxide covering mounted on and overlying said support surface and a portion of at least one of said side walls at a corner thereof with said support surface, said covering consisting of overlapping coatings of said refractory metal oxide beginning opposite and extending around said corner, said overlapping coatings extending generally longitudinal with respect to the direction of motion of the traveling screen and having integral portions with smooth molded exterior surfaces for contacting said screen and overhanging said portion of said side wall and rough interior surfaces adhesively attached to the substructure.

2. A bearing structure as defined in claim 1 wherein the coating is a flame sprayed coating.

3. A bearing structure for use in a processing machine which includes means in engagement with and moving over said bearing structure, said bearing structure comprising a substructure having a support surface and side walls, a layer of bonding material overlying the support surface of said substructure and a portion of at least one side wall at a corner thereof and an integral preformed refractory metal oxide covering having a smooth molded exterior surface and a rough interior surface overlying said bonding material on said support surface and said portion of said side wall, said covering consisting of overlapping coatings of refractory metal oxide beginning opposite and extending around said corner, said overlapping coatings extending generally longitudinally with respect to the direction of movement of said means over said bearing structure.

4. The bearing structure of claim 3 wherein said side wall and said support surface form an acute angle.

5. The bearing structure of claim 4 wherein said acute angle is in the range between 70 and less than 90 degrees.

6. The bearing structure of claim 4 wherein said molded exterior surface over said support surface is at an included angle of at least 75 degrees from said molded exterior surface on said side wall.

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