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DISTRIBUTION PLATE FOR PAPER MACHINE HEAD
BOX HAVING TAPER-FLOW INLET
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3,119,733

FIG. 1

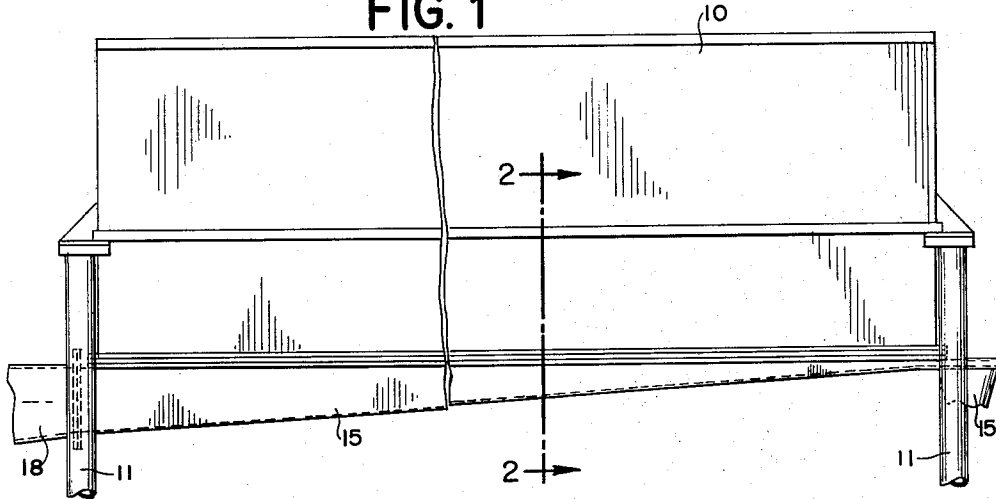


FIG. 2

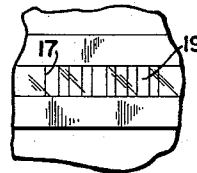
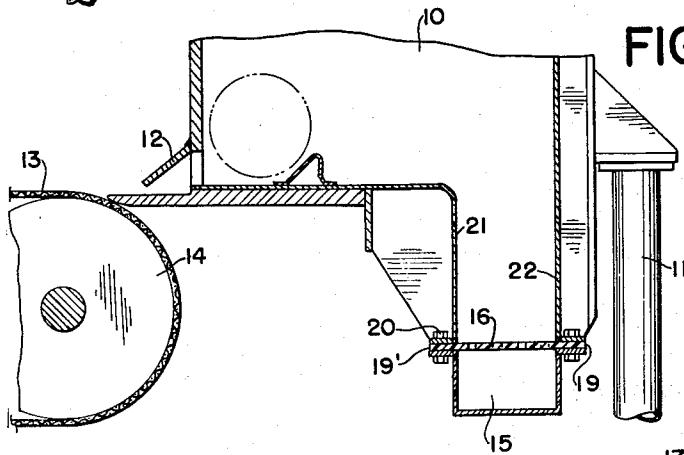
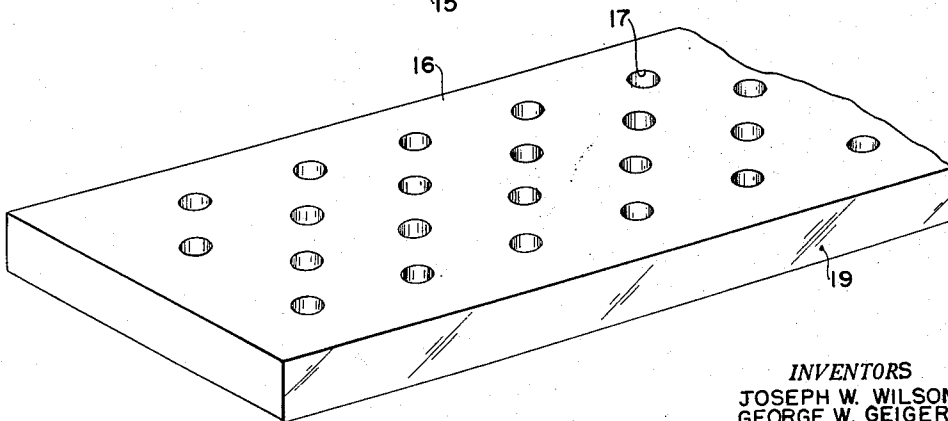


FIG. 4

FIG. 3



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DISTRIBUTION PLATE FOR PAPER MACHINE HEAD BOX HAVING TAPER-FLOW INLET

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The present invention relates to apparatus for making paper, and more particularly to specific and advantageous improvements in so-called taper-flow manifolds for the head boxes of paper-making machines.

In conventional paper-making procedures, paper-making stock, consisting of the desired fibers and additives dispersed in copious quantities of water, is introduced into a head box and flowed from the head box onto a moving screen or wire, for example, which allows most of the water to drain, leaving a web of felted fibers. In connection with this procedure, it is important that the fibrous component of the paper-making stock be evenly dispersed throughout, unclotted and otherwise uniformly conditioned to be laid down on the wire. In addition it is important that the paper-making stock flowing onto the wire be free of local turbulence, which could cause non-uniformities in the weight, thickness and appearance of the finished product. In this respect, most conventional paper-making machines incorporate means in the head box, the intended purpose of which is to disperse and make uniform the various flowing streams of stock, in an attempt to achieve a more uniform flow of the material onto the moving wire or screen.

One of the proposed arrangements for achieving uniformity of paper-making stock flow onto the moving wire is the so-called taper flow inlet header. With this arrangement, introduction of the paper-making stock into the head box is carried out under the conditions of substantial uniformity of stock flow distribution, reducing the need for excessive baffling in the head box and thereby reducing to a minimum the conditions which could cause non-uniformity of flow from the head box onto the screen. The taper-flow inlet header may take a variety of specific forms. However, fundamentally, it comprises an inlet duct running substantially the full width of the head box, having a paper stock inlet at one side and being of specially contoured and progressively reduced cross section from the inlet side to the opposite side of the head box. The header duct and the head box are separated by a distribution plate or like means having a plurality of openings, spaced appropriately across the entire width of the head box, such that the paper stock flows through the plate and into the head box in a plurality of relatively small streams. The tapered contour of the header duct is so calculated that the pressure head is substantially constant across the entire width of the duct, whereby the large plurality of individual streams issuing through the distribution plate are substantially uniform in nature.

While the above-described taper-flow inlet arrangement has substantial theoretical advantages, considerable difficulty is experienced in realizing these theoretical advantages in actual practice. In this respect, in one conventional construction of the taper flow inlet arrangement, the distribution plate is made of a non-corrosive material, such as stainless steel, which is drilled to provide a large plurality of holes over its entire surface. A typical such plate might have a length well over 100 inches, for example, a width of 10 to 12 inches and a substantial thickness of, say, 2 inches. The cost of such a plate may be in the order of \$2,500.

Although the theoretical considerations going into the design of a taper-flow inlet header appear to be relatively

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simple, it is a practical fact that there is little standardization of head box design, and each installation of a taper-flow inlet header usually involves unique problems and considerations, particularly in connection with the design of the distribution plate. Thus, while a distribution plate having a predetermined number of openings, of predetermined size, shape and location, may function adequately in one installation, it may not be suitable for another. And considerable difficulty can be experienced in connection with clogging of the holes, lump formations, etc., resulting from specific flow variations of the head box and inlet assembly.

Heretofore, it has been extremely difficult, if not actually impossible to obtain proper empirical data for the design of distribution plates for taper flow inlet headers. This extreme difficulty extends from two factors: first, visual observation of the assembly under actual operating conditions has not been practical and, second, the relatively prohibitive cost of the conventional manifold plate renders the usual trial and error methods completely unfeasible, from an economic standpoint.

In accordance with the present invention, a novel and improved distribution plate has been provided, for a taper-flow inlet system, which not only permits of visual observation of the system under actual operating conditions, but also permits of trial and error experimentation, based on the visual observations, all while providing a more economical installation than has been realized in the past. More specifically, the invention provides a novel and improved distribution plate which is formed of a transparent, or at least translucent material, the plate being treated or conditioned along at least one of its longitudinal edges to accommodate visual observation of the interior of the plate from such edge. In the complete assembly of the head box, distribution plate and taper-flow header, the longitudinal edge of the plate is exposed, or capable of being exposed, so that an observer may look edgewise into the plate during actual operation of the system and observe the flow of stock through the various holes of the distribution plate. If clogging conditions are occurring at one or more of the holes, such conditions are readily observed by the attendant, who may study the flow conditions on a leisurely basis and under a variety of actual operating conditions.

If, after installation of an experimental distribution plate of the type contemplated by the invention, it is observed that undesirable flow conditions are occurring at one or more places, appropriate redesign can be carried out and a new plate can be manufactured and installed (or, perhaps the old plate can be reworked) to obviate the undesirable conditions. In this respect, and as an important aspect of the invention, the material of which the distribution plate is manufactured, advantageously a transparent plastic material such as Plexiglas, is of such significantly lower cost relative to the cost of stainless steel or other materials conventionally used, that the total cost of the installation is substantially less, even though the distribution plate of the invention might be replaced or reworked one or more times. Thus, not only are significantly better flow conditions assured, but a lower installed cost is realized, even as compared to a conventional installation in which the conventional distribution plate was neither replaced nor reworked in an effort to improve the result.

For a better understanding of the above and other objects and advantages of the invention, reference should be made to the following detailed description and to the accompanying drawing, in which:

FIG. 1 is an end elevation of a conventional paper machine head box having a taper-flow inlet header and

incorporating a distribution plate according to the invention;

FIG. 2 is a fragmentary cross sectional view taken generally along line 2—2 of FIG. 1;

FIG. 3 is an enlarged, fragmentary perspective view of the improved distribution plate of the invention; and

FIG. 4 is an enlarged, fragmentary, end elevational view of the head box of FIG. 1, showing details of the new distribution plate.

Referring now to the drawing, the reference numeral 10 designates generally the head box of a conventional paper making machine. The head box is supported in an elevated position by structural members 11 and has a discharge 12 adjacent to the leading end of a paper making wire or screen 13, which is traveling about a breast roll 14 and then horizontally away from the head box discharge.

In accordance with conventional paper-making procedure, paper stock is introduced into the head box, where it is maintained under a predetermined head and in a condition to keep the fibers dispersed. The stock is flowed out through the discharge 12 onto the screen 13 and away from the head box with the traveling screen. Most of the water in the stock drains through the screen, leaving the fibers in a solid condition and forming a web, which is subsequently dried and otherwise treated to form a paper web.

The illustrated head box arrangement includes a taper-flow inlet header 15, which extends across the full width of the head box at one end. The upper wall of the header and the lower wall of the corresponding portion of the head box 10 is formed by a distribution plate 16 provided with a large plurality of openings 17, through which stock flows from the header into the head box. The taper flow header is provided with an inlet 18 at one side, which discharges the stock into the header flowing in a transverse direction and under a predetermined inlet pressure. As the flow of stock progresses transversely through the header 15, portions of the stock flow upward through the openings 17 in the distribution plate and into the bottom portion of the head box. The excess stock passes through the outlet 15' and is recirculated.

To obtain a uniform flow of stock from the header 15 into the head box 10, the header 15 gradually diminishes in cross section from the inlet 18 to the recirculation outlet 15' of the head box. The degree of taper is related to the number, size, location and other characteristics of the openings 17, such that, under ideal conditions, each of the large plurality of openings in the distribution plate would issue a uniform stream of stock into the head box.

In accordance with the present invention, the distribution plate 16 is constructed of a transparent, workable material, advantageously a plastic, such as Plexiglas. The plate 16 is cut in the desired, rectangular form, and typical dimensions would be, for example, 120 inches in length, 10 inches in width and 2 inches in thickness. At least one longitudinal edge 19 of the distribution plate is made optically smooth, the term "optically smooth" being used herein not in a strictly technical sense, but with the intended meaning that the surface is sufficiently smoothed or polished to remove raw cuts and other substantial irregularities to enable one to see into the interior of the plate.

In the apparatus of the invention, a distribution plate of the typical dimensions specified, having an optically smooth longitudinal edge 19 and a plurality of openings 17 of size, shape and location determined by previous general experience in the field, may be manufactured for a cost of around \$200, as against a cost of around \$2,500 for an equivalent plate of the conventional material of construction, stainless steel. The distribution plate 16 is installed in the manner shown in FIGS. 1 and 2, advantageously being clamped about its edges by bolts 20 or other suitable means so that a fluid tight assembly is provided between the tapered header duct 15 and the bot-

tom wall portions 21, 22 of the head box. The optically smooth longitudinal edge 19 is exposed at one side, or at least provisions are made for exposing the edge quickly, when desired, for observation of the interior of the plate through its edge.

When the plate 16 is installed, the paper machine is set in operation in the normal manner, and the flow characteristics through the openings 17 of the distribution plate are studied carefully by an observer looking into the plate through the optically smooth edge 19. The observation may be facilitated, where desired, by an assistant holding a light along the opposite edge 19' of the plate and, in this connection, the edge 19' may also be made optically smooth, if desired. In fact, in plates of substantial width, it may be necessary to make both longitudinal edges optically smooth, so that observation may be made from both sides.

Observations of the interior of the plate, made from one or both of the optically smooth edges 19, 19', will quickly locate undesirable flow characteristics in the system, and comprehensive evaluations of the flow pattern may be made. On the basis of such comprehensive flow pattern observations, made in the specific machine under actual operating conditions, the plate 16 may be redesigned or reworked, if necessary, in order to obtain or closely approximate ideal operating conditions.

The advantages of the invention are of a truly startling nature, considering that the total cost of the installation, even including reworking or remanufacture of the distribution plate 16, are significantly less than the initial installation charges for a plate of conventional materials of construction, and the arrangement of the invention assures the achievement of proper operating conditions, based upon actual observation, whereas the conventional installations may or may not achieve proper operating conditions, and it is difficult, if not impossible, to ascertain the actual operating characteristics of a conventional assembly. Thus, in a typical assembly, the improved distribution plate may be installed, reworked and if necessary, replaced for a cost of a few hundred dollars, whereas a conventional plate installation would involve a cost of about \$2,500, with no assurance of proper operating characteristics.

The new distribution plate assembly, including a translucent or transparent distribution plate having at least one optically smooth longitudinal edge, is not only useful in connection with the proper location and size of the various openings 17, but is further useful to great advantage in connection with the actual contouring of the openings. Thus, whereas previous knowledge indicated that contoured, tapered openings were desirable for certain types of installations, observations made in the installation of a manifold plate according to this invention demonstrated that such openings were, in fact, specifically undesirable for the installation and that cylindrical openings gave significantly better performance.

A further collateral advantage of the invention resides in the fact that the new distribution plate may be readily installed in an existing installation, permitting the desired empirical observations to be made and providing for the upgrading of the performance of the entire line of equipment.

It should be understood that the specific form of the invention herein shown and described is intended to be representative only, as certain specific changes may be made therein without departing from the clear teachings of the disclosure. Accordingly, reference should be made to the following appended claims in determining the full scope of the invention.

We claim:

1. In a paper making apparatus including a head box, a distribution header for introducing stock into said head box over a wide area of distribution, and an apertured distribution plate separating said header from said head box and providing for the distributed flow of stock from

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the manifold to the head box, the improvement in which said distribution plate is formed of a substantially transparent material, at least one edge of said plate being optically smooth to provide visual access to the interior of said plate, said plate being incorporated in said apparatus in a manner providing for exposure of said optically smooth edge while said apparatus is in operation.

2. The apparatus of claim 1, in which said plate is of elongated, rectangular, flat form, and one of the longitudinal edges of said plate is optically smooth.

3. The apparatus of claim 2, in which both longitudinal edges of said plate are optically smooth and said plate is incorporated in said apparatus in a manner providing for exposure of both longitudinal edges.

4. The apparatus of claim 1, in which said plate is formed of a substantially transparent, plastic material having optical properties characteristic of Plexiglas.

5. The apparatus of claim 1, in which said header has an inlet at one side and is of progressively diminishing internal cross section in a direction away from said inlet, the principal longitudinal axis of said header being in the direction of the progressively diminishing cross section thereof, and the optically smooth edge of said distribution plate extending in the direction of said axis.

6. In a paper making apparatus including a head box, a distribution header for introducing stock into said head

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box over a wide area of distribution, and an apertured distribution plate separating said header from said head box and providing for the distributed flow of stock from the manifold to the head box, the improvement in which said distribution plate is formed of a substantially transparent plastic material, means are provided for mounting said distribution plate with one edge exposed, and said one edge is sufficiently smooth to enable the interior of said distribution plate to be observed through said one edge.

7. The apparatus of claim 6, in which said distribution plate is of rectangular, flat form having a thickness on the order of two inches, and said plate has a plurality of substantially cylindrical openings therein for the distributed, uniform flow of stock into said head box.

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