Nov. 9, 1937. J. W. SALE 2,098,733

PLYBOARD

Filed Sept. 20, 1937

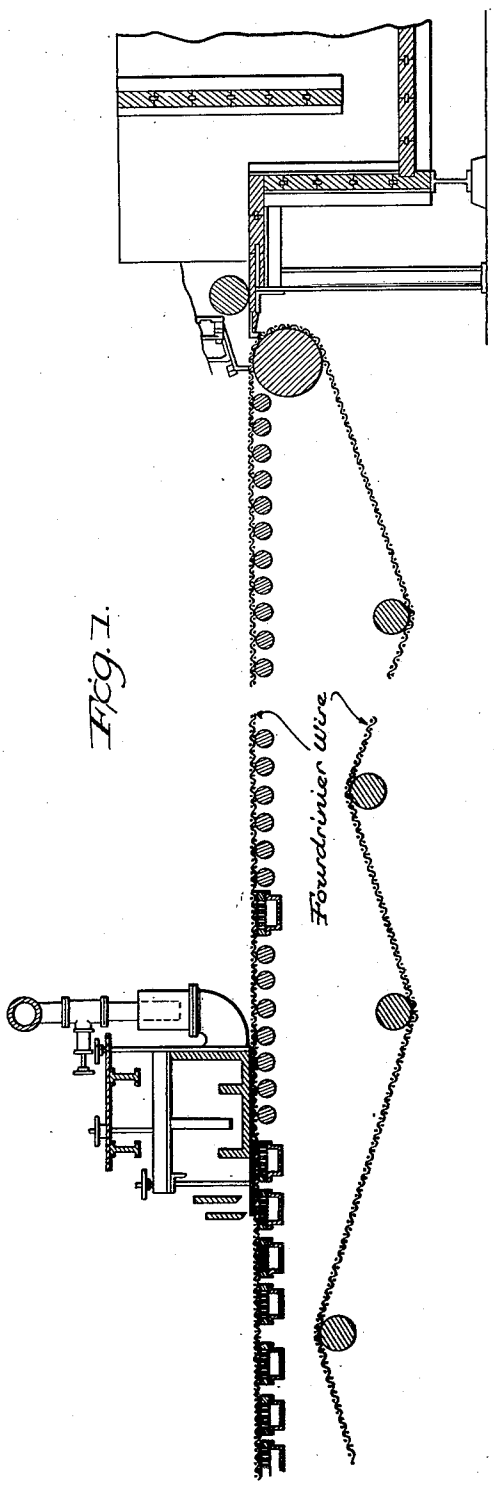


Fig. 1.

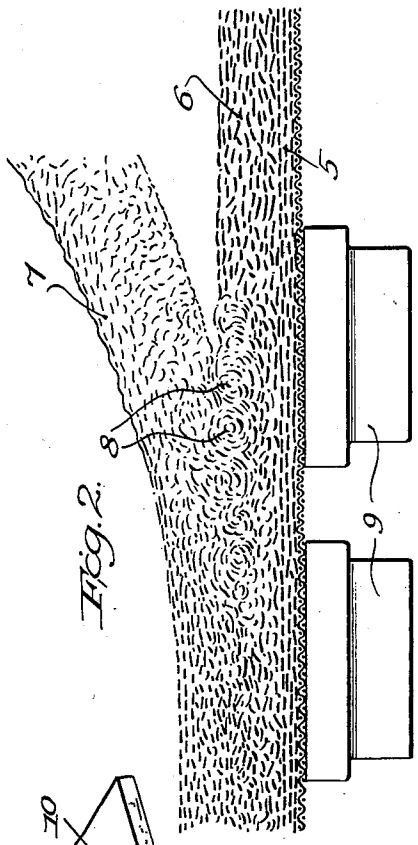


Fig. 2.

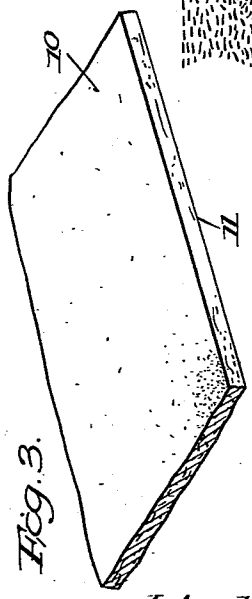


Fig. 3.

Inventor

John W. Sale.

By Cushman, Darby & Cushman

Attorneys

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UNITED STATES PATENT OFFICE

2,098,733

PLYBOARD

John W. Sale, Hopewell, Va., assignor to Hummel-Ross Fibre Corporation, Hopewell, Va., a corporation of Virginia

Application September 20, 1937, Serial No. 164,808

7 Claims. (Cl. 92—39)

This invention relates to improvements in plyboard and the method of making same.

In the manufacture of paper (i. e. cellulosic stock) board, liners, and various grades of built-up vat-lined combination plyboard, it has heretofore been necessary to use a single cylinder or multi-cylinder rotary machine. This type of machine has a number of serious disadvantages which are well known to those skilled in this art.

A general object of the present invention is to render it possible to manufacture the aforementioned type of paper or the like on a continuous wire of a Fourdrinier type of paper-making machine, thereby being able to greatly increase speed of manufacture with a resulting increase in production. In practicing my method, I form the usual web or sheet of paper or board on a Fourdrinier wire belt and superpose on this web or sheet, after it has been dehydrated to a certain extent, another sheet, in a very fluid condition, made from the same materials and of the same color, or from different materials and of different colors, and a different grade of stock, in such manner as to, first, improve the formation and texture of the sheet and give it greater tensile strength both with and across the grain; secondly, to provide a more uniform formation, improve the Mullen test and the finish or surface characteristics and produce a much more uniform and highly polished surface without the aid of starch, wax, or other ingredients used as a surface coating on some types of board, and thirdly, to obtain greater bulking, thus resulting in a lower weight per unit area for a given thickness of paper or board.

My invention further eliminates certain disadvantages which heretofore have been inherent in the Fourdrinier type of machine, in that, first, my invention enables the paper maker to control the sizing or absorbency on one or both sides of the sheet, especially for use by the manufacturer of corrugated or solid fiber shipping cases, as it enables the box maker to get quicker and more uniform adhesion in pasting the board; secondly, the elimination of danger of splitting, blowing or checking frequently found in board made on cylinder machines, as more fully hereinafter set forth.

A specific object of the invention is to produce on a Fourdrinier type of machine, a homogeneous sheet of certain or known fiber content with a maximum amount of dilution, thus obtaining far better sheet finish than is regularly obtained on a cylinder machine, the advantageous result being especially noticeable where the bottom stock is of a greater degree of freeness than the liner stock which allows the use of increased volumes of water in the formation, to the end that the formation is greatly aided.

A further specific object of the invention is to lay down a homogeneous sheet of known fiber content with varying amounts of sizing materials in each face, thereby eliminating a substantial amount of sizing material on the bottom face, resulting in a considerable saving in sizing material cost, and also increasing the qualities of the ultimate product which are desired when the finished product is to be used in corrugating or pasting machines, the lower or base sheet in the present product, having less sizing than the liner, i. e., being entirely or substantially devoid of sizing, e. g., may be slack sized, permitting of quicker setting of silicate adhesive while the lner contains an appropriate amount of sizing, e. g., may be hard sized.

Another specific object of the invention is to provide a homogeneous sheet of known fiber content having a more even surface than it was possible of attainment heretofore, with the result that there can be a substantial reduction in the amount of surface or sizing materials over that required in standard practice for the attainment of a high finish with the elimination of hills and valleys.

A further specific object of the invention is to produce on a Fourdrinier type of machine, a homogeneous sheet of certain or known fiber content with varying amounts of stock hydration, thus obtaining far better drying qualities than regularly obtained on a Fourdrinier machine, the advantageous result being especially noticeable where the bottom stock or the base sheet is relatively unhydrated or unrefined as compared to the top stock and of a greater degree of freeness than the relatively highly hydrated or more refined and relatively slow liner or top stock which permits faster drying, to the end that the production is greatly increased.

Another object of the invention is to provide a method of making ply board on a continuous wire such as employed in a Fourdrinier type of paper making machine wherein a base layer of stock is first deposited onto a wire and is dehydrated a substantial amount prior to the deposit thereon of another stream of stock in a very diluted condition. At the time of introduction of the top stream, the extreme under portion of the lower stream and the extreme top portion of the upper stream retain their independent identities, but there is a turbulence as between the intermediate

portions of the streams resulting in a mixing and coalescence of the stock of said portions of the streams, followed by a setting of the fibers thereof and a dilution of the lower stream.

Still another specific object of the invention is to produce a homogeneous sheet of known fiber content, which in the finished product will have surfaces susceptible of readily receiving coloring or printing. This is particularly true with the liner stock in relatively highly hydrated condition and suitably sized.

Another specific object of the invention is to provide plural ply paper board embodying superposed coextensive layers of fibrous materials, wherein certain fibers of one layer or strata extend into a portion of an adjacent layer and interlock with the fibers thereof.

Still another specific object of the invention is to provide paper board, or like material, formed of a pair of superposed plies of different grades of stock, and so joined that there is no line of jointure between said layers with adjacent portions of the plies actually mixed together with the fibers intermingled, the finished paper board, however, being homogeneous and having opposite surfaces of different characters.

An additional specific object of the invention is the provision of paper board, or like material, formed of a plurality of superposed plies so associated that there are no visible or effective lines of jointure between adjacent layers or strata, resulting in a homogeneous, composite sheet.

Another object of the invention is to form so-called ply board in accordance with this invention, wherein substantial amounts of inferior and relatively cheap stock, such as news or corrugated waste, and/or screenings from pulping operations, which may be suitably refined as in a Jordan or beating engine if required, may be used in the furnish for a portion of the composite sheet, namely the base layer. The advantages of being able to employ screenings resides in using up a waste material which formerly had to be lapped in order to be disposable by the paper mill.

A further object of the invention is to form a composite board on a continuous wire characteristic of the Fourdrinier type of paper-making machine, wherein all operations are expeditious and commercially practical and in which various types of cellulosic fibers may be employed. In this connection, it has been found that the use of entirely or an appreciable amount of kraft fiber stock for one or both strata of the sheet produces a very satisfactory paper in accordance with this invention. Also, other very satisfactory products in accordance with this invention are produced from a liner stock containing entirely or an appreciable amount of kraft fiber stock and a base strata consisting of an appreciable amount of relatively cheap stock, such as the waste and screenings above referred to and mixtures of the same. In connection with the base stock where the waste and screenings are relatively short fibered, it is preferable to mix therewith an appreciable amount of long fibered stock such as kraft. It will be understood that, for example, a preferred construction of sheet will consist of an upper strata containing a relatively highly hydrated or refined slow stock composed of relatively short fibers and a base or lower strata of relatively less refined or hydrated free stock and including an appreciable amount of long fibers.

Another object of the invention is to produce a sheet of paper formed of cellulosic fibers and made on the continuous wire of a Fourdrinier type machine, which sheet comprises two co-extensive strata of fibers having varying amounts of stock hydration or refinement, preferably obtained by suitably beating the fibers of the respective stocks in the usual manner such as with beaters, Jordans or pulping engines.

Another object is to provide a sheet of the character described wherein the base layer is made of fibers having relatively greater freeness and relatively less hydration or substantially unhydrated with respect to the other strata to obtain a porous absorbent outer surface constituting a pasting side.

A still further object of the invention is to form the other strata of a slower stock, i. e., having relatively less freeness and a greater amount of hydration or relatively highly hydrated with respect to the base stock and producing a hard, smooth, outer surface constituting the liner side which is readily susceptible of coating, coloring or printing.

In this connection, and as previously explained, it is an aim of the invention to substantially reduce the amount of size required and at the same time facilitate the usefulness of the board for pasting purposes and, to this end, the preferred product of the present invention has the base layer substantially free of size or relatively unsized, e. g., slack sized with respect to the liner strata, which latter will have a greater and appropriate amount of size and will, for example, be hard sized.

An additional object of the invention is to provide a sheet of the character described in which the top or liner stock is hard sized and relatively slow and is preferably composed of an appreciable amount of relatively short, fine, cellulosic fibers, relatively highly hydrated or refined, to form a hard, smooth, outer surface for the liner side of the sheet.

Likewise, it is a further object of the invention to form the base or wire side of the sheet of relatively long fibered, free stock in which the fibers are relatively unhydrated and entirely or substantially devoid of sizing or slack sized to produce a porous absorbent outer surface constituting a pasting side.

The above and other objects and advantages will be apparent from the following detailed description.

An example of a machine and method for forming the product of this invention is set forth and claimed in my Patent No. 2,018,832 granted October 22, 1935.

In practicing this method, I lay down in the usual manner upon a continuously-travelling Fourdrinier wire a base sheet of relatively unhydrated stock, and at a suitable point in the travel of this base sheet from the headbox to the calenders, I lay down on the upper side of this sheet a top or supplemental sheet, the stock for this top sheet or liner being relatively slow and relatively highly hydrated or refined and continuously fed from an overhead headbox or chest. At approximately the point where the two streams of stock are brought into contact, I apply a downward suction entirely across the composite sheet thus formed.

The wire or bottom sheet is subjected to sufficient drainage and suction to dehydrate it to a substantial extent, but care must be taken to avoid such a degree of dehydration, as will cause the fibers, at least in the upper side of this

sheet, to set, by which I mean that the upper face at least of the base sheet, at the point where the liner sheet is laid down thereon, must be in a watery condition with its fibers afloat, but the fibers in the lower portion of the base sheet are fairly well set. This watery condition may be readily maintained throughout the operations of the process by means of the usual suction boxes arranged on the wire.

The top or liner sheet containing an appreciable amount of short, highly refined or hydrated fibers is laid down in a highly diluted condition in order that there shall be a complete coalescence of the slow stock of the under portion of this top sheet and the upper portion of the free stock of the under sheet, so that when the suction is applied at this point of coalescence of the two sheets, the fibers of the under portion of the top sheet will be more or less drawn into and amongst the floating fibers of the upper portion of the base sheet, so that the line of jointure between the two sheets will be completely obliterated; and further, the fibers of these portions of the two sheets will be entirely interlocked to thus produce a two-ply homogeneous sheet having the fibers unmixed at the surfaces of the sheet and which cannot be peeled or separated by any amount of flexure of the composite sheet. It is this coalescing of these portions of the two sheets at the point of formation of the composite sheet and the sucking down of the lower fibers of the top sheet into interlocking relation with the upper fibers of the base sheet that is the essence of my method. So far as I am aware, no plural ply paper board or paper (or cellulosic stock) has ever been commercially produced on a traveling wire of the Fourdrinier type of paper making machine.

In the drawing:

Figure 1 is a diagrammatic view showing a paper-making machine having a continuous wire of the Fourdrinier type for making the product of the present invention, the apparatus illustrated being in accord with the construction shown and described in my aforesaid United States patent.

Figure 2 is a diagrammatic view in which I have attempted to illustrate in a greatly magnified degree what takes place in the practice of my method, wherein the fibers indicated by the lighter lines in the lower portion of the upper sheet are pulled down into and amongst and mixed with the upper and darker fibers of the base sheet or wire side, while there is sufficient water present to enable this amalgamation to take place, the fibers of the respective strata at the surfaces of the sheet being unmixed; and

Figure 3 is a perspective view of a sheet made in accordance with the present invention.

In the practice of my method, I use different stocks or furnish in the two sheets; for instance, for carton and box board, it will be desirable to have a base sheet of more porous nature so as to give it a better pasting surface, while the top layer may be made of such fibers that it will take a hard, smooth polish in the calenders. It will be understood also that one or more additional supplemental sheets may be employed if it be desired to produce a board having more than two plies, and also that it is a simple matter to color either or all of said plies.

All Fourdrinier machines are provided with means for edgewisely shaking the wire after it leaves the breast-roll at the forming end of the machine to thus insure interlocking of the fibers in the sheet. I may arrange to lay the supplemental sheet upon the base sheet without laterally shaking the supplemental sheet, in which case the fibers of the supplemental sheet lie approximately parallel with each other when they are bonded to the base sheet, and thus give to the finished composite sheet the highest possible degree of stiffness. On the other hand, I may so mount the supplemental chest that it too may be laterally shaken during the delivery operation to thus laterally agitate the fibers of the supplemental sheet and criss-cross certain of them with respect to some of the fibers of the base sheet, and thus not only increase the homogeneous structure of the finished sheet, but also give to it a flexibility that is desirable in many cases.

In carrying out the invention, stock which has a percentage of water of about 99.51% is deposited onto the moving wire. By means of one or more suction boxes this layer or stream of stock is partially dehydrated. After it has had its water content reduced to about 92.74%, said stream of stock has a second stream of stock introduced thereonto. The percentage of water in the second stream of stock is about the same as that of the first stream prior to any dehydration thereof. It happens, however, that at this point the extreme bottom portion 5 of the first stream of stock 6 has become set to a substantial extent. At the point of introduction of the top stream 7, there is turbulence as between the bottom portion of the top stream and the upper portion of the lower stream. This turbulence causes rearwardly extending whirl-pools 8 whereby a mixing of the stocks of the two streams occurs. Immediately thereafter, and/or at the point of introduction of the top stream to the base stream, the composite stream passes over a suction box 9, which aids in holding the lower portion of the stream 6 in a set condition, and thus draws water from the highly diluted upper stream through the lower stream. This action first causes an intermeshing of the fibers of the mixed intermediate portion of the composite stream to form a coalescence, and then dilutes the lower stream to raise its percentage of moisture from about 92.74% to approximately 99.24%. However, the action does not impair the condition of the lower portion of the stream 6 and it retains its identity with its fibers, while the upper portion of the top stream 7 also remains unmixed. After the amalgamation of the adjacent portions of the two streams, the composite stream continues along with the wire and is further dehydrated as by one or more suction boxes 9 so that when it leaves the wire its moisture content has been reduced to about 85%. Eventually, the sheet reaches the usual finishing mechanism.

The finished sheet is a composite, homogeneous sheet with no line of demarcation therein. The stock of the intermediate portion of the sheet is mixed together and amalgamated, while the stock on both surfaces of the sheet is unmixed and retains the properties of the stock used in that particular stream.

In actual practice, it is very desirable to use for the base layer a coarse, inexpensive, long-fibered, free, slack-sized stock, which is relatively unhydrated or has been subjected to very little hydration or refinement. This stock is preferably composed of an appreciable amount of long fibers, and may also include screenings and other waste fibers. In some cases, the base stock will be composed of an appreciable amount of waste fibers

with some additional stock such as kraft. For the top stock or liner, an appreciable amount of relatively short, fine-fibered and relatively highly hydrated or refined, hard-sized, slow stock is preferably employed. As previously explained, the hydration is preferably accomplished by subjecting the fibers to the customary beating action. As one example of the type of cellulosic fibers which may be used for one or both strata of the sheet, kraft fiber stock has been found to produce a very acceptable product, in accordance with this invention.

The product constructed in the manner described results in a considerable saving, as in most instances it is only necessary to finish the surface of the finer layer, and the material of this layer is unaffected at the surface, and will of course receive the necessary finishing operations and materials and may be colored or printed upon, as desired.

It should be observed that by the addition of a highly sized slow stock to the lower slack sized free stock on the wire, the intermixture of the highly sized stock with the long-fibered free stock serves to convey size into the upper portion of the long-fibered base stock, which takes place at the point of turbulence in the streams, and the lower undisturbed surface of this base stock remains free from the added size. This results in a higher Mullen test for the produced sheet without the added size appearing on the long-fibered surface, and by this means, there is no interference with the absorption of adhesive. The added short-fibered stock may also be effective in filling up any slight depressions which might naturally exist in the top surface of the long-fibered sheet before the calendering operation, and this aids in the formation of a very even and highly finished surface.

From the foregoing description, it will be evident that the improved plural ply paper board has many desirable characteristics and that the finished board is homogeneous and is devoid of lines of juncture as between adjacent plies rendering the plies unsusceptible of being peeled or separated during usage of the board. Also, the method employed is economical, expeditious, and commercially practical.

Referring to Figure 3, I have indicated the liner side of the sheet at 10 and the base or wire side at 11.

It should be understood that it is not desired to limit the invention to the exact details of construction, or the precise steps herein shown and described, for various modifications within the scope of the claims may occur to persons skilled in the art.

This application is a continuation in part of my copending applications, Serial Nos. 30,833 and 113,712, filed July 11, 1935, and December 1, 1936. respectively, and allowed August 23, 1937.

I claim:

1. A facing sheet of paper formed on the continuous wire of a Fourdrinier type machine comprising two co-extensive strata of cellulosic fibers having varying amounts of stock hydration, the two strata having the fibers of each unmixed at the surfaces of the sheet but intermingled and interlocked within the body of the sheet so that the sheet is devoid of lines of jointure and does not peel or separate under flexure, one of said strata constituting the wire side being formed of long fibered, slack-sized stock having a greater freeness and being relatively less hydrated with respect to the other strata and producing a porous absorbent outer surface on one face of the sheet constituting a pasting side of the facing, while the other of said strata is formed of relatively short, fine fibered and highly refined hard-sized, slow stock having a greater amount of hydration and providing a hard, smooth outer surface on the other face of the facing sheet constituting a liner side, the sheet having the characteristics resulting from the simultaneous dewatering of both strata on a single continuous Fourdrinier wire.

2. A facing sheet of paper formed on the continuous wire of a Fourdrinier type machine, comprising two co-extensive strata of fibers having varying amounts of stock hydration, the two strata having the fibers of each unmixed at the surfaces of the sheet but intermingled and interlocked within the body of the sheet so that the sheet is devoid of lines of jointure and does not peel or separate under flexure, one of said strata constituting the wire side being formed of cellulosic fibers having a greater freeness and being relatively less hydrated with respect to the other strata and producing a porous absorbent outer surface on one face of the sheet constituting a pasting side of the facing, while the other of said strata is formed of a stock of cellulosic fibers having less freeness and a greater amount of hydration and providing a hard, smooth outer surface on the other face of the facing sheet constituting a liner side, the sheet having the characteristics resulting from the simultaneous dewatering of both strata on a single continuous Fourdrinier wire.

3. A facing sheet of paper formed on the continuous wire of a Fourdrinier type machine, comprising two co-extensive strata of fibers having varying amounts of stock hydration, the two strata having the fibers of each unmixed at the surfaces of the sheet but intermingled and interlocked within the body of the sheet so that the sheet is devoid of lines of jointure and does not peel or separate under flexure, one of said strata constituting the wire side being formed of cellulosic fibers having a relatively small amount of size, a greater freeness and being relatively less hydrated with respect to the other strata and producing a porous absorbent outer surface on one face of the sheet constituting a pasting side of the facing, while the other of said strata is formed of a stock of cellulosic fibers having less freeness and a greater amount of hydration and size providing a hard, smooth outer surface on the other face of the facing sheet constituting a liner side, the sheet having the characteristics resulting from the simultaneous dewatering of both strata on a single continuous Fourdrinier wire.

4. A paper sheet formed on the continuous wire of a Fourdrinier type machine comprising two co-extensive strata of different grades of cellulosic pulp, the two strata having the fibers of each unmixed at the surfaces of the sheet but intermingled and interlocked within the body of the sheet so that the sheet is devoid of lines of jointure and does not peel or separate under flexure, one of said strata constituting the wire side being formed of long-fibered, free, slack-sized stock producing a porous, absorbent outer surface on one face of the sheet constituting a pasting side while the other of said strata is formed of an appreciable amount of relatively short, fine-fibered and highly refined hard-sized, slow stock providing a hard, smooth, outer surface on the other face of the sheet constituting a liner side, the sheet having the characteristics resulting from

the simultaneous dewatering of both strata on a single continuous Fourdrinier wire.

5. A paper sheet formed on the continuous wire of a Fourdrinier type machine comprising two coextensive strata of different grades of cellulosic pulp, the two strata having the fibers of each unmixed at the surfaces of the sheet but intermingled and interlocked within the body of the sheet so that the sheet is devoid of lines of jointure and does not peel or separate under flexure, one of said strata constituting the wire side being formed of long-fibered, free stock substantially free of size producing a porous, absorbent outer surface on one face of the sheet constituting a pasting side while the other of said strata is formed of an appreciable amount of relatively short, fine-fibered and highly refined hard-sized slow stock providing a hard, smooth, outer surface on the other face of the sheet constituting a liner side, the sheet having the characteristics resulting from the simultaneous dewatering of both strata on a single continuous Fourdrinier wire.

6. A paper sheet formed on the continuous wire of a Fourdrinier type machine comprising two coextensive strata of different grades of cellulosic pulp, the two strata having the fibers of each unmixed at the surfaces of the sheet but intermingled and interlocked within the body of the sheet so that the sheet is devoid of lines of jointure and does not peel or separate under flexure, one of said strata constituting the wire side being formed of long-fibered free, slack-sized, kraft stock producing a porous absorbent outer surface on one face of the sheet constituting a pasting side while the other of said strata is formed of an appreciable amount of relatively short, fine-fibered and highly refined, hard-sized, slow kraft stock providing a hard, smooth, outer surface on the other face of the sheet constituting a liner side, the sheet having the characteristics resulting from the simultaneous dewatering of both strata on a single continuous Fourdrinier wire.

7. A paper sheet formed on the continuous wire of a Fourdrinier type machine comprising coextensive strata of different grades of cellulosic pulp, the two strata having the fibers of each unmixed at the surfaces of the sheet but intermingled and interlocked within the body of the sheet so that the sheet is devoid of lines of jointure and does not peel or separate under flexure, one of said strata constituting the wire side being formed of long-fibered, free kraft stock substantially free of size producing a porous absorbent outer surface on one face of the sheet constituting a pasting side while the other of said strata is formed of an appreciable amount of relatively short, fine-fibered and highly refined, hard-sized, slow kraft stock providing a hard, smooth, outer surface on the other face of the sheet constituting a liner side, the sheet having the characteristics resulting from the simultaneous dewatering of both strata on a single continuous Fourdrinier wire.

JOHN W. SALE.