April 17, 1945. R. G. QUINN 2,373,914

METHOD OF FORMING ASBESTOS PAPERS WITH GEL BINDERS

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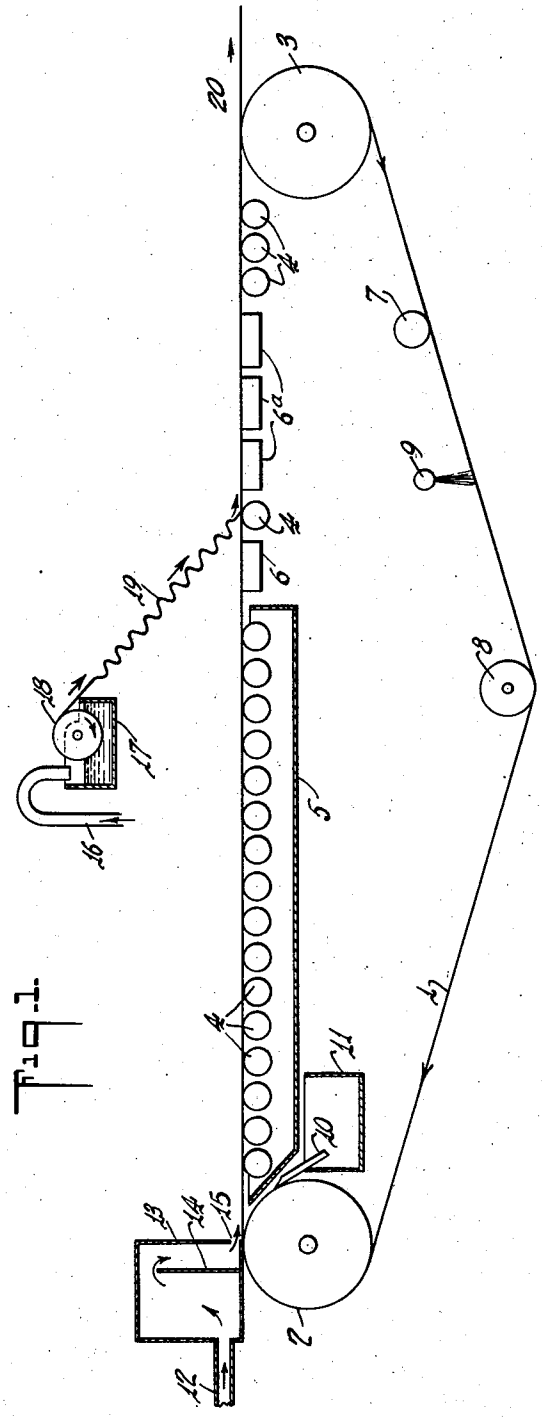


Fig. 1.

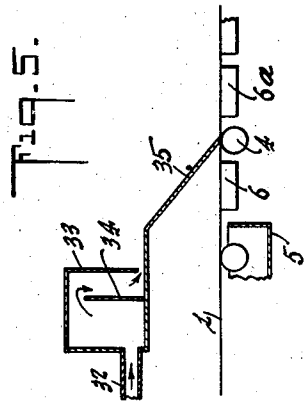


Fig. 5.

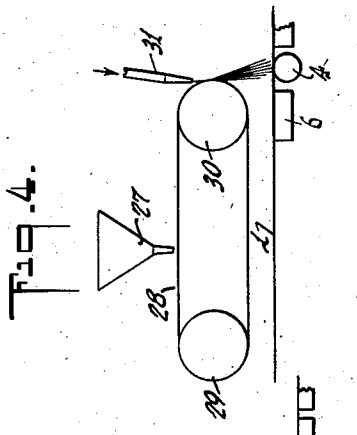


Fig. 4.

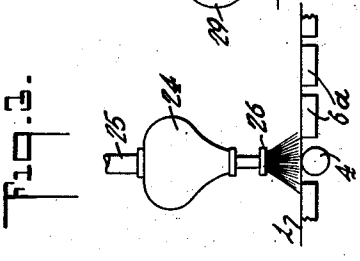


Fig. 3.

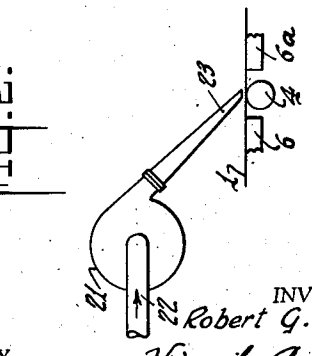


Fig. 2.

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METHOD OF FORMING ASBESTOS PAPERS WITH GEL BINDERS

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2 Claims. (Cl. 92—40)

This invention relates to the production of improved papers and the method of manufacturing the same. Although the features of the invention are directed primarily to the manufacturing of comparatively thin papers such as .0005 inch to .005 inch in thickness, the process is applicable to materials of greater thicknesses such as building boards, and the like. It relates particularly to papers of high strength and possessing desirable electrical properties which adapt these papers to be used for electrical insulation and equivalent uses. It relates more particularly to papers in which the binding material used to hold the fibers into a sheet, is placed or deposited within the body of the paper after the sheet has been formed.

Heretofore in the manufacture of papers, especially thin papers, it has been the common practice to prepare a mixture of the fibrous components and the binder in a comparatively thin slurry. The thin mixture was then flowed upon a conventional paper machine such as a Fourdrinier machine, and the material sheeted in the customary manner. Difficulty has been, however, generally experienced in that when binders, in the form of colloidal materials, are used, the greater proportion of the binders is lost. This is true particularly when long fibrous materials are used since the binder tends to pass through the formed sheet with the white water during the felting operation. On the other hand, if slurries, containing fine fibrous stock and binders, are felted, slow drainage of the water from the felted sheet will occur thereby preventing an economical and satisfactory sheeting operation.

To remedy these undesirable characteristics, a novel method has been devised in which, broadly, the fibrous materials are first sheeted and after the sheeting action the binder is applied to the upper surface of the sheeted material. Thereafter the binder is uniformly distributed throughout the body of the sheet. Through the use of the method broadly described, the binder will be retained in the felted sheet and will tend to strengthen the sheet since the binder will hold the fibres together at their crossing points as well as being deposted in the interstices between the fibres. It will also be evident that since a large proportion of the water has been drained from the felted sheet before the application of the binder to the surface, more economical and satisfactory felting operations are obtained.

The invention is illustrated in the attached drawing, and it will be more readily understood from the more specific and detailed description of the invention in the specification when considered in conjunction with the drawing.

Fig. 1 discloses a conventional paper machine ordinarily including a binder applying device used in the production of papers and sheets described herein.

Figs. 2, 3, 4 and 5 show different types of mechanisms which may ordinarily be used in applying the binder materials to the surface of the sheeted material produced on the machine in Fig. 1.

Fig. 1 shows a substantially conventional machine comprising an endless forming wire 1 generally about a 60 mesh wire, disclosed as travelling over the breast roll 2 and the couch roll 3. A series of carrying rolls 4 and suction boxes 6 and 6a support the forming wire 1 and create a comparatively level supporting base for the fibrous sheet material which is formed thereon. The wire guide roll 7 and the stretching roll 8 tend to hold the forming wire comparatively taut which assist in holding the forming wire level at all times.

The fibrous mix, which will be described more fully below, is pumped through the pipe 12 into the flow box 13. A baffle 14 tends to form a constant level in the box and regulates a uniform flow of the fibrous mixture through the opening 15 upon the forming wire 1. The water of the mixture flows through the forming wire and drains into the white water tray or box 5 and may be returned and again mixed with the stock material pumped through the pipe 12. The sheeted fibrous material is then passed over a suction box 6 to remove a large proportion of the water remaining in the fibrous sheet. This suction box may be eliminated if the water has been satisfactorily removed during the passage of the wet sheet over the carrying rolls above the white water box. In the above procedure, the felting operation is described as being accomplished on a conventional Fourdrinier machine but this description is given for the purpose of illustration only. The invention which will be more fully described below, may be employed with any type of a felting machine where the wet fibres are supported by a pervious member and which passes over suction devices.

In accordance with my invention, a liquid suspension of binder material pumped through the pipe 16 to the reservoir 17 is flowed on the upper surface of the fibrous sheet through the medium of the transfer or pick-up roll 18 and the inclined corrugated surface 19. Suction is then applied to the lower side of the sheet coated with the binder, through the medium of suction boxes

6a and the binder is drawn into the body of the formed fibrous sheet. Additional suction may be applied at the couch roll 3 in order to effect further uniform distribution of the binder in the interstices of the fibres if this step is considered necessary. The formed sheet 20 is then passed into heaters and subjected to elevated temperatures to promote a drying action. The temperatures used to promote satisfactory drying of the sheet may be varied but satisfactory results have been obtained when subjected to drying at about 200° F.

The apparatus as disclosed by the numerals 16, 17, 18 and 19, is very satisfactory to be used for comparatively liquid binders. Another satisfactory apparatus to flow very liquid binders upon the sheeted fibrous material is disclosed in Fig. 5, and may readily be substituted for the liquid binder distributing means disclosed in Fig. 1. In operation of the binder distributing means disclosed in Fig. 5, the liquid binder or gel is pumped through pipe 32 into the flow box 33 and then permitted to flow down an incline 35 onto the felted sheet formed on carrying wire 1. The baffle plate 34 assists in controlling the flow and in regulating the uniform application of the liquid binder upon the surface of the fibrous sheet.

When heavier gels or binders are used, applying means as disclosed in Figs. 2, 3 and 4 are very satisfactory. In Fig. 2, the heavy binding gel is pumped through pipe 22 into the extruding mechanism 21 and flowed upon the fibrous sheet formed on the forming wire 1 through the medium of the nozzle 23. In Fig. 3, the heavy binding gel is pumped through pipe 25 into the reservoir 24 and then sprayed under pressure through the nozzle 26 onto the prepared fibrous sheet. In Fig. 4 the heavy binding gel is dropped from the container 27 onto an endless belt 28, carried on rolls 29 and 30 and is spread upon the fibrous sheet by means of a stream of air forced under pressure from nozzle 31. These various distributing mechanisms may readily be substituted and replaced by each other or equivalent distributing means. In each case, the fluidity and density of the substance to be distributed is the determining factor as to what type mechanism should be used.

Any of the treated fibrous material which may remain occluded to the carrying wire 1 after the sheet 20 has been removed therefrom is washed from the screen by means of a spraying device 9 and the materials may then be returned into the process through pipe 12 with fresh fibrous stock. Also, any fibrous material which may have occluded to the breast roll 2 is removed by means of a doctor blade 10 and the loosened material drops into the bin 11.

In preparing the fibrous stock material, different fibres may be used. Thoroughly cleaned asbestos fibres have given excellent results, but asbestos fibres mixed with mineral wool fibres, glass wool fibres, or the like, also give satisfactory products. It is desirable that the fibres used in the process of my invention, particularly in the case of asbestos fibres, should be thoroughly cleaned in order to develop the maximum strength in the product. These fibres are mixed with a large quantity of water to form a thin slurry mixture. The quantity of solid material in the mixture is generally very small, usually about 1% solids based on the weight of the mixture although it is understood that this concentration of solids to water may be varied in accordance with well-known practices known in the paper manufacturing industry. It is also desirable that the fibrous material be carefully cleaned free of grit, gangue, dust or other undesirable ingredients in order to be certain that the finished sheeted product will be free of pin holes, lumps or voids. If such undesirable ingredients are not satisfactorily removed, the resulting sheet material will not generally possess high dielectric strength, thus the importance of clean fibres will be apparent.

As illustrated above, gels or binders of different concentrations may be used. These concentrations may be varied in accordance with the speed of operations, and also with the amount of binder desired in the finished product. As for example, with means as illustrated in Figs. 1 and 5, gels or binding substances having approximately 1 to 3% solids, may be employed. In this case the gels or binding substances are quite liquid and readily flowable. With equipment as illustrated in Figs. 3 and 4, the amount of solid in the gel or slurry binder may reach 6 to 8%, while with an extrusion apparatus illustrated in Fig. 2, the amount of solid in the gel or binder may be as high as 10 or 12%. It will be evident that as the solid content of the gel or binding substance is increased, the density of the substance will also increase. These percentages are merely given as illustrations and may be varied within a wide range without departing from the spirit and scope of the invention.

The amount of suction applied to the sheeted material must be regulated with care. This suction is applied to the under or lower side of the sheeted materials. It is desirable that the gel or binder should only be drawn into the body of the fibrous sheet and not through the sheet. If insufficient suction is applied, the binder will not be drawn uniformly through the fibrous sheet and also, if too much suction is applied the binder will be drawn through the fibrous sheet and into the suction boxes. It will, therefore, be evident that this step in the procedure must be carefully regulated and the amount of suction will vary in accordance with the density of the fibrous sheet and the concentration of the gel applied to the upper surface. It has been found that, with an apparatus as illustrated in Figs. 1 and 5, to deposit the gel or binder substantially uniformly throughout the sheet, a suction of 25 inches of mercury has given satisfactory results. In actual operation it has been found that with gel-like binding materials having a 12% concentration of solids, a sheet containing 50% asbestos fibres and 50% binder could readily be made in accordance with the procedure herein described. In the case where gel-like binding substances having a solid content of about 8%, the binder content that could be drawn into the sheet is approximately 40%, while with substances having 2% solid concentration, approximately 12% binder could be distributed throughout the sheet. The percentage of binding substances which can satisfactorily be distributed throughout the sheet is also limited by the wetness of the sheeted material. Satisfactory gels which have been employed in my operations as binders are inorganic substances and include such substances as silica, aluminum hydroxide, colloidal clay, bentonite, or other equivalent substances which have a tendency to gel when distributed in a liquid medium and shrink when the liquid medium is separated therefrom.

In manufacturing papers, or sheet material in accordance with my invention, other binders than gels may be deposited or distributed uniformly

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throughout the fibrous layer. Lime may be mixed with the fibrous stock material and then sheeted with the fibrous material in accordance with the procedure described above. A suspension or dispersion of silica such as pulverized quartz or diatomaceous earth, or of a colloidal silicate such as bentonite, or the like, suspended in a water medium, may then be flowed upon the fibrous sheet. Suction is applied in the manner discussed above, and the silica is drawn into the body of the prepared sheet. After the sheet 20 is dried, it is subjected to the action of steam which causes a chemical reaction between the lime and the silica. This procedure may be modified in that the powdered silica or the diatomaceous earth may be mixed with the fibrous material and then flowed with the fibrous material on the forming wire and sheeted in the conventional manner. An aqueous suspension of finely divided hydrated lime is then deposited upon the surface of the sheeted material and drawn into the body of the sheet by means of the suction. This product is dried, as by being placed in heaters, and is thereafter subjected to the action of steam and heat in order to promote the chemical reaction between the lime and the silica.

As another alternative, the lime and diatomaceous earth or other finely divided silica may be made into a suspension in water at normal temperatures and flowed on the felted fibrous sheet. The suspended materials are then drawn into the body of the sheet through the application of suction to the lower side. After drying the sheet, the product is subjected to the action of steam which, as pointed out above, promotes the chemical reaction between the components found in the suspension and forms a calcium silicate binder in the product.

The method of distributing binders or gels throughout the bodies of fibrous sheets may also be used in treating finished or dry sheet products when it is considered necessary that additional binders should be incorporated within sheet materials which are relatively porous. In this case the binders or gels are deposited upon the upper surface of the dry and relatively porous sheets, followed with the application of suction to the under surface thereof, which results in a uniform distribution of the substance throughout the thickness of the sheet. This procedure is especially useful in reinforcing sheet materials which are loosely bonded with insufficient binder and therefore would have very little strength.

In the above, papers have been described in which the reaction products of lime and diatomaceous earth are used as one of the binders. Other metallic oxides may be used in place of lime particularly such oxides as magnesium oxide, aluminum oxides or such oxides which react readily with diatomaceous earth. Iron oxide cannot readily be used where electrical properties or discoloration of the paper are factors but in uses where these characteristics are of little importance, the reaction product of iron oxide and diatomaceous earth forms a good binder for the fibres. Similarly, finely divided silica, bentonite, or the like, may be used in place of diatomaceous earth.

The papers formed in accordance with the above invention have unusual and novel characteristics. These papers can be made very thin and still have the binder or gel distributed uniformly throughout the sheet. The method is especially useful in making such papers which are less than .004 inch or .005 inch in thickness. Another unusual feature is that the papers have very high wet strength, as for example, a sheet of the paper was subjected to a stream of water for a period of about 24 hours and no apparent change in the strength characteristic of the paper resulted. Inasmuch as the papers are made from thoroughly cleaned asbestos, the paper is white in color, unless coloration is desired, and is fireproof. It is quite stable at 500° F. Furthermore, such papers are very useful where permanency of the product is desired because the product is fireproof and the mineral components are not generally deteriorated through normal usage as compared to ordinary papers. In addition, these papers are very pliable and will withstand 180° folds, have low expansion and contraction due to humidity changes, and can be saturated with oils, resins (such as chlorinated diphenyl, or the like) to yield sheets having a dielectric strength up to 2000 volts per mil. The dielectric strength of untreated papers, i. e., unsaturated as described above, made in accordance with my invention, normally have a dielectric strength of about 250 to 600 volts per mil. The density varies between 40 to 80 pounds per cu. ft.

It will be understood that the details given are for the purpose of illustration, not restriction, and that variations within the spirit of the invention are intended to be included in the scope of the appended claims.

I claim:

1. The method of manufacturing thin asbestos paper of not to exceed .005 inch thickness including asbestos fibers and a binder containing the reaction product of lime and diatomaceous earth, which comprises the steps of preparing a dilute slurry mixture including asbestos fibers, diatomaceous earth and water, flowing the slurry mixture on a forming screen, removing a substantial portion of the water content to form a thin felted fibrous sheet, then depositing an aqueous suspension of finely divided hydrated lime on the upper surface of the fibrous sheet, applying suction to the lower side of the fibrous sheet and drawing the lime substantially throughout the body of the fibrous sheet, and finally subjecting the prepared fibrous sheet to the action of heat in the presence of steam to chemically react the lime and diatomaceous earth, thereby forming a bonded asbestos paper.

2. The method of manufacturing thin asbestos paper of not to exceed .005 inch thickness including asbestos fibers and a binder comprising calcium silicate, which comprises the steps of preparing a dilute slurry mixture including asbestos fibers, finely divided silica and water, flowing the mixture on a forming wire, removing a substantial portion of the water content to form a thin felted fibrous sheet, then depositing an aqueous suspension of finely divided hydrated lime on the upper surface of the fibrous sheet, applying suction to the lower side of the sheet and drawing the lime substantially uniformly throughout the body of the fibrous sheet, and finally subjecting the fibrous sheet to the action of heat in the presence of steam to finally react the lime and finely divided silica, thereby forming a bonded asbestos paper.

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