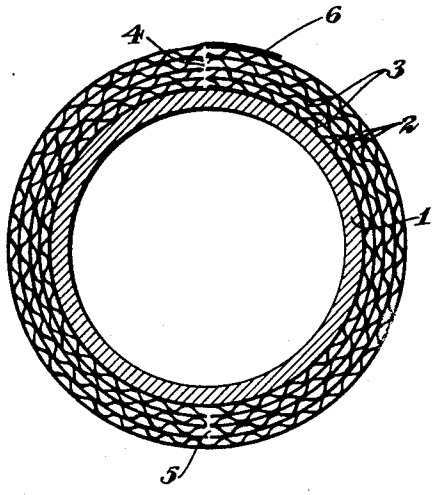
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INSULATING MATERIAL

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INVENTORS
Edward A. Toohey.
Earle R. Williams
BY D. N. Halstead.
ATTORNEY

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INSULATING MATERIAL

Edward A. Toohey, Somerville, and Earle R. Williams, North Plainfield, N. J., assignors to Johns-Manville Corporation, New York, N. Y., a corporation of New York

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This invention relates to insulating material and more particularly to thermal insulating material of minimized vapor breathing properties as indicated by minimized change in volume or length of a unit of the material with variation in the relative humidity of air in contact therewith. The invention pertains especially to such improved material comprising felted fibres of asbestos, wool, or other insulating products in the form of commercial articles, such as tubular pipe covering.

Woven or felted fabrics are widely used in thermal insulation. Thus asbestos and wool are much used in the form of felts, of which so-called asbestos paper and wool felt are examples. Asbestos paper is widely used in tubular sections for application around pipes that are to be insulated. The paper of which these sections are constructed may be any of several forms, of which those enclosing air cells are among the most important. This type may be corrugated, or corrugated and then cross indented, as described in U. S. Patent 1,444,397 to Seigle, and may be alternated in pipe covering with backing sheets of plain asbestos paper cemented by water glass solution. Because of the specific advantages of the invention as applied to the manufacture of these forms of insulation, the invention will be illustrated by particular reference thereto.

A process of making asbestos air cell insulation in sections of tubular form comprises the following steps:

Usual asbestos paper forming ingredients, such as a mixture of 87% by weight of Canadian short fibre asbestos, 12.8% of starch, and .2% of caustic soda are mixed in a paper beater and formed into a felt on a cylinder paper machine. The felt is removed and dried continuously. A portion of the paper is then corrugated, as for example, as described in U. S. Patent 1,444,396 to Seigle. This corrugated material is then cemented firmly to a backing sheet of plain asbestos paper, by means of a solution of water-glass. The resulting product may be dried and used as composited corrugated and plain asbestos paper, in single sheets or multiply blocks, or it may be wound spirally into tubular form, as by being wrapped around a mandrel to give a thickness of as many plies as desired. For the latter use, the plain backing paper is suitably used in length a few inches greater than that of the corrugated paper so that, after the wrapping operation is completed, there will project a free end of the plain paper which may be cemented to the underlying ply to prevent the tube from unrolling after being removed from the mandrel and to give a smooth outer surface. The section of cylindrical pipe covering is then dried, cut to length desired, suitably 36 inches, and sawed and scored longitudinally so that it may be opened like a clam shell. There may then be glued or cemented around the product a covering, such as one of canvas with a lap section for closing the horizontal joint when the section is later installed around a pipe that is to be insulated. The assembled section of pipe covering is then thoroughly dried, as in a tunnel drier at a temperature below 150° F.

When pipe covering made as above described or in a similar manner is allowed to remain in contact with the atmosphere and then placed in use on a warm pipe, it is found that the insulation undergoes a shrinkage which is evidenced by contraction in length with consequent exposure of a certain part of the pipe which was originally covered. Thus, it is not unusual to find up to one foot of pipe exposed by shrinkage of the covering for each 100 feet of pipe originally covered.

Various theories have been advanced to explain the cause of this contraction, sometimes followed by subsequent expansion when the covering is cold, contraction again when the covering is warm, etc. It has now been discovered that this expansion and contraction depends in part at least upon the relative humidity of the air in contact with the insulating pipe covering and particularly upon the property of the hygroscopic binder, of which starch is an example, of absorbing moisture to an extent varying with the temperature and/or the humidity of the surrounding atmosphere. In fact we have found possible a substantial reduction and, in some cases, practically complete elimination of this undesired change in length of the pipe covering, without greatly increasing the weight or thermal conductance of the insulator, by fabricating it from asbestos fabric substantially free from capillarity for water in all parts of the fabric, made in such manner as to minimize the vapor breathing properties, as for example, from asbestos fibres treated with a water repellent agent, in limited proportion, so applied as to decrease substantially the absorption of moisture from a relatively humid atmosphere but to allow penetration of liquid water into the asbestos paper formed from such fibres. It has been found also that asbestos paper made in the usual process and thoroughly dried will absorb several percent, in many cases as much as 5%, of moisture when allowed to

come into equilibrium with the atmosphere in a storage room or a freight car. On the other hand, asbestos paper made from fibres treated by the process of this invention absorb substantially less moisture under the same conditions and shrink either very much less or not at all when subsequently applied and used on heated pipes, as, for example, on pipes carrying low pressure steam.

The fact that the felted fabric or paper made from the treated fibres is permeable to water makes possible the use of an aqueous adhesive, such as a solution of sodium silicate (water glass) or casein glue, for firmly cementing one unit to another, as in the case of cementing a corrugated sheet to a backing sheet of plain surface. The individual fibres associated with the hygroscopic binder are so treated as to be given a reduced or negative capillarity for water, with a consequent minimized tendency to absorb moisture from the atmosphere, without closing the pores between the fibres of the finished fabric or paper. Our process gives a maximum vapor-proofness without filling the pores of the fabric with an agent that may ooze out on warming or, under any circumstances, increases substantially the thermal conductance.

While the invention may be embodied in various forms, an embodiment that is preferred at this time is illustrated in the drawing, which shows a cross sectional view of a section of tubular pipe covering installed around a pipe.

The pipe 1 is of conventional type for conveying steam or other fluid. Disposed around this pipe is tubular sectional pipe covering consisting principally of felted fibers of asbestos or the like and water-repellent material intimately associated therewith, as will be described later. The felted asbestos fibers are in the form of a plurality of composited sheets of paper, including plain paper 2 alternated and adhered firmly to corrugated sheets 3 by means of adhesive (not shown). The composite, forming a tube of substantial thickness of wall, is cut through longitudinally, on one side, as indicated at 4 and partway through on the opposite side as illustrated at 5, so that the tube may be opened for insertion around the pipe. The outer sheet of plain paper may extend over the joint 4, in the form of the flap 6.

The following example of one method of practicing this invention is given for the purpose of illustration.

2000 pounds of asbestos paper stock fibre, suitably a mixture of Canadian or similar short fibres, are mixed in a paper beater of usual design, the roll being elevated, with sufficient water to give a mixture suitable for felting into paper on a paper machine. There is then added a rather concentrated hot aqueous solution of 50 lbs. of soluble soap, such as common laundry soap, with which is emulsified 50 lbs. of melted paraffine wax. At about the same time there is added to the beater a binding agent adapted to absorb moisture, suitably a mixture of 500 lbs. of starch in hot water at approximately 190° F. There is then added an aqueous solution containing 35 lbs. of zinc chloride. Finally there is added an aqueous solution containing 45 lbs. of aluminum sulphate (paper makers' alum). The temperature of the water originally added with the asbestos fibre should be such that the final mixture is tepid, as, for example, at a temperature of approximately 120° F. After all of the ingredients have been added the beater roll is lowered to such a position as to give very gentle beating to the mixture and rotated for about five minutes. The mixture is then transferred to the stock tank from which it is furnished to the paper making machine for forming into the asbestos paper of minimized breathing properties. The paper is finished in a usual manner. A paper weighing five to eight pounds per hundred square feet has been made and used satisfactorily.

During the mixing in the beater, the wax, starch and other ingredients become intimately associated with the asbestos fibres in such a manner that these ingredients are uniformly distributed throughout the paper made from the mixture, as distinguished from simply a surface coating. The fibres are made individually water-repellent.

Also, certain chemical reactions occur during the mixing. For example, the zinc and aluminum salts form insoluble soaps of the metals. These soaps are precipitated in contact with the fibres, in part within the fibres of asbestos, in such a manner as to produce a maximum effect upon the capillarity of the fibres for moisture, with a minimum effect in closing pores between the fibres in the finished product.

Particularly satisfactory pipe covering of the type sold under the trade name "Asbestocel" and consisting of corrugated and cross-indented sheets backed with plain sheets and made into tubular sections, have been constructed of paper made as above described, with the units of plain and corrugated paper cemented firmly together by water-glass or other adhesive applied in aqueous solution. Such pipe covering, dried thoroughly at 240° F. and then exposed to air at a relative humidity of 55% and a temperature of approximately 60° F., for a week, increases in weight by less than 2%, frequently less than ½ of 1%. After such exposure, the pipe covering applied to a low pressure steam line shows practically no shrinkage during use, as for example, less than 0.2% in length and, in many cases, less than 0.1%. These favorable results may be due to the minimized vapor breathing properties, although the invention is not limited by this or any other explanation of the manner of operation. We make use of all of the effects produced by the treatment described.

That the product is not waterproofed in the usual meaning of the term is indicated by the fact that asbestos paper or asbestos air cell pipe covering or other insulating product made from this special asbestos paper will absorb liquid water. Thus, it has been found that a section of "Asbestocel" pipe covering made in accordance with our invention and then immersed in water will absorb 30 to 40% of its weight of water.

In another example of a method of practicing this invention, there was substituted a different water-repellent agent, namely, a composition containing wax, for the mixture of soap, paraffin wax, zinc chloride and alum used in the first example given. The wax was of such a quality and was so applied to the fibres as to minimize the vapor breathing properties, as indicated by decreased absorption of moisture from a humid atmosphere, without closing the pores between the fibres in the finished fabric. Thus there has been added to the beater charge comprising asbestos fibres and starch as above, an emulsion of 34% by weight of centrifuged petroleum wax, 6% of pure crude Montan wax, and 60% of water. Of waxes, on the anhydrous basis, there are used approximately 2 to 10 pounds, suitably not more than 5

pounds, for each hundred pounds of finished paper. The paper so made is finished in conventional manner, including maintenance at an elevated temperature, to produce drying and also to cause melting of the wax composition present.

In another modification of this invention, wool and other fibres have been substituted for the asbestos and starch of the two examples above. Thus, a well disintegrated or beaten mixture of wool scrap, suitably with approximately 20% of disintegrated wood pulp or old newspapers, has been treated with a water-repellent agent in the form of one of the mixtures described above. The resulting product was then formed into a felt and fabricated into commercial insulators, such as sectional pipe covering of tubular form, in the usual manner.

In a modification of the invention particularly suitable for use in making inexpensive but very satisfactory pipe covering of minimum weight and also minimized vapor breathing properties, decreased capillarity for water is imparted principally to the fibers at or near the surface of asbestos paper, the paper is then corrugated or corrugated and cross-indented, composited with a plain surface backing sheet which has been similarly treated to decrease the capillarity of the surface fibers, and the composite is wound into tubular pipe covering.

For the treatment of asbestos paper to decrease the capillarity of the surface fibers for water, the paper is suitably sprayed with, immersed in, or otherwise coated with a fluid adapted to produce a water-repellent surface.

In one example of this modification of the invention, asbestos paper is made and dried in a usual manner and then is drawn through a bath containing water-repellent materials in such manner as to coat both sides of the paper. The treated paper is then dried and fabricated into pipe covering in a conventional manner. For the water-repellent materials there has been used satisfactorily an emulsion comprising 34% by weight of centrifuged petroleum wax, 6% of pure crude Montan wax, and 60% of water, diluted with additional water, as, for example, 4 to 20 times as much additional water as there was used of the total original emulsion to give 6 to 30 parts by weight of total water to one part of waxes. The asbestos paper may be drawn through this diluted emulsion at a rapid speed, such as 200 linear feet per minute.

Another water-repellent composition which may be used in this process of surface coating by immersion or spraying consists of 28 lbs. of aluminum stearate, dispersed in a solvent therefor, as, for example, in 8.5 gal. of warm turpentine, and then diluted by the slow addition of 105 gal. of high test gasoline, the temperature of the gasoline during the blending operation being maintained near the boiling point.

Another composition which may be used for the spraying or immersion process is one containing 2 parts by weight of aluminum stearate, 2 to 5 parts turpentine and approximately 100 parts of motor gasoline or very low test gasoline, the composition being blended as described immediately above.

Another composition containing aluminum stearate that has been used satisfactorily consists of 5 parts by weight of aluminum stearate, 25 parts of very low test gasoline (Varnolene), 2 parts of casein, one part of ammonia water, one part of orthodichlorobenzol, and 66 parts of water, the mixture being made into an emulsion by vigorous agitation.

For some purposes the process of intimately associating the water-repellent material with the inner asbestos fibers may be combined with the surface-treating process. Thus asbestos fabric may be made from a beater furnish containing the usual asbestos paper making ingredients plus water-repellent materials, the asbestos paper so made may then be dried, and the surface treated with one of the compositions described above for coating the fabric by spraying or immersion.

Starch as used in the above examples is a binding or sizing agent. It may be replaced by other materials, as, for example, a rosin size. The caustic soda specified in certain examples may be omitted if its effect is not desired. As used, caustic soda facilitates the swelling or gelatinizing of the starch.

It will be understood that many variations from the details given in the illustrative examples may be made without departing from the scope of the invention. Thus, variations in proportions of materials used may be made and many different types of insulating products may be fabricated from the fabrics of minimized vapor breathing properties.

By the term "permeable" as applied to a product of minimized vapor breathing properties is meant penetrability by liquid water or aqueous solutions of cements, as distinguished from waterproofness imparted, for example, by a heavy pore-sealing impregnation with a bituminous material, such as asphalt.

What we claim is:

1. A thermal insulating article comprising lightweight, permeable, corrugated paper, including asbestos fibres, a binding agent adapted to absorb moisture, and a water-repellent agent.

2. Sectional pipe covering for thermal insulation comprising sheets of paper including felted asbestos fibres, a hygroscopic binder therefor, and water-repellent material in amount not in excess of 10% of the weight of the paper.

3. A permeable insulating material comprising a fabric including felted asbestos fibres, a hygroscopic binder therefor, and a surface coating adapted to decrease the capillarity of the surface of the fabric for water.

4. A permeable insulating material comprising a sheet including felted asbestos fibers and a hygroscopic binder therefor and a surface coating comprising a wax composition adapted to decrease the capillarity of the surface of the sheet for water.

5. A permeable insulating material comprising a felted asbestos fabric and a surface coating comprising Montan wax and a petroleum wax and adapted to decrease the capillarity of the surface of the fabric for water.

6. A permeable insulating fabric of minimized vapor breathing properties comprising fibrous material, a hygroscopic binder therefor, and a water-repellent material of the type of aluminum stearate substantially uniformly distributed throughout the said fibrous material.

7. A permeable insulating fabric of minimized vapor breathing properties comprising fibrous material, a hygroscopic binder therefor, and a limited proportion of a water-repellent material intimately associated with the fibers, to decrease substantially the absorption of moisture from a relatively humid atmosphere and to allow penetration of the fabric by liquid water.

8. A permeable asbestos fabric, suitable for use

in thermal insulation, comprising felted asbestos fibres, a hygroscopic binder therefor, and a water-repellent agent including wax substantially uniformly distributed throughout the fabric.

9. An asbestos paper of the character described comprising felted asbestos fibres, a hygroscopic binder therefor, and a limited proportion of water-repellent agent intimately associated with the fibres, to decrease substantially the absorption of moisture from a relatively humid atmosphere and to allow penetration of the paper by liquid water.

10. Sectional pipe covering for thermal insulation comprising spirally wound corrugated sheets of asbestos paper alternating with plain sheets of asbestos paper, said paper consisting of felted water-repellent fibres, a hygroscopic binder therefor, and approximately 2 parts by weight of material of negative capillarity for water to 100 parts of finished paper.

EDWARD A. TOOHEY.
EARLE R. WILLIAMS.