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METHOD OF HEAT TREATING AN INORGANIC FIBROUS BODY FOR MOISTURE TRANSFER AND/OR HEAT

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Fig. 1

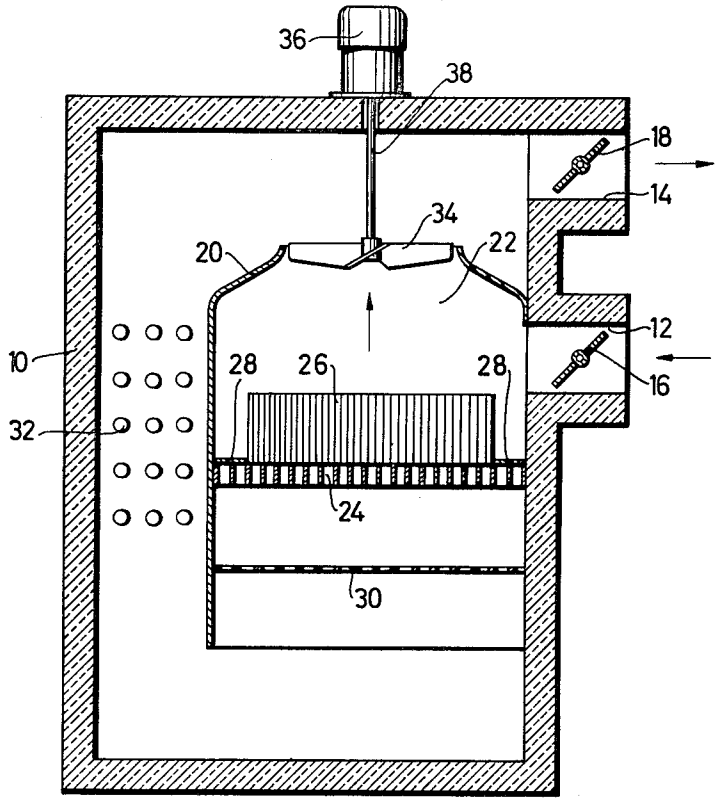
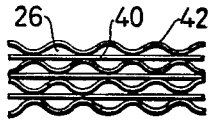


Fig. 2



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METHOD OF HEAT TREATING AN INORGANIC FIBROUS BODY FOR MOISTURE TRANSFER AND/OR HEAT

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This invention relates to a method for the manufacture of a packing or body for transfer of moisture and/or heat.

More particularly this invention relates to improvements in a method for manufacture of a packing or body for transfer of heat and/or moisture which packing is composed of sheets or layers consisting of asbestos or other equivalent, non-metallic, inorganic fibrous material and directly or possibly indirectly bearing against one another at mutually spaced places and therebetween forming open channels or passageways extending throughout the packing or body.

Usually, at least every second sheet or layer is undulated or corrugated, the spaced places of contact of adjacent sheets being constituted by the ridges of the undulations or corrugations.

An important field of application of the invention is the transfer of moisture and/or heat between two air flows. The transferrer packing or body may in this connection be formed as a rotor moving along a closed path between two passages transgressed by the one and the other of the air flows, respectively.

The sheets or layers of asbestos shall, in order to be capable of fulfilling their moisture and/or heat transferring function in the most effective manner, have a thickness not exceeding about one tenth or some few tenths of a millimeter. Such thin sheets cannot be given the required mechanical strength unless a bonding agent of organic nature such as starch or cellulose fibres contained in the stock is used to cement the asbestos fibres together.

It has been observed that the constituents of material of organic nature in the asbestos sheets in spite of their small proportion relative the total sheet material are capable of constituting fuel for a fire in the packing of such intensity that the asbestos is destroyed. Asbestos has a relatively high fusing point, but the combustion may become so intensive as to convert the asbestos fibres into a powder causing the sheets to disintegrate into dust. A fire may even be started on a moderate heating of the mass of sheets, for example when the packing or body employed for transfer of moisture is regenerated by means of a heated gaseous medium such as air. The combustion may be started some time after the regenerating flow has been stopped while the mass of the sheets in the packing is still hot. A packing composed of thin asbestos sheets with small channels is an excellent heat insulation and consequently constitutes an effective bar to emission of heat remaining in the interior of the packing. The temperature rises to the ignition point due to the absence of the cooling effect produced earlier by the circulation of air or gas through the packing. In this way an oxidation is produced in the hot body of sheets and due to the fact that the air within the channels of the body is almost stationary, the temperature rises gradually until the critical point is reached.

The asbestos fibres contain crystal water which escapes when the fiibres are heated to sufficiently high temperature and which causes the fibres to be decomposed into a powder. The temperature at which the crystal water is expelled, is approximately about 500° C. in the case of relatively long heating periods, but may be higher if the

time of combustion is reduced to seconds or still less. As soon as the critical temperature has been reached, the curve indicating the reduction of weight takes a steep descent which implies that the crystal water escapes rapidly.

One main object of the present invention is to provide a method of manufacturing packings or bodies for transfer of moisture and/or heat of the structure and material in consideration which eliminates the inconveniences which may result from a non-intended ignition of the packing or body.

Another object of the present invention is to provide a method of manufacturing packings or bodies for transfer of moisture and/or heat of the structure and material in consideration which ensures that organic constituents present in the material of which the sheets are made, are rendered innocuous with regard to ignition or combustion or neutralised prior to employment of the packing or body for its purpose.

According to one main feature of the invention the sheets of the packing or body before their use in the moisture and/or heat transferrer in the manner in view, are subjected to a heat treatment by which the organic constituents contained in the sheet material are oxidized.

The neutralisation of the organic constituents may be effected by combustion inasmuch as adjustment of the conditions for this combustion renders it possible to control the oxidation to thus avoid reaching a dangerous temperature. One possibility to attain this object is to blow air through the channels of the transferrer packing with such velocity as to prevent the heat developed in the packing during the combustion from surpassing a critical value. It is also possible to control the combustion of the organic constituents by suitably adjusting the supply of oxygen to the combustion air in relation to the velocity thereof.

The oxidation may even be conducted so as to heat the transferrer packing slowly to a temperature such as between 400 and 550° C. Under this heating various products of distillation will be formed in succession to one another or escape from the packing so that any direct ignition never will occur. The oxidation can in this manner be advanced until the packing becomes non-combustible without any visible combustion in the specific meaning of this term which means combustion producing a flame or temper colouring of the packing. Experiments have revealed that a packing if directly exposed to temperature reaching as high as about 500° C., such packing was immediately subjected to a combustion creating smoke and incandescence.

In some cases a pyrolysis can be carried out until a carbonized residue of organic constituents remains in the asbestos. This residue is then of such kind as not to involve any danger of subsequent combustion. The invention may also be realised by a combined oxidation and pyrolysis which is not selfsustaining.

It is an essential feature of the present invention that the oxidation or combustion is controlled so as to ensure that the crystal water present in the asbestos is not expelled. A transferrer packing or body of asbestos paper treated according to the invention has the remarkable and surprising effect that it permits to dry air to a lower moisture content than has hitherto been attainable with transferred packings of the type in consideration.

It is known per se in the manufacture of transferrer bodies of ceramic material to apply a ceramic paste onto a strip-formed carrier of a combustible material. This carrier is wound in layers positioned one upon the other and causes the transferrer body to retain its form during the firing of the paste to take its solidified state. In connection therewith the carrier is eliminated by combustion which may be conducted at a high temperature without

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any danger of the ceramic material becoming destroyed or damaged. In this case the initial carrier is thus replaced by ceramic material which stands a temperature by far exceeding even the temperature developed by forced combustion.

Further objects and advantages of the method according to the present invention will become apparent from the following description, considered in connection with the accompanying drawing which forms part of this specification and which in a diagrammatic manner illustrates an apparatus for carrying out the method and in which:

FIG. 1 is a longitudinal vertical sectional view of an apparatus constructed for realisation of the method according to the invention, FIG. 2 being a partial top view of a transferrer packing shown in a larger scale than that used in FIG. 1.

Referring to the drawing, reference numeral **10** denotes a kiln having walls of a heat insulating material. Formed in one of said walls is an inlet opening **12** and an outlet opening **14**, said openings being each provided with a damper denoted by **16** and **18**, respectively, or a similar throttling device. The kiln encloses an internal casing **20** made of sheet metal or similar material defining a chamber **22**. Positioned within said chamber is a screen or lattice **24** intended to carry a transferrer packing **26** placed thereon for the purpose of being treated. The portion of the lattice **24** not covered by the packing can be screened off by means of shields **28** so as to force all air passing through the lattice to pass through the transferrer packing **26**. A perforated plate **30** or similar member may be located below the lattice **24** and has for its purpose to bring about a uniform distribution of the air over the cross-section of the chamber **22**. A heater **32** is located outside the chamber **22**. A gaseous medium, in most cases air, is caused to circulate upwardly through the chamber **22** and downwardly past the heater **32** by means of a fan **34** driven by a motor **36** through a shaft **38**.

The transferrer packing **26** is composed of thin sheets of asbestos formed by undulation or in other suitable way so as to bear against one another at mutually spaced places so as to form flow passages extending throughout the packing between the sheets. In the embodiment illustrated in FIG. 2 the packing is composed of alternately plane sheets **40** and corrugated sheets **42**. The spacing between the plane sheets is suitably less than 3 millimeters such as between about 1 and 2 millimeters, when a packing for a transferrer intended for dehydrating or influencing the temperature of one air flow by means of another flow of air or a gas is in consideration. The sheets are at their places of mutual contact rigidly secured to one another by means of a bonding agent, preferably of inorganic nature, such as water glass, for example.

The asbestos sheets are made of asbestos fibers which usually are composed of filaments having an extremely small diameter. In order to impart to the sheets required mechanical strength organic bonding agents such as starch, are added and in addition a minor quantity of cellulose fibers is usually admixed with the asbestos fibre stock, since cellulose fibres possess a higher felting capacity than the asbestos fibres.

By the heater **32** the gaseous medium circulating within the kiln **10** is heated to a temperature of between about 200 to 300 and about 500 to 600° C., in other words to so high a temperature that the organic constituents in the transferrer packing **26** located on the lattice **24** can be oxidised under predetermined and controllable conditions. During this processing the gaseous medium contains oxygen in a quantity which can be adjusted by supply of combustion air into the closed circuit circulating within the kiln through the inlet opening **12**, a corresponding quantity of medium being allowed to escape through the outlet opening **14**. Further, the velocity of circulation within the channels or passageway of the packing is adjusted so as to keep the combustion at a temperature below the temperature at which the asbestos is

attached in a detrimental manner. A combustion zone is produced which in a controllable manner migrates through the transferrer packing which in this way is relieved from its content of combustible substance.

If the treatment of oxidation or pyrolysis is effected by gradually heating the flow or gas while it passes through the channels or passageways of the packing the neutralisation or removal of the combustible constituents may be carried out without any visible combustion. More volatile products gassified by the heating will escape at a lower temperature than less volatile products until finally an oxidation of non-volatile residues (carbon) can take place at the highest temperature.

It is not necessary to eliminate the organic constituents completely, provided that they are brought to such a state as to become harmless with regard to combustion or ignition when the transferrer packing is employed for moisture and/or heat transfer.

By the removal of the organic bonding agent from the packing the mechanical strength of the sheets of which the packing is composed, is reduced in a corresponding degree. Due to the fact that the sheets are united with one another the entire structure nevertheless in many cases possesses satisfying strength which, if desired, may be improved in particular when it is desired to make the sheets water-resistant by impregnation with inorganic substances such as water glass and calcium chloride which substances together produce a precipitation of calcium silicate on the sheets. The impregnation with these substances is preferably effected after the packing or body has been built up but prior to its combustion treatment according to the present invention.

When the transferrer packing or body is to be used for dehydration of an air flow the sheets are impregnated with a hygroscopic substance such as a salt constituted, for example, by lithium chloride. This impregnation is most suitably effected after the treatment according to the present invention of the sheets of the packing or body.

The invention is also applicable to other types of contact packings or bodies, such as cooling towers, within which a liquid, in the first instance water, and a gas, primarily air, are brought into direct contact with one another.

It is of advantage to begin with the manufacture of the transferrer packing or body before the treatment by the gasification or controlled combustion is started, since the sheets then bear against, or are united with one another and in this way have obtained additional strength compensating for the removal of the organic bonding agent. The asbestos sheets may also be covered with a thin metal sheet.

While one more or less specific embodiment of the method according to the invention has been shown and described, it is to be understood that this is for purpose of illustration only, and that the invention is not to be limited thereby, but its scope is to be determined by the appended claims.

What I claim is:

1. The method of producing a body for moisture transfer, said body being composed of sheets of asbestos fibers and which sheets are mutually joined to one another at spaced points and thus form a plurality of substantially parallel channels between them, and which sheets contain a small amount of organic particles to strengthen the sheets, the said method consisting in the subjection of the body before use to heat treatment by means of which the organic particles in the sheets are oxidized and at least partly removed in gaseous form, leaving water of crystallization remaining in the asbestos fibers.

2. The method as provided for in claim **1**, including the step of impregnating the body with an inorganic substance to thereby compensate for any weakening of the sheet structure caused by the removal of the organic constituents.

3. The method as provided for in claim 1, and including the step of adding a hygroscopic substance to the sheets after the heat treatment so that the moisture-absorbing capacity of the body will be increased.

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