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CORE FOR USE IN HUMIDITY EXCHANGES AND HEAT EXCHANGERS AND METHOD OF MAKING THE SAME.

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References cited :
DE-A- 2 831 075
DE-B- 1 776 210
US-A- 2 983 486
US-A- 4 228 847

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Description

The present invention concerns a rotor or similar core for use in humidity exchangers and/or heat exchangers comprising a number of fine channels running parallel to the rotor axis between two end faces of the rotor according to the first part of claim 1. The invention is also concerned with a procedure for the manufacturing of a rotor of this nature.

Rotors of the type described and as known for example from US-A- 4 228 847 are normally manufactured by assembling and uniting, usually by glueing, alternately flat and corrugated layers, the structure so obtained consisting of one flat and one corrugated layer, being thereafter wound or coiled to form a rotor or similar core of essentially cylindrical form in which the individual coils are also mutually united by the method described or some other method.

Earlier, rotors of this kind were made by joining sheets of non-metallic, fibrous, inorganic and incombustible material, but lately metal has come to be extensively used in the rotor layers, primarily aluminium, which is cheaper and also simpler to handle in manufacturing the rotor giving it equally good transfer properties while maintaining the non-combustion requirement. As a rule, the foil thickness is 50-100 μ . In actual fact it would be possible to obtain satisfactory rotor performance by using even thinner material and thereby achieve a still lower manufacturing cost. However, the use of aluminium foil of such a small thickness in the layer will entail problems. The edges of the exposed foil at the end faces of the rotor are sensible to pressure and point loads and can therefore be damaged by impacts to the end faces in handling and transport of the finished rotor after manufacture. When the rotor has been installed and is in operation its end faces, which constitute inlets and outlets for the air or gas flows passing through the rotor, are exposed to wear by sealings and to other effects caused by air and/or gas flows if they contain contaminations. Also large or small particles conveyed in the air or gas flow cause wear to the end faces of the rotor and may also attach to them or on their immediate fringe areas.

The contaminations are mainly of two kinds, i.e. chemical contaminations causing corrosion and eroding of the foil material, and mechanical, such as dust and different kinds of particles causing clogging of the fine channels. Both these types of contaminations have proved to have effects mainly on the rotor end surfaces down to a few millimeters in depth.

For the purpose of counteracting the chemical contaminations the alternative usually chosen is to use an alloy between aluminium and other substances giving the foil increased resistance to the contamination concerned and, in addition, the foil thickness is increased in order to obtain further protection against weakening by corrosion attacks.

As regard soiling and clogging up of the end faces of the rotor some kind of cleaning must be done, such as flushing with a cleaning fluid, blowing them clean with compressed air or steam or some combination of these measures. Such flushing and blowing is effected under high pressure and entail risk of deformation of the end faces. Also in this case, the antidote is to increase the foil thickness in order to give the end faces greater mechanical strength and resistivity.

The drawbacks inherent in alloying the foil and increasing its thickness are obvious since both measures increase the cost of the rotor substantially and unnecessarily, since only the end faces are in need of the protection thus achieved.

Attempts have been made in order to increase the strength of the end faces of the rotor. Thus, US-A-4 228 847 discloses a rotor in which the edges of the layers are reinforced by folding the strip material, especially the corrugated strip.

DE-B-1 776 210 discloses a contact body especially for cooling towers, in which the edges of the layers have been reinforced by dipping the non-metallic material.

The chief objective of the present invention is to achieve a rotor in which the problems described have been eliminated and a method of manufacturing such a rotor, which method produces even and flat end faces and a greater resistance to damage to all the rotor layers.

This objective is achieved in that the rotor, and the method of its manufacture, are given the characteristics set out in the patent claims 1 and 5.

The invention will be described in more detail in the following paragraphs with reference to the construction specified on the drawing.

Fig 1 shows the perspective view of the rotor devised according to the procedure according to the invention aiming at strengthening the edges of the rotor layers at the one end face.

Fig. 2 is a perspective view in enlarged scale of a detail of the end face of the rotor according to Fig 1.

The rotor 10 shown on the drawing has the form of a cylinder with a hub 12 through which a shaft (not shown) passes, this shaft keeping the rotor rotatable in the suspension rack of an air humidity and/or heat exchanger. The rotor body is formed by a number of alternately flat 14 and corrugated 16 layers (Fig. 2) inter-changingly joined and connected with each other and thereafter wound spirally on the cylindrical rotor body 10 at the same time as the individual coils are united with each other. As already mentioned, layers 14 and 16 consist of a thin metal, primarily an aluminium foil, or an aluminium alloy or similar, and are, in cases where the rotor is to be used for humidity transfer, hygroscopic, which is achieved by coating them with hygroscopic material or by surface restructuring of the material as such in order to render it hy-

droscopic.

Since the folds of the corrugated layer 16, out of which the rotor is made up, run in an axial direction in the rotor 10, a large number of fine through channels are formed in it.

The height of the folds in the corrugated layer 16 is as a rule less than 5 mm, e.g. 1-3mm, which consequently constitutes the height of the channels.

In order to reduce the manufacturing costs of the rotor 10 and to make it low-weight, as thin a foil as possible is used in layers 14, 16, e.g. layers less than 100 μ thick, e.g. 35-50 μ .

As described in the introduction this makes the finished rotor's 10 end faces sensitive to load, since the edges of the thin foil sheets easily give way particularly to point pressure which may ensue while the rotor is operating or being cleaned.

According to the invention a strengthening of the edges of the thin rotor layers 14, 16 is achieved by metal spraying of the end face of the rotor which means that finely dispersed metal, in the present case aluminium, is sprayed in molten condition onto the end face of the rotor. The spraying should preferably be flame spraying with stranded aluminium which is melted with a gas flame or arch and sprayed finely dispersed onto the end face of the rotor with compressed air. The metal particles are expelled towards the end face at high speed and when hitting the edges of layers 14 and 16 they are flattened out and attach mechanically to the surface structure of the layers by adhesion. A tight metal coating is consequently built up, particle by particle upon each other, on the edges of layers 14 and 16, this metal coating rapidly forming its own oxides to generate an edge reinforcement as shown in the encircled and enlarged section of Fig. 2.

In the embodiment alternative shown in Fig. 2 the corrugated layers 16 protrude beyond the flat layers 14, which results in a heavier edge reinforcement being achieved on the corrugated layers. Since these corrugated layers 16 extend beyond the flat layers 14 the coating can consequently be made thicker without the pressure drop via the rotor being influenced, as the additionally reinforced edge portions of the corrugated layer 16 extend beyond the opening of the rotor channels.

As shown in Fig. 1 the spraying on of the metal, i.e. aluminium, is done at an angle to that end face of the rotor 10 which is to be reinforced, for instance the one at 30° angle, which increases the adhesion between the metal particles being sprayed on and the rotor layers. The apparatus 18, which is of a well-known design, and rotor 10 are during this process moving relative to each other, e.g. by the rotor 10 being rotated in order that the whole end face be coated when spraying. Selfevidently more than one spraying apparatus 18 can be set up if desired.

During flame spraying with compressed air the

air stream cools the metal drops as well as the sprayed-on coat, which means that the rotor body 10 is not exposed to any detrimental heating, but should this be required the excess heat can be conducted away from the rotor body during the flame spraying by means of any known cooling arrangement. Since the rotor material is aluminium, as described in the above, the metal sprayed on should preferably be pure aluminium which provides excellent protection in a sulphurous atmosphere and has excellent resistance to smoke gases with high concentrations of sulphur dioxide or in sour environments. For the purpose of other installations and applications it may be suitable that the metal to be sprayed on be constituted of alloys between aluminium and some other metal, such as magnesium, zinc or similar.

By processing the rotor according to the description of the invention a number of advantages are obtained with regard to the rotor's resistance to damage due to point loads or abrasion or wear when in operation or when being cleaned. By this, the rotor is given a homogenous and durable surface with a higher corrosion resistance to air and gas flows which are sulphurous or contain salts or acids. By flame spraying with aluminium strands a much harder rotor end face is obtained, which facilitates cleaning of the rotor by flushing or spraying without the edges of the thin foil layers giving way under high point pressure. The edge reinforcement obtained according to the description of the invention has proved to not significantly influence the pressure drop via the rotor 10, this particularly being the case in the embodiment alternative shown in Fig. 2, where the corrugated layer 16 extends beyond the flat layers 14, where the coating can be made thicker without the pressure drop being influenced.

Claims

1. A rotor or similar for humidity exchangers and/or heat exchangers comprising a number of fine channels running parallel to the rotor axis and between two end faces of the rotor (10), the channels being separated by thin walls or layers (14, 16) out of a thin foil and the edges of the layers (14, 16) being provided with a reinforcement at the end face or faces of the rotor, **characterized** by the reinforcement being a coating of sprayed-on metal on the finished rotor end face.
2. A rotor according to claim 1, **characterized** by the rotor material being aluminium or an aluminium alloy and by the fact that the sprayed-on metal is pure aluminium.
3. A rotor according to claim 1, **characterized** by the rotor material being aluminium or an aluminium

alloy and by the fact that the sprayed-on metal is an alloy containing aluminium.

4. A rotor according to either of the claims 1 to 3, in which the channels are formed by flat and corrugated layers alternately united and wound into a rotor body, **characterized** by the corrugated layers at the end face of the rotor extending beyond the flat layers.

5. Procedure for the manufacturing of a rotor or similar for humidity exchangers and/or heat exchangers according to either of the claims 1 to 4, comprising the devising of a number of fine channels running parallel to the rotor shaft and between two end faces on the rotor, which channels are separated by thin walls of layers out of a thin foil the edges of the layers being provided with a reinforcement, **characterized** by the reinforcement of the edges being accomplished by spraying metallic material onto the end surface or surfaces of the finished rotor.

6. Procedure according to claim 5, **characterized** by the fact that the spraying-on of the metallic material takes place at an angle to the end face of the rotor 10°-50°, preferably ca. 30°.

7. Procedure according to claim 5 or 6, **characterized** by the fact that the spraying-on of the metallic material is effected by flame spraying with a strand of the said metallic material as an additive.

8. Procedure according to either of the claims 5 to 7, **characterized** by heat being conducted from the rotor body during the spraying-on of the metallic material.

Patentansprüche

1. Rotor oder ähnliches für Feuchte- und/oder Wärmetauscher mit mehreren, feinen Kanälen, die zwischen zwei Stirnflächen des Rotors (10) parallel zur Rotorachse verlaufen, wobei die Kanäle durch dünne Wände oder Lagen (14, 16) aus einer dünnen Folie getrennt sind und wobei die Kanten der Lagen (14, 16) an der Stirnfläche oder den Stirnflächen des Rotors mit einer Verstärkung versehen sind, dadurch **gekennzeichnet**, daß die Verstärkung aus einer Metallbeschichtung besteht, die auf die fertige Rotor-Stirnseite aufgesprüht worden ist.

2. Rotor nach Anspruch 1, dadurch gekennzeichnet, daß das Material des Rotors Aluminium oder eine Aluminiumlegierung ist und daß das aufgesprühte Metall reines Aluminium ist.

3. Rotor nach Anspruch 1, dadurch gekennzeichnet, daß das Rotormaterial Aluminium oder eine Aluminiumlegierung ist und daß das aufgesprühte Metall eine Legierung ist, die Aluminium enthält.

4. Rotor nach einem der Ansprüche 1 bis 3, wobei die Kanäle durch ebene und gewellte Lagen gebildet sind, die abwechselnd miteinander verbunden und zu einem Rotorkörper aufgewickelt sind, dadurch gekennzeichnet, daß die gewellten Lagen (16) an der Stirnfläche des Rotors (10) über die ebenen Lagen (14) hinausragen.

5. Verfahren zur Herstellung eines Rotors oder dergleichen für Feuchte- und/oder Wärmetauscher nach einem der Ansprüche 1 bis 4, durch Vorsehen von einer Anzahl feiner Kanäle zwischen den Stirnflächen des Rotors, die parallel zur Rotorwelle verlaufen, wobei die Kanäle durch dünne Wände von Lagen einer dünnen Folie voneinander getrennt sind und wobei die Kanten der Lagen mit einer Verstärkung versehen sind, dadurch **gekennzeichnet**, daß die Verstärkung der Kanten durch Aufsprühen eines metallischen Materials auf die Stirnfläche oder die Stirnflächen des fertigen Rotors bewerkstelligt wird.

6. Verfahren nach Anspruch 5, dadurch gekennzeichnet, daß das Aufsprühen des metallischen Materials unter einem Winkel zur Stirnfläche des Rotors von 10 bis 50°, vorzugsweise von 30°, stattfindet.

7. Verfahren nach einem der Ansprüche 5 oder 6, dadurch gekennzeichnet, daß das Aufsprühen des metallischen Materials durch ein Flamm-spritzverfahren mit einem Strang oder einem Draht des metallischen Materials als Zusatz durchgeführt wird.

8. Verfahren nach einem der Ansprüche 5 bis 7, dadurch gekennzeichnet, daß von dem Rotorkörper während des Aufsprühens des metallischen Materials Wärme abgeführt wird.

Revendications

1. Rotor ou organe similaire pour échangeurs d'humidité et/ou échangeurs de chaleur comprenant un certain nombre de fins canaux courant parallèlement à l'axe du rotor et entre deux faces extrêmes du rotor (10), les canaux étant séparés par de fines parois ou couches (14, 16) en clinquant fin et les bords des couches (14, 16) étant munis d'un renforcement à la face ou aux faces extrêmes du rotor, caractérisé en ce que le ren-

forcement est un revêtement d'un métal projeté sur la face extrême du rotor fini.

2. Rotor selon la revendication 1, caractérisé en ce que la matière du rotor est l'aluminium ou un alliage d'aluminium et en ce que le métal projeté est de l'aluminium pur. 5

3. Rotor selon la revendication 1, caractérisé en ce que la matière du rotor est de l'aluminium ou un alliage d'aluminium et en ce que le métal projeté est un alliage contenant de l'aluminium. 10

4. Rotor selon l'une quelconque des revendications 1 à 3, dans lequel les canaux sont formés de couches plates et ondulées réunies en alternance, et enroulées pour former un corps de rotor, caractérisé en ce que les couches ondulées situées à la face extrême du rotor s'étendent au-delà des couches plates. 15
20

5. Procédé pour la fabrication d'un rotor ou organe similaire pour des échangeurs d'humidité et/ou échangeurs de chaleur selon l'une des revendications 1 à 4, comprenant la disposition d'un certain nombre de fins canaux courant parallèlement à l'arbre du rotor et entre les deux faces extrêmes du rotor, canaux qui sont séparés par de fines parois ou couches en clinquant fin, les bords des couches étant munis d'un renforcement, caractérisé en ce que le renforcement des bords est exécuté en projetant une matière métallique sur la ou les surfaces extrêmes du rotor fini. 25
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6. Procédé selon la revendication 5, caractérisé en ce que la projection de la matière métallique a lieu à un angle par rapport à la face extrême du rotor de 10°-50°, de préférence, environ 30°. 35

7. Procédé selon la revendication 5 ou 6, caractérisé en ce que la projection de la matière métallique est effectuée par projection par flamme avec un toron de ladite matière métallique comme additif. 40
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8. Procédé selon l'une des revendications 5 à 7, caractérisé en ce que le chauffage est effectué à partir du corps du rotor pendant la projection de la matière métallique. 50
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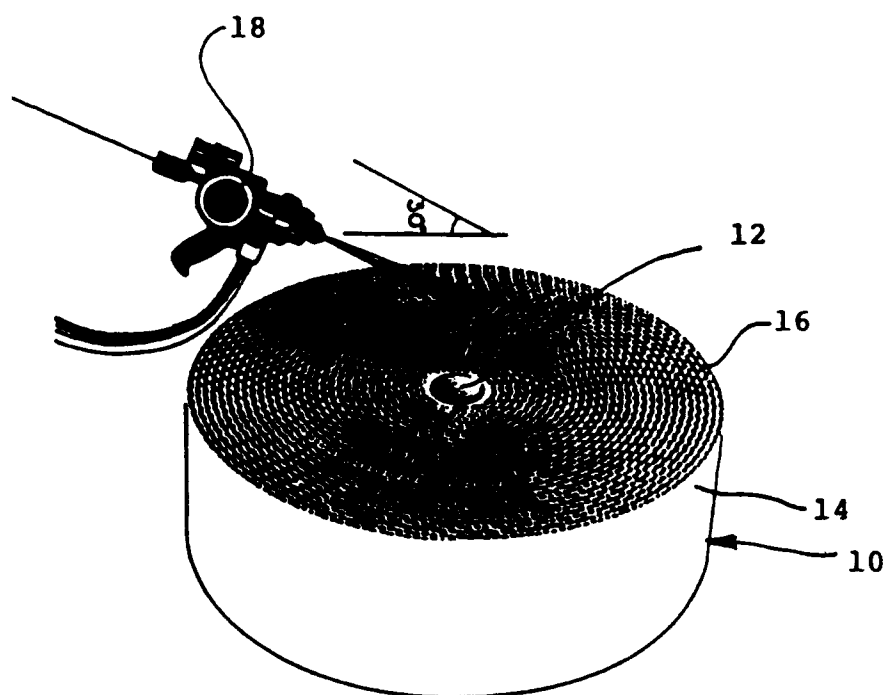


FIGURE 1

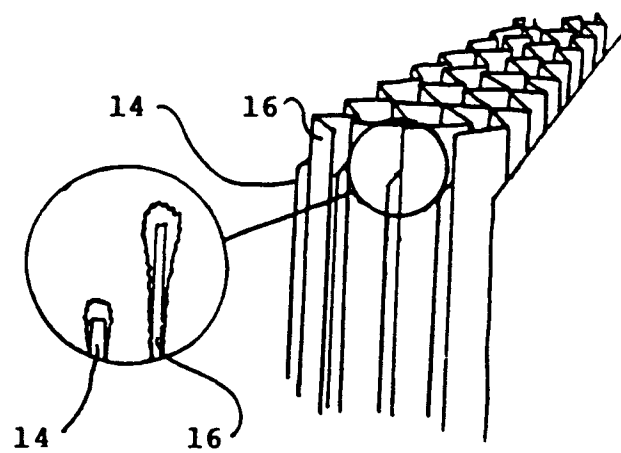


FIGURE 2