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(54) HEAT EXCHANGER

(71) We, VEB POLYGRAPH LEIPZIG Kombinat für polygraphische Maschinen und Ausrüstungen, of 705 Leipzig, Zweinaundorfer Strasse 59, German Democratic Republic, a corporation organised under the laws of the German Democratic Republic do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:

The present invention relates to a heat exchanger intended for example to be used to cool, warm or dry web-like substances, such as paper, fabrics, synthetic material film, plywood and the like.

DT-AS 1 134 272 discloses a heat exchanger for warming or drying web-like substances and comprises two cylinders, one within the other. The annular space between them is provided with helical flow paths defined by webs having a height corresponding to the height of the annular space and through which heating or cooling medium flows in counter current from both ends of the cylinders. As a result of the non-rectilinear flow path of the heat exchange medium, a relatively large flow resistance exists, which in turn causes the flow speed of the medium to be reduced and thereby the heat exchange effect. Furthermore, the heat exchange medium forms a bad heat conducting layer, the so-called boundary layer, at the inner surface of the outer cylinder due to the centrifugal force. Since this layer reduces the efficiency of the heat transfer from the material web to the heat exchange medium or vice versa, the intended effect, i.e. that the co-efficient of heat transmission depends only on the speed of flow of the medium is not fully realised. Also, when for example, cooling printed paper, it is often disadvantageous for the different heat zones, which occur through the counter current feeding of the cylinder each time with a heat exchange medium, to be produced on the roller surface.

DT-PS 861 642 discloses a heat exchanger in which the annular space is provided with helically shaped flow paths which are formed by webs which do not quite reach the inner surface of the outer cylinder. The cooling or heating medium accordingly does not flow rectilinarly in this cylinder and only an insubstantially lower flow resistance exists compared with the aforementioned cylinder, since the web height is short of the height of the annular space by a distance that allows only a small part of the medium over the webs to touch the inner surface of the outer cylinder. As a result of the weak vortex formation at the webs, only a small part of the medium boundary layer is reduced, which has arisen through the centrifugal force occurring at the inner surface of the outer cylinder and which is relatively inactive in respect of its speed of flow and thereby in its heat exchanging effect. The high flow resistance and the consequently relative low speed of the flow thus do not permit optimal heat exchange.

By reason of the speed of flow of the respective heat exchange medium being too low, the medium tends to assume the temperature of the cylinder wall before it has flowed through the heat exchanger so that intolerably large temperature differences or too large a temperature rise can occur along the axis of the heat exchanger in the direction of flow of the medium.

In order at least partially to attain the desired cooling or heating effect, a large quantity of heat exchange medium is necessary when using known heat exchangers. When medium for heating the cylinder is required, the high energy expenditure for the preparation thereof has to be considered.

According to the present invention there is provided a heat exchanger comprising an

outer cylinder and an inner cylinder, the inner cylinder having an outer surface and the outer cylinder having an inner surface which together define an annular passageway for the flow of heat exchange medium, at least one of the outer and inner surfaces being provided with at least one sharp edged groove and the volume of the passageway being less than the volume of the shell of the outer cylinder. It is possible to arrange the grooves parallel to the axis of the cylinders. The turbulence of the heat exchange medium in that case occurs as a result of the rotation of the cylinders. A rectilinear course of flow of the heat exchange medium in the annular passageway is ensured; the flow resistance to the medium in spite of simultaneous turbulence of all layers of the medium being appreciably reduced by means of sharp-edged spiral grooves as well as the speed of flow increased in the same ratio. Thereby, the temperature gradient along the axis of the cylinder is hardly measurable and is thus practically negligible. Complete turbulence of the heat exchange medium and the high speed of flow thereof provide optimal heat exchange between the medium and for example web-like substances. The formation of an inactive boundary layer in the medium due to the centrifugal force is not possible.

Because the volume of the annular passageway is less than that of the shell of the outer cylinder a heat exchange medium volume is required which is low in relation to this high efficiency. Thus, the temperature of for example a dried web-like substance on being cooled by the heat exchanger may be so low that further processing thereof is possible immediately or that the material web on warming is uniformly dried over its entire width.

An embodiment of the present invention will now be more particularly described by way of example and with reference to the accompanying drawing in which:-

Figure 1 shows a longitudinal section of a heat exchanger, and

Figure 2 shows the detail Z of Figure 1.

Referring now to the drawings, disposed on the outer surface 1 of the inner cylinder 2 of the heat exchange cylinder 3 is a spiral groove 4, which is formed to be square in its cross-section and which is sharp-edged in the plane of the surface 1. The groove 4 extends from one axial end of the inner cylinder to the other and provides parallel flow paths for a heat exchange medium 5. To secure a high speed of flow of the heat exchange medium 5, the volume of an annular passageway 7 defined between the shell of the inner cylinder 2 and that of the outer cylinder 6 is smaller than the volume of the shell of the outer cylinder 6. The inflow of the heat exchange medium 5 into the annular passageway 7 takes place in known manner by way of a rotation transmitter 8, an axial bore 10 disposed in an axial limb 9 of the heat exchanger 3 and by way of a distributor space 11. The inclination of the spiral groove 4 and therefore the speed of the heat exchange medium 5 is dependent upon the chosen ratio of the volumes of the outer cylinder 6 and of the annular passgeway 7 so that an adequate turbulence of the medium is secured.

The heat exchange medium 5 passing through the rotation transmitter 8 and the axial bore 10 of the heat exchanger 3 is accelerated by the centrifugal force of the rotating heat exchanger 3, through the distributor space 11 into the annular passageway 7, through which it flows rectilinearly and is made turbulent in all its layers at the sharp edges of the spiral groove 4. Thus, no boundary layer can build up in the annular passageway 7 even at high rotational speeds. Thereby and in consequence of the high speed of flow of the heat exchange medium 5, optimum heat exchange occurs over the entire cylinder surface between the web-like substances and the heat exchange medium 5.

In another embodiment grooves 4 may be disposed in and extend from one axial end of the outer cylinder to the other. In a further embodiment a groove 4 may be disposed in both the inner and outer cylinder.

An advantage of the above described embodiment of the present invention by way of example is that the ratio of the expenditure on basic means, such as for example the volume of heat exchange medium for cooling or heating required in a certain unit of time, the quantity of energy for preparation of the respective medium and the like, to the useful effect, such as for example a low stack temperature of folded substances during cooling, smear-proof prints on the web during drying and the like, is an improvement on known methods, the heat exchange capability of the cylinders thus having a high efficiency. Also a rectilinar turbulent flow of the heat exchange medium is attained in the annular gap between the shell of the inner cylinder and the shell of the outer cylinder and the formation of a badly conducting layer of medium at the inner surface of the shell of the outer cylinder due to the centrifugal force is at least largely avoided and a speed of flow of the medium, which is large compared with such speeds in known double cylinder heat exchangers, assures an optimum heat transfer.

WHAT WE CLAIM IS:-

1. A heat exchanger comprising an outer cylinder and an inner cylinder, the inner cylinder having an outer surface and the

outer cylinder having an inner surface which together define an annular passageway for the flow of heat exchange medium, at least one of the outer and inner surfaces being provided with at least one sharp-edged groove and the volume of the passageway being less than the volume of the shell of the outer cylinder.

2. A heat exchanger as claimed in claim 1, wherein the at least one groove is helical.

3. A heat exchanger as claimed in claim 1, wherein the or each groove extends parallel to the axis of the cylinders.

4. A heat exchanger substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

DR. WALTHER WOLFF & CO.,
6 Buckingham Gate,
London SW1E 6JP.
Chartered Patent Agents,
Agents for the Applicants.

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1585280 COMPLETE SPECIFICATION
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

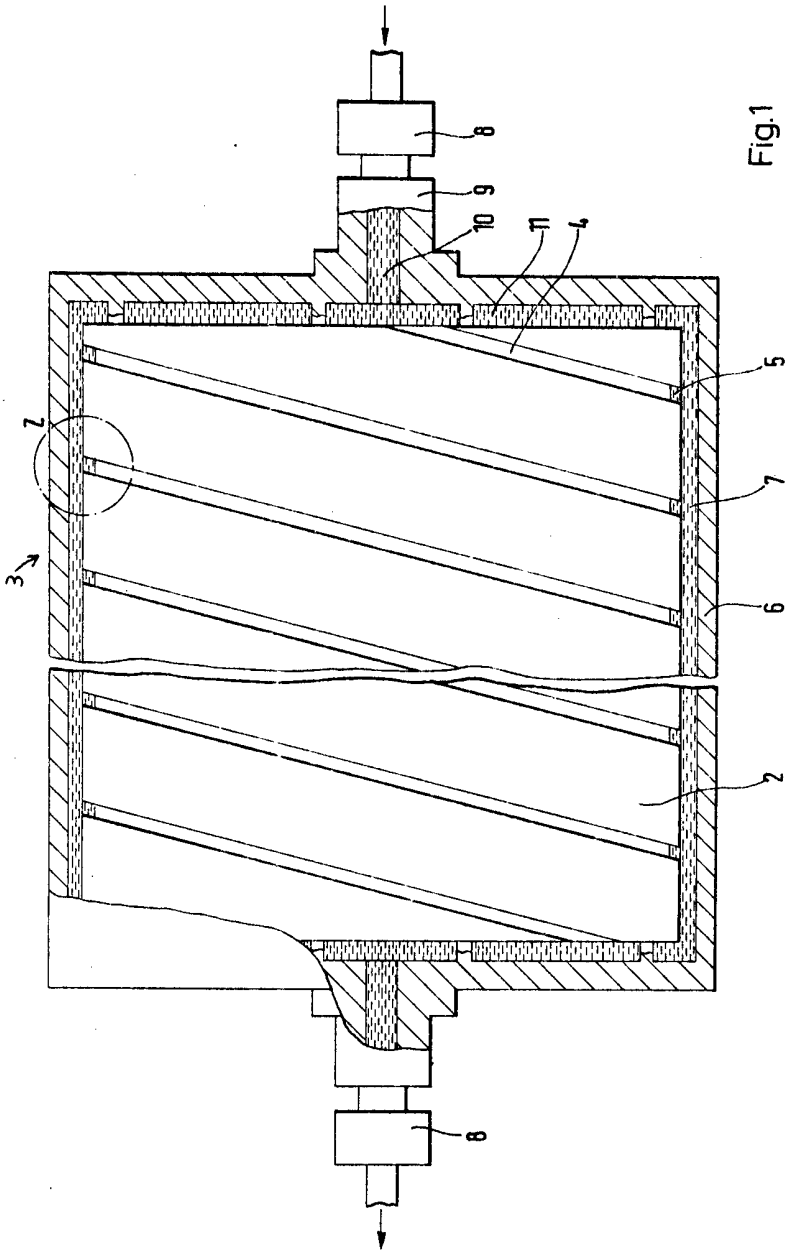

Fig.1

1585280 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 2

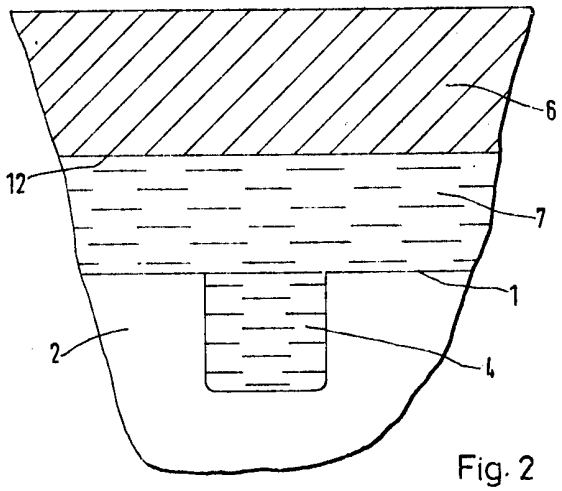

Fig. 2