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54 **HEAT EXCHANGER.**

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Description

The present invention is related to a heat exchanger providing heat transfer between two mediums. The heat exchanger comprises a tubular shell and a finned tube provided in the shell, the fins of the tube being substantially perpendicular to the direction of the tube. One medium is flowing in the shell outside the finned tube and the other medium is flowing in the finned tube. The heat exchanger is particularly intended for use in vapour condensers, e.g. in connection with heat pumps and similar devices in which the vapour is routed through the shell outside the finned tube and a cooling medium is routed through the finned tube.

It has been proposed to use finned tubes in heat exchangers for providing heat transfer between two flowing mediums. An example of such a prior art device is described in FR—A—2 083 547. This specification discloses a heat exchanger which comprises a tubular shell and a finned tube provided within the shell. The fins on the tube are substantially perpendicular to the direction of the tube. The internal cross-sectional area of the shell is longer than the area enclosed by the outer periphery of the fins. Vapour to be condensed is passed through the shell outside the finned tube and a coolant to condense the vapour is passed through the finned tube. The shell is divided by the finned tube into chambers which are provided on respective sides of the finned tube. The finned tubes are advantageous due to their large heat transfer surfaces. While these prior art heat exchangers can be used for condensing vapour, they have in this use the disadvantage that the condensate has a tendency to remain on the fin surfaces, thus reducing the capacity of the heat exchanger and slowing down the condensation process.

The main object of the invention is to provide a heat exchanger utilising the advantage of the large heat transfer surfaces of finned tubes but eliminating or at least reducing the tendency of the condensate to remain on the heat transfer surfaces.

Accordingly, the present invention provides a heat exchanger for condensing a vapour, comprising a tubular shell and a finned tube provided in the shell, the fins of the tube being substantially perpendicular to the direction of the tube, the internal cross sectional area of the shell being larger than the area enclosed by the outer periphery of the fins, the arrangement being such that vapour to be condensed may pass through the shell outside the finned tube and a coolant to condense said vapour may pass through the finned tube, wherein the shell is divided by the finned tube into chambers which are provided on respective sides of the finned tube and wherein only two chambers are formed within the shell, the first chamber being provided above the second chamber the first chamber having an inlet through which said

vapour may be introduced to the heat exchanger and the second chamber having an outlet through which condensate may be removed from the heat exchanger.

Due to the fact that the shell is divided into two chambers provided on respective sides of the finned tube, the vapour can flow between the fins of the finned tube in good contact with the fins, thus providing a good heat transfer between the vapour flowing in the shell outside the finned tube and the coolant flowing in the finned tube. If the tube fins abut two opposite walls of the shell, a good heat transfer may also be provided between the finned tube and the shell, so that the shell will form a heat transfer surface for further improving the heat exchange between the two mediums passing through the heat exchanger. By positioning the finned tube diagonally in the shell, so that at the inlet end of the shell the first chamber occupies the larger portion of the space available outside the finned tube and at the outlet end of the shell the other chamber occupies the larger portion of the space available outside the finned tube, a comparatively large inlet and outlet can be provided, although the shell has a relatively small cross sectional area. Thus, comparatively large amounts of the said vapour can be fed into the shell, enabling the transfer of relatively large amounts of heat between the vapour and the coolant.

The vapour flowing between the fins will tend to remove the condensate from the fin surfaces, so that the condensate does not remain on the fins and prevent further condensation. This effect has been found to be particularly evident when the first chamber, i.e. the inlet chamber, in the shell is positioned above the second chamber, i.e. the outlet chamber. By designing the shell as an upright coil having a steep pitch, the condensate can be collected in the lower portion of the coil, where it will surround the finned tube, thus supercooling the condensate.

Two embodiments of a heat exchanger in accordance with the invention will now be described by way of way of example and in more detail with reference to the accompanying drawings.

Figure 1 is a side view of a finned tube having a surrounding straight shell;

Figure 2 is a cross section through the apparatus of Figure 1 along the line II—II; and

Figure 3 is an embodiment similar to the one shown in Figures 1 and 2, but in which the shell has been wound to form a coil.

The embodiment of the invention shown in Figure 1 comprises a tubular outer shell 10 having substantially oval cross section, as shown in Figure 2. A finned tube 11 is inserted in the shell 10. The fins 12 of the tube consist of annular discs provided substantially perpendicularly to the longitudinal direction of the tube. The fins of tubes of this type are normally made by rolling and turning tubes having thick

walls, so that the fins form an integral part of the tube. Alternatively, the fins can form a helix surrounding the tube along its length. The fins 12 of the finned tube 11 about two opposed walls of the shell 10, as is shown in Figure 2. This abutment has been found to provide a good heat transfer between the finned tube 11 and the shell 10, so that the inner surface of the shell will provide a heat transfer surface for heat transfer between the two mediums flowing respectively through the shell and the finned tube.

The shell, having a larger cross sectional area than the finned tube, is divided into two chambers 13, 14 by the finned tube 11, the chambers running from one end of the shell to the other and being provided on respective sides of the finned tube, so that the medium entering the first chamber 13 has to flow between the fins 12 of the tube to enter the second chamber 14. In the embodiment shown in Figures 1 and 2, the shell 10 is a straight tube into which a straight finned tube 11 has been inserted diagonally, so that at the inlet end of the shell the first chamber 13 occupies the larger portion of the space available outside the finned tube, and at the outlet end the second chamber 14 occupies the larger portion of the space available outside the finned tube. This facilitates the attachment of inlet and outlet pipes 15, 16 and the pipes 15, 16 can be comparatively thick, even though the shell has a small cross-section. The finned tube 11 is also provided with an inlet pipe 17 and an outlet pipe 18 for the medium flowing through the finned tube, the inlet and outlet pipes of the finned tube, however, being reversed as compared with the corresponding pipes of the shell, so that the two mediums will flow in opposite directions through the heat exchanger. The flow directions of the mediums are indicated by arrows in Figure 1.

The heat exchanger according to the invention is intended to be used for condensing vapour. The shell of the heat exchanger is preferably designed as an upright helical coil having a steep pitch. An embodiment of this type is shown in Figure 3, where the same reference numerals as in Figure 1 have been used for the corresponding elements. The finned tube 11 has been positioned diagonally in the shell 10 in this embodiment, as in the first, so that the inlet pipe 17 of the finned tube at the outlet end of the shell is situated in the upper portion of the shell and the outlet pipe 18 of the tube at the inlet end of the shell is situated in the lower portion of the shell. Thus, the first chamber 13 of the shell is positioned above the second chamber 14. This has been found to be particularly convenient for a condensation process, because the vapour flowing through the shell efficiently contributes to the removal of the condensate from the fin surfaces, as the vapour will be flowing substantially in the same directions as the condensate, namely downwards. Because the shell 10 has been wound to form

an upright coil having a steep pitch, the condensate can be collected at the lower portion of the coil. Under these circumstances, a comparatively small volume of condensate will be sufficient for surrounding the finned tube. This will cause a supercooling of the condensate, i.e. the temperature of the condensate will be lowered below the condensing temperature, because further cooling is provided by the medium in the finned tube. An outlet 19 is provided at the lower portion of the coil for draining the condensate.

While only two embodiments of the heat exchanger according to the invention have been shown and described, it is evident that many different embodiments and modifications are possible within the scope of the invention. For example, it is not necessary for the shell to have an oval or elongate cross section. The shell could have a circular cross section, but in that case sealing elements have to be provided between the finned tube and the walls of the shell, so that two separate chambers are formed in the shell, the chambers being connected to each other only through the spaces between the fins of the tube. Such sealing elements may be used also when the shell has an oval or elongate cross section. The finned tube need not necessarily run diagonally through the shell but can alternatively run along the central axis of the shell. However, in that case the shell must be sealed at its end by special walls. In the embodiment shown in the drawings, the closure of the shell at the ends may be provided by deformation of the shell to contact the inlet and outlet pipes, the complete sealing then being provided by, for example, soldering. When the shell is wound to form a coil, the major axis of the cross section of the shell is preferably parallel to the axis of the coil, as this will make it easier to wind the coil with a small diameter. However, it is important that the lower wall of the shell has a shape that at least slightly differs from the shape of the fins, so that the condensate can flow in the shell along the full length of the shell.

Claims

1. A heat exchanger for condensing a vapour, comprising a tubular shell (10) and a finned tube (11) provided in the shell, the fins (12) of the tube being substantially perpendicular to the direction of the tube, the internal cross sectional area of the shell being larger than the area enclosed by the outer periphery of the fins (12), the arrangement being such that vapour to be condensed may pass through the shell outside the finned tube and a coolant to condense said vapour may pass through the finned tube, wherein the shell (10) is divided by the finned tube (11) into chambers which are provided on respective sides of the finned tube (11) characterised in that only two chambers (13, 14) are formed within the shell (10), the

first chamber (13) being provided above the second chamber (14), the first chamber having an inlet through which said vapour may be introduced to the heat exchanger and the second chamber having an outlet through which condensate may be removed from the heat exchanger.

2. A heat exchanger according to claim 1, wherein the shell (10) has an elongate cross sectional area and the fins (12) of the tube (11) abut two opposed walls of the shell.

3. A heat exchanger according to claim 1 or 2, wherein the shell (10) has said inlet (15) at one end and said outlet (16) at the other end, the finned tube (11) being located, at the inlet end of the shell (10), in the lower portion of the shell and, at the outlet end of the shell, in the upper portion of the shell, so that at the inlet end of the shell the first chamber (13) occupies the larger portion of the space available outside the finned tube and at the outlet end of the shell the second chamber (14) occupies the larger portion of the space available outside the finned tube.

4. A heat exchanger according to any one of the preceding claims, wherein the shell (10) is in the form of an upright coil having a steep pitch.

5. A heat exchanger according to claim 4, wherein the major axis of the cross sectional area of the shell (10) is substantially parallel to the axis of the cylindrical coil.

6. A heat exchanger according to claim 4 or 5, wherein the said inlet (15) is provided in the upper portion of the coil and an inlet (17) for the coolant into the finned tube (11) is provided in the lower portion of the coil, in which said outlet means (19) are provided.

7. A heat exchanger according to claim 6, wherein the relative shapes of the lower wall of the shell (10) of the fins (12) are such that a condensate can flow in the shell along its full length.

8. A heat exchanger according to any one of the preceding claims, wherein each chamber (13, 14) extends from one end of the shell (10) to the other end of the shell.

Patentansprüche

1. Wärmetauscher zum Kondensieren von Dampf, mit einem rohrförmigen Mantel (10), einem in dem Mantel angeordneten gerippten Rohr (11), dessen Rippen (12) im wesentlichen rechtwinklig zu der Erstreckung des Rohres verlaufen, wobei die innere Querschnittsfläche des Mantels größer ist als der von dem äußeren Umfang der Rippen (12) umschlossene Raum, und wobei die Anordnung derart ist, daß der zu kondensierende Dampf außerhalb des gerippten Rohres durch den Mantel strömen kann und ein Kühlmittel zum Kondensieren des Dampfes durch das gerippte Rohr strömen kann, wobei der Mantel (10) von dem gerippten Rohr (11) in seitlich zu dem gerippten

Rohr (11) angeordnete Kammern geteilt wird, dadurch gekennzeichnet, daß in dem Mantel (10) nur zwei Kammern (13, 14) vorgesehen sind, wobei die erste Kammer (13) oberhalb der zweiten Kammer (14) angeordnet ist, die erste Kammer einen Einlaß aufweist, durch den der Dampf in dem Wärmetauscher eingeführt werden kann und die zweite Kammer einen Auslaß aufweist, durch den das Kondensat aus dem Wärmetauscher entnommen werden kann.

2. Wärmetauscher nach Anspruch 1, wobei der Mantel (10) eine längliche Querschnittsfläche hat und die Rippen (12) des Rohres (11) zwei einander gegenüberliegende Wände des Mantels berühren.

3. Wärmetauscher nach Anspruch 1 oder 2, wobei der Einlaß (15) an dem einen Ende und der Auslaß (16) an dem anderen Ende des Mantels angeordnet ist, und das gerippte Rohr an dem Einlassende des Mantels (10) in dem unteren Abschnitt des Mantels und an dem Auslassende des Mantels in dem oberen Abschnitt des Mantels angeordnet ist, so daß die erste Kammer (13) an dem Einlassende des Mantels den größeren Abschnitt des außerhalb des gerippten Rohres verfügbaren Raumes einnimmt und die zweite Kammer (14) an dem Auslassende des Mantels den größeren Abschnitt des außerhalb des gerippten Rohres verfügbaren Raumes einnimmt.

4. Wärmetauscher nach einem der vorangehenden Ansprüche, wobei der Mantel (10) als aufrechte Wendel mit großer Steigung ausgebildet ist.

5. Wärmetauscher nach Anspruch 4, wobei die Hauptachse der Querschnittsfläche des Mantels (10) im wesentlichen parallel zu der Achse der zylindrischen Wendel ist.

6. Wärmetauscher nach Anspruch 4 oder 5, wobei der Einlaß (15) in dem oberen Abschnitt der Wendel und ein Einlaß (17) für das Kühlmittel in das gerippte Rohr (11) in dem unteren Abschnitt der Wendel, in dem das Auslassmittel (19) vorgesehen ist, angeordnet sind.

7. Wärmetauscher nach Anspruch 6, wobei die Form der unteren Wand des Mantels (10) und der Rippen (12) derart sind, daß ein Kondensat über die volle Länge des Mantels in diesem fließen kann.

8. Wärmetauscher nach einem der vorangehenden Ansprüche, wobei jede Kammer (13, 14) sich von dem einen Ende des Mantels (10) zum dem anderen Ende des Mantels erstreckt.

Revendications

1. Echangeur de chaleur pour condenser une vapeur, comprenant une enveloppe tubulaire (10) et un tube à lamelles (11) disposé à l'intérieur de l'enveloppe, les lamelles (12) du tube étant sensiblement perpendiculaires à la direction du tube, la surface de la section transversale interne de l'enveloppe étant plus grande que la surface délimitée par le bord externe des lamelles (12), la disposition étant telle que de la

vapeur à condenser puisse passer dans l'enveloppe à l'extérieur du tube à lamelles et qu'un réfrigérant pour condenser la vapeur puisse passer dans le tube à lamelle, où l'enveloppe (10) est divisée par le tube à lamelle (11) en chambres qui sont disposées sur des côtés respectifs du tube à lamelles (11) caractérisé en ce que seulement deux chambres (13, 14) sont formées dans l'enveloppe (10), la première chambre (13) étant disposée au-dessus de la seconde chambre (14), la première chambre ayant un orifice d'entrée à travers lequel la vapeur peut être introduite dans l'échangeur de chaleur et la seconde chambre ayant un orifice de sortie à travers lequel du condensat peut être retiré de l'échangeur de chaleur.

2. Echangeur de chaleur selon la revendication 1 où l'enveloppe (10) a une surface en coupe transversale allongée et les lamelles (12) du tube (11) sont en butée sur deux parois opposées de l'enveloppe.

3. Echangeur de chaleur selon la revendication 1 ou la revendication 2 où l'enveloppe (10) a l'orifice d'entrée (15) à une extrémité et l'orifice de sortie (16) à l'autre extrémité, le tube à lamelles (11) étant disposé à l'extrémité d'entrée de l'enveloppe (10), dans la partie inférieure de l'enveloppe et, à l'extrémité de sortie de l'enveloppe, dans la partie supérieure de l'enveloppe, de sorte qu'à l'extrémité d'entrée de l'enveloppe la première chambre (13) occupe la plus grande partie de

l'espace disponible à l'extérieur du tube à lamelles et à l'extrémité de sortie de l'enveloppe, la seconde chambre (14) occupe la plus grande partie de l'espace disponible à l'extérieur du tube à lamelles.

4. Echangeur de chaleur selon l'une quelconque des revendications précédentes où l'enveloppe (10) a la forme d'une hélice verticale ayant un pas élevé.

5. Echangeur de chaleur selon la revendication 4, où l'axe principal de la surface de la section transversale de l'enveloppe (10) est sensiblement parallèle à l'axe de l'hélice cylindrique.

6. Echangeur de chaleur selon la revendication 4 ou la revendication 5 où l'orifice d'entrée (15) est réalisé dans la partie supérieure de l'hélice et un orifice d'entrée (17) pour le réfrigérant dans le tube à lamelles (11) est réalisé à la partie inférieure de l'hélice dans laquelle l'orifice de sortie (19) est réalisé.

7. Echangeur de chaleur selon la revendication 6 où les configurations relatives de la paroi inférieure de l'enveloppe (10) et des lamelles (12) sont telles qu'un condensat peut s'écouler dans l'enveloppe sur toute sa longueur.

8. Echangeur de chaleur selon l'une quelconque des revendications précédentes où chaque chambre (13, 14) s'étend depuis une extrémité de l'enveloppe (10) jusqu'à l'autre extrémité de l'enveloppe.

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Fig. 1

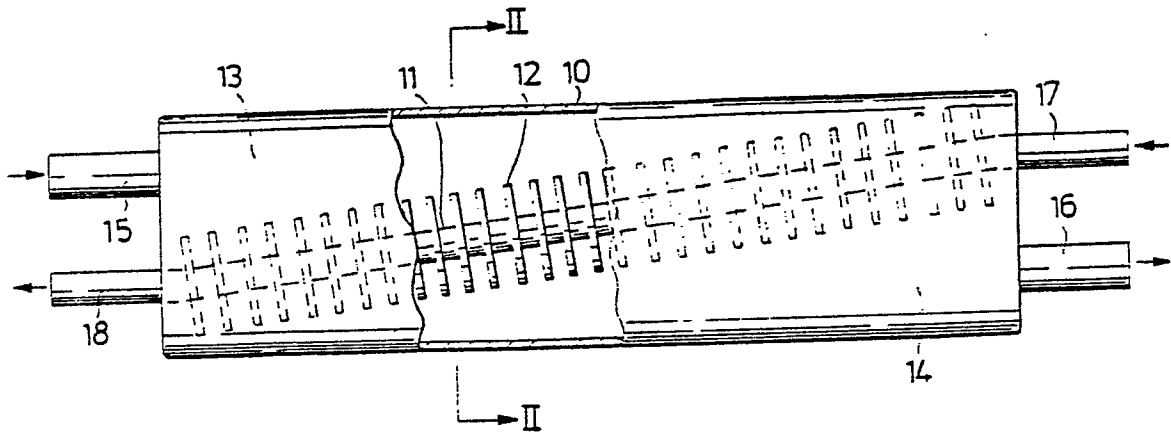


Fig. 2

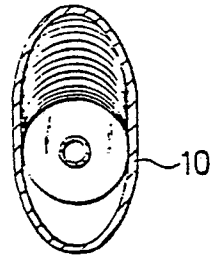


Fig. 3

