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HEAT EXCHANGER HAVING A FILLING OF ROLLING OR TUMBLING BODIES AND METHOD FOR THE OPERATION THEREOF

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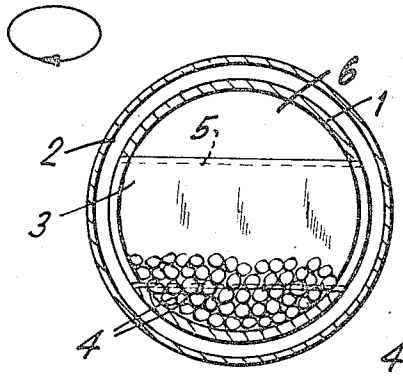


FIG. 2

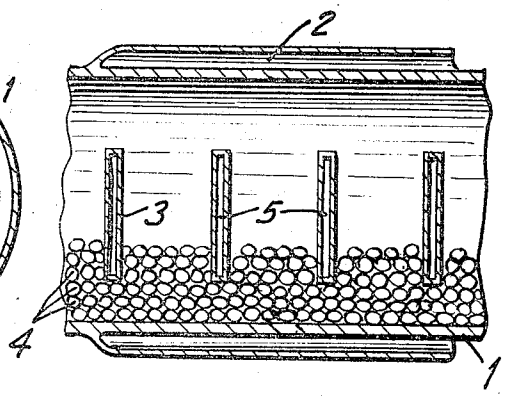


FIG. 1

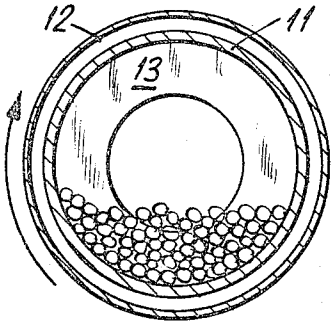


FIG. 4

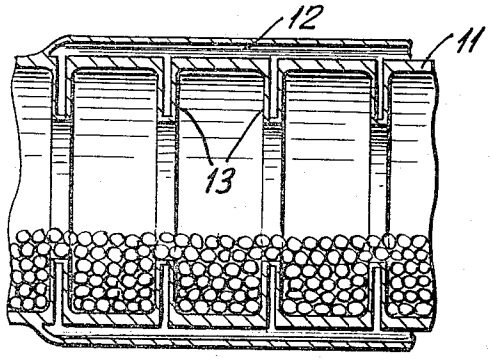


FIG. 3

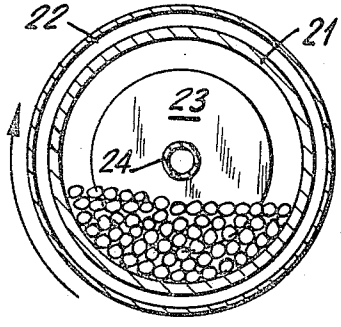


FIG. 6

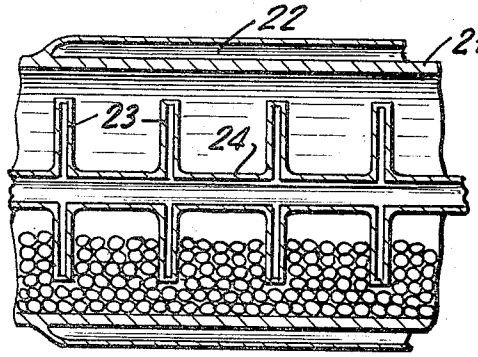


FIG. 5

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HEAT EXCHANGER HAVING A FILLING OF ROLLING OR TUMBLING BODIES AND METHOD FOR THE OPERATION THEREOF

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3 Claims. (Cl. 165—90)

This invention relates to a heat exchanger having a filling or rolling or tumbling bodies and to a method for the operation thereof.

Apparatuses having a filling or rolling or tumbling bodies were originally used only for the grinding of the moist various products in a dry or in a wet-pulpy condition. This universal utility with different states of aggregation has meanwhile also led to utilization in drying and reaction processes. It was here repeatedly found to be a disadvantage that the thermal transmission areas in such apparatuses are only very limited. In the case of relatively great thermal effects therefore recourse must be made to auxiliary means. For example in the case of drying processes a hot gas current is conducted through the ball mill, in order to supply the necessary quantity of heat. In the case of reaction processes it is necessary, for relatively great thermal effects, to conduct the rolling bodies also out of the apparatus with the product, to heat them up again outside and to pass them with the product into the apparatus again. Since the balls must be cleaned again in the heating up, the utilization of such apparatus for reactions hitherto is limited.

According to the present invention a heat exchanger is provided for liquid, pasty and granular materials, which heat exchanger comprises a housing with a filling or rolling bodies. The invention consists in that for the regulation of the thermal transmission areas there are provided heated, rib-like surfaces protruding into the rolling bodies filling, along which the rolling bodies move past, being cleaned at the same time.

The method for the operation of the heat exchanger consists in that in addition to the movement of the rolling bodies in the interior of the housing, they are brought constantly into circulating movement out of the housing and into it again, the rolling bodies being heated or cooled in their path outside the housing.

The invention will be further explained hereinafter with reference to examples of embodiment of the object thereof which are illustrated in the accompanying drawings, wherein:

FIGURE 1 shows a longitudinal section through an oscillatory mill,

FIGURE 2 shows a cross-section through this oscillatory mill,

FIGURE 3 shows a longitudinal section through a ball mill with annular heat transmission ribs,

FIGURE 4 shows a cross-section of FIGURE 3,

FIGURE 5 shows a ball mill with smooth outer wall and the arrangement of the heat-transmitting plates on a central tube and

FIGURE 6 shows a cross-section through this ball mill.

In the drawings, the oscillatory mill as illustrated in FIGURES 1 and 2 comprises a cylindrical housing **1** with a heating jacket **2**. The housing **1** is divided by plates **3** into individual chambers, which in turn are filled with suitable rolling bodies **4**, for example balls or rolls. The plates **3** are hollow, and the cavities **5** are connected with the heating jacket **2** of the housing **1**, and thus also conduct heat. The plates **3** have apertures **6** which provide a possibility of levelling for the rolling bodies. Moreover

the product can run through the entire arrangement and provision is also made for withdrawal of gas if necessary.

The housing **1** is provided with an entry pipe, with an outlet pipe and with a gas-withdrawal pipe, which parts are not represented in the drawing. The rolling bodies **4** are set, by a suitable oscillatory drive, mostly into a circular oscillation perpendicular of the longitudinal axis of the apparatus, in which case according to experience a vigorous radial movement of the rolling bodies takes place in the apparatus. If now the raw material or materials is or are introduced, for example in liquid form, into the apparatus, the product will firstly fill the apparatus, in order then to flow out by way of an overflow at the outlet pipe, so that a continuous through-flow occurs. The product is here conducted past the heat-transmitting surfaces of the housing **1** and the plates **3**, it being possible for heat to be supplied or equally removed by cooling through these surfaces. The vigorous movement of the product by the rolling bodies and the constant cleaning of these surfaces on the one hand permit good thermal transmission and on the other hand prevent the possibility of the material caking in certain plastic states of aggregation. The manner of the working through of the product by the movement of the rolling bodies prevents blockage even if the product is plastic. Therefore apart from reaction processes it is also possible for every kind of drying process to be carried out without difficulty, in which the product is dried from the liquid condition, with constant expulsion of the liquid vapour, by way of the plastic condition to the dry or granular condition at the discharge.

A further embodiment of the object of the invention is represented in FIGURES 3 and 4. In these there is illustrated a ball mill with rotating housing. The cylindrical housing is designated by **11**, and carries a heating jacket **12**. In the housing **11** there are installed annular ribs **13** with heated cavities, as additional heat transmitting surfaces. The supply and removal of the products take place in known manner through the shaft journals of the ball mill.

FIGURES 5 and 6 show a ball mill in which additional heat transmitting surfaces **23** of disc form are arranged on a central tube **24** in a housing **21** with heating jacket **22**. This tube **24** rotates together with the housing **21**. According to a variant it is possible to make the housing **21** stationary and to arrange the central tube **24** with the discs **23** for rotation therein as agitator. Due to the arrangement of appropriate transverse bars it is ensured that the rolling bodies filling is circulated between the discs.

Moreover a combination of annular heat transmission surfaces arranged on the housing of the ball mill and the discs on the central tube is also possible.

The heating or cooling of the heat exchangers can take place with gaseous or with liquid media: the installation of a furnace chamber is also readily possible for higher temperatures.

In a further development of the heat exchanger as described, the rolling bodies carry out, in addition to the movement in the interior of the housing, a movement outside the housing. They are continuously withdrawn from the housing and brought in a cycle into the housing again, the rolling bodies being heated or cooled according to the need in their path outside the housing.

Various modifications may be introduced without departing from the invention as defined in the appended claims, and where the context permits it the term "heated" as used herein is to be construed as meaning "either heated or cooled according to whether it is desired to raise or lower the temperature of materials in the heat-exchanger."

What I claim is:

1. A heat exchanger for liquid, pasty and granular materials, which comprises a housing having a material inlet, a material outlet and a gas withdrawal outlet, and displaceable about its longitudinal axis; a filling of rolling bodies in said housing; heat exchange means operatively associated with said housing to exchange heat with the latter; heat transfer ribs extending within said housing and into said filling and in heat exchange relation with said heat exchanging means, said heat transfer ribs augmenting the heat transmission surfaces effective on the material; said rolling bodies, upon displacement of said housing about its longitudinal axis, being displaced along the surfaces of said ribs to effect a cleaning action on the same.

2. A heat exchanger according to claim 1, in which said housing is divided by radially installed heated plates into chambers which are in communication with one another through apertures in the plates, said plates constituting said heat transfer ribs; the rolling bodies being

set in motion by oscillation of said housing about its longitudinal axis.

3. A heat exchanger according to claim 1, in which said housing is made in drum form and has annular heat transfer ribs secured on the inner surface of its cylindrical wall; the rolling bodies being set in motion by rotation of the drum.

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