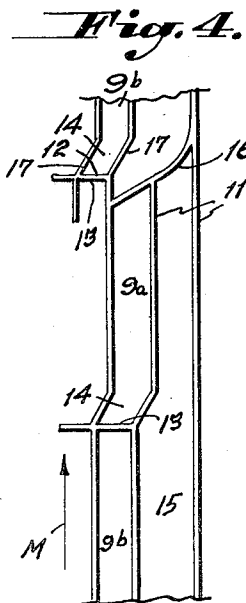
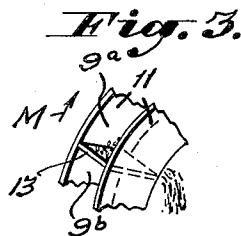
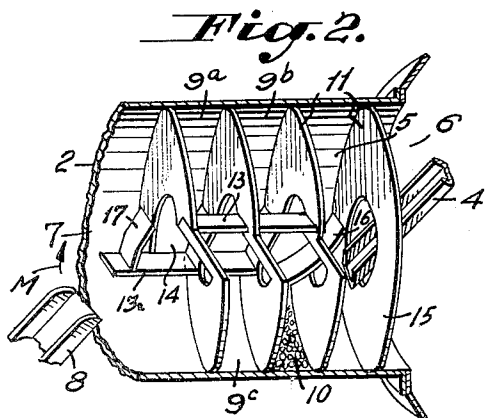
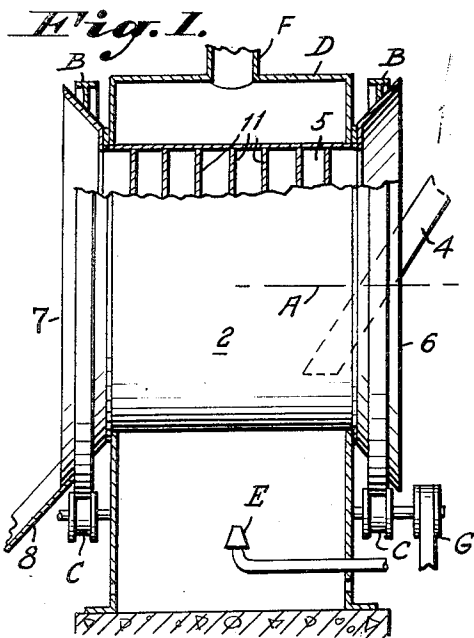


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HEAT EXCHANGER FOR CONTINUOUS TREATMENT
OF FLUENT MATERIAL
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HEAT EXCHANGER FOR CONTINUOUS
TREATMENT OF FLUENT MATERIALJohn Ernest Laschinger, Johannesburg,
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1 Claim. (Cl. 257—88)

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This invention relates to heat exchangers for continuously effecting heat exchange to or from a stream of material that is fluent in bulk; such as granular solid material or material in which the characteristics of a liquid are more highly developed.

The object of the invention is to approximate closely to the condition that every small element of the stream is equally exposed to the heat exchanging influence for an equal period of time; and thereby produce a product of a homogeneous character throughout, notwithstanding that the material, for instance vermiculite undergoing expansion, is sensitive to both temperature and time of heating. The attainment of this object is promoted by subdividing the stream into small batches which are passed through the heat exchanger successively and in isolation from one another and in equal time periods; and by frequently agitating the contents of each batch in a manner calculated to give all its small elements equal exposure to the heat exchanging influence.

A heat exchanger for the continuous treatment of material fluent in bulk comprising a heat conductive rotatable drum which is impermeable to said material, means for keeping said drum at a predetermined temperature, a plurality of substantially semi-annular plates dividing each of the opposite longitudinal halves of said drum into a series of semi-circumferential compartments each of which is axially displaced from the corresponding compartment of the opposite series and is open towards said compartment; a lifting member comprising a shelf which is fixed on the base and across the width of the trailing end of each compartment and whereon material after agitation and heat exchange in dispersed condition in said compartment is collected and lifted as said member moves upward, a forwarding member comprising slanting walls at said trailing end of each compartment in advance of said shelf whereby said shelf will be positioned in the plane of the adjacent compartment in the opposite half of said drum and said material lifted by said shelf will be discharged on further movement of said drum directly into said adjacent compartment, means for delivering said material into the first compartment of said drum once in every revolution thereof in successive batches, and driving means for rotating said drum that each said batch is separately dispersed, agitated and subjected to heat exchange and then transferred into the adjacent opposite compartment, progressively along the whole of said drum.

A feeding device places a single batch of the

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material in the first compartment of the series, once in every revolution of the rotary conveyor; and each such single batch is passed through all the compartments of the series in succession, so that assuming uniform rotation, each batch remains in the heat exchange zone for the same period of time. Another result is that during the normal operation of the heat exchanger the conveyor is always transporting a number of batches.

The trailing end of each compartment forms a scoop that lifts the batch in the compartment when said trailing end is on the rising side of its orbit; and each compartment is so shaped as to cause its batch, upon being thus raised, to fall out of and away from the compartment.

By keeping the batches small, the time periods of conveyance of their constituent small elements are approximated closely to that of the batches themselves. The interruption of the relatively quiet heat transfer to or from the batches by a succession of falls causes all the small elements of each batch correspondingly to be subject to frequent changes of position in the batch, which is conducive to equalizing their exposure to the heat exchanging influence.

The importance of isolating the batches lies in preventing the small elements of the batches from escaping from the control that determines their time period in the heat exchanger. The isolation is commenced by the feeding means which may itself cut the successive batches from the stream of material and which feeds one batch per revolution into the initial compartment of the series. The isolation is thereafter maintained by two means: firstly by the structure of the compartments being such as to isolate the batches while they are within the compartments; and secondly by the means that prescribes the transfer paths for the batches while the latter are moving from each compartment to the next of the series. These two means are interdependent; their construction and arrangement being such that they co-operate with one another.

Regarding the construction of the compartments, they are preferably formed in the known manner by structure on the interior of a rotating drum so that the latter forms part of the compartment structure and is available to conduct heat to or from the material in the compartments. The compartments thus constructed are of arcuate shape. Their circumferential walls that divide one compartment from that or those on either side of it or them in the axial direction

are provided by annular partitions of plate material extending from the drum wall towards the axis. The result in practice is that the compartments may be regarded as curved troughs with open mouths that are directed towards the axis and are inverted once per revolution of the drum. Each partition may approximate to a circular plate occupying most of the cross section of the drum, and it is preferred to cut out the centre of the plate, so that in all cases an end view shows an open axial channel extending completely through the drum; which channel is useful for such purposes as passing off moisture vaporized when the material is heated: for visual inspection of the material in the drum; and if desired for the introduction of heating gas or accommodating a radiating element.

As regards the structure that determines the transfer path along which a batch is transferred from one compartment to the next advanced compartment of the series, the means prescribing the transfer path is divided into two parts, one of which imposes on the material under transfer the axial or advancing component of its movement, and the other of which controls the descent of the material and in particular so controls it that the material can be poured as a more or less free cascade without danger of its being received into other than the next advanced compartment.

In general, the transfer path and the compartment structure are such that each batch, after being received in a compartment, remains on the orbital bottom of said compartment during a substantial part of the rotation of the latter so that the batch is exposed to quiet heat transfer by contact with the outer wall; and so also that the relative movement between compartment and batch causes a mild agitation of the batch. The circumferential extent of the compartment structure is a factor in safeguarding isolation of each batch from all preceding or following batches during the period of such relative movement.

An example of a heating furnace according to the invention for treating fluent material is described with reference to the accompanying drawing, in which

Figure 1 is a side elevation partly in section,

Figure 2 is a perspective view of the internal arrangement, with the drum partly broken away,

Figure 3 is a view seen in the direction of the axis of part of Figure 2, and

Figure 4 is a developed view of the feed division and two compartments of the Figure 2 furnace.

In the drawings, 2 designates a drum barrel positioned with its axis A horizontal. The drum is provided with circular treads B rotatably supported on rollers C. The drum is rotated constantly in the direction of the arrow M by driving means G. The barrel of the drum 2 is enclosed within a furnace casing D and is heated by fuel burnt at E in the lower part of the casing. Products of combustion pass away through the chimney F. The fluent material to be subjected to furnace treatment is fed by a launder 4 to a batch making section 5 of the drum at the feed end 6 thereof; and the treated material is gravitationally discharged from the delivery end 7 of the drum to a receiver 8. 11 designates a number of partitions providing compartments extending in planes materially traverse to the axis A and spaced along the length of the drum.

The compartments above mentioned are provided by annular partition walls 11 with their central areas cut away at 11a.

In the interior of the furnace, there is a single

series of compartments indicated by 9a, 9b . . . and so on. Each compartment is an open trough of about 180° circumferential extent; this being an extent that allows the fluent material fed into the furnace to lie for a period as a free mass in the bottom of the compartment and in contact with the drum wall, as indicated at 10. While lying there the mass is not inert, but is subjected to advantageous agitation by the drag of the relatively moving drum wall.

A pair of compartments is shown separately in Figure 4. The greater part of the circumferential extent of each compartment lies in a vertical plane, between the partition walls 11 each of which is in a single vertical plane; and the whole extent of that greater part is thus available, when at the lower position of its orbit, to receive material poured into it from a higher point in said plane. The scoop end 12 of each compartment is constituted partly by the shelf 13 that is preferably tilted upwardly and inwardly with reference to the drum wall when on the rising side of the drum, and partly by the partition walls on each side of the shelf.

The direction of advance of the series is axial, and the magnitude of each step of advance is half the axial width of the compartments. The means for imparting this axial advance to the material is provided by the trailing end 14 of each compartment, immediately before the lifting shelf 13. This trailing end is slanted forward with reference to the direction of the rotation so as to bring the shelf 13 into the plane of the next compartment. That is to say, the shelf 13 of compartment 9a is in the plane of the greater part of compartment 9b.

The batch making feed end 5 consists of a completely annular trough 15 into which the spout 4 delivers constantly. At one circumferential point of said trough is the scoop 16 that during its rotation gathers up, as a single batch, all the material that has been fed into the trough during a revolution; then, acting like the shelves 13 lifts the gathered batch and tips it to fall into the bottom of the first compartment 9a of the series.

The batch remains in the bottom of said compartment 9a as indicated by 10, during a considerable part of one half revolution of the drum. Thereafter the walls 17 of the slanting trough portion 14 come round and shift the batch axially forward, so that the batch is now in the plane of the next compartment 9b. Immediately thereafter the first shelf 13 comes round and collects and raises the batch at the upgoing side of the drum. As the trailing end of the compartment 9a turns over to about the position shown in Figure 2, the batch begins to shower out of said trailing end and falls into the right-plane portion of the next trough 9b which is then vertically under it. In order to confine the cascading material within the vertical planes limiting said right-plane portion, the shelf 13 is made wholly parallel with the axis.

The batch remains in compartment 9b, sliding in the bottom portion thereof, until the shelf at the trailing end of compartment 9b in turn comes round and begins to lift the batch. While this has been going on another batch has been collected in 15 and is cascaded into the first compartment 9a at the moment that the first batch begins to fall from said shelf at the trailing end of compartment 9b, and into the bottom of compartment 9c.

The means prescribing the isolating transfer

path are thus in combination, the long circumferential extent of each of two consecutive compartments: the slanted portion 14; and the arrangement of the shelf 13 that causes the batch to fall in the plane of the greater part of the next following compartment.

A fresh batch is formed and delivered to the first compartment once per revolution of the drum; so that during the regular operation of the furnace, all the compartments which are in the angular position in which they can be occupied are occupied, each with its separate batch.

I claim:

A heat exchanger for the continuous treatment of material fluent in bulk comprising a heat conductive rotatable drum which is impermeable to said material, means for keeping said drum at a predetermined temperature, a plurality of substantially semi-annular plates dividing each of the opposite longitudinal halves of said drum into a series of semi-circumferential compartments each of which is axially displaced from the corresponding compartment of the opposite series and is open towards said compartment; a lifting member comprising a shelf which is fixed on the base and across the width of the trailing end of each compartment and whereon material after agitation and heat exchange in dispersed condition in said compartment is collected and lifted as said member moves upward, a forwarding member comprising slanting walls at said trailing end of each compartment in advance of said

shelf whereby said shelf will be positioned in the plane of the adjacent compartment in the opposite half of said drum and said material lifted by said shelf will be discharged on further movement of said drum directly into said adjacent compartment, means for delivering said material into the first compartment of said drum once in every revolution thereof in successive batches, and driving means for rotating said drum so that each said batch is separately dispersed, agitated and subjected to heat exchange and then transferred into the adjacent opposite compartment, progressively along the whole of said drum.

JOHN ERNEST LASCHINGER.

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