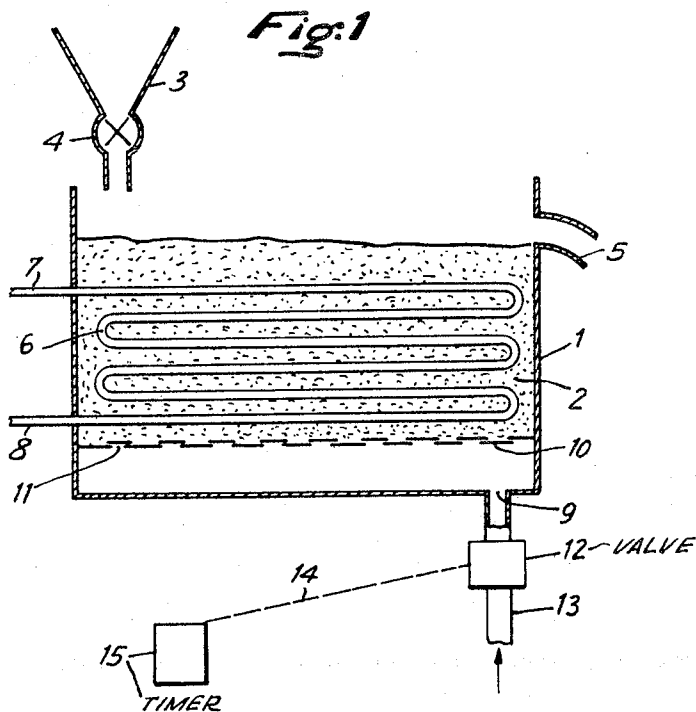
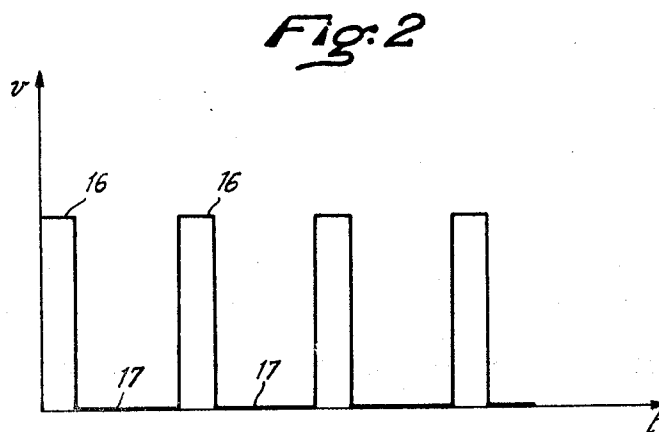


March 29, 1966

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3,242,974

METHOD OF HEAT EXCHANGE BY MEANS OF A SURFACE BETWEEN
FLUIDS ON THE ONE HAND AND GRANULAR OR POWDERED
MATERIALS ON THE OTHER HAND
Filed Feb. 12, 1962



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METHOD OF HEAT EXCHANGE BY MEANS OF A SURFACE BETWEEN FLUIDS ON THE ONE HAND AND GRANULAR OR POWDERED MATERIALS ON THE OTHER HAND

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Filed Feb. 12, 1962, Ser. No. 172,742

Claims priority, application France, Feb. 14, 1961, 852,682

2 Claims. (Cl. 165—1)

The present invention is concerned with a method of heat exchange by means of a surface between fluids on the one hand and granular or powdered materials on the other hand.

A problem which is frequently met with is the industrial need to exchange heat between on the one hand a heating or cooling fluid such as gas, vapor, liquid and, on the other hand, a solid material to which it is desired to make an addition or removal of heat, either with a view to increasing or decreasing the temperature thereof, or with a view to ensuring the performance of an endothermic or exothermic process at the center of the material during a treatment of this latter, or alternatively with a view to producing both the above actions combined. When it is desired at the same time that the transmission of heat should be effected without any contact with the heating or cooling agent, there is interposed between the treated material and the said agent a fluid-tight surface which serves as a heat-exchanging means. It is known that when the material subjected to treatment is granular or powdered, the intensity of heat exchange is an increasing function on the one hand of the density of the material in contact with the exchange surface and, on the other hand, of the frequency of renewal of the grains of material in contact with the said surface.

There exists a large number of devices for effecting such exchanges. Certain devices ensure the necessary relative movements between the material and the exchange surface by making use of mechanical means for producing movement either of the said material or of the said surface. Another device makes use of the continuous fluidization of the material by means of a gas in order to produce the movement of the material around the stationary exchange surface which is placed in the bed of fluidized material. This latter device has had very few applications up to the present time despite the remarkable simplicity which it offers.

One of the disadvantages which it involves consists in the fact that it is necessary to pass a substantial quantity of fluidization gas through the mass of material in order to maintain this latter in the fluidized state, thereby entailing a considerable expenditure of energy and substantial secondary effects which are in proportion to the quantity of the said fluidization gas. Moreover, the fluidized state of the material entails the disadvantage that this latter is not in a state of maximum density when in contact with the exchange surfaces. Lastly, this method does not permit of satisfactory flexibility of variation of intensity of the heat exchange, since the movement of the material is governed by the requirements of appropriate maintenance of the fluidization, thereby permitting only a very small margin of latitude in the variation of movements of the material.

The object of the present invention consists in the practical application of a method of heat exchange by means of a surface between fluids on the one hand and granular or powdered materials on the other hand, which comprises in practice the simplicity of continuous fluidiza-

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tion systems while at the same time reducing the disadvantages thereof.

This method differs from that in which the continuous fluidization process is employed inasmuch as the fluidization gas is injected in a pulsatory manner, that is to say by pulses which are repeated periodically and the frequency of which can be referred to as the "fluidization frequency" and inasmuch as, during the time of each pulse corresponding to a fraction of the total period, the injection is effected at an instantaneous velocity which is either similar to or higher than that of the injection carried out in continuous fluidization while the remainder of the period does not comprise any injection of fluidization gas.

In another form of practical application of the method, the variability of the fluidization frequency is achieved.

In yet another form of practical application of the method, the variability of the pulse time is achieved.

In a further form of practical application, the simultaneous variability of the fluidization frequency and of the pulse time is achieved.

In order that the invention may be clearly understood, there follows below a description of one form of execution which is given solely by way of example without implied limitation, reference being made therein to the accompanying drawings, in which:

FIG. 1 is a diagrammatic view of the installation;

FIG. 2 is a diagrammatic graph showing the variation of velocity of the fluidization gas injected as a function of time.

In FIG. 1, the reference 1 designates the vessel which contains the material 2 under treatment, the supply of the said material being effected at one end of the said vessel from a hopper 3 through the intermediary of a supply distributor 4. The outlet of the treated material has been illustrated in the form of an overflow 5 located near the top of the vessel at the end opposite to the hopper 3.

The heat exchange surface, for example a heating surface, has been shown on the drawings in the form of a coil 6 which is arranged at the center of the material 2 and through which the heating fluid circulates. The ends of the said coil pass through a wall of the vessel and the extended portions 7 and 8 of the said coil-ends are intended to be connected respectively to a pipe for the supply of the heating fluid and a pipe for the return of the said heating fluid.

The injection of the fluidization gas is provided for at 9 at the base of the vessel beneath a distribution plate 10 in which are formed staggered passages 11. This injection is carried out through a valve 12 which is supplied at 13 with the fluidization gas. A broken line 14 has served in the drawings to represent diagrammatically the control of the valve 12 by means of a timing mechanism or timer 15 which ensures that the injection is carried out under the conditions desired.

The graph of FIG. 2 represents diagrammatically the velocity v of the fluidization gas admitted as a function of the time t . In accordance with the example given, the injection is effected by periodic pulsations which comprise relatively short injection periods 16 alternating with longer stationary periods 17. The length of the total period of time which comprises an injection period and a stationary period can vary to a considerable extent depending on the applications, for example from a few seconds to one minute or more.

As a specific example of the present method, the total period of a cycle comprising both the pulse period and the stationary period for the fluidization gas may be two seconds with the pulse period alone being 0.3 second and the velocity of the fluidizing gas being 20 centimeters per second when treating a material having 35% of the

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particles smaller than 100 microns and 25% of the particles larger than 200 microns while all the particles are smaller than one millimeter and have a specific weight of approximately 2.5 kilograms per cubic decimeter.

I claim:

1. A method of heat exchange between a granular or powdered material and a fluid consisting in confining the material to be treated in a normally compact state in a given area, separating said material from a fluid by a fixed heat exchange surface, intermittently injecting a fluidizing gas into said material in pulses of said gas for intermittently fluidizing said material only during each injection pulse of said gas and timing said gas injection to allow said material to return to a compact state between said injections of said gas.

2. A method of heat exchange between a granular or powdered material and a fluid consisting in passing the material to be treated into and from a given area with said material assuming a normally compact condition

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when stationary in said area, passing a fluid into and from said area while separated from said material by a fixed heat exchange surface, and injecting periodic pulsations of a fluidizing gas into said material alternately moving and fluidizing said material along said heat exchange surface between stationary compact periods of said material.

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