Oct. 4, 1938. H. C. AMME 2,131,929

HEAT EXCHANGE SURFACE

Filed April 7, 1934

Fig. 1

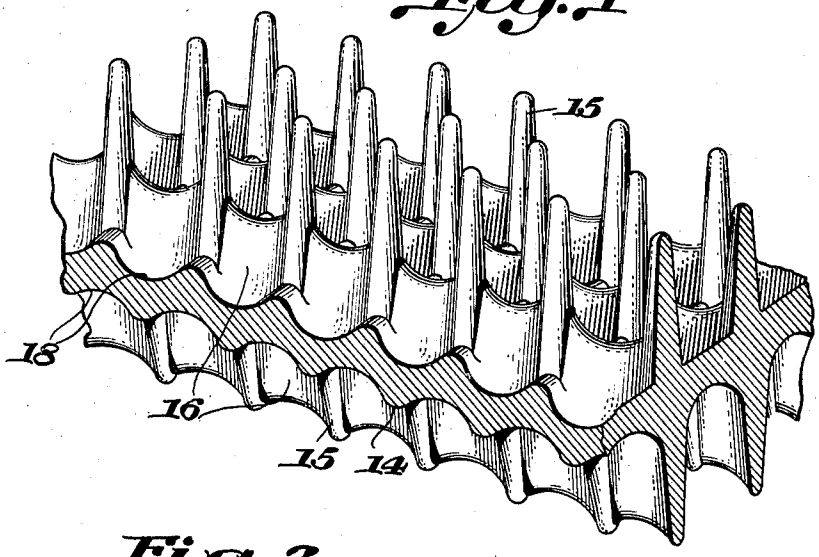


Fig. 2.

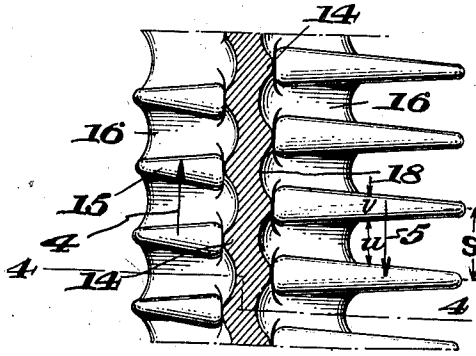


Fig. 3.

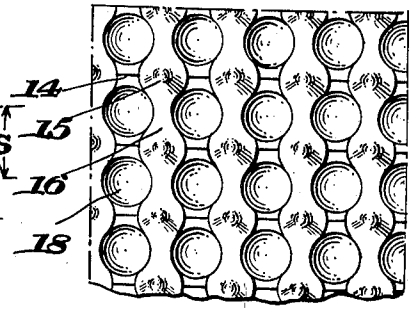
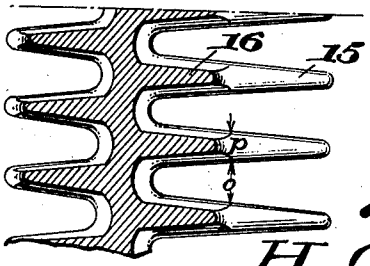


Fig. 4.



Inventor,
H. C. Amme
By Glascock Downing & Seibold
Attys.

Patented Oct. 4, 1938 2,131,929

UNITED STATES PATENT OFFICE

2,131,929

HEAT EXCHANGE SURFACE

Hermann Carl Amme, Dusseldorf, Germany

Application April 7, 1934, Serial No. 719,575
In Switzerland April 13, 1933

7 Claims. (Cl. 257—263)

This invention relates to a novel construction of heat exchange surfaces.

It is already known to provide heat exchange surfaces with projections of various kinds in order to obtain improved transmission of heat.

According to the invention it is possible by suitably constructing and dimensioning these projections to increase the amount of heat transmitted to an extent which has not hitherto been known. The applicant has discovered, more particularly, that the amount of heat transmitted can be increased very considerably, for example, 5-fold or even to a greater extent if the heat exchange surfaces along which the substances, for example gases, vapours or liquids, flow are provided with projections extending across the path of flow which are repeated one behind another in the direction of flow and are constructed and dimensioned in a particular manner. The applicant has discovered that the amount of heat transmitted in general becomes less the longer a particle of the flowing substance remains in contact with the surface. On the other hand, an essential improvement of the heat transference can be obtained when steps are taken to procure repeated interruption of the contact of each particle of the flowing substance with the wall, that is, when the particles flowing along the surface are removed from the wall and return to it again at short intervals of time. Such a repeated lifting or changing of the direction of the flowing particles is obtained by the projections on the heat transferring surface, which, according to the invention, are arranged across the direction of flow and are constructed, for example, in the form of ribs or fins suitably dimensioned and spaced with respect to each other. It has been found that the heat transference is considerably increased when the spaces or chambers between these projections interrupt the normal path of flow of the fluid to such an extent that the length of the wall surface which is not in contact with the streamlines of the fluids is 0.3 to 4 times as great as the length of the contacting wall surface; it thus is a question of bringing the length of the interruption path into a proportion lying within definite numerical limits with respect to the length of the contacting path of each particle of material.

The projections may be shaped in various ways. It is possible to use, for example, in addition to the projections running across the flow of fluid also projections in the form of ribs or fins which extend in the direction of flow, that is, at right angles to the first-mentioned ribs or obliquely thereto. The projections may further be, for example, of annular shape or in the shape of a 4-sided walk. When using intersecting projections, the projections at the points of intersection may be provided with extensions in the form of pins. The contacting path is then formed by the thickness of the projections past which particles flow and the interrupted path is formed by the distance between two projections lying one behind the other in the direction of flow. Preferably the projections in the form of ribs or fins protruding from the surface will be of a height of at most 40 mm. and they will be arranged in the direction of flow, as seen across this direction, at intervals of at most 100 mm. The length of the pins, on the other hand, may amount to 100 mm. It has been found very suitable to make the projections tapered, as is the case, for example, with pins and also to offset the projections. Preferably the projections and the surface are made in one piece, for example in the form of a casting, or are metallically secured to the surface, for example, by soldering or welding.

The complete separation of the flow obtained according to the invention behind the projections with the formation of a small hollow space in which the flow does not touch the wall gives, apart from the increase in the amount of heat transferred, the advantage that the surface will largely cleanse itself from soot, ash, dust and so forth. This gives the advantage that apparatus in which the new construction of the heat transferring surface is used can be kept in use longer than has hitherto been the case without special cleaning measures but with a constant output.

The above-mentioned intersecting form of the projections which is obtained, for example, by arranging ribs or fins in the direction of flow of the material and across the same gives the advantage that the heat exchanging surface is increased. It can further be of advantage, for example, in regenerative heat exchanging apparatus in which the two substances exchanging heat flow one after the other over the same side of the wall but in intersecting directions.

The staggering of the projections on the same side of the wall favours the mixing of cooler and warmer parts of the flowing substance. Further, there is the advantage of diminished soiling of the projections by the flow. If the projections are staggered on the two opposite surfaces of the wall in many cases a saving in con-

structional material is obtained since the chambers on one side of the wall coincide with the projections on the other side of the wall so that the whole wall is of smaller weight.

The invention is illustrated in the accompanying drawing, in which:—

Fig. 1 is a fragmentary perspective view of one form of the invention;

Fig. 2 is a longitudinal section through the arrangement shown in Fig. 1;

Fig. 3 is a plan view of the arrangement shown in Fig. 2 as viewed from the left and,

Fig. 4 is a section on the line 4—4 of Fig. 2.

Referring more particularly to the drawing, there is provided a heat interchanging surface or wall 1 which is provided on both sides with staggered projections in the form of ribs or fins 14 extending at right angles to the plane of the wall. The ribs 14 extend transversely to the direction of flow of the heat exchanging substance which is indicated by the direction of the arrows 4 and 5. The substance flows on both sides of the wall. On the transverse ribs 14, pins 15 are arranged which may be interconnected partly or wholly by means of intermediate or longitudinal ribs 16. The transverse ribs 14 extend between every two pins 15. Between the pins 15 there are also the intermediate or longitudinal ribs 16 in the direction of flow. The gases flow over and through the spaces or depressions 18 bounded by the transverse ribs 14 and the longitudinal ribs 16.

It is to be noted that the projections and pins are arranged one behind another in the direction of flow and are so constructed and arranged at such distances apart that the length of the direction between the pins is 0.3 to 4 times as great as the surfaces of the pins in contact with the stream lines.

It is also to be noted that the projecting pins 15 are arranged at the points of intersection of the transverse ribs 14 and the longitudinal ribs 16.

Incidentally in the form illustrated it is apparent that the transverse and longitudinal ribs extend from both sides of the surface 1 and are offset or staggered relative to each other.

For better illustration, the distance V represents the contacting path; the distance U represents the interrupted path, while the distance S represents the sum of the two paths U and V. Also, in the drawing, Fig. 4, o designates the opening between two projections and p the thickness of the projection in a plane transverse to the flow.

It is believed that in view of the foregoing that a further detailed description of the invention is entirely unnecessary. Likewise, it is believed that the advantages of the invention will be readily apparent.

Having thus fully described the invention what is claimed as new and desired to be secured by Letters Patent is:

1. A heat transference surface having projections arranged transversely to the flow and positioned successively one behind the other in the direction of flow and arranged so that the surface not in contact with the fluid stream is from 0.3 to 4 times the length of the contacting surface, the projections being in the form of intersecting ribs and the points of intersection being formed with projecting pins.

2. A heat transferring surface having ribs extending transversely to the direction of flow and arranged successively one behind the other, and spaced pins integral with the ribs at the point of juncture of the ribs with the surface and projecting beyond the outer edges of the ribs and between which the flow passes.

3. A heat transferring surface according to claim 2, characterized by the fact that fins extending in the direction of flow are arranged between the pins.

4. A heat transferring surface having ribs extending transversely to the direction of flow and arranged successively one behind the other and also having longitudinal ribs intersecting the transverse ribs, and pins integral with the ribs at the points of intersection and projecting beyond the outer edges of the ribs and between which the flow passes.

5. A heat transferring surface according to claim 2, characterized by the fact that the ribs and pins extend from both sides of the heat transferring surface and are offset relatively to each other.

6. A heat transferring surface as claimed in claim 4, in which the transverse and longitudinal ribs extend from both sides of the surface and are offset relative to each other.

7. A heat transference surface having projections arranged transversely to the flow and positioned successively one behind the other in the direction of flow and arranged so that the projections are in the form of intersecting ribs and the points of intersection being formed with projecting pins.

HERMANN CARL AMME.