Jan. 12, 1954 A. HUET 2,665,889

HEAT EXCHANGER

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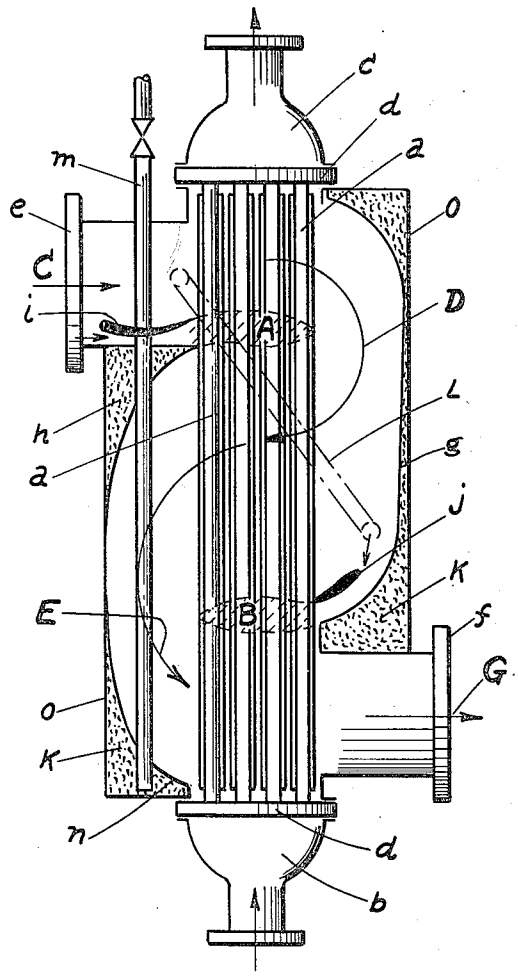

Fig. 1.

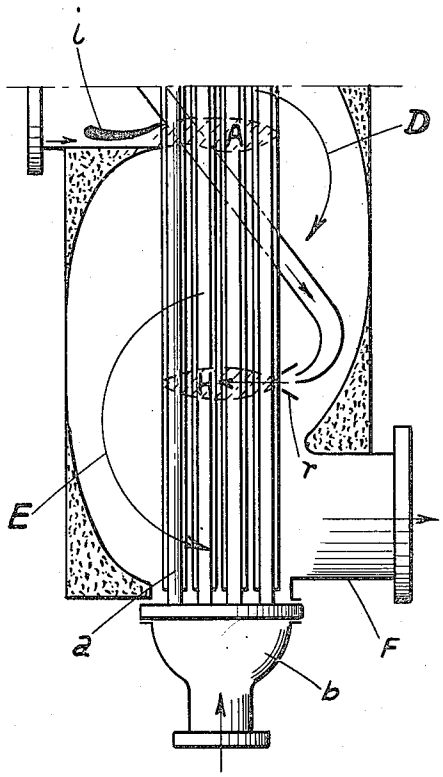

Fig. 2.

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HEAT EXCHANGER

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1 Claim. (Cl. 257—224)

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This invention relates to heat exchangers in which a fluid flowing through a bundle of tubes receives heat from or transfers heat to a second fluid flowing over and around the tubes, and it is specifically concerned with determining the path to be followed by the external fluid by means of deviating members or nozzles that create in the fluid circulating outside the tubes relatively stable zones which constitute fluid baffles adapted to direct as requisite the circulation of the fluid.

The invention is applicable to economisers, heaters of air, boilers and other tubular heat exchange apparatus, but will be described more particularly in its application to an economiser in which water flows through the tube bundle and a stream of hot gas circulates in the space outside the said bundle to heat the water.

According to the present invention there is located at one side of the tube bundle, in the stream of gas entering from one side of the tube bundle, a deviating apparatus or diffuser which creates on its downstream side a zone of fluid having a reduced speed but a higher static pressure than the main gas stream. This forms a fluid baffle extending across the tubes and compelling the main gas stream to flow forwardly in one pass across the tubes, around the said baffle, and return in a second pass across the tubes of the bundle just as would be the case with a solid refractory or metal baffle extending partway across the bundle. A similar arrangement may be provided at the opposite side of the economiser so as to create another fluid baffle between the second and third pass and cause a further reversal of direction of the gas flow.

The following description, when read with reference to the accompanying drawings, will reveal the manner in which the invention may be carried into practice.

In the drawings:

Fig. 1 is a vertical section of an economiser, selected by way of example, provided with means for creating fluid baffles according to the invention.

Fig. 2 illustrates a modification of the arrangements shown in Fig. 1.

The economiser shown in Fig. 1 is formed in a known manner of a bundle of straight tubes *a*, mostly shown diagrammatically by means of their axes. The tubes *a* are traversed internally by the water to be heated which enters and leaves the bundle through entry and exit headers *b* and *c*, respectively. The tube bundle is contained in a parallelopipedal casing *d* having on one side at its upper end inlet *e* for the hot gases, while

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on the opposite side, but in the lower portion thereof, there is provided the outlet *f* for the gases.

According to the invention, over approximately the upper two-thirds of its height, the inner wall of the casing *d* opposite the inlet *e* for the hot gases is a curved metal sheet *g*, and a similar metal sheet *h* is provided over the lower two-thirds of the opposite wall of the casing, which is positioned opposite the outlet *f* for the gases.

In the inlet *e* for the gases there is located a deviator or diffuser *i* constituted by a baffle or plate forming, between the wall of the inlet duct *e* and itself, a diverging channel in which the hot gas loses speed, and which has the effect of creating a zone A of relatively stationary gas at a higher pressure than that of the main gas stream. The body of gas in this zone A constitutes a fluid baffle extending across the tubes *a* of the bundle. The gases flowing in the direction indicated by the arrow C will circumvent this baffle by flowing in the direction of the arrow D, being deflected around its end by the plate *g*, so that after the first transverse passage over the upper one third of the tube bundle *a*, the gas so deflected by the plate *g* and following the direction of the arrow D traverses the tube bundle a second time in the direction of the arrow E. A second diffuser *j* is provided so as to form a second fluid baffle B between the intermediate or second pass of the economiser and the third pass thereof. The fluid baffle B in combination with the plate *h* forces the gases to flow a third time transversely over the tubes *a*, i. e. over the lower one-third thereof, before escaping in the direction of the arrow G by the outlet duct *f*.

To facilitate the action of the diffuser *j*, there may be provided a hot gas feed to the said diffuser by means of a duct *l* extending directly from the inlet of the hot gases *e* to an appropriate point upstream of the diffuser *j*.

In the space not occupied by the tubes *a* opposite the plate *h* there is less resistance to the passage of the gases than across the bundle *a*, the reduced pressure of the gas obtaining in such free space creating, in effect, a suction which facilitates the change of direction of flow of the gas stream, and its following of the path indicated by the arrow E.

By means of the arrangement described the gases at all points of their travel are caused to flow transversely over the tubes of the bundle *a* without any rigid baffle being required for obtaining the required deviations or changes in direction of flow. The tubes *a* are thus free from ob-

structions over their whole length which facilitates cleaning of the economiser and enables efficient soot blowing to be effected by means of an ordinary blower lance *m*.

The arrangement according to the invention is particularly suitable when the tube bundle is formed of tubes *a* with tangential fins such as those described in applicant's earlier application Serial No. 748,561, filed May 16, 1947, now Patent No. 2,578,136 of December 11, 1951. It is known that the advantages obtained by the tangential disposition of the fins on the tubes are materially increased when the external fluid flows over the tubes perpendicularly to their axes.

There may be provided in the lower portion of the plate *h*, for example at *n*, an aperture equipped with a door to facilitate the cleaning of the tubes.

The plates *g* and *h* may be covered externally with plating *o* giving to the exterior a parallelopipedic appearance, and a heat insulating medium *k* may be provided between the plates *g* and *h* and the said plating.

In the modification shown in Fig. 3 the intermediate diffuser *j* of Fig. 1 is replaced by a converging nozzle *r* which has the effect of creating a baffle H (shown hatched) similar to the baffle B, Fig. 1, around which the gases flow as indicated by the arrow E. This last arrangement may be advantageous in some cases inasmuch as in the lower part of the economiser the gases circulating at the places indicated by the arrows D and E may be of slower speed. The baffle H thus formed is a dynamic baffle instead of being static like baffle A.

The gaseous baffles of the invention permit mechanical and complete cleaning of the tubes. In addition they themselves have an aerodynamic shape which precludes all dead spaces, except insofar as the spaces they occupy are concerned in which spaces the activity of the gases is only slightly reduced, since although the gas speed there is less, the static pressure there is higher, which provides a compensation. In the case of dynamic baffles the activity there is even increased. Finally these fluid baffles may have any desired orientation.

It will be appreciated that modifications of detail may be made without departing from the invention. For example, baffles may be provided in parallel and side by side in the case of exchangers of large section. Furthermore, blowers or pulsators may be provided to increase the size or the stability of the fluid baffles. Lastly, the invention may be applied to exchangers of the plate type.

What I claim is:

In heat exchange apparatus having a bundle of tubes through which one fluid flows arranged in a space traversed in several passes by another fluid which thus circulates over and amongst said tubes to effect transfer of heat, a casing surrounding said bundle of tubes having an inlet through which the external fluid enters the casing in a direction at right angles to the longitudinal axis of the tube bundle, and an outlet opening for the external fluid; a fluid diffusing device and a converging nozzle each effective to create on its downstream side, within the space occupied by the tube bundle, a fluid baffle which the main stream of the external fluid must circumvent in traversing the tube bundle, the said diffusing device being located adjacent the said inlet for the external fluid and being fed by the incoming fluid and creating the baffle first encountered by the said main stream of the external fluid, the fluid composing such baffle having a lesser speed and higher static pressure than the main stream of external fluid, and the said nozzle being positioned to create another baffle subsequently encountered by the main stream of external fluid; a duct for conveying external fluid from said inlet to said nozzle, said latter baffle having a higher speed than the main stream of external fluid.

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