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(54) **Cleaning equipment for a heat exchanger.**

(57) Cleaning equipment for a heat exchanger of the jacket-pipe section type with built-in baffles. The baffles are stiffened with bars and connected to one or more pulling devices which can be moved longitudinally forwards and backwards, thus pulling the baffles over the outside of the pipes and scraping off encrustation.

EP 0 544 348 A2

The present invention is related to cleaning equipment for a heat exchanger of the so-called jacket-pipe section type with built-in baffles and containing a jacket fitted with an inlet and an outlet for a medium which circulates through the jacket and a number of pipes fitted in the jacket parallel with the jacket's longitudinal axis and supported by built-in baffles.

When a liquid or gas is led through heat exchangers, soot or other particles will always be deposited. For example, when gas is used in the jacket and water in the pipes, soot will be deposited on the outside of the pipes and after a period of time efficiency will be reduced. It is consequently necessary to clean the outside of the pipes at regular intervals.

One disadvantage of pipe heat exchangers is that they are relatively complicated to clean for encrustation. Pipe heat exchangers are usually cleaned by flushing both the jacket and the pipes in countercurrent direction with a fluid, possibly with an added anti-encrustation solvent. Another method is to dismantle the whole heat exchanger and clean the baffles and the pipes mechanically. However, both these methods require that the heat exchanger be disconnected from the process, which is relatively expensive and laborious.

The objective of the present invention is thus to produce cleaning equipment which makes it possible to clean the heat exchanger efficiently and speedily during operation.

After having examined alternative cleaning methods, the inventors reached the surprising conclusion that it would be possible to use the main pipe and the baffles as part of a cleaning device. Both the main pipe and the baffles are already part of the heat exchanger itself, and it would consequently not be necessary to make further changes to the heat exchanger jacket unit. The design of spiral heat exchangers is such that the whole pipe section is fitted around a main pipe which secures the baffles. The inventors were therefore of the opinion that it would be possible to scrape the outside of the pipes free of encrustation by pulling/pushing the baffles forwards and backwards over the pipes. The baffles had to be modified by enlarging the bores for the pipe insertion holes to such an extent that there would be a clearance all around the pipe. In addition, all baffles were stiffened to prevent them from being displaced. Furthermore, the baffles were secured in the main pipe thus allowing for all the baffles to be moved over the outside of the pipes by pulling/pushing the main pipe out/in. The necessary displacement length for the main pipe was equivalent to the distance between two adjoining baffles. The whole length of the pipes could consequently be scraped. As an alternative design the inventors discovered that it was possible to mount circular brushes at the pipe holes of the baffles. In addition to an increase in cleaning efficiency, the brushes also reduced the necessity of making pipe holes with extremely low tolerances.

Another possible solution of the problems related to the pipe insertions is to mount a pipe casing in the baffle holes. These pipe casings have an internal diameter adjusted to the pipes' external diameter and an external diameter adjusted to the baffle's hole. When the pipe is pulled forwards and backwards through the inside of the casing, the outside of the pipe will be scraped free of any encrustation. The casings have a smaller diameter than the holes in the baffles so that they will fit concentrically with the pipes. This prevents the pipes from becoming stuck in the casings in connection with the baffles being moved back and forth.

Pulling/pushing the baffles forwards and backwards over the pipes can be achieved in a number of ways, for example by using motor power or a hydraulic or pneumatic cylinder which is directly connected to the main pipe. In connection with the use of hydraulic or pneumatic operation the cylinder may be placed outside the end bottom of the heat exchanger, or it can be mounted internally as part of the main pipe. The hydraulics can be operated by external oil/gas pressure or, by using a pump, the pressure for either the inflowing liquid or gas can be used to operate the cylinder. The choice of solution for operation of the main pipe depends, among other things, on where the heat exchanger is to be used.

The sweeping operation can be controlled in a number of ways. The baffles can be moved over the pipes automatically at fixed intervals or depending on the outflow temperature of the medium, as an increase in the medium's outflow temperature would indicate poor heat transfer due to pipe encrustation. After each scraping/sweeping, the scraped off encrustation flows out with the gas or falls to the bottom of the heat exchanger from where it can be removed with a mechanical device such as a scraper, a screw, etc.

The invention covers all types of baffle heat exchanger with or without a main pipe. A baffle heat exchanger without a main pipe has to be modified by the baffles being stiffened and attached to a joint bar which links all the baffles together. Furthermore, it will be necessary to mount one or more push/pull bars on the end baffle which is/are, for example, operated by a hydraulic device, as previously described.

The invention has been defined in the attached patent requirements and will be described in the following in relation to the drawings which show a detailed example of the design of a baffle heat

exchanger.

More precisely fig. 1 shows a schematic cross-section through the heat exchanger with the main pipe, baffles and an attached hydraulic cylinder.

Fig. 2 shows a cross-section AA of the heat exchanger.

Fig. 3 shows an enlarged section of a baffle with a bar, pipe and casing.

Fig. 1 shows a schematic section of a heat exchanger 7 consisting of a jacket 1 with an inlet 2 for the inflow of the heating medium, which is gas in the example shown. In this example the inlet 2 and an upper inlet part (a vapour belt) 3 and the jacket 1 have been insulated with a fire-proof substance. This is done because the inflowing medium may have a temperature of up to approx. 1000 °C. Furthermore, an outlet pipe 5 for the cooling medium, in this case water, is connected to an end lid 6. The end lid 6 is secured to the jacket 1 by flanges 8. At the other end there are an inlet pipe 9 for the cooling medium and an outlet pipe 10 for the heating medium. Inside the jacket a main pipe 11 has been concentrically fitted to the pipe section as shown in fig. 2. The baffles 12 carry the pipes 13 as they are fitted with a number of openings 19 through which the pipes run. The baffles have been adjusted exactly in accordance with the reference line both in relation to each other and the pipes. The pipes are not fixed to the baffles but are mounted freely. In turn, the pipes have been welded or fixed in another way to the pipe plates 18. The baffles are mutually secured by the bars 14 stretching through all the baffles. This can be seen more clearly in fig. 3 which shows a section of a baffle 12 with bars 14, pipes 13 and pipe casings 16.

The pipe casings 16 are placed in the baffle holes. The pipe casings have an internal diameter which has been adjusted to the external pipe diameter, and an external diameter which has been adjusted to the baffle diameter. The casing is secured in the baffle holes by two end stops which prevent the casing from being pulled out of the baffle when the pipes are pulled/pushed forwards and backwards. The movement of the casings will also contribute to cleaning the baffles.

The main pipe 11 is attached to a hydraulically-controlled arm 20 allowing the main pipe to be pulled/pushed forwards and backwards.

At the same time this has the effect that all baffles which are connected to the main pipe will also be pulled/pushed forwards and backwards over the pipes and consequently scrape/brush any encrustation of the pipes. The hydraulic device can be controlled automatically, for example on the basis of the outflow temperature of the heating medium measured with a sensor. If the flow quantity and the inflow temperature are constant, an increase in the outflow temperature registered by a sensor will indicate a reduction of the heat transfer between the media due to pipe encrustation. The hydraulic device can thus be activated. Other solutions are to control the hydraulic device manually or automatically at regular intervals. With these solutions it will be necessary neither to dismantle the heat exchanger nor to stop the process for cleaning. Cleaning can be carried out during operation.

As mentioned, the majority of the scraped off material will be led out through the outlet pipe along with the water/gas. A screw 17, however, leads heavier, scraped off particles out of the heat exchanger, as shown in the figures. In case of scraped off encrustation which can be melted, it is, moreover, possible to fit a heated jacket part at the base of the heat exchanger. In this case the heat exchanger may be fitted with a valve for draining out the molten encrustation.

Even if the invention primarily covers cleaning equipment for a heat exchanger, it is also within the scope of the invention to cover the same type of cleaning equipment adjusted to be used in a boiler.

With the present invention equipment is available for cleaning a baffle pipe heat exchanger with the heat exchanger remaining in full operation during cleaning of the outside of the pipes. The equipment is very simple to use and easy to install.

Claims

1. Cleaning equipment for heat exchangers of the so-called jacket-pipe section type which consists of a jacket (1) with an inlet (2) and an outlet (10) for a medium which circulates through the jacket and a number of pipes (13) fitted in the jacket parallel with the longitudinal axis and supported by built-in baffles (12),
characterized in that
the baffles (12) are stiffened and secured in relation to each other by bars or similar devices (14), and that a pulling device is connected with the baffles (12) which can move these forwards and backwards in relation to the pipes.

2. Equipment in accordance with claim 1,
characterized in that
the pulling device consists of a main pipe (11) which is connected to a drive device.

3. Equipment in accordance with claim 2,
characterized in that
the drive device consists of a hydraulically or pneumatically operated bar 20.

4. Equipment in accordance with claim 1, **characterized in that** pipe casings (16) are provided in the pipe holes (19) of the baffles (12) so that the pipes run through these casings.

5. Equipment in accordance with claims 1-3, **characterized in that** circular brushes are provided in the baffle pipe holes (19).

6. Equipment in accordance with claim 1, **characterized in that** the heat exchangers are provided with a removal device in the form of a screw (17) or similar device for the removal of soot, encrustation, etc. scraped off the outside of the pipes.

7. Equipment in accordance with claim 1, **characterized in that** the pull/push device (20) is controlled automatically by a temperature sensor (15) fitted in the outlet (10).

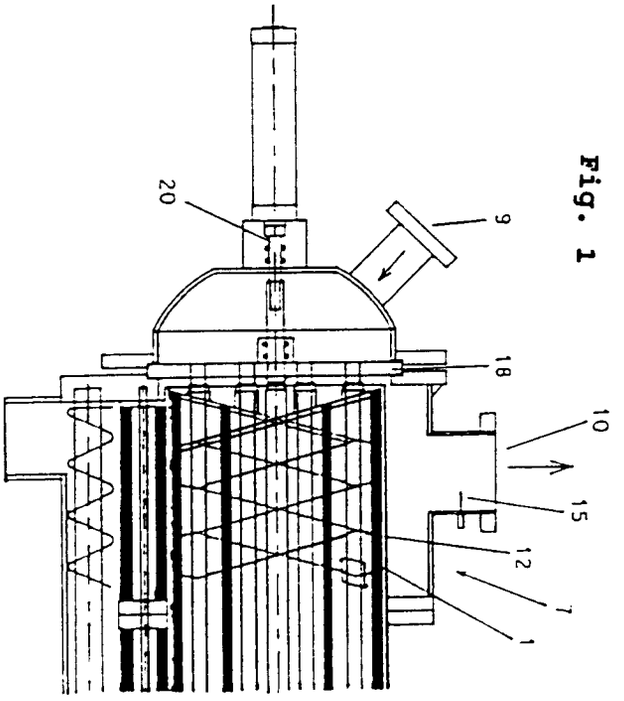

Fig. 1

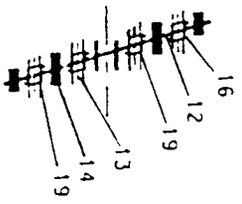

Fig. 3

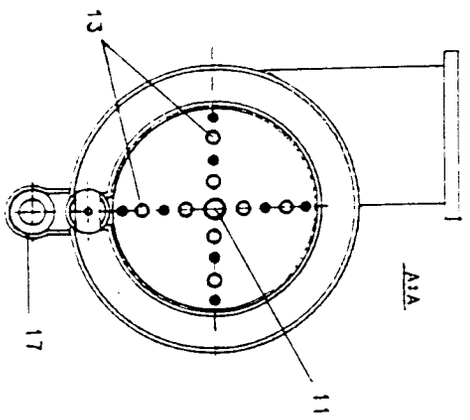

Fig. 2