Dec. 12, 1939. H. PETERS 2,183,496

CLEANING TUBULAR HEAT EXCHANGING SURFACES

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Fig. 1.

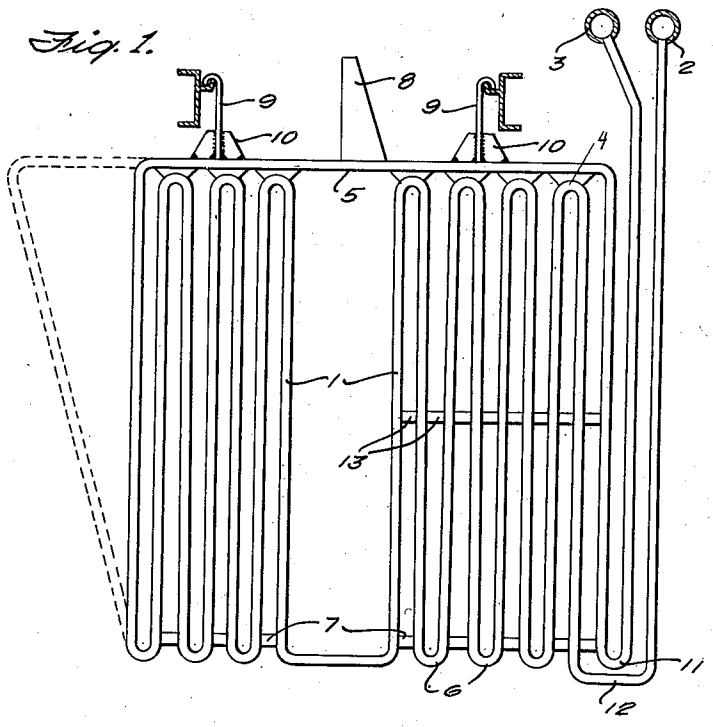


Fig. 2.

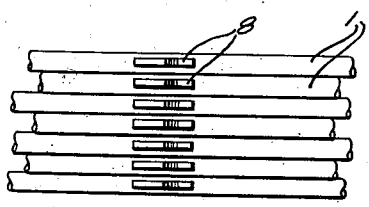
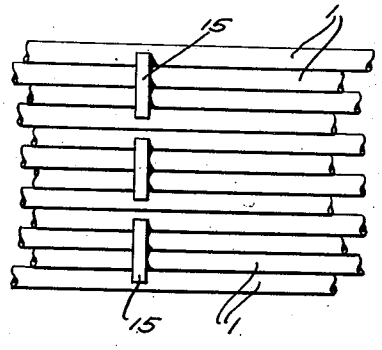


Fig. 3.



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CLEANING TUBULAR HEAT EXCHANGING SURFACES

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Fig. 4.

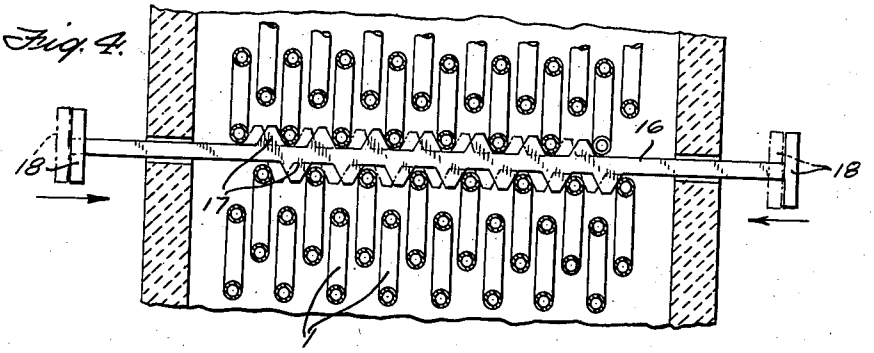

Fig. 5.

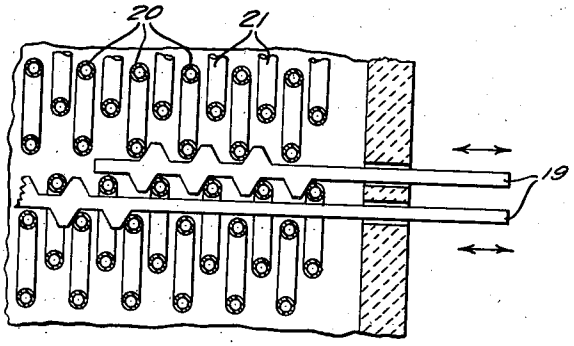

Fig. 6.

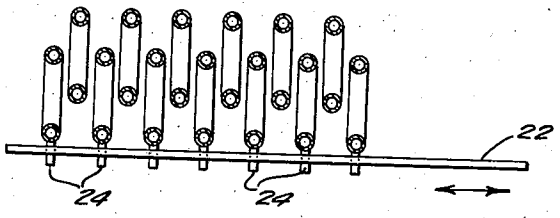

Fig. 7.

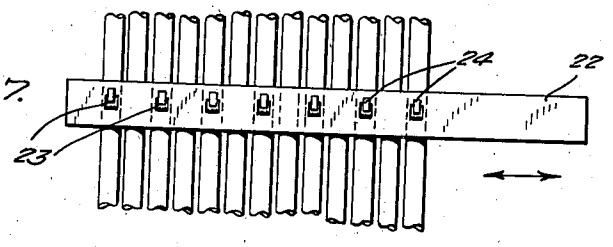

Fig. 8.

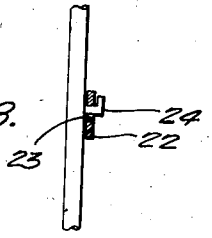

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Fig. 9.

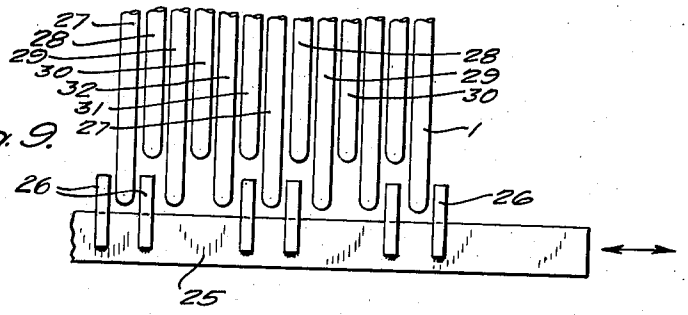


Fig. 10.

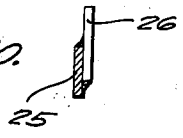


Fig. 11.

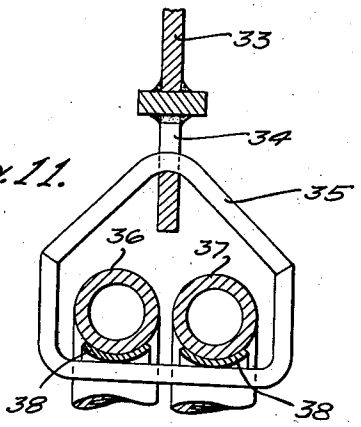
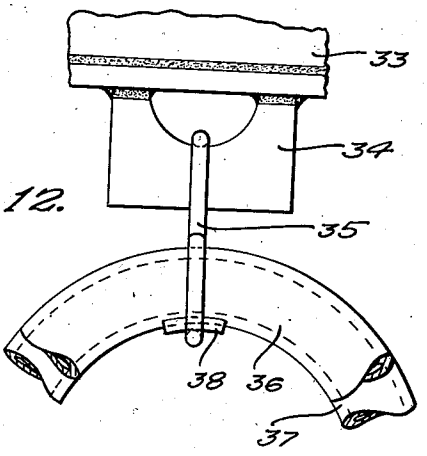


Fig. 12.



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UNITED STATES PATENT OFFICE

2,183,496

CLEANING TUBULAR HEAT EXCHANGING SURFACES

Heinrich Peters, Berlin, Germany, assignor to La Mont Corporation, New York, N. Y., a corporation of New York

Application February 14, 1939, Serial No. 256,336
In Germany November 15, 1937

4 Claims. (Cl. 257—1)

This invention relates to the cleaning of tubular heat exchanging surfaces which are exposed to the dirtying effects of the passage thereover of combustion gases, and particularly to means for insuring the transmission throughout the tubular structure of vibrations of a character which will insure a separation therefrom of accumulations of dirt, dust, ashes, soot, etc.

Heretofore attempts have been made to effect, by means of shaking mechanism, sufficient movement of heating surfaces which are exposed to intense dirtying as to effect the jarring therefrom of dirt and dust accumulations. Experience has shown, however, that with firmly sticking accumulations the vibrations of the heating surfaces thus produced, that is by shaking mechanism, are not sufficient to effect satisfactory cleaning of the heating surfaces, since these vibrations produce too small accelerating and retarding forces and therefore the resultant mass forces are not sufficient to dislodge the dirt particles.

On the other hand, it has been shown that vibrations of a higher vibration number or pitch such as are produced for example through striking apparatus are far more effective, if care be taken that these vibrations be allowed to proceed throughout all parts of the heating surface without material variation of the pitch or vibration number.

The present invention proposes, therefore, to provide for setting the tube coils into vibration by striking and, through a relatively stiff construction of the individual tube coils, to insure the transmission of these vibrations from the point of origin throughout the entire tube element.

An important feature of the invention is the construction and arrangement of the tube coil to give it the stiffness required to insure the transmission of the vibrations, initiated by a blow, throughout the coil structure. Various ways of securing the required stiffness are contemplated in accordance with the general shapes and sizes of the coils, a suitable arrangement, when the individual windings are not too long, being to weld the individual windings at their upper bends to a part of the same tube and to connect the lower bends to each other through bridges welded between them, so that a closed frame is thus produced. With longer individual windings it is advantageous to connect the several tube windings also midway of their longer dimensions, or even more frequently, through bridges, and in certain cases the stiffness of the frame can be increased by giving it another shape as, for example, through drawing forth the first tube winding to produce a trapeze-like shape.

Another important feature of the invention is the arrangement for initiating the vibrations. To this end a striking surface is located on the tube coil, against which the vibration-initiating blow is struck. If the heating surface be comparatively small, then several tube coils can be connected with each other through a common striking plate.

In constructions in which the tubes are rolled into chests, such for example as distributors or collectors, it is advisable to prevent the dirt-removing vibrations from putting too great strain upon these connections and, to this end, an important feature of the invention is the provision of elastic bends between the heating surfaces and the chests.

A further important feature of the invention is the construction and arrangement of the individual tube coils of such character that through it the least possible damping of the blow produced vibrations is caused. A suitable construction for this purpose has been found to be the suspension of the tube coils on long elastic hooks.

The invention relates further to the provision of means for producing the impact vibrations, such means being particularly important in structures where the heating surfaces are not readily accessible. Among the means contemplated are a reciprocating toothed striking plate, the toothed edge of which, according to the direction of movement, strikes against one or the other side of a tube. Other arrangements for producing the impact vibrations comprise the provision of means for causing two adjacent tube coils to strike against each other so that vibrations go out simultaneously from numerous points of contact. With a normal arrangement of the tube coils, contact points exist in the upper and lower bends. In certain cases, with especially long tube coils, any desired number of additional contact points may be created by welding on bridges and the like.

The striking of the tubes against each other can also be brought about by means of a reciprocating toothed plate, for example by causing it to strike, according to the direction of movement, alternately the one tube coil against the other.

Instead of toothed plates, upon the comparatively large surfaces of which accumulations of dust and dirt can easily form, the invention also contemplates an arrangement of plates, with

their edges upright, which either engage hooks welded on the tube coils or engage the lower ends of the tube coils themselves.

A further important feature of the invention, when the impact vibrations are to be produced by causing the tube coils to strike against each other, is an arrangement by which the upper tube bends can bounce against each other. To this end the invention contemplates the suspension of two neighboring tubes in a common ring in which they are freely movable, it being usually desirable in such case to reinforce the under sides of the supported bends since, because of their sliding in the rings, these parts are subjected to increased wear.

Other objects and important features of the invention will appear from the following description and claims, when considered in connection with the accompanying drawings in which—

Figure 1 is a side elevation of a tube coil constructed and arranged to form a stiff coil frame capable of transmitting impact vibrations throughout the frame structure, this view also showing the non-damping suspension of the coil and the elastic connection to the chests;

Figure 2 is a detail plan showing striking plates for the respective coils;

Figure 3 is a plan view of a modified construction in which a single striking plate serves a plurality of coils;

Figure 4 is a plan view partly in section showing an arrangement of a reciprocating striking plate for imparting impact vibrations to the tubes;

Figure 5 is a view somewhat similar to Figure 4 but showing a plurality of reciprocating striking plates;

Figures 6, 7 and 8 are plan, elevation and end views, respectively, partly in section, showing a form of impact initiating plate arranged edge up and connected to welded on hooks on the tubes;

Figure 9 shows still another form of impact plate arranged edge up and having projecting arms which engage the coils to be struck together;

Figure 10 is a vertical section through the plates shown in Figure 9;

Figure 11 is a front elevation partly in section of a shackle and suspended ring for supporting the upper bends of two tubes to permit their bouncing against each other; and

Figure 12 is a side elevation of the construction shown in Figure 11.

In the form of the invention shown in Figure 1, the tube coil 1 is connected at its ends to two chests comprising a distributor 2 and a collector 3. The fluid, such for example as water, to be vaporized, is introduced into the tube coil 1 through the distributor 2 and the resultant fluid vapor mixture is conducted away through the collector 3 into a liquid and vapor separator or drum not illustrated. The individual windings of the tube coil 1 are welded at their upper bends 4 to a horizontal part 5 of the tube while the lower bends 6 are connected to each other by bridge pieces 7.

In this manner a stiff frame is formed to which the striking plate 8 is rigidly connected. If now a strong blow be struck against the striking plate 8 in the longitudinal direction of the tubes, the vibrations produced by this blow will extend in uniform measure throughout the entire tube coil 1. The tube coil 1 is supported by relatively long elastic hooks 9 welded thereto which make possible approximately undamped vibrations of the tube coils. For relieving the load on the welds where the hooks 9 are welded to the tube coil 1, strengthening plates 10 are also welded on the tube assembly.

In order that the vibrations shall not put too great a strain upon the rolled in joints between the tube coil 1 and the chests 2 and 3, whereby they might become untight, elastic bends 11 and 12 are provided. Furthermore, to increase the stability and general stiffness of the frame it may be desirable to make a trapeze-like winding such as shown in dotted lines in Fig. 1, whereby the end loop subtends a longer section of the horizontal part 5 of the tube, thus providing a more acute bend with the greater stiffness incident thereto. At the right hand side of the same figure is shown an additional reinforcement through bridges 13, which may be provided especially with long windings.

As is to be seen from Figure 2, a striking plate 8 is provided on each tube coil 1. Figure 3 shows that sometimes several tube coils 1 are united by a common striking plate 15.

Another illustrative embodiment of the invention is shown in Figure 4. A toothed striking plate 16 is struck back and forth so that the teeth 17, according to the direction of movement, strike upon the one side or the other of the tube coil 1. The striking plate 16 is provided at each end with a striking head 18.

In Figures 5, 6, 7, 8, 9 and 10 is illustrated, as a further embodiment, a mechanism which causes the impact vibrations to be produced by the striking against each other of two neighboring tubes. In Figure 5 this mechanism consists of several likewise toothed slides 19, the teeth of which, however, do not themselves strike against the tubes as in the other form of the invention, but at times cause the tube coils 20 to partake of their direction of movement and to strike against the neighboring tube coils 21. Several slides 19 are provided so that at one time only one group of tube coils is struck against another.

In Figures 6, 7 and 8 is shown a plate 22, edge up, so that accumulations upon the plate are to a large extent avoided. The plate 22 is provided with vertical slots 23 which hook over and receive hooks 24 welded to every second tube.

By reciprocation of the plate or slide 22, each of the tubes connected with the plate or slide 22 is from time to time struck against the intervening tubes.

In the illustrative embodiment of the invention shown in Figures 9 and 10, the slide 25 for carrying the tubes with it is shown as arranged below the tube coils. Arms 26 are welded to the slide 25 which arms engage every sixth tube at its lower bend. On movement of the slide 25 towards the right in Figure 9, the tube coils 27 are first caused to strike against the tube coils 28. By further movement in this direction a striking together of the tube coils 28 and 29 takes place as well as 29 and 30. By reverse movement of the slide 25 the tube coils 27, 31, 32 and 30 are struck together one after the other.

In order to make possible that, with the striking against each other of two neighboring tube coils, these also bounce against each other at their upper bends, the suspension apparatus for the tube coils must permit a lateral movement at the upper bends. Such a suspension is shown, for example, in Figures 11 and 12, Figure 11 showing a section through the apparatus and Figure 12 a side elevation. As shown in these two figures, the carrier 33 is provided with a shackle 34 by which a ring 35 is carried. In this

ring 35 the tube coils 36 and 37 are so suspended that they can move laterally and strike against each other. Reinforcing pieces 38 are welded to the tubes 36 and 37 inside their upper bends to take up wear, due to sliding in the ring or stirrup 35.

What is claimed as new is:

1. A heat exchanger tube coil construction for facilitating the transmission of impact-produced dirt-removing vibrations therethroughout, comprising a tube formed into a series of loops and having a straight portion to which said loops are welded at some of their bends and rigid bridges connecting the other bends, means independent of its input and discharge connections for suspending the coil unit thus formed and a striking plate through which impact vibrations may be imparted to said unit.

2. A heat exchanger tube coil construction for facilitating the transmission of impact-produced dirt-removing vibrations therethroughout, comprising a tube formed into a series of loops and having a straight portion to which said loops are welded at some of their bends, rigid bridges connecting the other bends, means independent of its input and discharge connections for suspending the coil unit thus formed and means comprising a slide arranged to be struck against said unit for setting up impact vibrations therein.

3. The combination with a heat exchanger tube coil unit constructed for facilitating the transmission of impact-produced dirt-removing vibrations therethroughout, said unit comprising a tube formed into a series of loops and having a straight portion extending across one end of said loops to which said loops are welded at some of their bends and having rigid bridges connecting the other bends, of a distributor and a collector, input and discharge connections to said distributor and collector and flexible means, independent of said input and discharge connections, for effecting a bell-like suspension of said coil unit, said flexible suspending means providing substantially non-damping suspension and said input and discharge connections each comprising a relatively long elastic extension of an end of the tube coil opposite said flexible suspension means, said extensions being at least as long as the reaches of said loops, otherwise unconnected to said tube coil and otherwise unsupported.

4. The combination with a heat exchanger tube coil unit constructed for facilitating the transmission of impact-produced dirt-removing vibrations therethroughout, said unit comprising a tube formed into a series of loops and having a straight portion extending across one end of said loops to which said loops are welded at some of their bends and having rigid bridges connecting the other bends, of a distributor and a collector, input and discharge connections to said distributor and collector and flexible means, independent of said input and discharge connections, for effecting a bell-like suspension of said unit, said flexible suspending means providing substantially non-damping suspension and said input and discharge connections each comprising a relatively long elastic extension of an end of the tube coil opposite said flexible suspension means, said extensions being at least as long as the reaches of said loops, otherwise unconnected to said tube coil and otherwise unsupported, but being each provided with an elastic bend between the coil unit and the distributor or collector for preventing transmission to the junction with the distributor or collector of vibrations of sufficient intensity to tend to loosen the said joint.

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