June 13, 1944. W. P. THOMAS 2,351,163

BOILER CLEANER

Original Filed Aug. 14, 1940 2 Sheets-Sheet 1

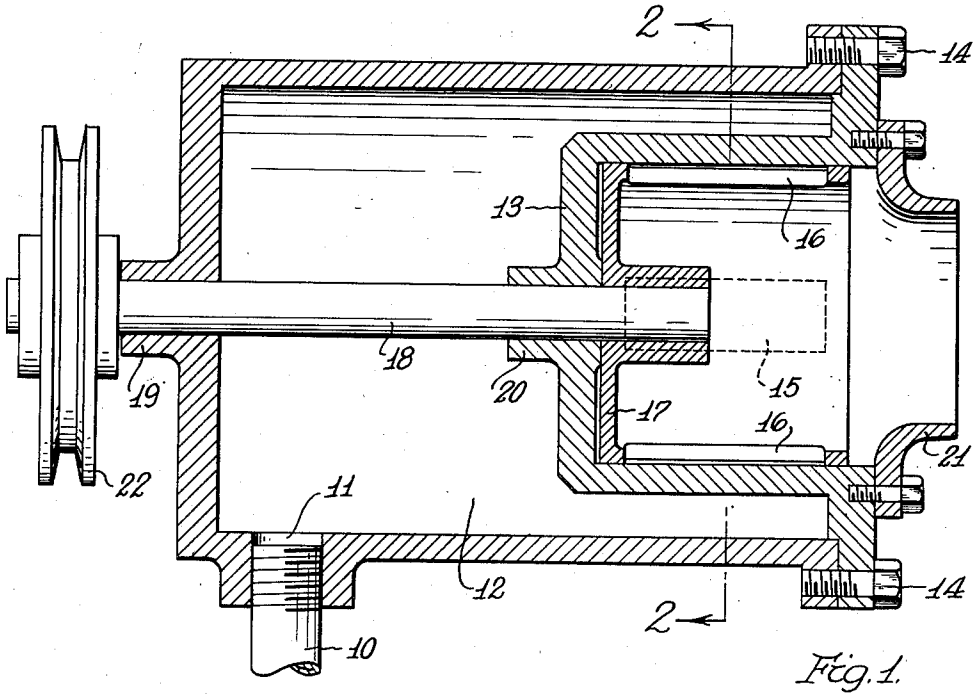


Fig. 1.

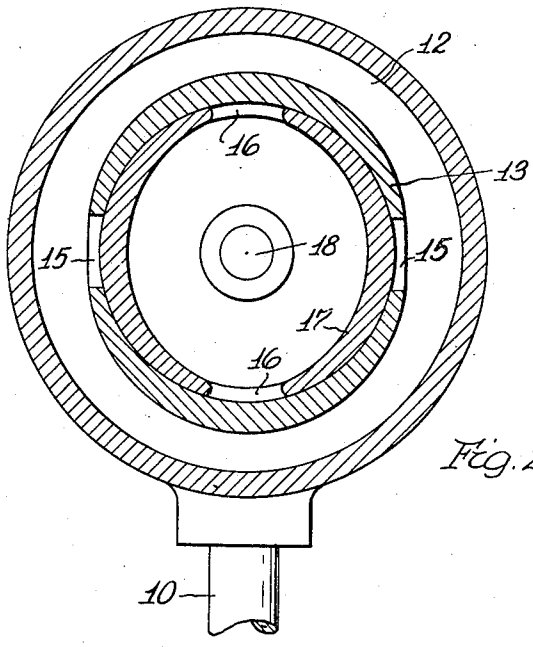


Fig. 2.

INVENTOR.
Willis P. Thomas

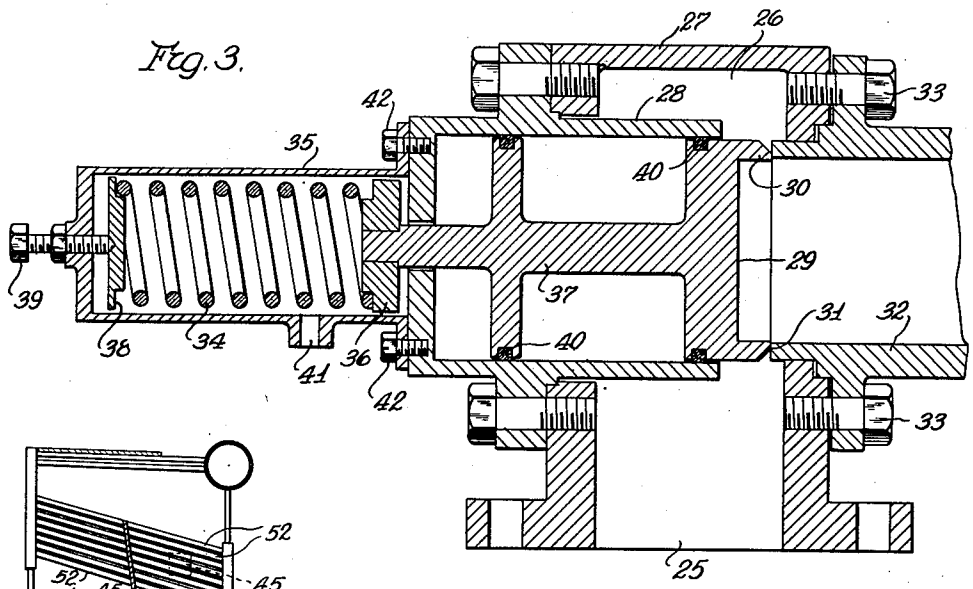
BY
J. Windsor Davis

June 13, 1944. W. P. THOMAS 2,351,163

BOILER CLEANER

Original Filed Aug. 14, 1940 2 Sheets-Sheet 2

Fig. 3.



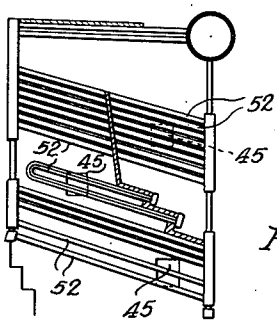


Fig. 5.

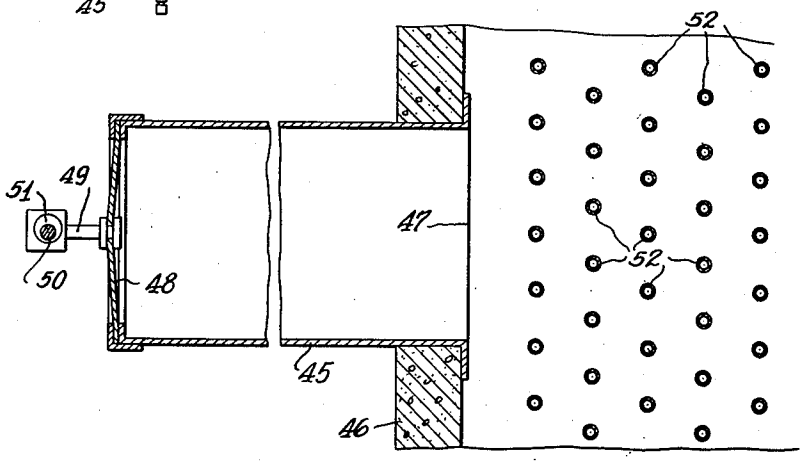


Fig. 4.

INVENTOR.
Willis P. Thomas

BY

Patented June 13, 1944

2,351,163

UNITED STATES PATENT OFFICE

2,351,163

BOILER CLEANER

Willis P. Thomas, Detroit, Mich., assignor to Diamond Power Specialty Corporation, Detroit, Mich., a corporation of Michigan

Substituted for abandoned application Serial No. 352,494, August 14, 1940. This application January 21, 1943, Serial No. 473,080

6 Claims. (Cl. 122—379)

My invention relates to boiler cleaners and is adaptable to any heat transfer unit wherein the removal of soot or ash from heat transfer surfaces is a problem.

It is well known that in the operation of a boiler the acccumulation of soot and ash on the heat transfer surfaces causes a great loss of heat and seriously impairs the efficiency of any boiler unless it is removed frequently and thoroughly. Numerous devices and methods are used to accomplish this cleaning but all have certain limitations and disadvantages and none are wholly satisfactory.

The most common method of cleaning modern boilers is to direct a fluid such as air, water or steam adjacent surfaces to be cleaned either in a continuous or an intermittent stream. This method of cleaning is accomplished in part by the fluid striking the soot or ash dislodging it from the surface to which it is adhering and to a great extent by creating eddies and local turbulences of the gases near those surfaces not contacted directly by the cleaning fluid. This type of cleaning while in most cases satisfactory often requires a number of expensive and complicated soot blowers to do a thorough job. It is also true of this type of cleaning that the elements or nozzles through which the fluid is jetted must be interposed into the boiler proper and hence are subject to rapid deterioration through contact with the hot furnace gases.

It is, therefore, the object of the present invention to provide a boiler cleaner having no parts in the boiler proper and wherein the cleaning of the tubes and walls is accomplished by setting up vibrations of the gases in the boiler.

It is a further object of my invention to provide a method of cleaning boilers by means of gas vibrations wherein the air and gases in the entire boiler may be vibrated in such a manner as to dislodge the soot and ash from all of the heat transfer surfaces simultaneously. A still further object is to provide a device for setting up more or less localized vibration of the gases in particular sections of a boiler so that localized cleaning is possible.

Still another object of my invention is to provide a method for cleaning a boiler by means of gas vibrations whereby no extraneous gases or fluids are introduced into the boiler to dilute the hot furnace gases.

When steam or air streams or puffs are emitted into a boiler the gases and hence the boiler tubes are cooled to such a great extent that if blowing were continued for long periods of time the excess cooling would result in prohibitive fuel costs. It is an object of the present invention to provide a tube scavenging means which prevents lodgement of solid particles without any reduction in boiler temperature and which may be operated continuously through all boiler operations. It is also effective for use as an interval cleaner and such use is contemplated in cases where such use will suffice.

Specifically it is an object of this invention to subject the flue gases to a series of rapid impacts and hence to set up vibrations of the gases to such an extent that the solid particles thereof are diverted from their natural direction in passing toward the stack. The intensity is sufficient to cause the vibrations to traverse the entire boiler section. The gases are given a shimmering movement, so that their travel will have lateral movements in addition to vertical. If the gases are submitted to very short vibrations these lateral movements may be so small as to have no effect. If the vibrations are too long they will have no effect unless very intense in which case the boiler walls may be shaken apart. The particular wave length will vary depending upon the arrangement of boiler tubes, the character of the solid particles to be removed or to be prevented from lodging and upon other factors including general furnace design and will vary for different installations similarly to the variation in velocity and frequency of puffs from a puff blower. Vibrations of the order of the longest wave of sound are very satisfactory for certain typical installations. The device creating the vibrations is preferably adjustable in order that wave length and intensity of vibrations may be varied.

Other objects and advantages will become hereinafter more fully apparent as reference is had to the accompanying drawings in which my invention is illustrated and in which:

Fig. 1 is a sectional view of a revolving drum vibrator for use in the present invention,

Fig. 2 is a view taken on the line 2—2 of Fig. 1.

Fig. 3 is a view in section of a pressure operated vibrator for use with my invention,

Fig. 4 is a view in section of a drum type vibrator, and

Fig. 5 is a schematic view of a series of vibrators showing their location with respect to the various sections of a boiler in which localized cleaning is desired.

Referring first to Figs. 1 and 2, the reference character 10 designates a line through which a fluid such as air or steam under pressure is ad-

mitted through opening 11 to the interior of the pressure tight chamber 12. One end of the chamber 12 is closed by the drum housing 13 and the two are joined as by studs 14. Ports 15 in the drum housing 13 and ports 16 in the revolving drum 17 establish communication between the chamber 12 and the drum 17 when the two are brought into alignment. A shaft 18 journaled in the journal boxes 19 and 20 of the chamber 12 and housing 13 respectively is fixed to the drum 17. The flanged member 21 connects the drum housing 13 with the line leading to the interior of the boiler (not shown). Any available power means may be employed to rotate the shaft 18 through the pulley wheel 22. The chamber 12 is mounted in the wall of a boiler so that the tubes and surfaces to be cleaned or kept clean are exposed to the opening 21. The installation is preferably similar to that illustrated in Figure 5 and generally similar to the installation of Figure 4. The valve will be rotated at a speed such that the fluid inletted into the boiler does not contact the surfaces to be cleaned but rather at a speed such that the force of the fluid pressure is transmitted to the heating surfaces by the heating gases. In other words, the products of combustion are subjected to a continued series of impacts which will cause the solid particles to vibrate and hence to change direction as they pass the vibrating zone in front of the opening 21 and while they are passing the boiler tubes.

In operation, rotation of the shaft 18 effects a similar rotation of the drum 17 so that with the arrangement shown every revolution of the shaft 18 brings the ports 15 and 16 twice into alignment and two impulses pass through the member 21 into the boiler as the fluid under pressure escapes into the hollow drum 17. It is necessary that the line 21 leading to the boiler be of substantially the same circumferential size as the interior of the drum 17 or the vibrations will be smothered before reaching the boiler. Obviously the vibration frequency can be readily changed by changing the rotation speed of the shaft 18. Preferably, the frequency is in the lower range of sound and the intensity is sufficient to carry the effect entirely across the boiler.

It might be pointed out that the fluid which is used and supplied through the line 10 of Figure 1 could be the exhaust gases from the boiler or other heat exchange apparatus.

In the embodiment of my invention shown in Fig. 3 a fluid under pressure is conducted through a line 25 to an annular chamber 26 in the valve housing 27 which contains a cylinder 28. A manual control valve may be provided at a convenient and possibly remote point to control the pressure in the line 25. Fitted for movement in the cylinder 28 is a piston 29 having a valve portion 30 adapted to seat on the surface 31 of a conduit member 32. The conduit member 32 is fixed to the housing 27 by studs 33. A biasing spring 34 in a spring housing 35 normally holds the valve 30 in its closed position through the abutting flange 36 and shaft 37 fixed to the piston 29. A second abutting flange 38 and adjustment screw 39 are provided to vary the compression of spring 34. Piston rings 40 are provided to to prevent leakage of fluid past the piston 27 and a drain 41 to permit the escape of any fluid reaching the spring housing 35. Studs 42 connect the spring housing 35 to the valve housing 27. The conduit member 32 leads to the interior of the boiler (not shown), so that the conduit 32 is open to the flue gases within the boiler.

The arrangement is such that when fluid under pressure is admitted to the line 25 it builds up until the pressure on the shoulder 43 is sufficient to overcome the resistance of the spring 34 whereupon the valve 30 is forced open and a quantity of fluid escapes into the conduit 32 setting up an impulse which passes into the boiler and which is immediately effective upon the flue gases. The escape of this fluid causes a sharp drop in the pressure in the line 25 and hence on the shoulder 43, this pressure drop in turn permitting the spring 34 to return the valve 30 to its seat and the pressure again starts to build up in the line 25 and the cycle is repeated.

Any desired frequency of vibrations can be obtained with this embodiment by varying the compression of the spring 34 and the pressure available in the line 25. For example the valve may be adjusted to open when the pressure reaches 300# and to close at 100#. Under average conditions this would mean that the valve would remain open for approximately one-fourth of a second and would operate about twenty times to the minute sending a similar number of impulses or impacts into the boiler. These impacts cause vibrations of the flue gases without the fluid which causes the impacts penetrating to the interior of the boiler for a distance great enough to contact the tubes. The introduced fluid does no direct cleaning as is done by the conventional puff.

A still further method of vibrating the boiler gases in such a manner that soot and ash are dislodged from or prevented from lodging on the interior surfaces of the boiler is shown in Fig. 4. In this embodiment a large chamber 45 is mounted in the wall 46 of the boiler being entirely or substantially open to the boiler on the one side. At the end of the chamber 45 opposite the opening 47 is a diaphragm which can be vibrated in several ways but is herein illustrated as being vibrated mechanically. As illustrated, the diaphragm 48 is secured to a connecting rod 49 which is driven by an eccentric 50 on the shaft 51. The operation of this embodiment will be readily apparent. Upon rotation of the shaft 51 an inward and outward movement is given to the diaphragm 48 through the rod 49 and eccentric 50. The resultant vibration of the diaphragm vibrates the gases in the chamber 45 and transmits the vibrations inside of the boiler or other heat exchange apparatus upon which it is mounted. Thus, the vibrations serve to dislodge the accumulated soot and ash from the heating surfaces, which, in the present case are the tubes 52.

The chamber 45 may be of any desired size depending upon the work which it has to do. The work may be of two kinds, one of which is to move each lodged particle through a distance sufficient to dislodge it, and the other of which is to maintain each particle in a state of shimmering movement through small distances sufficient to prevent its lodgment. If one vibrator is to clean the entire boiler it would necessarily be of considerable size, while much smaller units could be used for localized cleaning as shown in Fig. 5. This method of setting up the desired vibrations in the boiler has an advantage over the other methods shown in that no extraneous gases are introduced into the boiler in obtaining the results desired.

The vibrators are shown located in a vertical wall of a boiler to set up vibrations laterally of the normal direction of flow of the boiler gases

but it will be understood that the invention is equally applicable to vibrating the gases in their direction of flow or in a direction constituting a component of the lateral and longitudinal directions. While the devices herein shown are of a mechanical nature vibrators of other types may prove to be equally applicable.

This application is a substitute for my application number 352,494, filed August 14, 1940.

What I claim is:

1. The method of cleaning heat exchange surfaces of solid particles from combustion gases which consists in subjecting said gases to a series of impacts at short intervals such that said gases are vibrated continuously on regular wave lengths, such impacts being of a severity and from a direction such that the solid particles are caused to deflect from their normal travel whereby lodgment on the surfaces is discouraged.

2. The method of preventing the lodgment of boiler gas residue on heat exchange surfaces which consists in subjecting said gases to vibrations directed angularly of the direction of flow of said gases and with sufficient intensity to cause back and forth movements of the particles constituting said residue out of their normal direction of flow whereby the particles are discouraged from lodgment on surfaces.

3. The method of operating a boiler containing boiler tubes which consists in vibrating a surface disposed in one wall thereof at a frequency such that all solid particles in the combustion gases are given a shimmering movement as they pass said surface.

4. The method of maintaining heat exchange surfaces free from deposition of solid particles of combustion gases without dilution of and change in temperature of the gases which consists in subjecting said gases to vibrations having a wave length equal to that of sound said vibrations being directionally imposed substantially normal to the normal direction of travel of the gases and of an intensity such that the particles are deflected from their normal paths in passing through the section in which said surfaces are located.

5. The combination of a boiler having tubes, a vibratory device opening to the interior of the boiler in the vicinity of the tubes, means operating said device to impose a continuous series of rapid, continuous impacts on said gases of sufficient intensity and in a direction to cause vibrations entirely throughout said boiler and to cause solid particles in said products of combustion to shimmer and to alter their natural course.

6. The combination of a boiler having heat exchange surfaces, a device for creating sound exposed to the interior of said boiler, and means operating said device continuously to subject products of combustion passing over said surfaces to vibrations having the wave length of sound, said device being so disposed in said boiler that the vibrations therefrom are directed against said gases angularly with respect to their direction of travel whereby solid particles of said products of combustion are individually vibrated during transit past said tubes.

WILLIS P. THOMAS.