Jan. 16, 1951 A. MEYER 2,538,701

GAS TURBINE PLANT HEAT EXCHANGER CLEANING APPARATUS

Filed June 3, 1946 2 Sheets-Sheet 1

Fig. 1.

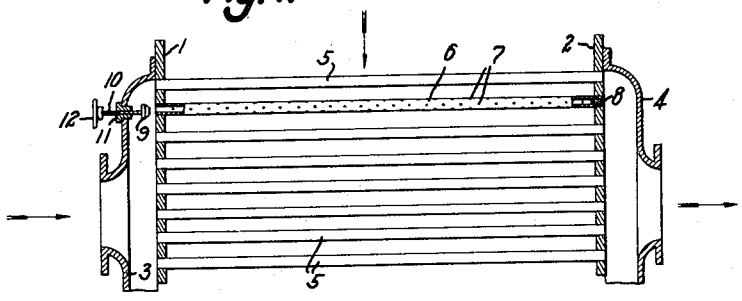


Fig. 2.

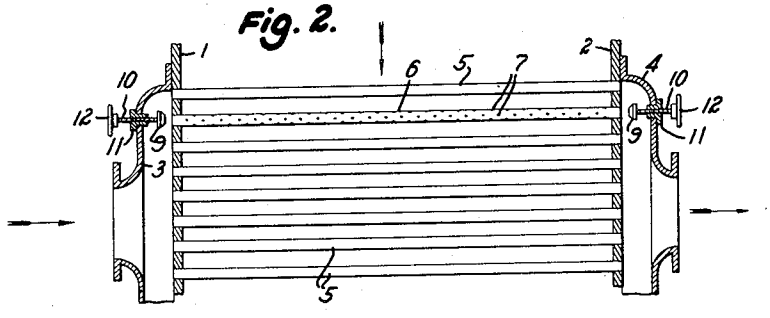
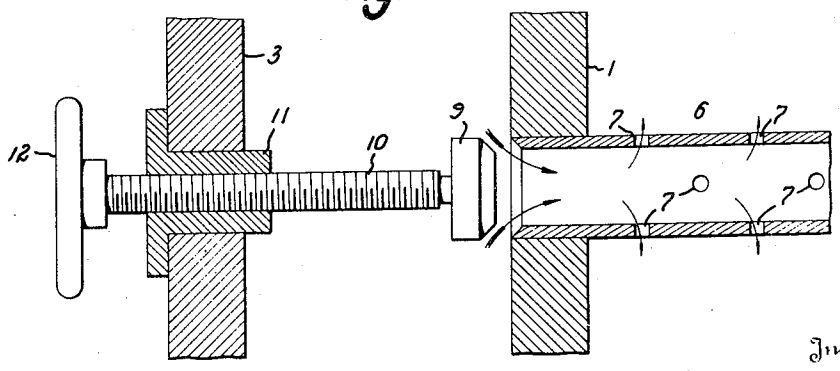


Fig. 3.



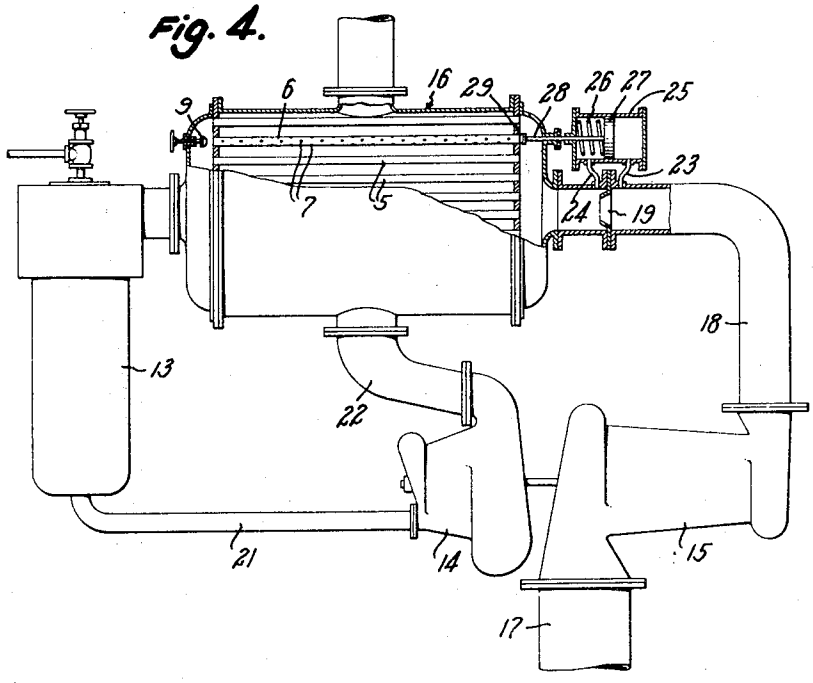
Inventor:
Adolf Meyer
By Pierce & Scheffler
His Attorneys.

Jan. 16, 1951 A. MEYER 2,538,701

GAS TURBINE PLANT HEAT EXCHANGER CLEANING APPARATUS

Filed June 3, 1946 2 Sheets-Sheet 2

Fig. 4.



Inventor:
Adolf Meyer,
By: Pierce, Scheffler & Parker,
Attorneys

Patented Jan. 16, 1951 2,538,701

UNITED STATES PATENT OFFICE

2,538,701

GAS TURBINE PLANT HEAT EXCHANGER CLEANING APPARATUS

Adolf Meyer, Kusnacht, Switzerland, assignor to Aktiengesellschaft Brown, Boveri & Cie, Baden, Switzerland, a joint-stock company

Application June 3, 1946, Serial No. 674,001
In Switzerland June 21, 1945

1 Claim. (Cl. 60—41)

1

The invention relates to heat exchangers of the type in which heat is exchanged through a heat conducting wall between a clean gas, such as air, to be heated and an impure gas, such as waste combustion gas, which is to be cooled or from which heat is to be recovered. In the operation of such a heat exchanger, for example a heat exchanger serving to preheat the combustion air supply to a gas turbine plant by heat exchange with the hot waste combustion gas, the heat conducting wall becomes coated with dust and soot and has to be cleaned in order to avoid the heat insulating effect of the deposit and maintain the efficiency of heat transfer.

An object of the present invention is to provide a heat exchanger and a method of operation by which such a heat exchanger readily may be cleaned.

A further object of the invention is to provide a heat exchanger and a method of operation by means of which the heat exchanger is cleaned during continuous operation by means of the air supply to the heat exchanger.

The invention is applicable to any heat exchanger such as that of a gas turbine plant in which the pressure of the gas, such as air, being heated is greater than the pressure of the gas such as combustion gas being cooled.

The invention resides in the provision of means whereby a portion of the air delivered under pressure to the heat exchanger may be discharged against the surfaces to be cleaned. In a specific embodiment of the invention in which the heat exchanger consists of heat exchange tubes extending across a conduit or chamber through which the hot combustion gas passes in contact with the outside surfaces of the tubes and air passes through the tubes, one or more of the heat exchange tubes, or a tube or tubes, specially provided and positioned with respect to the heat exchange tubes to be cleaned, may have bore holes for discharging air forcibly against the tubes to be cleaned. Since the heat exchange tubes need not be cleaned continuously and since the air used for cleaning is taken from the supply of air to the gas turbine plant it is preferable to provide means for controlling the supply of air to the jet tube which may be operated intermittently and in the case of a plurality of jet tubes distributed within a bank of heat exchange tubes it is preferable to provide means for controlling the supply of air to the jet tubes individually so that only one or only a small proportion of the jet tubes are supplied with air at one time. The means for controlling the supply

2

of air to the jet tube preferably is so positioned that air entering the heat exchanger is delivered directly to the jet tube before traversing the heat exchange tubes so as to avoid the loss of heat incident to first heating the air by heat exchange and then discharging it through the jet tube. It is within the scope of my invention, however, to control the admission of air to the jet tube so that the latter is supplied with only heated air or air may be supplied to both ends of the tube. Supplying air to both ends of the jet tube has the advantage that the delivery of air through the jets thereof is more nearly uniform throughout the length of the jet tube.

The invention is illustrated in the accompanying drawings in which:

Fig. 1 is a vertical section of a heat exchanger with means for controlling the supply of air to the cold end only of the jet tube,

Fig. 2 is a vertical section of a heat exchanger with means for controlling the supply of air to both ends of the jet tube,

Fig. 3 is an enlarged section of the air supply control valve and

Fig. 4 is an elevation, partly in section, of a gas turbine plant employing a heat exchanger cleaner and surge reducer.

In Figs. 1 through 3, walls 1 and 2 are the walls of the conduit or chamber through which the hot combustion gas passes and into which the heat exchange tubes are secured, 3 and 4 are inlet and outlet headers for the air which passes through the heat exchange tubes 5, and 6 is a jet tube which, as appears in Fig. 3, is provided with jet openings 7, suitably distributed to discharge jets of air against the surrounding tubes 5. It will be appreciated that a plurality of jet tubes 6 may be distributed among the heat exchange tubes 5 and that the heat exchange tubes may be arranged to take the best advantage of the cleaning action of the jets. In the embodiment illustrated in Fig. 1 the right hand end or hot end of the jet tube 6 is closed by a plug 8 while the left hand end is provided with a control valve comprising valve plate 9 carried on the end of screw threaded spindle 10 which works through screw threaded plug 11 in the wall of the header 3. On the outer end of the spindle 11 is a hand wheel 12 by means of which the valve plate 9 can be moved to open and closed positions. By opening the valve a portion of the air entering the exchanger is permitted to enter the jet tube 6 and flow out through the jet openings 7 and clean the accumulation of soot and dust off of the surrounding tubes 5. The valve is

opened only as often and for so long as is necessary to effect the cleaning and is then closed in order to avoid wasting the compressed air. When there are a plurality of jet tubes each controlled by a separate valve it is advisable to operate one at a time in order to avoid interference with the operation of the heat exchanger and the air supply.

It will be appreciated that means may be provided for operating a single valve periodically or for operating a plurality of valves periodically and in sequence.

In the embodiment illustrated in Fig. 2 the jet tube 6 is controlled by valves at both ends, either or both of which may be opened to admit air.

The jet tubes may have an additional function or utility in a gas turbine plant in that they may serve to prevent the so-called pumping or surging of the blast. Pumping generally occurs when the air supply is low and it is customary to provide an automatic blow out valve to prevent pumping. The jet tubes may serve as a substitute for the blow out valve and the valves controlling the supply of air to the jet tubes may be made to open automatically to prevent pumping. Thus the cleaning of the heat exchange tubes occurs automatically at each occurrence of a small air blast supply to the combustion chamber or burner of the gas turbine plant.

Fig. 4 shows a heat exchanger installed in a gas turbine plant of a common type having a combustion chamber 13, a gas turbine 14, a compressor 15, and a heat exchanger 16. Air drawn in by the compressor 15 at 17, is compressed and forced through header 18, provided with metering nozzle 19, and through the tubes 5 of the heat exchanger 16 into the combustion chamber 13 where it serves in part to support fuel combustion, and in part to mix with and cool the produced combustion gases as they leave the combustion chamber.

The mixed gases flow through pipe 21 to the gas turbine 14 wherein they expand while actuating rotation of the turbine rotor, and then pass through exhaust gas conduit 22 to the heat exchanger 16. In the heat exchanger, the hot gases passing around the tubes give up a part of their heat to the compressed air flowing through the tubes en route to the combustion chamber, thus increasing the thermal efficiency of the plant in customary fashion.

In front of and behind the metering nozzle 19, conduits 23 and 24 respectively lead to the two sides of a piston 27 which is reciprocable in a closed cylinder 25, but normally maintained in position, as shown, by the pressure of a spring 26. The piston 27 is joined by a connecting rod 28 to a valve plate 29 identical with the valve plate 9 controlled by a manually operable valve of the type described above. The valve plate 29 normally closes the admission opening of the jet pipe 6, since the pressure at the right of the piston 27, due to the pressure drop in the nozzle 19, is greater than at the left. When conditions conducive to "pumping" and surging arise, i. e., when pressure in the cylinder drops on the right hand side of the piston, the pressure at the left finally prevails and moves the piston 27 to the right so that tube 6 is opened and the compressed air, not yet heated up by the hot exhaust gases of turbine 14, escapes through the holes 7 and cleans the adjacent tubes 5 on the outside removing the soot, etc. of the exhaust gases. If the compressor 15, upon increasing load, for instance, pumps a greater amount of air again, the pressure at the right of the piston 27 prevails over the opposed pressure and closes the admission opening of the tube 6 with the valve plate 29. The valve 9 at the left end of the tube 6 can be opened or closed at will, but obviously will normally be closed.

It will be understood that the invention is applicable to any type of heat exchanger, that other forms of valve mechanism may be employed for controlling the flow of gas through the jet tubes, that the hot ends only of the jet tubes may be valved and the cold ends plugged as distinguished from the arrangement illustrated in Fig. 1 and that still other modifications of the embodiments illustrated may be made within the scope of my invention as defined in the appended claim.

I claim:

Means for cleaning the heat exchanger and simultaneously preventing pumping of the gas supply in a gas turbine plant having a compressor, said means comprising a heat exchanger having at least one normally inactive tube and a plurality of normally active tubes through the latter of which said gas passes to receive heat by indirect exchange from hot combustion products sweeping against the outside of said tubes, the normally inactive tube having valve means for normally excluding said gas therefrom and having at least one perforation providing for jetting said gas against the outside surfaces of the normally active tubes, a header supplying said gas to said heat exchanger from said compressor, means responsive to incipient pumping conditions within said header, and means actuated by said incipient pumping responsive means for opening said valve means when an incipient pumping condition occurs in the gas supply.

ADOLF MEYER.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,764,189	Bell	June 17, 1930
2,028,250	Rossner	Jan. 21, 1936
2,109,855	Arey	Mar. 1, 1938
2,200,668	Carlson	May 14, 1940
2,302,513	Abraham, Jr.	Nov. 17, 1942
2,403,388	Morey	July 2, 1946
2,418,911	Smith	Apr. 15, 1947

FOREIGN PATENTS

Number	Country	Date
212,269	Switzerland	Feb. 17, 1941