Feb. 16, 1926. 1,573,427

H. H. STOUT

UTILIZATION OF WASTE HEAT OF FURNACE GASES

Filed Sept. 17, 1920

Fig. 1

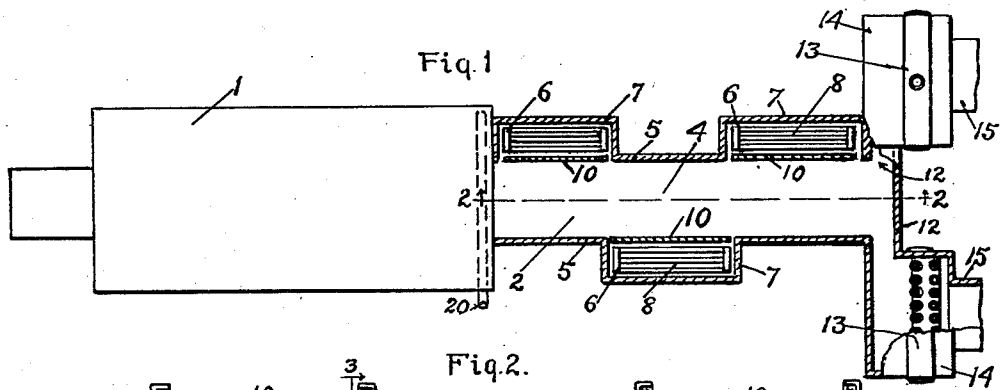


Fig. 2.

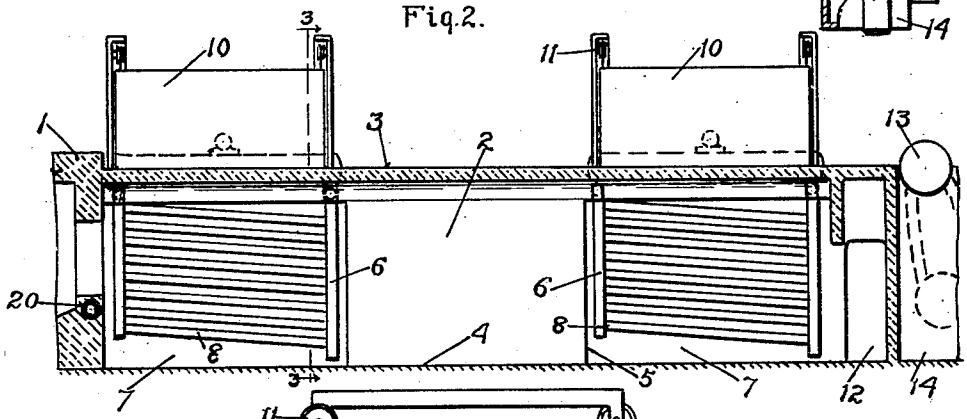
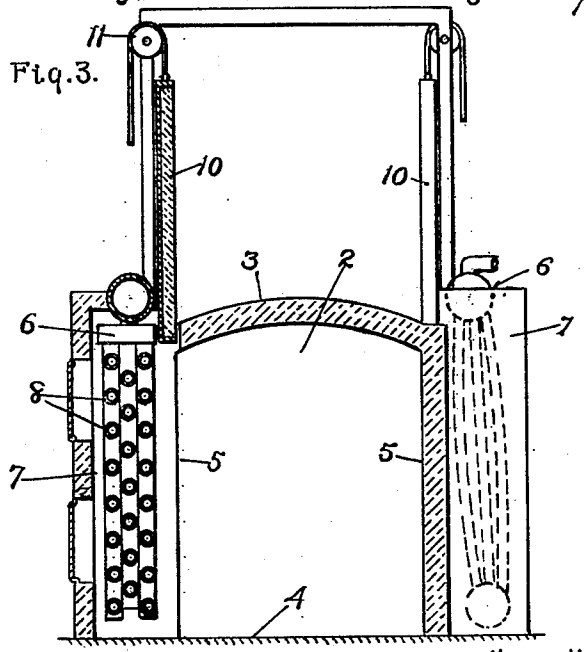


Fig. 3.



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UNITED STATES PATENT OFFICE.

HARRY HOWARD STOUT, OF DOUGLAS, ARIZONA.

UTILIZATION OF WASTE HEAT OF FURNACE GASES.

Application filed September 17, 1920. Serial No. 410,998.

To all whom it may concern:

Be it known that I, HARRY HOWARD STOUT, a citizen of the United States, residing at Douglas, in the county of Cochise and State of Arizona, have invented a new and useful Improvement in Utilization of Waste Heat of Furnace Gases, of which the following is a specification.

This invention relates to waste heat boilers for generation of steam by utilization of the waste heat in gases passing from metallurgical furnaces, cement kilns, or other furnaces producing hot gases containing more or less dust, fume, or suspended material. A serious difficulty in the operation of such waste heat boilers arises from the deposition of such suspended material on the boiler tubes, particularly where the temperature of the gases is so high that such material deposits in fused or partly fused condition, forming a hard adherent deposit. These deposits clog the passages between the boiler tubes and interfere with the passage of the gases and also interfere with the transmission of heat from the gases to the boiler tubes, and it is necessary to remove the deposits from time to time, this requiring opening of the fire doors, or even shutting down the boilers temporarily while the boiler tubes are being cleaned, with resulting diminution in steam production.

The main object of this invention is to prevent or reduce the accumulation of such adherent deposits on the boiler tubes. A further object of the invention is to provide a waste heat boiler construction in which the boiler tubes are out of the direct path of the hot dusty gases so that such gases do not encounter obstructing surfaces tending to receive the fused or semi-fused deposits. Another object of the invention is to provide for absorbing heat from the hot gases by means which do not obstruct the flow of gases and for radiating the heat so absorbed to steam boiler tubes which are out of the direct path of the gases.

The accompanying drawings illustrate apparatus suitable for carrying out my invention, and referring thereto:

Fig. 1 is a diagrammatic plan view, partly in section, of a furnace and waste heat boiler installation embodying the invention;

Fig. 2 is a vertical section on line 2—2 in Fig. 1;

Fig. 3 is a transverse section on line 3—3 in Fig. 2.

My invention is applicable in connection with various kinds of furnaces, for example, reverberatory, or other metallurgical furnaces, cement kilns, or other furnaces or kilns whose effluent gases contain dust or fume constituent at such high temperature as to tend to collect on obstructing surfaces in a more or less fused condition. In Fig. 1 of the drawing I have, by way of example, illustrated the application of the invention to a reverberatory furnace, indicated at 1. An outlet flue 2 is connected to such furnace to receive the hot gases therefrom, the walls (including the top 3 and floor 4, as well as the side walls 5 of the flue) being of suitable refractory construction, such as firebrick, so as to be adapted to be heated to high temperature by contact with the hot furnace gases.

Located alongside of the flue 2 are a series or plurality of steam boiler units 6, each mounted, for example, in a bay, recess or boiler chamber 7, beside the flue, so as to be out of the direct path of the gases passing in the flue but exposed to radiation of heat from the opposite side wall as well as from adjacent roof and floor portions of the flue, the water tubes 8 of said boilers being, therefore, heated largely by radiation. It will be understood that while the main gas stream passes in a general longitudinal direction through flue 2 without passing in direct contact with the water tubes 8 in recesses 7, there are of course some local convection currents or eddy currents in said recesses and around said tubes. Some heat is therefore imparted to the water tubes by convection, in addition to the heat derived by radiation from the hot walls of the flue facing the water tubes. Said water tubes preferably extend more or less in the direction of the gas flow so as to minimize any obstructing effect they may present, but can be vertical, as shown at the right hand side of Fig. 3. Successive boilers, or boiler units, are preferably arranged alternately on opposite sides of the flue as shown in Fig. 1 so as to permit the exposed radiating portions of the side walls to be distributed with maximum uniformity throughout the length of the flue and on both sides thereof and therefore enable such

radiating side walls to more uniformly and effectively take up the heat from the gases passing in the flue.

In case any material collects on the boiler tubes it may be removed from time to time, the boiler chamber being shut off from flue 2 at such time by means of a partition or curtain wall 10, which is normally supported by suitable means 11 and is brought into position between the flue and the boiler chamber, when required, the boiler tubes being then cleaned in the usual manner.

The gases may pass from flue 2 through conduits 12 to additional heat utilizing means comprising steam boilers 13, mounted in boiler chambers or settings 14 in the usual manner of waste heat boilers, the gases finally passing by flues 15 to suitable stack means.

The operation of the invention is as follows:

The hot gases coming from furnace 1 pass through the flue 2 and give up a part of their heat to the flue walls, which are thereby heated to a high temperature and caused to radiate heat to the boiler tubes opposite or adjacent thereto. The boiler tubes also receive some heat directly from the gases, but as the gas stream does not impinge directly on the boiler tubes there is little tendency for deposition of suspended material on the tubes. The flue presents sufficient heat absorbing and radiating surfaces, including top 3, floor 4, and the unrecessed portions of the side walls 5, to reduce the temperature of the gases in passing through the flue to or below the fusing point of any constituent liable to be deposited on the boiler tubes, and as the gases pass from the flue they are therefore at such temperature that any suspended material they may contain is in solid conditions or sufficiently cooled to prevent the formation of a fused or semi-fused deposit. The effluent gases from the flue 2 may therefore be passed through the water tube, or other boilers 13, without liability of forming an adherent deposit thereon, and any solid material that may collect on the tubes of such boilers may be readily removed.

In the application of the invention to gases from reverberatory furnaces used in copper smelters, the gases, as they leave the furnace, have a temperature of about 2300° F., at which temperature the suspended material in the gases tends to form a more or less molten deposit, and in passing through the flue the gases should be reduced in temperature to about 1400° F., at which temperature the suspended material is solid.

My invention is applicable with advantage to other kinds of furnaces, for example, to cement kilns using waste heat boilers and producing effluent gases containing fusible constituents; for example, alkali-metal compounds which tend to fuse onto the boiler tubes. This is especially the case where an agent, such as sodium chloride, is used to increase the volatilization of potassium compound from the raw mix in the kiln, and has heretofore been considered as preventing the use of such an agent where waste heat utilization is required. By operation of the process above described, the gases from the kiln may first be reduced in temperature in a preliminary radiation boiler plant, for example, of the construction described, and the gases then passed through an ordinary waste heat boiler installation to further utilize the heat thereof.

While I have shown the boiler units as arranged at the sides of the flue through which the hot gases pass, and in alternate arrangement, it will be understood that they may be arranged in any position adjacent to the gas stream but out of the direct path of the gas, and may be of any desired number and closeness of arrangement, according to the requirement of any particular case.

By reason of the suspended matter contained in the gasses passing through the flue and adjacent to or alongside the boiler tubes considerable radiation may take place from such suspended matter directly to the boiler tubes, and in some cases, this may be an important factor in the operation of the boilers.

As shown in Figs. 1 and 2, means, such as a water pipe 20, may be provided at the bridge wall below the outlet of the furnace 1, so that the molten slag will not break through into the boiler setting.

What I claim is:

1. In combination with a furnace, a flue adapted to receive hot gasses therefrom, and having a heat-absorbing and heat-radiating side wall, and having a lateral recess opposite said wall and in open communication with the flue passage, steam boiler means in said recess, out of the direct path of such gases through the flue, and adapted to receive heat by radiation from said side wall, and partition means movably mounted adjacent to the flue and adapted to be moved into position between said recess and said flue, to temporarily shut off said boiler means from the flue.

2. Means for utilizing heat of furnace gases comprising a flue for passage of the gases and having heat absorbing and heat-radiating walls, and a plurality of steam boiler units arranged along the flue in open communication therewith and out of the direct path of the gases through the flue, and in alternate arrangement on opposite sides of the flue, so that the boiler units alternate with radiating wall portions and a radiating wall portion is opposite each boiler unit.

3. Means for utilizing heat of furnace gases comprising a flue adapted for passage

of the gases and having heat-absorbing and heat-radiating walls, and a plurality of boiler units arranged along the flue in open communication therewith and out of the direct path of the gases passing in the flue, each boiler unit being adapted to receive heat by radiation from opposite and adjacent wall portions of the flue, and partition means adapted to be brought into position between the flue and the respective boiler units to shut off any boiler unit from the flue independently of the other units.

In testimony whereof I have hereunto subscribed my name this 31st day of August, 1920.

HARRY HOWARD STOUT.