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PROVISIONAL SPECIFICATION.

Improvements in and relating to Air Heaters.

We, TYNESIDE FOUNDRY AND ENGINEERING COMPANY LIMITED, of Skinnerburn Road, Low Elswick, Newcastle upon Tyne 4, a British Company, and GEORGE NORMAN STRAUGHAN, of the Company's address, a British subject, do hereby declare the nature of this invention to be as follows:—

This invention relates to air heaters, and has for its object to provide an air heater of simple and compact construction which is particularly suitable for the production of hot pressure air for use in a tea, copra or similar drier, but may be employed generally for heating or superheating air.

The air heater of the present invention is of the kind having means for delivering air under pressure to the inlet ends of externally-heated air tubes the outlet ends of which communicate with a drying chamber or the like, and is characterised by the use of air-heating tubes of flat section, their transverse section being not more than half their vertical section, and preferably not greater than three-quarters of an inch wide, to ensure that the air under pressure passing through will rub against the walls of the tubes and be heated to the maximum extent. This arrangement supersedes the customary practice of inserting spiral baffles in tubes of circular section for the same purpose. Moreover the use of flat section tubes has the advantage that the external area of the tubes liable to gather soot is reduced.

In the preferred arrangement, two nests of air-heating tubes are mounted in heat-insulated boxes on each side of a central furnace thereby reducing the wear and strain on the tubes and avoiding wastage of heat. The products of combustion are drawn into the boxes from the upper portion of the furnace through lateral openings therein and pass down through the nests of air-heating tubes and through openings in the bottoms of the boxes to a flue leading to a fan in a chamber at the base of a chimney. A valve is provided in said flue for controlling the flow of flue gas and hence the combustion of the furnace. The flue gas fan operates at a lower pressure than the air fans delivering pressure air to the air-heating tubes, thus ensuring that, in the event of leakage or fracture of an air tube, no flue gas, soot, ash or the like can enter the leaking or cracked tube and so gain access to the air stream and be carried thereby into the drying chamber. All risk of the contents of the drying chamber being set on fire by sparks or detrimentally affected by the accidental introduction of smoke is thus eliminated.

For the purpose of controlling the air temperature, we provide a valve in the conduit leading from the nests of air-heating tubes to the drying chamber. This valve can be set to maintain a pre-determined maximum temperature for operation, and said temperature can be raised by slightly increasing the normal opening of the flue gas valve, or lowered by slightly increasing the normal opening of the valve in the air conduit.

Dated this 9th day of July, 1948.

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[*Price* 2/-]

COMPLETE SPECIFICATION.

Improvements in and relating to Air Heaters.

We, TYNESIDE FOUNDRY AND ENGINEERING COMPANY LIMITED, of Skinnerburn Road, Low Elswick, Newcastle upon Tyne 4, a British Company, and GEORGE NORMAN STRAUGHAN, of the Company's address, a British subject, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to air heaters, and has for its object to provide an air heater of simple and compact construction which is particularly suitable for the production of hot pressure air for use in apparatus for drying tea, copra, coffee and cocoa beans, nuts, roots or the like, but may be employed generally for heating or superheating air.

The air heater of the present invention is of the kind provided with nests of externally-heated air tubes in heat-insulated boxes on each side of a furnace, separate fans being provided for drawing the gaseous products of combustion from the furnace downwards through said boxes and for delivering air under higher pressure than said products to the inlet ends of said air tubes, the outlet ends of which communicate with a drying chamber or the like, the construction being characterised in that the air-heating tubes are of flat section, the major internal diameter of each tube being at least twice its minor internal diameter, the opposite longer sides of the sectional shape of the tubes being straight and parallel to each other and the opposite shorter ends of the section being curved whereby the tubes are substantially of oval section. Preferably, the minor internal diameters of the tubes do not exceed three-quarters of an inch to ensure that the air under pressure passing through them will rub against the walls of the tubes and be heated to the maximum extent. This arrangement supersedes the customary practice of inserting spiral baffles in tubes of circular section for the same purpose. Moreover, the use of flat section tubes has the advantage that the external area of the tubes liable to gather soot is reduced.

The expression "flat section tubes" used herein is intended to define tubes resulting from the flattening of tubes of a circular section.

The accompanying drawings illustrate, by way of example, the application of our invention to an air-heating furnace fed with solid fuel. In the drawings:

Figures 1 and 2 are elevations at right-angles, partly in section.

Referring to the drawings, in the example therein illustrated, the furnace is provided with two nests of air-heating tubes *a* of flat section which are mounted in heat-insulated boxes *b* on each side of a central furnace *c*, thereby reducing the wear and strain on the tubes and avoiding wastage of heat. The products of combustion are drawn into the boxes from the upper portion of the furnace through lateral openings *d* therein and pass down through the nests of air-heating tubes and through openings *e* in the bottoms of the boxes to a flue *f* leading to a fan *g* in a chamber *h* at the base of a chimney *j*. A valve *k* is provided in said flue for controlling the flow of flue gas and hence the combustion of the furnace. Pressure air at atmospheric temperature is delivered by a fan *m* to an air flue *n* leading to the air-heating tubes *a*. The flue gas fan *g* operates at a lower pressure than the air fan *m*, thus ensuring that, in the event of leakage or fracture of an air tube, no flue gas, soot, ash or the like can enter the leaking or cracked tube and so gain access to the air stream and be carried thereby into the conduit *o* leading from the air tubes *a* to the drying chamber. All risks of the contents of the drying chamber being set on fire by sparks or detrimentally affected by the accidental introduction of smoke is thus eliminated.

For the purpose of controlling the air temperature, we provide a valve (not shown, but which may be of the vertical slide type) in the hot pressure-air conduit *o* which can be set to maintain a predetermined maximum temperature for operation. The temperature in the drying chamber can be raised by slightly increasing the normal opening of the flue gas valve *k*, and can be lowered by slightly increasing the normal opening of the valve in the air conduit *o*.

The tubes *a* are disposed with their major transverse axis vertical and the minor transverse axis horizontal. Preferably the internal horizontal transverse dimension, that is, the internal minor axis, is not more than three-quarters of an inch. The internal vertical dimension, that is, the internal major axis is not less than twice the internal minor axis. Suitably, the internal major axis has a length of four inches, whilst the internal minor axis is three-quarters of an inch.

The use in our improved air heater of air-heating tubes *a* of flat section ensures

that the air under pressure delivered by the fan *m* is heated to a maximum extent by the products of combustion from the furnace *c*, the shape and dimensions of the tubes causing the air to rub against their walls during its passage to the hot pressure-air conduit *o*. As the upper ends of the tubes are of small diameter, they afford minimum lodgment for soot and dust, and the tubes present almost the whole of their external surfaces directly to the products of combustion.

We are aware that air-heating tubes of elliptical or flat cross-section have been provided in the upper part of the combustion chamber of a stove having a power fan for driving air through said tubes, and we make no claim to such tubes of themselves, but, having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. An air heater of the kind referred to wherein the air-heating tubes provided therein are of flat section, the major internal diameter of each tube being at least twice its minor internal diameter, the opposite longer sides of the sectional shape of the tubes being straight and parallel to each other and the opposite shorter ends of the section being curved whereby the tubes are substantially of oval section.

2. An air heater as claimed in Claim 1 having air-heating tubes whose respective minor internal diameters do not exceed three-quarters of an inch.

3. The air heater illustrated in the accompanying drawings and herein described with reference thereto.

Dated this 7th day of June, 1949.

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