To all whom it may concern:

Be it known that I, WILLIAM HENRY OWEN, residing at 19, Home Park Road, Wimbledon, S. W. 19, in the county of London, England, have invented certain new and useful Improvements in or Relating to Arrangements for Supplying Heated Air to Furnaces, of which the following is a specification.

This invention relates to pre-heating air for furnaces, and its reference more particularly to the system in which the air is delivered to the furnaces above the grate is heated to a higher temperature than the air delivered to the ash-pit, that is to say below the grate.

The main object of the invention is to facilitate the application of such a system to cylindrical marine or Scotch boilers, by the employment of air heaters situated immediately above the smoke boxes and in the path of the waste gases to the chimney, such heaters effecting the heating of the air to the furnaces in two (or more) stages.

According to the invention the heat from the boiler or from the smoke boxes is utilized to maintain or increase the temperature of the hotter part of the air, viz. that which is delivered above the grate to promote the combustion of the fuel gases.

In order that such hot air for the furnace shall have its temperature maintained as high as possible after leaving the heaters it is led according to the invention through the ducts or passages arranged close to or upon the front end wall of the boiler and situated between or at the side of the openings of the ends of the boiler tubes so that the said passages are also subject to the heat of the waste gases, being as it were jacketed with waste gas on one or both sides.

These ducts or passages may conveniently be formed by the walls of the smoke boxes and the boiler front, and be arranged to form supplementary heaters, not only maintaining but raising still further the temperature of the air.

The main heater above the smoke-box may advantageously be placed a little away from the boiler front, the intervening space forming or accommodating a distributing belt or passages along the back of the main heater to distribute the hotter air to the passages leading to the furnaces. The cooler air may conveniently pass from the main heater to the ash-pits by passages arranged outside the wing smoke-boxes and be separated from the ducts for the hotter air (if also in that position) by insulation or insulating walls. The whole arrangement may be enclosed in a casing with the ducts or passages for the hotter air nearest the boiler front, suitable valves or dampers being provided for controlling the supply to the furnaces and ash-pits as desired.

In order that the invention may be clearly understood and readily carried into effect reference will now be had by way of example to the accompanying diagrammatic drawings or sketches in which:

Fig. 1 is a front view, half in section, of a boiler with the invention applied thereto and provided with super heaters for the steam. Three furnaces are shown for the purpose of illustration, but the invention may be applied to boilers having any number of furnaces.

Fig. 2 is a side view thereof, partly in vertical central section.

Fig. 3 is a similar view to Fig. 2, but with the vertical section running through the left-hand furnace and its smoke-box.

Figs. 4 and 5 are views corresponding to Figs. 1 and 2 but illustrating a boiler without steam super-heaters.

Referring more particularly to Figs. 1 to 3, of these drawings:

a represents the shell of the boiler which is of the ordinary cylindrical marine or Scotch type and is provided with smoke tubes c' and with three furnaces, b, b' and b''

c, c', c'' represents the smoke-boxes of these furnaces. Interposed between these smoke boxes and the base or uptake d leading to the funnel or chimney is a chamber or box e which forms a two-stage heater for the air-supply to the furnace. This heater is provided with vertical smoke tubes f for the waste gases, the ends of these tubes being fixed in the sheet metal floor and roof of the chamber e. About one-third of the way up, the latter is divided horizontally into an upper and lower compartment by a horizontal partition or division plate g.

The air to be heated is admitted through an opening i in the upper middle front part of the chamber and flows outward above the
division plate and undergoes the first stage of its heating as it makes its way through the nest of tubes \( f \), which may be staggered or be provided with baffles to cause it to follow a zig-zag path and promote the heating effect.

It then splits up, part going down the ducts or passages \( j \) outside the wing smoke boxes \( a \) to the ash-pits of the respective furnaces \( b \), and through branch passages leading into the ash-pit of the central furnace from each side. This part of the air forms what is herein termed the cooler portion of the hot-air supply.

The other part of the air in the two-stage heater \( e \) turns back under the division plate \( g \), and as it travels again in and out between the smoke tubes \( f \) it undergoes the second heating stage and forms the hotter or superheater portion of the air supply, which is delivered to the furnaces above the grate bars.

In order that this hotter air shall have its temperature maintained as high as possible after leaving the heater, \( e \) is led out at the back of the heater \( e \) through one or more openings \( k \), as may be convenient to the distributing belt or passage \( k \) and thence to the vertical ducts or down flow passages \( k \) close to or upon the front end of the boiler and situated between (or at the side of) the ends of the group of boiler tubes \( a \) etc.

These ducts or passages may conveniently be formed by the walls or part of the walls of the smoke boxes or be structurally incorporated therewith, and being in direct contact with the waste gases immediately leaving the boiler, they form supplementary heaters which not only maintain but actually raise still further the temperature of the downflowing air.

The superheated air then passes to the tops of the mouths of the furnaces by distributing ducts \( k \) under the smoke-boxes, close to the boiler front plate and through suitable dampers \( m \) worked by lever handles \( l \).

In the arrangement illustrated, steam superheaters are as stated fitted to the boilers, their headers \( n \) being fixed in the smoke-boxes, and it will be seen that the air-ducts or passages \( k \) above referred to are placed behind the headers, and next to the boiler front.

Alternatively however they may be near to the internal front of smoke-box and structurally incorporated therewith, or be partly in front of the headers and partly behind the same as may be found convenient according to circumstances, and air being delivered to the passages \( k \) below the smoke-box leading to the furnace through air-valves or dampers \( m \), as before.

The cooler air would still pass from the main heater to the ash-pits as explained by passages \( j \) leading down and around the wing smoke-boxes and suitably separated from the hot air passages, for instance by insulating walls.

As stated the cooler air is distributed to the central ash-pit or ash-pits, and also to the inner sides of the wing ash-pits, by passages \( j \) leading under the smoke-boxes and overlaiding above the furnace fronts—see Figs. 2 and 3. To the outer sides of the wing ash-pits it is distributed simply by a prolongation of the passages \( j \) outside the wing smoke-boxes.

The whole arrangement is enclosed in a sheet metal casing, all the ducts for the hotter air being preferably next to the boiler front.

The various air-valves or dampers \( m \) are arranged as required in any convenient positions and operated by handles or cranks \( t \). In the arrangement shown in Figs. 4 and 5 the superheaters \( n \) are omitted and the whole depth of the space between the smoke boxes is utilized to form the heating space or down-flow passage which is indicated by \( k \).

Suitable baffles \( p \) are provided to distribute the air through the tubes \( f \) before entering the passages \( k \), especially when no distributing belt at the back or front is provided. Baffles \( t \) may also be fitted as indicated in Fig. 5, in the downflow passages \( k \) in order to give the air a zig-zag path and so promote the transfer of heat.

Obviously the above arrangements may be modified in various ways in carrying the invention into practice. For instance each smoke box might have a separate and independent air heater if desired. Also the number and arrangement of passages, ducts and baffles for the distribution of the air may be added to or modified according to the number of furnaces in the boiler, as convenient.

I claim—
1. In an air-heating arrangement for furnaces, the combination of means for heating all the air for combustion by waste gas, means for further heating a part of said air to a higher temperature by waste gas, means for supplying such hotter air to the space above the grate, and means for delivering the rest of said air below the grate.

2. In an air-heating arrangement for furnaces, the combination of a two stage air heater heated by waste gases, means for heating all the air through the first stage, means for conducting a part of such air along the sides of the boiler to the space below the grate, means for superheating the other part of said air, and means for conditioning such air from the hotter section of the heater to the space above the grate.

3. In an air-heating arrangement for furnaces, the combination of means for heating all the air for combustion by waste gas, means for further heating a part of said air, and means for conditioning such air from the hotter section of the heater to the space above the grate.
naces the combination of a two-stage air-heater comprising two sections one above the other, vertical tubes for the waste gases extending through both sections, means for conducting all the air for combustion through the upper section, means for further heating a part of said air in the lower section, means for conducting the air from the lower section to the space above the grate, and means for conducting the rest of the air from the upper and cooler section to the space below the grate, substantially as described.

4. In an air-heating arrangement, the combination of a two-stage air-heater comprising two distinct sections, tubes in said sections for the waste gases, means for heating all of the air in one section, means for conducting part of such air along the side walls of the boiler to the space below the grate, and means for further heating the rest of such air in the second section and between the smoke boxes, and means for conducting such hotter air to the space above the grate, substantially as described.

In testimony whereof I affix my signature.

WILLIAM HENRY OWEN.