Jan. 4, 1927. 1,613,306

J. E. BELL

OIL STILL

Filed Jan. 22, 1925 2 Sheets-Sheet 1

Fig. 1,

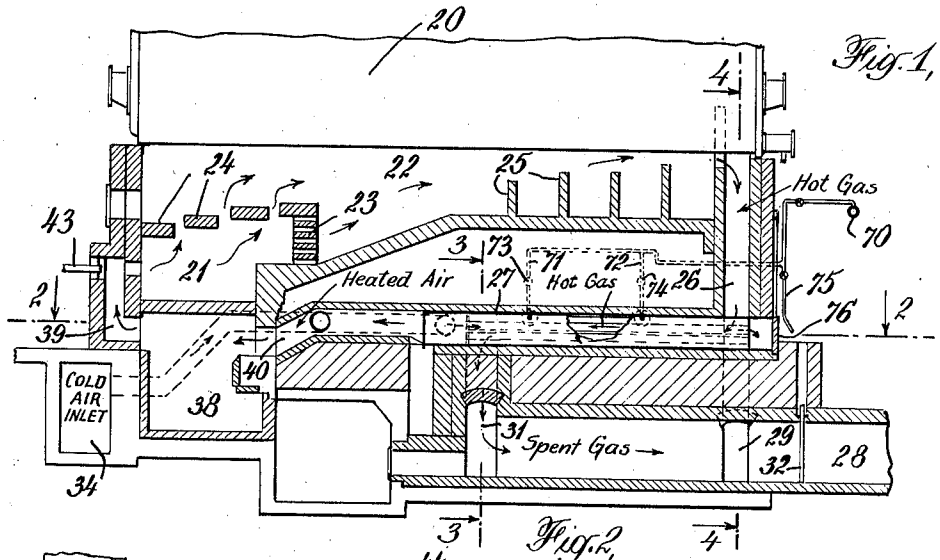


Fig. 2,

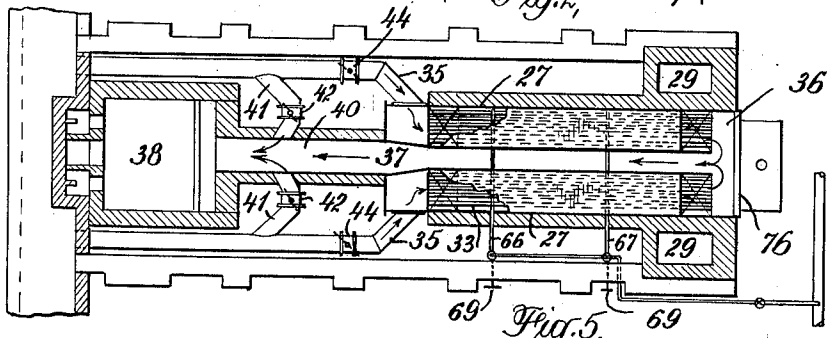


Fig. 5,

Fig. 3,

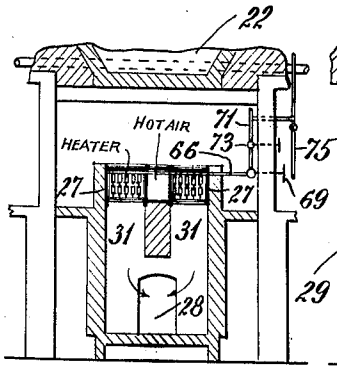
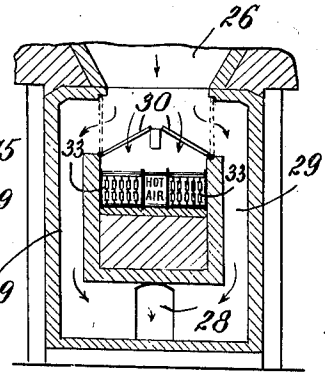
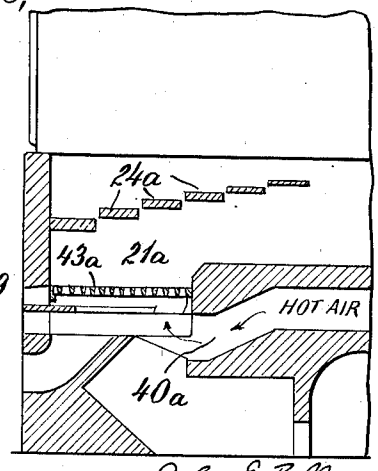


Fig. 4,





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by Lola R. Bell, Executrix

BY

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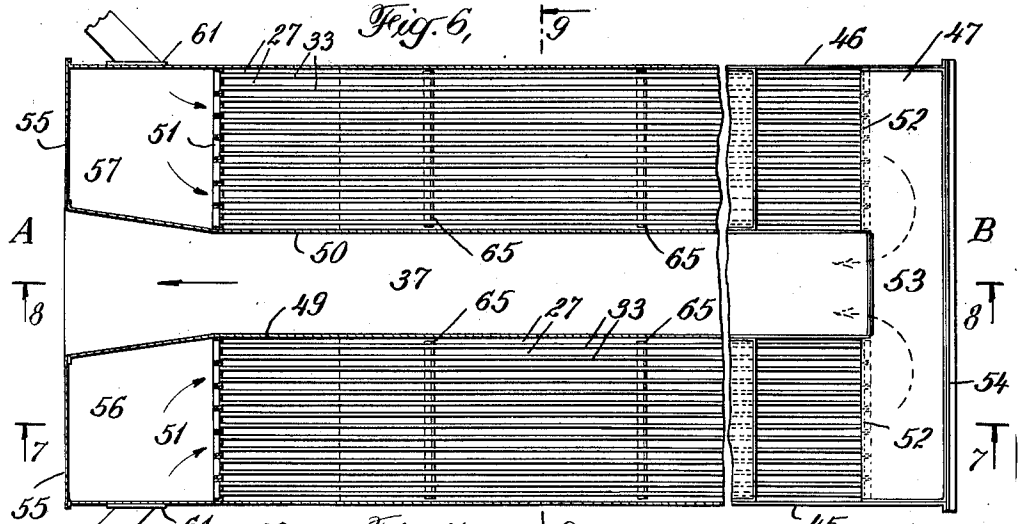
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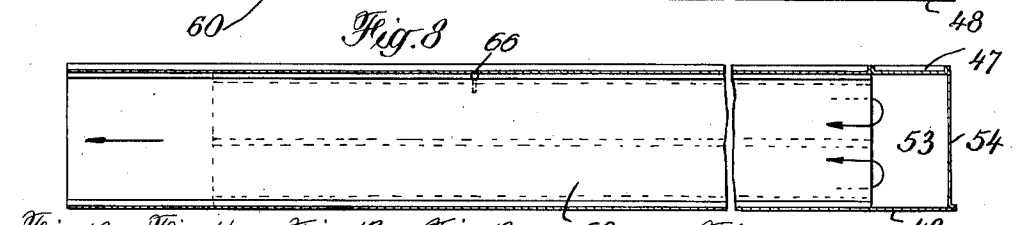
Jan. 4, 1927. 1,613,306

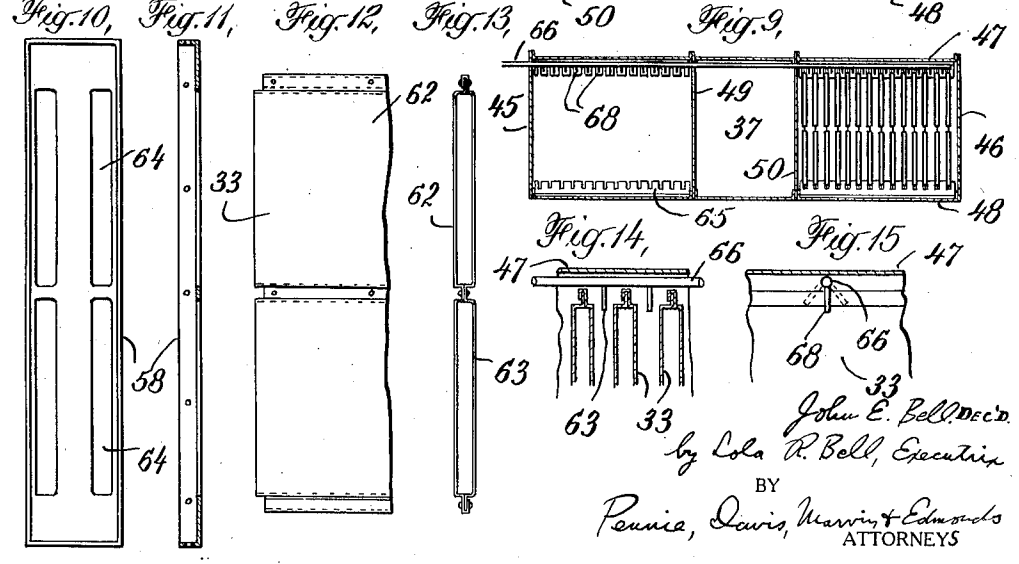
J. E. BELL

OIL STILL

Filed Jan. 22, 1925 2 Sheets-Sheet 2







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Patented Jan. 4, 1927. 1,613,306

UNITED STATES PATENT OFFICE.

JOHN E. BELL, DECEASED, LATE OF BROOKLYN, NEW YORK; BY LOLA R. BELL, EXECUTRIX, OF BROOKLYN, NEW YORK, ASSIGNOR TO SINCLAIR REFINING COMPANY, OF NEW YORK, N. Y., A CORPORATION OF MAINE.

OIL STILL.

Application filed January 22, 1925. Serial No. 3,989.

This invention relates to improvements in oil still settings and in the arrangements for heating oil stills. More particularly, the present invention relates to improvements in the construction and arrangement of oil still settings in which hot products of combustion of some suitable fuel are employed for heating the still externally.

The accompanying drawings illustrate an apparatus embodying the invention and in which the objects and advantages of the invention are secured. It is one of the objects of the invention to provide a still setting and heating furnace of improved capacity and efficiency. It is another object of the invention to provide a heating furnace in which the heating operation may be readily controlled and which is flexible in operation and capable of more or less sustained operation at high capacity and under overloads. It is a further object of the invention to provide a still setting and heating furnace in which these advantages of efficiency and capacity and control are secured, and which is compact and easily kept in order. Other and further objects will appear as the invention is described in connection with the accompanying drawings.

In the drawings:

Fig. 1 is a vertical section of a still setting embodying the invention, showing a fragmentary view of an oil still in place thereon,

Fig. 2 is a horizontal section on line 2—2 of Fig. 1,

Fig. 3 is a transverse section on line 3—3 of Fig. 1,

Fig. 4 is a transverse section on line 4—4 of Fig. 1,

Fig. 5 is a fragmentary view, similar to Fig. 1, showing a modified fire box construction,

Fig. 6 is a view, on an enlarged scale, partly in plan and partly in horizontal section, of the air heater shown in the preceding figures,

Fig. 7 is a vertical section on line 7—7 of Fig. 6,

Fig. 8 is a vertical section on line 8—8 of Fig. 6,

Fig. 9 is a transverse section on line 9—9 of Fig. 6,

Fig. 10 is a detail, on a further enlarged scale, of a partition member in the air heater,

Fig. 11 is a transverse section of the partition member illustrated in Fig. 10,

Fig. 12 is a fragmentary view of one of the air heating passages in the air heater,

Fig. 13 is an end view of one of the air heating passages,

Fig. 14 is a fragmentary detail showing a section of the soot blower piping in the air heater, and

Fig. 15 is another fragmentary view of this piping at right angles to Fig. 14.

The still 20 illustrated in the drawings is of the ordinary shell type and is fitted with the usual accessories. The still shell shown is 40′ 7″ long and 12′ 6″ in diameter. The drawings are scale drawings of an actual installation.

The heating furnace comprises a fire box 21 and a heating flue 22, the still 20 being supported in the heating flue by the setting so that the hot combustion gases from the firebox pass over the heating surface of the still in the heating flue. A refractory shield 23 and arches 24 are provided to shield, to a certain extent, the heating surface of the still from direct radiation from the fire box, the refractory material of the arches and shield being heated by the radiant energy from the firebox and becoming secondary radiators so that a part of the radiant energy is converted into sensible heat in the combustion gases. Baffles 25 are also provided in the heating flue to promote effective heat transfer as the temperature of the combustion gases decreases in flowing through the heating flue. At the end of the setting away from the fire box, the combustion gases, partially cooled by passage through the heating flue where they give up their heat to the still, escape and flow downwardly through the flue 26.

From the lower end of the flue 26, the partially cooled combustion gases may flow through the return flues 27 or on downwardly to the stack flue 28 through connecting flues 29. Dampers 30 are arranged at the junction of the several flues to control the distribution of the spent heating gases from the heating flue to the return flues 27 or directly to the stack flue 28. As shown in full lines in Fig. 4 all of the gases are directed to the stack flue and as shown in dotted lines all of the gases are directed to the return flues 27. The opposite ends of the return flues 27 discharge into the stack flue

28 through connecting flues 31. A damper 32 is also provided in the stack flue 28.

A series of air heating passages 33 are arranged in the return flues 27 so that the combustion gases flowing through the return flues pass over and about them. Air is supplied to the end of the heating passages adjacent the firebox from the duct 34 through connecting flues 35 having control dampers 44 therein. The other end of the air heating passages discharges into the common chamber 36 which communicates with the heated air passage 37. Arranged beneath the firebox 21 is a chamber 38 from which air for combustion of the fuel burned in the firebox is supplied through duct 39. The heated air passage 37 discharges into the chamber 38 through connecting flue 40. By-pass connections 41 having dampers 42 therein are arranged for bypassing part of the cold air supplied from the duct 34 directly to the chamber 38 through connecting flue 40. The return flues 27, the air heating passages 33, and the heated air flue 37 are advantageously combined in a unitary structure more fully illustrated in Figs. 6 to 9.

The firebox shown in Fig. 1 is arranged for burning gaseous or liquid fuel, such as natural gas or fuel oil. The fuel is introduced through the burner 43 and mixes with heated air entering from the chamber 38, combustion taking place principally in the firebox 21. The firebox shown in Fig. 5 is arranged for burning solid fuel, such as coal or coke. A grate 43^a is provided for supporting the fuel in the firebox 21^a and the heated air passage 40^a is arranged to discharge into the space beneath the grate from which air for combustion is supplied through the grate. Refractory arches 24^a are provided to shield the still bottom from direct radiation.

It will be apparent that the improved still setting of the invention is compact and that at the same time all of the elements are readily accessible for inspection and repair. The still setting is closely arranged and self contained and heat losses are minimized. The arrangement also is such that the flow of both the combustion gases and the air for combustion is relatively free from obstruction in the setting. It will be noted that the still setting is arranged in three general tiers. The heating flue in which the combustion gases are passed over the heating surface of the still is in the upper tier, the stack flue is in the lower tier, and the air heater is arranged in the middle tier. By employing this arrangement, and by passing the combustion gases through the air heater from the end of the setting away from the firebox and supplying the air to the other end of the air heater, the connecting flues are made of minimum length and low resistance to the flow of the combustion gases and air for combustion is attained. The air heater, likewise, is advantageously arranged in two parts, as illustrated, with the duct for supplying heated air to the firebox arranged between the air heating passages so that heat loss from the heated air circulating to the firebox is avoided.

A particularly advantageous construction for the air heater is illustrated in some detail in Figs. 6 to 9, as well as in the following figures. In the structure so illustrated, the return flues, the air heating passages and the heated air duct are combined in a unitary casing. The entire air heating apparatus may thus be inserted and removed from the still setting as a unit. The improved air heater structure of the present invention also promotes efficient and effective transfer of the heat in the waste heating gases to the air for combustion.

The casing of the improved air heater comprises side plates, 45 and 46, and top plate 47 and bottom plate 48. The top and bottom plates are made up in sections, as shown, so that the heater is easily assembled and so that easy access is had to the several compartments of the heater. A pair of walls, 49 and 50, divide the space within the heater into three longitudinal passages, a central heated air duct 37 and return flue passages 27. These walls extend from the end of the casing A adjacent the firebox to a point short of the other end of the casing B. Partitions 51 and 52 are arranged transversely of the outer passages between the walls 49 and 50 and the side plates 45 and 46 at both ends of the passages forming two return flues between the pairs of partitions. The partitions 52 at the end of the casing B thus provide a common chamber 53 communicating with the duct 37, the end of the casing being closed by plate 54. End plates 55 are arranged across the ends of the outer passages at the other end of the casing A and form with the partitions 51 air supply compartments 56 and 57. The partitions 51 and 52 are made up of sectional headers 58, as shown in Figs. 10 and 11. The air supply compartments 57 are provided with openings 61 for communication with the air supply ducts 35. At the end of the casing B openings 59 are provided in the top plate 47 communicating with that end of the return flues 27 and at the other end of the return flues openings 60 are provided in the bottom plate 48.

Arranged in the return flues 27 are a series of air heating passages 62 extending from the partitions 51 to the partitions 52, and communicating at one end with the supply compartments 57 and at the other with the chamber 53. The air heating passages are made up of pairs of flat sheets 62 and 63 riveted together at their edges, and at their center for added strength, to form relatively

thin passages of rectangular cross section whereby effective heat transfer is promoted, as shown in Figs. 12, and 13. At the ends of each of these flat passages the riveted edges and the central web are cut back from the ends of the rectangular sections so that the ends of the rectangular sections, which register with the openings 64 in the sectional headers 58, will enter the openings in the headers. With this construction, the headers support the air heating passages in the casing and when the headers are riveted in the casing the entire structure is held in place permanently. Spacing elements 65 may also be arranged at intervals in the casing to maintain uniform the passages in the return flues, and these elements also assist in making the entire heater structure more rigid. With the construction shown, any one of the air heating passages may be readily removed simply by removing the end plate 54 and the header section connected to that passage at that end of the casing. In Fig. 9 it will be noted that the left flue passage is shown without the air heating passages in place.

For the purpose of maintaining high efficiency in the heater, soot blowers are provided for periodically removing from the exterior of the air heating passages any soot deposited thereon by the combustion gases. In the still setting illustrated, these soot blowers consist of a pair of pipes 66 and 67 extending through the air heater transversely of the air heating passages and having a series of nozzles 68 thereon directed into the spaces between the air heating passages. The pipes 66 and 67 are arranged within the casing of the air heater so that they are entirely external to and do not penetrate the air heating passages, minimizing air leakage in the heater and consequent inefficiency. These pipes are rotatably mounted, and hand wheels 69 are provided outside of the setting for effecting rotation of the pipes so that jets from the nozzles 68 can be directed to all parts of the surfaces of the air heating passages. These pipes are connected to a steam header 70 through connections 71 and 72 respectively in which separate control valves 73 and 74 are provided. A valved outlet 75 is arranged for draining the connections between the steam header and the nozzle pipes.

The air heating unit may be inserted in and removed from the still setting through the closure 76. When in place in the setting, the openings 61 in the air supply compartments register with the ducts 35 and the end of the passage 37 with the flue 40, and the openings 59 open into the flue 30 and the openings 60 into the flues 31, so that the air supplied from the duct 34 flows through the heating passages from A toward B and then back through the central passage and the waste combustion gases from B toward A about the heating passages, the waste combustion gases thereby being cooled and giving up their heat to the air flowing through the heating passages and preheating the air for combustion.

In the actual operation of the apparatus illustrated, using the still as a coke still, the still was charged with about 960 barrels of Burbank crude oil of a gravity of about 38° Bé. And distillation was begun. When the stream of condensate showed a gravity of about 49° Bé. an additional 240 barrels of crude oil were added at the rate of approximately 80 barrels per hour so that the total charge was about 1200 barrels of crude oil. Air was supplied to the duct 34 under a pressure of about 6″ to 6½″ of water by means of a blower and a draft of about 0.02″ of water was maintained in the firebox during the entire firing period. The firing time to pot was about 30 hours. The air heater, as illustrated, had a total heating surface of about 2000 sq. ft., a cross section for the passage of combustion gases of about 8.5 sq. ft. and for the passage of air of about 2.6 sq. ft. The temperature of the combustion gases entering the heater averaged about 700° F. and was reduced to about 300° F. in the heater, and the temperature of the air entering the heater averaged about 70° F. and that leaving about 425° F. Natural gas was used as fuel and about 195 cu. ft. of a calorific value of about 1083 B. t. u. cu. ft. were consumed per barrel of charge. The heater absorbed upwards of 500,000 B. t. u. per hour from the waste gases and this heat was substantially all returned to the fire box. A saving of 14% to 15% or more was effected in fuel consumption and at the same time the operation of the still could be closely controlled.

The improved still setting of the present invention enables a marked saving in fuel, and while decreasing fuel costs makes a decided improvement in still operation possible. The firing capacity is much increased and the still can be forced, particularly during the early part of the run, without high fuel loss. The increased firing capacity also enables the making up of time so that the still can be kept on schedule. In coke stills, a minimum of excess air can be employed during the coking period with close control of the firebox conditions. The control of the firing operation afforded by control of the temperature, as well as the amount, of air supplied for combustion, also makes it easy to regulate the still operation.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. In an oil still setting, a firebox adjacent one end of the setting, a heating flue for conducting combustion gases from the firebox to the other end of the setting over the heating surfaces of a still arranged thereon,

a pair of return nues in the setting communicating with the heating flue at the end of the setting away from the firebox and connected at their other end to a stack flue, a passage arranged between the return flues and discharging into the firebox at its near end, and air heating passages in the return flues with the air inlets at the end adjacent the firebox and discharging into the passage between the return flues at the end of the setting away from the firebox.

2. In an oil still setting, a firebox adjacent one end of the setting, a heating flue for conducting combustion gases from the fire box to the other end of the setting over the heating surfaces of a still arranged thereon, a return flue in the setting communicating with the heating flue at the end of the setting away from the firebox, air heating passages arranged in the return flue with the air inlet at the end adjacent the firebox, means arranged within said air-heating passages for dividing up the incoming air into small streams, a heated air flue common to all of said air-heating passages for conducting air from the other end of the air heating passages to the firebox, an air supply flue communicating with the inlet to the air heating passages, and a flue with a damper therein connecting the air supply flue and the heated air flue.

3. An improved oil still setting arranged in three superimposed tiers, comprising a heating flue arranged in the upper tier, a pair of return flues and a heated air passage therebetween arranged in the middle tier, and a stack flue arranged in the lower tier, said stack flue extending beneath the return flues the entire length of said return flues, a firebox arranged at one end of the setting communicating with the adjacent end of the heating flue, a flue connecting the other end of the heating flue with the adjacent end of the return flues, flues connecting the ends of the return flues adjacent the firebox with the stack flue. air heating passages in the return flues and connected with the heated air passage at the end of the setting away from the firebox, air supply flues connected to the other end of the air heating passages, and a connection between the firebox and the end of the heated air passage adjacent the firebox.

4. In an air heater, a unitary casing enclosing a pair of flues adapted for passage of combustion gases therethrough and a heated air passage arranged between the first mentioned flues, partitions in the casing closing both ends of both said flues, the partitions at one end of the flues being arranged away from the end of the casing to provide a common chamber communicating with the heated air passage, the partitions at the other end being arranged to provide air supply compartments within the casing at the end of the flues, openings on one side of the casing into the said flues at one end and openings on the other side of the casing into the said flues at the other end, and air heating passages arranged in the said flues between the said partitions communicating at one end with the air supply compartments and at the other with the common chamber connected to the heated air passage.

5. In an air heater, a casing forming a flue, a pair of headers in the ends of the casing, said headers being secured to the casing and having spaced apertures therein, heating passages arranged between the headers, said passages being formed of thin sheets fastened together by webs extending beyond the passage proper, the ends of the passage proper being of size and shape to fit the apertures in the headers and the webs being cut back from the end of the passages, said passages being supported between the headers by the end portions of the passages extending therethrough and being held in place between the headers by the extending webs abutting thereagainst, and inlet and outlet openings through the casing into the flue between the headers.

6. In a heater unit for furnaces, the combination with a casing, of three longitudinally disposed parallel compartments, combined air conducting passages and passages for furnace flue gases positioned within the outside compartments, a chamber in one end of the casing connecting said air conducting passages with the intermediate compartments, said casing being constructed at its opposite end for the admission of cold air to said air conducting passages and the discharge of the heated air from the intermediate compartment.

7. In a heater unit for furnaces, the combination with a casing, of spaced parallel flues disposed along opposite side walls within the casing, air passages arranged within said flues, an intermediate air passage formed by the spacing of said flues, a transversely arranged chamber in one end of the casing communicating with the adjacent ends of all of said air passages, said casing being constructed at its opposite end for the admission of air to the air passages in the spaced parallel flues and the discharge of the air from the intermediate passage, and means for supplying a heating medium to and around the air passages in said flues.

8. In a heater unit for furnaces, the combination with a casing, of spaced parallel flues disposed along opposite side walls within the casing, an intermediate passage formed by the spacing of said flues, headers transversely arranged in opposite ends of said flues and spaced from the ends of the casing, a series of air conducting passages connecting said headers, a transversely disposed chamber in one end of the casing con-

necting the air conducting passages and the intermediate passage, said casing being constructed at its opposite end for the admission of cold air to the series of air conducting passages and the discharge of heated air from the intermediate passage, and means for admitting a heating medium to and around the air conducting passages in said flues.

In testimony whereof I affix my signature.

LOLA R. BELL,
Executrix of the last will and testament of John E. Bell, deceased.