May 5, 1931. L. DE FLOREZ 1,804,155

FURNACE

Filed Dec. 28, 1927 2 Sheets-Sheet 1

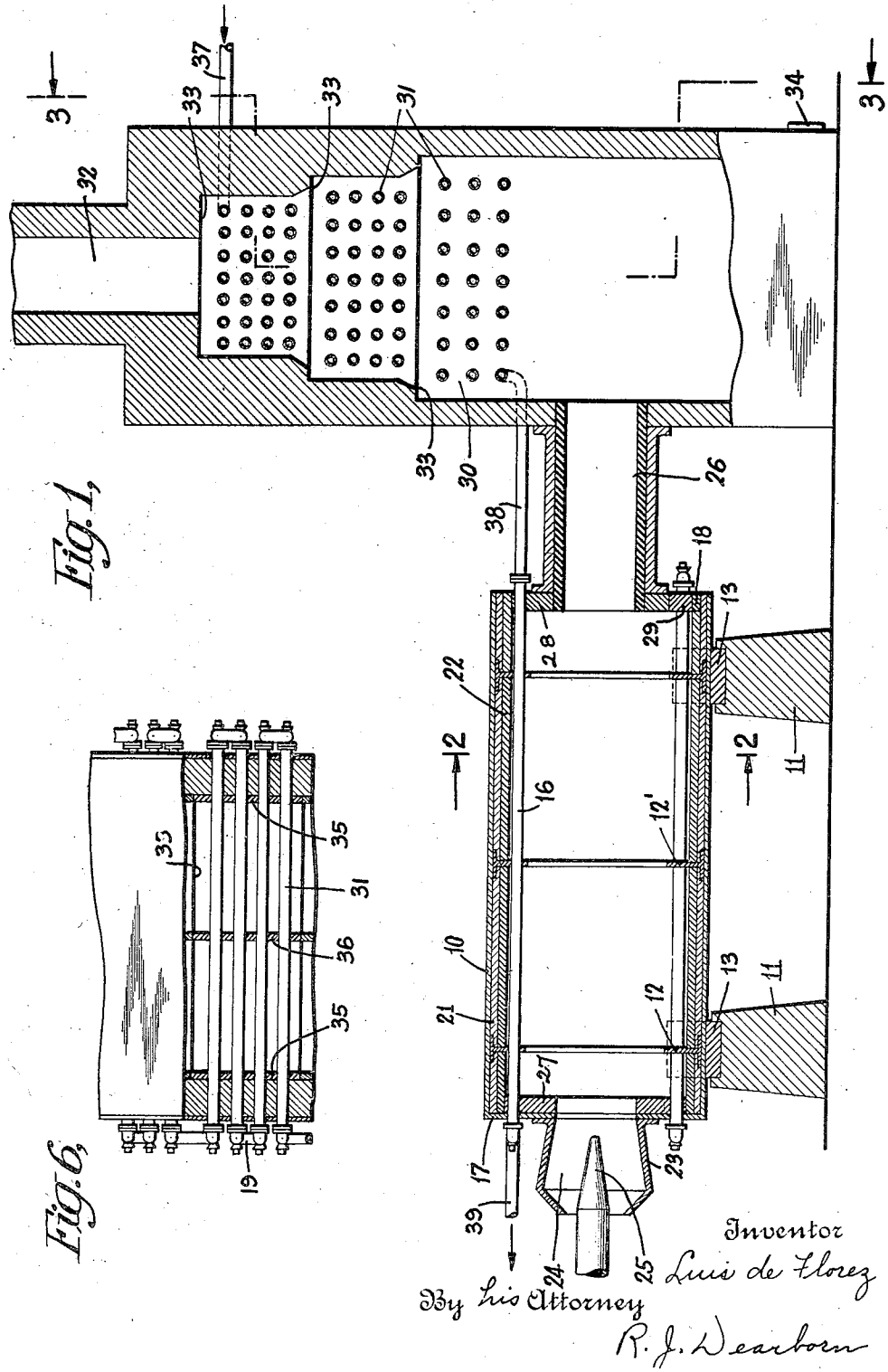


Fig. 1,

Fig. 6,

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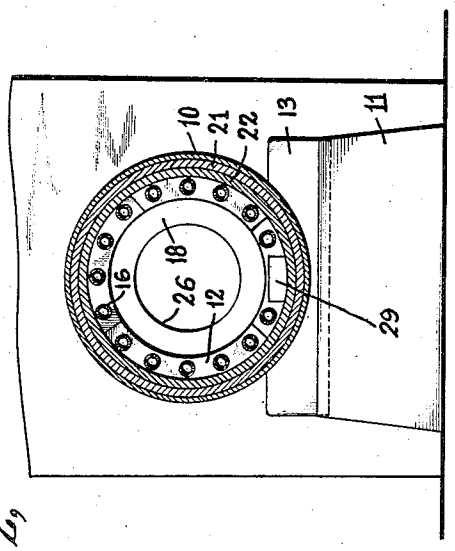


Fig. 2,

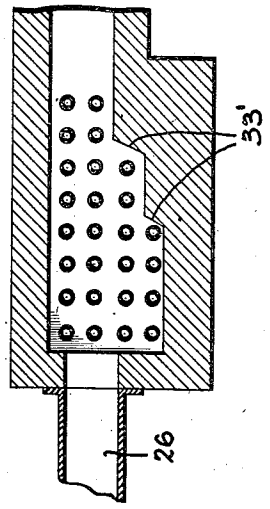


Fig. 4,

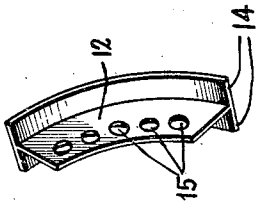


Fig. 5,

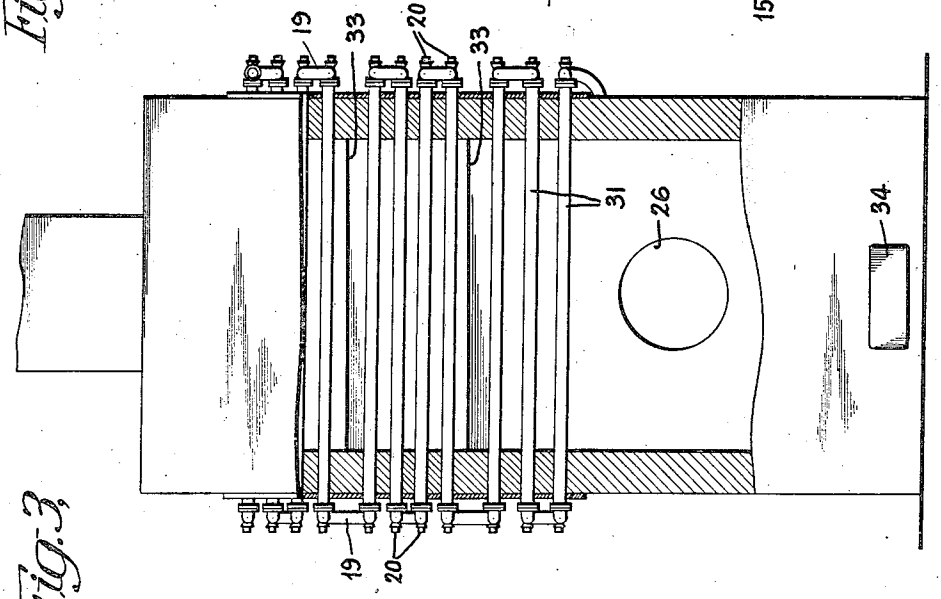


Fig. 3,

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Patented May 5, 1931 1,804,155

UNITED STATES PATENT OFFICE

LUIS DE FLOREZ, OF POMFRET, CONNECTICUT, ASSIGNOR TO THE TEXAS COMPANY, A CORPORATION OF DELAWARE

FURNACE

Application filed December 28, 1927. Serial No. 242,986.

This invention relates to improvements in furnaces and in particular to the type of furnace in which a fluid is heated in tubular elements maintained in heat radiating relation with, but substantially out of the path of, the products of combustion in that part of the heating zone in which the temperature of the products of combustion is sufficiently high to transfer heat by radiation.

Furnaces of this general type are shown in my co-pending applications Serial Nos. 120,067 and 145,054, filed respectively July 2nd, 1926, and October 29th, 1926, and the general objects and advantages set forth in the said co-pending applications are applicable to the present invention. However, the structure illustrated and described in this application differs in a number of important respects from those disclosed in the said co-pending applications, and the differences will be pointed out more fully hereinafter.

One object of the present invention is to provide a furnace structure of the general type above mentioned requiring a minimum of material for a maximum amount of strength and which may be made up in the shop, transported to the place where it is to be used and erected with a minimum amount of labor and trouble. The invention includes a combustion chamber, preferably circular in cross section, adapted to be positioned horizontally and in which the combustion products are caused to travel lengthwise of the combustion chamber and parallel to the tubular elements containing the fluid to be heated. Another feature of the invention consists in supporting the tubes at suitably spaced points by means of annular supporting plates and thereby preventing sagging of the tubes under the influence of heat, and also so disposing the supporting plates as to break up any currents of the heating gases which might tend to circulate about or along the tubes in their passage through the combustion chamber, thus furnishing a quiescent zone about the tubes favorable to the absorbtion of radiant heat without convection of the gases. The invention also covers the use of additional baffle members tending to create "dead" gas spaces about the heating tubes. Other important advantages of the present construction will appear from the drawings and following description.

I shall describe an embodiment of my invention as a pipe still or tubular heater adapted to heat petroleum or its products having a horizontally arranged cylindrical heating chamber around the inner wall of which the tubes or pipes are disposed, and having an inlet at one end adjacent to which is located a burner adapted to discharge a flame into, and longitudinally of, the heating chamber, and provided at the opposite end with an outlet leading to an economizer or preheating chamber in which additional heating tubes are disposed directly in the path of the heating gases.

It will be understood that the heater is applicable to a wide variety of uses, such as the generation of steam, heating of gases, etc., and I therefore do not desire to be confined to any use or construction beyond that set forth in the appended claims.

In the accompanying drawings, in which like reference numerals denote like parts throughout the several views thereof:

Fig. 1 is a vertical longitudinal section of a pipe still constructed in accordance with my invention.

Fig. 2 is a vertical section through the combustion chamber taken on the line 2—2 of Fig. 1.

Fig. 3 is a part elevation and part section through the heat economizer portion of the furnace taken on the line 3—3 of Fig. 1.

Fig. 4 is a vertical section through a modified form of the heat economizer unit.

Fig. 5 is a detailed perspective view of a section of one of the tube-supporting plates.

Fig. 6 is a perspective view of a tube assembly for use in the economizer or secondary heating unit.

Referring more particularly to the drawings, a steel shell 10, preferably cylindrical in form, is supported in a horizontal position by, and secured to, concrete or other suitable foundation blocks or piers 11 positioned at suitable distances apart. Preferably, the piers 11 should be located at points directly in line with the tube-supporting

plates 12 so as to prevent the setting up of unnecessary stresses in the steel shell 10. Cast iron or other suitable cradle or bolster members 13 may be interposed between the piers 11 and the steel shell 10 for convenience in attaching the shell 10 to the piers.

The tube-supporting plates 12 are preferably formed of a plurality of segmental sections, one of which is illustrated in Fig. 5. The plates 12 may be provided with oppositely extending flanges 14 on the outer edge by means of which the plates 12 may be secured directly to the shell 10 by bolts or other suitable means not shown. The plates 12 are provided with one or more annular rows of apertures 15 to receive the tubes 16 and of slightly larger diameter than the tubes so as to permit longitudinal movement of the tubes due to expansion and contraction under the influence of temperature changes. The ends of the shell 10 are closed by annular end plates 17 and 18 suitably secured at their outer edges to the shell 10. Apertures in line with those in the tube-supporting plates 12 are provided in the end plates 17 and 18, and the oil heating tubes 16 are inserted in the thus aligned apertures with their ends extending outside the ends of the heating chamber. The tubes are shown as serially joined at their ends by couplings 19 provided with plugs 20 in their ends which may be removed to permit access to the tubes for cleaning.

The chamber defined by the shell 10 and the end plates 17 and 18 is provided with a heat insulating lining 21 and an inner refractory lining 22.

Joined to the inner annular edge of the end plate 17 is a metal shell section 23 preferably conical in shape and preferably lined with suitable insulating and refractory materials not illustrated. The chamber 24 thus created constitutes a preliminary combustion chamber into which a suitable fluid or powdered fuel and air mixture is introduced from a burner nozzle 25. The burner 25 and the chamber 24 are centrally disposed with respect to the heating chamber and in line with the outlet 26 defined by the centrally disposed opening in the end plate 18, and for this reason the hot products of combustion tend to flow through the center of the furnace away from direct contact with the tubes 16 and to transmit heat thereto mainly by radiation, the shoulders 27 and 28 serving to maintain a blanket of "dead" or relatively slow moving gases in the portion of the heating chamber between the tubes and the central space through which the products of combustion may follow a straight path from their point of entrance to the outlet 26. The tube-supporting plates 12 being imperforate except for the apertures receiving, and substantially filled by, the tubes 16, serve further as baffles to prevent the flow of gases longitudinally of, and in and around, the tubes 16, thus further insuring that substantially no heat shall be transmitted to the tubes 16 from the hot products of combustion by convection currents and that the heat transmission that does take place shall be practically all by radiation. If desired, one or more auxiliary tube sheets 12′ may be provided at points intermediate the main tube-supporting sheets or intermediate such sheets and the ends of the heating chamber. In this way creation of "dead" gas spaces in and about the tubes is even more positively assured. The tube-supporting plates 12 and auxiliary tube sheets 12′ are preferably formed of a heat resisting alloy, such for example as a chromium steel alloy.

It may be desirable, particularly if powdered fuel or a fluid fuel of such character as to tend to produce ash or other solid residual matter is used, to omit tubes from the bottom of the heating chamber as is shown in Fig. 2. In this event, doors 29 may be provided in the end plates to permit the introduction of tools for cleaning.

In the construction shown in Fig. 1, the products of combustion after having cooled to the point where substantially no heat transmission will take place by radiation, are led from the primary heating chamber above described through the outlet 26 to a secondary heating chamber or economizer 30 in which a bank of tubes 31 is positioned directly in the path of the gases so that in passing to the stack 32 the gases must pass over and around such tubes in tortuous paths and thus be brought into intimate contact with the walls of the tubes and give up a still further amount of their sensible heat.

In order to compensate for the decrease in volume of the gases as they cool and to maintain a flow velocity at the outlet end of the economizer 30 equal to, or greater than, that at the entrance thereof, and thereby insure more effective heat transfer by reason of the more vigorous swirling action and cross currents which will be set up in the gases in their passage through the bank of tubes, I greatly reduce the cross section of the economizer from the entrance to the outlet. While this may be brought about by tapering the walls of the economizer chamber, I prefer to reduce the cross section in stages, and to accomplish this I have shown the economizer 30, which in Fig. 1 is shown as being arranged vertically, as having inwardly projecting shoulders 33 placed at suitable intervals. That portion of the heated gases passing toward the outlet end of the economizer 30 along the walls thereof will, when the inwardly projecting shoulders are encountered, be deflected laterally and set up eddy currents in contact with the heating tubes, thus increasing the effectiveness of contact between the heating tubes and the gases.

The economizer 30 is shown in Fig. 1 as provided with a relatively large unobstructed space below the bank of tubes 31. The velocity of the gases on entering this space from the outlet 26 will be greatly decreased thus tending to permit any ash or other solid particles carried by the gases to drop out and collect in the bottom from whence they may be removed through a door 34. The provision of this expansion chamber is of particular advantage when powdered fuel or a similar fuel is used since the deposition upon the tubes 31 of ash or soot particles from the products of combustion of such fuel is thereby substantially prevented.

Instead of arranging the economizer 30 as shown in Fig. 1 it may be arranged horizontally as shown in Fig. 4 and decreased in cross section toward the outlet to the stack by insetting the lower wall to form shoulders 33'. According to the construction shown in Fig. 4 the heated gases are led directly from the outlet 26 from the primary heating chamber to the tube section of the economizer 30. It will be understood, however, that an expansion chamber may be interposed between the outlet 26 and the tube section similarly as shown in Fig. 1 and hereinbefore described.

The economizer or preheating unit 30 may be built up on the ground, or, as in the case of the primary heating chamber, it may be assembled in the shop and transported to the place where it is to be used. In either case, the tubes 31 will be mounted in tube sheets or plates 35 disposed at opposite sides of the economizer 30 and shown more or less diagrammatically in Fig. 6. In order to prevent the tubes from sagging, one or more auxiliary tube sheets 36 of a suitable heat resisting alloy may be placed between the main tube sheets 35. The tubes may be, and preferably are, extended through the walls of the economizer and joined together by suitable couplings 19 in a manner similar to the tubes 16 of the primary heating chamber. In this way individual tubes may be disconnected and withdrawn and replaced without disturbing the rest of the assembly.

According to the construction shown in Fig. 1, oil or other fluid to be heated is introduced into one end of the economizer 30 through a pipe 37 and caused to pass back and forth through the respective tubes of the economizer 30 and is then led by the pipe 38 to the primary heating chamber where it is circulated back and forth through tubes 16 and finally is led off through the pipe 39. It will be understood, however, that instead of arranging the pipe connections so as to cause the oil or other fluid being heated to pass serially through the tubes, the arrangement may be modified by the provision of suitable headers or the like so as to cause flow through a plurality of tubes in parallel or in series parallel or any other desired arrangement.

The construction shown is particularly adapted for use in small and more or less temporary installations and may be taken down, moved and set up in a new location with a minimum of expense for labor and materials.

It is to be understood that my invention is not limited to the embodiments shown in the accompanying drawing, but includes all changes and modifications which fall within the scope of the appended claims.

What I claim is:

1. In a furnace, a horizontally arranged cylindrical metal shell having a refractory lining, a plurality of horizontally disposed heating tubes annularly arranged within said shell adjacent said lining, and annular tube plates having their outer edges abutting the inner walls of said shell and constructed and arranged to support said tubes and to define dead air spaces about said tubes.

2. In a furnace, a horizontally arranged combustion chamber, means for passing products of combustion heated to a radiating temperature lengthwise of said chamber and centrally thereof, heat-absorbing tubes positioned in said chamber in an annular space adjacent the walls thereof and outside the direct path of the products of combustion, and longitudinally-spaced annular baffles extending from the walls of said chamber inwardly toward the center thereof to a point beyond the inner surfaces of said tubes to prevent the circulation of products of combustion in and about said tubes longitudinally of said chamber.

3. In a furnace, a horizontally arranged combustion chamber, means for passing products of combustion heated to a radiating temperature lengthwise of said chamber and centrally thereof, serially connected heat absorbing tubes positioned in said chamber annularly and adjacent the walls thereof and outside the direct path of the products of combustion, and longitudinally spaced annular baffles extending from the interior walls of said chamber inwardly toward the center thereof to a point beyond the inner surfaces of said tubes and constructed and arranged to support said tubes in their annular spacing about said chamber and prevent the sagging of the tubes upon intense heating, whereby a central longitudinal and unobstructed passage is formed for the radiating combustion products and the circulation of products of combustion in and about said tubes longitudinally of said chamber is substantially avoided.

In witness whereof I have hereunto set my hand this 22 day of December, 1927.

LUIS DE FLOREZ.