March 27, 1928. 1,664,099

H. A. ATWATER

OIL BURNING LOCOMOTIVE FURNACE

Original Filed Oct. 8, 1923 2 Sheets-Sheet 1

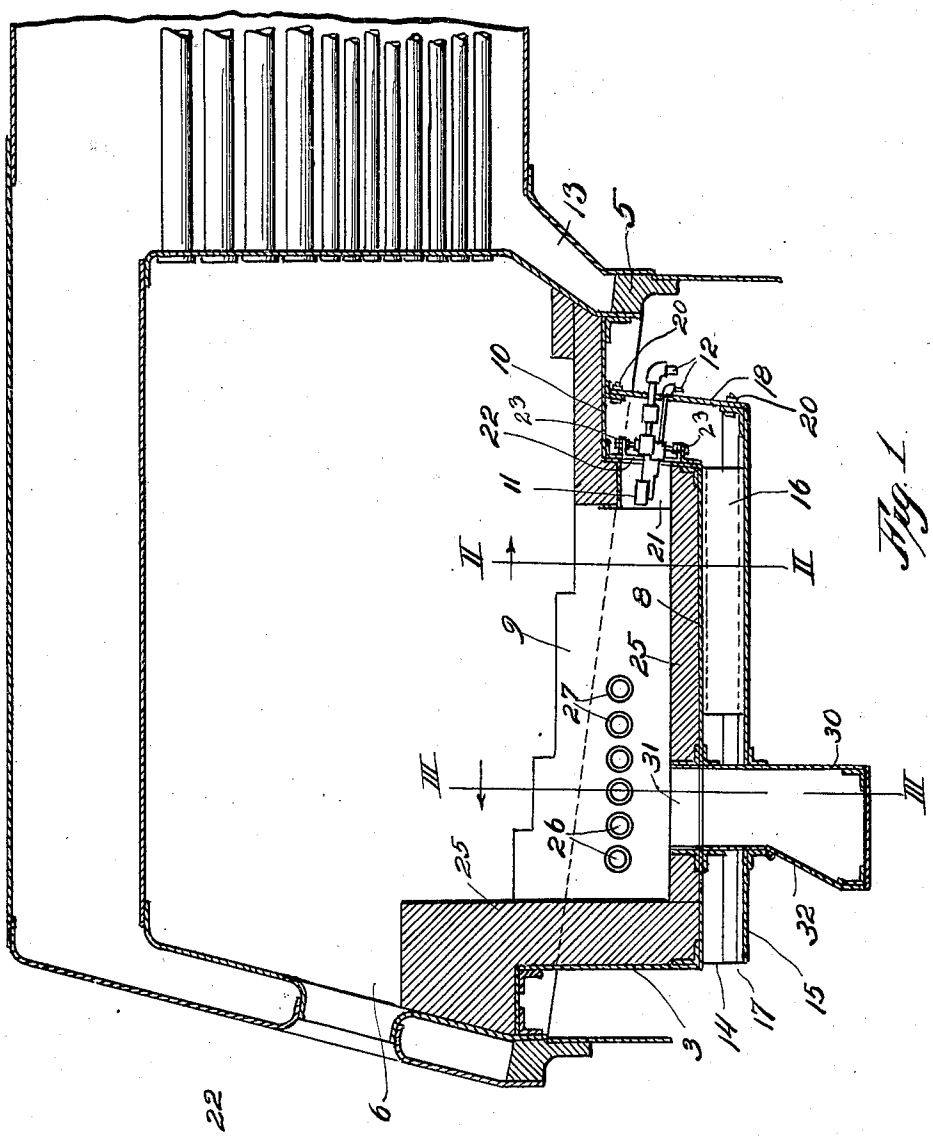

Fig. 1

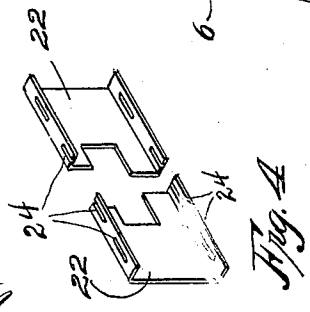

Fig. 4

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Fig. 2

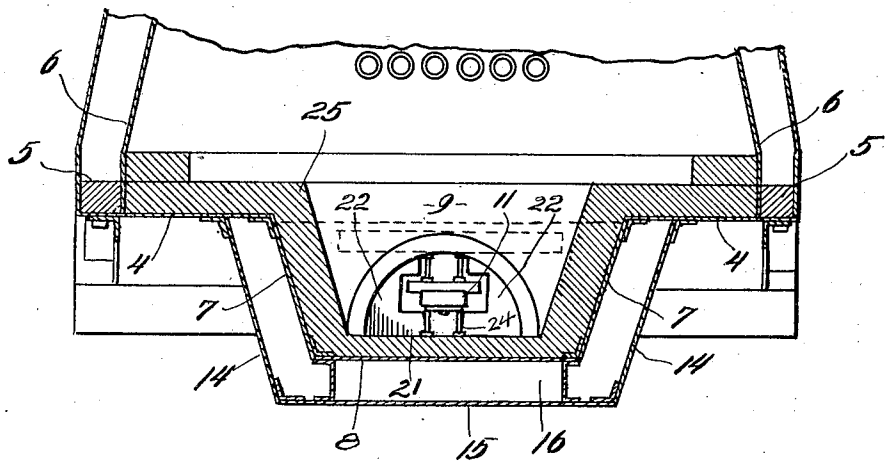
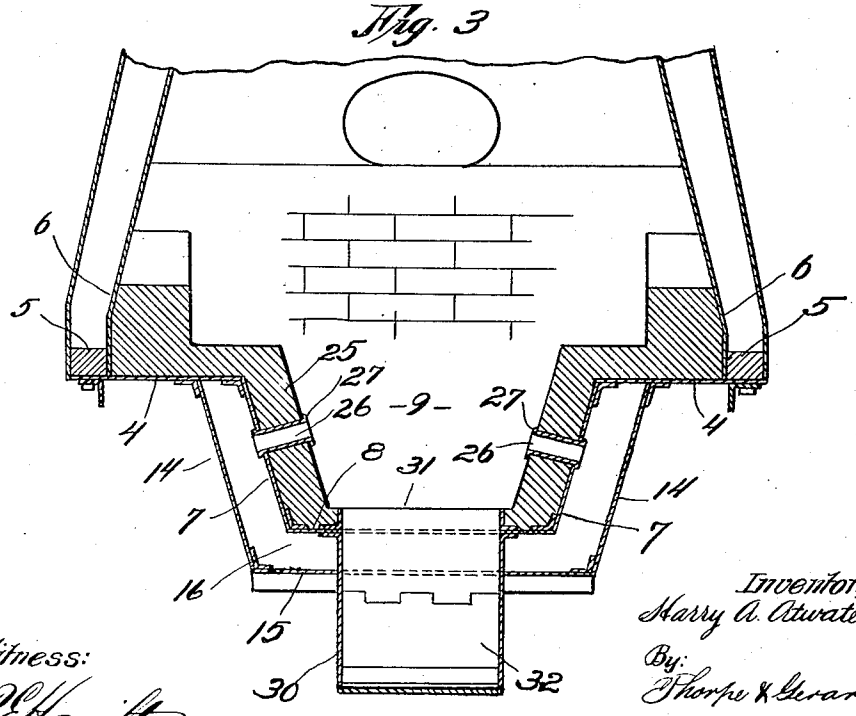


Fig. 3



Witness:
R. E. Hamilton

Inventor;
Harry A. Atwater.
By:
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Patented Mar. 27, 1928. 1,664,099

UNITED STATES PATENT OFFICE.

HARRY A. ATWATER, OF KANSAS CITY, MISSOURI.

OIL-BURNING LOCOMOTIVE FURNACE.

Application filed October 8, 1923, Serial No. 667,177. Renewed November 30, 1927.

The present invention relates to improvements in the construction of locomotive fireboxes, and particularly to that type of construction which is adapted for oil burning, and the primary object in view is to provide an improved fire pan structure by which much of the heat loss by radiation from the bottom surface of the pan will be prevented.

A further object of the invention is to promote the efficiency of the combustion within the firebox, by means of an air supply in which air is effectively preheated on its way to the burner.

For this purpose I have devised a firebox construction in which the fire pan is formed with a flame channel extending from the burner through the lower portion of the firebox, and also with an air-preheating passage underlying all sides of said flame channel and adapted to subject the air, prior to its admission to the burner, to an effective preheating action by being conducted from one end of the firebox to the other over the hot exterior surfaces of said flame channel.

Incidentally it is sought to prolong the life of firebox structures of this type, by virtue of a more even, uniform temperature being maintained, and the elimination of sharp temperature changes in that part of the structure which is most directly exposed to the outside air currents.

With the foregoing general objects in view, the invention will now be described by reference to the accompanying drawings illustrating a practical form of embodiment of the same, after which those features deemed to be novel will be particularly set forth and claimed.

In the drawing—

Figure 1 is a central vertical sectional view illustrating a locomotive firebox embodying the present improvements;

Figures 2 and 3 are transverse sections taken on the lines II—II and III—III respectively, of Figure 1, and

Figure 4 is a detail perspective of the adjustable partition plates for the burner compartment.

In the earlier firebox construction for oil-burning locomotives, the burner was located in the back end of the firebox, which arrangement, for successful operation, required an arch opposite the burner not only for preventing any direct flame impact on the rear flue sheet but also to increase the length of flame travel within the firebox, as required for efficient combustion of the fuel. This arch has proved very difficult and expensive to maintain under the severe conditions imposed by locomotive practice, and experience has shown that the use of the arch does not effect the same increase in oil fuel economy as attends its use in coal-burning fireboxes, and consequently the tendency for several years has been to favor the location of the burner at the front end of the firebox (whether with or without an arch), as representing the best mode of introducing the oil and initiating its combustion within the firebox.

According to present firing operation, a part of the air required for combustion is conducted in around the burner, while the rest is admitted through the sides of the fire pan, or by means of a boot through the bottom of the pan. Unless some special means is provided for preheating all or a part of this air, its temperature at the point of admission will approach that of the surrounding atmosphere, and the result is retarding of the oil ignition and a decrease in the possible length of flame travel, and a resultant tendency to the formation of carbon in the firebox, as well as an aggravated popping of the oil flame in case the adjustments of the steam and oil connections to the burner are not very carefully regulated. These conditions bring about sharp temperature variations and a localization of high and low temperature areas, and lead to such firebox troubles as broken stay-bolts, cracks or fractures and leaks in the furnace and boiler structure, and materially decreased life in the firebrick lining of the firebox. The object of the present improvement is to eliminate such troubles to a very great extent, by promoting a more uniform temperature within and around the firebox and a more efficient combustion of the liquid fuel.

In the drawing, the fire pan construction is illustrated as comprising the usual rear or flash wall plate 3, and side shelf sheets 4 suitably secured to the mud ring 5 or lower ends of the inner sheets 6 of the side water legs. To the inner margins of the side shelf sheets 4 are secured side sheets 7 extending downwardly and having their lower edges connected by a bottom plate 8, thereby forming a longitudinally extending depressed portion

for providing a flame channel 9 through the middle portion of the draft pan and below the level of the side shelf portions 4. At the front end of the fire pan is located an end shelf or table sheet 10 overlying and extending forward of the burner 11 and its connections 12 to the front water leg 13.

Spaced laterally from the side sheets 7 a suitable distance and parallel thereto are additional exterior side sheets 14 depending from the sheets 4 and having their lower margins connected by a bottom sheet 15, and thus enclosing an air-preheating passage 16 surrounding the exterior side and bottom faces of the flame channel portion of the pan. The rear end of this passage 16 is open, as indicated at 17, for the intake of air, while the front end of the passage is closed by a plate 18 mounted in position between the front ends of the sheets 14 and plate 15 and the under face of the sheet 10 (see Figures 1 and 2). This plate is removably secured by bolts 20, or the like, to permit access to the burner 11 and connections 12, said burner being positioned in a compartment 21 at the front of the flame channel and separated by adjustable partition plates 22 from the front end of the passage 16, by the adjustment of which plates, by means of bolts 23 engaging slots 24 (see Figure 4), the flow of air through said compartment may be conveniently regulated.

The floor and sides of the fire pan and flame channel 9 are lined with firebrick 25 in the usual manner, and through the side walls of said flame channel are preferably built air passages 26 lined with sleeves or tubes 27 for providing communication between the preheating passage 16 and the flame channel 9. If found desirable under some conditions, one or more of the tubes or sleeves 27 may be extended entirely across the passage 16 to take air from the exterior of the side sheets or walls 14. It is preferred, however, to extend the passages 26 merely through the walls of the flame channel, as this tends to retain in the air flowing through the passage 16 all heat which may be given off at moments of excess pressure in the firebox, and also serves to protect adjacent parts from contact with any flame issuing from the passages 26.

A boot member 30 may also be provided for conducting additional outside air through the bottom sheet 15 to an opening 31 in the bottom of the flame passage 9. The interior of this boot is entirely closed from communication with the air passage 16, and the rear side of the boot is provided with a hinged door 32 adapted to be opened to different degrees to regulate the intake flow of air through the boot. No communication is provided between the boot opening 31 and the air-preheating passage 16 because the main flow of air, when the locomotive is working, enters by way of the burner compartment 21, through which a strong draft pull is always acting, whereas the boot and side air passages 26 may admit air only intermittently due to the effect of back pressure at these points caused by sudden expansion of the gases of combustion and particularly noticeable when the locomotive is being worked hard at low speed.

In the usual fire pan construction, the bottom plate is exposed to swiftly moving air currents when the locomotive is in motion, thereby necessarily resulting in the radiation of a very considerable amount of heat. In addition to this actual waste of heat, the firebrick lining is subjected to a cooling action. Now since the rapid ignition of the oil issuing from the burner is dependent to a very great extent upon the heat reflection from the hot firebrick lining, acting as an inverted refractory arch, the cooling of this lining, combined with the further cooling effect caused by the inrush of cold air through the burner compartment, very seriously interferes with the rapid and steady ignition of the oil, with consequent sharp variations in temperature within the firebox and the operating troubles always accompanying such conditions.

With the present improvement, a protective sheathing of air space is provided around the sides and bottom of the flame channel portion of the fire pan, through which a flow of air is maintained for preheating purposes throughout the length of said flame channel and finally discharged into the burner compartment. With this arrangement, all the heat absorbed by the air in its course through the preheating passage 16 is carried back into the firebox, while the radiation from the outside walls of the passage 16 is practically negligible since the surfaces of these walls are obviously not at the relatively high temperature of the inside walls 7 and bottom plate 8, which are kept highly heated by their direct contact with the firebrick lining of the flame channel. It is apparent, therefore, that a very considerable amount of radiation is prevented which would otherwise take place.

Another beneficial result of the improved construction is the speeding up of the ignition at the burner. It will be understood that before ignition of the oil can take place, the atomized oil and surrounding volume of air not only must be heated to the ignition temperature, but sufficient additional heat must be absorbed to take care of the latent heat of vaporization of the oil. When the velocity of the incoming mixture of oil and air is considered, it is of course apparent that the time available for this heat absorption is necessarily very brief, and hence the utilization of preheated air to speed up the

ignition of the oil and produce a longer effective flame length becomes an important feature.

One common fault with the operation of fire-box constructions of previously known types has been the particularly unsteady action of the fire at times when the locomotive is drifting or standing by, the fire frequently going out and then re-igniting with consequent sharp changes in the firebox temperature, causing undesirable flashing and drumming pulsations. With the improved construction and preheating arrangement, a more complete and uniform flame propagation is obtained, insuring a steadier fire at all times, for not only is the cooling of the firebrick lining by heat radiation through the fire pan plates greatly reduced, but the direct cooling action on the inside surfaces caused by the flow of cold air into the firebox is also practically eliminated. This enables a higher temperature to be maintained in the firebox lining, with steadier and a more uniform ignition of oil.

As a further important benefit following the maintenance of higher temperatures in the incoming air and in the firebrick lining, the improved construction eliminates to a marked degree the formation and deposit of carbon in the firebox, which fact is practical proof of efficient burner action and completeness of fuel combustion.

While I have shown and described one common type of firebox construction in connection with the improved air-preheating feature, it is to be understood that the invention is not limited to use with the precise firebox construction herein illustrated; for example, the invention is equally adapted for either the front or rear end burner arrangement, and either with or without a main arch in the firebox or an ignition arch over the burner, and it is likewise immaterial whether the ordinary firebox construction is employed or one with the Gaines wall type. I therefore desire to limit the invention only as defined in the appended claims.

What I claim is:

1. In an oil-burning locomotive firebox construction, a fire pan comprising side shelf portions and a longitudinally extending depressed portion providing a flame channel between and below the level of said shelf portions, exterior side and bottom walls spaced from the sides and bottom of said depressed portion and cooperating therewith to form an air-preheating passage, and a burner compartment forming a communicating passage between said flame channel and one end of said preheating passage, the bottom or floor of said depressed portion being closed as regards communication with said preheating passage.

2. In an oil-burning locomotive firebox construction, a fire pan comprising side shelf portions and a longitudinally extending depressed portion providing a flame channel between and below the level of said shelf portions, and exterior side and bottom walls spaced from the sides and bottom of said depressed portion and cooperating therewith to form an air-preheating passage, and a burner compartment forming a communicating passage between said flame channel and one end of said preheating passage, the bottom or floor of said depressed portion being closed as regards communication with said preheating passage, and the side walls of said depressed portion having air passages for feeding air through said walls into said flame channel.

3. In an oil-burning locomotive firebox construction, a fire pan comprising side shelf portions and a longitudinally extending depressed portion providing a flame channel between and below the level of said shelf portions, exterior side and bottom walls spaced from the sides and bottom of said depressed portion and cooperating therewith to form an air-preheating passage leading into said flame channel, and a boot member arranged to feed outside air through said passage into said flame channel.

4. In an oil-burning locomotive firebox construction, a fire pan comprising side shelf portions and a longitudinally extending depressed portion providing a flame channel between and below the level of said shelf portions, a burner compartment at one end of said flame channel, and exterior side and bottom walls spaced from the sides and bottom of said depressed portion and cooperating therewith to form an air-preheating passage communicating with said burner compartment and having its air intake end adjacent to the opposite end of said flame channel.

5. In an oil-burning locomotive firebox construction, a fire pan comprising side shelf portions and a longitudinally extending depressed portion providing a flame channel between and below the level of said shelf portions, a burner compartment at one end of said flame channel, exterior side and bottom walls spaced from the sides and bottom of said depressed portion and cooperating therewith to form an air-preheating passage communicating with said burner compartment and having its air intake end adjacent to the opposite end of said flame channel, and means for regulating the flow of air from said passage through said burner compartment.

In witness whereof I hereunto affix my signature.

HARRY A. ATWATER.