No. 833,008. PATENTED OCT. 9, 1906.

C. SMITH.

MECHANICAL DRAFT AND MIXING APPARATUS FOR FLUE BOILERS.

APPLICATION FILED FEB. 1, 1905. RENEWED MAR. 15, 1906.

2 SHEETS—SHEET 1.

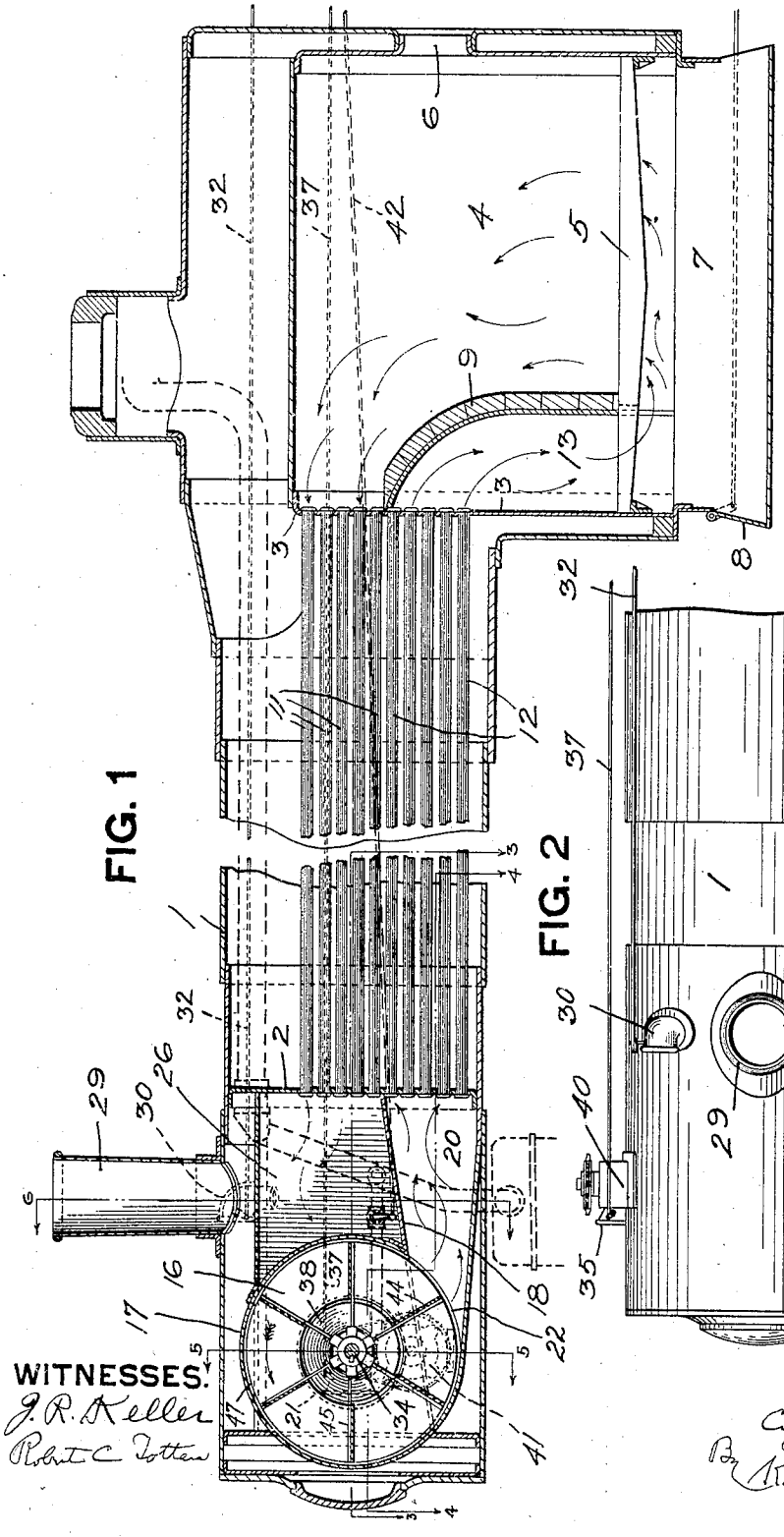


FIG. 1

FIG. 2

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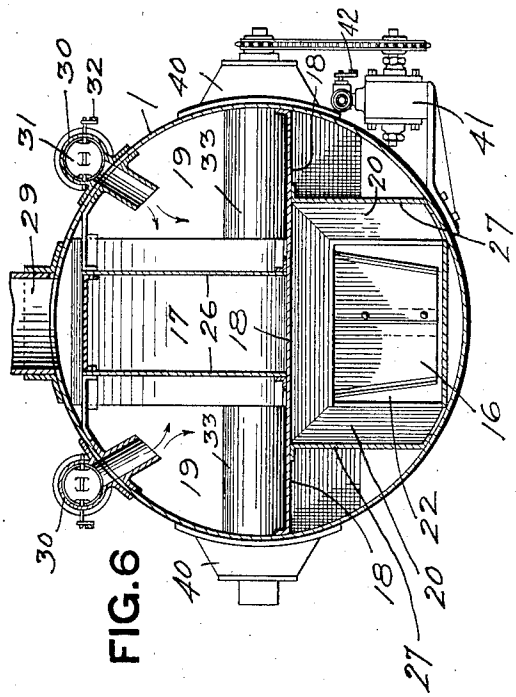


FIG. 6

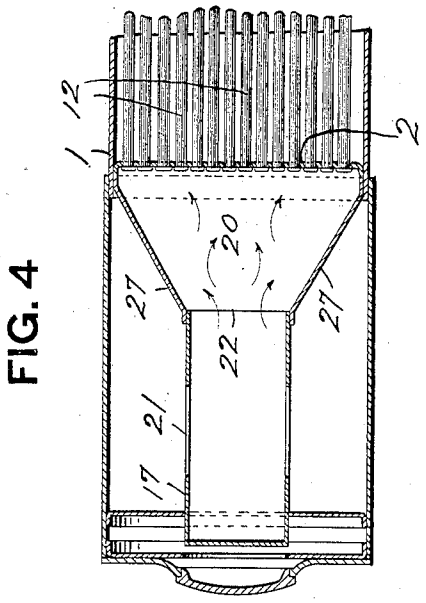


FIG. 4

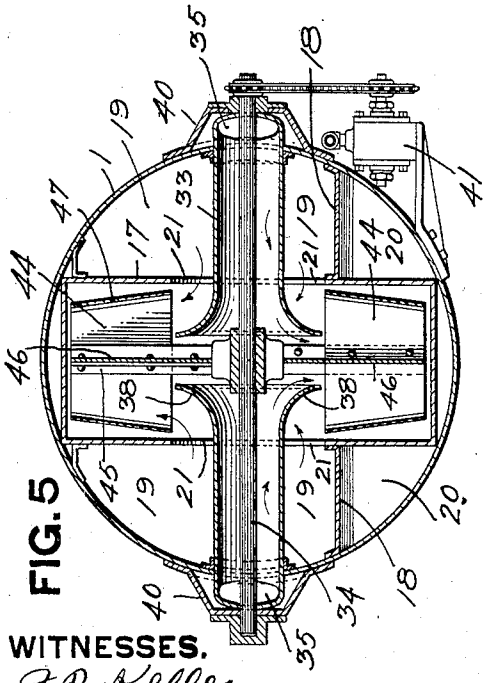


FIG. 5

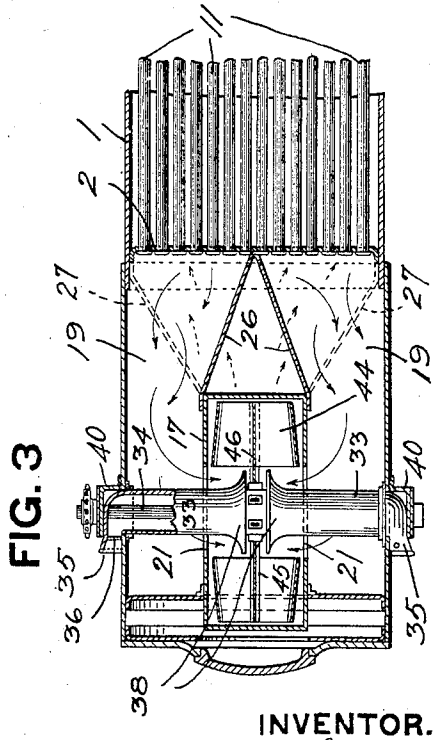


FIG. 3

WITNESSES.

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CYRUS SMITH, OF IRWIN, PENNSYLVANIA.

MECHANICAL DRAFT AND MIXING APPARATUS FOR FLUE-BOILERS.

No. 833,008. Specification of Letters Patent. Patented Oct. 9, 1906.

Application filed February 1, 1905. Renewed March 15, 1906. Serial No. 306,261.

To all whom it may concern:

Be it known that I, CYRUS SMITH, a resident of Irwin, in the county of Westmoreland and State of Pennsylvania, have invented a new and useful Improvement in Mechanical Draft and Mixing Apparatus for Flue-Boilers; and I do hereby declare the following to be a full, clear, and exact description thereof.

My invention relates to apparatus for securing more perfect combustion in steam-boiler furnaces, and is more especially applicable to boilers for locomotives, traction-engines, and other types of internally-fired steam-boilers in which the flues are arranged horizontally and the fire-box or furnace is contained within the shell of the boiler itself.

Boilers of the character specified are extremely wasteful of fuel, this being due to the fact that the draft is either artificial or produced by the exhaust from the engine. By reason of the short lengths of the flues only a small portion of the heat generated in the furnace or fire-box is absorbed in the passage through the flues, the remainder escaping through the stack. The rapidity of the draft, especially when under exhaust, withdraws a very large volume of gases at a high temperature and in a condition when still capable of further combustion.

The object of my invention is to provide an arrangement for increasing the efficiency of boilers of this character; and to this end it consists, generally stated, in an arrangement whereby the boiler is practically converted into a return-flue boiler, thus enabling an absorption of a larger amount of the heat from the fire.

It also consists in an arrangement for returning the gases and unconsumed fuel to the boiler-furnace, thus providing for a more complete combustion of said gases and fuel, as well as securing a higher heat in the flues.

The invention also consists in arrangement of apparatus for mixing fresh air with the gases prior to their return to the fire for combustion, thus supplying the necessary oxygen for combustion and also neutralizing the carbonic-acid gas by mixing sufficient fresh air with it to convert it into a fuel-gas.

The invention also consists in details of construction and arrangement hereinafter described.

In the accompanying drawings, Figure 1 is a vertical longitudinal section through a locomotive-boiler, showing my invention applied thereto. Fig. 2 is a plan view of the front portion thereof. Fig. 3 is a horizontal section of a portion thereof on the line 3 3, Fig. 1. Fig. 4 is a similar section on the line 4 4, Fig. 1. Fig. 5 is a transverse vertical section on the line 5 5, Fig. 1; and Fig. 6 is a similar view on the line 6 6, Fig. 1.

My invention is applicable to any internally-fired steam-boiler having horizontally-arranged fire-flues—such as boilers for locomotive engines and marine or other internal-fired stationary boilers.

As the invention can be as well illustrated in connection with a locomotive-boiler as any other type, it is so shown in the drawings.

The shell of the boiler is indicated at 1. In it is the front flue-sheet 2 and the rear flue-sheet 3, which are connected by a series of fire-flues 11 and 12 in the well-understood manner. To the rear of these flues and within the shell is located the fire-box 4, which is provided with the usual grate-bars 5, firing-door 6, ash-pan 7, and ash-door 8. The ash-door preferably will be air-tight.

In the application of my invention the furnace or fire-box may be of the usual construction except that a portion of the flues of the boiler are connected to communicate with the furnace-chamber beneath the grate 5. This I accomplish by providing a partition 9, which is covered with fire-brick or tile, and which extends at least as low as the grate and has its upper end contacting with the rear flue-sheet 3 at the desired height, so as to divide the flues into groups. As shown in the drawings, the flues 11 at the upper portion of the boiler communicate directly with the fire-box, while the flues 12 in the lower part of the boiler communicate with the space 13, back of the partition 9, and thus with the fire-box or ash-pan underneath the grate-bars.

At the forward end of the boiler is a chamber, as is now the case, and in this I locate a fan 16 for returning the products of combustion to the fire-box through the lower group of flues 12. This fan is mounted in a vertical casing 17, and a partition 18 divides the chamber in front of the flues into an upper chamber 19 and a lower chamber 20. The inlet to the fan is through openings 21 in the sides of the casing 17, and the outlet is through an opening 22 in the periphery of the fan-casing. The partition 18 contacts with the front flue-sheet 2 on the line sepa-

rating the upper and lower groups of flues 11 and 12 and slopes downwardly so that it passes underneath the side openings 21 into the fan-casing. As a consequence, the products of combustion coming from the fire-box through the upper group of flues 11 pass into the fan-casing through the openings 21 and are driven by the fan out through the opening 22 and through the lower group of flues 12 and delivered to the fire-box underneath the fire. They then pass up through the fire and provide a gas fuel.

The upper chamber 19 is divided by means of a vertical partition 26, Fig. 3, which is of triangular shape, having its apex located at the front flue-sheet 2 and its base resting against the fan-casing 17, this partition serving to separate the flame and products of combustion and direct the same to the sides of the fan-casing. This partition extends upwardly slightly above the uppermost row of flues 11. The lower chamber 20 is provided with partitions 27, extending from the sides of the fan-casing and diverging outwardly and connected with the boiler-casing 1 in proximity to the front flue-sheet 2.

The stack 29 communicates with the chamber 19 in front of the flue-sheet 2 and is always open for the escape of all or any gases which are of no aid to the combustion of the fuel. A quantity of fresh air will be mixed with the gases before they enter the fan and are returned to the fire-box. This fresh air may be admitted in any suitable way. As shown in the drawings, on each side of the boiler-casing I provide elbow-pipes 30, having their inner ends projecting into the chamber 19 and directed forwardly and having their outer ends also directed forwardly and slightly flaring or conical, so as to catch the air and force in a large quantity when the engine is running. These elbow-pipes are provided with valves or shutters 31 of any well-known type and which have connected thereto the controlling-rods 32, which extend back to the cab of the locomotive for the fireman's convenience, so that the quantity of fresh air entering the chamber 19 can be regulated as desired. This air not only supplies oxygen for the fire, but also cools and condenses the products of combustion as they enter the chamber 19, thus preventing burning out the fan and fan-casing.

A further quantity of air is admitted through sleeves 33, surrounding the shaft 34 of the fan, these sleeves at their outer ends communicating with the atmosphere through elbow-pipes 35, which are controlled by valves or shutters 36, having connected thereto the controlling-rods 37, extending back to the cab of the locomotive. The inner ends of the sleeves 33 project into the fan-casing and are flared outwardly, as at 38, so as to direct the air toward the periphery of the fan. The primary object of these hollow sleeves with the air-inlet is to keep the fan, shaft, and bearings cool; but the fresh air admitted therethrough is used for supporting combustion.

The air entering through the elbow-pipes 30 and hollow sleeves 33 will by the revolution of the fan be mixed with the products of combustion drawn through the upper series of flues 11, thus supplying the same with a quantity of oxygen sufficient to neutralize the gases generated by the combustion of the fuel, thereby securing additional fuel from a hitherto waste product.

The fan-shaft 34 is mounted in bearings in suitable brackets 40, secured to the boiler-casing. This shaft may be driven in any suitable way, but preferably by having a motor 41 connected to said shaft by cog-gearing or sprocket-wheel. This motor may be of any suitable rotary type—such, for instance, as a small steam-turbine or other rotary engine, which can be supplied with steam directly from the boiler. The exhaust-pipe from said engine will enter the stack on the outside. The controller for said motor will have connected thereto an operating-rod 42, which will extend to the cab of the locomotive for the fireman's convenience to regulate the combustion of the fuel in the furnace.

The fan itself is provided with a series of vanes or blades 44, carried on the ends of arms 45, which will be suitably secured to the hub and shaft 34. The fan will be divided transversely at its middle by means of partitions 46, of sheet metal, which are riveted to the arms 45 and hub. The outer edges of the vanes will preferably be connected to annular sheets 47 for strengthening the same. This construction of fan is very simple and efficient and can be rotated at a high speed, thus drawing in the air and products of combustion through the side of the casing and discharging the same tangentially in the well-understood manner.

The use of my apparatus will be understood from the foregoing description and the drawings. The products of combustion in the fire-box 4 are drawn by means of the fan through the upper series of flues 11 into the chamber 19. The lighter gases of no value or aid to combustion will escape through the normally open stack 29. The other gases having value as fuel are drawn by means of the fan through the opening 21 in the sides of the fan-casing and are driven by the fan tangentially into the chamber 20 and back through the bottom group of flues 12 of the boiler. In this manner the boiler is practically converted into a return-flue boiler, thus providing a much longer course for the hot gases through the flues and permitting the absorption of a larger amount of heat from said gases. The fan also draws in and mixes with said products of combustion a sufficient

quantity of air to supply the necessary oxygen, so that when the mixed gases and air are returned to the fire they supply an effective gas fuel. The sparks which are usually thrown out by the exhaust are prevented by the use of the fan, thus preventing fires along railroads. A very great economy of fuel is secured, the heating ability of the boiler greatly increased, and it is also possible to so regulate the same as to get a uniform steaming capacity and to hold it at any desired pressure. At the same time the boiler can be easily converted into a natural draft or exhaust boiler

What I claim is—

1. In a device of the character specified, the combination with a furnace, of a series of horizontally-arranged fire-flues leading therefrom, a portion of said fire-flues communicating with the furnace underneath the fire, a shell inclosing all of said flues and providing a chamber at the outer ends thereof, a normally open stack communicating with said chamber, and a fan located in said chamber and having its inlet communicating with said chamber and its outlet communicating with the flues leading underneath the fire.

2. In a device of the character specified, the combination with a furnace, of a series of horizontally-arranged fire-flues leading therefrom, a portion of said fire-flues communicating with the furnace underneath the fire, a shell inclosing all of said flues and providing a chamber at the outer ends thereof, a normally open stack communicating with said chamber, a valve-controlled air-inlet into said chamber, and a fan located in said chamber and having its inlet communicating with said chamber and its outlet communicating with the flues leading underneath the fire.

3. In a device of the character specified, the combination with a furnace, of a series of horizontally-arranged fire-flues leading therefrom, a portion of said flues communicating with the furnace underneath the fire, a shell inclosing all of said flues and providing a chamber at the outer ends thereof, a horizontal partition leading from the outer end of said flues and dividing said chamber into two, one of which communicates with the flues leading underneath the fire and the other of which communicates with the flues leading from above the fire, a normally open stack communicating with said last-named chamber, a fan in said chamber and having its inlet communicating with the chamber on one side of the partition and its outlet communicating with the chamber on the opposite side of the partition, and a flaring deflector having its apex at the outer ends of said flues and its base at the fan-casing.

4. In a device of the character specified, the combination with a locomotive-furnace, of a series of horizontally-arranged fire-flues leading therefrom, a portion of said flues communicating with the furnace underneath the fire, a shell inclosing all of said flues and providing a chamber at the outer ends thereof, a partition leading from the outer end of said flues and dividing said chamber into two, one of which communicates with the flues leading underneath the fire and the other of which communicates with the flues leading from above the fire, a normally open stack communicating with said last-named chamber, a funnel having its mouth outside of said shell and directed forwardly and leading into said chamber, and a fan in said chamber having its inlet communicating with the chamber on one side of the partition and its outlet communicating with said chamber on the opposite side of said partition.

5. In a device of the character specified, the combination with a locomotive-furnace, of a series of horizontally-arranged fire-flues leading therefrom, a portion of said flues communicating with the furnace underneath the fire, a shell inclosing said flues and providing a chamber at the forward ends thereof, a normally open stack communicating with said chamber, a fan located in said chamber and having its inlet communicating with said chamber and its outlet communicating with the flues leading underneath the fire, sleeves surrounding the fan-shaft and communicating at their inner ends with the fan-chamber and at their outer ends extending through the shell and being directed forwardly, and valves for controlling said sleeves.

6. In a device of the character specified, the combination with a furnace, of a series of fire-flues leading therefrom, a portion of said flues communicating with the furnace underneath the fire, a shell inclosing said flues and providing a chamber at the outer ends thereof, a normally open stack communicating with said chamber, a fan located in said chamber and having its inlet communicating with said chamber and its outlet communicating with the flues leading underneath the fire, sleeves surrounding the fan-shaft and communicating at their inner ends with the fan-chamber and at their outer ends extending through the shell, and valves for controlling said sleeves.

7. In a device of the character specified, the combination with a furnace, of a series of flues leading therefrom, a portion of said flues communicating with the furnace underneath the fire, a shell inclosing said flues and providing a chamber at the outer ends thereof, a valve-controlled air-inlet to said chamber, a normally open stack communicating with said chamber, a fan located in said chamber and having its inlet communicating with said chamber and its outlet communicating with the flues leading from underneath the fire, and sleeves surrounding the valve-shafts and

communicating at their inner ends with the fan-chamber and at their outer ends extending through the shell.

8. In a device of the character specified, the combination with a furnace, of a series of flues leading therefrom, a chamber with which the outer end of said flues communicate, a partition dividing said chamber horizontally, a normally open stack communicating with the upper of said chambers, a valve-controlled air-inlet into said upper chamber, a fan having its inlet communicating with said upper chamber and its outlet communicating with the lower chamber, and a partition in the furnace connecting the lower group of flues with the fire-box underneath the grate.

9. In a device of the character specified, the combination with horizontal fire-flues, a fire-box connected to one end of the flues, a chamber communicating with the opposite ends of the flues, a fan located in said chamber, a horizontal partition dividing said chamber, the inlet to the fan communicating with the chamber on one side of the partition and the outlet with the chamber on the opposite side of the partition, a normally open stack communicating with the first-named chamber, a flaring deflector in said chamber having its apex at the outer ends of said flues and its base at the fan-casing, and a motor for driving said fan.

In testimony whereof I, the said CYRUS SMITH, have hereunto set my hand.

CYRUS SMITH.

Witnesses:
J. B. GALLAGHER,
D. N. SHAW.