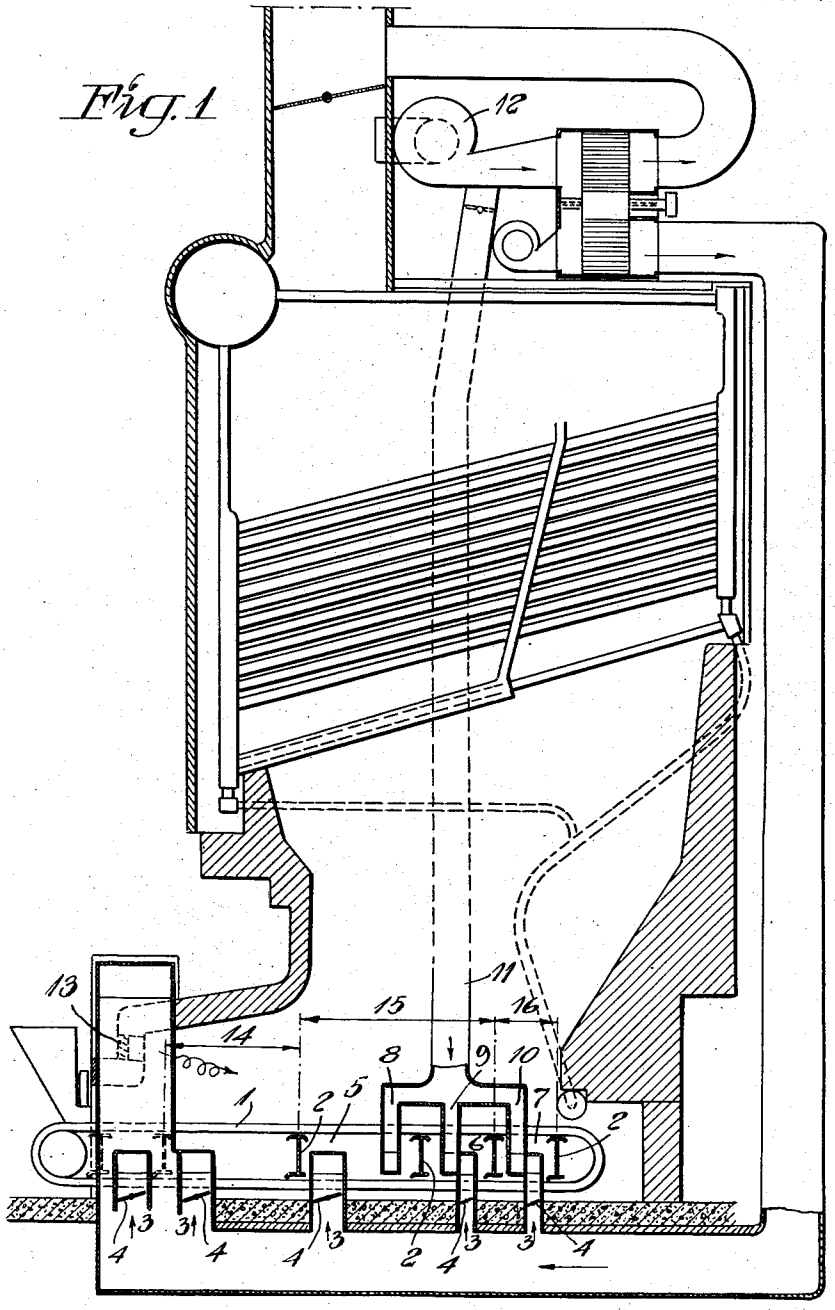
Nov. 3, 1931. A. LYSHOLM ET AL 1,829,996

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Filed March 25, 1927 4 Sheets-Sheet 1

Fig. 1



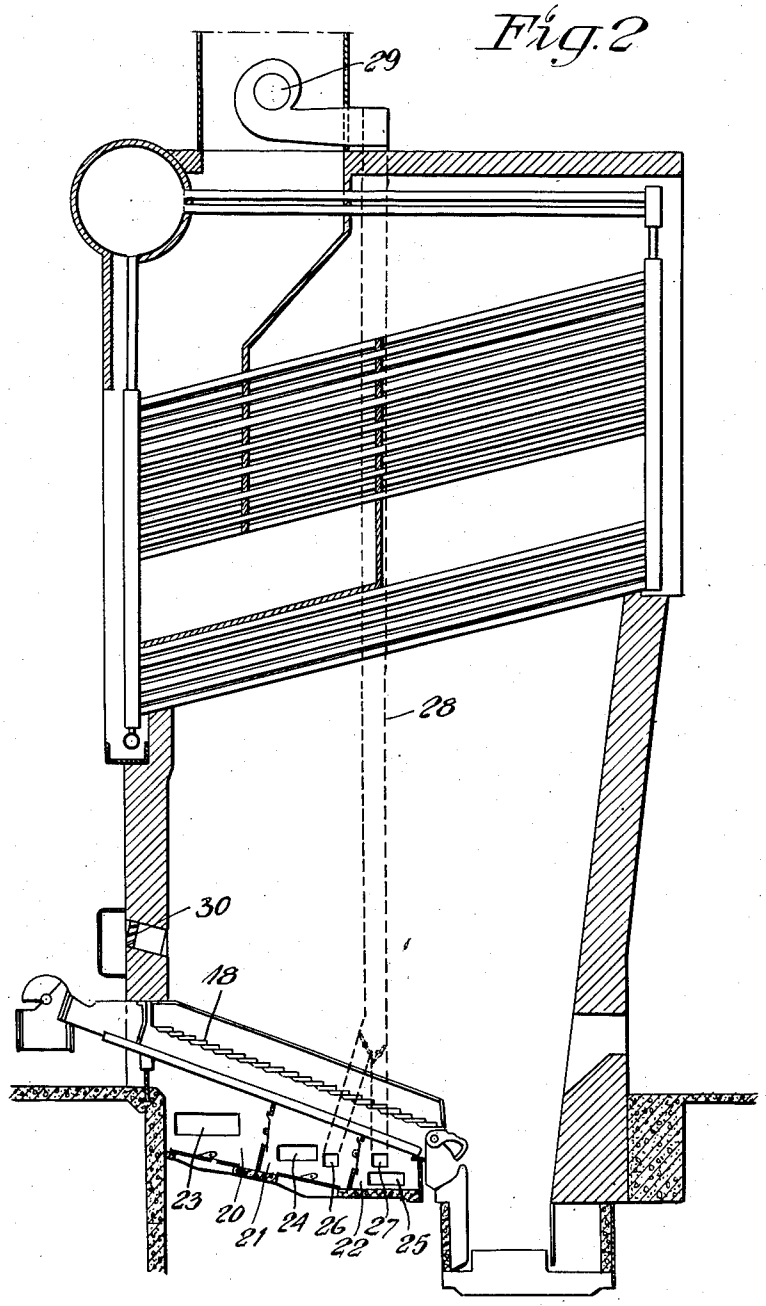
Alf Lysholm
John Strindlund
Inventors,
by Hedlund & Trucht
their Attys.

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Fig. 2



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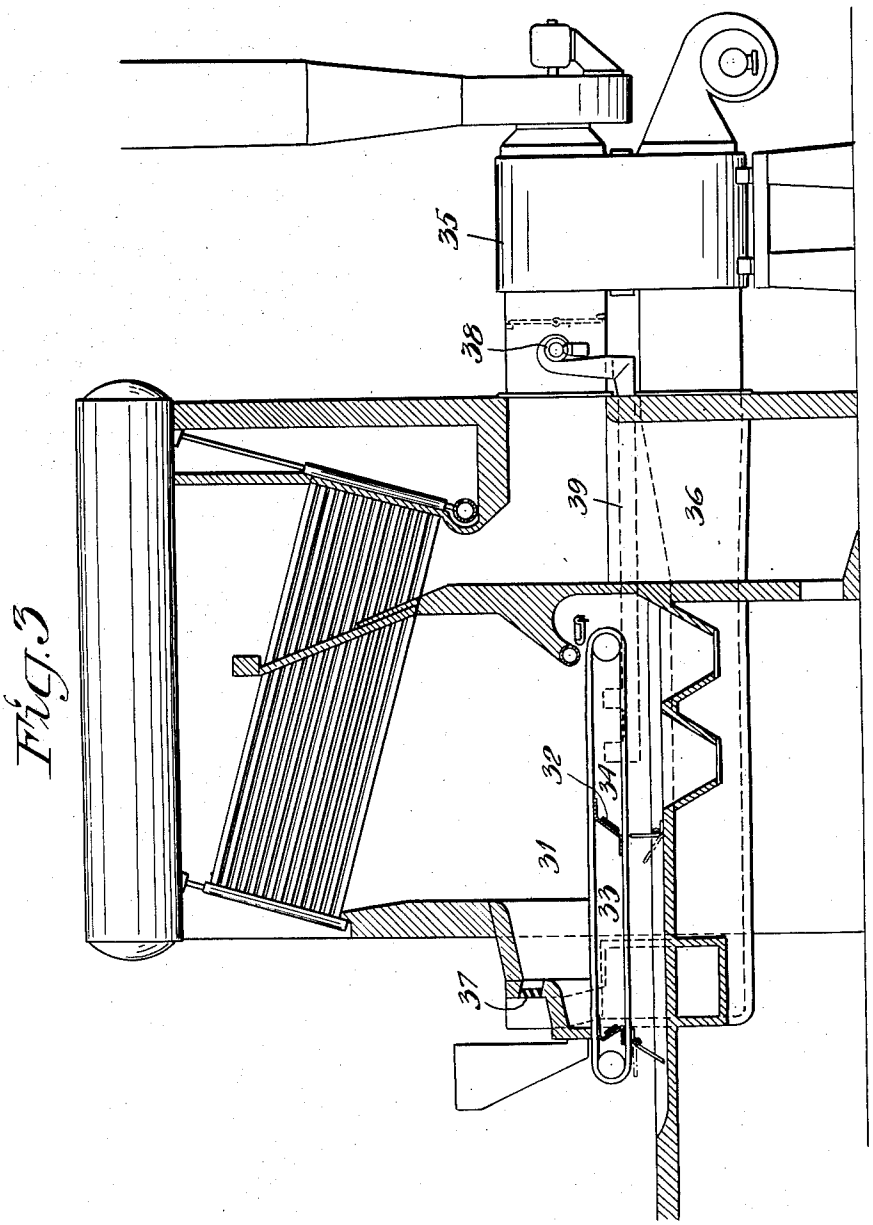


Fig. 3

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Fig. 4

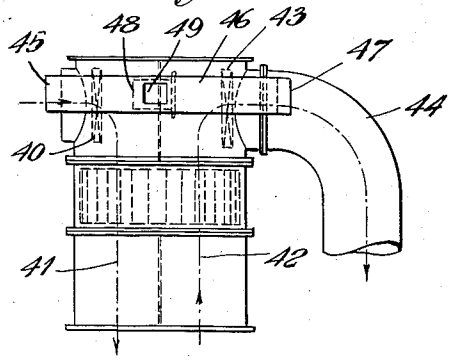


Fig. 5

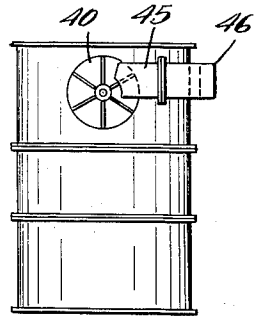
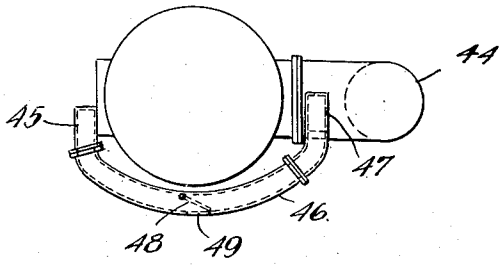


Fig. 6



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Patented Nov. 3, 1931

1,829,996

UNITED STATES PATENT OFFICE

ALF LYSHOLM, OF STOCKHOLM, SWEDEN, AND JOHN STRINDLUND, OF HURUM, NORWAY, ASSIGNORS TO AKTIEBOLAGET LJUNGSTRÖMS ÅNGTURBIN, OF STOCKHOLM, SWEDEN, A CORPORATION

FURNACE

Application filed March 25, 1927, Serial No. 178,470, and in Sweden December 22, 1925.

According to examinations of a recent date regarding the combustion of solid fuel, for instance coal, on grates, three layers may be distinguished, viz. lowermost, a layer in which the coal is burnt to carbon dioxide by the air of combustion added according to the formula:

$$C+O_2=CO_2$$

above a layer, in which the carbon dioxide formed reacts with carbon according to the formula:

$$C+CO_2=2CO$$

and uppermost a layer in which the degassing proper takes place.

On burning solid fuel on grates it may happen, for instance in forced service or especially by using preheated air, that the temperature in the coal bed, especially in the lower portion thereof, rises so high that the coal ashes melt, causing the grate openings to be clogged so that the air for combustion will not be supplied to the coal bed to the necessary extent and uniformly distributed. This causes a decrease in the combustion effect in qualitive as well as quantitive respect.

The present invention has for its object to avoid this drawback which represents an important inconvenience to a rational combustion and relates to a method for producing an air mixture to be used for combustion in furnaces provided with air preheaters in which the air is preheated by the heat of the flue gases, by which method the highest temperature in the coal bed is so to say displaced upwards from the dangerous nearness of the grate. To this end the invention consists in mixing with the air to be used for combustion a substance capable of reacting, wholly or partly, with carbon under heat absorption. This substance may consist of water or steam, in which case the following reactions will take place in the coal bed:

$$a.\ C+H_2O=CO+H_2$$
$$b.\ C+2H_2O=CO+2H_2$$

If water is added to the air, 38.6 and 38.5 Cal. per kilogram of carbon respectively will be absorbed in these reactions, whereas, when using steam, these values will be 27.9 and 17.8 Cal. per kilogram of carbon respectively.

Instead of adding water or steam, carbon dioxide, for instance in the form of flue gases, may be used as addition to the air. In this case the following reaction will take place:

$$C+CO_2=2CO-38.8\ \text{Cal.}$$

By adding, according to the invention, to the air for combustion a substance capable of reacting, wholly or partly, with carbon under heat absorption, only the temperature in the coal bed, especially the lower portion thereof is reduced so that the risk is eliminated that the ashes will melt, but not the temperature of the flame, as the gases formed by the substance reacting with the carbon are combustible and partake in the gas combustion above the coal bed. If water is introduced together with the air for combustion, the heat of evaporation of the water introduced will, of course, be lost and, moreover, the waste-heat losses will also be increased on account of the increased content of water in the flue gases, but the advantages attained are predominating. However, it is preferred to use flue gases as the substance to be added to the air for combustion, said flue gases being preferably drawn off from the gases leaving the air preheater.

Further, it has been found, that it is not suitable or necessary to supply such mixed air to all portions of the grate, as all portions thereof are not subjected to temperatures critical to the duration of the grate. For this purpose flue gases are preferably supplied only to the air to be supplied to those portions of the grate which are situated inside that portion thereof where the main degassing of the coal takes place, or, in other words, flue gases are only added to the air to be supplied to those portions of the grate where a critical heat development arises, that is to say especially the central portion of the grate, reckoned in the longitudinal direction thereof.

The invention will be more closely described with reference to the accompanying drawings in which the invention is shown as applied to furnaces of different kinds. Fig. 1

is a side elevation, partly in section, and illustrates the invention as applied to a boiler plant having a compartment stoker. Fig. 2 shows a steam boiler plant having an underfeed stoker to which the invention is applied. Fig. 3 shows a steam boiler plant provided with a regenerative preheater and arranged according to the present invention. Figs. 4, 5 and 6 illustrate an embodiment of a regenerative rotating air preheater adapted to be used for carrying out the method according to the invention, Figs. 4 and 5 being side views and Fig. 6 a plan view of same. The air preheater is of a type previously known and described in, for instance, the French patent specification No. 537,102, and for this reason it is not deemed necessary to describe said preheater in detail.

According to Fig. 1 the space between the two parts of the endless grate 1 is divided into several compartments by means of partitions 2. These compartments are each provided with an inlet 3 for air for combustion which is preheated in a suitable preheater by means of heat from the flue gases, the amount of air introduced being regulated by means of dampers 4 arranged in said inlets 3. Further, the middlemost compartment 5, the compartment 6 adjacent thereto and lying behind thereof and, if desired, also the compartment 7 are each provided with an inlet 8, 9 and 10 respectively for flue gases supplied to said compartments through the conduit 11 from the uptake by means of a fan 12 arranged therein. Arranged above the grate 1 is a device for introducing secondary air, said device consisting of one or more nozzles in each of which a stationary propeller or similar guiding means is inserted in order to impart to the air a rotating motion.

Consequently, flue gases are only supplied to the air to be supplied to those portions of the grate which are situated inside the degassing zone 14 thereof, that is to say only to the combustion zone 15 and the out-burning zone 16. On account of the nature of the reactions taking place in the degassing zone 14, temperature therein will not arise higher than the melting point of the ashes, whereas in the combustion zone 15 there is risk of the temperature becoming so high that the ashes melt and stick to the grate. In the zone 16 the combustion is approximately completed, and for this reason the temperature in this zone does not, as a rule, attain critical values.

It is clear that the addition to the air for combustion of flue gases represents a contamination of said air which has a disadvantageous influence upon the course of combustion, and for this reason the dilution of the air for combustion with flue gases is limited to those sections of the grate where such dilution is absolutely necessary, that is to say especially to the combustion zone, which, in several cases, corresponds to the central third of the grate.

According to Fig. 2 which, as mentioned above, illustrates a steam boiler plant with an underfeed stoker, the space below the grate 18 is divided into three compartments 20, 21 and 22, each of which is provided with an inlet 23, 24 and 25 respectively for preheated air for combustion, whereas only the compartments 21 and 22 are each provided with an inlet 26 and 27 respectively for flue gases, supplied to said compartments through the conduit 28 from the uptake by means of a fan 29 situated therein. Also in this case a device 30 for introducing secondary air is arranged above the grate, said device imparting to the air a rotating motion. The dilution of the air with flue gases may, of course, be limited to the compartment 21 which corresponds to the combustion zone, if it proves to be unnecessary to reduce the temperature in the compartment 22 by the dilution with flue gases.

According to Fig. 3 the endless grate 31 is divided into two compartments 33 and 34 by means of the partition 32. From the regenerative rotating preheater 35 the hot air flows through the channel 36 to the space below the grate as well as to the device 37 adapted to introduce turbulent secondary air. Arranged in the flue gas channel leading to the preheater 35 is a fan 38 communicating with the compartment 34 by means of the channel 39. The air for combustion supplied to said compartment 34 from the channel 36 will, consequently, be diluted by flue gases, whereas the compartment 33 adjacent to the furnace opening will be supplied with air free from flue gases. In this case the compartment 34 corresponds to both the combustion zone and the out-burning zone.

As already stated, Figs. 4, 5 and 6 illustrate an air preheater of the known regenerative and rotating type adapted for carrying out the method according to the present invention, the preheated air from the preheater being admixed with the necessary amount of flue gases immediately when leaving said preheater.

The air sucked in by the fan 40 flows through the preheater in the direction of the arrow 41 and is supplied to the furnace in a preheated state. Hot flue gases coming from the furnace flow through the preheater in the direction of the arrow 42 and are forced out into the uptake through the pipe 44 by the fan 43 after having given off part of their heat content to the air. According to the invention the suction side of the air fan 40 is connected to the pressure side of the flue gas fan 43, a metal sheet cap 45 being secured in front of the air fan 41 which cap is disposed as close to the fan blades as possible and takes up a suitable portion of the fan opening. The cap 45 is connected with a pipe

46 arranged around the preheater and leading to the flue gas outlet, at which place another cap 47 is provided which takes up a suitable portion of the outlet opening. Disposed within the pipe 46 is a damper 48 arranged in such manner that, when it throttles the sectional area of the pipe 46, it opens simultaneously an inlet opening for air 49. By means of this damper 49 the amount of flue gases drawn from the flue gas channel 44 through the pipe 46 by the fan 40 may be regulated. The inlet opening 49 of the pipe 46 serves to prevent formation of vacuum in that portion of the pipe 46 which is adjacent to the fan 40, when the damper 48 entirely closes the pipe 46.

Instead of adding the hot flue gases leaving the preheater to the cold air, the air already preheated in the preheater may be diluted, either with flue gases leaving the preheater or directly with flue gases having not passed through the preheater. In certain cases special measures must be taken to equalize the pressure difference between the air and the flue gases.

The amount of the substance to be added to the air for combustion may vary. If flue gases are used as addition to the preheated air, an amount of 10 to 15% of flue gases is suitable, said amount increasing with the temperature of the furnace and with the easiness with which the ashes melt.

The dilution of the air for combustion according to the invention may, of course, be carried out continuously during the entire course of combustion, but preferably such dilution should take place only a suitable time, for instance one or two hours, before cleaning the grate.

Evidently the invention may be applied to grates of other types than those described above.

What we claim as new and desire to secure by Letters Patent of the United States of America is:—

1. In a boiler, a combustion chamber, a progressive feed grate extending across said combustion chamber and providing degasifying, coke-burning and outburning zones, partitions extending below the grate dividing the space below the grate area into separated compartments corresponding to the grate zones, means for supplying combustion air to the degasifying and the outburning zone compartments, and means for supplying combustion air diluted with an endothermic carbon-reacting substance to the coke-burning compartment.

2. In a boiler, a combustion chamber, a progressive feed grate extending across said combustion chamber and providing degasifying, coke-burning and outburning zones, partitions extending below the grate dividing the space below the grate area into separated compartments corresponding to the grate zones, means for supplying combustion air to the degasifying and the outburning zone compartments, and means for supplying combustion air diluted with flue gases to the coke-burning compartment.

3. In a boiler, a combustion chamber, an air preheater, a progressive feed grate extending across said combustion chamber and providing degasifying, coke-burning, and outburning zones, partitions below the grate dividing the space below the grate into separated compartments corresponding to the grate area zones, means for supplying heated combustion air from said preheater to the degasifying and the outburning zone compartments, and means for supplying heated combustion air from said preheater diluted with cooled flue gases from said preheater to the coke-burning compartment.

4. In boiler operation, the method of controlling temperatures adjacent the grate of a furnace comprising the steps of progressively conveying fuel in degasifying, coke-burning, and outburning zones in the combustion chamber, supplying combustion air to the degasifying and outburning zones, and lowering excessive temperature in the coke-burning zone by supplying combustion air diluted with an endothermic carbon-reacting substance thereto.

5. In boiler operation, the method of controlling temperatures adjacent the grate of a furnace comprising the steps of progressively conveying fuel in degasifying, coke-burning, and outburning zones in the combustion chamber, supplying combustion air to the degasifying and outburning zones, and lowering excessive temperature in the coke-burning zone by supplying combustion air diluted with flue gases thereto.

6. In boiler operation, the method of controlling temperatures adjacent the grate of a furnace comprising the steps of progressively conveying fuel in degasifying, coke-burning, and outburning zones in the combustion chamber, supplying preheated combustion air to the degasifying and outburning zones, and lowering excessive temperature in the coke-burning zone by supplying preheated combustion air diluted with low temperature flue gases thereto.

In testimony whereof we affix our signatures.

ALF LYSHOLM.
JOHN STRINDLUND.