

950,013.

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UNITED STATES PATENT OFFICE.

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FLOAT COMBUSTION-INDICATOR.

950,013.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, ASA WHITE KENNEY BILLINGS, a citizen of the United States of America, and a resident of Habana, in the Province of Habana and Republic of Cuba, have invented certain new and useful Improvements in Float Combustion-Indicators, of which the following is a specification.

This invention relates to an apparatus for regulating the combustion in boilers, furnaces, or other heating devices provided with a fire-pot and an exit for the products of combustion, and consists in providing a suitable indicator and recorder connected to different parts of the heating device in such a manner that the differences of pressure existing in two different portions of said heating device will operate the indicator and recorder and cause a visual indication to be made of the ratio of the said differences of pressure in said different portions and a permanent record made of same.

Ordinarily in the process of fuel combustion no attempt is made to keep track of the actual condition of the combustion process, the fireman regulating the fire in the heating device in accordance with his best judgment. Under such conditions a material source of loss is caused by the lack of regulation of the amount of air entering the furnace, for if this is too large, as is usually the case, fuel is wasted by the unnecessary heating of a mass of cold air to the temperature of the chimney. If the amount of air is insufficient, an equally important loss occurs through imperfect combustion with a consequent liberation of soot and combustible gases which pass out through the chimney. When attempts have been made to control these losses it has generally been made by chemical analysis of the products of combustion which is very inconvenient, more or less costly, and the results obtained are not suited to a prompt and continuous control of the operation of the furnace or other heating device.

The present invention offers a very simple and effective apparatus for indicating to the fireman, and making a permanent record thereof, the ratio of the differences of pressure existing in any two portions of the

heating device, such, for instance, as the fuel-bed and the flue-passages or other exit through which the products of combustion pass.

The invention also consists in providing a casing in which a float is adapted to move vertically and thereby operate an indicating and marking member co-acting with a record-receiving member superimposed upon said casing to indicate to the fireman the ratio of the differences of pressure in any two portions of the heating device, these two portions, as, for instance, the fuel-bed and the flue-passages or other exit, being connected by means of tubes or pipes to the interior of said casing, and to the interior chambers of the said float.

The invention further consists in dividing the interior of the float into two chambers, by a conical partition or otherwise, one of which chambers communicates by means of a tube or pipe with the ash-pit, or source of air supply, while the other communicates with a point in the flue-passage or other exit. The two chambers into which the interior of the float is divided are so shaped that the ratio of the areas of the free surface of the liquid in said chambers varies continuously from one suitable value corresponding to one extreme position of said float to another suitable value corresponding to the other extreme position of said float.

The invention further consists in providing a counterbalance for said float, so that it remains in neutral equilibrium in all positions when not subjected to any differences of pressure, preferably by means of a counterbalance attached to a curved arc operated by the rising and falling of the float, which counterbalance is so arranged as to increase its force as the float rises and thus compensate for the variable displacement of the metal walls of said float.

Any change of the differences of pressure existing in either portion of the heating device will act upon the float and cause it to rise or fall, as the case may be, and thus operate the marking or indicating member. By such a device, the approximate relation of the rate of combustion of the fuel to the amount of the gases leaving the furnace may

be readily indicated and a permanent record made thereof from which the fireman may secure such information as will assist him in efficiently controlling the operation of said heating device.

The invention further consists in certain novel features of construction and arrangement of parts which will be readily understood by reference to the description of the drawings and to the claims hereinafter given.

Of the drawings: The drawing shows a section of a boiler and a vertical section of a float-operated indicator and recorder connected to said furnace, the entire drawing being diagrammatical with the float-operated indicator and recording devices greatly enlarged in proportion to the furnace to show more clearly their construction.

In the drawings, 10 represents any well-known form of boiler beneath one end of which is a fire-pot 11 which is connected by means of a passage 12 for the products of combustion passing through the usual tubes in the boiler to a stack, chimney, or other exit 13.

While in the drawing, a boiler as a means of generating steam is shown, it is obvious that the invention might be applied equally as well to any other form of heating device in which a fire-pot 11 and stack or other exit 13 for the products of combustion are used.

Beneath the grate 14 of the fire-pot is a chamber 15, as, for instance, the usual ash-pit. At some convenient point adjacent to the heating device is located a casing 16 in which are placed or formed two inclosed chambers 17 and 40, the latter being superimposed upon the former.

The lower portion of the casing 16 is usually cylindrical in form and has contained therein a cylindrical float 18 closed at the top and open at the bottom and divided, as, for example, by a conical partition into two compartments, one of which 20 increases in area toward the top of the float while the other 21 decreases in area toward the top of the float. A tube or pipe 22 extends from the top of the float chamber to the interior of the fire-pot 11, thus permitting any pressure contained therein to be transmitted to the interior of the float chamber and act upon the float 18 contained therein.

Extending from the interior of the chamber 20 is a pipe 23, the other end of which extends into the ash-pit chamber 15, thus permitting any pressure contained therein to be transmitted through the pipe 23 into the interior of the said chamber 20 to act upon the float 18. In like manner a tube or pipe 24 extends from the upper part of

the chamber 21 to the interior of the farther portion of the flue-passages or base of stack 13, thus permitting any pressure existing at said point to be transmitted to the interior of the chamber 21 to act upon the float 18.

The float chamber 17 is filled partially with some suitable liquid 25 in which the float 18 operates. This float 18 is provided with a central depression 26 into which extends a downwardly extending tubular member 27 formed upon or secured to the partition 28 in the casing 16.

The bottom of the depression 26 is perforated so that the liquid contained within said float chamber 17 will partially fill said depression and cover the lower end of the tubular projection 27 to form a suitable seal for the reciprocating rod 29 secured to the float 18 and passing through the tubular member 27, the upper end of said rod 29 being provided with a pen or other marking device 30 which co-acts with a graduated band or ribbon 31 mounted upon spools or drums 32 and movable by means of a clock mechanism 33 in the path of said marking member 30. It is obvious that the movement of said marking member 30 transversely of said ribbon 31 and its position relative thereto at any moment will provide a visual indication of the operation of said float 18.

The upper end of the rod 29 is connected by means of a cord 34 with a pulley 35 upon a revoluble shaft 36 to which is secured a curved cam-shaped arc 37, to the periphery of which is secured a band 38 supporting a counterbalance 39. The outer face of this curved arc is approximately a spiral, being so formed that the counterbalancing force exerted on the float increases as the float rises in sufficient amount to balance the float in all positions when under no pressure, thus compensating for the variable displacement of the liquid by the metal walls of the float.

When there are no ash-pit doors or when the ash-pit doors are always open, the pipe 23 may communicate directly with the atmosphere instead of with the ash-pit chambers 15, as shown. If a blower or similar device is used as the source of air-supply for the combustion, this pipe must be connected to the ash-pit chamber or otherwise, as may be required in order to obtain a difference of pressure between said pipe 23 and the pipe 24, which is dependent upon the rate of combustion of the fuel. It is also obvious that in cases when the fuel is supplied in the form of a powder in suspension, a liquid or a gas, that the pipe 23 should be connected in each case in such manner that the resulting difference of pressure between the interior of the float chamber 20 and the interior of the float casing 17 is dependent

upon the rate of combustion or rate of supply of said fuel.

Owing to the increase in the area of the chamber 20 and the decrease in the area of the chamber 21 toward the top of the float, as determined by the shape of the partition 19, there will always be a definite position of the float to correspond to each ratio of pressures within the working range, and this position will be nearly independent of the total pressures when the float is properly counterbalanced to allow for the varying displacement.

The record upon the record member 31 is made in any usual manner, it only being necessary that the rod 29 supporting the recording member 30 should pass out through the partition 28 of the casing 16 through a seal, thus enabling the pen and clockwork to be manipulated without affecting the pressure readings. It is obvious that while only one means, as, for example, a cylindrical float 18 with the conical partition 19, is shown for this purpose, there are many other possible arrangements containing the essential feature that the overpowering of one difference of pressure by the other shall cause a movement which reduces the effective area over which the pressure difference causing the movement is applied, as compared with the area exposed to the other pressure difference, and that the apparatus may be varied to accomplish this end without altering the principles of this invention. It is also obvious that the centers of gravity of the float and of the volume of liquid displaced by same, and the centers of pressure on the different surfaces must be so related that the float will not tend to capsize or bind and thus introduce excessive friction.

When a uniform quality of fuel is used with a given thickness of fuel-bed, the difference in the pressure above and below the fuel-bed is a measure of the rate of combustion while the difference in the pressure between the fire-pot and the farther portion of the flue-passage or exit is a measure of the amount of gases passing. As long as the air supply is limited to that necessary for the most efficient combustion the rod 29 and marking device 30 will remain in the position corresponding to this best efficiency. Any departure from these most efficient conditions will be made evident at once and recorded by the operation of the marking device upon the strip or ribbon 31. This provides a ready means for indicating the general conditions of combustion within a furnace or other heating device, particularly in relation to the proportionate amount of air supplied for the combustion of the fuel, and affords a means of informing the fireman, and of keeping a record of, when the

air supply is insufficient, resulting in a loss of efficiency due to the resulting imperfect combustion, or is too great, resulting in a loss of efficiency due to the useless heating of this amount of excess air.

While this invention is adapted for use in connection with furnaces or other heating devices, it is principally intended for use in connection with steam boilers, in order to obtain the maximum efficiency in the consumption of the coal or other fuel, and to enable a permanent record to be kept of the departure from maximum efficiency.

It is believed that the operation of the invention and its many advantages will be fully apparent without any further description.

Having thus described my invention, I claim:

1. In a device of the class described, the combination of a heating device; a movable member carrying a graduated strip; a rod the end of which is adapted to be moved transversely of said strip; a float for operating said rod; a casing containing the float and the liquid in which said float is immersed; and means interposed between said float and different parts of said heating device for causing the relative differences of pressure in two portions of said heating device to be visually shown by said indicator.

2. In a device of the class described, the combination of a heating device; a movable member carrying a graduated strip; a rod the end of which is adapted to be moved transversely of said strip; a float provided with two compartments and adapted to operate said rod; a casing containing said float and the liquid in which said float is immersed; and a pipe extending from each of said compartments and from the casing to a different portion of the said heating device for causing the relative differences of pressure in two portions of said heating device to be visually shown by said indicator.

3. In a device of the class described, the combination of a heating device; a movable member carrying a graduated strip; a rod the end of which is adapted to be moved transversely of said strip; a float provided with two compartments and adapted to operate said rod, the relative areas of the horizontal cross-sections of said compartments varying continuously from the top to the bottom of said compartments; a casing inclosing said float and the liquid in which it is immersed; and pipes extending from each of the said compartments and from the inclosing casing to different parts of said heating device for causing the relative differences of pressure in two different portions of said heating device to be visually shown by said indicator.

4. In a device of the class described, the

combination of a heating device; a movable member carrying a graduated strip; a rod the end of which is adapted to be moved transversely of said strip; a float provided
5 with two compartments and adapted to operate said rod, one of said compartments increasing and the other decreasing in area of horizontal cross-section toward the top of the float; a casing inclosing said float and
10 the liquid in which it is immersed; and pipes extending from each of said compartments and from the casing to different parts of said heating device, for causing the relative
15 differences of pressure in two portions of said heating device to be visually shown by said indicator.

5. In a device of the class described, the combination of a heating device; a reciprocating rod; a float provided with two compartments and adapted to operate said rod;
20 a pipe leading from one compartment to the ash-pit or source of air supply of the said heating device; a pipe leading from the other compartment to the back-pass or the
25 farther portion of the flue-passages of said heating device; and a pipe leading from the float chamber to the fire-pot of said heating device.

6. In a device of the class described, the combination of a heating device; a casing; a liquid contained therein; a float therein, provided with two compartments, one of which
30 increases and the other of which decreases in area of horizontal cross-section toward the top of said compartments; a rod secured to and movable with said float; a support for a record member; a recording member
35 secured to the end of said rod and operated by said float; a pipe from said casing or float chamber to the fire-pot of said heating device; a pipe from the first-mentioned
40 chamber to the ash-pit or source of air supply of said heating device; a pipe from the other compartment to the back-pass or farther portion of the flue-passages of said
45 heating device.

7. In a device of the class described, the combination of a heating device; a casing; a liquid contained therein; a cylindrical float
50 therein, provided with a conical partition; a support for a record member; a recording member operated by said float; a pipe from said casing to the combustion chamber or fire-pot of said heating device; a pipe from
55 one compartment of said float to the ash-pit or source of air supply of said heating device; and a pipe from the other compartment of said float to the back-pass or the farther portion of the flue-passages of said
60 heating device.

8. In a device of the class described, the combination of a heating device; a casing; a liquid therein; a float therein, provided

with two compartments; a recording member secured to said float and passing through
65 said casing; a support for a record member with which said recording member co-acts; a pipe from the float chamber or casing to the fire-pot of said heating device; a pipe from one compartment of said float to the
70 back-pass or farther portion of the flue-passages of said heating device; and a pipe from the other compartment of said float to the ash-pit or source of air supply of said heating device.
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9. In a device of the class described, the combination of a heating device; a casing; a liquid contained therein; a float therein; provided with two compartments; a seal in
80 said casing; a recording member secured to said float and passing through the said seal; a support for a record member with which said recording member co-acts; a pipe from the float chamber to the fire-pot of said
85 heating device; a pipe from one compartment of said float to the back-pass of said heating device; and a pipe from the other compartment of said float to the ash-pit or source of air supply of said heating device.

10. In a device of the class described, the combination of a heating device; a casing; a liquid contained therein; a float therein; a seal in said casing; a recording member secured to said float and passing through the
90 seal; a support for a record member with which said recording member co-acts; a pipe from the float chamber or casing to the fire-pot of said heating device; a pipe from the interior of said float to the farther portion of the flue passages of said heating device; a
100 pipe from the interior of said float to the ash-pit or source of air-supply of said heating device; and means of counterbalancing said float.

11. In a device of the class described, the combination of a heating device; a casing; a liquid therein; a float therein, provided
105 with two compartments; a seal in said casing; a recording member secured to said float and passing through the said seal; a support for a record member with which the said recording member co-acts; a pipe from the float chamber to the fire-pot of said heating device; a pipe from one compartment of said float to the farther portion
110 of the flue passages of said heating device; a pipe from the other compartment to the ash-pit or source of air supply of said heating device; and means for compensating for the variable displacement of the walls of
120 said float in all its positions.

12. In a device of the class described, the combination of a heating device; a casing; a liquid therein; a float therein; provided
125 with two compartments; a seal in said casing; a recording member secured to said

float and passing through the seal; a support for a record member with which the said recording member co-acts; a pipe from the float chamber to the fire-pot of said heating device; a pipe from one compartment of said float to the back-pass or farther portion of the flue passages of said heating device; a pipe from the other compartment to the source of air-supply of said heating device;

a curved arc operable by said float; and a 10 counterbalance secured thereto.

Signed by me at Habana, Cuba, this thirtieth day of March, in the year nineteen hundred and nine.

ASA WHITE KENNEY BILLINGS.

Witnesses:

HENRY P. STARRETT,
VICTOR NORMAND.