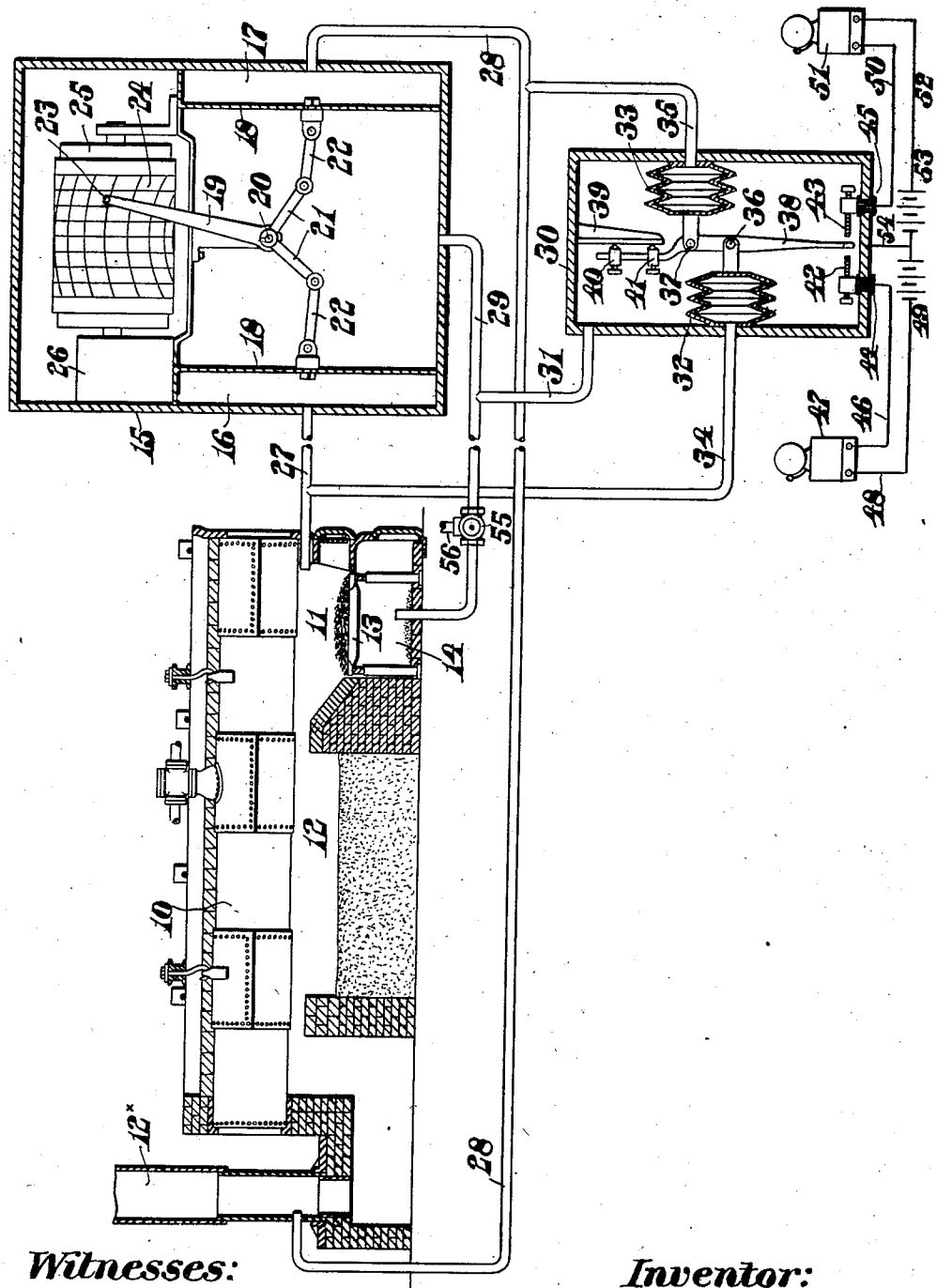
A. W. K. BILLINGS.

PRESSURE RATIO ALARM.

APPLICATION FILED JULY 21, 1909.

1,007,178. Patented Oct. 31, 1911.



Witnesses:

Nathan C. Lombard.

Edna C. Cleveland.

Inventor:

Asa W. K. Billings,

by Walter C. Lombard,

Atty.

UNITED STATES PATENT OFFICE.

ASA WHITE KENNEY BILLINGS, OF HABANA, CUBA.

PRESSURE-RATIO ALARM.

1,007,178. Specification of Letters Patent. Patented Oct. 31, 1911.

Application filed July 21, 1909. Serial No. 508,856.

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 Pressure-Ratio Alarms, of which the following is a specification.

This invention relates to alarms for indicating the abnormal values of two differences in pressure, as, for instance, those of a heating device, to determine accurately the conditions of the fire, said alarms being operated whenever the ratio of said differences of pressure passes its normal range of variation as predetermined by the adjustment of the device for the purpose in view.

It is adapted to operate in combination with a combustion indicator and recorder or independently thereof as may be desired.

The invention consists of a hermetically sealed casing, the interior of which is connected by a suitable pipe to one source of pressure which is common to both differences of pressure, above referred to. This source of pressure may be, for instance, the ashpit of a heating device. The casing contains two diaphragm chambers, each of which is connected by a pipe to a different source of pressure, as, for instance, one diaphragm chamber may be connected to the firepot of a heating device while the other diaphragm chamber is connected to the back-pass or exit from the said heating device, these diaphragm chambers being pivotally connected to a movable member operable between two contacts, each of which is electrically connected to an alarm which is capable of being operated whenever the movement of the diaphragm chambers operates said movable member to complete the electrical circuits in which it is connected, one of the alarms indicating one limit and the other the other limit, of the permissible range of variation of the ratio of the two differences of pressure. As stated above, such a pressure ratio alarm may be applied, for example, to a heating device to operate under the difference of pressure above and below the fuel-bed and the difference of pressure between the combustion chamber or fire-pot and the farther portion of the flue or heating passages. One of these differences of pressure corresponds to the rate of combustion of the fuel; the other corresponds to the amount of products of combustion. The ratio of the two corresponds approximately to the proportion of air supplied for the combustion, and the alarm, when properly connected and adjusted, will indicate either the one extreme of having too thick a fire, or a fuel-bed choked with clinkers, or the other extreme of having too thin a fire or a fuel-bed full of holes.

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.

The drawing shows a section of a heating device, a vertical section of a combustion indicator and recorder connected to said device, and also in connection with said heating device a diagrammatical representation of the pressure ratio alarms, as applied to indicate the existence of either too thick a fire or clinkers, or too thin a fire or holes in the fuel-bed, the indicating and recording devices and the alarm operating mechanisms being greatly enlarged in proportion to the furnace or heating device, to show more clearly their construction.

In the drawing, 10 represents any well-known form of boiler beneath one end of which is a fire-pot 11 with flue-passages 12 conducting the gaseous products of combustion to the stack or chimney 12*.

While in the drawing, a boiler as a means of generating steam is shown, it is obvious that the invention might be applied equally well to any other form of heating device in which a fire-pot 11 and flue-passages or other exit 12 for the products of combustion are used, or to any other form of apparatus in which it is convenient to give notice by an alarm of variations from the normal operation of the apparatus by means of variations beyond predetermined limits of the ratio of two differences of pressure which are affected by the operation of said apparatus. For convenience only one application of the invention will be described—that to a heating device as shown in the drawings.

Beneath the grate 13 of the fire-pot is a chamber 14, as for instance, the usual ashpit. At some convenient point adjacent to the heating device is located a casing 15 in which are placed or formed two inclosed chambers 16 and 17, one wall 18 of each of

which is made movable, as, for instance, in the form of a thin flexible diaphragm.

The diaphragms or movable walls 18 face one another and centrally disposed between the same is a pivoted indicating member 19 mounted upon a pivot 20 and provided at its lower end with two radiating arms 21, the ends of which are connected by a link 22 with the center of one of the diaphragms 18.

The indicating end of the pivoted member 19 is provided with a marking device 23 such as a pen, this marking device 23 cooperating during the operation of the indicator with a record-receiving strip or member 24 mounted upon suitable rollers 25 and when the indicator is in operation this record-receiving member 24 is caused to move at a uniform rate in the path of the marking member 23 by means of any well-known form of clock mechanism 26.

The inclosed chamber 16 is connected by a suitable pipe 27 to the firepot 11, the ends of said pipe 27 being situated so that it is not in the direct path of the currents of gases in said fire-pot 11. In a similar manner the inclosed chamber 17 is connected by means of a pipe 28 with the farther part of the flue-passages, or exit from the heating device, the end of this pipe 28 being situated so that it is not in the direct path of the gases passing through said flue-passages or exit.

The casing 15 is connected by means of a pipe 29 with the chamber 14 beneath the fire-pot 11, its end being situated so as not to be in the direct path of the currents of air in said chamber 14, so that any pressure existing in said chamber is transmitted to the interior of the casing 15, thereby causing the diaphragm 18 of the chamber 16 to be affected by the difference of pressures above and below the fuel bed, and the diaphragm 18 of the chamber 17 to be affected by the difference of pressures between that in the ashpit 14 and the farther portion of the flue-passages or exit 12.

It is obvious that, in the arrangement described, the difference of pressures between the ashpit 14 and the fire-pot 11, which varies with the rate of combustion, other conditions of the fuel-bed remaining the same, and affects the diaphragm 18 of the chamber 16, is always less than the difference of pressures between the ashpit 14 and the farther portion of the flue-passages or exit 12, which affects the diaphragm 18 of the chamber 17, by an amount which is equal to the difference of pressure due to friction of the gaseous products of combustion passing through the flue-passages or exit and varying according to the amount of said gases.

When a uniform quality of fuel is used with a given thickness in the fuel-bed, the difference in the pressure above and below the fuel-bed is a measure of the rate of combustion, while the difference of pressure between the fire-pot and the farther portion of the flue-passages 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 indicating arm and marking device will remain in the position corresponding to the best efficiency. Any departure from these most efficient conditions will be made evident at once and recorded by the indicator and recorder.

The apparatus above described is substantially the same as that shown and described in another application of mine, filed Mar. 15, 1909, Ser. No. 483,664. It is highly desirable, however, to use in connection with the above described apparatus an alarm of some nature, preferably audible, which will attract the attention of the fireman and indicate to him the presence of clinker in the fuel-bed or holes through which cold air is passing uselessly, and it is desirable that these alarms should be operated automatically by the variations in the ratio between two pressure differences in different portions of the heating apparatus. To this end a hermetically sealed compartment 30 is provided, the interior of which is connected by means of a pipe 31 to the pipe 29 communicating with the chamber 14.

Within the compartment 30 and secured to opposite walls thereof are the diaphragm chambers 32 and 33, these diaphragm chambers being made of thin flexible material capable of expanding and contracting under various conditions of pressure therein. The diaphragm chamber 32 is connected by means of a pipe 34 to the pipe 27 communicating with the fire-pot 11 while the diaphragm chamber 33 is connected by means of a pipe 35 with the pipe 28 communicating with the farther part of the flue-passages or exit 12. The centers of the diaphragm chambers 32 and 33 are out of alinement with one another and the inner closed ends thereof are pivotally connected, respectively, at 36 and 37 with a movable member 38 interposed between the same.

Secured to or forming part of the inner wall of the compartment 30 is a support 39 projecting inwardly from said wall and adjustably mounted upon said movable member 38 are two bearing members 40 and 41 each of which is provided with a conical end just touching normally the support 39. The opposite end of the movable member 38 extends between two adjustable contacts 42 and 43, said contacts being in the path of movement of said member 38 and insulated from the walls of the compartment 30, as indicated, by the members 44 and 45.

The contact 42 is connected by the wire 46 with one binding post of an audible signal 47, the other binding post of said signal 47

being connected by a wire 48 to a battery 49. In a similar manner the contact 43 is connected by means of a wire 50 to one binding post of an audible signal 51, while the opposite binding post is connected by a wire 52 to a battery 53. The batteries 49 and 53 are both connected by a common wire 54 to the casing 30 and it is obvious that when the movable member 38 comes into contact with either of the adjustable contact members 42 or 43 an electric circuit will be completed through the movable member 38, one of the bearing members 40 or 41, the support 39 therefor, and the casing 30. While for convenience in making the diagram two batteries are shown, it is obvious that in practice a single battery may be used without altering the principles of the invention.

When there is a normal fire in the heating device the movable member 38 occupies a position midway between the two contacts 42 and 43, with both the bearing members 40 and 41 in contact with the support 39. When, however, the fire becomes very thick or choked with clinker, it is obvious that the ratio of the difference in pressure between that in the ashpit and that in the furnace acting upon the diaphragm chamber 32 to the difference in pressure between that in the ashpit and that in the back-pass acting upon the diaphragm chamber 33 will increase so as to cause a movement of the member 38 about the bearing point 40 until in contact with the adjustable contact member 42, with a pressure on said contact member such as will produce mechanical equilibrium between the forces due to the two diaphragm chambers and the bearing point 40, and at the same time completing a circuit through the member 42, the casing 30 and the wires 46, 48, 54, battery 49 and the alarm 47, this completion of the circuit causing the alarm 47 to be sounded and to continue the sound until the fireman has restored the fire to within its normal range of condition, when the member 38 will return to its normal position midway between the contacts 42 and 43 and with both bearing points 40 and 41 in contact with their support 39. When the condition of the fire reaches its other extreme, that is, with holes in the fire, or too thin a fuel-bed, the ratio between the difference in pressure between the ashpit 14 and farther portion of flue-passages or exit 12 acting upon the diaphragm 33 and the pressure difference between the ashpit 14 and the fire-pit 11 acting upon the diaphragm 32 will so increase as to move the lever 38 about the other bearing point 41 until it comes into contact with the adjustable member 43, thus producing a pressure on said bearing point 41 and contact member 43 to produce equilibrium of the forces involved, and completing at the same time the circuit through the member 38, the bearing member 41, the support 39, casing 30, contact member 43, wires 50, 52, 54, battery 53, and the alarm 51 which will be sounded and will continue to sound until the fireman restores the fire to its normal condition. In either case when the member 38 is bearing upon the adjustable members 42 or 43, the more the fire becomes choked or the greater the holes become in the fuel-bed, the greater will be the pressure of said member 38 against the contact 42 or 43 without however causing any further movement of the lever.

The diaphragm chambers 32 and 33 are made self-sustaining but very flexible and the entire apparatus is adjusted so that when under no pressure the bearing points 40 and 41 are in contact with the support 39, with the member 38 midway between the contacts 42 and 43. In comparison with the tensions produced by the pressure differences upon the diaphragm chambers 32 and 33, the stiffness of these diaphragm chambers is so small that it is unnecessary to take it into consideration, as its only effect will be to make the alarm operate in either direction at slightly different pressure ratios, according to the relative values of the total draft. It is obvious, therefore, from the foregoing description that when the furnace conditions are within the normal range the ratio of the two tensions in the diaphragm chambers 32 and 33, corresponding to the pressure difference between, in the one case, the furnace and the ashpit, and in the other case, the back-pass and the ashpit, is such as to keep the member 38 with its bearing members 40 and 41 both pressing upon the support 39. The relative pressures on these bearing members under these conditions will vary with the furnace conditions, but without causing movement of the member 38, as long as the said furnace conditions remain within their normal range of variation. In these normal conditions the sum of the pressures exerted by the two bearing members 40 and 41 upon the support 39 and the tension exerted by the diaphragm chamber 32 will just equal the tension exerted by the diaphragm chamber 33, thus retaining the member 38 between its two contacts 42 and 43. As soon, however, as the ratio of these tensions in the diaphragm chambers 32 and 33 exceeds the limit in either direction, one diaphragm will overpower the other and move the lever about one or the other of the two bearing points 40 or 41 until it comes into contact with and exerts pressure against one of the contacts 42 or 43, after which any further departure from the normal range or increase in the total draft merely increases the relative pressure against said contact.

The diaphragm chambers 32 and 33 are

normally expanded to their normal limit, but are adapted to be collapsed to a greater or less degree by the action of the pressures in that portion of the heating device with which they are connected, or to be extended by the overpowering action of the other diaphragm chamber, the pressure differences acting upon the chamber 33 being always in excess of those acting upon the chamber 32, although the latter by reason of its greater leverage may at times overpower the former.

It is obvious that the pressure within the casing 30 must always conform to that within the ashpit 14 and therefore a valve 55 is provided for the pipe 29 by which communication through the inlet 56 may be made between the chamber within the casing 30 and the external atmosphere whenever the ashpit door remains wide open, thus equalizing the pressure in these two chambers. It is evident, if the heating device is such that the ashpit 14 is always open, that the chamber in the casing 30 will also be open to the atmosphere, either through the pipes 31—29 and valve 55 or these pipes and valve may be dispensed with, opening said chamber direct to the external atmosphere.

This apparatus provides a very effective means of automatically signaling to the fireman and informing him when the fire is in an abnormal condition, as, for instance, choked with clinkers or too thick, which condition will be made known to him by the bell 47 which is of a certain tone, or when the fuel bed is too thin or has holes in it, in which case the other bell 51 of a different tone will be sounded, warning him to correct these conditions and secure a normal fire again.

It is believed that the operation and many advantages of the invention will be thoroughly understood from the foregoing.

Having thus described my invention, I claim:

1. In a device of the class described, the combination of controlling means responsive to the ratio of two varying differences of pressure, with means for operating an alarm at certain predetermined conditions of said controlling means.

2. In a device of the class described, the combination of controlling means responsive to the ratio of two varying differences of pressure; with a circuit closure operable at certain predetermined conditions of said controlling means; and electric alarms operable by said circuit closer.

3. In a device of the class described, the combination of controlling means responsive to the ratio of two varying differences of pressure comprising, a diaphragm chamber having communication with one portion of said device at which the pressure has one value, a second diaphragm chamber having communication with another portion of said device at which the pressure has another value, a casing inclosing both said diaphragm chambers and communicating with a third portion of said device at which the pressure has a third value, and a movable member connected to each of said diaphragm chambers; with means for operating an alarm at certain predetermined conditions of said controlling means.

4. In a device of the class described, the combination of controlling means responsive to the ratio of two varying differences of pressure comprising, a diaphragm chamber having communication with one portion of said device at which the pressure has one value, a second diaphragm chamber having communication with another portion of said device at which the pressure has another value, a casing inclosing both said diaphragm chambers and communicating with a third portion of said device at which the pressure has a third value, and a movable member having said diaphragm chambers connected thereto at different points; with means for operating signals at certain predetermined conditions of said controlling means.

5. In a device of the class described, the combination of controlling means responsive to the ratio of two varying differences of pressure comprising, a diaphragm chamber having communication with one portion of said device at which the pressure has one value, a second diaphragm chamber having communication with another portion of said device at which the pressure has another value, a casing inclosing both said diaphragm chambers and communicating with a third portion of said device at which the pressure has a third value, and a movable member having said diaphragm chambers connected thereto at different points; a fixed support; two members secured to said movable member and adjusted to bear on said support; and means whereby said member shall operate signals at certain predetermined conditions of said controlling means.

6. In a device of the class described, the combination of controlling means responsive to the ratio of two varying differences of pressure comprising, a diaphragm chamber having communication with one portion of said device at which the pressure has one value, a second diaphragm chamber having communication with another portion of said device at which the pressure has another value, a casing inclosing both said diaphragm chambers and communicating with a third portion of said device at which the pressure has a third value, and a movable member having said diaphragm chambers connected thereto at different points; a fixed support; two members adjustably secured

to said movable member and adapted to bear on said support; and means whereby said member shall operate signals at certain predetermined conditions of said controlling means.

7. In a device of the class described, the combination of controlling means responsive to the ratio of two varying differences of pressure comprising, a diaphragm chamber having communication with one portion of said device at which the pressure has one value, a second diaphragm chamber having communication with another portion of said device at which the pressure has another value, a casing inclosing both said diaphragm chambers and communicating with a third portion of said device at which the pressure has a third value, and a movable member connected to each of said diaphragm chambers; alarms having electric circuits connected thereto; and contact points in each of said circuits located adjacent to said movable member whereby said member shall cause certain of said alarms to operate at certain predetermined conditions of said controlling means.

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

ASA WHITE KENNEY BILLINGS.

In presence of—
HENRY P. STARRETT,
VICTOR NORMAND.