Oct. 31, 1939. F. A. HELLMANN ET AL 2,178,171

STOKER CONTROL

Filed Oct. 27, 1937 3 Sheets-Sheet 1

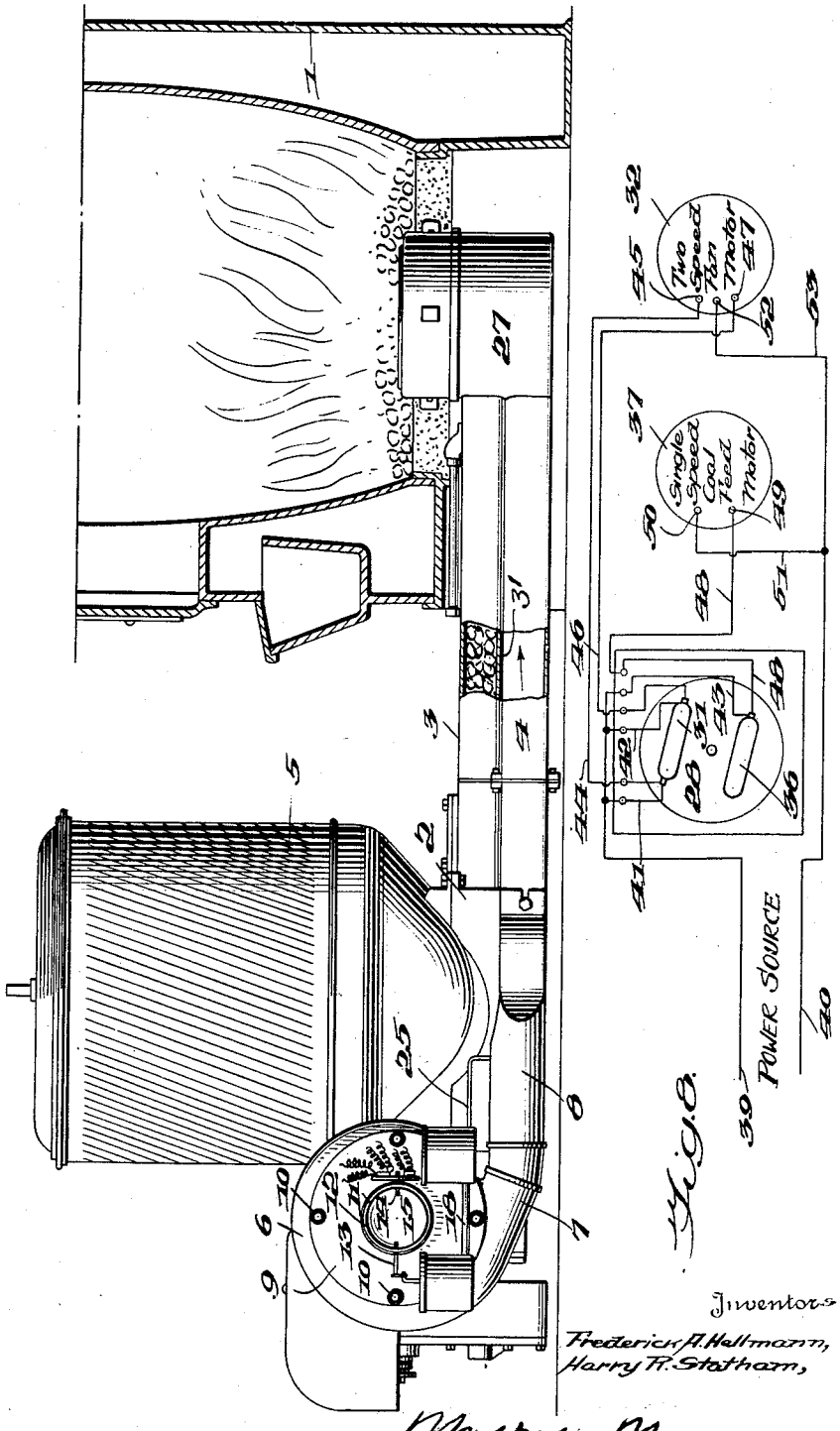


Fig. 1.

Fig. 3.

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Filed Oct. 27, 1937 3 Sheets-Sheet 2

Fig. 3.

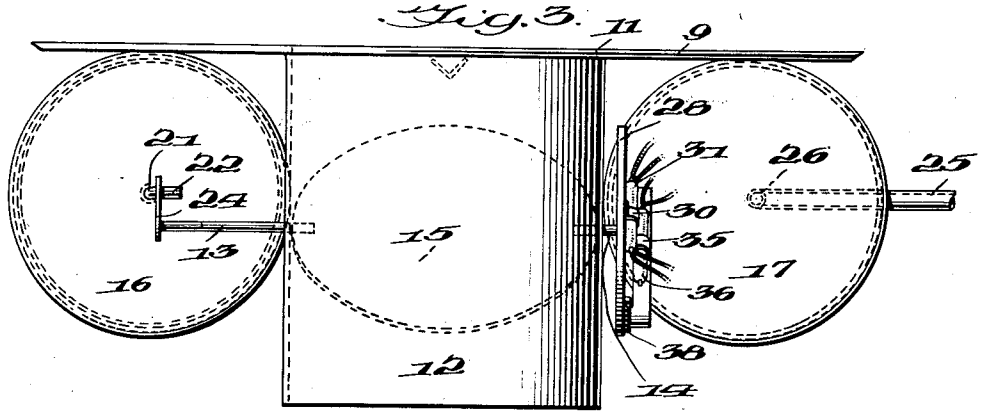
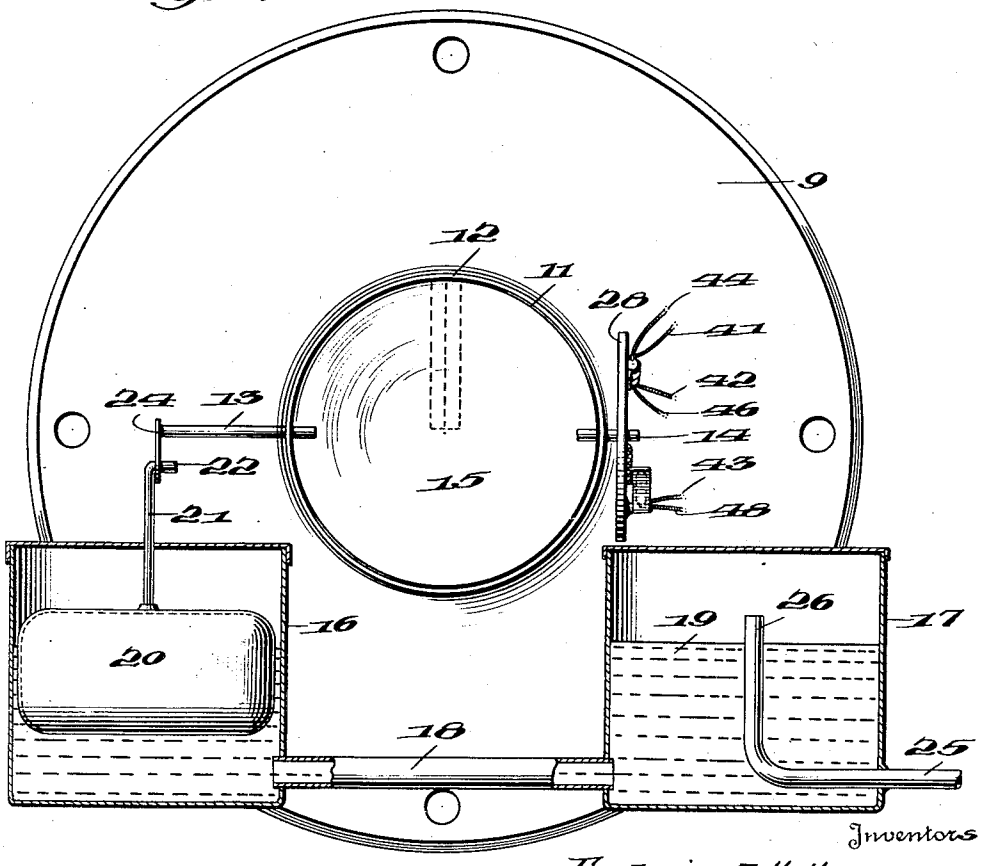


Fig. 2.



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Filed Oct. 27, 1937 3 Sheets-Sheet 3

Fig. 4.

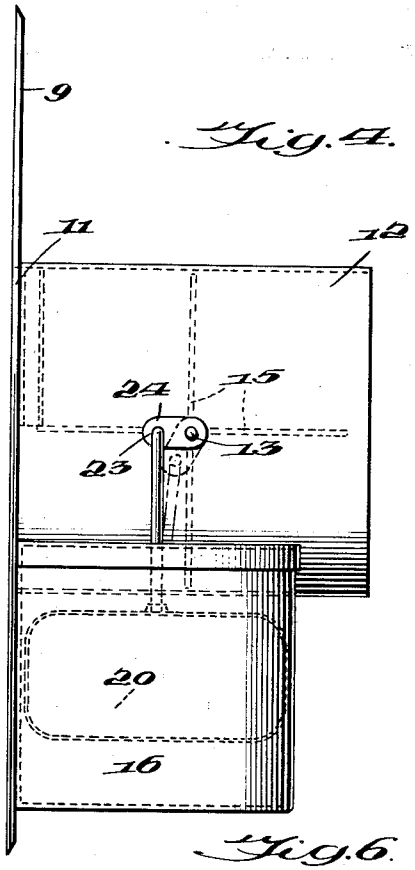


Fig. 5.

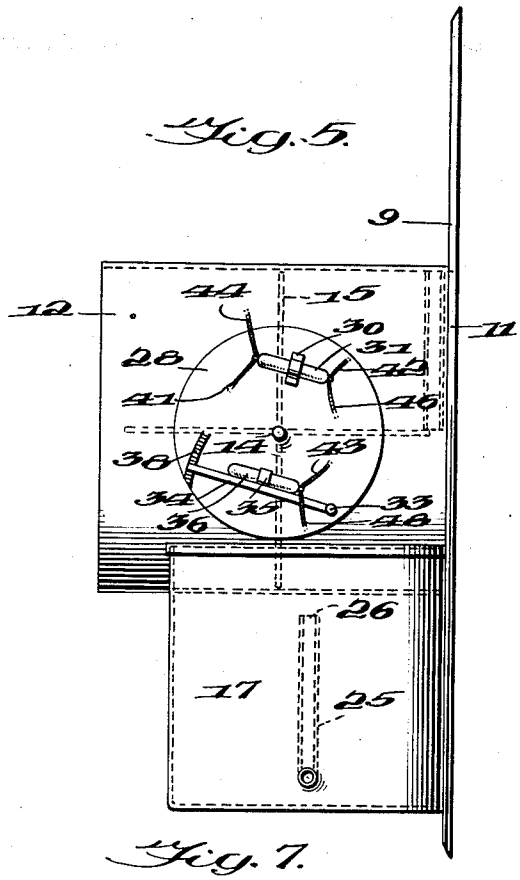


Fig. 6.

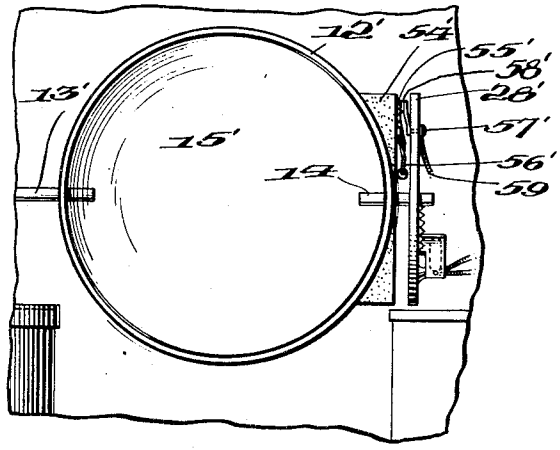
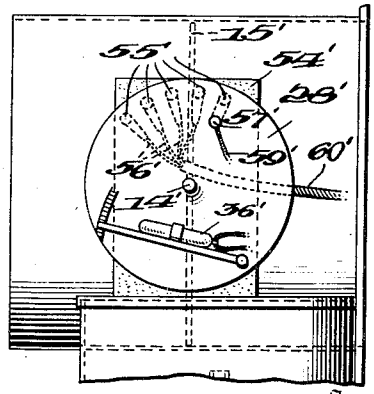


Fig. 7.



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UNITED STATES PATENT OFFICE

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STOKER CONTROL

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Application October 27, 1937, Serial No. 171,376

15 Claims. (Cl. 110—44)

This invention relates to an automatic air volume and coal supply regulator to be used as an addition to an automatic coal stoker.

It is the primary object of this invention to combine an automatic means for controlling both the feeding of coal and the feeding of air to a furnace or boiler so that the amount of coal and amount of air fed to the furnace are synchronized with each other and in accordance with the amount of unburned coal in the combustion chamber of the furnace, to thus provide a balanced ration of coal and air.

Another object of the invention is to provide a control for a coal stoker where installed in a boiler or furnace, or as an attachment thereto, whereby the stoker is operated entirely automatically and in conjunction with the usual thermostatic or other controls of the stoker.

Another object of the invention is to correct fire depth so that the proper amount of air and coal will be fed into the combustion chamber and at all times.

Still another object of the invention is the provision of an automatic damper control installed on the intake of the fan.

A further object of the invention is the provision of an automatic damper, the operation of which is controlled by the condition in the fire box of the furnace.

Other objects will appear hereinafter throughout the specification.

In the drawings—

Figure 1 is a side elevation of a furnace, a stoker having the improved control attached thereto, the furnace being shown in section, and the coal and air conduits in partial section;

Figure 2 is a front elevation of the adapter plate and damper operating assembly, certain parts being shown in section;

Figure 3 is a top plan view of the structure shown in Figure 2;

Figure 4 is a side elevation of the structure shown in Figure 2, as viewed from the left of said figure;

Figure 5 is a side elevation of the structure shown in Figure 2, as viewed from the right of said figure;

Figure 6 is a front elevation of a modified form of a damper control switch;

Figure 7 is a side elevation of the structure shown in Figure 6 as viewed from the right hand side, and

Figure 8 is a wiring diagram of the electric controls of the motors for operating the coal feeding mechanism and air blower mechanism.

In the drawings, the numeral 1 designates a furnace, although any other suitable heating apparatus may be used, and 2 indicates a stoker of any conventional type. It is common practice to provide such stokers with a coal feeding conduit 3 having the usual feed screw, not shown, located therein and an air conduit 4 located therebelow, said conduits being separated by a horizontal partition 3', as shown in Figure 1. The numeral 5 indicates a coal hopper, the lower portion of which is provided with an aperture leading into the conduit 3.

The fan blower is indicated by the numeral 6. Such fan blowers are usually provided with a manually controlled damper, to control the entrance of air into the blower. The outlet 7 connects with a pipe 8, the opposite end of which opens into the air conduit 4.

In the illustrative example of one application of this invention, as shown in the drawings, the usual side plate which supports a manually operated damper of the fan blower, is removed, and there is attached in place thereof, an adapter plate 9, which is bolted to the casing by the conventional bolts 10. The adapter plate is provided with an aperture 11, forming an air intake to the eye of the blower. Mounted on the plate in alignment with the aperture 11, is a thimble 12, forming an air inlet conduit, the diameter of which is substantially the same diameter as the aperture 11.

Mounted on shafts 13 and 14, is a damper 15. Said shafts extend through apertures or bearings in the thimble 12.

Rigidly mounted on the adapter plate is a float chamber 16 and an hermetically sealed chamber 17; said chambers are connected to each other by means of a pipe 18 which passes through the lower extremities of the chambers. The chambers are partially filled, preferably with a non-vaporizing liquid 19, such as oil, or a non-inflammable liquid may be used instead of oil. Within the chamber 16 is a float 20, having a stem 21 and a right-angled portion 22, which latter projects through an aperture 23 of a crank 24. The crank is rigidly attached to the shaft 13 so that as the float rises and falls, the damper 15 is turned from the fully closed position shown in Figures 1 and 2, and in dotted lines in Figure 4, to the inclined position indicated in dotted lines in Figure 3, or to the fully open or horizontal position shown in dotted lines in Figure 4.

An air pressure pipe 25 extends into the hermetically sealed chamber 17 so that its open end

26 is at all times in communication with the air space above the liquid 19. The opposite end of the pipe 25 communicates with the interior of the pipe 8, but this end may be connected to the air conduit 4, instead of the pipe 8, as shown. In either instance, the air space above the liquid in the hermetically sealed chamber 17 is exposed to pressure conditions within the pipe 8, and conduit 4. Such pressure conditions are affected by the rate burning, and the amount of coal within the furnace 1. The coal feed conduit 3 and air conduit 4 are connected, as is the usual practice, so as to feed coal and air to the retort 27, which retort is provided with the usual tuyeres, not shown.

Referring now particularly to Figure 5, there is rigidly mounted on the shaft 14, so as to be rotated thereby, when the damper 15 is rotated, a disk 28. Foxed on the disk are spring clips 30 and held by these clips is a single pole, double throw, mercury tube switch 31, controlling the operation of the two-speed motor 32, which drives the fan blower 6. The numeral 33 indicates a pivot having an arm 34 adapted to pivot thereabout. The arm 34 has attached thereto spring clips 35, which rigidly hold the single throw mercury switch 36, which latter controls the coal feed screw driving motor 37. The opposite end of the arm 34 may be adjustably positioned and held by the rack 38, mounted on the disk 28. By this means the proper adjustment may be effected for causing the coal feed motor 37 to operate under different conditions of use, and in accordance with the size of the furnace 1, the grade of coal being used, furnace draft conditions, etc.

Referring to Figure 8, the numerals 39 and 40 are line connections from a source of current. The wire 39 is connected to the left end of the mercury tube switch 31 by means of a wire 41, and to the right end of switch 36 by wire 42. The wire 44 connects the left end of switch 31 to a terminal 45 of the two-speed fan motor. Wire 46 connects the right end of switch 31 to terminal 47 of this motor. Wire 48 connects the right end of mercury tube switch 36 to terminal 49 of the coal feed motor. Line connection 40 is connected to terminal 50 of said motor by wire 51, and is connected to terminal 52 of the fan motor by wire 53.

In place of the single pole, double throw, mercury switch 31, shown in Figures 1 to 5, the speed of the fan motor 32 (which motor would be of the single speed variety), may be controlled by a rheostat, such as the rheostat shown in Figures 6 and 7, wherein is shown the disk 28' rigidly mounted on the shaft 14', and turnable therewith. The shaft 14' is rotated by damper 15' by means of the shaft 13', in the same manner as described in connection with the form shown in Figures 1 to 5.

Mounted on the thimble 12' is an insulated support 54' having a plurality of contacts 55', having the usual resistances and to which are connected wires 56'. The terminal 57' is mounted so as to extend through disk 28'. Attached to the terminal 57' on opposite side of the disk is a wiping contact 58'. As the damper 15' is rotated, due to different conditions of pressure in conduit 8, the disk 28' is rotated and as this takes place, the wiping contact 58' moves into successive engagement with the several contacts 55', thus changing the speed of the fan motor and increasing or decreasing the amount of air forced into conduit 4 and retort 27. All of the wires 56' connect to one terminal, and wire 59' connects to the other terminal of a fan motor which, in the present instance, is of the ordinary type. The bundle of wires leading to the several contacts is indicated by the numeral 60'.

Operation

Assuming that the stoker has been shut down, with the damper in a closed or substantially closed position; in this position the disk is, as shown in Figures 1, 2 and 8, with the mercury in tube 31 at the right end of the tube so as to allow current to pass from wire 42 to wire 46, and thence to the lower speed terminal 47 of the fan motor. As will be seen by referring to Figure 5, the terminals within the tube 36, which are connected to wires 43 and 48, are connected by the mercury within the tube so that the coal feed motor is thereby operated. In this position, the fan motor is operated at low speed, and the coal feed motor is running, to thereby feed coal into the retort. As the internal air pressure within the conduit 4 is built up, due to the increasing depth of the fire bed as the coal is fed to the same, and the consequent inability of the air to escape only slowly through the retort, air pressure increases in conduit 4 and pipe 8, as well as in the air space within the chamber 17, because of the connecting pipe 25. Increased air pressure in chamber 17 forces the fluid 19 through pipe 18 into float chamber 16, thereby raising the float 20 which, by means of the crank 24, rotates shafts 13 and 14 and the damper 15.

It is to be understood that with the damper closed, and the fan rotating at slow speed, some air is being forced continuously into conduit 4 and retort 27, due to the fact that some air enters around the periphery of the damper 15.

The opening of the damper 15 permits the entrance of additional air to be sucked into the fan chamber, whereupon such additional air is forced through pipe 8 and conduit 4, and into the retort 27, where it passes through the tuyère gates. As the damper 15 continues to open, the disk 28 rotates in a counterclockwise direction (see Figure 5). Such rotation of the disk 28 continues until the mercury within the tube 31 moves from the right end of said tube to the opposite or left end thereof, thereby completing contact between the terminals of tube 31 which are connected to the two wires 41 and 44, to thereby switch the fan motor from low to high speed.

Simultaneously, the rotation of the disk 28 will cause the tube 36 to move to a position (according to its position of adjustment) where its left end becomes lower than its right end, whereupon the mercury leaves the right end of the tube, thereby breaking the connection between the wires 43 and 48, and stopping the coal feed motor. In this position of the disk, the coal feed motor has stopped, but the fan motor continues to operate at high speed. This operation continues until such time as the fuel bed is burned down to a point which allows air to pass more freely through the fire bed, whereupon the pressure gradually drops in conduit 4 and pipe 8. The drop in pressure allows the damper to move back, or in a reverse direction, toward the closed position, the disk moving in a clockwise direction. As the disk moves in a clockwise direction, the lower tube rotates to such position that its right end becomes lower than the left end, whereupon the mercury within tube 36 moves back so as to again connect the wires 43 and 48, and thereby

starting the coal feed motor operating again, and the tube 31 again assumes the position shown in Figure 5 to thereby again switch the fan motor to its low speed of rotation.

By the above described operation, it will be understood that both the feeding of air and coal is controlled by the depth of the fuel bed and the control of each is synchronized with the other, thus insuring a balanced ration of coal and air feed for the furnace.

The control shown in Figures 6 and 7 operate substantially the same as that shown in other figures, except that the fan motor is gradually accelerated, or decelerated, according to the direction in which the disk 28' is moved. In the position shown in Figure 7, the motor is running at low speed. Its speed is accelerated as the disk rotates in a counter-clockwise direction, and as pressure is being built up in the conduit 4, until it reaches its maximum speed, about the time when the damper reaches its open position. Also, the coal motor, according to the position of adjustment to which the coal motor thermostat switch 36' has been set, will be cut out of circuit during the rotation of disk 28'. Subsequently, as the coal in the combustion chamber burns shown, a condition of gradually reduced pressure in conduit results, and the parts slowly return to the position shown in Figures 6 and 7, with the coal motor again operating and the fan motor running at reduced speed, with the damper 15' in closed or substantially closed position. The parts remain in this position until there is again in conduit 4 a condition of higher pressure, whereupon the operation is repeated.

The invention is not limited to the construction shown and described, such being merely one application of the invention. We desire to be limited only to the extent indicated by the appended claims.

We claim:

1. In a coal stoker of the character wherein the stoker is provided with means for feeding coal and air into a combustion chamber including a damper, a coal passageway and an air passageway; the combination with such means, of damper control means operatively connected to said air passageway, and electrically operated switch means adapted to be actuated by said damper control means for controlling the operation of said coal feeding and air feeding means, and said damper by means of said damper control means according to the amount of unburned fuel within said combustion chamber, said first named means additionally including a motor for feeding coal and a separate motor for feeding air, said last named motor having means for varying the amount of air fed to said combustion chamber in synchronism with the movements of said damper.

2. In a coal stoker of the character wherein the stoker is provided with means for feeding coal and air into a combustion chamber; the combination with such means, of automatic means operatively connected to said first-named means for controlling the operation of said coal feeding means according to the amount of unburned fuel within said combustion chamber, said air feeding means including a blower an electric motor for operating said blower and a damper mounted on said blower, said automatic means including a connection to said damper and an electrical connection to said motor which latter includes switch means for said motor whereby said control means may regulate said damper and control the operation of said motor in accordance with the amount of unburned fuel within said combustion chamber.

3. For association with a coal feeding stoker, which stoker comprises means for feeding coal and air into a combustion chamber; means operatively connected to said first-named means for controlling the amount of air according to the amount of unburned fuel within said combustion chamber, said control means including a damper and electrical switch means operated thereby, and electrical connections from said switch means to said means first named, said first named means additionally including a motor for feeding coal and a separate motor for feeding air, said last named motor having means for varying the amount of air fed to said combustion chamber in synchronism with the movements of said damper.

4. For association with a coal feeding stoker, which stoker comprises for feeding coal and air into a combustion chamber including a damper, an electric motor for operating said air feeding means and a second motor for operating said coal feeding means; means operatively connected to said motors and damper including separate electric switches for said motors and electrical connections thereto, and a mechanical connection to said damper for controlling the amount of air and coal according to the amount of unburned fuel within said combustion chamber.

5. In a coal stoker of the character wherein the stoker is provided with motor means for feeding coal and air into a combustion chamber and including a blower driven by said motor means, a damper for said blower, and air and coal passageways to said combustion chamber; the combination with such means, of switch means actuated by said damper and electrically connected to said motor means, and pressure means connected to said damper for operating said damper, said pressure means being actuated by differences of pressure within said air passageway, said motor means including a multi-speed motor for driving said blower to vary the amount of air fed to said combustion chamber in synchronism with the movements of said damper.

6. In a coal stoker of the character wherein the stoker is provided with coal feed means, a motor for driving said coal feed means, an air blower, a second motor for operating said air blower, a hopper for coal, a retort, a coal passageway from said hopper to said retort, an air passageway from said blower to said retort, a damper for controlling the entrance of air to said blower; the combination with said stoker, of a float chamber, a float in said float chamber, means connecting said float to said damper, an hermetically sealed chamber, a conduit from said hermetically sealed chamber to said float chamber, liquid in said chambers, a pressure pipe located in said hermetically sealed chamber, and having one of its ends located above the level of the liquid in said last-named chamber, and its other end connected into said air passageway, and switch means electrically connected to both of said motors and operatively connected to said damper and actuated thereby to control said coal feed motor and said air blower motor and automatically thereby the amount of coal and air fed to said retort.

7. In a coal stoker of the character wherein the stoker is provided with coal feed means, a motor for driving said coal feed means, an air blower, a second motor for operating said air

blower, a hopper for coal, a retort, a coal passageway from said hopper to said retort, an air passageway from said blower to said retort, a damper for controlling the entrance of air to said blower; the combination with said stoker, of a float chamber, a float in said float chamber, means connecting said float to said damper, an hermetically sealed chamber, a conduit from said hermetically sealed chamber to said float chamber, liquid in said chambers, a pressure pipe located in said hermetically sealed chamber, and having one of its ends located above the level of the liquid in said last-named chamber, and having its other end connected into said air passageway, a rotatable disk operatively connected to said damper, a plurality of mercury tube switches mounted on said disk, said switches being electrically connected to said coal feeding motor and said air blower motor to automatically thereby control the amount of coal and air feed to said retort.

8. In a coal stoker of the character wherein the stoker is provided with coal feed means, a motor for driving said coal feed means, an air blower, a second motor for operating said air blower, a hopper for coal, a retort, a coal passageway from said hopper to said retort, an air passageway from said blower to said retort, a damper for controlling the entrance of air to said blower; the combination with said stoker, of a float chamber, a float in said float chamber, means connecting said float to said damper, an hermetically sealed chamber, a conduit from said hermetically sealed chamber to said float chamber, liquid in said chambers, a pressure pipe located in said hermetically sealed chamber having one of its ends located above the level of the liquid in said last-named chamber, and having its other end connected into said air passageway, a rotatable disk operatively connected to said damper, a plurality of mercury tube switches mounted on said disk, said switches being electrically connected to said coal feeding motor and said air blower motor to automatically thereby control the amount of coal and air fed to said retort, said blower motor having a plurality of speeds and one of said mercury tubes having two sets of contacts connected to said blower motor, one set of contacts being opened and the other set being closed when said disk is rotated in one direction, and said one set being closed and other set being opened when said disk is rotated in the opposite direction.

9. In a coal stoker of the character wherein the stoker is provided with motor means for feeding coal and separate motor means for feeding air into a combustion chamber, and including a blower driven by said motor means, a blower damper and air and coal passageways; the combination with such means of means for automatically operating said damper, and including pressure operated means actuated by differences of pressure within said air passageway, to thereby actuate said damper, and a plurality of electrical switch means operated by said damper and electrically connected to each of said motor means to thereby control the operation of the same.

10. In a coal stoker of the character wherein the stoker is provided with motor means for feeding coal and separate motor means for feeding air into a combustion chamber, and including a blower driven by said motor means, a blower damper and air and coal passageways; the combination with such means, of means for automatically operating said damper, and including pressure operated means actuated by differences of pressure within said air passageway, to thereby actuate said damper, and a plurality of electrical switch means operated by said damper, and electrically connected to each of said motor means to thereby control the operation of the same, one of said switch means including a rheostat switch connected to said fan blower motor.

11. In a coal stoker of the character wherein the stoker is provided with motor means for feeding coal and air into a combustion chamber and including a blower driven by said motor means, a damper on said blower, and air and coal passageways to said combustion chamber; the combination with such means, of pressure means for operating said damper, said pressure means being actuated by differences of pressure within said air passageway, said motor means comprising a two-speed motor for feeding air, and a single speed motor for feeding coal, and means actuated by said pressure means for controlling the operation of both motors.

12. In a coal stoker of the character wherein the stoker is provided with motor means for feeding coal and air into a combustion chamber, and including a blower driven by said motor means, a damper on said blower, and air and coal passageways to said combustion chamber; the combination with such means, of pressure means for operating said damper, said pressure means being actuated by differences of pressure within said air passageway, said motor means including a motor for feeding air, and a separate motor for feeding coal, and mercury tube switch means actuated by said pressure means for controlling said motors.

13. In a coal stoker of the character wherein the stoker is provided with motor means for feeding coal and air into a combustion chamber, and including a blower driven by said motor means, a damper on said blower having supporting means therefore, and air and coal passageways to said combustion chamber; the combination with such structure, of pressure means for operating said damper, said pressure means being actuated by differences of pressure within said air passageway, and switch means mounted on said damper supporting means for controlling said motor means, said switch means having means for controlling the speed of said blower at high and low speeds, and said switch means including means for stopping the feeding or coal when the blower is operating at high speed.

14. In a coal stoker of the character wherein the stoker is provided with motor means for feeding coal and air into a combustion chamber, and including a blower driven by said motor means, a damper on said blower, and air and coal passageways to said combustion chamber; the combination with such means, of pressure means for operating said damper, said pressure means being actuated by differences of pressure within said air passageway, a rotatable support, rotatable by said damper, and mercury tube switch means mounted on said support, said switch means having means for controlling the speed of said blower at high and low speeds, and said switch means including means for stopping the feeding of coal when the blower is operating at high speed.

15. In a coal stoker of the character wherein the stoker is provided with motor means for feeding coal and air into a combustion chamber, and including a blower driven by said motor means, air and coal passageways, and damper means for said blower; the combination with such means, of pressure means for operating said damper

actuated by differences of pressure within said air passageway, a rotatable support, rotatable by said damper, and electric switch means mounted on said support for controlling automatically the operation of said motor means, and the amount of air and coal fed to said combustion chamber, said switch means having means for controlling the speed of said blower at high and low speeds, and said switch means including means for stopping the feeding of coal when the blower is operating at high speed.

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