

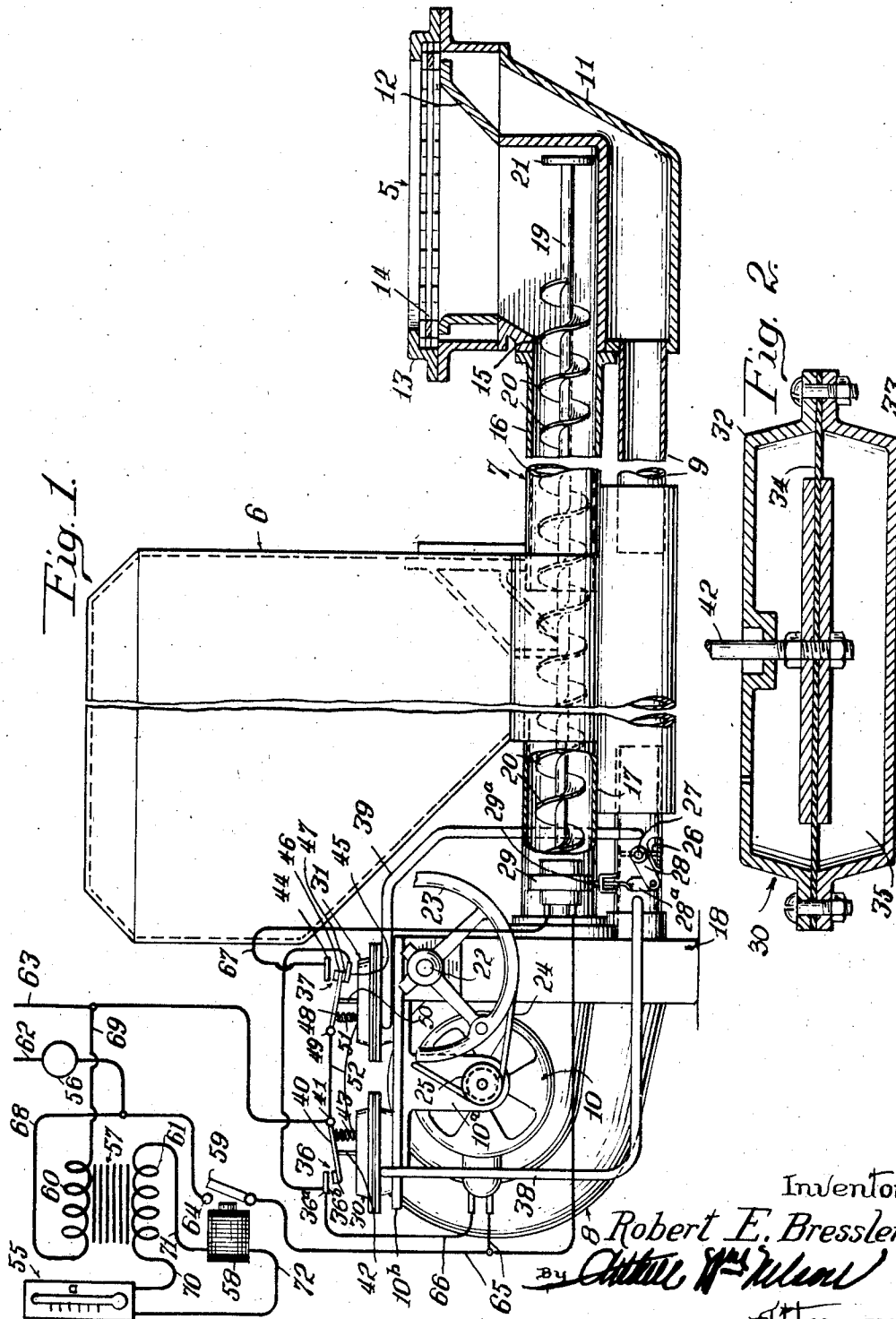
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APPARATUS FOR BURNING FUEL

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APPARATUS FOR BURNING FUEL

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This invention relates to improvements in apparatus for burning fuel and it consists of the matters hereinafter described and more particularly pointed out in the appended claims. The apparatus with which the present invention is more especially concerned is of the kind, wherein during a burning period the fuel is burned in successively occurring burning cycles. In one part of a cycle, the fuel is fed to the fuel bed faster than it is burned and in another part of said cycle, the fuel is burned faster than it is fed to the fuel bed and when the fuel bed has burned down to a predetermined depth, another burning cycle is initiated.

One of the objects of the present invention is to provide improved means for controlling the cycling action of the apparatus and which means is simple in construction for low cost production and at the same time is automatic, accurate and dependable so as to be trouble-free in operation over long periods of use.

Another object of the invention is to provide improved means for controlling the cycling action of the apparatus, which functions by reason of the change in pressure of the supplied air, thus eliminating the necessity for the use of independent cycle timing elements, which increase the cost of the apparatus as a whole.

Also, it is an object of the invention to provide means for this purpose, whereby the cycling action is obtained without momentarily stopping the entire apparatus, thus relieving the driving motor of the apparatus from undue starting torques and materially reducing the consumption of power required for the apparatus and therefore assuring more economical operation.

The above mentioned objects of the invention, as well as others, together with the several advantages thereof, will more fully appear as the specification proceeds.

In the drawing:

Fig. 1 is a view in side elevation of a fuel burning apparatus and associated electric circuit embodying the invention, with parts of the apparatus shown in section or as broken away, better to illustrate the parts involved.

Fig. 2 is a vertical sectional view, on an enlarged scale through one of the pressure responsive elements or diaphragms embodied in the apparatus.

Referring now in detail to that embodiment of the invention illustrated in the drawing and especially to Fig. 1 thereof, the improved apparatus, which is in the form of an underfeed stoker, includes a burner 5, a fuel hopper 6 and

a means 7 whereby fuel, such as coal is fed from the hopper to the burner. The apparatus also includes a blower 8 for supplying air under pressure, a duct 9 for conveying said air from the blower to the burner to support combustion of the fuel bed therein and a motor 10 which in this instance drives both the fuel feeding means and the blower.

The burner 5 comprises a hollow windbox 11, in which a retort 12 is located in suitable relation to define an air chamber surrounding the retort, the windbox having an air inlet at its front bottom end. At the top of the windbox is a dead plate 13 and arranged between the inner margin of the dead plate and the top of the retort are tuyères 14 whereby air under pressure is admitted from the windbox chamber to the fuel bed in the retort for combustion purposes. The front end of the bottom portion of the retort is formed with a fuel inlet opening 15.

The fuel feeding means 7 before mentioned, includes a feed tube section 16 that extends between the rear end of the lower portion of the hopper 6 and the fuel inlet opening 15. The fuel feeding means as herein shown also includes a second tube section 17 in axial alignment with the first mentioned one and which is disposed between the front end of the lower portion of the hopper and the rear side of an upright casing 18 located in front of the hopper.

In the tube sections 16 and 17, which are disposed in the median line of the hopper, is located a feed screw that includes a shaft 19 with a helical flight 20 thereon of a diameter approximating the inside diameter of said tube sections.

The feed screw extends from the casing 18 through the tube section 17, the bottom of the hopper 6 and through the tube section 16 into the rounded bottom of the retort and where it terminates as a fuel lifting disc 21 that has a floating bearing in the fuel in this part of the retort. That end of the feed screw shaft disposed within the casing 18 is operatively connected by speed reducing gear to a horizontal shaft 22 that is journaled in the upper end of the casing and extends transversely of the shaft of the feed screw. One end of said shaft 22 extends beyond one side of said casing where it is provided with a pulley 23. This pulley is driven by a belt 24 from a pulley 25 on one end of the armature shaft of the motor 10. The other end of said armature shaft extends into the casing of the blower 8 and there has a fan or rotor of any suitable kind (not shown) secured thereto.

The duct 9 is operatively connected at one end

to the discharge or outlet side of the blower casing 8 and the other end of said duct is connected to the inlet of the windbox 11. In the duct 9 near the blower casing, I provide a damper 26 mounted on a cross shaft 27 that is journaled in opposite sides of this part of the duct. One end of this shaft extends outside of the duct where it has fixed thereto an arm 28. By means of the arm 28, the damper may be rocked from a vertical position, whereby only a minimum volume of air can pass the same, to a horizontal position whereby a maximum volume of air can pass the damper for delivery to the fuel bed.

To move the damper from one position to the other, I provide an electromagnetic device 29 having an armature 29a which is connected by a link 28a to the arm 28 on the damper shaft. When the device 29 is deenergized, the damper assumes a vertical and substantially closed position in the duct, and at this time only a minimum volume of air can pass the same when the blower is being driven by the motor. When the device 29 is energized, the damper is moved into its horizontal and wide open position in the duct, permitting the passage of the maximum volume of air through the duct.

From the above, it is apparent that when the motor 10 is energized, the blower is driven to provide air under pressure and the shaft 19 of the feed screw is driven to feed fuel to the retort. When the damper 26 is in its substantially closed position and the motor 10 is energized, the fuel is fed to the retort faster than it can burn so that the fuel bed builds up in depth and provides a resistance to the passage of air therethrough, which increases the pressure of said air in the duct. When the damper 26 is in its substantially wide open position and the motor 10 is energized, the fuel bed burns at a rate faster than the rate of feed of fuel thereto so that the fuel bed burns down in depth and decreases the pressure of the air in the duct. The movement of the damper from its closed to its open position constitutes one cycle of burning operation in a burning period of the apparatus, after which the damper is caused to return to its closed position to initiate a succeeding cycle and the operation goes on as before.

To move the damper from one position to the other in order to produce the cycling action, I provide the following means.

On any suitable part of the apparatus I provide a pair of pressure sensitive devices 30 and 31 respectively. As best shown in Fig. 2, each device 30-31 includes a pair of opposed casing parts 32-33 respectively, with the peripheral marginal part of a flexible diaphragm 34 clamped between them. For convenience in future reference, I term the device 30 the "high pressure" diaphragm device and the device 31 the "low pressure" diaphragm device. The casing parts of each device 30-31 in connection with the diaphragm 34 provides a pressure chamber 35 in each device at the bottom thereof. These devices 30 and 31 may be located at any convenient place on the apparatus and preferably toward the front thereof. Therefore, I have shown both of said devices as mounted on a plate 10b that is arranged above the motor 10 and is supported by a bracket 10a.

A tube 38 opens at one end into the chamber 35 of the "high pressure" diaphragm device 30 and opens at its other end into the duct 9 at a point between the casing 18 and the damper 26. Another tube 39 opens at one end into the chamber 35 of the "low pressure" diaphragm device

and opens at its other end into the duct 9 at a point between the damper 26 and the burner 5.

The "high pressure" diaphragm device 30 operates a single contact switch 36 and the "low pressure" diaphragm device 31 operates a double contact switch 37. The switch 36 includes a fixed contact 36a and a contact 36b carried on one end of an arm 40 which is pivoted at its other end as at 41. The diaphragm 34 of the device 30 carries an axial stem 42 which extends upwardly to engage the under side of the arm 40 at a point between its ends. A spring 43 is so connected to the arm 40 as to normally hold its contact 36b separated from its associated contact 36a.

The switch 37 includes spaced apart fixed contacts 44 and 45 respectively and associated contacts 46 and 47 respectively that are carried on one end of a movable contact arm 48 which is pivotally mounted at its other end as at 49. The diaphragm 34 of the device 31 carries an axial stem 50 which extends upwardly to engage the arm 48 at a point between its ends. A spring 51 is so connected to the arm 48 as to normally hold its contact 47 engaged with the contact 45 and to normally hold its contact 46 out of engagement with the contact 44. The two arms 40 and 48 are electrically connected together by a line 52.

In Fig. 1 is illustrated one form of control circuit for the apparatus heretofore described and which circuit includes a temperature responsive device 55 in the nature of a room thermostat, limit control 56, a transformer 57, and a relay 58 and associated armature 59.

The thermostat is usually located in the room or space being heated and the limit control, which is associated with the furnace with which the apparatus described is used, normally functions as a closed switch. The transformer includes primary and secondary windings 60 and 61 respectively.

62 and 63 indicate the main current conductors leading from a suitable source of supply. The conductor 62 passes through the limit control 56 to a contact 64 associated with the armature 59 and a line 65 connects said armature to one side of the motor 10 and to one side of the electromagnet 29. The other side of the motor is connected by a line 66 to the fixed contacts 36a and 45 of the switches 36 and 37 respectively. The other side of the electromagnet 29 is connected by a line 67 to the fixed contact 44 of the switch 37 while the main current conductor 63 leads to the arm 40 of the switch 36. The opposite ends of the primary winding of the transformer 57 are connected by lines 68 and 69 to the main current conductors 62 and 63 respectively and the opposite ends of the secondary winding of said transformer are connected by lines 70 and 71 to one side of the thermostat 55 and to one side of the coil of the relay 58 respectively. The other side of the thermostat and said armature are connected together by a line 72.

In a standby or non-burning period of the apparatus, when the thermostat 55 is not calling for heat, the armature 59 is out of engagement with the contact 64 so that the circuit is open. When the circuit is open, the motor 10 is deenergized so that the shaft 19 of the feed screw and the blower 8 are stopped. At this time atmospheric pressure exists in the duct 17, and the damper 26 therein is in the closed position. At this time atmospheric pressure is present in the chambers 35 of the diaphragm casings of the pressure responsive devices 30 and 31 so that the contacts 36a-36b are disengaged, the contacts

44 and 46 are disengaged while the contacts 45 and 47 are engaged.

When the thermostat 55 calls for heat, the coil of the relay 58 becomes energized and it attracts its armature 59 to engage the same with the contact 64. This closes a circuit from the line 62, contact 64, armature 59, through the line 65 to one side the motor 10, out the other side of the motor by means of line 66 to contacts 36a and 45. As the contact 47 is engaged with the contact 45, current passes through the switch arm 48, connector 52 to switch arm 40 to line 63. The motor is now energized and drives the shaft 19 of the feed screw, to feed fuel to the bed on the retort. The motor also drives the blower 8 to provide air under pressure to support combustion. At this time, the damper 26 is closed so that only a minimum amount of air can pass the same to provide a relatively low burning rate for the fuel bed and which rate is lower than the feeding rate of fuel to the fuel bed.

As the damper at this time is still closed, the pressure of the air in the duct between the damper and blower builds up and is exerted through the tube 38 to cause the diaphragm 34 of device 30, at some predetermined pressure, in the casing of the pressure responsive device 30, to function through its stem 42 to operate through the arm 40 to engage the contact 36b with the contact 36a. This closes a second part of the circuit for the motor 10, through the lines 65—66, contacts 36a—36b and arm 40 to the line 63.

The switches 36 and 37 are so set that at a predetermined pressure in the windbox and in the duct 9 between the windbox and damper, said pressure functions through the diaphragm 34 in the casing of the pressure responsive device 31 to cause its stem 50 to swing the arm 48 upwardly to disengage its contact 47 from the contact 45 and engage its contact 46 with the contact 44. This closes a circuit through the line 65 to one side of the electromagnet and out the other side and through line 67, contacts 44—46, arm 48, connector 52 to arm 40 and then out through the main current conductor 63.

This energizes the electromagnet 29 which swings the damper 26 into its open horizontal position for the passage of the maximum amount of air past the same. The fuel bed, having been previously built up to a considerable depth, then starts to burn at a rate that is faster than the feeding rate of fuel thereto and therefore the fuel bed burns down in depth.

When the damper is opened, after a fuel bed build up, the pressure of the air in the entire duct is the same, but it is still sufficient to function through the diaphragm in the casing of the device 30 to hold the contacts 36a and 36b in the engaged position pending a reduction in fuel bed depth.

When the fuel bed has burned down to a predetermined depth, its resistance to the passage of air therethrough is reduced, so that the pressure of the air in the entire duct 9 is likewise reduced. When a predetermined lower pressure is reached in the duct under the conditions above noted, the contact 36b is disengaged from the contact 36a so that the circuit to the motor 10 is opened and the motor reduces or slows down its speed toward its stopped condition. As the motor slows down in speed and before it can stop, the pressure of the air throughout the duct reduces in proportion and this momentarily causes a pressure below that at which the diaphragm in the casing of the device 31 is able to maintain

contact 46 in engagement with contact 44. Thus, this arm 48 swings downwardly and disengages the contacts 46—44 and reengages the contact 47 with the contact 45. This finishes one burning cycle since when the contacts 46—44 are disengaged, the circuit to the electromagnet 29 opens and the same is deenergized permitting the damper again to close.

As the contacts 45—47 are at this time engaged, the circuit is again completed to the motor, before it comes to a dead stop, so as to reenergize and restart it again to initiate another burning cycle as before. Thus, the feed of fuel is again faster than its burning rate and thereby increases in depth to build up pressure in the duct to function as before. It is to be noted that while the circuit to the motor is opened at the end of each burning cycle, it is again closed so shortly thereafter as to be restarted again before it stops entirely. Thus, the slowing down of the motor and the attached blower causes a reduction in pressure in the duct to produce the recycling action by initiating a succeeding burning cycle before the motor stops. Hence, the motor being still under momentum, starts much easier into operation at the beginning of each cycle of operation.

When the thermostat 55 is satisfied in its demand for heat, it opens the circuit to the relay 58 so that the armature 59 drops away or disengages from the contact 64, whereby the circuit to the motor is broken and the motor stops. When the motor stops, the parts return to the positions shown in Fig. 1, ready to initiate another burning cycle as soon as a burning period is necessary to satisfy the demand for heat by the thermostat.

While in describing the invention, I have referred in detail to the form, arrangement and construction of the parts involved, the same is to be considered only in the illustrative sense and therefore I do not wish to be limited thereto except as may be specifically set forth in the appended claims.

I claim as my invention:

1. Apparatus for substantially continuously power burning solid fuel in cycles each having a plurality of fixed rates, one faster than the feeding rate and another slower than the feeding rate during a burning period of the apparatus and embodying therein a retort for supporting a fuel bed, means for feeding fuel to the retort, an air duct leading to the retort, means for moving air through the air duct, means for driving said fuel feeding means and said air moving means, a damper associated with the air duct and having relatively heavy and relatively light air resistance positions, said driving means being adapted to drive said fuel feeding means to feed fuel to the retort at a rate faster than the burning rate of the fuel bed when the damper is in its relatively heavy air resistance position, means operative upon a predetermined increase in air pressure in said duct to move the damper to a relatively light air resistance position whereby the fuel bed is burned at a rate faster than the feeding rate, and means operative when the pressure of the air in the air duct reaches a predetermined lower pressure condition to deenergize said driving means so that it slows down and so drives the air moving means as to produce a still lower pressure in said duct to return the damper to said relatively heavy air resistance position and thereby reenergize said driving means to initiate another burning cycle.

2. Apparatus for substantially continuously power burning solid fuel in cycles each having a plurality of fixed rates, one faster than the feeding rate and another slower than the feeding rate during a burning period of the apparatus and embodying therein a retort for supporting a fuel bed, means for feeding fuel to the retort, an air duct leading to the retort, means for moving air through the air duct, a motor for driving said fuel feeding means and said air moving means, a damper associated with the air duct and having relatively heavy and relatively light air resistance positions, electrically operable means for moving said damper from one of said positions to the other thereof, a circuit for said motor and said electrically operable means, said motor being adapted to drive said fuel feeding means to feed fuel to the retort at a rate faster than the burning rate of the fuel bed when said damper is in its relatively heavy air resistance position, switch means in said circuit for controlling the same, a part of said switch means normally holding the circuit closed at one point to the motor and open to said electrically operable means, pressure responsive means for actuating said switch means, said pressure responsive means operating through another part of said switch means upon a predetermined increase of air pressure in the air duct to close said circuit to the motor at a second point and to open the circuit to the motor at the first point and to close said circuit to said electrically operable means so that it causes said damper to move to said relatively light air resistance position, whereby said fuel bed burns faster than the feeding rate of fuel to said retort and establishes a reduced air pressure in said duct, said pressure responsive means functioning at said reduced air pressure in the duct and through said switch means first to open said circuit at said second point to said motor and later to said electrically operable means and close said circuit to the motor at said first point so that said damper returns to its relatively heavy air resistance position and said motor is reenergized before it stops to initiate another burning cycle for the apparatus.

3. Apparatus for substantially continuously power burning solid fuel in cycles each having a plurality of fixed rates, one faster than the feeding rate and another slower than the feeding rate during a burning period of the apparatus and embodying therein a retort for supporting a fuel bed, means for feeding fuel to the retort, an air duct leading to the retort, means for moving air through the air duct, a motor for driving said fuel feeding means and said air moving means, a damper associated with the air duct and having relatively heavy and relatively light air resistance positions, electrically operable means for moving said damper from one of said positions to the other thereof, a circuit for said motor and said electrically operable means, said motor being adapted to drive said fuel feeding means to feed fuel to the retort at a rate faster than the burning rate of the fuel bed when said damper is in its relatively heavy air resistance position, a switch in said circuit for controlling only the operation of said motor, a second switch in said circuit for controlling jointly the operation of said motor and said electrically operable means, pressure responsive means for actuating the first mentioned switch and operatively connected to said duct at one side of the damper, a second pressure responsive means for actuating said second mentioned switch and operatively con-

nected to the duct on the other side of the damper and normally acting through its switch to hold said circuit closed to the motor and opened to said electrically operable means at a lower pressure of air in said duct so that the damper normally remains in said relatively heavy air resistance position, said first mentioned pressure responsive means operating through its switch, upon a predetermined increase of air pressure in said duct to close said circuit to said motor to maintain the same energized, said second mentioned pressure responsive means operating through its switch at said increase in pressure to open the circuit to the motor and to close the same to said electrically operable means so that it causes said damper to move to said relatively light air resistance position whereby said fuel bed burns faster than said feeding rate and produces a lower pressure in said duct and where at the first mentioned pressure responsive means functions through its switch again to open the circuit to the motor and the second mentioned pressure responsive means functions through its switch to open the circuit to said electrically operable means so that the damper returns to its substantially heavy air resistance position and to reclose said circuit to said motor before it stops and thereby to initiate another burning cycle for the apparatus.

4. In a fuel burning apparatus having burning periods, each constituting a plurality of successively occurring burning cycles, the combination of a retort, means for feeding fuel to the retort to form a fuel bed thereon, means for supplying air under pressure to the fuel bed to support combustion thereof, means for driving said fuel feeding means and said air supplying means, means operative in a burning period of the apparatus for controlling the volume of air supplied to the fuel bed, means for initiating a burning cycle for the apparatus and embodying therein means for connecting said driving means at one point to said fuel feeding means and said air supplying means for driving the same and for causing said controlling means to reduce the pressure and the volume of the air supplied to the fuel bed so that fuel is fed to the retort faster than the burning rate thereof and whereby the fuel bed builds up in depth and increases its resistance to the passage of air therethrough to increase the pressure thereof, and means operative under the action of the increased pressure of the supplied air for operatively connecting said driving means to said fuel feeding means and to said air supplying means at another point and for disconnecting said driving means from said fuel feeding means and from said air supplying means at the first mentioned point and for causing said air controlling means to provide a maximum volume of air under pressure to the fuel bed so that its burning rate is faster than its feeding rate and whereby said fuel bed burns down in depth and decreases its resistance to the air supplied so that the pressure thereof is decreased to that which initiates a succeeding burning cycle for the apparatus during a burning period.

5. In a fuel burning apparatus having burning periods, each constituting a plurality of successively occurring burning cycles, the combination of a retort, means for feeding fuel to the retort to form a fuel bed thereon, means for supplying air under pressure to the fuel bed to support combustion thereof, a motor for driving said fuel feeding means and said air supplying means, a

circuit for said motor, means for controlling the volume of air supplied to said fuel bed, means operative in a burning period of the apparatus for initiating a burning cycle for the apparatus and embodying therein means for closing the circuit at one point to said motor for driving said fuel feeding means and said air supplying means and for causing said controlling means to reduce the pressure and the volume of the air supplied to the fuel bed so that fuel is fed to the retort faster than the burning rate thereof and whereby the fuel bed builds up in depth and increases its resistance to the passage of air therethrough to increase the pressure thereof, and means operative under the action of the increased pressure of the supplied air for closing said circuit for said motor at another point and for opening said circuit at the first mentioned point for causing said air controlling means to provide a maximum volume of air under pressure to the fuel bed so that its burning rate is faster than its feeding rate and whereby said fuel bed burns down in depth and decreases its resistance to the air supplied so that the pressure thereof is decreased to that which initiates a succeeding burning cycle for the apparatus during a burning period.

6. In a fuel burning apparatus having burning periods, each constituting a plurality of successively occurring burning cycles, the combination of a retort, means for feeding fuel to the retort to form a fuel bed thereon, means for supplying air under pressure to the fuel bed to support combustion thereof, means for driving said fuel feeding means and said air supplying means, an electrically operated means for controlling the volume of air supplied to the fuel bed, a circuit for said electrically operated means, means operative in a burning period of the apparatus for initiating a burning cycle for the apparatus and embodying therein means for connecting said driving means at one point to said fuel feeding means and said air supplying means for driving the same and for so changing the condition of said circuit as to cause said controlling means to reduce the pressure and the volume of the air supplied to the fuel bed so that fuel is fed to the retort faster than the burning rate thereof and whereby the fuel bed builds up in depth and increases its resistance to the passage of air therethrough to increase the pressure thereof, and means operative under the action of that increased pressure of the supplied air for operatively connecting said driving means to said fuel feeding means and to said air supplying means at another point and for disconnecting said driving means for said fuel feeding means and said air supplying means at the first mentioned point and for changing the condition of said circuit so as to cause said air controlling means to provide a maximum volume of air under pressure to the fuel bed so that its burning rate is faster than its feeding rate and whereby said fuel bed burns down in depth and decreases its resistance to the air supplied so that the pressure thereof is decreased to that which initiates a succeeding burning cycle for the apparatus during a burning period.

7. In a fuel burning apparatus having burning periods, each constituting a plurality of successively occurring burning cycles, the combination of a retort, means for feeding fuel to the retort to form a fuel bed thereon, means for supplying air under pressure to the fuel bed to support combustion thereof, a motor for driving said fuel feeding means and said air supplying means, a

circuit for said motor, electrically operated means for controlling the volume of air supplied to the fuel bed, means operative in a burning period of the apparatus for initiating a burning cycle for the apparatus and embodying therein means for closing the circuit at one point to said motor so that it drives said fuel feeding means and said air supplying means and for so changing the condition of said circuit as to cause said controlling means to reduce the pressure and the volume of the air supplied to the fuel bed so that said fuel is fed to the retort faster than the burning rate of the fuel bed thereon and whereby the fuel bed builds up in depth and increases its resistance to the passage of air therethrough to increase the pressure thereof, and means operative under the action of the increased pressure of the supplied air for closing the circuit at another point to said motor and for opening the circuit at the first mentioned point and for again changing the condition of said circuit with respect to the said electrically operated means so that it operates to provide a maximum volume of air under pressure to the fuel bed so that the burning rate is faster than its feeding rate of fuel to the fuel bed and whereby said fuel bed burns down in depth and decreases its resistance to the air supplied so that the pressure thereof is decreased to that which initiates a succeeding burning cycle for the apparatus during a burning period.

8. In a fuel burning apparatus having burning periods, each constituting a plurality of successively occurring burning cycles, the combination of a retort, means for feeding fuel to the retort to form a fuel bed thereon, a blower for producing a volume of air under pressure, means for driving said fuel feeding means and said blower, a duct for conveying air from the blower to the retort, means in said duct and operable to control the volume of air passing therethrough to the retort, means actuated by the low pressure of the air in the duct on one side of said controlling means and operative in a burning period of the apparatus for initiating a burning cycle of the apparatus and for connecting said driving means at one point to said fuel feeding means and said blower for driving the same while said control means is in a position providing for the minimum passage of air through the duct to the retort and whereby the air in the duct on the other side of the control means builds up to a relatively high pressure, and means actuated by said high pressure of air in the duct for connecting said driving means at another point to said fuel feeding means and to said blower while lower pressure air in the duct on the other side of said control means, through said means actuated thereby disconnects said driving means therefrom at the first mentioned point and operates said control means to permit the maximum passage of air through the duct to provide a burning rate for the fuel bed that is faster than the feeding rate for the fuel thereto in the final part of said burning cycle so that the pressure is reduced throughout the duct, said two last mentioned means operating at said reduced pressure to initiate a succeeding burning cycle of the apparatus.

9. In a fuel burning apparatus having burning periods, each constituting a plurality of successively occurring burning cycles, the combination of a retort, means for feeding fuel to the retort to form a fuel bed thereon, a blower for producing a volume of air under pressure, a motor for

driving said fuel feeding means and said blower, a duct for conveying air from the blower to the retort, electrically operable means for controlling the volume of air passing through the duct to the retort, a circuit for said motor and said electrically operable means, pressure responsive means actuated by the pressure of air in the duct on one side of said electrically operable means for closing said circuit to the motor at one point to initiate a burning cycle of the apparatus and so that said motor drives said fuel feeding means and said blower, said pressure responsive means including a spring pressed part normally holding said circuit to said electrically operable means open and whereby said controlling means permits the minimum passage of air to the fuel bed so that fuel is fed thereto faster than the burning rate thereof and whereby the air in the duct on the other side of said controlling means builds up to a relatively high pressure, and means actuated by said high pressure of air on the other side of said controlling means for closing the circuit to the motor at another point, said spring pressed part of said pressure responsive means operating to open the circuit to the motor at said first point and to close the same to said electrically operable means which then functions to permit the passage of a maximum amount of air through the duct to the fuel bed so that its burning rate is faster than the feeding rate of fuel in the final part of a burning cycle and whereby the pressure in said duct is reduced to operate through both of said pressure-actuated means to initiate a succeeding burning cycle for the apparatus.

10. In a fuel burning apparatus, the combination of a retort, means for feeding fuel thereto, a blower, a duct connecting the blower to the retort, a motor for driving the fuel feeding means and the blower, a damper in said duct and movable from a position permitting the passage of a minimum amount of air therethrough to the retort to a position permitting the passage of a maximum amount of air therethrough, electrically operable means connected to the damper for moving the same from the first mentioned position to the second mentioned position, a circuit for said motor and electrically operable means, switch means in said circuit for normally holding the circuit to the motor closed at one

point and open at another point and also open at the first point to the electrically operable means, pressure-actuated means connected to said duct and operating at one pressure in the duct for closing said circuit to the motor at said another point and for opening it at the first point to the motor and for closing it at said first point to said electrically operable means, said pressure actuated means operating at a lower pressure of air in the duct to open said circuit to the motor at said another point.

11. In a fuel burning apparatus, the combination of a retort, means for feeding fuel thereto, a blower, a duct connecting the blower to the retort, a motor for driving the fuel feeding means and the blower, a damper in said duct and movable from a position permitting the passage of a minimum amount of air therethrough to the retort to a position permitting the passage of a maximum amount of air therethrough, electrically operable means connected to the damper for moving the same from the first mentioned position to the second mentioned position, a circuit for said motor and said electrically operable means, a switch in said circuit and normally holding the same closed at one point to the motor and normally holding the circuit open at said point to said electrically operable means, a second switch in said circuit and normally holding said circuit open to said motor at a second point, two pressure actuated means, one operatively associated with each switch, means connecting each pressure actuated means to said duct on opposite sides of said damper, said two pressure actuated means operating at predetermined pressures of air in the duct on opposite sides of the damper when the latter is in its first mentioned position to actuate their respective switches so that the second switch will close the circuit to the motor and the first switch will open the circuit to the motor and will close the circuit to said electrically operable means, said two pressure actuated means operating at the pressure in the duct when the damper is in the second mentioned position to actuate said switches to open the circuit to the motor at the second point and close it at the first point and simultaneously therewith open the circuit to said electrically operable means.

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