To all whom it may concern:

Be it known that I, GEORGE FURUHOLMEN, a subject of the King of Norway, residing at Minneapolis, in the county of Hennepin and State of Minnesota, have invented new and useful Improvements in Stoves and other Heaters, of which the following is a specification.

My invention relates to improvements in stoves and other heaters and has for its object to provide a highly efficient heat-producing device.

More specifically its object is to provide a stove having means adapted to feed coal from a source of supply into the fire box, advance the same across the grate thereof and eject the unconsumed material therefrom, said means being also adapted to vary the draft through certain portions of the grate and thereby regulate consumption within the fire box.

It is also my object to provide a stove having a device adapted to advance a comparatively thin layer of coal to the grate and force said fuel across the grate, said grate being formed with a recess or retort adapted to receive a relatively large quantity of coal and thereby retard its advance, whereby said coal is subjected to heat for a considerable time at the margin of the fire to distil the gases therefrom, preparatory to later consumption.

A further object is to provide a stove of this kind adapted to feed fuel on the grate at an elevation where the temperature is relatively high to expedite the process of coking the coal.

A further object is to provide in a stove of this kind a baffle plate having an air inlet conduit at its lower margin, said plate being adapted to direct liberated gases from the coking coal onto the surface of the burning fuel and supply fresh air to said gases to form therewith a combustible mixture of high efficiency.

A further object is to provide a stove of this kind in which the surface of the burning mass rises toward the flue of the fire box to conform with the path of the gases and insure the ignition of the same before exit from said fire box.

A further object is to provide means for disintegrating the caked coke at the margin of the fire and also for removing coke which may adhere to the sides of the fire box while undergoing the coking process.

A still further object is to provide an adjustable exit for cinders and to furnish means for crushing said cinders and ejecting the same from said exit.

In the drawings, Figure 1 is a longitudinal sectional view illustrating that portion of a stove embodying my invention; Fig. 2 is an end elevation of a portion of a stove showing in detail certain parts of my improvements; Fig. 3 is a sectional view taken on the line 3—3 of Fig. 1; Fig. 4 is a detail perspective view illustrating a portion of the stationary stove grate; Fig. 5 is a perspective view illustrating in detail a portion of the tiltable stove grate; Fig. 6 is a detail perspective view of the disintegrating device; Fig. 7 is a detail perspective view of the movable grate and fire wall showing different positions of the movable grate and fire wall.

Referring to the drawings, I have used the reference numeral 10 to indicate the sides of the fire box, 11 the baffle plate between said sides, 12 the fresh air conduit at the margin of said plate, 13 the fire wall at one end of the fire box, 14 the hopper at the other end thereof, 15 the stationary grate, 16 the tiltable grate at the bottom of the fire box, 17 the conveyor tray leading from the hopper to said grate and 18 the plunger or stoker head. This fire box is assembled in a stove or furnace of ordinary construction having a top 19, sides 20, 21 and flue 22, as indicated in the drawings.

The conveyor tray 17 receives coal from the hopper 14 and carries it to the stationary grate 15, from which said fuel is advanced by the reciprocating plunger head 18 across said grates 15 and 18. The coal first passes through a zone of high temperature when on the tray 17 and a quantity of gases is distilled therefrom. Said coal is then delivered upon the stationary grate adjacent to the margin of the fire, where substantially all of the remaining gases are distilled and finally the coke is forced into
the fire and there consumed. The gases liberated from the coal are supplied with fresh air and are directed by the baffle plate 11 onto the burning mass at a point remote 5 from the flue 22.

Each side 10 of the fire box comprises a double wall open at its base, the inner wall thereof being formed with an aperture 23 and also with supporting flanges 24 and 25. The fuel hopper 14 at one end of the fire box is formed with a horizontal opening 26 in the lower side thereof. The stationary grate 15, supported transversely of the fire box, and resting upon the flanges 24 on 10 the sides thereof, consists of the step-like bars 27, 28 and 29, joined at their ends by the pieces 30. The bar 29 is formed with narrow slots 20° therein and with depending flanges 31 at the forward and rear margin. 20 gins thereof, said flanges being adapted to form with the end pieces 30 an air inlet conduit 32, which will be more fully hereinafter described. The tiltable grate 16 extends transversely of the fire box and spans the space between the stationary grate 15 and the rear wall 18 of the fire box. This grate consists of a plurality of parallel bars 33 with spaces between the forward portions thereof and said bars are detachably secured 30 to an oscillatory shaft 34, which is journaled at its ends in the sides 10. The heavier portions of the bars 33 overhang the forward side of the shaft 34 and said shaft is moved by the weight of said bars 33 to position engaging the arm 35 thereon with the stop 36 at the side of the fire box to return the grate to normal position after the same has been tilted. A curved depending projection 37 is formed at the forward end of each bar to block the space between said bar and the stationary grate 15, when said tiltable grate is lifted. At the rear of each bar a crushing face 38 and ash retaining lug 39 are formed. The lug 39 supports the refuse when the grate 16 is in normal position and the crushing face 38 breaks up the material between the grate 16 and the concave surface 40 of the fire plate 18 as said grate is tilted upward. The arrangement of the crushing devices 38 and 40 is such that the lower part of the opening between them is increased as the forward end of the grate is raised to facilitate the exit of the waste material through said opening. The fire wall 13 is hung on pivots 41 and is moved to the desired position with respect to the grate bars 33, by adjusting the set screw 42 which is threaded in the lower edge of said wall and abuts against 55 the wall 43. The reciprocating conveyor tray 17 extends across the space between the bottom of the hopper 14 and the stationary grate 15. Said tray is inserted into the hopper 17 and one end thereof slides backward and forward on the bottom of said hopper to withdraw a charge of fuel therefrom during one stroke and advance said charge on said tray during the reverse stroke. The plunger head 18, to which the tray 17 is attached, consists of the plates 44, 45 and 46 joined by a plurality of webs 47 integral therewith. The plate 44 plays over the stationary grate bar 27, the intermediate plate 35 passes between the bars 27 and 28 and the lower plate 46 between the bars 28 and 29 of said stationary grate. The lower bar 29 of the grate 15 is wider than the others and said bars, owing to their step-like structure, form a recess or retort into which the fuel is delivered from the tray 17. Said plates 44, 45 and 46 pass into this recess and remove the fuel therefrom. Rollers 48, traveling upon tracks 49 at the sides of the fire box, are revoluble upon the rod 50, which is mounted in the lugs 51 depending from the webs 47 at the extremities of the plunger head 18, and said rollers slidably support said conveyor tray and plunger head.

Suitable means are provided for reciprocating the conveyor tray 17 and plunger head 18. The rack shaft 52, revoluble in the sides 20 of the stove, is furnished with the arm 53 which is connected by the link 54 with the rod 50 on the plunger head 18. Said shaft is oscillated by any convenient mechanism such as the hand lever 55, movable between the stops 56 and 57 on the side of the stove. Successive manipulations of this lever backward and forward cause the reciprocation of the conveyor tray 17 and plunger head 18, and this movement carries fuel step by step from the hopper 14 to the grates 15 and 16 and also forces said fuel across said grates.

Means are provided for tipping the movable grate to remove waste products from the rear of the fire box simultaneously with the feeding operation. One of the tiltable grate bars 33 is formed with a depending lug 58 having a notch 59 in the lower surface thereof. The arm 60, pivotally secured to the rod 50 on the plunger head 18 and yieldingly supported by the spring-actuated roller 61, is provided with an adjustable screw 62 adapted to engage the notch 59 of said lug and raise the forward ends of the grate bars 33 on the return stroke of the plunger. Said screw becomes disengaged from the notch 59 before the completion of said return stroke and releases the grate 18, such point of release being determined by the adjustment of said screw 62. The conveyor tray 17, the stationary grate 15 and tiltable grate 16 are inclined and cause the surface of the fuel to slope toward the flue 22. It will be noted that the fuel on the tiltable grate is loosened or expanded by the movement of said grate 16 and that fuel on the station...
ary grate is correspondingly expanded for the reason that it is slightly raised by the wedge-shaped end of the plunger head 18 during each working stroke thereof.

I provide means whereby the area of the grate, through which air is allowed to pass, is increased or diminished as desired. The sliding damper 63 regulates the draft through the conduit 82. Said damper is pivotally mounted upon the branches 64 of the arm 65, which swings from the rod 50, and is yieldingly engaged with the lower edges of the draft conduit 22 by the action of the weight 66 on said arm. The lower plates 45 and 46 of the plunger head 18 close the openings between the grate bars 27, 28 and 29. The damper 63 moves simultaneously with the plunger head and said plates 45 and 46 and damper 63 are arranged in such a relation that the draft conduit 32 and with the openings between the grate bars 29, 28 and 27 are opened consecutively in the order named and closed consecutively in the opposite order. Suitable adjustments may be provided for limiting the rotation of the shaft 52 and determining the position of the plunger head 18 and damper 63 with respect to the stationary grate, such as the adjustable screw 67 in the stop 60, which is adapted to engage the hand lever 55 at different positions thereof. In case the damper 63, in its normal position, closes the draft conduit 32, the material escaping through the slots 29a in the stationary grate bar 15 is retained by said damper until the working stroke of the plunger 18, when it is discharged.

The baffle plate 11 is provided with a fresh air conduit which communicates at its ends with the apertures 28 in the sides 10 of the fire box and is perforated with outlet ports 68 for the purpose of mixing air with the gases as they strike the flames or glowing coals to form with said gases a combustible mixture at a point where the same is readily ignited.

The disintegrator 69 is arranged within the fire box and is designed to break up the fuel which is often formed in a cohesive mass or cake as it approaches the grate.

Said device is also adapted to remove the portion of the fuel adhering to the sides of the fire box. This disintegrator comprises a pair of arms 70 beveled at their edges 70a and joined at the upper ends thereof with a cross-piece 71 having large teeth 72 thereon on each of said arms being provided at its lower end with a journal 73 revolving in a side 10 of the fire box. Levers 74 and 75 are secured to one of the journals 73. Two bar springs 76, attached to the side 20 of the stove, is secured to the lever 74 and forces the arms 70 and teeth 72 into the fuel, as indicated in dotted lines in Fig. 1, the limit of such movement being determined by the stop 78, against which the lever 74 impinges.

The disk 80, revoluble upon the shaft 52, is provided with spaced notches 81 in its periphery and also with spaced pins 82 protruding from the sides thereof. The hand lever 55 is furnished with a dog 83 to engage said pins and is adapted to turn said disk a step upon each working stroke thereof, said disk being secured against reverse movement, when the hand lever 55 is turned, by the spring-actuated dog 84, which engages one of its notches 81. The pins 82 travel through the path of the lever 75 and during the movement of the disk at each step, one pin releases the lever, thus permitting the fall of the arms 70 and toothed bar 71 accelerated by the action of the spring 76. The next succeeding pin engages and moves the lever 75 against the action of said spring to raise said teeth from the path of the plunger head 18 and retain the same in a position remote from the heated fuel.

In operation, the shaft 52 is reciprocated at intervals as desired. Upon each forward stroke of said lever, the coal on the tray 15 is advanced a step toward the grate 15, the fuel upon the grate 15 and 16 is moved by the plunger head 18 across the grate, the disintegrator falls and is returned to elevated position and the damper 63 is shifted to permit the escape of waste material if there is any retained in the conduit 32. Upon each return stroke of said hand lever, a quantity of fuel is delivered from the tray into the retort in the grate 15 and the grate 16 is tilted to remove ashes therefrom. Meanwhile, the fuel upon the conveyor tray 17 and upon that portion of the grate 15 through which there is no draft, is heated or coked, thus causing gases to be emitted therefrom. These gases in their course toward the flue 22 are directed by the baffle plate 11 against the burning coals, and said gases are supplied at the margin of said plate with fresh air from the conduit 20 to form therewith a highly combustible mixture.

The draft area of the grate is determined by adjusting the throw of the hand lever 55 and thereby fixing the normal position of the plunger head 18 and damper 63 with respect to the stationary grate 15.

The desired movement of the tiltable grate is secured by adjusting the set screw 62 in the arm 60 to determine the point at which the said screw is released from the notch 59 in the lug 58.

The fire wall 13 is adjusted to position adjacent to the grate 15 when the refuse or waste particles are small and in case said particles are coarse, the wall is permitted to recede a sufficient distance from said grate so that the coarser residuum may enter the space between the crushing surfaces 33 and 40 of said grate and wall.
Having described my invention, what I claim as new and desire to protect by Letters Patent, is:

1. In a stove, an upwardly inclined grate having a retort at the lower margin thereof, a reciprocating tray adapted to deliver fuel into said retort and a plunger arranged to pass into and out of said retort to move the fuel step-by-step toward the elevated side of the grate.

2. In a stove, a fire box, a fuel hopper thereon, a grate in said fire box, a reciprocating plunger adapted to play over a portion of said grate to deliver fuel from the hopper and advance the same across said grate, said reciprocating plunger being also adapted to control the passage of air through a portion of the grate and means for regulating the stroke of said plunger.

3. In a stove, a fire box, a fuel hopper thereon, a grate in the bottom of said box, a reciprocating plunger adapted to play over a portion of said grate to deliver fuel from the hopper and advance the same across said grate, said reciprocating plunger being also adapted to control the passage of air through a portion of the grate.

4. In a stove, a fire box, a fuel hopper thereon, a grate in the bottom of said box having stationary and pivotally mounted grate sections, an upwardly inclined carrier adapted to deliver fuel from the hopper to the stationary grate section, then pass it across said grate to the pivoted grate section, and means for simultaneously moving said carrier and tilting said pivoted grate section.

5. In a stove, a fire box, a fuel hopper thereon, a grate in the bottom of said box having stationary and pivotally mounted grate sections, a plunger adapted to deliver fuel from said hopper to the stationary grate section and advance the same upon said pivoted grate section and also to control the passage of air through a portion of the grate, and means for reciprocating said plunger and tilting the pivoted grate section.

6. In a stove, a fire box, a fuel hopper, a grate for said fire box having a stationary and a tiltable section, an upwardly inclined reciprocating conveyor tray extending from said hopper to the stationary section, a plunger head secured to said tray and means for reciprocating the latter, whereby fuel is fed upon the stationary grate, then moved across both thees and the residue thereof discharged from the tiltable grate.

7. In a stove, a fire box, a fuel hopper at the forward end thereof, a grate at the other end having a movable section therein, an upwardly inclined reciprocating plate extending from the bottom of said hopper to said grate to carry fuel from the former to the latter, a plunger co-acting with said tray to advance fuel across said grate and means in operative connection with said plunger for tilting said movable grate section.

8. In a stove, a fire box, having a grate therein, a fuel hopper for said fire box, a conveyer tray between said hopper and grate sloping upward toward the grate, said grate being arranged with steps down from said tray and then inclined upward to form a retort, means for reciprocating said tray to feed the grate, means extending between the grate bars for advancing fuel across the grate, a baffle plate extending transversely in the fire box to direct the gases liberated from the coking fuel on one side thereof in a thin stream immediately over the burning fuel on the other side and an air conduit at the margin of said plate, adapted to supply fresh air to said stream of gases.

9. In a stove, a fire-box, a fuel hopper, a grate having steps down from the feeding side thereof, then sloped upward to the discharge side to form a coking retort for fuel in said feeding side and to provide an upwardly inclined path for the burning fuel, a carrier to deliver fuel from the hopper into said retort, means to push the fuel from the retort across the upwardly inclined portion of the grate, a flue opening above the discharge side of the grate and a baffle-plate extending transversely into the fire box to direct the gases liberated from the coking fuel on the feeding side of the grate in a thin stream against the rising mass of burning fuel on the other side.

10. In a stove, a fire box, a fuel hopper, a grate having steps down from the feeding side thereof, then sloped upward to the discharge side to form a coking retort for fuel in said feeding side and to provide an upwardly inclined grate-section for the burning fuel, a flue above the discharge side of the grate, a carrier to deliver fuel from the hopper into said retort and means to push the fuel from the retort across said upwardly inclined section of the grate.

11. In a stove, a fire-box, a fuel hopper, a grate having steps down from the feeding side thereof, then sloped upward to the discharge side to form a coking retort for fuel in said feeding side and to provide an upwardly inclined support for the burning fuel, a carrier to deliver fuel from the hopper into the retort, means to push the fuel from the retort across the upwardly inclined portion of the grate, a flue, opening above the discharge side of the grate and a baffle-plate extending transversely into the fire box to direct the gases liberated from the coking coal on the feeding side of the grate in a thin stream against the rising mass of burning fuel on the other side, and an air conduit at the margin of said plate to supply fresh air to said gases.

12. In a stove, a fire box, a grate therein...
having a stationary and a movable section, a damper for regulating the draft through said stationary grate section, a movable tray to carry fuel to said grate, a plunger to force said fuel across the grate, a revoluble shaft in operative connection with the tray, plunger and damper and means for turning said shaft to reciprocate said tray and plunger and shift said damper.

In a stove, a stationary grate, a tiltable grate adjacent to said stationary grate, a fire-wall adjacent to the tiltable grate, said grate and fire-wall having co-acting crushing surfaces adapted to crush and discharge a quantity of material when the grate is tilted, a fuel hopper, a carrier to deliver fuel from the hopper to said stationary grate, reciprocating means to advance fuel across the grates upon one stroke thereof and for tilting said movable grate during the opposite stroke.

In testimony whereof, I have signed my name to this specification in the presence of two subscribing witnesses.

GEORGE FURUHOLMEN.

Witnesses:

OLAF B. ANDERSON,

F. C. CASWELL.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."