UNITED STATES PATENT OFFICE

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APPARATUS FOR FEEDING FUEL

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This invention relates to a furnace, and more particularly to a mechanism for feeding fuel material into the chamber or fuel box of a furnace and over or onto the grate thereof.

The invention is shown applied to a hot air furnace by way of one illustrative application, but it may be used for other types of furnaces whether the latter are used for heating or power purposes.

One object of the invention is to provide an improved feeding mechanism, whereby the power required is materially reduced, which tends to economize on the cost of operation as well as to simplify and reduce the cost of construction.

Another object of the invention is to provide an improved feeding mechanism in which the fuel material is fed more uniformly and with less danger of clogging, thereby preventing an undue load on the power means as well as eliminating noise which would otherwise result in the operation of the mechanism to feed the clogged portions of the fuel material into the fire box.

Another object of the invention is to provide an improved hopper which is shaped and arranged to insure gravitation of the fuel material in feeding position.

Other objects of the invention will be apparent to those skilled in the art to which my invention relates from the following description taken in connection with the accompanying drawings, wherein

Fig. 1 is a sectional view of a furnace having a feeding mechanism embodying my invention including the power means and the control for the latter.

Fig. 2 is a fragmentary section of parts shown in Fig. 1, but slightly enlarged.

Fig. 3 is a section on the line 3—3 of Fig. 2.

Fig. 4 is a view similar to Fig. 1, but showing the feeding member at the end of its force stroke.

Figs. 5 and 6 are fragmentary views, with parts broken away, of the controlling valve.

For convenience I have shown my present invention applied to a circular type of furnace, similar to that shown in my co-pending application Ser. No. 727,680, a delivery and spreading member of the same general shape and a grate sloped to fit a fire box of circular section, but these parts may be variously shaped and the furnace may be of the steam, hot water or vapor type, as desired.

These parts comprise a base 1 and a casing 2, which encloses the ash-pit 3, fire box 4 and a dome (not shown).

The ash-pit 3 is formed by a casing 3', having an inwardly extending flange 3'', on which the fire box 4 is supported.

6 indicates as an entirety a delivery and spreading member for the fuel. The fuel delivery and spreading member 6 comprises a trough shaped casting having at its outer or receiving end a neck portion 5', which is connected with a fuel feeding or charging mechanism, indicated as an entirety at 6. At its inner end 5'', the walls of the delivery member flare upwardly and outwardly and terminate in a horizontal rim that is preferably circular and which may be slightly eccentric to the fire-box 4. The rim of the delivery member 6 is preferably provided with a flange 7 over which the fuel is caused to move or flow 75 as it feeds to and through the delivery member. The flange 7 operates to deliver or spread the fuel upon the grate 8, and it is supported above and spaced from the grate 8 by posts 7a so that air contacts with the fuel as it is delivered over and spread by the flange, the air serving to insure combustion during the delivery of the fuel onto the grate and resulting in maintaining that portion of the fuel which is under active combustion relatively close and substantially concentric to the wall of the fire-box 4. The delivery member is open throughout the length of the neck portion from its discharge opening, this arrangement permitting the fuel to be received in the delivery member slightly below the plane of the delivery opening and to be fed up a relatively low inclined wall, as shown at 5'' in Fig. 1. By this arrangement, clogging of the fuel in the delivery member is prevented and the fuel is directed or fed to and over the flange 7 at an angle. As shown in the drawings, the flange 7 is extended around the upper edge of the member 5 to the wall of the firepot, the purpose being to prevent air...
contacting with the fuel as it is fed through the delivery member and combustion of the fuel therein. Accordingly, clogging of the neck portion by coking, incident to combustion of the fuel, is eliminated. The neck portion $5^a$ of the delivery member $5$ is preferably provided with lugs (not shown) which extend laterally below the interned flange $3^a$, so as to be connected thereto by cap screws.

The delivery member $5$ is preferably supported by the following instrumentalities: 10 indicates a bar extending across the ashpit $3$, having secured to its front end by a screw $10^a$ the lower side of the neck portion $5^a$ and being secured at its rear end by a bolt $10^b$ to the wall or casing $5$. The bar $10$ is arranged to form a support for an upwardly member $11$, which in turn supports an arcuate device $12$. The upwardly member $11$ preferably comprises a pipe section $11^a$ supported on the bar $10$ and engaging at its upper end the device $12$ and a bolt $11^b$ extending through an opening formed in the device $12$ and through the pipe section $11^a$ and an opening formed in the bar $10$, and clamped in position with these elements in rigid relationship by a nut $11^a$. The flange $7$ is preferably rigidly secured to the device $12$ by devices each similar to those connecting the device $12$ to the bar $10$, to wit, a pipe section $7^a$, a bolt or screw extending through the pipe section $7^a$ and openings formed in the flange $7$ and device $12$ and a nut engaging the bolt and clamping the ring shaped device $12$, pipe section $7^a$ and flange $7$ in fixed relation, as shown in Fig. 1.

The grate $8$ is of arcuate shape and surrounds the rim of the delivery member $5$, but terminates at opposite sides of the neck portion $5^a$, the space between the ends of the grate $8$ being greater than the diameter of the neck portion $5^a$ so that the grate may be oscillated about the axis of the fire-box $4$ for a purpose to be later set forth. The grate $8$ is disposed in a plane below the flange $7$, so that the fuel may be delivered thereto and also to provide a space therebetween for the circulation of air to and through the fuel as it is delivered to or falls upon the grate $8$ to insure proper combustion. The grate $8$ is preferably supported to oscillate on the device $12$ by a spider $13$ pivotally connected by a bolt $14$ to the bar $10$ on an axis coincident with the axis of the fire-box $4$. For this purpose, each arm of the spider $13$ consists of an inclined section $13^a$ (Fig. 2) extending upwardly from the bolt $14$ and a horizontal section $13^b$ which slides on the device $12$. The grate $8$ may be secured to the under surface of the outer or extended sections $13^b$ of the arms of the spider $13$ by bolts $15$ or other equivalent devices.

The grate $8$ may be operated about the pivot bolt $14$ by hand, but in the preferred form of construction, it is connected to a movable part of the feeding or charging mechanism so that in each feeding or return stroke of the feeding member thereof the grate is actuated, that is, oscillated about the bolt $14$ relative to the rim $7$, to effect its shaking; whereby the shaking of the grate may be correlated to the movement of the fuel charging mechanism and the quantity of fuel supplied thereby to the delivery member $5$ and delivered by the latter unto the grate $8$, so that the ashes will be automatically discharged from the grate in accordance with the amount of fuel delivered thereto and the speed with which burning or consumption of the fuel takes place. The connection between the grate and the feeding or charging mechanism may be similar to that shown in the above referred to application.

The delivery and spreading member $5$ and the fuel feeding and charging mechanism $6$ are adapted to supply any kind of solid fuel in relatively small pieces. As will be later pointed out, the preferred form of charging mechanism, such as herein illustrated, lends itself admirably to the charging of fuel in which the lumps are relatively small, since the plunger of the charging mechanism is operated by a power means which permits the plunger to stop at various points in its force stroke direction, dependent upon the amount or character of the fuel in its path so that it may return and then move forwardly to feed the material or fuel into and through the delivery member $5$.

Of the fuel charging mechanism $6$, $16$ indicates a hopper to receive a supply of the fuel. The hopper is open at its lower end, as shown at $16^a$, so as to permit the discharge of the fuel into a conduit $17$. The conduit $17$ preferably comprises a tubular member, the opening $16^a$ thereof being intermediate its ends. The inner end $17^a$ of the conduit $17$ is connected with the outer end of the neck portion $5^a$, preferably tellurial thereinto (see Figs. 1 and 4), an opening $17^b$ being formed in the wall of the casing $5^a$ to receive the tubular conduit $17$.

$18$ indicates a feeding member the purpose of which is to feed the fuel material by successive strokes into and through the delivery $115$ and spreader member $5$. The feeding member $18$ is constructed and operated in such manner that in its movement in one direction it acts on the fuel material or a plurality of portions of fuel material in successive order to feed or move the same forward or along the conduit into the delivery member, so that a sufficient quantity of fuel material is maintained in the delivery member and fresh material supplied as fast as it moves over unto the grate where combustion takes place; whereas in its movement in the opposite direction, the feeding member $18$ is ineffective to move the material and therefore moves rearwardly so as to again engage and move...
the material forwardly and to engage and move forwardly additional material received from the hopper 16. I accomplish these functions and operations by using a feeding member that is preferably of spiral formation from end to end capable of sliding and rotating in the conduit 17, and moving said member non-rotatively in one direction to effect feeding movement of the fuel material (see Fig. 4), and moving the device endwise and rotationally in the opposite direction, these latter movements being proportional relative to each other so that the endwise movement will be rendered by the rotational movement ineffective on the material. Thus the feed member is returned to starting position without correspondingly moving the fuel material, whereby in its next stroke said member may act on the fuel to feed it forwardly.

As illustrative of suitable means for effecting these operations I provide a mechanism 19 for reciprocating or endwise moving the feed member and devices 20 which control and effect the non-rotation of the member in its active or force stroke and its rotation in and during its inactive or return stroke.

The reciprocating mechanism 19 preferably consists of the following: 21 indicates a cylinder having a piston 22 and a rod 23 extending through one head of the cylinder.

By preference the shank 18* of the feed member 18 and the rod 23 may be formed from one piece or rigidly connected end to end. 24 indicates a plurality of plates, (one thereof forming the end wall for the outer end of the conduit 17 to prevent sittings therefrom) formed with aligned openings 28* the walls of which serve as guides for the shank 18*. The plates 24 are supported rigidly relative to the conduit 17 and cylinder 21 and in spaced relation by rods 25 extending through openings in the plates and nuts 26 threaded thereon and tightened against the plates. 27 indicates a closed chamber containing liquid (such as water) and air and connected by a pipe 28 to the cylinder 21 at one side of the piston 22, the pipe 28 extending to a point below the level of the liquid in the chamber. The air in the chamber 27 is maintained at such a pressure as to maintain the pipe 28 and cylinder 21 full of liquid when the piston 22 is in the position indicated in Fig. 1. 29 indicates a pipe leading from the cylinder, at the opposite side of the piston 22, and connected to a liquid supply under pressure, preferably water, and a means 30 for controlling such supply, whereby the piston 22 is reciprocated as will later be set forth. The controlling means 30 will be later referred to.

Fig. 1 shows the feed member at one extreme position ready to move toward the left as viewed in Fig. 1 for feeding the fuel material as already set forth. To effect such movement, the liquid is admitted from the supply system and control means 30. The pressure of the liquid will move the piston 22 and through it the shank 18* and feed member 18 endwise to the position shown in Fig. 4. This movement of the piston 22 will force the water out of the cylinder 21, through the pipe 28 into the chamber 27, compressing the air therein, which built-up pressure is utilized, upon the cutting off of the pressure through the pipe 29, to return the piston 22 and through it the shank 18* and feed member 18 to their first position (see Fig. 1). I have found that the ordinary pressures furnished in city water systems are usually sufficient to effect operation of my feeding mechanism; in fact, in some cases a reducing valve may be desirable to reduce the pressure. To prevent the pressure in the chamber 27 from becoming too high, for example, by water leaking past the piston and raising the mean level of the water in the chamber, I provide a relief valve 27*, which may be constructed to operate automatically at a predetermined pressure.

The rotating means 20 preferably comprise the following instrumentalities: 31 indicates a clutch element carried by one of the plates 24, such element preferably comprising radial teeth 31* cast on the plate. One side of each clutch tooth may be disposed at right angles to the plates and its opposite side inclined, in order to insure effective engagement and disengagement between it and the other clutch element 32. The clutch element 32 comprises a disk surrounding the shank 18* but having a key 33 fitting into a spiral slot or groove 34 formed in the pitch of the slot 34 being equal or similar to the pitch of the spiral member 18, so that the rotation thereof will be proportioned to its endwise movement, to avoid movement of the fuel material rearwardly and increased resistance to the return movement of the spiral member 18. The clutch disk 32 is mounted between the clutch element 31 and an abutment 35, which is preferably carried by the adjacent plate 24, the abutment being spaced from the clutch element 31 a sufficient distance to permit disengagement of the clutch elements from each other. Due to the friction between the disk 32 and shank 18* or the key 33 and walls of the slot 34, the former will move with the shank 18*.

Accordingly, when the piston 22 and shank 18* start to move toward the left, the disk 32 will move to the position shown in Fig. 2, out of engagement with the clutch 31 and against the abutment 35. As the disk 32 is free to rotate relative to the abutment 35, the co-rotation between the walls of the spiral slot 34 and key 33 will rotate the disk and thus permit the shank 18* to move endwise non-rotatively. When the piston 22 and shank 18* start to move from their operated positions (see Fig. 4) toward the right, the disk 32 will move into clutching relation with the clutch element 31, which will hold.
the disk 32 against turning, and as a result the co-action between the walls of the slot 34 and key 33 will rotate the shank 18 and effect rotation of the feed member, as already set forth. To reduce the friction between the disk 32 and abutment 35, I may provide between them an anti-friction bearing 36, so arranged that the anti-friction elements will not be displaced by the movement of the disk away from the abutment. As shown in the drawings, the abutment 35 is spaced from the clutch element 31 only far enough to permit clearance of the clutch elements. As a result but slight movement of the plate 32 is required to effect engagement or disengagement of the clutch elements. Accordingly they will be effective to start rotation of the shank 18 immediately following the movement thereof toward the right and to release the shank for non-rotative endwise movement immediately following the movement thereof toward the left.

The liquid pressure supply and the control means herein illustrated will form the subject-matter of a separate application, but in order that the same may be fully understood it is briefly described as follows: 37 indicates a pipe leading from a source of water supply under pressure. 37 indicates a branch pipe leading to a tank 38 where a normal supply is maintained by a valve 39, controlled by a suitable float 40. 41 indicates an overflow pipe connected to a discharge pipe 42. The pipe 37 is connected to one port of a three-way valve casing 43. Flow of liquid from the pipe 37 into the casing 43 is controlled by a ball check valve 44 urged toward its seat 44b by a compression spring 45. Between the pipe 29, which is also connected to the valve casing, and a return pipe 48 leading to the tank 38, there is provided a second check valve 46 urged toward its seat 46b by a compression spring 47. A plunger 49 is connected to the valve element 46 and is arranged, when the latter is seated, to depress or open the valve element 44a, in opposition to its spring 45, and allow water to flow from the pipe 37 to the pipe 29. On the other hand, when the valve element 46 is unseated, the plunger 49 is retracted to permit the spring 45 to seat its valve 44b, and in this latter position of the elements, flow from the pipe 37 into the casing 43 is prevented, while water in the pipe 29 is permitted to flow into and through the pipe 48, which operation takes place due to movement of the piston 22 toward the right as viewed in Figs. 1 and 4 due to the pressure in the tank 27. The operation of the valves 44a and 46 is effected by the tilting of a container 490 and the control of such tilting operation is effected by the rate of flow of water from the tank 28 into the tiltable container 490, which—when tilted—positively unseats the valve element 46 and permits the cut-off of the water pressure by the seating of the valve element 44a. The container 490 may comprise a cylindrical casing closed except for an overflow nipple 491 in its upper portion and may be weighted at one end to normally maintain its horizontal, as shown in Fig. 1. 50 indicates a siphone mounted in the container 490 having its intake at that end which tilts downwardly. The siphone 50 is connected by a flexible pipe 50a with the waste pipe 42. 51 indicates a pipe (having a flexible portion) extending from the bottom of the tank 38 and leading into the container 490 and preferably discharging water into the opposite end thereof. The flow of water through the pipe 51 is controlled by a valve 52, the operation of which may be effected manually or automatically by a suitable timing or thermostatic mechanism of any desired construction or both such mechanisms, the connection thereof with being made by devices indicated at 53. 54 indicates one or more damns provided in the container 490 and operating to retard the flow of the water from the weighted end of the container to its other end and also permitting the building up of a quantity of water effective to flow quickly to the tilting end of the container 490 after the tilting operation starts, thereby to accelerate the tilting movement and produce a positive and quick actuation of the valves 44a and 46. The container 490 is provided with a pair of spaced lugs 55 which straddle a wall 56 on the valve casing 43. The wall 56 is formed with a guide slot to slidably receive the shank 44 of the valve element 46. The lugs 55 are pivoted at 57 to the shank. The lower ends of the lugs 55 bear on the upper surface of a plate 59, preferably a plug fitted into the casing 43 and so-act therewith to raise the shank when the container 490 tilts. Accordingly, it will be seen that each time the container tilts the valves 46 and 44a will be operated (the former being opened and the latter closed). After the container 490 tilts, the water therein is siphoned out, following which the container 490 will return to normal (horizontal) position and thus operate the valves 44a and 46 (the former being opened and the latter closed.)

With the parts positioned as shown in Fig. 1 (valve 46 closed, valve 44a opened and the valve 32 adjusted to the desired extent) water will flow from pipe 37 through pipe 29 to the cylinder 22 toward the left to the Fig. 4 position. Water will also flow from the tank 38 into the container 490, filling the same until its unweighted end tilts, whereupon the valve 46 will be opened and the valve 44a closed, cutting off pressure on the right-hand face of the piston 22. The back pressure built up in the chamber 27 will then actuate the piston 22 in the opposite direction to the Fig. 1 position and force the water in the cylinder
back through the pipe 29 and through the return pipe 48 to the tank 38. The water thus suddenly discharged into the tank 38 over-flows through the pipe 41 to set up the desired siphoning effect in the device 50 Upon the siphoning of the water from the container 490, the latter will return to normal position, closing the valve 46 and opening the valve 47 thus re-establishing the pressure supply upon the piston to again activate it to the Fig. 4 position. To regulate the siphoning of the water from the container 490, I may provide a valve 60 in the pipe 50. These operations continue until the valve 52 is operated, either manually or mechanistically, to cut off the flow of liquid from the tank 38 to the container 490.

The connections of the pipes 51 and 50 with or through the walls of the container 490 are preferably arranged rotatively close to the trunnion 57 so that they will not be unduly flexed. Also, the container is mounted at such an elevation as to thus restore the normal level of water therein that when the container 490 tilts, the discharge end of the pipe 51 will be above such water level so as to stop the flow of water to the container 490.

The hopper 16 is preferably arranged above the fuel material receiver 17 so that such material may gravitate thereinto or into the path of movement of the feed member 18. I have discovered that if at least one of the side walls of the hopper preferably the inner side wall 16' or that portion thereof adjacent to the delivery opening of the hopper is inclined, instead of downwardly and inwardly toward the center of the hopper, downwardly and outwardly away from such center, I overcome all danger of the material clogging or packing in the hopper and thus insure its gravitation downwardly substantially uniformly into position for feeding. As will be understood from the drawings, with the wall 16' inclined, as shown, the material at the bottom of the hopper in gravitating falls away from such wall, thus leaving space for the material above to fall into and occupy. As a result the upper portion of the material will feed downwardly and finally drop into the receiver. The wall adjacent the furnace casing is preferably inclined in the manner just described for the reason that the radiating heat would ordinarily tend to cake the material on this wall and the thrusts of the feed member would also tend to pack it theretofore, but by arranging this wall in the manner shown I have found that all of these tendencies as well as the tendency for the material to pack in the opening from the hopper are entirely overcome.

The feed member being of spiral form, said member provides (a) a series of shearing edges which tend to agitate the fuel material in the lower portion of the hopper 16 as it moves relative thereto and thus further insure a more even feed of the material into position for feeding and (b) an engagement with the material at a plurality of points so that materially less power is required to feed it forwardly and less danger of a large mass accumulating in front of the feed member results.

To those skilled in the art to which my invention relates many changes in construction and widely differing embodiments and applications of the invention will suggest themselves, without departing from its spirit and scope. My disclosures and the descriptions herein are purely illustrative and are not intended to be in any sense limiting.

What I claim is:

1. In a feeding mechanism, the combination of a delivery member, a conduit connected to said member, a device reciprocating endwise of said conduit, means for rotating said device as it moves in one direction, and means for reciprocating the device.

2. A mechanism as claimed in claim 1 in which said device comprises a spiral member.

3. A mechanism as claimed in claim 1 in which said rotating means comprise elements that are automatically engaged and disengaged by the reciprocation of said device.

4. A mechanism as claimed in claim 1 in which said rotating means comprise elements which co-act to effect rotation of said device due to its movement in one direction.

5. In mechanism of the class described, the combination of a delivery member, a tubular conduit for fuel material, a supply means leading to said conduit, a spiral member slidably and rotatably fitting said conduit, and means operating to move said member endwise non-rotatively in one direction and endwise and rotatively in the opposite direction.

6. A mechanism as claimed in claim 5 in which said operating means comprise a reciprocating mechanism and elements between a portion of said member and its support which coact to effect rotation during movement of the member in one direction.

7. A mechanism as claimed in claim 1 in which said rotating means comprises an element slidably and rotatably fitting a portion of the feeding device and having a key disposed in a spiral slot in said device and spaced members either of which is engaged by said element when said device is moved in one direction, one member serving to lock the element against rotation and the other member permitting its rotation.

8. In mechanism of the class described, the combination of a conduit, a spiral feed mem-
ber movably mounted in said conduit having a shank, an abutment, a relatively stationary clutch element in spaced relation to said abutment, a clutch element slidably and rotatably fitting said shank, a key and a spirally shaped slot therefor between said shank and last mentioned clutch element, whereby engagement of the clutch elements will hold the last element stationary and effect rotation of the shank when moved in one direction and release of the clutch elements will permit rotation of the last mentioned element and non-rotative movement of the shank when moved in the opposite direction and means for reciprocating said shank.

10. A mechanism as claimed in claim 9 in which the slot for the key and the spiral wall of the feed member have the same pitch.

In testimony whereof, I hereunto subscribe my name.

CHARLES W. THOMAS.