This invention relates to burning rubbish and other like waste material capable of being disposed of by incineration. It is not uncommon to dispose of trash, garbage, waste paper and the like which is cast off by populated communities by burning this rubbish in a furnace. Furnaces for burning such rubbish are known wherein there is provided a stoker device so arranged as to mechanically stoke a pile of rubbish being burned in the furnace while causing a stream of air to pass through the rubbish serving to wholly or partially dry it while it is being burned and furnish secondary air for sustaining combustion. In the type of furnace referred to there is provided an annular hearth with a central opening through which extends a vertical shaft mounting a rotatable stoker which has arms extending outwardly to sweep over the hearth. The overlying pile of rubbish is stoked by the arms as they rotate and at the same time the arms move the rubbish outwardly onto a surrounding annular grate lying adjacent the hearth. Such combustible material as is not burned prior to the time it reaches the grate is ultimately burned on the grate and the ashes fall through it into an ash pit. It is an object of this invention to provide improvements over the prior art devices. In prior devices wherein a mechanical stoker having arms extending outwardly and adapted to sweep over the hearth as the stoker is rotated on its vertical axis is provided, there is a tendency for lumps or particles of rubbish to become lodged between the outwardly extending stoker arms and the underlying hearth. This sometimes results in forces exerted upwardly on the stoker tending to push it up out of its proper operating position. Also it puts an unwanted burden on the mechanism which drives the stoker. It is a further object of this invention to provide means to eliminate or at least to minimize the lodging of objects between the stoker arms and the hearth as the rotating arms sweep over the hearth.

To accomplish that desirable end and others which will become apparent in the more detailed description hereinafter set forth, there is provided a hearth which includes grooves or ridges in its surface extending in a direction so that particles of rubbish or objects lying adjacent the surface of the hearth are directed outwardly toward the periphery of the hearth as the stoker arms travel around in a circuitous path above the hearth. Moreover, means are provided whereby the arms are attached to the stoker in such a way as to permit them to have a limited vertical movement if an upwardly directed force is exerted on the arms as they sweep over the hearth, the purpose being to relieve the strain on the stoker mechanism which otherwise might result if the stoker arms were rigidly mounted and also to aid in the dislodgment of material causing the upwardly directed force. Although the novel features which are believed to be characteristic of the invention will be pointed out in the annexed claims, the invention itself as to its objects and advantages and the manner in which it may be carried out may be better understood by reference to the following description taken in connection with the accompanying drawings forming a part hereof, in which:

Fig. 1 is a view in elevation in cross-section showing the general arrangement of a typical plant embodying the invention;

Fig. 2 is a section view in elevation to larger scale showing the lower end of the furnace and more particularly the stoker mechanism, hearth and grate;

Fig. 3 is a plan view partly in section on line 3–3 of Fig. 2;

Fig. 4 is a plan view partly in section, partly broken away on line 4–4 of Fig. 2;

Fig. 5 is a partial view in section on line 5–5 of Fig. 4;

Fig. 6 is a partial plan view to larger scale and partly in section further illustrating the stoker and hearth arrangement, showing a hearth with spiral ridges and a stoker with hinged stoker arms; and

Fig. 7 is a view in elevation partly in section showing the hinged stoker arms.

Referring now to the drawings in which like reference characters indicate like parts, the plant as illustrated in Fig. 1 comprises a furnace A having a cylindrical side wall 10, a roof 11 and an ash pit 12 in the form of a hopper, and a flue B connecting to a combustion chamber C. The combustion chamber connects with a flue D, in turn connected to a chimney (not shown). The furnace roof 11 is provided with a charge port 13 connected to a charge chute 14 having an openable and closable charge gate 15 (shown conventionally). The ash pit has a discharge port connected to a discharge chute 16 provided with an openable and closable discharge gate 17 (shown conventionally).

The lower end of the furnace is provided with an annular hearth E having a central opening through which extends a vertical shaft to rotate...
a stoker $F$ having arms to sweep over the hearth and a tuyère head $G$. The hearth is surrounded by a grate $H$. An air heater $J$ in the flue $D$ is connected by a conduit $18$ which supplies air to the ash pit beneath the grate $H$ and also to the stoker $F$ and tuyère head $G$. The weight of the stoker $F$ and tuyère head $G$ is carried on steel structural members $K$, the ends of which are mounted in the walls of the furnace. It will be understood the furnace is provided with such complement of doors $19$ as may be desired.

The hearth $E$ is supported in the lower part of the firebox $30$ on radially extending T bars $21$. The outer ends of the T bars are supported in the side wall of the furnace. The walls of the furnace are built of brick $22$ and encased within a steel shell $22a$. Better insulation is provided by additional insulation material $32$. The inner ends of the T bars $21$ are supported on brackets $24$ (see Fig. 2) secured to a stationary cylindrical casting $25$ which in turn is carried upon structural members, designated generally by reference character $K$. The structure shown in Fig. 2 further detail hereinafter, extend across the ash pit and are suitably supported in the walls of the furnace.

The hearth $E$ is made up of a plurality of complementary cast sections $30$ (see Figs. 3 and 9). When the sections $30$ are in place they form with the top of webs $31$ of the T bars $21$ the annular hearth $E$ having a central opening $32$ (See Fig. 2). The top surface of each section $30$ is provided with raised spiral ribs $33$ and the top surface of the horizontal webs of the T bars at their inner ends is provided with complementary rib portions $33a$. Accordingly, when the hearth sections $30$ are in place on the T bars $21$, the annular hearth has on its surface a continuous series of circumferentially spaced raised ribs running spirally from the central opening $32$ to the periphery of the hearth; or, to state it another way, a series of circumferentially spaced spiral grooves or channels between the raised ribs.

The annular grate $H$ is also mounted on the T bars $21$. It comprises grate sections $34$ and the top flanges $35$ at the outer ends of the T bars (see Figs. 3 and 6). The T bars each have a flange $36$ to provide a bearing opening $37$ at either side. These bearings support the inner ends of grate bars $38$ which are supported at their outer ends by a bearing support $39a$. The grate bars extend through the wall of the furnace and are provided with rocker arms $39$ so that they may be rotated on their long axes. Each grate sector $34$ is provided with square holes $40$ along one side and the grate bar intermediate its ends is square and extends through the square holes (see Fig. 6). Hence, the grate sectors are keyed to the grate bars, thus providing hinged grate sectors which may be operated from outside the furnace to dump ashes. It may be noted that the T bars $21$ are provided with outwardly extending flanges $41$ running along the bottom, upon which to mount the hearth sections $30$.

The stoker $F$ and tuyère head $G$ are carried on structural members $K$ (see Figs. 1, 2 and 9). As shown, these structural members are made up of channels forming a pair of hollow box beams $42$ and $43$ reinforced intermediate their ends by additional lengths of channels $44$, $45$, $46$ and $47$. Box beam $42$ comprises channels $44$ and $45$ and box beam $43$ comprises channels $46$ and $47$. The ends of the channels forming the box beams $42$ and $43$ are welded and thus the box beams provide air conduits, for a purpose to be explained. It may be noted that the webs of channels $49$ and $50$ have openings $52$ and $53$ (see Figs. 2 and 4) and the webs of channels $46$ and $50$ have openings $54$ and $55$. These provide air ports from the box beams into the stoker air chamber $56$. The box beams are carried on the wall of the furnace, it being noted that the ends $57$ and $58$ are closed while the other ends $59$ and $60$ connect with an air port $62$ which in turn connects with air conduit $63$. If desired, the arrangement may be such that air is admitted at both ends of the box beams, particularly in large furnaces.

As shown in Fig. 5, air port $62$ is provided with an adjustable damper $63$ to regulate the amount of air passing from conduit $10$ into the box beam air conduits $42$ and $43$. In addition to air port $62$ there is provided another air port $64$ above it and connecting the air conduit $16$ to the ash pit $65$ below the grate $H$. Port $64$ is provided with an adjustable damper $66$ to regulate the amount of air passing through this port.

Resting upon the structural members $K$ is a cylindrical shroud $3$ (see Fig. 2), the brackets $24$ are supported to support the inner ends of the T bars $21$ (see Fig. 2). This casting $25$ together with the structural members and a bottom plate $70$ provide a stoker air chamber $56$. At the lower end of casting $25$ is a plate $67$ having an opening $68$ in its center. It closes the gap between the outside of cylindrical casting $25$ and the tops of the box beams $42$ and $43$. The upper end of the casting $25$ has an outwardly extending annular flange or shoulder $71$ in which is a race to support ball bearings $72$.

Mounted within the cylindrical casting $25$ and resting upon cover plate $70$ is a stationary hollow center post $73$ formed in two half sections; an upper section $75$ and a lower section $74$ kept in vertical alignment by an internal telescoping hollow neck $76$. At the top end of the neck $76$ is a round clamping plate $77$ and at the bottom a round clamping plate $78$. The bottom plate $78$ is welded to the lower section $74$ of the center post. The welding is done as shown at $81$ and $82$ (see Fig. 7) by providing small holes in the wall of the center post $73$. The clamping bolt $78$ which extends through the plates is drawn tight by nut $86$.

The stoker $F$ is rotatably mounted on the stationary center post $73$. As shown in Fig. 2 a hollow sleeve $83$ rotates about the post. The sleeve $83$ is provided with bearing surfaces $84$ and $85$ on the inside. At its lower end the sleeve is provided with a flange $86$ (see Fig. 2) to which is secured, as by bolts $87$, a bevel gear ring $88$. Cast or otherwise secured to the sleeve $83$ at its upper end are a plurality of radially extending webs $89$ to which is securely mounted an L-shaped ring $90$. This ring and its webs may conveniently be referred to as a spider ring. The vertical portion of this ring $99$ extends into the cylindrical stoker air chamber and support casting $25$ and the horizontal portion overlies and is secured to a bearing ring $95$ which rotates on the ball bearings $72$. Consequently, the overlying weight of the stoker is carried by the webs of the spider ring $99$.

Securely mounted on the spider ring $99$ is a rotatable hollow stoker hub $91$ of generally dome shape having an opening $92$ at the bottom and an opening $93$ at its top. The hollow stoker hub $91$ is provided with a plurality of outward extending hollow webs $94$ as shown. As shown, there are three rearwardly curved stoker arms, each of which is hinged at its inner end to the stoker hub $91$ and they are arranged to sweep over the hearth.
E as the stoker is rotated on its vertical axis. The hinged joints are arranged to permit of limited vertical movement of the arms. The hollow interiors of the stoker arms communicate with the hollow interior of the rotatable stoker hub.

The hinged joints of each arm rotate face 95 rearwardly curved and rearwardly inclined from bottom to top (see Fig. 7), a substantially flat top wall 96, and a trailing substantially vertical wall 97. It may be noted the top wall 96 extends a little over the vertical trailing wall 95 without providing any space to keep particles from falling into the air ports 99 along the top of the trailing wall.

The inner ends of the stoker arms have a neck portion 100 fitting into a complementary collar portion 101 on the stoker hub. The neck portion of each stoker arm is hinged to a collar portion of the stoker hub so that the arm will have a limited hinged or pivoted movement in a vertical direction. As shown, the collar portions 101 are cast to the stoker hub and extend outwardly in a radial direction from its surface. The vertical side walls 102 and 103 of the collar portion and the vertical side walls 104 and 105 of the neck portion of the stoker arm are provided with registering apertures to accommodate a hollow hinge pin 106 fastened in place by stop nuts 107 and 108. The hollow hinge pins 105 are provided with air ports 109, the better to keep the pins cool.

The upper wall 110 of the hub collars 101 extends outwardly over the top wall 111 of the necks of the arms to provide a protecting case 112 (see Fig. 2 and a depending shoulder 115 limits the amount of angular rotation of the arm in an upward direction about the pivot pin 106. Also the bottom wall 114 of a collar provides a shoulder 115 serving as a stop to limit the downward movement of the arm. The stops are arranged so that normally the arms rotate about the vertical axis of the stoker with the bottom wall slightly above the hearth E and so that the outer end of the stoker arm can rise a distance of the order of an inch or so.

Mounted on the center post 73 and above the rotating stoker hub is a plurality of superimposed truncated domes progressively smaller in diameter from bottom to top and open at both ends. Truncated dome 120 is carried on radial webs 121 secured to a ring 122 which rests upon a flange 123 secured to the center post. The lower peripheral edge of this dome overhangs the top opening 93 of the stoker hub and provides an annular air port 124 from the interior of the dome to a pile of rubbish overlying the stoker. Another similar but smaller truncated dome 125 is likewise mounted on the center post above the lower dome 120 and provides an annular air port 125 from the interior of the dome. The two truncated domes 120 and 125 are surmounted by a dome-shaped cap 127 provided with webs 129 shaped to set into the hollow center post. This cap 127 is held in place by the center post 73. Thus the domes 120, 125 and the cap 127, as shown, provide a stationary tuyère head which for convenience is herein designated as a "Christmas tree" tuyère head.

To regulate the relative amounts of air passing to the tuyère head and to the hollow stoker arms a baffle 116 in the shape of an inverted truncated hollow cone is mounted in central opening 93 of the stoker hub. It is mounted on the center post 73 by means of a bracket 117. It may be noted that this baffle 116 extends down into the stoker air chamber 56.

Mechanism is provided to rotate the stoker F about its vertical axis. It comprises a bevel pinion 130 meshing with the bevel gear ring 88 and keyed to the end of a rotatable drive shaft 131 (see Figs. 2 and 6). The drive shaft is housed in bearing 132 mounted in the webs of the structural beams K and a bearing 133 outside the wall of the furnace. The drive shaft 131 is driven by a motor 134 (see Figs. 3 and 4) connected by a belt 135 to a pulley 136 of a speed reducer 137, the driven shaft of which provides a coupling 138 of the shearing type to the drive shaft 131.

In the operation of the furnace it may be assumed that a pile of rubbish (indicated at 140) is charged through the charging port 14 into the firebox 29 and over lies the stoker and hearth as generally indicated in Fig. 1. The rubbish is ignited and the furnace ultimately brought up to temperature and additional rubbish is charged from time to time. The stoker F is put into operation. Air is passed through the air heater J and travels through conduit 15. The dampers 63 and 66 are adjusted to regulate the relative amounts of air which pass into stoker air chamber 55 and to the ash pit 12. As the incineration or burning of the rubbish proceeds hot combustion gases pass through flue E to combustion chamber C where any unburned gas is burned. A part of the air which is introduced into the stoker air chamber 55 passes outside the baffle 116 into the hollow rotating stoker hub 91 and thence out through the hollow arms 94 and finally through air ports 95 into the pile of rubbish B and then toward the hearth. A part of the air introduced into the stoker air chamber 55 passes up through the interior of the baffle 116 into the hollow tuyère head G. The air passing into the tuyère head then passes out through the annular air ports 124, 125 and 129 (see Figs. 5 and 7) into the pile of rubbish B. The heated air passing into the rubbish helps in drying it out and also aids combustion. Upon rotation of the stoker arms about the vertical axis of the stoker hub the pile of rubbish is rabbed or stoked and is gradually moved outwardly toward the periphery of the annular hearth E. Burning of the rubbish is completed on the grate H through which air passes upwardly from the ash pit 12. It may be noted that the air passing through conduit 15 is heated by the hot combustion gases passing through flue D around the tubes of the air heater J. The combustion gases then pass to a chimney (not shown). Ashes fall through the grate into the ash pit or hopper 12 and may be removed from time to time through the discharge chute 16. The spiral grooves on the surface of the hearth E assist in directing particles of rubbish outwardly to prevent them from tending to stay in a fixed location on the hearth. Also, if the particles of rubbish on the hearth tend to lodge beneath the stoker arms thus exerting a force upwardly, strain on the stoker mechanism is relieved by reason of the hinged stoker arms which will more readily ride over any particles which tend to become lodged upon the hearth. This is an advantage in relieving undue strains upon the driving mechanism of the stoker.

The illustrative embodiment shown in the drawings includes an ash hopper but it will be understood that a furnace may be constructed in accordance with other features of the invention where no ash hopper is provided. In such a case the stoker mechanism need not be supported on box beams extending into the walls but may be supported on the concrete serving as the bottom...
of the ash pit and air conduits of less strength may be utilized to carry air to the stoker. The terms and expressions which have been employed herein are used as terms of description and not of limitation and there is no intention in the use of such terms and expressions of excluding any equivalent of the features shown and described or portions thereof, but it is recognized that various modifications are possible within the scope of invention claimed.

1. An incinerator furnace for burning rubbish and the like which comprises a firebox, an annular hearth having a central opening in the lower part of the firebox, a grate surrounding said hearth, a rotatable stoker having a vertical shaft through said central opening and outwardly extending arms sweeping over the surface of said hearth upon rotation of said stoker about its vertical axis, said hearth having outwardly extending channels spaced circumferentially over substantially its entire area to direct particles of rubbish on the hearth toward its periphery as said arms sweep over the hearth.

2. An incinerator furnace for burning rubbish and the like which comprises a firebox, an annular hearth having a central opening in the lower part of the firebox, a grate surrounding said hearth, a rotatable stoker having a vertical shaft through said central opening and outwardly extending arms sweeping over the surface of said hearth upon rotation of said stoker about its vertical axis, said hearth surface having a continuous series of circumferentially spaced, outwardly extending, spiral ribs providing channels therebetween to direct particles of rubbish on the hearth toward its periphery as said arms sweep over the hearth.

3. An incinerator furnace for burning rubbish and the like which comprises a firebox, an annular hearth having a central opening in the lower part of the firebox, a grate surrounding said hearth, a rotatable stoker having a hollow hub member for supporting outwardly extending stoker arms and a vertical shaft through said central opening, said hub member having outwardly extending hollow arms sweeping over the surface of said hearth upon rotation of said stoker about its vertical axis, said hearth surface having outwardly extending channels to direct particles of rubbish on the hearth toward its periphery as said arms sweep over the hearth and hinging means connecting said arms to said hub member to permit of limited vertical movement of said arms, said hinging means including a hollow member providing passageway from said hollow hub for the passage of air therethrough to the interior of said arms.

4. An incinerator furnace for burning rubbish and the like which comprises a firebox, an annular hearth having a central opening in the lower part of the firebox, a grate surrounding said hearth, a rotatable stoker having a hollow hub member for supporting stoker arms, a vertical shaft through said central opening, said hub member having outwardly extending hollow stoker arms sweeping over the surface of said hearth upon rotation of said stoker about its vertical axis, said hearth surface having a continuous series of outwardly directed, circumferentially spaced, spiral ribs extending from said central opening to the periphery of said hearth and hinged connections securing the inner ends of said stoker arms to said hub member to permit of limited vertical movement of said arms, each of said hinged connections including hollow mem-
bers secured to said hub providing passageway for air from the interior of said hub into its adjacent hollow arm.

5. An incinerator apparatus for burning rubbish wherein a firebox, an annular hearth in said firebox having a central opening, an annular grate at the periphery of said hearth, said hearth having raised ribs extending from said central opening to its periphery, a hollow rotatable stoker hub, hollow arms each having a hinged connection to said stoker hub for forming a pile of rubbish on said hearth and having air ports, a hollow sleeve connected to said stoker hub, a normally closed ash pit below said grate, a hollow tuyère head surmounting said rotatable stoker hub, power means to rotate said sleeve whereby to rotate said stoker hub on its vertical axis together with said arms, means for supplying a stream of air to said grate, means including a conduit for supplying a stream of air to said stoker hub and tuyère head, each of said hinged connections comprising a hollow collar on said hub and a hollow neck on the arms protruding into said collar, and a hollow pin pivotally connecting said collar and neck permitting of limited vertical movement of said arms, a bevel pinion secured to said sleeve, a rotatable shaft, a bevel pinion connected to said rotatable shaft, said bevel pinion having a ring gear and means to rotate said shaft whereby to rotate said stoker, each of said collars providing passageway for air from said hub to its connected arm and each of said pins providing passageway for air for cooling the pin.

6. An incinerator furnace for burning rubbish and the like which comprises a firebox, an annular hearth having a central opening in said firebox, a grate surrounding said hearth, and a stoker and tuyère device, said stoker and tuyère device comprising a rotatable hollow truncated cone shaped hub having an opening at its bottom and an opening at its top, hollow stoker arms adapted to sweep over the surface of said hearth secured to said rotatable hub and extending outwardly therefrom and having air ports in their walls, a plurality of hollow members circumferentially spaced about said hub providing means for pivotally connecting said arms, each of said arms having a neck portion pivotally connected to one of said hollow members so that the interiors of said arms communicate with the interior of said rotatable hub and so that each arm has limited vertical movement about its pivot, a rotatable hollow sleeve secured to and depending from said rotatable hub, a stationary hollow casting surrounding said rotatable sleeve providing a wall for a stoker air chamber and providing a bearing surface for said stoker hub, said rotatable sleeve extending downwardly through said stationary hollow casting, a stationary post extending upwardly through said sleeve, a plurality of stationary superimposed truncated hollow domes carried by said post, each having an opening at its bottom and top and surmounting said rotatable hub, and a stationary capping dome closed at its top crowning said stationary truncated domes, said stationary domes being vertically spaced to provide air ports at their peripheral edges through which to pass air into rubbish piled on said hearth, and means including a prime mover to rotate said sleeve and stoker hub.

7. An incinerator furnace for burning rubbish and the like, which comprises a firebox, an annular hearth having a central opening in said firebox, a grate surrounding said hearth, and a stoker and tuyère device, said stoker comprising a rotat-
able hollow truncated dome-shaped hub having an opening at its bottom and an opening at its top, hollow stoker arms adapted to sweep over the surface of said hearth secured to said rotatable hub and extending outwardly therefrom and having air ports in their walls, a plurality of radially extending hollow collars secured to and circumferentially spaced about said hub providing means for pivotally connecting said arms each of said arms having a neck portion extending into an adjacent collar, a pivot pin for each arm pivotally mounting it on its adjacent collar for vertical movement so that the interiors of said arms communicate with the interior of said rotatable hub, a rotatable hollow sleeve secured to and depending from said rotatable hub, a stationary hollow casting surrounding said rotatable sleeve providing a wall of a stoker air chamber and providing a bearing surface at its upper end for said stoker hub and also providing a support for said hearth, said rotatable sleeve extending downwardly through said stationary hollow casting, a stationary center post extending upwardly through said hollow, a plurality of stationary superimposed truncated hollow domes carried by said post, each having an opening at its bottom and top and surmounting said rotatable hub, and a stationary capping dome closed at its top crowning said stationary truncated domes, said stationary domes being vertically spaced to provide air ports at their peripheral edges through which to pass air into rubbish piled on said hearth, means including a prime mover to rotate said sleeve and stoker hub, structural members to support said stationary casting and providing an air conduit to said stoker air chamber, and means to support said stationary center post.

8. An incinerator apparatus for burning rubbish which comprises a firebox, an annular horizontally disposed hearth in said firebox and having a central opening, an annular grate at the periphery of said hearth, a dome-shaped hollow rotatable stoker hub, a plurality of rectangular-shaped hollow collars radially disposed and circumferentially spaced on said hub and providing a passageway for air from the interior of said hub, a hollow stoker arm extending in a radial direction from each of said collars, each stoker arm having a rectangular-shaped hollow neck portion snugly and slidably fitting in its adjacent collar and providing a passageway for air into said arm, a pivot pin on each of said collars mounting each of said neck portions for vertical movement of said arms about said pivots, each of said collars having a portion extending over the neck portion of its adjacent arm providing an eave preventing particles of overlying rubbish from entering into said hub and arms and each of said collars having a portion engageable with its adjacent arm providing a stop limiting the amount of upward movement of said arms when swung upwardly on their pivots, a hollow sleeve connected to said stoker hub and extending down through said central opening, a hollow tuyère head surmounting said rotatable hub, power means to rotate said sleeve whereby to rotate said stoker hub on its vertical axis together with said arms, means for supplying a stream of air to said grate and means including a conduit for supplying a stream of air to said stoker hub and tuyère head.

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