

[54] **BURNER HAVING MEANS INCLUDING UNDERFIRE AIR MEANS FOR ELIMINATING SMOKE**

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[22] Filed: Apr. 13, 1970

[21] Appl. No.: 27,576

[57] **ABSTRACT**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 828,113, May 26, 1969.

[52] U.S. Cl.....110/7 A, 110/18 R, 110/75 R

[51] Int. Cl.....F23g 7/00

[58] Field of Search110/7, 8, 18, 75, 75 C, 182.5

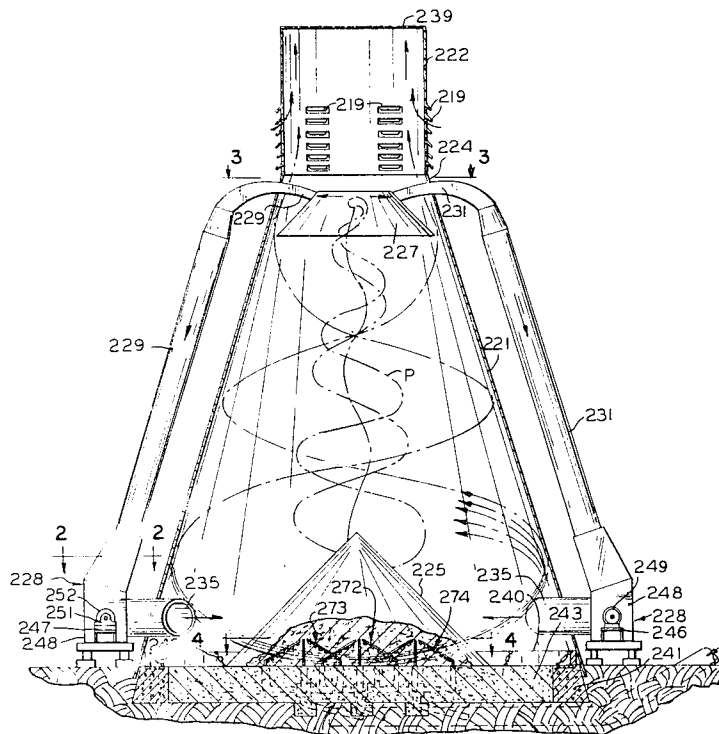
Tepee burners having means for concentrating, collecting and reintroducing unburned particles are provided with underfire air systems which uniformly distribute air to the fire piles. An early underfire air system (FIG. 1) includes inclined pipe sections having downwardly directed nozzle tubes. A later underfire air system (FIG. 10) includes nozzles having partially embedded, slotted burner pots and caplike grates having diffuser plates setting in the slots in the pots. A latest underfire air system (FIGS. 16 and 18) includes partially embedded burner pots and caps having radial nozzles positioned on the pots. The means for concentrating, collecting and reintroducing the unburned particles include crown collectors from which ducts lead to blowers which draw the unburned particles and gases from the collectors and blow them with ambient air chordally into the burners so as to aid the coriolis effect, one of the burners (FIGS. 13-15) having adjustable blower outlet nozzles.

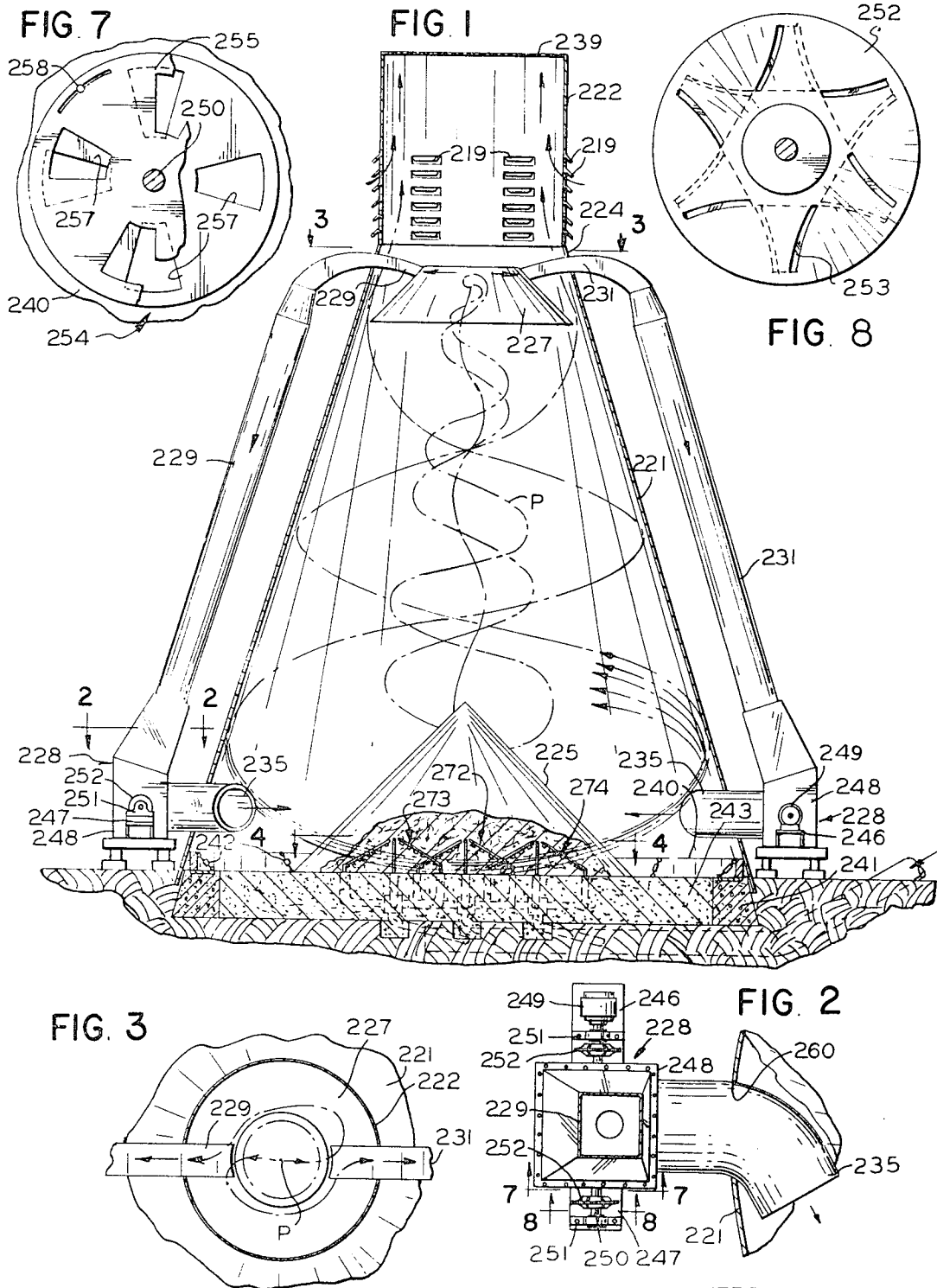
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11 Claims, 20 Drawing Figures





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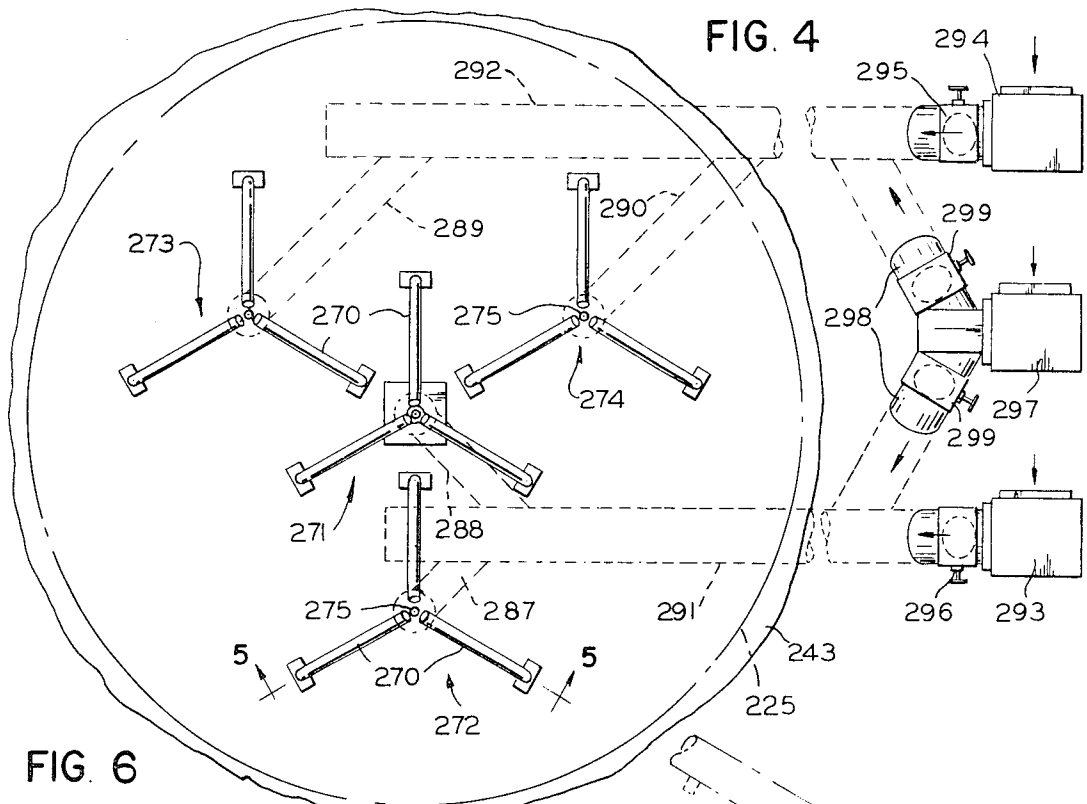


FIG. 6

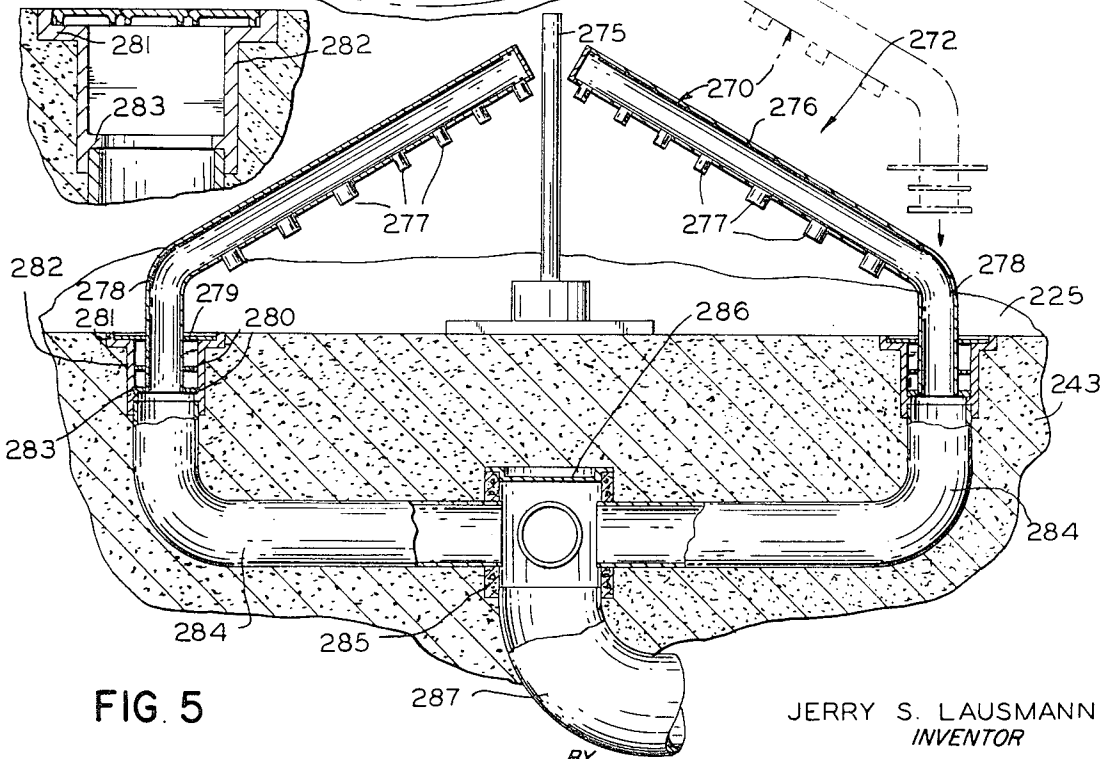
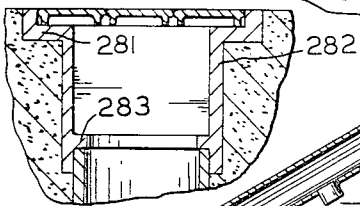


FIG. 5

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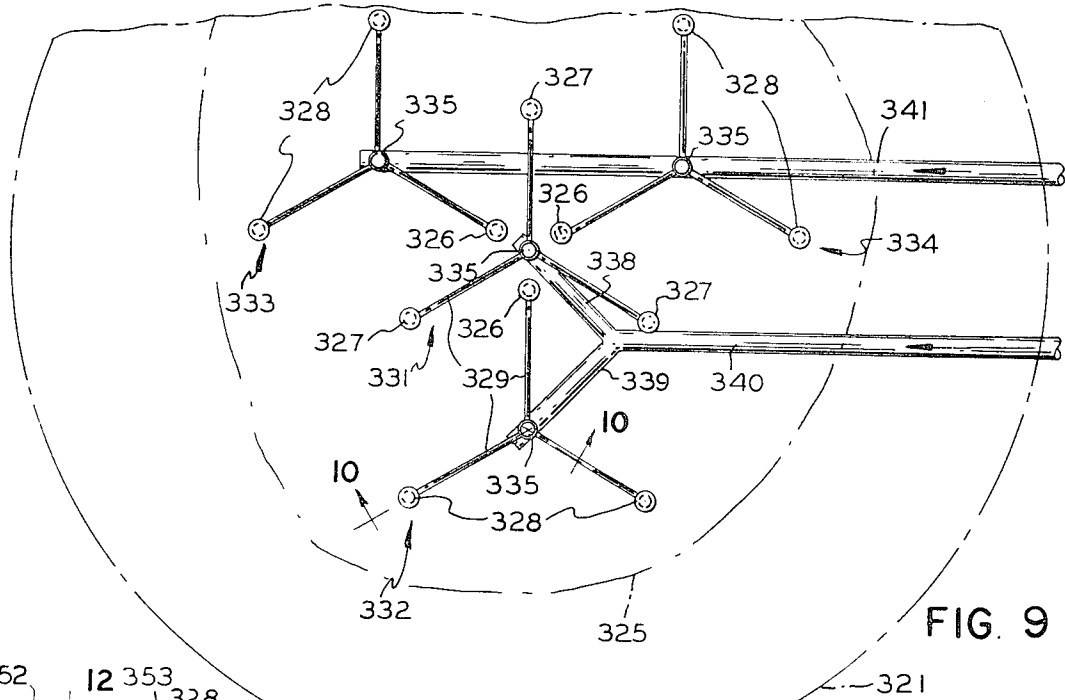


FIG. 9

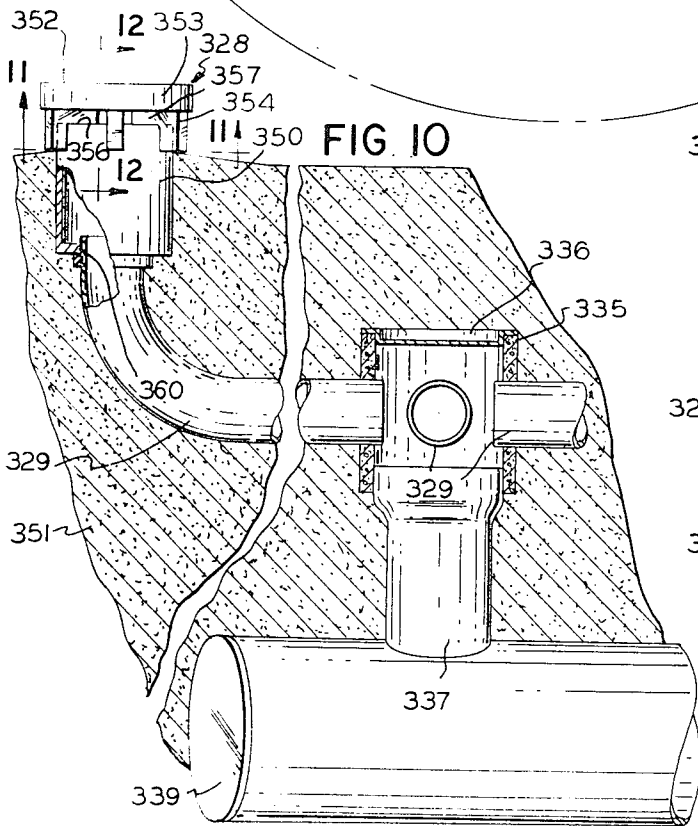


FIG. 10

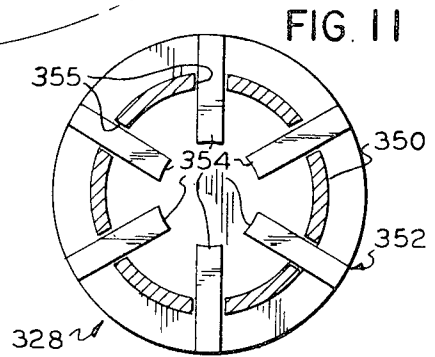


FIG. 11

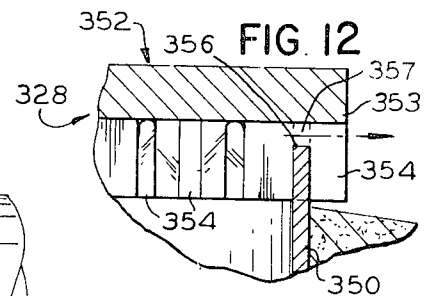


FIG. 12

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FIG. 17

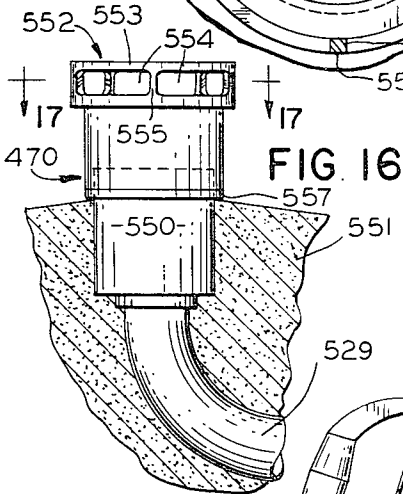
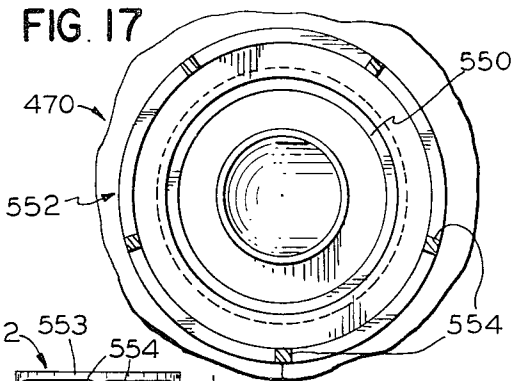


FIG. 16

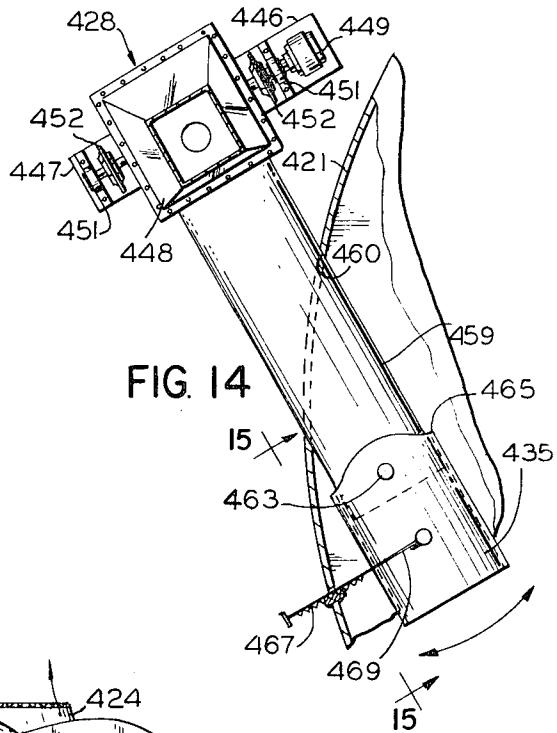


FIG. 14

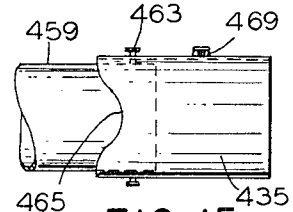
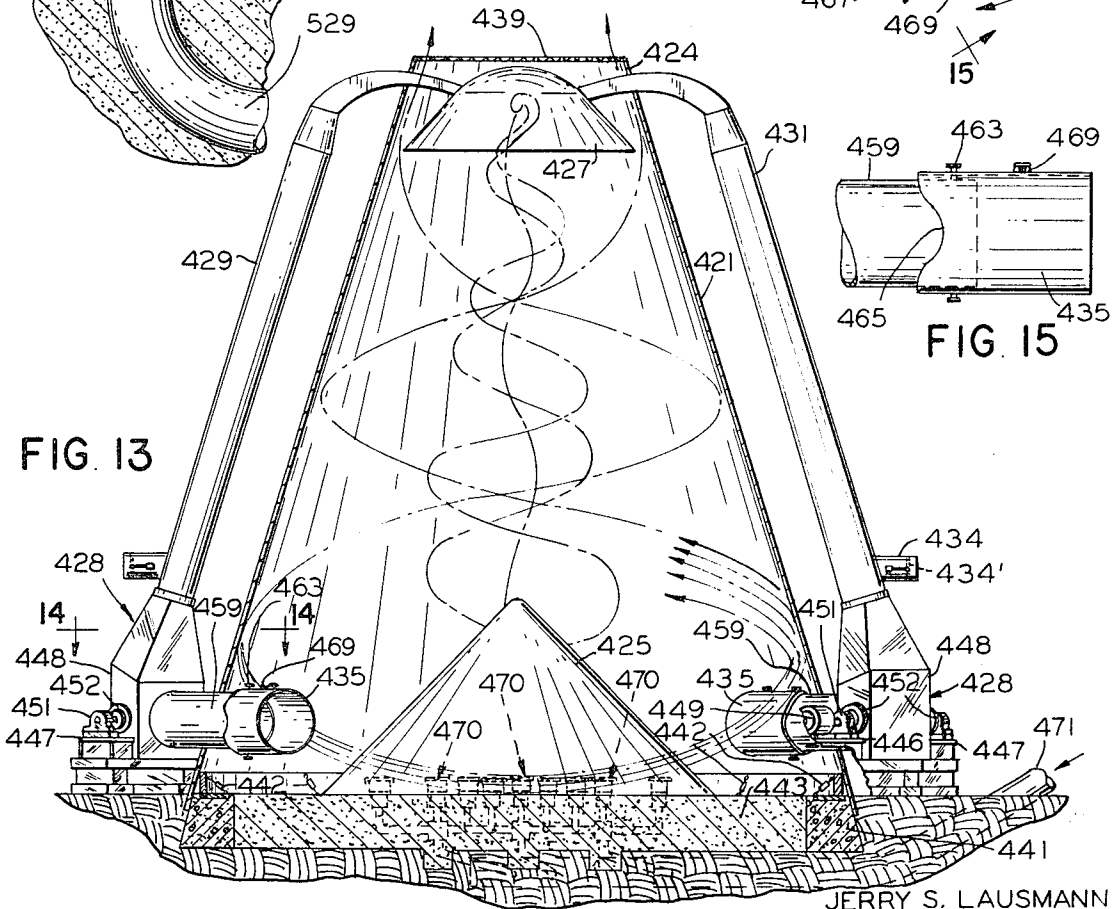


FIG. 15

FIG. 13



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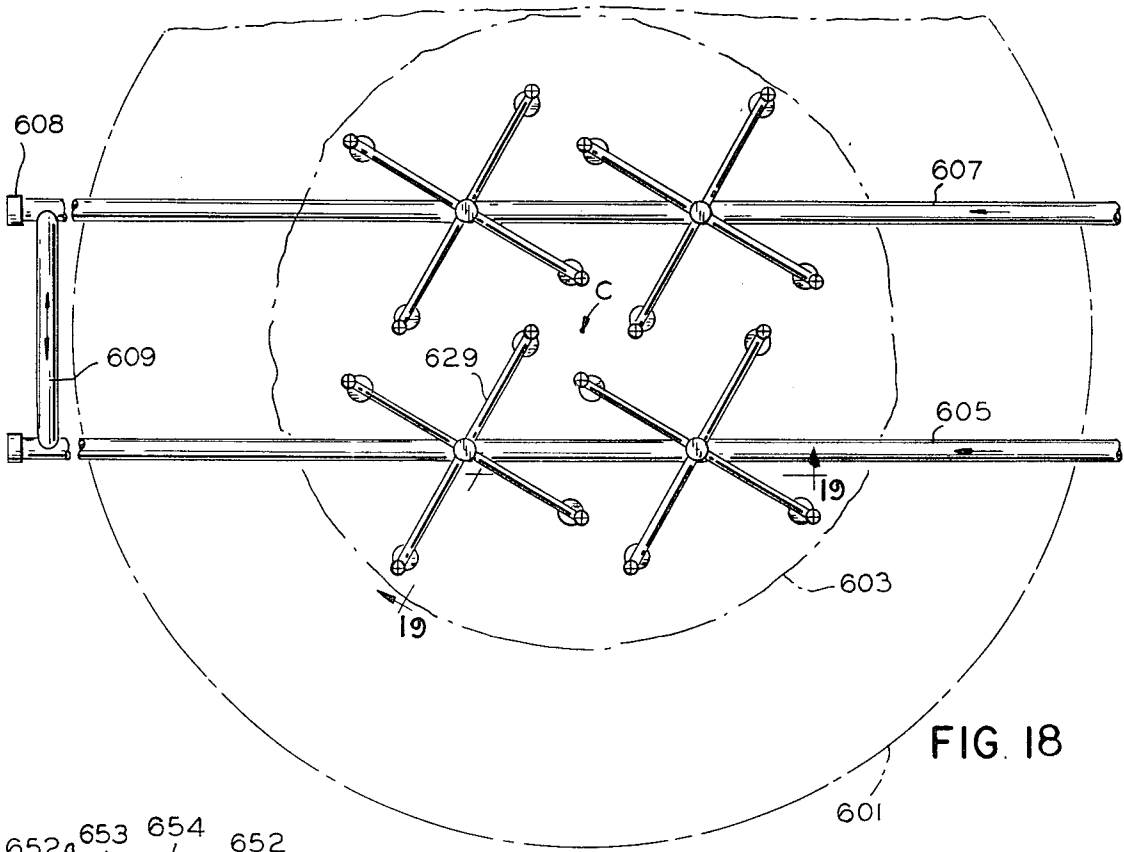


FIG. 18

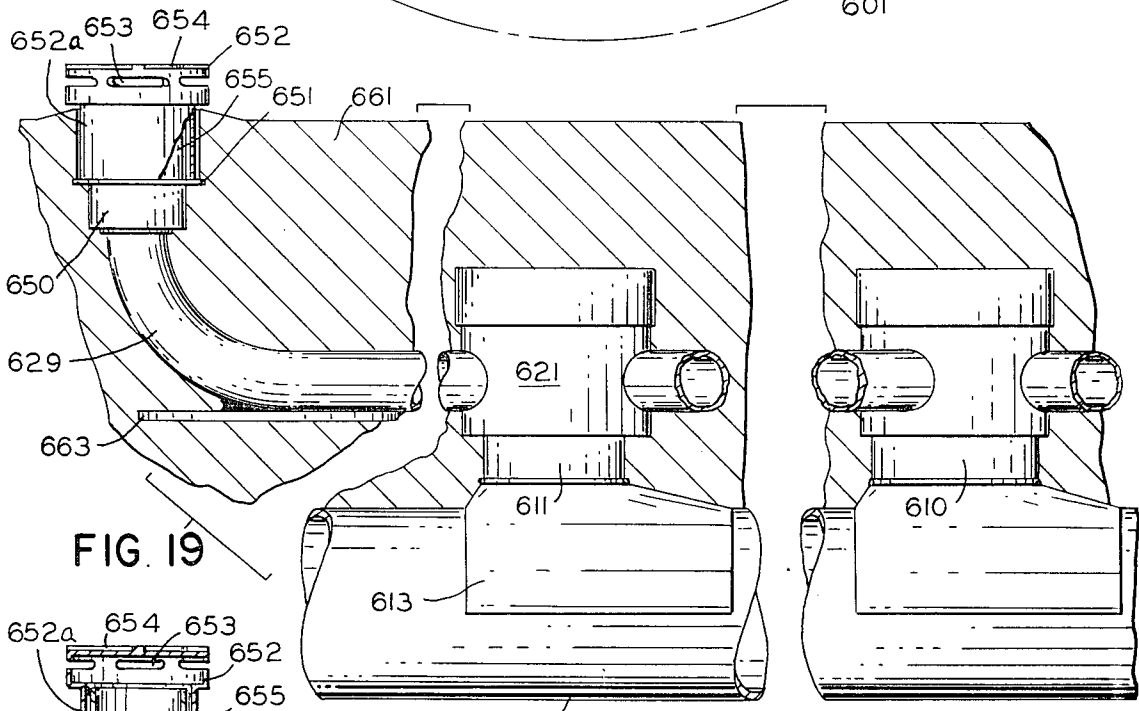


FIG. 19

FIG. 20

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BURNER HAVING MEANS INCLUDING UNDERFIRE AIR MEANS FOR ELIMINATING SMOKE

This invention is a continuation-in-part of my copending application, Ser. No. 828,113, filed May 26, 1969.

DESCRIPTION

This invention relates to underfire air systems for waste burners, and more particularly to nonclogging underfire air systems for tepee burners.

Underfire air systems for tepee or wigwam burners known hitherto have tended to form clinkers, clog, form hot spots and burn out, or tend to blow holes through the pile. It would be desirable to provide underfire air systems which would not form clinkers, clog, form hot spots or burn out, and which also would not interfere with cleaning out the burners, and which is adapted for providing a significant volume of underfire air at relatively low pressure and so widely distributed as to avoid blowing holes through the fire pile.

The invention will be explained in connection with the accompanying drawings, wherein:

FIG. 1 is a vertical sectional view of a burner including an underfire air system forming an early embodiment of the invention;

FIG. 2 is an enlarged horizontal sectional view taken along line 2—2 of FIG. 1;

FIG. 3 is a horizontal sectional view taken along line 3—3 of FIG. 1;

FIG. 4 is an enlarged diagrammatic view taken along line 4—4 of FIG. 1;

FIG. 5 is an enlarged, fragmentary, vertical sectional view taken along line 5—5 of FIG. 4;

FIG. 6 is a view of a portion of FIG. 5 showing a pipe section temporarily replaced by a grate;

FIG. 7 is an enlarged, vertical sectional view taken along line 7—7 of FIG. 2;

FIG. 8 is an enlarged, vertical sectional view taken along line 8—8 of FIG. 2;

FIG. 9 is a fragmentary, diagrammatic, top plan view of a burner including an underfire air system forming a later embodiment of the invention;

FIG. 10 is an enlarged, fragmentary, vertical sectional view taken along line 10—10 of FIG. 9;

FIG. 11 is an enlarged, horizontal sectional view taken along line 11—11 of FIG. 10;

FIG. 12 is an enlarged, fragmentary, vertical sectional view taken along line 12—12 of FIG. 10;

FIG. 13 is a vertical sectional view of a burner including an underfire air system forming a still later embodiment of the invention;

FIG. 14 is an enlarged horizontal sectional view taken along line 14—14 of FIG. 13;

FIG. 15 is an enlarged, fragmentary elevational view taken along line 15—15 of FIG. 14;

FIG. 16 is an enlarged vertical sectional view of a portion of the burner of FIG. 13;

FIG. 17 is an enlarged horizontal sectional view taken along line 17—17 of FIG. 16;

FIG. 18 is a fragmentary, somewhat diagrammatic, plan view of a still later form of underfire system;

FIG. 19 is an enlarged fragmentary vertical section taken generally along line 19—19 of FIG. 18; and

FIG. 20 is a vertical section through a diffuser cap.

In order to make it easier to understand the functioning and operation of the underfire air systems and adjustable recirculating nozzles, the general designs of the tepee burners are described also.

EARLY EMBODIMENT (FIGS. 1 to 8)

A tepee or wigwam burner shown in FIGS. 1 to 8 includes a frustoconical shell or housing 221 of the usual form, to the outlet 224 of which is secured a stack 222 having six rows of downwardly and outwardly sloping louvres 219 positioned in the lower portion of the stack. A pile 225 of waste products,

such as wood waste, is burned and produces products of combustion which rise upwardly from the pile. Ambient air from the atmosphere outside the burner and particle laden gases to be recirculated are blown tangentially or chordally into the housing through nozzles 235 by blowers 228 which direct the air and gases chordally relative to the housing as best shown in FIGS. 1 and 2 in a generally counterclockwise direction in the housing when viewed from the top.

The particle laden gases are taken from an axial or central column of particle laden gases P by a frustoconical, crown collector 227 supported by ductwork legs 229 and 231 leading to the inlets of the blowers 228, which also draw in ambient air. The mixture of ambient air and particle laden gases is thus injected into the peripheral portions of the flames from the pile 225 to complete combustion of the particles and add oxygen to the fire.

The chordal or generally tangential injections from the nozzles aid or reinforce the natural coriolis effect and cause the heated gases from the fire and those introduced by the nozzles 235 to swirl around an upwardly in multiconvolution spirals to transfer substantial portions of the heat thereof to the housing to heat all portions of the housing substantially uniformly to prevent formation of hot spots. The housing thus dissipates the heat by convection and radiation. This keeps the temperatures of the gases discharged from the burner through the stack 222 quite low. The stack 222 may have a fire screen 239 (if required by authorities) at the discharge end thereof. The stack preferably intensifies the draft and increases the intensity of the burning. While the stack and screen are shown as part of the burner structure, it has been found that neither is necessary in most burner installations.

The lower portion of the housing is secured to arcuate angle members 240 (FIG. 1), which are secured in circular form to a circular concrete base 241 by turnbuckles 242. The base 241 confines a bed 243 of rock which may be decomposed granite.

The blowers 228, except as brought out below, are substantially the same as the blowers 28 disclosed in the above-mentioned copending application, Ser. No. 828,113. The blowers 228 and ducts 229 and 231 are supported by stools, and each blower includes shelves 246 and 247 fixed to blower housings 248. The shelves support motors 249 driving impellers of which shafts 250 extend through the blower housings driving impeller blades (not shown) in the blower housings. The shafts 250 are journaled in outboard, pillow block bearings 251 mounted on the shelves, and heat slingers 252 keyed to the shafts 250 are positioned between the bearings 251 and the housing 221 to shield the bearings from the heat.

The slingers have helical air impelling slots 253 (FIG. 8) and act as fans to draw ambient air from the bearings and impel it toward dampers 254 (FIG. 7) in the walls of the blower housings 248. The slingers taper from thick at the hubs thereof to thin at the outer peripheries thereof. Each damper 254 (FIG. 7) allows the ambient air to be drawn into the housing 248 by the impeller member in the housing and includes a closure disc 255 having openings and rotatable on the shaft 250. The disc 255 is adapted to be turned on the shaft to vary as desired the extent that the openings overlap or register with openings 257 in the adjacent wall of the housing 248. A headed pin 258 extends through an arcuate slot in the disc 255 and is releasably secured to the wall of the housing 248 to normally lock the disc to the housing in a selected position of adjustment.

The nozzles 235 (FIGS. 1 and 2) are angular sections of pipes or ducts having flanges (not shown) releasably bolted to the housings 248 and extending loosely through openings 260 in the shell 221 and in position in which the axes of the nozzles lie in a horizontal plane. The nozzles may be straight rather than angular and the blowers 228 turned to positions in which the nozzles extend chordally into the shell 221, like the discharge portions of the angular nozzles 235 do.

To further increase the intensity, rate and completeness of combustion of the pile 225, an underfire system forming an early embodiment of the invention is provided in the burner.

The purpose of the system is to provide low-pressure air in substantial volume to the fire pile, at places distributed over the area of the pile, whereby to avoid blow holes in the pile, yet supply sufficient air to maintain combustion, without significantly raising the pressure of the low-pressure zone at the central column of the rising gases.

The underfire system includes tripod or triad grouped nozzles 270 (FIGS. 1 and 5-7) arranged in groups 271, 272, 273 and 274 around stanchions 275.

Each nozzle includes a straight, inclined pipe section 276 having downwardly directed nozzle or orifice outlet tubes 277 on the underside thereof of progressively decreasing cross-sectional area proceeding upwardly along the pipe section. The pipe sections 276 are supported by vertical portions 278 having secured thereto caps 279 and spacer discs 280. The caps 279 fit into dished flange portions 281 of sock members 282, and the lower discs 280 bear on collars 283 resting on the ends of angular distributing pipes 284 secured to cylindrical couplings 285 having end caps 286 and supplied with air from branch pipes 287, 288, 289 and 290 (FIG. 4) leading to headers 291 and 292. Blowers 293 and 294 having adjustable valves 295 and 296 blow ambient air into the headers and to and through the nozzles 270, and a booster blower 297 is connected by ducts 298 and adjustable valves 299 to add further ambient air to either, both or neither of the headers when and if necessary. The ducts 287 and 288 are of the same diameter to supply equal quantities of air to the groups 271 and 272, and equal quantities of air are supplied to the groups 273 and 274. The nozzles 270, stanchions 275 and caps 279 are of high-melting point materials, such as, for example, stainless steel, titanium, ceramic or ceramic coated material.

The effective diameter of the collector 227 is that of the lower edge portion of the collector, and, for most efficient operation of the burner, the effective diameter of the collector should be a major portion of the diameter of the portion of the housing or shell 221 at the same level as the lower edge of the collector. The gases passing to the outside of the collector travel on up and out of the burner these gases containing little or no particles not fully oxidized.

The gases P (FIG. 1) in the axial column and containing particles not fully oxidized travel upwardly into the collector and these particles and substantially all the gases carrying these particles are drawn into the ducts 229 and 231 and are injected chordally or substantially tangentially into the outer peripheral portions of the flames of the pile 225 to complete the combustion of the particles, additional air being drawn into the particle laden gases through the dampers 254.

The shell 221 has a service door (not shown) and a charging door (not shown) therein like those of the shell 21. While not included as shown, the shell 221 also may have overfire air doors like the overfire doors of the burner of said copending application, Ser. No. 828,113, if desired. The collector 227, the ducts 229 and 231 and the blowers 228 may be installed in existing tepee burners to greatly improve the efficiency thereof. This also is true of the underfire air systems of FIGS. 1 and 4 to 6.

LATER EMBODIMENT (FIGS. 9-12)

The burner of FIGS. 9-12 having an underfire air system forming a later embodiment of the invention, is like the burner of FIGS. 1-8 except for the underfire air system. The burner burns a pile outlined at 325 in FIG. 9, and includes underfire burners or nozzles 326, 327 and 328 arranged in groups 331, 332, 333 and 334 of three nozzles each. Each group receives air from its own manifold, each nozzle being connected by a pipe 329 to a distributor or manifold cylinder 335 covered by a cap 336 and supplied by a vertical pipe or riser 337. The pipes 337 which lead to the groups 371 and 332 are connected to branch ducts 338 and 339 leading from a header 340 from a blower (not shown) taking ambient air from outside the burner. The pipes 337 leading to the groups 333 and 334 are connected directly to a header 341 from a blower (not shown) taking in ambient air from outside the burner.

Each nozzle 326, 327 and 328 includes a burner pot 350 partially embedded in a bed 351 of decomposed granite or like material, and also includes a caplike diffuser 352. Each diffuser 352 includes an imperforate cap or disc 353 of a greater diameter than the outside diameter of the pot 350 and six radial diffuser or spacer plates or legs 354 integral with the cap. The pots and diffusers preferably are of a high-melting point metal, such as, for example, cast iron containing a higher than usual percentage of nickel. The spacer plates are in equiangular positions 60° apart and fit slightly loosely into upwardly opening vertical slots 355 (FIG. 11) in the pots 350. Each cap 353 defines, with the sides of the plates 354 and top edge 356 of the pot 350, horizontally directed orifices 357 for passage of the air into the pile 325. The slots and the plates hold the gate substantially centered on the pot.

The effective size of the orifices of each of the nozzles 326, 327 and 328 is determined by the spacing between the top 356 of the pot 350 and the bottom of the cap 353, which spacing is determined by the depth of the slots 355. To achieve optimum distribution of the underfire air to the pile, each orifice of the nozzles 326 is made substantially smaller than each orifice of the nozzles 327 and each orifice of the nozzles 327 is made substantially smaller than each orifice of the nozzles 328. This is accomplished by making the depth of each slot 355 in the pots 350 of the nozzles 326 less than the depth of each slot in the pots of the nozzles 327 and making the depth of each slot of the pots of the nozzles 327 less than the depth of each slot in the pots of the nozzles 328. Preferably these depths are made such that the total cross-sectional orifice area of each group of the nozzles 326, 327 and 328 is such relative to that of the other groups of the nozzles that the total flow of air through the nozzles 326 is about three times the total flow through the nozzles 328 and the total flow of air through the nozzles 327 is about twice that of the nozzles 328. The nozzles 326, 327 and 328 lie on concentric circles centered relative to the pipe 335 of nozzles 327, there being three nozzles 326 on the smallest, innermost circle, three nozzles 327 on the intermediate circle and six nozzles 328 on the largest, outermost circle.

Each diffuser 352 is larger in diameter than the pot 350 so that, as best shown in FIG. 11, the cap 353 and the plates 354 project radially beyond the pot to protect the orifices 357 from clogging by clinkers, and, as best shown in FIG. 10, the upper surface of each of the portions of the bed 351 surrounding the pots 350 slopes downwardly away from the pot at an angle of about 10° with the horizontal to disperse slag.

The shell 321 has a service door (not shown) and charging door (not shown) like the shell 221. While not included as shown, the shells 221 and 321 also may have overfire air doors, if desired.

STILL LATER EMBODIMENT (FIGS. 13-17)

A tepee or wigwam burner shown in FIGS. 13 to 17 and forming a still later embodiment of the invention includes a frustoconical shell or housing 421 generally like the shell 221 (FIG. 1).

The shell preferably has overfire doors (not shown) like those in my prior application (previously identified) but the doors may be manually adjustable, and may be adjusted to desired (closed or almost closed) positions and left there for normal burner operation.

A pile 425 of waste products, such as wood waste, is burned and produces products of combustion which rise upwardly from the pile. Ambient air from the atmosphere outside the burner and particle laden gases to be recirculated are blown almost tangentially but somewhat chordally into the housing or shell through nozzles 435 by blowers 428 which direct the air and gases chordally relative to the housing in a generally counterclockwise direction when viewed from the top.

The rising particle laden gases are taken from an axial or central column of particle laden gases by a cupped, partially frustoconical, crown collector 427 supported from the shell by cables (not shown) and inlet portions of ductwork legs 429

and 431 leading from the collector to blowers 428. Preferably the ducts are connected to the collector at the distance from the top of the collector that equals one-third the height of the collector.

The collector 427 and the downstacks or ductwork legs 429 and 431 may be supported independently of the burner shell, such as is shown in my prior pending application entitled "Improved Burner Construction," sent to the Patent Office on Mar. 17, 1970 (our Docket No. 13684). If not, the cables would be anchored to the shell, and the downstacks 429 and 431 would be supported by the burner shell and the ground.

There are no dampers in the downstacks or legs 429 and 431 like those in the aforesaid copending application. However, there are ambient air inlet sections 434 on the downstacks like inlet sections 84 of said prior application. The inlet sections have weighted dampers 434' like dampers 83 of said prior application. The provision of the inlet sections make it unnecessary to provide ambient air inlets on the blowers 428 themselves, and thus the blowers may be of standard construction.

The fire screen 439 (if required) may be provided at the discharge end of the burner shell. The lower portion of the housing or shell 421 is secured to arcuate angle members 440 (FIG. 13), which are secured in circular form to a circular concrete base 441 by turnbuckles 442. The base 441 confines a bed 443 of rock which may be decomposed granite.

The blowers 428 include shelves 446 and 447 fixed to blower housings 448. The shelves support motors 449 driving impellers of which shafts extend through the blower housings driving impeller blades (not shown) in the blower housings. The shafts are journaled in outboard, pillow block bearings 451 mounted on the shelves, and have heat slingers 452.

There are sleeve-like nozzles 435 (FIGs. 14 and 15) comprising sections of pipes or ducts fitting loosely on and pivoted on tubular outlets 459 of the blowers. The outlets 459 extend through openings 460 in the shell 421 and in positions in which the axes of the nozzles lie in a horizontal plane. Each outlet may have an auxiliary burner-like burner 161 of my copending application, Ser. No. 828,113.

Each nozzle 435 fits loosely on the tubular outlet and is pivotal horizontally about aligned pins 463 secured to the tubular outlet. The nozzles have cutout portions 465 (FIG. 15) to permit limited pivoting on the pins 463. Rods 469 (FIG. 14) pivotally connected to the nozzles and having ratchetlike catches 467 extend through holes in the shell and may be pushed or pulled to adjust the nozzles, the ratchetlike catches then being set in engagement with the shell to hold the nozzles in adjusted positions.

Except for the inlets of the ductwork legs which open into the crown collector, the crown collector 427 is imperforate. The crown collector covers a large portion of the horizontal cross-sectional area of the shell at the lever of the lower edge portion of the collector. The lower edge portion of the crown collector has a diameter constituting a major portion of the internal diameter of the shell at the same level as that of the lower edge portion. The crown collector is axially located relative to the shell. The collector is preferably made of sheet metal, and preferably is so cupped as to reflect the heat from the fire pile back to the fire pile in a conelike bundle substantially covering the fire pile and not widely varying in intensity over the entire area of the fire pile. To insure this, the crown collector has a focal point which is spaced sufficiently below (or above) the fire pile, that there are no hot spots created in the fire pile. The crown collector may be somewhat parabolic.

To increase the intensity, rate and completeness of combustion of the pile 425, a very effective underfire system is provided in the burner. The underfire system includes triad grouped nozzles 470 (FIG. 13) which are arranged in groups identical with the arrangement of the nozzles 326, 327 and 238 and similarly supplied with air. Thus there are underfire air blowers (not shown) for two headers, one 471 being shown in FIG. 13. Each blower may have an outlet damper (not

shown) whose position is controlled by a thermostat (not shown) located to detect the temperature of the gases exiting the top of the burner. The arrangement is such that as the outlet temperature rises, the damper is moved toward closed position.

Each nozzle 470 includes a burner pot 550 (FIG. 16) partially embedded in a bed 551 of decomposed granite or like material, and also includes a caplike diffuser 552. Each diffuser 552 includes an imperforate disc 553 of a substantially greater diameter than the outside diameter of the pot 550 and plural radial diffuser slotlike orifices 554 in cylindrical wall 555. A reduced, sleeve-like portion of the diffuser 552 fits loosely over the upper end portion of the pot 550 and rests on a retaining ring 557 (FIG. 16). The pots and diffusers preferably are of a high-melting point metal, such as, for example, cast iron containing a higher than usual percentage of nickel. The upper portion of the diffuser 552 provides a plenum chamber which is larger than the pot 550 and which assures even distribution of air to the orifices 554.

The widths or heights of the slotlike orifices 554 are so different in different parts of the fire pile 425 and the groups of the nozzles 470, so as to provide the same distribution of air to the pile as the distribution effected by the nozzles 326, 327 and 328 as described above.

LATEST EMBODIMENT (FIGS. 18-20)

Referring to FIG. 18, the latest form of underfire system is disclosed in relation to a burner, the shell of which is shown in outline form at 601. The fire pile outline is indicated at 603. The burner is like that in FIG. 13 except as described below.

While the diffusers of the system shown in FIGS. 18 and 19 are much like the one shown in FIG. 16, the distribution system is somewhat different in that (a) in FIG. 18 all of the groups of diffusers receive air directly from the pair of headers 605 and 607, rather than some of them receiving air from branches of a header (as in the case for the groups of diffuser grates for header 340 in FIG. 9), and (b) in that each of the groups of diffusers in FIG. 18 has four rather than three diffusers as in FIG. 9.

Referring to FIG. 18, the headers 605 and 607 are shown extending beneath the burner shell and the fire pile, and then extend upwardly to ground level and are terminated by caps 608 which can be removed for clean out purposes. An equalizer duct 609 connects header 605 and 607, so that should the underfire air blower for either of the headers fail, air will still be supplied to the diffusers of the other header through the equalizer duct. This arrangement would prevent damage to the diffusers until such time as the system can be put into proper and normal operation.

Since the two headers supply air to their respective diffusers in the same manner, the arrangement for ducts 605, only, will be explained. As shown in FIG. 18, each set of diffusers has its own riser, labeled 610 for the upstream diffuser group and 611 for the downstream group. Each riser is connected by a transition connector 613 to its header. A manifold 621 like manifold 335 of FIG. 10 is provided for each riser.

The upstream risers 610 are larger than the downstream risers 611 in order to provide uniform flow through these risers. When the risers are of the same diameter I have noted a tendency for the flow through the downstream risers to exceed that of the upstream risers.

Each manifold has four distribution pipes 629 leading upwardly in equally spaced relationship and then upwardly where each pipe fits in its own pot 650. Each pot has a stop flange 651 against which the skirt 652a of a diffuser cap 652 abuts.

The diffuser cap 652 is much like cap 552 in that it is hollow and has lateral outlets, but cap 652 has six equally spaced lateral outlets 653, rather than five, the six outlets being uniformly distributed about the cap. The top plate of the cap is also reinforced by a cross rib 654. The skirt of the cap is centered on the pot 650 by the upper portion 655 of the pot.

The pots 650 and the skirt portions 652a of the caps 652 are embedded in a bed 661 which is like bed 551. Each of the pipes 629 is provided with a foot or pad 663 which rests in the bed 661 and resists the tendency of the pipes to be pressed downwardly in the bed in the event a clean out vehicle should ride over the diffusers (or the upper ends of the pots 650 should the diffusers be removed). In other words, the pads or feet 663 tend to maintain the original position of the pipes 659 in the bed 661.

FIG. 18 shows that the groups of diffusers are located in equally spaced relation around a common center point C, while diffusers of each group are equally spaced from the associated manifold (as center). However, the arms of the diffuser set (provided by the pipes 629) are oriented so their centerlines are offset from the centerline C in uniform fashion so as to dispose the innermost diffusers farther from the center C than would otherwise be the case; but on the other hand, located the next set of diffusers outwardly a distance not much greater than that of the manifolds 621. This arrangement also provides third and fourth sets of diffusers having their own distances from the center C. Thus, the diffusers can be considered as divided into not only four groups, but also four sets wherein the sets are located along different arcs from the center C.

If the arms 629 pointed directly at the center C, the distribution pattern of the diffusers would provide only three sets, insofar as distances from the center C are concerned. Thus, a greater uniformity in distribution is obtained by the arrangement shown in FIG. 18 than would be the case if the arms 629 pointed directly at the center C.

An advantage of the FIG. 18 distribution system over the FIG. 9 system is that the headers of FIG. 18 supply the diffuser groups with air in the same manner for each header, while this is not so in FIG. 9 because of the use of branches for the header 340.

The above-described underfire air systems serve to intensify the fires, and distribute the air so as to provide substantially uniform burning over the entire area of the fire piles. The nozzles minimize slag and clinker formation, and enable the fire pile area to be easily cleaned.

Typical temperatures for a burner incorporating my invention are around 1,000° F. for exhaust gases, 750° F. for the collector cone and 250°-300° F. for the burner shell.

Preferably the overfire air is injected counterclockwise in the northern hemisphere, but clockwise in the southern hemisphere.

What is claimed is:

1. In an underfire air system, plural diffusers spaced and separated from one another, header means for supplying air to said diffusers from a source of air, said plural diffusers being distributed in uniform fashion around a common center, the diffusers being divided into groups, the diffusers of each group having a center different from that of the other groups and different from said common center.

2. A system as in claim 1 in which there are at least two headers and two groups of diffusers for each header.

3. A system as in claim 2 in which there are feeder arms for the diffusers of each group and wherein the distance between the centers of adjacent groups is less than twice the effective length of an arm to attain an overlapping relationship.

4. A system as in claim 3 in which the headers and feeder arms are embedded in a supporting strata and wherein the diffusers project above such strata.

5. A system as in claim 4 wherein the strata is inclined downwardly away from each diffuser.

6. A system as in claim 4 wherein at least most of the diffusers are each in the form of a removable diffuser cap having an interior plenum chamber communicating with lateral orifice ports.

7. A system as in claim 3 in which the axes of the arms which are closest the common center, bypass said center in spaced relation, and wherein there are four diffusers for each group and each diffuser has its own feeder arm.

8. In an underfire air system, a nozzle comprising a pot to be embedded in the ground and having a plurality of slots, and a cap member fitting on said pot and having a top plate, the cap member having radial spacer plates positioned in the slots and spacing the top plate from the top of the pot to define lateral orifices leading from said chamber to the exterior surface of said cap member.

9. A diffuser cap for an underfire air system, said cap comprising:

a cylindrical skirt portion of a predetermined diameter for fitting on upwardly projecting portion of a feeder element,

and a head portion defining a plenum chamber surrounded by a cylindrical wall of a diameter greater than said predetermined diameter,

said wall having slots defining lateral ports for the delivery of air,

said head having an imperforate top portion, said plenum chamber extending laterally beyond said skirt portion so that rising air will be uniformly discharged from said slots.

10. A nozzle unit for a burner having an upright shell within which burning is to occur,

said unit including an infeed nozzle for delivering a gas to the interior of said shell,

said nozzle comprising a conduit member projecting through said shell in fixed relation to said shell, a tubular deflector,

mounting means mounting the tubular deflector on the inner end of said conduit for adjustment oblique to the axis of the conduit whereby to permit varying the direction of discharge from said conduit.

11. A nozzle unit as in claim 10 wherein said mounting means has a control portion projecting exteriorly of said shell to facilitate adjustment of said deflector from outside the burner shell.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,638,591 Dated February 1, 1972

Inventor(s) JERRY S. LAUSMANN

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 3, line 32, change "material" to --metal--

Col. 3, line 61, change "9-9" to --9-12--

Col. 5, line 2, change "the", third occurrence. should read
-- a --;

Col. 5, line 21, change "The" to --A--

Col. 5, line 37, change "trough" to --through--

Col. 5, line 53, change "lever" to --level--

Col. 6, line 35, change "(ain" to --(a) in--

Signed and sealed this 4th day of July 1972.

(SEAL)

Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents