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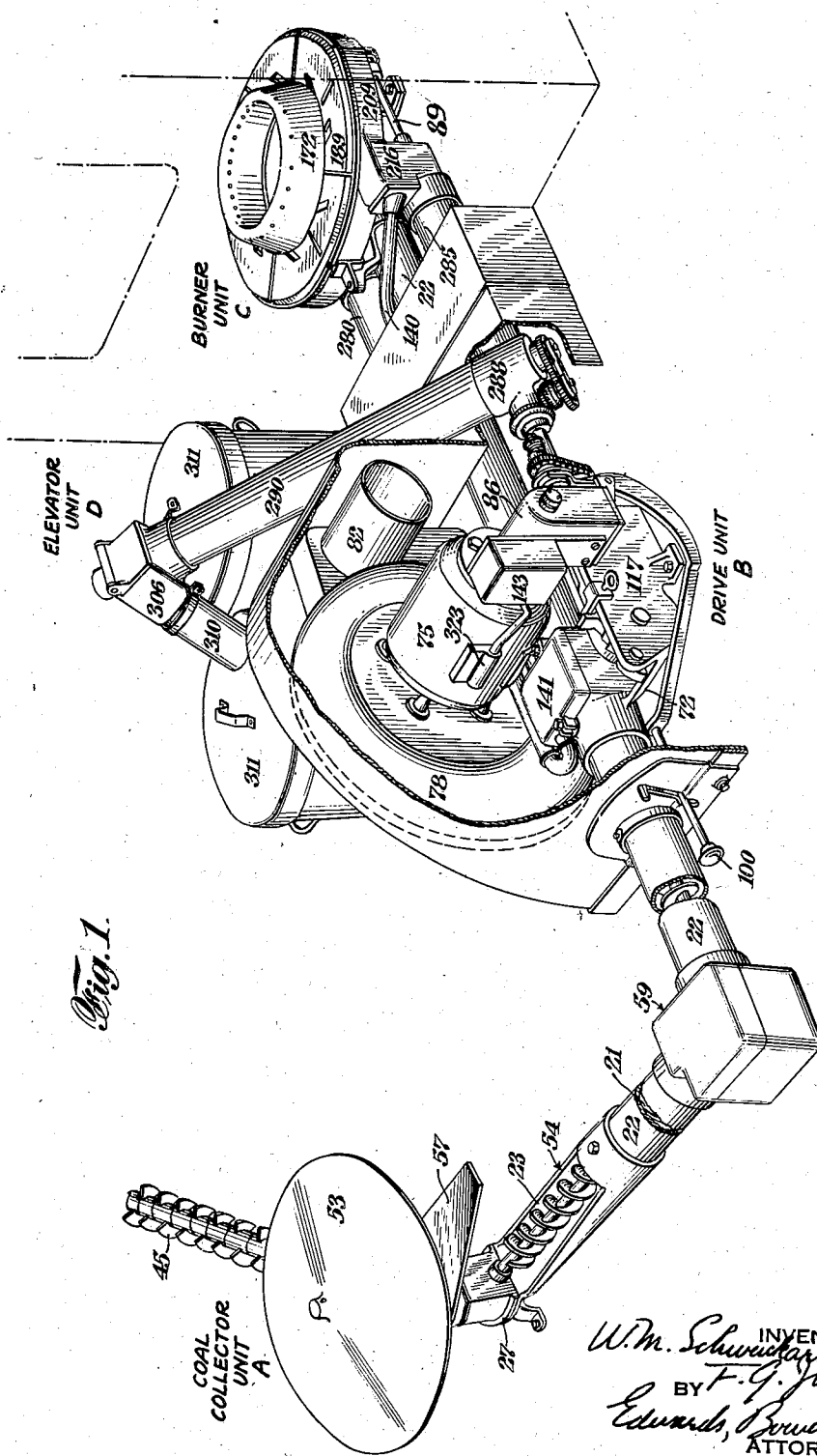
W. M. SCHWEICKART ET AL

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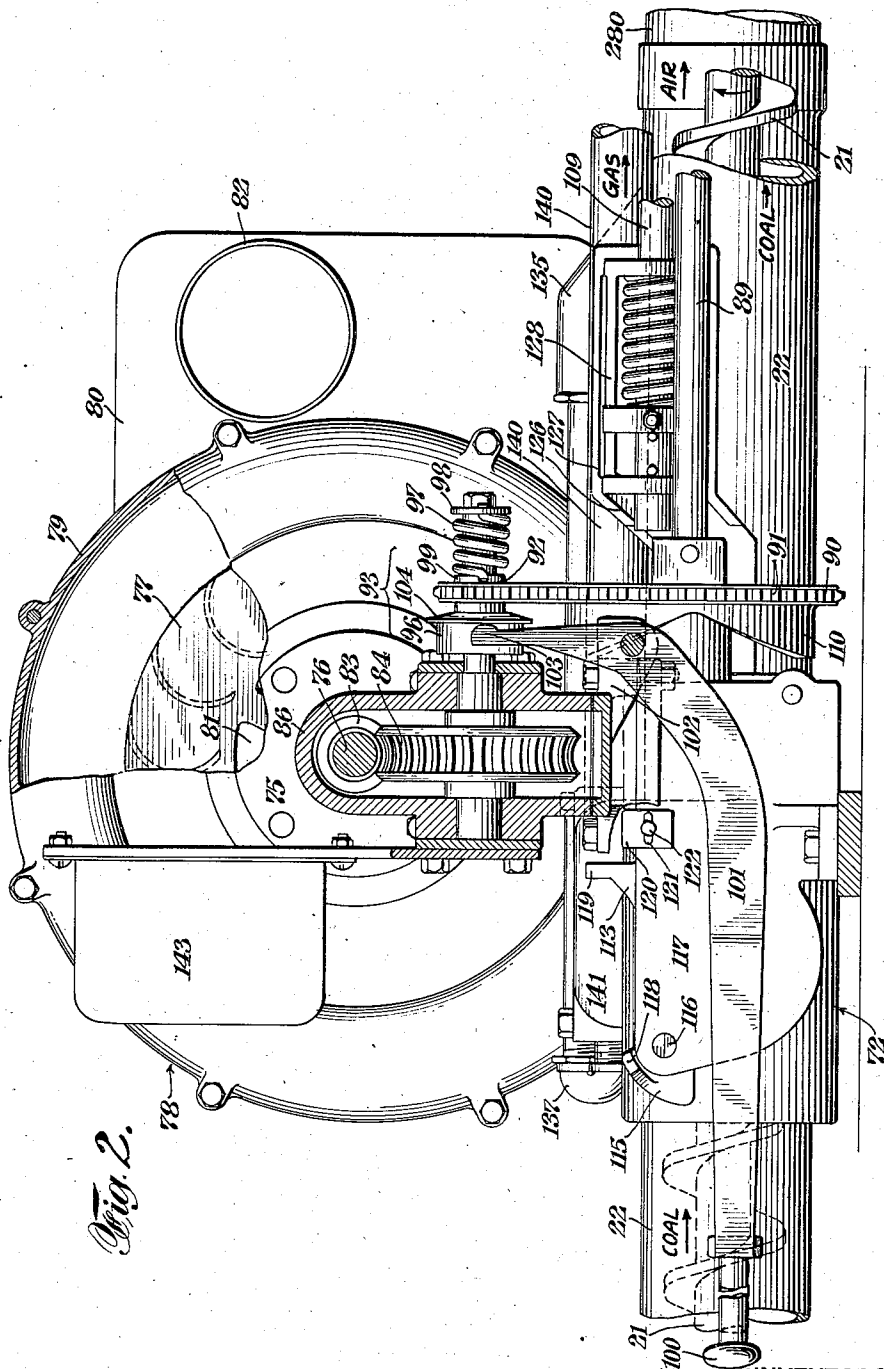


Fig. 2.

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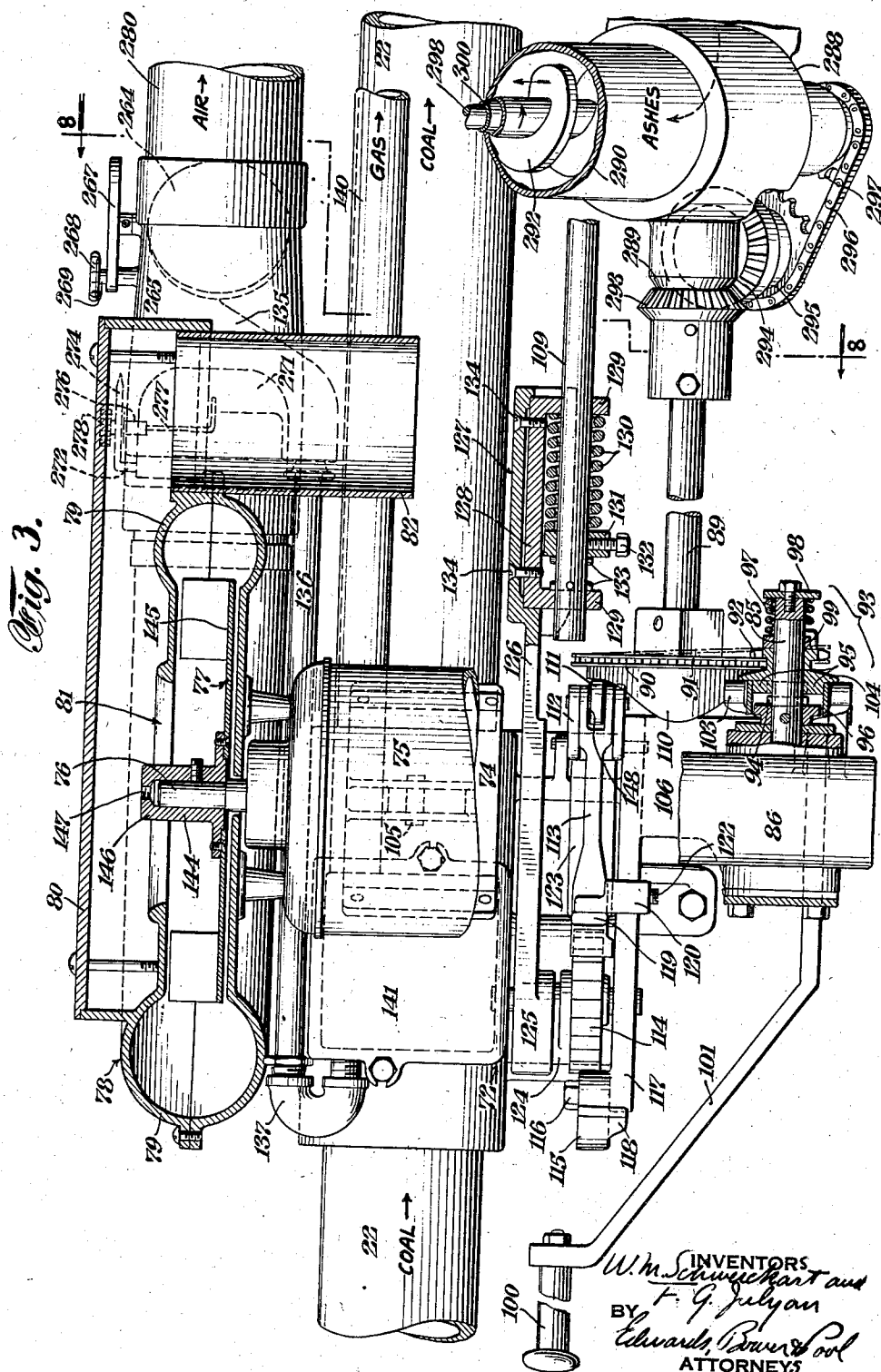
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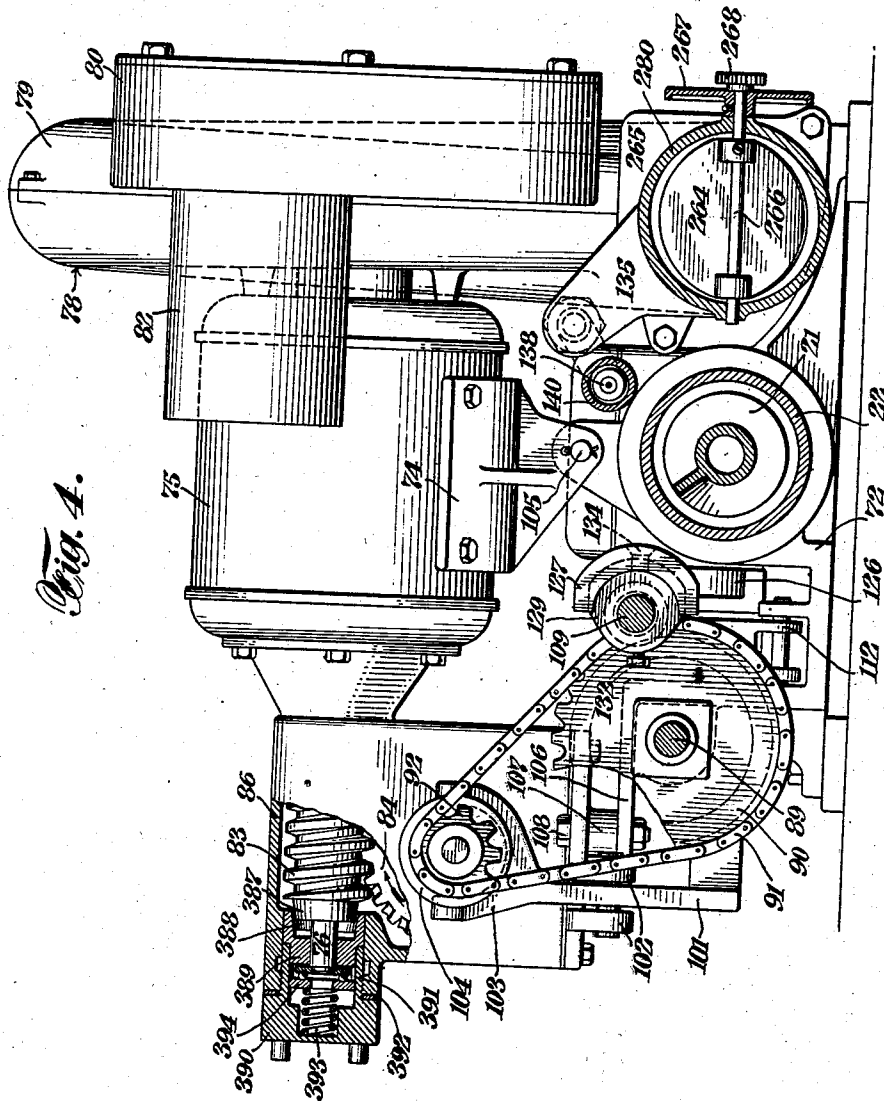
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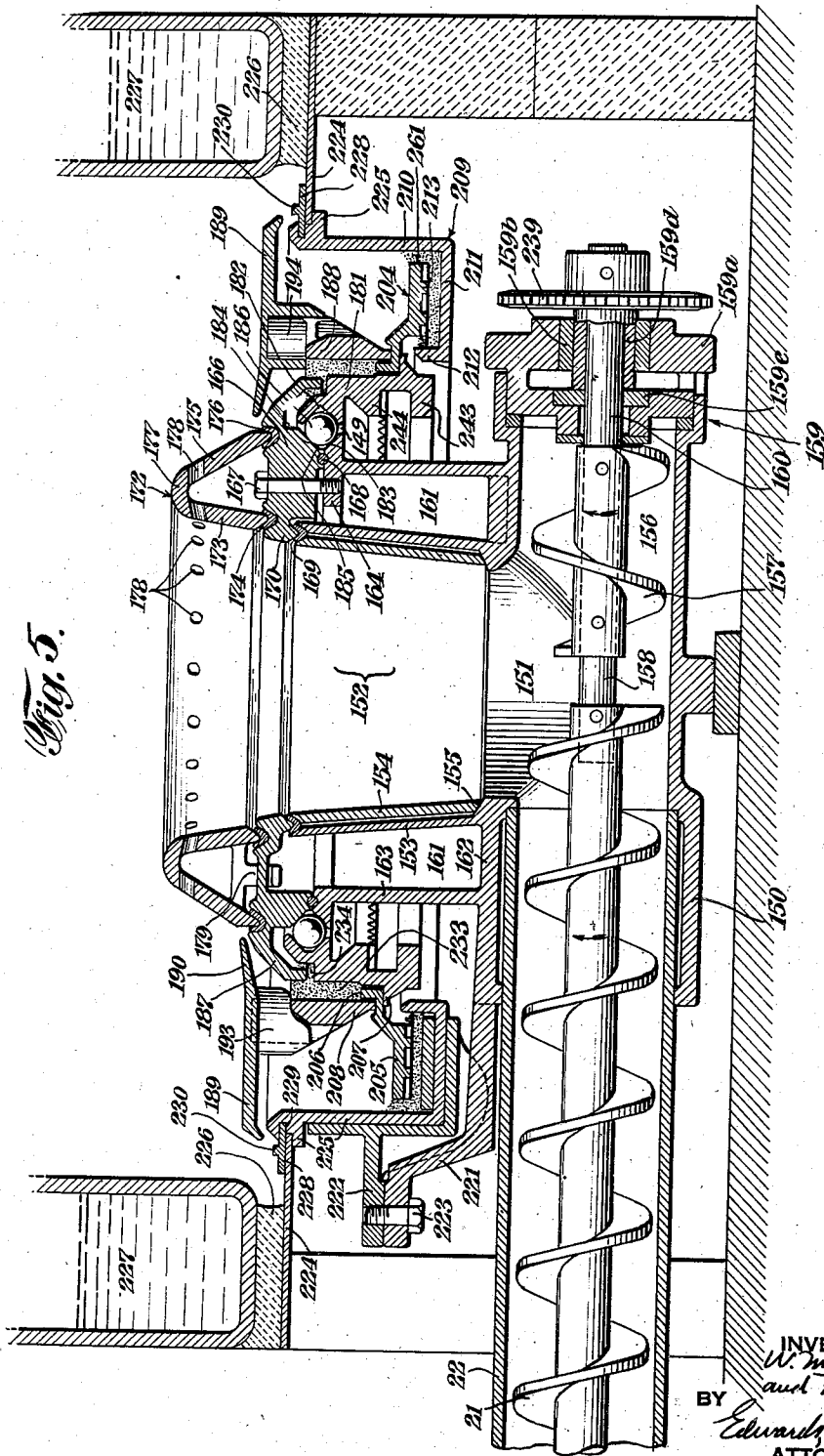
W. M. SCHWEICKART ET AL

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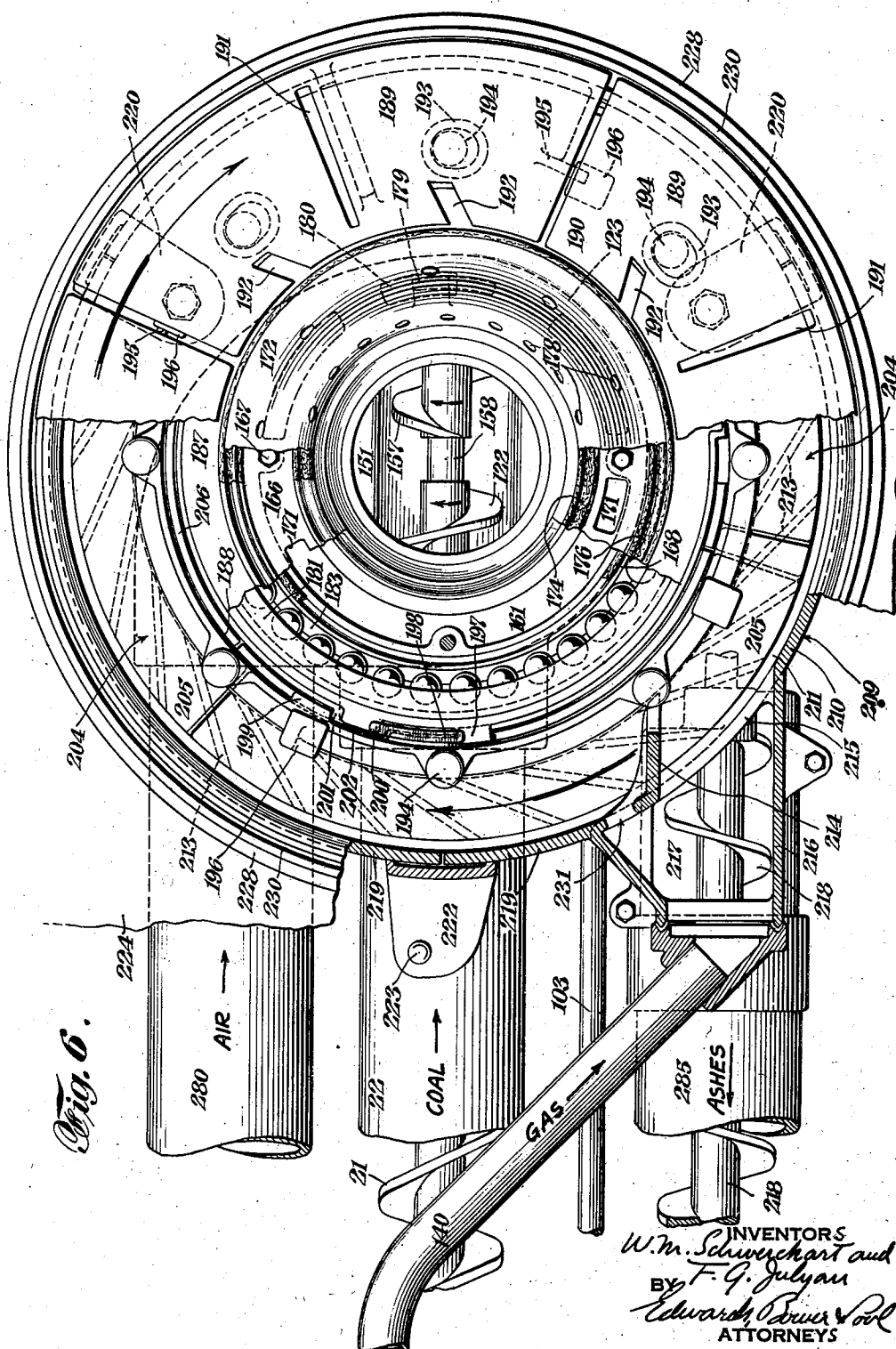
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Fig. 7.

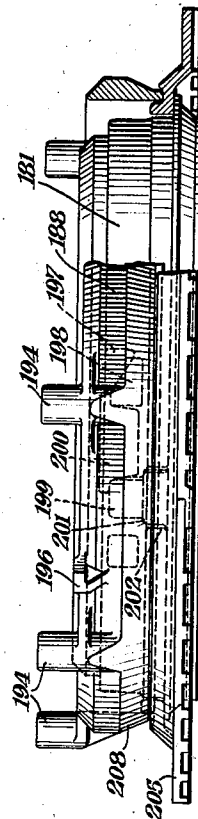
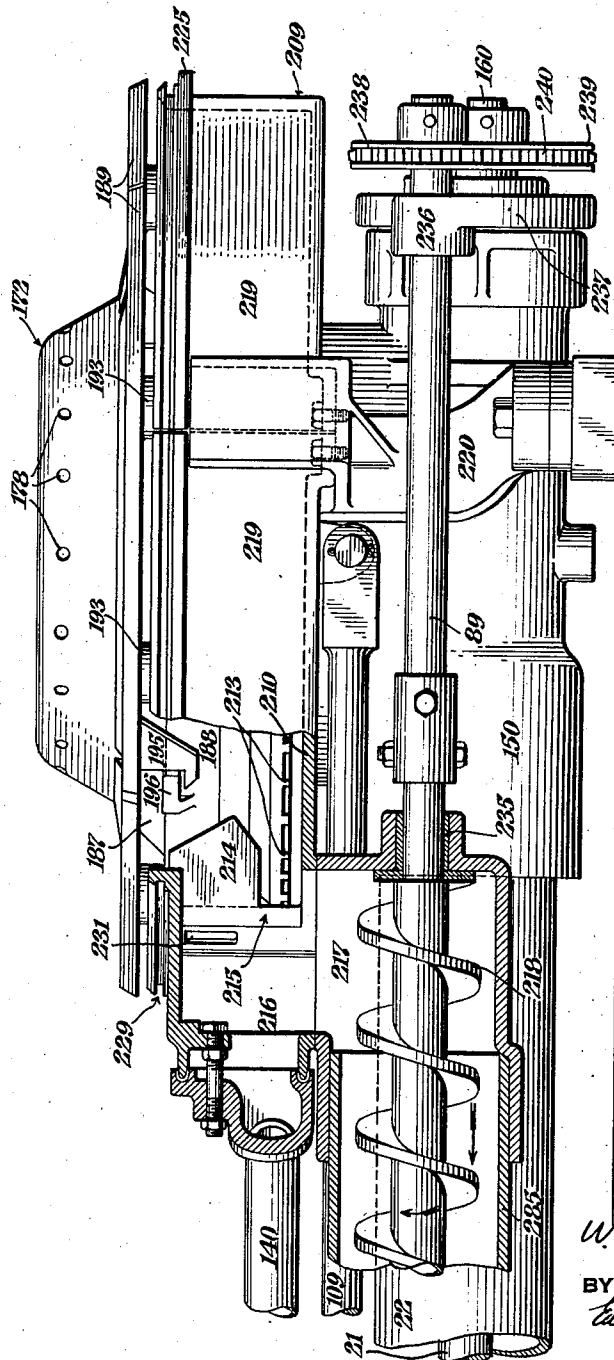


Fig. 8.

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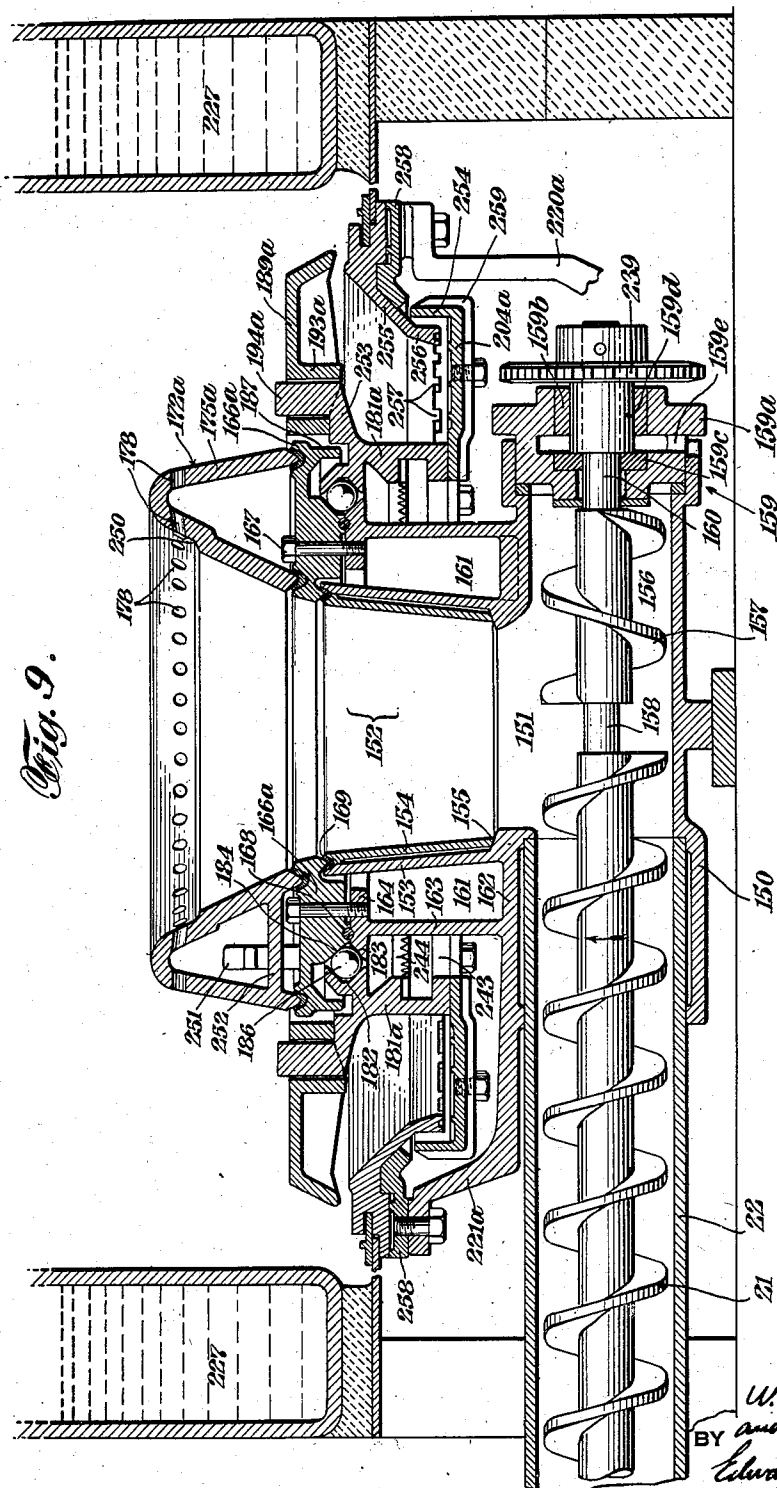
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UNITED STATES PATENT OFFICE

2,306,189

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Application August 28, 1937, Serial No. 161,494

3 Claims. (Cl. 110—45)

This invention relates to improvements in automatic coal burners.

A primary feature of this invention is the provision of a burner that will burn different types of coking coal efficiently and economically, in small domestic installations as well as in larger furnaces, and which is adapted to utilize various sizes of coal down to slack.

An important characteristic of the burner is the provision of improved means for translating the horizontal coal feed into upward feed at the bottom of the burner, avoiding any zone of high pressure at this point.

The burner is arranged to provide a novel combustion zone properly related to the feed so as to assure efficient coking, ignition and combustion of the solid and gaseous components without danger of back coking or clinker formation at points that would interfere with the coal feed and efficient combustion, arranged moreover to avoid the back flow of gas under appropriate operating conditions.

Another object is to provide a burner that will have high combustion efficiency, particularly when burning bituminous coal. The burner is arranged to produce a relatively thin bed of burning fuel, and to eliminate difficulties with clinker formation and ash accumulation which would tend to interfere with proper combustion. The ash removal mechanism removes the ashes and small clinkers rapidly and uniformly without interference with the fire bed, conveying them continuously to an ash discharge.

An efficient electrical control system has been provided, which may be incorporated in combination with standard proven electrical devices. In general, the drive unit is controlled from the room thermostat and is protected by safety devices.

Other objects and advantages of the invention will appear from the following description considered in connection with the accompanying drawings in which,

Fig. 1 is a perspective view of the entire assembly;

Fig. 2 is a side elevation of the drive unit;

Fig. 3 is a plan of said unit with parts in section and broken away;

Fig. 4 is a transverse vertical section on line 4—4 of Fig. 3;

Fig. 5 is a longitudinal vertical section through the burner;

Fig. 6 is a plan view of the burner with parts broken away;

Fig. 7 is a side elevation of the burner with parts broken away;

Fig. 8 is a fragmentary side view showing the mounting of parts of the grate mechanism;

Fig. 9 is a view similar to Fig. 5 showing a modified form of burner; and

Fig. 10 is a side elevation of said modified form with parts broken away.

In the specific embodiment shown (Fig. 1) the apparatus comprises a coal collector unit A, a drive unit B, a burner unit C, and an ash discharge unit D.

The drive unit B includes the motor with its controls, the blower and air supply, the drive for the coal feed and ash discharge screws, the grate rotor drive and gas withdrawal construction, and is shown in Figs. 2-4.

The drive assembly is mounted on a base 72 provided with a longitudinal cylindrical passage for the coal to which sections of the coal-feed tube 22 are connected and through which the last section of the coal feed screw 21 passes. The base 72 above the feed end of the coal passage carries a cradle 74 (Fig. 4) supporting motor 75 by pin connection 105. The motor 75 is bolted as shown to the reduction gear casing 86, which in turn is supported from bracket 106 of the base 72 by a pair of lugs 107 through which pass bolts 108. The lugs 107 and the cradle-pin support 74, 105 form a three point support relieving the motor and the junction with the gear box from stress. The rear end of motor shaft 76 (Fig. 3) carries the rotor 77 of blower 78. In the form shown the usual circular blower casing 79 is attached to the adjacent end of motor 75. This rotor 77 is built up of a cast iron hub 144 and an aluminum fan rotor 145, the hub having a hollow extension 146 with a threaded opening 147 at the end for engagement with a threaded wheel puller device to remove the rotor. This fan construction facilitates a change of motor or fan and the combined cast iron hub and aluminum rotor formation protects the hub parts against fatigue and failure likely to occur where aluminum is used in these central portions under the constant vibration to which the parts are subjected in service. A suitable muffler is preferably provided (Figs. 2-4) comprising a housing 80 surrounding the blower air inlet 81 and extending to the right (Figs. 2 and 3) in the form of a rectangular closed compartment projecting beyond blower casing 79 sufficiently to accommodate the large air inlet tube 82. The air inlet tube 82 provides a definite column of air whose vibration period may be varied by altering the length of tube 82 until the inlet air noise is reduced to a minimum.

The various conveying mechanisms are driven

by motor 75 connected to the end of motor shaft 76 opposite to the blower 78, and carrying a worm 83 engaging worm gear 84 on drive shaft 85 journaled in drive casing 86, mounted on the drive unit base 72. The end of worm 83 (Fig. 4) is provided with a conical friction face 387 registering with a conical friction face 388 on bearing block 389 mounted in a suitable bore in casing 86 and held in place by retainer head 390 carrying a tubular extension 391 threaded in said bore and engaging a shoulder on block 389 to position faces 388 and 387 at an appropriate distance under normal operation. A felt seal washer 392 prevents oil leakage between head 390 and the casing 86 and cooperates in determining the location of face 388. A spring 393 seated in head 390 bears against a ball thrust bearing 394 engaging shaft 76, bearing 394 being slidable in the extension 391. Spring 393 counterbalances the endwise thrust of worm 83 under normal loads, maintaining faces 387 and 388 in spaced relation; but yields under the endwise thrust of said worm due to a predetermined overload to bring faces 387 and 388 into frictional engagement, the inclination of said faces being adapted to provide rapidly increasing friction after initial engagement protecting the working parts against breakage.

Drive shaft 85 is suitably connected to the coal feed screw 21, and to the ash removal apparatus hereinafter described. This apparatus includes an ash removal shaft 89 journaled in the base 72 and the coal feed screw 21 and the ash removal shaft 89 both extend to the burner unit C. In the form illustrated herein, the ash removal shaft 89 is provided with a sprocket 90 connected by chain 91 with sprocket 92 on drive shaft 85. Chain 91 is preferably arranged so that the run carrying the driving stress (the lefthand run as shown in Fig. 4) extends downwardly from sprocket 92 in a direction appropriate to throw such stress on the mounting lugs 107 of the gear casing 86. With this arrangement motor cradle 74 receives little, if any, of such stress and serves largely to stabilize the drive unit.

Means for disconnecting the motor drive from shaft 89 comprises a clutch 93 including dogs 94 on drive shaft 85 and interlocking dogs 95 in clutch housing 96 which carries sprocket 92 and is journaled on drive shaft 85. Dogs 94 and 95 are normally maintained in engaging position by a spring 97 on shaft 85 attached at its ends to thrust washer 98 and thrust collar 99 bearing against sprocket 92.

An arrangement is provided for releasing the clutch 93, preferably operable by hand from a convenient point outside of the drive unit. In the form illustrated a handle 100 at the left of the unit (Fig. 3) is mounted on clutch release arm 101 pivoted to ears 102 on the case 86 and provided with fork 103 extending upwardly into engagement with annular flange 104 on clutch housing 96.

The burner unit C hereinafter described includes a rotating grate structure which is intermittently operated by reciprocating shaker rod 109. A suitable mechanism is provided for imparting such reciprocating movement at the proper rate. In the form shown best in Fig. 3, the sprocket 90 is provided with a suitable cylindrical face cam 110 engaging cam roller 111 rotatably mounted on the upper end of rocker arm 112 pivoted at its lower end to a base. Pawl 113 is pivoted at one end on rocker arm

112 with the friction washer 148 between the pawl and the arm to silence the pawl by holding it so that it will not drop freely and, noisily against the teeth of the ratchet 114. The pawl engages ratchet 114 which is rotatably mounted on base 72 and is prevented from backlash by a silent detent cam 115 having an offset pivotal mounting 116 on vertical web 117 of the base 72 arranged so that the unbalanced weight of cam 115 will maintain its cam surface in locking engagement with the teeth of ratchet 114 to prevent backlash, lug 118 on cam 115 being positioned to engage the upper face of web 117 when cam 115 is rotated out of engagement with ratchet 114, preventing cam 115 from being accidentally jarred or otherwise shifted into inoperative position.

Means for regulating the throw of pawl 113 and thereby varying the actuation of the rotary grate structure includes an upward extension 119 on pawl 113 positioned to engage stop lug 120 adjustably mounted as by slot 121 and locking screw 122 on web 117 to control the length of the return throw of pawl 113. The lug 120 acts to swing the pawl 113 downward into engaging position with the ratchet 114. Cam roller 111 is suitably maintained in engagement with cam 110, as by leaf spring 123 bearing against base 72 and rocker arm 112.

The intermittent movement of ratchet 114, which in the form shown is actuated twice during each revolution of sprocket 90, is suitably transmitted to the ash grate, as by eccentric 124 mounted on ratchet 114 and carrying eccentric strap 125 on connecting rod 126 which may be connected to shaker rod 109 by a suitable shock absorbing arrangement. For this purpose rod 126 may terminate in frame 127 in which the spring cage 128 is mounted, including end flanges 129 in which shaker rod 109 is slidably mounted, between which flanges shock absorber spring 130 is set under initial compression and maintained in compressed condition by compression collar 131 held in suitable position on rod 109 by stop pins 133 projecting from shaker rod 109 in position to engage the adjacent flange 129 and collar 131 under pressure of spring 130. Collar 131 is held against rotation by engagement with cage 128, and operates through clamp screw 132 to hold rod 115 in adjusted rotated position. Cage 128 is preferably mounted removably on frame 127 as by screws 134. This shaker rod spring construction 130 will allow the stoker to run even though the grates are jammed, the rest of the mechanism continuing to function normally and the placing of the absorber spring 130 under initial tension is important to quiet operation.

This rotary grate structure surrounds an inner retort of the burner unit C of the type in which the coal is forced upwardly through the bottom of the burner retort or pot structure, burning in the upper portion thereof and traveling over the edge onto the grate structure through which the ashes pass. In the arrangement disclosed in Figs. 5-8 the section of the coal feed tube 22 extending from the drive unit base 72 is clamped in the burner body 150 and supplies coal to the throat 151 at the bottom of the fire pot 152, which preferably is tapered outwardly from throat 151.

The lower portion of pot 152 may consist of a pot wall 153 integral with burner body 150, and a frusto-conical pot liner 154 having a smooth, preferably enameled inner surface, fitting within wall 153 and resting on a suitable

ledge 155 to provide a smooth continuation of the surface of throat 151.

A principal problem in feeding coal to the bottom of burners of this type is presented by the difficulty hitherto encountered in forcing the coal slowly upward at right angles to the horizontal feed tube. The tendency of the feed screw is to force the coal against the surface in line with the end of the feed tube tending to produce a packed mass of coal at this point which greatly increases the resistance to the feed screw and introduces serious problems in providing feed screw bearings and suitable pot throat contours, and aggravates greatly the tendency of such mechanisms to become jammed by even slight increased resistance to the travel of the coal.

In the form specifically illustrated these objections are overcome by providing a pocket 156 extending beyond throat 151 concentric with the axis of coal feed screw 21, and mounting in pocket 156 a reverse screw 157. Feed screw 21 preferably terminates at a point in throat 151 slightly spaced in advance of the pot axis, and reverse screw 157 preferably terminates some distance on the opposite side of said axis, providing a balanced thrust from opposite directions substantially at the center of pot 152. In practice with feed and reverse screws approximately $2\frac{1}{2}$ " in diameter the ends of the screws are separated by 1" to $1\frac{1}{2}$ ".

For drive purposes reversed screw 157 may be tubular and connected to the adjacent section of feed screw 21 by connecting shaft 158. A suitable bearing 159 mounted on the burner body 150 at the end of pocket 156 provides a suitable journal for the terminal shaft 160 rigidly mounted in reverse screw 157, the arrangement being such that terminal shaft 160, reverse screw 157, connecting shaft 158, coal feed screw 21, pickup screw 23 and the final, connecting shaft and sleeve at the collector unit A constitute a continuous rotary coal feed screw structure which may be of any desired length and may be driven from an end thereof, as herein-after set forth.

Bearing 159 includes a head 159a carrying a journal bushing 159b for the hub 159d of sprocket 239 which bears against thrust ring 159c. A suitable outlet 159e for material passing ring 159c may be included.

To provide for supply of air to the burning fuel, inlet air chamber 161 surrounds the pot wall 153, formed by bottom wall 162 and outer wall 163 and generally open at the top.

A suitable upper margin for the pot 152 is provided preferably in separable form and is generally referred to as a retort. While the retort may be formed and mounted in various ways, it is advantageous to provide a retort base ring 166 which may perform a number of functions. In the form illustrated ring 166 is held in position by bolts 167 threaded into lugs 164 on outer wall 163 of air chamber 161, and may have a sealed engagement therewith by employing an asbestos gasket 168. Base ring 166 may likewise form a closure for the junction between pot wall 153 and pot liner 154, the form shown in Fig. 5 having an annular ridge 170 engaging a seal ring 169 of asbestos or the like located on the suitably beveled edges of wall 153 in liner 154. The ring 166 is provided with openings 171 (Fig. 6) to permit the air from air chamber 161 to pass upwardly to the retort.

The retort 172 is removably mounted on the base ring 166 and forms a continuation of the

pot 152, being provided with air outlets or tuyères for furnishing air in the most advantageous zone for efficient operation. In the form shown in Figs. 5-7 the retort 172 is provided with an inner wall 173 forming a continuation of pot 152 and the inner face of base ring 166, and resting on an asbestos gasket 174 in a suitable depression in base ring 166. The outer wall 175 slopes outwardly and downwardly to the grate structure, and rests on an asbestos gasket 176 in a suitable depression in base ring 166. The retort crown 177 provides an integral smooth curve between walls 173 and 175, and is preferably relatively narrow to prevent retention of material thereon.

Suitable tuyère openings 178 extend through the retort 172 at appropriate points. It has been determined that with the arrangement described the most advantageous construction comprises provision of a series of tuyères 178 adjacent the upper part of the inner retort wall 173, preferably sloping slightly downward, and a smaller number of tuyères 178 extending through the upper part of the outer retort wall 175 at about the same level. The retort 172 is held in place by means which preferably permits its ready removal and replacement, such as hooks 179 which may be cast integral with the retort walls 173 and 175, and which engage the lower face of the retort base ring 166 through suitable retort lock openings 180.

The rotary grate structure located around the retort 172 is adapted to receive the burning coal and ashes which flow outwardly over the retort, sifting the ashes into a suitable annular receiver in which they are carried around the burner to a point of discharge. The various parts are carried by a rotor ring 181 which is rotatably mounted on the pot 152. The mounting of rotor ring 181 on ball bearings is such that the parts may be readily assembled, the bearing will be easily accessible and the structure will function smoothly under the substantial variations in temperature and consequent expansion and contraction of the parts encountered under these conditions, the ball race being formed by cast surfaces. The arrangement comprises a ball race groove 182 in the inner face of the upper part of rotor ring 181. An upwardly beveled flange 183 on wall 163 and a downwardly beveled flange 184 on base ring 166 are arranged to provide a ball race groove 185 cooperating with groove 182 to retain the balls 186. By the removal of retort base ring 166, the balls 186 will be readily accessible; and as the faces of grooves 182 and 185 are substantially at 90° to each other, their spacing permits smooth unobstructed travel of the balls under various conditions of expansion due to changes in temperature.

The outer margin of the retort base ring 166 is provided with an apron 187 extending outwardly and downwardly over the upper edge of the rotor ring 181, apron 187 providing a smooth path of flow for ashes around the ball bearing structure and beyond the outer face of rotor ring 181, the adjacent faces of apron 187 and rotor ring 181 being suitably shaped to provide a relatively slight clearance and prevent substantial amounts of ashes from reaching the balls 186, the opening 149 below said balls permitting any ashes or the like to fall out of the raceway. The annular pocket 233 below apron 187 accumulates ashes and an inner seal of ashes 234 is formed at the lower edge of the apron, restricting the passage of air to the space above the grate.

In the embodiment shown in Figs. 5-7 a grate ring 188 is utilized, removably mounted on rotor ring 181 and adapted to receive removable grate segments 189. These segments are preferably flat integral castings provided with an inner flange 190 extending into close relationship to retort base ring apron 187. Suitable slots permitting ashes to pass the segments 189 include the radial slots 191, restricted marginal slots 192 in flange 190, preferably angled inwardly in the direction of rotation, and the spaces left between the periphery of each segment 189 and the adjacent parts.

Segments 189 are mounted on the grate ring 188 in suitable manner securely held in operation but permitting ready removal and preferably adapted to construction by casting. In the form shown in Figs. 5-7 each grate segment 189 is provided with two downwardly extending slightly elongated annular sockets 193 adapted to receive supporting studs 194 on the upper margin of grate ring 188. An integral locking tongue 195 on the advance end of each segment 189 extends beneath a locking lug 196 formed on the upper edge of grate ring 188. Grate ring 188 may extend to a point higher than the lower edge of apron 187, the intervening space normally filling with ashes which form the air seal across the narrow slot between the apron margin and ring 181.

The grate ring 188 is suitably mounted on rotor ring 181 to permit ready removal without affecting the rigidity and reliability of the mounting under service conditions. A suitable arrangement is indicated best in Figs. 6 and 8, and includes beveled wedge lugs 197 on rotor ring 181 engaging beveled wedge lugs 198 on grate ring 188 to force the grate ring downwardly into proper position by rotating it relative to rotor ring 181; stop lugs 199 on rotor ring 181 and removable locking slugs 200 fitting between stop lugs 199 and wedges 198 when the grate ring 188 has been turned into proper position.

The grate rotor structure is preferably provided with an ash table 204, receiving ashes which pass the grate segments 189 and conveying such ashes to a point of discharge. A plurality of ash table segments 205 forms a continuous annular platform around rotor ring 181 adapted to receive the ashes. Each table segment 205 is provided with an inner flange 206 extending inwardly and upwardly, resting on an annular shoulder 207 on rotor ring 181, the abutting edges of the table segments 205 being in overlapping relationship to provide continuity and accurate registration. The lower rim 208 of grate ring 188 bears against flanges 206 and securely locks the table segments 205 in firm fixed position when wedge lugs 197 are forced against wedge lugs 198 as above described. Table segments 205 may be accurately located by positioning lugs 201 on rotor ring 181 engaging corresponding positioning recesses 202 in segments 205.

An ash trough extends around and below the ash table segments 205, for the direct discharge of ashes from the ash table. The ash trough 209 (Figs. 5-7) has an outer wall 210, a bottom 211 extending beneath and slightly spaced from the table segments 205, and an inner flange 212 extending upwardly substantially beyond the lower face of table segments 205. Segments 205 are preferably provided with diagonally tangential ribs 213 which serve to plow outwardly toward wall 210 ashes which fall between ash table 204 and wall 210, preventing the ashes from escaping

over flange 212 while avoiding any engagement between the rotating and fixed parts. The ashes brushed outward by the ribs 213 accumulate at the outer edge of the bottom plate 211 and form an outer ash seal 261 at the periphery of the table 204 so as to restrict the flow of air to the space above.

The ashes carried around by ash table 204 are continuously discharged by a simple scraper arrangement (Figs. 5 and 6) including an ash plow or vertical plate 214 on the outer wall 210 of the ash trough extending into juxtaposition to the ash table 204 and grate ring 188 and deflecting ashes outwardly through discharge opening 215 in wall 210 into the ash discharge pocket 216 formed in said wall. An ash discharge chamber 217 forms a downward continuation of pocket 216 and houses the receiving end of the ash removal screw 218 mounted on ash removal shaft 89.

A suitable arrangement is provided for supporting ash trough 209 and for connecting it to the furnace body. For convenience, trough 209 may be constructed in three segments as shown, supported at the right of the burner (Figs. 6 and 7) by bracket legs 220 overlying the junctions of the segments 219 and removably mounted on the burner body 150 to permit convenient mounting and disassembly of the ash trough 209. The remaining junction between segments 219 overlying the coal feed tube 22 is supported by a bracket 221 on the burner body 150, provided with a detachable clamp 222 overlying the junction and which may be detachably fastened to the bracket 221.

The upper margin of the ash trough 209 is connected to the furnace body to close the space between the body and the burner unit. This may be accomplished by providing a closure plate 224 resting on shoulder 225 formed at the upper margin of outer wall 210 of the ash trough, and extending outwardly to the furnace walls. A suitable filling or lagging 226, such as furnace cement or the like, may be employed to fill the spaces between plate 224 and the furnace walls, which in Fig. 5 are shown as comprising the usual water leg 227 of a domestic furnace. Plate 224 may be locked on shoulder 225 by segmental locking plates 228 fitting into an annular recess 229 in the upper margin of the outer wall 210 of the ash trough and provided with a longitudinal rib 230.

The mechanism for rotating the grate unit employs an intermittent drive, imparting a periodic impact to the rotating structure, as such an arrangement serves to break up the fuel mass and to facilitate the sifting of the ashes and small clinkers through the grate.

A suitable arrangement is provided for automatically removing the ashes from the burner unit C and discharging them at an appropriate point, the construction preferably including an ash removal conveyor and an elevator for transferring the ashes from the conveyor to a suitable discharge point. In the form illustrated the ashes are removed from the ash discharge chamber 217 (Fig. 7) by ash removal tube 235 mounted in the burner body 150 and forming a continuation of chamber 217. Tube 235 extends to an appropriate point and is shown as terminating adjacent drive unit B (Figs. 1 and 3). At this point a suitable elevator is positioned to receive the ashes.

A suitable arrangement is provided for driving the coal feed screw 21 from shaft 89. In the arrangement indicated in Figs. 5 and 7 shaft 89

extends through a bearing 235 in chamber 217 and bearing 236 on bracket 237 on burner body 150, and drives coal feed screw 21 through sprockets 238 and 239 (on shaft 160), and sprocket chain 240.

A modified burner construction is shown in Figs. 9 and 10. In this arrangement the retort 172a is provided with a depressed portion 250 immediately below the inner tuyères 178 to facilitate the introduction of the air, and is relatively higher, the outer retort wall 175a having a relatively sharp downward slope toward the grate. Retort 172a is held in position by locking hooks 251 on the retort base ring 166a engaging cross-bars 252 in retort 172a. The grate segments 189a are mounted on studs 194a carried directly by the rotor ring 181a and extending through the top of sockets 193a, the segments 189a resting on suitable flanges 253 at the base of studs 194a.

The ash table 204a is mounted directly on rotor ring 181a and is arranged to retain the ashes by including an upwardly extending lip 254 at its outer margin, dispensing with the use of an ash trough. Mounted in place of such trough but in the same general manner is a conical ash hopper wall 255 having its lower rim 256 extending downwardly inside lip 254 and provided with diagonal ribs 257 on its lower face arranged to plow inwardly ashes which tend to work beneath rim 256 toward lip 254. The ash hopper 255 may be arranged and supported in the same manner as the ash trough 209, but legs 220a and bracket 221a may carry detachable retaining clamp members 258. Ash table 204a may be provided with suitable means, such as ribs 259 extending upwardly around lip 254, which may be engaged by a poker or other suitable implement for manually rotating or shaking the grate structure.

A somewhat different ash discharge arrangement is employed with this modification, the ash plow 214a having an advance portion 262 curved upwardly and outwardly to convey ashes accumulating on table 204a over lip 254 into the discharge passage 263 communicating with ash discharge pocket 216a.

While various proportions and designs may be employed in the different parts of the apparatus disclosed herein, the proportions are of importance in various parts, and particularly in the burner structure, the size and proportions of the pot, retort, grate segments, ash slots in the spacing thereof, having been determined after substantial experiment as adapted to most efficient operation with coking bituminous coal; and the drawings herein are drawn to scale to show the proper dimensional relationships between the various parts.

While the apparatus is adapted for use with various types of coal it has been particularly designed to solve certain special problems encountered in the burning of bituminous coal, which has special characteristics affecting its collection, transportation and combustion.

Proper feeding of the coal is highly important, for the purpose of assuring proper burner operation, for economy in driving the feed screws, and to avoid the jamming of the feed which has heretofore been a prolific source of trouble in apparatus of this type. A feature of the present arrangement involves keeping the feed tube 22 substantially less than full of coal, and preferably about half full.

The appropriate feeding of the coal has been accomplished partly by providing uniform feed

conditions regardless of the depth of coal, as already indicated, and partly by the use of a special pickup screw section 23 which has substantially less capacity than the feed screw 21.

The rotating element 157 provided at the side of the throat opposite to the discharge end of the coal feed tube serves to prevent the coal from forming a packed mass at this point, and thereby increasing notably the facility with which it may be forced upwardly by the horizontal pressure of the feed screw. In one sense it may be said that this auxiliary screw increases the relative fluidity or flowing qualities of coal at this point. In the preferred form the rotating element is in the form of a reverse screw exerting a counterbalancing horizontal pressure on the coal discharge by the feed screw while likewise preventing the formation of a solidly packed mass of coal, the result being that the coal will travel upward as gradually as may be desired without exerting any pressure whatever on the surfaces opposite the coal feed tube discharge. The reverse screw may be arranged to impel coal continuously away from the feed screw bearing, which may therefore be of any desired type. The elimination of the tendency to pack the fuel in throat 151 furthermore permits the maintenance of fuel feed in tube 22 at substantially less than the full capacity of the tube as already indicated, since substantial back pressure on the fuel at the burner owing to the resistance caused by forcing the fuel upward under previous conditions causes the coal to back up along the feed screw; and even if feeding at less than coal tube capacity is attempted, substantial back pressure at the burner and the resultant accumulation of coal in the tube will make it impossible to operate the feed tube 22 partially filled at any point within a substantial distance of the burner. With the construction illustrated however the feed tube is filled for only a short distance from the burner, an arrangement which not only reduces to a minimum the power necessary for feeding at this most exacting point, but which also is desirable since a full feed tube 22 for a short distance from the burner is serviceable in forcing the gases to travel upwardly through the burner and not back through tube 22.

In burner retorts of the prior art difficulties have been encountered because of the tendency of the coal under certain conditions to burn down in the pot toward the feed screw, resulting in the formation of coke and clinkers which obstruct the feed and burning of the coal and may result in breakage or stoppage of the mechanism. The travel of the coal upwardly in the pot may likewise be obstructed by the formation of clinkers and the like which adhere to the pot walls, and by mechanical obstructions provided by the wall surfaces. In the present construction a retort is provided in which the zone of active combustion is restricted to the upper portion, and which extends downwardly for a sufficient distance below the lowest point of air supply so that the fire will not reach the region where formation of clinkers, coke and the like will interfere with the feed mechanism. Any clinker formation developing will be prevented from adhering to the pot by the smooth liner 154 but will be forced upward and broken up by the incoming coal.

The drive, operated by a single motor and compactly arranged, is constructed so that the blower may be operated without the coal feed.

which may at times permit operation by hand firing in cold weather pending repairs to the coal feed mechanism. The clutch 93 is likewise arranged to permit throwing in the coal feed and ash removal mechanism abruptly after motor 75 is up to speed, exerting a sudden impulse that may be valuable in dislodging a slight obstruction. The apparatus is likewise arranged so that the motor 75 will be stalled before breakage of any of the drive parts, allowing the electrical system to throw out the motor circuit and take care of emergency conditions without damage to any part of the machine. This result is accomplished partly by the strength and simplicity of the construction, partly by the use of especially strong feed screws, and to some extent by the use of a special thrust bearing 388, which serves to take a substantial part of the stress caused by an obstruction to the conveying mechanism thereby reducing correspondingly the maximum stress on such mechanism, without materially reducing the power transmitted from the motor 75 under normal conditions.

Subject matter shown herein and not claimed is claimed in applicants' co-pending applications Serial Nos. 383,432 filed March 14, 1941, and 405,894 filed August 8, 1941.

We claim:

1. A burner for an underfeed stoker comprising a stationary frame having two upstanding, spaced, generally annular walls and a bottom wall connecting the bottoms of said upstanding walls, the inner of said upstanding walls enclosing an area to form an upward coal passage or fire pot, the outer of said upstanding walls surrounding the inner wall, and the three walls forming sides of an air chamber into which is fed air for the stoker, a stationary base ring engaging the tops of both upstanding walls, the inner surface of the base ring forming a continuation of the upward coal passage and the base ring having apertures therein to permit the upward passage therethrough of air from said air chamber, a stationary tuyère ring of generally annular form with inner and outer surfaces joined at the top by a rounded apex surface so that in cross section the ring is generally shaped like an inverted V, the lower ends of said inner and outer tuyère ring surfaces engaging said base ring and straddling said apertures therein so that the air passing through said base ring is conducted to the enclosed spaced formed

by said tuyère and base rings, said inner tuyère ring surface being positioned so as to form a continuation of the upward coal passage and both inner and outer tuyère ring surfaces having tuyère openings therein near the apex thereof, base ring securing means securing said base ring to said frame, said means having control portions positioned in the base ring area straddled by said tuyère ring and accessible from above said base ring when said tuyère ring is removed, and interengaging members on said base and tuyère rings for securing said tuyère ring upon said base ring by moving said tuyère ring relative to said base ring in a substantially horizontal plane.

2. The burner as set forth in claim 1 in which the burner is provided with a rotatable grate surrounding said tuyère ring and positioned below the apex thereof, the rotatable mounting for said grate comprising a ring having a V groove to serve as the outer ball race of a ball bearing, an inward slope of the top of said outer upstanding wall and an inward slope of the portion of said base ring adjacent thereto to form a V groove to serve as the inner ball race of the ball bearing, and bearing balls positioned in said V grooves to complete the ball bearing mounting for said grate.

3. In a stoker having a burner, a conveyor for feeding the coal thereto, an electric motor, and connections including reduction gearing between said motor and said conveyor to drive the conveyor at a relatively slow speed, said reduction gearing including a worm and worm gear, the worm having a small range of axial movement and the worm and support therefor having co-operating friction faces adopted to engage upon the axial movement of the worm incident to its axial thrust, and a spring opposing said axial thrust sufficiently to prevent engagement of said friction faces only until said excess mechanical load is imposed upon said worm, the combination therewith of an electrical overload cutout device responsive to a predetermined amount of current in excess of normal current drawn by the motor to de-energize the motor, said friction faces acting to increase substantially the frictional resistance to the motor drive and thereby substantially overloading the motor and causing said cutout device to de-energize said motor.

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