Dec. 18, 1934. J. E. TONE 1,984,665

GAS GENERATING APPARATUS

Filed June 14, 1929 3 Sheets-Sheet 1

Fig. 1.

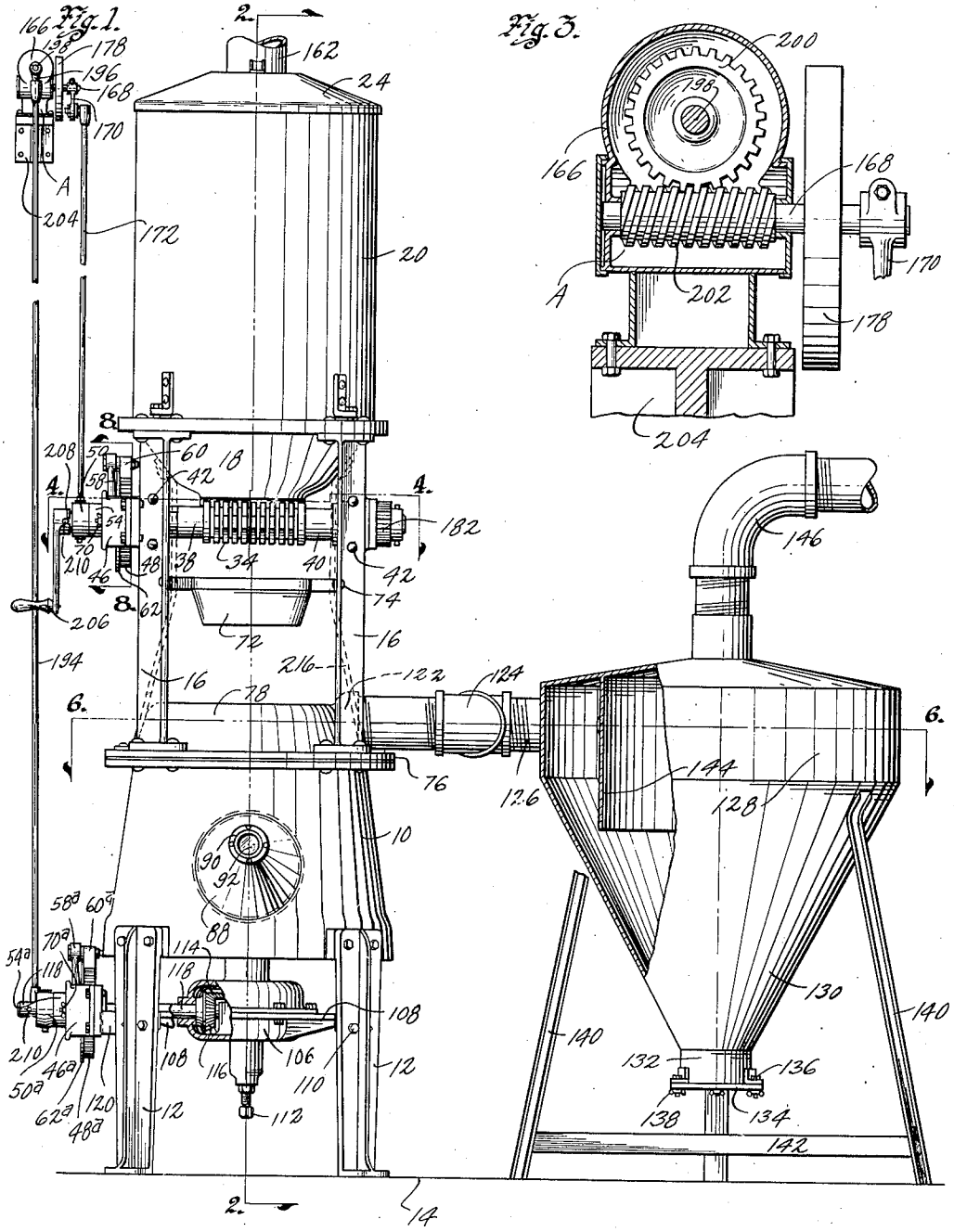


Fig. 3.

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GAS GENERATING APPARATUS

Filed June 14, 1929 3 Sheets-Sheet 2

Fig. 2.

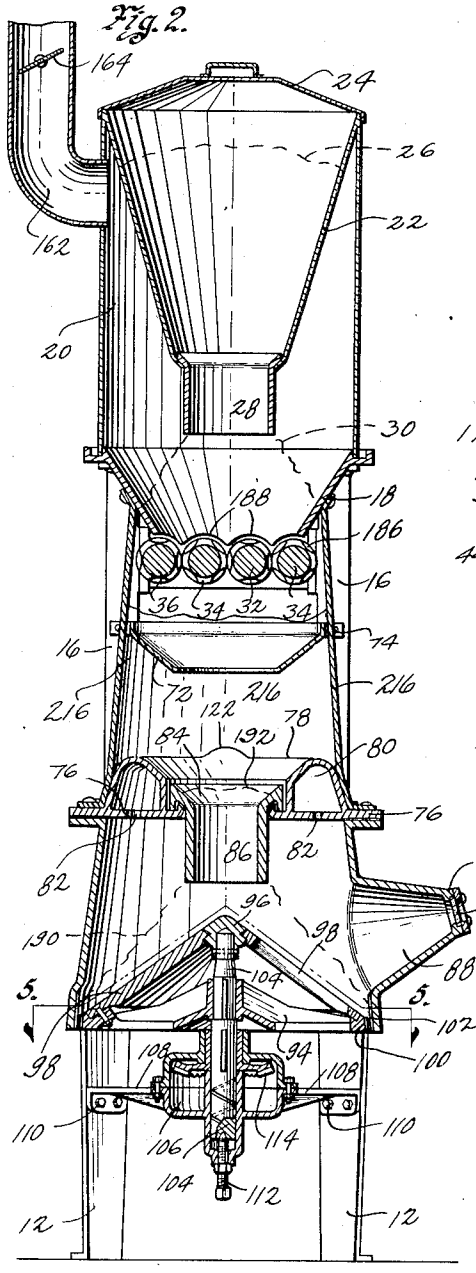


Fig. 10

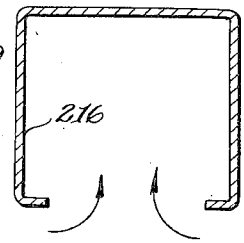


Fig. 4.

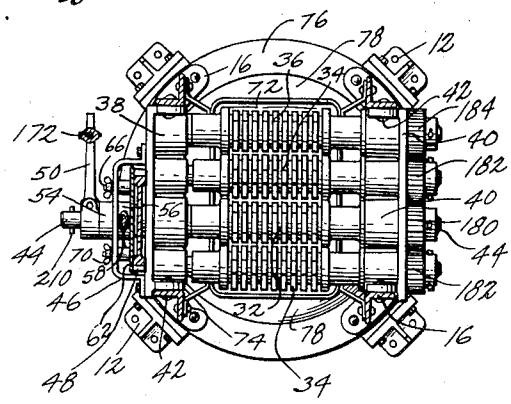
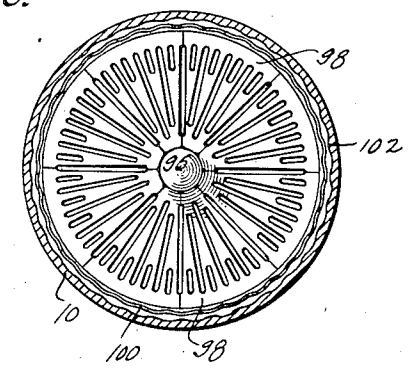


Fig. 5.



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Filed June 14, 1929 3 Sheets-Sheet 3

Fig. 6.

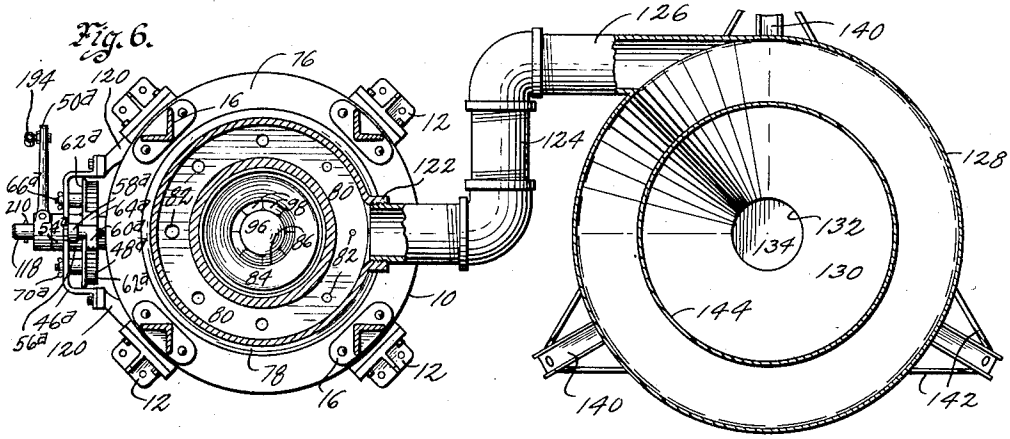


Fig. 7.

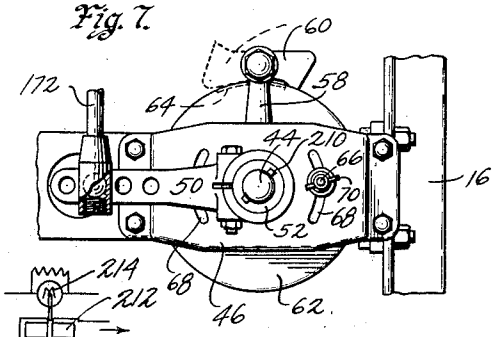


Fig. 8.

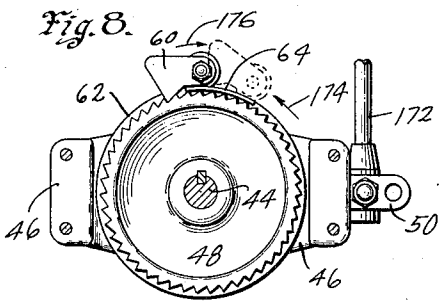
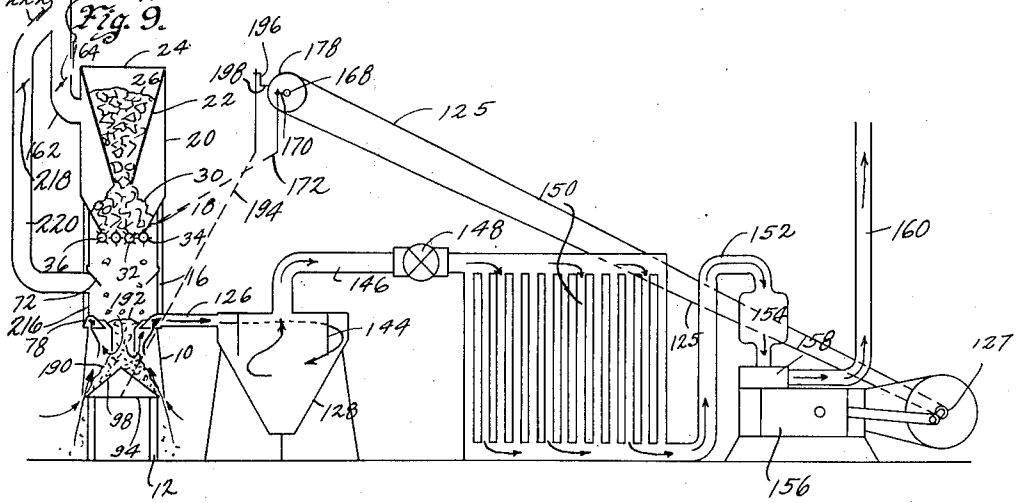


Fig. 9.



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UNITED STATES PATENT OFFICE

1,984,665

GAS GENERATING APPARATUS

Jay E. Tone, Des Moines, Iowa

Application June 14, 1929, Serial No. 370,759

8 Claims. (Cl. 23—277)

The object of my invention is to provide an economical and efficient process for producing an inert gas and an apparatus for accomplishing the process, the apparatus being of simple, durable and comparatively inexpensive construction.

More particularly it is my object to provide a process in which charcoal is initially burned and and the gas and smoke removed therefrom after which the partially burned charcoal is secondarily burned and air is forced through the burning charcoal whereby an inert gas results.

Still a further object is to provide an apparatus for producing gas by this process, consisting of primary and secondary combustion chambers and means for transferring the burning charcoal from the primary chamber to the secondary chamber and for drawing air through the burning charcoal in the secondary chamber whereby the air becomes an inert gas.

With these and other objects in view my invention consists in the construction, arrangement and combination of the various parts of my device, whereby the objects contemplated are attained, as hereinafter more fully set forth, pointed out in my claims and illustrated in the accompanying drawings. Although the invention is susceptible of a variety of embodiments, it is unnecessary to fully describe and illustrate more than one in order to give a full understanding of the invention both from its structural and functional standpoints. Accordingly, I have illustrated a preferred and desirable embodiment of the invention in the accompanying drawings, in which:—

Figure 1 is a side elevation of a portion of the apparatus used in producing gas by my improved process.

Figure 2 is a vertical sectional view through the same on the line 2—2 of Figure 1.

Figure 3 is an enlarged view partially in section, showing the gearing mechanism for the operation of parts of the gas producing apparatus.

Figure 4 is a horizontal sectional view on the line 4—4 of Figure 1, illustrating the upper grates forming the bottom of the primary combustion chamber.

Figure 5 is a horizontal sectional view on the line 5—5 of Figure 2, illustrating the grates forming the bottom of the secondary combustion chamber.

Figure 6 is a horizontal sectional view on the line 6—6 of Figure 1, illustrating the gas take-off portion of the apparatus.

Figure 7 is an end elevation of a portion of the operating mechanism of the apparatus.

Figure 8 is a sectional view on the line 8—8 of Figure 1, illustrating the reverse side of the mechanism shown in Figure 7.

Figure 9 is a diagrammatic view of my apparatus for producing inert gas; and

Figure 10 is a horizontal sectional view of the shield between the upper and lower combustion chambers.

In the packing of coffee in metal cans, the vacuum pack system has been extensively used. The vacuum pack system consists in filling the can with ground coffee and then removing the air therefrom by vacuum. It is well known that a perfect vacuum cannot be attained and therefore, a small quantity of air remains in the coffee can. This air has a deteriorating effect on the quality and taste of the coffee, the amount of deterioration increasing with age.

I have attempted to eliminate such a contingency by substituting for the air removed from the can, an inert gas and a small amount of reducing gas such as carbonmonoxide. I have found that the introduction of an inert gas into the coffee will neither harm nor deteriorate the flavor and quality of the coffee even though left in the can indefinitely.

One way of producing an inert gas is to burn charcoal and draw air through the burning charcoal whereby an inert gas results. However, a gas produced in this manner also draws the smoke from the charcoal and other gases of combustion and even though the smoke is very small in quantity, it has a tendency to affect the flavor of the coffee.

I have, therefore, endeavored to provide a process wherein the smoke and gases are first removed from the charcoal as it is being burned and thereafter the burning charcoal is introduced into a combustion chamber through which air is drawn and this air I find becomes an inert gas lacking the odorous and foreign taste imparting elements common to gas produced from charcoal which is only burned and the air passed directly through it while burning. I will now describe the apparatus for producing an inert gas by my improved process.

Referring to the drawings, 10 indicates a secondary combustion chamber which is substantially cylindrical in cross section. Legs 12 are secured to the chamber 10 for supporting the same relative to a floor 14. Supporting members 16 are secured to the top of the combustion chamber 10 and support on their up-

per ends, a combustion chamber 18. I will refer to the combustion chamber 10 as a secondary combustion chamber and to the combustion chamber 18 as a primary combustion chamber.

A charcoal container 20 is supported on the upper end of the primary combustion chamber 18 and has positioned therein, a feed hopper 22. A removable lid 24 is provided for the hopper 22. The hopper 22 may be filled with charcoal as indicated at 26 which settles by gravity through a thimble 28 and spreads as indicated at 30 over the bottom of the primary combustion chamber 18.

The combustion chamber 18 is in the shape of an inverted cone and its bottom is formed by a plurality of rotatable grates 32, 34 and 36. The grates 32, 34 and 36 have their ends journaled in bearing members 38 and 40. The members 38 and 40 are secured as indicated at 42 to the supporting members 16. The shaft 44 of the grate 32 extends beyond the bearing member 38 and through a bracket 46. Between the bracket 46 and the bearing member 38, a ratchet wheel 48 is provided.

An actuating arm 50 is secured to a sleeve 52 which surrounds the shaft 44 and extends through a bearing 54 formed on the bracket 46. Secured to the sleeve 52 between the bracket 46 and the ratchet wheel 48, is a hub 56 from which extends a pawl arm 58. A pawl 60 is mounted on the free end of the arm 58 and is adapted to engage the teeth of the ratchet wheel 48.

A gauge plate 62 is rotatably mounted on the shaft 44 adjacent the ratchet wheel 48. A pawl engaging flange 64 is formed on the gauge plate 62, the purpose of which will hereinafter be referred to. The gauge plate 62 may be adjusted by rotation and for holding it at any of its adjusted positions, threaded studs 66 are provided thereon extending through slots 68 in the bracket 46. Clamp wing nuts 70 are provided on the studs 66.

A substantially cone-shaped deflector 72 is mounted between the primary combustion chamber 18 and the secondary combustion chamber 10. The deflector 72 is supported in position relative to the supporting members 16 by means of rivets or the like 74.

The top of the combustion chamber 10 is formed by a plate 76 secured thereto and on which an annular manifold 78 is formed. Within the manifold 78, an annular passageway 80 is provided which communicates by means of openings 82 with the interior of the combustion chamber 10. The top of the manifold 78 is substantially cone-shaped and its top surface is in alignment with a cone-shaped surface 84 formed on a removable thimble 86. The combustion chamber 10 is formed with an extension 88 terminating in a head 90. An inspection glass 92 is mounted in the head 90 for the purpose of viewing the interior of the combustion chamber 10.

The bottom of the combustion chamber 10 is formed by a rotatable grate supporting member 94 and a head 96. Removable grate members 98 are supported by the member 94 and the head 96. The grate members 98 are substantially triangular-shaped and the head 96 being higher than the grate supporting edge of the member 94, the grate members form a substantially cone-shaped rotatable grate.

The periphery of the member 94 is corrugated as indicated at 100 and the lower inner periphery of the combustion chamber 10, is corrugated as indicated at 102. The grate supporting member 94 and the head 96 are secured to a shaft 104. The shaft 104 is rotatably mounted in a casing 106 provided with supporting arms 108. The arms 108 as indicated at 110 are secured to the supporting legs 12 of the device.

An adjustable thrust screw 112 is mounted in the bottom of the casing 106 for the purpose of supporting the shaft 104 and the parts secured thereto. Within the casing 106 a bevel gear 114 is secured to the shaft 104. A bevel pinion 116 best shown in Figure 1 of the drawings, is mounted on a shaft 118 journaled in one side of the casing 106 and in mesh with the bevel gear 114. The shaft 118 extends through a bracket 46*a* supported on extensions 120 which are in turn secured to the supporting legs 12 of the device.

The parts supported with relation to the bracket 46*a* and the shaft 118 are identical to the parts bearing the reference numerals 48 to 70 as already described in connection with the grates 32, 34 and 36. I will therefore refer to similar parts for operating the shaft 118 with similar reference numerals with the addition of the distinguishing character *a*.

A boss 122 is formed on the manifold 78 into which a pipe line 124 is screwed. The pipe line 124 extends to an intake pipe 126 formed on a separator 128. It will be noted by referring to Figure 6, that the intake pipe 126 of the separator 128 is arranged tangentially relative to the separator.

The separator 128 is substantially cylindrical in cross section and has a downwardly extending cone-shaped portion 130 terminating in a reduced cylindrical portion 132. A removable cover plate 134 held in position by bolts 136 and wing nuts 138, is mounted on the lower end of the cylindrical portion 132. Leg members 140 and braces 142 are provided for supporting the separator 128 relative to the floor 14. Within the separator 128 an annular baffle wall 144 is provided extending downwardly from the top of the separator and spaced from the outer wall thereof. Connected with the top of the separator 128 and communicating with the portion of the separator inside of the baffle wall 144, is an outlet pipe 146.

Referring to the diagrammatic view shown in Figure 9, the outlet pipe 146 communicates with a shut-off control valve 148. The control valve 148 is connected with a condenser 150 which is merely a plurality of tubes cooled by atmosphere and may, in practical construction, be a steam or hot water radiator.

A pipe line 152 leads from the condenser 150 to the air chamber 154 of a compressor 156. The valve box of the compressor 156 is indicated at 158 and from the valve box, a pipe line 160 extends. The pipe line 160 may discharge into a storage tank wherein the gas may be stored for immediate or future use as desired. Suitable automatic controlling devices may be utilized for regulating the pressure of the gas introduced into the storage tank.

Practical operation

In the practical operation of my device, the lid 24 is removed and the hopper 22 filled with charcoal as indicated in dotted lines at 26 in Figure 2 of the drawings. The charcoal feeds down-

wardly by gravity assuming approximately the position with respect to the primary combustion chamber 18 indicated at 30 and resting on the grates 32, 34 and 36. The charcoal resting on the grates is ignited by means of a blow torch or a gas torch which might be operated by the city gas and permanently attached to the machine.

After being ignited, the charcoal burns on the grates 32, 34 and 36 and whatever little smoke there is arising from the burning charcoal and some of the gas therefrom, pass upwardly in the container 20 and are discharged to atmosphere through a chimney 162. The burning of the charcoal on the grates may be controlled by means of a damper 164 mounted in the chimney 162. Preferably the chimney 162 extends to the intake side of an exhaust fan or blower 212, and from the top side thereof to a chimney or smoke stack. The blower 212 is operated by an electric motor 214 or may be driven from the compressor 127 if desired. A sliding check door may be provided in the chimney 162 so that cool air can be admitted to the gas being drawn by the blower from the casing 20 if desired.

My generating machine may or may not include a shield 216 (see Figure 2) extending from the hopper 18 to the flange 76 of the manifold 80. The shield 216 may be provided for the purpose of preventing the escape of gas into the atmosphere of the room in which the apparatus is located. I prefer to use the shield, and where it is used, it is open on one side to admit air as shown in Figure 10. The interior of the shield 216 is preferably connected by means of a pipe 220 with the chimney 162. A damper 218 and slide check door 222 are provided for controlling the draft of air through the pipe 220. It will be noted that the pipe 220 being connected with the chimney 162 (see the diagrammatic view Figure 9) whereby the blower 212 serves for exhausting the gas from both the interior of the hopper casing 20 and the shield 216.

The grate 32 is slowly rotated by oscillating the arm 50. For oscillating the arm 50, I provide an actuating device A including a casing 166 having a shaft 168 journaled therein.

A crank arm 170 is secured to the shaft 168 and through the medium of a link 172, oscillates the arm 50. Oscillation of the arm 50 causes the arm 58 to oscillate and thereby rotate the ratchet wheel 48 intermittently through the medium of the pawl 60. During each oscillation of the arm 58, the pawl 60 may rotate the ratchet wheel 48 any desired number of teeth therein by adjusting the gauge plate 62.

Referring to Figure 8 for instance, adjustment of the plate 62 in the direction of the arrow 174 will cause the pawl 60 to disengage the teeth of the ratchet wheel 48 due to the undersurface thereof engaging the flange 60 sooner upon oscillation of the arm 58 in the direction of the arrow 176 and therefore, the next tooth engaged by the pawl 60 will not be moved as far in the direction opposite to the arrow 176 as when the plate 62 is adjusted in the direction opposite to the arrow 174.

For rotating the shaft 168 and thereby rotating the grate 32, a pulley 178 is provided which may be belted by means of a belt 125 and pulley 127 to the shaft of the compressor 156 or run by an independent motor. A pin 180 is provided on the shaft 44 of the grate 32 and pinions 182 are provided on the grates 34 which mesh with the pinion 180. A pinion 184 on the shaft of the grate 36, meshes with one of the pinions 182.

From the construction of the parts just described, it will be obvious that rotation from the grate 32 is imparted to the grates 34 and 36. Disc like end portions 186 are provided on the grates 32, 34 and 36 for forming substantial end members slightly spaced from the irregular shaped lower edges 188 of the primary combustion chamber 18.

As the grates 32, 34 and 36 are slowly rotated, the partially burned charcoal falls into the deflector 72 and then through the thimble 86 and into the combustion chamber 10 where they pile up on the grate members 98 as indicated in dotted lines at 190 in Figure 2. The partially burned charcoal also fills the thimble 86 and assumes the position indicated at 192 whereby the thimble 86 and the space between the corrugated surfaces 100 and 102, is substantially filled. As the partially burned charcoal is burned in the secondary combustion chamber 10, the grate members 98 are slowly rotated through the medium of the bevel gear 114, the bevel pinion 116, the shaft 118, the ratchet wheel 48*a*, the pawl 60*a*, the pawl arm 58*a*, the sleeve 52*a* and the arm 50*a*.

The arm 50*a* is operatively connected by a link 194 to a crank arm 196 mounted on a shaft 198. The shaft 198 is journaled in the housing 166 of the gearing mechanism A and is operatively connected with the rotating shaft 168 by means of a worm gear 200 and a worm 202. The mechanism A is mounted on a bracket 204 which may be secured to the wall or to the container 20 if found desirable.

As a vacuum is produced in the condenser 150, atmospheric pressure will force air through the spaces between the corrugated portions 100 and 102 in the bottom of the secondary combustion chamber 10, and through the thimble 86 thereof. Such air in passing through the burning charcoal forms an inert gas free from oxygen and smoke produced when burning the charcoal in the primary combustion chamber.

This inert gas is forced by the atmospheric pressure through the openings 82 in the cover plate 76 of the combustion chamber 10 and into the manifold 78. It will be noted by referring to Figure 6, that the openings 82 vary in size whereby the pressure is equalized throughout the manifold 78 and there is a substantially even distribution of inert gas passing through the openings 82 into the annular passageway 80. From the passageway 80, the inert gas is discharged tangentially into the separator 128 whereby it is given a whirling motion before passing beneath the annular baffle wall 144 and into the discharge pipe 146 from whence the gas travels through the condenser and cooler 150 to the compressor 156.

The separator 128 receiving the gas in a whirling motion, causes any particles of charcoal ash which might have been collected thereby, to settle toward the outer surface of the separator due to centrifugal force. Then by gravity such particles drop into the cylindrical portion 132 from which they may be removed at intervals by removing the cover plate 134.

The condenser 150 is provided so that the gas will not leave the compressor 156 in a hot and expanded condition which would throw unnecessary work onto the compressor for having to compress an expanded gas. Therefore, by providing a condenser and cooler 150, a com-

pressor 156 of small capacity can be used for extracting the inert gas from the gas producing apparatus.

When cleaning out the combustion chambers 10 and 18, the grates 32, 34 and 36 and the grate members 98 may be manually rotated by a crank 206. The crank 206 is provided with slots 208 adapted to engage pins 210 extending through the shafts 44 and 118.

By operatively connecting the gear box A with the compressor 156, the speed of rotation of the grates of the combustion chambers and consequently the burning gate of the charcoal can be regulated with respect to the capacity of the compressor. Automatic control means for the damper 164 might also be provided whereby the burning rate of the charcoal could be controlled depending on the consumption of the inert gas or other factors.

Some changes may be made in both the specific manner of performing my process and in the construction and arrangement of the parts of my apparatus without departing from the real spirit and purpose of my invention and it is my intention to cover by my claims, such modified methods of performing the process and in the apparatus, such modified forms of structure or use of mechanical equivalents, as may be reasonably included within the scope of the claims.

I claim as my invention:

1. A gas generating apparatus comprising a casing, a grate extending across the casing and forming thereabove a combustion chamber in which fuel may be partially burned, a second grate extending across the casing for receiving the partially burnt fuel, means extending across said casing between the grates for forming above said second grate a substantially closed combustion chamber, means whereby air may be directed through the burning fuel on the second grate for converting the air into an inert gas collecting in said chamber above the burning fuel, and means whereby the inert gas may be drawn from said chamber.

2. A gas generating apparatus comprising a casing, a grate extending across the casing and forming thereabove a combustion chamber in which fuel may be partially burned, a second grate extending across the casing for receiving the partially burnt fuel, a fuel receiving means extending across the casing between the grates for receiving the partially burnt fuel and directing the same on to the second grate, said fuel receiving means being disposed so as to form a substantially closed chamber beneath the same, means whereby air may be directed through the burning fuel on the second grate for converting the air into an inert gas collecting in said chamber above the burning fuel, and means whereby the inert gas may be drawn from said chamber.

3. A gas generating apparatus comprising a casing, a grate extending across the casing and forming thereabove a combustion chamber in which fuel may be partially burned, a second grate extending across the casing for receiving the partially burnt fuel, means extending across said casing between the grates for forming above said second grate a substantially closed combustion chamber, means whereby air may be directed through the burning fuel on the second grate for converting the air into an inert gas, and a manifold connected with said closed chamber for collecting the inert gas.

4. A gas generating apparatus comprising a casing, a grate extending across the casing and forming thereabove a combustion chamber in which fuel may be partially burned, a second grate extending across the casing for receiving the partially burnt fuel, means extending across said casing between the grates for forming above said second grate a substantially closed combustion chamber, means whereby air may be directed through the burning fuel on the second grate for converting the air into an inert gas, a manifold connected with said closed chamber for collecting the inert gas, said manifold having a discharge opening at one side thereof, and openings from the manifold leading to the combustion chamber of progressive size with the smallest openings adjacent the discharge openings.

5. A gas generating apparatus comprising a casing, a grate extending across the casing and forming thereabove a combustion chamber in which fuel may be partially burned, a second grate extending across the casing for receiving the partially burnt fuel, an annular manifold attached to the casing and disposed between said grates, a thimble carried thereby and extending below the manifold for receiving and directing the partially burnt fuel on to the second grate, said thimble being disposed so that the fuel accumulating on the grate together with the thimble and the manifold will form a substantially closed chamber above said second grate, and means whereby air may be directed through the burning fuel on the second grate for converting the air into an inert gas collecting in the manifold.

6. A gas generating apparatus comprising a casing, an upper adjustable grate structure extending across the casing and forming thereabove a combustion chamber in which fuel may be partially burned, a second adjustable grate structure extending across the casing for receiving the partially burnt fuel, means for operating said grates in synchronism whereby the fuel after it is partially burned on the upper grate is discharged on to the lower grate where it is finally consumed, means extending across said casing between said grates for forming above said second grate a substantially closed combustion chamber, means whereby air may be directed through the burning fuel on the second grate for converting the air into an inert gas, collecting in said chamber above the burning fuel, and means whereby the inert gas may be drawn from said chamber.

7. In a gas generating apparatus, a casing, an upper combustion chamber in said casing, means for drawing off gaseous products of the first stage of combustion, a lower combustion chamber in said casing arranged to receive the partially burned fuel discharged from the bottom of the upper combustion chamber, means extending across the casing between the combustion chambers and having a passageway through which the partially burned fuel passes into the lower combustion chamber, means independent of said first means for drawing gases from the upper part of said lower combustion chamber and means for controlling the discharge of fuel and ashes from said last named chamber at such rate as to maintain a supply of partially burned fuel in the passageway extending entirely across the same.

8. In a gas generating apparatus, a combustion chamber, means for drawing off gaseous products of the first stage of combustion there-

from, a second combustion chamber arranged to receive partially burned fuel discharged from the bottom of the first chamber, means forming a passageway into the second chamber for partially burned fuel from the first chamber, a cone-shaped grate in said second combustion chamber open to the passage of air and having its apex adjacent the outlet end of said passageway, suction means for creating draft through the fuel in said passageway and through the fuel on said grate and for drawing gases from the upper part of the second chamber and means for controlling the discharge of fuel and ashes from the chambers at such rates as to maintain a supply of fuel in said passageway entirely across it.

JAY E. TONE.