Jan. 8, 1924.

1,479,875

B. F. SHAUGHNESSY

REFUSE INCINERATOR

Filed Oct. 2, 1920

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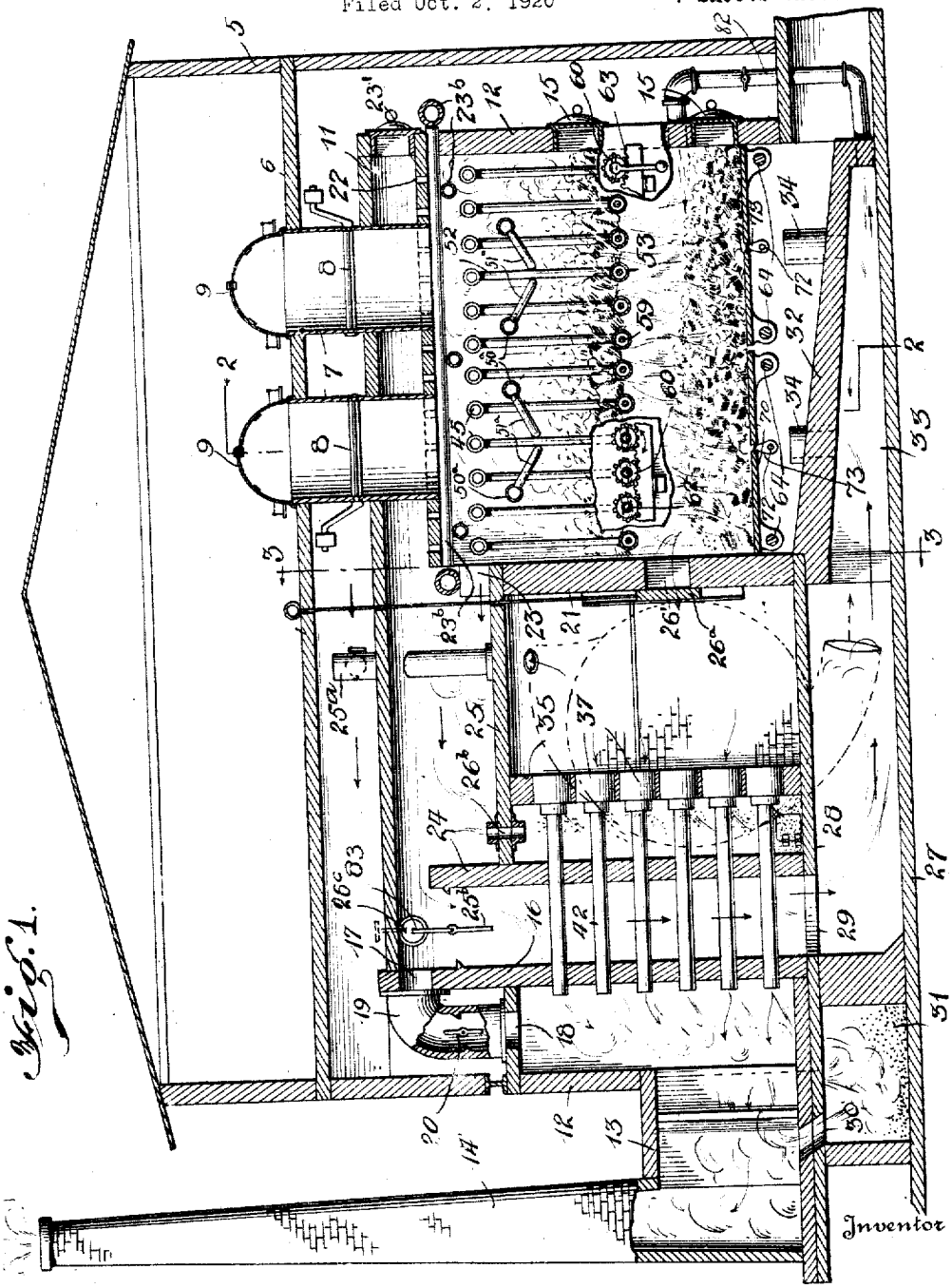


Fig. 1.

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By

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Jan. 8, 1924.

1,479,875

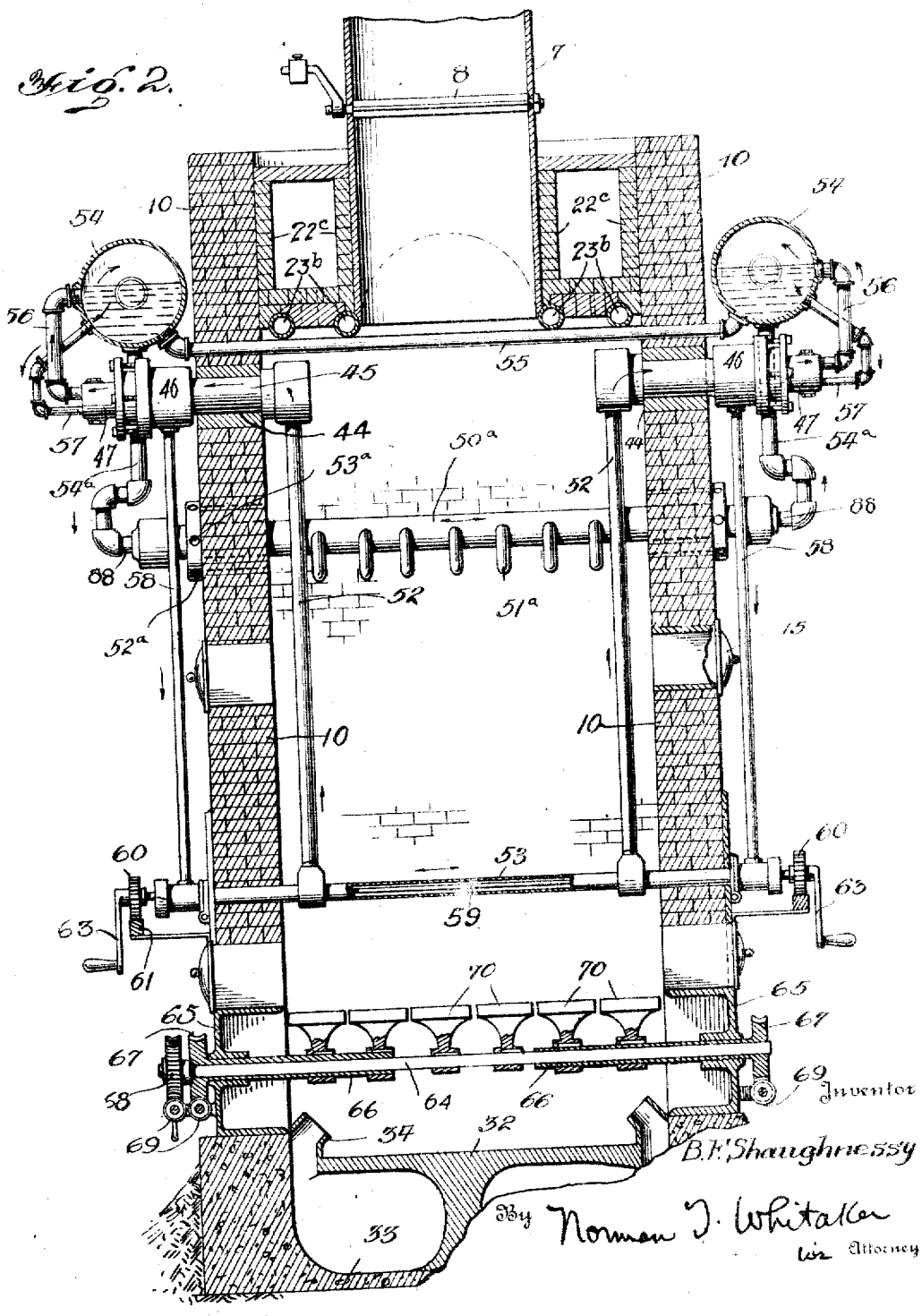
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REFUSE INCINERATOR

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7 Sheets-Sheet 2

Fig. 2.



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REFUSE INCINERATOR

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7 Sheets-Sheet 3

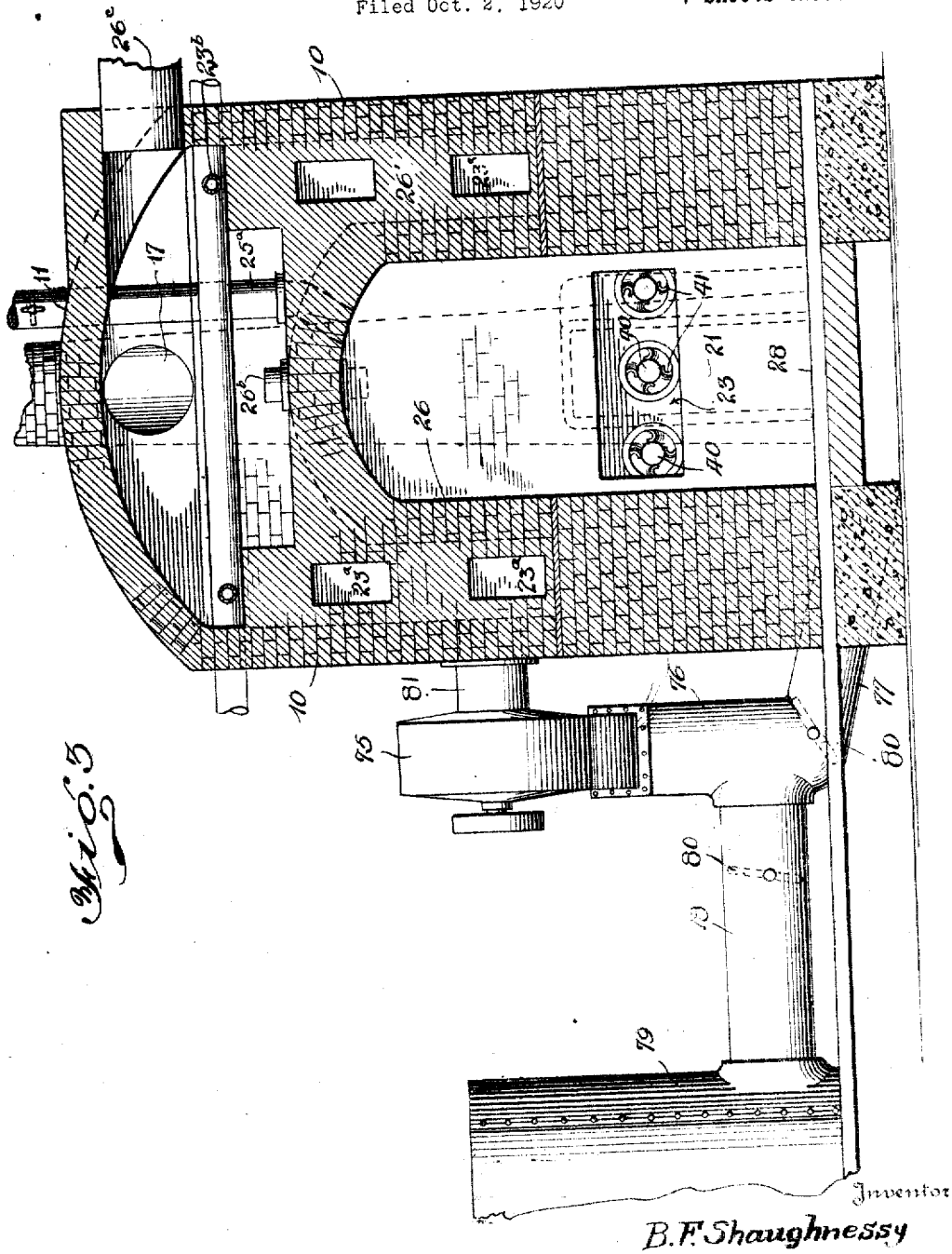


Fig. 5

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B. F. SHAUGHNESSY

REFUSE INCINERATOR

Filed Oct. 2, 1920 7 Sheets-Sheet 4

Fig. 4.

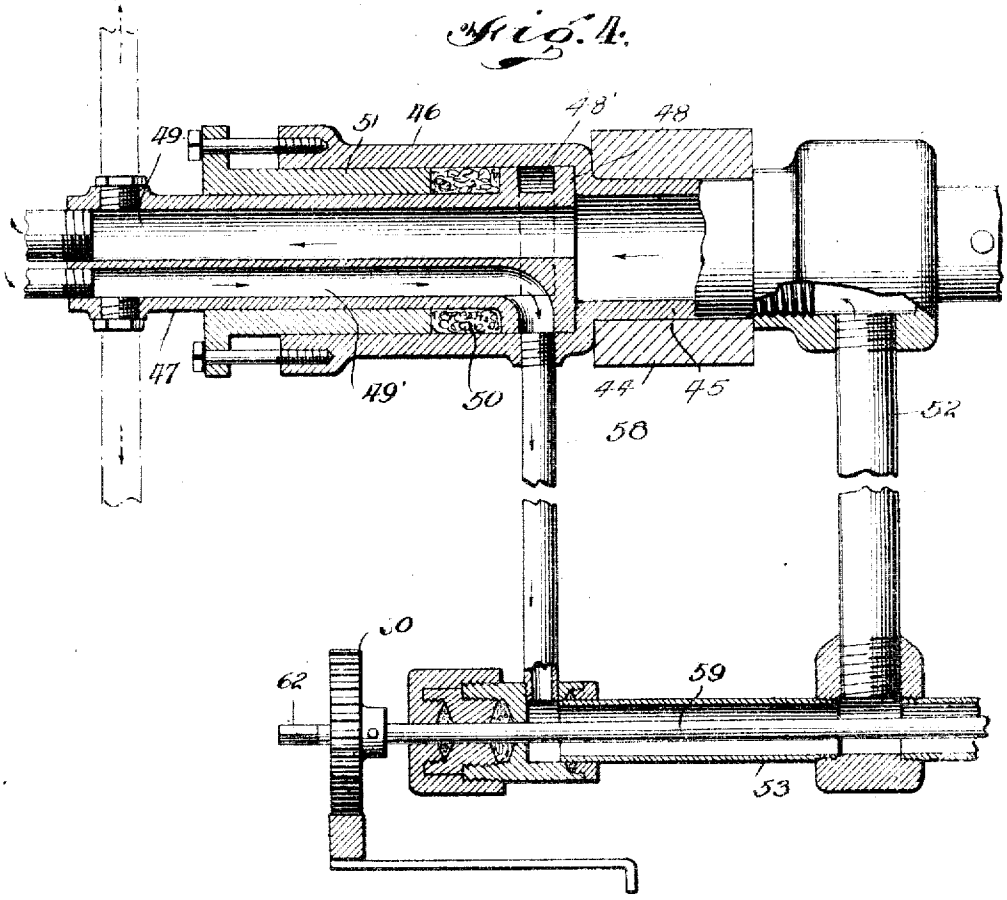
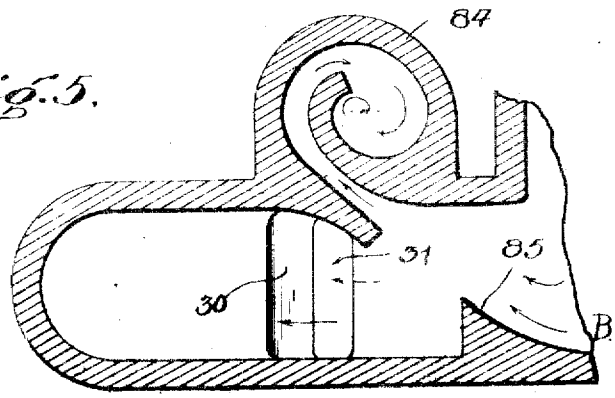


Fig. 5.



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REFUSE INCINERATOR

Filed Oct. 2, 1920 7 Sheets-Sheet 5

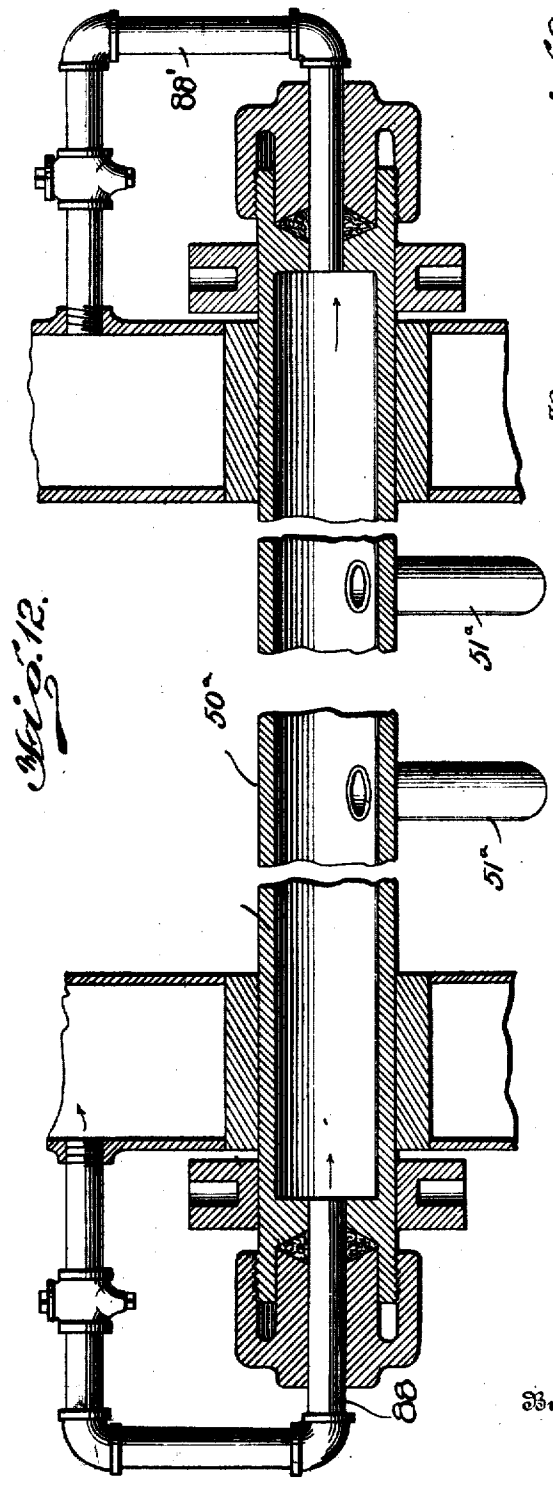


Fig. 12.

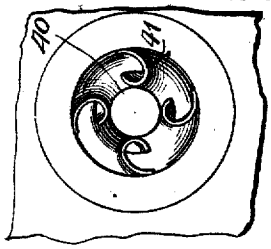


Fig. 8.

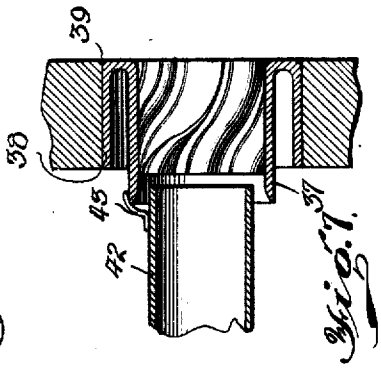


Fig. 7.

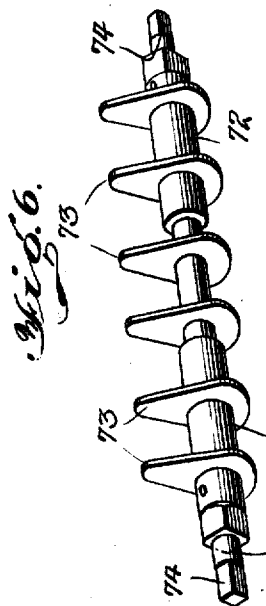


Fig. 6.

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REFUSE INCINERATOR

Filed Oct. 2, 1920 7 Sheets-Sheet 6

Fig. 9.

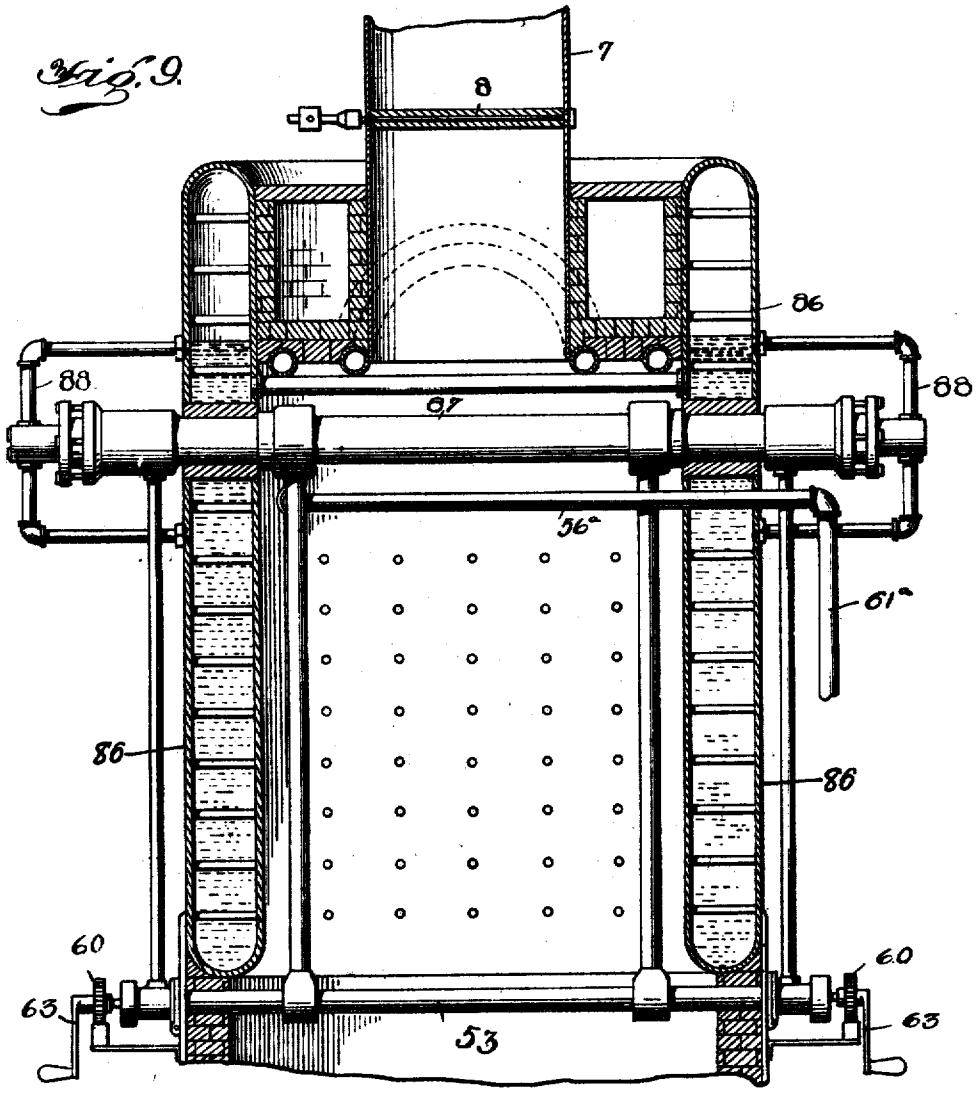


Fig. 10.

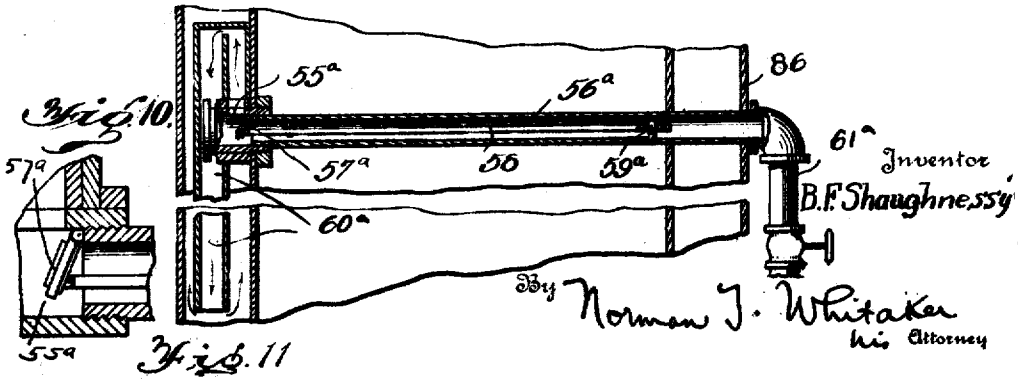


Fig. 11

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REFUSE INCINERATOR

Filed Oct. 2, 1920 7 Sheets-Sheet 7

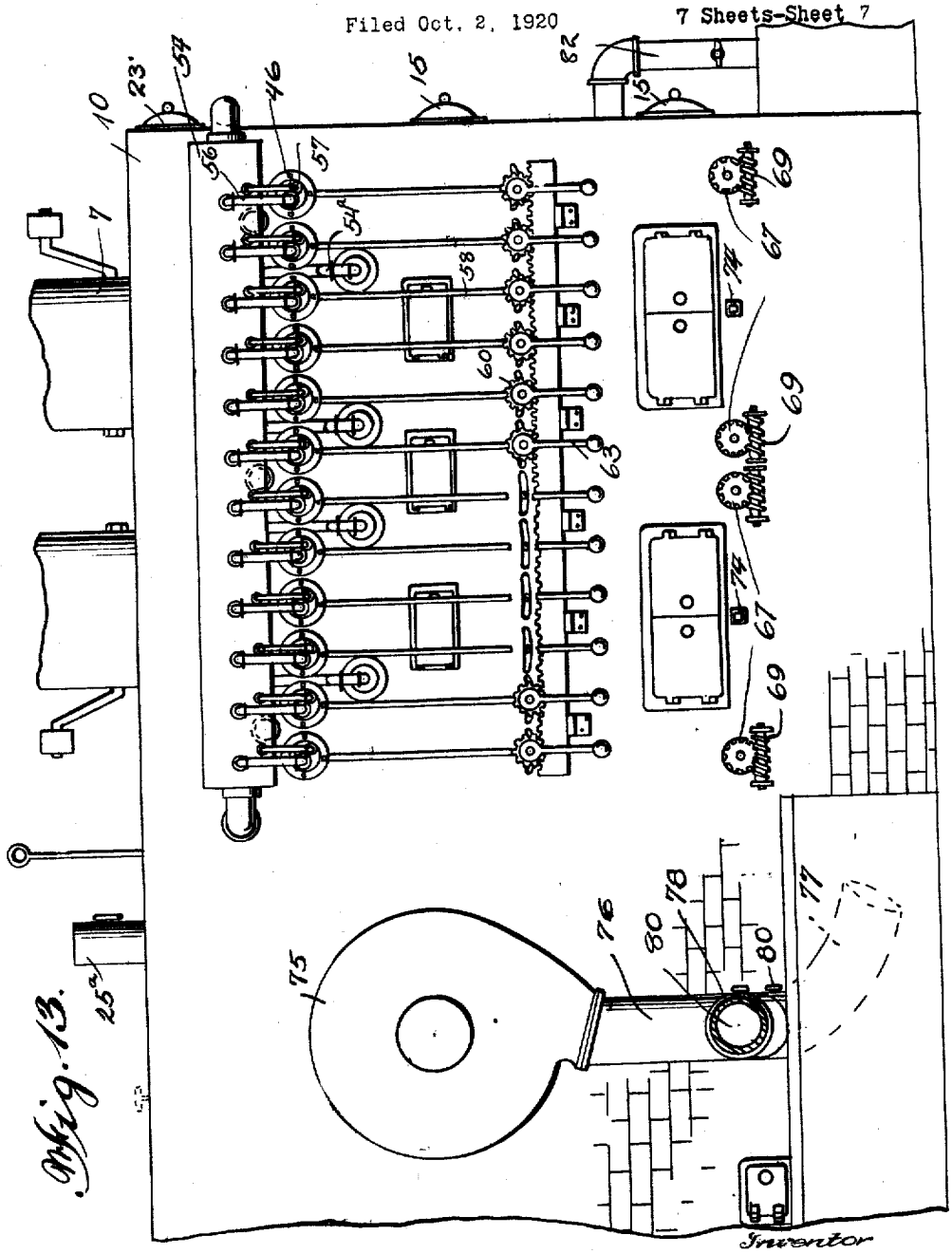


Fig. 13.

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Patented Jan. 8, 1924. 1,479,875

UNITED STATES PATENT OFFICE.

BERNARD F. SHAUGHNESSY, OF BROOKLYN, NEW YORK.

REFUSE INCINERATOR.

Application filed October 2, 1920. Serial No. 414,174.

To all whom it may concern:

Be it known that I, BERNARD F. SHAUGHNESSY, a citizen of the United States, and a resident of Brooklyn, in the county of Kings and State of New York, have invented a new and useful Refuse Incinerator, of which the following is a specification.

My invention is a refuse incinerator and its all important object resides in the provision of an apparatus that will burn or incinerate all combustible refuse including green or wet material together with the resultant gases, smoke and odors.

Further, my invention provides an incinerator or furnace for burning material such as garbage and other waste wherein these materials are first dumped upon a grate arranged above a main fire grate for drying and burning whereby to drive off all gases, odors and smoke, and subsequently dumped upon the main fire for further combustion, these gases, etc. being circulated through the furnace until they are wholly destroyed.

My invention also embodies a refuse burner or furnace which embodies a number of grates supported one above the other, which may be quickly and readily dumped.

Still another object of the invention resides in the provision of a refuse burner wherein the gases or products of combustion are conducted through separators where the heavy particles are separated from the gases and conducted to the ash pit before these burned gases have finally passed from the burner.

It is also within the provisions of the invention to provide a refuse incinerator employing an upper and lower grate, the former being water cooled to obviate being burned out due to the intense heat from the fire on the lower grate.

With the preceding and other objects and advantages in mind the invention consists in the novel combination of elements, constructions, arrangement of parts and operations which will be hereinafter enlarged upon, claimed and illustrated in the accompanying drawings, wherein:

Figure 1 is a vertical sectional view of the complete apparatus;

Figure 2 is a vertical sectional view taken on line 2—2 of Figure 1;

Figure 3 is a similar view taken on line 3—3 of Figure 1;

Figure 4 is an enlarged detail fragmentary view of one of the water-cooled grate sections;

Figure 5 is a fragmentary horizontal sectional view of the ash or particle collector arranged at the entrance of the chimney of the apparatus;

Figure 6 is a perspective of the lower grate bar latch embodied in the invention;

Figure 7 is is a fragmentary sectional view of one of the separators embodied in the invention;

Figure 8 is an end elevation of the same;

Figure 9 is a vertical sectional view of a modified embodiment of the invention;

Figure 10 is a fragmentary detail view of an automatic cut-off embodied in the construction disclosed in Figure 9;

Fig. 11 is a detail view of a valve.

Figure 12 is a detail fragmentary sectional view of the structure shown in Figure 9; and

Fig. 13 is an enlarged view of the furnace with adjacent parts.

Referring in detail to the drawings wherein similar characters of reference designate corresponding parts throughout the several views, the numeral 5 designates a building or shed having a floor 6 and extending below the floor and through the floor are discharge pipes or hoppers 7 in each of which a normally closed counter-balanced swinging trap door 8 is mounted. Overlying the upper ends of each of these pipes or hoppers 7 is a hood 9 including slidable sections adapted to be slid into one another at one side of the pipes when it is desired to discharge the refuse on the swinging trap door.

The furnace is built up of fire brick and consists of vertically disposed side walls and also consists of a top wall 11 through which the pipes or hoppers 7 extend and communicate with the interior of the furnace.

The front and rear walls of the furnace are designated at 12, the former being constructed with a passageway 13 for the escape of the products of combustion and from which the chimney 14 is built up. The rear wall is provided with doors 15 whereby access to the furnace may be had.

The top wall 11 extends to a vertically disposed wall 16 arranged adjacent the front wall 12 and extends above this wall. This wall 16 is provided with an outlet opening 17 while the passageway 13 is provided with an inlet opening 18 at its top and communicating with these openings is a pipe fitting 19 to conduct exhaust gases from the furnace

proper to the passageway 13. A valve 20 is arranged in the fitting 19 to control the passage of exhaust gases to the passageway.

A wall 21 constitutes a forward wall of the fire box of the furnace and is built up to a distance of more than one-half the height of walls 12 or 16. The wall 21 is provided with an opening 23 at its upper end that extends partly across the same. It serves to conduct some of the products of combustion from the fire box. This wall is also formed with smaller outlet openings 23^a below the opening 23. Arranged below the top wall 11 is a perforated top wall 22 of the fire box which is supported and braced by horizontally disposed tubes 23^b. Disposed between the walls 11 and 22 at opposite sides of the hoppers 7 are pairs of spaced walls 22^c which extend from the wall 22 to the wall 11 and with these walls constitute passageways for the products of combustion passing through the perforated wall. Doors 23' are mounted at the outer ends of these passageways whereby to regulate the draft therethrough.

Arranged at a point adjacent the wall 16 is a vertical wall 24 that stops short of the top wall 11, and extending from the upper end of the wall 21 to this wall 24 is a horizontal wall 25. An air supply pipe 25^a enters the combustion chamber, as clearly shown in Fig. 1. Numeral 25^b is a valve which will be described later. Extending from wall 21 to the wall 24 and to the horizontal wall 25 are vertical side walls 26. An opening 26' will be found in wall 21 and slidably mounted herein is a gate valve 26^a for governing the passage of smoke or gas from the fire held on the lower grate. A ventilator 26^b is provided in wall 25. There is further provided an inlet air passage 26^c, as clearly shown in Fig. 3. The walls 21, 24, 25 and 26 constitute what may be termed a somke or gas combustion chamber.

Extending the entire length and width of the structure is a cement or concrete foundation 27 and disposed above the latter and extending from the lower end of the wall 21 to chimney 14 is a floor 28 provided with openings 29 and 30. Below the openings 30 is a dust pit 31. There is also an inclined floor 32 upon which ashes fall. Below the same are longitudinal draft passages 33 and below floor 32 there is provided upwardly direct flue ducts 34 communicating with the fire box.

A vertically disposed wall 35 is arranged in the smoke or gas chamber and supported therein and extending through the walls 16 and 24 are a plurality of horizontally disposed ash separators and smoke or gas conduits. Each of these ash separators and conduits consists of a cylindrical head 37 bent at one end and extending around to afford a spacing ring 38 accommodated in an opening 39 in wall 35.

Arranged centrally in the head 37 is a plurality of spiral grooves 31. For each head 37 there is provided a tube 42, which passes through walls 16 and 24. The tube 42 is arranged concentrically with the horizontal axis of the head 37 and is held in place by clip 43. Owing to the draft through the pipes 42, the products of combustion will be concentrated at the center of each of the heads 37. Owing to the shape of the groove 41, the products of combustion will be given a whirling motion and thereby the heavier particles are thrown outwardly and will be discharged between the end of the tube 42 and head 37 and fall to the floor 28 thereof. The wall 24 with the wall 16 forms a preheating and mixing chamber through which the smoke and gas are drawn from the furnace. An air inlet 26^c supplies air to the chamber for the purpose of mixing with the gases to make the same more combustible. In other words, oxygen will be mixed with the gases on their way to be reburned, the direction being clearly shown by the arrows in Fig. 1 of the drawings.

The partially burned gases from the fire on the upper grate leave the combustion chamber by means of ports 22 and opening 23. These gases then take the following course, as indicated by arrows in Fig. 1.

An inner valve 26^c supplies air to those gases so as to make them more combustible. These gases reach the fire on the lower grate via opening 29, air passage 33 and air duct 34. For gas which is completely burned on the upper grate a by-pass 19 is provided. By-pass 19 is for the purpose of giving a more direct course to the chimney for gas which is sufficiently burned which might be if the refuse was paper or other dry material. This course will then be through pipes 19, butterfly valve 20 and opening 18 to the chimney 14, as clearly shown by the direction of the arrows in Fig. 1. Valve 25^b functions with valve 20 and can be opened or closed to suit the course.

Journaled in bearings 44 mounted on the side walls 10 are pairs of transversely aligned hollow rock shafts 45. Each rock shaft 45 is provided at its outer end with a packing cylinder 46 and disposed therein is a conduit 47 provided with a grooved head 48 positioned against the inner end of the cylinder 46. This conduit 47 is provided with a longitudinal passage 49 that communicates with the rock shaft 45 while a second longitudinal passage 49' opens into the groove 48' in the head 48. A packing 50 is arranged in the cylinder 46 against the head 48 and a stuffing box 51 is received around the conduit 47 and is bolted or otherwise secured to the cylinder 46. Depending from each of these rock shafts is a

tubular supporting arm 52 and supported in each pair of these arms 52 is a tubular grate bar 53 whose ends extend through the side walls 10 and are fixed for slight lateral movement therein, each of these grate bars 53 having communication with its supporting arms. Supported at each side of the furnace are water drums 54 having communication with each other by way of a conduit 55.

Water leaves the drum 54 by means of passage 57 then into conduit 47 (see Fig. 4) thence into groove 48', thus into pipes 58 and 59, as shown by the direction of the arrows in Fig. 4. Pipes 53 and 59 are constantly being heated and water in these pipes will be converted into steam. Steam will rise in pipe 52 and enter drum 54 by means of conduit 49 and pipe 56. The steam entering the drum 54 can be used for power purposes.

In order to swing any one or more of the grate bars from each other to dump the burning material supported thereon, there is provided for each grate bar a shaft 59 that extends longitudinally through the same and has gears 60 fixed to its opposite ends. A horizontally disposed rack bar 61 is rigidly supported upon each side of the furnace and is in mesh with the gears 60. The ends of the shafts 59 project beyond the gears and are squared as at 62, and adapted to have a wrench or crank handle 63 engaged on any one of these squared ends to rotate the gears which will rock the shafts a sufficient distance to move the grate bar carried by the operated shaft.

Inasmuch as the swinging grate bars 53 are a considerable distance below the floor 6 I have provided a rack which is located at a sufficient distance below the hoppers 7 to catch the refuse discharged therefrom and thereby break the fall of the same. This rack includes pairs of relatively heavy tubes 50ª having their ends journaled in the side walls of the furnace. Each pair of these tubes is disposed below one of the hoppers 7 and each is provided with a plurality of downwardly inclined fingers 51ª upon which the refuse discharged from the hoppers is supported and is subjected to the fire on the swinging grates 53. The tubes are provided with collars 52ª at their outer ends provided with a plurality of openings 53ª adapted to be engaged by a handle or implement whereby to rotate these tubes to any desired point to move the fingers toward or away from each other to enable the desired quantity of material to fall from the rack as it is burned by the fire on the swinging grates 53. If desired these tubes may be rotated to move the fingers away from each other to permit all of the refuse to fall from the rack to the swinging grates below.

Pipes 54ª lead from the water drums 54 to the ends of the tube 52ª to cool the same in the same manner as the grate bars 53.

Below the upper grate I employ a secondary grate which consists of pairs of rock shafts 64 having their ends journaled in bearings 65 in the side walls 10. Loosely mounted on each of the rock shafts 64 is a pair of tubular rock shafts 66 whose ends project beyond the side walls 10 and have worm wheels 67 fixed thereto while one end of each of the shafts 64 has fixed thereto a worm wheel 68. All of these worm wheels are operated by hand operated worm shafts 69 mounted on the side walls 10. Grate elements 70 are fixed to each of the tubular shafts 66 and to the central part of the shafts 64. It will be seen that by operating the desired worm wheel any pair or more of the grate elements may be dumped. In order to prevent the free ends of the grate elements from sagging there is provided a shaft 71 below the free end of the grate elements 70 and independently mounted on each of these shafts are relatively short tubular shafts 72.

Carried by each of the shafts 72 and the central part of the shaft 71 are pairs of upstanding parallel fingers 73, one pair for each pair of grate elements and are normally disposed in the position where the free ends of these grate elements will rest thereon. The outer ends of the shafts 71 and 72 project beyond the side walls 10 and are provided with squared surfaces 74 adapted to receive a wrench or crank handle or the like whereby any one or more of the shafts 71 and 72 may be operated to swing the desired fingers 73 downwardly so that the grate elements may then be dumped upon operation of the desired worm wheels 67 and 68.

Mounted to one side of one of the furnace walls is a vacuum producing fan designated in its entirety at 75, and leading therefrom is a pipe 76 having a lateral branch 77 at its lower end that extends through one of the side walls 10 below the bottom 28 of the smoke or gas combustion chamber. A branch pipe 78 extends from the pipe 76 and communicates with a condenser 79. Valves 80 are arranged in the branches 77 and 78 controlling communication to the furnace and condenser 79.

The intake of the fan is designated at 81 and communicates with the furnace at a point between one of the side walls 10 and one of the walls 26.

The fan is operated through any suitable driving mechanism (not shown) and under normal conditions draws the products of combustion upwardly through the perforated top wall 22 and outlet openings 23, thence into the fan from where it is conducted either to the condenser 79 or back to the furnace. In the latter case these products pass into the passageways

33 and intermingle with the combustible mixture from the pre-heating chamber and are discharged through the ducts 34 where they are subjected to the fire on the secondary or lower grates.

A by-pass 82 leads from one of the passageways 33 and is extended through the rear wall 12 at a point between the upper and lower grates, thus some of the products of combustion passing through the passageways 33 will be discharged into the fire box to cause a draft to aid the combustion of the fire. After the burned gases are subjected to the fire in the lower grate, they pass into the smoke or gas chamber and out by way of the separating head 37, the latter deflecting the heavier particles to the bottom of the furnace as hereinabove stated.

The passageway 13 is provided with a convoluted or spiral wall 84, one end of which projects within the passageway 13 in the path of the exhaust products passing therethrough. The opposite wall of the passageway 13 is formed with an angularly disposed deflector surface 85 forwardly of the inwardly projecting end of the convoluted or spiral wall 84, thus any particles that may remain intermingled with the exhaust gases that pass through the separating head 37 will be deflected into the passageway afforded by the spiral wall 84 upon contact with the deflector surface 85 and will drop to the bottom of the ash pit 31 while the exhaust gases pass into the chimney 14 to the atmosphere.

In the course of the burned particles of combustion from the furnace to the chimney, they pass in the direction of the arrows (see Fig. 5). The coarse particles are forced to the side by a deflector 85 and pass into 84 and dropping into the ash pit 31, while the gases pass into 30 and through chimney 14. This opening 30 from the pit 31 is a vent to let the gases up into the chimney while the ashes remain in pit 31.

In Figure 9 I have illustrated modified embodiments of the invention. In this construction I employ double walled water-cooled side walls 86. Extending transversely across the furnace and supported in these side walls is a plurality of evaporation tubes 87 having communication with pipes 88 leading to the double walled side walls 86 through which water circulates to and from the tubes 87 to cool the latter.

In Figure 10 I have illustrated an automatic cut-off associated with the water feed pipe and double walled furnace which comprises a valve chamber 55^a arranged between the walls forming one of the side walls of the furnace and is connected with one end of the water feed pipe 56^a. A check valve indicated at 57^a is pivoted in the valve chamber and is held in open position by a rod 58 arranged in the pipe 56^a having one end supported by a fusible element 59^a. Leading from the valve chamber 55^a is a pipe 60^a having two legs one leg of which extends downwardly below the pipe 56^a. It follows that should the water in the double walled jacket fall below the safety level, the tube 56^a would become dried out and upon permitting the water to flow from the feed line in an endeavor to supply water to the double walled jacket this tube would break or in case the fusible element 59^a melted before the water was again turned on the rod 58 would drop and permit the valve 60^a to close, thus preventing escape of hot water and steam from the burst or broken tube.

In Figure 12 I have shown one of the tubes forming the refuse rack associated with the double walled water cooled furnace. In this instance tubes 88′ lead from the double walled side walls to the ends of the tube so that the water will circulate from these side walls through the tubes.

The water feed line for the double walled side walls is indicated at 61^a.

It is to be understood that the forms of my invention herein shown and described are to be taken as preferred examples of the same, and that various changes in the shapes, sizes and arrangement of parts may be resorted to without departing from the spirit of the invention or the scope of the subjoined claims.

Having thus described my invention, what I claim as new and desire to secure and protect by Letters Patent of the United States, is:

1. A refuse incinerator comprising a furnace casing, refuse hoppers extending through the top of the casing, a fire box in the casing below the hoppers, upper and lower grates in the fire box, a gas chamber adjacent the fire box, a fan communicating with the interior of the casing and including a return passage communicating with the fire box below the lower grate, the fan drawing the products of combustion through the top of the fire box and discharging the same below the lower grate to be reburned and subsequently returned to the gas chamber, and means to conduct the smoke from the gas chamber to the atmosphere.

2. A refuse furnace comprising a furnace casing, a fire box in the casing, upper and lower grates in the fire box, means for discharging the refuse on the grates, an ash pit below the lower grate and provided with longitudinal passageways opening into the fire box, a fan arranged outside of the casing and having an inlet communicating with the casing forwardly of the fire box and hav-

ing an outlet communicating with the longitudinal passageways whereby the gases are returned to the fire held on the lower grate for reburning, and means for conducting the reburned gases from the fire box.

3. A refuse furnace comprising a furnace casing, a fire box in the casing, upper and lower grates in the fire box, means for discharging the refuse on to the grates, an ash pit below the lower grate and provided with longitudinal passageways opening into the fire box, a fan arranged outside of the casing and having an inlet communicating with the casing forwardly of the fire box and having an outlet communicating with the longitudinal passageways whereby the gases are returned to the fire held on the lower grate for reburning, means for conducting the reburned gases from the fire box, a chamber in the casing having communication with the fire box, a plurality of tubes having communication with the chamber and communicating with a common outlet, a tubular head at the rear end of each tube, and a plurality of downwardly inclined spiral plates extending through each of the heads whereby heavy particles are deflected downwardly to the bottom of the casing during the passage of gases passing through the heads on their way to the common outlet.

4. A refuse furnace comprising a casing, a fire box arranged at one end thereof, upper and lower grates arranged therein, a gas chamber adjacent the fire box and including side and top walls, a fan having its inlet communicating with the casing at one side of the gas chamber, an outlet pipe leading from the fan and having communication with the fire box below the lower grate whereby gases conducted from the fire box to the fan will be returned to the lower grate for reburning, and means for conducting the reburned gases discharged into the gas chamber from the same.

5. A refuse furnace comprising a casing, a fire box arranged at one end thereof, upper and lower grates arranged therein, a gas chamber adjacent the fire box and including side and top walls, a fan having its inlet communicating with the casing at one side of the gas chamber, an outlet pipe leading from the fan and having communication with the fire box below the lower grate whereby gases conducted from the fire box to the fan will be returned to the lower grate for reburning, means for conducting the reburned gases discharged into the gas chamber from the same, a common gas outlet at one end of the casing, a plurality of tubes communicating with the gas outlet and the gas chamber, and means at the rear end of the tubes to separate heavy particles from the gases before their entrance into the tubes.

6. A refuse furnace comprising a walled structure, a chimney at one end of the structure, a pipe communicating with the chimney and the walled structure and having a control valve therein, a gas chamber adjacent the fire box, a plurality of tubes passing through one end wall of the gas chamber and having communication with the chimney, means at the rear ends of the tubes to separate ashes therefrom before their entrance into the tubes, and suction means for drawing the gases from the top of the fire box and returning the same to the fire on the lower grate for reburning.

7. A refuse furnace comprising a walled structure, transverse walls in the structure, one of which constitutes a wall of the fire box, side and top walls extending from one transverse wall to the other, said walls constituting a gas chamber, a bottom for the structure supported above the ground and spaced therefrom, an ash pit extending from said wall to the rear end of the casing and provided with longitudinal passageways, a vertically disposed flue rearwardly of the gas chamber and communicating at its lower end with the passageway, a fan having an inlet communicating with the interior of the structure whereby the gases are drawn from the top of the fire box and an outlet pipe leading from the fan to the passageway below the bottom of the fire box.

8. An incinerator comprising a fire brick structure, a chimney at one end thereof, a passageway leading from the structure to the chimney, a spiral wall disposed to one side of the passageway and having one end thereof extended within the passageway, an angularly disposed baffle wall in the passageway rearwardly of the spiral wall to deflect products of combustion therein to discharge heavy particles to the bottom of the structure while the gas passes into the chimney, and a fire box in the structure for burning the refuse.

9. An incinerator comprising a casing, a fire box in the casing, upper and lower grates in the fire box, means for discharging material on the upper grate, a gas and smoke combustion chamber in the furnace having communication with the fire box between the upper and lower grates, a preheating and mixing chamber through which the smoke and gas from the upper grate pass, a conduit supplying air to the mixing chamber, passage-ways at the bottom of the mixing chamber and leading to the fire held on the lower grate, and suction producing means communicating with the interior of the casing whereby partially burned products of combustion are drawn from the upper grate to the lower grate for a second combustion, the products of combustion from the lower grate passing into the smoke and gas combustion chamber for a third combustion.

10. An incinerator comprising a casing, a

fire box in the casing, upper and lower grates in the fire box, means for discharging material on the upper grate, a gas and smoke combustion chamber in the furnace having communication with the fire box between the upper and lower grates, a preheating and mixing chamber through which part of the smoke and gas from the upper grate passes, a conduit supplying air to the mixing chamber, passage-ways at the bottom of the mixing chamber and leading to a point below to the lower grates, and suction producing means communicating with the interior of the casing whereby to draw the major part of the smoke and gas from the upper grate to conduct the same to the passage-ways to be conducted with the preheated products to the lower grate for a second combustion, the products of combustion from the lower grate passing into the smoke and gas combustion chamber for a third combustion, a plurality of tubes extending through the pre-heating and mixing chamber and having their inner ends disposed in the combustion chamber and the outer ends communicating with a common outlet and an ash separator arranged at the inner end of each tube to separate ashes from the exhaust products.

11. An incinerator including a casing, a fire box in the casing provided with a perforated top, upper and lower grates in the fire box, means for discharging material on the upper grate, a pre-heating and mixing chamber in the casing through which partly burned products of combustion pass, means for supplying air to the chamber, means for heating the air and products of combustion, a chamber having communication with the bottom of the fire box and the lower end of the pre-heating and mixing chamber, suction producing means whereby partially burned products of combustion are drawn through the casing and to the fire on the lower grate, a smoke and gas combustion chamber adjacent to and communicating with the fire box below the upper grate and adapted to receive the products of combustion from the lower grate, means for supplying air to the smoke and gas combustion chamber, and means leading from the last mentioned chamber to a common outlet to conduct the exhaust products to the atmosphere.

12. A refuse furnace comprising a casing, a fire box at one end thereof, a plurality of tubular water cooled grate bars supported in the fire box and capable of being rocked, means for rocking any one or more of the grate bars away from each other to permit the partly burned refuse to fall therefrom, a lower grate also in the fire box and upon which the partly burned refuse falls, an ash pit below the lower grate and provided with longitudinal passageways opening into the fire box, a suction fan arranged outside of the casing and having an inlet communicating with the casing forwardly of the fire box and having an outlet communicating with the longitudinal passageways whereby the partially burned gases are returned to the fire held on the lower grate for reburning.

13. A refuse furnace comprising a casing, a fire box in the casing, a plurality of tubular water cooled grate bars supported in the fire box and capable of being rocked, means for rocking any one or more of the grate bars away from each other to permit the partly burned refuse to fall therefrom, a lower grate in the fire box, a gas chamber arranged forward of the fire box, a suction fan having its inlet communicating with the casing at one side of the gas chamber, an outlet pipe leading from the fan and having communication with the fire box below the lower grate whereby gases conducted from the fire box to the fan will be returned to the fire held on the lower grate for reburning, and means for conducting the returned gases from the gas chamber.

14. An incinerator comprising a walled structure, transverse walls in the structure, side and top walls extending from one of the transverse walls to the other to define a gas chamber, a bottom for the structure supported above the ground and spaced therefrom, an ash pit extending from one of the transverse walls to the rear end of the structure and provided with longitudinal passageways, a vertically disposed flue rearwardly of the gas chamber and communicating at its lower end with the passageway, a suction fan having communication with the interior of the structure whereby the gases are drawn from the top of the structure, and an outlet pipe leading from the fan to the fire held on the lower grate for reburning.

15. An incinerator comprising a casing, a fire box arranged at one end thereof, pairs of tubular swinging arms journaled in the sides of the fire box, a tubular grate bar carried by each pair of arms, means for circulating a cooling agent through the arms and grate bars, means for rocking any one or more pairs of arms away from each other to dump the partly burned refuse from the grate bars, a gas chamber arranged adjacent the fire box, a suction producing fan communicating with the casing at one side of the gas chamber and having an outlet pipe communicating with the fire box whereby gases conducted from the fire box to the fan will be returned to the lower grate for reburning.

16. An incinerator comprising a casing, a fire box in the casing, an upper grate including grate elements mounted for rocking movement, means for supplying a cooling agent to the grate elements, a lower grate in

the fire box, a mechanism operatively connected with the grate bars whereby said grate bars may rock to permit partially burned refuse to fall therefrom, a gas and smoke combustion chamber in the casing having communication with the fire box between the upper and lower grates, a preheating and mixing chamber through which partly burned gases from the upper grate pass, means for supplying air to the mixing chamber, passageways at the bottom of the mixing chamber, and means for forcing the partially burned gases from the upper grate and to circulate the same through the passageway to the fire held on the lower grate for a second combustion, the products of combustion from the lower grate passing into the smoke and gas chamber for a third combustion.

17. An incinerator comprising a casing, a fire box arranged therein, a plurality of movable grate bars in the casing, a pair of tubular rock shafts for each grate bar journaled in the casing, a packing two passage cylinder carried by one end of each rock shaft, said cylinder having a head at one end having a circumferential groove, water reservoirs communicating with the passages, vertically arranged tubes communicating with the circumferential grooves and with the grate bars, a pair of tubular supporting arms for each grate bar having communication therewith and fixed at their upper ends to the rock shafts, and means for swinging any one or more pairs of arms away from each other to rock the grate bars.

18. An incinerator comprising a casing, a fire box arranged therein, a plurality of movable grate bars in the casing, a pair of tubular rock shafts for each grate bar journaled in the casing, a packing two passage cylinder carried by one end of each rock shaft, said cylinder having a head at one end having a circumferential groove, water reservoirs communicating with the passages, vertically arranged tubes communicating with the circumferential grooves and with the grate bars, a pair of tubular supporting arms for each grate bar having communication therewith and fixed, at their upper ends, to the rock shafts, means for swinging any one or more pairs of arms away from each other to rock the grate bars, a lower grate below the grate bars, a gas chamber arranged forwardly of the fire box, and a suction producing fan communicating with the casing and having an outlet pipe communicating with the fire box whereby gases conducted from the fire box to the fan will be returned to the lower grate for reburning.

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