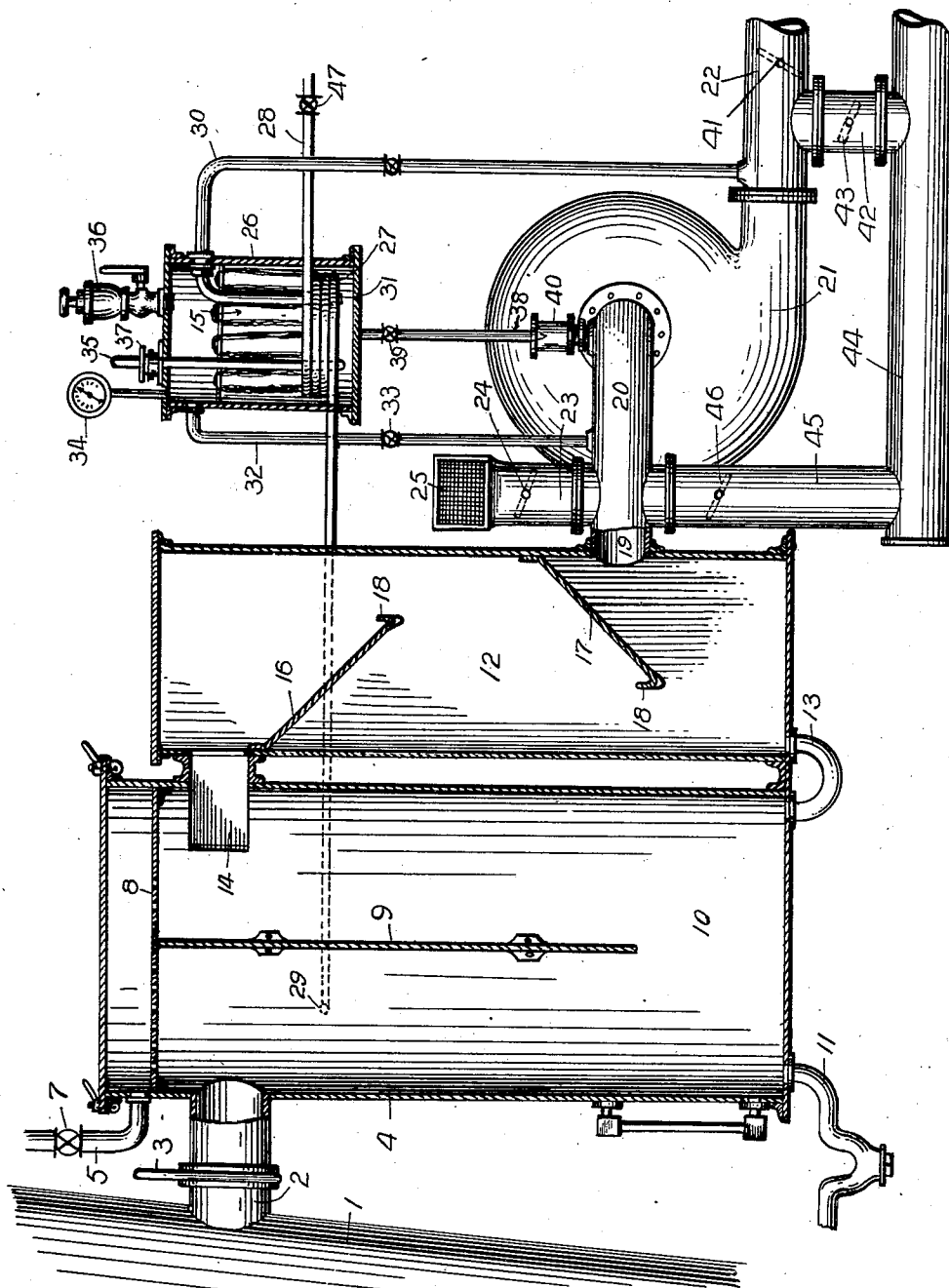


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 APPARATUS FOR COOLING, WASHING, AND DRYING GASEOUS PRODUCTS OF COMBUSTION,
 AND CHARGING THE SAME WITH FUMIGANTS.

1,087,290.

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WITNESSES:

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APPARATUS FOR COOLING, WASHING, AND DRYING GASEOUS PRODUCTS OF
COMBUSTION, AND CHARGING THE SAME WITH FUMIGANTS.

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Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, GEORGE HARKER, a subject of the King of Great Britain and Ireland, residing at 35 Boulevard, Petersham, near Sydney, in the State of New South Wales, Australia, have invented certain new and useful Improvements in Apparatus for Cooling, Washing, and Drying Gaseous Products of Combustion, and Charging the Same with Fumigants, of which the following is a specification.

It is well known that the gaseous products obtained from the combustion of carbonaceous fuel, such for instance as boiler flue gases and the exhaust of internal combustion engines, may be effectively applied for extinguishing fire in ships' holds and other chambers, and for destroying bacterial, insect, and animal life in such chambers. When those gases are used for the latter purposes it is usual to mix with them or to charge them with vapors or gases having germicidal or lethal properties.

It has been recognized that it is highly desirable in utilizing waste gaseous products of combustion for such purposes, to first extract soot from them and also to cool them, in order that furniture and goods contained in the chambers being operated upon will not be injured by dirt or heat. In some cases it has been proposed to cool the gases only, (omitting any scrubbing operation) by passing them through a pipe cooler of the surface condenser type in which they are caused to make contact with tubes or plates which are in turn cooled by water circulation or air contact. In other cases the gases are scrubbed and cooled in an apparatus of the shower condenser type in which they are brought directly in contact with a shower of water by which the soot is wetted and caused to be deposited while their temperature is reduced. The latter type of apparatus consists essentially of a source of gases of carbonaceous fuel combustion, a scrubber and cooler of the water shower type, a pump or steam blast device for moving the gases through the system, and ducts for conveying the cooled scrubbed gases to the points of use; to which is superadded in the case of a disinfecting or fumigating plant, means for

introducing into the gas flow a substance having disinfecting or lethal qualities. The gas delivered from such latter apparatus invariably carries with it a greater or less amount of entrained water, which has been carried over with it from the shower cooler and scrubber, and such entrained water injuriously affects the pump and the gas ducts, and wets and consequently injures furniture and goods contained in the holds or chambers being operated upon. In the case of disinfecting or fumigating apparatus, the presence of water in the gas is further objectionable for the reason that it usually takes the fumigant agent into solution, thus removing it from the gas atmosphere and reducing the potency of that atmosphere for purposes of fumigation.

In modified types of such apparatus (rarely if ever used in practice) in which the gas is forced into a body of water contained in a washing and cooling chamber and allowed to bubble up through said water, entrainment of water also occurs, though not to such a great extent as in the case of the usual type of apparatus in which the gases are passed through a shower of water; but the quantity of water carried over is in either case considerable and sufficient to cause injury either to the apparatus itself or to goods and furniture contained in the chambers operated upon.

Almost invariably, apparatus of the type to which the invention relates, is constructed for use on shipboard or is erected on a carriage, and in either of these cases it is practically essential to limit the dimensions of the cooler and scrubber so that the gases pass through it at a considerable velocity. It is found that in view of this practically necessary condition, the only effective form of cooler and scrubber usable which offers the necessary capacity within the permissible limit of dimensions, is a cooler and scrubber of the water shower type, in which the liability of entrainment of cooling water with the gas flow is a maximum. Owing to the absence of any recognition of the fact that it is necessary to remove entrained water from the gases after they leave the scrubber and cooler, it has been proposed

in several cases to use a steam jet as a forcing appliance for impelling the gases through the ducts to the point of use, thereby necessarily further wetting the gases and so increasing their maleficent properties.

I have discovered that the objectionable results found in practice to arise particularly in fumigating operations with apparatus including a cooler and scrubber in which the gases are brought into direct contact with water, may be entirely obviated by providing means for the removal of the entrained water from the gases after they leave the cooler and scrubber and before they enter the pump or equivalent forcing or circulating appliance. The provision of means for removing entrained water from the cooled and scrubbed gas insures the supply of a gas for use which is sufficiently dry to be unobjectionable and non-injurious in respect of apparatus through which it passes, and in respect also of the contents of the chamber in which it is applied.

My invention consists in the combination of a device for removing entrained water from the gas in fire extinguishing and fumigating apparatus having a water cooler and scrubber of the direct contact type. The device for removing entrained water may consist of a chamber fitted with a system of baffles against which the gas current strikes, or it may consist of an absorbing chamber in which materials known to be avid absorbers of water are contained; or it may consist of a vortex fan (such as is used for extracting tar from producer gas) which fan throws the water out of the gas current passing over it, by centrifugal action; but unless where special circumstances are present I invariably use an apparatus of the first mentioned type, owing to the obvious objection to the employment of absorbing agents which require to be replenished, and the inconvenience, cost, wear, and liability to break-down of mechanical apparatus of the centrifugal type.

The quantity of water which may be entrained in a current of gas is proportionate to the velocity of the gas; when therefore, the gas is passed through the eduction port or neck of the cooler or scrubber at a relatively high velocity, it carries with it a considerable volume of water. I therefore connect the cooler and scrubber with the chamber in which the entrained water is abstracted from the gas, through a duct, port, or neck of large area whereby it is permitted to pass from the former to the latter chamber at as low a velocity as the structural dimensions of those chambers will permit. The quantity of free water which the gas can carry in suspension from the cooler and scrubber is thus reduced to a minimum. The entrainment chamber is provided with a baffle plate, secured to one wall thereof and

having its free edge spaced from the opposite walls so as to leave an opening for the passage of the gas. This plate is preferably inclined downwardly from its point of attachment to its free edge at a rather sharp angle and the outlet from the chamber is disposed in the wall beneath this plate at a height intermediate between the upper and lower edges thereof. The gas passing through the opening is thus deflected sharply to one side, whereby the greater inertia of the water particles causes them to be thrown out of the gas current and to be thrown to the bottom of the chamber where they are taken up by the layer of liquid which is ordinarily present and removed through a suitable drain pipe. Other baffles can, if desired, be introduced into the chamber above the particular plate above described. The gases thus treated will be substantially free from entrained water or will contain only a negligible proportion thereof.

The chamber containing baffles for abstracting entrained water from the gas in the manner described, is made of greater cross section than the area of the ducts through which the gas is conveyed to the points of use; in practice it is made preferably at least twice the area of the delivery ducts. I wish it to be understood however that when an adequate system of baffles is used, I do not restrict myself to any certain proportion in areas of these parts so long as the area of the water depositing chamber be substantially greater than the area of the gas delivery ducts. I illustrate in the accompanying diagrammatic drawing the principle of construction of an apparatus embodying my invention as applied to an apparatus usable either for the preparation and movement of gases for the extinguishing of fire in, or the fumigating of a ship's hold.

1 is a furnace chimney, 2 an offtake gas duct leading therefrom, 3 a valve or damper in the duct 2, 4 water shower cooler and scrubber, 5 water service to same, 7 water control valve, 8 horizontal perforated diaphragm in upper part of chamber 4, 9 septum subdividing chamber 4 vertically and extending downward from the diaphragm 8, 10 open space below septum 9, 11 trapped drain pipe for removing waste water from bottom of chamber 4, 12 water baffle chamber in which entrained water is extracted from the gas, 13 trapped connection from the bottom of chamber 12 into the bottom of chamber 4 to admit of waste water from chamber 12 passing into the bottom of chamber 4, 14 intake mouth or duct connecting chambers 4 and 12. The duct 14 is made the full width of the chamber 12 so as to obtain a slow gas flow through it; immediately in its locality the diaphragm 8 is not perforated, the object of this omission being to

prevent water from passing directly from it into the duct 14.

16 and 17 are angular baffle plates in the chamber 12, arranged to change the direction of the gas flow in such a way that the gas in passing through the chamber will successively strike the walls of the chamber and those baffles, whereby water will be removed from it, said water thereafter flowing along said plates and baffles and finding its way to the bottom of the chamber. The lower ends of the baffles 16 and 17 are bent up as shown at 18 to form gutters which are set with a fall toward one side of the chamber so that water passing into said gutters will drain along to the lower end thereof and pass down in a stream.

19 is the gas off-take duct from the chamber 12 to the intake 20 of the gas pump 21. This pump is a pump of the ordinary centrifugal type, but where the gas is required to be delivered through a considerable length of duct to points of use or is required to be delivered under higher pressure than is conveniently obtainable with a one chamber centrifugal pump, then a two, three or four chamber centrifugal pump or a positive pressure blower may be used.

23 is an air intake duct leading into the duct 19 and fitted with a valve 24 and covered with a screen cap 25 to prevent solid matter passing into the duct.

26 is a closed receptacle which is charged with a fumigating liquid or a vaporizable solid fumigant. This receptacle is fitted with a steam coil 27 served by a pipe 28 valved at 47 leading from the boiler, and having its eduction end 29 carried into the entry side of the cooler and scrubber 4.

30 is a valved pipe leading from the gas delivery duct 22 into the fumigant receptacle 26, its end 31 being preferably dipped and brought near the bottom of said receptacle so that gas passing through it will be forced through liquid contained in the receptacle, and such gas thereby charged with fumigant.

32 is a pipe valved at 33 and leading from the top of the chamber 26 into the intake 20. 15 are hanging cotton wicks the lower ends of which dip into the fumigant liquid contained in the receptacle 26, and raising same by capillary action, expose a large surface thereof to the gas passing through said receptacle.

34 is a pressure gage, 35 a thermometer, and 36 a valved feed cup. The thermometer is inserted through a stuffing box 37 which is fitted in one of the walls of the receptacle 26.

38 is a pipe leading from the bottom of the fumigant receptacle 26 into the intake 20 of the pump 21. This pipe is valved at 39, and inserted in its length is a glass tube or sight feed lubricator device 40

through which liquid may be seen when permitted to pass through the pipe 38 from the receptacle 26.

22 is the outflow connection from the pump 21; it is fitted with a valve 41 which controls its connection with atmosphere, and it is connected through a neck 42, also valved as shown at 43, with the gas service trunk 44 from which pipe ducts lead away to the points of use of the prepared gas. A neck 45 is also provided between the gas trunk 44 and the duct 19. This neck is fitted with a valve 46.

The valves 3, 24, 41, 43, and 46 may be gate valves or valves of the butterfly or other type, the particular construction used not being material, though it will usually be found satisfactory to use any valve of the gate type such as used in ordinary ventilation practice.

The mode of operation of the system when applied for the extinction of fire is as follows:—All the valves are closed with the exception of the gas valves 3 and 43 and the water valve 7, which are opened. The pump 21 being now set in operation, hot gas is drawn from the furnace chimney 1 or other source of products of combustion of carbonaceous fuel. That gas passes through the duct 2, through the cooling and scrubbing chamber 4, first downwardly and then upwardly therein, the water shower from the perforated diaphragm plate 8 meantime cooling the gas and washing soot out of it. The gas then passes through the duct 14 into the water baffle chamber 12 and strikes against the walls of said chamber and the baffles 16 and 17 in its passage therethrough to the duct 19, being deflected to and fro in said chamber and at each surface of deflection depositing some of the entrained water. Water abstracted from the gas in its passage through the chamber 12 is thrown down to the bottom of that chamber or trickles over the surfaces on which it is deposited and so passes to the bottom of said chamber, whence it is drained back into the chamber 4 through the trapped connection 13 and thence passes to waste with the waste water from the chamber 4 through the trapped outlet 11. From the duct 19 the washed and cooled gas deprived of its entrained water passes to the intake 20 of the pump 21 and is forced by the pump through the neck 42 into the service duct 44 from which it is led off to the points of use through pipe ducts.

For the purpose of freeing a hold or other inclosed chamber from the gas after a fire has been extinguished therein, the pump and its connections are again used. In that case the valves 41 and 42 are opened and all other valves are closed. On the pump being then operated, gas is sucked back from the chambers in

which it has been used, through the duct 44 and the neck 45, thence through the duct 19 into the pump and is ejected by the pump through its outflow connection 22. When
 5 it is desired to force atmospheric air into such chambers for the purpose of ventilation, the valves 24 and 43 are opened and all other valves closed. This atmospheric air is drawn in through the cap 25, and the
 10 ducts 23 and 19 to the pump 21, and is forced by the pump through the neck 42 into the service trunk 44 and thence to the points of use.

In operating the apparatus for disinfecting or fumigating purposes, a liquid disinfecting agent is charged into the receptacle 26 through the feed cup 36; thence it may be allowed to pass through the pipe 38, by opening the valve 39 therein, into the pump
 15 intake, while the apparatus is being otherwise operated as for fire extinguishing purposes. When it is required to supply the fumigating agent to the gas current in a vaporized or gasified condition, the coil 27
 20 is heated by opening the valve 47 to pass steam through the pipe 28, and the valves in the pipes 30 and 32 are opened and the valve 39 is closed. Thereupon, the pump being put in operation as before, gas under
 25 pressure passes upward through the pipe 30 and is caused to bubble up through the heated liquid in the receptacle 26, and the vapors or gases produced are then carried through the pipe 32 into the pump intake 20. Similarly, when solid vaporizable fumigating
 30 agents are used, they are fed into the receptacle 26 and subjected to heating by means of the steam coil 27 as already described. When the fumigant is vaporizable without
 35 heating it will be unnecessary to open the steam valve in the pipe 28.

The valved feeding cup 36 permits the charge in the receptacle 26 to be replenished without discontinuing the operation. The
 40 gage 34 and the thermometer 35 indicate the pressure and temperature within the chamber 26 and so enable the operator to control the production of gaseous disinfectant by manipulating the valve 47, and also the
 50 valves in the pipes 30 and 32.

On the completing of the disinfecting operations, the chamber treated may be pumped out or atmospheric air may be driven into the same in the manner already described with reference to the treatment of chambers
 55 after the extinction of fire therein by means of this apparatus.

What I claim as my invention and desire to secure by Letters Patent is:—

1. In apparatus for the purpose set forth, 60 the combination of a source of supply of hot gaseous products of combustion or carbonaceous fuel, a duct therefrom, a water shower cooler and scrubber, means for abstracting entrained water from gas, a gas pump, ducts between the cooler and scrubber and the water
 65 abstracting device and between said device and the suction side of the pump, and ducts between the delivery side of the pump and the place of use of the gas. 70

2. The combination of a source of supply of hot gaseous products of combustion of carbonaceous fuel, a duct therefrom, a water shower cooler and scrubber, a water baffle
 75 chamber, a gas pump, ducts between the cooler and scrubber and the water baffle chamber, and between the water baffle chamber and the suction side of the pump and ducts between the delivery side of the pump and the place of use of the gas. 80

3. The combination, with a source of supply of hot gaseous products of combustion, of a water shower cooler and scrubber, a chamber having an outlet connection in its lower portion and a connection with
 85 said scrubber and cooler at its upper portion, said latter connection being of greater cross sectional area than said former connection whereby the gas velocity is lowered and its tendency to entrain water diminished, means in said chamber between said
 90 connections for removing entrained water particles from said gas, and means for aspirating gas through said outlet connection.

In testimony whereof I have affixed my
 95 signature in presence of two witnesses.

GEORGE HARKER.

Witnesses:

M. J. CANDRICK,
 W. J. DAVIS.