No. 656,601. Patented Aug. 21, 1900.

E. J. DUFF.

APPARATUS FOR PURIFYING GAS.

(Application filed Feb. 16, 1900.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

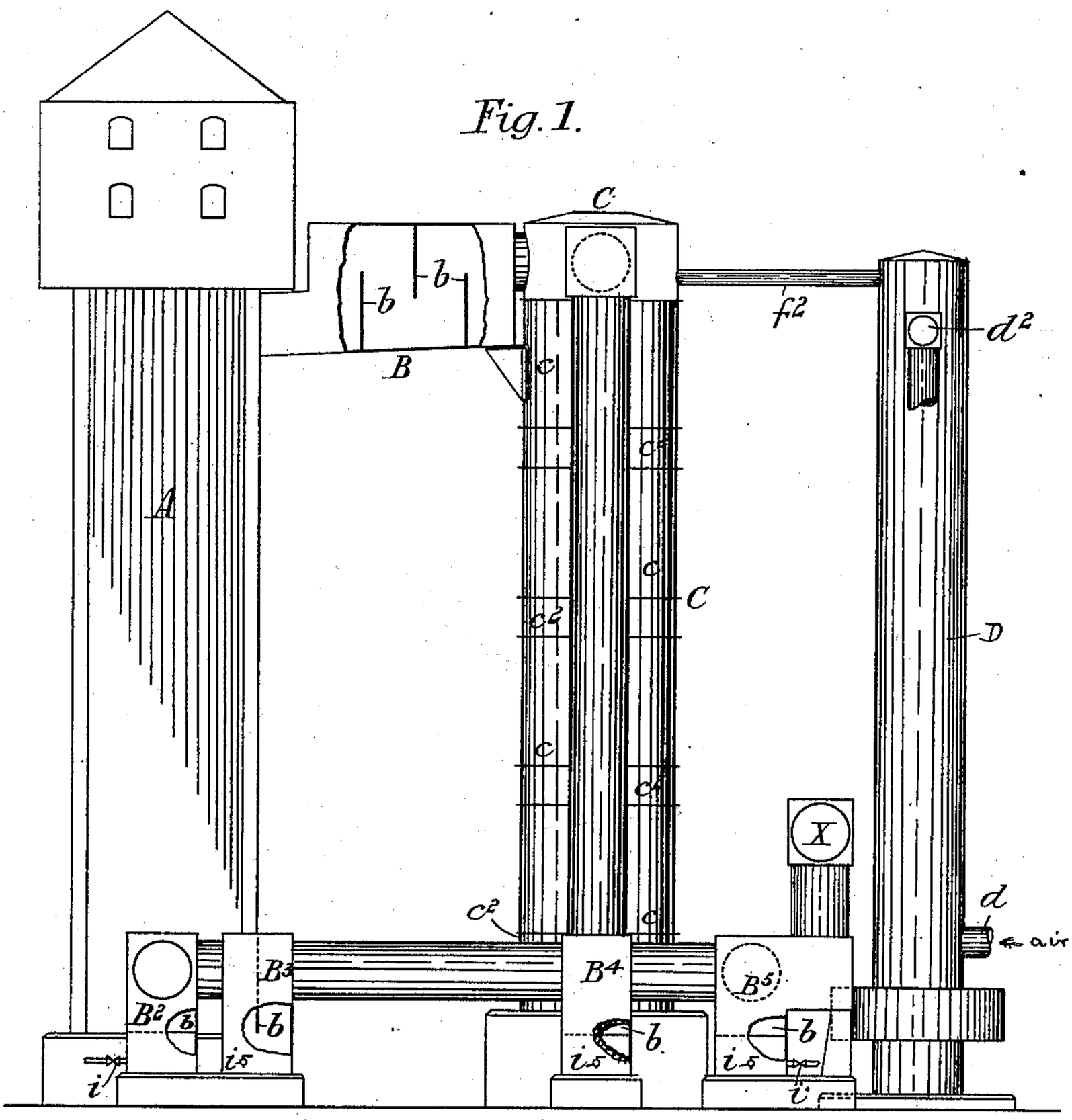
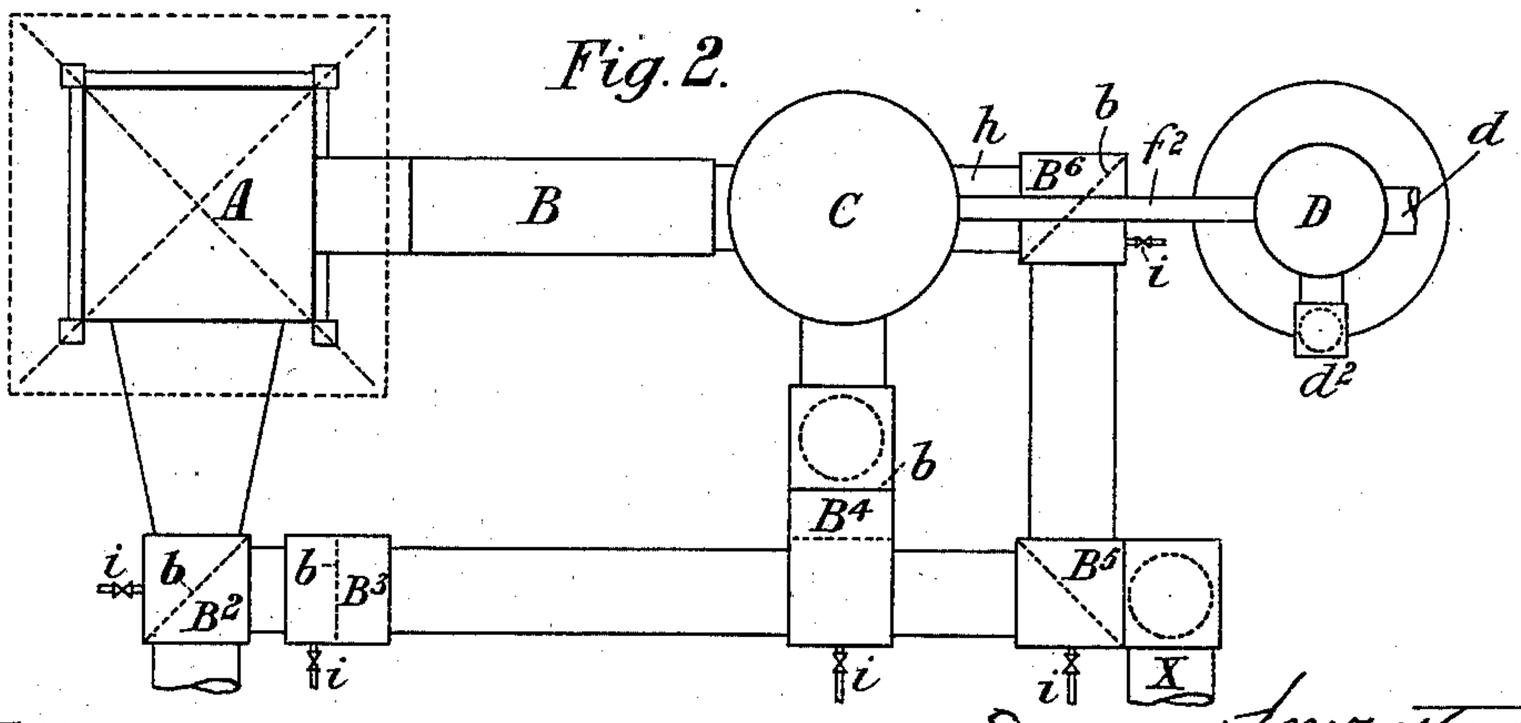


Fig. 2.



Witnesses:—
Fenwick Peters
W. B. Forkum

Inventor:—
Edward J. Duff
by Philip Thurso
his Atty.

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Fig. 3.

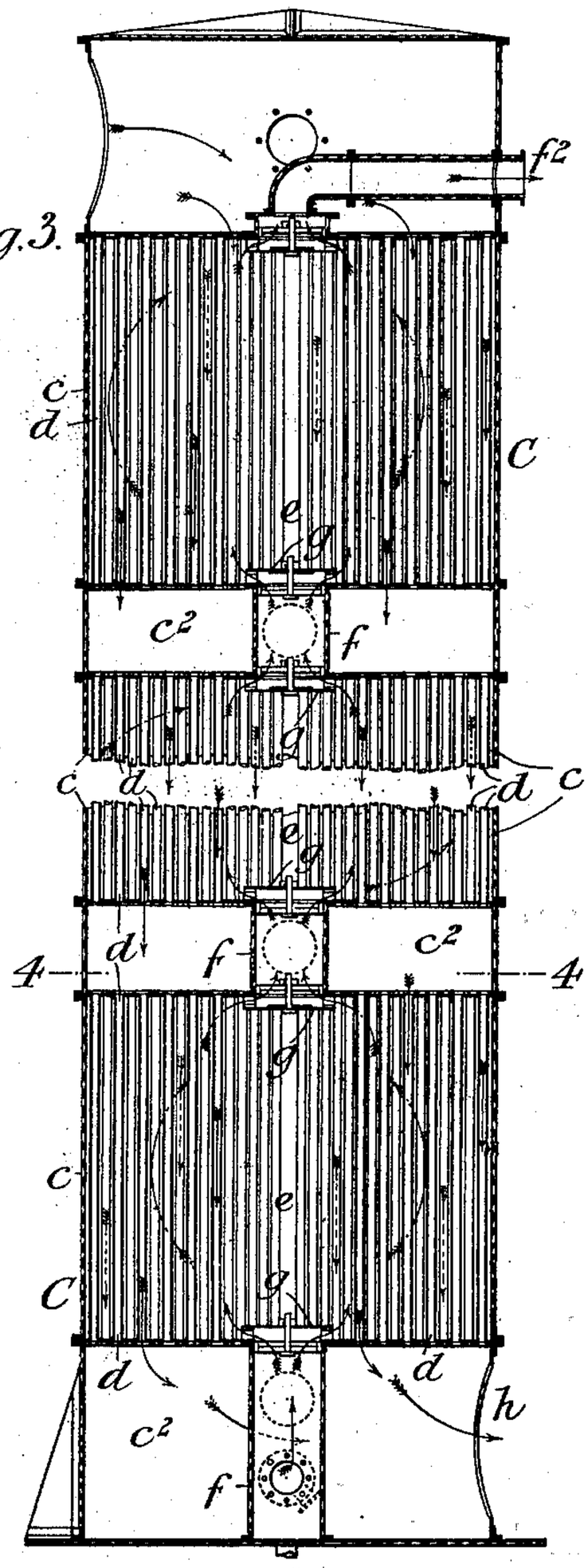
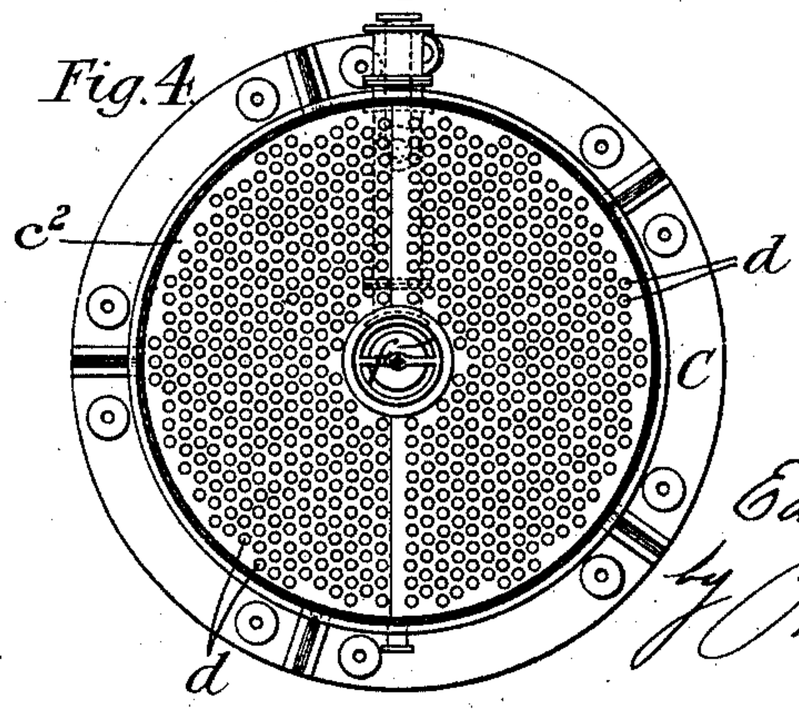


Fig. 4.



Witnesses:
Fenwick Lewis
W. B. Hackman.

Inventor
Edward James Duff
by Philip Mauro
his Atty.

UNITED STATES PATENT OFFICE.

EDWARD JAMES DUFF, OF LIVERPOOL, ENGLAND, ASSIGNOR OF ONE-HALF TO THE UNITED ALKALI COMPANY, LIMITED, OF SAME PLACE.

APPARATUS FOR PURIFYING GAS.

SPECIFICATION forming part of Letters Patent No. 656,601, dated August 21, 1900.

Application filed February 16, 1900. Serial No. 5,518. (No model.)

To all whom it may concern:

Be it known that I, EDWARD JAMES DUFF, a subject of the Queen of Great Britain and Ireland, and a resident of 30 James street, Liverpool, in the county of Lancaster, England, have invented certain new and useful Improvements in and Connected with the Treatment of Producer-Gases and Apparatus Therefor, (for which British Letters Patent have been applied for, No. 18,580, September 14, 1899,) which invention is fully set forth in the following specification.

This invention has for its object to effect greater efficiency and economy in the treatment of the gases generated in gas-producers, more especially with regard to the cooling of the gases and the utilization of otherwise waste heat therefrom.

The tar is separated and the ammonia recovered, which may be done in the usual manner by passing the gases from the producer upward through an absorption-tower containing material down over which acid is caused to flow. The gases so deprived of tar and ammonia leave the absorption-tower at the upper part or top and are ready to be cooled before burning, and it is chiefly to the construction and arrangement of cooling apparatus for this purpose that the improvements according to this invention relate.

In the following description the accompanying drawings are referred to, Figures 1 and 2 being respectively an elevation and a plan showing diagrammatically an arrangement of apparatus according to this invention. Fig. 3 is a vertical section of the interchanger or cooler; and Fig. 4 is a horizontal section of the same on the line 4 4, Fig. 3.

The absorption-tower is indicated at A. The gases on leaving the said tower traverse a pipe and lute-box B and pass to the top of a cooling-tower C, which consists of any convenient number of superposed chambers c and c^2, preferably different in size and arranged alternately.

Passing vertically through each of the larger chambers c are tubes d, arranged around a central space e, the open ends of these tubes opening into the smaller chambers c^2 above and below.

In each smaller chamber c^2 and flush with the dividing-walls between adjacent chambers there is concentrically arranged a pipe f, and opposed to the open ends of this pipe, but at a short distance from it, are placed in each larger chamber c plates g of somewhat greater diameter than the pipes f. The hot gases entering at the top pass downward through the tubes d in the larger chambers c, the various streams reuniting and mixing in each of the intervening smaller chambers c^2. In their downward passage the gases are cooled by water, which enters at the bottom of the tower by means of the central pipe f in the lowest of the smaller chambers c^2. On entering the larger chambers c the water is deflected by the plates g opposite the pipe-exit, and it passes upward between and around the vertical tubes d, through which the gases are passing. A similar deflection of the water takes place in each of the larger chambers c, since the water always enters these through the concentric pipes f of the smaller chambers c^2. The gases thus deprived of their heat and of much of their water-vapor pass away at h from the bottom of the cooling-tower C and are conducted to the place at which they are to be consumed.

The water used for cooling the gases has attained a high temperature by the time it reaches the top of the tower C and is conducted by the pipe f^2 directly to the top of a second tower D, (suitably packed,) through which air is forced at d, the said air in its upward passage meeting the descending hot water. The mixture of air and water-vapor so obtained is conducted from the outlet d^2 to the gas-producer and gives rise to the production of a further quantity of gas, which is treated as hereinbefore described.

The lute B in the pipe connecting the ammonia-recovery tower A and the cooling-tower C is provided with baffle-plates b, fixed at the sides and alternately at top and bottom to the walls of the pipe B. There are also similar luting arrangements below. When these lute-boxes contain no liquid, the gases pass freely through the spaces beneath the plates; but on the admission of liquid an effective lute is formed (by the liquid closing the spaces beneath the plates) which the gases will not pass at the ordinary

working pressure. The first lute-box is a double one, consisting of the portions B^2 B^3, and according to which one is luted (by liquid admitted by the pipes and valves *i*) the gases from the producer pass either to the ammonia-recovery tower A or without traversing this directly to the cooling-tower C through the lute-box B^4, or when this latter and the lute-box B^6 are closed then through the lute-box B^5 direct to the point of consumption, as required. When the lute-box B^2 is open—that is, not luted with liquid—and the lute-box B is closed—luted with liquid—the gas passes through the lute-box B^2 into the absorption-tower A and afterward passes through the pipe and lute-box B down through the cooling-tower C and out through the then-open lute-box B^6 at the back of the baffle-plate *b* in the closed lute-box B^5 to the exit X.

To put the absorption-tower A out of operation, the lute-boxes B, B^2, and B^5 are closed by liquid and the lute-boxes B^3, B^4, and B^6 are opened by the removal of liquid, so that the gas will then pass only through the cooling-tower C. When both the absorption-tower A and the cooling-tower C are to be put out of operation, the lute-boxes B^2, B^4, and B^6 are closed by liquid and the lute-boxes B^3 and B^5 are opened by withdrawing liquid, so that the gas will pass from the inlet and in front of the baffle-plate *b* in the lute-box B^2 directly to the exit X. This arrangement allows the ammonia-recovery tower or the cooling-tower, or both, to be shut off for repairs or other purpose without interfering with the production of gas.

Having now particularly described and ascertained the nature of the said invention and in what manner the same is to be performed, I declare that what I claim is—

1. The combination with gas-producers of an interchanger of heat through which the gases from the producer are passed and through which water is also passed so that the water abstracts heat from the gases, and means for bringing the water, thus heated into contact with air to produce a mixture of air and water-vapor, and means for passing the said mixture to the gas-producer, substantially as hereinbefore described.

2. In combination with gas-producers of an interchanger for cooling the gases therefrom consisting of alternately-arranged chambers, the alternate ones of which are provided with tubes in communication with intervening chambers provided with a passage for water, into, and from, the first-named chambers, and with deflectors to cause the water to pass around the tubes through which the gases pass, substantially as hereinbefore described.

3. The combination with an absorption-tower through which gases from a producer are adapted to be circulated, a cooling-tower having a plurality of contiguous passages for the gas and water respectively, a passage connecting the upper ends of the gas-passages with the outlet from the absorption-tower, and a mixing-tower having an air-inlet at its lower end, and a water-inlet at its upper end connected by a passage with the upper ends of the water-passages of the cooling-tower, substantially as described.

4. The combination with an absorption-tower through which gases from a producer are adapted to be circulated, a cooling-tower having a plurality of contiguous passages for the gas and water respectively, a passage connecting the upper ends of the gas-passages with the outlet from the absorption-tower, a mixing-tower having an air-inlet at its lower end, and a water-inlet at its upper end connected by a passage with the upper ends of the water-passages of the cooling-tower, by-passages from the gas-inlet pipe to the absorption-tower, to the upper ends of the gas-passages through the cooling-tower, and to the gas-outlet passage from the cooling-tower, and means at the junctions of the connecting-passages between the towers and in the passage from the upper end of the absorption-tower to the cooling-tower, whereby said passages may be closed and the absorption-tower, or both the absorption-tower and the cooling-tower, cut out of the circuit for the circulation of the gases, substantially as described.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

EDWARD JAMES DUFF.

Witnesses:

ALFRED PATCHETT,

THOMAS SPROAT.