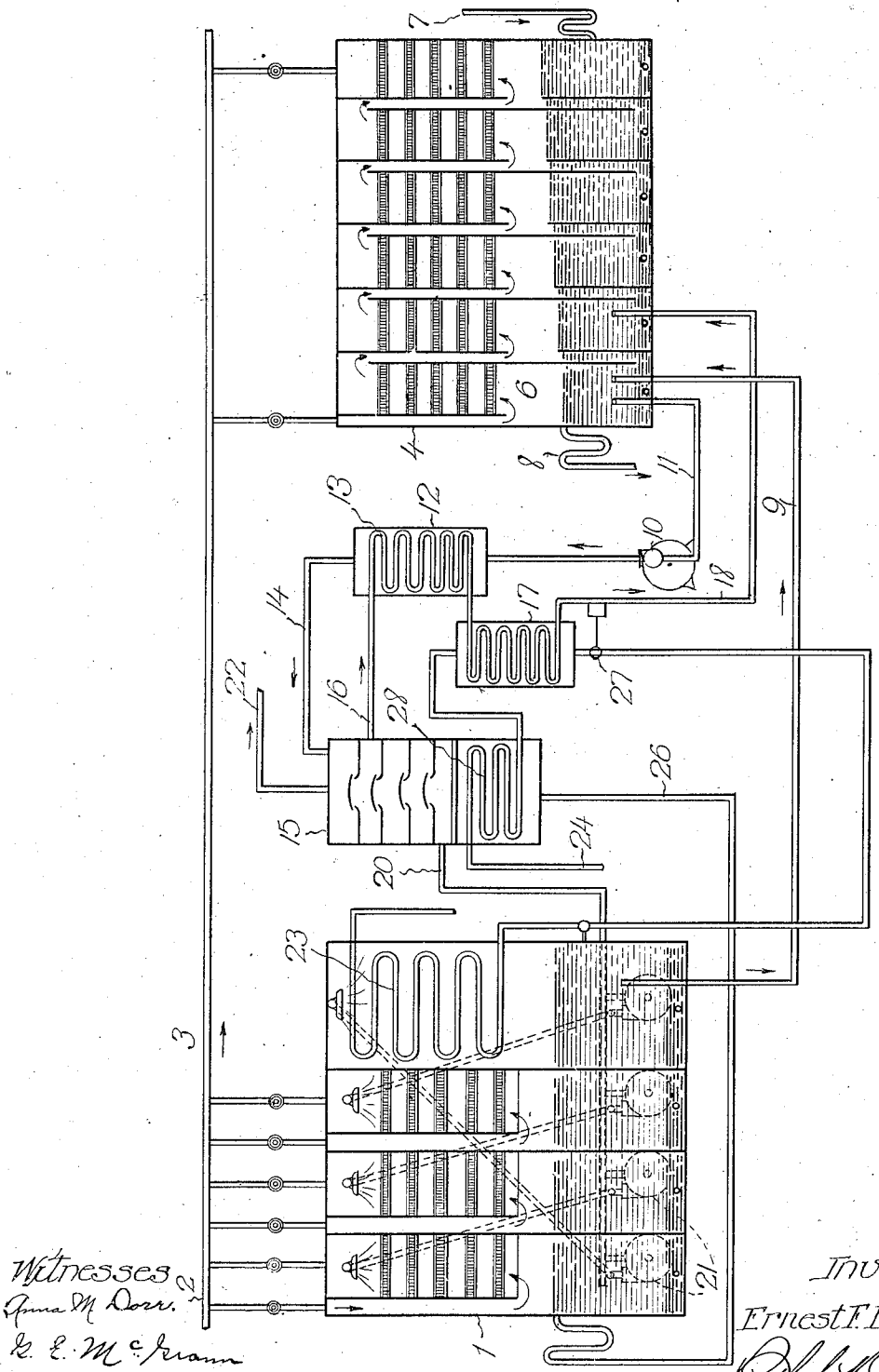
E. F. LLOYD.

APPARATUS FOR RECOVERING SULFUR AND AMMONIA FROM GAS.

APPLICATION FILED APR. 21, 1913.

1,132,594. Patented Mar. 23, 1915.



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UNITED STATES PATENT OFFICE.

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1,132,594. Specification of Letters Patent. Patented Mar. 23, 1915.

Application filed April 21, 1913. Serial No. 762,534.

To all whom it may concern:

Be it known that I, ERNEST F. LLOYD, a citizen of the United States of America, residing at Detroit, in the county of Wayne and State of Michigan, have invented certain new and useful Improvements in Apparatus for Recovering Sulfur and Ammonia from Gas, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to an apparatus for washing and cooling gas, and at the same time eliminating and recovering the sulfur and ammonia therefrom.

The invention consists in the matters hereinafter set forth and more particularly pointed out in the appended claims.

The drawing is a view, largely diagrammatic, of an apparatus that embodies features of the invention.

As herein indicated, a wash cooler 1 of any preferred type, or similar means for taking down the tars and reducing the gas to a proper temperature for scrubbing, has a gas inlet pipe 2 and a gas outlet pipe 3 whereby the washed and cooled gas is led into a scrubber 4. The wash cooler is of any type wherein the gas comes into contact with a washing and cooling liquor. The scrubber is of any suitable construction; it may be a rotary scrubber or other such similar apparatus for removing ammonia from gas by washing with fresh water.

The gas is introduced from the outlet pipe 3 of the cooler to the portion or chamber 6 of the scrubber wherein the liquor has attained a temperature which is substantially that of the gas, and is also, for purposes of this particular process, preferably the same as that of the liquor in the outlet chamber 6 of the wash cooler. The scrubber has a fresh water supply pipe indicated at 7 and an overflow pipe 8 from which the excess liquor flows to the crude liquor or "works" tank or cistern. A pipe 9 leads from the wash cooler to the compartment 6 of the scrubber 4. Another pipe 11 from this compartment is connected to a pump 10 whereby the liquor is forced into a heat recoverer 12. A discharge pipe 14 from the heat recoverer opens into the upper portion or chamber of a still 15. At the point of maximum efficiency, which in this type of apparatus apparently is near the lower portion of the second section or chamber of the still, the liquor introduced through the pipe 14 is tapped off through a pipe 16. This pipe discharges into the coils 13 of the heat recovery device, and from thence passes through a temperature regulator 17 and a return pipe 18 to a chamber of the scrubber 4 adjacent the chamber 6. The regulator is merely introduced to insure the reduction of the liquor to a temperature closely approximating that of the scrubber. Steam is forced into the still, as from a pipe 20, so as to rise through the sections thereof, and meet the incoming stream of liquor with its ammonia contents. As a matter of economical operation, the steam may be supplied from the exhaust of pumps 21 that form a part of the wash cooler 1. An outlet pipe 32 from the top of the still conducts the vapor therefrom. In the wash cooler refrigerating coils 23 are used and these may be connected through the regulator 17 and pipe 24 with cooling coils 28 in the base of the ammonia still. The liquor from the base of the still or condensing compartment therein is returned through a pipe 26 into the wash cooler 1 at a point where the liquor in the latter is at the highest temperature. A thermostatic valve 27 may be used for regulating the flow through the pipe 24 if desired.

In operation, the liquor from the wash cooler and the water from the intensive scrubber which is impregnated with sulfur and ammonia in combination, is forced into the top of the still where it meets the ascending current of steam. Apparently in the presence of the steam and above a certain temperature, the descending liquor is freed of the bulk of the sulfur content, while still retaining a considerable proportion of the ammonia. The sulfur is either volatilized in a free state or else forms a gaseous combination with other elements in the still so that it is free to be discharged therefrom. This is the point at which the pipe to the heat recovery apparatus is tapped into the still. Consequently, the sulfur escapes with the steam through the still outlet pipe while the retained ammonia passes out into the heat recoverer in the washing liquor, and is returned for further use in the apparatus. The washing liquor from the still is returned to the wash cooler. There is sufficient fresh water added continually to the scrubber to prevent surcharging of the liquor with ammonia. The overflow or excess liquor from the scrubber discharges into the work tank or cistern. As a result the ordi-

nary apparatus for gas manufacture is rendered available for removing both the sulfur and the ammonia, and allowing substantially complete recovery of both.

Obviously, changes in details of the construction of the apparatus to meet the requirements of particular plants and conditions of service may be made without departing from the spirit of the invention, and I do not care to limit myself to any particular form or arrangement of parts.

What I claim is:—

1. Apparatus for recovering sulfur from coal gas during the manufacture thereof, comprising a wash cooler, a gas scrubber in series therewith, means introducing liquor from the wash cooler to the scrubber, a still supplied with a current of steam, means for forcing combined liquors of the cooler and scrubber from the latter into the still into contact with any steam passing therethrough, and means for tapping off liquor in the still at a point where it is substantially free from sulfur and returning it to the scrubber.

2. Apparatus for recovering sulfur from coal gas during the manufacture thereof, comprising a wash cooler, a gas scrubber in series therewith, means introducing liquor from the wash cooler to the scrubber, a still supplied with a current of steam, means for forcing the combined liquors of the cooler and scrubber from the latter into the still into contact with any steam passing therethrough, means for tapping off liquor in the still at a point where it is substantially free from sulfur and returning it to the scrubber, means for circulating a cooling medium through the wash cooler, and means for utilizing the cooling medium expelled from the wash cooler for reducing the temperature of the liquors discharged from the still and reducing the temperature of the sulfur free liquor tapped from the still and returned to the scrubber.

3. Apparatus for removing sulfur and ammonia from coal gas during the process of manufacture thereof comprising a wash cooler, a gas scrubber in series therewith, a still supplied with a current of steam, means for forcing crude liquor from the wash cooler and scrubber to pass through the still, means for tapping liquor from the still at a point where it is free from sulfur and returning it to the gas scrubber, a heat recovery device for equalizing the temperatures between the ingoing and outgoing columns of crude liquor passing through the still, means for regulating the temperature of the sulfur free liquor discharged from the heat recovery mechanism, and means for passing a cooling medium used in the wash cooler and heat regulating means through the still.

4. Apparatus for removing impurities from gas, comprising means for washing and cooling the gas with liquor, means for removing ammonia by scrubbing with fresh water, and means for freeing ammoniacal liquor from sulfur and returning it for use in said scrubbing means.

5. Apparatus for removing impurities from gas, comprising means for washing and cooling the gas with liquor, means for scrubbing the gas with fresh water, means for withdrawing a portion of the liquor produced by the scrubbing means and substantially eliminating the sulfur therefrom, and means for returning the sulfur free liquor to the washing and cooling and scrubbing means.

6. Apparatus for removing impurities from gas comprising means for washing and cooling gas with liquor, means for scrubbing the gas with fresh water, means for withdrawing a portion of the liquor produced by the scrubbing means, and substantially distilling the sulfur therefrom, means for cooling a portion of the sulfur free liquor to substantially the temperature at withdrawal and returning it to the scrubbing means and means discharging the remainder to the washing and cooling means.

7. In combination apparatus for removing impurities from gas, comprising a wash cooler, a scrubber, a still for bringing liquor into contact with steam, a heat recoverer for returning to the still heat withdrawn therefrom, a temperature regulator for controlling the temperature of a portion of liquor withdrawn from the still, means for withdrawing liquor from the scrubber, passing it through the heat recoverer and discharging it into the still, means for withdrawing a portion of the liquor from the still and discharging it into a determined point in the scrubber after passing it through the heat recoverer and temperature regulator, means for discharging the remainder of the liquor from the still into the wash cooler after partially cooling the same, means for supplying the still with steam and means for discharging evolved vapors from the still.

In testimony whereof I affix my signature in presence of two witnesses.

ERNEST F. LLOYD.

Witnesses:

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