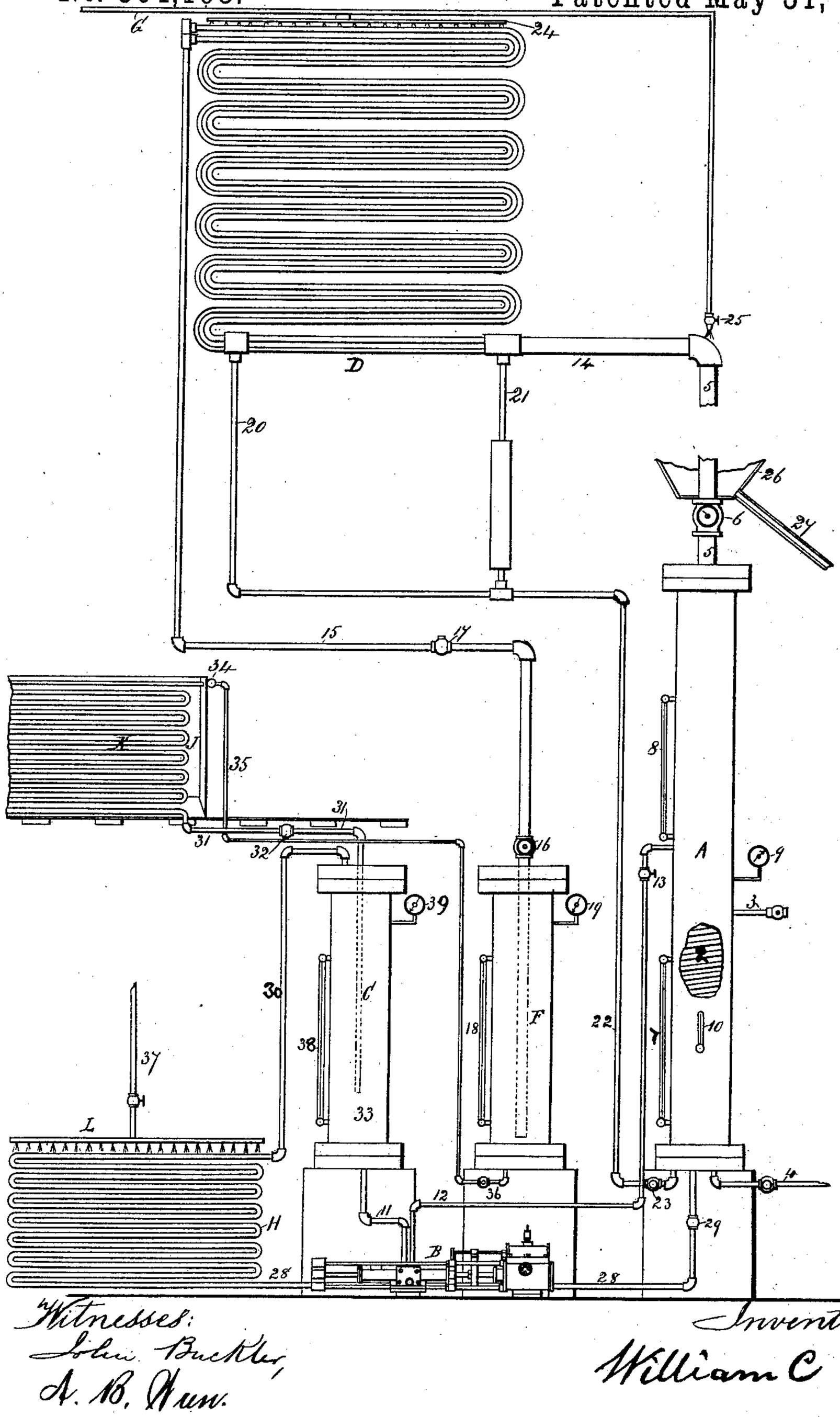
(No Model.)

W. C. WREN.

DISTILLING AMMONIA AND PRODUCING REFRIGERATION.

No. 364,198. Patented May 31, 1887.



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DISTILLING AMMONIA AND PRODUCING REFRIGERATION.

SPECIFICATION forming part of Letters Patent No. 364,198, dated May 31, 1887.

Application filed July 22, 1886. Serial No. 208,707. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM C. WREN, a citizen of the United States, residing at Brooklyn, in the county of Kings, State of New York, have invented certain new and useful Improvements in Apparatus for Distilling Ammonia and Producing Refrigeration, of which the following is a specification.

The object of my invention is to convert the gas produced by the distillation of aqua-ammonia into a pure liquid anhydrous ammonia entirely free from water without the use of compression-pumps or mechanical devices of any kind, which, as is well known, are now generally employed in this art; also, to reabsorb the ammonia into the water from which it has been driven after utilizing its cold-producing properties.

Heretofore, as is well known, anhydrous ammonia has been produced from the aqua-ammonia of commerce and compressed into liquid form by the aid of pumps, and has also been produced by distilling aqua-ammonia under pressure, as shown and described in my application and specification for Letters Patent of even date herewith. Refrigeration has also been produced by absorbing ammonia into water by Carré and others.

The accompanying drawing shows an elevation of the entire apparatus employed by me.

A represents a still in which aqua-ammonia is vaporized, which, together with the whole apparatus, is made very strong of steel or iron to withstand a great pressure, its vertical dimension being much greater than the horizontal diameter. The still contains a coil of pipe, 2, through which steam is admitted, as hereinafter described, through the steam-pipe 3, and a pipe, 4, at the bottom, through which the exhausted steam is discharged. A stand-pipe, 5, extends from the top of the still to a height of, say, forty feet, more or less, above the base, communication between the interior of the still and the stand-pipe being regulated by a valve, 6, placed in the pipe just above the top of the still. Glass gages 7 and 8 are mounted on one side of the still, communicating with the interior, in order that the height of the aqua-ammonia in the still may be readily ascertained. A pressure-gage, 9, and a thermometer, 10, of ordinary construction, are also connected with the still.

B represents a feed-pump, which must be capable of delivering aqua-ammonia into the still under or against a pressure of one hundred and fifty pounds to the square inch. The suction end of this pump is connected by a pipe, 11, to a receiver or water-tank, C. The discharge end is connected by a pipe, 12, having a cock, 13, inserted therein, with the interior of the still above the steam-coil. Any ordinary steam-boiler may be connected to the pipe 3 to supply steam to the coil.

A coil of pipe, D, is mounted on any suitable place at sufficient height above the stand-pipe to allow a horizontal pipe, 14, to be connected with the bottom section of the coil. Connected with the top section is a discharge-pipe, 15, which enters the top of a receiving-tank, F, and extends nearly to the bottom thereof, a cock, 16, being placed in the pipe just above the top of the receiver, and a check-valve, 17, being placed in the pipe on any horizontal part. The receiver F has a glass gage, 18, and a pressure-gage, 19, as shown.

Connected to the coil D, and inserted into the bottom section thereof, are two pipes, 20 and 21, which are extended down to the bottom of the still and connected to the interior thereof by the pipe 22, having inserted therein a cock, 23.

G represents a water-pipe, through which water may be forced by any suitable means. The pipe extends above the coil D, where it is provided with a perforated sprinkler, 24, through which water is allowed to drip upon the coil, the water running down on the outside of the coil into a suitable trough and waste-pipe.

In a refrigerating apparatus it is essential to the best and most economical results that the ammoniacal vapor should be anhydrous, to secure which has hitherto been attended with much difficulty; and it has often occurred that when the expansion of the liquid ammonia occurs, for the refrigerating operation, the water carried along therewith, even though of small amount, will freeze in the pipes, particularly in the expansion-cock, the opening from which is small, and will thus stop the circulation;

but I have succeeded in delivering the vapor of ammonia to the condensing-receiver, and thence to the expansion-coil, without carrying therewith any of the water of condensation, by arranging the coil D in the manner shown—that is, so that the vapors from the still shall pursue a constantly-ascending passage as they pass through the coil from the time they enter from the pipe 14 until the anhydrous-ammonia vapor is discharged through the pipe 15, it being insured that all aqueous vapor condensed in the coil, whether such condensation occur in the upper or in the lower portion thereof, shall be carried back and delivered into the still and not out along with the ammonia-vapor. Moreover, the water so carried back is delivered to the still at the bottom, where the pipe 28 has its exit. It is desired to carry away by this latter pipe for recharging as cold and weak a liquid as possible, and since the water delivered to the bottom of the still by pipe 28 is both cold and weak, and keeps down comparatively the temperature of the contents at that point, it results that the said pipe 28 receives a liquid weaker and of a lower temperature than if said parts were arranged as heretofore. The main water-pipe extends to a point above the stand-pipe, where it has a cock, 25, which may permit water to drip down upon the stand-pipe and run down into a trough, 26, connected to a waste-pipe, 27. The upper part of the stand-pipe and the coil D thus act as coolers.

H represents a cooling-coil connected at one end to the pipe 28, which pipe 28 has inserted therein a regulating-cock, 29. Said pipe communicates with interior of the bottom of the still, as shown, the other end of the coil to a pipe, 30, which pipe is inserted into and communicates with the interior of the tank or receiver C on the top thereof.

J represents a cooling-chamber or refrigerator, having inclosed therein an expansion-coil, K, the lower end of which is connected by a pipe, 31, having inserted therein a check-valve, 32, the other end of the pipe being inserted into the tank or receiver C and extended nearly to the bottom, as shown by the dotted lines at 33. The top end of the coil K has attached to and inserted therein an expansion-valve, 34, which valve and coil are connected by a pipe, 35, to the interior of the anhydrous-ammonia receiver F at the bottom, the pipe 35 having inserted therein a cock, 36.

L represents a perforated water-sprinkler placed above the coil H to sprinkle water thereon, said sprinkler being connected to a water-supply pipe, 37.

The tank or receiver C has a glass gage, 38, attached to one side and inserted therein to show the height of the fluid therein; also a pressure-gage, 39, of ordinary construction, inserted therein and attached thereto, as shown.

In the operation of distilling ammonia and producing refrigeration, aqua-ammonia is first placed in the still by any means until the still is about two-thirds or three-quarters full, as indicated by the glass gage. The cock 6 in the stand-pipe and the cock 16 are open, all the rest being closed. When the still contains sufficient aqua-ammonia, the cock in the steam-pipe 3 is opened, and steam from the boiler is admitted into the coil 2 in the still until the heat in the still reaches about 190° Fahrenheit. The effect of this is to vaporize the ammonia, which escapes as a gas into the stand-pipe 5, while the greater part of the water remains in the still. It is a well-known fact that the affinity of water and ammonia-gas for each other decreases with increase of heat, and since the ammonia, being the lighter, is always on top when heated, as the pressure increases, the greater amount of water or watery vapor which may rise in the stand-pipe is condensed before reaching the great height to which the stand-pipe is carried, as well as by the water dripping upon the stand-pipe, as before described, and falls back into the still, leaving the ammoniacal gas and the water and vapor of water to pass on to the coil D, where it is further cooled by the water that is sprinkled upon the coil, when the remainder of the water in the ammonia gas and vapor is condensed and settles to the bottom section of the coil, from whence, being heavier than the anhydrous ammonia, it returns to the still at the bottom thereof by the drips and pipes 20, 21, and 22, the cock 23 being open, while the pure ammonia-gas, being lightest, rises through the coil, and is then forced by the pressure from the still through the discharge-pipe and into the bottom of the receiver F, where, by means of the continuous pressure throughout the pipes, it is liquefied. Since the discharge-pipe extends nearly to the bottom of the receiver F, a very small quantity of liquefied ammonia will cover the mouth of the pipe; so a siphon is formed, and thereafter the gas will liquefy much more rapidly and readily than if the discharge-pipe terminated at the top of the receiver. When sufficient anhydrous ammonia has been formed and liquefied in the receiver F, as indicated by the glass gage, the cock 36 may be opened full, which will allow the liquid anhydrous ammonia to flow into the pipe 35 to the expansion-cock 34, when the expansion-cock may be opened and the liquid anhydrous ammonia will expand into a gas during its passage through the expansion-coil K, and by so doing will absorb more or less of the heat contained in the refrigerating-chamber J. Then the expanded ammoniacal gas will pass through the pipe 31 into the tank or receiver C, where it will be discharged nearly at the bottom thereof. At the same time the cock 29 in the pipe 28 must be opened sufficiently and so regulated that the flow of water or weak water-ammonia from the still into the water tank or receiver C shall be sufficient in quantity to reabsorb the heated anhydrous ammonia-gas discharged from the pipe 30 into the tank C. The weak ammonia-water in its passage through the coil H is cooled by the water from the sprinkler L

trickling over the coil, which action, by reducing the water to a normal temperature, allows it to reabsorb the ammonia discharged into the tank C from the expansion-coil K.

When the receiver or tank C is partially filled with fluid discharged from the still, the outlet of the siphon or pipe 33 will be covered, and the ammonia-gas from the coil K, being discharged below the surface of the fluid, will be absorbed into and taken up much more readily and at less pressure than if the gas were to be discharged into the top of the tank or receiver C.

When a sufficient quantity of ammonia-gas, after its passage through the expansion-coil K, and the fluid from the bottom of the still, after its passage through the cooling-coil H, have been forced into the tank or receiver C in the manner heretofore described, which will be indicated by the glass gage, the contents of the receiver C may be drawn off from the bottom through the suction-pipe 11, and forced into the still through the pipe 12 (the valve 13 being open) by the action of the pump B, when the operations heretofore described can be repeated.

The action of the still and other parts of the whole apparatus can be periodical or occasional, or the action of each part can be so arranged with reference to each other that the action of all parts can be continuous.

It will be observed that the cooler D, wherein the temperature of the ammoniacal vapors from the still is lowered, and the coil H, wherein the weak liquid from the bottom of the still is cooled, are separate from each other, and are cooled by water from separate supply-pipes, each provided with regulating devices. Such cooling of both the ammoniacal vapor and the weak liquor has frequently heretofore been attempted in one and the same cooler; but by the arrangement of the devices which I have hereinbefore described advantages in operation are attained which I believe are new. I am thereby enabled to readily tell the temperature of the products as they pass from each coil and to vary the temperature of either one independent of the other, so that the absorption of the gas in tank C may always be rendered uniform and regular, which can best be done where the temperature of the liquor passing from the coil may be examined and the supply of water to such coil varied as the temperature of the water or the surrounding atmosphere may require independently of the water-supply which cools the ammoniacal gas as it comes from the still.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The combination, in a refrigerating apparatus, of the still, the stand-pipe, the cooling-coil above the stand-pipe and leading continuously upward, as described, the anhydrous-ammonia receiver connected with said coil, the expansion-coil connected with the receiver, the cooling-chamber, the reabsorbing-tank, a pipe connecting said tank with the bottom of the still, an intermediate cooler independent of the first-mentioned cooler and capable of being independently regulated as to temperature, and means, substantially as described, for recharging the still from said tank, as set forth.

2. The combination, in a refrigerating apparatus, of the still, the stand-pipe, the cooling-coil leading continuously upward, as described, drip-pipes connected with the lower part of said coil and leading to the bottom of the still, the anhydrous-ammonia receiver connected with the top of the coil, the expansion-coil and cooling-chamber, the reabsorbing-tank connected with the bottom of the still, an intermediate cooling-coil between said tank and still, and a force-pump and connections for recharging the still from said tank, substantially as set forth.

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