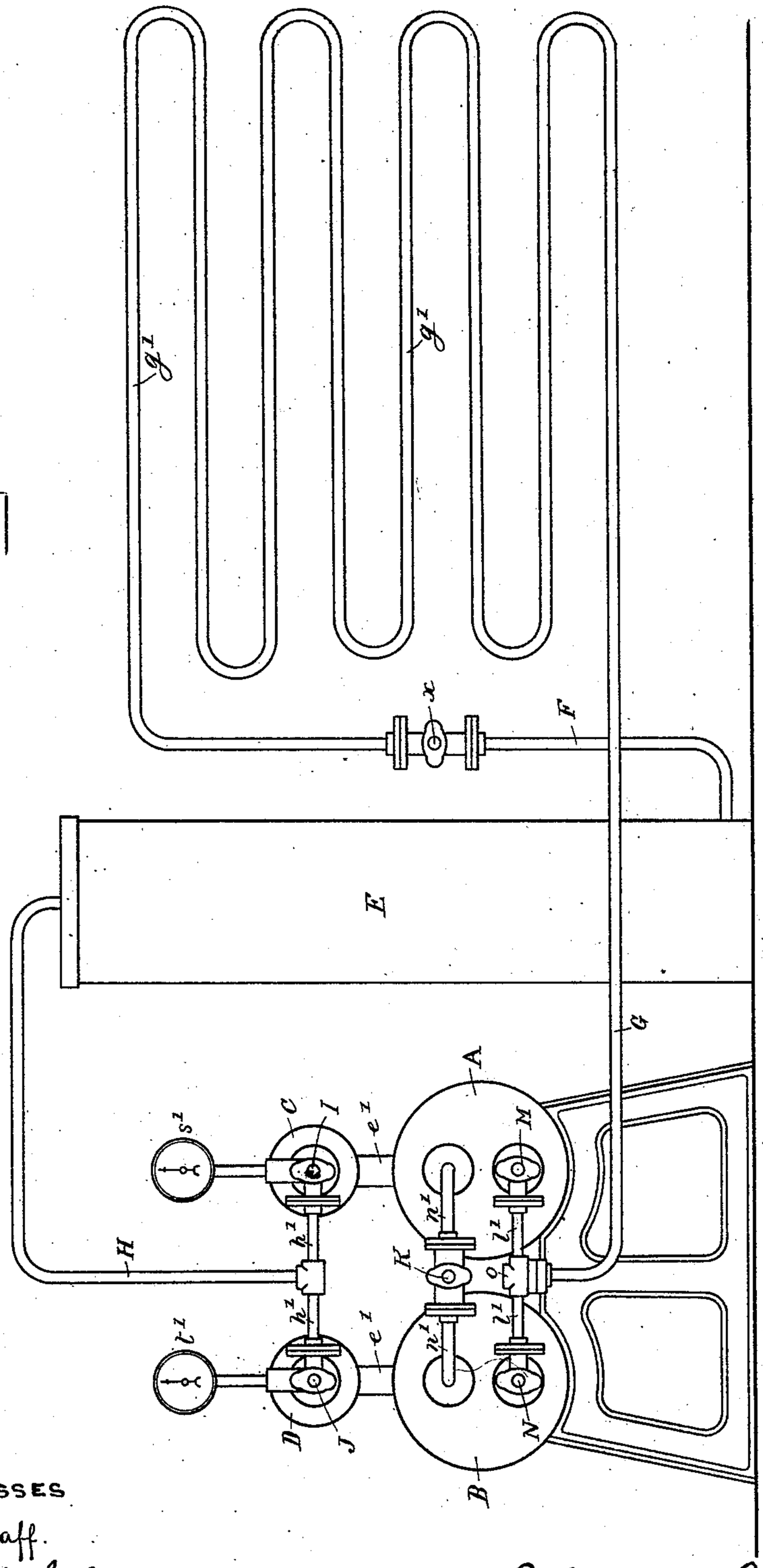
(No Model.) 2 Sheets—Sheet 1.

R. J. CRACKNELL.

REFRIGERATING MACHINERY.

No. 572,696. Patented Dec. 8, 1896.

Fig. 1.



WITNESSES

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E. C. Deghuee

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(No Model.) 2 Sheets—Sheet 2.

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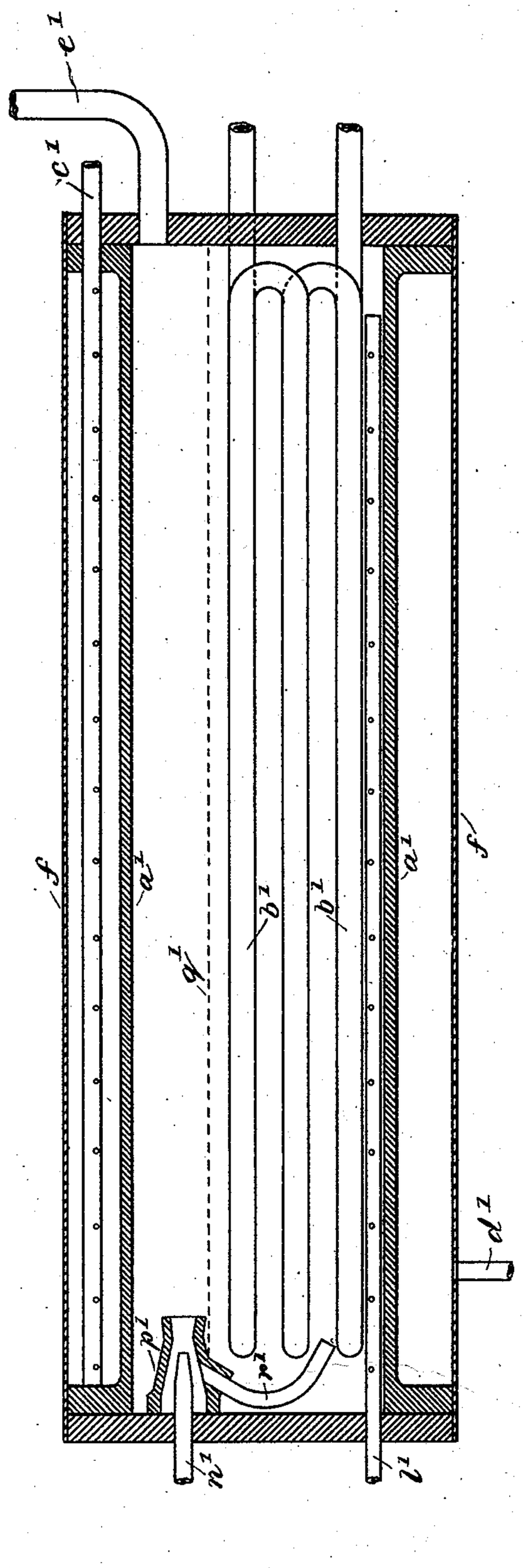

FIG. 2.

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UNITED STATES PATENT OFFICE.

RICHARD JOHN CRACKNELL, OF ROCHESTER, ENGLAND.

REFRIGERATING MACHINERY.

SPECIFICATION forming part of Letters Patent No. 572,696, dated December 8, 1896.

Application filed February 9, 1895. Serial No. 537,775. (No model.) Patented in England March 1, 1892, No. 4,035.

To all whom it may concern:

Be it known that I, RICHARD JOHN CRACKNELL, engineer, a subject of the Queen of Great Britain, residing at Old Bank, Rochester, in the county of Kent, England, have invented certain new and useful Improvements in Refrigerating Machinery, (for which I have received Letters Patent in Great Britain, No. 4,035, dated March 1, 1892;) and I do hereby declare that the following is a full, clear, and exact description of the invention, which will enable others to make and use the same.

This invention relates to refrigerating machinery working on the ammonia-absorption principle, and especially to those machines which work intermittently and have two ammonia-containers which are alternately used as generators and absorbers, so that when one is acting as a generator the other is the absorber. Machines of this class as hitherto made are very inefficient, owing to the time taken up and the loss of heat incurred every time the operation is reversed before the machine assumes its normal working conditions. Owing to the same cause the action of that part of the apparatus where the cold is produced is seriously interfered with.

The object of this invention is to minimize these defects, which I accomplish in the following manner:

I provide machinery of the class hereinbefore referred to with means for opening communication between the vapor-chambers of the two ammonia-containers. When it is required to reverse the operation, the machine can be much more quickly brought to its normal working condition by opening this communication between the two ammonia-containers, thereby transferring a large amount of ammonia-gas from one container to the other and equalizing the pressures in the two containers. By this means also the ammonia solution in the absorber will become weaker and will consequently be able to absorb more ammonia-gas, and the strength of the solution in the other container—the one which is to act as the generator—will be increased. At the same time the effect of this transference of gas is to heat up the solution in the generator and to cool that in the absorber, all of which results are very advantageous to the working of the machine. In order to get the full advantage of this transference of gas from one container to the other, I provide means whereby the gas on entering the container sets up a circulation of the liquid therein, whereby a much greater quantity of gas passes from one to the other than would be otherwise possible.

In order that my invention and the manner in which the same may be carried into practice may be well understood, I will further describe it with reference to the accompanying drawings, wherein—

Figure 1 shows the arrangement of a refrigerating-machine constructed in accordance with this invention. Fig. 2 is a longitudinal section of one of the ammonia-containers.

Referring to Fig. 1, A and B are two ammonia-containers, which act alternately as generators and absorbers.

C and D are rectifiers.

E is a condenser, and g' is the refrigerator-coil.

e' and e' are pipes connecting the containers to the rectifiers.

h' and h' are pipes which unite into a common pipe H, which passes to the condenser E.

I and J are valves connecting the rectifiers C and D to the pipes h' and h'.

F is the pipe by which the ammonia liquefied in the condenser E passes to the refrigerator-coil g'.

x is the expansion-valve.

G is the pipe by which the ammonia-gas expanded in g' passes back through a check-valve o and then through the pipe l' and valve N into the ammonia-container B, or else through pipe l' and valve M into the ammonia-container A.

When the container A is acting as the generator, the valves I and N are open and J and M shut. The object of the check-valve o is to prevent the return of any liquor from either of the containers into the refrigerator-coil g'.

n' is the pipe for establishing communication between the vapor-spaces of the two containers A and B, and K is a valve for opening or shutting off this communication.

The two ammonia-containers A and B (see Fig. 2) are both alike in construction and a description of one will serve for both. The container consists of a cylindrical vessel a', having inside it a coil or coils of pipe b', through which steam is passed when the container is used as a generator and water when it is used as an absorber. The vessel a' is in-

closed in an outer casing f', and c' is a perforated pipe through which water passes to cool the outside of the vessel a' at the same time as the water passes through the coil b' to cool the inside.

d' is a pipe by which the water that flows through the perforated pipe c' is conducted away to the drain.

e' is the pipe by which the ammonia-gas passes into the rectifier C or D, and l' is the pipe by which the gas returns from the refrigerator-coil to be absorbed.

n' is the pipe opening communication between the vapor-spaces of the two containers. Within the container the pipe n' tapers inward at its extreme end, which latter opens into a constricted chamber p', the outlet from which is situated above the dotted line q', which represents the height of the liquor ammonia in the vessel a'. Opening communication with the chamber p' is a pipe r', the lower end of which reaches to near the bottom of the vessel a'. As the ammonia-gas entering by the pipe n' passes through the chamber p' it will create a partial vacuum in the said chamber, causing the liquor ammonia to be drawn up through the pipe r' into the chamber p' and to be discharged therefrom in the form of a spray, with which the entering gas will be intimately mixed and to a great extent absorbed.

s' and t' are gages for indicating the pressures in A and B, respectively.

The steam and water connections can be so arranged that when it is required to reverse the operation of the machine by one movement of a handle the steam can be turned off from A and onto B and the water turned off from B and onto A.

The manner of working the machine is as follows: A charge consisting of a saturated solution of ammonia is placed in the container A and a weak solution in B. The valves I and N are opened and the valves J, M, and K shut. The expansion-valve x is also slightly opened. Steam is turned on into the coil in the container A and water into that in B. Water is also turned on to the condenser E. The heat of the steam in the coil evaporates the ammonia solution in the container A and the ammonia-gas passes off through the rectifier C and into the condenser E, and the pressure quickly rises to, say, one hundred and twenty pounds per square inch, this latter pressure varying with the temperature of the condensing water. As the gas passes through the rectifier C any watery vapor which it may contain is condensed and falls back into the container A. The ammonia-gas being cooled in the condenser liquefies and passes by the pipe F through the expansion-valve x into the refrigerator-coil g', where it expands at a low temperature and abstracts heat from the air or brine surrounding the coil g'. The ammonia-gas returns by the pipe G through the check-valve o and valve N into the container B, where it is absorbed by the weak solution contained therein. After a time the solution in A will have become weak and that in B strong, and it will then be necessary to reverse the operation—*i. e.*, to heat B and cool A. This is done as follows: The valves I and N are shut and the valve K is opened. Ammonia-gas will then rush out of the container A into B, and in a few minutes the pressure in the two containers A and B, as indicated by the gages s' and t', will be equal. The valve K is then shut. Steam is then admitted to the container B and water to A and the valves J and M opened. In a short time the pressure in the container B will have reached the liquefying pressure—say one hundred and twenty pounds—and the pressure in A will have fallen to, say, ten pounds or lower. The ammonia-gas now passes from the container B through the rectifier D into the condenser E, where it liquefies, thence through the expansion-valve x and coil g', where it expands, and back to the absorber A. At the end of another period, the length of time depending upon the conditions under which the machine is being worked, the process is again reversed, and can thus be continued indefinitely. The length of time necessary to get the pressure down on one side from, say, one hundred and twenty pounds to ten pounds and to raise it from ten pounds to one hundred and twenty pounds on the other side will in some cases not exceed four or five minutes. By this invention therefore the production of cold or the abstraction of heat by means of the coil g' is almost continuous. Suitable valves are provided to remove the air from the apparatus when first starting the machine.

I wish it to be understood that I make no claim for apparatus of the kind hereinbefore described wherein two generators or absorbers are used, as I am aware that such apparatus has been already in use.

What I claim is—

In refrigerating machinery working on the ammonia-absorption principle, the combination of two ammonia-containers, one generating vessel being adapted to act as an absorber while the second is being used as a generator, and the said second acting as a generator while the other is being used as an absorber, and so on, alternately and indefinitely, and means for causing the ammonia-gas, passing from one container to the other, to produce a circulation or agitation of the liquor in the latter, whereby the amount of gas passing from one container to the other is increased, consisting of a chamber surrounding the end of the gas-entry pipe, said chamber having a tap leading thereunto, the other end of which dips below the surface of the liquid ammonia in an absorbing vessel.

RICHARD JOHN CRACKNELL.

Witnesses:
THOMAS WISHART,
JOHN MCGLASHAN.