(No Model.) 4 Sheets—Sheet 1.

D. BRANSON, R. D. THORNBURGH & J. E. STARR.

UNDERGROUND DISTRIBUTION AND RECOVERY OF ANHYDROUS AMMONIA.

No. 489,729. Patented Jan. 10, 1893.

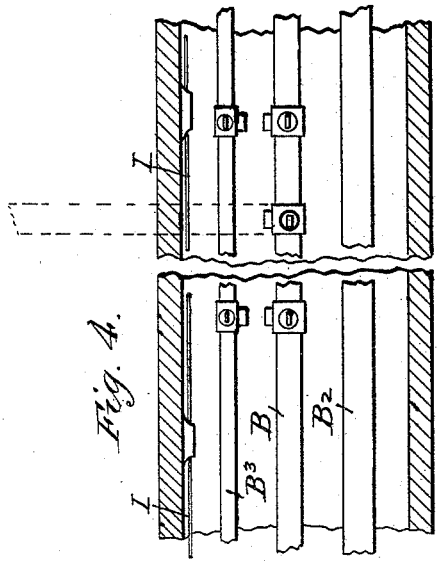


Fig. 4.

Fig. 1.

Witnesses:
F. R. Stuart
J. M. Fowler Jr.

Inventors:
David Branson,
R. D. Thornburgh.
J. E. Starr.
By Marble & Mason,
Attorneys.

(No Model.) 4 Sheets—Sheet 2.

D. BRANSON, R. D. THORNBURGH & J. E. STARR.

UNDERGROUND DISTRIBUTION AND RECOVERY OF ANHYDROUS AMMONIA.

No. 489,729. Patented Jan. 10, 1893.

Fig. 5.

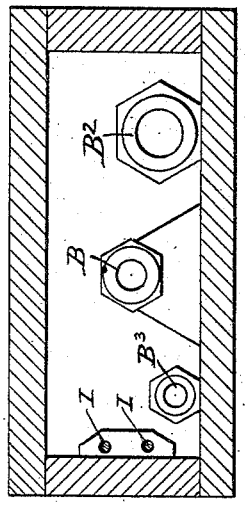
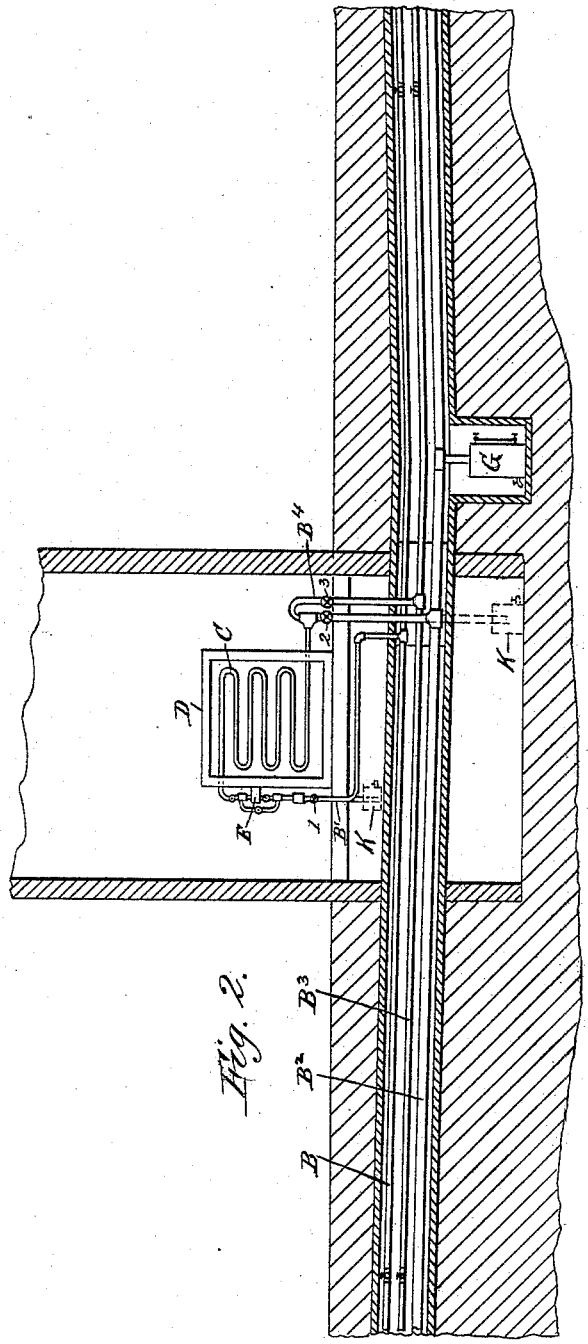


Fig. 2.



Witnesses:
F. K. Stuart.
J. N. Fowler Jr.

Inventors:
David Branson.
R. D. Thornburgh.
J. E. Starr.
By Marble & Mason,
Attorneys.

(No Model.) 4 Sheets—Sheet 3.

D. BRANSON, R. D. THORNBURGH & J. E. STARR.

UNDERGROUND DISTRIBUTION AND RECOVERY OF ANHYDROUS AMMONIA.

No. 489,729. Patented Jan. 10, 1893.

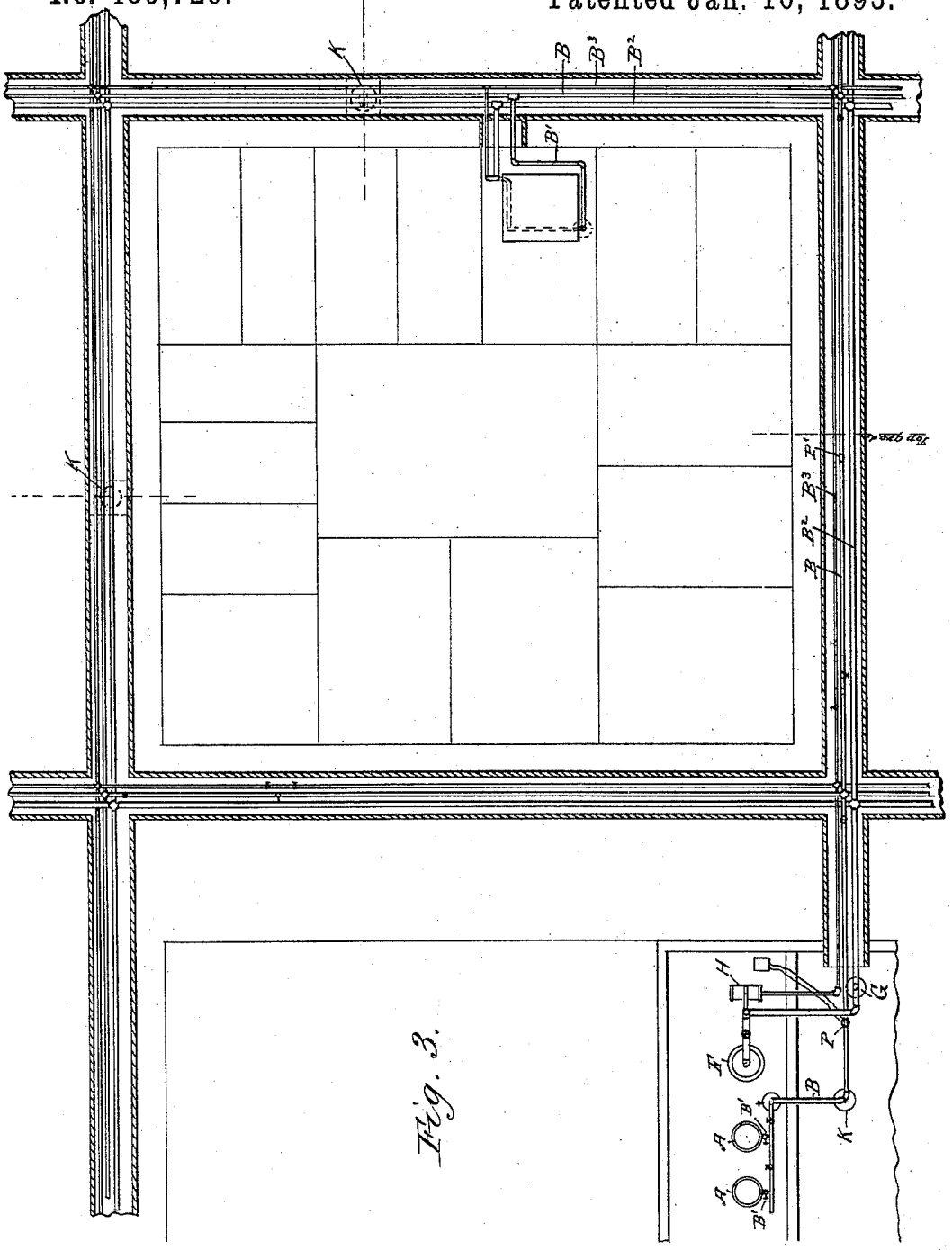


Fig. 3.

Witnesses:
T. R. Stuart
J. M. Fowler Jr.

Inventors:
David Branson
R. D. Thornburgh
J. E. Starr
By Marble & Mason,
Attorneys.

(No Model.) 4 Sheets—Sheet 4.

D. BRANSON, R. D. THORNBURGH & J. E. STARR.

UNDERGROUND DISTRIBUTION AND RECOVERY OF ANHYDROUS AMMONIA.

No. 489,729. Patented Jan. 10, 1893.

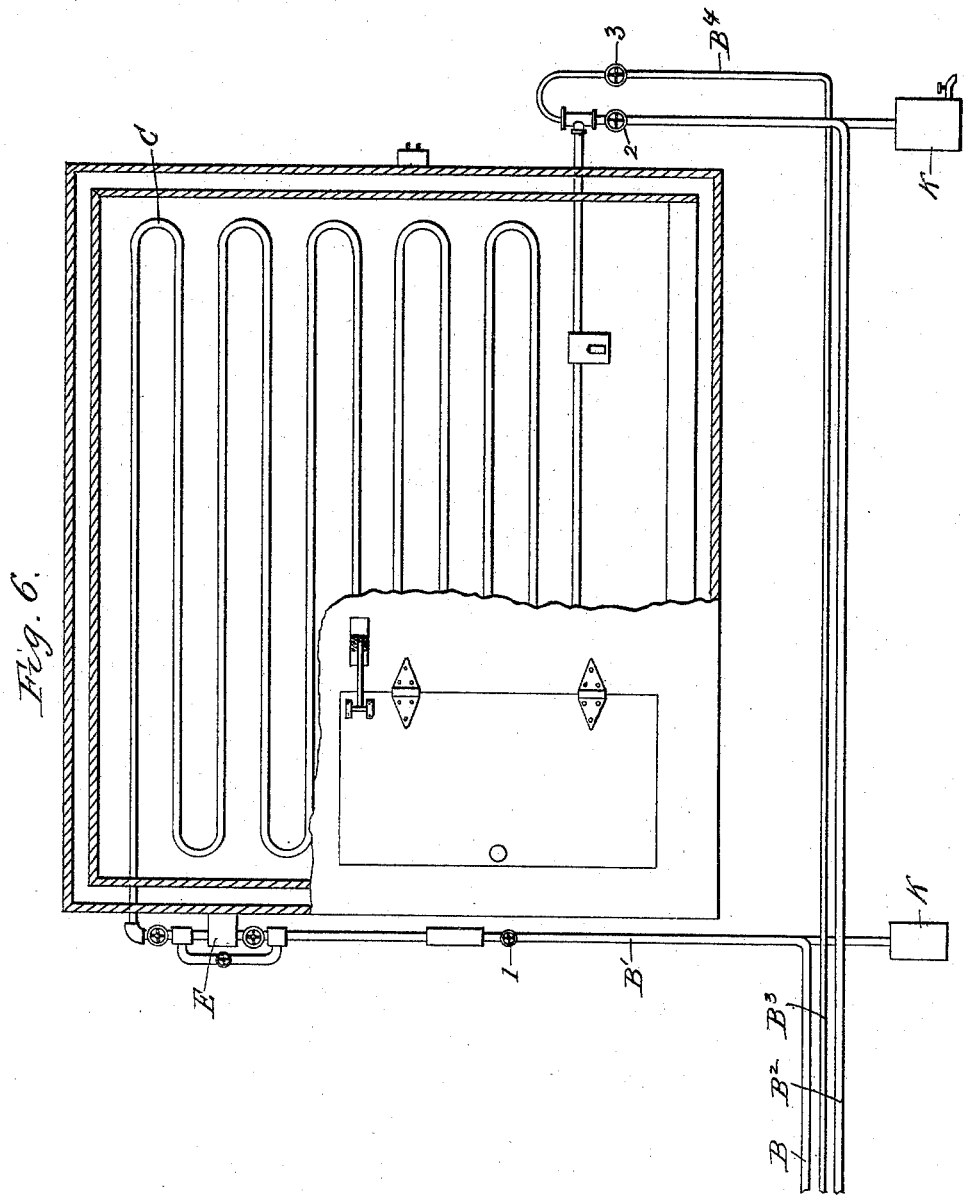


Fig. 6.

Witnesses:
T. R. Stuart.
J. N. Fowler Jr.

Inventors:
David Branson.
R. D. Thornburgh.
J. E. Starr.
By Marble & Mason,
Attorneys.

UNITED STATES PATENT OFFICE.

DAVID BRANSON, ROBERT D. THORNBURGH, AND JOHN E. STARR, OF ST. LOUIS, MISSOURI.

UNDERGROUND DISTRIBUTION AND RECOVERY OF ANHYDROUS AMMONIA.

SPECIFICATION forming part of Letters Patent No. 489,729, dated January 10, 1893.

Application filed January 31, 1890. Renewed June 16, 1892. Serial No. 436,996. (No model.)

To all whom it may concern:

Be it known that we, DAVID BRANSON, ROBERT D. THORNBURGH, and JOHN E. STARR, citizens of the United States, residing at St. Louis, in the State of Missouri, have invented certain new and useful Improvements in a System of Underground Distribution and Recovery of Anhydrous Ammonia; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

Our invention relates to a system of underground distribution and recovery of anhydrous ammonia when employed as a refrigerating agent, and consists in the construction and arrangement of the apparatus, piping, and devices, used in carrying it out which will be more fully hereinafter described and particularly pointed out in the claims.

The principal object of our invention is to provide simple and practical means by which anhydrous ammonia may be conveyed under pressure from a central or convenient building where it is produced and held in suitable reservoirs, to any required number of buildings or places of business, however distant, for use in refrigerators, boxes, or rooms, and after such use, to return such ammonia in its expanded form to the place from which it was originally taken, and there recover the same and distill it over for use again.

A further object of our invention is to provide means by which to regulate and control the flow of the ammonia from the reservoir through the pipes, to keep the pipes free from foreign matter and retarding substances, and in case of the bursting and leakage of the pipes, to have notice of such leakage automatically communicated at once to the central office.

A further object of our invention is to provide means by which, in case of the bursting or leakage of the pipes through which such ammonia is conveyed, or the disarrangement or destruction of any of the devices or appliances used and employed in the system, to at once cut out from the entire system the part or section of it so affected until it is repaired, without disturbing the operation of the system at any other point.

A further object of our invention is to secure with certainty and safety, and with greater economy than it has heretofore been done, the distribution and recovery of the ammonia used as a refrigerating agent.

These objects we attain with the devices, appliances and apparatus illustrated in the accompanying drawings, forming a part of this application.

Figures 1 and 2, when taken together, represent a longitudinal vertical section of our invention on line *x x* of Fig. 3. Fig. 3 is a plan view of our invention with the cover of the conduit removed. Fig. 4 is an enlarged broken plan view of the conduit, showing the means by which street connections are made. Fig. 5 is a vertical cross section of the conduit, showing the manner of arranging the pipes and electric wires therein. Fig. 6 is an elevation of a refrigerator, partly in section, showing the cooling coil and its connections.

Referring to Fig. 1 of the drawings, A A represent anhydrous ammonia receivers erected within a building where such ammonia is produced, or at other convenient place or places on the liquid supply line. The ammonia still and apparatus are not shown in the drawings, as they do not form a part of the invention herein claimed.

B represents the supply pipe, having branch pipes B′ B′ connecting it with the receivers A A, and also with the cooling coils C, through valves E, on the refrigerators set up in buildings along the line, as D, in Fig. 2. This pipe B is arranged and secured in a conduit in the street as shown in Fig. 4, and may be of any required length extending in a straight line but conforming to the grade of the street as shown in Figs. 1 and 2, or it may extend around a square or block as shown in Fig. 3.

B^2 is the return pipe or main, of equal length, but of greater diameter than B, to convey the expanded gas from the cooling coils C, in the refrigerators D, along the line, back to the absorber, F, and is also secured in the conduit as shown in Fig. 4. In constructing or laying the conduits containing said pipes the grades are established for as long distances as possible, and at the lowest point of each grade, a T is placed in the return main which is connected to a suitable

trap as G, in a man-hole. These traps are for the purpose of collecting any water or liquid which may accumulate in the coils of the refrigerators and flow down into the return main. The traps have suitable outlets with cocks, so they can be connected with a portable vessel and when filled, or partly filled, the trap is connected to such vessel, the cock is opened and the pressure in the return main forces any aqueous fluid which may have collected therein, into the portable vessel, which is then carried away for further use. In this way the return pipes are kept free from obstructions, and the ammonia collected in the traps is saved.

B^3 is a vacuum pipe secured in the conduit as shown in Fig. 4, and extends from the vacuum pump, H, the entire length of the conduit, the same as pipes B and B^2. It has a branch B^4, connecting it with the discharge end of the cooling coil C, just before its connection with return pipe B^2, as shown in Fig. 2. The principal object of this pipe, B^3, is to provide for making repairs or changes in any of the refrigerators along the line without the loss or escape of any gas, or occasioning any smell in the vicinity of the works. We will now explain how this can be accomplished. Normally, the cock which connects the vacuum pipe to the discharge end of the cooling coil is closed, but should occasion arise to make any changes in the refrigerator box, the supply of ammonia to the expansion valve is cut off by turning cock 1, the return of the expanded gas through pipe B^2 is cut off by turning cock 2, and cock 3 is opened, thus connecting the cooling coil of said refrigerator with the vacuum pipe B^3. Vacuum pump H being now started, all of the ammonia and ammoniacal vapor remaining in said coil are drawn out and forced, by means of connecting pipe *h*, into pipe B^2, as shown, near absorber F, and thence into the absorber. By keeping the vacuum pump constantly running, refrigerators at different points on the line may be repaired at the same time, if necessary, as the vacuum pump will keep a constant current of air in the pipe, thus preventing any smell of ammonia. This vacuum line may also be connected at intervals with the liquid supply line, so that any break, in any section of it, may be repaired, or the ammonia may be diverted into the vacuum line and run around any break in the main line until repairs can be made. It may also be used to operate the electric, and the expansion valves by means of compressed air.

I I represent electrical wires arranged in the conduit as shown in Fig. 4. These wires are for the purpose of operating the electric valves, alarm bells and danger signals and in cases where large warehouses are refrigerated, for electric lighting.

The source of electricity may be a dynamo electric machine, or a battery, as the circumstances may require, preferably the former. In the drawings, Fig. 1, a dynamo electric machine is indicated, as it has thus far been found to produce the best results.

The flow of the ammonia through the supply pipe B is controlled by a pressure reducer and by check valves as P and P′. The pressure reducer and check valves may be of any well known construction and are so set as to maintain a uniform flow of the ammonia. The pressure reducer is set so as to remain stationary under ordinary pressures. It is electrically connected, however, with an alarm bell in the central office, so that in case of unusual pressure by reason of breakage of the pipe and the escape of the gas, contact will be made, the bell rung and the superintendent of the works admonished to shut off the supply of ammonia and proceed at once to ascertain where the break is and repair it.

In Figs. 4 and 5 the construction of the conduit is shown. It consists, simply, of a rectangular box with supports for the pipes and wires, as shown.

In Fig. 6, we have shown a refrigerator box with a suitable coil and pipes connecting it with our system. No claim is made to any of the patentable features shown therein, in this application, as such features, so far as patentable, are the subject-matter of other applications.

It is well known that scale is found on the inside of iron pipes, and owing to the searching nature of anhydrous ammonia, this scale is disengaged from the pipes and in time partially fills up the pipes and greatly injures the action of the valves. To remove this difficulty as far as possible, we place scale traps as K, wherever the ammonia is caused to flow in a vertical line, but more particularly in connection with each refrigerator box. These scale traps require attention only at long intervals, but they practically remove all the difficulties which otherwise would result from the deposit of the scale in the pipes and valves.

The operation of our system is so obvious, in view of the state of the art and the explanations herein given, as not to require further description.

What we claim and desire to secure by Letters Patent is the following:—

1. In a system of underground distribution and recovery of anhydrous ammonia, the combination of an ammonia receiver, a liquid supply pipe provided with branches, refrigerator boxes provided with cooling coils, a return pipe for the expanded gas provided with fluid traps, and an absorber, substantially as described.

2. In a system of underground distribution and recovery of anhydrous ammonia, the combination of an ammonia receiver, a liquid supply pipe provided with branches and having scale traps with each branch, cooling coils within chambers, a return main provided with branches corresponding in num-

ber to the branches from the liquid supply pipe, fluid traps connected to the return main, and an absorber, substantially as described.

3. In a system of underground distribution and recovery of anhydrous ammonia, the combination of an ammonia receiver, a liquid supply pipe provided with branches, cooling coils in chambers, a return main with branches, a vacuum pipe with branches connected to each cooling coil, and a vacuum pump connected to the vacuum pipe and discharging into the return main at or near the absorber, substantially as described.

4. In a system of underground distribution and recovery of anhydrous ammonia, the combination, with the supply pipe, the cooling coils, and the return pipe, of a vacuum pipe and a vacuum pump for exhausting the ammonia from said pipes and coils, substantially as described.

5. In a system of underground distribution and recovery of anhydrous ammonia, the combination, with an ammonia receiver, a liquid supply pipe provided with branches, refrigerating boxes provided with cooling coils, a return pipe for the expanded gas, and an absorber, of a pressure reducer situated in the supply pipe and an alarm bell electrically connected to said pressure reducer, substantially as described.

In testimony whereof we affix our signatures in presence of two witnesses.

DAVID BRANSON.
ROBERT D. THORNBURGH.
JOHN E. STARR.

Witnesses as to David Branson and Robert D. Thornburgh:

E. C. GILMAN,
SAML. E. HEASLEY,

Witnesses as to John E. Starr:

ROB. H. LEACH,
P. H. SELLERS.