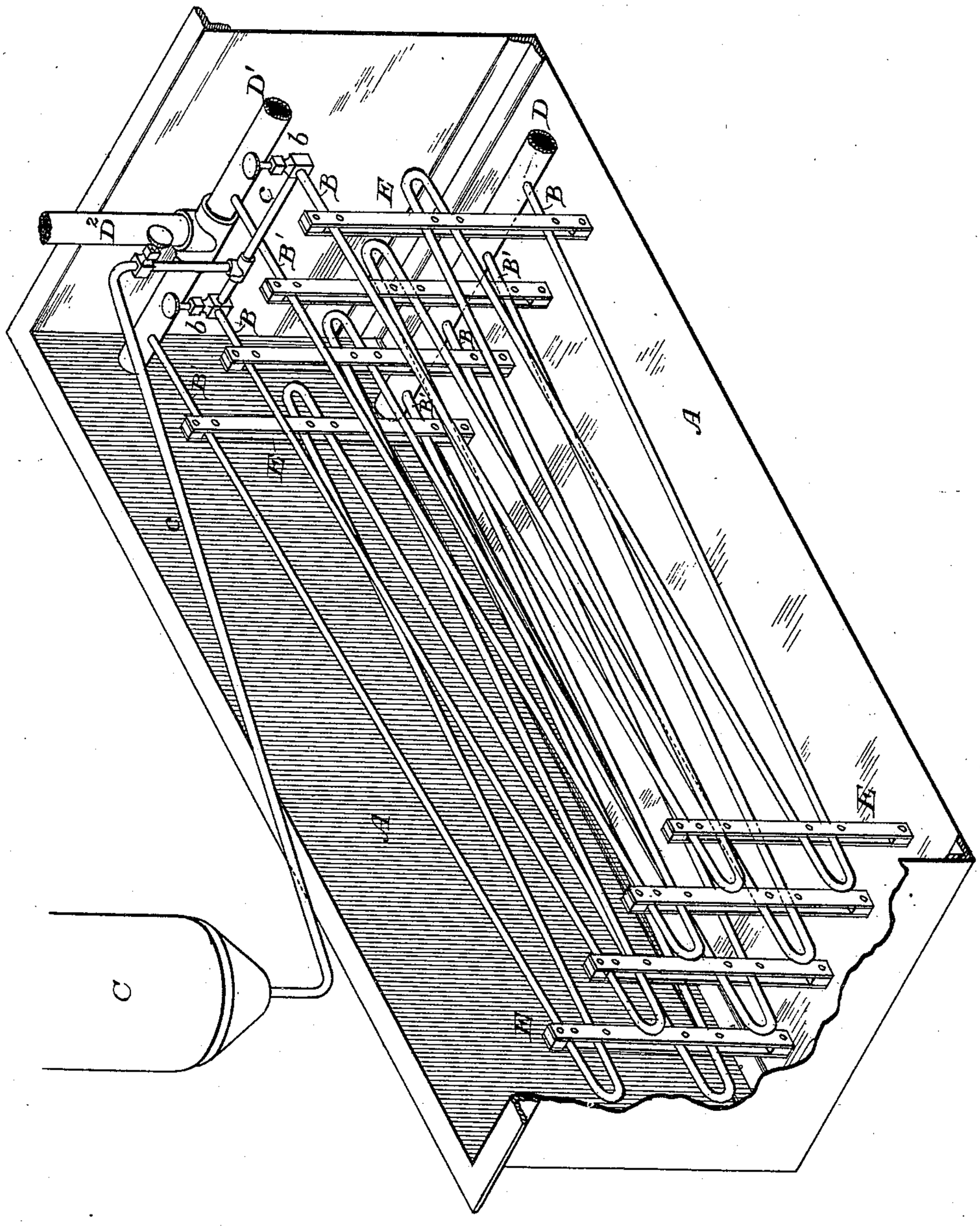
(No Model.)

E. T. SKINKLE & J. M. WESTERLIN.

AMMONIA EXPANSION COIL.

No. 426,690. Patented Apr. 29, 1890.



Witnesses

Chas. E. Gorton.

C. A. Skinkle

Inventors

Eugene T. Skinkle

John M. Westerlin

By their Attorney

Wm A. Skinkle

UNITED STATES PATENT OFFICE.

EUGENE T. SKINKLE, OF ENGLEWOOD, AND JOHN M. WESTERLIN, OF LAKE VIEW, ILLINOIS.

AMMONIA EXPANSION-COIL.

SPECIFICATION forming part of Letters Patent No. 426,690, dated April 29, 1890.

Application filed November 24, 1888. Serial No. 291,742. (No model.)

To all whom it may concern:

Be it known that we, EUGENE T. SKINKLE, residing at Englewood, Cook county, Illinois, and JOHN M. WESTERLIN, residing at Lake View, Cook county, Illinois, both citizens of the United States, have invented certain new and useful Improvements in Ammonia Expansion-Coils, of which the following is a description.

Our invention relates to expansion-coils for systems of artificial refrigeration, employing ammonia or analogous gases. Its objects are to effect a thorough evaporation or expansion of the refrigerant that enters and passes through the coil, an even distribution of the resultant pressures in all the pipes thereof, thus securing a higher degree of efficiency for a given quantity of refrigerant than has heretofore been attained and to secure a uniform thermal effect throughout the entire coil.

It consists of a coil composed of a series of substantially parallel lengths of pipe connected at one end to an inlet or feed pipe and at the other to an outlet or offtake pipe, and intersected at one or more points within their lengths by transverse headers or manifolds of larger diameter, with which all the pipes communicate. These pipes might in some cases be continued in a right line from one end to the other; but to carry out another part of our invention we place the feed-pipe and the outlet-header in close proximity so that each length of the coil-pipe terminates at or very near its starting-point, the return portion lying substantially parallel to the outgoing portion. They might also be placed in a horizontal position; but we prefer to incline them, the outgoing portion descending to an intermediate union-header which must be at the lowest point in the system, while the return portions ascend to the altitude of the inlet. In its preferred form, therefore, it consists of a coil composed of a series of substantially parallel lengths of pipe, preferably arranged with a slight inclination, a portion of them being connected at their upper ends to an inlet or feed pipe and the remainder to an outlet-pipe, while all of them are connected at their lower ends to a common header or manifold which acts as a distributer or pressure equalizer between all the pipes at a point midway in the system, and in such other details of construction and arrangement as will hereinafter be fully set forth.

The accompanying drawing shows our invention as applied to use in a cooling-tank, such as is now commonly used in a brine-circulating system of artificial refrigeration; but it might also be used in the "direct-expansion" system or in various locations and ways other than here suggested, and the details modified or changed within the skill of a good mechanic without departing from the spirit of our invention, as set forth in the claims at the end of the specification.

In a brine-tank A, which may be of any suitable shape or dimensions, is a coil composed of a series of pipes B B′, preferably formed into flat coils, as shown, and arranged to stand edgewise in parallel vertical planes, each pair of the pipes constituting a single coil or complete circuit through the system from inlet to outlet. In the drawing these pipes are shown as widely separated to secure greater perspicuity; but, in practice, they are placed in as close proximity to each other as the convenience of construction and a free circulation of the brine, which, in operation, surrounds them, will permit.

The pipes B are provided with valves *b* and connected at their upper ends to a feed or supply pipe *c*, leading from a reservoir C, containing anhydrous ammonia or any other suitable refrigerant. The pipes B are connected at their lower ends to a header or manifold D, which we prefer to make considerably larger in diameter than the pipes B. The pipes B′ are also connected at their lower ends to this manifold and at their upper ends to a header D′, which is connected to a suction-pipe D^2, leading to a compressor-pump, as will be understood by those skilled in the art to which our invention pertains. The coils B B′ are braced and supported by suitable standards E.

In operation our invention works as follows: The tank will be filled with brine until all the pipes are submerged. The refrigerant

is then admitted through the valves *b* into the pipes B, down the inclines of which it flows toward the lower manifold D, evaporating as it moves. From this manifold the refrigerant passes into the return-pipes B′, and from them into the header D′ and thence is drawn off through the suction-pipe D^2. Now the most rapid expansion takes place, and consequently the lowest temperature is produced in each pipe B at or near the valve *b*, where the refrigerant (we prefer to use anhydrous ammonia) is first released from the pressure of its storage-reservoir. As the ammonia passes down through the pipe B into the header D and then up through the pipes B′, it continues to expand and also to absorb the heat from the brine surrounding the pipes until it passes into the header D′, when it will have become a highly-attenuated gas, charged with all the heat it could extract from the brine. By this arrangement the coldest end of one set of pipe is brought into close proximity with the warmest end of the other, and as the two sets extend down to the header D this condition of temperature prevails, but with constantly-decreasing ratio, until at the header their temperature is the same. It will thus be seen that the mean cooling effect of each pair of pipes B B′ will be substantially uniform throughout their lengths, and that the brine in the tank will be cooled equally at its top and bottom and all through. To secure this result alone the header D might be dispensed with and the lower end of each pair of pipes B B′ be connected by a return-bend, thus constituting them a single coil, in one half of which the ammonia would descend, while it would ascend in the other half. With such a construction, however, it would be necessary to so graduate the feed that the amount of ammonia admitted to each pipe would not exceed the amount that could be expanded in that pipe alone, or the liquid would accumulate in the return-bend at the bottom of the coil, gradually filling the pipe and retarding evaporation, which cannot occur where the pipe is filled with the liquid.

It has been found in practice impossible to graduate the feed to such a nicety that each pipe shall receive an amount of liquid ammonia exactly equal to its duty, for some get more and some less than would be expanded in a single pair of pipes B B′; but as the feed occurs at the top of the incline of the pipes B, the excessive charge which some of them may receive will simply flow down into the large header, and there compensate for the deficient supply from some other pipe B, so that each of the return-pipes B′ will draw from a uniform supply and receive its due amount of the gas to be transmitted up its incline to the header D′.

The header D must be of ample size, and should never be filled with the liquid above the surface of which a space should be maintained to aid the expansion of the liquid lying in the header and afford free communication between the mouths of all the pipes tapped into it. The header would also act as a trap for any oil that may have been carried through the condenser and liquid-reservoir in vaporous form, but condensed by the intense cold of the expanding process. This oil would settle in the bottom of the header below any liquid ammonia that it might contain, and could be drawn off through the purger-pipe F, which taps into the header D for this purpose.

We are aware that it is not new to make expansion-coils composed of a series of inclined pipes connected to a feed-supply pipe at their lower ends and to an exhaust-header at their upper ends. Under such a construction, however, the pipes are liable to become filled up through excessive feeding at the bottom and the extreme thermal effects localized, and the coldest ends of all of the pipes being at the bottom and their warmest ends at the top of the tank. We are also aware that it is not new to feed into a similar series of pipes at their top ends and draw off the expanded gas or unexpanded liquid from a header at their bottoms. Under this construction there is the same localization of thermal effect as under that just described, and also a large loss of energy due to the liquid being fed into certain pipes in excess of their capacity to evaporate and finding its way into the bottom header, where it must be drawn off in the liquid state.

It is customary to employ a stirring apparatus of some kind in tanks having the ordinary form of cooling-coils fed only at their top or bottom ends, because the thermal effect is localized by such a coil and the brine must be artificially forced into circulation to bring it all into the zone of lowest temperature; but with our invention this artificial circulation is not necessary, as the brine is equally cooled throughout its bulk. This is a particularly desirable feature in very shallow tanks. We have mentioned and described each pair of pipe-sections B B′ as constituting a single complete circuit through the system; but it is not essential that there be an equal number of these sections, the relative number being determined by the nature of the service or peculiar conditions under which the coil is to work.

What we claim as our own invention, and desire to secure by Letters Patent, is—

1. The combination of a series of pipes provided with valves and connected at one end to an inlet or feed pipe and at the other to an offtake header, with a manifold intercepting and connecting them at a point between their ends, substantially as hereinbefore set forth.

2. The combination of a series of pipes connected at one end to an inlet or feed pipe and at the other to an offtake header located in close proximity to the feed-pipe, the re-

turn portion of each pipe being parallel with and in close proximity to the outgoing portion, substantially as hereinbefore set forth.

3. The combination of a series of pipes connected at one end to an inlet or feed pipe and at the other to an offtake header located in close proximity to the feed-pipe, valves at the inlet ends of the pipes, and a manifold, which intercepts and connects all the pipes between their ends, substantially as hereinbefore set forth.

4. The combination of a series of pipes connected at one end to an inlet or feed pipe and at the other to an offtake header located in substantially the same horizontal plane as the feed-pipe, the pipes of the series being inclined throughout, with their ends at the highest elevation, substantially as hereinbefore set forth.

5. The combination of a series of pipes provided with valves and connected at one end to an inlet or feed pipe and at the other to an offtake header, the pipes being inclined from both ends downward, with a manifold which intercepts and connects all the pipes between their ends and at their lowest point, substantially as and for the purpose hereinbefore set forth.

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

EUGENE T. SKINKLE.
JOHN M. WESTERLIN.

Witnesses:
HARRY SKINKLE,
C. M. GAY.