The Gas Refrigerator

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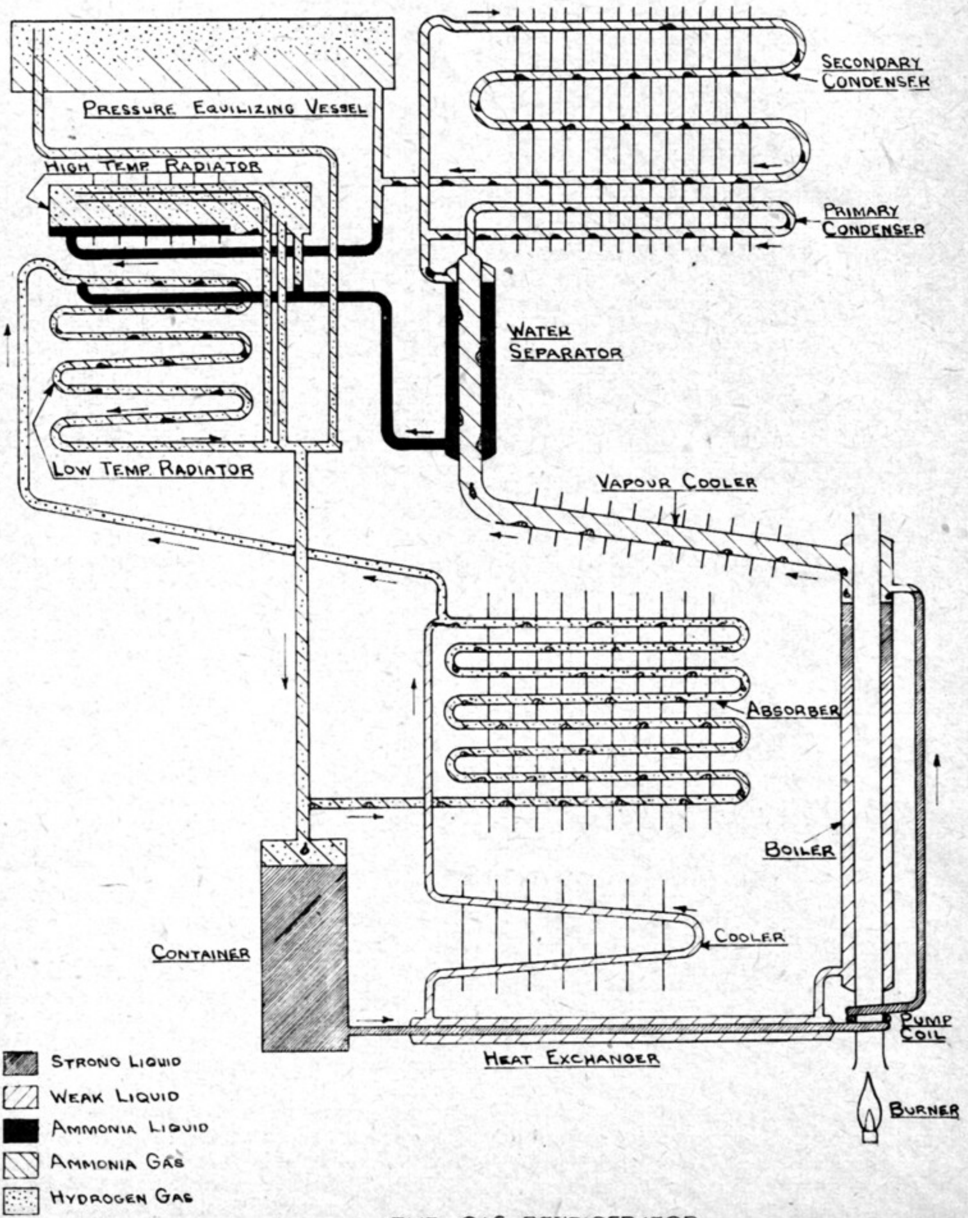
A description of the principle of its operation

THE refrigerator unit is composed of a series of steel vessels and tubes welded together to form a single inter-connected container. The unit is charged with distilled water, ammonia, and hydrogen at a pressure sufficient to condense ammonia vapour at ordinary room temperature. It is then hermetically sealed. The liquid seeks the lowest levels and the hydrogen fills the remaining space.



THE GAS REFRIGERATOR

The working of the unit depends on three cycles which operate simultaneously: (1) The ammonia cycle; (2) the hydrogen cycle, and (3) the aqua-ammonia cycle. The rate at which these cycles are performed, governed by the heat input of the burner, controls the amount of refrigeration. The diagram illustrates the working principle.

When the annular boiler is heated by the burner at its base, ammonia and a small quantity of water are vaporised. The vapours pass through a cooler to the water separator. This is cooled by liquid ammonia contained in the outer jacket. The water vapour is condensed and drains back to the boiler. The ammonia gas passes into the primary condenser where it is cooled and, therefore, liquified. The liquid ammonia runs to the low-temperature radiator where it evaporates, causing a cooling effect and producing refrigeration.

If any ammonia vapour is not condensed in the primary condenser, it passes into the secondary condenser, where it should be condensed. However, if the room temperature is such that the pressure in the unit is insufficient to condense the ammonia vapour in the condenser, some ammonia vapour passes into the pressure-equalising vessel, displacing hydrogen which flows into the absorber and radiator systems. The pressure within the unit is increased because the hydrogen is insoluble in the water in the absorber, and the ammonia vapour which has displaced the hydrogen occupies a greater volume than the same amount of ammonia in solution. When the room temperature falls, the ammonia in the pressure-equalising vessel liquifies, and the reserve hydrogen returns thereto.

The ammonia vapour condensed in the secondary condenser flows in the high-temperature radiator. Some of this evaporates into a mixture of ammonia and hydrogen fed from the low-pressure radiator, and assists in refrigeration; the remainder flows to the low-temperature radiator.

As the liquid ammonia runs through the low-temperature radiator it evaporates into a stream of hydrogen which circulates through the low-temperature radiator and absorber. The evaporation causes refrigeration.

The cool, heavy mixture of hydrogen and ammonia vapour enter at the bottom of the absorber. A week ammonia solution from the boiler enters at the top of the absorber. As the weak solution flows downwards, the upward flowing ammonia vapour is absorbed and the resulting strong ammonia solution flows from the bottom of the absorber into a container. The flow of hydrogen continues upwards to the low-temperature radiator, completing its cycle. The hydrogen circulation is maintained by the difference in densities of hydrogen and the mixed gases. Heat is evolved in the process of absorption, and the absorber is provided with cooling fins.

From the container the strong solution flows through a heat exchanger to the circulating pump. This lifts the solution to the top of the boiler, completing the ammonia cycle. The weak ammonia solution leaves the bottom of the boiler and passes through the heat exchanger and then a cooler to the top of the absorber.

As long as the necessary heat input to the boiler is maintained, the cycles described operate continuously, resulting in continuous refrigeration.