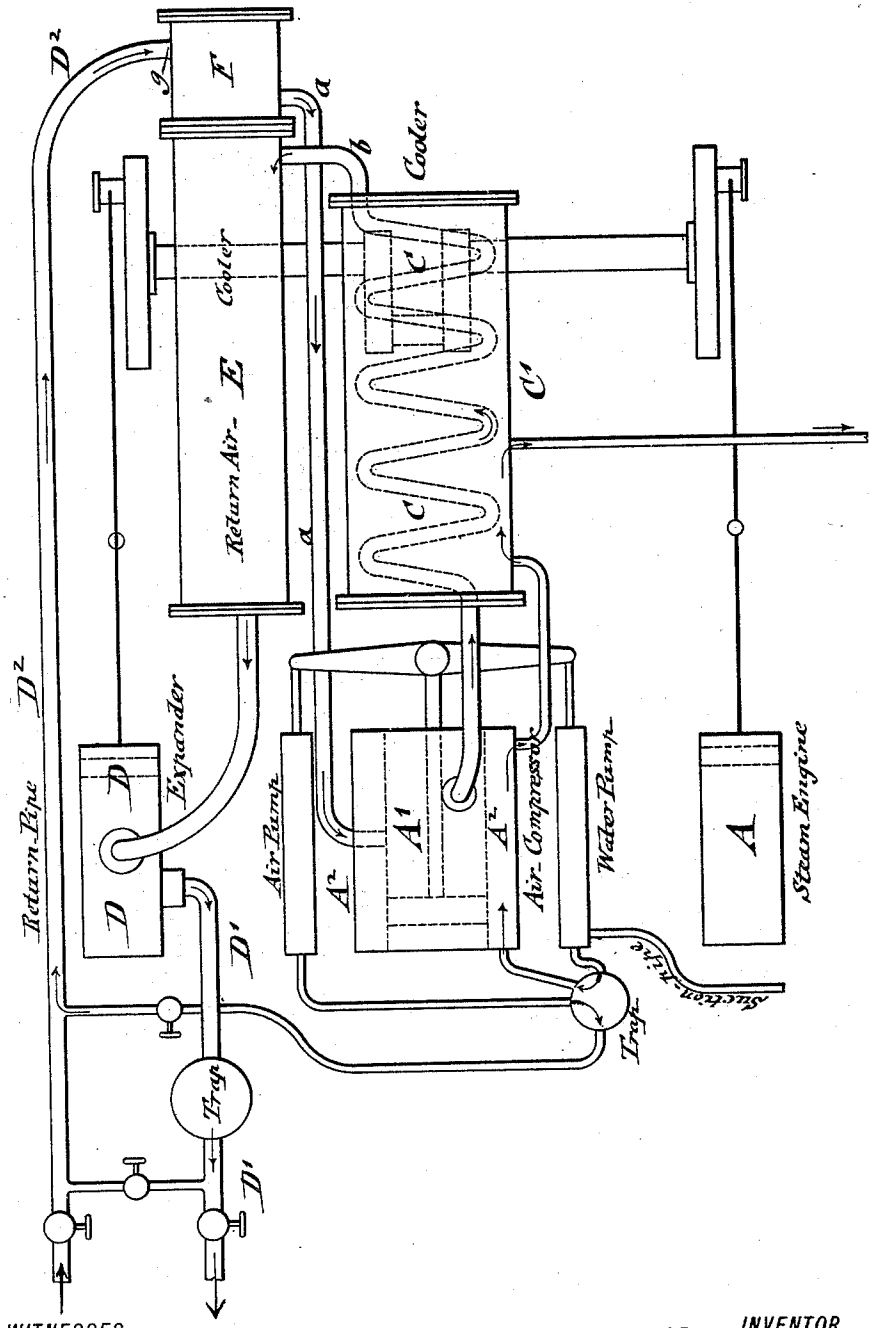
(No Model.) 3 Sheets—Sheet 1.

# H. B. ROELKER.

## RETURN AIR COOLER.

No. 484,979 Patented Oct. 25, 1892.

FIG. 1.




WITNESSES:

Charles Schroeder

Charles Bles

INVENTOR

Hugo B. Roelker

BY Goepel & Raegener

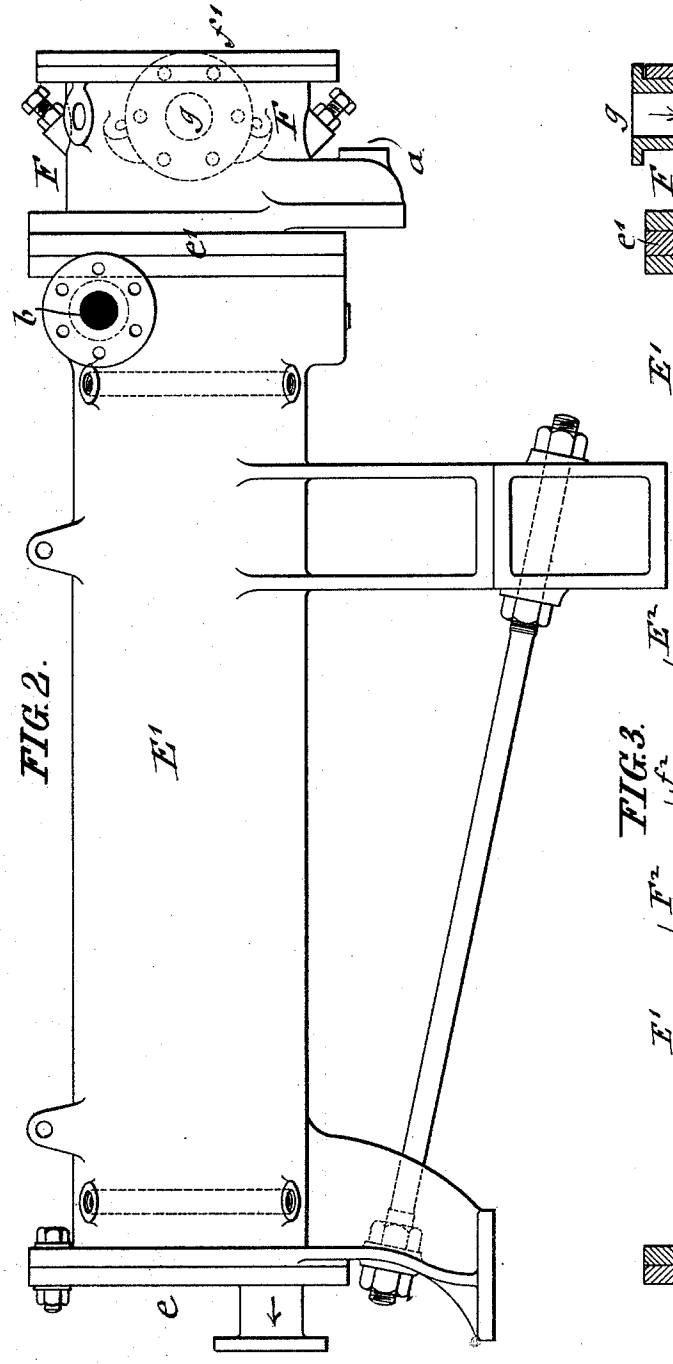
ATTORNEYS.

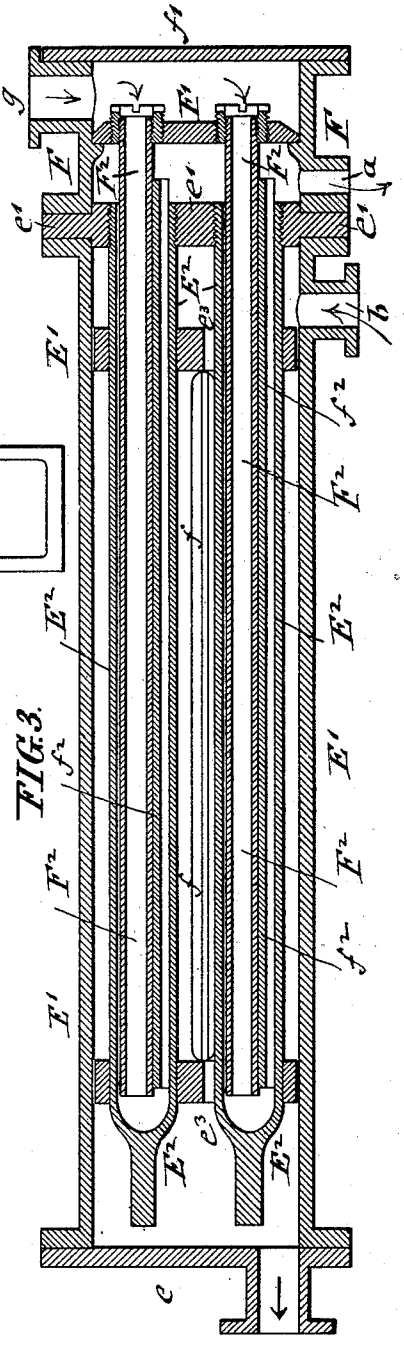
(No Model.) 3 Sheets—Sheet 2.

# H. B. ROELKER.

## RETURN AIR COOLER.

No. 484,979. Patented Oct. 25, 1892.




WITNESSES:
Charles Schroeder
Charles Bles

INVENTOR
Hugo B. Roelker
BY
Goepel & Wagener
ATTORNEYS.

(No Model.) 3 Sheets—Sheet 3.

# H. B. ROELKER.

## RETURN AIR COOLER.

No. 484,979. Patented Oct. 25, 1892.

FIG. 4

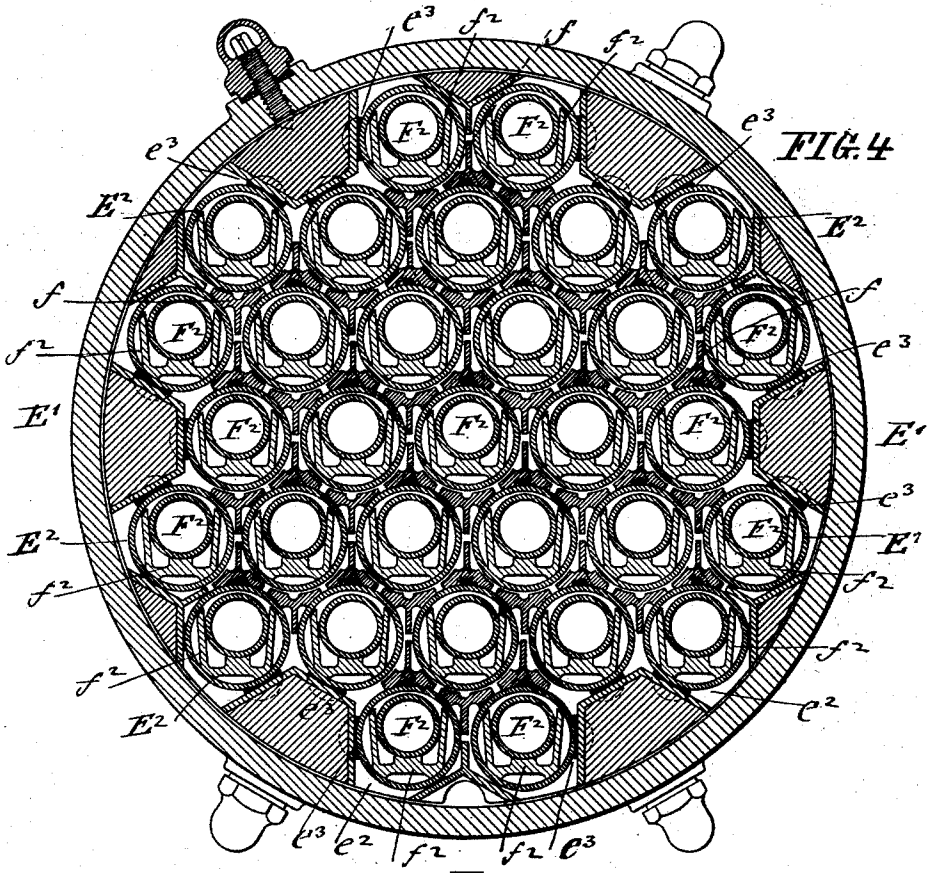
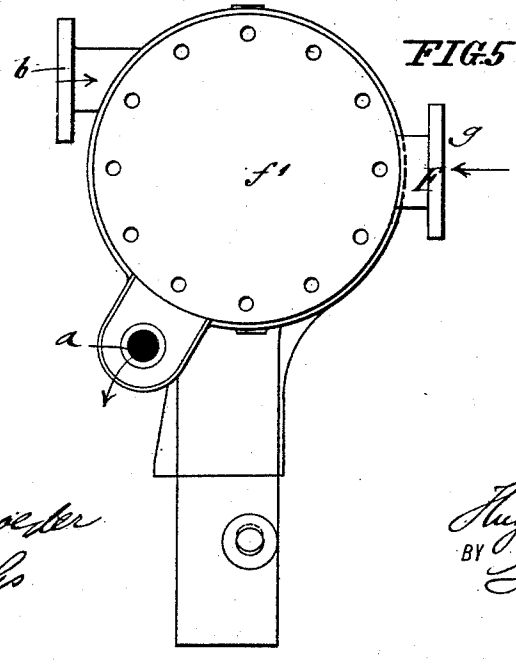



FIG. 5




WITNESSES:
Charles Schroeder
Charles Bliss

INVENTOR
Hugo B. Roelker
BY
Goepel & Raegener
ATTORNEYS.

# UNITED STATES PATENT OFFICE.

HUGO B. ROELKER, OF NEW YORK, N. Y.

## RETURN-AIR COOLER.

SPECIFICATION forming part of Letters Patent No. 484,979, dated October 25, 1892.

Application filed August 3, 1891. Serial No. 401,549. (No model.)

*To all whom it may concern:*

Be it known that I, HUGO B. ROELKER, a citizen of the United States, residing at New York city, in the county of New York and State of New York, have invented certain new and useful Improvements in Return-Air Coolers, of which the following is a specification.

In dynamic refrigerating-machines of the type known as the "Allen Dense-Air Refrigerating-Machine," for which Letters Patent of the United States were granted to Leicester Allen, No. 252,921, dated January 31, 1882, the air or other refrigerating medium is first compressed and then passed through a cooling-coil, around which water is circulated, so that the heat of compression is removed. The compressed cooled air is then conducted to an expanding-engine, which is made in the form of a cut-off engine, into which the air is admitted during a portion of the stroke of the piston. The charge of air is then cut off, so that the air in the cylinder is expanded as the piston proceeds to finish its stroke. The expanded air is then forced by the return-stroke of the piston into a system of pipes located in the refrigerating-room or other space to be cooled. From the system of pipes in the refrigerating-room the air is returned, while being still above the normal atmospheric pressure, to the compressor, where it is compressed again, then cooled, and then again expanded into the system of cooling-pipes by the cut-off engine, as before described. During the course of the air through the different parts of the refrigerating-machine and the conveying and refrigerating pipes the air is kept in a closed cycle, known as the "Carnot cycle," and is then used over and over again. As the temperature of the returning air is still considerably below the temperature of that of the surroundings, the cold still remaining in the same can be utilized before the air is returned to the compressor, and thus the efficiency of the refrigerating-machine may be considerably increased.

The object of this invention is to utilize the return-air, after the same has done its work in the refrigerating-room and elsewhere, for cooling the air that has just been compressed and then deprived of the heat of compression in the usual manner, so that the thus-cooled compressed air is then taken up by the expanding-engine and conducted to the refrigerating-room, and thereby a lower temperature and the more economical working of the refrigerating-machine are produced. For this purpose the invention consists of a return-air cooler composed of an exterior shell, longitudinal tubes supported in said shell and being open at one end and closed at the other end, a tube-head for supporting the open end of said tubes, a compartment at one end of the shell, next to said tube-head, interior pipes open at both ends and extending into said tubes, and a second tube-head in said compartment for supporting the ends of the interior pipes.

The invention consists, further, of certain details of construction, which will be more fully described hereinafter, and finally pointed out in the claims.

In the accompanying drawings, Figure 1 represents a diagram of an Allen dense-air refrigerating-machine with my improved return-air cooler shown in connection with the working parts of said machine. Fig. 2 is a side elevation of my improved return-air cooler, drawn on a larger scale. Fig. 3 is a vertical longitudinal section of the same. Fig. 4 is a vertical transverse section of the return-air cooler with a large number of tubes, drawn on a larger scale; and Fig. 5 is an end elevation of Fig. 2.

Similar letters of reference indicate corresponding parts.

Referring to the drawings, A represents the steam-cylinder, which furnishes the power for the entire refrigerating apparatus.

A′ is the air-compressing cylinder, which is surrounded by a water-jacket $A^2$ for cooling the cylinder and preventing the deterioration of the piston-packing.

C is a cooling-coil which is surrounded by a cylinder C′, filled with water, and D is the expanding-engine, to which the cooled and compressed air is admitted until it fills a portion of the volume of the cylinder. The air is then shut off and the piston continues its motion until it arrives at the end of its stroke, so that the air is expanded and then forced by the next stroke of the piston through a well-insulated pipe system D′ to the refrigerating-room or other point. In the refrig-

erating-room the temperature is reduced by passing the cold air from the ice-machine through a system of refrigerating-pipes, the air being then returned by the return-pipe $D^2$ to a return-air cooler E, which is interposed between the air-cooler C, compressor A′, and expander D, as shown clearly in the diagram, Fig. 1. In the return-air cooler the returning air (which is considerably colder than the water used for cooling the air in the air-cooler) is employed for imparting a still lower degree of temperature to the air that has just been compressed in the compressor and deprived of its heat of compression in the cooler, so that the air is conducted, at a still lower temperature than heretofore, to the expanding-engine and into the system of refrigerating-pipes connected therewith. The return-air cooler E consists more specially of an exterior cylinder or shell E′, which is closed at one end by a plain head *e* and at the opposite end by a tube-head *e′*, into which a number of longitudinal tubes $E^2$ are tightly secured. The tubes $E^2$ are open at that end supported by the tube-head *e′* and closed at the opposite end next to the head *e*, to which the pipe that leads to the expanding-engine is connected. The tubes $E^2$ are further supported at one or more points by tube-heads $e^2$. (Shown in Figs. 3 and 4.) The open ends of the tubes $E^2$ communicate by a pipe with the suction side of the compressor A′, while the space in the exterior cylinder E around the tubes $E^2$ is connected by a pipe *b* with the cooling-coil C. Intermediately between the pipes $E^2$ are arranged a number of longitudinally-grooved strips *f*, preferably of T-shaped cross-section, which serve for dividing the spaces that surround the tubes into small longitudinal passages, through which the compressed air, gas, or other medium, after passing through the cooler C, is forced from one end of the cylinder E′ to the other and then conducted to the expanding-engine. The cooled and compressed air is thus compelled to pass in close contact with the surface of the tubes $E^2$ by the arrangement of the interposed longitudinal strips *f*. The tube-heads $e^2$ are provided with a number of small openings $e^3$, which are arranged at suitable points, so as to communicate with the spaces between said tubes and which produce a retarding action on the air, so as to distribute the same uniformly throughout the spaces between the tubes $E^2$.

To the cylinder E′ is attached, at the end next to the tube-head *e′*, a cylindrical compartment or box F, which is provided with a closed head *f′* and with a transverse tube-head or partition F′, to which the ends of a series of longitudinal pipes $F^2$ are attached, which are made of smaller diameter than the tubes $E^2$ and which are extended into the same to nearly their full length. The pipes $F^2$ are open at both ends and supported by means of longitudinal strips $f^2$ of U shape or other suitable cross-section, which, like the longitudinal strips that are placed between the outer tubes $E^2$, serve to divide the space inside of the tubes $E^2$ into a number of small longitudinal passages. The compartment or box F is provided with an opening *g*, that is connected with the return-air pipe at a point between the tube-heads *e′* and F′ with the pipe *a*, which leads to the suction side of the compressor A′, so that the return-air is compelled to pass through the interior pipes $F^2$ until it arrives at the ends of the inner pipes and the closed ends of the outer tubes $E^2$, when it is returned into the passages formed between the pipes $F^2$ and the tubes $E^2$ into the space between the tube-heads *o′* and F′, and then conducted to the compressor. By being exposed to the temperature of the return-air in the interior pipes $F^2$ and outer tubes $E^2$, which are arranged in the cylinder of the return-air cooler, the temperature of the compressed air or gas which passes through the cylinder E′ from the cooler to the expanding engine is still more reduced, so that the same does more effective work in the system of refrigerating-pipes in the chill-room or other place of use and permits the more economical working of the refrigerating-machine.

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

1. In a dynamic refrigerating apparatus, a return-air cooler composed of an exterior shell, longitudinal tubes open at one end and closed at the other end, supported in said shell, a tube-head for supporting the open end of said tubes, a compartment at one end of said shell next to said tube-head, interior pipes open at both ends and extending into said tubes, and a tube-head in said compartment for supporting the interior pipes, substantially as set forth.

2. In a dynamic refrigerating apparatus, the combination of an exterior cylinder or shell, longitudinal tubes open at one end and closed at the opposite end, tube-heads for supporting said tubes, said tube-heads having openings, a compartment arranged at one end of the shell, interior pipes open at both ends and extending from the compartment into the longitudinal tubes, exterior longitudinal strips interposed between the longitudinal tubes, and interior longitudinal strips interposed between the outer tubes and interior pipes, so as to furnish a large number of small longitudinal channels or passage-ways for the passage of the compressed air and of the return-air, substantially as set forth.

In testimony that I claim the foregoing as my invention I have signed my name in presence of two subscribing witnesses.

HUGO B. ROELKER.

Witnesses:
PAUL GOEPEL,
A. M. BAKER.