O. BANNER.

TURBO-COMPRESSOR.

APPLICATION FILED SEPT. 4, 1912.

1,102,635.

Patented July 7, 1914.

2 SHEETS—SHEET 1.

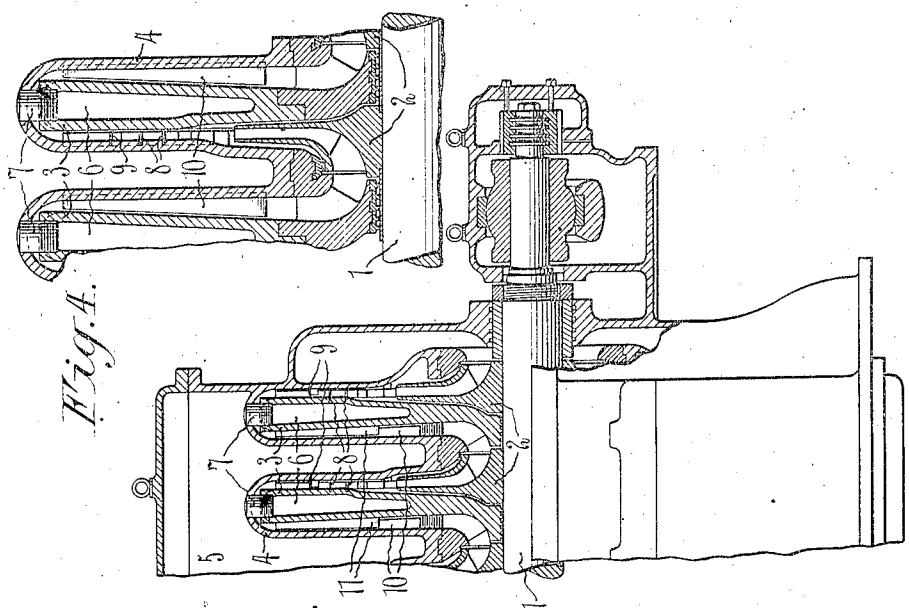


Fig. 4.

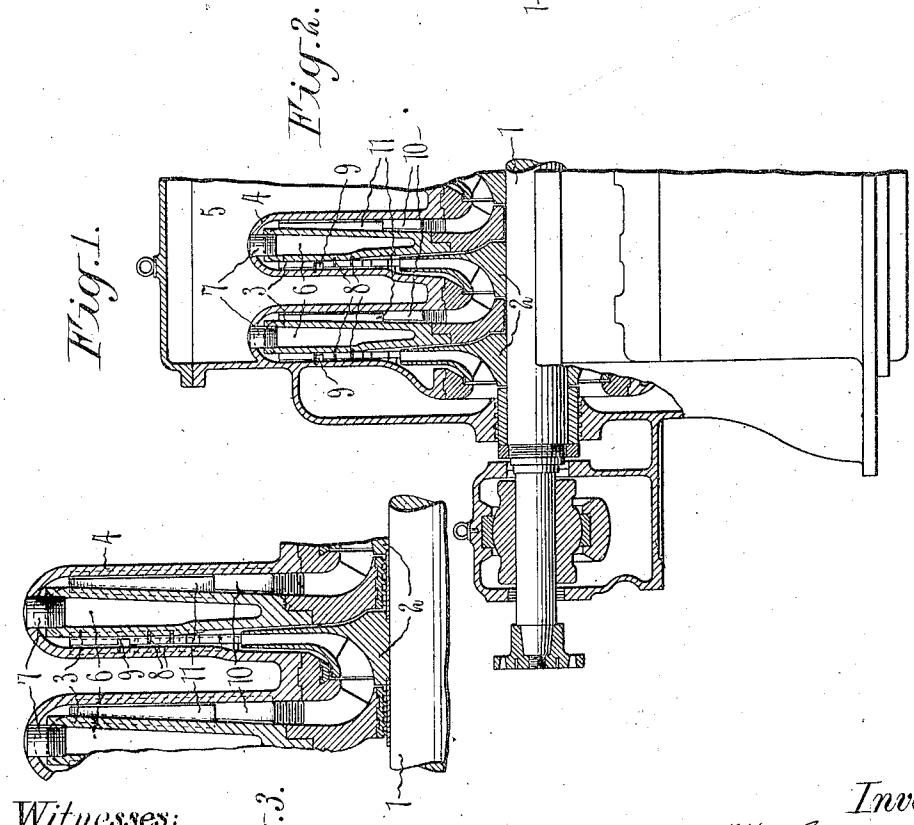


Fig. 2.

Fig. 1.

Fig. 3.

Witnesses:
Harry G. Fleischer
F. George Barry

Inventor:
Otto Banner
by his attorneys
Brown & Ward

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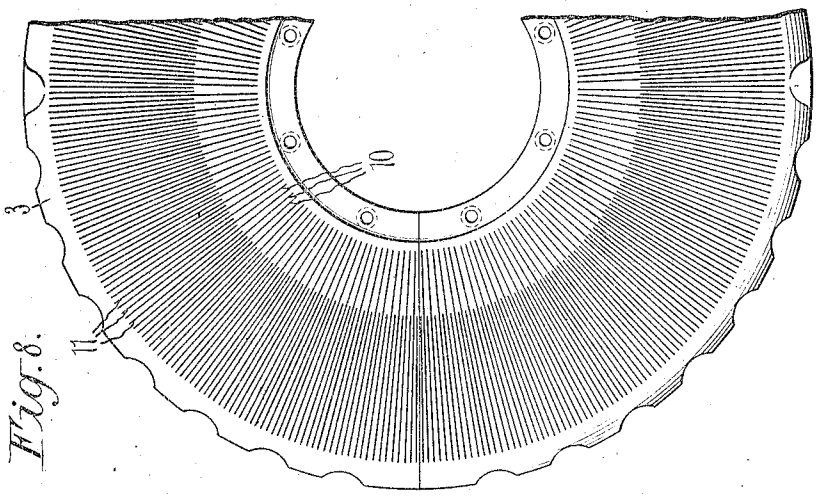


Fig. 8.

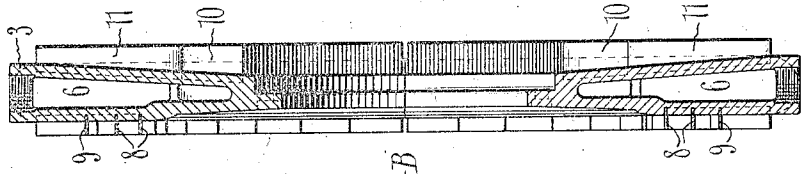


Fig. 6.

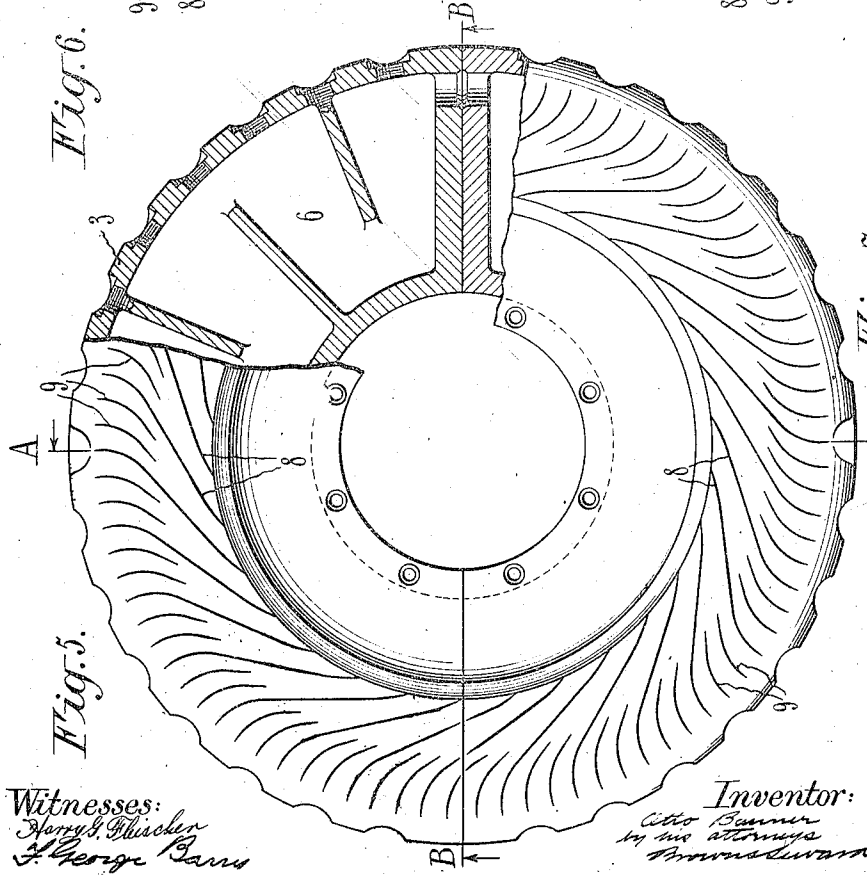


Fig. 5.

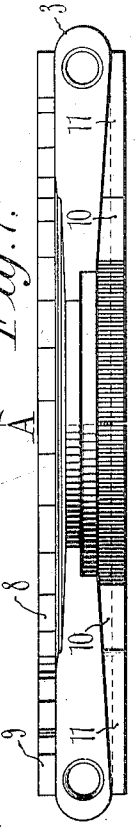


Fig. 7.

Witnesses:
Harry G. Thurber
F. George Barns

Inventor:
Otto Banner
by his attorneys
Brownell & Ward

UNITED STATES PATENT OFFICE.

OTTO BANNER, OF EASTON, PENNSYLVANIA, ASSIGNOR TO INGERSOLL-RAND COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW JERSEY.

TURBO-COMPRESSOR.

1,102,635. Specification of Letters Patent. Patented July 7, 1914.

Application filed September 4, 1912. Serial No. 718,576.

To all whom it may concern:

Be it known that I, OTTO BANNER, a subject of the German Emperor, and resident of Easton, in the county of Northampton and State of Pennsylvania, have invented a new and useful Improvement in Turbo-Compressors, of which the following is a specification.

In turbo-compressors it is very desirable to have the fluid which is being compressed cooled as much as possible during the compression stages in order to secure high efficiency in the compressor.

The object of this invention is to provide novel means for cooling the fluid as it is being compressed, said means forming an integral part of the compressor and thereby eliminating the necessity of the use of a separate intercooling means.

This invention is particularly directed to the cooling of the fluid as it passes outwardly from one wheel along the front of a diaphragm and inwardly along the back of the diaphragm to the next succeeding wheel, means being provided for diffusing the fluid as it passes outwardly from the first-named wheel and finely sub-dividing the fluid as it passes inwardly to the last-named wheel.

Practical embodiments of this invention are represented in the accompanying drawings, in which—

Figure 1 represents, partly in side elevation and partly in vertical longitudinal central section, so much of a turbo-compressor as will give a clear understanding of my invention, the diffusing and cooling vanes in this instance being shown as formed on the diaphragm, and the diaphragm being shown as having its hub and outer member separable. Fig. 2 is a similar view with the exception that the diaphragm is shown as having its hub and outer member formed integral, Fig. 3 is a detail section showing part of the vanes carried by the casing and part of the vanes carried by the diaphragm, Fig. 4 is a detail section showing all of the vanes carried by the casing, Fig. 5 is an enlarged front view of the outer member of a diaphragm of the form shown in Fig. 1, a portion of the same being broken away to more clearly show its interior construction, Fig. 6 is a section taken in the plane of the line A—A of Fig. 5, Fig. 7 is a view taken in the plane of the line B—B of Fig. 5, and Fig. 8 is a partial back view of the diaphragm shown in Figs. 5, 6 and 7.

The shaft of the turbo-compressor is denoted by 1 and it has fixed to rotate therewith one or more wheels 2 of the usual type. The turbo-compressor is provided with one or more diaphragms 3 so arranged as to have the fluid thrown out along one face thereof from one wheel and drawn in along the other face thereof to another wheel. A casing 4 surrounds the diaphragm 3, which casing is water-jacketed as shown at 5. The interior 6 of the diaphragm is brought into open communication with the interior of the water jacket 5 by suitable hollow connections 7. In the form shown in Fig. 1 the hub member and the outer ring member of the diaphragm are shown separable while in Fig. 2 they are shown integral. The diaphragm is divided transversely into half members for facilitating the assembly of the parts.

Diffusing vanes 8 are located in the space between the casing 4 and the front of the diaphragm 3 thus forming diffusing channels through which the fluid is thrown by the wheel 2. Cooling vanes 9 may be interposed in these diffusing channels between the outer portions of the vanes 8 for use in abstracting more or less heat from the fluid as it is diffused. The diffusing vanes 8 also serve to abstract more or less heat from the said fluid. The gradually widening channels formed between the diffusing vanes 8 serve to materially reduce the velocity of the fluid as it passes outwardly. Cooling vanes set closely together are interposed in the space between the casing 4 and the back of the diaphragm 3 for abstracting heat from the fluid as it is drawn inwardly along the back of the diaphragm to the next succeeding wheel 2. There are shown long cooling vanes 10 and short cooling vanes 11 so as to very finely sub-divide the stream of fluid and thus more readily abstract the heat therefrom. In the form shown in Fig. 1, the vanes are shown on the diaphragm. In Fig. 3 the vanes are shown some on the diaphragm and some on the casing. In Fig. 4 the vanes are all shown on the casing.

In operation; as the fluid being compressed is thrown outwardly from the rotary wheel, it passes through the channels formed by the outwardly diverging diffusing vanes

between the casing and the front of the diaphragm, and loses its velocity to a considerable extent on account of the increasing cross sectional area of said diffusing channels. Cooling vanes may be located in the channels between the outer portions of these diffusing vanes, where the fluid has lost much of its velocity. The fluid then passes around the outer edge of the diaphragm and inwardly through the channels formed by the cooling vanes between the casing and the back of the diaphragm, to the next succeeding wheel. These vanes will abstract much of the heat from the fluid before it enters said succeeding wheel. This operation is repeated for each stage of the compressor thus keeping the temperature of the fluid constantly down to a limit which will insure great efficiency for the compressor.

It is intended to put as many diffusing vanes as possible in the space between the casing and the front of the diaphragm so as to abstract as much heat as possible at this point as well as reduce the velocity of the fluid. However, too many of these vanes should not be thus placed as in that event there will be too great frictional losses and too many shocks for the fluid as it leaves the wheel. A great many cooling vanes may be placed in the space between the back of the diaphragm and the casing without danger of losing energy by shocks or frictional losses thus making it possible to abstract a great amount of heat on the rear side of the diaphragm. I have shown, in the accompanying drawings, various ways in which these cooling vanes may be placed between the casing and the diaphragm. The cooling vanes may be obtained by casting sheet metal vanes into the adjacent parts or by casting thin ribs on said parts, as may be desired. I have also shown these diaphragms as being divided transversely into two half sections or transversely and circumferentially into inner and outer members divided into two half sections. These forms are only instances of many different ways in which these diaphragms can be constructed.

It is evident that changes might be resorted to in the form, construction and arrangement of the several parts without departing from the spirit and scope of my invention; hence I do not wish to limit myself strictly to the structure herein shown and described, but

What I claim is:—

1. In a turbo-compressor, compressing wheels, an interposed diaphragm, means for passing the fluid being compressed from one wheel to the next wheel outwardly and inwardly along the front and back of the diaphragm, means for diffusing the fluid to reduce its velocity and for reducing the temperature of the fluid as it passes outwardly from one compressing wheel along the front of the diaphragm and means consisting of heat conducting material for further reducing the temperature of the fluid as it passes inwardly along the back of the diaphragm to the next compressing wheel.

2. In a turbo-compressor, compressing wheels, an interposed diaphragm, means for passing the fluid being compressed from one wheel to the next wheel outwardly and inwardly along the front and back of the diaphragm, means for diffusing the fluid being compressed to reduce its velocity as it passes outwardly from one compressing wheel along the front of the diaphragm and heat conducting vanes arranged to finely subdivide the fluid to reduce its temperature as it passes inwardly along the back of the diaphragm to the next compressing wheel.

3. A turbo-compressor including a casing, compressing wheels and an interposed diaphragm, the walls of said casing extending along the front and back of the diaphragm, and cooling vanes in the space between the walls of the casing and the diaphragm along the front and back of the diaphragm.

4. A turbo-compressor including a casing, compressing wheels and an interposed diaphragm, the walls of said casing extending along the front and back of said diaphragm, outwardly diverging diffusing vanes in the space between the walls of the casing and the front of the diaphragm, and cooling vanes located between the outer portions of said diffusing vanes.

5. A turbo-compressor including a casing, compressing wheels and an interposed diaphragm, the walls of said casing extending along the front and back of said diaphragm, outwardly diverging diffusing vanes in the space between the walls of the casing and the front of the diaphragm, cooling vanes located between the outer portions of said diffusing vanes, and cooling vanes in the space between the walls of the casing and the back of the diaphragm.

6. A turbo-compressor including a casing, a wheel and a diaphragm, and cooling vanes on the diaphragm in the space between the casing and diaphragm upon opposite sides of the diaphragm.

7. A turbo-compressor including a casing, a wheel and a diaphragm, and cooling vanes on the casing in the space between the casing and the diaphragm upon opposite sides of the diaphragm.

8. A turbo-compressor including a casing, a wheel and a diaphragm, and cooling vanes on both the casing and the diaphragm in the space between the casing and the diaphragm.

9. A turbo-compressor including a casing, a wheel and a diaphragm, and cooling vanes on both the casing and the diaphragm in the space between the casing and the diaphragm upon opposite sides of the diaphragm.

10. A turbo-compressor diaphragm hav-

ing front and back walls and cooling vanes on the diaphragm along its front wall.

11. A turbo-compressor diaphragm having front and back walls and cooling vanes on the diaphragm along its front and back walls.

12. A turbo-compressor diaphragm having front and back walls, outwardly diverging diffusing vanes on the diaphragm along its front wall and cooling vanes located on the diaphragm between the outer portions of said diffusing vanes.

13. A turbo-compressor diaphragm having front and back walls, outwardly diverging diffusing vanes on the diaphragm along its front wall, cooling vanes located on the diaphragm between the outer portions of said diffusing vanes and cooling vanes on the diaphragm along its back wall.

In testimony, that I claim the foregoing as my invention, I have signed my name in presence of two witnesses, this 30th day of August 1912.

OTTO BANNER.

Witnesses:
F. A. POPE,
PAUL T. HOFFMAN.