W. GRUN.

COOLING APPARATUS FOR TURBO COMPRESSORS.

APPLICATION FILED JUNE 22, 1910.

985,161. Patented Feb. 28, 1911.

Fig. 1.

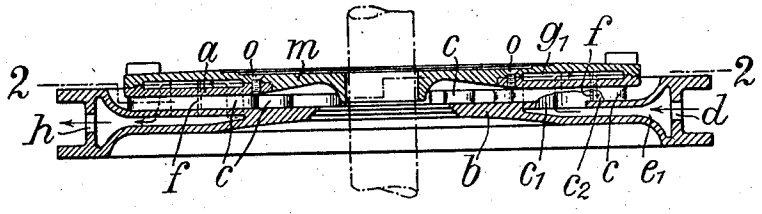


Fig. 2.

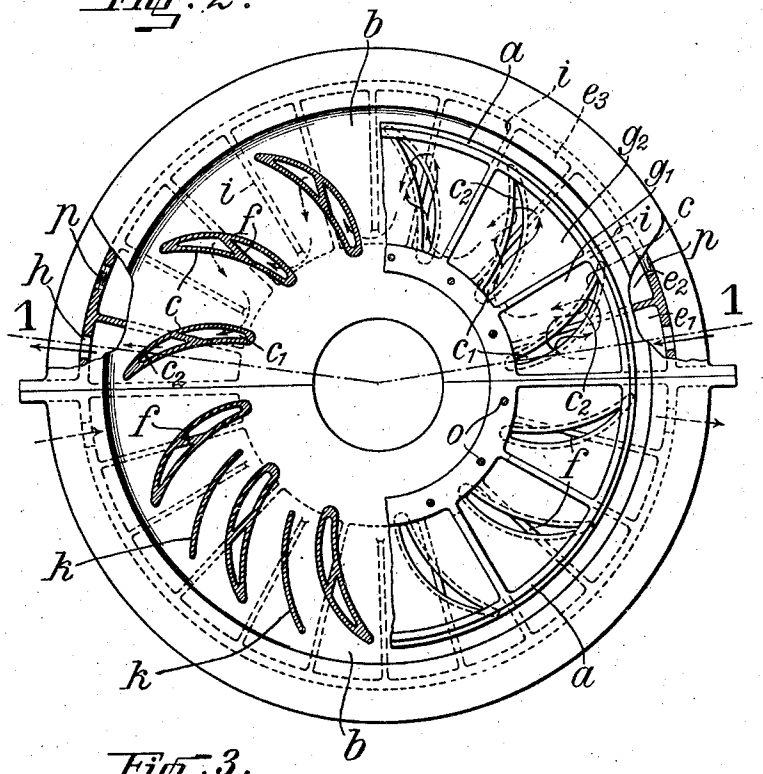
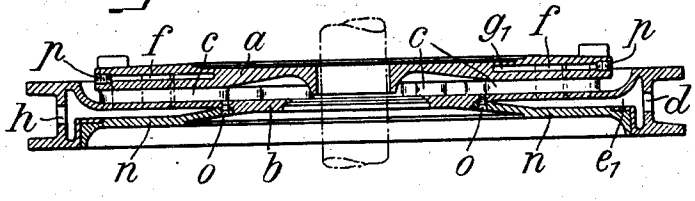


Fig. 3.



Witnesses:

M. L. Brose

E. L. Dawson.

Inventor

Willibald Grun

by John Lotka

Attorney

UNITED STATES PATENT OFFICE.

WILLIBALD GRUN, OF FRANKFORT-ON-THE-MAIN, GERMANY.

COOLING APPARATUS FOR TURBO-COMPRESSORS.

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Application filed June 22, 1910. Serial No. 568,249.

To all whom it may concern:

Be it known that I, WILLIBALD GRUN, chief engineer, a citizen of the German Empire, and a resident of Westendstrasse 81, Frankfort-on-the-Main, in the Kingdom of Prussia, Germany, have invented certain new and useful Improvements in Cooling Apparatus for Turbo-Compressors; and I 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.

My invention relates to improvements in cooling apparatus for turbo-compressors or rotary blade compressors. And the object of the improvements is to provide cooling apparatus whereby the cooling medium and the cooling surfaces are utilized as completely as possible. In turbo-compressors now in use the fluid has been cooled in the successive stages of the compressor by circulating a cooling medium through chambers provided in the walls of the compressors. In turbo-compressors it is of the utmost importance to keep the temperature of the fluid subjected to the compressing operation as low as possible. However, the space for providing cooling means in the compressor is exceedingly small. Therefore in order to sufficiently cool the fluid, the cooling means provided between the successive stages of the compressor must be as effective as possible. In cooling apparatus now in use the cooling medium flows in a direction parallel to the cooling surface. Now I have discovered, that the cooling effect can be considerably increased by causing the cooling medium to strike against the cooling surfaces as often as possible in a perpendicular or substantially perpendicular direction, because thereby the transmission of the temperature of the cooling medium to the cooling surfaces is increased. Therefore my invention consists in so arranging the cooling devices for the turbo-compressor, that within the comparatively small space the cooling medium strikes several times against the cooling surfaces in a substantially perpendicular direction.

For the purpose of explaining the invention an example embodying the same has been shown in the accompanying drawing in which the same letters of references have been used in all the views to indicate corresponding parts.

In said drawings—Figure 1, is a horizontal cross-section of the cooling apparatus taken on the line 1—1 of Fig. 2, Fig. 2, is a section of the apparatus taken on the broken line 2—2 of Fig. 1, and Fig. 3, is a horizontal cross-section similar to that of Fig. 1 and showing a modification of the apparatus.

In the example shown the cooling apparatus consists of two flat annular hollow bodies a and b which communicate with each other through intermediate chambers c arranged perpendicularly thereto. The cooling medium is admitted for example to the chamber provided by the body b through an aperture d formed in the cylindrical wall of the said body, and it is conducted in the direction of the arrow through the intermediate chamber c until it strikes perpendicularly against the cooling wall of the inner hollow body a. In a similar way the cooling medium passes through the first intermediate chambers successively from the chamber a to the chamber b and from the chamber b to the chamber a. In the example illustrated the effect of the cooling medium is further increased by dividing the intermediate chambers c by partitions f into two sections or passages c^1 and c^2, and the cooling medium flows as follows: The cooling medium is admitted for instance through the aperture d of the cylindrical wall of the outer hollow body b and into the chamber e^1 of the latter, flows through the inner part c^1 of the intermediate chamber c and into the chamber g^1 of the inner hollow body a, and is admitted through the part c^2 of the intermediate chamber c into the chamber e^2 of the body b. From thence the cooling medium flows through the inner part c^1 of the next intermediate chamber c and into the chamber g^2 of the body a, and it passes through the part c^2 of the adjacent intermediate chamber c and into the chamber e^3 of the body b, and so on, until it is discharged through the opening h of the hollow body b. The cooling medium is therefore always conducted through the sections of the intermediate chambers c in opposite directions, so that it is twice thrown against the cooling surfaces in a perpendicular direction. The successive sections

e^2, e^3, etc. of the hollow body b are preferably subdivided by radial partitions i in such a way, that the cooling medium flows through the chambers thus provided along a serpentine path. This arrangement is particularly advantageous, because only a limited number of intermediate chambers c can be arranged between the hollow bodies a and b, because otherwise the cross-sectional area of the passages for the air would be too small.

By the arrangement described, with the largest possible number of intermediate chambers c the direction of the flow of the cooling medium can twice as often be reversed as compared with hollow intermediate chambers which are not provided with partitions. The chambers c may be further subdivided by providing two or more partitions f in each chamber c. Finally in order to increase the cooling effect ribs k may be provided between the chambers c.

As the hollow bodies a and b are rigidly connected with each other by the intermediate chambers c the chambers traversed by the cooling medium can not easily be cleaned, if cleaning apertures are exclusively provided in the cylindrical outer walls of the hollow bodies, as was done in compressors of this class heretofore in use. However, such cleaning should be frequently done, if unclean cooling water is used.

A feature of my invention consists in so arranging the cooling apparatus, that the chambers traversed by the cooling liquid are more easily accessible. For this purpose the disk shaped outer wall of the hollow body a (Fig. 1), or the outer wall of the hollow body b (Fig. 3), or both of them, are constructed in the form of substantially cup shaped disks provided with covers or lids m and n respectively which, without increasing the size of the cooling device, are connected with the hollow bodies by means of screw bolts o, or the like which can easily be loosened. After removing one of the covers or lids m or n the spaces traversed by the cooling medium are sufficiently accessible to be cleaned by means of a simple tool. The annular chamber of the hollow body which is not provided with a cover or lid can easily be cleaned from the side and through apertures p provided in the said body. The arrangement of the covers or lids m and n is advantageous also in this respect that in the manufacture of the cooling apparatus the cores which are used for forming the hollow spaces in the casting can easily and completely be removed.

I claim herein as my invention:

1. A cooling apparatus comprising in combination two annular bodies arranged adjacent to each other and formed with annular chambers subdivided into sections, and connecting walls between said bodies providing intermediate chambers through which each of the sectional chambers of one of said hollow bodies communicates with two adjacent sectional chambers of the other one of said hollow bodes.

2. A cooling apparatus, comprising in combination two annular bodies arranged adjacent to each other and formed with annular chambers subdivided into sections, connecting walls between said bodies providing intermediate chambers, and partitions dividing said intermediate chambers into passages, two passages of each intermediate chamber communicating with the same chamber of one body and with successive chambers of the other body.

3. A cooling apparatus, comprising two annular bodies arranged adjacent to each other and formed with annular chambers subdivided into sections, connecting walls between said bodies providing intermediate chambers through which each of the sectional chambers of one of said hollow bodies communicates with two adjacent sectional chambers of the other one of said hollow bodies, and ribs provided between said connecting walls and connecting the said hollow bodies.

4. A cooling apparatus comprising a body formed with an annular chamber, an annular cup shaped disk arranged adjacent to said body and closed at its outside by a cover so as to provide an annular chamber, the chambers provided by said hollow body and cup shaped disk and its cover being divided by partition walls into sections, and connecting walls arranged between said bodies forming intermediate chambers through which each of the sections of one of said annular chambers communicates with two adjacent sections of the other one of said annular chambers.

In testimony whereof I hereunto affix my signature in the presence of two witnesses.

WILLIBALD GRUN.

Witnesses:

HENRY HASPER,

WOLDEMAR HAUPT.