O. BANNER.

CENTRIFUGAL COMPRESSOR.

APPLICATION FILED MAR. 21, 1912.

1,050,419. Patented Jan. 14, 1913.

Fig. 1.

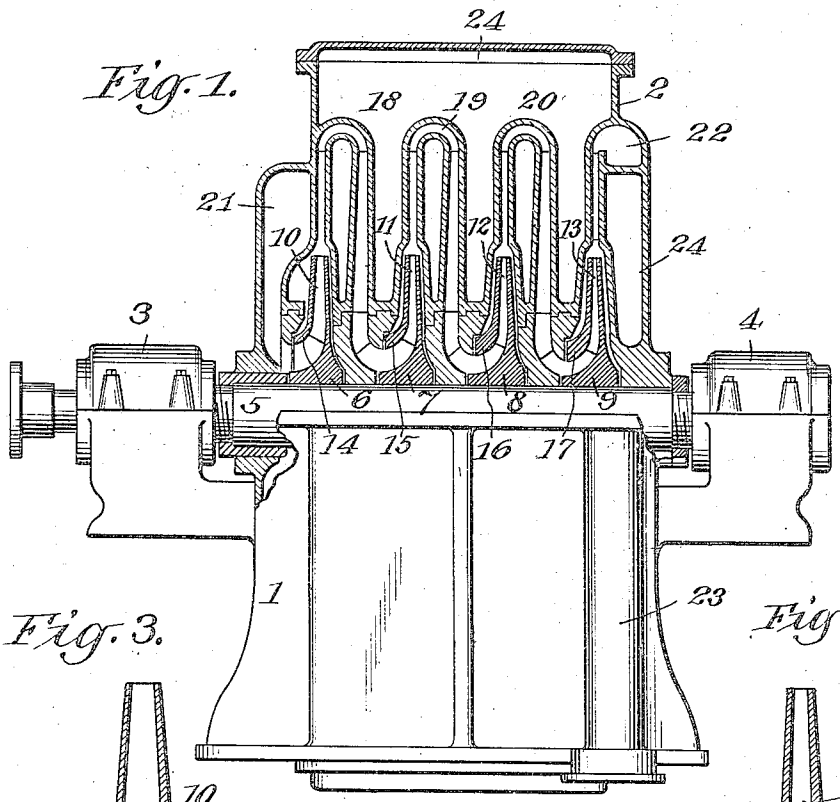


Fig. 3.

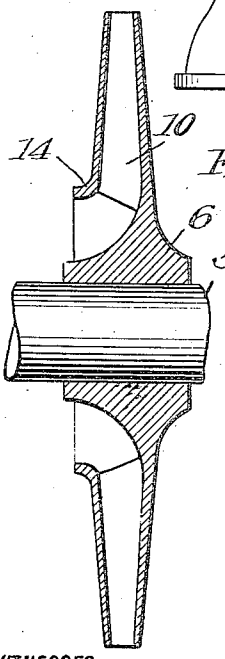


Fig. 2.

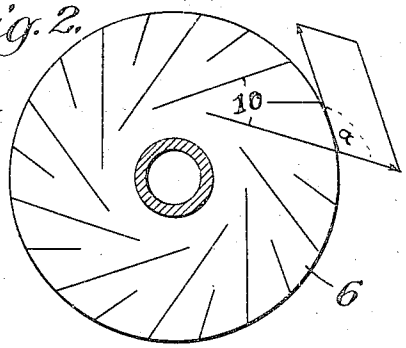


Fig. 5

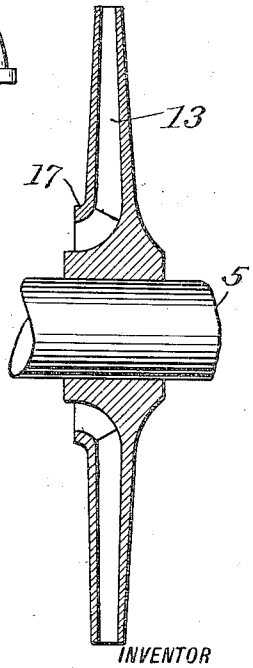
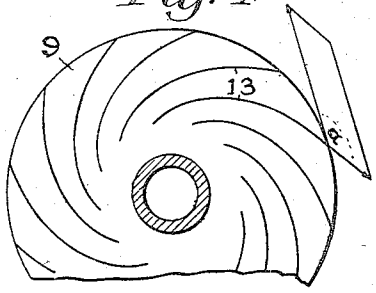


Fig. 4



WITNESSES

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CENTRIFUGAL COMPRESSOR.

1,050,419. Specification of Letters Patent. Patented Jan. 14, 1913.

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To all whom it may concern:

Be it known that I, OTTO BANNER, subject of the German Emperor, residing at Easton, in the State of Pennsylvania, have invented certain new and useful Improvements in Centrifugal Compressors, of which the following is a specification.

This invention relates to multi-stage centrifugal turbo compressors for air and similar fluids, and more particularly to the design of the blades, and the radial distance of the inner ends of the blades in the impellers of such machines.

The machines at present used are made up of a series of impellers, the blades of which are all set at approximately the same angle on the impeller disks. A constant ratio between the radial distance of the inner ends of the blades of the impellers and their radii is likewise generally maintained. In the construction of these machines great difficulty is experienced in the impellers in the high pressure stages, particularly in machines of small capacity. In order to provide for the decrease in volume of the air from impeller to impeller or from stage to stage, it is necessary to decrease the blade width and hence the area of the peripheral orifice of the impeller. Another way of decreasing this area, and at the same time the force impelling the air outward, is to decrease the diameter of the impellers. In practice both of these methods are resorted to, but in the higher stages of a compressor of low capacity it becomes almost impossible to construct the impellers with a small enough peripheral orifice to get the proper decrease in the volume of the air and hence the efficiency.

The object of my invention is to so design the blades of the impellers that it is possible to maintain the impeller orifice of a width which can be constructed without difficulty and yet at the same time to attain a high degree of efficiency in the impeller.

With this object in view, I increase the angle of the impeller blades and at the same time decrease the ratio of the radial distance of the inner ends of the blades to the radius of the impeller, from stage to stage or in the last stage or stages. The advantage obtained thereby is an increase in the ease and consequently a decrease in the cost of construction, coupled with an increase in the efficiency of the compressor.

A practical embodiment of my invention is shown in the accompanying drawings in which—

Figure 1 is a side elevation partly in section of the complete compressor. Fig. 2 is a diagrammatic showing of the position of the blades in the impeller in the first stage. Fig. 3 is a section on larger scale through the impeller shown in Fig. 2. Fig. 4 is a diagrammatic showing of the position of the blades in the impeller in the last stage, and Fig. 5 is a section on a larger scale through the impeller shown in Fig. 4.

The compressor comprises a horizontally divided casing made up of a lower casing or base 1, and an upper casing 2. In bearings 3, 4, on the base is journaled the shaft 5, on which are mounted a plurality of impellers of the same diameter which consist of disks 6, 7, 8, 9, blades 10, 11, 12, 13, and covers 14, 15, 16, 17. The impellers are connected by air passages 18, 19, 20, which are provided with the usual guide vanes, and the air enters the compressor by the inlet chamber 21, which is supplied by any convenient opening, in this case through the base 1, and is taken out through exhaust chamber 22 and exhaust pipe 23.

The usual water jacket 24 is provided.

In the first impeller the blades 10 have a comparatively small angle of inclination, and the air leaves the impeller with comparative ease. In the last stage, the blades 13 have a large exit angle and approach much more nearly to a tangential position at their outer ends, thus retarding the air to a considerable extent and causing it to pass through the impeller with considerable less velocity than in the first wheel. The angles of the blades of the intermediate impellers in the present compressor may be either graduations between the first and last, or in one or more impellers may be the same as the nearer end impeller.

Another feature of the present device is that in the impellers the inner ends of blades 11 are nearer the shaft center than the inner ends of blades 10 and likewise the inner ends of blades 12 and 13 are successively nearer the shaft center. This feature contributes to the efficiency of the machine

as the decrease of the ratio of this radial distance of the inner ends of the blades from the shaft center to the radius of the successive impellers makes it more difficult for the air to enter the impellers and hence adds to the retarding effect of the blades.

The width of the blades or the distance between the disks and covers of the impellers is shown as successively decreased from inlet to exhaust, although this is not essential in all cases.

The effect of these changes in design singly or combined is to make it possible for the impellers in a multi-stage turbo compressor to be built with a higher degree of efficiency and with greater ease of construction than has heretofore been known.

It is to be understood that the present showing only discloses one embodiment of my invention.

My invention contemplates using the principles herein disclosed and claimed, in compressors of a less or greater number of impellers whether in groups of the same design and dimensions and changing from group to group, or changing from impeller to impeller, or changing from group to single impeller, or in any way consonant with the principles herein set forth. Furthermore, although my invention is particularly adapted to compressors of small capacity and high pressure, yet it is equally applicable in any compressor where it is desirable to keep the impellers of substantially the same dimensions without loss or efficiency.

It is to be understood that a slight variation in the angle of the blades will have no appreciable effect and that there must be a material difference in the exit angle in the last impeller or impellers to accomplish the desired result.

What I claim is:

1. In a compressor, a plurality of impellers, the fluid to be compressed passing through said impellers in series from the first to the last, and blades for said impellers, the blades in the first impeller having smaller exit angles than the blades of the last impeller.

2. In a compressor, a plurality of impellers, the fluid to be compressed passing through said impellers in series from the first to the last, and blades for said impellers, the blades in one of said impellers having smaller exit angles than the blades of the impeller succeeding it.

3. In a compressor, a plurality of impellers, the fluid to be compressed passing through said impellers in series from the first to the last, and blades for said impellers, the blades in successive impellers having successively greater exit angles.

4. In a compressor, a plurality of impellers of substantially the same diameter, the fluid to be compressed passing through said impellers in series from the first to the last, and blades for said impellers, the blades of the first impeller having smaller exit angles than the blades of the last impeller.

5. In a compressor, a plurality of impellers, the fluid to be compressed passing through said impellers in series from the first to the last, and blades for said impellers, the blades of the first impeller having smaller exit angles than the blades of the last impellers and the ratio of the radial distance of the inner ends of the blades of the first impeller to the radius of said impeller being greater than the corresponding ratio in the last impeller.

6. In a compressor, a plurality of impellers, the fluid to be compressed passing in series therethrough, and blades for said impellers, the ratio of the radial distance of the inner ends of the blades from the shaft center, to the radius of the impeller being less in the first impeller than in the last.

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