May 4, 1948. F. W. LYNCH ET AL 2,440,865

COMPRESSOR

Filed Aug. 26, 1944

Fig 1

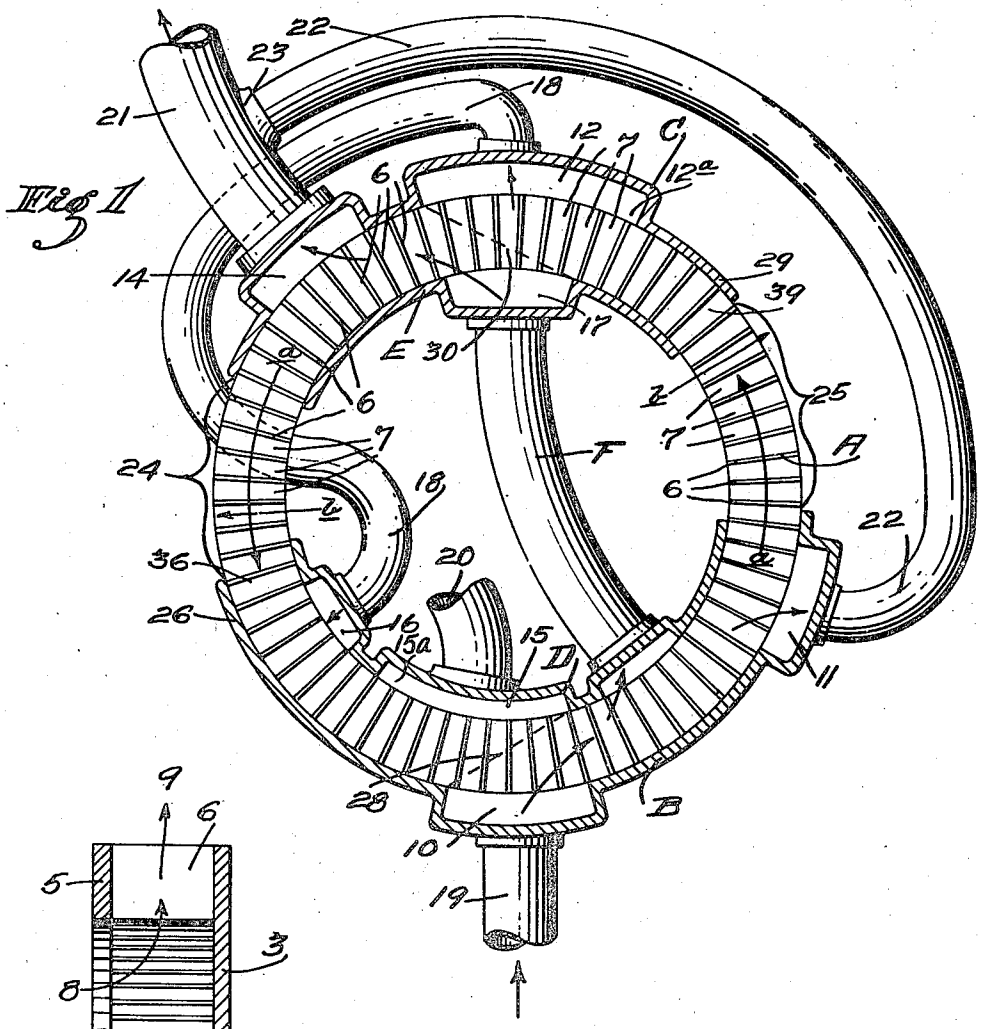
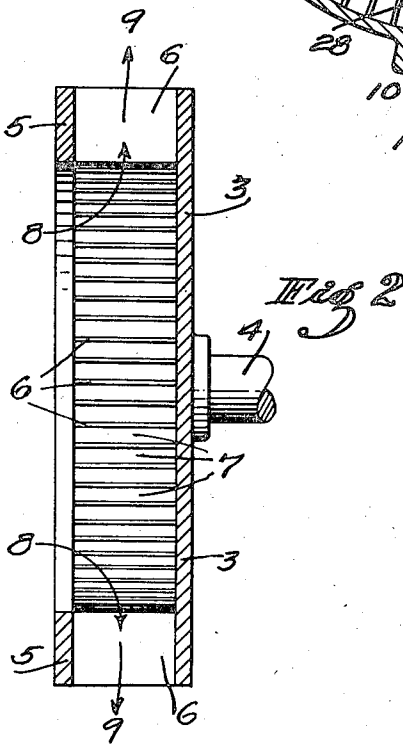


Fig 2



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COMPRESSOR

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3 Claims. (Cl. 230—108)

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This invention relates to a gas operated compressor of the type disclosed in Patent No. 2,361,939 issued November 7, 1944, and entitled, "Method and apparatus for compressing gases" and particularly to improvements thereon whereby the overall efficiency will be materially increased.

In the patent above referred to there is disclosed a compressor in which a fluid or gas under pressure from any source and in direct contact with another fluid or air is utilized to compress the air without the use of any intervening medium. The gas under pressure which is utilized to compress the air is maintained at a predetermined pressure during the entire compressing cycle and is then exhausted at that pressure without utilizing any of the expanding force or energy contained therein.

The object of the present invention is generally to improve the operation and overall efficiency of compressors of the character described and particularly to provide means for utilizing the expanding force or energy of the exhaust gases from a high zone of compression to partly compress air at a lower zone of compression and then to introduce the air from the lower zone of compression into the zone of high compression, thereby materially increasing the volume of air discharged by the compressor.

The compressor is shown by way of illustration in the accompanying drawings in which Fig. 1 is a diagrammatic side elevation partially in section of the compressor, and Fig. 2 is a vertical cross section of a rotor disposed within the compressor.

Referring to the drawings in detail and particularly Fig. 2, 3 indicates a circular disk which is secured to a shaft 4. Spaced from the disk is a ring 5 and secured between the disk and the ring are radially disposed vanes 6 between which are formed vane passages 7 through which air or any suitable fluid medium flows. The structure thus described forms a rotor or blower in which the air enters in the direction of arrows 8 and discharges radially and outwardly through the vane passages in the direction of arrows 9 when the rotor is rotated at a suitable speed.

Now referring to Fig. 1, A indicates in general the rotor. Disposed exterior of the rotor and maintained in running contact therewith are two housings indicated at B and C respectively. Similarly disposed within the rotor and maintained in running contact therewith are two housings D and E which are connected by a pipe F. Formed in the housing B are two chambers

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generally indicated at 10 and 11. Formed in the housing C are two chambers generally indicated at 12 and 14. Formed in the housing D are two chambers generally indicated at 15 and 16, and formed in the housing E is a single chamber 17 with which pipe F is connected. Chambers 12 and 16 are connected by a pipe 18. Chamber 10 has an inlet pipe 19. Chamber 15 has a discharge pipe 20. Chamber 14 has a discharge pipe 21 and chamber 11 has a discharge pipe 22 which connects with the discharge pipe 21 at 23.

The compressor here shown has numerous applications but let it be assumed that it is to be employed as a supercharger in connection with an internal combustion engine. In that case pipe 19 would be connected with the exhaust manifold of the engine and when the engine is in operation there would be a continuous flow of exhaust gases through pipe 19 into chamber 10. This gas under any desired pressure or at the pressure required for supercharging purposes comes in direct contact with air contained in the passages formed between the vanes of the rotor. The rotor may be directly connected to the crank shaft of the engine or may be driven therefrom at a higher or lower speed and as this is the case air will be continuously entering the rotor in the direction of the arrow shown in Fig. 2 and will thus fill the vane passages and will also flow through said passages wherever they are unobstructed. For instance, in Fig. 1 the vane passages are unobstructed at the points indicated at 24 and 25. Thus as the rotor rotates in the direction of arrows *a* air will be flowing through the vane passages in the direction of arrows *b* and will discharge to the atmosphere, but as a vane passage passes in under a shroud indicated at 26 which forms a part of housing B the air therein will be trapped and it will stay trapped until it registers with the end 15*a* of chamber 15. At this point air from chamber 15 will enter the vane passage and compress the air trapped therein to the same pressure as the pressure maintained in chamber 15, the pressure maintained in chamber 15 depending entirely upon the pressure of the exhaust gases delivered to chamber 10. For instance, if it is desired to supercharge the air to five pounds gauge or twenty pounds absolute then the exhaust gases entering through pipe 19 will be maintained at that pressure and as the gases travel inwardly in the vane passages along the dotted line indicated at 28 the air in the passages will be forced back into chamber 15 and

the air forced into the chamber will assume substantially the same pressure as the exhaust gas pressure. No mixing of air or gas takes place when the gases enter the outer ends of the vane passages as the air in the vane passages is maintained at the same pressure as the exhaust gases; furthermore, the vane passages are comparatively narrow and turbulence or mixing is thus avoided.

From the foregoing it would be apparent that air trapped in a vane passage by the shroud 26 is forced into the chamber 15 by the exhaust gases and that the exhaust gases completely expel the air from said passages and as such fill the vane passages as they leave chamber 15. When a vane passage moves away from chamber 15 and registers with pipe F about one-half of the volume of gas contained in each vane passage will exhaust into said pipe and is thus delivered to chamber 17 of housing E while the gases remaining in the vane passages will discharge into chamber 11 and pipes 22 and 21. In chamber 17 the exhaust gases serve the same purposes, to wit that of forcing air out of the vane passages into chamber 12; that is the air flowing through the vane passages in the direction of arrow *b* at the unobstructed point shown at 25 is trapped by a shroud 29 forming a part of housing C and when the vane passages with trapped air communicate with the end 12*a* of chamber 12, air from that chamber will enter the outer ends of the vane passages and compress the air in the vane passages to the same pressure as the pressure maintained by the exhaust gases in chamber 17. This pressure may be assumed to be 2½ pounds gauge or 17½ pounds absolute as the gases entering the vanes from the pipe 19 and chamber 10 are exhausted partially into pipe F and the rest into chamber 11 and pipes 22 and 21 which may exhaust directly into the atmosphere. The exhaust gases entering chamber 17 will force the air out of the vane passages along the dotted line indicated at 30. All the air is thus expelled from the vane passages into chamber 12 and the passages are filled with exhaust gases at 2½ pounds gauge pressure when they leave chamber 12 and they will exhaust into said chamber and into pipe 22 which connects with pipe 21 at 23. These gases may discharge directly to the atmosphere or they may be directed to a second compressor unit identical to the one here shown.

It is possible that a heat exchanger may be used. In that case the exhaust gases from pipe 21 would pass through the same.

In order to make the operation of the compressor as clear as possible it must be noted that air is admitted to the rotor at the two points indicated at 24 and 25 and that the air admitted is trapped in the vane passages by the shrouds 26 and 29. Further let it be assumed that the volume of air trapped in one vane passage or that indicated at 39 measures 5 cubic inches at atmospheric pressure and similarly that the volume of air in the vane passages indicated at 36 also measures 5 cubic inches. Then two volumes totaling 10 cubic inches at atmospheric pressure enters the compressor during each revolution of the rotor, i. e. if it is assumed that the rotor is solid or has no other vane passages formed therein. If this assumption is made the air in the passage 39 is delivered to chamber 12 and is there compressed by the expanding low pressure exhaust gases delivered by pipe F and chamber 17. The air thus compressed flows through pipe 18 to chamber 16 and enters the vane passage 36 containing air at atmospheric pressure and pre-compresses that air to the same pressure as that maintained in chambers 12—16 and pipe 18. Passage 36 after leaving chamber 16 will next register with chamber 15 and as this is the high pressure air chamber, air from that chamber will enter the same passage 36 and further compress the air contained therein to the final high pressure and when the vane passage 36 registers with the chamber 10 where the exhaust gas under the highest pressure enters, the compressed air will be forced back into chamber 15 from where it is delivered by pipe 20 to the carburetor of the engine. The pressure in chambers 10 and 15 will always be substantially the same. This is of great importance as each vane passage with partially compressed or low pressure air registers first with chamber 15 and is thus compressed to the same pressure as that maintained in chambers 10 and 15. Thus when a vane passage moves into register with chamber 10 the air in the vane passages is at the same pressure as that in chamber 10 and no mixing of gases takes place. On the other hand if the air pressure in a vane passage moving into register with chamber 10 is under a lower pressure there is a tendency towards turbulence and mixing of air and gas and that is avoided by having equal pressures. The same balancing of pressures in the vane passages entering chambers 12 and 17 is also maintained but at a lower pressure; hence, there is no mixing of air or gas either in the zone of low compression or in the zone of high or final compression.

By admitting air to the rotor under atmospheric pressure at two points and utilizing the exhaust gas from the high pressure zone in a lower zone of compression the volumetric output of air for a rotor or compressor of a given size is materially increased and thereby the overall efficiency when comparison is made with the compressor disclosed in Patent 2,361,939 heretofore referred to as that compressor has only one air inlet or handles only one volume of air per revolution of the rotor and does not utilize the exhaust gases in a second zone of compression.

While the compressor has here been described for use as a supercharge in conjunction with an internal combustion engine it is obvious that there are many applications and uses for a compressor of this character; for instance, it may be used as an air compressor for combustion gas turbines in which case the exhaust gases escaping from chambers 11 and 14 and pipes 22 and 21 may be further utilized in the heat exchanger which such turbines usually employ, the compressor itself being supplied with gas from the combustion chamber of such a turbine.

The structure shown in Fig. 1 may be modified first by placing a second rotor identical to the one here shown on the same shaft so that both will rotate in unison, secondly by placing the housings C and E on the second rotor, and thirdly by connecting the exhaust pipe F with the housing E on the second rotor and connecting pipe 18 with chamber 16 of housing D. By that arrangement one rotor will be utilized for the high compression stage only and the second rotor for the low compression stage and while this and other features of the present invention have been more or less specifically described and illustrated, we wish it understood that changes may be resorted to within the scope of the claims and that the materials and finish of the several employed

parts may be such as the experience and judgment of the manufacturer may dictate or bearing applications or conditions may demand.

Having thus described our invention, what we claim and desire to secure by Letters Patent, is:

1. Apparatus for compressing air comprising a rotor having a passage formed therein open at both ends, means for introducing air to said passage under a predetermined pressure at one position of the rotor, means for trapping the air against removal at a second position of the rotor, means for introducing air at a higher pressure into the passage to partially pre-compress the trapped air in the passage at a third position of the rotor, means for introducing a gas under a still higher pressure through the opposite end of the passage to compress and discharge the partially compressed air from the passage at a fourth position of the rotor and means for utilizing the air thus compressed and discharged from the vane passage to compress the partially pre-compressed air in the vane passage to substantially the same pressure as the gas before introduction of the gas.

2. Apparatus for compressing air comprising a rotor having a passage formed therein open at both ends, means for introducing air to said passage under a predetermined pressure at one position of the rotor, means for trapping the air against removal at a second position of the rotor, means for introducing air at a higher pressure into the passage to partially pre-compress the trapped air in the passage at a third position of the rotor, means for introducing a gas under a still higher pressure through the opposite end of the passage to compress and discharge the partially compressed air from the passage at a fourth position of the rotor, means for utilizing the air thus compressed and discharged from the vane passage to compress the partially pre-compressed air in the vane passage to substantially the same pressure as the gas before introduction of the gas, means for exhausting the gas after compression and discharge of the air from the vane passage and means for utilizing said exhaust gas to supply the air introduced at the third position of the rotor.

3. In a compressor having a rotor with a plurality of vane passages formed therein, a housing in communication with one end of said passages, said housing having a low pressure air receiving chamber formed therein, a second housing disposed on the opposite side of the rotor and having a chamber formed therein for the reception of a low pressure gas, a third housing having a chamber formed therein communicating with one end of the vane passages and adapted to receive a high pressure gas, a fourth housing opposing the third housing and having a chamber formed therein for the reception of high pressure air, means for introducing air to the vane passages of the rotor before they communicate with the low pressure air receiving chamber, the air in the low pressure chamber pre-compressing the air in the vane passages to substantially the same pressure as the low pressure gas and said gas compressing and discharging the low pressure air back into the low pressure air chamber, means for introducing air into the vane passages prior to communicating with the high pressure chamber, means for introducing air from the low pressure air chamber to said vane passages to partially pre-compress the air therein before registering with the high pressure air chamber, means for utilizing the high pressure air from said high pressure air chamber to compress the partially compressed air in the vane passages and means for introducing high pressure gas to compress and discharge the compressed air from the last named vane passages into the high pressure air chamber.

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