Nov. 7, 1944. F. K. GRUSS 2,361,939

APPARATUS FOR COMPRESSING GASES

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Fig. 1.

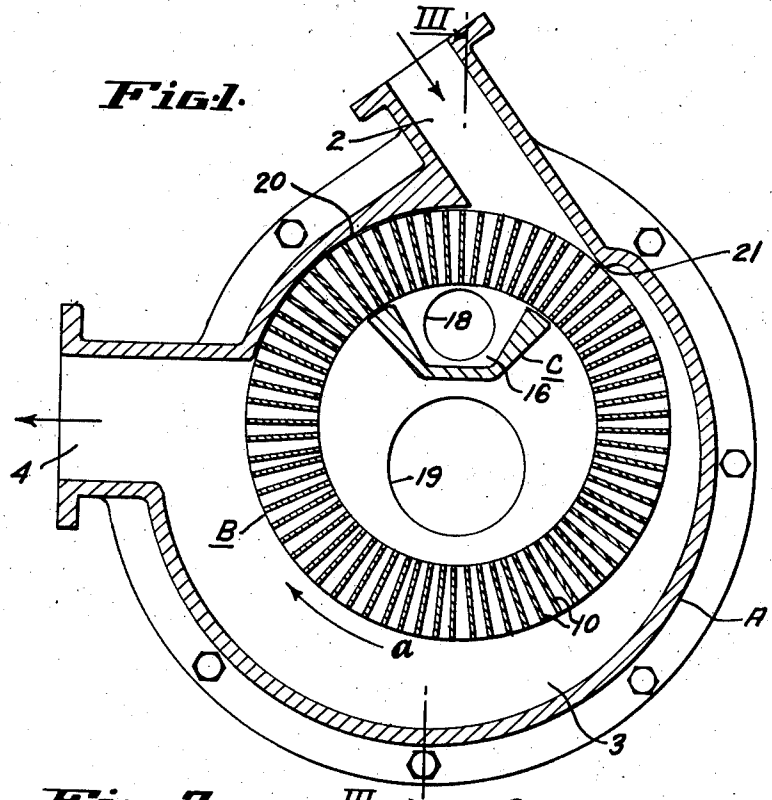
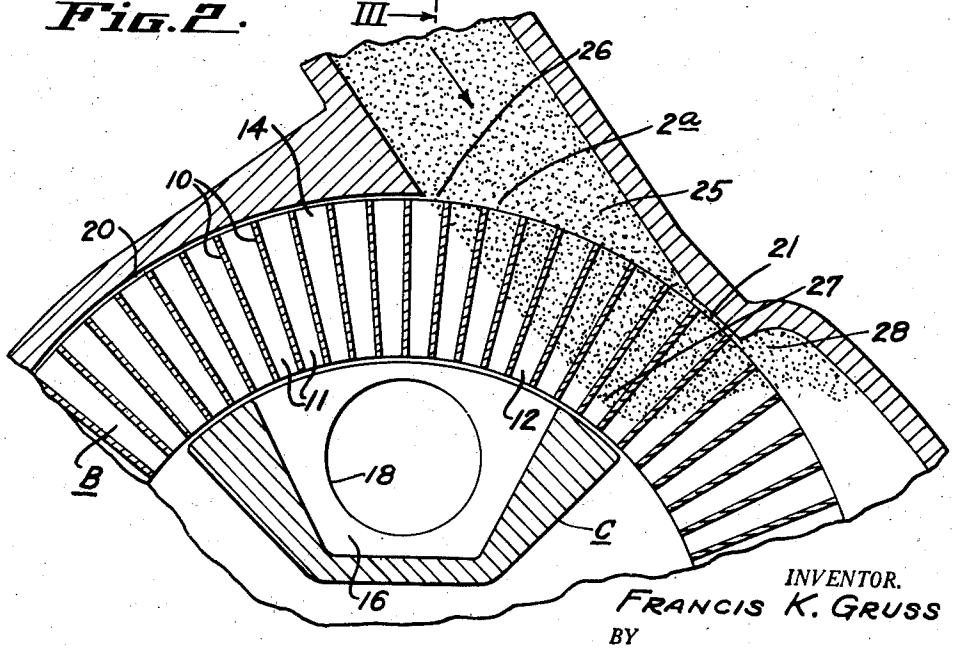


Fig. 2.



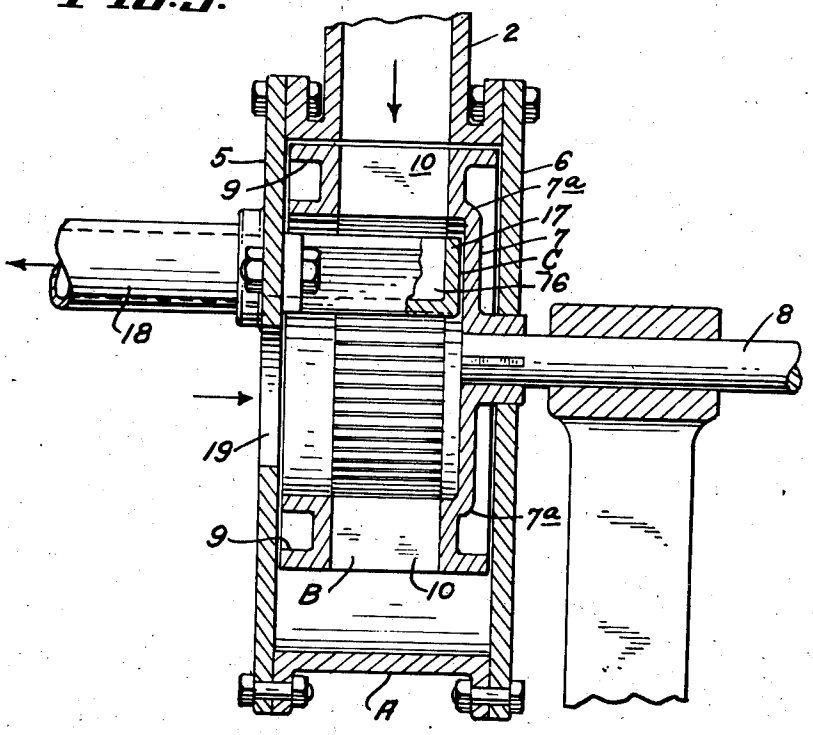
INVENTOR.
FRANCIS K. GRUSS
BY
Eastberg & Roemer
ATTORNEYS.

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Fig. 3.



INVENTOR.
FRANCIS K. GRUSS
BY
Eastberg & Koemer
ATTORNEYS.

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APPARATUS FOR COMPRESSING GASES

Francis K. Gruss, Belvedere, Calif.

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8 Claims. (Cl. 230—108)

This invention relates to an apparatus for compressing gases.

The object of the present invention is to efficiently transfer the potential and kinetic energy of the molecules of one gas to those of another gas in the form of potential and kinetic energy, without the use of an intermediate mechanical medium; more specifically stated, a gas or fluid under pressure and in direct contact with another gas is utilized to compress said other gas, and thereby insure a direct energy transfer from one gas or fluid to another.

A form of apparatus whereby energy transfer, such as described, may be accomplished is shown by way of illustration in the accompanying drawings, in which

Fig. 1 is a cross section of the compressor;

Fig. 2 is a diagrammatic enlarged view of the upper portion of the compressor showing the manner in which a gas or fluid under pressure is utilized to compress another gas or fluid; and

Fig. 3 is a cross section taken on line III—III of Fig. 1.

Referring to the drawings in detail, and in particular to Figs. 1 and 3, A indicates a housing in which is formed an inlet in the form of a nozzle 2, a volute shaped chamber 3, and an exhaust or outlet 4. The housing is closed on opposite sides by side plates 5 and 6, and disposed within the housing between the plates 5 and 6 is a rotor generally indicated at B.

The rotor as here shown consists of a side plate 7 secured on a shaft 8 which is driven. Bolted or otherwise secured to the side plate 7 is a ring 9, and secured between the ring 9 and the side plate 7 are a plurality of vanes 10 between which are formed pockets or chambers 11 which are open both at their inner and outer ends, as indicated at 12 and 14 respectively.

Mounted within the rotor is a housing C. This housing is bolted or otherwise secured to the inner face of the end plate 5, in such a position that a fairly snug fit is maintained between the inner surface of a ring 9, the inner ends of the vanes 10, and an annular shoulder 7a formed on the inner face of the plate 7. A chamber 16 is formed within the housing C which is open to the inner ends of the vanes. Both ends of the chamber are closed in the manner indicated at 17, but a pipe 18 extends through plate 5 and into one end of the housing, so that compressed air or gas may be discharged, as will hereinafter be described.

To facilitate the description of the operation of the compressor, let it be assumed that it is to be utilized as a supercharger on an internal combustion engine. In that case, shaft 8 may be directly connected with the crank shaft of the engine or driven thereby. As the rotor 3 is secured to the shaft, it will also be rotated, and as the vanes are radially disposed with relation to the axis of rotation, air between the vanes in the rotor will be centrifugally expelled into the volute chamber and a constant flow of air will result, as an air inlet opening 19 is provided in plate 5, which communicates with the interior of the rotor. A running fit is maintained between the rotor and housing C, as previously described, and a similar fit will be maintained exterior of the rotor at the points indicated at 20 and 21. The running fit referred to need not be closer than $\frac{3}{1000}$ of an inch, as a small leakage may be tolerated without materially affecting the overall efficiency. However, carbon tends to collect at the points indicated at 20 and 21, and between the housing C and the rotor, so that a snug fit will be maintained regardless of the original clearance provided. The exhaust manifold of the engine will be connected to the nozzle or inlet 2 and pipe 18 will be connected to the carburetor.

In actual practice, when the engine is in operation, the air entering between the vanes will be substantially trapped by the shroud maintained at 20, as the direction of rotation is that indicated by arrow a. As each pocket advances or approaches the exhaust inlet 2, a further quantity of air will enter from housing C, depending upon the supercharging pressure maintained ahead of the carburetor; hence as each pocket enters the area 2a acted upon by the exhaust gases, it will contain air under the same pressure as that contained in housing C, and this pressure can be no greater than that of the exhaust gases in nozzle 2; but it must be remembered that the carburetor is constantly being drawn upon by the respective cylinders in the engine. Hence there must be a constant flow of air toward the carburetor. In other words, the pressure in the pockets between the vanes and in housing C would almost instantly drop to zero if the exhaust gases entering the upper ends of the pockets did not drive the partially compressed air back into the housing C, as clearly shown in Fig. 2. That is, the stippled area 25 in that view indicates the flow of the exhaust gases inwardly through the pockets, and clearly shows that the air trapped by the shroud 20, plus the air supplied by the housing C, is returned to the housing, the air trapped by the shroud 20

being the quantity of air which is added by each pocket.

If absolutely pure air is required, for instance, to supercharge the engine of an airplane, the peripheral speed of the rotor with relation to the velocity of the exhaust gases should be such that gases entering the outer end of a pocket at the point 26 will not reach the inner end thereof until that pocket reaches the position or point indicated at 27. By maintaining this relationship between peripheral velocity and gas velocity, commingling of the gas and air is prevented. The exhaust gases which substantially fill the pockets at the point 27 are liberated or exhausted into the volute chamber the moment the point 26 is reached, and from that point until the vanes again reach the shroud 20, air will be freely flowing through the pockets between the vanes, thus preventing heating of the vanes or rotor, and at the same time diluting and cooling the exhaust gases which have entered the volute chamber, and, in fact, cooling the exhaust gases to such an extent that danger of fire from the final exhaust outlet 4 is entirely eliminated.

While the compressor has been described in conjunction with an internal combustion engine for the purpose of supercharging, it may obviously be employed for other purposes, and gases or fluids other than exhaust gases, such as water, steam, mercury vapor, etc., may be employed as the motivating medium. The ultimate pressure that is obtainable by this method is not known, but gauge pressures from 5, 25, 50 or 100 pounds per square or more would appear to be obtainable, and the total efficiency should be high, particularly when used as a supercharger, as the heat losses and the friction encountered are comparatively small. The important feature to be considered is the fact that there is a direct energy transfer from one gas or fluid to another; and as no mechanical medium is interposed between the gases, diffusion or commingling of the gases would seemingly take place, but the pockets in which the gases contact each other are long and narrow and the time element is so short, due to the high velocity of the motivating gas and the peripheral speed of the rotor, that there is no apparent commingling of exhaust gases with the compressed air discharging from the housing C. In fact, in a supercharger already built and in operation, careful analysis of the compressed air shows substantially no trace of exhaust gases.

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

1. An apparatus for compressing a gas, comprising a rotor having a passage formed therein open at both ends, means for introducing a gas through one end of the passage at one position of the rotor, means for trapping the gas against removal at a second position of the rotor, means for introducing a second gas under pressure through the opposite end of the passage to compress and discharge the first gas from the passage at a third position of the rotor, and means for applying said first gas after compression to precompress the trapped gas to substantially the same pressure as the second named gas before introduction of the second named gas.

2. An apparatus for compressing air by means of a gas under pressure and without mixing of the gas and air, comprising a rotor having a passage formed therein open at both ends, means for introducing air into said passage at one position of the rotor, means for trapping the air against removal from the passage at a second position of the rotor, means for introducing the gas under pressure through the opposite end of the passage at a third position of the rotor to compress and discharge the air from the passage, and means for applying the compressed air to pre-compress the trapped air to substantially the same pressure as the gas before introduction of the gas, whereby gas and air pressure is equalized and mixing of gas and air avoided.

3. A compressor of the character described, comprising a rotor having a plurality of passages formed therein open at both ends, means for maintaining a flow of air through said passages, means for interrupting said flow to trap the air in said passages during a portion of the rotation of the rotor, a housing contacting the rotor and communicating with one end of the passages, said housing containing air under a higher pressure than the trapped air in the passages, and said air entering the passages of the rotor in which the air is trapped and compressing the air to the same pressure as the air in the housing, a second housing contacting the rotor and communicating with the opposite ends of the passages, means for delivering a gas under pressure to said housing under sufficent pressure to force the compressed air in the passages back into the first named housing, and an outlet in said first named housing for discharge of the compressed air.

4. In a compressor of the character described, a rotor having a plurality of passages formed therein open at both ends, means for maintaining a flow of air through said passages, means for interrupting said flow to trap the air in said passages during a portion of the rotation of the rotor, a housing contacting the rotor and communicating with one end of the passages, a second housing contacting the rotor and communicating with the opposite ends of the passages, means for delivering a gas under pressure to the first named housing to cause said gas to enter the passages and force air out of the passages and into the second named housing, said air in being forced out of the passages being compressed to the same pressure as the gas under pressure, and means for directing a portion of said compressed air into the passages containing the trapped air to compress the trapped air to the same pressure as the air in the second named housing and at a point in advance of the admission of gas under pressure, whereby the air in the passages will be under substantially the same pressure as the gas under pressure when this is admitted to the passages to force the air into the second named housing, and an outlet in the second named housing for the discharge of compressed air.

5. In a compressor of the character described, a rotor having a plurality of passages formed therein open at both ends, means for maintaining a flow of air through said passages, means for interrupting said flow to trap the air in the passages, a housing contacting the rotor and communicating with one end of the passages, means for pre-compressing the trapped air in the passages to a predetermined pressure, a second housing contacting the rotor and communicating with the opposite ends of the passages, and means for delivering a gas under substantially the same pressure as the precompressed air in the rotor passages to the first named housing to force the pre-compressed air out of the rotor passages and into the second named housing and an outlet in said second named housing for the discharge of compressed air.

6. In a compressor of the character described, a rotor having a plurality of passages formed therein open at both ends, means for maintaining a flow of air through said passages, means for interrupting said flow to trap the air in said passages during a portion of the rotation of the rotor, a housing contacting the rotor and communicating with one end of the passages, a second housing contacting the rotor and communicating with the opposite ends of the passages, said second named housing functioning as a compressed air receiver and being offset with relation to the first named housing so that a rotor passage containing trapped air will come into register first with said second named housing and thereafter register with both housings, said offset causing air under pressure from the second named housing to enter a rotor passage and precompress the trapped air to the same pressure as that maintained in the second named housing, means for delivering a gas under pressure to the first named housing to force the compressed air in the rotor passages when they register with both housings back into the second named housing, said gas under pressure in the first named housing equalizing and determining the pressure of the air in the second named housing and the pressure to which the trapped air in the rotor passages is pre-compressed, and an outlet in the second named housing for discharge of compressed air.

7. In a compressor of the character described, a rotor having a plurality of passages formed therein open at both ends, means for maintaining a flow of air through said passages, means for interrupting said flow to trap the air in said passages during a portion of the rotation of the rotor, a housing contacting the rotor and communicating with one end of the passages, a second housing contacting the rotor and communicating with the opposite ends of the passages, said second named housing functioning as a compressed air receiver and being offset with relation to the first named housing so that a rotor passage containing trapped air will come into register first with said second named housing and thereafter register with both housings, said offset causing air under pressure from the second named housing to enter a rotor passage and pre-compress the trapped air to the same pressure as that maintained in the second named housing, means for delivering a gas under pressure to the first named housing to force the compressed air in the rotor passages when they register with both housings back into the second named housing, said gas under pressure in the first named housing compressing the air in the second named housing to the same pressure as the gas and thereby also maintaining the precompressed air at the same pressure, and an outlet in the second named housing for discharge of compressed air.

8. An apparatus for utilizing a fluid under pressure to compress a second fluid to the same pressure comprising a movable member having a passage formed therein open at both ends, a housing containing said second fluid under the same pressure as the first-named fluid, means for charging the passage with a fluid and trapping the fluid therein, means for moving the movable member to a position where the passage containing the trapped fluid will communicate with the housing to permit the fluid under pressure in the housing to enter the passage and compress the trapped fluid to the same pressure as the fluid in the housing, means for moving the movable member to a position where the first-named fluid under pressure will enter the passage and discharge the compressed fluid in the passage into the housing, and means for discharging the first-named fluid under pressure from the passage at another position of the movable member.

FRANCIS K. GRUSS.