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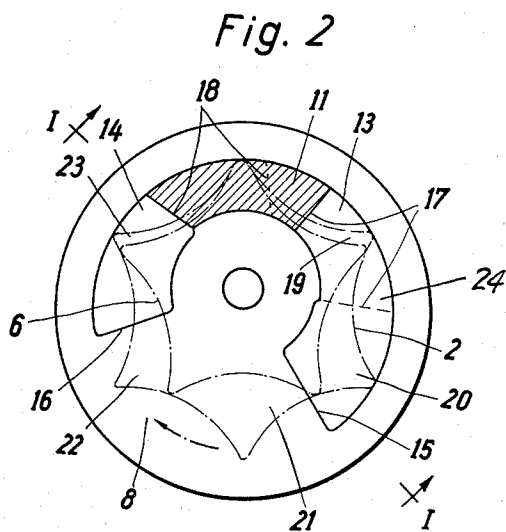
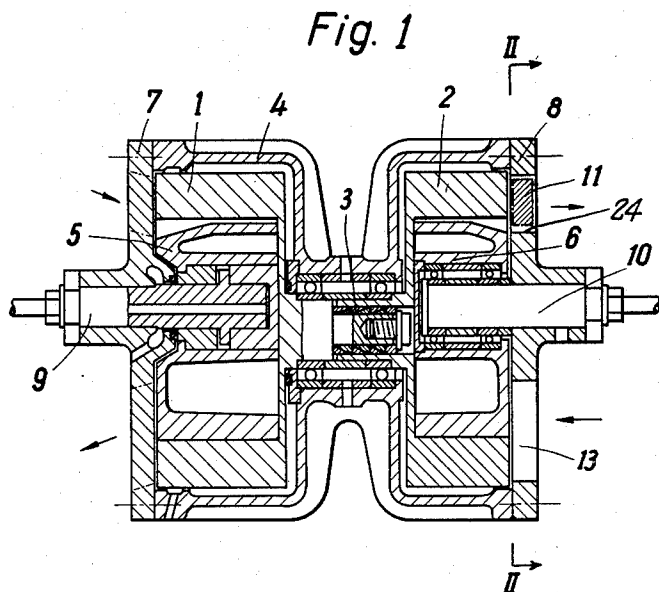
F. W. LÜCK

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EXHAUST GAS DRIVEN COMPRESSOR

Filed Sept. 28, 1960

3 Sheets-Sheet 1



Inventor:
Friedrich W. Lück
By *Walter Buhner*

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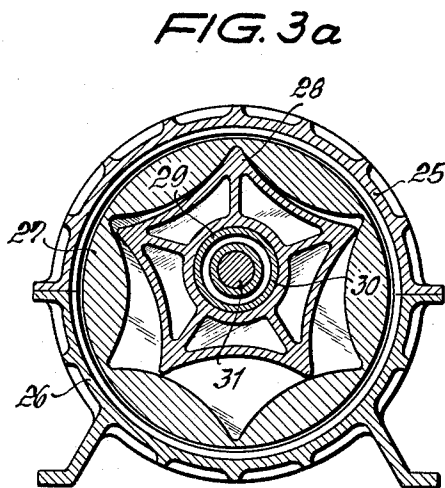
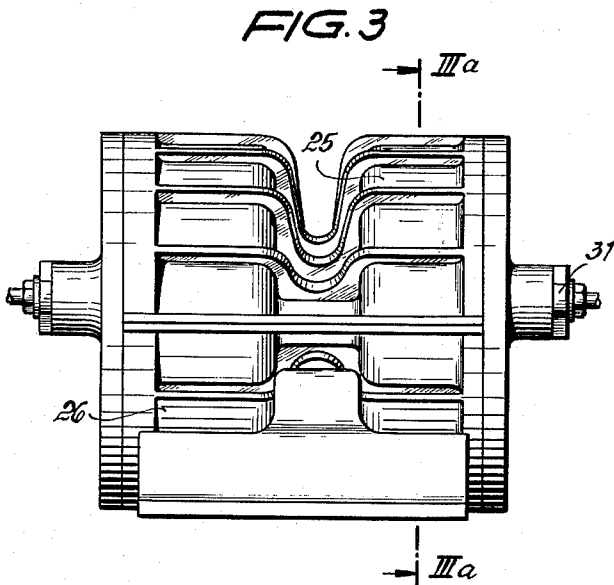
F. W. LÜCK

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EXHAUST GAS DRIVEN COMPRESSOR

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INVENTOR

Friedrich W. Lück

By *Carl F. Bueh*

July 16, 1963

F. W. LÜCK

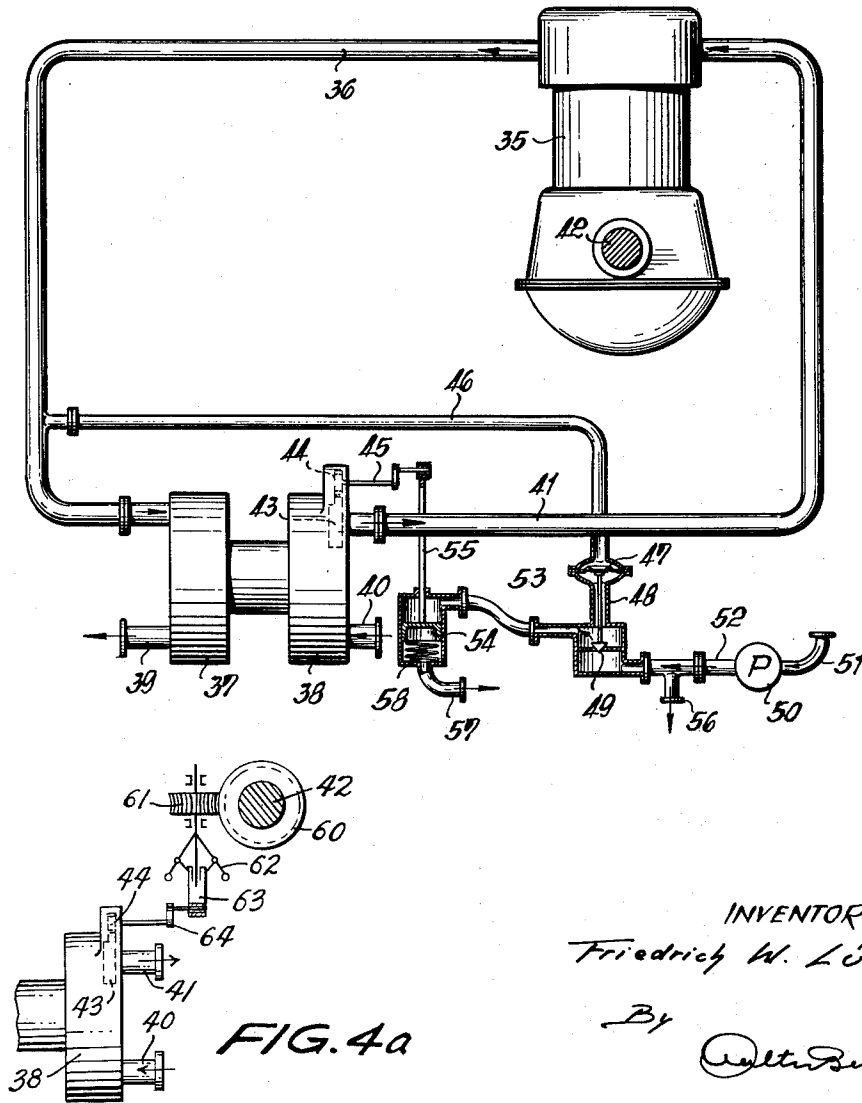
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EXHAUST GAS DRIVEN COMPRESSOR

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FIG. 4



INVENTOR
Friedrich W. Lück
By 

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EXHAUST GAS DRIVEN COMPRESSOR

Friedrich W. Lück, Berlin-Tegel, Germany, assignor to
Borsig Aktiengesellschaft, Berlin-Tegel, and Wankel
G.m.b.H., Lindau, Bodensee, Germany

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6 Claims. (Cl. 60-13)

The present invention relates to an exhaust gas driven compressor for combustion engines which comprises a turbine or rotary piston motor driven by exhaust gases and a rotary piston blower driven by the turbine or motor, the delivery of the blower being controlled by control means.

Exhaust gas driven compressors comprising a turbine and a blower wheel are known in which the speed of rotation depends substantially on the quantity and pressure of the combustion gases being conveyed to the exhaust gas driven compressor. At low engine speed, especially at idling speed, also the speed of rotation of the compressor is low because in spite of the reduced blower pressure, the quantity of exhaust gas will not suffice to maintain the compressor at high speed. Consequently, whenever the compressor is being started it has to be brought up first to its normal speed. In view of the low quantity of combustion gases initially available and in view of the inertia of the rotating compressor elements, this bringing up the compressor to normal speed is effected at a more or less delay with regard to the quickly increasing engine speed. Consequently, the engine will for some time during the starting phase of the compressor work under a lack of air and with rather smoky exhaust gas which is frequently not permissible, especially with street vehicles in city traffic. If the turbine part were coupled to a Root's blower, the result would not be better but rather worse because the mass of the Root's rotor exceeds that of a blower wheel.

It is, therefore, an object of the present invention to provide an exhaust gas driven compressor for combustion engines which will overcome the above mentioned drawbacks.

It is another object of this invention to provide an exhaust gas driven compressor which will obviate the necessity of bringing the compressor up to speed each time the engine has idled, and would also obviate the fuming of the surroundings of the engine.

These and other objects and advantages of the invention will appear more clearly from the following specification in connection with the accompanying drawings, in which:

FIG. 1 illustrates a longitudinal section through an exhaust gas driven compressor composed of two rotary piston units combined to a unit, said section being taken along the line I—I of FIG. 2.

FIG. 2 is a cross section taken along the line II—II of FIG. 1.

FIG. 3 represents a rotary piston unit similar to that of FIG. 1 but with a housing sub-divided along its longitudinal extension.

FIG. 3a is a section along the line IIIa—IIIa of FIG. 3.

FIG. 4 is a diagrammatic illustration of a rotary piston unit according to the invention in connection with an internal combustion engine.

FIG. 4a is a diagrammatic representation of a control device according to which the control member of an air compressor is adjusted in conformity with the speed of the engine.

The above mentioned objects have been realized in conformity with the present invention by a rotary piston blower provided with a quantity controlling member which automatically at low engine speed or low engine output

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will reduce the delivery in conformity with the engine speed or the pressure of the exhaust gases. The thus reduced delivery means a reduced output of the blower or compressor and thus also a reduction in the output of the driving member thereby permitting a higher speed with the same quantity of exhaust gases.

The employment of a rotary piston unit as a blower part suggests to design also the driving part as rotary piston unit. The type of constructions must meet the fundamental requirement that their admissible speeds will be high and will be adapted to each other and that furthermore the blower part will be adapted to be controlled as to delivery. These conditions are met particularly favorably by rotary piston units which comprise two rotary pistons arranged one within the other and of which only the one driven rotary piston performs work, whereas the other rotary piston is idly rotated by direct contact with the driven piston or through the intervention of a pair of gears.

According to a further development of the invention, two of the above mentioned rotary piston units are employed while the work performing rotary pistons thereof are interconnected by coupling elements whereas the other two rotary pistons are freely rotatable. Advantageously, the two parts of the compressor, i.e. the motor part and the compressor part, are combined into a unit. According to the invention, this is effected by providing each of the two work performing rotary pistons with a short shaft or stud and by connecting these short shafts or studs in a rigid and bend-resistant manner. The rotary pistons combined as a unit are then journaled on the said short shafts or studs. This type of connecting the rotary pistons to each other furthermore yields the possibilities of journaling both rotary pistons in a common housing.

If desired, the work performing rotary pistons may be made of one piece but in this instance they would have to be journaled in a housing which is split in longitudinal direction. The employment of two rotary piston units according to the invention is not limited to exhaust gas driven compressors. Also prime movers and machine tools for other purposes may be connected in the same manner.

Referring now to the drawing in detail, the exhaust gas driven compressor shown in FIG. 1 has on the left-hand side thereof the driving part with the outer rotary piston 1 and the inner rotary piston 5. The blower or compressor part comprises an outer rotary piston 2 and an inner rotary piston 6. The outer rotary piston 1 is rigidly and in a bend-resistant manner connected to the outer rotary piston 2 in any convenient manner for instance by means of annular tension springs 3. The rotary pistons thus forming a unit are journaled in a common nonsplit housing 4.

Within the outer rotary pistons there are arranged the inner rotary pistons 5 and 6 which do not perform any work and which are directly rotated by the outer rotary pistons. The air inflow and outflow for both machine parts is effected through lids or covers 7 and 8, respectively. These lids also have fixedly mounted therein bearing studs 9 and 10 for the inner rotary pistons 5 and 6 respectively. Within lid 8 there is arranged a control member 11 which for purposes of illustration has been angularly displaced into the plane of the section shown in FIG. 1.

FIG. 2 illustrates the control means and shows in dot-dash lines the rotary pistons 2 and 6 which are for instance provided with six and five teeth respectively. The shaded control member 11 is designed for instance as a segment or sector which is adapted to be adjusted in tangential direction in the slot 24 in lid 8 by means operable from the outside thereof in a well-known man-

ner. On both sides of the segment 11 there are respectively provided an inlet opening 13 and an outlet opening 14. These openings are de-limited by two stationary radial and by two movable radial edges. The stationary radial edge 15 determines the end of the intake cycle, whereas the stationary edge 16 releases the discharge of the compressed air. The movable edge 17 controls the start of the intake cycle, and the movable edge 18 determines the end of the discharge or more specifically the quantity of the air conveyed into the pressure conduit. The two rotary pistons rotating in clockwise direction confine for instance working chambers 19, 20, 21, 22, 23 which increase in volume ahead of the intake opening and which decrease in volume after passing the lower dead center. If now the control member is displaced in right-hand direction and moved into the position indicated by dash lines, control edge 18 will establish communication of the pressure connection behind the outlet opening 14 with the indrawing working chambers, in the particular showing with chamber 19. Air which has already been conveyed into the pressure connection will then be able from there to flow back into the working chambers. By reexpanding of the returned quantity of air, the major portion of the compressing work employed for this quantity of air will be re-gained. The driving part of the compressor thus has to furnish substantially only the energy for the actually delivered quantity of air.

Referring now to FIGS. 3 and 3a, the housing for the rotary piston unit illustrated therein comprises an upper portion 25 and a lower portion 26. The arrangement likewise comprises an outer rotor 27 and an inner rotor 28. The outer spacing sleeve for the journalling of the inner rotor 28 is designated with the reference numeral 29 while the corresponding inner spacing sleeve is designated with the reference numeral 30. The bearing stud for the inner rotor is designated with the reference numeral 31. The housing portion for the rotary piston motor is closed by a lid 32, whereas the housing portion for the compressor is closed by a lid 33.

In the diagrammatic illustration of FIG. 4 showing a unit according to the invention in connection with an internal combustion engine, the internal combustion engine 35 is provided with an exhaust gas conduit 36 leading to the exhaust gas driven rotary piston motor 37 while leading from the motor is conduit 39. Coupled to the rotary piston motor 37 is a rotary piston compressor 38. The compressor 38 has connected thereto an intake conduit 40 and a pressure or discharge conduit 41 which simultaneously represents the intake conduit for the internal combustion engine 35. The internal combustion engine 35 is provided with a crank stud 42. The compressor 38 has associated therewith a control member 43 which corresponds to the control member 11 of the arrangement shown in FIGS. 1 and 2. The control member 43 is adjustable in circumferential direction for instance by means of a pinion 44 and crank 45.

As will be seen from FIG. 4, an impulse conduit 46 branches off from the exhaust conduit 36 and leads to the diaphragm 47 of a diaphragm valve 48 which in turn forms part of the valve 49. The arrangement furthermore comprises an oil pump 50 adapted to take in oil from a conduit 51 which may communicate with the lubricating system of the engine 35. Oil pump 50 delivers the oil through a conduit 52, valve 49 and a conduit 53 to a servomotor piston 54 which, by means of a link system 55, is connected to the crank 45. The arrangement also comprises an oil circulating conduit 56, an oil return conduit 57 and a spring 58.

The oil pump 50 delivers more oil than flows off through the oil circulating conduit 56. The valve 49 and the servomotor piston 54 have each an overflow opening through which continuously a small quantity of oil passes which returns to the circuit through the oil return conduit 57. At full load of the engine 35, i.e. at high exhaust gas

pressure, diaphragm 47 closes valve 49 against the oil pressure acting thereupon. Spring 58 presses servomotor piston 54 upwardly which latter through the rod system 55 rotates crank 45 so that the control member 43 will be moved into its position for full delivery as illustrated in FIG. 2. If the throttle of the engine 35 is moved toward closed position, also the exhaust gas pressure drops so that valve 49 will be opened by the oil pressure which presses against the servomotor piston in downward direction with regard to FIG. 4. As a result thereof, the control member 43 will be adjusted in the direction of a reduction of the delivery of the compressor without the speed of the exhaust gas driven compressor dropping. When again accelerating the engine 35 by opening the throttle thereof, the exhaust gas driven compressor need not have to be accelerated again but the control device will under the influence of the increasing exhaust gas pressure adjust the control member 43 in such a way that without delay there will be delivered the quantity of combustion air which corresponds to the increasing requirement of the engine 35.

While according to the arrangement of FIG. 4 the delivery of the compressor is reduced in response to the pressure of the exhaust gas furnished by the engine when the pressure drops below a certain magnitude, the arrangement of FIG. 4a shows a control arrangement according to which the control member 43 of the compressor 38 is adjusted in conformity with the speed of the engine 35. To this end, the crankshaft stud 42 has mounted thereon a worm wheel 60 which drives the worm 61 of a centrifugal governor 62. The governor 62 acts by means of a sleeve 63 upon the crank 64 whereby the control member 43 by means of pinion 44 is adjusted in the above described manner in order without delay to adapt the delivery of the compressor 38 to the combustion air requirement of the engine 35.

With any of the illustrated arrangements, it will be understood that an operator controlled pedal or the like is provided to adapt the fuel supply to the engine to the load. A control element of this nature would control, for example, a valve in the engine suction conduit or the like.

It is, of course, to be understood that the present invention is, by no means, limited to the particular construction shown in the drawing but also comprises any modifications within the scope of the appended claims.

What I claim is:

1. In combination with an internal combustion engine: an exhaust gas driven motor in the form of a first rotary piston unit connected to receive exhaust gas from said combustion engine, a compressor in the form of a second rotary piston unit drivingly connected to said first rotary piston unit, each of said rotary piston units comprising two rotary pistons one arranged within the other, one piston only of each of said rotary piston units being a working piston while the other rotary piston in each of said rotary piston units is arranged so as to be idly moved by the respective adjacent working piston, said second rotary piston unit including control means adjustable for controlling the delivery of said compressor, and means operatively connecting said engine with said control means for causing the latter to reduce the delivery of said compressor in response to the pressure of said exhaust gas furnished by said engine dropping below a certain magnitude, whereby an undue drop in the speed of said compressor is avoided.

2. An arrangement according to claim 1, which includes a housing common to both of said rotary piston units to thereby combine the same as a unit.

3. An arrangement according to claim 1, in which each of said two working pistons is provided with a short shaft, and in which said shafts are substantially rigidly connected to each other for rotation of said working pistons as a unit.

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4. In combination with an internal combustion engine: an exhaust gas driven motor in the form of a first rotary piston unit connected to receive exhaust gas from said combustion engine, a compressor in the form of a second rotary piston unit drivingly connected to said first rotary piston unit, each of said rotary piston units comprising two rotary pistons one arranged within the other, one piston only of each of said rotary piston units being a working piston while the other rotary piston in each of said rotary piston units is arranged so as to be idly moved by the respective adjacent working piston, each of said working pistons having a short shaft connected thereto, means rigidly interconnecting said shafts, bearing means supporting said shafts and thereby said working pistons, said second rotary piston unit including control means adjustable for controlling the delivery of said compressor, and means operatively connecting said engine with said control means for causing the latter to reduce the delivery of said compressor in response to the pressure of said exhaust gas furnished by said engine dropping below a certain magnitude, whereby an undue drop in the speed of said compressor is avoided.

5. In combination with a internal combustion engine: an exhaust gas driven motor in the form of a first rotary piston unit connected to receive exhaust gas from said engine, a compressor in the form of a second rotary piston unit drivingly connected to said first rotary piston unit, each of said rotary piston units comprising two rotary pistons one arranged within the other, one piston only of each of said rotary piston units being a working piston while the other rotary piston in each of said rotary piston units is arranged so as to be idly moved by the respective adjacent working piston, said two rotary piston units being combined in a single unit, said second rotary piston unit including control means adjustable for controlling the delivery of said compressor, and means operatively connecting said engine with said control means for causing the latter to reduce the delivery of said compressor in response to the pressure of said exhaust gas furnished by said engine dropping below a certain magnitude, whereby an undue drop in the speed of said compressor is avoided.

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ing the latter to reduce the delivery of said compressor in response to the pressure of said exhaust gas furnished by said engine dropping below a certain magnitude, whereby an undue drop in the speed of said compressor is avoided.

6. In combination with an internal combustion engine: an exhaust gas driven motor in the form of a first rotary piston unit connected to receive exhaust gas from said combustion engine, a compressor in the form of a second rotary piston unit drivingly connected to said first rotary piston unit, each of said rotary piston units comprising two rotary pistons one arranged within the other, one piston only of each of said rotary piston units being a working piston while the other rotary piston in each of said rotary piston units is arranged so as to be idly moved by the respective adjacent working piston, said working pistons consisting of a single piece, a longitudinally split housing surrounding all of said pistons and having the same journaled therein, said second rotary piston unit including control means adjustable for controlling the delivery of said compressor, and means operatively connecting said combustion engine with said control means for causing the latter to reduce the delivery of said compressor in response to the pressure of said exhaust gas furnished by said combustion engine dropping below a certain magnitude, whereby an undue drop in the speed of said compressor is avoided.

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