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(54) **ARRANGEMENT OF INTERNAL COMBUSTION ENGINES PROVIDED WITH A SUPERCHARGER AND A FUEL INJECTION SYSTEM**

MIT EINEM LADER UND EINEM KRAFFSTOFFEINSPRITZSYSTEM VERSEHENE BRENNKRAFTMASCHINENANLAGE

CONFIGURATION DE MOTEURS A COMBUSTION INTERNE EQUIPES D'UN COMPRESSEUR A SURALIMENTATION ET D'UN SYSTEME D'INJECTION DE CARBURANT

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(56) References cited:
EP-A- 0 458 670
DE-A- 2 553 561
US-A- 2 111 568

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Description

The present invention relates to a device in internal combustion engines provided with a supercharger of the rotary screw compressor type and a compressed air assisted fuel injection system, in which the supercharger includes a casing provided with outlet and inlet end walls with inlet port and outlet port and two rotors, one being a male rotor and the other one a female rotor, which have helically extending lobes and intermediate grooves, the intermeshing lobes of the rotor and the casing forming towards the outlet end wall movable chambers with an overpressure of about 1 to 2 bars as the rotors rotate.

In many engine constructions with fuel injection direct into the combustion chamber or alternatively into the intake manifold a pressure source of a relatively high pressure, such as about 5 bars overpressure is required in order to attain an adequate injection. In some cases the injection must take place so fast that the fuel has to be mixed with and injected with the compressed air. For this purpose a suitably driven compressor, e.g. a small reciprocating compressor is provided irrespective of if the engine is supercharged or not. In the case the motor is supercharged with a compressor this means mounting of further a component in connection with the engine with increasing costs as a consequence.

A compressor for this purpose is known by EP-A-0 458 670 disclosing a screw compressor providing air at two different pressures, the higher of which is used to assist the injection of fuel. If an air pressure of about 5 bar is requested for assisting the injection of fuel two screw compressors are preferably used in series connection.

The object of the invention is to attain a corresponding function for the fuel injection of a supercharged engine without the requirement to provide a particular compressor for the fuel injection.

This has according to the invention been achieved in that a rotary screw compressor of a kind known as such is used as the supercharger, which compressor through a special, from the ordinary outlet port separated, outlet port delivers a minor air flow of considerably higher pressure than that from the ordinary outlet port of the compressor after that the ordinary outlet port has been closed, which special outlet port by a pipe is connected to the fuel injection system for pressurizing this with a considerably higher pressure than the outlet pressure of the supercharger. In this way the air volume enclosed between the rotors and the casing at the outlet end after final compression can be withdrawn at the desired pressure level and be used for the fuel injection. In an internal combustion engine with a rotary screw compressor as supercharger and in which fuel injection with the aid of compressed air is required, an extra compressor or pump for the fuel injection thus is not necessary.

The invention is explained in detail through the following with reference to the accompanying drawing, schematically showing two embodiments of devices according to the invention, wherein fig. 1 is a view from above of an engine with supercharger and fuel injection device, fig. 2 is an end view of a first embodiment of the device according to the invention and fig. 3 is an end view of a second embodiment for achieving a particularly high pressure ratio and a larger air quantity.

Fig. 1 shows an internal combustion engine 1 provided with a supercharger 2 of the rotary screw compressor type, driven by a belt transmission 3 from a pulley mounted on the engine crankshaft. The supercharger 2 feeds the intake manifold 4 of the engine through a channel 5 with an overpressure of about 1 bar. The supercharger 2 is provided with a high pressure outlet 6 for compressed air, which will be described in connection with figs. 2 and 3. From the high pressure outlet 6 compressed air with a pressure of about 5 bars is led through a compressed air pipe 7 to a fuel injection device 8, which receives fuel from a pipe 9. The fuel is mixed with the compressed air in the fuel injection device 8 and is supplied to the intake manifold 4 alternatively the cylinder of the engine (at direct fuel injection) through injection nozzles.

The supercharger is of a kind known by US-A-2 111 568, namely a rotary screw compressor with a special outlet port 11, fig. 2, provided in the compressor casing, for emptying the air volume enclosed between the rotors and therethrough eliminating the powerful pressure pulses, that can occur after closing of the outlet port. The port is here very small and located in a part of the outlet end wall 12 in a position such that the air volume enclosed between the rotors at the outlet end after a final compression will be located to face the port when the desired pressure level has been reached. Fig. 2 also shows the ordinary axial outlet port 13 of the compressor, formed by the axial outlet port 13F and 13M in the outlet end wall. The port thus is formed by two port sections, divided by the end wall part 12 with the flanks of the female rotor 14F and the male rotor 14M nearest to the end wall part 12 indicated by dotted lines. Straight below the port 13F, 13M the radial outlet port 15 of the supercharger is projected with a for a supercharger normal opening edge 16 and an early acting closing edge 17 for the compression of high pressure air. The position of the closing edge 17 is chosen with regard to the desired quantity of high pressure air, which naturally makes use of a corresponding part of the capacity of the supercharger. This air quantity, however, will be supplied to the engine together with the fuel.

If a particularly high pressure is desired, a recess 20 can be provided in each groove of the female rotor 14F adjacent to the outlet end wall 12 and in that port 21, located such that communication with the recess 20 is established, when the desired pressure has been reached.

In this way normally about 5 % of the capacity of the supercharger can be made use of for compressed air to

the fuel injection at an overpressure of about 5 bars. Due to the higher pressure, leakage will increase somewhat and therefore the supercharger should be dimensioned with regard to that.

Claims

1. Internal combustion engine provided with a supercharger (2) of the rotary screw compressor type and a compressed air assisted fuel injection system (8, 9, 10), in which the supercharger includes a casing provided with outlet and inlet end walls with inlet port and outlet port (13, 15) and two rotors (14), one being a male rotor (14M) and the other one a female rotor (14F), which have helically extending lobes and intermediate grooves, the intermeshing lobes of the rotors and the casing forming towards the outlet end wall movable chambers as the rotors rotate, wherein a rotary screw compressor (2) is used as the supercharger, and is provided with a special, from the ordinary outlet port (13, 15) separated, outlet port (11, 21) creating a pressure that differs from the ordinary outlet pressure, characterized in that said special outlet port (11, 21) is located in the outlet end wall (12) in a position such that the air volume enclosed by the rotors at the outlet end after final compression will be located to face the special outlet port (11, 21) when the desired pressure level is reached delivers a minor air flow of considerably higher pressure than that delivered from the ordinary outlet port (13, 15) of the compressor after that the ordinary outlet port has been closed, which special outlet port (11, 21) by a pipe (7) is connected to the fuel injection system (8, 9, 10) for pressurizing this with a considerably higher pressure than the outlet pressure of the supercharger.

2. Engine according to claim 1, characterized in that in the bottom of each groove of the female rotor (14F) adjacent to the outlet end wall (12) a narrow axially extending recess (20) is provided, which recesses at rotation of the rotors are arranged to one after another be brought in communication with the high pressure port (21) at a turning angle ofthe rotor when the pressure in the working chamber reaches the intended level.

Patentansprüche

1. Verbrennungskraftmaschine mit einem Lader (2) von der Art eines Rotationsschraubenverdichters und einer druckluftunterstützten Kraftstoff-Einspritzanlage (8, 9, 10), bei welcher der Lader ein Gehäuse, das mit Auslaß- und Einlaßstirnwänden mit Einlaßöffnung und Auslaßöffnung (13, 15) versehen ist, und zwei Rotoren (14) besitzt, von denen einer ein männlicher Rotor (14M) und der andere ein weiblicher Rotor (14F) ist, die sich schraubenförmig erstreckende Rippen und dazwischenliegende Nuten besitzen, wobei die ineinandergreifenden Rippen der Rotoren und das Gehäuse in Richtung der Auslaßstirnwand bewegliche Kammern bilden, wenn sich die Rotoren drehen, und als Lader ein Rotationsschraubenverdichter (2) eingesetzt ist, der mit einer besonderen, von der normalen Auslaßöffnung (13, 15) getrennten Auslaßöffnung (11, 21) versehen ist, die einen Druck erzeugt, der vom normalen Auslaßdruck abweicht, **dadurch gekennzeichnet**, daß die besondere Auslaßöffnung (11, 20) in der Auslaßstirnwand (12) an einer solchen Stelle angeordnet ist, daß das von den Rotoren am Auslaßende nach der abschließenden Verdichtung eingeschlossene Luftvolumen dann an der besonderen Auslaßöffnung (11, 21) anliegt, wenn das gewünschte Druckniveau erreicht ist, und einen kleineren Luftstrom mit deutlich höherem als dem von der normalen Auslaßöffnung (13, 15) des Verdichters gelieferten Druck liefert, nachdem die normale Auslaßöffnung geschlossen worden ist, wobei die besondere Auslaßöffnung (11, 21) durch eine Röhre (7) mit der Kraftstoff-Einspritzanlage (8, 9, 10) verbunden ist, um diese mit einem deutlich höheren Druck als dem Druck des Laders unter Druck zu setzen.

2. Maschine nach Anspruch 1, **dadurch gekennzeichnet**, daß im Grund jeder Nut des weiblichen Rotors (14F) nahe der Auslaßstirnwand (12) eine schmale, sich in axialer Richtung erstreckende Vertiefung (20) vorgesehen ist, wobei die Vertiefungen so angeordnet sind, daß sie bei Rotation des Rotors nacheinander mit der Hochdrucköffnung (21) in einem Stellungswinkel des Rotors in Verbindung gebracht werden, bei welchem der Druck in der Arbeitskammer das gewünschte Niveau erreicht.

Revendications

1. Moteur à combustion interne comportant un suralimenteur (2) du type compresseur à vis rotatives et un système d'injection de carburant (8,9,10) assisté par de l'air comprimé, dans lequel le suralimenteur comprend un carter, pourvu de parois d'extrémité de sortie et d'entrée comportant un orifice d'entrée et un orifice de sortie (13,15), et deux rotors (14), dont l'un est un rotor mâle (14M) et l'autre un rotor femelle (14F) et qui comportent des lobes de forme hélicoïdale et des rainures intermédiaires, les lobes, qui engrènent entre eux, des rotors et le carter formant en direction de la paroi d'extrémité de sortie, des chambres mobiles lorsque le rotor tourne, et dans lequel un compresseur à vis rotatives (2) est utilisé en tant que suralimenteur et est muni d'un

orifice de sortie spécial (11,21), qui est séparé de l'orifice de sortie ordinaire (13,15) et crée une pression qui diffère de la pression de sortie ordinaire, caractérisé en ce que ledit orifice de sortie spécial (11,21), est situé dans la paroi d'extrémité de sortie (12) dans une position telle que le volume d'air qu'emprisonnent les rotors au niveau de l'extrémité de sortie après la compression finale soit situé en vis-à-vis de l'orifice de sortie spécial (11,21), lorsque le niveau de pression désiré est atteint, délivre un écoulement d'air secondaire ayant une pression nettement plus élevée que celui délivré par l'orifice de sortie ordinaire (13,15) du compresseur une fois que l'orifice de sortie ordinaire a été fermé, ledit orifice de sortie spécial (11,21) étant raccordé par une canalisation (7) au système d'injection de carburant (8,9,10) pour mettre en pression ce dernier à une pression nettement supérieure à la pression de sortie du suralimenteur.

2. Moteur selon la revendication 1, caractérisé en ce qu'un renfoncement étroit (20), qui s'étend axialement, est prévu dans le fond de chaque rainure du rotor femelle (14F) au voisinage immédiat de la paroi d'extrémité de sortie (12), ces renfoncements étant disposés de telle sorte que, lors de la rotation des rotors, ils sont amenés successivement en communication avec l'orifice à haute pression (21) pour un angle de rotation du rotor, lorsque la pression dans la chambre de travail atteint le niveau prévu.

Fig.1

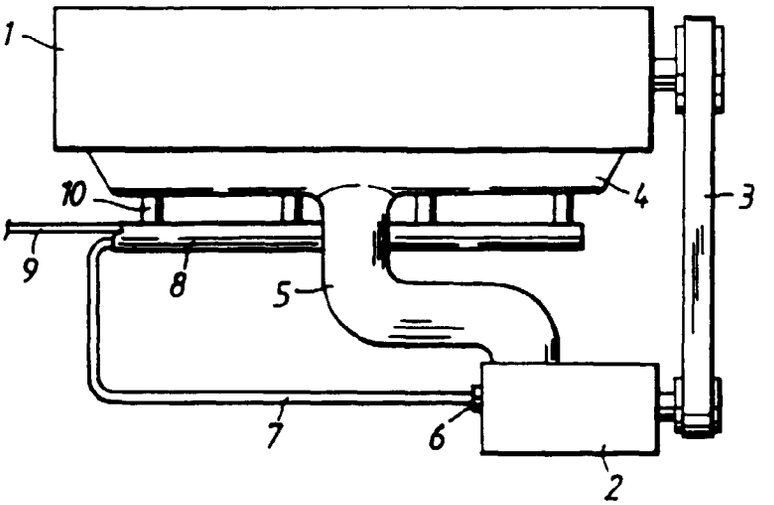


Fig.2

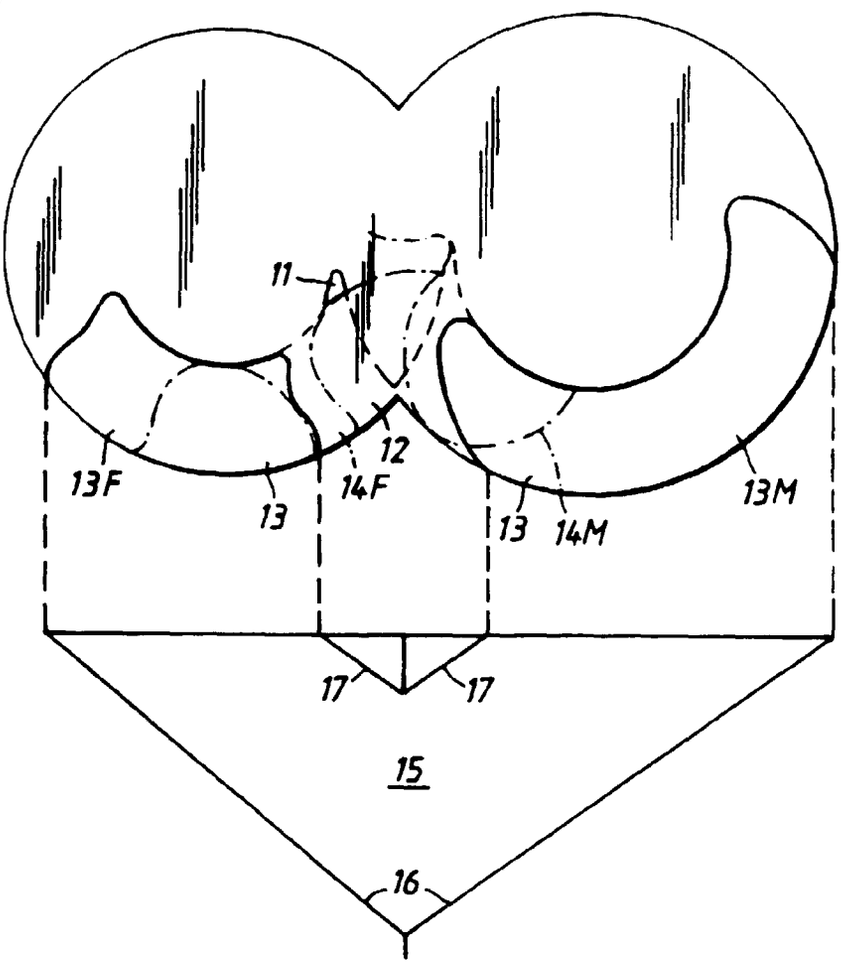


Fig.3

