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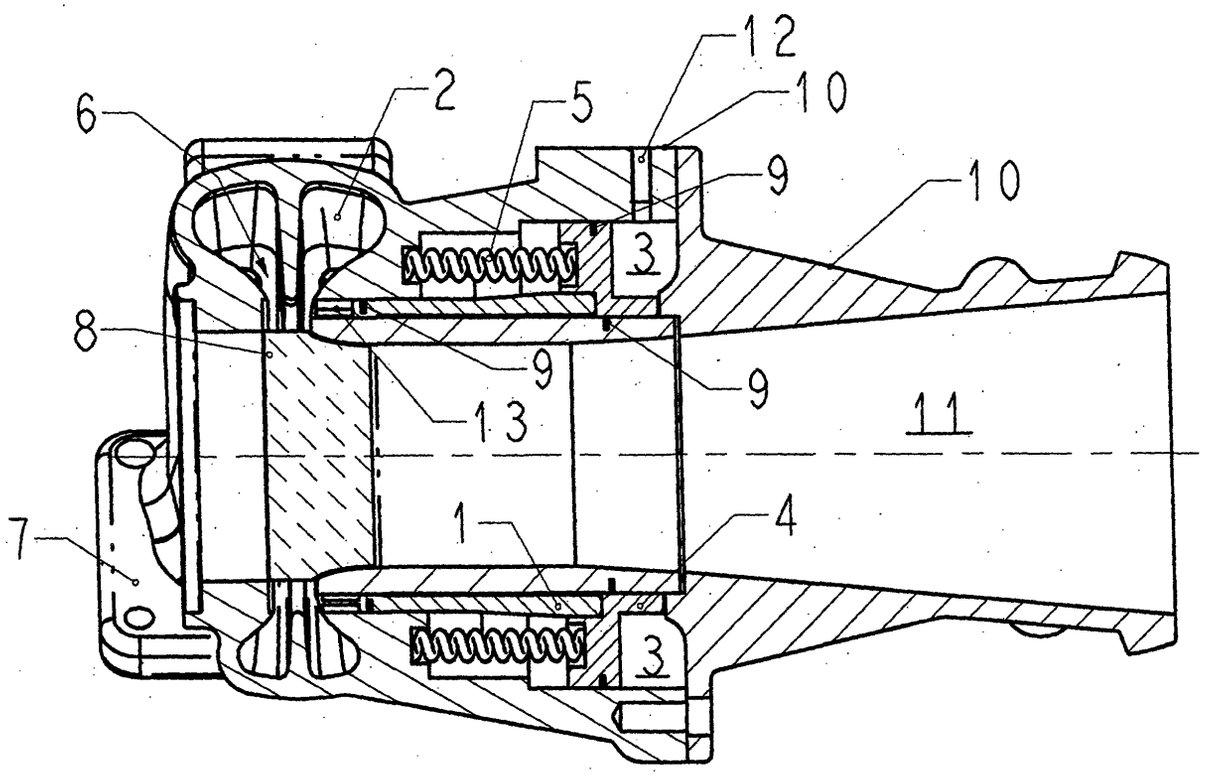
(54) Turbocharger flow control

(57) A turbocharger for an internal combustion engine is described, which is provided in the exhaust gas flow stream and which is provided with a turbine. The effective surface of a ring aperture (6) between the exhaust gas flow channel (2) and a turbine wheel (8) is reduced via an axial valve (1) with a grating ring (13) for the braking operation of the internal combustion engine. The axial displacement of the axial valve (1) necessary therefore is achieved pneumatically using a pressure space (3) in combination with a piston (4). The total size of the turbocharger can thereby be reduced and the frictional wear of parts can be reduced.

Fig. 1



EP 1 304 447 A1

Description

[0001] The invention concerns a turbocharger which is provided in the exhaust gas stream of an internal combustion engine, wherein a turbine is driven using an exhaust gas flow channel and wherein the effective flow cross section thereof is adjustable in the transition between the flow channel and the turbine wheel via an axial valve.

[0002] An internal combustion engine turbocharger system is known for example from DE 197 27 141 C1 (US Patent 6,269,643). In an annular-shaped area beginning at the flow channel and communicating with the turbine wheel, a ring shaped insert is provided to be axially displaceable. The insert, formed in part as a guide device with guide blades or vanes, is generally referred to as an axial valve. The axial valve includes a tubular sleeve part for guiding the displacement, carrying at its end associated with the annular nozzle a guide vane system formed by guide vanes, which can be displaced into a position in which the guide vanes of the guide vane system are in the cross section of the annular nozzle, reducing the free cross section of flow. The guide vane system is dimensioned to form a restriction which lies in the region of the annular nozzle, throttling the flow of exhaust gasses to the turbine rotor. This throttling, with reference to the coverage, can be constant and maximal or could also be variable. Thereby high braking characteristics can be achieved, combined with low thermal load of the internal combustion engine.

[0003] The adjustment or shifting of the axial valve in accordance with the state of the art, in particular the adjusting out of the rest position into the work position, exhibits certain shortcomings. The operation of the axial valve has occurred until now as a rule using mechanical adjusting cams or adjusting rods, which are driven by an external pneumatic cylinder. During mechanical operation of the axial valve it is however not ensured that the cams, generally provided pair-wise, are equally loaded. This results in excessive wear. The cause for the uneven force acting on the cams can be attributed to either the deformation of a control rod as a result of temperature influence or the unsymmetrical geometry of an adjusting rod as a result of certain constructional variations.

[0004] The invention is concerned with the task of simplifying the design and construction of the adjusting elements for the movement of an axial valve for introduction of a braking effect into a turbocharger of an internal combustion engine, and to make it more resistant to wear.

[0005] This task is solved by the combination of characteristics set forth in claim 1. Advantageous embodiments can be seen in the dependent claims.

[0006] In accordance with the invention a turbocharger for an internal combustion engine with an axial valve is modified in such a manner, that the control of the axial valve can occur in reproducible manner. This is achieved thereby, that in the housing of the turbocharger there is provided at least one system comprising a pressure space and a therewith operatively associated piston, by means of which the axial valve can be moved into the working or operating position. For return, there is provided a system comprised of at least one pressure spring, wherein the piston is returned to the rest position via the spring force when the pressure is reduced in the pressure space. There is a form-fitting or interlocking connection between the piston and the axial valve. The essentially cylinder or ring-shaped piston is constructively adapted or associated with the cylindrical shaped axial valve, so that when pressure acts on the pressure space an even movement of the piston in the direction of the axis of the turbocharger is achievable.

[0007] The subsequent return of the piston, actuated by one or more pressure springs, can in advantageous manner likewise occur pneumatically or, as the case may be, by compressed air. For this a further system of piston and pressure space is necessary, which upon pressure actuation returns the piston into the return position, which corresponds to the operating direction of the return pressure spring system. Preferred is the use of one single piston with two opposing pressure spaces. Therewith a pneumatic control system is provided which permits the movement of the axial valve out of its rest position into a work position and the reverse.

[0008] Further advantages are comprised therein, that a large number of mechanical construction components can be dispensed with, as well as that by external pneumatic cylinders the total or overall size of the turbocharger can be reduced. Further associated herewith is a turbocharger design, which is less liable to frictional wear.

[0009] In the following an illustrative embodiment will be described on the basis of the figures which should be understood as not limiting the scope of the invention:

Figure 1 shows a section through a turbocharger and

Figure 2 shows an embodiment of the turbocharger according to Figure 1 with pneumatic return.

[0010] Figure 1 shows a turbocharger with an axial valve **1** in a housing **10**. The flow channel **2** forms a ring surrounding an area of the turbocharger which contains a turbine wheel **8**. The effective cross section of the ring aperture or nozzle **6**, via which the exhaust gas is directed upon the turbine wheel **8**, is then reduced via a throttle or restrictor device, which in this case can be formed as a grating or restrictor ring **13** and which is provided on the end of the axial valve **1**. For this, the axial valve **1** is partially or completely inserted into the annular nozzle or ring aperture **6**. The blocking device can be in the form of a guide device with guide blades or a grating ring **13**, which exhibits surface openings defined for example by a number of boreholes. The complete turbocharger unit is fastened to an internal combustion en-

gine via at least one flange **7**. Seals **9** seal the pneumatic part.

[0011] It can be seen from Figure 1 that the axial channel **11**, the turbine wheel **8** and the ring aperture **6**, as well as the axial valve **1** are provided co-axially. The axial valve **1** is guided in the axial direction essentially by the housing **10**. The sleeve or tube-shaped part of the axial valve **1** carries a grating ring **13** on its end nearest the ring aperture.

[0012] If the exhaust gas supply from the flow channel **2** to the turbine wheel **8** through the ring aperture **6** is to be throttled or restricted, then the axial valve is slid into the area of the ring aperture **6**. This occurs via the co-axially provided and ring shaped piston **4**. This piston **4** is axially moved by a pressure actuatable pressure space **3** in such a manner, that the axial valve **1**, which is form fittingly connected with the piston **4**, is displaced axially in the desired direction. If the grating ring **13** is positioned in the area of the ring aperture **6**, wherein this advanced into this area up to an abutment, so there results a maximal cross-sectional reduction in the ring aperture **6**, which corresponds to a maximal braking effect for the turbocharger. By the operation of the axial valve via compressed air in association with appropriate clearance or tolerance fittings, it is ensured that the grating ring **13** always comes to be seated evenly axially. This is achieved by the ring shaped co-axial design of pressure space **3**, piston **4** and longitudinally extending axial valve **1**. In comparison to operation with mechanical adjustment devices, the pneumatic piston **4** moves without axial tilting or tipping, since a filling of the pressure space **3**, for example with compressed air via the compressed air supply line **12**, provides an even force distribution in the axial direction upon the piston **4**.

[0013] The return of the axial valve into its rest position occurs in one embodiment of the invention by return springs **5**, which, supported against housing **10**, exercise a return force upon the piston **4**. This should act upon the piston **4** in the axial direction distributed as evenly as possible, so that also in the return movement no tilting or tipping occurs. The coupling between axial valve **1** and piston **4** is form-locking in both directions.

[0014] In an advantageous further development of the invention it is envisioned that the return movement of the axial valve **1**, shown as being via pressure springs **5**, is also carried out pneumatically. For this, the pressure springs **5** are replaced by a further pressure space **14**. This serves to apply the necessary return force pneumatically upon the piston **4**. The compressed air supply **12**, as well as appropriate controls for a one-way or two-way pressure space design, occurs via generally well known compressed air control means.

[0015] Independently of whether the grating ring **13** or the axial valve **1** are formed overall as a closed ring, the pressure actuation, which is evenly distributed about the circumference in the pressure space **3**, **14**, results in an even slide movement of the piston **4**. The pressure actuated surfaces of the piston **4** are thereby preferably formed as continuous ring. It is however conceivable that separate individual pressure spaces **3** are distributed evenly about the circumference of the piston **4**.

Reference Number List

[0016]

1	Axial valve
2	Supply channel
3, 14	Pressure space
4	Piston
5	Pressure spring
6	Ring aperture
7	Flange
8	Turbine wheel
9	Seal
10	Housing
11	Axial channel
12	Compressed air supply
13	Grating ring

Claims

1. Turbocharger for an internal combustion engine with at least one turbine provided in the exhaust gas flow stream of the internal combustion engine, with a flow channel (2) which communicates with the turbine wheel (8) via a ring shaped area, in which communicating cross section an axial valve (1) is introducible for a braking operation, via which the flow cross section in the transition to the turbine wheel (8) can be controlled, thereby **characterized,** that in the housing (10) of the turbocharger a pneumatic pressure space (3) and a therewith operatively associated ring shaped piston (4) is provided, wherein the piston (4) is form fittingly connected with the axial valve (1) for moving the axial valve into the working position, and at least one pressure means (5) is provided for returning the piston (4) or, as the case may be, the axial valve (1), into a rest position.

2. Turbocharger according to Claim 1, thereby **characterized**, that the least one pressure means (5) for return of the axial valve (1) into the rest position comprises a pressure space operatively associated with the piston (4), which has the same working direction as the pressure means (5).

3. Turbocharger according to Claim 2, thereby **characterized**, that for movement of the axial valve (1) the piston (4) is alternatively moveable into a work position or as the case may be into a rest position.

4. Turbocharger according to one of the preceding claims, thereby **characterized**, that a pneumatic pressure space is connected to a controllable com-

pressed air system.

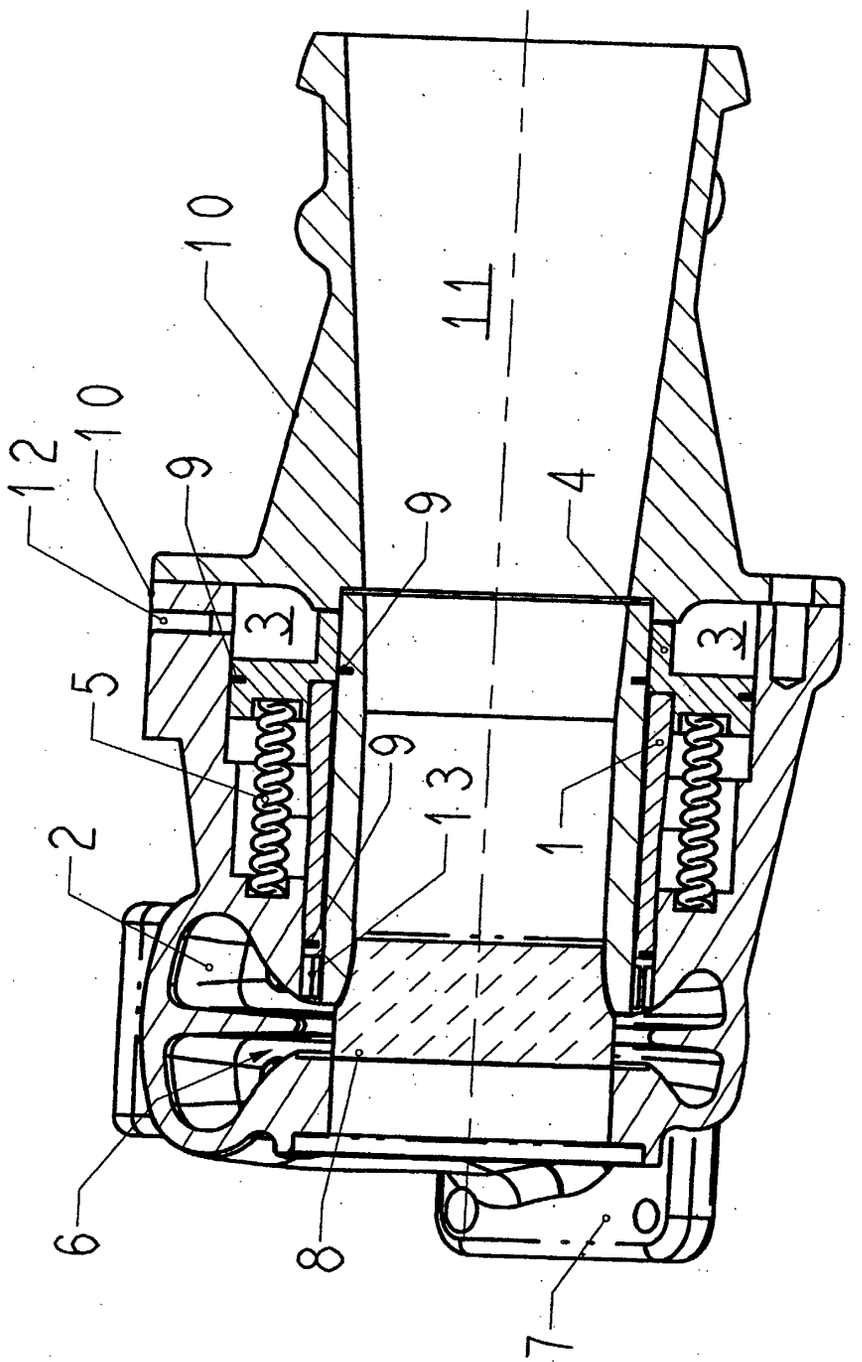


Fig. 1

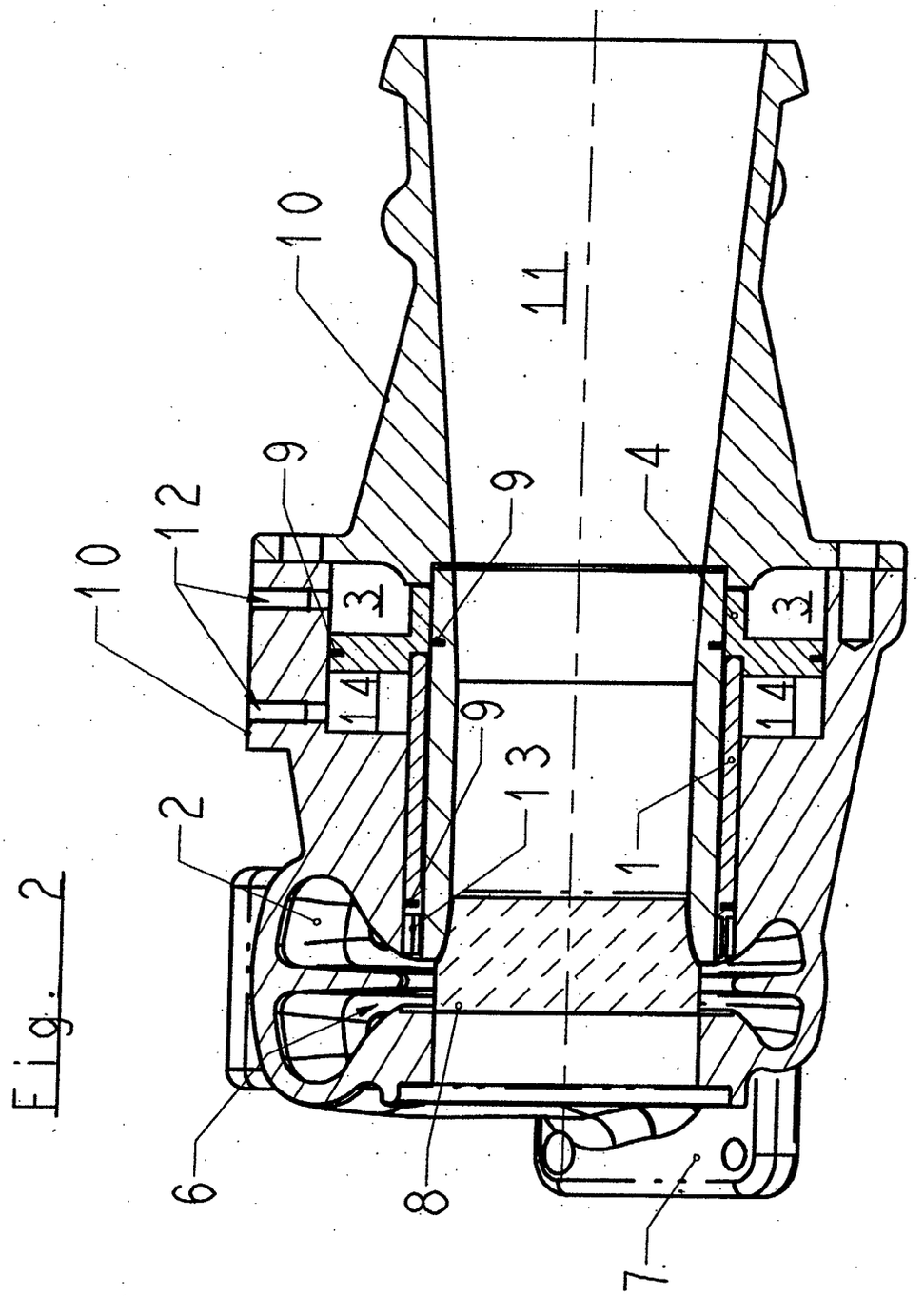


Fig. 2

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 01 12 4916

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	DE 198 16 645 A (DAIMLER CHRYSLER AG) 21 October 1999 (1999-10-21) * column 3, line 68 - column 4, line 36; figure 4 *	1-4	F01D17/14 F02C6/12
X	US 4 378 194 A (BANDUKWALLA PHIROZE) 29 March 1983 (1983-03-29) * abstract; figure 1 *	1-3	
X	GB 1 138 941 A (STUART SWINFORD WILSON) 1 January 1969 (1969-01-01) * the whole document *	1-4	
X	US 3 365 120 A (KURT JASSNIKER) 23 January 1968 (1968-01-23) * claims 1-4; figures 1,2 *	1-4	
X	CH 428 775 A (ESCHER WYSS AG) 31 January 1967 (1967-01-31) * column 2, line 32 - column 3, line 18; claims 1-3; figures 3,4 *	1-4	TECHNICAL FIELDS SEARCHED (Int.Cl.7)
X	EP 0 034 915 A (HOLSET ENGINEERING CO) 2 September 1981 (1981-09-02) * claims 2,6,7; figure 1 *	1-4	F01D
X	DE 31 51 414 A (DAIMLER BENZ AG) 11 May 1983 (1983-05-11) * claims 1-3; figures 1,2 *	1-4	
X	EP 0 569 702 A (MAK MASCHINENBAU KRUPP) 18 November 1993 (1993-11-18) * claims 3,7; figure 1 *	1-3	
A	US 3 426 964 A (SILVERN DAVID H) 11 February 1969 (1969-02-11)		

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	22 March 2002	Iverus, D

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 01 12 4916

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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22-03-2002

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 19816645 A	21-10-1999	DE 19816645 A1	21-10-1999
		WO 9953180 A1	21-10-1999
		EP 1071871 A1	31-01-2001
US 4378194 A	29-03-1983	IT 1138614 B	17-09-1986
		JP 57088297 A	02-06-1982
		KR 8801268 B1	16-07-1988
		MX 154244 A	26-06-1987
GB 1138941 A	01-01-1969	NONE	
US 3365120 A	23-01-1968	CH 413201 A	15-05-1966
		FR 1429138 A	18-02-1966
		GB 1106107 A	13-03-1968
		NL 126489 C	
		NL 6406513 A	12-11-1965
CH 428775 A	31-01-1967	NONE	
EP 0034915 A	02-09-1981	BR 8101054 A	25-08-1981
		EP 0034915 A1	02-09-1981
		ES 499627 D0	01-07-1982
		ES 8205932 A1	01-11-1982
		JP 56129705 A	12-10-1981
		PL 229827 A1	18-09-1981
DE 3151414 A	11-05-1983	DE 3151414 A1	11-05-1983
		DE 3244190 A1	20-10-1983
EP 0569702 A	18-11-1993	DE 4215301 A1	11-11-1993
		DE 9218827 U1	05-10-1995
		EP 0569702 A1	18-11-1993
		FI 932026 A	10-11-1993
US 3426964 A	11-02-1969	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82