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(54) **REGULATING DEVICE FOR A SCREW ROTOR MACHINE INTENDED FOR SUPERCHARGING INTERNAL COMBUSTION ENGINES**

REGELUNGSANLAGE FÜR EINE SCHRAUBENROTORMASCHINE ZUM AUFLADEN VON INTERNEN VERBRENNUNGSMOTOREN

DISPOSITIF REGULATEUR POUR MACHINE A ROTOR EN FORME DE VIS DESTINEE A SURALIMENTER DES MOTEURS A COMBUSTION INTERNE

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Description

[0001] The present invention relates to a regulating device for a screw rotor machine intended for supercharging internal combustion engines, which machine at the inlet end is provided with an adjustable inlet port, that is adjustable to an area less than the area at which the machine changes over from operating as a supercharger to operating as an expander.

[0002] The capacity of a screw rotor machine usually is adjusted by means of an axially movable slide valve, which continuously exposes and sealingly covers, respectively, radial openings in the rotor housing forming the inlet port of the machine. If the machine is intended for operating also as an expansion machine, i.e. expander, in a combustion engine space the slide valve has been considered unsuitable from different points of views, as adjusting possibilities and wear as well as space demands, because a slide valve has a large axial space demand.

[0003] It has been well- known for more than 30 years in connection with screw compressors to use turning slides at the inlet port for regulating the capacity. The turning slides were fitted in ring-shaped notches in the wall of the inlet port and permitted regulation of only high capacity values, as disclosed by US 3,108,740. This solution has proved to be impractical and has not been used notwithstanding its less space demands.

[0004] The object of the invention is to obtain an improved regulating device of the kind set forth introductory comprising a regulation of the inlet port such that the screw rotor machine can be operated alternatively as a compressor and an expander.

[0005] This object is achieved in that the device has obtained the characterizing features stated in claim 1. By arranging the inlet port in the end wall of the machine an axially beyond the end wall protruding slide valve is avoided, and the regulating is preferably performed by means of two turnable cover plates, as set forth in claim 2. There are no problems associated with the arranging of a compressor capacity regulating by means of two turnable cover plates because the regulating range is restricted. In case of such an extreme throttling of the inlet port that is in question in connection with the claimed device there will be no space for the two required turnable cover plates. Therefore a solution in accordance with claim 2 is a preferred embodiment of the invention.

[0006] Other suitable embodiments are set forth in claims 3-5.

[0007] The invention will now be described in more detail with reference to the attached drawings schematically illustrating two exemplifying embodiments of the invention and in which Figure 1 is an end view of a first embodiment as seen towards the inlet end, Figure 2 is a sectional part view taken on the line II-II in Fig.1, Figure 3 is a similar view as in Fig.1 but in another working state, Figure 4 is a sectional view taken on the line IV-IV in Fig.5 showing a second embodiment, and Figure 5 is a sectional part view taken on the line V-V in Fig.4.

[0008] The screw rotor machine shown in Figs. 1-3 comprises a housing 1 with two end walls, only one of which 2 being visible. In the housing 1 there are two rotors, a female rotor 3 and a male rotor 4, rotatably mounted in the usual way by bearings in the end walls (not shown). Characterizing for the invention are an arrangement with turning cover plates 5,6 tunably on fixed shafts 9,10 coaxial to the center axes 7,8 of the rotors 3,4, respectively. The turnable cover plates 5,6 are sealingly bearing on a tuned cavity 11 and a plane-tuned surface 12 in the end wall 2 around the shafts 9,10.

[0009] In the turned cavity 11 and plane-turned surface 12 an inlet port 13 is arranged in the form of a first section 13a of openings to the threads of the female rotor 3, and a second section 13b of openings to the threads of the male rotor 4. The inlet port has a total opening indicated by the arc 14.

[0010] The cover plates 5,6 (their positions are indicated a.o. by dot-dashed lines in Fig.2) have hubs 15,16 provided with exterior ring-shaped notches 17,18, in which a wire 19 runs such, that at pulling the wire 19 the turnable cover plates 5,6 are turned in counter clockwise and clockwise directions, respectively. One end of the wire 19 is attached by a screw 20 to the hub and the other end to a foot throttle 21. The hubs 15,16 are connected each to one end of combined pressure and turning springs 22,23 the other ends of which being attached to a corresponding shaft 9,10 for the return movement of the cover plates to the rest position shown in Fig.1.

[0011] The deep of the turned cavity 11 and the thickness of the cover plate 5 is adapted such, that the top side or outer side of the cover plate 5 is positioned just below the level of the plane-turned surface permitting the turning of cover plate 6 out over the port section 13a, which is required for obtaining the large regulation range of a supercharger and expander.

[0012] As illustrated by Fig.1 the section 13a includes two further openings 25, which are positioned beyond the rear edge of cover plate 5. Said openings constitute the smallest inlet port at idling speed of the associated engine, and the position is decided by a finger 26 on the periphery of the cover plate 5, which finger is bearing on a pin 27 of a mechanism (not shown) adapted to move to the position shown in Fig.3 at the connecting of a load, for instance an airconditioner, so that the cover plate 5 is turned a corresponding angle relative to the hub 15, that is resiliently attached to the cover plate 5. At this tuning motion two further circular openings 28 are exposed and the inlet port is opened a bit for counteracting a reduction of the engine speed. A further opening of the inlet port till a complete opening is performed by means of the foot throttle 21, which brings the screw rotor machine to successively turn from being an expansion machine to be a supercharger.

[0013] The embodiment according to Fig.4 differs from the one shown above in that all the inlet port 13 is positioned in one and the same level partly covered by a cover plate means 30 having a central opening 31 by which a part of the openings of the inlet port 13 are exposed. The cover plate 30 is movably mounted together with a shaft 32, that is slidingly journalled in an opening 33 through a wall 34 belonging to the housing. A diaphragm 41 is clamped in a space 35 formed by the wall 34 and a cap 36 with a pressure spring 37 acting to push the diaphragm in the direction towards the cap 36, and by that open the inlet port 13 completely such, that the machine is operated as a supercharger. The cover plate can be restored to the position shown in Fig.5 in which the machine is operated as an expansion machine or expander in that a negative pressure is applied in the spring chamber 38 through the aperture 39 or a positive pressure is applied in the chamber 40 on the other side of the diaphragm 41 through an aperture 41' in the cap 36.

Claims

1. A regulating device for a screw rotor machine intended for supercharging internal combustion engines, which machine at the inlet end is provided with an adjustable inlet port (13a,13b) that is adjustable to an area less than the area at which the machine changes over from operating as a supercharger to operating as an expander, **characterized** in that the inlet port is positioned in end wall (2) of the inlet end with a part communicating with the threads of the male rotor (4) and a part communicating with the threads of the female rotor (3), in addition to which a larger portion of said two parts (13a,13b) of the inlet port are sealingly covered by a movably mounted cover plate means (5,6) when the machine is operated as an expander, which cover plate means is at least partly removed from the two parts of the inlet port when the machine is operated as a supercharger.

2. A device according to claim 1, **characterized** in that the inlet port comprises inlet openings forming a first arc-shaped section (13a) with its centre positioned in the centre axis (7) of one of the rotors and a second arc-shaped section (13b) with its centre positioned in the centre axis (8) of the other rotor, and the first section (13a) is positioned in a level (11) below and in parallel with the level (12) in which the other section (13b) is positioned, in addition to which the cover plate means is divided into two, round each a rotor axis turnable cover plates (5,6) bearing each against one of said sections, and with the top side of the cover plate (5) bearing against said first section positioned below the level of said second section.

3. A device according to claim 1 or 2, **characterized** in that said two cover plates (5,6) are mutually connected by a operating mechanism, preferably comprising a band or wire (19), which when actuated positively turns the cover plates (5,6) in opposite directions from a position with a smallest open area of the inlet port (13a,13b) to a position with a completely opened area.

4. A device according to any of claims 1-3, **characterized** in that the cover plate means is movable under the influence of a means (21) for regulating engine speed, and moreover - when it is in a position with the smallest area of the inlet port - is movable a small step in increasing direction under the influence of a means (26,27) that is activated for counteracting a tendency of reduction of the engine speed at the connecting of an auxiliary apparatus loading the engine, for instance an air-conditioning unit.

5. A device according to claim 1, **characterized** in that the cover plate means (30) covers all the inlet port (13) with the exception of a portion with a position and size requested for the operating of the machine as an expander, in addition to which the cover plate means is mounted to be lifted up from the inlet port by means of an operating mechanism (32,41).

Patentansprüche

1. Steuervorrichtung für eine Schraubenrotormaschine zum Aufladen von Verbrennungskraftmaschinen, die am Einlaßende mit einem einstellbaren Einlaß (13a, 13b) versehen ist, der bis in einen Bereich unterhalb des Bereiches einstellbar ist, in welchem die Maschine vom Betrieb als Lader zum Betrieb als Entspanner wechselt, **dadurch gekennzeichnet**, daß der Einlaß in einer Stirnwand (2) des Einlaßendes angeordnet ist, wobei ein Teil mit den Schraubengängen des männlichen Rotors (4) und ein Teil mit den Schraubengängen des weiblichen Rotors (3) in Verbindung steht und weiterhin ein größerer Abschnitt der beiden Teile (13a, 13b) des Einlasses abdichtend durch beweglich angebrachte Abdeckplattenmittel (5,6) abgedeckt ist, wenn die Maschine als Entspanner betrieben wird, die wenigstens teilweise von den beiden Teilen des Einlasses entfernbar sind, wenn die Maschine als Lader betrieben wird.

2. Steuervorrichtung nach Anspruch 1, **dadurch gekennzeichnet**, daß der Einlaß Einlaßöffnungen aufweist, die einen ersten bogenförmigen Abschnitt (13a), dessen Zentrum auf der Mittelachse (7) eines Rotors liegt, und einen zweiten bogenförmigen Abschnitt (13b) bilden, dessen Zentrum auf der

Mittelachse (8) des anderen Rotors liegt, wobei der erste Abschnitt (13a) auf einem Niveau (11) unterhalb und parallel bezüglich des Niveaus (12) des anderen Abschnitts (13b) liegt und weiterhin die Abdeckplattenmittel in zwei um jeweils eine Rotorachse schwenkbare Abdeckplatten (5, 6) unterteilt sind, die jeweils gegen einen der Abschnitte abgestützt sind, wobei die Oberseite der an dem ersten Abschnitt abgestützten Abdeckplatte (5) unterhalb des Niveaus des zweiten Abschnittes liegt.

3. Steuervorrichtung nach Anspruch 1 oder 2, **dadurch gekennzeichnet**, daß die beiden Abdeckplatten (5, 6) durch einen Betätigungsmechanismus miteinander verbunden sind, der vorzugsweise ein Band oder Seil (19) aufweist und beim Betätigen die Abdeckplatten (5, 6) in entgegengesetzter Richtung aus einer Stellung mit einem am wenigsten offenen Bereich des Einlasses (13a, 13b) in eine Stellung mit vollständig geöffnetem Bereich verdreht.

4. Steuervorrichtung nach einem der Ansprüche 1 - 3, **dadurch gekennzeichnet**, daß die Abdeckplattenmittel unter dem Einfluß von Mitteln (21) zum Steuern der Maschinendrehzahl beweglich sind und weiterhin - wenn sie sich in einer Stellung mit dem am wenigsten offenen Bereich des Einlasses befinden - ein kleines Stück in zunehmender Richtung unter dem Einfluß von Mitteln (26, 27) beweglich sind, die zum Entgegenwirken gegen eine Neigung zur Reduzierung der Maschinendrehzahl beim Zuschalten eines Hilfsaggregates betätigt werden, daß die Maschine belastet, beispielsweise eine Klimaanlage.

5. Steuervorrichtung nach Anspruch 1, **dadurch gekennzeichnet**, daß die Abdeckplattenmittel (30) den gesamten Einlaß (13) mit Ausnahme eines Bereiches mit einer solchen Lage und Größe abdecken, wie es zum Betreiben der Maschine als Entspanner erforderlich ist und weiterhin die Abdeckplattenmittel von dem Einlass mittels eines Betätigungsmechanismus (32, 41) anhebbar angebracht sind.

Revendications

1. Dispositif de régulation destiné à une machine à rotor à vis prévue pour suralimenter des moteurs à combustion interne, laquelle machine au niveau de l'extrémité d'entrée est munie d'un orifice d'entrée réglable (13a, 13b) qui peut être réglé à une surface inférieure à la surface à laquelle la machine bascule du fonctionnement en tant que turbocompresseur au fonctionnement en tant que détendeur, caractérisé en ce que l'orifice d'entrée est positionné dans la paroi d'extrémité (2) de l'extrémité d'entrée, une partie communiquant avec les filets du rotor mâle (4) et une partie communiquant avec les filets du rotor femelle (3), et en ce que une portion plus grande desdites deux parties (13a, 13b) de l'orifice d'entrée est recouverte de façon hermétique par un moyen de plaques de recouvrement montées de façon mobile (5, 6) lorsque la machine est mise en oeuvre en tant que détendeur, lequel moyen de plaques de recouvrement est au moins en partie enlevé des deux parties de l'orifice d'entrée de la machine lorsque la machine est mise en oeuvre en tant que turbocompresseur.

2. Dispositif selon la revendication 1, caractérisé en ce que l'orifice d'entrée comprend des ouvertures d'entrée formant une première section en forme d'arc (13a), son centre étant positionné dans l'axe central (7) de l'un des rotors, et une seconde section en forme d'arc (13b), son centre étant positionné dans l'axe central (8) de l'autre rotor, et la première section (13a) est positionnée à un niveau (11) au-dessous du niveau (12), et parallèle à celuici, auquel l'autre section (13b) est positionnée, et en ce que le moyen de plaques de recouvrement est divisé en deux, avec des plaques de recouvrement (5, 6) pouvant tourner chacune autour d'un axe de rotor, portant chacune contre l'une desdites sections, et la face supérieure de la plaque de recouvrement (5) portant contre ladite première section positionnée au-dessous du niveau de ladite seconde section.

3. Dispositif selon la revendication 1 ou 2, caractérisé en ce que lesdites deux plaques de recouvrement (5, 6) sont reliées mutuellement par un mécanisme fonctionnel comprenant de préférence une bande ou un fil métallique (19), qui, lorsqu'il est actionné directement tourne les plaques de recouvrement (5, 6) dans les directions opposées depuis une position présentant une surface ouverte la plus petite de l'orifice d'entrée (13a, 13b) jusqu'à une position présentant une surface complètement ouverte.

4. Dispositif selon l'une quelconque des revendications 1 à 3, caractérisé en ce que le moyen de plaques de recouvrement peut être déplacé sous l'influence d'un moyen (21) en vue de réguler la vitesse du moteur, et en outre - lorsqu'il est dans une position présentant la surface la plus petite de l'orifice d'entrée - peut être déplacé d'un petit cran dans la direction d'augmentation sous l'influence d'un moyen (26, 27) qui est actionné en vue de contrecarrer une tendance à la réduction de la vitesse du moteur au moment du raccordement d'un appareil auxiliaire chargeant le moteur, par exemple une unité de conditionnement d'air.

5. Dispositif selon la revendication 1, caractérisé en ce que le moyen de plaques de recouvrement (30) recouvre la totalité de l'orifice d'entrée (13) à l'exception d'une portion présentant une position et une dimension requise pour le fonctionnement de la machine en tant que détendeur, et en ce que le moyen de plaques de recouvrement est monté de façon à pouvoir être soulevé depuis l'orifice d'entrée au moyen d'un mécanisme fonctionnel (32, 41).

Fig.1

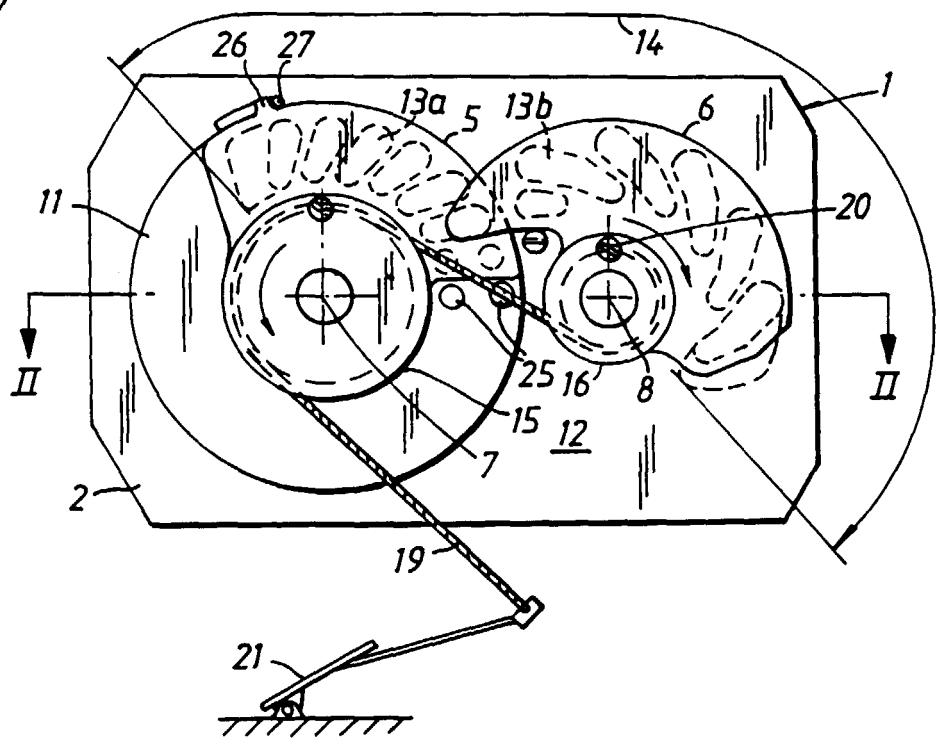
26
27
14
1
13a
5
13b
6
11
20
II
II
25
16
8
15
12
7
2
19
21

Fig.2

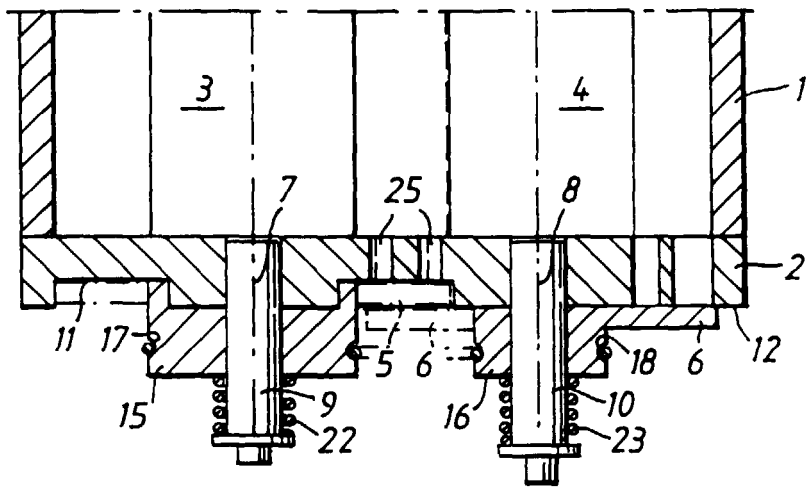
3
4
1
7
25
8
2
11
17
5
6
18
6
12
15
9
16
10
22
23

Fig.3

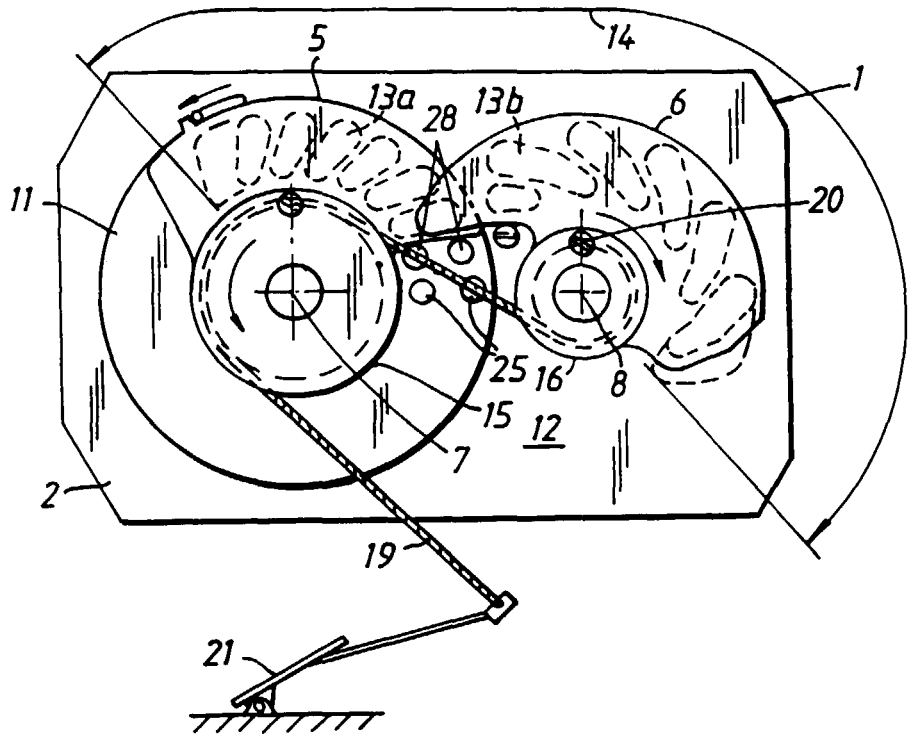

Fig. 4

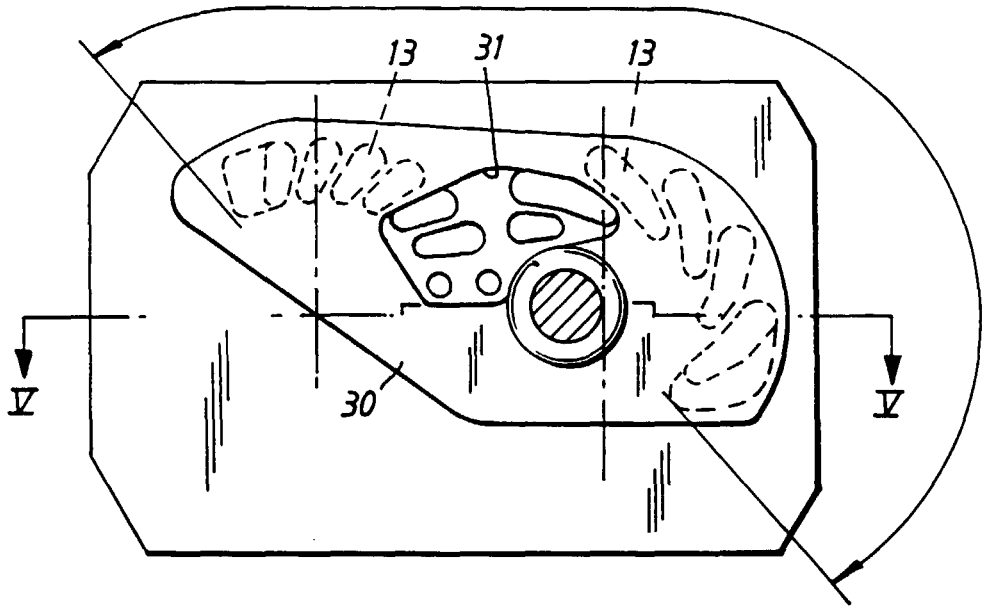

Fig. 5