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(54) **SUPERCHARGING DEVICE FOR A COMBUSTION ENGINE**

AUFLADEVORRICHTUNG FÜR EINE BRENNKRAFTMASCHINE

DISPOSITIF DE TURBOCOMPRESSION POUR MOTEUR À COMBUSTION

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(74) Representative: **Peterreins Schley**
Patent- und Rechtsanwälte PartG mbB
Hermann-Sack-Strasse 3
80331 München (DE)

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(73) Proprietor: **Borgwarner Inc.**
Auburn Hills, Michigan 48326 (US)

(72) Inventor: **SCHERI, Alessio**
34100 Trieste (TS) (IT)

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Description

[0001] The invention relates to a supercharging device for a combustion engine as per the preamble of claim 1.

[0002] In the case of a known supercharging device of said type, as a cooling arrangement, provision is made merely of an air-type cooling arrangement which, firstly, is inadequate and, secondly, leads to a bulky design of the supercharging device, because the compressor housing is equipped with a spiral.

[0003] US 6,129,524 discloses a motor-driven compressor-electronic motor power package assembly that places temperature-sensitive components of the electric motor or the electronic power package for the electric motor, or both, in heat transfer relationship with the flow of compressed air from the compressor.

[0004] DE 102 38 527 discloses an electrically driven air compressor, in particular for internal combustion engines, with a housing with at least one air inlet and with at least one air outlet as well as with at least one compressor wheel arranged on a driving shaft and in a compression space of the housing. An electric motor drives the compressor wheel. The at least one compressor wheel is displaceable relatively to the driving shaft and the driving shaft comprises a driver at its compressor side end.

[0005] By contrast, it is an object of the present invention to provide a supercharging device as per the preamble of claim 1 which makes it possible to realize a space-saving design and an improved cooling arrangement.

[0006] This object is achieved by the features of claim 1.

[0007] In this way, firstly, a more compact design is attained because the compressor of the supercharging device according to the invention dispenses with a spiral arrangement. The performance of the compressor of the supercharging device according to the invention is nevertheless at least as good as that of conventional compressors with spirals.

[0008] Furthermore, certain improvements are attained with regard to the swirling of the compressed outlet air flow, wherein it is possible for the compressor of the supercharging device according to the invention to be equipped with a diffuser arrangement provided with flow-guiding surfaces.

[0009] The dependent claims contain advantageous developments of the invention.

[0010] Through the provision of a motor-holding device which, in a particularly preferred embodiment, may be provided with flow-guiding blades, it is possible to form a heat exchanger for the electric motor, which considerably improves the dissipation of heat. For the control of and supply of energy to the electric motor, a motor control unit and power supply unit is provided, the lines of which for control and for the supply of electrical energy can, in a particularly preferred embodiment, be guided through leadthroughs in one or more of the flow-guiding blades.

[0011] In a particularly preferred embodiment, it is pos-

sible for multiple so-called cascades of flow-guiding blades to be arranged in series. The flow-guiding blades of individual cascades may in this case preferably have different circumferential spacings.

[0012] Further details, advantages and features of the present invention emerge from the following description of exemplary embodiments with reference to the drawing, in which:

Figure 1 shows a first view of a schematically slightly simplified sectional illustration through an embodiment of a supercharging device according to the invention;

Figure 2 shows an illustration, corresponding to Figure 1, of a second view of the embodiment of the supercharging device according to the invention, Figure 3 shows a perspective, sectional partial view of a further embodiment of a supercharging device according to the invention, and

Figure 4 shows a diagrammatic sketch of a combustion engine that may be provided with a supercharging device according to the invention corresponding to the embodiment as per Figure 1 and Figure 2.

Figure 1 shows an embodiment of a supercharging device 1 having an electrically driven compressor 2. The compressor 2 has a compressor housing 3 in which a compressor wheel 6 is arranged. The compressor wheel 6 is fastened to one end of a motor shaft 7 of an electric motor 8. As shown in Figures 1 and 2, the compressor housing 3 does not have a spiral duct.

[0013] The compressor wheel 6 is in the form of a radial compressor wheel and thus draws in air via a compressor inlet 4 and delivers said air to a diffuser 9 that is provided with flow-guiding blades 32, 33.

[0014] As can be seen from a juxtaposition of Figures 1 and 2, there is arranged in the compressor housing 3 a motor-holding device 11 which serves for mounting the electric motor 8 and which is fixed in a suitable manner in the compressor housing 3.

[0015] Here, a juxtaposition of Figures 1 and 2 likewise shows that the outer contour 12 of the motor-holding device 11 is matched to the inner contour 13 of the compressor housing 3.

[0016] In detail, the motor-holding device 11 has a cylindrical first housing section 14 which is arranged in an associated cylindrical first housing section 15 of the compressor housing 3. Here, said first housing section 15 of the compressor housing 3 adjoins the diffuser 9. As viewed in the flow direction S of the air flowing through the compressor housing 3, a second housing section 16 of funnel-like form is arranged downstream of the cylindrical housing section 14 of the motor-holding device 11, which second housing section adjoins the first housing section 14.

[0017] Accordingly, the cylindrical first housing section 15 is adjoined by a second housing section 17, which is

of funnel-like form, of the compressor housing 3, which second housing section merges into a cylindrical housing section 18 that leads to the compressor housing outlet 5.

[0018] Here, Figures 1 and 2 show that the compressor housing inlet 4 and the compressor housing outlet 5 are in the form of an axial inlet and axial outlet respectively, thus enabling the supercharging device 1 according to the invention to be used as a so-called plug-in/plug-out arrangement, which is easy to handle. According to the invention, an "axial" orientation of the inlet 4 and of the outlet 5 is to be understood to mean an orientation of the inlet and outlet surface, respectively, at least substantially, preferably exactly, perpendicular to the longitudinal axis or flow direction S.

[0019] Furthermore, the supercharging device 1 according to a preferred embodiment of the invention has a flow-guiding blade arrangement which is provided on an outer circumferential surface 19 of the cylindrical housing section 14 of the motor-holding device 11, wherein three blades of the flow-guiding blade arrangement are denoted, as representatives for all of the guide blades, by the reference numeral 20. Said flow-guiding blade arrangement improves the flow behavior within the compressor housing 3 and makes it possible for the cylindrical section 14 to additionally perform the function of a heat exchanger, which improves the dissipation of heat from the electric motor 8.

[0020] Here, the flow-guiding blade arrangement 20 is illustrated merely in schematically simplified form. It may have both rigid guide blades and also adjustable guide blades. The rigid guide blades 20 preferably hold the motor holding device 11 mechanically in a central and co-axial position in the compressor housing 3 and lock said holding device in the compressor housing 3.

[0021] As also shown in Figure 1, the region between the cylindrical housing sections 15 and 18 forms a longitudinal diffuser 10, which likewise has a positive influence on the flow behavior of the compressor 2.

[0022] Figure 3 shows a further particularly preferred embodiment of the supercharging device 1 according to the invention which is provided with cascades of flow-guiding blades in series with one another, wherein two of said flow-guiding blades are denoted, by way of example for all of the cascaded flow-guiding blades, by the reference signs 20A and 20B. The flow-guiding blades 20A and 20B of individual cascades may preferably have different circumferential spacings.

[0023] Figure 4 is a schematically highly simplified illustration of a combustion engine 21, for example in the form of an internal combustion engine (diesel or Otto-cycle engine). The combustion engine 21 has an intake line 22 in which the compressor 2 of the supercharging device 1 is arranged, said compressor being driven by the electric motor 8. A charge-air cooler 23, followed by a throttle 24, can be arranged downstream of the compressor 2 in the intake line 22. The compressed air, which is symbolized by the arrow CA, from the compressor 2 is supplied to an intake manifold 25, and the cylinders of

the combustion engine 21 are supplied with the compressed air from said intake manifold.

[0024] As is also shown in Figure 4, the supercharging device 1 is provided with a device 34 for motor control and for supplying electrical energy to the electric motor 8. Said control device and power supply unit is symbolized in schematically simplified form in Figure 4 by the block 34. Accordingly, the device 34 is, depending on the embodiment, arranged at a suitable location outside or within the supercharging device 1. In a particularly preferred embodiment, for the leadthrough of lines for control and for energy supply, the flow-guiding blades are provided with corresponding leadthrough recesses, which are symbolized in schematically highly simplified form in Figures 1 and 2 by the circles 35 and 36.

[0025] The exhaust gas EG is supplied to an exhaust line 27 via an exhaust manifold 26.

[0026] In the particularly preferred embodiment which is illustrated in Figure 4, the internal combustion engine 21 is also provided with an exhaust-gas recirculation line 28 in which an exhaust-gas cooler 29 and a valve 23 are arranged. However, said exhaust-gas recirculation line 28, together with its components 29 and 30, is not mandatory, but rather constitutes merely a particularly preferred embodiment.

[0027] In addition to the above written description of the invention, reference is hereby explicitly made, for additional disclosure thereof, to the diagrammatic illustration of the invention in Figures 1 to 4. The scope of the invention is however solely defined by the appended claims.

LIST OF REFERENCE SIGNS

[0028]

- 1 Supercharging device
- 2 Compressor
- 3 Compressor housing
- 4 Compressor housing inlet
- 5 Compressor housing outlet
- 6 Radial compressor wheel
- 7 Motor shaft
- 8 Electric motor
- 9 Diffuser
- 10 Longitudinal diffuser
- 11 Motor-holding device
- 12 Outer contour
- 13 Inner contour
- 14 First housing section of the motor-holding device 11
- 15 First housing section of the compressor housing 3
- 16 Second housing section of the motor-holding device 11
- 17 Second housing section of the compressor housing 3
- 18 Second cylindrical housing section of the compressor housing 3

19 Outer circumferential surface
 20, 20A, 20B Flow-guiding blades/ flow-guiding
 blade arrangement/flow-guiding vanes
 21 Combustion engine
 22 Intake line
 23 Charge-air cooler
 24 Throttle
 25 Intake manifold
 26 Exhaust manifold
 27 Exhaust line
 28 Exhaust-gas recirculation line
 29 Exhaust-gas cooler
 30 Valve
 31 Compressor wheel rear side
 32, 33 Flow-guiding blades of the diffuser 9
 34 Motor control and energy supply device
 35,36 Leadthrough recesses
 CA Compressed air
 EG Exhaust gas
 S Flow direction or longitudinal axis of the compres-
 sor housing 3/supercharging device 1

Claims

1. A supercharging device (1) for a combustion engine (21),
 having an electrically driven compressor (2) which
 has a compressor housing (3) with a compressor
 housing inlet (4) and a compressor housing outlet
 (5),

in which compressor housing (3) there is ar-
 ranged a radial compressor wheel (6) which is
 fastened to one end of a motor shaft (7) of an
 electric motor (8), and
 which compressor housing has a radially out-
 wardly directed diffuser (9),

wherein

the compressor housing outlet (5) is in the form of
 an axial outlet; **characterized in that** a cylindrical
 first housing section (15) of the compressor housing
 (3) adjoins the radially outwardly directed diffuser
 (9); and

in that the said diffuser (9) is provided with flow-
 guiding blades (32, 33).

2. The supercharging device as claimed in claim 1,
 wherein the compressor housing (3) has a longitu-
 dinal diffuser (10) downstream of the diffuser (9) as
 viewed in the flow direction (S) of the air flowing
 through the compressor housing (3).
 3. The supercharging device as claimed in claim 1 or
 2, wherein a motor-holding device (11) is arranged
 in the compressor housing (3).

4. The supercharging device as claimed in claim 3,
 wherein an outer contour (12) of the motor-holding
 device (11) is matched to an inner contour (13) of
 the compressor housing (3).

5. The supercharging device as claimed in claim 3 or
 4, wherein the motor-holding device (11) has a cy-
 lindrical first housing section (14) which is arranged
 in the associated cylindrical first housing section (15)
 of the compressor housing (3).

6. The supercharging device as claimed in claim 5,
 wherein, as viewed in the flow direction (S), the cy-
 lindrical first housing section (14) of the motor-hold-
 ing device (11) is adjoined by a second housing sec-
 tion (16) of funnel-like form.

7. The supercharging device as claimed in claim 5 or
 6, wherein the cylindrical first housing section (15)
 of the compressor housing (3) is adjoined by a sec-
 ond housing section (17) which is of funnel-like form
 and which merges into a cylindrical second housing
 section (18) in which the compressor housing outlet
 (5) is arranged.

8. The supercharging device as claimed in one of
 claims 5 to 7, wherein an outer circumferential sur-
 face (19) of the cylindrical housing section (14) of
 the motor-holding device (11) is provided with flow-
 guiding blades (20).

9. The supercharging device as claimed in claim 8,
 wherein the flow-guiding blades (20) are adjustable.

10. The supercharging device as claimed in one of
 claims 1 to 9, **characterized by** a motor control and
 energy supply device (34) for the electric motor (8).

11. The supercharging device as claimed in claim 10,
 wherein control lines and/or energy supply lines of
 the motor control and energy supply device (34) are
 guided through leadthrough recesses (35, 36) in the
 flow-guiding blades (20).

12. The supercharging device as claimed in one of
 claims 8 to 11, wherein the flow-guiding blades (20A,
 20B) are provided in a cascaded arrangement.

13. The supercharging device as claimed in claim 12,
 wherein the flow-guiding blades (20A, 20B) of the
 cascade are arranged in series.

14. The supercharging device as claimed in claim 12 or
 13, wherein the flow-guiding blades (20A, 20B) of
 individual cascades have different circumferential
 spacings.

Patentansprüche

1. Aufladevorrichtung (1) für eine Brennkraftmaschine (21),
einen elektrisch angetriebenen Verdichter (2) auf-
weisend, der ein Verdichtergehäuse (3) mit einem
Verdichtergehäuseeinlass (4) und einem Verdich-
tergehäuseauslass (5) hat,
wobei in dem Verdichtergehäuse (3) ein Radialver-
dichterrad (6) angeordnet ist, das an einem Ende
einer Motorwelle (7) eines Elektromotors (8) befestigt ist, und
wobei das Verdichtergehäuse einen radial auswärts
gerichteten Diffusor (9) aufweist, wobei der Verdich-
tergehäuseauslass (5) in der Form eines axialen
Auslasses ist; **dadurch gekennzeichnet, dass** ein
zylindrischer erster Gehäuseabschnitt (15) des Ver-
dichtergehäuses (3) an den radial auswärts gerichteten
Diffusor (9) angrenzt; und dadurch, dass der
Diffusor (9) mit strömungsleitenden Schaufeln (32,
33) versehen ist. 5
2. Aufladevorrichtung nach Anspruch 1, wobei das Ver-
dichtergehäuse (3) einen längs verlaufenden Diffu-
sor (10) stromabwärts des Diffusors (9) aufweist, wie
in Strömungsrichtung (S) der Luft betrachtet, die
durch das Verdichtergehäuse (3) strömt. 10
3. Aufladevorrichtung nach Anspruch 1 oder 2, wobei
eine Motorhaltevorrichtung (11) im Verdichterge-
häuse (3) angeordnet ist. 15
4. Aufladevorrichtung nach Anspruch 3, wobei eine äu-
ßere Kontur (12) der Motorhaltevorrichtung (11) auf
eine innere Kontur (13) des Verdichtergehäuses (3)
abgestimmt ist. 20
5. Aufladevorrichtung nach Anspruch 3 oder 4, wobei
die Motorhaltevorrichtung (11) einen zylindrischen
ersten Gehäuseabschnitt (14) aufweist, der im zu-
gehörigen zylindrischen ersten Gehäuseabschnitt
(15) des Verdichtergehäuses (3) angeordnet ist. 25
6. Aufladevorrichtung nach Anspruch 5, wobei, wie in
Strömungsrichtung (S) betrachtet, der zylindrische
erste Gehäuseabschnitt (14) der Motorhaltevorrich-
tung (11) an einen zweiten Gehäuseabschnitt (16)
von trichterähnlicher Form angrenzt. 30
7. Aufladevorrichtung nach Anspruch 5 oder 6, wobei
der zylindrische erste Gehäuseabschnitt (15) des
Verdichtergehäuses (3) an einen zweiten Gehäuse-
abschnitt (17) angrenzt, der von trichterähnlicher
Form ist und der in einen zylindrischen zweiten Ge-
häuseabschnitt (18) zusammenläuft, in dem der Ver-
dichtergehäuseauslass (5) angeordnet ist. 35
8. Aufladevorrichtung nach einem der Ansprüche 5 bis

7, wobei eine äußere umlaufende Oberfläche (19)
des zylindrischen Gehäuseabschnitts (14) der Mo-
torhaltevorrichtung (11) mit strömungsleitenden
Schaufeln (20) versehen ist.

9. Aufladevorrichtung nach Anspruch 8, wobei die strö-
mungsleitenden Schaufeln (20) einstellbar sind.
10. Aufladevorrichtung nach einem der Ansprüche 1 bis
9, **gekennzeichnet durch** eine Motorsteuerungs-
und Energieversorgungsvorrichtung (34) für den
Elektromotor (8).
11. Aufladevorrichtung nach Anspruch 10, wenn abhän-
gig von Anspruch 8 oder 9, wobei Steuerleitungen
und/oder Energieversorgungsleitungen der Motor-
steuerungs- und Energieversorgungsvorrichtung
(34) durch durchführende Aussparungen (35, 36) in
den strömungsleitenden Schaufeln (20) geleitet wer-
den.
12. Aufladevorrichtung nach einem der Ansprüche 8 bis
11, wobei die strömungsleitenden Schaufeln (20A,
20B) in einer kaskadierten Anordnung bereitgestellt
sind.
13. Aufladevorrichtung nach Anspruch 12, wobei die
strömungsleitenden Schaufeln (20A, 20B) der Kas-
kade in Reihe angeordnet sind.
14. Aufladevorrichtung nach Anspruch 12 oder 13, wo-
bei die strömungsleitenden Schaufeln (20A, 20B)
von einzelnen Kaskaden unterschiedliche umlau-
fende Abstände aufweisen.

Revendications

1. Dispositif de turbocompression (1) pour un moteur
à combustion (21),
ayant un compresseur actionné électriquement (2)
qui comporte un carter de compresseur (3) avec une
entrée de carter de compresseur (4) et une sortie de
carter de compresseur (5),
une roue de compresseur radiale (6) étant agencée
dans ledit carter de compresseur (3) et étant fixée à
une extrémité d'un arbre moteur (7) d'un moteur
électrique (8), et
ledit carter de compresseur ayant un diffuseur (9)
dirigé radialement vers l'extérieur, la sortie de carter
de compresseur (5) étant sous la forme d'une sortie
axiale ; **caractérisé en ce que** :

une première section de carter cylindrique (15)
du carter de compresseur (3) jouxte le diffuseur
(9) dirigé radialement vers l'extérieur ; et
en ce que ledit diffuseur (9) est muni d'aubes
de guidage d'écoulement (32, 33).

2. Dispositif de turbocompression selon la revendication 1, dans lequel le carter de compresseur (3) comporte un diffuseur longitudinal (10) en aval du diffuseur (9) vu dans le sens d'écoulement (S) de l'air circulant à travers le carter de compresseur (3).
3. Dispositif de turbocompression selon la revendication 1 ou 2, dans lequel un dispositif support de moteur (11) est agencé dans le carter de compresseur (3).
4. Dispositif de turbocompression selon la revendication 3, dans lequel un profil extérieur (12) du dispositif support de moteur (11) épouse un profil intérieur (13) du carter de compresseur (3).
5. Dispositif de turbocompression selon la revendication 3 ou 4, dans lequel le dispositif support de moteur (11) a une première section de carter cylindrique (14) qui est agencée dans la première section de carter cylindrique (15) associée du carter de compresseur (3).
6. Dispositif de turbocompression selon la revendication 5, dans lequel, vue dans le sens d'écoulement (S), la première section de carter cylindrique (14) du dispositif support de moteur (11) est jouxtée par une seconde section de carter (16) de forme de type entonnoir.
7. Dispositif de turbocompression selon la revendication 5 ou 6, dans lequel la première section de carter cylindrique (15) du carter de compresseur (3) est jouxtée par une seconde section de carter (17) qui est de forme de type entonnoir et qui converge en une seconde section de carter cylindrique (18) où est agencée la sortie de carter de compresseur (5).
8. Dispositif de turbocompression selon l'une des revendications 5 à 7, dans lequel une surface circonférentielle extérieure (19) de la section de carter cylindrique (14) du dispositif support de moteur (11) est munie d'aubes de guidage d'écoulement (20).
9. Dispositif de turbocompression selon la revendication 8, dans lequel les aubes de guidage d'écoulement (20) sont réglables.
10. Dispositif de turbocompression selon l'une des revendications 1 à 9, **caractérisé par** un dispositif de commande et d'alimentation en énergie de moteur (34) pour le moteur électrique (8).
11. Dispositif de turbocompression selon la revendication 10, prise en dépendance de la revendication 8 ou 9, dans lequel des lignes de commande et/ou des lignes d'alimentation en énergie du dispositif de commande et d'alimentation en énergie de moteur (34) sont guidées à travers des évidements de conduite (35, 36) dans les aubes de guidage d'écoulement (20).
12. Dispositif de turbocompression selon l'une des revendications 8 à 11, dans lequel les aubes de guidage d'écoulement (20A, 20B) sont situées en un agencement en cascade.
13. Dispositif de turbocompression selon la revendication 12, dans lequel les aubes de guidage d'écoulement (20A, 20B) de la cascade sont agencées en série.
14. Dispositif de turbocompression selon la revendication 12 ou 13, dans lequel les aubes de guidage d'écoulement (20A, 20B) de cascades individuelles ont différents espacements circonférentiels.

FIG. 1

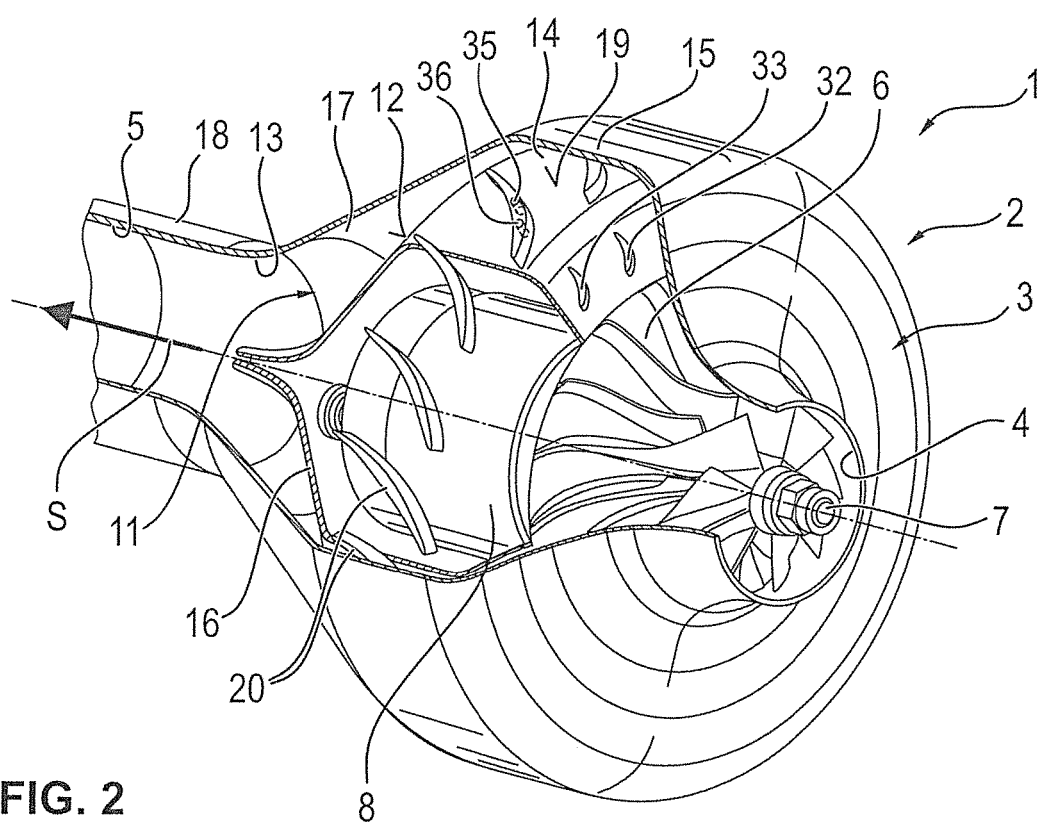
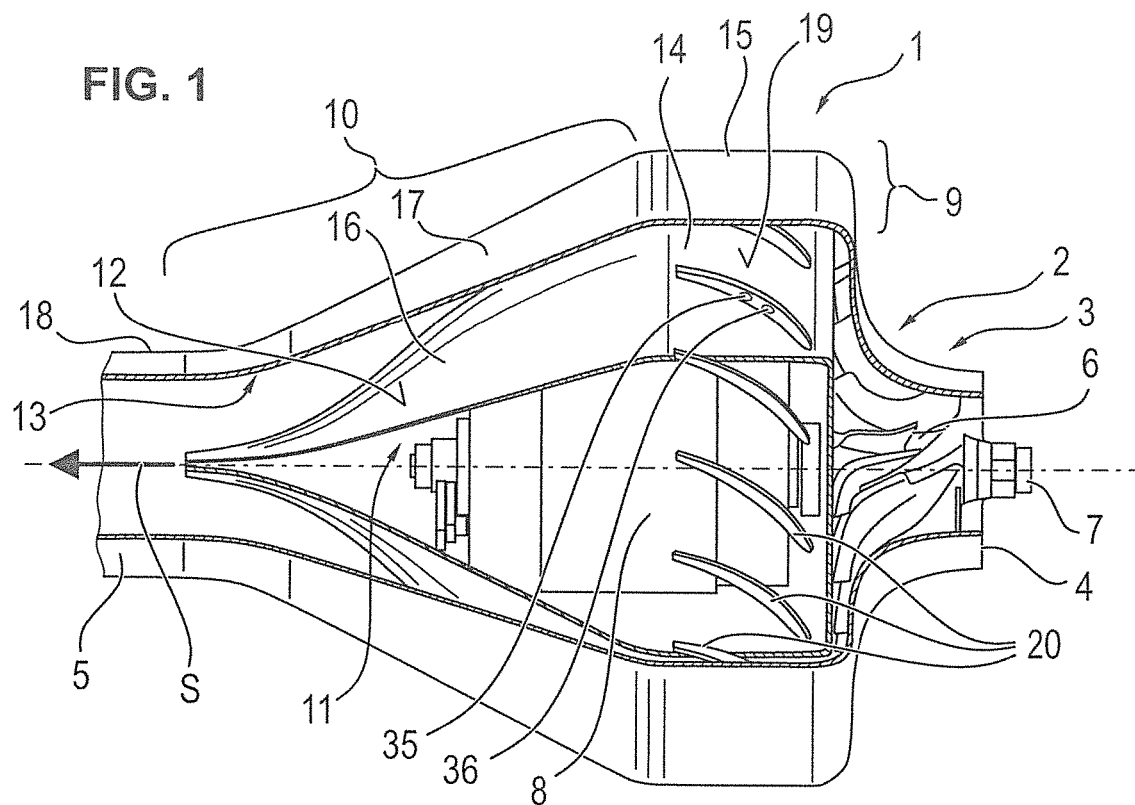


FIG. 2

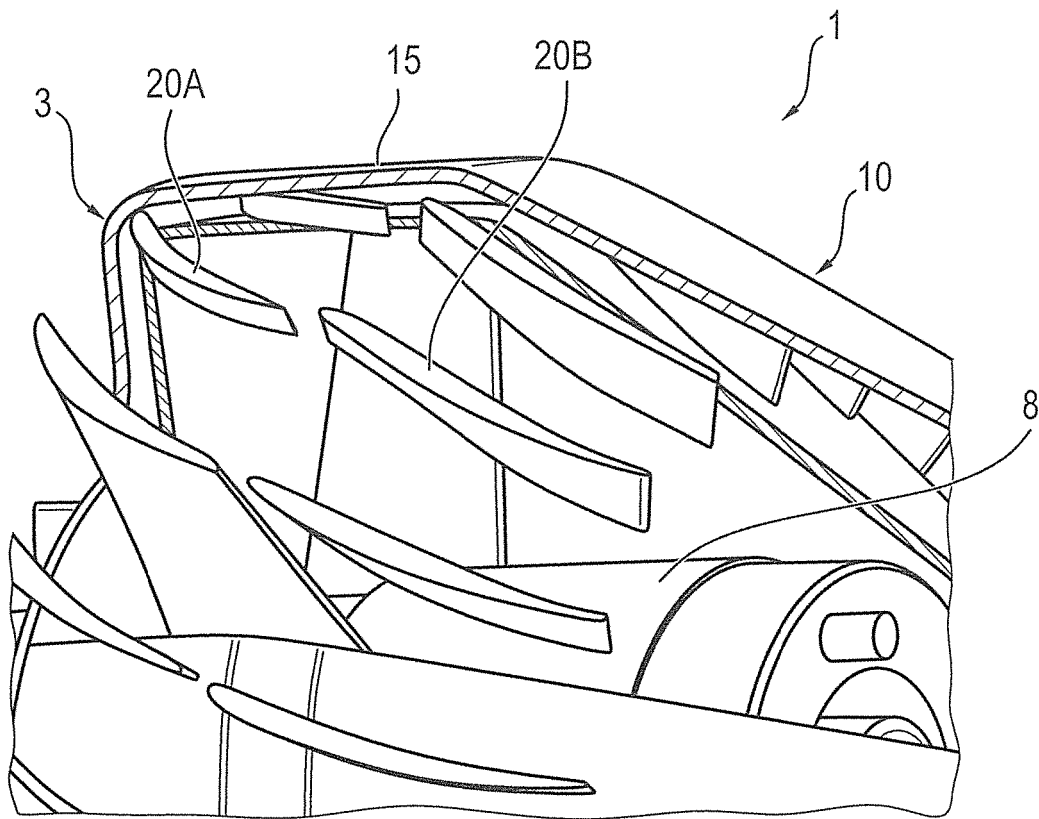


FIG. 3

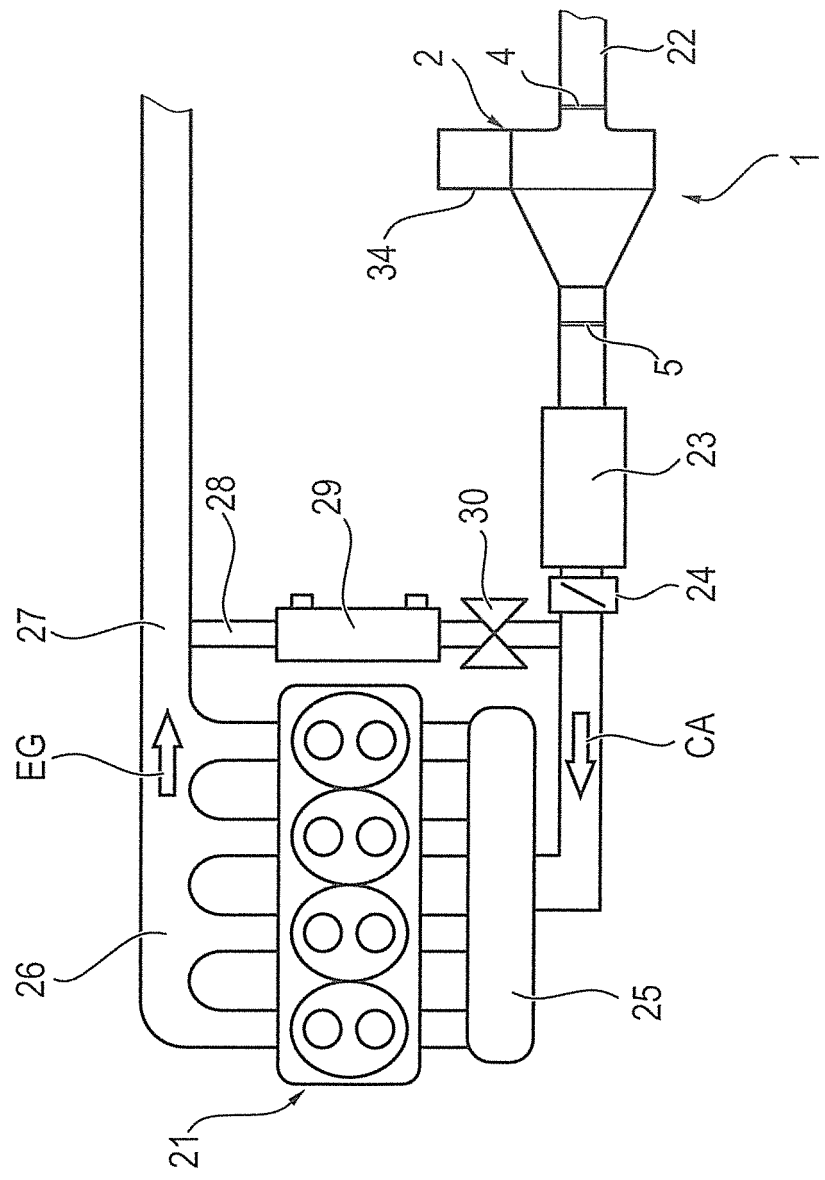


FIG. 4

REFERENCES CITED IN THE DESCRIPTION

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