

(19)



(11)

EP 3 004 575 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:

13.12.2017 Bulletin 2017/50

(51) Int Cl.:

F01L 1/08 ^(2006.01) **F01L 13/06** ^(2006.01)
F02D 13/02 ^(2006.01) **F02D 13/04** ^(2006.01)
F01L 13/00 ^(2006.01)

(21) Application number: **14735862.6**

(86) International application number:

PCT/EP2014/060903

(22) Date of filing: **27.05.2014**

(87) International publication number:

WO 2014/191385 (04.12.2014 Gazette 2014/49)

(54) **SYSTEM FOR PERFORMING AN ENGINE BRAKING PROCEDURE BASED ON DECOMPRESSION
EVENTS FOR A 4-STROKE CYCLE ENGINE**

SYSTEM ZUR DURCHFÜHRUNG EINES MOTORBREMSVERFAHRENS BASIEREND AUF
DEKOMPRESSIONSEREIGNISSEN EINES 4-TAKT-MOTORS

SYSTÈME PERMETTANT DE RÉALISER UNE INTERVENTION DE FREINAGE MOTEUR SUR LA
BASE DES ÉVÉNEMENTS DE DÉCOMPRESSION POUR UN MOTEUR À CYCLE À QUATRE TEMPS

(84) Designated Contracting States:

**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR**

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(30) Priority: **27.05.2013 EP 13169302**

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(43) Date of publication of application:

13.04.2016 Bulletin 2016/15

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Description

Field of the invention

[0001] The present invention relates to an engine braking system based on decompression events for a 4-stroke cycle engine.

Description of the prior art

[0002] Engine braking systems for 4-stroke cycle engine are well known.

[0003] One of the braking system concept is based on a compression-decompression event. In practice, during a compression phase, where the fuel injection is inhibited, fresh air is compressed. When the piston reaches the top dead center (TDC), the exhaust valves are opened in order to release the compressed air, before such compressed air, acting as a spring, returns the energy received during the compression phase to the piston. Therefore, the engine compression energy is dissipated as braking force.

[0004] Several systems are known in order to enable engine braking. In addition, some of them are not implemented due to the high complexity connected with the profiles of the cams.

[0005] Usually, only one braking event is carried out for one complete cycle. In a 4-stroke engine, a complete cycle is intended when the crankshaft realizes two complete turns, namely 720 deg.

[0006] Two compression-decompression event strategies, for a complete cycle, are known to double the engine braking power. In this case the braking strategy enables a 2-stroke like engine behavior. Such strategies are currently not used due to their complexity in connection with the cam profiles on basis of a 4-stroke engine. Document GB 307753 B discloses a braking method based on the axial displacement of a camshaft comprising tri-dimensional cams.

Summary of the invention

[0007] Therefore, it is the main object of the present invention to provide a system for easily implementing a 2-stroke braking strategy.

[0008] The present invention enables a 2-stroke-like engine braking in a simple and effective way.

[0009] A special exhaust lift profile in combination with a standard inlet profile is provided in order to realize a 2-stroke like engine braking in a 4-stroke engine.

[0010] In this context "standard" means that the cam profile commanding the inlet valves is completely unchanged with respect to the "fired" mode of the engine. In addition, the concept of standard means also that the present invention has not to do with those special applications called bleeder-type, where the valves are maintained slightly open. On the contrary, the present invention is directed to a modification of a traditional scheme

where the valves, when closed are completely closed.

[0011] Therefore, thanks to the present invention, a compression-decompression event is carried out every crankshaft turn. In particular, a decompression event at each TDC.

[0012] According to a preferred embodiment of the present invention a braking strategy is carried out through the implementation of a cam shifting method, such as the "INA cam shifting method" Norbert Nitz, Harald Elendt, Arndt Ihlemann, Andreas Nendel, Schaeffler Symposium 2010.

[0013] The INA cam shifting method is based on a sleeve having at least two cam profiles. The sleeve is able to slide axially on a base shaft, while it is forced to rotate with the base shaft.

[0014] The cooperation of a control groove on the sleeve and an eccentric pin, supported by a rotating mandrel, which touches tangentially the control groove commands the axially sliding of the sleeve.

[0015] The method of the present invention comprises a step of providing the exhaust sleeve with two or more cam profiles on adjacent portions of the sleeve and a step of axially shifting said sleeve on said base shaft in order to enable a profile implementing two decompression events of a braking procedure.

[0016] The concept "adjacent portions" is clear in light of the abovementioned paper: several cam profiles are annularly defined on adjacent and consecutive portions of the sleeve along its longitudinal development.

[0017] According to another embodiment of the present invention the 2-stroke braking procedure is implemented by means of three-dimensional cams having different profiles according to an axial shifting of the cam itself on the base shaft. An example of such tridimensional cams is shown on EP0208663. Also the use of an axially shifting cam profile method in an engine braking procedure is part of the present invention. Preferably, such method is implemented in order to carry out an engine braking operation in heavy and commercial vehicles. These and further objects are achieved by means of the attached claims, which form an integral part of the present description.

Brief description of the drawings

[0018] The invention will become fully clear from the following detailed description, given by way of a mere exemplifying and non limiting example, to be read with reference to the attached drawing figures, wherein:

- Fig. 1 shows a comparison between the four phases of a standard operating condition of a 4-stroke combustion engine and a braking condition according to the present invention;

- Fig. 2 shows a comparison between the same conditions of figure 1 according to the cam angle. The diagram shows the standard exhaust profile and an example of the required exhaust lift to realize the 2-

stroke brake operation according to the present invention.

[0019] The same reference numerals and letters in the figures designate the same or functionally equivalent parts.

Detailed description of the preferred embodiments

[0020] According to the present invention the control of the engine valves during a braking operation is carried out through at least one outlet cam profile switched according to a cam shifting method, i.e., by axially shifting a sleeve on the base shaft in order to enable a different cam profile. According to a preferred embodiment of the present invention for each complete cycle, i.e. for every 720 deg of the crankshaft, two decompression events are provided through the same outlet cam profile, while the one or more outlet valves are kept fully closed during the remaining time, with the sole exception of an additional sucking phase B-III carried out by the one or more outlet valves, as disclosed in the following.

[0021] For a clear understanding of the invention, the first compression phase, during the braking procedure, coincides with the standard compression phase, i.e. when the engine is fired, even if during the braking procedure, the engine is dragged and the injectors are prevented to inject the fuel. The first decompression B-II' event happens approximately at the TDC. It is preferable that the exhaust valves open slightly before the piston reaches the TDC, to release the pressure.

[0022] According to the present invention the exhaust valves remain open after the first decompression event B-II' - on the contrary with the respect to a standard (fired) valve behaviour - in order to permit the same piston to suck air from the exhaust pipe B-III.

[0023] During the second lifting phase of the piston, namely the fourth phase F-IV of a 4-stroke engine cycle, (fired engine), the exhaust valves are open in order to eject the exhaust gasses. On the contrary, according to the present invention, during the braking operation, the second lifting phase, the exhaust valves are kept closed in order to carry out a second compression phase followed by a second decompression event. As clarified above, for "close" is intended "fully close" and not partially as in the bleeder schemes.

[0024] It is clear that the inlet cam lifting profile of the inlet valves is completely unchanged with respect to a standard cycle, i.e. a cycle in which the engine is fired.

[0025] Instead, according to the present invention, the one or more exhaust valves are kept open during the second lowering phase of the piston, namely the third phase B-III of a 4-stroke engine cycle, and closed during the second lifting phase B-IV (fourth phase of a 4-stroke engine cycle), contrarily with the outlet standard behaviour shown in F-IV, where the outlet valves are open for discharging the exhaust gasses.

[0026] In other words, the first sucking phase is real-

ized through the inlet valves, thus the inlet cam lifting profile is unchanged, while the second sucking phase is realized through the outlet valves, thus only the outlet cam lifting profile is varied.

[0027] Figure 1 shows a comparison, through the four phases of a 4-stroke engine, between a fired condition from F-I to F-IV, on the left of the figure, and a braking procedure from B-I to B-IV, on the right of the figure, according to the present invention.

F-I and B-I: first lowering of the piston for sucking fresh air from the inlet side. This phase is in common with both the conditions standard/braking, that is when the engine is fired and when it is in braking mode;

F-II and B-II: first lifting of the piston; during the braking procedure the fuel injection is inhibited and the second phase, B-II comprises the decompression event B-II';

F-III and B-III: second lowering of the piston: when the engine is fired both the inlet and outlet valves are closed; when the engine is in braking mode the exhaust valve is open, in order to carry out a second air sucking, but from the exhaust side;

F-IV and B-IV: when the engine is fired, during the fourth phase the exhaust gasses are ejected by the exhaust valves, instead during the braking procedure, the exhaust valves follow the same behaviour discussed during the second phase, that is a compression phase B-IV followed by decompression event B-IV'.

[0028] The decompression events are always commanded by the outlet cam/valve.

[0029] Also through this comparison it is clear that the behaviour of the inlet valves is completely unchanged through the four phases of both the cycles fired/braked.

[0030] It should be also clear that the cylinder shown through figure 1 is provided with only one set of inlet valves commanded by one common inlet cam profile at the same time and is provided with only one set of outlet valves commanded by one common outlet cam profile at the same time.

[0031] The cylinder does not possess further valves as for example the fifth valve in DE102004006681.

[0032] Figure 2 shows a diagrammatic comparison of an exhaust cam profile between the two conditions standard (fired) and braking.

[0033] Two arrows indicate the decompression events. One could appreciate the sucking hump following the first decompression event between -30 and 30 deg in the exhaust cam profile according to the present invention.

[0034] One could also appreciate that the inlet cam profile (long dashed line) remains unchanged between 180 deg and -90 deg independently from the fired/braking operation.

[0035] Such kind of diagrams is well known, therefore, its interpretation is immediately derivable by the figure 2

itself. The exhaust valves displacement, and thus the shape of the cam, can be varied according to the kind of combustion engine. Therefore, the lifting millimetres indicated on figure 2 should be considered as a non limitative example. The switching between the standard lifting profile and the braking profile, according to the present invention, is advantageously realised by an axially shifting cam profile or any other cam switching device.

[0036] The adverb "axially" is well clear in this context, where it is clear that the shifting is operated on the base shaft of the cams.

[0037] With particular reference to figure 2, the dashed line refers to the braking profile, i.e. to the eccentricity of a portion of the sleeve defining the "braking profile".

[0038] These kinds of diagrams are clear and well known for the skilled person in the art.

[0039] During a braking procedure, the cam profile enabled is the short dashed one on figure 2: it

- remains flat in the range -120 to -60 deg with a first value, substantially zero, that means that the valve is fully closed,
- (first decompression event) increases its eccentricity in the range -45;-20 deg to a second value, substantially 1,8 mm, and
 - remains flat in the range -20;30 with said second value, then
 - (sucking air from exhaust valve) increase its eccentricity until 70 deg, where a first peak is defined with a third value, substantially 5,2 mm, then
 - decreases until 140 deg, returning to said first value, then
 - (second decompression event) increases its eccentricity in the range 140; 180 deg, where a second peak is defined, by reaching said second value, then
 - decreases toward said first value at 220 deg. and
 - assumes said first value until 240 deg, then the cycle restarts.

[0040] The continuous line of figure 2 shows a standard exhaust lift profile, adopted when the engine is fired. The just one peak is disposed substantially between said first and second peaks of the dashed curve.

[0041] By means of the present invention, it is possible to enable a 2-stroke braking strategy in a 4-stroke engine without changing the lifting control of the inlet valves.

[0042] Therefore, it is possible to double the engine braking power without implementing highly complex systems.

[0043] Many changes, modifications, variations and other uses and applications of the subject invention will become apparent to those skilled in the art after considering the specification and the accompanying drawings

which disclose preferred embodiments thereof. All such changes, modifications, variations and other uses and applications which do not depart from the spirit and scope of the invention are deemed to be covered by this invention.

[0044] Further implementation details will not be described, as the man skilled in the art is able to carry out the invention starting from the teaching of the above description.

Claims

1. Method for performing an engine braking procedure based on decompression events for a 4-stroke cycle engine, the engine comprising at least a cylinder having

- one or more cylinder inlet valves commanded by one common inlet cam profile at the same time and
 - one or more cylinder outlet valves commanded by one common outlet cam profile at the same time,
- the method comprising the switching of only said common outlet cam profile in order to carry out the following steps:

a first compression phase (B-II) wherein the inlet and outlet valves are fully closed, followed by a first decompression event (B-II') through the one or more outlet valves and, in succession,

- a sucking phase (B-III) from the one or more outlet valves, wherein the one or more inlet valves are fully closed and
- a second compression phase (B-IV) followed by a second decompression event (B-IV') through the one or more outlet valves.

2. Method according to claim 1, further comprising a preliminary sucking phase (B-I) through the one or more inlet valves before said first compression phase (B-II).

3. Method according to one of the preceding claims, wherein said inlet cam profile is kept unchanged either during a fired operation condition or during said engine braking procedure.

4. Method according to one of the preceding claims, wherein the control means comprise a base shaft on which is fixed a sleeve with one outlet cam profiles, the method comprising a step of providing said sleeve with two or more outlet cam profiles on adjacent portions of the sleeve and a step of axially shifting said sleeve on said base shaft in order to enable

a profile implementing said decompression events (B-II', B-IV') and said sucking phase (B-III) of the braking procedure.

5. Method according to one of claims 1 to 3, wherein the control means comprise a base shaft on which is fixed a sleeve with a three-dimensional cam profile, the method comprising a step of axially shifting said sleeve on said base shaft in order to enable an outlet profile implementing said decompression events (B-II', B-IV') and said sucking phase (B-III) of the braking procedure. 5
6. Device for performing an engine braking procedure based on decompression events for a 4-stroke cycle engine, the engine comprising at least a cylinder having 10
 - one or more cylinder inlet valves commanded by one common inlet cam profile at the same time and
 - one or more cylinder outlet valves commanded by one common outlet cam profile at the same time, 15

the device control means configured to perform all the steps of any of the previous claims. 20
7. Device according to claim 6, wherein said means for controlling said cylinder valves by implementing said two decompression events (B-II', B-IV'), is according to the "2-stroke braking lift" curve of the diagram of figure 2. 25
8. Device according to claim 7, wherein said profile, implementing said at least one decompression events (B-II', B-IV') of a braking procedure 30
 - remains flat in the range -120 to -60 deg with a first value, 35
 - increases its eccentricity in the range -45;-20 deg, 40
 - remains flat in the range -20;30 with a second value,
 - increases its eccentricity until 70 deg, where a first peak is defined with a third value, then 45
 - decreases until 140 deg, returning to said first value,
 - increases its eccentricity in the range 140; 180 deg, where a second peak is defined with said second value, then 50
 - decreases toward said first value at 220 deg. 55
9. Device according to any of the preceding claims from 6 to 8, wherein a second exhaust lifting cam profile is suitable to operate the cylinder exhaust valve during a fired operating condition of the engine.

10. Device according to claim 8, wherein said second exhaust lifting cam profile has only one third peak disposed substantially between said first and second peaks.

11. 4-stroke cycle combustion engine comprising at least a cylinder having

- one or more cylinder inlet valves commanded by one common inlet cam profile at the same time and
- one or more cylinder outlet valves commanded by one common outlet cam profile at the same time,

and **characterized in** comprising the device for performing an engine braking procedure according to one of the claims 6 to 10.

12. Terrestrial Vehicle **characterised in** comprising a combustion engine according to claim 11.

Patentansprüche

1. Verfahren zum Durchführen eines Motorbremsvorgangs basierend auf Dekomprimierungsereignissen für einen 4-Takt-Motor, wobei der Motor mindestens einen Zylinder umfasst, der
 - ein oder mehrere Zylindereinlassventile, die von einem gemeinsamen Einlassnockenprofil gleichzeitig angesteuert werden, und
 - ein oder mehr Zylinderauslassventile, die von einem gemeinsamen Auslassnockenprofil gleichzeitig angesteuert werden, aufweist, wobei das Verfahren das Schalten von nur dem gemeinsamen Auslassnockenprofil zum Durchführen folgender Schritte umfasst:
 - eine erste Komprimierungsphase (B-II), wobei die Einlass- und Auslassventile vollständig geschlossen sind, gefolgt von einem ersten Dekomprimierungsereignis (B-II') durch das eine oder die mehreren Auslassventile, und nacheinander
 - eine Ansaugphase (B-III) von dem einen oder den mehreren Auslassventilen, wobei das eine oder die mehreren Einlassventile vollständig geschlossen sind, und
 - eine zweite Komprimierungsphase (B-IV) gefolgt von einem zweiten Dekomprimierungsereignis (B-IV') durch das eine oder die mehreren Auslassventile.
2. Verfahren nach Anspruch 1, ferner umfassend eine vorausgehende Ansaugphase (B-I) durch das eine

oder die mehreren Einlassventile vor der ersten Komprimierungsphase (B-II).

3. Verfahren nach einem der vorherigen Ansprüche, wobei das Einlassnockenprofil entweder während einem gezündeten Betriebszustand oder während dem Motorbremsvorgang unverändert gehalten wird. 5
4. Verfahren nach einem der vorherigen Ansprüche, wobei die Steuermittel eine Grundwelle umfassen, auf welcher eine Hülse mit einem Auslassnockenprofil fixiert ist, wobei das Verfahren einen Schritt des Verschiebens der Hülse mit zwei oder mehr Auslassnockenprofilen auf benachbarten Abschnitten der Hülse und einen Schritt des axialen Verschiebens der Hülse auf der Grundwelle zum Ermöglichen eines Profils, das die Dekomprimierungsereignisse (B-II', B-IV') und die Ansaugphase (B-III) des Bremsvorgangs implementiert, umfasst. 10 15 20
5. Verfahren nach einem der Ansprüche 1 bis 3, wobei die Steuermittel eine Grundwelle umfassen, auf welcher eine Hülse mit einem dreidimensionalen Nockenprofil fixiert ist, wobei das Verfahren einen Schritt des axialen Verschiebens der Hülse auf der Grundwelle zum Ermöglichen eines Auslassprofils, das die Dekomprimierungsereignisse (B-II', B-IV') und die Ansaugphase (B-III) des Bremsvorgangs implementiert, umfasst. 25 30
6. Vorrichtung zum Durchführen eines Motorbremsvorgangs basierend auf Dekomprimierungsereignissen für einen 4-Takt-Motor, wobei der Motor mindestens einen Zylinder umfasst, der 35
 - ein oder mehr Zylindereinlassventile, die von einem gemeinsamen Einlassnockenprofil gleichzeitig angesteuert werden, und
 - ein oder mehr Zylinderauslassventile, die von einem gemeinsamen Auslassnockenprofil gleichzeitig angesteuert werden, 40

aufweist, wobei die Vorrichtungssteuermittel konfiguriert sind, um alle Schritte eines der vorherigen Ansprüche durchzuführen. 45

- 7. Vorrichtung nach Anspruch 6, wobei die Mittel zum Steuern der Zylinderventile durch Implementieren der beiden Dekomprimierungsereignisse (B-II', B-IV') gemäß der "2-Takt-Bremshub"-Kurve des Diagramms von Figur 2 sind. 50
- 8. Vorrichtung nach Anspruch 7, wobei das Profil, das das mindestens eine Dekomprimierungsereignis (B-II', B-IV') eines Bremsvorgangs implementiert, 55
 - im Bereich von -120 bis -60 Grad mit einem

ersten Wert flach bleibt,

- seine Exzentrizität im Bereich von -45; -20 Grad erhöht,
- im Bereich von -20; 30 mit einem zweiten Wert flach bleibt,
- seine Exzentrizität bis 70 Grad erhöht, wo eine erste Spitze mit einem dritten Wert definiert wird, dann
- bis 140 Grad abnimmt, wobei es zu dem ersten Wert zurückkehrt,
- seine Exzentrizität im Bereich 140, 180 Grad erhöht, wo eine zweite Spitze mit dem zweiten Wert definiert wird, dann
- zu dem ersten Wert bei 220 Grad hin abnimmt.

9. Vorrichtung nach einem der vorherigen Ansprüche 6 bis 8, wobei ein zweites Auslasshubnockenprofil geeignet ist, um das Zylinderauslassventil während eines gezündeten Betriebszustands des Motors zu betreiben.
10. Vorrichtung nach Anspruch 8, wobei das zweite Auslasshubnockenprofil nur eine dritte Spitze aufweist, die im Wesentlichen zwischen der ersten und der zweiten Spitze angeordnet ist.
11. 4-Takt-Verbrennungsmotor umfassend mindestens einen Zylinder, der
 - ein oder mehr Zylindereinlassventile, die von einem gemeinsamen Einlassnockenprofil gleichzeitig angesteuert werden, und
 - ein oder mehr Zylinderauslassventile, die von einem gemeinsamen Auslassnockenprofil gleichzeitig angesteuert werden, 35

aufweist, und **dadurch gekennzeichnet, dass** er die Vorrichtung zum Durchführen eines Motorbremsvorgangs nach einem der Ansprüche 6 bis 10 umfasst.

- 12. Landfahrzeug, **dadurch gekennzeichnet, dass** es einen Verbrennungsmotor nach Anspruch 11 umfasst.

Revendications

1. Procédé pour réaliser une procédure de freinage moteur sur la base d'événements de décompression pour un moteur à 4 temps, le moteur comprenant au moins un cylindre ayant
 - une ou plusieurs soupapes d'entrée de cylindre commandées en même temps par un profil de came d'entrée commun et
 - une ou plusieurs soupapes de sortie de cylindre commandées en même temps par un profil

- de came de sortie commun,
le procédé comprenant la commutation unique-
ment dudit profil de came de sortie commun,
afin de réaliser les étapes suivantes : une pre-
mière phase de compression (B-II) dans laquel-
le les soupapes d'entrée et de sortie sont com-
plètement fermées, suivie d'un premier événe-
ment de décompression (B-II') par le biais des
une ou plusieurs soupapes de sortie et, de ma-
nière successive,
- une phase d'aspiration (B-III) depuis les une
ou plusieurs soupapes de sortie, dans laquelle
les une ou plusieurs soupapes d'entrée sont
complètement fermées et
- une seconde phase de compression (B-IV) sui-
vie d'un second événement de décompression
(B-IV') par le biais des une ou plusieurs soupa-
pes de sortie.
2. Procédé selon la revendication 1, comprenant en
outre une phase d'aspiration préliminaire (B-I) par le
biais des une ou plusieurs soupapes d'entrée avant
ladite première phase de compression (B-II).
3. Procédé selon l'une des revendications précéden-
tes, dans lequel ledit profil de came d'entrée est
maintenu inchangé durant une condition de fonction-
nement déclenchée ou durant ladite procédure de
freinage moteur.
4. Procédé selon l'une des revendications précéden-
tes, dans lequel le moyen de commande comprend
un arbre de base sur lequel est fixé un manchon
présentant un profil de came de sortie, le procédé
comprenant une étape consistant à doter ledit man-
chon de deux profils de came de sortie ou plus, sur
des parties adjacentes du manchon et une étape
consistant à décaler axialement ledit manchon sur
ledit arbre de base, afin d'activer un profil mettant
en oeuvre lesdits événements de décompression (B-
II', B-IV') et ladite phase d'aspiration (B-III) de la pro-
cédure de freinage.
5. Procédé selon l'une des revendications 1 à 3, dans
lequel le moyen de commande comprend un arbre
de base, sur lequel est fixé un manchon présentant
un profil de came en trois dimensions, le procédé
comprenant une étape consistant à décaler axiale-
ment ledit manchon sur ledit arbre de base afin d'ac-
tiver un profil de sortie mettant en oeuvre lesdits évé-
nements de décompression (B-II', B-IV') et ladite
phase d'aspiration (B-III) de la procédure de freina-
ge.
6. Dispositif pour réaliser une procédure de freinage
moteur sur la base d'événements de décompression
pour un moteur à 4 temps, le moteur comprenant au
moins un cylindre ayant
- une ou plusieurs soupapes d'entrée de cylindre
commandées en même temps par un profil de
came d'entrée commun et
- une ou plusieurs soupapes de sortie de cylin-
dre commandées en même temps par un profil
de came de sortie commun,
- le moyen de commande de dispositif étant configuré
pour effectuer toutes les étapes selon l'une quelcon-
que des revendications précédentes.
7. Dispositif selon la revendication 6, dans lequel ledit
moyen pour commander lesdites soupapes de cy-
lindre en mettant en oeuvre lesdits deux événements
de décompression (B-II', B-IV') est selon la courbe
« montée de freinage à 2 temps » du schéma de la
figure 2.
8. Dispositif selon la revendication 7, dans lequel ledit
profil, mettant en oeuvre ledit au moins un événe-
ment de décompression (B-II', B-IV') d'une procédu-
re de freinage
- reste plat dans la plage de -120 à -60 degrés
avec une première valeur,
- augmente son excentricité dans la plage de
-45 ; -20 degrés,
- reste plat dans la plage de -20 ; 30 avec une
deuxième valeur,
- augmente son excentricité jusqu'à 70 degrés,
où un premier pic est défini avec une troisième
valeur, puis
- diminue jusqu'à 140 degrés, revenant à ladite
première valeur,
- augmente son excentricité dans la plage de
140 ; 180 degrés, où un deuxième pic est défini
avec ladite deuxième valeur, puis
- diminue vers ladite première valeur à 220 de-
grés.
9. Dispositif selon l'une quelconque des revendications
précédentes de 6 à 8, dans lequel un deuxième profil
de came de montée d'échappement est approprié
pour faire fonctionner la soupape d'échappement de
cylindre durant une condition de fonctionnement dé-
clenchée du moteur.
10. Dispositif selon la revendication 8, dans lequel ledit
deuxième profil de came de montée d'échappement
a seulement un troisième pic disposé sensiblement
entre lesdits premier et deuxième pics.
11. Moteur à combustion à 4 temps comprenant au
moins un cylindre ayant
- une ou plusieurs soupapes d'entrée de cylindre
commandées en même temps par un profil de
came d'entrée commun et

- une ou plusieurs soupapes de sortie de cylindre commandées en même temps par un profil de came de sortie commun,

et **caractérisé en ce qu'il** comprend le dispositif 5
pour effectuer une procédure de freinage moteur selon l'une des revendications 6 à 10.

12. Véhicule terrestre **caractérisé en ce qu'il** comprend 10
un moteur à combustion selon la revendication 11.

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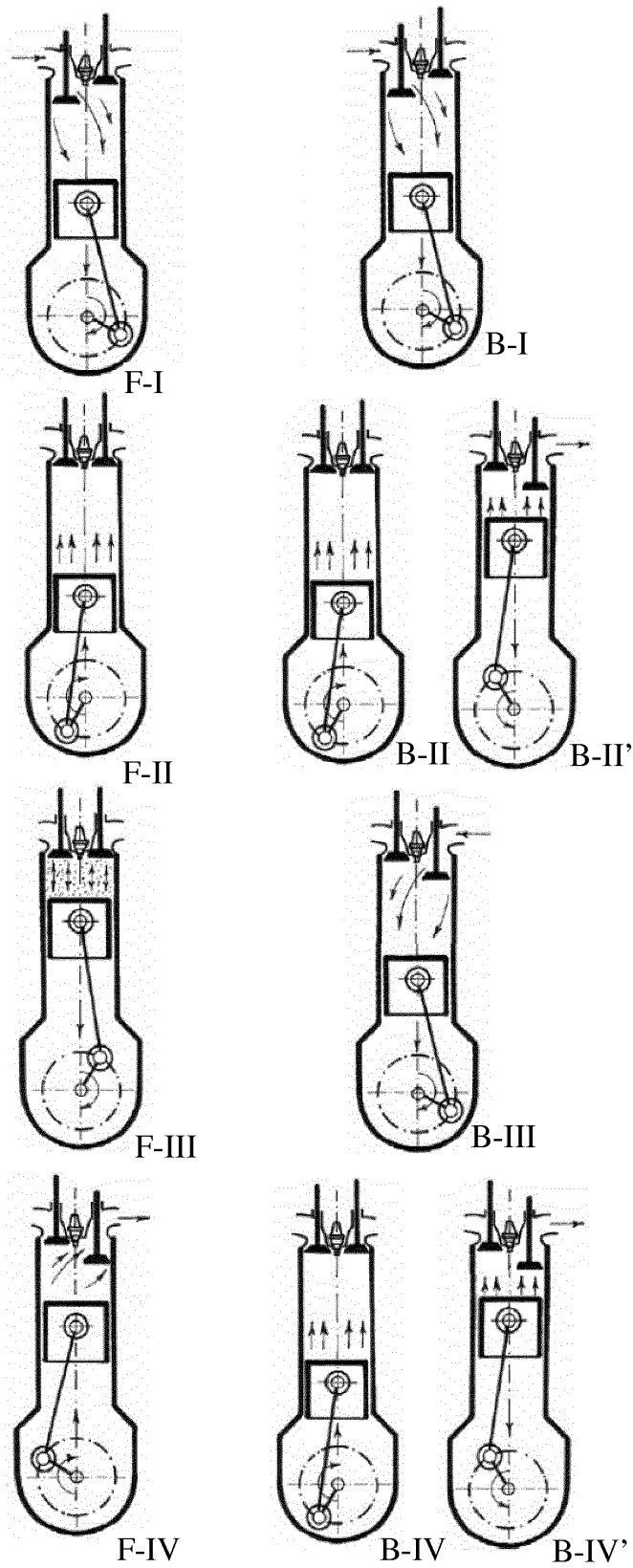


Fig. 1

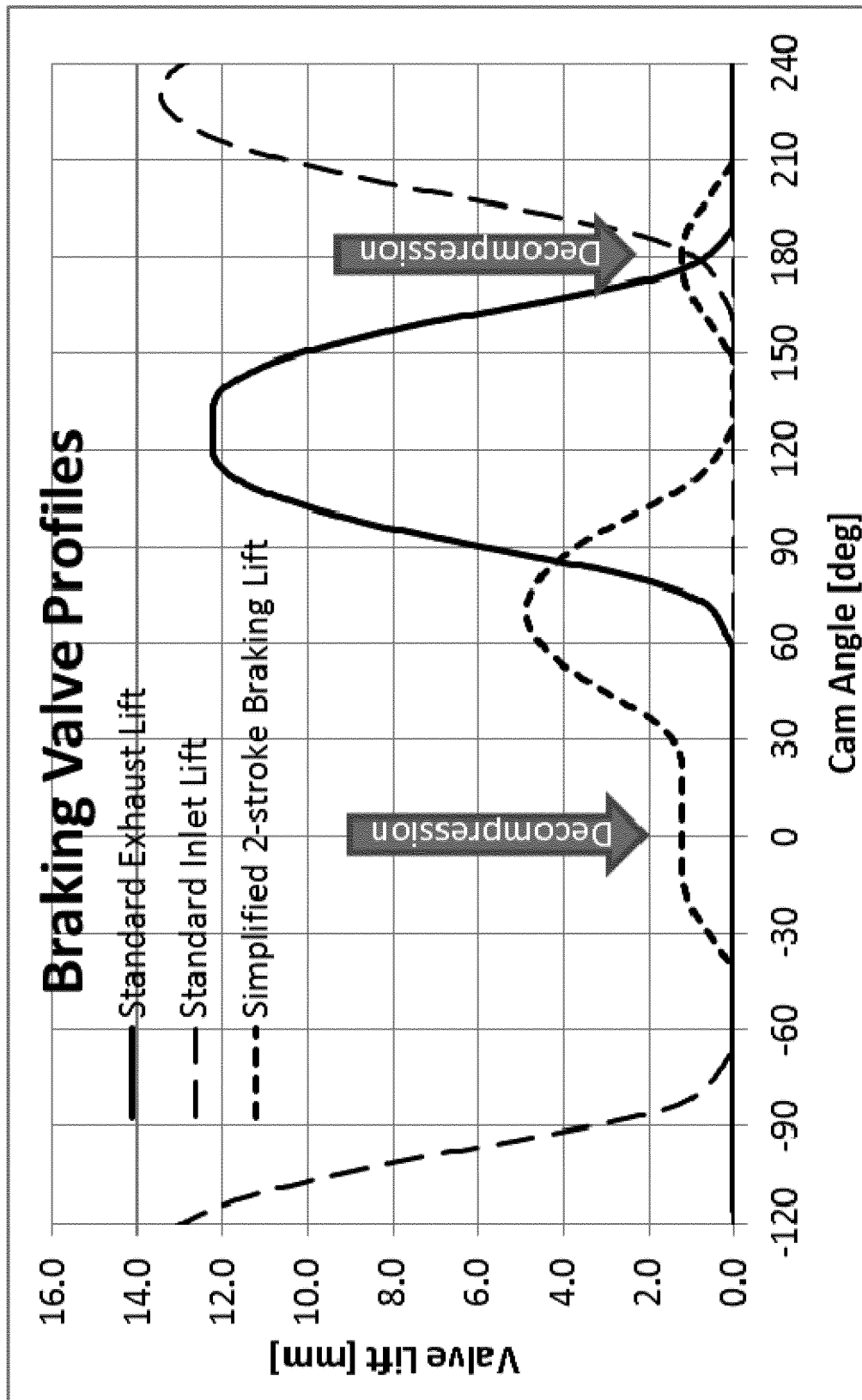


Fig. 2

REFERENCES CITED IN THE DESCRIPTION

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