Abstract: A 6-stroke, 3-piston internal combustion engine for general purpose. It is based on the 6-stroke principle founded by Samuel Griffin (1883 AD) in which there are two additional strokes (power work) -stroke and a second compression stroke) in additional to the classical 4 strokes in order to minimize pollution and to increase the engine economy. It consists of 3 pistons within the cylinder block and 2 dual - compression - chambers (DCC). It works similar to the 4 stroke engine but with two additional strokes as mentioned before. According to the DCC action: one of the power strokes generated is due compressed hot mixture of air and fuel (work), and this mixture shall be ignited later to generate the second power stroke (expansion).

Diagram (1): the general assembly of the G63
SIX STROKE INTERNAL COMBUSTION ENGINE

Description

1- The Gabora 6-stroke, 3-piston internal combustion engine (G 63) is an intellectual property of Akram Mohd. A. Gabora which is based on the 6-stroke concept/principle founded by Samuel Griffin (1883 AD) in which there are two extra stokes (compression and power strokes) plus the classical (regular) 4-strokes in order to minimize pollution and increase the engine economy (lower fuel consumption) at the same time. There are many rival designs based on Griffin prototype, but none has been proved to be efficient enough to be commercially produced on large scale. The complete engine may require 6 or 8 pistons in order to run smoothly which makes it huge and heavy weighted.

2- The G 63 consists of 3 pistons within the cylinder block and 2 dual-compression-chambers (DCC). It works very similar to the 4-stroke engine, but with two additional compression and power strokes.

3- There are two power strokes per revolution as shown in diagram 1, and according to the DCC action: one of the power strokes generated is due compressed hot mixture of air and fuel (work-stroke), which shall be ignited later, and the second power stroke generated is due actually ignited mixture of air and fuel (expansion-stroke).

4- The DCC consists of a central hollow cylinder contained within an outer hollow cylinder in a manner such that the two spaces formed are of equal volumes, and as shown in diagram 2: Both cylinders are thermally connected i.e. the DCC actually operates as a heat exchanger for all mixtures of (air and fuel) which are compressed inside it. Ignition occurs in the outer space.
5- Due to the construction and the action of the DCC: the ratio of the piston volume and clearance to the volume of the central cylinder within the DCC should be in the order of (10:1) or more if possible in order to minimize the loss in power production because some of the ignited mixture or the very hot mixture of air and fuel remains inside the DCC and does not go in whole to the piston, also the compression ratio (CR) of the piston should be within the same figure as well or even more (11:1) for example.

6- The estimated efficiency of the 6-stroke engine and thus the related reduction in fuel consumption for the same power generated was found to be around 60% compared to a classical (regular) 4-stroke engine, and the performance of the G63 is expected to be within the same figure as well.

7- Now for the presence of the 3-pistons and the 2 DCC, there are 12 valves in the 663 (4 valves per piston), the DCC may be part of the cylinder head or can be an outer part connected to the assembly by means of screws, in general the G63 is expected to be more efficient and more reliable compared to the other rival designs due its relatively light weight (only 2 DCC are involved in the process). The G63 requires no cooling system as well as all 6-stroke engines for all compression and ignition actions occurs within the DCC, and it requires an ordinary oil system (wet slump type). Finally it is expected to be made as small as 100cc capacity engine up to 3000cc capacity engine or more if possible, also it can be made in either on-fine design or in V-design (90-degrees).

8- Diagram 1 shows the action of the G63 in detail, with the definition of each stroke. The complete cycle consists of two revolutions with: 2-
intake strokes, 4- power stroke, 4-compfession-stf ofces and finally 2-
haust strokes. Diagram 2 shows both the sectional and longitudinal
view of the DCC from the inside and from the outside (all diagrams are
sketches and not to scale).
A comparison between the G 63 a classical/traditional 6-stroke engine

1- In the G 63 there are 2-power-strokes (work and expansion) per revolution, but in the Griffin prototype and thus all the rival designs there are 2-power-strokes in every 3-revolutions for each piston works individually in the following manner intake-stroke, 1st compression-stroke, power {expansion} -stroke, exhaust-stroke, power (work)-stroke and finally 2nd compression-stroke.- But since each power stroke can not last more than 180 degrees (half revolution) then there is a silent peak where the engine runs by the inertia of the fly-wheel only, So for the rival designs which are based Griffin prototype there is a need for 6 or 8 piston per engine in order to enable the engine to run smoothly and perfectly which makes the engine cumbersome however its capacity is, and this limits the use of the 6-strokes engine in general.

2- In diagram 3, we see the action of a 6-strokes 1-piston model according to Griffin prototype in which there are 2-power-strokes every 3 revolutions.

3- It should be noted that in all these engines and designs: ignition occurs at 8 degrees before the "top-dead-center" as ordinary 4-stroke engines.

4- Finally for all of the G 63 design it is mostly recommended that the DCC should be thermally isolated from the outside i.e., each should has its thermal isolator (jacket) for better performance.
The Gabora 6-Stroke, 3-Piston Engine (G63)

Sequence listing and tables relating there to drawings

Definitions of Items in diagram (1)

(1) - (12) Valve with associated number.

(13) - (14) DCC

(15) – (16) Ignition points

(17) - (18) Exhausts gas out

(19) - (20) Intake of air and fuel mixture.

(21) - (23) Piston Head

(24) Internal Oil System (Wet Slump)

(25) Crank shaft

<table>
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<tr>
<th>Stroke No.</th>
<th>Piston A</th>
<th>Piston B</th>
<th>Piston C</th>
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<tr>
<td>1</td>
<td>Intake (1)</td>
<td>Compression (6)</td>
<td>Power (10)</td>
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<tr>
<td>2</td>
<td>Compression (4)*</td>
<td>Power (8)</td>
<td>Exhaust (11)</td>
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<td>3</td>
<td>Power (3)</td>
<td>Compression (7)</td>
<td>Intake (12)</td>
</tr>
<tr>
<td>4</td>
<td>Exhaust (2)</td>
<td>Power (5)</td>
<td>Compression (9)*</td>
</tr>
</tbody>
</table>

*Ignition occurs in the outer of DCC just after compression stroke in piston A.

*Again ignition occurs the outer space of DCC just after compression stroke in piston C.

The arrow (in the table) shows the direction of each piston during the stroke: down. ↓ — up: ↑
Definitions of Items in diagram (2)

(1) : Inner space.
(2) : Outer space.
(3) : Rc (Central Cylinder Radius)
(4) : Ro (Outer Cylinder Radius)
(A) : Sectional view of the DCC: the two spaces have equal volumes
      \[ Rc = 0.707 \times Ro. \]
(B) : Longitudinal view of the DCC from the inside.
(C) : Longitudinal view of the DCC from the outside.
Definitions of Items in diagram (3)

(1) - (4): Valve with associated number.

(5): Ignition.

(6): Exhaust gas out

(7): Air and fuel mixture in

(8): Two concentric cylinders

(9): Piston head

(10): Cylinder block

(II): Crank shaft

<table>
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<tr>
<th>Stroke no.</th>
<th>1</th>
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<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
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<tr>
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<td>Intake (1)</td>
<td>Compression (4)</td>
<td>Power (3) expansion</td>
<td>Exhaust (2)</td>
<td>Power (4) work</td>
<td>Compression (3)</td>
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<tr>
<td>Action outside piston</td>
<td>------</td>
<td>Ignition</td>
<td>------</td>
<td>------</td>
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</table>

Note: the arrows in the table show the direction of movement of the piston.
**The Gabora 6-siroke, 3-piston Engine (G 63)**

**Claims**

1) The design and the operating method of the G 63.
2) The naming, description, definition, thermal isolation and the function of the dual-compression-chamber (DCC).
3) The positioning of the DCC as an external part mounted to cylinder head **by screws and/or as an internal part within the cylinder head** between each group of valves with respect to each piston.
4) The crank shaft design: up-right, down-right, up-right (UDU) sequence.
5) The introduction of two DCC units to a 3-piston internal combustion engine with the crank shaft design as mentioned in (3) above in order to have a smooth and even production and distribution of power strokes (expansion and work) according to the design and the operating method of the G 63.
6) The concept/principle of a 6-stroke, 3-piston economical internal combustion engine: the alternative theory, the mechanism (practical formation of parts) and the application.
7) All the components and with its functions of the G 63 (including the 12 valves from above) in whole and/or in part and how the G 63 works.
8) The concept/principle of the complete cycle of the G 63 which consists of two revolutions in which there are: 2-intake-stroke, 2-1st compression-stroke, 2-power (expansion)-stroke, 2-exhaust-stroke, 2-power (work)-stroke and finally 2-2nd compression-stroke i.e. there are 6 strokes per revolution.
9) The use and making of the G 63 either in an on-line design and/or in a V-shape design.
AMENDED CLAIMS
received by the International Bureau on 3 September 2012 (03.09.12).

1. Basically: the elimination of the "silent peak" which is an unwanted feature in all preceded 6-stroke engines, through the (G63) style in which whenever a piston is going down from TDC to BDG, this would be by the effect / cause of a power (expansion)-stroke (piston (A) and (C)) or by the effect / cause of a power (work)-stroke (piston (B)).

2. The working / running cycle of the (G63), which consists of two revolutions only unlike all the preceding 6-stroke engines, in which the complete cycle consists of three revolutions.

3. The preservation of the "low fuel consumption" feature of the 6-stroke engine, which means less pollution to the environment, but through the (G63) style.
Diagram (1): the general assembly of the G63
Diagram (2): The general assembly of the DCC
Diagram (3): the general assembly of a 6-stroke, 1-piston engine according to Griffin prototype.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

INV. F02B75/02 F02B41/06
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F02B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance
"B" earlier application or patent but published on or after the international filing date
"C" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"D" document referring to an oral disclosure, use, exhibition or other means
"E" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"Z" document member of the same patent family

Date of the actual completion of the international search
24 May 2012

Date of mailing of the international search report
24/07/2012

Name and mailing address of the ISA
European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
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Fax: (+31-70) 340-3016

Authorized officer
Yates, John
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This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. □ Claims Nos.: because they relate to subject matter not required to be searched by this Authority, namely:

2. ✗ claims Nos.: because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
   
   see FURTHER INFORMATION sheet PCT/ISA/210

3. □ Claims Nos.: because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

This International Searching Authority found multiple inventions in this international application, as follows:

1. □ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ✗ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. □ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ✗ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

- The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

- No protest accompanied the payment of additional search fees.
Continuation of Box II.2

Claims Nos.: 1-9 (partially)

The claims as filed do not correspond to claims in the sense of Rule 6 PCT since they do not give the technical features of either the method or the apparatus, so that no search for relevant prior art can take place based on the claims. This does not, however, mean that no search is possible. A search may possibly be able to be performed on the general disclosure, however, the disclosure in the description is extremely unclear. This means that the requirements of Articles 5 and 6, as well as Rule 5 PCT are not met. The applicant may wish to consult a professional patent attorney to ascertain if the current application can be rewritten within the original disclosure so as to clearly and adequately describe the invention as required under the PCT. None the less, on the basis of diagram 1/A and the table in diagram 1/B enough information is given in order to ascertain how the engine should function. This is sufficient for a general search to be able to be performed so that the applicant can gain an appreciation of the prior art.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examination Authority is normally not to carry out a preliminary examination on a matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the applicant proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guideline C-VI, 8.2), should the problems which led to the Article 17(2) declaration be overcome.
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<td>US 7201156 B1 10-04-2007 NONE</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>US 4917054 A 17-04-1990 BE 1000774 A5 04-04-1989</td>
<td></td>
<td></td>
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<tr>
<td>DE 3871276 D1 25-06-1992</td>
<td></td>
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<tr>
<td>EP 0302042 A1 01-02-1989</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>ES 2033015 T3 01-03-1993</td>
<td></td>
<td></td>
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<tr>
<td>US 4917054 A 17-04-1990</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>CN 86102231 A 31-12-1986</td>
<td></td>
<td></td>
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<tr>
<td>EP 0200714 A2 05-11-1986</td>
<td></td>
<td></td>
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<tr>
<td>CN 1982665 A 20-06-2007</td>
<td></td>
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<tr>
<td>JP 2007162694 A 28-06-2007</td>
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<tr>
<td>BE 1013791 A5 06-08-2002</td>
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<td>DE 60116942 T2 26-10-2006</td>
<td></td>
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<tr>
<td>EP 1201892 A1 02-05-2002</td>
<td></td>
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<tr>
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<td></td>
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