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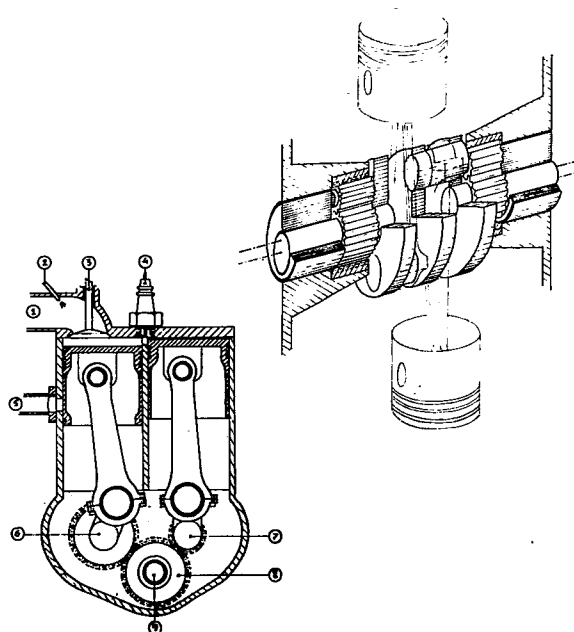
⑤④ **Combi-stroke and combi-shaft combustion engine.**

⑤⑦ 1. An internal combustion engine nameable combi-stroke engine in which the crank-shafts have such a position with regard to each other that the smallest volume of the combustion chamber is attained when the pistons connected to one crank-shaft have passed the highest dead point in order to get a higher output or power.

2. An internal combustion engine nameable combi-shaft engine. In such an engine the linear motion of a piston is transformed in rotation by means of a crank-shaft combination. In this combination one or more crank-shafts can be considered as crank or cranks for a secondary crank-shaft in order to get a higher output and torque.

3. An internal combustion engine can be composed by using the abstract 1 and abstract 2 in one engine.

4. Transformation of rectilinear motion into rotation by means of combi-shaft can also be used in other construction than internal combustion engines.



Combi-stroke and combi-shaft combustion engine

The invention relates to two kinds of combustion engines, nameable combi-stroke and combi-shaft engine; in a combi-stroke
5 engine, the smallest volume of the combustion chamber between the pistons is attained, when fast- or slow moving piston or pistons has or have past the highest dead point; in a combi-shaft engine the piston motion is transformed into rotation by means of a crank-shaft combination.

10 Almost all reciprocating engines with internal combustion are based on the two-stroke, four-stroke or Wankel principle. A new principle nameable combi-stroke has been put forward in the Dutch patent application nr. 7807179.

15 The inventions as claimed are intended to create internal combustion engines with considerable higher output.

Theoretical a higher output in piston-engines can be got when:

1. the pressure on the pistons staves on a higher level during
20 whole or a part of the active stroke;
2. pressure and temperature are on a lower level at the end of the active stroke;
3. the obtained turning-effect on the crank-shaft is larger especially at the start of the active stroke.

25 Those conditions can be fulfilled in combi-stroke engines of which the graphical rendering is shown in the figures 1 and 2. They distinguish themselves of combi-stroke engines as described in the Dutch application nr. 7807179 by the position of the crank-shafts, which is changed in this way, that the smallest volume of the
30 combustion chamber is attained, after the slow moving piston(s)

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has (have) past the highest dead point.

The conditions can also be fulfilled by means of a new construction in four-stroke engines, nameable combi-shaft, or in
5 full combined crank-shaft. In such an engine the motion of every piston is transformed into rotation by means of a composed crank-shaft, in which one or more crank-shafts can be considered as crank or cranks for a secondary crank-shaft.

Fig.3 shows such a combi-shaft in outline; AB is the crank of the
10 primary crank-shaft, rotating around point B; BC is the crank of the secondary crank-shaft, rotating in the same time and direction as AB around point C. A piston with connecting-rod to point A will make four strokes during one rotation of BC.

Fig. 4 gives a graphical representation of the piston motion,
15 brought about by every part of the crank-shaft and in full line the addition of the two, which represents the total piston travel.

Considering the figures, it is obvious that the almost smallest volume of the combustion chamber in both types of engines changes
20 less than in normal four-stroke engines during some time and that the expansion proportion is bigger ^{than} as the compression proportion.

A further analysis of the combi-stroke cycle shows remarkable differences to a normal four-stroke process. In fig. 5, the
25 pressure courses during compression and expansion in a combi-stroke and a four-stroke process have been drawn in outline. They show that the duration of compression and expansion are considerable longer in the combi-stroke process. The compression starts earlier through which the pressure in the ignitionmoment of a combi-stroke
30 petrol engine is higher. During whole the expansion in a 2-4 combi-stroke engine, the slow moving crank-shaft turns 45° just inside the area in which the largest turning effect is brought about.

The fast moving crank-shaft meets with a turning effect analogous to a normal four-stroke engine. Owing to this, the total torque
35 in a combi-stroke engine, theoretical can be about 25% higher as in four-stroke engines, in case of low number of revolutions.

The difference decreases to about 10% in case of high number of revolutions.

The total increase of output as result of bigger torque and larger
40 expansion could be, theoretical, up to 100% in comparison with

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usual four-stroke engines.

Other crank-shafts can be constructed e.g. to be employed in two-stroke engines (see fig. 6) or in order to get rectilinear motion of a connecting-rod (see fig. 7).

Other possibilities, related to these inventions are application of combi-stroke and combi-shaft together in one engine and combi-shaft, used in other constructions where linear motion must be transformed into rotation.

10 In combi-stroke engines a larger torque can also be formed, when the fast moving piston or pistons reach(es) earlier the highest dead point ^{than} ~~as~~ the slow moving piston or pistons.

15 The ways to carry out the invention concerning combi-stroke are the same as in the Dutch application 7807179; only the position of the crank-shafts is different.

One way of carrying out the invention concerning combi-shaft is drawn in fig. 8, showing a perspective view of a combi-shaft;

20 fig. 8a is a side view in cross section and fig 8b is a front view of the connection between primary and secondary crank-shaft by means of toothed wheels.

The connection in order to get the wished rotation of primary and secondary crank-shaft in the same time and direction,

25 contains:

a inside toothed wheel 1 attached to the engine's body; a toothed wheel 5 is attached to the primary crank-shaft 4; a intermediary toothed wheel 3 turns on the shaft 2, sticking out from the segment 6 of the secondary crank-shaft; toothed wheel 3 seizes in the

30 toothed wheels 1 and 5.

In fig. 8a, AB and BC are corresponding to AB and BC in fig. 3.

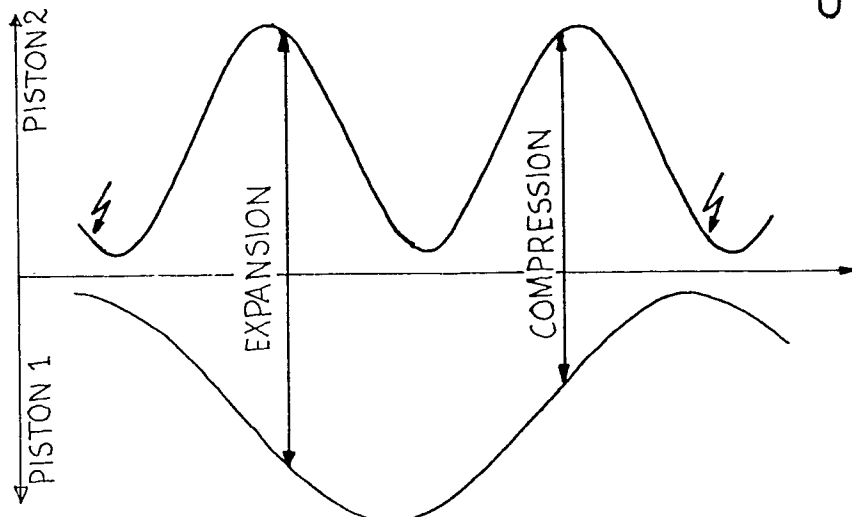
In fig. 9 any conbistroke engine has been drawn in outline; 1 is the inlet (under pressure e.g. by a turbine); 2 fuel injection; 3 inlet valve; 4 sparkle; 5 exhaust holes, circularly in the cylinder-wall;

35 6 two-stroke crank-shaft; 7 four-stroke crank-shaft; 8 connecting toothed wheel; 9 shaft.

Claims

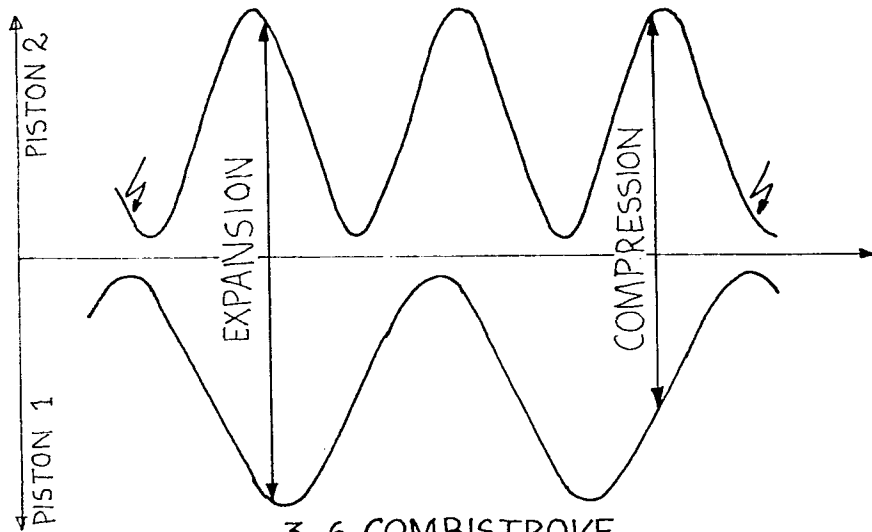
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1. Internal combustion engine, in accordance with the Dutch patent application no. 7807179 nameable combi-stroke engine characterised in
5 that the smallest volume of the combustion chamber is attained, when slow or fast moving piston or pistons has or have passed the highest dead point.
2. Internal combustion engine nameable combi-shaft or in full
10 combined crank-shaft engine characterised in that the linear motion of the piston or pistons is or are transformed in rotation by means of a crank-shaft combination in which one or more crank-shaft(s) can be considered as crank or cranks for a secondary crank-shaft.
- 15 3. Internal combustion engine in which claim 1 and claim 2 both are employed.
4. Construction not being an internal combustion engine to transform
20 linear motion into rotation by means of a crank-shaft combination as in claim 2.



2-4 COMBISTROKE

FIG. 1



3-6 COMBISTROKE

FIG. 2

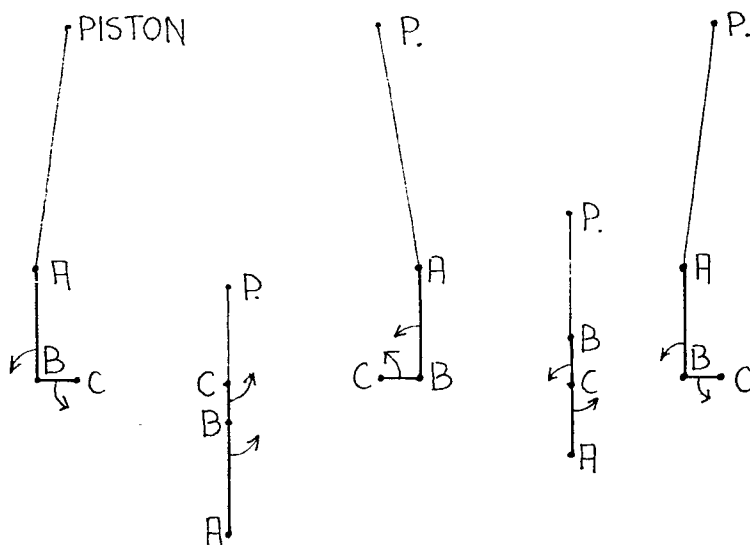


FIG. 3

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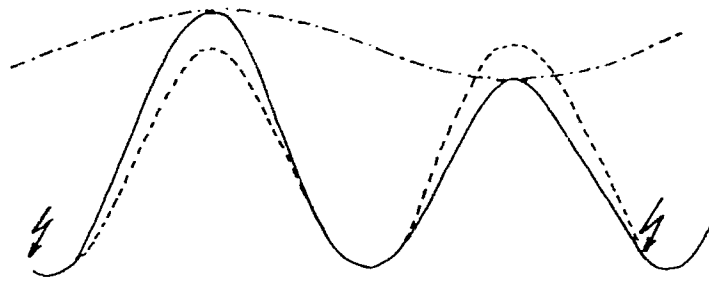


FIG. 4

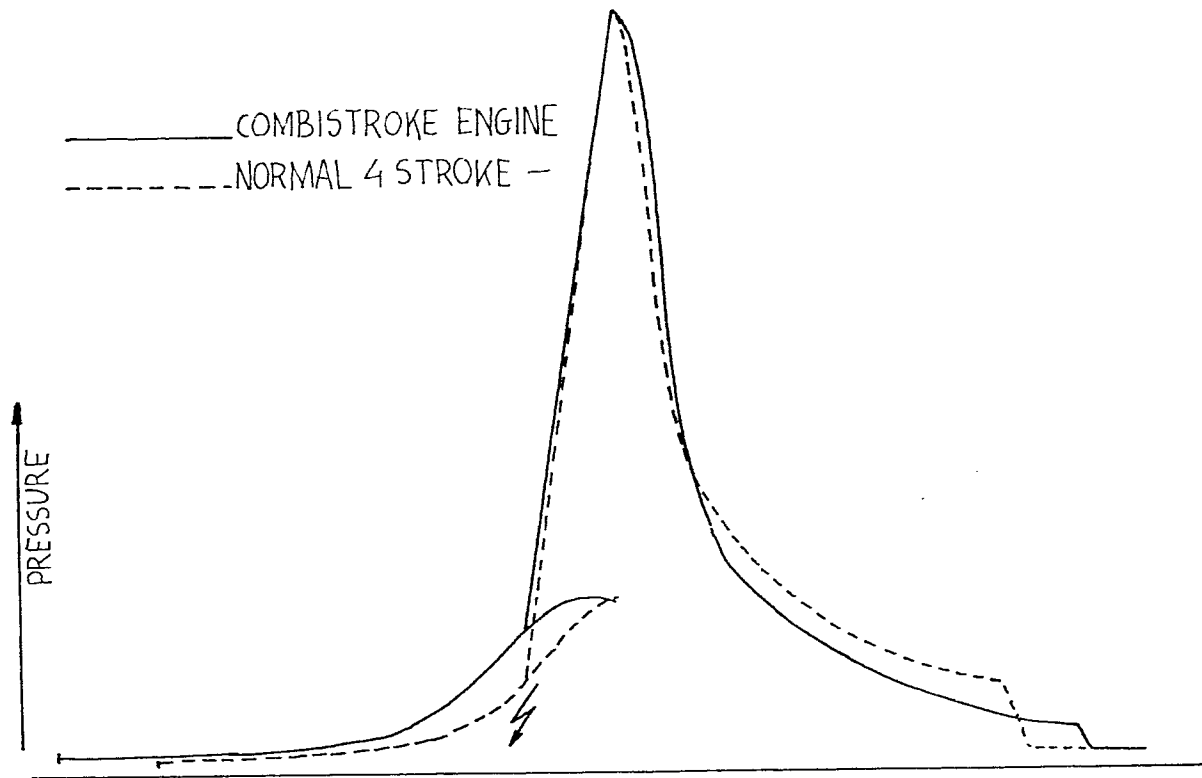


FIG. 5

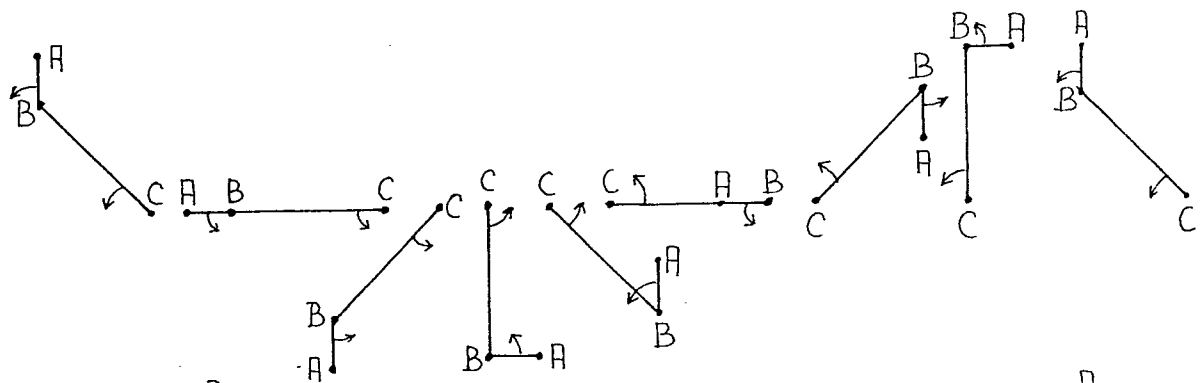


FIG. 6

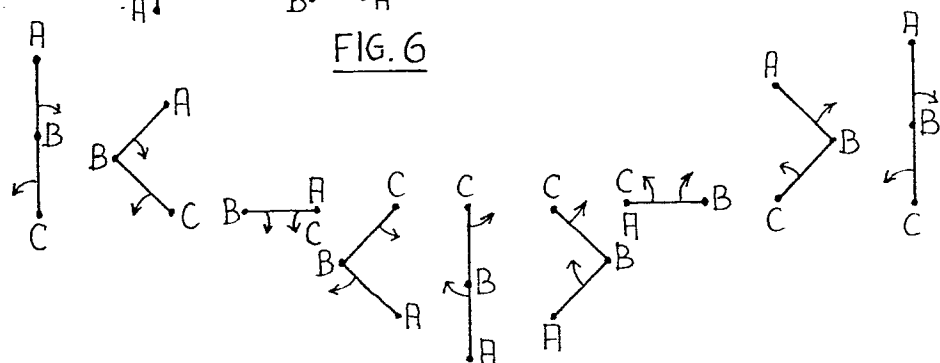
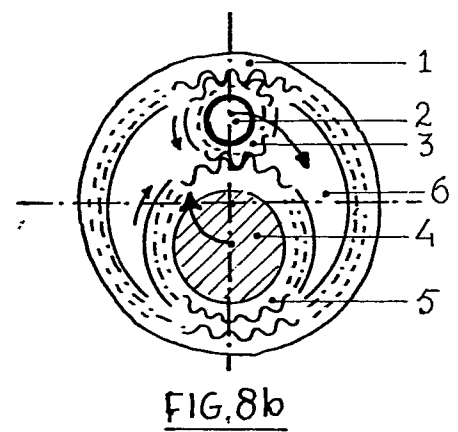
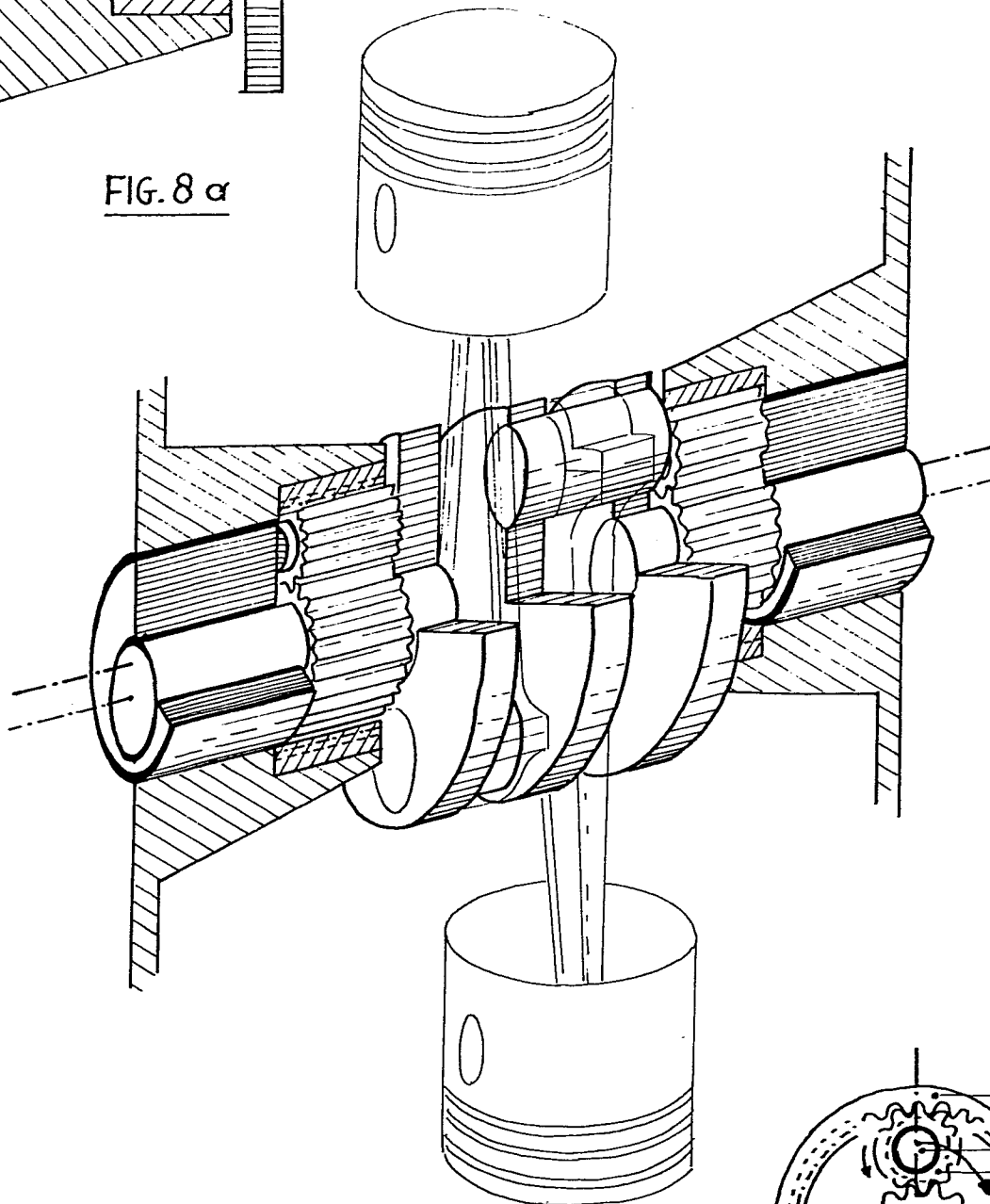
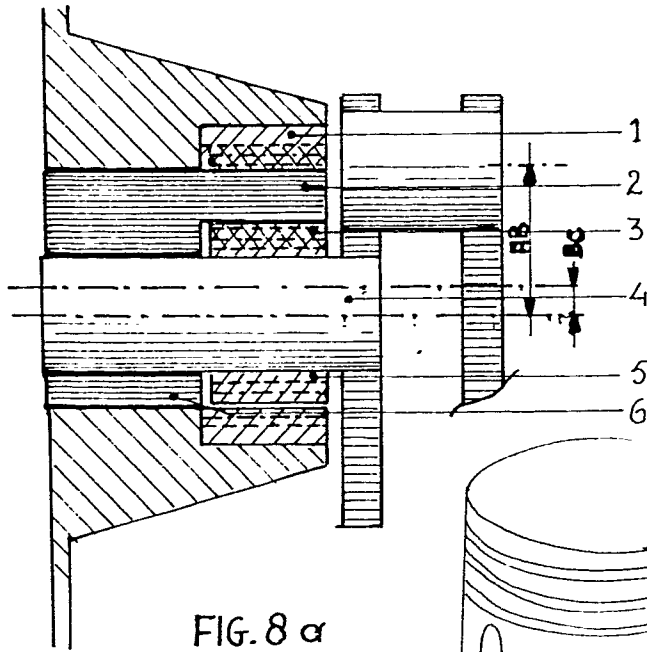
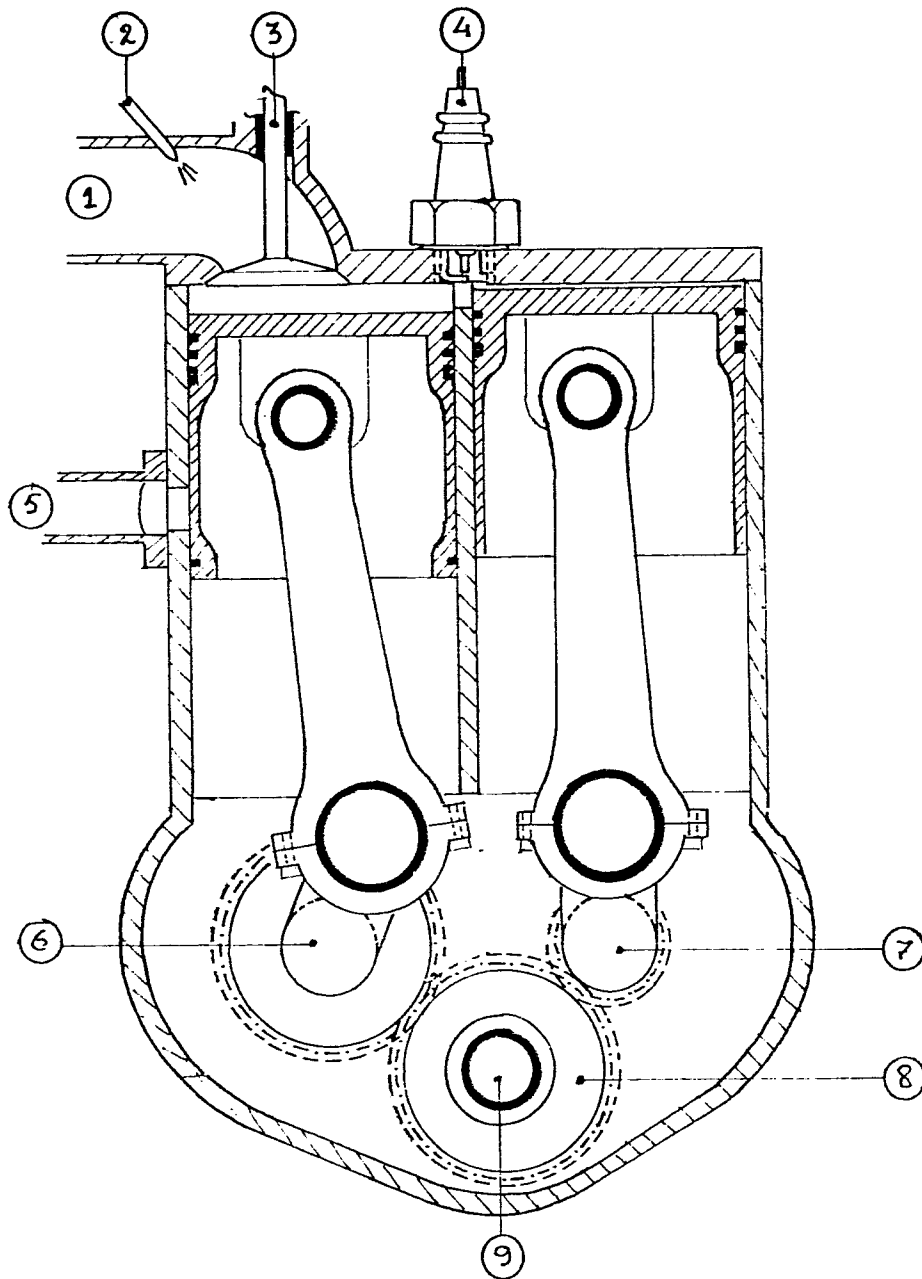


FIG. 7

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2-4 COMBISTROKE ENGINE

FIG. 9



DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl.)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
X	<u>US - A - 2 473 759</u> (MALLORY) * claim 1 * --	1	F 02 B 75/28
	<u>DE - C - 439 350</u> (CORDES) * claim 2; page 2, lines 16 to 20 * --	1	
	<u>AT - B - 157 310</u> (LIRSA-LICENCES, INVENTIONS REPRESENTATIONS S.A. et al.) * claims 1 to 3; page 2, lines 41 to 43; fig. 1 to 5 * --	1-3	
	<u>DE - A - 2 336 013</u> (DUTRY et al.) * claim 1, lines 1 to 7; page 6, paragraph 4 to page 7, paragraph 2 * --	2	F 02 B 25/00 F 02 B 73/00 F 02 B 75/00 F 16 H 21/00
	<u>US - A - 3 446 192</u> (WOODWARD) * page 1, column 1, line 65 to column 2, line 14; fig. 1 and 2 * --	2	
A	<u>DE - C - 758 073</u> (GERLACH) * whole document * --		
A	<u>DE - A - 2 043 231</u> (STEIN) * page 1, paragraph 1; fig. * -- ./..		
☒ The present search report has been drawn up for all claims			
Place of search Berlin			Date of completion of the search 03-04-1980
Examiner STÖCKLE			

