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## (54) Gas engine with rotating blades.

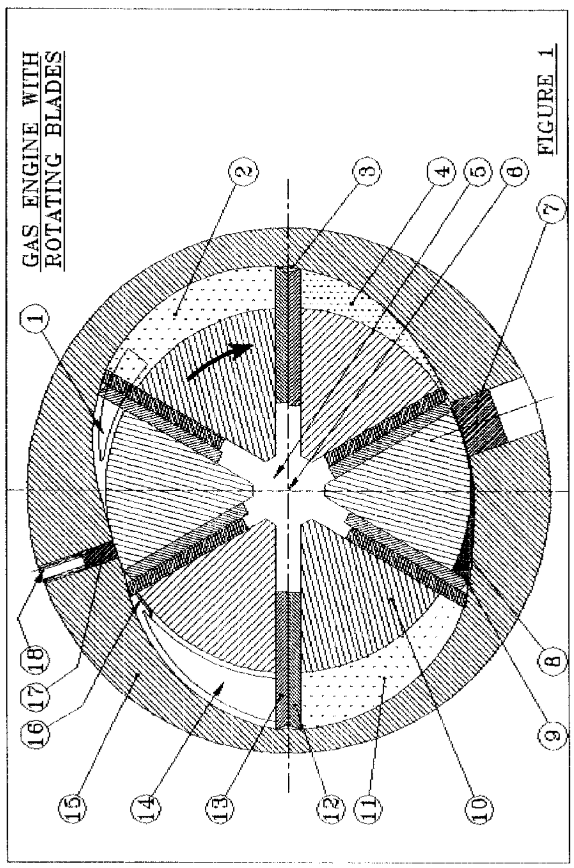
(57) The invention consists in an internal combustion engine (or gas engine) shaped by an internal profiled static ring where run blades (or segmants) drived by a central rotor connected by a slip fit.

The lateral surfaces of the ring are connected to seal flanges where the driving shaft connected to the central rotor comes through.

During rotation, the blades provide for volume variation necessary to absolve the strokes : i.e. inlet, compression, firing and exhaust.

Figure 1 of the attached drawing showes how it works.

The applications fields are all those where it is possible to employ a gas engine, for example : motor car, aero-engine, naval, agricultural industries, etc.

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## DISCLOSURE OF INVENTION

At the moment, the technics disposes of internal combustion engine as: gas turbine, pistone engine (**Otto** or Diesel) and rotating engine (**Wankel**).

These kinds of engines have reached such a perfection through the years that any further effort to improve them could be uneconomical compared whith the new efficiency obtained.

The **advantages** of the invention are:

**1- more power at the same cubic capacity**

2- low ratio weight/power

3- less volume

4- low production cost

The invention is shown in the attached figures. Figures, 1 through 7, represent the working strokes of the engine. By these crossing sections, the shape proposed is the preferred design, but it could also be a different one.

The engine we are talking about can have one or more stages connected between each other.

The following description is refererred to one stage only in order to show its items and how the engine works.

The **figure 1,** of the attached drawings, shows a schematic crossing section where the ring **15** is static and his internal surfaces is shaped and the central rotor **10** runs around the axis **6.** The couple of blades **12** and **13** have a radial motion inside the rotor and the end seal of blades describe the internal shape of the ring 15 during rotation.

The blades are pushed to contact the internal shape of the ring **15** by a radial pressure.

The pressure can be: pneumatic, hydraulics, mechanical or of a different kind.

At a given R.P.M. the centrifugal thrust could be sufficient to ensure the sealing of blades to the profile of ring **15** without requiring any additional pressure.

The number of blades is not binding, it fixes the shape of the inner ring surface which permits the working strokes of the engine.

The working strokes of the engine are: **inlet, compression, firing** and **exhaust.**

The following description is referred to the running of the segment marked by the arrow showing the rotation direction.

The **figure 2** shows the **beginning of the inlet stroke (see arrow F).**

The exhaust hole is sealed from the inlet hole by a seal **17** which is loaded on the rotor by the spring **18.** Any different energy may be employed.

The inlet of gases is realized during the rotation of the rotor **10** in direction of **arrow F**.

The volume variation is defined by the external diameter of rotor, by the internal profile of ring **15** and the left lateral surface of blade **12.**

Gases comes through the inlet hole **1 (see arrow)** that is on the sealing lateral flanges fixed at the lateral surfaces of the ring **15.**

The inlet holes and the exhaust holes could have a different arrangement.

The **figure 3** shows the **inleted gases at the end of inlet stroke (see arrow A).**

The inlet hole, now, is closed by blade **13.** The inleted gases, showed by **arrow A,** start to be compressed.

The **arrow B** shows the gases during the compression stroke between the blade **13P** and the blade showed by **arrow C.**

The **figure 4** shows the volumetric change during the most difficult position of the compression stroke.

It is well known that during an adiabatic transformation there is an absorbtion of thermal energy as much bigger as the thermic level is, and as much lower as the insulation is.

Moreover, the thermic level raises as much as the pressure and the absorbtion of thermal energy increases.

At this point, the compression ratio is bigger than the compression ratio during the firing stroke **(see figure 5),** which means that will be spent more energy than required for the firing condition.

By increasing the compression ratio could be generated a spontaneous ignition involving the engine work.

To avoid these troubles, a pressure relieving piston **7** driven by a mechanical or different one fastener has been foreseen.

The **figure 5** shows the compressed gases when the firing stroke starts.

At this moment, between elctrodes of spark-plug **9,** which has to be designed for this kind of engine, the ignition spark is on.

The fired gases energy produces a pressure, inside the combustion chamber, constraining the surface **S** of the **blade 12P** to rotate around the axis **6** and to slip along the internal profile of the static ring **15.**

At this moment starts the **expansion** of fired gases and it finishs at the beginning of exhaust hole **14,** as showed in the **figure 6.**

The **figure 7** shows the end of the exhaust of burned gases. To eliminate the burned gases as much as possible, an additional little duct connected to the exhaust hole has been designed. It can be seen on the **figure 1.**

The seal **17** insures the separation of the inlet hole by the exhaust hole.

At this moment the working cycle of the engine is completed. It must noted that during a 360° run there will be a number of complete cycles (all strokes) equal to the number of the couples of blades **12 ,13.**

The power attachement (the power shaft) is on the central rotor **10** and comes out from the flanges of the external seals coupled to the static ring **15** surfaces.

Any kind of fuel can be used for this engine: gasoline, fuel oil, gas, petroil, etc.

The ignition system may have a coil ignition, electronic ignition, or a different one.

The cooling system can be with:

1) cooling liquid with:
- natural circulation with radiator
- forced circulation with a pump, thermal switch and radiator
- forced circulation of a cooling liquid in a sealed system, with pump, thermal switch and radiator

**2)** air circulation:
- with a fan and duct
- flowing ram air.

Using cooling liquid, the engine must be provided of internal ducts for the coolant.

In case of air cooling system, the engine must be provided of cooling ribs.

The engine must be provided of a suitable lubricating system to allows parts to move one on each other freely without friction.

The engine must have a complete set of accessories to rum in complete autonomy.

To understand the advantages of such engine, it must point out with follows:

**1)** for a reciprocating engine the capacity is measured after a complete cycle. That happens in two revolution of the power shaft (crankshaft). i.e.

**C = V·N** where:

**C** = total capacity in $cm^2$

**V** = volume of a single cylinder during inlet stroke (radius of piston$^2 \cdot \pi \cdot$suction stroke)

**N** = number of cylinders

Than, to compare the engine we are talking about, the capacity will be the volume of inleted gases during two revolutions of the rotor (item **10**) i.e.

**C = 2·V·n·S** where:

**C** = total capacity

**V** = volume of inleted gases between blades 13 and 12p (see pos. A fig. 3)

**n** = number of couples of blades (12 and 13)

**S** = number of stages

**2)** Talking of a reciprocating engine at the moment of the max pressure (firing), the lever torque lenght measured, normally to the axis of the piston, between the center of the crank and the power shaft axis, is at minimum lenght and increases to the max lenght when the gases pressure is drastically decreased. It still decreases up to the beginning of exit stroke.

It is then possible to say that the max pressure works (power stroke) for about **1/15 of the complete** cycle with a **lever torque lenght of about 1/2** of its maximum.

Knowing that:

**P = C·N/716.2** where:

**P** = power in HP

**C** = torque in Kgm

**N** = RPM

It is then possible to consideres that in a reciprocating engine, the output power is 1/30 of the power calculated as the maximum pressure, during firing stroke on the piston surface, was on during the complete cycle (inlet, compression, firing, exhaust) and with the maximum torque lenght, refereted to the crankshaft.

In conclusion:

**(1) P = (Ps·S·b·N·n/716.2)·1/30** where:

**P** = power in HP

**Ps** = max pressure in $Kg/cm^2$

**S** = piston topsurface

**b** = max torque lever lenght in m

**N** = RPM

**n** = number of pistons

Looking at this new engine we are talking about, we can to consider the max torque lenght to be constant and equal to the **radius of rotor 10.**

To be noted that such radius is not related to the volume of the inleted gases (volume of the engine).

The max fired pressure works with an angle equal to:

**(360°/n)·n** where:

**n** = number of blade couples

Than we can to assume such pressure to be constant during a revolution of rotor **10**.

This is possible because, during the expansion, if the pressure of the fired gases decreases, the acting surface increases.

It is possible to say:

**(2) P1 = Ps·S·b·N·n/716.2** where:

**P1** = power in HP

**Ps** = max pressure in $Kg/cm^2$

**S** = acting surface (see fig.5)

**b** = torque lever lenght (radius of rotor 10)

**N** = RPM

**n** = total efficiency

Using comparable values in **(1)** and **(2)**, it is possible to demostrate that **P1 is from 2 to 4 times higher then P.**

An other advantage is the **weight/power ratio** that can be as low as **0.2,** similar to the **aviation gas turbine ratio.**

## Claims

**1)** Gas engine with rotating blades based on a new working principle.

**2)** Gas engine with rotating blades, like as previous claim, based on the fact that the new working way is that the volume change, necessary to develope the engine strokes, is obtained by slide blades **(12,13)** located in a central rotor **(10)** and sliding on a special shaped stator **(15).**

**3)** Gas engine with rotating blades, like as previous claims, based on the fact that the inlet and compression stroke could be done by an external fastener and flowing the gases in the engine we are talking about.

**4)** Gas engine with rotating blades, like as previous claims, based on the fact that the parts configuration is not binding.

**5)** Gas engine with rotating blades, like as previous claims, based on the fact that the rotating direction is not binding.

**6)** Gas engine with rotating blades, like as previous claims, based on the fact that the position of the inlet and exhaust holes **(1,14)** is not binding.

**7)** Gas engine with rotating blades, like as previous claims, based on the fact that the position of the spark plug **(9)** is not binding.

**8)** Gas engine with rotating blades, like as previous claims, based on the fact that the presence of the spark plug **(9)** is not binding if the compression ratio is so much to allow a self ignition (like Diesel engine).

**9)** Gas engine with rotating blades, like as previous claims, based on the fact that the load done by the blades **(12,13)** on the shaped surface of the stator **(15)** to assure the correct sealing can be applied pneumatically, hydraucally or in any other way.

**10)** Gas engine with rotating blades, like as previous claims, based on the fact that the load done by the blades **(13,13)** on the shaped surface of the stator **(15)** to assure the correct sealing could be generated by centrifugal load only during the rotor **(10)** rotation.

**11)** Gas engine with rotating blades, like as previous claims, based on the fact that the seal between the inlet and exhaust hole **(1,14)** can be realized in any technical way and could also be not necessary.

**12)** Gas engine with rotating blades, like as previous claims, based on the fact that the relieve piston **(7)** could be driven by a mechanical fastener or different one.

**13)** Gas engine with rotating blades, like as previous claims, based on the fact that the relieve piston **(7)** is not binding and couldn' t be necessary.

**14)** Gas engine with rotating blades, like as previous claims, based on the fact that the supplementary duct **(16)** for the total ejection of the exhausted gases is not binding.

**15)** Gas engine with rotating blades, like as previous claims, based on the fact that the number of rotating blades **(12,13)** is not binding.

**16)** Gas engine with rotating blades, like as previous claims, based on the fact that the fuel system can be of any kind.

**17)** Gas engine with rotating blades, like as previous claims, based on the fact that the ignition system can be of any kind.

**18)** Gas engine with rotating blades, like as previous claims, based on the fact that the cooling system can be of any kind.

**19)** Gas engine with rotating blades, like as previous claims, based on the fact that the lubricating system may have any different technical solution one.

**20)** Gas engine with rotating blades, like as previous claims, based on the fact that the accessories to allow the engine to self run are not binding.

**21)** Gas engine with rotating blades, like as previous claims, based on the fact that the number of stages is not binding.

GAS ENGINE WITH ROTATING BLADES

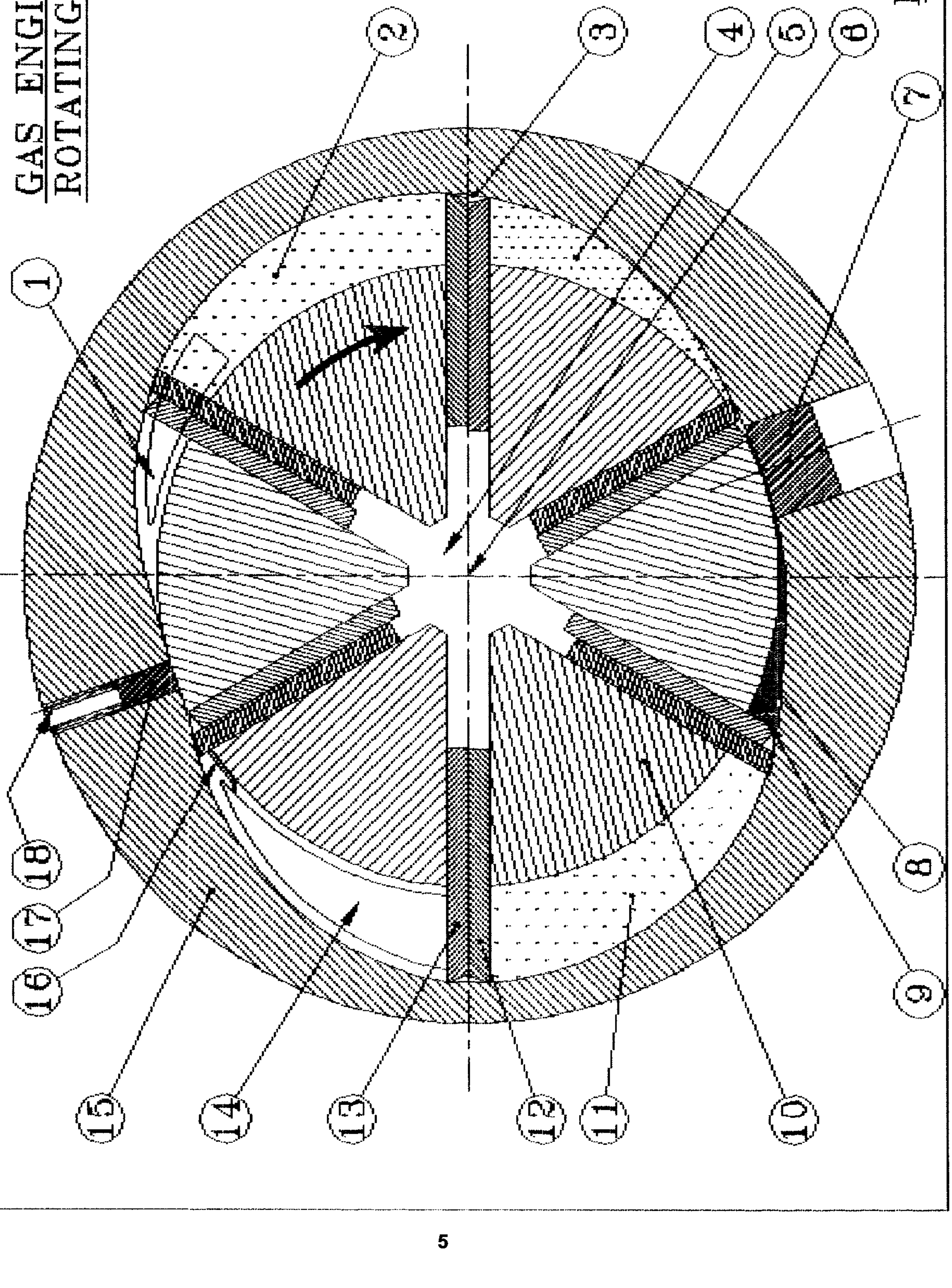



FIGURE 1

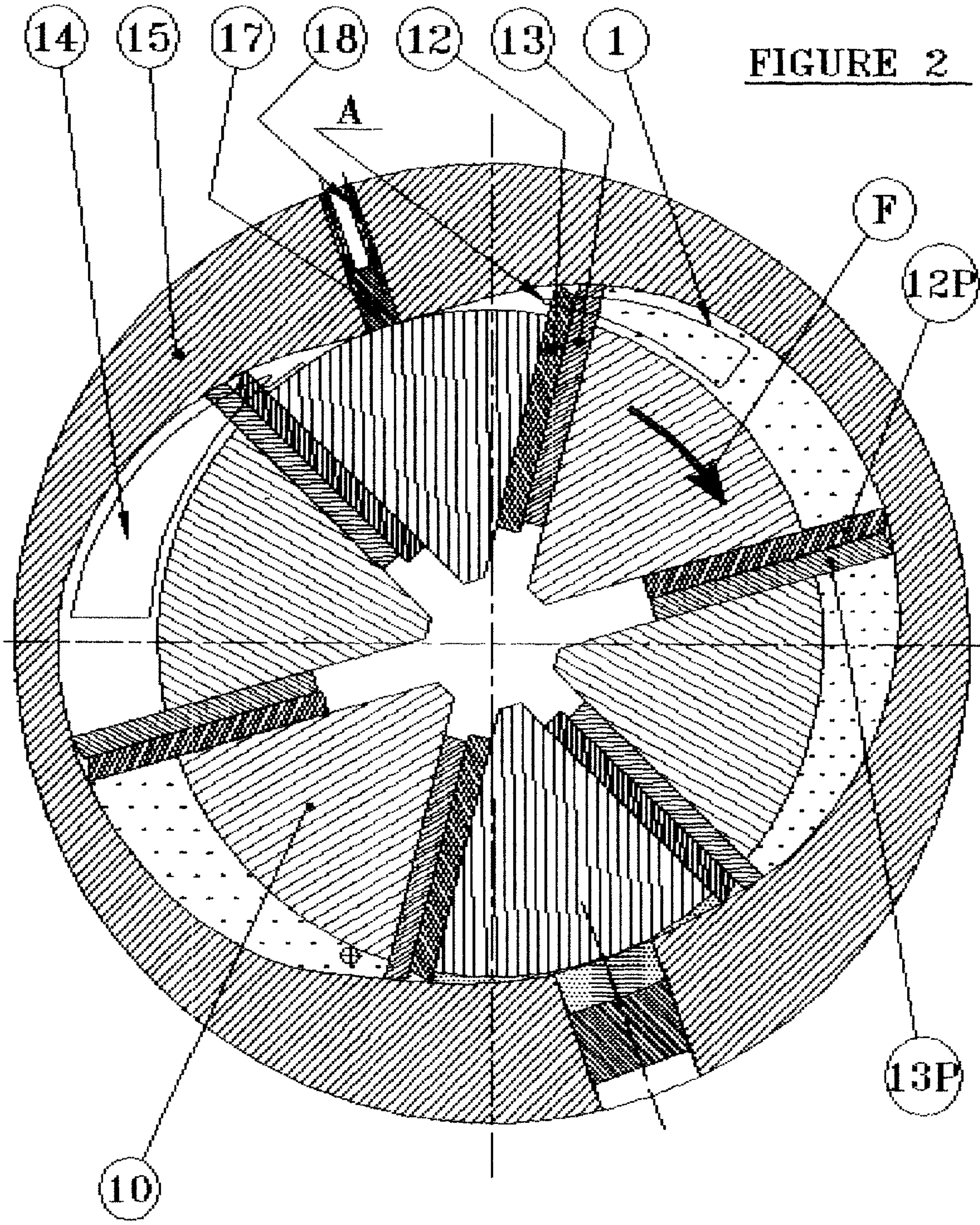



FIGURE 2

GAS ENGINE WITH ROTATING BLADES

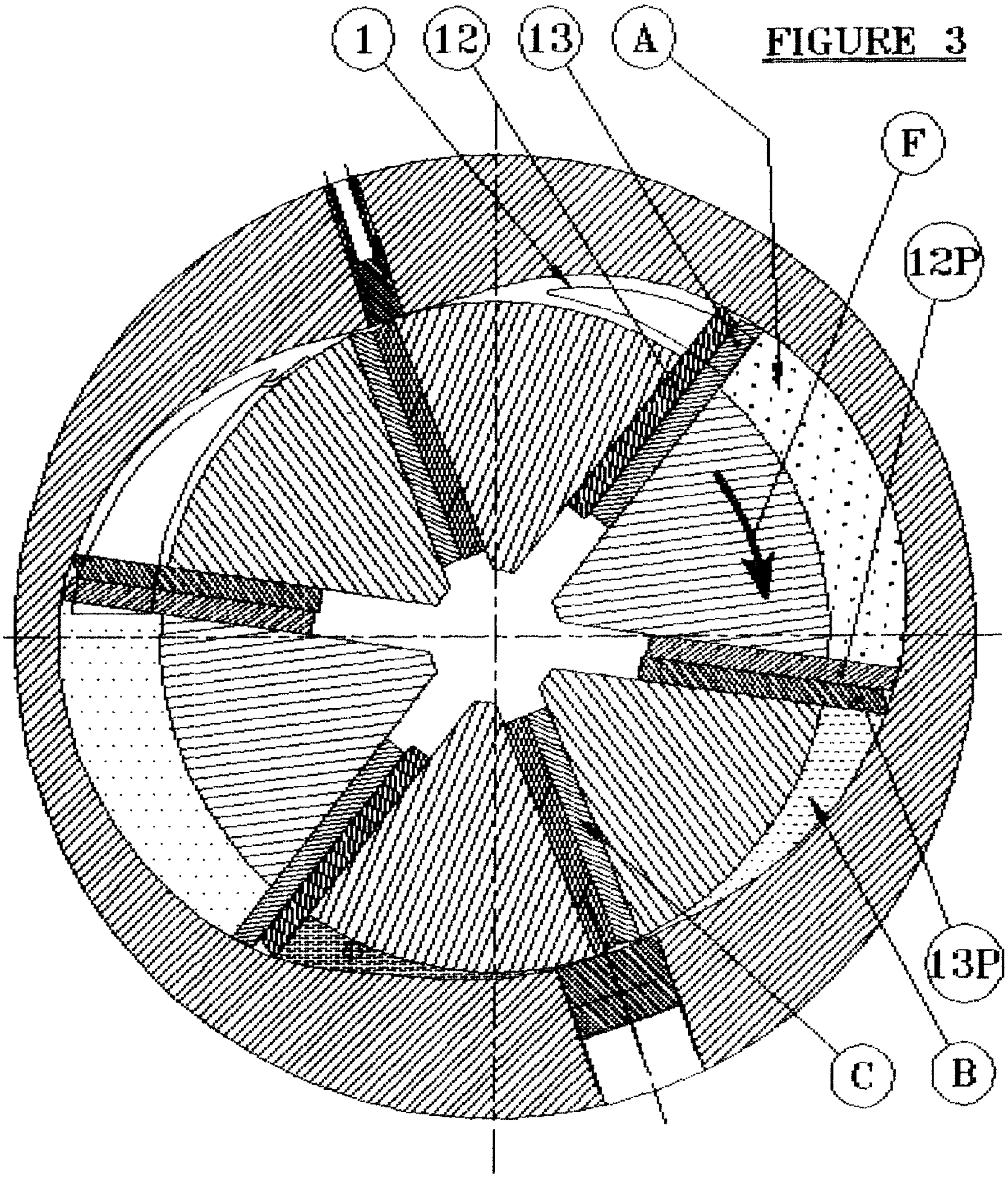
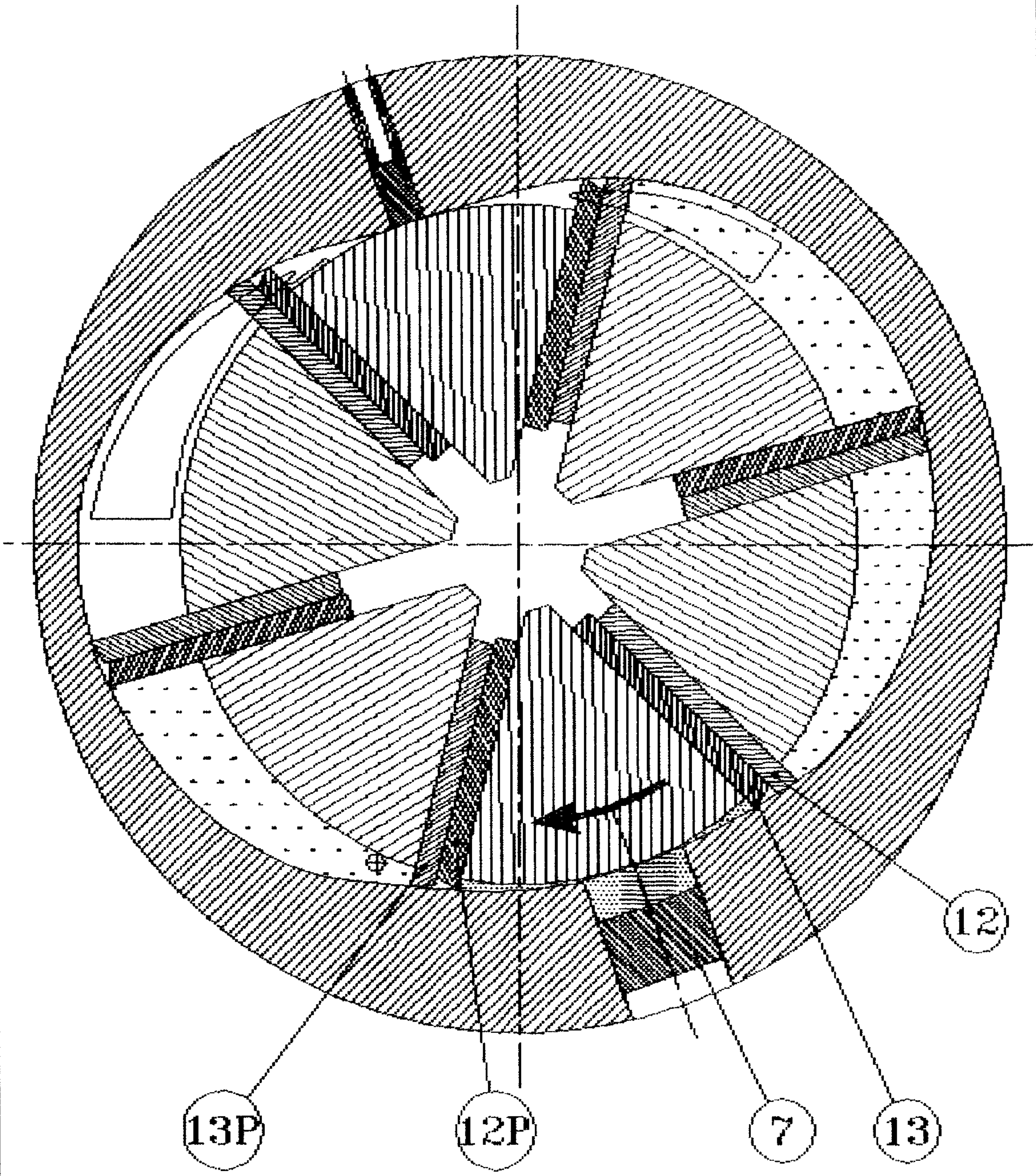


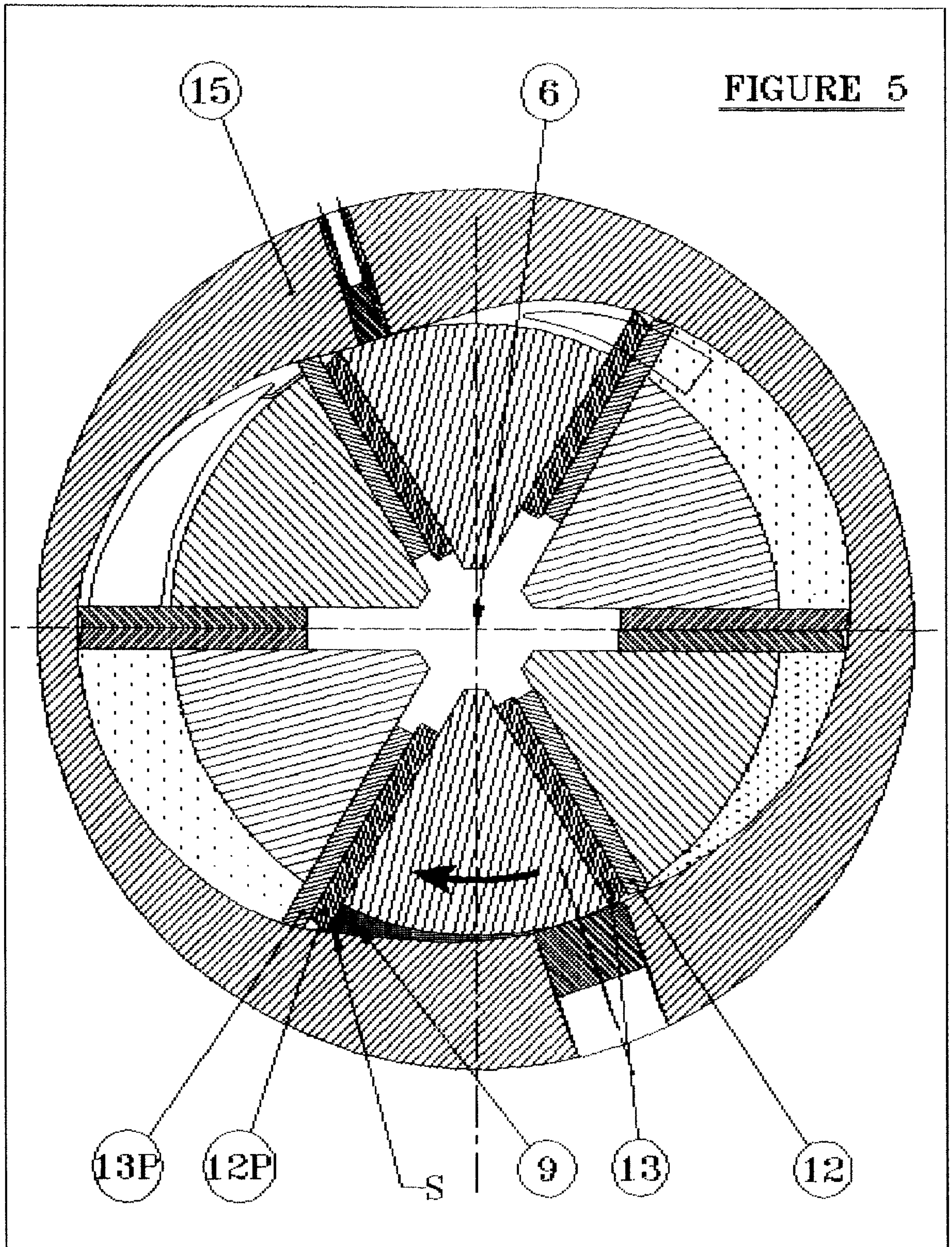

FIGURE 3

GAS ENGINE WITH ROTATING BLADES

# FIGURE 4

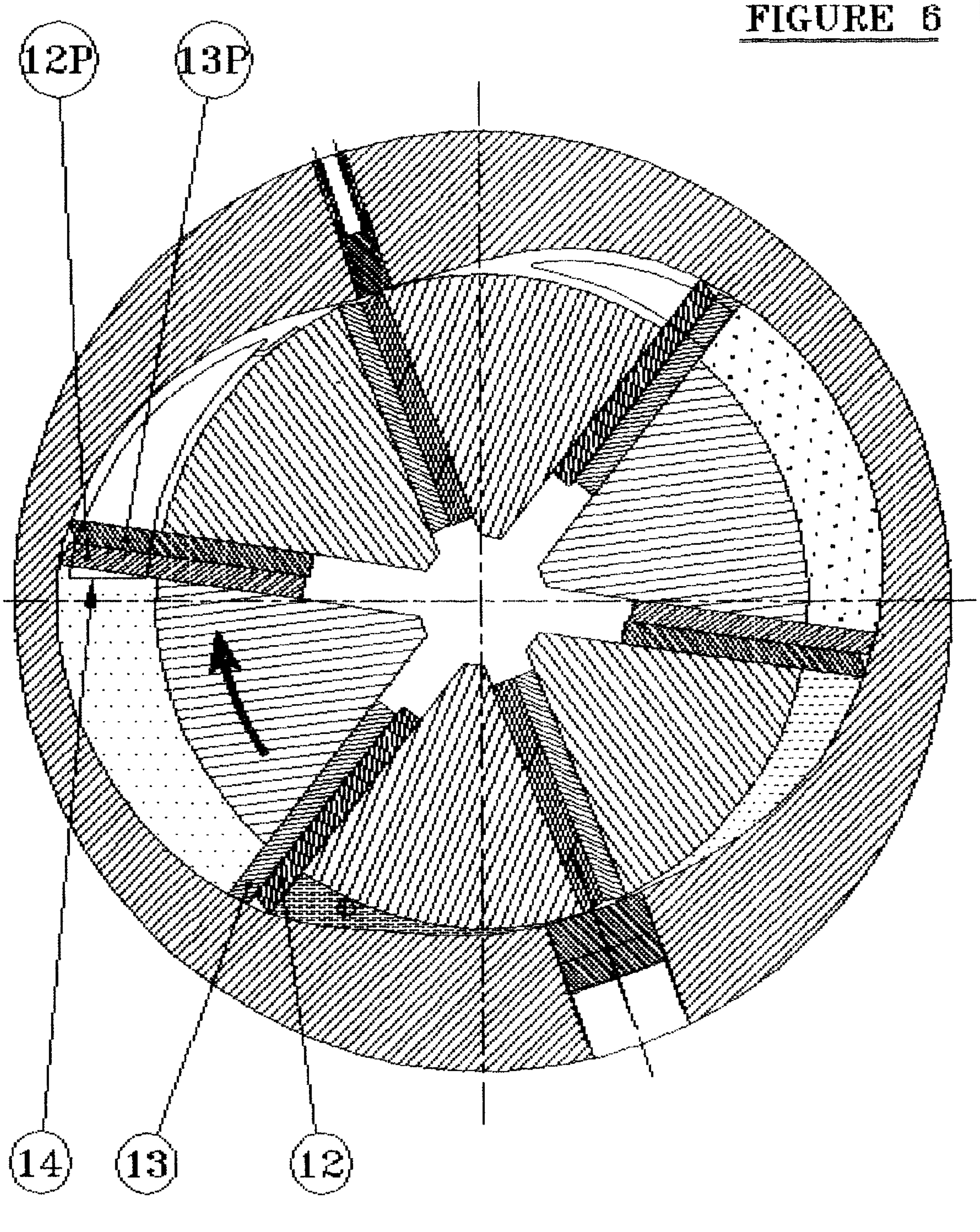



GAS ENGINE WITH
ROTATING BLADES



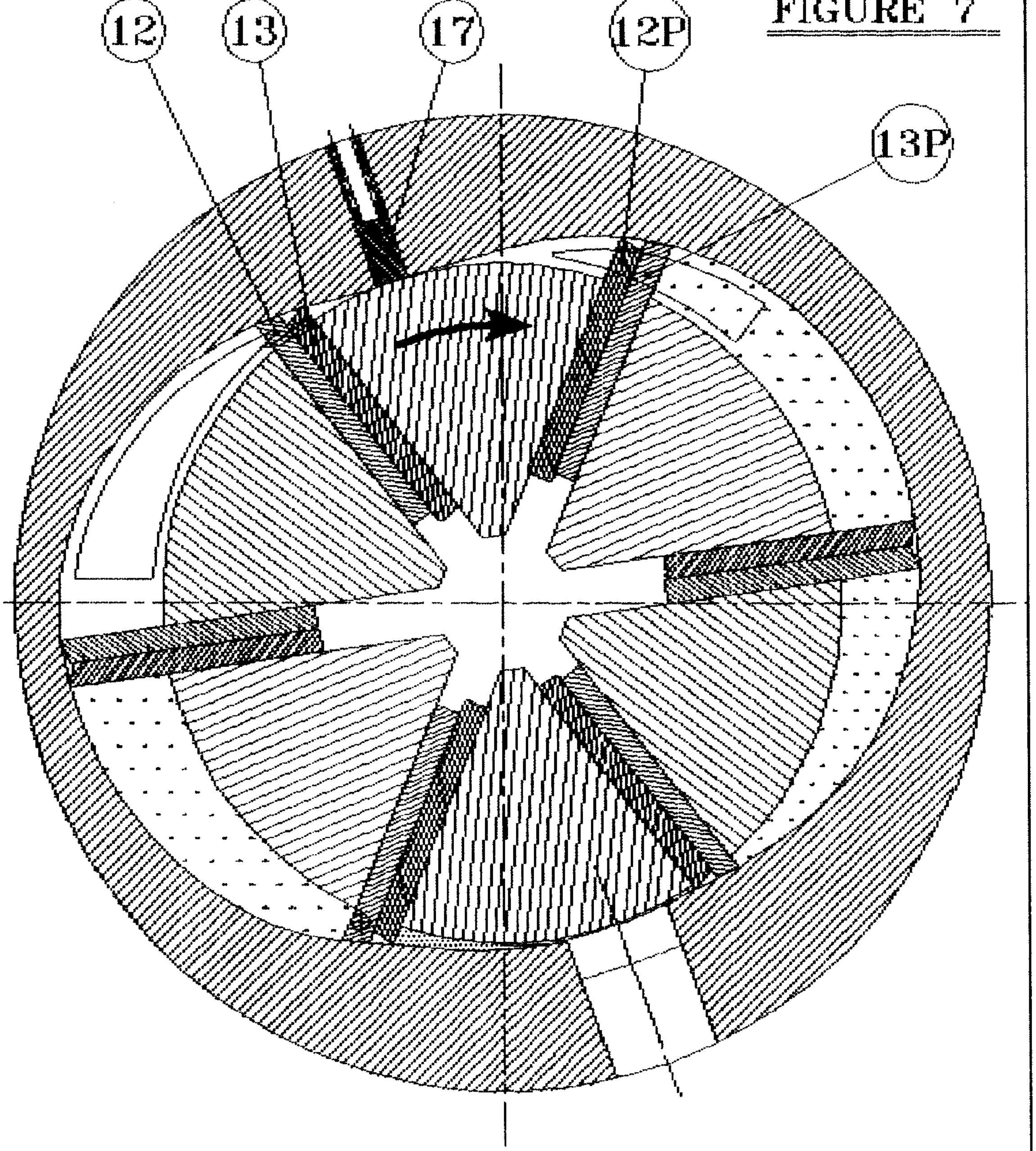

GAS ENGINE WITH ROTATING BLADES

FIGURE 6




GAS ENGINE WITH ROTATING BLADES

FIGURE 7




GAS ENGINE WITH ROTATING BLADES