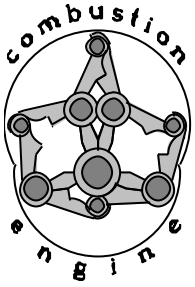
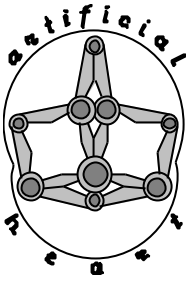


UNIVERSAL DISPLACEMENT MACHINE

QUADRORHOMB

US Pat.# 5,004,409 Euro Pat.# 0334302
Jap.Pat.#2,727,197 Russ.Pat.#2032112



The notion "**Displacement Machine**" defines a machine with one or more chambers having changed volumes. Such a machine can work as a pump, as hydro- and compressed air motor, as a steam- and combustion engine. The most well-known and dominant construction of displacement machine is the zylinder-piston one; the another example is the Wankel stator-rotor construction.

An absolut new construction (Fig.1) is called '**QuadroRhomb**", because it has four chambers with rhomb-shaped cross-sections. These chambers are formed by twelve dumb-bell-shaped elements and by one immobile (2) and one rotating (3) plate. The twelve elements are connected in a grid of four rhombs; all these nine connections are joints. Therefore the grid has nine axles.

The central axle (7) of the grid (which joints four inner dumb-bell elements) is connected with the immobile plate (2). Two axles (6a and 6b) of opposite joints (connecting only two external elements) are connected with the rotating plate (3). The remaining six axles of the grid are free.

The rotating plate has in its center a fixed connection with the power shaft (8), which rotates in a bearing placed in the plate (10). This shaft is placed parallel to the axles of the grid. The distance between the shaft (8) and the central axle (7) is a little bit smaller as compared with the distance between two axles of one element of the grid. The plates (2) and (10) and intermediate part (9) form the case of the machine.

In the immobile plate (2) there are four openings (13a, 13b, 14a, 14b), which serve for input and output of the working substance (gas, steam, liquid). These openings are controled by the grid elements during their movement. If the machine works as combustion engine with Otto- or Diesel-cycle, only one input and one output opening are needed (for example 13a and 14a). But in this case into the plate (2) must be placed spark plugs and/or fuel sprayers.

If the power shaft (8) turns around, each chamber changes twice per revolution its volume from minimum V_{min} (total compressed rhombic cross-section) to maximum V_{max} (quadratic cross-section) and vice versa. Therefore the total volume displaced per revolution is $8\times(V_{max}-V_{min})$. The compression V_{max}/V_{min} up to 35 is possible. It must be emphasised, that during rotation of the shaft (8) the center of masses of **QuadroRhomb** stays in the same point, also if there is a liquid in the chamber and/or in the case. This is also valid for the asymmetrical variant of the grid (Fig.3).

As compared with existing displacement machines **QuadroRhomb** is small, light, effective and cheap. It is very simple: it has no connecting rods, no crank shaft, no balancing masses, no valves, no cam shaft, no tooth gears. It does not need sealing elements like piston rings and it does not need a special fly wheel, because its rotating plate works as fly wheel too and smooths over the angle vibrations. **QuadroRhomb** also has no radial vibrations, because its mass center stays in the same point. As a pump it pumps twice per revolution of power shaft from each of its chambers. As a combustion engine performs **QuadroRhomb** all four strokes in each of its four chambers only per one revolution of power shaft and works as an 8-cylinder machine.

The sealing, cooling and lubrication problems can be successful solved. For example, the sealing of joints can be ensured by the fabrication accuracy of order of 0.01 mm. Because the joints are relative small and their parts having almost the same temperatures, the joints remain hermetic if the

machine is going to work. Application of materials with a small thermal expansion (e.g. invar or ceramics) can be also useful. The sealing between the grid and the plates (2) and (3) is provided by the unique peculiarity of the new machine, namely, the possibility of operational changing of the distance between the plates (2) and (3). In Figure it is symbolically showed by the spring which moves the plate (3) toward to the plate (2). Such a possibility does not exist in the old machines: it is not possible to change the diameter of zylinder or piston, the size of stator or rotor, and therefore special sealing elements between these parts are necessary.

The zylinder serves as a bearing for a push-pull moving of the piston. This bearing is attacted by mechanical (especially when the connecting rod stays obliquely), thermal, and chemical influences. In contrast to it, in **QuadroRhomb** there are no essential mechanical forces between the grid and the plates, and the bearings of axles of grid have no direct contact with the combustion gas. The central axle (7) of the grid can be lubricated through a channel in it (it is shown in Figure); the rest eight axles of the grid can be lubricated through channels (in grid elements) connecting these axles with the case where the oil is sprayed because of the rotation. This oil lubricates the plates (2), (3) also. The openings of **QuadroRhomb** have large apertures (better as with 4-valves technique).

The chambers of Wankel engine are too flat during combustion and first third of expansion phase. Because of that too much thermal energy is lost by the thermal flows to the walls. Also the combustion is not complete, and many poison products are generated. In contrast to that, the chambers of **QuadroRhomb** are compact, especially if "asymmetrical" (Fig.3), not "symmetrical" (Figs.1, 2) form of grid is used, und have approximately the same volume-to-surface ratio as the zylinder-piston engine.

The critical loading of the new machine arises in the bearings of the grid and is the same order as the loading in the piston-finger bearing of zylinder-piston machine. The maximal revolution rate depends on the size of the machine. Small machines can rotate faster. If the maximal revolution rate is limited by the dynamical forces, its value is approximately the same or some lower as compared with maximal revolution rate of existing machines having the same volume of chambers. But the whole productivity of **QuadroRhomb** is higher, because each of four chambers changes its volume from maximum to minimum and vice versa two times per revolution of power shaft. If the maximal revolution rate is limited by the ability of the valve's mechanism, the advantage of **QuadroRhomb** is still more, because it has no valves.

The thermodynamics of **QuadroRhomb** as a heat engine has the next advantage: during the intake and compression strokes the working substance contacts with the relative cold zone of the immobile plate (3) and only later goes into contact with the hot zone. Such a space division leads to a high efficiency of the machine. Because of its simplicity the production of **QuadroRhomb** needs only a small quantity of raw materials and energy that is better for the environment.

There are three colour demo-programs for computer having MS DOS.

Dr. Raoul Nakhmanson
Waldschmidtstr. 131
D-60314 Frankfurt am Main
Germany

Tel. +49 69 44 29 17
Fax +49 69 43 88 84

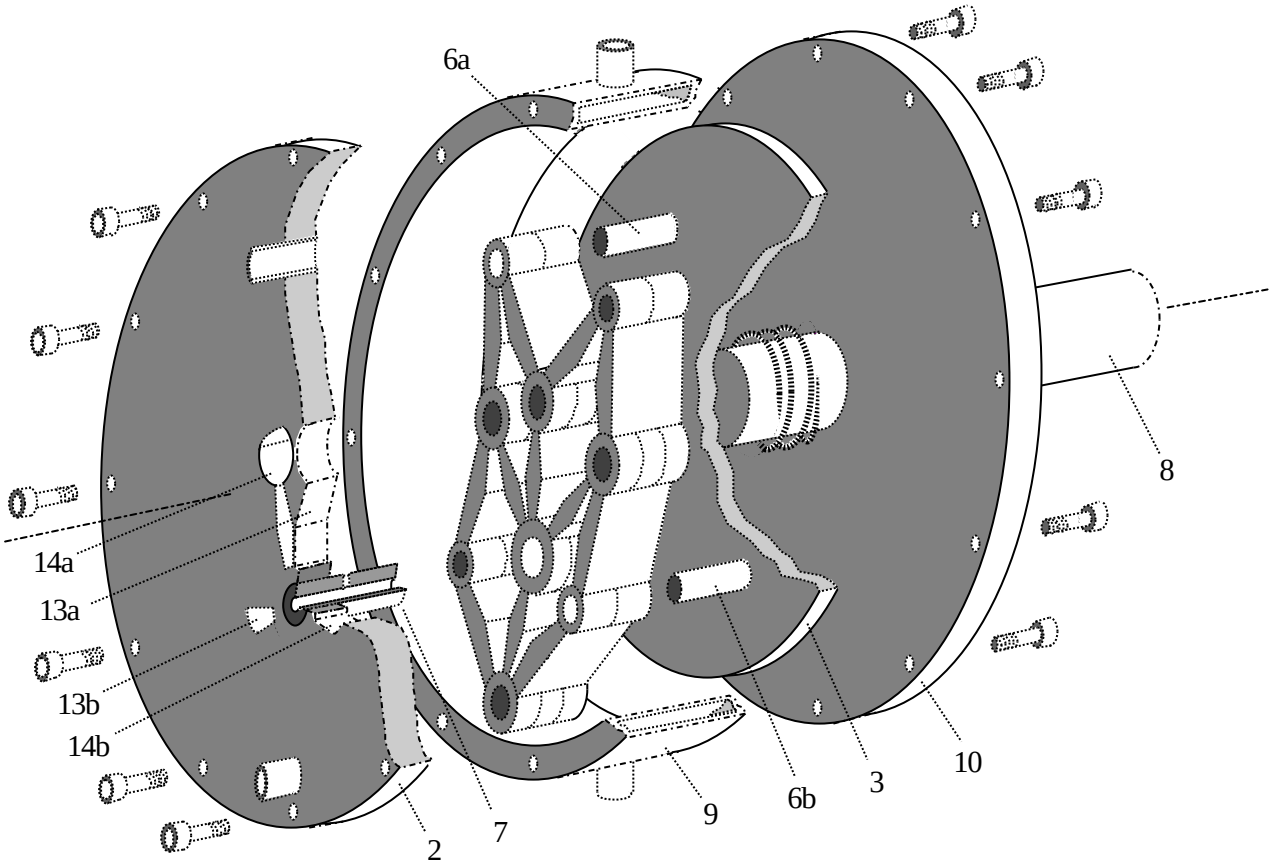


Fig.1

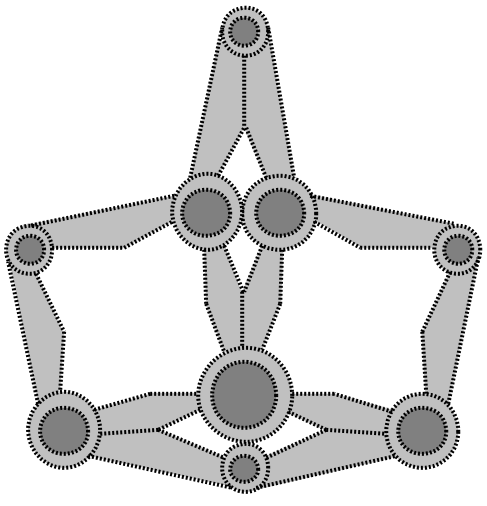


Fig.2

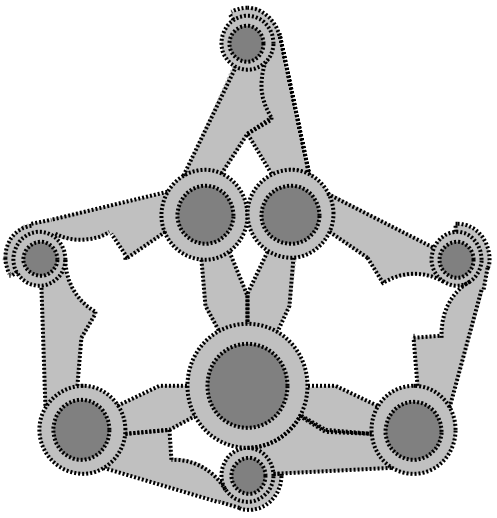


Fig.3