May 16, 1967

E. HÉJJ ETAL

3,319,610

CIRCULAR PISTON MACHINE

Filed Feb. 28, 1964

Fig. 1

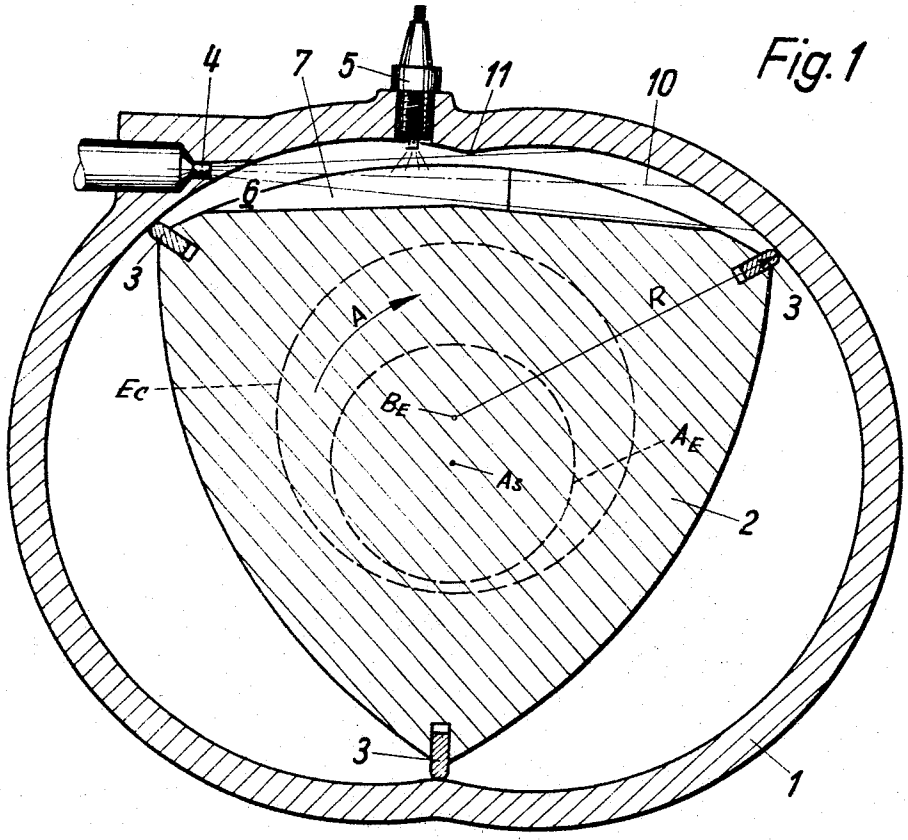
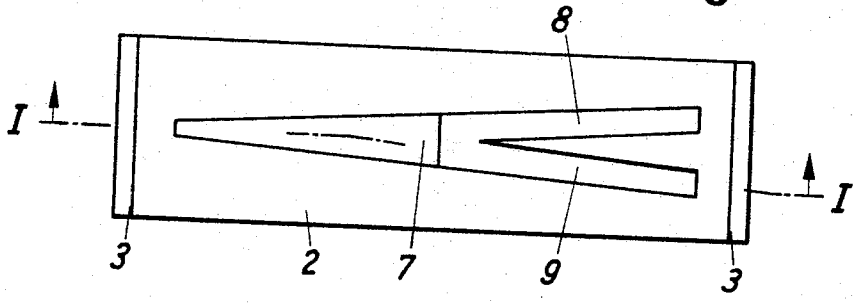


Fig. 2



Inventors:
Erwin Héjj
Eberhard Fezer
By Walter Becker

United States Patent Office

3,319,610
Patented May 16, 1967

3,319,610

CIRCULAR PISTON MACHINE

Erwin Héjj, Essen, and Eberhard Fezer, Essen, Bredeney, Germany, assignors to Beteiligungs- und Patentverwaltungsgesellschaft mit beschrankter Haftung, Essen, Germany

Filed Feb. 28, 1964, Ser. No. 348,133
Claims priority, application Germany, Mar. 12, 1963, B 71,080
6 Claims. (Cl. 123—8)

The present invention relates to a circular piston machine, and especially circular piston motor with a triangular rotor, for operation by means of external ignition, while the fuel injection is effected into a trough-shaped recess provided between two adjacent edges of the rotor.

A satisfactory operation of circular piston motors of the above-mentioned type could heretofore not be realized when between two adjacent edges of the rotor there was provided one single combustion chamber trough. Therefore, it has been suggested to provide a plurality of combustion chamber troughs one adjacent the other between two successive edges of the rotor and to provide one spark plug each for each combustion trough. Such an arrangement, however, requires a rather complicated and expensive construction.

It is, therefore, an object of the present invention to provide a circular piston machine which will overcome the above-mentioned drawbacks.

It is another object of this invention to provide a circular piston machine of the above mentioned type with one combustion chamber trough only between two successive edges of the rotor, which will permit a satisfactory operation of the circular piston machine.

It is still another object of this invention to provide a circular piston machine as set forth in the preceding paragraph, which will be characterized by a low load on the driving mechanism and which shows a favorable starting behavior on the one hand and offers the possibility of mixture control and the advantage of insenstivity to fuel quality on the other.

Still another object of the present invention consists in the provision of a circular piston machine as outlined above which will bring about a favorable course of the combustion.

It is also an object of this invention to provide a circular piston machine with a single combustion chamber trough between two successive edges of the rotor, which will bring about a highly satisfactory intermixture of the fuel and the combustion air.

These and other objects and advantages of the invention will appear more clearly from the following specification in connection with the accompanying drawings, in which:

FIG. 1 diagrammatically illustrates a section through a circular piston machine, said section being taken perpendicularly with regard to the axis of rotation of the rotor along the line I—I of FIG. 2.

FIG. 2 is a top view of the rotor shown in FIG. 1.

According to the present invention it has been found that surprisingly it is possible satisfactorily to operate a circular piston machine in which only one combustion chamber trough is provided in the rotor between each

two successive edges thereof, provided that certain conditions are met. More specifically, it has been found that for a satisfactory operation of a circular piston machine of the type just mentioned the combustion chamber trough must be so designed that its volume equals at least 15% of the total volume of the combustion chamber. Moreover, the machine has to be so dimensioned that the maximum turning angle (Schwenkwinkel) of the sealing strips amounts to at least 21° and that an effective compression ratio of at least 10 be realized.

By the maximum turning angle φ is meant the ratio between the eccentricity E (see FIG. 1)—i.e. the distance between the axis A_S of the eccentric shaft A_E and the axis B_E of the eccentric E_C—and the generating radius R—i.e. the distance between the rotor edges from the axis B_E of the eccentric E_C. This may be expressed by the formula

$$\frac{E}{R}=\frac{\sin\varphi}{3}$$

This results in a certain definite shape of the circular piston motor. In addition thereto, the circular piston motor according to the present invention has an effective compression ratio of at least 10, which means that the ratio of the maximum volume of each individual combustion chamber to the minimum volume thereof is at least 10:1.

With further reference to the drawing, it is assumed that the triangular rotor 2 rotates in the housing 1 in the direction of the arrow A. Between each two adjacent edges of the rotor 2, which edges are formed by sealing strips 3, there is provided a combustion chamber trough 7. This combustion chamber trough 7, when facing that inner contour section of housing 1 which in FIG. 1 is located between the upper two sealing strips 3, confines with said inner contour section the minimum volume of the combustion chamber into which fuel is injected from an injection nozzle 4 and is ignited by a spark plug 5. For the sake of convenience, the combustion chamber, as it is formed in this instance, has been designated with the reference numeral 6. The combustion chamber trough 7 extends in circumferential direction of the rotor and gradually widens in said circumferential direction whereby a favorable course of the combustion will be obtained. Moreover, it is advantageous that the walls of the combustion chamber trough are so laid out that the fuel jet during its injection will pass therealong as far as possible without touching the same. This will assure a proper mixture of fuel and air and thereby favor a good combustion. In order to avoid too great an increase in the combustion chamber volume, at least a section of said combustion chamber trough is split into two diverging branches 8 and 9 respectively.

As will be evident from the above and from the drawing, the fuel jet 10 will, when the rotor occupies the position shown in FIG. 1, pass along the walls of the combustion trough 7 substantially without contacting the same and after a certain distance comes within the range of the spark plug 5 which is located near the restriction or axis near zone 11 of the housing 1. The combustion chamber content which during the rotation of the rotor 2 passes

from one side of the axis near zone 11 to the other side thereof will to a major extent pass through the combustion chamber trough 7 and the branches 8 and 9 thereof.

According to a further development of the present invention, the combustion chamber and the combustion chamber trough are so designed that during this last mentioned passage of the combustion chamber contents from one side to the other side of said axis near zone 11, the major portion of said combustion chamber contents, preferably more than 75% thereof, will pass through the combustion chamber trough. The flow velocity obtained in this way in the combustion chamber trough brings about a good intermixture of the fuel and the combustion air.

In order to assure an ignition time which is favorable for the combustion and to secure a favorable location of the spark plug in the combustion chamber, it has been found highly advantageous so to arrange the spark plug or ignition source that the fuel jet which flows substantially tangentially to the direct of rotation of the rotor in the combustion chamber trough, will reach the spark plug after the fuel jet has passed over an inner surface area of housing 1 which corresponds to a sector angle of approximately 30°. As mentioned above, the spark plug is preferably located within the range of the axis near zone 11 and thereby approximately in the center of the minimum volume-combustion chamber.

To adapt the width of the fuel jet to the shape of the combustion chamber and combustion chamber trough, it has been found advantageous to give the fuel jet an opening angle of approximately 15°.

It is, of course, to be understood that the present invention is, by no means, limited to the particular construction shown in the drawing but also comprises any modifications within the scope of the appended claims.

What we claim is:

1. A circular piston machine, especially circular piston motor, which includes: a housing with an epitrochoidal inner contour, a shaft journalled in said housing and provided with an eccentric, a rotary piston rotatable relative to said inner contour of said housing and journalled on said eccentric for rotation relative thereto, said piston being of triangular cross sectional shape so as to have three circumferentially spaced edges extending in the direction of the axis of rotation of said piston, sealing strip means respectively mounted at said edges and contacting said inner contour, said piston having the three areas thereof which are located between said strip means and face said inner contour each provided with a single trough structure only having a volume of at least 15% of the minimum volume confined by said housing and each of said areas of said rotary piston during a complete rotation of the latter, each of said trough structures extending in a direction transverse to the axle of rotation of said rotary piston and substantially circumferentially of the piston, and nozzle means located in said housing and having its mouth opening into an area of said housing which together with said trough structure during a revolution of said rotary piston confines a chamber of minimum volume, said nozzle means injecting fuel into each trough structure substantially in the direction of the longitudinal axis of the respective trough structure and the side walls of said trough structures diverging in the direction of fuel injection so as to be free at least to the major extent from contact with the fuel jet ejected by said nozzle means into the chamber confined by the respective trough structure and the respective adjacent housing inner contour, the effective compression ratio of said machine being at least 10:1, and the maximum turning angle of the sealing strip means being at least 21°, said turning angle being defined by the equation:

$$\sin \varphi = \frac{3E}{R}$$

in which E=the distance between the axis of said shaft and the axis of said eccentric, whereas R=the distance between the axis of said eccentric and the tip of said strip means.

2. A circular piston machine according to claim 1, in which spark plug means are provided in the housing and extend into the interior thereof at a distance from the mouth of said nozzle means in the direction of rotation of said rotary piston which distance corresponds to a sector angle of 30°.

3. A circular piston machine, especially circular piston motor, which includes: a housing with an epitrochoidal inner contour and with two axis-near zones, a shaft journalled in said housing and provided with an eccentric, a rotary piston rotatable relative to said inner contour of said housing and journalled on said eccentric for rotation relative thereto, said piston being of triangular cross sectional shape so as to have three circumferentially spaced edges extending in the direction of the axis of rotation of said piston, sealing strip means respectively mounted at said edges and contacting said inner contour, said piston having the three areas thereof which are located between said strip means and face said inner contour each provided with a single trough structure only in each piston area having a volume of at least 15% of the minimum volume confined by said housing and each of said areas of said rotary piston during a complete rotation of the latter, each of said trough structures extending circumferentially of the piston in a direction transverse to the axis of rotation of said rotary piston, and nozzle means located in said housing and having its mouth opening into an area of said housing which together with said trough structure during a revolution of said rotary piston confines a chamber of minimum volume, said nozzle being near the trailing end of the respective trough structure and injecting fuel in a direction substantially coinciding with the longitudinal axis of the respective trough structure, the minimum volume chamber confined by each trough structure and the respective inner contour portion of the housing extending at both sides of one of said axis-near zones, said chamber being so designed that the major portion of the charge in said chamber during the rotation of said rotary piston from one side of said one axis-near zone will pass through the respective trough structure, each said trough structure diverging in the direction of injection of fuel therein.

4. A circular piston machine according to claim 3, in which said major portion of said charge amounts to at least 75%.

5. A circular piston machine according to claim 3, which includes spark plug means arranged within the range of said one axis-near zone.

6. A circular piston machine, especially circular piston motor, which includes: a housing with an epitrochoidal inner contour, a shaft journalled in said housing and provided with an eccentric, a rotary piston rotatable relative to said inner contour of said housing and journalled on said eccentric for rotation relative thereto, said piston being of triangular cross sectional shape so as to have three circumferentially spaced edges extending in the direction of the axis of rotation of said piston, sealing strip means respectively mounted at said edges and contacting said inner contour, said piston having the three areas thereof which are located between said strip means and face said inner contour each provided with a single trough structure only having a volume of at least 15% of the minimum volume confined by said housing and each of said areas of said rotary piston during a complete rotation of the latter, each of said trough structures extending in a direction transverse to the axis of rotation of said rotary piston, and nozzle means located in said housing and having its mouth opening into an area of said housing which together with said trough structure during a revolution of said rotary piston confines a chamber of minimum volume, the side walls of said trough structures being so

designed as to be free at least to the major extent from contact with the fuel jet ejected by said nozzle means into the chamber confined by the respective trough structure and the respective adjacent housing inner contour, the effective compression ratio of said machine being at least 10:1, and the maximum turning angle of the sealing strip means being at least 21°, said turning angle being defined by the equation:

$$\sin \varphi = \frac{3E}{R}$$

in which E=the distance between the axis of said shaft and the axis of said eccentric, whereas R=the distance between the axis of said eccentric and the tip of said strip means, at least a portion of each trough structure being split into two diverging branches.

References Cited by the Examiner

UNITED STATES PATENTS

2,988,065	6/1961	Wankel et al.	123—8
3,136,302	6/1964	Nallinger et al.	123—8
3,196,852	7/1965	Bentele	123—8
3,213,836	10/1965	Keylwert et al.	123—8

FOREIGN PATENTS

918,651	2/1963	Great Britain.

MARK NEWMAN, *Primary Examiner.*

F. T. SADLER, *Assistant Examiner.*