

Feb. 23, 1937.

R. MABILLE

2,071,799

ROTARY ENGINE

Filed Aug. 27, 1935

2 Sheets-Sheet 1

Fig. 1.

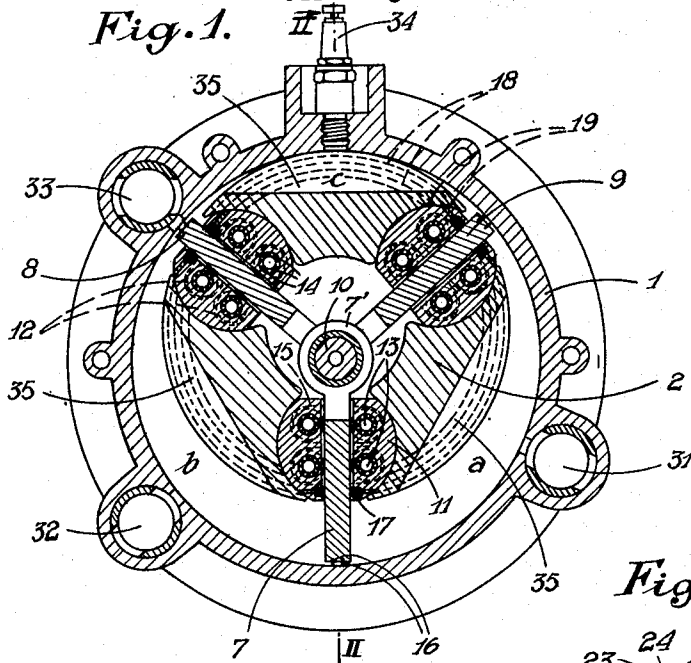


Fig. 2.

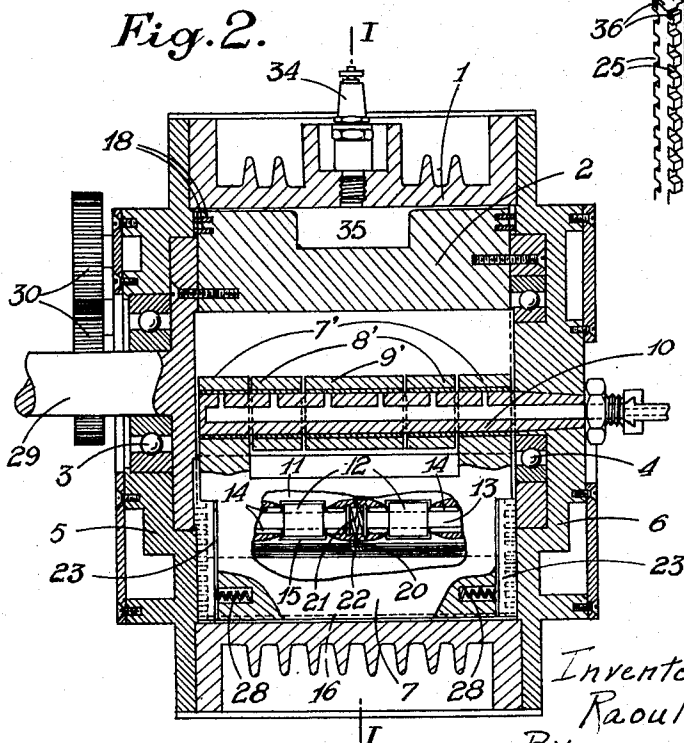
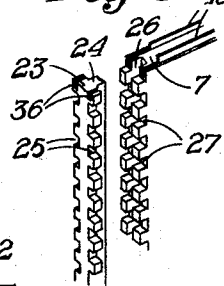


Fig. 3. 16



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Fig. 4.

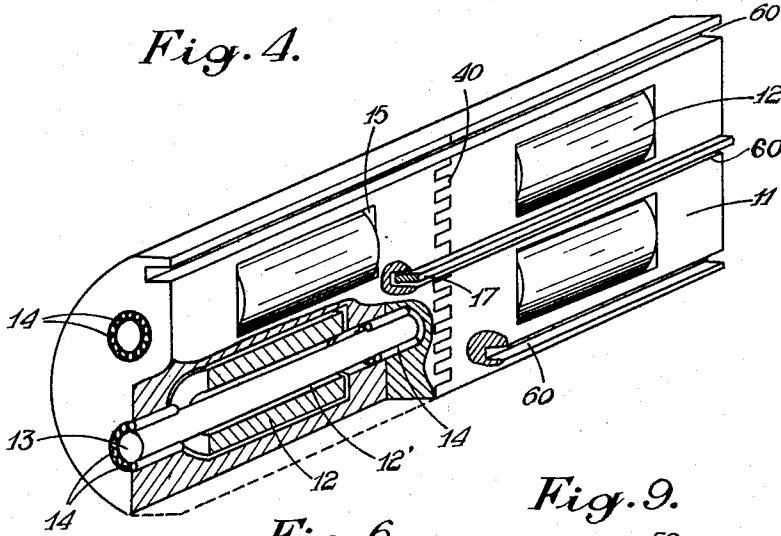


Fig. 6.

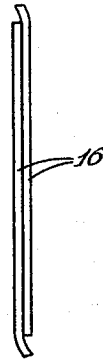


Fig. 9.

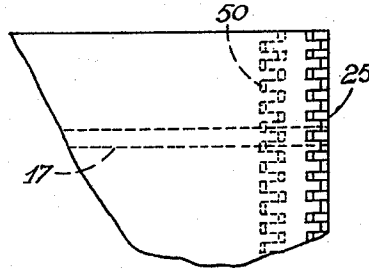


Fig. 5.

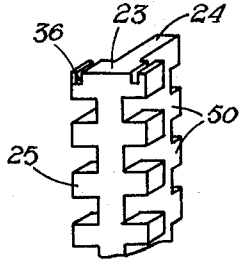


Fig. 8.

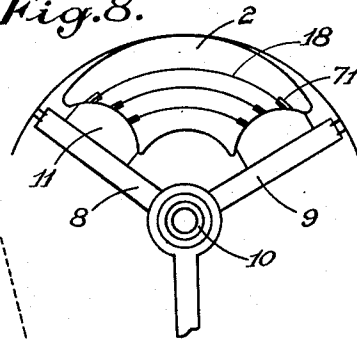
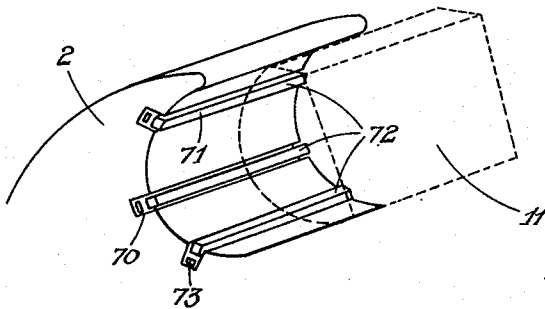


Fig. 7.



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UNITED STATES PATENT OFFICE

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ROTARY ENGINE

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12 Claims. (Cl. 103—144)

The present invention relates to rotary engines or machines of the type comprising, in a cylindrical stator, an eccentric rotor fitted with vanes mounted radially on a shaft coaxial with the stator, said vanes extending through the wall of the rotor in oscillating cylindrical bearings in which they reciprocate while transmitting the drive to the rotor, or inversely. The difficulties which are met with in the practical construction of machines or engines of this kind generally arise, as is shown by experience, from excessive friction due to the reciprocation of the vanes in the bearings, from lack of gas tightness at the joints between the movable and the stationary parts of the engine, as well as from lack of co-operation between the various packing means. It is an object of my invention to overcome these difficulties and to provide a rotary engine or machine of the type referred to which will have an efficiency hitherto unattained.

More particularly an object of my invention is to provide a rotary engine of the type aforesaid wherein the vanes are guided between rollers mounted in the semi-cylindrical halves of the oscillating bearings in which the vanes are to reciprocate. In accordance with my invention, the guiding rollers of the vanes are mounted on spindles which in turn are journaled in antifriction bearings, such as ball bearings or needle bearings, supported in the semi-cylindrical halves of the oscillating bearings, and means are provided on said vanes, oscillating bearings and rotor, for assuring the requisite tightness between the parts in mutual relative motion without impeding the movement of said parts.

As some play should be left between the vanes and the half bearings on either side thereof so that the vanes will contact with the rollers only, I have arranged longitudinally of the vanes, in the half bearings, packing members in the form of blocks at the periphery of the rotor.

I also have observed that in order to obtain an effective operation of the engine, it is desirable that the above-mentioned rollers be arranged in such manner that the vane be guided between at least two pairs of rollers placed side by side, symmetrically, one pair above the other, on either side of the vane. By this arrangement, the harmful effects of forces directed parallel to the faces of the vanes are practically done away with, thus avoiding undue stresses on the vane hubs which are overhung, and preventing any jamming of the bearings.

These advantages may still be further enhanced by mounting the said rollers freely (i. e. with a

certain amount of play) on their shafts, or else, mounting them on their shafts by the intermediary of needle bearings or by the intermediary of anti-friction materials. This construction reduces the effects of friction to a minimum, and avoids the vibratory effects due to the variation of friction stresses between vanes and bearings.

The half-cylindrical bearings themselves should come into close contact with the ends of the stator, at their extremities. For this purpose they are divided, transversely of their length into two or more parts, each of which is pressed against the corresponding stator end by means of a spring. This spring may be common to both parts, and it may be arranged on the roller spindle journaled in the half-bearings. The two half-bearings are rendered interdependent by the two spindles bearing the rollers, and by a packing key.

According to a further feature of the present invention, the two parts of the half-bearings may be rendered independent, by also dividing the said roller spindles into two sections. On the other hand, in order to avoid any leakage between the parts of the half bearings they may be provided with serrations and caused to interengage, one or more springs being interposed between said parts to press them apart, into tight engagement with the stator ends.

Simple rectilinear fittings placed in the grooves of the peripheral faces of the vanes may suffice to ensure a tight joint between the vanes and the cylindrical wall of the stator. However, between the sides of the vanes and the ends of the stator, tightness must be assured not only in a lateral direction, but also radially, that is to say both against the end of the stator and across the bearings which reach as far as the stator ends. The packing of the joint in both directions is obtained by serrating the edges of the groove which is provided in the face of the vane to accommodate the packing and by likewise serrating the wings of the packing members which are conveniently given a T-shaped cross-section. The interengagement of the serrations provides the desired tightness in the radial direction.

The stem of the T member may be plain, but it is preferably serrated and caused to engage the correspondingly serrated bottom of the groove in the vane. By means of this combined arrangement with the above-mentioned serrations, all leakage is absolutely prevented in the radial direction, at the extremities of the vanes.

According to a further feature of the invention, the required tightness between the half-bearings

and the vanes is realized by blocks fitted in longitudinal grooves provided in the bearings, opposite the vanes, the height of the said blocks being greater, on one hand, than the height of a serration of the interengaging parts of the half-bearings, and on the other hand, than the height of a serration of the packing block at the extremity of the vane.

According to still another feature of the invention, the recesses provided in the rotor for the purpose of receiving the half-bearings are provided with grooves in which are fitted packing blocks which extend longitudinally of the bearings, the surface of said blocks adjacent the curved side of the bearing being made concave so that it will exactly fit this curved side.

In accordance with a further feature of the invention, curved packing segments are placed in arcuate grooves in the end faces of the rotor, in such a manner as to ensure tightness between these surfaces and the stator ends; these segments may also engage the rear ends of the packing blocks extending longitudinally of the bearings.

Further details and particulars of the invention will appear in the course of the description of the accompanying drawings, which are given by way of example only:

Fig. 1 is a cross section of the engine, on line I—I of Fig. 2; Fig. 2 is a longitudinal section, on line II—II of Fig. 1, the vane shown in the lower part of the figure being partly broken away so as to show the supporting bearings placed behind it; Fig. 3 shows, on a larger scale, a serrated joint.

Fig. 4 is a perspective view showing one of the half cylindrical bearings, partly broken away; Figs. 5 and 6 show packing blocks and Fig. 7 shows a detail of the rotor. Fig. 8 is a partial end view of the rotor, and Fig. 9 is a side view of a vane.

In the drawings, 1 denotes the cylindrical stator of the engine, 2 is the rotor mounted eccentrically on ball bearings 3, 4 in the ends 5, 6 of the stator, and 7, 8, 9 indicate the radial vanes, three in number, the vanes 7', 8', 9' of which are mounted individually like hinge eyes, on a common shaft 10 which is supported at one end from the stator wall 6, and extends concentrically to cylinder 1.

The vanes project from the rotor through bearings each formed of two half cylindrical members 11 placed in cylindrical recesses of the rotor, on either side of the vane with which they are associated. It is understood that when the eccentric rotor revolves, the bearings reciprocate radially on the vanes by oscillating in their seats, following the inclination of the vanes relatively to the eccentric rotor. Any friction between the bearings and the vanes is avoided by the guiding and supporting rollers 12 which are fitted into each half-bearing 11. These rollers are carried by spindles 13 which rotate in needle bearings 14 fitted in the half cylindrical bearings. Opposite the rollers, the spaces 15 enclosing same, are open towards the vanes as is shown in Fig. 4.

Each vane is guided between rollers symmetrically arranged, one above the other, on either side of the vane. As is shown in Fig. 4, the rollers 12 are mounted freely, that is to say, with some amount of play 12', on their spindles 13. They may also be mounted on needle bearings 14, or anti-friction fittings may be provided between the rollers 12 and the spindles 13.

In the broken part of Fig. 2, it is seen that the half-bearing 11 is divided into two parts by

a medial division 20, and that a coil spring 21 mounted on the spindle 13 tends to press these two parts away from each other in order to apply their side faces against the ends 5 and 6 of the stator. Packing members 22 engaged between the two parts of the bearing close the joint between them.

The spindles 13 may each extend from one end to the other of the half-bearings, and each may carry two rollers situated at the same level. However, these spindles are preferably interrupted at the middle of the half-bearing so as to render each half of the half-bearing entirely independent, which facilitates the mounting and further allows of constructing these halves of half-bearings in series, each of them identical. According to the size of the engine or for reasons of construction, the half-bearings 11 and the spindles 13, may in some cases be divided into more than two parts.

As is shown at 40, in Fig. 4, the two parts of the half-bearings are coupled together and to that end their adjoining faces are provided with interengaging serrations. These serrations may naturally be straight, curved or of zigzag or other suitable shape, to ensure the engagement. In the case of Fig. 4, the two parts of the half-bearing may also be kept apart by one or more springs, (not shown) similar to those shown at 21 in Fig. 2. The constructive arrangement of Fig. 4 is easy to manufacture and it ensures perfect tightness between the parts of the half-bearing. In order to hold the needle bearings 14 in place, I may provide a small cover and a spring in the form of a split ring, not shown.

The side faces of the vanes 7, 8, and 9 which contact with the ends 5 and 6 of the stator, are fitted with serrated packing members, as shown in Fig. 3. Each such member comprises a block 23 of T-shaped cross-section, the stem 24 of which is continuous, whilst the wings have serrations 25.

The serrations may naturally be of straight, zigzag or other shape suitable for interengagement. This interengagement is made with a slight play, permitting all the time a perfect fit of the packing members against the stator ends, even if the vane should not be strictly parallel to the engine shaft. The rotor and the vanes are mounted on their shafts or bearings with a corresponding lateral play, which is favourable to an easy rotation while permitting of ensuring tightness.

The packing in the radial direction is assured by the interengagement of the serrations 25 with complementary serrations 27, cut in the edges of grooves 26 provided in the sides of the vanes and adapted to receive the stem 24. Springs 28 (Fig. 2), fitted in the vanes, force the packing members 23 against the stator ends 5 and 6. Along the outer edges of the vanes the tightness is assured by means of thin blocks 16. Each of these blocks 16 preferably comprises two resilient metal strips having bent ends, the combined length of said strips (Fig. 6) being greater than the distance between the stator ends so that when two such strips are inserted in grooves in the outer edges of the vanes, their outer ends are urged towards the respective stator ends 5, 6. The respective ends of the strips 16 extend into grooves 36 formed in the outer ends of the blocks 23 and they co-operate with them, in such a way that any leakage at the angle is made impossible.

The same arrangement is applicable to all the packing blocks extending longitudinally in the

engine. As is shown in Fig. 5, the stems 24 of the fittings 23 are preferably also serrated as at 50, these serrations co-operating with serrations provided in the bottom of the grooves 26 in the vanes. This arrangement completes the tightness of the joint at both sides of the vanes and allows, in addition, of giving greater play between the vanes and the stator ends, which is essential in the case of engines working at high temperature where provisions must be made to allow for the expansion of such parts as can only be cooled with difficulty.

At the crossing of the bearings by the vanes, I provide packing blocks 17 (Figs. 1 and 4) pressed by a spring (not shown) and arranged in grooves 60 (Fig. 4) provided in the flat faces of the half-bearings. I preferably give these blocks a thickness (measured vertically in Fig. 4) greater than the thickness of the serrations 40 and greater than the height of the serrations 25 of the blocks 23 shown in Fig. 5. The serrations 40 and the serrations 25 moreover are advantageously made of the same height. By this arrangement, a co-operation of the various packings is realized and perfect tightness is obtained.

The half-bearings 11 are placed in part-cylindrical recesses provided in the rotor 2 in which they can oscillate. In order to ensure tightness in the said recesses their walls are provided with grooves 70 (Fig. 7) adapted to receive packing blocks 71. The surfaces 72 of these blocks which come into contact with the half-bearings 11 (outlined in dotted lines) are made concave so as to fit the curvature of the bearings, as shown in Fig. 7. Instead of arranging the blocks 71 in grooves 70 provided in the rotor 2, they may of course be fitted in grooves provided in the bearing itself, but the arrangement shown is the more advantageous.

At the rotor ends, the tightness between the end faces of the latter and the stator ends is assured by arcuate segments 18 engaged in correspondingly arcuate grooves. These packing segments face the stator ends 5 and 6 and are in contact, at their ends with the bearings 11 Fig. 1. In order to provide a tight contact the end surfaces of the segments are made concave so as to fit the concavity of the bearings as is shown at 19 (Fig. 1).

When packing blocks 71 (Fig. 7) are used, which are accommodated in grooves of the rotor, the arcuate segments 18 may be so arranged that they interengage the blocks 71, as shown in Fig. 8.

The engine described has a distribution with rotary slides or valves, controlled from the rotor shaft 29 by means of gears 30. 31 is an inlet valve for the fuel mixture, 32 and 33 are exhaust valves and 34 is a sparking plug.

The vanes, 7, 8 and 9 divide the inside of the stator into three chambers a, b, and c, the volume of each varying during the rotation of the vanes on account of the eccentricity of the rotor, as is well known in the art. Recesses 35 are provided in the periphery of the rotor in order to increase the size of the chambers a, b, c, in each of which the fuel mixture is successively sucked, compressed, ignited and expanded.

It will be understood that the construction described and illustrated is adapted to operate not only for use in an explosion engine or an internal combustion engine, but also in a fluid pressure machine, a pump, a compressor, etc.

Moreover, modifications may be brought about in the form, the number, the constitution and the

nature of the parts described without departing from the scope of the invention as defined in the appended claims. In said claims the term "engine" is to be understood as including a driven machine as well as a power engine.

I claim:

1. In a rotary engine, the combination of a cylindrical stator, two parallel shafts, one being concentric and the other eccentric to said stator, a rotor on said eccentric shaft, bearings in said rotor comprising each two substantially semi-cylindrical members, radial vanes on said concentric shaft, said vanes extending each through said rotor between two of said semi-cylindrical members, needle bearings mounted in said semi-cylindrical members, spindles in said needle bearings extending parallel to said vanes, rollers on said spindles, said rollers bearing against said vanes, packing between said semi-cylindrical members and the associated vanes, packing along the outer edges and the sides of said vanes, and packing along the sides of said rotor.

2. In a rotary engine, the combination of a cylindrical stator, a shaft mounted concentrically and a shaft mounted eccentrically in said stator, a rotor on said eccentric shaft, oscillating bearings in said rotor comprising each a pair of substantially semi-cylindrical members, each of said semi-cylindrical members comprising two serrated interengaging parts capable of longitudinal movement with respect to each other, springs for urging said parts towards the stator ends, radial vanes on said concentric shaft, said vanes extending each between a pair of said semi-cylindrical members, rollers mounted in said semi-cylindrical members for guiding said vanes, continuous packing between said semi-cylindrical members and said vanes, and packing between said semi-cylindrical members and said rotor.

3. In a rotary engine according to claim 2, spindles rotatably mounted in said semi-cylindrical members and extending parallel to said vanes, said rollers being freely mounted on said spindles, said spindles being divided into two sections, one in each part of the semi-cylindrical member in which it is mounted.

4. In a rotary engine, the combination of a cylindrical stator, a shaft mounted concentrically to said stator and projecting into the same, a shaft mounted eccentrically to said stator, a rotor on said eccentric shaft, radial vanes on said concentric shaft, oscillating bearings in recesses of said rotor comprising each two semi-cylindrical half bearings, said vanes extending each between two of said half bearings as far as the inner wall of the stator, spindles in said half bearings extending parallel thereto, rollers rotatably mounted on said spindles, said rollers being in guiding engagement with said vanes, packing between the adjacent faces of said half bearings and said vanes, and packing along the edges of said vanes.

5. In a rotary engine according to claim 4, the packing along the edges of said vanes comprising blocks of T-shaped cross-section, the stems of said blocks fitting in grooves in the side edges of the vanes, the wings of said blocks having serrated end faces, the edges of said grooves being likewise serrated and engaging the said serrated wings.

6. In a rotary engine according to claim 4, the packing along the side edges of said vanes comprising blocks of T-shaped cross-section, the said side edges having grooves adapted to receive the

stems of said blocks, the wings of said blocks having serrations adapted to engage corresponding serrations in the edges of said grooves, the stems of said blocks having serrations adapted to engage corresponding serrations in the bottoms of said grooves.

7. In a rotary engine according to claim 4, the packing along the side edges of said vanes comprising serrated blocks of T-shaped cross-section, the said side edges having serrated grooves adapted to be engaged by said blocks, the packing along the outer edges of said vanes comprising spring packing members adapted to engage the outer ends of said serrated blocks.

8. In a rotary engine according to claim 4, the packing along the side edges of said vanes comprising serrated blocks of T-shaped cross-section, the said side edges having serrated grooves adapted to be engaged by said blocks, the packing along the outer edges of said vanes comprising a pair of resilient strips bent at their ends and tending to move away from each other in the longitudinal direction, said strips engaging the outer ends of said serrated blocks.

9. In a rotary engine according to claim 4, said half bearings being divided transversely into at least two parts, the adjoining faces of said parts having interengaging serrations, means for urging said parts away from one another, packing blocks being provided between said vanes and the adjacent sides of said half bearings, said packing blocks being of greater thickness than said serrations, said blocks being fitted in longitudinal grooves in said half bearings and extending over the combined length of both parts of each half-bearing.

10. In a rotary engine according to claim 4, said half bearings being divided transversely into at least two parts, the adjoining faces of said parts having interengaging serrations, means for urging said parts away from one another,

packing being provided between the recesses in said rotor and the half bearings accommodated in said recesses, said packing comprising blocks of greater thickness than said serrations, said blocks having concave faces fitting the curvature of said half bearings and being arranged in grooves provided in said rotor longitudinally of said half bearings.

11. In a rotary engine according to claim 4, packing between the recesses in said rotor and the half bearings accommodated in said recesses, said packing comprising blocks fitted in longitudinal grooves provided in the walls of said recesses, said blocks having concave outer faces to fit the curvature of said half bearings, and packing between the rotor ends and the adjacent stator ends, said latter packing comprising arcuate segments fitted in arcuate grooves provided in the rotor ends, the ends of said segments bearing against and engaging with said blocks.

12. In a rotary engine, the combination of a cylindrical stator, an eccentric rotor in said stator, a set of radial vanes coaxial with said stator, said vanes extending through said rotor, oscillatory bearings in recesses provided in said rotor comprising each two semi-cylindrical half bearings, spindles in said bearings, rollers loosely mounted on said spindles, said rollers being in guiding engagement with said vanes, packing blocks between said vanes and said half bearings, packing blocks between said half bearings and said rotor, packing segments between the rotor ends and the stator ends, said segments interengaging with said second mentioned blocks, and interengaging packing blocks along the side edges and the outer edges of each vane, the said blocks along the side edges having serrations engaging corresponding serrations provided in said side edges.

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