(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 213 444 A1**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **86110864.5**

(51) Int. Cl.4: **F02F 1/38** , F01L 1/04

(22) Date of filing: **06.08.86**

(30) Priority: **03.09.85 IT 6774985**

(43) Date of publication of application:
11.03.87 Bulletin 87/11

(84) Designated Contracting States:
DE FR GB

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(54) Improvement in cylinder heads for internal combustion engines.

(57) The invention relates to a cylinder head on which a camshaft rotates with its axis disposed to one side of the plane containing the cylinder axes, and comprises a body fixed to the motor crankcase by two sets of tie bolts screwed into said crankcase and a cover fixed to said body; each seat housing the heads of the tie bolts of one of the two sets is positioned below the camshaft axis, and the body comprises a first flat inclined surface which forms an angle of between 0° and 90° with the plane containing the cylinder axes and on which there rests a corresponding flat surface of said body.

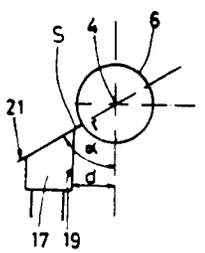

Fig. 2

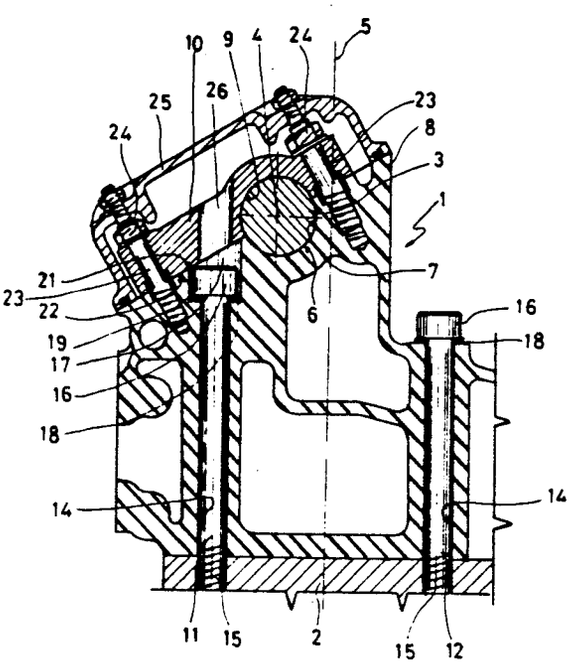

Fig. 1

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IMPROVEMENT IN CYLINDER HEADS FOR INTERNAL COMBUSTION ENGINES

This invention relates to an improvement in cylinder heads for an internal combustion engine, in particular for a direct injection diesel engine, on which a camshaft rotates for operating the engine valves and has its axis disposed to one side of the plane containing the engine cylinder axes.

In cylinder heads of the indicated type, the camshaft is normally supported by sliding bearings, each of which has a first portion formed on the body of the cylinder head and a second portion formed on a cover fixed to this body. This latter is fixed to the engine crankcase by two sets of tie bolts with their threaded shanks screwed into the engine crankcase, a first set being disposed on the aforesaid side of the plane containing the cylinder axes, and the second set being disposed on the opposite side of the plane.

The tie bolt shanks are normally housed in corresponding bores in the body, and their heads are disposed in corresponding seats provided in said body.

Cylinder heads of the indicated type have the following drawback. With them it is normally not possible to arrange the camshaft-operated valves in every given geometrical configuration because the distance of the axis of this valve from the plane containing the axes of the relative cylinders cannot be very large. This is because if this distance exceeds a predetermined value dependent on the geometrical characteristics of the cylinder head, the outer surface of the camshaft can interfere with the seats housing the heads of the said first set of tie bolts. Again, the minimum thickness of the material lying below the cylindrical surfaces of the body and cover which form the sliding bearings for said shaft may be insufficient to ensure adequate bearing strength.

The object of the present invention is to provide a cylinder head for an internal combustion engine of the aforesaid type which is free from the said drawback and in which the distance of the camshaft axis from the plane containing the cylinder axes can be very large to enable the valves to be arranged in any desired geometrical configuration.

This object is attained by an internal combustion engine cylinder head on which a camshaft rotates for operating the valves of said engine and has its axis disposed to one side of the plane containing the engine cylinder axes, said camshaft being supported by sliding bearings each of which has a first portion formed on the body of said cylinder head and a second portion formed on a cover fixed to said body, said body being fixed to the engine crankcase by two sets of tie bolts with their threaded shanks screwed into said crankcase and of which a first set is disposed on said side of the plane containing the cylinder axes and the second set is disposed on the opposite side of said plane, said tie bolt shanks being housed in corresponding bores of said body and the heads of said tie bolts being housed in corresponding seats in said body, characterised in that each of said seats for the heads of the tie bolts of said first set is positioned below said camshaft axis, and said body has a first flat inclined surface which forms an angle of between 0° and 90° with said plane and on which a corresponding flat surface of said cover rests, in such a manner that the minimum thickness of said first bearing portion has a predetermined value.

The present invention will be more apparent from the detailed description given hereinafter by way of example with reference to the accompanying drawings in which:

Figure 1 is a vertical section through part of a direct injection diesel engine cylinder head in which the improvement of the present invention is applied;

Figure 2 represents certain geometrical elements of Figure 1;

Figure 3 is a section through a second embodiment of the cylinder head according to the invention.

The improvement of the invention relates to a direct injection diesel engine cylinder head which is indicated overall by 1 and is fixed to the engine crankcase 2. On this head a camshaft 3 rotates for operating the engine valves (not shown) and has its axis, indicated by the point 4, disposed to one side of the plane containing the engine cylinder axes (plane indicated by the line 5 in Figure 1). The outer surface 6 of said shaft is supported by sliding bearings each of which has a first support surface 7 formed on the body 8 of the cylinder head, and a second support surface 9 formed on one or more cylinder head covers 10 fixed to the body 8.

The body 8 is fixed to the crankcase of the engine 2 by two sets of tie bolts indicated by 11 and 12 respectively, those of the first set being disposed on one side of the plane 5 containing the cylinder axes and those of the second set being disposed on the opposite side of the plane as can be clearly seen in the figures. Each of these tie bolts passes through a correpsonding bore 14 and comprises a lower threaded end 15 screwed into the crankcase 2 and a head 16 which allows the shank to be screwed down. This head is conveniently cylindrical and is provided with a cavity suitably shaped to cooperate with the end of a

suitable operating key. Each head 16 of the tie bolts of the first set of tie bolts 10 is housed in a corresponding seat 17 conveniently defined by a cylindrical surface. In contrast, the heads 16 of the tie bolts of the second set 14 rest on a flat surface of the body 8, a washer 18 being conveniently disposed between each head and the relative support surface.

As can be clearly seen from the figures, each seat 17 is positioned below the axis of the camshaft 3 in such a manner that its cylindrical lateral surface 18 does not interfere with the outer surface 6 of the camshaft 3 but lies a certain distance from this surface. In addition the body 8 is bounded upperly by an inclined flat surface 21 which forms an angle α (Figure 2) of between 0° and 90° with the plane 5 containing the cylinder axes. On this surface there rests a corresponding flat surface 22 of each cover 10. This latter is fixed to the body 8 in any convenient manner, for example by studs 23 fixed to the body 8 and on which nuts 24 are screwed. A covering element 25, fixed to the body 8 by the studs 23, upperly closes the cylinder head.

The angle α can assume any value between 0° and 90°, and is chosen such as to define a required value of the distance s (Figure 2) between the point at which that generating line of the surface 19 closest to the plane 5 intersects the plane 21, and the outer surface 6 of the camshaft 3. This distance s obviously represents the minimum thickness of the sliding bearing which supports the camshaft, and on which the mechanical strength and operating characteristics of said bearing obviously depend. Consequently, with reference to Figure 2, it is apparent that in order to define a required value of s, the angle α must be chosen to satisfy the following relationship between the radius r of the cylindrical surface 6 and the distance d between the said generating line and the point 4:

$$\sin \alpha = d/(r + s).$$

It is therefore apparent that the position of the axis of each tie bolt of the first set 11 and the dimensions of the relative seat 17 can be chosen such that the said distance d is equal to or less than the radius r of the camshaft 3. As can be clearly seen from Figure 2, under these geometrical conditions, by suitably choosing the angle α it is possible to define a minimum thickness s of the bearing for the camshaft 3 which is sufficient for proper operation thereof. The geometrical condition represented diagrammatically in Figure 2 corresponds to that in which the distance d is equal to the radius r of the cylindrical surface 6.

It is therefore apparent that with the described constructional arrangement it is possible to position the axis 4 of the camshaft 3 at a considerable distance from the plane 5 containing the cylinder axes without the risk of interfering with the tie bolts of the first set 14 or with the seats 17 of the tie bolt heads, or of creating minimum thicknesses for the sliding bearing supporting the camshaft 3 which are totally insufficient. By positioning the axis 4 a large distance from the plane 5, a greater freedom is obviously allowed in positioning the axes of the engine valves and thus in the possible choice of geometrical arrangements for the valves themselves.

In each cover 10 there is provided a plurality of holes 26, each of which is coaxial with a corresponding tie bolt of the first set 11 as can be clearly seen in the figures. Each of these holes allows passage of an operating key for screwing said tie bolts, the end of the key having a shape suitable for insertion into the cavity provided in the tie bolt head. The tightness of the tie bolts 11 can thus be periodically checked in a simple and rapid manner without the need to remove the cover 10 from the body 8, but instead by simply removing the covering element therefrom.

The embodiment of Figure 3 differs from that of Figure 1 only by the height of each seat 17, which in this second case is chosen at least equal to the sum of the height of the relative tie bolt head 16 and the length of the threaded tie bolt portion 15 screwed into the corresponding threaded bore of the crankcase 2. With this constructional arrangement the entire cylinder head can be removed from the crankcase 2 without removing the covers 10 from the body. For this purpose it is necessary only to insert a suitable key through the holes 26 and unscrew the tie bolts of the first set 11 until their threaded end 15 has been completely separated from the corresponding threaded bore of the crankcase 2. When this condition has been attained, the tie bolt heads 16 are in their upper limiting position within the relative seats 17.

It is apparent that modifications can be made to the described embodiments of the present invention but without leaving the scope of the inventive idea.

Claims

1. An internal combustion engine cylinder head on which a camshaft rotates for operating the valves of said engine and has its axis disposed to one side of the plane containing the engine cylinder axes, said camshaft being supported by sliding bearings each of which has a first portion formed on the body of said cylinder head and a

second portion formed at least on a cover fixed to said body, said body being fixed to the engine crankcase by two sets of tie bolts with their threaded shanks screwed into said crankcase and of which a first set is disposed on said side of the plane containing the cylinder axes and the second set is disposed on the opposite side of said plane, said tie bolt shanks being housed in corresponding bores of said body and the heads of said tie bolts being housed in corresponding seats in said body, characterised in that each of said seats for the heads of the tie bolts of said first set is positioned below said camshaft axis, and said body has a first flat inclined surface which forms an angle of between 0° and 90° with said plane and on which a corresponding flat surface of said cover rests, in such a manner that the minimum thickness of said first bearing portion has a predetermined value.

2. A cylinder head as claimed in claim 1, characterised in that said first inclined surface passes through said camshaft axis.

3. A cylinder head as claimed in one of claims 1 or 2, characterised in that each of said covers is fixed to said body by fixing members provided with shanks which are inserted into bores in said body and are disposed on opposite sides of said camshaft, said tie bolts of said first set being disposed between said camshaft and said fixing member located on one side of said camshaft.

4. A cylinder head as claimed in one of the preceding claims, characterised in that the minimum distance of the surface defining each of said seats for the heads of the tie bolts of said first set from said camshaft axis is equal to or less than the radius of said camshaft.

5. A cylinder head as claimed in one of the preceding claims, characterised in that the angle α formed by said first inclined surface with said plane is chosen in such a manner as to satisfy the relationship:

$$\sin \alpha = d/(r + s)$$

where s is the distance between said camshaft and the point of intersection of that generating line of said surface defining each of said head seats which is closest to said camshaft and said first flat surface,

d is the distance between said generating line and said plane containing the cylinder axes, and

r is the camshaft radius.

6. A cylinder head as claimed in one of the preceding claims, characterised in that in each cover there are provided through bores, each of which has its axis coinciding with the axis of one of said tie bolts of said first set, the diameter of said bore being chosen to enable insertion therein of a key able to cooperate with the head of the corresponding tie bolt, so as to screw down the tie bolt and adjust its tightness.

7. A cylinder head as claimed in claim 6, characterised in that the height of each of said seats for the heads of the tie bolts of said first set is substantially equal to the height of the head of the relative tie bolt.

8. A cylinder head as claimed in one of claims 1 to 6, characterised in that the height of each of said seats for the heads of the tie bolts of said first set is at least equal to the sum of the height of the head of the relative tie bolt and the length of that threaded portion of the tie bolt which is screwed into the corresponding threaded bore of the crankcase, so as to be able to remove said cylinder head from said crankcase without separating said cover from said body.

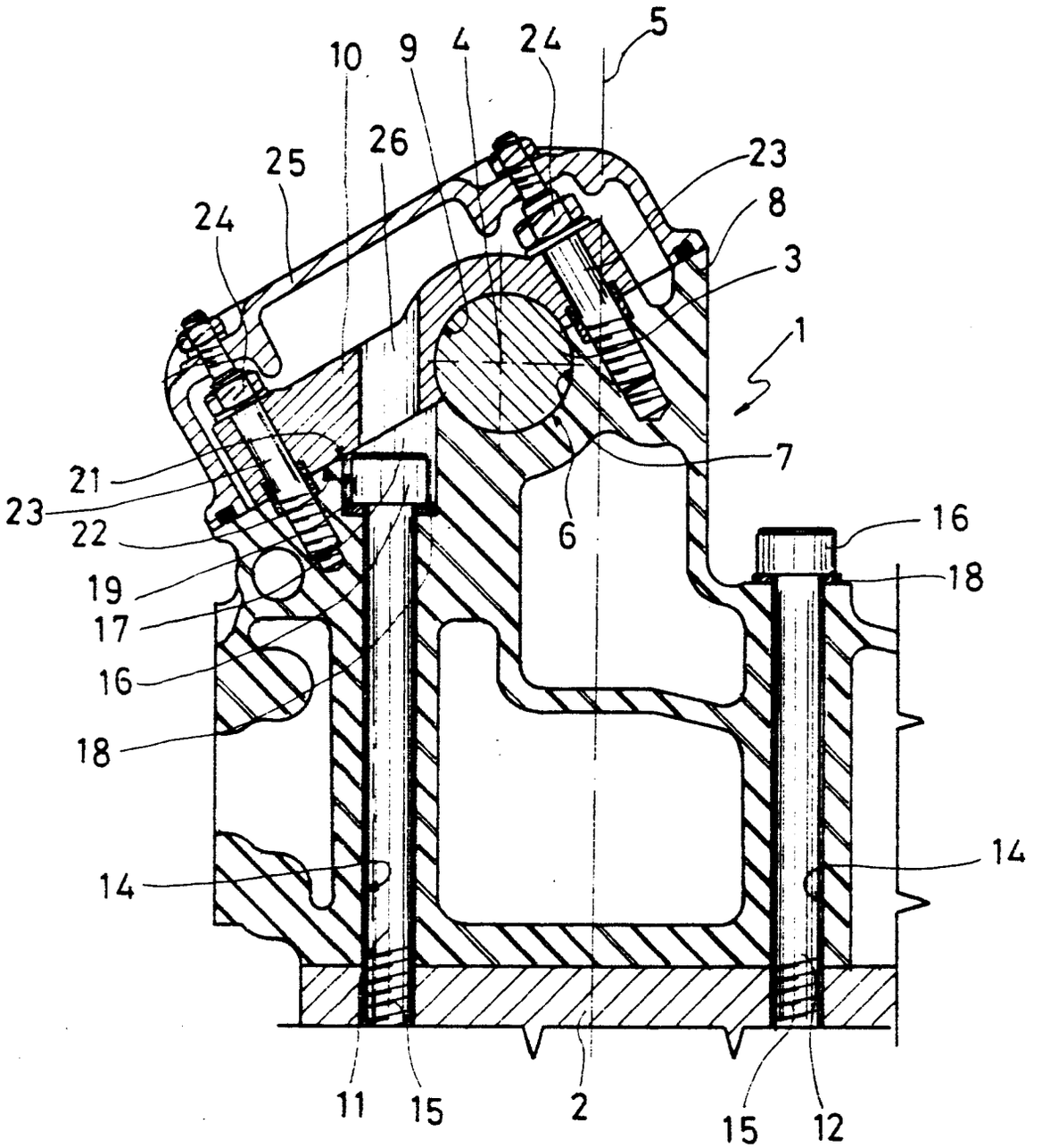
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Fig. 1

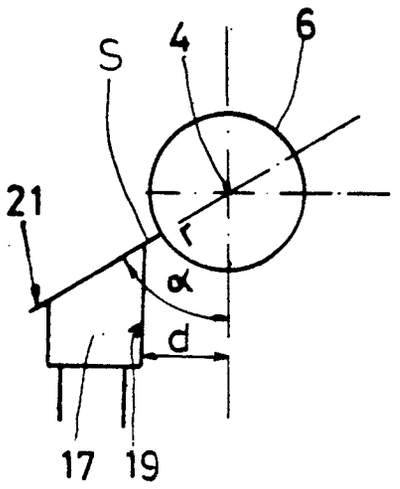
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Fig. 2

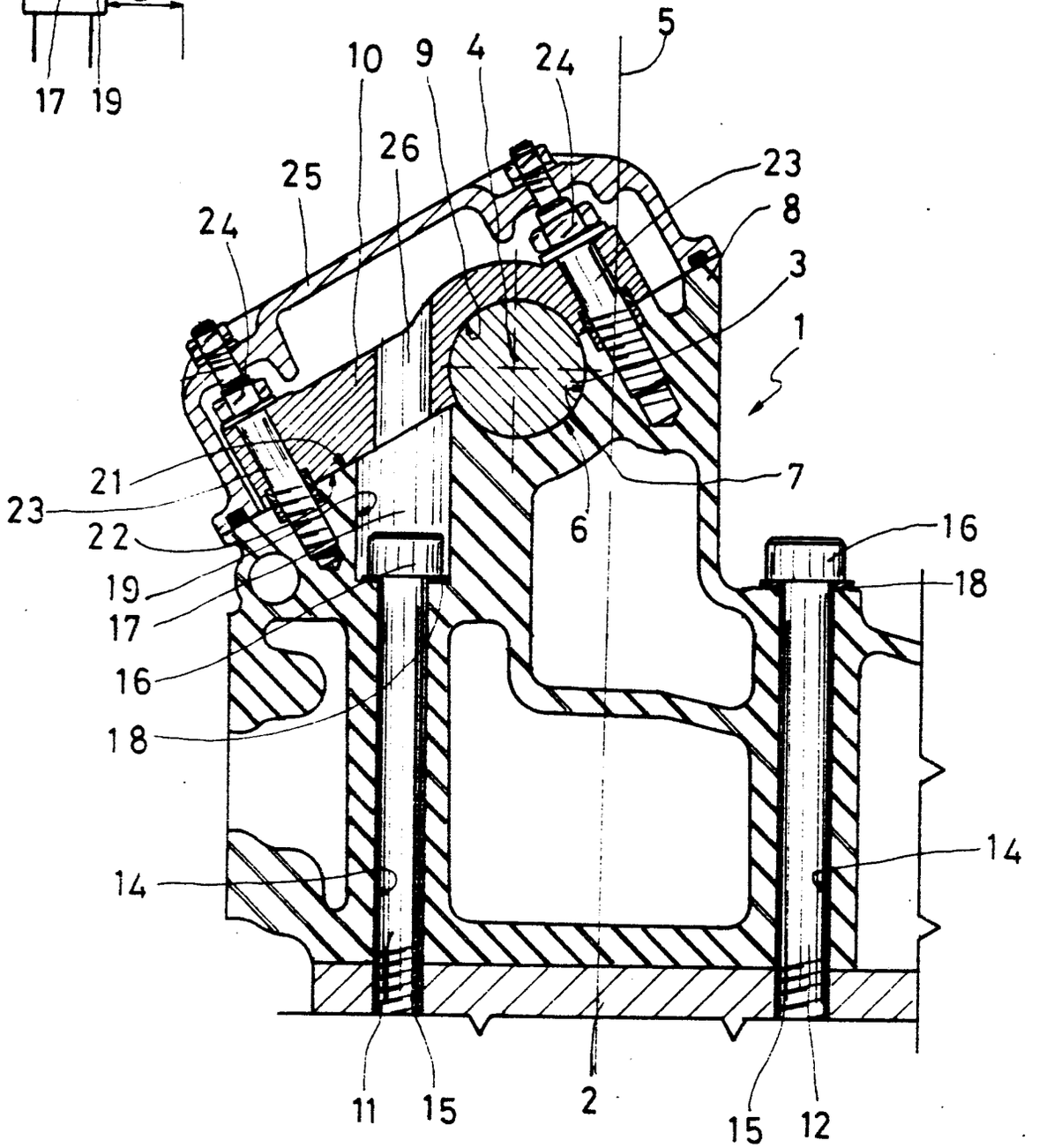
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Fig. 3

European Patent Office

EUROPEAN SEARCH REPORT

Application number

EP 86 11 0864

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	DE-C-3 209 901 (AUDI) * Figure 1; column 2, lines 38-60 * ---	1	F 02 F 1/38 F 01 L 1/04
A	US-A-2 016 734 (WITTENBERG) * Figure 1; page 1, lines 1-51 * ---	1	
A	US-A-3 672 338 (ISUZU) -----		

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

F 02 F
F 01 L
F 02 B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	29-10-1986	WASSENAAR G.

CATEGORY OF CITED DOCUMENTS

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