Dec. 2, 1952 C. N. GOLDSMITH 2,619,948

DECOMPRESSION MECHANISM FOR RECIPROCATING INTERNAL-COMBUSTION ENGINES

Filed Nov. 30, 1949

3 Sheets-Sheet 1

FIG. 1.

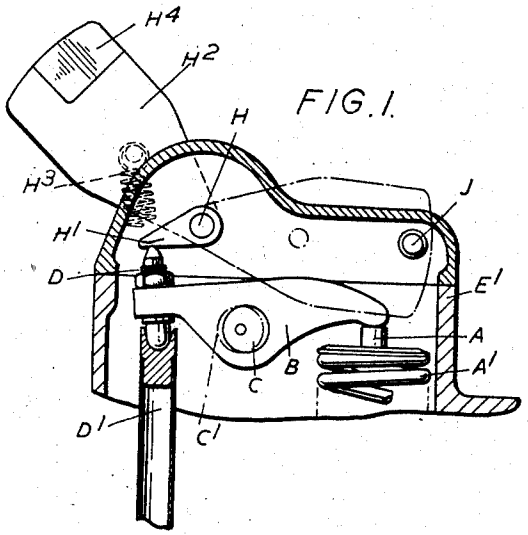


FIG. 3.

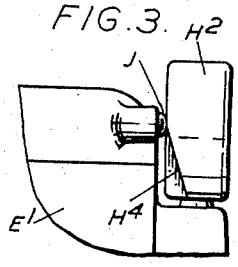
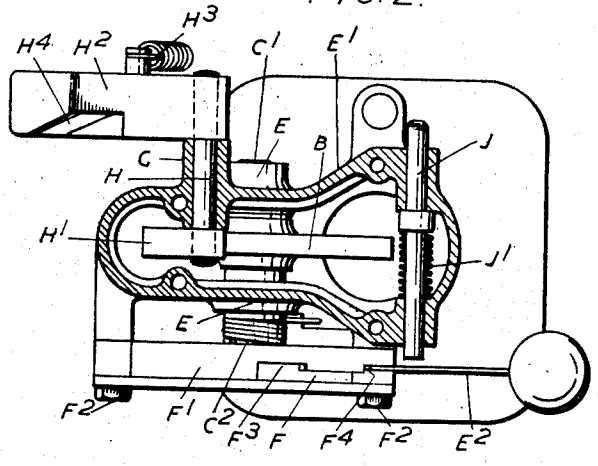


FIG. 2.



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FIG. 4.

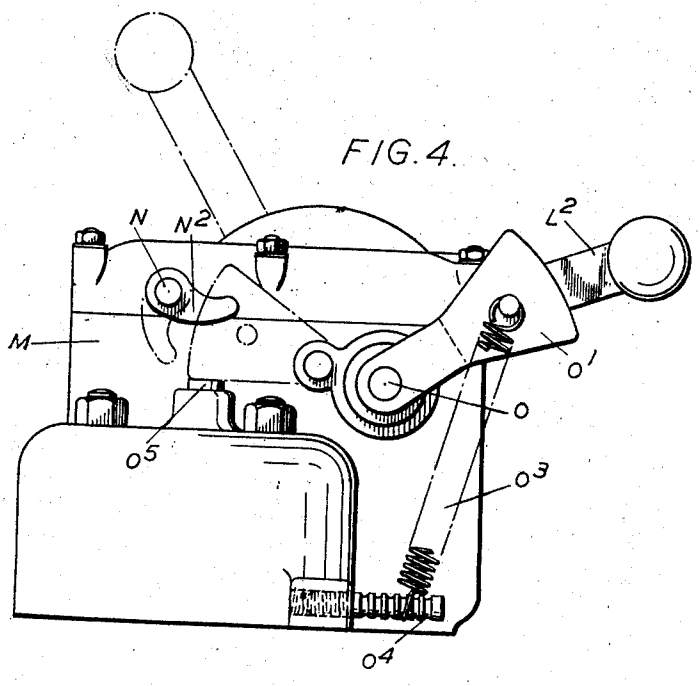
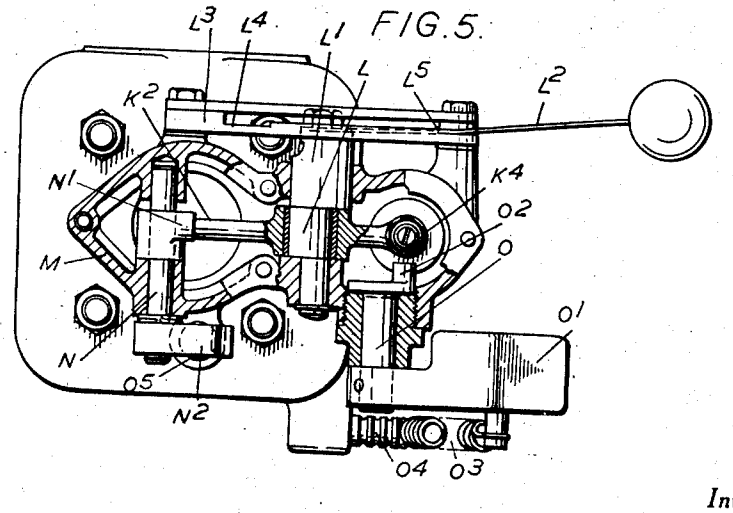


FIG. 5.



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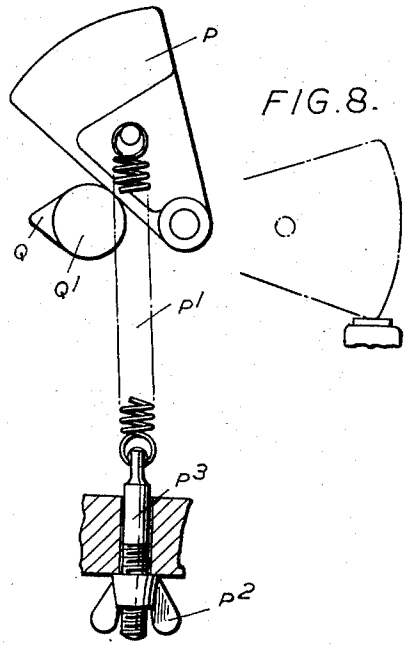


FIG. 8.

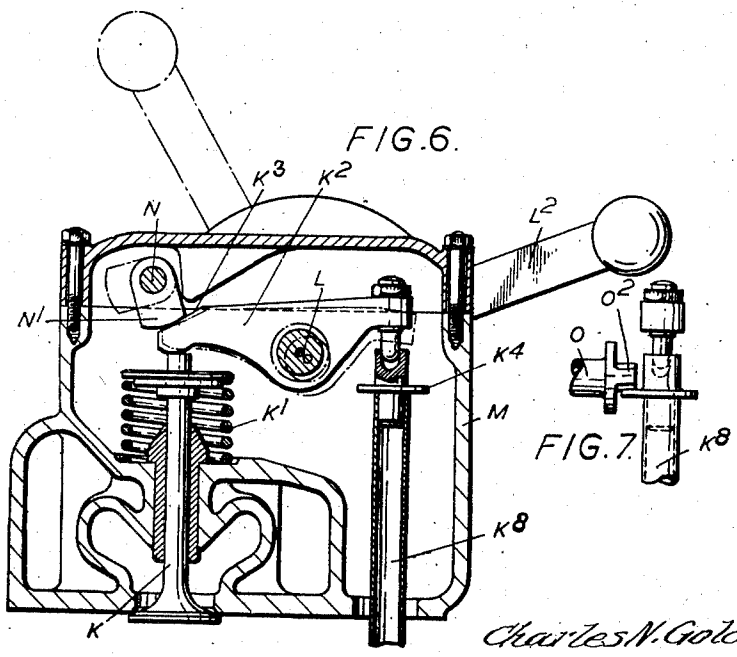


FIG. 6.

FIG. 7.

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UNITED STATES PATENT OFFICE

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DECOMPRESSION MECHANISM FOR RECIPROCATING INTERNAL-COMBUSTION ENGINES

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Application November 30, 1949, Serial No. 130,324
In Great Britain December 14, 1948

10 Claims. (Cl. 123—182)

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This invention relates to reciprocating internal combustion engines having decompressing mechanism, that is to say mechanism which, during the starting period occupies a "starting" position in which it maintains a port in the cylinder or each cylinder open so as to reduce or eliminate compression within the cylinder and thus facilitate the rotation of the engine for starting purposes up to an appropriate speed, whereupon the decompressing mechanism is moved into a "running" position in which it is inoperative.

The invention is concerned with internal combustion engines of the above kind having a port in the cylinder or each cylinder controlled by a poppet valve, and decompressing mechanism which in the "starting" position maintains the poppet valve lifted from its seat so as to facilitate rotation of the engine whereas in the "running" position it permits the valve to seat normally. The invention is particularly applicable to engines in which the poppet valve acted upon by the decompressing mechanism is a normal inlet or exhaust valve taking part in the normal operation of the engine, but it may also be applied to engines in which the valve is a special decompressing valve which during normal operation of the engine remains permanently closed.

In the usual known decompressing arrangements for engines of the kind referred to, the decompressing mechanism is either arranged to be moved from its "starting" into its "running" position by the operator when he considers that a sufficient rotational speed has been imparted to the engine, or means are provided for moving the decompressing mechanism from its "starting" into its "running" position automatically after a predetermined number of revolutions have been imparted to the engine crankshaft from a state of rest.

The object of the present invention is to provide an engine of the kind referred to having an improved arrangement of decompressing mechanism.

An internal combustion engine of the kind referred to according to the present invention has in combination with a port in the cylinder or each cylinder controlled by a poppet valve and decompressing mechanism which in a "starting" position maintains the valve lifted from its seat and in a "running" position permits the valve to seat normally, mechanism arranged to be moved by and to be responsive to the speed of movement of a moving part of the engine and arranged automatically to cause movement of the decompressing mechanism from its "starting" to its "running" position when the engine, during the starting period, reaches a predetermined speed.

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It will be understood that in speaking in the present specification of the speed of the engine the speed of movement of its moving parts is meant.

In a convenient arrangement according to the invention an inertia member is arranged to have movement against the action of gravity and/or a spring imparted to it intermittently in one direction relatively to a part supporting it by reason of the movement of a moving part of the engine during the starting period in association with means whereby when it moves beyond a predetermined point relatively to the part supporting it by reason of its inertia or the momentum imparted to it by the action thereon of the moving part, it automatically causes movement of the decompressing mechanism into its "running" position.

In such an arrangement the inertia member is conveniently in the form of a pivoted weight which is mounted to rock about a fixed axis and, during the starting period, is rocked intermittently in one direction against the action of gravity and/or a spring towards a dead centre position and, when it moves by reason of its momentum, over that dead centre position travels automatically under the action of gravity and/or the spring through a further path to cause the decompressing mechanism to move to its "running" position.

In a convenient arrangement the inertia member has its intermittent movement imparted to it by a cam on a cam-shaft forming part of the engine and either directly or through intermediate mechanism such as the tappet mechanism or push rod and rocker mechanism serving normally in the usual manner to operate the valve which is to be lifted by the decompressing mechanism during the starting period.

Further the action of the inertia member may be either to trip the decompressing mechanism which then moves under the action of a spring into its running position or to move such mechanism by reason of the weight and/or momentum of the inertia member with or without the assistance of a spring.

The invention may be carried into practice in various ways but two constructions according to the invention are illustrated, together with a modification thereof, in the accompanying drawings, in which,

Figure 1 is a sectional side elevation of one construction,

Figure 2 is a sectional plan of the construction shown in Figure 1,

Figure 3 is an end elevation of a part of the construction shown in Figures 1 and 2,

Figure 4 is a side elevation of an alternative construction according to the invention as applied to an engine incorporating the invention forming the subject of British patent application No. 7,753 of 1948,

Figure 5 is a sectional plan of the construction shown in Figure 4,

Figure 6 is a sectional side elevation of the construction shown in Figures 4 and 5,

Figure 7 is an end elevation of part of the mechanism in the construction shown in Figures 4, 5 and 6, and

Figure 8 is a diagrammatic illustration of a modified arrangement according to the invention.

In the construction illustrated in Figures 1, 2 and 3 of the engine, which may be of the two-stroke or four-stroke type, has an overhead exhaust valve A actuated by push rod and rocker mechanism of conventional type and, for the purpose of illustrating the invention, only the valve rocker housing and its associated parts are shown.

As shown the valve A constituting the exhaust or inlet valve of the engine, has the usual valve spring A^1 and is arranged to be operated by a rocker B pivoted at C and acted upon, through an adjusting screw D by the upper end of a push rod D^1 the lower end of which is actuated by a cam in the usual manner.

In the construction illustrated the pivot C for the rocker B is constituted by an eccentric pin on a shaft C^1 supported in bearings E in the rocker housing E^1 and having rigidly secured to one end thereof a control lever E^2 movable in a slot F in a guide member F^1 secured by bolts F^2 to the rocker housing E^1. The slot F has two notches F^3, F^4 formed in the inner wall at the respective ends of the slot, and the lever E^2 is in the form of a resilient strip so that it tends to enter and remain in one or other of the two notches F^3, F^4 according to the end of the slot at which the lever for the moment lies.

The arrangement and the eccentricity of the pin C is such that when the lever E^2 occupies the notch F^4 as shown in Figure 2 the valve A will be maintained permanently lifted, whereas when the lever E^2 occupies the notch F^3 the valve A will be operated normally.

Supported in a bearing G in the rocker housing E^1 is a shaft H to the inner end of which is rigidly connected a finger H^1 while its outer end has rigidly mounted on it a weight H^2 acted upon by one end of a tension spring indicated at H^3. Mounted to slide in the rocker housing E^1 is a push rod J acted upon by a compression spring J^1 and so arranged that if it is moved against the action of this spring when the lever E^2 occupies the position shown in Figure 2 the push rod J will dislodge the lever E^2 from the notch F^4, whereupon the lever will move automatically under the action of the valve spring A^1 (acting through the rocker B and pin C) assisted if necessary by a spring wound round the pin C as shown at C^2 along the slot F into the notch F^3.

The weight H^2 is formed with a cam surface H^4 adapted to cooperate with the push rod J in the manner hereinafter described.

When the engine is to be started the lever E^2 is moved into the notch F^4 to maintain the valve A lifted and the weight H^2 is moved into the position shown in full line in Figures 1 and 2, in which it will be seen that the finger H^1 rests upon the upper end of the adjusting screw D and tends to be maintained in contact therewith both by the weight H^2 and the action of the tension spring H^3 thereon.

The engine is now rotated by hand or by power starting apparatus and it will be seen that each time the rocker B is rocked by the periodic rise of the push rod D^1, the shaft H and weight H^2 will be rocked clockwise in Figure 1 through the finger H^1. Up to a certain speed of rotation the momentum given to the weight H^2 during each upward movement of the push rod D^1 will be insufficient to carry the weight over its dead centre against the action of its own weight and the force of the spring H^3. When, however, the speed of rotation reaches a predetermined value the momentum of the weight H^2 will carry it over its dead centre, thereupon its weight, now assisted by the tension of the spring H^3, will carry it into the position shown in chain line in Figure 1 and in full line in Figure 3.

Towards the end of its travel into this position the cam surface H^4 will act on the push rod J to cause it to push the lever E^2 out of the notch F^4, whereupon this lever will move along the slot F into the notch F^3 in the manner above explained so that the valve A is enabled to begin its normal operation.

In the construction shown in Figures 4, 5, 6 and 7 the engine is of the kind forming the subject of British patent application No. 7,753 of 1948, that is to say is a two stroke engine having piston controlled scavenging ports and an exhaust port controlled by a mechanically operated poppet valve in the cylinder head and including means whereby the exhaust valve timing can be given a special setting during the initial running period after starting.

In this construction the exhaust valve K, having the usual spring K^1, is operated by a rocker K^2 pivoted at L and acted upon by a cam-operated push rod K^3 in usual manner. The pivot L is in the form of an eccentric pin on a shaft L^1 carried in bearings in the rocker housing M and this shaft has rigidly mounted on one end thereof a lever L^2 moving a slot in a guide member L^3 having notches L^4, L^5 at its ends to retain the lever in whichever of its two end positions it occupies at any moment. The arrangement is such that when the lever L^2 occupies the position shown in chain lines in Figures 4, 5 and 6 the valve K is operated normally, whereas when the lever L^2 occupies its other position as shown in full line in Figures 4 and 6 the valve opens later and closes earlier than normally for the purpose of providing an increased effective compression ratio during the period of running on and immediately after starting.

Also mounted in bearings in the rocker housing M is a shaft N carrying a cam or step N^1, when in the position shown in full line in Figure 6 cooperates with a ramp K^3 on the rocker K^2 and thus maintains the valve K lifted for decompressing purposes but, when moved into the position shown in chain line in Figure 6, permits free operation of the valve. The shaft N also carries at one end a finger N^2 which, when the cam N^1 occupies the position shown in full line in Figure 6 occupies the position shown in full line in Figure 4.

A third shaft O is also mounted in a bearing within the rocker housing M and carries a weight O^1 at the outer end and an eccentric pin O^2 at its inner end arranged to be engaged by a collar

K^4 on the push rod K^8 as shown, the weight O^1 being acted upon by one end of a tension spring O^3 the other end of which is anchored in an adjustable manner to an anchoring pin O^4 as shown.

The operation of the apparatus is as follows:

When the engine is to be started the lever L^2 is to be in the position shown in chain dot lines in Figures 4 and 6 in which, as explained, gives the normal full period valve timing. The weight O^1 is rocked into the position shown in Figures 4 and 5 and the shaft N is rocked by means of the finger N^2 into the position shown in full lines in Figures 4, 5 and 6.

The engine is now rotated by hand or by power operated starting mechanism and it will be seen that each time the push rod K^8 rises the collar K^4 will cut through the pin O^2 to rock the shaft O through and thus rock the weight O^1. The movement of the push rod K^8 is insufficient positively to move the weight O^1 over its dead centre position so that, when the engine is only rotated comparatively slowly the weight O^1 returns to the position shown in Figures 4 and 5 each time the push rod K^8 descends. When the speed of rotation of the engine reaches a certain predetermined value however, the momentum imparted to the weight O^1 by the more rapid upward movement of the rod K^8 will carry the weight O^1 over its dead centre with the result that it will fall under its own weight, assisted by the tension of the spring O^3, into engagement with the finger N^2 which it will thus force round into the position shown in chain line in Figure 4, as the weight finally drops on to a resilient stop indicated at O^5. It will be seen that the movement thus imparted to the finger N^2 will rock the shaft N and the cam or stop N^1 so that the latter is moved into the position shown in chain line in Figure 6, thus permitting the valve K to close and therefore to be opened only at the required times by the action of the push rod K^8. The engine will thus be enabled to start, the timing of the valve K being such at the moment however as to provide an effective compression ratio higher than that during normal running in accordance with the invention forming the subject of British patent application No. 7,753 of 1948 in view of the position of the lever L^2, as explained above.

At an appropriate time after the engine has started to run under its own power the lever L^2 is moved by hand into the position shown in chain lines in Figures 4, 5 and 6 so that the timing of opening and closing of the valve K becomes that appropriate to normal running conditions.

It will be seen that the tension spring O^3 assists both in preventing the weight O^1 being thrown over its dead centre at too low a speed during the initial rotation of the engine prior to starting and also assists in moving the weight into the position shown in chain line in Figure 4 after it has been thrown over its dead centre. It will also be seen that by adjusting the point of anchorage of the lower end of the spring O^3 on the anchoring pin O^4 by moving that end of the spring into one or other of the series of circumferential grooves shown in the pin O^4, the speed at which the engine must be rotated before the weight O^1 will be thrown over its dead centre can be controlled within limits.

In the modification diagrammatically illustrated in Figure 8 a weight P is shown as acted upon by a tension spring P^1 and is adapted to

operate for example in the same general manner as the weight O^1 in the construction shown in Figures 4, 5 and 6 to render decompressing apparatus inoperative. The weight P, however, instead of being acted upon indirectly through a shaft O and pin O^2 by a push rod is acted upon directly, when in its starting position by a cam Q on a cam shaft Q^1 which rotates when the engine rotates. Such an arrangement would be suitable for example for use in an engine having an exhaust valve operated by an overhead cam shaft through a rocker in conventional manner in which case the cam shaft Q^1 would constitute the overhead cam shaft, and the valve would be held open for decompressing purposes by a cam or stop similar to the cam N^1 and arranged on a shaft with a finger similar to the finger N^2 adapted to be engaged and moved by the descent of the weight P into the position shown in chain line in Figure 8 in the same manner as the finger N^2 is moved in Figures 4, 5 and 6 by the weight O^1.

In this modified arrangement the spring P^1 is adjustable at the tension by means of an adjusting nut P^2 on an anchoring pin P^3 for the purpose of enabling the engine speed at which the weight will be thrown over its dead centre to be varied.

It will be understood that in some cases a weight such as the weight H^2, O^1 or P may be used without a tension spring such as H^3, O^3 or P^1 while in other cases it might prove convenient to arrange the weight so that it rocks in a substantial horizontal plane in which case the final movement of the weight to move the decompressing mechanism into its inoperative position would be effected wholly or mainly by a spring arranged similarly to the spring H^3, O^3 or P^1.

I claim:

1. An internal combustion engine having a port controlled by a poppet valve, and decompressing mechanism which has a starting position in which said valve is lifted from its seat and a running position in which the valve is permitted to seat normally, comprising an inertia member subject to a restoring force, engine-operated means for striking said member intermittently to move it against said restoring force, and means operated by said inertia member to move said decompressing mechanism from said starting position to said running position when said member reaches a predetermined position due to the momentum imparted to it by said engine-operated means.

2. An internal combustion engine according to claim 1, wherein said inertia member is pivoted on a fixed pivot and said engine-operated means acts to rock said member on its pivot, and when said member has rotated through a predetermined angle against said restoring force said force acts in a direction to continue the rotation of said member towards said predetermined position.

3. An internal combustion engine according to claim 1, wherein said valve is opened by a rocker arm operated by an engine-driven cam shaft through a push rod, and said means for striking said inertia member is operated by said push rod.

4. An internal combustion engine according to claim 1, wherein said valve is opened by a rocker arm and said decompressing mechanism comprises a pivot on which said rocker arm pivots, said pivot being fixed eccentrically on a shaft, which is rotatable between a starting position in which said valve is held open and a running

position in which the valve is permitted to close, and said means operated by said inertia member is arranged to rotate said shaft from said starting to said running position.

5. An internal combustion engine according to claim 1, wherein said valve is opened by a rocker arm and said decompressing mechanism comprises an abutment which is movable between a starting position in which it abuts on said rocker arm and holds the valve open and a running position in which it leaves the rocker arm free, and said means operated by said inertia member is arranged to move said abutment from said starting to said running position.

6. An internal combustion engine according to claim 1 wherein said means operated by said inertia member is held in its starting position against the action of a spring by a catch mechanism and said inertia member acts to release said catch mechanism to allow said means to move to its running position under the action of said spring.

7. An internal combustion engine according to claim 1, wherein adjusting means are provided for adjusting the predetermined engine speed at which said means is operated by said inertia member.

8. An internal combustion engine according to claim 1, wherein said inertia member is under the restoring force of a spring, adjusting means are provided for adjusting the predetermined engine speed at which said means is operated by said inertia member, and said adjusting means comprises means for varying the effective point of anchorage of the spring.

9. An internal combustion engine according to claim 1, wherein said inertia member is under the restoring force of a spring, adjusting means are provided for adjusting the predetermined engine speed at which said means is operated by said inertia member, and said adjusting means comprises means for varying the tension of the spring.

10. An internal combustion engine which comprises an exhaust port controlled by a poppet valve; decompressing mechanism having a starting position in which said valve is lifted from its seat and a running position in which the valve is permitted to seat normally, and comprising an inertia member subject to a restoring force, engine-operated means for striking said member intermittently to move it against said restoring force, and means operated by said inertia member to move said decompressing mechanism from said starting to said running position due to the momentum imparted to it by said engine-operated means; and means for retarding opening and advancing closing of said valve to facilitate starting of the engine, said last-named means being unaffected by movement of the decompressing mechanism from said starting to said running position.

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