Nov. 3, 1964 G. A. MacSWEEN 3,155,180

DRILL BIT WITH FLUID PASSAGES

Filed April 27, 1962 3 Sheets-Sheet 1

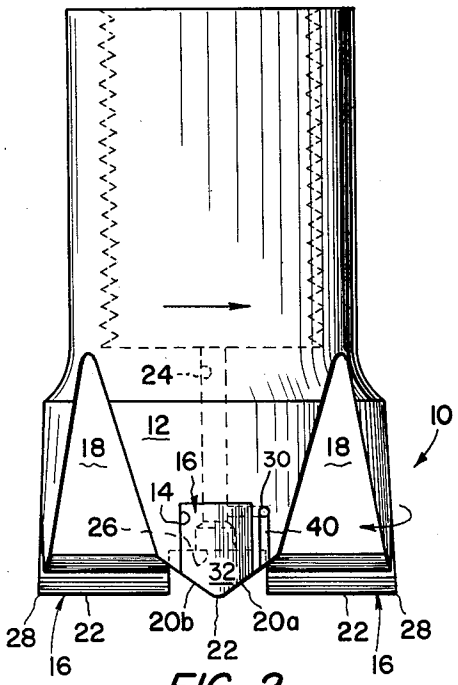


FIG. 2

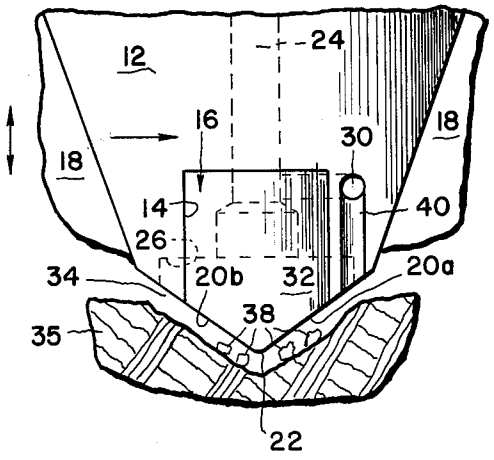


FIG. 3

FIG. 1

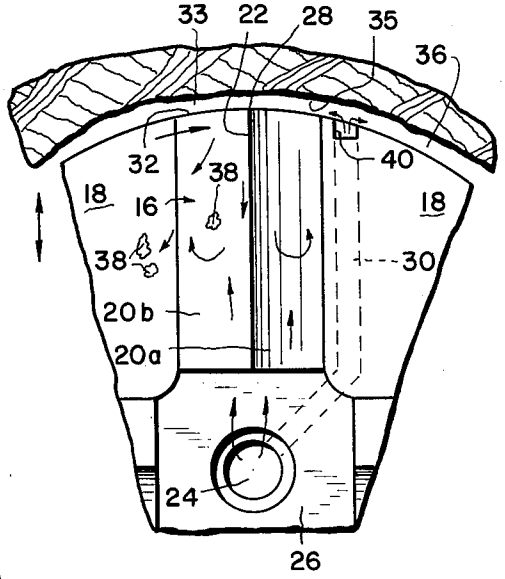
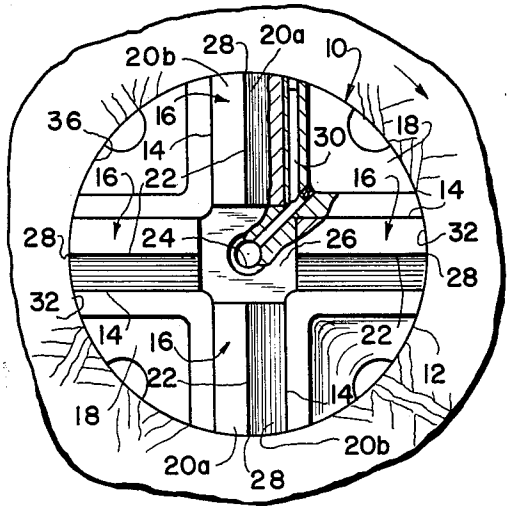


FIG. 4



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DRILL BIT WITH FLUID PASSAGES

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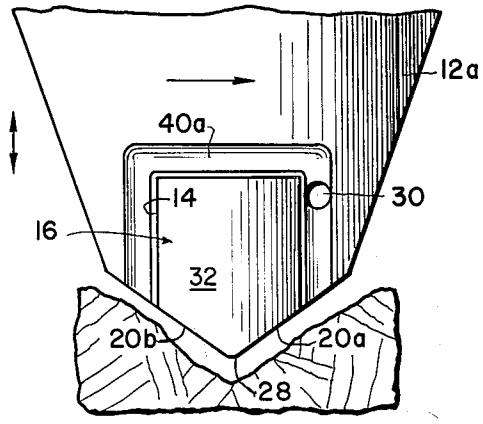

FIG. 5

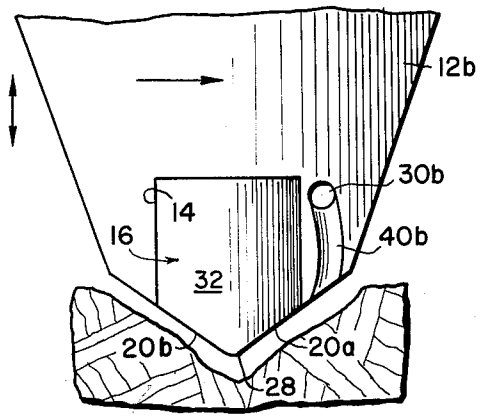

FIG. 6

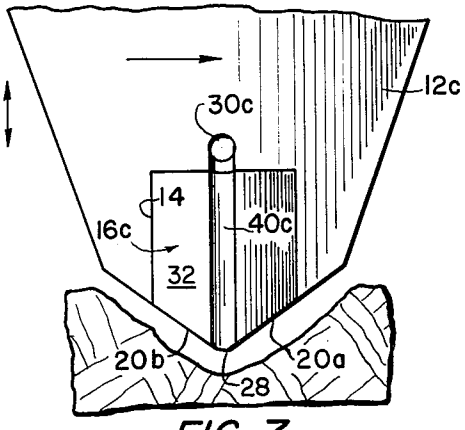

FIG. 7

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DRILL BIT WITH FLUID PASSAGES

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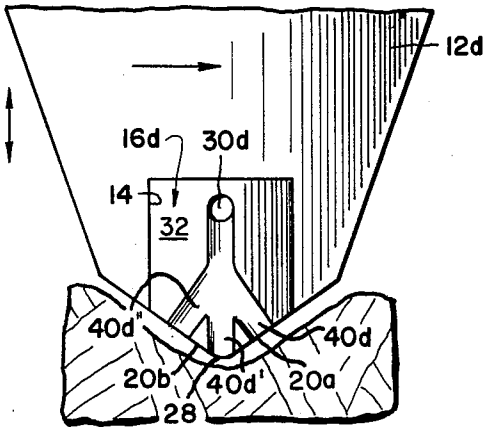

FIG. 8

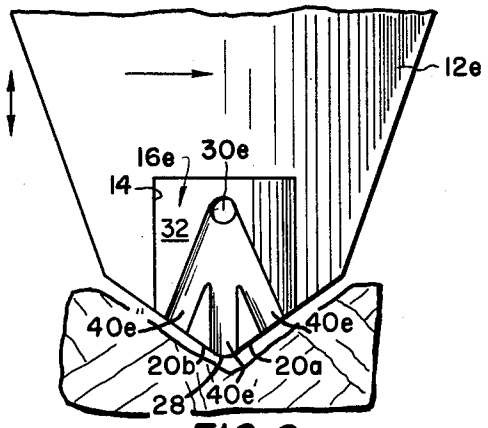

FIG. 9

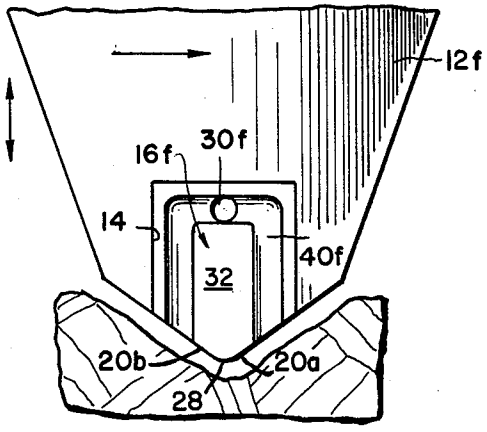

FIG. 10

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DRILL BIT WITH FLUID PASSAGES

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8 Claims. (Cl. 175—418)

This invention relates to drilling apparatus and more particularly to an improved drill bit for such drilling apparatus.

Conventional drill bits are subject to certain difficulties and objections. First, if the cuttings or muck (i.e. the suspension of water and rock particles) is not quickly removed from the cutting edge and cutting faces of the tungsten carbide inserts or cutters, body erosion occurs. This body erosion or wearing of the steel body is due to the grinding of the unremoved rock particles (which vary in size from the size of sand particles to sizable particles having a diameter of about one half inch) between the bottom of the hole being drilled and the cutters. As a result of this body erosion the inserts become exposed and due to the failure of the removed or eroded support often snap off or fall out. Further when the cutters impact against the solid rock side wall being drilled, the exposed corners of the cutting edges of the cutters sometimes shatter. Again the unremoved muck causes braze washing or the wearing away of alloy solder braze which secures the indiviudal cutters in the cutter grooves in the wings, thereby permitting the cutters to fall out of their grooves. In addition when a large unremoved rock particle jams between the cutter and the side wall of the hole, longitudinal or transverse fracture of the cutting edge and cutting faces result.

When hard rock, such as diabase is being drilled, the overdrilling (i.e. the bouncing around of the cutters to cause enlargement of the hole) is slight but the friction head is large with the result that conventional drill bits do not provide means for allowing the muck cleansing fluid to reach the cutting edges of the cutters. Further when the drill bit becomes overrun (i.e. dulled) the hole diameter gets smaller thus leaving insufficient space between the drill bit and the bottom of the hole to permit the muck cleansing fluid to contact the cutting edges. Also in the case of drill bits where the exhaust from the drill is forced through the auxiliary and central cleansing fluid passages, when such passages become clogged, the drill will slow down or stall unless the back pressure is relieved.

The use of internal branch cleansing fluid passages of the type shown in U.S. Patent No. 2,800,303 is limitedly satisfactory because (as the drill bit is retracted) the primary high pressure stream is disposed at the mid portion of the cutting edge and cutting faces. During retraction of the drill bit the chamber defined by the bottom of the hole and drill bit increases with resultant proportional decrease in the cleansing fluid pressure and flow over the vital unprotected exposed corners of the cutting edges. As a result the muck on such corners is usually not removed therefrom and does not flow as desired into the low pressure muck grooves disposed between adjacent cutters.

It is the general object of the present invention to avoid and overcome the foregoing and other difficulties of and objections to prior art practices by the provision of an improved drill bit which is adapted to quickly remove the cuttings or muck from the cutting edges and cutting faces of the cutters thereby substantially eliminating body erosion and braze washing and the falling out of the cutters from the cutter grooves in the wings of the body.

Another object of the present invention is the provision

of an improved drill bit which prevents the jamming of large rock particles between a cutter and the side wall of the hole thus eliminating fracture or breakage of the cutting edges and cutting faces.

Yet another object of the present invention is the provision of an improved drill bit which guarantees the cushioning of the impact of the cutting edges and cutting faces of the cutters against the rock side wall with a uniform blanket of cleansing fluid.

Still another object of the present invention is the provision of an improved drill bit which guarantees the uniform flow of cleansing fluid over the cutting edges and cutting faces of the cutters even in cases of hard rock drilling where overdrilling is small but the friction head is large and in the case where the drill bit is overrun and the hole diameter becomes smaller with resultant insufficient space between the drill bit and the bottom of the hole.

A still further object of the present invention is the provision of an improved drill bit which prevents slowing or stalling of the drill due to exhaust back pressure when the auxiliary and central cleansing passages become clogged.

Another object of the present invention is the provision of an improved drill bit which applies primary high pressure flow of the cleansing fluid at a desired peripheral location on the cutters with resultant complete cleansing thereof and directs the flow of cleansing fluid across the cutting edges and cutting faces as the intermediate pressure chamber is formed by retraction of the drill bit with the result that substantially all the muck is removed from the cutting edges and cutting faces and flows into the low pressure muck grooves.

The aforesaid objects of the present invention, and other objects which will become apparent as the description proceeds, are achieved by providing an improved drill bit for drilling a hole containing muck, the improved drill bit having a body provided with a cutter groove having a periphery and a low pressure muck groove, a cutter disposed in the cutter groove adjacent the muck groove and provided with cutting faces, a cutting edge and an internal cleansing fluid passage. The cutting edge has an exposed peripheral corner. The improvement comprises the body being provided with a fluid cleansing passage communicating with the internal cleansing fluid passage and extending through the body to a point adjacent the periphery of the cutting groove whereby as the drill bit is retracted, a primary high pressure flow of cleansing fluid is directed against a selected peripheral location on the cutter and as the intermediate pressure chamber defined by the retracting drill bit and the side wall of the hole is formed cleansing fluid flow is maintained across the cutting edge and the cutting faces to remove the muck therefrom and to flow the muck into the low pressure muck groove.

For a better understanding of the present invention reference should be had to the accompanying drawings, wherein like numerals of reference indicate similar parts throughout the several views and wherein:

FIG. 1 is a plan view of the improved drill bit;

FIG. 2 is a side elevational view of the improved drill bit;

FIG. 3 is a fragmentary enlarged side elevational view showing the intermediate pressure chamber formed during the retraction of the drill bit and defined by the drill bit and the hole;

FIG. 4 is a fragmentary enlarged plan view of FIG. 3; and

FIGS. 5–10 are views similar to FIG. 3 of alternative embodiments of the invention.

Although the principles of the present invention are broadly applicable to all types of drill bits the present invention is particularly adapted for use in conjunction

with rock drill bits and hence it has seen so illustrated and will be so described.

With specific reference to the form of the present invention illustrated in the drawings, and referring particularly to FIGS. 1 and 2, a drill bit (which is utilized for drilling a hole containing muck) is indicated generally by the reference numeral 10.

This drill bit 10 has a body 12 (FIGS. 1–3) provided with cutter grooves 14 in which cutters 16 are secured as by brazing with a suitable alloy solder. Disposed between cutters 16 the body 12 is provided with suitable low pressure muck grooves 18, the rearwardly tapering contour of which provides facile disposition rearwardly of drilled material and cleansing fluid. Each cutter 16 is provided with cutting faces 20*a* and 20*b* and a cutting edge 22. As shown in FIGS. 1 and 2 the body 12 is also provided with an internal cleansing fluid passage 24 which terminates in a recess 26 formed by the inner end walls of the cutters 16. Each cutting edge 22 has an exposed peripheral selected location, such as an exposed peripheral corner 28 (FIGS. 1, 2 and 4), which corner 28 forms an important part of the present invention.

In order to direct a primary high pressure flow of a cleansing fluid, such as water, up the peripheral face 32 of a cutter 16 in the annulus 33 (defined by the peripheral face 32 and the hole 36 (FIG. 4)) against the peripheral corner 28 as the drill bit 10 (FIG. 3) is retracted in the direction of the arrow, a fluid cleansing passage 30 (FIGS. 1, 3 and 4) is provided in the body 12 at any desired position along the leading edge (in the direction of index of the drill bit 10 indicated by arrows in FIGS. 1 and 2) of the cutter 16. If it is desired to flush the entire peripheral face 32 of the cutter 16 such fluid cleansing passage 30 should be disposed near the bottom of the cutter 16. The spacing of the fluid cleansing passage 30 from the leading edge of the cutter 16 is determined by the mechanical and metallurgical strength characteristics of the body 12.

Further, as an intermediate pressure chamber 34 (see FIG. 3) defined by the retracting drill bit 10 and the side wall 35 of the hole 36 is formed, cleansing fluid flow is maintained across the cutting edge 22 and the cutting faces 20*a* and 20*b* to remove muck 38 therefrom and to flow the muck 38 into the low pressure muck grooves 18 (FIGS. 3 and 4).

As shown in FIG. 4 the flow of cleansing fluid from the internal cleansing fluid passage 24 in the body 12 combines with the flow of cleansing fluid from the cleansing fluid passage 30 to provide a vortex of cleansing fluid, which vortex scours the cutting edge 22 and cutting faces 20*a* and 20*b*.

In order to provide directional control of the flow of cleansing fluid from the cleansing fluid passage 30, a flow groove 40 (FIGS. 3–4) is provided in the periphery of the body 12 adjacent peripheral face 32 of the cutter 16 for conducting the flow of cleansing fluid from the fluid cleansing passage 30 to one of the cutting faces, such as the leading cutting face 20*a*. By varying the cross sectional area of the flow groove 40, the amount of proportionate flow up the flow groove 40 and across the peripheral face 32 of the cutter 16 may be controlled.

It will be understood by those skilled in the art that the above described preferred embodiment of the present invention may have alternative embodiments.

Alternative Embodiments

Referring now to FIGS. 5 and 6, it will be appreciated that a peripheral flow groove 40*a* (FIG. 5) and an arcuate flow groove 40*b* (FIG. 6) which arcuate flow groove 40*b* is a segment of either a circular, elliptical, parabolical or hyperbolical groove, may be used for directing the flow of cleansing fluid as desired.

In cases where the life of the cutter 16 is not important or where stronger materials than tungsten carbide are utilized in the fabrication of such cutter 16*c*, the cleansing fluid passage 30*c* (FIG. 7) may be disposed beneath the bottom edge of the cutter 16*c* and the central straight flow groove 40*c* is cut into the body 12*c* and the cutter 16*c* to direct the flow of cleansing fluid directly on the peripheral corner 28 of the cutting edge 22. Further as shown in FIGS. 8 and 9, the cleansing fluid passages 30*d* and 30*e* may be drilled in the cutters 16*d* and 16*e* respectively and anyone or combinations of all flow grooves 40*d*, 40*d'*, 40*d''*, 40*e*, 40*e'*, and 40*e''* may be used to direct the flow of cleansing fluid onto the faces 20*a* and 20*b* and the peripheral corner 28 of the cutting edge 22 as desired.

In FIG. 10 the flow groove 40*f* extends around the periphery of the cutter 16*f*.

It will be recognized by those skilled in the art that the objects of the present invention have been achieved by providing an improved drill bit which quickly removes the muck from the cutting edges and cutting faces of the cutters thus substantially eliminating body erosion and braze washing and the falling out of the cutters from the cutter grooves in the wings of the body. This improved drill bit prevents the jamming of large rock particles between the cutter and the side wall of the hole thereby eliminating fracture of the cutting edges and cutting faces. In addition the improved drill bit cushions the cutting edges and cutting faces with a uniform blanket of cleansing fluid from impact against the rock side wall of the hole. This feature is also present even in the hard rock case where overdrilling is small but the friction head is high, also where the drill bit is overrun and the hole diameter smaller so that the space between the drill bit and the bottom of the hole is insufficient for proper flow. Also the improved drill bit prevents slowing down and stalling of the drill even when the auxiliary and central cleansing fluid passages are clogged. Primarily the improved drill bit provides a directed primary high pressure flow of the cleansing fluid against a desired peripheral location on the cutter, and as the intermediate pressure chamber defined by the retracting drill bit and the hole is formed, cleansing fluid flow is maintained across the cutting edge and the cutting faces to remove the muck therefrom and to flow the muck into the low pressure muck groove.

While in accordance with the patent statutes a preferred and alternative embodiments of the present invention have been illustrated and described in detail, it is to be particularly understood that the invention is not limited thereto or thereby.

I claim:

1. In a rotatable and reciprocable drill bit (10) for drilling a side wall (35) of a hole (36) containing muck (38), said drill bit (10) having a body provided with a periphery and a cutter groove (14) in said periphery, a cutter (16) disposed in said cutter groove, said cutter (16) having a back and a cutter periphery (32) and provided with cutting faces (20*a*, 20*b*) and a cutting edge (22), said cutting edge having an exposed peripheral corner (28), the improvement comprising:

(*a*) said body (12) being provided with a substantially central cleansing fluid passage (24) extending through said body (12) to a point behind said cutting edge (22) for directing high pressure cleansing fluid against the back of said cutter (16) and across said cutting edge (22) and said cutting faces (20*a*, 20*b*),

(*b*) said body being provided with rearwardly extending low pressure muck grooves (18) on opposite sides of said cutter groove (14) and cutter (16), said muck grooves defining on said periphery a cutter land,

(*c*) said land (12) being provided with a fluid cleansing passage (30) communicating with said internal cleansing fluid passage (24) and extending through said body (12) to said cutter land to a point adjacent said cutter periphery (32) and for directing high

pressure cleansing fluid against said peripheral corner (28) and across said cutting edge (22) and said cutting faces (20*a*, 20*b*) from said cutter periphery (32),

(*d*) the flow of high pressure cleansing fluid from said fluid cleansing passage (30) impacting against the flow of high pressure cleansing fluid from said internal cleansing fluid passage (24) to create a vortex of high pressure cleansing fluid which scours said cutting edge (22) and said cutting faces (20*a*, 20*b*) to remove said muck (38) therefrom and to flow said muck (38) rearwardly into said low pressure muck grooves (18),

(*e*) and said body (12) being provided with a peripheral flow groove (40) for conducting said flow of high pressure cleansing fluid from said fluid cleansing passage (30) to said peripheral corner 28.

2. The improvement recited in claim 1 wherein said flow groove (40) for conducting said flow of high pressure cleansing fluid from said fluid cleansing passage (30) to said peripheral corner (28) is linear.

3. The improvement recited in claim 1 wherein said flow groove (40*a*) extends peripherally around said cutter (16) for conducting said flow of high pressure cleansing fluid from said fluid cleansing passage (30) to said peripheral corner (28).

4. The improvement recited in claim 1 wherein said flow groove (40*b*) for conducting said flow of high pressure cleansing fluid from said fluid cleansing passage (30) to said peripheral corner (28) is arcuate.

5. In a rotatable and reciprocable drill bit (10) for drilling a side wall (35) of a hole (36) containing muck (38), said drill bit (10) having a body provided with a periphery and a cutter groove (14) in said periphery, a cutter (16) disposed in said cutter groove, said cutter (16) having a back and a cutter periphery (32) and provided with cutting faces (20*a*, 20*b*) and a cutting edge (22), said cutting edge having an exposed peripheral corner (28), said body (12) being provided with a substantially central cleansing fluid passage (24) extending through said body (12) to a point behind said cutting edge (22), for directing high pressure cleansing fluid against the back of said cutter (16) and across said cutting edge (22) and said cutting faces (20*a*, 20*b*), the improvement comprising:

(*a*) said body being provided with rearwardly extending low pressure muck grooves (18) on opposite sides of said cutter groove (14) and cutter (16), said muck grooves defining on said periphery a cutter land,

(*b*) said land being provided with a fluid cleansing passage (30) communicating with said internal cleansing fluid passage (24) and extending through said body (12) to said cutter land to a point adjacent said cutter periphery (32) and for directing high pressure cleansing fluid against said peripheral corner (28) and across said cutting edge (22) and said cutting faces (20*a*, 20*b*) from said periphery (32),

(*c*) the flow of high pressure cleansing fluid from said fluid cleansing passage (30) impacting against the flow of high pressure cleansing fluid from said internal cleansing fluid passage (24) to create a vortex of high pressure cleansing fluid which scours said cutting edge (22) and said cutting faces (20*a*, 20*b*) to remove said muck (38) therefrom and to flow said muck (38) rearwardly into said low pressure muck grooves (18) and

(*d*) said cutter (16) being provided with a peripheral flow groove (40) for conducting said flow of high pressure cleansing fluid from said fluid cleansing passage (30) to said peripheral corner (28).

6. The improvement recited in claim 5 wherein said flow groove (40*d*, *e*) has a cross section adapted to direct a portion of said flow through to said periphery (28) while directing the remainder of said flow to said cutting edges (20*a*, 20*b*).

7. The improvement recited in claim 5 wherein said flow groove (40*f*) extends along the periphery of said cutter (16) for conducting said flow of cleansing fluid from said fluid cleansing passage (30) to said peripheral corner (28).

8. The improvement recited in claim 1 wherein said flow groove (40*c*) extends from said fluid cleansing passage (30) to said peripheral corner (28).

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