A bit includes a body portion having a first shape, a first length, a first end and a second end. A collar portion having a second shape, a thickness, a first surface disposed adjacent a second end of the body portion and a second surface forming a ledge for seating against a surface of a rotary cutting head of a mining machine. A shank portion, has a diameter and a second length. A first end of the shank is secured to the second surface of the collar portion. A groove formed around the shaft portion closely adjacent the second end thereof. A bit tip disposed adjacent the first end of the body portion to contact a hard surface. The bit tip tapers to a pointed end. A connecting means is disposed in the groove for connecting the bit to the working machine. A plurality of fins is disposed along an outer surface of the body portion.
FIG. 16
(PRIOR ART)
BIT FOR USE IN AT LEAST ONE OF MINING, TRENCHING AND MILLING APPLICATIONS

CROSS REFERENCE TO RELATED APPLICATION

[0001] This application is related to and claims priority from U.S. Provisional Patent Application Ser. No. 61/187,869 titled, “Twisted Fin Longwall Mining Bit” the teachings of which are incorporated herein by reference thereto.

FIELD OF THE INVENTION

[0002] The present invention relates, in general, to bits used in trenching, milling and mining operations and, more particularly, this invention relates to a rotating bit and, still more specifically, the invention relates to a bit for use in a longwall mining machine.

BACKGROUND OF THE INVENTION

[0003] In the field of mineral mining, the practice of “longwall mining” generally involves the grinding of minerals from along a straight, vertically inclined wall of a natural hard surface, such as coal, rock and a combination of coal and rock, in a mineral mine. In performing longwall mining, a machine known as a longwall shearer is used. A longwall shearer includes a power-driven rotary cutting head mounted along a linear guide. The linear guide aids in moving the rotary cutting head along the hard wall surface of the mine such that the rotary cutting head engages the wall surface to grind away a planar section of rock/coal from the exposed wall of such mine. The rotary cutting head typically includes several substantially pointed nodules or “bits” which are deployed about the surface of the rotary cutting head. As the rotary cutting head rotates, the bits impact the rock/coal surface and assist in breaking apart the rock/coal surface into manageable-sized chips which move along the surface of the rotary cutter head in the space between the bits to be carried away for further processing.

[0004] In the grinding operations when using a longwall shearer, repeated contact of a bit against a rock/coal surface often results in significant wear of the bit along the portion of the bit contacting the rock/coal surface, thereby causing the substantially pointed shape of the bit to deteriorate. This deterioration of the bit shape typically results in decreased efficiency of the longwall shearer. Accordingly, the bits of a longwall shearer are typically manufactured to be removable from the rotary cutting head for selective replacement upon becoming worn. As a result of having to frequently replace the bits, the longwall shearer must be taken out of production between the bit replacement process. Further, it is often the case that to minimize production down time all of the bits will be replaced even if certain bits may still be usable. Obviously this practice leads to added costs being incurred.

[0005] Numerous developments have been made in the field of longwall shearer bits for prolonging the life of the bit. To this extent, in one prior art device, a bit having a substantially conical shape which is substantially radially symmetrical about a central axis is provided. The conical bit is adapted to be mounted to the surface of the rotary cutting head such that the conical bit is free to rotate about the central axis. In this configuration, as rock/coal chips rush over the bit surface while rock/coal is channeled along the rotary cutting head surface, the rock/coal chips encourage rotation of the conical bit about the central axis, thereby encouraging more even wearing of the conical bit about the central axis.

[0006] In another prior art device, commonly known as a “finned bit,” a similarly conical-shaped bit is provided, and includes a plurality of fins extending radially outwardly from the central axis along the surface of the conical-shaped bit. As mentioned above, rotation of the bit is driven as rock/coal chips rush over the bit surface while the rock/coal chips are channeled along the surface of the rotary cutting head, thereby engaging the radially extending fins. This friction on the bit surface, (aided by water lubrication when present) is the entire driving force for rotation of the bit, and hopefully even bit wear about the central axis of the bit. However, in each of the above-referenced prior art devices, bit rotation often ranges from a nearly non-existent halflazard event on a smooth bodied conical bit to a still less than orderly but more efficient process on a finned bit. Finned bits are often moved in a mostly non-directional, imprecise manner that, though not perfect, is far better than the smooth bodied tools.

[0007] The ribbed design prior art teaches that these products can only be produced at the same time the original body section is made. The ribs or fins are integral parts of the entire body. The manufacturing process is a one step process—that is when the body is formed as a cold headed process or as an investment casting process, the rib/fins are extruded or shaped feature on the nose portion of the bit body.

[0008] Additional prior art devices can be found in U.S. Pat. Nos. 7,445,294; 7,455,484; 6,846,048; 6,739,327; 6,354,771; 6,196,636; 6,019,434; 5,324,098; 5,131,725; 4,809,789; 4,065,185 reissued as RE30,807; 3,833,264; 3,652,130; 3,476,438; 3,361,481; 2,783,038; 1,903,772; 1,550,669; D572,735; D387,072; D382,887; and D347,232. The teachings in each of these prior art references are incorporated herein by reference thereto.

BRIEF SUMMARY OF THE INVENTION

[0009] According to one aspect of the present invention, there is provided a bit for use in at least one of a trenching, milling and mining machine. The bit includes a body portion formed from a first predetermined material and having each of a first predetermined shape, a first predetermined length, a first end and a second end. A collar portion having a second predetermined shape, a predetermined thickness, a first surface disposed adjacent the second end of the body portion and a second surface forming a ledge portion for seating against a surface of a rotary cutting head of such at least one of a trenching, milling and mining machine. There is a substantially cylindrical shank portion, having each of a predetermined diameter, a second predetermined length, a first end and a second end. The first end of the shank portion is secured to the second surface of the collar portion. A groove, having a predetermined axial length and a predetermined depth, is formed along the shank portion closely adjacent the second end thereof. There is a bit tip, formed from a predetermined material, secured to and adjacent the first end of the body portion adapted to contact a hard surface to accomplish removal of such hard surface, the bit tip tapering to a substantially pointed end. A connecting means is disposed in the groove for connecting the bit to such at least one of a trenching, milling and mining machine. Finally, a predetermined number of fins are disposed, in a predetermined pattern, along an outer surface of the body portion about a central axis thereof.
According to a second aspect of the present invention there is provided a method of manufacturing a bit having improved rotational capability for use in at least one of a trenching, milling and mining application. The method includes the steps of selecting a profile for such bit and a material the profile selected is to be manufactured from. Thereafter, at least one of casting and forging the profile selected and then at least one of manually and robotically welding a predetermined number of fins in a predetermined pattern on an outer surface of a forward body portion of the bit at a predetermined location.

The instant invention further provides a method of reconditioning a used bit for use in at least one of a trenching, milling and mining application. The method includes the steps of examining the used bit to determine its suitability for reconditioning and removing a predetermined forward portion of a body portion of the bit including a bit tip when it is determined that the bit is suitable to be reconditioned. Thereafter, adhering a new said predetermined forward portion of such body portion to a remaining portion of the body portion left after the predetermined forward portion has been removed. The new predetermined portion of the bit including a new bit tip adhered thereto.

OBJECTS OF THE PRESENT INVENTION

It is, therefore, one of the primary objects of the present invention to provide an improved which allows increased production time of at least one of a trenching, milling and mining machine between bit changes.

A further object of the present invention is to provide a method of manufacturing a finned mining bit.

Another object of the present invention is to provide a twisted fin mining bit which provides substantially enhanced rotational capability of the bit thereby enabling a longer bit life.

Still another object of the present invention is to provide a twisted fin mining bit which provides significantly better shattering capability of material being mined using a longwall mining shearer.

Yet another object of the present invention is to provide a twisted fin mining bit which provides greater scattering of the material being mined.

A still further object of the present invention is to provide a twisted fin mining bit which significantly reduces the volume of respirable dust being generated during the mining operation.

An additional object of the present invention is to provide a twisted fin mining bit which provides a greater degree of self sharpening capability.

Yet still another object of the present invention is to provide a method of reconditioning a mining bit.

In addition to the numerous objects and advantages of the instant invention described in detail above it should be understood that various other objects and advantages of the present invention will become more readily apparent to those skilled in the mining and bit manufacturing arts.

BRIEF DESCRIPTION OF THE VARIOUS EMBODIMENTS OF THE INVENTION

Prior to proceeding to the more detailed description of the present invention it should be noted that identical components having identical functions have been designated with identical reference numerals for the sake of clarity in understanding the invention.

Additionally, it should be noted that those skilled in the art that as used in the present application and claims the term mining bit is meant to include mining bits, trenching bits and milling bits and further that although the mining bit will now be described for use in a longwall mining shearer it can be used in various other mining, trenching and/or milling machines.

Now referring more particularly to the drawings, FIGS. 1 and 2 illustrate a mining bit, generally designated 10, for use in a longwall mining machine (not shown) according to a first embodiment of the present invention. The mining bit 10 includes a body portion 12 formed from a first predetermined material and having each of a first predetermined shape, a first predetermined length, a first end 14 and a second end 16.

A collar portion 18 having a second predetermined shape, a predetermined thickness, a first surface 20 disposed
adjacent the second end 16 of the body portion 12 and a second surface 22 forming a ledge portion 24 is provided for seating against a surface of a bit holder (not shown) which is attached to a head (not shown) of a mining machine.

[0044] The second predetermined shape of the collar portion 18 is selected from the group consisting of generally round, rectangular, hexagon and octagon. The presently preferred shape of the collar member 18 is generally round.

[0045] The mining bit 10 further includes a substantially cylindrical shank portion 26, having each of a second predetermined length and a predetermined diameter, a first end 28 and a second end 30. The first end 28 of the shank portion 26 is secured to the second surface 22 of the collar portion 18.

[0046] The predetermined diameter of the cylindrical shank portion 26 is between about 1.0 inch and about 2.0 inches. The most presently preferred range for the predetermined diameter of the cylindrical shank portion 26 is between about 1.2 inches and about 1.75 inches. Also, the second predetermined length of the shank portion 26 is generally between about 3.5 inches and about 5.00 inches with about 4.0 inches to about 5.0 inches being presently preferred.

[0047] A groove 32, having a predetermined axial length and a predetermined depth, is formed around the shank portion 26 closely adjacent the second end 30 thereof. The predetermined axial length of the groove 32 is generally between about 0.25 inch and about 3.00 inch and the predetermined depth of the groove 32 is between about 0.125 inch and about 0.2 inch.

[0048] There is a bit tip 34, formed from a predetermined material, disposed adjacent the first end 14 of the body portion 12 which is adapted to contact a hard surface, such as coal and/or a combination of coal and rock, to accomplish removal of the hard surface. The bit tip 34 tapers to a substantially pointed end 36. The predetermined material of the bit tip 34 is formed from the group consisting of tungsten carbide and diamond.

[0049] A connecting means, generally designated 40 (FIG. 3), is disposed in the groove 32 for connecting the mining bit 10 to such mining machine.

[0050] In the presently preferred embodiment of the invention the overall length of the bit including the body portion 12 and the shank portion 26 and the thickness of the collar portion 18 is between about 7.60 inches and about 7.80 inches.

[0051] There are a predetermined number of fins 42 disposed in a helical shape along an outer surface of the body portion 12 about a central axis 38 thereof. The fins 42 preferably exhibit a predetermined degree of slope both axially and radially about such central axis 38 of the body portion 12.

[0052] The predetermined degree of axial and radial slope of the fins 42 is generally between about 1 degree and about 30 degrees. A more preferred range is between about 6 degrees and about 15 degrees. The presently preferred range for the predetermined degree of slope is between about 8 degrees and about 12 degrees.

[0053] The plurality of fins 42 extend generally outwardly from the central axis 38 along the surface of the body 12 to engage a hard surface, such as coal and/or a combination of coal and rock chips, passing over the surface of the body 12, thereby promoting rotation of the bit 10 about the central axis 38. The fins 22 are preferably oriented to extend in a helical shape about the central axis 38, along the surface of the body 12.

[0054] In one embodiment, the fins 42 are fabricated from a material having a compressive strength greater than the compressive strength of the body 12. In this embodiment, the fins 42 further serve to provide structural support to the body 12, thereby protecting the body 12 and discouraging breakage of the body 12 upon impact with a hard surface.

[0055] In this embodiment, as well as the other embodiments to be described in detail hereinafter, the fins 42 are formed from hard surfacing ridges, such as STOODY 101 HC hard surfacing wire.

[0056] However, those skilled in the art will recognize other materials having suitable strength and wear resistance for use in forming the fins 42.

[0057] The predetermined degree of axial and radial slope of the fins 42 is generally between about 1 degree and about 30 degrees. A more preferred range is between about 6 degrees and about 15 degrees. The presently preferred range for the predetermined degree of slope is between about 8 degrees and about 12 degrees. Further, in this embodiment of the invention, the first predetermined material is selected from the group consisting of iron, steel and tungsten carbide. Also, the first predetermined shape of the body portion 12 taps axially inwardly from the second end 16 thereof toward the first end 14. The predetermined length of the body portion 12 is generally between about 3.50 inches and about 5.00 inches. A more preferred range for the body portion 12 length is between about 3.50 inches and about 5.00 inches.

[0058] According to a second embodiment, illustrated in FIGS. 3-5, the collar portion 44 of a mining bit, generally designated 50, includes a tapered portion 46 disposed adjacent the second surface 22 of collar portion 44. In this embodiment, the fins 42 are positioned closer to the first end 14 of the body portion 12 and terminate at a point further away from the first surface 20 of the collar portion 44 than in the embodiment illustrated in FIGS. 1-2.

[0059] In a third embodiment, illustrated in FIGS. 6-11, the body portion 12 further includes a hard surfacing buildup between said fins closely adjacent said first end of said body portion. Further, in this embodiment the body portion 12 further includes each of a hard surfacing buildup 48 between the fins 42 closely adjacent the first end 14 of such body portion 12 and a cavity 52 formed in said first end 14 thereof for receiving a tapered portion 54 of a bit tip 34. It should also be noted that tip 34 is tapered along nearly an entire sidewall length.

[0060] Reference is now made, more particularly, to FIGS. 12 and 13 wherein there is illustrated the fins 42 extending out to the first end 14 of the body portion 12.

[0061] The present invention further provides a method of manufacturing a mining bit having improved rotational capability. The method includes the steps of selecting a profile for said mining bit and selecting a material the profile selected in step (a) is to be manufactured from. The method further includes the steps of at least one of casting, cold heading and forging the profile selected and at least one of manually and robotically welding a predetermined number of fins in a helical pattern on an outer surface of a body portion of the mining bit at a predetermined location.

[0062] The distinguishing difference between the prior art designs and method of manufacturing these designs and the new bit designs and methods of manufacturing these new designs is that the process for generating these features can only be done in a secondary manufacturing operation. The
rib/fin is attached by a manual welding technique or preferably by a robotic welding process.

When robotically welding the rib/fin configuration on the nose portion of the bit body, the design parameters become nearly endless. For example, the axial length, height as well as length of the rib can be the same or different on the same bit body. The material used can be applied to match the cutting conditions. When cutting mainly coal, a less expensive hardsurfacing material can be used. When cutting primarily rock, a more wear resistant material is used. We currently use Stooey 101HC hardsurfacing welding material, or equivalent. However, a tungsten carbide impregnated material can be applied in a hardsurfacing process. The method of robotic welding allows greater flexibility in the choice of hardsurfacing materials as well as application of the rib/fin profile.

In still another embodiment of the invention there is provided a method of reconditioning a used mining bit. The method includes the steps of examining the used mining bit to determine its suitability for reconditioning. Then, removing a predetermined portion of a body portion from the front of the mining bit including a bit tip when it is determined that the mining bit is suitable to be reconditioned and thereafter adhering a new predetermined portion of the body portion to a remaining portion of such body. The new predetermined portion of the mining bit including a new bit tip. Such adhering of the new predetermined portion to the remaining portion of such body portion is accomplished by friction welding.

Preferably, the method includes the additional steps of determining a number of fins to be attached to an outer surface of the new predetermined portion of such body portion and at least one of manually and robotically welding the number of fins in a predetermined pattern on an outer surface of a body portion of said mining bit at a predetermined location. The fins are preferably welded by a robotic welder although manually welding may be used.

According to a final embodiment of the invention there is provided in combination with a bit holder, generally designated 60, attached to at least one of a trenching, milling and mining machine (not shown) in a position to provide a predetermined angle between about 40.0 degrees and 50.0 degrees such that a bit, generally designated 10 will rotate while in use, the improvement comprising a bit 10 having a predetermined number of fins 42 disposed on the forward end of the body portion 12. A bit tip 34 is disposed adjacent the first end of the body portion 12 and is adapted to contact a hard surface to accomplish removal of such hard surface.

While the present invention has been illustrated by description of several embodiments and while the illustrative embodiments have been described in detail, it is not the intention of the applicant to restrict or in any way limit the scope of the appended claims to such detail. Additional modifications will readily appear to those skilled in the art. The invention in its broader aspects is therefore not limited to the specific details, representative apparatus and methods, and illustrative examples shown and described. Accordingly, departures may be made from such details without departing from the spirit or scope of applicant’s general inventive concept.

We claim:

1. A bit for use in at least one of a trenching, milling and mining machine, said bit comprising:
   (a) a body portion formed from a first predetermined material and having each of a first predetermined shape, a first predetermined length, a first end and a second end;
   (b) a collar portion having a second predetermined shape, a predetermined thickness, a first surface disposed adjacent said second end of said body portion and a second surface forming a ledge portion for securing against a surface of a rotary cutting head of such at least one of a trenching, milling and mining machine;
   (c) a substantially cylindrical shank portion, having each of a predetermined diameter, a second predetermined length, a first end and a second end, a first end of said shank portion being secured to said second surface of said collar portion;
   (d) a groove, having a predetermined axial length and a predetermined depth, formed around said shaft portion closely adjacent said second end thereof;
   (e) a bit tip, formed from a second predetermined material, disposed adjacent said first end of said body portion adapted to contact a hard surface to accomplish removal of such hard surface, said bit tip tapering to a substantially pointed end;
   (f) a connecting means disposed in said groove for connecting said bit to such at least one of a trenching, milling and mining machine; and
   (g) a predetermined number of fins disposed along an outer surface of said body portion about a central axis thereof.

2. A bit, according to claim 1, wherein said fins are disposed in a helical shape in an axial direction of said mining bit.

3. A bit, according to claim 2, wherein said fins exhibit a predetermined degree of slope in an axial and radial direction.

4. A bit, according to claim 3, wherein said predetermined degree of slope in said axial and radial direction is between about 1 degree and about 30 degrees.

5. A bit, according to claim 4, wherein said predetermined degree of slope is between about 6 degrees and about 15 degrees.

6. A bit, according to claim 5, wherein said predetermined degree of slope is between about 8 degrees and about 12 degrees.

7. A bit, according to claim 1, wherein said first predetermined material is selected from the group consisting of iron, steel and tungsten carbide.

8. A bit, according to claim 7, wherein said first predetermined shape of said body portion tapers inwardly toward said central axis from said second end thereof to said first end.

9. A bit, according to claim 8, wherein said first predetermined length is between about 3.5 inches and about 5.00 inches.

10. A bit, according to claim 1, wherein said predetermined diameter of said cylindrical shank portion is between about 0.75 inch and about 2.00 inches.

11. A bit, according to claim 10, wherein said predetermined diameter of said cylindrical shank portion is between about 1.375 inches and about 1.75 inches.

12. A bit, according to claim 10, wherein said second predetermined length is between about 3.5 inches and about 5.0 inches.
13. A bit, according to claim 1, wherein said predetermined axial length of said groove is between about 0.25 inch and about 0.625 inch.

14. A bit, according to claim 13, wherein said predetermined depth of said groove is between about 0.125 inch and about 0.2 inch.

15. A bit, according to claim 1, wherein an overall length of said body portion and said shaft portion and said thickness of said collar portion is about 7.80 inches and about 7.80 inches.

16. A bit, according to claim 13, wherein said predetermined axial length of said groove is between about 0.625 inch and about 3.00 inches.

17. A bit, according to claim 1, wherein said predetermined material for said bit tip is selected from the group consisting of tungsten carbide and diamond.

18. A bit, according to claim 1, wherein said second predetermined shape of said collar portion is selected from the group consisting of generally round, rectangular, hexagon and octagon.

19. A bit, according to claim 18, wherein a presently preferred shape of said collar portion is generally round.

20. A bit, according to claim 1, wherein said predetermined diameter of the cylindrical shank portion is generally between about 1.0 inch and about 2.0 inches.

21. A bit, according to claim 20, wherein said predetermined diameter of said cylindrical shank portion is generally between about 1.2 inches and about 1.75 inches.

22. A bit, according to claim 1, wherein said collar portion includes a tapered portion disposed adjacent said second surface of said collar portion.

23. A bit, according to claim 1, wherein said fins are formed from STOOGY 101 HIC hard surfacing wire.

24. A bit, according to claim 1, wherein said body portion further includes a hard surfacing buildup between said fins closely adjacent said first end of said body portion.

25. A bit, according to claim 1, wherein said bit tip further includes a tapered portion behind a working forward tapered surface thereof.

26. A bit, according to claim 25, wherein said body portion further includes a cavity formed in said first end thereof for receiving said tapered portion of said bit tip.

27. A bit, according to claim 1, wherein said bit tip further includes a generally cylindrical portion disposed behind a working forward tapered surface thereof.

28. A bit, according to claim 27, wherein said body portion further includes a generally cylindrical cavity formed in said first end thereof for receiving said generally cylindrical portion of said bit tip.

29. A bit, according to claim 1, wherein each of said body portion, said collar portion and said shaft portion are formed as a single piece.

30. A method of manufacturing a mining bit having improved rotational capability, said method comprising the steps of:
   (a) selecting a profile for said mining bit;
   (b) selecting a material said profile selected in step (a) is to be manufactured from;
   (c) at least one of casting, cold heading and forging said profile selected in step (b);
   (d) determining a number of fins to be attached to an outer surface of said body portion; and
   (e) at least one of manually and robotically welding said number of fins determined in step (d) in a predetermined pattern on an outer surface of a body portion of said mining bit at a predetermined location.

31. A method, according to claim 30, wherein steps (a) and (b) are be reversed.

32. A method, according to claim 30, wherein said fins are robotically welded to said outer surface of said body portion.

33. A method, according to claim 30, wherein said number of fins is four.

34. A method, according to claim 30, wherein said method includes the additional step of brazing a bit tip to a working end of said bit.

35. A method of reconditioning a used mining bit, said method comprising the steps of:
   (a) examining said used mining bit to determine suitability for reconditioning;
   (b) removing a predetermined portion of a body portion of said mining bit including a bit tip when in step (a) it is determined that said mining bit is suitable to be reconditioned;
   (c) adhering a new said predetermined portion of said body portion to a remaining portion of said body portion left after said predetermined portion has been removed in step (b), said new predetermined portion of said mining bit including a new bit tip.

36. A method, according to claim 35, wherein said method includes the additional steps of:
   (d) determining a number of fins to be attached to an outer surface of said new predetermined portion of said body portion; and
   (e) at least one of manually and robotically welding said number of fins determined in step (d) in a predetermined pattern on an outer surface of a body portion of said mining bit at a predetermined location.

37. A method, according to claim 36, wherein said adhering is accomplished by friction welding.

38. A method, according to claim 35, wherein said welding of said fins to said body portion is accomplished by at least one of manual and robotic welding.

39. A method, according to claim 38, wherein said welding of said fins to said body portion is accomplished by robotic welding.

40. In combination with a bit holder attached to at least one of a trenching, milling and mining machine in a position to provide a predetermined attack angle such that a bit will rotate while in use, the improvement comprising a bit having:
   (a) a body portion formed from a first predetermined material and having each of a first predetermined shape, a first predetermined length, a first end and a second end;
   (b) a collar portion having a second predetermined shape, a predetermined thickness, a first surface disposed adjacent said second end of said body portion and a second surface forming a ledge portion for seating against a surface of a rotary cutting head of such at least one of a trenching, milling and mining machine;
   (c) a substantially cylindrical shank portion, having each of a predetermined diameter, a second predetermined length, a first end and a second end, a first end of said shank portion being secured to said second surface of said collar portion;
   (d) a groove, having a predetermined axial length and a predetermined depth, formed around said shaft portion closely adjacent said second end thereof;
   (e) a bit tip, formed from a second predetermined material, disposed adjacent said first end of said body portion
adapted to contact a hard surface to accomplish removal of such hard surface, said bit tip tapering to a substantially pointed end;

(f) a connecting means disposed in said groove for connecting said bit to such at least one of a trenching, milling and mining machine; and

(g) a predetermined number of fins disposed along an outer surface of said body portion about a central axis thereof.

The combination, according to claim 40, wherein said predetermined attack angle is generally between about 40.0 degrees and about 50.0 degrees.

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