



(43) **Pub. Date:** **Jun. 26, 2014**

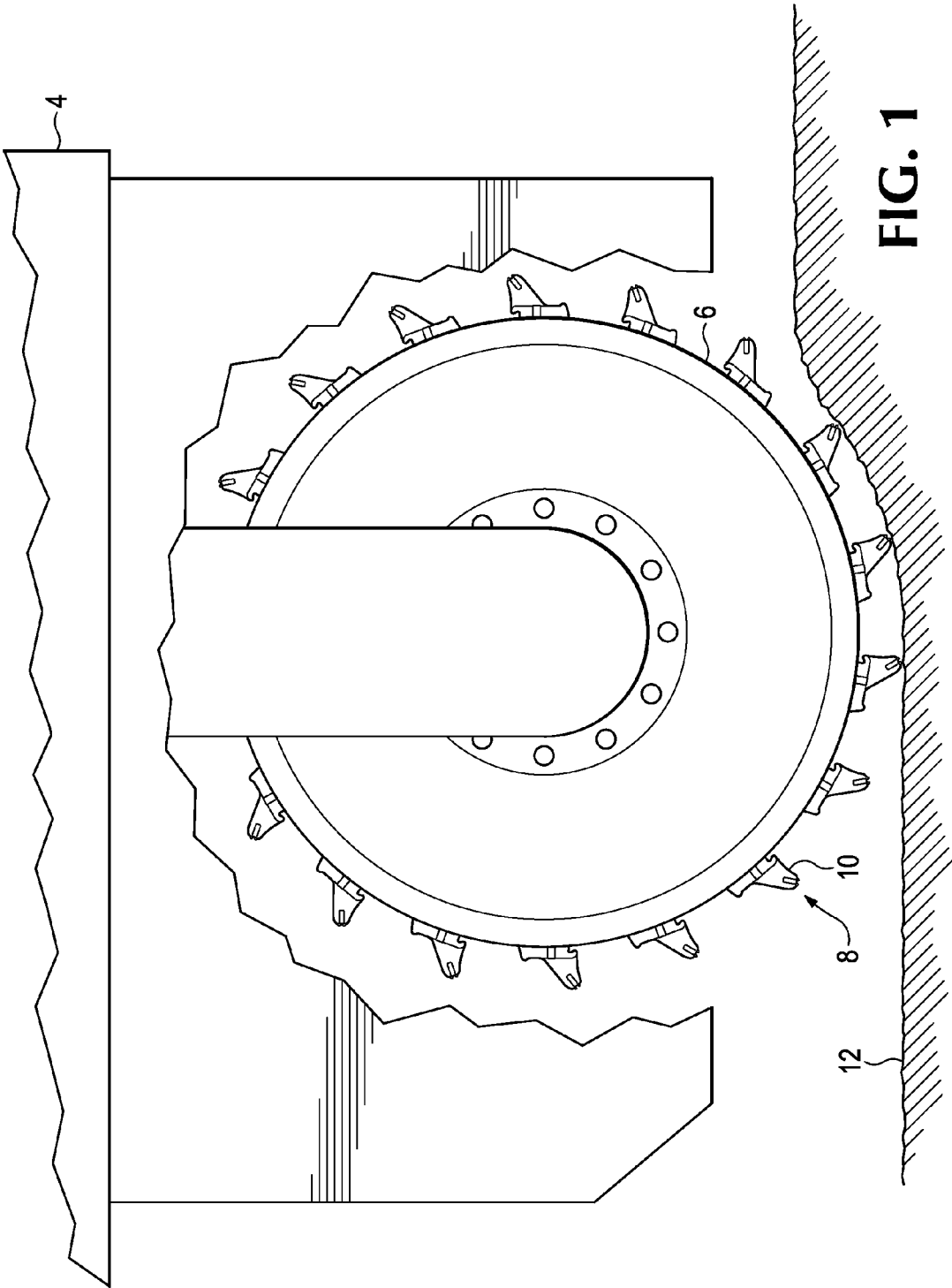
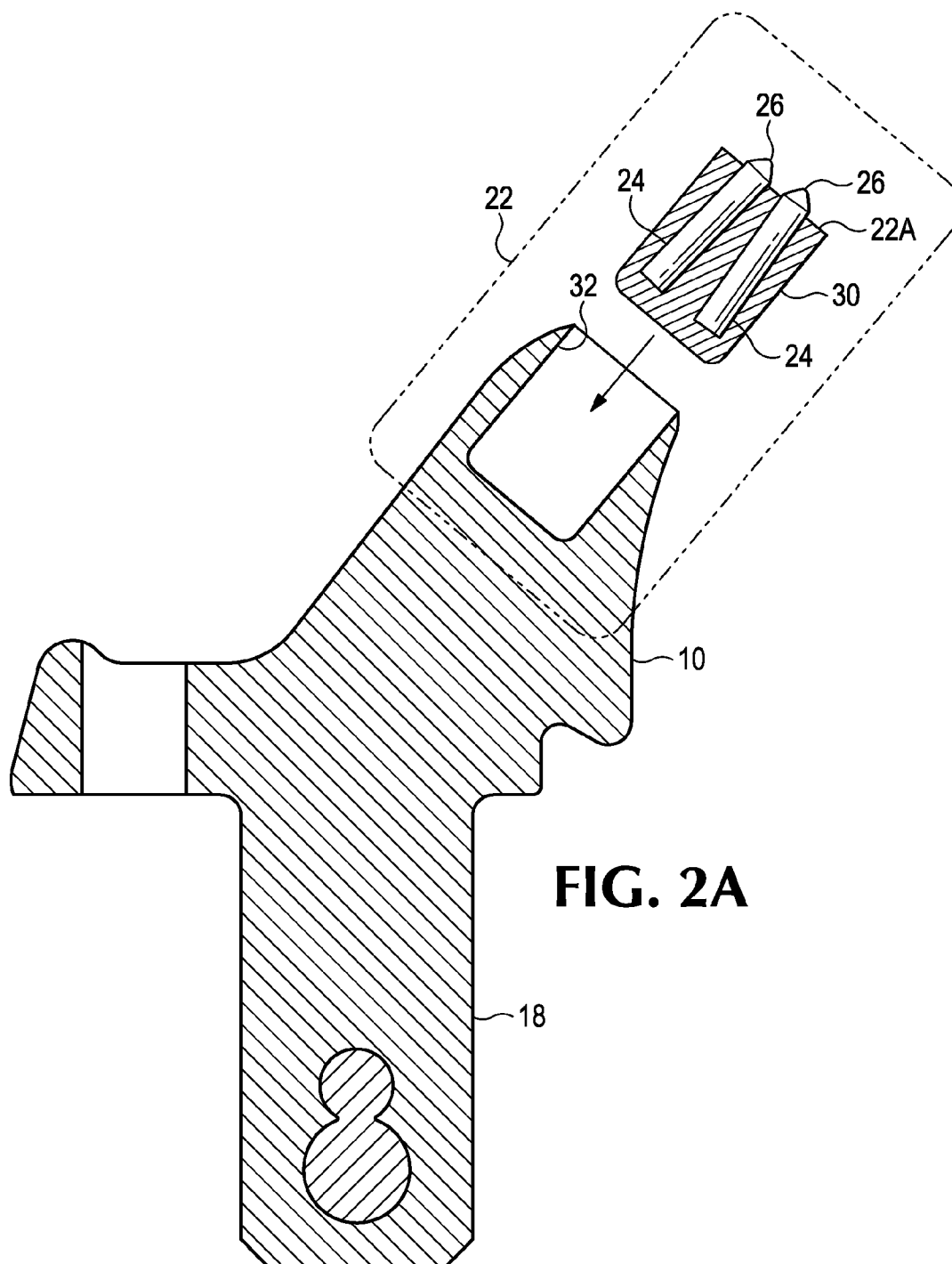
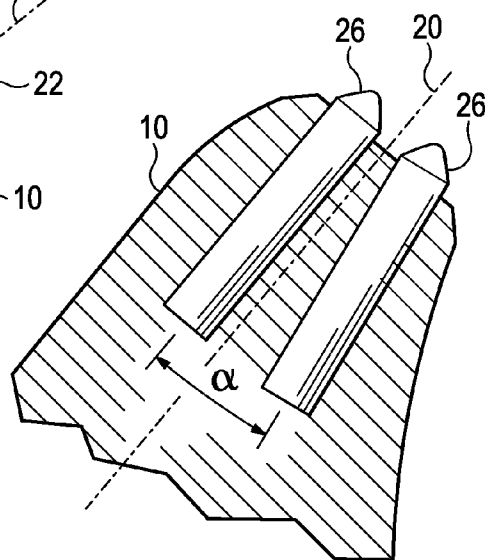
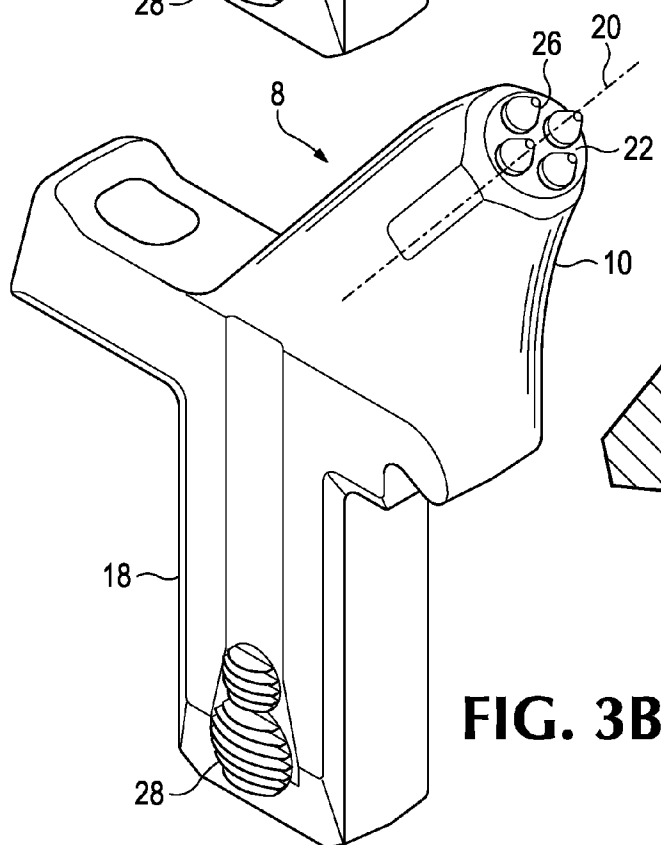
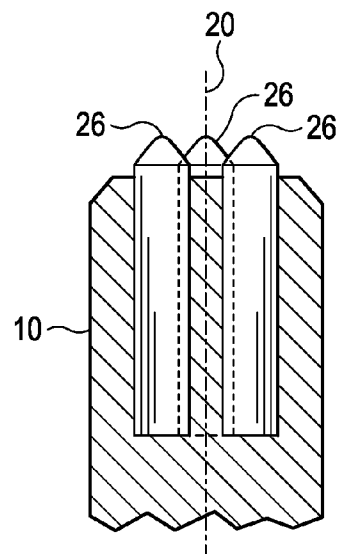
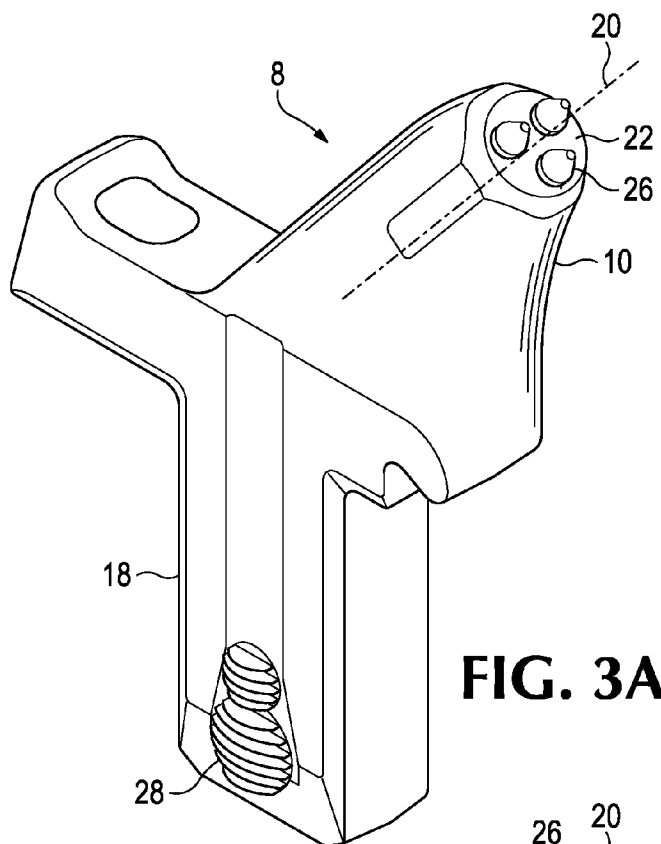


FIG. 2





PICK FOR EARTHWORKING MACHINE

FIELD OF THE INVENTION

[0001] This invention relates to a cutter tool, primarily for use in mineral winning, such as coal mining, but also usable for other underground purposes such as tunnel or roadway driving, or above ground for civil engineering works such as road planing and trench cutting, whether with drums or endless chains, both on land and underwater.

BACKGROUND OF THE INVENTION

[0002] A number of machines involved in mining, construction and public works use rolls or drums that are driven for the crushing, mining, milling and the like of earthen materials. These earth working rolls or drums include an array of pick assemblies to engage and separate a consolidated material into smaller portions that can be further separated in subsequent operations. A pick assembly may include a pick releasably attached to a holder secured to the drum or roll. The pick includes a head configured to contact the material and separate it. The picks are wear parts that are replaced after a certain length of use.

[0003] Conventional mineral cutter picks of the shearer type are produced as steel forgings and may include a rectangular section shank whereby the pick is releasably latched in a rectangular receiving aperture of the tool holder or block secured to the roll. The head of the pick projects from the tool holder and above the roll surface.

[0004] The head of the pick is typically notched at its forward end to provide a seat into which is brazed a hard material (usually tungsten carbide) as a tip. The tip may be approximate in width to the head of the pick so as to be capable of cutting clearance for the head. 50 to 100 picks may be attached to a shearer drum of a longwall coal, potash etc. cutting machine. This type of machine has been in use for decades.

[0005] In operation, the impact of the tips can generate significant heat. Dissipation of this heat is critical as the carbide tips are subject to thermal fatigue when they consistently reach or operate at high temperatures. Inefficient operation of the picks due to damage or wear can also generate excessive heat, raising the temperature of proximate parts of the drum and significantly degrading structural properties of components.

[0006] The head of a pick may be damaged by inadvertent collision with a roof support or by hitting hard inclusions in the ore seam such as rocks. When this occurs, a portion of the head of the pick may break away taking the tip with it. The remaining portion of the pick head, without the hardened tip, continues to impact ore material as the machine operates and the drum rotates. The damaged pick then sustains more damage which results in a shortened useful life and lower machine efficiency.

SUMMARY OF THE INVENTION

[0007] The present invention pertains to an improved pick for use on an earth working roll for mining, construction and public works machines such as crushers, surface miners, underground mining machines, milling machines and the like. The pick includes a head with multiple tips or inserts in a strike face of the pick that impact the worked surface. The inserts are positioned in holes of the pick head that open at a face of the head and the inserts extend beyond the face. The

inserts are configured to impact the surface of the consolidated material more efficiently and dissipate generated heat more efficiently to the body of the pick.

[0008] The head of the pick protrudes beyond the tool holder with the head oriented away from the drum and in the direction of rotation of the roll. The inserts are a hard material configured in one construction as elongate rods of any cross-section approximately the same dimension as the holes in the face. The inserts may be held frictionally in the hole, brazed in place, soldered, glued or by any other method that maintains their position in the hole during operation. Multiple small inserts as compared to one relatively large carbide tip positioned in the head presents smaller areas of carbide impacting the target material, generating less heat.

[0009] The pick is configured so that the inserts initially impact the earthen material as the drum rotates. Any number of two or more inserts may be positioned in the head of the pick. Positioning the inserts in the head of the pick with an appropriate configuration and separation between the inserts can more efficiently transfer heat away from the inserts during operation. Where the generated heat can efficiently flow from the carbide tips to the body of the pick and the holder, the life of the inserts can be extended and downtime and expense for replacing the picks can be reduced.

[0010] In a first embodiment, the tips are configured in the head so that they are spaced apart about a central axis of the strike face or contact face of the pick and extend beyond the face. The multiple tips protruding from the face impact the target material over a smaller contact area and generate less heat than a single large tip.

[0011] In a second embodiment the elongate inserts are parallel to each other in the head along their length. Preparing the head of the pick to accept parallel inserts is a less complex and lower cost process than other configurations and the closely spaced tips impacting the material work more efficiently than a single large tip.

[0012] In a third embodiment the holes with inserts are spaced apart in the head of the pick and the inserts converge toward the face to a closely spaced configuration. Heat generated at the tip of the insert from impacting the target material is more efficiently transferred to the head and body of the pick in this embodiment by dissipating the heat over a larger body area than would occur with the picks in a parallel configuration.

[0013] A pick assembly configured to operate and dissipate heat more efficiently from the inserts to the head would be advantageous by reducing insert thermal fatigue, machine downtime and power consumption.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] FIG. 1 is a depiction of an earth working operation including a roll drum with picks.

[0015] FIG. 2 is a side cross section view of a pick with inserts in accordance with the present invention including a tool holder mounted to a drum.

[0016] FIG. 2A is a side cross section view of an alternative configuration of a pick with inserts in a carrier received by the head of the pick.

[0017] FIG. 3A is a perspective view of a pick with three inserts.

[0018] FIG. 3B is a perspective view of a pick with four inserts.

[0019] FIG. 4 is a cross-section view of a pick with three inserts along line 4-4 of FIG. 2.

[0020] FIG. 5 is a side cross section view of a pick with inserts.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0021] FIG. 1 depicts an earth working operation including a face miner with pick assemblies for extracting earthen material such as coal in a mining operation. The operation is shown as including a mining machine 4 with a driven drum, roll or cylindrical body 6 mounted with pick assemblies 8 including picks 10 for impacting the ore seam or consolidated earthen material 12 as drum 6 rotates. Picks 10 are mechanically attached or secured to rotating drum or cylindrical body 6. Earthen material 12 to be extracted is typically in a seam and rotating drum 6 passes across the mine face so the picks impact the face and dislodge material from the seam in manageable portions. Picks 10 impinge on the material with adequate speed and force to fracture the material.

[0022] The spacing of the picks determines the size of the dislodged material, but also is a factor in stress on individual picks and heating of components. The mined material is typically dropped onto a conveyor and transported away to a roll crusher or other processing. Pick assembly 8 is one of many similar assemblies attached to drum 6, often in staggered rows.

[0023] In all figures, like components use similar numbering. FIG. 2 is a cross section view of pick assembly 8 mounted to drum 6. Drum 6 has a direction of rotation R and a radial direction r away from the axis of drum 6. Pick assembly 8 as shown includes a pick 10 and a tool holder or base 14. Pick 10 has a proximal end 10A and a distal end 10B. Pick 10 is shown with a shank 18 at proximal end 10A which is the portion of pick 10 received by holder 14. Pick 10 is shown with a head 22 at distal end 10B and a body 16 generally between shank 18 and head 22.

[0024] Head 22 tapers forward and away from body 16 and is configured to contact consolidated materials to be separated. In FIG. 2 head 22, indicated by a dotted line, generally extends away from the drum and in the direction of rotation R. Head 22 defines a longitudinal axis 20 and includes a strike face or contact face 22A. The pick body 16 is shown with a pry point 16A at a forward portion of body 16 configured to receive a pry bar for removing pick 10 from holder 14. At a rear portion body 16 includes an opening 16B associated with a water spray system not shown in this embodiment.

[0025] Head 22 includes face 22A with holes 24 configured to receive inserts 26. In a preferred embodiment, holes 24 with inserts 26 are shown inclined to each other and converging toward face 22A. Each hole 24 and insert 26 may define an axis and the inclination of the holes may be defined by an angle between the axis of the hole and the longitudinal axis 20 of head 22, preferably between 5 and 20 degrees. Alternatively, the inclination of the holes may be defined by an angle α between holes in the head 22. Hole 24 may be inclined at any angle α that fits within the envelope of head 22, but preferable is between 5 and 40 degrees.

[0026] In one embodiment, the axes of adjacent holes 24 may be substantially parallel to the longitudinal axis 20 as shown in FIG. 4. In another embodiment the inserts may be distributed about the longitudinal axis, each insert 26 with the same inclination to axis 20 as shown in FIG. 2. In another alternative embodiment, inserts 26 may be parallel to each other and axis 20 in one perspective. Then from an orthogonal perspective one or more inserts 26 are inclined to axis 20.

[0027] Holes 24 may extend more than a quarter of the distance between head 22 and the top of shank 18. Preferably, hole 24 extends 30 to 50 millimeters in depth. The length of inserts 26 and depth of hole 24 affects heat propagation, structural integrity of the inserts and transfer of impact forces from the inserts to head 22 and body 16 of pick 10. Holes 24 and inserts 26 may be round, triangular, rectangular or square in cross section or any other shape and can be manufactured by several processes.

[0028] Holes 24 may not extend substantially into head 22. Holes 24 in an alternative embodiment may be of adequate depth to accept an insert configured as a tile and to limit transverse movement of the tile on strike face 22A.

[0029] In a preferred process, holes 24 are drilled into head 22 and inserts 26 inserted into the drilled holes. Round holes are most easily drilled, but square and other cross-sectioned blind holes can be produced using more sophisticated machining processes.

[0030] In another embodiment pick 10 includes a carrier for inserts 26 as shown in FIG. 2A. FIG. 2A includes a pick 10 with a shank 18 and a head 22 similar to the pick of FIG. 2. In this embodiment pick 10 further includes a carrier 30 and a carrier opening 32. Holes 24 are machined in carrier 30 and inserts 26 are positioned into each hole 24. Head 22 then receives carrier 30 with the inserts in carrier opening 32. As an example, a square hole can be configured in carrier 30 by square swaging through the carrier to configure the hole and a square insert 26 positioned in the swaged square hole 24. Carrier 30 can then be mounted to head 22 by any of various means including threading the carrier and carrier opening, brazing or welding. Swaging a hole in carrier 30 is a lower cost process than other forms of machining for some hole configurations.

[0031] In still another embodiment, carrier 30 of FIG. 2A could be formed around inserts 26. Inserts 26 could be held in position in a carrier mold or in a carrier opening 32 in head 22. A casting material such as bronze, aluminum, epoxy or other compatible material is then poured around inserts 26. If a carrier mold is used, the carrier 30 is separated from the mold and received by carrier opening 32 of head 22.

[0032] Casting around inserts 26 would provide for any shape of insert 26 to be used, as well as inserts that vary in cross section along their length. Heat transfer characteristics, wear and structural properties in head 22 can be modified by appropriate selection of casting materials.

[0033] Returning to FIG. 2, tool holder 14 is shown with an aperture or opening 14A configured to receive shank 18. Shank 18 is preferably rectangular in cross-section, but may be oval or round or any other shape which is compatible with the holder. Holder or base 14 is secured to the surface of drum 6 or in a depression or indentation for a lower profile by any means that reliably retains the holder such as welding or bolting. Pick 10 may further include a shoulder 14B. With shank 18 fully inserted in opening 14A, shoulder 14B abuts an edge of opening 14A limiting the depth of insertion.

[0034] Pick assembly 8 is shown with a resilient retention feature 28 in shank 18. Retention feature 28 may be a button inserted into a hole of shank 18 and configured to work cooperatively with a feature of holder 14 to retain pick 10 in holder 14. Shank 18 may be inserted and extracted from tool holder 14 along radial direction r. Longitudinal axis 20 may be may have an angle of inclination between the direction of rotation R and the drum radial direction r so that it is inclined in the direction of rotation. Pick 10 may not have a

shank. Pick assembly 8 may be secured to roll 6 by another means such as welding or bolting holder 14 or pick base 16 to roll 6.

[0035] The portion of head 22 proximate to face 22A may be configured with a narrower cross section, acutely angled surfaces, sharper edges and smaller radii of curvature than sections of pick 10 and head 22 farther from face 22A. This forward area is also more exposed to impact from material separated by inserts 26. This makes the area around face 22A more prone to fatigue cracking, chipping and fracture. Having the end of insert 26 about the body of pick 10 at the bottom end of hole 24 farther from face 22A, allows impact forces to be transmitted to an area of pick 10 less prone to damage. This reduces stress in the area proximate to face 22A and increases service life of pick 10.

[0036] When pick 10 is damaged, a portion of head 22 may be broken off from pick 10. With multiple inserts, a remaining portion of head 22 may retain one or more inserts that continue to efficiently impact earthen materials 12. In previous configurations with a single large tip, any damage to head 22 tended to separate the tip from the head, severely reducing the efficiency of the pick.

[0037] Pick 10 and tool holder 14 may be composed of iron, steel or any other material that is durable enough to withstand continuous impacting and abrading of the surface by the fractured materials. Inserts 26 are selected to be a much harder material than pick 10 and are preferably cemented carbide, diamond or ceramic, but other materials can be used. The inserts may vary in hardness. One insert may have a different hardness than the other picks in the same pick head.

[0038] Carbide may have twice the thermal conductivity of steel. With the higher thermal conductivity, insert 26 acts as a radiator and the entire length of the insert will tend to stay at a higher temperature than the surrounding steel. This temperature differential in turn drives a higher rate of heat transfer or heat flux along the entire surface of the insert.

[0039] Three smaller inserts 26 with a larger surface area will dissipate the heat more readily than the single larger tip. For the purpose of illustration only and as an example, insert 26 may be round with a diameter of 1 millimeter (mm) and a length of 10 mm. The total circumference of 3 tips, each with a diameter of 1 mm is 9.4 mm and a typical single large tip may have a diameter of 1.85 mm inserted in the head for a circumference of 5.8 mm. The inserts significantly increase surface area for transfer of heat from the insert to the steel body. Making insert 26 longer than a standard single tip also significantly increases the surface area for heat transfer to the steel body. Drilling insert holes 24 so they diverge from face 22A into the head of pick 10 provides a further advantage in dissipating the heat over a greater volume of pick 10.

[0040] A pick operates over a wide range of temperatures and mismatch of thermal expansion between components can cause internal stresses. The coefficient of expansion of the carbide, 5×10^{-6} m/m-K, is less than that of steel which is 13×10^{-6} m/m-K. Using three smaller diameter tips results in less tension between the steel and carbide as the contact area is greater. The brazing and soldering materials also act as an interface between the inserts and the head and compensate for mismatch at the interface.

[0041] The service life of a pick is a function of the volume of carbide removed during operation (wear rate) as well as the susceptibility of insert 26 falling out of pick 10. When the portion of insert 26 remaining in the head is small, it is more susceptible to leverage from side impacts that can extract the

insert from head 22 and face 22A. The smaller diameter insert is less likely to be extracted by side forces because of the mechanical advantage that it has over the larger tip. For example, when both tips wear down to 5 mm long, there is a higher extracting force exerted by side or angled impacts on the large tip than the smaller insert because of its larger diameter.

[0042] A large single tip is usually sized to the same general width as head 22 to limit wear to the head. The smaller diameter inserts 26 leave the head 22 of pick 10 more exposed to the abrasive materials even though inserts 26 make the primary impact on the consolidated materials to separate it. This results in more wear of head 22. Insert 26, a much harder material than head 22 and body 16 of pick 10, has a lower wear rate.

[0043] With an optimal tip length (the portion of insert 26 extending beyond the face 22A), wear and erosion of head 22 and insert 26 are minimized. If insert 26 extends beyond head 22 too far, it is susceptible to lateral forces and portions of the insert tend to break off. Where exposed tip lengths of inserts 26 are short, head 22 wears at a higher rate, exposing the inserts. Pick 10 can continue in service as long as inserts 26 are retained in head 22 with an adequate tip length.

[0044] FIG. 3A is a perspective view of an embodiment of pick 10 with three inserts 26 and longitudinal axis 20 passing through the center of head 22 of pick 10. The three inserts are distributed about longitudinal axis 20 with 120 degrees between each insert.

[0045] FIG. 3B is a perspective view of an alternative embodiment of pick 10 shown with four inserts 26 and longitudinal axis 20. Inserts 26 are distributed about longitudinal axis 20 with 90 degrees between each insert. There can be any number of two or more inserts 26 in head 22 and in any configuration. The two configurations shown are examples for illustration.

[0046] FIG. 4 shows an alternative configuration of pick 10. Pick 10 in FIG. 4 is a section view from FIG. 2 showing a top view of inserts 26 and longitudinal axis 20. In this embodiment in this perspective inserts 26 are parallel to longitudinal axis 20 while from the orthogonal perspective of FIG. 2 each insert is inclined to longitudinal axis 20 at the same angle.

[0047] FIG. 5 is a side view of an alternative pick 10 in cross section, again showing three inserts 26. In this view, orthogonal to a top view such as FIG. 4, and in contrast to FIG. 2, one or more inserts are inclined to axis 20 with other inserts parallel to axis 20.

[0048] The present invention pertains to picks for an earth working roll or roller such as used in roll crushers, surface miners, milling machines and the like. The use of relative terms such as forward, front, rear or sides or the use of specific shapes is not intended to be limiting, but rather to more clearly illustrate the invention. Also, picks as described here are shown primarily in the context of mining machines. Nevertheless, the invention is not limited to this operation. Picks in accordance with the invention are also suitable for use in conjunction with other earth working machines involving the use of driven rolls with picks such as single roll crushers, scroll crushers, surface miners, underground mining machines, milling machines and the like.

1. A pick for attachment to a driven roll for working a consolidated material comprising:

- a head configured to separate the consolidated material including:
 - a strike face;
 - holes that open at the strike face; and
 - inserts received in the holes that extend beyond the strike face to impact the consolidated material; and
- a body that contacts the driven roll.

2. The pick of claim 1 where the inserts are equidistant about a center point of the strike face.

3. The pick of claim 1 where the holes are parallel to each other.

4. The pick of claim 1 where the angle between any two holes is between 5 and 40 degrees.

5. The pick of claim 1 where the inserts are made of one or more material selected from the material group comprising carbide, steel, diamond and ceramic.

6. The pick of claim 1 where the hardness of at least one of the inserts is different than the hardness of the other inserts.

7. The pick of claim 1 where the head receives three inserts.

8. The pick of claim 1 where the head receives four inserts.

9. The pick assembly of claim 1 where the holes are all parallel viewed from a first perspective and the angle between two of the holes is between 5 and 40 degrees viewed from a perspective orthogonal to the first perspective.

10. The pick of claim 1 where the pick includes a shank to be received in an opening of a tool holder secured to the roll.

11. The pick of claim 10 where the pick includes a shoulder proximate to the shank that abuts the tool holder on fully receiving the shank in the opening.

12. The pick of claim 10 where the holes extend 30-50 millimeters.

13. A pick assembly to be used on a rotating drum to separate a consolidated material comprising:

a pick including a head with a strike face;

holes that open at the strike face;

a holder mounted on the drum to receive the pick; and

a plurality of inserts received in the holes.

14. The pick assembly of claim 13 where the head includes a longitudinal axis inclined at an angle between the direction of rotation of the drum and a radial of the drum and the inserts at the face are equidistant from the longitudinal axis

15. The pick assembly of claim 13 where the inserts comprise one material selected from the group of cemented carbide, steel, diamond and ceramic.

16. The pick assembly of claim 13 where the holes are parallel to each other.

17. The pick assembly of claim 13 where the holes converge toward the strike face.

18. The pick assembly of claim 13 where at least one of the holes is inclined from at least one other hole at an angle between 5 and 40 degrees.

19. The pick assembly of claim 13 where the inserts are parallel to each other when viewed from a first perspective and the angle between a first hole and a second hole is between 5 and 40 degrees viewed from a perspective orthogonal to the first perspective.

* * * * *