ABSTRACT

This invention relates to a lock for the key which holds a digging tooth point on an adapter. The lock comprises a roller that is engageable with a recess in the key and is mounted in an open-ended cage so that it cannot move laterally or longitudinally with respect to the key but is free to rotate on a transverse axis and to move toward and away from the key. A rubber backup plug biases the roller toward the key, but does not prevent its rotation.

9 Claims, 11 Drawing Figures
ROLLING LOCK FOR DIGGING TOOTH ASSEMBLY

BACKGROUND OF THE INVENTION

This is a continuation of U.S. Pat. application Ser. No. 825,124, filed May 7, 1969 now abandoned.

Digging teeth assemblies for large excavating machines generally comprise an adapter that is fitted to or formed with the lip of the bucket and is provided with a forwardly extending wedge-shaped nose, and a replaceable tooth point provided with a rearwardly facing wedge-shaped socket which receives the nose. The point and adapter nose are provided with vertical or horizontal transverse openings which extend wholly or partially therethrough and are aligned when the point is in place to define a keyway. A key is removably received in the keyway to hold the point on the adapter.

It is generally necessary to provide some sort of lock to hold the key against axial or longitudinal movement out of the keyway, and many forms of locks have been tried. One well-known type includes a roller plug mounted in the adapter nose and a metal member wholly or partially embedded in the plug to define a detent which is engageable with a recess in the key when the key is in place, the plug serving to resiliently bias the detent toward the key. While this sort of lock is generally satisfactory, it is difficult to construct a lock of this type that will function satisfactorily after repeated uses. A particular problem in this regard is that the key must be driven past the detent as it is inserted and removed, and this results in a considerable shear force parallel to the direction of movement of the key. This force tends to twist the plug and pull it into the keyway unless special shoulders or some other expense expedient is provided to hold the plug in the adapter nose, and it also results in undue wear. Also, in some locks of this type it is not possible or convenient to provide for inserting the key from either side.

SUMMARY OF THE INVENTION

It is the general purpose of this invention to provide a roller lock for a digging tooth assembly in which the detent element that engages the key is a roller that is mounted in a cage to be held against longitudinal or lateral movement with respect to the key while being freely rotatable on a transverse axis to take up the aforementioned shear force and to be movable toward and away from the key so that the key can be driven past. The roller is biased toward the key by a rubber backup plug or other spring means which bears against the roller but is not fastened to it as has been the case with prior locks so that the roller remains free to rotate.

It is the object of the invention to provide several species of a lock arrangement of this roller type which are highly effective and readily adaptable to various sizes of tooth assemblies while still being relatively simple, inexpensive and easy to use.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view in cross section showing a digging tooth assembly incorporating one embodiment of the invention, the view being taken through the plane 1-1 shown in FIG. 2.

FIG. 2 is a view in cross section of the embodiment of FIG. 1 taken through the plane 2-2 shown in FIG. 1.

FIG. 3 is another view in cross section of the embodiment of FIG. 1 which is taken through the plane 3-3 shown in FIG. 1.

FIG. 4 is a cross section of a second embodiment of the invention taken through the plane 4-4 shown in FIG. 5.

FIG. 5 is a view in cross section of the embodiment of FIG. 4 taken through the plane 5-5 shown therein.

FIG. 6 is a view in cross section of a third embodiment of the invention taken through the plane 6-6 shown in FIG. 7.

FIG. 7 is a view in cross section of the embodiment of FIG. 6 taken through the plane 7-7 shown in FIG. 6.

FIG. 8 is a view in cross section of a fourth embodiment of the invention taken through the plane 8-8 shown in FIG. 9.

FIG. 9 is a view in cross section of the embodiment of FIG. 8 taken through the plane 9-9 shown therein.

FIG. 10 is a view in cross section of a fifth embodiment of the invention taken through the plane 10-10 shown in FIG. 11.

FIG. 11 is a view in cross section of the embodiment of FIG. 10 taken through the plane 11-11 shown therein.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The embodiment of the invention shown in FIGS. 1-3 is particularly preferred for teeth in the range of three to eight inches in width. The overall construction of the tooth assembly shown is generally conventional and it includes an adapter that is designated by the reference numeral 1. In accordance with usual practice the adapter 1 can be formed on or fastened to the lip of a bucket or other digging implement, and depending on the size of the teeth the adapter 1 might itself be a multi-part assembly. In any event, the adapter 1 is provided at its forward end with a generally wedge-shaped nose 2 which receives a tooth point as will be described. The forward end of the nose 2 has an upper and lower recesses 3, and the upper and lower wedge surface of the nose 2 are provided with spaced, parallel flut strips 4 which define the surfaces that actually bear against facing surfaces of the tooth point. Similar strips 4' are provided on the sides of the nose 2, and these define the surfaces that actually bear against the facing side surfaces of the tooth point. As best be seen in FIG. 3, the strips 4 on the upper surface of the nose 2 are slightly angled downwardly from the axial center line of the adapter 1 to the outside and the strips 4 on the lower nose surface are angled upwardly from center to outside, this slight angularity serving to help in taking up side loads during digging. The use of the flut strips 4, 4' is particularly advantageous in that they provide a conveniently machinable set of surfaces for insuring a tight fit of a point on the adapter 1.

The tooth point is designated generally by the reference numeral 5, and it is provided with a rearwardly facing generally wedge-shaped socket 6 which receives the nose 2 with a tight wedge fit to mount the point 5 on the adapter 1, the upper and lower walls of the socket 6 engaging the faces of the strips 4. Near the forward end of the socket 6 there are upper and lower bosses 7 which are received in the recesses 3, this arrangement providing conventional flat surfaces to help in taking beam loads.

The nose 2 is provided with a vertical key bore 8 of rectangular cross section which extends completely therethrough, and the tooth 5 is provided with upper and lower key openings 9 which are of the same general size and which are in alignment with the bore 8 when the teeth are opened 9 and openings 9 together define a vertical keyway that extends entirely through the tooth assembly. An elongated metal key 10 of generally rectangular cross section is received in the keyway thus formed, and serves to hold the point 5 in place on the adapter 1. The key 10 has a tapered end 11 which is intended to be inserted into the keyway first, but the keyway is straight sided so that the key 10 can be inserted either from above or from below. The forward face of the key 10 is provided with a transverse groove 12 of substantially circular cross section at about its midpoint, the groove 12 being engageable with a lock roller as will be described. The side walls of the adapter key bore 8 are preferably relieved along the curved lines 13, this configuration serving to define short ledges 14 at approximately the level of the groove 12, and the rear wall of the bore 8 is preferably relieved at 15.

The nose 2 is provided with a second vertical passage 16 therethrough which is located forwardly of the bore 8 and which receives a blocklike, resilient compressible natural or synthetic rubber backup plug 17. The plug 17 does not quite extend to the ends of the passage 16, and its free size is such that it must be compressed slightly in the passage 16 so that it will remain in place as shown with a friction fit. An opening 18 extends between the bore 8 and passage 16 and defines a rectangular, open-ended cage within
which there is a cylindrical metal lock roller 19 which is disposed parallel to and facing the key groove 12 to be engageable therewith. The dimensions of the roller 19 are only slightly less than those of the cage 18 so that the roller 19 is held against substantial longitudinal movement (movement up and down as seen in FIG. 1) or lateral movement (movement up and down as seen in FIG. 2) with respect to the key 10. The roller 19 is, however, free to rotate about its own axis, which is transverse to the key 10 and parallel to the groove 12, and is also free to move toward and away from the key 10 through the open front and rear ends of the cage 18. The plug 17 bears against the forward side of the roller 19 and urges it to the rear or into engagement with the groove 12, but does not prevent the roller 19 from rotating.

When the parts are assembled as shown in FIGS. 1-3, the roller 19 is received in the groove 12 to be engaged with the key 10 to hold the same against longitudinal movement in either direction. This is not a load engagement, however, and the primary load of holding the point 5 on the adapter 1 is taken by the key 10 during working. The roller 19 is approximately directly on both the horizontal and vertical center lines of the assembly to insure uniform distribution of forces. To remove the point 5, the key 10 is driven upwardly or downwardly as seen in FIG. 1. During this action, the key 10 exerts a shear force on the roller 19, but this is taken up by a slight rotation of the roller 19 and does not cause any particular problems. If the roller 19 were embodied in or fastened to the plug 17 as in older locks, however, this force would tend to rip it free or pull the entire plug 17 into the bore 8. When the key 10 is reinserted it exerts a similar shear force in the opposite direction, but this is again taken up by rotation of the roller 19.

When the key 10 is removed, the plug 17 moves the roller 19 to the right as seen in FIG. 1, but it cannot come out of the cage 18 because it comes against the ledges 14. Thus, there is no danger of the roller 19 falling out and being lost during replacement of a tooth point. The roller 19 is of course inserted into the cage 18 during initial assembly through the larger passage 16, which is as wide as the roller 19, and the plug 17 is inserted after the roller 19 is in place. It should be appreciated that the ledges 14 are in essence the result of the fact that the width of the bore 8 is less than that of the cage 18. That the ledges 14 are found only at about the center of the cage 18 in the preferred embodiment is due to the relieving of the side walls of the bore 8 along the lines 13.

The embodiment of the invention shown in FIGS. 1-3 provides an extremely effective lock for the key 10, and is also highly desirable because it is relatively simple to manufacture and has a minimum number of parts. The bore 8 and passages 16 and the cage opening 18 are all relatively easy and inexpensive to form during manufacture of the adapter 1, and both the plug 17 and roller 19 are easy to make and assemble. None of the parts need be made to extremely close tolerances or substantially machined.

The embodiments of the invention shown in FIGS. 4 through 9 are quite similar to the embodiment of FIGS. 1-3 and operate in much the same way but they differ in manufacturing details. Since the basic elements of the tooth assembly are similar to those of the embodiment of FIGS. 1-3, like reference numbers have been used to refer to like parts, and different numbers have been used only for the lock rollers, backup plugs and associated elements.

Turning first to the embodiment of FIGS. 4 and 5, in this embodiment there is a horizontal transverse passage 20 which extends entirely through the nose 2 and is generally oval in cross section. A suitably formed compressible rubber strip 21 is mounted on the forward side of the passage 20 and extends along substantially the entire length thereof, and is provided with a generally U-shaped metal saddle 22, which is vulcanized or otherwise affixed to the rear surface of the strip 21. The saddle 22 retains a cylindrical roller 23 and, with the upper and lower walls of the passage 20, serves to define a cage which allows the roller 23 to rotate about a transverse axis and move toward and away from the key 10 but holds it against longitudinal or lateral movement with respect thereto. It is important to note that although the saddle 22 is affixed to the rubber strip 21 to help form the cage, the roller 23 is still free to rotate about its own axis with the same effect as the roller 19 in the embodiment of FIGS. 1-3. In this embodiment, the rear end of the passage 20 extends into the bore 8, and this defines curved ledges 24 which limit rearward movement of the roller 23. The advantage of this embodiment is that only the single passage 20 need be formed in the nose 2 as opposed to the passage 16 and cage 18 of the embodiment of FIGS. 1-3, and the saddle 22 can be fabricated separately and fastened to the strip 21 before the latter is inserted. Again, the key 10 can be inserted or removed in either direction.

In the embodiment of FIGS. 6 and 7, there is a single vertical passage 25 through the nose 2 which is formed of, extends into, and is of greater width than the bore 8. A metal insert 26 is received in and substantially fills the bore 25 with a relatively close fit. The rear surface of the insert 26 is channeled along its entire vertical length so that it establishes the forward part of the bore 8 and receives the forward part of the key 10. The forward wall of the insert 26 is recessed to define a pocket 27 which tightly receives a backup plug 28. An insert 29 is cut transversely through the insert 26 and communicates with the pocket 27 and the forward portion of the bore 8 established by the channel. A roller 30 is received in the opening 29, and the upper and lower walls of the opening 29 and the nose surfaces at the ends thereof together define a cage. The opening 29 is horizontally elongated to present rear curved ledges 31 on opposite sides of the channel which limit rearward movement of the roller 30 and forward curved ledges 32 on opposite sides of the pocket 27 which limit forward movement. The advantage of this embodiment is that it is necessary only to provide the single straight walled passage 25 in the adapter 1, and the insert 26 can be separately formed and machined. The key 10 can be inserted or removed in either direction.

In the embodiment of FIGS. 8 and 9, instead of a passage running entirely through the nose 2, there is a pocket 33 formed on the upper surface thereof which receives a compressible backup plug 34 and a roller 35. In this embodiment, the groove 12 of the key 10 is located higher to put it at the higher level of the roller 35, and the side walls of the bore 8 are shaped to define curved ledges 36 which limit rearward movement of the roller 35. Also, the upper portion 37 of the tooth 5 that overhangs the pocket 33 serves as part of the cage for the roller 35. This embodiment functions generally the same as the previous embodiments, and is very easy to manufacture, but has one disadvantage in that the locking forces are not as uniformly distributed about the center line of the assembly as in the previous embodiments in all of which the rollers are at the horizontal and vertical center lines. Also, in this embodiment the key 10 should be driven in from above, but can be removed in either direction.

The embodiment of FIGS. 10 and 11 is particularly designed for large teeth where the use of a single key is not feasible. In this embodiment, there is a transverse key bore 38 of circular cross section, somewhat enlarged in the center, which extends through the adapted nose 2 to define opposite, outwardly opening portions 39, and the tooth point 5 is provided with circular side openings 39 which are aligned with respective end portions 38 of the bore 38 when the tooth point 5 is in place to define two opposite keyways. In each keyway there is received a headed cylindrical pin or key 40, the two keys 40 together serving to hold the tooth point 5 on the adapter 2. Each key 40 has a circumferential lock groove 41 near its inner end.

Forwardly of the bore 38, the adapter nose 2 is provided with opposite pockets or passages 42, and each pocket 42 receives a rubber backup plug 43 which is slightly compressed to be held in place. A cage opening 44, like the other passing 21, leads rearwardly from each passage 42 to the bore 38 and receives and serves as a cage for a roller 45. The rollers 45 engage the grooves 41 to hold the keys 40 in place, and as in the
case of the previous embodiments, the rollers 45 are held in the cages 44 against lateral or longitudinal movement relative to the keys 40 but are free to move toward and away from the keys 40 and are also free to rotate about axes transverse to the keys 40 to take up shear forces exerted by the keys 40 as they are driven past during insertion or as they are removed. The cage openings 44 are transverse to and extend into the circular bores 38, and this defines upper and lower retaining ledges 46 for the rollers 45. Advantages of this embodiment are its suitability for larger teeth, ease of manufacture, and the fact that the cylindrical keys 40 with the circumferential grooves 41 need have no particular orientation since a portion of the recess defined by the grooves 41 will always appear on the faces of the pins 40 that face the rollers 45. Although it is preferred in this embodiment to have the continuous bore 38, it would be possible to drill separate bores only partially into each side of the nose 2.

In each of the embodiments shown and described, the basic structure and operation is the same in that there is a roller which is engageable with a recess in a key to hold the key in place, and the roller is in a cage to be freely rotatable about a transverse shear force axis as the cage is inserted or removed. Although the embodiments shown represent several preferred manners to effect this desired result, it will be obvious that variations and modifications might be possible without departure from the scope of the invention. A ball roller might be substituted for the cylindrical roller shown, with a spherical recess then replacing the groove recess 38 in a circular cage replacing the rectangular cages shown, and this would still provide the desired rotatability about an axis transverse to the key. Further, an appropriately shaped leaf spring or other bias means might be substituted for the rubber plug to bias the roller toward the key. In the embodiment of Figs. 1–3, it would be possible instead of providing the throat or cage opening 18 to provide a circular cross bore extending entirely through the adapter nose 2 and to replace the roller 19 with a pin approximately of the same length as the width of the nose 2 which extends entirely therethrough. It is not absolutely necessary in any of the embodiments to have a keyway running entirely through the assembly or to have a key that can be inserted or removed in either direction. In view of the many possible modifications, it is not intended that the invention be limited by the showings herein or in any other manner except as may specifically be required.

I claim:

1. In a digging tooth assembly of the type including an adapter nose with a transverse key bore therein, a removable point thereon and further provided with an opening which is in alignment with the key bore when the point is in place to define a keyway, and an elongate key longitudinally movable into and out of the keyway to hold the point in place, the key being provided on one surface with a lock recess that is within the nose when the key is in place and that is engageable by a detent to limit longitudinal movement of the key, the combination of:
   a passage in the adapter nose that has a communication with said key bore at a point facing the lock recess when the key is in position in which there is a transverse dimension at such point of communication that is greater than the key bore width;
   upper, lower and side surfaces at said point of communication that form a cage therebetween that opens toward the key bore;
   a lock roller disposed within said cage that is restricted from lateral and longitudinal movement relative to the key by said cage surfaces, said lock roller being rotatable about an axis transverse to the key bore and being movable toward and away from the key bore, said lock roller having a lateral dimension greater than the width of the key bore to be limited in movement toward the bore, said roller defining a curved surface that extends into the key bore when the roller has moved toward the bore and serves as a detent engageable with the lock recess; and a resilient plug disposed in said passage on the side of said lock roller opposite said key bore, said plug biasing said lock roller toward said key bore, both said plug and said lock roller being assembled into position by insertion through said passage;
   said lock roller being engageable by the key as it is moved into and out of said keyway to be rotated about said axis and moved away from the key bore.

2. The combination of claim 1 wherein the passage is in a plane parallel to and spaced from the plane of the key bore; and there is an opening leading from said passage to the key bore, which opening defines the cage; and the plug is disposed in the passage.

3. The combination of claim 2 wherein the roller is disposed approximately on the vertical and horizontal center lines of the nose and point.

4. The combination of claim 3 wherein the key bore extends entirely through the adapter and the point is provided with openings at both ends of the key bore to define a continuous keyway, straight side thereof to the key bore and the point is provided with an opening so disposed that the key can be removed or inserted from either direction.

5. The combination of claim 1 wherein the passage is transverse to and extends partially into the key bore and extends entirely through the nose; and the plug comprises a strip extending along the side of said passage opposite from the keyway, and there is a generally U-shaped saddle fixed to said strip near its center and facing the keyway, said saddle and the walls of said passage together receiving and defining the cage for the roller.

6. The combination of claim 1 wherein the passage extends entirely through the nose and is parallel to, in communication with and of greater lateral width than the key bore; and there is an insert disposed in and substantially filling said passage, which insert is provided with an opening against which is opposite from the key bore and an opening leading from the pocket toward the key bore, which opening defines the cage; and the resilient plug is received in said pocket.

7. The combination of claim 1 wherein the passage comprises a pocket in one surface of the nose which is in communication with and of greater lateral extent than the key bore and which is covered by an overhanging portion of the point when the point is in place; and the plug is received in the pocket at the end thereof opposite from the key bore; and the roller is received in the pocket between the plug and key bore, the side and bottom walls of the pocket serving with the overhanging portion of the point to define the cage.

8. The combination of claim 1 wherein the key bore comprises outwardly opening portions of circular cross section on opposite sides of the nose; and the point is provided with circular openings which are in alignment with respective bore portions when the point is in place to define opposite keyways; and there are a pair of cylindrical keys removably received in respective keyways, each of the keys being provided near its inner end with a circumferential groove which defines the lock recess; and the nose is provided with a pair of passages associated with and spaced from respective key bores; and there is a pair of plugs received in respective passages; and there are openings leading from said passages to respective keyways, said openings defining two cages; and there are two rollers, one received in each cage to be engageable with the circumferential groove of the associated key.

9. A lock roller arrangement for a digging tooth assembly of the type including an adapter nose with a transverse key bore, a point which has a socket that receives the nose and which is provided with an opening that is in alignment with the key bore when the point is in place to define a keyway, and an elongate locking key that is longitudinally movable into and out of the keyway and that is provided intermediate its ends with a recess that is within the nose when the key is in place and that is adapted to receive a detent to hold the key against longitudinal movement, said lock arrangement comprising:
a passage in the nose that is in a plane parallel to and spaced from the key bore; an opening in the nose that leads from the passage and extends into the key bore and that has an axis transverse to and of greater lateral extent than the key bore; a lock roller freely disposed in said opening to be rotatable about said opening axis, the peripheral walls of said opening defining a cage which limits lateral and longitudinal movement of the roller relative to the key, the roller being movable into and out of the opening through the passage and being of greater lateral extent than the keyway so that it cannot move out of the opening into the key bore; and a separate resilient bias means that is movable into and out of the passage and that is engageable with the roller to bias the roller toward the key bore, the roller being rotatable about said axis notwithstanding engagement with the bias means, the roller presenting a curved surface which extends into the key bore when the roller has been moved toward the key bore and which serves as a detent engageable with the lock recess.

* * * * *
It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Fig. 9 should include section line 8-8 as shown below.

![Fig. 9](image)

Fig. 10 should include section line 11-11 as shown below.

![Fig. 10](image)

Signed and sealed this 9th day of January 1973.

(SEAL)

Attest:

EDWARD M. FLETCHER, JR.
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