United States Patent [19]

Petersen

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[45] **July 30, 1974**

[54] **EXCAVATOR TOOTH, HOLDER AND RETAINER**

[76] Inventor: **Gerald Alger Petersen,** Chemin des Salles Villa Pengopia, 06 Vence, France

[22] Filed: **Feb. 6, 1973**

[21] Appl. No.: **330,050**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 215,739, Jan. 6, 1972, Pat. No. 3,751,834.

[52] **U.S. Cl.** ..... **37/142 A,** 279/79, 287/20.5 SL, 24/211 K

[51] **Int. Cl.** **E02f 9/28**

[58] **Field of Search** ..... 37/142; 279/79; 287/20.5 SL; 24/211 K

[56] **References Cited**

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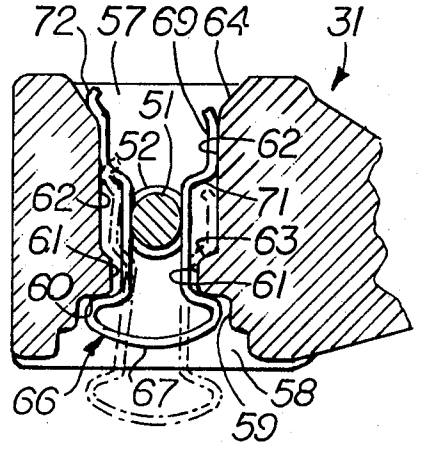
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Primary Examiner—Robert E. Pulfrey
Assistant Examiner—Clifford D. Crowder
Attorney, Agent, or Firm—Julian Caplan

[57] **ABSTRACT**

An excavating tooth holder has a recess receiving the proximal, non-circular end of a tooth formed wth a groove to provide a circular spindle forward of a shoulder. A staple-shaped retainer in the holder has an inwardly disposed stretch which fits into the groove and locks the tooth in place when the retainer is operative. When the retainer is retracted, the inward stretch is lifted from the groove, permitting the tooth to be removed. The shape of the retainer and the opening in the holder in which it fits permit lifting of retainer with removal of the retainer from the holder.

6 Claims, 18 Drawing Figures



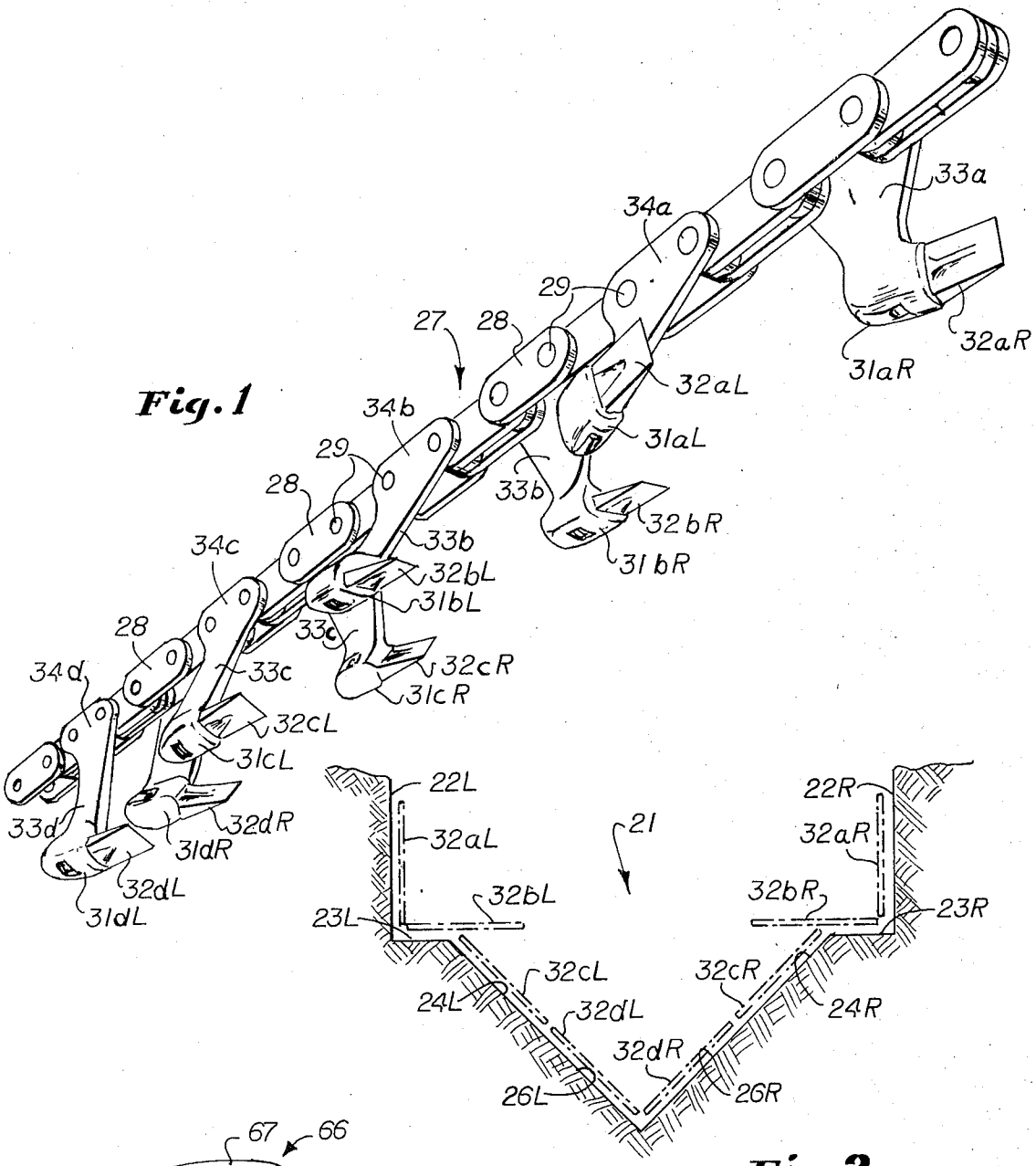


Fig. 1

Fig. 2

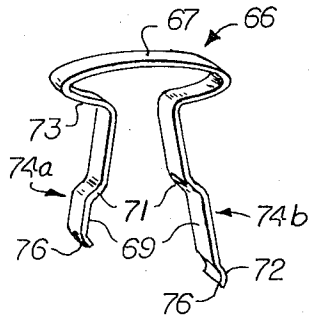


Fig. 10

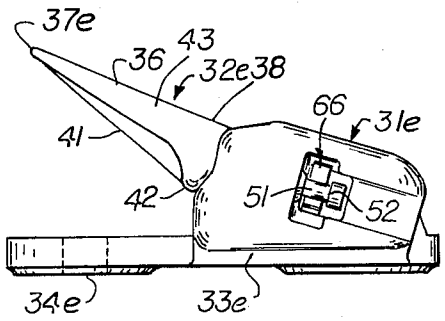


Fig. 3C

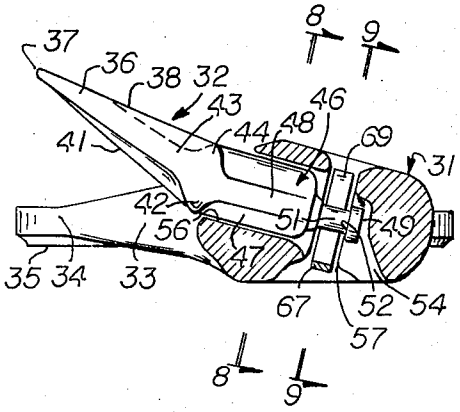


Fig. 7

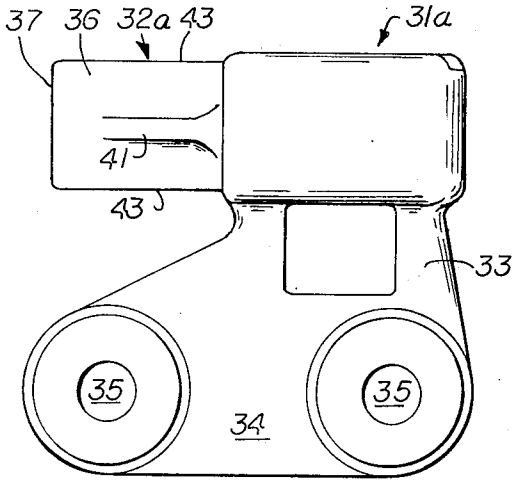


Fig. 3A

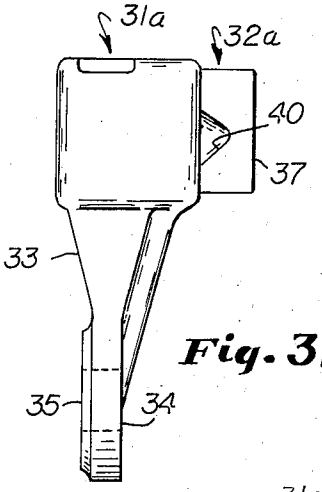


Fig. 3B

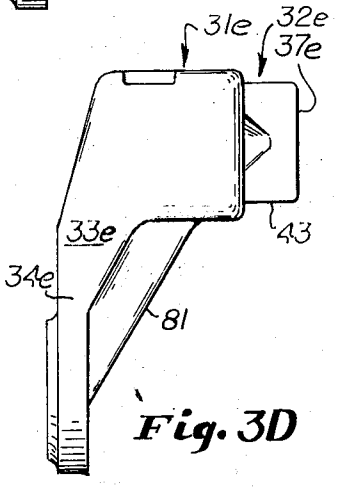


Fig. 3D

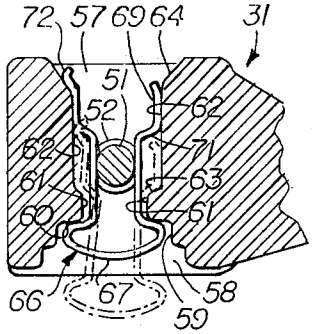


Fig. 9

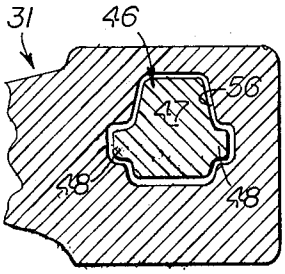


Fig. 8

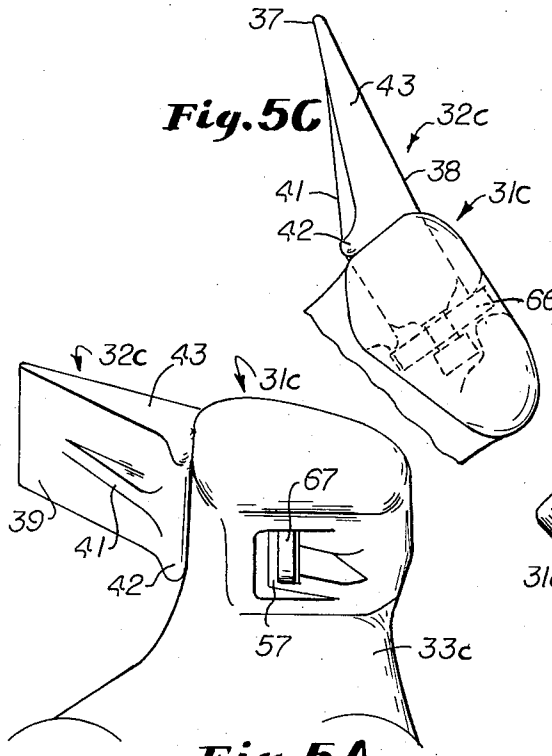


Fig. 5C

Fig. 5A

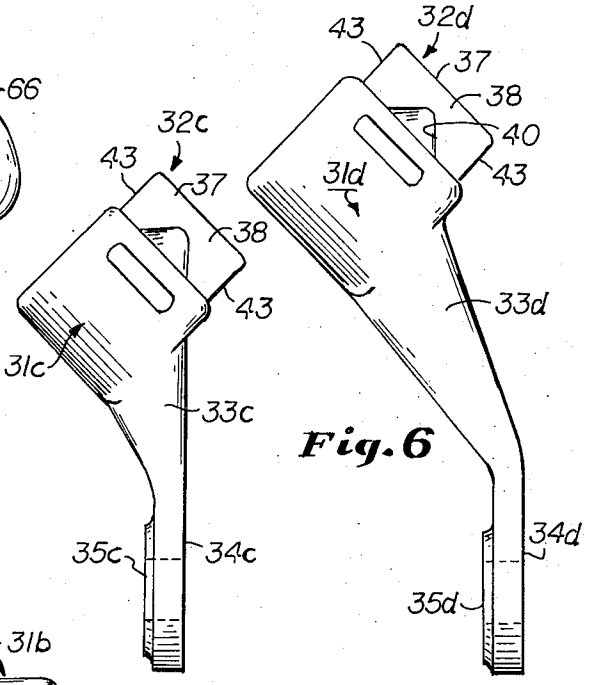


Fig. 5B

Fig. 6

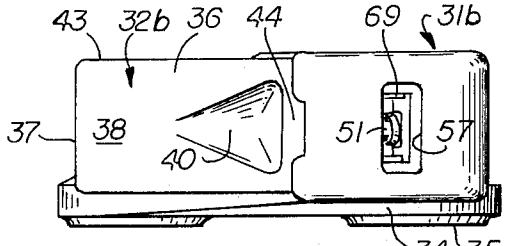


Fig 4C

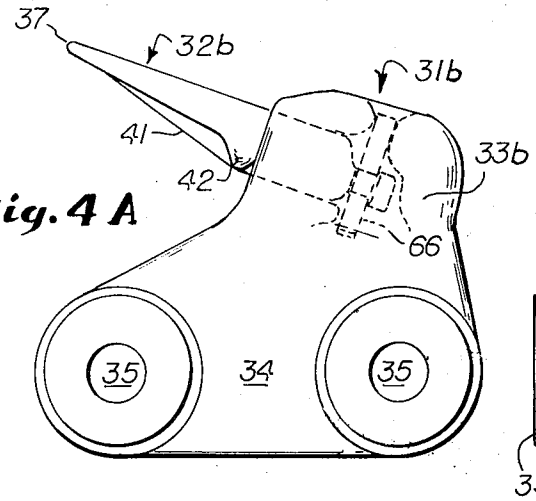


Fig. 4A

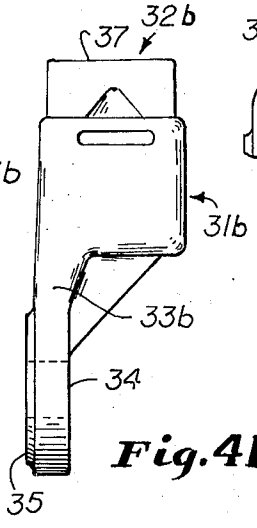


Fig. 4B

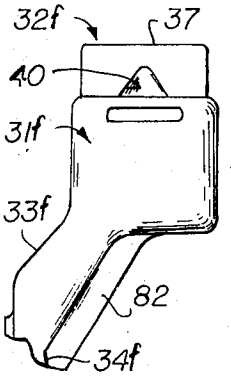


Fig. 4D

EXCAVATOR TOOTH, HOLDER AND RETAINER

This invention is a continuation-in-part of U.S. Patent application Ser. No. 215,739 filed Jan. 6, 1972, now U.S. Pat. No. 3,751,834.

This invention relates to a new and improved chain-mounted trencher tooth system and to a retainer for such teeth. For simplicity and brevity, this system is referred to in this Specification and in the claims as a "chain," but the term "chain" is intended to cover other trencher systems, such as ladders, wheels and the like.

The present invention provides teeth mounted on a trencher machine chain which dig a trench having vertical sides extending downward from the surface, a horizontal shelf and a V-shaped bottom. The V-shaped bottom is satisfactory for installation of drainage pipe. The vertical sides and horizontal shelf are located at such depths as required in the drainage system for the field in which the trench is formed.

A further feature of the invention is the fact that the shape of the trench accommodates continuous plastic pipes or short sections of clay pipes or similar drainage pipes which are usually fed into the trench automatically by the machine as it makes the trench. Square pipes turned 45° fit very satisfactorily into the bottom of the trench.

A further feature of the invention is the fact that the teeth are replaceably mounted in holders which are supported at their inner ends by pins attaching the holders to links of the trencher chain. The teeth are located rearwardly of the point of attachment of the holder-supporting arm to the chain, as contrasted with conventional trencher chain construction, so that the chain tends to pull the tooth rather than push it. Each holder is attached to an arm, the length of the arm and the disposition of the holders for the teeth on the arms being varied at different positions along the section of the chain. In one section of chain are a first tooth on each side which digs the vertical side, the second tooth the horizontal shelf, the third tooth the upper portion of the V-shaped bottom and the fourth tooth the bottom of the V-shaped bottom. The sequence of the teeth need not be in the order named, although this sequence is convenient. The holders on the two sides are alternated so that the first tooth on the right side digs first and then the first tooth on the left side until the bottom of the trench is reached whereupon the series is repeated. The holders are substantially uniform in shape and only the arms connecting the holders to the links of the chain are different. Further, the teeth themselves are identical in all of the holders and the retainers likewise are identical. Economy in manufacture is achieved by this construction.

Another feature of the invention is the fact that the retainers are so positioned relative to the holders that, as the chain revolves, even at high speeds, the retainers do not tend to fall out of the holders by centrifugal force. The angles at which the retainers fit into the holders are such that centrifugal force tends to assist in holding the retainers in place, yet the retainers are so located that when it is necessary to replace a tooth the retainers can easily be raised to free the tooth.

Still another feature of the invention is the fact that simple, readily available tools such as screwdrivers may be used to retract retainers. The teeth may be removed from their holders and replaced by hand unless the

teeth have rusted into the holders or some other unusual conditions occur. The operation requires little time and comparatively little skill of the workman. The fact that the tooth may ordinarily be inserted and pulled out by hand is a distinctive feature of this invention.

The retainer of the present invention is staple-shaped and the tooth holder slidably receives the retainer. The tooth holder has a recess which receives the shank or proximal part of the tooth in a non-rotative mode and a portion of the proximal end of the tooth adjacent to the rear is formed in a cylindrical spindle with a shoulder rearward of the spindle. When the retainer is fully inserted in an opening in the holder, the upper portion of the retainer fits closely against the spindle portion and forwardly of the shoulder, thereby retaining the tooth in place. On the other hand, when the retainer is pulled partially outward to retracted position, the upper portion of the retainer slides away from the spindle portion and there is no engagement of the retainer in the shoulder of the shank, thereby permitting the tooth to be lifted out of the holder by hand and replaced.

It is, thus, a principal feature of the invention to provide a retainer which is formed with offset legs so that the upper end of each leg comprises a shoulder-engaging portion, which, when the retainer is fully inserted in the holder, is operative and the lower portion of the legs are offset outwardly relative to the upper portions so that when the retainer is partially withdrawn the lower portions of the legs do not fit ahead of the shoulder and the retainer is inoperative. Further, the legs of the retainer are formed so that they initially diverge, thereby requiring that the legs be compressed toward each other for insertion into the opening in the holder. The end of one leg of the retainer slants outward and engages the diverging wall of the opening to prevent the retainer from slipping to retracted position unintentionally.

Still another feature of the invention is the provision of an internal shoulder in the opening of the holder into which the retainer is inserted and which is engaged by the retainer and limits outward movement of the retainer relative to the holder when the retainer has been withdrawn to inoperative position.

A feature of the retaining means for the tooth is, therefore, rapid installation and removal and secure holding of the tooth in place against unintentional dislodgment. The retainer is inexpensive and readily replaced if the original retainer is lost or damaged.

Other objects of the present invention will become apparent upon reading the following specification and referring to the accompanying drawings in which similar characters of reference represent corresponding parts in each of the several views.

In the drawings:

FIG. 1 is a perspective view of a portion of a chain of a trencher having a plurality of holders installed thereon in accordance with the present invention.

FIG. 2 is a schematic sectional view of a trench formed in accordance with the invention showing schematically the locus of the teeth which form the various portions of the walls of the trench.

FIG. 3A is a side elevational view of the first tooth of the series.

FIG. 3B is an end elevation thereof.

FIG. 3C is a top plan thereof.

FIG. 3D is a view similar to FIG. 3B showing a modified holder for a wider trench.

FIGS. 4A–D, inclusive, are views similar to FIGS. 3A–D respectively, of the second tooth on the same side of the chain as the first tooth.

FIGS. 5A–C are views similar to FIGS. 3A–C of the third tooth of the series.

FIG. 6 is a view similar to FIG. 5B of the fourth tooth of the series.

FIG. 7 is a view similar to FIG. 3C broken away to reveal internal construction.

FIG. 8 is a sectional view taken substantially along the line 8—8 of FIG. 7.

FIG. 9 is a sectional view taken substantially along the line 9—9 of FIG. 7.

FIG. 10 is a perspective view of a retainer used in the present invention.

Directing attention to FIG. 2, a trench 21 formed in accordance with the present invention is illustrated more or less schematically. Said trench, immediately below the surface has vertical side walls 22L and 22R, the depth of penetration of these walls depending upon the control of the trencher machine on which the system of the present invention is installed. The teeth are mounted on chain 27 in a sequence, which is subject to variation in the order the teeth are positioned. One sequence is illustrated and described, it being understood that the terms "first", "second," etc. may be changed. As set forth in the claims hereof the series of chain links may be altered in the order of their sequence. The walls 22L and 22R are cut by the first teeth of the series of teeth making up the system of the present invention designated as 32*a*L and 32*a*R, respectively. Below walls 22L and 22R are horizontal shelves 23L and 23R which are cut by teeth 32*b*L and 32*b*R, respectively. Sloping downward on either side and meeting at an apex in the middle of the trench are, on the left side, sections 24L, 26L and on the right side 24R and 26R disposed at a 90° angle and cut by teeth 32*c*L, 32*d*L, 32*c*R and 32*d*R, respectively. The V-shaped bottom of the trench accommodates a pipe for drainage or irrigation and the depth of the side walls 22 is subject to considerable variation.

Directing attention to FIG. 1, the chain 27 which cuts the trench 21 is partially illustrated. In the section illustrated in FIG. 1 there are eight tooth holders 31 in a sequence, four on each side, each holding a tooth 32. Tooth 32*a*R is the leading tooth and cuts one of the side walls of the trench 21 and the other teeth are located rearwardly thereof. It will be understood that the series of teeth is repeated several times, the chain being made up of a plurality of such series, the number of series depending upon the length of the chain. The chain 27 passes around sprockets (not shown) at either end of the machine, one of the sprockets being a drive sprocket for the chain. The angle which the chain 27 assumes relative to the horizontal controls the depth of the trench dug or in other words the depth of the side walls 22R, 22L.

Each holder 31 is connected by means of arm 33 to a link portion 34 having two apertured disks 35 through which pins 29 fit to pivotally connect the link portions 34 to the adjacent links 28 of the chain. The lengths of arms 33 and the disposition of holders 31 determine the cutting positions of the teeth 32 mounted therein.

Each tooth 32 has a distal portion 36 formed with a cutting edge 37. The top 39 of the tooth has a flat central rib 41 and the top 39 diverges outwardly rearwardly relative to bottom 38. Bottom 38 has a central depression 40 which increases in depth proceeding rearwardly. Rib 41 merges with a transverse protuberance 42 across the width of the tooth located immediately forwardly of holder 31 and limiting inward movement of the tooth relative to the holder. There is a corresponding protuberance 44 on bottom 38. The side edges 43 of the tooth are substantially vertical and transverse to cutting edge 37.

The proximal end 46 of tooth 32 in its forward area is formed with a trapezoidal portion 47 preferably formed with outward protruding ears 48. It is important that the ears 48 prevent rotation of proximal end 46 and assist in locating the tooth in its holder. The back end 49 of proximal end 46 may be circular in cross-section and immediately forwardly thereof is a cylindrical spool 51 of lesser diameter than back end 49 there being a shoulder 52 at the forward end of back end 49 which cooperates with the retainer 66 hereinafter described to limit withdrawal of the tooth 32 when the retainer 66 is in place. As best shown in FIG. 7, distal end 36 is disposed at an angle relative to proximal end 46, or in other words the bottom surface 38 diverges outwardly relative to the chain on which the holder 31 is mounted. Thus the cutting edge 37 provides clearance for the holder 31. It should also be noted that the holder 31 is located rearwardly of the forward disk 35 of link portion 34 and that the cutting edge 37 of the tooth 32 held therein is disposed somewhat rearwardly of the forward end of link portion 34. Thus the chain tends to pull the tooth 32 forwardly behind it rather than pushing the tooth 32 ahead of the link to which it is attached as in other trencher chain constructions.

Holder 31 is formed with a recess 56 extending from the forward end of the holder rearwardly, said recess 56 being substantially complementary to the proximal end 46 of tooth 32. At about the middle of holder 31, and in alignment with spool portion 51 of tooth 32 when the tooth is fully seated, is an opening 57 extending transversely through holder 31. Shown in the bottom of FIG. 9 but frequently in the top of the holder 31 is a depression 58, there being a bottom 60 which limits inward movement of the retainer 66 as hereinafter appears. Below bottom 60 are inwardly offset walls 61 and beyond walls 61 are outwardly offset walls 62, there being shoulders 63 at the merger of the inward and outward walls, said shoulders 63 limiting withdrawal of retainer 66 as hereinafter appears. On the side opposite depression 58 the opening 57 has outwardly flared extremities 64 which assist in expelling dirt and also function to assist in holding the retainer 66 in place.

Retainer 66 is staple-shaped and is preferably formed of a non-corroding spring stock having a width substantially greater than its thickness. Stainless steel or rust proof steel is suitable material for the retainer 66. There is a bowed connecting portion 67 which has a width greater than the space between walls 61 having in-turned return portions 73 which seat on bottom 60 when the retainer is in operative position (solid lines in FIG. 9). Initially, the legs 74*a*, *b* of retainer 66 diverge outwardly and one leg 74*b* is preferably longer than leg 74*a*. The longest leg 74*b* is first inserted between the wall portions 61 and the shorter leg is then forced toward the longer leg until the legs fit between the walls 61. The upper portions 68 of each leg are elongated

and, in the assembled position of the retainer **66** in the holder **31**, these upper leg portions **68** fit around the spool **51** and forwardly of shoulder **52** and thus prevent withdrawal of the tooth from the holder. Beyond the upper leg portions **68** are outwardly offset leg portions **69** which engage the outward offset walls **62** of the opening **57**. To facilitate sliding of retainer **66** in and out relative to opening **57** the ends **76** are turned inward in short 45° bends. In inward position the upper leg portions prevent withdrawal of the tooth **32** but in retracted position with the interconnection **71** between each leg portion **68** and leg portion **69** engaging shoulders **63** (dot and dash position of FIG. **9**) the shoulder **52** is free to move forwardly so that the tooth may be removed.

To facilitate removal of the tooth, an opening **54** is formed in holder **31** behind the back end **49** of the tooth **32** so that an instrument may be inserted to drive the tooth out of its holder. However, ordinarily the tooth may be manually withdrawn. Further, the opening **54** permits egress of dirt.

In use, the retainer **66** is installed as heretofore explained and is pulled up to retracted or dot-and-dash position as shown in FIG. **9** with the interconnection **71** abutting the shoulder **63**. In this position, the proximal end **46** of the tooth **32** may be inserted in the recess **56**. If necessary, a hammer may be used to drive the tooth into place. When the tooth is in place, the connecting portion **67** of retainer **66** is forced down until the return portions **67** seat against the bottom **60**. In this position, the upper leg portions **68** straddle the spool **51** and fit ahead of the shoulder **52** and prevent the tooth from being withdrawn from the holder. To secure retainer **66** in operative position, the end **72** of the longer leg **74***b* is bent outward as shown in FIG. **9** against the flared portion **64**. When it is necessary to remove the tooth, a prying tool may be inserted under the connection portion **67**, pulling the retainer **66** from solid line to dot-and-dash line position as shown in FIG. **9**. Thereupon the tooth may be removed by hand and a new tooth installed by hand. If needed, an instrument may be inserted through the opening **54** to drive the tooth out if it tends to stick in its holder. Occasionally a retainer **66** will be fractured. The retainer is easily replaced when this occurs but in normal usage the retainer may be used repeatedly and the tooth **32** removed for replacement or sharpening as frequently as necessary.

Directing attention now to the structures of FIGS. **3**A–C, it will be seen that the arm **33** is relatively short and is substantially in alignment with the link portion **34**. The holder **31** has its recess **56** (best shown in FIG. **7**) diverging slightly outwardly-forwardly and the distal **36** of the tooth **32** also diverges outwardly. Hence, the cutting edge **37** of the tooth **32** cuts a substantially vertical sidewall **22** as shown in FIG. **2**. The holder on the opposite side of the chain is a mirror image of that shown in FIGS. **3**A–C.

Directing attention now to FIGS. **4**A–C, again the arm **33***b* is comparatively short but longer than arm **33**. The holder **31***b* is offset outwardly relative to the link portion **35**. Again the recess in the holder **31***b* faces forwardly in the direction of movement of the chain and is so disposed that in normal operative position the cutting edge **37** of the tooth **32***b* is horizontal.

In FIGS. **5**A–C, again arms **33***c* are relatively short and the holders **31***c* are offset inwardly relative to the link portions **34***c*. The holders **31***c* are disposed at angles so that the cutting edges **37** are at about 45° angles with respect to the vertical.

The holder **31***d* shown in FIG. **6** is supported by an arm **33***d* which is substantially longer than the arms of the previous modification. As is shown by a comparison of FIG. **5**B and FIG. **6**, the cutting edge **37** of the tooth **32***d* is elevated above the cutting edge **37** of the tooth **32***c* of FIG. **5**B. In other respects the structures of FIGS. **5**B and **6** are the same except that there is an offset of the holder **31***d* to the right of that of **31***c* which results in the wall portion **26** being set in relative to the wall portion **24**.

The holder **31***a* shown in FIGS. **3**A–C is for a relatively narrow trench. Holder **31***a* of FIG. **3**D is for a wider trench. Link portion **34***c* is the same as the corresponding portion of FIG. **3**B but arm **33***c* slants outward away from the center line of the chain and may be reinforced by gusset **81**. Thus holder **31***c* and tooth **32***c* are similar but outwardly disposed relative to the corresponding elements of FIG. **3**B.

For the wider trench, holder **31***f*, as shown in FIG. **4**D, is outwardly disposed relative to holder **31***b* of FIG. **4**B. Arm **33***f* bends outward and is reinforced by gusset **82**. The holders **31***c* and **31***d* accommodate either the wider or narrower trench. Note in FIG. **2** that the outer corner of tooth **32***c*R intersects the center line of tooth **32***b*R for the narrower trench. The trench may be wider by twice the overlap (i.e. one tooth width) by offsetting teeth **32***a*R and L and **32***b*R and L outward. Thus, assuming teeth **32** are 2 inches in width, either a 7 or 9 inch trench may be dug merely by changing the angles of arms **33***c* and *f* relative to arms **32***a* and *b*.

It will be understood that the chain **27** moves at a relatively high speed. There is a tendency for centrifugal force to dislodge the retainer **66**. This is overcome in accordance with the present invention by locating the opening **57** so that the retainer **66** tends to be forced inward relative to the opening **57** rather than being forced outwardly. Thus, in FIG. **3**A the opening **57** is transverse to the direction of movement of the chain and centrifugal force neither drives the retainer out nor forces it in. Similarly in FIG. **4**C the retainer **66** is inserted from the underneath upwardly and the opening **57** shown in FIG. **4**C is for the leg portion **69** rather than for the connecting portion **67**. Hence, centrifugal force drives the retainer **66** inward relative to holder **31***b*. Again in FIG. **5**A the opening **57** is slanted so that the retainer is driven in. Although not shown, the members illustrated in FIG. **6** have their opening **57** located in a same manner.

In all of the locations of the openings **57** which have been illustrated, it is clear that access to pull the connecting portion **67** of the retainers **66** to inoperative position is convenient so that changing teeth **32** is relatively simple. Very few tools are required to remove and replace teeth and such tools are screwdrivers and hammers, all of which are conveniently on hand at construction sites.

What is claimed is:

1. A holder for a tooth comprising a member formed with a recess shaped to receive the proximal end of a tooth opening inward from one end of said member in a first direction, said holder formed with an opening spaced back from said one end, said opening extending inward from a first surface of said holder generally perpendicular to said first direction to a second surface of

said holder opposite said first surface, at least one wall of said opening comprising a continuation of a wall of said recess, said one wall of said opening having a straight first portion parallel to said first direction, a second portion adjacent said first surface laterally offset with respect and approximately parallel to said first portion, a shoulder interconnecting said first and second portions, said first surface formed with a depression intersecting said opening and extending transverse to said first direction having a bottom spaced outwardly of said shoulder, said second surface formed with an outward flared extremity comprising a continuation of said first portion.

2. In combination, an excavating tooth having a proximal portion of non-circular cross-section and a distal portion formed with a cutting edge, a tooth holder formed with at least one recess complementary to said proximal portion and opening inward from the forward end of said holder and extending inward from said forward end in a first direction, said recess having first side walls extending approximately parallel to said first direction, and a retainer, said retainer having a pair of legs and a connecting portion connecting one end of each said leg, said retainer being formed of a resilient material to resist movement of said legs toward and away from each other, said retainer being slideable in said holder between operative and retracted positions, said holder formed with an opening extending from a first side of said holder to the second side of said holder opposite said first side, said opening having opposed second side walls extending approximately parallel to said first direction, said opening being spaced back from said forward end, said opening extending parallel to a plane generally perpendicular to said first direction, at least one said second side wall having a first portion, a second portion laterally offset with respect and approximately parallel to said first portion and a first shoulder interconnecting said first and second portions, said proximal portion of said tooth formed with a notch and having a second shoulder rearward of said notch, at least one leg of said retainer extending along one said second wall adjacent said first and said second sides and into said notch when said retainer is in operative position and abutting said second shoulder to restrain said tooth against dislodgement from said holder, said one leg being movable out of said notch without total removal of said one leg from said holder when said retainer is in retracted position, said legs biased to diverge from each other so that said legs engage said second walls to resist unintentional movement of said retainer, said one retainer leg being entirely inside said holder when said retainer is in operative position, said retainer being assembled with said holder when either in retracted or in operative position, at least one leg of said retainer having an upper portion, a lower portion offset laterally relative to said upper portion and a short interconnection joining said upper and lower portions, said interconnection being located approximately midway of the length of said one leg and being at all times within said opening when said retainer is either in operative or in retracted positions, said first shoulder engaging said interconnection to limit outward movement of said retainer when said retainer is in retracted position.

3. The combination of claim **2** in which said proximal portion of said tooth forwardly of said notch has a first surface extending in said first direction, a second surface parallel to said first surface, and two third surfaces intersecting said first and second surfaces, at least one said third surface having an outwardly protruding ear extending in said first direction, said ear being intermediate said first and second surfaces and having both its width and its breadth substantially less than one-half the distance between said first and second surfaces, said third surface to either side of said ear comprising a flat plane.

4. The combination of claim **2** in which the walls of said opening diverge proceeding outwardly from said recess to permit dirt to escape from said opening.

5. The combination of claim **4** in which at least one leg of said retainer is bent outward into the diverging portion of said opening to restrain unintentional withdrawal of said retainer.

6. The combination of claim **2** in which the ends of the legs of said retainer are curled inward to facilitate movement of said retainer within said holder.

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