July 2, 1946. H. C. HETTELSATER 2,403,078

EXCAVATING TOOTH

Filed May 26, 1944 2 Sheets-Sheet 1

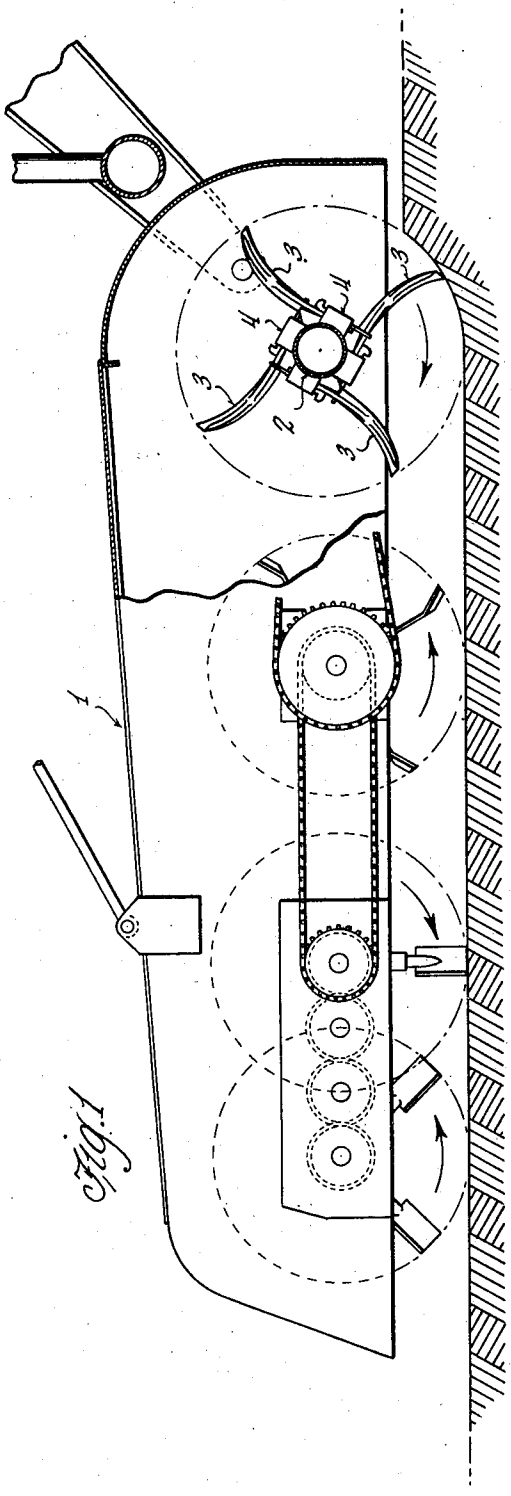


Fig. 1

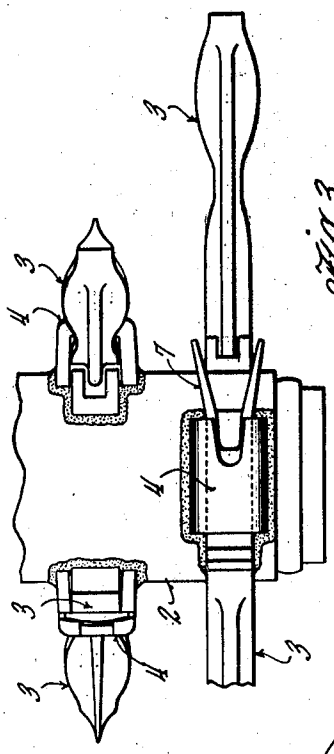


Fig. 3

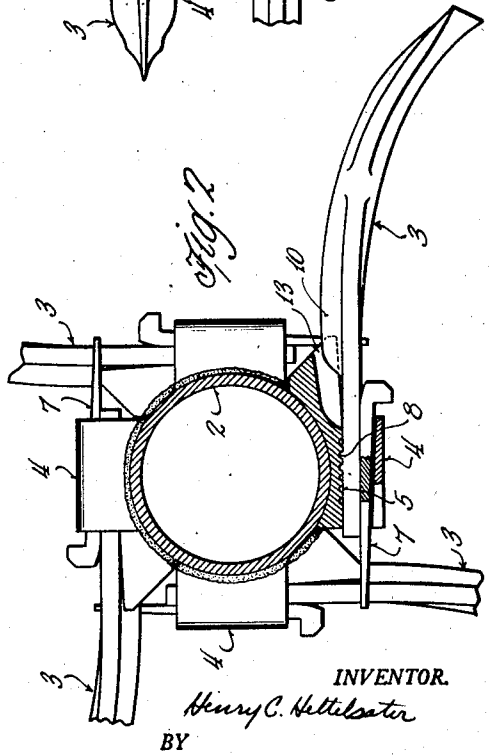


Fig. 2

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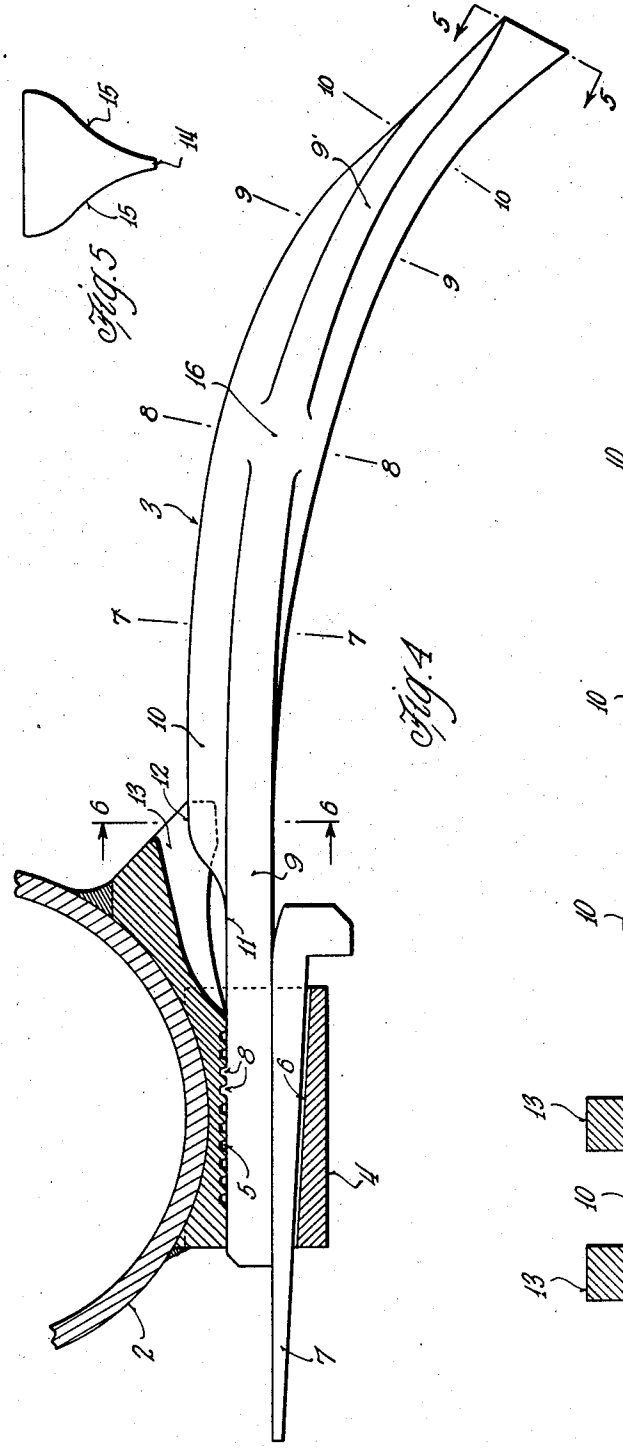


Fig. 4

Fig. 5

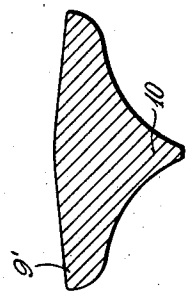


Fig. 10

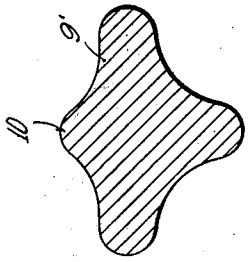


Fig. 9

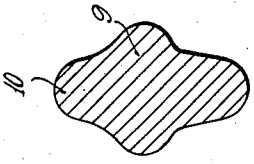


Fig. 8

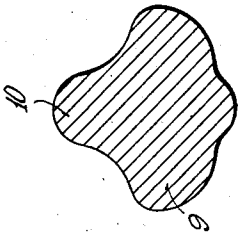


Fig. 7

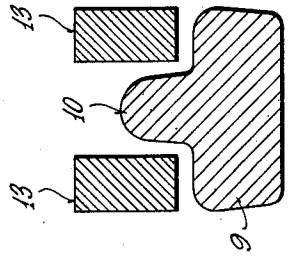


Fig. 6

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Patented July 2, 1946

2,403,078

UNITED STATES PATENT OFFICE

2,403,078

EXCAVATING TOOTH

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Application May 26, 1944, Serial No. 537,450

10 Claims. (Cl. 97—216)

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This invention relates to improvements in the construction and form of teeth of the type employed in rotary earth-removing appliances and resides more particularly in an improved construction of the same which renders them more durable and effective and at the same time capable of yielding to avoid self-destruction upon encountering hidden indestructible obstacles.

In the excavation of native soil, there is no feasible way in which the nature and location of indestructible obstacles can be forecast. As a consequence an earth-removing instrumentality may at any time come into engagement with an obstacle which may neither be dislodged or disintegrated. Large advantages can flow from rapid movement of an excavating instrumentality, but by reason of the high inertia forces which develop upon engagement with a difficultly dislodged obstacle great difficulties have been encountered in efforts which have been made to avail of the advantages of high speed operation. Usually, lower speeds are employed so that stalling can occur without destruction of the instrumentality which is doing the excavating. One effort which has been made to avoid the difficulties encountered with high speed operation is to employ digging teeth of low inertia and of large resiliency so that they may yield to entirely clear an obstacle, but limited success has been experienced with constructions of this sort, partly because the destructive effect of rebound forces which occur and partly because of the impossibility of producing an excavation of accurate and uniform depth.

It is the discovery of this invention, however, that a more durable high speed tooth results when a very limited and carefully controlled degree of resiliency is provided for clearing minor obstacles and a moderate amount of inertia, sufficient to demolish others, is involved, and in addition sufficient strength is provided so that the apparatus will "climb" and "walk over" a large and obstinate obstruction. These conditions may be fulfilled through the use of the novel tooth form herein described and claimed.

By following the novel construction of this invention, the rapidly moving tooth upon engaging a difficultly demolished obstacle acts by reason of its very considerable inertia to deliver an intense and destructive blow. Many such obstacles are thus cleared without the violent rebound and reaction which occurs in older, low inertia, high resiliency teeth, which cannot deliver as intense a blow. In the event, however, that the obstacle cannot be demolished by such a blow, the tooth

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of this invention is capable of resilient deflection laterally or tangentially sufficient to permit the tooth to clear the obstacle without self-destruction, providing a moderate deflection is sufficient for the purpose. The extent of tangential deflection is carefully controlled and limited and in this way destructive rebound forces in the tooth are avoided. Such limitation of tangential deflection will not permit the clearing of an unusually large obstacle by tooth deflection alone, which has been the objective sought in apparatus heretofore provided. Under such extreme conditions in accordance with this invention, forces which come into play, sufficient to deflect the tooth to the full limit of its permissible tangential deflection, reach such a magnitude that upward displacement of the mounting mechanism which is driving the tooth occurs thus clearing the obstruction by climbing over it. There is thus provided both resilient displacement of the tooth and actual bodily displacement of the mounting means as actions effective to accommodate various sizes of obstacles. I have discovered that when this is done, high speed earth-removing teeth can be provided having greatly augmented life and excavation to an accurate and uniform grade level is rendered possible.

This invention is herein described by reference to the accompanying drawings which form a part hereof and in which there is set forth by way of illustration and not of limitation one specific form in which the invention may be embodied.

In the drawings:

Fig. 1 is a side view in elevation and partly in section with parts broken away of a mounting and driving means carrying one form of the high speed earth-removing tooth of this invention.

Fig. 2 is a fragmentary detailed view in elevation and in section showing the teeth and their mounting in greater detail.

Fig. 3 is a fragmentary top plan view of the teeth and their mounting appearing in Fig. 2.

Fig. 4 is an enlarged detail view in elevation and partly in section of one of the teeth appearing in the preceding figures.

Fig. 5 is an oblique end view of the tooth shown in Fig. 4 viewed through the plane 5—5 indicated in Fig. 4.

Fig. 6 is a sectional view of the tooth shown in Fig. 4 and part of its mounting viewed through the plane 6—6.

Fig. 7 is a sectional view of the tooth shown in Fig. 4 viewed through the plane 7—7.

Fig. 8 is a sectional view of the tooth shown in Fig. 4 viewed through the plane 8—8.

Fig. 9 is a sectional view of the tooth shown in Fig. 4 viewed through the plane 9—9.

Fig. 10 is a sectional view of the tooth shown in Fig. 4 viewed through the plane 10—10.

Referring to the drawings, Fig. 1 shows an earth-treating unit 1 of the type shown and described in detail in my co-pending application for Letters Patent, Serial Number 514,177 filed December 13, 1943. Contained within the earth-treating unit 1 are a plurality of transversely extending horizontal shafts adapted to be revolved to perform various earth-engaging functions. The most forwardly disposed of these shafts designated 2 constitutes the driving means for earth-removing teeth 3 intended to excavate native material in place. The construction of the teeth 3 and their mounting upon shaft 2 constitutes the subject matter of the present invention.

As appears in greater detail in Figs. 2, 3 and 4, the teeth 3 are held in place by mounting brackets 4 which are secured by welding to the tubular shaft 2. Brackets 4 are provided with a tangentially extending mortise having a serrated inner face 5 and a slightly inclined outer face 6. The shanks of the teeth 3, which are of substantially rectangular section, are adapted to be received in the mortise in the brackets 4 and to be held against the serrated face 5 by a forked taper key 7. After key 7 is driven in place, the forked ends are spread to prevent dislodgment, as appears clearly in Fig. 3. Extending transversely across that face of the shank of the teeth 3 which is in engagement with the serrated face 5 are two protruding ridges 8 which by reason of their registry with the serrations 5 preclude longitudinal withdrawal of the teeth 3.

By this method of mounting, a tooth shank is provided whose cross section is free of abrupt alterations which could give rise to localization of stress and the fatigue life of the tooth under repeated stress is thereby greatly enhanced. Not only is the tooth shank itself so designed as to avoid areas of localized stress but the mounting means which hold it are such as to spread the clamping forces over a wide extent of the shank surface. In this way a secure mounting is provided without the high local prestressing which is involved when set screws, clamping bolts, or the like, are relied upon to grip the shank of the tooth. While maintaining all of these advantages the mounting is such as to permit a very substantial amount of inward or outward adjustment of the teeth to alter the effective diameter of the rotor or to compensate for wear of the teeth. In making such adjustment it is only necessary to drive out the retaining keys 7, move the protrusions 8 to a new position in the serrated face 5 and then to replace the keys 7 and respread their forked ends.

By reference more particularly now to the showing of the tooth 3 appearing in Fig. 4 and to the sectional views thereof, 6 to 10 inclusive, it will be observed that the shank 9 of the tooth 3 as it emerges from bracket 4 is of relatively uniform flat cross section having a substantially greater width than depth constituting a portion capable of resilient deflection to permit tangential deflection of the tooth 3. Shank portion 9 extends with gradually diminishing lateral extent to approximately the mid-point of the free portion of tooth 3 before its width and depth become practically equal. In the area at which shank 9 reaches minimum width, a zone designated 16 is formed, within which a limited amount of lateral resilient deflection of the tooth 3 may occur. Beyond and in a position corresponding to that occupied by shank 9 and on the opposite side of zone 16 is a gradually spreading shovel-face portion 9'.

United to and formed integrally with the shank portion 9 and the shovel face portion 9' is a vertical stiffening rib 10. Stiffening rib 10 rises out of the material of which the shank 9 is formed at a point 11, substantially removed from bracket 4, and quickly rises to a substantial height at point 12. Rib 10 extends from point 12 throughout the remaining length of tooth 3, increasing slightly in depth in the vicinity of zone 16, and gradually passing through a transition from the back face of tooth 3 at point 12 to the forward or cutting face thereof at its outer end. Rib 10 serves to stiffen the tooth 3 against tangential or circumferential deflection, excepting for the part thereof between the point 11 and the bracket 4.

Formed with and as a part of the bracket 4 are a pair of deflection limiting stops 13 arranged to straddle the rib 10 and to bear against the back face of the shank 9 whenever the tooth 3 is tangentially deflected a predetermined amount.

By reason of the manner in which the stops 13 are related to the bracket 4 and straddle the rib 10, they remain effective for the purpose intended throughout the full range of adjustability of the tooth 3 within its mounting since it is the shank 9 of relatively uniform thickness which is contacted rather than the rib 10. The predetermined tangential deflection, limited by the stops 13, is within the limits of elastic deformation for the material of shank 9 and the stops 13 thus serve to prevent permanent deformation of the teeth 3 due to abnormally high tangential stresses applied thereto. By reason of the disposition of material in rib 10, the tooth 3 is highly resistant to deformation in a tangential direction beyond that permitted by the stops 13 and is of sufficient strength in case an unusually obstinate obstruction is encountered to cause the shaft 2 and its mounting to rise as a whole and climb over a particularly large and refractory obstruction.

The merging of the shovel face 9' and the rib 10 at the outer tip of the tooth 3 as appears more clearly in Fig. 5 results in the formation of a triangular end face having a cutting tip 14 which remains quite sharp as wear progresses and furthermore provides sloping faces 15 which serve to deflect the tooth 3 laterally in case a minor obstacle is encountered. By reason of the gradual diminution in lateral dimension of the shank 9 and shovel face 9' as the zone 16 is approached, lateral deflection of the tooth 3 is somewhat localized but nevertheless distributed in the vicinity of zone 16, away from influence upon the function to be performed by the deflectable part of shank 9.

In the normal use of high speed earth-removing apparatus of the type herein referred to, a relatively small layer of earth is removed by each successive engagement of the tooth with the soil being removed. The forward rate or "feed" employed is therefore small enough so that even though an entirely indestructible obstacle is encountered, the total amount of climbing of the apparatus to accommodate thereto which must occur within one pass of the tooth is small. It therefore is not necessary that the entire apparatus be lifted the entire height of the obstacle within the interval of time during which a single pass of a tooth takes place. By making teeth 3 strong and permitting the same a controlled and

limited amount of resilient deflection, it is possible to cause the entire apparatus upon which the teeth are mounted to lift when an unusual obstruction is encountered, such lifting taking place at a gradual and moderate rate in keeping not with the high speed of the teeth but with the moderate forward or feed rate of the excavation. Under normal working conditions the very limited resilient deflection allowed to the teeth results in the excavation of a very accurate and uniform subgrade and the high and unpredictable stresses arising out of severe rebound action is avoided.

I claim:

1. A high speed rotary earth cutting tooth adapted for mounting on a rotatable shaft, comprising a continuous metallic body having a flat tangentially deflectable inner attachment shank portion extending with diminishing width substantially to the mid-point of said tooth and being adapted to be rigidly secured to said shaft in position to permit a pre-determined limited tangential deflection thereof, a longitudinal stiffening rib portion adapted to resist tangential deflection merged with and disposed transversely with respect to said shank portion commencing at a point outwardly beyond the part of said shank portion adapted to be attached to said shaft and extending therefrom to the outer end of said tooth, and a shovel-face portion merged with and disposed transversely with respect to said rib commencing at the substantial mid-point thereof and extending therefrom with increasing width toward the outer end of said tooth, whereby a zone facilitating tangential deflection of said tooth is provided near the mounting thereof on said shaft and a zone facilitating lateral deflection of said tooth is provided near the mid-point thereof.

2. A high speed rotary earth cutting tooth adapted for mounting on a rotatable shaft, comprising a continuous metallic body having a flat tangentially deflectable inner attachment shank portion extending with diminishing width substantially to the mid-point of said tooth and being adapted to be rigidly secured to said shaft in position to permit a predetermined limited tangential deflection thereof, a longitudinal stiffening rib portion adapted to resist tangential deflection merged with and disposed transversely with respect to said shank portion commencing at a point outwardly beyond the part of said shank portion adapted to be attached to said shaft and extending therefrom to the outer end of said tooth, and a shovel-face portion merged with and disposed transversely with respect to said rib commencing at the substantial mid-point thereof and extending therefrom with increasing and then decreasing width to the outer end of said tooth, whereby a zone facilitating tangential deflection of said tooth is provided near the mounting thereof on said shaft and a zone facilitating lateral deflection of said tooth is provided near the mid-point thereof.

3. A high speed rotary earth cutting tooth, adapted for mounting on a rotatable shaft, comprising a continuous forwardly curved metallic body having a flat tangentially deflectable inner attachment shank portion extending with diminishing width substantially to the midpoint of said tooth and being adapted to be rigidly secured to said shaft in position to permit a predetermined limited tangential deflection thereof, a forwardly curved longitudinal stiffening rib portion adapted to resist tangential deflection merged with and disposed transversely with respect to said shank portion commencing on the back of said shank at a point outwardly beyond the part of said shank portion adapted to be attached to said shaft and extending therefrom toward the outer end of said tooth, said shank and said rib extending in oblique intersecting arrangement with one another so that said rib is substantially evenly disposed on the back and the front of said shank at the shank's outer extremity, and a shovel-face portion merged with and disposed transversely with respect to said rib commencing at the substantial mid-point thereof opposite the outer extremity of said shank and extending obliquely therefrom with increasing width toward the outer back face of said rib, whereby a zone facilitating tangential deflection of said tooth is provided near the mounting thereof on said shaft and a zone facilitating lateral deflection of said tooth is provided near the mid-point thereof.

4. A high speed rotary earth cutting drum having a rotatable shaft, and a plurality of radially disposed teeth secured thereto; each of said teeth comprising a continuous metallic body having a flat tangentially deflectable inner attachment shank portion extending with diminishing width toward the outer end of said tooth, a longitudinal stiffening rib portion adapted to resist tangential deflection merged with and disposed transversely with respect to said shank portion commencing at a point outwardly beyond the part of said shank portion adapted to be secured to said shaft and extending therefrom toward the outer end of said tooth; said shaft having mounting means thereon adapted to engage and hold the shank portions of said teeth, each of said mounting means comprising means for gripping the shank portion of a tooth at a point spaced inwardly from the point of commencement of said longitudinal rib to provide a portion of said shank capable of being tangentially deflected, and stopping means associated with said mounting means adapted to engage and resist tangential deflection of said shank and tooth at a point beyond the commencement of said longitudinal rib when said shank and tooth have been tangentially deflected a predetermined amount.

5. A high speed rotary earth cutting drum having a rotatable shaft, and a plurality of radially disposed teeth secured thereto; each of said teeth comprising a continuous metallic body having a flat tangentially deflectable inner attachment shank portion extending with diminishing width toward the mid-point of said tooth, a longitudinal stiffening rib portion adapted to resist tangential deflection merged with and disposed transversely with respect to said shank portion commencing at a point outwardly beyond the part of said shank portion adapted to be secured to said shaft and extending therefrom toward the outer end of said tooth, and a shovel-face portion disposed transversely with respect to said rib commencing at the substantial mid-point thereof opposite the end of said shank and extending therefrom toward the outer end of said tooth with increasing width; said shaft having mounting means thereon adapted to engage and hold the shank portions of said teeth, each of said mounting means comprising a socket for holding the shank portion of a tooth at a point spaced inwardly from the point of commencement of said longitudinal rib to provide a portion of said shank capable of being tangentially deflected, and stopping means associated with said mounting means adapted to engage and resist tangential deflection of said

shank and tooth at a point outwardly beyond the point of commencement of said longitudinal rib when said shank and tooth have been tangentially deflected a predetermined amount.

6. A high speed rotary earth cutting drum having a rotatable shaft, and a plurality of radially disposed teeth secured thereto; each of said teeth comprising a continuous metallic body having a flat tangentially deflectable inner attachment shank portion extending with diminishing width toward the outer end of said tooth, a longitudinal stiffening rib portion adapted to resist tangential deflection merged with and disposed transversely with respect to said shank portion commencing on the back of said shank portion at a point outwardly beyond the part of said shank portion adapted to be secured to said shaft and extending therefrom toward the outer end of said tooth, said shaft having mounting means thereon adapted to engage and hold the shank portions of said teeth, each of said mounting means comprising a socket for holding the shank portion of a tooth at a point spaced inwardly from the point of commencement of said longitudinal rib to provide a portion of said shank capable of being tangentially deflected, and stopping means associated with said mounting means comprising a pair of stopping fingers disposed to straddle said rib and engage the back of said shank and stop further movement thereof when it has been tangentially deflected a predetermined amount.

7. In a high speed rotary earth cutting drum having a rotatable shaft and a plurality of radially disposed cutting teeth; mounting means for said teeth secured to said shaft, each of said mounting means comprising a socket for holding the inner end of a tooth, retaining means in said socket adapted to preclude withdrawal of a tooth held therein, and stopping means rigidly associated with said shaft and socket, disposed to permit a predetermined tangential deflection of a tooth held in said socket and to engage the rear of said tooth in the near vicinity of said socket to limit tangential deflection of said tooth at said socket without limiting further deflection of said tooth beyond said point of engagement.

8. In a high speed rotary earth cutting drum having a rotatable shaft and a plurality of radially disposed cutting teeth; mounting means for said teeth secured to said shaft, each of said mounting means having a tangential mortise having an indented internal wall adapted for receiving the inner end of a tooth; a tooth for each of said mounting means received within said mortise and having locking means integrally formed with said tooth on the face thereof contiguous to said indented internal wall and adapted for interfitting locking engagement with said indentations in a plurality of adjusted positions, the extent of said locking means lengthwise of said tooth being but a small fraction of the length of said mortise, the remaining surface of said tooth extending beyond said locking means and said mortise being smooth and continuous, and removable binding means adapted to engage said mortise and said tooth and to maintain firm engagement of said locking means on said tooth with said indented internal wall of said mortise.

9. In a high speed rotary earth cutting drum having a rotatable shaft and a plurality of radially disposed cutting teeth; mounting means for said teeth secured to said shaft, each of said mounting means having a tangential mortise having an indented internal wall adapted for receiving the inner end of a tooth; a tooth for each of said mounting means received within said mortise and having locking means integrally formed with said tooth on the face thereof contiguous to said indented internal wall and adapted for interfitting locking engagement with said indentations in a plurality of adjusted positions, removable binding means adapted to engage said mortise and said tooth and to maintain firm engagement of said locking means on said tooth with said indented internal wall of said mortise, and stopping means rigidly associated with said shaft and socket, disposed to permit a predetermined tangential deflection of a tooth held in said socket and to engage the rear of said tooth and resist tangential deflection thereof in excess of said predetermined deflection in each adjusted position of said tooth with respect to said socket.

10. In a high speed rotary earth cutting drum having a rotatable shaft and a plurality of radially disposed cutting teeth; mounting means for said teeth secured to said shaft, each of said mounting means having a tangentially disposed receiving socket for holding the inner end of one of said teeth, a series of transversely disposed equally spaced serrations formed in a wall of each of said sockets, a tooth for each of said sockets having an end adapted to be received therein, said end having a transversely ridged portion of an extent lengthwise of said tooth which is but a small fraction of the length of said receiving socket adapted for selective interfitting engagement with said serrations, the remaining surface of said end portion being smooth and continuous, a tapered key adapted to be received side by side with the end of said tooth within said socket, and adapted to maintain engagement between said ridge and a selected serration.

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