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Hahn et al.

[11] **3,919,792**

[45] **Nov. 18, 1975**

[54] **EXCAVATING TOOTH ASSEMBLY**

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[21] Appl. No.: **526,589**

[52] **U.S. Cl.** .... **37/142 R;** 299/91; 403/333; 403/361

[51] **Int. Cl.**[2] **E02F 9/28**

[58] **Field of Search** .... 37/141 R, 141 T, 142 R, 37/142 A; 299/91, 92, 93; 403/333, 334, 361; 172/713, 719

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[57] **ABSTRACT**

An assembly including a socket member and a tooth member having longitudinally spaced bearing surfaces for ready interchange of tooth members so as to accommodate the excavating equipment for various types of work.

25 Claims, 12 Drawing Figures

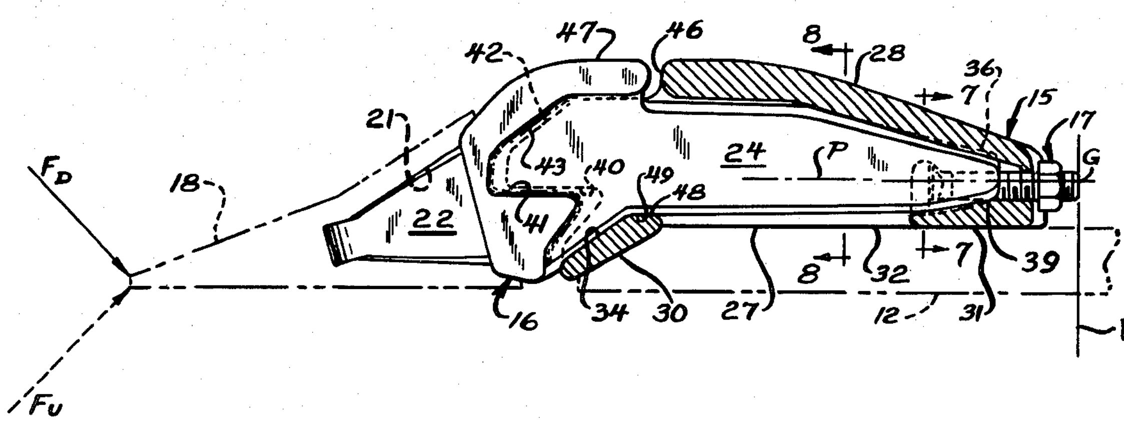
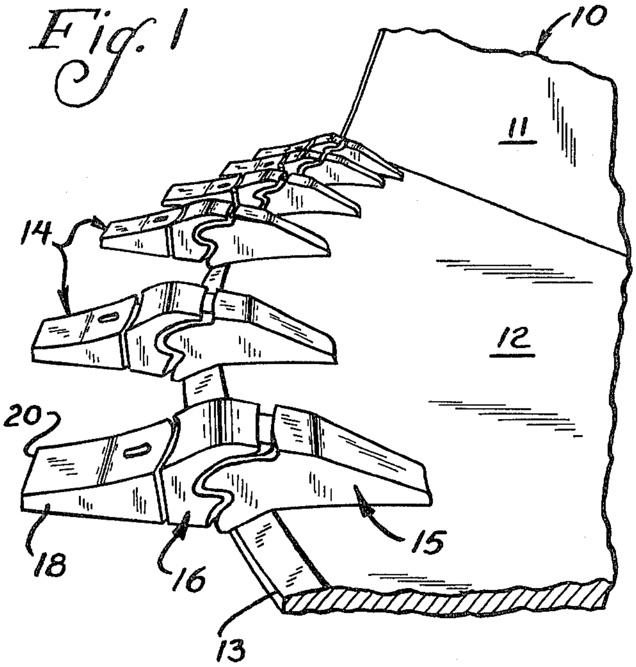


Fig. 1



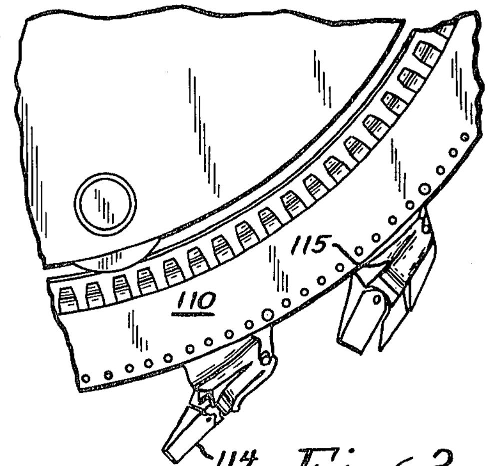
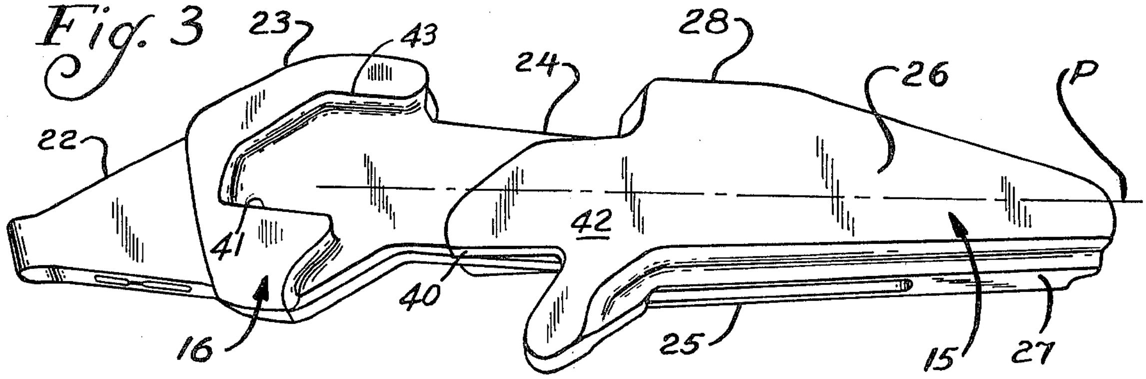


Fig. 2

Fig. 3



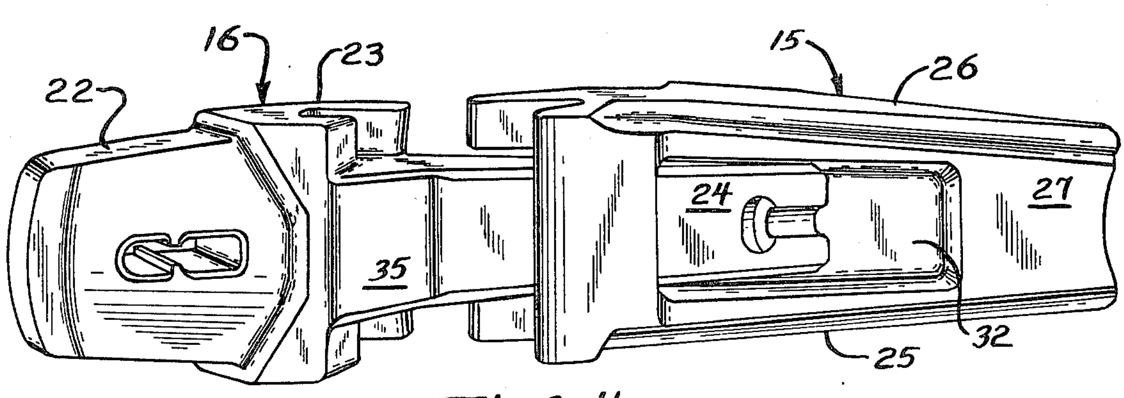


Fig. 4

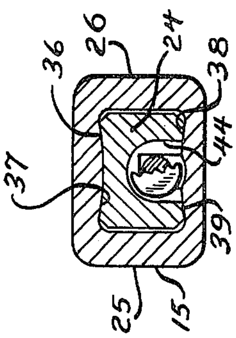


Fig. 7

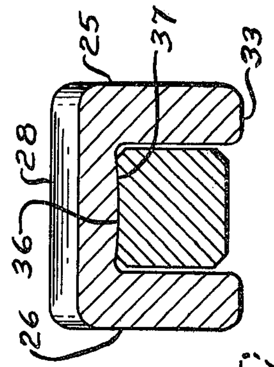


Fig. 8

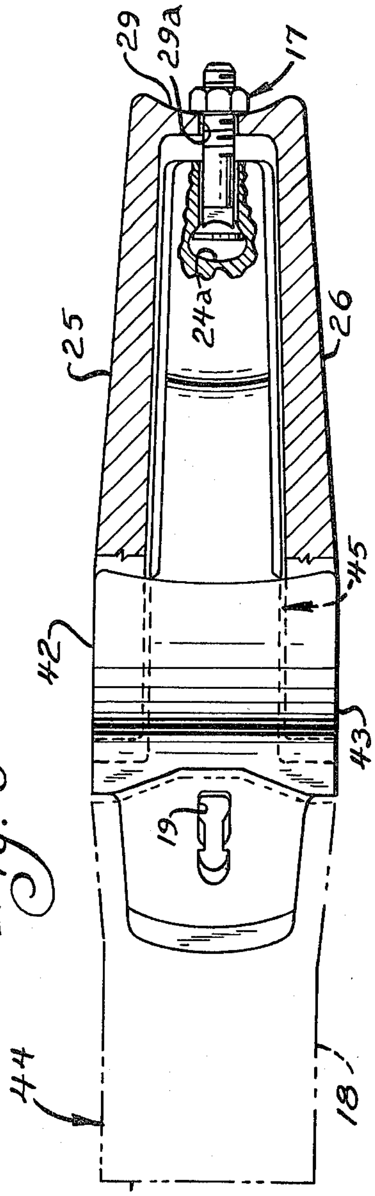


Fig. 6

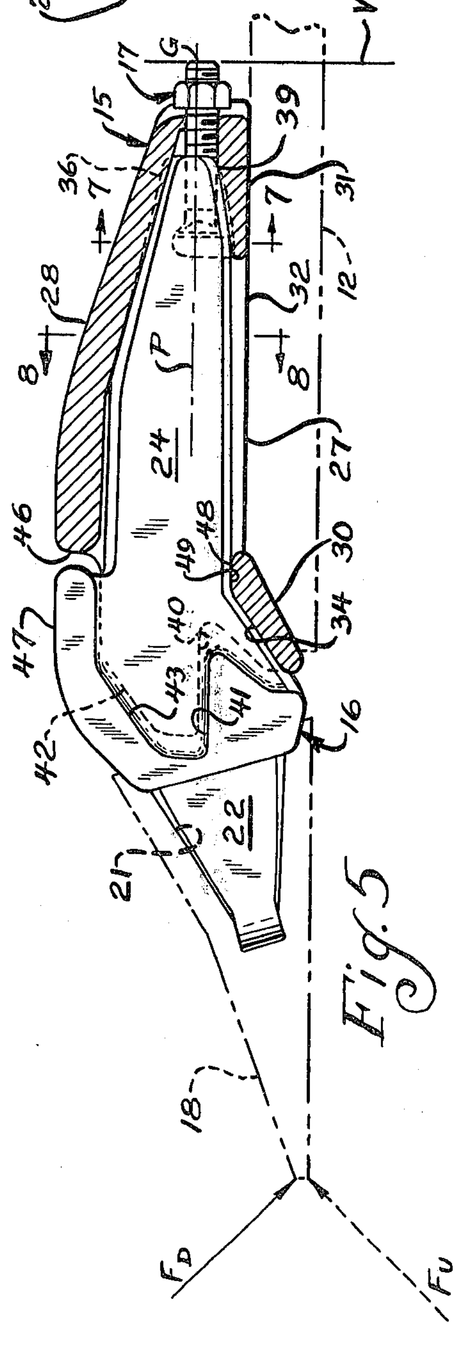


Fig. 5

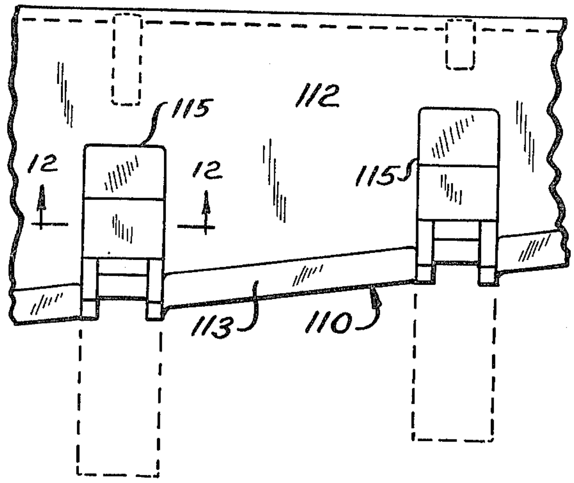


Fig. 9

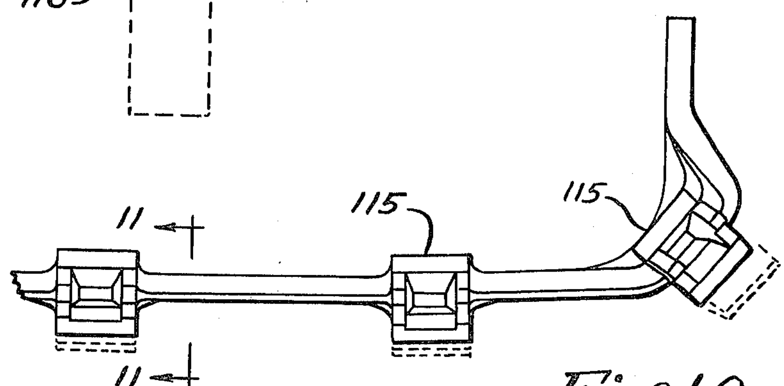


Fig. 10

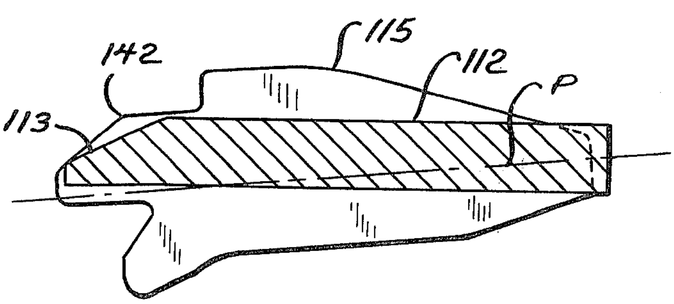
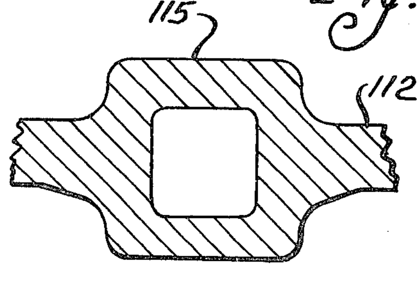


Fig. 11

Fig. 12



EXCAVATING TOOTH ASSEMBLY

BACKGROUND AND SUMMARY OF INVENTION

This invention relates to an excavating tooth assembly and, more particularly, to an assembly including a socket member and a tooth member. The tooth member may be either a single piece tooth or a two-part tooth but in any event provides a forward digging edge for ground engagement. Such excavating teeth are mounted on a variety of excavators, viz., drag line buckets, shovel dippers, front end loaders, trenchers, etc. Normally the teeth are connected to the excavating machine in one of two basic ways: the rear portion of the tooth (generally designated the "shank") can either (1) extend into the mounting lip or other surface or (2) can extend around it — as in the case of a bifurcated shank. The actual connection between the shank and the lip can be achieved through pins, bolts or welding. The primary requirement of a tooth mounting is strength, i.e., resistance to failure when encountering harsh shock loads. On the other hand, an almost as important requirement is simplicity of dissassembly — excavating people being realistic to realize that even the strongest tooth may fail and require replacement. Thus, a dilemma has been presented over the years to the excavating people — providing connections which are strong and rugged, yet connections that can be readily disassembled so as to require minimum down-time of very expensive equipment.

This dilemma has been approached in a number of ways — most generally by making "multi-part" teeth. For example, starting with the lip of an excavator, the lip may be equipped with a recess into which a holder is welded. The holder, in turn, may receive an adapter, i.e., a connective member which has a shank at one end received on or in the holder and a nose at the forward end for the receipt of a replaceable tip or point. The point may be pinned to the adapter nose and the adapter shank pinned or welded to the holder. However, there usually was welding or extremely strong connections in the portion of the tooth immediately adjacent the excavating machine. This was all well and good when the machinery was employed well within its designed rating. However, difficulties have arisen when the excavating people recognized that larger, stronger teeth should be used on a given machine. When this occurred, there had to be a virtual rebuilding of the lip to accommodate a larger size tooth.

Thus, the object of this invention is to provide a replaceable adapter which fits into a socket — the socket either being cast, forged or welded in or on a lip to provide an adapter holding device that will last the life of the lip — while providing rapid change capability on the machine in the field to suit a different type of digging application or to replace the adapter nose due to a failure developed by excessive service loads.

We achieve this advantageous versatility by a unique arrangement of bearing surfaces between the socket member and the tooth member. The tooth member is equipped with a massive section intermediate its length, i.e., between the tapered forward end or nose and the rearwardly extending, relatively elongated shank. The bottom wall of this massive section provides a bearing surface which is substantially inclined relative to the path of movement of the tooth member when it is being installed in the socket member. Cooperating with this external bearing surface is an internal bearing surface on the socket bottom wall which is complementarily arranged. These surfaces take the brunt of downward shock loads on the tooth assembly. The bottom wall of the socket member is relatively thicker in this area to provide a pad-like part which also is advantageously utilized for the securement of the socket to the beveled portion of an excavator lip.

Spaced considerably rearwardly of the first mentioned pair of cooperating bearing surfaces, i.e., those on the massive section of the socket member and the pad-like part of the socket member, are top and bottom bearing surfaces on the external walls of the shank and the internal walls of the socket member. These surfaces coact with the first mentioned pair of surfaces, i.e., those, positioned more forwardly, to resist beam loading. Additionally, we provide forwardly extending ears on the side walls of the socket member which are received within complementarily shaped recesses in the side walls of the massive section and which cooperate with the rear bearing surfaces in resisting upward beam shock loadings. Other details of construction, advantages of operation, and objectives of the invention may be seen in the details of the ensuing specification.

DETAILED DESCRIPTION

The invention is described in conjunction with the accompanying drawing, in which

FIG. **1** is a fragmentary perspective view of the ground engaging portion of a front end loader and equipped with tooth assemblies according to the instant invention;

FIG. **2** is a fragmentary perspective view of a ditcher wheel equipped with tooth assemblies according to the instant invention;

FIG. **3** is a perspective view of the inventive tooth member and socket member in the process of being assembled, i.e., only partially assembled;

FIG. **4** is another perspective view of the elements of FIG. **3** in about the same stage of assembly but showing the parts generally from below;

FIG. **5** is a side elevational view of the inventive tooth assembly, partially in section, and corresponding generally (but with parts assembled) of the showing in FIG. **3**;

FIG. **6** is a top plan view, partially in section, of the assembly of FIG. **5**;

FIG. **7** is a sectional view as would be seen along the sight line **7—7** of FIG. **5**;

FIG. **8** is another sectional view such as would be seen along the sight line **8—8** of FIG. **5**;

FIG. **9** is a fragmentary top plan view of a ditcher equipped with tooth holders according to the instant invention;

FIG. **10** is a fragmentary front elevational view of the ditcher seen in FIG. **9**;

FIG. **11** is a view taken along the line **11—11** of FIG. **10**; and

FIG. **12** is a view taken along the line **12—12** of FIG. **9**.

Referring now to the drawing and, in particular, to FIG. **1**, the numeral **10** designates generally an excavating machine which, in the specific illustration given, is a front end loader bucket. The bucket has the usual side walls **11** which flank a bottom wall **12**. The bottom wall **12** terminates in a lip **13** which is beveled, i.e., having a tapered top surface to develop better digging efficiency. A plurality of tooth assemblies generally designated **14** project forwardly from the bottom wall **12**, that is, in advance of the beveled lip 13.

In the specific illustration given, each tooth assembly 14 includes a socket member generally designated 15 which is weldably secured to the bucket 10 and which slidingly receives a tooth member generally designated 16. As can be appreciated from a brief consideration of FIG. 5, the tooth member 16 is secured within the socket member 15 by a rear nut and bolt assembly generally designated 17 (see the extreme right hand end). This is not a tension fit, it only being necessary to prevent loss of assembly through gravity or other negative thrust.

In the version illustrated in FIGS. 1, 5 and 6, the tooth member 16 does not itself provide the digging edge but receives a tip or point 18 which is fastened to the tooth member 16 by a pin lock (designated only in FIG. 6). As indicated previously, it is possible in some operations to combine the two parts 18 and 16 into a single piece tooth although, generally speaking, separate points have been preferred because their usage minimizes the amount of throw-away metal. It will be appreciated that the principal wear occurs on the apex 20 of the point 18 and by suitably proportioning the point (as illustrated most graphically in FIG. 5) it is possible to wear the point 18 almost down to its socket 21, thereby reducing the amount of throw-away metal to 50 percent or less of the original point. However, inasmuch as the instant invention is concerned primarily with structures positioned more rearwardly, we utilize the expression "tooth member" to comprehend both single piece and two-piece teeth, viz., teeth made up of points and adapters.

Referring now to FIGS. 3 and 4, the tooth member 16 is seen to be partially received within the socket member 15. The path of movement (for inserting a portion of the tooth member 16 into the socket member 15) is designated P in FIG. 3. The tooth member 16 has a tapered nose 22 at its forward end, a massive section 23 intermediate its length, and a relatively elongated shank 24 at its rear end.

The socket member 15, like the tooth member 16, is a unitary cast body of alloy steel and is generally rectangular having a hollow interior to provide a socket for the receipt of the shank 24. As such, the socket member 15 has side walls as at 25 and 26 — the latter being best seen in FIG. 3. The side walls 25 and 26 are connected by a bottom wall 27 and a top wall 28 (see FIG. 3). Also provided is a rear wall 29 which is not designated in FIGS. 3 and 4 but which can be seen clearly in FIG. 6. The rear wall 29 is apertured as at 29*a* to receive the bolt shank of the assembly 17 while the shank 24 of the tooth member 16 is recessed as at 24*a* to receive the head of the bolt.

Referring now to FIG. 5, the bottom wall 27 of the socket member 15 is seen to have a relatively thicker portion 30 at the forward end thereof — particularly in contrast to the rearward portion 31 of the bottom wall 27. As can be appreciated from a comparison of FIGS. 4 and 5, the bottom wall portions 30 and 31 are separated by an opening 32 which extends from the interior of one side wall to the other and thereby develops rail-like bottom surfaces on the side walls 25 and 26 — see the element designated 33 in FIG. 8 — relative to the side wall 25. This assists in achieving excellent weld securement of the socket member 15 to the bucket 10, more particularly to the rock steel cutting edge thereof.

The relatively thicker forward portion 30 can be considered an essentially pad-like part and serves as a primary bearing surface for a downward shock load such as is designated by the vector F_D — at the extreme left in FIG. 5. It will be appreciated that the pad-like part 30 is associated with massive section 23 of the tooth member, thereby achieving advantageous transmission of shock loads and this, irrespective of the size of the tooth, viz., the size of the nose 22 and hence the size of the point 18. For the purpose of receiving stress, the pad-like part 30 has an upper bearing surface 34.

Cooperating with the bearing surface 34 is a confronting complementarily contoured bearing surface 35 (designated only in FIG. 4) on the bottom wall of the massive section 23 of the tooth member 16. We have found it advantageous to contour both of the surfaces 34 and 35 as surfaces of revolution generated about a vertical axis V at the rear of the assembly (designated only in FIG. 5). Further details and advantages of the surfaces of revolution 34 and 35 in resisting loads (particularly those having lateral components) can be appreciated from a consideration of co-owned U.S. Pat. No. 2,919,506. In the specific illustration given, we contour the surface 35 so that the same is inwardly concave. By inwardly concave, we mean that the sides of the surface of a male type member extend further out than the central portion — as can be readily appreciated by a consideration of the top bearing surface 36 of the shank 24 as seen in FIG. 7.

Cooperating with the surface 36 is a surface 37 on the interior of the top wall 28 and which is complementarily contoured. These two surfaces, 36 and 37, are also surfaces of revolution generated about the vertical axis V. As seen in FIG. 5, the surface 36 (and hence the surface 37) is seen to extend a substantial distance along the length of the assembly, i.e., approximately one-half the length of the shank 24 insofar as the surface 36 is concerned and in the same proportion relative to the length of the socket member 15 insofar as the surface 37 is concerned.

Also cooperating in absorbing beam loading are the bottom wall surfaces 38 on the socket member 15 and 39 on the tooth member 16 (see the lower portion of FIG. 7). Again, these are surfaces of revolution generated about the vertical axis of revolution V.

From a consideration of FIG. 5, it will be seen that the inclination of the forward bearing surface 34 (and hence the surface 35 also) is much steeper relative to the path of movement P (for installing the shank 24 in the socket member 15) than the inclination of the surface 39 (and also 38) therewith. In the illustration given, the surfaces 38 and 39 form an angle of about 10° relative to the path of movement P. In contrast, the surfaces 34 and 35 are at an inclination of about 35°.

All of the surfaces 34–39 are generated from the same point of generation G (see the right hand end of FIG. 5). The upper surfaces 36 and 37 of about 15° with the path of movement P. The paired surfaces 36 and 37 relative to the top walls and 38 and 39 on the bottom walls are effective to resist both upward and downward shock loads, i.e., F_U as well as F_D (see the left hand end of FIG. 5).

Further assisting in resisting upward shock loads is a pair of confronting bearing surfaces 40 and 41 positioned centrally of the massive section 23, i.e., generally centrally of FIG. 5. For the purpsoe of providing the surfaces 40, we extend the side walls 25 and 26 forwardly to provide ears 42. The bottom walls of the ears 42 provide the surfaces 40 and the ears are received in complementarily contoured recesses 43 in the massive portion **23** of the tooth member **16.** Through the arrangement of the four sets of bearing surfaces as just described, we transmit the other deleterious shock loads most effectively to the excavating lip or other support surface (for example, the ditcher wheel **110** of FIG. **2**), and substantially irrespective of the size of the tooth, viz., width and length of the point **18.** Further, the surfaces **40** and **41** are particularly effective in resisting back slap, i.e., the use of the teeth **14** as tampers or compressive tools.

The upper and lower bearing surfaces **36–37** and **38–39,** respectively, serve to transmit both upward and downward applied loads, being part of convergently related top and bottom walls on the shank **24** and the socket member **15.** We also have the corresponding side walls of the shank **24** and the socket member **15** (more particularly the interior side wall surfaces thereof) rearwardly convergent. Clearance is provided between the side walls of the shank and the socket member **15** to permit lateral shifting of the tooth member relative to the socket member and without substantial loss of bearing area. This also is a tapered type clearance and affords side loading stabilization. Thus, as side loading develops (as at **44** in FIG. **6**) the shank **24** will come into full contact with the interior side wall of the holder, particularly at the front as the shank rotates about the axis of revolution V. For example, the force **44** is resisted as at **45** in FIG. **6.**

We also find it advantageous to terminate the top wall **28** of the socket member **15** in general vertical alignment with the rear of the pad-like part **30** — as at **46** in FIG. **5.** This enables the top wall **47** of the massive portion **23** of the tooth member **16** to extend rearwardly into general alignment with the pad **30** and overlie the ears **42.**

Further advantageous transmission of shock loads is achieved through a further set of bearing surfaces as at **48** relative to the rear portion of the pad **30** and **49** on the bottom wall of the shank **24.** The inclination of the surfaces **48** and **49** relative to the path of movement P is less than that of the surfaces **38** and **39.** However, we also find it advantageous to construct the surfaces **48** and **49** as surfaces of revolution generated about the vertical axis V.

By providing the socket and tooth member arrangement described, it is now possible for the user of excavating equipment to convert to a larger size tooth, nose and point for heavy duty applications and even larger sized noses and points for extreme service applications. All of the noses are mounted on the same size shank to fit interchangeably in the integral welded socket. This provides the user a feature for quickly changing broken adapters or other tooth parts rather than spending the extra time and money for shutting the machine down and welding on a new adapter. This is particularly crucial in front end loader buckets or light and standard duty hoe and drag lines which have weld on adapters with an integral nose. Through the use of the invention, the user is provided the feature of considerably reduced machine down time, improved machine availability for duty service as well as reducing the overall maintenance cost in terms of material and labor.

Also, it will be appreciated that the socket member **15** can be cast integrally with the excavating tooth — in contrast to the embodiment of FIGS. **1–8** where the lower wall **27** is welded to the top of the cutting edge **12** (see particularly FIG. **5**). The teeth **114** on the ditcher

110 of FIG. **2** are supported by integrally cast holders and this is seen in greater detail in FIGS. **9–12.**

A portion of the ditcher **110** is seen in FIGS. **9** and **10.** There the socket members **115** are cast as integral components of the cutting edge **112.** More precisely, the holder members **115** extend forward of the tapered edge **113** (see particularly FIG. **9**).

As can be readily appreciated from a consideration of FIG. **11,** the base or edge portion **112** of the ditcher is integrally connected to the socket member **115** midway of the height thereof — this in contrast to the showing in FIG. **5** wherein the holder member **15** is positioned above the cutting edge **12.** More particularly, the cutting edge **112** is essentially bracketed by the ears **142** (see FIG. **11**) and extends at a slight angle to the path of movement P, i.e., about 5° upward.

Irrespective of the type of mounting, the socket member **15** or **115,** as the case may be, is substantially protected by the tooth member **16** from wear. Thus, the holder can be made of ferritic low alloy steel for superior welding characteristics while the tooth member can be made in a minimum hardness range of **388–440** Brinell to yield high strength and wear resistance. Thus, with the structure of the instant invention, it is possible not only to achieve versatility in tooth assemblies but also achieve an advantageous marriage of the most effective alloys.

Further, in operation, there is an advantageous wedging action developed between the ears **42** and the forward bearing surface or ramp **34.** As wear occurs between the surfaces **34** and **35** (compare FIGS. **5** and **4,** respectively), the adapter or tooth member **16** moves back and up-along the forward ramp surface **34** of the socket member or holder **15** until there is contact between the ears **42** and the confronting bearing surface **41,** i.e., contact between the confronting surfaces **40** and **41.** Once this contact is established, the overall assembly is further stabilized, becoming stronger and more resistant to wear.

We claim:

1. An excavating tooth assembly comprising a socket member and a tooth member, said socket member having top, bottom, rear and side walls providing a socket for receipt of a shank of said tooth member, said bottom wall being rearwardly convergent relative to said top wall and said side walls being rearwardly convergent relative to each other, said tooth member having a tapered forward end and a relatively elongated shank at its rear end, said shank being tapered complementarily to said socket member convergent walls and being movable along a generally linear path into assembled relation with said socket member,

said shank rear end being equipped with a bolt-head receiving recess and said socket member rear wall being equipped with an aperture, a bolt assembly in said recess and aperture for maintaining said tooth member in assembled relation with said socket member,

said top and bottom walls each having internal bearing surfaces for transmitting beam loads on said tooth member to said socket member, a portion of said bottom wall internal bearing surface being positioned adjacent the forward end of said socket member and being more steeply inclined to said path than the portion of said bottom wall internal bearing surface adjacent said rear wall,

said tooth member having a massive section in the portion thereof immediately rearward of said tapered forward end to transmit a substantial portion of a downward beam load to said forward portion of said bottom wall bearing surface, said bottom wall being relatively thicker in said forward portion than the remainder thereof to provide a pad-like part for receiving said downward beam load,

said side walls being equipped with forwardly projecting ears spaced above said bottom wall forward portion and said tooth member being complementarily recessed to receive said ears to provide means for transmitting a portion of an upward beam load.

2. The structure of claim **1** in which said bottom wall has a third internal bearing surface portion positioned immediately rearward of said forward portion on said pad-like part and disposed at less of an inclination to said path than the portion of said bottom wall bearing surface adjacent said rear wall.

3. The structure of claim **1** in which said socket member has a substantially flat external surface on said bottom wall rearward of said relatively thicker portion whereby said socket is adapted to be weldably secured to an excavator lip.

4. The structure of claim **3** in which said bottom wall is equipped with an opening extending therethrough between the internal surfaces of said side walls and extending longitudinally from said relatively thicker portion to said bearing surface portion adjacent said rear wall to provide rail-like bottom portions on said side walls for weldable securement to an excavator lip.

5. The structure of claim **1** in which said socket member is integrally connected to a cutting edge, said cutting edge being disposed generally midway of the height of said socket member and generally bracketed by said ears.

6. The structure of claim **1** in which the forward end of said bearing surface portion adjacent said rear wall is generally aligned with said bolt-head receiving recess.

7. The structure of claim **6** in which the internal bearing surface of said top wall extends further forward than said bottom wall bearing surface portion adjacent said rear wall and approximately one-half the length of said socket member.

8. The structure of claim **1** in which each of said bearing surfaces is a surface of revolution generated about a generally vertical axis adjacent to but spaced rearwardly of said rear wall.

9. The structure of claim **8** in which each of said bearing surfaces in said socket member is inwardly concave.

10. The structure of claim **1** in which said top wall has its forward end generally in alignment with the rear end of said relatively thicker portion, said tooth member in said massive section having a top wall portion extending generally over said relatively thicker portion.

11. A socket member adapted to be mounted on an excavator lip for receiving an excavating tooth member comprising a unitary generally rectangular, hollow element having top, bottom, rear and side walls to provide a socket for the receipt of a shank of a tooth member when said shank is moved along a generally linear path into said socket,

said top and bottom walls being rearwardly convergent and said side walls also being rearwardly convergent, said rear wall being apertured to receive a securing bolt for maintaining said tooth member in assembled relation with said socket member,

said top and bottom walls each having internal bearing surfaces for transmitting beam loads on said tooth member from said shank to said socket member, a portion of said bottom wall internal bearing surface being positioned adjacent the forward end of said socket member and being more steeply inclined to said path than the portion of said bottom wall internal bearing surface adjacent said rear wall,

said tooth member having a massive section in the portion thereof immediately rearward of said tapered forward end to transmit a substantial portion of a downward beam load to said forward portion of said bottom wall bearing surface, said bottom wall being relatively thicker in said forward portion than the remainder thereof to receive said downward beam load,

said side walls being equipped with forwardly projecting ears spaced above said bottom wall forward portion to receive a portion of an upward beam load applied to said tooth member.

12. The structure of claim **11** in which said bottom wall has a third internal bearing surface portion positioned immediately rearward of said forward portion on said pad-like part and disposed at less of an inclination to said path than the portion of said bottom wall bearing surface adjacent said rear wall.

13. The structure of claim **11** in which said socket member has a substantially flat external surface on said bottom wall rearward of said relatively thicker portion whereby said socket is adapted to be weldably secured to an excavator lip.

14. The structure of claim **13** in which said bottom wall is equipped with an opening extending therethrough between the internal surfaces of said side walls and extending longitudinally from said relatively thicker portion to said bearing surface portion adjacent said rear wall to provide rail-like bottom portions on said side walls for weldable securement to an excavator lip.

15. The structure of claim **11** in which the internal bearing surface of said top wall extends further forward than said bottom wall bearing surface portion adjacent said rear wall and approximately one-half the length of said socket member.

16. The structure of claim **11** in which each of said bearing surfaces is a surface of revolution generated about a generally vertical axis adjacent to but spaced rearwardly of said rear wall.

17. The structure of claim **16** in which each of said bearing surfaces in said socket member is inwardly convex.

18. The structure of claim **11** in which said top wall has its forward end generally in alignment with the rear end of said relatively thicker portion.

19. A tooth member for mounting in the socket of an excavator lip comprising a unitary body having a tapered forward end and a relatively elongated shank at its rear end, said shank being generally rectangular in cross section and having rearwardly convergent top and bottom walls and rearwardly convergent side walls adapted to complement walls in said socket whereby said tooth member is movable along a linear path into assembled relation with said socket,

the rear end of said shank bottom wall being equipped with a bolt-head receiving recess for maintining said tooth member in assembled relation with said socket, said tooth member having a massive section in the portion thereof immediately rearward of said tapered forward end and forward of said shank to transmit a substantial portion of a downward beam load,

said shank top and bottom walls each having external bearing surfaces for transmitting beam loads on said tooth member to said socket, said massive section also having a bottom wall external bearing surface and being more steeply inclined to said path than the portion of said bottom wall internal bearing surface adjacent said rear shank end,

said massive section having side walls being equipped with rearwardly facing recesses to provide means for transmitting a portion of an upward beam load.

20. The structure of claim **19** in which said shank bottom wall has another external bearing surface portion positioned immediately rearward of said massive section and disposed at less of an inclination to said path than the portion of said bottom wall bearing surface adjacent said rear shank end.

21. The structure of claim **19** in which the forward end of said bearing surface portion adjacent said rear shank end is generally aligned with said bolt-head receiving recess.

22. The structure of claim **21** in which the external bearing surface of said top wall extends further forward than said bottom wall bearing surface portion adjacent rear shank end and approximately one-half the length of said shank.

23. The structure of claim **19** in which each of said bearing surfaces is a surface of revolution generated about a generally vertical axis adjacent to but spaced rearwardly of said rear shank end.

24. The structure of claim **23** in which each of said bearing surfaces in said socket member is inwardly concave.

25. The structure of claim **19** in which said tooth member in said massive section has a top wall portion coextending generally with said massive section bottom wall external bearing surface.

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