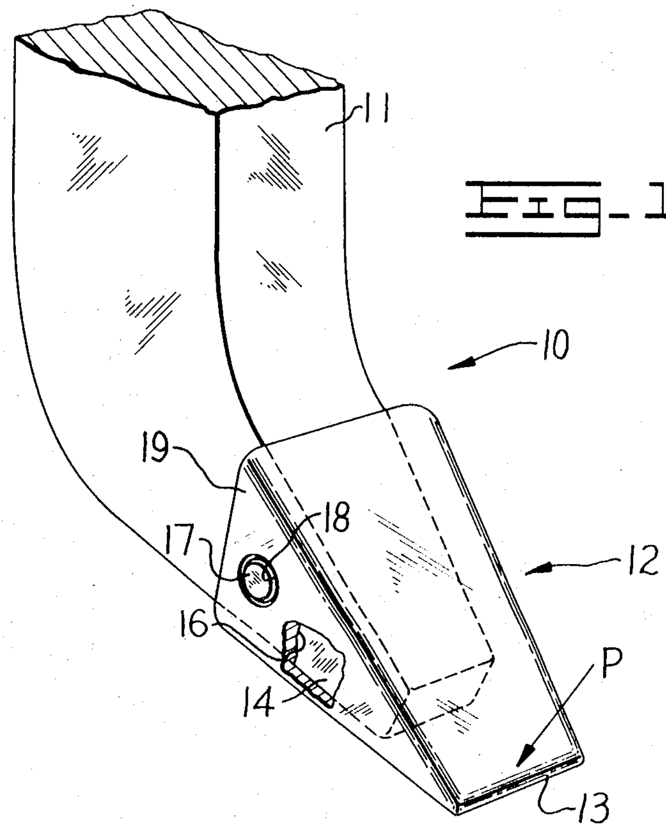

FIG. 1.

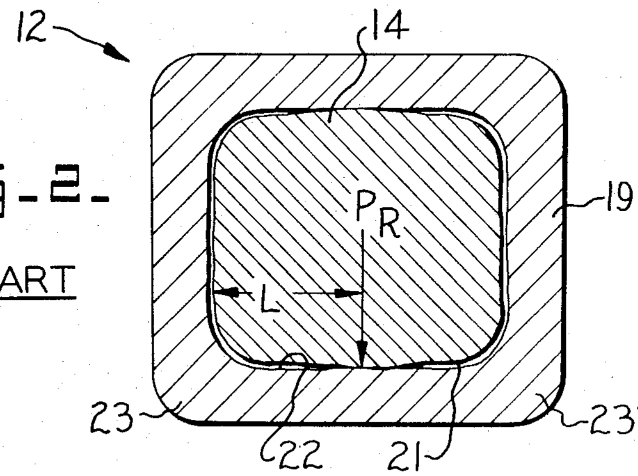

FIG. 2.

PRIOR ART

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HIGH STRENGTH DIGGING TOOTH

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FIG. 5

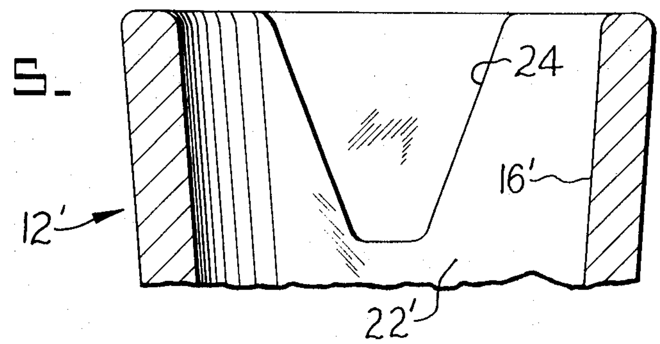

FIG. 3

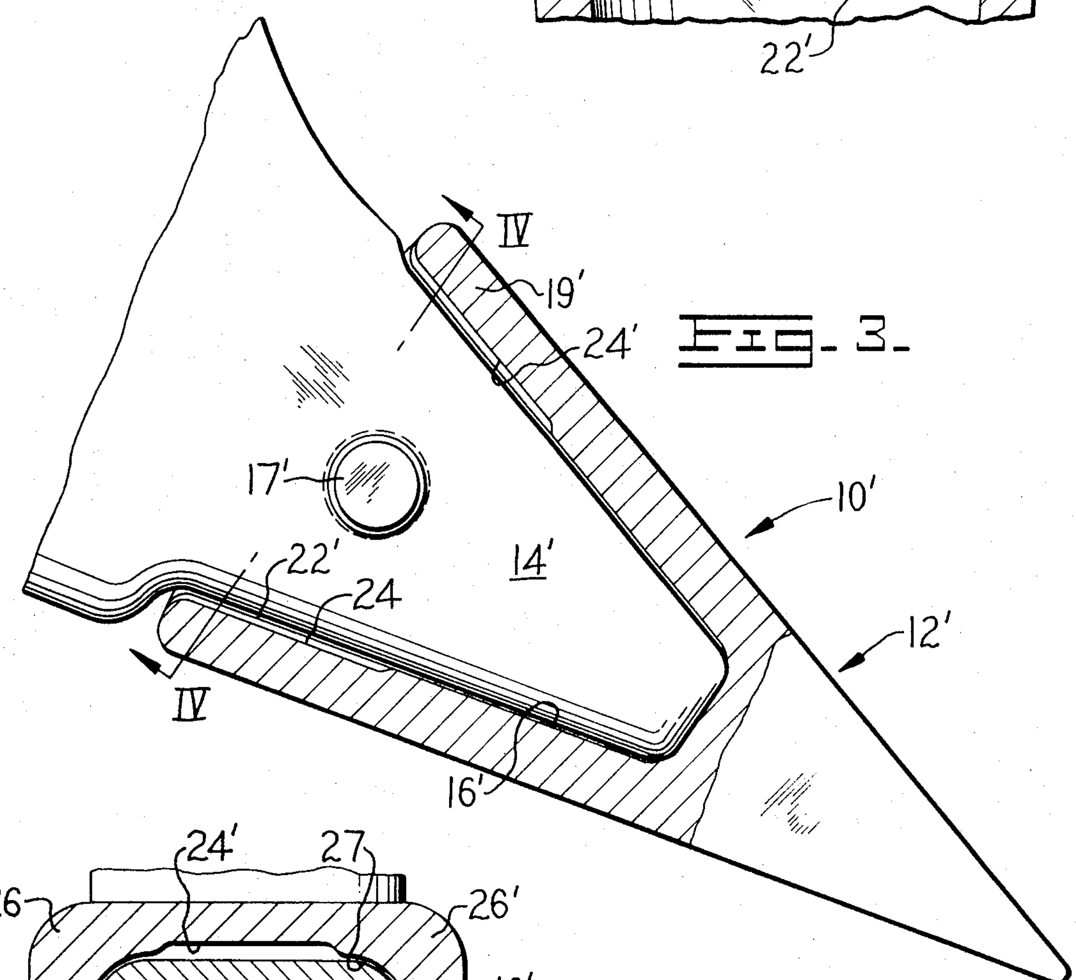

FIG. 4

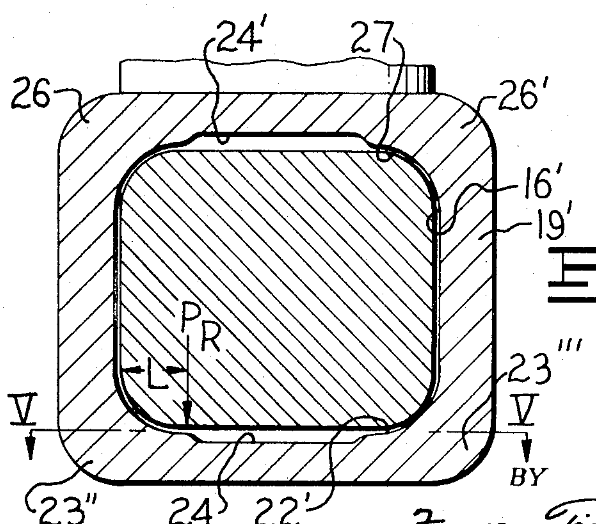

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FIG. 7.

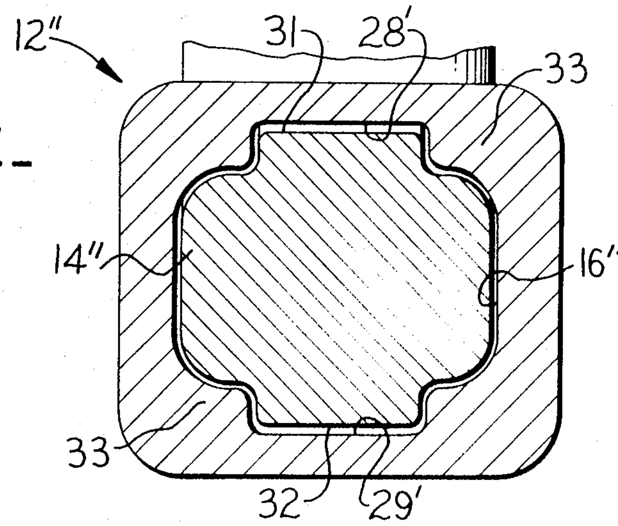

FIG. 6.

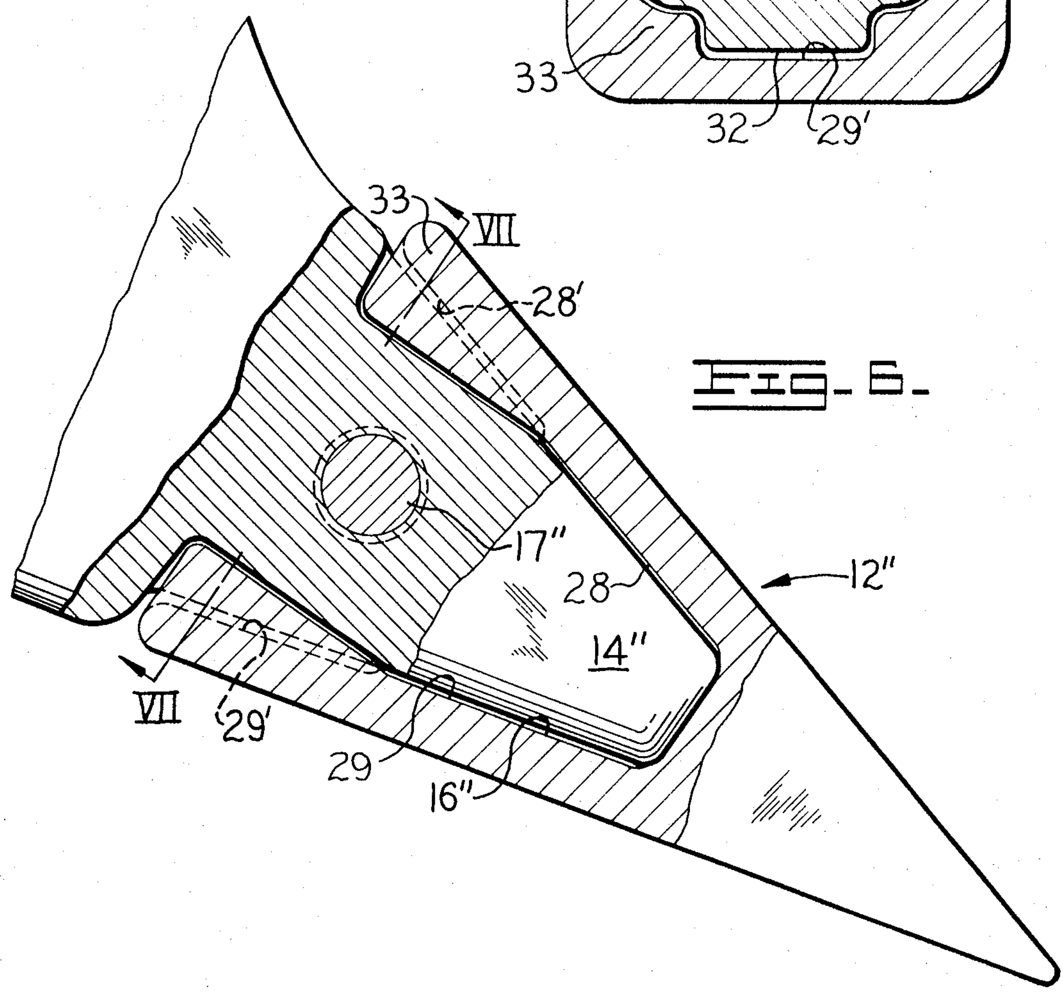

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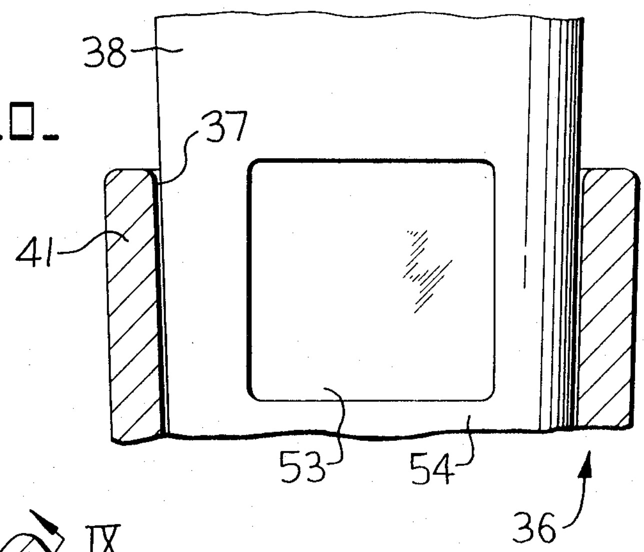
FIG. 10



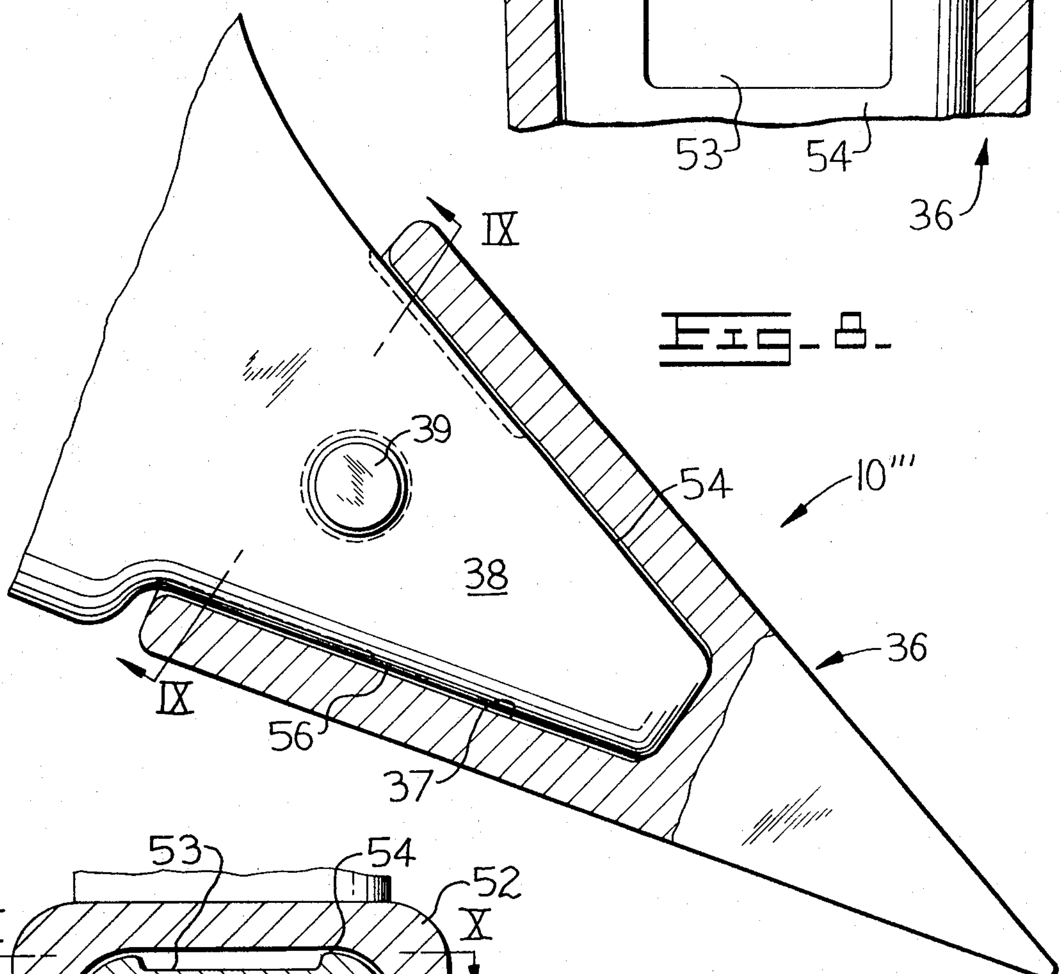


FIG. 8

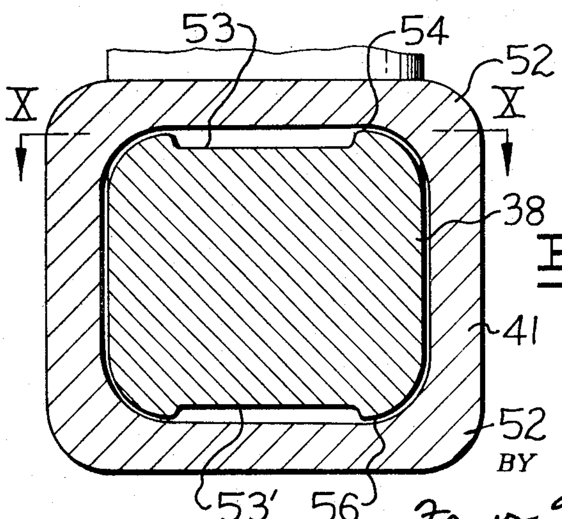


FIG. 9

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3,623,247

Patented Nov. 30, 1971

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3,623,247

HIGH STRENGTH DIGGING TOOTH

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Filed Jan. 26, 1970, Ser. No. 5,806
Int. Cl. E02f 9/28
U.S. Cl. 37—142 R 1 Claim

ABSTRACT OF THE DISCLOSURE

A replaceable tip of a digging tooth for earthmoving equipment or the like has a socket cavity into which a toothlike support is received, the tip being retained on the support by a transverse pin. The possibility of breakage of the tip under severe load forces is reduced by recessing central portions of the contacting surfaces of the tip or support means within the cavity thereby assuring that stresses are directed to the relatively high strength side regions of the tip.

BACKGROUND OF THE INVENTION

This invention relates to mechanical teeth carried on various forms of equipment for digging into earth or other material and more particularly to digging teeth having replaceable tips.

Powered earthworking equipment such as scrapers, loaders and rippers as well as apparatus for handling other material frequently have one or more digging teeth disposed along a cutting edge to loosen earth or other material. As considerable abrasion and impact damage may occur in use, the teeth usually have tips which may be removed and replaced. In most such constructions, the tip has a pointed forward end and has a socket cavity formed in the opposite end to receive a toothlike extension of an adapter or other support means and a transverse pin secures the tip to the adapter. To avoid the high cost of precision finishing, loose tolerances between the sidewalls of the tip and adapter are usually present. Clearance is also provided where the retainer pin transpierces the skirt of the tip and forward end of the adapter contacts the base of the socket so that load forces are transmitted directly between the tip and adapter rather than through the pin. As a consequence of this construction, a slight amount of rocking motion of the tip relative to the adapter may occur.

Thus, load forces on the tip tend to bend the tip relative to the adapter and this generates stresses within the skirt region of the tip which defines the socket cavity. If sufficiently severe, such forces cause a catastrophic failure of the tip and such breakage is a fairly common occurrence in practice. This is highly undesirable, not only because of the cost of replacing the tips and possibly the adapter, but also because of the resulting delays in operation of the associated equipment. To decrease the frequency of tip breakage, it has heretofore been thought necessary to use more costly higher strength tip material, or to increase the massiveness of the tip.

SUMMARY OF THE INVENTION

This invention provides a more reliable digging tooth construction wherein the pattern of stress distribution is controlled to reduce the possibility of tip breakage. The invention provides for recessing a portion of the adjacent surfaces of a replaceable tip and adapter within the tip socket to assure that load forces cannot be transmitted between the surfaces at certain areas. By this means load forces are caused to act in a manner which avoids generating very high transverse bending moments in the skirt of the tip.

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Accordingly, it is an object of this invention to provide a digging tooth construction including a replaceable tip wherein tip breakage from external load forces is less likely to occur.

The invention, together with further objects and advantages thereof, will best be understood by reference to the following description of preferred embodiments in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings:

FIG. 1 is a perspective view of a ripper tooth of a type to which the invention is applicable;

FIG. 2 is a cross-section view through a prior art digging tooth of the general type shown in FIG. 1 illustrating a structural characteristic of prior art tooth constructions which results in a proneness to breakage in the presence of severe load forces;

FIG. 3 is a side view of a digging tooth in accordance with the present invention with certain portions of the replaceable tip of the tooth being broken out;

FIG. 4 is a cross-section view of the tooth construction of FIG. 3 taken along the line IV—IV thereof;

FIG. 5 is a fragmentary section view taken along line V—V of FIG. 4;

FIG. 6 is a side view of a second embodiment of the invention with portions of the structure being broken out;

FIG. 7 is a cross-section view taken along line VII—VII of FIG. 6;

FIG. 8 is a broken out side view of a third embodiment of the invention;

FIG. 9 is a cross-section view of the digging tooth of FIG. 8 taken along line IX—IX thereof, and

FIG. 10 is a fragmentary section view taken along line X—X of FIG. 9.

DESCRIPTION OF PREFERRED EMBODIMENTS

Referring to FIG. 1 of the drawing, there is shown a digging tooth **10** of a general type employed on earthworking equipment and on apparatus for handling certain other forms of bulk materials as well. Teeth of this general type are used, for example, on the cutting edges of scrapers and loader buckets for the purpose of loosening earth or other material which is to be loaded. For purposes of illustration, the tooth **10** shown herein is of the form employed on the shank **11** of a ripper of the kind which is drawn behind a tractor to loosen earth, it being understood that the tooth construction is not limited to this particular usage.

A tooth **10** of this general type has a replaceable tip element **12** which may be of substantially rectangular cross-section, preferably with rounded edges, and is wedge shaped to taper towards a linear edge **13** at the forward end. The support means for tip **12** is an adapter element **14** which in the present example is formed integrally on the lower forwardly extending portion of the ripper shank **11**. In some other digging teeth, the adapter or support may be a separate element from the implement with which the tooth is used.

Adapter **14** has a configuration generally resembling that of the tip **12** but is of somewhat smaller dimensions, so that it may be received into a conforming socket cavity **16** in the back end of the tip, and the adapter has a relatively blunt forward end. Thus, the tip **12** is supported by adapter **14** and to retain the tip thereon a pin **17** may be transpierced through both elements in the region of the socket cavity. To assure that load forces are transferred directly between the tip **12** and adapter **14**, the passages **18** in the tip skirt **19** through which pin **17** passes are larger than the pin.

Referring now to FIG. 2 in conjunction with FIG. 1, cost considerations generally prevent machining of the inner surfaces of cavity **16** and the outer surfaces of adapter **14** to the close tolerances which would be necessary to provide a precision fit. Thus, there are irregularities in the adjacent surfaces of the two elements, as shown in somewhat exaggerated form in FIG. 2, and a small clearance space of randomly variable magnitude is present between the adapter **14** and the skirt **19** of tip **12** within cavity **16**. I have discovered that this clearance space and more particularly the irregularity thereof is a highly significant causative factor in tip breakage. In the presence of such random manufacturing variations, certain specific tips will have a chance configuration which is particularly prone to promote breakage.

In particular, a load force acting downward and backward on the forward end of tip **12** as indicated by arrow P in FIG. 1 creates sheer and tensile stresses at the back of the tip as is well recognized in the art but it has not heretofore been recognized that a transverse bending moment is also generated about the corners of the skirt as illustrated in FIG. 2. Due to manufacturing irregularities in the underside surface **21** of adapter **14** and the bottom surface **22** of socket cavity **16** load stress may be concentrated at certain points rather than being evenly distributed. Further, the primary point of contact P_R may randomly occur at any position along a transverse line through the tooth, the contact point being illustrated as being midway between the sidewalls of socket **16** in FIG. 2.

Thus, in the presence of a load force P on the tip of the tooth as shown in FIG. 1, a transverse bending moment exists at each bottom corner **23** of the skirt **19** wherein the magnitude of the bending moment at a particular corner **23** is proportional to the product of the stress force at point P_R and the distance L between point P_R and the corner **23**. Comparative failure tests of conventional tips and tips embodying the present invention have demonstrated that these bending moments are a primary factor in tip breakage.

Having recognized the situation discussed above, it becomes possible to reduce the likelihood of tip breakage. While the total load forces at contact points P_R cannot be reduced without changing the socket to overall length ratio, it is possible to limit the size of the bending moments by controlling the location of the contact points P_R so that the moment arm L will necessarily be relatively small and the load P_R divided. This is accomplished by slightly recessing the area of surface **21** or surface **22**, or both, at the more central portions thereof whereby the load is divided between at least two contact points P_R close to the corners **23** and **23'** and therefore produce relatively low bending moments. Thus, the strength of the tooth can actually be increased by removing material.

A first example of a digging tooth embodying this higher strength construction is illustrated in FIGS. 3 to 5. Basic elements of the tooth **10'** of FIGS. 3 to 5 may be essentially similar to that previously described except for the presence of recesses in certain surfaces as will hereinafter be discussed in more detail. Thus, the tooth **10'** has a tip **12'** with a socket cavity **16'** into which an adapter element **14'** is received each element having the general configuration hereinbefore described. As in the previous instance, a retainer pin **17'** transpierces both the tip **12'** and adapter **14'**.

To limit bending moments of the kind discussed above, the bottom surface **22'** of socket cavity **16'** is formed with a slightly recessed area **24** centered between bottom corners **23''** and **23'''** of skirt **19'** but which does not reach either corner. As best shown in FIG. 5 the recessed area **24** extends from about one-half of the depth of cavity **16** to the open back end thereof and is of progressively greater width towards the open end of the cavity.

Accordingly, as illustrated in FIG. 4, the transverse bending moments about corners **23''** and **23'''** can have only a relatively small effective moment arm L. The value of P_R in FIG. 4 has been decreased since the load force has been divided between the two corners. For a given load force on the tip **10'** the bending moments tending to promote skirt breakage are greatly reduced without any increase in the size of the tooth or any change in the quality of the metal employed.

Since an upwardly directed load force on the point of the tip **10** can create essentially similar bending moments about the upper corners **26** and **26'** of tip skirt **19'**, it is also advantageous to provide a similar recess **24'** at the upper surface **27** of socket cavity **16'**. This provides for the beneficial load distribution if the tip is inverted.

Relief of loading on the rear central areas of the top and bottom of the tip skirt as described above can advantageously be combined with a further strengthening of the tip without necessitating an increase in overall size. Referring now to FIGS. 6 and 7, a second embodiment of the invention is shown which includes a tip **12''** with socket cavity **16''** into which an adapter **14''** is received and having a transverse pin **17''** for retaining the tip on the adapter as previously described. The central portions of the top and bottom surfaces **28** and **29** respectively of socket cavity **16''** as well as the central portions of the upper and lower surfaces **31** and **32** of adapter **14'** are inclined with respect to each other as hereinbefore described and the back central portions **28'** and **29'** of the tip surfaces in this area are recessed as previously described so that contact is confined to the side regions of the surfaces to limit bending moments. The side regions of socket cavity surfaces **28** and **29** which border the recessed areas—i.e., the contact zones, are angled relative to the rest of the surfaces **28** and **29** so that additional material is present in the corners **33** of the skirt, with the corners being thickest at the back end of cavity **16''**. The side areas of adapter surfaces **31** and **32** are similarly angled relative to the central areas thereof to accommodate to the thickened corners **33** of the tip **12''**. To provide for including a maximum amount of material at the back of the tip corners **33**, the side areas of surfaces **28** and **31** and the side areas of surfaces **29** and **32** may be made parallel in the back region of the socket cavity **16''**. Accordingly, bending moments at the corners **33** of the tip **12''** are limited to relatively low magnitudes and the thickness of the material in the critical corner regions is increased as well. This further increases tip strength and adds to wear life.

The increase in reliability of a digging tooth against breakage may also be realized by forming essentially similar recesses in the adapter element rather than the tip itself since this also confines stress to the side regions of the tip skirt. A tooth construction of this form is shown in FIGS. 8 to 10.

Referring now to FIGS. 8 to 10 in conjunction, tooth **10'''** again has a wedge shaped replaceable tip **36** with a socket cavity **37** for receiving a conforming adapter element **38** and the two components are transpierced by a retainer pin **39** which secures the tip on the adapter. As best seen in FIGS. 9 and 10 in particular, the tip **36** including the cavity **37** and skirt region **41** around the cavity may be of essentially conventional construction. Control of load forces to reduce bending moments about the corners **52** at the top and bottom of the skirt is provided by forming recesses **53** and **53'** respectively in the top and bottom surfaces **54** and **56** of adapter **38**. As best seen in FIG. 10, the recesses **53**, which may be of rectangular configuration in this embodiment, are confined to the intermediate region of surfaces **54** and **56** and very importantly extend through the open end of tip socket cavity **37** a small distance when the tip is emplaced on adapter **38**.

What is claimed is:

1. A digging tooth comprising:

support means having an adapter extension with opposite outer surfaces, the side regions of each of said outer surfaces being angled relative to the other portions of said outer surfaces, and

a replacable tip element disposed on said support means and having a socket cavity with an opening into which said adapter extension of said support means is received, said cavity having opposite inner surfaces which face said outer surfaces of said adapter extension, each of said inner surfaces of said tip element having a recessed area confined to an intermediate region between the side regions thereof, said recessed areas in said inner surfaces of said tip element being confined to the portions of said inner surfaces closest to said opening of said cavity and the regions of said inner surfaces on each side of said recessed areas being angled relative to the other portions of said inner surfaces to fit against angled side regions of said outer surfaces of said adapter extension with the portions of said tip adjacent said side regions of said inner surfaces being of progressively greater thickness towards said opening of said cavity.

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U.S. Cl. X.R.

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