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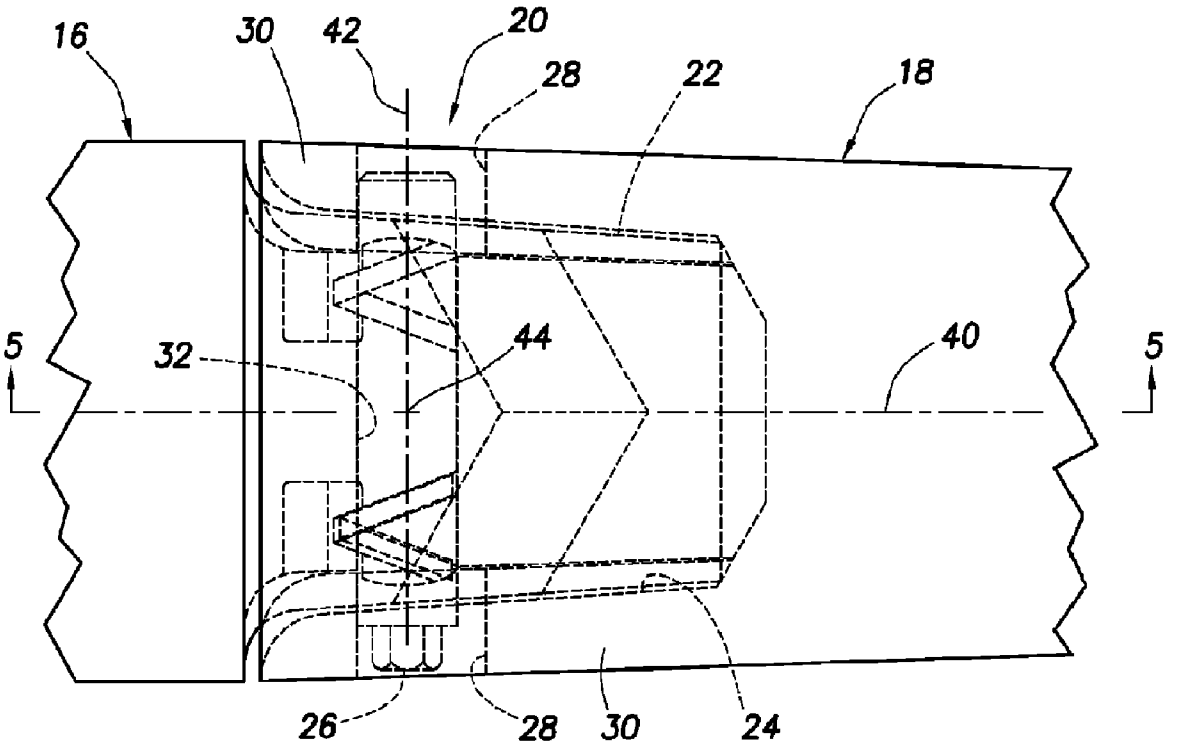
(54) Titre : FIXATION DE DENT D'EXCAVATRICE ENTIEREMENT STABILISEE
(54) Title: FULLY STABILIZED EXCAVATOR TOOTH ATTACHMENT



(57) Abrégé/Abstract:
A fully stabilized excavator tooth attachment. An excavator tooth includes a nose-receiving pocket bounded by an inner end, upper and lower, and opposing side walls, the end wall having a nose-engaging interface surface formed orthogonal to a longitudinal axis of the tooth, at least one of the side walls having a fastener opening formed therethrough, and each of the upper and lower walls having two spaced apart nose-engaging interface surfaces formed thereon substantially parallel to each other. Another excavator tooth includes side walls having generally planar nose-engaging interface surfaces formed therein, one surface resisting rotation of the tooth about the longitudinal axis in one direction, and another interface surface resisting rotation of the tooth in an opposite direction. An attachment system includes a fastener configured for releasably securing the tooth on the nose, the fastener having a thread which is eccentric relative to a body of the fastener.

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AUTRE DOCUMENT
OTHER DOCUMENT

Un document a été enregistré au Bureau des brevets, visant le ou les numéros de brevet(s) et/ou de demande(s) de brevet, apparaissant ci-dessous.	**A document has been registered in the Patent Office, against the following patent(s) and/or application(s) for patent.**
BREVET(S)/PATENT(S) 2,755,824	

T. DUFF
Commis aux cessions de brevets/Patent Assignment Clerk

BUREAU DES BREVETS
CONSTAT DE RÉEXAMEN

PATENT OFFICE
CERTIFICATE OF RE-EXAMINATION

N° de brevet - Patent No: **2,755,824**

Par la présente, les soussignés certifient que le brevet susmentionné a été réexaminé selon les paragraphes 48.1 à 48.3 de la *Loi sur les brevets* et que le Conseil de réexamen convient de ce qui suit:

The undersigned hereby certify that the above-noted patent has been re-examined pursuant to section 48.1 to 48.3 of the *Patent Act* and that the Re-examination Board has determined the following:

(i)	Les revendications/ Claims	1 and 9	du brevet susmentionné sont non brevetables et sont rejetées / are unpatentable and are cancelled from the above noted patent.
(ii)	Les revendications Claims	2-8 and 10-12	du brevet susmentionné sont brevetables / of the above noted patent are hereby confirmed to be patentable.
(iii)	Les nouvelles revendications/ New claims	13-23	(soumise le 14 fevrier, 2019 / submitted February 14, 2019) sont brevetables et font partie du brevet susmentionné à compter de ce jour / are patentable and have been incorporated into the above noted patent as of this date.

Paul Fitzner	Bethany Seaman	Jarret Diggins
Président Chairperson	Membre Member	Membre Member

Daté à Gatineau (Québec), ce 21^{e} jour de fevrier, 2019
Dated at Gatineau, Quebec, this 21st day of February, 2019

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Innovation, Science and Economic Development Canada
Canadian Intellectual Property Office

Our File no.: RX-108/17

February 21, 2019

Norton Rose Fulbright Canada LLP/S.E.N.C.R.L., s.r.l.
1 Place Ville Marie, Suite 2500
MONTREAL, Quebec
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Re: **Request for re-examination of Patent no. 2,755,824**

Title	:	FULLY STABILIZED EXCAVATOR TOOTH ATTACHMENT
Patentee	:	Black Cat Blades Ltd.
Requester	:	Black Cat Blades Ltd.
Your File No.	:	05014044-11CA

In accordance with subsection 48.3(3) of the *Patent Act*, the Re-examination Board ("the Board") has completed a re-examination of claims 1-12 of Canadian Patent no. 2,755,824 ("the '824 Patent").

PROCEDURAL HISTORY

A request for the re-examination of the '824 Patent on October 2, 2017. By a letter dated November 21, 2017, a re-examination board was established.

Due to a clerical error, one of the names of the members was incorrectly listed. Accordingly, by a letter dated December 20, 2017, the re-examination board establishment letter of November 21, 2017 was cancelled, and a new re-examination board was established.

The Board, in a letter dated January 30, 2018, determined the request for re-examination raised a substantial new question of patentability with respect to claims 1 and 9 of the '824 Patent.

In particular, the Board indicated that our preliminary opinion was that claim 1 of the '824 Patent is not novel in view of the prior art reference submitted by the requester and is therefore non-compliant with paragraph 28.2(1)(*b*) of the *Patent Act*, and that claim 9 would have been obvious to the skilled person on the claim date having regard to the prior art reference, in view of the common general knowledge, and therefore is non-compliant with section 28.3 of the *Patent Act*.

The Board also indicated that the document submitted by the requester did not raise a substantial new question of anticipation or obviousness with respect to claims 2-8 and 10-12 of the '824 Patent.

Pursuant to subsections 48.2(5) and 48.3(2) of the *Patent Act*, the Patentee in a letter dated February 22, 2018, proposed new claims (1-11), and presented arguments in favour of their patentability. No arguments were submitted in relation to claims 1 and 9 of the '824 Patent.

With the Patentee's February 22, 2018 communication, the re-examination proceeding under subsection 48.3(1) began.

In a letter dated January 22, 2019, the Board advised the Patentee to amend the claim numbering of the proposed claims in accordance with rule 45.1 of the *Patent Rules.*

In a letter dated February 14, 2019, the Patentee resubmitted the set of proposed claims, renumbered as claims 13-23.

In light of the Patentee's proposals and our own views in respect of the patentability of the issued and proposed claims, the Board provides below a final determination as to the patentability of the issued claims of the '824 Patent, as well as the patentability of proposed new claims 13-23.

PRIOR ART DOCUMENT

D1: AU2003264586 B2 MEYERS et al. 01 July 2004 (2004-07-01)

Document D1 is considered to be citable against claims 1 and 9.

D1 teaches an excavator tooth system comprising a mounting nose having a projecting spigot and a wear member.

Overview of independent claim 1 of the '824 Patent

The '824 Patent contains one independent claim. The features of independent claim 1 are as follows:

An excavator tooth for use on a nose of an excavator adaptor, the tooth comprising:

- a nose-receiving pocket bounded by an inner end wall, opposing upper and lower walls, and opposing side walls;
- the end wall having a first nose-engaging interface surface formed orthogonal to a longitudinal axis of the tooth;
- at least one of the side walls having a fastener-receiving opening formed therethrough perpendicular to the tooth longitudinal axis;
- and each of the upper and lower walls having second and third spaced apart nose-engaging interface surfaces formed thereon, the second and third interface surfaces being substantially parallel to each other,
- wherein complementary engagement between the nose-engaging interface surfaces of the tooth and corresponding tooth-engaging interface surfaces of the nose reduces wear between the tooth and the nose.

LACK OF NOVELTY

In the request for re-examination, it is asserted that claim 1 of the '824 Patent is not novel in view of D1.

Analysis

Independent claim 1

Table 1 sets out the features of independent claim 1 of the '824 Patent and features disclosed by D1.

TABLE 1

Independent Claim	Claim features of '824 Patent	Features disclosed by D1
1	an excavator tooth for use on a nose of an excavator adaptor, the tooth comprising: a nose-receiving pocket bounded by an inner end wall, opposing upper and lower walls, and opposing side walls	an excavator tooth (tooth assembly 12, 13) for use on a nose (1) of an excavator adaptor (page 1, lines 6-8); the tooth comprising: a nose-receiving pocket (socket 18) bounded by an inner end wall (10a), opposing upper and lower walls (7a, 8a), and opposing side walls (figure 4; corresponding surface to nose side walls 1)
1	the end wall having a first nose-engaging interface surface formed orthogonal to a longitudinal axis of the tooth	the end wall (10a) having a first nose-engaging interface surface formed orthogonal to a longitudinal axis of the tooth (Figure 5; page 16, lines 13-15)
1	at least one of the side walls having a fastener-receiving opening formed therethrough perpendicular to the tooth longitudinal axis	at least one of the side walls having a fastener-receiving opening formed therethrough perpendicular to the tooth longitudinal axis (15, Figure 4; page 8, lines 3-4)
1	each of the upper and lower walls having second and third spaced apart nose-engaging interface surfaces formed thereon, the second and third interface surfaces being substantially parallel to each other	each of the upper and lower walls having second and third spaced apart nose-engaging interface surfaces formed thereon, the second and third interface surfaces being substantially parallel to each other (page 7, lines 15-18; 7a, 8a; Figure 3)
1	complementary engagement between the nose-engaging interface surfaces of the tooth and corresponding tooth-engaging interface surfaces of the nose reduces wear between the tooth and the nose	complementary engagement between the nose-engaging interface surfaces of the tooth and corresponding tooth-engaging interface surfaces of the nose reduces wear between the tooth and the nose (page 1, line 19-22; page 16, lines 13-17; Figure 3)

The Board determines that independent claim 1 of the '824 Patent encompasses subject-matter that was disclosed in D1, which was disclosed prior to the claim date of the '824 Patent, and thus the claim does not comply with paragraph 28.2(1)(*b*) of the *Patent Act*.

OBVIOUSNESS

In *Apotex Inc v Sanofi-Synthelabo Canada Inc*, 2008 SCC 61, the Supreme Court of Canada set out a framework to be used in making an obviousness assessment. The four-step approach adopted by the Court is as follows:

(1) (a) Identify the notional "person skilled in the art";
(b) Identify the relevant common general knowledge of that person;

(2) Identify the inventive concept of the claim in question or if that cannot readily be done, construe it;

(3) Identify what, if any, differences exist between the matter cited as forming part of the "state of the art" and the inventive concept of the claim or the claim as construed;

(4) Viewed without any knowledge of the alleged invention as claimed, do those differences constitute steps which would have been obvious to the person skilled in the art or do they require any degree of invention?

Analysis

The first two steps are as follows:

(1)(a) The person skilled in the art is a designer/engineer of excavator equipment.

(b) The following is considered common general knowledge of the skilled person:

- conventional techniques in designing and building an excavator tooth for use on a nose of an excavator adaptor;

(2) The inventive concept for claim 9 is set out in Table 2 below.

Steps (3) and (4) are discussed with respect to the prior art following the table.

Dependent claim 9

Table 2 sets out the additional features of dependent claim 9 of the '824 Patent and features disclosed by D1.

TABLE 2

Dependent claim	Additional claim features of '824 Patent	Features disclosed by D1
9	wherein the fastener-receiving opening is centered on a lateral axis perpendicular to the tooth longitudinal axis, and wherein each of the longitudinal and lateral axes are perpendicular to an orthogonal axis which intersects each of the upper and lower walls	wherein the fastener-receiving opening (15) is located on a lateral axis perpendicular to the tooth longitudinal axis, and wherein each of the longitudinal and lateral axes are perpendicular to an orthogonal axis which intersects each of the upper and lower walls

Claim 9 is considered obvious having regard to D1 in view of common general knowledge.

(3) D1 is the closest prior art, and discloses all of the recited features of the independent claims, except that the D1 embodiment does not center the fastener-receiving opening on the lateral axis.

(4) Although the D1 embodiment does not center the fastener-receiving opening on the lateral axis, D1 does teach that a centered position is well known, and subsequently teaches why the axis was shifted from center in the D1 embodiment; page 14, lines 11-15; page 18, lines 2-4.

The Board determines that dependent claim 9 of the '824 Patent encompasses subject-matter that would have been obvious at the claim date of the '824 Patent to a person skilled in the art or science to which it pertains having regard to D1, in view of common general knowledge, and thus the claim does not comply with section 28.3 of the *Patent Act*.

Remaining dependent claims

Claims 2-8 and 10-12 are not considered to be anticipated or obvious in view of D1 since the prior art reference does not teach or fairly suggest the additional fourth, fifth, sixth or seventh nose engaging surfaces, which are inclined relative to the tooth longitudinal, lateral or orthogonal axes, or a tooth fastener-receiving opening includes a thread-engaging portion.

CONCLUSIONS FOR CLAIMS 1-12 OF '824 PATENT

In the Patentee's February 22, 2018 letter, no arguments were submitted in relation to claims 1 and 9 of the '824 Patent.

In view of the above, the Board determines that: claim 1 of the '824 Patent encompasses subject-matter that was disclosed in D1, and thus the claim does not comply with paragraph 28.2(1)(*b*) of the *Patent Act* ; and claim 9 of the '824 Patent encompasses subject-matter that would have been obvious at the claim date to a person skilled in the art having regard to D1, in view of common general knowledge, and thus the claim does not comply with section 28.3 of the *Patent Act*.

Further, the Board determines that claims 2-8 and 10-12 of the '824 Patent are neither anticipated nor obvious in view of D1.

PROPOSED NEW CLAIMS 13-23

Proposed independent claim 13, and proposed dependent claims 14-23, each of which depends directly or indirectly on claim 13, includes at least the features of claim 12, which we have found to be neither anticipated nor obvious in view of D1. Accordingly, the Board determines that proposed claims 13-23 are novel and unobvious in view of D1.

SUMMARY OF RE-EXAMINATION

The Board concludes that:

- claim 1 of the '824 Patent is anticipated by D1 and thus does not comply with paragraph 28.2(1)(*b*) of the *Patent Act*;
- claim 9 of the '824 Patent would have been obvious to the skilled person on the claim date having regard to D1, in view of common general knowledge, and thus does not comply with section 28.3 of the *Patent Act*;
- claims 2-8 and 10-12 of the '824 Patent are novel and unobvious in view of D1, and thus comply with paragraph 28.2(1)(*b*) and section 28.3 of the *Patent Act*; and
- proposed claims 13-23 are novel and unobvious in view of D1, and thus comply with paragraph 28.2(1)(*b*) and section 28.3 of the *Patent Act*.

COMPLETION OF RE-EXAMINATION

Please find enclosed a Certificate of Re-examination issued under section 48.4 of the *Patent Act*, cancelling claims 1 and 9, confirming claims 2-8 and 10-12, and incorporating new claims 13-23 into CA Patent number 2,755,824.

A Registration Certificate will be provided to the Patentee in separate correspondence indicating that the enclosed Certificate of Re-examination has been registered as an "Other Document" against CA Patent number 2,755,824.

Under section 48.5 of the *Patent Act*, no appeal may be taken from the decision of the Re-examination Board after 3 months from the date a copy of the Certificate of Re-examination is sent by registered mail to the Patentee.

Paul Fitzner	Bethany Seaman	Jarret Diggins
Chair	Member	Member

CLAIMS:

1. An excavator tooth for use on a nose of an excavator adaptor, the tooth comprising:

a nose-receiving pocket bounded by an inner end wall, opposing upper and lower walls, and opposing side walls;

the end wall having a first nose-engaging interface surface formed orthogonal to a longitudinal axis of the tooth;

at least one of the side walls having a fastener-receiving opening formed therethrough perpendicular to the tooth longitudinal axis; and

each of the upper and lower walls having second and third spaced apart nose-engaging interface surfaces formed thereon, the second and third interface surfaces being substantially parallel to each other,

wherein complementary engagement between the nose-engaging interface surfaces of the tooth and corresponding tooth-engaging interface surfaces of the nose reduces wear between the tooth and the nose.

2. The excavator tooth of claim 1, wherein the end wall further comprises fourth and fifth nose-engaging interface surfaces formed thereon, each of the fourth and fifth interface surfaces being inclined relative to the tooth longitudinal axis.

3. The excavator tooth of claim 2, wherein the end wall further comprises sixth and seventh nose-engaging interface surfaces formed thereon, each of the sixth and seventh interface surfaces being inclined relative to the tooth longitudinal axis, and each of the fourth, fifth, sixth and seventh interface surfaces intersecting the first interface surface at a generally rectangular-shaped periphery of the first interface surface.

4. The excavator tooth of claim 3, wherein the fourth, fifth, sixth and seventh interface surfaces center the tooth relative to the longitudinal axis in response to a force directed along the longitudinal axis.

5. The excavator tooth of claim 1, wherein each of the upper and lower walls further comprises fourth and fifth nose-engagi ıg interface surfaces formed thereon, each of the fourth and fifth interface surfaces being inclined relative to the tooth longitudinal axis.

6. The excavator tooth of claim 5, wherein the fourth and fifth interface surfaces center the tooth relative to the longitudinal axis in response to a force directed orthogonal to the longitudinal axis.

7. The excavator tooth of claim 1, wherein each of the side walls further comprises fourth and fifth nose-engaging interface surfaces formed thereon, each of the fourth and fifth interface surfaces being inclined relative to the tooth longitudinal axis.

8. The excavator tooth according to claim 7, wherein the fourth and fifth interface surfaces center the tooth relative to the longitudinal axis in response to a force directed lateral to the longitudinal axis.

9. The excavator tooth of claim 1, wherein the fastener-receiving opening is centered on a lateral axis perpendicular to the tooth longitudinal axis, and wherein each of the longitudinal and lateral axes are perpendicular to an orthogonal axis which intersects each of the upper and lower walls.

10. The excavator tooth of claim 9, wherein each of the upper and lower walls further comprises fourth and fifth nose-engaging planar interface surfaces

formed thereon, each of the fourth and fifth interface surfaces being inclined relative to each of the longitudinal, lateral and orthogonal axes.

11. The excavator tooth of claim 9, wherein each of the side walls further comprises fourth and fifth nose-engaging planar interface surfaces formed thereon, each of the fourth and fifth interface surfaces being inclined relative to each of the longitudinal, lateral and orthogonal axes.

12. The excavator tooth of claim 1, wherein the tooth fastener-receiving opening includes a thread-engaging portion which engages a fastener thread as a fastener is unthreaded from a nose fastener-receiving opening.

13. An excavator tooth for use on a nose of an excavator adaptor, the tooth comprising:

a nose-receiving pocket bounded by an inner end wall, opposing upper and lower walls, and opposing side walls;

the inner end wall having a first nose-engaging interface surface formed orthogonal to a longitudinal axis of the tooth;

at least one of the opposing side walls having a fastener-receiving opening formed therethrough perpendicular to the tooth longitudinal axis, the fastener-receiving opening including a thread-engaging portion which engages a fastener thread as a fastener is unthreaded from a nose fastener-receiving opening; and

each of the opposing upper and lower walls having second and third spaced apart nose-engaging interface surfaces formed thereon, the second and third nose-engaging interface surfaces being substantially parallel to each other,

wherein complementary engagement between the nose-engaging interface surfaces of the tooth and corresponding tooth-engaging interface surfaces of the nose reduces wear between the tooth and the nose.

14. The excavator tooth of claim 13, wherein the end wall further comprises fourth and fifth nose-engaging interface surfaces formed thereon, each of the fourth and fifth interface surfaces being inclined relative to the tooth longitudinal axis.

15. The excavator tooth of claim 14, wherein the end wall further comprises sixth and seventh nose-engaging interface surfaces formed thereon, each of the sixth and seventh interface surfaces being inclined relative to the tooth longitudinal axis, and each of the fourth, fifth, sixth and seventh interface surfaces intersecting the first interface surface at a generally rectangular-shaped periphery of the first interface surface.

16. The excavator tooth of claim 15, wherein the fourth, fifth, sixth and seventh interface surfaces center the tooth relative to the longitudinal axis in response to a force directed along the longitudinal axis.

17. The excavator tooth of claim 13, wherein each of the upper and lower walls further comprises fourth and fifth nose-engaging interface surfaces formed thereon, each of the fourth and fifth interface surfaces being inclined relative to the tooth longitudinal axis.

18. The excavator tooth of claim 17, wherein the fourth and fifth interface surfaces center the tooth relative to the longitudinal axis in response to a force directed orthogonal to the longitudinal axis.

19. The excavator tooth of claim 13, wherein each of the side walls further comprises fourth and fifth nose-engaging interface surfaces formed thereon, each of the fourth and fifth interface surfaces being inclined relative to the tooth longitudinal axis.

20. The excavator tooth according to claim 19, wherein the fourth and fifth interface surfaces center the tooth relative to the longitudinal axis in response to a force directed lateral to the longitudinal axis.

21. The excavator tooth of claim 13, wherein the fastener-receiving opening is centered on a lateral axis perpendicular to the tooth longitudinal axis, and wherein each of the longitudinal and lateral axes are perpendicular to an orthogonal axis which intersects each of the upper and lower walls.

22. The excavator tooth of claim 21, wherein each of the upper and lower walls further comprises fourth and fifth nose-engaging planar interface surfaces formed

thereon, each of the fourth and fifth interface surfaces being inclined relative to each of the longitudinal, lateral and orthogonal axes.

23. The excavator tooth of claim 21, wherein each of the side walls further comprises fourth and fifth nose-engaging planar interface surfaces formed thereon, each of the fourth and fifth interface surfaces being inclined relative to each of the longitudinal, lateral and orthogonal axes.

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

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Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

— *of inventorship (Rule 4.17(iv))*

Published:

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(54) Title: FULLY STABILIZED EXCAVATOR TOOTH ATTACHMENT

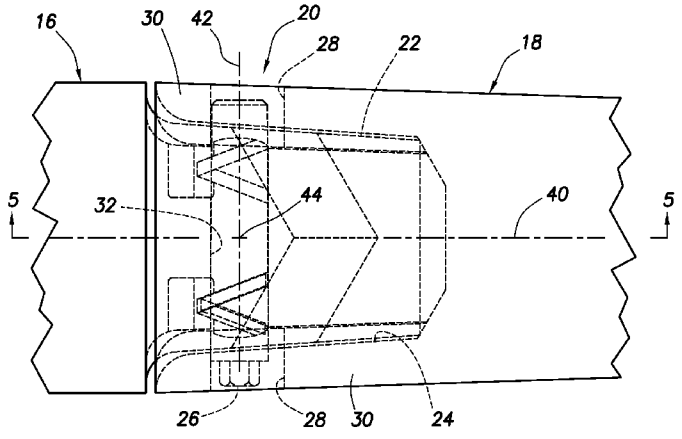

FIG.2

(57) Abstract: A fully stabilized excavator tooth attachment. An excavator tooth includes a nose-receiving pocket bounded by an inner end, upper and lower, and opposing side walls, the end wall having a nose-engaging interface surface formed orthogonal to a longitudinal axis of the tooth, at least one of the side walls having a fastener opening formed therethrough, and each of the upper and lower walls having two spaced apart nose-engaging interface surfaces formed thereon substantially parallel to each other. Another excavator tooth includes side walls having generally planar nose-engaging interface surfaces formed therein, one surface resisting rotation of the tooth about the longitudinal axis in one direction, and another interface surface resisting rotation of the tooth in an opposite direction. An attachment system includes a fastener configured for releasably securing the tooth on the nose, the fastener having a thread which is eccentric relative to a body of the fastener.

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FULLY STABILIZED EXCAVATOR TOOTH ATTACHMENT

TECHNICAL FIELD

This disclosure relates generally to equipment utilized and operations performed in conjunction with excavating and, in an example described below, more particularly provides a fully stabilized excavator tooth attachment.

BACKGROUND

Excavator implements, such as excavator buckets, trenchers, etc., are commonly provided with one or more teeth releasably secured to the implements for convenient replacement as the teeth wear out. In the past, such excavation teeth were secured to noses on adaptors positioned on lips of the implements, with various forms of pins, wedges, etc. being used to releasably attach the teeth.

Early attachment pins were installed and removed by hammer impact, which was later widely recognized as unsafe and inconvenient, leading to development of non-impact methods of attachment. Unfortunately, most of these non-impact attachment systems are unduly complex, costly,

inconvenient to use and/or unsuited to the hostile environment of an excavation operation.

In conjunction with the problems of attaching the teeth to the adaptor noses are problems associated with wear at interfaces of the teeth and noses. The problems go hand-in-hand, since insecure attachment can lead to excessive wear between a tooth and an adaptor nose, and *vice versa*.

Therefore, it will be appreciated that advancements are needed in the art of excavator tooth attachment. Such advancements could include provision of a fully stabilized excavator tooth and/or provision of an improved attachment system.

SUMMARY

In the disclosure below, an excavator tooth and an attachment system are provided which solve at least one problem in the art. One example is described below in which the excavator tooth is fully stabilized against forces imparted in excavation operations. Another example is described below in which an excavator tooth is secured to an adaptor nose using a unique attachment system.

In one aspect, this disclosure provides to the art an excavator tooth for use on a nose of an excavator adaptor. The tooth includes a nose-receiving pocket bounded by an inner end wall, opposing upper and lower walls, and opposing side walls. The end wall has a nose-engaging interface surface formed orthogonal to a longitudinal axis of the tooth. At least one of the side walls has a fastener-receiving opening formed therethrough perpendicular to the tooth longitudinal axis. Each of the upper and lower walls has spaced apart nose-engaging interface surfaces formed

thereon, with the interface surfaces being substantially parallel to each other.

In another aspect, an excavator tooth includes a nose-receiving pocket bounded by an inner end wall, opposing upper and lower walls, and opposing side walls. At least one of the side walls has a fastener-receiving opening formed therethrough perpendicular to a longitudinal axis of the tooth. Each of the side walls has generally planar nose-engaging interface surfaces formed therein, with one surface resisting rotation of the tooth about the longitudinal axis in one direction, and another interface surface resisting rotation of the tooth about the longitudinal axis in an opposite direction.

In yet another aspect, an attachment system for an excavator implement is provided to the art. The system includes an excavator tooth having a nose-receiving pocket formed therein, and a nose of an excavator adaptor. The nose is complementarily shaped relative to the pocket. A threaded fastener is configured for releasably securing the tooth on the nose. The fastener has a helical fastener thread formed thereon which is eccentric relative to a body of the fastener.

In a further aspect, an attachment system for an excavator implement includes an excavator tooth having a nose-receiving pocket formed therein, and a fastener-receiving opening formed through at least one of opposing lateral side walls of the pocket; a nose of an excavator adaptor, the nose being complementarily shaped relative to the pocket, and the nose having a threaded fastener-receiving opening formed therein; and a threaded fastener which releasably secures the tooth on the nose. The fastener has a helical fastener thread formed thereon. The

tooth fastener-receiving opening includes a thread-engaging portion which engages the fastener thread as the fastener is unthreaded from the nose fastener-receiving opening.

A still further aspect of this disclosure is an excavator tooth for use on a nose of an excavator adaptor. The tooth includes a nose-receiving pocket bounded by an inner end wall, opposing upper and lower walls, and opposing side walls. At least one of the side walls has a fastener-receiving opening formed therethrough perpendicular to a longitudinal axis of the tooth. The tooth fastener-receiving opening includes a thread-engaging portion which engages a fastener thread as a fastener is unthreaded from a nose fastener-receiving opening.

These and other features, advantages and benefits will become apparent to one of ordinary skill in the art upon careful consideration of the detailed description of representative examples below and the accompanying drawings, in which similar elements are indicated in the various figures using the same reference numbers.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of an excavator implement embodying principles of the present disclosure.

FIG. 2 is a top plan view of an excavator tooth, adaptor nose and fastener, each of which embodies principles of the present disclosure and may be used on the implement of FIG. 1.

FIG. 3 is a side view of the excavator tooth, adaptor nose and fastener of FIG. 2.

FIG. 4 is a cross-sectional view of the tooth and adaptor nose, taken along line 4-4 of FIG. 8.

FIG. 5 is a cross-sectional view of the tooth and adaptor nose, taken along line 5-5 of FIGS. 2 & 6.

FIG. 6 is a cross-sectional view of the tooth and nose, taken along line 6-6 of FIG. 3.

FIG. 7 is a cross-sectional view of the tooth and a top plan view of the nose therein.

FIG. 8 is a cross-sectional view of the tooth and a side view of the nose therein.

FIG. 9 is a top plan view of the nose.

FIG. 10 is a side view of the nose.

FIG. 11 is a top plan view of another configuration of the nose.

FIG. 12 is a cross-sectional view of the nose configuration of FIG. 11 in a complementarily shaped configuration of the tooth.

FIGS. 13-16 are views of an attachment system for the tooth and adaptor nose.

FIGS. 17-21 are views of another configuration of the attachment system.

FIGS. 22-26 are views of yet another configuration of the attachment system.

FIGS. 27-29 are views of a further configuration of the attachment system.

DETAILED DESCRIPTION

Representatively illustrated in FIG. 1 is an excavator implement 10 which embodies principles of this disclosure. The implement 10 is depicted in FIG. 1 as including a bucket 12 having a material-engaging lower lip 14. Mounted along

the lip 14 are spaced apart adaptors 16. The adaptors 16 allow for mounting excavator teeth 18 along the lip 14, so that the implement 10 is more efficient in breaking up and scooping material into the bucket 12.

At this point, it should be noted that the implement 10 as depicted in FIG. 1 is merely one example of a wide variety of implements which can incorporate the principles of this disclosure described more fully below. Other types of implements, such as trenchers, etc., can utilize the principles of this disclosure. Indeed, most excavation equipment which utilizes replaceable excavator teeth can benefit from the principles of this disclosure.

Multiple configurations of the adaptors 16 and teeth 18 are depicted in the drawings and are described below for purposes of illustration and example, so that a person skilled in the art can appreciate how to make and use the principles of this disclosure, and the advantages thereof. However, it should be clearly understood that the principles of this disclosure are not limited at all to the specific configurations of the adaptors 16, teeth 18 and associated components described herein. Instead, the principles of this disclosure are applicable to a wide variety of excavator teeth, adaptor and attachment system configurations.

Referring additionally now to FIG. 2, a top plan view of engaged portions of an adaptor 16 and tooth 18 are representatively illustrated. FIG. 2 also depicts an attachment system 20 which is used to releasably secure the tooth 18 to the adaptor 16.

In FIG. 2 it may be seen that a “male” nose 22 of the adaptor 16 is received within a “female” pocket 24 formed in a rearward end of the tooth 18. To releasably secure the

tooth 18 on the nose 22, a fastener 26 is installed in openings 28 formed through opposing side walls 30 of the tooth. The fastener 26 also extends through another opening 32 formed laterally through the nose 22.

Each of these components is described more fully below, along with the advantages derived from their unique construction and operation. Among these advantages are the secure, reliable, economical, robust and convenient attachment of the tooth 18 to the adaptor nose 22 using the attachment system 20, as well as the fully stabilized complementary engagement between the tooth and the adaptor nose which beneficially reduces wear between these components.

Referring additionally now to FIG. 3, a side view of the attachment system 20 is representatively illustrated. In this view, it may be seen that the tooth pocket 24 is bounded by an upper wall 34, a lower wall 36 and an end wall 38, as well as by the side walls 30 described above.

The tooth 18 and adaptor nose 22 are aligned along a longitudinal axis 40 of the tooth. The fastener 26 is aligned with a lateral axis 42 which extends transversely (perpendicular to the longitudinal axis 40). Another axis 44 is orthogonal to a plane defined by the other two axes 40, 42, and intersects the upper and lower walls 34, 36.

Note that, although the axes 40, 42 are depicted in the drawings as being horizontally oriented, and the axis 44 is depicted as being vertically oriented, the axes could be oriented in any directions when the tooth 18 is attached to the adaptor nose 22, and when the implement 10 is used in excavating operations. Thus, the orientations of the axes 40, 42, 44 shown in the drawings are merely for convenience of description, illustration and example.

Referring additionally now to FIG. 4, a cross-sectional view of the adaptor 16 and tooth 18 is representatively illustrated. In this view, several additional features of the attachment system 20 can be more clearly seen.

The opening 32 has helical threads 46 at each opposite end thereof. Note that the threads 46 are not coaxial with the openings 28, 32, but are instead eccentric relative to the openings. Preferably, the threads 46 are tangential to one side of the opening 32 (as described more fully below), and are discontinuous, in that each of the threads terminates without connecting with the thread at the other end of the opening.

The two threads 46 permit the fastener 26 to be installed from either end of the openings 28, 32. The terminations of the threads 46 in the opening 32 prevents the fastener 26 from being installed too far into the opening. The eccentric position of the threads 46 relative to the openings 28, 32 allows a body of the fastener 26 to fully contact the openings upon installation, thereby providing increased surface area and reduced wear, as described more fully below.

The openings 28 are also not coaxial with the opening 32. In addition to the benefits discussed above, the eccentric positioning of the openings 28, 32 also provides for automatic, intuitive alignment of the fastener 26 with the openings at installation, as described more fully below.

Recesses 48 (used for one example of a lock device 82 described below) are depicted in FIG. 4 as being formed in the nose portion 22 adjacent the opening 32 and threads 46. Various devices for locking the fastener 26 in the tooth 18 and adaptor nose 22 are described more fully below.

Referring additionally now to FIG. 5, another cross-sectional view of the tooth 18 and adaptor nose 22 is representatively illustrated. In this view it may be seen that the tooth 18 abuts the nose 22 primarily at a planar interface surface 50 formed on the end wall 38. The surface 50 is oriented orthogonal to the longitudinal axis 40 of the tooth 18 and thereby provides substantial resistance to force 52 applied to the tooth along the longitudinal axis.

In addition, inclined planar interface surfaces 53 are provided which, in addition to resisting the longitudinal force 52, also function to center and stabilize the tooth 18 relative to the longitudinal axis 40. The surfaces 53 are preferably inclined relative to the longitudinal and orthogonal axes 40, 44, but are parallel to the lateral axis 42 of the tooth 18.

Referring additionally now to FIG. 6, another cross-sectional view of the tooth 18 and adaptor nose 22 is representatively illustrated. In this view it may be seen that additional inclined interface surfaces are utilized in the attachment system 20 to resist various other forces applied to the tooth 18, and to stabilize the tooth on the adaptor nose 22.

Planar interface surfaces 54, 56 formed on the upper and lower walls 34, 36 resist forces 58 applied to the tooth along the axis 44 and function to center and stabilize the tooth 18 on the adaptor nose 22 in response to these forces. Planar interface surfaces 60, 62 formed on the side walls 30 resist forces 64 applied to the tooth 18 along the axis 42 and function to center and stabilize the tooth on the adaptor nose 22 in response to these forces.

In addition, the surfaces 54, 62 function to resist rotation of the tooth 18 about the adaptor nose 22 due to

torque 66 applied to the tooth about the longitudinal axis 40. Similarly, the surfaces 56, 60 function to resist rotation of the tooth 18 about the adaptor nose 22 due to oppositely directed torque 68 applied about the axis 40.

Preferably, each of the interface surfaces 54, 56, 60, 62 is inclined relative to each of the axes 40, 42, 44 for enhanced stabilization of the tooth 18 on the adaptor nose 22. However, the surfaces 54, 56, 60, 62 could be otherwise oriented, without departing from the principles of this disclosure. Furthermore, since the tooth pocket 24 is substantially complementarily shaped relative to the adaptor nose 22, the nose has interface surfaces formed thereon which are similarly shaped and oriented as the surfaces 50, 53, 54, 56, 60, 62 and other interface surfaces described herein.

The interface surfaces 60, 62 combine to form a convex portion of the pocket 24, thereby increasing the lateral thickness of the side walls 30. This is advantageous for providing sufficient contact surface area between the openings 28 and each end of the fastener 26, as described more fully below.

Referring additionally now to FIG. 7, another cross-sectional view of the tooth 18 on the adaptor nose 22 is representatively illustrated. In this view it may be seen that additional planar interface surfaces 70 are formed on the end wall 38 adjacent and on opposite sides of the surface 50.

The surfaces 70 resist the longitudinal force 52, and also function to center and stabilize the tooth 18 relative to the longitudinal axis 40 in response to the force. The surfaces 70 are preferably inclined relative to the longitudinal and lateral axes 40, 42, but are parallel to

the orthogonal axis 44 of the tooth 18. In the examples depicted in the drawings, the surfaces 53, 70 intersect the surface 50 at a generally rectangular periphery thereof, due to the orientations of these surfaces, but other configurations may be used, if desired.

Referring additionally now to FIG. 8, another cross-sectional view of the tooth 18 on the adaptor nose 22 is representatively illustrated. In this view it may be seen that the upper and lower walls 34, 36 have planar interface surfaces 72, 74 formed thereon which resist the forces 58 applied to the tooth along the axis 44.

The surfaces 72, 74 are preferably longitudinally spaced apart from each other along each of the upper and lower walls 34, 36, and are preferably parallel to each other. The surfaces 72, 74 are also preferably offset relative to each other in a direction perpendicular to the surfaces. The surfaces 72, 74 could be somewhat inclined relative to each other, if desired, but preferably such relative inclination is minimal.

The surfaces 72, 74 are preferably inclined somewhat relative to the longitudinal axis 40 and the orthogonal axis 44, but are parallel to the lateral axis 42. The surfaces 72, 74 could be parallel to the longitudinal axis 40, if desired.

The surfaces 72 function to resist rotation of the tooth 18 about the adaptor nose 22 due to torque 76 applied to the tooth about the lateral axis 42. Similarly, the surfaces 74 function to resist rotation of the tooth 18 about the adaptor nose 22 due to oppositely directed torque 78 applied about the axis 42.

Referring additionally now to FIGS. 9 & 10, respective top and side views of the adaptor nose 22 are

representatively illustrated, apart from the remainder of the attachment system 20. In these views, the interface surfaces described above as being formed in the tooth pocket 24 are indicated on the adaptor nose 22 to demonstrate how the surfaces on the nose and pocket cooperate to form a complementarily shaped attachment and stabilization system.

Referring additionally now to FIGS. 11 & 12, another configuration of the tooth 18 and adaptor nose 22 is representatively illustrated. In this configuration, the interface surfaces 54, 56 on the upper and lower walls 34, 36 are separated by another inclined planar surface 80. Otherwise, the configuration of FIGS. 11 & 12 is substantially similar to the configuration of FIGS. 2-10 and functions in essentially the same way. This demonstrates that various configurations of the attachment system 20 may be utilized in keeping with the principles of this disclosure.

Referring additionally now to FIGS. 13-16, the attachment system 20 is representatively illustrated, along with components of a lock device 82 for preventing inadvertent removal of the fastener 26 from the adaptor nose 22 and tooth 18. FIG. 13 depicts the lock device 82 installed in the assembled adaptor nose 22 and tooth 18, FIGS. 14 & 15 depict the specially constructed fastener 26, and FIG. 16 depicts a lock member 84 of the lock device.

The fastener 26 as depicted in FIG. 14 has an elongated body 86, with a helical thread 88 formed near one end of the body. The thread 88 is eccentric relative to the body 86, such that the thread is tangential with one lateral side of the body.

The body 86 is generally cylindrical-shaped, but may be tapered somewhat (e.g., tapering inward from the thread 88

end toward the unthreaded end approximately one degree on a side), in order to facilitate removal of the fastener 26 from the opening 32 in the adaptor nose 22. Contact surfaces 90 are provided at each end of the body 86 for contacting the opening 28 in each side of the tooth 18 (as depicted in FIG. 13), and an intermediate portion of the body provides a contact surface 92 which contacts the opening 32 in the adaptor nose 22.

When installing the fastener 26, the body 86 is inserted through the opening 28 on one side of the tooth 18, and into the opening 32 in the adaptor nose 22. The fastener 26 is rotated until the thread 88 aligns with the opening 28.

Note that the thread 88 is eccentrically offset relative to the body 86 of the fastener 26 by the same amount as the opening 28 is eccentrically offset relative to the opening 32, and the thread 88 is somewhat smaller in diameter than the opening 28. Thus, it is intuitive to an operator to align the thread 88 with the opening 28 once the body 86 has been inserted into the opening 32 of the adaptor nose 22.

With the thread 88 inserted into the opening 28, the thread 88 will also be aligned for ready engagement with the respective one of the threads 46 in the adaptor nose 22. The fastener 26 is then rotated 180 degrees (or another amount of rotation, such as 90 degrees, if desired, depending upon the depth of the thread 46 in the adaptor nose 22).

At this point, with the contact surfaces 90 engaging the openings 28, the contact surface 92 engaged in the opening 32 and the threads 46, 88 engaged with each other, the tooth 18 is secured onto the adaptor nose 22. The lock

device 82 can then be used to prevent unintended unthreading of the fastener 26.

Note that a socket 94 is provided in one end of the fastener 26 for use of an appropriate tool to rotate the fastener when threading or unthreading it in the attachment system 20. The lock device 82 utilizes this socket 94, in conjunction with a slot 96 extending laterally between the socket and the outer surface of the body 86, to retain the lock member 84.

As depicted in FIG. 16, the lock member 84 is complementarily shaped relative to the socket 94 and slot 96 on one side 98 of the lock member, and has a lobe 100 extending outwardly from an opposite side. The lobe 100 has an outer curvature which matches that of the opening 28 so that, when the fastener 26 is appropriately threaded into the opening 32 and the side 98 of the lock member 84 is inserted into the socket 94 and slot 96, the lobe will cooperatively engage the opening 28 to thereby prevent unthreading of the fastener.

Preferably, the lock member 84 is made of a resilient material, such as an appropriately durable elastomer. The lock member end 98 and lobe 100 are preferably sized for an interference fit in the respective socket 94 and opening 28, to thereby prevent inadvertent dislodging of the lock member from the fastener 26 and tooth 18.

In the lock device 82 of FIGS. 13-16, the lock member 84 engages the opening 28 to prevent unintentional unthreading of the fastener 26. However, other types of lock devices can be used, if desired.

Referring additionally now to FIGS. 17-21, another configuration of the lock device 82 is representatively illustrated. In this configuration, the lock member 84

engages the fastener 26 and a slot 102 formed in the adaptor nose 22 adjacent the opening 32 to prevent inadvertent unthreading of the fastener.

The lock member 84 as depicted in FIGS. 20 & 21 includes an elongated key 104 which is inserted into the aligned slot 96 in the fastener 26 and the slot 102 in the adaptor nose 22 after the fastener has been appropriately threaded into the adaptor nose. The slot 96 in the fastener 26 is appropriately elongated for this purpose, as depicted in FIGS. 18 & 19. Again, the lock member 84 is preferably made of a resilient material and is preferably interference fit in the fastener 26 and slots 96, 102 to prevent inadvertent removal.

Referring additionally now to FIGS. 22-26, another configuration of the lock device 82 is representatively illustrated. In this configuration, the lock member 84 is in the form of a cylindrical rod which is retained in the adaptor nose 22 between the recess 48 and the opening 32 (the recess 48 is more clearly viewed in FIGS. 4 & 8).

The lock member 84 is resiliently biased toward the opening 32 by a biasing device 106 positioned in the recess 48. The biasing device 106 is preferably made of an elastomeric material, but other types of biasing devices (such as springs, etc.) could be used, if desired.

A detent 108 is formed on the thread 88 of the fastener 26, as depicted in FIG. 23. As the fastener 26 is rotated to thread the fastener into the adaptor nose 22, the thread 88 displaces the lock member 84 toward the recess 48, thereby compressing the biasing device 106. When the fastener 26 has been appropriately threaded into the adaptor nose 22, the detent 108 will be aligned with the lock member 84, and the lock member 84 will be biased by the biasing

device 106 into engagement with the detent, thereby preventing inadvertent unthreading of the fastener.

This sequence is depicted in FIGS. 24-26. FIG. 24 depicts the arrangement of the fastener 26, lock member 84 and biasing device 106 when the fastener is inserted into the opening 32 and the thread 88 is aligned with the opening 28, just prior to threading the fastener into the adaptor nose 22.

FIG. 25 depicts the arrangement of the fastener 26, lock member 84 and biasing device 106 when the fastener has been rotated 90 degrees, thereby partially threading the fastener into the adaptor nose 22. Note that the lock member 84 has been displaced by the thread 88 (due to its eccentric positioning relative to the body 86) toward the biasing device 106, thereby compressing the biasing device.

FIG. 26 depicts the arrangement of the fastener 26, lock member 84 and biasing device 106 when the fastener has been rotated 180 degrees, thereby fully threading the fastener into the adaptor nose 22. Note that the lock member 84 is now engaged with the detent 108, and such engagement is resiliently maintained by the biasing device 106. Unthreading of the fastener 26 would require again compressing the biasing device 106, which may be conveniently accomplished when desired, but which would not be expected to happen inadvertently.

Referring additionally now to FIGS. 27-29, another configuration of the attachment system 20 is representatively illustrated. The attachment system 20 is depicted without the fastener 26 and lock device 82 for illustrative clarity, but the attachment system example of FIGS. 27-29 is configured to utilize a fastener and lock

device of the type illustrated in FIGS. 22-26 and described above.

The configuration of FIGS. 27-29 differs in at least one significant way from the configuration of FIGS. 22-26, in that the openings 28 in the side walls 30 of the FIGS. 27-29 configuration have thread-engaging portions 110 formed therein. The thread-engaging portions 110 are depicted in the drawings as a partial thread or helical ramp which extends only partially circumferentially about the interior of the opening 28. However, other types of thread-engaging structures may be used, if desired.

The thread-engaging portions 110 function to engage the thread 88 on the fastener 26 as the fastener is unthreaded from the opening 32 in the nose 22. The thread 88 engages one of the portions 110 and, as the fastener is rotated counter-clockwise (as depicted in the drawings), the threaded or ramped configuration of the thread-engaging portion causes the fastener 26 to continue withdrawal from the opening 32. This provides more convenient removal of the fastener 26 from the openings 28, 30.

Note that the thread-engaging portions 110 are eccentric relative to the opening 32 in the nose 22. In addition, although the thread-engaging portions 110 are formed in each of the openings 28 in each of the side walls 30 as depicted in the drawings, the principles of this disclosure could be practiced with only one opening 28 formed through one of the side walls 30, in which case only one thread-engaging portion 110 may be used.

It will now be fully appreciated that the attachment system 20, excavator tooth 18 and adaptor nose 22 described above provide several advancements to the art of excavator teeth installation, securement and removal. The tooth 18 is

fully stabilized, in that forces 52, 58, 64 and torque 66, 68, 76, 78 applied from any direction are capably resisted, and the tooth is centered relative to its longitudinal, lateral and orthogonal axes 40, 42, 44. The fastener 26 and lock device 82 releasably secure the tooth 18 on the adaptor nose 22 in a manner which is desirably simple, safe, efficient, convenient and reliable.

The above disclosure describes an excavator tooth 18 for use on a nose 22 of an excavator adaptor 16, with the tooth 18 including a nose-receiving pocket 24 bounded by an inner end wall 38, opposing upper and lower walls 34, 36, and opposing side walls 30. The end wall 38 has a first nose-engaging interface surface 50 formed orthogonal to a longitudinal axis 40 of the tooth 18. At least one of the side walls 30 has a fastener-receiving opening 28 formed therethrough perpendicular to the tooth longitudinal axis 40. Each of the upper and lower walls 34, 36 has second and third spaced apart nose-engaging interface surfaces 72, 74 formed thereon, the second and third interface surfaces 72, 74 being substantially parallel to each other.

The end wall 38 may include fourth and fifth nose-engaging interface surfaces 53 formed thereon, with each of the fourth and fifth interface surfaces 53 being inclined relative to the tooth longitudinal axis 40. The end wall 38 may include sixth and seventh nose-engaging interface surfaces 70 formed thereon, with each of the sixth and seventh interface surfaces 70 being inclined relative to the tooth longitudinal axis 40.

Each of the fourth, fifth, sixth and seventh interface surfaces 53, 70 may intersect the first interface surface 50 at a generally rectangular-shaped periphery of the first interface surface 50. The fourth, fifth, sixth and seventh

interface surfaces 53, 70 preferably center the tooth 18 relative to the longitudinal axis 40 in response to a force 52 directed along the longitudinal axis 40.

Each of the upper and lower walls 34, 36 may include fourth and fifth nose-engaging interface surfaces 54, 56 formed thereon, with each of the fourth and fifth interface surfaces 54, 56 being inclined relative to the tooth longitudinal axis 40. The fourth and fifth interface surfaces 54, 56 preferably center the tooth 18 relative to the longitudinal axis 40 in response to a force 58 directed orthogonal to the longitudinal axis 40.

Each of the side walls 30 may include fourth and fifth nose-engaging interface surfaces 60, 62 formed thereon, with each of the fourth and fifth interface surfaces 60, 62 being inclined relative to the tooth longitudinal axis 40. The fourth and fifth interface surfaces 60, 62 preferably center the tooth 18 relative to the longitudinal axis 40 in response to a force 64 directed lateral to the longitudinal axis 40.

The openings 28 in the side walls 30 may be centered on a lateral axis 42 perpendicular to the tooth longitudinal axis 40. Each of the longitudinal and lateral axes 40, 42 are perpendicular to an orthogonal axis 44 which intersects each of the upper and lower walls 34, 36.

Each of the upper and lower walls 34, 36 may include fourth and fifth nose-engaging planar interface surfaces 54, 56 formed thereon. Each of the fourth and fifth interface surfaces 54, 56 may be inclined relative to each of the longitudinal, lateral and orthogonal axes 40, 42, 44.

Each of the side walls 30 may include fourth and fifth nose-engaging planar interface surfaces 60, 62 formed thereon. Each of the fourth and fifth interface surfaces

60, 62 may be inclined relative to each of the longitudinal, lateral and orthogonal axes 40, 42, 44.

The above disclosure also describes an attachment system 20 for an excavator implement 10. The system 20 includes an excavator tooth 18 having a nose-receiving pocket 24 formed therein, and a nose 22 of an excavator adaptor 16, with the nose 22 being complementarily shaped relative to the pocket 24. A threaded fastener 26 is configured for releasably securing the tooth 18 on the nose 22. The fastener 26 has a helical fastener thread 88 formed thereon which is eccentric relative to a body 86 of the fastener 26.

The fastener thread 88 may extend outwardly from the body 86. The fastener thread 88 on one lateral side of the body 86 may be tangential with an outer surface 90, 92 of the body 86.

The nose 22 may have a threaded fastener-receiving opening 32 formed therein. At least one fastener-receiving thread 46 may be formed in the nose 22, and the thread 46 may be eccentric relative to the opening 32.

The opening 32 may extend laterally through the nose 22. The fastener-receiving thread 46 may be formed about each opposite end of the opening 32, so that the fastener 26 is threadable into either end of the opening 32.

The tooth 18 may have a fastener-receiving opening 28 formed through each opposite lateral side wall 30 of the pocket 24. The fastener body 86 may engage the openings 28 on opposite sides of the thread 88 when the fastener 26 secures the tooth 18 on the adaptor nose 22.

The nose 22 may have a fastener-receiving opening 32 formed therein, with the nose fastener-receiving opening 32

being eccentric relative to the tooth fastener-receiving openings 28. In this manner, the fastener thread 88 may be coaxial with the tooth fastener-receiving opening 28 when the fastener body 86 is coaxial with the nose fastener-receiving opening 32.

The system 20 may include a lock device 82 which engages both the fastener 26 and the tooth 18, whereby the lock device 82 prevents rotation of the fastener 26 relative to the tooth 18.

The system 20 may include a lock device 82 which engages both the fastener 26 and the nose 22, whereby the lock device 82 prevents rotation of the fastener 26 relative to the nose 22.

The system 20 may include a lock device 82 which prevents unthreading of the fastener 26, with the lock device 82 comprising a detent 108 engaged by a resiliently biased lock member 84 when the fastener 26 secures the tooth 18 on the adaptor nose 22.

Also described by the above disclosure is an excavator tooth 18 for use on a nose 22 of an excavator adaptor 16, with the tooth 18 including a nose-receiving pocket 24 bounded by an inner end wall 38, opposing upper and lower walls 34, 36, and opposing side walls 30. At least one of the side walls 30 has a fastener-receiving opening 28 formed therethrough perpendicular to a longitudinal axis 40 of the tooth 18. Each of the side walls 30 has first and second generally planar nose-engaging interface surfaces 60, 62 formed therein. The first interface surface 60 resists rotation of the tooth 18 about the longitudinal axis 40 in a first direction, and the second interface surface 62 resists rotation of the tooth 18 about the longitudinal axis 40 in a second direction opposite to the first direction.

Each of the fastener-receiving openings 28 may intersect the first and second interface surfaces 60, 62 of a respective one of the side walls 30.

Each of the first and second interface surfaces 60, 62 may be inclined relative to a lateral axis 42 of the tooth 18 perpendicular to the longitudinal axis 40.

Each of the first interface surfaces 60 may intersect the second interface surface 62 of a respective one of the side walls 30.

The end wall 38 may have a third nose-engaging interface surface 50 formed orthogonal to the tooth longitudinal axis 40. Each of the upper and lower walls 34, 36 may have fourth and fifth spaced apart nose-engaging interface surfaces 72, 74 formed thereon, the fourth and fifth interface surfaces 72, 74 being substantially parallel to each other.

The above disclosure also describes an attachment system 20 for an excavator implement 10 which includes an excavator tooth 18 having a nose-receiving pocket 24 formed therein, and a fastener-receiving opening 28 formed through at least one of opposing lateral side walls 30 of the pocket 24. A nose 22 of an excavator adaptor 16 is complementarily shaped relative to the pocket 24, and the nose 22 has a threaded fastener-receiving opening 32 formed therein. A threaded fastener 26 releasably secures the tooth 18 on the nose 22, with the fastener 26 having a helical fastener thread 88 formed thereon. The tooth fastener-receiving opening 28 includes a thread-engaging portion 110 which engages the fastener thread 88 as the fastener 26 is unthreaded from the nose fastener-receiving opening 32.

The thread-engaging portion 110 may comprise a threaded and/or ramped portion of the tooth fastener-receiving

opening 28. The thread-engaging portion110 may be eccentric relative to the nose fastener-receiving opening 32.

Also provided by the above disclosure is an excavator tooth 18 for use on a nose 22 of an excavator adaptor 16. The tooth 18 includes a nose-receiving pocket 24 bounded by an inner end wall 38, opposing upper and lower walls 34, 36 and opposing side walls 30. At least one of the side walls 30 has a fastener-receiving opening 28 formed therethrough perpendicular to a longitudinal axis 40 of the tooth 18. The tooth fastener-receiving opening 28 has a thread-engaging portion 110 which engages a fastener thread 88 as a fastener 26 is unthreaded from a nose fastener-receiving opening 32.

It is to be understood that the various examples described above may be utilized in various orientations, such as inclined, inverted, horizontal, vertical, etc., and in various configurations, without departing from the principles of the present disclosure. The embodiments illustrated in the drawings are depicted and described merely as examples of useful applications of the principles of the disclosure, which are not limited to any specific details of the embodiment.

CLAIMS:

1. An excavator tooth for use on a nose of an excavator adaptor, the tooth comprising:

a nose-receiving pocket bounded by an inner end wall, opposing upper and lower walls, and opposing side walls;

the end wall having a first nose-engaging interface surface formed orthogonal to a longitudinal axis of the tooth;

at least one of the side walls having a fastener-receiving opening formed therethrough perpendicular to the tooth longitudinal axis; and

each of the upper and lower walls having second and third spaced apart nose-engaging interface surfaces formed thereon, the second and third interface surfaces being substantially parallel to each other,

wherein complementary engagement between the nose-engaging interface surfaces of the tooth and corresponding tooth-engaging interface surfaces of the nose reduces wear between the tooth and the nose.

2. The excavator tooth of claim 1, wherein the end wall further comprises fourth and fifth nose-engaging interface surfaces formed thereon, each of the fourth and fifth interface surfaces being inclined relative to the tooth longitudinal axis.

3. The excavator tooth of claim 2, wherein the end wall further comprises sixth and seventh nose-engaging interface surfaces formed thereon, each of the sixth and seventh interface surfaces being inclined relative to the tooth longitudinal axis, and each of the fourth, fifth, sixth and seventh interface surfaces intersecting the first interface surface at a generally rectangular-shaped periphery of the first interface surface.

4. The excavator tooth of claim 3, wherein the fourth, fifth, sixth and seventh interface surfaces center the tooth relative to the longitudinal axis in response to a force directed along the longitudinal axis.

5. The excavator tooth of claim 1, wherein each of the upper and lower walls further comprises fourth and fifth nose-engaging interface surfaces formed thereon, each of the fourth and fifth interface surfaces being inclined relative to the tooth longitudinal axis.

6. The excavator tooth of claim 5, wherein the fourth and fifth interface surfaces center the tooth relative to the longitudinal axis in response to a force directed orthogonal to the longitudinal axis.

7. The excavator tooth of claim 1, wherein each of the side walls further comprises fourth and fifth nose-engaging interface surfaces formed thereon, each of the fourth and fifth interface surfaces being inclined relative to the tooth longitudinal axis.

8. The excavator tooth according to claim 7, wherein the fourth and fifth interface surfaces center the tooth relative to the longitudinal axis in response to a force directed lateral to the longitudinal axis.

9. The excavator tooth of claim 1, wherein the fastener-receiving opening is centered on a lateral axis perpendicular to the tooth longitudinal axis, and wherein each of the longitudinal and lateral axes are perpendicular to an orthogonal axis which intersects each of the upper and lower walls.

10. The excavator tooth of claim 9, wherein each of the upper and lower walls further comprises fourth and fifth nose-engaging planar interface surfaces

formed thereon, each of the fourth and fifth interface surfaces being inclined relative to each of the longitudinal, lateral and orthogonal axes.

11. The excavator tooth of claim 9, wherein each of the side walls further comprises fourth and fifth nose-engaging planar interface surfaces formed thereon, each of the fourth and fifth interface surfaces being inclined relative to each of the longitudinal, lateral and orthogonal axes.

12. The excavator tooth of claim 1, wherein the tooth fastener-receiving opening includes a thread-engaging portion which engages a fastener thread as a fastener is unthreaded from a nose fastener-receiving opening.

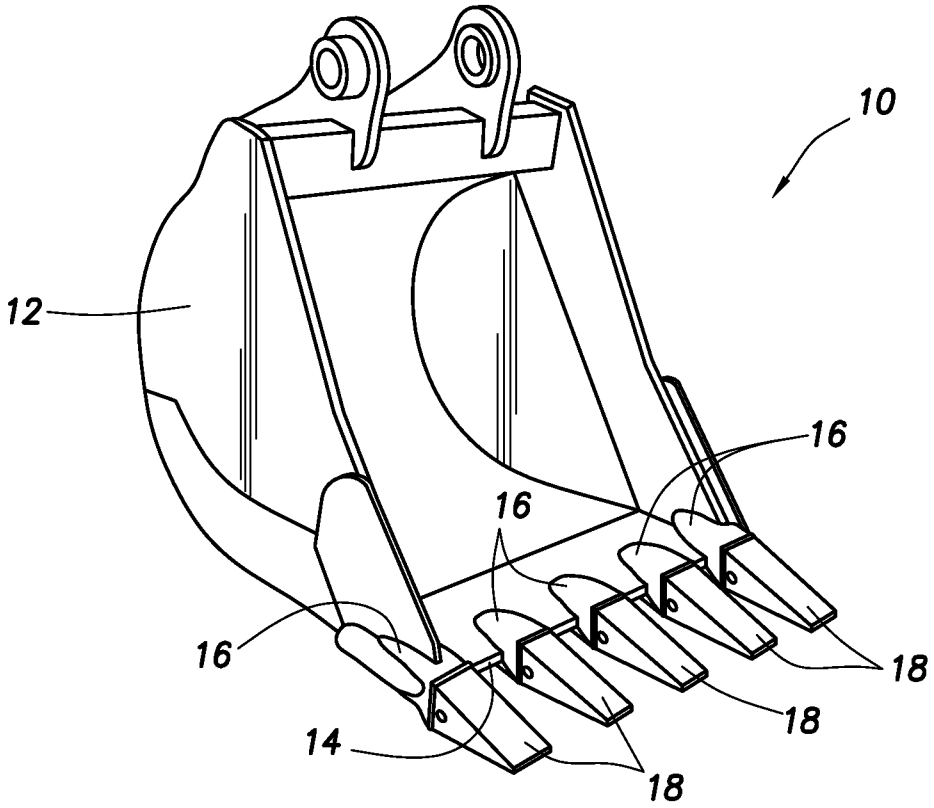

FIG. 1

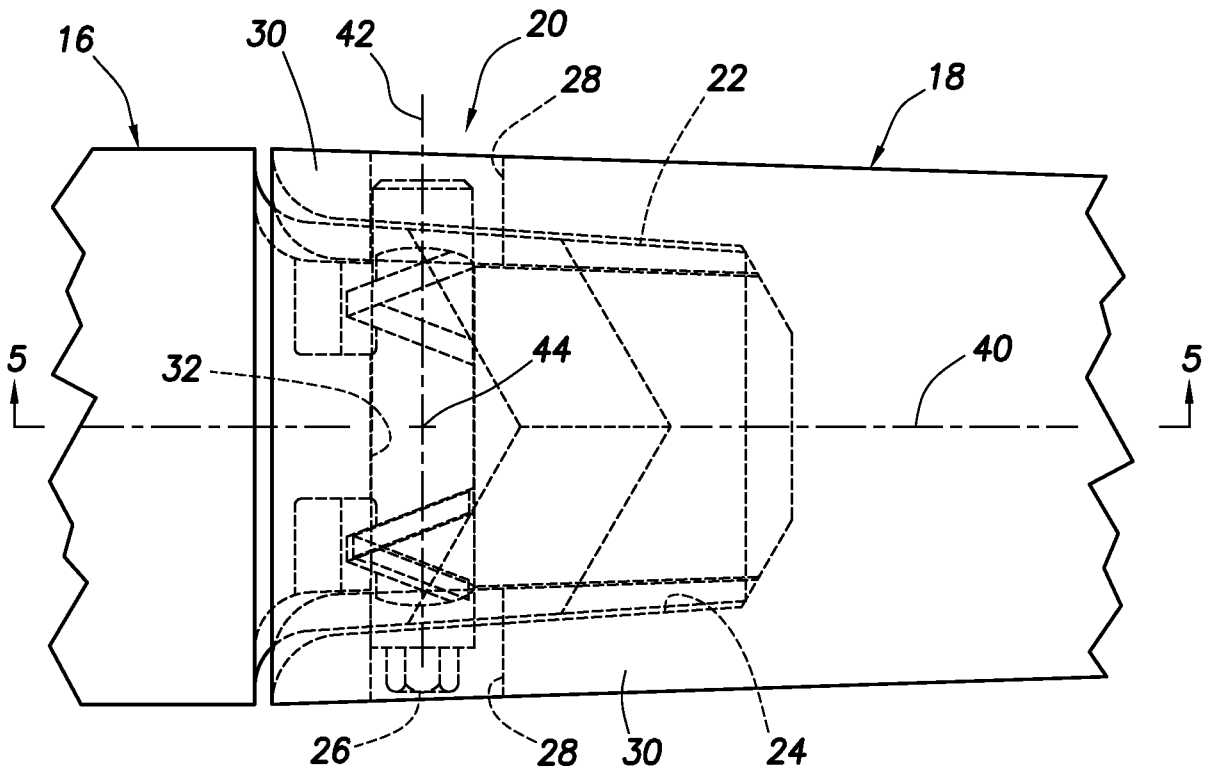

FIG. 2

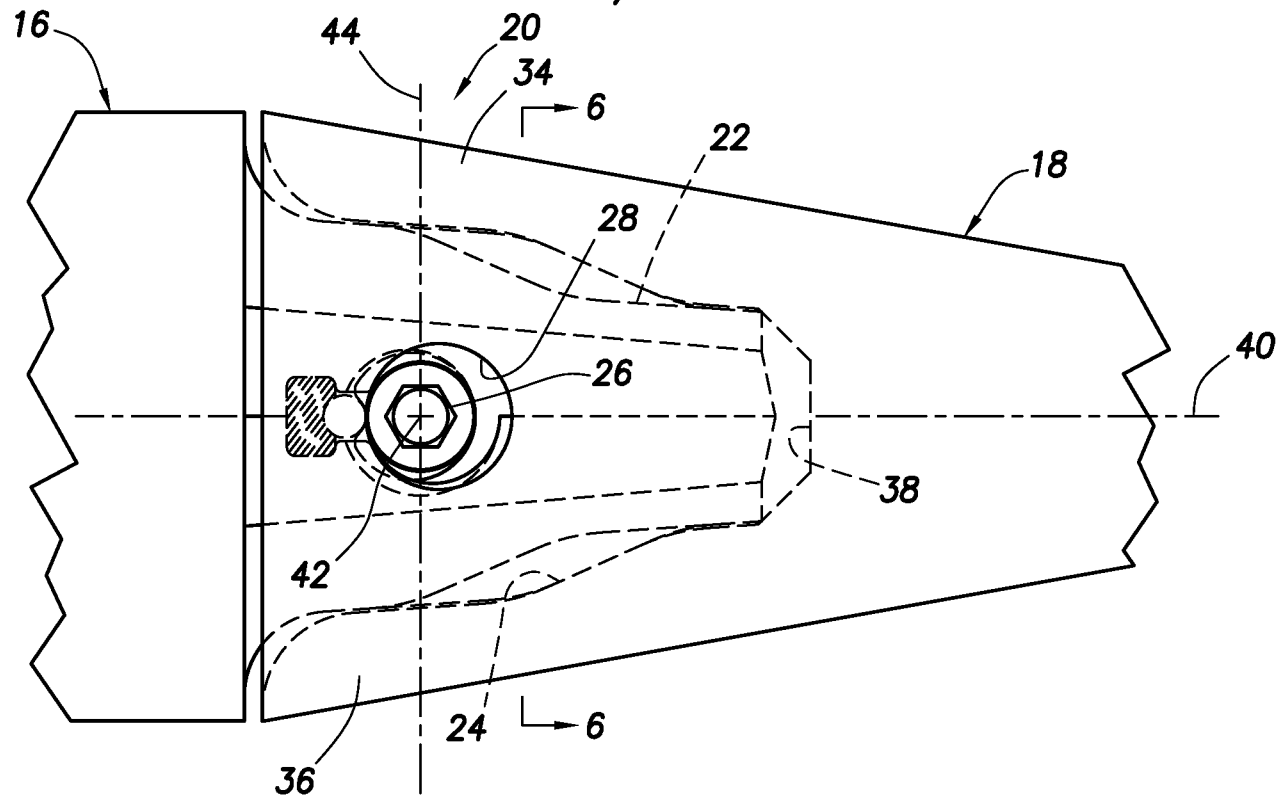
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FIG.3

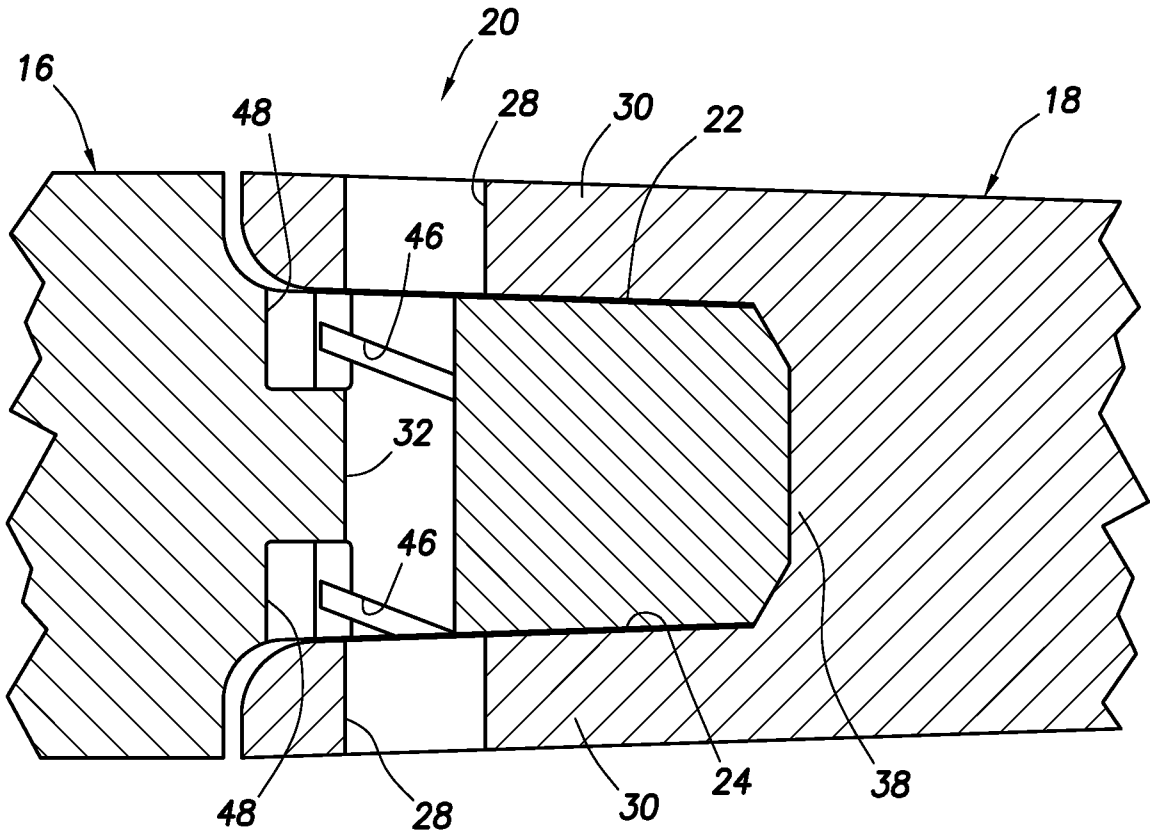
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FIG.4

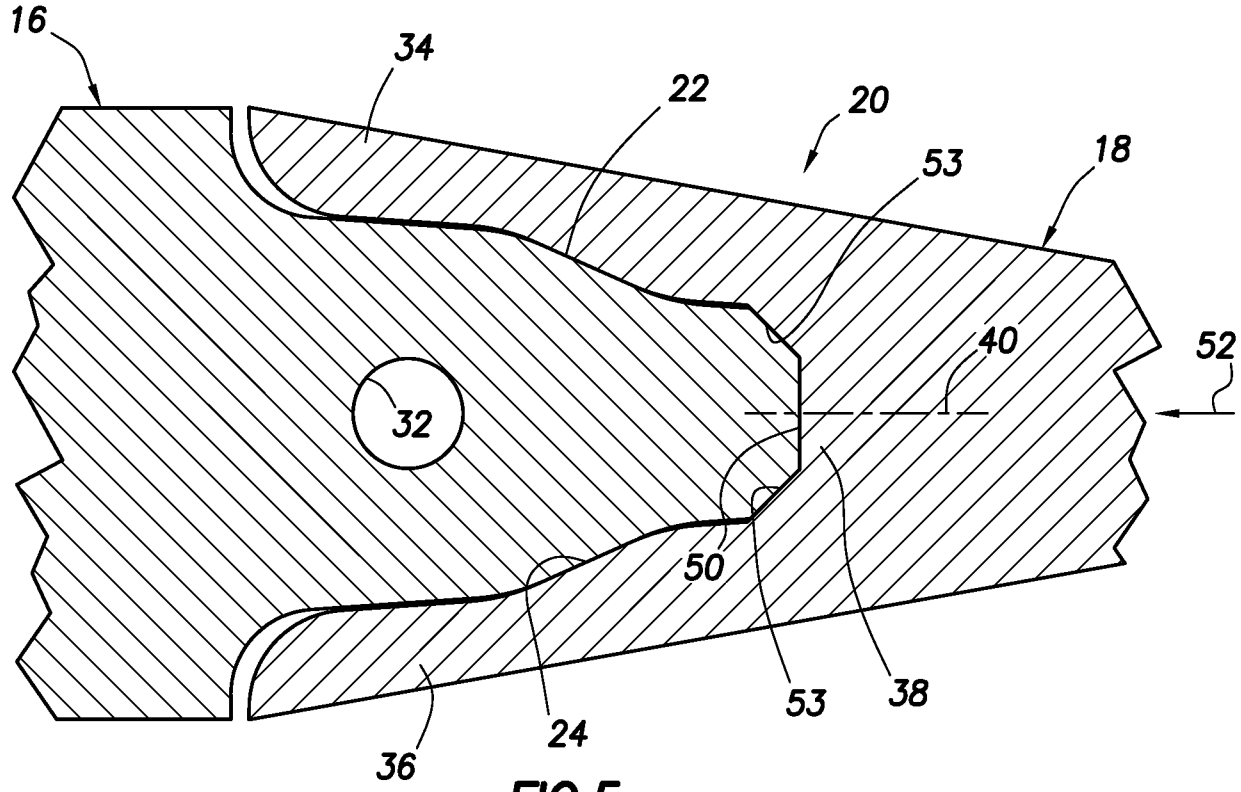
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FIG.5

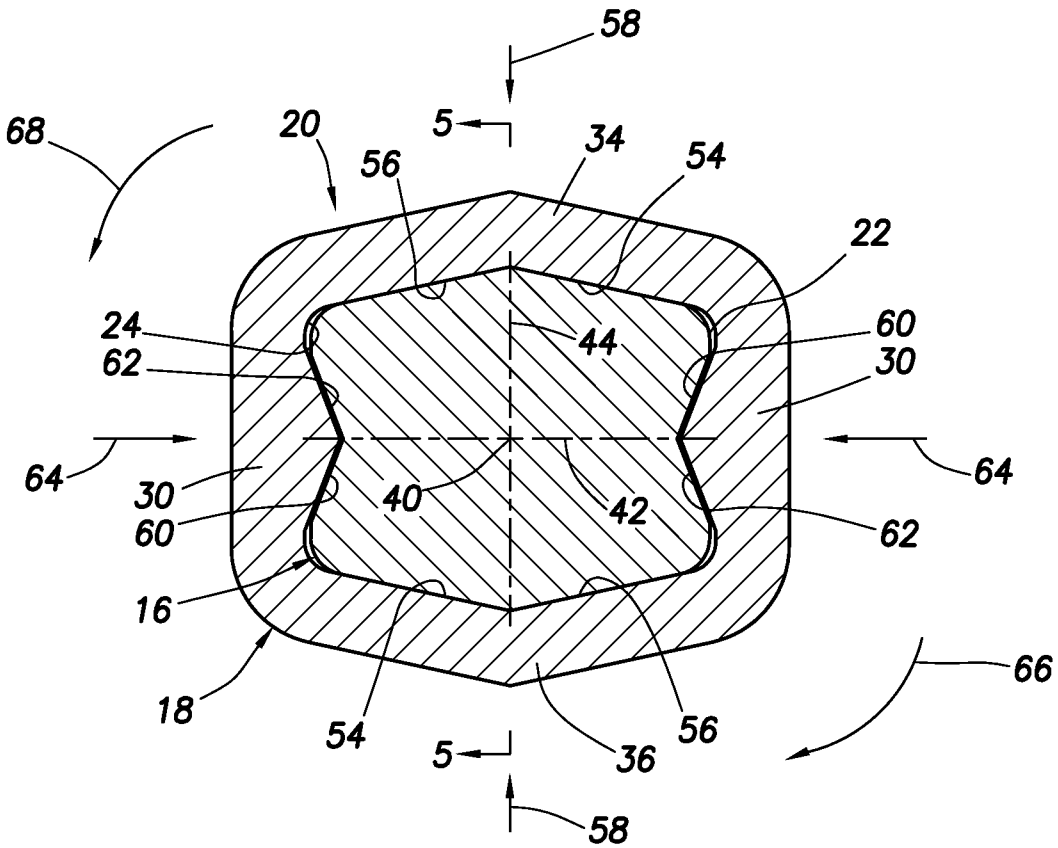
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FIG.6

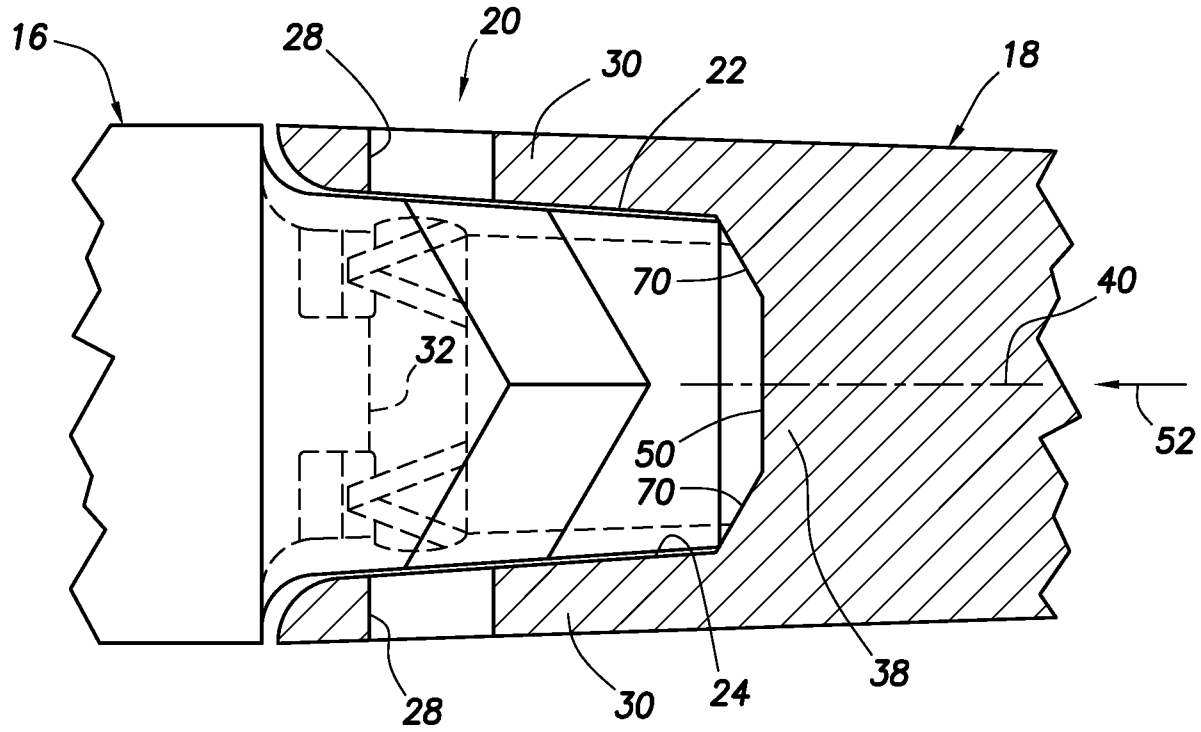
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FIG.7

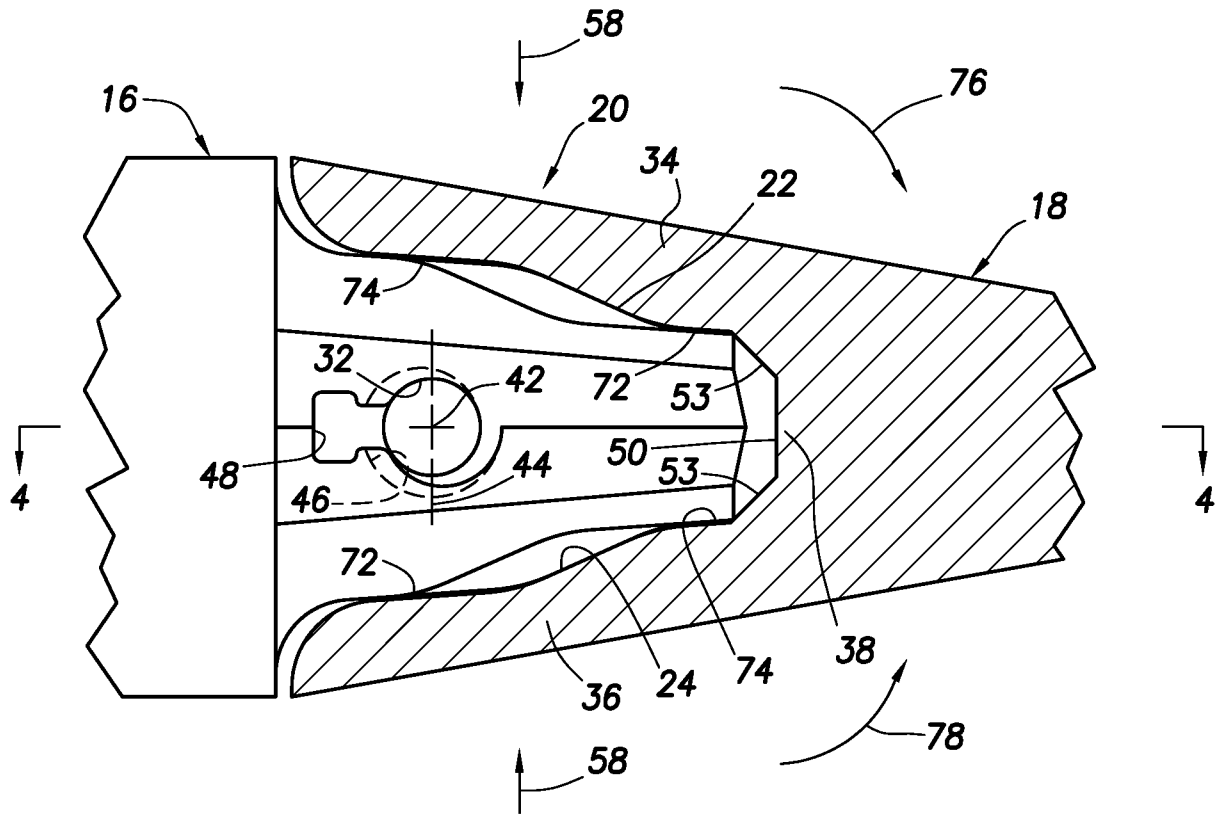
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FIG.8

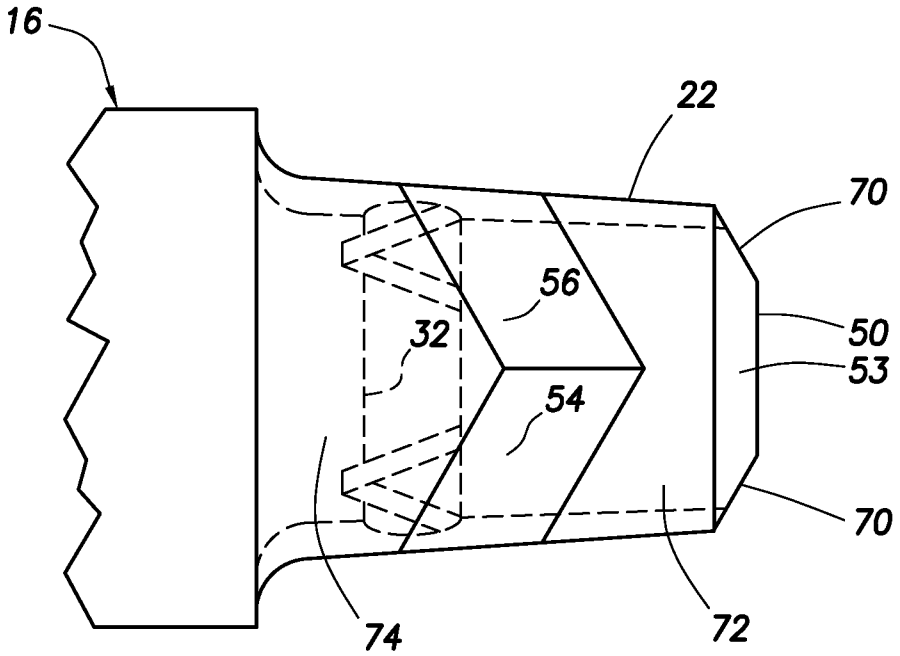
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FIG.9

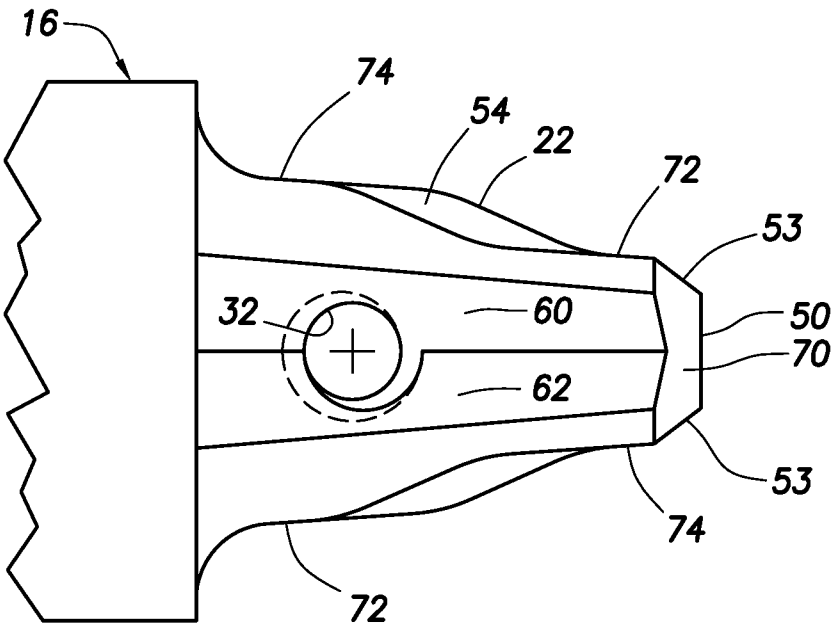
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FIG.10

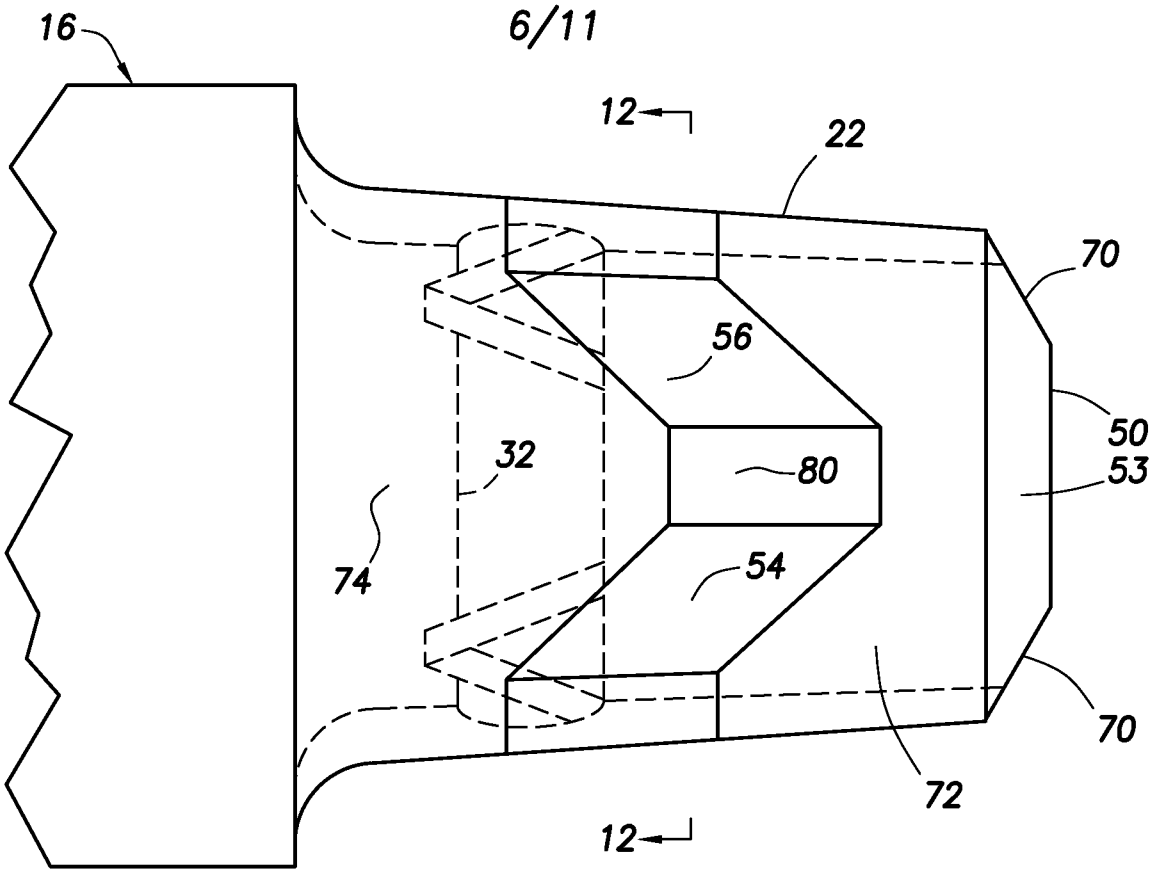
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FIG. 11

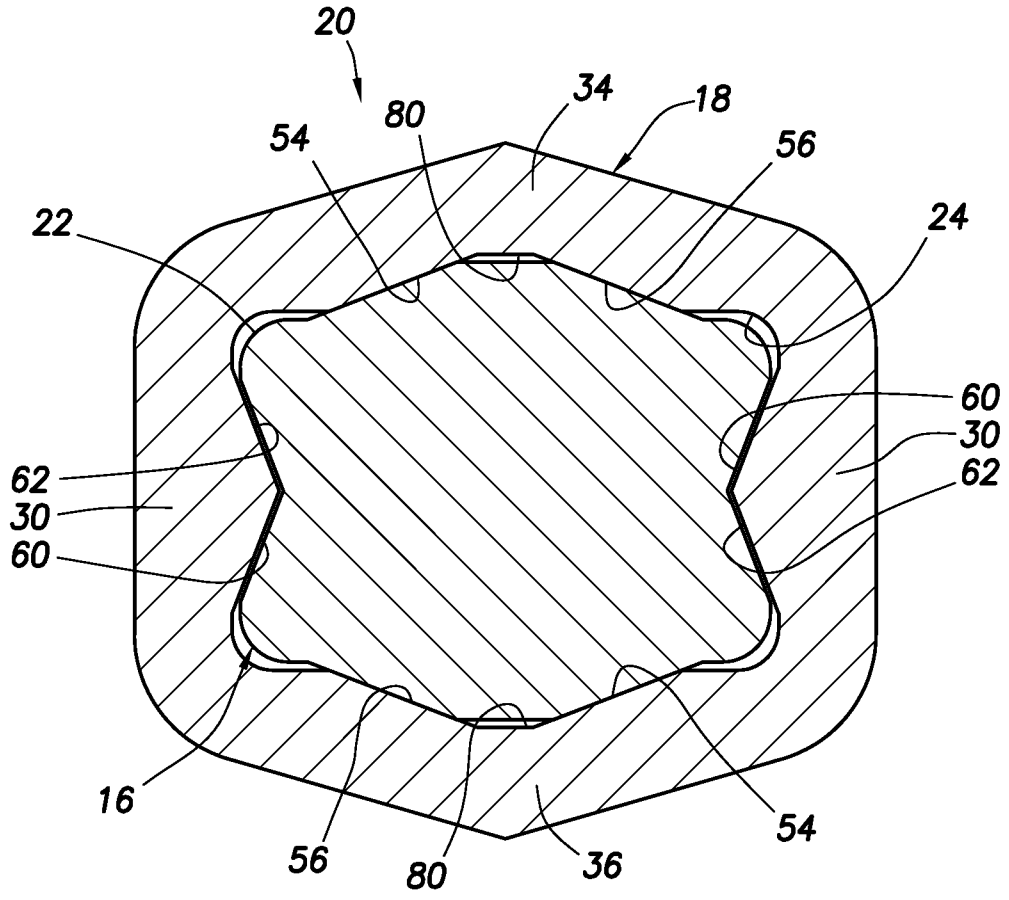
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FIG. 12

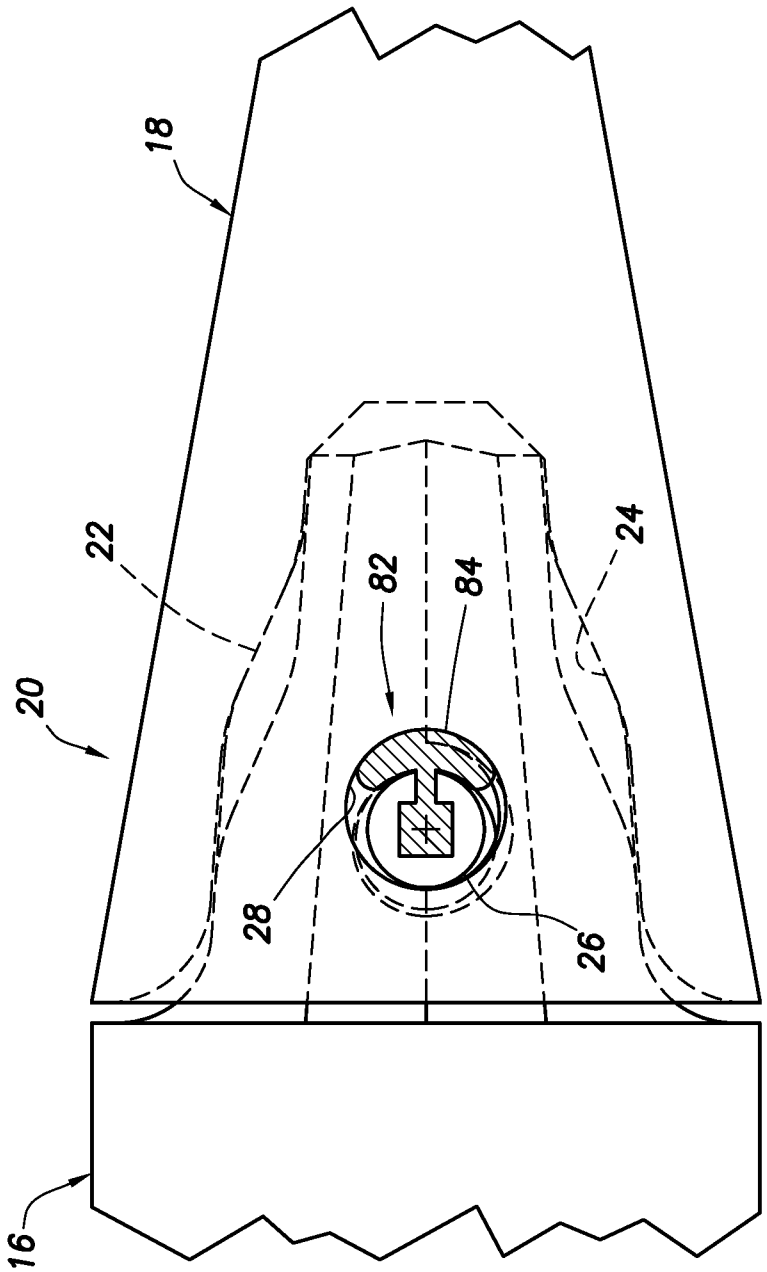

FIG.13

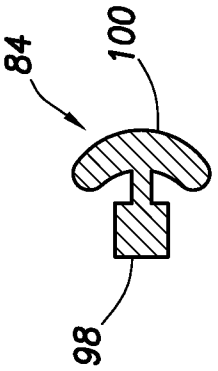

FIG.16

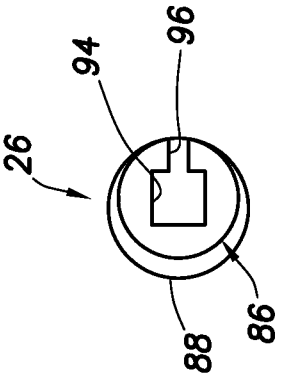

FIG.15

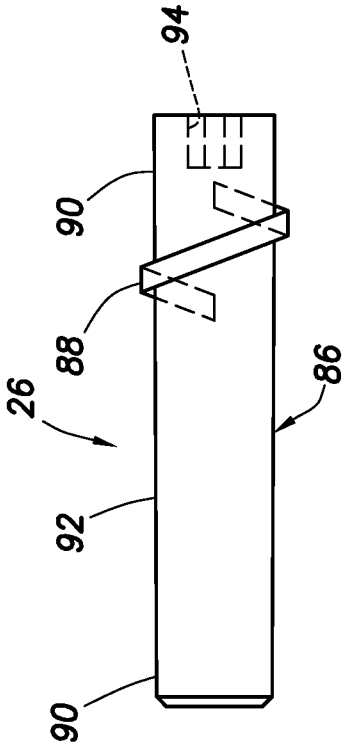

FIG.14

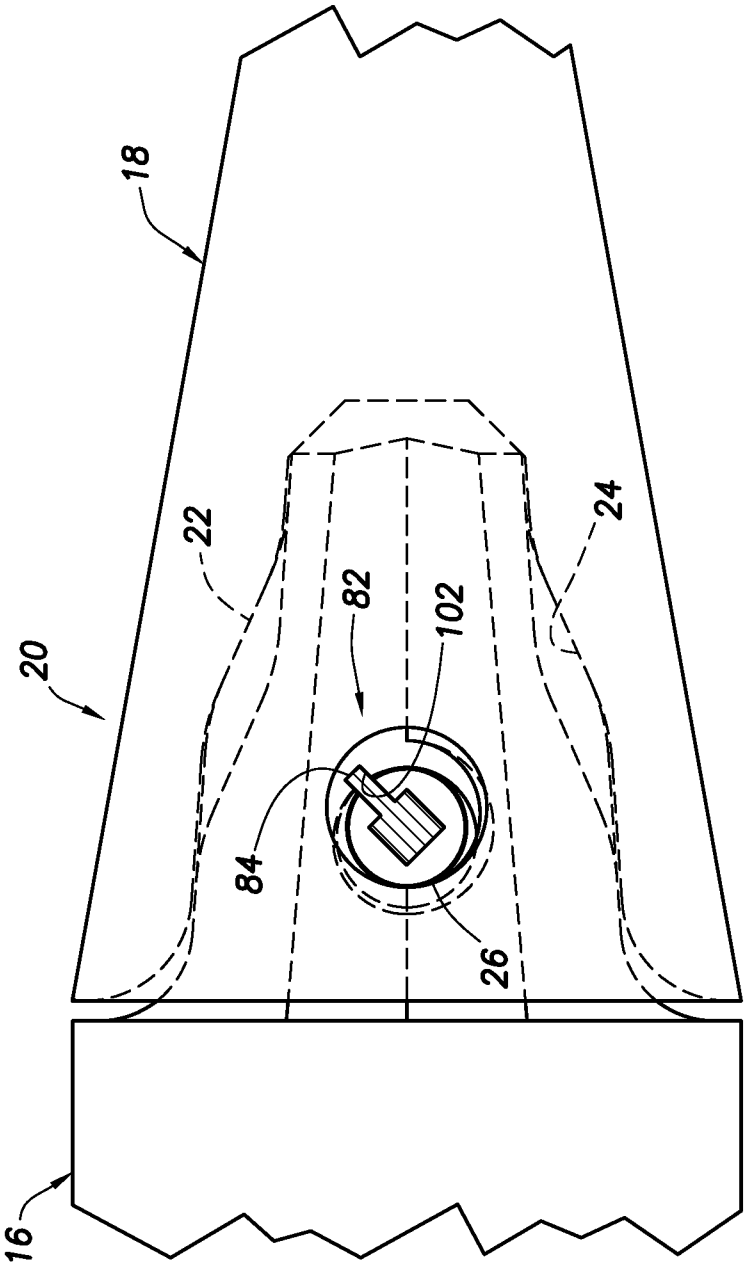

FIG.17

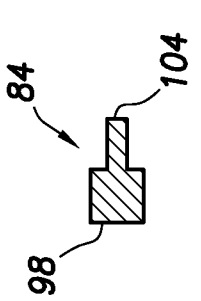

FIG.20

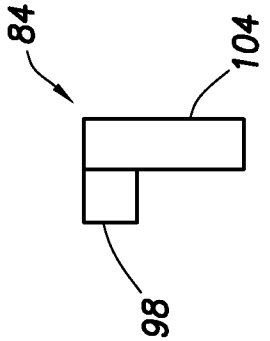

FIG.21

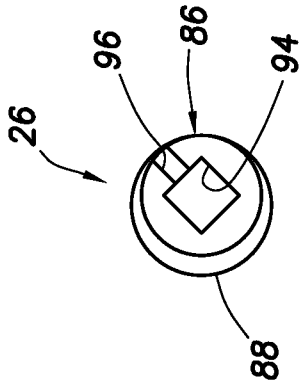

FIG.19

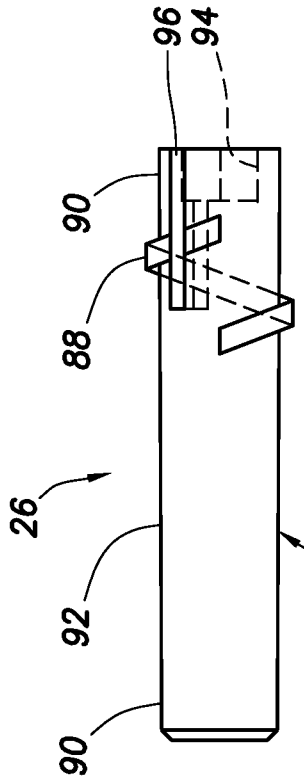

FIG.18

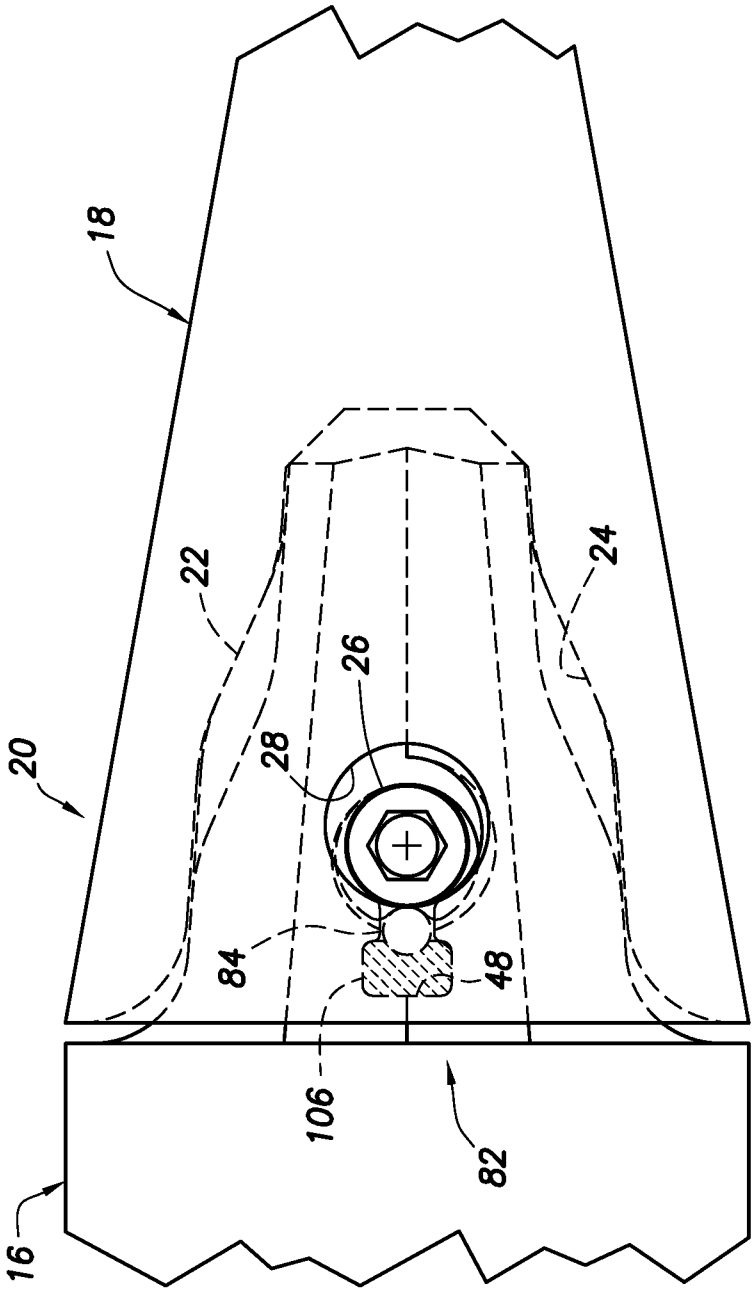

FIG.22

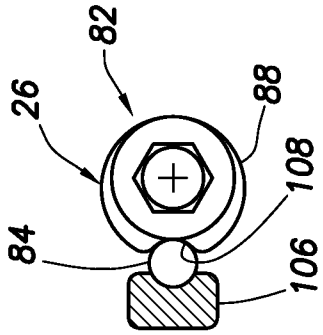

FIG.26

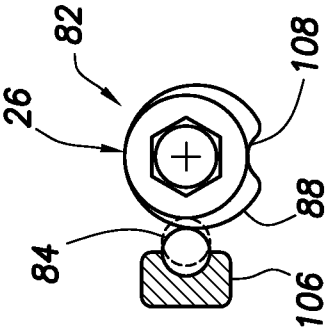

FIG.25

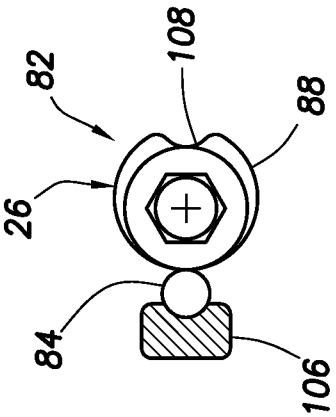

FIG.24

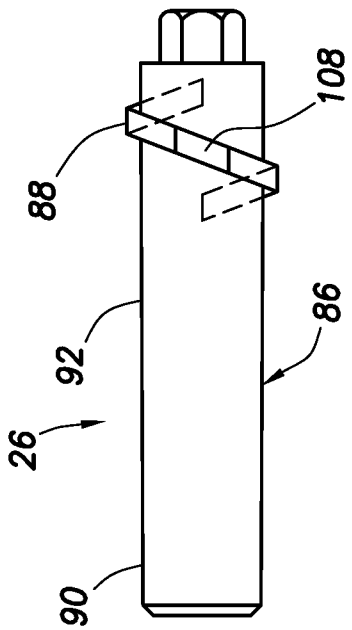

FIG.23

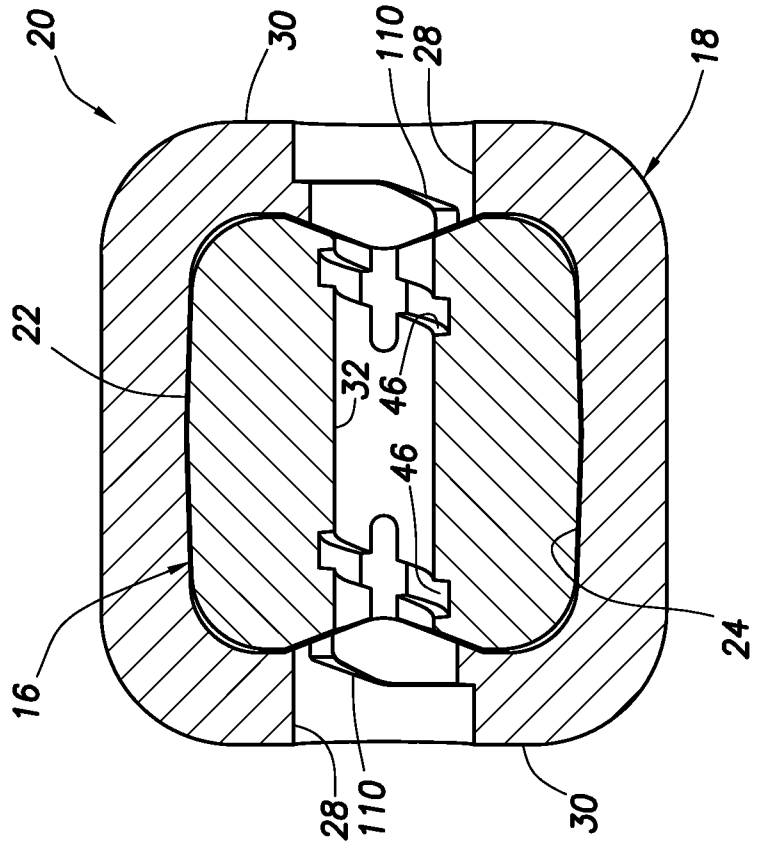
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FIG.28

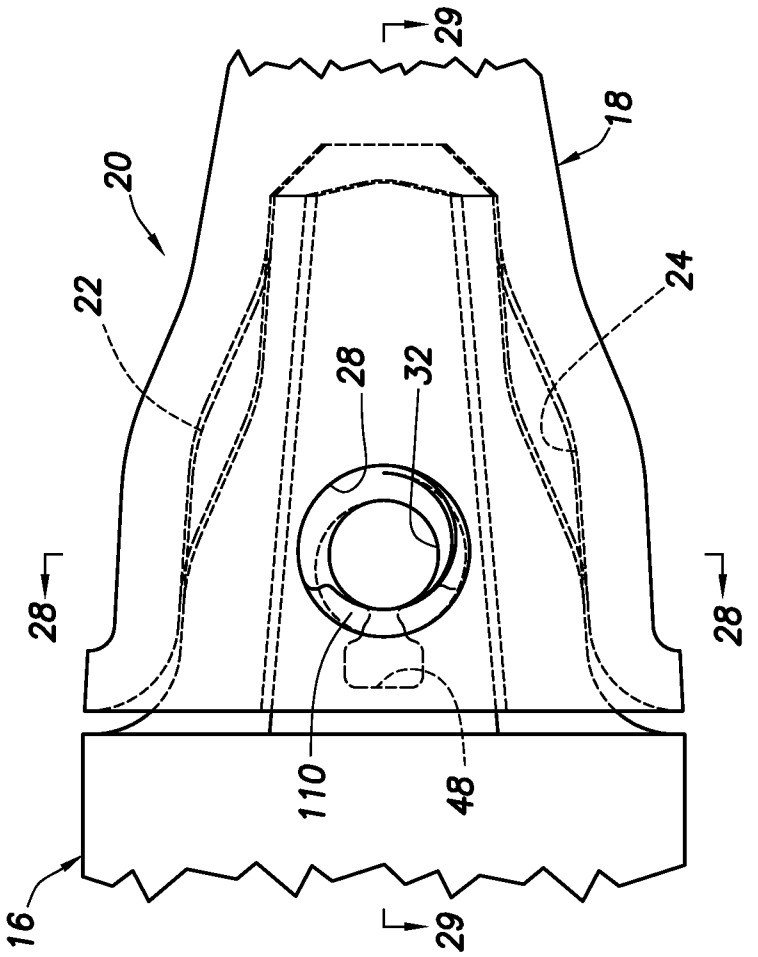
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FIG.27

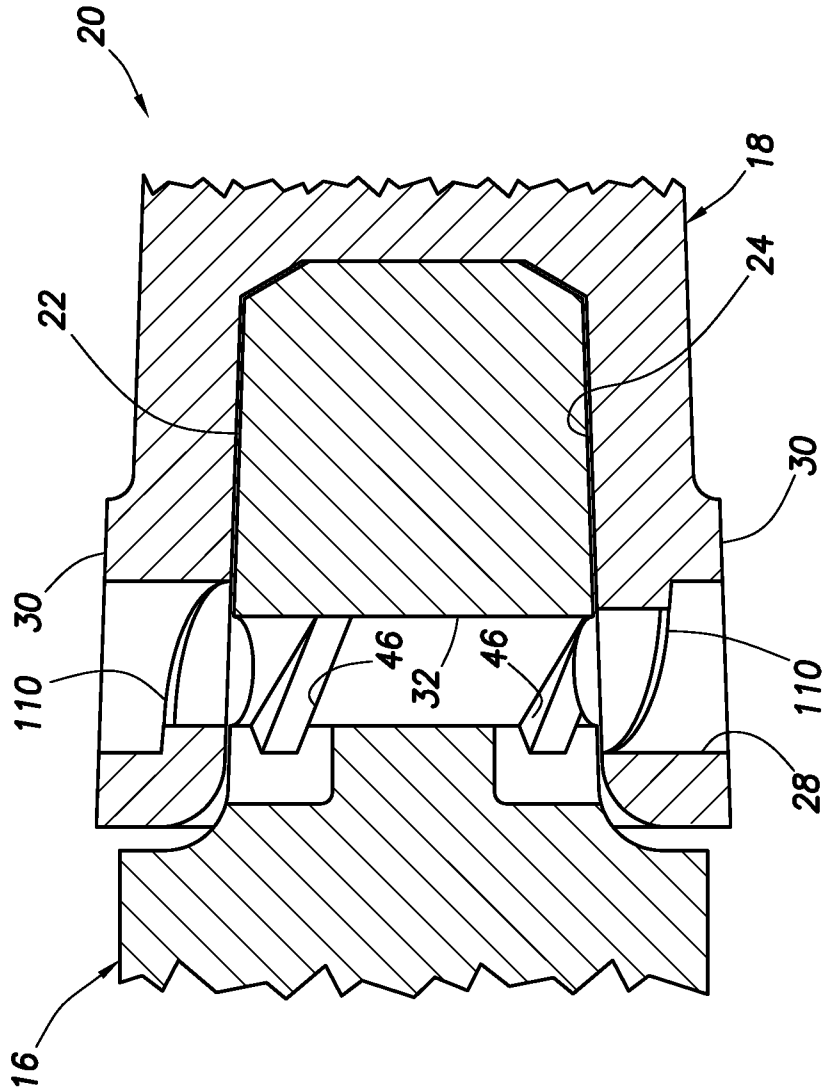
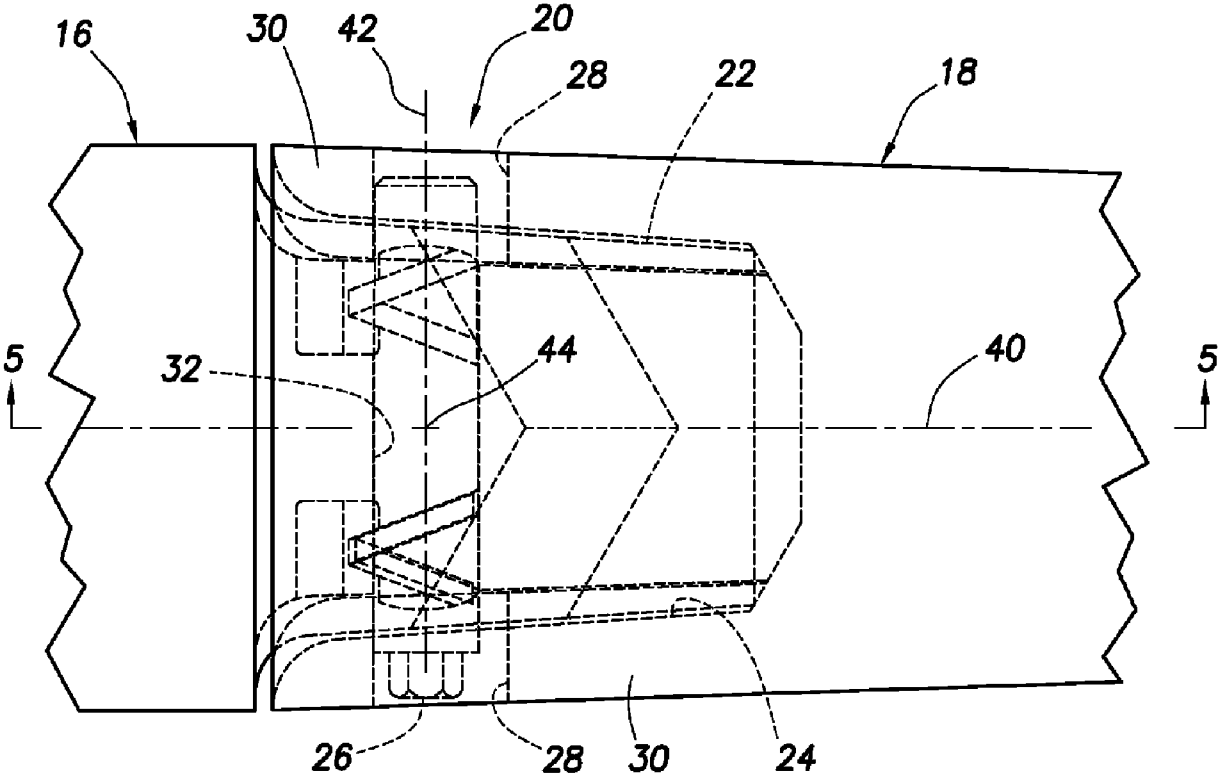


FIG.29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