

Filed September 16, 2025

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

CMS Cepcor Limited and CMS Cepcor Americas LLC,
Petitioner

v.

Sandvik Mining and Construction USA LLC

Patent Owner

Case No. IPR2024-01381
US Patent 11,014,090

**SECOND DECLARATION OF DAVID G. SMITH, IN SUPPORT OF
PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT 11,014,090**

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I. INTRODUCTION

1. I, David G. Smith, submit this Second Declaration on behalf of CMS Cepcor Limited and CMS Cepcor Americas LLC (hereafter CMS, or Defendants), regarding a Petition for *Inter Partes* Review of U.S. Patent No. 11,014,090 ('090 patent or Pat '090).

2. On August 27, 2024 I provided my First Declaration on behalf of CMS Cepcor Limited and CMS Cepcor Americas LLC (hereafter CMS, or Petitioner), regarding a Petition for Inter Partes Review of U.S. Patent No. 11,014,090 ('090 patent or Pat '090). My First Report outlined my, qualifications, compensation and opinions on the invalidity of the original claims of the '090 Patent. My First Declaration is incorporated herein by reference.

3. In the time since issuing my First Report, it is my understanding that Sandvick has proposed changes to the original issued claims, in the form of new claims 15-26. In this declaration I have been asked to respond to comments and opinions of Sandvick's Expert Dr. Kytömaa provided in his second and third declarations and provide opinions on the invalidity of the original claims and the new (changed) claims. This declaration is provided after my review and analysis of the '090 patent, the prior art, relevant background technology, Patent Owners motion to amend and accompanying exhibits and is also based on my education and experience, as well as additional materials identified herein.

II. CLAIM CONSTRUCTION

4. In this section I will address the Patent Owner's expert, Dr. Kytömaa's arguments that several of the terms in the '090 patent require claim construction. As an initial matter, it is curious that the Patent Owner apparently does not believe that the specification of their own patent was adequate in being able to understand the meaning of claim terms used in their own patent. As stated in my First Declaration, it is my contention that the claim terms Dr. Kytömaa contend need construction would be understood by a POSITA using their plain and ordinary meaning. Each of Dr. Kytömaa's proposed constructions will be addressed below.

A. Claim Construction Principles

5. It is my understanding that in an IPR the PTAB has responsibility for construing the claims and uses the "ordinary and customary meaning" standard, also known as the *Phillips* standard, the same standard that federal courts use. It is my understanding that this standard holds that a claim term is to be given the meaning it would have to a person of ordinary skill in the art in question at the time of the invention. It is also my understanding that the ultimate responsibility for adopting a claim construction rests with the PTAB, which issues a final written decision on the patentability of the challenged claims. It is also my understanding that if the PTAB adopts a new construction that was not raised by the petitioner,

the petitioner must be given a chance to present new invalidity arguments under that new construction.

6. It is also my understanding that error occurs when interpreting a claim term too narrowly especially if limitations from the specification are imported into the claims. This often happens when a specific example or embodiment described in the patent's written description is focused on and the construction mistakenly concludes that the invention is limited to that specific detail.

7. It is my understanding that the claims are typically intended to cover a broader scope than just the specific examples provided in the patent. The Federal Circuit, which hears all patent appeals, has repeatedly reversed these types of errors, cautioning against limiting claims to only the described embodiments.

8. It is my understanding that intrinsic evidence, or how the term is used within the specification of the patent, holds more weight than extrinsic evidence, such as outside reliable sources such as dictionary definitions or expert testimony. If the claim construction cannot be resolved using the intrinsic evidence, extrinsic evidence such as dictionaries, other prior art and expert testimony may be considered. It is also my understanding that though the language in the claim determines what the patent owner has invented, the specification (including the original claims) describes what has been invented and should be the principle intrinsic evidence considered during claim construction. Considering the above, it

is of note that Dr. Kytömaa does not appear to have used even a single citation to the specification of the '090 patent as justification for any of the claim constructions he has proposed.

B. “End”

9. The Patent Owner’s proposed construction of “end” as “an extremity of a shaft body or sleeve” is not correct as it is overly narrow and unsupported in the '090 specification. A POSITA would understand the term “end” from the '090 specification, and from extrinsic definitions and common uses, to include more than merely the extreme end, or face, of the shaft.

1. Intrinsic Evidence

10. There are multiple examples in the '090 specification where the term “end” is used to denote at least two meanings. “End” is used in '090 in conjunction with other words to form compound words in most instances. In the couple of instances where this is not the case “end” actually has the broader meaning as shown by the context¹. Examples include “end region” and “radially tapered end section”. These are used to denote when the term “end” means a portion or region. When “end” denotes “an extremity of a shaft body or sleeve”, the specification often uses the compound terms such as “end surface”, “lowermost end”, or “uppermost end”. I will discuss the intrinsic evidence for both meanings below.

¹ '090 5:31-35

a. **“End” region**

11. The following are example citations from the '090 patent where the term “end” denotes a region and not “an extremity of a shaft body or sleeve”.

“a main shaft having an axial upper **end region** that tapers radially inward and comprises at least one groove to receive a pressurised (sic) fluid to facilitate mounting and demounting of a sleeve at the shaft” (1:17-19)

“...the **radially tapered end section** of the main shaft...” (2:49-50)

“A first (axial upper) **end region 113** of shaft 107...” (4:57-58) (see figure 2 below)

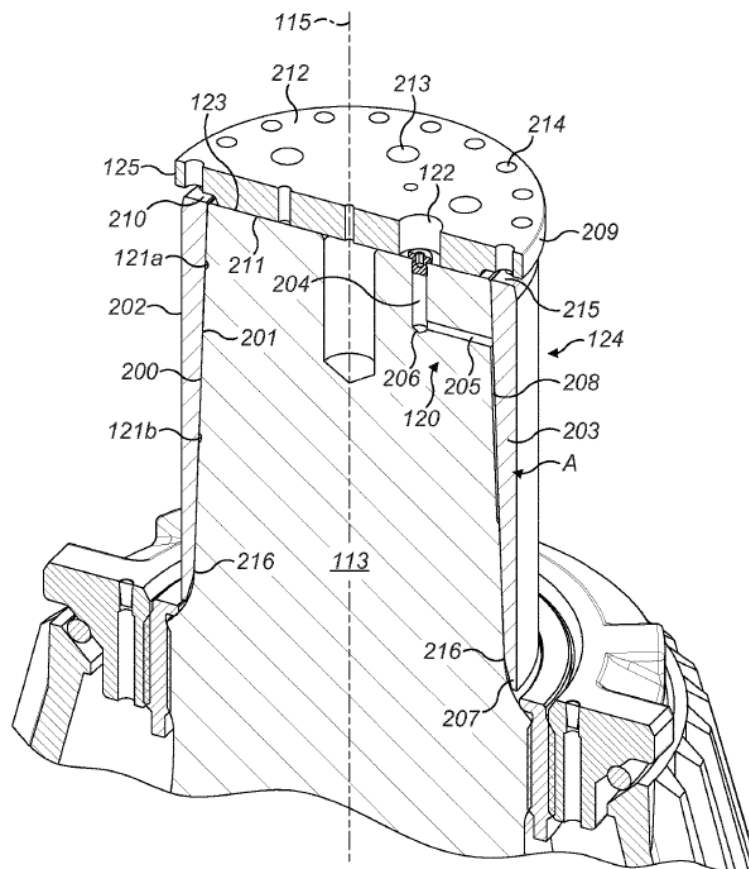


FIG. 2

12. The citations above use the words “region” and “radially tapered

section” to clarify that the term “end” denotes more than “an extremity of a shaft body or sleeve”. Figure 2 from the ’090 patent, shown above, places the label 113 in the center of the “end region” of the shaft. The citations below are examples of the term “end” used without modifiers, but clearly refer to this same end region 113 when taken in context.

“...a top bearing **into which an upper end of the main shaft is journalled**. Typically, the **main shaft upper end is protected against wear by a sleeve**.” (1:33-36)

“However, a number of problems exist with conventional protective sleeves. In particular, if the time taken to friction fit the heated sleeve **onto the main shaft end**...” (1:42-44)

“...FIG. 2 is a perspective partial **cross section through the upper end** of the main shaft and sleeve assembly;” (4:32-33)

“FIG. 3 is a perspective partial **cross section of the shaft upper end** of FIG. 2 with the protective sleeve removed; (4:34-35)

FIG. 4 is a further external perspective view of the **tapered axial section of the main shaft upper end** of FIG. 3 (4:36-37).

“...main shaft supported at its upper **end** by a top bearing assembly and having a **protective sleeve mounted about the upper end** of the main shaft...” (4:28-30)

13. All of the citations above include descriptions that clarify the term “end” to mean region and could not be referring to “an extremity of a shaft body or sleeve.” It is not reasonable to believe the ’090 patent writers meant for the sleeve to only protect the “extremity of the shaft body”, or for there to be a friction fit between the heated sleeve and the “extremity of the shaft body”, or for figures 2-4 to be a cross sections of the “extremity of the shaft body”, or that a protective

sleeve can be mounted about the “extremity of the shaft body”. The Patent Owner’s proposed claim construction of the term “end” is not consistent with the meaning of the term according to the above intrinsic evidence from the ’090 patent.

b. “End” extremity of a shaft body or sleeve

14. The specification of the ’090 patent on some occasions use the term “end” to denote “an extremity of a shaft body or sleeve”. The following citations include both meanings as the context in specification shows.

“Referring to FIGS. 2 to 4 **tapered region 113** comprises a **lowermost end 300** and an **uppermost end 301**.” (5:26-27)

“Upper **end region 113** comprises a radial taper that defines an upper conical region of main shaft 107. The **conical region 113** is tapered so as to decrease in cross sectional area in a direction from shaft second (lower) end 118 to an upper **end surface 123** positioned uppermost within the crusher.” (5:1-5)

“Sleeve 124 comprises a first (lower) **end 216** for mating at the **end 300** of **region 113** and a second (upper) end 215 for positioning at **uppermost end 301** substantially coplanar with shaft **end surface 123**.” (5:31-35)

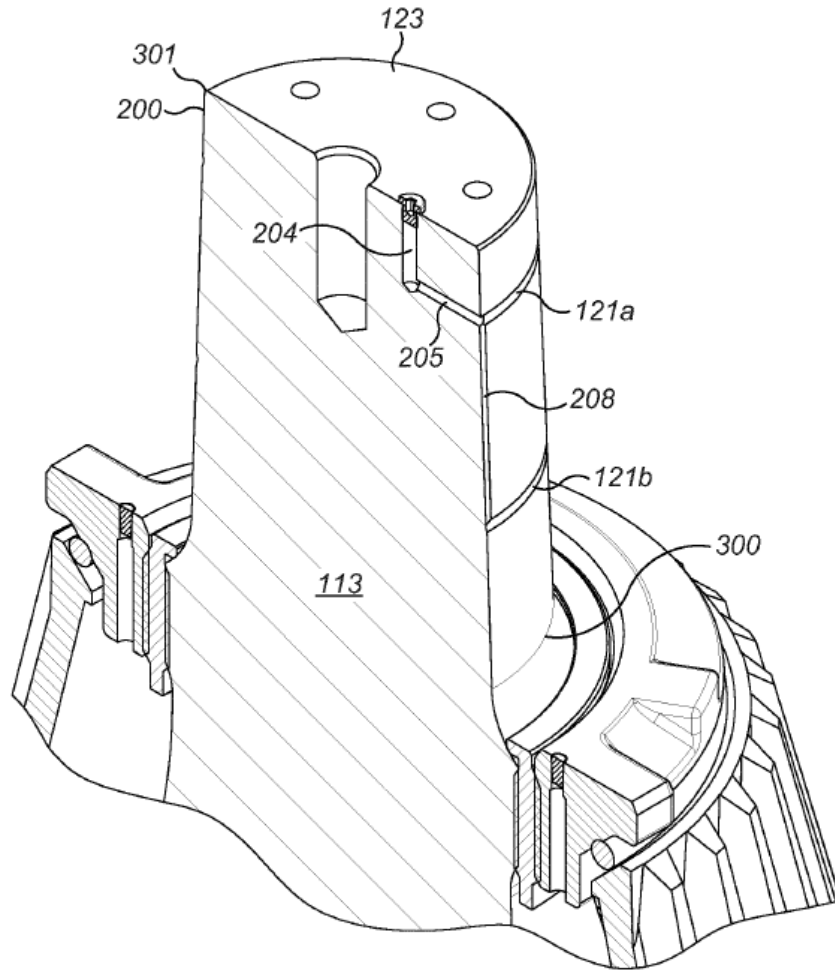


FIG. 3

15. Item 113, as shown previously, denotes the “end region” of the shaft as labeled in figure 3 above. The specification refers to item 123 as an “end surface” to denote that it is the extremity of the end region 113. The specification uses “conical region”, “tapered region”, and just “region” as substitute terms for “end region” to describe item 113. The following citation specifies that end 216 is not just the extremity of the sleeve but “comprises a chamfer region.”

“Sleeve lower end 216 comprises a chamfer region 207 of decreasing wall thickness such that very a **lowermost end region** of sleeve 124 is chamfered to sit close to a radius section of main shaft **region 113** below **region end 300**.” (5:52-55)

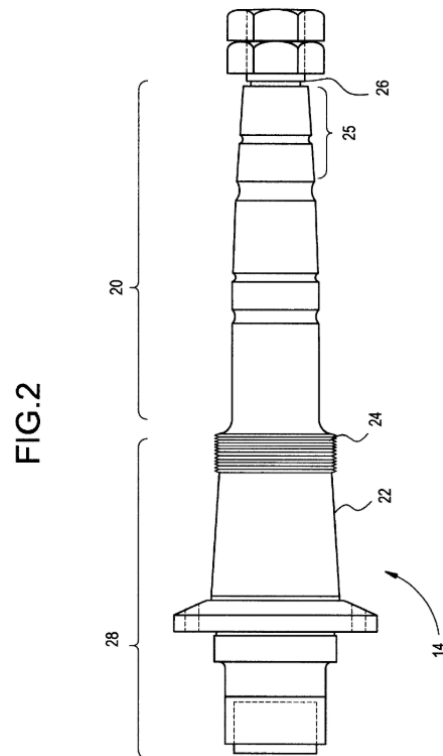
16. The above citation is yet another example of how the writers of patent '090 intend “end” to include additional regions beyond the extreme end surface. Dr. Kytömaa does cite the claim language as intrinsic evidence, but the claim language does not give enough information to differentiate between the two uses of the term “end” used throughout the specifications and claims are to be read in light of the specification. The claims use the term “end” without any descriptive compound words that would help a POSITA distinguish between the two meanings explained above. As the claims do not specify the meaning, a POSITA would conclude that the patent writers intended the term “end” to denote the broadest possible meaning of the term including both an “end region” and “an extremity of a shaft body or sleeve”. This is consistent with the plain and ordinary use of the term “end” as explained in the extrinsic evidence section below.

2. Extrinsic Evidence

17. Extrinsic evidence includes references outside the contended patent such as uses of the term in the field of the art or dictionary definitions. A POSITA is assumed to be aware of the prior art and would look to references in the field of the art for further confirmation of proper construction for the term “end”.

18. All of the cited prior art references in the field of rock crushers use the term “end.” Piepho '026, shown below, labels the majority of the main shaft of the device the “yoke end (20)” and the “top end (20)”. Piepho refers to a smaller

section of the “yoke end (20)” as the “top end (25)”, “tapered end (25)”, “shaft end (25)”, and “cylindrical end (25)”. Piepho uses the term “end” to denote a region.



19. Polinski '143 also uses end to denote a region as shown in the following citations: “a bearing sleeve fitted about the **end** of the shaft” (abstract emphasis added), “The **end** of the shaft is provided with a bearing journal fitted with a replaceable sleeve arrangement...” (1:51-53 emphasis added), and “...annular lip 36 on the **upper end** of the sleeve 12.” (3:26-27 emphasis added) As with the '090 patent, Polinski uses specific language to indicate when the term “end” refers to “an extremity of a shaft body or sleeve” and not a region, “a retaining ring 51 sized to axially overlies the **outermost ends** of the journal 11 and the sleeve 50.” (3:64-66 emphasis added)

20. Dictionary definitions would also be extrinsic evidence to be considered. Dr. Kytömaa quotes the following Dictionary:

“Sandvik’s proposed construction is also consistent with a definition of end provided by Merriam-Webster’s Collegiate Dictionary (2012) as “**the extreme or last part lengthwise: TIP.**” (Ex. 2012, 411 (definition 1c).) A POSITA would understand this definition is consistent with the use of “end” in the claim language and the specification of the ’090 Patent and supports Sandvik’s construction of “end” as an extremity of the shaft body or sleeve.”²

21. I note that Dr. Kytömaa did not share that a dictionary such as Webster’s Unabridged dictionary make it clear that “end” does not always mean “an extreme or last part lengthwise.” For instance:

End – 3. a part or place at or adjacent to an extremity: at the end of the table; the west end of town. (Random House Webster’s Unabridged Dictionary 2001 p.641)

22. This additional definition makes it clear that end does not have to be the extreme last part, but may also may just be near such an extremity. As shown above, the ’090 patent uses both definitions. It is easy to find many colloquial uses of “end” that agree with this second definition of “end.” For example, a caboose is located at the end of a train. The caboose is the last part lengthwise in the train. The caboose is a region or section, and not merely the last surface or point. Another example is the end of a novel. The end is the last few pages/chapters and not merely the last period, or the back surface of the cover.

² 2nd Declaration of Dr. Kytömaa ¶29 emphasis added

23. A POSITA would be aware of both definitions shown above and the colloquial uses of the term “end” as mentioned. A POSITA would not randomly pick one of these definitions but would rely on the intrinsic evidence to inform them which extrinsic definition is most appropriate for a given term.

24. Again, as the claim language includes no modifier to “end”, such as “end region” or “end surface.” A POSITA must conclude that since the claim have no modifier to help inform meaning, that the meaning in the claims would have the broadest possible meaning of “end” which would include the region at the “end.”

3. Inconsistencies in Dr. Kytömaa’s Declaration

25. Dr. Kytömaa admits “claims are to be given their broadest reasonable construction consistent with the specification” (§ 5), but attempts to argue for a very narrow meaning of the term “end” based primarily on extrinsic evidence. Dr. Kytömaa unsuccessfully attempts to explain how his narrow construction of “end” could be consistent with the figures in the ’090 patent where the label for the lowermost end 216 does not point to the end surface but to the chamfer on the end region of the sleeve.

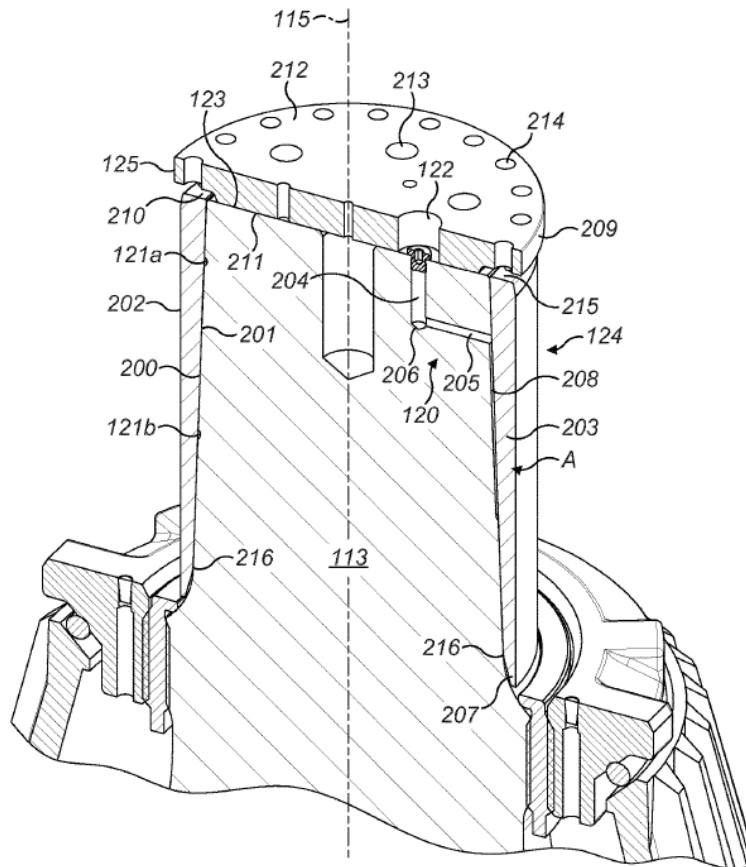


FIG. 2

“(Ex. 1001, FIG. 2.) To be sure, the ’090 Patent illustrates the lowermost end 216 at a chamfer region 207. (FIG. 2; see also Ex. 1001, 5:52–55. Emphasis mine.) But chamfers and fillets are extremely common features often positioned at the outermost edges of objects, for instance, to reduce stress concentrations and ease assembly of components. The disclosure is thus still consistent with the lowermost end 216 being at an extremity of the sleeve.”³

Here, Dr. Kytömaa admits that an “end” can include more than just “an extremity of a shaft body or sleeve”. Dr. Kytömaa explains that “the ’090 Patent illustrates the lowermost end 216 at a chamfer region 207” and that though the chamfer is not the end surface, or “an extremity of a shaft body or sleeve”, that the chamfer is part

³ 2nd Declaration of Dr. Kytömaa ¶28 emphasis added

of the lowermost end 216. Dr. Kytömaa then attempts to explain this inconsistency by stating that “chamfers and fillets are extremely common features” and that their purpose is “to reduce stress concentrations”, neither argument having any relevance to the meaning of the term “end” nor explaining why the figure points to the chamfer that is not at “an extremity of a shaft body or sleeve”.

26. If a chamfer can be part of the lowermost end 216, then the logical conclusion is that other features also can be part of the end of the shaft. The proposed claim construction of “end” as “an extremity of a shaft body or sleeve” is clearly not consistent with all uses of the word in the ’090 specification nor reasonable to expect a POSITA to conclude such from the intrinsic evidence.

27. In light of the above, a POSITA would construe “end” in the claims to have its plain and ordinary meaning including a “a part or place at or adjacent to an extremity” and/or “an extremity of a shaft body or sleeve”.

C. “Indented at the external surface”

28. Patent Owner and Dr. Kytömaa have proposed that the phrase “indented at the external surface” should be “properly construed as a depression or recess in an external surface—specifically, the external facing surface of the shaft body”.⁴ Again, the Patent Owner and Dr. Kytömaa attempt to import limitations from embodiments shown in the specification and construe terms narrower than

⁴ 2nd Declaration of Dr. Kytömaa ¶33 emphasis added

“their broadest reasonable construction consistent with the specification” (§ 5). The crucial term “at” greatly affects the breath of the claim. As will be shown below, the specification of the ’090 patent uses several connecting words for this term such as, “at”, “in”, “on”, and “within.”. These words have different and distinct meanings that should not be ignored when construing the meaning of the claim term “indented **at** the external surface”.

1. Intrinsic Evidence

29. As Dr. Kytömaa points out, the abstract of the ’090 patent explains “at least one groove is indented **within** a radially external facing surface of the main shaft at the region of the cone to allow fluid to be introduced under pressure to the region between the sleeve and the cone.” The specification uses the term “within” here but uses “at”, “in”, and “on” in the following citations.

“...at least one groove indented **at** the external surface...” (2:42-43)

“An annular recess 210 extends circumferentially around retainer perimeter 209 and is indented **in** surface 211” (6:9-14)

“A channel or groove indented **on** the external surface of the main shaft.” (3:10-13)

30. While three of the connecting words (in, on and within) appear to have similar meanings, “at” is much broader. The specification does not appear to delineate between or give any reasoning why one word is used as opposed to another. Thus, a POSITA would look to extrinsic definitions of the four connecting

words to better interpret the possible differences that could be meant by the patent writers' choice to use “at” in the patent claims.

2. Extrinsic Evidence

31. The writers of the '090 patent purposefully chose to use the term “at” in all of the patent claims but used “in”, “on”, and “within” in other parts of the specification as shown previously. As shown below, the definition of “at” has a broader meaning than any of the other connecting words used for this term in the '090 patent.

Within 1a: on the inside or on the inner side. 2: inside the bounds of a place or region.⁵

In 1a: used as a function word to indicate location or position in space or in some materially bounded object.⁶

On 1b: used as a function word to indicate presence within.⁷

At 1a: used as a function word to indicate presence in, on, or near.⁸

Near 1: at, within, or to a short distance or a short time.⁹

32. With respect to the shaft surface, the terms “within”, “in” and “on” appear to convey that the indentation must interact with the shaft surface. On the other hand, while the term “at” would include “in”, “on” and within, “at” denotes that

⁵ Websters Third New International Dictionary 1993 p.2627

⁶ Websters Third New International Dictionary 1993 p.1139

⁷ Websters Third New International Dictionary 1993 p.1574

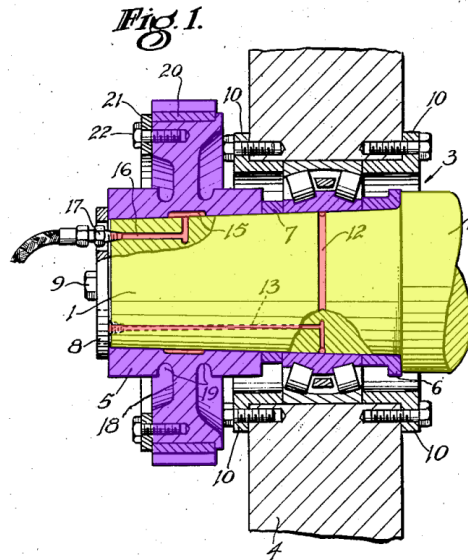
⁸ Websters Third New International Dictionary 1993 p.136, emphasis added.

⁹ Websters Third New International Dictionary 1993 p.1510

the element may only be “near” the shaft surface. A POSITA would recognize that by choosing the word “at”, the claims convey that the groove could be either on the shaft, in the shaft or near the shaft. This meaning would include a groove located within the sleeve, but still near the shaft surface.

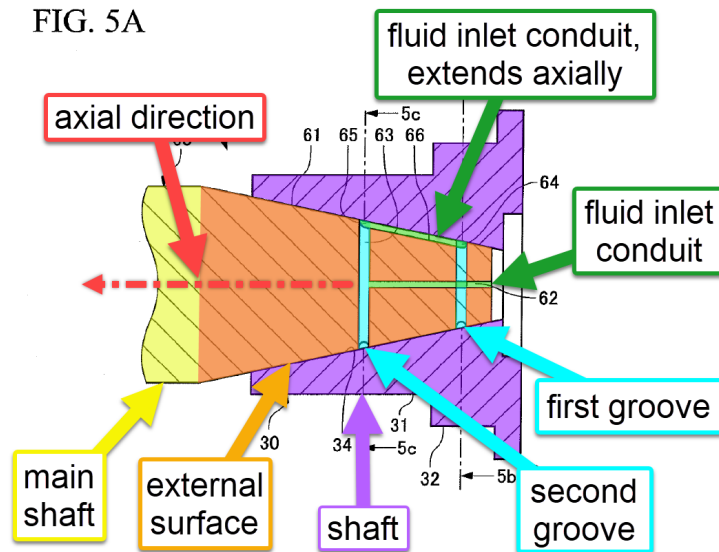
33. A POSITA would be aware of the state of the art, and would know that sometimes it is advantageous for an oil groove to be located in the shaft and at other times more advantageously located in the sleeve, both of which would conform to the claim term using “at”, rather than one of the other terms. A POSITA would also be aware of the use of a single groove and multiple grooves, both in the shaft and in the sleeve. A POSITA would understand that in order to have much of the art in this field, such as many examples disclosed in my first declaration, one would have to use the broader term. Some of those examples from my first declaration are briefly illustrated below.

34. Harless shows one groove in the shaft and one groove in the sleeve.



35. Yagi shows two grooves in the shaft.

FIG. 5A



36. Sillett shows two grooves in the sleeve.

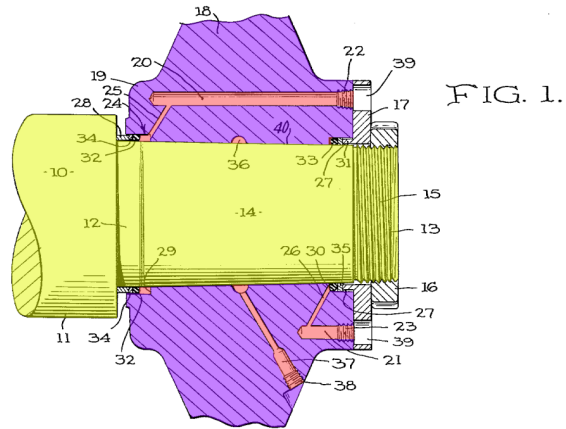


FIG. 1.

37. Behm shows only one groove in the shaft.

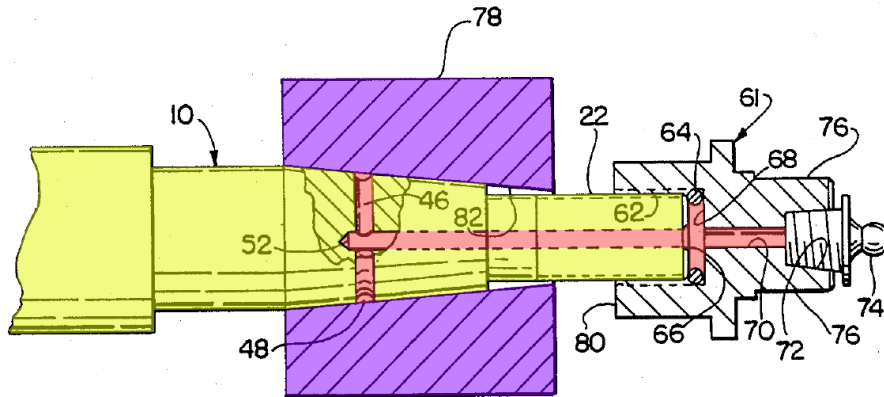
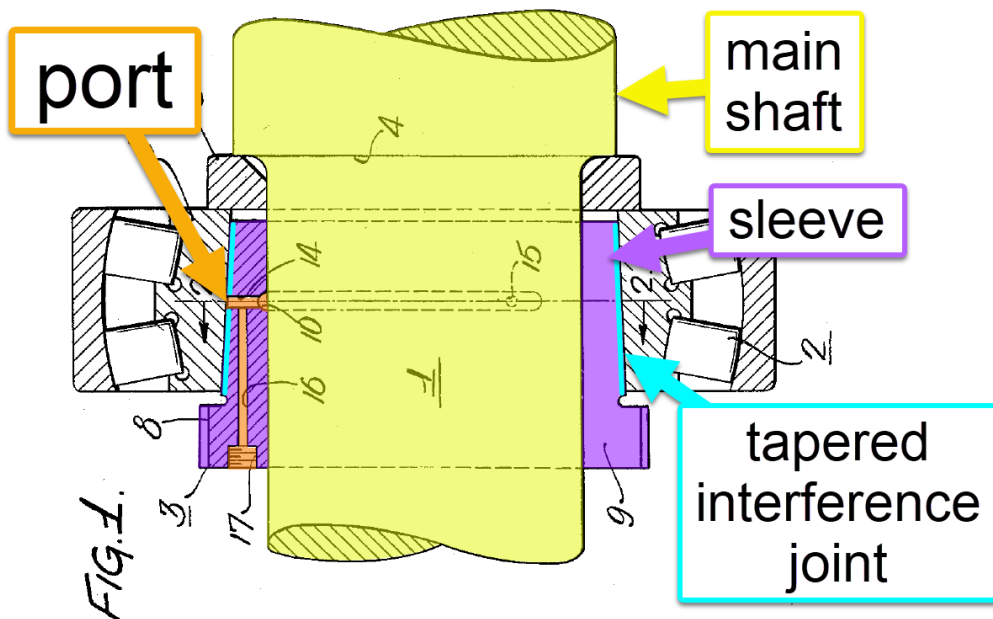


FIG. 2

38. Bratt shows only one groove in the sleeve.



39. As shown in the figures above, the prior art discloses many possible combinations of single and multiple oil grooves in both the shaft and the sleeve. Thus, by using the word “at” in the claim term “indented at the external surface”, the writers of the ’090 patent include many of the combinations of groove positions of which a POSITA would have been aware.

3. Inconsistencies in Dr. Kytömaa’s Declaration

40. In Dr. Kytömaa’s declaration he attempts to justify the Patent Owner’s proposed construction for the term “indented at the external surface” as “at least one groove indented at the external surface and positioned at the tapered axial region.” Clearly this is impermissibly adding limitations from the specification to the claim limitation. It appears that Dr. Kytömaa by his construction is trying to limit the term to include only one specification described method with grooves

on/in the shaft. If this is the case, the construction would actually read out of the claim an alternative embodiment described below:

“According to a specific embodiment, the assembly may optionally comprise a fluid inlet conduit extending radially through the wall of the sleeve in fluid communication with the groove to allow a fluid to be supplied to the groove through the sleeve.”¹⁰

41. Here the groove may be “indented” on the other side of the sleeve, yet still be “at” or “near” the surface of the shaft. The figures of the ’090 patent only illustrate grooves on/in the shaft, they do not show this other embodiment.

Nonetheless, it is inappropriate to import limitations into the claim language based on the figures of only one of the preferred embodiments.

42. Dr. Kytömaa also cites passages from the prosecution history where Patent Owner explains that “the groove 121 is indented specifically at the external surface 200 of the main shaft as opposed to being recessed into the sleeve 124” along with engineering reasons for this preference. As explained previously, the term “at” includes both the possibility of the groove on the shaft or in the sleeve. If the patent writers wanted to limit the claim language to only include grooves on the sleeve, as they argued to the patent examiner above, they could have chosen any of the other words they used in the specifications such as “within”, “in”, and “on”, but instead they used “at”.

43. Like with the term “end” the Patent Owner’s expert, Dr. Kytömaa, is

¹⁰ ’090 patent 4:13-18, emphasis mine

attempting to change the meaning of the claim to limit the term “indented at the external surface” to only include grooves on the shaft to preserve the validity of the claim when the claim plainly uses the word “at” to broaden the claim term to include grooves on both the shaft, the sleeve and even other objects near the shaft surface.

III. INCONSISTENCIES OF DR. KYTÖMAA

44. Throughout Dr. Kytömaa’s second declaration he argues that a POSITA would not have the understanding necessary to combine the prior art references, as defined by Mr. Smith as “a person who has a bachelor’s degree in mechanical engineering or a related field and at least two years of experience with industrial equipment design and development.”

“...Mr. Smith testified elsewhere that “rock crushers are fairly complex machines” and their successful design requires understanding of a number of fields, such as “tribology, fracture mechanics, and fluid mechanics. (Ex. 1002, ¶ 27.)”¹¹

“Designing the shaft for a gyratory rock crusher involves significant challenges due to demanding conditions. The shaft must withstand variable and unpredictable fatigue loads resulting from a wide range of material hardnesses. Its eccentric design introduces complexity not typically encountered by an engineer with only two years of experience.”¹²

45. Later Dr. Kytömaa argues that a POSITA would have extraordinary insight of stresses when he states that a POSITA would understand that “adding an

¹¹ 2nd Declaration of Dr. Kytömaa ¶ 29

¹² 2nd Declaration of Dr. Kytömaa ¶ 19-20

oil groove to the bearing journal would have a similar effect to the threads described by Polinski”. Dr. Kytömaa goes on to attribute this extraordinary insight to the teachings of Shigley’s Mechanical Engineering Design, which is a common textbook used in undergraduate studies by Mechanical Engineering students. This same Shigley textbook addresses every one of the complexities that Dr. Kytömaa believes a POSITA would not typically encounter. These inconsistencies show how Dr. Kytömaa is attempting to use apposing arguments to support his biased opinions whenever one or the other suits him. The following table illustrates Dr. Kytömaa’s inconsistencies.

Statement of Dr. Kytömaa	Inconsistency
Things that “would not be obvious to a POSITA” and “beyond the level of skill”¹³: • Tribology • Fracture mechanics • Fluid mechanics	Dr. Kytömaa argues that a POSITA would be aware of Shigley¹⁴, but Shigley addresses these very subjects. Shigley 9e Section 5-12 – Introduction to Fracture Mechanics Tribology – the study of friction, wear, lubrication, and the design of bearings; the science of interacting surfaces in relative motion. Shigley has a section concerning this subject as well: Shigley 9e Section 3-16 – Press and Shrink Fits

¹³ 2nd Declaration of Dr. Kytömaa ¶ 20

¹⁴ 2nd Declaration of Dr. Kytömaa ¶ 78

	As shown above, Shigley provides instruction on tribology and fracture mechanics. If Dr. Kytömaa believes a POSITA would be aware of Shigley, as it is a commonly used textbook for one of the required curricula in undergraduate mechanical engineering studies, then all other curriculum and associated textbooks should also be something a POSITA would be aware of and capable of utilizing. Fluid mechanics is another required subject for all mechanical engineering students. A commonly used textbook is Munsun's "Fundamental of Fluid Mechanics". Munsun dedicates much of the book to aspects of fluid dynamics: Munsun 3 – Fluids in Motion – The Bernoulli Equation Munsun 4 – Kinematics of Fluid Motion Munsun 5 – Flow Analysis Using Control Volumes Munsun 6 – Flow Analysis Using Differential Methods A POSITA would be well aware of tribology, fracture mechanics and fluid mechanics.
"The shaft must withstand variable and unpredictable fatigue loads resulting from a wide range of material hardnesses. Its eccentric design introduces complexity not typically encountered by an	Dr. Kytömaa attempts to diminish the capabilities of a POSITA. Again, Dr. Kytömaa implies that a POSITA would be unaware of major sections of Shigley. Chapter 6 – Fatigue Failure Resulting from variable loading

engineer with only two years of experience.”¹⁵	Section 6-5 – The Strain-Life Method Section 6-6 – The Linear-Elastic Fracture Mechanics Method Section 2-4 – Hardness Section 5-16 – Surface Fatigue Strength Mechanical engineers are trained to deal with these exact challenges. Stresses are not unpredictable and many sources are available to quantify material properties. A POSITA would not be so intimidated to lack any motivation to combine known solutions as taught in the prior art.
“Nor would it have been obvious to modify Polinski to reduce the thickness of the threaded shoulder 28 because this would significantly increase the likelihood that the connection between the sleeve and mantle would fail.”¹⁶ “...Adding an oil groove to the bearing journal would have a similar effect to the threads described by Polinski. This would have been evident to a person of ordinary skill in the art.”¹⁷	In the previous section above Dr. Kytömaa argues that a POSITA would have no experience with fatigue or material hardness. Now he argues that it would not have been obvious to a POSITA to change the thickness of a threaded shoulder because they would know intuitively that any change would lead to failure. He goes on to say a POSITA would also know that an oil groove would have the same stress as a threaded connection. Dr. Kytömaa’s assumptions are not only inconsistent, but also incorrect. The many sections in Shigley dedicated to calculating fatigue failure both enables a POSITA to analyze the stress as well as educate them on the many methods to reduce high stress regions and concentrations in order to optimize a

¹⁵ 2nd Declaration of Dr. Kytömaa ¶ 20

¹⁶ 2nd Declaration of Dr. Kytömaa ¶ 73

¹⁷ 2nd Declaration of Dr. Kytömaa ¶ 78

	design for the intended use. No experienced mechanical engineer would immediately know the fatigue life of a component, or the fatigue life due to a change to that component, without some analysis. Again, a POSITA would be educated to solve those very stress concerns.
“Cutting oil grooves into the Polinski shaft in the bearing journal 11 would introduce stress raisers and corresponding stress concentrations into the shaft, thus increasing the chance of fracture, precisely what Polinski aims to prevent by removing threads from the shaft. Given Polinski’s teaching that discontinuities should be removed from high-stress regions of the shaft, a POSITA would not have been motivated to one or more a grooves in the journal 11 of the shaft body of Polinski.”¹⁸ “Because such failure would be an existential threat...”¹⁹ “Any benefits associated with the addition of a groove in	Dr. Kytömaa attempts to use Polinski to prove that any discontinuities “should be removed” while Polinski actually teaches that these high stress regions are “satisfactory for most crusher installations” and “normal”. “To secure the mantle to the shaft, a threaded section has generally been provided on the shaft immediately above the tapered portion supporting the mantle for receiving a head nut which forces the mantle against the tapered portion of the shaft. While this type of arrangement has proven to be satisfactory for most crusher installations, experience has indicated that the relatively abrupt changes in the cross-sectional area of the shaft above and below the threaded section have resulted in high local stress concentrations in these regions of the shaft.” Polinski 1:15-25 (emphasis added) A POSITA would know that the small depth of the grooves required to perform their function would not amount to the “abrupt changes in cross-sectional area of the shaft” that Polinski was alluding to.

¹⁸ 2nd Declaration of Dr. Kytömaa ¶ 81

¹⁹ 2nd Declaration of Dr. Kytömaa ¶ 86

Polinski would appear diminished in view of the existential risk of shaft failure...”²⁰	“The sleeve arrangement, which is releasably secured to the bearing journal at the low stressed, outermost end of the shaft, includes a head nut which abuts the mantle to secure it to the tapered portion of the shaft. From the foregoing, it can be seen that the invention contemplates an arrangement wherein abrupt structural discontinuities in the normally high-stressed regions of the main shaft have been essentially eliminated to minimize the development of fatigue fractures in the shaft while at the same time providing an arrangement which can be easily maintained and repaired in the field,” (Polinski 1:56-67, emphasis added) Polinski teaches what any POSITA would understand; that stress must be calculated and then the stress must be managed to meet the requirements of the machine operation. This is a typical and normal task for any machine design, or redesign.
“Moreover, a POSITA would not be motivated to incorporate a groove into the shaft of Polinski as modified by the proposed combination with Piepho at least for the additional reason that incorporating such a groove would increase the likelihood of fretting wear and fretting	Dr. Kytömaa then attempts to argue a lack of motivation to combine Piepho with Polinski due to the threat of fretting wear and fatigue failure. Again, fretting is another issue that a POSITA would be aware of from textbooks and prior art, such as Shigley Section 6-9 Endurance Limit Modifying Factors and Piepho. Piepho teaches that fretting issues occur in rock crushers, as well as how these high stress interactions have been mitigated

²⁰ Patent Owner Response ('090) Pg. 3

induced fatigue failure.”²¹	and often do not produce stress concentrations. “Additionally, to abate fretting corrosion of the main shaft in the normally high stressed portion of the shaft at the base of the bearing journal 11, the sleeve is counterbored as indicated at 28' to prevent engagement between the sleeve and the main shaft in the proximity of the threaded annular shoulder 28.” (Polinski 3:9-15) In addition, the coating should resist cracking or Separation at Surface Strains up to approximately ± 65 micro inches/inch (corresponding to +20,000 psi stress) for essentially unlimited number of cycles. (Piepho 3:55-59, emphasis added) Some of the advantages of the present invention include the following. The existing shaft and yoke geometries need not be changed. The application of an intervening layer of coated material allows the use of Surface treatments like shot peening which can mutilate the Surface, but the final Surface is refined with the coating material while leaving the treated Surface undisturbed. The intervening layer is of high hardness for maximum resistance to fretting and wear. Minor fretting does not produce Stress concentrations in the Shaft material. The coating provides protection from mechanical and corrosion damage in the area outside the fitted joint. An additional advantage with the
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²¹ 2nd Declaration of Dr. Kytömaa ¶ 82

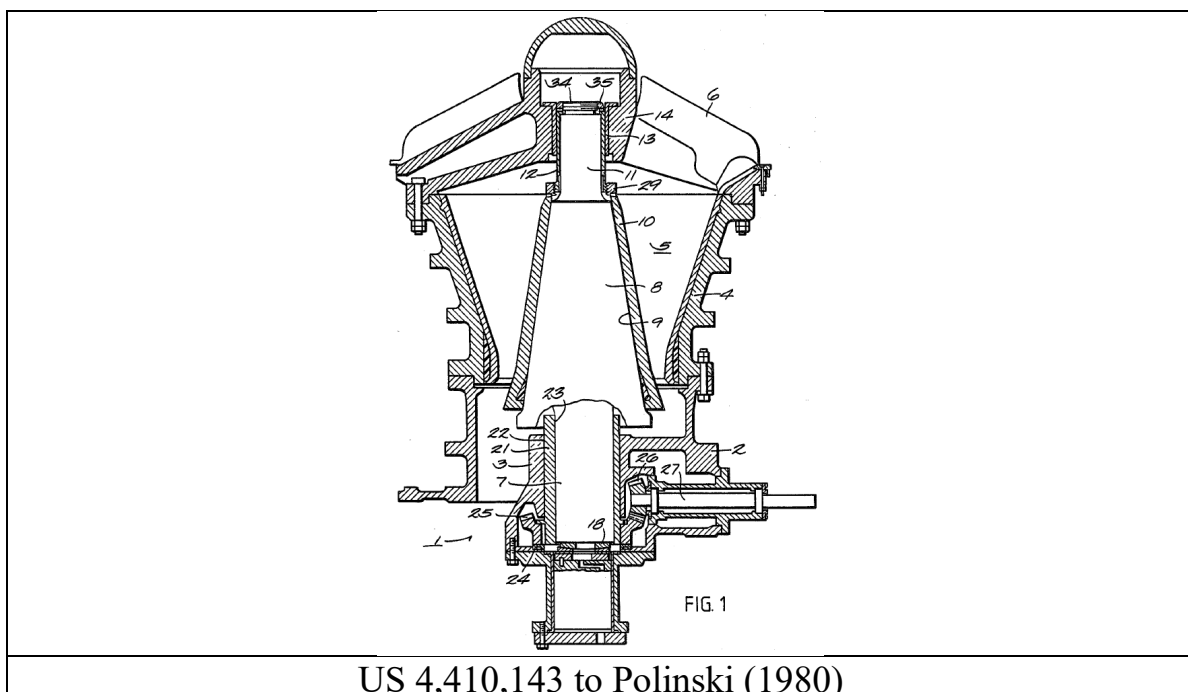
	present invention is the ability to use lubricants Such as tungsten disulfide on the bushing and the coated tapered end. (Piepho 4:23-36) A POSITA would not be dissuaded from combining Polinski with Piepho due to fretting concerns. Again, fretting is another well-known mechanism that a POSITA would be aware of and be able to solve.
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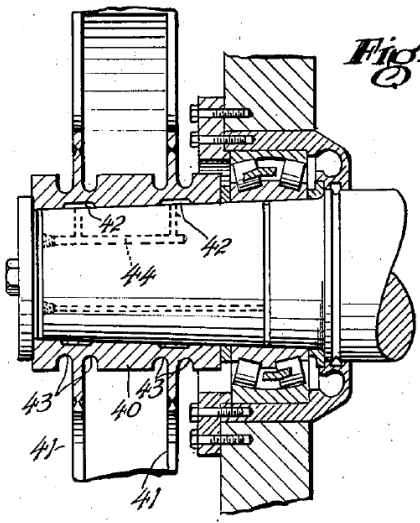
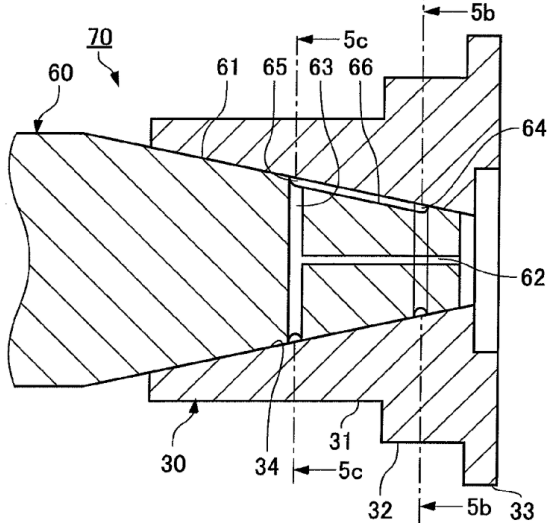
IV. INVALIDITY OF THE '090 ORIGINAL CLAIMS

46. Other than the exclusion of Aberg, I maintain that my first declaration, incorporated herein by reference, renders the original claims invalid

V. INVALIDITY ANALYSIS OF THE '090 SUBSTITUTE CLAIMS

**A. Polinski in view Harless and/or Yagi and the knowledge of a POSITA
Render Substitute Claims 15-26 Obvious**



i.e. “Polinski”	
 Fig. 7	
US 2,840,399 to C.A. Harless (1958) i.e. “Harless”	US 8,302,754 to Katsuki Yagi (2009) i.e. “Yagi”

47. The primary reference used in my First Declaration to show that the claims of the '090 patent are obvious was US 4,410,143 to Polinski. In this declaration I again use Polinski as a primary reference for my obviousness analysis. Much of the language in the Patent Owner's new substitute claims is identical to the original claim language.

48. Polinski is entitled “Main Shaft Assembly for a Gyratory Crusher” and states that “The present invention relates to gyratory crushers...”²² As such it is clearly relevant prior art to the '090 patent entitled “Gyratory Crusher Main Shaft and Assembly.” Polinski is also concerned with eliminating abrupt structural discontinuities, especially in high stressed areas of the main shaft by improving the

²² Polinski 1:44

mounting of the mantle, or crushing shell.

“The main shaft includes a **tapered head** supporting portion which extends through a correspondingly **tapered bore** in a conically shaped crusher mantle to support the mantle on the shaft. The end of the shaft is provided with a **bearing journal** fitted with a replaceable sleeve arrangement retained in a stationary bushing on the frame of the crusher which accommodates gyratory movement of the shaft about the bushing during crushing operations. The **sleeve arrangement, which is releasably secured to the bearing journal at the low stressed, outermost end of the shaft, includes a head nut which abuts the mantle to secure it to the tapered portion of the shaft.**”²³

49. Harless teaches methods using hydraulic pressure to facilitate mounting and demounting a tapered gear sleeve on a tapered shaft. Harless was included in the validity analysis in my First Declaration. For a more complete discussion on Harless see my First Declaration.

50. Yagi addresses coupling and decoupling tapered coupling structures by pumping oil into the interstitial area between the tapered shaft and sleeve utilizing a plurality of grooves and oil passages.

“In the **tapered coupling structure** (hereinafter, sometimes referred to simply as a coupling structure), when the tapered shaft is coupled to the hub, or when the tapered shaft is decoupled from the hub, **oil is fed to the coupling surfaces of the tapered shaft and the hub to increase the diameter of the hub, by which coupling and decoupling are enabled.** For this purpose, the coupling structure is configured so that an oil passage is provided in the tapered shaft (or the hub), and **an oil groove** connecting with the oil passage is provided in the outer peripheral surface of the tapered shaft (or the inner peripheral surface of the hub) **to feed oil to the coupling surfaces via the oil passage and oil groove.**”²⁴

51. Yagi explicitly discloses a port in the end of a shaft through which

²³ Polinski 1:48-60, emphasis added

²⁴ Yagi 1:26-37, emphasis added

pressurized hydraulic oil is introduced to a hydraulic conduit running in an axial direction in the shaft. Cross holes connect the axial conduit with a first circumferential groove around the shaft. A groove on the surface of the shaft connects the first circumferential groove to a second circumferential groove. Both Harless and Yagi disclose the tapered end of the shaft with the taper extending to the extreme end of the shaft.

1. Reasons to Combine

52. It is my understanding that a determination of obviousness “requires ‘identify[ing] a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does’” (quoting KSR, 550 U.S. at 418, 82 USPQ2d at 1395). The following provides a consolidation of motivations for a POSITA to combine the cited prior art references. Specific reasons to combine for each claim element can be found in my First Declaration and within the chart in the next section.

53. Polinski uses a straight heat-shrink sleeve as it is well known that a shrink-fit solidly connects two parts.

“When the bearing sleeve 12 is installed on the bearing journal 11, **it is initially heated so that as it cools it forms a heat-shrink type fit** releasably securing it to the journal.”²⁵

54. Heat shrinking requires heating the part to dangerous temperatures,

²⁵ Polinski 3:15-18, emphasis added

requiring skilled workers. Heat shrinking a straight sleeve is far more difficult than a tapered sleeve, since the additional axial travel of a straight sleeve introduces far more possibility of the sleeve cooling down before reaching the final sleeve release position on the shaft. Removal of a heat shrunk sleeve is extremely difficult, as the outer sleeve cannot be heated independent of the shaft once installed. The sleeve usually needs to be cut and a puller tool utilized to remove it. As illustrated in my First Declaration, a tapered sleeve is superior to a straight sleeve as it only requires a very small axial travel during installation and removal.

55. Thus, a POSITA would be motivated to combine Harless with Polinski as Harless teaches the use of a tapered sleeve on a tapered shaft to provide a simpler, safer, and less expensive way to install and remove a regularly replaced sacrificial sleeve. Harless discloses a method for installing and removing a tapered sleeve without the need to heat the sleeve, or a puller. By using hydraulic pressure to expand the sleeve oil can be pumped into the interstitial area between the shaft and sleeve to expand the sleeve facilitating its removal. This installation and removal process requires less skill, takes less time, is less expensive, and is safer than the traditional heat shrink method.

“Oil under pressure is introduced into a circumferential groove 12 through a bore 13, expanding the bearing sufficiently to permit it to be pushed up against the spacer 6, by conventional means. Thereafter, the oil pressure is released, permitting the bearing inner race to contract and fixing it to the shaft with a shrink fit, the extent of shrink or

interference being, as indicated, about .003 inch.”²⁶

56. Harless also teaches a means of axially moving, or preventing the excess movement, of the sleeve during these processes. Harless discloses a bolt threaded into the shaft and that contacts a washer which then can make contact with the shrink-fit sleeve. The bolt and washer perform two functions. During installation the washer makes contact with the sleeve while the bolt is tightened to move the sleeve axially to the sleeve's final position while oil pressure in the interstitial area between the tapered surfaces expand the diameter of the sleeve. During removal process, the bolt is loosened to provide space between the washer and the end of the sleeve. When pressure is applied and the sleeve expands to loosen the press fit, there is also a force component that would move the sleeve in an axial direction. Due to the extreme oil pressure required to expand the sleeve, this axial movement can be very fast and present a safety hazard. The washer acts as a stop to prevent the sleeve from moving too far, yet allowing enough movement to break the press fit. A POSITA would be motivated to combine Harless with Polinski to facilitate safe installation and removal of the tapered sleeve.

“The axial movement of the gear may be accomplished by tightening the bolts 9, so as to cause the washer 8 to move the gear axially of the shaft, and the axial movement of the bearing may be accomplished in a similar manner, utilizing a sleeve to transmit the thrust from the washer plate to the bearing. A hydraulic jack may also be utilize for this purpose, being fastened in place by the bolts fitting in the holes in the shaft ends provided

²⁶ Harless 2:19-26

for the bolts 9.”²⁷

“The arrangement of the invention is also highly advantageous in facilitating removal and replacement of a gear. To remove a gear, it is only necessary to back off the bolts 9 slightly and introduce oil under pressure through the bore 16 so as to expand the gear hub, where upon the gear will slide back against the washer 8 with no difficulty and may then be removed.”²⁸

57. Yagi teaches many different options for the fluid paths and grooves to achieve the teachings of Harless. A POSITA would be motivated to combine Yagi with Polinski and Harless as it teaches that a surface oil groove connecting two circumferential grooves can be “machined easily as compared with the first radial oil passage 43 in the second embodiment.”²⁹ A POSITA would also make this combination to obtain the advantages of proper placement of the grooves to expand the sleeve without having to use O-rings.

be advantageous to the particular design constraints or stresses present in the application.

“The present invention has been accomplished to solve the above-described technical problems, and accordingly an object thereof is to provide a tapered coupling structure in which a tapered shaft can be coupled to and decoupled from a hub without the use of an O-ring.”³⁰

2. Invalidity Charts

58. The following invalidity charts demonstrate that none of the substitute

²⁷ Harless 2:52-61

²⁸ Harless 3:16-22

²⁹ Yagi 7:23-25.

³⁰ Yagi 2:24-28

claims proposed by the patent owner constitute anything but combining known technology in a known way to produce predictable results.

Challenged Claim 15 (Substitute for Claim 1)	Obvious by Prior Art?
15P. A gyratory crusher main shaft of a crusher comprising:	YES: Although the preamble is generally not considered limiting, d Polinski discloses a gyratory crusher main shaft of a crusher. “The present invention relates to gyratory crushers...”³¹
No change to original claim element. This limitation is in Polinski. FIG. 1 32 <i>“In a gyratory crusher, a main shaft having a tapered mantle supporting portion extending through a correspondingly tapered bore in the crusher mantle to support the mantle on the shaft, and a bearing sleeve fitted about the end of the shaft releasably securing the crusher mantle to the tapered portion of the shaft.”³³</i> Polinski discloses a main shaft in a gyratory crusher.	

³¹ Polinski 1:44

³² Polinski Figure 1, annotated

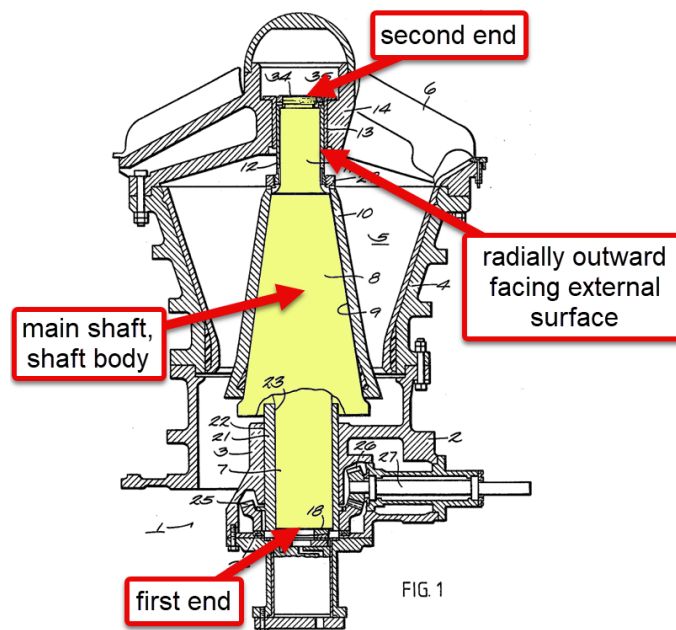
³³ Polinski Abstract

15a. a shaft body having a radially outward facing external surface, and a first end and a second end;

YES: As shown my First Declaration, as shown in the figures below, Polinski discloses a shaft body having a radially outward facing external surface, and a first end and a second end.

No change to original claim element.

See previous discussion regarding “END.” Note that despite Dr. Kytömaa arguing that end is literally the very extreme surface and nothing more, this is NOT the broadest reasonable construction in light of the intrinsic evidence nor is it consistent with the plain and ordinary meaning.



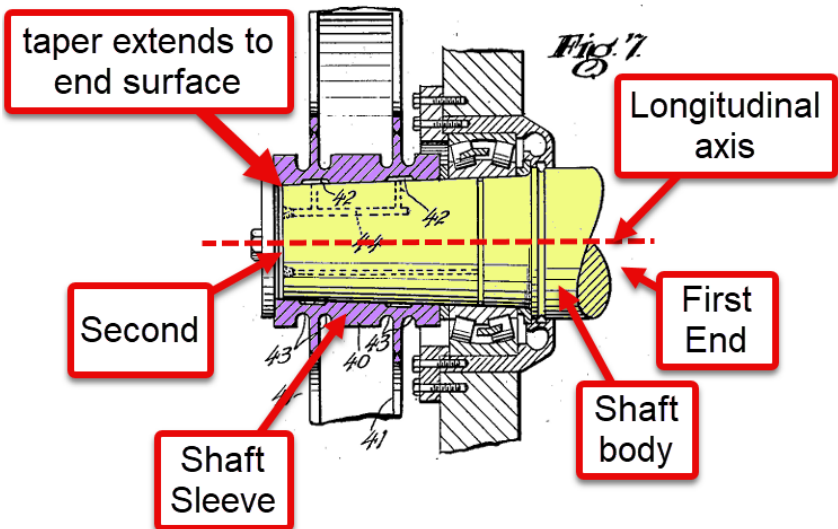
34

As shown above, Polinski discloses a main shaft having a radially outward facing external surface, and a first and second end.

15b. an axial region of the shaft body extending from the second end and being tapered relative to a longitudinal axis of the shaft body such that a cross sectional area of the shaft body at the tapered axial region decreases in a

YES: As shown in the figures below, Polinski in view of Harless, discloses an axial region of the shaft body extending from the second end and being tapered relative to a longitudinal axis of the shaft body such that a cross

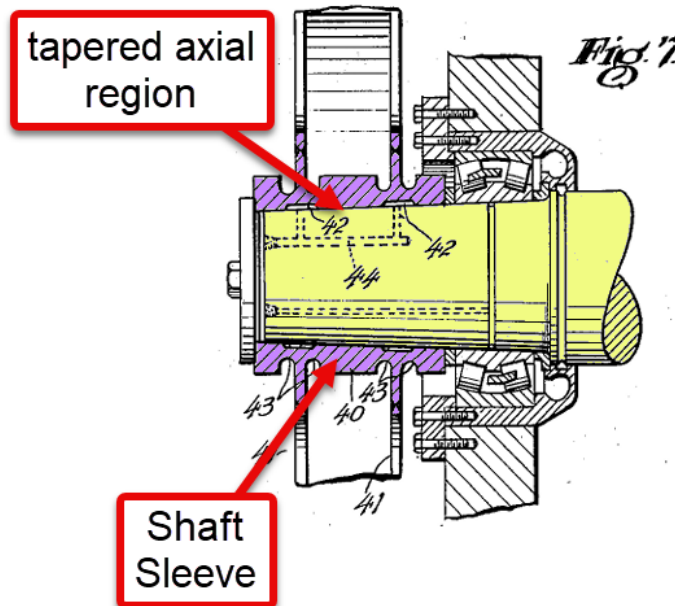
³⁴ Polinski Figure 1, annotated

direction from the first end to the second end;	section area of the shaft body at the tapered axial region
No change to original claim element. See also the previous discussion regarding “END.” As has been discussed previously, the plain and ordinary meaning of end of the shaft includes more than the extreme end surface. But even if the extremely narrow construction of Dr. Kytömaa was adopted, as shown below, Harless discloses an axial region of the shaft body extending from the second end and being tapered relative to a longitudinal axis of the shaft body with the cross sectional area decreasing in the direction from the first end to the second end. See figure below.  35	
If the erroneous claim construction of “end”, proposed by Dr. Kytömaa, was adopted, Harless discloses this limitation even using the narrower construction of “end”. A POSITA would be motivated to combine Harless with Polinski to gain the advantages of easier assembly and disassembly disclosed by Harless as discussed above.	
15c. a shaft sleeve mounted on the tapered axial region; and	YES: As shown in the figures below, Polinski in view of Harless discloses a shaft sleeve mounted on the tapered axial region.

³⁵ Harless Figure 7, annotated

No change to original claim element.

Polinski shows a sleeve mounted on a shaft as shown in the figure above (purple). Harless discloses a sleeve mounted on a tapered axial region. A POSITA would be motivated to combine Harless with Polinski as a tapered sleeve is more robust and easier to install and remove.



36

15d. a plurality of grooves indented at the external surface and positioned at the tapered axial region, the plurality of grooves being arranged to receive a pressurised (sic) fluid to facilitate mounting and dismounting of the shaft sleeve at the shaft body,

YES: As shown in the figures below, Polinski in view of Harless OR Polinski in view of Harless and Yagi disclose a plurality of grooves indented at the external surface and positioned at the tapered axial region. The grooves in Harless and Yagi are arranged to receive pressurized fluid to make mounting and dismounting of the shaft sleeve on the shaft easier.

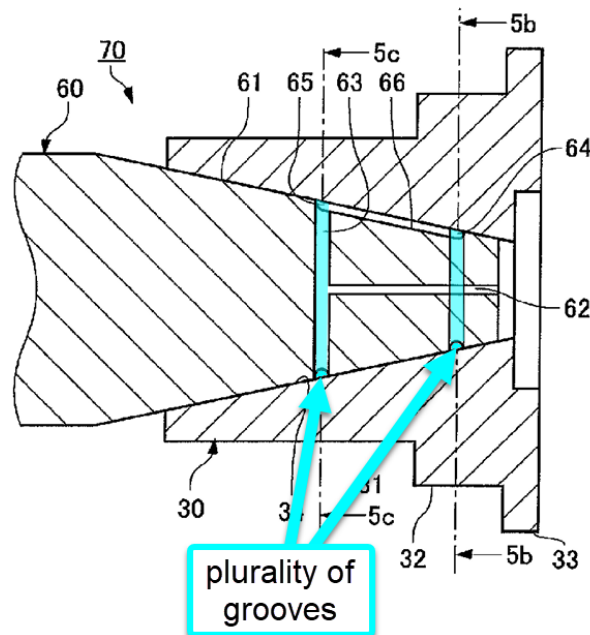
Changes: Replaced “at least one groove” with “a plurality of grooves”.

As explained in my First Declaration, Harless teaches a plurality of grooves (two in the sleeve and one in the shaft). See 1d1 in my First Declaration. As discussed in the Claim Construction section above, the word “at” in this limitation only requires the indented grooves to be near the external surface of the shaft and the tapered axial region. Thus, the two grooves in the sleeve such as shown in Fig. 7

³⁶ Harless Figure 7, annotated

of Harless would satisfy this part of the limitation. A POSITA will recognize that whether the groove is cut in the sleeve or in the shaft is a design choice, either one of which will function to spread pressurized fluid to the interstitial space between the sleeve and the shaft.

Yagi also teaches a plurality of grooves in the shaft.



"The radial oil passage 63 communicates with the terminal end of the axial oil passage 62, and both ends thereof are open to the outer peripheral surface of the taper part 61. Therefore, oil fed from a hydraulic pressure source, not shown, flows in the axial oil passage 62 and the radial oil passage 63 in order, and flows out to the outer peripheral surface of the taper part 61. At a position at which the radial oil passage 63 is open on the outer peripheral surface of the taper part 61, a second oil groove 65 is formed along the circumferential direction of the taper part 61. The oil flowing out of the opening of the radial oil passage 63 flows in the second oil groove 65, by which the oil is permeated in the circumferential direction of the outer peripheral surface of the taper part 61. In the outer peripheral surface of the taper part 61, there is provided a connecting oil groove 66 one end of which communicates with the second oil groove 65 and which extends in the axial direction toward the frontend of the tapered shaft 60. The other end of the connecting oil groove 66 communicates with a first oil groove 64."³⁸

Yagi teaches that multiple grooves allow the oil to permeate a larger region more easily. From Harless and Yagi a POSITA would understand that the number of

³⁷ Yagi Figure 5A, annotated

³⁸ Yagi 6:44-63

oil grooves as taught is merely a design choice. As explained previously, a POSITA would be motivated to utilize oil grooves as opposed to shrink fitting as the process is easier and cheaper. In addition, a POSITA would be motivated to use multiple grooves to supply a larger region, as taught by Yagi.

As explained previously, the term “at” denotes that the groove is near the surface of the shaft. This includes on the shaft or in the sleeve. A POSITA would understand that the choice of machining a groove in the shaft or the sleeve is a design choice as taught by Harless and Yagi. In fact, Yagi teaches this very thing and calls it “conventional”.

“Conventionally, to feed oil to between the tapered shaft 110 and the hub 120, an oil groove 112 provided in the outer peripheral surface of the tapered shaft 110 (or the inner peripheral surface of the hub 120) has been arranged in the center (or in the vicinity of the center) in the axial direction of a taper part 111 of the tapered shaft 110.”³⁹

Both Harless and Yagi teach using pressurized fluid in the grooves to mount and dismount a sleeve. Harless teaches:

“As in the case of the bearing, the gear. hub, is expanded by pumping oil under pressure into the groove 15 and the gear is moved along the shaft until seated against the spacer 7, at which time the oil pressure is released and the gear hub contracts into place, with a shrink fit or potential interference of about .003, inch.”⁴⁰

The arrangement of the invention is also highly advantageous in facilitating removal and replacement of a gear. To remove a gear, it is only necessary to back off the bolts 9 slightly and introduce oil under pressure through the bore 16 so as to expand the gear hub, where upon the gear will slide back against the washer 8 with no difficulty and may then be removed.⁴¹

Yagi also teaches this:

“In the tapered coupling structure (hereinafter, sometimes referred to simply as a coupling structure), when the tapered shaft is coupled to the hub, or when the tapered shaft is decoupled from the hub, oil is fed to the coupling surfaces of the tapered shaft and the hub to increase the diameter of the hub, by which coupling and decoupling are enabled. For this purpose, the coupling structure is configured so that an oil passage is provided in the tapered shaft (or the hub), and an oil groove connecting with the oil passage is provided in the outer peripheral surface of the tapered shaft (or the inner peripheral surface of the hub) to feed oil to the coupling surfaces via the oil passage and oil groove.”⁴²

³⁹ Yagi 2:47-52

⁴⁰ Harless 2:45-51

⁴¹ Harless 3:16-22.

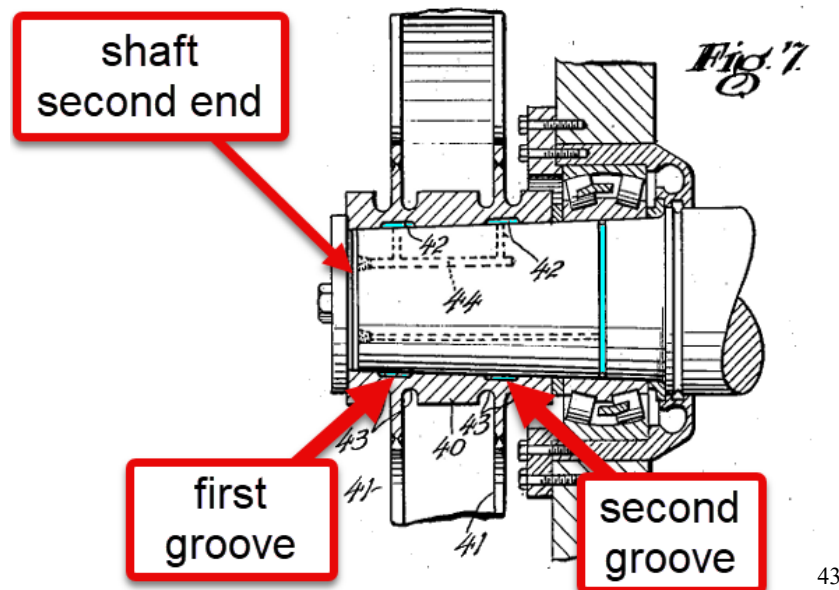
⁴² Yagi 1:26-37

15e. wherein the plurality of grooves comprise a first groove and a second groove, wherein the first groove is positioned closer to the second end relative to the second groove; and

YES: As shown in the figures below, Polinski in view of Harless OR Yagi discloses a first groove closer to the second end of the shaft relative a second groove.

New Element

Both Harless and Yagi disclose a first groove and a second groove where the first groove is closer to the second end of the shaft.

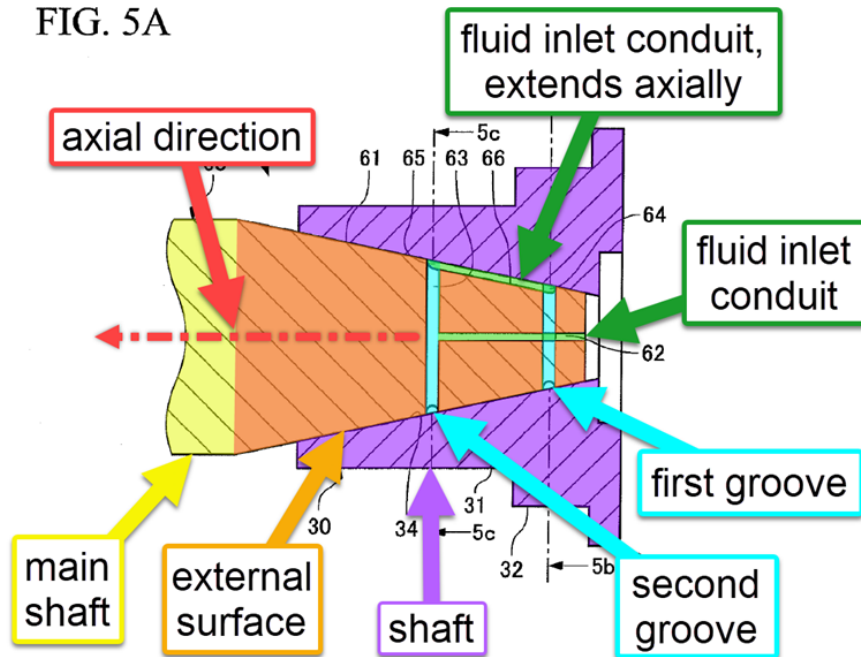


⁴³ Harless Figure 7, annotated

	44
15f. a fluid inlet conduit extending axially from the second end and provided in fluid communication with the first groove, wherein the fluid inlet conduit extends internally within the shaft body only to the first groove,	YES: Polinski in view of Harless and in further view of Yagi discloses a fluid inlet in communication with only one groove.
New Element As explained in my First Declaration, Harless teaches a fluid inlet conduit extending from the second end to only a single groove as well as a separate conduit in fluid communication with two grooves. This is a clear teaching that how the pressurized fluid is connected to the grooves is a design choice that a POSITA would understand. As shown below, Yagi also teaches a fluid inlet ported to the one of two grooves that is furthest from the second end of the shaft. There is a second groove closer to the second end of the shaft that is connected to the first groove by an axially running groove on the surface of the shaft as shown below.	

⁴⁴ Yagi Figure 5A, annotated

FIG. 5A



45

“The tapered shaft 60 comprises a taper part 61, and an axial oil passage 62 is formed along the axial direction of the tapered shaft 60 from the front end surface of the taper part 61. Also, in the radial direction of the taper part 61, a radial oil passage 63 is formed. The radial oil passage 63 communicates with the terminal end of the axial oil passage 62, and both ends thereof are open to the outer peripheral surface of the taper part 61. Therefore, oil fed from a hydraulic pressure source, not shown, flows in the axial oil passage 62 and the radial oil passage 63 in order, and flows out to the outer peripheral surface of the taper part 61.

In the outer peripheral surface of the taper part 61, there is provided a connecting oil groove 66 one end of which communicates with the second oil groove 65 and which extends in the axial direction toward the frontend of the tapered shaft 60. The other end of the connecting oil groove 66 communicates with a first oil groove 64.”⁴⁶

While Yagi explicitly teaches “a fluid inlet conduit extending axially from the second end and provided in fluid communication with the” first second “groove, wherein the fluid inlet conduit extends internally within the shaft body only to the” first second “groove.”

So while Yagi explicitly shows connecting from the port to what would be the second groove, Yagi also recognizes that a POSITA could make appropriate changes:

⁴⁵ Yagi Figure 5A, annotated

⁴⁶ Yagi 6:40-63

“Besides the above-described embodiments, the configurations described in the above-described embodiments can be taken and left, or can be changed appropriately to another configuration as far as not departing from the spirit and scope of the present invention.”⁴⁷

Although Yagi connects from the port from what would be the second groove, a POSITA would be motivated to connect to what would be the first groove as the drill depth from the end would be less and be easier to manufacture and would cost less.

The purpose of the fluid conduit and grooves is to provide fluid pressure to the entire tapered axial region in order to expand the sleeve and compress the shaft. Multiple concentric grooves allow this pressure to be distributed along the length of the tapered axial region. How the fluid arrives at these grooves is merely a design choice that would be well known by a POSITA. For instance, the grooves could all be connected from a port in the end of the shaft with a conduit that connects to both grooves internal to the shaft. Alternatively, a POSITA would understand that a port in the end of the shaft could be connected to a first groove internal to the shaft and a second groove connected to the first groove by a groove on the external surface of the shaft.

15g. wherein the first groove and the second groove are coupled in fluid communication.

YES: Polinski in view of Harless and Yagi discloses a first and second groove coupled in fluid communication.

New Element

Both Harless and Yagi disclose two grooves in fluid communication. Harless accomplishes this internally to the shaft as shown below.

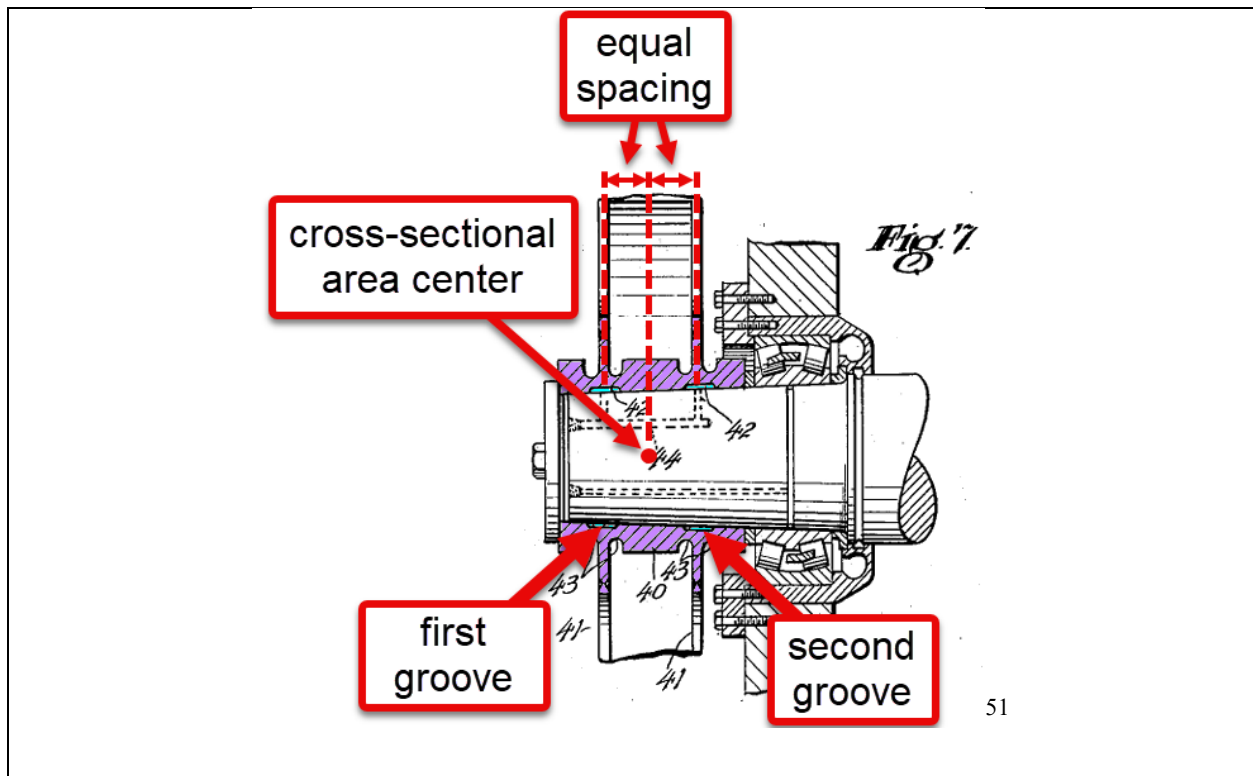
⁴⁷ Yagi 8:12-16

In the outer peripheral surface of the taper part 61, there is provided a connecting oil groove 66 one end of which communicates with the second oil groove 65 and which extends in the axial direction toward the frontend of the tapered shaft 60. The other end of the connecting oil groove 66 communicates with a first oil groove 64.”⁵⁰

Yagi teaches a “connecting oil groove 66” that extends axially along the outside of the tapered shaft to communicate fluid between the first and second grooves. (highlighted in green above). A POSITA would understand that the method used to connect multiple grooves is a well understood design choice. A POSITA would be motivated to use the teachings of Yagi in combination to connect the first and second grooves on the exterior of the shaft to simplify machining and reduce cost.

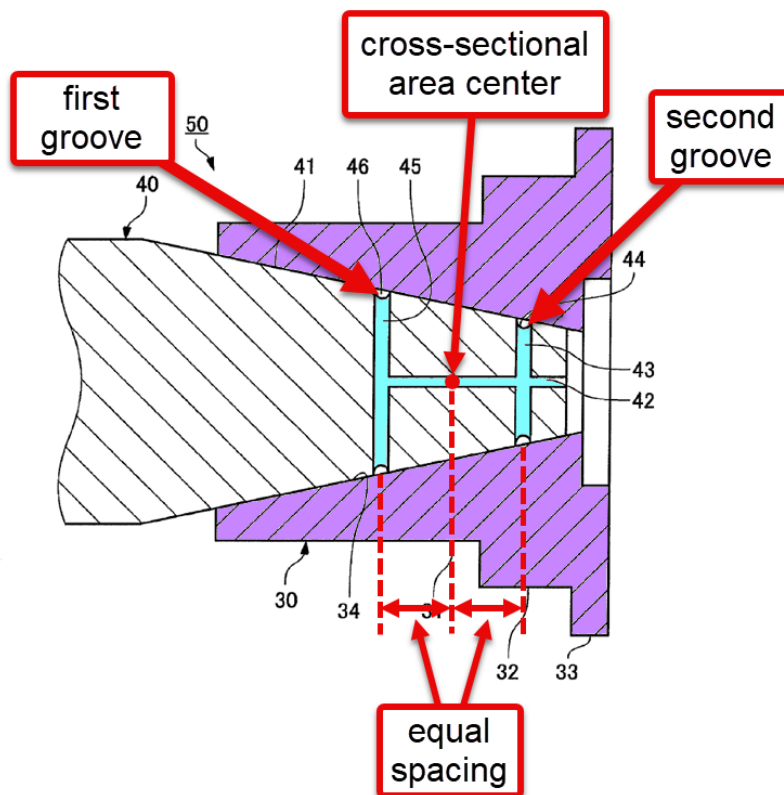
Challenged Claim 16 (Substitute for Claim 2)	Obvious by Prior Art?
16P. The main shaft as claimed in claim 15,	YES: As shown above, Polinski in view of Harless and Yagi discloses the main shaft as claimed in claim 15.
16a. wherein the first groove is positioned on a first side of a cross-sectional area center of the shaft sleeve relatively closer to the second end and the second groove is positioned on a second side of a cross-sectional area center of the shaft sleeve relatively further from the second end.	YES: As shown below, Polinski in view of Harless and Yagi disclose two grooves which are on opposing sides relative to the cross-sectional area center of the shaft sleeve with the first groove being positioned closer to the second end of the shaft with the second groove being further from the second end.
Original Claim 2a: further comprising a fluid inlet conduit extending axially from the second end and provided in fluid communication with the at least one groove to allow a fluid to be supplied to the at least one groove from the second end.	
The grooves in Harless are equal distance on either side of the cross-sectional area center of the shaft sleeve.	

⁵⁰ Yagi 6:51-63



⁵¹ Harless Figure 7, annotated

FIG. 4



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The grooves in Yagi are in the shaft and are also on either side of the cross-sectional area center of the shaft sleeve. The two figures above indicate the “cross-sectional area center” of the sleeve (red dot). This point was calculated in CAD as the area center of the purple highlighted cross-section. A POSITA would recognize that by positioning the oil grooves on opposite sides of the cross-sectional area center of the sleeve the fluid would permeate to the whole interstitial region between the sleeve and the shaft more evenly. While the grooves of Yagi are not exactly equidistant from the cross-sectional area of the sleeve, their exact placement would merely be a design choice that would be affected by the change in thickness of the sleeve as disclosed in Yagi.

Challenged Claim 17 (Substitute for Claim 3)

Obvious by Prior Art?

⁵² Yagi Figure 5A, annotated

17P. The main shaft as claimed in claim 16,	YES: As shown above, Polinski in view of Harless and Yagi discloses the main shaft as claimed in claim 16.
17a. wherein the first groove and the second groove are positioned at an equal distance from the cross-sectional area center of the shaft sleeve such that when the pressurised (sic) fluid is supplied to the first groove and the second groove, an expansion force is distributed substantially uniformly along the axial length of the sleeve.	YES: As shown above, Polinski in view of Harless and Yagi discloses a first and second oil groove positioned equal distance from the cross-sectional area center of the shaft sleeve. As the positioning is the same as that described in the claim the expansion force would be distributed the same as the structure disclosed in the '090 patent, described as being distributes substantially uniformly along the axial length of the sleeve.
Original Claim 3a: wherein the fluid inlet conduit extends internally within the shaft body such that a part of the fluid inlet conduit extends radially outward to the at least one groove. Harless and Yagi (see 16a). For a relatively uniform thickness sleeve, it would be obvious for a POSITA to try the claimed groove positions as equidistant positions from the cross-sectional area of the sleeve would cause the sleeve diameter to expand more evenly. A POSITA would know that the positions of the grooves could be adjusted to improve the oil distribution evenly along the axial length of the sleeve	
Challenged Claim 18 (Substitute for Claim 4)	Obvious by Prior Art?
18P. The main shaft as claimed in claim 15,	YES: As shown above, Polinski discloses the main shaft as claimed in claim 15.
18a. wherein the plurality of grooves extend in a circumferential direction around the tapered axial region shaft body.	YES: Polinski in view of Harless and Yagi disclose that the plurality of grooves extend in a circumferential direction around the shaft body.
Changes: Replaced “at least one groove” with “plurality of grooves”. See 4a in my First Declaration.	

Harless and Yagi both disclose a plurality of grooves extending circumferentially around the tapered axial region of the shaft body. See previous figures and explanations above.

Challenged Claim 19 (Substitute for Claim 5)

Obvious by Prior Art?

19P. The main shaft as claimed in claim 18,

YES: As shown above, Polinski in view of Harless and Yagi discloses the main shaft as claimed in claim 18.

19a. wherein the plurality of grooves extend substantially or completely circumferentially around the shaft body.

YES: As shown and described above, Polinski in view of Harless and Yagi disclose that the plurality of grooves extends completely around the shaft body.

Changes: Replaced “at least one groove” with “a plurality of grooves”.

See 5a in my First Declaration.

As both Harless and Yagi show circumferential grooves completely around the shaft and Yagi shows a plurality of circumferential grooves around in in the surface of the shaft. A POSITA would understand that whether the grooves are in the shaft or in the sleeve, either will distribute oil around the circumference of the shaft. This is, again, merely a design choice where one type of groove could be substituted for another with very predictable results. As discussed above both of these are known techniques.

Challenged Claim 20

Obvious by Prior Art?

20P. The main shaft as claimed in claim 15,

YES: As shown above, Polinski in view of Harless and Yagi discloses the main shaft as claimed in claim 15.

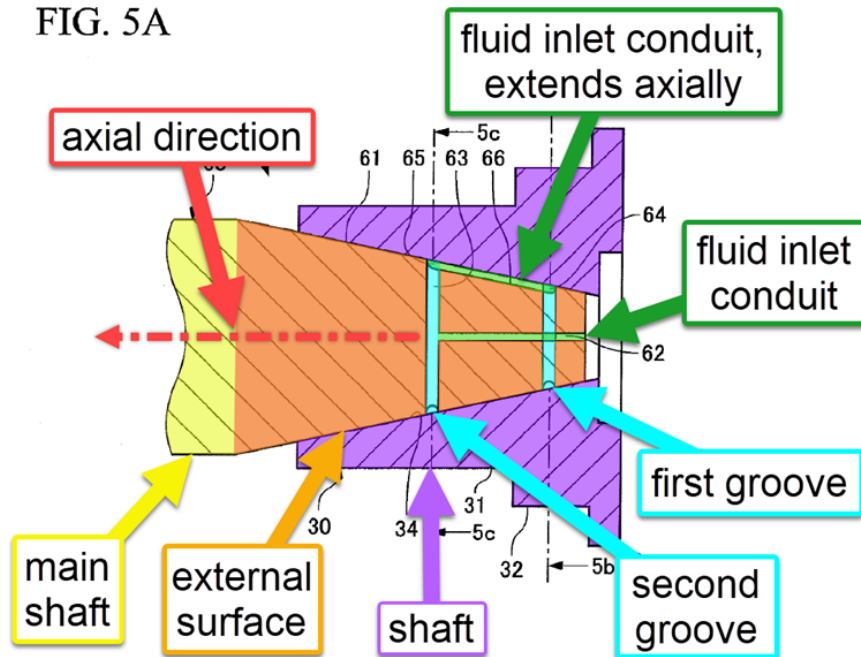
20a. wherein at least a part of the fluid inlet conduit is indented and extends axially at the external surface as a channel to couple the first and second grooves in fluid communication.

YES: As shown below Yagi discloses an axial external channel that couples the first and second grooves in fluid communication.

New Claim

See 15g above.

FIG. 5A



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“In the outer peripheral surface of the taper part 61, there is provided a connecting oil groove 66 one end of which communicates with the second oil groove 65 and which extends in the axial direction toward the front end of the tapered shaft 60. The other end of the connecting oil groove 66 communicates with a first oil groove 64. The first oil groove 64 is formed along the circumferential direction in the outer peripheral surface of the taper part 61. Some of the oil flowing in the second oil groove 65 passes through the connecting oil groove 66 and reaches the first oil groove 64.”⁵⁴

Yagi teaches an external axial groove called connecting oil groove 66 which allows fluid to communicate between the first and second circumferential grooves. A POSITA would understand that the method for connecting the oil grooves is a design choice, which includes a groove on the outside of the shaft. A POSITA would be motivated to implement this teaching of Yagi as it requires less machining to create a groove on the outer surface of the shaft rather than machining additional holes in the shaft to connect the two grooves.⁵⁵

Challenged Claim 21 (Substitute for Claim 9)

Obvious by Prior Art?

⁵³ Yagi Figure 5A, annotated

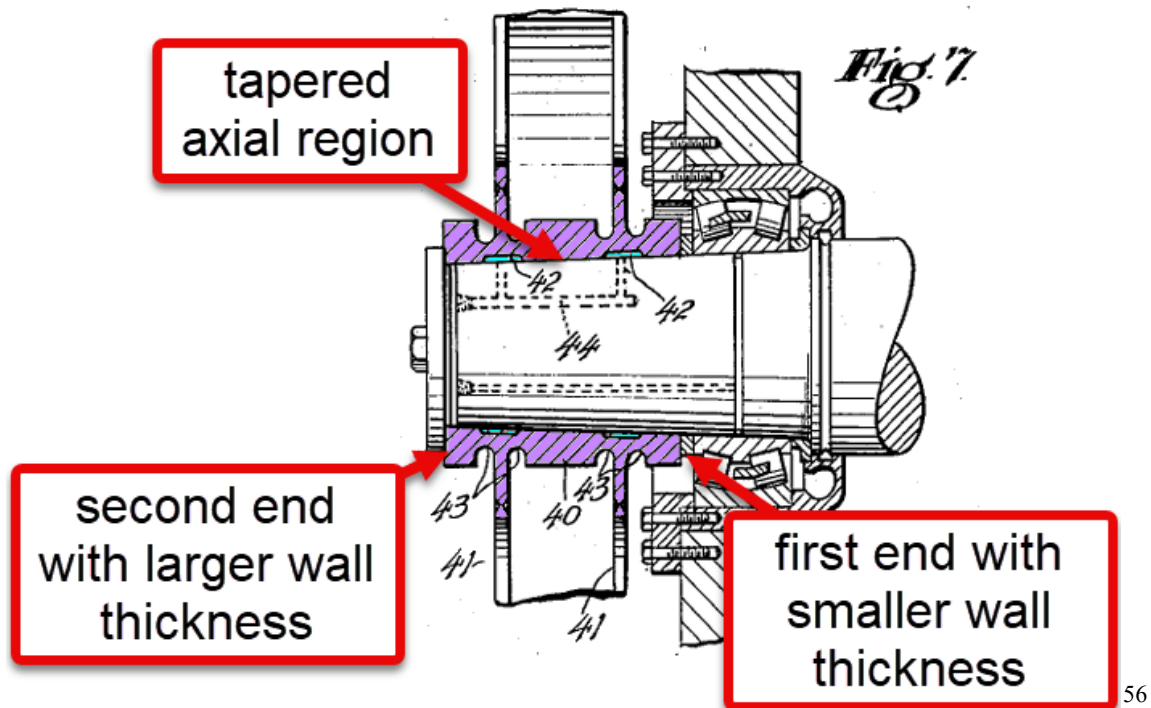
⁵⁴ Yagi 6:58-67, emphasis added

⁵⁵ Yagi 7:23-25

21P. A gyratory crusher main shaft assembly for a crusher comprising:	YES: While the preamble to a claim is generally not considered limiting, see claim element 15P.
21a. a shaft body having a radially outward facing external surface, and a first end and a second end, an axial region of the shaft body extending from the second end and being tapered relative to a longitudinal axis of the shaft body such that a cross sectional area of the shaft body at the tapered axial region decreases in a direction from the first end to the second end,	YES: See element 15a and 15b. No change to original claim element. See previous discussion regarding “end”.
21b. a shaft sleeve mounted on the tapered axial region, and	YES: See element 15c. No change to original claim element.
21c. at least one groove indented at the external surface and positioned at the tapered axial region, the at least one groove being arranged to receive a pressurised (sic) fluid to facilitate mounting and dismounting of the sleeve at the shaft body;	YES: See element 15d. No substantive change to original claim element (the “plurality of grooves” in 15d would certainly satisfy the instant limitation of “at least one groove.”)
21d. wherein the shaft sleeve is fitted over the tapered axial region, the shaft sleeve having a tapered wall thickness, such that the wall thickness at a second end of the shaft sleeve is greater than the wall thickness at a first end of the sleeve; and	YES: Harless discloses a sleeve fitted over the tapered axial region, the sleeve having a tapered wall thickness, such that the wall thickness at a second end of the sleeve is greater than the wall thickness at a first end of the sleeve.
Original Claim 9d: a sleeve fitted over the tapered axial region, the sleeve having a tapered wall thickness, such that the wall thickness at a second end of the sleeve is greater than the wall thickness at a first end of the sleeve. Changes: Replaced “sleeve” with “shaft sleeve”. The sleeve discussed in previous claim charts was already a “shaft sleeve”. This substitute claim element provides no substantive change to the claim as there is only a single sleeve that is a shaft sleeve.	

See 9b in my First Declaration.

Harless has a sleeve fitted over a tapered axial region with a first end with a smaller wall thickness and a second end with a larger wall thickness. See annotated figure below.



21e. an end retainer releasably mounted at the second end of the shaft body and having a perimeter region extending radially outward beyond the external surface at the tapered axial region, the perimeter region positioned to radially overlap the shaft sleeve at the second end of the sleeve to inhibit axial separation of the shaft sleeve from the shaft body,

YES: Polinski in view of Harless discloses a main shaft assembly further comprising an end retainer releasably mounted at the second end of the shaft body and having a perimeter region extending radially outward beyond the external surface at the tapered region.

Dependent claim 10 included as New Element

See 10a1 and 10a2 in my First Declaration.

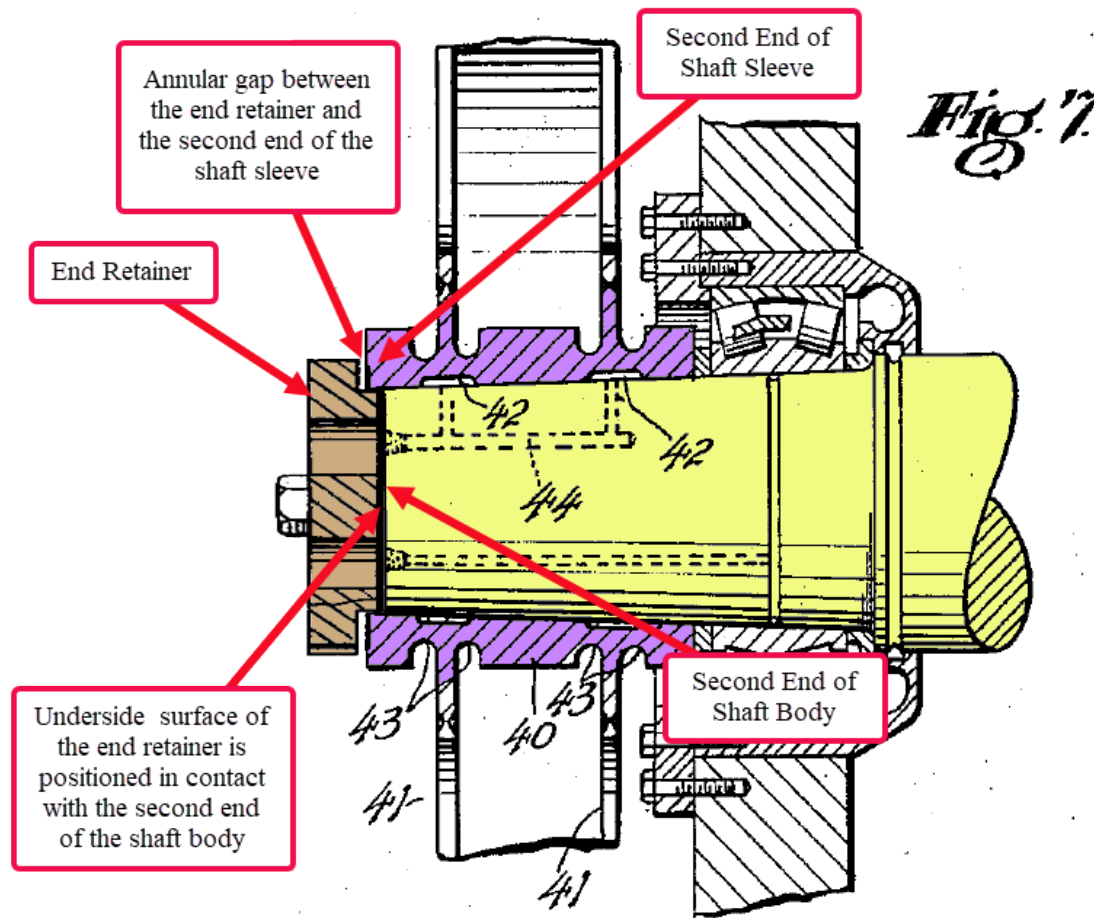
21f. wherein the end retainer includes a recess extending circumferentially at

YES: Harless discloses that the end retainer includes a recess extending

⁵⁶ Harless Figure 7, annotated

the perimeter region to allow axial movement of the shaft sleeve into the recess,	circumferentially at the perimeter region to allow axial movement of the sleeve into the recess.
Dependent claim 11 included as New Element See 11a in my First Declaration. Harless discloses that the bolts holding the washer can be backed off slightly creating a recess the extends circumferentially at the perimeter region such that the sleeve is retained when pressure is applied to slide the sleeve off the shaft. <i>The arrangement of the invention is also highly advantageous in facilitating removal and replacement of a gear. To remove a gear, it is only necessary to back off the bolts 9 slightly and introduce oil under pressure through the bore 16 so as to expand the gear hub, where upon the gear will slide back against the washer 8 with no difficulty and may then be removed.</i>	
21g. wherein the recess defines an annular gap between the end retainer and the second end of the shaft sleeve when an underside surface of the end retainer is positioned in contact with the second end of the shaft body.	YES: Harless teaches a gap between an end retainer and the sleeve to both allow the sleeve to move axially to release the press fit and yet be retained so as not to become a projectile and cause safety issues. A POSITA would be motivated to make a simple substitution of an end retainer that has such a gap so as not to rely on a user to back off the bolts the correct amount. If the bolt were to be backed off too much, the additional velocity of the sleeve and the lack of thread engagement could cause the end retainer to fail. It would be obvious for a POSITA to try such an end washer. It would be a predictable solution to eliminate these issues and there would be more than a reasonable expectation of success.
New Element As discussed previously, Harless uses a washer and bolt to during the installation and removal of the sleeve. This installation method performs the same function as the process described in the '090 patent. Harless actually discloses an end retainer that a POSITA would be motivated to try and would make a simple	

substitution to eliminate the issues described above. In the following figure, I have substituted an end retainer (brown) of the shape shown in Fig. 5 of Harless on Fig. 7 of Harless.



This shows an annular gap between the end retainer (brown) and the second end of the shaft sleeve (yellow) when an underside surface of the end retainer (brown) is positioned in contact with the second end of the shaft body (yellow).

Challenged Claim 22	Obvious by Prior Art?
22P. The assembly as claimed in claim 21,	YES: As shown above, the combinations have all the limitations of claim 21.
22a1. wherein the end retainer comprises a first plurality of	YES: Polinski discloses several pluralities of holes distributed circumferentially to attach one part to

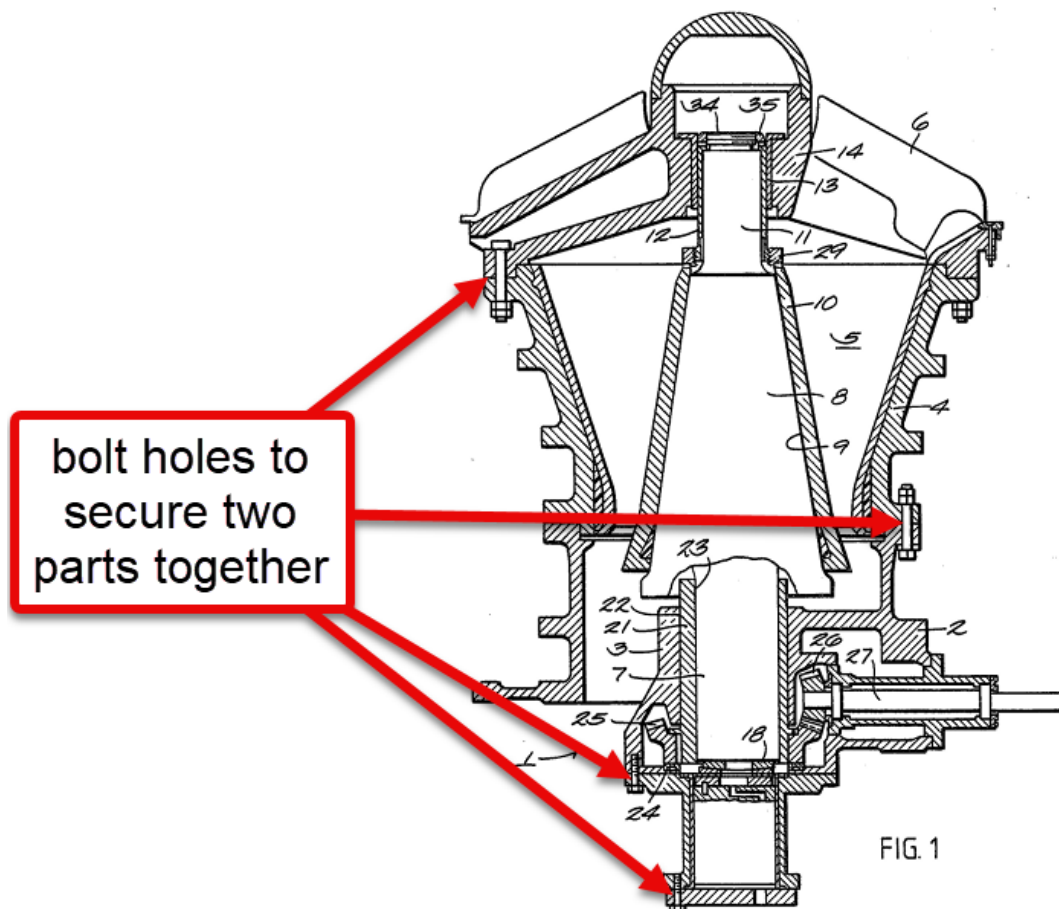
⁵⁷ Harless Figure 7, annotated with Figure 5 end retainer

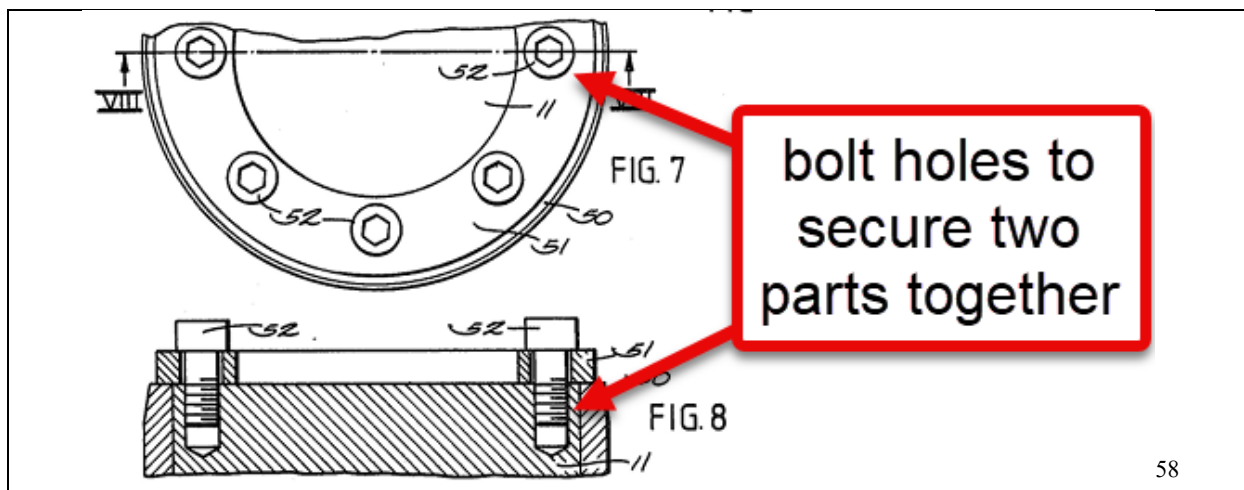
bores distributed circumferentially around the end retainer and configured to align with a plurality of sleeve bores in the second end of the shaft sleeve such that the end retainer can be attached to the shaft sleeve.

the other. It is a known technique to use bolts with aligned bores to attach two separate parts together. This technique is ubiquitous in the mechanical arts and would be well known to a POSITA.

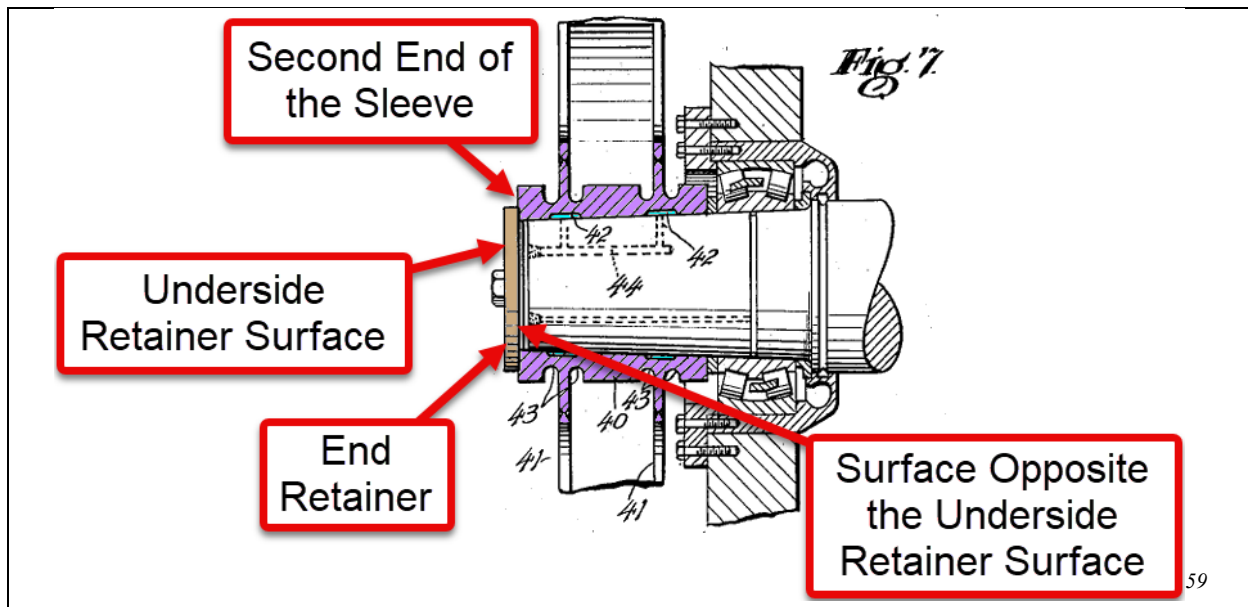
New Claim

Aligning bolt holes to secure two parts together would be obvious to a POSITA. In fact, there are several examples of this in Polinski, as shown below in Figures 1, 7, & 8.





Challenged Claim 23	Obvious by Prior Art?
23P. The assembly as claimed in claim 22,	YES: As shown above, the combinations disclose all the limitations claim 22.
23a1. wherein the end retainer comprises a surface opposite the underside surface of the end retainer configured to mate against the second end of the shaft sleeve when the end retainer is inverted, and	YES: Harless discloses an end retainer configured to mate against the second end of the shaft sleeve when the end retainer is inverted.
New Claim Both sides of the washer, or end retainer of Harless are flat. Therefore, both sides would be configured to mate against the flat end surface of the Harless shaft sleeve.	



23a2. wherein the end retainer is configured to force the shaft sleeve axially over the tapered axial region when a plurality of attachment members extending through a second plurality of bores in the end retainer and into a plurality of corresponding shaft bores in the second end of the shaft body are tightened.

YES: Harless discloses an end retainer configured to force the shaft sleeve axially over the shaft with a bolt. The substitution multiple bolts for the single bolt of Harless would be a simple substitution of one known element for another known in the field (Harless shows many pluralities of bolts used for forcing objects together). Using multiple bolts is certainly known in the field and would only yield a predictable result.

New Claim

As shown in the previous section, Harless discloses a washer, or end retainer, used to force the shaft sleeve axially over the tapered axial region when a attachment member extending through a bore in the washer into a bore in the second end of the shaft body is tightened. It would be obvious to a POSITA that multiple bolts could be used to perform the same function. A POSITA would be motivated to use a plurality of bolts if a single bolt could not deliver sufficient force for the process or if a more even loading to reduce stresses in the washer was desired.

⁵⁹ Harless Figure 7, annotated

Challenged Claim 24 (Substitute for Claim 12)	Obvious by Prior Art?
24P. The assembly as claimed in claim 21,	YES: As shown above, the combinations have all the limitations of claim 21.
24a. further comprising a fluid inlet conduit extending axially from the second end of the shaft body in fluid communication with the at least one groove to allow a fluid to be supplied to the at least one groove from the second end of the shaft body.	YES: Polinski in view Harless and/or Yagi discloses that the main shaft further comprises a fluid inlet conduit extending axially from the second end and provided in fluid communication with the at least one groove to allow a fluid to be supplied to the at least one groove from the second end.
No Change See 12a and 2a in my First Declaration.	
Challenged Claim 25 (Substitute for Claim 13)	Obvious by Prior Art?
25P. The assembly as claimed in claim 21,	YES: As shown above, the combinations have all the limitations of claim 21.
25a. further comprising a fluid inlet conduit extending radially through the wall thickness of the sleeve in fluid communication with the at least one groove to allow a fluid to be supplied to the at least one groove through the sleeve.	YES: Polinski in view of Harless and the knowledge of a POSITA. A POSITA would recognize an optional ordinary design choice of including a fluid inlet conduit extending radially through the wall thickness of the sleeve in fluid communication with the at least one groove to allow a fluid to be supplied to the at least one groove through the sleeve.
No Change See 13a in my First Declaration.	
Challenged Claim 26 (Substitute for Claim 14)	Obvious by Prior Art?

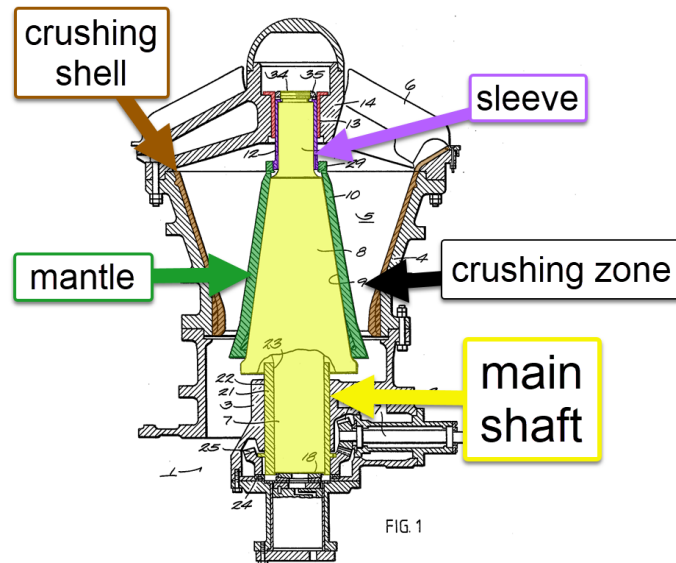
26P. A gyratory crusher comprising;	YES: While the preamble is generally not considered limiting, Polinski discloses a gyratory crusher. ⁶⁰
No Change See 14P in my First Declaration.	
26a. a main shaft including a shaft body having a radially outward facing external surface, a first end for positioning at a lower region of the crusher and a second end for positioning at an upper region of the crusher relative to the first end;	YES: See element 15a above and 14a in my First Declaration.
No Substantive Change: adds semicolon only See 14a in my First Declaration.	
26b. an axial region of the shaft body extending from the second end and being tapered relative to a longitudinal axis of the shaft body such that a cross sectional area of the shaft body at the tapered axial region decreases in a direction from the first end to the second end, the tapered axial region being configured to mount a shaft sleeve;	YES: See element 15b above and 14b in my First Declaration.
No Change See 14b in my First Declaration.	
26c. a sleeve fitted over the tapered axial region, the sleeve having a tapered wall thickness such that a wall thickness at a second upper end of the sleeve is greater than a wall thickness at a first lower end of the sleeve; and	YES: See element 15c above and 14c in my First Declaration.
No Change See 14c in my First Declaration.	

⁶⁰ Polinski 1:44

26d. at least one groove indented at the external surface and positioned at the tapered axial region, the at least one groove being arranged to receive a pressurized fluid to facilitate mounting and dismounting of the sleeve at the shaft body,	YES: See element 15d above and 14d in my first declaration.
No Change See 14d in my First Declaration.	
26e. wherein the shaft sleeve is configured such that when positioned on the shaft body, the shaft sleeve is independent of a crushing head and a crushing shell.	YES: Polinski discloses a sleeve that is independent of the crushing head and a crushing shell.
New Element As the term “independent” is not found anywhere in the '090 specification, a POSITA would be left with extrinsic definitions to understand the meaning of this claim element. Independent – b1. not requiring or relying on something else: not contingent.⁶¹ Independent – 5. not relying on another or others for aid or support.⁶²	

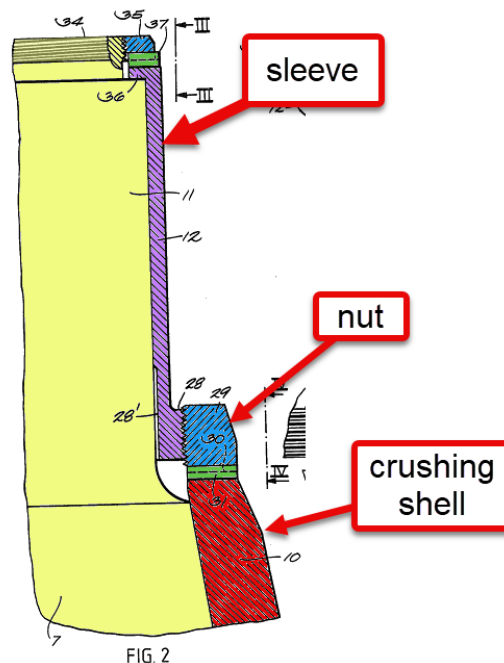
⁶¹ <https://www.merriam-webster.com/dictionary/independent>

⁶² Webster’s Unabridged Dictionary 2001 p.970



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The shaft sleeve of Polinski is press-fit to the main shaft body. This means the shaft sleeve is dependent on the shaft body for its support. The shaft sleeve is essentially bonded to the shaft body. The sleeve in Polinski is not supported by a crushing head or crushing shell. Therefore, a POSITA would understand that the sleeve of Polinski is independent of the crushing head and crushing shell.



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⁶³ Polinski Figures 1 annotated

⁶⁴ Polinski Figures 2 annotated

“As shown in FIGS. 1 and 2, the bearing sleeve 12 extends generally coextensively with the bearing journal 11 and includes an externally threaded annular shoulder 28 about its lower periphery threadably receiving a head nut 29. The head nut 29 abuts the upper edge 30 of the mantle 10 to secure it to the tapered portion of the main shaft 7...”⁶⁵

As shown in Figure 2 from Polinski above, the mantle, or crushing shell is not even attached to the shaft sleeve. A POSITA would the sleeve of Polinski to be independent of the crushing shell and crushing head as it is not attached to either of them.

59. As shown above, the combination of Polinski in view of Harless and/or Yagi and the knowledge of a POSITA renders obvious all of the Substitute Asserted Claims of the '090 patent. A POSITA will be familiar with the common design elements normally used in conjunction with tapered interference joints. Further a POSITA will be familiar with many of the available design choices that can be made with tapered interference joints. The '090 patent merely describes the use of ordinary and highly predictable design elements used for tapered interference fits as would be expectable when used on the main shaft of a gyrating rock crusher.

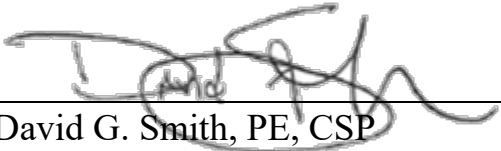
VI. CONCLUSION

60. For these above stated reasons, it is my opinion that challenged claims of the '090 patent would have been obvious to a person of ordinary skill in the art.

61. I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true,

and further that these statements were made with the knowledge that willful, false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Executed on 16 September 2025 in Meridian, ID.



David G. Smith, PE, CSP