

Filed September 4, 2024

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

CMS CEP COR LTD., and
CMS CEP COR AMERICAS LLC,
Petitioners,

v.

SANDVIK INTELLECTUAL PROPERTY AB,
Patent Owner.

Case No. IPR2024-01380
Patent No. 9,827,568

**DECLARATION OF DAVID SMITH IN SUPPORT OF PETITION
FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 9,827,568**

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I. INTRODUCTION

1. I, David G. Smith, submit this 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. 9,827,568 ('568 patent or Pat '568).

2. The subject of my declaration is the invalidity of the '568 patent. This declaration is provided after my review and analysis of the '568 patent, the prior art, relevant background technology, and is also based on my education and experience, as well as additional materials identified herein.

II. BACKGROUND AND QUALIFICATIONS

3. Beusse Sanks, PLLC and Gunster, Yoakley & Stewart, P.A. have retained me as a technical expert in this action.

4. I have attached, as Exhibit 1, a copy of my Curriculum Vitae, which outlines my educational and employment history. I received a Bachelor's degree in Mechanical Engineering from Brigham Young University - Idaho. I received a Master's of Science degree in Mechanical Engineering from Brigham Young University (BYU), and a Masters of Business Administration from Brigham Young University (BYU) with an emphasis in Product Development. I am a licensed professional engineer (PE) and a certified safety professional in comprehensive practice (CSP).

5. I have experience in the fields of mechanical engineering, structural design, new product development, the design of equipment, machinery, safety and consumer products. In my role as a consultant, I have consulted on numerous products and custom testing devices. Among the products I have consulted on are drill rigs, pipe breakers, brick saws, auger conveyors, belt conveyors, dry bulk trailers, rock slingers and dump trailers.

6. I am a named inventor on seven U.S. Patents. I believe that my credentials as set forth above and, in my Curriculum Vitae, demonstrate that I am an expert in the fields of mechanical design, structural design, product design, design of equipment, and design safety.

7. I have attached as Exhibit 2 a list of all my deposition or trial testimony in the last four years.

8. In forming my opinions, I have considered the documents listed in Exhibit 3 in addition to any other documents cited in this declaration. To the best of my knowledge, these documents are true and accurate copies of what they purport to be. An expert in the field would reasonably rely on them to formulate opinions such as those set forth in this declaration.

III. LEGAL PRINCIPLES

9. I am not a lawyer. Therefore, in formulating my opinions and conclusions in this proceeding, I have been provided with an understanding of the

relevant aspects of U.S. patent law that govern the issues of patent validity.

A. Prior Art

10. I understand that, in this IPR proceeding, the prior art to the '568 patent includes patents and printed publications in the relevant field(s) that predate the respective patent's priority date. I am informed that the effective filing date for this analysis is August 2, 2012.

B. Obviousness

11. I understand that a claim of a patent may be obvious to a person of ordinary skill in the art if the differences between the subject matter set forth in the patent claim and the prior art are such that the claimed subject matter as a whole would have been obvious at the time of the invention.

12. I understand that obviousness is a determination of law based on various underlying determinations of fact. In particular, these underlying factual determinations include (1) the scope and content of the prior art; (2) the level of ordinary skill in the art at the time the claimed invention was made; (3) the differences between the claimed invention and the prior art; and (4) the extent of any proffered objective "indicia" of non-obviousness. I understand that the objective indicia, also known as secondary considerations, which may be considered in such an analysis include, among other factors: the commercial success of the patented invention (including evidence of industry recognition or

awards), the existence of a long-felt but unmet need in the field satisfied by the invention, the failure of others to arrive at the invention, industry acquiescence and recognition of the invention, initial skepticism of the invention by others in the field, the extent to which the inventors proceeded in a direction contrary to the accepted wisdom of those of ordinary skill in the art, and licensing of the patent.

13. In determining the scope and content of the prior art, I understand a reference is considered prior art for the obviousness analysis if it falls within the inventors' field of endeavor. Additionally, a reference is prior art for the obviousness analysis, even if from a different field of endeavor, if it is reasonably pertinent to the particular problem for which the invention was made. A reference is reasonably pertinent if it is something a person of ordinary skill in the art would have looked to when attempting to solve the problem.

14. While multiple prior art references or elements may be combined to render a patent claim obvious, I understand that a patent claim composed of several elements is not proven obvious merely by demonstrating that each of its elements was, independently, known in the prior art. I understand that I should consider whether there is an "apparent reason" or motivation to combine the prior art references or elements in the way the patent claims. It is my further understanding that the law recognizes several rationales for combining references or modifying a reference to show obviousness of claimed subject matter. Some of these rationales

include: combining prior art elements according to known methods to yield predictable results; simple substitution of one known element for another to obtain predictable results; a predictable use of prior art elements according to their established functions; applying a known technique to a known method or product ready for improvement; and choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success.

IV. THE LEVEL OF ORDINARY SKILL IN THE ART

15. I have been advised by counsel that the Federal Circuit has noted a list of six factors that may be considered when determining the level of ordinary skill in the art. The factors are listed below. I have used the factors in combination with the available information in determining the level of ordinary skill in the art.

- A. The education level of the inventor.
- B. The type of problems encountered in the art.
- C. Prior art solutions to those problems.
- D. The rapidity with which innovations are made.
- E. The sophistication of the technology.
- F. The education level of active workers in the field.

A. The education level of the inventor(s)

16. The named inventors on the '568 patent are shown in the table below:

'568 Patent – Named Inventors
Niklas Aberg – Sodra Sandby (SE)

17. I have located public information on the level of education for some of the above-named inventors. For example, Mr. Niklas Aberg has a Masters of Science degree in Mechanical Engineering.¹ Mr. Fredrik Rosdahl doesn't list his educational background on his LinkedIn profile but his work history shows he has filled engineering roles professionally.²

B. The type of problems encountered in the art.

18. The field of the '568 patent pertains to rock crushing machinery. Rock crushing equipment must repeatedly produce extremely large crushing forces in highly abrasive environments. Crushed rock is used for a wide variety of applications including feeding societies insatiable demand for aggregate, a key input for concrete which makes up a large part of the infrastructure for society and is the single most widely used construction material worldwide with billions of tons used each year.³ Crushed rock is also used to create aggregate input for asphalt, another major construction material. Currently about 375 million tons of asphalt are produced every year⁴ which requires significant input for crushed rock. Other uses of crushed rock include structural base for foundations, railroads,

¹ Exhibit 1003, accessed 8-8-2024

² Exhibit 1004, accessed 8-8-2024

³ Exhibit 1005, accessed 8-5-2024

⁴ Exhibit 1006, accessed 8-5-2024

drainage, and even landscaping in general. In total 1.5 billion tons of crushed stone was produced in 2021 and the use of crushed stone has been consistently trending upward.⁵ Common types of rock that are crushed include limestone, dolomite, granite, marble, slate, quartzite, and more. Some rocks, like granite, marble, and quartzite are extremely hard and abrasive.

19. Cumulatively, the demand for crushed rock is enormous, which drives the need for production machinery as well as the need to run production machinery for as many hours as possible. Considering the heavy nature of the task of crushing rock, this can lead to significant maintenance requirements which includes the need to repeatedly assemble and disassemble to replace consumables.

20. Further still, other commonly encountered issues with rock crushing include feeding issues such as how to recover from a jam and how to handle uncrushables that inevitably get in the mix. Jamming may occur when a rock of the right size and orientation is fed into the crushing chamber and is unable to make it to the crush zone such as shown below:

⁵ Exhibit 1007, accessed 8-5-2024



21. Another significant problem that can occur is when the rock feed is contaminated with uncrushables, which are foreign object that cannot be crushed such as large chunks of steel. Uncrushables present a significant hazard to rock crushing machinery as they can cause significant damage to components resulting in large maintenance costs and downtime.

C. Prior art solutions to those problems.

22. The prior art presents many solutions to the above-mentioned problems. For example, jaw-style rock crushers use highly abrasion resistant materials on the jaws to handle long term use, wear, and tear. The jaw panels are commonly designed to have stout ribs that interleave, creating a three-point bending load setup on the rock, significantly reducing the amount of force required

⁶ Exhibit 1008, accessed 8-5-2024

to break the rock. This rib structure also makes the crushing zone relieved so that broken rock has somewhere to go rather than being further compacted. Rock crushers use an incrementally progressive tapered crushing zone which spreads the crushing operation to fracture events. This spreads out the rock breaking action thereby further reducing the necessary force. Gyratory rock crushers similarly use highly abrasion resistant materials and a tapered crush zone that spreads out the crushing operation over time and space.

23. Rock crushers of all types commonly incorporate an eccentric over-center drive that is capable of generating significant amounts of periodic mechanical advantage and therefore force. Jaw-style crushers commonly incorporate large flywheels that build up momentum that can be put back into the jaws system as-needed. These features allow the drive systems to be reasonably sized while still reliably performing the crushing operations.

24. The prior art teaches having a protective abrasion and deformation resistant shell positioned over top of key areas inside the crushing zone. Not only do these protective shells protect the underlying components from the enormous contact pressures and stresses, they are also commonly separate pieces that are replaceable as-needed.

25. Beyond this rock crushers in the industry have been provided with various adjustment means to control the degree of crushing implemented. The size

of the aggregate needed will depend on the needs of the application. Consequently, it is not uncommon for rock crushers to be provided with an adjustment means to accomplish this. Further still, it is not uncommon for rock crushers to be provided with a relief mechanism that allows it to pass uncrushables. In gyratory cone crushers this is known to be accomplished by mounting the cone on a hydraulic ram that allows it to be retracted a sufficient distance to allow an uncrushable to pass before returning back to normal operating conditions. This allows a small amount of uncrushed rock to pass along with the uncrushable but crucially prevents the system from destroying itself against an uncrushable particle.

26. As mentioned previously, despite being designed to avoid jamming, inevitably, jamming can occur with a rock crushing machine. When this happens, various systems and tools have been devised to remove a jam so that the crushing operation may proceed. Some systems are as simple as having manual labor swing a sledge hammer at a jammed rock on a small enough machine. Other solutions involve placing wedges into the machine to help it grasp a rock particle in the right way so as to crush it. Still others systems involve crane elements or active jackhammering elements to either re-orient or partially break up the stubborn rock particle.

D. The sophistication of the technology.

27. Fundamentally, the function and motion of rock crushers is fairly

simple. Whether it is a reciprocating jaw crusher, a gyrating cone crusher, or other design topology, rock crushing machinery generally has a crushing zone with a simple fixed member and a driven member. However, rock crushers are fairly complex machines. Crushers incorporate complicated physics, fracture mechanics, material science, and drive systems. Rock crushers commonly incorporate extensive interconnected mechanical systems, as well as electrical systems, and hydraulic systems. All of these systems must seamlessly cooperate in order for the rock crusher to do its job. Successful design of a rock crusher requires an understanding of tribology, fracture mechanics, and fluid mechanics to understand how to make a system that will guide widely varying particles of rock into the correct level of depth in the crushing zone, and then apply crushing forces without allowing the rock to slip back up and avoid being crushed. Crushed rock, especially granite and quartzite are notoriously abrasive and will test the durability of any system or material. Enhancing product life expectancy and reducing downtime for maintenance requires careful structural and fatigue analysis and intricate knowledge and extensive testing.

E. The rapidity with which innovations are made.

28. Rock crushing machinery has been designed, manufactured, and operated for over 150 years. Innovations have been slow and incremental over time. Some of the rock crushing machinery (notably jaw crushers) use similar

design topology to the original jaw style rock crusher by Eli Whitney. Gyrating cone crushers have been around for about 100 years and have been seeing slow and incremental improvements over time. Designing, building, and testing rock crushing machinery is no small task. It will typically require teams of people to accomplish the production of a single design. As such, innovations are going to be slow due to the time and cost involved.

F. The education level of active workers in the field.

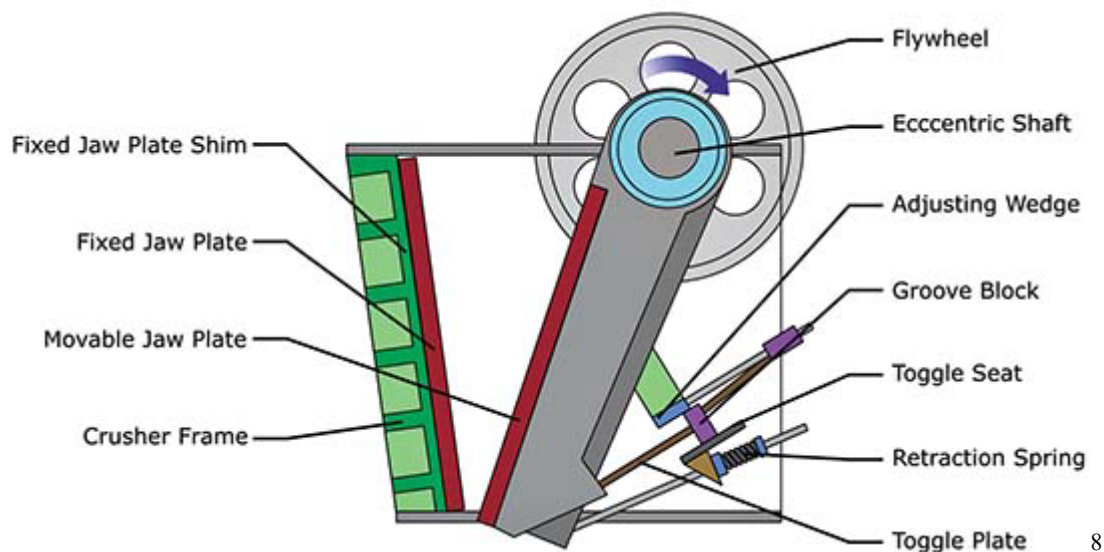
29. Active workers in the field would typically be individuals with a bachelor's degree in mechanical engineering who may be fresh out of college and have no professional experience. Teams will also invariably require experienced engineers to help guide the process in the correct direction.

30. Considering the above, it is my opinion that at the time of the invention and the Challenged Claims of the '568 patents, a person having ordinary skill in the art would be a person who has a bachelor's degree in mechanical engineering or a related field, and at least 2 years of experience with industrial equipment design and development. A POSITA may also have a combination of more formal education and less work experience or a combination of less/different formal education and more work experience. I use that level of skill in forming my opinions and reaching my conclusions herein, unless otherwise stated. As a result of my education and experience, I am qualified to testify as a person of ordinary skill in the art (POSITA)

in this case.

V. BACKGROUND AND STATE OF THE ART

31. As discussed previously, the present matter relates to gyrating rock crushers. Before the advent of crushing machinery, aggregate was produced with manual labor such as by using hammers and pickaxes to break boulders and rocks into smaller pieces. The labor requirements were steep, which led to the development early mechanized rock crushing machinery. Eli Whitney Blake (the nephew of Eli Whitney who invented the cotton gin) is credited with inventing the first reciprocating jaw rock crusher in the 1850's.⁷ The basic reciprocating jaw crusher (a design still in use to this day) is shown below:



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⁷ Exhibit 1009, accessed 7-30-2024

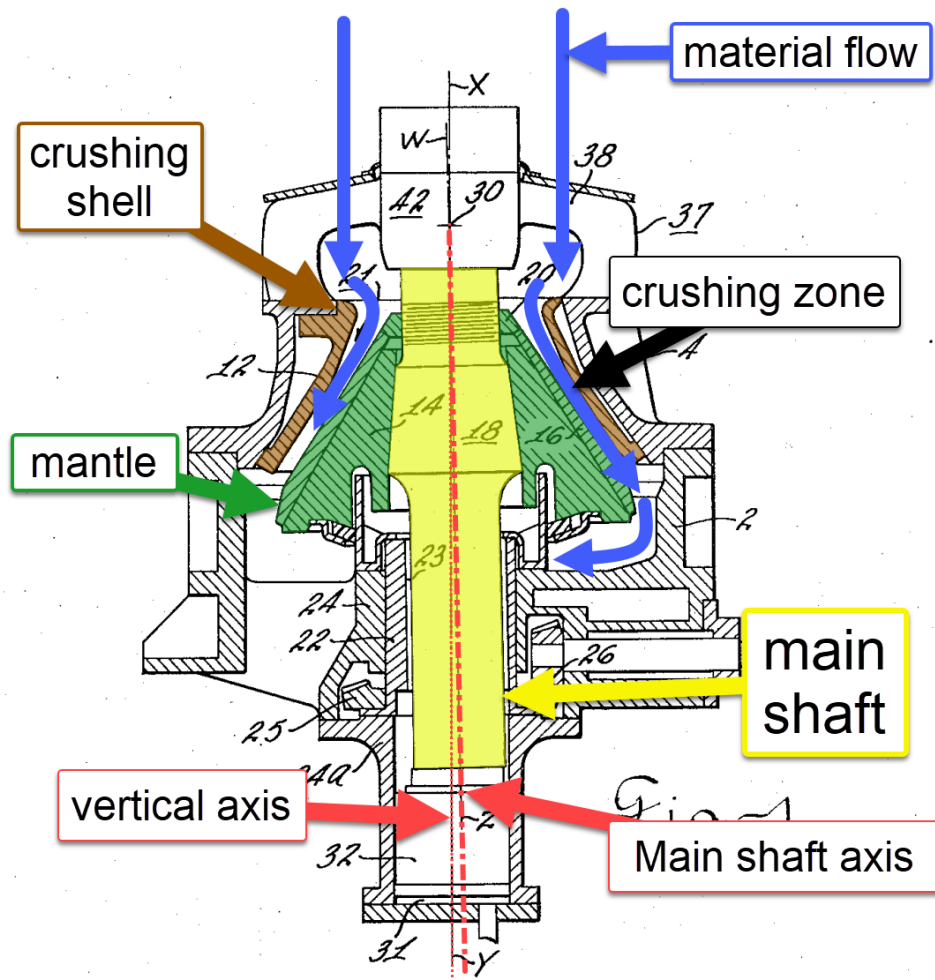
⁸ Exhibit 1010, accessed 7-30-2024

32. As shown above, the jaw crusher uses two jaws (one stationary and one reciprocating) arranged in a V-shape that successively crushes rock into smaller and smaller pieces.

33. The invention of the reciprocating jaw crusher was a quantum leap over manual labor in the rock crushing industry. As time went on, various improvements have been made to this design. Notably, modern jaw crushers have added the ability to pass uncrushable objects (such as large steel scrap) without damaging the equipment. Depending on the size, shape, orientation, and sequence of the rock entering the crusher, it is possible for a jam to occur. Various methods for eliminating jams have been devised, which typically require manual input or attention.

34. The gyrating cone crusher was first introduced to the market in the 1920's by the Symons brothers.⁹ The design topology for a typical gyrating cone crusher (as shown in US 3,813,047 to Torrence) is shown below:

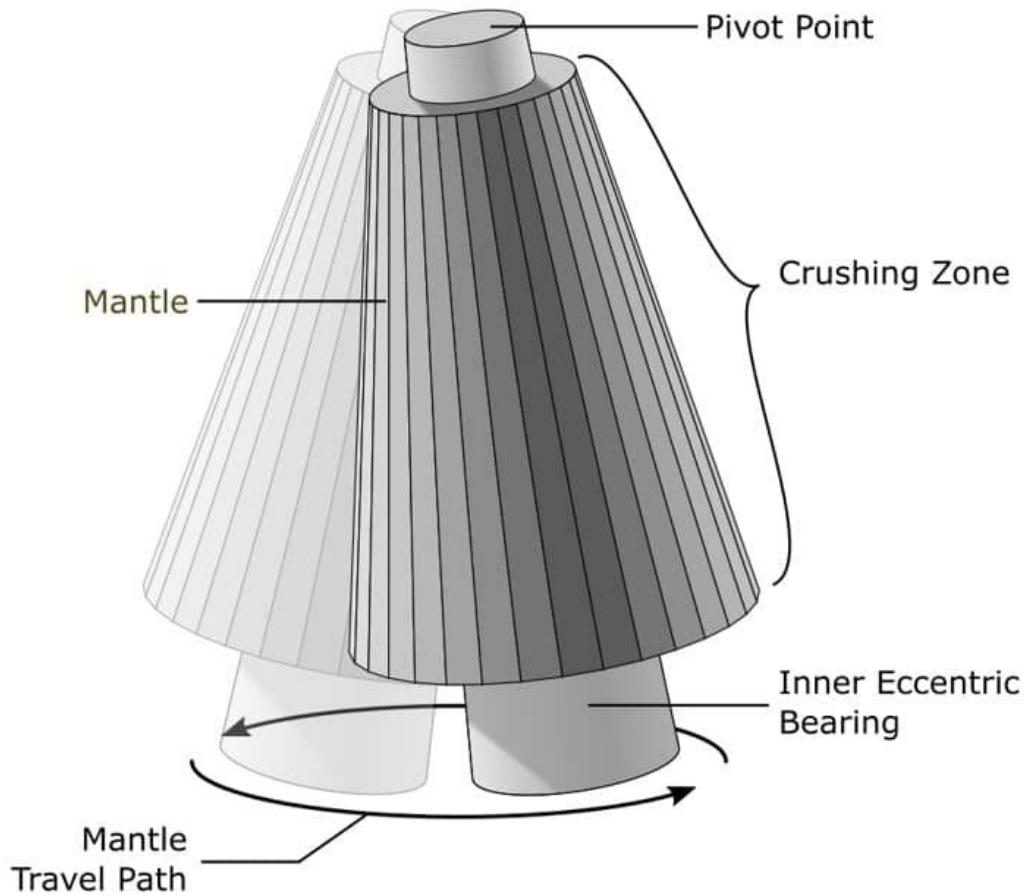
⁹ Exhibit 1012, accessed 7-30-2024



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35. As shown above, the typical gyrating cone crusher has a central main shaft fitted with an internal crushing shell (mantle). The main shaft and mantle are situated inside an external crushing shell with some clearance there between (the crushing zone). The main shaft is driven by an eccentric drive about an axis that makes it rotate and gyrate. The gyrating motion of the eccentric drive is shown below:

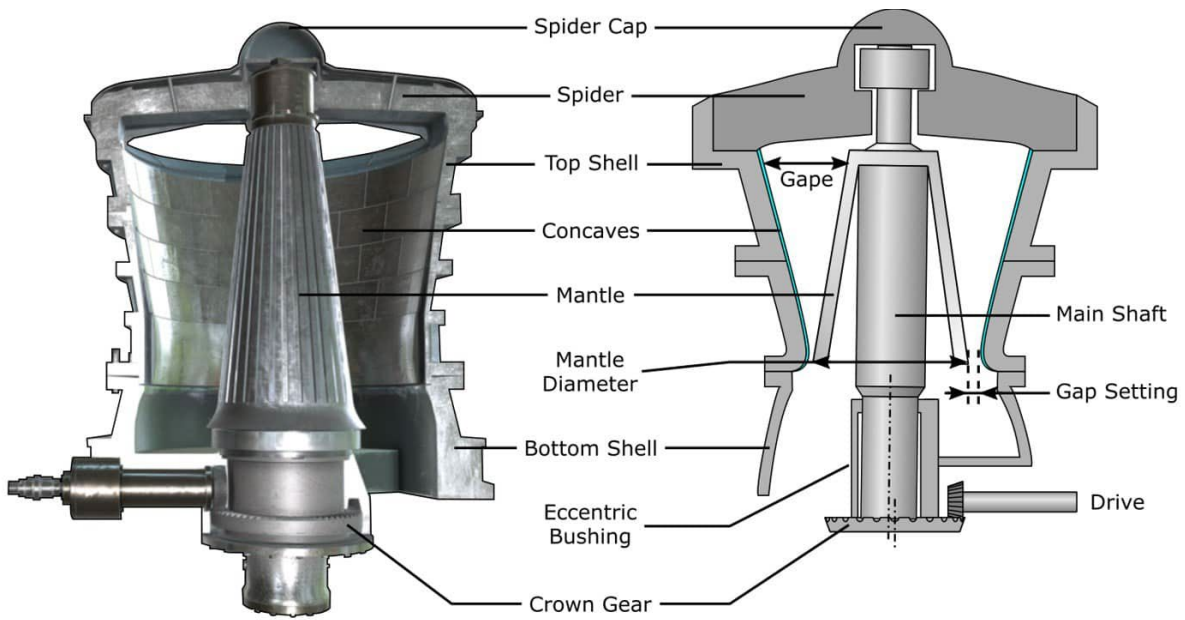
¹⁰ Exhibit 1011, Figure 1, annotated



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36. The gyrating motion of the eccentric drive (shown above) allows rock to slide into the crushing zone and be sequentially crushed into smaller and smaller pieces until it is discharged out the base of the machine. For further clarity, the figure below shows how the diagram of a gyratory cone crusher relates to a physical build:

¹¹ Exhibit 1013, accessed 7-30-2024



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37. As discussed previously, the present matter relates to a patent on a particular gyrating cone crusher. The main figure of the '568 patent is shown below:

¹² Exhibit 1014, accessed 7-30-2024

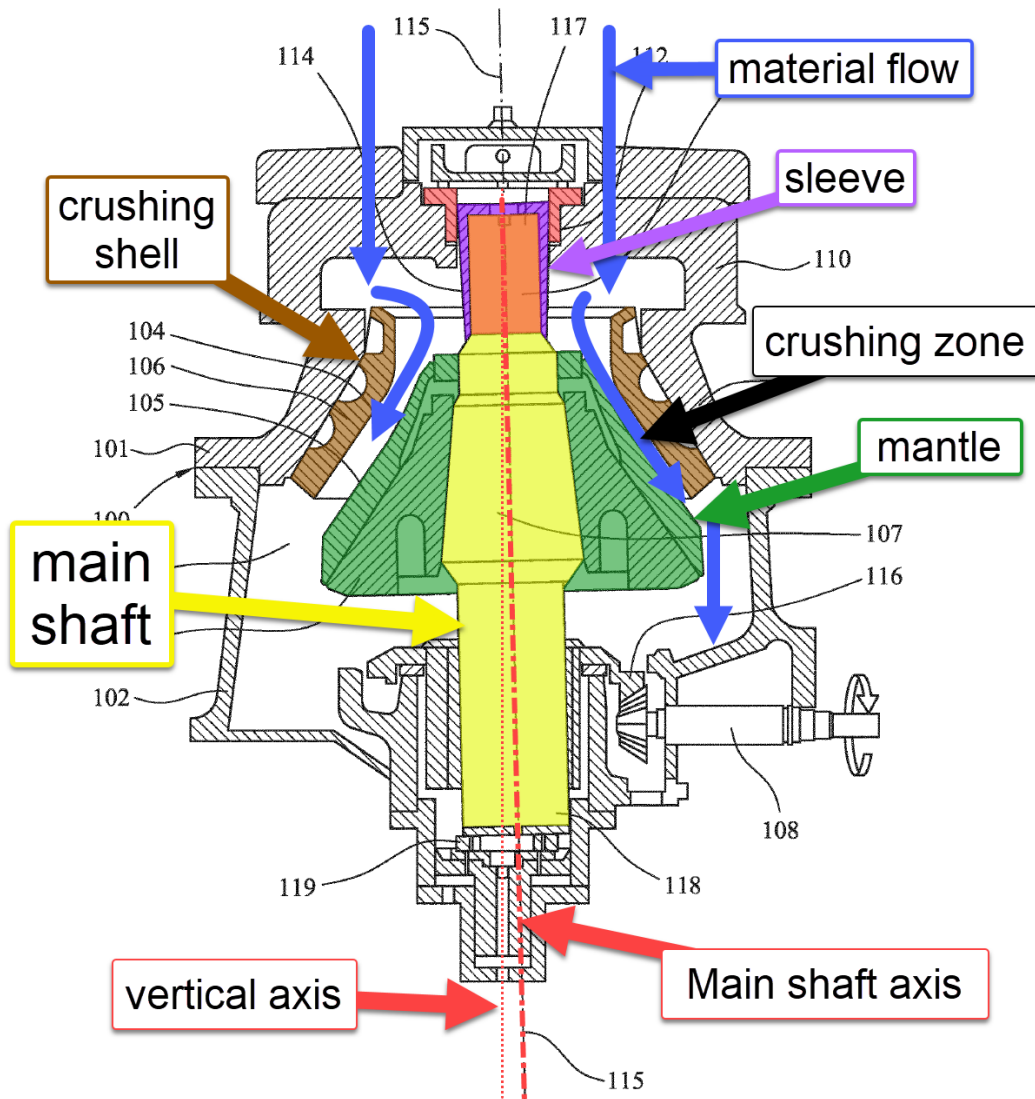
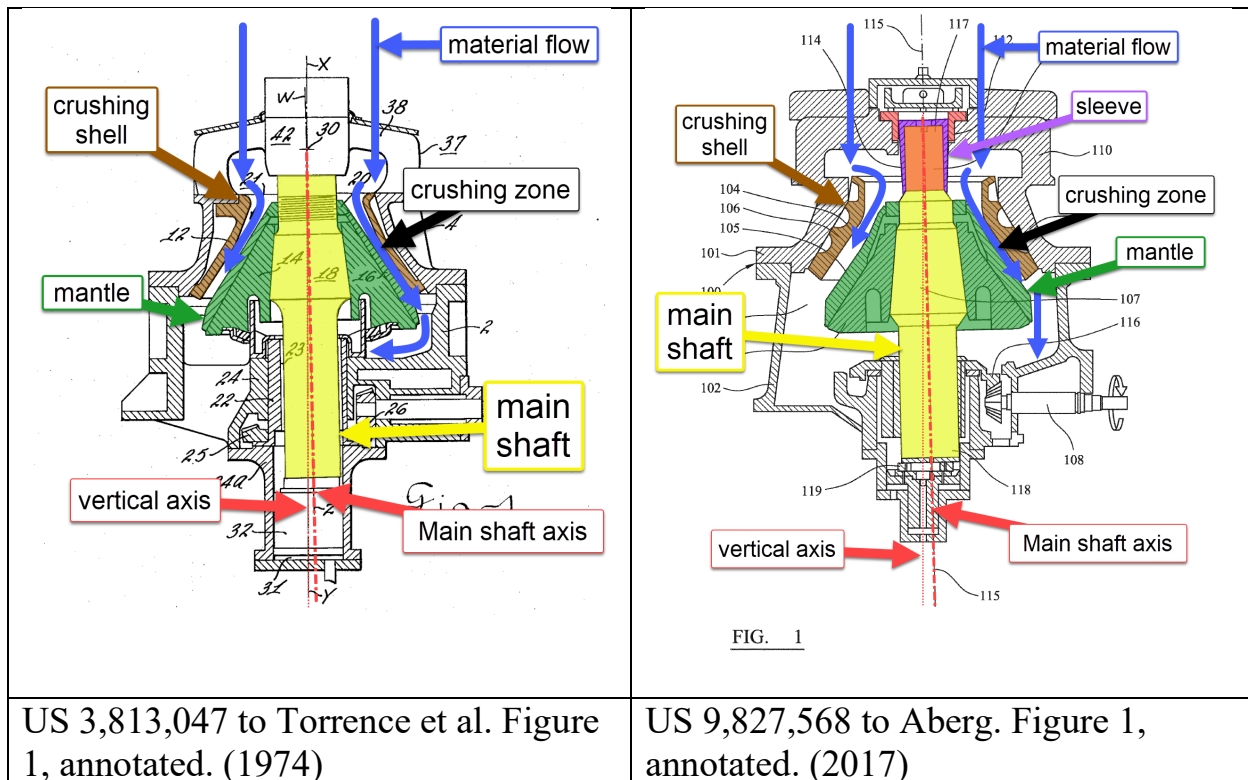


FIG. 1

38. As can be seen above, especially as compared with the Torrence cone crusher, the '568 patent shows a cone crusher of typical design. It has a main shaft fitted with a mantle on an eccentric drive. The central cone shaft assembly is mounted internal to a crushing shell creating a crushing zone.



39. The '568 patent does not claim to disclose a new cone crusher design topology. Rather, the '568 patent claims to disclose an allegedly new and non-obvious arrangement for assembling, disassembling, and supporting the topmost portion of the main shaft. Specifically, the '568 patent states:

*"It is an object of the present invention to provide a sleeve for a main shaft of a gyratory crusher that enables convenient attachment and detachment at the shaft so as to be quickly and conveniently assembled and disassembled."*¹³

40. However, as will be demonstrated in this declaration, the '568 patent does not disclose anything new and non-obvious whatsoever. To the contrary, the '568 patent merely uses ordinary, well-known design elements to produce

¹³ Exhibit 1001, 1:66-2:2

predictable results. It is the result of nothing more than standard engineering design and does not present anything inventive. For example, the '568 patent describes including a sleeve fitted over the topmost portion of the main shaft of the gyratory crusher. The sleeve is provided with a tapered interference fit of ordinary design. Optionally, the sleeve may also comprise a fluid pathway where a fluid such as oil may be supplied under pressure to assist with mounting or dismounting the tapered sleeve. Finally, the sleeve may optionally have a flared base which tapers the sleeve thickness to zero allowing it to match corresponding geometry of the main shaft. As will be demonstrated, each of these design elements are ordinary and well-known to a POSITA. Further, each of these design elements are well understood and the prior art teaches their use in rock crushing machinery already.

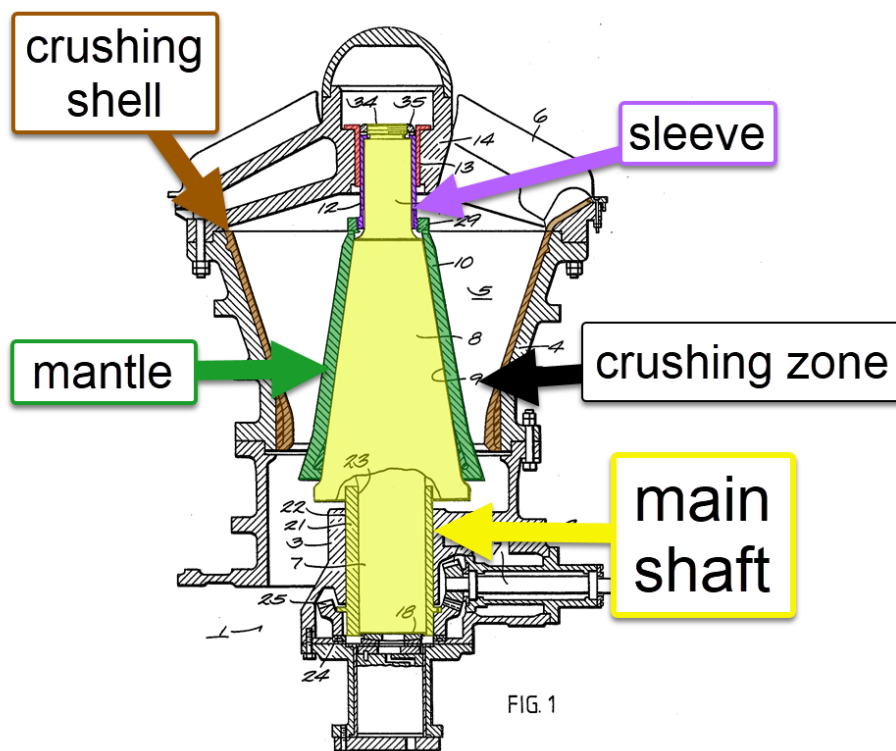
A. Gyratory Crusher with Wear Sleeve

1. U.S. Patent Publication No. 4,410,143 to Polinski

41. Gyratory crushers with wear sleeves were known in the art. For example, U.S. Patent Publication No. 4,410,143 ('143 patent or Pat '143) to Polinski describes a prior art system for a gyratory crusher with a bearing sleeve fitted over an upper region of a main shaft. The '143 patent is not listed as a cited reference for the '568 patent. I understand Polinski is prior art to the '568 patent because it was filed September 26, 1980, which is well before the earliest filing date for the '568 patent in 2013. I am not aware of any information suggesting the

'568 patent inventors made their alleged invention before June 20, 2013.

42. The Polinski gyratory crusher with wear sleeve in FIG. 1 of the '143 patent is shown below.



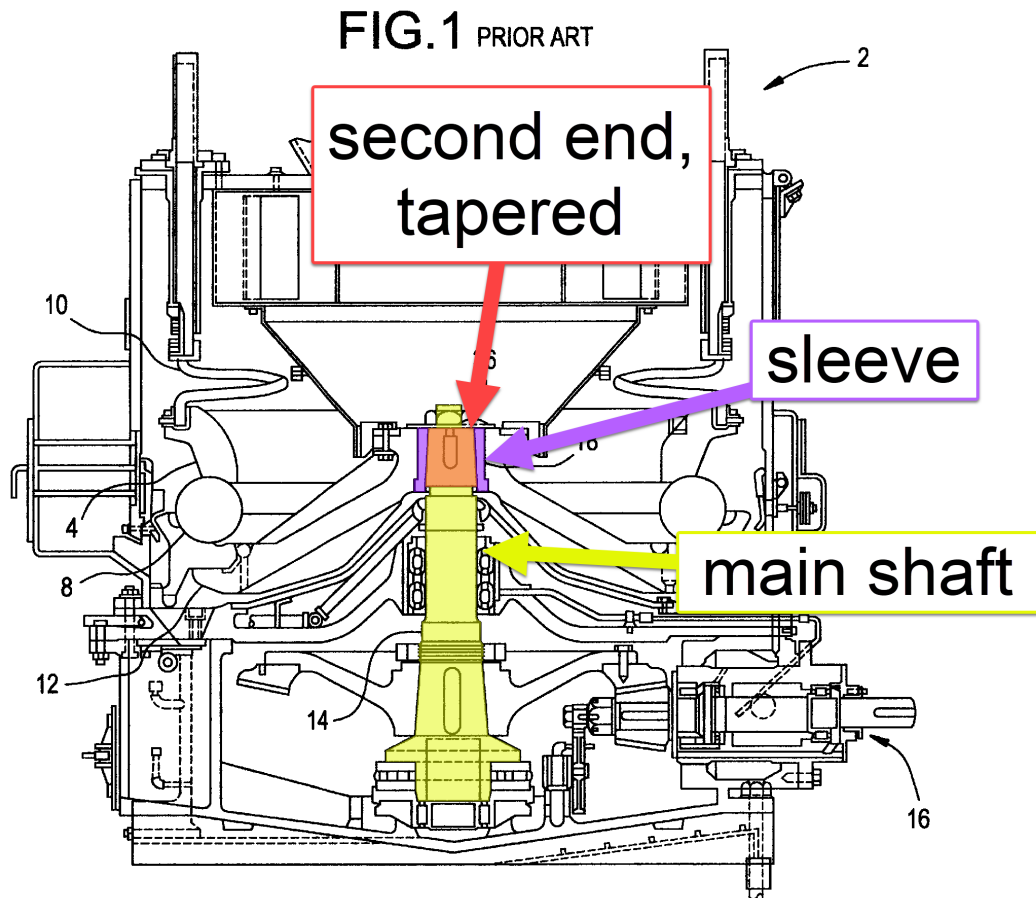
14

2. U.S. Patent Publication No. 6,270,026 to Piepho et al

43. Another example of a rock crusher with a wear sleeve is disclosed in U.S. Patent Publication No. 6,270,026 ('026 patent or Pat '026) to Piepho et al. (Piepho). The '026 patent is not listed as a cited reference for the '568 patent. I understand Piepho is prior art to the '568 patent because it was filed June 5, 1997, which is before the earliest filing date for the '568 patent in 2013. The Piepho rock

¹⁴ Exhibit 1015, Figure 1, annotated

crusher with wear sleeve in FIG. 1 of Pat '026 is shown below.



15

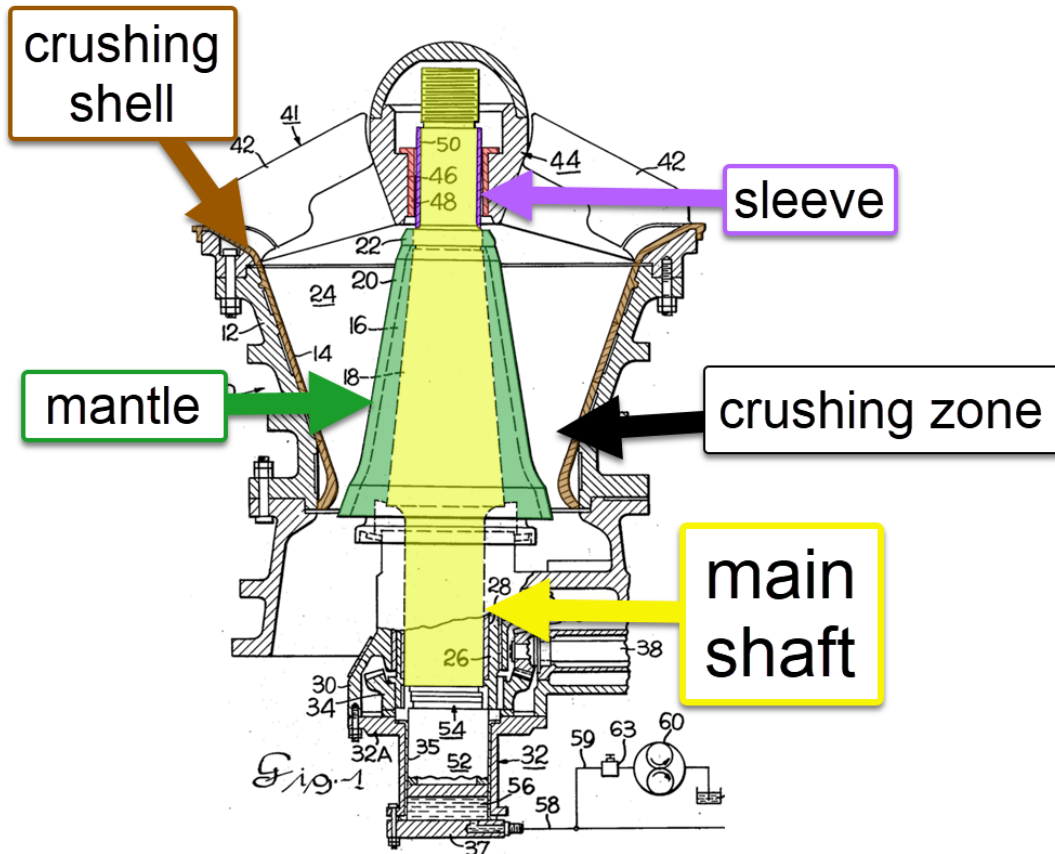
44. As shown in the figure above, I note that Figure 1 of Piepho is listed as representative of the prior art. As such, while Piepho was filed in 1997 as discussed above, Figure 1 of Piepho would have a priority date of at least as early as 1997 or earlier.

3. U.S. Patent Publication No. 4,060,205 to Pollak

45. Yet, another example of a gyratory crusher with a wear sleeve is disclosed in U.S. Patent Publication No. 4,060,205 ('205 patent or Pat '205) to

¹⁵ Exhibit 1016, Figure 1, annotated

Pollak. Pat '205 is listed as a cited reference for the '568 patent. I understand Pollak is prior art to the '568 patent because it was filed November 29, 1977, which is before the earliest filing date for the '568 patent in 2013. Pollak discloses a gyratory crusher with wear sleeve in FIG. 1 of the '205 patent as shown below.



16

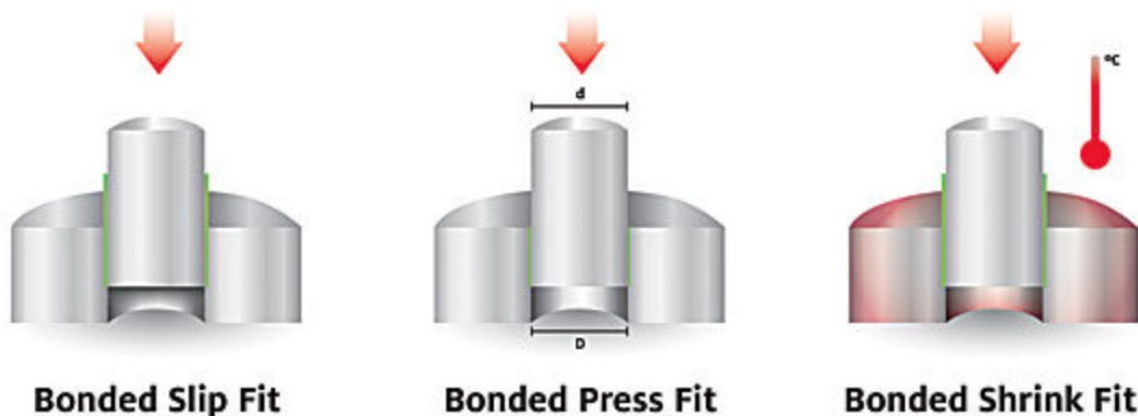
B. Friction Fit Shaft and Sleeve Arrangement

46. The '568 patent describes the use of a friction fit joint between the tapered sleeve and the main shaft.¹⁷ A friction joint is created when a pin or shaft is

¹⁶ Exhibit 1017, Figure 1, annotated

¹⁷ Exhibit 1001, 4:4-12

connected to a bore in a way that requires compression on the pin component and expansion of the bore. Also known as an interference fit joint, a friction fit is so called because the joint is held together by intense pressure developed between the shaft and the bore. The figure below is provided for further clarity:



47. As shown above, three options for bonding a pin or shaft inside of a bore. In the first scenario (bonded slip fit) the pin diameter is smaller than the hole diameter. The pin is capable of sliding (slipping) freely in or out of the bore. A slip fit can be bonded or held stationary by use of adhesives.

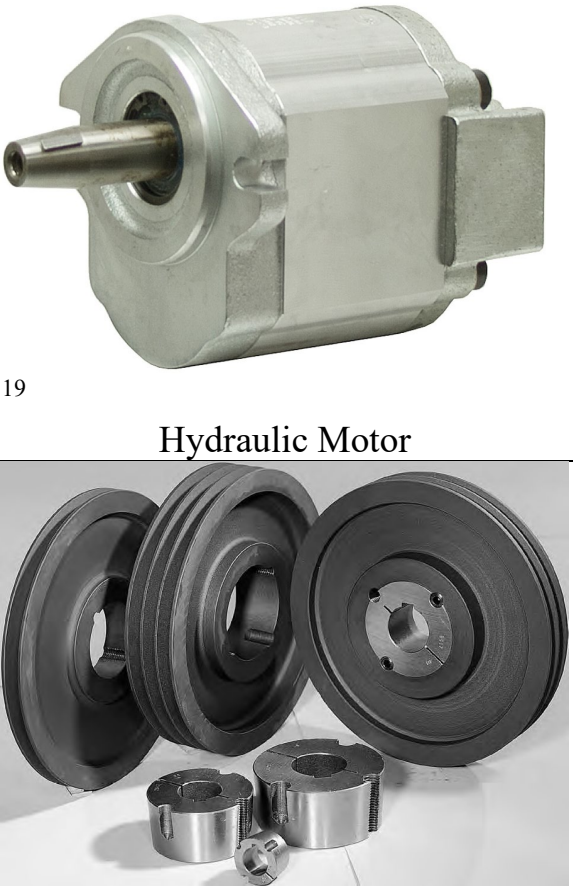
48. In the middle scenario (the press fit) the diameter of the pin is *larger* than the diameter of the bore. This being the case, a pin cannot slide into the bore nor slide freely. This condition is why this type of joint is called an interference fit, specifically because the pin is bigger than the hole. As the name suggests, a “press fit” is one where the degree of interference is small enough that the joint can be pressed together with sufficient force. This pressing action applies radial

compression to the pin (making it a smaller diameter) and radial force outward on the bore surface (making it a larger diameter). When sufficient force is applied the diameters are changed enough to move the pin into the hole. The forces that expanded the hole and contracted the pin generate a large amount of force/pressure and a large amount of friction, holding the pin in place inside of the hole.

49. In the third scenario above (a shrink fit) the degree of interference is commonly even larger than what it would be for a press fit. Typically, the interference in a shrink fit is large enough that the pin and bore cannot be reasonably pressed together. Rather, the bore needs to be heated and/or the pin needs to be cooled. This change in temperature causes the material to expand or contract enabling the pin to be inserted into the bore or hole. As the material returns to an equilibrium temperature, the pin will expand (if it was cooled) and the bore will contract (if it was heated) and the mating joint surfaces will develop extremely high forces/pressures that will effectively bond the two components together by friction.

50. It is well-known in the art and would be well-known to a POSITA that interference fits can be accomplished using a straight cylindrical shape, or a tapered conical shape. Not only are conical interference joints common in rock crushers, they are also common across many industries and applications such as boat propellers, hydraulic motors, pulley hubs, gearboxes, engine shafts, lathes,

drill chucks, etc. They are a standard design element, are well-known, and well understood as demonstrated by the following table:

 18 Boat Propellers	 19 Hydraulic Motor 20 Tapered fit pulley hub
---	--

¹⁸ Exhibit 1018, accessed 7-31-2024. I note that this website was available at least as early as 2010: (https://web.archive.org/web/20101027092713/https://pbase.com/mainecruising/fitting_a_prop) Further, boat propellers have been fitted with tapered interference joints for a far longer time than that.

¹⁹ Exhibit 1019, accessed 7-31-2024

²⁰ Exhibit 1020 accessed 7-31-2024



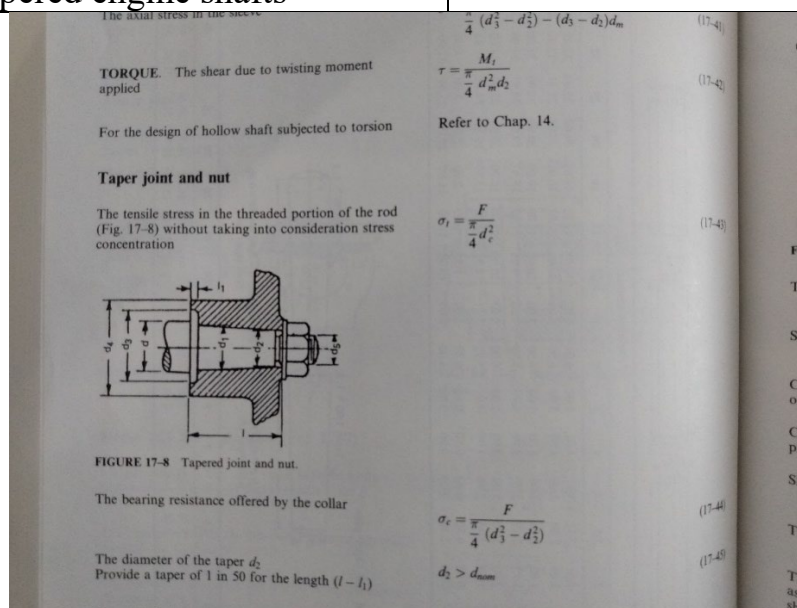
21

Tapered engine shafts

Drill chucks



22



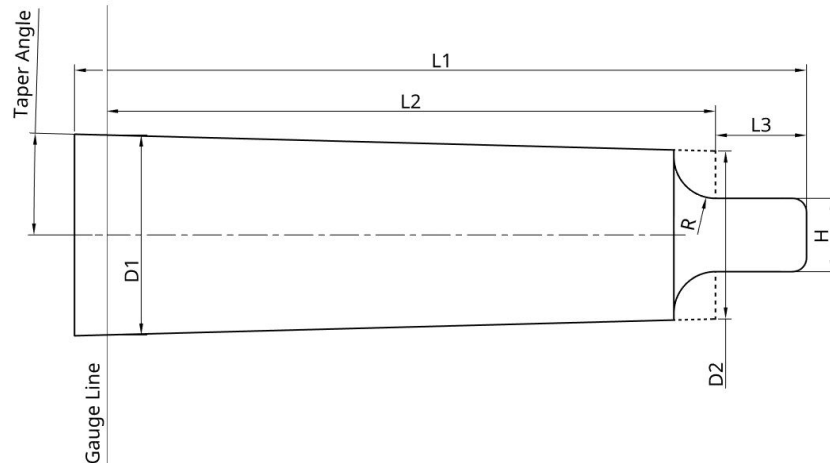
23

I note that tapered interference joints are literally a topic in a typical engineering course on machine design. For example, the above textbook excerpt shows a tapered press fit joint and several formulas of interest for stress calculation.

²¹ Exhibit 1021, accessed 7-31-2024

²² Exhibit 1022, accessed 7-31-2024

²³ Exhibit 1023

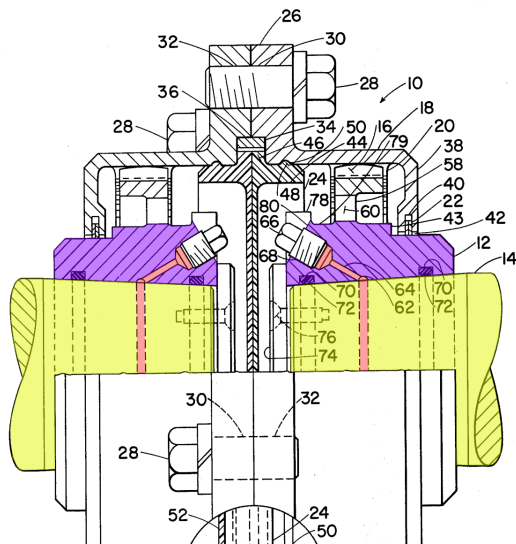


24

The famous Morse taper, also a topic covered in a typical engineering course on machine design, was invented in 1864 by Stephen A. Morse.²⁵ Morse tapers are used to create tapered interference joints commonly used on all manner of shafting for machinery. A Morse taper is a self-holding taper used to reliably hold two components together for transmission of torque.

Engineering standards such as SAE J755 (Exhibit 1026), SAE J1419 (Exhibit 1027), ASME B18.8.2 (Exhibit 1028) and more are written to specify tapered interference fits.

US 4,019,344 to Calistrat (1977)
Symetrical sealed gear coupling



I note that not only does Calistrat disclose a dual tapered interference joint setup, it also features a fluid pathway

US 3,343,376 to K.K. Carman (1967)
Lubricant seal for couplings

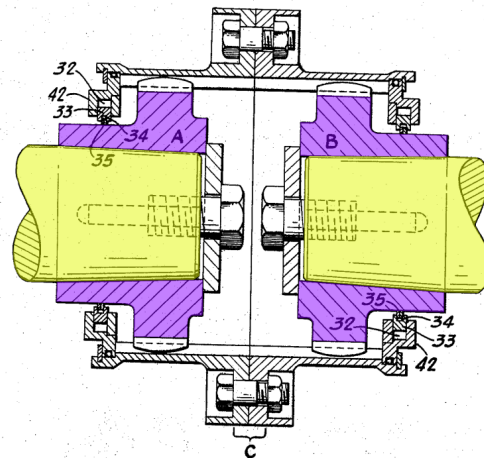


FIG. 8

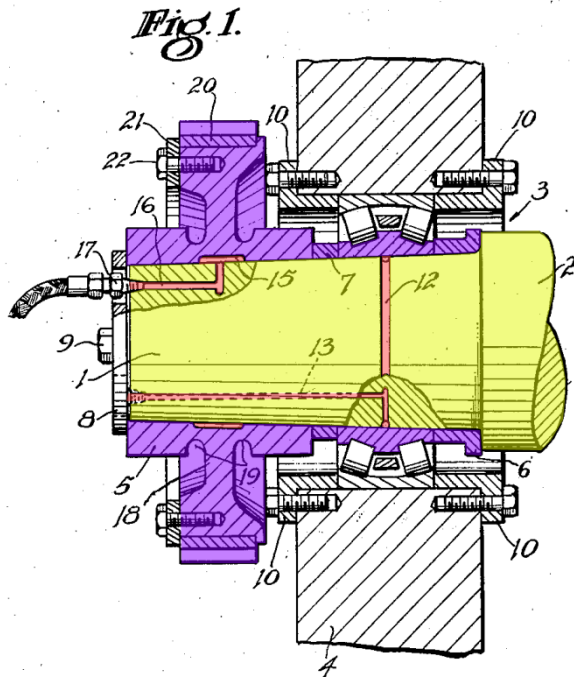
As shown above, two tapered interference joints are disclosed which use hex bolts to apply the

²⁴ Exhibit 1024, accessed 7-31-2024

²⁵ Exhibit 1025, accessed 7-31-2024

which is used to help break the tapered interference joints, as is well known.²⁶

US 2,840,399 to C.A. Harless Et Al (1958) Attachment of Gears to tapered shaft ends

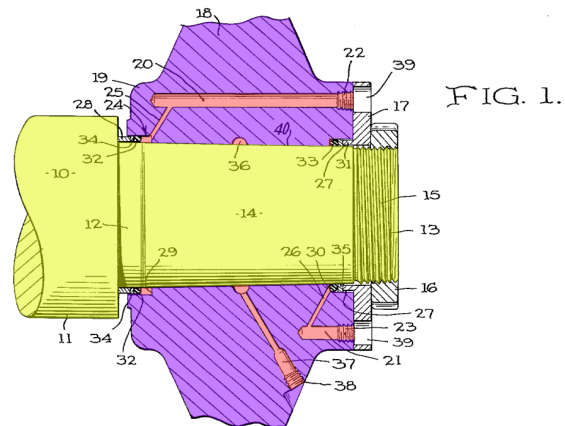


I note that not only does C.A. Harless disclose a tapered interference joint setup, it also features a fluid pathway which is used to help make or break the tapered interference joints, as is well known.

“The shaft is provided with a bore 16 for supplying oil from a removable fitting 17. 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.”

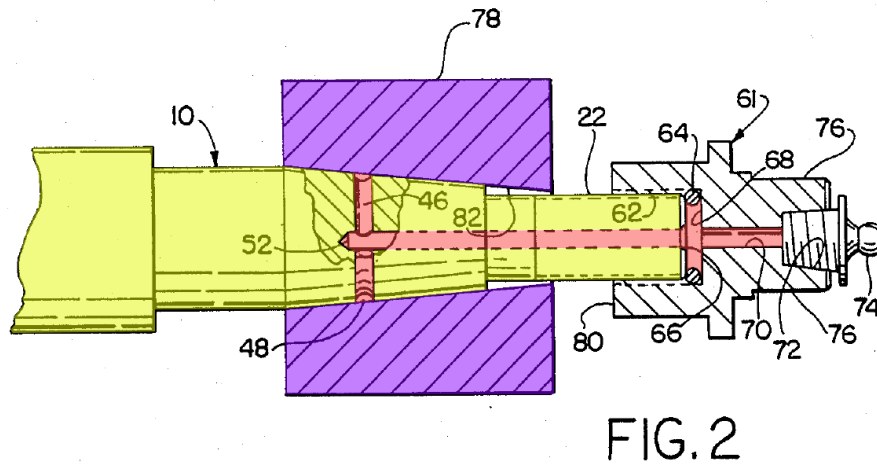
preload. This is an extremely common way for tapered joints to be implemented.

US 3,228,102 to R.E. Sillett (1963) Hydraulic assembly and disassembly of parts having a heavy Interference fit



I note that not only does R.E. Sillett disclose a tapered interference joint setup, it also features a fluid pathway which is used to help make or break the tapered interference joints, as is well known.

²⁶ Exhibit 1029, 3:36-43



51. As shown above, tapered interference joints are extremely common and ordinary in mechanical machine design. Tapered interference fits have significant and important benefits over straight fits, that would motivate a POSITA to incorporate them into the design of equipment, including in the design of rock crushing apparatuses. One important benefit is that with a tapered interference fit, the distance that the sleeve must slide over the shaft while expanded to make the fit is significantly smaller. As illustrated below (left), with a straight interference fit, the sleeve must traverse the entire length of the sleeve while expanded to make the fit. With a tapered joint, (right below) the sleeve can slide freely onto the shaft for the majority of the length and only needs to travel a short distance when expanded to make the joint.



52. Other benefits that would motivate a POSITA to implement the well-known tapered interference fits taught in the prior art include the ease of removal and ability to prevent damage,²⁷ they are able to be used in more locations as they do not require presses and gear pullers,²⁸ and make removing components on a tapered shaft particularly easy,²⁹ particularly when combined with known hydraulic systems for making and breaking the interference fit.

53. Additional examples of tapered interference joints as used with rock crushing apparatus specifically are shown below:

1. U.S. Patent Publication No. 4,410,143 to Polinski

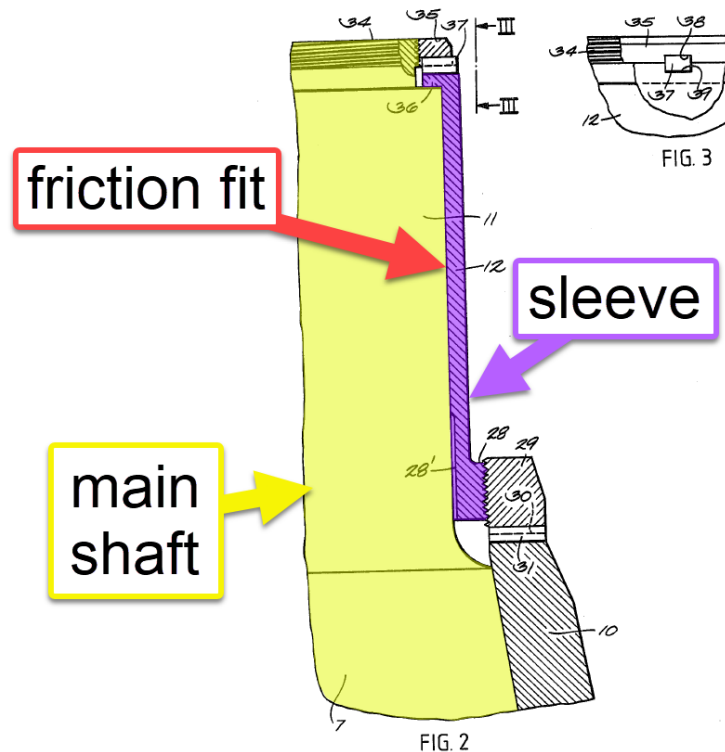
54. Gyratory crusher having a friction fit shaft and sleeve arrangement were also known in the art. Polinski, discussed above, describes a prior art gyratory

²⁷ Exhibit 1033, 1:13-15, 1:35-42

²⁸ Exhibit 1032, 1:15-24

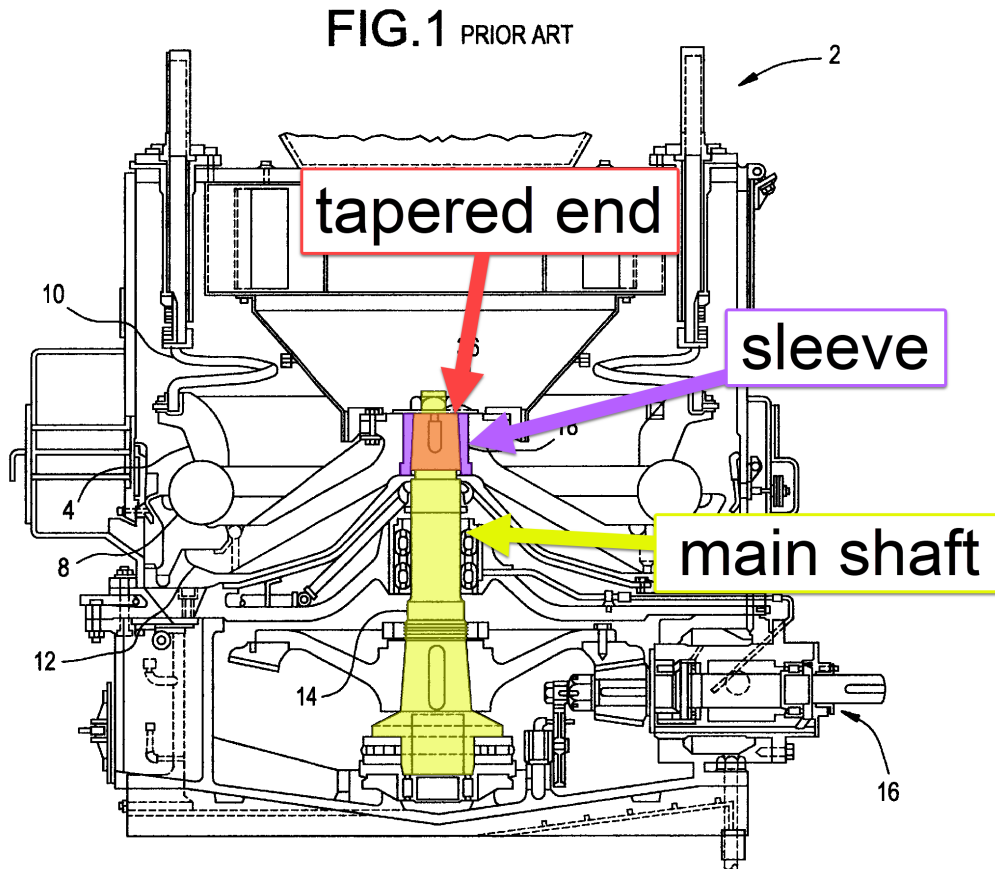
²⁹ Exhibit 1031, 3:15-22

crusher with a sleeve that is friction fitted to the upper portion of the shaft, see Polinski 3:15-20. The Polinski gyratory crusher shaft and sleeve arrangement in FIG. 2 of Pat '143 is shown below.



2. U.S. Patent Publication No. 6,270,026 to Piepho et al

55. Piepho, discussed above, also describes a prior art rock crusher with a sleeve that is friction fitted to the upper portion of the shaft, see Piepho 3:6-7 and 3:23-32. The rock crusher shaft and sleeve arrangement in FIG. 1 of the '026 patent is shown below.

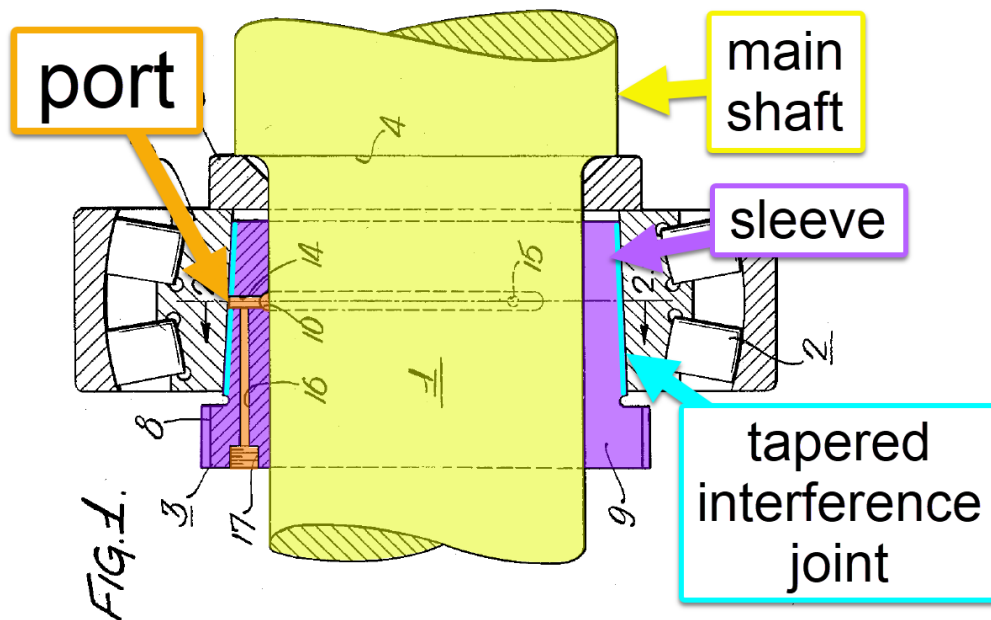


C. Pressurized Fluid Groove for Mounting and Dismounting Components

1. U.S. Patent Publication No. 2,764,437 to A. E. Bratt

56. Grooves configured to receive pressurized fluid for the mounting and dismounting of components were known in the art. For example, U.S. Patent Publication No. 2,764,437 ('437 patent or Pat '437) to A. E. Bratt, (Bratt) describes a prior art system for producing an interference joint between two components and a means of making and separating said components. Pat '437 is not listed as a cited reference for the '568 patent. I understand Bratt is prior art to the '568 patent because it was filed May 31, 1951, and issued in September 1956, which is before

the earliest filing date for the '568 patent in 2013. The grooves configured to receive pressurized fluid for the mounting and dismounting of components is shown below in FIG. 1 of the '437 patent.



30

57. As shown above, A.E. Bratt discloses pressurizing oil into the tapered interference joint through the port.³¹ Specifically, pumping sufficiently pressurized oil into the port in this tapered interference joint facilitates the creates of the joint as it lubricates the mating components allowing them to be moved into their final positions more readily. Further, the pumping of sufficiently pressurized oil into the port will apply a force that will tend to push the joint apart due to the direction of the tapering of the joint.

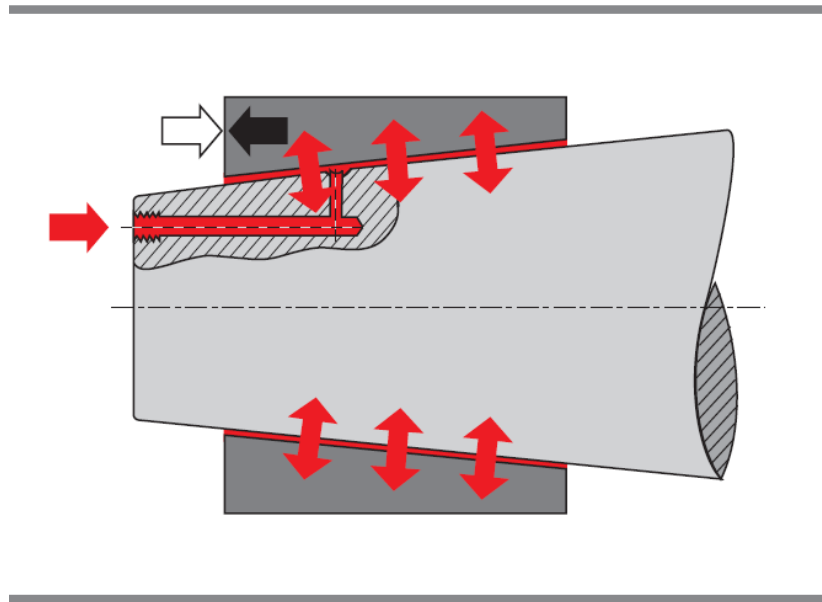
³⁰ Exhibit 1034, rotated and annotated

³¹ Exhibit 1034, 1:19-21, 29-34, 69-72, 2:6-29, emphasis added

2. Public Literature “Accurate mounting of bearings, propellers and gears has never been quicker...”

58. Public literature titled “Accurate mounting of bearings, propellers and gears has never been quicker...” by SKF Maintenance Products is another example of grooves configured to receive pressurized fluid for the mounting and dismounting of components that was known in the art. I understand “Accurate mounting of bearings, propellers and gears has never been quicker...” is prior art to the ’568 patent because it has been available to the public since 2003, which is before the earliest filing date for the ’568 patent in 2013.

59. The grooves configured to receive pressurized fluid for the mounting and dismounting of components can be seen on page 2 of “Accurate mounting of bearings, propellers and gears has never been quicker...” as shown in the image below.



*Mounting and dismounting,
directly on a tapered shaft*

VI. THE '568 PATENT

D. Specification of the '568 Patent

60. The '568 patent to Aberg discloses “A gyratory crusher main shaft sleeve for positioning at an uppermost end of a crusher main shaft and in particular, although not exclusively, to a sleeve having a tapered wall thickness”. Pat '568, 1:12-15. The '568 patent includes an embodiment of a gyratory crusher having a main shaft and protective sleeve in FIG. 1. The '568 patent includes an embodiment of an upper region of the crusher in FIG. 2.

61. FIG. 1 of the '568 patent is shown below. The gyratory crusher includes a crusher head 103 mounted upon an elongate shaft 107. Pat '568, 3:38-40. “An upper end region of a shaft 113 comprises an axial taper to define an upper

conical section. The cone 113 tapers inwardly in the bottom to top direction away from head 103". Pat '568, 3:64-66. A substantially cylindrical wear sleeve 114 is friction fitted along its axial length over region 113 of shaft 107. Pat '568, 4:4-8.

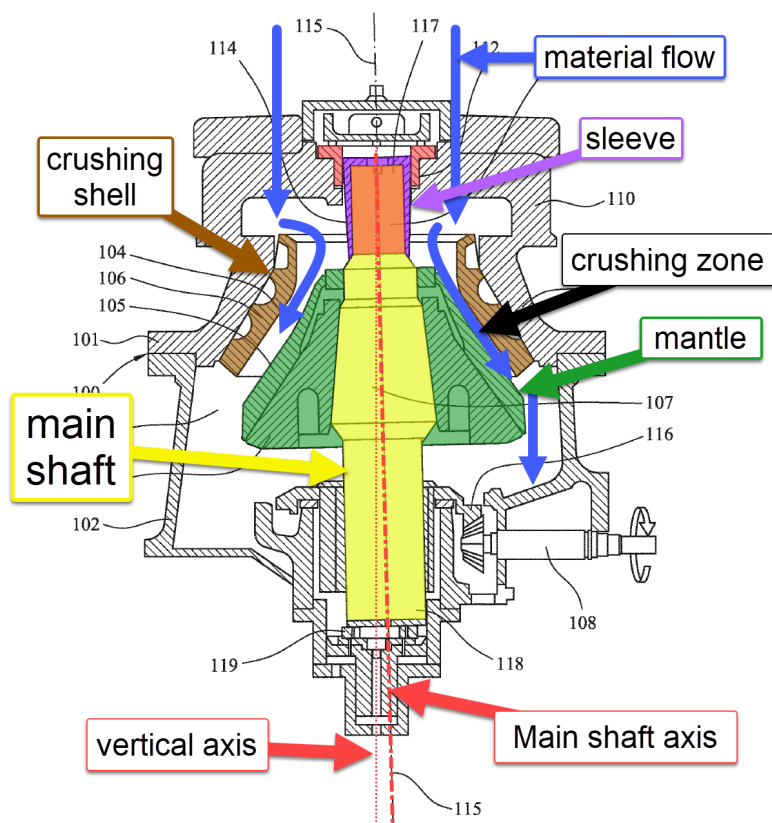


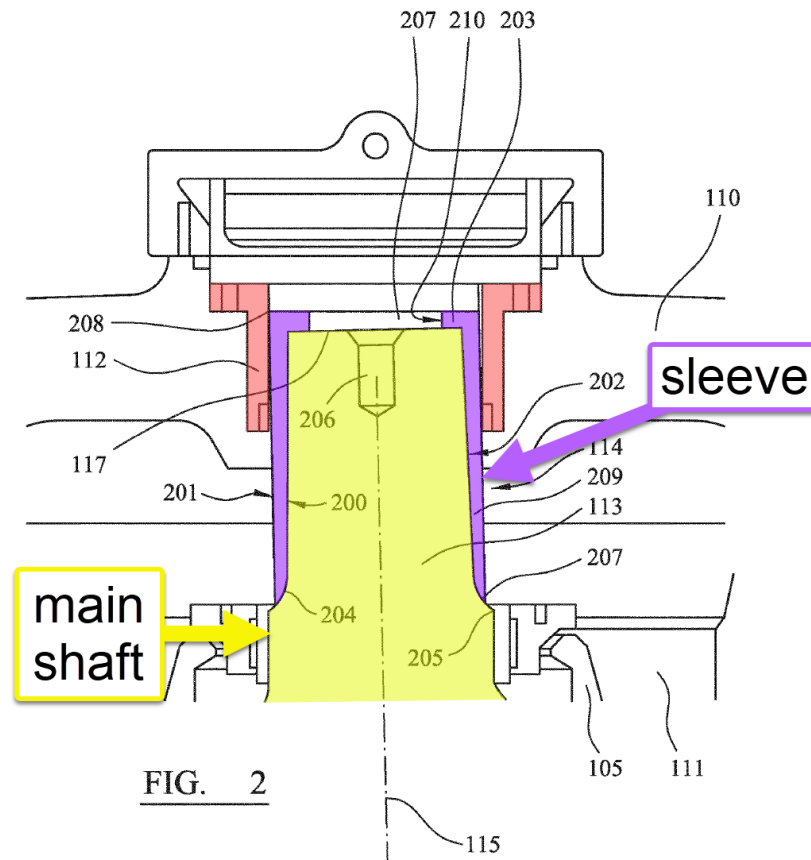
FIG. 1

32

62. FIG. 2 of the '568 patent is shown below. With respect to longitudinal axis 115, sleeve 114 is shown to have an axial wall 209 with external facing surface 201 and an internal facing surface 200. Axial wall 209 decreases in thickness from second upper end 208 to first lower end 207. Pat '568, 4:13-33. "A radial wall 203 extends perpendicular to axial wall 209 and is orientated inwardly

³² Exhibit 1001, Figure 1, annotated

towards axis 115 at second end 208". Pat '568 4:49-51.



E. Claims of the '568 patent

63. Claim 1, the sole independent claim of the '568 patent, is set forth below.

1P. A gyratory crusher comprising:

1a1. a main shaft including a shaft body having 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,

1a2. a thickness of the shaft body being tapered in an axial direction of the main shaft at a region of the second end so as to decrease in cross-sectional area; and

1b1. a sleeve fitted over the tapered region at the second end of the main shaft,

1b2. the sleeve including an elongate axial wall extending around a longitudinal axis of the sleeve,

1b3. the axial wall having an internal facing surface for positioning in contact with an outward facing surface of the main shaft, and

1b4. an external facing surface relative to the longitudinal axis,

1b5. the axial wall extending between the internal and external facing surfaces,

1b6. the axial wall having a first end for positioning at a lower region of the main shaft and a second end for positioning at an upper region of the main shaft relative to the lower region,

1b7. wherein a thickness of the axial wall at a region between the first and second ends decreases in a direction from the second end to the first end,

1b8. in the axial direction the internal facing surface at said region between the first and second ends extending transverse to the longitudinal axis so as to taper inwardly towards the longitudinal axis in the direction from the first to the second end.

2P. The gyratory crusher as claimed in claim 1,

2a. wherein the region over which the thickness of the axial wall decreases extends substantially the full axial length of the sleeve.

3P. The gyratory crusher as claimed in claim 1,

3a1. further comprising a radial wall extending perpendicular or transverse to the axial wall,

3a2. the radial wall being positioned at or towards the second end and extending inwardly towards the longitudinal axis.

4P. The gyratory crusher as claimed in claim 3,

- 4a.** wherein the radial wall includes a through bore positioned at the longitudinal axis of the sleeve.
- 5P.** The gyratory crusher as claimed in claim 1,
- 5a.** wherein a cross-sectional shape profile of the external facing surface is substantially circular.
- 6P.** The gyratory crusher as claimed in claim 1,
- 6a.** wherein a cross-sectional shape profile of the internal facing surface is substantially circular.
- 7P.** The gyratory crusher as claimed in claim 1,
- 7a.** wherein a shape profile of the external facing surface defines a section of a cylinder in the axial direction.
- 8P.** The gyratory crusher as claimed in claim 1,
- 8a.** wherein a shape profile of the internal facing surface defines a section of a cone in the axial direction.
- 9P.** The gyratory crusher as claimed in claim 1,
- 9a.** further comprising at least one bore provided through the axial wall to allow the passage of a fluid to the internal facing surface.
- 10P.** The gyratory crusher as claimed in claim 1,
- 10a.** wherein at a curved region of the first end, the internal facing surface is curved radially outward relative to the longitudinal axis in a direction towards the external facing surface such that the axial wall thickness decreases to zero at the curved region.

F. Prosecution History of the '568 Patent

64. I have reviewed the prosecution history of the application that led to the '568 patent. Changes were made to the application by the applicant prior to

PTO examination. During prosecution of the '568 patent, one notable Office Action was issued by the Patent and Trademark Office (PTO). Changes to the application by the applicant were made in response to the PTO Office Action. An interview between the examiner, applicant, and applicant representative was initiated before granting the '568 patent.

65. Changes made to the patent application by the applicant prior to PTO examination can be found on Application No. 14/418,535: New, filed January 30, 2015 (Exhibit 1001-1, at 34-41). Changes were made to claims 1-14.

66. Claim 1 of Application No. 14/418,535: New state “main shaft sleeve is for friction fitting over an uppermost end of a crusher main shaft.” (Exhibit 1001-1, at 35). Final granted '568 patent does not include “friction fitting” in any of its claims. Abstract, background and summary of the granted patent do mention friction fitting.

67. Claims 2-13 of Application No. 14/418,535: New reference “The sleeve” for the each of the claims (Exhibit 1001-1, at 35-37). The granted '568 patent references “The Gyratory Crusher” for each of the claims to narrow the claims to only Gyratory Crushers.

68. Claims 9-11 of Application No. 14/418,535: New cover a sleeve groove indented in the internal facing surface of the sleeve; groove extending circumferentially around a region of the internal facing surface; and a groove

extending axially along the internal facing surface (Exhibit 1001-1, at 36). The '568 patent only mentions such groove in the patent summary and no claims cover a groove. This groove is discussed for lubrication use, but movement of this groove from sleeve to shaft is then claimed for use in mounting and dismounting.

69. Claim 14 of Application No. 14/418,535: New states “a sleeve friction fitted over the tapered region at the second end of the main shaft” (Exhibit 1001-1, at 37). The '568 patent does not include “friction fitting” in any of its claims. Abstract, background, and summary of the granted patent do mention friction fitting.

70. Office Action dated April 19, 2017 rejected claims 1-15 under U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA) stating “as being indefinite for failing to particularly point out and distinctly claim the subject matter which the inventor or a joint inventor, or for pre-AIA the applicant regards as the invention.” (Exhibit 1001-1, at 208 section 3).

71. Office Action dated April 19, 2017, rejection to claims 1-15 states “The recitation of “A gyratory crusher main shaft sleeve” in the preamble of claim 1 renders the claim indefinite since the body of the claim does not provide any positive limitation to a crusher or a main shaft” (Exhibit 1001-1, at 208 section 4). The office later states “Also, how is “gyratory crusher main shaft sleeve” different from sleeve/cover per se? Note also claims 14 and 15 with similar regard.”

(Exhibit 1001-1, at 208 section 4).

72. Office Action dated April 19, 2017, rejected claims 1-8 and 9-11 stating “The claims are interpreted as best understood by the examiner. The claims are interpreted as requiring a gyratory crusher, a main shaft, and a sleeve having a first and second end with a decreasing thickness between the first and second ends. Coxhill ’825 patent is considered to clearly show a device having the structural elements of the claims that can be understood.” (Exhibit 1001-1, at 209 section 6). Claims 9-11 are rejected as being unpatentable over either Coxhill ’825 or Sandborn ’255 in view of Gunnarsson et al. US Patent 2011/0006143. Office states either Coxhill ’825 or Sandborn ’255 discloses most of the elements of these claims, but for the groove. Gunnarsson et al is cited to show desirability, in the relevant art, to provide a gyratory crusher with ducts and groove in order to lead the lubricating oil to the crusher. It would have been obvious to one of ordinary skill in the art at the time the invention was made to provide the device of either Coxhill or Sandborn with the groove as taught by Gunnarsson et al for lubricating the crusher shaft.

73. The applicant responded to Office Action dated April 19, 2017, with Application No.: 14/418,535 on August 21, 2017 (Exhibit 1001-1, at 226-232). Claims 1-13 were cancelled, but the subject matter of cancelled claims 2-8, 12 and 13 appear in newly submitted claims 16-24.

74. Applicant notes in Application No. 14/418,535 that no prior art rejections have been made against independent claims 14 and 15 (Exhibit 1001-1, at 231 par. 10). Preamble of claim 14 is changed from “A gyratory crusher main shaft comprising:” to “A main shaft associated with a gyratory crusher, the shaft comprising:” The word “Axial” is added to the description of the wall in claim 15. The words “between the first and second end” are added to the description of the region extending transverse to the longitudinal axis.

75. Application No. 14/418,535 references “The shaft” for claims 16-24 and the granted ’568 patent references “The Gyratory Crusher” to narrow them to only gyratory crushers.

76. PTO examiner initiated an interview with the applicant and applicant representative following Application No. 14/418,535. The examiner was given authorization to amend the application (Exhibit 1001-1, at 244 section 2). The following changes were documented on page 244 section 2 of 78686_14418535 – File History.pdf pg. 244. The examiner cancelled claim 14. In line 1 of claims 16-24, “The shaft” was replaced with “The gyratory crusher”. Claims 16-17 and 19-24 reference claim 15 instead of claim 14. Claims 15-24 were then allowed.

77. Comparing the issued claims given the rejection by the Examiner to the original claims leaves me with no clear understanding of the scope of the Examiner’s review. The issues conceded or acquiesced in by the Applicant during

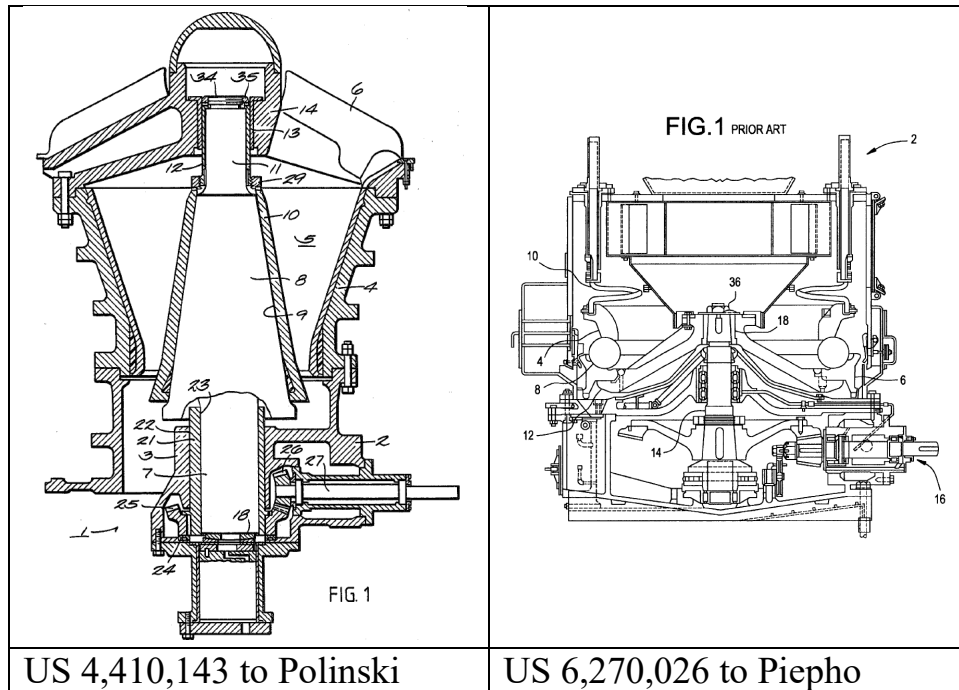
the initial rejection remained, in my opinion, with the amended claims. I feel that there was no meaningful review of the allowed claims given the record in the file history.

VII. CLAIM CONSTRUCTION

78. It is my understanding that claim construction has not been completed in the present matter. As such, I understand that the claim terms are to be given their meaning as they would be understood by a POSITA in view of the intrinsic evidence. I understand that unless the intrinsic record indicates otherwise, claim terms are to be given their plain and ordinary meaning as they would be understood by a POSITA. Consequently, I have used the plain and ordinary meaning in my analysis.

VIII. INVALIDITY ANALYSIS OF THE '568

A. Polinski in View of Piepho Render Claims 1-8 Obvious



79. As discussed previously, Polinski discloses a gyrating rock crusher.

Piepho is also a rock crushing apparatus. In particular, Piepho is designed to crush coal:

“The present invention relates in general to an improved main Shaft for a coal pulverizer, and more particularly to an improved main shaft for use in B&W Type E and EL pulverizers”³³

80. As a rock crushing apparatus, Piepho is in the same field of endeavor as Polinski and thus (being analogous art) would easily be within the purview of a POSITA. Further, Piepho teaches the interchangeability between a cylindrical joint and a tapered joint. Piepho also teaches that a tapered joint is preferable.

³³ Exhibit 1016 1:5-8

*“The present invention provides an intervening material between the shaft end (25) and the mating bore in yoke bushing (18) fitted within the bore of yoke (12) to prevent fretting damage. For accurate alignment and for reliable Support of the yoke, this joint (21) must be capable of accepting radial, axial, and bending or overturning loads. **Preferably, the joint (21) is a tapered joint with the tapered end (25) of shaft (14).** The yoke bushing (18) has a mating bore similarly tapered. Shaft end (25) may be constructed for either a keyless or a keyed fit. Also, **Shaft end (25) alternatively may be cylindrical rather than tapered as seen in FIG. 4.**”³⁴*

81. A POSITA would be motivated to combine the tapered joint of Piepho with the teachings of Polinski as Piepho teaches it is preferable. In addition to this, a POSITA would understand that a tapered joint is preferable to a cylindrical joint at least because they are easier to install and remove. A POSITA would have reasonable expectation of success in making the combination as both cylindrical and tapered interference fit joints were common in the prior art and had been used for decades. This combination is nothing more than a simple combination of known elements according to known methods to yield predictable results.

Challenged Claim	Does the Prior Art disclose this?
1P. A gyratory crusher comprising:	YES: Although the preamble is generally not considered limiting, Polinski discloses a gyratory crusher. In particular Polinski states: <i>“The present invention relates to <u>gyratory crushers</u> and, in particular, to the main shaft supporting the crusher head or mantle within the crusher.”³⁵</i>

³⁴ Exhibit 1016 3:24-35, emphasis added

³⁵ Exhibit 1015 1:6-8, emphasis added

Gyratory
crusher

eccentric axis

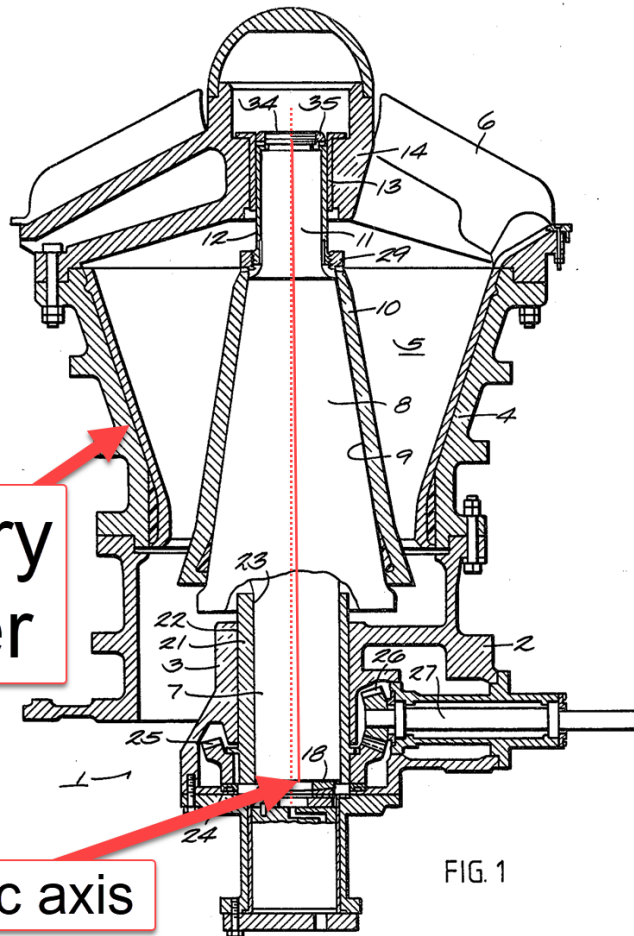


FIG. 1

36

As can be seen above, Figure 1 of Polinski shows a cross section of a conventional gyratory crusher. The central cone is part of the main shaft which is mounted on an eccentric drive which creates the gyrational crushing motion as it is driven. Specifically, Polinski states,

*"The main shaft 7, which is carried on an axial thrust bearing 18 mounted on the lower frame 2 beneath the shaft, is rotatably journaled within an eccentric sleeve bearing carried within the vertical hub 3 to direct the gyratory movement of the shaft."*³⁷

Beyond this, as discussed previously, Piepho is also a rock crushing apparatus. In particular, Piepho is designed to crush coal.

*"The present invention relates in general to an improved main Shaft for a coal pulverizer, and more particularly to an improved main shaft for use in B&W Type E and EL pulverizers"*³⁸

³⁶ Exhibit 1015 Figure 1, annotated

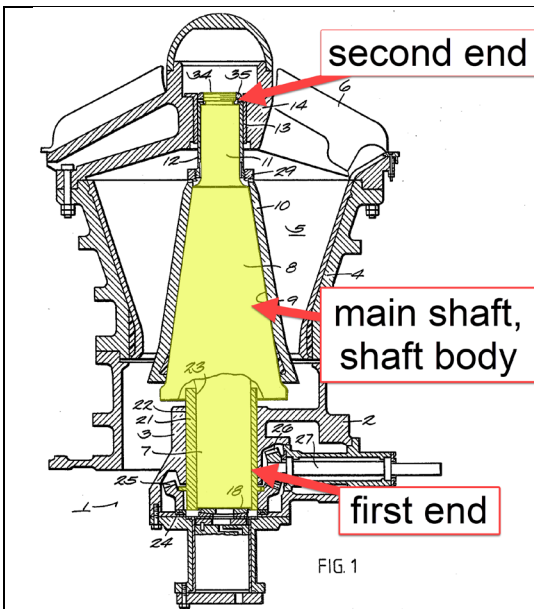
³⁷ Exhibit 1015 2:48-52, emphasis added

³⁸ Exhibit 1016 1:5-8

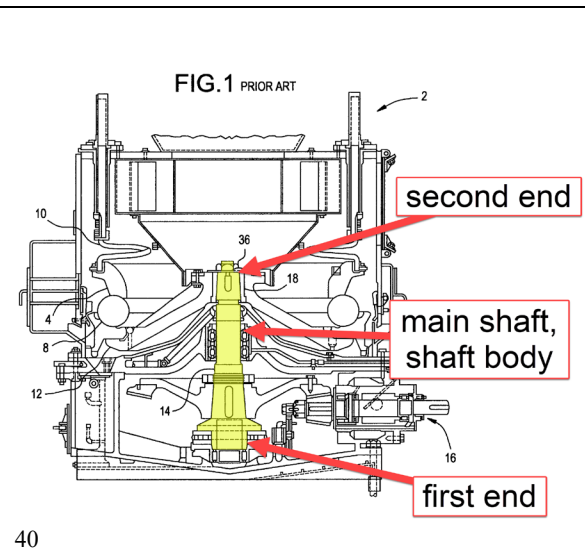
As a rock crushing apparatus, Piepho is in the same field of endeavor as Polinski.

1a1. a main shaft including a shaft body having 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: As shown below, both Polinski and Piepho disclose a main shaft including a shaft body having 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.



Polinski main shaft



Piepho main shaft

Polinski teaches:

"Referring to FIG. 1, the gyratory crusher 1 embodying the invention includes a lower frame 2 provided with a vertical hub 3, an upper frame 4 forming the outer shell of the crusher chamber 5, a top frame or spider 6 mounted on the upper frame 4, and a centrally located gyratable main shaft 7."⁴¹

Piepho teaches:

"The bottom ring 6 is driven by the yoke 12 which is attached to a vertical main shaft assembly 14 of the pulverizer."⁴²

³⁹ Exhibit 1015 Figure 1, annotated

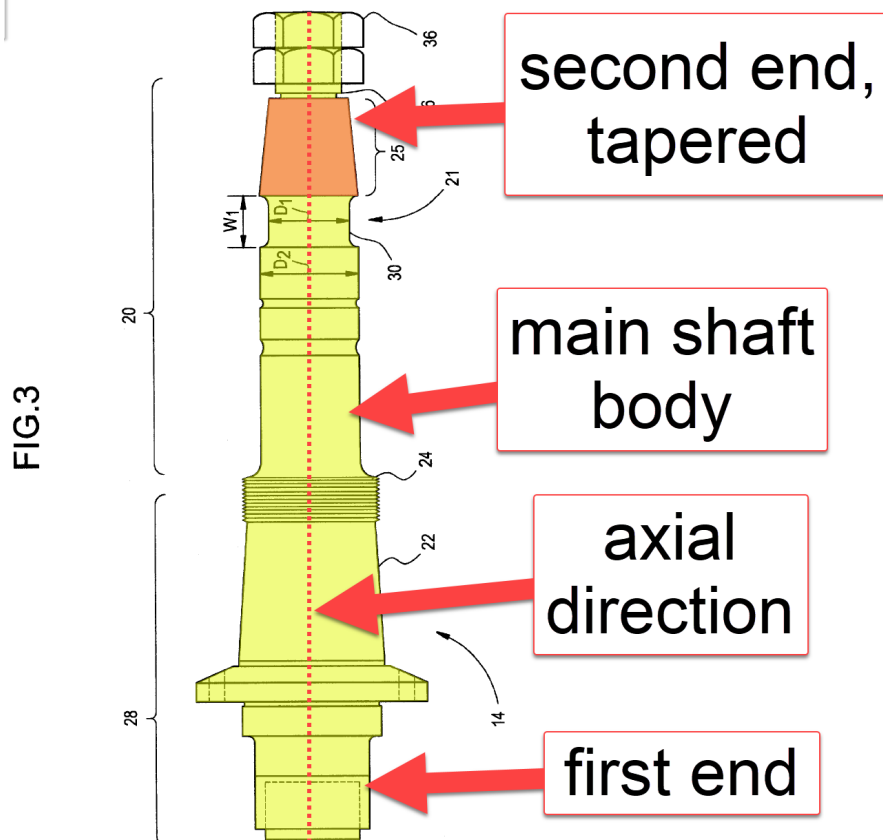
⁴⁰ Exhibit 1016, Figure 1 annotated

⁴¹ Exhibit 1015 2:32-37, emphasis added

⁴² Exhibit 1016 1:26-27

1a2. a thickness of the shaft body being tapered in an axial direction of the main shaft at a region of the second end so as to decrease in cross-sectional area; and

YES: Polinski in view of Piepho discloses a thickness of the shaft body being tapered in an axial direction of the main shaft at a region of the second end so as to decrease in cross-sectional area.



43

As shown above, the main shaft of Piepho is tapered on the second end of the shaft body. Further, the taper is in an axial direction. Due to this taper, the cross-sectional area of the shaft body decreases as shown by the orange highlighted area above.

*“The present invention provides an intervening material between the shaft end (25) and the mating bore in yoke bushing (18) fitted within the bore of yoke (12) to prevent fretting damage. For accurate alignment and for reliable Support of the yoke, this joint (21) must be capable of accepting radial, axial, and bending or overturning loads. **Preferably, the joint (21) is a tapered joint with the tapered end (25) of shaft (14).**”*⁴⁴

⁴³ Exhibit 1016, Figure 3 annotated

⁴⁴ Exhibit 1016 3:23-31, emphasis added.

A POSITA would have been motivated to combine the tapered end on the main shaft of Piepho with the main shaft on Polinski. This combination would have been nothing more than combining known elements according to known methods to yield predictable results. A POSITA would be further motivated, as Piepho describes, as the tapered shaft aids in accurate alignment which is notoriously more difficult with purely cylindrical shafting.

1b1. a sleeve fitted over the tapered region at the second end of the main shaft,

YES: Polinski in view of Piepho discloses a sleeve fitted over the tapered region at the second end of the main shaft.

Polinski teaches a sleeve fitted over the second end of the main shaft.

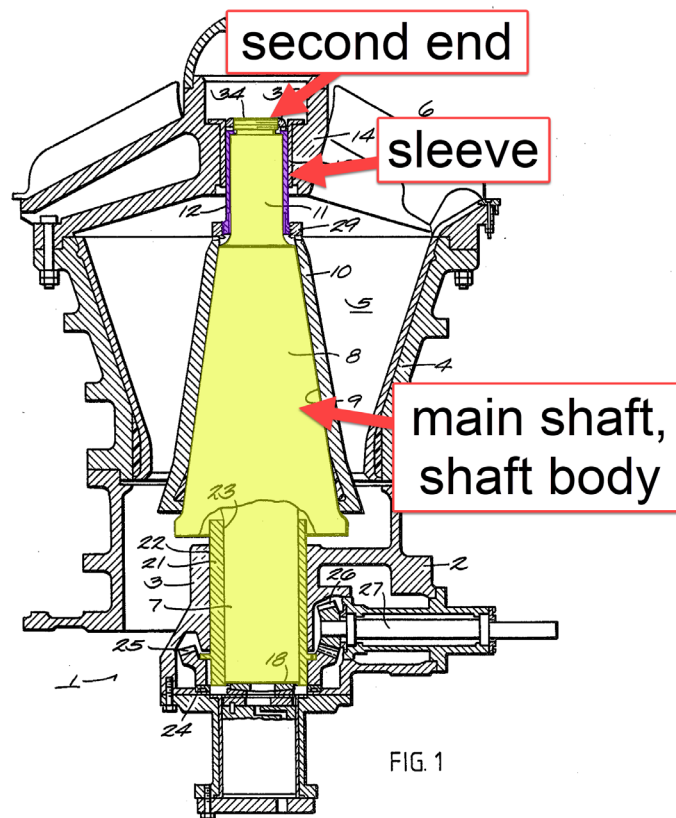
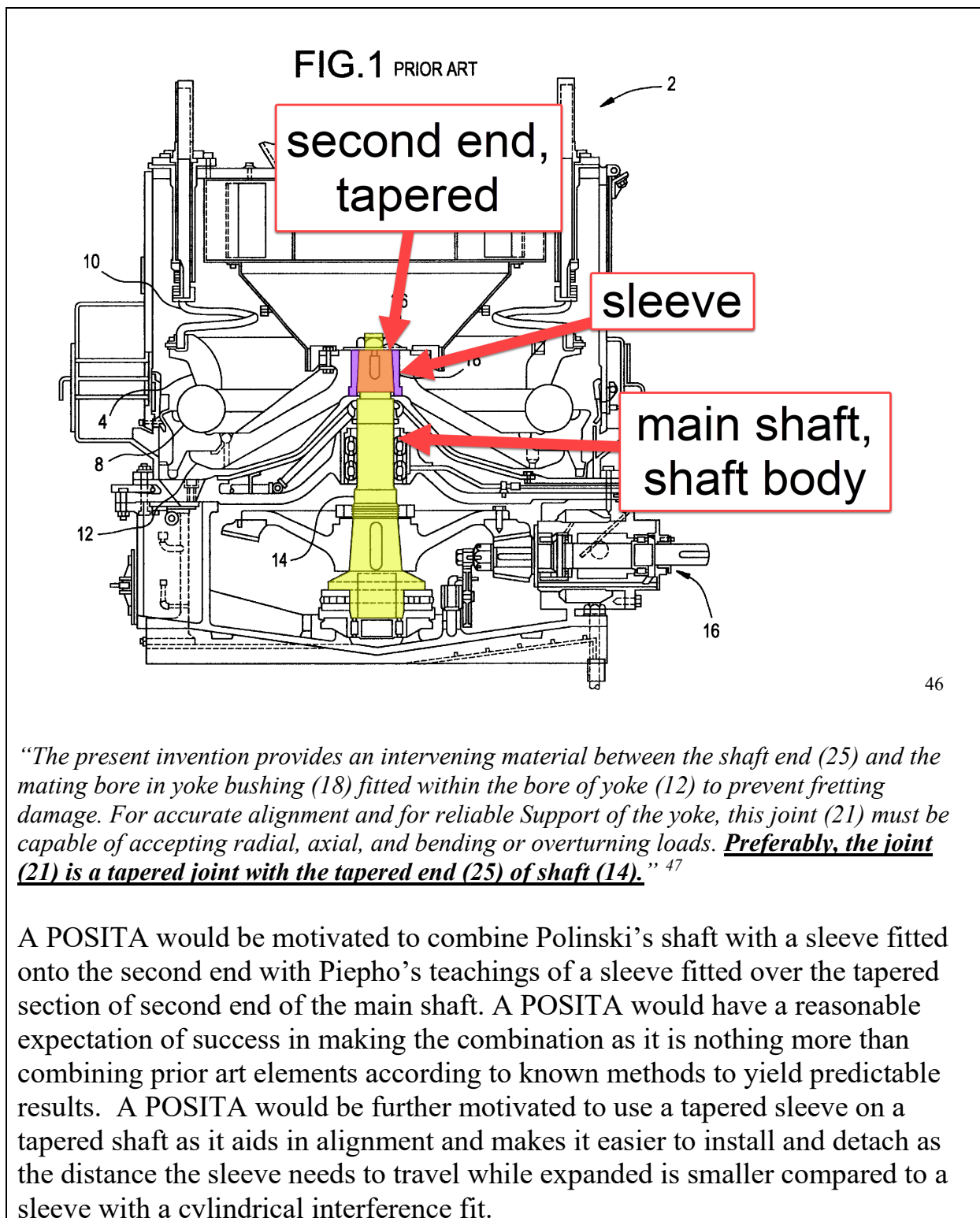


FIG. 1

45

Piepho further teaches a sleeve fitted over the tapered region at the second end of the main shaft. This sleeve is the bushing 18 (highlighted in purple below). Piepho teaches that the bushing has a tapered internal surface that is fitted over the tapered region of the main shaft.

⁴⁵ Exhibit 1015 Figure 1, annotated

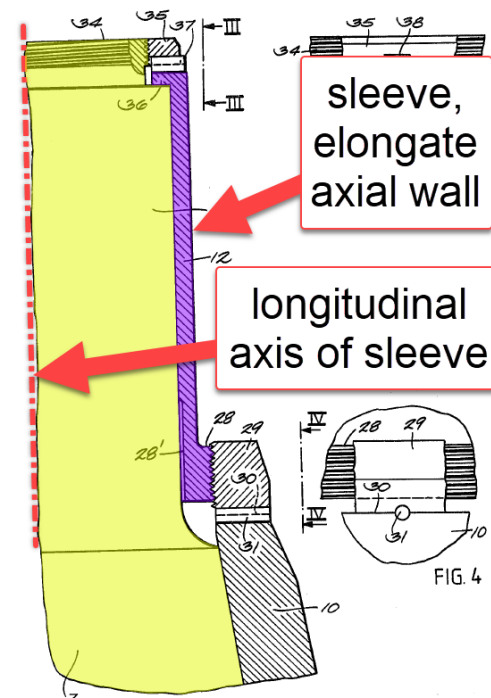


⁴⁶ Exhibit 1015 Figure 1, annotated

⁴⁷ Exhibit 1016 3:23-31, emphasis added.

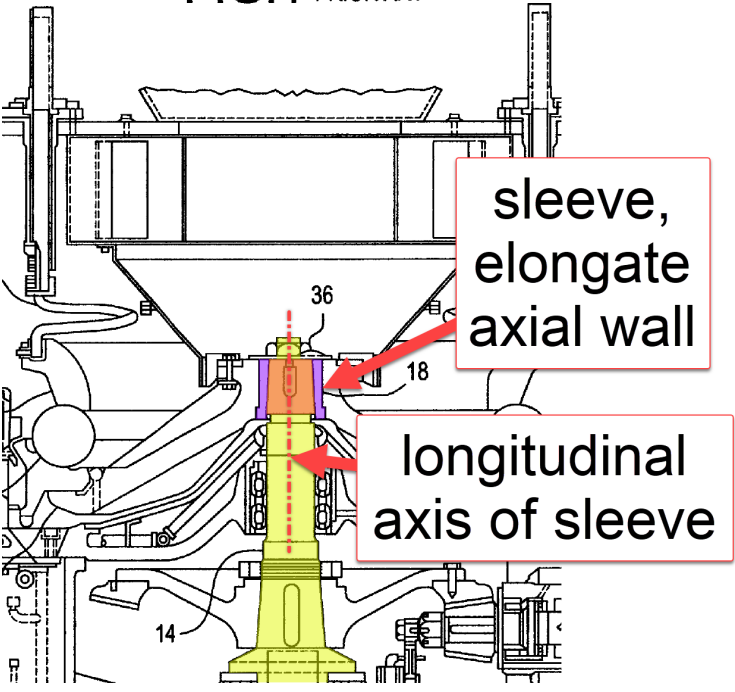
1b2. the sleeve including an elongate axial wall extending around a longitudinal axis of the sleeve,

YES: Polinski in view of Piepho discloses a sleeve including an elongate axial wall extending around a longitudinal axis of the sleeve.

 FIG. 2 FIG. 4	Polinski sleeve <i>“As will be described, the cross-section of the upper end of the shaft 7 gradually converges to form a bearing journal 11 extending from the tapered portion of the shaft <u>which is fitted with a cylindrical bearing sleeve 12</u> rotatably retained within a bearing bushing 13 secured within a coaxially aligned hub 14 in the spider 6.”⁴⁹</i>
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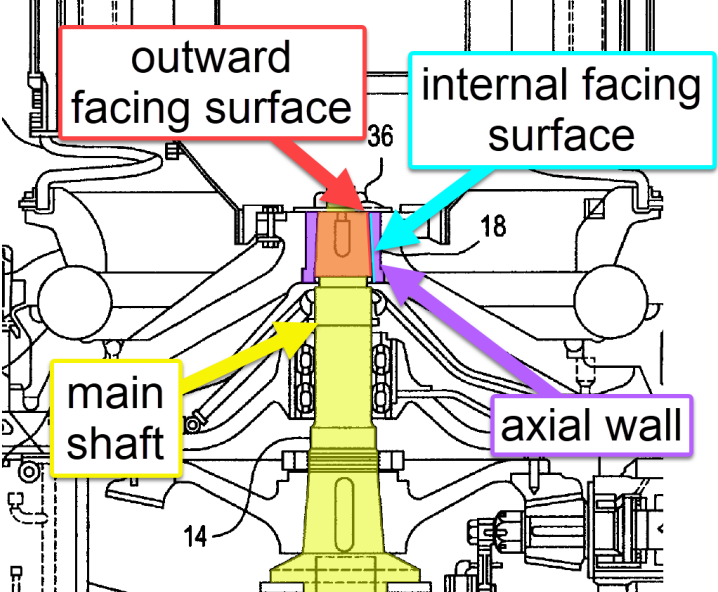
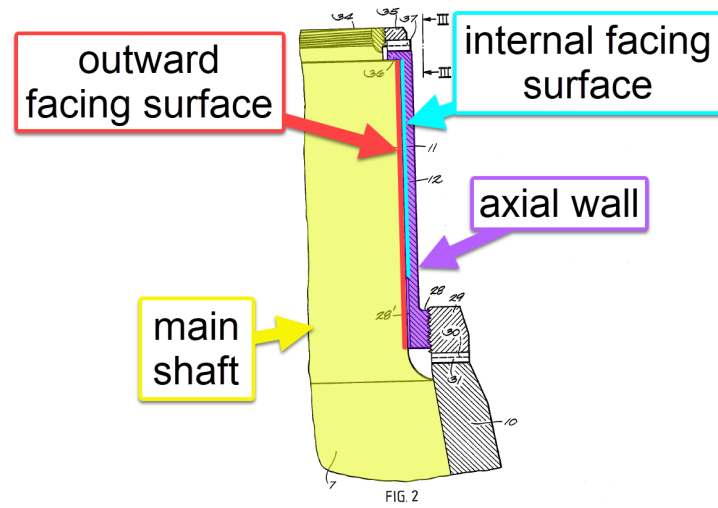
⁴⁸ Exhibit 1015 Figure 2, annotated

⁴⁹ Exhibit 1015 2:41-47, emphasis added.

FIG.1 PRIOR ART  sleeve, elongate axial wall longitudinal axis of sleeve	Piepho sleeve <i>“The present invention provides an intervening material between the shaft end (25) and the mating bore in yoke bushing (18) fitted within the bore of yoke (12) to prevent fretting damage. For accurate alignment and for reliable support of the yoke, this joint (21) must be capable of accepting radial, axial, and bending or overturning loads. Preferably, the joint (21) is a tapered joint with the tapered end (25) of shaft (14).”⁵¹</i>
As shown above, both Polinski and Piepho have a sleeve with an elongate axial wall. Further, as shown, the axial wall of the sleeve extends around the longitudinal axis of the sleeve. In either sleeve, the length is greater than the diameter of the sleeve, demonstrating it is elongate in shape. However, even if the sleeve was shorter, the axial wall would still be elongated along the longitudinal axis of the sleeve.	
1b3. the axial wall having an internal facing surface for positioning in contact with an outward facing surface of the main shaft, and	YES: Both Polinski and Piepho disclose a sleeve with an axial wall having an internal facing surface for positioning in contact with an outward facing surface of the main shaft.

⁵⁰ Exhibit 1015 Figure 1, annotated

⁵¹ Exhibit 1016 3:23-31

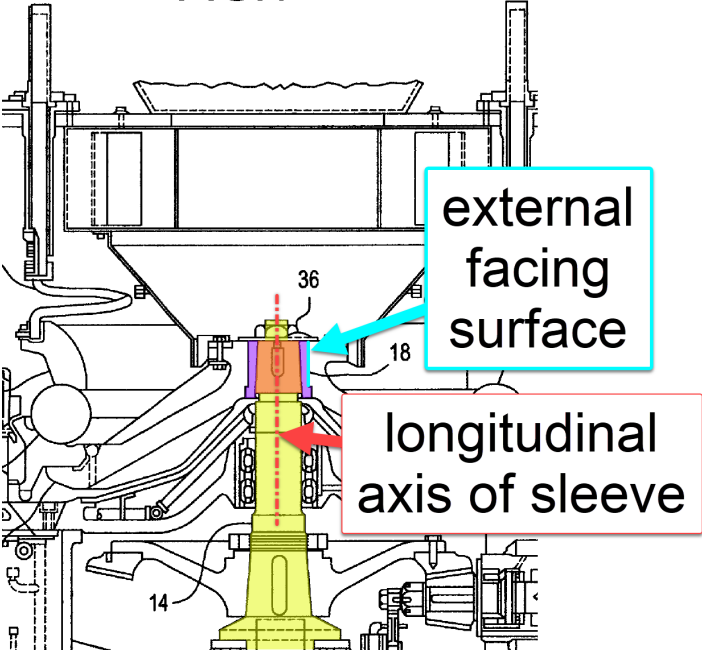
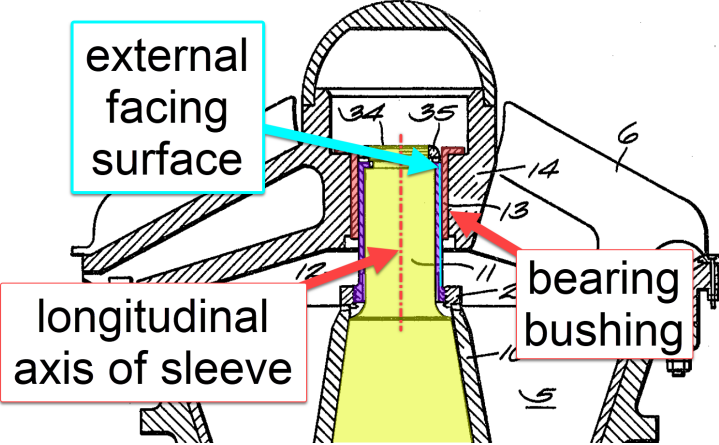
	Piepho <i>“The fit or joint between the yoke bushing (18) and upper taper (25) is an interference type fit.”⁵³</i>
	Polinski <i>“When the bearing sleeve 12 is installed on bearing journal 11, it is initially heated so that as it cools it forms a heat-shrink type fit releasably securing it to the journal 11.”⁵⁵</i>
As shown above, both Piepho and Polinski teach that the axial wall of the sleeve has an internal facing surface which is positioned in contact with an outward facing surface of the main shaft. Each of the sleeves of Piepho and Polinski have an interference fit which generates contact pressure between the inside face of the axial wall and the outside face of the main shaft.	
1b4. an external facing surface relative to the longitudinal axis,	YES: Both Polinski and Piepho disclose a sleeve with an external facing surface relative to the longitudinal axis.

⁵² Exhibit 1016, Figure 1 annotated

⁵³ Exhibit 1016 3:6-7

⁵⁴ Exhibit 1015 Figure 2, annotated

⁵⁵ Exhibit 1015 3:15-18

FIG.1 PRIOR ART  56	Piepho <i>“The present invention provides an intervening material between the shaft end (25) and the mating bore in yoke bushing (18) fitted within the bore of yoke (12) to prevent fretting damage.”⁵⁷</i> As shown and described, the bushing (18) is fitted into a bore on the yoke (12). This fit-up involves contact between an external facing surface of the bushing (18) and the bore of yoke (12).
 58	Polinski <i>“As will be described, the cross-section of the upper end of the shaft 7 gradually converges to form a bearing journal 11 extending from the tapered portion of the shaft which is fitted with a cylindrical bearing sleeve 12 rotatably retained within a bearing bushing 13 secured within a coially aligned hub 14 in the spider 6.”⁵⁹</i>

⁵⁶ Exhibit 1016, Figure 1 annotated

⁵⁷ Exhibit 1016 3:24-27

⁵⁸ Exhibit 1015 Figure 2, annotated

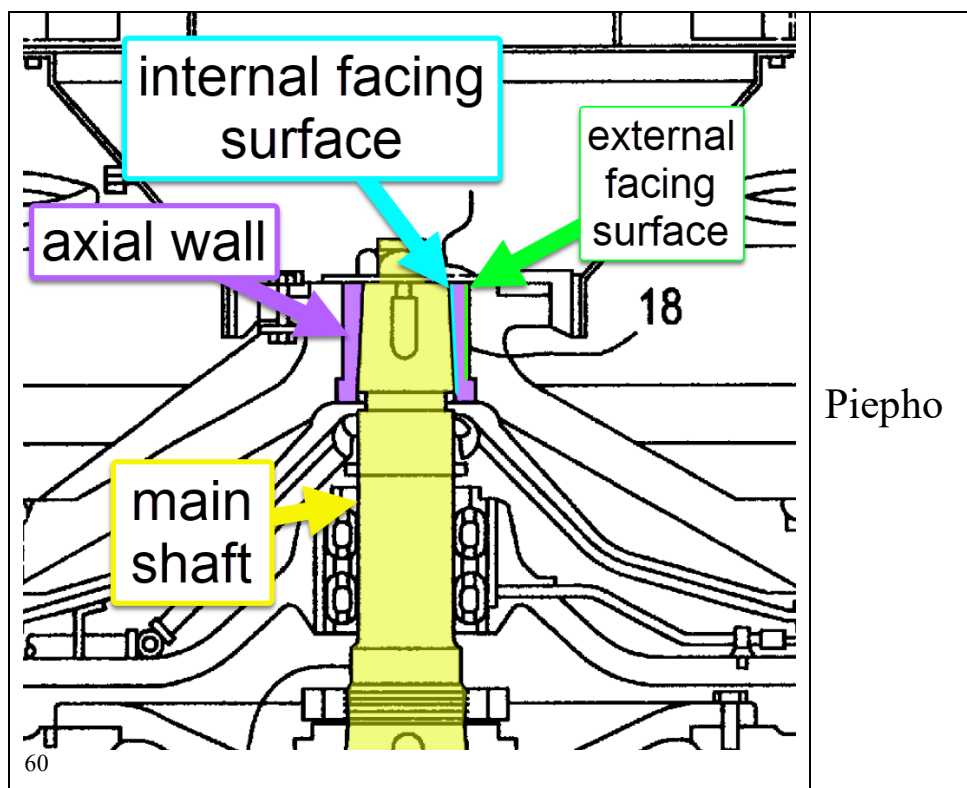
⁵⁹ Exhibit 1015 2:41-47

	As shown and described, the sleeve 12 is fitted within a bearing bushing 13. This fit-up involves contact between the externally facing surface of the sleeve and the bearing bushing.
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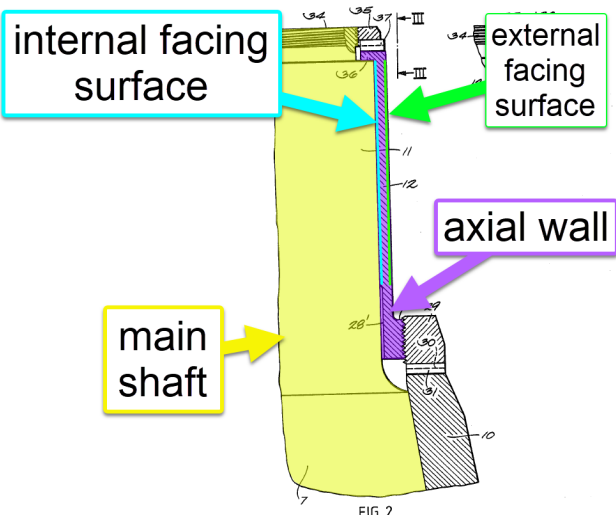
As shown above, both Polinski and Piepho disclose a sleeve with an external facing surface relative to the longitudinal axis of the sleeve.

1b5. the axial wall extending between the internal and external facing surfaces,

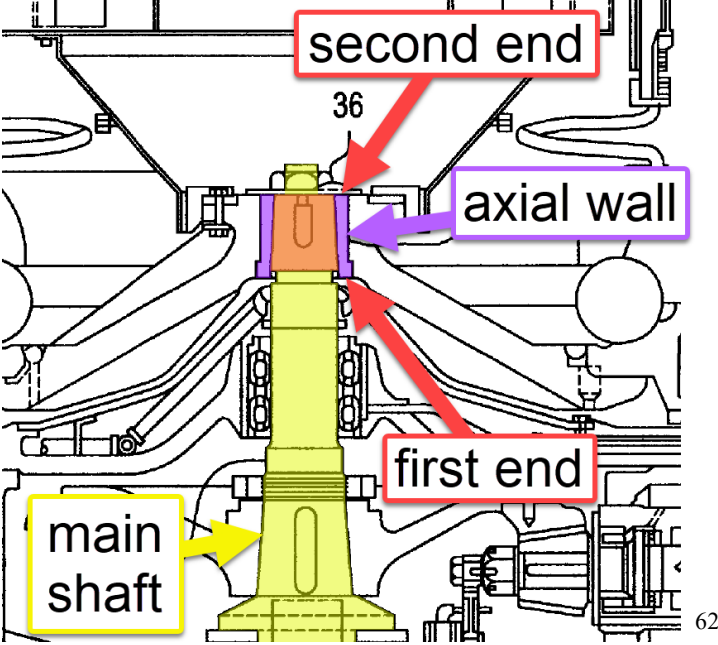
YES: Both Polinski and Piepho disclose a sleeve with an axial wall extends between the internal and external facing surfaces.



⁶⁰ Exhibit 1016, Figure 1 annotated

	Polinski
As shown above, both the sleeve of Piepho and of Polinski are arranged in a way such that the axial wall of the sleeve extends between the internal and external facing surfaces.	
1b6. the axial wall having a first end for positioning at a lower region of the main shaft and a second end for positioning at an upper region of the main shaft relative to the lower region,	YES: Both Polinski and Piepho discloses an axial wall having a first end for positioning at a lower region of the main shaft and a second end for positioning at an upper region of the main shaft relative to the lower region.

⁶¹ Exhibit 1015 Figure 2, annotated

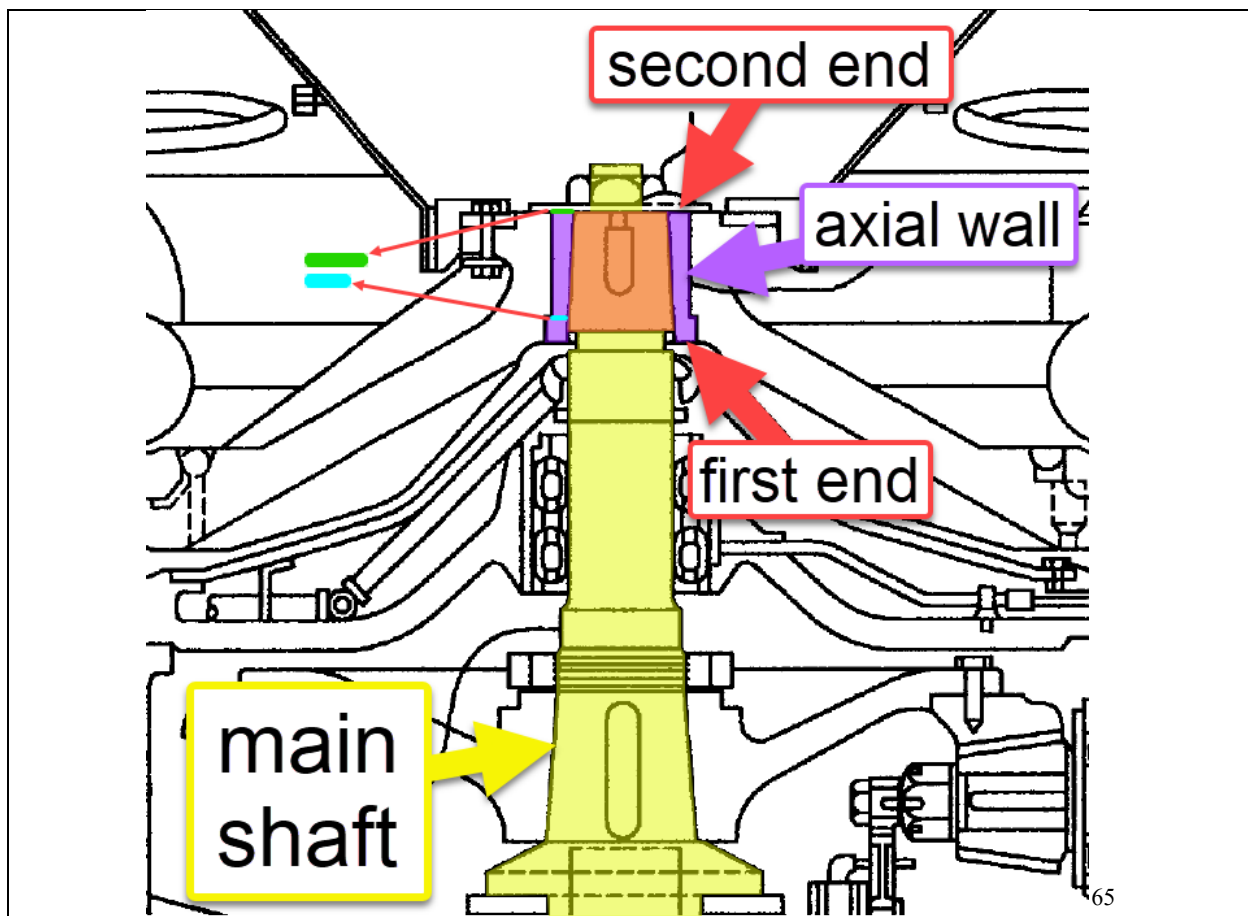
 second end 36 axial wall first end main shaft 62	Piepho As shown the axial wall has a first end positioned at a lower region of the main shaft and a second region positioned at an upper region of the main shaft relative to the lower region. I note that the first end is on a lower region of the main shaft in exactly the same way as disclosed for the '568. That is, the first end of the sleeve is at the lower region of the tapered section. Thus, even though both the first and second ends of the axial wall are positioned at the second end of the main shaft, the first end of the sleeve is at a lower region of the main shaft <i>relative</i> to the second end. See '568 Figure 1.
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⁶² Exhibit 1016, Figure 1 annotated

FIG. 2 FIG. 3 second end axial wall first end main shaft	Polinski As shown, the axial wall of Polinski has a first end at a lower region of the main shaft, and a second end at an upper region of the main shaft. Thus, Polinski is the same as Piepho in this regard except that the shaft/sleeve joint is cylindrical rather than tapered. Piepho teaches the interchangeability between a cylindrical joint and a taper joint as would be well understood by a POSITA. <i>“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.”⁶⁴</i>
As shown above, both Piepho and Polinski have an axial wall with a first end at a lower region of the main shaft and a second end at an upper region of the main shaft.	
1b7. wherein a thickness of the axial wall at a region between the first and second ends decreases in a direction from the second end to the first end,	YES: Piepho discloses that the thickness of the axial wall at a region between the first and second ends decreases in a direction from the second end to the first end.

⁶³ Exhibit 1015 Figure 2, annotated

⁶⁴ Exhibit 1015 2:67-3:3



As shown above the thickness of the axial wall decreases from the second end to the first end. This is demonstrated by the figure above which shows the turquoise line at the first end is shorter than the green line at the second end. This is because the sleeve bushing (18) is tapered to match the tapered portion of the main shaft.

“Preferably, the joint (21) is a tapered joint with the tapered end (25) of shaft (14). The yoke bushing (18) has a mating bore similarly tapered.”⁶⁶

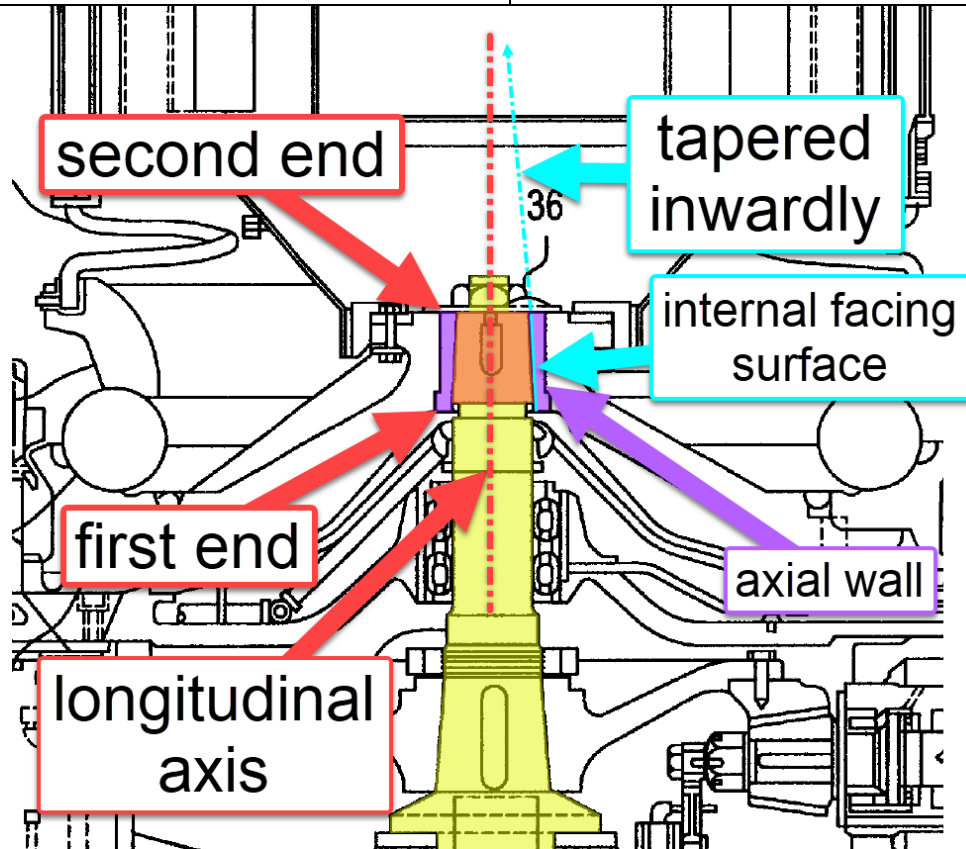
A POSITA would have been motivated to combine the sleeve (including the axial wall) and tapered shaft of Piepho with the main shaft of Polinski. This combination would have been nothing more than combining known elements according to known methods to yield predictable results. A POSITA would be further motivated, as Piepho describes, as the tapered shaft aids in accurate alignment which is notoriously more difficult with purely cylindrical shafting. Piepho further teaches that a tapered joint is preferable to a cylindrical joint.

⁶⁵ Exhibit 1016, Figure 1 annotated

⁶⁶ Exhibit 1015 3:30-31

1b8. in the axial direction the internal facing surface at said region between the first and second ends extending transverse to the longitudinal axis so as to taper inwardly towards the longitudinal axis in the direction from the first to the second end.

YES: Piepho discloses that in the axial direction, the internal facing surface at said region between the first and second ends extends transverse to the longitudinal axis so as to taper inwardly towards the longitudinal axis in the direction from the first to the second end.



67

As shown above the internal facing surface at the region between the first and second ends of the axial wall tapers inwardly towards the longitudinal axis in the direction from the first end of the sleeve to the second end of the sleeve. This is because the sleeve bushing (18) is tapered to match the tapered portion of the main shaft.

*“Preferably, the joint (21) is a tapered joint with the tapered end (25) of shaft (14). The yoke bushing (18) has a mating bore similarly tapered.”*⁶⁸

⁶⁷ Exhibit 1016, Figure 1 annotated

⁶⁸ Exhibit 1015 3:30-31

As the citation above describes, the bushing has a tapered bore that spans the entire axial length.

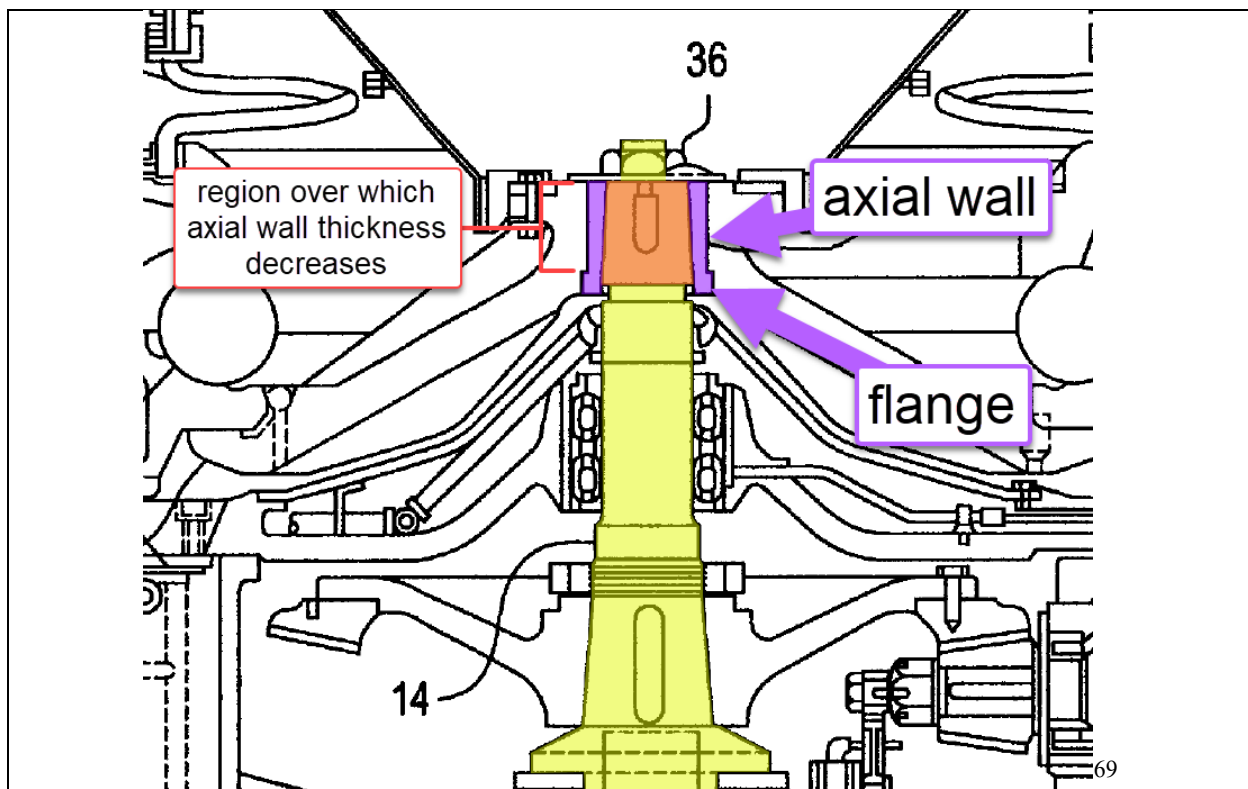
A POSITA would have been motivated to combine the sleeve (including the tapered internal surface) and tapered shaft of Piepho with the main shaft of Polinski. This combination would have been nothing more than combining known elements according to known methods to yield predictable results. A POSITA would be further motivated, as Piepho describes, as the tapered shaft aids in accurate alignment which is notoriously more difficult with purely cylindrical shafting. Piepho further teaches that a tapered joint is preferable to a cylindrical joint.

2P. The gyratory crusher as claimed in claim 1,

YES: As shown above, Polinski in view of Piepho discloses the gyratory crusher as claimed in claim 1.

2a. wherein the region over which the thickness of the axial wall decreases extends substantially the full axial length of the sleeve.

YES: Piepho discloses that the region over which the thickness of the axial wall decreases extends substantially the full axial length of the sleeve.



As shown above the region over which the thickness of the axial wall decreases extends substantially the full axial length of the sleeve. The internal tapered bore of the sleeve bushing (18) spans its entire length. There is also a flange (labeled above) which extends from the base of the flange as is common for bushings. These flanges provide a suitable depth stop when performing the shrink-fitting operation and provide a shoulder bearing surface which can transmit axial loads. Notwithstanding the flange portion of the bushing (18) it is clear that the region over which the thickness of the axial wall decreases extends at least substantially the full axial length of the sleeve (bushing 18).

*"Preferably, the joint (21) is a tapered joint with the tapered end (25) of shaft (14). The yoke bushing (18) has a mating bore similarly tapered."*⁷⁰

As the citation above describes, the bushing has a tapered bore that spans substantially the entire axial length.

A POSITA would have been motivated to combine the sleeve (including the axial wall with decreasing thickness) and tapered shaft of Piepho with the main

⁶⁹ Exhibit 1016, Figure 1 annotated

⁷⁰ Exhibit 1015 3:30-31

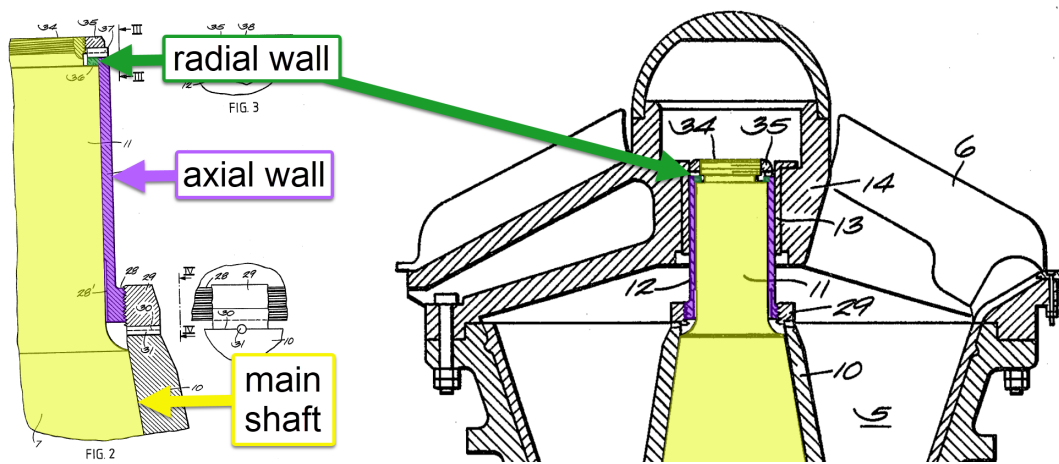
shaft of Polinski. A POSITA would have a reasonable expectation of success in making the combination as it is nothing more than combining prior art elements according to known methods to yield predictable results. A POSITA would be further motivated to use a tapered sleeve on a tapered shaft as it aids in alignment and makes it easier to install and detach as the distance the sleeve needs to travel while expanded is smaller compared to a sleeve with a cylindrical interference fit.

3P. The gyratory crusher as claimed in claim 1,

YES: As shown above, Polinski in view of Piepho discloses the gyratory crusher as claimed in claim 1.

3a1. further comprising a radial wall extending perpendicular or transverse to the axial wall,

YES: Polinski discloses a radial wall extending perpendicular or transverse to the axial wall.



As shown above Polinski discloses a radial wall that extends transversely to the axial wall. This feature serves as a shoulder that sets the depth of the sleeve during fit-up and provides a shoulder for potentially bearing axial loads.

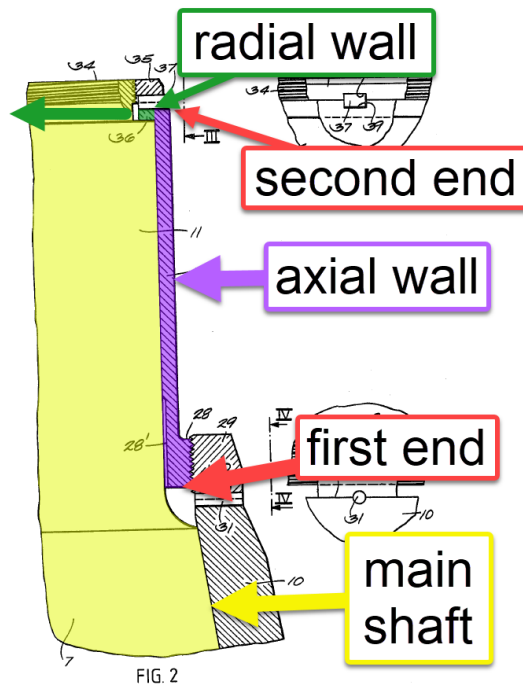
*“As best shown in FIGS. 2 and 3, a threaded lug 34 is provided on the end of the journal which is adapted to receive a sleeve nut 35 which axially overlies an inwardly projecting annular lip 36 on the upper end of the sleeve 12.”*⁷¹

A POSITA would be motivated to include this radial wall in the combination of Polinski in view of Piepho as it makes for a more predictable assembly process and provides additional bearing surface for the top sleeve securing nut.

⁷¹ Exhibit 1015 3:25-29, emphasis added.

3a2. the radial wall being positioned at or towards the second end and extending inwardly towards the longitudinal axis.

YES: Polinski discloses that the radial wall is positioned at or towards the second end and extends inwardly towards the longitudinal axis.



As shown above the radial wall of Polinski is positioned at the second end of the sleeve. Further it extends inwardly towards the longitudinal axis.

“As best shown in FIGS. 2 and 3, a threaded lug 34 is provided on the end of the journal which is adapted to receive a sleeve nut 35 which axially overlies an inwardly projecting annular lip 36 on the upper end of the sleeve 12.”⁷²

A POSITA would be motivated to include this radial wall in the combination of Polinski in view of Piepho as it makes for a more predictable assembly process and provides additional bearing surface for the top sleeve securing nut.

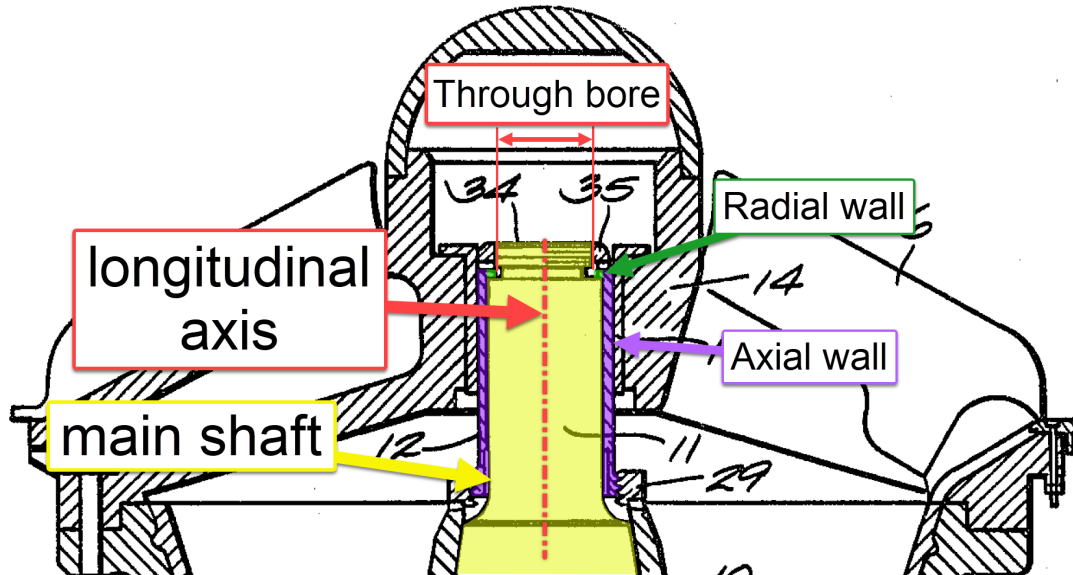
4P. The gyratory crusher as claimed in claim 3,

YES: As shown above, Polinski in view of Piepho discloses the gyratory crusher as claimed in claim 3.

⁷² Exhibit 1015 3:25-29, emphasis added.

4a. wherein the radial wall includes a through bore positioned at the longitudinal axis of the sleeve.

YES: Polinski discloses that the radial wall includes a through bore positioned at the longitudinal axis of the sleeve.



As shown above, the radial wall includes a through bore. Further, the through bore is positioned at the longitudinal axis of the sleeve. This is clear in the Figure above which shows that the topmost threaded portion of the main shaft, which is aligned with the longitudinal axis extends through the opening bore in the radial wall of the sleeve.

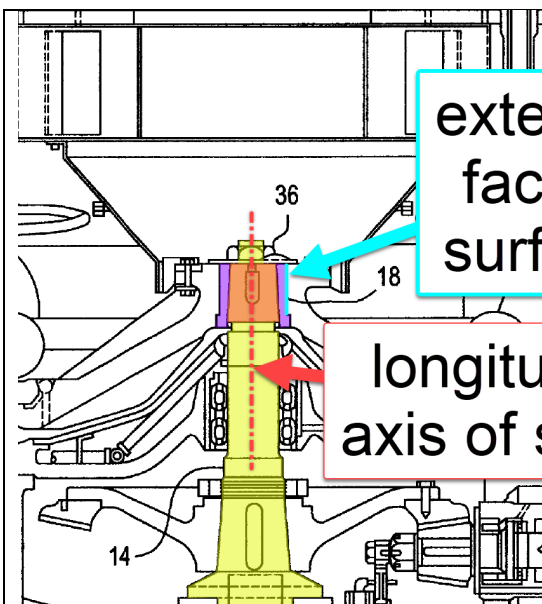
“As best shown in FIGS. 2 and 3, a threaded lug 34 is provided on the end of the journal which is adapted to receive a sleeve nut 35 which axially overlies an inwardly projecting annular lip 36 on the upper end of the sleeve 12.”⁷³

As described in the citation above, the threaded lug 34 is adapted to receive the sleeve nut 35 and axially overlies the inwardly projecting annular lip 36. Being axially overlain is consistent with the bore in the radial wall being positioned at the longitudinal axis.

A POSITA would be motivated to include this radial wall in the combination of Polinski in view of Piepho as it makes for a more predictable assembly process and provides additional bearing surface for the top sleeve securing nut.

⁷³ Exhibit 1015 3:24-27

5P. The gyratory crusher as claimed in claim 1,	YES: As shown above, Polinski in view of Piepho discloses the gyratory crusher as claimed in claim 1.
5a. wherein a cross-sectional shape profile of the external facing surface is substantially circular.	YES: Both Polinski and Piepho discloses that the cross-sectional shape profile of the external facing surface is substantially circular.



longitudinal
axis of sleeve

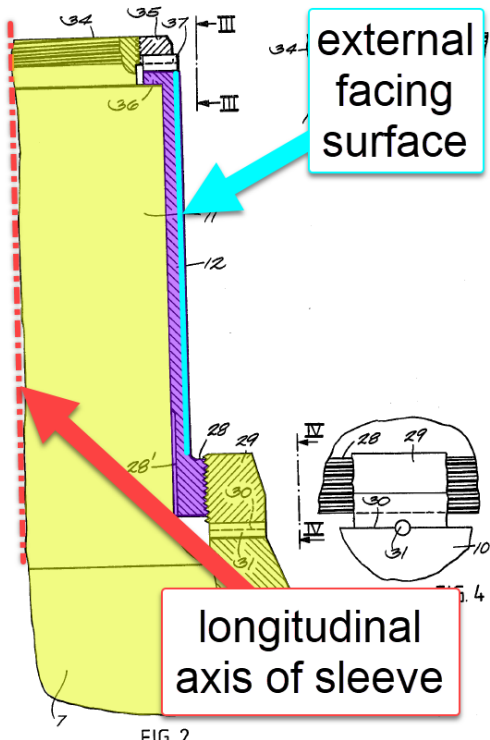
Piepho

As shown in the figure, the cross section of Piepho is consistent with a circularly shaped external facing surface.

“The present invention provides an intervening material between the shaft end (25) and the mating bore in yoke bushing (18) fitted within the bore of yoke (12) to prevent fretting damage.”⁷⁴

As described above, the sleeve bushing (18) is fitted in a bore of yoke (12). A POSITA would understand that the bore feature in yoke 12 would be circular in shape. Further, the components are used in power transmission shafting which is generally circular in shape.

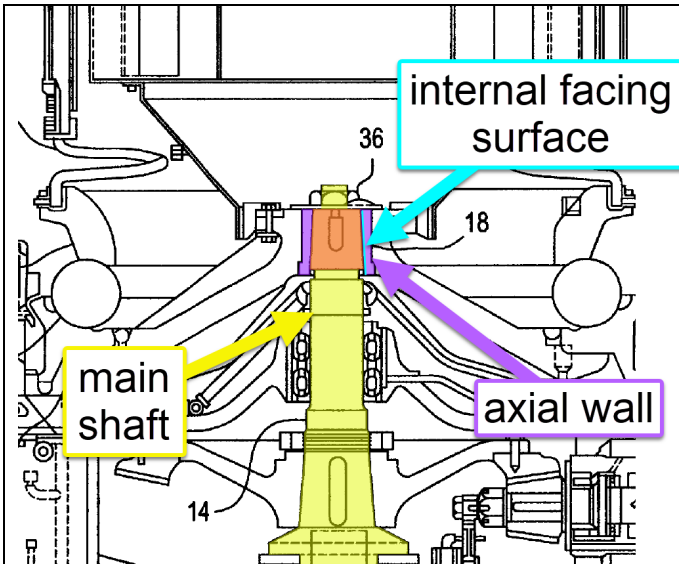
⁷⁴ Exhibit 1016 3:24-27, emphasis added

 FIG. 2	Polinski As shown in the figure, the cross section of Polinski is consistent with a circularly shaped external facing surface. <i>“As will be described, the cross-section of the upper end of the shaft 7 gradually converges to form a bearing journal 11 extending from the tapered portion of the shaft which is fitted with a <u>cylindrical bearing sleeve 12</u> rotatably retained within a bearing bushing 13 secured within a coaxially aligned hub 14 in the spider 6.”⁷⁵</i> As described, the bearing sleeve (12) is cylindrical in shape. A POSITA would understand that a cylindrical shape has a circular cross section. Further, the components are used in power transmission shafting which is generally circular in shape.
As shown above, the external facing surface of both Piepho and Polinski has a circular cross-sectional shape.	
6P. The gyratory crusher as claimed in claim 1,	YES: As shown above, Polinski in view of Piepho discloses the gyratory crusher as claimed in claim 1.

⁷⁵ Exhibit 1015 2:41-47, emphasis added

6a. wherein a cross-sectional shape profile of the internal facing surface is substantially circular.

YES: Both Polinski and Piepho disclose that the cross-sectional shape profile of the internal facing surface is substantially circular.



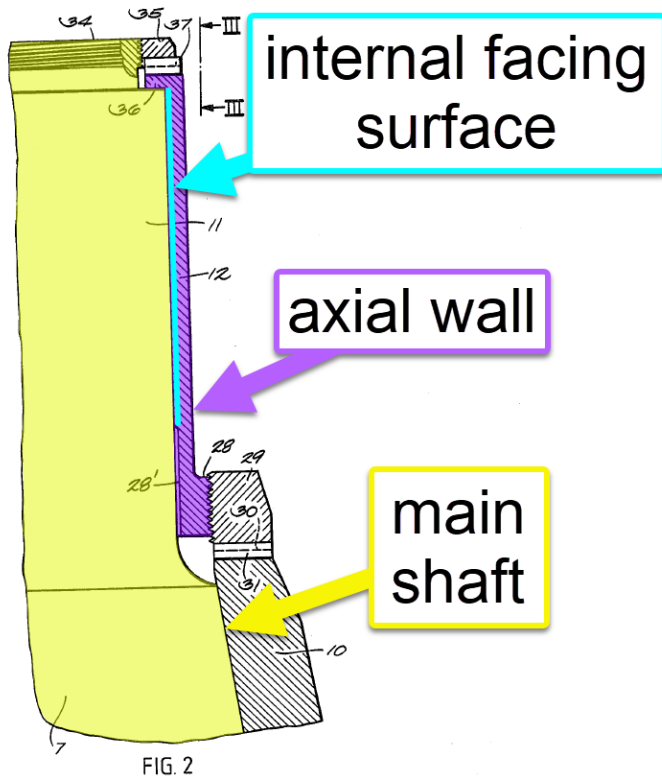
Piepho

As seen in the figure, the cross section of Piepho shows the internal facing surface engages with the tapered portion of the main shaft. As such the internal bore of the bushing (18) has a conical taper. A POSITA would understand that a conical bore has a cross-sectional profile that is circular when it is sectioned on any plane that is perpendicular to the axis of the cone.

“Preferably, the joint (21) is a tapered joint with the tapered end (25) of shaft (14). The yoke bushing (18) has a mating bore similarly tapered.”⁷⁶

As described in the above citation, the sleeve bushing (18) has a mating bore that is similarly tapered to the tapered end of the shaft. This is consistent with the figures and just as discussed above, a conically tapered bore has a circular cross-section.

⁷⁶ Exhibit 1016 3:30-32



Polinski

As shown in the figure, the cross section of Polinski is consistent with a circularly shaped internal facing surface.

*"As will be described, the cross-section of the upper end of the shaft 7 gradually converges to form a bearing journal 11 extending from the tapered portion of the shaft which is fitted with a **cylindrical bearing sleeve 12** rotatably retained within a bearing bushing 13 secured within a coaxially aligned hub 14 in the spider 6."*⁷⁷

As described, the bearing sleeve (12) is cylindrical in shape. A POSITA would understand that a cylindrical shape has a circular cross section. Further, the components are used in power transmission shafting which is generally circular in shape.

As shown above, both Piepho and Polinski have internal facing surfaces that have a circular cross-sectional shape. Thus, it is reasonable that the combination of Polinski in view of Piepho would have a internal facing surface has a circular cross-sectional shape.

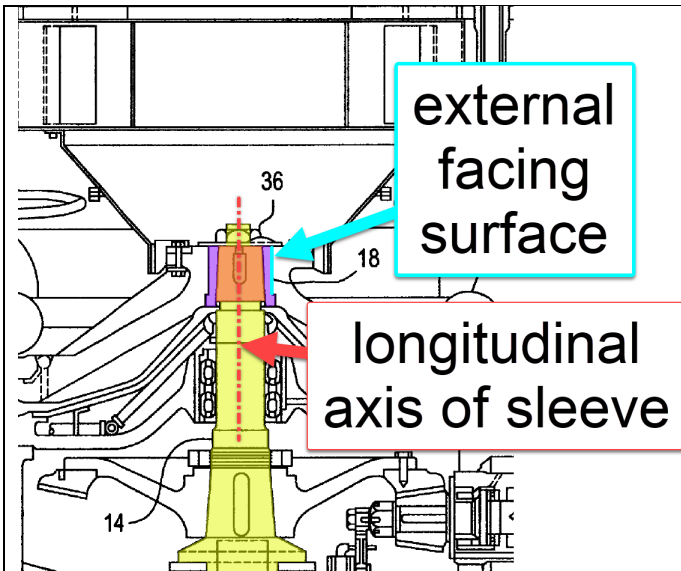
7P. The gyratory crusher as claimed in claim 1,

YES: As shown above, Polinski in view of Piepho discloses the gyratory crusher as claimed in claim 1.

⁷⁷ Exhibit 1015 2:41-47, emphasis added

7a. wherein a shape profile of the external facing surface defines a section of a cylinder in the axial direction.

YES: Both Polinski and Piepho disclose that the shape profile of the external facing surface defines a section of a cylinder in the axial direction.



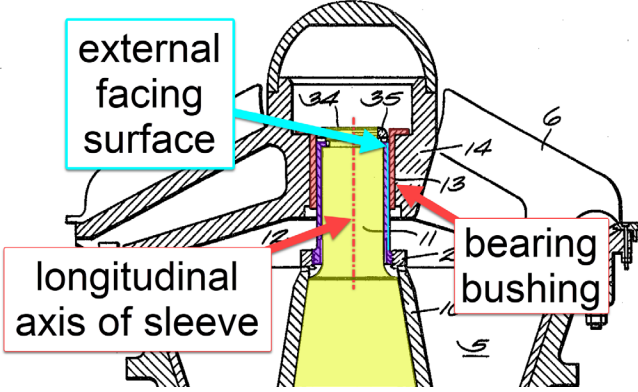
Piepho

As shown in the figure, Piepho discloses an external facing surface that defines a section of a cylinder in the axial direction.

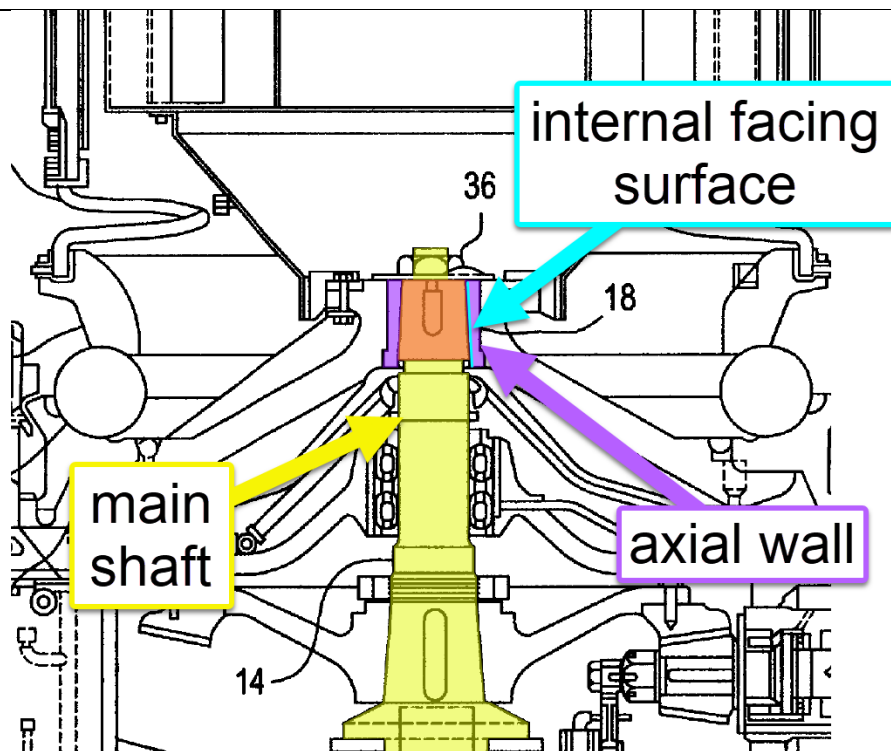
*“The present invention provides an intervening material between the shaft end (25) and the mating bore in yoke **bushing (18) fitted within the bore of yoke (12)** to prevent fretting damage.”⁷⁸*

As described above, the sleeve bushing (18) is fitted in a bore of yoke (12). A POSITA would understand that the bore feature in yoke 12 would be cylindrical in shape. As shown in the figure, the cylindrical shape is oriented in the axial direction of the main shaft.

⁷⁸ Exhibit 1016 3:24-27, emphasis added

	Polinski As shown in the figure, the cross section of Polinski is consistent with a cylindrically shaped external facing surface. <i>“As will be described, the cross-section of the upper end of the shaft 7 gradually converges to form a bearing journal 11 extending from the tapered portion of the shaft which is fitted with a <u>cylindrical bearing sleeve 12</u> rotatably retained within a bearing bushing 13 secured within a coaxially aligned hub 14 in the spider 6.”⁷⁹</i> As described, the bearing sleeve (12) is cylindrical in shape. Further, the components are used in power transmission shafting which is generally cylindrical in shape.
As shown above, both Piepho and Polinski have external facing surfaces that a section of a cylinder and further that such a cylinder is oriented in the axial direction. Thus, it is reasonable that the combination of Polinski in view of Piepho would meet this limitation as well.	
8P. The gyratory crusher as claimed in claim 1,	YES: As shown above, Polinski in view of Piepho discloses the gyratory crusher as claimed in claim 1.
8a. wherein a shape profile of the internal facing surface defines a section of a cone in the axial direction.	YES: Piepho discloses that the shape profile of the internal facing surface defines a section of a cone in the axial direction.

⁷⁹ Exhibit 1015 2:41-47, emphasis added



As shown above the shape of the internal facing surface of the sleeve bushing (18) is tapered to fit up with the tapered portion of the main shaft. A tapered internal facing surface is a section of a cone and it is oriented in the axial direction. This is consistent with the description in the specification of Piepho.

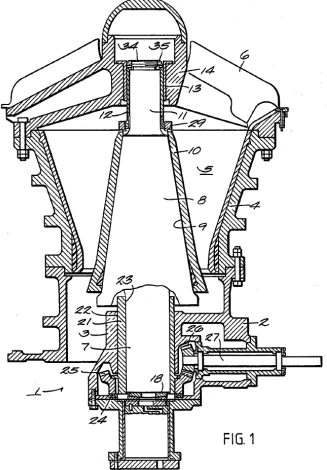
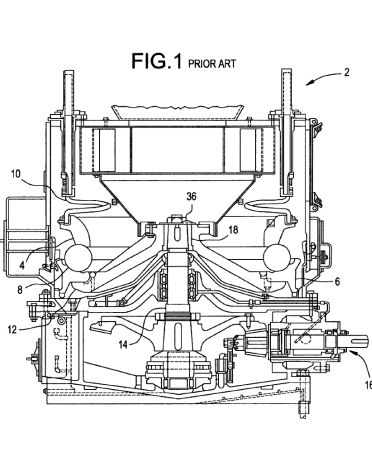
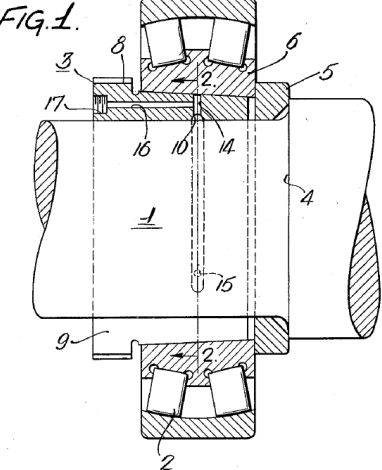
“Preferably, the joint (21) is a tapered joint with the tapered end (25) of shaft (14). The yoke bushing (18) has a mating bore similarly tapered.”⁸⁰

A POSITA would be motivated to combine Polinski’s shaft and sleeve with Piepho’s teachings of a tapered shaft end and tapered sleeve (with an internal facing surface that defines a section of a cone) fitted over the tapered section of second end of the main shaft. A POSITA would have a reasonable expectation of success in making the combination as it is nothing more than combining prior art elements according to known methods to yield predictable results. A POSITA would be further motivated to use a tapered sleeve on a tapered shaft as it aids in alignment and makes it easier to install and detach as the distance the sleeve needs to travel while expanded is smaller compared to a sleeve with a cylindrical interference fit.

⁸⁰ Exhibit 1016 3:30-32

82. As shown above, Polinski in view of Piepho renders claims 1-8 obvious to a POSITA.

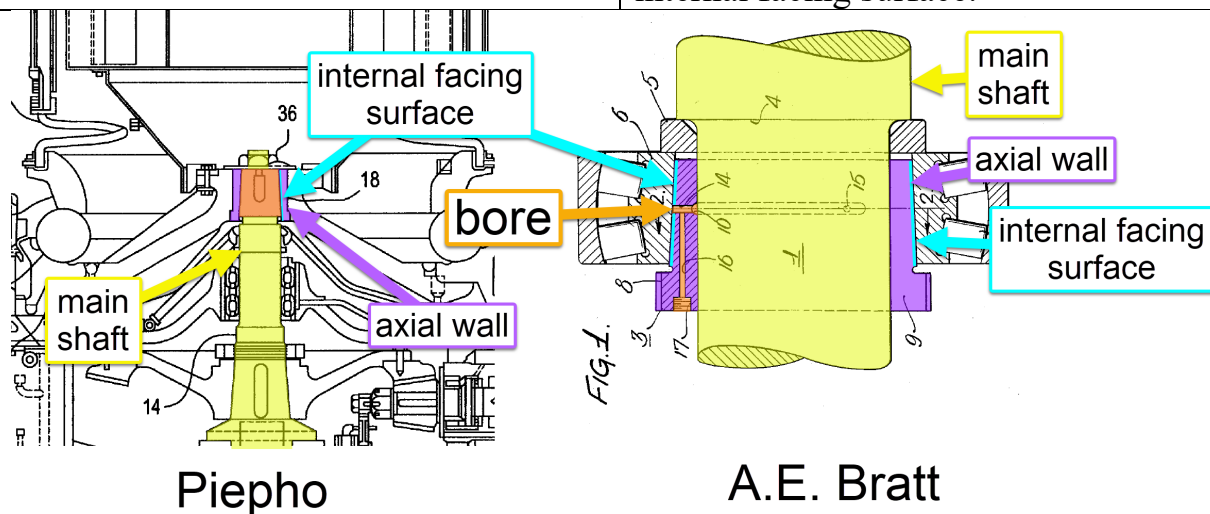
B. Polinski in view of Piepho, and in further view of A.E. Bratt Render Claim 9 Obvious

 FIG. 1	 FIG. 1 PRIOR ART	 FIG. 1.
US 4,410,143 to Polinski	US 6,270,026 to Piepho	US 2,764,437 to A. E. Bratt

83. As discussed above A POSITA would be motivated combine Polinski in view of Piepho to create the apparatus claimed in claim 1 of the '568. A POSITA would be further motivated to combine Polinski in view of Piepho, and in further view of US 2,764,437 to A.E. Bratt and/or the knowledge of a POSITA based on the teachings of the prior art. The use of lubricating oil to assist with making or breaking tapered interference fit joints is extremely well-known. Further, the use of lubrication ports of various styles including through the axial wall of the sleeve is well known. For example A.E. Bratt discloses a tapered sleeve for an interference-fit joint and a bore through the sleeve wall to deliver lubricating

oil to the internal facing surface.

Challenged Claim	Does the Prior Art disclose this?
9P. The gyratory crusher as claimed in claim 1,	YES: As shown above, Polinski in view of Piepho discloses the gyratory crusher as claimed in claim 1.
9a. further comprising at least one bore provided through the axial wall to allow the passage of a fluid to the internal facing surface.	YES: Polinski in view of Piepho and further in view of A.E. Bratt discloses further comprising at least one bore provided through the axial wall to allow the passage of a fluid to the internal facing surface.



As shown above, A.E. Bratt discloses a tapered sleeve on a shaft, and a bore provided through the axial wall allow the passage of a fluid to the internal facing surface between the sleeve and the shaft.

“The present invention relates to a press fitted or shrunk joint and has for its purpose to facilitate the making of the joint or the separation thereof.

...

*According to the present invention arrangements are made for introducing under pressure a fluid, either liquid or gaseous, between the engaging surfaces so that the metallic contact is relieved over at least the greater part of the surfaces whereby **these may be more easily displaced relative each other.***

...

A passage 16, extending from the flanged end of the sleeve axially to the hole 14, establishes a channel of communication between the groove 10, and holes 13, 14 and 15, and an exposed surface of the assembly.

...

The outer end of the passage 16 is then connected to a source of a suitable pressure fluid, for example oil, such connection being facilitated by the threads 17 at the outer end of the passage. The pressure of the oil must be as great at least as the specific pressure between the engaging surfaces of the sleeve and shaft and of the sleeve and bearing so that the oil may force its way between the said surfaces. The oil thus introduced and distributed by way of the groove 10 and holes 13, 14 and 15, forms films between the inner and outer surfaces of the sleeve and the confronting surfaces of the shaft and bearing respectively and make it possible to displace the sleeve axially with respect both to the shaft and bearing by application of forces of relatively low order and without damage to the said surfaces. The oil film may be so thin that it relieves the metallic contact between the surfaces but does not materially expand or contract the engaging parts.

The same procedure may be used in obvious manner to aid in effecting the force fit between [sic] the sleeve and the shaft and bearing. The oil introduced in this operation quickly disappears from between the surfaces and does not affect the strength of the joint and its ability to transmit power.”⁸¹

As described above, A.E. Bratt discloses an apparatus for delivering lubricating oil through a bore in the axial wall of a tapered sleeve to assist in the making or braking of a tapered interference-fit joint. A POSITA would understand that this is the only reasonable function of adding lubricating oil to the mating surfaces of a tapered interference-fit joint.

A POSITA would be motivated to implement the well-known hydraulic processes for making and breaking interference fits, for example between the sleeve and the shaft, as they are well known to protect the shaft from damage,⁸² they are able to be used in more locations as they do not require presses and gear pullers,⁸³ does not require the maintenance that presses and gear pullers do,⁸⁴ and make removing components on a tapered shaft particularly easy.⁸⁵

84. As shown above, Polinski in view of Piepho and in further view of A.E. Bratt renders claim 9 obvious to a POSITA.

C. Polinski in view of Piepho, and in further view of Pollak Render Obvious Claim 10

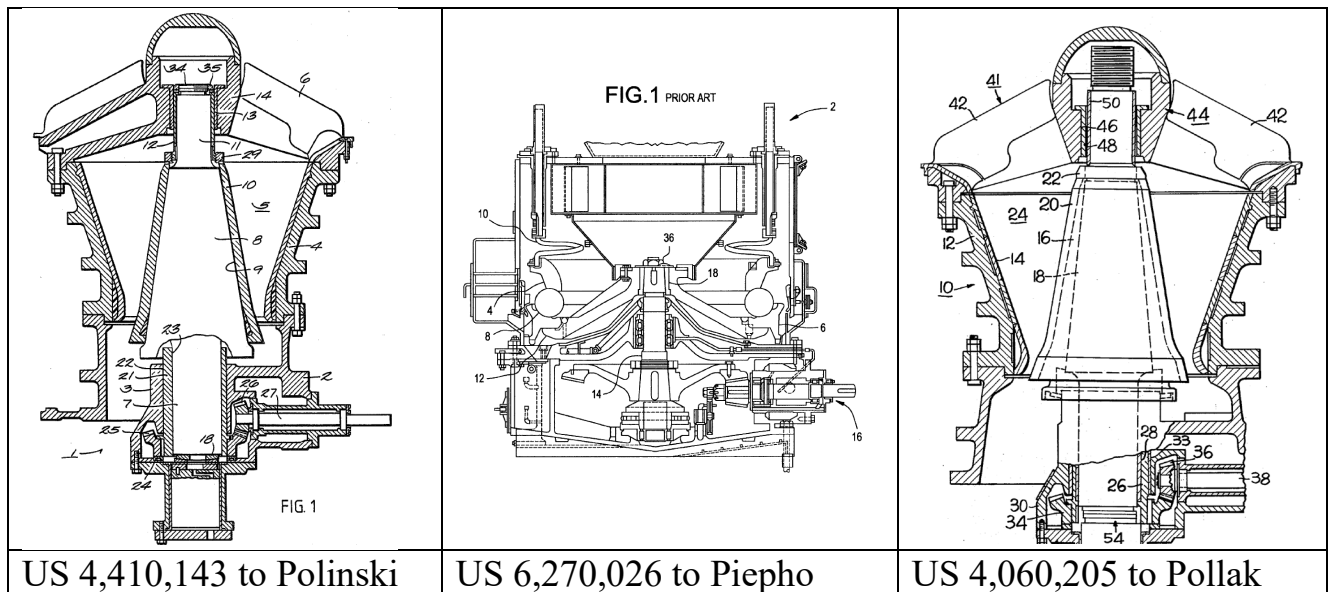
⁸¹ Exhibit 1034, 1:19-21, 29-34, 69-72, 2:6-29, emphasis added

⁸² Exhibit 1033, 1:13-15, 1:35-42

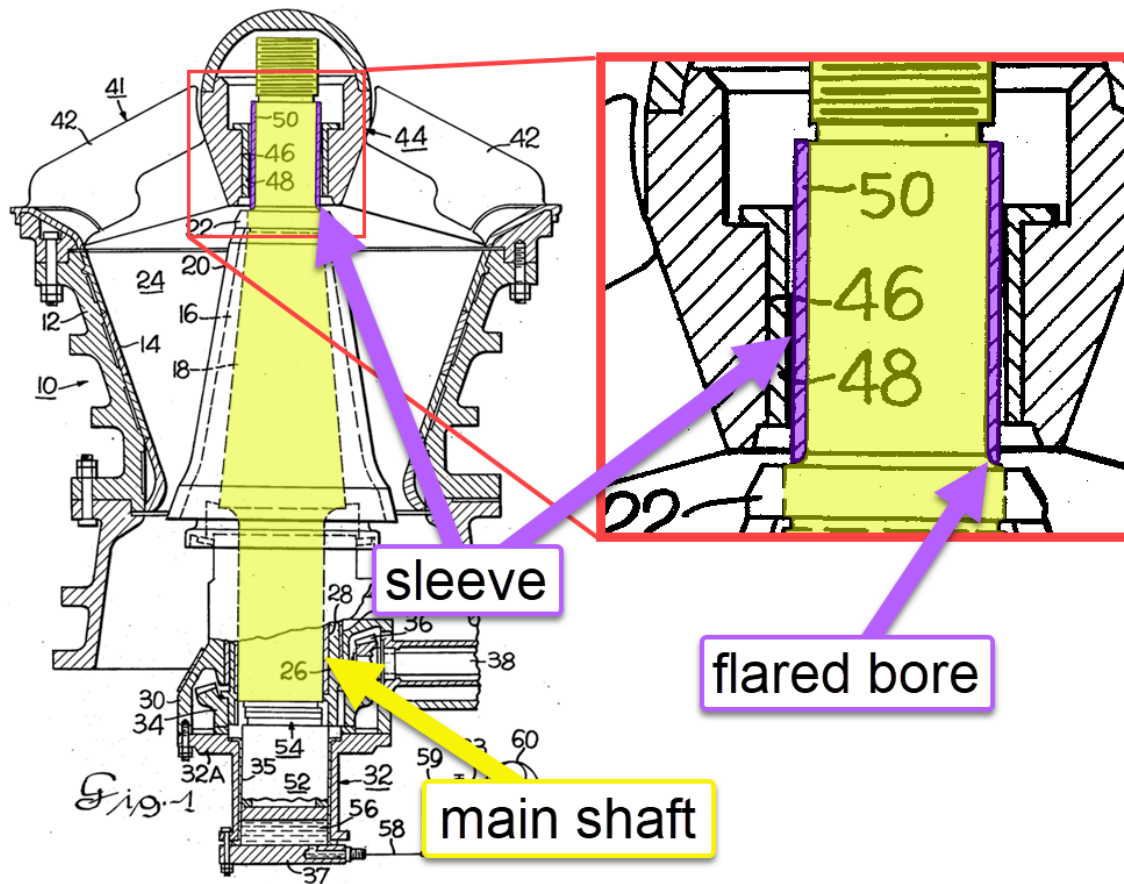
⁸³ Exhibit 1032, 1:15-24

⁸⁴ Exhibit 1032, 1:35-40

⁸⁵ Exhibit 1031, 3:15-22



85. As discussed previously A POSITA would have been motivated to combine Polinski in view of Piepho. A POSITA would further be knowledgeable about the design of power transmission shafting as well as stress and fatigue analysis. As such, they would be motivated to make certain design choices that would enhance the assembly process, as well as improve the part fit-up and stress flow. One such choice a POSITA would be motivated to make would be to flare the internal bore of the upper wear sleeve so as to permit the sleeve to sit lower and more evenly distribute loads and stresses thereby improving the expected fatigue life of the power transmission shafting of the gyrating crusher. The prior art shows this minor design choice being made, for example in US 4,060,205 to Pollak as shown below:



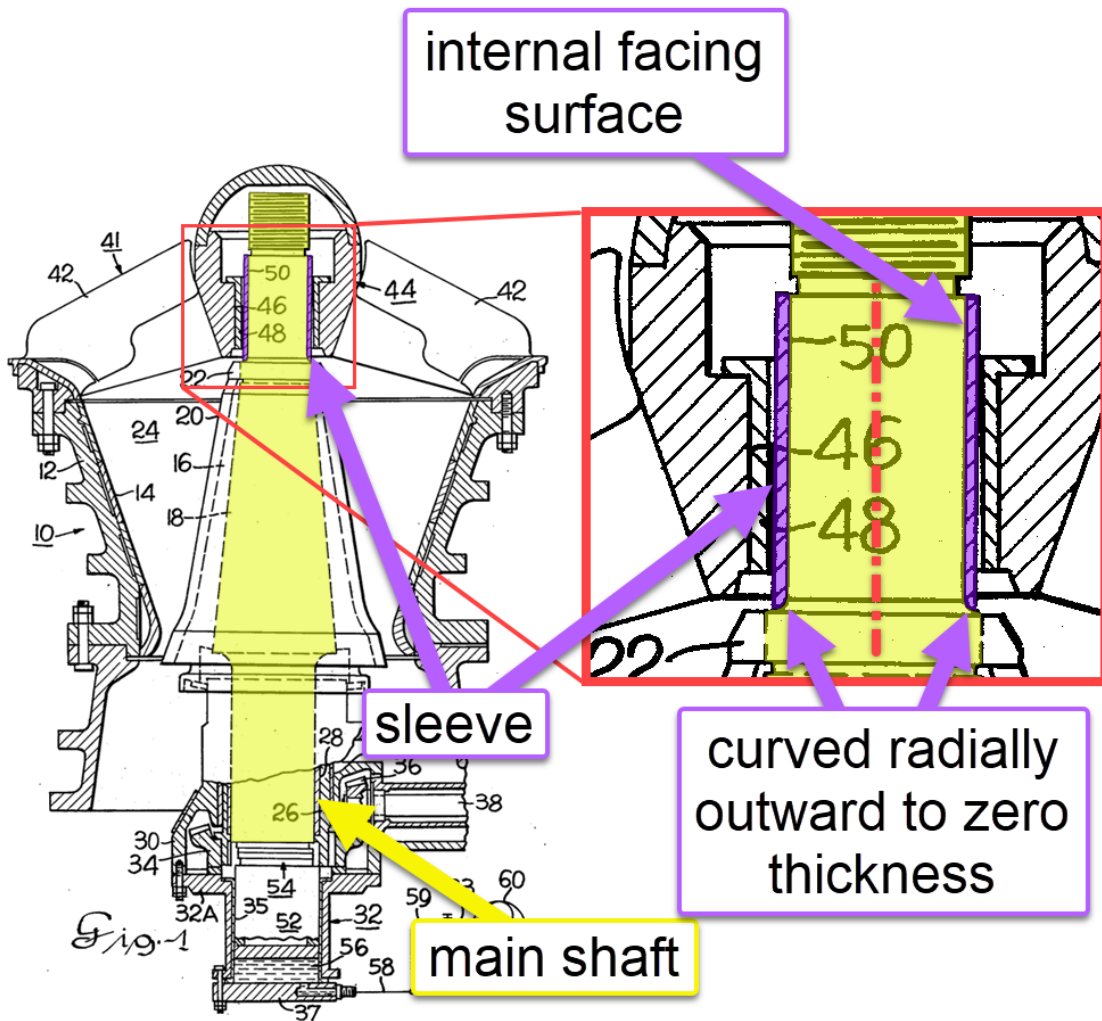
86

86. As shown above, Pollak discloses a gyrating rock crusher and is therefore analogous art to the '568. Like Polinski and Piepho, Pollak has a sleeve fitted onto the upper end of the main shaft. As shown in the figure above, and consistent with the design principles discussed, the bore of the Pollak sleeve is flared outwardly on the lowermost portion. This outward flare gradually reduces the wall thickness of the sleeve allowing it to fully seat on the corresponding geometry of the main shaft. As discussed, this flare also acts to more evenly distribute the flow of loads and stresses from the sleeve to the main shaft and

⁸⁶ Exhibit 1017, Figure 1, annotated.

within the main shaft itself. This flare feature is a design choice that improves the mechanical performance and lifespan of the components. This design choice is not always made because the flared bore can be more expensive to manufacture.

Challenged Claim	Does the Prior Art disclose this?
10P. The gyratory crusher as claimed in claim 1,	YES: As shown above, Polinski in view of Piepho discloses the gyratory crusher as claimed in claim 1.
10a. wherein at a curved region of the first end, the internal facing surface is curved radially outward relative to the longitudinal axis in a direction towards the external facing surface such that the axial wall thickness decreases to zero at the curved region.	YES: Polinski in view of Piepho and in further view of Pollak or the knowledge of a POSITA discloses wherein at a curved region of the first end, the internal facing surface is curved radially outward relative to the longitudinal axis in a direction towards the external facing surface such that the axial wall thickness decreases to zero at the curved region.



As shown in element 1b6 the first end is the lowermost portion of the sleeve element, just as disclosed by Pollak. As such, the first end (lower end) of the internal facing surface of the sleeve is curved radially outward relative to the longitudinal axis (central to the sleeve as shown in red). The direction radially outward from the longitudinal axis of the sleeve is the same as the direction from the internal facing surface towards the external facing surface. As can be clearly seen above, this sleeve geometry results in the gradual decrease in the thickness of the axial wall (the wall of the sleeve) from the full thickness down to zero.

A POSITA would be motivated to combine the internal facing surface that is curved radially outward relative to the longitudinal axis in a direction towards the external facing surface of Pollak with the sleeve on the end of the shaft shown by the combination of Polinski in view of Piepho. A POSITA would have a reasonable expectation of success in making the combination as it is

nothing more than combining prior art elements according to known methods to yield predictable results. A POSITA would be further motivated to use curved internal facing surface as it aids in alignment and makes it easier to install as the sleeve is fitted over the shaft.

87. As shown above, Polinski in view of Piepho and in further view of Pollak renders claim 10 obvious to a POSITA.

IX. CONCLUSION

88. For these reasons, it is my opinion that challenged claims of the '568 patent would have been obvious to a person of ordinary skill in the art.

89. 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 August 29, 2024 in Meridian, ID.

David G. Smith, PE, CSP