

**CMS Cepcor LTD and CMS Cepcor Americas LLC
v. Sandvik Intellectual Property AB**

IPR2024-01381—U.S. Patent No. 11,014,090 ('090 Patent)

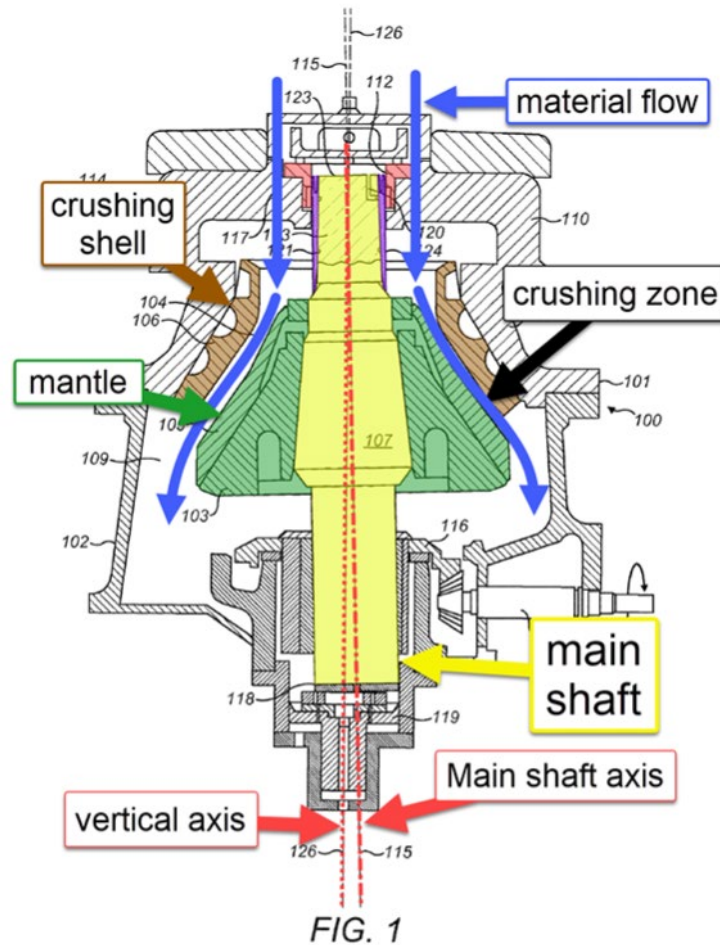
**CMS Cepcor LTD and CMS Cepcor Americas LLC
(Petitioners) Demonstrative Exhibits**

**Oral Hearing
USPTO, Alexandria, VA
January 13, 2026**

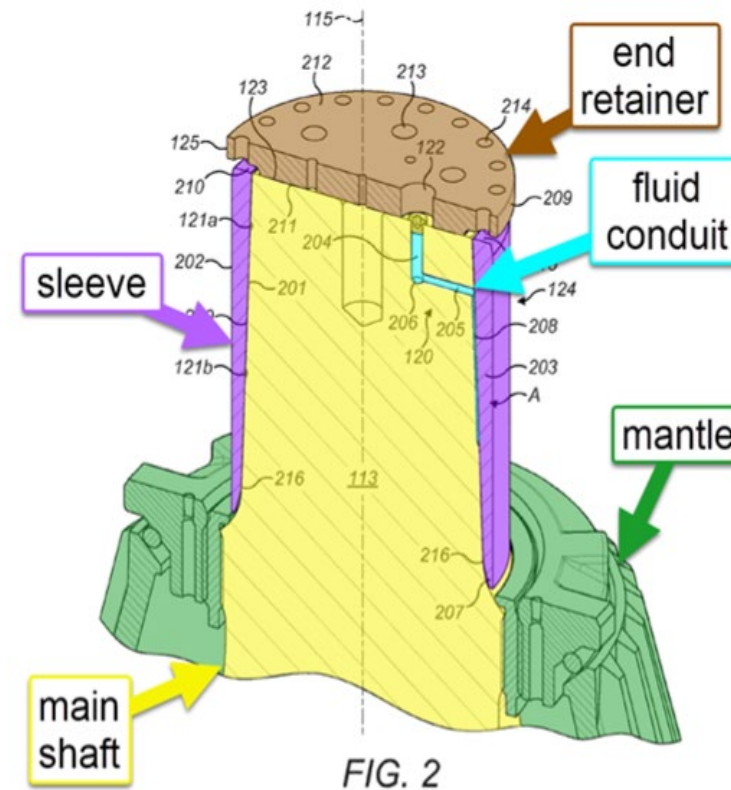
Agenda

- Sandvik '090 Patent Slides 2
- Level of Skill & Field of Endeavor Slides 3
- Prior Art Slides 4-5
- Motivation to Combine Slides 6-7
- Reasonable Expectation of Success (Primary Claims) Slides 8-16
- Reasonable Expectation of Success (Amended Claims) Slides 17-27
- Analogous Art Slides 28-31

The '090 Patent



Ex. 1002, at ¶ 67



Ex. 1002, at ¶ 68

Level of Skill & Field of Endeavor

- For purposes of this Petition, 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. Paper 2, p. 3 (citing Ex. 1002, at ¶ 29).
- Patent Owner's Expert does not object to the above level of skill.
- Field of endeavor is main shaft assemblies for rock crushers. See generally Ex. 1044, ¶ 18; Ex. 1001 at 1; Ex. 1018 at 1.

Representative Prior Art

Primary Claims:

- U.S. Patent No. 4,410,143 (“Polinski,” Ex. 1017): Polinski discloses a gyrating rock crusher
- U.S. Patent No. 6,270,026 (“Piepho,” Ex. 1018): Piepho is a rock crushing apparatus (coal pulverizer)
- U.S. Patent No. 2,840,399 (“C.A. Harless,” Ex. 1033): Harless discloses a method of fixedly attaching components to tapered shaft ends, as facilitated by the use of fluid power elements

Representative Prior Art

Amended Claims (Additional Prior Art Used):

- U.S. Patent No. 4,037,800 (“Coxhill,” Ex. 1053): Coxhill discloses feature to prevent the shaft from spinning in the same rotational direction as the driven eccentric rotation when the machine is idling and a protective bearing sleeve on the upper end of the shaft.
- U.S. Patent No. 8,302,754 (Yagi, Ex.1040): Yagi discloses coupling and decoupling tapered coupling structures by pumping oil into the interstitial area between the tapered shaft and sleeve utilizing a plurality of grooves and oil passages.
- U.S. Patent No. 3,813,047 (Torrence, Ex. 1012): Torrence discloses a protective bearing sleeve on the upper end of the shaft.
- U.S. Patent No. 2,381,697 (Shepard Ex. 1057)

Motivation

- A POSITA would be motivated to combine the tapered joint of Piepho with the teachings of Polinski based on the explicit teachings of the prior art. Ex. 1002, at ¶ 86.
- In addition to this, a POSITA would understand the advantages afforded by the use of a tapered joint as compared with a cylindrical joint. Ex. 1002, at ¶ 86.
- 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. Ex. 1002, at ¶ 87.

Motivation Continued

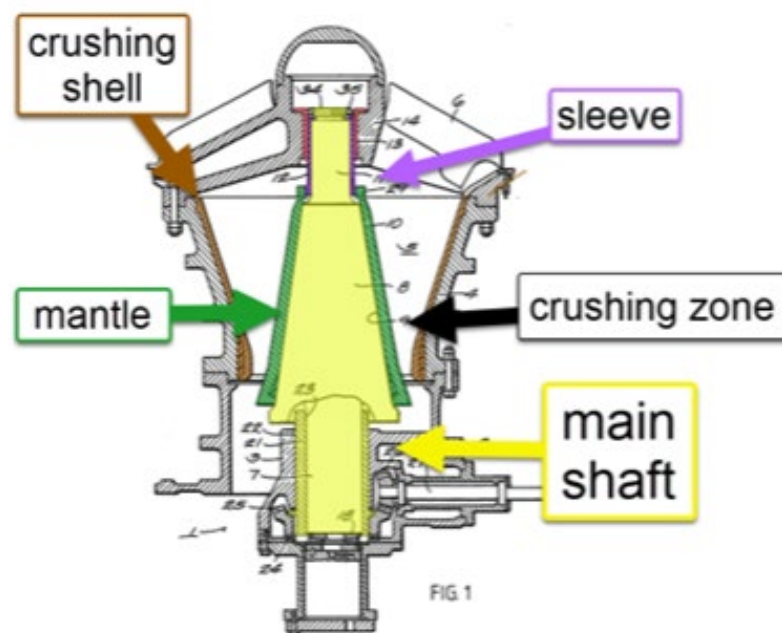
- Piepho similar to the '090 Patent is directed to increasing the life of the main shaft of a rock crusher, and would lend itself to consideration in solving that problem. Ex. 1001, 1:42-59 and Ex. 1018, 1:45-65
- Piepho teaches that a tapered shaft is preferable, and a POSITA would understand that the tapered shaft is preferable because it makes it easier and faster to replace a bushing, with less damage to the main shaft. Ex. 1018, 3:29-30
- Piepho thus lends itself to consideration and solving the problem addressed by the '090 Patent.
- Yagi is directed to using hydraulics to seat and unseat bushings on tapered shafts, and lends itself to consideration in solving the problem addressed by the '090 Patent. Ex. 1051, ¶ 48 and P 74.

Overview of the Original Independent Claims

Claim Features	Claim 1	Claim 9	Claim 14
Preamble	A gyratory crusher main shaft	A gyratory crusher main shaft assembly	A gyratory crusher
a shaft body having a first end and a second end	Yes	Yes	Yes
the shaft body being tapered	Yes	Yes	Yes
a shaft sleeve at the tapered region	Yes	Yes	Yes
at least one groove indented at the tapered axial region of the shaft	Yes	Yes	Yes
the at least one groove arranged to receive a pressurized fluid to facilitate mounting and dismounting	Yes	Yes	Yes

Claim 1 is Obvious (See Ex. 1002, pp. 57-63)

Challenged Claim Element Obvious by Prior Art?	
1P. A gyratory crusher main shaft of a crusher comprising:	YES: Although the preamble is generally not considered limiting, Polinski discloses a gyratory crusher main shaft of a crusher.



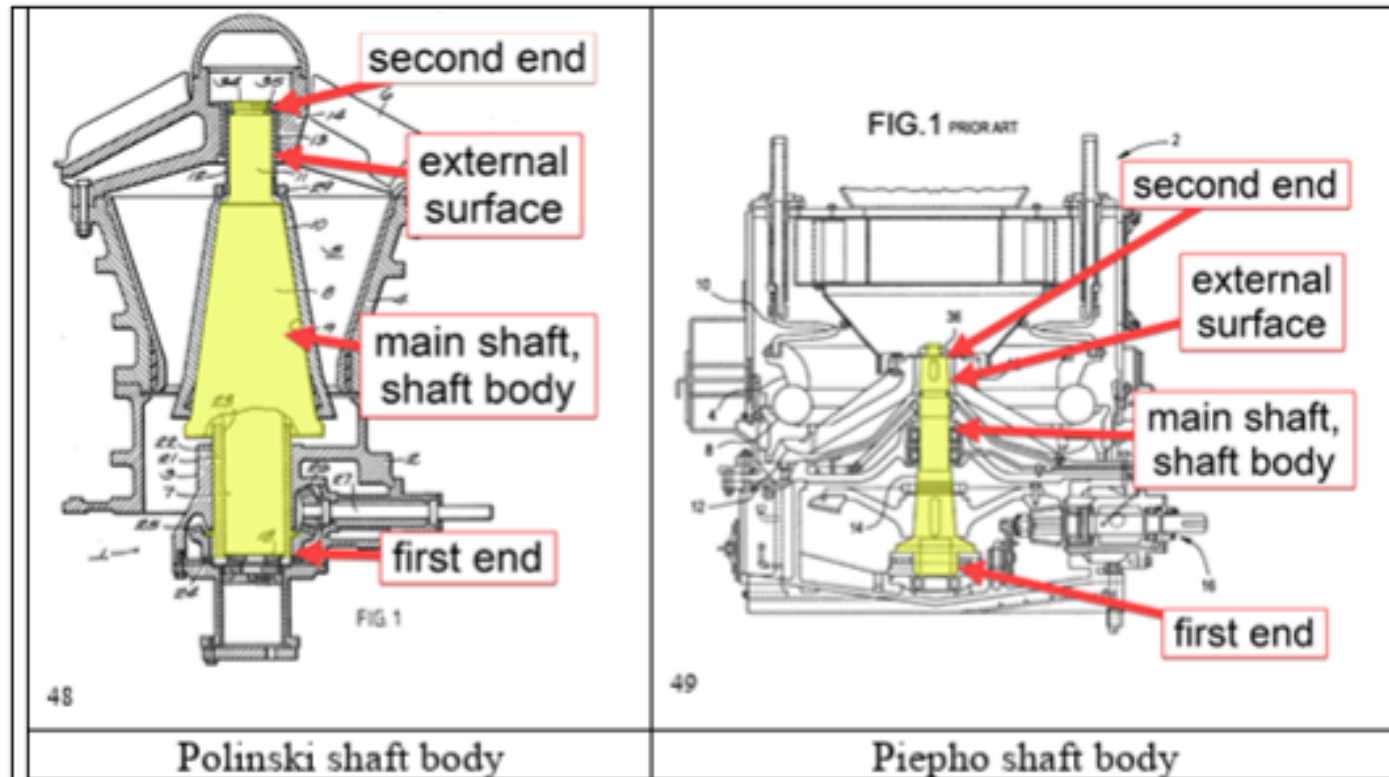
Polinski Ex. 1017

Element 1a of Claim 1

Challenged Claim Element Obvious by Prior Art?

1a. A shaft body having a radially outward facing external surface, and a first end and a second end;

YES: **Polinski and Piepho** each disclose a shaft body having a radially outward facing external surface, and a first end and a second end.

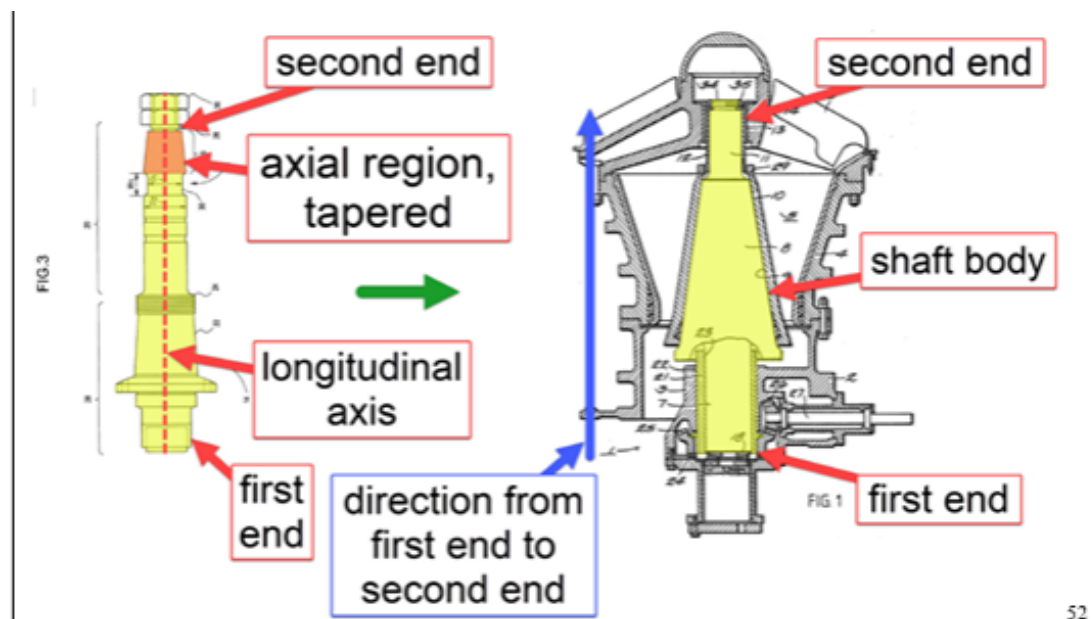


Element 1b of Claim 1

1b. Challenged Claim Element Obvious by Prior Art?

1b. an axial region of the shaft body extending from the second end and being tapered relative to a longitudinal axis of the shaft body such that a cross sectional area of the shaft body at the tapered axial region decreases in a direction from the first end to the second end.

YES: Polinski in view of Piepho discloses an axial region of the shaft body extending from the second end and being tapered relative to a longitudinal axis of the shaft body such that a cross section area of the shaft body at the tapered axial region decreases in a direction from the first end to the second end.



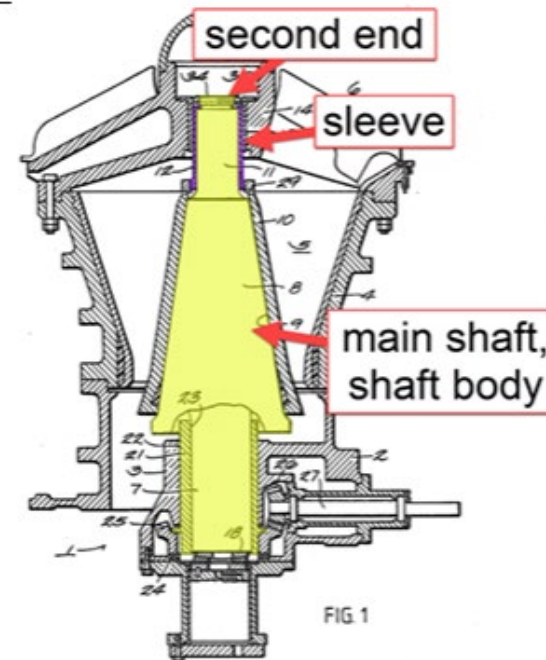
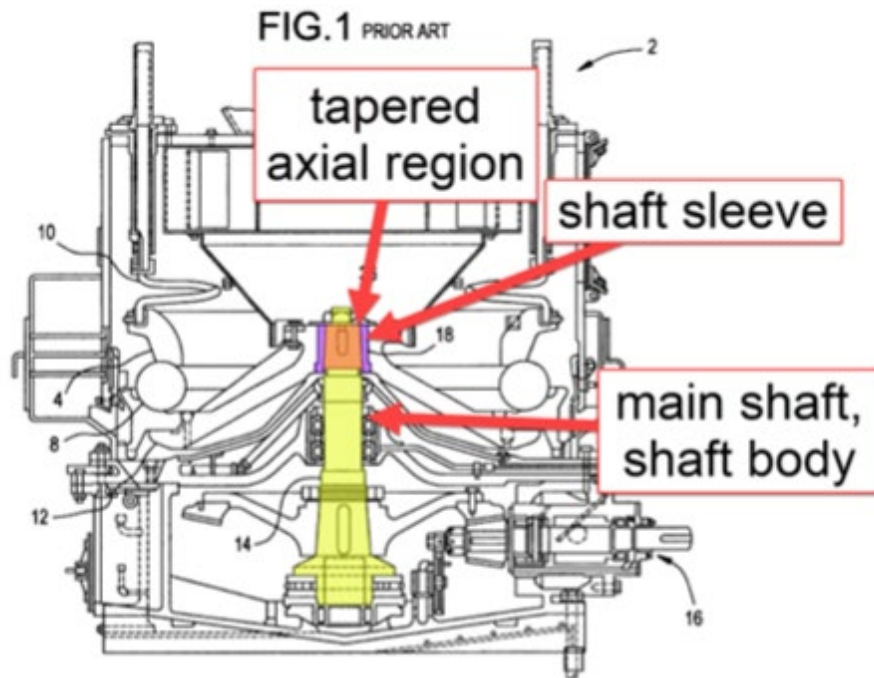
52

Element 1c of Claim 1 is Obvious

1c. Challenged Claim Element Obvious by Prior Art

1c. a shaft sleeve mounted on the tapered axial region;
region; and

YES: Polinski in view of Piepho discloses a shaft sleeve mounted on the tapered axial region.

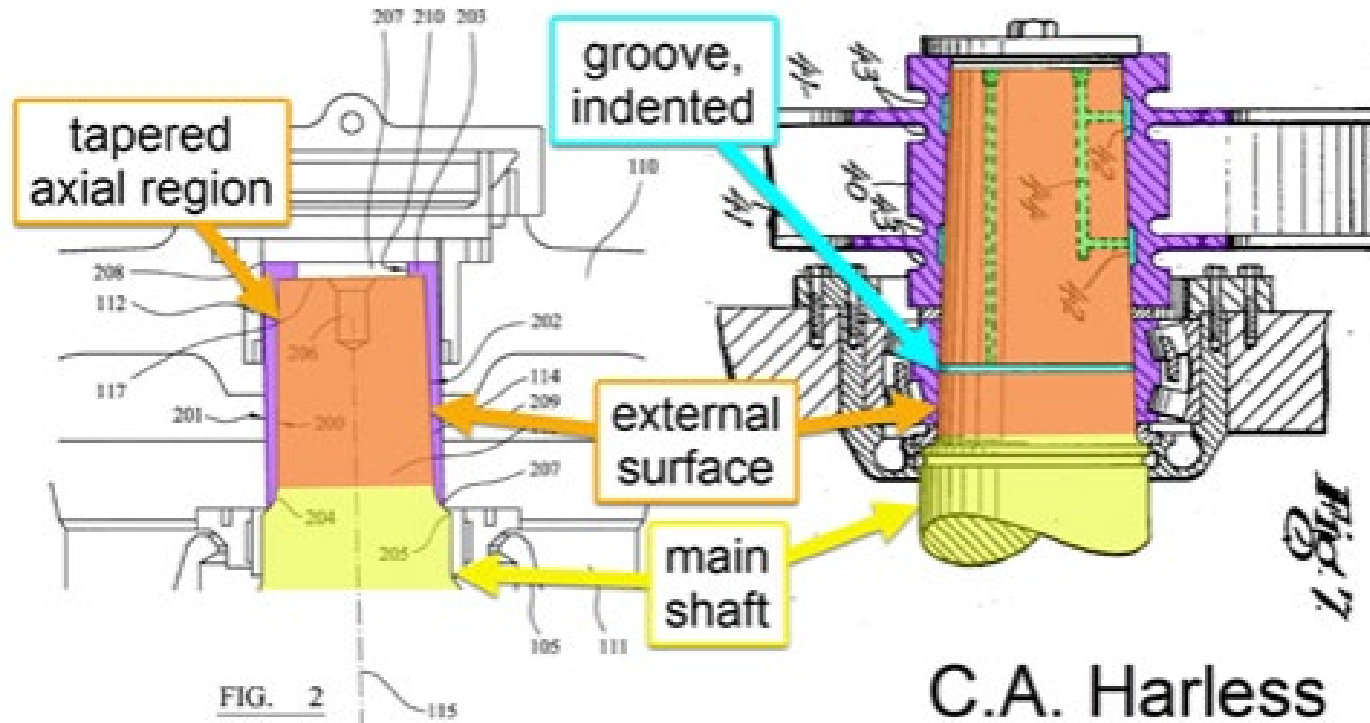


Element 1d1 of Claim 1 is Obvious

1d1. Challenged Claim Element Obvious by Prior Art

1d1. at least one groove indented at the external surface and positioned at the tapered axial region,

YES: Polinski in view of Piepho, and in further view Harless discloses at least one groove indented at the external surface and positioned at the tapered axial region.



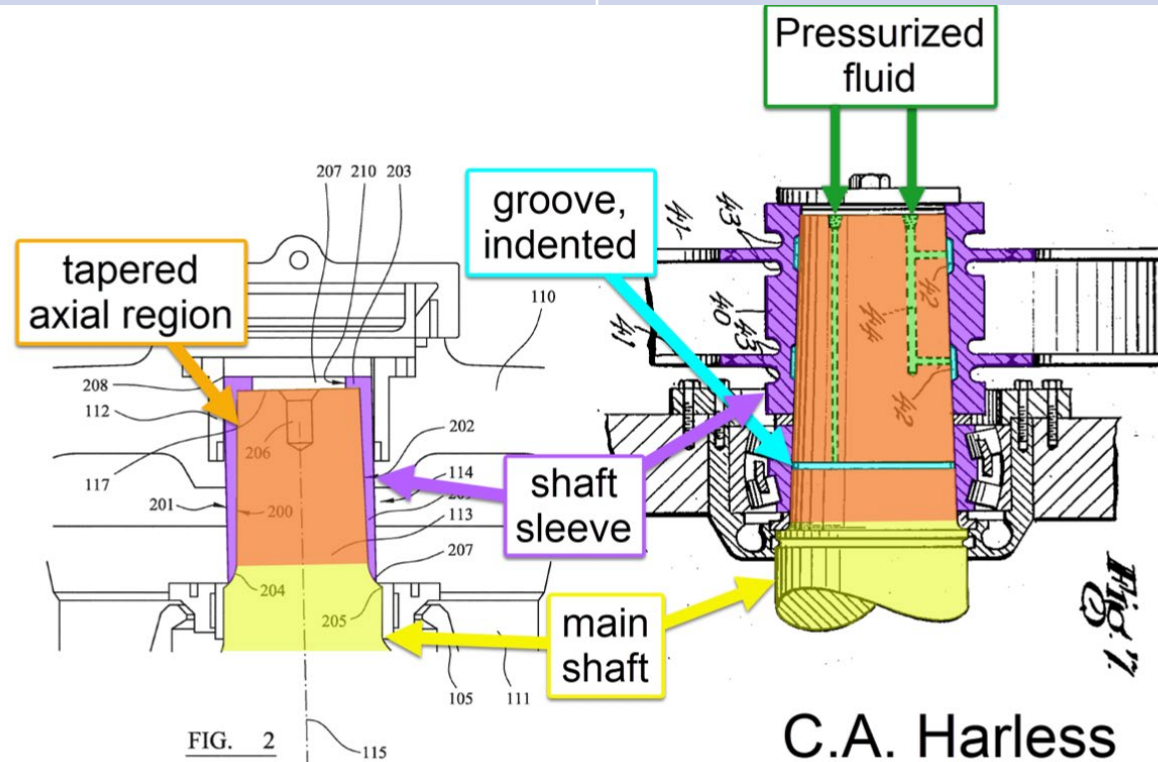
57

Element 1d2 of Claim 1 is Obvious

1d1. Challenged Claim Element Obvious by Prior Art

1d2. the at least one groove being arranged to receive a pressurised[sic] fluid to facilitate mounting and dismounting of the shaft sleeve at the shaft body.

YES: Polinski in view of Piepho and Harless discloses that at least one groove is arranged to receive a pressurized fluid to facilitate mounting and dismounting of the shaft sleeve at the shaft body.



Claim 9 is Obvious (See Ex. 1002, pp. 78-80)

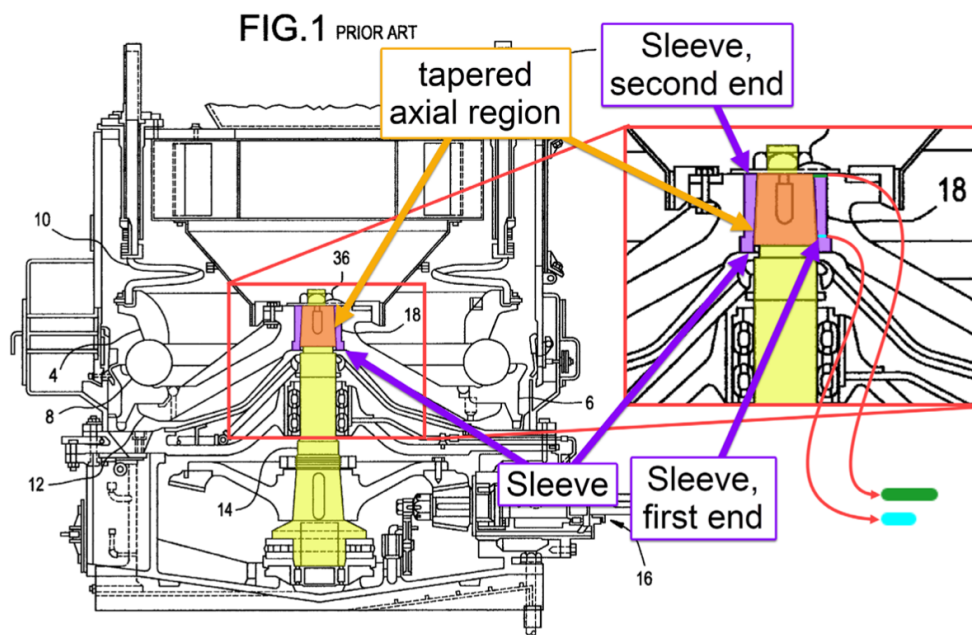
Challenged Claimed Elements Obvious?	
9P. A gyratory crusher main shaft assembly for a crusher comprising:	YES: See 1P.
9a. a shaft body having a radially outward facing external surface, and a first end and a second end,	YES: See element 1a.
9a3. an axial region of the shaft body extending from the second end and being tapered relative to a longitudinal axis of the shaft body such that a cross sectional area of the shaft body at the tapered axial region decreases in a direction from the first end to the second end,	YES: See element 1b.
9a4. a shaft sleeve mounted on the tapered axial region,	YES: See element 1c.
9a5. and at least one groove indented at the external surface and positioned at the tapered axial region,	YES: See element 1d1.
9a6. the at least one groove being arranged to receive a pressurised[sic] fluid to facilitate mounting and dismounting of the sleeve at the shaft body; and	YES: See element 1d2.

Element 9b of Claim 9 is Obvious

Challenged Claimed Element 9b Obvious?

9b. a sleeve fitted over the tapered axial region, the sleeve having a tapered wall thickness, such that the wall thickness at a second end of the sleeve is greater than the wall thickness at a first end of the sleeve.

YES: Polinski in view of Piepho and Harless discloses a sleeve fitted over the tapered axial region, the sleeve having a tapered wall thickness, such that the wall thickness at a second end of the sleeve is greater than the wall thickness at a first end of the sleeve.



Claim 14 is Obvious (See Ex. 1002, pp. 87-92)

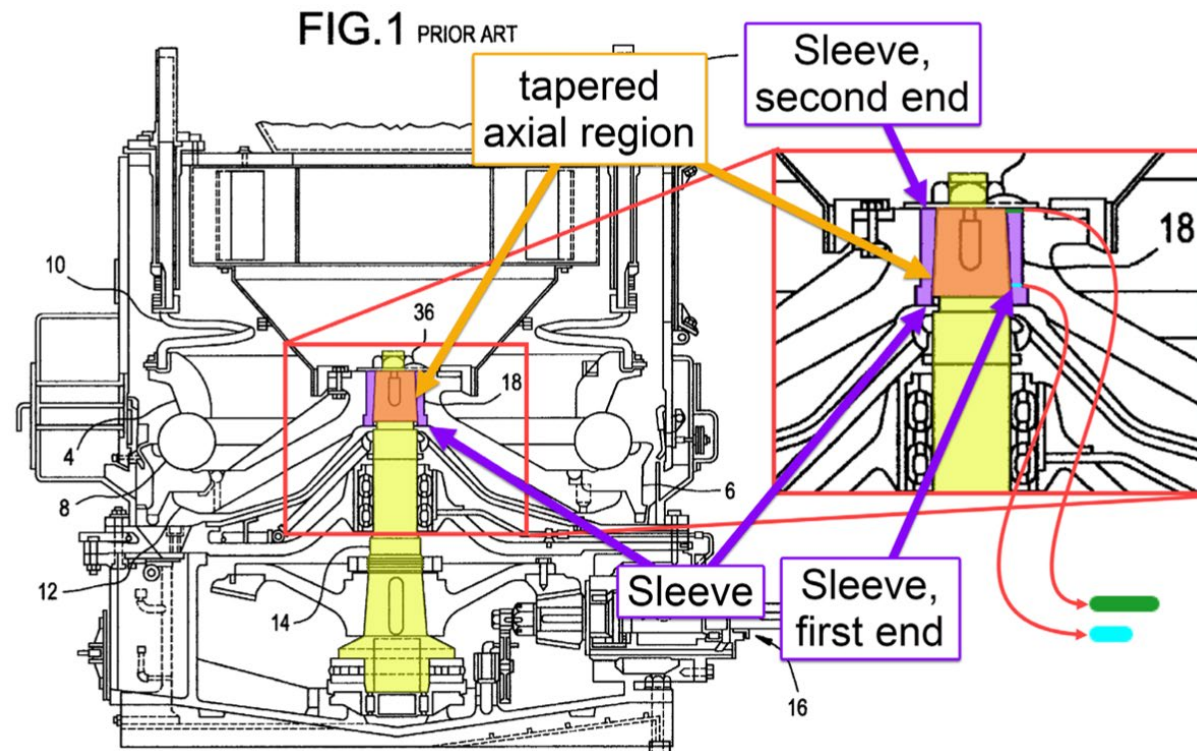
Challenged Claim Elements of Claim 14 Obvious?	
14P. A gyratory crusher comprising:	YES: See 1P.
14a1. a main shaft including a shaft body having a radially outward facing external surface, a first end for positioning at a lower region of the crusher and a second end for	Yes: See element 1a.
14a2. an axial region of the shaft body extending from the second end and being tapered relative to a longitudinal axis of the shaft body such that a cross sectional area of the shaft body at the tapered axial region decreases in a direction from the first end to the second end,	YES: See element 1b.
14a4. the tapered axial region being configured to mount a shaft sleeve;	YES: See element 1c.
14c1. at least one groove indented at the external surface and positioned at the tapered axial region,	YES: See element 1d1.
14c2. the at least one groove being arranged to receive a pressurised[sic] fluid to facilitate mounting and dismounting of the sleeve at the shaft body.	YES: See element 1d2.

Element 14b of Claim 14 Is Obvious

14b. Challenged Claim Element Obvious by Prior Art?

14b. a sleeve fitted over the tapered axial region, the sleeve having a tapered wall thickness such that a wall thickness at a second upper end of the sleeve is greater than a wall thickness at a first lower end of the sleeve; and

YES: Polinski in view of Piepho discloses a sleeve fitted over the tapered axial region, the sleeve having a tapered wall thickness such that a wall thickness at a second upper end of the sleeve is greater than a wall thickness at a first lower end of the sleeve.



Revised Amended Independent Claims

Original Claim 1	Revised Contingent Claim 15
1a. a shaft body having a radially outward facing external surface, and a first end and a second end;	15a. a shaft body having a radially outward facing external surface, and a first end and a second end, <u>wherein the second end is an uppermost extremity of the shaft body;</u>
1b. an axial region of the shaft body extending from the second end and being tapered relative to a longitudinal axis of the shaft body such that a cross sectional area of the shaft body at the tapered axial region decreases in a direction from the first end to the second end;	NO CHANGE
1c. a shaft sleeve mounted on the tapered axial region; and	NO CHANGE
1d1 & 1d2. at least one groove indented at the external surface and positioned at the tapered axial region, the at least one groove being arranged to receive a pressurised[sic] fluid to facilitate mounting and dismounting of the shaft sleeve at the shaft body.	15d. <u>a plurality of grooves</u> indented at the external surface and positioned at the tapered axial region, the <u>plurality of grooves</u> being arranged to receive a pressurised (sic) fluid to facilitate mounting and dismounting of the shaft sleeve at the shaft body,

Revised Amended Independent Claims

Original Claim 9	Revised Amended Claim 21
9a. a shaft body having a radially outward facing external surface, and a first end and a second end,	21a. a shaft body having a radially outward facing external surface, and a first end and a second end, <u>wherein the second end is an uppermost extremity of the shaft body;</u>
9a3., 9a4, 9a5 & 9a6	NO CHANGES
9d. a sleeve fitted over the tapered axial region, the sleeve having a tapered wall thickness, such that the wall thickness at a second end of the sleeve is greater than the wall thickness at a first end of the sleeve; and	<u>21d. wherein the shaft [[a]] sleeve is fitted over the tapered axial region, the <u>shaft</u> sleeve having a tapered wall thickness, such that the wall thickness at a second end of the <u>shaft</u> sleeve is greater than the wall thickness at a first end of the <u>shaft</u> sleeve, <u>wherein the first end of the shaft sleeve is a lowermost extremity of the shaft sleeve.</u></u>

Revised Amended Independent Claims

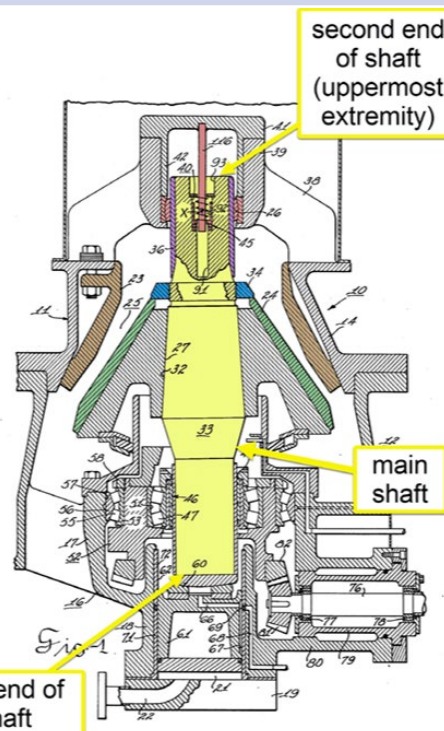
Original Claim 14	Revised Amended Claim 26
14a. a main shaft including a shaft body having a radially outward facing external surface, a first end for positioning at a lower region of the crusher and a second end for positioning at an upper region of the crusher relative to the first end,	26a. a main shaft including a shaft body having a radially outward facing external surface, a first end for positioning at a lower region of the crusher and a second end for positioning at an upper region of the crusher relative to the first end, <u>wherein the second end is an uppermost extremity of the shaft body;</u>
14a2, 14c1 & 14c2.	NO CHANGE
14c. a sleeve fitted over tapered axial region, the sleeve having a tapered wall thickness such that a wall thickness at a second upper end of the sleeve is greater than a wall thickness at a first lower end of the sleeve; and	26c. a sleeve fitted over tapered axial region, the sleeve having a tapered wall thickness such that a wall thickness at a second upper end of the sleeve is greater than a wall thickness at a first lower end of the sleeve, <u>wherein the first end of the sleeve is a lowermost extremity of the sleeve;</u> and
	26e. <u>wherein the sleeve is configured such that when positioned on the shaft body, the sleeve is separated from and not fastened to a crushing head and a crushing shell.</u>

Element 15a of Claim 15 is Obvious

Challenged Element 15a Obvious?

15a. a shaft body having a radially outward facing external surface, and a first end and a second end, wherein the second end is an uppermost extremity of the shaft body;

YES: Coxhall further teaches “[T]he upper portion of the crusher shaft 33 is fitted with a bearing sleeve 36 and is received in the pivot bearing member 26.” Ex. 1053 2:29-31. Coxhall also teaches “[T]he lower end of the crusher head shaft 33 is provided with a bearing sleeve assembly 46 which is journalled in the inner race of a radial bearing 47.” Ex. 1053, 2:41-43; Ex. 1051 p. 64.

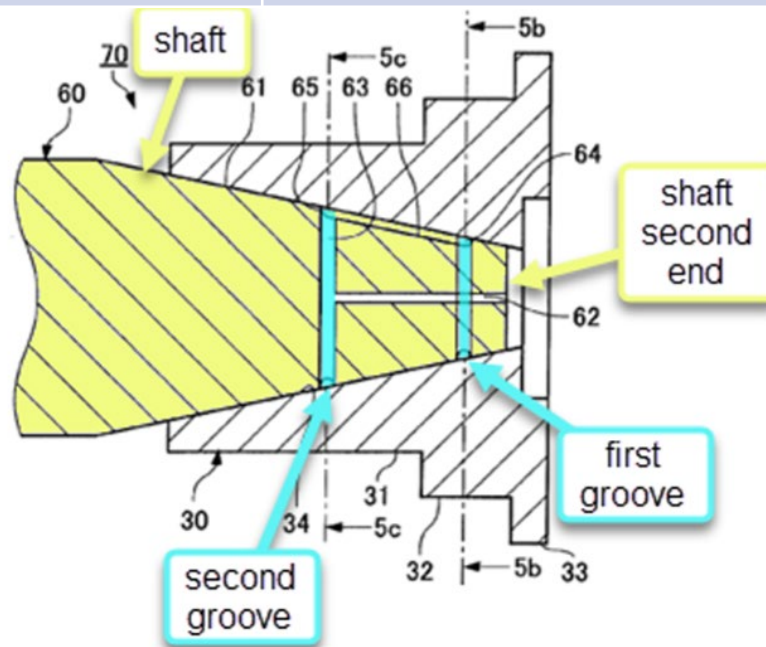


Element 15d of Claim 15 is Obvious

Challenge Claim Element 15d. Obvious?

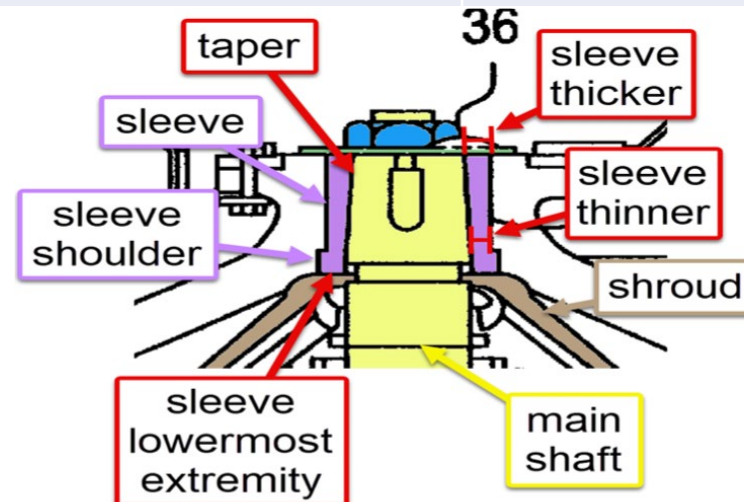
15d. a plurality of grooves indented at the external surface and positioned at the tapered axial region, the plurality of grooves being arranged to receive a pressurised (sic) fluid to facilitate mounting and dismounting of the shaft sleeve at the shaft body,

Coxhill in view of Piepho, and in further view of Yagi, discloses a plurality of grooves indented at the external surface and positioned at the tapered axial region. The grooves in Yagi are arranged to receive pressurized fluid to facilitate mounting and dismounting of the shaft sleeve on the shaft. More specifically, Yagi teaches a plurality of grooves in the shaft. Ex. 1051, FIG. 5A at p. 70.



Elements 21a and 21d of Claim 21 are Obvious

Challenged Claim Elements 21a and 21d Obvious?	
21a. Remarks above regarding Element 15a apply to Element 21a.	YES:
<u>21d. wherein the shaft [[a]] sleeve is fitted over the tapered axial region, the <u>shaft</u> sleeve having a tapered wall thickness, such that the wall thickness at a second end of the <u>shaft</u> sleeve is greater than the wall thickness at a first end of the <u>shaft</u> sleeve, wherein the first end of the shaft sleeve is a lowermost extremity of the shaft sleeve.</u>	YES: Incorporating Piepho in Coxhill would result in a sleeve having a tapered wall thickness, such that the wall thickness at the second end of the shaft sleeve is greater than the wall thickness at a first end of the sleeve, wherein the first end of the sleeve is the lowermost extremity of the shaft sleeve as the sleeve of Coxhill does not have a flange. Ex. 1051, p. 87



Dependent Claims 16 & 24 (Substitute for Claims 2 and 12) (Paper 33, p. 15)

- Patent Owner amended claims 16 and 24, in part, to include:

...further comprises an oil path **consisting of:** a fluid inlet positioned at the second end; the first groove; the second groove; an axially extending channel indented at the external surface of the shaft body to couple the first groove and the second groove in fluid communication; and an internal oil path extending within the shaft body only to the first groove, the internal oil path **consisting of:** a first conduit extending axially toward the first end from the fluid inlet; and a second conduit extending from the first conduit toward the radially outward facing external surface of the shaft body to the first groove.

- These amendments are taught by the prior art discussed with respect to Claims 15 and 21.

Inclusion of “Consisting Of” (Paper 52, p. 11)

- MPEP 2111.03 provides for "**consisting of**" being **closed**, strictly limiting the invention to *only* the recited elements, excluding anything else.
- A claim with "consisting of" is much narrower and therefore easier to invalidate against prior art, whereas "comprising" offers broader protection, as seen in MPEP 2111.03.
- While the use of “consisting of” may defeat anticipation, such claims may still be obvious if obvious to omit or modify the extra elements.
- Yagi teaches grooves in the shaft. Modifying the number of grooves is an obvious change.

Elements 26a and 26e of Claim 26 are Obvious (Paper 33, p. 25)

Challenged Claim Elements 26a and 26e Obvious?	
Remarks above with respect to element 15a are applicable to 26a.	YES
Remarks above with respect to element 15c are applicable to 26e.	YES

The Cited Prior Art is Analogous Art

- Two separate tests define the scope of analogous prior art; (1) whether the art is from the same field of endeavor, regardless of the problem addressed and (2) if the reference is not within the field of the inventor's endeavor, whether the reference still is reasonably pertinent to the particular problem with which the inventor is involved. *In re Deminski*, 796 F.2d 436, 442 (Fed. Cir. 1986); *see also In re Wood*, 599 F.2d 1032, 1036 (CCPA 1979).
- It is further well established that “[i]n a simple mechanical invention a broad spectrum of prior art must be explored and it is reasonable to permit inquiry into other areas where one of ordinary skill in the art would be aware that similar problems exist.” *See Stevenson v. Int’l Trade Comm.*, 612 F.2d 546, 550, 204 USPQ 276, 280 (CCPA 1979).

Analogous Art Continued

- MPEP 904.01(c) (“Not only must the art be searched within which the invention claimed is classifiable, but also all analogous arts must be searched regardless of where the claimed invention is classified.”).
- The '090 Patent and Piepho have the same section, class, and subclass Cooperative Patent Classification (“CPC”) identifier of B02C—**CRUSHING, PULVERIZING OR DISINTEGRATING IN GENERAL** (emphasis added). Ex. 1001 at 1; Ex. 1018 at 1.

Patent Owner Delayed Arguing Piepho Isn't Analogous Art

- Piepho has been cited by Petitioners since their first Petition (Paper 2) initiating this action filed in August 2024.
- Piepho was continuously cited in Petitioners' Response in Opposition to Patent Owner's Contingent Motion to Amend and Request for Preliminary Guidance (Paper 19) and in Petitioners' Response to Patent Owner's Revised Contingent Motion to Amend (Paper 33).
- Patent Owner did not claim not analogous art until its Reply Brief filed December 16, 2025 (Paper 38).

Why Piepho Is Analogous Art

- In a simple mechanical invention, a broad spectrum of prior art must be explored and it is reasonable to permit inquiry into other areas where one of ordinary skill in the art would be aware that similar problems exist."
Stevenson v. Int'l Trade Comm., 612 F.2d 546, 550, 204 USPQ 276, 280 (CCPA 1979). (Paper 47, p. 2).
- Patent Owner's expert admits that coal is specific kind of rock. Ex. 1063 2nd Deposition of Dr. Kytömaa, 7:4-25.
- Rock crushing and pulverizing is a multi-stage process where "depending on the mining operation, you'll start with a broad range of sizes, and there may be sort of a, let's say, a course size classification that allows smaller components to –let's say, smaller pieces of rock to move on, and larger ones may get crushed by some kind of crusher that accommodates large rocks. Ex. 1063 2nd Deposition of Dr. Kytömaa, 26:9-18.