IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

NAVISTAR, INC.
Petitioner

v.

FATIGUE FRACTURE TECHNOLOGY, LLC.
Patent Owner

Patent No. 7,143,915
Filing Date: January 6, 2004
Issue Date: December 5, 2006
Title: PROCESS TO FRACTURE CONNECTING RODS AND THE LIKE WITH RESONANCE-FATIGUE

Inter Partes Review No. Unassigned

PETITION FOR *INTER PARTES* REVIEW

UNDER 35 U.S.C. §§ 311-319 AND 37 C.F.R. § 42.100 *et seq.*

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Exhibit 1003: U.S. Patent No. 4,754,906 ("Brovold")

Exhibit 1004: U.S. Patent No. 5,699,947 ("Cavallo")

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[1] Citations to page numbers for Exhibits 1014-1024, 1030, and 1031 refer to the exhibit page numbers added for each exhibit.

Exhibit 1019: Prosecution History for U.S. Patent Application No. 11/482,123[2]

Exhibit 1020: S. SURESH, FATIGUE OF MATERIALS (Cambridge University Press, 2nd ed. 1998)

Exhibit 1021: Email correspondence from FFT regarding claim construction, including FFT's latest chart containing its litigation positions

Exhibit 1022: CHAMBERS DICTIONARY OF SCIENCE AND TECHNOLOGY (Peter M. B. Walker, ed., 1999)

Exhibit 1023: Exhibit 1 to FFT's January 11, 2018 Validity Contentions

Exhibit 1024: January 22, 2018 Deposition of Sameh Guirgis (pp. 93-97, 161-167)

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Exhibit 1030: SOCIETY OF AUTOMOTIVE ENGINEERS, SAE FATIGUE DESIGN HANDBOOK (3rd ed. 1997)

Exhibit 1031: POPE, J. EDWARD, RULES OF THUMB FOR MECHANICAL ENGINEERS (Gulf Publishing Company, 1997)

Exhibit 1032: Con Rod Fracturing video, accessed at https://youtu.be/JR7C2yqlfBY

Exhibit 1033: Connecting Rod Manufacturing animation, accessed at https://youtu.be/BPfVQm_Q1sw

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[2] The official file for this application is not available. FFT has provided some documents that it asserts represent the complete file for this application, and Petitioner includes those documents in this Exhibit.

Exhibit 1034: U.S. Patent No. 3,442,120

Exhibit 1035: U.S. Patent No. 4,676,110

Exhibit 1036: U.S. Patent No. 5,703,446

LISTING OF CHALLENGED CLAIMS

Claim 1
1. A process for the fracture separation of a part having a cylindrical bore passing therethrough into a first portion and a second portion, the cylindrical bore having a central axis, the part having two opposed sides proximate to the intersection of a predetermined fracture plane passing through the cylindrical bore and the part, the process including the steps of:
a) optionally applying at least one pre-stressing force to at least one of the first portion, the second portion and said sides of said part, said at least one pre-stressing force selected from the group compromising:
i) a longitudinal pre-stressing force applied to one of the first portion and the second portion relative to the other of the portion and the second portion, said longitudinal pre-stressing force being applied in a direction substantially perpendicular to said predetermined fracture plane, and
ii) a lateral pre-stressing force applied to each of the opposed sides of the part, each of said lateral pre-stressing forces being applied along substantially straight line that is substantially parallel to the predetermined fracture plane and substantially perpendicular to the central axis, where at any time instant, each of the lateral pre-stressing forces being substantially equal in magnitude and acting opposite in direction to one another;
b) applying at least one fatigue force to at least one of the first portion and the second portion, said at least one fatigue force being selected from the group comprising:
i) a longitudinal cyclic force applied to one of the first portion and the second portion relative to the other of the first portion and the second portion, said longitudinal cyclic force being applied in a direction substantially perpendicular to said predetermined fracture plane, and
ii) a lateral cyclic force applied to each of the opposed sides of the part, each of the said lateral cyclic forces being applied along a substantially straight line that is substantially parallel to the predetermined fracture plane and substantially perpendicular to the central axis, where at any time instant, each of said lateral cyclic forces being substantially equal in magnitude and acting opposite in direction to one another;

Claim 1
c) applying at least one dynamic force to one of the first portion and the second portion relative to the other of the first portion and the second portion, said at least one dynamic force being applied in a direction substantially perpendicular to said predetermined fracture plane, said dynamic force being applied to fracture the part into the first portion and the second portion so as to separate the first portion from the second portion substantially along said predetermined plane.
Claim 7
7. A process as claimed in claim 1, wherein said at least one pre-stressing force is said longitudinal pre-stressing force applied to one of the first portion and the second portion relative to the other of the first portion and the second portion, said longitudinal pre-stressing force being applied in a direction substantially perpendicular to said predetermined fracture plane.
Claim 9
9. A process as claimed in claim 1, wherein said part is a connecting rod, said first portion is a cap portion and said second portion is a rod portion.
Claim 10
10. A process as claimed in claim 1, wherein said at least one fatigue force is said longitudinal cyclic force applied to one of the first portion and the second portion relative to the other of the first portion and the second portion, said longitudinal cyclic force being applied in a direction substantially perpendicular to said predetermined fracture plane.

Navistar, Inc. (“Navistar” or “Petitioner”) petitions for *Inter Partes* Review (“IPR”) of claims 1, 7, 9, and 10 (“Challenged Claims”) of U.S. Patent No. 7,143,915 (“the ’915 Patent”). Ex. 1001. The ’915 Patent is purportedly assigned to Fatigue Fracture Technology, LLC (“Patent Owner” or “FFT”). Trial should be instituted because there is a reasonable likelihood that Petitioner will prevail by proving the Challenged Claims are unpatentable and should be canceled.

I. REQUIREMENTS FOR A PETITION FOR *INTER PARTES* REVIEW

A. Payment of Fees

The required fee is being paid through PRPS. Should additional fees be required, the undersigned authorizes the Commissioner to charge such fees to Deposit Account No. 06-0029.

B. Grounds for Standing

Petitioner certifies that the ’915 Patent is available for IPR and that Petitioner is not barred or estopped from requesting IPR of the Challenged Claims on the identified grounds. The ’915 Patent was first asserted against Petitioner on February 7, 2018, in an amended complaint. Ex. 1002.

II. CHALLENGE AND RELIEF REQUESTED

Petitioner requests cancellation of the Challenged Claims based on U.S. Patent No. 4,754,906 (“Brovold,” Exhibit 1003); U.S. Patent No. 5,699,947 (“Cavallo,” Exhibit 1004); U.S. Patent No. 5,320,265 (“Becker,” Exhibit 1005); and U.S. Patent No. 3,155,300 (“Bayliss,” Exhibit 1006).

Petitioner presents the following Grounds demonstrating the unpatentability of each Challenged Claim. Each Ground applies to each Challenged Claim.

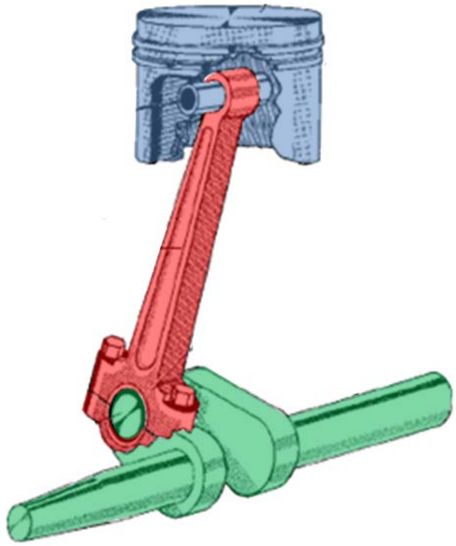
Ground	Basis
1	Anticipated by Brovold under § 102 and/or obvious in view of Brovold under § 103
2	Anticipated by Cavallo under § 102 and/or obvious in view of Cavallo under § 103
3	Obvious under § 103 over Brovold in view of Cavallo
4	Obvious under § 103 over Cavallo in view of Brovold
5	Obvious under § 103 over Brovold in view of Bayliss and/or Becker
6	Obvious under § 103 over Brovold, in view of Cavallo, in further view of Bayliss and/or Becker
7	Obvious under § 103 over Cavallo in view of Bayliss
8	Obvious under § 103 over Cavallo, in view of Brovold, in further view of Bayliss

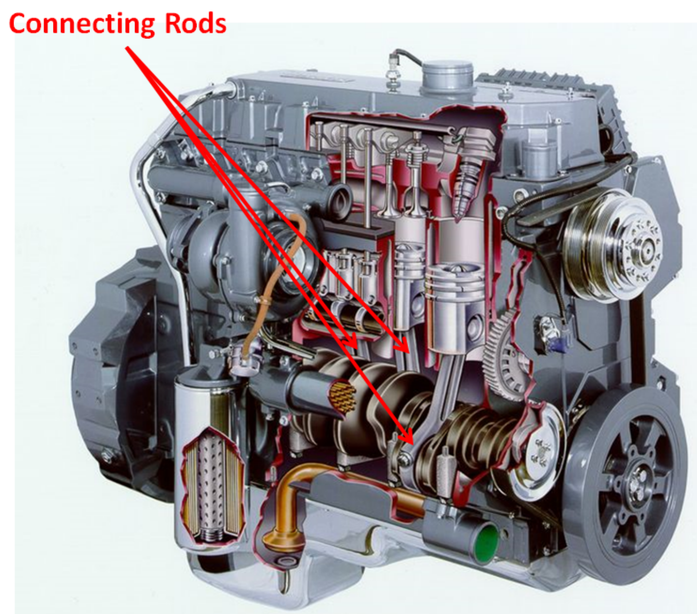
This Petition relies on the Declaration of Thomas Brovold. Ex. 1007. Mr. Brovold has considerable experience with apparatuses, processes, and techniques for manufacturing mechanical components, including fracture separating connecting rods or similar structures. He is the inventor of the Brovold Patent. His declaration provides factual support for issues discussed herein and explains why each Challenged Claim was anticipated and would have been obvious to a skilled artisan at the time of the '915 Patent.

III. BACKGROUND

The '915 Patent describes certain processes for fracturing parts, preferably connecting rods.

A **connecting rod** couples an engine's **piston** to the **crankshaft**:

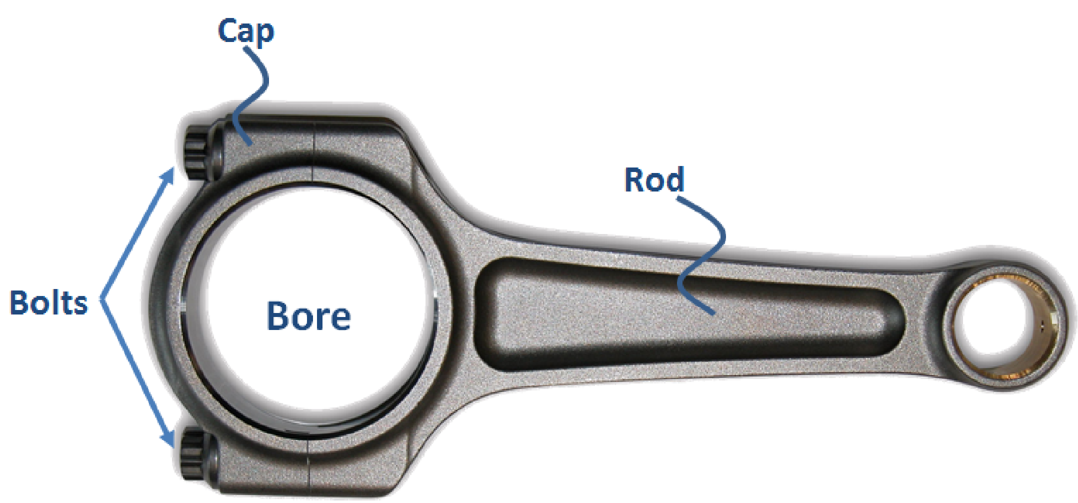




Ex. 1007, ¶¶52-53. The connecting rod converts linear reciprocation of the piston into crankshaft rotation to power the vehicle's wheels. *Id*.

A. Connecting Rod Fracturing

The large bore of the connecting rod is formed by two pieces: a "cap" and a "rod" (or "yoke") secured by bolts.



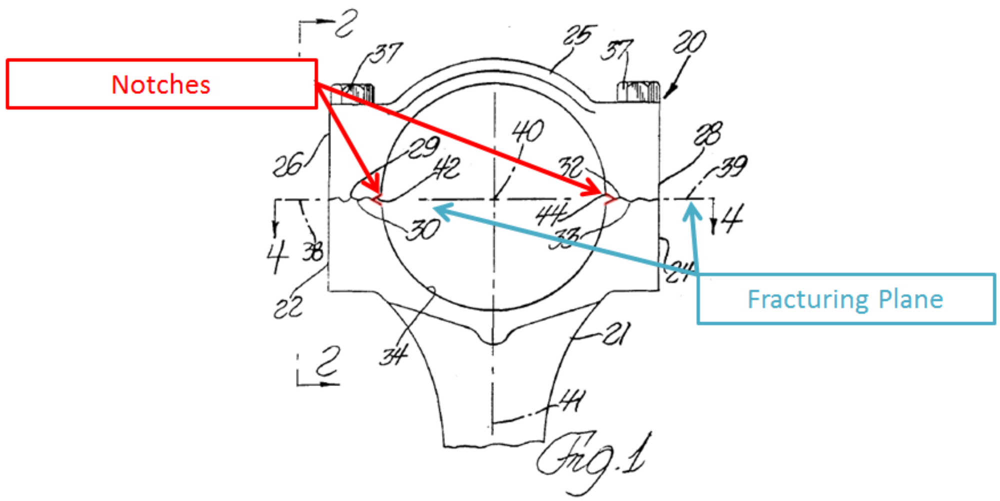
Id., ¶54. Two-part connecting rods are initially manufactured as a single piece.

The cap and rod could be sawed apart (*E.g.*, Ex. 1004, 1:19-25; Ex. 1007, ¶55), but the industry recognized long ago that intentionally fracturing the cap from the rod created better interfaces, and therefore better connecting rods. *E.g.*, Ex. 1004, 1:26-37 (fractured "parting surfaces allow subsequent perfect connection of the cap"); Ex. 1003, 1:13-22 (fracturing so that "the two parts ... will fit back together exactly as they separated…."); Ex. 1005, 1:15-16 ("It is known to intentionally crack automotive engine connecting rods…."); Ex. 1007, ¶56.

Cavallo and Brovold disclose only some of the many known processes for fracturing connecting rods. The '915 Patent acknowledges that fracturing connecting rods was well-known. Ex. 1001, 1:15-38. The idea dates back to at least 1948 (U.S. Patent No. 2,553,935, Ex. 1012, 2:8-17 ("improved method of producing a two-piece connecting rod ... by fracturing"), and was known by major automotive manufacturers and suppliers. *E.g.*, Chrysler's 1997 European Patent Publication, Ex 1008, 1:28-33; Tri-Way's 1996 Patent, Ex. 1009, 1:11-13; Becker's (Giddings & Lewis) 1994 Patent, Ex. 1005, 1:15-16; GM's 1989 Patent, Ex. 1010, Abstract. *See also* Ex. 1007, ¶¶57-62.

B. Stress-Risers Predetermining the Fracture Plane

To predetermine the fracture plane location, it was common to use notches or "stress risers." For example:



Ex. 1010, Fig. 1. These **notches** "locate the starting points of separation" of cracks that subsequently form along the **fracturing plane**. *Id.*, 4:7-25; *see also* Ex. 1005, 3:62-66 ("The connecting rod fractures … along a plane passing through the center of the crankshaft bore and containing suitably defined and positioned stress concentration notches."); Ex. 1009, 1:50-55 (disclosing a "stress-riser" to "control the location of fracture initiation" and known processes for creating notches); U.S. Patent No. 5,208,979, Ex.1013, Abstract ("laser cutting a stress riser" before "separat[ing] the connecting rod"); Ex. 1007, ¶¶63-64.

The '915 Patent acknowledges that stress-risers were already known, and are not part of its invention. Ex. 1001, 3:11-14 ("a stress-riser should be provided **in a prior process**, [*i.e.*, prior to the process described and claimed] using any of the **known methods, in order to predetermine the fracture plane**.") (emphasis added); Ex. 1007, ¶65.

C. Fatigue

In addition to these aspects of connecting rod manufacture, skilled artisans were familiar with principles of mechanical engineering, including fatigue, and how fatigue could be used to fracture connecting rods and other parts. Ex. 1007, ¶¶67-69.

Generally speaking, "fatigue" refers to a "decrease of strength by repetitive loading." Ex. 1014, p.3; Ex. 1007, ¶67. Skilled artisans knew that certain materials (*e.g.*, metal) can withstand a certain amount of stress before cracking. That amount is sometimes referred to as "fracture strength." *Id.*, ¶68. However, the fracture strength of a component lessens when the component is repeatedly subjected to smaller stresses (*i.e.*, repetitive loading). This is generally known as "fatigue." Ex. 1006, 1:15-19; Ex. 1007, ¶¶68-69. Thus, connecting rods subjected to repeated cycles of stresses from fatigue forces are weaker (fatigued), and will fracture under smaller stress levels. *Id.*, ¶69. As can be seen from, *e.g.*, Brovold, skilled artisans would have been familiar with these principles and how fatigue could be used in connecting rod fracturing. *Id.*, ¶69.

IV. THE '915 PATENT

A. Challenged Claims

Claim 1 recites three steps: (a) optionally applying a pre-stressing force, (b) applying a cyclic fatigue force, and (c) applying a dynamic force. Applying the "pre-stressing" force is entirely optional, and therefore non-limiting. Therefore, in effect, Claim 1 recites two required process steps: (b) applying a cyclic fatigue force (longitudinally or laterally) and (c) applying a dynamic force.

Claim 7 depends from Claim 1, reducing the options for the optional pre-stressing force to the "longitudinal" pre-stressing option 1(a)(i). Claim 9 depends from Claim 1, adding that the part is a connecting rod with a cap. Claim 10 depends from Claim 1, adding that the fatigue force is the longitudinal fatigue option 1(b)(i). Ex. 1007, ¶¶70-73.

B. Specification

The '915 Patent purportedly describes "a novel approach to fracture connecting rods." Ex. 1001, 3:3-4. The specification acknowledges some early techniques for fracturing connecting rods, criticizing them as requiring a single "big magnitude" force to fracture the rod. *Id.*, 1:39-42. According to the specification, the "use of big force has a negative effect on the quality of the fractured connecting rod" and can lead to fracture machine maintenance issues ("breakage of force exertion elements of the machine"). *Id.*, 1:40-50. The '915 Patent purports to solve such problems by summing "several small magnitude forces" together to fracture the rod. *Id.*, 3:4-9; 4:22-26, 4:58-34. *See also* Ex. 1007, ¶74.

However, no claim (challenged or otherwise) recites any force magnitude. Nor does the specification provide any exemplary magnitudes, or even relative magnitudes, for any force. At most, it describes some optional pre-stressing forces as "slightly press[ing] the part" (Ex. 1001, 4:18-20) and describes a dynamic force as a "sudden increase" (which is directed more to timing/duration, not magnitude) (*id*., 6:33).[3] Ex. 1007, ¶75.

1. Optional Pre-Stressing

The specification discusses optional pre-stressing forces at Ex. 1001, Abstract, 4:3-20, 6:22-26, and in the descriptions of Figures 1, 3 and 5 in column 5. The specification unequivocally states that pre-stressing forces are merely optional: "eliminating the pre-stressing forces or either of them should not be construed as a departure from the scope of this invention. This is a valid option…." Ex. 1001, 6:45-52; *see also id*. (teaching "to skip the steps related to the omitted force or forces").

Thus, the "optional" pre-stressing forces recited in the Challenged Claims are optional and non-limiting, and the unpatentability of the Challenged Claims

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[3] The specification discusses theoretical concepts in its background section, including the stress intensity factor of a material. Ex. 1001, 2:9-24. However, the specification provides no real-world guidance for what constitutes a "big magnitude" force or the extent of any purported potential improvements for fracturing a "part" or "connecting rod." Ex. 1007, ¶75, n.9.

requires minimal attention (if any) to "pre-stressing force." *See also* IPR2015-01162, Paper No. 14 (November 16, 2015) at 9-11 (construing an "optionally…" phrase as non-limiting and not required to satisfy the claim, particularly in view of the specification); IPR2014-01412, Paper No. 8 (March 18, 2015) at 8-10 (construing "optionally" to mean "left to choice, not compulsory" and thus non-limiting, particularly in view of the specification); IPR2014-00118, Paper No. 16 (April 25, 2014) at 15-16 ("optionally" clause was "left to choice" and thus non-limiting).

The specification describes (and Claim 1 optionally recites) two types of pre-stressing forces: (1) **a longitudinal, primary pre-stressing force, F_1** (Ex. 1001, 4:3-7, 6:22-23, 5:7-24); and (2) **lateral, secondary pre-stressing forces F_{2L} and F_{2R}** applied to the left and right sides of the part. *Id.*, 1001, 4:14-20, 6:24-26, 5:7-24; Figure 3 (below):

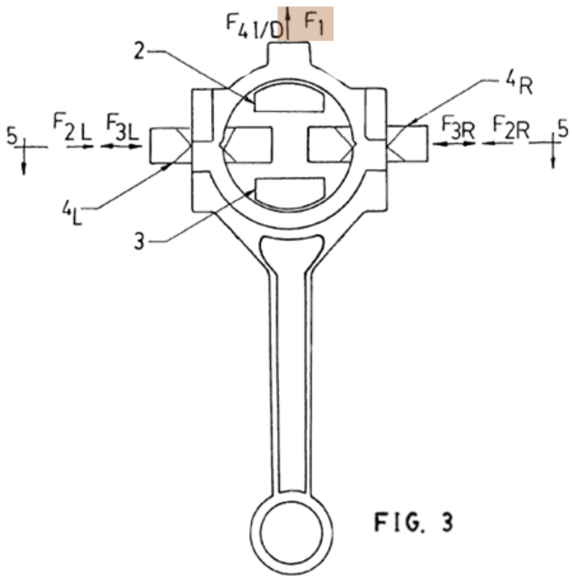

FIG. 3

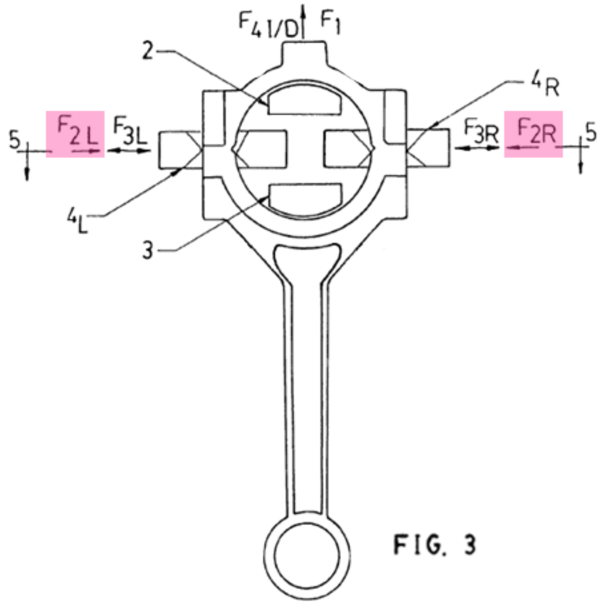

FIG. 3

These pre-stressing forces have "clamping" effects and add "rigidity" to the connecting rod. *Id.*, 4:11-22. Ex. 1007, ¶¶76-78.

2. Fatigue

The Challenged Claims recite a "fatigue force" that is "cyclic." The specification focuses on cyclic "harmonic" forces applied at a "frequency" designed to create resonance. *E.g.*, Ex. 1001, Title, 2:26-67; 3:25-4:2; 5:44-6:10, 6:30-33 (applying harmonic forces at a frequency "as close as practically possible to the selected natural frequency" to create resonance); Ex. 1007, ¶¶79-81. Yet, no Challenged Claim expressly recites resonance or harmonic forces. The '915 Patent briefly discusses non-harmonic, non-resonance fatigue at Ex. 1001, 3:16-24: "Fatigue: if the stresses in a pre-notched connecting rod fluctuate due to the application of harmonic forces ***(or any time varying forces),*** the pre-existing crack (stress-riser) will extend incrementally depending on the range of fluctuation in the stress intensity factor." (emphasis added).

The '915 Patent describes two mechanisms for applying fatigue forces: ***First,*** the "contacts" (**4_L** and **4_R**), which are used to apply the optional, lateral pre-stressing forces, can also apply **harmonic fatigue forces** (**F_{3L}** and **F_{3R}**). Ex. 1001, 4:14-21, 6:27-31, 5:7-24, Fig. 3:

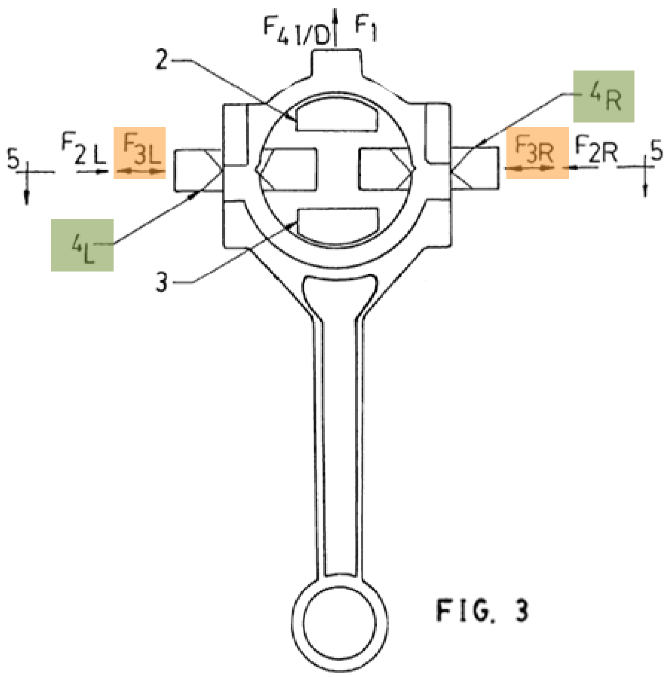

FIG. 3

Ex. 1007, ¶82.

Second, the specification briefly describes an "alternative mode[]" that applies "a harmonic force to the cap, in a direction that is perpendicular to the predetermined fracture plane." Ex. 1001, 6:41-44. That force is not explained any further, nor identified in any Figure. Ex. 1007, ¶83.

3. Dynamic Force

The specification provides two examples of "dynamic force" at Ex. 1001, 4:35-56, 5:18-19, and 6:32-38. First, "impulsive" force F_{4I}, causes "a sudden increase of F_1" that "fractur[es] the connecting rod." *Id.*, 6:32-34. However, the specification does not indicate any particular mechanism for **how** (*e.g.*, by a wedge, impact, or hydraulic system) the primary pre-stressing force, F_1 increases to deliver the dynamic force. Ex. 1007, ¶84. Second, the specification briefly describes "apply[ing] a slow rate dynamic force" (F_{4D}), again without discussing **how** to generate that force. Ex. 1001, 6:36-38.

Both dynamic force examples are labeled as "$F_{4I/D}$" in Figure 3 (below), where F_{4I} and F_{4D} "are the impulsive and the slow rate dynamic force, respectively":

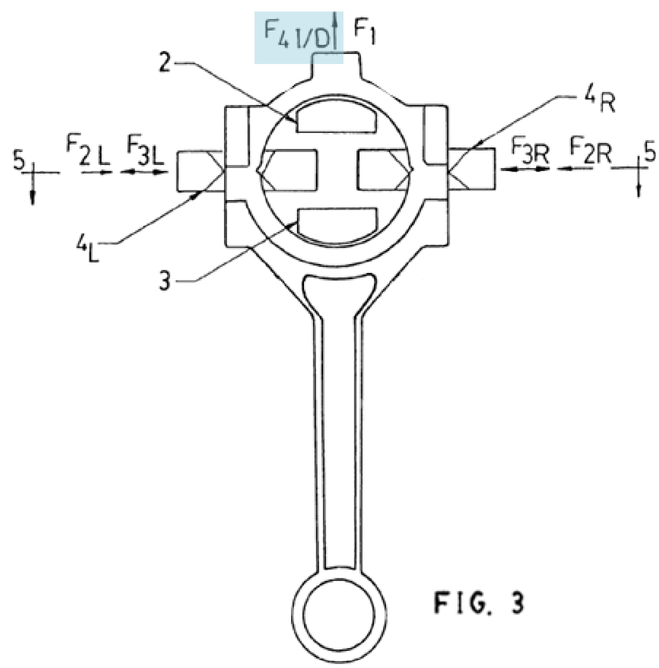

FIG. 3

Ex. 1001, 5:18-19; Ex. 1007, ¶85.

Consistent with its focus on resonance/harmonic fatigue, the specification describes applying the dynamic force during cycles of harmonic force, with the impulsive dynamic force applied at a particular time instant (T_f), or with the slow rate dynamic force applied over a time period centered about that same instant. Ex. 1001, 4:35-56. The specification instructs that the "instant" for applying the dynamic force can be determined by "applying the fracturing force during different cycles, and at different time instants, and by comparing the quality of the fractured connecting rods…." *Id.*, 4:52-55. Thus, the specification leaves the skilled artisan to identify the exact timing through trial-and-error. Ex. 1007, ¶¶86-87.

4. Processes Described

The specification briefly describes its actual fracturing process in a "Process Implementation" section. The process includes (1) a positioning step (not claimed); (2) a primary pre-stressing step; (3) a secondary pre-stressing step; (4) two harmonic forces applied laterally; and (5) a dynamic "impulsive" force applied at time T_f. Ex. 1001, 6:12-35.

The specification then identifies three alternatives. One alternative substitutes the "impulsive" dynamic force with "a slow rate dynamic force." *Id.*, 6:36-38. Another applies "a harmonic force to the cap, in a direction that is <u>perpendicular</u> to the predetermined fracture plane," rather than being applied to the lateral sides, parallel to that plane. *Id.*, 6:39-44 (underlining added). Finally, the specification teaches that omitting any or all pre-stressing is “a valid option” within “the scope of this invention.” *Id.*, 6:45-52; Ex. 1007, ¶¶88-89.

C. Prosecution History

The ’915 Patent family includes two abandoned applications, Nos. 10/643,910 (“the ’910 Application”) and 11/482,123, and three issued U.S. Patents: 6,644,529, the ’915 Patent, and 7,497,361 (“the ’361 Patent”). Most of the prosecution is less relevant, focusing on “harmonic forces” and other features absent from the Challenged Claims, as well as Section 112 issues.

But in connection with the ’910 Application, the applicant stated: “a fatigue exerting force is a force which fluctuate[s] between [] maximum and [] minimum values, such force could be described as a harmonic force, cyclic force, periodic force, oscillating force, etc.” and “Applicant referred to all of these variations as ‘*(or any time varying forces)*’ [in the specification].” Ex. 1016, p.84 (italics in original). During the ’361 Patent prosecution, the applicant noted: “A fatigue exerting force is a force that fluctuates between two values.” Ex. 1018, p.98.

Applicant made another statement material to this proceeding by incorrectly telling the examiner “there was no reference anywhere for utilizing fatigue” in a connecting rod fracturing process and that his invention was “the first technology that utilizes fatigue … in the cracking of connecting rods.” Ex. 1016, p.79. This is untrue in view of at least Brovold.[4] Ex. 1007, ¶¶90-94.

V. CLAIM CONSTRUCTION

Each challenged claim is given "its broadest reasonable construction in light of the specification" of the '915 Patent. *Cuozzo Speed Techs., LLC v. Lee,* 136 S.Ct. 2131 (2016).

A. Level of Ordinary Skill

The relevant field is manufacturing techniques for mechanical components, including fracturing connecting rods or similar parts. *See* Ex. 1001, Abstract ("A process to fracture connecting rods and the like"), claim 1 (reciting "a part"); Ex. 1007, ¶45. A skilled artisan in this field, prior to the '915 Patent, would have a bachelor's degree in mechanical engineering or an equivalent field, and approximately 1-2 years of practical experience fracturing connecting rods or similar parts; an associate's degree in mechanical engineering or an equivalent field, and approximately 2-3 years of practical experience fracturing connecting rods or similar parts; or equivalent knowledge and experience. *Id*., ¶¶46-49, 51, 66.

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[4] In litigation, Petitioner has alleged that the inventor committed inequitable conduct because he knew of Brovold, withheld that reference, and made these false statements to the patent office.

B. Fatigue Force

Claim 1 recites a "fatigue force." Generally, "fatigue" refers to a "decrease of strength by repetitive loading." Ex. 1007, ¶135; Ex. 1014, p.3; Ex. 1020, p.20 (fatigue defined as "changes in properties which can occur in a metallic material due to the repeated application of stresses or strains…."). In the '915 Patent, only mechanical fatigue is described. Ex. 1001, 3:16-4:2; Ex. 1007, ¶¶135-136. Thus, other fatigue types, including "corrosion fatigue" and "thermal fatigue," are inapplicable. Ex. 1007, ¶¶135-136. The '915 Patent makes no suggestion that it fatigues with heat, laser energy, or chemicals – to the contrary, it criticizes approaches using "cryogenic cooling" and "electron beam hardening." Ex. 1001, 1:34-38. Thus, "fatigue" in the '915 Patent refers to the weakening of a material, caused by repeated mechanical stressing. Ex. 1007, ¶¶135-136.

Accordingly, a "fatigue force" is a force that causes mechanical fatigue, *i.e.,* mechanically stressing a material by fluctuating between maximum and minimum values. *Id*., ¶137. Applicant's prosecution statements are confirmatory: "a fatigue exerting force is a force which fluctuate[s] between [] maximum and [] minimum values" and "[a] fatigue exerting force is a force that fluctuates between two values." Ex. 1016, p.84; Ex. 1018, p.98; Ex. 1007, ¶137.

In litigation, FFT asserts that "fatigue force" means "time varying forces that cause fluctuation of stresses." Ex. 1021, p.3. While Petitioner disputes this under the *Phillips* standard, for purpose of this IPR only, Petitioner, with some reservation, accepts this could be the broadest reasonable construction.[5] Ex. 1007, ¶138.

C. Cyclic Force

Claim 1 further requires the "fatigue force" to be "cyclic." A "cyclic" force is one that cycles – *i.e.*, regularly repeats between a maximum value and a minimum value. Ex. 1022, p.3 (defining "cycle" as a "series of occurrences in which conditions at the end of the series are the same as they were at the beginning. Usually, but not invariably, a cycle of events is recurrent."). As applicant noted during prosecution, a fatigue force "fluctuate[s] between [] maximum and [] minimum values" (Ex.1016, p.84); thus "cyclic" further limits that fluctuation to a pattern of regular repetition. Ex. 1007, ¶139.

In litigation, FFT asserts "cyclic force" means "forces that cycle." Ex. 1021, p.4. While Petitioner disputes this under the *Phillips* standard, for purpose of this IPR only, Petitioner accepts, with some reservation, this could be the broadest

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[5] Petitioner reserves all litigation arguments, including other constructions and invalidity arguments under Section 112.

reasonable construction.[6] Ex. 1007, ¶140.

D. Dynamic Force

Claim 1 recites a "dynamic force." The specification does not define "dynamic force" but provides two examples: "an impulsive force" and "a slow rate dynamic force." Ex. 1001, 6:33-39, 4:36-38. Thus, regardless of the exact meaning of "dynamic force," it must include these two examples. Ex. 1007, ¶141.

The specification identifies prior patents that fracture rods using "an impulsive force" (Ex. 1001, 1:25-27), including U.S. Patent No. 5,320,265 ("Becker"), which fractures a rod using "an impulsive force" generated by a "spring-loaded mass," a pneumatically accelerated piston, or a "fluid powered system with an appropriately designed accumulator, impact tool, valves, and connecting lines," (Ex. 1005, 3:22-60). Becker also describes fracturing a rod using a "relatively slow acting force" from a "hydraulic cylinder." *Id.*, 4:6-20. Ex.

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[6] Petitioner reserves all litigation arguments, including other constructions and invalidity arguments under Section 112. FFT's somewhat circular construction of "cyclic force" as "forces the cycle" suggests that FFT may attempt a broad interpretation of "cycle" that would encompass forces like the "Pre-Loading" force in Cavallo. Accordingly, Petitioner demonstrates how the claims would be invalid under that broad interpretation. *See* n.7, *infra*.

1007, ¶142.

In litigation, FFT asserts that "dynamic force" need not be construed. Ex. 1021, p.4. Petitioner, under *Phillips* and based on the deposition of Mr. Guirgis, preliminarily asserts that "dynamic force" is an indefinite term of degree, because the '915 Patent lacks any guidance to determine the outer limit/scope of a "slow rate" dynamic force. Ex. 1001. However, neither that issue, nor the outer limit of "dynamic force," need be addressed here, because Brovold, Cavallo, and Becker each disclose a dynamic force, regardless of such limit. Ex. 1007, ¶¶143-144.

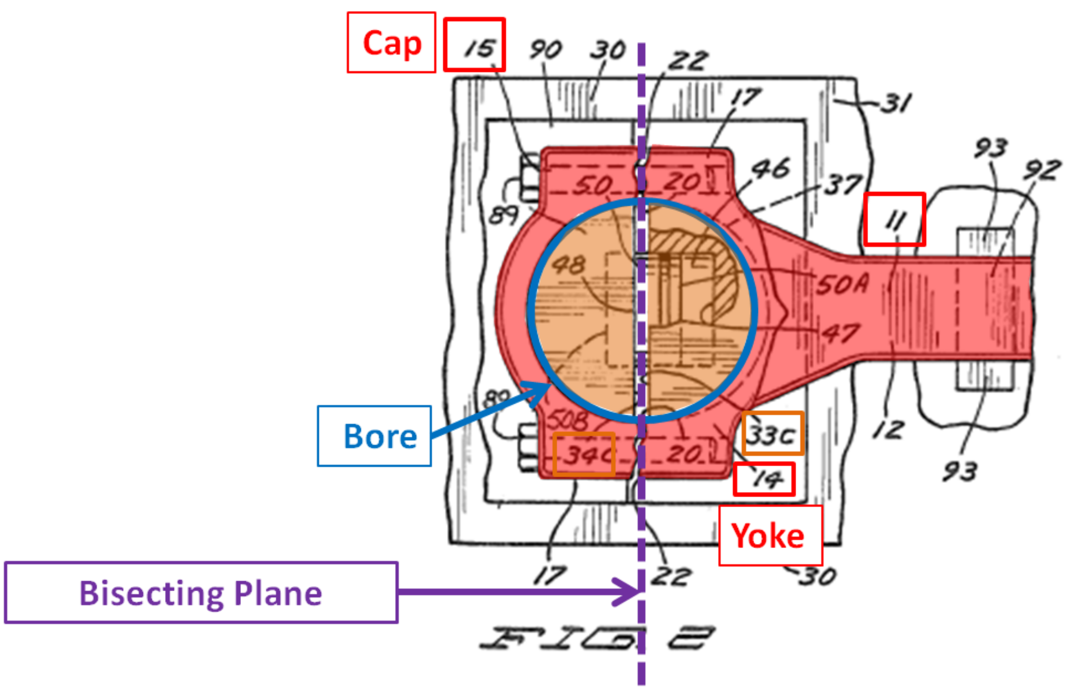
VI. PRIOR ART OVERVIEW

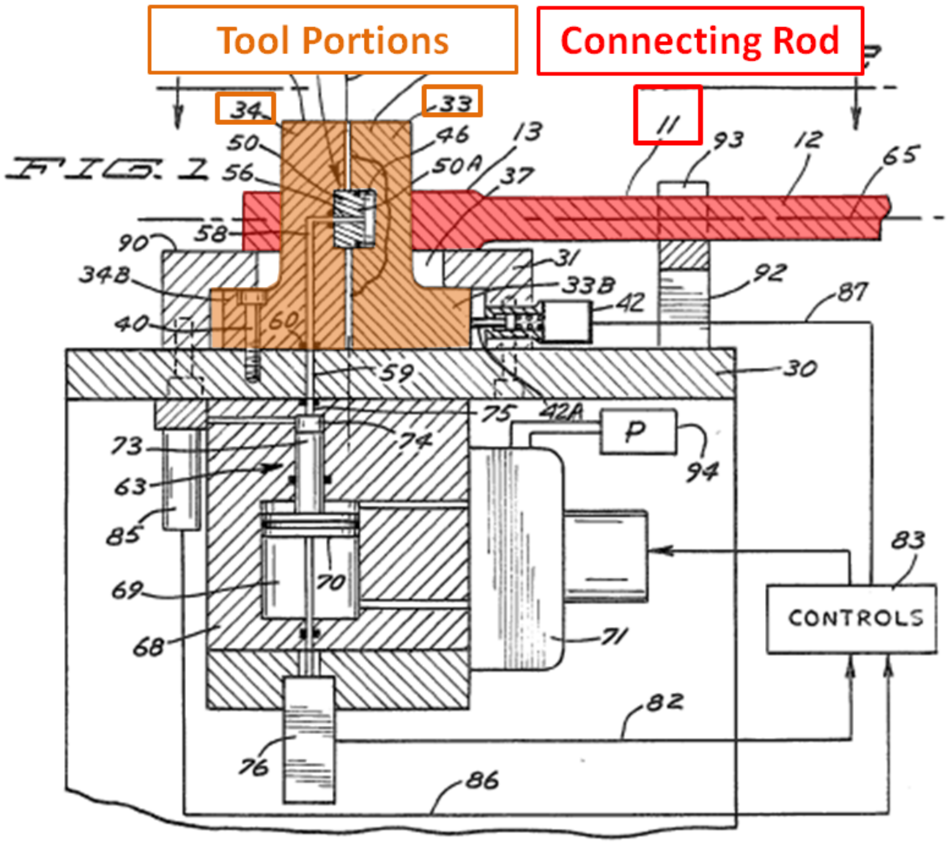
A. Brovold

U.S. Patent No. 4,754,906 ("Brovold," Ex. 1003) issued in 1988, over a decade before the earliest possible priority date for the '915 Patent. Brovold is prior art under pre-AIA 35 U.S.C. §102(b). Brovold was never of record during prosecution of the '915 Patent family.

Brovold discloses a hydraulic machine that fractures connecting rods "into two parts to provide a properly fitting bearing cap." Ex 1003, 1:9-11. Importantly, Brovold discloses fracturing a rod using both (i) a large magnitude force for achieving "brittle fractures," and (ii) cyclic fatigue forces "to cause fatigue breaks." *Id.*, 2:30-33, 4:6-14, 6:19-24; Ex. 1007, ¶98.

Before the fracturing process, "notches" (20) are placed in the connecting rod "in the regions where failure is to occur" and align with a "bisecting plane" in which the fracture occurs. Ex. 1003, 1:59-65. That **bisecting plane (65)** (shown below) is a "predetermined fracture plane" as that term is used in the '915 Patent. Ex. 1007, ¶99. Like many pre-1999 connecting rod fracturing processes, Brovold inserts two semicircular "**tool portions**" 33 and 34 into the **large bore** of a **connecting rod** (11) and applies fracturing forces through those **tool portions** to fracture the **connecting rod** into a **cap (15)** and **yoke (14)**. **Tool portion 34** is stationary. **Tool portion 33** is movable (horizontally in the figures). Ex. 1003, Figs. 1, 2:





Ex. 1003, 2:3-9; Ex. 1007, ¶100. Brovold's hydraulic system uses piston 50 mounted in **chamber 46** in fluid communication with various **hydraulic passageways** (*e.g.*, **56** and **58**). Ex. 1003, 3:41-66, Fig. 3 (below); Ex. 1007, ¶100.

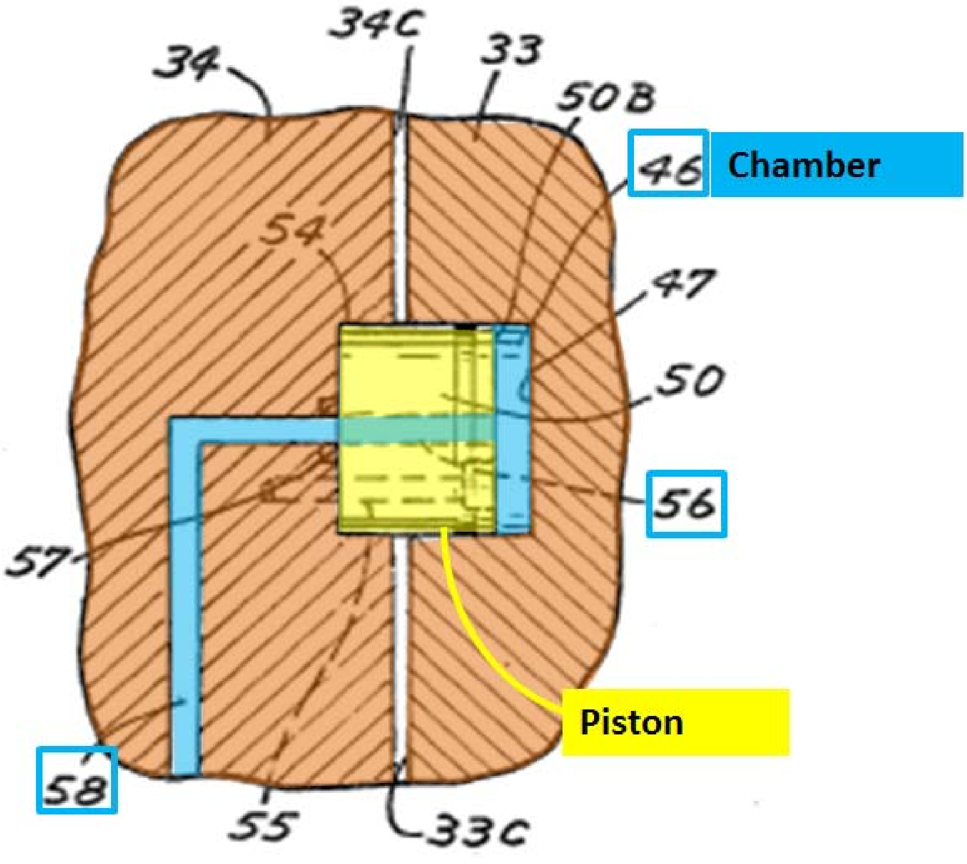


FIG. 3

Hydraulic pressure presses the **two tool portions** apart, thereby "exert[ing] **forces** generally perpendicular to the **diametrical plane** [**predetermined fracture plane**] aligned with the notches 20" in order to cause the **connecting rod** "to fail and break into two parts." Ex. 1003, 5:17-28; 1:53-58; Fig. 2 (below):

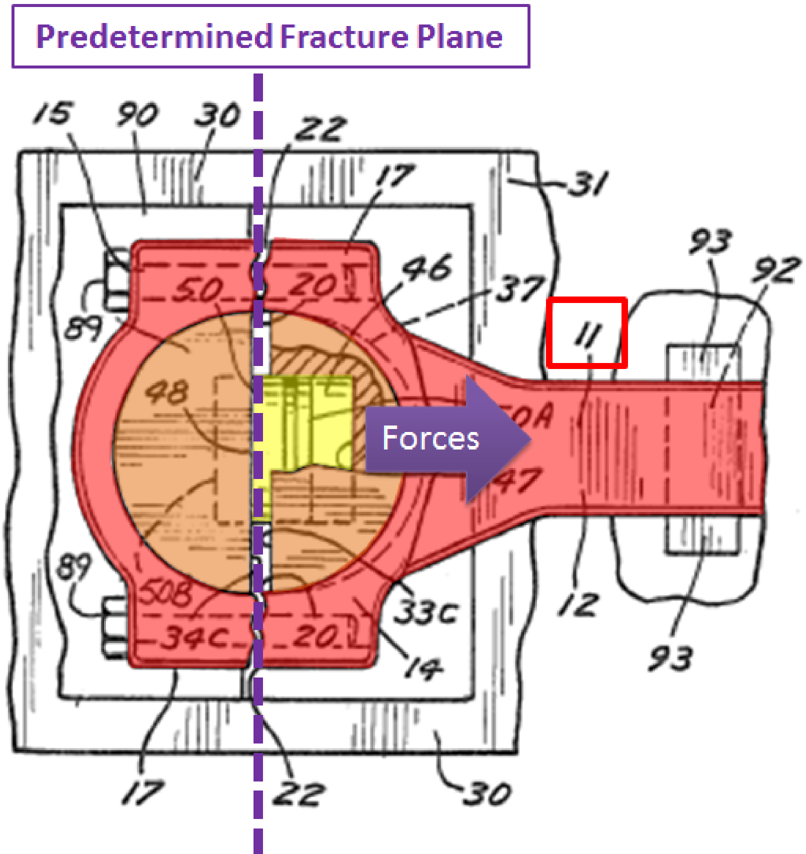
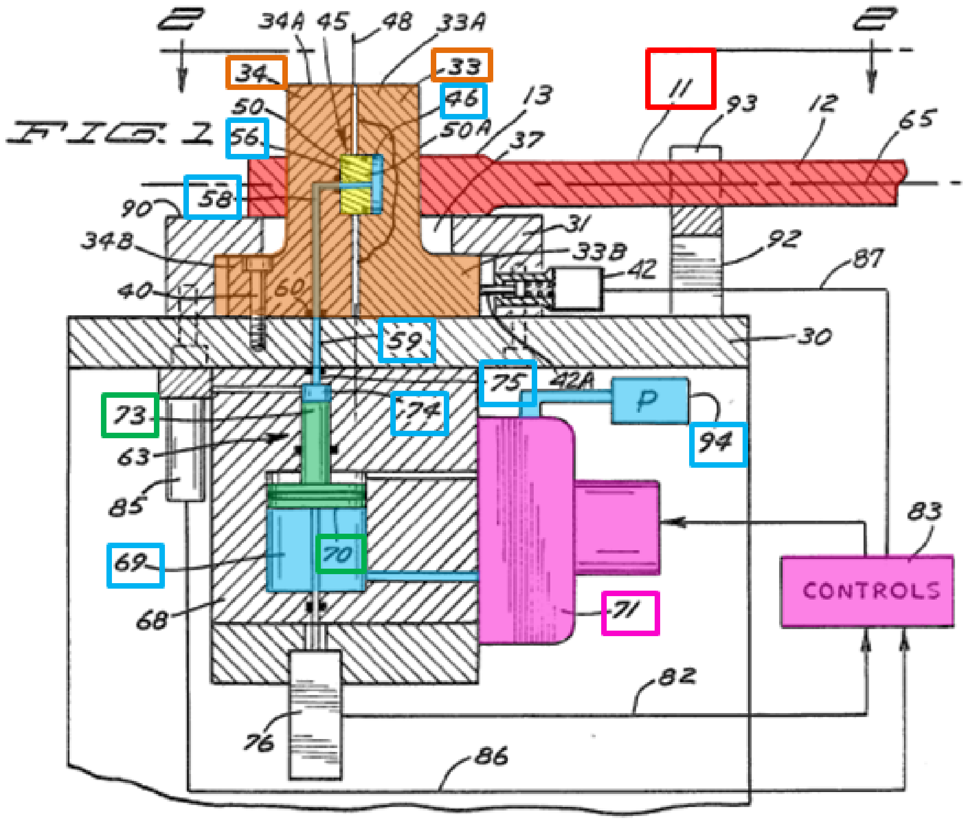


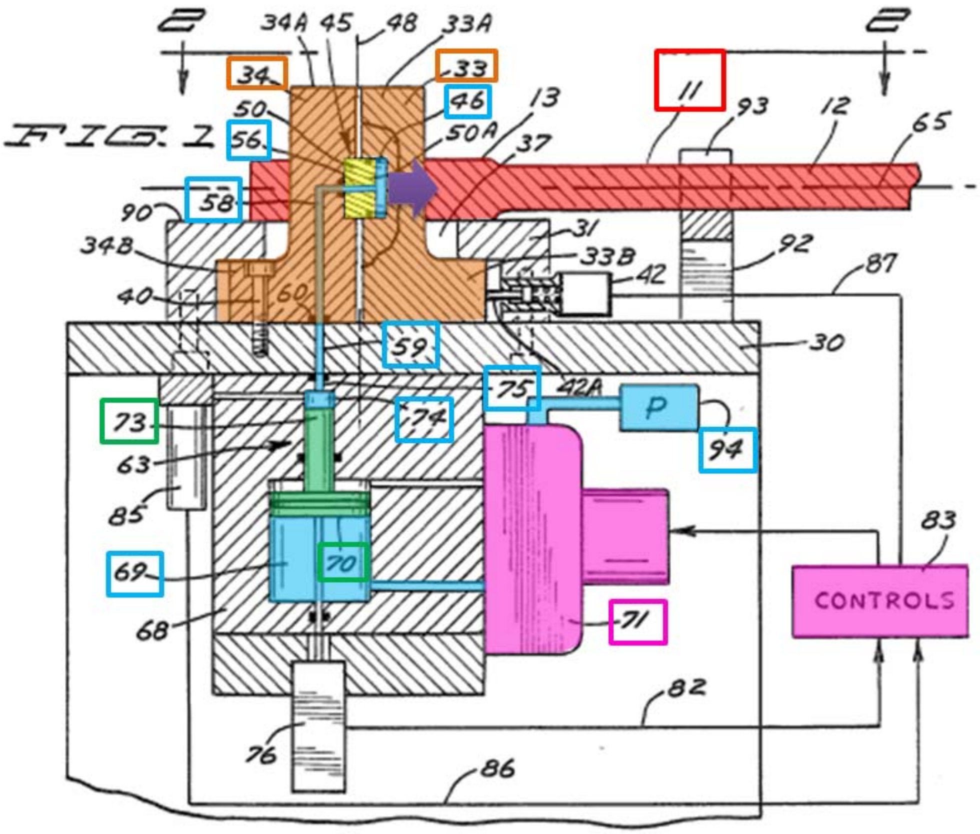
FIG 2

Ex. 1007, ¶100.

Brovold also discloses "pressure intensifier system 63" that can "raise the pressure" on piston 50 "to a level in the range of at least 30,000 psi in order to obtain enough force to carry out the cracking or breaking operation." Ex. 1003, 3:62-4:10. As shown in Figure 1 (below), that "pressure intensifier system" includes "**large internal piston 70**," fluid "**source 94**," "**servo-valve 71**," and "**controls 83**" responsible for "controlling pressure" in the system. *Id.*, 4:24-5:46, Fig. 1 (below):

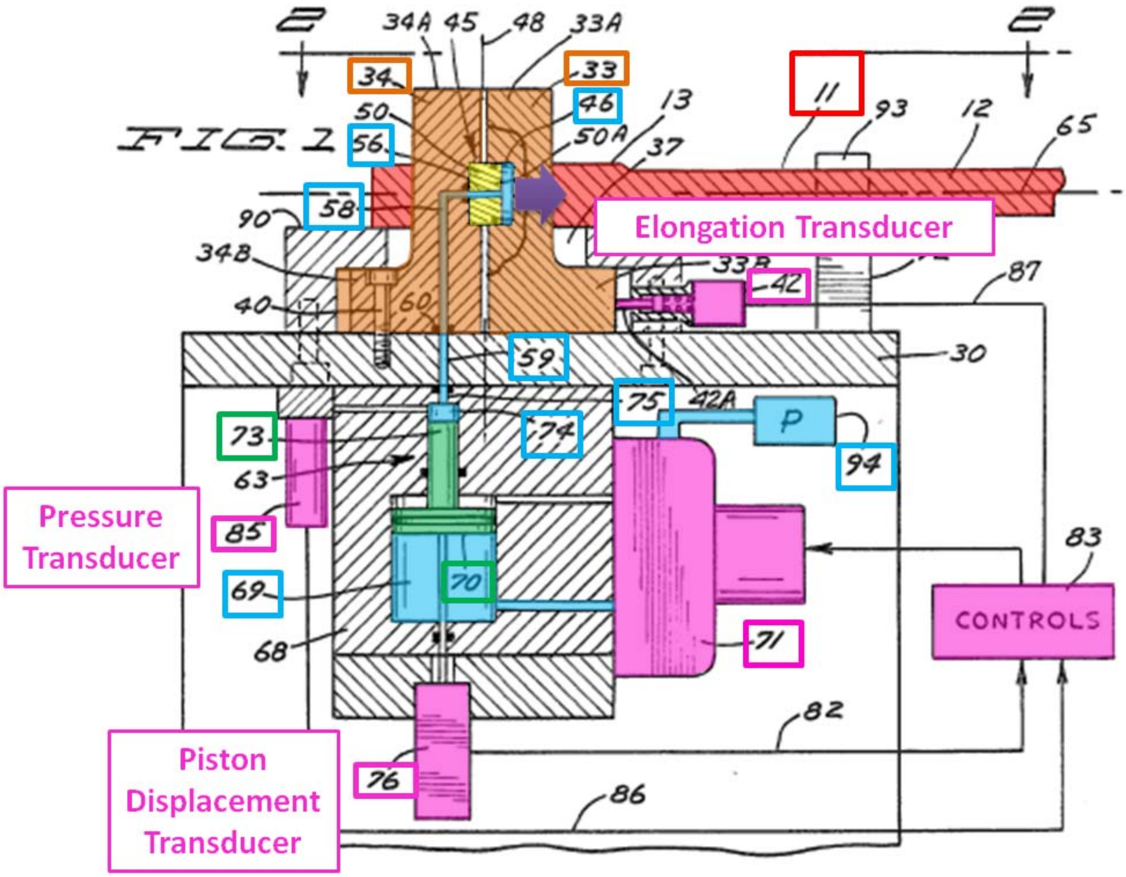


Ex. 1007, ¶101. The **servo-valve 71** controls the system pressure, and thus the forces applied to the **connecting rod**, “in accordance with a predetermined program, or manually” via **controls 83**. Ex. 1003, 5:11-12, 34-35; Ex. 1007, ¶102. “The **servo-valve 71** … direct[s] pressure from a **source 94** to the base end of the **piston 70**,” which, in turn, changes the pressure for the **tool portions** and applies forces (shown with the **purple arrow** below) to the **connecting rod**. *Id.*, 2:1-9; 3:25-26; 5:11-17; Fig. 1 (below):



Ex. 1007, ¶102.

The **servo-valve controls 83** receive feedback signals from sensors monitoring (i) the pressure, (ii) the displacement of **piston 70**, and (iii) the cracking of the **connecting rod**. These signals enable the **servo-valve** to quickly adjust the forces applied to the **connecting rod** during fracturing. *E.g.*, Ex. 1003, 4:49-52 ("pressure transducer 85" "provides a load feedback signal along a line 86 to the controls 83"); 4:41-47 (transducer 76 reports "the position of the piston 70" to "servo-valve controls 83"); 3:32-35 & 4:52-53 (transducer 42 "directly indicates any elongation or motion of the bearing housing" and "provides a feedback signal to controls 83 along line 87"); Figure 1:



Ex. 1007, ¶¶103-104.

For example, these signals identify "material characteristics of the part being broken," including when fatigue forces have created a partial crack and elongate the housing. Ex. 1003, 4:53-57; 5:29-32. Ex. 1007, ¶¶104-105. This information can be used as "one control input" for "**controls 83**," which "can be programmed to fatigue fail the bearing housing 13," for example "by controlling the pressure[,] displacement[,] or time cycle[,] and having the servo-valve programmed to repeat the needed cycle." Ex. 1003, 3:34-35, 6:20-24. In other words, Brovold teaches how these feedback signals enable the servo-control to alter the forces, so the last few forces needed to fatigue fail the connecting rod are more precisely crafted. Ex. 1007, ¶¶105-106. In this manner, "[u]sing servocontrols for the pressure intensifier system, and using load and stroke feedback signals results in precise control for breaking the parts." Ex. 1003, 2:21-24; Ex. 1007, ¶106.

Thus, Brovold teaches using longitudinal, cyclic, fatigue forces to fracture a connecting rod into two portions. *Id*., 1:9-11, 5:23-28. Brovold includes a servo-valve programmed for "cycling the members to cause fatigue breaks" and for using control inputs to precisely tailor the forces as the rod begins to fracture. *Id*., 2:21-24, 31-33; 6:19-24; Ex. 1007, ¶107. Brovold further discloses using a large magnitude "separating force" (*e.g*., at least 30,000 psi) in fracturing a connecting rod, as well as the use of "brittle fractures" and "fatigue breaks." Ex. 1003, 2:31-33, 3:36-4:14. Using these resources, Brovold teaches a method for "precise control for breaking the parts." *Id*., 2:23-24; Ex. 1007, ¶108.

B. Cavallo

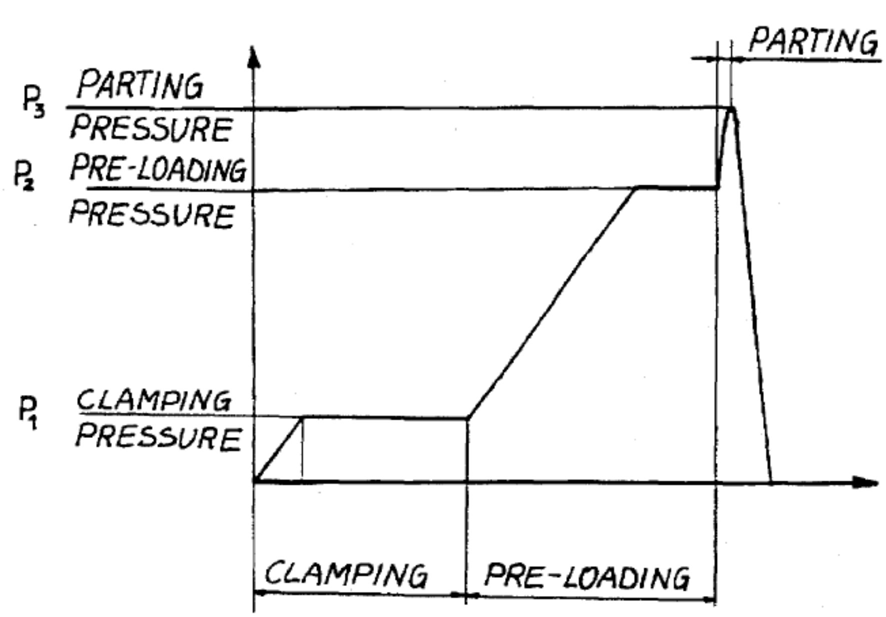
U.S. Patent No. 5,699,947 ("Cavallo") issued in 1997, more than a year before the earliest possible priority date of the '915 Patent. Ex. 1004. Cavallo is prior art under pre-AIA 35 U.S.C. §102(b). Cavallo was only cursorily considered during prosecution of the '915 Patent, and the arguments discussed during prosecution are not substantially the same as those addressed herein. For example, the combination of Cavallo, Brovold and/or Bayliss in Grounds 3-4 and 6-8 involve prior art teachings regarding fatigue not considered by the examiner. As for Ground 2, the arguments are not substantially the same as those discussed during prosecution, at least in view of FFT's broad litigation constructions regarding the claimed cyclic fatigue force.

Cavallo "relates to a process and a machine for parting the cap of connecting rods, particularly connecting rods for internal-combustion engines," and adopts the known use of notches or grooves to define a predetermined fracture plane. Ex. 1004, Title, 1:7-9, 4:41-44 ("In a per se known manner, parting occurs along a parting plane that passes through diametrically opposite initiation grooves provided on the inner surface of the eye of the big end 11b and not shown in the figure."). *See also* Ex. 1007, ¶111.

Cavallo notes that prior approaches for fracturing connecting rods were "essentially mechanical or hydraulic." Ex. 1004, 1:45-46. As one example of a "typical hydraulic parting procedure," Cavallo references the Brovold patent. Ex. 1004, 2:13-22. Cavallo considered those procedures and devised a fracturing technique that "combine[d] the advantages of mechanical and hydraulic parting procedures." Ex. 1004, 2:38-39. Thus, rather than discard the hydraulic techniques in Brovold, Cavallo embraced hydraulics and added a mechanical aspect. Ex. 1007, ¶112.

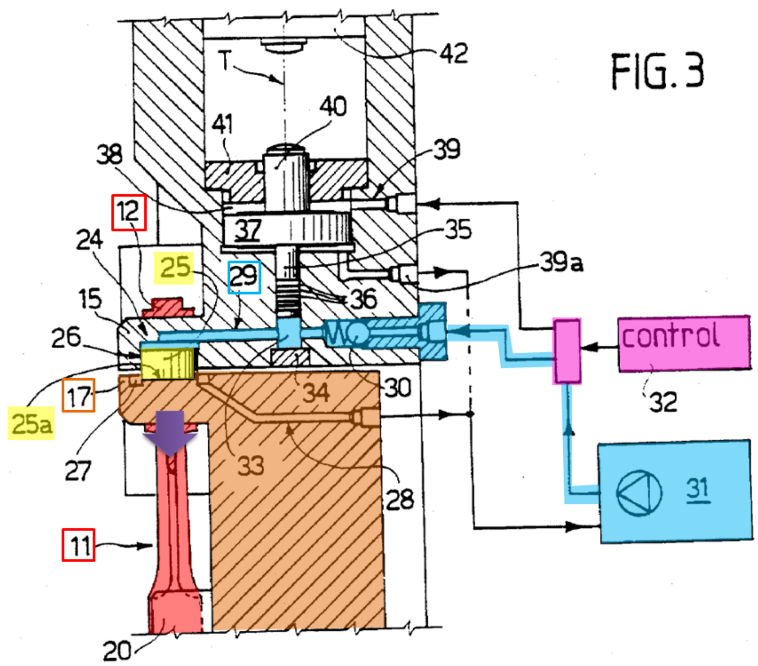
Specifically, Cavallo created a "mixed hydraulic and mechanical procedure" in which "clamping" and "pre-loading" pressures are applied hydraulically. Ex. 1004, 2:66-3:8. With those forces in place, Cavallo introduces a mechanically-originated "parting" force to complete the fracture (*id.*, 3:10-13), as shown in Figure 4:

FIG. 4



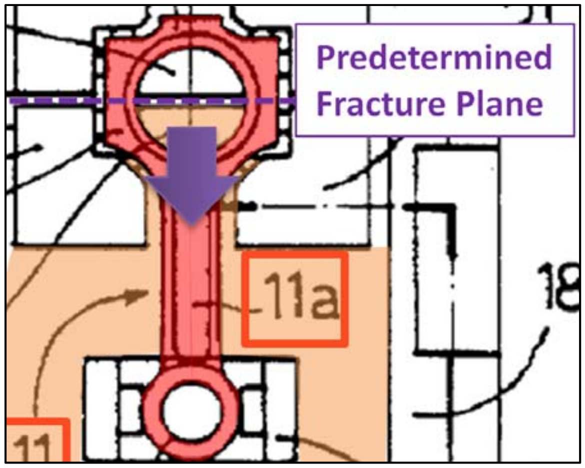
Ex. 1007, ¶113.

In this fracturing procedure, Cavallo applies a first force using what it calls "clamping pressure," to create the same force as what the '915 Patent calls its primary, longitudinal pre-stressing force. *Id.*, ¶114. To apply this longitudinal clamping/pre-stressing force, electronic "**control element 32**" feeds fluid from "**source of fluid 31**" into "**feed duct 29**" to place the clamping/pre-stressing force on "expansion piston 25." Ex. 1004, 4:45-49, Fig. 3; Ex. 1007, ¶115.



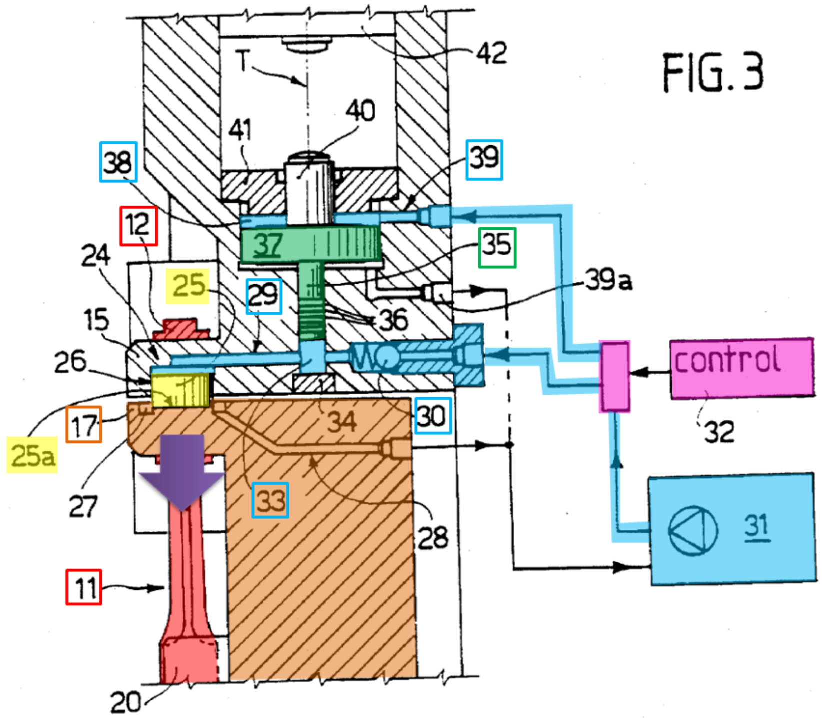
This pressure causes surface (25a) of piston (25) to press on "**moveable semicylindrical fixture 17**," exerting a clamping/pre-stressing force on the **lower end of the connecting rod (11)** relative to **the cap portion of the connecting rod (12).** Ex. 1004, 4:4-11, 44-49; Ex. 1007, ¶115.

The clamping/pre-stressing force is applied longitudinally, perpendicular to the **predetermined fracture plane**:



Ex. 1004, Fig. 1 (partially reproduced), Ex. 1007, ¶116.

Next, as shown in Figure 3 below, Cavallo applies "pre-load" pressure, stressing the rod to just below its fracture strength. Ex.1004, 3:33-36; 4:62-5:11. To accomplish this, Cavallo uses **multiplier piston 37** in fluid communication with **feed duct 29**. *Id.*, 4:62-65. **Control element 32** uses additional fluid from **source 31** to place pressure on **multiplier piston 37**, which raises the pressure on piston 25 "to a preloading value P2." *Id.,* 5:2-9. This higher pressure on piston 25 results in additional, longitudinal forces, bringing the stress to a point slightly "lower than the yield point of the metal." *Id.,* 5:9-11.



Ex. 1007, ¶117. As a skilled artisan would recognize, these portions bear a striking similarity to the hydraulic system discussed in Brovold. *Id.*, ¶117.

Finally, as shown in the figure below, "**striking mass 42**" creates a "momentary pressure peak" that generates a "momentary force" on the rod. Ex. 1004, 5:14-33; 4:36-43. **Striking mass 42** accelerates toward "**second rod 40,**" which transfers the impact of **striking mass 42** onto **multiplier piston 37**. *Id.*, 5:12-37; Ex. 1007, ¶118.

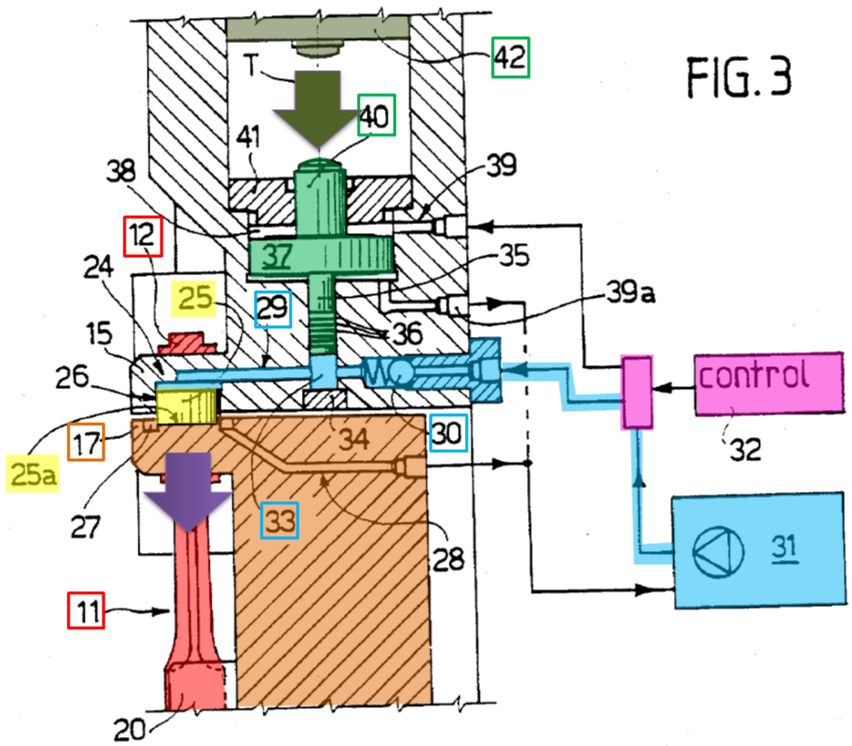


FIG. 3

This impact "produce[s] a corresponding momentary pressure peak P3 (Fig. 4)" causing piston (25) to "discharge[] a momentary force on the **fixtures 15 and 17**" that is "capable of instantaneously parting **the cap 12**." Ex. 1004, 5:24-27. "The momentary nature of the action" created by the impacting **striking mass 42** "produces parting sections that are particularly adapted for" recombining into a finished **connecting rod 11**. *Id.*, 5:27-33; Ex. 1007, ¶119.

Thus, Cavallo teaches a process for fracturing a connecting rod using multiple longitudinal forces, each perpendicular to the fracturing plane. The hydraulically generated forces (clamping/pre-stressing and pre-loading) are less than the total needed for fracture. Cavallo then mechanically adds a "momentary force," which is also smaller than the total needed for fracture, to create a cumulative force sufficient to cleanly fracture the rod. Ex. 1007, ¶119.

C. Becker

U.S. Patent No. 5,320,265 ("Becker") issued in 1994, years before the earliest possible priority date of the'915 Patent. Ex. 1005. Becker is prior art under pre-AIA 35 U.S.C. §102(b). Becker was only cursorily considered during the prosecution of the '915 Patent, and the arguments discussed during prosecution are not substantially the same as those addressed herein. For example, the combination of Becker, Brovold and/or Bayliss in Grounds 5-6 involve prior art teachings regarding fatigue not considered by the examiner.

Becker describes fracturing connecting rods using "either an impulsive **force** or a relatively slowly applied **force**" longitudinally applied to the connecting rod through "**semi circular dies**" **(33, 35)** placed in the bore of the **connecting rod**. Ex. 1005, Abstract; 3:22-4:21; 7:66-8:6; Fig. 11 (partially reproduced below).

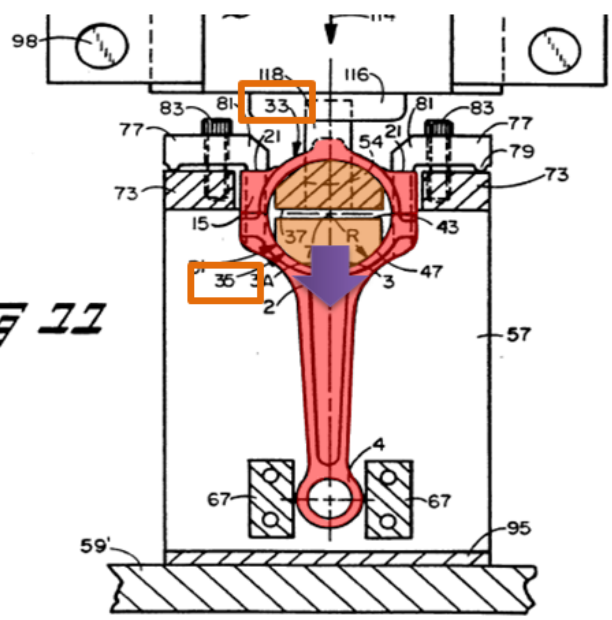


Fig. 11

Ex. 1007, ¶123. Becker discloses numerous ways to generate fracturing forces, including that a "[s]atisfactory apparatus for applying an impulsive force to the connecting rod includes a fluid powered system with an appropriately designed accumulator, impact tool, valves, and connecting lines." Ex. 1005, 3:22-27. Thus, Becker discloses a hydraulic system generating an "impulsive" force for fracturing a rod with, *e.g.*, "an appropriately designed accumulator." Ex. 1007, ¶124.

As a viable alternative, Becker uses a "relatively slow acting force applied by a hydraulic cylinder" to "crack the connecting rod." Ex. 1005, 4:6-20; 7:37-8:6. Both the impulsive force and the relatively slower force are applied to the rod by semicircular, expanding mandrels/jaws, in the longitudinal direction perpendicular to the fracture plane. *Id.*, 7:3-8:6; Ex. 1007, ¶¶125-128.

D. Bayliss

U.S. Patent No. 3,155,300 ("Bayliss"), issued in 1964, decades before the earliest possible priority date of the '915 Patent. Ex. 1006. Bayliss is prior art under pre-AIA 35 U.S.C. §102(b). Bayliss was never of record throughout prosecution of the '915 Patent family.

Bayliss describes various techniques for "applying alternating stresses to induce rapid fatigue failure" of a steel bar. Ex. 1006, 1:11-19; 1:68-2:7; 2:37-57. These "alternating stresses" can be longitudinal "positive half-waves" of stresses "applied mechanically, electrically, hydraulically or pneumatically by any suitable apparatus." *Id*., 1:24-26; 2:2-22. Ex. 1007, ¶131.

Bayliss teaches "to accelerate the onset of fatigue fracture" by superimposing longitudinal "pre-stress" forces on fatigue forces. Ex. 1006, 1:20-27; 2:2-22. Like the fatigue forces, the pre-stress forces can be longitudinal tensile forces. *Id*., 2:17-22. "Thus … the pre-stressing may be such that when added to the positive half-waves of the alternating stress applied, the total stress in the bar will be somewhat less than the elastic limit so as to accelerate the onset of fatigue fracture." *Id*., 1:24-28. While Bayliss describes advantages of lowering temperature, this is simply an optional, "further feature" and not required. *Id*., 1:39-53. Ex. 1007, ¶132. Bayliss also teaches using "a sharp notch" "to weaken the bar in the position in which it is to be parted." Ex. 1006, 1:15-17; Ex. 1007, ¶132.

Thus, Bayliss demonstrates that, decades before the '915 Patent, skilled artisans were familiar with principles of fatigue, including how "to accelerate the onset of fatigue fracture" using superimposed fatigue and pre-stressing forces that are both longitudinal (among other directions) and tensile (among other types). Ex. 1006, 1:20-28; Ex. 1007, ¶133.

E. Analogous Art

Brovold, Cavallo, Bayliss, and Becker are in the same field of endeavor as the '915 Patent, as each seeks to fracture parts (connecting rods or steel bar stock).

Ex. 1001, Title ("Process to Fracture Connecting Rods and the Like"), claims 1, 7 and 10; Ex. 1003, Abstract; Ex. 1004, Abstract; Ex. 1005, Abstract; Ex. 1006, 1:11-14. Furthermore, each is reasonably pertinent to some of the problems facing the inventor, such as seeking more efficient or effective techniques for fracturing parts. Ex. 1001, 1:15-50. Ex. 1007, ¶¶95-133. Thus, each is analogous to the '915 Patent.

F. Motivations to Combine Brovold and Cavallo

A skilled artisan would have readily appreciated how teachings from Cavallo and teachings from Brovold could be combined to achieve the Challenged Claims. For example, both disclose similar, hydraulically actuated components placed within the connecting rod bore. Ex. 1003, 2:3-9 (tool portions); Ex. 1004, 5:24-27 (fixtures). Control systems in both patents generate hydraulic pressure to apply longitudinal forces to the rod in a direction perpendicular to a predetermined fracture plane marked by stress-risers in the form of notches. Ex. 1003, 5:11-28, 6:19-24 (servo-valve 71 and controls 83); Ex. 1004 4:55-61 (control element 32). Both have the stated goal of improving the fracturing process through a simplified, reliable machine. Ex. 1003, 2:13-32; Ex. 1004, 2:23-60. In addition, Cavallo explicitly refers to Brovold and is intended to be an improvement thereto. Ex. 1004, 2:13-39. Ex. 1007, ¶120.

Thus, a skilled artisan, reading Cavallo and Brovold, would be motivated to consider ways to combine Cavallo with Brovold or ways to modify Brovold or Cavallo to leverage particular features in the other, especially since Cavallo identifies improvements to Brovold (Ex. 1004, 2:13-39), and Cavallo explicitly references Brovold as a "typical hydraulic parting procedure" that it adopts. Ex. 1004, 2:13-14, 36-39. Ex. 1007, ¶120.

G. Motivations to Combine Bayliss with Brovold or Cavallo

A skilled artisan would readily appreciate how teachings from Bayliss, Brovold, and Cavallo could be combined to achieve the Challenged Claims. For example, each discloses applying particular forces to fracture a part along a predetermined fracture plane. Ex. 1003, 3:1-4; Ex. 1004, 4:41-44; Ex. 1006, 1:15-19. Furthermore, Brovold and Bayliss both disclose longitudinal fatigue forces as part of a fracturing process, (Ex. 1003, 2:31-32; Ex. 1006, 1:15-19, 2:8-22), and Cavallo and Bayliss both disclose longitudinal pre-stressing forces as part of a fracturing process (Ex. 1004, 4:55-61; Ex. 1006, 1:20-28, 2:17-22). Thus, a skilled artisan, reading Cavallo, Brovold, and Bayliss, would be motivated to consider ways to combine Bayliss with Cavallo or Brovold, or ways to modify Brovold or Cavallo to leverage particular features in Bayliss, *e.g.*, specific forces to fracture metal parts. Ex. 1007, ¶133.

H. Motivations to Combine Becker with Brovold

A skilled artisan would readily appreciate how teachings from Becker and Brovold could be combined to achieve the Challenged Claims. For example, each discloses hydraulically actuated components placed within the connecting rod bore. Ex. 1003, 2:3-9 (tool portions); Ex. 1005, Abstract, 4:6-20, 5:44-46 (dies). In addition, each generates hydraulic pressure to apply longitudinal forces to connecting rods in a direction perpendicular to the fracture plane. Ex. 1003, 5:11-28 (servo-valve 71 and controls 83); 4:41-61; Ex. 1005, 3:24-27. Ex. 1007, ¶128. Thus, a skilled artisan, reading Becker and Brovold, would be motivated to consider ways to combine Becker with Brovold or ways to modify Brovold to leverage particular features in Becker, *e.g.*, specific forces to fracture separate connecting rods. *Id*.

VII. GROUND 1: ANTICIPATION BY AND/OR OBVIOUSNESS OVER BROVOLD

To a skilled artisan, each Challenged Claim would have been anticipated by or rendered obvious over Brovold.

A. Claim 1, Preamble

The preamble recites a "process for the fracture separation of a part having a cylindrical bore passing therethrough into a first portion and a second portion, the cylindrical bore having a central axis, the part having two opposed sides proximate to the intersection of a predetermined fracture plane passing through the cylindrical bore and the part." Ex. 1001, 6:61-67. A connecting rod is one example of such a part in the '915 Patent. *E.g., id.*, Abstract.

Brovold discloses these features. This is undisputed. Ex. 1023, p.2. Brovold discloses a process for the fracture separation of a connecting rod (11) into a first portion (bearing cap 15) and a second portion (yoke 14). Ex. 1003, Abstract; 1:7-11 (describing a process for "cracking" the connecting rod "into two parts to provide a properly fitting bearing cap during manufacture of the connecting rods"); 2:58-61 ("As can be seen as FIG. 2, the bearing hub or housing 13 is to be formed into two separate parts comprising a yoke 14, and a bearing cap 15."). Ex. 1007, ¶¶147-148.

A **connecting rod**, as disclosed in Brovold, has a cylindrical bore (**internal bore 16**, referenced at Ex. 1003, 2:63) passing therethrough. As a skilled artisan would recognize, that bore has a **central axis 48** (normal to the page in Figure 2). Ex. 1003, Figure 2 (below, annotated):

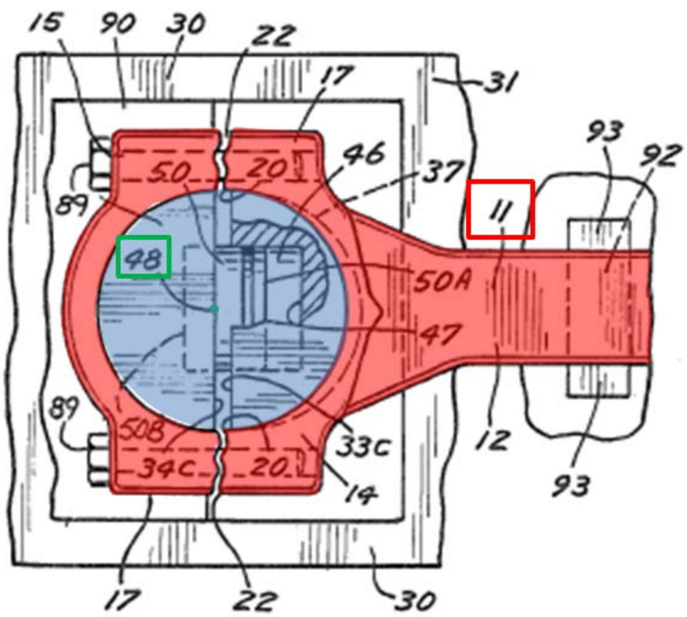
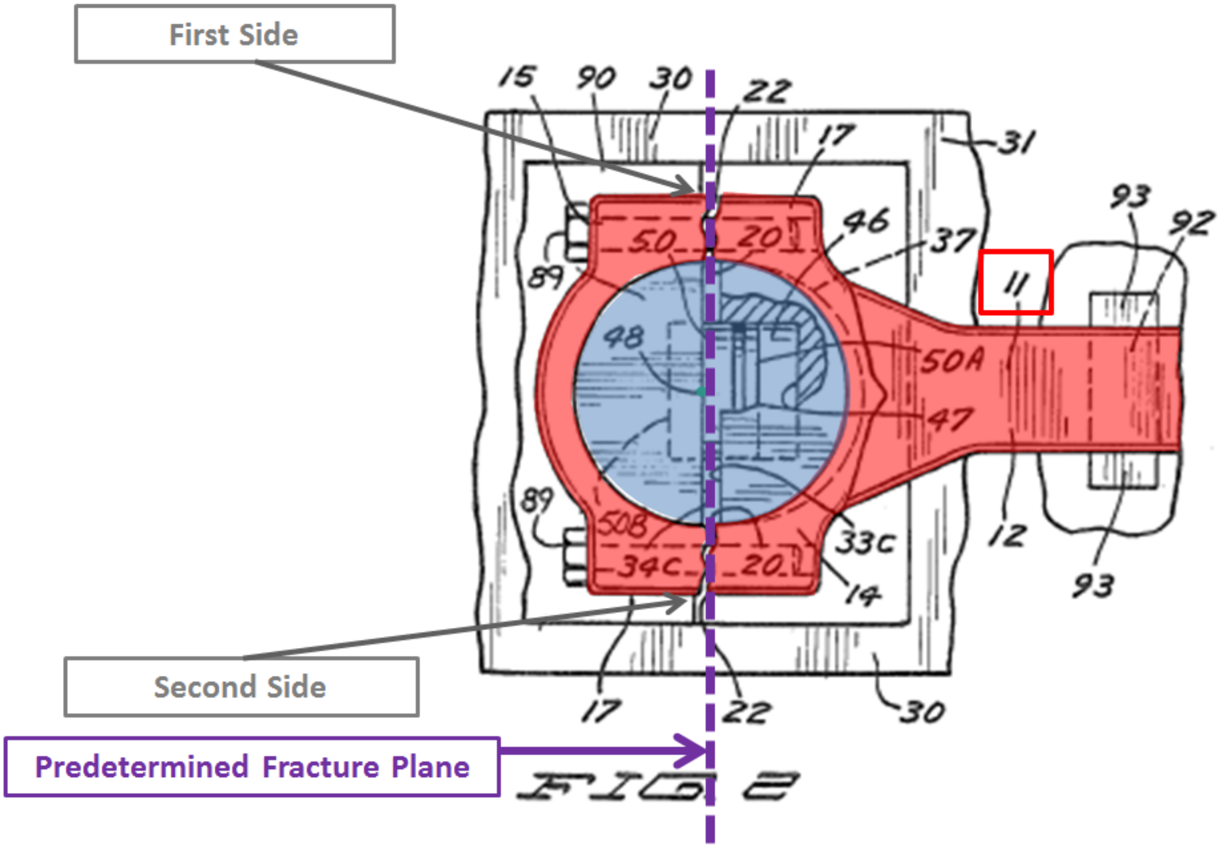


FIG. 2

Ex. 1007, ¶149.

Brovold's **connecting rod** also has two opposed (lateral) sides located proximate to the intersection of a **predetermined fracture plane** (the **bisecting plane 65**, which passes through the **connecting rod** 11 and is predetermined by the notches 20 on the interior surface defining **bore 16**). *E.g.*, Ex. 1003, 2:66-3:4; Figure 2 (below annotated):

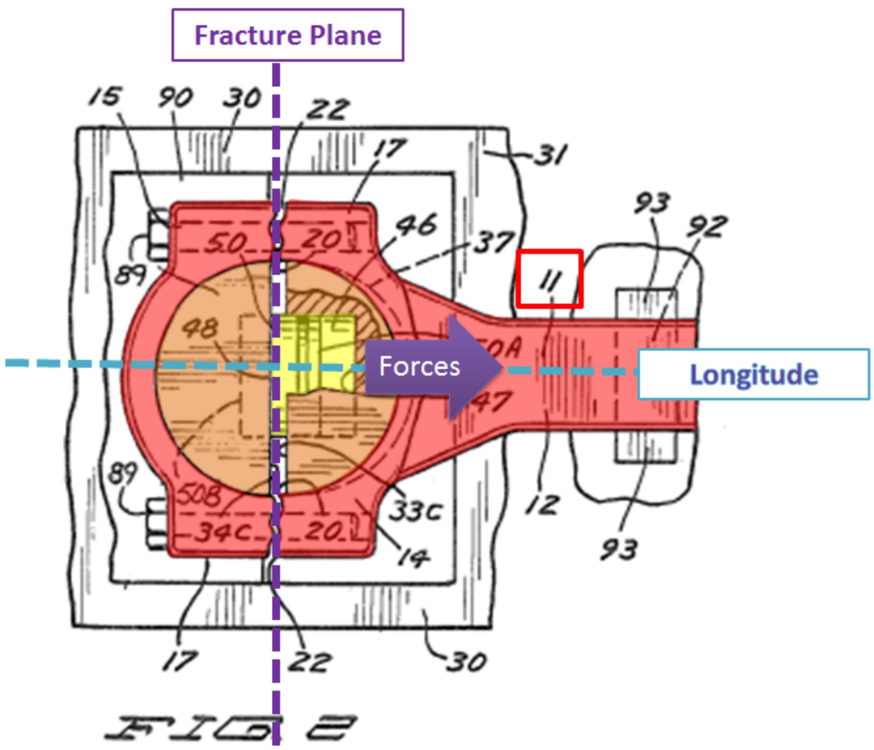


Ex. 1007, ¶150. Thus, Brovold discloses these features.

B. Claim 1, optional part (a), including option (a)(i)

Part (a) recites "optionally applying at least one pre-stressing force…." Assuming, *arguendo*, that pre-stressing is required, applying a longitudinal pre-stressing force, as in option (a)(i), would have been implicitly disclosed by Brovold or obvious in view of Brovold. The pre-stressing in claim 1 is satisfied by a "longitudinal pre-stressing force applied to one of the first portion and the second portion relative to the other of the portion and the second portion." This "longitudinal pre-stressing force" is "applied in a direction substantially perpendicular to said predetermined fracture plane." Ex. 1007, ¶¶151-152.

As discussed above, Brovold applies longitudinal forces on a **connecting rod** by **longitudinally** separating the two **tool portions (33 and 34)**. Those **longitudinal forces** are perpendicular to the **predetermined fracture plane** (identified by the notches 20).



Ex. 1003, Fig. 2; Ex. 1007, ¶152. Furthermore, a skilled artisan would have known that, in a mass production scenario where repeatability is important, it would be beneficial to eliminate variability from "slack" or "play" in the system before applying the fracturing forces. Ex. 1007, ¶153; Ex. 1003, 6:25-26 ("A much more accurate level of repeatability of loading then previous methods can be obtained."). A skilled artisan would also have known that fatiguing a connecting rod (as in Brovold) is greatly facilitated when the component is secured or clamped in place during the fatigue forces. Ex. 1007, ¶153. A skilled artisan also would have known that applying a "pre-stressing" force would tighten the tool portions 33 and 34 against the connecting rod, thereby removing slack or play, and would help secure the connecting rod in place during application of the fatigue forces. *Id.*, ¶153.

Thus, to the extent pre-stressing is (i) limiting, and (ii) not implicitly described by Brovold, a skilled artisan would have been motivated to add a longitudinal pre-stressing force to Brovold. Modifying the "predetermined program" in Brovold, for example, to apply this force would have been routine engineering work for a skilled artisan. *Id.*, ¶154. Such a change would have been nothing more than a "predictable use of prior art elements according to their established functions." *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 417 (2007). Thus, Brovold discloses or renders obvious these features. Ex. 1007, ¶¶154-155.

C. Claim 1, part (b), including option (b)(i)

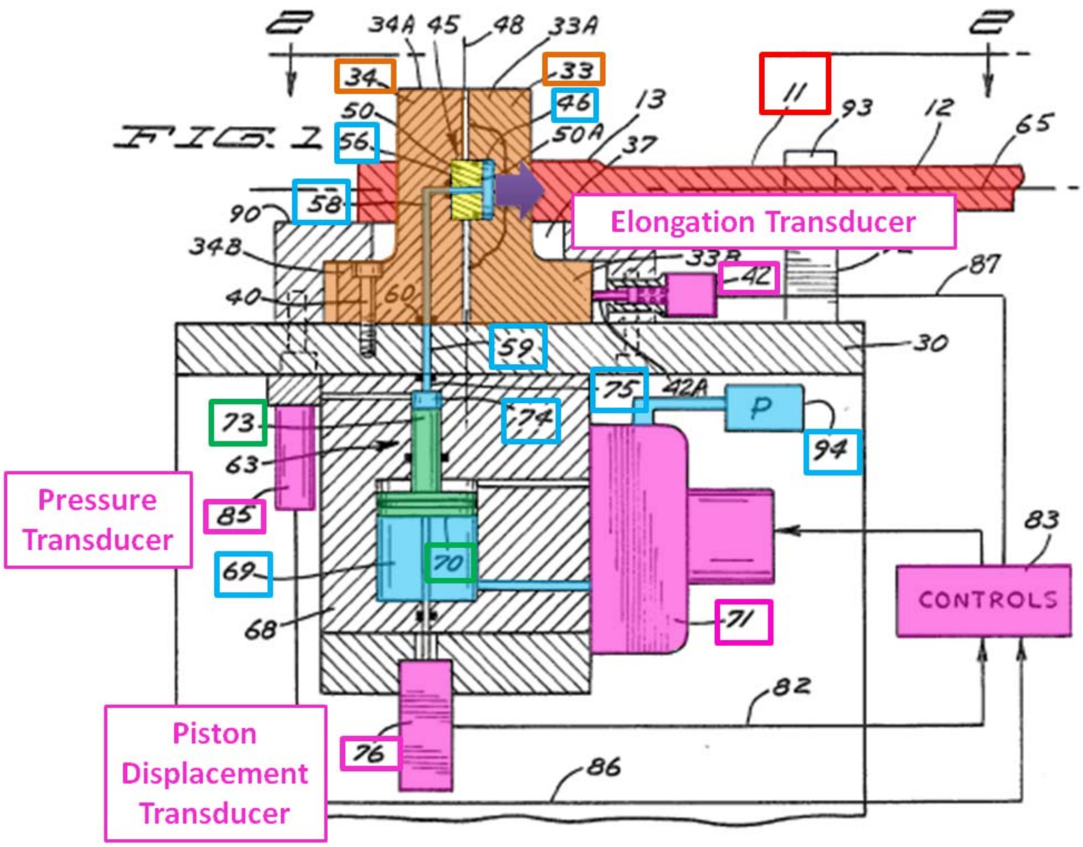
Limitation (b) recites "applying at least one fatigue force to at least one of the first portion and the second portion," followed by two options: (b)(i) and (b)(ii). Option (b)(i) recites "a longitudinal cyclic force applied to one of the first portion and the second portion relative to the other of the first portion and the second portion, said longitudinal cyclic force being applied in a direction substantially perpendicular to said predetermined fracture plane."

In the connecting rod embodiment, the "first portion" is the cap portion, and the "second portion" is the rest of the rod/yoke. *E.g.*, Ex. 1001, claim 9. Thus, this limitation covers applying a cyclic fatigue force to either the cap or the yoke, relative to the other, in a longitudinal direction that is perpendicular to the predetermined fracture plane.

Brovold teaches these features. As discussed above, Brovold applies longitudinal forces to the connecting rod yoke, relative to the cap, with those forces being perpendicular to the predetermined fracture plane. Ex. 1003, Fig. 2; Ex. 1007, ¶¶156-157.

Brovold teaches that those forces are cyclic fatigue forces. *E.g.*, Ex. 1003, 2:29-32 ("The tool system is adaptable for … cycling the members to cause fatigue breaks, generally under a low number of cycles."); 6:19-24 ("In some instances, the controls 83 can be programmed to fatigue fail the bearing housing 13. The part may be cyclically loaded two or three times before fracture by controlling the pressure displacement or time cycle and having the servo-valve programmed to repeat the needed cycle."). Ex. 1007, ¶158.

In particular, those cyclic fatigue forces are governed by the **controls 83** and **servo-valve 71**, which direct hydraulic pressure to the system and thereby apply cyclic fatigue forces to the **connecting rod**, "in accordance with a predetermined program." Ex. 1003, 5:11-12, 6:19-21. Various **transducers** (85, 76, 42) provide feedback and control signals to the **controls**, which enable "precise control" of the pressure, piston displacement, or time cycle during the fatigue cycles leading up to the fracture. *Id.*, 2:20-24, 6:19-24, Fig. 1; Ex. 1007, ¶¶159-160.



Thus, a skilled artisan would recognize that Brovold teaches the longitudinal cyclic force recited in step (b), option (b)(i). *Id.*

D. Claim 1, part (c)

The final part of claim 1 recites "applying at least one dynamic force to one of the first portion and the second portion relative to the other of the first portion and the second portion," and further requires the "dynamic force being applied in a direction substantially perpendicular to said predetermined fracture plane," in order to “fracture the part into the first portion and the second portion so as to separate the first portion from the second portion substantially along said predetermined plane.”

In the ’915 Patent, the dynamic force can be an “impulsive fracturing force” or a “slow rate dynamic force.” In the specification, the **dynamic force “$F_{4I/D}$”** (either the impulse force or the slow rate dynamic force) is applied by moving the **upper jaw 2** away from **plane 1E**, thereby increasing the **force F_1**. Ex. 1001, 6:33-39, Fig. 1; Fig. 3; Ex. 1007, ¶163.

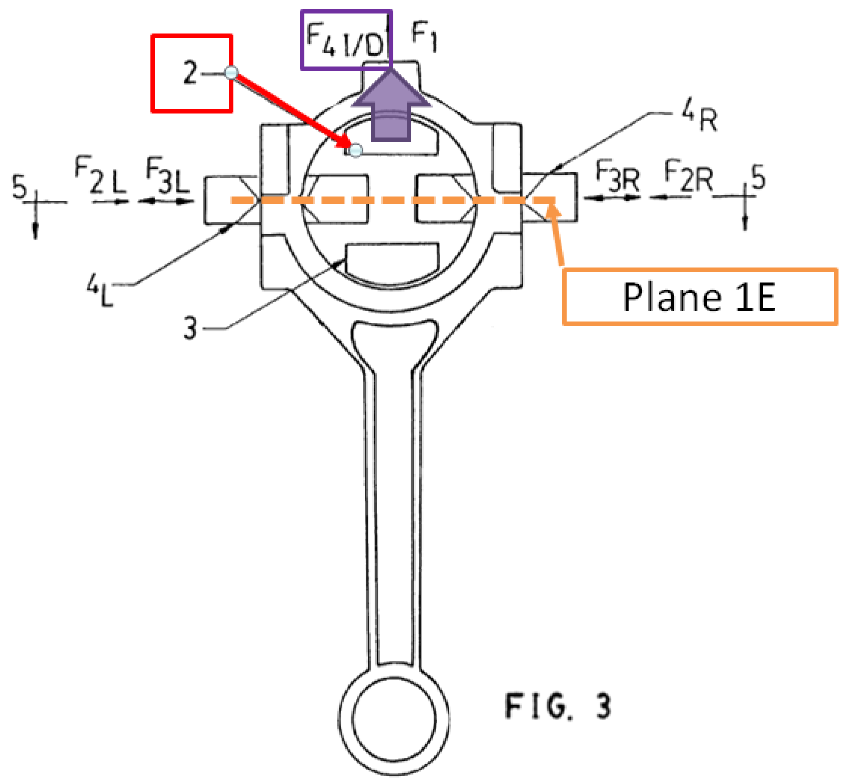
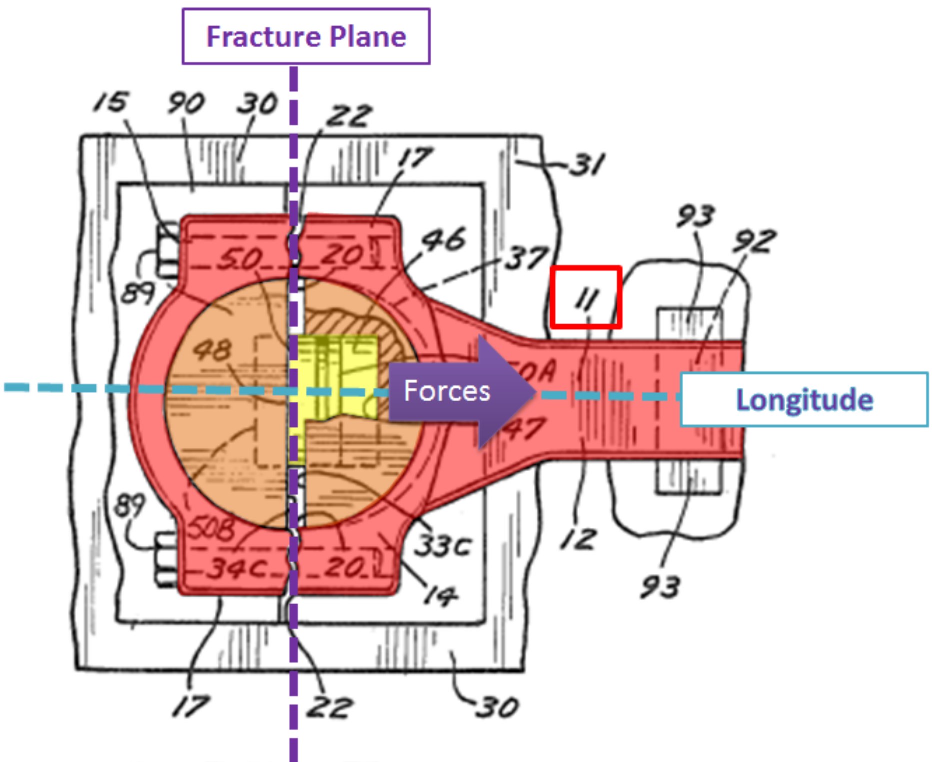


FIG. 3

Brovold discloses these features. As a skilled artisan would understand, hydraulic fluid systems like those disclosed in Brovold can deliver an “impulsive” force or a "relatively slower" force, *i.e.,* the "impulse force" and "slow rate" dynamic forces described in the '915 Patent. Ex. 1007, ¶¶161-167.

For example, Brovold discloses applying a "separating" force in the range of at least 30,000 psi to fracture **connecting rod** into **bearing cap** (15) and **yoke** (14). Ex. 1003, 3:36-4:10. That dynamic force is applied **longitudinally**, and perpendicular to the **predetermined fracture plane** (Bisecting Plane 65).



Ex. 1003, Fig. 2; Ex. 1007, ¶¶162-165.

The 30,000 psi dynamic force is applied, via the piston 50 and the **tool portions 33 and 34**, to the second portion of the **connecting rod** (yoke 14), relative to the first portion (bearing cap 15). Ex. 1003, 2:10-17 ("The tool portions are positioned so that the fluid pressure, and the central line or axis of the force from the piston lie along the bisecting plane of the bore that is perpendicular to the bore axis"); 5:25-28 (the forces applied to the connecting rod are "generally perpendicular to the diametrical plane aligned with the notches 20"). This teaches the claimed dynamic force. Ex. 1007, ¶¶164-165.

Brovold further discloses that the forces applied to the connecting rod can be tailored during the fracturing operation, thereby applying a carefully controlled separating force falling within the scope of a "dynamic force." Ex. 1003, 2:20-23 ("Using servocontrols for the pressure intensifier system, and using load and stroke feedback signals results in precise control for breaking the parts."). For example, a skilled artisan would have recognized that Brovold's embodiment "for cycling the members to cause fatigue breaks, generally under a low number of cycles" (Ex. 1003, 2:30-33), teaches the application of cyclic fatigue forces whose magnitude is lower than the initial fracture strength of the connecting rod. Ex. 1007, ¶¶166-167. Those cyclic forces reduce the fracture strength of the connecting rod, including by expanding cracks in the rod, which is detected by transducer (42) as the rod elongates. Ex. 1003, 3:32-35, 4:52-57, 5:29-32. Ex. 1007, ¶167. The subsequent "displacement signal" sent from transducer 42 to controls 38 is a "control input in the system." Ex. 1003, 3:32-35, 4:52-57. With the connecting rod nearing complete fracture, this "control input" signals the controls 83 to complete the fracture separation of the connecting rod, *e.g.*, by "controlling the pressure" applied by the servo-valve 71. Ex. 1003, 6:22-24; Ex. 1007, ¶169. As a skilled artisan would readily understand, the increased hydraulic force (which could be "to a level in the range of at least 30,000 psi" (Ex. 1003, 4:8-10)) surpasses the fracture strength of the fatigued connecting rod, resulting in the complete separation of the two parts. Ex. 1007, ¶167. As Brovold's forces are applied to one portion (yoke 14) relative to the other (bearing cap 15) in longitudinal direction that is perpendicular to the predetermined fracture plane, Brovold discloses the use of the claimed "dynamic force" to separate the connecting rod. *Id*., ¶167.

To the extent FFT contends that Brovold does not explicitly teach the claimed dynamic force in combination with the claimed fatigue force (which Petitioner asserts is incorrect), it would have been obvious for a skilled artisan to apply both the claimed fatigue force and the claimed dynamic force in view of Brovold. *Id*., ¶168.

As discussed above, Brovold teaches the application of cyclic fatigue forces on a connecting rod. Ex. 1003, 6:19-21. Brovold also teaches the application of a large, 30,000 psi "separating force." *Id.,* 3:36-4:14. Brovold further teaches the use of a servo-valve and controls that enable "precise control for breaking the parts" by controlling the nature of the forces immediately preceding the separation, including by "controlling the pressure." *Id*., 6:21-24, 2:21-24. A skilled artisan would have found it obvious to reprogram the servo-valve so that it applies a single dynamic force (*e.g*., up to 30,000 psi) to the connecting rod, in combination with the fatigue forces, to cause a "brittle fracture[]" and complete separation of the fatigued connecting rod. *Id*., 2:30-31. Ex. 1007, ¶¶168-169. For example, the controls 83 could be programed to add the large separating force once the transducer 42 detects that the fatigue forces have expanded a crack in the connecting rod. Ex. 1003, 3:32-35, 5:29-32; Ex. 1007, ¶169. Such a change would have involved routine engineering work to, *e.g*., modify the "predetermined program," and a skilled artisan would have been motivated to add a dynamic force in order to, *e.g*., reduce the amount of time needed to fracture the connecting rod by reducing the number of fatigue force cycles. Ex. 1003, 2:19-20; Ex. 1007, ¶169. Such a change would simply be the "combination of familiar elements according to known methods" that does "no more than yield predictable results." *KSR*, 550 U.S. at 416; Ex. 1007, ¶169.

Thus, for the reasons discussed above, Brovold anticipates or renders obvious claim 1 as arranged therein. Ex. 1007, ¶146.

E. Claim 7

Claim 7 discusses the "optional" pre-stressing force, and reduces the list of optional choices to "said longitudinal pre-stressing force." Nevertheless, this language remains optional and non-limiting. If required, this pre-stressing force is anticipated or rendered obvious by Brovold. *Supra*, Section VII(B), incorporated by reference herein; Ex. 1007, ¶¶170-171.

F. Claim 9

Claim 9 recites "wherein said part is a connecting rod, said first portion is a cap portion and said second portion is a rod portion." Brovold teaches these features. Ex. 1003, 2:58-61 ("As can be seen as FIG. 2, the bearing hub or housing 13 is to be formed into two separate parts comprising a yoke 14, and a bearing cap 15."), Fig. 2; Ex. 1007, ¶¶172-173; *supra*, Section VII(A), incorporated by reference herein.

G. Claim 10

As discussed above, claim 1 describes two choices for the "at least one fatigue force." Claim 10, which depends from claim 1, restricts the selection to one of those two choices – "said longitudinal cyclic force." The additional language of dependent claim 10 is exactly the same as the language of claim 1, limitation (b)(i). As discussed above with respect to claim 1, part (b), including option (b)(i), Brovold teaches this feature. *Supra*, Section VII(C), incorporated by reference herein. Ex. 1007, ¶¶174-175.

VIII. GROUND 2: ANTICIPATION BY AND/OR OBVIOUSNESS OVER CAVALLO

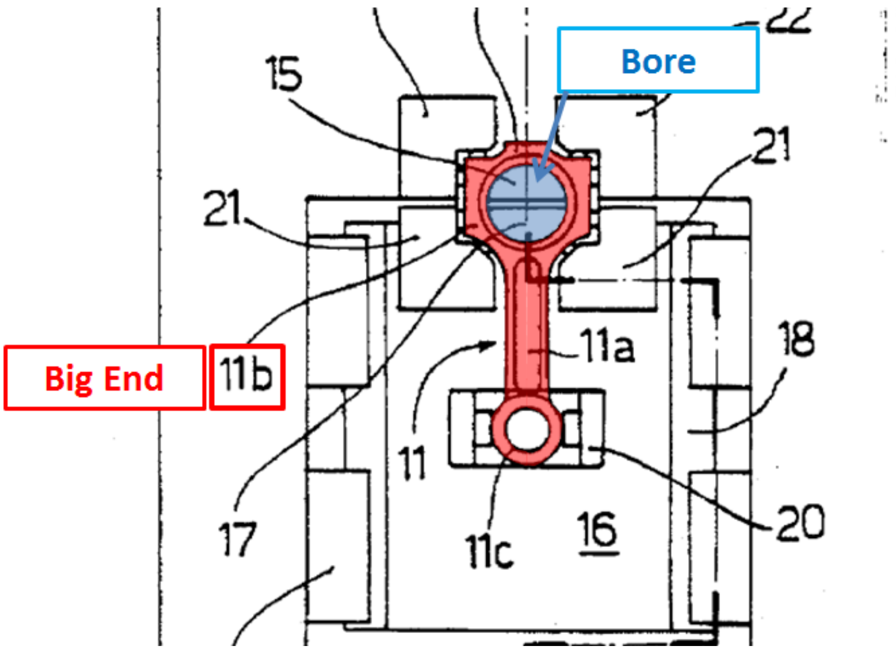
To a skilled artisan, each Challenged Claim would have been anticipated by or rendered obvious over Cavallo.

A. Claim 1, Preamble

The preamble to claim 1 recites a "process for the fracture separation of a part having a cylindrical bore passing therethrough into a first portion and a second portion, the cylindrical bore having a central axis, the part having two opposed sides proximate to the intersection of a predetermined fracture plane passing through the cylindrical bore and the part." One example of such a part in the '915 Patent is a connecting rod. *E.g.*, Ex. 1001, Abstract.

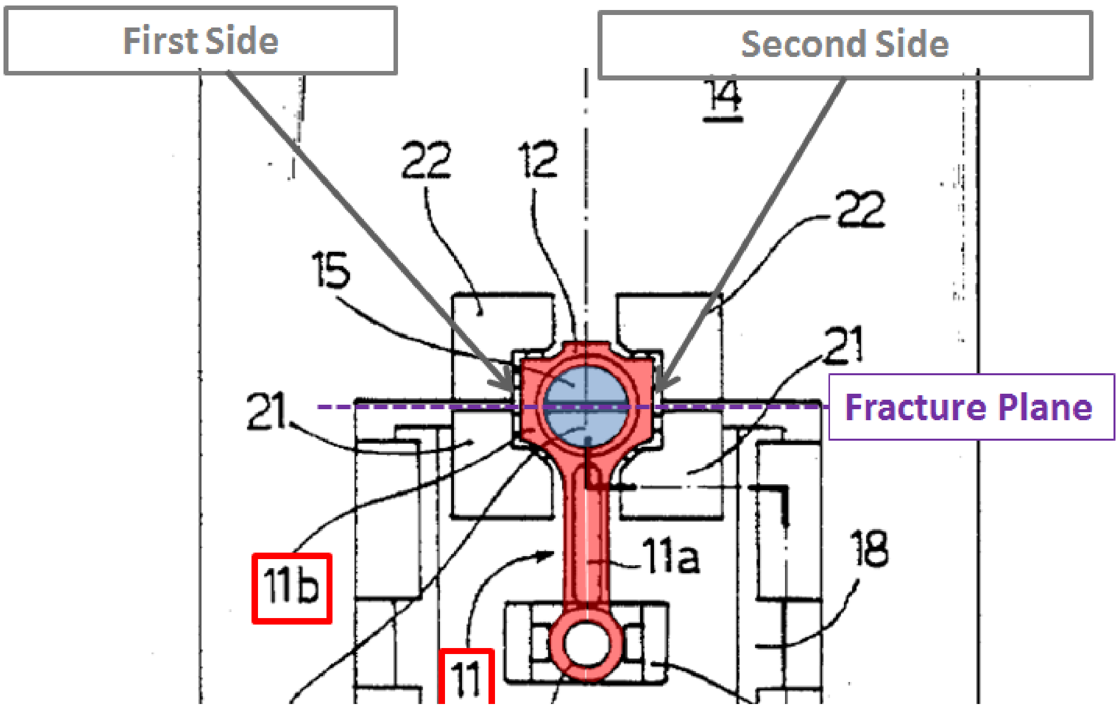
Cavallo discloses both a machine and a process for fracture separation of a connecting rod 11 into a first portion (cap 12) and a second portion (the rest of rod 11, including shank 11a, small end 11c, and big end 11b (from which the cap portion 12 must be broken off)). Ex. 1004, Title (Process and machine for parting the cap of connecting rods, particularly connecting rods for internal-combustion engines); 3:66-4:3 ("In the drawings, the reference numeral 10 generally designates the machine, and the reference numeral 11 designates the connecting rod of an internal-combustion engine which comprises a shank 11a, a big end 11b, from which the cap 12 must be broken off, and a small end 11c."). Ex. 1007, ¶177.

A **connecting rod**, as disclosed in Cavallo, has a **cylindrical bore** passing therethrough. Ex. 1004, Figures 1-3. Although the **cylindrical bore** is not numbered, the bore is within **big end 11b**, in which semicircular fixtures 15 and 17 are located. A cylindrical bore, including the one in Cavallo, inherently has a central axis. Ex. 1007, ¶178. In Figure 1 of Cavallo (excerpt below, annotated), the central axis is normal to the page at the center of the **bore** in the **big end 11b**.



Ex. 1007, ¶178.

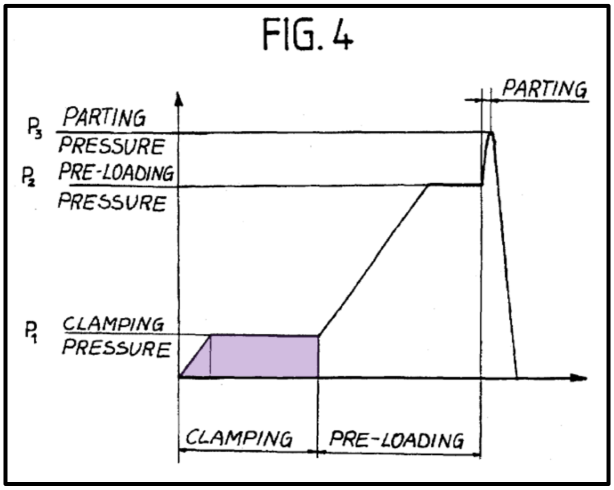
The **connecting rod 11** has two opposed sides (the lateral outer sides of the big end of the rod, as shown in the Figure below). These sides are proximate the intersection of a **predetermined fracture plane** (referred to as the parting plane, and predetermined by the location of diametrically opposite initiation grooves in the bore) that passes through the **cylindrical bore** and the **connecting rod** (**big end 11b**). Ex. 1004, 4:41-44 ("In a per se known manner, parting occurs along a parting plane that passes through diametrically opposite initiation grooves provided on the inner surface of the eye of the big end 11b and not shown in the figure.”); Figure 1 (below excerpt, annotated):

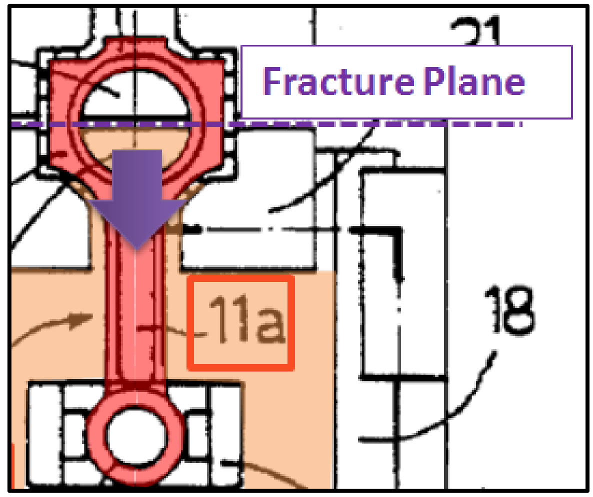


Ex. 1007, ¶179. Thus, Cavallo discloses or renders obvious these features. Ex. 1007, ¶¶176-177.

B. Claim 1, optional part (a), including option (a)(i)

The optional pre-stressing forces of Claim 1 are non-limiting. If that pre-stressing is required, Cavallo teaches these features. Cavallo’s hydraulic system uses a “**clamping pressure**” to exert a **longitudinal force** on a lower portion (11a) of the **connecting rod** relative to an upper (cap) portion 12. Ex. 1004, 3:29-33; 4:55-61. This **force**, which is perpendicular to a **predetermined fracture plane**, is applied via **fixture 17**. Ex. 1004, 4:41-61, Fig. 4 (below), Fig. 1 (below excerpt, annotated):





Ex. 1007, ¶182.

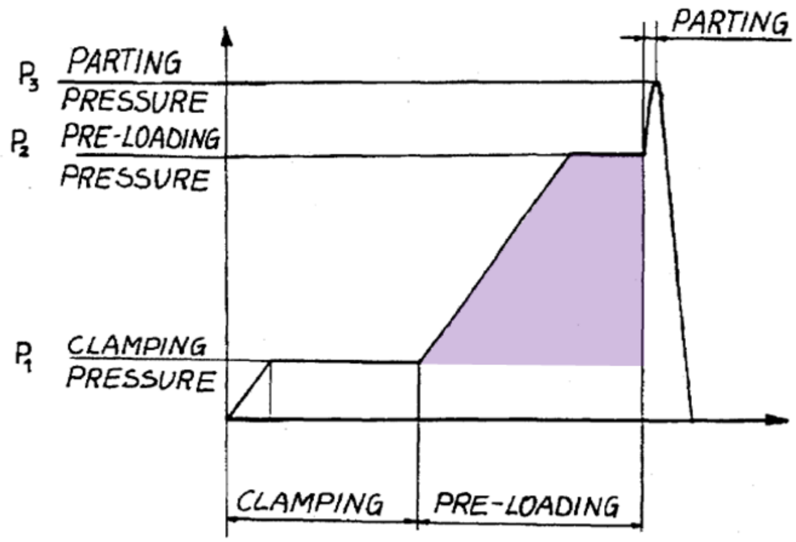
A skilled artisan would readily recognize that this teaches the longitudinal pre-stressing force in claim 1(a), option a(i). *Id.*, ¶¶180-184.

C. Claim 1, part (b), including option (b)(i)

Limitation (b) recites "applying at least one fatigue force to at least one of the first portion and the second portion, said at least one fatigue force being selected from the group comprising..." and then identifies two options, including a "longitudinal" force in (b)(i). In the connecting rod embodiment, the "first portion" is the cap portion, and the "second portion" is the rest of the rod/yoke. Ex. 1001, claim 9. Thus, this limitation (b) covers applying a longitudinal fatigue force to either the cap or the lower rod (yoke) portion, relative to the other.

Under a broad construction of "fatigue force," Cavallo discloses this feature. Cavallo discloses Pre-Loading Pressure P_2, which applies a force to the rod portion, relative to the cap portion. *E.g.*, Ex. 1004, Figure 4; 4:62-5:11. The magnitude of this force varies over time, from a lower magnitude (P_1) to a higher magnitude (P_2), thereby "fluctuating" in a broad sense,[7] as shown in Figure 4:

FIG. 4



Ex. 1007, ¶¶185-186. This pressure results in a corresponding **longitudinal force** applied to the **connecting rod** in a direction perpendicular to the **predetermined fracture plane.** Fig. 1 (partially reproduced and annotated):

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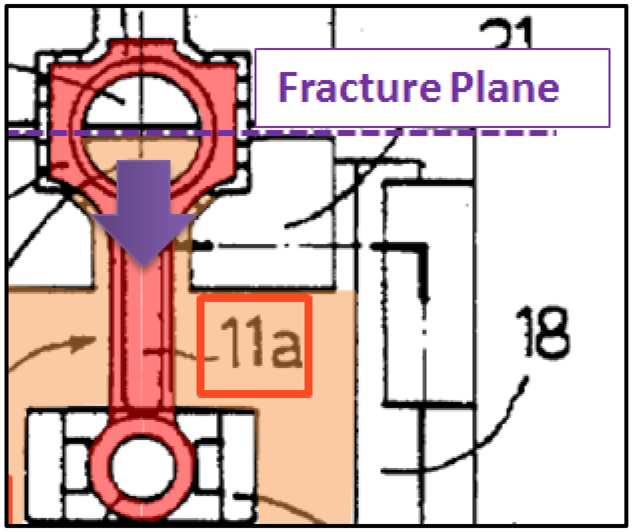
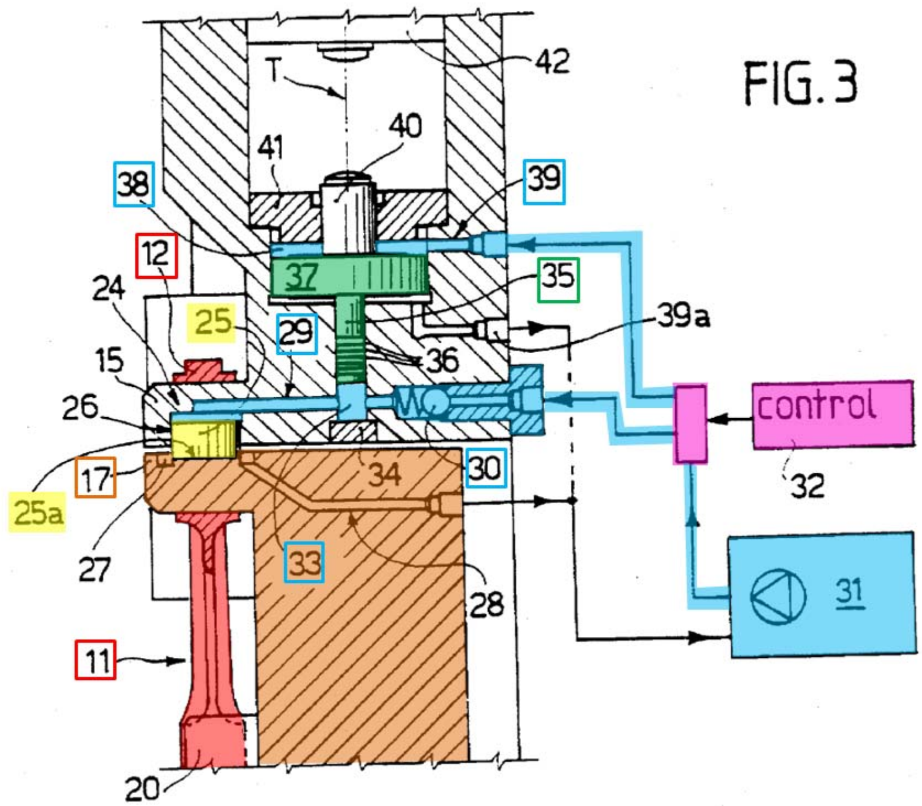
[7] FFT's litigation actions suggest that it may attempt to broadly construe "fluctuation of stresses" in a manner that covers forces like the "Pre-Loading" force in Cavallo. Accordingly, Petitioner demonstrates how the claims would be invalid under such a broad construction.



Ex. 1007, ¶187.

The increasing Pre-Loading Pressure P_2 is applied hydraulically, via a **source of fluid 31**, into **duct 39**, and then into **multiplier cylinder 38**, so that the **penetrating rod 35**, by virtue of the **thrust multiplier piston 37**, is pushed downward into **cavity 33**, increasing the hydraulic pressure applied (via **feed duct 29**) to the top side of expansion piston 25. Expansion piston 25 is driven downward, such that active pusher surface 25a pushes downward on **movable fixture 17**, which (as seen in Figure 1) is a semi-circular fixture placed in the lower half of the cylindrical bore of **connecting rod 11.** Ex. 1004, 4:62-5:11, Fig. 3; Ex. 1007, ¶187.



Option (b)(i) of claim 1 further requires the fatigue force to be "cyclic." Under a broad construction, Cavallo's Pre-Loading Force P_2 can be considered "a force that cycles."[8] A skilled artisan would recognize that this force is repeated with each connecting rod as one cycle (the pre-load cycle) in the overall fracturing

[8] FFT's litigation actions, including its somewhat circular definition of "cyclic force" as "forces that cycle," suggest that it may attempt to broadly construe "cycle" in a manner that covers forces like the "Pre-Loading" force in Cavallo. Accordingly, Petitioner demonstrates how the claims would be invalid under that broad construction.

process, during which the pressure increases from an initial pressure to a higher pressure and resets back to the initial pressure for the next fracturing operation. Ex. 1004, Fig. 4, 2:52-53 (noting how the invention is "capable of ensuring high efficiencies in terms of parts machined per unit time"); Ex. 1007, ¶188.

Thus, under a broad construction of the terms "fatigue" and "cyclic," Cavallo teaches the cyclic fatigue force of claim 1, option (b)(i). Ex. 1007, ¶¶189-190.

D. Claim 1, part (c)

The final part of claim 1 recites "applying at least one dynamic force to one of the first portion and the second portion relative to the other of the first portion and the second portion," and further requires the "dynamic force being applied in a direction substantially perpendicular to said predetermined fracture plane," in order to "fracture the part into the first portion and the second portion so as to separate the first portion from the second portion substantially along said predetermined plane."

In the '915 Patent, this dynamic force can be an "impulsive fracturing force" or a "slow rate dynamic force." In the specification, the dynamic force "$F_{4I/D}$" (either the impulse force or the slow rate dynamic force) is applied by moving the **upper jaw 2** away from **plane 1E**, thereby increasing the **force F_1**. Ex. 1001, 6:33-39; Fig. 1; Fig. 3.

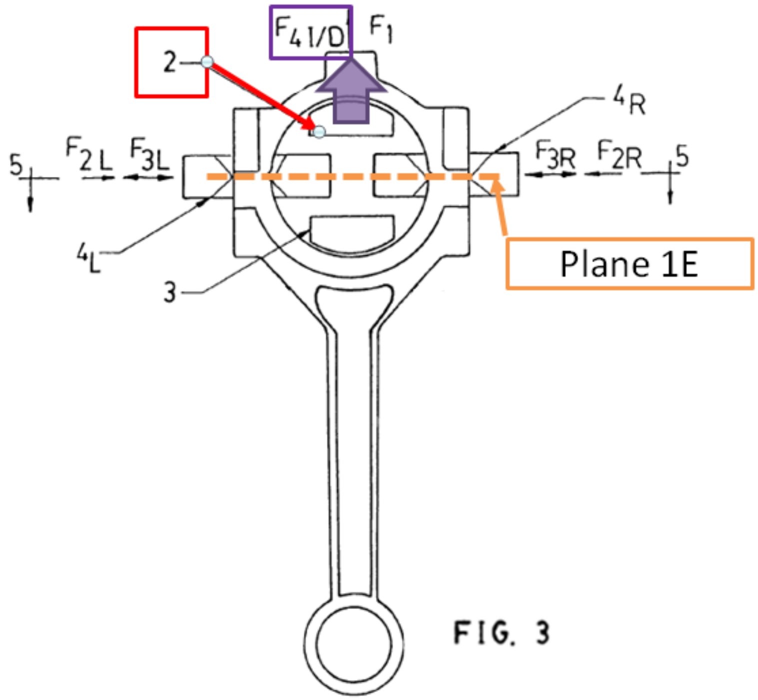
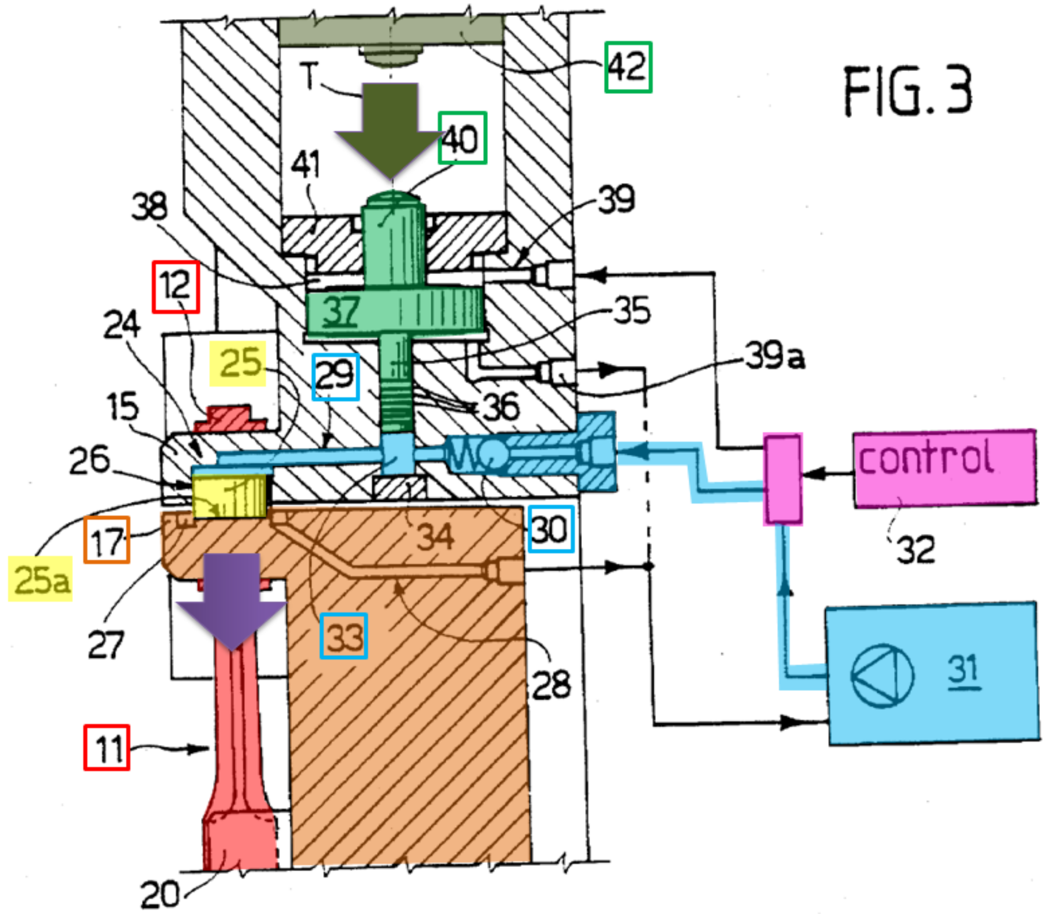


FIG. 3

Ex. 1007, ¶191.

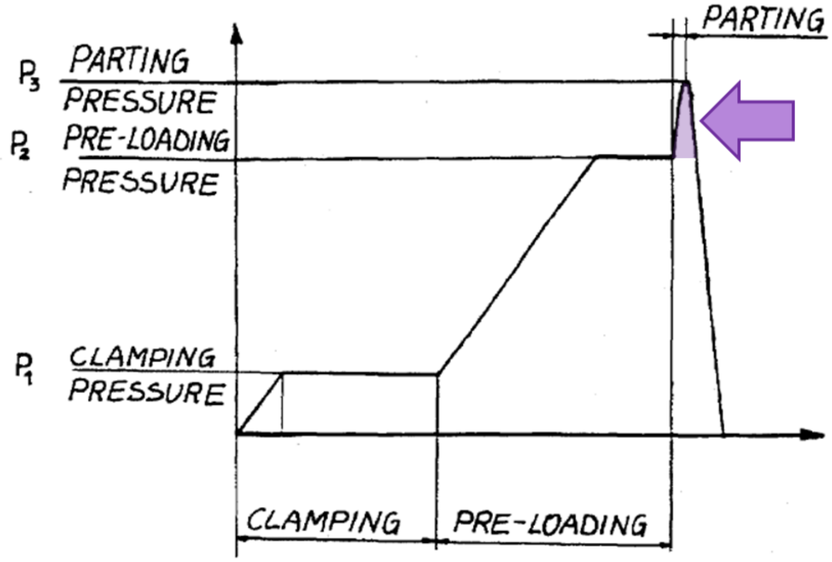
Cavallo teaches the claimed dynamic force in the form of an impulsive force. Specifically, Cavallo creates a mechanically generated impulsive force by impacting **striking mass 42** onto **second rod 40** of **multiplier piston 37**, thereby creating a "momentary pressure peak" in the **hydraulic system** that results in a **longitudinally applied fracturing force**. Ex. 1004, 3:36-44, 5:14-32, (describing the "momentary force" that "is capable of instantaneously parting the cap"), Fig. 3:



Ex. 1007, ¶192.

Cavallo further teaches adding that impulsive force to the hydraulic forces (*e.g.*, the pre-load forces). Ex. 1004, 3:35-43; 5:14-33. This reduces the magnitude of the dynamic force required to fracture the connecting rod. Ex. 1007, ¶193.

FIG. 4



Thus, Cavallo anticipates or renders obvious claim 1, especially with "cyclic fatigue" construed broadly. Ex. 1007, ¶¶191-193.

E. Claim 7

As discussed above, if longitudinal pre-stressing is required, Cavallo teaches this feature. *Supra*, Section VIII(B), incorporated by reference herein; Ex. 1007, ¶¶194-195.

F. Claim 9

Claim 9 depends from claim 1 and recites "wherein said part is a connecting rod, said first portion is a cap portion and said second portion is a rod portion." Cavallo teaches these features. *Supra*, Section VIII(A), incorporated by reference herein; Ex. 1007, ¶¶196-197.

G. Claim 10

As discussed above, the additional language of dependent claim 10 is exactly the same as the language of claim 1, option (b)(i). As discussed above with respect to claim 1, Cavallo teaches this feature, broadly construed. *Supra*, Section VIII(C), incorporated by reference herein; Ex. 1007, ¶¶198-199.

IX. GROUND 3: OBVIOUSNESS OVER BROVOLD IN VIEW OF CAVALLO

Each Challenged Claim would have been obvious to a skilled artisan over Brovold in view of Cavallo. As discussed above in Grounds 1 and 2, each of Brovold and Cavallo (with cyclic fatigue construed broadly in the case of Cavallo) anticipates or renders obvious each Challenged Claim. This Ground 3 demonstrates how the combination of Brovold, in view of Cavallo, confirms the obviousness of each Challenged Claim. Petitioner incorporates by reference Grounds 1 and 2, focusing below on obvious modifications a skilled artisan would have been motivated to make to Brovold in view of Cavallo.

A. Claim 1, optional part (a), including option (a)(i), and Claim 7

Brovold discloses, or at least renders obvious, the optional pre-stressing features of 1(a), option (a)(i), and claim 7. *Supra*, Sections VII(B), VII(E). Furthermore, as discussed above, all "pre-stressing" of claims 1 and 7 is "optional" and non-limiting. Nevertheless, if these features are deemed (i) limiting, and (ii) not disclosed or rendered obvious by Brovold, Cavallo discloses them (*supra*, Sections VIII(B), VIII(E)), and a skilled artisan would have found it obvious to modify Brovold to apply Cavallo's "clamping" pre-stressing force, particularly in view of the similarities between their hydraulic systems and force-applying mechanisms. Ex. 1007, ¶¶200-206, 214-216.

Such a modification would have involved routine engineering work for a skilled artisan, *e.g.*, to reprogram the servo-valve control unit in Brovold to apply Cavallo's "clamping" pre-stressing force. A skilled artisan would have been motivated to make that modification in order to, *e.g.*, remove slack or play in the connecting rod and to further secure the connecting rod in preparation for applying the subsequent forces. *Id.,* ¶205. Such a change would have been nothing more than the "predictable use of prior art elements according to their established functions." *KSR*, 550 U.S. at 417; Ex. 1007, ¶205.

B. Claim 1, part (c)

Part (c) of claim 1 recites applying a "dynamic force." As discussed above, "dynamic force" in the '915 Patent includes an impulsive force. *Supra*, Section V(D).

Brovold discloses, or at least renders obvious, the dynamic force limitations of part (c). Nevertheless, even if the Board concludes these features are not disclosed or rendered obvious by Brovold, Cavallo discloses them (*supra*, Section VIII(D)), and a skilled artisan would have found it obvious to modify Brovold to include the “impulsive” dynamic force disclosed in Cavallo.

As Cavallo teaches, hydraulic systems (such as Brovold) can sometimes be relatively slow (compared to a strong impact force, for example). Ex. 1004, 2:10-26. As Cavallo also teaches, adding an impulsive dynamic force overcomes this and other drawbacks of hydraulic fracturing. *Id.*, 2:33-39. Following those teachings, a skilled artisan would have found it obvious to add Cavallo’s impulsive force to Brovold, for example, by modifying Brovold’s piston 70 in view of Cavallo’s piston 37 and adding Cavallo’s striking mass. Ex. 1007, ¶¶209-212. This would have required nothing more than routine engineering work for a skilled artisan. *Id.,* ¶¶211-213.

A skilled artisan would have been motivated to make that change in order to, *e.g.*, decrease the amount of time needed to fracture a component or to improve on the hydraulic fracturing process, as explicitly taught by Cavallo. *Id.*, ¶¶212-213. As Brovold’s forces (just like Cavallo’s impulsive force) are applied to one portion of the connecting rod relative to another, and in a longitudinal direction perpendicular to the predetermined fracture plane, such a modification would result in the claimed “dynamic force.” *Id.*, ¶¶212-213.

Furthermore, a skilled artisan would have found it obvious to apply Cavallo’s impulsive force during application of Brovold’s fatigue force. As Cavallo demonstrates, the magnitude of the impulsive force can be smaller when added to the forces generated by the hydraulic forces. Ex. 1004, Fig. 4. Thus, whether the impulsive force is added at the peak of Brovold's fatigue force or whether the impulsive force is simply added during the application cycle of Brovold's fatigue force,[9] a skilled artisan would have found it obvious to apply Cavallo's impulsive force during application of Brovold's fatigue force. Ex. 1007, ¶¶212-213. This would have been nothing more than the "predictable use of prior art elements according to their established functions," *KSR*, 550 U.S. at 417, and would have resulted in an improved fracturing process, as suggested by Cavallo. Ex. 1007, ¶¶212-213.

X. GROUND 4: OBVIOUSNESS OVER CAVALLO IN VIEW OF BROVOLD

Each Challenged Claim would have been obvious to a skilled artisan over Cavallo in view of Brovold. As discussed above in Grounds 1 and 2, each of Cavallo and Brovold anticipates or renders obvious each limitation of each Challenged Claim (with cyclic fatigue construed broadly in the case of Cavallo). This Ground 4 demonstrates how the combination of Cavallo, in view of Brovold,

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[9] The '915 Patent teaches, at least for purposes of testing to identify the preferred timing (T_f), that the "instant" for applying its dynamic force can be "the time instant [T_0] at which the deformed shape of the connecting rod is the closest to its original shape." Ex. 1001, 4:40-42; 6:6-8. Ex. 1007, ¶213, n.15.

confirms the obviousness of each Challenged Claim. Petitioner incorporates by reference Grounds 1 and 2, focusing below on obvious modifications that a skilled artisan would have been motivated to make to Cavallo in view of Brovold.

A. Claim 1, part (b), including option (b)(i), and Claim 10

Broadly construed, Cavallo discloses, or at least renders obvious, the longitudinal, cyclic fatigue force requirements of 1(b), option (b)(i), and claim 10. *Supra*, Section VIII(C), VIII(G). Even if the Board concludes these features are not disclosed or rendered obvious by Cavallo (*e.g.*, due to a narrower construction of "cyclic fatigue force"), Brovold discloses these features if narrowly construed (*supra*, Section VII(B), VII(G)). A skilled artisan would have found it obvious to modify Cavallo to include the longitudinal, cyclic fatigue forces of Brovold, either in place of, or in addition to, Cavallo's longitudinal Pre-Load force. For example, Cavallo uses hydraulics to exert the "pre-loading" force on the rod, *e.g.*, Ex. 1004, 2:66-3:9, and Cavallo specifically identifies Brovold as an exemplary hydraulic process as a reference point for its "mixed hydraulic and mechanical procedure," *id.*, 2:13-22, 66-67. Thus, a skilled artisan would have readily considered incorporating Brovold's hydraulic, longitudinal, cyclic fatigue force as part of (or instead of) Cavallo's "pre-loading" step. Ex. 1007, ¶¶224-226. As Cavallo's forces (just like Brovold's) are all applied to one portion of the connecting rod relative to another, and in a longitudinal direction that is perpendicular to the predetermined fracture plane, such a modification would result in the claimed "cyclic fatigue force." *Id*., ¶226.

Furthermore, modifying Cavallo to use Brovold's cyclic fatigue would have involved nothing more than routine engineering work, for example, modifying the "control 32" in Cavallo to include the cyclical fatigue controls provided by the "servo-valve" and "controls" of Brovold. Ex. 1007, ¶227. A skilled artisan would have been motivated to make such a change in order to, *e.g*., fatigue the connecting rod and thereby reduce the magnitude of the force ultimately required to fracture separate the connecting rod. *E.g*., Ex. 1004, 2:3-6 (noting how the "intensity of the forces" involved in prior art mechanical parting procedures created "considerable and quick wear of the contact surfaces of the machine parts that are subjected to the parting force"). Specifically, a skilled artisan would have known that applying a cyclic fatigue force would lower the fracture strength of the connecting rod, thus requiring a lower-magnitude impulsive force to complete the fracture separation. Ex. 1007, ¶227. Thus, in view of these teachings, modifying Cavallo to include a cyclic fatigue force (even narrowly construed), as taught by Brovold, would have been nothing more than the "predictable use of prior art elements according to their established functions." *KSR*, 550 U.S. at 417; Ex. 1007, ¶¶227, 233.

XI. GROUND 5: OBVIOUSNESS OVER BROVOLD IN VIEW OF BAYLISS AND/OR BECKER

Each Challenged Claim would have been obvious to a skilled artisan over

Brovold in view of Bayliss and/or Becker. As discussed above in Ground 1, Brovold teaches or renders obvious each limitation of each Challenged Claim. This Ground 5 demonstrates how the combination of Brovold, in view of Bayliss and/or Becker, further confirms the obviousness of each Challenged Claim. Petitioner incorporates by reference Ground 1, focusing below on obvious modifications that a skilled artisan would have been motivated to make to Brovold in view of Bayliss and/or Becker.

A. Claim 1, optional part (a), including option (a)(i), and Claim 7

As discussed above, the "pre-stressing" of claims 1 and 7 is "optional" and non-limiting. If required, Brovold discloses, or at least renders obvious, the optional pre-stressing features. *Supra*, Sections VII(B), VII(E). However, if these features are deemed (i) limiting and (ii) not disclosed or rendered obvious by Brovold, Bayliss discloses these pre-stressing features. A skilled artisan would have found it obvious to modify Brovold to add Bayliss' longitudinal "pre-stress" force, in order to "accelerate the onset of fatigue fracture," as expressly taught by Bayliss (Ex. 1006, 1:20-28, 2:8-22), thereby reducing the duration of the manufacturing process and allowing for greater throughput and efficiency (and lower hourly labor cost per-part) in the manufacturing line. Ex. 1007, ¶¶235-239. As Brovold's forces are already applied to one portion of the connecting rod relative to another, and in a longitudinal direction that is perpendicular to the predetermined fracture plane, such a modification would result in the optional "pre-stressing" of claim 1, option (a)(i). *Id.*, ¶238. This modification would have involved routine engineering work for a skilled artisan to, *e.g.*, reprogram the servo-valve control unit in Brovold, and would have been nothing more than a "predictable use of prior art elements according to their established functions." *KSR*, 550 U.S. at 417; Ex. 1007, ¶¶238, 255-256.

B. Claim 1, part (b), including option (b)(i), and Claim 10

Even narrowly construed, Brovold discloses, or at least renders obvious, the cyclic fatigue force requirements of 1(b), option (b)(i), and claim 10. *Supra*, Sections VII(C), VII(G). However, if the Board concludes these features are not disclosed or rendered obvious by Brovold, Bayliss also teaches a cyclic fatigue force (even narrowly construed), for example, in the form of longitudinal, tensile "positive half-waves of [] alternating stress," perpendicular to the fracture plane, which is predetermined by a stress-riser notch. Ex. 1006, 1:15-26; 2:8-22; Ex. 1007, ¶¶240-241. A skilled artisan would have found it obvious to modify Brovold to use the cyclic fatigue forces of Bayliss, resulting in the features of 1(b), including option (b)(1). This modification would have involved routine engineering work for a skilled artisan to, *e.g.*, reprogram the servo-valve control unit in Brovold. Ex. 1007, ¶242. A skilled artisan would have been motivated to model Brovold's cyclic fatigue forces (which are longitudinal, tensile, and perpendicular to the predetermined fracture plane established by a notch) in view of Bayliss' cyclic fatigue forces (which are similarly longitudinal, tensile, and perpendicular to the predetermined fracture plane established by a notch) in order to, *e.g.*, ensure positive force on the connecting rod, thereby ensuring continuous contact with the connecting rod and thus preventing slack or play in the system. Ex. 1007, ¶243. Such a change would have been a "predictable use of prior art elements according to their established functions." *KSR*, 550 U.S. at 417; Ex. 1007, ¶¶243-244, 260-262.

C. Claim 1, part (c)

Brovold discloses, or at least renders obvious, the dynamic force limitations of part (c). S*upra*, Section VII(D). However, if the Board concludes otherwise, Becker discloses these dynamic force features, and a skilled artisan would have found it obvious to modify Brovold to include any of the "impulsive" dynamic forces disclosed in Becker. Ex. 1007, ¶¶245-246.

The term "dynamic force" includes an impulsive force and a "slow rate dynamic force." *Supra*, Section V(D). Becker teaches that a "fluid powered system" such as a hydraulic system, "with an appropriately designed accumulator, impact tool, valves, and connecting lines," can deliver an "impulsive force" to fracture a connecting rod. Ex. 1005, 3:24-27. Becker also teaches the use of a "spring-loaded mass" as well as a "pneumatic system" that accelerates a piston to create an "impulsive separating force" through "momentum transfer" with the accelerated piston. *Id.*, 3:27-60. Becker further teaches cracking a connecting rod using "a relatively slow acting force applied by a hydraulic cylinder." *Id.*, 4:6-21.

Like Brovold, Becker's forces are applied longitudinally to one portion of the rod relative to another, and in a longitudinal direction perpendicular to the fracture plane . Ex. 1005, Figs. 1A, 2-3, 11; 5:15-48, 6:19-31, 6:54-7:36. Ex. 1007, ¶¶247-248.

In view of these teachings, it would have been obvious for a skilled artisan to modify Brovold to include any one of Becker's dynamic forces. In particular, adding Becker's impulsive force from its "fluid powered system," for example, would have required nothing more than routine engineering work to include "an appropriately designed accumulator, impact tool, valves, and connecting lines," each of which was known to a skilled artisan. *Id.*, ¶249. Adding a different one of Becker's "impulsive" forces would likewise have required nothing more than routine engineering work to add familiar elements according to known methods. *Id.*, ¶250.

Alternatively, modifying Brovold to use Becker's "relatively slowly applied" dynamic force would have involved routine engineering work for a skilled artisan to, *e.g.*, reprogram the servo-valve control unit in Brovold. Ex. 1007, ¶250.

A skilled artisan would have been motivated to make any of those changes in order to, *e.g.*, decrease the number of fatigue force cycles and/or to decrease the amount of time needed to fracture a component, thereby reducing the resources needed for each fracture separation operation and creating a more efficient overall process. Ex. 1007, ¶251. Each of Becker's dynamic forces could be applied, *e.g.*, during application of Brovold's fatigue forces and as part of Brovold's "precise control for breaking the parts." Ex. 1003, 2:20-24, 6:19-24; Ex. 1007, ¶251.

Furthermore, a skilled artisan would have found it obvious to apply any of Becker's dynamic forces in conjunction with the application of the cyclic fatigue force of Brovold, and/or the cyclic fatigue force taught by the combination of Brovold in view of Bayliss. *Id.*, ¶252. As a skilled artisan would have known, applying the dynamic force in this way can reduce the number of fatigue cycles and decrease the time needed to fracture the rod. *E.g.*, Ex. 1003, 2:19-21; Ex. 1007, ¶252.

Thus, regardless of whether the dynamic force is (i) an impulsive force added at the peak of a cyclic fatigue force, (ii) an impulsive force simply added at some moment somewhere in the fatigue force cycle, (iii) a "relatively slow" dynamic force spanning one or more segments of a fatigue cycle, or (iv) a dynamic force applied at the end of the fatigue cycle, a skilled artisan would have found it obvious to apply Becker's dynamic force in conjunction with the cyclic fatigue forces taught by Brovold (either alone or in view of Bayliss). Ex. 1007, ¶253.

This would have been nothing more than the "predictable use of prior art elements according to their established functions." *KSR,* 550 U.S. at 417; Ex. 1007, ¶253.

Brovold's forces are applied to one portion of the connecting rod relative to another, and in a longitudinal direction perpendicular to the predetermined fracture plane established by a stress-riser notch. Bayliss also teaches longitudinal cyclic fatigue perpendicular to its predetermined fracture plane, as determined by its notch. Similarly, Becker's dynamic forces are disclosed in the form of longitudinal forces perpendicular to the fracture plane. Accordingly, modifying Brovold (or the combination of Brovold and Bayliss), with Becker's dynamic force, would result in the claimed "dynamic force" of part (c) of claim 1. *Id*., ¶254.

XII. GROUND 6: OBVIOUSNESS OVER BROVOLD IN VIEW OF CAVALLO, IN FURTHER VIEW OF BAYLISS AND/OR BECKER

Each Challenged Claim would have been obvious over Brovold in view of Cavallo, in further view of Bayliss and/or Becker. Ex. 1007, ¶263-269. Petitioner incorporates by reference Grounds 1-5, focusing below on obvious modifications that a skilled artisan would have been further motivated to make to the combination of Brovold and Cavallo (Ground 3), in view of Bayliss and/or Becker.

A. Claim 1, optional part (a), including option (a)(i), and Claim 7

All "pre-stressing" of claims 1 and 7 is "optional" and non-limiting. Nevertheless, Brovold (Ground 1), Cavallo (Ground 2), and the combination of Brovold and Cavallo (Ground 3) discloses, or at least renders obvious, the pre-stressing of 1(b), option (b)(i), as well as dependent claim 7. S*upra*, Sections VII-IX; Ex. 1007, ¶¶263-270. However, if these features are deemed (i) limiting, and (ii) not disclosed or rendered obvious by the combination of Brovold and Cavallo, a skilled artisan would have found it obvious to further modify that combination to add the "pre-stressing" forces disclosed in Bayliss, as discussed in Ground 5 (Brovold + Bayliss), incorporated by reference herein. *Supra,* Section XI; Ex. 1007, ¶¶271-274, 288-289.

B. Claim 1, part (b), including option (b)(i), and Claim 10

Even narrowly construed, Brovold (Ground 1) and the combination of Brovold and Cavallo (Ground 3) disclose, or at least render obvious, the cyclic fatigue force requirements of 1(b), option (b)(i) and claim 10. *Supra*, Sections VII, IX. However, if the Board concludes these features are not disclosed or rendered obvious by Brovold or the combination of Brovold and Cavallo, a skilled artisan would have found it obvious to modify that combination to use the longitudinal, cyclic fatigue force in Bayliss, as discussed in Ground 5 (Brovold + Bayliss) *Supra,* Section XI; Ex. 1007, ¶¶275-279, 293-294.

C. Claim 1, part (c)

Brovold (Ground 1) discloses, or at least renders obvious, the dynamic force limitations of part (c), as does the combination of Brovold and Cavallo (Ground 3). S*upra*, Sections VII, IX. However, if the Board concludes these features are not disclosed or rendered obvious by the combination of Brovold and Cavallo, a skilled artisan would have found it obvious to use the "dynamic" force in Becker, as discussed in Ground 5 (Brovold + Becker). *Supra*, Section XI; Ex. 1007, ¶¶280-287.

D. Combinations Explained

A skilled artisan would have recognized how each of these variations could be implemented with a reasonable expectation of improving the fracturing process. Each of these teachings, including those from Brovold itself, present "familiar items" to a skilled artisan, who would readily understand how they can be used "together like pieces of a puzzle." *KSR*, 550 U.S. at 420; *see also id*. at 417 ("[I]f a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill."). Thus, using the "pre-stressing" force in Cavallo, for example, would be completely compatible with the fatigue force in Bayliss and any of Becker's impulsive dynamic forces, as applied to Brovold. Ex. 1007, ¶¶268-269. Likewise, using the dynamic force in Cavallo would be completely compatible with the pre-stressing force and fatigue force in Bayliss, as applied to Brovold. *Id*. Under any of these variations, each of claims 1, 7, 9, and 10 would have been obvious. *Id*.

XIII. GROUND 7: OBVIOUSNESS OVER CAVALLO IN VIEW OF BAYLISS

Each Challenged Claim would have been obvious to a skilled artisan over Cavallo in view of Bayliss. Petitioner incorporates by reference Grounds 2, 4, and 6, focusing below on obvious modifications that a skilled artisan would have been motivated to make to Cavallo in view of Bayliss.

A. Claim 1, optional part (a), including option (a)(i), and Claim 7

As discussed above, all "pre-stressing" of claims 1 and 7 is "optional" and non-limiting. Nevertheless, Cavallo (Ground 2) discloses the recited optional pre-stressing of these claims. *Supra*, Section VIII.

Furthermore, a skilled artisan would have found it obvious to modify Cavallo to add an application of Bayliss' longitudinal "pre-stress" force, in order to "accelerate the onset of fatigue fracture," as expressly taught by Bayliss (Ex. 1006, 1:20-28, 2:8-22), thereby reducing the duration of the manufacturing process and allowing for greater throughput, efficiency, and lower hourly labor cost per-part in the manufacturing line. Ex. 1007, ¶¶297-298, 308-309. As Cavallo's forces are applied to one portion of the connecting rod relative to another, and in a longitudinal direction that is perpendicular to the predetermined fracture plane, such a modification would result in the optional "pre-stressing" of claim 1, option (a)(i) and claim 7. *Id.* This modification would have involved routine engineering work for a skilled artisan to, *e.g.*, program the control unit in Cavallo. *Id.* Such a change would have been nothing more than a "predictable use of prior art elements according to their established functions." *KSR*, 550 U.S. at 417; Ex. 1007, ¶¶298, 309.

B. Claim 1, part (b), including option (b)(i), and Claim 10

If a "cyclic" "fatigue force" is construed narrowly, such that Cavallo is deemed to not disclose the cyclic fatigue force recited in claim 1, part (b), option (b)(1), and claim 10, the claims would nevertheless have been obvious over Cavallo in view of Bayliss.

A skilled artisan would have found it obvious to modify Cavallo to apply the longitudinal cyclic fatigue force of Bayliss. Modifying Cavallo to use Bayliss' cyclic fatigue force would have involved nothing more than routine engineering work, for example, modifying the "control 32" in Cavallo and adding a servo-valve to produce those cyclical fatigue forces. Ex. 1007, ¶¶300-306, 312-314. A skilled artisan would have been motivated to make such a change in order to, *e.g.*, fatigue the connecting rod and thereby reduce the magnitude of the forces required to fracture the connecting rod. *E.g.*, *id.*; Ex. 1004, 2:3-6 (noting how the "intensity of the forces" involved in prior art mechanical parting procedures created "considerable and quick wear of the contact surfaces of the machine parts that are subjected to the parting force"). Thus, in view of these teachings, modifying Cavallo to include a longitudinal, cyclic fatigue force, as taught by Bayliss, would have been nothing more than "the predictable use of prior art elements according to their established functions." *KSR*, 550 U.S. at 417; Ex. 1007, ¶305.

XIV. GROUND 8: OBVIOUSNESS OVER CAVALLO IN VIEW OF BROVOLD, IN FURTHER VIEW OF BAYLISS

Each Challenged Claim would have been obvious to a skilled artisan over Cavallo in view of Brovold, further in view of Bayliss. Petitioner incorporates by reference Grounds 1-7, focusing below on obvious modifications to the combination of Cavallo and Brovold (Ground 4) that a skilled artisan would have been further motivated to make, in view of Bayliss.

A. Claim 1, optional part (a), including option (a)(i), and Claim 7

If required, Cavallo discloses or at least renders obvious optional pre-stressing features covered by claim 1 and claim 7 (Ground 2), as does Brovold (Ground 1), the combination of Cavallo in view of Brovold (Ground 4), and the combination of Cavallo in view of Bayliss (Ground 7). *Supra*, Sections VII-VIII, X, XIII. Additionally, a skilled artisan would have found it obvious to further modify the combination of Cavallo and Brovold (Ground 4) to add the "pre-stressing" forces disclosed in Bayliss, for the same reasons set forth in Ground 7 (Cavallo + Bayliss) and/or Ground 6 (Brovold + Cavallo + Bayliss).

B. Claim 1, part (b), including option (b)(i), and Claim 10

Broadly construed, Cavallo discloses, or at least renders obvious, cyclic fatigue forces covered by claim 1, part (b) and claim 10, as does Brovold (Ground

1), the combination of Cavallo and Brovold (Ground 4), and the combination of Cavallo and Bayliss (Ground 7). *Supra*, Sections VII-VIII, X, XIII. However, if the Board concludes otherwise (*e.g.*, in light of a narrower construction of "cyclic fatigue force"), Bayliss discloses these features, even narrowly construed, and it would have been obvious to further modify the combination of Cavallo and Brovold to include the longitudinal cyclic fatigue features of Bayliss.

Ground 4 discusses modifying Cavallo to add Brovold's cyclic fatigue force. Ground 7 discusses modifying Cavallo to add Bayliss' cyclic fatigue force. Ground 5 discusses combining Bayliss with Brovold. For the reasons discussed therein, a skilled artisan would have found it obvious to modify Cavallo to use the longitudinal, cyclic "fatigue" force in accordance with the teachings of Brovold and/or Bayliss.

C. Combinations Explained

A skilled artisan would have recognized how each of these variations could be implemented with a reasonable expectation of improving the fracturing process. Ex. 1007, ¶¶315-346. Each of these teachings, including those from Cavallo itself, presents "familiar items" to a skilled artisan, who would readily understand how they can readily be used "together like pieces of a puzzle." *KSR*, 550 U.S. at 420; *see also id*. at 417 ("[I]f a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill."). Thus, using the "pre-stressing" and "dynamic" forces in Cavallo, for example, would be completely compatible with the fatigue force in Bayliss or Brovold, as applied to Cavallo. Ex. 1007, ¶¶269, 321-322. Under any of these variations, each Challenged Claim would have been obvious. *Id.,* ¶322.

XV. CONCLUSION

For the foregoing reasons, Petitioners respectfully request *inter partes* review of claims 1, 7, 9 and 10 of U.S. Patent No. 7,143,915.

FAEGRE BAKER DANIELS LLP

Dated: March 26, 2018

By: /Richard Marsh, Jr./
Richard Marsh, Jr.
Reg. No. 59,031

XVI. MANDATORY NOTICES PURSUANT TO 37 C.F.R. § 42.8(a)(1)

A. Real Party in Interest

Navistar, Inc. is the real party-in-interest for this petition.

B. Related Matters

FFT asserts the '915 Patent (and related U.S. Patent No. 7,497,361) against Petitioner in the United States District Court for the Northern District of Illinois, Eastern Division, Case No. 15-cv-5667, which may affect or be affected by this proceeding.

C. Lead and Back-Up Counsel and Service Information

Petitioner designates counsel listed below and consents to electronic service. A power of attorney for counsel is filed with this Petition.

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CERTIFICATION UNDER 37 CFR § 42.24(d)

Under the provisions of 37 CFR § 42.24(d), the undersigned hereby certifies that the word count for the foregoing Petition for *Inter Partes* Review totals 13,979 (including words added as annotations to the figures), which is less than the 14,000 allowed under 37 CFR § 42.24(a)(i).

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CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. § 42.105, I hereby certify that I caused a true and correct copy of the Petition for *Inter Partes* Review in connection with U.S. Patent No. 7,143,915 and supporting evidence to be served via FedEx Priority Overnight on March 26, 2018, on the following:

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I hereby further certify that I also caused a true and correct copy of the same Petition for *Inter Partes* Review to be served via electronic mail on the following individuals currently serving as counsel for the Patent Owner:

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