

UNITED STATES PATENT AND TRADEMARK OFFICE
PATENT TRIAL AND APPEAL BOARD

KLX ENERGY SERVICES LLC

Petitioner

v.

SAFOCO, INC.

Patent Owner

CASE IPR2024-00198

Petition for IPR of US Patent No. 9,890,609 B2

DECLARATION OF DR. ROBERT DURHAM

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I. INTRODUCTION

1. My name is Dr. Robert A. Durham. I make this declaration based upon my own personal knowledge and, if called upon to testify, would testify competently to the matters contained herein.

2. I have been asked to provide technical assistance in responding to the Petition for an Inter Partes Review of US Patent No. 9,890,609, which I may abbreviate as “the ’609 Patent”. I may also refer to this Patent as the “Challenged Patent.” This declaration is a statement of my opinions on issues related to the patentability of specific claims of the ’609 Patent. I am being compensated at my standard hourly rate for my analysis, plus reimbursement for expenses. My compensation does not depend on the content of my opinions or the outcome of this proceeding.

II. EXPERIENCE AND QUALIFICATIONS

3. In formulating my opinions, I have relied upon my knowledge, training, and experience in the relevant art. My qualifications are stated more fully in my curriculum vitae, which has been provided in Appendix A. My CV also lists publications on which I am a named author and identifies parties on behalf of whom I have previously offered expert testimony within the past four years. Here, I provide a summary of my qualifications.

4. I am a consulting engineer with experience in several technical areas. I have expertise in the electrification of the oil and gas industry from drilling and completion to downstream. I have worked with oil field production companies, refining and

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chemical plants, equipment manufacturers, and technology development companies for nearly twenty years as a consultant. My work relates to the subject matter of the Challenged Patents, which I describe below in Section VII (“Overview of the Challenged Patents”).

5. I received my Bachelor of Science in Electrical Engineering and Master of Engineering and Technology Management degrees from the University of Tulsa in 1992 and 1997, respectively. After years of professional work and research, I received my Ph.D. in Engineering Management from Kennedy Western University in 2004.

6. I have also served in leadership positions in the Petroleum and Chemical Industry Committee (PCIC) of the Institute of Electrical and Electronics Engineers (IEEE) for nearly twenty years. IEEE is the world’s largest technical professional association. The PCIC is the premier forum for exchanging electrical applications technology related to the petroleum and chemical industry. From 2005 to 2012, I served as Secretary, Vice Chair, and ultimately Chair of the Production Subcommittee of the PCIC. The Production Subcommittee is the primary method for PCIC members to communicate technical papers related to drilling, wellhead, and facilities operations of oil and gas wells. In 2013, I was appointed vice Chair of the Standards Subcommittee of the PCIC, a role which I transitioned to Chair in 2014. I served as Chair until 2022. The Standards Subcommittee of the PCIC is the Sponsor of IEEE standards relating to electrification and electrical equipment operations in the Oil and Gas Industry. The

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PCIC Standards Subcommittee sponsors nearly 50 electrical and oil and gas related standards. In September 2022, I was elected as an Executive Officer of the PCIC. I will serve as an Executive Officer for eight years, serving two-year terms in each of the following positions: Secretary, Vice Chair, Chair, and Chair of Advisory and Awards.

7. My peers have recognized my contributions, particularly in the area of electrical equipment in the oil and gas industry. Because of this recognition, in 2019 I was elevated to the grade of Fellow of the IEEE for “contributions to submersible electrical equipment analysis and multi-point ground methods in hazardous petroleum and chemical environments.” The IEEE Fellow grade is limited to the top 0.1% of the membership of IEEE worldwide.

8. I have worked directly in the electrification of oil and gas fields both as an employee and as a consulting engineer. From 2000 until the end of 2002, I was employed as Manager of Electric Infrastructure for New Dominion, LLC (NDL). In that capacity, I administratively owned and was responsible for all electrical equipment, including overhead power lines, transformers, switchgear, drives, and motors throughout NDL’s production, exploration, and drilling areas.

9. After a brief stint as Vice President for EDG Power Group, responsible for Engineering and Project Management of generation and co-generation facilities across the U.S., I transitioned to the role of consulting engineer. In that role, I have served as in designing, constructing, and analyzing of all kinds of power and fluid systems,

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especially those in the oil and gas industry. This has included not only the design and selection of equipment but also the analysis of equipment failures in the oil and gas field from drilling/completion sites to production facilities, midstream, and downstream (refinery) locations.

10. I am also a principal of PEDOCS, Inc., an oil and gas production company operating nearly 50 oil and gas production wells in Oklahoma. As such, I am familiar with the operations of oil and gas wells, including well stimulation, completion, hydraulic fracturing, and production.

11. I have been familiar with oil and gas drilling, fracturing (fracking) and completion operations for nearly twenty years. In addition to being responsible for interfacing with drilling and fracturing operations with regard to electrical needs as an employee of New Dominion, LLC, I have been further educated about drilling, fracturing, and operations as I have consulted and investigated incidents on multiple well drilling, fracturing, and completion pad sites over my engineering consulting engagements.

12. I have been familiar with power distribution, including generation, transmission, and distribution equipment. I worked as a design and construction engineer for generation facilities for Central and Southwest (now American Electric Power (AEP)). I was also responsible for the design and construction of generation facilities when employed by EDG Power Group, as discussed above. While at AEP, I

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spent three years as a transmission planner, modeling transmission systems and developing plans for increased power distribution capacities at high voltages. While at New Dominion LLC, I owned and was responsible for the design, construction, and maintenance of several hundred miles of medium voltage (5 – 25 kV) distribution lines, switchgear, drives, and motors used for oil and gas drilling, completion, and production. Over the last ~ 20 years, I have consulted with numerous clients ranging from utilities to oil and gas development and production companies on the design, upgrades, and maintenance of generation and power distribution facilities.

13. I have been familiar with the Occupational Safety and Health Administration (“OSHA”) and its responsibilities at oil and gas locations. I have consulted and investigated incidents on multiple oil and gas sites where OSHA has also performed investigations with regard to injuries and fatalities that have occurred at oil and gas locations, including drilling, fracturing and completion operations. As Principal Scientist of THEWAY Labs, my responsibilities include overseeing the Health Safety and Environmental (HSE) program at THEWAY Labs and establishing policies and procedures commensurate with OSHA requirements at all locations, including the requirements for oil and gas sites.

14. I have been familiar with valves, control systems for valves, and relief valve systems for my entire practice. I have designed and supervised the installation of such systems, including relief valves, control valves, and control systems for valves in

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applications including water handling, steam handling, liquid oil handling, and natural gas handling and other fluids. I have studied the operation of valves and relief valve systems as part of these control systems for over 30 years.

15. I am the author or co-author of over fifty published papers and five books. A list of publications that I have authored over the last thirty years is included in my professional CV, which is attached as Appendix A.

16. Therefore, based on my education, professional experience of over 30 years, and scholarly books and publications, I am an expert in the relevant field of the Challenged Patent at issue here and have been an expert in this field since before the Challenged Patent was filed with the United States Patent and Trademark Office (“USPTO”). I am familiar with how a person having ordinary skill in the art would have understood and used the terminology found in the ’609 Patent at the time of its filing.

III. TASK SUMMARY AND MATERIALS REVIEWED

17. I have been asked to review the Challenged Patent and its prosecution history, to provide an understanding of the technology relevant to the Challenged Patent, to review specific prior-art references claimed by Petitioner as anticipating or rendering obvious various claims of the Challenged Patent, and to analyze whether or not those references disclose or teach limitations of claims from the Challenged Patent. The opinions stated in this declaration are from the perspective of a person of ordinary

skill in the art (POSITA) at the time of the filing of the applications that led to the Challenged Patents.

IV. LIST OF EXHIBITS

18. In forming my opinions, I have reviewed the Challenged Patent, its prosecution history and references cited by the Examiner, the materials cited in the List of Exhibits, and the materials cited throughout my declaration.

Exhibit	Name
1001	Complaint, <i>Safoco, Inc. v. KLX Energy Services, LLC.</i> , No. 2:22-cv-00437-JRG-RSP (E.D. Tex.)
1002	Affidavit of Process Server, <i>Safoco, Inc. v. KLX Energy Services, LLC.</i> , No. 2:22-cv-00437-JRG-RSP (E.D. Tex.)
1003	U.S. Patent No. 3,198,207
1004	U.S. Patent No. 1,151,661
1005	Russell W. Henke, Introduction to Fluid Power Circuits and Systems by R. Henke. Addison. (1970) (“Intro to Fluid Power Circuits and Systems”)
1006	U.S. Patent No. 4,920,811
1007	U.S. Patent No. 9,890,609 (“’609 Patent”)
1008	U.S. Patent No. 9,890,609 Continuity Data
1009	U.S. Patent Application No. 13/480,704 Continuity Data
1010	May 18, 2017, Non-Final Office Action
1011	U.S. Patent No. 9,890,609 Patent Prosecution History
1012	March 24, 2015, Final Office Action (‘453 Patent)
1013	June 18, 2015, Office Action Response

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1014	Office Action Response Claim Amendments
1015	Parallel Proceeding Docket Control Order
1016	U.S. Patent Publication No. 2008/0078586 (“ <i>Tettleton</i> ”)
1017	Definition of the term “Valve”
1018	Definition of the term “Assembly.”
1019	U.S. Patent No. 5,335,730 (“ <i>Cotham</i> ”)
1020	Definition of the term “External.”

V. GROUND OF CHALLENGE

19. I have been informed that the Petitioner in the Inter Partes Review, KLX Energy Services, LLC (“Petitioner”) has claimed that certain claims are disclosed or rendered obvious over certain prior art. The following table lists the challenged claims, and the grounds Petitioner has argued invalidate the claims. Independent claims are identified in bold font.

Ground	Claims	Basis
1	1 , 4, 5, 8 & 10	Anticipated by U.S. Patent Publication No. 2008/0078586 (“ <i>Tettleton</i> ”)
2	2, 3, 6, 7, 11 , 12, 13, 14, 15 & 16	Obvious over <i>Tettleton</i> in view of U.S. Patent No. 5,335,730 (“ <i>Cotham</i> ”)
3	9	Obvious over <i>Tettleton</i> in view of U.S. Patent No. 5,597,042 (“ <i>Tubel</i> ”)

4	17 and 18	Obvious over <i>Tettleton</i> in view of <i>Cotham</i> and <i>Tubel</i>
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VI. LEGAL STANDARDS

A. LEVEL OF ORDINARY SKILL IN THE ART

20. When interpreting a patent, I understand that it is important to identify the relevant art pertaining to the patent-in-suit as well as the level of ordinary skill in that art at the time of the claimed invention. The “art” is the field of technology to which the patent is related.

21. I have been instructed by counsel that the person of ordinary skill in the art is a hypothetical person who is presumed to know the relevant prior art. I understand that the actual inventor’s skill is not determinative of the level of ordinary skill. I further understand that the factors that may be considered in determining the level of skill include: the types of problems encountered in the art; prior art solutions to those problems; rapidity with which innovations are made; sophistication of the technology; and educational level of active workers in the field. I understand that not all such factors may be present in every case, and one or more of them may predominate.

B. LEGAL STANDARD FOR CLAIM CONSTRUCTION

22. I understand that the first step in determining whether a patent claim would have been anticipated or obvious is to ascertain how a POSITA would have understood the claim terms.

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23. I have been instructed by counsel on the law regarding claim construction and patent claims, and I understand that a patent may include two types of claims: independent claims and dependent claims. An independent claim stands alone and includes only the limitations it recites. A dependent claim can depend from an independent claim, or it can further depend from another dependent claim. I understand that a dependent claim includes all the limitations that it recites, in addition to all the limitations recited in the claim(s) from which it depends.

24. It is my understanding that in proceedings before the USPTO, the claims of a patent are to be construed under what is referred to as the “Phillips standard.” I understand that this means that claim terms of a patent are given the meaning the terms would have to a POSITA, in view of the description provided in the patent itself and the patent’s file history.

25. I understand that to determine how a person of ordinary skill would understand a claim term, one should look to those sources available that show what a person of skill in the art would have understood the disputed claim language to mean. In construing a claim term, I understand that one looks primarily to the intrinsic patent evidence, including the words of the claims themselves, the remainder of the patent, and the patent’s prosecution history. I understand that extrinsic evidence, which is evidence external to the patent and the prosecution history, may also be useful in interpreting patent claims when the intrinsic evidence itself is insufficient.

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26. I understand that words or terms should be given their ordinary and accepted meaning unless it appears that the inventors were using them to mean something else. In making this determination, the claims, the remainder of the patent, and the prosecution history are of paramount importance. Additionally, the patent and its prosecution history must be consulted to confirm whether the patentee has acted as its own lexicographer (i.e., provided its own special meaning to any disputed terms), or intentionally disclaimed, disavowed, or surrendered any claim scope.

27. In comparing the claims of the Challenged Patent to the prior art, I have considered the Challenged Patent and its file history in light of the understanding of a person of skill at the time of the alleged invention.

C. ANTICIPATION

28. It is my understanding that a prior art reference anticipates the claims of a patent if each and every element of the claim is found either explicitly or inherently in a single prior art reference or system. I understand that inherency requires a showing that the missing descriptive matter in the claim is necessarily or implicitly present in the allegedly anticipating reference and that it would have been so recognized by a POSITA. In addition, I understand that an enabling disclosure is a disclosure that allows a POSITA to make the invention without undue experimentation. Although anticipation typically involves the analysis of a single prior art reference, I understand that additional references may be used to show that the primary reference has enabling

disclosure, to explain the meaning of a term used in the primary reference, and/or to show that a characteristic is inherent in the primary reference.

D. OBVIOUSNESS

29. I understand that the prior art may render a patent claim “obvious.” I understand that two or more prior art references (e.g., prior art articles, patents, or publications) that each discloses fewer than all elements of a patent claim may nevertheless be combined to render a patent claim obvious if the combination of the prior art collectively discloses all elements of the claim and one of ordinary skill in the art at the time would have been motivated to combine the prior art in such a way. I understand that this motivation to combine need not be explicit in any of the prior art but may be inferred from the knowledge of one of ordinary skill in the art at the time the patent was filed. I also understand that one of ordinary skill in the art is not an automaton but is a person having ordinary creativity. I further understand that one or more prior art references, articles, patents or publications that disclose fewer than all the elements of a patent claim may render a patent claim obvious if including the missing element would have been obvious to one of skill in the art (e.g., the missing element represents only an insubstantial difference over the prior art or a reconfiguration of a known system).

30. I understand that under the doctrine of obviousness, a claim may be invalid if the differences between the invention and the prior art are such that the subject matter

as a whole would have been obvious at the time the invention was made to a POSITA to which the subject matter pertains.

31. To assess obviousness, I understand that I am to consider the scope and content of the prior art, the differences between the prior art and the claim, the level of ordinary skill in the art, and any secondary considerations to the extent they exist.

32. I understand that any evidence of secondary indicia of non-obviousness should be considered when evaluating whether a claimed invention would have been obvious to one of ordinary skill at the time of invention. These secondary indicia of non-obviousness may include, for example:

- a long-felt but unmet need in the prior art that was satisfied by the claimed invention;
- commercial success of processes claimed by the patent;
- unexpected results achieved by the invention;
- praise of the invention by others skilled in the art;
- the taking of licenses under the patent by others; and
- deliberate copying of the invention.

33. I understand there must be a nexus between any such secondary indicia and the claimed invention.

34. It is also my understanding that there are additional considerations that may be used as further guidance as to when the above factors will result in a finding that a claim is obvious, including the following:

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- the claimed subject matter is simply a combination of prior art elements according to known methods to yield predictable results;
- the claimed subject matter is a simple substitution of one known element for another to obtain predictable results;
- the claimed subject matter uses known techniques to improve similar devices or methods in the same way;
- the claimed subject matter applies a known technique to a known device or method that is ready for improvement to yield predictable results;
- the claimed subject matter would have been “obvious to try,” choosing from a finite number of identified, predictable solutions with a reasonable expectation of success;
- there is known work in one field of endeavor that may prompt variations of it for use in either the same field or a different one based on design incentives or other market forces if the variations would have been predictable to a POSITA;
- there existed at the time of the invention a known problem for which there was an obvious solution encompassed by the patent’s claims; and
- there is some teaching, suggestion, or motivation in the prior art that would have led a POSITA to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed subject matter.

35. Finally, I understand that a claim may be deemed invalid for obviousness in light of a single prior art reference, without the need to combine references, if the elements of the claim that are not found in the reference can be supplied by the knowledge or common sense of one of ordinary skill in the relevant art.

E. PRIORITY DATE

36. I understand that, subject to the next paragraph, the asserted “priority date” of a patent is the earlier of: (a) the date on which a patent application is filed; or (b) the

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date on which an earlier-filed patent application is filed if the patentee claims the benefit of priority to that earlier-filed patent application.

37. I understand that it is not enough for a patent to merely claim the benefit of an earlier filed application, but that additional criteria must be met. In particular, the prior application itself must describe the claimed invention and must do so in sufficient detail that one skilled in the art can clearly conclude that the inventor invented the claimed invention as of the filing date sought. First, I understand that a priority-date analysis is on a claim-by-claim basis. Second, I understand that, in order for a patent claim to be entitled to the filing date of an earlier patent application, a “Section 112 analysis” must be conducted. I am informed that a “Section 112” analysis encompasses looking to the earlier patent application and ascertaining whether that earlier patent application meets both the written-description and enablement requirements as of the filing date of the earlier application. I understand that it is not enough that the claim would have been obvious from the earlier application, but that application itself must describe the claimed invention.

38. I understand that in order to satisfy the written description requirement the earlier application must reasonably convey to those skilled in the art that the inventors had possession of the subject matter of the patent as of the filing date of the earlier Application. I have been informed that it is the disclosures of the earlier patent application that count, and that while the meaning of terms, phrases, or diagrams in the

earlier patent application must be interpreted from the vantage point of one skilled in the art, all the claimed limitations must appear in the specification. Further, I understand that this analysis is not a question of whether one skilled in the art might be able to construct the claimed invention from the teachings of the disclosure. The question is not whether a claimed invention is an obvious variant of that which is disclosed in the specification; rather, I understand that an earlier application must itself describe each of the claim limitations.

39. I also understand that in order to satisfy the enablement requirement, the earlier application must enable a person of ordinary skill in the art to practice the claimed invention without undue experimentation.

VII. LEVEL OF ORDINARY SKILL IN THE ART

40. I understand that Petitioner has proposed the following definition of a Person of Ordinary Skill in the Art. “A person of ordinary skill in the art (‘POSITA’) would have a working knowledge of system(s) having one or more actuators and one or more safety valves for pressure relief in fluid lines including methods and their applications. In addition, a POSITA would have a working knowledge of fluid system(s) in the oil and gas industry. The working knowledge would have been gained via an undergraduate education in engineering (electrical, mechanical, petroleum, or the like) or a related field of study, along with relevant experience studying or developing pressure relief safety valves in industry or academia. This description is approximate;

varying combinations of education and practical experience also would be sufficient.”¹

For purposes of this declaration, I have applied Petitioner’s proposed definition.

VIII. OVERVIEW OF THE CHALLENGED PATENT

41. I have reviewed U.S. Patent No. 9,890,609 (“the ’609 Patent”), which is entitled “Safety Valve Control System and Method of Use.” Ex. 1007. I understand that the application which led to the ’609 Patent (US Patent Application #15/262,642) was filed on September 12, 2016, and was issued on February 13, 2018. The ’609 Patent is a continuation of U.S. Patent Application Serial No. 13/480,704, filed May 25, 2012, now U.S. Patent No. 9,441,453 (the ’453 Patent”), which claims benefit of U.S. Provisional Patent Application Serial No. 61/551,319, filed October 25, 2011. Additionally, the ’453 Patent is a continuation-in-part of U.S. Patent Application Serial No. 13/195,662, filed August 1, 2011, which claims the benefit of U.S. Provisional Patent Application Serial No. 61/415,238, filed November 18, 2010. U.S. Provisional Patent Application Serial No. 61/370,721, filed August 4, 2010, the disclosures of which were incorporated by reference into the ’609 Patent.

A. THE SUBJECT MATTER OF THE CHALLENGED PATENT

42. The ’609 Patent is directed towards a “safety valve control system”² to protect and operate “emergency shut down control systems for surface and subsurface

¹ Petition at 11

² Ex. 1007 at Abstract

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safety valves.”³ The ’609 Patent teaches that its system can be used “when conducting a fracking operation”⁴ or may be used “in communication with a well production flow line 145 used to recover oil and/or gas from the oil/gas well.”⁵

43. The ’609 Patent identifies several features that are not shown in the Prior Art, including “a second fluid line [] configured to return fluid from the first fluid line back to the fluid supply or direct fluid from the first fluid line to a different reservoir,” and “a safety valve in-line with the second fluid line.”⁶

³ Ex 1007 1:21-25

⁴ Ex 1007 1:66-67

⁵ Ex 1007 4:15-17

⁶ Ex 1007 Claim 1

B. PROSECUTION HISTORY

44. The same Examiner, William M. McCalister, examined all the related, non-provisional applications. In doing so, the Examiner considered a host of alleged prior art references, some of which Petitioner cites in the Petition, and arguments related thereto over the course of several office actions and continued examination requests, which only proves that the Examiner did more than a cursory review, as Petitioner suggests.

45. For example, during the prosecution of the parent '453 Patent, the Examiner rejected the then-pending claims, which were directed to similar subject matter as the Challenged Claims, as obvious in view of the following references in a variety of combinations: *Wailes*, *Moore*, *Vinegar*, *Cotham*, *Ohtsuka*, *Etheridge*, *Koketsu*, and *Kotapish*. See Ex. 2004 ('453 Patent prosecution history). The Examiner considered Safoco's arguments and requests for continued examination, and the claims of the '453 Patent were allowed. Petitioner's cited references, *Tettleton* and *Tubel*, are nothing more than cumulative of those considered by the Examiner during the prosecution of this family of patent applications.

46. With his examination of the related applications in mind, and after performing yet another detailed search, the Examiner examined the application leading to the '609 Patent and issued a Non-Final Office Action dated May 18,

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2017—Ex. 1011 at 64-68. In the Office Action, Claims 1-18 were indicated to be allowable but for a double patenting rejection. Ex. 1011 at 66-67. Patent Owner amended the claims to clarify the subject matter and submitted the terminal disclaimer. Ex. 1011 at 38-43. The Challenged Claims were then issued.

**C. COMPARISON OF ASSERTED REFERENCES TO PRIOR ART DISCUSSED
DURING PROSECUTION**

47. I have been asked to review the examination history of the '609 Patent, and to compare the prior art grounds presented herein to those considered in rejections by the Examiner during the examination of the '609 Patent. As I describe below, the art asserted by Petitioner is the same or substantially the same art considered during prosecution of the '609 Patent.

48. *Cotham* was considered in prosecution of related U.S. Patent No. 9,671,794 (“the '794 Patent”) and was used as the basis for an obviousness rejection of filed claim 22 of the '794 Patent by the examiner. This resulted in claim 22 being canceled by the Patent Owner in order to overcome the rejection.⁷ Accordingly, *Cotham* was substantively considered by the examiner.

⁷ Ex. 1001 at 43.

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49. *Tettleton* is cumulative of prior art considered by the examiner during prosecution. *Etheridge* and *Kotapish*⁸, cited on the face of the '609 Patent and by the Examiner in Office Actions in the parent '435 Patent, which is presumptive evidence that the Examiner considered the same art in reviewing the '609 Patent. Like *Etheridge* and *Kotapish*, *Tettleton* discloses a) an angle-body pressure relief valve for use in a system for controlling fluid flow and pressure at a well site; b) a valve that may be in a closed position or open position, wherein a valve actuator may determine the position; and c) a pressure measuring device that monitors pressure within the system as shown below.

<i>Tettleton</i>	<i>Etheridge</i>	<i>Kotapish</i>
A pressure relief valve for use in a system for controlling fluid flow and pressure at a well site;	"A high-pressure relief valve 216 is connected to the discharge of pump 208 in conduit 206c. A remotely actuated blocking valve 218 is connected into conduit 206 at 206c and 206b to block flow through conduit 206." Ex. 2010 at col. 5 ll. 50-54, Fig. 5.	"[T]he pressure relief system 10 includes a relief valve 12 connected to the discharge line 11 and to the relief valve 12." Ex. 2011 at [0016].
A valve that may be in a closed position or an open position;	"By-pass valve 220 is switched to open position for by-pass when high pressure of a prescribed magnitude switches the valve 222 which in turn switches the valve 220 from the close to the opened by-pass position." Ex. 2010 at col. 5 ll. 58-62.	"[A] selectively openable dump valve in pressure communication with the low pressure side of the piston, and opening the dump valve, when the pressure in the pumping circuit reaches a set point." Ex. 2011 at [0005].
A pressure measuring device that monitors	"[S]witch valves 228 and 222, therefore provides for manipulation of the control valve	"The sequence valve 32 may be selectively adjustable to open at a pre-determined pressure at the side in

⁸ *Etheridge* is US Patent 4,774,980; *Kotapish* is US Patent Application Publication 2010/0154894

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pressure within the system.	12 in response to the pressure sensed in the product stream 204.” Ex. 2010 at col. 7 ll. 2-4.	fluid communication with the sensing unit 27 []. A pressure indicator 60 may be used in conjunction with the sequence valve 32 to establish the opening pressure.” Ex. 2011 at [0027].
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50. Similarly, *Tubel* is cumulative of *Etheridge* which each disclose a system for regulating flow of fluid from a well using an actuator to operate a wellhead valve. Further, each reference discloses a) a system for regulating the flow of fluid from a well using actuation to drive a wellhead valve and b) a system having a pipe, a flow sensor for sensing the flow of process fluid through the pipe, an electrical power source, and a wellhead valve for regulating the flow of process fluid through collection pipe. Examples are shown below.

<i>Tubel</i>	<i>Etheridge</i>
A system for regulating flow of fluid from a well using actuation to drive a wellhead valve;	“[C]ontrol system which actuates the control valve 10. The valve 10 is connected into a wellhead or other piping 202 which brings product from a well bore through the valve and out through a product line 204.” Ex. 2010 at col. 5 ll. 38-42.
A system having a pipe,	“[P]roduct pipe downstream of the flow control valve.” Ex. 2010 at col. 2 ll. 68.
a flow sensor for sensing the flow of process fluid through the pipe,	“[S]witch valves 228 and 222, therefore provide for manipulation of the control valve 12 in response to the pressure sensed in the product stream 204.” Ex. 2010 at col. 7 ll. 2-4.
an electrical power source, and	“[A]ll of the switching as described could be performed electrically [] whereby the valves 230, 218, and 220 would be switched electrically.” Ex. 2010 at col. 7 ll. 11-14.
a wellhead valve for regulating the flow of process fluid through collection pipe.	“[T]he valve 10 is usually equipped with the valve member 66 shown in FIG. 2, when initially placed on a wellhead to control the initial and new flow of product from the well.” Ex. 2010 at col. 7 ll. 50-53.

D. THE CHALLENGED CLAIMS OF THE '609 PATENT

51. The Challenged Claims of the '609 Patent, which are Claims 1-18, are set forth below. Some of the claim elements have been further subdivided for ease of reference.

Claim Element	Claim Language from '609 Patent
1(pre)	1. A control system for controlling fluid flow through a flow line at a wellsite, the control system comprising:
1(a)	a fluid supply;
1(b)	a first fluid line in fluid communication with the fluid supply;
1(c)	a pump in fluid communication with the first fluid line and configured to pump fluid from the fluid supply to one or more wellheads through the first fluid line;
1(d)	a second fluid line in fluid communication with the first fluid line at a location downstream of the pump and configured to return fluid from the first fluid line back to the fluid supply or direct fluid from the first fluid line to a different reservoir;
1(e)	a safety valve in-line with the second fluid line and movable into a closed position to close fluid flow through the second fluid line;
1(f)	a valve actuator configured to actuate the safety valve from the closed position to an open position to open fluid flow through the second fluid line;
1(g)	an electronic controller assembly programmed with a predetermined condition and configured to receive a signal from a transducer connected to the first fluid line, wherein the signal corresponds to a measured physical property;
1(h)	a valve assembly in communication with the controller assembly; and

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Claim Element	Claim Language from '609 Patent
1(i)	a fluid drive assembly in communication with the controller assembly, wherein the controller assembly is operable to actuate the fluid drive assembly to supply fluid to the valve actuator to move the safety valve into the closed position, and wherein the controller assembly is operable to actuate the valve assembly in response to a comparison of the measured physical property to the predetermined condition to release the fluid from the valve actuator to move the safety valve into the open position and thereby open fluid flow through the second fluid line to return fluid in the first fluid line back to the fluid supply or direct fluid in the first fluid line to the different reservoir.
2	2. The system of claim 1, further comprising a housing for supporting the controller assembly, the valve assembly, and the fluid drive assembly.
3.	3. The system of claim 2, wherein the fluid supplied to the valve actuator by the fluid drive assembly is supplied from a reservoir disposed outside of the housing.
4.	4. The system of claim 1, wherein the fluid drive assembly is a compressor and the fluid supplied to the valve actuator by the fluid drive assembly is a pneumatic fluid.
5.	5. The system of claim 1, wherein the fluid drive assembly is a pump and the fluid supplied to the valve actuator by the fluid drive assembly is a hydraulic fluid.
6.	6. The system of claim 1, further comprising a power source for supplying power to the controller assembly, the valve assembly, and the fluid drive assembly.
7.	7. The system of claim 1, further comprising a housing for supporting the fluid drive assembly, and a filter attached to the housing for filtering fluid entering the housing by the fluid drive assembly.
8.	8. The system of claim 1, wherein the fluid supplied to the valve actuator by the fluid drive assembly is ambient air.

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Claim Element	Claim Language from '609 Patent
9.	9. The system of claim 1, wherein the controller assembly is operable to communicate a signal corresponding to the measured physical property to a remote computer system.
10.	10. The system of claim 1, wherein the controller assembly is a programmable logic controller.
11 (pre)	A method for controlling fluid flow through a flow line at a wellsite, the method comprising: providing a control system comprising:
11 (a)	a fluid supply;
11 (b)	a first fluid line in fluid communication with the fluid supply;
11 (c)	a pump in fluid communication with the first fluid line and configured to pump fluid from the fluid supply to one or more wellheads through the first fluid line;
11 (d)	a second fluid line in fluid communication with the first fluid line at a location downstream of the pump and configured to return fluid from the first fluid line back to the fluid supply or direct fluid from the first fluid line to a different reservoir;
11 (e)	a safety valve in-line with the second fluid line;
11 (f)	a valve actuator configured to actuate the safety valve;
11 (g)	a housing;
11 (h)	an electronic controller assembly;
11 (i)	a fluid drive assembly; and
11 (j)	a valve assembly;

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Claim Element	Claim Language from '609 Patent
11 (k)	supplying fluid to the valve actuator using the fluid drive assembly to actuate the valve actuator to move the safety valve into a closed position;
11 (l)	maintaining the safety valve in the closed position to close fluid flow through the second fluid line;
11 (m)	monitoring a physical property in the first fluid line using the controller assembly; and
11 (n)	actuating the valve assembly using the controller assembly to release the fluid from the valve actuator to move the safety valve into an open position and thereby open fluid flow through the second fluid line based upon a comparison of the monitored physical property to a predetermined condition to return fluid from the first fluid line back to the fluid supply or direct fluid from the first fluid line to the different reservoir.
12.	12. The method of claim 11, wherein the fluid supplied to the valve actuator by the fluid drive assembly is a pneumatic fluid disposed external to the housing, and further comprising filtering the pneumatic fluid as it enters the housing by the fluid drive assembly.
13.	13. The method of claim 11, wherein the fluid supplied to the valve actuator by the fluid drive assembly is a hydraulic fluid disposed in a reservoir within the housing that is in fluid communication with the fluid drive assembly.
14.	14. The method of claim 11, further comprising measuring the physical property using a transducer configured to communicate a signal corresponding to the measured physical property to the controller assembly.
15.	15. The method of claim 11, wherein the fluid supplied to the valve actuator by the fluid drive assembly is a pneumatic fluid, and wherein the fluid drive assembly is a compressor.

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Claim Element	Claim Language from '609 Patent
16.	16. The method of claim 11, wherein the fluid supplied to the valve actuator by the fluid drive assembly is a hydraulic fluid, and wherein the fluid drive assembly is a pump.
17.	17. The method of Claim 11, further comprising communicating a signal from the controller assembly to a remote computer system, wherein the signal corresponds to an operational characteristic of the safety valve.
18.	18. The method of claim 11, further comprising actuating the safety valve by communicating a signal from a remote computer system to the controller assembly.

52. The challenged claims relate to both control systems (Claims 1-10) and methods (Claims 11-18) for controlling fluid flow through a flow line at a well site.

Each of the Challenged Claims contains common elements, including:

- Fluid Supply.
- Pump in communication with the fluid supply.
- Second fluid line in communication with the first fluid line.
- Safety valve in-line with the second fluid line.

IX. TECHNOLOGY BACKGROUND AND STATE OF THE ART

53. In the subsections below, I describe some of the basic principles of engineering that would be used, or at least considered for use, in the field of oil and gas operations and, in particular, wellhead control.

A. DRILLING AND DIRECTIONAL DRILLING

54. Oil and gas exploration and production operations depend on identifying, locating and collecting hydrocarbon (i.e., oil and gas (natural gas)) reserves for sale, use as a fuel, for lubrication, or for the development of chemicals, pharmaceuticals and plastics used in modern society. For most of human history, petroleum products such as natural asphalts, coal, and surface seeps of oil have been used for various purposes, including paving, construction, waterproofing of boats, and fuel.⁹ Mostly, these materials were naturally occurring on the earth's surface and were collected by digging the materials up and transporting them for use. However, some hydrocarbon reservoirs are located beneath the earth's surface and must be reached by some type of well-drilling technique. The first recorded petroleum wells were drilled circa 347 AD during the Jin dynasty in modern-day China.¹⁰ These were percussion-type wells similar to cable tool drilling, widely used in the 1800s. Modern oil and gas production depends heavily on wells drilled to reach hydrocarbon-bearing formations located below the earth's surface.

55. In 1859, Edwin Drake drilled the first commercial oil well in the United States near Titusville, PA. This well was drilled with a cable-tool percussion drilling

⁹ (Vassiliou 2018) at xxv - xxvi

¹⁰ (Brewer 2022)

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rig and struck oil at a depth of 69 feet.¹¹ A Cable tool drilling rig uses a heavy chisel-type tool suspended from cable (usually rope) and repeatedly dropped to chip away at the rock formation. After a certain amount of rock has been chipped, a bucket-type tool (bailer) is lowered to collect and remove the rock chips. The use of cable-tool rigs was widespread through the end of the 19th century. This technique led to the discovery of many large oil and gas fields in the United States, including the NW Pennsylvania fields, Pico Canyon and Los Angeles fields in California, the Neodesha fields in Kansas (Norman No 1), and the Bartlesville-Dewey field in Oklahoma (Nellie Johnstone No. 1).¹²

56. Rotary drilling techniques, where a drill stem is spun, and a drill bit cuts into the rock, had been used as far back as the Egyptian era but had limited use until Howard Hughes invented the roller cone drill bit in 1908. In a rotary drilling system, the drill bit cuts or pulverizes the rock. A fluid, known as drilling mud, is circulated down the hollow drill stem, out orifices in the bit, and then up the annulus, or the area between the drill stem and the wellbore walls. The drilling mud serves the dual purpose of lubricating and cooling the bit teeth and grinding surfaces, as well as

¹¹ (Vassiliou 2018) at xxix, 147, 174-175

¹² (Vassiliou 2018) at 149

carrying residue from the drilling process out of the hole and to the surface where it is observed for its characteristics (logged), collected (shale shakers) and discarded.

57. The drilling mud is pumped by relatively large positive displacement pumps, often plunger pumps. Plunger pumps pump the same fluid volume each stroke, regardless of the discharge pressure. Discharge pressure from these pumps is a function of the fluid resistance of the system, along with the speed of the pump. The higher the resistance, the higher the discharge pressure for the same flow rate being pumped.

B. HISTORY OF HYDRAULIC FRACTURING

58. Fracturing the hydrocarbon-bearing formations is a technique that has been used to increase or speed up oil and gas production for nearly as long as oil and gas production has existed. As early as the 1850s, fracturing methods used explosives such as gunpowder ignited by red-hot iron or nitroglycerin “torpedoes.”¹³ Hydraulic fracturing, in its modern form of pumping liquids and proppants (*e.g.*, sand) into the formation, began in the 1940s using a process developed by Stanolind Oil and used by Halliburton in the mid-continent region. Early hydraulic fracturing in the 1940s and 1950s used frac pumps, including pumps that could operate at

¹³ Michael Morton, “Unlocking the Earth: A Short History of Hydraulic Fracturing,” GEO ExPro, Vol. 10, No. 6, December 2013 (<https://geoexpro.com/unlocking-the-earth-a-short-history-of-hydraulic-fracturing/>) (last accessed July 17, 2023) (Ex. 1015).

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around 1500 Hp.¹⁴ On March 17, 1949, Stanolind and Haliburton performed the first commercial application of hydraulic fracturing at a location about 12 miles east of Duncan, Oklahoma.¹⁵



59. The expansion of directional and horizontal drilling extended the use of hydraulic fracturing into previously underdeveloped “tight” formations, including shale.¹⁶ In oil and gas exploration, directional drilling is a technique for accessing hydrocarbon-bearing formations (oil and gas formations) that are not located immediately beneath the surface location or to increase the amount of formation

¹⁴ Carl T. Montgomery and Michael B. Smith, “Hydraulic Fracturing: History of an Enduring Technology,” *Journal of Petroleum Technology* vol. 62 issue 12 p. 26 (Dec. 2010) (Ex. 1017).

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exposed to the wellbore. Some tool or process is used to cause the wellbore to deviate from the vertical to reach previously inaccessible formation locations, to expose more of the hydrocarbon-bearing formation to the wellbore, or to drill several wells from a single surface location, such as an offshore platform or a land-based drilling pad. Like most oil and gas industry developments, “the early drilling of directional wells was clearly motivated by economics.”¹⁷ The offshore fields of California spawned the technology, which led to modern directional and horizontal drilling. In the 1930s, directional drilling was used in the Huntington Beach, California field to reach an offshore oil-bearing formation from a well initiated on an onshore pad.

60. Throughout the 1980s, directional drilling (a technique for accessing hydrocarbon-bearing formations (oil and gas formations) that are not located immediately beneath the surface location or to increase the amount of formation exposed to the wellbore) increased. Techniques for drilling wells to intersect natural fractures were, in particular, used on offshore pads and in the Austin Chalk trend of central Texas. The Austin Chalk is a soft, loosely cemented, easily pulverized limestone characterized by natural fractures oriented primarily vertically.

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Horizontally deviated wells were drilled into the chalk to intersect several of the natural fractures, allowing for transport of the hydrocarbons into the wellbore. This was combined with artificial fracturing to increase the flow rate of hydrocarbons into the wellbore.



61. Because more formation is exposed to be fractured, horizontal wells use much higher volumes of fracturing fluid and proppant than do vertical wells. This requires the use of more and bigger blending and pumping systems. As discussed

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by *Sanborn*, pumping systems of 32,000 hp were typically used as early as 2012.¹⁸ Other references, such as *Coli*, suggest systems of pumps as large as 2,500 hp each, with total system power as high as 40,000 HP, were used in the same time period (four trailers, each with four 2500 hp pumps operating in parallel).¹⁹ These pumps are typically triplex or quintuplex positive displacement (plunger) type pumps.²⁰ Although some fracturing systems have been converted to electric-driven pump motors, the large majority of hydraulic pumping systems “are typically mobilized on skids or tractor-trailers and powered using diesel motors.”²¹ These diesel engines require large amounts of fuel and the requisite extra safeguards to address potential safety concerns.²²

¹⁸ U.S. Patent Application Publication No. 2013/0306322 to Sanborn *et al.* entitled “System and Process for Extracting Oil and Gas by Hydraulic Fracturing” (“*Sanborn*”) (Ex. 1020), [0005].

¹⁹ U.S. Patent Publication No. 2012/0255734 to Coli *et al.* entitled “Mobile, Modular, Electrically Powered System for Use in Fracturing Underground Formations” (“*Coli*” [0049], FIG. 2.

²⁰ *Sanborn* at [0005]; *Coli*, at [0011].

²¹ *Coli* at [0005]; *see also Id.*, [0007] (“standard fluid pumps require large volumes of diesel fuel and extensive equipment maintenance programs”).

²² *Sanborn* at [0007].

C. TYPES OF PUMPS – FRACTURING PUMP CHAIN

62. The basics of hydraulic fracturing have not changed significantly since 1949 when Halliburton first commercialized the “hydrafrack” process. Hydraulic fracturing still involves pumping water (or another liquid) blended with a proppant (*e.g.*, sand) and other chemicals into the downhole reservoir at a sufficient pressure to crack (fracture) the downhole rock. The sand-water mixture is then forced into the cracks, where the sand keeps the cracks (fractures) open to allow hydrocarbons, such as oil and natural gas, to flow out of the formation into the well bore. What has changed are the pressures and flow rate of the fracturing jobs, the sizes of equipment, and the particular proppants, chemicals, and liquids used.

63. A modern fracturing process requires multiple pumps operating together as a system to provide fracturing fluid with the suitable composition at the correct flow rate and at a pressure sufficient to fracture the formation. At the beginning of the pumping chain are the water transfer pumps. These pumps operate at a relatively low pressure to move water from the storage location (*e.g.*, ponds, tanks) to the blender or the hydration unit.

64. In the blender, the water is mixed with a proppant, such as sand, resin-coated sand, or ceramics, to form the fracturing slurry. Additionally, other chemicals, such as acids, gels, friction reducers, biocides, and the like, are added to the slurry. Dry products, such as sand, are transported into the blender tub using

conveyors or augers. Liquid products, such as acids, are transported into the blender tub using various sizes and types of pumps. These are typically relatively small horsepower pumps operating at lower pressures, as the blender tub operates at, more or less, ambient pressures.

65. Once the fracturing slurry is blended to the proper makeup and consistency, it is transferred to the fracturing pumps using a blender discharge pump. This pump typically operates at a higher pressure than the water or chemical transfer pumps for several reasons. First, the viscosity of the slurry is typically higher than that of water, which requires higher pressures to move the same volume of slurry. Second, the slurry is heavier than plain water, requiring additional horsepower to move the slurry (as compared to plain water).

D. PRODUCTION, SEPARATION AND STORAGE FACILITIES

66. Economic production from oil (and natural gas) wells requires the flow of significant fluid volumes from the wells to the surface and storage tanks. The fluid from oil wells is typically a three-phase fluid comprising liquid (oil and saltwater), gas (methane and other gases), and solids (sand and rock remnants). At the wellhead, these components are part of a single flow stream. For the sale of the commercially valuable components (oil and hydrocarbon gases), the three phases are initially separated in a three-phase separator. A three-phase separator is a vessel that ‘slows down’ the production stream (often in a pressurized vessel) and allows for the

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settling of the solids to the bottom of the separator (where they are collected and discarded) as well as allowing the gaseous products to “break out” of the liquid stream. The gas is then collected, often compressed, and delivered to a natural gas pipeline for sale or, in cases where no pipeline is available, burned off in a controlled manner using a flare system.

67. The liquid stream, comprised primarily of salt water and oil (along with treating chemicals and other trace minerals), is then delivered to a processing facility, typically on-site or near the wellhead, where the oil and salt water are separated by another settling process, sometimes accelerated by heat. As oil has a lower density than salt water, most of the oil “floats” to the surface of a settling tank (heater treater, gun barrel, free water knockout, or other names). The oil is collected and delivered to storage tanks or a pipeline for sale. The saltwater (i.e., produced water) is directed to storage tanks or a pipeline for eventual disposal. In many wells, the volume of produced water is ten times or greater than that of produced oil.

68. A typical oil and gas production facility is diagramed in Figure 1.

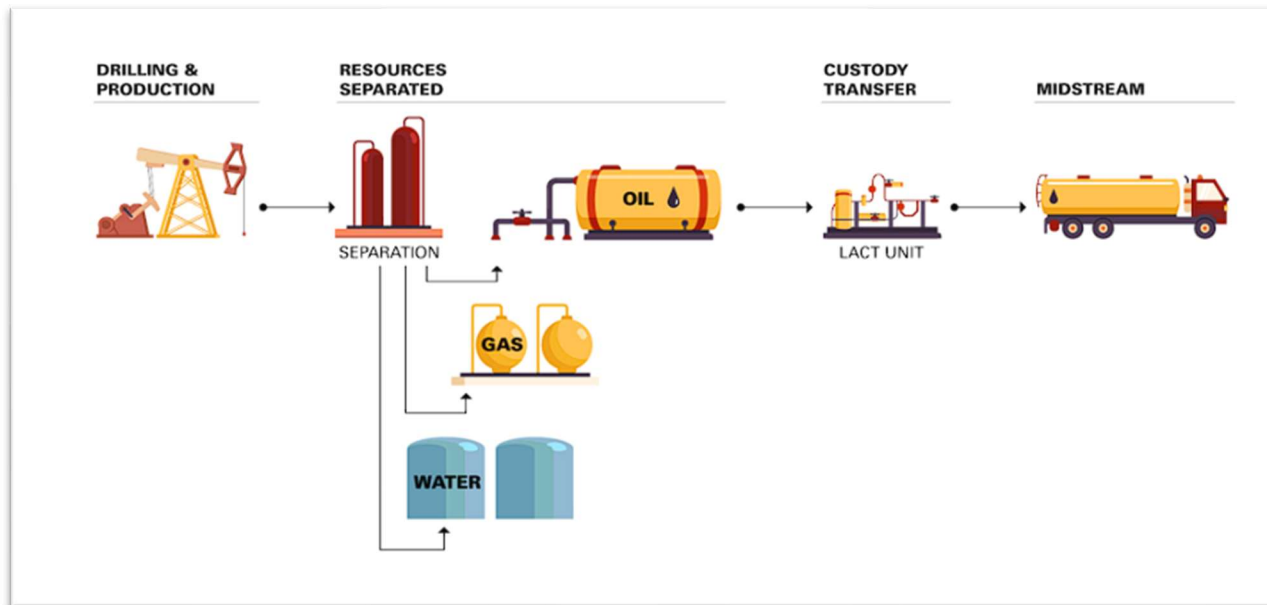


Figure 1 – Typical Oil and Gas Production Facility

X. CLAIM CONSTRUCTION

69. It is my opinion that a POSITA would have understood each of the terms of the Challenged Claims at the time of the filing of the '609 Patent. The inventors have defined none of the terms in a unique way. Accordingly, I have applied each term's plain and ordinary meaning for this declaration.

XI. OVERVIEW OF THE PRIOR ART

A. TETTLETON (EX. 1016)

a. Status of *Tettleton*

70. *Tettleton* is a publication of a United States patent application, U.S. Patent Publication No. 2008/0078586. *Tettleton* is titled "Mud Systems with Pressure

Relief Valve.” *Tettleton* was filed on August 31, 2006, and published on April 3, 2008.

b. Overview of the Disclosure of *Tettleton*

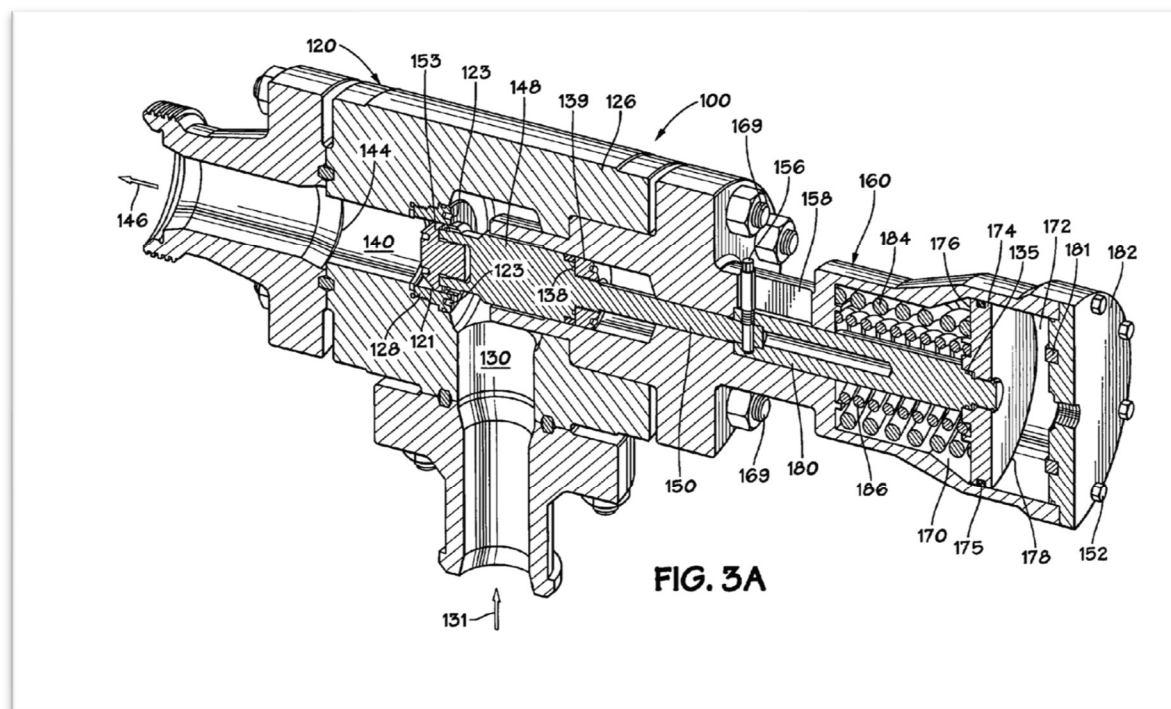
71. *Tettleton* describes “a pressure relief valve assembly useful for relieving fluid pressure in a pressurized device.”²³ *Tettleton* further describes certain characteristics of its pressure valve assembly, including “a valve body with an inlet passageway in fluid communication with an outlet passageway, a valve member for selectively controlling fluid flow from the inlet passageway, [and] a wear member around a portion of an entrance end of the outlet passageway.”²⁴ *Tettleton* further describes certain characteristics of the wear member, including certain positions and attachments of the wear assembly.²⁵ *Tettleton* states, “Fig 3A is a perspective cutaway view of the relief valve according to the present invention.”²⁶ Fig. 3A is duplicated below:

²³ Ex 1016 Abstract

²⁴ Ex 1016 Abstract

²⁵ See, e.g., Ex 1016 Abstract

²⁶ Ex 1016 [0027]



72. *Tettleton* further describes the invention relates to “drilling fluid or “mud” systems; to relief valves for such systems; and to apparatus, systems, and methods for relieving fluid pressure in pressurized systems.”²⁷ *Tettleton* describes several characteristics of its pressure relief valve, including “a valve body with an inlet passageway in fluid communication with an outlet passageway,” a “valve member movable into the outlet passageway to prevent fluid flow,” a “wear member having an interior surface” and “an angle-body valve having a valve piston disposed therein

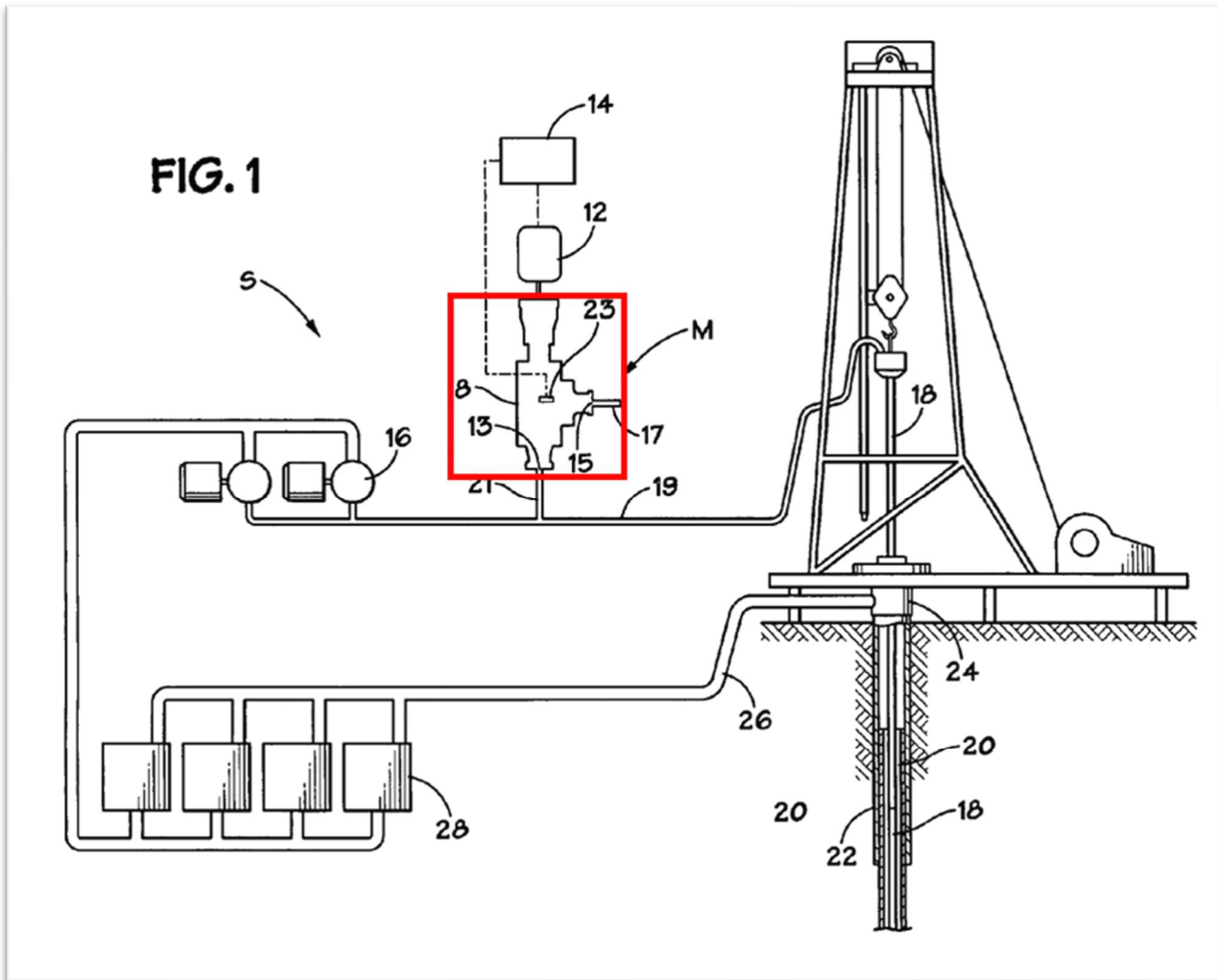
²⁷ Ex 1016 [0002]

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and being movable between at least one closed position and at least one open position.”²⁸

73. While *Tettleton*’s primary focus is on the design and construction of the angle-body valve itself, *Tettleton* also discloses its angle-body valve in a system to control pressure in a drilling mud system. FIG. 1 of *Tettleton* discloses such a system, with the purportedly improved valve annotated in red.

²⁸ Ex 1016 [0009]- [0010]



74. *Tettleton* describes “a system S according to the present invention includes a mud system M with mud pits **28** for containing and storing drilling fluid; mud pumps **16** for pumping the drilling fluid to drillstring **18** and back to the mud pits **28**; and a relief valve **8** according to the present invention for relieving pressure in the system.”²⁹ *Tettleton* further teaches, “[w]hen the mud pressure exceeds the pre-

²⁹ Ex 1016 [0040]

selected pressure, the valve 10 [sic should be valve 8] opens, and the mud that was previously flowing to the drill stem **18** flows through the inlet **13** of the valve **8** and exits through an outlet **15** into an exit line **17**.”³⁰ *Tettleton* describes controlling valve **8** with changes to the air supply to the valve.³¹

B. COTHAM (EX. 1019)

a. Status of *Cotham*

75. *Cotham* is United States Patent No. 5,335,730. *Cotham* is entitled “Method for Wellhead Control” and was issued to Heman C. *Cotham* III on August 9, 1994. *Cotham* results from Patent Application No 1,479,893 filed Feb 8, 1993, and published on the issue date. *Cotham* claims priority (continuation in part) of Application 753,755 dated Sept 3, 1991.

b. Overview of the Disclosure of *Cotham*

76. *Cotham* is primarily directed towards control panels for oil and gas production valves. *Cotham* describes a method for “providing power to a system for controlling a wellhead from a self-contained stand-alone power source.”³² *Cotham*’s method includes “using a valve to control flow of fluids from within the well and

³⁰ Ex 1016 [0041]

³¹ Ex 1016 [0041]

³² Ex 1019 at Abstract

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from the well in one or more flow lines and monitoring various parameters [] including but not limited to fluid pressures and emergency conditions, and shutting in the well in response.”³³ *Cotham* is primarily directed to “a safe wellhead and wellhead control system that is operable by other than pneumatic power” and is “solar powered.”³⁴

77. *Cotham*’s method is used “for controlling a wellhead having a plurality of two or more valves, including a downhole valve in the well that controls flow of well fluid from the well to the surface and at least one surface valve that controls flow of the fluid in one or more flowlines from the wellhead to a location” other than the wellhead.³⁵ The valve control system is powered “with an integral stand-alone self-contained power producer.”³⁶ One claimed advantage of *Cotham*’s method is that it is “useful in extremely remote areas at which other forms of power are not available” through the use of “solar power.”³⁷

³³ Ex 1019 at Abstract

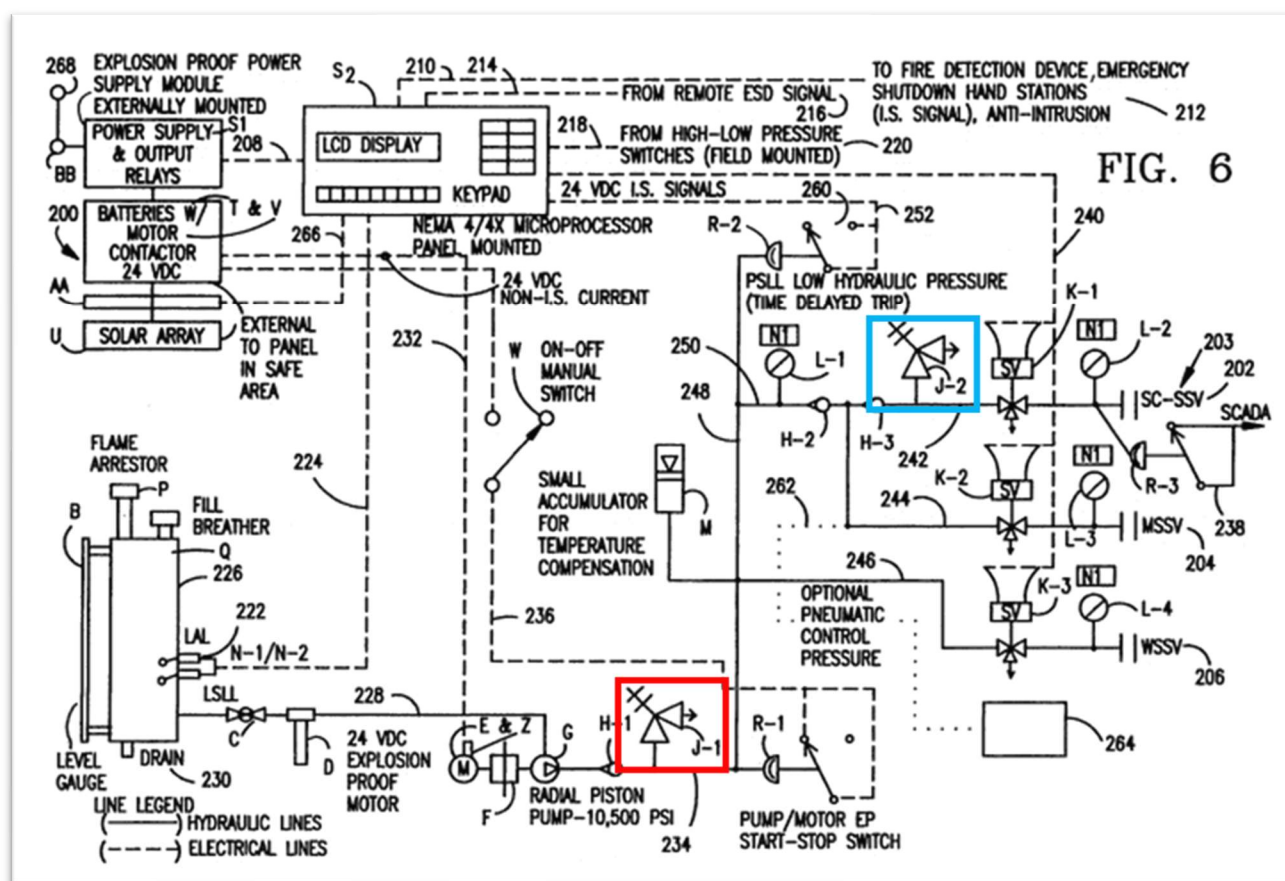
³⁴ Ex 1019 2:17-20

³⁵ Ex 1019 2:35-40

³⁶ Ex 1019 41-43

³⁷ Ex 1019 5:57-62

78. *Cotham* further describes two angle-body relief valves within the system, “relief valve J-1 [annotated in red] provides overpressure protection”³⁸ and “relief valve J-2 [annotated in blue] relieves thermal pressure.”³⁹ *Cotham* states, “Fig. 6 is a schematic view of a system according to the present invention.”⁴⁰ Fig. 6 is duplicated below:



³⁸ Ex. 1019 at col. 9 ll. 7-8.

³⁹ Ex. 1019 at col. 10 ll. 24-25.

⁴⁰ Ex. 1019 at col. 6 ll. 54-55.

According to *Cotham*, valves J-1 and J-2 are “Relieve valve, ¼” NPT SST, 10,000 PSI, Poppet Type” valves.

C. TUBEL (EX. 1023)

a. Status of *Tubel*

79. *Tubel* is United States Patent No. 5,597,042. *Tubel* was issued on January 28, 1997. *Tubel* is titled “Method for Controlling Production Wells Having Permanent Downhole Formation Evaluation Sensors.” The application that led to *Tubel* (App no 386,480) was filed on February 9, 1995.

b. Overview of the Disclosure of *Tubel*

80. Like *Cotham*, *Tubel* is directed towards controlling the production of hydrocarbon wells rather than controlling systems at those wells during the drilling or completion stage. *Tubel* describes that a “downhole control system for a production well is associated with permanent downhole formation evaluation sensors.”⁴¹ These sensors may include “neutron density, gamma ray porosity, and resistivity sensors” for evaluation of “formation parameters including [] water entering the production tubing.”⁴² Additionally, *Tubel*’s system “will monitor actual downhole parameters (such as pressure, temperature, flow, gas influx, etc.) and

⁴¹ Ex 1021 at Abstract

⁴² Ex 1021 at Abstract

automatically execute control instructions when the monitored downhole parameters are outside a selected operating range” indicating an unsafe condition.⁴³ This information allows *Tubel*’s system to “automatically control[] downhole tools in response to sensed selected downhole parameters.”⁴⁴ Control is accomplished by causing “an electromechanical control device (such as a valve) to actuate a suitable tool (for example, actuate a sliding sleeve or packer, or close a pump or other fluid flow device).”⁴⁵ According to *Tubel*, one advantage of its system is “the automatic control is initiated downhole without an initial control signal from the surface or from some other external source.”⁴⁶

XII. GROUND 1: CLAIMS 1, 4, 5, 8, AND 10 ARE NOT ANTICIPATED BY TETTLETON

81. Petitioner cites *Tettleton* as anticipating Claims 1, 4, 5, 8 & 10 of the ’609 Patent. However, *Tettleton* does not disclose each and every element of these claims.

A. INDEPENDENT CLAIM 1

82. As discussed below, not all the claim elements of Claim 1 are explicitly or inherently disclosed by *Tettleton*. Because *Tettleton* has not disclosed all the

⁴³ Ex 1021 4:57-62

⁴⁴ Ex 1021 4:45-47

⁴⁵ Ex 1021 62-65

⁴⁶ Ex 1021 4:47-49

Claim elements, *Tettleton* does not anticipate Claim 1. Certain claim limitations and elements that are not disclosed, either explicitly or inherently, by *Tettleton* are discussed below.

- a. **Claim 1 (d): “a second fluid line in fluid communication with the first fluid line at a location downstream of the pump and configured to return fluid from the first fluid line back to the fluid supply or direct fluid from the first fluid line to a different reservoir;”**

83. *Tettleton* does not disclose “a second fluid line in fluid communication with the first fluid line at a location downstream of the pump and configured to return fluid from the first fluid line back to the fluid supply or direct fluid from the first fluid line to a different reservoir.” Petitioner claims “*Tettleton* also discloses a method by which the system regulates pressure within the system by releasing fluid into a different reservoir when the pressure exceeds a predetermined threshold.”⁴⁷ However, Petitioner’s expert, Dr. Stevick, contradicts this claim: “*Tettleton* does not explicitly disclose that fluid is transferred to a reservoir as a result of the pressure relief valve being actuated.”⁴⁸ Further, there is no teaching in *Tettleton* that the fluid line is “configured to return fluid from the first fluid line to the fluid supply.”⁴⁹

⁴⁷ Paper 2 pg. 22

⁴⁸ Ex 1027 at 47.

⁴⁹ See, e.g., Ex 1016 [0040] – [0041], Figs. 1 and 3 and generally.

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84. Dr. Stevick goes on to state that transferring fluid to a reservoir as a result of the pressure relief valve being actuated “is inherent to the reduction of pressure within the otherwise closed system that is explicitly disclosed by *Tettleton*.”⁵⁰ Further, Dr. Stevick states, “fluid must be redirected to a different location than the closed fluid line system. This alternative location would be either back to the fluid supply or another reservoir”.⁵¹ Dr. Stevick’s statement is conclusory, incorrect, and inconsistent with the teaching of *Tettleton* and other references.

85. *Tettleton* teaches an “exit line **17**”⁵² that Petitioner points to as the second fluid line of Claim 1. *Tettleton* teaches, “[w]hen the mud pressure exceeds the pre-selected pressure, the valve **10** opens and the mud that was previously flowing to the drill stem **18** flows through the inlet **13** of the valve **8** and exits through an outlet **15** into an exit line **17**.”⁵³ Fig. 1 of *Tettleton* is “a schematic view of a system according to the present invention with a relief valve according to the present invention.”⁵⁴ Fig. 1 is duplicated below with “exit line **17**” annotated in red. Other than the single

⁵⁰ Ex 1027 at 47

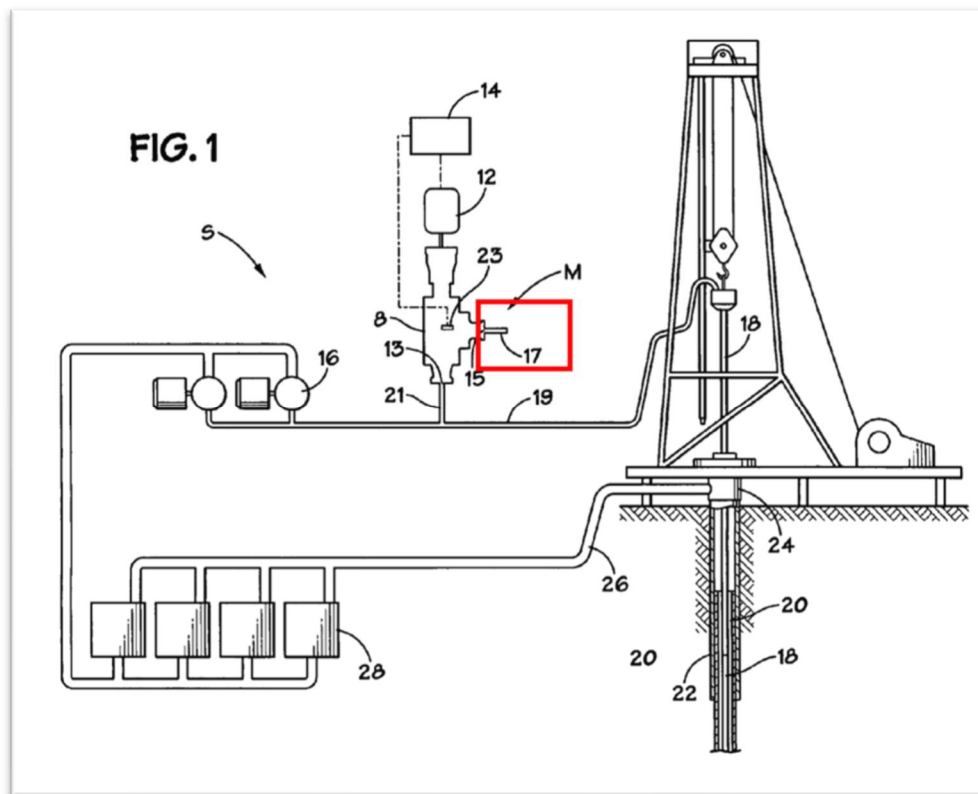
⁵¹ Ex 1027 at 47

⁵² Ex 1022 [0042]

⁵³ Ex 1016 [0041]

⁵⁴ Ex 1016 [0025]

sentence in [0041] and Fig. 1, *Tettleton* does not address “exit line 17” or its connections.



86. As seen in Fig. 1, *Tettleton* shows exit line **17** connected to outlet **15** of valve **8** on one end and not connected on the other. There is no teaching in *Tettleton* of exit line **17** returning fluid to anything, much less the fluid supply or another reservoir. Further, a POSITA reading *Tettleton* would have understood that *Tettleton* is teaching that exit line **17** is open-ended, and the relieved fluid would be undirected as to location (i.e., directed to the atmosphere). A POSITA would have understood this was a common practice in oil and gas operations.

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87. As another example of this practice, US Patent 6,796,321 to Berton Vicars (“*Vicars*” or “the ‘321 Patent”), filed June 19, 2002, and issued September 28, 2004, addresses a pressure relief valve used in oil and gas fracturing operations. According to *Vicars*, when the fluid pressure in the system exceeds the setting of the valve, the pressure relief valve will open, and “[f]luid may now pass from the pumping chamber **18** through cage **12** and out to the atmosphere”.⁵⁵ Accordingly, despite Dr. Stevick’s conclusory statement, it is not inherent for the second fluid line to be configured to return fluid from the first fluid line to the fluid supply or another reservoir.

88. Petitioner states, in footnote 6, “For the element of independent claim 1 to be disclosed it is not necessary for *Tettleton* to disclose the second fluid line in fluid communication with the first fluid line at a location downstream of the pump and configured to return fluid from the first fluid line back to the fluid supply or another reservoir.”⁵⁶ I disagree. Because it is not inherent for the second fluid line to be configured to return fluid back to the fluid supply or another reservoir, *Tettleton* must disclose the entire claim limitation for Claim 1 to be disclosed by *Tettleton*.

⁵⁵ *Vicars* 4:47-48. See also 2:56-58,

⁵⁶ Paper 2 footnote 6 pg. 26

b. **Claim 1(e): “a safety valve in-line with the second fluid line and movable into a closed position to close fluid flow through the second fluid line;”**

89. *Tettleton* does not disclose “a safety valve in-line with the second fluid line”. In fact, *Tettleton* teaches against such a configuration.

90. Neither Dr. Stevick’s declaration nor the Petition addresses the “safety valve in-line” claim term. Dr. Stevick’s declaration jumps straight from a discussion of the discharge line limitation (discussed above in Section XII.A.a) to a discussion of a “gate” limitation.⁵⁷ The petition similarly ignores the claim element of “a safety valve in-line with the second fluid line and movable into a closed position to close fluid flow through the second fluid line.”⁵⁸ Unsurprisingly, Dr. Stevick and the Petition ignore this claim element, as *Tettleton* teaches against it.

91. *Tettleton* describes its safety relief valve as having “an angle-body configuration and/or a fluid flow path with approximately a ninety-degree turn”.⁵⁹ According to *Tettleton*, “[i]n an “angle-body” valve, the axis of the first passageway

⁵⁷ See, e.g., Ex 1027 at 47-48. The gate limitation is not claimed in 1(e) of the ‘609 Patent but is claimed as part of the ‘609 Patent. Dr. Stevick’s declaration addresses the “gate” limitation even in his discussion of the ‘609 Patent.

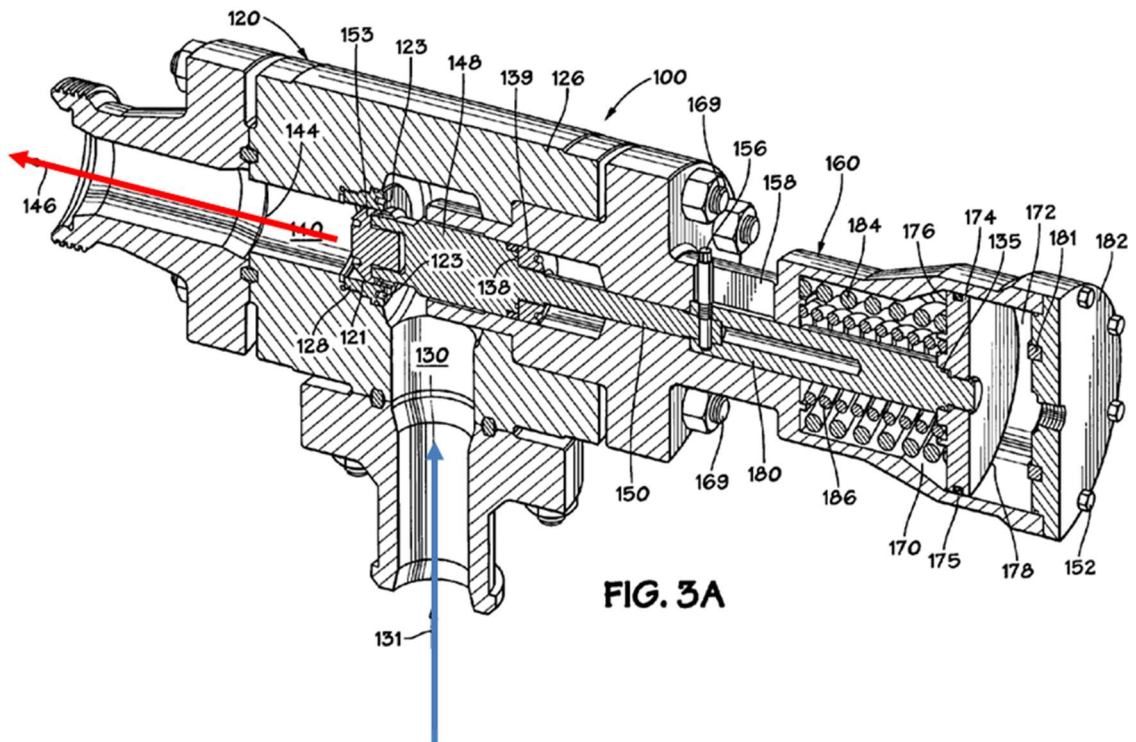
⁵⁸ See, e.g., Paper 2 at 26-27.

⁵⁹ Ex 1016 [0008]. See also [0010], [0013], [0043]

130 is not concentric or coaxial with [] the axis of the second passageway 140.”⁶⁰

This is visually evident in the figures of *Tettleton* of which Fig. 3A is exemplary.

The figure below shows the “first passageway” with a blue arrow and the “second passageway” with a red arrow.

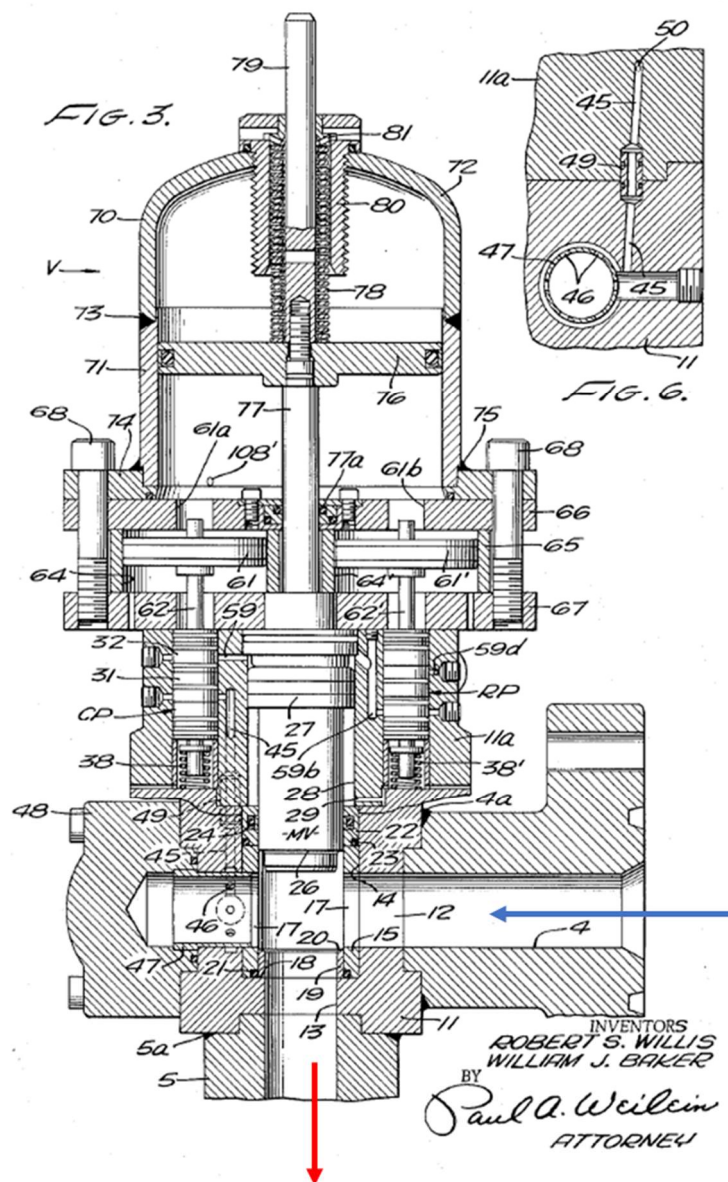


92. This is the “normal” configuration for pressure relief valves, as pressure relief valves have been “globe”⁶¹ type valves, as the *Tettleton* valve is. For example, this angle-body configuration is shown in Fig. 3 of Ex. 1003.

⁶⁰ Ex 1016 [0043].

⁶¹ A globe valve uses a plug in the manner of the valve of *Tettleton*. A globe valve typically has a different style body. However, the use of a plug in the manner of *Tettleton* classifies this as a globe type valve as it relates to fluid shutoff.

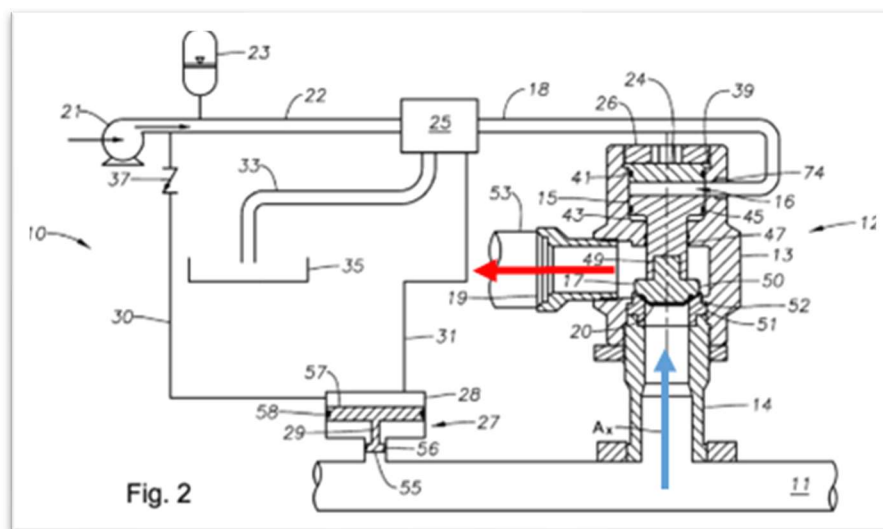
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Ex 1003, Fig. 3

93. The face of the '609 Patent lists several other pieces of art that identify angle body valves. These valves have similar characteristics to the valve in *Tettleton* in that, in each case, the axis of the inlet passageway is not concentric or coaxial with the axis of the discharge passageway.

94. For example, Fig.2 of *Kotapish*⁶² (annotated below) is a “side partial sectional view of a relieving system”⁶³ including “relief valve 12 [] with annular inlet 14”⁶⁴ and “annular relief port 19”.⁶⁵ As shown in Fig. 2, the inlet port 14 is not coaxial or concentric with the relief (outlet) port 19.



95. As another example, *Koketsu*⁶⁶ Figure 4 (annotated below) is a “cross-sectional view of a vacuum proportional opening and closing valve” in an open

⁶² US Patent Publication No. 2010/0154894

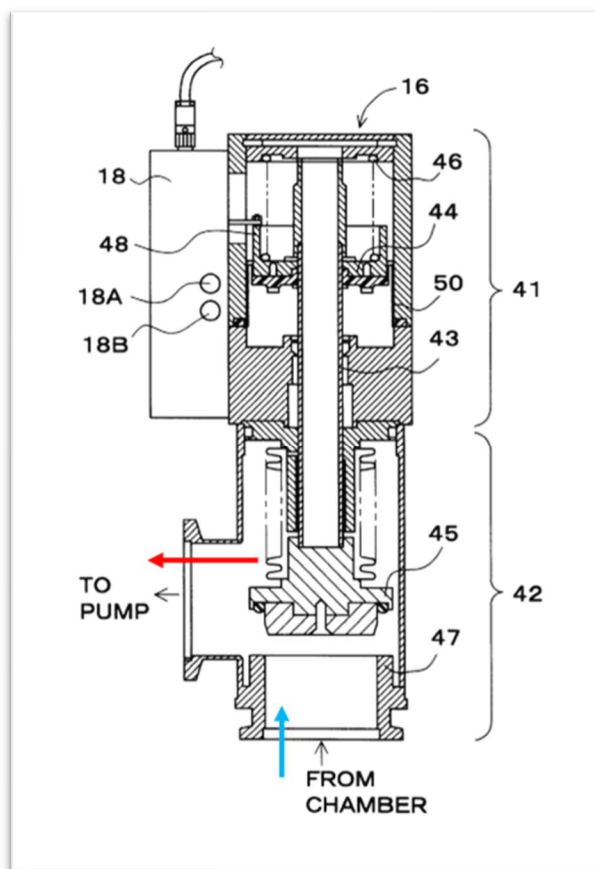
⁶³ *Kotapish* [0010]

⁶⁴ *Kotapish* [0017]

⁶⁵ *Kotapish* [0018]

⁶⁶ *Koketsu* US Patent No 6,289,737 B1

state.⁶⁷ Fig. 4 contains an inlet port (marked “from chamber”) and an outlet port (marked “to pump”), which are not concentric or coaxial with each other.



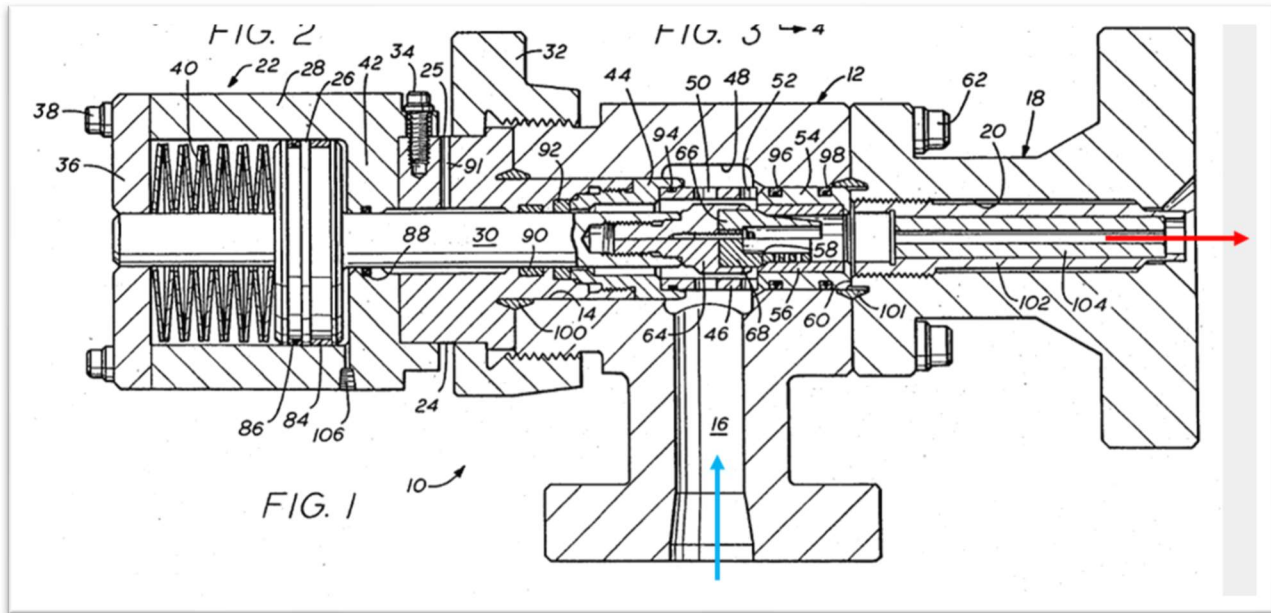
96. As yet another example, *Etheridge*⁶⁸ contains Figure 1 (annotated below), which shows “a longitudinal cross-sectional view of the control valve.”⁶⁹ Fig. 1 shows a “flow inlet passage 16 which intersects the operating chamber 14” and a

⁶⁷ *Koketsu* 6:28-31

⁶⁸ US Patent No. 4,774,980

⁶⁹ *Etheridge* 2:54-55

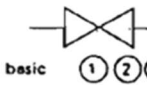
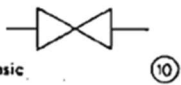
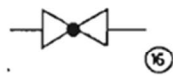
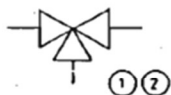
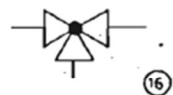
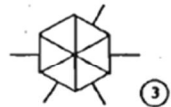
“cylindrical discharge outlet passage **20** in alignment with the cylindrical operating chamber **14**.”⁷⁰ In this example, the inlet and outlet passages are not concentric or coaxial (i.e., inline) but have an angle between them (shown as near 90 degrees).



97. Further, as evidenced by the 1979 publication *Chemical Engineering Drawing Symbols* (“*Drawing Symbols*”) published by John Wiley & Sons, a POSITA would have understood the fundamental difference between “in-line” valves, such as claimed in the ’609 Patent, and “angle valves,” such as taught in *Tettleton*. For example, page 77 of *Drawing Symbols* shows both in-line valves (annotated in red) and angle valves (annotated in blue).

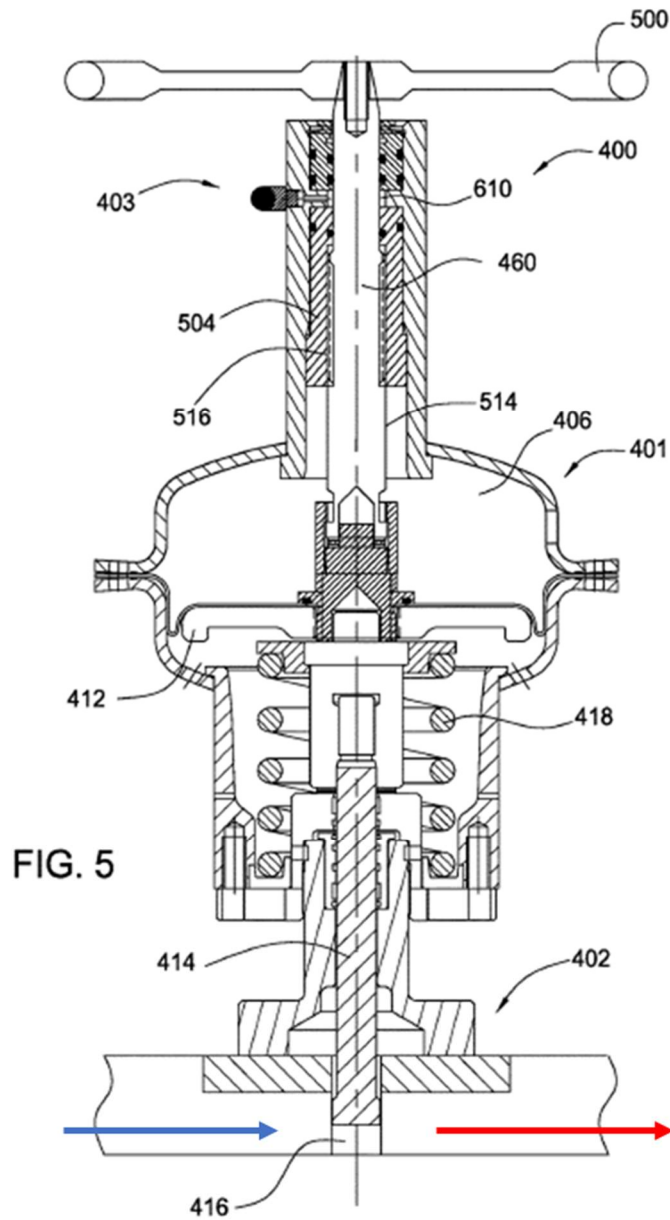
⁷⁰ *Etheridge* 3:6-12

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	BS	ANSI(ASA)	Alternative	Alternative
In-line valve (any type or pattern)	 basic ① ② ③ ⑥	 basic ⑩		
Straightway valve			 ⑯	
Simple screwdown valve	 ①			
Three-way valve	 ① ②		 ⑯	
Four-way valve	 ① ②			
Multi-way valve <i>Show as many leads as are required, one to each side of hexagon.</i> Illustrated: 5-way valve.	 ③			
Angle valve	 ① ③ ⑥	 ⑩	 ⑯	 ⑭ ⑮ ⑱

As would have been clear to a POSITA, in-line valves have inlet and outlet ports “in-line” or concentrically or coaxially organized. In contrast, angle valves have the inlet and outlet ports not concentrically or coaxially organized (i.e., the inlet and outlet ports have an angle between them). The valve in the claim, and described elsewhere in the ’609 Patent, is in-line and not an angle valve. For example, Fig. 5 of the ’609 Patent is exemplary.

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Ex 1007 Fig. 5

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98. The '609 Patent discloses, “Fig. 5 is a sectional view of the gate valve in an open position”.⁷¹

99. Lastly, according to Merriam-Webster’s online dictionary, from the time of the filing of the '609 Patent,⁷² the ordinary and customary meaning of “in-line” is “having the parts or units arranged in a straight line.”



100. Based on this definition, a POSITA would have understood the ordinary and customary meaning of “safety valve in-line” as being in-line valves with inlet and outlet ports being arranged in a straight line, i.e., concentrically or

⁷¹ Ex 1007 1:45-46

⁷² <https://web.archive.org/web/20161018114018/https://www.merriam-webster.com/dictionary/in-line> I understand the URL to mean that the web pages were archived on October 18, 2016, just 3 months prior to the filing of the application which led to the '609 Patent.

coaxially arranged, and not angle valves that have inlet and outlet ports at an angle relative to each other (i.e., not concentrically or coaxially arranged).

101. In a system with highly abrasive fluid streams, such as drilling mud or fracturing slurry, an in-line valve would benefit from wear and erosion of the internal components of the valve. In an angle valve, the slurry must change direction ($\sim 90^\circ$), as shown in the figures. The highly abrasive slurry would strike the “back wall” of the inlet port and cause additional erosion. Significant turbulence would also be created (more than an in-line valve), leading to further erosion of the valve's interior components. Additionally, an in-line valve has a lower pressure drop than an angle valve, allowing for easier upstream pressure relief.

- c. **Claim 1(i): “a fluid drive assembly in communication with the controller assembly, wherein the controller assembly is operable to actuate the fluid drive assembly to supply fluid to the valve actuator to move the safety valve into the closed position, and wherein the controller assembly is operable to actuate the valve assembly in response to a comparison of the measured physical property to the predetermined condition to release the fluid from the valve actuator to move the safety valve into the open position and thereby open fluid flow through the second fluid line to return fluid in the first fluid line back to the fluid supply or direct fluid in the first fluid line to the different reservoir.”**

102. This claim limitation requires the system to “return fluid in the first fluid line back to the fluid supply or direct fluid in the first fluid line to the different reservoir” when the valve assembly is moved to the open position. As discussed

above regarding Claim 1(e), *Tettleton* fails to disclose a second fluid line “configured to return fluid from the first fluid line back to the fluid supply or direct fluid from the first fluid line to a different reservoir;” For the same reasons as those discussed above regarding Claim 1(e) in Section XII.A.a, *Tettleton* does not disclose the similar language in 1(i). Accordingly, *Tettleton* does not disclose claim limitation 1(i).

B. DEPENDENT CLAIM 4: “4. THE SYSTEM OF CLAIM 1, WHEREIN THE FLUID DRIVE ASSEMBLY IS A COMPRESSOR AND THE FLUID SUPPLIED TO THE VALVE ACTUATOR BY THE FLUID DRIVE ASSEMBLY IS A PNEUMATIC FLUID.”

103. Claim 4 depends from Claim 1 and contains all the limitations of Claim

1. As discussed above, *Tettleton* fails to disclose all the elements of Claim 1. Accordingly, *Tettleton* fails to disclose all the elements of Claim 4. *Tettleton*, therefore, fails to anticipate Claim 4.

C. DEPENDENT CLAIM 5: “5. THE SYSTEM OF CLAIM 1, WHEREIN THE FLUID DRIVE ASSEMBLY IS A PUMP AND THE FLUID SUPPLIED TO THE VALVE ACTUATOR BY THE FLUID DRIVE ASSEMBLY IS A HYDRAULIC FLUID.”

104. Claim 5 depends from Claim 1 and contains all the limitations of Claim

1. As discussed above, *Tettleton* fails to disclose all the elements of Claim 1. Accordingly, *Tettleton* fails to disclose all the elements of Claim 5. *Tettleton*, therefore, fails to anticipate Claim 5.

D. DEPENDENT CLAIM 8: “8. THE SYSTEM OF CLAIM 1, WHEREIN THE FLUID SUPPLIED TO THE VALVE ACTUATOR BY THE FLUID DRIVE ASSEMBLY IS AMBIENT AIR.”

105. Claim 8 depends from Claim 1 and contains all the limitations of Claim

1. As discussed above, *Tettleton* fails to disclose all the elements of Claim 1. Accordingly, *Tettleton* fails to disclose all the elements of Claim 8. *Tettleton*, therefore, fails to anticipate Claim 8.

E. DEPENDENT CLAIM 10: “10. THE SYSTEM OF CLAIM 1, WHEREIN THE CONTROLLER ASSEMBLY IS A PROGRAMMABLE LOGIC CONTROLLER.”

106. Claim 10 depends from Claim 1 and contains all the limitations of

Claim 1. As discussed above, *Tettleton* fails to disclose all the elements of Claim 1. Accordingly, *Tettleton* fails to disclose all the elements of Claim 10. *Tettleton*, therefore, fails to anticipate Claim 10.

XIII. GROUND 2: CLAIMS 2, 3, 6, 7, 11, 12, 13, 14, 15 & 16 ARE NOT OBVIOUS OVER THE COMBINATION OF *TETTLETON* AND *COTHAM*

107. Petitioner cites *Tettleton* in combination with *Cotham* as rendering Claims 2, 3, 6, 7, 11, 12, 13, 14, 15, and 16 obvious. Not so. *Tettleton* and *Cotham*, alone and in combination, fail to disclose all the elements of Claims 2, 3, 6, 7, 11, 12, 13, 14, 15, and 16. In addition, one of ordinary skill in the art would not have been motivated to combine *Tettleton* and *Cotham* as asserted by Petitioner.

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Accordingly, the combination of *Tettleton* and *Cotham* fails to render Claims 2, 3, 6, 7, 11, 12, 13, 14, 15, and 16 obvious.

A. THERE IS NO MOTIVATION TO COMBINE THE REFERENCES

108. Neither the Petition nor the declaration of Dr. Stevick provide any rationale for a motivation to combine the references in the way Petitioner argues. Indeed, there is no such motivation to combine the references.

a. Dr. Stevick's declaration is devoid of any rationale for the combinations

109. Dr. Stevick's declaration contains no rationale for why a POSITA would have been motivated to combine the references. In fact, Dr. Stevick's declaration is devoid of any analysis regarding why a POSITA would have been motivated to combine the references. Dr. Stevick addresses a motivation to combine in paragraphs 56 – 61. However, these paragraphs are simply a series of conclusory statements and broad quotes from some references.

110. For example, in Paragraph 56, Dr. Stevick states, "In my opinion, a POSITA would have been motivated and capable of combining the teachings of *Tettleton*, *Cotham*, and *Tubel* to render the challenged claims obvious. My opinion is based on what was known by POSITA prior to the alleged invention of the '609 patent as shown by evidence cited in this declaration and what was known to

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POSITA based on my personal experience discussed in this declaration.”⁷³ No rationale or support for this conclusory statement is provided.

111. In Paragraph 57, Dr. Stevick restates his conclusory opinion differently: “In my opinion, a POSITA would have known the disclosed elements of the claimed invention and would have understood to combine the disclosed elements for their known purpose to construct the claimed system.”⁷⁴ Again, no rationale of motivation or explanation for what would have led a POSITA to combine the references is provided.

112. Paragraphs 58 – 60 provide summaries and quotations from various sources. However, what is glaringly missing is any analysis of why these quotes and summaries would have led a POSITA to combine the references, much less combine them in the manner the Petitioner alleges.

113. Finally, in Paragraph 61, Dr. Stevick concludes this section of his declaration with another conclusory statement: “Based on my experience and my review of the prior art noted herein, the needs and problems to which the challenged claims are directed were known by POSITA at the time of the alleged invention and were also noted in the teachings of prior art at the time, including the publications

⁷³ Ex 1027 at 56.

⁷⁴ Ex 1027 at 57.

noted in this declaration. In light of these teachings and what was known by POSITA at the time, POSITA would have been motivated to combine the teachings of *Tettleton*, *Cotham*, and *Tubel* with success to render the challenged claims obvious.”⁷⁵ Yet again, this conclusory statement contains no analysis or rationale discussing why a POSITA would have been motivated to combine the references, or why a POSITA would have combined them “with success.”

b. The Petition is devoid of any rationale for the combinations and relies on misapplied regulations

114. The Petition is equally devoid of any such analysis. The section of the Petition dedicated to discussing the purported motivation to combine similarly summarizes several references and then relies on Dr. Stevick’s declaration as to how a POSITA would have understood these references.⁷⁶ Dr. Stevick’s declaration is devoid of a rationale for combining the references and provides no analysis as to why a POSITA would have combined the references or why a POSITA would have had a reasonable expectation of success; Dr. Stevick’s declaration provides no support for these otherwise conclusory arguments.

⁷⁵ Ex 1027 at 61.

⁷⁶ See, e.g., Paper 2 at 55 – 57.

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115. The Petition further attempts to bolster its argument by relying on “government regulations known at filing.” Petitioner claims that “the regulations illustrate the “background knowledge, creativity, and common sense of the person of ordinary skill [in the art.]””. However, the regulations provide *no* understanding of what a POSITA would have known at the time of filing the ’609 Patent and are in no way applicable to the field of the ’609 Patent. The references that the Petition relies on are contained in Ex 1030 and are “Process safety management of highly hazardous chemicals” in regulation number 1910.119 of the Occupational Safety and Health Standards promulgated by the US Department of Labor Occupational Safety and Health Administration.

116. Contained in 1910.119 is 1910.119(a)(2), which lists locations, operations, and industries to which the regulations do not apply”. Included in this section are “Oil or gas well drilling or servicing operations.”⁷⁷

⁷⁷ Ex 1030 at 1910.119(a)(2)

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1910.119(a)(2)

This section does not apply to:

1910.119(a)(2)(i).

Retail facilities;

1910.119(a)(2)(ii).

Oil or gas well drilling or servicing operations; or,

1910.119(a)(2)(iii).

Normally unoccupied remote facilities.

117. Accordingly, a POSITA would not have relied on any teachings of the “government regulations” when looking at art relating to “oil and gas well drilling or servicing operations,” including the art of *Tettleton*, *Tubel*, *Cotham*, or the ’609 Patent. To the extent that the “government regulations” provide any information to a POSITA, these regulations would teach against using the systems described in the rules in any “oil or gas well drilling or servicing operations.”

c. The references are in different fields of endeavor and teach opposing methods

118. Further, the references themselves are in different fields of endeavor. *Tettleton* describes “a pressure relief valve assembly useful for relieving fluid pressure in a pressurized device.”⁷⁸ *Tettleton* further describes the invention relates

⁷⁸ Ex 1016 Abstract

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to “drilling fluid or “mud” systems; to relief valves for such systems; and to apparatus, systems, and methods for relieving fluid pressure in pressurized systems.”⁷⁹ Accordingly, *Tettleton*, like the ’609 Patent, teaches art regarding “pressure relief devices” in “drilling fluid or mud systems.” A POSITA would have understood *Tettleton* teaching assemblies for removing pressure from a drilling system by *opening* valves to allow venting or release of fluid from the closed drilling mud system to the atmosphere.⁸⁰

119. Neither *Tubel* nor *Cotham* are directed to pressure relief systems, nor are they directed to drilling systems. *Tubel* and *Cotham* address closing-in an otherwise open and flowing wellhead to contain the pressure downhole rather than releasing it into the production flowline or the atmosphere.

120. *Cotham* describes a method for “providing power to a system for controlling a wellhead from a self-contained stand-alone power source.”⁸¹ *Cotham*’s method includes “using valve to control flow of fluids from within the well and from the well in one or more flow lines and monitoring various parameters [] including but not limited to fluid pressures and emergency conditions, and shutting in the well

⁷⁹ Ex 1016 [0002]

⁸⁰ See discussing regarding exit line 17 contained in Section XII.A.a.

⁸¹ Ex 1019 at Abstract.

in response.”⁸² Accordingly, a POSITA would have understood *Cotham* to discuss methods to “shut in” the well by *closing* valves and containing the pressure downhole in the formation and wellbore. *Tettleton* does describe two angle body relief valves. However, such valves are described as “¼” NPT SST, 10,000 PSI, Poppet Type” valves.⁸³ These valves are used to relieve hydraulic fluid from the control system of *Cotham*.⁸⁴ These would not be suitable for venting or releasing high-pressure well fluid. The very small orifice contained in such the ¼” valves of *Cotham* would become plugged with drilling mud, which has a relatively high weight (i.e. density) and viscosity as compared with hydraulic fluid. Further, the ¼” valves would not relieve significant pressure from a drilling mud system as the volume of fluid in a drilling mud system is orders of magnitude higher than that of a system containing merely hydraulic lines. Common drilling mud systems provide wellbores of around 10” diameter for tens of thousands of feet underground. Typical hydraulic systems comprise hundreds of feet (or less) of hydraulic line, typically around 1” or smaller.

⁸² Ex 1019 at Abstract

⁸³ Ex 1019 Fig. 6.

⁸⁴ See, e.g., Ex 1019 9:7-12; 10:23-25.

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121. Like *Cotham*, *Tubel* directs production operations (as opposed to drilling operations) and shuts in wells to contain the pressurized fluid in the wellbore and the formation. *Tubel* describes that a “downhole control system for a production well is associated with permanent downhole formation evaluation sensors.”⁸⁵ These sensors are located beneath the surface of the earth (i.e., Downhole) and measure “formation parameters”⁸⁶ and “actual downhole parameters (such as pressure, temperature, flow, gas influx, etc. and automatically execute control instructions when the monitored downhole parameters are outside a selected operating range” indicating an unsafe condition.⁸⁷ When these downhole and formation parameters are outside the operating ranges, the well is shut in by causing “an electromechanical control device (such as a valve) to actuate a suitable tool (for example, actuate a sliding sleeve or packer, or close a pump or other fluid flow device.”⁸⁸ *Tubel* further teaches the use of a downhole “shut-in valve” to accomplish this action.⁸⁹

⁸⁵ Ex 1021 at Abstract

⁸⁶ Ex 1021 at Abstract

⁸⁷ Ex 1021 4:57-62

⁸⁸ Ex 1021 62-65.

⁸⁹ Ex 1021 23–50.

122. Absent the teaching of the '609 Patent or any rationale describing why a POSITA would have combined the teachings of drilling systems designed to release pressurized fluid with production systems designed to contain pressurized fluid, a POSITA would not have been motivated to combine the references.

B. DEPENDENT CLAIM 2: “2. THE SYSTEM OF CLAIM 1, FURTHER COMPRISING A HOUSING FOR SUPPORTING THE CONTROLLER ASSEMBLY, THE VALVE ASSEMBLY, AND THE FLUID DRIVE ASSEMBLY.”

123. Claim 2 depends from Claim 1 and contains all the limitations of Claim 1. Petitioner referenced arguments that *Tettleton* discloses all the elements of Claim 1. As discussed above, *Tettleton* fails to disclose all the elements of Claim 1. Petitioner points to no portion of *Cotham* that fills in the missing elements, as discussed above regarding Claim 1. Accordingly, the combination of *Tettleton* and *Cotham* fails to render Claim 2 obvious.

C. DEPENDENT CLAIM 3: “3. THE SYSTEM OF CLAIM 2, WHEREIN THE FLUID SUPPLIED TO THE VALVE ACTUATOR BY THE FLUID DRIVE ASSEMBLY IS SUPPLIED FROM A RESERVOIR DISPOSED OUTSIDE OF THE HOUSING.”

124. Claim 3 depends from Claim 2, which further depends from Claim 1 and contains all the limitations of Claim 2 and Claim 1. Petitioner referenced arguments that *Tettleton* discloses all the elements of Claim 2. As discussed above, *Tettleton* fails to disclose all the elements of Claim 1. Petitioner points to no portion of *Cotham* that fills in the missing elements, as discussed above regarding Claim 1.

Accordingly, the combination of *Tettleton* and *Cotham* fails to render Claim 3 obvious.

D. DEPENDENT CLAIM 6: “6. THE SYSTEM OF CLAIM 1, FURTHER COMPRISING A POWER SOURCE FOR SUPPLYING POWER TO THE CONTROLLER ASSEMBLY, THE VALVE ASSEMBLY, AND THE FLUID DRIVE ASSEMBLY.”

125. Claim 6 depends from Claim 1 and contains all the limitations of Claim 1. Petitioner simply referenced arguments that *Tettleton* discloses all the elements of Claim 1. As discussed above, *Tettleton* fails to disclose all the elements of Claim 1. Petitioner points to no portion of *Cotham* that fills in the missing elements, as discussed above regarding Claim 1. Accordingly, the combination of *Tettleton* and *Cotham* fails to render Claim 6 obvious.

E. DEPENDENT CLAIM 7: “7. THE SYSTEM OF CLAIM 1, FURTHER COMPRISING A HOUSING FOR SUPPORTING THE FLUID DRIVE ASSEMBLY, AND A FILTER ATTACHED TO THE HOUSING FOR FILTERING FLUID ENTERING THE HOUSING BY THE FLUID DRIVE ASSEMBLY.”

126. Claim 7 depends from Claim 1 and contains all the limitations of Claim 1. Petitioner simply referenced arguments that *Tettleton* discloses all the elements of Claim 1. As discussed above, *Tettleton* fails to disclose all the elements of Claim 1. Petitioner points to no portion of *Cotham* that fills in the missing elements, as discussed above regarding Claim 1. Accordingly, the combination of *Tettleton* and *Cotham* fails to render Claim 7 obvious.

F. INDEPENDENT CLAIM 11

127. As discussed below, not all the claim elements of Claim 11 are disclosed or rendered obvious by *Tettleton* and *Cotham*. Because not all the Claim elements are disclosed or suggested by *Tettleton* and *Cotham*, the combination fails to render Claim 11 obvious. Certain claim limitations and elements not disclosed or taught by *Tettleton* or *Cotham* are discussed below.

- a. **11(d): “a second fluid line in fluid communication with the first fluid line at a location downstream of the pump and configured to return fluid from the first fluid line back to the fluid supply or direct fluid from the first fluid line to a different reservoir;”**

128. Petitioner claims “*Tettleton* expressly and inherently discloses a second fluid line (17) in fluid communication with the first fluid line (19) downstream on the pump (16) configured to return fluid from the first fluid line (19) to a different reservoir.”⁹⁰ I disagree.

129. *Tettleton* does not disclose “a second fluid line in fluid communication with the first fluid line at a location downstream of the pump and configured to return fluid from the first fluid line back to the fluid supply or direct fluid from the first fluid line to a different reservoir.” Petitioner claims “*Tettleton* also discloses a method by which the system regulates pressure within the system by releasing fluid

⁹⁰ Pet. at 24

into a different reservoir when the pressure exceeds a predetermined threshold.”⁹¹ However, Petitioner’s expert, Dr. Stevick, contradicts this claim: “*Tettleton* does not explicitly disclose that fluid is transferred to a reservoir as a result of the pressure relief valve being actuated.”⁹² Further, there is no teaching in *Tettleton* that the fluid line is “configured to return fluid from the first fluid line to the fluid supply.”⁹³

130. Dr. Stevick goes on to state that transferring fluid to a reservoir as a result of the pressure relief valve being actuated “is inherent to the reduction of pressure within the otherwise closed system that is explicitly disclosed by *Tettleton*.”⁹⁴ Further, Dr. Stevick states, “fluid must be redirected to a different location than the closed fluid line system. This alternative location would be either back to the fluid supply or another reservoir”.⁹⁵ Dr. Stevick’s statement is conclusory, incorrect, and inconsistent with the teaching of *Tettleton* and other references.

⁹¹ Paper 2 pg. 22

⁹² Ex 1027 at 47.

⁹³ See, e.g., Ex 1016 [0040] – [0041], Figs. 1 and 3 and generally.

⁹⁴ Ex 1027 at 47

⁹⁵ Ex 1027 at 47

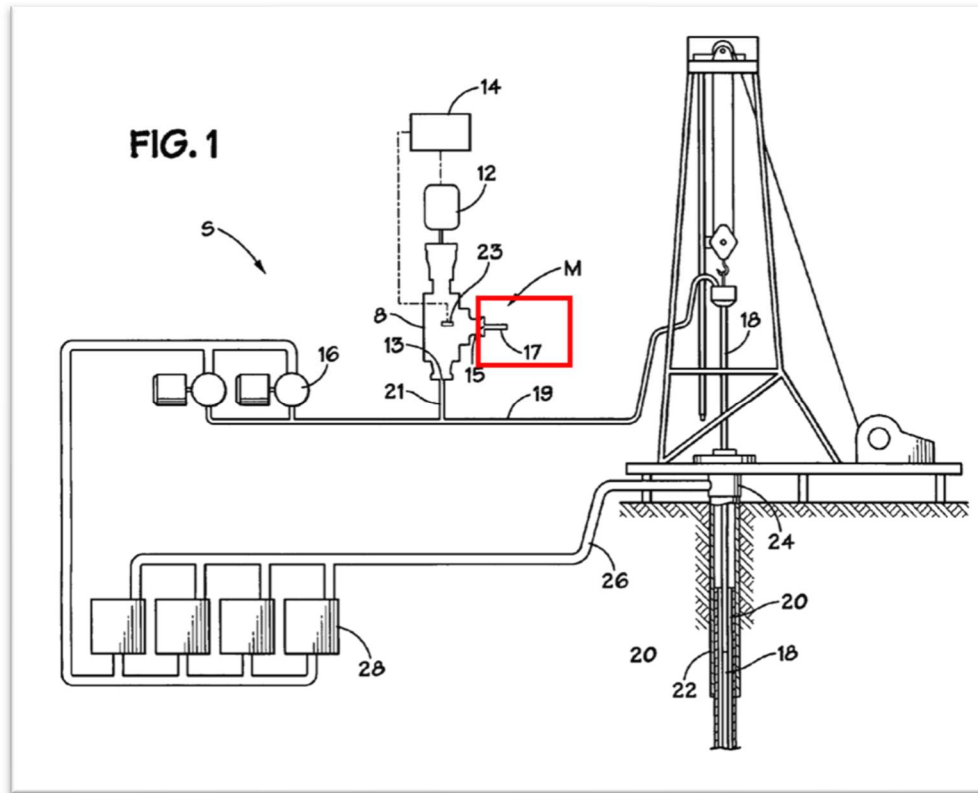
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131. *Tettleton* teaches an “exit line **17**”⁹⁶ that Petitioner points to as the second fluid line of Claim 1. *Tettleton* teaches, “[w]hen the mud pressure exceeds the pre-selected pressure, the valve **10** opens and the mud that was previously flowing to the drill stem **18** flows through the inlet **13** of the valve 8 and exits through an outlet **15** into an exit line **17**.”⁹⁷ Fig. 1 of *Tettleton* is “a schematic view of a system according to the present invention with a relief valve according to the present invention.”⁹⁸ Fig. 1 is duplicated below with “exit line **17**” annotated in red. Other than the single sentence in [0041] and Fig. 1, *Tettleton* does not address “exit line **17**” or its connections.

⁹⁶ Ex 1016 [0042]

⁹⁷ Ex 1016 [0041]

⁹⁸ Ex 1016 [0025]



132. As seen in Fig. 1, *Tettleton* shows exit line **17** connected to outlet **15** of valve **8** on one end and not connected on the other. There is simply no teaching in *Tettleton* of exit line **17** returning fluid to anything, much less the fluid supply or another reservoir. Further, a POSITA reading *Tettleton* would have understood that *Tettleton* is teaching that exit line **17** is open-ended, and the relieved fluid would be undirected as to location (i.e., directed to the atmosphere). A POSITA would have understood this was a common practice in oil and gas operations.

133. As another example, US Patent 6,796,321 to Berton Vicars (“*Vicars*” or “the ‘321 Patent”) filed June 19, 2002, and issued September 28, 2004, addresses a pressure relief valve used in oil and gas fracturing operations. According to *Vicars*,

when the fluid pressure in the system exceeds, the pressure relief valve will open, and “[f]luid may now pass from the pumping chamber **18** through cage **12** and out to the atmosphere”.⁹⁹ Accordingly, despite Dr. Stevick’s conclusory statement, it is not inherent for the second fluid line to be configured to return fluid from the first fluid line to the fluid supply or another reservoir.

134. Petitioner states, in footnote 6, “[f]or the element of independent claim 1 to be disclosed it is not necessary for *Tettleton* to disclose the second fluid line in fluid communication with the first fluid line at a location downstream of the pump and configured to return fluid from the first fluid line back to the fluid supply or another reservoir.”¹⁰⁰ I disagree. Because it is not inherent for the second fluid line to be configured to return fluid back to the fluid supply or another reservoir, *Tettleton* must disclose the entire claim limitation for Claim 11 (d) to be disclosed by *Tettleton*. As it does not, the combination of *Tettleton* and *Cotham* fails to render the limitation obvious.

b. 11(e): “a safety valve in-line with the second fluid line;”

135. Petitioner claims, “*Tettleton* discloses a safety valve (8) in-line with the second fluid line (17).” This is incorrect. *Tettleton* does not disclose “a safety valve

⁹⁹ Vicars 4:47-48. See also 2:56-58,

¹⁰⁰ Paper 2 footnote 6 pg. 26

in-line with the second fluid line”. In fact, *Tettleton* teaches against such a configuration.

136. Neither Dr. Stevick’s declaration nor the Petition addresses the “safety valve in-line” claim term. Dr. Stevick’s declaration jumps straight from a discussion of the discharge line limitation (discussed above in Section XII.A.a) to a discussion of a “gate” limitation.¹⁰¹ The petition similarly ignores this claim element.¹⁰² Unsurprisingly, Stevick and the Petition ignore this claim element, as *Tettleton* teaches against it.

137. *Tettleton* describes its safety relief valve as having “an angle-body configuration and/or a fluid flow path with approximately a ninety-degree turn.”¹⁰⁴ According to *Tettleton*, “[i]n an “angle-body” valve, the axis of the first passageway **130** is not concentric or coaxial with [] the axis of the second passageway **140**.”¹⁰⁵ This is visually evident in the figures of *Tettleton*, of which Fig. 3A is exemplary. In

¹⁰¹ See, e.g., Ex 1027 at 47-48. The ‘609 patent does not contain a “gate” limitation. However, Dr. Stevick’s declaration does discuss such a limitation.

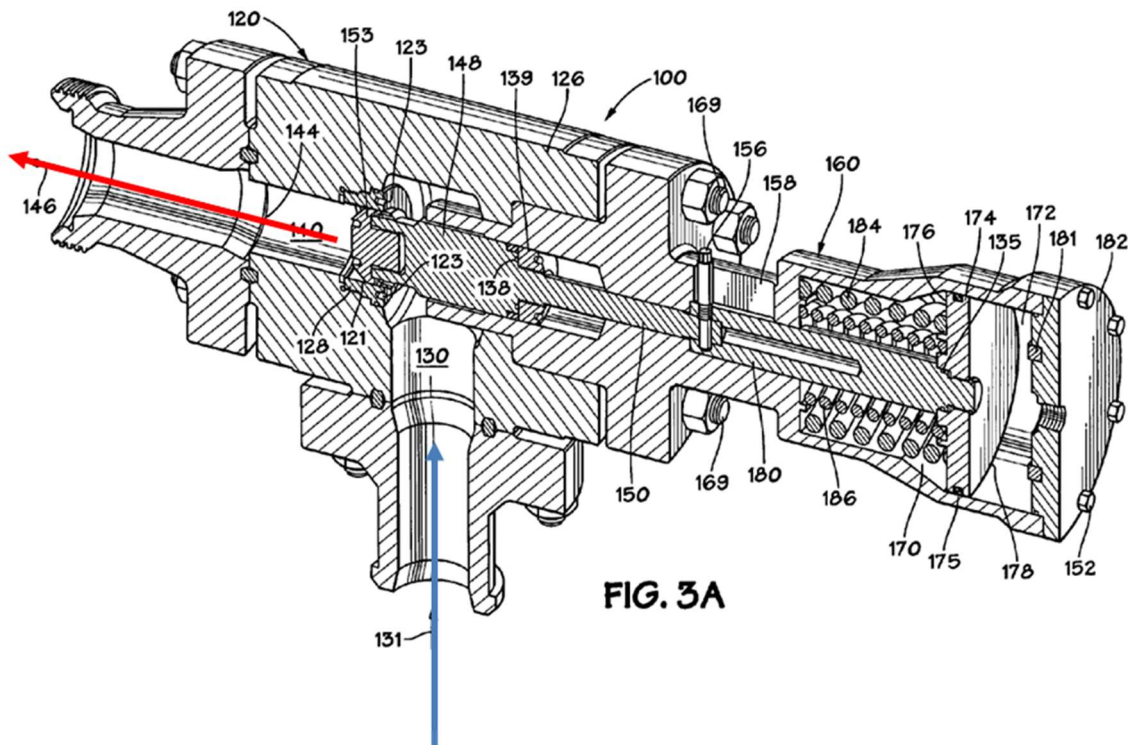
¹⁰² See, e.g., Paper 2 at 26-27.

¹⁰⁴ Ex 1016 [0008]. See also [0010], [0013], [0043].

¹⁰⁵ Ex 1016 [0043].

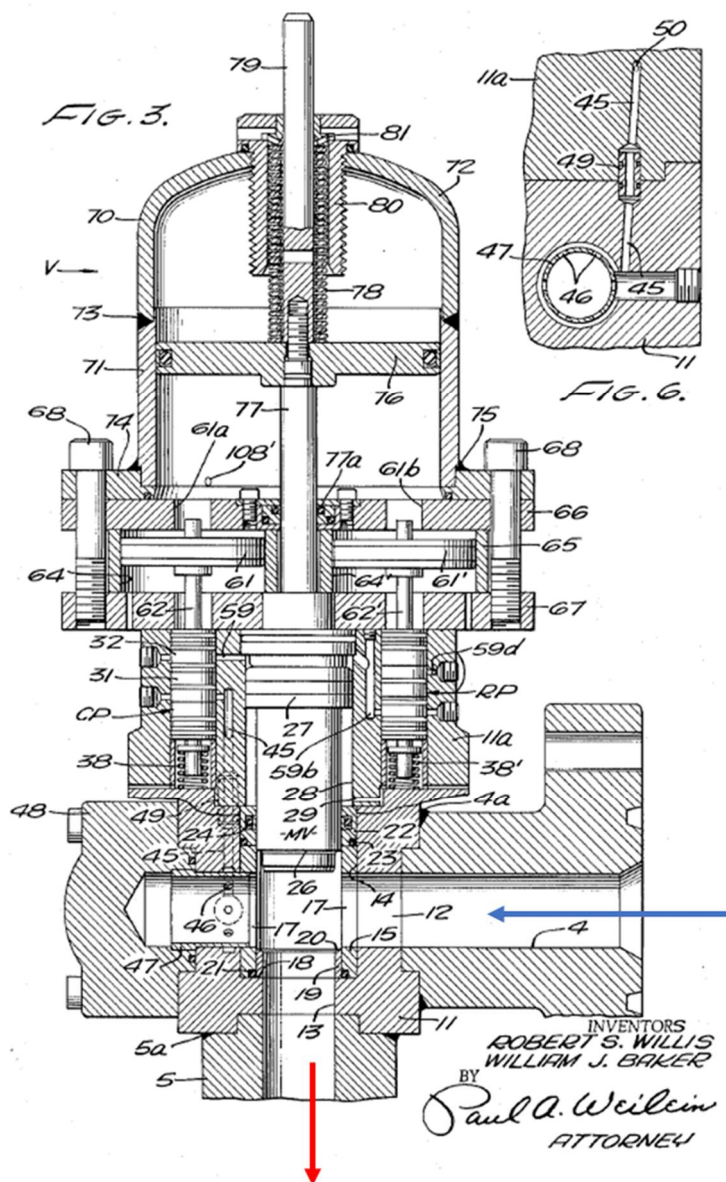
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the figure below, the “first passageway” is shown with a blue arrow, and the “second passageway” is shown with a red arrow.



138. This is the “normal” configuration for pressure relief valves, as pressure relief valves have been “globe” type valves, as the *Tettleton* valve is. This angle-body configuration is shown in, for example, Fig. 3 of Ex. 1003

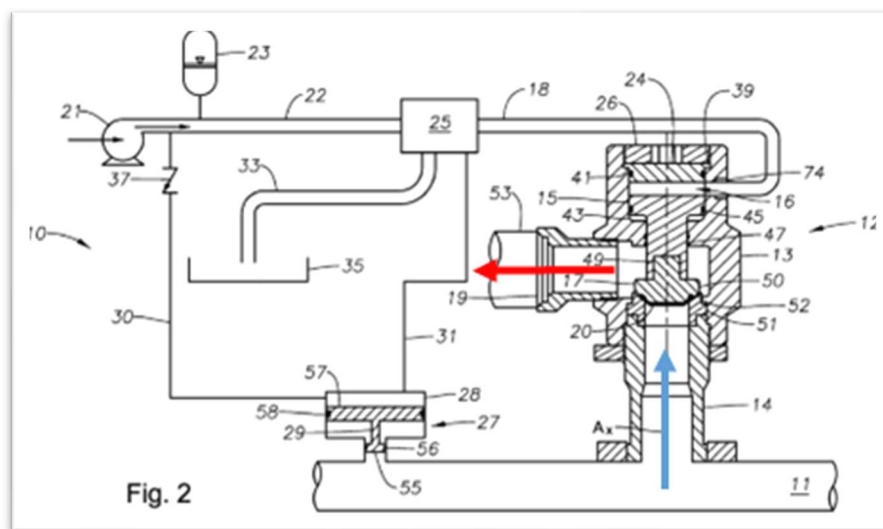
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Ex 1003, Fig. 3

139. The face of the '609 Patent lists several other pieces of art that also identify angle body valves. These valves have similar characteristics to the valve in *Tettleton* in that, in each case, the axis of the inlet passageway is not concentric or coaxial with the axis of the discharge passageway.

140. For example, Fig. 2 of *Kotapish*¹⁰⁶ (annotated below) is a “side partial sectional view of a relieving system,”¹⁰⁷ including “relief valve **12** [] with annular inlet **14**”¹⁰⁸ and “annular relief port **19**”.¹⁰⁹ As shown in Fig. 2, the inlet port **14** is not coaxial or concentric with the relief (outlet) port **19**.



141. As another example, *Koketsu*¹¹⁰ Figure 4 (annotated below) is a “cross-sectional view of a vacuum proportional opening and closing valve” in an open

¹⁰⁶ US Patent Publication No. 2010/0154894

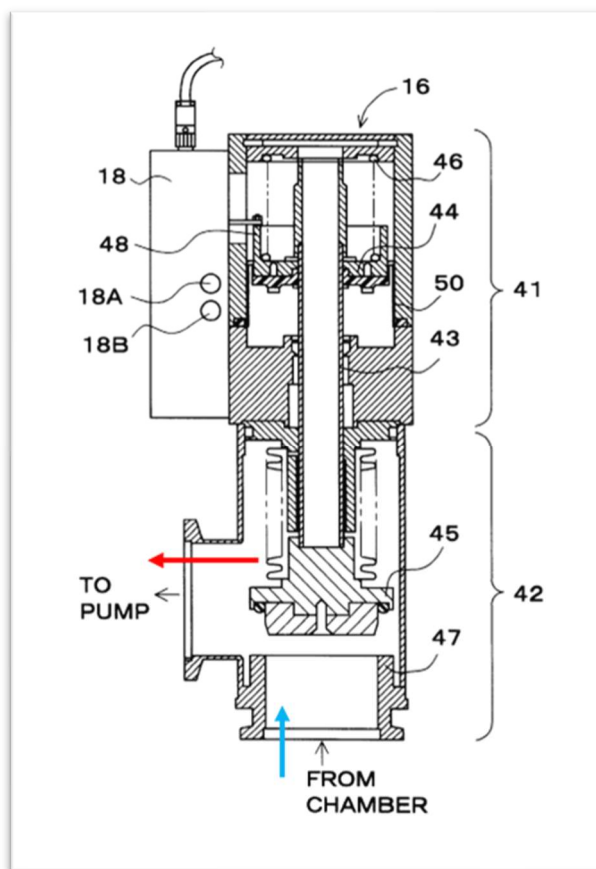
¹⁰⁷ *Kotapish* [0010]

¹⁰⁸ *Kotapish* [0017]

¹⁰⁹ *Kotapish* [0018]

¹¹⁰ *Koketsu* US Patent No 6,289,737 B1

state.¹¹¹ Fig. 4 contains an inlet port (marked “from chamber”) and an outlet port (marked “to pump”), which are not concentric or coaxial with each other.



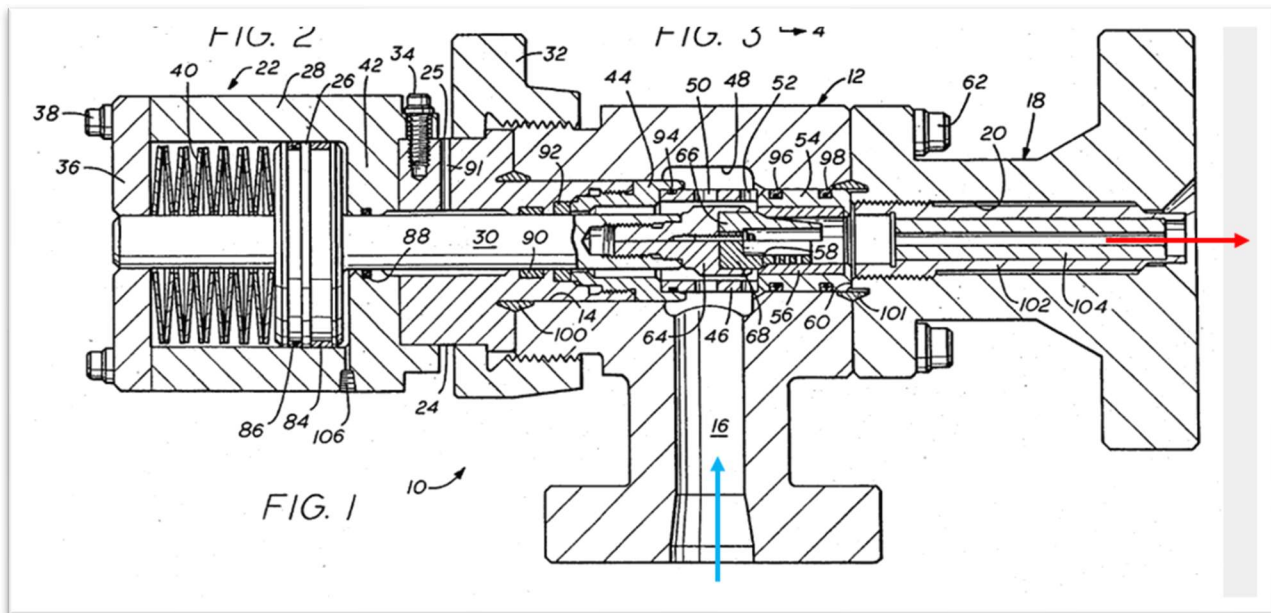
142. As yet another example, *Etheridge*¹¹² contains Figure 1 (annotated below), which shows “a longitudinal cross-sectional view of the control valve.”¹¹³ Fig. 1 shows a “flow inlet passage **16** which intersects the operating chamber 14”

¹¹¹ *Koketsu* 6:28-31

¹¹² *Etheridge* US Patent No. 4,774,980

¹¹³ *Etheridge* 2:54-55

and a “cylindrical discharge outlet passage 20 in alignment with the cylindrical operating chamber 14.”¹¹⁴ In this example, the inlet and outlet passages are not concentric or coaxial (i.e., inline) but have an angle between them (shown as near 90 degrees).



143. Further, as evidenced by the 1979 publication *Chemical Engineering Drawing Symbols* (“*Drawing Symbols*”) published by John Wiley & Sons, a POSITA would have understood the fundamental difference between “in-line” valves, such as claimed in the ’609 Patent, and “angle valves,” such as taught in *Tettleton*. For example, page 77 of *Drawing Symbols* shows both in-line valves (annotated in red) and angle valves (annotated in blue).

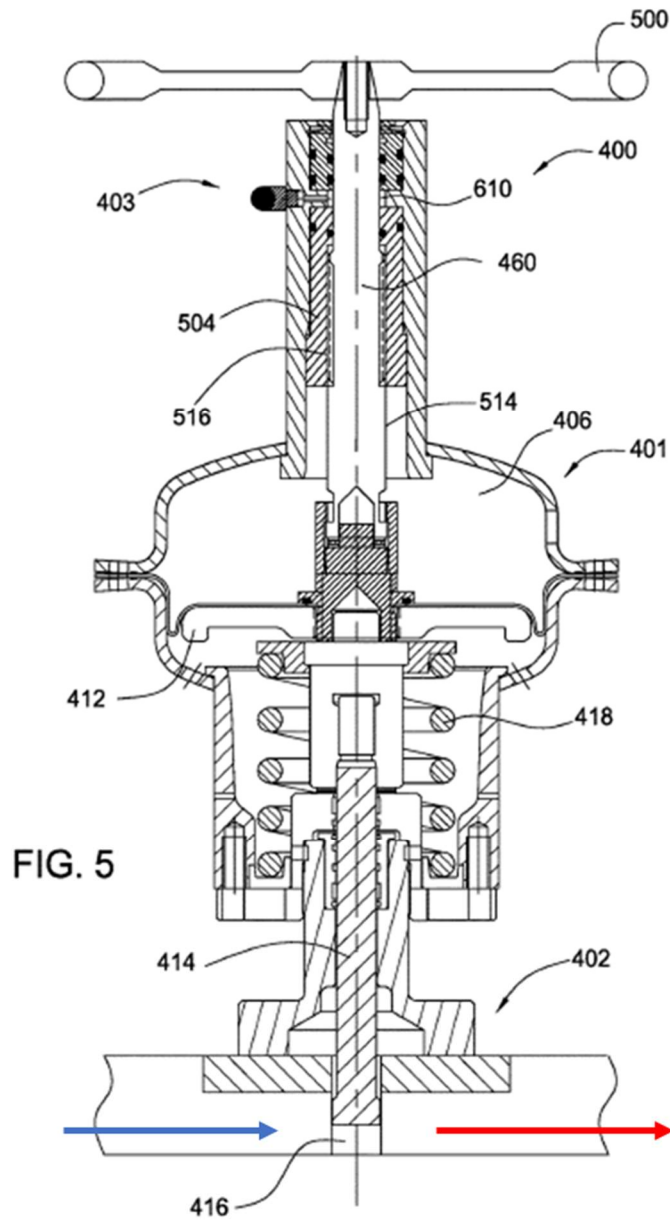
¹¹⁴ *Etheridge* 3:6-12

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	BS	ANSI(ASA)	Alternative	Alternative
In-line valve (any type or pattern)	 basic ① ② ③ ⑥	 basic ⑩		
Straightway valve			 ⑫	
Simple screwdown valve	 ①			
Three-way valve	 ① ②		 ⑫	
Four-way valve	 ① ②			
Multi-way valve <i>Show as many leads as are required, one to each side of hexagon.</i> Illustrated: 5-way valve.	 ③			
Angle valve	 ① ③ ⑥	 ⑩	 ⑫	 ⑭ ⑮ ⑯

As would have been clear to a POSITA, inline valves have inlet and outlet ports “in-line” or concentrically or coaxially organized. In contrast, angle valves have the inlet and outlet ports not concentrically or coaxially organized (i.e., the inlet and outlet ports have an angle between them.) The valve in the claim, and described elsewhere in the ’609 Patent, is in-line and not an angle valve. For example, Fig. 5 of the ’609 Patent is exemplary.

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Ex 1007 Fig. 5

144. The '609 Patent discloses "Fig. 5 is a sectional view of the gate valve in an open position."¹¹⁵

145. In a system with highly abrasive fluid streams, such as drilling mud or fracturing slurry, an in-line valve would benefit from wear and erosion of the internal components of the valve. In an angle valve, the slurry must change direction ($\sim 90^\circ$), as shown in the figures. The highly abrasive slurry would strike the "back wall" of the inlet port and cause additional erosion. Significant turbulence would also be created (more than an in-line valve), leading to further erosion of the valve's interior components. Additionally, an in-line valve has a lower pressure drop than an angle valve, allowing for easier upstream pressure relief.

- c. **11(n): "actuating the valve assembly using the controller assembly to release the fluid from the valve actuator to move the safely valve into an open position and thereby open fluid flow through the second fluid line based upon a comparison of the monitored physical property to a predetermined condition to return fluid from the first fluid line back to the fluid supply or direct fluid from the first fluid line to the different reservoir."**

146. Petitioner references arguments regarding claim limitation 11(d) regarding the element "return fluid from the first fluid line back to the fluid supply or direct fluid from the first fluid line to the different reservoir." Petitioner claims

¹¹⁵ Ex 1007 1:45-46

that *Tettleton* discloses the limitation inherently. This is incorrect. For the same reasons as those discussed above regarding limitation 11(d), *Tettleton* does not disclose the limitation expressly or inherently. Accordingly, the combination of *Tettleton* and *Cotham* fails to render the limitation obvious.

G. DEPENDENT CLAIM 12: “12. THE METHOD OF CLAIM 11, WHEREIN THE FLUID SUPPLIED TO THE VALVE ACTUATOR BY THE FLUID DRIVE ASSEMBLY IS A PNEUMATIC FLUID DISPOSED EXTERNAL TO THE HOUSING, AND FURTHER COMPRISING FILTERING THE PNEUMATIC FLUID AS IT ENTERS THE HOUSING BY THE FLUID DRIVE ASSEMBLY.”

147. Claim 12 depends from Claim 11 and contains all the limitations of Claim 11. Petitioner simply referenced arguments that *Tettleton* discloses all the elements of Claim 11. As discussed above, *Tettleton* fails to disclose all the elements of Claim 11. Petitioner points to no portion of *Cotham* that fills in the missing elements, as discussed above regarding Claim 11. Accordingly, the combination of *Tettleton* and *Cotham* fails to render Claim 12 obvious.

H. DEPENDENT CLAIM 13: “13. THE METHOD OF CLAIM 11, WHEREIN THE FLUID SUPPLIED TO THE VALVE ACTUATOR BY THE FLUID DRIVE ASSEMBLY IS A HYDRAULIC FLUID DISPOSED IN A RESERVOIR WITHIN THE HOUSING THAT IS IN FLUID COMMUNICATION WITH THE FLUID DRIVE ASSEMBLY.”

148. Claim 13 depends from Claim 11 and contains all the limitations of Claim 11. Petitioner simply referenced arguments that *Tettleton* discloses all the elements of Claim 11. As discussed above, *Tettleton* fails to disclose all the elements of Claim 11. Petitioner points to no portion of *Cotham* that fills in the missing

elements, as discussed above regarding Claim 11. Accordingly, the combination of *Tettleton* and *Cotham* fails to render Claim 13 obvious.

I. DEPENDENT CLAIM 14: “14. THE METHOD OF CLAIM 11, FURTHER COMPRISING MEASURING THE PHYSICAL PROPERTY USING A TRANSDUCER CONFIGURED TO COMMUNICATE A SIGNAL CORRESPONDING TO THE MEASURED PHYSICAL PROPERTY TO THE CONTROLLER ASSEMBLY.”

149. Claim 14 depends from Claim 11 and contains all the limitations of Claim 11. Petitioner simply referenced arguments that *Tettleton* discloses all the elements of Claim 11. As discussed above, *Tettleton* fails to disclose all the elements of Claim 11. Petitioner points to no portion of *Cotham* that fills in the missing elements, as discussed above regarding Claim 11. Accordingly, the combination of *Tettleton* and *Cotham* fails to render Claim 14 obvious.

J. DEPENDENT CLAIM 15: “15. THE METHOD OF CLAIM 11, WHEREIN THE FLUID SUPPLIED TO THE VALVE ACTUATOR BY THE FLUID DRIVE ASSEMBLY IS A PNEUMATIC FLUID, AND WHEREIN THE FLUID DRIVE ASSEMBLY IS A COMPRESSOR.”

150. Claim 15 depends from Claim 11 and contains all the limitations of Claim 11. Petitioner simply referenced arguments that *Tettleton* discloses all the elements of Claim 11. As discussed above, *Tettleton* fails to disclose all the elements of Claim 11. Petitioner points to no portion of *Cotham* that fills in the missing elements, as discussed above regarding Claim 11. Accordingly, the combination of *Tettleton* and *Cotham* fails to render Claim 15 obvious.

K. DEPENDENT CLAIM 16: “16. THE METHOD OF CLAIM 11, WHEREIN THE FLUID SUPPLIED TO THE VALVE ACTUATOR BY THE FLUID DRIVE ASSEMBLY IS A HYDRAULIC FLUID, AND WHEREIN THE FLUID DRIVE ASSEMBLY IS A PUMP.”

151. Claim 16 depends from Claim 11 and contains all the limitations of Claim 11. Petitioner simply referenced arguments that *Tettleton* discloses all the elements of Claim 11. As discussed above, *Tettleton* fails to disclose all the elements of Claim 11. Petitioner points to no portion of *Cotham* that fills in the missing elements, as discussed above regarding Claim 11. Accordingly, the combination of *Tettleton* and *Cotham* fails to render Claim 16 obvious.

XIV. GROUND 3: CLAIM 9 IS NOT OBVIOUS OVER THE COMBINATION OF *TETTLETON* AND *TUBEL*

A. DEPENDENT CLAIM 9: “9. THE SYSTEM OF CLAIM 1, WHEREIN THE CONTROLLER ASSEMBLY IS OPERABLE TO COMMUNICATE A SIGNAL CORRESPONDING TO THE MEASURED PHYSICAL PROPERTY TO A REMOTE COMPUTER SYSTEM.”

152. Claim 9 depends from Claim 1 and contains all the limitations of Claim 1. Petitioner simply referenced arguments that *Tettleton* discloses all the elements of Claim 1. As discussed above, *Tettleton* fails to disclose all the elements of Claim 1. Petitioner points to no portion of *Tubel* that fills in the missing elements, as discussed above regarding Claim 1. Accordingly, the combination of *Tettleton* and *Tubel* fails to render Claim 9 obvious.

XV. GROUND 4: CLAIMS 17 AND 18 ARE NOT OBVIOUS OVER THE COMBINATION OF *TETTLETON*, *COTHAM*, AND *TUBEL*

A. DEPENDENT CLAIM 17: “17. THE METHOD OF CLAIM 11, FURTHER COMPRISING COMMUNICATING A SIGNAL FROM THE CONTROLLER ASSEMBLY TO A REMOTE COMPUTER SYSTEM, WHEREIN THE SIGNAL CORRESPONDS TO AN OPERATIONAL CHARACTERISTIC OF THE SAFETY VALVE.”

153. Claim 17 depends from Claim 11 and contains all the limitations of Claim 11. Petitioner simply referenced arguments that *Tettleton* discloses all the elements of Claim 11. As discussed above, *Tettleton* fails to disclose all the elements of Claim 11. Petitioner points to no portion of *Tubel* or *Cotham* that fills in the missing elements, as discussed above regarding Claim 11. Accordingly, the combination of *Tettleton* and *Tubel* fails to render Claim 17 obvious.

B. DEPENDENT CLAIM 18: “18. THE METHOD OF CLAIM 11, FURTHER COMPRISING ACTUATING THE SAFETY VALVE BY COMMUNICATING A SIGNAL FROM A REMOTE COMPUTER SYSTEM TO THE CONTROLLER ASSEMBLY.”

154. Claim 18 depends from Claim 11 and contains all the limitations of Claim 11. Petitioner simply referenced arguments that *Tettleton* discloses all the elements of Claim 11. As discussed above, *Tettleton* fails to disclose all the elements of Claim 11. Petitioner points to no portion of *Tubel* or *Cotham* that fills in the missing elements, as discussed above regarding Claim 11. Accordingly, the combination of *Tettleton* and *Tubel* fails to render Claim 18 obvious.

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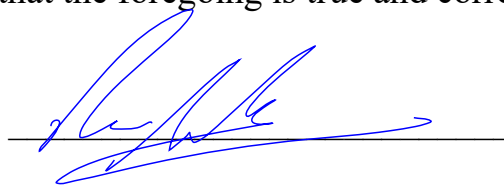
XVI. SECONDARY CONSIDERATIONS

155. Should the Patent Owner put forth any alleged evidence of secondary considerations in this proceeding or the Related Litigation, I reserve the right to consider such evidence, to consider whether any such evidence has a nexus to any claims of the Challenged Patent, and to update my analysis accordingly.

XVII. CONCLUSION

156. All statements made herein of my own knowledge are true, and all statements made on information and belief are believed to be true. I further understand that willful false statements and the like are punishable by fine or imprisonment, or both under Section 1001 of Title 18 of the United States Code. I declare under penalty of perjury that the foregoing is true and correct.

Executed on February 23, 2024.



Dr. Robert A. Durham

Dr. ROBERT A DURHAM, PhD, FIEEE

Resume
Specialization
Honors & Awards
Publications

Dr ROBERT A DURHAM, PhD, FIEEE

Robert A Durham is the Principal of D² Tech Solutions, a technology related firm concentrating on Mechanical and Electrical systems and energy conversions. He also serves as a Principal Scientist of THEWAY LABs, Tulsa, OK, an engineering and energy consulting firm that provides design and failure analysis of facilities and system installations.

Dr. Durham's work experience is broad and encompasses all areas of the energy industry. Dr. Durham spent 11 years with AEP/CSW, at the time the country's largest utility, in electrical engineering positions in the power generation and transmission planning departments. He then accepted a position as Manager of Electric Infrastructure for New Dominion, LLC., a major independent energy producer in Oklahoma. Dr. Durham then moved on to hold the position of Vice President of Engineering and Project Management for EDG Power Group, an Engineering Procurement and Construction company specializing in design and construction of small to medium size power generating facilities. Dr. Durham left EDG Power Group to accept his current positions. Dr. Durham has been accepted as an expert and offered testimony in several jurisdictions.

Dr. Durham's extensive client list includes the development of a broad spectrum of forensic, electrical and facilities projects for many companies. He has also taught University offered courses in electrical engineering review for board licensure. He has published five books, six magazine articles and over 40 other technical papers and articles. Dr. Durham's extensive work on standards and electrical systems has resulted in his elevation to Fellow of the IEEE, the highest grade of recognition in the electrical technology industry.

Dr. Durham received the B.S. in electrical engineering from the University of Tulsa in 1992 and the M.E. in Technology Management from The University of Tulsa in 1997. Tulsa, OK. In 2004, Dr. Durham received a PhD in Engineering Management from Kennedy Western University.

Degrees Earned

BSEE, with Honors, The University of Tulsa
Master of Engineering, The University of Tulsa
PhD , Kennedy Western University

Area of Specialization

lightning & grounding
failure analysis & forensic engineering
electrical power systems & safety
power generation
utility industry competition
economics & management
petroleum & chemical industry
electrical / mechanical energy conversion

Registration

Professional Engineer - Oklahoma
Professional Engineer – Texas
Professional Engineer – California
Professional Engineer – New Hampshire (Inactive)
Professional Engineer – Kansas
Professional Engineer – North Carolina (Inactive)
Professional Engineer – Missouri
Professional Engineer – Arkansas
Professional Engineer – Virginia (Inactive)
Professional Engineer – Illinois (Inactive)
Electrical Contractor - Oklahoma

Work History

D² Tech Solutions, Inc. 2002 - 2022
Principal

THEWAY Corp. 2004 - 2022
Principal Scientist

EDG Power Group, Inc. 2002 - 2004
Vice President Engineering & Project Management

New Dominion, LLC 2000 - 2002
Mgr Electric Infrastructure

Central & Southwest, Inc 1989 - 2000
Electrical Engineer

Professional Memberships

Fellow	Institute of Electrical and Electronic Engineers
Diplomate	American College of Forensic Examiners, International
Member	National Association of Fire Investigators
Voting Member	National Fire Protection Institute, Electrical Section
Executive Member	Petroleum and Chemical Industry Committee, IEEE
Diplomate,	
Past Board Member	American Board of Forensic Engineering and Technology
Member	IEEE Standards Association
Past Chair	Production Subcommittee, IEEE IAS/PCIC
CFC	American College of Forensic Examiners
Member	International Association of Arson Investigators
CFEI, CVFEI	National Association of Fire Investigators
Past Chair	Tulsa Section IEEE
Chair	IEEE RP1017.1 Working Group
Chair	IEEE RP1017.2 Working Group
Chair	IEEE RP1017.3 Working Group
Chair	IEEE RP1017.4 Working Group
Past Chair	IEEE PCIC Standards Subcommittee
Secretary	IEEE Petroleum and Chemical Industry Committee

Honors and Awards

Fellow of the IEEE

For contributions to submersible electrical equipment analysis and multi-point ground method in hazardous petroleum and chemical environments.

Honor Societies

Tau Beta Pi, national engineering honors

Eta Kappa Nu, national electrical engineering honors

Dr. Durham's publications have often successfully competed for outstanding paper awards from journals of the Institute of Electrical and Electronic Engineers (PCIC and IAS). This is an

international competitive peer review and evaluation of papers that provide a significant contribution to the advancement and understanding of electrical applications.

IEEE Industry Applications Society, New Orleans, LA: Prize Article for “Data Quality and Grounding: Considerations in a Mixed Use Facility”

PCIC, Cincinnati, OH: Prize Paper for “Grounding and Bonding Conductors: Solid, Stranded, Bare or Insulated”

PCIC, New Orleans, LA: Prize paper for "Industrial Design Application for Power Distribution over Extra-Long Distances"

PCIC, Philadelphia, PA: Prize paper for "Paradigm Shifts and Impact on Engineers and Industry"

Transactions on Industry Applications, Orlando, FL: Prize Paper for "Lightning, Grounding, and Protection for Control Systems”.

PCIC, Denver, CO: Prize Paper for “Grounding System Design for Isolated Locations and Plant Systems”

PCIC, St. Louis, MO: First place for "Lightning, Grounding, and Protection for Distributed Control and Communications Systems: A Retrofit".

Publications

Electrical Engineering in a Nutshell, Dr. Robert A Durham, Dr. Marcus O. Durham, ISBN 978-1466236795, 2011

Electrical Failure Analysis for Fire and Incident Investigations, Marcus O. Durham, Robert A. Durham, Rosemary Durham, Jason Coffin, ISBN 978-1463773472, 2011

Leadership and Success in Relationships and Communication, Marcus O. Durham and Robert A Durham, ISBN 978-1463758769, 2011

Leadership and Success in Organizations, Culture & Ethics: Group or Horizontal Interactions, Marcus O. Durham and Robert A Durham, ISBN 978-1466250338, 2011

Leadership and Success in Economics, Law & Technology: Society or External Influence, Marcus O. Durham and Robert A Durham, OK, ISBN 978-1466250461, 2011

How Should Generating Asset Acquisitions by Regulated, Vertically Integrated Utilities be Overseen in Today's Quasi-Regulated Electric Utility Environment? A Dissertation Presented to the Faculty of the School of Engineering Kennedy-Western University, KWU Press, Thousand Oaks, CA, 2004

R. A. Durham, M. O. Durham and T. W. Gillaspie, "Lightning Protection at Petrochemical Facilities - Part 3 Alternative Systems," *2022 IEEE Petroleum and Chemical Industry Committee Conference (PCIC)*, Denver, CO 2021.

R. A. Durham, M. O. Durham and T. W. Gillaspie, "Lightning Protection at Petrochemical Facilities - Part 2 Standards Requirements," *2021 IEEE Petroleum and Chemical Industry Committee Conference (PCIC)*, San Antonio, TX, 2021.

R. A. Durham, M. O. Durham and T. W. Gillaspie, "Petrochemical Facility Lightning Protection Primer: Part 1: History and Basic Science," in *IEEE Industry Applications Magazine*, vol. 27, no. 2, pp. 47-56, March-April 2021, doi: 10.1109/MIAS.2020.3024492.

R. A. Durham, S. J. Szczecinski and M. O. Durham, "Factors Impacting Selection of Grounding and Bonding Conductors," in *IEEE Transactions on Industry Applications*, vol. 56, no. 5, pp. 4652-4661, Sept.-Oct. 2020, doi: 10.1109/TIA.2020.3005637.

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R. A. Durham, S. J. Szczecinski and M. O. Durham, "Grounding and Bonding Conductors: Solid, Stranded, Bare or Insulated?: Copyright Material IEEE, Paper No. PCIC-2018-03," *2018 IEEE Petroleum and Chemical Industry Technical Conference (PCIC)*, Cincinnati, OH, USA, 2018, pp. 19-28, doi: 10.1109/PCIC31437.2018.9080442.

F. P. Feletto, R. Durham, E. Bortoni and J. Costa, "IMPROVEMENT OF MV CASCADED H BRIDGE INVERTER (CHBI) VFD AVAILABILITY FOR HIGH POWER ESP OIL WELLS," in *IEEE Transactions on Industry Applications*.

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F. Feletto, R. A. Durham, E. da Costa Bortoni and J. G. C. Costa, "Techniques to improve MV cascaded H bridge inverter (CHBI) VFDs availability applied to drive high power esp oil wells," *2017 Petroleum and Chemical Industry Technical Conference (PCIC)*, Calgary, AB, Canada, 2017, pp. 363-370.

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“Lightning, Transient & High Frequency Impact on Material Such As Corrugated Tubing”, Marcus O. Durham & Robert Durham, *Proceedings of 41st Annual Frontiers in Power Conference*, OSU, Stillwater, OK, October 2008.

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"Eleven Ground Systems and Connections", Marcus O. Durham & Robert Durham, *Proceedings of 37th Annual Frontiers in Power Conference*, OSU, Stillwater, OK, October 2004.

"Engineering Management, An Oxymoron?", Marcus O. Durham, Robert Durham & Rosemary Durham, *Proceedings of 37th Annual Frontiers in Power Conference*, OSU, Stillwater, OK, October 2004.

"Corrosion and Electrical Safety", Marcus O. Durham & Robert Durham, *Proceedings of 36th Annual Frontiers in Power Conference*, OSU, Stillwater, OK, October 2003.

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"A Cost Effective, Numeric Technique for Projecting Quality of Insulation and Impending Failures," Marcus O. Durham and Robert A. Durham, *Proceedings of 33rd Annual Frontiers in Power Conference*, OSU, Stillwater, OK, October 2000.

"An Engineering Selection for Size of Long Conductors Considering Factors in Addition to NEC," Marcus O. Durham and Robert A. Durham, *Proceedings of 33rd Annual Frontiers in Power Conference*, OSU, Stillwater, OK, October 2000.

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"Can Electrical Insulation and Conductor Performance Be Predicted?" Marcus O. Durham and Robert A. Durham, *Proceedings of Production Operations Symposium*, SPE 52161, Oklahoma City, OK, March 1999

"Engineering Paradigms: Change, Opportunity and Benefit," Robert A. Durham and Marcus O. Durham, *Proceedings of 31st Annual Frontiers in Power Conference*, OSU, Stillwater, OK, October 1998.

"Electric Re-regulation and Impact on Users," Robert A. Durham and Marcus O. Durham, *Proceedings of 30th Annual Frontiers in Power Conference*, OSU, Stillwater, OK, October 1997.

"Remote Transmitter and Distributed Control Grounding and System Protection," Robert A. Durham and Marcus O. Durham, *Proceedings of 27th Annual Frontiers in Power Conference*, OSU, Stillwater, OK, October 1994.

Robert A Durham, PhD, PE
Expert Witness
Previous Four Years from February 14, 2023

Attorney	Case	Location	Issue	
Denton Law	Robbins v. Madewell	Mayes County, OK	Fire / injury	Trial
Baker Botts	IPR 2023-00558	USPTA PTAB	Intellectual Property	Depo
Haynes Boone	Nabors v. Helmerich & Payne et al	Northern District, TX	Intellectual Property	Trial
McDermott Will & Emery LLP	Halliburton V. U.S. Well Services	Western District, TX	Intellectual Property	Trial
Jones, Oten & Jewell	Davis v. Tapp	Garfield County, OK	Fire / Injury	Trial
Haynes & Boone	Nabors Driling v. Helmerich & Payne et al	Northern District, TX	Intellectual Property	Depo
Mattingly Law	Fulton v. Aviagen et al	Muskogee County, OK	Building Codes	Trial
Baker Botts	US Well Services v. Halliburton	Western District, TX	Intellectual Property	Depo
Kelly, Morgan	Montanez v. Deepwell Energy Svcs	Ector County, TX	Flash Fire / Injury	Depo
Baker Botts	IPR 2021-01316	USPTO PTAB	Intellectual Property	Depo
Baker Botts	IPR 2021-01238	USPTO PTAB	Intellectual Property	Depo
Baker Botts	IPR 2021-01315	USPTO PTAB	Intellectual Property	Depo
Baker Botts	IPR 2021-01065	USPTO PTAB	Intellectual Property	Depo
Clancy & Thompson	Borth v. Phillips & Sons Trucking et al	Canadian County, OK	Injury	Depo
Baker Botts	IPR 2021-01034	USPTO PTAB	Intellectual Property	Depo
Baker Botts	IPR 2021-01033	USPTO PTAB	Intellectual Property	Depo
Baker Botts	IPR 2021-01032	USPTO PTAB	Intellectual Property	Depo
Stephen Jones	Davis v. Tapp	Garfield County	Fire / Injury	Depo

Kelly, Morgan	Calvillo v. On Point	Travis County, TX	Flash Fire / Injury	Depo
Hartline Barger	Ramirez v. Home Depot	Southern District, TX	Electrical Failure / Fire	Depo
Mcafee & Taft	Hale v. Southeast Colorado Power Association	Baca County, CO	Electrical Failure / Fire	Depo
Hartline Barger	Siqueros v. Templo Monte Horeb et al	El Paso County, TX	Injury	Depo
Naman, Howell	Lentz v Brenntag Pacific et al	Upton County, TX	Flash Fire / Injury	Depo
Craft Law Firm	Cason v. Cimarex et al	Victoria County, TX	Flash Fire / Injury	Depo
Naman, Howell	Lentz v Brenntag Pacific et al	Upton County, TX	Flash Fire / Injury	Depo