

## **APPENDIX**

1a

**APPENDIX A**

NOTE: This disposition is nonprecedential.

UNITED STATES COURT OF APPEALS  
FOR THE FEDERAL CIRCUIT

[Filed 10/24/2017]

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2016-2344

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WORLDWIDE OILFIELD MACHINE, INC.,

*Appellant*

v.

AMERIFORGE GROUP, INC.,

*Appellee*

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Appeal from the United States Patent and  
Trademark Office, Patent Trial and Appeal  
Board in No. IPR2015-00233.

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**JUDGMENT**

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AARON E. HOMER, Hirsch & Westheimer, PC,  
Houston, TX, argued for appellant. Also represented  
by SANDEEP SETH, SethLaw, Houston, TX.

EAGLE HOWARD ROBINSON, Norton Rose Fulbright  
US LLP, Austin, TX, argued for appellee. Also repre-  
sented by STEPHANIE DEBROW, MARK T. GARRETT;  
JONATHAN S. FRANKLIN, Washington, DC; CHARLES  
BRUCE WALKER, JR., Houston, TX.

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THIS CAUSE having been heard and considered, it  
is ORDERED and ADJUDGED:

PER CURIAM (MOORE, CHEN, and HUGHES,  
*Circuit Judges*).

AFFIRMED. *See* Fed. Cir. R. 36.

ENTERED BY ORDER OF THE COURT

October 24, 2017

Date

/s/ Peter R. Marksteiner

Peter R. Marksteiner  
Clerk of Court

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**APPENDIX B**

Trials@uspto.gov  
571-272-7822

Paper No. 37  
Date: May 16, 2016

UNITED STATES PATENT AND  
TRADEMARK OFFICE

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Case IPR2015-00233  
Patent 6,601,650 B2

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AMERIFORGE GROUP, INC.,  
*Petitioner,*

v.

WORLDWIDE OILFIELD MACHINE, INC.,  
*Patent Owner.*

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BEFORE THE PATENT TRIAL  
AND APPEAL BOARD

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FINAL WRITTEN DECISION

35 U.S.C. § 318(a) and C.F.R. § 42.73

Before JOSIAH C. COCKS, JAMES A. TARTAL, and  
GARTH D. BAER, *Administrative Patent Judges.*

COCKS, *Administrative Patent Judge.*

I. INTRODUCTION

Petitioner, Ameriforge Group, Inc. (“Ameriforge”), filed a Petition (Paper 1, “Pet.”) requesting *inter partes* review of claims 1, 2, 4–10, 12–14, 16, 18, and 19 of U.S. Patent No. 6,601,650 B2 (“the ’650 patent”). We issued a Decision to institute an *inter partes* review

(Paper 17, “Inst. Dec.”) of the ’650 patent on the following grounds:

- A. Claims 9 and 12 are unpatentable under 35 U.S.C. § 102(b) as anticipated by Baker<sup>1</sup>;
- B. Claims 1, 2, 4–10, 12–14, 16, 18, and 19 are unpatentable under 35 U.S.C. § 103(a) over Baker and Dare<sup>2</sup>;
- C. Claims 1, 2, 4–7, 9, 12–14, 16, 18, and 19 are unpatentable under 35 U.S.C. § 103(a) over Baker and Collie<sup>3</sup>; and
- D. Claims 6–8 and 10 are unpatentable under 35 U.S.C. § 103(a) over Baker and Schlegelmilch.<sup>4</sup>

Inst. Dec. 26.

After institution of trial, Patent Owner, Worldwide Oilfield Machine, Inc. (“WOM”), filed a Patent Owner’s Response (Papers 20, 22 “PO Resp.”),<sup>5</sup> to which Ameriforge replied (Paper 25, “Pet. Reply”). WOM also filed a Motion to Seal. Paper 21.<sup>6</sup> Oral argument was

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<sup>1</sup> U.S. Patent No. 4,997,162 issued March 5, 1991 (Ex. 1002).

<sup>2</sup> U.S. Patent No. 4,215,749 issued August 5, 1980 (Ex. 1003).

<sup>3</sup> U.S. Patent No. 7,013,970 B2 issued March 21, 2006 (Ex. 1004).

<sup>4</sup> *The Design of a Coiled Tubing Cutter for Use in Subsea Oil Drilling Applications*, Masters Thesis, Massachusetts Institute of Technology, 1999 (Ex. 1005).

<sup>5</sup> Paper 20 is a public, redacted version of Patent Owner’s Response, and Paper 22 is a version of the Response that currently is available only to the parties and Board.

<sup>6</sup> WOM is seeking to seal portions of its Patent Owner Response (Paper 22), and portions of a Declaration of William G.

conducted on February 3, 2016. A transcript of that argument has been made of record. Paper 36, “Tr.”

We have jurisdiction under 35 U.S.C. § 318(a). After considering the evidence and arguments of both parties, and for the reasons set forth below, we determine that Ameriforge met its burden of showing, by a preponderance of the evidence, that claims 1, 2, 4–10, 12–14, 16, 18, and 19 of the ’650 patent are unpatentable.

#### A. Related Matters

The ’650 patent is the subject of litigation styled *Worldwide Oilfield Machine, Inc. v. Ameriforge Group, Inc. d/b/a AFGlobal Corp.*, Civil Action No. 4:13-cv-3123 (S.D. Tex.). Pet. 1; Paper 5, 2.

#### B. The ’650 Patent (Ex. 1001)

The ’650 patent is titled “Method and Apparatus for Replacing BOP with Gate Valve.” In setting forth the background of the invention, the ’650 patent explains:

Blowout Preventor (B.O.P.) stacks are frequently utilized in oilfield wellbore Christmas trees such as, for instance, lower riser packages in offshore wells.

Ex. 1001, 1:18–20.

In that respect, the term “Christmas trees” is industry nomenclature for the assemblies that are placed on a wellhead and operate to control the flow of hydrocarbons or oil from the well. The ’650 patent further expresses that B.O.P. (or “BOP”) stacks have certain disadvantages, specifically:

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Kinnear (Paper 23). Ameriforge did not file an opposition to the Motion to Seal.

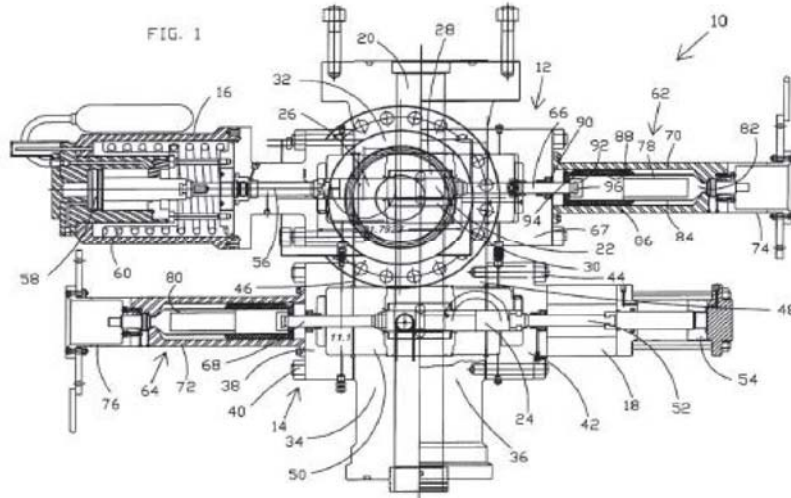
B.O.P. stacks tend to be quite bulky and heavy, which are undesirable features especially in lower riser packages for undersea operation where space is often at a premium. B.O.P. stacks tend to be expensive for initial installation. Moreover, if maintenance is required, then the maintenance costs for replacing such B.O.P. stacks can be many times the original installation costs. B.O.P. stacks may frequently require maintenance after cutting pipe is required. For instance the cut pipe may become stuck within the B.O.P. stack blocking other operations.

*Id.* at 1:23–32.

The '650 patent also notes that wellbore Christmas trees generally also incorporate “gate valves with one or more cutting edges for cutting wireline,” but that “such gate valves have not been utilized to replace B.O.P. stacks.” *Id.* at 1:33–36. The Abstract of the '650 patent describes that “[t]he present invention discloses apparatus and methods for replacing a BOP with a gate valve to thereby save space, initial costs, and maintenance costs that is especially beneficial for use in offshore subsea riser packages.”

Furthermore, in addressing the perceived disadvantages of a BOP stack, the '650 patent describes its invention as being an “improved gate valve with capability of reliably and repeatable cutting tubulars of at least 2 3/4” or more.” *Id.* at 1:46–49. Figure 1 of the '650 patent is reproduced below:

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As shown in Figure 1 above, subsea valve assembly 10 includes gate valve 12 and gate valve 14. *Id.* at 3:22–23. Figures 2 and 3 of the '650 patent are reproduced below, and depict the configuration of one or more of the above-noted gate valves.

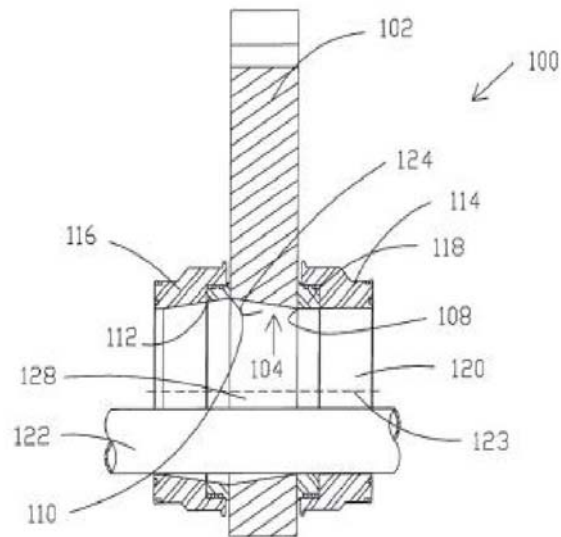


FIG. 2

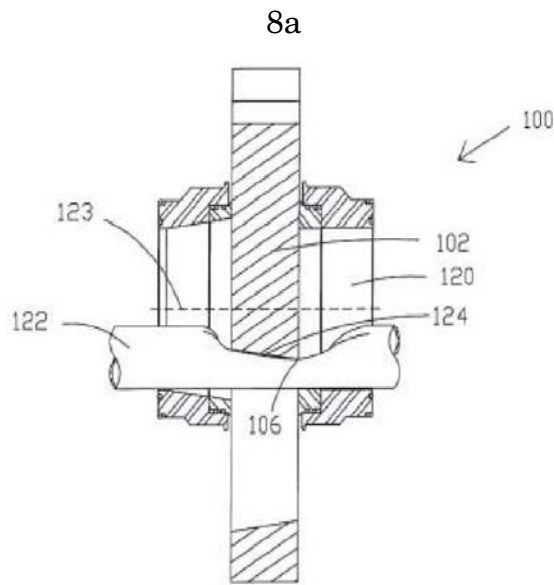


FIG. 3

As shown in Figures 2 and 3 above, valve 100 may be operated to seal off path 120, and, during that process, may also cut tubular 122. *Id.* at 7:61–62. More particularly, the '650 patent explains the following:

FIG. 2 shows gate valve 100 for  $7\frac{3}{8}$  inch casing having  $2\frac{7}{8}$  inch production tubing extending therethrough. . . . Gate element 102 is designated to have a blade 104 with initial cutting surface 106 having a minimum gate aperture 128 diameter directly adjacent seat 108.

\* \* \*

As shown in FIG. 3, when valve 100 is closed such that gate element 102 moves in the direction of sealing off flow path 120, then cutting edge 106 engages, crushes, and cuts pipe [122]. As pipe [122] is being cut the sloping or inclined edge 124 of the gate valve

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acts to push the pipe [122] out of valve 100. Therefore, unlike many other cutting devices such as BOP's, pipe [122] is not stuck in the valve. If desired, pipe [122], can be pulled during cutting such as toward the left direction as shown in FIG. 3, or not. In any event, due to the design of cutting edge 106 and inclined edge 124, the present invention may be reliably utilized for cutting tubing and/or wireline.

*Id.* at 7:5–12; 7:63–8:8.<sup>7</sup>

Thus, gate element 102 operates to seal passageway 120, and, by operation of cutting edge 106 and inclined edge 124, cuts pipe 122 and directs it in the left direction, as shown in Figure 3.

#### C. Illustrative Claims

Claims 1, 9, and 14 are independent, and are illustrative of the claimed subject matter. Those claims are reproduced below:

1. A method for a gate valve mountable onto a wellbore casing, said gate valve being operable for controlling fluid and cutting tubing, comprising:

mounting said gate valve on aid well casing for controlling fluid flow in place of at least one BOP on said well casing;

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<sup>7</sup> The reproduced portion of the '650 patent spanning columns 7 and 8 uses reference character "106" in designating both the "cutting edge" and "pipe." As best can be determined, however, reference character 122 is intended to designate the pipe.

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mounting a slidable gate within said gate valve, said slidable gate having a first side and a second side opposite said first side;

providing first and second seats for said slidable gate;

positioning said slidable gate between said first and second seats such that said first side of said gate is adjacent said first seat and said second side of said gate is adjacent said second seat;

providing that said first and second seats each have different internal diameters adjacent said slidable gate;

forming an aperture through said slidable gate;

providing a cutting edge on said slidable gate of said gate valve within said aperture such that said cutting edge defines at least a portion of said aperture.

9. A method for cutting a pipe within a wellbore utilizing a gate valve such that said pipe is pushed away from a gate within said gate valve, said gate defining an aperture therethrough, said method comprising:

providing said gate valve with a cutting edge on one side of said gate along said aperture through the gate;

providing a single inclined surface on said aperture through said gate such that said aperture opens from a minimum size adjacent said cutting edge to a maximum size distal said cutting edge, said single inclined surface

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extending from said minimum size to said maximum size of said aperture;

inserting said pipe into said wellbore through said gate valve;

closing said gate within said gate valve, and

cutting said pipe as said gate closes such that said inclined surface produces a force on said pipe to move said pipe away from said gate.

14. A gate valve for a subsea riser package installation, said gate valve comprising a valve body defining a flow passageway there through, said gate valve being operable for cutting a tubular extending through said gate valve and said subsea riser package, said subsea riser package installation being operable for replacement of a B.O.P, said subsea riser package being connectable to a wellbore casing, said subsea river package installation further comprising:

a sliding gate within said gate valve;

a cutting edge mounted on one side of said sliding gate;

an inclined surface adjacent said cutting edge such that

said cutting edge and said inclined surface define at least a portion of aperture through said sliding gate;

a hydraulic actuator for said gate valve operable to apply sufficient force to said sliding gate to cut said tubular; and

a first seat on a first side of aid sliding gate and a second seat on a second side of said sliding gate, at least one of said first seat of said second seat defining an interior passageway with an axial seat length wherein said interior passageway comprises a conical surface extending along a substantial portion of said axial sea length.

## II. ANALYSIS

### A. Claim Construction

We interpret a claim of an unexpired patent using the “broadest reasonable construction in light of the specification of the patent in which it appears.” 37 C.F.R. § 42.100(b); see *In re Cuozzo Speed Techs., LLC*, 793 F.3d 1268, 1278–79 (Fed. Cir. 2015) (“We conclude that Congress implicitly adopted the broadest reasonable interpretation standard in enacting the AIA.”), *cert. granted sub nom. Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 890 (mem.) (2016). Claim terms also are given their ordinary and customary meaning as would be understood by one of ordinary skill in the art in the context of the entire disclosure. *In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007). Nevertheless, a “claim term will not receive its ordinary meaning if the patentee acted as his own lexicographer” and clearly set forth a definition of the claim term in the specification. *CCS Fitness, Inc. v. Brunswick Corp.*, 288 F.3d 1359, 1366 (Fed. Cir. 2002).

For purposes of our Decision instituting this *inter partes* review, no terms of the claims of the ’650 patent required any special meaning, and, thus, all terms were afforded their broadest reasonable meaning, as would be understood by a skilled artisan in light of the Specification. Inst. Dec. 9. We made explicit that

meaning for the following claim terms/phrases (*id.* at 9–12):

| Term/Phrase                                                                                                                                                                                  | Construction                                                                                                                                                                  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| “cutting edge”                                                                                                                                                                               | “a narrow surface that performs the cutting function.”                                                                                                                        |
| “for controlling fluid flow in place of at least one BOP on said well casing” (claim 1), and “said subsea riser package installation being operable for replacement of a B.O.P.” (claim 14). | “requiring a gate valve that is sized suitably to perform the functions of wellbore sealing, tube cutting, and fluid flow controlling that would be expected of a BOP stack.” |

Neither party offers an alternative construction for “cutting edge,” and, based on the record developed during trial, we discern no reason to alter the meaning provided above. Ameriforge, however, does propose a slightly altered construction for the phrases concerning “in place of at least one BOP” and “replacement of a B.O.P.” To that end, Ameriforge contends the following:

For purposes of its Institution Decision, the Board determined that claims 1 and 14 of the '650 Patent require “a gate valve that is sized suitably to perform the functions of a wellbore sealing, tube cutting, and fluid flow controlling that would be expected of a BOP stack.” The functions identified are applicable, but the suggestion that the valve can replace an entire BOP stack is not fully consistent with the way a person of ordinary skill would interpret these claims. Ex 1022 at

¶¶ 18–23. For the reasons below, Petitioner requests that the Board revise this determination to be that claims 1 and 14 of the '650 Patent require “a gate valve that is sized suitably to perform the functions of a wellbore sealing, tube cutting, and fluid flow controlling that would be expected of a BOP.”

Pet. Reply 1.

In support of its altered claim construction, Ameriforge makes reference to a Supplemental Declaration of Dr. Glen Stevick (Ex. 1022). In that Declaration, Dr. Stevick testifies that the '650 patent draws distinction between a “BOP stack” and a single “BOP” (Ex. 1022 ¶ 19), and that the claims themselves refer to “at least one BOP” (claim 1) or “a B.O.P.” (claim 14) rather than a BOP “stack” (Ex. 1022 ¶¶ 20–21). WOM’s own declarant, Mr. Gregg Perkin, also testifies that a “BOP stack” is understood as being composed of multiple individual BOPs. Ex. 2004 ¶ 32.

We are cognizant that the '650 patent generally characterizes its invention as being directed to a gate valve “suitable for replacing an entire BOP stack in a lower riser package.” Ex. 1001, 1:11–16. Nevertheless, in light of the record before us, including the noted distinction drawn between a BOP stack and a single BOP, and the plain language of the claims in referring only to a “BOP” or “B.O.P.,” we determine that the broadest reasonable interpretation of the pertinent phrases in claims 1 and 14 is “a gate valve that is sized suitably to perform the functions of wellbore sealing, tube cutting, and fluid flow controlling that would be expected of a BOP.”

## B. Overview of Prior Art

## 1. Baker

Baker is titled “Shearing Gate Valve.” Ex. 1002, Title. Baker describes the following with respect to its disclosed invention:

An object of the present invention is to provide an improved shearing type of gate valve in which the gate has a seal which is not damaged by the shearing action of the gate.

Another object is to provide an improved shearing type of gate valve in which the valve may be retained in service after multiple shearing closures of the gate.

*Id.* at 2:15–22.

Baker’s Figures 9, 10, and 11 (reproduced below) depict an embodiment of a valve according to Baker’s invention that provides for the shearing of a cable element. *Id.* at 5:63–67.

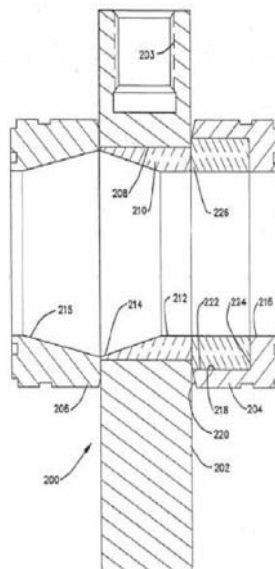
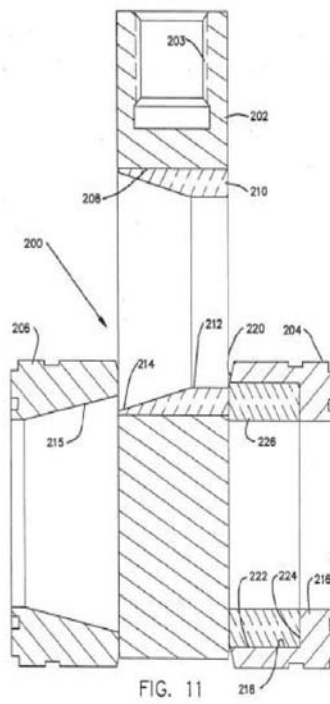
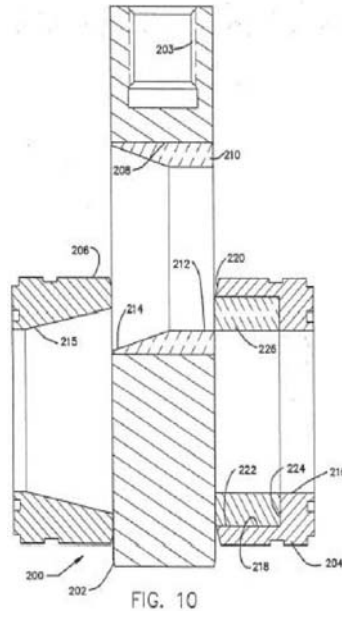


FIG. 9

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Figures 9, 10, and 11 of Baker, above, depict valve 200 including gate valve 202. *Id.* at 5:63–6:8. The gate valve is positioned between seat rings 204 and 206, and includes bore 208. *Id.* Bore 208 extends through gate 202 and insert sleeve 210 is positioned therein. *Id.* at 6:5–6. Sleeve 210 includes outlet bore 212 and inlet tapered surface 214, which diverges outwardly toward seat ring 206. *Id.* at 6:9–11. Baker further explains the following:

As shown in FIGS. 9, 10 and 11, gate 202 is shown in its open position (FIG. 9), in its position at the completion of shearing of the cable element (FIG. 10), and in its closed position of sealing against seat ring 204. As can be seen in FIG. 10, with the completion of the shearing of the cable element extending through gate 202, there is sufficient open space between the interior of gate insert sleeve 212 and the interior of seat ring 206 to allow the sheared cable element to fall into the well without any additional shearing of the cable element.

*Id.* at 6:25–34.

Figure 11 illustrates “the gate in its closed and sealed position with respect to the seat rings.” *Id.* at 3:1–3.

Baker also expresses the following in connection with its above-noted discussion of the embodiment of its invention shown in Figures 9, 10, and 11:

[T]he improved design of the shearing gate valve of the present invention provides a gate valve which can shear a wire line or other tubular member extending therethrough without damage to the hardened insert rings

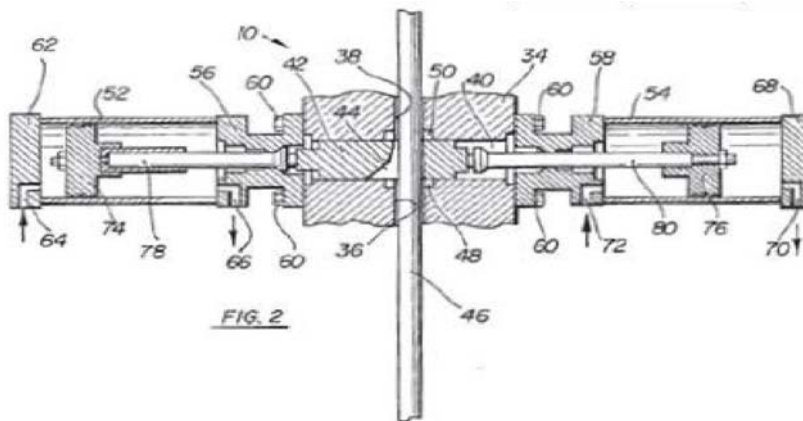
or the hardened insert sleeves or without in any way interfering with the sealing of the gate and the seat ring.

*Id.* at 6:35–41.

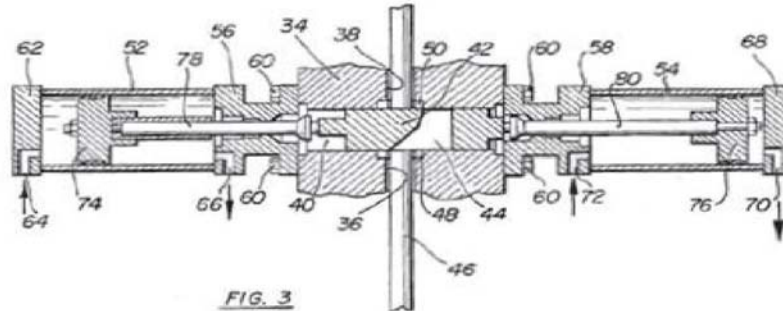
## 2. Dare

Dare is titled “Gate Valve for Shearing Workover Lines to Permit Shutting in of a Well.” Ex. 1003, Title. Dare describes that its invention is directed to a “gate valve which is capable of being closed in a manner to cut tubing and other suspension members that extend downwardly into a well.” *Id.* at 1:6–10. Dare also describes that its gate valve is used in a “subsea wellhead and Christmas tree assembly.” *Id.* at 2:42–45. In such applications, “macaroni tubing” of varying thickness may be used. *Id.* at 1:11–32. Dare explains that its gate valve is “capable of readily shearing the largest and thickest ‘macaroni’ type tubing employed in well treatment and workover operations, as well as smaller suspension members such as wires and cables.” *Id.* at 2:4–9.

Dare’s Figures 2 and 3 are reproduced below:



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Figures 2 and 3 of Dare, above, show sectional views of a portion of a gate valve according to Dare's invention. In particular, Figure 2 shows a gate in an open position with a string of "macaroni" tubing suspended therethrough. Ex. 1003, 2:22-27. Figure 3 depicts the gate moving to a closed position to shut in the well and cut off the tubing string. *Id.* at 2:27-29. Dare's Figure 5 is reproduced below:

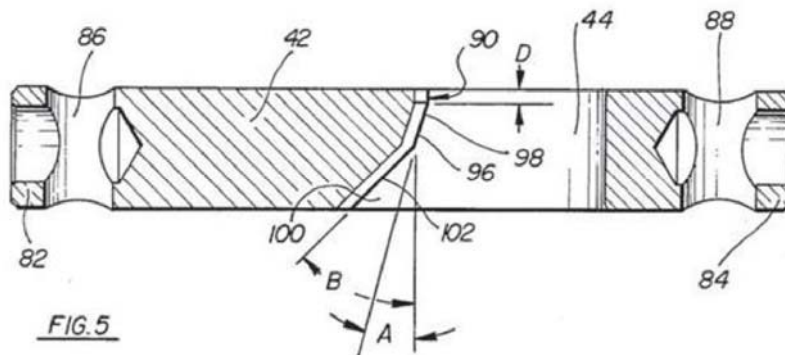


Figure 5 of Dare, above, illustrates a sectional view of a gate. As shown in Figure 5, gate 42 includes port 44 whose left side is the form of cutting edge 90. *Id.* at 4:13-25. Cutting edge 90 is "located adjacent to the flat upper surface of gate 42." *Id.* at 4:25-27. The cutting edge is formed with dimension "D", which represents the thickness of the cutting edge, and may be varied in size. *Id.* at 4:27-32. The cutting edge

includes undercut portion 96 with inclined surface 98, and lower undercut portion 100 with inclined surface 102. *Id.* at 4:39–53.

Dare also explains the following in connection with its invention:

Each gate 42 is normally in its open position so that suspension members such as tubing 46 may be extended through each passage of the valve, the Christmas tree, the wellhead assembly and into the well for the performance of various workover and well treatment operations and other services. In the event of an emergency requiring that the well be immediately shut in, each gate 42 may be forcefully closed by the hydraulic actuator mechanism to shut in the well and shear tubing 46 and other suspension members extending in to the well.

When gate 42 is forcefully closed cutting edge 90 cooperates with an adjacent corner 104 (see FIG. 6) of the upper of downstream valve seat 50 to shear off the large diameter tubing 46 or the smaller diameter “macroni” type tubing 106 shown in FIG. 6.

Ex. 1003, 4:56–5:3.

Dare further describes the following:

The location of cutting edge 90 adjacent the upper surface of gate 42 and the provision of undercut portions 96 and 100 permits the sheared suspension member to freely fall downwardly through port 44 and through the Christmas tree valves in the well without jamming gate 42.

*Id.* at 5:24–29.

### 3. Collie

Collie is directed to a “completion system comprising a christmas tree mounted on a wellhead housing.” Ex. 1004, 1:37–39. An embodiment of Collie’s system includes “lower riser package 128” that operates with coiled tubing string, and describes that the system may be used in situations where a BOP stack has been removed. *Id.* at 6:36–60. Collie also discloses the following:

Installation and recovery of the coiled tubing string may be carried out from a lightweight intervention vessel, without the use of a BOP. The lower riser package includes upper and lower valves 138, 140 (for example large bore gate valves) at least one of which may, if required in an emergency, be used to shear the coiled tubing string.

*Id.* at 6:53–59.

### 4. Schlegelmilch

Schlegelmilch is a thesis from the Massachusetts Institute of Technology titled “The Design of a Coiled Tubing Cutter for Use in Subsea Oil Drilling Applications.” Ex. 1005, Title. The document includes detailed description of determining the amount of cutting force necessary to shear coiled tubing of various sizes and dimensions. *See, e.g., id.* at 41–42.

### C. Anticipation

Ameriforge proposes that claims 9 and 12 are anticipated by Baker. Anticipation is established when a single prior art reference discloses all elements of the claimed invention. *In re Spada*, 911 F.2d 705, 708 (Fed. Cir. 1990). Here, Ameriforge contends that

all of the features of claims 9 and 12 are disclosed in Baker.

1. Claim 9

As noted above, claim 9 is independent and drawn to a “method for cutting a pipe within a wellbore utilizing a gate valve such that said pipe is pushed away from a gate within said gate valve, said gate defining an aperture therethrough.” Ameriforge points to content of Baker in its Petition that it contends discloses all the features of claim 9. Pet. 24. Ameriforge also relies on the Declaration testimony of its declarant, Dr. Glen Stevick (Ex. 1011). *Id.* The focus of the disagreement between Ameriforge and WOM rests on the following steps in claim 9:

providing said gate valve with a cutting edge on one side of said gate along said aperture through the gate;

providing a single inclined surface on said aperture through said gate such that said aperture opens from a minimum size adjacent said cutting edge to a maximum size distal said cutting edge, said single inclined surface extending from said minimum size to said maximum size of said aperture. . . . cutting said pipe as said gate closes such that said inclined surface produces a force on said pipe to move said pipe away from said gate.

In that respect, at issue is whether Baker discloses: (1) the claimed “cutting edge”; and (2) the act of cutting the pipe such that an “inclined surface” of the gate valve “produces a force on said pipe to move said pipe away from said gate.”

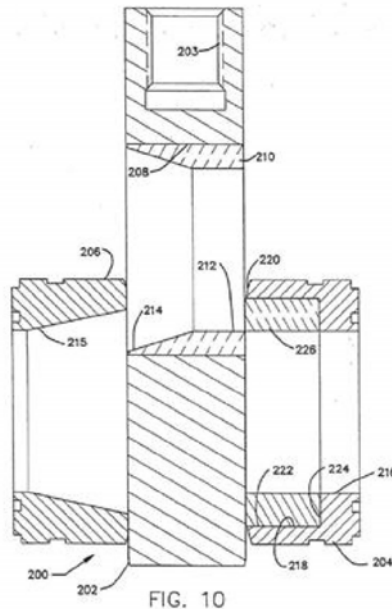
## a. “cutting edge”

As set forth above, we construe “cutting edge” as “a narrow surface that performs the cutting function.” In the Petition, Ameriforge urges that Baker accounts for that feature in Figures 9 and 10, stating that the cutting edge disclosed there is the “square edge at right of outlet bore 212 and adjoining surface of outlet bore 212.” Pet. 22. Ameriforge’s declarant, Dr. Stevick, also testifies that Baker’s Figure 9 shows the required cutting edge. Ex. 1011 ¶ 62.

WOM generally advocates that Baker does not disclose the claimed cutting edge. At the outset, we discern that WOM contends that no content of Baker’s disclosure conveys any structure that performs a “cutting function.” *See, e.g.*, PO Resp. 17. More particularly, WOM argues that “Baker uses a broad shearing surface that is designed to crush the wireline or cable in order to shear it at the point adjacent to its upper corner.” *Id.* In that respect, it appears that WOM is drawing a distinction between an act of “shearing” and an act of “cutting.” Indeed, that was a position advocated by WOM at oral argument. *See, e.g.*, Tr. 32–33. Yet, WOM does not point to adequate record evidence tending to support the proposition that the shearing operations described in Baker would not have been understood as acts of cutting. Here, it is clear that in “shearing” a pipe, Baker contemplates the severing of one portion of the pipe from another, and recognizes that such shearing action is accomplished using “blades.” *See, e.g.*, Ex. 1002, 1:49–53. Indeed, other prior art of record, directed to gate valves performing a shearing operation, describe the component facilitating such “shear[ing] off” of tubing as a “cutting edge.” Ex. 1003, 1:35–38, 4:22–25. We, thus, are persuaded on this record that Baker’s disclosure of

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shearing such structures as “a wire line or other tubular member” (Ex. 1002, 6:37–38), would be recognized as “cutting” those structures.



WOM advocates two additional approaches in contending that Baker does not disclose the “cutting edge” required by the claims. On the one hand, WOM contends that if the horizontal flattened portion of Baker’s outlet bore 212 of sleeve 210 (shown, for instance, in Figure 10, reproduced on the right) that contacts a pipe is likened to the required “cutting edge,” the alleged deficiency, in such respect, is that the noted portion of Baker is not “narrow,” and “not all of it would perform the required cutting function.” PO Resp. 17–18. On the other hand, WOM contends that if the cutting edge is considered only the “upper corner” of outlet bore 212 (shown in Figure 10 contacting the corner of insert ring 226), then “that upper corner is not adjacent to the inclined surface as in the ’650 Patent’s claimed design.” *Id.* at 18.

WOM does not explain persuasively why the portion of outlet bore 212 that is depicted in Figure 10 as a flattened horizontal portion is a structure that is not “narrow.” Indeed, pointing to the supplemental Declaration testimony of Dr. Stevick, Ameriforge urges that the noted surface is one that would be regarded as narrow and performing the act of cutting. Pet. Reply 18 (citing Ex. 1022 ¶¶ 15–16, 48). In that respect, Dr. Stevick testifies that “the width of the surface defining Baker’s outlet bore 212 is only about 7.3% of the circumference of the bore, meaning that the surface is about 13.7 times longer than it is wide.” Ex. 1022 ¶ 16. We credit that testimony. A surface that is significantly longer than it is wide is consistent with a conclusion that the surface is a component regarded as narrow. Although WOM and its declarant, Mr. Gregg Perkin, disagree, characterizing the noted surface as “broad” (PO Resp. 17; Ex. 2004 ¶ 59), they do not explain adequately the basis for that characterization. Moreover, WOM also does not explain persuasively why the pertinent surface does not perform the required cutting function. As is clear from Baker’s disclosure, the pertinent surface is one that contacts the pipe during the course of the shearing operation of the pipe.

We also observe that other prior art of record makes clear how a person of ordinary skill in the art would understand what constitutes a “cutting edge.” To that end, we note that Dare, which, as noted above, also is directed to a gate valve performing shearing of tubing, explains that its gate 42 includes a “cutting edge” having a variable dimension/thickness “D.” Ex. 1003, 4:22–38. That dimension extends a distance along gate 42 within port 44. *See* Ex. 1003, Figure 5 (reproduced *supra*). Dare’s disclosure, thus, supports a conclusion that a skilled artisan would view the surface of Baker’s

sleeve 212, shown, for instance, in Figure 10, as a horizontal surface extending within bore 208 as part of a cutting edge.

In any event, even assuming that the above-discussed horizontal surface of Baker's sleeve 212 is not considered properly the "cutting edge," we are persuaded that Baker has that structure so configured as required by claim 9. Claim 9 recites the step of:

providing a single inclined surface on said aperture through said gate such that said aperture opens from a minimum size adjacent said cutting edge to a maximum size distal said cutting edge, said single inclined surface extending from said minimum size to said maximum size of said aperture.

Thus, the claim requires that an aperture on which a single inclined surface resides includes a "minimum size" adjacent the cutting edge and a "maximum size" distal from the cutting edge. In that respect, the claim specifies how the slope of the inclined surface is oriented.

Here, Ameriforge has pointed to Baker's inlet tapered surface 214 as constituting the claimed single inclined surface. Pet. 24.<sup>8</sup> Baker illustrates inlet tapered surface 214 in Figures 9–11 (reproduced *supra*), and describes that the surface "diverges outwardly toward seat ring 206." Ex. 1002, 6:9–11. Ameriforge's position concerning the presence of a single inclined surface in Baker, thus, is persuasive. Indeed, we do not discern disagreement in that respect by WOM. Even if the

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<sup>8</sup> Dr. Stevick testifies that the configuration of Baker's tapered surface 214 is analogous to that of inclined surface 124, shown, for instance in Figures 2 and 3 of the '650 patent (reproduced *supra*). See Ex. 1011 ¶¶ 67, 58.

“cutting edge” must be considered only the upper corner of Baker’s sleeve 212, it is clear that the slope or incline of inlet tapered surface 214 is oriented in the same manner set forth in claim 9, i.e., the minimum size of the aperture that forms part of the tapered surface is proximal the cutting edge and the maximum size is distal the cutting edge. Although there is some expanse of the horizontal surface of sleeve 212 at the point of the minimum size, it is not apparent why that precludes a determination that the minimum size is, nonetheless, adjacent the cutting edge.

For the foregoing reasons, we are satisfied that Baker discloses the “cutting edge” required by claim 9.

- b. “said inclined surface produces a force on said pipe to move said pipe away from said gate.”

Claim 9 also requires that the inclined surface operates to produce a force on the pipe to move the pipe away from the gate. Ameriforge contends that the required force would be produced by Baker’s tapered surface 214. Pet. 24. In support of that contention, Ameriforge relies on Dr. Stevick’s Declaration, in which he testifies that “Baker’s gate includes a single inclined surface that extends along a majority of the length of the bore and that, once in contact with the tubular, will impart a force on the tubular in a direction away from the gate[.]” Ex. 1011 ¶ 67.

WOM argues that Baker’s tapered surface 214 would not operate to impart the force required by claim 9. *See, e.g.*, PO Resp. 19. In making that argument, WOM generally urges that “Baker’s design will not necessarily forcibly push a cut tubing away from its gate in any and all circumstances because in some cases its broad shearing surface may not reliably cut it while in other cases the Baker design may

pinch the cut OCTG [oil country tubular goods].” *Id.* Thus, according to WOM, Baker does not satisfy the pertinent requirement of claim 9 because, in some circumstances, a particular type of tubular component, i.e., OCTGs, may be pinched if used in Baker’s gate valve. In taking that position, WOM relies on the testimony of Mr. Perkin (Ex. 2004). *See, e.g., id.* at 17–21. In Mr. Perkin’s view, use of a particular 27/8” outer diameter (“OD”) tubing may cause a tube to be “pinched” and thus not forced away from the gate. *See, e.g., Ex. 2004* ¶ 59. Ameriforge does not agree with WOM or Mr. Perkin, and points to the countervailing testimony of its declarant, Dr. Stevick, challenging WOM’s position and the opinion of Mr. Perkin. *See Pet. Reply 9–18* (citing Ex. 1022).

At the outset, we observe that claim 9 does not call for any particular sized tubing to be cut and pushed away via the inclined surface. Rather, the claim simply requires that it is a “pipe” that is cut and moved away from the gate. Baker clearly provides that its shearing gate valve is operable to “shear a wire line or other tubular members extending” through the valve. Ex. 1002, 6:35–41. WOM does not undermine Ameriforge’s showing that Baker’s disclosure encompasses the shearing of a “pipe.”

Moreover, WOM does not offer any persuasive explanation why Baker’s tapered surface 214 would be unable to impart a force to a pipe or other tubular member contemplated by Baker to move that tubular member away from the gate once it has been cut. In that respect, WOM seeks to discredit Dr. Stevick’s testimony, but does not explain adequately why that testimony should be disregarded. *See PO Resp. 19–20.* WOM relies on the testimony of Mr. Perkin (*id.*, citing Ex. 2004 ¶¶ 62–66), but Mr. Perkin seemingly bases

his testimony on a particular size and type of OCTG that is not required by claim 9. Given Dr. Stevick's testimony, and noting the marked similarity in the design and operation of the gate valves of the '650 patent and Baker, and in particular the arrangement of their respective inclined or tapered surfaces, we are satisfied that the particular requirement in claim 9 directed to the production of a force by the inclined surface to move a "pipe" away from the gate is met.

Nevertheless, even assuming the claims are construed to require the particular type and size of tubing that is contemplated by Dr. Perkin, we are not persuaded that such construction patently distinguishes claim 9 from Baker. WOM's assertion that Baker's assembly "will not necessarily" push the tube away from the gate "in any and all circumstances" (PO Resp. 19) is seemingly a recognition that, in some cases, it will. WOM does not explain why the success of Baker's gate valve in some circumstances in pushing the noted tubing away from the gate is insufficient to account for the pertinent requirement of claim 9. *See Hewlett-Packard Co. v. Mustek Sys., Inc.*, 340 F.3d 1314, 1326 (Fed. Cir. 2003) ("a prior art product that sometimes, but not always, embodies a claimed method nonetheless teaches that aspect of the invention").

Moreover, we are cognizant of Dr. Stevick's testimony that the very potential deficiency that WOM and Mr. Perkin attribute to Baker's gate valve vis-à-vis the 27/8" OD tubing would also be present in the gate valve of the '650 patent. *See, e.g.*, Ex. 1022 ¶¶ 31–34, 50–54. In that regard, we understand Dr. Stevick's testimony to convey that, given the similarity in the design of Baker's gate valve and that of the '650 patent, to the extent that the prospect of potential pinching exists in Baker's gate valve, such prospect

would also arise in the gate valve of the '650 patent. Yet, there is no suggestion from WOM that the gate valve described in the '650 patent lies outside the scope of claim 9.

For the foregoing reasons, we do not discern why Baker's tapered surface 214 would somehow be inadequate to direct a cut tubular away from the gate valve as required. Accordingly, we are persuaded that Ameriforge has shown that the requirement of an inclined surface that produces a force on a pipe to move the pipe from a gate upon cutting of the pipe is taught in Baker.

c. Conclusion – Anticipation of Claim 9

We have considered the record before us, including the Petition, WOM's opposition, and Ameriforge's Reply. We conclude that Ameriforge has shown by a preponderance of the evidence that claim 9 is anticipated by Baker. *See, e.g.*, Pet. 24.

2. Claim 12

Claim 12 depends from claim 9 and adds the limitation of "utilizing said gate valve on a wellbore without using a B.O.P." In that respect, claim 12 does not require that the gate valve itself be used to replace a BOP, but, instead, must be operable to be used without a BOP. Baker does not limit its gate valve to use with a BOP. We do not discern that claim 12 adds any feature distinct from the disclosure of Baker.

Accordingly, we are persuaded that Ameriforge has shown by a preponderance of the evidence that claim 12 is anticipated by Baker.

*D. Obviousness*

Ameriforge proposes grounds of unpatentability for claims of the '650 patent based on: (1) Baker and Dare; (2) Baker and Collie; and (3) Baker and Schlegelmilch.

1. Principles of Law

A claim is unpatentable under § 103(a) if the differences between the claimed subject matter 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 person having ordinary skill in the art to which said subject matter pertains. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) where in evidence, so-called secondary considerations. *See Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). We also recognize that prior art references must be “considered together with the knowledge of one of ordinary skill in the pertinent art.” *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994) (citing *In re Samour*, 571 F.2d 559, 562 (CCPA 1978)).

2. Level of Skill in the Art

In determining the level of skill in the art, various factors may be considered, including “type 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.” *In re GPAC, Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995) (citing *Custom Accessories, Inc. v. Jeffrey-Allan Indus., Inc.*, 807 F.2d 955, 962 (Fed. Cir. 1986)).

There is evidence in the record before us that reflects the knowledge level of a person with ordinary skill in the art. Ameriforge's declarant, Dr. Stevick, testifies the following as to the level or ordinary skill in the art:

21. It is my opinion that a person of ordinary skill in the art at the time the '650 Patent was originally filed (November 6, 2001)[footnote omitted] is a person who earned a bachelor of science degree in mechanical engineering and had two to three years of engineering experience related to shearing gate valves and/or shear ram-type blowout preventers in the oil and gas industry.

22. Such a person would be generally familiar with the use of shearing gate valves for cutting wirelines, and "macaroni" and coiled tubing in oil and gas wells, such as during drilling and/or workover operations of wells. Such a person would also recognize that the functionality of shearing tubulars with shearing gate valves is largely governed by the same mechanical engineering principles that govern the shearing of tubulars in shearing-ram blowout preventers.

Ex. 1011 ¶¶ 21, 22.

WOM's declarant, Mr. Perkin, expresses agreement with Dr. Stevick's characterization of the level of ordinary skill in the art. Ex. 2004 ¶ 30. We acknowledge and accept the parties' representations as to the level of ordinary skill in the art.

### 3. Obviousness Based on Baker and Dare

Ameriforge contends that claims 1, 2, 4–10, 12–14, 16, 18, and 19 are unpatentable over Baker and Dare, and lays out in the Petition the basis for that contention. *See* Pet. 27–33. WOM generally contends that Dare does not remedy deficiencies discussed above with respect to Baker vis-à-vis a cutting edge and an inclined surface producing a force to push cut pipe out of the way of a gate valve, as is required by each of claims 1, 2, 4–10, 12–14, 16, 18, and 19. For the reasons noted above, we do not agree that Baker has such deficiencies.

We take opportunity here, however, to consider the disclosures of Dare also pertaining to a “cutting edge” and an “inclined surface.” As discussed above, Dare provides that its gate valve 42 includes cutting edge 90 that extends within bore 44 and is variable in size. Ex. 1003, 4:22–38. The gate also has inclined portions characterized as “inclined surface 98” and “inclined surface 102.” To the extent that those surfaces are not regarded as “a single inclined surface,” we observe that Dare makes clear that the angles of incline of those surfaces are variable. *Id.* at 4:39–53. Although Dare gives particular examples of preferred angles, Dare also contemplates that different angles may be employed in other circumstances. *Id.* at 5:20–23, 45–47. In light of Dare’s teachings, we discern that a skilled artisan would have appreciated readily that a uniform angle was a viable option for the inclination of both surface 98 and surface 102.

WOM also mounts a challenge to the Baker and Dare ground that generally centers on the following claim requirements: (1) “mounting said gate valve on said well casing for controlling fluid flow in place of at least one BOP on said well casing” (claim 1); and (2)

“said subsea riser package installation being operable for replacement of a B.O.P.” (claim 14).

Ameriforge contends that in combining the teachings of Dare and Baker, the resulting gate valve, or subsea riser package installation, would be operable to replace a BOP. Pet. 28–29. In that respect, Ameriforge explains that, to the extent “Baker’s gate valve is not sufficiently large to be used in place of or without using a BOP, it would have been obvious to also simply increase the size of Baker’s gate valve to do so.” *Id.* at 32. Ameriforge supports its obviousness position through citation to Dr. Stevick’s testimony. *Id.* Dr. Stevick testifies that the type of “macaroni tubing” that Dare contemplates as needing to be cut is recognized in the art as being variable in size, including “up to 3.5 inches.” Ex. 1011 ¶ 43. That particular size of tubing is notable as, during the course of this proceeding, WOM has represented that to replace a BOP, a gate valve “must be able to reliably and repeatably cut production tubing of at least 2.5 inch diameter.” Paper 12, 9.<sup>9</sup> Ameriforge, thus, urges the following:

A person of ordinary skill would have recognized the “macaroni tubing” discussed in Dare was known to range in diameter up to 3 1/2 inches. Ex. 1011 at ¶ 44. Such a person thus would have understood that Dare’s shearing gate valve and similar types of shearing gate valves could be sized to shear macaroni tubing with such larger diameters,

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<sup>9</sup> In making that representation, WOM pointed to column 1, lines 33–53 of the ’650 patent, which expresses a desire for a gate valve to cut production tubing measuring 27/8 inches to replace BOP stacks. We observe also that claim 18 recites that the tubular in question that is to be cut is “greater than two and one-half inches” in diameter.

and that it would have been desirable to do so to be usable with various known sizes of tubing. Ex. 1011 at ¶ 79.

Pet. 32.

It is apparent that WOM generally disagrees that Dare's teachings amount to a configuration of a gate valve operating in place of, or to replace, a BOP. *See, e.g.*, PO Resp. 34–35. In our view, however, WOM neglects to consider fully what the teachings of Dare would have conveyed to one of ordinary skill in the art. Dare contemplates that, by operation of a hydraulic actuator mechanism and due to the configuration of its gate valve, the gate valve is useful in an emergency to shut in a well. Ex. 1003, 4:61–66. We understand that shutting in the well means that the well is sealed such that fluid no longer passes through the valve. Furthermore, in shutting in the well, the gate valve severs “large diameter tubing,” and “‘macaroni’ type tubing.” *Id.* at 4:67–5:3. Ample evidence of record conveys that “macaroni” tubing is understood in the art as being used in well workover operations and includes tubing sizes of “up to 3.5 inches” *See, e.g.*, Ex. 1011 ¶ 43 (citing “Coiled Tubing Handbook, 3rd Ed. 1998 at 131”). Furthermore, Dare, itself, conveys that its gate valve is configured to shear even larger diameter tubing than that regarded as “macaroni” tubing. Ex. 1003, 5:1–3.

Accordingly, on this record, including the Specification of the '650 patent, we are persuaded that a skilled artisan would have appreciated that Dare's gate valve is sufficiently robust to operate in place of, or as a replacement for, a BOP.<sup>10</sup> We also agree with

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<sup>10</sup> Although not required by the claims of the '650 patent, we also are persuaded that, based on description in the '650 patent

Ameriforge that it would have been obvious to combine Baker's and Dare's teachings so as to arrive at the gate valve configuration required by claims 1, 2, 4–10, 12–14, 16, 18, and 19. *See* Pet. 29–33; Pet. Reply 21. For instance, with recourse to content of the prior art, and Dr. Stevick's testimony, Ameriforge contends that the combination of Baker and Dare predictably would have conveyed a gate valve configured to harness the particular beneficial characteristics attributed to the respective valves of Baker and Dare. In particular, Ameriforge contends that one of ordinary skill would have appreciated that Baker's gate valve demonstrates improved flow characteristics arising due to the particular configuration of its tapered bore. Pet. 29–30 (citing Ex. 1011 ¶¶ 79–82. Ameriforge also submits a skilled artisan would have recognized from Dare's teachings the practical benefits of a gate valve sized and constructed to provide the shearing capacity and flow control of a BOP, without the need for an additional BOP component. *Id.* at 32 (citing Ex. 1011 ¶¶ 44, 70–72, 79). We are persuaded that Ameriforge relies on rational, credible reasons for combining the teachings of Baker and Dale. The combination of those teachings would have suggested to a person of ordinary skill in the art, who is also a person of ordinary creativity, *see KSR*, 550 U.S. at 421, a gate valve structured as required by the claims of the '650 patent, and one that accomplishes the emergency shearing functions attributed to Dare's invention. More particularly, given the content of the prior art, a skilled artisan would have recognized reasonably that a gate valve may be configured, and be operable, to cut

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(for instance, column 1, lines 33–40), one of ordinary skill in the art also would have understood that Dare's gate valve may operate in lieu of a "BOP stack."

tubing and seal a wellbore at a level understood as suitable for replacing a BOP.

We have considered the record before us, including the record evidence, the Petition, WOM's Patent Owner Response, and Ameriforge's Reply. We are persuaded that Ameriforge has demonstrated that all the features of claims 1, 2, 4–10, 12–14, 16, 18, and 19 are disclosed by Baker and Dare, and that there is persuasive reasoning for combining the teachings of Baker and Dare. *See* Pet. 20–33.

#### 4. Obviousness Based on Baker and Collie

Ameriforge contends that claims 1, 2, 4–7, 9, 12–14, 16, 18, and 19 are unpatentable over Baker and Collie. As noted above with respect to the Baker and Dare combination, WOM argues that Collie does not remedy alleged deficiencies in Baker in connection with a cutting edge and the arrangement and operation of an inclined surface of a gate valve. Those are arguments with which we do not agree.

Ameriforge generally relies on Collie for its teaching of configuring a gate valve to be used without the need for a BOP. As discussed above, Collie is directed to a “completion system comprising a christmas tree mounted on a wellhead housing.” Ex. 1004, 1:37–39. An embodiment of Collie's system includes “lower riser package 128” that operates with coiled tubing string, and describes that the system may be used in situations specifically where “a BOP stack is not used on the tree.” *Id.* at 6:36–60. Collie also discloses the following:

Installation and recovery of the coiled tubing string may be carried out from a lightweight intervention vessel, without the use of a BOP. The lower riser package includes upper and

lower valves 138, 140 (for example large bore gate valves) at least one of which may, if required in an emergency, be used to shear the coiled tubing string.

*Id.* at 6:53–59.

Thus, Collie conveys that gate valves may be employed that operate in emergency situations to shear tubing without the use of a BOP. As noted by Ameriforge, a skilled artisan also would have known that gate valves may employ a hydraulic actuator as the driving component for such a valve. Pet. 36–37 (citing Ex. 1004, 5:20–22; Ex. 1011 ¶¶ 23, 68, 69). In light of Collie’s teachings, we are persuaded that one of ordinary skill in the art would have understood that a gate valve, such as that of Baker, may be rendered suitably robust so as to operate in place of a BOP. In that regard, a skilled artisan would have looked to Collie for its teachings of a gate valve having a configuration that is beneficial in providing for a structure viewed as “lightweight,” yet, in an emergency situation, operates to shear coiled tubing string. Ex. 1004, 6:53–59.

We have considered the record, including Ameriforge’s Petition with respect to the ground of unpatentability based on Baker and Collie (Pet. 33–37), as well as WOM’s Response challenging that ground. We are persuaded that Ameriforge has accounted for the features of claims 1, 2, 4–7, 9, 12–14, 16, 18, and 19 based on Baker and Collie.

#### 5. Obviousness Based on Baker and Schlegelmilch

Ameriforge contends that claims 6–8 and 10 are unpatentable over Baker and Schlegelmilch. Claims 7 and 8 depend from claim 6. Claim 10 depends from claim 9. Claim 6 includes a step of measuring the force

necessary to cut pipe. Claim 10 also includes a step of determining such force. WOM presents no arguments with respect to claims 6–8 in connection with the ground based on Baker and Schlegelmilch. With respect to claim 10, WOM generally urges that the claim is patentable based on its dependency from claim 9, which WOM maintains has not been shown to be unpatentable.

The record before us supports a determination that the act of measuring or determining the necessary cutting forces is the routine exercise of an ordinary artisan’s skill. *See* Ex. 1011 ¶¶ 51, 74, and 75 (citing [American Petroleum Institute] Specification 16A, Specification for Drill-Through Equipment § 4.7.2.4 *Shear Ram Test* (1997)” and Ex. 1002, 6:47–53).<sup>11</sup> Indeed, that determination also is evidenced by Schlegelmilch. Schlegelmilch is a thesis from the Massachusetts Institute of Technology that describes tests and processes for determining the amount of cutting force necessary to shear coiled tubing of various sizes and dimensions. *See, e.g.*, Ex. 1005, 41–42. Given both Schlegelmilch’s and Baker’s teachings, we agree with Ameriforge that “a person of ordinary skill in the art would have recognized the potential benefits of performing the tests contemplated by Schlegelmilch using a test fixture and cutting blade with dimensions corresponding to Baker’s valve.” Pet. 40–41 (citing Ex. 1011 ¶ 96). We, thus, conclude that one of ordinary

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<sup>11</sup> As testified by Dr. Stevick, “[a] person of ordinary skill would have understood that it would have been . . . beneficial to measure the ‘actual pressure and force’ required to shear tubing with a shearing gate valve (such as, for example, to validate its ability to perform its intended functions), especially where such a shearing gate valve could be used in place of a BOP.” Ex. 1011 ¶ 51.

skill in the art would have appreciated that the amount of force necessary to cut a pipe may be measured or determined.

#### 6. Secondary Considerations of Non-Obviousness

“Secondary considerations,” such as “commercial success,” may have relevance in assessing the obviousness or nonobviousness of a claimed invention. *See Graham v. John Deere Co.*, 383 U.S. at 17–18. In its Patent Owner Response, WOM contends that it has enjoyed commercial success in selling its “lightweight intervention systems” to a single customer entity—Helix Energy Solutions (“Helix”). PO Resp. 5. In support of that contention, WOM relies on the Declaration of William Kinnear.<sup>12</sup>

WOM generally represents that it has sold some of its systems to Helix since 2002, and that such sales “and WOM’s services delivered in connection with” those systems have generated a certain revenue. PO Resp. 5. WOM, however, provides little, if any, context for the numbers that it advances. In that respect, the number of units sold to a single customer and the amount of revenue generated from those sales tells us little with respect to any commercial success of the particular product referenced by WOM. *See In re Huang*, 100 F.3d 135, 140 (Fed. Cir. 1996) (“This court has noted in the past that evidence related solely to the number of units sold provides a very weak showing of commercial success, if any.”). Indeed, notably absent from WOM’s evidence of commercial success is any indication of the market share that its asserted sales represent, or any breakdown between sales revenue

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<sup>12</sup> A redacted version of Mr. Kinnear’s Declaration appears in the record as Exhibit 2003. An unredacted version appears as Paper 23.

and revenue associated with servicing the systems. Accordingly, WOM has provided a very weak showing of commercial success in support of nonobviousness based on secondary considerations.

#### 7. Conclusion – Obviousness

We recognize that evidence of secondary considerations, such as that presented by Patent Owner, must be considered in route to a determination of obviousness/nonobviousness under 35 U.S.C. § 103. Accordingly, we consider anew the issue of obviousness under 35 U.S.C. § 103, carefully evaluating and weighing both the evidence presented by Petitioner and the objective evidence of nonobviousness provided by Patent Owner. We have considered the entirety of the evidence in this proceeding, including Ameriforge's strong evidence of obviousness and WOM's very weak evidence of commercial success, and conclude that Petitioner has shown by a preponderance of the evidence that claims 1, 2, 4–10, 12–14, 16, 18, and 19 would have been obvious over Baker taken with any of Dare, Collie, or Schlegelmilch.

#### E. Motion to Seal

WOM filed a Motion to Seal portions of its Patent Owner Response,<sup>13</sup> as well as portions of the Declaration of Mr. William Kinnear.<sup>14</sup> Ameriforge has not filed an opposition to the Motion to Seal.

There is a strong public policy in favor of making information filed in an *inter partes* review open to the

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<sup>13</sup> Unredacted (Paper 20) and redacted (Paper 22) versions of the Patent Owner Response appear in the record.

<sup>14</sup> An unredacted version of Mr. Kinnear's Declaration appears in the record as Paper 23, and a redacted version appears as Exhibit 2003.

public, especially because the proceeding determines the patentability of claims in an issued patent and, therefore, affects the rights of the public. Under 35 U.S.C. § 316(a)(1) and 37 C.F.R. § 42.14, the default rule is that all papers filed in an *inter partes* review are open and available for access by the public; however, a party may file a concurrent motion to seal and the information at issue is sealed pending the outcome of the motion. It is only “confidential information” that is protected from disclosure. 35 U.S.C. § 316(a)(7); *see* Office Patent Trial Practice Guide, 77 Fed. Reg. 48,756, 48,760 (Aug. 14, 2012). The standard for granting a motion to seal is “good cause.” 37 C.F.R. § 42.54(a). The party moving to seal bears the burden of proof in showing entitlement to the requested relief, and must explain why the information sought to be sealed constitutes confidential information. 37 C.F.R. § 42.20(c). As set forth in the Trial Practice Guide (77 Fed. Reg. at 48,761), there is an expectation that information will be made public if identified in this Final Written Decision.

We have reviewed the unredacted versions of WOM’s Patent Owner Response (Paper 20) and Mr. Kinnear’s Declaration (Paper 23). We conclude that they contain confidential business information. None of the content of those documents that is asserted as constituting confidential business information has been identified in this Final Written Decision in reaching a determination in this proceeding with respect to the claims of the ’650 patent. We are persuaded that good cause exists to have those documents remain under seal.

The record will be maintained undisturbed pending the outcome of any appeal taken from this decision. At the conclusion of any appeal proceeding, or if no appeal

is taken, the documents will be made public. *See* Trial Practice Guide, 77 Fed. Reg. at 48,760–61. Further, either party may file a motion to expunge the sealed documents from the record pursuant to 37 C.F.R. § 42.56. Any such motion will be decided after the conclusion of any appeal proceeding or the expiration of the time period for appealing.

### III. CONCLUSION

Ameriforge has shown by a preponderance of the evidence that:

- A. Claims 9 and 12 are unpatentable under 35 U.S.C. § 102(b) as anticipated by Baker;
- B. Claims 1, 2, 4–10, 12–14, 16, 18, and 19 are unpatentable under 35 U.S.C. § 103(a) over Baker and Dare;
- C. Claims 1, 2, 4–7, 9, 12–14, 16, 18, and 19 are unpatentable under 35 U.S.C. § 103(a) over Baker and Collie;
- D. Claims 6–8 and 10 are unpatentable under 35 U.S.C. § 103(a) over Baker and Schlegelmilch;

### IV. ORDERS

After due consideration of the record before us, it is:

ORDERED that claims 1, 2, 4–10, 12–14, 16, 18, and 19 of the '650 patent are held unpatentable;

FURTHER ORDERED that WOM's Motion to Seal (Paper 23) is *granted*; and

FURTHER ORDERED that, because this is a Final Written Decision, the parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

Case IPR2015-00233

Patent 6,601,650 B2

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**APPENDIX C**

(12) United States Patent Sundararajan  
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 (54) METHOD AND APPARATUS FOR  
 REPLACING BOP WITH GATE VALVE  
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 Sep. 10, 2001.  
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 (52) U.S. Cl. ....166/361; 166/55; 166/86.3; 166/376  
 (58) Field of Search .....  
 166/373, 376, 166/383, 86.3, 91.1, 55, 55.1, 55.2, 361  
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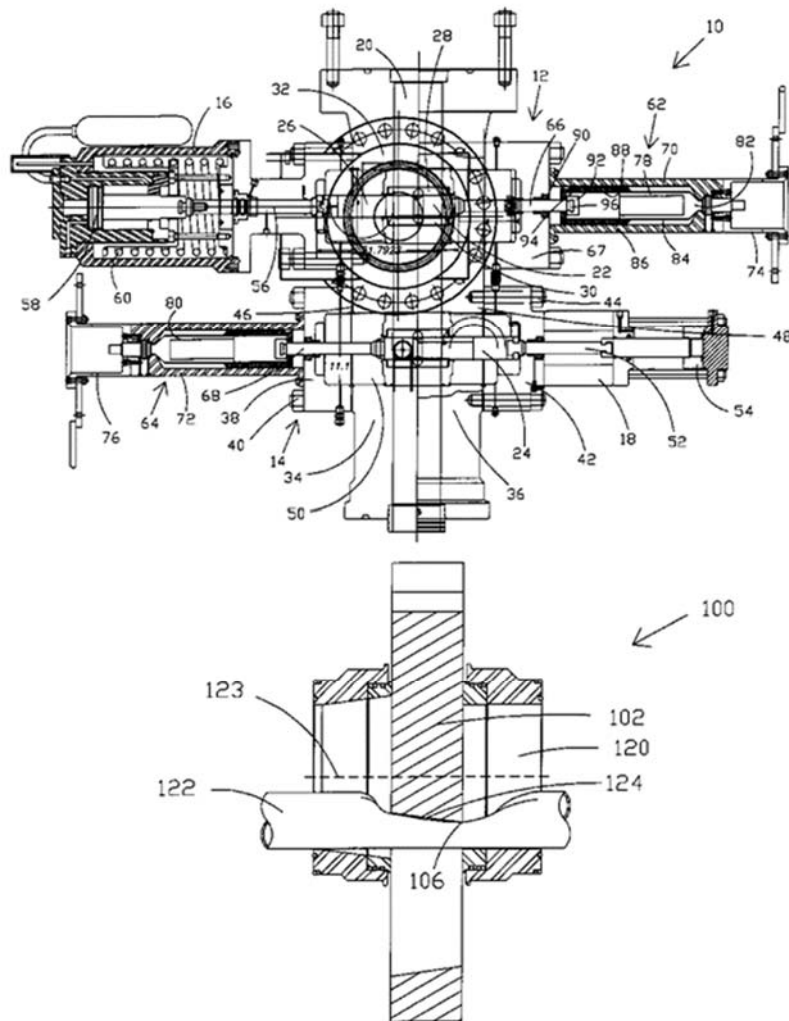
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(57) ABSTRACT

The present invention discloses apparatus and methods for replacing a BOP with a gate valve to thereby save space, initial costs, and maintenance costs that is especially beneficial for use in offshore subsea riser packages. The method provides a gate valve capable of reliably cutting tubing utilizing a cutting edge with an inclined surface that wedges the cut portion of the tubing out of the gate valve body. A method and apparatus is provided for determining the actuator force needed to cut the particular size tubing.

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19 Claims, 4 Drawing Sheets



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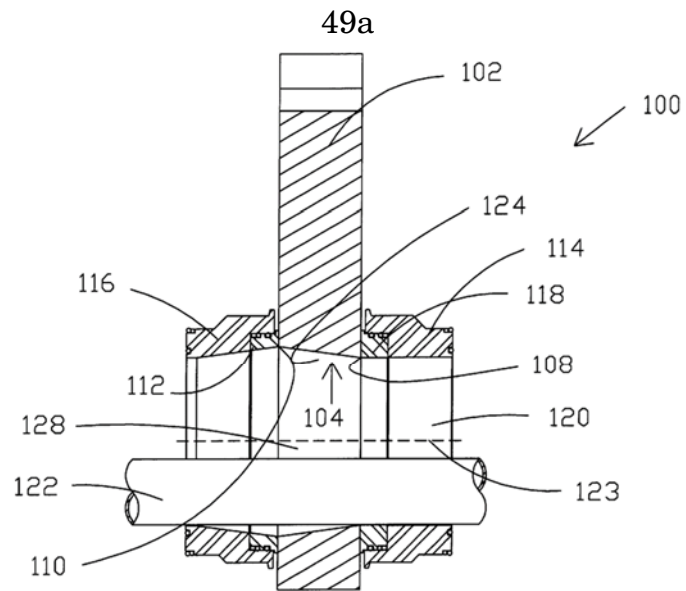


FIG. 2

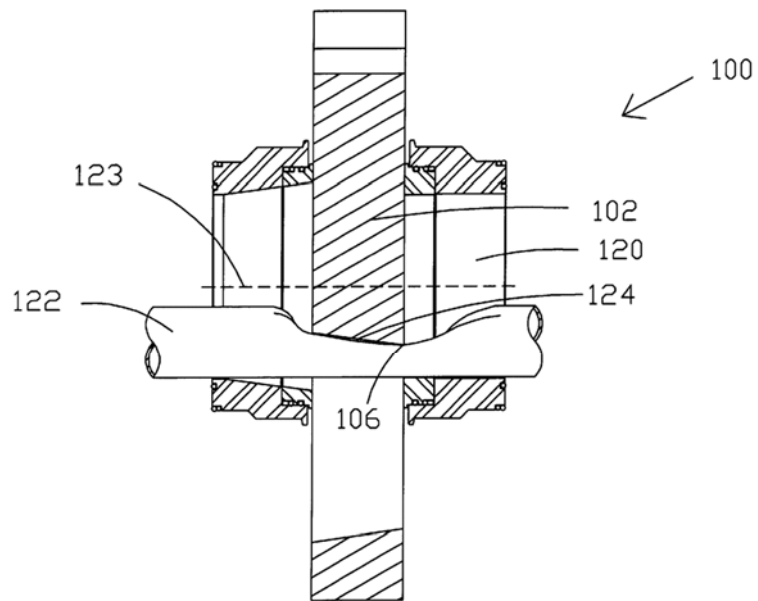


FIG. 3

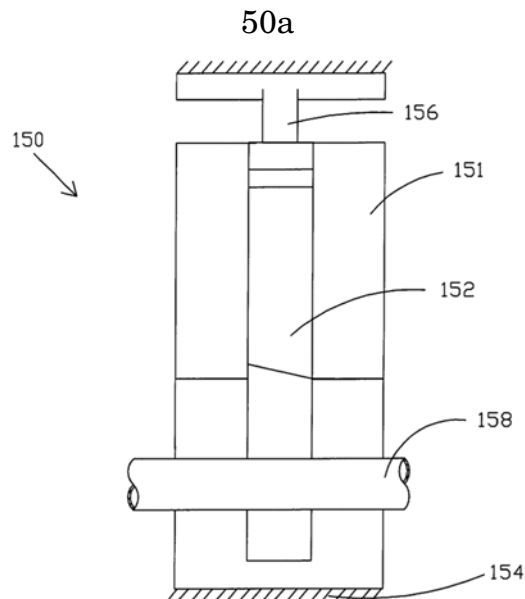


FIG. 4

## METHOD AND APPARATUS FOR REPLACING BOP WITH GATE VALVE

This application claims benefit of U.S. Provisional Application No. 60/318,371 filed Sep. 10, 2001, and is a continuation-in-part of U.S. patent application Ser. No. 09/925,676 filed Aug. 9, 2001.

### BACKGROUND OF THE INVENTION

#### 1. Field of the Invention

The present invention relates generally to gate valves and, more particularly, to a large I.D. gate valve with a cutter operable for repeatable cutting pipe and/or wireline so as to be especially suitable for replacing an entire BOP stack in a lower riser package.

#### 2. Description of the Background

Blowout Preventor (B.O.P.) stacks are frequently utilized in oilfield wellbore Christmas trees such as,

for instance, lower riser packages in offshore wells. B.O.P. stacks may include a first set of rams for sealing off the wellbore and a second set of rams for cutting pipe such as tubing and/or cutting wireline. However, B.O.P. stacks tend to be quite bulky and heavy, which are undesirable features especially in lower riser packages for undersea operation where space is often at a premium. B.O.P. stacks tend to be expensive for initial installation. Moreover, if maintenance is required, then the maintenance costs for replacing such B.O.P. stacks can be many times the original installation costs. B.O.P. stacks may frequently require maintenance after cutting pipe is required. For instance, the cut pipe may become stuck within the B.O.P. stack blocking other operations.

While gate valves with various types of cutters have been developed including gate valves with one or more cutting edges for cutting wireline, such gate valves have not been utilized to replace B.O.P. stacks. Moreover, it would be desirable to provide a gate valve for casing such as in the  $7\frac{3}{8}$  inch range operable for cutting production tubing such as, for instance,  $2\frac{7}{8}$  inch production tubing with 0.204 wall thickness.

Consequently, those skilled in the art will appreciate the present invention that addresses the above problems.

#### SUMMARY OF THE INVENTION

An objective of the present invention is to provide an improved gate valve with capability of reliably and repeatably cutting tubulars of at least  $2\frac{3}{4}$ " or more, if desired, without the need for maintenance.

Another objective of the present invention is to provide a large diameter gate valve suitable for replacing

a B.O.P. stack containing rams for sealing the wellbore and rams for cutting tubing.

Accordingly, the present invention provides a method for a gate valve mountable onto a wellbore casing. The gate valve is preferably operable for controlling fluid and cutting tubing. The method may comprise one or more steps such as, for instance, mounting the gate valve on the well casing for controlling fluid flow without also utilizing a BOP on the well casing, mounting a slidable gate within the gate valve, providing the slidable gate may have a first side and a second side opposite the first side, providing first and second seats for the slidable gate such that the first side of the gate is preferably adjacent the first seat and the second side of the gate is preferably adjacent the second seat, providing a single cutting edge on the slidable gate of the gate valve such that the slidable gate defines an aperture through the slidable gate, positioning the single cutting edge such that the aperture has a minimum diameter at the cutting edge, forming the cutting edge adjacent the first side of the gate, and/or providing an inclined surface on the gate such that the inclined surface defines at least a portion of the aperture such that the aperture increases in diameter with respect to axial distance away from the cutting edge such that the aperture has a maximum diameter towards an opposite side of the gate.

Other steps may comprise mounting the gate valve in a subsea installation. In one embodiment the method may further comprise providing that the first seat is preferably formed by telescoping interconnecting two seat elements with respect to each other, providing that the second seat is preferably formed by telescoping interconnecting two seat elements with

respect to each other, and/or providing that the aperture has a minimum diameter at the first side of the slidable gate.

In another embodiment, a method is provided for determining force needed on a gate to cut a tubular disposed within a gate valve. The gate valve is preferably mountable on a wellbore casing such that the tubular is preferably positional within the wellbore casing. The method may comprise one or more steps such as, for instance, providing a test body for slidably supporting a test gate, the test gate may comprise dimensions related to the gate, inserting a test pipe through the test body and the test gate, the test pipe may comprise dimension related to the tubular, applying force to the test gate until the pipe is cut by the test gate, and measuring the force on the test gate required for cutting the test pipe. The method may also comprise designing an actuator for the gate such that the actuator is capable of producing the force and/or utilizing a hydraulic press for applying the force to the test gate.

In another embodiment, a method is provided for cutting a pipe within a wellbore utilizing a gate valve such that the pipe is pushed away from a gate within the gate valve. The method may comprise one or more steps such as, for instance, providing the gate valve with a single cutting edge on one side of the gate along the aperture through the gate, providing an inclined surface on the aperture through the gate such that the aperture opens to a maximum diameter distal the single cutting edge, inserting the pipe into the wellbore through the gate valve, closing the gate within the gate valve, and cutting the pipe as the gate closes such that the inclined surface produces a force on the pipe to move the pipe away from the gate.

Therefore an apparatus is provided comprising a gate valve for a subsea riser package installation the subsea riser package installation may have no B.O.P. The apparatus comprises one or more elements such as, for instance, a sliding gate within the gate valve, a single cutting edge mounted on one side of the sliding gate, an inclined surface adjacent the cutting edge such that the single cutting edge and the inclined surface define an aperture through the sliding gate, and a hydraulic actuator for the gate valve operable to apply sufficient force to the sliding gate to cut the tubular. In one embodiment, the inclined surface is angled with respect to an axis through the aperture and flow path of the gate valve by from three degrees to twenty degrees.

#### BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an elevational view, partially in section, of a subsea valve assembly in accord with the present invention;

FIG. 2 is an elevational view, partially in section, of a hydraulically operated subsea gate valve that may be utilized as either gate valve in the subsea valve assembly of FIG. 1;

FIG. 3 is an elevational view, partially in section, of the gate valve of FIG. 2 in the process of cutting tubing;

FIG. 4 is a schematic showing an assembly for determining the required hydraulic pressure applied to the gate for a gate valve for cutting tubing in accord with the present invention.

While the present invention will be described in connection with presently preferred embodiments, it will be understood that it is not intended to limit the

invention to those embodiments. On the contrary, it is intended to cover all alternatives, modifications, and equivalents included within the spirit of the invention and as defined in the appended claims.

#### BRIEF DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, and more particularly to the figure, there is shown a subsea valve assembly 10, in accord with the present invention. Due to the physical space limitations, it is desirable that subsea valve assembly 10 be as compact as possible.

Subsea valve assembly 10 may include one or more gate valves, such as gate valve 12 and gate valve 14. Various types of hydraulic gate valve actuators may be utilized within subsea valve assembly 10, such as fail-safe gate valve actuator 16 and hydraulic actuator 18. An exemplary embodiment of a fail-safe gate valve actuator is disclosed in U.S. patent application Ser. No. 09/802,209, filed Mar. 8, 2001, referenced hereinbefore, and incorporated herein by reference. Gate valves 12 and 14 are utilized to control fluid flow through conduit 20 which is part of a subsea installation. Subsea valve assembly 10 shown in the FIG. 1 is of a type that may be utilized in very deep water.

Gate valve 12 comprises a slidable gate 22 and gate valve 14 comprises a slidable gate 24. Gates 22 and 24 are each individually moveable between an open position and a closed position whereby fluid flow through conduit 20 may be controlled. Gate 22 includes passageway 26 therethrough such that in the position shown gate 22 is in the closed position. Seat elements 28 and 30 work with gate 22 for sealing and opening passageway 20. Likewise, gate 24 is shown in the open position to thereby permit fluid flow through

passageway 20. In many cases, it may be desirable to include both a hydraulic actuator gate valve and a failsafe hydraulic actuator for ensuring that fluid flow through conduit 20 is properly controlled if hydraulic power is lost.

Gate valve 12 includes gate valve housing 32 and gate valve 14 includes gate valve housing 34. The gate valve housings may be constructed in different ways. However, a preferred embodiment of the present invention provides for a gate valve housing comprised of a gate valve body which is symmetrical on both sides for attachment to two gate valve bonnets. Thus gate valve housing 34 comprises gate valve body 36 which includes a first gate valve bonnet 38 secured by connectors such as stud/nut assemblies 40 to gate valve body 36. Gate valve housing 34 also includes a second gate valve bonnet 42 which is secured by stud/nut assemblies 44 to gate valve body 36. In this presently preferred embodiment, gate valve body 36 is substantially symmetrical on each side such that either gate valve bonnet may attach to either symmetrical side 46 or symmetrical side 48 of gate valve body 36. While not required, this symmetrical construction permits significant flexibility of design whereby hydraulic actuators and/or manual override operators, as discussed subsequently, may be positioned as desired on whichever side of the gate valve most suitable for the particular dimensional requirements.

The gate valve housings include a chamber defined therein in which the gate moves. Thus, gate valve housing 34 defines chamber 50 in which gate 24 moves translationally between the open and closed position in response to action of hydraulic actuator 18. Gate 24 is controlled by hydraulic actuator 18 by means of operating stem 52. Piston 54 is hydraulically activated

to control operating stem 52 which in turn controls the position of gate 24. Likewise, failsafe actuator 16 connects to operating stem 56 and operates as described in detail in my above referenced previous patent application in response to hydraulic activation of piston 58 and/or control spring 60. Usually, a failsafe valve is either a normally open valve or a normally closed valve, depending on the requirement, such that if failure occurs then the valve returns to the desired position.

In general, it will be understood that such terms as “up,” “down,” “vertical,” and the like, are made with reference to the drawings and/or the earth and that the devices may not be arranged in such positions at all times depending on variations in operation, transportation, mounting, and the like. As well, the drawings are intended to describe the concepts of the invention so that the presently preferred embodiments of the invention will be plainly disclosed to one of skill in the art but are not intended to be manufacturing level drawings or renditions of final products and may include simplified conceptual views as desired for easier and quicker understanding or explanation of the invention. One of skill in the art upon reviewing this specification will understand that the relative size and shape of the components may be greatly different from that shown and the invention can still operate in accord with the novel principals taught herein.

Valve system 10 preferably also utilizes manual override operators such as manual override operators 62 and 64 which operate in conjunction with fail-safe hydraulic actuator 16 and hydraulic actuator 18, respectively. Each manual override operator is preferably mounted to one of the two gate valve bonnets. Thus, manual override operator 64 is mounted to gate

valve bonnet 38. Manual override operator 62 is mounted to gate valve bonnet 67 preferably in the same manner as discussed previously. Because the opposing bonnets, such as bonnets 38 and 42 may be connected to either of the opposite sides 46 and 48 of gate valve body 36, the respective manual override operator and actuator, such as manual override actuator 64 and hydraulic actuator 18 may be positioned on either side of valve body 36. In this way, the flexibility of subsea valve system 10 is significantly enhanced and provides significant flexibility of design.

Manual override operators 62 and 64 are therefore mounted on an opposite side of the gate valve with respect to the hydraulic actuator. By this placement in accord with the present invention, the overall size of valve system 10 is greatly reduced. My prior application shows mounting an exemplary compact manual override operator onto an actuator. In this application, my invention provides a manual override operator that is not directly connected to the actuator but is instead positioned on an opposite side of the gate valve as shown in FIG. 1. By positioning the manual override operator in this manner, it will be understood by those of skill in the art that space is much more efficiently utilized. This is especially true for a preferred subsea valve system 10 construction which may require the valve housing be positioned at a center position for controlling flow through a conduit, such as conduit 20, and having only a limited amount on either side of conduit 20.

Preferably, manual override operator 62 and 64 operate in the same manner as other possible override operators that may be mounted directly to a respective actuator. The present invention permits such operation by utilizing reverse cut threads and by utilizing

a balance stem. Thus, gate valve 12 also comprises balance stem 66 and gate valve 14 comprises balance stem 68. Balance stems generally have the additional purpose of providing pressure balancing for deep water operation.

Balance stem 66 connects to an opposite side of gate 22 from operator stem 56. Likewise balance stem 68 connects to an opposite side of gate 24 as compared to operator stem 52. Preferred connections to the gate that provide additional features such as seals and so forth are discussed in my previous application.

While various constructions of manual override operators may be provided, in the present embodiment the manual override operator comprises a manual override housing such as housing 70 or 72. A rotatable element, which may be activated either by divers or by remotely operated vehicles (ROV), such as rotatable element 74 or 76 is provided. Rotatable element 74, for instance, is utilized to rotate manual override shaft 78. Rotatable element 76 may likewise rotate manual override shaft 80.

Since the two manual override operators are substantially the same, the present discussion will cover manual override operator 62 and it will be understood that manual override 64 operates in a similar manner. Rotary connector 82 is utilized to rotatably secure manual override shaft 78 within manual override housing 70 such that manual override shaft 78 is rotatable with respect to manual override housing 70 but preferably is prevented from translational and/or longitudinal movement within manual override housing 70. Manual override shaft 78 has a threaded portion 84 along an outer periphery of override drive shaft 78. The threads of threaded portion 84 mate with corresponding threads of threaded portion 88 on an

inner side of override slave member 86. Thus, override slave member 86 is threadably connected to manual rotary shaft 78 and is prevented from rotation as discussed subsequently but is free to move translationally or along its axis. Therefore, override slave member 86 reciprocates or moves translationally or along its longitudinal axis when manual override rotary drive shaft 78 is rotated. Preferably the threads of threaded portion 84 and the corresponding mating threads of threaded portion 88 are reverse cut or left-handed threads. Thus, it will now be appreciated by those of skill in the art that rotational operation of manual override operator 62 will be exactly the same as if the manual override operator were located on the actuator as occurs in the prior art. While this embodiment shows threads on an outer surface of threaded portion 84 of rotary drive shaft 78 and on the inner surface of threaded portion 88 of override slave member 86, it will be understood that other mechanical constructions could also be utilized whereupon the end result is that rotation of operator 74 will result in translational movement of balance stem 66 and, accordingly, gate 22. Thus, if manual operation of gate valve 12 and/or gate valve 14 is desired or required, the corresponding manual override operator can be utilized for this purpose.

Override slave member 86 engages balance stem 66 which slidably extends through opening 90 in the gate valve bonnet 67. As override slave member 86 moves translationally or along its axis, then gate 22 also moves translationally or along its axis. If a manual override is not desired, then a closed bonnet can be installed and/or a suitable plug may be secured to bonnet 67. For deepwater applications, a balance stem may preferably be desirable regardless of whether a manual override operator in accord with the present

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invention is utilized and a housing of some type such as manual override housing may be utilized. While various types of connectors may be utilized for attaching override slave member 86 to balance stem 66, a preferred embodiment utilizes inserts to connect to the T-slot end 96 of balance stem 66 is utilized. The inserts may be released by pins, retractable elements, or the like (not shown).

In this embodiment of the invention, one or more rib/slot connections, such as rib/slot connection 94, may be utilized to prevent rotation of manual override slave member 86 to thereby require manual override slave member 86 to move translationally as manual override drive shaft 78 is rotated. In this particular embodiment, the rib is mounted to manual override housing 70 and the mating slot is formed on override slave member 86. However, this construction could be reversed and/or other means to effect the same mechanical operation could be utilized.

If desired, various types of indicators may be utilized to indicate the position of the manual override operator and/or the position of the actuator. My previous application discusses a few of such indicators including highly compact position indicators.

Thus, when assembling valve assembly 10, the operator has wide flexibility of where to position the manual override operator as well as where to position the hydraulic actuators. In the embodiment shown, the manual override operators are positioned on opposite sides of the gate valves from the hydraulic operators. Since the valve body is symmetrical, the position of the manual override operator and hydraulic actuator can be reversed if necessary to fit the desired dimensional requirements. If necessary, the manual override operator could also be positioned on the

actuator as described in my previous application. Therefore, it will be understood that the present invention provides considerable flexibility of operation.

To operate the manual override operator in accord with the present invention, element 74 may be rotated by a diver or ROV in a manner well known in the prior art. Since the threaded portions 88 and 84 comprise reverse cut or left-handed threads, the operation is exactly the same as if standard or right-handed threads were utilized and the manual override assembly were mounted directly to the actuator an exemplary example of which is shown in my previous application. However, instead of pushing the gate to the desired position through the operating stem, the action involves pulling the gate to the desired position by means of balance stem 66. Rotation of element 74 results in rotation of override drive shaft 78, which is rotatably mounted but is prevented from translational movement along its axis. Rotation of override drive shaft causes rotation of threaded portion 84 which in turn causes translational movement of manual override slave member 86. Manual override slave member 86 cannot rotate but can move translationally along its axis. Since manual override slave member 86 is connected to balance stem 66 by means of inserts 92 and T-slot connector 96, balance stem 66 must move in response to movement of override slave member 86. In turn, gate 22 is secured to balance stem 66 and must move in response thereto.

Gate valve cutter 100 could be used for either gate valve, such as gate valve 12 or gate valve 14 disclosed in valve system 10. Gate valve cutter 100 may be used in many other circumstances such as for large diameter valves wherein it is desirable to provide

means for reliably cutting tubing. It would be highly desirable to be able to eliminate the high initial costs and even higher maintenance costs of BOP stacks. Gate valve 10 of the present invention provides the ability to eliminate BOB stacks with a large diameter gate valve that can seal off the wellbore as well as repeatedly cut pipe or wireline with reduced or no need for maintenance.

FIG. 2 shows gate valve 100 for  $7\frac{3}{8}$  inch casing having  $2\frac{7}{8}$  inch production tubing extending therethrough. Gate valve 100 may be used for larger diameter bores such as wellbores with tubing therein. Such bores are generally greater than about  $4\frac{1}{2}$  inches although the embodiment disclosed herein is for  $7\frac{3}{8}$  inch casing. Gate element 102 is designed to have a blade 104 with initial cutting surface 106 having a minimum gate aperture 128 diameter directly adjacent seat 108. The maximum diameter of gate aperture 128 defined by blade 104 is preferably at the opposite side of blade 104 at 110 directly adjacent seat 112. Thus, the blade opens up to provide volume opposite surface 106. This volume and the inclined sloping surface 124 actually pushes the tubing 122 out of the path of gate element 102 as gate element 102 closes the valve thereby decreasing the likelihood of jamming the valve element or preventing the valve element from operating. Inclined sloping surface 124 is angled with respect to axial line 123 through flow path 120. The line may slope with straight line variation or the angle of the slope with respect to axial line 123 of inclined sloping surface 124 may vary with axial length. The angle with respect to axial line 123 may vary from a rather small angle of a part of one degree up to about 30 degrees, although a more preferred range may be from about three degrees up to about fifteen degrees.

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Preferably the diameter of aperture 128 is at a maximum on the edge of the gate at 110 and at a minimum on the other edge at 106. However, it is conceivable that the maximum and minimums of aperture 128 would not be at the very edges of gate 102. For instance the maximum may be adjacent the edge 110 but not at the edge. If desired, aperture 128 could have an axially constant diameter portion or slightly increase or decrease in diameter.

In a presently preferred embodiment, gate 100 is used with a telescoping gate seat assemblies which include outer retainers 114 and 116 which are mounted in the valve housings such as gate valve housings 32 and 34 in FIG. 1. Telescoping seal assemblies 114, 118 and 112, 116 are mounted in surrounding relationship to flow path 120. Each seal assembly comprises elements such as 114 and 118 which are telescopingly moveable with respect to each other and also each axially moveable with respect to the valve housing such that the overall length of the telescoping seat assembly can lengthen and shorten by a small amount. The amount of axial movement of telescoping seat elements, such as elements 114 and 118, is limited in both directions. However, telescoping seal assembly 114, 118 is, in a presently preferred embodiment, different from telescoping seal assembly 112, 116. Telescoping seal assembly 112, 116 has a larger diameter aperture adjacent gate 102 and also may have an internal slope, incline, cone, along an internal surface of the elements 112, 116 which decreases until it reaches the bore size of aperture 120 which, in a preferred embodiment is equal to internal diameter size of elements 114, 118. In a preferred embodiment, 114, 118 have a constant internal diameter.

In accord with the present invention, gate element 102 may be utilized not only for sealing off and opening flow path 120, but also for cutting tubular 122. As shown in FIG. 3, when valve 100 is closed such that gate element 102 moves in the direction of sealing off flow path 120, then cutting edge 106 engages, crushes, and cuts pipe 106. As pipe 106 is being cut, the sloping or inclined edge 124 of the gate valve acts to push the pipe 106 out of valve 100. Therefore, unlike many other cutting devices such as BOP'S, pipe 106 is not stuck in the valve. If desired, pipe 106 can be pulled during cutting such as toward the left direction as shown in FIG. 3, or not. In any event, due to the design of cutting edge 106 and inclined edge 124, the present invention may be reliably utilized for cutting tubing and/or wireline. Moreover, the process is very reliable. Thus, the process can be repeated as often as desired with little or no need for maintenance as is normally required each time for B.O.P. tubing cutters.

FIG. 4 discloses an apparatus and method for determining the pressure on gate 102 required for cutting the desired size of pipe. Gate 102 has the same dimension as test gate 152. Tubing 158 has the same dimensions as tubing 122. It is difficult to calculate the required force on gate 102 to cut tubing 122 due to the many variables involved. Given the number of variables involved in such calculations, the preferred method of determining the amount of pressure or force on gate 152 is best made empirically by utilizing test system 150. Thus, test housing 151 slidably engages gate 152 by providing an aperture of the same general type as the gate valve housing would support gate 102. Test housing is also suitably supported by some means such as the earth 154 to thereby provide a suitable mounting against which large forces may be applied such as in a machine shop. Hydraulic press 156 or

other suitable means may then be utilized to apply a known, measurable, and selected amount of force or pressure to gate 152 until pipe 158 is cut. The process can be repeated as desired until an amount of force or pressure is determined that is assured of reliably cutting the pipe. Moreover, it can be verified that the system operates well and reliably. Valves such as gate valves 12 and 14 utilize hydraulic operators that can then be designed to provide the force required for cutting. Operation of the hydraulic operators is known in the prior art and operation of an exemplary hydraulic fail safe operator, such as fail-safe operator 16, is discussed in some detail in my previous application.

It will be noted that directions, e.g., “up”, “down”, “left”, “vertical”, and so forth, are used in this specification only for convenience of understanding with respect to the figures and that the actuators/valves may be oriented in various ways which will not affect reliable operation of the present invention so that such directions as used are not intended to be limiting in any way. While the present invention preferably illustrates the invention in terms of subsea valves, the same principles of operation could be used in other valves such as surface valves, hydrocarbon well christmas trees, valves used in place on B.O.P.’s while drilling, and so forth. For subsea valves, it will also be understood that depending on the water depth, suitable modifications may be made to offset water depth pressure. Moreover, different seals and/or relief valves and so forth may be used in the valve system such as in the valve bonnet, manual override housing, actuator housing, and the like. Moreover, a housing for an actuator, valve, or the like may include various portions or components that may or may not comprise part of another housing used for another purpose and

so a housing is simply construed as a container for certain components, for example an actuator housing is a container or body for actuator components, that may be constructed in many ways and may or may not also comprise a housing of a different type such as a valve housing.

While the present invention is described in terms of a subsea valve system especially suitable for a lower riser package, the valve system of the present invention may be utilized in surface valve systems, pipelines, and any other applications, if desired.

The foregoing disclosure and description of the invention is illustrative and explanatory thereof, and it will be appreciated by those skilled in the art, that various changes in the size, shape and materials as well as in the details of the illustrated construction or combinations of features of the various coring elements may be made without departing from the spirit of the invention.

What is claimed is:

1. A method for a gate valve mountable onto a wellbore casing, said gate valve being operable for controlling fluid and cutting tubing, comprising:

mounting said gate valve on said well casing for controlling fluid flow in place of at least one BOP on said well casing;

mounting a slidable gate within said gate valve, said slidable gate having a first side and a second side opposite said first side;

providing first and second seats for said slidable gate;

positioning said slidable gate between said first and second seats such that said first side of said gate is

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adjacent said first seat d said second side of said gate is adjacent said second seat;

providing that said first and second seats each have different internal diameters adjacent said slidable gate; forming an aperture through said slidable gate;

providing a cutting edge on said slidable gate of said gate valve within said aperture such that said cutting edge defines at least a portion of said aperture.

2. The method of claim 1, further comprising:

mounting said gate valve in a subsea installation.

3. The method of claim 1, further comprising:

providing that said first seat is formed by telescoping interconnecting two seat elements with respect to each other, and

providing that said second seat is formed by telescoping interconnecting two seat elements with respect to each other.

4. The method of claim 1, further comprising:

providing that said aperture has a minimum size at said first side of said slidable gate.

5. The method of claim 1, further comprising:

providing a single inclined space defining aperture which is angled with respect to an axis through said aperture from about three degrees to about twenty-five degrees.

6. A method for determining force needed on a gate to cut a tubular disposed within a gate valve, said gate valve being mountable on a wellbore casing such that said tubular is positional within said wellbore casing, said method comprising:

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providing a test body for slidably supporting a test gate, said test gate comprising dimensions related to said gate;

inserting a test pipe through said test body and said test gate, said test pipe comprising a dimension related to said tubular;

applying force to said test gate until said pipe is cut by said test gate; and

measuring said force on said test gate required for cutting

said test pipe by sliding movement of said gate.

7. The method of claim 6, further comprising:

designing an actuator for said gate such that said actuator is capable of producing said force.

8. The method of claim 6, further comprising:

utilizing a hydraulic press which is not utilized for controlling a gate valve for applying said force to said test gate.

9. A method for cutting a pipe within a wellbore utilizing a gate valve such that said pipe is pushed away from a gate within said gate valve, said gate defining an aperture therethrough, said method comprising:

providing said gate valve with a cutting edge on one side of said gate along said aperture through the gate;

providing a single inclined surface on said aperture through said gate such that said aperture opens from a minimum size adjacent said cutting edge to a maximum 10

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size distal said cutting edge, said single inclined surface extending from said minimum size to said maximum size of said aperture;

inserting said pipe into said wellbore through said gate valve;

closing said gate within said gate valve; and

cutting said pipe as said gate closes such that said inclined surface produces a force on said pipe to move said pipe away from said gate.

10. The method of claim 9, further comprises:

determining said force for cutting said pipe utilizing a hydraulic press prior to said step of cutting, wherein said hydraulic press of a type not utilized for controlling a valve for said wellbore.

11. The method of claim 9, further comprising:

mounting said gate within said valve between a first set of telescopingly interconnected seat elements and a second set of telescopingly interconnected seat elements.

12. The method of claim 9, further comprising:

utilizing said gate valve on a wellbore without using a B.O.P.

13. The method of claim 9, further comprising:

providing that said inclined surface is angled with respect to an axis through said aperture of said gate within said gate valve in a range of from three degrees to twenty-five degrees.

14. A gate valve for a subsea riser package installation, said gate valve comprising a valve body defining a flow passageway therethrough, said gate valve being operable for cutting a tubular extending

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through said gate valve and said subsea riser package, said subsea riser package installation being operable for replacement of a B.O.P, said subsea riser package being connectable to a wellbore casing, said subsea riser package installation further comprising:

- a sliding gate within said gate valve;

- a cutting edge mounted on one side of said sliding gate;

- an inclined surface adjacent said cutting edge such that said cutting edge and said inclined surface define at least a portion of aperture through said sliding gate;

- a hydraulic actuator for said gate valve operable to apply sufficient force to said sliding gate to cut said tubular; and

- a first seat on a first side of said sliding gate and a second seat on a second side of said sliding gate, at least one of said first seat or said second seat defining an interior passageway with an axial seat length wherein said interior passageway comprises a conical surface extending along a substantial portion of said axial seat length.

15. The gate valve of claim 14, further comprising:

- a first telescopingly interconnected set of at least two seating elements mounted adjacent said one side of said sliding gate, each of said first telescopingly interconnected set of at least two seating elements being moveable within said valve body with respect to said valve body; and

- a second telescopingly interconnected set of seating elements mounted adjacent an opposite side of said sliding gate.

16. The gate valve of claim 14, wherein said inclined surface is angled with respect to an axis through said aperture by from three degrees to twenty degrees.

17. A gate valve for a subsea riser package installation, said gate valve comprising a valve body defining a flow passageway therethrough, said subsea riser package being sized for carrying a tubular therein having a diameter greater than two and one-half inches, said subsea riser package being connectable to a wellbore casing, said subsea riser package installation further comprising:

- a sliding gate within said gate valve; a cutting edge mounted on said sliding gate;

- an inclined surface adjacent said cutting edge such that said cutting edge and said inclined surface define at least a portion of aperture through said sliding gate;

- a hydraulic actuator for said gate valve operable to apply sufficient force to said sliding gate to cut through said diameter greater than two and one-half inches of said tubular;

- a first telescopingly interconnected set of at least two seating elements mounted adjacent said one side of said sliding gate, each of said first telescopingly interconnected set of at least two seating elements being moveable within said valve body with respect to said valve body; and

- a second telescopingly interconnected set of seating elements mounted adjacent an opposite side of said sliding gate.

18. A gate valve for a subsea riser package installation, said gate valve comprising a valve body defining a flow passageway therethrough, said subsea

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riser package being sized for carrying a tubular therein having a diameter greater than two and one-half inches, said subsea riser package being connectable to a wellbore casing, said subsea riser package installation further comprising:

- a sliding gate within said gate valve mounted for transverse movement with respect to said flow passageway;

- a cutting edge mounted on said sliding gate;

- a first inclined surface adjacent said cutting edge such that said cutting edge and said first inclined surface define at least a portion of an aperture through said sliding gate;

- a hydraulic actuator for said gate valve operable to apply sufficient force to said sliding gate to cut through said diameter of said tubular; and

- a valve seat adjacent said sliding gate, said valve seat having an axial seat length, said valve seat defining an interior wall with second inclined inner surface, said second inclined surface defining an inner diameter which decreases with respect to axial distance away from said sliding gate.

19. The gate valve of claim 18, wherein said second inclined inner surface extends along at least a substantial portion of said axial seat at length.

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UNITED STATES PATENT AND  
TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO.: 6,601,650 B2

DATED: August 5, 2003

INVENTOR(S): Alagarsamy Sundararajan

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 9,

Line 12, delete “aid” and replace with – said –.

Line 21, delete “d” and replace with – and –.

Line 42, delete “space” and replace with – surface –.

Column 10,

Line 38, delete “therethough” and replace with – therethrough –.

Line 43, delete “river” and replace with – riser –.

Line 48, insert – an – between of and “aperture”.

Line 52, delete “aid” and replace with – said –.

Line 54, delete the second of and replace with – or –.

Column 11,

Line 9, delete “therethough” and replace with – therethrough –. Line 11, delete an and replace with – than –.

Column 12,

Line 3, delete “therethough” and replace with – therethrough –. Line 5, delete an and replace with – than –.

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Line 26, delete “at”.

Signed and Sealed this

Thirtieth Day of December, 2003

/s/ James E. Rogan

JAMES E. ROGAN

Director of the United States  
Patent and Trademark Office

**APPENDIX D**

UNITED STATES CODE ANNOTATED

Title 35. Patents (Refs & Annos)

Part III. Patents and Protection of Patent Rights

Chapter 31. Inter Partes Review (Refs & Annos)

Effective: January 14, 2013

Currentness

**35 U.S.C.A. § 311. Inter partes review**

(a) In General.—Subject to the provisions of this chapter, a person who is not the owner of a patent may file with the Office a petition to institute an inter partes review of the patent. The Director shall establish, by regulation, fees to be paid by the person requesting the review, in such amounts as the Director determines to be reasonable, considering the aggregate costs of the review.

(b) Scope.—A petitioner in an inter partes review may request to cancel as unpatentable 1 or more claims of a patent only on a ground that could be raised under section 102 or 103 and only on the basis of prior art consisting of patents or printed publications.

(c) Filing Deadline.—A petition for inter partes review shall be filed after the later of either—

(1) the date that is 9 months after the grant of a patent; or

(2) if a post-grant review is instituted under chapter 32, the date of the termination of such post-grant review.

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Part III. Patents and Protection of Patent Rights  
Chapter 31. Inter Partes Review (Refs & Annos)  
Effective: September 16, 2012  
Currentness

**35 U.S.C.A. § 312. Petitions**

(a) Requirements of Petition.—A petition filed under section 311 may be considered only if-

(1) the petition is accompanied by payment of the fee established by the Director under section 311;

(2) the petition identifies all real parties in interest;

(3) the petition identifies, in writing and with particularity, each claim challenged, the grounds on which the challenge to each claim is based, and the evidence that supports the grounds for the challenge to each claim, including—

(A) copies of patents and printed publications that the petitioner relies upon in support of the petition; and

(B) affidavits or declarations of supporting evidence and opinions, if the petitioner relies on expert opinions;

(4) the petition provides such other information as the Director may require by regulation; and

(5) the petitioner provides copies of any of the documents required under paragraphs (2), (3), and (4) to the patent owner or, if applicable, the designated representative of the patent owner.

(b) Public Availability.—As soon as practicable after the receipt of a petition under section 311, the Director shall make the petition available to the public.

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Chapter 31. Inter Partes Review (Refs & Annos)

Effective: September 16, 2012

Currentness

**35 U.S.C.A. § 313. Preliminary response to petition**

If an inter partes review petition is filed under section 311, the patent owner shall have the right to file a preliminary response to the petition, within a time period set by the Director, that sets forth reasons why no inter partes review should be instituted based upon the failure of the petition to meet any requirement of this chapter.

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**35 U.S.C.A. § 314. Institution of inter partes review**

(a) Threshold.—The Director may not authorize an inter partes review to be instituted unless the Director determines that the information presented in the petition filed under section 311 and any response filed under section 313 shows that there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition.

(b) Timing.—The Director shall determine whether to institute an inter partes review under this chapter pursuant to a petition filed under section 311 within 3 months after—

(1) receiving a preliminary response to the petition under section 313; or

(2) if no such preliminary response is filed, the last date on which such response may be filed.

(c) Notice.—The Director shall notify the petitioner and patent owner, in writing, of the Director's determination under subsection (a), and shall make such notice available to the public as soon as is practicable. Such notice shall include the date on which the review shall commence.

(d) No Appeal.—The determination by the Director whether to institute an inter partes review under this section shall be final and nonappealable.

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**35 U.S.C.A. § 315. Relation to other proceedings or actions**

(a) Infringer's Civil Action.—

(1) Inter partes review barred by civil action.—An inter partes review may not be instituted if, before the date on which the petition for such a review is filed, the petitioner or real party in interest filed a civil action challenging the validity of a claim of the patent.

(2) Stay of civil action.—If the petitioner or real party in interest files a civil action challenging the validity of a claim of the patent on or after the date on which the petitioner files a petition for inter partes review of the patent, that civil action shall be automatically stayed until either—

(A) the patent owner moves the court to lift the stay;

(B) the patent owner files a civil action or counterclaim alleging that the petitioner or real party in interest has infringed the patent; or

(C) the petitioner or real party in interest moves the court to dismiss the civil action.

(3) Treatment of counterclaim.—A counterclaim challenging the validity of a claim of a patent does not constitute a civil action challenging the validity of a claim of a patent for purposes of this subsection.

(b) Patent Owner's Action.—An inter partes review may not be instituted if the petition requesting the

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proceeding is filed more than 1 year after the date on which the petitioner, real party in interest, or privy of the petitioner is served with a complaint alleging infringement of the patent. The time limitation set forth in the preceding sentence shall not apply to a request for joinder under subsection (c).

(c) Joinder.—If the Director institutes an inter partes review, the Director, in his or her discretion, may join as a party to that inter partes review any person who properly files a petition under section 311 that the Director, after receiving a preliminary response under section 313 or the expiration of the time for filing such a response, determines warrants the institution of an inter partes review under section 314.

(d) Multiple Proceedings.—Notwithstanding sections 135(a), 251, and 252, and chapter 30, during the pendency of an inter partes review, if another proceeding or matter involving the patent is before the Office, the Director may determine the manner in which the inter partes review or other proceeding or matter may proceed, including providing for stay, transfer, consolidation, or termination of any such matter or proceeding.

(e) Estoppel.—

(1) Proceedings before the Office.—The petitioner in an inter partes review of a claim in a patent under this chapter that results in a final written decision under section 318(a), or the real party in interest or privy of the petitioner, may not request or maintain a proceeding before the Office with respect to that claim on any ground that the petitioner raised or reasonably could have raised during that inter partes review.

(2) Civil actions and other proceedings.—The petitioner in an inter partes review of a claim in a

patent under this chapter that results in a final written decision under section 318(a), or the real party in interest or privy of the petitioner, may not assert either in a civil action arising in whole or in part under section 1338 of title 28 or in a proceeding before the International Trade Commission under section 337 of the Tariff Act of 1930 that the claim is invalid on any ground that the petitioner raised or reasonably could have raised during that inter partes review.

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**35 U.S.C.A. § 316. Conduct of inter partes review**

(a) Regulations.—The Director shall prescribe regulations—

(1) providing that the file of any proceeding under this chapter shall be made available to the public, except that any petition or document filed with the intent that it be sealed shall, if accompanied by a motion to seal, be treated as sealed pending the outcome of the ruling on the motion;

(2) setting forth the standards for the showing of sufficient grounds to institute a review under section 314(a);

(3) establishing procedures for the submission of supplemental information after the petition is filed;

(4) establishing and governing inter partes review under this chapter and the relationship of such review to other proceedings under this title;

(5) setting forth standards and procedures for discovery of relevant evidence, including that such discovery shall be limited to—

(A) the deposition of witnesses submitting affidavits or declarations; and

(B) what is otherwise necessary in the interest of justice;

(6) prescribing sanctions for abuse of discovery, abuse of process, or any other improper use of the proceeding, such as to harass or to cause unnecessary

delay or an unnecessary increase in the cost of the proceeding;

(7) providing for protective orders governing the exchange and submission of confidential information;

(8) providing for the filing by the patent owner of a response to the petition under section 313 after an inter partes review has been instituted, and requiring that the patent owner file with such response, through affidavits or declarations, any additional factual evidence and expert opinions on which the patent owner relies in support of the response;

(9) setting forth standards and procedures for allowing the patent owner to move to amend the patent under subsection (d) to cancel a challenged claim or propose a reasonable number of substitute claims, and ensuring that any information submitted by the patent owner in support of any amendment entered under subsection (d) is made available to the public as part of the prosecution history of the patent;

(10) providing either party with the right to an oral hearing as part of the proceeding;

(11) requiring that the final determination in an inter partes review be issued not later than 1 year after the date on which the Director notices the institution of a review under this chapter, except that the Director may, for good cause shown, extend the 1-year period by not more than 6 months, and may adjust the time periods in this paragraph in the case of joinder under section 315(c);

(12) setting a time period for requesting joinder under section 315(c); and

(13) providing the petitioner with at least 1 opportunity to file written comments within a time period established by the Director.

(b) Considerations.—In prescribing regulations under this section, the Director shall consider the effect of any such regulation on the economy, the integrity of the patent system, the efficient administration of the Office, and the ability of the Office to timely complete proceedings instituted under this chapter.

(c) Patent Trial and Appeal Board.—The Patent Trial and Appeal Board shall, in accordance with section 6, conduct each inter partes review instituted under this chapter.

(d) Amendment of the Patent.—

(1) In general.—During an inter partes review instituted under this chapter, the patent owner may file 1 motion to amend the patent in 1 or more of the following ways:

(A) Cancel any challenged patent claim.

(B) For each challenged claim, propose a reasonable number of substitute claims.

(2) Additional motions.—Additional motions to amend may be permitted upon the joint request of the petitioner and the patent owner to materially advance the settlement of a proceeding under section 317, or as permitted by regulations prescribed by the Director.

(3) Scope of claims.—An amendment under this subsection may not enlarge the scope of the claims of the patent or introduce new matter.

(e) Evidentiary Standards.—In an inter partes review instituted under this chapter, the petitioner shall have the burden of proving a proposition of unpatentability by a preponderance of the evidence.

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**35 U.S.C.A. § 317. Settlement**

(a) In General.—An inter partes review instituted under this chapter shall be terminated with respect to any petitioner upon the joint request of the petitioner and the patent owner, unless the Office has decided the merits of the proceeding before the request for termination is filed. If the inter partes review is terminated with respect to a petitioner under this section, no estoppel under section 315(e) shall attach to the petitioner, or to the real party in interest or privy of the petitioner, on the basis of that petitioner's institution of that inter partes review. If no petitioner remains in the inter partes review, the Office may terminate the review or proceed to a final written decision under section 318(a).

(b) Agreements in Writing.—Any agreement or understanding between the patent owner and a petitioner, including any collateral agreements referred to in such agreement or understanding, made in connection with, or in contemplation of, the termination of an inter partes review under this section shall be in writing and a true copy of such agreement or understanding shall be filed in the Office before the termination of the inter partes review as between the parties. At the request of a party to the proceeding, the agreement or understanding shall be treated as business confidential information, shall be kept separate from the file of the involved patents, and shall be made available only to Federal Government agencies on written request, or to any person on a showing of good cause.

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**35 U.S.C.A. § 318. Decision of the Board**

(a) Final Written Decision.—If an inter partes review is instituted and not dismissed under this chapter, the Patent Trial and Appeal Board shall issue a final written decision with respect to the patentability of any patent claim challenged by the petitioner and any new claim added under section 316(d).

(b) Certificate.—If the Patent Trial and Appeal Board issues a final written decision under subsection (a) and the time for appeal has expired or any appeal has terminated, the Director shall issue and publish a certificate canceling any claim of the patent finally determined to be unpatentable, confirming any claim of the patent determined to be patentable, and incorporating in the patent by operation of the certificate any new or amended claim determined to be patentable.

(c) Intervening Rights.—Any proposed amended or new claim determined to be patentable and incorporated into a patent following an inter partes review under this chapter shall have the same effect as that specified in section 252 for reissued patents on the right of any person who made, purchased, or used within the United States, or imported into the United States, anything patented by such proposed amended or new claim, or who made substantial preparation therefor, before the issuance of a certificate under subsection (b).

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(d) Data on Length of Review.—The Office shall make available to the public data describing the length of time between the institution of, and the issuance of a final written decision under subsection (a) for, each inter partes review.

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Effective: September 16, 2012

Currentness

**35 U.S.C.A. § 319. Appeal**

A party dissatisfied with the final written decision of the Patent Trial and Appeal Board under section 318(a) may appeal the decision pursuant to sections 141 through 144. Any party to the inter partes review shall have the right to be a party to the appeal.