UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

WEATHERFORD U.S., L.P.,
Petitioner,

v.

HALLIBURTON ENERGY SERVICS, INC.,
Patent Owner.

Case No. IPR2024-00990
U.S. Patent No. 11,333,007

SECOND DECLARATION OF MICHAEL R. CHAMBERS, SR.

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VI. MTA GROUND 1a 14

A. Substitute Claim 24 14

1. Claim 24[preamble]: "The completion assembly of claim 1," 14

2. Claim 24[a]: "wherein the first sand screen assembly further comprises a junction block from which the transport tube and the packing tube extend, the plurality of nozzles being spaced apart from the junction block;" 14

3. Claim 24[b]: "wherein the second sand screen assembly further comprises a junction block from which the transport tube and the packing tube extend, the plurality of nozzles being spaced apart from the junction block, ... 15

4. Claim 24[c]: "wherein the distance between the first sand screen assembly junction block and the packing tube nozzles is greater in the first sand screen assembly than the distance between the second sand screen assembly junction block and the packing tube nozzles in the second sand screen assembly;" 15

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5. Claim 24[d]: "and wherein shunt tube assemblies of the second sand screen assembly have different spacing between the nozzles." 15

B. Substitute Claim 25 20

1. Claim 25[preamble]: "The completion assembly of claim 1," 20

2. Claim 25[a]: "wherein the second end of the first sand screen assembly base pipe is connected to the first end of the second sand screen assembly base pipe forming a joint therebetween," 20

3. Claim 25[b]: "the completion assembly further comprising a coupling interconnecting one end of a jumper tube to the transport tube of the first sand screen assembly, the other end of the jumper tube in fluid communication with the junction block of the second sand screen assembly whereby the jumper tube straddles the joint between the first and second sand screen assemblies;" 21

4. Claim 25[c]: "and wherein the cross-sectional flow area of the first transport tube is less than the cross-sectional flow area of the second transport tube." 21

C. Substitute Claim 26 28

1. Claim 26[preamble]: "The completion assembly of claim 1," 29

2. Claim 26[a]: "wherein the shunt tube assembly of the first sand screen assembly has a pressure rating of between 5000 and 10000 psi;" 29

3. Claim 26[b]: "and the packing tube of the first sand screen assembly is interconnected to a junction block of the second sand screen assembly." 29

VII. MTA GROUND 1b 30

A. Substitute Claim 27 30

1. Claim 27[preamble]: "The completion assembly of claim 1," 30

2. Claim 27[a]: "wherein the shunt tube assembly of the first sand screen assembly has a pressure rating of over a select threshold and the shunt tube assembly of the second sand screen assembly has a pressure rating of no more than the select threshold;" 31

3. Claim 27[b]: "and wherein the first sand screen assembly and the second sand screen assembly are eccentric assemblies." 31

B. Substitute Claim 28 40

1. Claim 28[preamble]: "A completion assembly for deployment in a wellbore, the completion assembly comprising:" 40

2. Claim 28[a]: "a source of pressurized working fluid;" 40

3. Claim 28[b]: "a first eccentric sand screen assembly attached to a second eccentric sand screen assembly," 41

4. Claim 28[c]: "wherein the first eccentric sand screen assembly comprises a shunt tube assembly with a first burst pressure and the second eccentric sand screen assembly comprises a shunt tube assembly with a burst pressure less than the first burst pressure, and" 41

5. Claim 28[d]: "wherein the shunt tube assembly with the first burst pressure is fluidly coupled between the source of pressurized working fluid and the shunt tube assembly with the burst pressure less than the first burst pressure." 43

C. Substitute Claim 29 43

1. Claim 29[preamble]: "The completion assembly of claim 28," 43

2. Claim 29[a]: "wherein the shunt tube assembly of the first eccentric sand screen assembly is disposed to operate at pressures between 5000 psi and 10000 psi and the shunt tube assembly of the second eccentric sand screen assembly is disposed to operate at pressures of no more than 5000 psi;" ... 44

3. Claim 29[b]: "and wherein a cross-sectional flow area of a packing tube of the high pressure shunt tube system is less than the cross-sectional flow area of a packing tube of the low pressure shunt tube system." 46

VIII. MTA GROUND 2 48

A. Substitute Claim 31 48

1. Claim 31[preamble]: "A method of installing a completion assembly in a wellbore, the method comprising:" 49

2. Claim 31[a]: "identifying an elongated production zone having an upstream proximal end and a downstream distal end with respect to a source of pressurized working fluid;" 49

3. Claim 31[b]: "determining a shunt tube system operating pressure associated with the proximal end of the production zone and selecting a high pressure shunt tube system based on the proximal end determined pressure;" 49

4. Claim 31[c]: "determining a shunt tube system operating pressure associated with the distal end of the production zone and selecting a low pressure shunt tube system based on the distal end determined pressure;" 49

5. Claim 31[d]: "installing a first eccentric sand screen assembly in a wellbore adjacent the distal downstream end of the elongated production zone;" 50

6. Claim 31[e]: "attaching a second eccentric sand screen assembly to the first eccentric sand screen assembly at the proximal upstream end of the elongated production zone, wherein the first eccentric sand screen assembly has the low pressure shunt tube system and the second eccentric sand screen assembly has the high pressure shunt tube system, such that a downstream end of the high pressure shunt tube system is coupled to an upstream end of the low pressure shunt tube system; and," 51

7. Claim 31[f]: "coupling the source of pressurized working fluid to an upstream end of the high pressure shunt tube system." 51

B. Substitute Claim 32 52

1. Claim 32[preamble]: "The method of claim 31, further comprising:" 52

2. Claim 32[a]: "installing a plurality of interconnected first eccentric sand screen assemblies in a wellbore adjacent the production zone;" 52

3. Claim 32[b]: "and attaching a plurality of second eccentric sand screen assemblies to an uppermost first eccentric sand screen assembly upstream of the first sand screen assemblies." 52

C. Substitute Claim 33 53

1. Claim 33[preamble]: "The method of claim 31," 53

2. Claim 33[a]: "further comprising introducing a working fluid into the shunt systems, wherein the working fluid is pressurized in accordance with the operating pressure of the high pressure shunt tube system" 53

3. Claim 33[b]: "and a packing tube of the high pressure shunt tube system is interconnected to a shunt tube junction block of the high pressure shunt tube system." 54

D. Substitute Claim 34 55

1. Claim 34[preamble]: "The method of claim 31," 56

2. Claim 34[a]: "further comprising injecting the working fluid into the annulus adjacent the shunt tube system so as to form a gravel pack in the annulus," 56

3. Claim 34[b]: "wherein a cross-sectional flow area of a packing tube of the high pressure shunt tube system is less than a cross-sectional flow area of a packing tube of the low pressure shunt tube system." 56

E. Substitute Claim 35 56

1. Claim 35[preamble]: "The method of claim 31," 57

2. Claim 35[a]: "wherein the high pressure shunt tube system is disposed to operate at pressures of 5000 psi and the low pressure shunt tube system is disposed to operate at pressures of no more than 5000 psi." 57

F. Substitute Claim 36 57

1. Claim 36[preamble]: "The method of claim 31," 58

2. Claim 36[a]: "wherein the high pressure shunt tube system is disposed to operate at pressures above a select threshold and the low pressure shunt tube system is disposed to operate at pressures of no more than the select threshold." 58

G. Substitute Claim 37 59

1. Claim 37[preamble]: "The method of claim 31," 59

2. Claim 37[a]: "wherein installing the first eccentric sand screen assembly and attaching the second eccentric sand screen assembly include disposing the first eccentric sand screen assembly and the second eccentric sand screen assembly in a horizontal portion of the wellbore." 59

IX. MTA GROUND 3 60

A. Substitute Claim 38 60

1. Claim 38[preamble]: "A completion assembly for deployment in a wellbore, the completion assembly comprising:" 60

2. Claim 38[a]: "a source of pressurized working fluid;" 60

3. Claim 38[b]: "a first, eccentric sand screen assembly comprising a base pipe having perforations therein and extending between a first end and a second ends, a sand screen disposed around a portion of the base pipe, and a shunt tube assembly disposed outwardly of the sand screen, the shunt tube assembly having a transport tube and a packing tube, where each of the tubes has a passageway defined therein, the packing tube further including a plurality of nozzles spaced apart from each other, wherein each of the tubes and each nozzle has a cross-sectional flow area; and" 61

4. Claim 38[c]: "a second, eccentric sand screen assembly comprising a base pipe having perforations therein and extending between a first end and a second ends, a sand screen disposed around a portion of the base pipe, and a shunt tube assembly disposed outwardly of the sand screen, the shunt tube assembly having a transport tube and a packing tube, the packing tube including a plurality of nozzles spaced apart from each other, wherein each of the tubes and each nozzle has a cross-sectional flow area;" 66

5. Claim 38[d]: "wherein the first and second eccentric sand screen assemblies are arranged end to end relative to one another so that the base pipes are in fluid communication with one another and the transport tubes are in fluid communication with one another and the source of pressurized working fluid, the transport tube of the second eccentric sand screen assembly fluidly coupled to the source

of pressurized working fluid downstream of the transport tube of the first eccentric sand screen assembly; and" 67

6. Claim 38[e]: "wherein the transport tube of the first eccentric sand screen assembly is formed of a first material and the transport tube of the second eccentric sand screen assembly is formed of a second material, the first material having a greater tensile strength than the second material."..... 67

B. Substitute Claim 39 70

1. Claim 39[preamble]: "The completion assembly of claim 38,"..... 71

2. Claim 39[a]: "wherein the transport tube of the first sand screen assembly has a first wall thickness and the transport tube of the second sand screen assembly has a second wall thickness, the first wall thickness being greater than the second wall thickness;"..... 71

3. Claim 39[b]: "and wherein a cross-sectional flow area of the packing tube of the first, eccentric sand screen assembly is less than a cross-sectional flow area of the packing tube of the second, eccentric sand screen assembly." 72

X. MTA GROUND 4..... 73

A. Substitute Claim 40 73

1. Claim 40[preamble]: "The completion assembly of claim 38,"..... 73

2. Claim 40[a]: "wherein the first sand screen assembly has a shunt tube assembly with a first pressure rating and the second sand screen assembly has a shunt tube assembly with a second pressure rating less than the first pressure rating," ... 73

3. Claim 40[b]: "and a packing tube of the first eccentric sand screen assembly is interconnected to a shunt tube junction block of the second eccentric sand screen assembly."..... 73

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XIII. CONCLUSION 81

I, Michael R. Chambers, Sr., hereby declare as follows:

I. INTRODUCTION

1. I have prepared this Second Declaration in connection with Weatherford U.S., L.P.'s Petition for *Inter Partes* Review of U.S. Patent No. 11,333,007 (the "'007" Patent).

2. I previously prepared a declaration in support of Weatherford's petition in this case. My compensation and my qualifications are set forth in my first Declaration, EX1003 ¶¶4-23, and Curriculum Vitae, EX1004. My statements made in paragraphs 43-445 of my first Declaration (EX1003) regarding the '007 Patent, the Oil and Gas Drilling Background, and related materials remain unchanged.

II. MATERIALS CONSIDERED

3. In addition to the documents I reviewed in my first Declaration, EX1003 ¶¶2, 24, in preparing this Second Declaration, I also reviewed Patent Owner's Response ("POR," Paper 10), the Declaration of Dr. Durham in support of the POR (EX2002), Patent Owner's Contingent Motion to Amend Claims ("MTA," Paper 11), the Second Declaration of Dr. Robert A. Durham in Support of Patent Owner's Contingent Motion to Amend (EX2004), the May 15, 2025 Deposition Transcript of Dr. Robert Durham (EX1043), and any other documents cited below.

III. RELEVANT LAW

4. I am not an attorney. For the purposes of this Declaration, I have been informed about certain aspects of the law that are relevant to my opinions regarding claim construction and patent validity. My understanding of this law is summarized in my first Declaration, EX1003 ¶¶26-35, 41-42, and below.

5. I have been informed and understand that a patent owner whose patent is subject to an *inter partes* review can request to amend the challenged claims by either canceling any challenged claim or for each challenged claim, propose a reasonable number of substitute claims to be considered.

6. I understand that a request to cancel claims is not regarded as contingent, whereas a request to substitute claims is ordinarily considered contingent upon whether the preponderance of the evidence established that the original patent claim that it replaces is unpatentable.

7. I understand that before the patentability of any substitute claims can be considered, it must be determined whether patent owner's motion to amend meets certain requirements: (1) patent owner proposed a reasonable number of substitute claims, wherein the reasonable number of substitute claims per challenged is one substitute claim, unless patent owner demonstrates the need for more than one substitute claim; (2) whether the proposed amendments respond to a ground of

unpatentability involved in the *inter partes* review; and (3) the substitute claims must not enlarge claim scope or introduce new subject matter.

IV. FURTHER OIL AND GAS DRILLING BACKGROUND

8. In my first Declaration, I provided extensive background of the history of the development of Alternate Pathway Gravel Packing Technology, beginning with its first introduction in the early 1990s for sand control in unconsolidated formations. EX1003 ¶¶43-237. As I explained, a POSITA in June 2018 considering a problem in the gravel-packing area had a wealth of research to consider. EX1003 ¶228. Based on this robust body of prior art that would have been known to a POSITA, my opinion that the '007 Patent did not provide a new or inventive concept also holds true for Patent Owner's proposed substitute claims.

A. Patent Owner's Prior Art

9. In 2014, Patent Owner Halliburton published SPE 169440 ("Bonner"), entitled *Design and Validation of an Improved Shunt Tube System*, co-authored by Bonner, Hailey and Veit. EX1016 at 1. I opined on Bonner in my first Declaration including in the Summary of Grounds. EX1003 ¶¶103-04 (in Section VIII.G.1.b, Shunt Tube Geometry), 153-59 (in Section VIII.G.7, Shunt Tube Coupling), and 255 (in Section XI, Summary of Grounds).

10. Bonner disclosed:

> [A]n ***improved version of the traditional shunt tube system*** *…* ***to enhance sand screens for gravel packing in long production intervals***. The system was designed primarily for gravel packing in horizontal wells and is a system with two larger transport tubes and two smaller packing tubes, all mounted to ***standard sand screens in an eccentric design***.

EX1016 at Abstract (emphases added).

11. Bonner explained that "shunt tube equipped screens that provide alternate paths for the gravel pack placement" in long horizontal intervals have been "increasingly called on as the completion method of choice" because these secondary pathways "can lead to improved gravel pack placement." EX1016 at 1-2. For its explanation, Bonner relied on numerous references I also relied on in my first Declaration, including Hurst (EX1013). *See* EX1016 at 1-2 (citing Hurst et al., 2004 (EX1013); Bryant and Jones, 1995 (EX1034); Tibbles et al., 2000 (EX1026); Jones et al., 1997 (EX1033)).

12. As I described in my first Declaration, Bonner disclosed that the "main basis of design for the new system was to keep it functionally the same as existing industry-proven designs, in order to enjoy the empirical evidence of years of successful application of shunt tube gravel-packing technology." *See* EX1016 at 2; EX1003 ¶154 (citing EX1016 at 2).

13. Bonner considered "functionally the same" achieved:

> [I]f the flow areas for gravel packing slurry were essentially the same, the branching of flow to secondary tubes (packing tubes) from the primary flow tubes (transport tubes) was done in approximately the same manner, and the location and size of exit ports for flow to exit from the packing tubes were essentially the same. The mounting of the shunt tube system to each sand screen joint was designed in a common eccentric configuration, with the transport tubes brought into alignment at each joint connection via the use of an "oriented" premium thread.

EX1016 at 2; *see* EX1003 ¶154 (quoting EX1016 at 2).

14. As I explained in my first Declaration, Bonner's shunt tube assembly had an eccentric design and utilized rectangular tubing. EX1016 at Fig. 5; EX1003 ¶155. Bonner reported that its "shunt tube system is using the same size, the same geometry of the transport and packing tubing, the same exit port spacing and arrangement (shown in Figure 5)." EX1016 at 3. For reference, I reproduced Figure 5 below:

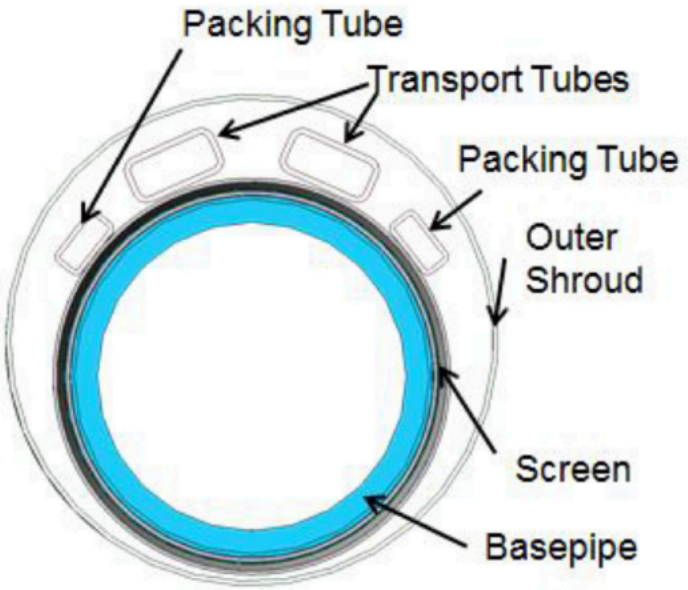


Figure 5—Cross section of shunt tube system

EX1016 at Fig. 5.

15. Bonner's shunt tube assembly included a box crossover on one end for connecting a transport tube and a packing tube with nozzles, and a pin connector attached to the other end of the transport tube. EX1016 at Figs. 8-9; *see also id.* at 3; EX1003 ¶156. For reference, I reproduced Figures 8 and 9 below:

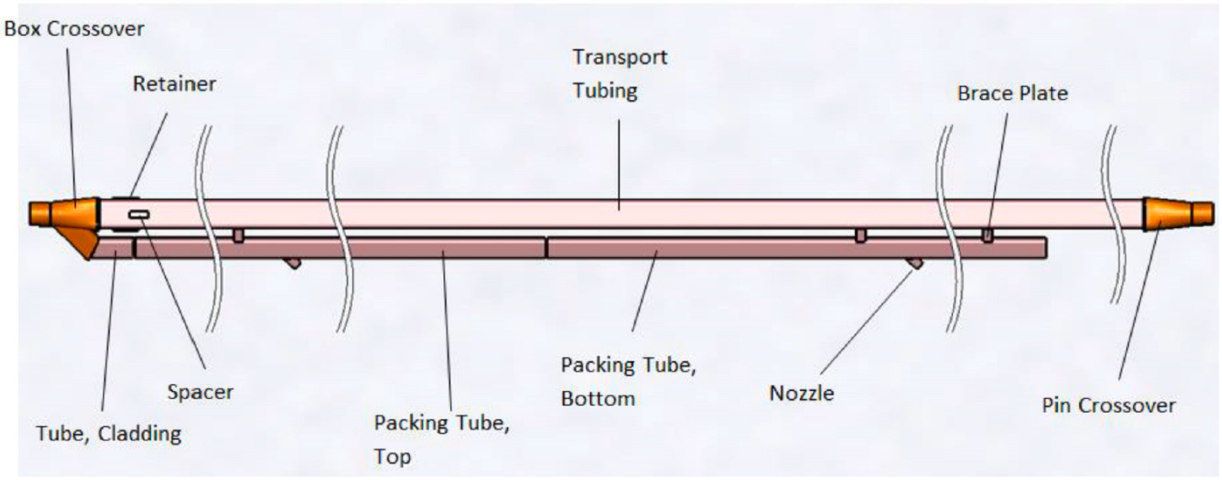


Figure 8—Shunt system tubing weldment with its components



Figure 9—Box end crossover, internally-cladded Packing Tube, and Pin end crossover

EX1016 at Figs. 8-9.

16. Bonner used round, instead of rectangular, jumper tubes to connect shunt assemblies across joint connections using the box and pin connectors

illustrated in Figures 8 and 9. EX1016 at 3, Figs. 8-9. I provide Figure 42 below, which illustrates two shunt tube assemblies connected using this system:

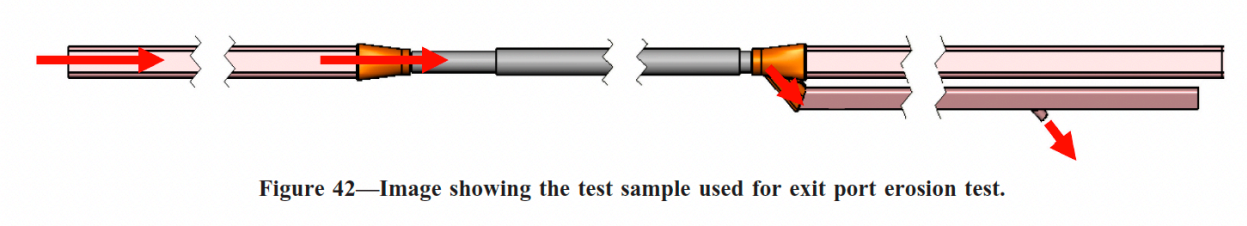


Figure 42—Image showing the test sample used for exit port erosion test.

EX1016 at Fig. 42.

17. Bonner performed a CFD, or computational fluid dynamics, analysis to evaluate whether using round jumper tubes would result in an increased pressure drop and reported that "the flow characteristics of the [round] shunt system was compared with the flow characteristics of a shunt system using rectangular tubes only (see Figures 35 and 36). CFD analysis indicates that round jumper tubing does not result in increased pressure drop," even though the round tubes had less cross-sectional area for flow than the rectangular jumper tubes, which was due "to the nature of friction pressure loss in round tubes versus rectangular tubes." EX1016 at 2, 16-17.

18. Bonner disclosed other extensive testing to validate its improved shunt tube assembly, including shunt tubing and jumper tubing pressure testing. EX1016 at 6-7; *see* EX1003 ¶157.

19. Bonner's validation testing included shunt tubing pressure tests to "determine the burst pressure rating of the shunt system … performed on stand-alone shunt tubing (see Figure 20) and on complete sections of the joint assembly with screen and outer (fixed) shroud (see Figure 21)." EX1016 at 11. Bonner's test results in Figure 23 showed "typical test data recording" for "Rectangular Sample A3C." EX1016 at 11-12, Fig. 23. Figure 23 showed the pressure (units in psi; y-axis) gradually applied to a rectangular shunt tube across time (units in sec; x-axis) shown by the **green line**. EX1016 at 12, Fig. 23. The sample rectangular shunt tube tolerated about 6400 psi before failing, indicated by the vertical drop at around 560 seconds. EX1016 at 12, Fig. 23. Bonner also reported that the "overall testing substantiated the goal rating of 5000 psi burst pressure." EX1016 at 12. This 5000-psi rating was shown by the **red dashed line**. EX1016 at 12, Fig. 23. I provide Bonner's Figure 23 below for reference:

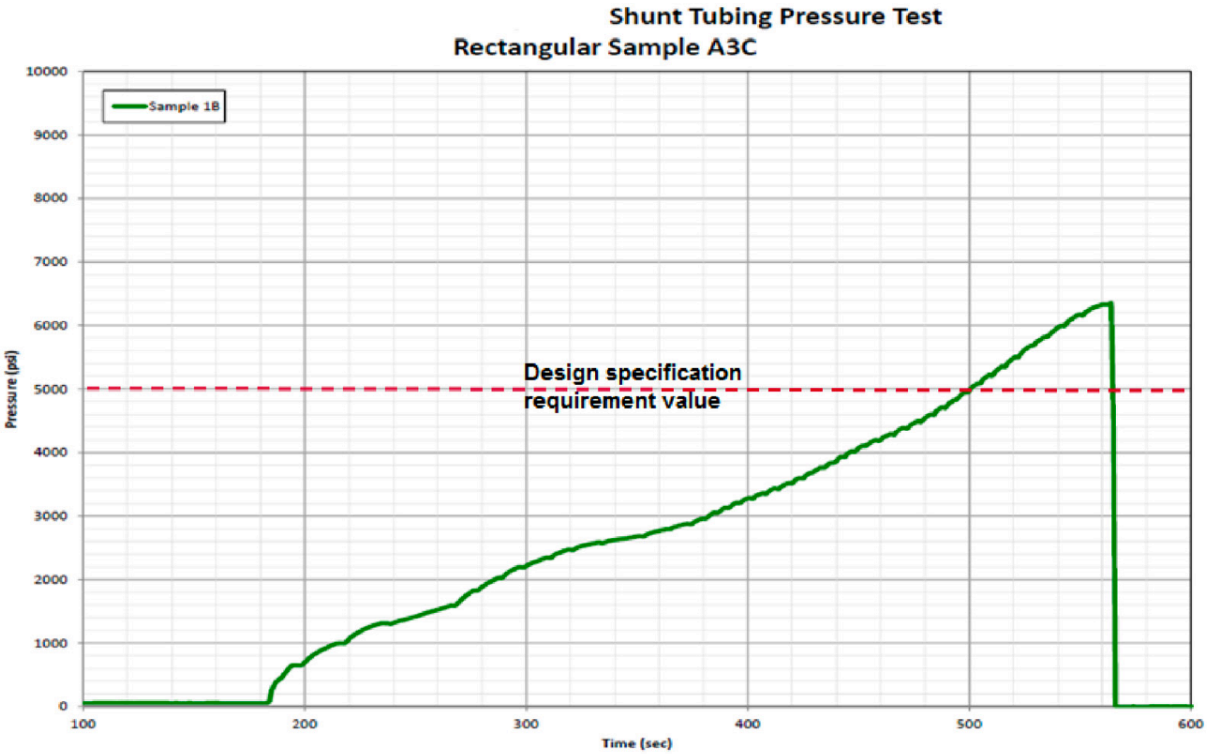


Figure 23—Image showing typical test data recording.

EX1016 at Fig. 23.

20. Bonner also performed jumper tube burst pressure testing to "determine the burst pressure rating of the jumper tube system." EX1016 at 15. Burst pressure test data from a "Sample B (aka Left)" were reported in Figure 32. EX1016 at 16, Fig. 32. Pressure (y-axis) was applied to the jumper tube across time (x-axis), as shown by the **blue line**, until failure, which was above 7,500 psi. EX1016 at 16, Fig. 32. Bonner reported that "[a]ll jumper tube system testing failures were above 5000 psi, easily supporting the shunt tube system pressure rating of 5000 psi (see Figure 32)," shown by the **blue dashed line** in Figure 32 identifying the "Design

specification requirement value." EX1016 at 16, Fig. 32. I provide Bonner's Figure 32 below for reference:

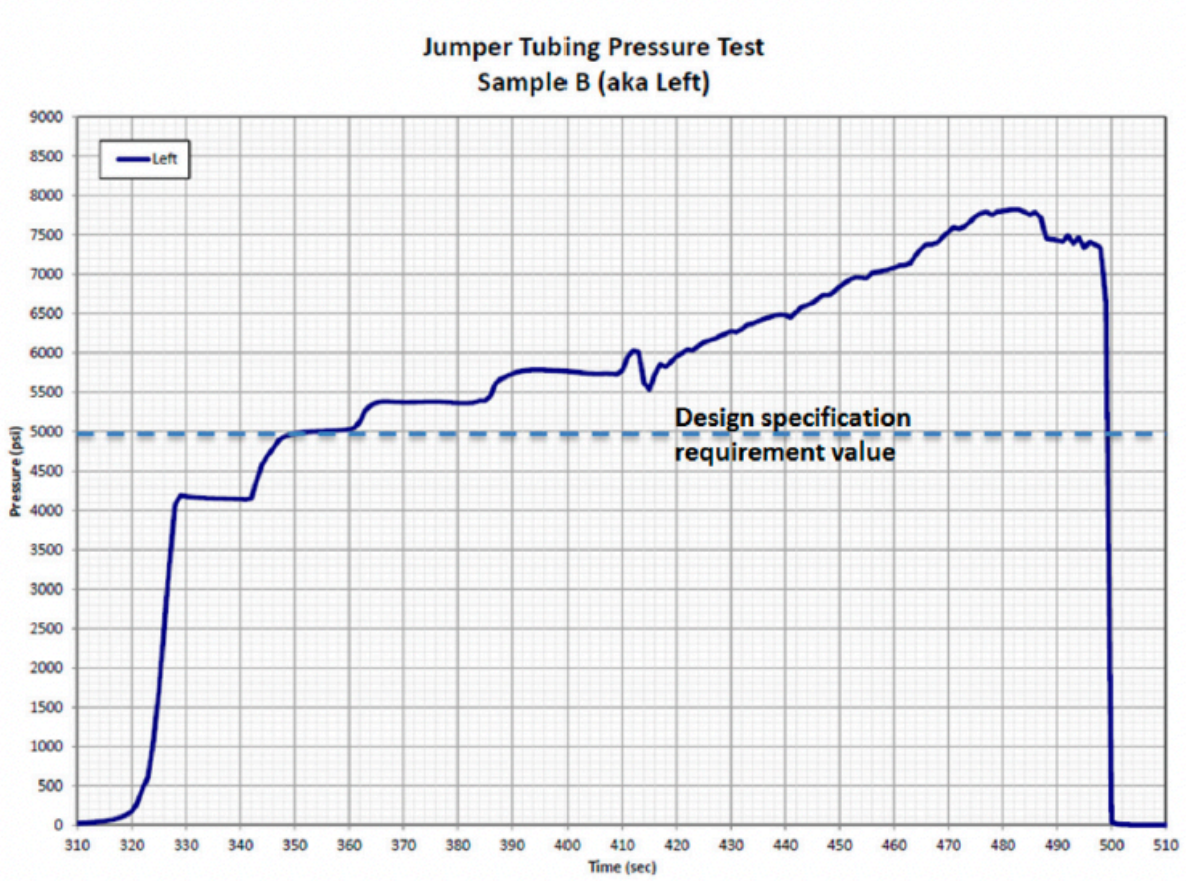


Figure 32—Example of jumper tube burst pressure test data

EX1016 at Fig. 32.

21. Bonner ultimately concluded based on its testing that its improved eccentric shunt tube assembly that "[l]everag[ed] the traditional slurry bypass mechanisms of a 2×2 shunt system," "stayed true to the functionality of a proven base design, while utilizing design optimizations validated on a solid platform of robust testing methods. In so doing, the industry is offered an improved approach to a shunt system for reliable gravel packing operations." EX1016 at 20. Bonner

confirmed that its improved eccentric shunt system was capable of handling 5,000 psi, which was superior to previous conventional eccentric shunt systems, which typically handled about 3,000 psi.

22. In my review of Dr. Durham's declarations, I did not find analysis or mention of Bonner's teachings or a response to my opinions regarding the same, despite many of Patent Owner's proposed substitute claims including new eccentric screen requirements. *See generally* EX2002; EX2004.

V. SUMMARY OF GROUNDS

23. I provide a table below that summarizes the Grounds upon which I believe Substitute Claims 24-29 and 31-40 of the '007 Patent are invalid.

Ground	Substitute Claim(s)	Prior Art
MTA 1a	24-26 (proposed amendments to Claims 3, 6, 8)	Yeh optionally in view of Yeh2
MTA 1b	27-29 (proposed amendments to Claims 9, 11, 12)	Yeh in view of Bonner and optionally Yeh2
MTA 2	31-37 (proposed amendments to Claims 14-20)	Yeh in view of Yeh2, Bonner, and optionally Jones2
MTA 3	38-39 (proposed amendments to Claims 21-22)	Yeh in view of Jones and Bonner
MTA 4	40	Yeh in view of Jones, Yeh2, and Bonner

	(proposed amendment to Claim 23)	

24. I understand Patent Owner proposed amending original claim 13 as Substitute Claim 30. *See* MTA at 1; *id.* at App. A at 3-4. However, I was not asked to offer an opinion on Substitute Claim 30.

25. For the purposes of my analysis, I have been asked to assume that the following references are prior art, which I assume for the same reasons I provided in my first Declaration. *See* EX1003 ¶255.

- Yeh (EX1005).
- Yeh2 (EX1006).
- ’476 Patent (EX1010).
- Hurst (EX1013).
- Lagrone (EX1014).
- Hecker (EX1015).
- Jones2 (EX1008).
- ’487 Patent (EX1012).
- Jones (EX1007).
- Bonner (EX1016).

26. For reference, I annotated Patent Owner's proposed amendments to its claims in **blue**.

VI. MTA GROUND 1a

A. Substitute Claim 24

27. I understand this claim is a proposed substitute for Claim 3. It is my opinion that Substitute Claim 24 would have been obvious over Yeh in view of Yeh2 for all the reasons I provided for Claims 1 and 3, in addition to the reasons I provide below.

1. Claim 24[preamble]: "The completion assembly of claim 1,"

28. For all the same reasons I explained in Claim 1, it is my opinion that Yeh in view of Yeh2 disclosed or suggested the preamble. EX1003 ¶¶256-97.

2. Claim 24[a]: "wherein the first sand screen assembly further comprises a junction block from which the transport tube and the packing tube extend, the plurality of nozzles being spaced apart from the junction block;"

29. It is my opinion that Yeh in view of Yeh2 disclosed this limitation for the same reasons I provide for Claims 1[a] and 3. EX1003 ¶¶260-70, 308-22.

3. Claim 24[b]: "wherein the second sand screen assembly further comprises a junction block from which the transport tube and the packing tube extend, the plurality of nozzles being spaced apart from the junction block,

30. It is my opinion that Yeh in view of Yeh2 disclosed or suggested this limitation for the same reasons I provide for Claims 1[b] and 3. EX1003 ¶¶271-77, 308-22.

4. Claim 24[c]: "wherein the distance between the first sand screen assembly junction block and the packing tube nozzles is greater in the first sand screen assembly than the distance between the second sand screen assembly junction block and the packing tube nozzles in the second sand screen assembly;"

31. It is my opinion that Yeh in view of Yeh2 disclosed or suggested this limitation for the same reasons I provide for Claim 3. EX1003 ¶¶308-22.

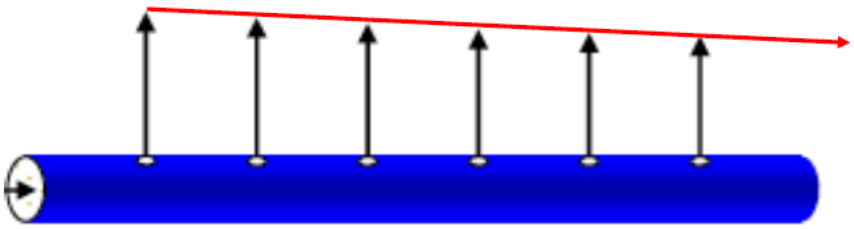
5. Claim 24[d]: "and wherein shunt tube assemblies of the second sand screen assembly have different spacing between the nozzles."

32. It is my opinion that Yeh in view of Yeh2 taught or suggested this limitation.

33. As I explained for Claims 3 and 24[c], a POSITA would understand that optimizing packing tube nozzle spacing would be a method to achieve a complete gravel pack. EX1003 ¶¶308-22; *supra* ¶31. I also explained these concepts in my opinions previously. EX1003 ¶¶66.g, 107-08, 161, 189, 323-26 (Claim 4).

34. A POSITA understood that there was less pressure available for gravel slurry flow at distal portions of the interval and thus had to make shunt system modifications to account for that pressure drop. *See* EX1003 ¶317. For example, Yeh2 recognized the challenge of obtaining a complete gravel pack in long horizontal intervals due to known factors including the pressure drop of the gravel slurry as it traveled away from the pressure source towards the toe, illustrated in Yeh2's Figure 15 and the extent of gravel slurry dehydration, shown in Yeh2's Figure 14. EX1006 at 4-5, Figs. 14-15; EX1003 ¶¶110, 312-22. At the same time, a POSITA would also know that "a single shunt porthole could successfully pack up to an 8-10 ft annular void" and that gravel slurry flow through the packing tube nozzles decreased over the length of the packing tube as shown in Yeh2's Figure 7. *See* EX1006 at 4, Fig. 7. Even though Yeh2's closed-end packing tubes illustrated in Figure 7 showed a small drop in gravel slurry flow (which is also shown in Figure 8), EX1043 (Durham Tr.) at 140:15-20, a POSITA would be motivated to correct for this pressure drop to ensure adequate gravel slurry flow and adequate gravel pack by shortening or lessening the spacing toward the downhole end of the packing tube. The downward trend in gravel slurry flow over the length of the packing tube is evident even in Figure 7 Case C and would be more pronounced in the real-world example of a 40-foot-long packing tube. Although Dr. Durham testified that he was

unsure if there was a steady drop down in flow down the length of the packing tube in Case C, that is plainly what the figure shows. See the annotated figure below:



EX1006 at Fig. 7 (excerpted and annotated).

35. A POSITA would understand that the number of nozzles would impact gravel slurry flow. For example, Jones' group performed experimental testing on the ALLPAK™ system which "verif[ied] the advantages" of this system. EX1009 at Abstract. Gravel packing laboratory tests were performed in horizontal interval simulators "to provide the most difficult packing conditions." EX1009 at 2. The testing conditions were listed in Table 1 and included experiments with different nozzle diameter and number. EX1009 at 2, 5, Table 1. The authors reported that while these experiments "were relatively successful, the packing mechanics were haphazard with slurry running in and out of shunt holes almost at random. From this it was surmised that the shunt holes were too large and that there were too many holes." EX1009 at 2.

36. Around the same time, Jones2 (EX1008) issued. Jones2 disclosed a shunt tube with varied nozzle spacing (and nozzle diameter), as shown in Figure 3, and explained that its invention provided for "a good distribution of gravel over the entire interval" and comprised "a plurality of conduits, each of which is perforated along a length which is different from the perforated lengths of the other conduits." EX1008 at 2:20-25, 2:55-59, Fig. 3. As I show to the right, Jones2's Figure 3 depicts a shunt tube with "relatively large" diameter perforations 326a ("e.g. $^{1}/_{8}$ inch diameter") at the bottom with one spacing, a second set of "intermediate" diameter perforations 326b ("e.g. $^{3}/_{32}$ inch diameter") in the middle of the shunt tube with a second spacing, and "smaller" diameter perforations 326c ("e.g. $^{1}/_{16}$ inch diameter") at the top that have a third spacing. EX1008 at 4:55-60. A POSITA would readily understand that Jones2 provided the least cross-sectional area for flow (combination of nozzle number and diameter) at the top of the tube where pressure was highest (e.g., 0.009 in^2 for three 1/16 inch holes), the next smallest cross-sectional area for flow in the middle (e.g., 0.035 in^2 for five 3/32 inch holes), and the largest cross-sectional area for flow at the

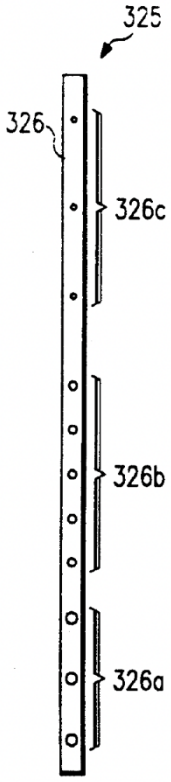


FIG. 3

bottom where pressure would be least (e.g., 0.037 in^2 for three 1/8 inch holes) all by adjusting number of nozzles and nozzle area along the length of the tube.

37. Hurst, which was specifically referenced by Yeh, EX1005 at 3:27-31, later confirmed Jones' observations, explaining that nozzle frequency, i.e., nozzle number, was a parameter that could be used to manipulate gravel slurry flow: "For a given fluid composition and gravel concentration, friction and thus the pressure applied to each zone can be controlled through … the nozzle diameter and frequency." EX1013 at 3-4; EX1043 (Durham Tr.) at 134:19-135:1 (agreeing Hurst taught "that slurry flow out of nozzles can be controlled by modifying shunt tube nozzle frequency").

38. As can be appreciated by the prior art disclosures on nozzle frequency I discuss here, a POSITA would understand that gravel slurry flow could be controlled by adjusting nozzle number through routine optimization. Dr. Durham agrees. EX1043 (Durham Tr.) at 138:12-19 (agreeing that "a skilled artisan in 2018, reading Lagrone, Hurst, and Jones 2, would understand that gravel slurry flow out of shunt tubes could be manipulated by adjusting nozzle characteristics, including adjusting the nozzle cross-sectional area or the number of nozzles on a shunt tube").

39. Like all modifications to packing tubes, shortening the nozzle spacing would involve some known tradeoffs, such as increased leak-off, but a skilled

artisan, well aware of all effects from the change, would have been motivated to make the change to achieve the benefit of a better gravel pack in a region where the gravel slurry pressure dropped. Indeed, nothing about making nozzle spacing different to optimize obtaining a complete gravel pack was new, critical, or unexpected. Quite the opposite, the general parameters were well understood by 2018.

B. Substitute Claim 25

40. I understand that this claim is a proposed substitute for Claim 6. It is my opinion that Substitute Claim 25 would have been obvious over Yeh in view of Yeh2 for all the reasons I provided for Claim 6 in addition to the reasons I provide below.

1. Claim 25[preamble]: "The completion assembly of claim 1,"

41. For all the same reasons I explained in Claim 1, it is my opinion that Yeh in view of Yeh2 disclosed or suggested the preamble. EX1003 ¶¶256-97.

2. Claim 25[a]: "wherein the second end of the first sand screen assembly base pipe is connected to the first end of the second sand screen assembly base pipe forming a joint therebetween,"

42. For all the same reasons I discussed for Claim 6, Yeh in view of Yeh2 disclosed or suggested this limitation. EX1003 ¶¶334-40.

3. Claim 25[b]: "the completion assembly further comprising a coupling interconnecting one end of a jumper tube to the transport tube of the first sand screen assembly, the other end of the jumper tube in fluid communication with the junction block of the second sand screen assembly whereby the jumper tube straddles the joint between the first and second sand screen assemblies;"

43. For all the same reasons I discussed for Claim 6, Yeh in view of Yeh2 disclosed or suggested this limitation. EX1003 ¶¶334-40.

4. Claim 25[c]: "and wherein the cross-sectional flow area of the first transport tube is less than the cross-sectional flow area of the second transport tube."

44. In my opinion, Yeh suggested this limitation for the same reasons I explained for Claim 1[e], which requires the first transport tube wall thickness be greater compared to the second transport tube thickness. *See* EX1001 at 18:51-55; EX1003 ¶¶290-97.

45. A POSITA would understand that the eccentric orientation concentrated the annular space outside the base pipe, allowing for larger shunt tubes that had greater cross-sectional flow areas while still providing for a larger base pipe for the primary flow path. For example, Yeh disclosed a known design option for a concentric screen in which its shunt tubes had a smaller internal cross-sectional area offset by more shunt tubes compared to an eccentric screen, which had fewer shunt tubes with a larger internal cross-sectional area. *Compare* EX1005 at Fig. 9A, *with* EX1005 at Fig. 8C; *see also* EX1013 (Hurst) at 3 ("The key advantage of the

eccentric design is the increased base-pipe size, allowing, for example, 5.5-in base pipe in an 8.5-in open hole."). In this scenario, using Yeh's recommendation of concentric screens followed by eccentric screens, the cross-sectional flow area of the first transport tube would be less than the cross-sectional flow area of the second transport tube without regard to wall thickness. However, that would be balanced against the size of the primary flow path through the base pipe resulting in an optimization with which a POSITA was very familiar. Thus, the cross-sectional flow area of the second transport tube would likely be increased, but the increase would be limited by balancing the primary flow path cross-sectional area.

46. Alternatively, a POSITA would understand that shunt tube wall thickness and cross-sectional flow area of shunt tubes were related, with reductions in wall thickness increasing the internal diameter if the outer diameter remained constant. A POSITA would also understand that when considering shunt system modifications in a fixed space, adjusting the wall thickness and corresponding internal diameter is an obvious design choice because it does not impact the remainder of the tool. Material selection is an obvious second choice for the same reason. Thus, if transport tubes upstream and downstream in a horizontal wellbore were the same outside diameter, the downstream transport tubes with a smaller wall thickness would have a larger cross-sectional area.

47. Given Yeh's teaching that both concentric screens and eccentric screens have "two or more shunt tubes," EX1005 at 16:26-37, a POSITA would understand that the concentric and eccentric screens could have the same number of transport tubes that were the same size. Although that would require a smaller primary bore in the concentric screens, in many wells that would not cause a concern. For example, Hurst recognized that as gravel pack lengths became longer, there was a need for shunt tubes with larger cross-sectional areas to obtain "sufficient flow area" to "reduc[e] friction pressures over the [pump] rates of interest" and that increasing the cross-sectional area from the original design of "0.5×1.0-in external (0.31×0.81-in internal)" to "0.75×1.5-in external (0.56×1.31-in internal)" "yield[ed] 3 times the flow area of the original design and reduc[ed] friction pressures over the [pump] rates of interest by approximately an order of magnitude, for long horizontal gravel packs." EX1013 at 2. Hurst also understood that even an eccentric screen using larger shunt tubes "was at the expense of a reduced base pipe diameter" but noted that "in many instances [reduced base pipe diameter] does not impact well productivity in either frac-packed or gravel-packed horizontal completions, although this should be verified through reservoir simulators that couple friction in the wellbore with the pressure drop through the wellbore." EX1013 at 2; EX1043 (Durham Tr.) at 144:3-20 (agreeing that a POSITA in 2018 would understand the

tradeoffs associated with increasing secondary flow paths at the expense of primary flow paths and that Hurst described the tradeoff as beneficial).

48. Although Yeh taught an example of concentric screens with a greater number of smaller diameter shunt tubes, a POSITA would understand that all these design options were determined based on the application in a particular well, such that in a particular circumstance as taught by Hurst in which the primary bore was not a design limitation, a POSITA would be motivated to use fewer larger shunt tubes to avoid the weight and cost of more smaller shunt tubes for a given cross-sectional flow area. For example, Yeh's concentric screen could include up 9 shunt tubes (6 transport, 3 packing), which required a complex manifold capable of distributing flow to nine separate tubes combined with connections for nine separate tubes to the manifold and six transport tube connections on the opposite end. EX1006, Figs.9-10. This would create an expensive and heavy tool compared to a typical eccentric screen with 4 shunt tubes (2 transport, 2 packing) that included simpler connections and was lighter. *See, e.g.*, EX1016, Fig. 8, EX1003 ¶¶141-59 (shunt tube coupling). Hurst confirms that this was desirable in certain circumstances by providing an example of just such an arrangement, as shown in Figure 7, reproduced below.

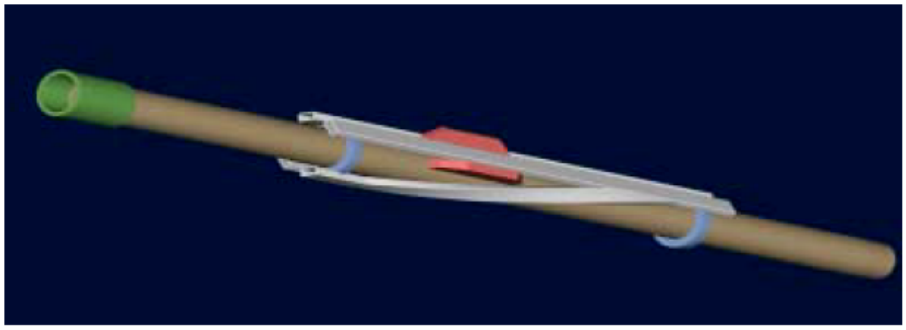


Figure 7 – Concentric Entrance (Y-manifold).

Hurst explains the benefit of this "concentric entrance" design: "This design ensures that there is at least one transport tube in the top section of the horizontal well, providing a path for continuation of the gravel pack job in cases where long shut down periods may result in gravel settling and thus blocking of the entry to the shunt tubes, should the shunts end up on the low side." EX1013 at 3, Fig. 7. Thus, it would have been obvious to use a concentric screen with the same number of tubes as an eccentric screen and even of the same outside diameter to facilitate shunt tube flow and reduce pressure drop while using a lighter and less expensive tool, which would have involved simply routine design and optimization for a given application. A POSITA would have expected success because the design aspects of tubing for gravel slurry applications was well understood and well documented, as evidenced by the background discussion in my first Declaration. *See* EX1003 §§VIII generally, VIII.G particularly.

49. In this scenario, it also would have been obvious to reduce shunt tube wall thickness in downstream tubes to further reduce weight and cost where the

higher-pressure containment was not needed. Yeh disclosed that wall thickness was a factor considered because "to maintain the mechanical integrity (that is, to stay within the burst, bending, and collapse ratings) of the secondary flow paths, a certain surrounding wall thickness is required." EX1005 at 28:20-23. Dr. Durham agreed that round shunt tube wall thickness is directly proportional to that shunt tube's pressure rating. EX1043 (Durham Tr.) at 66:21-67:4. He also agreed that wall thickness is generally proportional to burst pressure rating for rectangular shunt tubing. EX1043 (Durham Tr.) at 67:14-68:14, 93:18-94:6, 96:12-97:5; *see also* EX2002 ¶96 ("It was widely known that the pressure rating of eccentric screens prior to the '007 Patent was limited to 3,000 PSI, which in turn limited the overall gravel pack length to around 3,200 feet…. This was because 'shunt tubes are typically formed from thin-walled' steel…. [e]ven with some increased wall thickness, the working pressure rating of these eccentric designs was still limited to 3,000 PSI, limiting the overall length of the sand screen assembly."). Again, such modifications were well understood, and a POSITA would have expected success because engineering tubing for gravel slurries was well understood and predictable, as noted above. *See* EX1003 §§VIII generally, VIII.G particularly.

50. A POSITA installing Yeh's proposed wellbore tool sequence: "concentric screen → crossover tool → eccentric screen," *see* EX1005 at 30:13-14,

would understand then that the transport tube wall thickness in the downstream eccentric screens could be reduced compared to the upstream concentric screen shunt tube wall thickness. This modification could be done without compromising the eccentric screen shunt tube integrity, as supported by my previous calculations showing different yield and burst pressures of three different sets of round tubes with dissimilar wall thicknesses and metallurgies. EX1003 ¶¶231-32. While I understand Dr. Durham took issue with the ASTM standard A554-16 (EX1018), which I used for my calculations because it provided tensile strengths for "ornamental" tubing, *see* EX2002 ¶107 n.115, he did not challenge the yield and tensile strength values reported in A554-16, EX1043 (Durham Tr.) at 104:20-105:12, 106:17-107:10. Indeed, he agreed that the burst pressure rating of a shunt tube could be increased by using higher tensile strength material compared to a shunt tube of the same dimension comprised of a lower tensile strength material. *See* EX1043 (Durham Tr.) at 104:6-11.

51. Thus, a POSITA motivated by reducing material costs would use thinner-walled shunt tubes in the downstream eccentric screens because material was typically sold by weight. EX1003 ¶¶184, 294-95. A POSITA would also understand that using a thinner-walled transport tube in the downstream eccentric screens could increase its cross-sectional flow area, which would reduce overall gravel slurry

pressure drop in transport tubes as it traveled downstream towards the toe of a horizontal well. *See* EX1006 at 4 ("The friction loss in transport tubes and manifold limits the overall distance of shunt diversion."), Fig. 15; EX1003 ¶296. This same logic was applied to designing packing tubes to have smaller cross-sectional areas compared to transport tubes, which would be expected to have a proportionally smaller cross-sectional area than the corresponding transport tube. *See* EX1003 ¶129. Hurst, which Yeh references, also described the relationship between cross-sectional area and gravel slurry flow pressure drop. *See* EX1013 at 3-4 ("For a given fluid composition and gravel concentration, friction and thus the pressure applied to each zone can be controlled through the shunt tube dimensions (diameter and length) as well as the nozzle diameter and frequency.").

52. Either Yeh's teachings regarding concentric and eccentric screens or the knowledge of a POSITA in 2018 would motivate a POSITA to use a second transport tube with a greater cross-sectional flow area than that of a first transport tube.

C. Substitute Claim 26

53. I understand that this claim is a proposed substitute for Claim 8. It is my opinion that Substitute Claim 26 would have been obvious over Yeh in view of Yeh2 for all the reasons I provided for Claims 7 and 8 in addition to the reasons I provide below.

1. Claim 26[preamble]: "The completion assembly of claim 1,"

54. For all the same reasons I explained in Claim 1, it is my opinion that Yeh in view of Yeh2 disclosed or suggested the preamble. EX1003 ¶¶256-97.

2. Claim 26[a]: "wherein the shunt tube assembly of the first sand screen assembly has a pressure rating of between 5000 and 10000 psi;"

55. For all the same reasons I discussed for Claims 7 and 8, Yeh in view of Yeh2 disclosed or suggested this limitation. EX1003 ¶¶341-50.

3. Claim 26[b]: "and the packing tube of the first sand screen assembly is interconnected to a junction block of the second sand screen assembly."

56. For all the same reasons I discussed for Claims 1[d], 3, and 6, Yeh in view of Yeh2 disclosed or suggested this limitation. EX1003 ¶¶285-89, 308-11, 334-40.

57. As I previously explained for Claims 1[c] and 1[d], Yeh disclosed that the fluid (gravel slurry in the sand screen example) flows through the shunt tubes of the first wellbore tool, secondary flow path 1020 of the crossover joint, and shunt tubes of the second wellbore tool, confirming that the packing tube of the first sand screen assembly is interconnected to the shunt tubes of the second sand screen assembly. EX1033 ¶¶ 278-89. Because the shunt tubes of the second sand screen assembly would be accessed via a junction block, as I explained with respect to

Claim 3, EX1003 ¶¶308-11, the packing tube of the first sand screen assembly is also interconnected to a junction block of the second sand screen assembly.

58. Dr. Durham agreed that this sequence of physical connections in Bonner's example resulted in the first shunt tube system fluidly connected to the second shunt tube system. EX1043 (Durham Tr.) at 111:22-112:7, 114:12-20 (referring to EX1016 at Fig. 42).

59. Consequently, a POSITA in 2018 would understand that this connectivity results in the packing and transport tube of the first sand screen assembly being interconnected to the junction block of the second sand screen assembly via the junction block (or manifold) and transport tube of the first sand screen assembly and the secondary flow path of the crossover joint.

VII. MTA GROUND 1b

A. Substitute Claim 27

60. I understand that this claim is a proposed substitute for Claim 9. It is my opinion that Substitute Claim 27 would have been obvious over Yeh in view of Yeh2 and Bonner for all the reasons I provided for Claims 7 and 9 in addition to the reasons I provide below.

1. Claim 27[preamble]: "The completion assembly of claim 1,"

61. For all the same reasons I explained in Claim 1, it is my opinion that Yeh in view of Yeh2 disclosed or suggested the preamble. EX1003 ¶¶256-97.

2. Claim 27[a]: "wherein the shunt tube assembly of the first sand screen assembly has a pressure rating of over a select threshold and the shunt tube assembly of the second sand screen assembly has a pressure rating of no more than the select threshold;"

62. For all the same reasons I discussed for Claims 7 and 9, Yeh in view of Yeh2 disclosed or suggested this limitation. EX1003 ¶¶341-47, 351-52.

3. Claim 27[b]: "and wherein the first sand screen assembly and the second sand screen assembly are eccentric assemblies."

63. It is my opinion that Yeh in view of Yeh2 and Bonner disclosed or suggested this limitation.

64. Yeh disclosed using high-pressure concentric screens near the heel or higher-pressure section of a horizontal wellbore. EX1005 at 28:17-24, 30:13-26, 30:44-45; EX1003 ¶¶291-92. Yeh explained that concentric screen shunt assemblies would have to tolerate a 6,500-psi differential pressure at the heel to gravel pack a 5,000-foot horizontal wellbore. EX1005 at 28:11-24 ("For example, a 6,500 psi differential pressure is expected near the heel of [sic] when gravel packing a 5,000-foot horizontal completion interval."); EX1003 ¶222 (quoting EX1005 at 28:11-24). By contrast, Yeh taught to install the eccentric screens with lower pressure ratings farther down the wellbore near the toe. EX1005 at 30:15-26; EX1003 ¶223 (citing EX1005 at 30:15-26). Specifically, Yeh disclosed installing eccentric screens in lower-pressure, distal regions of the interval because "known concentric screens are

capable of gravel packing 5,000 feet, compared to 3,000 feet with the commercial eccentric screens." EX1005 at 30:18-25. Dr. Durham agrees. EX1043 (Durham Tr.) at 81:7-83:8; EX2002 ¶170 (Dr. Durham opining that "*Yeh* teaches using an eccentric screen in the lower pressure sections of the wellbore (near the toe) because the eccentric screens are less expensive, easier to acquire, and lower friction."). Hecker also confirmed that conventional eccentric screens had a lower pressure rating: "In-house best practices limit the shunt friction pressure [in eccentric screens] to 3,000 psi to maintain reliability in the shunt packing system." EX1015 at 2; *see also id.* at 3 (describing rectangular shunt tubes having a working pressure of 3,000 psi). Figure 15 of Yeh2 illustrated the pressure change on the shunt assemblies as a function of distance from the heel. EX1006 at Fig. 15; EX1003 ¶343 (citing EX1006 at Fig. 15).

65. While Yeh disclosed using round shunt tubing in its high-pressure-rated concentric screen, a POSITA reading Bonner would also understand that Bonner disclosed an eccentric screen with a shunt tube system that was able to tolerate higher pressure than the conventional eccentric screens disclosed in Yeh and Hecker. Bonner explained that its new, high-pressure-rated eccentric screen "improved pressure sealing, erosion resistance, ruggedness, improved rig assembly times, and system qualification." EX1016 at 1.

66. As I explained above, Bonner reported its shunt tubing assembly was rated to hold 5,000 psi, which is greater than Yeh's conventional eccentric screen, which was limited to 3,000 psi. EX1016 at 11-12, Fig. 23; *supra* ¶¶19-20. Dr. Durham agreed that Bonner's high-pressure shunt tube system could tolerate 5,000 psi, which was more than the 3,000 psi expected of conventional eccentric screens. EX1043 (Durham Tr.) at 123:7-14.

67. A POSITA interested in keeping costs down, as disclosed by Yeh, would understand that using eccentric screens was one way to achieve this goal. *See* EX1005 at 30:25-26; EX1003 ¶295 (citing EX1005 at 30:25-26). Substituting Bonner's high-pressure eccentric screens for Yeh's concentric screens would also provide a larger primary flow path because of the added space when using the eccentric orientation. *See, e.g.,* EX1003 ¶128 (eccentric screens provided the largest flow area for the transport tubes); EX1013 at 3 ("The key advantage of the eccentric design is the increased base-pipe size, allowing, for example, 5.5-in base pipe in an 8.5-in open hole."). Additionally, utilizing Bonner's eccentric screens eliminates the need for a crossover tool to match up concentric and eccentric flow paths and increasing installation efficiency and speed, which are also cost saving measures. As Bonner explained:

> Within the constraint of keeping the design functionally the same as proven designs, several enhancements were made to operational

> features. These enhancements were targeted primarily at decreasing the time required to assemble joints of shunted screen on the rig and also improving some features of reliability of the shunted screens. ***In general, all features were designed with the intention to equal or improve on industry standards for speed and reliability.***

EX1016 at 2 (emphasis added).

68. Avoiding the combination of concentric and eccentric tools along with the crossover joint had the added benefit of eliminating the offset in primary flow paths between concentric and eccentric tools. This offset in primary flow paths shown in Yeh's crossover tool in Figure 10A (reproduced below) created a problem for moving tools down the primary flow path. As Yeh explained,

> The axis-offset and curvature of a crossover joint 1000 are important considerations. The primary flow path of the crossover joint 1000 should be able to accommodate movement of a tool such as the setting tool 750 of FIG. 7C through the bore 1005. It can be seen that the curvature range shown at line 1120A in FIG. 11A has a smaller range than the curvature range shown at line 1120B in FIG. 11B. This is to be expected as the crossover joint of FIG. 11A has twice the length of the crossover joint of FIG. 11B, thereby reducing the "rate of change of direction" for the curvature.
>
> Another way to mitigate the curvature impact on the primary flow path is to increase the internal diameter of the crossover joint. The

increased diameter eases the run of other downhole tools through the curved crossover joint.

EX1005 at 27:62-28:8. Dr. Durham agrees that here Yeh is teaching that "the offset center line due to combining eccentric and concentric tools create[s] a restriction in the primary flow path that has to be overcome." EX1043 at 56:21-57:6. A POSITA would understand that using eccentric sand screens in the entire horizontal wellbore rather than concentric combined with eccentric sand screens would eliminate this problem and provide a benefit.

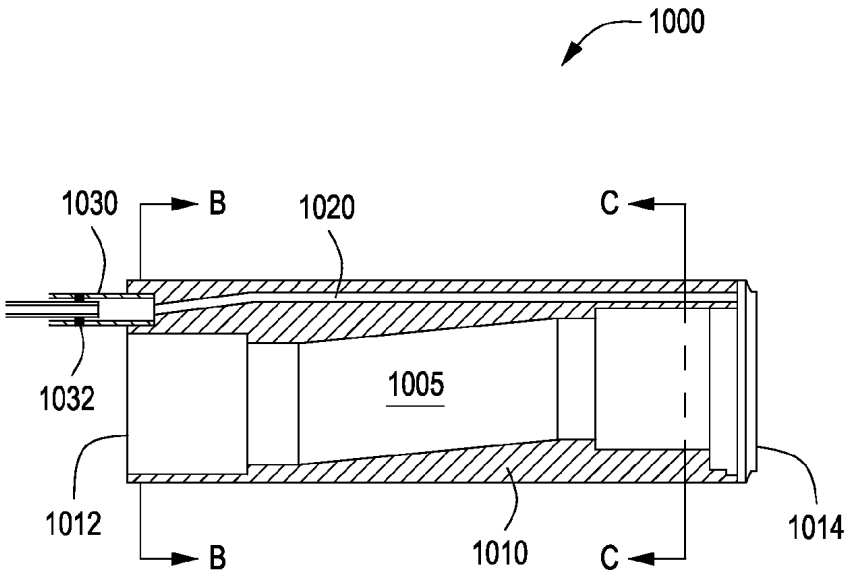


FIG. 10A

EX1005 at Fig. 10A.

69. Therefore, a POSITA would be motivated to substitute Bonner's higher-pressure-rated eccentric screen in place of Yeh's concentric screens to the extent

feasible based on the known pressure requirements in a horizontal as exemplified in Figure 15 of Yeh2. *See* EX1006 at Fig. 15. I previously explained for Claim 14[c], according to the pressure data illustrated in Yeh2's Figure 15, concentric screens would be installed starting from the heel and continuing until around 2,800 psi, or roughly 3,000 feet from the toe, and then eccentric screens would be installed at that transition point and further along the horizontal towards the toe. *See* EX1003 ¶388; EX2001 at 60:18-62:3 (clarifying sentence in EX1003 ¶388 to be "[a]ccording to Yeh, this transition point would be about 3,000 feet down the horizontal from the [***toe***]." (emphasis added)). While Bonner's high-pressure screens were not rated for the 6,500-psi differential pressure Yeh disclosed existed at the heel, Bonner's high-pressure screens could be installed much closer to the heel than conventional eccentric screens. A POSITA would have expected success in using Bonner's eccentric sand screens in this application because Bonner describes the extensive testing of its sand screens for just such an application. *E.g.*, EX1016 at 1 ("The improved pressure sealing, erosion resistance, ruggedness, improved rig assembly times, and system qualification will be presented in the paper.").

70. I provide Figure 15 of Yeh2 below to illustrate this concept. I either removed or moved some of the graphics within the original figure for clarity and added some annotations. First, I showed the portion of the horizontal interval where

conventional eccentric screens could be installed (i.e., 3,000 feet from the toe) using a light-gray box. I also showed the portion of the horizontal interval where Bonner's high-pressure eccentric screen could be installed with a gray box. Despite Bonner's high-pressure screens not being rated to tolerate a 6,500-psi differential pressure, these annotations to Yeh2's Figure 15 indicate that Bonner's high-pressure screens could be installed in most of Yeh2's interval.

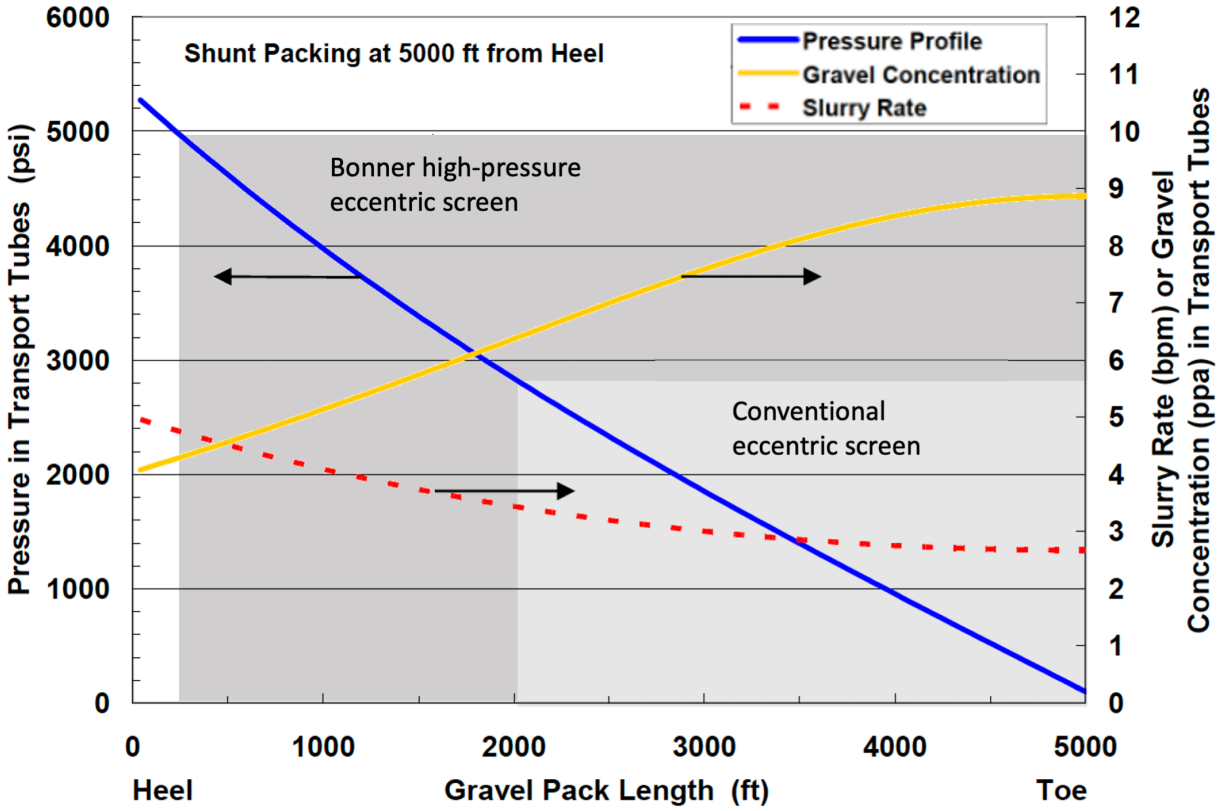


Figure 15 Gravel packing 5,000 ft with multiple-shunt manifold system

EX1006 at Fig. 15 (annotated and modified).

71. Even if Bonner's high-pressure eccentric screen did not meet the 6,500-psi pressure differential disclosed by Yeh, a POSITA would also know that Bonner's rectangular shunt tubes could be strengthened to tolerate 6,500 psi by increasing tube wall thickness. I explained this relationship between wall thickness and pressure tolerance previously for Claim 1[e]. EX1003 ¶¶290-97. Dr. Durham agreed there is a relationship between wall thickness and tubing pressure ratings for both round and rectangular shunt tubing. EX1043 (Durham Tr.) at 66:21-68:14, 93:18-94:6, 96:12-97:5; *see also* EX2002 ¶96. A POSITA would be aware of and understand the hydraulic principles related to the tradeoff of increased pressure containment by increasing shunt tube wall thickness and reduced cross-sectional flow area. *See* EX1006 at 5 ("Burst strength of shunt tubes must therefore be capable of accommodating this high hydraulic pressure.").

72. Additionally, the eccentric orientation provided more space for adjusting tubing wall thickness without negatively impacting the space of the primary flow path. EX1013 at 3 ("The key advantage of the eccentric design is the increased base-pipe size, allowing, for example, 5.5-in base pipe in an 8.5-in open hole."), Fig. 5; EX1003 ¶102 (quoting EX1013 at 3).

73. A POSITA would have been motivated to modify Bonner's high-pressure screens even though increasing thickness could decrease cross-sectional

flow area. This known tradeoff did not outweigh substituting Bonner's tubing for thicker-walled tubing to be able to install the less costly eccentric screens throughout the entire horizontal interval. Additionally, it can be seen from the annotated Figure 15 of Yeh2 I included above, only a minority of Bonner's high-pressure sand screens would have to be modified with thicker-walled shunt tubing as Bonner's existing design had a pressure tolerance sufficient to be installed across most of the interval. EX1005 at 28:17-30; EX1006 at 5 ("Burst strength of shunt tubes must therefore be capable of accommodating this high hydraulic pressure."); *supra* ¶67. A POSITA would thus use an improved Bonner high-pressure eccentric screen in the highest-pressure areas of the interval instead of Yeh's concentric screen and transition over to a traditional eccentric screen for the remainder of the interval, which would do away with the crossover joint at the transition point between Yeh's concentric and eccentric screen. A POSITA would have expected success with this modification because it was routine practice to design tubing to withstand internal pressure requirements and to design around any additional pressure drop created by the loss of cross-sectional flow area. These design considerations were basic and well understood in the industry in 2018. *See* EX1003 §§VIII generally, VIII.G particularly.

74. Additionally, by increasing shunt tube wall thickness in the higher-pressure upstream shunt tube assemblies, these shunt tube assemblies would have walls that were thicker than the walls of the lower-pressure, downstream shunt tube assemblies, thereby satisfying Claim 1[e]. *See* EX1003 ¶¶290-97.

B. Substitute Claim 28

75. I understand that this claim is a proposed substitute for Claim 11. Dr. Durham did not provide a response to my original opinion regarding Claim 11. *See generally* EX2002. It is my opinion that Substitute Claim 28 would have been obvious over Yeh in view of Yeh2 and Bonner for all the reasons I provided for Claim 11 in addition to the reasons I provide below.

1. Claim 28[preamble]: "A completion assembly for deployment in a wellbore, the completion assembly comprising:"

76. For all the same reasons I explained in Claim 1[preamble], to the extent limiting, it is my opinion that Yeh disclosed or suggested the preamble. EX1003 ¶¶256-59.

2. Claim 28[a]: "a source of pressurized working fluid;"

77. For all the same reasons I discussed for Claims 1[c] and 11[a], Yeh in view of Yeh2 disclosed or suggested this limitation. EX1003 ¶¶278-84, 357.

3. Claim 28[b]: "a first eccentric sand screen assembly attached to a second eccentric sand screen assembly,"

78. For all the same reasons I discussed for Claims 1[d], 11[b], and 27[b], Yeh in view of Yeh2 and Bonner disclosed or suggested this limitation. EX1003 ¶¶285-89, 358; *supra* ¶¶64-75.

79. As I explained for Claim 27[b], it would have been obvious to substitute Bonner's high-pressure eccentric sand screen for Yeh's high-pressure concentric screen. *See supra* ¶¶63-73. Bonner's high-pressure eccentric screen could also be modified by increasing the wall thickness of its shunt tubing so that it could gravel pack a 5,000-foot horizontal interval. *See supra* ¶¶71-73.

80. Together, this substitution would result in the first sand screen assembly being Bonner's high-pressure eccentric screen, either as is or modified with thicker-walled shunt tubing, connected to Yeh's eccentric screen.

4. Claim 28[c]: "wherein the first eccentric sand screen assembly comprises a shunt tube assembly with a first burst pressure and the second eccentric sand screen assembly comprises a shunt tube assembly with a burst pressure less than the first burst pressure, and"

81. For all the same reasons I discussed for Claims 1[e], 7, 10, and 11[d], Yeh in view of Yeh2 disclosed or suggested this limitation. EX1003 ¶¶290-97, 341-47, 353-54, 360-61.

82. In addition, for all the same reasons I discussed for Claim 27[b], Bonner's high-pressure eccentric screen, which would be the first eccentric screen, would have a burst pressure that is greater than the burst pressure of the second eccentric screen, i.e., Yeh's eccentric screen. EX1043 (Durham Tr.) at 123:7-14 (agreeing that Bonner's high-pressure shunt tube system could tolerate 5,000 psi, which was more than the 3,000 psi expected of conventional eccentric screens); *see supra* ¶¶63-74.

83. Bonner disclosed a high-pressure screen with a 5,000-psi burst shunt tube pressure rating. EX1016 at 12 ("The overall testing substantiated the [shunt tubing] goal rating of 5000 psi burst pressure."). The burst pressure of the shunt tube system in Yeh's conventional eccentric screen, which had about a 3,000 psi pressure limit, would be lower than Bonner's shunt tube system burst pressure rating.

84. Bonner's eccentric screen rating would also be increased by adding thicker-walled shunt tubing to accommodate the 5,000-foot horizontal wellbore example disclosed by Yeh and Yeh2. As I explained for Substitute Claim 27[b], *supra* ¶¶71-73, Bonner's high-pressure eccentric screen would be modified to have thicker walls, which would further increase the burst pressure difference between the first sand screen (Bonner's high-pressure eccentric screen) and the second sand screen (Yeh's eccentric screen). *See* EX1005 at 28:17-20.

5. Claim 28[d]: "wherein the shunt tube assembly with the first burst pressure is fluidly coupled between the source of pressurized working fluid and the shunt tube assembly with the burst pressure less than the first burst pressure."

85. For all the same reasons I discussed for Claim 11[d], Yeh in view of Yeh2 and Bonner, which would change only the identity of the shunt tube assembly with the first burst pressure (substituting eccentric for concentric screens), disclosed or suggested this limitation. EX1003 ¶¶360-61.

C. Substitute Claim 29

86. I understand that this claim is a proposed substitute for Claim 12. Dr. Durham did not provide a response to my original opinion regarding Claim 12. *See generally* EX2002. It is my opinion that Substitute Claim 29 would have been obvious over Yeh in view of Yeh2 and Bonner for all the reasons I provided for Claim 12 in addition to the reasons I provide below.

1. Claim 29[preamble]: "The completion assembly of claim 28,"

87. For all the same reasons I explained in Claim 28, it is my opinion that Yeh in view of Yeh2 and Bonner disclosed or suggested the preamble. *See supra* ¶¶75-85.

2. Claim 29[a]: "wherein the shunt tube assembly of the first eccentric sand screen assembly is disposed to operate at pressures between 5000 psi and 10000 psi and the shunt tube assembly of the second eccentric sand screen assembly is disposed to operate at pressures of no more than 5000 psi;"

88. For all the same reasons I discussed for Claims 7 and 12, Yeh in view of Yeh2 and Bonner, which would change only the identity of the shunt tube assembly with the first burst pressure (substituting eccentric for concentric screens), disclosed or suggested this limitation. *See* EX1003 ¶¶341-47, 362-64.

89. In addition, for all the same reasons discussed for Claim 27[b], Bonner's high-pressure eccentric screen would be modified to operate at 6,500 psi as disclosed by Yeh, which is in between 5,000 psi and 10,000 psi. *See* EX1016 at 12, Fig. 23; *supra* ¶¶63-74.

90. Yeh's eccentric screens, which were disclosed to have a maximum operating pressure of 3,000 psi or less, would be installed in an interval to operate in locations where the pressures were not more than 5,000 psi.

91. A POSITA would also understand that friction causes an almost linear drop in pressure as gravel slurry travels along the horizontal interval towards the toe as shown by the **blue** line in Yeh2's Figure 15. As I show in my annotated version of Yeh2's Figure 15 below, lower-pressure-rated conventional eccentric screens could be installed at any location along the horizontal where the pressure was below the capacity of Yeh's eccentric screens. This range is illustrated by the light-gray

box, which shows that the concentric-to-eccentric transition point occurs where the operating pressure is about 2,800 psi and at about 2,000 feet from the heel, or 3,000 feet from the toe. *See supra* ¶70.

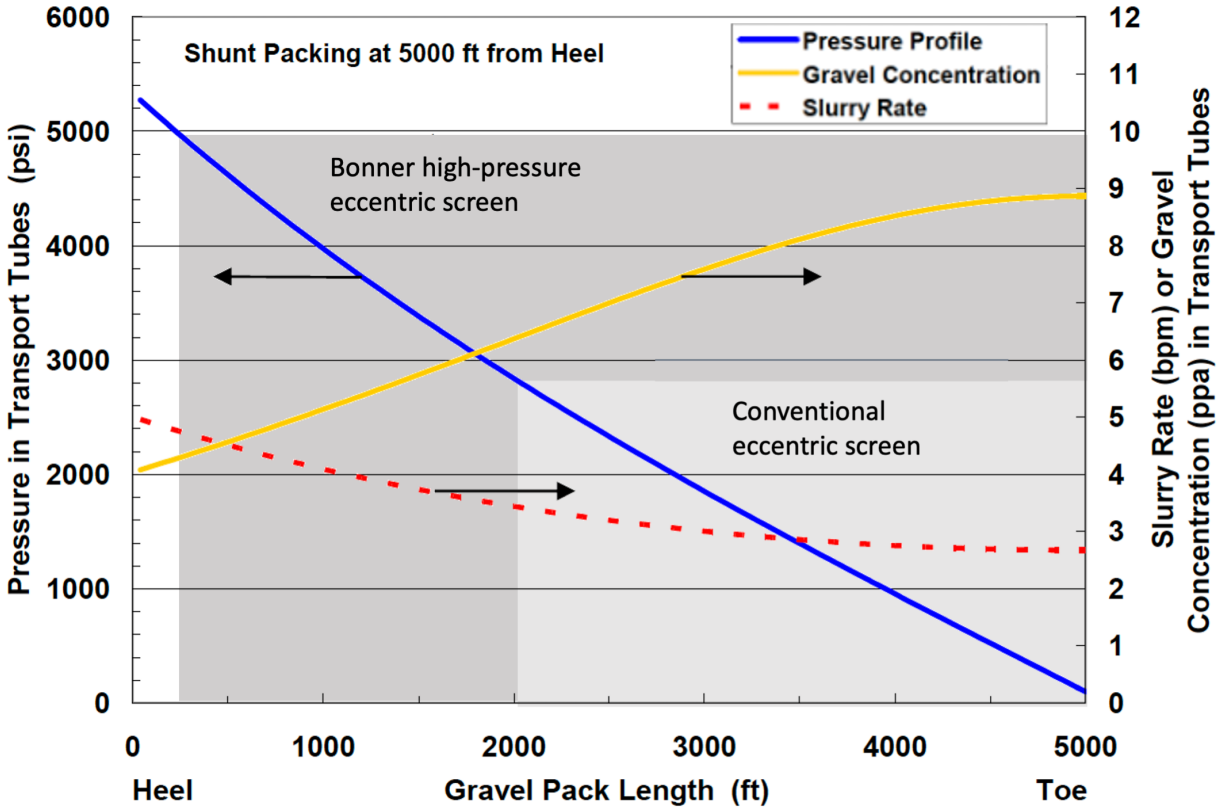


Figure 15 Gravel packing 5,000 ft with multiple-shunt manifold system

EX1006 at Fig. 15 (annotated and modified).

92. Dr. Durham agrees. EX1043 (Durham's Tr.) at 81:14-83:8 (agreeing that a POSITA "would understand based on Yeh and Yeh2's teachings that they could begin using eccentric screens with a 3000 psi pressure rating at any point past 2,000 feet from the heel" in a 5,000-foot well).

93. This concept was also disclosed by Hecker (EX1015), which was specifically referenced in Yeh, EX1005 at 3:34-44, which confirms what a POSITA would understand about the pressure limitations of conventional eccentric screens. Hecker taught that the "[m]aximum [conventional eccentric screen] shunt system working pressure of 3,000 psi which limits the packable length to ~3,200 ft pumping at 5 barrels per minute (bpm)." EX1015 at 1.

3. Claim 29[b]: "and wherein a cross-sectional flow area of a packing tube of the high pressure shunt tube system is less than the cross-sectional flow area of a packing tube of the low pressure shunt tube system."

94. For the same reasons I discussed for Claim 27[b], Yeh in view of Yeh2 and Bonner disclosed or suggested this limitation. *See supra* ¶¶63-74.

95. As I explained in my first Declaration, a POSITA would understand that when gravel slurry was subjected to high pressures, the slurry would be traveling at a high velocity and cause nozzle erosion. *See* EX1013 at 2, Fig. 1 (summarizing erosion test results "where nozzles with and without Tungsten[] Carbide inserts were submitted to extreme slurry velocities."); EX1003 ¶¶189, 206. This erosion concern carried over to the shunt tubing, including the packing tubes, as well. A POSITA would understand erosion could be addressed by using thicker-walled packing tubes. *See* EX1003 ¶206.

96. Additionally, as I explained in my opinion for Claim 27[b], Bonner's high-pressure eccentric screen would be modified with thicker-walled shunt tubing to increase its pressure tolerance and be able to operate at 6,500 psi. *See* EX1016 at 12, Fig. 23; *supra* ¶¶71-73. That would include the packing tubes, which are part of the pressure containment shunt tube assembly. As I also explained, a POSITA would be motivated to make this change to Bonner's high-pressure eccentric screen so that it could operate in higher pressure regions of the interval, including pressures ranging between 5,000 to 10,000 psi. *See supra* ¶73. A POSITA would also be motivated to make this change to address erosion in this high pressure, high fluid velocity application where erosion was a significant concern as Bonner recognized. EX1016 at 19-20 (describing erosion tests in shunt tubes and the results). Bonner reported that for an unclad packing tube, the test sample "failed after 4 minutes … and the test sample with cladded entry section failed after 8 minutes …." EX1016 at 20. Thus, a POSITA would recognize that some increase in packing tube wall thickness to enhance erosion resistance was warranted. Increasing the wall thickness of the packing tubes would reduce cross-sectional flow area compared to conventional eccentric sand screen packing tubes absent increasing the outer diameter of the packing tubes and potentially affecting other aspects of the design, which would be undesirable unless absolutely necessary. As I explained above,

Bonner taught that some loss in the cross-sectional flow area in its packing tubes was acceptable when needed for increasing pressure containment as would be the case here. Although Bonner's cladding was limited to the packing tube entrance, a POSITA would understand that erosion is occurring throughout the packing tube and thus some increase in wall thickness for this high differential pressure application is warranted, which would also help achieve the enhanced pressure containment capability. A POSITA would have expected success with increasing packing tube wall thickness because these design parameters were well understood for gravel slurry shunt tubes. *See* EX1003 §§VIII generally, VIII.G particularly.

VIII. MTA GROUND 2

A. Substitute Claim 31

97. I understand that this claim is a proposed substitute for Claim 14. Dr. Durham only provided a response to my original opinion for Claim 14[c] and had no response to my opinions regarding Claims 14[preamble], [a]-[b], [d]-[f]. *See generally* EX2002 ¶¶155-63. It is my opinion that Substitute Claim 31 would have been obvious over Yeh in view of Yeh2, Bonner, and optionally Jones2 for all the reasons I provided for Claim 14 in addition to the reasons I provide below.

1. Claim 31[preamble]: "A method of installing a completion assembly in a wellbore, the method comprising:"

98. For all the same reasons I explained for Claim 14[preamble], to the extent limiting, it is my opinion that Yeh disclosed or suggested the preamble. EX1003 ¶¶365-67.

2. Claim 31[a]: "identifying an elongated production zone having an upstream proximal end and a downstream distal end with respect to a source of pressurized working fluid;"

99. For all the same reasons I discussed for Claim 14[a], Yeh disclosed or suggested this limitation. EX1003 ¶¶368-79.

3. Claim 31[b]: "determining a shunt tube system operating pressure associated with the proximal end of the production zone and selecting a high pressure shunt tube system based on the proximal end determined pressure;"

100. For all the same reasons I discussed for Claim 14[b], Yeh disclosed or suggested this limitation. EX1003 ¶¶380-83.

4. Claim 31[c]: "determining a shunt tube system operating pressure associated with the distal end of the production zone and selecting a low pressure shunt tube system based on the distal end determined pressure;"

101. For all the same reasons I discussed for Claim 14[c], Yeh disclosed or suggested this limitation. EX1003 ¶¶384-88.

102. As I explained above for Claim 27[b], a POSITA, motivated to keep costs down, would know that using eccentric screens was a way to achieve this goal.

See supra ¶67. As I also explained for Claim 29[a], a POSITA would understand that conventional eccentric screens could be installed along the interval near the toe, or distal end, in any location where the pressure was below the capacity of those conventional eccentric screens. *See supra* ¶¶91-92.

103. Dr. Durham agreed. EX1043 (Durham Tr.) at 81:7-83:8; EX2002 ¶170 (Dr. Durham opining: "*Yeh* teaches using an eccentric screen in the lower pressure sections of the wellbore (near the toe) because the eccentric screens are less expensive, easier to acquire, and lower friction.").

5. Claim 31[d]: "installing a first eccentric sand screen assembly in a wellbore adjacent the distal downstream end of the elongated production zone;"

104. For all the same reasons I discussed for Claims 14[d] and 31[c], Yeh disclosed or suggested this limitation. EX1005 at 30:21-23; EX1003 ¶¶389-92; *supra* ¶¶101-103.

6. Claim 31[e]: "attaching a second eccentric sand screen assembly to the first eccentric sand screen assembly at the proximal upstream end of the elongated production zone, wherein the first eccentric sand screen assembly has the low pressure shunt tube system and the second eccentric sand screen assembly has the high pressure shunt tube system, such that a downstream end of the high pressure shunt tube system is coupled to an upstream end of the low pressure shunt tube system; and,"

105. For all the same reasons I discussed for Claims 14[a]-[b], and 14[e], Yeh in view of Yeh2 and Bonner disclosed or suggested this limitation. EX1003 ¶¶368-83, 393-96.

106. For the reasons I explained for Claim 27[b], a POSITA would have substituted Bonner's high-pressure eccentric sand screen for Yeh's concentric sand screen and additionally would have increased the pressure rating of Bonner's high-pressure eccentric screen to accommodate the 5,000-foot horizontal wellbore taught by Yeh and Yeh2. *See supra* ¶¶63-74.

7. Claim 31[f]: "coupling the source of pressurized working fluid to an upstream end of the high pressure shunt tube system."

107. For all the same reasons I discussed for Claim 14[f], Yeh in view of Yeh2, Bonner, and optionally Jones2 expressly or inherently disclosed or suggested this limitation. EX1003 ¶¶397-407.

B. Substitute Claim 32

108. I understand that this claim is a proposed substitute for Claim 15. It is my opinion that Substitute Claim 32 would have been obvious over Yeh in view of Yeh2, Bonner, and optionally Jones2 for all the reasons I provided for Claim 15 in addition to all the reasons I provide below.

1. Claim 32[preamble]: "The method of claim 31, further comprising:"

109. For all the same reasons I explained for Claim 31, it is my opinion that Yeh in view of Yeh2, Bonner, and optionally Jones2 disclosed or suggested the preamble. *See supra* ¶¶97-107.

2. Claim 32[a]: "installing a plurality of interconnected first eccentric sand screen assemblies in a wellbore adjacent the production zone;"

110. For all the same reasons I discussed for Claim 15, Yeh in view of Yeh2 disclosed or suggested this limitation. EX1003 ¶¶408-11.

3. Claim 32[b]: "and attaching a plurality of second eccentric sand screen assemblies to an uppermost first eccentric sand screen assembly upstream of the first sand screen assemblies."

111. For all the same reasons I discussed for Claim 15, Yeh in view of Yeh2 disclosed or suggested this limitation. EX1003 ¶¶408-11.

112. For the reasons I explained above regarding Claim 31[e] and ultimately Claim 27[b], Bonner's high-pressure eccentric screen would replace Yeh's

concentric screen as the second eccentric sand screen assembly, but otherwise, this limitation is disclosed or suggested by Yeh and Yeh2. *See supra* ¶¶63-74, 105-106.

C. Substitute Claim 33

113. I understand that this claim is a proposed substitute for Claim 16. It is my opinion that Substitute Claim 33 would have been obvious over Yeh in view of Yeh2, Bonner, and optionally Jones2 for all the reasons I provided for Claim 16 in addition to all the reasons I provide below.

1. Claim 33[preamble]: "The method of claim 31,"

114. For all the same reasons I explained for Claim 31, it is my opinion that Yeh in view of Yeh2, Bonner, and optionally Jones2 disclosed or suggested the preamble. *See supra* ¶¶97-107.

2. Claim 33[a]: "further comprising introducing a working fluid into the shunt systems, wherein the working fluid is pressurized in accordance with the operating pressure of the high pressure shunt tube system"

115. For all the same reasons I discussed for Claim 16, Yeh disclosed or suggested this limitation. EX1003 ¶¶412-14.

3. Claim 33[b]: "and a packing tube of the high pressure shunt tube system is interconnected to a shunt tube junction block of the high pressure shunt tube system."

116. As I discussed for Claim 3, both Yeh and Yeh2 disclose a junction block. EX1005 at Fig. 4A; EX1006 at 3, Fig. 6a; EX1003 ¶¶310-11; *see supra* ¶56-59 (Claim 26[b]).

117. Additionally, as I explained in my Further Oil and Gas Background section, Bonner disclosed connecting the packing tube to the transport tube of its shunt tube system of its high-pressure eccentric screen with a junction block, which Bonner refers to as a "Box Crossover" or "Box end crossover." *See supra* ¶15.

Bonner's box crossover is illustrated on the left of both Figures 8 and 9, which I reproduce below:

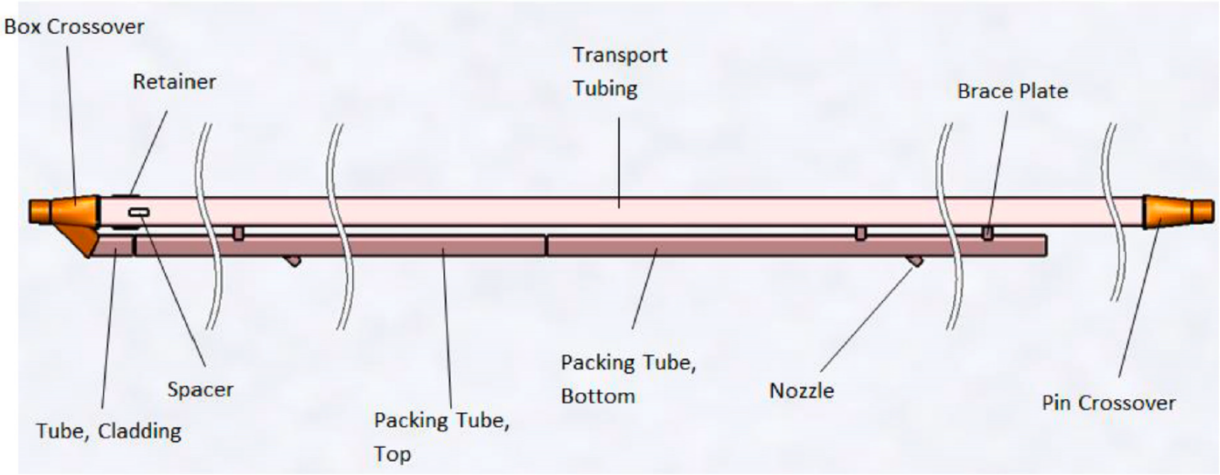


Figure 8—Shunt system tubing weldment with its components



Figure 9—Box end crossover, internally-cladded Packing Tube, and Pin end crossover

EX1016 at Figs. 8-9. Thus, in all cases, the packing tube of the high-pressure shunt tube system is interconnected to a shunt tube junction block of the high-pressure shunt tube system as is necessarily the case for the system to function.

D. Substitute Claim 34

118. I understand that this claim is a proposed substitute for Claim 17. It is my opinion that Substitute Claim 34 would have been obvious over Yeh in view of

Yeh2, Bonner, and optionally Jones2 for all the reasons I provided for Claim 17 in addition to all the reasons I provide below.

1. Claim 34[preamble]: "The method of claim 31,"

119. For all the same reasons I explained for Claim 31, it is my opinion that Yeh in view of Yeh2, Bonner, and optionally Jones2 disclosed or suggested the preamble. *See supra* ¶¶97-107.

2. Claim 34[a]: "further comprising injecting the working fluid into the annulus adjacent the shunt tube system so as to form a gravel pack in the annulus,"

120. For all the same reasons I discussed for Claim 17, Yeh in view of Yeh2 and optionally Jones 2 disclosed or suggested this limitation. EX1003 ¶¶415-19.

3. Claim 34[b]: "wherein a cross-sectional flow area of a packing tube of the high pressure shunt tube system is less than a cross-sectional flow area of a packing tube of the low pressure shunt tube system."

121. For the same reasons I discussed for Claim 29[b], Yeh in view of Yeh2 and Bonner disclosed or suggested this limitation. *See supra* ¶¶94-96.

E. Substitute Claim 35

122. I understand that this claim is a proposed substitute for Claim 18. I also understand that the only amendments to Claim 35 were to add dependency to Claim 31 and add "psi" units. *See* EX2004 ¶59 (p. 37). It is my opinion that Substitute Claim 35 would have been obvious over Yeh in view of Yeh2, Bonner, and optionally

Jones2 for all the reasons I provided for Claim 18 in addition to all the reasons I provide below.

1. Claim 35[preamble]: "The method of claim 31,"

123. For all the same reasons I explained for Claim 31, it is my opinion that Yeh in view of Yeh2, Bonner, and optionally Jones2 disclosed or suggested the preamble. *See supra* ¶¶97-107.

2. Claim 35[a]: "wherein the high pressure shunt tube system is disposed to operate at pressures of 5000 psi and the low pressure shunt tube system is disposed to operate at pressures of no more than 5000 psi."

124. For all the same reasons I discussed for Claim 18, Yeh in view of Yeh2 and optionally Jones2 disclosed or suggested this limitation. EX1003 ¶¶420-23.

125. Additionally, Bonner's high-pressure eccentric screen would be substituted for Yeh's concentric screen after modification for higher pressure as required by Yeh and would therefore operate at 5,000 psi at some point along the horizontal wellbore.

126. Bonner also disclosed or suggested this limitation for the same reasons I provided for Claim 29[a]. *See supra* ¶¶88-93.

F. Substitute Claim 36

127. I understand that this claim is a proposed substitute for Claim 19. I also understand that the only amendment to Claim 36 was to add dependency to Claim

31. *See* EX2004 ¶59 (p. 37). It is my opinion that Substitute Claim 36 would have been obvious over Yeh in view of Yeh2, Bonner, and optionally Jones2 for all the reasons I provided for Claim 19 in addition to all the reasons I provide below.

1. Claim 36[preamble]: "The method of claim 31,"

128. For all the same reasons I explained for Claim 31, it is my opinion that Yeh in view of Yeh2, Bonner, and optionally Jones2 disclosed or suggested the preamble. *See supra* ¶¶97-107.

2. Claim 36[a]: "wherein the high pressure shunt tube system is disposed to operate at pressures above a select threshold and the low pressure shunt tube system is disposed to operate at pressures of no more than the select threshold."

129. For all the same reasons I discussed for Claims 19, 29[a], and 35[a], Yeh in view of Yeh2, Bonner, and optionally Jones2 disclosed or suggested this limitation. EX1003 ¶¶424-25; *supra* ¶¶88-93,124-126. From my opinions regarding Claim 19, the only change would be the identity of the high-pressure screen as being Bonner's high-pressure eccentric screen instead of Yeh's concentric screen. When that screen is modified according to Yeh's teachings to operate at 6,500 psi, as I discussed above regarding Claim 27[b], *supra* ¶¶71-73, the range of select pressures for which this claim is satisfied remains 2,800 psi to 6,499 psi, as I described for Claim 19. EX1003 ¶425.

G. Substitute Claim 37

130. I understand that this claim is a proposed substitute for Claim 20. It is my opinion that Substitute Claim 37 would have been obvious over Yeh in view of Yeh2, Bonner, and optionally Jones2 for all the reasons I provided for Claim 20 in addition to all the reasons I provide below.

1. Claim 37[preamble]: "The method of claim 31,"

131. For all the same reasons I explained for Claim 31, it is my opinion that Yeh in view of Yeh2, Bonner, and optionally Jones2 disclosed or suggested the preamble. *See supra* ¶¶97-107.

2. Claim 37[a]: "wherein installing the first eccentric sand screen assembly and attaching the second eccentric sand screen assembly include disposing the first eccentric sand screen assembly and the second eccentric sand screen assembly in a horizontal portion of the wellbore."

132. For all the same reasons I discussed for Claim 20, Yeh in view of Yeh2 and optionally Jones2 disclosed or suggested this limitation. EX1003 ¶¶426-27.

133. Bonner disclosed utilizing an eccentric screen for the first sand screen assembly for the same reasons I provided for Claim 27[b]. *See supra* ¶¶63-74.

134. Consistent with Yeh's teachings as well as others, Bonner specifically disclosed using sand screens, including its high-pressure eccentric screen, in horizontal intervals: "While used in a variety of scenarios, shunt systems tend to have more recognized value in long openhole horizontal completions and deviated

wells due to the increased problems deploying the pack, as premature annuli bridging, voids, and thief zones are all working against success." EX1016 at 2.

IX. MTA GROUND 3

A. Substitute Claim 38

135. I understand that this claim is a proposed substitute for Claim 21. Dr. Durham only provided a response to my original opinion for Claim 21[e] and had no response for my opinions on Claims 21[preamble]-21[d]. *See generally* EX2002 ¶¶170-73. It is my opinion that Substitute Claim 38 would have been obvious over Yeh in view of Bonner and Jones for all the reasons I provided for Claim 21 in addition to all the reasons I provide below.

1. Claim 38[preamble]: "A completion assembly for deployment in a wellbore, the completion assembly comprising:"

136. For all the same reasons I explained for Claims 1[preamble] and 21[preamble], to the extent limiting, it is my opinion that Yeh disclosed or suggested the preamble. EX1003 ¶¶256-59, 428-29.

2. Claim 38[a]: "a source of pressurized working fluid;"

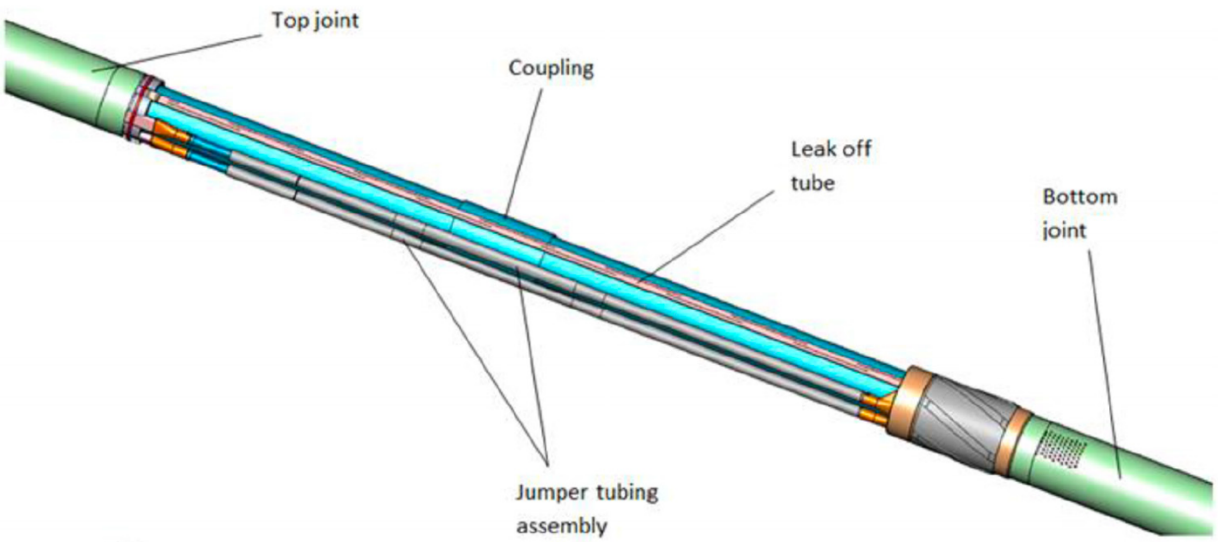
137. For all the same reasons I discussed for Claims 1[c], 11[a], and 21[a], Yeh disclosed or suggested this limitation. EX1003 ¶¶278-84, 357, 430.

3. Claim 38[b]: "a first, eccentric sand screen assembly comprising a base pipe having perforations therein and extending between a first end and a second ends, a sand screen disposed around a portion of the base pipe, and a shunt tube assembly disposed outwardly of the sand screen, the shunt tube assembly having a transport tube and a packing tube, where each of the tubes has a passageway defined therein, the packing tube further including a plurality of nozzles spaced apart from each other, wherein each of the tubes and each nozzle has a cross-sectional flow area; and"

138. For all the same reasons I discussed for Claims 1[a] and 21[b], other than the "first, eccentric sand screen" requirement, Yeh disclosed or suggested this limitation. EX1003 ¶¶260-70, 431.

139. It is also my opinion that Bonner disclosed the "first, eccentric sand screen" limitation for the same reasons I discussed for Claim 27[b]. *Supra* ¶¶63-74. As I explained, Bonner disclosed that its high-pressure eccentric sand screen was an "improved version of the traditional shunt tube system," and the "main basis of design for the new system was to keep it functionally the same as existing industry-proven designs, in order to enjoy the empirical evidence of years of successful application of shunt tube gravel-packing technology." EX1016 at Abstract, 2; *supra* ¶¶10-13. As I explained for Claim 27[b], a POSITA would have substituted Bonner's high-pressure eccentric screen for Yeh's concentric screen and would have modified Bonner's high-pressure eccentric screen to meet the 6,500-psi differential pressure requirement at the heel as described by Yeh. *See* EX1005 at 28:11-24; *supra* ¶71.

140. Bonner's high-pressure sand screen assembly included a base pipe (**blue**), as shown in Bonner's Figure 11. A POSITA would understand that this base pipe included perforations as the base pipe is used for receiving production fluids, and if the base pipe had no perforations, there would be no purpose for the screen disposed around the base pipe. Yeh explains this basic feature of sand screens. EX1005 at 2:37-39, 2:55-61, 24:4-8; EX1010, 2:20-28; EX1007, 3:24-26, Fig. 1. Because each of Bonner's high-pressure sand screen assemblies was a joint, it necessarily had a first and second end. Bonner repeatedly refers to its sand screens as "joints of screen" or simply "joint[s]." EX1016 at 2-11, 15, 20. The top and bottom joint connections are seen coupled in Figure 11, which I reproduced below for reference:



EX1016 at Fig. 11 (excerpted); *see also, e.g., id.* at 1 ("joints of screen"), 2 ("each sand screen joint").

141. Bonner's high-pressure sand screen assembly also included a screen around a portion of the base pipe and under the shunt tube assembly, as Bonner described it, "the sand screen filter media underlying" the shunt tube system. EX1016 at 9. Bonner's screen is illustrated in Figure 12, which shows that the screen (**yellow**) covered only a portion of the base pipe (**blue**). The screen was used to prevent particles or sand from entering the base pipe through the base pipe's

perforations. EX1005 at 2:37-41, 2:55-61, 16:1-8, 24:4-8, Figs. 2, 4A. I reproduced Figure 12 below for reference:

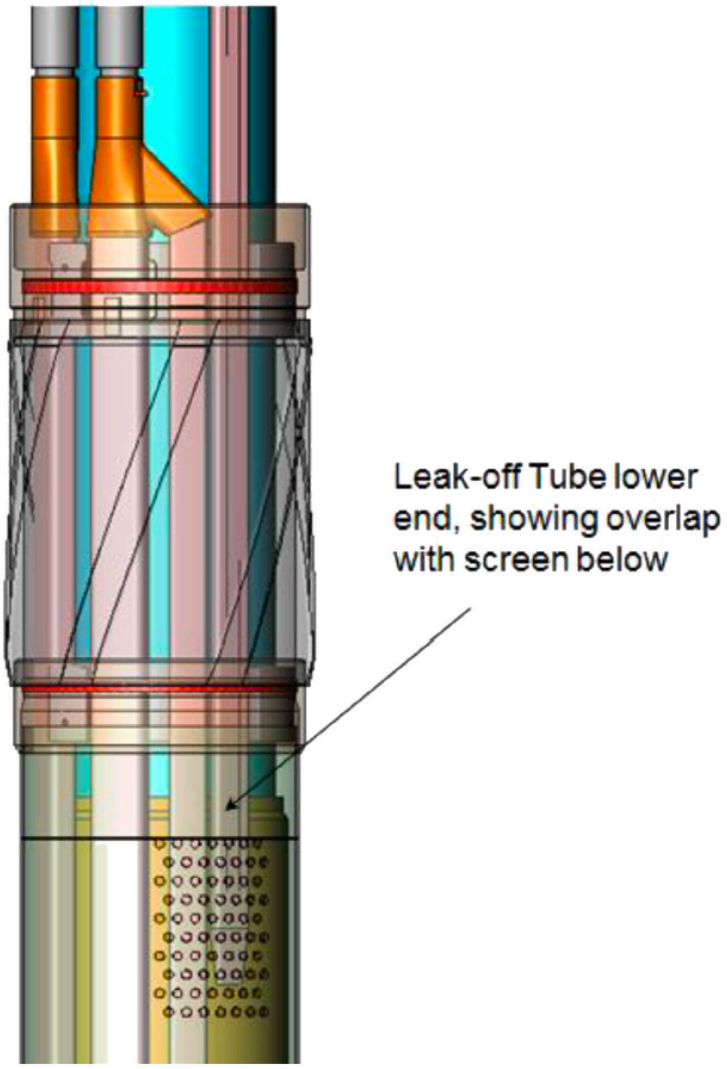


Figure 12—The leak off tube lower end placed under the centralizer

EX1016 at Fig. 12.

142. Bonner's Figure 5 provides a cross-sectional view of its high-pressure eccentric screen, which shows a sand screen disposed outwardly of a base pipe and a shunt tube assembly placed outward of the sand screen. The shunt assembly

includes transport and packing tubes, which both have a rectangular cross-sectional area. Tubes inherently have passageways and cross-sectional flow areas defined therein, but Figure 5 depicts the passageways and cross-sectional flow areas as well. Below I provide Figure 5 for reference:

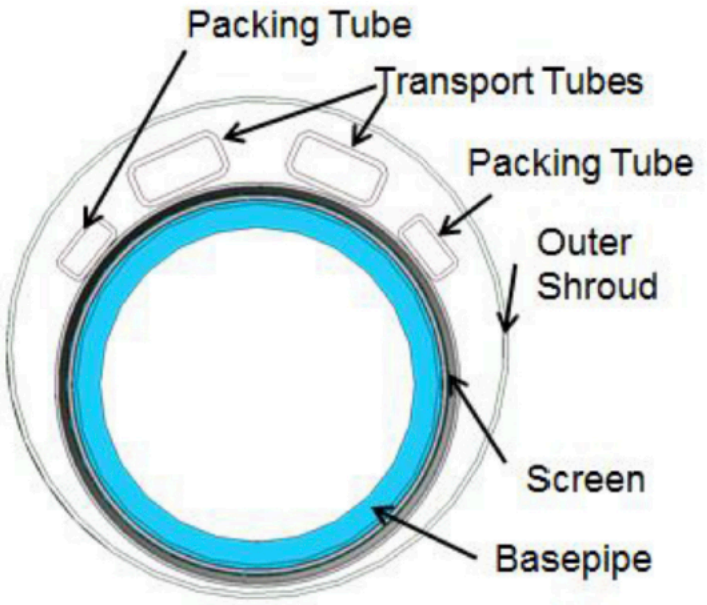


Figure 5—Cross section of shunt tube system

EX1016 at Fig. 5.

143. Bonner's packing tubes also included a plurality of nozzles spaced apart from each other based on Bonner's disclosure that its high-pressure eccentric screen was designed to "keep it functionally the same as existing industry-proven designs," which included "the location and size of exit ports for flow [and] exit from the packing tubes were essentially the same." EX1016 at 2, 3 ("the same exit port spacing and arrangement"). A POSITA would understand that nozzles inherently

have a cross-sectional flow area. I provide Bonner's Figure 8 below for reference, which illustrates its shunt assembly with a plurality of nozzles spaced apart from each other:

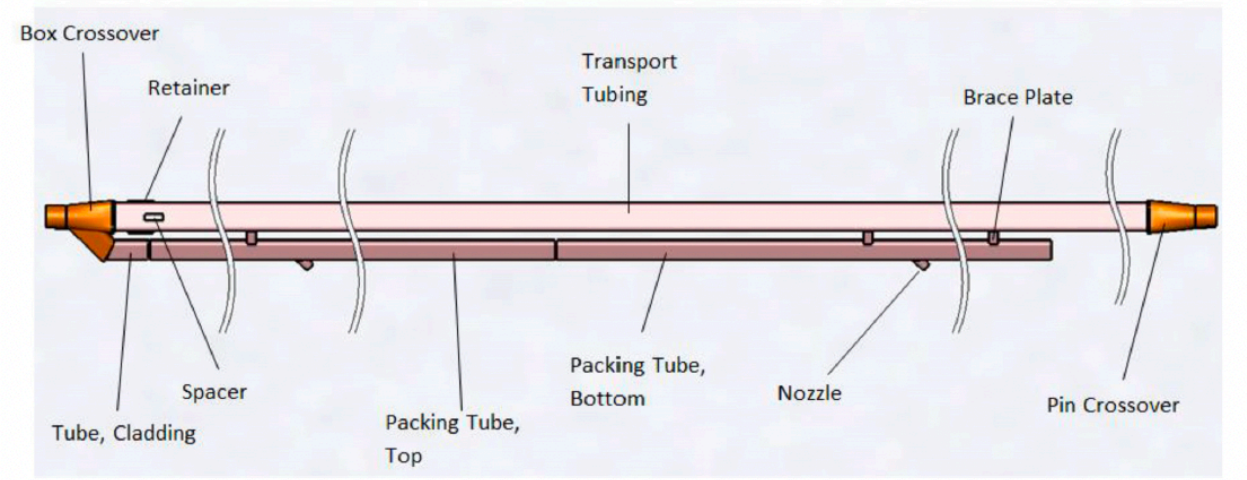


Figure 8—Shunt system tubing weldment with its components

EX1016 at Fig. 8.

4. Claim 38[c]: "a second, eccentric sand screen assembly comprising a base pipe having perforations therein and extending between a first end and a second ends, a sand screen disposed around a portion of the base pipe, and a shunt tube assembly disposed outwardly of the sand screen, the shunt tube assembly having a transport tube and a packing tube, the packing tube including a plurality of nozzles spaced apart from each other, wherein each of the tubes and each nozzle has a cross-sectional flow area;"

144. For all the same reasons I discussed for Claims 1[b] and 21[c], Yeh disclosed or suggested this limitation. EX1003 ¶¶271-77, 432.

5. Claim 38[d]: "wherein the first and second eccentric sand screen assemblies are arranged end to end relative to one another so that the base pipes are in fluid communication with one another and the transport tubes are in fluid communication with one another and the source of pressurized working fluid, the transport tube of the second eccentric sand screen assembly fluidly coupled to the source of pressurized working fluid downstream of the transport tube of the first eccentric sand screen assembly; and"

145. For the same reasons I discussed for Claims 1[d] and 21[d], Yeh disclosed or suggested this limitation, except that the first sand screen is eccentric. EX1003 ¶¶285-89, 433.

146. Yeh in view of Bonner also disclosed or suggested the "first" "eccentric screen" requirement for the same reasons I provided for Claim 27[b]. *See supra* ¶¶63-74.

6. Claim 38[e]: "wherein the transport tube of the first eccentric sand screen assembly is formed of a first material and the transport tube of the second eccentric sand screen assembly is formed of a second material, the first material having a greater tensile strength than the second material."

147. For the same reasons I discussed for Claims 1[e] and 21[e], Yeh in view of Jones disclosed or suggested this limitation, except that the first sand screen is eccentric. EX1003 ¶¶290-97, 434-39.

148. Yeh in view of Bonner also disclosed or suggested the "first eccentric" screen requirement for the same reasons I provided for Claim 27[b]. *See supra* ¶¶63-74.

149. I previously explained in my first Declaration (*e.g.,* EX1003 ¶¶103-04, 133-34, 139-40, 160-88, 291-97, 434-38) and for Substitute Claim 25[c] in paragraphs 44-52 that a POSITA would understand the basic principles of pressure containment, such as tubing wall thickness, tubing dimensions, and tensile strength, applied to both round and rectangular tubing, to which Dr. Durham agreed. *See* EX1043 (Durham Tr.) at 93:18-94:6, 104:6-11.

150. As I explained for Claim 21[e], a POSITA motivated by reducing material costs as suggested by Yeh would know that there were only three shunt tube design variables that could be used to decrease (or increase) shunt tube burst pressure. Those were: (1) the tensile strength of the material, (2) the tubing wall thickness, and (3) the outside diameter of the tubing. *See* EX1017 at 24; *see also* EX1003 §VIII.J. While these parameters derive directly from Barlow's Equation for round tubes, the same variables control the pressure containment of rectangular tubes even though there is not a formula describing the relationship. That is because the nature of pressure containment in tubing ultimately is proportional to the stress placed on the metal attempting to contain the pressure, whether the tube is round or rectangular. A greater outside dimension (diameter or height or width) and thus greater internal surface area for the fluid pressure to work against causes a greater stress on the tubing whether it is round or rectangular, which is why increasing

outside diameter decreases burst pressure rating, all other things being equal. Similarly, thicker tubing walls increase the ability of the tubing to resist a given stress, whether the tubing is round or rectangular. And finally, the tensile strength of the metal determines how much stress the metal tubing can withstand before rupturing, whether the tubing is round or rectangular. Although these proportionalities are true for rectangular tubing as well as for round tubing, they are not necessarily direct proportionalities for rectangular tubing as they are for round tubing under Barlow's Equation. Consequently, a POSITA looking to increase the pressure containment capabilities of Bonner's high-pressure eccentric screens would consider modifying Bonner's existing shunt system with higher tensile strength material for the same reasons and in the same manner as described for round tubing with respect to Claim 21[e].

151. A POSITA would understand that using higher tensile strength material could be an alternative to increasing tubing thickness (which would impact cross-sectional area) as taught by Yeh and Jones, or simply an alternative that lessened the tubing thickness increase required to contain the 6,500-psi operating pressure disclosed by Yeh. At the same time, a POSITA would also understand that lower tensile strength material was less costly and could be used in Yeh's eccentric screens

that are installed in more distal regions of an interval where the pressure demands are reduced, as I explained for Claim 21[e].

152. Selecting among tubing wall thickness or material tensile strength would involve nothing more than routine optimization using a set of three variables (outside dimension, wall thickness, and tensile strength), each of which had very well-understood properties and effects on the pressure containment of tubing such that a POSITA could readily use any of these three variables to control the pressure needs described by Yeh in round or rectangular tubing. All of such combinations of changing tubing wall thickness or material selection to contain a higher pressure in a portion of the wellbore as taught by Yeh would have been obvious to a POSITA. Additionally, a POSITA would have expected success with all such combinations because the effect of changing these parameters on shunt tube design was well understood and documented in the industry. *See* EX1003 §§VIII generally, VIII.G particularly.

B. Substitute Claim 39

153. I understand that this claim is a proposed substitute for Claim 22. It is my opinion that Substitute Claim 39 would have been obvious over Yeh in view of Bonner and Jones for all the reasons I provided for Claim 21 in addition to all the reasons I provide below.

1. Claim 39[preamble]: "The completion assembly of claim 38,"

154. For all the same reasons I explained for Claim 38, it is my opinion that Yeh in view of Bonner and Jones disclosed or suggested the preamble. *See supra* ¶¶135-152.

2. Claim 39[a]: "wherein the transport tube of the first sand screen assembly has a first wall thickness and the transport tube of the second sand screen assembly has a second wall thickness, the first wall thickness being greater than the second wall thickness;"

155. For all the same reasons I discussed for Claims 22 and 38[e], Yeh in view of Bonner and Jones disclosed or suggested this limitation. EX1003 ¶¶440-42; *supra* ¶¶147-152.

156. As I explained above with respect to Claim 38[e], a POSITA would understand from Yeh that the heel portion of a horizontal wellbore required higher pressure containment than the toe portion. As I also explained with respect to Claim 38[e], there were three variables applicable to rectangular or round tubing that controlled the pressure containment capacity of tubing: (1) outer dimension, (2) wall thickness, and (3) tensile strength of the metal. Increasing tensile strength and tubing wall thickness to meet the 6,500-psi operating pressure disclosed by Yeh using Bonner's high-pressure rectangular shunt tubing would have been obvious to a POSITA to both contain the pressure and to do so with the minimal wall thickness needed to preserve cross-sectional flow area for the gravel slurry and reduce pressure

drop. Similarly, it would have been obvious to a POSITA to decrease the tubing wall thickness and tensile strength of Yeh's eccentric screens in the lower-pressure portion of a horizontal wellbore for the same cost reasons explained by Yeh as well as increasing the cross-sectional flow area and thus reducing gravel slurry pressure drop. Both options were well known and well understood with more than a reasonable probability of success.

157. Consequently, a POSITA would understand which type of tubing material and tubing wall thickness would be appropriate to use depending on the needs and particulars of the horizontal interval as well as the benefits and tradeoffs of those design choices.

3. Claim 39[b]: "and wherein a cross-sectional flow area of the packing tube of the first, eccentric sand screen assembly is less than a cross-sectional flow area of the packing tube of the second, eccentric sand screen assembly."

158. For all the reasons I explained for Claim 29[b], a POSITA would have been motivated to decrease the cross-sectional flow area of the packing tube of the first sand screen assembly, i.e., Bonner's high-pressure eccentric screen, compared to the cross-sectional flow area of the packing tube of the second sand screen assembly, i.e., Yeh's conventional eccentric screen. *See supra* ¶¶94-96.

X. MTA GROUND 4

A. Substitute Claim 40

159. I understand that this claim is a proposed substitute for Claim 23. It is my opinion that Substitute Claim 40 would have been obvious over Yeh in view of Jones, Bonner, and Yeh2 for all the reasons I provided for Claim 23 in addition to all the reasons I provide below.

1. Claim 40[preamble]: "The completion assembly of claim 38,"

160. For all the same reasons I explained for Claim 38, it is my opinion that Yeh in view of Bonner and Jones disclosed or suggested the preamble. *See supra* ¶¶135-152.

2. Claim 40[a]: "wherein the first sand screen assembly has a shunt tube assembly with a first pressure rating and the second sand screen assembly has a shunt tube assembly with a second pressure rating less than the first pressure rating,"

161. For the same reasons I discussed for Claims 1[e], 7, 23, 27[b], and 38[e], Yeh in view of Jones, Bonner, and Yeh2 disclosed or suggested this limitation. EX1003 ¶¶290-97, 341-47, 443; *see also supra* ¶¶63-74, 147-152.

3. Claim 40[b]: "and a packing tube of the first eccentric sand screen assembly is interconnected to a shunt tube junction block of the second eccentric sand screen assembly."

162. For the same reasons I discussed for Claim 26[b], Yeh in view of Yeh2 disclosed or suggested a packing tube of an upstream sand screen interconnected to

a junction block of a downstream sand screen. EX1005 at Fig. 4A; EX1006 at 3, Fig. 6a; EX1003 ¶¶310-11; *supra* ¶56-59.

163. As I explained for Claim 33[b], Bonner also disclosed a packing tube of an upstream sand screen interconnected to a junction block of a downstream sand screen. EX1016 at Figs. 8-9; *supra* ¶¶16, 117. In the proposed combination, Bonner's packing tube would thus be interconnected to the shunt tube junction block of Yeh's eccentric sand screen.

XI. SECONDARY CONSIDERATIONS OF NON-OBVIOUSNESS

164. Relevant to each of the Grounds I have provided above and previously, I remain unaware of any evidence of secondary considerations of non-obviousness for which there is any nexus to any claim of the '007 Patent. Should I become aware of such evidence, I may offer my opinions on it at that time.

XII. ADDITIONAL POINTS

165. I was also asked to respond to Dr. Durham's characterization of my sample calculation in paragraph 331 of my first declaration as proving that the cross-sectional areas are not the same: "Mr. Chambers provides calculations showing that the first transport tube (concentric circular) has a capacity of 3.4 in^3/ft (a cross-sectional area, CSA, of 0.283 in^2), and the second transport tube (eccentric rectangular) has a capacity of 7.1 in^3/ft (a CSA of 0.592 in^2)." EX2002 ¶138. I was also asked to respond to Dr. Durham's assertion that "the first sand screen assembly

of *Yeh* has six round transport tubes, while the second sand screen assembly of *Yeh* has two rectangular tubes." EX2002 ¶141. I disagree with both of these assertions for the reasons I provide below.

166. Yeh's disclosure is much broader than Dr. Durham asserts, and its concentric and eccentric screens are not limited to the tubing configurations Dr. Durham identifies. Yeh describes its concentric sand screens as follows:

> A concentric flow channel sand screen comprises a central bore that receives production fluids, and a filtering medium concentrically disposed around the central bore. Further, two or more shunt tubes are placed radially around the central bore.

EX1005 at 16:26-30. Yeh describes its eccentric sand screens as follows:

> An eccentric flow channel screen also comprises a central bore that receives production fluids, but with a filtering medium disposed eccentrically around the central bore. Two or more shunt tubes are placed adjacent the central bore, typically outside of both the central bore and the filtering medium.

EX1005 at 16:30-35. Yeh describes both of its concentric and eccentric screens as comprising two or more shunt tubes.

167. Additionally, as I explained in my first declaration at paragraph 276, Yeh disclosed that "[t]he alternate flow channels in the illustrative sand screens 800A, 800C are rectangular or round shunt tubes …." EX1005 at 24:10-12; *see also*

id. at 4:57-60 ("In the sand screen, the elongated base pipe is preferably eccentric to the sand screen. Each of the at least one shunt tube then may have a round profile, a square profile, or a rectangular profile."). I reproduce below the annotated Figure 8C from my first declaration at paragraph 276 showing an eccentric screen with round packing and transport tubes from Yeh.

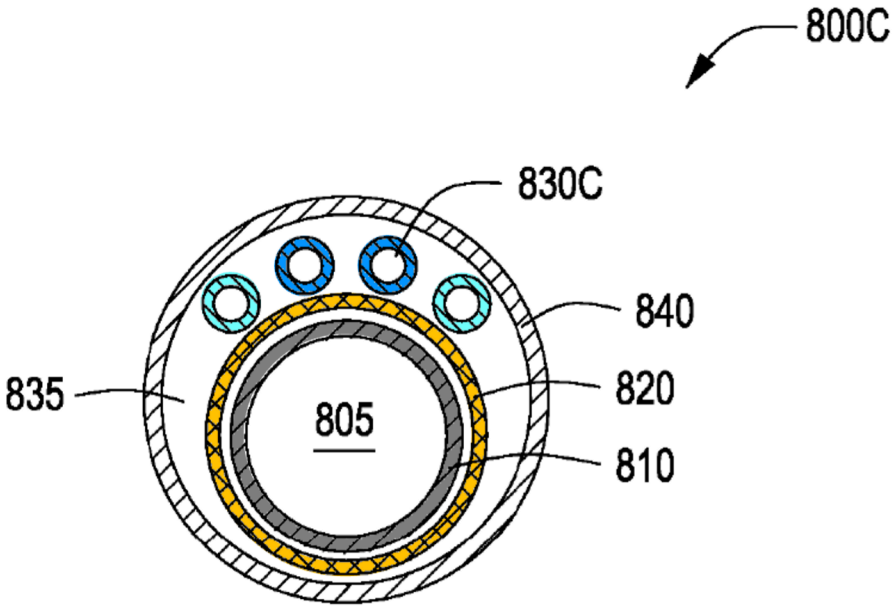


FIG. 8C

EX1005 at Fig. 8C (annotated).

168. These disclosures directly refute Dr. Durham's assertion that Yeh's concentric screen must have six transport tubes and that Yeh's eccentric screen has two rectangular tubes. EX2002 ¶141. Yeh instead discloses that each of these types of sand screen can have two or more shunt tubes and thus could readily have the

same amount. Additionally, because Yeh teaches that the eccentric screens can have round tubes, both Yeh's concentric and eccentric screens may have the same quantity of round tubes. Yeh was not the only prior art reference to teach this. Hurst (EX1013) also teaches concentric and eccentric sand screens that use the same number of rectangular tubes as shown below and as I discussed previously in this declaration:

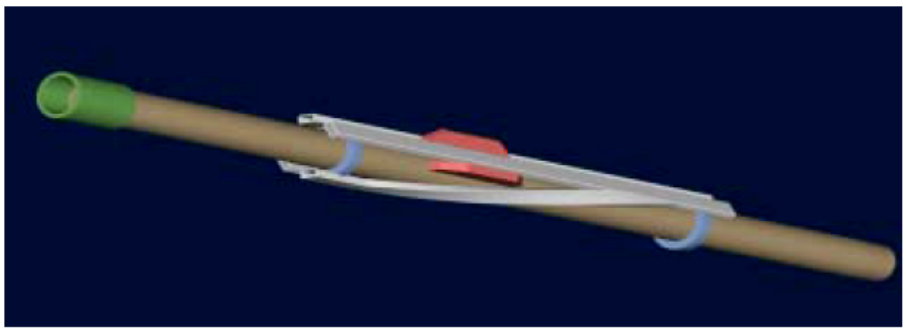
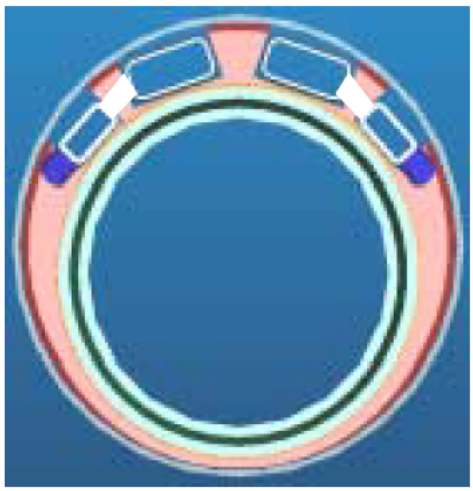


Figure 7 – Concentric Entrance (Y-manifold).

EX1013 at Fig. 7. In this "Concentric Entrance" design, Hurst teaches a concentric sand screen with the same rectangular tubes as its eccentric version, which is shown below:



EX1013 at Fig. 3 (excerpted).

169. Shunt tube sizing was based on a number of considerations as I discussed at length in my first declaration. *See* EX1003 §VIII.G. One consideration was friction pressure loss in shunt tubes, which was a primary factor in determining the internal cross-sectional area needed for shunt tubes. EX1015 at 2 ("The 3,200-ft limitation is due to the friction pressure associated with pumping through shunt tubes along the entire openhole interval."); EX1013 at 2 ("The original shunt tube design with 0.5x1.0-in external (0.31x0.81-in internal) dimensions did not provide sufficient flow area for the pump rates that are typically used in frac-pack applications, resulting in high frictional pressure drops through the shunt tubes. … The tube dimensions were modified to 0.75x1.5-in external (0.56x1.31-in internal), yielding 3 times the flow area of the original design and reducing friction pressures

over the rates of interest by approximately an order of magnitude, for long horizontal gravel packs.").

170. Because friction pressure loss was a primary design factor for shunt tubes, where upstream concentric screens and downstream eccentric screens had the same number of round shunt tubes, a POSITA would expect the cross-sectional flow areas of the shunt tubes to be approximately the same in those tubes because they are ultimately sized based at least in part on the expected flow rate. Although as Yeh2 explains, the flow rate may fall due to leakoff as the slurry progresses down a long horizontal well (red dashed line below), that is offset by the increasing viscosity of the slurry as the flow progresses down the production zone (orange line below), which would tend to increase friction pressure drop. Thus, the friction pressure drop for a given starting slurry flow rate is likely to remain relatively constant over a long horizontal wellbore.

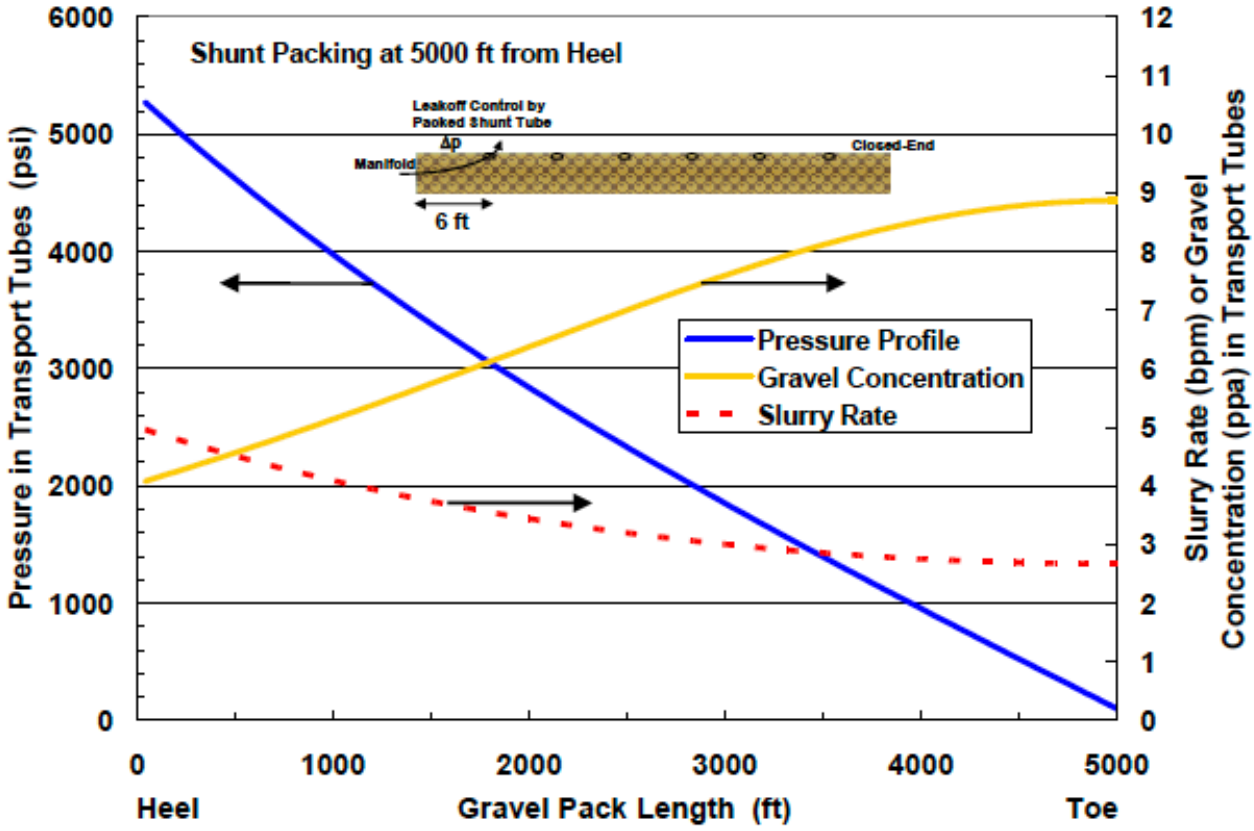


Figure 15 Gravel packing 5,000 ft with multiple-shunt manifold system

EX1006 at Fig. 15.

171. Thus, my comparison calculation from paragraph 331 of my first declaration was a plausible example, although just an example, of comparing a round concentric screen shunt tube to a round eccentric screen shunt tube and a rectangular concentric screen shunt tube to a rectangular eccentric screen shunt tube as taught in the prior art discussed above.

XIII. CONCLUSION

172. Based on the foregoing, it is my opinion that Substitute Claims 24-29 and 31-40 of the '007 Patent would have been obvious as discussed above.

173. In signing this Declaration, I recognize that the Declaration will be filed as evidence in a contested case before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I also recognize that I may be called upon to testify in deposition or before the Patent Trial and Appeal Board. If called upon to testify, I would testify truthfully and competently to all matters stated in this Declaration.

174. I reserve the right to supplement my opinions in the future to respond to any arguments that Patent Owner raises and to take into account new information as it becomes available to me.

175. I hereby declare that all statements made herein of my own knowledge are true, and that all statements made on information and belief are believed to be true and that such statements are made with the knowledge that willful false statements and the like are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Dated: 5/30/2025

Michael R. Chambers, Sr.

Weatherford Exhibit 1044
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