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Transcript of Michael R. Chambers, Sr.

Date: July 2, 2025

Case: Weatherford U.S., L.P. -v- Halliburton Energy Services, Inc. (PTAB)

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WORLDWIDE COURT REPORTING & LITIGATION TECHNOLOGY

1 UNITED STATES PATENT AND TRADEMARK OFFICE

2
3 BEFORE THE PATENT TRIAL AND APPEAL BOARD

4
5 WEATHERFORD U.S., L.P.,

6 Petitioner

7 v.

8 HALLIBURTON ENERGY SERVICES, INC.,

9 Patent Owner

10
11 Case IPR2024-00990

12 Patent No. 11,333,007

13
14
15 REMOTE ORAL DEPOSITION OF

16 MICHAEL R. CHAMBERS, SR.

17 Lindale, Texas

18 July 2, 2025 - 10:01 a.m.

19
20 Reported by:

21 Micheal A. Johnson, RDR, CRR

22 Job No. 588330

1 REMOTE ORAL DEPOSITION OF MICHAEL R.
2 CHAMBERS, SR., produced at the instance of the
3 Patent Owner, in the above-styled and numbered
4 cause on the 2nd day of July, 2025, at 10:01 a.m.,
5 before Micheal A. Johnson, RDR, CRR, Notary Public
6 in and for the State of Texas, reported by
7 realtime stenographic means, remotely at the
8 location of the witness, 11328 County Road 4102,
9 Lindale, Texas, pursuant to Notice of Oral
10 Deposition, and in accordance with 37 C.F.R.,
11 Section 42.53(d) (1) .
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July 2, 2025

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DEPOSITION EXHIBITS
MICHAEL R. CHAMBERS, SR.
July 2, 2025

NUMBER	DESCRIPTION	MARKED
Exhibit 2012	June 19, 2008 United States Patent Application Publication, US 2008/0142227 A1	11

PREVIOUSLY MARKED EXHIBITS

NUMBER	DESCRIPTION	PAGE
Exhibit 1003		39
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PROCEEDINGS

MICHAEL R. CHAMBERS, SR.,

called as a witness, having been duly sworn, was
examined and testified as follows:

EXAMINATION

BY MR. WALTERS:

Q Morning, Mr. Chambers.

A Good morning.

Q Where are you physically located right
now?

A I am at 11328 County Road 4102, Lindale,
Texas, in my study.

Q And you understand you've been sworn to
testify truthfully today?

A Yes, sir.

Q Is there any reason you cannot testify
truthfully today?

A No, sir.

Q What did you do to prepare for today's
deposition?

A I re-read my initial submittal report, I
read my second report, I looked at Yeh, Yeh 2,

1 Jones, Jones 2, Hurst, Bonner, Lagrone, several
2 other papers, and then I had two practice sessions
3 with my attorneys.

4 Q When were those practice sessions?

5 A Monday and Tuesday of this week.

6 Q And who was at -- who was present at the
7 practice sessions?

8 A Doug Wilson and Monica Arnold and myself.

9 Q And you submitted two declarations in this
10 IPR proceeding?

11 A Yes, I have.

12 Q And everything in those declarations is
13 accurate?

14 A I think in my first declaration I noted
15 some changes in the prior deposition. I don't
16 remember all those right now. And I'm not aware
17 of any changes I need to make in my second
18 declaration.

19 Q Okay. Do you have access to clean
20 versions of the exhibits used in this IPR?

21 A Yes. I have a Dropbox file that has all
22 the documents and they're all clean versions.

1 Q Okay. And I apologize in advance. I may
2 do a fair amount of skipping around between the
3 documents today, so just wanted to warn you on
4 that.

5 A Okay.

6 Q I'd like to first start with Yeh -- the
7 Yeh reference, Exhibit 1005.

8 A Okay. Let me get my Dropbox going here.
9 Okay.

10 Q And specifically I'd like to turn to
11 column 3, line 18.

12 A Column 3, line 18. Okay.

13 Q That line, there's a sentence that starts:
14 Additional references which discuss fluid bypass
15 technology include, and there are a few references
16 listed there.

17 Do you see that?

18 A Yes.

19 Q And one of those references is US patent
20 number 7,661,476.

21 A Okay. Yes.

22 Q That is Exhibit 1010 in this proceeding --

1 A Okay.

2 Q -- is that right?

3 A I guess.

4 Q Feel free to pull up Exhibit 1010 and
5 confirm.

6 A Exhibit 1010 is US 7,661,476. Okay. You
7 want like me to pull it up?

8 Q I'd like to -- I just wanted to introduce
9 it right now, and I'm going to refer to that as
10 the Yeh '476 reference. Okay?

11 A Okay.

12 Q And the next reference after that
13 reference in Exhibit 1005 in that same sentence is
14 the Barry reference. Do you see that?

15 A Yes.

16 Q And the Barry reference is Exhibit 1027 in
17 this proceeding.

18 A The SPE paper 110460?

19 Q Correct.

20 A Okay. Is 1020 [sic].

21 Q Okay. I think it's 1027.

22 A Okay. Would you like me to pull it up

1 or --

2 Q Feel free to pull it up just to confirm.

3 A Okay. Yeah, it says Mr. Barry. Okay.

4 Q And I'd like to go back to Yeh 1005, that
5 same column starting at line 34.

6 A Okay.

7 Q And that line -- there's a portion that
8 starts: Recent technological advances have led to
9 the development of two new downhole tools useful
10 for the installation of a gravel pack. The first
11 is an alternate path sand screen having concentric
12 internal shunt tubes.

13 And then it says: Embodiments of such a
14 sand screen are shown and described in, and there
15 are a few references listed.

16 Do you see that?

17 A I see a Michael Hecker there.

18 Q Right. And the Hecker reference
19 identified there is Exhibit 1015 in this
20 proceeding.

21 A Okay.

22 Q And then another reference identified as

1 showing embodiments of a sand screen assembly is
2 US Patent Publication 2008/0142227.

3 Do you see that?

4 A What line is that on?

5 Q 42.

6 A 42. Yeah, 2008/0142227. Okay.

7 Q Yes. That is not yet an exhibit in this
8 proceeding, but I'm going to link it in the chat.
9 Just bear with me. And we're going to call it
10 Exhibit 2012.

11 (Deposition Exhibit 2012 marked for
12 identification.)

13 A Okay. It showed up.

14 BY MR. WALTERS:

15 Q Were you able to access it from the chat?

16 A Uh-huh. It's a --

17 Q Okay. And I will --

18 A -- Yeh publication from 2008.

19 Q Correct. And I'll refer to that as the
20 Yeh '227 reference.

21 A Okay.

22 Q So I'd like to go back to the Hecker

1 reference, which is Exhibit 1015.

2 A Let me pull it up. Okay.

3 Q On page 1 of the Hecker reference, right
4 above the section that starts with Background.

5 A Uh-huh.

6 Q It says: This paper will discuss the key
7 differences between the new ISAPT gravel pack
8 screens and the current eccentric 2x2 APT screens.

9 Do you see that?

10 A Uh-huh.

11 Q Then turning to page 3.

12 A I'm there.

13 Q There's a section that -- concerning the
14 ISAPT screens.

15 Do you see that?

16 A Second paragraph, yes.

17 Q Yes. And Hecker says that ISAPT is a new
18 design.

19 A He starts with: A new and enhanced screen
20 design has been developed and qualified.

21 Q Yes. And then Hecker references the Barry
22 reference right there, which is Exhibit 1027 in

1 this proceeding.

2 Do you see that?

3 A Uh-huh.

4 Q And in the third sentence of that
5 paragraph Hecker described the ISAPT screens as
6 having nine round shunt tubes, six transport tubes
7 and three packing tubes.

8 Do you see that?

9 A Yes.

10 Q And that's a key difference between -- for
11 the ISAPT design versus the prior 2x2 eccentric
12 designs, correct?

13 A Of what he -- yeah, of the Yeh design that
14 he is talking about, yeah, of that single Yeh
15 design.

16 Q To have more transport tubes?

17 A In this particular Yeh design, there are
18 six transport tubes and three packer tubes.

19 Q And that is more transport tubes than were
20 in the previous 2x2 eccentric design, correct?

21 A Yes.

22 Q And later in that paragraph Hecker talks

1 about increasing -- this new design increases
2 shunt redundancy.

3 Do you see that? Feel free to review that
4 paragraph.

5 (Witness reviews document.)

6 A Okay. I read that. Now, what was your
7 question? I'm sorry.

8 BY MR. WALTERS:

9 Q Hecker describes that this new design
10 increases shunt redundancy in that paragraph.

11 A Uh-huh.

12 Q And Hecker also describes that this new
13 design with the increased number of transport
14 tubes is particularly important for prolonged
15 gravel packing.

16 Do you see that?

17 A Prolonged gravel packing, yes.

18 Q And two paragraphs later Hecker talks
19 about pressure rating.

20 A Okay. Yes.

21 Q And this new concentric 6x3 screen
22 increases the working pressure of the shunt system

1 to 6,500 PSI?

2 A Yes.

3 Q And this ISAPT design described in Hecker,
4 it achieves the higher pressure rating than
5 eccentric 2x2 screens by using a larger number of
6 smaller round shunt tubes; is that fair?

7 A I don't think the number of shunt tubes
8 has anything to do with the pressure rating.

9 Q What about the size of the shunt tubes?

10 A Well, they would all be all part of the
11 system, right. It would be a total system
12 components.

13 Q So does the number of shunt tubes or the
14 size of the shunt tubes affect pressure rating of
15 screens?

16 A It does as a function of the rate. You
17 know, at a given rate you have a given friction
18 pressure associated with that for a given length
19 for a given fluid, for a given -- you know, all
20 those sort of things. All those are
21 interdependent.

22 Q And for a given rate, how does the size of

1 shunt tubes affect the pressure rating?

2 A It affects the friction.

3 Q So if you make the shunt tubes smaller,
4 how does that affect the pressure rating?

5 A For the same rate, that would increase the
6 pressure.

7 Q It would increase the pressure rating?

8 A It would increase the required -- it would
9 increase the pressure that is seen in that shunt
10 tube.

11 Q And if you make the shunt tubes larger,
12 how would that impact the pressure rating?

13 A For the same pump rate, it would reduce
14 the pressure in that. For the same fluid, same
15 pressure, holding all the other variables equal,
16 it would decrease pressure.

17 Q And what would increasing the number of
18 shunt tubes do to the pressure rating?

19 A The more shunt tubes you have, well,
20 obviously the volume per shunt tube would be less,
21 right. And so the pressure would go down if you
22 had more of all the same size.

1 Q If you wanted to increase the pressure
2 rating of a shunt tube assembly, would you make
3 the shunt tubes larger or smaller?

4 A If you wanted to increase the pressure
5 rating, it would be a function of the wall
6 thickness, the metallurgy of the tubular. The
7 pressure rating is a function of the tube
8 metallurgy and wall thickness, not the number of
9 tubes.

10 Q What if you keep all that the same? So
11 all else being equal, if you wanted to increase
12 the pressure rating of a shunt tube assembly and
13 your only variable was to make the tubes larger or
14 smaller, would you make them larger or smaller?

15 A If I wanted to increase the allow -- okay.
16 So what we're talking about is the allowable
17 pressure that you could do in there by --
18 obviously by increasing the diameter of the tubes
19 would lower the pressure, so that would increase
20 the rating of the entire system.

21 Q Okay. And if you kept the size of the
22 shunt tubes the same and all else being equal, you

1 wanted to increase the pressure rating of the
2 system, so the allowable pressure, would you add
3 more shunt tubes or reduce the number of shunt
4 tubes?

5 A Holding the rate constant, if -- the more
6 shunt tubes you have, each shunt tube would take
7 some of the pressure or the friction, so you would
8 be -- it would be allowing -- it would lower the
9 pressure on those -- each one of those systems,
10 right, because each one would be taking a portion
11 of the fluid. So the overall pressure of the
12 system rating you could pump at higher rates is
13 what it would allow you to do which would increase
14 the pressure rating of the system. It would be a
15 function of allowing higher rates is what it --
16 and still stay within the constraints of the --
17 but the pressure rating is a function of the tubes
18 themselves, not of -- the system -- the pressure
19 rating for the system wouldn't change because it's
20 a function of the tubes, individual tubes, but it
21 would allow a higher rate to get there.

22 Q I'd like to turn to Figure 5 of Hecker.

1 A Yeah, I'm there.

2 Q Figure 5 shows a 6x3 ISAPT concentric
3 screen; is that right?

4 A Yeah, it's similar that -- it's the same
5 figure that's in my reports, yes.

6 Q And that's the same alternate path screen
7 design that's referenced in the Yeh reference,
8 Exhibit 1005?

9 A That's one of the screen designs listed in
10 Yeh's, not -- there are multiple designs in Yeh's.

11 Q If you go back to Yeh at column 3, lines
12 34 to 40.

13 A Okay. Which Yeh are we talking about?

14 Q I'm sorry. Thank you. Exhibit 1005.

15 A Exhibit 1005. Let me pull it up. Okay.
16 Yeh 1005. And what column again would you like?
17 I'm sorry.

18 Q Column 3, line 36.

19 A Okay.

20 Q And Yeh right there says: The first is an
21 alternate path sand screen having concentric
22 internal shunt tubes.

1 Do you see that?

2 A Yes.

3 Q And then it references the Hecker
4 reference?

5 A Yes.

6 Q And what it's referencing is that design
7 in Figure 5 of the Hecker reference that we just
8 looked at?

9 A I believe that particular quote is, you
10 know, in the patent as referenced in that would
11 appear. I mean, it follows right behind it.

12 Q And this was known in the industry as
13 internal shunt alternate path technology, that's
14 what ISAPT stands for?

15 A I believe so. I think that's what Exxon
16 Mobil, you know, coined it.

17 Q I'd like to turn to Exhibit 1006, which is
18 the Yeh 2 reference.

19 A Okay.

20 Q Specifically at Figure 10.

21 A Okay. I'm there.

22 Q Figure 10 of the Yeh 2 reference,

1 Exhibit 1006, shows the same 6x3 concentric screen
2 that was shown in the Hecker reference at
3 Figure 5?

4 A Yes.

5 Q And if you look at Figure 9 of the Yeh 2
6 reference, which is Exhibit 1006, do you see that?

7 A Yes.

8 Q That's the same as Figure 6 of the Hecker
9 reference?

10 A Let me go look at Hecker. It appears to
11 be the same, yes.

12 Q So sticking with Yeh 2, which is 1006, can
13 you turn to page 4.

14 A Okay.

15 Q There's a section that starts
16 Multiple-Shunt Manifold System for Extreme Length.

17 Do you see that?

18 A Yes.

19 Q And then Yeh 2 states: To extend
20 alternate path technology to extreme lengths, the
21 number of shunt tubes was increased in the
22 manifold system.

1 Do you see that?

2 A Yes.

3 Q And then the Yeh 2 references Figure 9 as
4 an example of that new design with increased shunt
5 tubes.

6 A Okay.

7 Q And Figure 9 shows a 6x3 assembly with six
8 transport tubes and three packing tubes.

9 A Let me look at Figure 9. Yes.

10 Q Going back to Figure -- I'm sorry, going
11 back to page 4 --

12 A Okay.

13 Q -- in that same paragraph we were looking
14 at previously.

15 A Okay.

16 Q The -- in that first sentence Yeh 2 also
17 states that the number of shunt tubes was
18 increased, forcing a re-examination of the shunt
19 size.

20 Do you see that?

21 A And porthole spacing, yes.

22 Q Yes. Yeh 2 describes that the shunt tube

1 size was made smaller; is that fair?

2 A I don't think he says that. He didn't --
3 he just says he changed it.

4 Q Okay. Was the shunt size made smaller?

5 A Well, the whole shunt design is different.
6 I mean, you had a -- he doesn't say what it was
7 changed from here.

8 Q So let's look at Figure 11.

9 A Okay.

10 Q Figure 11 states that there were six
11 16-millimeter inside diameter shunt tubes.

12 Do you see that?

13 A Yes.

14 Q So was the 16-millimeter inside diameter
15 in Yeh 2 a larger or smaller transport tube size
16 than the size of the transport tubes in the
17 eccentric 2x2 screens?

18 A Okay. What's your -- I was looking at the
19 graph. What is your question again?

20 Q Sure. Is this 16-millimeter inside
21 diameter size of the shunt tubes in the new ISAPT
22 design, are those shunt tubes larger or smaller

1 than the transport tubes size in the eccentric 2x2
2 screens?

3 A Each tube -- each of the tube -- each of
4 the -- let's see here. He's saying six
5 16-millimeter ID tubes. Okay. So that is a flow
6 rate through each line. So obviously the
7 16-millimeter is a smaller tube than the current
8 eccentric at the time was done, which were
9 one-and-a-half by three-quarter, but that we're
10 comparing a round to a rectangle. So the
11 cross-sectional area is less for each one of these
12 tubes. Is that your question?

13 Q Yes.

14 A Yeah, I'll just say the cross-sectional
15 area is less.

16 Q Okay. Let's look at the Barry reference,
17 which is 1027.

18 A Okay.

19 Q And this reference was also -- we
20 discussed earlier that it's referenced -- we
21 discussed earlier that it's referenced in the
22 Hecker reference, specifically at page 2 of the

1 Barry reference.

2 A Okay.

3 Q On the right column of the Barry reference
4 about halfway down, Barry is describing
5 limitations of current screens.

6 Do you see that?

7 A Yes. Uh-huh.

8 Q And those are current eccentric 2x2
9 screens?

10 A I believe that's probably what he's
11 referring to. He doesn't say that, but that's
12 likely.

13 Q And at the -- near the bottom of that
14 column right above the next section that states
15 New Alternate Path Screen Design, Barry states
16 that one limitation of the eccentric 2x2 screens
17 was that it had limited ability to provide
18 necessary pressure integrity.

19 A Let's see. I don't see it in that
20 paragraph. What was your sentence again you're
21 referring to? In the paragraph -- you're talking
22 about the paragraph right above New Alternate Path

1 Screen Design?

2 Q Yes. It's at the very end of that
3 paragraph.

4 A Okay. Let's see. A concentric openhole
5 packer that leak [sic] can be set prior to gravel
6 packing, seal openhole geometries, and provide
7 necessary pressure integrity? Or where are you
8 talking about?

9 Q So it's basically stating that the
10 eccentric 2x2 design limits the ability to provide
11 necessary pressure integrity; is that fair?

12 A Of the 2x2 alternate -- he's talking about
13 that it limits the ability to incorporate an open
14 hole packer.

15 Q And provide necessary pressure integrity.

16 A Yeah, but I think he's really talking more
17 about the openhole packer.

18 Q The eccentric 2x2 design was limited to a
19 packable length of 3,200 feet. Barry states that
20 just above.

21 A Yes.

22 Q And in the next section Barry discusses

1 the new ISAPT design.

2 Do you see that into the next page?

3 A Uh-huh. Yes.

4 Q And Barry describes that ISAPT is a
5 concentric screen for packing intervals up to
6 5,000 feet long?

7 A Yeah.

8 Q And Barry describes in the next column
9 that the ISAPT screen has nine round shunt tubes?

10 A Yeah, where it says shunt systems, nine
11 round shunt tubes are integrated into the design.
12 Yes.

13 Q And this shunt tube configuration results
14 in a higher burst capacity as described by Barry.

15 A Yes.

16 Q And that's compared to the rectangular
17 tubes in an eccentric 2x2 design?

18 A I just think he says it has a higher
19 burst -- or it has a higher burst capacity.

20 Q And then he says: Than the rectangular
21 tubes of the existing design.

22 And that's referring to the existing

1 eccentric 2x2 design?

2 A I guess at the time of the writing of this
3 paper, which was -- what was it? Let's see. When
4 is that? What was available in 2007. Yes.

5 Q And so is it fair that Barry is saying
6 that the concentric screens of this new design
7 achieved a higher burst capacity by using a larger
8 number of round tubes?

9 A I think the whole system he was able to
10 achieve it with multiple things, with a -- the
11 whole system was able to achieve that. I don't
12 know --

13 Q And this section -- go ahead. I don't
14 want to -- I don't want to talk over you. Go
15 ahead.

16 A It's the whole system. It's not an
17 individual component that we're talking about.

18 Q But the two components that Barry
19 references in this paragraph that we're looking at
20 are, one, the number of shunt tubes which
21 increased -- the transport tubes increased from
22 two to six and, two, Barry also references the

1 shape of the tubes, which went from rectangular to
2 round, correct?

3 A Yes.

4 Q And later in the middle of that column
5 Barry -- in the section that is called Flow
6 Capacity, Barry specifies the size of the six
7 transport tubes.

8 Do you see that?

9 A Let's see. Yes, flow capacity here.
10 Initial tests --

11 THE REPORTER: Either speak up or read to
12 yourself.

13 THE WITNESS: Sorry. I was just reading
14 through the paragraph.

15 (Witness reviews document.)

16 A Okay.

17 BY MR. WALTERS:

18 Q The size of the six tubes, Barry describes
19 that they have a 16-millimeter inside diameter and
20 a 20-millimeter outside diameter?

21 A Yes. It's the same information I put in
22 my report.

1 Q And again, each of those six transport
2 tubes is smaller than each of the two transport
3 tubes in the eccentric 2x2 design, correct?

4 A Yes, but the overall cross-sectional area
5 is greater than -- with the six is actually
6 greater than the two.

7 Q On an individual basis each tube is
8 smaller?

9 A On an individual basis if you're comparing
10 a transport tube to a transport tube, that is
11 correct.

12 Q Barry states in that same paragraph that
13 larger shunt tubes would reduce the pressure drop
14 and thus the pressure requirements for the system.

15 Do you see that?

16 A Yes.

17 Q But Barry also states that larger shunt
18 tubes make the screen too large?

19 A Well, it does for their desired
20 application for what he was designing around. Not
21 all. It wouldn't encompass in all places. Just
22 for his particular job that he was working on at

1 that time, if he went larger, it would affect it
2 with that design, yes.

3 Q And it's fair to say that at some point
4 larger shunt tubes may make the overall system too
5 large for any application?

6 A I don't know that's the case.

7 Q Why not?

8 A I mean, it's all economics of the hole and
9 how much you're wanting to produce. You know, for
10 Hecker's design here, if he wanted to produce
11 whatever it is, 10,000 barrels a day, then that
12 starts with the base pipe design, you know, and
13 works on its way up. If you wanted to produce
14 50,000 barrels a day, then Hecker's design is too
15 small. You're going to have to go from
16 four-and-a-half to five-and-a-half or seven-inch
17 base pipe, so you would need a different tube. So
18 it's all a function of that particular design to
19 meet that application. Also the base pipe size
20 can change. Towards the lower end of the hole,
21 you don't need as large a base pipe as you do up
22 near the heel, so that can change as well.

1 Q When you want to increase the size of the
2 transport tubes, is the overall size of the shunt
3 system a typical design criteria that you need to
4 account for?

5 A Well, obviously all the pieces, you know.
6 It depends on what size hole you drilled. It's
7 all a function of what size hole you drilled. Of
8 course you can under-ream the hole, you can make
9 the hole bigger, you can drill larger holes. So
10 that's -- that's a particular application design.
11 So we're talking about here for Hecker's
12 particular application.

13 Q But my question was a little different.
14 If you want to increase the size of the transport
15 tubes, is the overall size of the system a typical
16 design criteria that you need to account for?

17 A Well, yes. You could increase the overall
18 design or you could decrease the base pipe or
19 there's a lot of levers you can pull.

20 Q I'd like to turn to Exhibit 1005, the Yeh
21 reference -- the main Yeh reference again.

22 A Okay.

1 Q I'm sorry, I'm confusing myself. I'd like
2 to turn to the Yeh '227 reference, which is what
3 we added as Exhibit 2012.

4 A Let's see. Okay.

5 Q Specifically Figures 3B and 3C.

6 A Okay.

7 Q These figures show a concentric screen
8 with nine shunt tubes?

9 A Yes.

10 Q If you look at paragraph 49 of this
11 reference.

12 A Paragraph 49. Okay. Where it starts the
13 coupling assembly?

14 Q No. It's labeled 49. It's on page 6,
15 Yeh '227.

16 A Oh, okay. And it's shown in Figure 3B?

17 Q Correct. And specifically the very last
18 sentence of that paragraph. That sentence
19 describes that the nine shunt tubes shown in
20 Figures 3B and 3C are six transport tubes and
21 three packing tubes.

22 Do you see that?

1 A Yes.

2 Q And that's another example of the 6x3
3 ISAPT concentric screen that was referenced in the
4 main Yeh reference, Exhibit 1005?

5 A Apparently it would be similar, yeah.

6 Q I'd like to turn to Exhibit 1010, which is
7 the Yeh '476 reference.

8 A All right. Let me pull it up.

9 Q Sure.

10 A Okay.

11 Q Specifically at Figure 3.

12 A Okay.

13 Q So the 6x3 screen shown in Yeh '476,
14 Figure 3, are the same as those that we just
15 looked at in Yeh '227, Figure 3?

16 A They're the same -- similar, yes.

17 Q Can you turn to column 23 of this
18 reference, Exhibit 1010.

19 A What page is it on; do you know?
20 Column 23.

21 Q I don't. It's towards the end. I don't
22 have a page number.

1 A Let's see.

2 MR. WILSON: It's two pages from the end.

3 A I'm not seeing column number -- oh, 23.

4 Column 23. Okay. All right. Column 23.

5 BY MR. WALTERS:

6 Q And looking at line 41.

7 A Okay.

8 Q The Yeh '476 reference explains that the
9 6x3 concentric screen extends gravel packing
10 length to 5,000 feet and possibly 6,000 feet?

11 A Yes.

12 Q And the reason it can pack longer
13 intervals is due to increased pressure capacity?

14 A Well, one of -- it says by least increased
15 pressure capacity. Obviously other things too,
16 but...

17 Q In the next column, column 24, the section
18 that starts with Flow Capacity.

19 Do you see that?

20 A Uh-huh.

21 Q The Yeh '476 reference explains that the
22 size and number of shunt tubes were re-evaluated

1 in concentric screens?

2 A Yes.

3 Q And these are the same number of tubes and
4 the same tube size that were disclosed in the
5 Barry reference that we looked at earlier?

6 A I believe so. Yes.

7 Q Can you turn back to column 2 of this same
8 reference, Exhibit 1010.

9 A Okay.

10 Q The very bottom of that column, line 66,
11 Yeh '476 is teaching that small, round shunt tubes
12 were preferred in concentric screens?

13 A Where specifically are you looking at in
14 that?

15 Q Line 66 of column 2.

16 A Okay. Concentric alternate paths -- he
17 says concentric alternate flow paths utilizing
18 smaller diameter round tubes are preferable but
19 can create other design difficulties.

20 Yeah, for this particular project that he
21 had in mind for this particular application, he
22 found that round were better.

1 Q And smaller is better as well?

2 A For this particular application that he
3 was designing, not -- he doesn't make it -- I
4 believe he's just working on this one particular
5 design for the application he has. With whatever
6 other constraints that he has to work with, he
7 found this is better.

8 Q And that's consistent with later in the
9 reference where we saw Yeh '476 teaches that using
10 six smaller round shunt tubes could pack 5,000
11 feet?

12 A I believe Hecker and Yeh, all those guys
13 working together were working on some project in
14 the Sakhalins and West Africa, that the design
15 requirements for those wells required these sizes,
16 that hole constraint and those sort of things.
17 But it was all about the particular application
18 that they were working on.

19 Q And these sizes were smaller round shunt
20 tubes, correct?

21 A For this particular application. However,
22 there were other shunt tubes that were used prior

1 to this that were actually probably smaller than
2 these, you know. Because there was an evolution
3 of shunt tubes. The original shunt tubes, you
4 know, were about -- would only hold one third of
5 the capacity of these tubes. So --

6 Q But all --

7 A -- and what's available at that time for
8 his particular application.

9 Q But all of these references, they
10 repeatedly state that they're using smaller round
11 shunt tubes versus existing designs, correct?

12 A Yes, with the focus being on the
13 application they were working on.

14 Q And they increased the number of transport
15 tubes to six, correct?

16 A Because of the constraints they had to
17 meet, this was what they found to be the optimum
18 design for their application.

19 Q And that optimum design was to increase
20 the number of transport tubes to six?

21 A For this application.

22 Q We've been going almost an hour. Is it a

1 good time to take a short break?

2 A Okay.

3 MR. WILSON: Sure.

4 BY MR. WALTERS:

5 Q Mr. Chambers, before we go, you've been
6 through IPR depositions before, but the rules
7 prohibit conversations about your testimony with
8 your counsel during breaks.

9 A Sure.

10 Q Thank you.

11 (Recess taken from 10:54 a.m. to
12 11:06 a.m.)

13 BY MR. WALTERS:

14 Q Mr. Chambers, I'd like to turn to
15 Exhibit 1003, which was your first declaration in
16 the IPR.

17 A Okay. Let me pull it up.

18 Q Specifically at paragraphs 134 to 136.

19 A Okay.

20 Q In these paragraphs 134 to 136 you're
21 discussing the Yeh '476 reference.

22 Do you see that?

1 A Yes.

2 Q And you confirm here that Yeh '476 is
3 describing a concentric design with six transport
4 tubes?

5 A Yes.

6 Q And in paragraph 134 you state that:
7 Concentric screens were used for withstanding
8 higher pressures associated with greater depth
9 wells?

10 A I think I was talking about the '476
11 reference to the concentric design that Yeh had
12 where that application was, yes.

13 Q And these concentric screens could handle
14 working pressures of up to 6,500 PSI?

15 A Yeah, in my report -- yes. For this
16 particular design of Yeh, yeah.

17 Q And you state here in this paragraph that
18 the Yeh '476 patent explained the benefits of
19 concentric shunt tube design?

20 A Yeah, the benefits of that particular
21 design for the application that he was using.

22 Q And that particular shunt tube design

1 utilized six 16-millimeter inside diameter and
2 20-millimeter outside diameter shunt tubes?

3 A I don't know if I quote it here. I
4 believe that's what was in the '476 design.

5 Q And that number and size of shunt tubes
6 enabled Yeh '476 to achieve increased pressure
7 capacity up to 6,500 PSI?

8 A Yes, for the rate and pressure and overall
9 length and system and all the other variables that
10 went into it, yes.

11 Q Okay. I'd like to turn back to the main
12 Yeh reference, Exhibit 1005.

13 A Okay.

14 Q Specifically at column 28, line 17.

15 A Okay.

16 Q And at line 17 Yeh 1005 states: For
17 example, a 6,500 PSI differential pressure is
18 expected near the heel of when gravel packing a
19 5,000-foot horizontal completion interval.

20 Do you see that?

21 A Yes.

22 Q And Yeh -- this Yeh 1005 describes that

1 the tool that accomplished this was the 6x3 ISAPT
2 design?

3 A I don't see where he says that. What --
4 where are you referring to?

5 Q Well, Yeh 1005 repeatedly refers to
6 references that describe that ISAPT design,
7 correct?

8 A And other designs, but, yes, it does refer
9 to that and other designs.

10 Q Does Yeh 1005 ever describe that any other
11 design achieved a 6,500 PSI packing a 5,000-foot
12 interval?

13 A Yeh shows other designs of two and four.
14 I don't think he goes into the specifics of what
15 those systems would withstand, no.

16 Q I'd like to turn to column 30 of Yeh 1005.

17 A Okay.

18 Q Specifically at line 15.

19 A Okay.

20 Q The second sentence there in that
21 paragraph states: For example, known concentric
22 screens are capable of gravel packing 5,000 feet,

1 compared to 3,000 feet with the commercial
2 eccentric screens.

3 Do you see that?

4 A Yes.

5 Q And here Yeh is referring to the ISAPT 6x3
6 concentric design that has been described as
7 packing up to 5,000 feet?

8 A I would assume so.

9 Q I'd like to turn to the Hecker reference,
10 Exhibit 1015.

11 A Okay.

12 Q Specifically at page 2.

13 A Okay.

14 Q On page 2 Hecker discusses 2x2 packing
15 systems.

16 Do you see that?

17 A Uh-huh.

18 Q Turning to page 3, the last sentence of
19 the first paragraph, Hecker states that because of
20 limitations of the 2x2 design an alternative
21 solution was required?

22 MR. WILSON: Objection, form.

1 A I see where it says that.

2 BY MR. WALTERS:

3 Q And just below that Hecker describes an
4 ISAPT design as the alternative?

5 A Yes.

6 Q And as we discussed, ISAPT had six
7 transport tubes and three packing tubes?

8 A This particular design for this particular
9 application did.

10 Q But this 6x3 design was a different design
11 than the 2x2 designs Hecker described as having
12 limitations?

13 A For this hole size and for this
14 application where they were comparing the two
15 systems, that is true.

16 Q This 6x3 design added manifolds?

17 A I believe it had an option of a manifold,
18 yes.

19 Q And it had more transport tubes?

20 A Obviously, yes.

21 Q And it had a third packing tube?

22 A Yes.

1 Q Would a -- all else being equal, would a
2 concentric screen having larger transport tubes
3 have a lower pressure rating than a concentric
4 screen having smaller transport tubes?

5 MR. WILSON: Objection, form.

6 A Can you rephrase your -- ask your question
7 again?

8 BY MR. WALTERS:

9 Q Sure. All else being equal, would a
10 concentric screen having larger transport tubes
11 have a lower pressure rating than a concentric
12 screen having smaller transport tubes?

13 MR. WILSON: Objection, form.

14 A There are so many variables here. Are we
15 talking about the wall thickness being the same?
16 Are we talking about the metallurgy being the
17 same? Are we talking about the base pipe being
18 the same? Because that --

19 BY MR. WALTERS:

20 Q All that is the same.

21 A That configuration, the pump, you know.

22 Q All that is the same, the number of tubes

1 are the same.

2 A And the tubes are larger?

3 Q Correct.

4 A Okay. Well, in the case where the tubes
5 are larger for the same wall thickness, they're
6 going to have a lower pressure rating.

7 Q I'd like to go the Hurst reference,
8 Exhibit 1013.

9 A Hurst 1013. You want to go to my
10 declaration or --

11 Q 1013.

12 A Oh, 13. 003 [sic]. Okay.

13 Q On page 2 of Hurst, Hurst describes the
14 Introduction of Larger Tubes.

15 Do you see that?

16 A Uh-huh.

17 Q And in that first paragraph of that
18 section Hurst explains that early shunt tubes did
19 not provide sufficient flow area which resulted in
20 high frictional pressure drops through the shunt
21 tubes.

22 A Yes. I think I reference the same

1 paragraph in my first declaration.

2 Q And later in that same section Hurst
3 explains that providing three times the flow area
4 in shunt tubes reduced friction pressures by an
5 order of magnitude.

6 A Yes.

7 Q And Hurst describes rectangular tubes
8 here?

9 A Yes, that's what he's referring to.

10 Q So a larger tube cross-sectional flow area
11 reduces the frictional pressure drop through the
12 shunt tube as gravel is pumped through the tube?

13 A A larger cross-sectional area will provide
14 less friction and therefore would be at a lower
15 pressure.

16 Q And the frictional pressure drop is
17 reduced?

18 A Yes, over a given length. You know, I
19 mean if you had 1,000-foot length, a larger tube,
20 you know, bigger pipe. I mean, this is Petroleum
21 Engineering 101, right. Bigger pipe is less
22 frictional.

1 Q And decreasing the tube size increases the
2 frictional pressure drop through the tube as
3 gravel is pumped through the tube?

4 A For the same rate for the same slurry,
5 viscosity, all those sort of things, yes, sir.

6 Q I'd like to turn back to the Yeh -- main
7 Yeh reference, Exhibit 1005.

8 A Okay.

9 Q Specifically at column 24, line 54.

10 A Okay. Where it starts: In each of
11 Figures 8A, B and C?

12 Q Yeah. Specifically at line 54, a few
13 lines down from that. In one embodiment.

14 A Yes.

15 Q Yeh teaches that shunt tubes in eccentric
16 screens have lower friction relative to shunt
17 tubes in concentric screens?

18 A In one particular embodiment that he's
19 referring to. Not in general. That's not a
20 general statement, but it -- in that one
21 embodiment.

22 Q And that's a reason to use eccentric

1 screens at the toe?

2 A That could be one reason.

3 Q And the lower friction of eccentric
4 screens at the toe had the benefit of extending
5 the total gravel packing length?

6 A No, I wouldn't -- I don't think that had
7 anything to do with extending the gravel length.

8 Q Well, right here in this section Yeh's
9 talking about eccentric screen arrangement
10 offering lower friction, right?

11 A Yes.

12 Q And then it says: It is believed that the
13 use of eccentric screens at the toe will reduce
14 the overall friction or extend the maximum gravel
15 packing length of the completion.

16 A Okay.

17 Q So Yeh here is describing that the lower
18 friction of eccentric screens at the toe had the
19 benefit of extending the total gravel packing
20 length?

21 A That may be one benefit they might have,
22 but I believe with Yeh -- Yeh's overall design,

1 his concentric design could go all the way to the
2 toe and operate. So his -- his concentric design
3 could operate or you could switch to maybe a
4 lower-cost eccentric design.

5 Q Is the lower friction that Yeh is
6 describing in eccentric screens because of the
7 larger cross-sectional flow area of the tubes?

8 A I think he's recommending them here
9 because the rate is significantly less down at
10 that part of the hole. You know, you've had so
11 much leak-off and your rate is down --

12 Q Sure.

13 A -- so the equipment pressure and
14 everything is down. So it's not just the -- you
15 know, because his system -- his system would work
16 at that length.

17 Q But he says: In one embodiment an
18 eccentric screen arrangement offers lower friction
19 in the secondary flow paths when compared to shunt
20 tubes in a concentric screen, right?

21 A Yes. I mean, it says --

22 Q And is that low -- I'm sorry, go ahead.

1 A No.

2 Q Is that lower friction that he's
3 discussing in eccentric screens because of the
4 larger cross-sectional flow area of the tubes?

5 A I don't know because, like we said -- like
6 I said, the overall cross section of all his six
7 tubes was greater than the two tubes down there.
8 It's just a different arrangement, different
9 frictional properties, different -- everything is
10 different.

11 Q So you don't know why he's saying that
12 eccentric screens have a lower friction when
13 compared to shunt tubes in a concentric screen
14 here?

15 A I believe in one particular embodiment
16 that he's thinking of he thinks you could use a
17 concentric -- an eccentric screen for that
18 application.

19 Q And that that eccentric screen offers
20 lower friction, correct?

21 A That particular design he's thinking about
22 could have lower friction.

1 Q And would that be because that -- the
2 transport tubes of that design had a larger
3 cross-sectional flow area than the tubes of the
4 concentric screen?

5 A I think it's probably more related to when
6 you -- you get towards the lower end of the well,
7 the slurry concentration is much higher. So the
8 frictional characteristics are much higher. And
9 so with this -- each of the small tubes being
10 small, that works great maybe for, you know,
11 two-pound per gallon, but if it's six or eight,
12 that the friction may be -- you know, get too
13 high. So I think it's probably more a function of
14 the slurry concentration than -- than -- and the
15 characteristics of that.

16 Q Could it be because the eccentric screens
17 had a rectangular tube shape versus a round tube
18 shape?

19 A They would have a different flow
20 characteristic is what I'm saying, you know.
21 Bonner and others have said the actual friction
22 between round and rectangular for about the same

1 size isn't that much different.

2 Q Rectangular tube shapes provided --
3 typically provided a larger flow area than round
4 tube shapes within a given size?

5 A It -- you know, it depends -- it's the
6 design and the constraints within the system, the
7 size of the tubes and all that that you can put in
8 it. When Bonner compared a round tube for his
9 jumper tube to the cross-sectional -- or to the
10 rectangular shape, he found that the friction was
11 about the same. So I don't know -- you know,
12 round is the optimum design for friction. The
13 rectangular tubes actually have more turbulence in
14 them. So there's a lot of things that play into
15 that.

16 Q Yeh teaches that eccentric screens were
17 limited to packing 3,000 feet; is that right?

18 A Yeh teaches at this particular time that
19 eccentric screens were limited to packing about
20 3,000 feet, but I think the issue was probably
21 more the jumper connection, was not the tubes and
22 those sort of thing.

1 My early experience working with Jones and
2 people in the designing these systems, the weakest
3 link was the junction tube. And especially in
4 rectangular designs, the junction tube was -- so I
5 think the limitation was more the junction tube.
6 And when you go see that Bonner concentrated on
7 fixing that junction tube, the pressure rating
8 went up.

9 Q But Yeh describes that eccentric screens
10 at the time were limited to 3,000 feet, but does
11 not describe that the reason is because of issues
12 with the junction tubes, correct?

13 A He doesn't say why they're limited to
14 that.

15 Q Hecker also taught limiting eccentric
16 screens to 3,000 PSI and 3,200 feet; is that
17 right?

18 A He -- here again, he talked about that,
19 yes, they were limited to that. And here again, I
20 believe it is because of the junction tube because
21 in Bonner's paper he was using the exact same
22 configuration, the exact same tubes, the exact

1 same metallurgy, wall thickness, and was able to
2 increase the pressure rating.

3 Q Hecker did not talk about the junction
4 tubes, though?

5 A He did not explain why there was a
6 limitation.

7 Q Concentric screens at the time could pack
8 a longer length because they have a higher
9 pressure rating than eccentric screens?

10 A Than the screens at that time. The
11 eccentric screens in 2007 or whenever they're
12 writing these reports, those at that time.

13 Q Is that because the transport tubes in the
14 eccentric screens had a larger cross-sectional
15 flow area?

16 A No. Here again, I think it's probably
17 more due to the junction tubes.

18 Q Can you look at column 28 of Yeh,
19 Exhibit 1005.

20 A Okay.

21 Q And specifically at line 17 again.

22 A Okay.

1 Q And Yeh says that 6,500 PSI is the
2 pressure differential at the heel when packing
3 5,000 feet?

4 A For the particular design and size and
5 everything he was working with, yeah.

6 Q So Yeh's concentric screens that could
7 gravel pack 5,000 feet had to be rated to 6,500
8 PSI?

9 A For his design. The pump rate, the sand,
10 everything he was doing, yes. It was a function
11 of that.

12 Q And if they were not rated to 6,500 PSI,
13 then they might burst?

14 A Potentially they could burst.

15 Q I'd like to turn back to your first
16 declaration, 1003.

17 A Okay.

18 Q Paragraph 101.

19 A Okay. I'm there.

20 Q Here you state that an eccentric screen
21 having rectangular shunt tubes achieved a large
22 flow area.

1 A Yes.

2 Q An eccentric screen having rectangular
3 tubes would permit a larger flow area than the
4 flow area of an eccentric screen of the same tool
5 size having round shunt tubes?

6 A Yes.

7 Q Looking at paragraph 42 where you discuss
8 Hurst and show Figure 5.

9 Do you see that?

10 A Paragraph 42?

11 Q I'm sorry, 102.

12 A 102.

13 Q The next paragraph.

14 A Okay. I'm there.

15 Q This Figure 5 of Hurst shows that keeping
16 the base pipe and shunt tube size the same allowed
17 an eccentric screen to have a smaller outer tool
18 diameter than that of a concentric screen.

19 A Yes. That was known.

20 Q If you were to keep the base pipe and
21 outer tool diameter size the same in a concentric
22 screen and an eccentric screen, the eccentric

1 screen would allow for a larger shunt tube

2 cross-sectional flow area; is that right?

3 A If you use the same number of tubes.

4 Because like I said, with Yeh's design, his actual

5 cross-sectional flow area was greater.

6 Q If you were to keep the tube size and

7 outer tool diameter size the same in a concentric

8 screen and an eccentric screen, the eccentric

9 screen would allow for a larger base pipe

10 diameter, right?

11 A Yes.

12 Q And the differences between the space

13 available for the shunt tubes in eccentric and

14 concentric screens are also present when those

15 screens have round shunt tubes?

16 A I'm not certain. Your question again?

17 Q Eccentric and concentric screens, one main

18 difference is that with eccentric screens there's

19 more space available for the shunt tubes than

20 concentric screens?

21 A It depended on the number. If you -- for,

22 like, two.

1 Q But overall eccentric designs provide more
2 spacing to put shunt tubes?

3 A Eccentric designs limit you to only using
4 about two shunt tubes. They put a limit on you,
5 where concentric with smaller tubes does not put a
6 limit.

7 Q And the spacing available for shunt tubes
8 between eccentric and concentric screens does not
9 change even when you're using round shunt tubes in
10 the eccentric or concentric screens?

11 A I'm unclear of your question again. Can
12 you ask it in a different way?

13 Q Yeah. The differences in -- between the
14 space available for shunt tubes in eccentric and
15 concentric screens is also present when those
16 screens are using round shunt tubes?

17 A The space available -- do you have a
18 particular figure or something in your -- you want
19 to point to or...

20 Q I don't. So going back earlier I asked
21 that if we were to keep the base pipe and outer
22 tool diameter size the same in a concentric and

1 eccentric screen, the eccentric screen would allow
2 for a larger shunt tube cross-sectional flow area,
3 right?

4 A If you keep the base pipe the same in
5 those two different designs, you would limited to
6 two rectangular shunt tubes, and that
7 cross-sectional area, what are we comparing it to
8 now? If we were to have two -- I mean, Figure 5
9 shows a comparison of two to two. Right?

10 Q Yes. And the eccentric screen allows for
11 a larger shunt tube cross-sectional flow area in
12 that instance, correct?

13 A Looking at Figure 5, for it to fit in the
14 same base pipe, the shunt tube outer diameter
15 would have to -- probably the overall size would
16 have to decrease. That rectangular tube would
17 have to decrease.

18 Q Yeh talks about -- the main Yeh reference,
19 1005, talks about or states that it's known to use
20 rectangular shunt tubes in eccentric screens?

21 A It was very common at that time of the
22 patent writing that that was a common -- the Y

1 block, I put it in my report, and it shows it
2 right here. That was a common design.

3 Q And Yeh also teaches that the eccentric
4 layout reduces the overall tool diameter compared
5 to a concentric layout if both the concentric and
6 eccentric screens use equivalent shunt tubes?

7 A Well, Hurst shows that here in Figure 5;
8 that if you use equivalent diameter, that you
9 would need a larger base pipe. Or a shroud. You
10 would need a larger shroud for both of these.

11 Q And so another way to say that and what
12 Yeh teaches is that the eccentric layout reduces
13 the overall tool diameter compared to a concentric
14 layout if both the concentric and eccentric
15 screens use equivalent shunt tubes?

16 A Yes. That shows that here -- I put that
17 in my report here in Figure 5 above paragraph 103
18 shows that case.

19 Q Can you turn to paragraph 436 of this
20 report.

21 A Okay.

22 Q About two-thirds of the way down you state

1 that increasing the outside diameter of a shunt
2 tube is likely not possible.

3 Do you see that?

4 A Yes, D. Uh-huh.

5 Q And that's because the outside diameter
6 had already been maximized for a given size
7 constraint on the effective diameter of a tool?

8 A For that application that they were
9 looking at, I believe so.

10 Q And you cite a reference that explains
11 that rectangular tubes are typically used to keep
12 the tool diameter as small as possible?

13 A Yes.

14 Q And rectangular tubes are used even though
15 round tubes are cheaper and have substantially
16 greater burst strength?

17 A I don't know that -- okay.

18 Q That's what that reference that you cite
19 states, correct?

20 A Uh-huh. Yes.

21 Q I'd like to turn to the Barry reference,
22 Exhibit 1027.

1 A Okay.

2 Q Specifically at page 2. At the bottom of
3 the left column on page 2 there's a sentence a few
4 lines up from the bottom that states: The
5 rectangular-shaped tubes.

6 Do you see that?

7 A Where it starts, The rectangular-shaped?

8 Q Yes.

9 A Okay.

10 Q Barry here is teaching that using
11 rectangular tubes in eccentric screens minimizes
12 the outside diameter of the tool?

13 A Tubes and -- he says that, yes.

14 Q And using rectangular tubes in eccentric
15 screens also enabled a larger flow path while
16 minimizing the effective diameter of the tool,
17 correct?

18 A It would, but that -- the design also is
19 not the friction. The friction characteristics
20 are different.

21 Q If you were to keep the overall tool size
22 the same, eccentric screens had more space for

1 shunt tubes than 2x2 concentric screens?

2 A Yeh's concentric design resulted in a
3 larger cross-sectional area for fluid flow than a
4 conventional 2x2 design at that time.

5 Q That's because Yeh increased the number of
6 tubes, correct?

7 A Yes.

8 Q Okay.

9 A Yes.

10 Q But keeping the overall tool size the same
11 and the number of tubes the same, eccentric
12 screens had more space for shunt tubes than 2x2
13 concentric screens?

14 A If you kept the tube size the same, yes.
15 But here again, Yeh's design actually has greater
16 cross-sectional area of flow.

17 Q Okay. Keeping the overall tool size the
18 same, 2x2 eccentric screens had more space for
19 shunt tubes than 2x2 concentric screens?

20 A I believe Yeh's two -- Yeh's concentric
21 design and the existing eccentric design had the
22 exact same OD at that time. Right? And so Yeh's

1 system had more area for flow than did the
2 existing system at that time.

3 Q Irrespective of Yeh's system.

4 A Okay.

5 Q If you keep the overall tool size the same
6 and the number of tubes the same, so we're
7 comparing 2x2 screens, eccentric screens had more
8 space for the shunt tubes than concentric screens
9 in 2x2 designs?

10 A Yes.

11 Q And the 2x2 eccentric design was
12 commonplace in the industry at time of the '007
13 patent, correct?

14 A It had evolved to that design, yes.

15 Q And they were commonplace because they
16 allowed the largest shunt tubes?

17 A I don't know about that. They were
18 commonplace because they were very easy to
19 manufacture, you know, and assemble and probably
20 one of the lower costs. And I think there were
21 numerous reasons. They had a lot of disadvantages
22 to them as well, that current design, one of the

1 biggest disadvantages being that the tubes are
2 only on one side of the pipe. So if the pipe were
3 actually on the bottom, your shunt tubes would be
4 on the bottom and could get packed off and
5 screened off. So they were not the optimum design
6 I believe at the time. Hurst tried to improve on
7 that, Yeh tried to improve on that design.

8 Q The 2x2 eccentric designs also had lower
9 friction than 2x2 concentric designs?

10 A I don't know there was a 2x2 concentric
11 design.

12 Q Literally eccentric screens offer lower
13 friction?

14 A I don't know that.

15 Q Yeh 1005 did state that an eccentric
16 screen arrangement offered lower friction when
17 compared to shunt tubes in a concentric screen?

18 A For that particular design for that
19 particular rate for that particular slurry
20 concentration, for all those sort of things, you
21 know. Here again, if you change the viscosity of
22 the slurry concentration, you get a totally

1 different -- yeah, because the flow regime in a
2 rectangular tube, the friction characteristics are
3 different from a round tube. So the round tube is
4 the optimum design. So the round tube has the
5 best friction flow characteristics.

6 Q Is this a good time to take another break?

7 A Sure.

8 (Recess taken from 11:54 a.m. to
9 12:06 p.m.)

10 BY MR. WALTERS:

11 Q Mr. Chambers, when designing a shunt tube
12 assembly, one of skill in the art would need to
13 take a number of design parameters into account,
14 correct?

15 A Yes.

16 Q They would need to account for various
17 shunt tube features such as the tube shape, right?

18 A Yes.

19 Q And the tube size?

20 A Obviously.

21 Q And the sizes of specifically the
22 transport tubes and the sizes of the packing

1 tubes?

2 A Yes.

3 Q And the number of shunt tubes?

4 A Well, yes.

5 Q And specifically the number of transport
6 tubes?

7 A Yes.

8 Q And the number of packing tubes?

9 A Yes.

10 Q And the tube wall thickness?

11 A Yes.

12 Q And specifically the transport tube wall
13 thickness?

14 A Not specifically just it, but all the wall
15 thicknesses, yes.

16 Q The wall thicknesses of the transport
17 tubes and the wall thicknesses of the packing
18 tubes?

19 A Yes.

20 Q And the tube material and metallurgy?

21 A Yes.

22 Q The corrosion resistance?

1 A Depends on the application. Not
2 necessarily.

3 Q The tensile strength?

4 A Yes.

5 Q The weldability?

6 A Not necessarily, but potentially.

7 Q The shunt tube connectors?

8 A How you're going to connect the two
9 systems, yes.

10 Q Whether the tubes are internal or
11 external?

12 A Internal or external to the screen?

13 Q Yes.

14 A To the screen, yes.

15 Q The methods for joining or connecting
16 adjacent screen sections?

17 A Yes.

18 Q The manifolds or junction blocks?

19 A Yes.

20 Q The jumper tubes?

21 A If you had jumper tubes.

22 Q One would also need to account for

1 features of the packing tubes?

2 A Yes.

3 Q Such as the packing tube nozzle size?

4 A Number, size, orientation, all the above.

5 Q Spacing between nozzles?

6 A Yes.

7 Q The nozzle spacing from the junction block
8 or manifold?

9 A Yes.

10 Q The nozzle angle?

11 A Yes.

12 Q Whether the tubes are closed-ended or
13 open-ended?

14 A Yes.

15 Q The base pipe diameter?

16 A Yes.

17 Q The overall tool outer diameter?

18 A Yes.

19 Q The gravel slurry itself?

20 A Yes. The sand, the carrier fluid, yes.

21 Q The gravel size?

22 A Yes.

1 Q The gravel density?

2 A Yes.

3 Q The friction of the slurry?

4 A Yes.

5 Q The shunt tube weight?

6 A Not just the shunt tube weight, but the
7 weight of everything.

8 Q The cost?

9 A Yes.

10 Q And when designing a shunt tube assembly,
11 one must also account for various performance
12 metrics as well, correct?

13 A What do you mean by "performance metrics"?

14 Q Such as the gravel slurry pumping rate?

15 A Well, yes.

16 Q The friction pressure loss?

17 A Yes.

18 Q The leak-off from the gravel slurry?

19 A Yes.

20 Q The burst pressure?

21 A Burst pressure of the tubes?

22 Q Yes.

1 A Yes.

2 Q The erosion resistance?

3 A Yes.

4 Q The assembly or installation time?

5 A Yes.

6 Q The fact that you need to maintain
7 effective production through the primary flow
8 path?

9 A During the gravel pack operation or --

10 Q Yes.

11 A At the end or during the operation, yes.

12 Q How do the -- so we talked about design
13 parameters and performance metrics. How do the
14 design parameters we discussed affect the
15 performance metrics?

16 A The performance metrics of the production
17 or -- from the well?

18 Q Of the assembly.

19 A Of the -- just the assembly. The
20 performance metrics of the -- that you mentioned
21 of the --

22 Q Well, we talked about the gravel slurry

1 pumping rate, the friction pressure loss, the
2 burst pressure, the leak-off --

3 A Yes.

4 Q -- the assembly install time. How do the
5 design parameters we discussed affect those
6 performance metrics?

7 A They all have to work together. All those
8 have to work together to get your optimum design.
9 That's why we have computer programs, that's why
10 we did all the laboratory testing for the last 35
11 years on this.

12 Q Is it a complicated process?

13 A I wouldn't say it's complicated, you know.
14 Fluid hydraulics are what is Petroleum
15 Engineering 101. It's what we do every day.
16 Nozzles are in every piece of our business. It's
17 just part of what we do. All those exact same
18 things you mentioned are in casing design pretty
19 much.

20 MR. WALTERS: I don't have any further
21 questions. I'll pass the witness.

22 MR. WILSON: We don't have any questions,

1 but we reserve the right to read and sign.

2 MR. WALTERS: Can we talk about that for a
3 second? We can go off the record.

4 MR. WILSON: Sure. Yeah, let's go off the
5 record.

6 (Deposition concluded at 12:13 p.m.)
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CHANGES AND SIGNATURE
MICHAEL R. CHAMBERS, SR.
WEDNESDAY, JULY 2, 2025

PAGE/LINE	CHANGE	REASON

1 I, MICHAEL R. CHAMBERS, SR., have read the
2 foregoing deposition and hereby affix my signature
3 that same is true and correct, except as noted
4 herein.

5
6 MICHAEL R. CHAMBERS, SR.

7 STATE OF _____)

8 COUNTY OF _____)

9 Before me, _____, on this
10 day personally appeared MICHAEL R. CHAMBERS, SR.
11 known to me (or proved to me under oath through
12 _____ (description of
13 identity card or other document) to be the person
14 whose name is subscribed to the foregoing
15 instrument and acknowledged to me that they
16 executed the same for the purposes and
17 consideration therein expressed.

18 Given under my hand and seal of office
19 this _____ day of _____, 2025.

20
21 NOTARY PUBLIC IN AND FOR
THE STATE OF _____

22 My Commission Expires: _____

1 CERTIFICATE OF SHORTHAND REPORTER

2

3 I, Micheal A. Johnson, Certified Reporter
4 and Notary Public within and for the State of
5 Texas do hereby certify:

6 That MICHAEL R. CHAMBERS, SR., with
7 witness whose deposition is hereinbefore set
8 forth, was duly sworn by me before the
9 commencement of such deposition and that such
10 deposition was taken before me and is a true
11 record of the testimony given by such witness.

12 I further certify that the adverse party,
13 Weatherford U.S., L.P., was represented by counsel
14 at the deposition.

15 I further certify that the deposition of
16 MICHAEL R. CHAMBERS, SR. occurred remotely at the
17 location of the witness on Wednesday,
18 July 2, 2025, commencing at 10:01 a.m. to
19 12:13 p.m.

20 I further certify the inspection, reading
21 and signing of said deposition was not waived on
22 the record by agreement of all parties.

1 I further certify that I am not related to
2 any of the parties to this action by blood or
3 marriage, I am not employed by or an attorney to
4 any of the parties to this action, and that I am
5 in no way interested, financially or otherwise, in
6 the outcome of this matter.

7 IN WITNESS WHEREOF, I have hereunto set my
8 hand this 5th day of July, 2025.

9
10
11 

12 MICHEAL A. JOHNSON, RDR, CRR

13 NOTARY PUBLIC IN AND FOR

14 THE STATE OF TEXAS
15
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ERRATA SHEET

Case Name: *Weatherford U.S., L.P. v. Halliburton Energy Services, Inc.*
Case No.: IPR2024-00990
Witness Name: Michael R. Chambers, Sr.
Deposition Date: July 2, 2025

[illegible]

I, the undersigned, do hereby certify that I have read the foregoing transcript, and the same is a correct and complete transcription of the testimony given by me with the exception of the corrections listed above.

Date: July 11, 2025


Michael R. Chambers, Sr.