

DECLARATION PART 3

This section of my declaration addresses Grounds 8-9 and 10, as follows:

Declaration Part	Summary	Description
Part 3 (Ex. 1002-3)	Grounds 8-9	<i>Krupa</i> (§§ 102/103 against All Claims)
	Ground 10	<i>Krupa</i> , <i>FS-Video</i> , and <i>Al-Salmani</i> (§ 103 against All Claims)

C. GROUND 8 AND 9: KRUPA ANTICIPATES OR RENDERS OBVIOUS ALL CLAIMS

610. It is my opinion that *Krupa* discloses or at least renders obvious each claim of the '952 Patent obvious. *Krupa* is directed towards automating hydraulic fracturing systems and pumping.³³⁰

611. *Krupa* discloses a variety of overlapping concepts, as outlined in the sections below, including the use of manifolds and zipper valves, displays or HMIs, valve sequencing based on sensor data, computerized controllers, and well-known components of fracturing such as piping, blenders, pumps and wellheads.

612. *Krupa* teaches automating valve operations based on monitored fluid conditions. *Krupa* teaches, when describing the sequence of valve operations, that when “flowrate is reduced to 5-15 bbl/min” and pressure has stabilized, “the software application may move the fracturing pumping plan to the next step,”

³³⁰ *Krupa*, Cover.

including, for example, opening the second valve.³³¹ *Krupa* teaches that, in addition to flowrate and stabilized pressure, sensors may include “acoustic, piezoelectric, accelerometers, temperature, pressure, weight, position, *or any sensor in the art* to detect and monitor the plurality of devices.”³³² *Krupa* further teaches “the plurality of sensors 111 may communicate with the software application ... to automate the plurality of devices, such as a valve” including “an automated valve sequencing (e.g., when to open and close) during completion stage based on pre-approved sequence.”³³³

613. *Krupa* teaches explicit flowrate thresholds to determine the valve operations to conduct and that “valve sequencing” and automation can be the result of data from many different fluid conditions, including the sensor-measured conditions listed above. Further, *Krupa* teaches an explicit set of valve sequencing, including the specific open/close sequencing claimed in the '952 Patent.

614. *Krupa* teaches the advantages of automating hydraulic fracturing operations, including valve sequencing. These advantages include overcoming challenges with conventional fracturing systems such as increased speed, reduced human error, and less damage to equipment.³³⁴ *Krupa* teaches this is a result of

³³¹ *Krupa*, [0042].

³³² *Krupa*, [0024] emphasis added.

³³³ *Krupa*, [0037].

³³⁴ *Krupa*, [0016].

“sensors working in conjunction with built hydraulic fracturing system” to, at least, automate a particular valve sequence based off of flowrate thresholds and stabilized pressure.³³⁵

615. *Krupa* provides several examples (i.e. one or more embodiments) demonstrating “specific details [that] are set forth to provide a more thorough understanding of the claimed subject matter,” but “other embodiments can be devised which do not depart from the scope of the invention as disclosed.”³³⁶ Throughout the specification, *Krupa* discloses “in one or more embodiments” or “in some embodiments”. A POSITA would have understood from these disclosures that the disclosure of *Krupa* is not tied directly to a single embodiment, and that, absent a specific teaching otherwise, disclosures from different embodiments could be combined with a reasonable expectation of success.

616. Further *Krupa* explains that “well-known features have not been described in detail to avoid unnecessarily complicating the description.”³³⁷

³³⁵ *Krupa*, [0016].

³³⁶ *Krupa*, [0012], [0061].

³³⁷ *Krupa*, [0012].

1. INDEPENDENT CLAIM 1

617. It is my opinion that *Krupa* discloses or at least renders obvious Claim 1 of the '952 Patent. Details regarding the specific disclosures of *Krupa* are contained in the subsections following.

a. 1.1: “A method of hydraulically fracturing a plurality of wells, the plurality of wells comprising first and second wells, the method comprising:

618. To the extent the preamble is limiting,³³⁸ *Krupa* discloses systems/methods for “automated and intelligent frac pumping” for hydraulically fracturing a plurality of wells, including a first and second well.³³⁹ A POSITA would have recognized “frac pumping” to refer to pumping as part of hydraulic fracturing. *Krupa* further describes “a built hydraulic fracturing system ... in fluid combination with one or more wells” as well as “instructions to perform at least one continuous pumping operations for the one or more wells.”³⁴⁰ Therefore, *Krupa* discloses systems and methods for hydraulic fracturing first and second wells.

619. Accordingly, *Krupa* discloses Limitation 1.1.

³³⁸ I understand that the preambles may not be limiting. However, I include analysis of the preamble for Claim 1 out of an abundance of caution.

³³⁹ *Krupa*, Title, Abstract, Fig. 1.

³⁴⁰ *Krupa*, Abstract, Fig. 1.

b. 1.2: “communicating fluid from one or more pumps to the first well via a manifold and a first valve, wherein the first valve is associated with both the first well and the manifold so that the first valve is: in fluid communication with the manifold; and fluidically positioned between the first well and the one or more pumps; and”

(1)communicating fluid from one or more pumps to the first well via a manifold and a first valve,

620. *Krupa* discloses “[t]he hydraulic fracturing pumping system 100 may further include at least one pump manifold 103 in fluid communication with the zipper manifold 102. In use, the at least one pump manifold 103 *may be fluidly connected to and receive pressurized fracking fluid from one or more high pressure pumps* (not shown), and direct that pressurized fracking fluid to the zipper manifold 102, which may include *one or more valves* that may be closed to isolate the wellhead assembly 101 from the flow of pressurized fluid within the zipper manifold 102 and pump manifold 103.”³⁴¹ Further, *Krupa* teaches that it was known in the art that fracturing systems contained “one or more high-pressure, high-volume fracturing pumps”.³⁴²

³⁴¹ *Krupa*, [0019], emphasis added.

³⁴² *Krupa*, [0014].

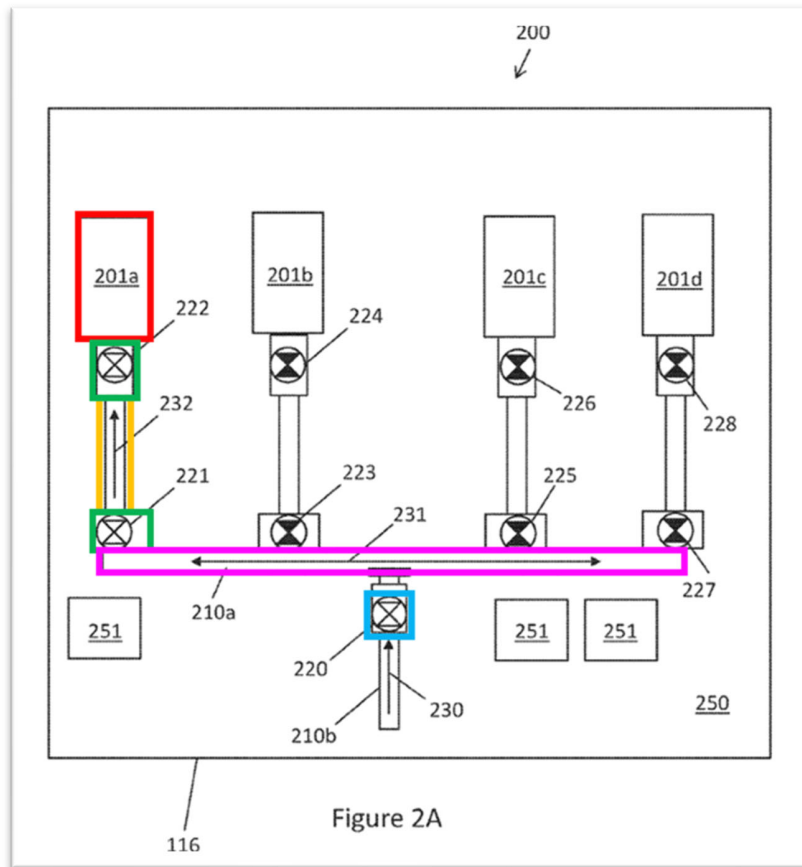
and efficiency (TE) or zipper manifold 102 through one or more flow lines (not shown).”³⁴³ *Krupa* further teaches that “zipper manifold 102 ... may include one or more valves that may be closed to isolate the wellhead assembly 101 from the flow of pressurized fluid within the zipper manifold 102 and pump manifold 103.”³⁴⁴ A POSITA would have understood that the flow lines (not shown) connect between the first wellhead and manifold 102 via the “one or more valves” that are a part of manifold 102 so that the “valves may be closed to isolate the wellhead assembly 101” from manifold 102. Accordingly the first valve is associated with both the manifold and the first well.

(3) so that the first valve is: in fluid communication with the manifold; and fluidically positioned between the first well and the one or more pumps; and”

623. In order to pump fluids from one or more pumps (and therefore communicate the fluid) into a first well (annotated in red) via both the manifold (210a, annotated in magenta) and a first set of valves (annotated in green), the valves must necessarily be associated with both the manifold and the first well. Fig. 2A of *Krupa* shows this configuration of the hydraulic fracturing system.

³⁴³ *Krupa*, [0019].

³⁴⁴ *Krupa*, [0019]; see also [0021] “the valves of the at least one wellhead assembly 101 and zipper manifold 102 may be gate valves that may be actuated, but not limited to, electrically, hydraulically, pneumatically, or mechanically.”



Krupa, Figure 2A (annotated)

624. Fig. 2A shows that first set of valves (annotated in green) is associated with both the first well 201a (annotated in red) and the manifold (210a, annotated in magenta) so that the first valve is: in fluid communication with the manifold; and fluidically positioned between the first well and the one or more pumps (connected to primary manifold connection 210b in the hydraulic fracturing pumping system 200). As *Krupa* explains, the “built hydraulic fracturing pumping system (see 100 of Fig.1)” contains a manifold connection 210a that “may fluidly couple each wellhead assembly 201a-201d to a primary manifold connection 210b of a pump

manifold (see 103 of FIG. 1).”³⁴⁵ The “hydraulic fracturing pumping system 100 may further include at least one pump manifold 103 in fluid communication with the zipper manifold 102. In use, the at least one pump manifold 103 may be fluidly connected to and receive pressurized fracking fluid from one or more high pressure pumps (not shown), and direct that pressurized fracking fluid to the zipper manifold 102, which may include one or more valves that may be closed to isolate the wellhead assembly 101 from the flow of pressurized fluid within the zipper manifold 102 and pump manifold 103.”³⁴⁶

625. *Krupa* discloses, for illustrative purposes in Figures 2A – 2G “closed valves are shown as blacked out while open valves are shown having no fill, thereby indicating the available path of fluid flow (see arrows 230-235) through the system.”³⁴⁷ As shown in Fig. 2A, the valves 221 and 222 (annotated in green) which allow flow of fracturing fluid into wellhead 201a (annotated in red, associated with the first well) are open, thus allowing fluid to be communicated to the first well via manifold 210a and valves 221 and 222. Accordingly, the first valve is in fluid communication with the manifold and fluidically positioned between the first well and the one or more pumps.

³⁴⁵ *Krupa*, [0038].

³⁴⁶ *Krupa*, [0019].

³⁴⁷ *Krupa*, [0040].

626. Accordingly, *Krupa* discloses the limitations of 1.2.

c. 1.3: “executing a continuous pumping (“CP”) swap to transition from hydraulically fracturing the first well to hydraulically fracturing the second well, the CP swap comprising:”

627. *Krupa* discloses executing a continuous pumping swap (“CP”) swap to transition from hydraulically fracturing the first well to hydraulically fracturing the second well as it is described in Claim 1. The specification of the ’952 Patent does not provide a specific definition for “continuous pumping” or “continuous pumping swap,” but rather describes various steps that may be a part of the CP swap. Claim Limitation 1.3 provides that a CP swap is executed and the subsequent claim language is used to define a “CP Swap” for purposes of Claim 1 and its dependent claims. Accordingly, I use the steps defined in Claim 1 as the definition of a CP swap in my analysis.

628. In *Krupa*’s automated hydraulic fracturing system, “[a]utomatic hydraulic fracturing pumping may be used, for example, to plan and execute hydraulic fracturing pumping operations *from one well to another well*. Further, automatic hydraulic fracturing pumping may be used for continuous non-stop pumping for one or more wells.”³⁴⁸

³⁴⁸ *Krupa*, [0017].

629. *Krupa* teaches that the valve sequences described in the subsections below are part of a “continuous pumping” sequence. *Krupa* teaches “embodiments herein and as described above may be configured to allow the continuous pumping of fluids, connecting the initial and terminal ‘cleaning’ portions of the frac operations of a first well and a second well, respectively. This will allow operations to not have to shut down and/or idle pumps while bleeding pressure.”³⁴⁹ FIGS. 2A-2G of *Krupa* show “continuous hydraulic fracturing pumping operations between the wellhead assemblies 201a – 201d” where the sequence of the fracturing pumping plan “may be conducted between any of the wellhead assemblies 201a-201d in any order.”³⁵⁰ Additionally, *Krupa* explains that one of the benefits of the *Krupa*’s continuous pumping operation according to the fracturing pumping plan of FIGS. 2A-2G is a transition time between stages that may be effectively zero.³⁵¹

630. Further, the control system described by *Krupa* and represented in FIGS. 2A – 2G “may include a sequence of valve operations to direct fluid flow through a selected path in one or more of the wellhead assemblies and manifolds on the frac pad, with the sequence of valve operations being automatically controlled by the software through a valve control system associated with the valves.”³⁵² As

³⁴⁹ *Krupa*, [0058]

³⁵⁰ *Krupa*, [0046].

³⁵¹ *Krupa*, [0046].

³⁵² *Krupa*, [0036].

described in the subsections below, *Krupa* discloses, or at least renders obvious, each and every limitation of the CP swap of Limitation 1.3, including swapping from hydraulically fracturing a first well to hydraulically fracturing the second well.

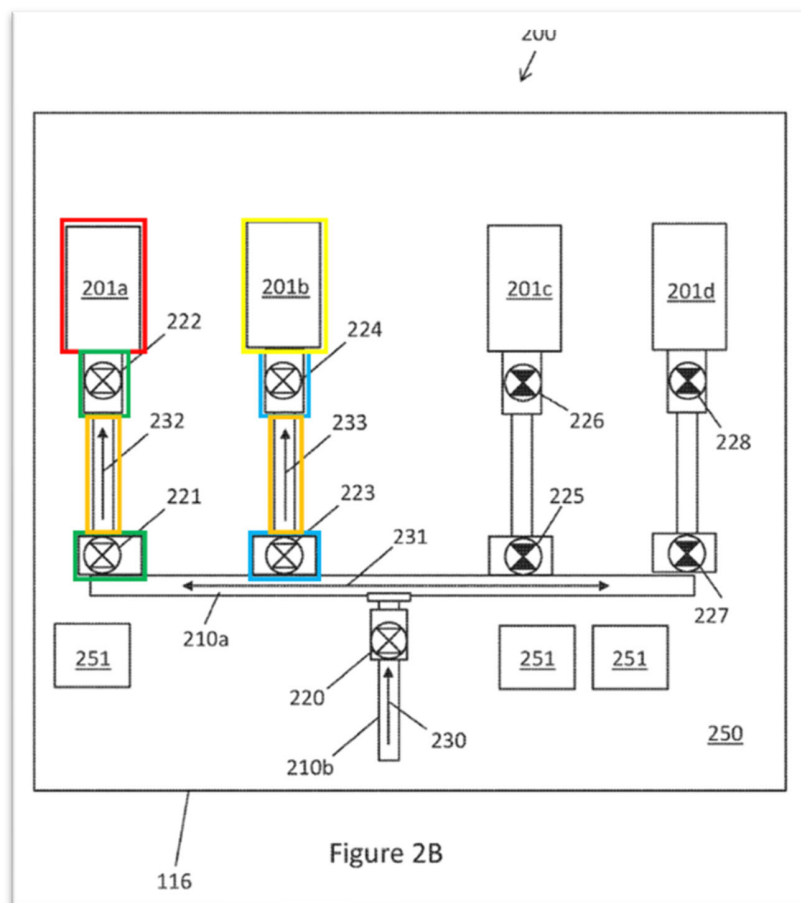
d. 1.3.1: “opening a second valve while fluid is communicated from the one or more pumps to the first well via the first valve and the manifold, wherein the second valve is associated with both the second well and the manifold so that the second valve is: in fluid communication with the manifold; and fluidically positioned between the second well and the one or more pumps from which fluid is communicated to the first well via the manifold and the first valve, wherein opening the second valve causes fluid to be communicated from the one or more pumps to the second well via the manifold and the second valve, and”

(1) opening a second valve while fluid is communicated from the one or more pumps to the first well via the first valve and the manifold,

631. *Krupa* discloses this limitation. *Krupa* teaches “pumping the fluids into a second well via the at least one pump manifold while continuously pumping the fluids into the first well *by opening a second set of valves* [claimed second valve].”³⁵³

632. This configuration of the hydraulic fracturing system is shown in Fig. 2B.

³⁵³ *Krupa*, [0005] (emphasis added).



Krupa, Figure 2B

633. In Fig. 2B, valves 223, 224 (annotated in blue) are opened while valves 221, 222 (annotated in green) are still open. This allows fracturing fluid flow both into first wellhead 201a (annotated in red) and second wellhead 201b (annotated in yellow). *Krupa* teaches further “[a] hydraulic fracturing system 200 may include a first wellhead assembly 201a of a first well” and “a second wellhead assembly 201b

of a second well,” and thus the fracturing fluid flowing through the wellheads with appropriate valves open would enter the associated wells.³⁵⁴

634. Further, *Krupa* teaches “[w]ith both the first set of valves 221, 222 and the second set of valves 223, [claimed second valve] 224 open, the flush fluid flows (see arrows 232, 233) [annotated in orange] into both the first wellhead assembly and the second wellhead assembly 201b.”³⁵⁵ Although not required by this claim, a POSITA would have recognized the “flush fluid” described by *Krupa* to be the “pad” fracturing fluid, or proppant free fluid, which flows into the well at the beginning of the fracturing stage to initiate fractures, and at the end of the stage to flush the wellbore of any remaining proppant.³⁵⁶ This would be a “fracturing fluid.” *Krupa* also discloses using its automated fracturing pumping systems/methods to “direct fluids (e.g., frac fluid) in a selected path” using the valve sequencing, where “fluids may refer to slurries, liquids, gases, and/or mixtures thereof,” and “solids may be present in the fluids.”³⁵⁷

³⁵⁴ *Krupa*, [0038].

³⁵⁵ *Krupa*, [0043].

³⁵⁶ See, e.g., *Krupa*, [0042] (“The flush fluid may be fresh water and cleaning agents to flush out excess fracturing fluids (e.g., proppant) in the well of the first wellhead assembly 201a.”)

³⁵⁷ *Krupa*, [0018].

635. Accordingly, *Krupa* discloses opening a second valve while fluid is communicated from the one or more pumps to the first well via the first well and the manifold.

(2) wherein the second valve is associated with both the second well and the manifold so that the second valve is: in fluid communication with the manifold; and

636. As discussed above, the fluid flows from the pumps through the manifold 210a and through the second valves 223, 224 and into the well associated with wellhead 201b.³⁵⁸ Thus, *Krupa* teaches that a second valve (223 or 224) is associated with both the second well (associated with wellhead 201b) and the manifold (via manifold connection 210a) and in fluid communication with the manifold.

(3) and fluidically positioned between the second well and the one or more pumps from which fluid is communicated to the first well via the manifold and the first valve,

637. *Krupa* teaches that the second valve (223 or 224, annotated in blue below) communicates fluid from manifold 210a (annotated in magenta) to the second well (associated with 201b, annotated in yellow). Further, *Krupa* teaches that flow through manifold 210a comes from manifold connection 210b of a pump manifold (e.g. 103). Further, *Krupa* discloses that “pump manifold 103 *may be*

³⁵⁸ See e.g., *Krupa*, [0043], Figs. 2A-2B.

Figure 2B is a schematic diagram of a fluid distribution system 200. The system includes a main horizontal supply line 210a with a central valve 220 and a vertical inlet 230. Four vertical branches lead to storage tanks 201a, 201b, 201c, and 201d. Each branch contains a valve (221, 222, 226, 228) and a flow indicator (231, 232, 233, 234). Two additional tanks 251 are connected to the main line via a side branch 210b. The entire assembly is labeled 250.

second valve 223/224 is located fluidical

308

Krupa supply fluid to manifold 201a through pump manifold (103) and pump manifold connection 201b, the second valve is also fluidically positioned between the second well and the same one or more pumps from which fluid is communicated to the first well via the manifold and the first valve.

(4) wherein opening the second valve causes fluid to be communicated from the one or more pumps to the second well via the manifold and the second valve,

639. *Krupa* teaches “pumping the fluids into a second well via the at least one pump manifold while continuously pumping the fluids into the first well *by opening a second set of valves* [claimed second valve].”³⁵⁹ Further, as discussed above, *Krupa* teaches that “a second set of valves 223, 224 may be opened while the first set of valves 221, 222 remain open during the pumping of the flush fluid. With both the first set of valves 221, 222 and the second set of valves 223, 224 open, the flush fluid flows (see arrows 232, 233) into both the first wellhead assembly 201a and the second wellhead assembly 201b.”³⁶⁰

640. *Krupa*, then, teaches that opening the second valve causes fluid to be communicated from the one or more pumps to the second well via the manifold and the second valve.

641. Accordingly, *Krupa* discloses the limitations of 1.3.1.

³⁵⁹ *Krupa*, [0005] (emphasis added).

³⁶⁰ *Krupa*, [0043].

- e. **1.3.2: “wherein the second valve is opened in response to at least a portion of fluid communicated via the manifold satisfying one or more conditions, which one or more conditions include a flow rate, and/or a pressure, of the at least a portion of fluid communicated via the manifold; and”**

642. *Krupa* discloses this limitation, or at least renders it obvious.

643. *Krupa* teaches the use of sensors to make the hydraulic fracturing plan more efficient (*i.e.* faster). *Krupa* discloses “a plurality of sensors working in conjunction with built hydraulic fracturing system may streamline and improve efficiency as compared with conventional hydraulic fracturing systems.”³⁶¹ Further, *Krupa* discloses “the plurality of sensors may, for example, monitor pressure data at a high sample rate to capture high pressure events for compliance and safety requirements. Additionally, the fracturing plan 301 may include a time to complete processes for each stage and the plurality of sensors may further provide information to modify said plans (301, 303) to improve operational efficiency.”³⁶² These sensors include “acoustic, piezoelectric, accelerometers, temperature, *pressure*, weight, position, *or any sensor in the art to detect and monitor the plurality of devices*,” and the “plurality of sensors 111 may be any sensor or device capable of wireline monitoring, valve monitoring, pump monitoring, flow line monitoring, accumulators

³⁶¹ *Krupa*, [0016].

³⁶² *Krupa*, [0055].

and energy harvesting, and equipment performance and damage.”³⁶³ Accordingly, a POSITA would have recognized that *Krupa* teaches these sensors include those for detecting pressure conditions (pressure sensors) and flowrate conditions (flow line monitoring sensors). Further, *Krupa* teaches monitoring the pump rate of the fluid being pumped via the manifold to the wells (e.g., monitoring/determining a full pump rate of about 50-150 bbl/min and a reduced pump rate of 5-15 bbl/min). A POSITA would have understood that pump rate is commonly used to monitor the flowrate of fluid being pumped into well(s) as the pump rate correlates to the flowrate. A POSITA would also have recognized that the fluid is being communicated to the well via the manifold.

644. *Krupa* further teaches “the plurality of sensors 111 may communicate with the software application [] to automate the plurality of devices, such as a valve” including “an automated valve sequencing (e.g., when to open and close) during completion stage based on pre-approved sequence.”³⁶⁴ *Krupa*’s teaching of using sensor data (including pressure conditions and flowrate conditions) to automate valve sequencing, such as the specific sequencing disclosed in *Krupa* as discussed above and below, disclosed, or at least would have rendered obvious performing the switching of *Krupa* (opening second valve while the first valve is still open) based

³⁶³ *Krupa*, [0024].

³⁶⁴ *Krupa*, [0037].

on a flowrate and/or a pressure condition in order to accomplish *Krupa*'s disclosed automated valve sequencing based on sensor communications with the software application.

645. *Krupa* teaches “[t]he method may also include pumping the fluids into a second well via the at least one pump manifold while continuously pumping the fluids into the first well *by opening a second set of valves* [claimed second valve].”³⁶⁵ The move to open the second set of valves is triggered by determining at least a portion of the fluid communicated via the manifold has satisfied one or more conditions. For example, *Krupa* discloses using flow conditions to determine the state of the fracturing job: *Krupa* teaches pumping fluid into the well “at a full pump rate of about 50-150 bbl./min,” and then at a reduced pump rate of 5-15 bbl./min.³⁶⁶ “Once a pressure has stabilized at the reduced pump rate, the software application may move the fracturing pumping plan to the next step.”³⁶⁷ Thus, *Krupa* teaches that once the pumping flowrate is reduced to 5-15 bbl/min (flowrate condition) and pressure is stabilized (pressure condition) the system determines that the fracturing job is at the end of that particular stage, and triggers “mov[ing] the fracturing pumping plan to the next step.”³⁶⁸ *Krupa*'s disclosure of, at least, “a pump rate may

³⁶⁵ *Krupa*, [0005] (emphasis added).

³⁶⁶ *Krupa*, [0042].

³⁶⁷ *Krupa*, [0042].

³⁶⁸ *Krupa*, [0042].

be reduced to 5-15 bbl/min” and “once the pressure has stabilized at the reduced pump rate” is an example of at least a portion of the fluid communicated via the manifold 201a satisfying one or more conditions, including both a flowrate and a pressure condition.

646. Accordingly, *Krupa* discloses the second valve (223/224) is opened in response to at least a portion of the fluid communicated via the manifold (210a) satisfying one or more conditions, which one or more conditions include a flow rate (*e.g.*, 5-15 bbl/min) and a pressure (*e.g.*, stabilized pressure) of the at least a portion of the fluid communicated via the manifold. Thus, *Krupa* discloses the limitations of 1.3.2.

647. To the extent that the Board determines that *Krupa* does not explicitly teach opening the second set of valves in response to the fluid meeting a condition (which it does), it would have been obvious to a POSITA to open the second valve in response to at least a portion of the fluid communicated via the manifold satisfying one or more conditions including flow and/or pressure conditions based on the teaching of *Krupa* above regarding opening the second valve once flowrate has been reduced (*e.g.* between 5 and 15 bbl/min) and once pressure has stabilized.

648. Further, *Krupa* teaches “[a]utomatic hydraulic fracturing pumping may be used, for example, to plan and execute hydraulic fracturing pumping operations from one well to another well. Further, automatic hydraulic fracturing pumping may

be used for continuous non-stop pumping for one or more wells.”³⁶⁹ With regard to Fig. 1 (which a POSITA would have been motivated to combine with the teachings of Figs. 2A – 2G as described above), “[i]n some examples, the plurality of sensors may provide information such that a current state of the hydraulic fracturing operation.”³⁷⁰ A POSITA would have recognized, based on the well-known conditions at the end of a fracturing stage, such as reduced flow and stabilized pressure (e.g., after the water hammer has settled out, *see* Sections XI.E-XI.F) that reduced flow and the resulting stabilized pressure (e.g., as measured by the sensors) would indicate the end of a stage, and that, combined with *Krupa*’s teaching of “continuous pumping” when switching between stages and wells that it would have been time to move to the next stage of the fracturing operation (i.e. open the second valve). Accordingly, it would have been obvious to a POSITA, based on the teaching of *Krupa* alone, to open the second valve in response to at least a portion of fluid communicated via the manifold (e.g. the portion going to the first well) satisfying one or more conditions, which one or more conditions include a flow rate, and/or a pressure, of the at least a portion of fluid communicated via the manifold.

649. Thus, *Krupa* discloses, or at least renders obvious, Limitation 1.3.2.

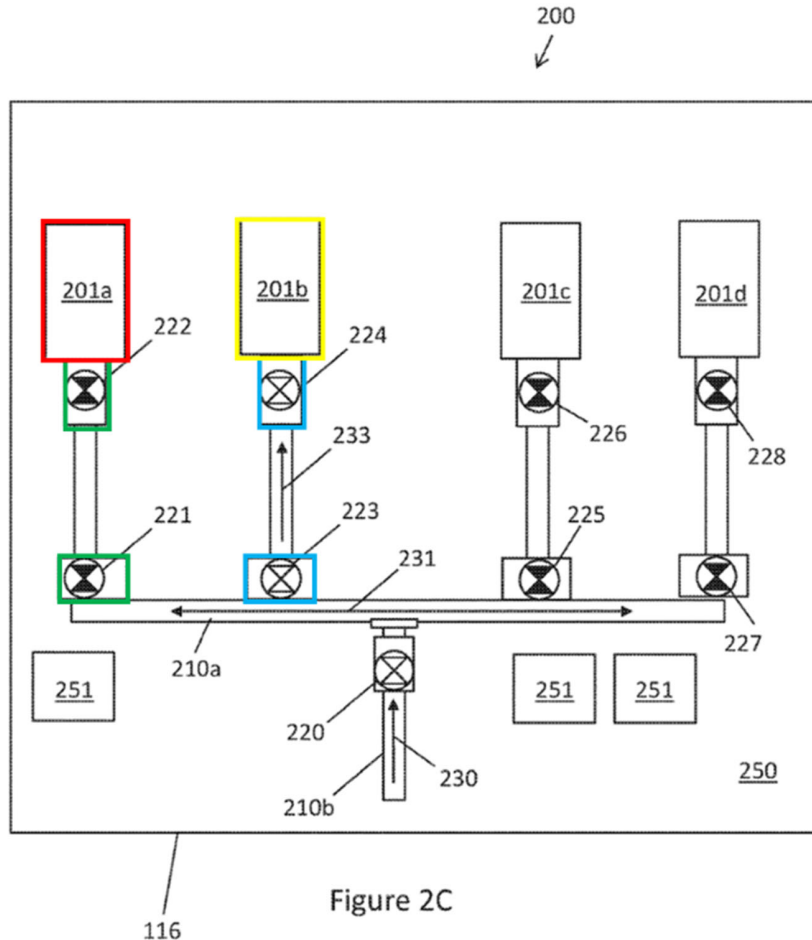
³⁶⁹ *Krupa*, [0016].

³⁷⁰ *Krupa*, [0026].

- f. 1.3.3: “closing the first valve: after the at least a portion of fluid communicated via the manifold has satisfied the one or more conditions, which one or more conditions include the flow rate, and/or the pressure, of the at least a portion of fluid communicated via the manifold, and”**

650. *Krupa* discloses this limitation. Initially, I note that Limitation 1.3.3 only claims closing the first valve “after” the fluid has met the one or more conditions, not “in response to” the fluid meeting the one or more conditions. *Krupa* teaches “a second set of valves 223, 224 may be opened while the first set of valves 221, 222 remain open during the pumping of the flush fluid. With both the first set of valves 221, 222 and the second set of valves 223, 224 open, the flush fluid flows (see arrows 232, 233) into both the first wellhead assembly 201a and the second wellhead assembly 201b. *Once injection is established and pressure has stabilized in both the first wellhead assembly 201a and the second wellhead assembly 201b,* the first set of valves 221, 222 may be closed remotely to shut in the first wellhead assembly 201a, as shown by FIG. 2C.”³⁷¹

³⁷¹ *Krupa*, [0043], emphasis added.



Krupa, Figure 2C (annotated)

651. *Krupa* teaches that the first valve (221/222) is closed after the second valve (223/224) is opened. Further, as discussed above, *Krupa* teaches that the second valve is opened after the fluid has satisfied one or more conditions (e.g., a reduced flowrate and stabilized pressure). Accordingly, because the second valve is opened after (and in response to) the satisfied condition(s) and the first valve is closed after opening the second valve, the first valve is closed after at least a portion of the fluid communicated via the manifold has satisfied the one or more conditions,

which one or more conditions include the flow rate, and/or the pressure (*e.g.*, reduced flowrate and stabilized pressure), of the at least a portion of fluid communicated via the manifold.

652. To the extent the Board finds that *Krupa* does not explicitly teach closing the first valve after at least a portion of the fluid communicated via the manifold has met one or more conditions (it does), it would have been obvious to a POSITA to perform the claimed sequence of valve operations for the same reasons as those described above regarding Limitation 1.3.2.

653. Accordingly, *Krupa* discloses, or at least renders obvious, closing the first valve: after the at least a portion of fluid communicated via the manifold has satisfied the one or more conditions, which one or more conditions include the flow rate, and/or the pressure, of the at least a portion of fluid communicated via the manifold and discloses, or at least renders obvious, Limitation 1.3.3.

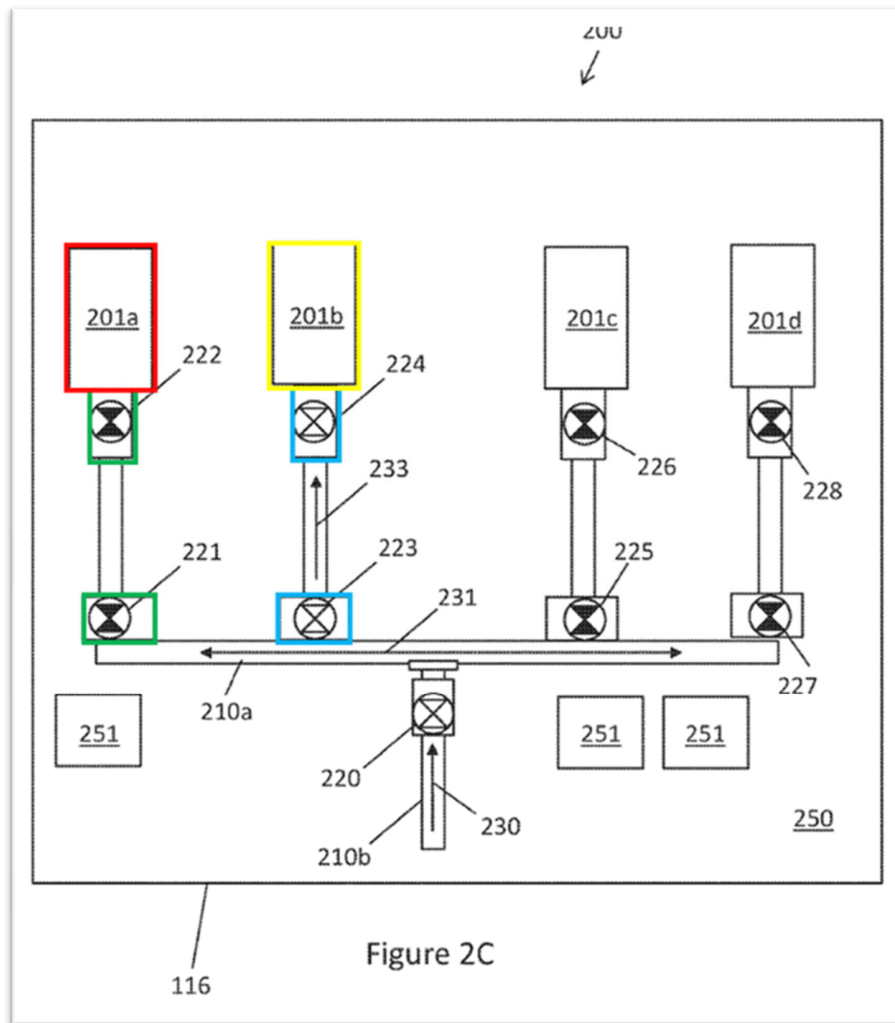
g. 1.3.4: “while fluid is communicated from the one or more pumps to the second well via the second valve and the manifold”

654. *Krupa* discloses this limitation. As discussed above regarding Limitation 1.3.3, *Krupa* teaches that once flowrate and pressure conditions of fluid being pumped into a first well are satisfied, a second set of valves 223/224 are opened while the first set of valves 221/222 remain open during pumping fluid via a

shared manifold.”³⁷² *“Once injection is established and pressure has stabilized in both the first wellhead assembly 201a and the second wellhead assembly 201b, the first set of valves 221, 222 may be closed remotely to shut in the first wellhead assembly 201a,”* while the fluid is continuously pumped from the pumps via the manifold and open second valves to the second well (shown by flow arrows 230, 231, 233), as shown by FIG. 2C.³⁷³

³⁷² *Krupa*, [0043].

³⁷³ *Krupa*, [0043], emphasis added.



Krupa, Figure 2C (annotated)

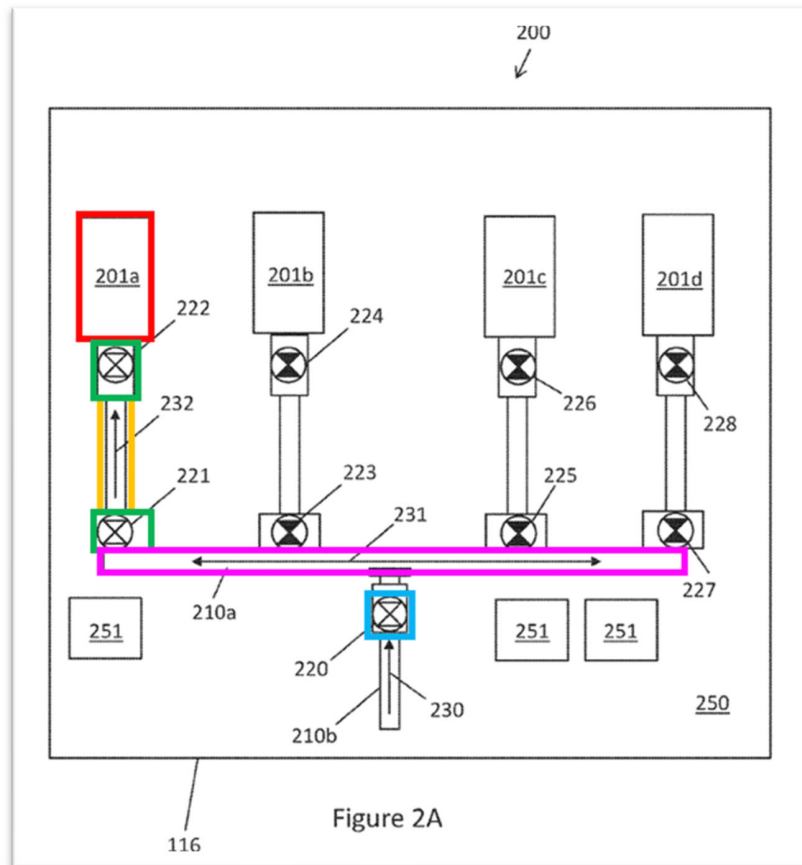
655. In *Krupa*, the first valve (221/222) is closed after the second valve (223/224) is opened and the fluid is communicated (arrow 233) into the second well via the second valve and the manifold (210a). Thus, *Krupa* discloses Limitation 1.3.4.

h. 1.4: “wherein, during the CP swap, the fluid is continuously communicated from the one or more pumps via the manifold.”

656. As described above, during the valve switching process described, and shown in Figures 2A-2C, fluid is continuously communicated via the manifold 210a to the first and second wells (associated with wellheads 201a, 201b) via the first valves (221/222) and second valves (223/224). Fig 2A is shown below as exemplary.³⁷⁴ Arrow 231 shows continuous flow through manifold 210a through the entire fracturing sequence. *Krupa* further discloses “Figs. 2A – 2G may provide continuous hydraulic fracturing pumping operations between the wellhead assemblies 201a-201d.”³⁷⁵

³⁷⁴ See also *Krupa*, Figs. 2B, 2C.

³⁷⁵ *Krupa*, [0046].



Krupa, Figure 2A (annotated)

657. *Krupa* teaches “[a]dvantageously, the transition time between stages may be effectively zero by using the fracturing plan described in Figs. 2A–2G”.³⁷⁶ Accordingly, *Krupa* teaches that during the swap between wells, fluids are continuously pumped (and therefore continuously communicated from the one or more pumps), during the CP swap as disclosed above. Accordingly, *Krupa* discloses

Limitation 1.4

³⁷⁶ *Krupa*, [0046].

658. *Krupa*, therefore, discloses each and every limitation of Claim 1 and anticipates and/or renders obvious Claim 1.

**2. DEPENDENT CLAIM 2: “THE METHOD OF CLAIM 1, WHEREIN:
THE FIRST VALVE IS A FIRST ZIPPER VALVE; AND/OR THE
SECOND VALVE IS A SECOND ZIPPER VALVE.”**

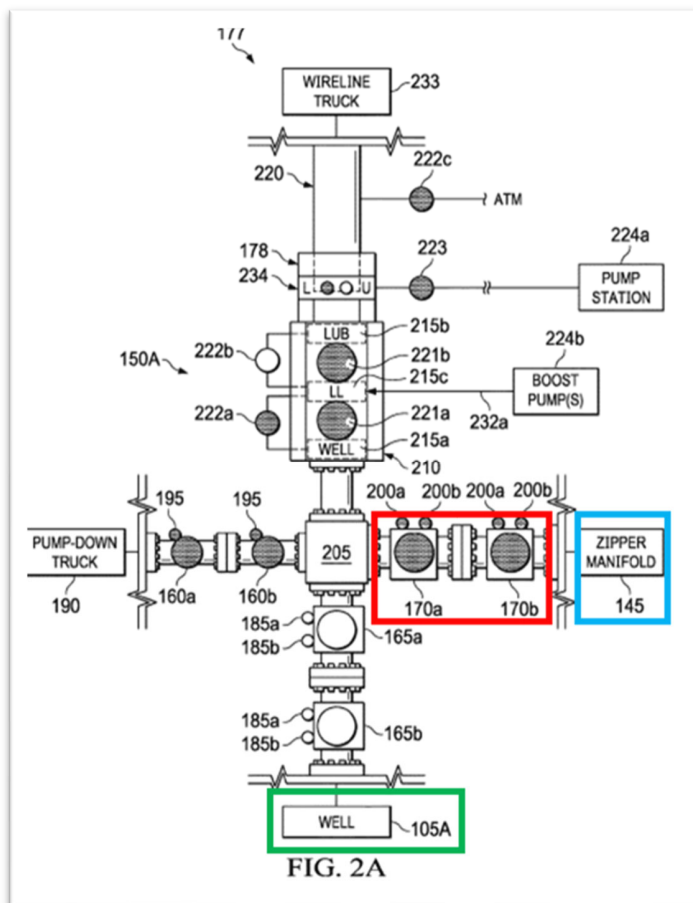
659. Dependent Claim 2 depends from Claim 1. In addition to the discussion above regarding Claim 1, *Krupa* discloses the additional limitations of Claim 2, or at least they would have been obvious to a POSITA.

660. A POSITA would have understood a “zipper valve” to simply be a valve used in a zipper fracturing operation, often in or fluidly connected to a zipper manifold between the pumps and the wellhead. These valves would be used to swap fracturing operations from one wellhead to another as described above in Section XI.C. Zipper fracturing was well known prior to the '952 Patent. The '952 Patent contains little written description of the structure of a “zipper valve” other than indicating zipper valves may be, for example, gate valves, and communicate fluid between the zipper manifold and a well.³⁷⁷ The figures of the '952 Patent show a “zipper valve” consistent with the general knowledge of a POSITA.

661. According to the '952 Patent, in “Figs. 2A through 2G, ... the zipper valves 170a-b (such as, for example, gate valves) operably coupled to, and adapted

³⁷⁷ Ex. 1001 at 7:60-63, 14:9-11, 23-26, 30-34, and 43-48.

communicate fluid between, the zipper manifold 145 [annotated in blue] and the well 105A [annotated in green].”³⁷⁸ Fig 2A is duplicated and annotated below.

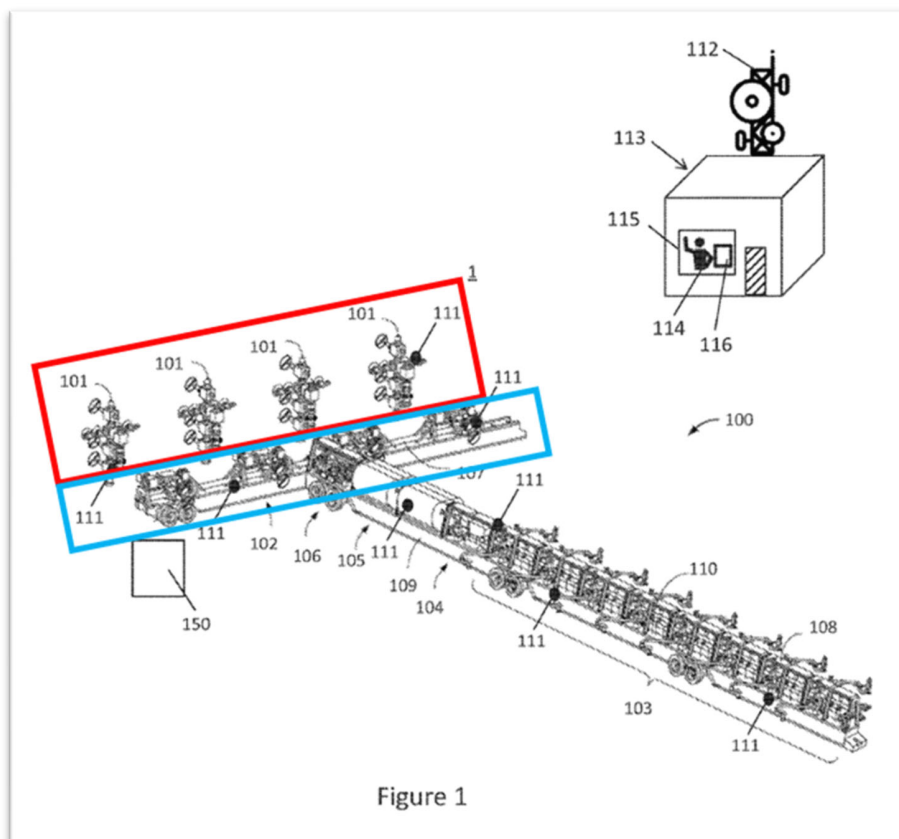


'952 Patent, Figure 2A

662. *Krupa* discloses zipper valves (e.g. 221, 223) in the same location and with the same function as zipper valves 170a-170b of the '952 Patent. Fig. 1 of *Krupa* “shows an automated hydraulic fracturing pumping system,” including “at least one wellhead assembly 101 [annotated in red] (e.g., a Christmas tree) coupled

³⁷⁸ Ex. 1001 at 7:47-8:5.

to at least one time and efficiency (TE) or zipper manifold 102 [annotated in blue] through one or more flow lines (not shown).”³⁷⁹



Krupa, Figure 1 (annotated)

663. Further, *Krupa* discloses valves as part of the zipper manifold, and these valves are used to pump fluid to the wellhead assembly or to isolate the wellhead assembly from the pressurized fluid. “In use, the at least one pump manifold 103 may be fluidly connected to and receive pressurized fracking fluid from one or more

³⁷⁹ *Krupa*, [0019].

high pressure pumps (not shown), and direct that pressurized fracking fluid to the zipper manifold 102, which may include one or more valves that may be closed to isolate the wellhead assembly 101 from the flow of pressurized fluid within the zipper manifold 102 and pump manifold 103.”³⁸⁰

664. A POSITA would have immediately recognized the valves on the zipper manifold of *Krupa* to be “zipper valves,” or valves used to open or isolate a wellhead during a zipper frac operation.³⁸¹ Further, a POSITA would have recognized the valves on the zipper manifold to be the valves depicted with the manifold in Figures 2A–2G as described above regarding Claim 1, *e.g.* valves 221/223 shown annotated in green and blue respectively.

³⁸⁰ *Krupa*, [0019].

³⁸¹ *See* Section XI.C.

666. To the extent that the Board determines that a “zipper valve” is not explicitly disclosed by *Krupa*, then it would have been obvious to a POSITA that the valves associated with zipper manifold 102 (and associated with the wells) would have been “zipper valves,” based on the teachings of *Krupa* regarding sequential or simultaneous (i.e., zipper) fracturing operations and the general engineering knowledge of a POSITA regarding such operations, and the fact that the valves are used to direct flow between wells in a zipper fracturing operations.³⁸²

667. Accordingly, *Krupa* discloses the limitations of Claim 2, and thus Claim 2 would have been obvious and/or anticipated by *Krupa* for the reasons discussed above.

3. DEPENDENT CLAIM 3

668. Dependent Claim 3 depends from Claim 1. In addition to the discussion above regarding Claim 1, *Krupa* discloses the additional limitations of Claim 3, or at least they would have been obvious to a POSITA.

a. 3.1: “The method of claim 1, wherein the plurality of wells further comprises third and fourth wells, and the method further comprises:”

669. *Krupa* discloses a third and fourth well. *Krupa*’s Fig. 1 shows four wellhead assemblies 101 (annotated in red), each of which a POSITA would have

³⁸² See, e.g., Sections XI.C-XI.D.



connected as they would be in the built hydraulic fracturing pumping system (see 100 of FIG. 1).”³⁸³

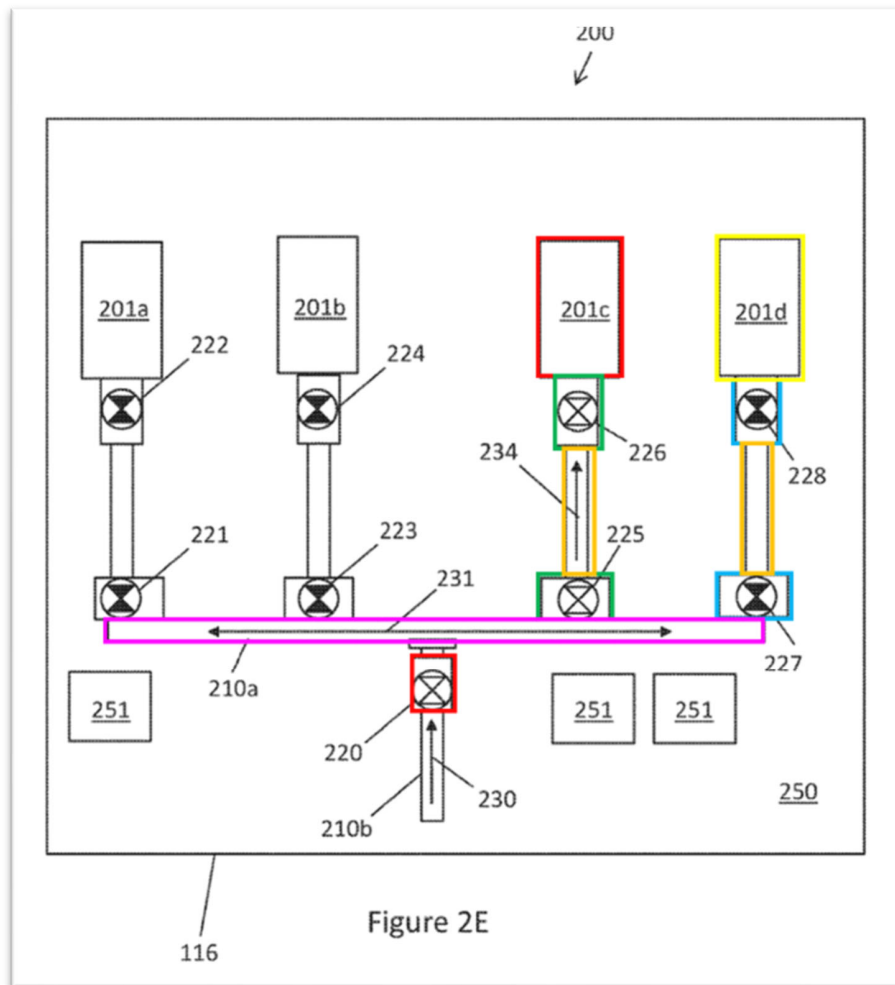
671. Accordingly, *Krupa* discloses Limitation 3.1.

b. 3.2: “communicating fluid to the third well via the manifold and a third valve, wherein the third valve is associated with both the third well and the manifold;”

672. *Krupa* further discloses this limitation. *Krupa* teaches “the fracturing pumping plan may next open a third set of valves 225, [annotated in green, claimed third valve] 226 while the second set of valves 223, 224 are still open. With both the second set of valves 223, 224 and the third set of valves 225, 226 open, the flush fluid flows (see arrows 233, 234) into both the second wellhead assembly 201b and the third wellhead assembly 201c [annotated in red, associated with third well].”³⁸⁴ As shown in Figure 2E, the fluid is communicated to the third well via manifold 210a (annotated in magenta) and third valves 225/226.

³⁸³ *Krupa*, [0038]

³⁸⁴ *Krupa*, [0044].



Krupa, Figure 2E (annotated)

673. As seen in Figure 2E, fluid is communicated to wellhead 201c via manifold 210a and third valve 225/226. Accordingly, the third valve 225/226 is associated with both manifold 210a and the third well (associated with wellhead 201c), as it controls flow between the manifold and the well.

674. Therefore, *Krupa* discloses the limitations of 3.2.

c. 3.3: “wherein executing the CP swap further transitions from hydraulically fracturing the third well to hydraulically fracturing the fourth well, the CP swap further comprising:”

675. *Krupa* discloses executing a continuous pumping swap (“CP”) swap as it is described in Claim 1, and further described in Claim 3. As described above regarding Limitation 1.3, and incorporated herein by reference, *Krupa* teaches a continuous pumping (CP swap). The CP swap steps are outlined in the analysis of Claim 1 with respect to swapping between fracturing a first well to fracturing a second well. However, *Krupa* states that the CP swaps may be conducted between any of first-fourth wells “in any order,” including from a third well to a fourth well.³⁸⁵ Thus, *Krupa* discloses, or at least renders obvious, performing its CP swaps between third and fourth wells, as outlined by Claim 3.

676. As described in the subsections below, *Krupa* discloses each and every additional limitation comprising the “CP” swap of Claim 3.

³⁸⁵ *Krupa*, [0046].

- d. 3.3.1: “opening a fourth valve while fluid is communicated to the third well via the third valve and the manifold, wherein the fourth valve is associated with both the fourth well and the manifold, wherein opening the fourth valve causes fluid to be communicated to the fourth well via the manifold and the fourth valve, and”**

677. *Krupa* discloses this limitation. *Krupa* explains, “[a]s shown by FIG. 2F, the fracturing pumping plan may next open a fourth set of valves 227, [claimed fourth valve] 228 while the third set of valves 225, 226 are still open. With both the third set of valves 225, 226 and the fourth set of valves 227, 228 open, the flush fluid flows (see arrows 234, 235) into both the third wellhead assembly 201c and the fourth wellhead assembly 201d.”³⁸⁶

³⁸⁶ *Krupa*, [0045].

fourth wellhead assembly 201d.”³⁸⁷ Accordingly, opening the fourth valve causes fluid communicated to fourth well (associated with 201d) via the manifold (210a) and fourth valve 227/228, as shown by flow arrow 235.

679. Therefore, *Krupa* discloses Limitation 3.3.1.

- e. 3.3.2: “wherein the fourth valve is opened in response to the at least a portion of the fluid communicated via the manifold satisfying the one or more conditions, which one or more conditions include the flow rate, and/or the pressure, of the at least a portion of the fluid communicated via the manifold; and ”

680. *Krupa* explains that sensors are used to aid in carrying out a fracturing plan, for example, by using collected data “to create real-time logging of operational metrics, such as duration between various stages” and “to determine current job state and provide[] choices for possible stages.”³⁸⁸ *Krupa* also teaches that “[a]fter hydraulic fracturing operations are conducted on the third wellhead assembly 201c, flush fluids may be pumped into the third wellhead assembly 201c *and the pump rate may be reduced once a total volume of the flush fluid has been pumped*. As shown by FIG. 2F, the fracturing pumping plan may next open a fourth set of valves 227, [fourth valve] 228 while the third set of valves 225, 226 are still open.”³⁸⁹

³⁸⁷ *Krupa*, [0045].

³⁸⁸ *Krupa*, [0026].

³⁸⁹ *Krupa*, [0045].

bbl./min, where “[o]nce a pressure has stabilized at the reduced pump rate, the software application may move the fracturing pumping plan to the next step.”³⁹¹ Thus, in one example, after the flowrate into the third well is reduced, and the reduced flowrate and pressure is determined to be stable, the fracturing pumping plan is moved to the next step. A POSITA would have recognized that the specific examples of flowrate thresholds (e.g., 5-15 bbl./min) and pressure stabilization taught by *Krupa* regarding a continuous pumping swap between the first well and second well would be equally applicable to the continuous pump swap between the third and fourth well, particularly since the teachings are in the same embodiment of *Krupa*.

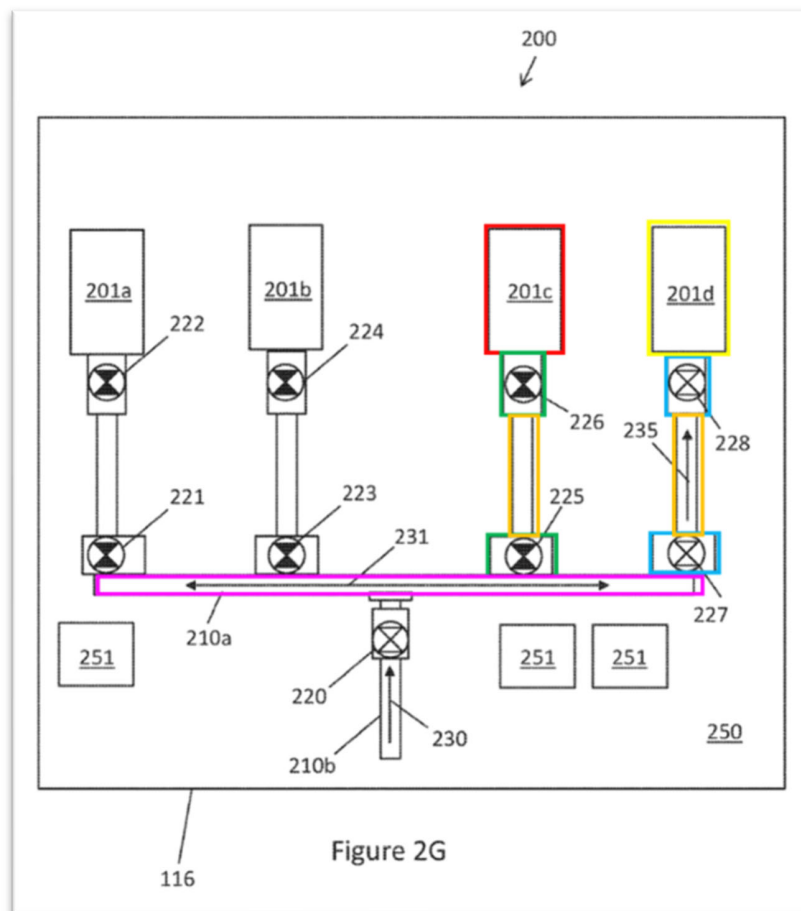
682. Accordingly, *Krupa* discloses the fourth valve is opened in response to the at least a portion of the fluid communicated by the manifold (flow arrow 234) satisfying the one or more conditions (reduced flowrate and stable pressure) which one or more conditions include the flowrate (e.g., reduced flowrate of 5-15 bbl./min.) and the pressure (pressure stable) of the at least a portion of the fluid communicated via the manifold, as claimed in Limitation 3.3.2.

³⁹¹ *Krupa*, [0042].

- f. 3.3.3: “closing the third valve: after the at least a portion of fluid communicated via the manifold has satisfied the one or more conditions, which one or more conditions include the flow rate, and/or the pressure, of the at least a portion of fluid communicated via the manifold, and”**

683. *Krupa* discloses this limitation. *Krupa* teaches that after the fourth valves are opened in response to fluid conditions (e.g., reduced flowrate and stabilized pressure) of fluid pumped to the third well being satisfied, and “[o]nce injection is established and pressure has stabilized in both the third wellhead assembly 201c and the fourth wellhead assembly 201d, the third set of valves 225, 226 may be closed remotely to shut in the third wellhead assembly 201c, as shown by FIG. 2G.”³⁹²

³⁹² *Krupa*, [0045].



Krupa, Figure 2G (annotated)

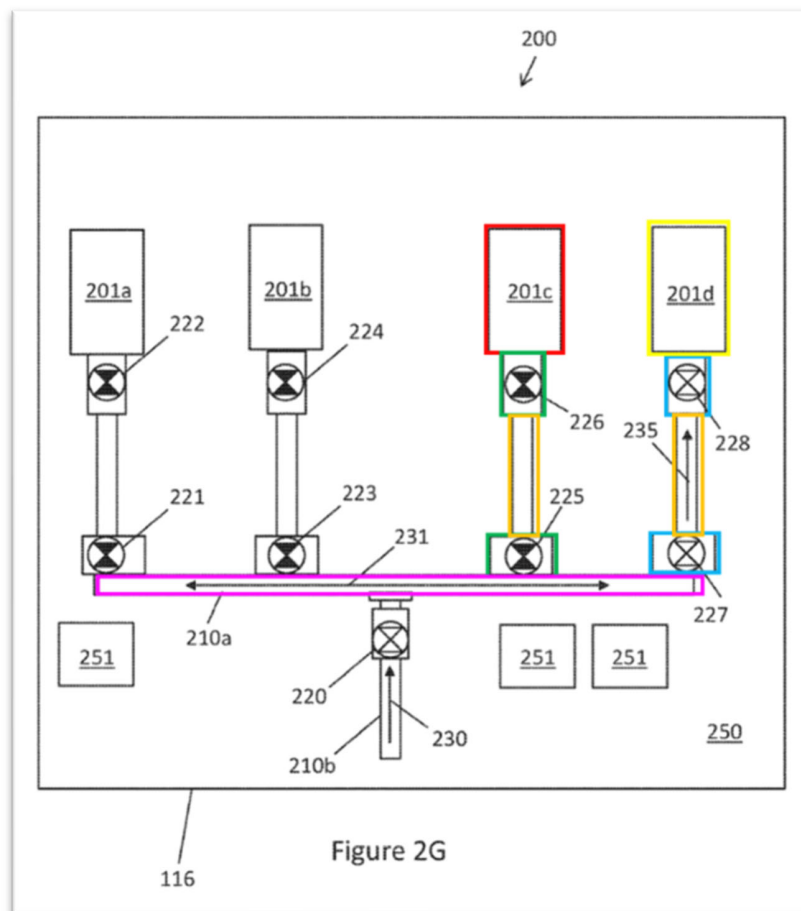
684. *Krupa* teaches “[w]ith both the third set of valves 225, 226 and the fourth set of valves 227, 228 open, the flush fluid flows (see arrows 234, 235) into both the third wellhead assembly 201c and the fourth wellhead assembly 201d. Once injection is established and pressure has stabilized in both the third wellhead assembly 201c and the fourth wellhead assembly 201d, the third set of valves 225, 226 may be closed remotely to shut in the third wellhead assembly 201c, as shown

by FIG. 2G.”³⁹³ Because *Krupa* teaches, as described above regarding Limitation 3.3.3, that the fourth valve is opened after pumped fluid to the wells has meet condition(s) (reduced flowrate and stabilized pressure), and that the third valve is closed after the fourth valve is opened, the third valve (225/226) is also closed after the fluid communicated via the manifold (e.g., the portion communicated to well 3) has satisfied the conditions, which include the flowrate (e.g. reduced flow of 5 -15 bbl/min and/or stabilized pressure).

g. 3.3.4: “while fluid is communicated to the fourth well via the fourth valve and the manifold.”

685. *Krupa* discloses this limitation. *Krupa* discloses, “With both the third set of valves 225, 226 and the fourth set of valves 227, 228 open, the flush fluid flows (see arrows 234, 235) into both the third wellhead assembly 201c and the fourth wellhead assembly 201d. Once injection is established and pressure has stabilized in both the third wellhead assembly 201c and the fourth wellhead assembly 201d, the third set of valves 225, 226 may be closed remotely to shut in the third wellhead assembly 201c, as shown by FIG. 2G.”³⁹⁴

³⁹⁴ *Krupa*, [0045].



Krupa, Figure 2G (annotated)

686. Accordingly, the third valve (225/226) is closes while fluid is communicated to the fourth well (associated with 201d) via the fourth valve (227/228) and the manifold (210a) as shown by fluid flow arrow 235.

687. As described above regarding Limitation 1.4, *Krupa* teaches “Figs. 2A – 2G may provide continuous hydraulic fracturing pumping operations between the

wellhead assemblies 201a-201d.”³⁹⁵ Further *Krupa* teaches “[a]dvantageously, the transition time between stages may be effectively zero by using the fracturing plan described in Figs. 2A – 2G”.³⁹⁶ Further, *Krupa* discloses that this is a reduced transition time (from up to 50 minutes or more for conventional systems to “eliminated” transition time) between fracturing wells, which would include transitioning between a third well and a fourth well.³⁹⁷

688. Accordingly, *Krupa* teaches that the third valve is closed while fluid is communicated to the fourth well via the fourth valve and the manifold.

689. *Krupa*, therefore, discloses each and every limitation of Claim 3 and anticipates and/or renders Claim 3 obvious.

4. DEPENDENT CLAIM 4: “THE METHOD OF CLAIM 1, FURTHER COMPRISING: DETERMINING THAT THE AT LEAST A PORTION OF FLUID COMMUNICATED VIA THE MANIFOLD HAS SATISFIED THE ONE OR MORE CONDITIONS.”

690. Dependent Claim 4 depends from Claim 1. In my opinion, Claim 4 adds no additional limitations to Claim 1. Limitation 1.3.2 recites “the second valve is opened in response to at least a portion of fluid communicated via the manifold satisfying one or more conditions”. Before the method claimed in claim 1 can open the valve “in response to” at least a portion of fluid communicated via the manifold

³⁹⁵ *Krupa*, [0046].

³⁹⁶ *Krupa*, [0046].

³⁹⁷ See, e.g., *Krupa*, [0058].

satisfying one or more conditions, the method must first “determine” that the fluid has met the one or more conditions.

691. To the extent that the Board finds that Claim 4 does add additional limitations, *Krupa* discloses the additional limitations of Claim 4. As described above regarding Limitations 1.3.2, 1.3.3, 3.3.2 and 3.3.3, valve operations, such as opening or closing, are performed in response to determining that the fluid communicated via the manifold has satisfied one or more conditions such as reduced flowrate or injection established (flowrate condition) and pressure has stabilized (pressure condition), and that these conditions may be determined using sensors. Accordingly, *Krupa* discloses determining that the at least a portion of fluid communicated via the manifold has satisfied the one or more conditions.

5. DEPENDENT CLAIM 5: “THE METHOD OF CLAIM 1, WHEREIN THE ONE OR MORE CONDITIONS INCLUDE THE FLOW RATE OF THE AT LEAST A PORTION OF FLUID COMMUNICATED VIA THE MANIFOLD.”

692. Dependent Claim 5 recites what has already been analyzed with Claim 1 – that the condition(s) include flowrate.

693. As described above regarding Limitations 1.3.2 and 1.3.3, valve operations, such as opening or closing, are performed in response to determining that the fluid communicated via the manifold has satisfied one or more conditions such as reduced flowrate or injection established (flowrate condition) and pressure has stabilized (pressure condition).

694. Accordingly, *Krupa* discloses the one or more conditions include the flow rate of the at least a portion of the fluid communicated via the manifold for the same reasons as discussed with Limitations 1.3.2-1.3.3.

6. DEPENDENT CLAIM 6: “THE METHOD OF CLAIM 5, WHEREIN THE AT LEAST A PORTION OF FLUID COMMUNICATED VIA THE MANIFOLD HAS SATISFIED THE ONE OR MORE CONDITIONS WHEN THE FLOW RATE IS BELOW AN UPPER THRESHOLD.”

695. Dependent Claim 6 depends from Claim 5, which further depends from Claim 1. In addition to the discussing above regarding Claims 1 and 5, *Krupa* discloses the additional limitations of Claim 6, or at least they would have been obvious to a POSITA.

696. As described above regarding Limitations 1.3.2, 3.3.2, *Krupa* teaches valve operations, such as opening valves, are conducted in response to flowrate being reduced from “a full pump rate of about 50-150 bbl./min”³⁹⁸ to a reduced flowrate of “5-15 bbl./min. Once a pressure has stabilized at the reduced pump rate, the software application may move the fracturing pumping plan to the next step.”³⁹⁹ Accordingly, *Krupa* discloses at least a portion of the fluid communicated via the

³⁹⁸ *Krupa*, [0042].

³⁹⁹ *Krupa*, [0042].

manifold has satisfied the one or more conditions when the flow rate is below an upper threshold (below 15 bbl/min).⁴⁰⁰ Accordingly, *Krupa* discloses Claim 6.

697. To the extent that the Board finds that “flow rate” being “below an upper threshold” is not explicitly disclosed as a condition by *Krupa*, then such a determination would be obvious from the teachings of *Krupa* regarding measuring flow rate, a reduction in flow indicating the end of the stage, and the subsequent “move to the next step” executed by the software application. Additionally, this element would have been obvious based on the general engineering knowledge of a POSITA, particularly knowledge of a rate step test (RST), or the measurement of water hammer in order to characterize fractures in the downhole formation, which is performed by reducing flowrate and measuring variations in pressure. *See* Sections XI.E – XI.F.

698. Accordingly, Claim 6 is anticipated and/or rendered obvious by *Krupa*.

⁴⁰⁰ The claim language is not restrictive to only flowrate being below an upper threshold. Instead, the claim language can include opening the next valves “in response to” the flowrate being below an upper threshold and one or more other conditions, such as *Krupa*’s stabilized pressure condition at the reduced flowrate.

7. DEPENDENT CLAIM 7: “THE METHOD OF CLAIM 5, WHEREIN THE AT LEAST A PORTION OF THE FLUID COMMUNICATED VIA THE MANIFOLD HAS SATISFIED THE ONE OR MORE CONDITIONS WHEN THE FLOW RATE IS ABOVE A LOWER THRESHOLD.”

699. Dependent Claim 7 depends from Claim 5, which further depends from Claim 1. In addition to the discussing above regarding Claims 1 and 5, *Krupa* discloses the additional limitations of Claim 7, or at least they would have been obvious to a POSITA.

700. As described above regarding Limitations 1.3.2, 3.3.2, *Krupa* teaches valve operations, such as opening valves, are conducted in response to flowrate being reduced from “a full pump rate of about 50-150 bbl./min”⁴⁰¹ to a reduced flowrate of “5-15 bbl./min. Once a pressure has stabilized at the reduced pump rate, the software application may move the fracturing pumping plan to the next step.”⁴⁰² Accordingly, *Krupa* discloses at least a portion of the fluid communicated via the manifold has satisfied the one or more conditions when the flow rate is above a lower threshold (above 5 bbl/min).⁴⁰³ Accordingly, *Krupa* discloses Claim 7.

⁴⁰¹ *Krupa*, [0042].

⁴⁰² *Krupa*, [0042].

⁴⁰³ Again, the claim language is not restrictive to only flowrate being above a lower threshold. Instead, the claim language can include opening the next valves “in response to” the flowrate being above a lower threshold and one or more other conditions, such as *Krupa*’s stabilized pressure condition at the reduced flowrate.

701. To the extent that the Board finds that “flow rate” is not explicitly disclosed as a condition by *Krupa*, then such a determination would be obvious from the teachings of *Krupa* regarding measuring flow rate, a reduction in flow indicating the end of the stage, and the subsequent “move to the next step” executed by the software application. Additionally, this element would have been obvious based on the general engineering knowledge of a POSITA, particularly knowledge of a rate step test (RST), or the measurement of water hammer in order to characterize fractures in the downhole formation, which is performed by reducing flowrate and measuring variations in pressure. *See* Sections XI.E – XI.F.

702. Accordingly, Claim 7 is disclosed by *Krupa*, or in the alternative, rendered obvious over *Krupa* for the reasons discussed above.

8. DEPENDENT CLAIM 8: “THE METHOD OF CLAIM 5, WHEREIN THE AT LEAST A PORTION OF FLUID COMMUNICATED VIA THE MANIFOLD HAS SATISFIED THE ONE OR MORE CONDITIONS WHEN THE FLOW RATE IS BOTH BELOW AN UPPER THRESHOLD AND ABOVE A LOWER THRESHOLD.”

703. Dependent Claim 8 depends from Claim 5, which further depends from Claim 1. In addition to the discussion above regarding Claims 1 and 5, *Krupa* discloses the additional limitations of Claim 8, or at least they would have been obvious to a POSITA.

704. As discussed above regarding Claim 6 (referring to the discussion of Claim 5) and Claim 7, *Krupa* discloses, or at least renders obvious, that the fluid

condition is satisfied when flow is both below an upper threshold (*e.g.*, 15 bbl/min) and above a lower threshold (*e.g.*, 5 bbl /min) for the same reasons provided in Sections XV.C.1.e and XV.C.5-7.

705. Accordingly, *Krupa* discloses, or at least renders obvious, wherein the at least a portion of the fluid communicated via the manifold (flow arrows 232 – 235) has satisfied the one or more conditions when the flow rate is both below an upper threshold and above a lower threshold.

706. Thus, *Krupa* anticipates and/or at least renders obvious Claim 8.

9. DEPENDENT CLAIM 9: “THE METHOD OF CLAIM 1, WHEREIN THE ONE OR MORE CONDITIONS INCLUDE THE PRESSURE OF THE AT LEAST A PORTION OF THE FLUID COMMUNICATED VIA THE MANIFOLD.”

707. Dependent Claim 9 depends from Claim 1 and recites what has already been analyzed with Claim 1 – that the condition(s) include pressure. In addition to the discussion above regarding Claim 1, *Krupa* discloses the additional limitations of Claim 9, or at least they would have been obvious to a POSITA.

708. As discussed above regarding Limitation 1.3.2, and included herein by reference, *Krupa* discloses, or at least render obvious, using data from pressure sensors to automate valve sequencing. For example, *Krupa* discloses “the plurality of sensors 111 may communicate with the software application [] to automate the plurality of devices, such as a valve” including “an automated valve sequencing (*e.g.*, when to open and close) during completion stage based on pre-approved

sequence.”⁴⁰⁴ The sensors 111 of *Krupa* include pressure sensors, which would measure the pressure of at least a portion of the fluid communicated via the manifold, e.g., the pressure in the manifold, the pressure in the flowline leading to the wellhead, or the pressure in the wellhead itself. Additionally, *Krupa* discloses “a pump rate may be reduced from the full pump rate” to a reduced pump rate, and “[o]nce a pressure has stabilized at the reduced pump rate, the software application may move the fracturing pumping plan to the next step.”⁴⁰⁵ Thus, *Krupa* teaches that once the pumping flowrate is reduced (flowrate condition) and pressure is stabilized (pressure condition), the system determines that the fracturing job is at the end of that particular stage, and then “move[s] the fracturing pumping plan to the next step.”⁴⁰⁶ *Krupa*’s disclosure of “once the pressure has stabilized at the reduced pump rate” is an example of the pressure of a fluid communicated via the manifold satisfying a pressure condition.

709. It would have been obvious to a POSITA to use the sensor data of *Krupa*, including data from pressure sensors, to “automate valve sequencing”, including the valve sequencing of *Krupa*, to move to the next stage in fracturing operations (e.g., open the valve to the second well), particularly in light of the

⁴⁰⁴ *Krupa*, [0037].

⁴⁰⁵ *Krupa*, [0042].

⁴⁰⁶ *Krupa*, [0042].

knowledge of a POSITA that pressure drops at the end of a fracturing stage, signaling the need to move to the next stage of the fracturing operations. Further, this general knowledge combined with the teachings of *Krupa* that moving to the next stage of fracturing operations (e.g. opening the second valve to swap between hydraulically fracturing the first well to hydraulically fracturing the second well) be performed “once pressure has stabilized” would have rendered using the pressure of at least a portion of the fluid communicated via the manifold (e.g. the portion being communicated to the first well via the first valve) as a measure of the end of the stage and triggers moving to the next stage of continuous pumping fracturing operations (e.g. opening the second valve). Further, a POSITA would have understood, based on the general knowledge of hydraulic fracturing and the characteristics of the formation, that once flowrate has dropped (to e.g. 5-15 bbl/min), the pressure in the wellhead would drop correspondingly as a function of flowrate and the impedance of the well / formation system.

710. Accordingly, *Krupa* discloses, or at least render obvious, the additional limitations of Claim 9.

10. DEPENDENT CLAIMS 10-12

- a. Dependent Claim 10: “The method of claim 9, wherein the at least a portion of the fluid communicated via the manifold has satisfied the one or more conditions when the pressure is below an upper threshold.”**
- b. Dependent Claim 11: “The method of claim 9, wherein the at least a portion of the fluid communicated via the manifold has satisfied the one or more conditions when the pressure is above a lower threshold.”**
- c. Dependent Claim 12: “The method of claim 9, wherein the at least a portion of the fluid communicated via the manifold has satisfied the one or more conditions when the pressure is both below an upper threshold and above a lower threshold.”**

711. Dependent Claims 10-12 each depend from Claim 9, which further depends from Claim 1. In addition to the discussion above regarding Claims 1 and 9, *Krupa* discloses the additional limitations of Claims 10-12, or at least they would have been obvious to a POSITA.

712. As discussed above regarding Limitation 1.3.2 and Claim 9, *Krupa* discloses using the pressure of at least a portion of the fluid communicated via the manifold as a trigger for automated valve sequencing. For example, *Krupa* teaches that once conditions of fluid being pumped into one well meets reduced pump rate (flowrate condition) and stabilized pressure (pressure condition) conditions, the next step in the CP swap is performed (e.g., opening the valves to the next well).⁴⁰⁷ A

⁴⁰⁷ *Krupa*, [0042]-[0043].

POSITA would understand that in order for pressure to be “stabilized,” it would be maintained within a range, including an upper and lower threshold. Additionally, *Krupa* uses a software application to automatically implement the fracturing plan, including opening the valves to the next well once the fluid pumped into the first well has stabilized pressure at the reduced pump rate.⁴⁰⁸ Using thresholds is commonly needed in automation processes so that the automation program knows when to automatically take action. Thus, based on the disclosure of *Krupa*, a POSITA would have found it obvious, if not necessary, to use specific pressure thresholds, including lower and/or upper pressure thresholds, as part of the automated valve sequencing operation.

713. Additionally, a POSITA would have understood that a pressure below an upper threshold, like a flowrate below an upper threshold, would indicate the end of a fracturing stage, and that it was time to move to the next step (i.e. opening the 2nd valve to fracture the second well, as taught in *Krupa*). Further, a POSITA would have understood, based on the general knowledge of hydraulic fracturing and the characteristics of the formation, that once flowrate has dropped (to e.g. 5-15 bbl/min), the pressure in the wellhead would drop correspondingly as a function of flowrate and the impedance of the well / formation system.⁴⁰⁹ As the pressure is a

⁴⁰⁸ *Krupa*, [0042], [0050].

⁴⁰⁹ See Section XI.C – XI.D above.

function of flowrate and impedance, a POSITA would have recognized that a drop below a flowrate threshold (e.g. 15 bbl/min) would correspondingly drop the pressure below a pressure threshold for any given well. Accordingly, *Krupa* discloses, or at least renders obvious, the additional limitations of Claim 10.

714. Further, *Krupa* discloses using a lower flowrate threshold (*i.e.*, 5 bbl/min) and the stabilized pressure of at least a portion of the fluid communicated via the manifold as a trigger for automated valve sequencing, e.g., to determine when to open the second valve on the second well to allow flow into the second well, while the first valve is still open. A POSITA would have understood that a pressure above a lower threshold, like a flowrate above a lower threshold, would indicate that the pumps were still running, allowing a continuous pumping swap as taught by *Krupa*. Accordingly, *Krupa* discloses, or at least renders obvious, the additional limitations of Claim 11.

715. As discussed above, *Krupa* discloses and/or renders obvious using specific pressure thresholds, including an upper and lower pressure threshold, as part of the automated valve sequencing operation. For example, *Krupa*'s "stabilized pressure" condition triggering the next step in the valve sequencing of the fracturing plan would require the pressure to be maintained for a time within a range (between an upper and lower threshold), *i.e.*, stable.

716. A POSITA would have understood that a pressure below an upper threshold, like a flowrate below an upper threshold, would indicate the end of a fracturing stage, and that it was time to move to the next step (i.e. opening the 2nd valve to fracture the second well, as taught in *Krupa*). Further, a POSITA would have understood that a pressure above a lower threshold, like a flowrate above a lower threshold, would indicate that the pumps were still running. Thus, a pressure between the thresholds would indicate that it was time to move to the next stage of fracturing and the pumps are still running, signaling that a continuous pumping swap (as taught by *Krupa*) was appropriate.

717. Further, a POSITA would have understood, based on the general knowledge of hydraulic fracturing and the characteristics of the formation, that once flowrate has dropped (to e.g. 5-15 bbl/min), the pressure in the wellhead would drop correspondingly as a function of flowrate and the impedance of the well / formation system.⁴¹⁰ As the pressure is a function of flowrate and impedance, a POSITA would have recognized that a drop to a flowrate between a lower threshold (e.g. 5 bbl/min) and an upper threshold (e.g. 15 bbl/min) would correspondingly drop the pressure to a level above a lower pressure threshold and below an upper pressure threshold for

⁴¹⁰ See Section XI.C – XI.D above.

any given well. Accordingly, *Krupa* discloses, or at least renders obvious, the additional limitations of Claim 12.

718. Accordingly, *Krupa* anticipates and/or renders obvious Claims 10-12.

11. DEPENDENT CLAIM 13

719. Dependent Claim 13 depends from Claim 1. In addition to the discussing above regarding Claim 1, *Krupa* discloses, or at least renders obvious, the additional limitations of Claim 13, or at least they would have been obvious to a POSITA. The limitations of Claim 13 are listed below.

- a. 13.1: “The method of claim 1, wherein the plurality of wells further comprises a third well, and the method further comprises:**
- b. 13.2: “communicating fluid to the third well via the manifold and a third valve, wherein the third valve is associated with both the third well and the manifold; and”**
- c. 13.3: “executing another CP swap to transition from hydraulically fracturing the third well to hydraulically fracturing the first well, the another CP swap comprising:”**
- d. 13.3.1: “opening the first valve while fluid is communicated to the third well via the third valve and the manifold, wherein opening the first valve causes fluid to be communicated to the first well via the manifold and the first valve, and”**
- e. 13.3.2: “wherein the first valve is opened in response to at least another portion of the fluid communicated via the manifold satisfying one or more conditions, which one or more conditions include a flow rate, and/or a pressure, of the at least**

**another portion of the fluid communicated via the manifold;
and”**

- f. 13.3.3: “closing the third valve: after the at least another portion of fluid communicated via the manifold has satisfied the one or more conditions, which one or more conditions include the flow rate, and/or the pressure, of the at least another portion of the fluid communicated via the manifold, and”**
- g. 13.3.4: “while fluid is communicated to the first well via the first valve and the manifold;”**
- h. 13.4: “wherein, during the another CP swap, fluid is continuously communicated via the manifold.”**

720. The limitations of Claim 13 are substantially similar to the limitations of Claim 3 except that the CP swap discussed swaps from hydraulically fracturing the third well to hydraulically fracturing the first well, as opposed to the swap to hydraulically fracturing the fourth well, as discussed in Claim 3. *Krupa* discloses, or at the least renders obvious, swapping between hydraulically fracturing the third well and the first well. The discussion regarding Claim 3, in Section XV.C.3, shows that *Krupa* discloses swapping between a third well and a fourth well. *Krupa* also contains the following explanation: “the sequence of the fracturing pumping plan

from the first wellhead assembly [] to the fourth wellhead assembly...may be conducted between any of the wellhead assemblies...*in any order*.”⁴¹¹

721. In one or more embodiments, FIGS. 2A-2G may provide continuous hydraulic fracturing pumping operations between the wellhead assemblies 201a-201d. While it is noted that FIGS. 2A-2G describes the sequence of the fracturing pumping plan from the first wellhead assembly 201a to the fourth wellhead assembly 201d, the sequence may be conducted between any of the wellhead assemblies 201a-201d *in any order*.

722. Accordingly the teachings of *Krupa* discussing swapping between a third well and a fourth well, as discussed regarding Claim 3, apply equally to swapping between a third well and a first well as “the sequence may be conducted between any of the wellhead assemblies 201a-201d *in any order*.”⁴¹² Accordingly, *Krupa* discloses, or at least renders obvious, the additional limitations Claim 13 for the same reasons as those discussed above regarding Claim 3 in Section XV.C.3, along with the teachings of *Krupa* above regarding the sequencing being conducted in any order.

⁴¹¹ *Krupa*, [0046] (emphasis added).

⁴¹² *Krupa*, [0046] (emphasis added).

12. DEPENDENT CLAIM 14 THE METHOD OF CLAIM 1, FURTHER COMPRISING: HYDRAULICALLY FRACTURING THE FIRST WELL; AND HYDRAULICALLY FRACTURING THE SECOND WELL; WHEREIN THE FLUID, WHICH IS CONTINUOUSLY COMMUNICATED VIA THE MANIFOLD DURING THE CP SWAP, IS HYDRAULIC FRACTURING FLUID.

723. Dependent Claim 14 depends from Claim 1. In addition to the discussing above regarding Claim 1, *Krupa* discloses the additional limitations of Claim 14, or at least they would have been obvious to a POSITA.

724. As discussed above regarding Claim 1, a POSITA would have recognized the “flush fluid” described by *Krupa* to be the “pad” fracturing fluid, or proppant free fluid, which flows into the well at the beginning of the fracturing stage to initiate fractures, and at the end of the stage to flush the wellbore of any remaining proppant. Thus, the “flush fluid” is an example of a “frac fluid” for several reasons:

725. The fluid is used in hydraulic fracturing operation; and

726. The fluid is used to initiate fractures when pumped at the beginning of the fracturing stage.

727. To the extent the Board finds that a “flush fluid” is not a fracturing fluid, *Krupa* also discloses using proppant-laden “fracturing fluid” in its valve sequencing operations. *Krupa* discloses fracturing fluid and pumping fracturing fluid through the manifold. As an example, *Krupa* discloses “[t]he method may include pumping fluids into a first well via at least one pump manifold by opening a first set of valves. The method may also include pumping the fluids into a second

well via the at least one pump manifold while continuously pumping the fluids into the first well by opening a second set of valves. The method further includes closing the first set of valves to stop pumping the fluids into the first well and isolating and continuously pumping the fluids into the second well.”⁴¹³ *Krupa* also discloses that the switching “may include automating valves within the hydraulic fracturing system to have a valve sequencing (e.g. opening and closing) to direct fluids (e.g. frac fluid) in a selected path...fluids may refer to slurries, liquids, gases and/or mixtures thereof. In some embodiments, solids may be present in the fluids.”⁴¹⁴ A POSITA would have understood the disclosure of a “frac fluid” and “slurries, liquids, gases and/or mixtures thereof”, including, in some embodiments, those with solids (*e.g.*, proppants) to teach that a “fracturing fluid” is pumped through the manifold using the switching sequence disclosed and discussed above.

728. To the extent that *Krupa* discusses using “flush fluid” in its valve sequencing operations, it would have been at least obvious to use fracturing fluid using the same valve sequencing operations based on *Krupa*’s teaching that “valve sequencing (e.g. opening and closing) to direct fluids (e.g. frac fluid) in a selected

⁴¹³ *Krupa*, [0005].

⁴¹⁴ *Krupa*, [0018].

path,” where the “fluids may refer to slurries, liquids, gases and/or mixtures thereof.”⁴¹⁵

729. Accordingly, *Krupa* discloses, or at least renders obvious, wherein the fluid of Claim 1 is a fracturing fluid, as recited in Claim 14.

13. DEPENDENT CLAIM 15: “THE METHOD OF CLAIM 14, WHEREIN THE HYDRAULIC FRACTURING FLUID COMPRISES SAND.”

730. Dependent Claim 15 depends from Claim 14, which further depends from Claim 1. In addition to the discussing above regarding Claims 1 and 14, *Krupa* discloses the additional limitations of Claim 15, or at least they would have been obvious to a POSITA.

731. As discussed above regarding Claim 15, *Krupa* discloses, or at least renders obvious, using its valve sequencing “to direct fluids (e.g. frac fluid) in a selected path,” where the “fluids may refer to slurries, liquids, gases and/or mixtures thereof. In some embodiments, solids may be present in the fluids.”⁴¹⁶ *Krupa* also teaches that sand is a solid used in the fracturing fluid. For example, *Krupa* teaches “Proppant, such as grains of sand of a particular size, is mixed with the treatment fluid to keep the fracture open when the treatment is complete.”⁴¹⁷ Additionally, as

⁴¹⁵ *Krupa*, [0018].

⁴¹⁶ *Krupa*, [0018].

⁴¹⁷ *Krupa*, [0001].

discussed above in Section XI.B, sand was a common proppant used in hydraulic fracturing for decades before the '952 Patent.

732. Accordingly, *Krupa* discloses or at least renders obvious wherein the hydraulic fracturing fluid comprises sand as recited in Claim 15.

14. DEPENDENT CLAIM 16

733. Dependent Claim 16 depends from Claim 1. In addition to the discussing above regarding Claim 1, *Krupa* discloses the additional limitations of Claim 16.

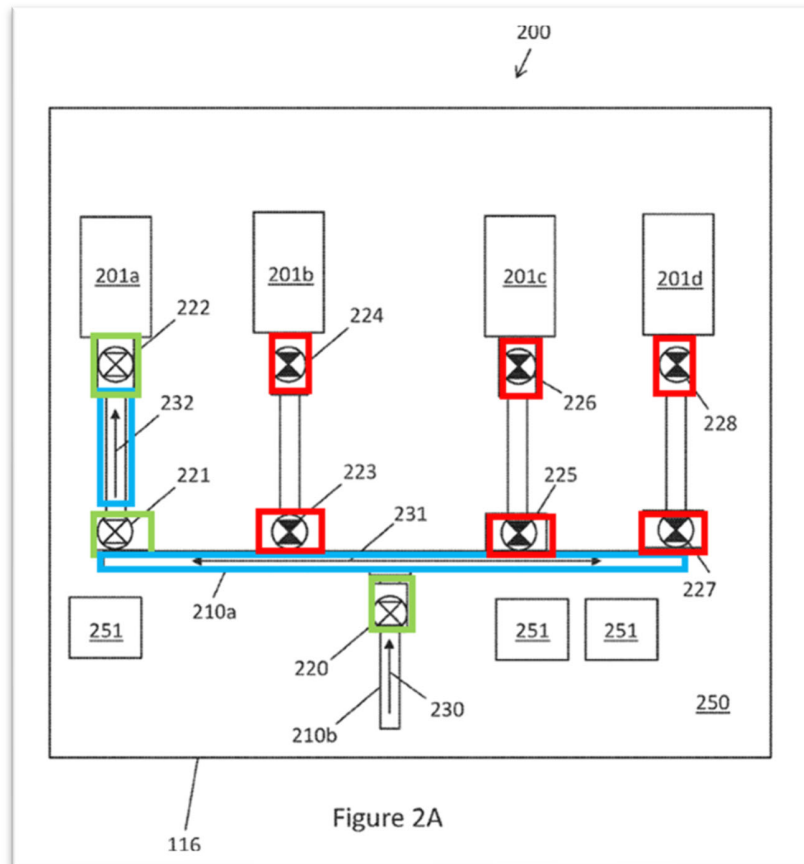
734. *Krupa* discloses the limitations of Claim 16 or would at least render Claim 16 obvious. *Krupa* discloses each and every limitation of Claim 16, as discussed in the subsections below.

a. 16.1: “The method of claim 1, further comprising: displaying a dashboard, which dashboard comprises:”

735. *Krupa* discloses this limitation. *Krupa* describes a computing system with “a human machine interface (“HMI”) using a software application and may be provided to aid in the automation of a built hydraulic fracturing system.”⁴¹⁸ *Krupa* further discusses: “The HMI 116 may include a screen, such as a touch screen, used as an input (e.g., for a person to input commands) and output (e.g., for display) of

⁴¹⁸ *Krupa*, [0027].

the computing system.”⁴¹⁹ Further, *Krupa* teaches some of the items displayed on the HMI, including “FIGS. 2A-2G show a non-limiting example of a fracturing pump plan of a hydraulic fracturing pumping system displayed on the HMI 116.”⁴²⁰ Fig. 2A is duplicated and annotated below as exemplary.



Krupa, Figure 2A (annotated)

736. In describing what is shown in Figs 2A-2G, *Krupa* teaches “In a non-limiting example, the HMI 116 may display the open and closed positions of valves

⁴¹⁹ *Krupa*, [0027].

⁴²⁰ *Krupa*, [0038].

220-228 in the hydraulic fracturing pumping system 200. For illustration purposes, closed valves are shown as blacked out while open valves are shown having no fill, thereby indicating the available path of fluid flow (see arrows 230-235) through the system.”⁴²¹ For example, in Fig. 2A duplicated above, valves 220, 221 and 222 (annotated in green) are shown open, allowing flow through manifold 210a and to wellhead 201, as shown by flow arrows 231 and 232 (annotated in blue). Other valves 223-228 (annotated in red) are shown closed, preventing flow to the associated wellheads. A POSITA would have recognized the HMI display screen that shows visual references of valves, along with the respective states of the valves to be a dashboard.

737. Accordingly, *Krupa* discloses a dashboard in the form of HMI 116. To the extent the Board determines *Krupa* does not explicitly use the term dashboard, it would have been obvious to a POSITA that HMI 116 is a “dashboard” as it encompasses all limitations of Claim 16 describing the “dashboard”.

b. 16.2: “a visual reference of the first valve; and a visual reference of the second valve;”

738. As discussed above regarding limitation 16.1 *Krupa*’s HMI 116 contains a visual reference of the first valve (221 or 222) and a visual reference of

⁴²¹ *Krupa*, [0040].

the second valve (223 or 224). Accordingly, *Krupa* discloses limitation 16.2.

c. 16.3: “wherein the display of the dashboard visually communicates respective states of the first and second valves.”

739. As discussed above regarding Limitation 16.1, *Krupa*’s HMI 116 communicates the respective states of the first and second valves (i.e. blank for open and filled-in for closed). For example, in Fig. 2A the first valve (221 or 222) is shown in the “open” state and second valve (223 or 224) is shown in the “closed” state. Accordingly, *Krupa* discloses Limitation 16.3.

740. Accordingly, *Krupa* discloses each and every limitation of Claim 16, and as a result renders Claim 16 obvious over *Krupa*.

15. DEPENDENT CLAIM 17: “THE METHOD OF CLAIM 16, WHEREIN THE DASHBOARD FURTHER COMPRISES: A FIRST VISUAL INDICATOR ASSOCIATED WITH THE VISUAL REFERENCE OF THE FIRST VALVE, THE FIRST VISUAL INDICATOR INDICATING THAT THE STATE OF THE FIRST VALVE IS OPEN TO PERMIT COMMUNICATING FLUID TO THE FIRST WELL VIA THE MANIFOLD AND THE FIRST VALVE.”

741. Dependent Claim 17 depends from Claim 16, which further depends from Claim 1. In addition to the discussing above regarding Claims 1 and 16, *Krupa* discloses the additional limitations of Claim 17, or at least they would have been obvious to a POSITA.

742. As discussed above regarding limitation 16.1, *Krupa* teaches that “the HMI 116 may display the open and closed positions of valves 220-228 in the

hydraulic fracturing pumping system 200. For illustration purposes, closed valves are shown as blacked out while open valves are shown having no fill, thereby indicating the available path of fluid flow (see arrows 230-235) through the system.”⁴²² Accordingly, the visual indicator indicating that a valve is open is a valve “having no fill”, which permits communicating fluid to the first well via the manifold and the first valve. In Fig. 2A, the first valve (221 or 222) is shown with no fill, indicating an “open” state. Flow arrow 232 indicates that this valve is open and permits communicating fluid to the first well via the manifold 210a and the first valve.

743. Accordingly, the additional limitations of Claim 17 are disclosed by *Krupa*, and *Krupa* discloses, or at least renders obvious, Claim 17.

16. DEPENDENT CLAIM 18: “THE METHOD OF CLAIM 17, WHEREIN THE DASHBOARD FURTHER COMPRISES: A VISUAL REFERENCE OF A FIRST WELLHEAD IN COMMUNICATION WITH THE FIRST WELL.”

744. Dependent Claim 18 depends from Claim 17, which further depends from Claims 1 and 16. In addition to the discussing above regarding Claims 1, 16 and 17, *Krupa* discloses the additional limitations of Claim 18. *Krupa* teaches “FIGS. 2A-2G show a non-limiting example of a fracturing pump plan of a hydraulic fracturing pumping system displayed on the HMI 116. A hydraulic fracturing

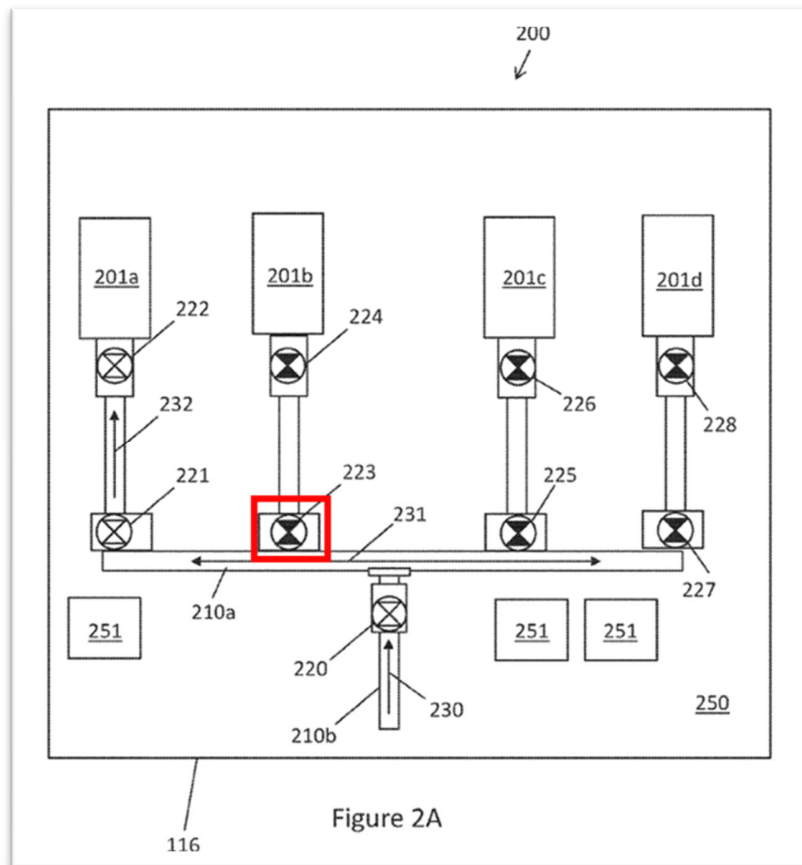
⁴²² *Krupa*, [0040].

745. Accordingly, *Krupa* discloses the limitations of Claim 18.

17. DEPENDENT CLAIM 19: “THE METHOD OF CLAIM 17, WHEREIN THE DASHBOARD FURTHER COMPRISES: A SECOND VISUAL INDICATOR ASSOCIATED WITH THE VISUAL REFERENCE OF THE SECOND VALVE, THE SECOND VISUAL INDICATOR BEING DIFFERENT FROM THE FIRST VISUAL INDICATOR TO INDICATE THAT THE STATE OF THE SECOND VALVE IS CLOSED.”

746. Dependent Claim 19 depends from Claim 17, which further depends from Claims 1 and 16. In addition to the discussing above regarding Claims 1, 16 and 17, *Krupa* discloses the additional limitations of Claim 19. As discussed above regarding limitation 17, *Krupa* teaches “the HMI 116 may display the open and closed positions of valves 220-228 in the hydraulic fracturing pumping system 200. For illustration purposes, closed valves are shown as blacked out while open valves are shown having no fill, thereby indicating the available path of fluid flow (see arrows 230-235) through the system.”⁴²⁴ Accordingly, the visual indicator indicating that a valve is closed is a valve which is “blacked out”. In Fig. 2A, the second valve (223 or 224) is shown blacked out, indicating a “closed” state. Note that no flow arrow extends past valve 223. As *Krupa* teaches the valve that is “blacked out”, showing a closed state, is a visual indicator that is different from a valve “having no fill” which is the visual indicator of the “open” state.

⁴²⁴ *Krupa*, [0040].



Krupa, Figure 2A (annotated)

747. Accordingly, *Krupa* discloses a second visual indicator (valve blacked out) associated with the visual reference of the second valve (223 or 224), the second visual indicator being different from the first visual indicator (valve with no fill) to indicate that the state of the second valve is closed. Thus, *Krupa* discloses the limitations of Claim 19.

748. Accordingly, Claim 19 is anticipated or at least rendered obvious to a POSITA based on the teachings of *Krupa* alone.

18. INDEPENDENT CLAIM 20

749. It is my opinion that *Krupa* anticipates and/or renders obvious Claim 20 of the '952 Patent. Details regarding the specific disclosure of *Krupa* is contained in the subsections following.

a. 20.1: “A non-transitory computer readable medium having stored thereon computer-readable instructions executable by one or more processors to perform operations for hydraulically fracturing a plurality of wells, the plurality of wells comprising first and second wells, the operations comprising:”

750. With the exception of a reference to a “non-transitory computer readable medium having stored thereon computer-readable instructions executable by one or more processors to perform operations”, which a POSITA would have recognized as a generic computer system, this claim limitation is substantially similar to Limitation 1.1 and is disclosed by *Krupa* for the same reasons as those described in Section XV.C.1.a.

751. Further, *Krupa* also discloses the reference to a generic computer system. *Krupa* teaches “[a]n automated hydraulic fracturing system may include a computing system for implementing methods disclosed herein.”⁴²⁵ Specifically, *Krupa* discloses “[s]oftware instructions in the form of computer readable program code to perform embodiments of the disclosure may be stored, in whole or in part,

⁴²⁵ *Krupa*, [0027].

temporarily or permanently, *on a non-transitory computer readable medium such as a CD, DVD, storage device, a diskette, a tape, flash memory, physical memory, or any other computer readable storage medium.*”⁴²⁶ The description in *Krupa* matches the claimed “non-transitory computer readable medium” of Limitation 20.1.

752. Further, *Krupa* describes that the software instructions “*may correspond to computer readable program code, that when executed by a processor(s), may perform one or any of the automated hydraulic fracturing systems features described herein, including that associated with data interpretation and automated hydraulic fracturing pumping systems.*”⁴²⁷

753. A POSITA would have immediately equated the “software instructions” of *Krupa* to the claimed “plurality of instructions.” A POSITA would have also immediately recognized the “computer readable code, that when executed by a processor(s)” of *Krupa* to be a disclosure of the instructions are “executable by one or more processors,” as claimed. Additionally, a POSITA would have immediately equated the disclosure of “that when executed by a processor(s), may perform one or any of the automated hydraulic fracturing systems features described herein” (and discussed with respect to Limitations 20.2-20.4 below) to the claimed

⁴²⁶ *Krupa*, [0032] (emphasis added).

⁴²⁷ *Krupa*, [0032] (emphasis added).

“when the instructions are executed by the one or more processors, the following steps are executed.”

754. Accordingly, *Krupa* discloses Limitation 20.1.

b. 20.2: “communicating fluid from one or more pumps to the first well via a manifold and a first valve, wherein the first valve is associated with both the first well and the manifold so that the first valve is: in fluid communication with the manifold; and fluidically positioned between the first well and the one or more pumps;”

755. This claim limitation is identical to Limitation 1.2 and is disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those described in Section XV.C.1.b.

c. 20.3: “executing a continuous pumping ("CP") swap to transition from hydraulically fracturing the first well to hydraulically fracturing the second well, the CP swap comprising:”

756. This claim limitation is identical to Limitation 1.3 and is disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those described in Section XV.C.1.c.

- d. 20.3.1: “opening a second valve while fluid is communicated from the one or more pumps to the first well via the first valve and the manifold, wherein the second valve is associated with both the second well and the manifold so that the second valve is: in fluid communication with the manifold; and fluidically positioned between the second well and the one or more pumps from which fluid is communicated to the first well via the manifold and the first valve, wherein opening the second valve causes fluid to be communicated from the one or more pumps to the second well via the manifold and the second valve, and”**

757. This claim limitation is identical to Limitation 1.3.1 and is disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those described in Section XV.C.1.d.

- e. 20.3.2: “wherein the second valve is opened in response to at least a portion of fluid communicated via the manifold satisfying one or more conditions, which one or more conditions include a flow rate, and/or a pressure, of the at least a portion of fluid communicated via the manifold; and”**

758. This claim limitation is identical to Limitation 1.3.2 and is disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those described in Section XV.C.1.e.

- f. 20.3.3: “closing the first valve: after the at least a portion of the fluid communicated via the manifold has satisfied the one or more conditions, which one or more conditions include the flow rate, and/or the pressure, of the at least a portion of the fluid communicated via the manifold, and”**

759. This claim limitation is identical to Limitation 1.3.3 and is disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those described in Section XV.C.1.f.

- g. 20.3.4: “while fluid is communicated from the one or more pumps to the second well via the second valve and the manifold;”**

760. This claim limitation is identical to Limitation 1.3.4 and is disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those described in Section XV.C.1.g.

- h. 20.4: “wherein, during the CP swap, fluid is continuously communicated from the one or more pumps via the manifold.”**

761. This claim limitation is identical to Limitation 1.4 and is disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those described in Section XV.C.1.h.

762. *Krupa*, therefore, discloses each and every limitation of Claim 20 and anticipates, or at least renders obvious, Claim 20.

19. DEPENDENT CLAIM 21: “THE NON-TRANSITORY COMPUTER READABLE MEDIUM OF CLAIM 20, WHEREIN: THE FIRST VALVE IS A FIRST ZIPPER VALVE; AND/OR THE SECOND VALVE IS A SECOND ZIPPER VALVE.”

763. Except for depending from Claim 20, the limitations of Claim 21 are identical to those of Claim 2, and is disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those described in Section XV.C.2.

20. DEPENDENT CLAIM 22

764. Except for depending from Claim 20, and referring to the computer system limitations in Limitation 20.1, this claim recites the same limitations as and is substantially similar to Claim 3. Claim 22 is disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those described with Limitations 1.1/20.1 and Claim 3 in Sections XV.C.1.a and XV.C.3.

21. DEPENDENT CLAIM 23: “THE NON-TRANSITORY COMPUTER READABLE MEDIUM OF CLAIM 20, WHEREIN THE OPERATIONS FURTHER COMPRISE: DETERMINING THAT THE AT LEAST A PORTION OF FLUID COMMUNICATED VIA THE MANIFOLD HAS SATISFIED THE ONE OR MORE CONDITIONS.”

765. Dependent Claim 23 depends from Claim 20. Except for depending from Claim 20, and referring to the computer system limitations in Limitation 20.1, this claim is substantially similar to Claim 4. *Krupa* discloses the additional limitations of Claim 23 for the same reasons as those described with Claim 4 in Section XV.C.4.

22. DEPENDENT CLAIM 24: “THE NON-TRANSITORY COMPUTER READABLE MEDIUM OF CLAIM 20, WHEREIN THE ONE OR MORE CONDITIONS INCLUDE THE FLOW RATE OF THE AT LEAST A PORTION OF FLUID COMMUNICATED VIA THE MANIFOLD.”

766. Dependent Claim 24 depends from Claim 20. Except for depending from Claim 20, and referring to the computer system limitations in Limitation 20.1, this claim is substantially similar to Claim 5. *Krupa* discloses the additional limitations of Claim 24 for the same reasons as those described with Claim 5 and Limitation 1.3.2 in Sections XV.C.5 and XV.C.1.e.

23. CLAIMS 25 – 27

767. Except for depending from Claim 24, the limitations of Claims 25-27 are identical to those of Claims 6-8, respectively, and are anticipated or obvious over *Krupa* for the same reasons as those described in Sections XV.C.6-8.

24. DEPENDENT CLAIM 28

768. Except for depending from claim 20, the limitations of Claim 28 are substantially similar to those of Claim 9 and are anticipated or obvious over *Krupa* for the same reasons as those described in Sections XV.C.1.e and XV.C.9.

25. CLAIMS 29 – 31

769. Except for depending from claim 28, the limitations of Claims 29-31 are substantially similar to those of Claim 10-12, respectively, and are anticipated or obvious over *Krupa* for the same reasons as those described in Section XV.C.10.

26. DEPENDENT CLAIMS 32 – 38

770. Except for depending from Claim 20, the limitations of Claim 32 - 38, are substantially similar to those of Claims 13-19, respectively, and are anticipated or obvious over *Krupa* for the same reasons as those described in Sections XV.C.11-17.

27. INDEPENDENT CLAIM 39

771. It is my opinion that *Krupa* renders obvious Claim 39 of the '952 Patent. Details regarding the specific disclosures of *Krupa* are contained in the subsections following.

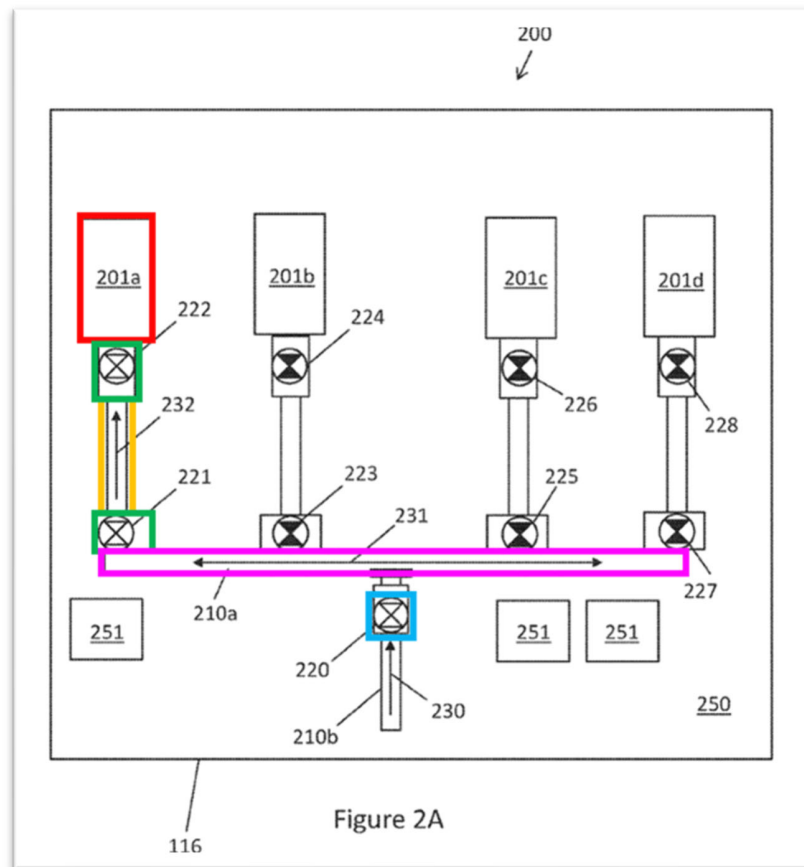
a. 39.1: “A system for hydraulically fracturing a plurality of wells, the plurality of wells comprising first and second wells, the system comprising:”

772. Except for being rewritten as a system claim, the limitations of 39.1 are identical to those of 1.1 and are disclosed by *Krupa* for the same reasons as those discussed above in Section XV.C.1.a.

b. 39.2: “a manifold via which fluid is adapted to be communicated from one or more pumps;”

773. *Krupa* discloses a manifold for the same reasons provided with Limitation 1.2 in Section XV.C.1.b. Additionally, *Krupa* discloses that in “the manifold connection 210a, the fluid flow (see arrow 230) may flow from one end to

another.”⁴²⁸ Manifold 210a (annotated in magenta) is shown, for example, in Fig. 2A of *Krupa*. High pressure pumps direct “pressurized fracking fluid” to the manifold.⁴²⁹



Krupa, Figure 2A (annotated)

774. Accordingly, *Krupa* discloses a manifold as claimed in Limitation 39.2.

⁴²⁸ *Krupa*, [0040].

⁴²⁹ *Krupa*, [0005], [0019].

- c. 39.3: “a first valve via which fluid is adapted to be communicated from the one or more pumps to the first well, the first valve being associated with both the first well and the manifold so that the first valve is: in fluid communication with the manifold; and fluidically positioned between the first well and the one or more pumps;”**

775. Limitation 39.3 recites substantially the same limitations as Limitation

1.2. *Krupa* discloses, or at least renders obvious Limitation 39.3 for the same reasons provided with Limitation 1.2 in Section XV.C.1.b.

- d. 39.4: “a second valve via which fluid is adapted to be communicated from the one or more pumps to the second well, the second valve being associated with both the second well and the manifold so that the second valve is: in fluid communication with the manifold; and fluidically positioned between the second well and the one or more pumps from which fluid is adapted to be communicated to the first well via the manifold and the first valve; and”**

776. Limitation 39.4 recites limitations that are also provided in and discussed with Limitation 1.3.1. *Krupa* discloses, or at least renders obvious, Limitation 39.4 for the same reasons discussed with Limitation 1.3.1 in Section XV.C.1.d.

- e. 39.5: “one or more controllers configured to execute a continuous pumping (“CP”) swap, during which CP swap fluid is continuously communicated via the manifold, to transition from hydraulically fracturing the first well to hydraulically fracturing the second well, by:”

777. *Krupa* discloses this limitation. *Krupa* teaches a controller “The auxiliary manifold 104 may provide a universal power and control unit, including a power unit and a primary controller of the hydraulic fracturing system”.⁴³⁰ Further, *Krupa* teaches “automatic hydraulic fracturing pumping system [which] may include automating valves within the hydraulic fracturing system to have a valve sequencing (e.g. opening and closing) to direct fluids (e.g. frac fluid) in a selected path.”⁴³¹ Further still *Krupa* teaches “the built hydraulic fracturing pumping system 100 may include a system 150 that may provide power to actuate the valves [] The system 150 may also be interchangeably referred to as a valve control system in the present disclosure.”⁴³² A POSITA would have understood any of the references above to disclose a controller.

778. *Krupa* discloses that the controller (i.e. valve control system) executes a continuous pumping (CP) swap. *Krupa* also discloses executing a continuous

⁴³⁰ *Krupa*, [0022].

⁴³¹ *Krupa*, [0018].

⁴³² *Krupa*, [0021].

pumping swap (“CP”) swap as it is described in Claim 39 for the same reasons provided with substantially the same Limitations 1.3 in Section XV.C.1.c.

(1)39.5.1: “opening the second valve: while fluid is communicated from the one or more pumps to the first well via the first valve and the manifold, to cause fluid to be communicated from the one or more pumps to the second well via the manifold and the second valve, and”

779. Except for being rewritten as a system claim, the limitations of 39.5.1 are substantially similar to those of Limitation 1.3.1 and are disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed above in Section XV.C.1.d.

(2)39.5.2: “in response to at least a portion of fluid communicated via the manifold satisfying one or more conditions, which one or more conditions include a flow rate, and/or a pressure, of the at least a portion of fluid communicated via the manifold; and

780. Except for being rewritten as a system claim, the limitations of 39.5.2 are substantially similar to those of Limitation 1.3.2 and are disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed above in Section XV.C.1.e.

(3)39.5.3: “closing the first valve: after the at least a portion of fluid communicated via the manifold has satisfied one or more conditions, which one or more conditions include the flow rate, and/or the pressure, of the at least a portion of fluid communicated via the manifold, and”

781. Except for being rewritten as a system claim, the limitations of 39.5.3 are substantially similar to those of Limitation 1.3.3 and are disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed above in Section XV.C.1.f.

(4)39.5.4: “while fluid is communicated to the second well via the second valve and the manifold.”

782. The limitations of 39.5.4 are identical to those of Limitation 1.3.4 and are disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed above in Section XV.C.1.g.

783. As discussed, *Krupa* discloses, or at least renders obvious each limitation of Claim 39, and Claim 39 is anticipated by and/or rendered obvious over *Krupa*.

28. DEPENDENT CLAIM 40: “THE SYSTEM OF CLAIM 39, WHEREIN: THE FIRST VALVE IS A FIRST ZIPPER VALVE; AND/OR THE SECOND VALVE IS A SECOND ZIPPER VALVE.”

784. Except for depending from Claim 39, the limitations of Claim 40 are identical to those of Claim 2 and are disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed above in Section XV.C.2.

29. DEPENDENT CLAIM 41

785. Except for depending from Claim 39, and referring to the controller limitations in Limitation 39.5, this claim recites the same limitations as and is

substantially similar to Claim 3. Claim 41 is disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those described with Limitation 39.5 and Claim 3 in Sections XV.C.27.e and XV.C.3.

30. DEPENDENT CLAIM 42: “THE SYSTEM OF CLAIM 39, WHEREIN THE ONE OR MORE CONTROLLERS ARE FURTHER CONFIGURED TO: DETERMINE THAT THE AT LEAST A PORTION OF THE COMMUNICATED VIA THE MANIFOLD HAS SATISFIED THE ONE OR MORE CONDITIONS.”

786. Except for depending from Claim 39 and referencing the controllers, which are disclosed by *Krupa*, as discussed above regarding Claim Limitation 39.5, Claim 42 is substantially similar to Claim 4 and is disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed in Sections XV.C.1.e and XV.C.4.

31. DEPENDENT CLAIM 43: “THE SYSTEM OF CLAIM 39, WHEREIN THE ONE OR MORE CONDITIONS INCLUDE THE FLOW RATE OF THE AT LEAST A PORTION OF THE FLUID COMMUNICATED VIA THE MANIFOLD.”

787. Except for depending from Claim 39 and referencing the controllers, which are disclosed by *Krupa* as discussed above regarding Claim Limitation 39.5, Claim 43 is substantially similar to Claim 5 and is disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed in Sections XV.C.1.e and XV.C.4.

32. DEPENDENT CLAIMS 44 - 46

788. Except for depending from Claim 43, Claims 44 - 46 are substantially similar to Claims 6 – 8, respectively, and are disclosed or obvious to a POSITA based on the disclosures of *Krupa* for the same reasons as those discussed in Sections XV.C.6-8.

33. DEPENDENT CLAIM 47: “THE SYSTEM OF CLAIM 39, WHEREIN THE ONE OR MORE CONDITIONS INCLUDE THE PRESSURE OF THE AT LEAST A PORTION OF FLUID COMMUNICATED VIA THE MANIFOLD.”

789. Except for depending from Claim 39, the limitations of Claim 47 are substantially similar to those of Claim 9 and are disclosed by *Krupa* or at least obvious by *Krupa* for the same reasons as those described in Sections XV.C.1.e and XV.C.9.

34. DEPENDENT CLAIMS 48-50

790. Except for depending from Claim 47, the limitations of Claims 48-50 are substantially similar to those of Claims 10-12, respectively, and are disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those described in Section XII.Y – XII.AA.

35. DEPENDENT CLAIM 51

791. Except for depending from Claim 39, and referring to the controller limitations in Limitation 39.5, this claim recites the same limitations as and is substantially similar to Claim 13. Claim 51 is disclosed by *Krupa* or at least obvious

over *Krupa* for the same reasons as those described with Limitation 39.5 and Claim 13 in Sections XV.C.27.e and XV.C.11.

36. CLAIMS 52 - 57

792. Except for depending from Claim 39, the limitations of Claims 52 - 57 are identical to those of Claims 14 – 19, respectively, and are disclosed by *Krupa* or at least rendered obvious by *Krupa* for the same reasons as those discussed above in Sections XV.C.12-17.

37. INDEPENDENT CLAIM 58

793. *Krupa* discloses the limitations of Claim 58 or at least renders Claim 58 obvious. *Krupa* discloses each and every limitation of Claim 58, as discussed in the subsections below.

a. 58.1: “A method of hydraulically fracturing a plurality of wells, the plurality of wells comprising first and second wells, the method comprising:”

794. Limitation 58.1 is identical to Limitation 1.1 and is therefore disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed in Section XV.C.1.a above.

- b. 58.2: “communicating fluid from the one or more pumps to the first well via a manifold and a first valve, wherein the first valve is associated with both the first well and the manifold so that the first valve is in fluid communication with the manifold; and fluidically positioned between the first well and the one or more pumps;”**

795. Limitation 58.2 is identical to Limitation 1.2 and is therefore disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed in Section XV.C.1.b above.

- c. 58.3: “displaying a dashboard, which dashboard comprises:”**

796. Limitation 58.3 recites the same limitations as Limitation 16.1 and is therefore disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed in Section XV.C.14.a above.

- (1)58.3.1: “a visual reference of the first valve;”**

797. Limitation 58.3.1 recites the same limitations as Limitation 16.2 and is therefore disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed in Section XV.C.14.b above.

- (2)58.3.2: “a first visual indicator associated with the visual reference of the first valve, the first visual indicator indicating that a state of the first valve is open to permit communicating fluid to the first well via the manifold and the first valve;”**

798. Limitation 58.3.2 recites the same limitations as Claim 17 and is therefore disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed in Section XV.C.15 above.

(3) 58.3.3: “a visual reference of a second valve,

(4) 58.3.4: “wherein the second valve is associated with both the second well and the manifold so that the second valve is: in fluid communication with the manifold; and fluidically positioned between the second well and the one or more pumps from which fluid is communicated to the first well via the manifold and the first valve; and”

799. Limitations 58.3.3 and 58.3.4 recite the same limitations as in Limitations 16.2 and Limitation 1.3.1 and is therefore disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed in Section XV.C.14.b and XV.C.1.d.(2)-(3) above.

(5) 58.3.5: “a second visual indicator associated with the visual reference of the second valve, the second visual indicator being different from the first visual indicator to indicate that a state of the second valve is closed; and”

800. Limitation 58.3.5 recites the same limitations as Claim 19 and is therefore disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed in Section XV.C.17 above.

d. 58.4: “executing a continuous pumping (“CP”) swap to transition from hydraulically fracturing the first well to hydraulically fracturing the second well, the CP swap comprising:”

801. Limitation 58.4 is identical to Limitation 1.3 and is therefore disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed in Section XV.C.1.c above.

(1)58.4.1: “opening the second valve while fluid is communicated from the one or more pumps to the first well via the first valve and the manifold, wherein opening the second valve causes fluid to be communicated from the one or more pumps to the second well via the manifold and the second valve, and”

802. Limitation 58.4.1 recites the same limitations as in Limitation 1.3.1 and is therefore disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed in Section XV.C.1.d above.

(2)58.4.2: “wherein the second valve is opened in response to at least a portion of fluid communicated via the manifold satisfying one or more conditions; and”

803. Limitation 58.4.2 is substantially similar to, though less limiting than, Limitation 1.3.2, as Limitation 58.4.2 does not limit the claimed “conditions” at all. According to the plain language of the claim, the “conditions” of Limitation 58.4.2 could be the fluid’s flowrate and/or pressure, as recited in Limitation 1.3.2, or could be any other condition of the fluid.

804. Despite the broad language of the claim, the '952 Patent does not describe any other condition of the fluid that should be met for opening the second valve other than flowrate (although, even the '952 Patent's disclosure of a flowrate condition leaves much to the imagination of the reader, as discussed in Section XIV.A). Thus, according to the language of Claim 58, the mere act of fluid being communicated via the manifold could satisfy a "condition," and the second valve could be opened in response. On the other hand, the '952 Patent only gives an example of operating the second valve in response to non-descript flowrate "conditions."

805. Nevertheless, whether the term "condition" is interpreted broadly or narrowly, *Krupa* discloses or at least renders obvious opening a second valve in response to fluid communicated via a manifold satisfying flowrate and/or pressure conditions, as discussed with Limitation 1.3.2 in Section XV.C.1.e above. Thus, Limitation 58.4.2 is disclosed by and would have been obvious to a POSITA based on the disclosures of *Krupa* for at least the same reasons as those discussed in Section XV.C.1.e above.

(3)58.4.3: “closing the first valve: after the at least a portion of the fluid communicated via the manifold has satisfied the one or more conditions, and”

806. Limitation 58.4.3 is substantially similar to, though less limiting than, Limitation 1.3.3 and is therefore disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed in Section XV.C.1.f above.

e. 58.5: “wherein the display of the dashboard visually communicates the respective states of the first and second valves; and”

807. As discussed above regarding Claims 16 and 19, *Krupa* discloses the dashboard visually communicates the respective states of the first and second valves. Accordingly, *Krupa* discloses or at least renders obvious the limitations of 58.5 for the same reasons as those discussed in Sections XV.C.14.c above.

f. 58.6: “wherein fluid is continuously communicated via the manifold during the CP swap.”

808. Limitation 58.6 is substantially similar to Limitation 1.4 and is therefore disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed in Section XV.C.1.h above.

38. DEPENDENT CLAIM 59: “THE METHOD OF CLAIM 58, WHEREIN THE DASHBOARD FURTHER COMPRISES A VISUAL REFERENCE OF A FIRST WELLHEAD IN COMMUNICATION WITH THE FIRST WELL.”

809. Except for depending from Claim 58, the limitations of Claim 59 are substantially similar to those of Claim 18 and are therefore disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed in Section XV.C.16 above.

39. DEPENDENT CLAIMS 60 - 61

810. Except for depending from Claim 58, the limitations of Claims 60-61 are substantially similar to those of Claims 4-5, respectively, and are therefore disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed in Sections XV.C.1.e XV.C.4-5 above.

40. DEPENDENT CLAIM 62: “THE METHOD OF CLAIM 58, WHEREIN THE ONE OR MORE CONDITIONS INCLUDE A PRESSURE CONDITION OF THE AT LEAST A PORTION OF FLUID COMMUNICATED VIA THE MANIFOLD.”

811. Except for depending from Claim 58, the limitations of Claim 62 are substantially similar to those of Claim 9 and are therefore disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed in Sections XV.C.1.e and XV.C.9 above.

41. DEPENDENT CLAIMS 63 - 64

812. Except for depending from Claim 58, the limitations of Claims 63 - 64 are identical to those of Claims 14-15, respectively, and are therefore disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed in Section XV.C.12-13 above.

42. INDEPENDENT CLAIM 65

813. *Krupa* discloses the limitations of Claim 65 or at least renders Claim 65 obvious. *Krupa* discloses each and every limitation of Claim 65, as discussed in the subsections below.

a. 65.1: "A non-transitory computer readable medium of hydraulically fracturing a plurality of wells, the plurality of wells comprising first and second wells, the method comprising:"

814. The limitations of 65.1 are substantially similar to those of Limitations 1.1/20.1 and are therefore disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed in Section XV.C.1.a above.

- b. 65.2: “communicating fluid from one or more pumps to the first well via a manifold and a first valve, wherein the first valve is associated with both the first well and the manifold so that the first valve is: in fluid communication with the manifold; and fluidically positioned between the first well and the one or more pumps;”**

815. The limitations of 65.2 are identical to those of Limitations 1.2/20.2 and are therefore disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed in Section XV.C.1.b above.

- c. 65.3: “displaying a dashboard, which dashboard comprises:”**

816. Limitation 65.3 recites the same limitations as Limitation 16.1 and is therefore disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed in Section XV.C.14.a above.

- (1) 65.3.1: “a visual reference of the first valve;”**

817. Limitation 65.3.1 recites the same limitations as Limitation 16.2 and is therefore disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed in Section XV.C.14.b above.

- (2) 65.3.2: “first visual indicator associated with the visual reference of the first valve, the first visual indicator indicating that a state of the first valve is open to permit communicating fluid to the first well via the manifold and the first valve;”**

818. Limitation 65.3.2 recites the same limitations as in Claim 17 and is therefore disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed in Section XV.C.15 above.

(3) 65.3.3: “a visual reference of a second valve,”

(4) 65.3.4: “wherein the second valve is associated with both the second well and the manifold so that the second valve is: in fluid communication with the manifold; and fluidically positioned between the second well and the one or more pumps from which fluid is communicated to the first well via the manifold and the first valve; and”

819. Limitations 65.3.3 and 65.3.4 recite the same limitations as in Limitation 1.3.1 and Claim 16 and is therefore disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed in Section XV.C.1.d.(2)-(3) and XV.C.14.b above.

(5) 65.3.5: “a second visual indicator associated with the visual reference of the second valve, the second visual indicator being different from the first visual indicator to indicate that a state of the second valve is closed; and”

820. Limitation 65.3.5 recites the same limitations as in Claim 19 and is therefore disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed in Section XV.C.17 above.

d. 65.4: “executing a continuous pumping ("CP") swap to transition from hydraulically fracturing the first well to hydraulically fracturing the second well, the CP swap comprising:”

821. The limitations of 65.4 are identical to those of Limitation 1.3 and are therefore disclosed by *Krupa* or at least been obvious over *Krupa* for the same reasons as those discussed in Section XV.C.1.c above.

(1)65.4.1: “opening the second valve while fluid is communicated from the one or more pumps to the first well via the first valve and the manifold, wherein opening the second valve causes fluid to be communicated from the one or more pumps to the second well via the manifold and the second valve, and”

822. Limitations 65.4.1 recites the same limitations as in Limitations 1.3.1 and 58.4.1 and is therefore disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed in Sections XV.C.1.d.(1) and XV.C.1.d.(4) above.

(2)65.4.2: “wherein the second valve is opened in response to at least a portion of fluid communicated via the manifold satisfying one or more conditions; and”

823. The limitations of 65.4.2 are identical to Limitation 58.4.2 and are therefore disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed in Section XV.C.1.e above.

(3) 65.4.3: “closing the first valve: after the at least a portion of the fluid communicated via the manifold has satisfied the one or more conditions; and”

824. Limitation 65.4.3 is identical to Limitation 58.4.3 and is therefore disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed in Section XV.C.1.f above.

e. 65.5: “wherein the display of the dashboard visually communicates the respective states of the first and second valves; and”

825. As discussed above regarding Claims 16 and 19, *Krupa* discloses the dashboard visually communicates the respective states of the first and second valves. Accordingly, *Krupa* discloses or at least renders obvious the limitations of 65.5 for the same reasons as those discussed in Section XV.C.14.c above.

f. 65.6: “wherein fluid is continuously communicated via the manifold during the CP swap.”

826. The limitations of 65.6 are substantially similar to, though less limiting than, those of Limitation 1.4 and are therefore disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed in Section XV.C.1.h above.

43. DEPENDENT CLAIM 66: “THE NON-TRANSITORY COMPUTER READABLE MEDIUM OF CLAIM 65, WHEREIN THE DASHBOARD FURTHER COMPRISES A VISUAL REFERENCE OF A FIRST WELLHEAD IN COMMUNICATION WITH THE FIRST WELL.”

827. Except for depending from Claim 65, the limitations of Claim 66 are substantially similar to those of Claim 18 and are therefore disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed in Section XV.C.16 above.

44. DEPENDENT CLAIMS 67 - 68

828. Except for depending from Claim 65, the limitations of Claims 67-68 are substantially similar to those of Claims 4-5, respectively, and are therefore disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed in Sections XV.C.1.e and XV.C.4-5 above.

45. DEPENDENT CLAIM 69: “THE NON-TRANSITORY COMPUTER READABLE MEDIUM OF CLAIM 65, WHEREIN THE ONE OR MORE CONDITIONS INCLUDE A PRESSURE CONDITION OF THE AT LEAST A PORTION OF FLUID COMMUNICATED VIA THE MANIFOLD.”

829. Except for depending from Claim 65, the limitations of Claim 69 are substantially similar to those of Claim 9 and are therefore disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed in Sections XV.C.1.e and XV.C.9 above.

46. DEPENDENT CLAIMS 70 - 71

830. Except for depending from Claim 65, the limitations of Claims 70 - 71 are substantially similar to those of Claims 14 – 15, respectively, and are therefore disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed in Sections XV.C.12-13 above.

47. INDEPENDENT CLAIM 72

831. *Krupa* discloses the limitations of Claim 72 or at least renders Claim 72 obvious. *Krupa* discloses each and every limitation of Claim 72, as discussed in the subsections below.

a. 72.1: “A system for hydraulically fracturing a plurality of wells, the plurality of wells comprising first and second wells, the system comprising:”

832. The limitations of 72.1 recite the same limitations as in Limitations 1.1 and 39.1 and are therefore disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed in Section XV.C.1.a above.

b. 72.2: “a manifold via which fluid is adapted to be communicated from one or more pumps;”

833. The limitations of 72.2 recite the same limitations as in Limitations 1.2 and 39.2 and are therefore disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed in Section XV.C.1.b above.

- c. 72.3: “a first valve via which fluid is adapted to be communicated from the one or more pumps to the first well, the first valve being associated with both the first well and the manifold so that the first valve is: in fluid communication with the manifold; and fluidically positioned between the first well and the one or more pumps;”**

834. The limitations of 72.3 recite the same limitations as in Limitations 1.2 and 39.3 and are therefore disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed in Section XV.C.1.b above.

- d. 72.4: “a second valve via which fluid is adapted to be communicated from the one or more pumps to the second well, the second valve being associated with both the second well and the manifold so that the second valve is: in fluid communication with the manifold; and fluidically positioned between the second well and the one or more pumps from which fluid is adapted to be communicated to the first well via the manifold and the first valve;”**

835. The limitations of 72.4 recite the same limitations as in Limitations 1.3.1 and 39.4 and are therefore disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed in Section XV.C.1.d above.

- e. 72.5: “a dashboard adapted to be displayed, which dashboard comprises:”**

836. The limitations of 72.5 recites the same limitations as Limitation 16.1 and are therefore disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed in Section XV.C.14.a above.

(1) 72.5.1: “a visual reference of the first valve;”

837. The limitations of 72.5.1 recite the same limitations as in Limitation 16.2 and are therefore disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed in Section XV.C.14.b above.

(2) 72.5.2: “a first visual indicator associated with the visual reference of the first valve, the first visual indicator indicating that a state of the first valve is open to permit communicating fluid to the first well via the manifold and the first valve;”

838. The limitations of 72.5.2 recite the same limitations as in Claim 17 and are therefore disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed in Section XV.C.15 above.

(3) 72.5.3: “a visual reference of the second valve; and”

839. The limitations of 72.5.3 recite the same limitations as in Limitation 16.2 and are therefore disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed in Section XV.C.14.b above.

(4) 72.5.4: “a second visual indicator associated with the visual reference of the second valve, the second visual indicator being different from the first visual indicator to indicate that a state of the second valve is closed;”

840. Limitation 72.5.4 recites the same limitations as in Claim 19 and are therefore disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed in Section XV.C.17 above.

- f. 72.6: “one or more controllers configured to execute a continuous pumping ("CP") swap, during which CP swap fluid is continuously communicated via the manifold, to transition from hydraulically fracturing the first well to hydraulically fracturing the second well, by:”**

841. The limitations of 72.6 recite the same limitations as in Limitations 1.3 and 39.5 and are therefore disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed in Sections XV.C.1.c and XV.C.27.e above.

- (1) 72.6.1: “opening the second valve: while fluid is communicated from the one or more pumps to the first well via the first valve and the manifold,”**

842. The limitations of 72.6.1 are substantially similar to those of Limitation 1.3.1 and are therefore disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed in Section XV.C.1.d.(1) above.

- (2) 72.6.2: “in response to at least a portion of fluid communicated via the manifold satisfying one or more conditions, and”**

843. The limitations of 72.6.2 are substantially similar to those of Limitation 1.3.2 and are therefore disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed in Section XV.C.1.e above.

- (3) 72.6.3: “to cause fluid to be communicated from the one or more pumps to the second well via the manifold and the second valve; and”**

844. The limitations of 72.6.3 recite the same limitations as in Limitation 1.3.1 and are therefore disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed in Section XV.C.1.d.(4) above.

(4) 72.6.4: “closing the first valve: after the at least a portion of the fluid communicated via the manifold has satisfied the one or more conditions,”

845. Limitation 72.6.4 recites the same limitations as in Limitations 1.3.3 and 58.4.3 and is therefore disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed above in Section XV.C.1.f.

g. 72.7: “wherein the display of the dashboard visually communicates the respective states of the first and second valves.”

846. The limitations of 72.7 recite the same limitations as in Limitations 16.3 and 58.5 and are therefore disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed in Section XV.C.14.c.

847. *Krupa* discloses or at least renders obvious each limitation of Claim 72, and Claim 72 is anticipated and/or rendered obvious over *Krupa*.

48. DEPENDENT CLAIM 73: “THE SYSTEM OF CLAIM 72, WHEREIN THE DASHBOARD FURTHER COMPRISES A VISUAL REFERENCE OF A FIRST WELLHEAD IN COMMUNICATION WITH THE FIRST WELL.”

848. Except for depending from Claim 72, the limitations of claim 73 are identical to those of Claim 18 and are therefore disclosed by *Krupa* or at least

obvious over *Krupa* for the same reasons as those discussed in Section XV.C.16 above.

49. DEPENDENT CLAIMS 74 - 75

849. Except for depending from Claim 72 and referencing the controllers disclosed by *Krupa*, as discussed above regarding Claim 72, Claims 74-75 are substantially similar to Claims 4-5, respectively, and are therefore disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed in Sections XV.C.1.e and XV.C.4-5.

50. DEPENDENT CLAIM 76: “THE SYSTEM OF CLAIM 72, WHEREIN THE ONE OR MORE CONDITIONS INCLUDE A PRESSURE CONDITION OF THE AT LEAST A PORTION OF FLUID COMMUNICATED VIA THE MANIFOLD.”

850. Except for depending from Claim 72, Claim 76 is substantially similar to Claim 9 and is therefore disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed in Sections XV.C.1.e and XV.C.9.

51. DEPENDENT CLAIMS 77 - 78

851. Except for depending from Claim 72, the limitations of Claims 77-78 are substantially similar to, but less limiting than, to those of Claims 14-15, respectively, and are therefore disclosed by *Krupa* or at least obvious over *Krupa* for the same reasons as those discussed above in Sections XV.C.12-13.

D. GROUND 10: KRUPA IN VIEW OF FS-VIDEO FURTHER IN VIEW OF AL-SALMANI RENDER OBVIOUS ALL CLAIMS

852. It is my opinion that the combination of *Krupa*, *FS-Video*, and *Al-Salmani* renders each claim of the '952 Patent obvious. A POSITA would have been motivated to combine *Krupa*, *FS-Video*, and *Al-Salmani* as all three references are directed towards efficiency improvements in multi-well hydraulic fracturing.

853. First, *Krupa*, *FS-Video*, and *Al-Salmani* are all directed towards automating hydraulic fracturing systems: *Krupa*'s systems/methods "for automated and intelligent frac pumping,"⁴³³ *FS-Video*'s "continuous zipper frac operations," and *Al-Salmani*'s "surface completion system for operations and monitoring."⁴³⁴

854. *Krupa*, *FS-Video*, and *Al-Salmani* each disclose a variety of overlapping concepts, as outlined in the sections below, including the use of manifolds and valves, displays or HMIs, valve control and monitoring based on sensor data, computerized controllers and well-known components of fracturing such as piping, blenders, pumps and wellheads. A POSITA would have understood that the systems and methods of *Krupa*, *FS-Video*, and *Al-Salmani* are compatible with each other and are directed toward the same goal – automated control of hydraulic fracturing systems, including valves, and improved fracturing efficiency.

⁴³³ *Krupa*, Cover.

⁴³⁴ *Al-Salmani*, Cover.

855. Both *Krupa* and *Al-Salmani* teach automating fracturing operations based on monitored fluid conditions. *Krupa* teaches, when describing the sequence of valve operations, that when “flowrate is reduced to 5-15 bbl/min” and pressure has stabilized, “the software application may move the fracturing pumping plan to the next step,”⁴³⁵ including, for example, opening the second valve. *Al-Salmani* teaches “a wellhead monitoring system includes a pressure sensor arranged at a fracturing tree, the pressure sensor being communicatively coupled to a control unit.”⁴³⁶ Further, *Al-Salmani* discloses “determining, based at least in part on the pressure information and the valve position information, a current status of a wellhead,”⁴³⁷ and “one or more pressure sensors may be incorporated into the frac tree in order to facilitate remote monitoring and control of the fracturing site,” including the ability to “evaluate a particular mode or stage within the fracturing operation, which may drive additional operations.”⁴³⁸

856. While *Krupa* teaches explicit flowrate thresholds to determine the valve operations to conduct, and renders using pressure conditions obvious, *Al-Samani* further teaches that valve monitoring and automation can be the result of pressure

⁴³⁵ *Krupa*, [0042].

⁴³⁶ *Al-Salmani*, [0006].

⁴³⁷ *Al-Salmani*, [0007].

⁴³⁸ *Al-Salmani*, [0024]

conditions, including evaluating the current mode of the fracturing system and driving additional operations.

857. *Krupa* teaches the advantages of automating hydraulic fracturing operations, including valve sequencing, including overcoming challenges with conventional fracturing systems such as increased speed, reduced human error, and less damage to equipment.⁴³⁹ *Krupa* teaches this is a result of “sensors working in conjunction with build hydraulic fracturing system”⁴⁴⁰ to, at least, automate a particular valve sequence based off flowrate thresholds and stabilized pressure. *Al-Salmani* furthers the teaching of *Krupa* regarding valve sequencing, teaching that additional sensor data, including pressure data, can be used to determine the current operation of the fracturing system and drive additional operations. A POSITA would have recognized the benefits of using additional sensor data, including the pressure sensors of *Al-Salmani*, to further the information available to the automation system useful for making decisions. In this way, the combined system can better “evaluate a particular mode or stage within the fracturing operation, which may drive additional operations.”⁴⁴¹ In the combined system, a particular mode of

⁴³⁹ *Krupa*, [0035].

⁴⁴⁰ *Krupa*, [0016].

⁴⁴¹ *Al-Salmani*, [0024].

operation being determined is the end of the fracturing stage, indicating it is time to move to the next stage of operation (e.g., open the second valve).

858. A POSITA would have had a reasonable expectation of success in combining the teachings of *Al-Salmani* regarding, for example, additional sensors and displays, within the system of *Krupa* in order to allow the automated system to have more complete information regarding the actual performance, and state or condition, of the fracturing system. A POSITA would have had a reasonable expectation of success in making the combination as adding sensors, displays and other equipment, as described in *Al-Salmani*'s multi-well fracturing system, to the multi-well fracturing system of *Krupa* would involve the substitution of known elements for another to obtain predictable results, such as enhanced information to the *Krupa* control system and to the operators. Further, the combination uses known techniques (sensing fluid conditions, display of information on displays) to improve similar devices (multi-well automated fracturing systems) in the same way.

859. A POSITA would have been further motivated to combine the teachings of *FS-Video* with those of *Krupa* and *Al-Samani*, as *FS-Video* teaches another example of continuous pumping operations for fracturing multiple wells, which allow for faster swaps and reduced red zone risks.⁴⁴²

⁴⁴² *FS-Video*, 0:28-0:37 and 0:44-1:06.

1. INDEPENDENT CLAIM 1

860. It is my opinion that the combination of *Krupa*, *FS-Video*, and *Al-Salmani* renders obvious Claim 1 of the '952 Patent. Details regarding the specific disclosures of *Krupa*, *FS-Video*, and *Al-Salmani* are contained in the subsections following.

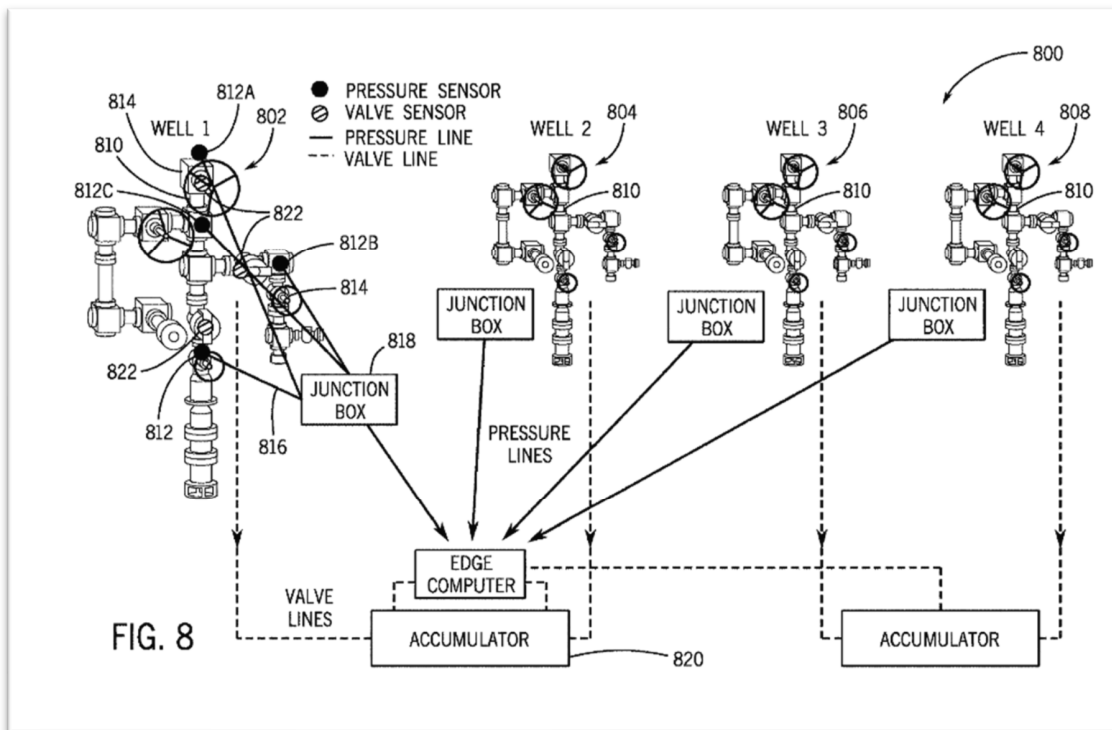
a. 1.1: “A method of hydraulically fracturing a plurality of wells, the plurality of wells comprising first and second wells, the method comprising:

861. As discussed above in Section XV.C.1.a, and incorporated herein by reference, *Krupa* teaches a method of hydraulically fracturing a plurality of wells, the plurality of wells comprising first and second wells.

862. Further, *Al-Salmani* teaches “systems and methods [] for operating electric powered fracturing pumps.”⁴⁴³ *Al-Salmani* further discloses its system “includes four wellheads, which may be described as a first wellhead 802, second wellhead 804, third wellhead 806, and fourth wellhead 808” as shown in Fig. 8. These wellheads each include valves, including “remotely controllable valves, for example, via hydraulic, pneumatic, electric, or other actuation devices,”⁴⁴⁴ which would be suitable for use in an automated system, such as the system of *Krupa*.

⁴⁴³ *Al-Salmani*, [0007].

⁴⁴⁴ *Al-Salmani*, [0027].



Al-Salmani, Fig. 8

863. FS-Video also shows a continuous zipper fracturing operation for two wells.

864. Accordingly, the combination of Krupa, FS-Video, and Al-Salmani disclose the preamble.

- b. 1.2: “communicating fluid from one or more pumps to the first well via a manifold and a first valve, wherein the first valve is associated with both the first well and the manifold so that the first valve is: in fluid communication with the manifold; and fluidically positioned between the first well and the one or more pumps; and”**

865. As discussed above in Section XV.C.1.b and incorporated herein by reference, *Krupa* discloses the limitations of 1.2. Accordingly, the combination of *Krupa*, *FS-Video*, and *Al-Salmani* render Limitation 1.2 obvious.

- c. 1.3: “executing a continuous pumping (“CP”) swap to transition from hydraulically fracturing the first well to hydraulically fracturing the second well, the CP swap comprising:”**

866. As discussed above in Section XV.C.1.c and incorporated herein by reference, *Krupa* discloses executing a continuous pumping swap (“CP”) swap as it is described in Claim 1. Further, *FS-Video* discloses executing a continuous pumping (“CP”) swap to transition from hydraulically fracturing the first well to hydraulically fracturing the second well and contains all of the elements of a CP swap as described in the subsections below.

867. Initially, *FS-Video* admits that the advantages of “continuous zipper frac operations”, which would include a CP swap, were previously known. To wit: “together the FS valve and FS latch system gives you the benefit of continuous frac

operations, previously available only with ball and sleeve systems.”⁴⁴⁵ Accordingly, *FS-Video* is teaching another method (other than ball and sleeve systems) for continuous pumping fracture operations, but the concept was already known.

868. As described in the subsections below, *Krupa*, *FS-Video* and/or *Al-Salmari* discloses, or at least renders obvious, each and every limitation comprising the “CP” swap of Claim 1.

(1) 1.3.1: “opening a second valve while fluid is communicated from the one or more pumps to the first well via the first valve and the manifold, wherein the second valve is associated with both the second well and the manifold so that the second valve is: in fluid communication with the manifold; and fluidically positioned between the second well and the one or more pumps from which fluid is communicated to the first well via the manifold and the first valve, wherein opening the second valve causes fluid to be communicated from the one or more pumps to the second well via the manifold and the second valve, and”

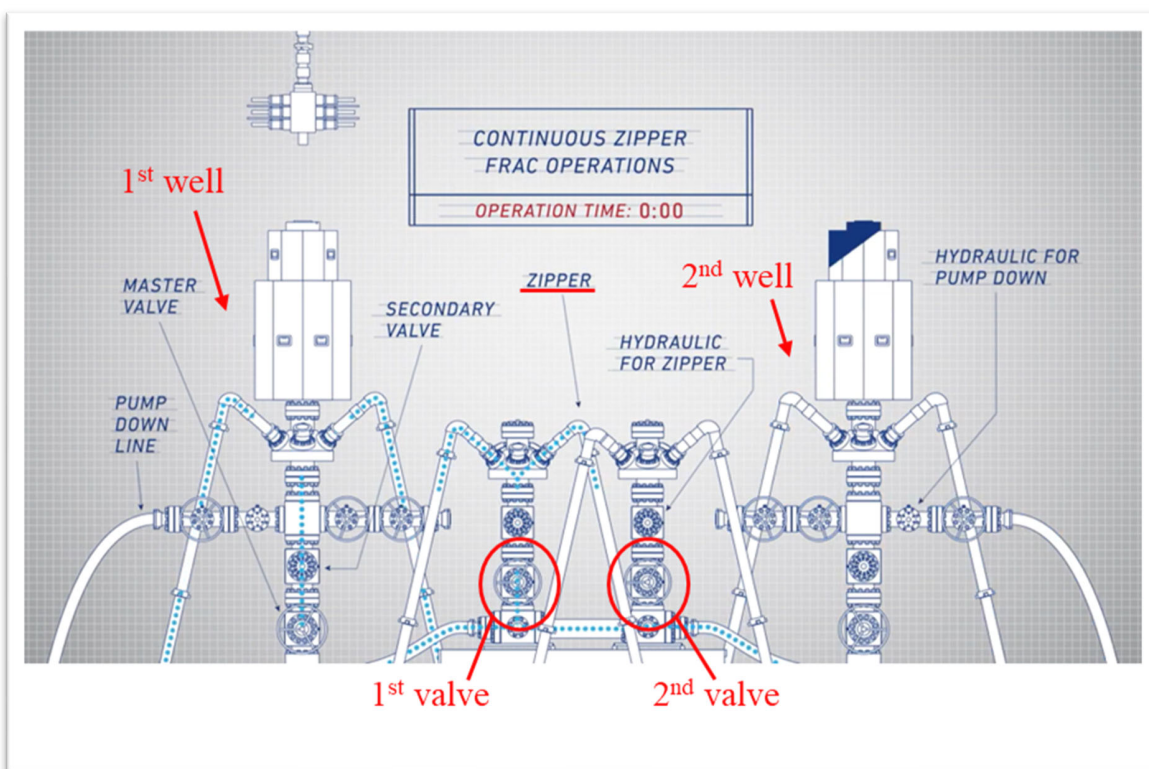
869. As discussed above in Section XV.C.1.d, and incorporated herein by reference, *Krupa* discloses the limitations of 1.3.1. Further, *FS-Video* discloses this limitation, or at least renders it obvious.

870. *FS-Video* teaches “together the FS valve and FS latch system gives you the benefit of continuous frac operations, previously available only with ball and sleeve systems. To illustrate, while fracking on one well you can simultaneously

⁴⁴⁵ *FS-Video*, 0:54-1:06.

attach the lubricator allowing you to complete swap and equalization operations in under five minutes.”⁴⁴⁶ In *FS-Video*, blue dots are moved through the fracturing system into a wellhead to “illustrate [] fracking on one well,” and thus, a POSITA would have recognized these blue dots as showing the flow of the fracturing fluid into the well.

871. Further, *FS-Video* shows both a second valve and a second well, along with the first valve and first well.

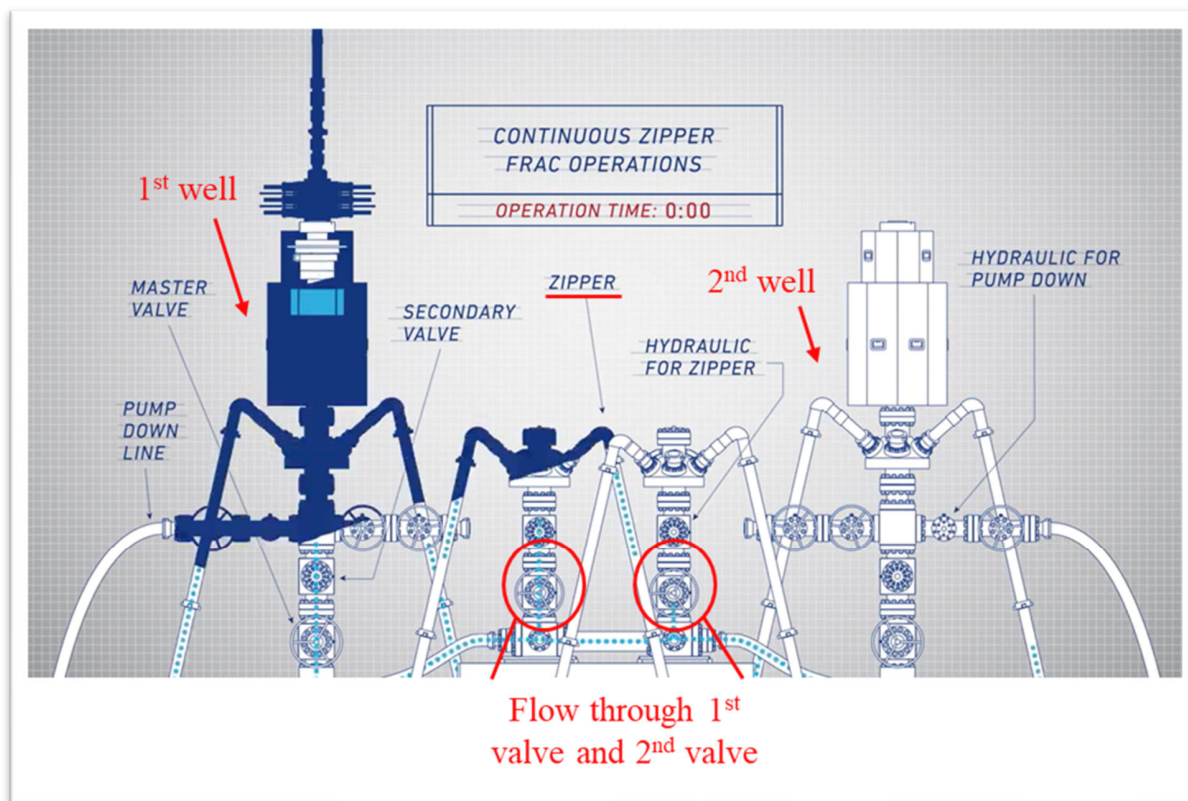


FS-Video, 1:05 (annotated)

⁴⁴⁶ *FS-Video*, 0:54.

872. *FS-Video* does not show the entire fracturing system including all flow paths/fluid connections. However, while *FS-Video* “illustrate[s] [] fracking on one well,” the blue dots representing the fluid flow continuously moves through the “zipper” and into the first well. Thus, a POSITA would have found it obvious that the “zipper” and zipper valves are fluidly connected to the wells, such that the fluid can be pumped through the zipper and through an open zipper valve to its associated well through some fluidly connected flow path not shown. Such arrangement, where each zipper valve is fluidically positioned between its respective well and the pumps, would obviously be used in the system partially shown in *FS-Video* as a typical “zipper frac” configuration.

873. While demonstrating the swap process, *FS-Video* shows fluid flow through the second valve (i.e. opening a second valve) starting while fluid is still being communicated to the first well via the first valve and the manifold. A POSITA would have obviously recognized the valve symbols used in *FS-Video* as showing valves, e.g., the valve symbols labeled “secondary valve” and “master valve,” as shown in the annotated screenshot of *FS-Video* below.



FS-Video, 1:07 (annotated)

874. Further, as discussed above regarding Limitation 1.2, it would have been obvious to a POSITA for the system of *FS-Video* to use pumps “during fracking”. Accordingly, it would have been obvious to a POSITA that the second valve is opened while fluid is communicated from the one or more pumps to the first well via the first valve and the manifold.

875. Accordingly, *FS-Video* discloses, or at least renders obvious, opening a second valve while fluid is communicated from the one or more pumps to the first well via the first valve and the manifold.

876. To the extent that the Board finds that the disclosure of *FS-Video* is insufficient to teach opening the second valve while fluid is communicated from the one or more pump, such a configuration is disclosed by *Krupa*. As discussed above *FS-Video* admits that the advantages of “continuous zipper frac operations”, which would include a CP swap, were previously known. To wit: “together the FS valve and FS latch system gives you the benefit of continuous frac operations, previously available only with ball and sleeve systems.”⁴⁴⁷

877. Accordingly, the combination of *Krupa*, *FS-Video* and *Al-Salmani* render Limitation 1.3.1 obvious.

(2) 1.3.2: “wherein the second valve is opened in response to at least a portion of fluid communicated via the manifold satisfying one or more conditions, which one or more conditions include a flow rate, and/or a pressure, of the at least a portion of the fluid communicated via the manifold; and”

878. As discussed above in Section XV.C.1.e, and incorporated herein by reference, *Krupa* discloses the limitations of 1.3.2. Accordingly, the combination of *Krupa*, *FS-Video* and *Al-Salmani* render Limitation 1.3.2 obvious.

879. Further, *Al-Salmani* discloses “determining, based at least in part on the pressure information and the valve position information, a current status of a

⁴⁴⁷ E.g., *Pitcher*’s continuous frac operations use ball and sleeve systems. Thus, *FS-Video*’s systems/methods teach improvements to such previously known continuous frac operations.

wellhead,”⁴⁴⁸ and “one or more pressure sensors may be incorporated into the frac tree in order to facilitate remote monitoring and control of the fracturing site,” including the ability to “evaluate a particular mode or stage within the fracturing operation, which may drive additional operations.”⁴⁴⁹ The “pressure” information which is discussed in *Al-Salmari* is the pressure of fluid in the wellhead, which, in combination with *Krupa*, would be the pressure of at least a portion of the fluid communicated via the manifold, i.e. the fluid that is communicated to the wellhead and down the wellbore.

880. Further, *Al-Salmari*’s pressure sensors measure the pressure in the wellbore do determine what is occurring at the wellbore, “the additional sensors may be pressure transducers that determine a wellbore pressure at various times. The wellbore pressure may be indicative of an ongoing operation within the wellbore. For example, a pressure pumping operation would result in high pressure, due to the pressure of the fluid injected into the well to enable hydraulic fracturing. However, a low pressure may be indicative of a shut in well or other wellbore operation.”⁴⁵⁰

⁴⁴⁸ *Al-Salmari*, [0007].

⁴⁴⁹ *Al-Salmari*, [0024]

⁴⁵⁰ *Al-Salmari*, [0029]. *See also*, [0033] (“the pressure may be indicative of an operation conducted via the frac tree”); [0038] (“the pressure sensor 112 may enable monitoring of stages of the fracturing operation, as described below, as different stages may be indicative of different operating pressures”).

881. As discussed above in Section XV.C.1.e, and incorporated herein by reference, *Krupa* already teaches conditions such as a reduced flowrate and stabilized pressure that indicate the end of a fracturing stage and which are used to signal the control system of *Krupa* to move to the next stage of fracturing operations such as opening a second valve, for example. *Al-Salmani* contains further teaching that the pressure in the wellbore, which would have been the pressure of at least a portion of the fluid communicated to the wellbore via the manifold, would be used to signal the control system the current status of the fluid in the wellbore, such as the end of the stage.

882. *Krupa* teaches “[t]he method may also include pumping the fluids into a second well via the at least one pump manifold while continuously pumping the fluids into the first well *by opening a second set of valves* [claimed second valve].”⁴⁵¹ The move to open the second set of valves is triggered by determining the fluid communicated via the manifold has satisfied one or more conditions. As one example of using flow conditions to determine the state of the fracturing job, *Krupa* teaches pumping fluid into the well “at a full pump rate of about 50-150 bbl./min.”⁴⁵² Further, *Krupa* teaches “a pump rate may be reduced from the full pump rate. For example, the pump rate may be reduced to 5-15 bbl./min. Once a pressure has

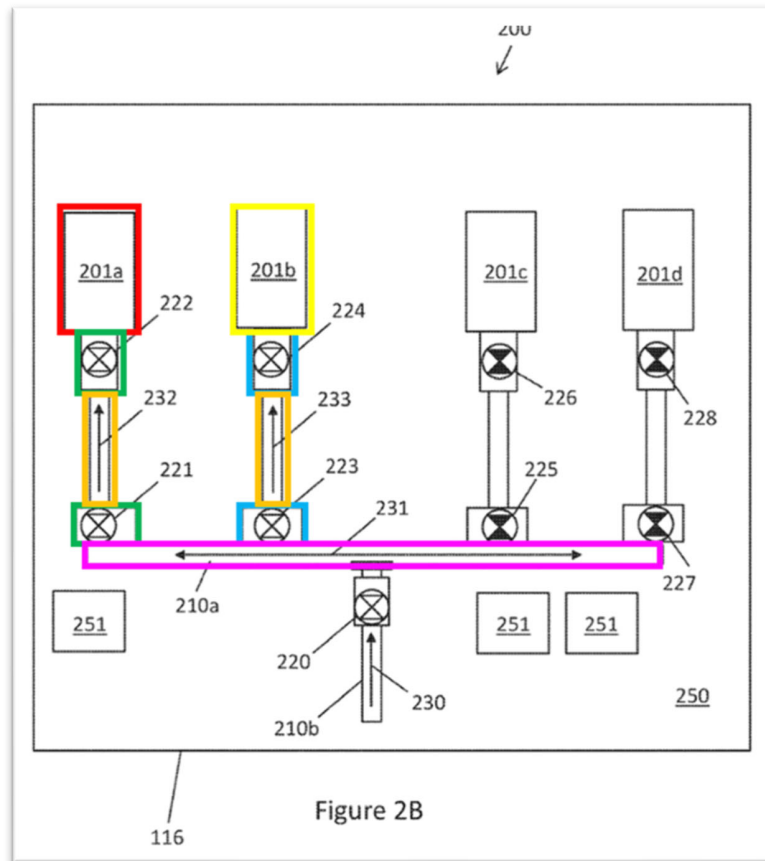
⁴⁵¹ *Krupa*, [0005] (emphasis added).

⁴⁵² *Krupa*, [0042].

stabilized at the reduced pump rate, the software application may move the fracturing pumping plan to the next step.”⁴⁵³ *Krupa* teaches that once the pumping flowrate is reduced to 5-15 bbl/min (flowrate condition) and pressure is stabilized (pressure condition), the system determines that the fracturing job is at the end of that particular stage, and then “move[s] the fracturing pumping plan to the next step.”⁴⁵⁴ *Krupa*’s disclosure of, at least, “a pump rate may be reduced to 5-15 bbl/min” and “once the pressure has stabilized at the reduced pump rate” is an example of a fluid communicated via the manifold (annotated in pink below) satisfying one or more conditions, including both a flowrate and a pressure condition. Further, coupled with *Al-Salmani*’s disclosure that pressure may be indicative of a particular operation or stage, *Krupa*’s system would use pressure to “evaluate a particular mode or stage within the fracturing operation” and “drive additional operations”, such as moving to the next stage (i.e. swapping to fracturing the second well).

⁴⁵³ *Krupa*, [0042].

⁴⁵⁴ *Krupa*, [0042].



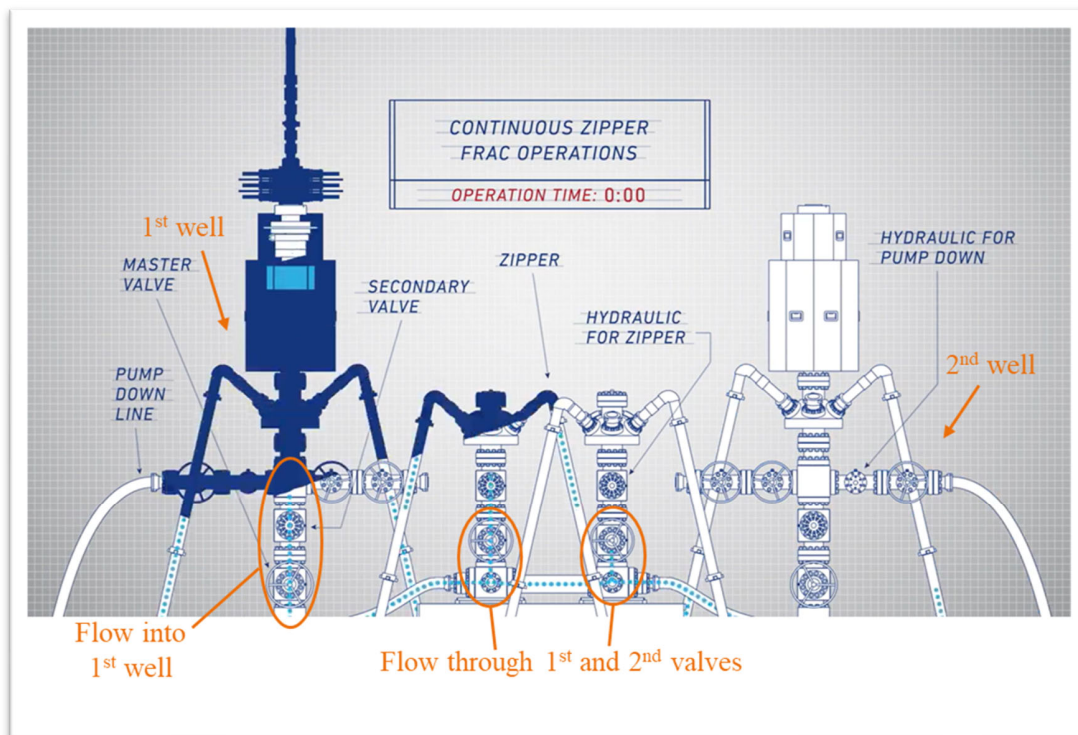
Krupa, Figure 2B (annotated)

883. Accordingly, the combination of *Krupa* and *Al-Salmami* discloses the second valve (223 or 224) is opened in response to at least a portion of the fluid communicated via the manifold (210a) satisfying one or more conditions, which one or more conditions include a flow rate (i.e., 5-15 bbl/min) and a pressure (i.e., pressure has stabilized and/or the pressure of the wellbore) of the at least a portion of the fluid communicated via the manifold (represented by flow arrow 233, and communicated into the wellbore).

884. Thus, *Krupa*, *FS-Video* and *Al-Salmi* render the limitations of 1.3.2 obvious.

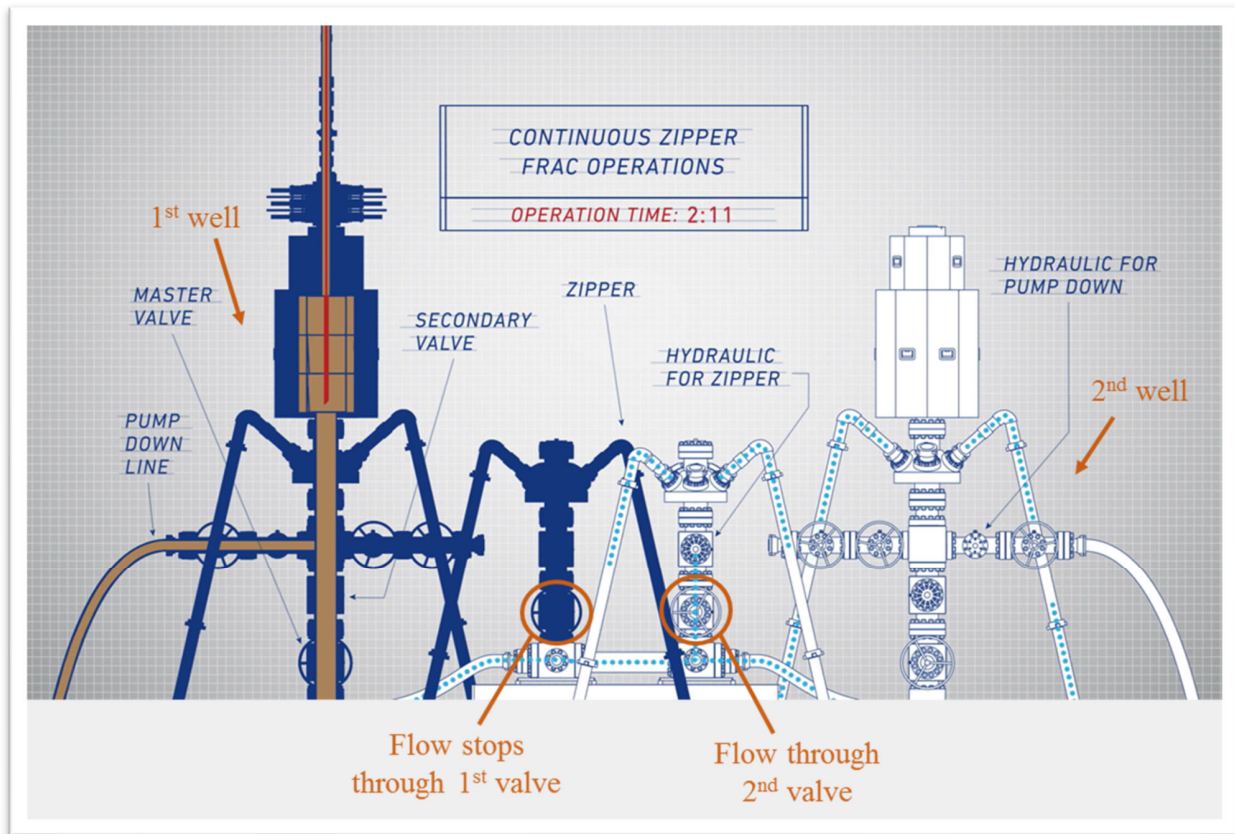
(3) 1.3.3: “closing the first valve: after the at least a portion of fluid communicated via the manifold has satisfied the one or more conditions, which one or more conditions include the flow rate, and/or the pressure, of the at least a portion of fluid communicated via the manifold, and”

885. As discussed above in Section XV.C.1.f, and incorporated herein by reference, *Krupa* discloses the limitations of 1.3.3. Further, *FS-Video* discloses that the first valve is closed after the second valve is opened. As discussed above, *FS-Video* shows that the second valve is opened while fluid is still flowing through the first valve and into the first well.



FS-Video, 1:07 (annotated)

886. Further, *FS-Video* shows closing the first valve after the second valve is opened.



FS-Video, 1:15 (annotated)

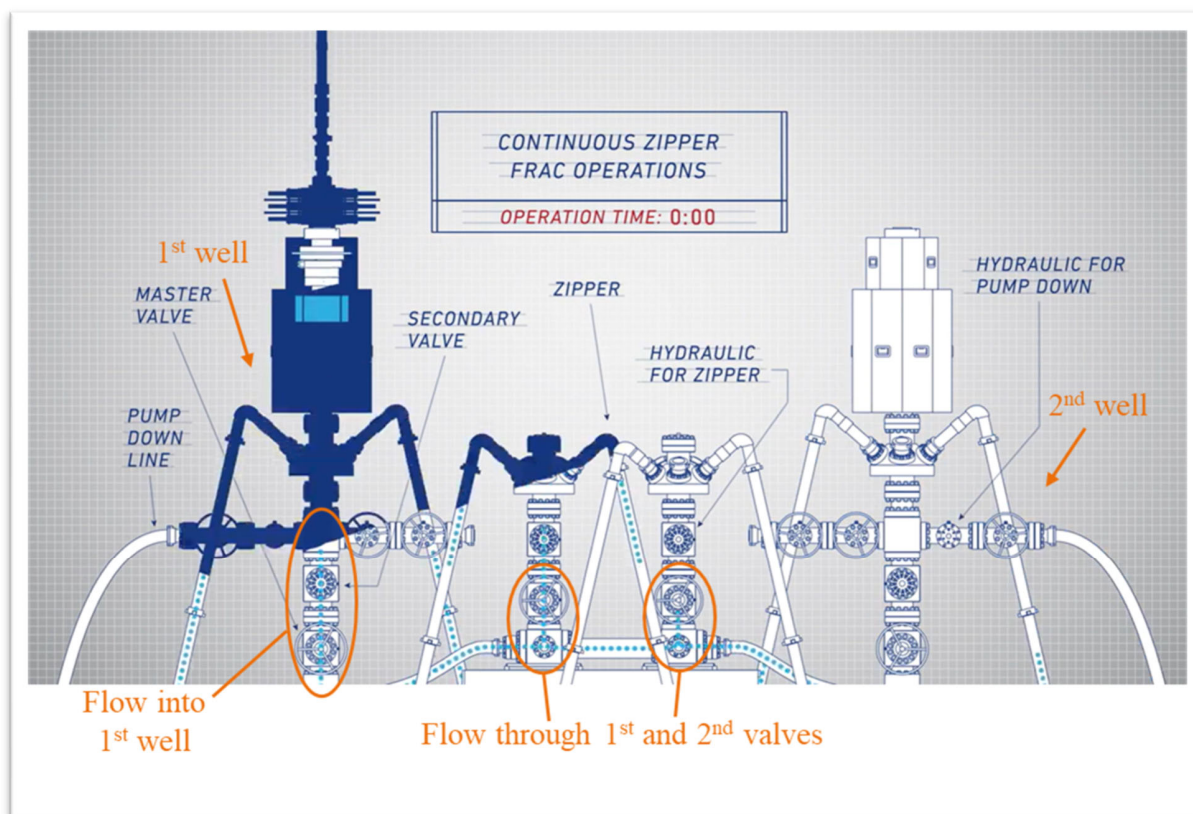
887. As the first valve is closed after the second valve, and the second valve is opened after the fluid has met a condition, as discussed above, the first valve is closed after the at least a portion of fluid communicated via the manifold has satisfied the one or more conditions, which one or more conditions include the flow

rate, and/or the pressure, of the at least a portion of fluid communicated via the manifold.

888. Accordingly, the combination of *Krupa*, *FS-Video* and *Al-Salmani* render Limitation 1.3.3 obvious.

(4) 1.3.4: “while fluid is communicated from the one or more pumps to the second well via the second valve and the manifold;”

889. As discussed above in Section XV.C.1.g, and incorporated herein by reference, *Krupa* discloses the limitations of 1.3.4. Further, as discussed above, *FS-Video* shows that the second valve is opened while fluid is still flowing through the first valve and into the first well. Pumps would have obviously been used for directing the fluid into the wells (via the second valve and zipper manifold) during *FS-Video*’s “frac operations,” as is generally known in the art to use pumps in fracturing operations, and the use of pumps is explicitly taught in *Krupa*.



FS-Video, 1:07 (annotated)

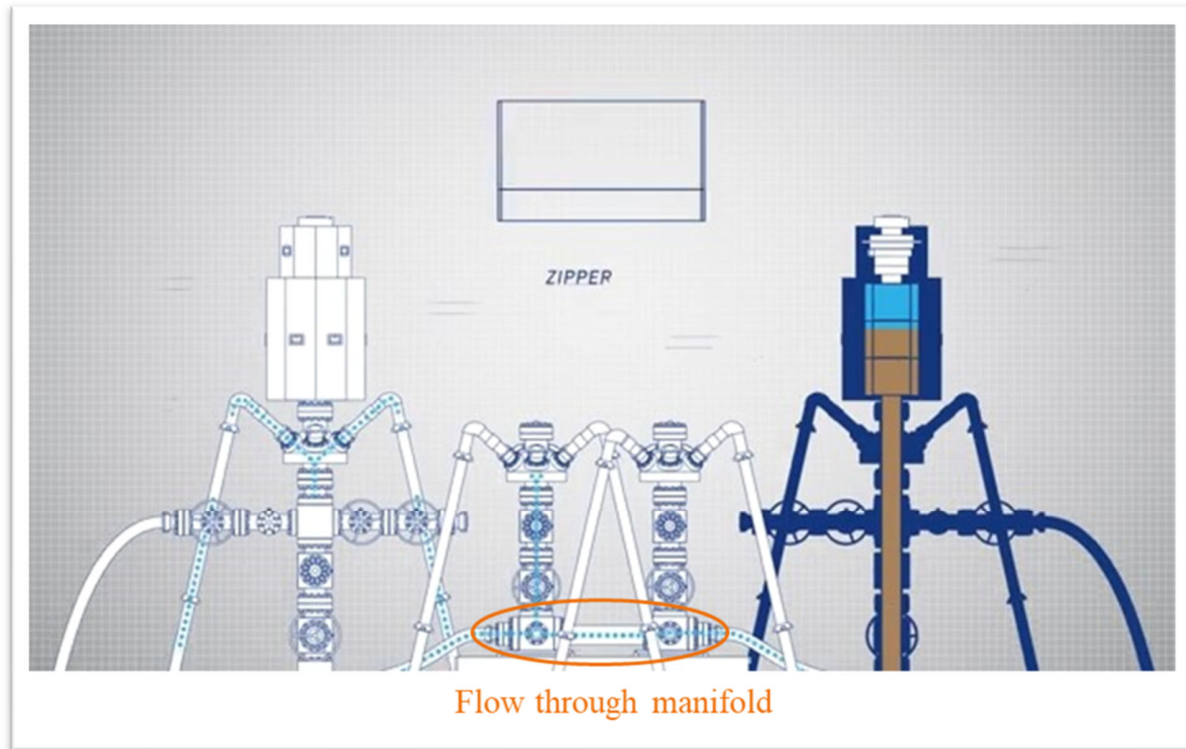
890. Accordingly, *FS-Video* discloses closing the first valve while fluid is communicated from the one or more pumps to the second well via the second valve and the manifold.

891. Therefore, the combination of *Krupa*, *FS-Video* and *Al-Salmani* render Limitation 1.3.4 obvious.

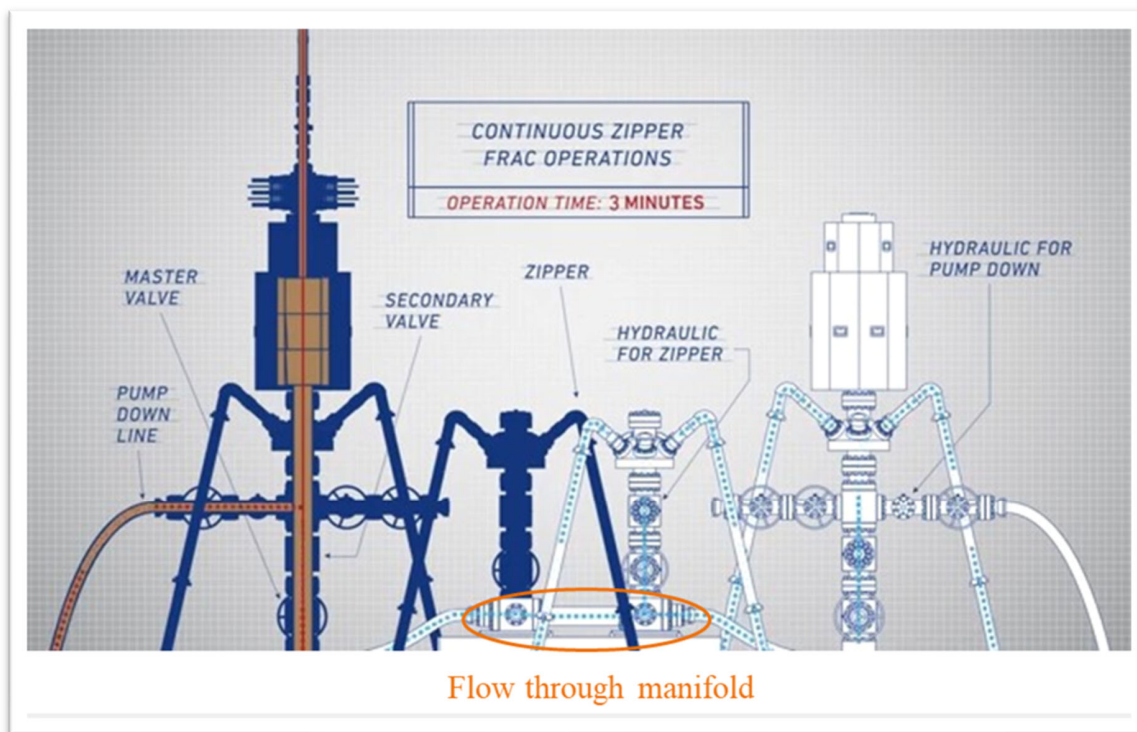
d. 1.4: “wherein, during the CP swap, fluid is continuously communicated via the manifold.”

892. As discussed above in Section XV.C.1.h, and incorporated herein by reference, *Krupa* discloses the limitations of 1.4. Further, *FS-Video* shows

continuous flow through the manifold during the entire swap process (i.e. 1:04 to 1:19) as shown in the images below.



FS-Video, 1:04 (annotated)



FS-Video, 1:21 annotated

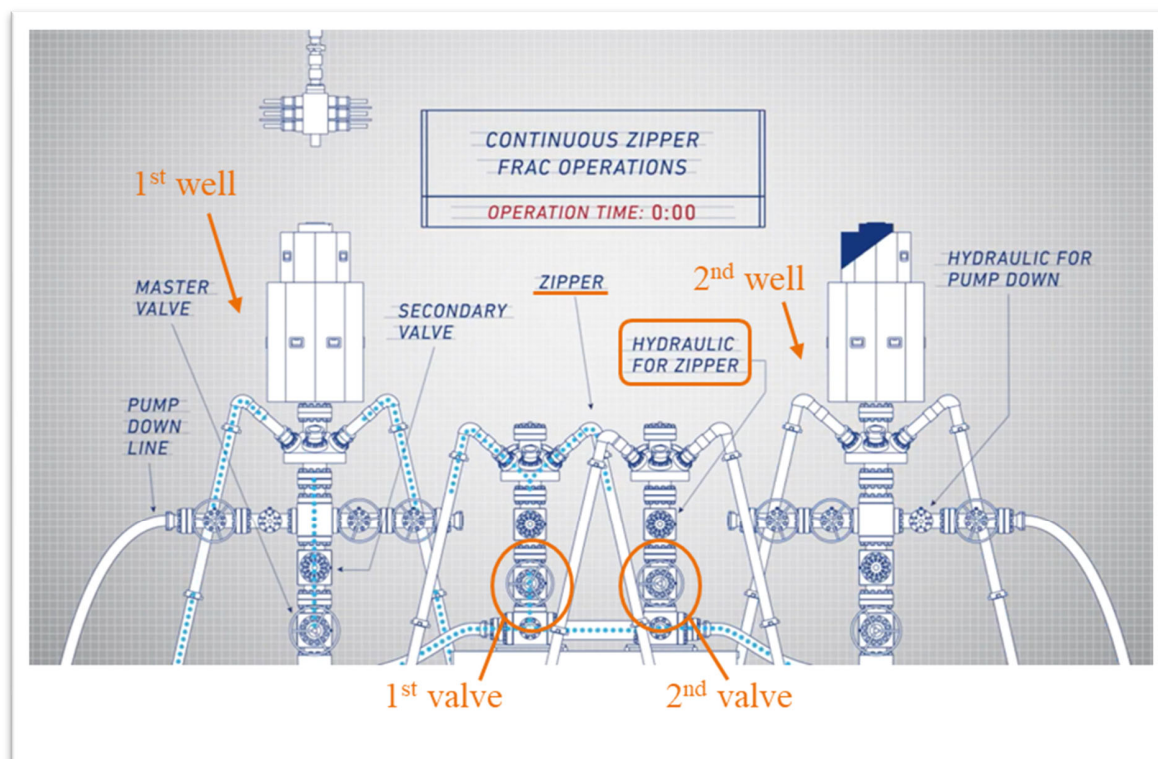
893. As discussed above regarding Limitation 1.2, it would have been obvious to a POSITA that, in the fracturing system of *FS-Video*, the fluid would have been communicated from one or more pumps to *FS-Video*'s zipper manifold for its frac operations.

894. Therefore, the combination of *Krupa*, *FS-Video* and *Al-Salmami* render Limitation 1.4 obvious.

2. DEPENDENT CLAIM 2: "THE METHOD OF CLAIM 1, WHEREIN: THE FIRST VALVE IS A FIRST ZIPPER VALVE; AND/OR THE SECOND VALVE IS A SECOND ZIPPER VALVE."

895. As discussed above in Section XV.C.2 and incorporated herein by reference, *Krupa* discloses the limitations of Claim 2. In addition to the discussion

above regarding Claim 1, *FS-Video* discloses the additional limitations of Claim 2. *FS-Video* references “continuous zipper frac operations” and points to the 1st valve, 2nd valve and the manifold and refers to them as “zipper.” Further, *FS-Video* contains an arrow that points to the second valve system and refers to it as “hydraulic for zipper”.



FS-Video, 1:05 annotated

896. Accordingly, a POSITA would have recognized that both the first and second valves in the “zipper” manifold in *FS-Video* are “zipper valves”. Accordingly, the combination of *Krupa*, *FS-Video*, and *Al-Salmanni* render Claim 2 obvious.

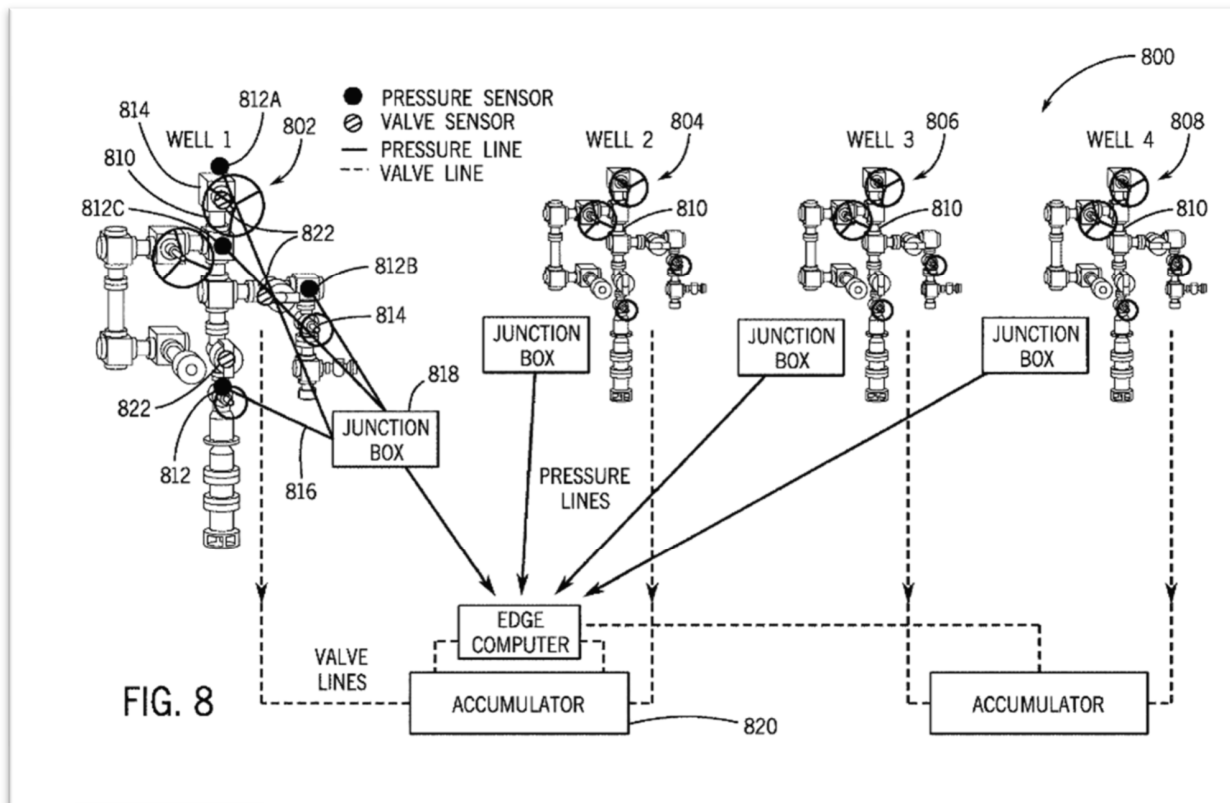
897. Accordingly, Claim 2 would have been obvious over *Krupa*, *FS-Video*, and *Al-Salmani* for the reasons discussed above.

3. DEPENDENT CLAIM 3

898. The combination of *Al-Salmani*, *FS-Video*, and *Krupa* disclose the limitations of Claim 3. As discussed in XV.C.3, *Krupa* discloses and/or renders obvious each limitation in Claim 3. As discussed above in XV.D.1, *FS-Video* also discloses CP swaps. *FS-Video*'s CP swaps could have obviously been applied to multiple wells, including third and fourth wells, by mere repetition and duplication of equipment (*e.g.*, as shown in *Krupa* and/or *Al-Salmani*'s disclosures of fracturing four wells) with a reasonable expectation of success. Accordingly, the combination of *Krupa*, *FS-Video*, and *Al-Salmani* would have rendered Claim 3 obvious, as discussed in the subsections below.

a. 3.1: "The method of claim 1, wherein the plurality of wells further comprises third and fourth wells, and the method further comprises:"

899. As discussed above in Section XV.C.3.a and incorporated herein by reference, *Krupa* discloses Limitations 3.1. Further, *Al-Salmani*'s Fig. 8 shows four wellheads each of which a POSITA would have recognized are associated with a well. *Al-Salmani*'s four wellheads include a first, second, third and fourth well.



Al-Salmani, Fig. 8

900. Accordingly, *Krupa* and *Al-Salmani* each disclose Limitation 3.1 and Limitation 3.1 would have been obvious in light of the combination of *Krupa*, *FS-Video* and *Al-Salmani*.

b. 3.2: “communicating fluid to the third well via the manifold and a third valve, wherein the third valve is associated with both the third well and the manifold;”

901. As discussed above in Section XV.C.3.b and incorporated herein by reference, *Krupa* discloses Limitation 3.2. Accordingly, Limitation 3.2 would have been obvious in light of the combination of *Krupa*, *FS-Video* and *Al-Salmani*.

c. 3.3: “wherein executing the CP swap further transitions from hydraulically fracturing the third well to hydraulically fracturing the fourth well, the CP swap further comprising:”

902. As discussed above in Sections XV.C.3.c and XV.D.1.c and incorporated herein by reference, *Krupa* and *FS-Video* disclose a “CP Swap,” as explained with Claim 1. Further, as described in the subsections below, *Krupa*, *FS-Video* and *Al-Salmani* disclose and/or render each and every additional limitation comprising the “CP” swap of Claim 3 obvious.

(1)3.3.1: “opening a fourth valve while fluid is communicated to the third well via the third valve and the manifold, wherein the fourth valve is associated with both the fourth well and the manifold, wherein opening the fourth valve causes fluid to be communicated to the fourth well via the manifold and the fourth valve, and”

903. As discussed above in Section XV.C.3.d and incorporated herein by reference, *Krupa* discloses the Limitation 3.3.1. Accordingly, Limitation 3.3.1 would have been obvious in light of the combination of *Krupa*, *FS-Video*, and *Al-Salmani*.

(2)3.3.2: “wherein the fourth valve is opened in response to the at least a portion of fluid communicated via the manifold satisfying the one or more conditions, which one or more conditions include the flow rate, and/or the pressure, of the at least a portion of fluid communicated via the manifold; and”

904. As discussed above in Section XV.C.3.e and incorporated herein by reference, *Krupa* discloses Limitation 3.3.2.

905. Further, *Al-Salmani* teaches using pressure sensors to determine fracturing operation status, such as the status of a fracturing stage, and based on the pressure (or other sensor data), driving next steps in the operations (e.g., “moving a valve between an open position and a closed position”⁴⁵⁵), as discussed with Limitation 1.3.1 in Section XV.D.1.c.(2).

906. *Krupa* describes operations of fracturing control systems. *Krupa* teaches “[w]ith reference to FIGS. 2A-2G, FIGS. 2A-2G show a non-limiting example of a fracturing pump plan of a hydraulic fracturing pumping system displayed on the HMI 116. A hydraulic fracturing pumping system 200 may include [] a third wellhead assembly 201d of a third well, and a fourth wellhead assembly 201d of a fourth well,”⁴⁵⁶

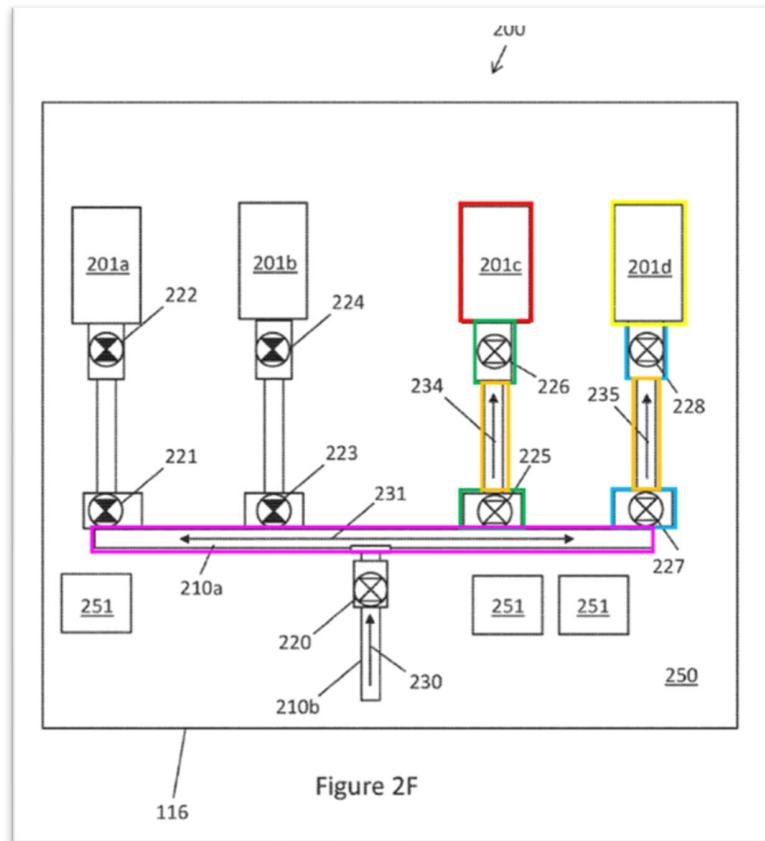
907. *Krupa* further explains that sensors are used to aid in carrying out a fracturing plan, for example, by using collected data “to create real-time logging of operational metrics, such as duration between various stages” and “to determine current job state and provide[] choices for possible stages.”⁴⁵⁷ *Krupa* also teaches that “[a]fter hydraulic fracturing operations are conducted on the third wellhead assembly 201c, flush fluids may be pumped into the third wellhead assembly 201c

⁴⁵⁵ *Al-Salmani*, [0044].

⁴⁵⁶ *Krupa*, [0038].

⁴⁵⁷ *Krupa*, [0026].

and the pump rate may be reduced once a total volume of the flush fluid has been pumped. As shown by FIG. 2F, the fracturing pumping plan may next open a fourth set of valves 227, [fourth valve] 228 while the third set of valves 225, 226 are still open.”⁴⁵⁸



Krupa, Figure 2F (annotated)

908. This disclosure of *Krupa* describes two different “conditions” that the fluid has satisfied before the fourth valve [227] is open: “pump rate reduced,” and

⁴⁵⁸ *Krupa*, [0045].

“a total volume of the flush fluid has been pumped.”⁴⁵⁹ Coupled with the teachings earlier in the description of the fracturing sequence of *Krupa*, a POSITA would have understood that “pump rate reduced” is describing the flowrate and pressure condition of “a pump rate may be reduced from the full pump rate. For example, the pump rate may be reduced to 5-15 bbl./min. Once a pressure has stabilized at the reduced pump rate, the software application may move the fracturing pumping plan to the next step.”⁴⁶⁰ Thus, in one example, after the flowrate into the third well is reduced, and the reduced flowrate and pressure is determined to be stable, the fracturing pumping plan is moved to the next step. Further, coupled with *Al-Salmani*’s disclosure that pressure may be indicative of a particular operation or stage, *Krupa*’s system would use pressure to “evaluate a particular more or stage” and “drive additional operations”, such as moving to the next stage (i.e. swapping to fracturing the second well).

909. Accordingly, the combination of *Krupa*, *FS-Video* and *Al-Salmani* discloses the fourth valve is opened in response to the at least a portion of the fluid communicated by the manifold (flow arrow 234) satisfying the one or more conditions (reduced flowrate and stable pressure) which one or more conditions include the flowrate (reduced flowrate) an the pressure (pressure stable) of the at

⁴⁵⁹ *Krupa*, [0045].

⁴⁶⁰ *Krupa*, [0042].

least a portion of the fluid communicated via the manifold, as claimed in Limitation 3.3.2.

910. Thus, *Krupa*, *FS-Video* and *Al-Salmani* renders the limitations of 3.3.2 obvious.

(3)3.3.3: “closing the third valve: after the at least a portion of fluid communicated via the manifold has satisfied the one or more conditions, which one or more conditions include the flow rate, and/or the pressure, of the at least a portion of fluid communicated via the manifold, and”

911. As discussed above in Section XV.C.3.f and incorporated herein by reference, *Krupa* discloses Limitation 3.3.3. Accordingly, Limitation 3.3.3 would have been obvious over the combination of *Krupa*, *FS-Video* and *Al-Salmani*..

(4)3.3.4: “while fluid is communicated to the fourth well via the fourth valve and the manifold; and”

912. As discussed above in Section XV.C.3.g and incorporated herein by reference, *Krupa* discloses Limitation 3.3.4. Accordingly, Limitation 3.3.4 would have been obvious over the combination of *Krupa*, *FS-Video* and *Al-Salmani*.

913. *Krupa*, *FS-Video* and *Al-Salmani* render obvious Claim 3.

4. DEPENDENT CLAIM 4: “THE METHOD OF CLAIM 1, FURTHER COMPRISING: DETERMINING THAT THE AT LEAST A PORTION OF THE FLUID COMMUNICATED VIA THE MANIFOLD HAS SATISFIED THE ONE OR MORE CONDITIONS.”

914. Dependent Claim 4 depends from Claim 1. In my opinion, Claim 4 adds no additional limitations to Claim 1. Claim 1, Limitation 1.3.2 claims “wherein

the second valve is opened in response to at least a portion of fluid communicated via the manifold satisfying one or more conditions”. Before the method claimed in claim 1 can open the valve “in response to” at least a portion of fluid communicated via the manifold satisfying one or more conditions, the method must first “determine” that the fluid has met the one or more conditions.

915. To the extent that the Board finds that Claim 4 does add additional limitations, *Krupa* and *Al-Salmani* disclose and/or render obvious the additional limitations of Claim 4, as discussed above in Section XV.D.1.c.(2) and incorporated herein by reference. Accordingly, Claim 4 would have been obvious to a POSITA over the combination of *Krupa*, *FS-Video* and *Al-Salmani*.

5. DEPENDENT CLAIMS 5 – 12

916. *Krupa* discloses and renders obvious opening the second valve in response to at least a portion of fluid communicated via the manifold satisfying one or more conditions, the condition(s) including a flow rate, as in Claim 5, and/or the condition(s) including pressure, as in Claim 9, for the same reasons provided in my analysis of Claim 1 in Grounds 8 and 9, in Section XV.C.1.e.

917. As discussed above regarding Grounds 8 and 9 *Krupa* also discloses and/or renders obvious the threshold limitations of Claims 6-8 and 10-12, or at least they would have been obvious.

918. To the extent that the Board finds the disclosure of Krupa and the general knowledge of a POSITA insufficient to teach using pressure thresholds to determine when to perform a CP swap, Al-Salmani discloses using pressure and flowrate thresholds “to categorize different operations of the well site, determine a phase of the operation, and/or monitor ongoing activities,”⁴⁶¹ including the ending of a stage, triggering a swap to fracturing the next stage, including in the next well.

919. As discussed above in Grounds 8 and 9, Krupa teaches performing a continuous pumping swap in response to at least a reduced flowrate of “5-15 bbl min”. Accordingly, the swap occurs when flowrate is above a lower threshold (e.g. 5 bbl/min” and below an upper threshold “15 bbl/min”.

920. Based on the teachings of Al-Salmani, a POSITA would have understood to use pressure thresholds to determine the state of the fracturing system to indicate when “stimulation is complete” in the first wellbore and the pumps are still running.

921. Al-Salmani teaches use of a “pressure sensor arranged at a fracturing tree” that is “coupled to a control unit”.⁴⁶² Further, Al-Salmani discloses “a method for monitoring operations at a well sit includes receiving, from a pressure sensor, pressure information for a fracturing tree, the pressure information indicative of an

⁴⁶¹ *Al-Salmani*, [0040].

⁴⁶² *Al-Salmani*, [0006].

operational stage.”⁴⁶³ Further, Al-Salmani discloses “determining, based at least in part on the pressure information and the valve position information, a current status of a wellhead.”⁴⁶⁴ Al-Salmani teaches that the control system “utilize[s] analytics to categorize different operations of the well site, determine a phase of the operation, and/or monitor ongoing activities, which may improve well site operations,”⁴⁶⁵ based on the sensor data, including both pressure sensors and flow sensors.⁴⁶⁶ Further, Al-Salmani teaches that “differences in the information received from the one or more sensors described herein may be utilized in order to determine various operations at the well site.”⁴⁶⁷ Further, Al-Salmani discloses that “readings from a single sensor may be used to determine operating parameters and conditions at wellsite.”⁴⁶⁸

922. Al-Salmani also teaches using flowrate from flow sensors to determine the state of the fracturing operation. Al-Salmani teaches that “[i]t should be appreciated that various other sensors and monitors may also be included within the frac tree 100, and that the illustrated pressure and position sensors are for illustrative purposes only. In embodiments, flow sensors may also be incorporated into the

⁴⁶³ *Al-Salmani*, [0007].

⁴⁶⁴ *Al-Salmani*, [0007].

⁴⁶⁵ *Al-Salmani*, [0040].

⁴⁶⁶ *Al-Salmani*, [0033], [0039]-[0040].

⁴⁶⁷ *Al-Salmani*, [0065].

⁴⁶⁸ *Al-Salmani*, [0066].

system, thereby enabling monitoring of fracturing fluid flow into and/or out of the wellbore.”⁴⁶⁹ The sensors may receive and transmit information to a control system, which may utilize analytics to categorize different operations of the well site, determine a phase of the operation, and/or monitor ongoing activities, which may improve well site operations.⁴⁷⁰ Accordingly, Al-Salmani teaches that flow sensors (flowrate) can be used in the same manner as pressure sensors (pressure).

923. In addition to the general teaching of Al-Salmani regarding using pressure (and flow) to determine the state of the fracturing operation, Al-Salmani specifically teaches comparing sensor data to upper and lower thresholds to determine the state of the fracturing operation. For example, Al-Salmani teaches that “information may further be transmitted to the control unit, which may be utilized to evaluate a change in the operating condition. For example, the pressure may increase and/or decrease more than a threshold amount or the valve may be transitioned from an open state to a closed state. This changed operating condition may be correlated to a different action at the wellsite, such as a closed in well in cases where the valve is closed and/or the pressure is below a threshold amount.”⁴⁷¹

⁴⁶⁹ *Al-Salmani*, [0040].

⁴⁷⁰ *Al-Salmani*, [0040].

⁴⁷¹ *Al-Salmani*, [0065].

924. Accordingly, Al-Salmani discloses that pressure thresholds (e.g. pressure below a threshold amount) indicate a state of the fracturing operation. A POSITA would have understood, based on the teachings of Al-Salmani disclosing flowrate indicative of the state of a fracturing operation that it would have been obvious to use flowrate thresholds to equally indicate a state of the fracturing operation.

925. A POSITA would have applied Al-Salmani's teaching of the use of pressure thresholds to the disclosure of Krupa that a well swap (CP swap) occurs after a reduction in flowrate. Accordingly, it would have been obvious to a POSITA, based on the combined teachings of Krupa and Al-Salmani that a CP swap occurs when flow or pressure is below an upper threshold (indicating that stimulation is complete in the first stage), when flow or pressure is above an upper threshold (indicating that the pumps are still running), and when flow and/or pressure is both below an upper and above a lower threshold.

926. Accordingly, Claims 5 – 12 would have been obvious to a POSITA based on the teachings of Krupa, FS-Video, Al-Samani, and the general knowledge of a POSITA.

6. DEPENDENT CLAIM 13

927. The combination of *Krupa*, *FS-Video*, and *Al-Salmari* disclose and/or render obvious the limitations of Claim 13 and would have rendered Claim 13 obvious. The limitations of Claim 13 are listed below.

- a. 13.1: “The method of claim 1, wherein the plurality of wells further comprises a third well, and the method further comprises:**
- b. 13.2: “communicating fluid to the third well via the manifold and a third valve, wherein the third valve is associated with both the third well and the manifold; and”**
- c. 13.3: “executing another CP swap to transition from hydraulically fracturing the third well to hydraulically fracturing the first well, the another CP swap comprising:”**
 - (1) 13.3.1: “opening the first valve while fluid is communicated to the third well via the third valve and the manifold, wherein opening the first valve causes fluid to be communicated to the first well via the manifold and the first valve, and”**
 - (2) 13.3.2: “wherein the first valve is opened in response to at least another portion of fluid communicated via the manifold satisfying one or more conditions, which one or more conditions include a flow rate, and/or a pressure, of the at least another portion of fluid communicated via the manifold; and”**
 - (3) 13.3.3: “closing the third valve: after the at least another portion of fluid communicated via the manifold has satisfied the one or more conditions, which one or more conditions include the flow rate, and/or the pressure, of the at least another portion of fluid communicated via the manifold, and”**

(4) 13.3.4: “while fluid is communicated to the first well via the first valve and the manifold;”

d. 13.4: “wherein, during the another CP swap, the fluid is continuously communicated via the manifold.”

928. The limitations of Claim 13 are substantially similar to the limitations of Claim 3 except that the CP swap discussed swaps from hydraulically fracturing the third well to hydraulically fracturing the first well, as opposed to the swap to hydraulically fracturing the fourth well, as discussed in Claim 3. The discussion regarding Claim 3, in Section XV.D.3, shows that the combination *Krupa*, *FS-Video*, and *Al-Salmani* discloses, or at least renders obvious, swapping between a third well and a fourth well while continuously pumping. *Krupa* also contains the following explanation:⁴⁷²

In one or more embodiments, FIGS. 2A-2G may provide continuous hydraulic fracturing pumping operations between the wellhead assemblies 201a-201d. While it is noted that FIGS. 2A-2G describes the sequence of the fracturing pumping plan from the first wellhead assembly 201a to the fourth wellhead assembly 201d, the sequence may be conducted between any of the wellhead assemblies 201a-201d *in any order*.

⁴⁷² *Krupa*, [0046] (emphasis added).

929. Accordingly the teachings of *Krupa* discussing swapping between a third well and a fourth well, as discussed regarding Claim 3, apply equally to swapping between a third well and a first well as “the sequence may be conducted between any of the wellhead assemblies 201a-201d in any order.”⁴⁷³

930. Accordingly, the combination of *Krupa*, *FS-Video* and *Al-Salmani* render Claim 13 obvious for the same reasons as those discussed above regarding Claim 3 in Section XV.D.3, along with the teachings of *Krupa* above regarding the sequencing being conducted in any order.

7. DEPENDENT CLAIMS 14 – 15 (FRACURING FLUID AND FRACTURING FLUID CONTAINING SAND)

931. As discussed above in Sections XV.C.12-13 and incorporated herein by reference, *Krupa* discloses the limitations of Claims 14 and 15. Accordingly, Claims 14 and 15 would have been obvious to a POSITA over the combination of *Krupa*, *FS-Video* and *Al-Salmani*.

932. *Al-Salmani* also teaches the use of fracturing fluid. *Al-Salmani* teaches “sensors may also be incorporated into the system, thereby enabling monitoring of fracturing fluid flow into and/or out of the wellbore,” and that to form the fracturing

⁴⁷³ *Krupa*, [0046] (emphasis added).

fluid “a sand supplier, provides sand to form the slurry that is injected during a fracturing operation.”⁴⁷⁴

933. Accordingly, *Krupa* discloses, and the combination of *Krupa*, *FS-Video* and *Al-Salmani* renders obvious, wherein the fluid of Claim 1 is a fracturing fluid as claimed in Claim 14, and that the fracturing fluid contains sand as claimed in Claim 15.

8. DEPENDENT CLAIM 16

934. The combination of *Krupa*, *FS-Video* and *Al-Salmani* disclose the limitations of Claim 16 and would have rendered Claim 16 obvious. *Krupa* and/or *Al-Salmani* disclose, or at least render obvious, each and every limitation of Claim 16, as discussed in the subsections below.

a. 16.1: “The method of claim 1, further comprising: displaying a dashboard, which dashboard comprises:”

935. As discussed above in Section XV.C.14.a and incorporated herein by reference, *Krupa* discloses the limitations of Limitation 16.1. Accordingly, Limitation 16.1 would have been obvious to a POSITA in light of the combination of *Krupa*, *FS-Video* and *Al-Salmani*.

936. *Al-Salmani* also discloses a dashboard. *Al-Salmani* teaches “a user interface and display module for presenting information, for example at the control

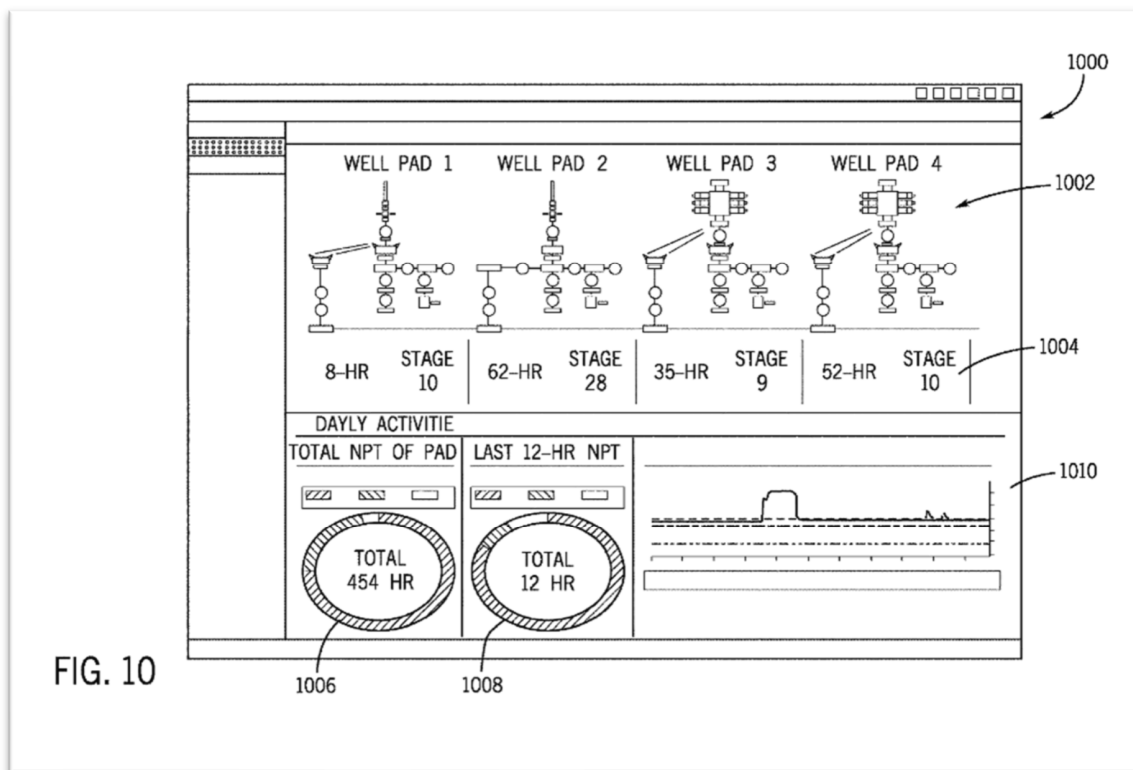
⁴⁷⁴ *Al-Salmani*, [0040], [0025].

panel, for operators to track and monitor well site operations.”⁴⁷⁵ *Al-Salmاني*’s display “may relay information to the user regarding pressures, valve state, and the like.”⁴⁷⁶ *Al-Salmاني*’s Fig. 10 “illustrates the user interface that includes graphical representations of frac trees illustrative of well configurations (e.g., number of wells, ball drop systems, etc.). In various embodiments, real or near-real time monitoring is provided, and may also include indicators of valve operations (e.g., color coded for different positions). For example, open valves may be presented in green, closed valves may be presented in red, and transitioning valves may be presented in yellow.”⁴⁷⁷

⁴⁷⁵ *Al-Salmاني*, [0026].

⁴⁷⁶ *Al-Salmاني*, [0046].

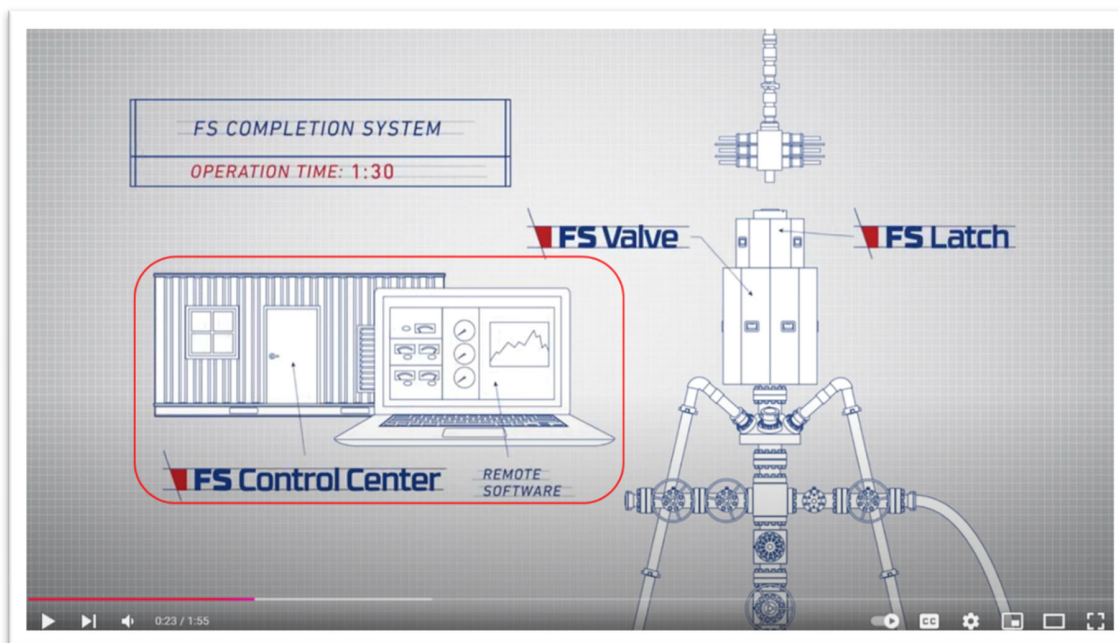
⁴⁷⁷ *Al-Salmاني*, [0063], Fig. 10.



Al-Salmani, Fig. 10

937. Accordingly, *Krupa* and *Al-Salmani* each disclose a dashboard in the form of HMI 116. To the extent the board determines *Krupa* and *Al-Salmani* do not explicitly use the term dashboard, it would have been obvious to a POSITA that *Krupa*'s HMI 116 is a "dashboard", as well as *Al-Salmani*'s "display", as they encompass all limitations of Claim 16 describing the "dashboard".

938. *FS-Video* also discloses the use of a "dashboard" displaying at least graphs and gauges to provide a visual reference of fracturing operational data to "remotely operate" the fracturing system.



FS-Video, 0:23

It would have been further obvious to incorporate the combined dashboard teachings of *Krupa*, *FS-Video* and *Al-Salmami* to improve remote visibility of well operations, including the status of various valves including the first and second valve.

b. 16.2: “a visual reference of the first valve; and a visual reference of the second valve;”

939. As discussed above regarding Limitation 16.1 *Krupa*’s HMI 116 contains a visual reference of the first valve (221 or 222) and a visual reference of the second valve (223 or 224). Further, *Al-Salmami*’s display contains a visual reference of the first valve (associated with Well Pad 1) and a visual reference of the second valve (associated with Well Pad 2). Accordingly, *Krupa* and *Al-Salmami* each disclose this limitation.

c. 16.3: “wherein the display of the dashboard visually communicates respective states of the first and second valves.”

940. As discussed above regarding Limitation 16.1 *Krupa*’s HMI 116 communicates the respective states of the first and second valves (i.e. blank for open and filled in for closed). For example, in Fig. 2A the first valve (221 or 222) is shown in the “open” state and second valve (223 or 224) is shown in the “closed” state.⁴⁷⁸ Accordingly, *Krupa* discloses this limitation.

941. Further, *Al-Salmani*’s display communicates the respective states of the first and second valves (e.g., green for open and red for closed).⁴⁷⁹

942. Accordingly, *Krupa* and/or *Al-Salmani* each disclose each and every limitation of Claim 16, and as a result renders Claim 16 obvious over the combination of *Krupa*, *FS-Video* and *Al-Salmani*.

9. DEPENDENT CLAIM 17: “THE METHOD OF CLAIM 16, WHEREIN THE DASHBOARD FURTHER COMPRISES: A FIRST VISUAL INDICATOR ASSOCIATED WITH THE VISUAL REFERENCE OF THE FIRST VALVE, THE FIRST VISUAL INDICATOR INDICATING THAT THE STATE OF THE FIRST VALVE IS OPEN TO PERMIT COMMUNICATING FLUID TO THE FIRST WELL VIA THE MANIFOLD AND THE FIRST VALVE.”

943. As discussed above in Section XV.C.15 and incorporated herein by reference, *Krupa* discloses and renders obvious the limitations of Claim 17.

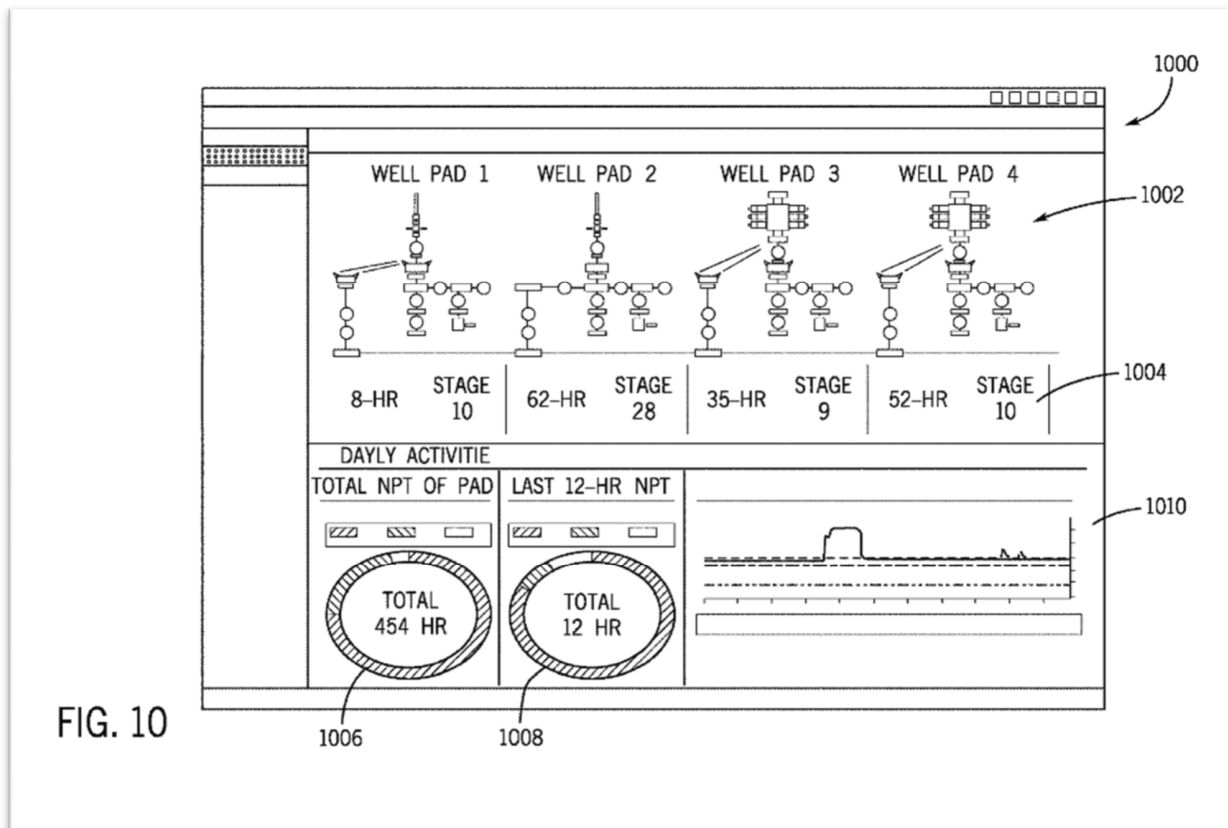
⁴⁷⁸ *Krupa*, [0040].

⁴⁷⁹ *Al-Salmani*, [0049].

Accordingly, Claim 17 would have been obvious to a POSITA in light of the combination of *Krupa, FS-Video* and *Al-Salmani*.

944. *Al-Salmani* also discloses this limitation. As discussed above regarding limitation 16.1, *Al-Salmani*'s Fig. 10 "illustrates the user interface that includes graphical representations of frac trees illustrative of well configurations (e.g., number of wells, ball drop systems, etc.). In various embodiments, real or near-real time monitoring is provided, and may also include indicators of valve operations (e.g., color coded for different positions). For example, open valves may be presented in green, closed valves may be presented in red, and transitioning valves may be presented in yellow."⁴⁸⁰ A POSITA would have understood that "open" wellhead valves permit communicating fluid to wellheads. The valves associated with the first wellhead (i.e. first valve) are shown in the diagram of "Well Pad 1" The "red" color coding indicating closed is different from the "green" color coding indicating open.

⁴⁸⁰ *Al-Salmani*, [0063], Fig. 10.



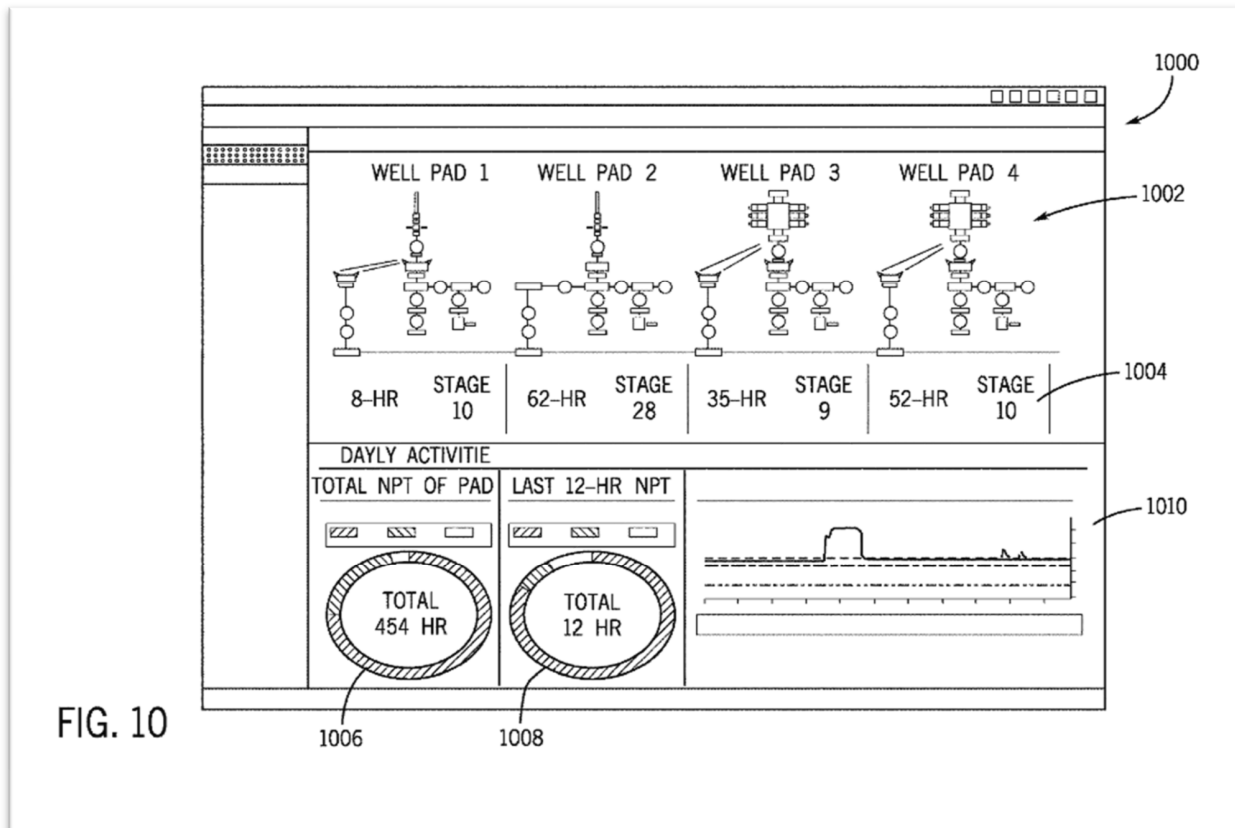
Al-Salmani, Fig. 10

945. Accordingly, Claim 17 would have been obvious to a POSITA based on the combined teachings of *Krupa*, *FS-Video* and *Al-Salmani*.

10. DEPENDENT CLAIM 18: “THE METHOD OF CLAIM 17, WHEREIN THE DASHBOARD FURTHER COMPRISES: A VISUAL REFERENCE OF A FIRST WELLHEAD IN COMMUNICATION WITH THE FIRST WELL.”

946. As discussed above in Section XV.C.16 and incorporated herein by reference, *Krupa* discloses the limitations of Claim 18. Accordingly, Claim 18 would have been obvious to a POSITA in light of the combination of *Krupa*, *FS-Video* and *Al-Salmani*.

947. *Al-Salmani* also discloses this limitation. *Al-Salmani's* Fig. 10 “illustrates the user interface that includes graphical representations of frac trees [i.e. wellheads] illustrative of well configurations (e.g., number of wells, ball drop systems, etc.).”⁴⁸¹



Al-Salmani, Fig. 10

⁴⁸¹ *Al-Salmani*, [0063], Fig. 10.

948. A POSITA would have understood the “frac trees” to at least include the wellheads, as shown in Figure 10, and the each frac tree is associated with a well.

949. Accordingly, *Krupa* and *Al-Salmani* each discloses the limitations of Claim 18, and the combination of *Krupa*, *FS-Video* and *Al-Salmani* renders Claim 18 obvious.

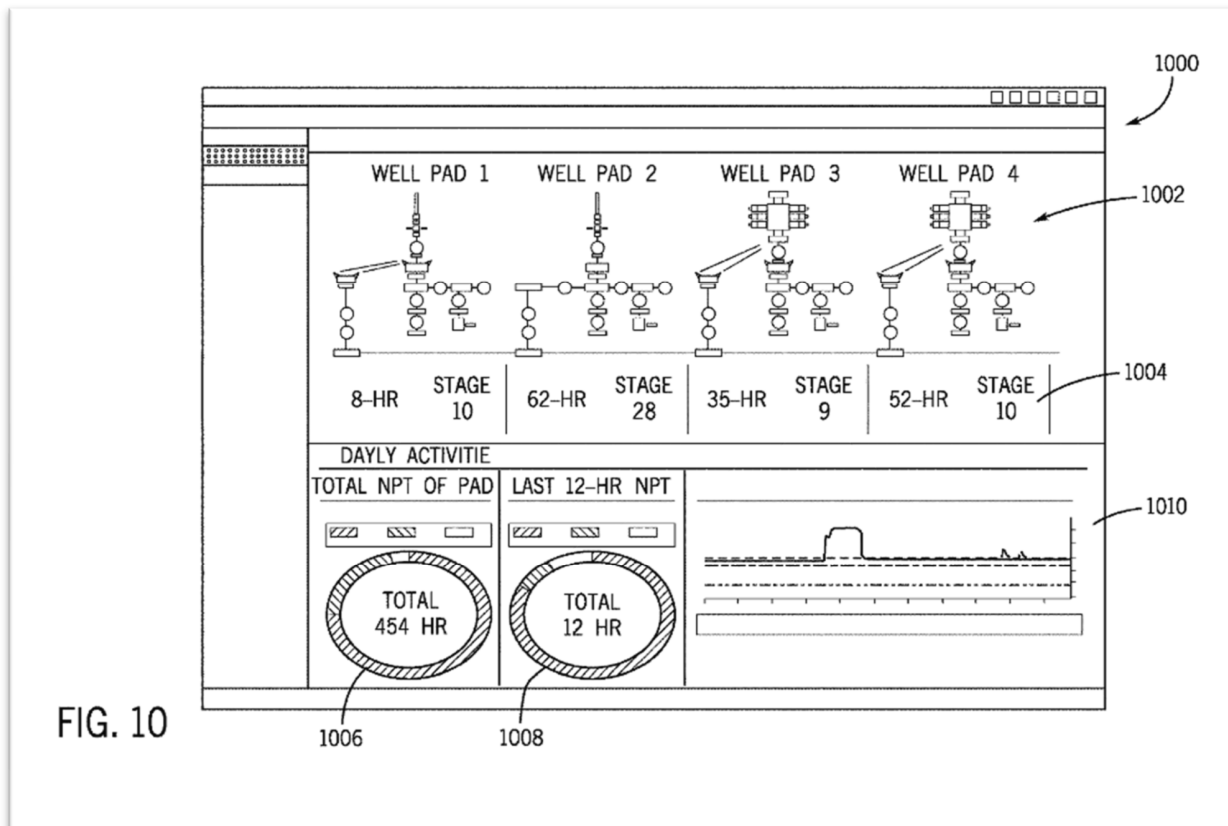
11. DEPENDENT CLAIM 19: “THE METHOD OF CLAIM 17, WHEREIN THE DASHBOARD FURTHER COMPRISES: A SECOND VISUAL INDICATOR ASSOCIATED WITH THE VISUAL REFERENCE OF THE SECOND VALVE, THE SECOND VISUAL INDICATOR BEING DIFFERENT FROM THE FIRST VISUAL INDICATOR TO INDICATE THAT THE STATE OF THE SECOND VALVE IS CLOSED.”

950. As discussed above in Section XV.C.17 and incorporated herein by reference, *Krupa* discloses the limitations of Claim 19. Accordingly, Claim 19 would have been obvious to a POSITA in light of the combination of *Krupa*, *FS-Video*, and *Al-Salmani*.

951. *Al-Salmani* also discloses this limitation. *Al-Salmani*’s dashboard in Fig. 10 “include[s] indicators of valve operations (e.g., color coded for different positions). For example, open valves may be presented in green, closed valves may be presented in red, and transitioning valves may be presented in yellow.”⁴⁸² The valves associated with the second wellhead (i.e. second valve) are shown in the

⁴⁸² *Al-Salmani*, [0063], Fig. 10.

diagram of “well pad 2”. The “red” color coding indicating closed is different from the “green” color coding indicating open.



Al-Salmani, Fig. 10

952. Thus, *Al-Salmani* discloses the limitations of Claim 19 and Claim 19 would have been obvious to a *POSITA* based on the combined teachings of *Krupa*, *FS-Video* and *Al-Salmani*.

12. INDEPENDENT CLAIM 20

953. It is my opinion that the combination of *Krupa*, *FS-Video*, and *Al-Salmani* renders obvious Claim 20 of the '952 Patent. Details regarding the specific

disclosures of *Krupa*, *FS-Video*, and *Al-Salmani* are contained in the subsections following.

- a. **20.1: “A non-transitory computer readable medium having stored thereon computer-readable instructions executable by one or more processors to perform operations for hydraulically fracturing a plurality of wells, the plurality of wells comprising first and second wells, the operations comprising:”**

954. As discussed above in Sections XV.C.1.a and XV.D.1.a and incorporated herein by reference, *Krupa* discloses the limitations of Limitation 20.1. Accordingly, limitation 20.1 would have been obvious to a POSITA in light of the combination of *Krupa*, *FS-Video*, and *Al-Salmani*.

955. *Al-Salmani* also discloses the limitation. *Al-Salmani* teaches:⁴⁸³

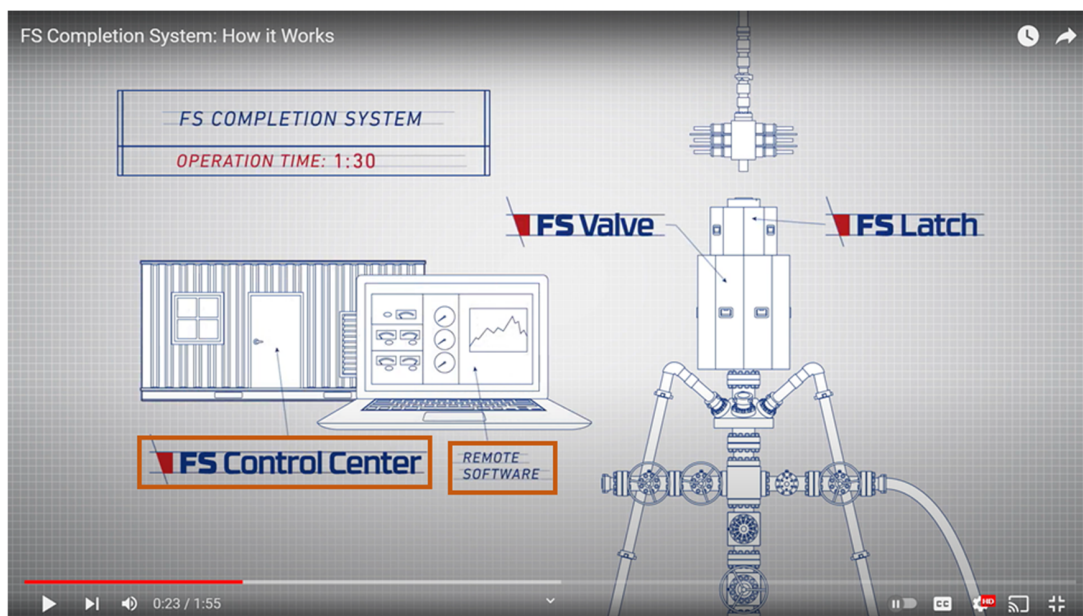
The remote control unit may include a memory and a processor, for example as part of a computer system. The processor may execute instructions stored on the memory to conduct one or more operations. Moreover, the memory and processor may be utilized to collect and analyze information received from the one or more sensors associated with the system. As described above, in various embodiments the remote control unit may be utilized to control operation of the valves from a distance away from the frac tree, for example, outside of a pressure barrier associated with the well and/or pad.

956. Further, as discussed above with respect to Limitation 1.1, *Krupa* and *Al-Salmani* also discloses that the “non-transitory computer readable medium having stored thereon computer-readable instructions executable by one or more

⁴⁸³ *Al-Salmani*, [0045].

processors” is provided “to perform operations for hydraulically fracturing a plurality of wells, the plurality of wells comprising first and second wells,” for the same reasons as those described in Section XV.D.1.a.

957. *FS-Video* also shows a “control center,” including an image of a computer having “remote software,” with its “remotely operated completion system.”⁴⁸⁴



FS-Video, 0:23

958. A POSITA would have found it obvious to use standard computer equipment, including a processor configured to execute the software/computer-

⁴⁸⁴ *FS-Video*, 0:20-0:27.

readable instructions for operating the continuous frac operations, with *FS-Video*'s control center.

959. Accordingly, *Krupa*, *FS-Video*, and *Al-Salmani* each separately and in combination disclose or render obvious Limitation 20.1.

- b. 20.2: “communicating fluid from one or more pumps to the first well via a manifold and a first valve, wherein the first valve is associated with both the first well and the manifold so that the first valve is: in fluid communication with the manifold; and fluidically positioned between the first well and the one or more pumps; and”**

960. This claim limitation is identical to Limitation 1.2 and is therefore disclosed by *Krupa* or at least is obvious over *Krupa*, *FS-Video* and *Al-Salmani* for the same reasons as those described in Section XV.D.1.b.

- c. 20.3: “executing a continuous pumping ("CP") swap to transition from hydraulically fracturing the first well to hydraulically fracturing the second well, the CP swap comprising:”**

961. This claim limitation is identical to Limitation 1.3 and is obvious over *Krupa*, *FS-Video* and *Al-Salmani* for the same reasons as those described in Section XV.D.1.c.

- (1)20.3.1: “opening a second valve while fluid is communicated from the one or more pumps to the first well via the first valve and the manifold, wherein the second valve is associated with both the second well and the manifold so that the second valve is: in fluid communication with the manifold; and fluidically positioned between the second well and the one or more pumps from which fluid is communicated to the first well via the manifold and the first**

valve; wherein opening the second valve causes fluid to be communicated from the one or more pumps to the second well via the manifold and the second valve, and”

962. This claim limitation is identical to Limitation 1.3.1 and is obvious over *Krupa, FS-Video* and *Al-Salmani* for the same reasons as those described in Section XV.D.1.c.(1).

(2) 20.3.2: “wherein the second valve is opened in response to at least a portion of fluid communicated via the manifold satisfying one or more conditions, which one or more conditions include a flow rate, and/or a pressure, of the at least a portion of fluid communicated via the manifold; and”

963. This claim limitation is identical to Limitation 1.3.2 and is obvious over *Krupa, FS-Video* and *Al-Salmani* for the same reasons as those described in Section XV.D.1.c.(2).

(3) 20.3.3: “closing the first valve: after the at least a portion of the fluid communicated via the manifold has satisfied the one or more conditions, which one or more conditions include the flow rate, and/or the pressure, of the at least a portion of the fluid communicated via the manifold, and”

964. This claim limitation is identical to Limitation 1.3.3 and is obvious over *Krupa, FS-Video* and *Al-Salmani* for the same reasons as those described in Section XV.D.1.c.(3).

(4) 20.3.4: “while fluid is communicated to the second well via the second valve and the manifold;”

965. This claim limitation is identical to Limitation 1.3.4 and is obvious over *Krupa, FS-Video* and *Al-Salmani* for the same reasons as those described in Section XV.D.1.(4).

d. 20.4: “wherein, during the CP swap, fluid is continuously communicated from the one or more pumps via the manifold.”

966. This claim limitation is identical to Limitation 1.4 and is obvious over *Krupa, FS-Video* and *Al-Salmani* for the same reasons as those described in Section XV.D.1.d.

967. The combination of *Krupa, FS-Video*, and *Al-Salmani*, therefore, discloses each and every limitation of Claim 20 and renders Claim 20 obvious.

13. DEPENDENT CLAIM 21: “THE NON-TRANSITORY COMPUTER READABLE MEDIUM OF CLAIM 20, WHEREIN: THE FIRST VALVE IS A FIRST ZIPPER VALVE; AND/OR THE SECOND VALVE IS A SECOND ZIPPER VALVE.”

968. Except for depending from Claim 20, the limitations of Claim 21 are identical to those of Claim 2, and would have been obvious over *Krupa, FS-Video*, and *Al-Salmani* for the same reasons as those described in Section XV.D.2.

14. DEPENDENT CLAIM 22

969. Except for depending from Claim 20, this claim is substantially similar to Claim 3 and is obvious over *Krupa, FS-Video* and *Al-Salmani* for the same reasons as those described in Section XV.D.3.

15. DEPENDENT CLAIM 23: “THE NON-TRANSITORY COMPUTER READABLE MEDIUM OF CLAIM 20, WHEREIN THE OPERATIONS FURTHER COMPRISE: DETERMINING THAT THE AT LEAST A PORTION OF THE FLUID COMMUNICATED VIA THE MANIFOLD HAS SATISFIED THE ONE OR MORE CONDITIONS.”

970. Except for depending from Claim 20, the limitations of Claim 23 are identical to those of Claim 4, and would have been obvious over *Krupa, FS-Video* and *Al-Salmani* for the same reasons as those described in Sections XV.D.1.c.(2) and XV.D.4.

16. DEPENDENT CLAIM 24: “THE NON-TRANSITORY COMPUTER READABLE MEDIUM OF CLAIM 20, WHEREIN THE ONE OR MORE CONDITIONS INCLUDE THE FLOW RATE OF THE AT LEAST A PORTION OF THE FLUID COMMUNICATED VIA THE MANIFOLD.”

971. Except for depending from Claim 20, the limitations of Claim 24 are identical to those of Claim 5, and would have been obvious over *Krupa, FS-Video* and *Al-Salmani* for the same reasons as those described in Sections XV.D.1.c.(2) and XV.D.5.

17. DEPENDENT CLAIMS 25 - 27

972. Except for depending from Claim 24, the limitations of Claims 25 - 26 are identical to those of Claims 6 - 8, respectively, and would have been obvious over *Krupa, FS-Video*, and *Al-Salmani* for the same reasons as those described in Sections XV.D.5 and XV.C.6-8.

18. DEPENDENT CLAIM 28: “THE NON-TRANSITORY COMPUTER READABLE MEDIUM OF CLAIM 20, WHEREIN THE ONE OR MORE CONDITIONS INCLUDE THE PRESSURE OF THE AT LEAST A PORTION OF THE FLUID COMMUNICATED VIA THE MANIFOLD.”

973. Except for depending from claim 20, the limitations of Claim 28 are substantially similar to those of Claim 9 and are disclosed or rendered obvious by the combination of *Krupa*, *FS-Video* and *Al-Salmani* for the same reasons as those described in Sections XV.D.1.c.(2) and XV.D.5.

19. DEPENDENT CLAIMS 29 - 31

974. Except for depending from claim 28, the limitations of Claims 29 - 31 are substantially similar to those of Claim 10 – 12, respectively, and are disclosed or rendered obvious by the combination of *Krupa*, *FS-Video* and *Al-Salmani* for the same reasons as those described in Sections XV.D.5 and XV.C.10.

20. DEPENDENT CLAIMS 32 - 38.

975. Except for depending from Claim 20, the limitations of Claims 32 - 38, are substantially similar to those of Claims 13 – 19, respectively, and are disclosed by *Krupa* or at least rendered obvious by the combination of *Krupa*, *FS-Video* and *Al-Salmani* for the same reasons as those described in Sections XV.D.6-11 and XV.C.11-17.

21. INDEPENDENT CLAIM 39

976. It is my opinion that the combination of the combination of *Krupa*, *FS-Video* and *Al-Salmani* renders obvious Claim 39 of the '952 Patent. Details

regarding the specific disclosures of the combination of *Krupa*, *FS-Video* and *Al-Salmani* are contained in the subsections following.

a. 39.1: “A system for hydraulically fracturing a plurality of wells, the plurality of wells comprising first and second wells, the system comprising:”

977. Except for being rewritten as a system claim, the limitations of 39.1 are identical to those of Limitation 1.1 and would have been obvious over the combination of *Krupa*, *FS-Video* and *Al-Salmani* for the same reasons as those discussed above in Section XV.D.1.a.

b. 39.2: “a manifold via which fluid is adapted to be communicated from one or more pumps;”

978. As discussed above in Sections XV.C.1.b and XV.D.1.b and incorporated herein by reference, *Krupa*, *FS-Video*, and *Al-Salmani* discloses or render obvious the limitations of Limitation 39.2. Accordingly, Limitation 39.2 would have been obvious to a POSITA in light of the combination of *Krupa*, *FS-Video* and *Al-Salmani*.

- c. 39.3: “a first valve via which fluid is adapted to be communicated from the one or more pumps to the first well, the first valve being associated with both the first well and the manifold so that the first valve is: in fluid communication with the manifold; and fluidically positioned between the first well and the one or more pumps;”**

979. As discussed above in Sections XV.C.1.b and XV.C.27.c and incorporated herein by reference, *Krupa* discloses the limitations of Limitation 39.3. This claim limitation is also obvious over *Krupa*, *FS-Video* and *Al-Salmani* for the same reasons as those described with Limitation 1.2 in Section XV.D.1.b. Accordingly, Limitation 39.3 would have been obvious to a POSITA in light of the combination of *Krupa*, *FS-Video* and *Al-Salmani*.

- d. 39.4: “a second valve via which fluid is adapted to be communicated from the one or more pumps to the second well, the second valve being associated with both the second well and the manifold so that the second valve is: in fluid communication with the manifold; and fluidically positioned between the second well and the one or more pumps from which fluid is adapted to be communicated to the first well via the manifold and the first valve; and”**

980. As discussed above in Sections XV.C.1.d and XV.C.27.d and incorporated herein by reference, *Krupa* discloses the limitations of Limitation 39.4. This claim limitation is also obvious over *Krupa*, *FS-Video* and *Al-Salmani* for the same reasons as those described with Limitation 1.3.1 in Section XV.D.1.c.(1). Accordingly, Limitation 39.4 would have been obvious to a POSITA in light of the combination of *Krupa*, *FS-Video* and *Al-Salmani*.

- e. **39.5: “one or more controllers configured to execute a continuous pumping ("CP") swap, during which CP swap fluid is continuously communicated via the manifold, to transition from hydraulically fracturing the first well to hydraulically fracturing the second well, by:”**

981. Except for including controllers, the limitations of 39.5 are substantially similar to those of Limitation 1.3 and would have been obvious over the combination of *Krupa*, *FS-Video* and *Al-Salmani* for the same reasons as those discussed above in Section XV.D.1.c.

982. As discussed with Limitation 39.5 in Grounds 8-9, *Krupa* also discloses the controllers, as claimed.

983. Further, *Al-Salmani* teaches a controller used to automate operations of the wellhead valves. *Al-Salmani* discloses “As described above, in various embodiments the remote control unit may be utilized to control operation of the valves from a distance away from the frac tree, for example, outside of a pressure barrier associated with the well and/or pad.”⁴⁸⁵

984. Additionally, a POSITA would have found it obvious that the “control center” in *FS-Video*, including a computer system with “remote software” for “remotely operat[ing]” the “completion system” for “continuous zipper frac operations” would be a “controller” for executing the CP swap, as claimed.

⁴⁸⁵ *Al-Salmani*, [0045]

985. Accordingly, the combination of *Krupa*, *FS-Video* and *Al-Salmani* render obvious Limitation 39.5.

(1)39.5.1: “opening the second valve: while fluid is communicated from the one or more pumps to the first well via the first valve and the manifold, to cause fluid to be communicated from the one or more pumps to the second well via the manifold and the second valve, and”

986. Except for being rewritten as a system claim, the limitations of 39.5.1 are substantially similar to those of Limitation 1.3.1 and would have been obvious over the combination of *Krupa*, *FS-Video* and *Al-Salmani* for the same reasons as those discussed above in Section XV.D.1.c.(1).

(2)39.5.2: “in response to at least a portion of fluid communicated via the manifold satisfying one or more conditions, which one or more conditions include a flow rate, and/or a pressure, of the at least a portion of fluid communicated via the manifold; and

987. Except for being rewritten as a system claim, the limitations of 39.5.2 are substantially similar to those of Limitation 1.3.2 and would have been obvious over the combination of *Krupa*, *FS-Video* and *Al-Salmani* for the same reasons as those discussed above in Section XV.D.1.c.(2).

(3)39.5.3: “closing the first valve: after the at least a portion of fluid communicated via the manifold has satisfied one or more conditions, which one or more conditions include the flow rate, and/or the pressure, of the at least a portion of fluid communicated via the manifold, and”

988. Except for being rewritten as a system claim, the limitations of 39.5.3 are substantially similar to those of Limitation 1.3.3 and would have been obvious over the combination of *Krupa*, *FS-Video*, and *Al-Salmani* for the same reasons as those discussed above in Section XV.D.1.c.(3).

(4)39.5.4: “while fluid is communicated to the second well via the second valve and the manifold.”

989. The limitations of 39.5.4 are identical to those of Limitation 1.3.4 and would have been obvious over the combination of *Krupa*, *FS-Video* and *Al-Salmani* for the same reasons as those discussed above in Section XV.D.1.d.

22. DEPENDENT CLAIM 40: “THE SYSTEM OF CLAIM 39, WHEREIN: THE FIRST VALVE IS A FIRST ZIPPER VALVE; AND/OR THE SECOND VALVE IS A SECOND ZIPPER VALVE.”

990. Except for depending from Claim 39, the limitations of Claim 40 are identical to those of Claim 2 and would have been obvious over the combination of *Krupa*, *FS-Video* and *Al-Salmani* for the same reasons as those discussed above in Section XV.D.2.

23. DEPENDENT CLAIM 41

991. Except for being rewritten as a system claim, the limitations of Claim 41 are substantially similar to those of Claim 3 and would have been obvious over the combination of *Krupa*, *FS-Video*, and *Al-Salmani* for the same reasons as those discussed above in Section XV.D.3.

24. DEPENDENT CLAIM 42: “THE SYSTEM OF CLAIM 39, WHEREIN THE ONE OR MORE CONTROLLERS ARE FURTHER CONFIGURED TO: DETERMINE THAT THE AT LEAST A PORTION OF COMMUNICATED VIA THE MANIFOLD HAS SATISFIED THE ONE OR MORE CONDITIONS.”

992. Except for depending from Claim 39 and referencing the controllers disclosed by *Krupa, FS-Video* and *Al-Salmani*, as discussed above regarding Claim 39, Claim 42 is substantially similar to Claim 4 and adds no additional limitations to Claim 39 for the same reasons as those outlined regarding Claim 4 discussed above in Section XV.D.4. To the extent the Board finds that Claim 42 does add additional limitations to Claim 39, Claim is obvious over the combination of *Krupa, FS-Video* and *Al-Salmani* for the same reasons as those discussed with Claim 4 in Section XV.D.4.

25. DEPENDENT CLAIM 43: “THE SYSTEM OF CLAIM 39, WHEREIN THE ONE OR MORE CONDITIONS INCLUDE THE FLOW RATE OF THE AT LEAST A PORTION OF FLUID COMMUNICATED VIA THE MANIFOLD.”

993. Except for depending from Claim 39 and referencing the controllers disclosed by *Krupa, FS-Video* and *Al-Salmani*, as discussed above regarding Claim 39, Claim 43 is substantially similar to Claim 5 and is obvious over the combination of *Krupa, FS-Video* and *Al-Salmani* for the same reasons as those discussed in Sections XV.D.1.c.(2) and XV.D.5.

26. DEPENDENT CLAIMS 44 - 46

994. Except for depending from Claim 39 and referencing the controllers disclosed by *Krupa*, *FS-Video* and *Al-Salmani*, as discussed above regarding Claim 39, Claims 44 - 46 are substantially similar to Claims 6–8, respectively, and are obvious over the combination of *Krupa*, *FS-Video* and *Al-Salmani* for the same reasons as those discussed in Section XV.D.5.

27. DEPENDENT CLAIM 47: “THE SYSTEM OF CLAIM 39, WHEREIN THE ONE OR MORE CONDITIONS INCLUDE THE PRESSURE OF THE AT LEAST A PORTION OF THE FLUID COMMUNICATED VIA THE MANIFOLD.”

995. Except for depending from Claim 39, the limitations of Claim 47 are substantially similar to those of Claim 9 and are disclosed or rendered obvious by the combination of *Krupa*, *FS-Video* and *Al-Salmani* for the same reasons as those described in Sections XV.D.1.c.(2) and XV.D.5.

28. DEPENDENT CLAIMS 48 - 50

996. Except for depending from Claim 47, the limitations of Claims 48-50 are substantially similar to those of Claims 10-12, respectively, and are disclosed or rendered obvious by the combination of *Krupa*, *FS-Video* and *Al-Salmani* for the same reasons as those described in Section XV.D.5.

29. DEPENDENT CLAIM 51

997. Except for being rewritten as a system claim, the limitations of Claim 51 are substantially similar to those of Claim 13 and would have been obvious over

the combination of Krupa, FS-Video and Al-Salmani for the same reasons as those discussed with Claim 13 above in Section XV.D.6.

30. DEPENDENT CLAIMS 52 - 57

998. Except for depending from Claim 39, the limitations of Claims 52 - 57 are identical to those of Claims 14 – 18, respectively, and are disclosed by or at least rendered obvious over the combination of Krupa, FS-Video, and Al-Salmani for the same reasons as those discussed above in Sections XV.D.7-10. Accordingly, Claims 14-18 are rendered obvious by Krupa, FS-Video, and Al-Salmani.

31. INDEPENDENT CLAIM 58

999. The combination of Krupa, FS-Video, and Al-Salmani disclose the limitations of Claim 58 and would have rendered Claim 58 obvious. Krupa, FS-Video, and/or Al-Salmani disclose each and every limitation of Claim 58, as discussed in the subsections below.

a. 58.1: “A method of hydraulically fracturing a plurality of wells, the plurality of wells comprising first and second wells, the method comprising:”

1000. Limitation 58.1 is identical to Limitation 1.1 and is obvious over the combination of Krupa, FS-Video and Al-Salmani for the same reasons as those discussed in Section XV.D.1.a above.

- b. 58.2: “communicating fluid from the one or more pumps to the first well via a manifold and a first valve, wherein the first valve is associated with both the first well and the manifold so that the valve is: in fluid communication with the manifold; and fluidically positioned between the first well and the one or more pumps;”**

1001. Limitation 58.2 is identical to Limitation 1.2 and is obvious over the combination of Krupa, FS-Video and Al-Salmani for the same reasons as those discussed in Section XV.D.1.b above.

- c. 58.3: “displaying a dashboard, which dashboard comprises:”**

1002. Limitation 58.3 recites the same limitations as Limitation 16.1 and is obvious over the combination of Krupa, FS-Video and Al-Salmani for the same reasons as those discussed in Section XV.D.8.a above.

- (1) 58.3.1: “a visual reference of the first valve;”**

1003. Limitation 58.3.1 recites the same limitations as in Limitation 16.2 and is obvious over the combination of Krupa, FS-Video and Al-Salmani for the same reasons as those discussed in Section XV.D.8.b above.

- (2) 58.3.2: “a first visual indicator associated with the visual reference of the first valve, the first visual indicator indicating that a state of the first valve is open to permit communicating fluid to the first well via the manifold and the first valve;”**

1004. Limitation 58.3.2 recites the same limitations as in Claim 17 and is obvious over the combination of Krupa, FS-Video and Al-Salmani for the same reasons as those discussed in Section XV.D.9 above.

(3)58.3.3: “a visual reference of a second valve, wherein the second valve is associated with both the second well and the manifold so that the second valve is: in fluid communication with the manifold; and fluidically positioned between the second well and the one or more pumps from which fluid is communicated to the first well via the manifold and the first valve; and”

1005. Limitation 58.3.3 recites the same limitations as in Limitation 16.2 and in Limitation 1.3.1 and is obvious over the combination of Krupa, FS-Video and Al-Salmani for the same reasons as those discussed in Sections XV.D.8.b and XV.D.1.c.(1) above.

(4)58.3.4: “a second visual indicator associated with the visual reference of the second valve, the second visual indicator being different from the first visual indicator to indicate that a state of the second valve is closed; and”

1006. Limitation 58.3.4 recites the same limitations in Claim 19 and is obvious over the combination of Krupa, FS-Video and Al-Salmani for the same reasons as those discussed in Section XV.D.11 above.

d. 58.4: “executing a continuous pumping (‘CP’) swap to transition from hydraulically fracturing the first well to hydraulically fracturing the second well, the CP swap comprising:”

1007. Limitation 58.4 is identical to Limitation 1.3 and is obvious over the combination of Krupa, FS-Video, and Al-Salmani for the same reasons as those discussed in Section XV.D.1.c above.

(1)58.4.1: “opening the second valve while fluid is communicated from the one or more pumps to the first well

via the first valve and the manifold, wherein opening the second valve causes fluid to be communicated from the one or more pumps to the second well via the manifold and the second valve, and”

1008. Limitation 58.4.1 recites the same limitations as in Limitation 1.3.1 and is obvious over the combination of Krupa, FS-Video and Al-Salmani for the same reasons as those discussed in Section XV.D.1.c.(1) above.

(2)58.4.2: “wherein the second valve is opened in response to at least a portion of fluid communicated via the manifold satisfying one or more conditions; and”

1009. Limitation 58.4.2 is substantially similar to, though less limiting than, Limitation 1.3.2, as Limitation 58.4.2 does not limit the claimed “conditions” at all. According to the plain language of the claim, the “conditions” of Limitation 58.4.2 could be the fluid’s flowrate and/or pressure, as recited in Limitation 1.3.2, or could be any other condition of the fluid.

1010. Despite the broad language of the claim, the ’952 Patent does not describe any other condition of the fluid that should be met for opening the second valve other than flowrate (although, even the ’952 Patent’s disclosure of a flowrate condition leaves much to the imagination of the reader, as discussed in Section XIV.A). Thus, according to the language of Claim 58, the mere act of fluid being communicated via the manifold could satisfy a “condition,” and the second valve could be opened in response. On the other hand, the ’952 Patent only gives an

example of operating the second valve in response to non-descript flowrate “conditions.”

1011. Nevertheless, whether the term “condition” is interpreted broadly or narrowly, the combination of *Krupa*, *FS-Video*, and *Al-Salmani* discloses or at least renders obvious opening a second valve in response to fluid communicated via a manifold satisfying flowrate and/or pressure conditions, as discussed with Limitation 1.3.2 in Section XV.D.1.c.(2) above. Thus, Limitation 58.4.2 is disclosed by and would have been obvious to a POSITA based on the disclosures of *Krupa*, *FS-Video*, and *Al-Salmani* for at least the same reasons as those discussed in Section XV.D.1.c.(2) above.

(3) 58.4.3: “closing the first valve: after the at least a portion of fluid communicated via the manifold has satisfied the one or more conditions,”

1012. Limitation 58.4.3 is substantially similar to, though less limiting than, Limitation 1.3.3 and is therefore obvious over the combination of *Krupa*, *FS-Video* and *Al-Salmani* for the same reasons as those discussed in Section XV.D.1.c.(3) above.

e. 58.5: “wherein the display of the dashboard visually communicates the respective states of the first and second valves; and”

1013. Limitation 58.5 recite the same limitations as in Limitation 16.3. Accordingly, the combination of *Krupa*, *FS-Video* and *Al-Salmani* render obvious

the limitations of 58.5 for the same reasons as those discussed in Section XV.D.8.c above.

f. 58.6: “wherein fluid is continuously communicated via the manifold during the CP swap.”

1014. Limitation 58.6 is substantially similar to Limitation 1.4 and is obvious over the combination of *Krupa*, *FS-Video* and *Al-Salmani* for the same reasons as those discussed in Section XV.D.1.d above.

32. DEPENDENT CLAIM 59: “THE METHOD OF CLAIM 58, WHEREIN THE DASHBOARD FURTHER COMPRISES A VISUAL REFERENCE OF A FIRST WELLHEAD IN COMMUNICATION WITH THE FIRST WELL.”

1015. Except for depending from Claim 58, Claim 59 recites the same limitations as in Claim 18 and would have been obvious over the combination of *Krupa*, *FS-Video* and *Al-Salmani* for the same reasons as those discussed in Section XV.D.10 above.

33. DEPENDENT CLAIMS 60 - 61

1016. Except for depending from Claim 58 and referencing the controllers disclosed by *Krupa*, *FS-Video* and *Al-Salmani*, as discussed above regarding Claim 58, Claims 60-61 are substantially similar to Claims 4–5, respectively, and are obvious over the combination of *Krupa*, *FS-Video* and *Al-Salmani* for the same reasons as those discussed in Sections XV.D.1.c.(2) and XV.D.4-5.

34. DEPENDENT CLAIM 62: “THE METHOD OF CLAIM 58, WHEREIN THE ONE OR MORE CONDITIONS INCLUDE A PRESSURE CONDITION OF THE AT LEAST A PORTION OF FLUID COMMUNICATED VIA THE MANIFOLD.”

1017. Except for depending from Claim 58, the limitations of Claim 62 are substantially similar to those of Claim 9 and are disclosed or rendered obvious by the combination of *Krupa*, *FS-Video* and *Al-Salmani* for the same reasons as those described in Section XV.D.1.c.(2) and XV.D.5.

35. DEPENDENT CLAIMS 63 - 64

1018. Except for depending from Claim 58, the limitations of Claims 63-64 are identical to those of Claims 14–15, respectively, and would have been obvious over the combination of *Krupa*, *FS-Video* and *Al-Salmani* for the same reasons as those discussed in Section XV.D.7 above.

36. INDEPENDENT CLAIM 65

1019. The combination of *Krupa*, *FS-Video*, and *Al-Salmani* disclose the limitations of Claim 65 and would have rendered Claim 65 obvious. *Krupa*, *FS-Video*, and/or *Al-Salmani* disclose, or at least render obvious, each and every limitation of Claim 65, as discussed in the subsections below.

- a. **65.1: “A non-transitory computer readable medium of hydraulically fracturing a plurality of wells, the plurality of wells comprising first and second wells, the method comprising:”**

1020. The limitations of 65.1 are substantially similar to those of Limitation 1.1/20.1 and would have been obvious over the combination of *Krupa*, *FS-Video* and *Al-Salmani* for the same reasons as those discussed in Section XV.D.1.a above.

- b. **65.2: “communicating fluid from one or more pumps to the first well via a manifold and a first valve, wherein the first valve is associated with both the first well and the manifold so that the first valve is: in fluid communication with the manifold; and fluidically positioned between the first well and the one or more pumps;”**

1021. The limitations of 65.2 are identical to those of Limitations 1.2 and would have been obvious over the combination of *Krupa*, *FS-Video* and *Al-Salmani* for the same reasons as those discussed in Section XV.D.1.b above.

- c. **65.3: “displaying a dashboard, which dashboard comprises:”**

1022. Limitation 65.3 recites the same limitations as in Limitation 16.1 and is obvious over the combination of *Krupa*, *FS-Video* and *Al-Salmani* for the same reasons as those discussed in Section XV.D.8.a above.

- (1) 65.3.1: “a visual reference of the first valve;”**

1023. Limitation 65.3.1 recites the same limitations as in Limitation 16.2 and is obvious over the combination of *Krupa*, *FS-Video* and *Al-Salmani* for the same reasons as those discussed in Section XV.D.8.b above.

(2) 65.3.2: “first visual indicator associated with the visual reference of the first valve, the first visual indicator indicating that a state of the first valve is open to permit communicating fluid to the first well via the manifold and the first valve;”

1024. Limitation 65.3. recites the same limitations as in Claim 17 and is obvious over the combination of *Krupa*, *FS-Video* and *Al-Salmani* for the same reasons as those discussed in Section XV.D.9 above.

(3) 65.3.3: “a visual reference of a second valve, wherein the second valve is associated with both the second well and the manifold so that the second valve is: in fluid communication with the manifold; and fluidically positioned between the second well and the one or more pumps from which fluid is communicated to the first well via the manifold and the first valve; and”

a. a visual reference of a second valve,

1025. This limitation recites the same limitations as in Limitation 16.2 and is disclosed by and rendered obvious over the combination of *Krupa*, *FS-Video* and *Al-Salmani* for the same reasons as those discussed in Section XV.D.8.b.

b. wherein the second valve is associated with both the second well and the manifold so that the second valve is: in fluid communication with the manifold; and fluidically positioned between the second well and the one or more pumps from which fluid is communicated to the first well via the manifold and the first valve; and”

1026. This limitation is contained within the limitations of Limitation 1.3.1 and is disclosed by and rendered obvious over the combination of *Krupa*, *FS-Video*

and Al-Salmani for the same reasons as those discussed above in Section XV.D.1.c.(1).

1027. Accordingly, Limitation 65.3.3. would have been obvious in light of the combination of *Krupa*, *FS-Video* and *Al-Salmani*.

(4)65.3.4: “a second visual indicator associated with the visual reference of the second valve, the second visual indicator being different from the first visual indicator to indicate that a state of the second valve is closed; and”

1028. Limitation 65.3.4 recites the same limitations as in Claim 19 and is obvious over *Krupa* combined with *FS-Video* and *Al-Salmani* for the same reasons as those discussed in Section XV.D.11 above.

d. 65.4: “executing a continuous pumping ("CP") swap to transition from hydraulically fracturing the first well to hydraulically fracturing the second well, the CP swap comprising:”

1029. The limitations of 65.4 are identical to those of Limitation 1.3 and would have been obvious over the combination of *Krupa*, *FS-Video*, and *Al-Salmani* for the same reasons as those discussed in Section XV.D.1.c above.

(1)65.4.1: “opening the second valve while fluid is communicated to the first well via the first valve and the manifold, wherein opening the second valve causes fluid to be communicated from the one or more pumps to the second well via the manifold and the second valve, and”

1030. The limitations of 65.4.1 are substantially similar to, though less limiting than, those of Limitation 1.3.1 and would have been obvious over the

combination of *Krupa*, *FS-Video* and *Al-Salmani* for the same reasons as those discussed in Section XV.D.1.c.(1) above.

(2) 65.4.2: “wherein the second valve is opened in response to at least a portion of fluid communicated via the manifold satisfying one or more conditions; and”

1031. The limitations of 65.4.2 are identical to Limitation 58.4.2 and would have been obvious over the combination of *Krupa*, *FS-Video*, and *Al-Salmani* for the same reasons as those discussed in Section XV.D.1.c.(2) above.

(3) 65.4.3: “closing the first valve: after the at least a portion of fluid communicated via the manifold has satisfied the one or more conditions;”

1032. The limitations of 65.4.3 are identical to those of Limitation 1.3.3/58.4.3 and would have been obvious over the combination of *Krupa*, *FS-Video* and *Al-Salmani* for the same reasons as those discussed in Section XV.D.1.c.(3) above.

e. 65.5: “wherein the display of the dashboard visually communicates the respective states of the first and second valves; and”

1033. Limitation 65.5 recites the same limitations as in Limitation 16.3. Accordingly, the combination of *Krupa*, *FS-Video* and *Al-Salmani* render obvious the limitations of 65.5 for the same reasons as those discussed in Section XV.D.8.c above.

f. 65.6: “wherein fluid is continuously communicated via the manifold during the CP swap.”

1034. The limitations of 65.6 are substantially similar to, though less limiting than, those of Limitation 1.4 and would have been obvious over the combination of *Krupa*, *FS-Video* and *Al-Salmani* for the same reasons as those discussed in Section XV.D.1.d above.

1035. Claim 65 is obvious over the combination of *Krupa*, *FS-Video*, and *Al-Salmani*.

37. DEPENDENT CLAIM 66: “THE NON-TRANSITORY COMPUTER READABLE MEDIUM OF CLAIM 65, WHEREIN THE DASHBOARD FURTHER COMPRISES A VISUAL REFERENCE OF A FIRST WELLHEAD IN COMMUNICATION WITH THE FIRST WELL.”

1036. Except for depending from Claim 65, the limitations of Claim 66 are substantially similar to those of Claim 18 and would have been obvious over the combination of *Krupa*, *FS-Video* and *Al-Salmani* or the same reasons as those discussed in Section XV.D.10 above.

38. DEPENDENT CLAIMS 67 - 68

1037. Except for depending from Claim 65, the limitations of Claims 67-68 are substantially similar to those of Claims 4-5, respectively, and would have been obvious over the combination of *Krupa*, *FS-Video* and *Al-Salmani* for the same reasons as those discussed in Sections XV.D.1.c.(2) and XV.D.4-5 above.

39. DEPENDENT CLAIM 69: “THE NON-TRANSITORY COMPUTER READABLE MEDIUM OF CLAIM 65, WHEREIN THE ONE OR MORE CONDITIONS INCLUDE A PRESSURE CONDITION OF THE AT LEAST A PORTION OF FLUID COMMUNICATED VIA THE MANIFOLD”

1038. Except for depending from Claim 65, the limitations of Claim 69 are substantially similar to those of Claim 9 and would have been obvious to a POSITA based on the disclosures of *Krupa*, *FS-Video* and *Al-Salmani* for the same reasons as those discussed in Sections XV.D.1.c.(2) and XV.D.5 above.

40. DEPENDENT CLAIMS 70 - 71

1039. Except for depending from Claim 65, the limitations of Claims 70-71 are substantially similar to those of Claims 14-15, respectively, and would have been obvious over the combination of *Krupa*, *FS-Video* and *Al-Salmani* for the same reasons as those discussed in Section XV.D.7 above.

41. INDEPENDENT CLAIM 72

1040. The combination of *Krupa*, *FS-Video* and *Al-Salmani* disclose, or at least render obvious, the limitations of Claim 72 and would have rendered Claim 72 obvious.

- a. 72.1: “A system for hydraulically fracturing a plurality of wells, the plurality of wells comprising first and second wells, the system comprising:”**

1041. The limitations of 72.1 are substantially similar to those of Limitations 1.1/39.1 and would have been obvious over the combination of *Krupa, FS-Video* and *Al-Salmani* for the same reasons as those discussed in Section XV.D.1.a above.

- b. 72.2: “a manifold via which fluid is adapted to be communicated from one or more pumps;”**

1042. The limitations of 72.2 recite the same limitations as in Limitations 1.2 and 39.2 and would have been obvious over the combination of *Krupa, FS-Video* and *Al-Salmani* for the same reasons as those discussed in Section XV.D.1.b above.

- c. 72.3: “a first valve via which fluid is adapted to be communicated from the one or more pumps to the first well, the first valve being associated with both the first well and the manifold so that the first valve is: in fluid communication with the manifold; and fluidically positioned between the first well and the one or more pumps;”**

1043. The limitations of 72.3 recite the same limitations as in Limitations 1.2 and 39.3 and would have been obvious over the combination of *Krupa, FS-Video* and *Al-Salmani* for the same reasons as those discussed in Section XV.D.1.b above.

- d. 72.4: “a second valve via which fluid is adapted to be communicated from the one or more pumps to the second well, the second valve being associated with both the second well and the manifold so that the second valve is: in fluid communication with the manifold; and fluidically positioned between the second well and the one or more pumps from which fluid is adapted to be communicated to the first well via the manifold and the first valve;”**

1044. The limitations of 72.4 recite the same limitations as in Limitations 1.3.1 and 39.4 and would have been obvious over the combination of *Krupa*, *FS-Video* and *Al-Salmani* for the same reasons as those discussed in Section XV.D.1.c.(1) above.

- e. 72.5: “a dashboard adapted to be displayed, which dashboard comprises:”**

1045. The limitations of 72.5 recite the same limitations as in Limitation 16.1 and would have been obvious over the combination of *Krupa*, *FS-Video* and *Al-Salmani* for the same reasons as those discussed in Section XV.D.8.a above.

- (1) 72.5.1: “a visual reference of the first valve;”**

1046. The limitations of 72.5.1 recite the same limitations as in Limitation 16.2 and would have been obvious over the combination of *Krupa*, *FS-Video* and *Al-Salmani* for the same reasons as those discussed in Section XV.D.8.b above.

- (2) 72.5.2: “a first visual indicator associated with the visual reference of the first valve, the first visual indicator indicating that a state of the first valve is open to permit communicating fluid to the first well via the manifold and the first valve;”**

1047. The limitations of 72.5.2 recite the same limitations as in Claim 17 and would have been obvious over the combination of *Krupa*, *FS-Video* and *Al-Salmani* for the same reasons as those discussed in Section XV.D.9 above.

(3) 72.5.3: “a visual reference of the second valve; and”

1048. The limitations of 72.5.3 recite the same limitations as in Limitation 16.2 and would have been obvious over the combination of *Krupa*, *FS-Video* and *Al-Salmani* for the same reasons as those discussed in Section XV.D.8.b above.

(4) 72.5.4: “a second visual indicator associated with the visual reference of the second valve, the second visual indicator being different from the first visual indicator to indicate that a state of the second valve is closed;”

1049. The limitations of 72.5.4 recite the same limitations as in Claim 19 and would have been obvious over the combination of *Krupa*, *FS-Video* and *Al-Salmani* for the same reasons as those discussed in Section XV.D.11 above.

f. 72.6: “one or more controllers configured to execute a continuous pumping (“CP”) swap, during which CP swap fluid is continuously communicated via the manifold, to transition from hydraulically fracturing the first well to hydraulically fracturing the second well, by:”

1050. The limitations of 72.6 recite the same limitations as in Limitations 1.3 and 39.5 and would have been obvious the combination of *Krupa*, *FS-Video* and *Al-Salmani* for the same reasons as those discussed in Section XV.D.1.c and XV.D.21.e above.

(1) 72.6.1: “opening the second valve: while fluid is communicated from the one or more pumps to the first well via the first valve and the manifold,”

1051. The limitations of 72.6.1 are substantially similar to those of Limitation 1.3.1 and would have been obvious over the combination of *Krupa, FS-Video* and *Al-Salmani* for the same reasons as those discussed in Section XV.D.1.c.(1) above.

(2) 72.6.2: “in response to at least a portion of the fluid communicated via the manifold satisfying one or more conditions, and”

1052. The limitations of 72.6.2 are identical to those of Limitation 58.4.2 and would have been obvious over the combination of *Krupa, FS-Video* and *Al-Salmani* for the same reasons as those discussed in Sections XV.D.1.c.(2) and XV.D.31.d.(2) above.

(3) 72.6.3: “to cause fluid to be communicated to the second well via the manifold and the second valve; and”

1053. The limitations of 72.6.3 recites the same limitations as in Limitation 1.3.1 and would have been obvious over the combination of *Krupa, FS-Video* and *Al-Salmani* for the same reasons as those discussed in Section XV.D.1.c.(1) above.

(4) 72.6.4: “closing the first valve: after the at least a portion of fluid communicated via the manifold has satisfied the one or more conditions;”

1054. The limitations of 72.6.4 are identical to those of Limitation 58.4.3 and would have been obvious over the combination of *Krupa, FS-Video* and *Al-Salmani*

for the same reasons as those discussed above in Section XV.D.1.c.(3) and XV.D.31.d.(3).

g. 72.7: “wherein the display of the dashboard visually communicates the respective states of the first and second valves.”

1055. Limitation 72.7 recites the same limitations as in Limitation 16.3. Accordingly, the combination of *Krupa*, *FS-Video* and *Al-Salmani* render obvious the limitations of 72.7 for the same reasons as those discussed in Section XV.D.8.c above.

1056. Claim 72 is rendered obvious by the combination of *Krupa*, *FS-Video*, and *Al-Salmani*.

42. DEPENDENT CLAIM 73: “THE SYSTEM OF CLAIM 72, WHEREIN THE DASHBOARD FURTHER COMPRISES A VISUAL REFERENCE OF A FIRST WELLHEAD IN COMMUNICATION WITH THE FIRST WELL.”

1057. Except for depending from Claim 72, the limitations of Claim 73 are identical to those of Claim 18 and would have been obvious over the combination of *Krupa*, *FS-Video* and *Al-Salmani* for the same reasons as those discussed in Section XV.D.10 above.

43. DEPENDENT CLAIMS 74 - 75

1058. Except for depending from Claim 72 and referencing the controllers disclosed by *Krupa*, *FS-Video* and *Al-Salmani*, as discussed with Claim 39, Claims 74-75 are substantially similar to Claims 4-5, respectively, and are obvious over the

combination of *Krupa*, *FS-Video* and *Al-Salmani* for the same reasons as those discussed with Claims 4-5 in Sections XV.D.1.c.(2) and XV.D.4-5.

44. DEPENDENT CLAIM 76: “THE SYSTEM OF CLAIM 72, WHEREIN THE ONE OR MORE CONDITIONS INCLUDE A PRESSURE CONDITION OF THE AT LEAST A PORTION OF FLUID COMMUNICATED VIA THE MANIFOLD.”

1059. Except for depending from Claim 72, Claim 76 is substantially similar to Claim 9 and would have been obvious over the combination of *Krupa*, *FS-Video* and *Al-Salmani* for the same reasons as those discussed in Sections XV.D.1.c.(2) and XV.D.5.

45. DEPENDENT CLAIMS 77 - 78

1060. Except for depending from Claim 72, the limitations of Claims 77-78 are substantially similar to those of claims 14-15, respectively, and are disclosed by or at least rendered obvious by the combination of *Krupa*, *FS-Video* and *Al-Salmani* for the same reasons as those discussed above in Section XV.D.7.

XVI. SECONDARY CONSIDERATIONS

1061. I have not seen any evidence of secondary considerations related to the '952 Patent. Should the Patent Owner put forth any alleged evidence of secondary considerations in this proceeding or any related proceeding, I reserve the right to consider such evidence, to consider whether any such evidence has a nexus to any claims of the Challenged Patent, and to update my analysis.

XVII. CONCLUSION

1062. Based on my education, experience, and expertise, it is my opinion that all of the Challenged Claims are anticipated and/or obvious in view of *Christie*, *Pitcher*, *Al-Salmani*, *Krupa*, and *FS-Video* for the reasons discussed above.

1063. All statements made herein of my own knowledge are true, and all statements made on information and belief are believed to be true. I further understand that willful false statements and the like are punishable by fine or imprisonment, or both under Section 1001 of Title 18 of the United States Code. I declare under penalty of perjury that the foregoing is true and correct.

Executed on November 14, 2024.



Dr. Robert A. Durham