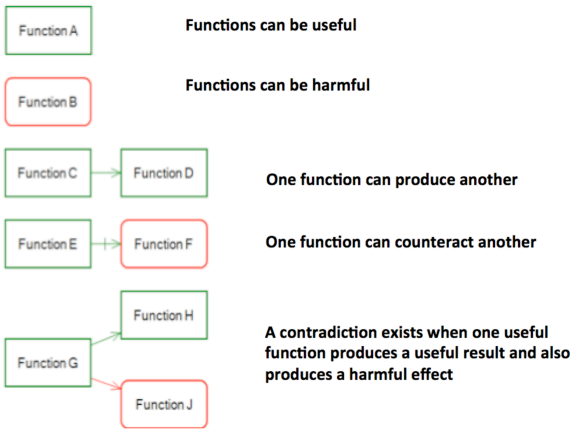
Prior Art Analysis Using Function Models

The concept of function models was developed by Charles Bytheway at GE in 1965. Bytheway built on the work of Lawrence Miles, the father of Value Engineering. Bytheway developed a structured method to model how a system functions. The technique is Function Analysis System Technique or FAST. Functions are activities, actions, processes or operations related to a system. A system's useful functions include the following:

- Primary useful function – the purpose for which the system was designed
- Secondary functions – other useful outputs that the system provides in addition to the primary useful function
- Auxiliary functions – functions that support or contribute to the execution of the system's primary useful function, such as corrective functions, control functions, housing functions, transport functions, etc.

A system's harmful functions include any actions that limit delivery of the primary useful function, the cost to design it, the space it occupies, the noise it emits, the energy it consumes, the resources needed to maintain it, manufacturing costs and so on.

A Function Model describes cause and effect in a system. The function model is composed of two main parts: functions and links. Useful functions are shown in green and harmful functions are shown in red. The arrows connecting the functions describe their relationship. A solid arrow means that the first function produces the second function. An arrow with a cross hatch means that the first function counteracts the second function. A contradiction exists when a useful function produces a useful result and also a harmful effect.



Analysis and Comparison of US 7210528 with US 2354570 and US 3127937

In patent litigation it may be difficult for a jury to comprehend the invention by reading the claims that may be elaborate and complex. A picture can be very valuable in contrasting the claims of one invention versus another. Function models were built of several claims in US 7210528, US 2354570 and US 3127937 to facilitate analysis of the

art taught in these patents. When we use function models to analyze a patent, we extract the description for each function directly from the claim language in the patent. One reason function analysis is useful for patent analysis because of the doctrine of equivalents. The models can provide a picture to help determine if the "system" described in one patent is the functional equivalent of another patent. The function model (a picture) can provide more information to the viewer than text and it can also be useful for an attorney to make a clear and concise argument to a judge or jury. In the U.S. the triple identity test can be used to determine if two devices or processes are equivalent. Something is deemed equivalent if

1. It performs substantially the same function
2. in substantially the same way
3. to yield substantially the same result.

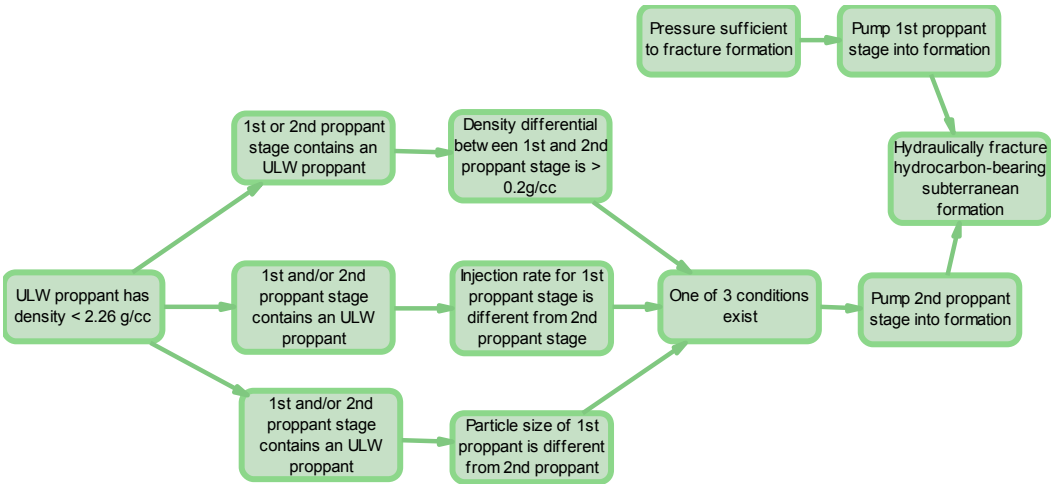
From the standpoint of function models, the triple identity test can be restated as

1. Are the functions extracted from the claims of one patent substantially the same as the functions extracted from another?
2. Is the internal structure of the claims in one patent substantially the same as the internal structure of the claims in another patent?
3. Are the primary functions of the patents substantially the same?

US 7210528 was issued to B J Services Company in May 2007. The model below describes functional relationships in claims 1 and 7.

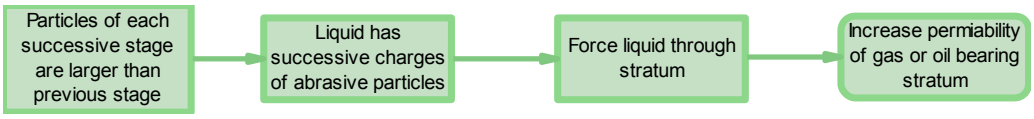
1. A method of hydraulically fracturing a hydrocarbon-bearing subterranean formation which comprises: pumping a first proppant stage either into a propagated fracture or into the formation at a pressure sufficient to fracture the formation; and pumping a second proppant stage into the fracture wherein at least one of the following conditions prevails: (i.) the density differential between the first proppant stage and the second proppant stage is greater than or equal to 0.2 g/cc and either the first proppant stage and/or the second proppant stage contains an ultra lightweight (ULW) proppant; (ii.) the proppant of the first proppant stage and/or the second proppant stage contains a ULW proppant and the rate of injection of the second proppant stage into the fracture is different from the rate of injection of the first proppant stage; or (iii.) the proppant of the first proppant stage and/or the second proppant stage contains a ULW proppant and the particle size of the proppant of the second proppant stage is different from the particle size of the proppant of the first proppant stage.

7. The method of claim 1, wherein the density of the ULW proppant in the first proppant stage and/or second proppant stage is less than or equal to 2.25 g/cc.



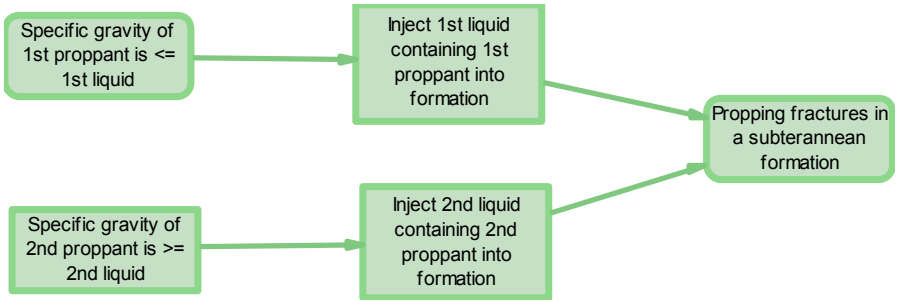
US 2354570 was issued to Charles Beckenstein in March 1941. The model below describes the functional relationships in US 234570 Claim 2

2. Method of increasing the permeability of an oil or gas bearing stratum comprising forcing through said stratum a liquid bearing successive charges of abrasive particles, the particles of each successive charge being of larger size that the particles of the preceding charge.



US 3127937 was issued to William McGuire et al in April 1964. The model below describes the functional relationships in US 3127937 Claim 1.

1. The method of propping fractures in a subsurface earth formation comprising injecting into said fracture a first carrier liquid containing a first solid, particle-form propping agent whose specific gravity is equal to or less than the specific gravity of said carrier liquid and thereafter injecting into said fracture a second carrier liquid containing a second solid, particle-form propping agent whose specific gravity is greater than the specific gravity of said second carrier liquid.



A comparison of the functions in US 7210528 with those in US 2354570 and US 3127937 reveals the following.

Test 3: The primary function in each patent is essentially the same.

- US 7210528: Hydraulically fracture a hydrocarbon bearing subterranean formation.
- US 2354570: Increase permeability of gas or oil bearing stratum
- US 312937: Propping fractures in a subterranean formation

Test 2: How the primary function is produced is also similar.

- US 7210528: Pump first (second) proppant stage into formation.
- US 2354570: Force liquid through stratum
- US 312937: Inject liquid (first/second) containing (first/second) proppant into formation

Test 1: Functional equivalents among the three patents.

Functional equivalents between US 7210528 and US 2354570.

- US 7210528: Particle size of first proppant is different from second
- US 2354570: Particles of each successive stage are larger than previous stage

Functional equivalents between US 7210528 and US 312937.

- US 7210528: Density difference between first and second proppant
- US 2354570: Specific gravity of (first/second) proppant is (<= / >=) (first/second) liquid

The model below summarizes several aspects of the triple identity test for US 7210528 as it relates to US 2354570 and US 3127937.