UNITED STATES DISTRICT COURT
DISTRICT OF CONNECTICUT

JACOBS VEHICLE EQUIPMENT CO., :

Plaintiff, :

V. :

No. 3:93-CV-1093(RNC)

PACIFIC DIESEL BRAKE CO., et al., :

Defendants. :

JENARA ENTERPRISES LTD., et al., :

Counterclaim Plaintiffs, :

V. :

JACOBS VEHICLE EQUIPMENT CO., et al., :

Counterclaim Defendants. :

RULING AND ORDER

This is a declaratory judgment action brought by Jacobs Vehicle Systems, Inc. ("Jacobs"), for a determination that U.S. Patent No. 4,848,289 ("the '289 Patent"), issued to Vincent A. Meneely and assigned to Pacific Diesel Brake Co. ("Pacbrake") for a combination of an engine brake and exhaust brake is invalid and not infringed. Pacbrake has filed a counterclaim alleging that Jacobs has infringed the '289 Patent by selling engine brakes to Mitsubishi Motors Corp. ("Mitsubishi") in Japan and AB Volvo ("Volvo") in Sweden, and a combination of an engine brake and exhaust brake to Mack Trucks, Inc. ("Mack") in the United States. A bench trial has been held. After careful review of the voluminous testimony and exhibits presented by the parties, I conclude that under the claim construction previously adopted by the Court most of the claims in the patent are invalid due to obviousness and the remaining claims are not infringed. This ruling contains my findings of fact and conclusions of law.

I. BACKGROUND

This case centers on the '289 patent, which claims methods and apparatuses for retarding diesel engines. Diesel trucks carry heavy loads and have significant braking problems when descending roadway grades. Conventional wheel brakes undergo stress during these runs and require frequent, expensive repairs and replacement. Automotive engineers have developed two kinds of brakes – engine brakes and exhaust brakes – that use the engine itself to

supplement the power of conventional wheel brakes, reducing brake maintenance costs and adding to the safety of diesel trucks. Exhaust brakes and engine brakes are designed in such a way that, when they are activated, the fuel supply to the engine is cut off while the engine continues to run. The "work" done by the pistons moving upward against additional air pressure inside the engine slows the rotation of the crankshaft, which helps slow the truck. The braking effect produced by an engine retarding device is measured in terms of "braking horsepower" ("BHP").[1] The '289 patent discloses a way to combine an engine brake and an exhaust brake to achieve better braking performance than can be obtained with either brake alone.

A. Parties

Jacobs, a wholly owned subsidiary of Danaher Corporation, is a manufacturer of engine brakes and exhaust brakes located in Bloomfield, Connecticut. Jacobs successfully commercialized the engine brake beginning in the 1960s and remains the dominant supplier of engine brakes in the United States. Jacobs' success is attributable to its ownership of the basic engine brake patent, No. 3,220,392, which was issued to Clessie Cummins in 1965 and expired in 1982. Jacobs' products are sold under the brand name "Jake Brake," which is sometimes used as a generic term to refer to

[1] The engine itself has its own retarding effect, which is referred to as "friction."

engine brakes. Prior to Jacobs' introduction of the engine brake, exhaust brakes were the principal supplemental brake for diesel trucks in the United States.

Pacbrake is a manufacturer of engine brakes and exhaust brakes located in British Columbia, Canada. Pacbrake is a corporate partnership owned by Jenara Enterprises Ltd., a corporation of British Columbia. Mr. Meneely, the inventor of the '289 patent, is the president of Pacbrake. His father was a Jacobs distributor headquartered in Vancouver until the early 1980s. In 1986, after Jacobs' patent for the basic engine brake expired, Pacbrake began manufacturing engine brakes in competition with Jacobs.

B. Technology

1. Diesel Engines

Diesel engines in heavy-duty trucks have six or more cylinders that move through four sequential "strokes": intake, compression, expansion and exhaust. The four-stroke cycle is controlled by a camshaft and delivers power to a crankshaft, both of which rotate in unison twice during each cycle. The first 180° of rotation is the intake stroke, the second 180° degree the compression stroke, the third 180° the expansion stroke, and the last 180° the exhaust stroke. The entire cycle makes up 720° rotation and the degree mark is used to define when various events occur.

The engine is equipped with an intake manifold and an exhaust manifold leading to each of the cylinders. The size and

configuration of these manifolds differ from engine to engine. Each cylinder has intake and exhaust valves communicating with the intake and exhaust manifolds, respectively. The valves are typically located at the top of each cylinder. Each valve has a stem that extends directly above the cylinder. The valves are kept closed by a valve spring, which holds the valve in its "seat." In the past, cylinders typically had one intake valve and one exhaust valve. Most diesel engines for heavy-duty trucks now have two intake valves and two exhaust valves per cylinder.

During the intake stroke, a piston moves to the bottom of the cylinder while air and fuel are brought into the cylinder from the intake manifold. Some engines are equipped with turbochargers, which increase the amount of air supplied to the cylinder and "supercharge" the engine. During the compression stroke, the valve to the intake manifold closes, and the piston moves upward, compressing the air/fuel mixture. When sufficiently compressed, the air/fuel mixture combusts, pushing the piston down on the expansion stroke, and moving the truck forward. The piston then moves upward on the exhaust stroke, expelling the hot exhaust gases from the cylinder into the exhaust manifold.

To open the exhaust valve of a cylinder, sufficient pressure must be exerted to overcome the closing force of the valve spring and the pressure inside the cylinder. When the pressure is sufficient, the valve leaves its seat in the direction of the

interior of the cylinder. Regardless of whether an engine retarding device is operating, the exhaust valve is mechanically opened on the cylinder's exhaust stroke by means of a cam.

2. Engine Brakes

The engine brake was invented by Clessie Cummins in the 1950s. The basic operating principle of all engine brakes is the same. The truck driver engages the engine brake and the fuel supply to the engine is stopped. The engine brake mechanically opens the exhaust valve of the cylinder during the compression stroke, after the piston has compressed the air in the cylinder, but before the piston reaches "top dead center" of its upward movement (i.e., the point beyond which it starts to move down)("TDC"). Braking horsepower is provided in two ways. Initially, the piston's upward movement is resisted by the compressed air in the cylinder, which causes the piston to work. Then, when the exhaust valve is opened by the engine brake, some of the compressed air is released from the cylinder into the exhaust manifold. In the absence of this compression release, the compressed air would remain in the cylinder and have a spring-like effect on the piston, pushing it down on the ensuing expansion stroke ("rebound effect"). In that event, the energy expended by the piston on its upward movement would be returned to the piston and there would be insignificant net gain in braking. With a compression release engine brake, little energy is returned to the piston.

Engine brakes are complex devices that can be used only with the engine for which they are designed. The Jake Brake is an add-on brake that fits on top of the engine. Some engine brakes are built into the engine.

When an engine brake is operating, the exhaust valve is opened twice during each 720° cycle: the engine brake opens the valve during the compression stroke near top dead center; and the cam opens the valve during the normal exhaust stroke. The size of the opening of the exhaust valve by the engine brake is typically 40/1000s of an inch at its widest; the size of the opening of the valve during the normal exhaust stroke is typically 500/1000s of an inch at its widest. As these openings take place, air is transferred from the cylinder into the exhaust manifold. The transfer of air changes the pressure within the exhaust manifold continuously as the engine rotates, which can be up to 2,300 revolutions per minute ("RPM") or more for some engines.

The engine brake opens the exhaust valve on the compression stroke by means of a rod located above the cylinder ("push tube"), which pushes against the top of the valve stem. The push tube must be strong enough to overcome both the closing force of the valve spring and also the substantial force of the pressure in the cylinder created by the piston's upward movement on the compression stroke ("push tube load"). Excessive push tube load can damage the engine. Engine manufacturers set acceptable push tube limits.

The braking horsepower provided by an engine brake can be increased by adjusting the time when the engine brake opens the exhaust valve. If the valve opens too early, less pressure is built up in the cylinder before release and the braking effect is weakened. If the valve opens too late, too much pressure is built up, preventing the valve from opening at all, or allowing too little air to escape. Late opening of the valve also risks valve-piston contact, which can destroy an engine. The optimal adjustment depends on the particular engine, but generally corresponds to a time when the piston is near top dead center.

The timing of the engine brake's opening of the exhaust valve can be optimized by turning a screw on the engine brake housing. Adjusting the timing by means of the screw is referred to as "adjusting the lash." The lash is the distance or "gap" between the slave piston of the engine brake and the component of the engine that is contacted by the slave piston to actuate the opening of the exhaust valve. When the size of the gap is increased, the piston must travel a greater distance and the timing of the opening of the valve is therefore delayed resulting in more work for the piston. When the size of the gap is decreased, the piston travels through less space and the timing of the opening is advanced. Adjusting the timing to delay the opening of the exhaust valve is called "retarding the lash."

The braking horsepower provided by an engine brake also can be

increased by injecting more air into the cylinder on its intake stroke than otherwise would be present. This additional air or "charge" enhances braking by increasing the pressure in the cylinder on the ensuing compression stroke creating more work for the piston on its upward movement. Adding air to the cylinder on the intake stroke is referred to as "supercharging." When an engine brake is installed on a turbocharged diesel engine, the turbocharger can provide a boost in retarding horsepower by injecting air into the cylinder through the cylinder's intake valve. To obtain the benefit of supercharging, it is necessary that the additional air injected into the cylinder during the intake stroke remain in the cylinder until the beginning of the compression stroke ("trapped charge").

At first, engine makers were skeptical about putting engine brakes on their engines and refused to factory-install engine brakes. To allay manufacturers' concerns, Jacobs offered a broad warranty covering both the engine and the engine brake. Jacobs also made engine brakes for the "after market" for truckers to install on their engines after they bought their trucks. Jacobs' engine brakes gained popularity because they usually provided more braking horsepower than exhaust brakes.

3. Exhaust Brakes

Exhaust brakes are relatively simple devices compared to engine brakes. They operate by means of a gate or valve placed at

the end of the exhaust manifold to restrict the flow of air from the manifold. Braking horsepower is generated by building high pressure within the exhaust manifold ("back pressure") to resist the upward movement of the piston in the cylinder during the normal exhaust stroke. Back pressure builds up as gas is released into the exhaust manifold during the exhaust stroke. Prior to Jacobs' introduction of the engine brake in the 1960s, exhaust brakes were the principal engine retarding system in the United States.

The braking horsepower provided by an exhaust brake depends on the degree to which the flow of air is restricted. Generally, the greater the restriction, the higher the back pressure against which the piston must work. Some exhaust brakes have a fixed setting, others an adjustable setting. With an adjustable brake, the amount of back pressure can be increased or decreased by adjusting the amount the gate or valve is closed or opened.

Back pressure is measured in terms of pounds per square inch ("psi"). The higher the psi, the greater the amount of work the piston must do. Thus, an exhaust brake set to produce back pressure of 50 psi can be expected to produce more braking horsepower than one set at 30 psi. Back pressure can be increased to a point that makes it counterproductive due to "valve float," which is discussed below.

The exhaust brake was first developed in Europe, where it was installed as standard equipment on heavy-duty diesel trucks.

Williams Air Controls ("Williams"), a manufacturer of exhaust brakes located in Tigard, Oregon, developed the exhaust brake market in the United States. Because the braking horsepower of an exhaust brake is directly dependent on the back pressure in the exhaust manifold, exhaust brake manufacturers, such as Williams, encouraged engine manufactures to permit higher back pressure in the exhaust manifold.

Exhaust brakes are less expensive than engine brakes (exhaust brakes costs hundreds of dollars; engine brakes cost thousands of dollars). They do not create the loud popping noise that can accompany the "engine brake event" (i.e., the engine brake's release of compressed air into the exhaust manifold). But the back pressure generated by an exhaust brake increases engine temperature and can also cause "valve float."

"Valve float" refers to the non-mechanical opening of an exhaust valve of a cylinder due to the pressure differential between the exhaust manifold and the cylinder. The pressure within the cylinder reaches its lowest points during the intake and expansion strokes when the piston is at the bottom of its downward travel. An exhaust brake set in a commercially reasonable manner operating near the rated speed of the engine (e.g., 2,200 RPM) increases the pressure of gases in the exhaust manifold to a level sufficient to float open the exhaust valve of a cylinder on its intake stroke.

Prior to the invention of the '289 Patent, valve float caused by an exhaust brake was well known in the field and in the published literature. See Meyer, "Manifold Braking for Heavy 'Over the Road' Trucks, A Review of European Practices and Experience," SAE Paper No. 571 (1955); Meyer, "Compression Retarder," SAE Paper No. 786 (1956); and Akiba, et al., "The Optimized Design of the Exhaust Brake of the Automotive Diesel Engine," SAE Paper No. 810344 (1981).

Excessive valve float can lead to engine damage. If the valve stays open too much of the time, the constant flow of hot exhaust gases can damage the valve through overheating. In addition, the valve and its seat can be damaged if the valve closes with sufficient velocity. Valve float can be reduced by installing heavier valve springs.

In the 1960s and 1970s, engine manufacturers, such as Caterpillar, were concerned that excessive valve float could cause engine damage. But Williams and others successfully urged engine manufacturers to allow increasing back pressure and valve float was kept within manageable levels.

C. Combination Brakes

Before Mr. Meneely applied for what became the '289 patent, others had experimented with combination braking.

1. Jacobs' Testing of Combinations

In the 1970s, Jacobs tested various combinations of engine

brakes and exhaust brakes in conjunction with its efforts to sell engine brakes to European engine manufacturers, including Berliet and Saviem, whose engines already had exhaust brakes.

In November 1976, Jacobs tested a Jake Brake with a standard lash setting in combination with an exhaust brake on a Berliet engine and obtained 276 BHP at 2,400 RPM. Jacobs tried different lash settings for the combination and found that retarding the lash produced increased braking horsepower: a lash setting of 0.024" produced 286.5 BHP at 2,400 RPM; a lash setting of 0.030" produced 290.2 BHP at 2,400 RPM; and a lash setting of .036" produced 303 BHP at 2,400 RPM. Jacobs did not retard the lash any further.

In May 1977, Jacobs tested a combination of a Jake Brake and exhaust brake on a Saviem 798 diesel engine. The combination produced approximately 50 BHP more than the Jake Brake alone. Jacobs adjusted the setting of the exhaust brake. With the exhaust brake set at 40 psi, the combination produced 163 BHP. With the exhaust brake set at 60 psi, the combination produced 192 BHP. Jacobs engineers observed the presence of valve float but noted that it did not have any detrimental effect on the engine and recommended that "[c]onsideration should be given to a prolonged valve float test if any of the above retarding configurations are proposed for a retarding concept for marketing." Pl. Ex. 3, at J000532.

In November 1977, Jacobs conducted similar testing of an engine brake and exhaust brake on a Mack 676 diesel engine (Pl. Ex. 1,4). With a lash setting of .041", the combination produced gains in braking horsepower over the Jake Brake alone especially at higher engine speeds.

In 1982, a Jacobs' engineer, Zdenek Meistrick, analyzed the likely performance of an engine brake and exhaust brake used in combination on a Volvo TD 120A engine. Mr. Meistrick estimated that the combination would produce 290 BHP at 2,200 RPM. Volvo wanted 300 BHP. Mr. Meistrick estimated that the combination would produce 310 BHP if Volvo allowed an increase in back pressure from 37 psi to 47 psi. Volvo decided against developing the combination due to cost considerations.

In 1984 and 1985, Jacobs tested a Jake Brake and a Williams exhaust brake on a Caterpillar 3406 turbocharged diesel engine. By that time, Caterpillar had approved use of an exhaust brake on the engine with allowable back pressure of 50 psi. At the 50 psi setting, the exhaust brake alone outperformed the engine brake alone (the Jacobs engine brake did not work well with the 3406 engine due to the design of the engine - the engine brake had to work off an exhaust cam, rather than an injector cam). Jacobs observed that the exhaust brake alone caused pronounced valve float. When the exhaust brake was set to minimize valve float, braking horsepower provided by the exhaust brake was reduced to 60%

of the braking horsepower provided by the engine brake. With the exhaust brake set at 50 psi, the combination produced more braking horsepower than the engine brake or exhaust brake alone. The engineers did not recommend the combination, however, because of valve float ("three added valve bounces [were] introduced per cycle") and "the questionable affect back pressure has on turbocharger life." Pl. Ex. 6, at J000659.

None of the foregoing tests performed by Jacobs on combinations prior to the '289 Patent was made available to the public and no combination brakes were sold by Jacobs at the time. Jacobs wanted its customers to use engine brakes for their engine retarding needs rather than exhaust brakes and therefore did not promote adding exhaust brakes to engines.

2. Williams' Combination

In 1973, Williams installed a combination brake on a Freightliner truck with an engine made by Cummins Inc. Williams informally tested the performance of the combination brake and displayed the truck with the combination brake at trade shows in San Francisco and Anaheim and to customers at Williams's headquarters between 1974 and 1975. Williams took no steps to market a combination.

3. Mitsubishi's Research and Development

Mitsubishi researched combination brakes and published its results in a series of patent applications and articles between

1982 and 1986. In 1982, Mitsubishi filed Unexamined Japanese Patent Application No. 57-171011, entitled "Braking Device for Multi-cylinder 4-stroke-cycle Internal Combustion Engine," by Okamura, et al. ("Okamura"). Okamura discloses using a combination brake to supercharge cylinders on intake, thereby increasing braking horsepower. Okamura describes a release of pressurized air on compression, which causes a pressure wave in the exhaust manifold sufficient to open an exhaust valve of a cylinder on its intake stroke. When this valve opens on intake, pressurized gas flows from the exhaust manifold into the cylinder. Okamura discloses that this increased volume of gas increases the retarding horsepower of the combination brake by increasing the work required during the compression stroke. While the Okamura specification discloses a "third valve," or dedicated compression-release valve, being opened when the piston nears top dead center of the compression stroke, it also discloses using an exhaust valve for the same function. Okamura depicts an example of how an exhaust valve could perform the compression release function in Figure 10. This figure shows a valve controlled by a rotating two-lobe cam, shaped to push open the exhaust valve both on compression and exhaust.

In 1983, Mitsubishi filed Unexamined Japanese Patent Application No. 59-186440, by Okamura, et al. The application discloses a combination brake that uses an exhaust valve, a third

valve or an intake valve to release compressed air during the compression stroke. Approximately six months later, Mitsubishi published an article entitled: "Development of the New Auxiliary Braking System 'Powertard' Engine Brake" ("Sato"). The Sato article discloses the combination of an engine brake and exhaust brake on a turbocharged diesel engine. In its discussion of compression engine brakes, leading up to its section on "dual braking systems," Sato specifically refers to a "Jacobs-type engine brake" and discloses that either the intake valve, exhaust valve, or third valve may be used to release compressed gas during the compression stroke. Sato § 2.2.2 & figs. 7-8. In its section on exhaust brakes, Sato notes that valve float occurs when the pressure inside the exhaust manifold exceeds the pressure in the cylinder by more than the valve's spring can withstand. Sato § 2.2.1. Sato discloses Mitsubishi's proprietary combination brake, the Powertard brake, which uses a small-diameter third valve, not the exhaust valve, for the compression release event.

In 1985, Mitsubishi published another article entitled: "Development of Powertard for the 8 DC 9T Engine" ("Powertard"), the English version of which was published in June 1986 in Mitsubishi Heavy Industries Technical Review, Vol. 23, No. 2, ¶. 1-7. In the Powertard article, Mitsubishi elaborated on its combination brake, reporting its testing and experience with an engine brake and an exhaust brake on an eight cylinder, two valve

diesel engine. The article describes the occurrence of valve float and a synergistic effect arising from the combination of the two brakes. Figure 13 of Powertard shows the timing of valve openings in each of four cylinders, as well as the exhaust port and cylinder pressure changes in one cylinder.

D. The '289 Patent

1. Development of the P-37

The '289 patent resulted from Mr. Meneely's development of a combination brake that became known as Pacbrake's Model P-37. By the late 1980s, Pacbrake was competing with Jacobs for Caterpillar's business and Mr. Meneely focused on designing an engine brake for the Caterpillar 3406 turbocharged diesel engine. Engine brakes designed by Jacobs for other engine manufacturers, such as Cummins and Detroit Diesel Corporation, produced approximately 325-350 BHP. In contrast, Jacobs' engine brake for the Caterpillar engine provided only 275-280 BHP. Caterpillar wanted a more effective retarding system for the engine and had increased the allowable back pressure in the exhaust manifold to 50 psi, which made the exhaust brake more effective and therefore more competitive with Jacobs' engine brake.

Mr. Meneely combined Pacbrake's existing engine brake for the Caterpillar 3406 engine, Pacbrake's Model P-36, with an exhaust brake set at 50 psi, on a Caterpillar test engine. When he ran the combination, he obtained no increase in braking horsepower

initially. He recognized that the exhaust brake reduced the benefit of the engine brake by cutting off the turbocharger's ability to inject air into the engine. He also observed that the 50 psi setting caused the engine to heat up to over 1000° Farenheit.

Mr. Meneely thought the counteracting effect of the exhaust brake in the combination could be reduced if air from the exhaust manifold could be forced into the cylinder on its intake stroke by another means. He developed and patented an apparatus that mechanically opened the exhaust valve of a cylinder on the intake stroke, allowing air to flow into the cylinder (U.S. Patent No. 4,741,307, issued May 3, 1988). His experience with this apparatus gave him the idea that the exhaust valve could be made to float open by delaying the timing of the engine brake and he therefore worked to develop an engine brake that could operate at a delayed timing. He noticed that push tube load was lighter in a combination brake, so the exhaust valve could be opened closer to top dead center, against greater cylinder pressure, than could be done safely using an engine brake alone. After experimenting with the effects of delaying the timing of the engine brake, he ultimately retarded the lash for the P-36 engine brake from 0.070" (the optimal setting when the engine brake was used alone) to 0.100".

Mr. Meneely appears to have been the first to retard a lash setting to this extent in optimizing a combination brake. The evidence suggests that others involved in engine brake design, including Jacobs' engineers, stopped retarding the lash before reaching a comparable setting due to concerns about valve float and push tube load. After Mr. Meneely set the lash at 0.100", he observed a significant boost in braking horsepower, leading to the subject patent application.

Mr. Meneely did not have equipment one would need to determine what was actually happening inside the engine during his tests of the combination brake. He concluded, however, that by retarding the lash to an unprecedented extent, he capitalized on valve float to add charge to the cylinder at the end of the intake stroke. His conclusion was based on the following inferences: the substantial delay in compression release created a pressure pulse; the pulse propagated through the exhaust manifold and opened another cylinder's exhaust valve near bottom dead center of the intake stroke; air traveled through the open exhaust valve into the cylinder as the intake valve was closing; and air got trapped in the cylinder when the intake valve closed.

Mr. Meneely believed that he had achieved a significant breakthrough. Jacobs and others discouraged combining an engine brake with an exhaust brake and the industry generally discouraged valve float. Mr. Meneely was unaware that Jacobs and others had

tested or used engine brake/exhaust brake combinations and did not know about the Mitsubishi patent applications and articles discussed above.

After testing the combination in the laboratory and the field, Pacbrake approached Caterpillar and offered to provide it with a combination retarder. Caterpillar agreed to try it. Pacbrake supplied Caterpillar with Pacbrake's Model P-37, which combined an engine brake and exhaust brake for use on the Caterpillar 3406 engine. Pacbrake conducted an advertising campaign for the P-37, which it sold under the brand name "SuperPac." Pacbrake advertised that the combination produced 400 BHP. The P-37 helped establish Pacbrake as a manufacturer of engine brakes in competition with Jacobs.

2. The Patent

On May 2, 1988, Mr. Meneely filed the application that led to the '289 patent. The application encompassed sixteen claims, including three independent claims. Claim 1 was to a method for retarding an engine. Claim 6 was to an apparatus for retarding a multi-cylinder, four-stroke engine having intake valves and exhaust valves communicating with a common exhaust manifold. Claim 11 was to a combination.

The PTO allowed claims 1-9 and 11-14 as filed, and rejected claims 10 and 15-16. Claim 16, drawn solely to the combination of an engine brake and exhaust brake, was rejected under 35 U.S.C.

§102(b) as being anticipated by Jacobs U.S. Patent 4,572,114 (issued to Sickler, Feb. 25, 1986). Claims 10 and 15 were rejected under 35 U.S.C. § 112, second paragraph, as being indefinite. The PTO stated that claims 10 and 15 "would be allowable" by overcoming the indefiniteness rejection.

In addition to the Sickler patent, the PTO cited other prior art, specifically, U.S. Patents No. 4,662,332 ("Bergmann"); 3,330,263 ("Weglage"); 1,637,118 ("Kirchensteiner"); and Japanese published patent application 0,003,437 ("Shimoda").

In response to the PTO's action, Mr. Meneely made certain clarifying amendments, amended claims 10 and 15 and cancelled claim 16. In addition, he filed an Information Disclosure Statement citing U.S. Patents Nos. 4,395,884 4,474,006, both listing Robert B. Price as inventor and each assigned to Jacobs, and German patent application 2,820,941.

The PTO subsequently allowed claims 1-15 and the patent issued July 18, 1989. Claims 1-5 are directed to a method for retarding an engine; claims 6-10 are directed to an apparatus for retarding a multi-cylinder, four-stroke engine having intake valves, and exhaust valves communicating with a common exhaust manifold; and claims 11-15 are directed to a combination of an engine with the retarder.

Claim 1 is an independent claim, with claims 2-5 dependent upon claim 1. Claim 6 is an independent claim, with claims 7 and

9 dependent upon claim 6, claim 8 dependent upon claim 7, and claim 10 dependent upon claim 9. Claim 11 is an independent claim, with claims 12 and 14 dependent upon claim 11, claim 13 dependent upon claim 12, and claim 15 dependent upon claim 14.

Each of the independent claims of the '289 Patent recites an engine brake opening a first exhaust valve in a compression release event, increasing the pressure of gases in the exhaust manifold sufficiently to open an exhaust valve of another cylinder on intake, after the compression release event. The specification discusses elements of the invention Mr. Meneely believes he made: (1) substantially delayed compression release, (2) generating a high pressure pulse, (3) to open an exhaust valve on intake and (4) supercharge the cylinder (5) through increased trapped charge. But these elements of his invention are not recited in the claims of the patent.

E. Jacobs' Response To The P-37

Beginning in 1989, Jacobs conducted testing of the P-37 in its laboratory and the field. The results of the tests showed a level of braking performance that was unexpected for a combination brake. Jacobs' engineers believed that the P-37 supercharged the cylinder on intake due to substantially delayed compression release and increased back pressure. Jacobs regarded the P-37 as a competitive threat.

In January 1990, Mr. Meistrick prepared a memorandum analyzing potential applications of the teachings of the '289 Patent. At the time, he was the development manager working on the new Jacobs Model 8360 engine brake for the Caterpillar 3406 engine, the same engine Mr. Meneely had tested in developing Pacbrake's Model P-37. The target for the Jacobs Model 8360 was 400 BHP, the same BHP advertised by Pacbrake for its P-37. Mr. Meistrick was asked to consider alternatives to deal with the competitive threat presented by the P-37 until the new Jacobs Model 8360 was ready.

In his memo, Mr. Meistrick outlined a number of potential combination brakes that could be used with the Caterpillar 3406. Among them was a combination of a "Jake Brake and exhaust brake adjusted to create maximum 'supercharging' effect by means of exhaust valve float (cylinder on intake), same or similar to P37." As an "example" of such a combination, he cited an exhaust brake with a lash setting of .102" "or optimum" and an exhaust brake with a setting of 50-55 psi. This combination would create "intentional valve float" and had the "potential" to produce greater braking horsepower than other combinations outlined in the memo (which created no valve float beyond the float inherent in the use of an exhaust brake set at 50 psi or more). Mr. Meistrick observed that this combination would be in "direct conflict" with the '289

patent, making it necessary to "evaluate patent strength."[2]

F. The Accused Products

After Jacobs tested the P-37, it sold a number of products for use in combination braking. Pacbrake has accused Jacobs of violating 35 U.S.C. §271 by making and selling the following four products: (1) Jacobs Model 864 engine brake for Mitsubishi's 6D40 engine; (2) Jacobs Model 882 engine brake for Mitsubishi's 8M20 engine; (3) Jacobs' engine brake for the Volvo TD 122 engine; and (4) Jacobs' Stealth Retarder, a combination engine brake/exhaust brake for Mack's E7 engine.

1. Jacobs Models 864 and 882 for Mitsubishi

In the 1980s, Mitsubishi developed a new six cylinder turbocharged diesel engine, the 6D40, and a new eight cylinder naturally aspirated engine, the 8M20. Unlike its earlier heavy diesel engines, these engines had four valves per cylinder, rather than two. Mitsubishi's Powertard combination brake, which employed an engine brake opening a dedicated compression release valve, could not be used on either of its new 4-valve engines because there was not enough space to put a fifth valve.

In late 1989, Mitsubishi approached Jacobs and requested a patent license for a single-valve engine brake for the 6D40 engine. Concerned that Mitsubishi might compete with Jacobs using Jacobs'

[2] Jacobs continued to work on the Model 8360 for Caterpillar, which proved to be successful.

own patented invention, Jacobs declined Mitsubishi's request for a license. Instead, Jacobs sought to manufacture the engine brake for Mitsubishi.

By letter of February 5, 1990, Mitsubishi proposed to enter into an agreement with Jacobs for manufacture of what became the Model 864 engine brake for the 6D40 engine. In April 1990, Mitsubishi sent Jacobs detailed engineering drawings for, along with a prototype of, the engine brake for the 6D40 engine. At a meeting in June 1990, Mitsubishi reached agreement with Jacobs for manufacture of what became the Model 882 engine brake for the 8M20 engine.

Jacobs was directly involved in the final design of both models supplied to Mitsubishi. In an interoffice communication of June 25, 1990, Adish Jain, Vice President of Engineering for Jacobs, summarized for other Jacobs employees the results of two days of meetings at Mitsubishi. Mr Jain stated, "We now have design control of Jake Brakes for both . . . engines and will be developing them on a highly accelerated schedule." The final agreement between Jacobs and Mitsubishi, signed in February 1991, shows that Mitsubishi "entrust[ed] Jacobs with the design and development of separate Jake Brake compression release engine retarder models for the MMC 6D40 and [8M20] engines respectively."

The Jacobs' engine brakes for the Mitsubishi engines were introduced in the fourth quarter of 1991. The Model 864 is

standard equipment on the 6D40 engine; the Model 882 is a standard option on the 8M20 engine. Neither model can be used on any other engine.

The engine brakes supplied by Jacobs to Mitsubishi were designed to be operated by the truck driver in combination with an exhaust brake. A single switch in the cab causes both the engine brake and exhaust brake to operate. When activated in this manner, the engine brake opens an exhaust valve of a cylinder on its compression stroke near top dead center. The exhaust brake maintains a high back pressure in the exhaust manifold. Release of cylinder pressure by the engine brake adds to the manifold pressure. An exhaust valve of a cylinder on its intake stroke subsequently opens permitting pressurized gases from the exhaust manifold to enter the cylinder.

As of 1996, Mitsubishi changed the operating controls to allow the engine brake to be used alone. Shop manuals published by Mitsubishi in 1996 and 1997 for the 6-cylinder and 8-cylinder engines show that both are configured to enable a truck driver to use the engine brake only.

At the June 1990 meeting, Mitsubishi provided Jacobs with valve traces showing that the combination caused valve float on intake.

In a fax of August 17, 1990, Mr. Meistrick stated:

> We expect that during the retarding mode (720° crank) each cylinder will generate one pressure pulse near to the TDC

> compression due to the cylinder pressure blow down by the Jake Brake and one pressure pulse near to the TDC exhaust due to the back pressure generated by the exhaust brake. Both pressure pulses will affect the retarding conditions of the neighboring cylinders. The effect of the exhaust brake pressure on the exhaust valve float of a cylinder on intake stroke is obvious from the 6D40 engine test. The effect of the Jake Brake pressure pulse, however, did not reflect on the exhaust valve float on this particular test. If the duration and magnitude of the Jake Brake pressure pulse is sufficient, we suspect, it may also cause an additional exhaust valve float.... The exhaust valve float will result in the additional mass flow to the cylinder on intake. (DX 74)

Jacobs subsequently conducted testing of an engine brake/exhaust brake combination for the 6D40 engine using various lash settings. The tests were conducted in Connecticut with the aid of a dynamometer. In a fax to Mitsubishi in January 1991, Jacobs stated that its dynamometer optimization suggested use of a lash setting of 1.25 mm for the 6D40 combination. (DX 79) The lash setting ultimately chosen for both Mitsubishi products is 1.2 mm. (DX 84, DX 85) This setting delays the engine brake's opening of the exhaust valve until late in the compression stroke.

2. Jacobs Model 122 for Volvo

In 1990, Jacobs undertook to supply Volvo with an engine brake for the Volvo TD 122 engine, a six cylinder engine that had an exhaust brake as standard equipment. The product was introduced in the third quarter of 1991. The Jacobs engine brake was not factory-installed but instead sold in the "after-market" to truck owners who wanted to add an engine brake to the exhaust brake that was already on the Volvo engine. The engine brake could be

operated either alone or in combination with the exhaust brake.

As with the Models 864 and 882 supplied to Mitshubishi, the engine brake supplied to Volvo opens an exhaust valve of each cylinder near top dead center of the compression stroke. Volvo's exhaust brake, like Mitsubishi's, serves to produce high back pressure in the exhaust manifold. The exhaust valve of the cylinder on intake opens after the engine break event.

3. Jacobs Stealth Retarder For Mack

In 1991, Mack released a new engine, the E7. Jacobs designed and manufactured an engine brake for this engine, Jacobs Model 680B. Mack received complaints that the Model 680B was not providing sufficient braking horsepower. In 1994, Jacobs and Mack began exploring alternative ways to improve the retarding horsepower of the Jacobs engine brake for this engine. Ultimately, they decided to add a Jacobs exhaust brake, the Model EX-ME7, to the Jacobs Model 680B engine brake. This combination came to be called the "Mack Stealth."

The Stealth included an engine brake that opened the exhaust valve near top dead center on the compression stroke and an exhaust brake set to produce high back pressure. Jacobs advertised that the Stealth increased the E7 engine's retarding power by up to 40 per cent compared to a Jake Brake alone.

By the time Jacobs undertook to supply Mack with what became the Stealth retarder, Pacbrake had already brought this suit,

alleging that the Jacobs' engine brakes sold to Mitsubishi and Volvo infringed the '289 Patent. Jacobs had previously received two opinions of counsel that the '289 Patent was invalid. Before supplying the Stealth to Mack, Jacobs sought a third opinion, this time from Bradford Kile of the law firm of Baker & McKenzie. On August 11, 1995, Mr. Kile rendered his opinion that the Stealth combination did not infringe the '289 Patent. Jacobs began selling the combination to Mack in April 1996.[3]

4. Summary of Accused Products

Jacobs' accused products do appear to apply the teachings of the '289 patent. The timing of the compression release event is optimized for the combination by means of a lash setting that results in substantially delaying compression release. Moreover, the exhaust brake is set to create sufficient back pressure to cause valve float on intake. And while Jacobs did not test the combination brakes to determine whether they actually achieved supercharging, Mr. Meistrick's writings show that Jacobs had supercharging in mind.

It must also be recognized, however, that the '289 patent did not teach Jacobs how to float a valve. It was known before the '289 patent that an exhaust brake operating at a commercially reasonable setting in a combination causes valve float independent

[3] Mr. Kile's opinion was later updated when Mack began selling an engine with a different cam design.

of the timing of the compression release event. It is possible that the exhaust valve might have opened closer to bottom dead center of the cylinder on intake in the accused products than in earlier combination brakes. But the valve did open in those earlier brakes. The evidence does not support a finding that Jacobs' use of the '289 patent's teachings caused valve float after compression release that otherwise would not have occurred.

G. Reexamination Proceeding

In August 2003, Jacobs filed with the PTO a request for reexamination of the '289 patent. In conjunction with this request, Jacobs submitted prior art not previously considered by the PTO: the Okamura patent, the Powertard article and three other publications: J.M. Rife & G.M. Bloom, Performance Analysis and Design of the Jake Brake (May 1976) ("Rife"); Okamura, "Trends in Auxiliary Engine Braking System"; and a patent by Mayne et al., U.S. Patent No. 4,423,712 (filed Apr. 28, 1982) ("Mayne").

In addition to citing the prior art identified above, Jacobs submitted (1) a claim chart listing the claims of the '289 patent and applying what it contended were the teachings of the prior art, (2) a Pre-Hearing Memorandum Of Law In Support Of Jacobs' Claim Construction of the '289 Patent, (3) the Declaration of Zdenek S. Meistrick, (4) a copy of US Patent No. 1,637,118, (5) a copy of US Patent No. 3,330,263, (6) a copy of US Patent No. 4,395,884, (7)a copy of US Patent No. 4,474,006, (8) a copy of US Patent No.

4,572,114, (9) a copy of US Patent No. 4,662,332, (10) a copy of German patent application no. 28 20 941, (11) a copy of Japanese patent application no. 60-3437, (12) a memorandum submitted by Pacbrake in connection with the Markman proceeding in this case, and (13) excerpts from this Court's claim construction.

The reexamination was assigned Control No. 90/006,764. By communication of November 12, 2003, Primary Patent Examiner Gimie granted reexamination; determined that Okamura raised a new question of patentability as to claims 1,3 and 6-8, and that Rife in combination with Okamura raised a new question of patentability as to claims 1-4 and 6-15. The examiner also determined that Powertard in combination with Okamura did not raise a new question of patentability as to claims 1-15, "because there is no motivation to combine the two references." Pacbrake did not respond to the order granting reexamination.

An Office Action issued December 21, 2004, in which the examiner initially rejected claims 1,3 and 6-8 as being anticipated by Okamura. Claims 2,4 and 9-15 were rejected as being obvious over Okamura in view of Rife. And claim 5 was rejected as being obvious over Okamura in view of the 8 DC 9T publication.

Thereafter, Pacbrake petitioned for an extension of time through and including May 1, 2005 to respond to the Office Action. The Petition was granted. An interview was held April 19, 2005, with Primary Examiner Gimie. Present on behalf of Pacbrake were

Mr. Meneely; Pacbrake's Chief Engineer, Robert Price; Pacbrake's expert witness, Frank Pekar; and Pacbrake's counsel, Joseph Berenato.

At the conclusion of the interview, the examiner issued an Interview Summary showing that agreement had been reached as to all claims. "Applicant, attorney, expert witness, and chief engineer explained how the third valve (34) of Okamura is not an exhaust valve. Independent clams 1,6, and 11 of the patent require, inter alia, an exhaust valve." Other claim language that was patentable over Okamura is "increasing the pressure of gases in the exhaust manifold sufficiently to open a second exhaust valve" or means to do so. Id. The examiner noted that he had been shown a "power point presentation of the function of the third valve (34) of Okamura (Jp-5717011) versus a conventional exhaust valve as claimed by patentee."

On April 28, 2005, Pacbrake submitted a request for reconsideration of the rejection and served a copy upon counsel for Jacobs. Included with the request were copies of the materials shown to the examiner during the interview, copies of which also were served upon counsel for Jacobs. In the request for reconsideration, Pacbrake pointed to the "fourth embodiment of Okamura as illustrated in Figure 10" and commented that the fourth embodiment and Figure 10 were "discussed" during the interview. In addition to submitting the request for reconsideration, Pacbrake

submitted additional prior art for consideration by the examiner.

On May 31, 2005, the PTO issued a Notice Of Intent To Issue Ex Parte Reexamination Certificate, a copy of which was served upon Jacobs' counsel. The Notice was signed by Primary Examiner Gimie, who had been present at the interview, and by Primary Examiner Andrew M. Dolinar, Primary Examiner Tony M. Argenbright, and Supervisory Patent Examiner Henry C. Yuen, none of whom had been present at the interview.

The Notice confirmed the patentability of claims 1-15 without requiring any change in the claims, specification or drawings. The Notice states that claims 1 and 6 are not anticipated by Okamura because the third valve of Okamura is not an exhaust valve. Claim 11 is patentable, the Notice states, because the third valve "is too small, does not close during [the] expansion stroke, has slow opening and closing and the intake and exhaust valve overlap minimizes/prevents exhaust manifold pressure increase." The Notice also states, "[w]ith regard to . . . obviousness over Okamura et al in view of the other references of record, none of the references in combination of Okamura makes it obvious to one of ordinary skill in the art at the time [the] invention was made to combine the references to achieve the patented invention." Finally, the Notice states that the remarks in the request for reconsideration "are persuasive and may further clarify the differences between the patented claims and the prior art, particularly the Japanese

reference of Okamura et al (JP-57171011)."

On July 15, 2005, Jacobs filed a petition with the PTO seeking to reopen the reexamination. By communication of August 16, 2005, the petition was dismissed. The Ex Parte Reexamination Certificate issued on October 18, 2005.

II. LEGAL ANALYSIS

A. Validity

Jacobs contends that the '289 patent is invalid as anticipated under 35 U.S.C. § 102(a), (b) and obvious under 35 U.S.C. § 103(a). Each claim of a patent is presumed valid, and a challenger must prove invalidity by clear and convincing evidence. Tokai Corp. v. Easton Enters., 632 F.3d 1358, 1367 (Fed. Cir. 2011) (citing Metabolite Labs., Inc. v. Lab. Corp. of Am. Holdings, 370 F.3d 1354, 1365 (Fed. Cir. 2004)). Pacbrake maintains that Jacobs has not sustained its burden, and the '289 patent should be upheld. I find that Claims 1, 3, 5, 6, 7, 8, 11, 12, and 13 are invalid as obvious, but Claims 2, 4, 9, 10, 14 and 15 are neither anticipated nor obvious and are therefore valid.

1. Anticipation

An invention must be new to be patentable. If the invention was disclosed in the prior art, then it is anticipated and may not be patented. Section 102(a) of the Patent Act of 1952 provides that a patent is invalid if the invention was known or used in this country or described in a printed publication before the date of

invention. Section 102(b) provides that the patent is invalid if it was described in a printed publication more than one year prior to the date of the patent application. Jacobs argues that the '289 patent is invalid under both sections.

Section 102(a)

Jacobs contends its combination brake testing for Berliet, Saviem and Volvo in the 1970s and early 1980s as well as Williams' 1974-75 trade show demonstration of the Freightliner truck containing a combination brake constitute knowledge or use of the invention under § 102(a).

There is no evidence that the Berliet, Saviem and Volvo testing were ever made available to the public. Mr. Stawski, a former Jacobs employee, testified that the testing was confidential. Other evidence also suggests the testing was kept secret. The purpose of the testing was not to develop or sell a combination brake, but rather to persuade the manufacturers to install Jacobs' engine brakes in lieu of or in addition to exhaust brakes manufactured by other companies. As Jacobs did not market exhaust brakes or combination brakes, it had no incentive to credit the value proposition of combination braking. Prior use of an invention by someone other than the applicant, when conducted in secret, does not invalidate a patent under either § 102(a) or § 102(b). Woodland Trust v. Flowertree Nursery, Inc., 148 F.3d 1368, 1370-71 (Fed. Cir. 1998). Accordingly, the Berliet, Saviem and

Volvo testing does not anticipate the '289 patent.

While the evidence suggests Williams' trade show demonstrations of a combination brake were sufficiently public, Jacobs has not met its burden of proving that the combination brake featured each element of the disputed claims. See In re Omeprazole Patent Litig., 483 F.3d 1364, 1371 (Fed. Cir. 2007) (anticipation analysis requires that the anticipating prior art disclose each and every element of the disputed claim). Jacobs relies on the deposition testimony of Chester Lundberg, Williams' former Chief Engineer. Mr. Lundberg testified that the truck installed with the combination brake was road-tested, exhibited at several trade shows and shown to customers at Williams' headquarters. However, Mr. Lundberg's testimony does not clearly establish that, at the trade shows, the exhaust brake was set at a high enough back pressure to produce valve float, an element of each of the '289 patent's claims. Further, this deposition testimony fails to establish that if valve float occurred, it happened on each intake stroke. Therefore, the evidence in the record does not clearly support a finding that the Williams demonstrations anticipated the '289 patent.

Section 102(b)

An invention is also anticipated if it was "patented or described in a printed publication . . . more than one year prior to the date of the application for patent in the United States."

35 U.S.C. § 102(b). Jacobs contends that Okamura, Powertard and Sato each anticipate several claims of the '289 Patent. I disagree.

Anticipation analysis requires two steps: first, the court construes the claim at issue; second, the court compares the construed claim to the prior art. Heliflex Ltd. v. Blok-Lok, Ltd., 208 F.3d 1339, 1346 (Fed. Cir. 2000). A single prior art reference must disclose every element of a claim for that claim to be anticipated. Constant v. Advanced Micro-Devices, Inc., 848 F.2d 1560, 1570 (Fed. Cir. 1988) (citing Kalman v. Kimberly Clark Corp., 713 F.2d 760, 771 (Fed. Cir. 1983), cert. denied, 465 U.S. 1026 (1984)). In addition, an anticipatory prior art reference must enable one of skill in the art to practice an embodiment of the claimed invention without "undue experimentation." American Calcar, Inc. v. American Honda Motor Co., Inc., 651 F.3d 1318, 1341 (Fed. Cir. 2011) (citing In re Gleave, 560 F.3d 1331, 1334 (Fed. Cir. 2009)). See also In re Donohue, 766 F.2d 531, 533 (Fed. Cir. 1985) ("Such possession is effected if one of ordinary skill in the art could have combined the publication's description of the invention with his own knowledge to make the claimed invention.") While I find that Okamura discloses every element of claim 1, Jacobs has presented insufficient evidence that Okamura is enabling. Neither Powertard nor Sato discloses every element of claim 1; therefore, neither anticipates the claim.

First, I construe the claim. Claim 1 is the broadest claim of the '289 patent and provides:

> A method for retarding an engine, comprising the steps of:
>
> opening a first exhaust valve of a first cylinder of the engine near top dead centre of each compression stroke of the first cylinder; and
>
> increasing the pressure of gases in the exhaust manifold sufficiently to open a second exhaust valve of a second cylinder of the engine on each intake stroke of the second cylinder after said first exhaust valve so opens.

'289 patent col. 7 ll. 46-55.

The preamble states that claim 1 is a method for retarding an engine. Ths claim has four elements: (1) opening a first exhaust valve of a first cylinder of the engine near top dead center of each compression stroke of the first cylinder ("compression release"); (2) increasing the pressure of gases in the exhaust manifold; (3) sufficiently to open a second exhaust valve of a second cylinder on each intake stroke of the second cylinder ("valve float"); and (4) valve float occurring after compression release occurs.

The first and third elements both use the term "open." During Markman proceedings, Pacbrake argued that the term "open" should be construed in light of the patent's specifications to encompass supercharging: trapping air in a cylinder on intake, so the cylinder performs more work on compression. The exhaust valve should be considered "open," Pacbrake argued, "when air is being diverted from the exhaust manifold in order to increase the

pressure charge in the cylinder." D.'s Mem. in Support of the Markman Hearing (Doc. 184) 23. Jacobs argued that "open" should be given its ordinary meaning: "affording unobstructed entrance and exit; not shut or closed." Pre-Hearing Mem. of Law in Support of Pl's Claim Construction (Doc. 186) 2. More in line with Jacobs than with Pacbrake, I construed "open" to mean "open enough to permit the passage of gas in or out of a cylinder." Tr. 11/20/01 32.

When I gave the parties this claim construction, both sides stated it was acceptable to them. In the absence of objection, it provided the basis for further proceedings, including motions for summary judgment and preparation for trial. On the eve of trial, Jacobs asked the Court to confirm its prior ruling that "supercharging" resulting from "trapped charge" is not part of the claims. Jacobs argued that Pacbrake's recently filed proposed conclusions of law revealed an intention to rely on such a claim construction. Addressing that possibility, I reaffirmed my original construction.

By construing "open" to mean "open enough to permit the passage of gas in or out of a cylinder," I gave the term its "ordinary and accustomed meaning[]." Teleflex, Inc. v. Ficosa N. Am. Corp., 299 F.3d 1313, 1327 (Fed. Cir. 2002); see also Retractable Techs., Inc. v. Becton, Dickinson and Co., 659 F.3d 1369, 1371 (Fed. Cir. 2011) ("It is not for the court to tailor the

claim language to the invention disclosed. The language is the language, and the same rules that apply to the construction of other legal instruments should apply to the construction of a patent claim.") (Moore, J., dissenting from denial of the petition for rehearing en banc). While patent claims should be construed in light of the specification, Phillips v. AWH Corp., 415 F.3d 1303, 1315 (Fed. Cir. 2005), a court should not give a claim term a meaning it cannot bear. See Ethicon Endo-Surgery, Inc. v. U.S. Surgical Corp., 93 F.3d 1572, 1579 (Fed. Cir. 1996) (rejecting a construction because "the plain meaning of the claim will not bear [such] a reading"). The simple word "open" cannot carry the weight of "supercharging" or "trapped charge," even read in light of the patent's specification. It is a "bedrock principle of patent law" that the words of the claims define the scope of a patented invention. See Phillips, 415 F.3d at 1312; Computer Docking Station Corp. v. Dell, Inc., 519 F.3d 1366, 1374 (Fed. Cir. 2008). By construing "open" as I did, I limited the '289 patent to its terms, instead of expanding its terms to meet its specifications. The '289 patent does not claim supercharging; it claims valve float sufficient "to permit the passage of gas in or out of a cylinder."[4]

[4] Mr. Meneely testified that the key to his invention is the timing of the opening of the exhaust valve on intake: the opening must occur late in the intake stroke when the cylinder's intake valve is closing; if the opening occurs earlier, air that enters the cylinder from the exhaust manifold will escape through the open intake valve and there will be no trapped charge. This limitation is not claimed in the '289 patent. Under the claim

Second, after construing the claim, I compare it to the prior art. The Okamura patent application discloses "a braking device for a 4-stroke-cycle internal combustion engine," Okamura 3, corresponding to the '289 patent's preamble. After briefly referring to conventional exhaust brakes and engine brakes, Okamura states that the "inventive braking device" it discloses "is constituted so that it introduces positive-pressure gas in an exhaust passage to a combustion chamber at or near bottom dead center of the suction [i.e. intake] stroke, and after the interior of the combustion chamber is in a supercharged state[,] the gas in that chamber is released near top dead center of the compression stroke, so it provides braking ability that is even better then the individual braking abilities of the conventional devices described above." Id. 4. This description corresponds closely to Mr. Meneely's description of the invention covered by the '289 patent.

I find that all the elements of claim 1 are present in Okamura. With regard to the first element – compression release near top dead center – Okamura discloses that "in the combustion chamber 22 whose stroke phase is near top dead center of the compression stroke, the third valve 34's third port 28 is opened just a little . . . and the high-pressure gas inside the combustion chamber 22 sprays energetically through the port 28 into the

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language, it is sufficient if the opening of the exhaust valve occurs at any point during the intake stroke after compression release.

exhaust manifold 4 and discharges the compression work in the combustion chamber 22, so a large braking effect is applied to the engine." Okamura 5. This text describes the operation of a compression release engine brake, except that a third valve is used instead of an exhaust valve. Okamura explicitly states, "the exhaust valve 32 in each combustion chamber may be used to constitute the first gas introduction means without having the third valve 34." Okamura 6. The "first gas introduction means" refers to the compression release event caused by the operation of the engine brake. Thus, Okamura discloses the first element of claim 1.

With regard to the second element of claim 1 - increasing the pressure of gases in the exhaust manifold - Okamura discloses that "the butterfly valve 8 goes into a closed state . . . the exhaust gas becomes blocked . . . [and] high-pressure gas that sprayed into the exhaust manifold 4 [from the compression release event]. . . creates a pressure wave inside . . . [the] exhaust manifold." Okamura 5. The "butterfly valve" disclosed in Okamura is an exhaust brake. When the butterfly valve is closed, the "high-pressure gas" sprayed into the exhaust manifold increases the pressure of the gases in the exhaust manifold.

With regard to the third element of claim 1 - valve float caused by increased exhaust manifold pressure - Okamura discloses that "[s]ome of this high-pressure gas pushes open the exhaust

valve 32 in another blocked combustion chamber whose stroke phase is near bottom dead center of the [intake] stroke and whose internal pressure is relatively small; the gas flows in and increases the pressure inside the combustion chamber and acts so as to increase the amount of gas filling the interior of the chamber." Okamura 5. This text refers to valve float caused by increased pressure in the exhaust manifold. Thus, the third element of claim 1 is disclosed in Okamura.

Finally, with regard to the fourth element of claim 1 - valve float occurring after compression release - Okamura discloses a "first gas introduction means," id. 6, which refers to compression release, and a following "second gas introduction means," Okamura 6, which refers to valve float. Therefore, I conclude that every limitation of claim 1 is disclosed in Okamura.

Prior art "must be sufficient to enable one with ordinary skill in the art to practice the invention." SmithKline Beecham Corp. v. Apotex Corp., 403 F.3d 1331, 1342 (Fed. Cir. 2005) (quoting Minn. Mining & Mfg. Co. v. Chemque, Inc., 303 F.3d 1294, 1301 (Fed. Cir. 2002)). At trial, the parties argued at length over whether Okamura's fourth embodiment, which discloses compression release via the exhaust valve instead of a third valve, is enabling. Jacobs argues that in a challenge to patent validity, prior art is presumed enabling, and the burden is therefore on Pacbrake to show that Okamura is not enabling. While the Federal

Circuit has not decided which party has the burden of showing whether prior art is enabling, I disagree with Jacobs and conclude that the burden is on the patent challenger.

At the PTO, prior art is presumed to be enabling. See In re Sasse, 629 F.2d 675, 681 (C.C.P.A. 1980); Manual of Patent Examining Procedure § 2121. Several district courts, citing In re Sasse, have held that the presumption applies in challenges to patent validity. See Mehl/Biophile Int'l Corp. v. Milgraum, 8 F. Supp. 2d 434, 444 (D.N.J. 1998), aff'd, 192 F.3d 1362 (Fed. Cir. 1999); Ciba-Geigy Corp. v. Alza Corp., 864 F. Supp. 429, 438 (D.N.J. 1994) , aff'd in part, vacated in part, 68 F.3d 487 (Fed. Cir. 1994); Procter & Gamble Co. v. Nabisco Brands, Inc., 711 F. Supp. 759, 772 (D. Del. 1989). Patents are presumed valid, however, and invalidity must be proven by clear and convincing evidence. Sinskey v. Pharmacia Ophthalmics, Inc., 982 F.2d 494, 498 (Fed. Cir. 1992). In other contexts, the Federal Circuit has held that this presumption requires a challenger to prove all factual issues relating to validity by clear and convincing evidence. 1 Donald S. Chisum, Chisum on Patents § 3.04(1)(b)(v) (2011); see, e.g., Budde v. Harley-Davidson, Inc., 250 F.3d 1369, 1376 (Fed. Cir. 2001). In these other contexts, courts employ a burden shifting framework: the challenger must establish a prima facie showing on the factual issue; the burden of production then shifts to the patent owner to produce evidence in its favor;

finally, the court weighs the evidence with the challenger bearing the burden of persuasion. See, e.g., Mahurkar v. C.R. Bard, Inc., 79 F.3d 1572 (Fed. Cir. 1996), cert. denied, 525 U.S. 1106 (1999). The Northern District of Illinois has used this approach with regard to prior art enablement, reasoning that In re Sasse applies to proceedings at the PTO, where an applicant has the burden of showing his application merits a patent, but does not apply in court, where the patent is presumed valid.[5] Abbott Labs. v. Diamedix Corp., 969 F. Supp. 1064, 1067-68 (N.D. Ill. 1997). I find that reasoning persuasive, and think the Federal Circuit is likely to find it persuasive as well. See Chisum on Patents § 3.04(1)(b)(v). Therefore, "once [Jacobs] has shown that each and every claim is cited in the [] reference, [Pacbrake] only has the burden of producing some material evidence which places the enablement of the reference in question. Once it has done so, [Jacobs] must show by clear and convincing evidence that the [] reference was, in fact, enabling." Abbott Labs., 969 F. Supp. At 1068.[6]

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[5] Where the prior art reference is itself a patent, it is presumed valid. Amgen Inc. v. Hoechst Marion Roussel, Inc., 457 F.3d 1293, 1307 (Fed. Cir. 2006). Okamura is a patent application, not a patent.

[6] Jacobs' allegation that Pacbrake misrepresented the evidence on enablement at the PTO does not alter my conclusion on this issue. The patent is presumed valid, and the challenger must prove all facts bearing on validity by clear and convincing evidence.

Pacbrake argues that Okamura is not enabling with regard to the fourth embodiment because the two-lobe cam in Okamura's figure 10 will not cause valve float. Instead, Pacbrake says, the cam will keep the exhaust valve open during the expansion stroke and a significant portion of the intake stroke. During the time the exhaust valve is open, air will flow from the exhaust manifold into the cylinder, and pressure in the exhaust manifold will decrease to a level where it will not cause valve float upon compression release. Also, the hydraulic timing mechanism could keep the valve open too long. In support of its position, Pacbrake submits that its expert witness Frank Pekar used a two-lobe cam when he built the Dynatard brake, and when he tested his invention with an exhaust brake, he could not build up enough pressure to float a valve. Jacobs' own testing of a Dynatard engine brake in combination with a Williams exhaust brake showed a slow return of the exhaust valve after the exhaust stroke – a return that appears to extend into the intake stroke. This testing also showed an exhaust manifold pressure of 21 psi – insufficient to float a valve – at the high engine speed of 2400 rpm.

Jacobs responds that a person of ordinary skill in the art would know how to make the exhaust valve close if it stayed open during intake or expansion. It submits that such a person would either substitute a roller tappet for the flat tappet or use a reset mechanism like the one disclosed in the Cavanaugh '787

patent. Jacobs further argues that Mr. Pekar's engine retarder patent, which uses a two-lobe cam similar to that in Figure 10 of Okamura to open an exhaust valve and a "transfer" valve, shows the exhaust valve closing quickly and completely after both compression and exhaust.

Pacbrake's evidence raises doubt as to whether Okamura's fourth embodiment is enabling by challenging the ability of an apparatus based on figure 10 alone to cause valve float. While Jacobs provides some evidence that Okamura would enable a person of ordinary skill in the art to make the invention, this evidence is not clear and convincing. In particular, the evidence does not show that a person of ordinary skill in the art, relying only on Okamura's disclosures and "his own knowledge," In re Donohue, 766 F.2d 531, 533 (Fed. Cir. 1985), would know to add a roller or a reset "without undue experimentation." In re Gleave, 560 F.3d 1331, 1334 (Fed. Cir. 2009). Given Mr. Pekar's struggle with Dynatard, it seems likely that a skilled person would need to experiment simply to learn that the fourth embodiment, as depicted in figure 10, would not work. Because Jacobs has not carried its heavy burden, I find that Okamura's fourth embodiment is not enabling.[7]

[7] Jacobs argues that because figure 10 is only an example of Okamura's fourth embodiment, it need not be enabling if a person of ordinary skill in the art could figure out how to practice the invention were figure 10 absent. Okamura's application invites the reader to try to build the apparatus depicted in figure 10.

Okamura, then, does not anticipate any claim in the '289 patent that includes opening a first exhaust valve and achieving sufficient pressure to open a second exhaust valve. Because all the claims contain these elements, Okamura does not anticipate any claim in the patent.

Jacobs also argues that the Powertard article anticipates claims 1, 3, 5, 6, 7 and 8 of the '289 patent. I disagree. The first element of the first claim in the '289 patent requires that an exhaust valve open near top dead center of its cylinder's compression stroke. In Powertard, a third valve performs this function. I find that the third valve is not an exhaust valve. It opens only during braking, does not open on the exhaust stroke and is smaller than the exhaust valve, which makes it easier to open on compression. Because Powertard does not disclose the use of an exhaust valve for compression release, it is missing an element of every claim. Powertard, then, does not anticipate the '289 patent.

Sato also fails to anticipate the patent in suit. The third element of claim 1 requires that valve float occur on a cylinder's intake stroke. While Sato discusses the phenomenon of valve float, it does not disclose that valve float will occur on each intake stroke. Therefore, it is missing the third element of claim 1. Also, Sato does not discuss the timing of valve float relative to

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Therefore, if Figure 10 is not enabling, that person would not be able to practice the invention without "undue experimentation."

the compression release event. Therefore it does not disclose the fourth element of claim 1, which requires that the second cylinder's valve float on intake occur after the first cylinder's compression release event. As these elements are in all the claims, Sato does not anticipate any claim of the '289 patent.

Having found that the '289 patent is not invalid as anticipated, I turn to obviousness under § 103.

2. Obviousness

An invention is not patentable if, in light of the relevant prior art, it would have been obvious to a person having ordinary skill in the art. See 35 U.S.C. § 103. Four factors are used to evaluate obviousness: (1) the scope and content of the prior art, (2) differences between the prior art and the claims at issue, (3) the level of ordinary skill in the pertinent art, and (4) secondary considerations, including, "commercial success, long felt but unsolved needs, [and] failure of others." Graham v. John Deere Co., 383 U.S. 1, 17-18 (1966). When combining references to show obviousness, a challenger must show by clear and convincing evidence that a person of ordinary skill in the art would have reason to attempt to combine them and a reasonable expectation of success in doing so. PharmaStem Therapeutics, Inc. v. ViaCell, Inc., 491 F.3d 1342, 1360 (Fed. Cir. 2007).

Following Graham, I first determine the scope and content of the prior art. I have already discussed much of the relevant art,

including the Okamura patent application, the Sato article, and the Powertard article. Several additional references are applicable. The Rife article, cited above, discloses the basic functionality of the Jacobs engine brake. It discloses the brake's adjusting screw, which advances or delays the compression release event by changing the lash, and it notes that the brake is sensitive to timing. The Mayne patent, also cited above, discloses a mechanism for closing exhaust valves opened on compression before the end of the expansion stroke. Mayne uses a cross-head to open multiple exhaust valves on a single cylinder simultaneously. Finally, Custer's patent, U.S. Patent No. 4,398,510 (filed Mar. 27, 1981), discloses a timing mechanism for engine brakes.

The third Graham factor – the second I consider here – is the level of ordinary skill in the pertinent art. At trial, Jacobs' expert Joseph Rife testified that a person of ordinary skill in the art should be defined as someone with an engineering degree or equivalent experience in the field, plus several years of experience with engine retarders. Mr. Pekar suggested that a person of ordinary skill is an engineer with a degree in mechanical engineering or equivalent field experience. After considering Mr. Meneely's background and the background of inventors and authors of the prior art featured in this case, all of whom meet Dr. Rife's description, I adopt his definition of a person of ordinary skill in the art.

Next, I consider the differences between each claim and the prior art to determine whether the '289 patent is invalid as obvious.

Claim 1

As discussed above, Okamura discloses all the elements of claim 1 but is not enabling because Jacobs has produced insufficient evidence that a person of ordinary skill in the art could practice the fourth embodiment without undue experimentation. Prior art need not be enabling to be considered in an obviousness analysis. Amgen Inc. v. Hoechst Marion Roussel, Inc., 457 F.3d 1293, 1308 (Fed. Cir. 2006), reh'g en banc denied, 469 F.3d 1039 (Fed. Cir. 2006), cert. denied, 550 U.S. 953 (2007). A reference disclosing an inoperable device is still prior art for all that it teaches. Beckman Instruments, Inc. v. LKB Produkter AB, 892 F.2d 1547, 1551 (Fed. Cir. 1989). Okamura teaches all of claim 1 except a method for opening the exhaust valve on compression so that manifold pressure remains high enough to float a second cylinder's exhaust valve on intake.

If the compression release mechanism in Okamura were replaced with a Jacobs engine brake, it would create a device satisfying the elements of Claim 1. The evidence establishes that such a device would build sufficient pressure to cause valve float. Pacbrake's witnesses admitted that an exhaust brake alone can cause valve float. Jack Ekchian, one of its experts, testified that if an

exhaust brake is set to the same restriction as it is on Pacbrake's Model P-37 or any of the accused products, it will cause valve float, even when not in combination. Mr. Meneely and Mr. Pekar also acknowledged that an exhaust brake at a high enough restriction will cause valve float on its own. Mr. Meistrick testified that commercially-reasonable exhaust brakes cause valve float. He further testified that if an engine brake were added to such an exhaust brake, the combination would still cause valve float. I find that a Jake Brake in combination with a sufficiently restrictive exhaust brake will cause valve float.

Prior art teaches that Jacobs' engine brakes can be combined with exhaust brakes. Sato explicitly refers to a "Jacobs-type brake" as an example of an engine brake that can be used for compression release. Sato 161 § 2.2.2 & fig.7. Immediately following this reference, Sato discloses combination braking (or "dual braking systems") with both an engine brake and an exhaust brake. Id. 161 § 2.2.3. Even though Sato goes on to discuss the Powertard brake, which uses a third valve, Sato makes it clear that a Jake Brake can be used in combination with an exhaust brake.

If a person of ordinary skill in engine retardation would have known to substitute a Jake Brake into Okamura's combination brake, then claim 1 should be held invalid as obvious. In KSR Int'l Co. v. Teleflex Inc., 550 U.S. 398 (2007), the Supreme Court addressed the question of when it would be obvious to combine prior art.

Rejecting the Federal Circuit's strict "teaching, suggestion, or motivation" test, the Court noted that "[t]he combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results." Id. at 416. Also, "[w]hen a work is available in one field of endeavor, design incentives and other market forces can prompt variations of it, either in the same field or a different one. If a person of ordinary skill can implement a predictable variation, § 103 likely bars its patentability." Id. at 417. Okamura notes that its "inventive braking device is organically linked to the conventional braking devices described above," Okamura 4, which include a compression release brake. Further, a design incentive – the desire to give Okamura's device a first gas introduction means that sustains pressure in the exhaust manifold – would prompt a person of ordinary skill to substitute a conventional compression release brake, which would work in its usual way. The Jacobs engine brake was the exemplar compression release brake. And if Okamura's discussion and the design incentive were insufficient to motivate the combination, Sato would have made it clear that a Jacobs engine brake could substitute for Okamura's compression release device.

It is true that "when the prior art teaches away from combining certain known elements, discovery of a successful means of combining them is more likely to be nonobvious." Id. at 416

(citing United States v. Adams, 383 U.S. 39, 51-52 (1966)). Sato does teach the benefits of using a third valve instead of an exhaust valve. Sato 163. However, if a person ordinarily skilled in the art wanted to reduce Okamura's fourth embodiment to practice, Sato indicates how this could be done. Therefore, it would have been obvious to a person ordinarily skilled in the art to use a Jake Brake instead of the "first gas introduction means" contemplated in Okamura. Accordingly, I find that claim 1 is obvious over Okamura and Sato.

By finding claim 1 to be obvious, I reach a conclusion at odds with the patent examiner's final determination in the reexamination proceeding. A patent examiner's finding in an ex parte proceeding, although accorded deference in district court litigation, is never binding on the court. See Fromson v. Advance Offset Plate, Inc., 755 F.2d 1549, 1555 (Fed. Cir. 1985). The court has the responsibility to determine whether a patent claim is valid in light of the totality of the evidence, which includes the examiner's finding. See Pfizer v. Apotex, Inc., 480 F.3d 1348, 1359-60 (Fed. Cir. 2007); Stratoflex, Inc. V. Aeroquip Corp., 713 F.2d 1530, 1534 (Fed. Cir. 1983).[8]

[8] The record before me on issues relating to obviousness is far more complete than the one before the PTO. The ex parte reexamination interview lasted about forty-five minutes. The trial, which was more about invalidity than infringement, lasted several weeks. Nearly all the prior art was before the examiner. But he did not have the benefit of the extensive evidence and arguments submitted to me.

Pacbrake argues that the patent is entitled to a heightened presumption of validity because it was upheld on reexamination. But the Federal Circuit has made it clear that the presumption of validity is the same for a patent confirmed through reexamination and a patent issued through the normal process. In both cases, a challenger must prove invalidity by clear and convincing evidence. Superior Fireplace Co. v. Majestic Prods. Co., 270 F.3d 1358, 1367 (Fed. Cir. 2001)(citing Kaufman Co. v. Lantech, Inc., 807 F.2d 970, 973-74 (Fed. Cir. 1986)).

When a patent has been reissued after consideration of prior art not considered by the PTO during the original prosecution, the challenger's burden of proof is usually more difficult to sustain. Kaufman, 270 F.3d at 973-74. In this case, however, two factors detract somewhat from the weight the examiner's ultimate determination in the reexamination proceeding might otherwise receive.

First, the evidence indicates that when Pacbrake participated in the ex parte reexamination interview, it represented to the examiner that the patented invention includes "supercharging" and "trapped charge" and did not discuss with the examiner my claim construction to the contrary.[9] In light of this, the "patented

[9] The materials shown to the examiner at the interview indicate that Pacbrake's presentation focused on what Mr. Meneely's invention accomplished – a secondary consideration – and not the primary consideration of how the claims of the '289 patent differ from the prior art. The opening slide in the

invention" the examiner evaluated may be the one disclosed in the '289 patent's specifications, not the one it actually claims.

Second, the reexamination proceeding took place in 2005, before the Supreme Court's decision in KSR. The patent examiner likely used the Federal Circuit's stricter "teaching, suggestion, or motivation" test to determine whether it would have been obvious to combine Okamura with Sato or any other prior art, including the Jake Brake itself. Under the old test, perhaps the examiner's decision was appropriate. Under KSR's more flexible test, however, there is motivation to combine Okamura with other references on combination braking. Therefore, I believe I am justified in finding certain claims in the '289 patent obvious although the patent examiner did not.

Claim 3

Claim 3 of the '289 patent is dependent on claim 1, but it adds the limitation: "the pressure of gases in the exhaust manifold is increased by restricting the outflow of exhaust gases from the manifold." '289 patent col. 7 ll. 60-63. In other words, the pressure is increased by adding an exhaust brake. Okamura

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presentation is titled "Need for Invention." Further, the "Powertard PV Chart" shows that, at any point in the compression stroke, Powertard does not have a higher cylinder pressure than would be present with an exhaust brake alone. Any additional pressure on compression would most likely be attributed by Pacbrake to trapped charge. Thus, Pacbrake seems to have implied that Powertard does not achieve what the '289 patent claims because it does not trap charge.

discloses the use of a butterfly valve exhaust brake. Okamura 5. A butterfly valve exhaust brake would increase the pressure in the exhaust manifold. As noted above, it would be obvious to a person having ordinary skill in the art of engine retardation to substitute a Jacobs engine brake for the compression release mechanism disclosed in Okamura. Therefore, claim 3 is also obvious over Okamura and Sato.

Claim 5

Claim 5, also dependent on the claim 1, adds the limitation that "the second exhaust valve is opened while the first exhaust valve is open." '289 patent col. 8 ll. 1-3. Jacobs argues that Powertard, which was co-authored by Okamura, in combination with Okamura, makes claim 5 obvious. Powertard shows a third valve in a first cylinder (No. 5) opening just before an exhaust valve floats open on intake in a second cylinder (No. 1). Powertard 5 & fig.13. The article notes that the "rise of pressure in the exhaust port [due to the influence of the compressive work of cylinder No. 5, etc.,] causes an uncontrolled opening of the [second cylinder's] exhaust valve." Powertard 5. While Powertard's third valve stays open through the entire period of valve float, an exhaust valve opened for a much shorter time would still precede and overlap with the second cylinder's valve float. As discussed above, Okamura's fourth embodiment discloses the substitution of an exhaust valve for a third valve. I agree with

Jacobs that it would have been obvious to a person of ordinary skill in the art aware of both Powertard and Okamura that the opening of one exhaust valve on compression would precede and overlap with the opening of another exhaust valve on intake.

I disagree with Pacbrake that Powertard teaches away from valve float entirely. Powertard says that "the impact force of [valve float] must be contained within tolerable limits. Powertard 6. Additionally, Okamura teaches the potential benefits of valve float. Okamura 5-6. "[I]n general, a reference will teach away if it suggests that the line of development flowing from the reference's disclosure is unlikely to be productive of the result sought by the applicant." In re Gurley, 27 F.3d 551, 553 (Fed. Cir. 1994). Powertard does not suggest the invention disclosed in the Okamura application would not work. Therefore, a person of ordinary skill looking at Okamura and Powertard would aim to achieve valve float, if constrained valve float. Neither claim 1 nor claim 5 specifies a degree of valve float necessary to practice the invention; therefore, claim 5 would be obvious to a person of ordinary skill who was familiar with the prior art, because he would aim to achieve constrained valve float, and Powertard and Okamura together disclose how to do so. Claim 5, then, is obvious over Okamura, Sato, and Powertard.

Claim 6

Claim 6 is an independent apparatus claim written in means-

plus-function language. The apparatus must have intake valves and "exhaust valves communicating with a common exhaust manifold." '289 patent col. 8 ll. 5-6. And it must have two functions: (1) "opening an exhaust valve of each cylinder of the engine near top dead center of each compression stroke;" and (2) "increasing the pressure of gases in the exhaust manifold sufficiently to open an exhaust valve of another cylinder of the engine on an intake stroke after each exhaust valve is so opened." '289 patent col. 8 ll. 8-14. In light of the patent's specifications, see 35 U.S.C. § 112; cf. Blackboard, Inc. v. Desire2Learn, Inc., 574 F.3d 1371, 1382 (Fed. Cir. 2009), I have construed the first function as performed by an engine brake and the second as performed by "a combination of an engine brake and an exhaust brake properly set or timed to achieve that function." Tr. 11/20/01 42.

As with claims 1 and 3, Okamura contains all the elements of claim 6, but it is not enabled. As discussed, it would be obvious to substitute a Jacobs engine brake for the compression release device in Okamura. The resulting apparatus would have an engine brake performing the compression release function and, in combination, an engine brake and an exhaust brake appropriately set to cause valve float, as the second function requires. This apparatus, then, would "perform[] the claimed function[s] in substantially the same way to achieve substantially the same result as the corresponding structure described in the specification."

Odetics, Inc. v. Storage Tech. Corp., 185 F.3d 1259, 1267 (Fed. Cir. 1999) (discussing structural equivalence in means-plus-function claims). Thus, it would be obvious to a person of ordinary skill how to engineer the structure disclosed in Claim 6. Like claims 1 and 3, claim 6 is obvious over Okamura and Sato.

Claims 7 & 8

Claim 7 is dependent on claim 6, adding the limitation that "the means for increasing includes means for restricting a flow of exhaust gases from the manifold." '289 patent col. 8 ll. 15-17. My construction of claim 6, in accordance with the patent's specifications, includes an exhaust brake as part of the structure of the claimed invention. Claim 7 makes this limitation explicit. Because claim 6 is obvious, claim 7 is obvious.

Claim 8 is dependent on claim 7 and adds the limitation that "the means for restricting includes a valve." '289 patent col. 8 ll. 18-19. The Okamura patent application discloses that "[a] butterfly valve 8 is interposed in the exhaust pipe 6 to control the gas discharge operation inside the pipe." Okamura 4. As Okamura's exhaust brake includes a valve, claim 8 is obvious.

Claim 11

Claim 11, the '289 patent's final independent claim, reads as follows:

> In combination,
> a multi-cylinder, four stroke internal combustion engine having intake valves and exhaust valves communicating with a common exhaust manifold; and

> an apparatus for retarding the engine including means for opening each exhaust valve of each cylinder of the engine near top dead centre of each compression stroke; and means for increasing the pressure of gases in the exhaust manifold sufficiently to open another exhaust valve of another cylinder of the engine on an intake stroke after said each exhaust valve is so opened.
>
> '289 patent col. 8 ll. 35-47.

Broadly speaking, the claim has two structural elements: 1) an engine having the components recited in the claim, and 2) an engine retarder written in means plus function language. The retarder element in claim 11 is distinguished from that in Claim 6 because the first recited function in claim 11 requires opening each exhaust valve of each cylinder, whereas the first recited function in claim 6 requires opening an exhaust valve. Claim construction doctrine requires that independent claims be construed such that different language in the two claims is not rendered superfluous while at the same time giving the claims their correct scope. See Curtiss-Wright Flow Control Corp. v. Velan, Inc., 438 F.3d 1374, 1381 (Fed. Cir. 2006). Thus, I construe the retarder's first recited function to require that, when an engine has multiple exhaust valves opening onto the same cylinder, the retarder opens each exhaust valve at the same time, near top dead center of the compression stroke. Given that the retarder's second recited function is substantively identical to that of claim 6, I construe the function identically to claim 6.

Okamura discloses the use of a combination brake on a multi-cylinder, four-stroke internal combustion engine, Okamura 3, having intake valves and exhaust valves communicating with a common exhaust manifold. Okamura 4 & figs.1-2. Okamura, then, discloses the first structural element of claim 11. As I noted in my discussion of claim 6, Okamura also discloses the second recited function of the retarder element: a means for increasing manifold pressure sufficiently to float a valve on intake. Okamura does not, however, disclose a means for opening multiple exhaust valves on a single cylinder simultaneously.

The '289 patent describes the crosshead component depicted in the patent as part of a "conventional valve opening mechanism." '289 patent col. 3 ll. 35-41. Jacobs argues that the Mayne patent, in addition to U.S. Patent Number 4,572,114, issued February 1986 to Sickler, et al., render claim 11 obvious in combination with Okamura. Jacobs points out that the Mayne patent uses a cross-head to simultaneously open multiple exhaust valves for a single cylinder, see Mayne col. 4 ll. 35-40 & fig.1, which is essentially the same structure disclosed in the '289 patent. See '289 patent col. 3 ll. 20-41. I agree with Jacobs that it would have been obvious to a person of ordinary skill in the art to combine these references for the purpose of constructing a combination brake to work on a cylinder having multiple exhaust valves. Given that Mr. Meneely developed the invention using a Jacobs-type engine brake

and the '289 patent discloses that "[e]ach of the cylinders, as with many diesel engines used in heavy trucks, may have a pair of exhaust valves," col. 3 ll. 30-32, Mr. Meneely would reasonably be motivated to combine the two references. I find that combining the two was not beyond the skill of a person of ordinary skill in the art. Accordingly, I conclude that claim 11 is obvious over Okamura and the '712 patent.

Claims 12 & 13

As claim 7 is dependent on claim 6 and adds the limitation of an exhaust brake, so is Claim 12 dependent on claim 11, adding an identical limitation. Claim 13 parallels claim 8: both are dependent on the preceding claim, and both add the limitation that the exhaust brake must include a valve. For the same reasons I found claims 7 and 8 to be obvious, I find that claims 12 and 13 are obvious.

Claims 2, 4, 9 & 14

Claim 2 is dependent on claim 1 and adds the limitation that "the pressure of gases in the exhaust manifold is increased by delaying opening of the first exhaust valve." '289 patent col. 7 ll. 56-58. I have construed the limitation in claim 2 to mean that there must be sufficient delay in the opening of the first exhaust valve to cause valve float. Tr. 1596-97. To show obviousness, then, a challenger has to show not only that given the prior art, a person of ordinary skill would know to delay the release event,

but also that it would be obvious that such a delay would cause valve float.

Jacobs argues that claim 2 must be held invalid because the adjustment of a parameter known to affect performance is necessarily obvious. Optimization of a known effective variable rarely permits a finding of non-obviousness. In re Boesch, 617 F.2d 272, 276 (C.C.P.A. 1980). And when an optimal value is found through "routine experimentation," the value will not be patentable. See In re Geisler, 116 F.3d 1465, 1470 (Fed. Cir. 1997). But "[i]t is well settled that a prima facie case of obviousness may be rebutted 'where the results of optimizing a variable, which was known to be result effective, (are) unexpectedly good.'" In re Boesch, 617 F.2d at 276 (quoting In re Antonie, 559 F.2d 618, 620 (C.C.P.A. 1977)). Evidence presented at trial indicates that before the '289 patent, Jacobs stopped retarding the lash when optimizing combination brakes because it observed too much valve float. Thus, Mr. Meneely's decision to delay the release event beyond the usual testing range was not "routine experimentation." And experts, including Mr. Meistrick, were surprised that Mr. Meneely could achieve the power he did with a combination brake, so the result was "unexpectedly good." Therefore, the nature of the claim – a timing adjustment – does not preclude a finding of non-obviousness.

Jacobs also argues that claim 2 is obvious because prior art

discloses the importance of timing, the increase in pressure caused by delay, and the method for optimizing a Jake Brake. However, no prior art reference cited by Jacobs teaches a method to cause valve float by delaying the compression release event. And no prior art in evidence shows an instance where an engine brake with an early compression release – either alone or in combination – failed to float a valve, but a similar engine brake with a late compression release event did float a valve. Instead, the evidence shows that an engine brake alone, independent of when the compression release event occurs, will not float a valve. Therefore, I find that claim 2 is not obvious.

Claim 4 is dependent on claim 1 and combines the limitations of claim 2 and claim 3: "the pressure of gases in the exhaust manifold is increased by delaying opening of the first exhaust valve and by restricting the outflow of exhaust gases from the exhaust manifold." '289 patent col. 7 ll. 64-68. In construing claim 4, I aim to differentiate it from claims 2 and 3 so it is not rendered superfluous. See Andersen Corp. v. Fiber Composites, LLC, 474 F.3d 1361, 1369 (Fed. Cir. 2007) (quoting Tandon Corp. v. United States Int'l Trade Comm'n, 831 F.2d 1017, 1023 (Fed. Cir. 1987)) ("To the extent that the absence of such difference in meaning and scope would make a claim superfluous, the doctrine of claim differentiation states the presumption that the difference between claims is significant."). Therefore, I construe claim 4 to

claim a method where the combination of the delayed release and the exhaust brake causes valve float, although neither one would cause valve float on its own.

As with claim 2, to prove claim 4 obvious, a challenger would have to produce prior art references showing, first, a combination brake with delayed compression release that causes valve float, and second, both an equivalent brake with early release and an equivalent brake with less restriction on the exhaust pipe, neither of which produces valve float. And the challenger would have to prove that it would be obvious to a person of ordinary skill in the art that he could produce such a brake. The evidence in the record is insufficient to show that a combination brake could be dependent on both delayed compression release and a restrictive exhaust valve for valve float. The evidence is also insufficient to show that it would be obvious to a person of ordinary skill that he could engineer such a brake. Therefore, claim 4 is non-obvious.

Claim 9 is dependent on claim 6 and adds the limitation, "the means for increasing [the pressure] includes means for retarding opening of each said exhaust valve near top dead centre of each said compression stroke to increase the pressure of gases released from each said cylinder." '289 patent col. 8 ll. 20-24. Because Claim 9 tracks the means-plus-function language pertaining to the second recited function of claim 6, I construe the claim to have a recited function of retarding the opening of an exhaust valve near

top dead center of the compression stroke to increase the pressure of gases released from that cylinder, which in turn increases the pressure in the exhaust manifold sufficient to cause valve float in another cylinder. Claim 9, like claim 2, requires that the delay in compression release cause valve float; therefore, claim 9, like claim 2, is not obvious.

Claim 14 is dependent on claim 11 and contains language very similar to that of claim 9. It too requires that the delay of the exhaust valve opening on compression be the cause of valve float. It too is non-obvious.

Claims 10 & 15

Claim 10 is dependent on claim 9 and adds the following structural limitations: 1) "the [exhaust] valves are operated by push tubes"; 2) "a slave cylinder having a slave piston operatively contacting each [] exhaust valve"; 3) "a master cylinder having a master piston operatively contacting one push tube"; 4) "an hydraulic conduit between the master cylinder and slave cylinder"; and 5) "the means for retarding including a gap operatively between the slave piston and each [] exhaust valve prior to opening [on the compression stroke] of each [] exhaust valve." '289 patent col. 8 ll. 25-34. These structural elements those comprising a typical Jacobs-type engine brake. Tr. 636-37; Rife fig.3.[10] Claim 10 is

[10] Rife does not identify a slave cylinder and master cylinder, but in a Jake Brake, the pistons are housed within their respective cylinders. Also, although Rife discloses "push

dependent on claim 9, and claim 9 is non-obvious; therefore, claim 10 is also non-obvious. Chisum on Patents § 8.06[5][c] ("Because a dependent claim is narrower in scope than the parent or base claim or claims upon which it depends, it follows that allowance of a parent or base claim as patentably novel and unobvious over the prior art results in allowance of a claim dependent upon that claim.").

Similarly, claim 15 is dependent on claim 14 and adds structural elements of a Jake Brake. For the same reasons, then, it is non-obvious. However, the end of claim 15 differs from the end of claim 10. The prosecution history of the '289 Patent shows that when Mr. Meneely's patent application was first submitted, claims 10 and 15 both ended with, "...the means for retarding including a gap between the one push tube and the master piston prior to said opening of the first exhaust valve." The examiner rejected these claims for indefiniteness under 35 U.S.C. § 112 because "the 'push tube' and the 'master piston' are not recited as having a gap in the specification." While claim 10 was rewritten to overcome this objection – the patent now claims a gap between the slave piston and each first exhaust valve – claim 15 was not. The patent office allowed claim 15 of the amended patent anyway. Before trial, Jacobs argued that the Court should invalidate claim 15 for indefiniteness. Shortly thereafter, Pacbrake dropped its

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rods," the terms "push rod" and "push tube" are interchangeable.

counterclaim for infringement of claim 15, and Jacobs no longer argued invalidity. As Jacobs no longer contests the validity of claim 15, I decline to invalidate it.

3. Conclusion on Validity

For the foregoing reasons, I find all the claims of the '289 patent invalid except 2, 4, 9, 10, 14 and 15, which I find to be non-anticipated and non-obvious. Jacobs has not sustained its burden of proving that these claims are invalid. Accordingly, I agree with the examiner's determination of validity with respect to claims 2, 4, 9, 10, 14 and 15.

B. Infringement

1. Relevant Claims

Jacobs has conceded that it has infringed claims 1, 3, 5, 6, 7, 8, 10, 11, 12 and 13. It does not concede that is has infringed claims 2, 4, 9 and 14. As claim 10 is dependent on claim 9, and infringement of a dependent claim implies infringement of its basis claim, the Court deems Jacobs to contest infringement of claim 10. Pacbrake has withdrawn its claim for infringement of claim 15.

The claims Jacobs denies infringing – 2, 4, 9, 10 and 14 – are the same claims I have found to be valid. As noted in my discussion of validity, the evidence presented at trial does not establish that delaying the compression release event has ever been a but-for cause of valve float. Therefore, Pacbrake has not sustained its burden of proving that delaying the compression

release causes valve float in any of the accused products. The evidence establishes that valve float occurs from use of the exhaust brake alone. Jacobs' counsel stated, and Mr. Meneely agreed, that to prove infringement, Pacbrake would have to show that a Jacobs engine brake optimized to perform alone - with a relatively early compression release event – in combination would not cause valve float, whereas a Jacobs brake with a delayed compression release event in combination would float a valve. Pacbrake has not made such a showing. As Pacbrake has failed to sustain its burden of proof on this issue, Jacobs cannot be held liable for infringing these claims.

In addition to claiming direct infringement under 35 U.S.C. § 271(a), Pacbrake has claimed active inducement of infringement under 35 U.S.C. § 271(f)(1), and contributory infringement under 35 U.S.C. § 271(f)(2). Active inducement claims and contributory infringement claims both require an underlying act of direct infringement. Aro Mfg. v. Convertible Top Replacement Co., 365 U.S. 336, 341 (1961); Fargo Elecs., Inc. v. Iris, Ltd., Inc., 287 Fed. Appx. 96, 102 (Fed. Cir. 2008). Because Pacbrake has produced insufficient evidence of any underlying act of direct infringement, Jacobs is liable for neither active inducement of infringement nor contributory infringement.

III. SUMMARY

To summarize, I conclude that claims 1, 3, 5, 6, 7, 8, 11, 12

and 13 of the '289 patent are invalid as obvious. I reach this conclusion because the patent claims a combination brake that causes valve float on intake, and it would have been obvious to a person ordinarily skilled in the art how to achieve valve float – in the late 1980s, people ordinarily skilled in the art were more concerned with constraining valve float.

I conclude that claims 2, 4, 9, 10 and 14 are valid but not infringed. I reach this conclusion because the prior art does not show delayed compression release causing valve float; therefore, these claims are not obvious. But Pacbrake has not shown that delayed compression release causes valve float in the accused products; therefore, the claims are not infringed.

Though I rule in favor of Jacobs, it is far from clear that Mr. Meneely's invention was obvious. The '289 patent discloses a combination brake that effects supercharging through radical delay of the engine brake's compression release event. An engine brake's compression release event must occur early enough to allow the gas to escape and keep push tube load at a safe level. In a combination brake, the air is hotter and therefore escapes more quickly, and the pressure in the exhaust valve manifold is greater, so less push tube load is required to open the exhaust valve on compression. Mr. Meneely noticed the latter point when he experimented with his combination brake, and realized he might be able to retard the lash significantly more than he could on an

engine brake acting alone. By drastically delaying the compression release event, he achieved impressive braking horsepower.

Evidence presented at trial indicates that Jacobs capitalized on the information disclosed in the '289 patent to create brakes for use in combinations with delayed compression release events. Mr. Meneely's invention, then, contributed to the advancement of the engine retardation industry. Had the '289 patent claimed a significant delay in the lash setting relative to an engine brake optimized to perform alone, or had the patent claimed supercharging, it might be both valid and infringed. However, my analysis is limited to the claims of the '289 patent. Given the language of the claims and the evidence presented at trial, I find in favor of Jacobs.

IV. CONCLUSION

The Clerk will enter judgment in favor of the plaintiff declaring that claims 1, 3, 5, 6, 7, 8, 11, 12 and 13 of the '289 patent are invalid, and that claims 2, 4, 9, 10, 14 of the patent are valid but not infringed. The Clerk will also enter judgment in favor of the counterclaim defendants dismissing the counterclaims.

So ordered this 9th day of December 2011.

_____/s/ RNC_____
Robert N. Chatigny
United States District Judge