# INVENTIONEERING®

Improving life and productivity with NEW PRODUCT & INVENTIONS
Design Development & Prototype

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## BREAKTHROUGH SUSPENSION TECHNOLOGY ANNOUNCED BY INVENTIONEERING

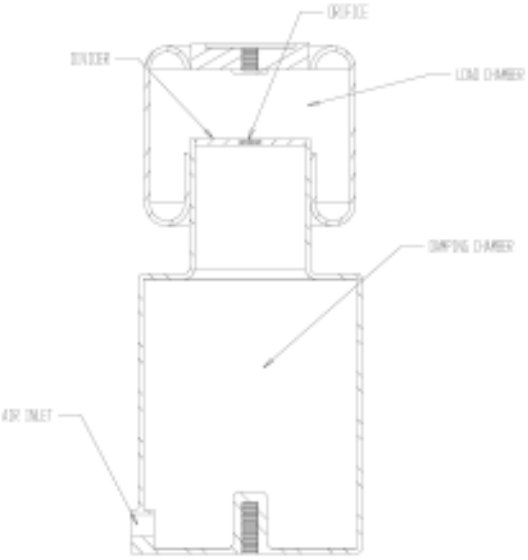
The self-damped air spring is breakthrough technology as described in patent #4,871,189. It is a basic patent in the field with far-reaching applications. It takes advantage of natural forces that occur in the air spring to damp the free vibrations of a suspension system. It makes the hydraulic shock absorber obsolete, as the self-damped air spring will always out perform a spring and hydraulic shock absorber combination.

self-damped air spring used in a seat suspension

Air damping comes about because of natural forces that are generated within the spring which are out of phase with the vibrations of the spring. The forces resist movement of the spring and thus damp its motion. These natural forces are always the most appropriate damping required at any given time.

Air damping is achieved by having a variable volume of pressurized air. (This would be called the "spring chamber.") A fixed volume "damping chamber" is

connected to the air spring chamber through an orifice. For the purpose of analysis, this system can be considered to have two natural frequencies, one arrived at by considering the orifice as being closed and the second by considering the orifice to be fully open. The latter would be the natural frequency of the system operating with a low frequency input or small deflections. The former would be the natural frequency of the system operating at high frequency inputs or large displacements. There is a region between the two calculated natural frequencies where the system operates at some intermediate frequency between the two.




This is a sketch of the self-damped air spring that could be used for a seat suspension.

In operation what actually happens is that the spring rate of the system is constantly changing in response to the forcing function. This means that if you were to calculate the natural frequency at any given time, it would be different from the spring rate a moment before or a moment after. Thus the system is constantly adjusting its response to deal with exterior forces. Ironically, this is what computer controlled suspensions attempt to deliver in a very complex and

expensive way. The self-damped air spring achieves simply and naturally what computer suspension engineers have been trying to achieve through complexity.

This type of air damped system is superior to other types of damping in several ways. First, when properly designed, it is practically impossible to bottom or top out. Secondly, you get a better ride.

Let's compare the air damped system with the hydraulic shock absorber. The hydraulic shock absorber does the wrong thing at least half of the time. In a vehicle suspension, when the wheel encounters a bump, its reaction is to rise up over the bump. This causes the spring to compress and store energy, but at the same time, the shock absorber resists this movement. This actually results in transmitting some of the movement of the wheel to the body, causing additional movement which must then be damped by the suspension.

In an air damped system, the initial reaction allows the wheel to rise up over the body without any resistance coming from the damper. If the travel of the wheel is extensive, the spring rate of the self damped air spring will increase and thus limit travel.

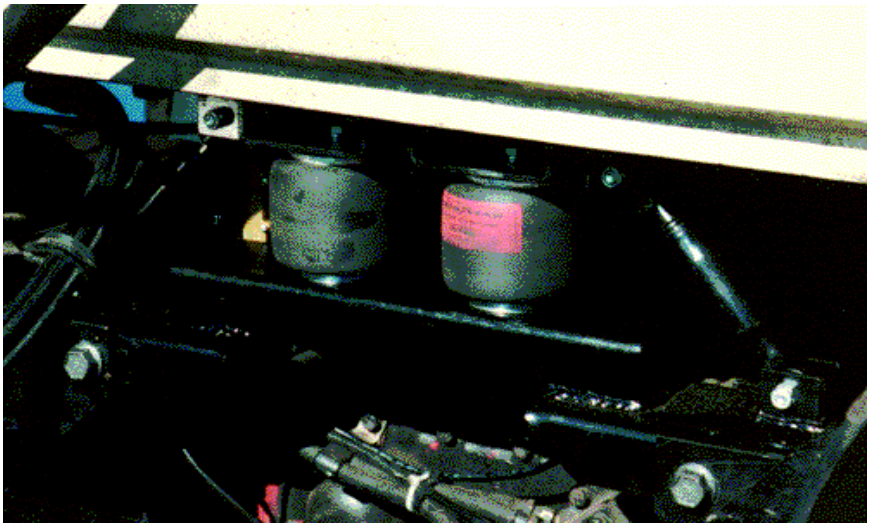
In the past, many types of air damping strategies have been tried and some are still being used. One example uses air in a device that is similar to a shock absorber, forcing the air through an orifice from one chamber to another. This has limited effectiveness. Air is

compressible, therefore, not all of the volume transfers through the orifice. This is most exaggerated with large displacements — just when most damping is needed. In air damping it is a truism that the simplest approach is most effective.

We have made using the simplest approach foolproof by developing a computer program that handles the mathematics required to size all parameters involved in achieving air damping. The result is a truly state of the art self-damped air spring that will improve any application.

## FIRST DEVELOPED FOR CAB SUSPENSIONS

The self-damped air spring was first developed by Charles Van Breemen for truck cab suspensions. He



Glide ride cab suspension utilised the self-damped air spring but did not benifit from a computer program to size critical componets

wasn't satisfied with the performance of conventional methods, so he turned to air damping. In those days, without the aid of a computer to determine the correct size for optimum performance, it was a hit or miss proposition. Performance is very sensitive to certain parameters such as orifice size. It is nearly impossible to determine the optimum size empirically as was done in the early days. In order to solve this problem, we developed a computer program which determines the correct size for all of the important parameters. This program demonstrated that it is possible to achieve damping ratios as high as 40 percent of critical damping. Although the original cab suspensions were built with shock absorbers, with the aid of this computer program, it is possible to build a self-damped air spring suspension with no hydraulic shock absorber.

## SEAT SUSPENSIONS

Truck seat suspensions have had to deal with a large range of driver weights. This makes the design a compromise that results in "bottoming out" for heavyweight drivers and "topping out" for lightweight drivers. This has lead some heavier drivers to buy expensive computer controlled shock absorbers in order to prevent bottoming. The self-damped air spring is an ideal solution, because it adapts to the driver

Truck seat suspensions like this on could benifit from the self-damped aisr spring technology

weight and is almost impossible to bottom or top out when properly designed. Several examples of the system are currently being tested in truck seat suspensions.

## BUS AND RV PRIMARY SUSPENSIONS

Bus and RV primary suspensions are an ideal application for the self-damped air spring. A soft ride is of primary importance in these suspensions. Soft ride suspensions, however, carry with them instability in roll that must be counteracted by stiff shock absorbers and sway bars. Both of these "cures" lessen ride quality. Also, soft suspensions require a large sway space in order to accomodate the travel necessary to get the soft ride. With the self-damped air spring, shock absorbers are no longer needed. Travel and thus, sway space is reduced. Since the damping effect of the self-damped air spring is travel sensitive, the harsh impacts that cause long travel in the normal suspension are snubbed by the air damping effect.

RV's need self-damped technology for better ride and stability

# TRUCK AND TRAILER SUSPENSIONS

The trend toward air suspensions in trucks has brought with it the need for additional stabilizing elements in suspensions. The self-damped air spring, because of its inherent stability and travel sensitive damping reduces the need for other stabilizing elements, such as sway bars, as well as shock absorbers.

An important factor in the cost of truck suspensions is the life cycle cost. The self-damped air spring reduces cost, because it eliminates the need for shock absorbers. Shock absorbers are a high maintenance item on the truck, so eliminating them reduces even more the life cycle cost of the truck.

Heat generation in large air springs is not a problem, since damping is the result of the system adjusting spring rate to control travel. This is different from hydraulic shock absorbers that damp by converting energy into heat.

## TRAILER HITCH SUSPENSIONS

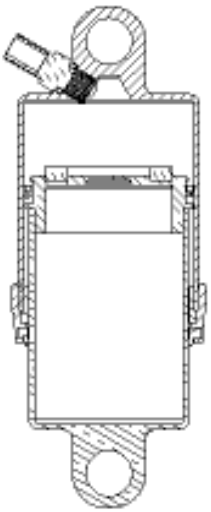
Several companies have recently introduced trailer hitch suspensions for lighter duty trucks and trailers (class 2 through 5). These hitches are available for both fifth wheel and conventional ball hitches. Here again, the self-damped air spring is ideal for this

Air suspension reciever hitch

application, because it eliminates the need for shock absorbers and gives better performance. Space is especially tight in the receiver hitch version of this suspension, and elimination of the shock absorber makes for a more compact suspension.

## BICYCLE & MOTOR CYCLE SUSPENSIONS

The self-damped air spring is ideally suited for bicycle suspensions, not only for the reason stated above, but also because it's lightweight and environmentally sound. Since it uses no oil, there is no oil leakage. Perhaps that is why many fork manufacturers offer air damping. The effectiveness of their product is limited, however, because they do not use the simple approach taught in patent #4,871,189.



Bicycle rear shoct with self-damping feature.

This technology works well for both front fork and rear suspension applications. It will result in a reduction of manufacturing costs: no oil, no piston with complicated valving. An air spring chamber, a damping chamber and an orifice is all that is required.

## LICENSES AVAILABLE

We are looking for companies that want to bring this exciting new technology to their customers. Please contact us at:

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## INVENTIONEERING

INVENTIONEERING was formed to help companies, like yours, develop and bring to market the new products they need for continued growth and prosperity. We are experts at new product development. Our business is turning ideas into new products for your business.

## NEW PRODUCT STRATEGY

At INVENTIONEERING we work with the client to develop a workable new product strategy which emphasizes the client's marketing and manufacturing skills and is within the client's financial limits.

**What We Can Do For You:**

- Original product concept including performance, cost and time parameters.
- Engineering and design.
- Prototype construction and testing.
- Pilot production and manufacturing processes.

**Capabilities and Specialities**

- **Inventing** – new product creation
- Computer analysis
- Computer controlled systems and suspensions
- Seat suspensions
- Passive suspensions of all types
- Electronic design
- Cadkey Solids modeling

## OUR GUARANTEE TO YOU:

We will give you an estimate of total project cost with milestones before accepting any project.

We will honor and assure confidentiality of your ideas, and recognize ownership of any patents and trade secrets involved.

We will inform you honestly of the feasibility of any product idea from an engineering, technological and marketing standpoint. By the same token, we will not accept a project we feel will not be successful. In such a case, we may be able to suggest an alternative product or technology.

## HOW TO WORK WITH A CONSULTANT

By using a consultant, it is possible to increase the effectiveness of your resources and speed up the process of bringing new products to market without building a large, unwieldy organization. A consultant can help you get a good product in a short time. We have worked out some guidelines that will help insure that you are happy with the results.

1) Have a clearly defined goal – product – deliverable.

2) Identify easily measured and verified targets or milestones so that progress can be monitored. This avoids ending up at the end of your budget or time period with no product and gives an indicator that trouble is brewing well before it can cause problems.

3) Frequent and open communication should be maintained between consultant and company. This is best accomplished by having one person in the company responsible for the project and for communicating with the consultant. They should feel free to contact each other about anything at any time.

4) Treat the company consultant relationship as a partnership. After all, you will be working together to create the new product.

# CHARLES VAN BREEMEN
# FOUNDER

Mr. Van Breemen received his BSME from the University of Portland, Portland, Oregon in 1977 and has worked in the field of new product development since that time. He's a successful inventor, entrepreneur and has been chief engineer, project engineer, and research engineer for various companies in aerospace, industrial and consumer environments.

He has extensive experience in taking a product from inception to market and has been responsible for million dollar budgets.

He has created new products and market opportunities for: Freightliner Corporation, Sears Manufacturing, Barry Controls, Gabriel Ride Control, H.O. Bostrom Company, Bostrom Seating, Inc. Hendrickson Truck Suspension Company and Vancom, Inc.

He is the inventor or co-inventor of six patents, five of them in the area of suspensions.

In manufacturing, he reduced the reject rate on Gabriel Ride Control assembly line for Ford Windstar struts from 76% to 37% in 3 days; to 4% in 3 weeks.

He is the president of the Tampa Bay Inventors Council and is active in helping other inventors be successful.

Mr. Van Breemen personally oversees all development projects.

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