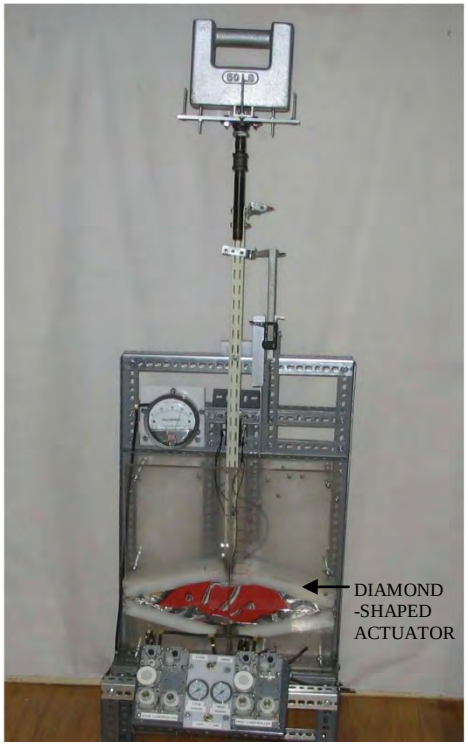
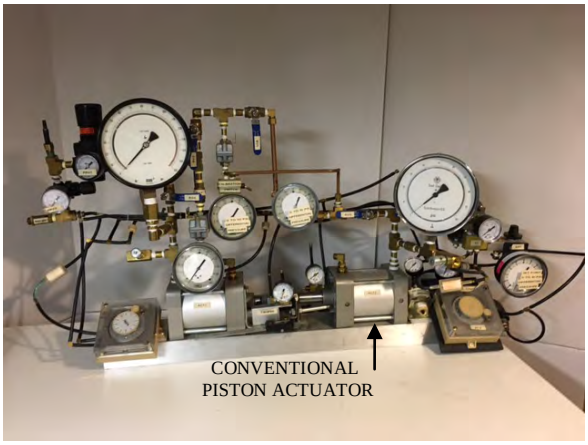
A NEWLY IDENTIFIED HYDRAULIC **MECHANICAL ADVANTAGE** EXTENDS OUR UNDERSTANDING OF THE FLUIDIC EQUATION **W** = **P**Δ**V** (**W**ORK = **P**RESSURE x **V**OLUME CHANGE), ALLOWING A MACHINE'S OPERATION TO ESTABLISH $W_{out} > W_{in}$

IMAGE 1



TEST MODEL PROVING THE **15%+ MECHANICAL ADVANTAGE** OF DIAMOND-SHAPED ACTUATORS OVER CONVENTIONAL PISTON ACTUATORS

IMAGE 2



TEST MODEL PROVING **< 4% MECHANICAL ADVANTAGE** IS REQUIRED FOR AN ACTUATOR TO PUMP PRESSURIZED FLUID FROM A CONVENTIONAL PISTON ACTUATOR.

CONTENTS

PREFACE

- The focus of this report is to present an explanation of a newly identified **mechanical advantage** in hydraulic applications. With this **mechanical advantage** applied, we are able to assist in facing one of our planets greatest threats; Climate Change.

  Quote from Donald Gorber Ph. D., P. Eng.

  " I believe that Mr. Strain's invention will advance the scientific community's understanding of thermodynamics relating to pressurized fluids and energy to a new level. If fully developed the invention has the potential to reduce energy and as a result a reduction in the use of fossil fuels, thus assisting in the battle against climate change."

  Three peer review letters are presented on pages one to seven from Scientists/Engineers who tested the actual models, concluding that the Diamond-Shaped Actuator has >15% more **mechanical advantage** over conventional hydraulic piston actuators. Apparatus used is presented in photo (IMAGE 1).

- The current scientific understanding of the working capability of pressurized liquids accepts the hydraulic formula **W**ork = **P**ressure X **V**olume change (**W**=**P**Δ**V**) in designing conventional hydraulic piston systems.

- The newly identified fluid-driven **mechanical advantage**, presented in an altered hydraulic actuator design, requires an extended assessment of the formula (**W**=**P**Δ**V**).

- This report illustrates a method where a lesser volume of fluid at a lower pressure generates a larger volume of fluid at a higher pressure.

- Applying the formula W = PΔV to both the larger volume of fluid ($Work_{out}$), at a higher pressure, and the lesser volume of fluid ($Work_{in}$), at a lower pressure, concludes with $Work_{out} > Work_{in}$.

- The formula W=PΔV does not apply to the Diamond-Shaped Actuator.

- The designed control circuit and photo (image 3) are presented of the actual apparatus that proves < 4% **mechanical advantage** of the Diamond-Shaped Actuator enables it to produce its full volume of hydraulic fluid by pumping the fluid from a conventional piston actuator.

- The remaining **mechanical advantage** is +15% - 4% = +11%, which produces $W_{out} > W_{in}$, concluding with +11% surplus work potential in each cycle of a reciprocating machine.

- Page 14 of the report linked in the summary illustrates a practical comparison of the Diamond-Shaped Actuator's **mechanical advantage** over a conventional piston's performance.

- Pages 15 to 18 of the report linked in the summary present a reciprocating machine design in its three modes of operation and a performance graph.

- More reports, You Tube videos and links to the patent files can be viewed via our website site at: http://www.apscontrols.ca

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9 March 2007

TO WHOM IT MAY CONCERN

Mr. David Strain requested that I provide a letter of support relating to his invention currently patented in the USA and Europe. (The Canadian patent is pending.) He also requested that I state my credentials allowing the reader some assessment of my opinion.

I am Donald M. Gorber, Ph.D., P.Eng., current and founding President of SENES Consultants Limited established in Ontario in 1980. I hold a doctorate degree in Chemical Engineering and have more than thirty-five years experience in the energy and environmental field.

Mr. Strain made a presentation to SENES to discuss his invention. This presentation involved myself and our senior energy scientist/engineer, Dr Mehran Monabbati and provided us with a clear understanding of the principles relating to the invention.

The fundamental basis of the invention is the efficiency differential when comparing a conventional hydraulic actuator to the new diamond-shaped actuator. The efficiency advantage of the new actuator was clearly demonstrated during his presentation. Dr. Monabbati, who holds a doctorate degree in Chemical Engineering, tested the actual model, at both Mr. Strain's location and at SENES, reviewed certifications for the test equipment, and was able to confirm Mr. Strain's claims.

The tests indicated an efficiency advantage of approximately 17% over conventional actuators.

The work done through the stroke of the diamond-shaped actuator can push back a conventional cylindrical actuator. The displacement volume of conventional actuator is slightly greater than that volume of fluid required by the diamond-shaped actuator to accomplish the work. This indicates that the diamond-shaped actuator requires less volume of hydraulic fluid to accomplish the work compared to that of the conventional actuator (at the same pressure).

It should be mentioned that in an old 1874 USA patent (No. 147,519), Mr. Terrance Reilley demonstrated the same efficiency advantage. However, specific knowledge and recent technological advancement in mechanical equipment and instrumentation were required to achieve the results of Mr. Strain's invention.

I believe that Mr. Strain's invention will advance the scientific community's understanding of thermodynamics relating to pressurized fluids and energy to a new level. If fully developed the invention has the potential to reduce energy and as a result a reduction in the use of fossil fuels, thus assisting in the battle against climate change.

Yours very truly,

SENES Consultants Limited

Donald M. Gorber, Ph.D., P.Eng.
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April 26, 2007

To Whom It May Concern:

My name is Rajendra K. Singh, a doctoral graduate of Kansas State University.
I am actively engaged as a consulting scientist at R& D division of Intellimeter Canada Inc.
I have 30+ years of experience with multi-national companies in Canada in the area of engineering, product development, and ITU standards.

I am writing this letter of support, regarding an invention developed by
Mr. David Strain, who has patents granted in Europe, the USA and Canada.
Mr. Strain has a document from Mr. Ed Komadowski, SIEMENS Building Technologies, which confirms the performance of his control circuitry.

Mr. Strain brought a model to our facility and demonstrated the efficiency advantage of the diamond-shaped actuator. The load was measured with certified scales. The objective was to develop a perpetual machine.

During the demonstration, the internal pressure was raised to 65" WG lifting the load and then dropped to 54" WG causing the load to fall. During the fall, the pressure was switched to 60" WG. The diamond-shaped actuator stopped the fall of the fifty-nine and three-quarter pound load and lifted it upward with 60" WG pressure. A conventional cylindrical actuator holding the same elevation with identical fluid volume requires a pressure of 69.013" WG, just holding equilibrium.
This demonstrated an efficiency advantage greater than 15% favoring the diamond-shaped actuator over a conventional actuator. The force/travel relationship is non-linear; therefore, readings vary depending on the percentage of stroke achieved when readings are taken.

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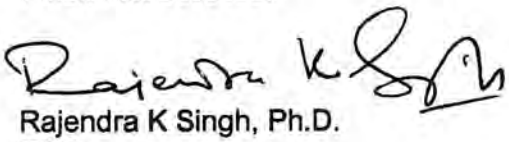
At the time of testing there was an air leak in the diaphragm of the diamond-shaped actuator. Correcting the leak could have improved the performance of the diamond-shaped actuator. Because of the high cost of manufacturing a proper diaphragm, the experiment could not be continued.

I wish him success.



Rajendra K Singh, Ph.D.
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Mr Dave Strain,
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Dear Mr Strain:

Re: DIAMOND-SHAPED FLUID POWER LINKAGE

On November 18, 2001 I visited your laboratory to observe the operation of your DIAMOND-SHAPED FLUID POWER LINKAGE, perform the collection of data with my TOUR & ANDERSSON calibrated electronic manometer, and discuss some questions you presented.

(8) What force is required to move the linkage **without** the walls of the diamond shaped piston?

- Four lb. and ten oz. was recorded on the certified digital scale to overcome the inertia.

(9) What force is required to move the linkage **and** the walls of the diamond shaped piston?

- Nine lb. and twelve oz. was recorded on the certified digital scale to overcome the inertia. The linkage and walls dropped when the force was reduced to 6 lb. on the digital scale.

(10) What is the total load for the face of the fluid in the diamond shaped piston model to lift considering the walls, linkage, and the 50 lb. weight?

Fifty lb. plus nine lb. and twelve oz. = 59.75 lb.

(1) What is the lowest pressure in the diamond shaped actuator that causes an upward lifting motion?

- I observed the threshold of upper motion to occur at 60" w.g. on the water column.

(7) What is the travel to the equilibrium point at 60" w.g. from completely collapsed?

- The short diameter of the rhombus measured about 1". see note for question 6.

(2) Does the electronic certified equipment agree with the 0-5# certified gauge?
(3) Does the electronic certified equipment agree with the water column?

- I used a certified electronic manometer connected in parallel with the 0-5# certified gauge, the water column, and a 0-60" w.g. magnehelic to collect the following data:

- The 0-5# gauge was within ±1.3% and the 0-60" magnehelic, and the water column were both within ±0.7% of the electronic meter. This data shows quite exceptional agreement when considering the decimals of the analogue instruments are interpolated by eye.

	Electronic Meter	0-5# certified gauge	0-60" w.g. magnehelic	water column
	4.823 ft.w.g.	2.09#	58.9 " w.g.	58.33"
	4.753 ft w.g.	2.04#	58.7 " w.g.	57.35"
	4.684 ft. w.g.	2.005#	58.2" w.g.	56.75"
Threshold of motion	4.961 ft.w.g.	2.12#	59.95" w.g.	60.0"
Increase to 61"	5.030 ft.w.g.	2.19#	60.5" w.g.	61.0"

Note: The reading at the electronic meter increased slightly when the air supply pressure was held constant and the valve to the water column was closed, then returned to the previous reading when the valve was opened. We repeated this observation three times with consistent results. We did not investigate the correlation of individual meters or gauges with respect to two or more connected in parallel. There is reason to believe that each device reads a force and thus consumes some small portion of the energy applied. While there is merit in applying three or four devices to establish calibration, the data used for calculations should be collected from a single gauge to negate the effect of the energy consumed by the other devices.

(6) What is the volume of the diamond shaped actuator at the equilibrium point for 60" w.g? Do not allow for the volume of the diaphragm, but qualify that it reduced the fluid volume by some amount.

- The calculated gross area contained by four 9.0" long sides of a rhombus with the short diameter of 1.0" is 8.9861in^2. Thus the volume contained by the rhombus with a depth of 2.625" is 23.589in^3. The diaphragm within the rhombus that contains the force exerted on the walls of the rhombus occupies a considerable portion of the volume. The interior of the clear sides of the test rig are smeared with grease to address the friction of the moving sides of the rhombus. Precise measurement of the length of the interior walls of the rhombus, the short diameter, or the percentage of space occupied by the diaphragm is difficult because of the grease.

Although the force of about 60" w.g. is exerted equally and perpendicular over the entire inside surface of the diaphragm, the force does not appear to be transferred equally over the entire interior surface of the rhombus because of the wrinkles in the diaphragm and spaces.

(5) What is the travel to the equilibrium point at 62" w.g. from completely collapsed?

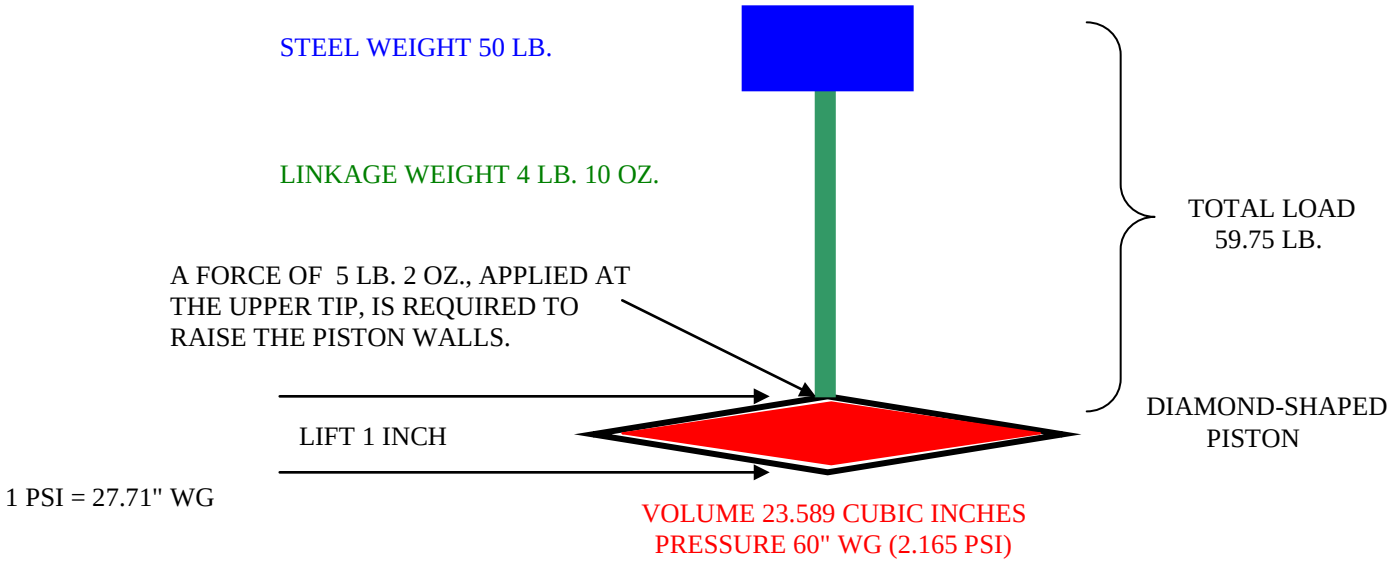
- The short diameter of the rhombus increased by 0.0858" from about 1" at 60" w.g.

(4) What is the volume of the diamond shaped actuator at the equilibrium point for 62" w.g? Do not allow for the volume of the diaphragm, but qualify that it reduced the fluid volume by some amount.

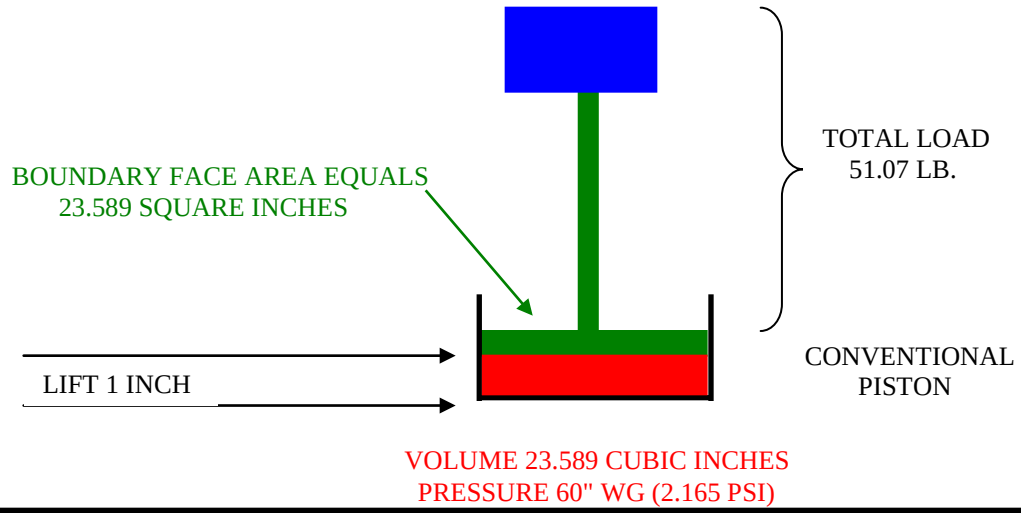
- When the air pressure exerted upon the diaphragm was increased from 60" w.g. to 62" w.g. the short diameter increased by 2.18mm (0.0858in).(Lifted the weight 0.0858). Using the previous data as a base, the new volume increases to 25.605in^3 a difference of 2.016in^3

MECHANICAL ADVANTAGE OF THE NEW DIAMOND-SHAPED PISTON RELATIVE TO THE CONVENTIONAL PISTON

This drawing is based on Robert J. Blanchard P.Eng.'s recorded observations, while using certified test equipment.
Note that 23.589 cubic inches of fluid at 60" WG (2.165 PSI) pressure, is at the point of equilibrium, with a 59.75 pound load, at one inch of travel..

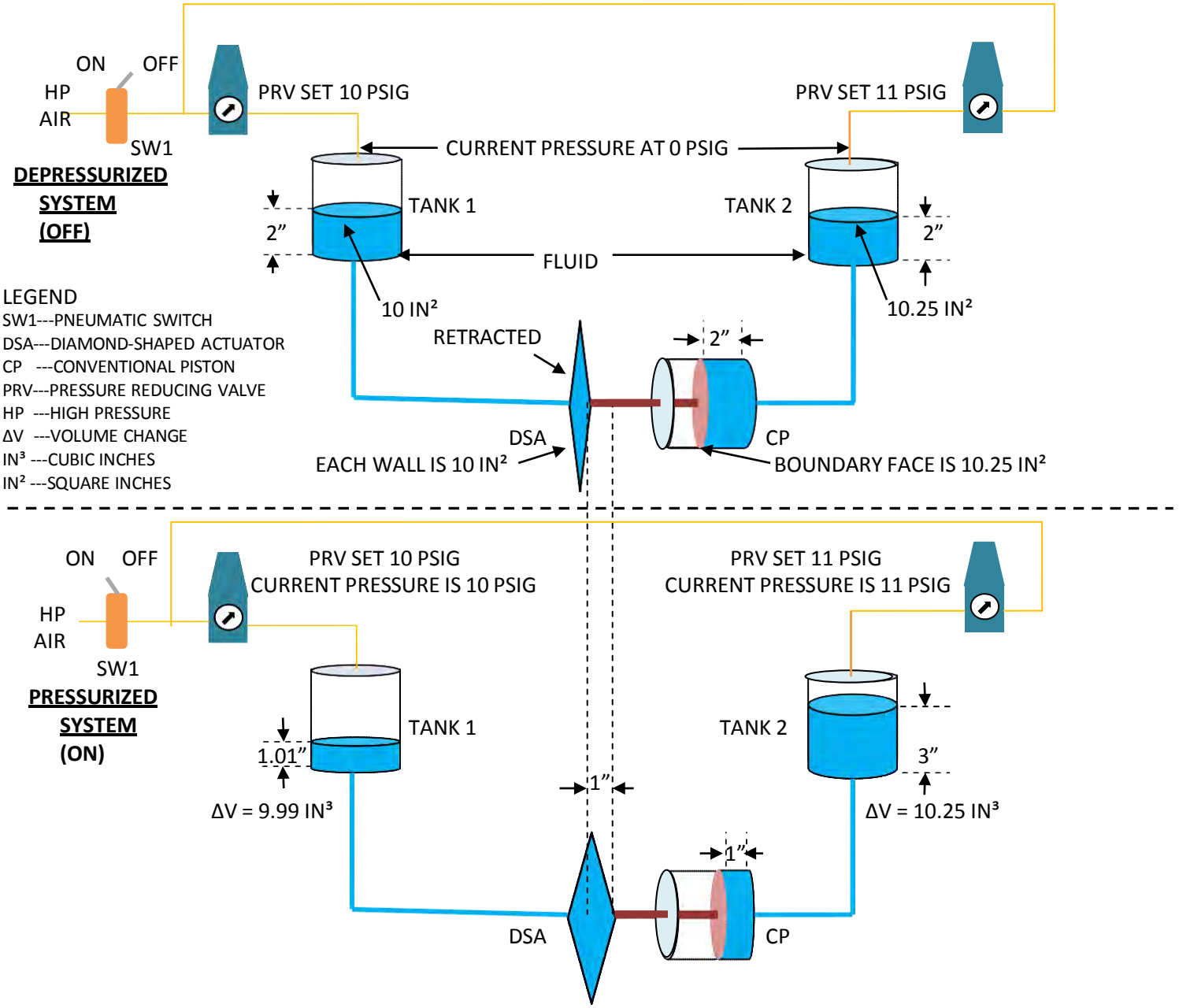


This drawing is based on completely frictionless conventional piston.
Note that 23.589 cubic inches of fluid at 60" WG (2.165 PSI) pressure is at the point of equilibrium with a 51.07 pound load, at one inch of travel.



Note that the diamond-shaped piston lifts 16.9% more load than the conventional piston through one inch of travel with the same volume of fluid, at the same pressure.

$W (P\Delta V)_{out} > W (P\Delta V)_{IN}$



TEST PROCEDURE

Prepare apparatus as per the upper illustration, DEPRESSURIZED SYSTEM (OFF), which disallows pressurization on both the Diamond Shaped Actuator (DSA) and the Conventional Piston (CP).

Turn switch (SW1) on to PRESSURIZED SYSTEM mode, allowing both PRV's to attain their pressure settings. (10 PSIG and 11 PSIG.) Observe the volume changes in TANKS 1 and 2.

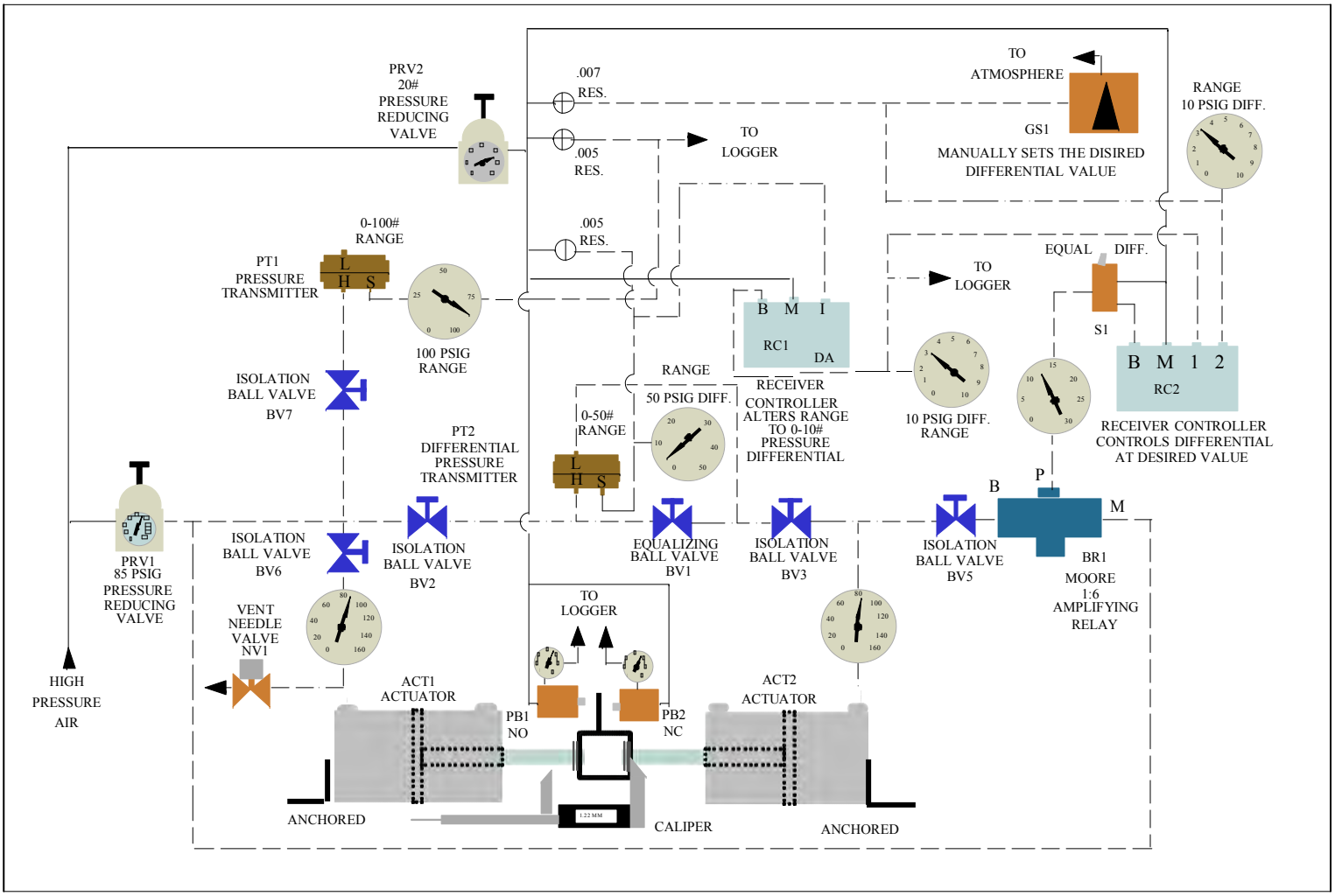
The minimum mechanical advantage of a DSA over a CP, reported by testing scientists is 15%. Please see the scientists' letters on pages one to seven. letters. The DSA, with 10 IN^2 walls and 10 PSIG pressure exerts a minimum force of 115 lb. The CP, with a 10.25 IN^2 boundary face and 11 PSIG pressure exerts a force of 112.75 lb. The DSA overpowers the CP (115 lb > 112.75 lb), forcing fluid from the CP.
The volume change (ΔV) in the DSA is 9.99 IN^3; therefore, ΔV in TANK 1 is 9.99 IN^3.
The volume change in CP is 10.25 IN^3; therefore, TANK 2 ΔV is 10.25 IN^3

Using the fluidic formula Work = Pressure x Volume Change (W = PΔV)
TANK 1's work input potential..... W = PΔV = 10.0 PSIG X 9.99 IN^3 = 99.90 in-lb
TANK 2'S work output potential..... W = PΔV = 11.0 PSIG X 10.25 IN^3 = 112.75 in-lb

CONCLUSION: Lesser work input can produce greater work output ($W_{out} > W_{in}$).

TEST APPARATUS PROVING THAT IF ACTUATOR ONE (ACT1) HAS MORE THAN **4%** MECHANICAL ADVANTAGE OVER ACTUATOR TWO (ACT2), ACT1 CAN PUMP ITS TOTAL FLUID REQUIREMENT FROM ACT2. SCIENTISTS TESTING THE MODELS CONCLUDE THAT THE DIAMOND-SHAPED ACTUATOR (IN ACT1'S PLACE) HAS A MECHANICAL ADVANTAGE OVER CONVENTIONAL PISTONS EXCEEDING **15%**

CONTROL CIRCUIT



PHYSICAL MODEL OF TEST APPARATUS IMAGE 3

SUMMARY

- The formula W = PΔV applies the conventional hydraulic piston.

- The formula W ≠ PΔV applies to the Diamond-Shaped Actuator.

- Scientists who tested the actual physical models confirm the mechanical advantage of the Diamond-Shaped actuator at +15% over the conventional piston.

- The mechanical advantage of < 4% produces a work advantage in favour of the Diamond-Shaped Actuator allowing it to overpower a conventional piston with identical volume changes.

- The Diamond-shaped Actuator generates its total fluid requirement by pumping the fluid from a conventional piston with > 11% mechanical advantage remaining. (+15% - 4% ≥ 11%)

- A reciprocating machine can be produced which produces enough work to run itself and deliver surplus work externally, suiting other requirements.

- The machine will only stop if commanded to do so by blocking fluid flow, depressurization or mechanical failure.

- A control circuit is presented on pages 15 to 18 and page 14 illustrates the mechanical advantage of the Diamond-Shaped Actuator in the report via the link below.

  https://static1.squarespace.com/static/5ee6829b4abd4867f862c3ca/t/61e6fbeb6df0663fb5f465e8/1642527723607/PATENTS%2C+DEVELOPMENT+AND+HISTORY.pdf

- Please send questions or comments.

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