TEST RESULTS

REGARDING

EFFICIENCY DIFFERENTIAL

COMPARING

CYLINDRICAL ACTUATORS

TO

DIAMOND-SHAPED ACTUATORS

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REPORT PURPOSE

This report's focus is the fundamental science regarding an invention patented in Europe, Canada and the USA.

The concept under consideration is when a diamond-shaped actuator and a conventional cylindrical shaped actuator oppose one another, with a common fluid source, there are two results observed:

(1) The diamond-shaped actuator displaces a volume of fluid from the cylindrical actuator. The displaced volume is greater than the volume added to the diamond-shaped actuator.

(2) The diamond-shaped actuator maintains >11% work potential, in each stroke, after attaining its own source of fluid from the cylindrical actuator.

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Note that the differential in the model illustrated on page four is required to over-come the inertia of two cylindrical actuators. The >15% advantage witnessed by scientist/engineers was based on the diamond-shaped actuator causing motion; therefore, had over-come its inertia and the differential is required to over-come the inertia of only one cylindrical actuator.

SURPLUS WORK DEMONSTRATION MODEL

TWO TYPES OF ACTUATORS

The diamond-shaped actuator shown in FIGURE 2 has been tested by several scientist/engineers, all observing an efficiency advantage >15% over the cylindrical actuator shown in FIGURE 1. (Pages six to twelve contain scientific observations.)

The advantage is gained via the pressure applied on the four moving walls of the diamond-shaped actuator compared to the single moving boundary face of the cylindrical actuator. The diamond-shaped actuator uses slightly less fluid, at the same pressure, as the comparable cylindrical actuator, accomplishing >15% more work.

FIGURE 1
CYLINDRICAL ACTUATOR

FIGURE 2
DIAMOND-SHAPED ACTUATOR

POWER RELATIONSHIP OF OPPOSING ACTUATORS

FIGURE 3
TWO IDENTICAL AND OPPOSING CYLINDRICAL ACTUATORS

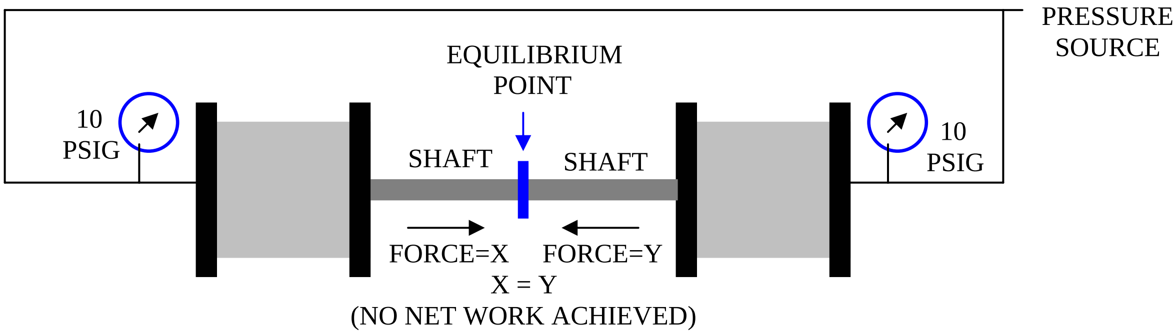


FIGURE 3 illustrates two opposing identical cylindrical actuators.

If both actuators receive fluid at the same pressure, the opposing forces on the two shafts are identical; therefore, they are in a state of equilibrium.

Three different approaches, causing one actuator to exert 15% more force, on its shaft, than an opposing actuator are:

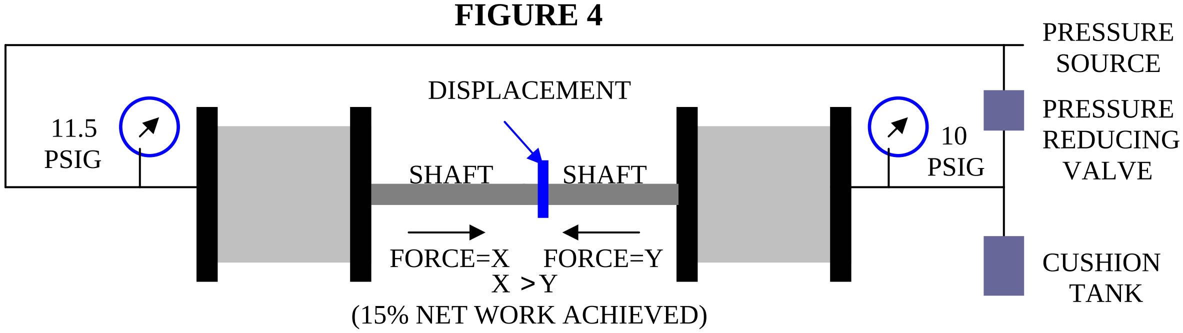
(1) Provide fluid at a 15% greater pressure than the opposing actuator receives. (FIGURE 4)

(2) Replace the actuator with a 15% larger actuator, thus consuming 15% more fluid.

(3) Increase the efficiency of the actuator, over the other, by 15%. This is achieved when replacing one with a diamond-shaped actuator, that is shown in FIGURE 2 and illustrated in FIGURE 5.

FLUID VOLUME RELATIONSHIP OF CYLINDRICAL OPPOSING ACTUATORS

TWO IDENTICAL OPPOSING ACTUATORS
FIGURE 4



If one actuator receives fluid at a higher pressure than the other, the one with the higher pressure develops more force, on its shaft, forcing fluid from the other.
As they are identical actuators, travelling identical distances, the amount of fluid forced from the one actuator is identical in volume to the fluid required by the other.

FLUID VOLUME RELATIONSHIP OF CYLINDRICAL AND DIAMOND-SHAPED OPPOSING ACTUATORS
FIGURE 5

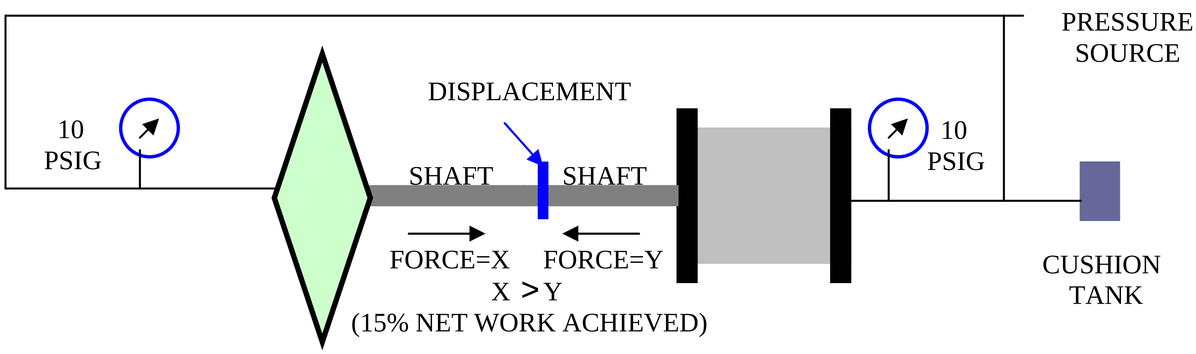


Figure 5 illustrates a diamond-shaped actuator and a cylindrical actuator receiving pressurized fluid at the same pressure with the boundary face of the cylindrical actuator equal in area to each of the four moving walls of the diamond-shaped actuator.

The diamond-shaped actuator is >15% more efficient than the cylindrical actuator, as proven by scientist/engineers; therefore, develops >15% more force than the opposing cylindrical actuator.

If the diamond-shaped actuator's >15% force advantage forces fluid from the cylindrical actuator, the cylindrical actuator's displaced volume is always greater than the fluid volume added to the diamond-shaped actuator.

To this point we have:

(1) The cylindrical actuator and the diamond-shaped actuator, as in FIGURE 5, pressurized from a common source; therefore, at the same pressure.

(2) The diamond-shaped actuator has been tested by scientist/engineers to exert >15% more force than the cylindrical actuator when the boundary face of the cylindrical actuator is equal in area to each of the four moving walls on the diamond-shaped actuator.

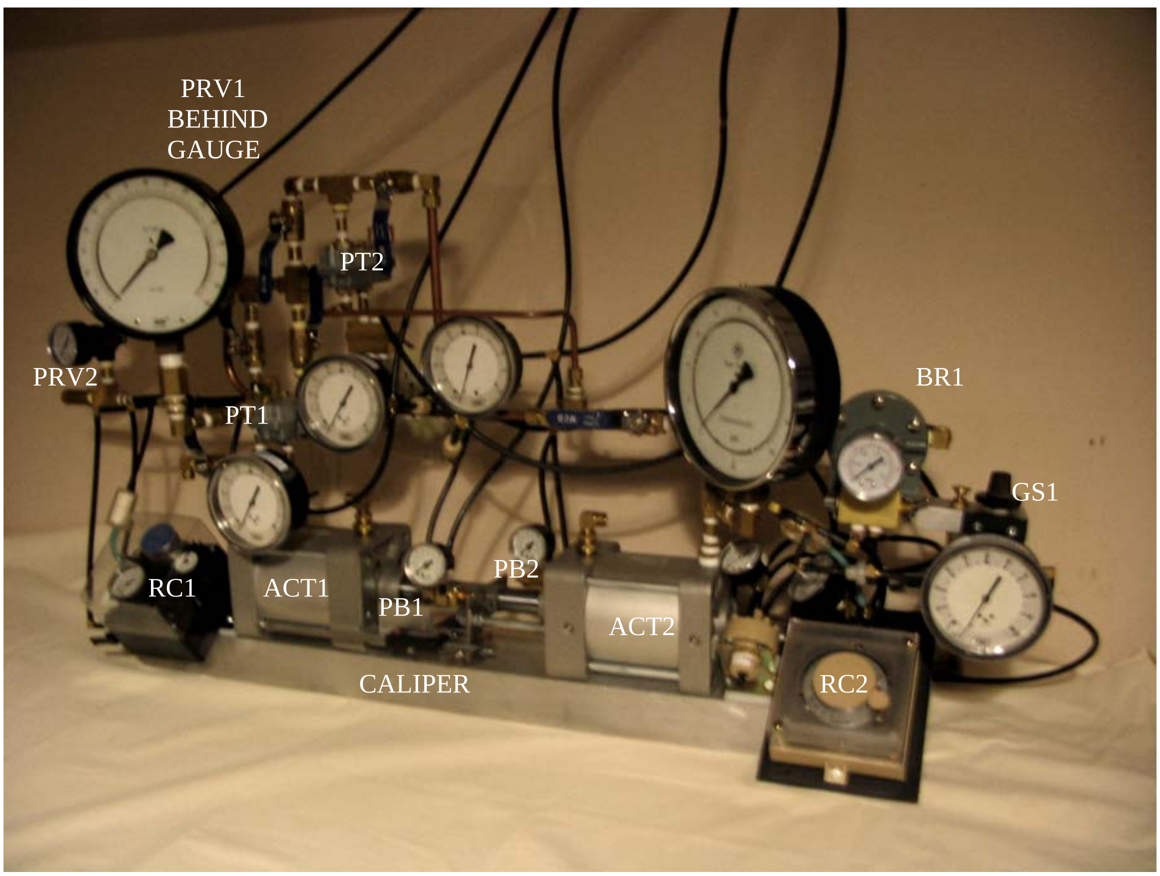
(3) If the diamond-shaped actuator's >15% greater force displaces fluid from the cylindrical actuator, the displaced fluid's volume is more than the volume added to the diamond-shaped actuator.

The question now is: "What is the counter force requirement to displace fluid from a pressurized cylindrical actuator?"

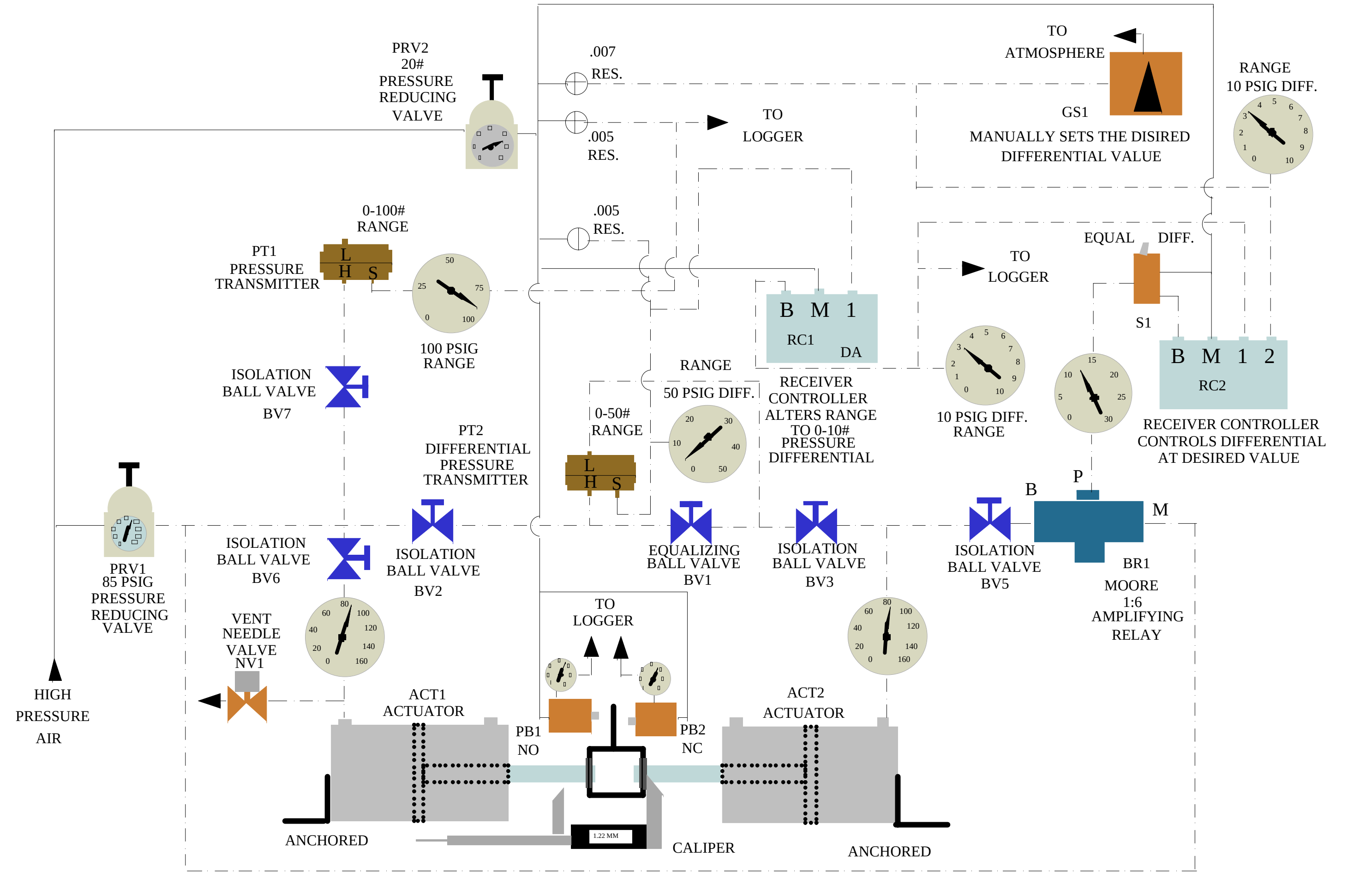
The physical model, presented in the photograph on this page, demonstrates that $<4\%$ greater counter force is required, forcing fluid from a cylindrical actuator. The diamond-shaped actuator develops $>15\%$ greater counter force based on investigations via scientist/engineers.

When the relationship illustrated in FIGURE 5 is employed, with the appropriate control system, the diamond-shaped actuator can produce its own source of pressurized fluid with $>11\%$ power potential remaining in each stroke.

PHYSICAL MODEL USED IN DETERMINING THE FORCE DIFFERENTIAL REQUIRED, DISPLACING FLUID FROM AN ACTUATOR, WHEN OPPOSED BY A MORE POWERFUL ACTUATOR.



The control drawing relating to the system in the above photograph is on page four.



NOTES

-Cylindrical actuators ACT1 and ACT2 are identical.

-The apparatus's purpose is:

-1-Precisely determine the minimum differential pressure required, causing ACT1 to over power ACT2, driving the linkage from push button (PB1) to push button (PB2), forcing fluid from ACT2.

-2-Illustrate the varying rate of achieving the travel from PB1 to PB2 relative to the differential pressure changes for 3 PSIG, 4 PSIG, 5 PSIG and 6 PSIG.

-Pressure transmitter (PT1) measures the main pressure in ACT1 and provides data.

-Differential pressure transmitter (PT2) measures the differential pressure between ACT1 and ACT2 and provides data.

-Receiver controller (RC1) allows a magnified range, displaying only a ten PSIG differential, for more accurate readings in the data collection.

-Receiver controller (RC2) controls the differential pressure to match the desired differential pressure, between ACT1 and ACT2, as set manually via gradual switch (GS1)

TEST PROCEDURE

(1) Manually set PRV1 to 85 PSIG, as the base test pressure, and PRV2 to 20 PSIG serving the control circuit.

(2) Manually set GS1 to demand 0 PSIG differential and manually open BV1.

(3) Manually close BV6 and slowly bleed air to atmosphere via NV1 until PB1 removes its signal from logger.

(4) Manually close NV1 and open BV6; then close BV1; then zero caliper.

(5) Manually set RC2's set point, via GS1, to 3 PSIG differential. At this point, ACT1 pressure = 85 PSIG and ACT2 pressure = 82 PSIG.

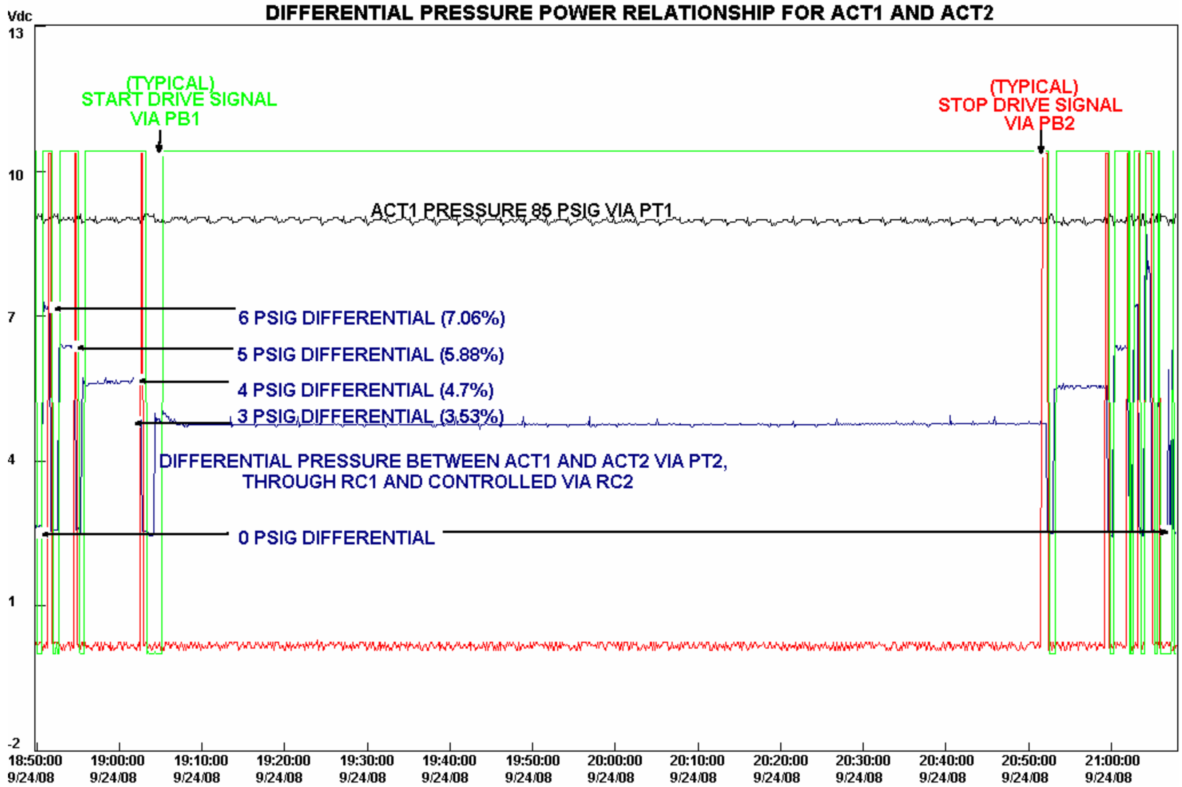
(6) As the linkage moves toward ACT2, PB1 is released, sending its signal to the logger, which alters the graph green line (page 5) from minimum to maximum (drive start). When the linkage pushes PB2, it sends its signal to the logger altering the graph red line from minimum to maximum (drive stop).

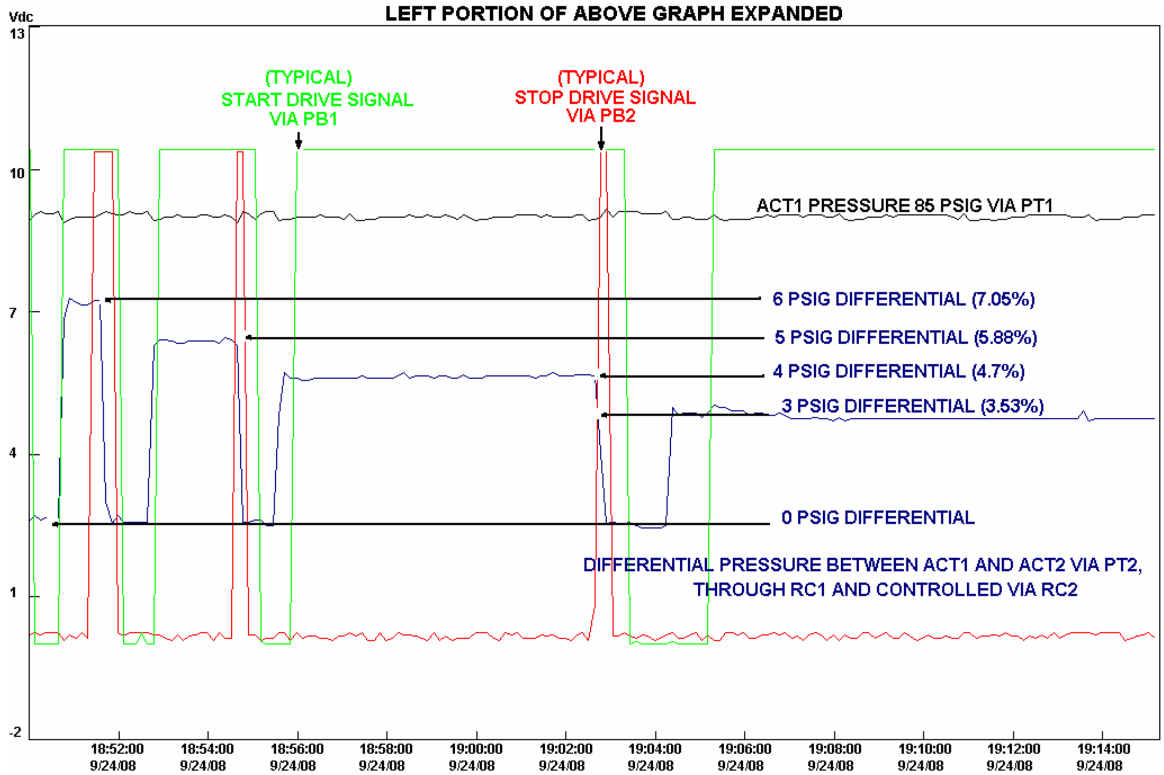
(7) Repeat steps two to five for 4 PSIG, 5 PSIG and 6 PSIG differential.

The two graphs below illustrate that only 3.53% more counter force is required on a cylindrical actuator's shaft to force fluid from that pressurized cylindrical actuator.

The scientist/engineers' testing demonstrates that the diamond-shaped actuator's efficiency advantage over cylindrical actuators is >15%; therefore, produces >15% counter force compared to the opposing cylindrical actuator illustrated in FIGURE 5.

The volume of fluid required by the diamond-shaped actuator is less than the volume of fluid it forces from the cylindrical actuator; therefore, the diamond-shaped actuator can generate its own source of pressurized fluid, while having >11% work potential remaining in each stroke.





Mr Dave Strain,
35 O'Brien Avenue
Stouffville, Ontario,
L4A 1G6

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?

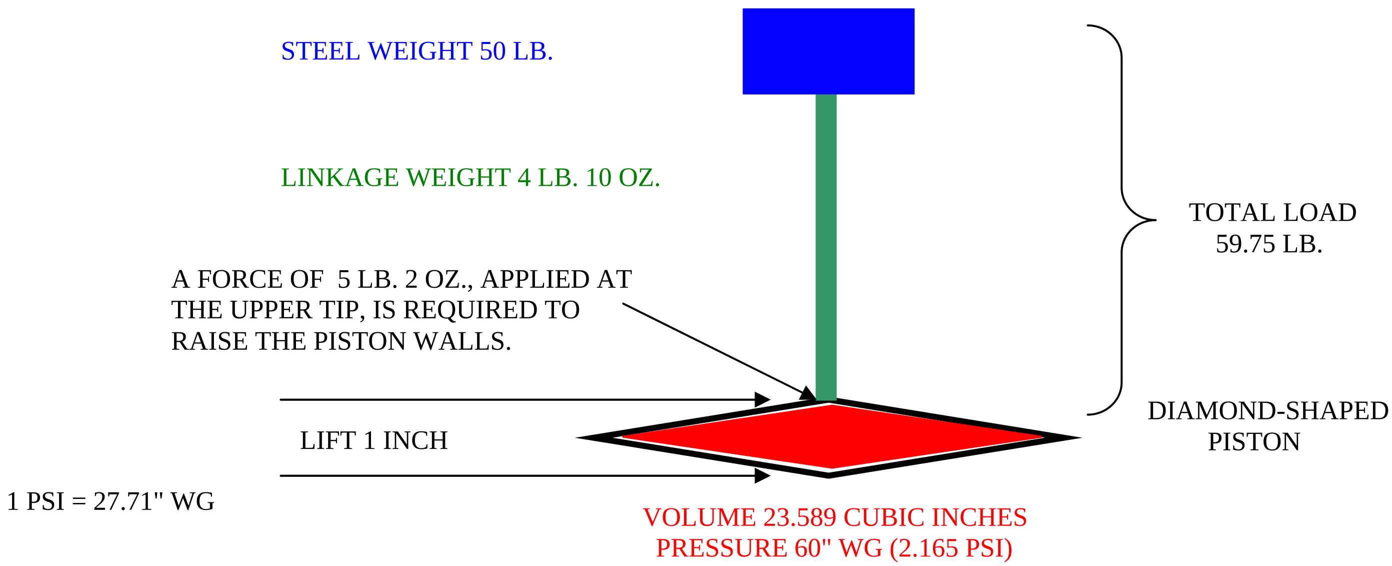
- The short diameter of the rhombus increased by 0.0858" from about 1" at 60" w.g.

(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.

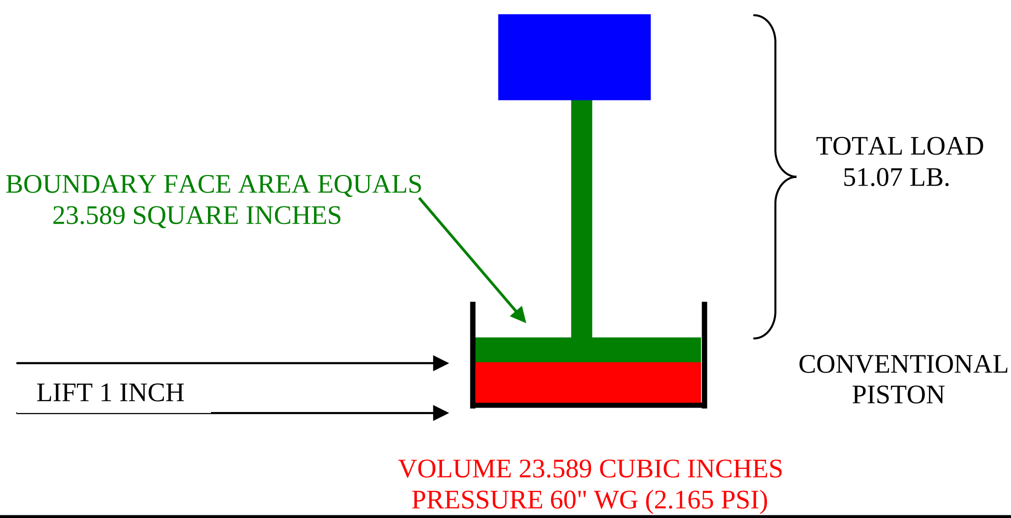
- When the air pressure exerted upon the diaphragm was increased from 60" w.g. to 62" w.g. the short diameter increased by 2.18mm (0.0858in).(Lifted the weight 0.0858). Using the previous data as a base, the new volume increases to 25.605in^3 a difference of 2.016in^3

POWER 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.

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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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90001

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.
President

Europäisches Patentamt | European Patent Office | Office européen des brevets

Urkunde Certificate Certificat

Es wird hiermit bescheinigt, daß für die in der beigefügten Patentschrift beschriebene Erfindung ein europäisches Patent für die in der Patentschrift bezeichneten Vertragsstaaten erteilt worden ist.

It is hereby certified that a European patent has been granted in respect of the invention described in the annexed patent specification for the Contracting States designated in the specification.

Il est certifié qu'un brevet européen a été délivré pour l'invention décrite dans le fascicule de brevet ci-joint, pour les Etats contractants désignés dans le fascicule de brevet.

Europäisches Patent Nr. | **European Patent No.** | **Brevet européen n°**

1240435

Patentinhaber | **Proprietor of the Patent** | **Titulaire du brevet**

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München, den
Munich,
Fait à Munich, le
20.10.04

Alain Pompidou

Präsident des Europäischen Patentamts
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Brevet canadien / Canadian Patent

Le commissaire aux brevets a reçu une demande de délivrance de brevet visant une invention. Ladite requête satisfait aux exigences de la *Loi sur les brevets*. Le titre et la description de l'invention figurent dans le mémoire descriptif, dont une copie fait partie intégrante du présent document.

Le présent brevet confère à son titulaire et à ses représentants légaux, pour une période expirant vingt ans à compter de la date du dépôt de la demande au Canada, le droit, la faculté et le privilège exclusif de fabriquer, construire, exploiter et vendre à d'autres, pour qu'ils l'exploitent, l'objet de l'invention, sauf jugement en l'espèce rendu par un tribunal compétent, et sous réserve du paiement des taxes périodiques.

The Commissioner of Patents has received a petition for the grant of a patent for an invention. The requirements of the *Patent Act* have been complied with. The title and a description of the invention are contained in the specification, a copy of which forms an integral part of this document.

The present patent grants to its owner and to the legal representatives of its owner, for a term which expires twenty years from the filing date of the application in Canada, the exclusive right, privilege and liberty of making, constructing and using the invention and selling it to others to be used, subject to adjudication before any court of competent jurisdiction, and subject to the payment of maintenance fees.

BREVET CANADIEN **2,424,712** CANADIAN PATENT

Date à laquelle le brevet a été accordé et délivré	**2007/11/20**	Date on which the patent was granted and issued
Date du dépôt de la demande	**2000/12/20**	Filing date of the application
Date à laquelle la demande est devenue accessible au public pour consultation	**2001/06/28**	Date on which the application was made available for public inspection

Commissaire aux brevets / Commissioner of Patents

Canada

OPIC CIPO

3256 (CIPO 91) 07-06

The United States of America

The Director of the United States Patent and Trademark Office

Has received an application for a patent for a new and useful invention. The title and description of the invention are enclosed. The requirements of law have been complied with, and it has been determined that a patent on the invention shall be granted under the law.

Therefore, this

United States Patent

Grants to the person(s) having title to this patent the right to exclude others from making, using, offering for sale, or selling the invention throughout the United States of America or importing the invention into the United States of America for the term set forth below, subject to the payment of maintenance fees as provided by law.

If this application was filed prior to June 8, 1995, the term of this patent is the longer of seventeen years from the date of grant of this patent or twenty years from the earliest effective U.S. filing date of the application, subject to any statutory extension.

If this application was filed on or after June 8, 1995, the term of this patent is twenty years from the U.S. filing date, subject to any statutory extension. If the application contains a specific reference to an earlier filed application or applications under 35 U.S.C. 120, 121 or 365(c), the term of the patent is twenty years from the date on which the earliest application was filed, subject to any statutory extensions.

Director of the United States Patent and Trademark Office

US006782800B2

(12) **United States Patent**
Strain

(10) **Patent No.:** **US 6,782,800 B2**
(45) **Date of Patent:** **Aug. 31, 2004**

(54) **DIAMOND-SHAPED FLUID POWERED LINKAGE, SYSTEM AND ENGINE**

(76) Inventor: David Strain, 35 O'Brien Avenue, Stouffville, ON (CA), L4A 1G6

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 6 days.

(21) Appl. No.: **10/130,272**

(22) PCT Filed: **Dec. 20, 2000**

(86) PCT No.: **PCT/CA00/01567**

§ 371 (c)(1), (2), (4) Date: **May 28, 2002**

(87) PCT Pub. No.: **WO01/46594**

PCT Pub. Date: **Jun. 28, 2001**

(65) **Prior Publication Data**

US 2002/0178719 A1 Dec. 5, 2002

Related U.S. Application Data

(60) Provisional application No. 60/172,998, filed on Dec. 21, 1999.

(51) **Int. Cl.**[7] **F01B 19/02**
(52) **U.S. Cl.** **92/36**; 92/89
(58) **Field of Search** 92/34, 36, 89

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Primary Examiner—F. Daniel Lopez
(74) *Attorney, Agent, or Firm*—Bereskin & Parr

(57) **ABSTRACT**

A fluid powered linkage (12) has at least three side plates (18) of substantially equal width joined by connectors (17) to form a polygon of variable cross sectional area. An upper plate and a lower plate enclose a variable volume within the polygon. At least one port (37) allows fluid to enter into or leave from the enclosed variable volume in a controllable manner. Seals prevent fluid from entering or leaving the enclosed variable volume other than through the one or more ports. Two abutments (19, 11) are located on the side plates or connectors and the distance between the two abutments varies non-linearly with, but in the same direction as, the variable cross-sectional area. Optionally, an inner surface of one or more of the side plates defines a recess. A preferred linkage has a cross-section in the shape of a diamond or rhombus of varying internal angles, or a half or quarter thereof. In use, the obtuse angle preferably ranges from nearly 180 degrees to about 135 degrees. The linkage is used in an apparatus for producing a fluid output with altered pressure, volume or flow compared to a fluid input and a hydraulic motor.

13 Claims, 12 Drawing Sheets