SCIENTIFIC / TECHNICAL

OBSERVATIONS AND OPINIONS VIA

SEVERAL PROFESSIONALS

REGARDING THE

DIAMOND-SHAPED

FLUID POWERED

LINKAGE,

SYSTEM AND ENGINE

CONTACT:
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(905) 640-2333
analystsofpneumatic@bellnet.ca

CONTENTS

REPORT GUIDE

Page two illustrates a diamond-shaped actuator and conventional piston.

Page three illustrates the work gain relationship relating to the diamond-shaped actuator and a conventional piston.

Page four illustrates the means by which the diamond-shaped actuator produces its own source of fluid.

Page five illustrates and page six explains the fundamental science and the application.

On page eight Dr. Mile Ostojic, Senior Researcher at IMTI of the National Research Council of Canada clearly differentiates these two points. Dr. Ostojic came to the site and witnessed the proof of the fundamental science. In Dr. Ostojic's emails on pages seven to nine he accepts the fundamental science as fact, but is not convinced of the application of this fact in the Hydraulic Displacement Motor's control circuitry.

In order to prove that the control circuitry functions as per our drawings for the application of the fundamental science we approached Siemens, one of the most respected control development companies in the world. Siemens had one of their control experts examine our drawings that illustrate the three modes of operation regarding the Hydraulic Displacement Motor.

Page ten defines the task of the Siemens' control expert.

Pages eleven to fifteen present his conclusions. As you see, he has signed off all drawings and confirms that the component positioning occurs as per our drawings.

Page sixteen is a statement from Dr. Rosalie Bertell, who witnessed an early model of the diamond-shaped actuator.

Page seventeen contains statements from Dr. Mehran Monabbati, of SENES Consultants who witnessed the diamond-shaped actuator on site.

Page eighteen and nineteen present data collected with certified test equipment by Mr. Robert Blanchard, P.Eng., regarding the diamond-shaped actuator.

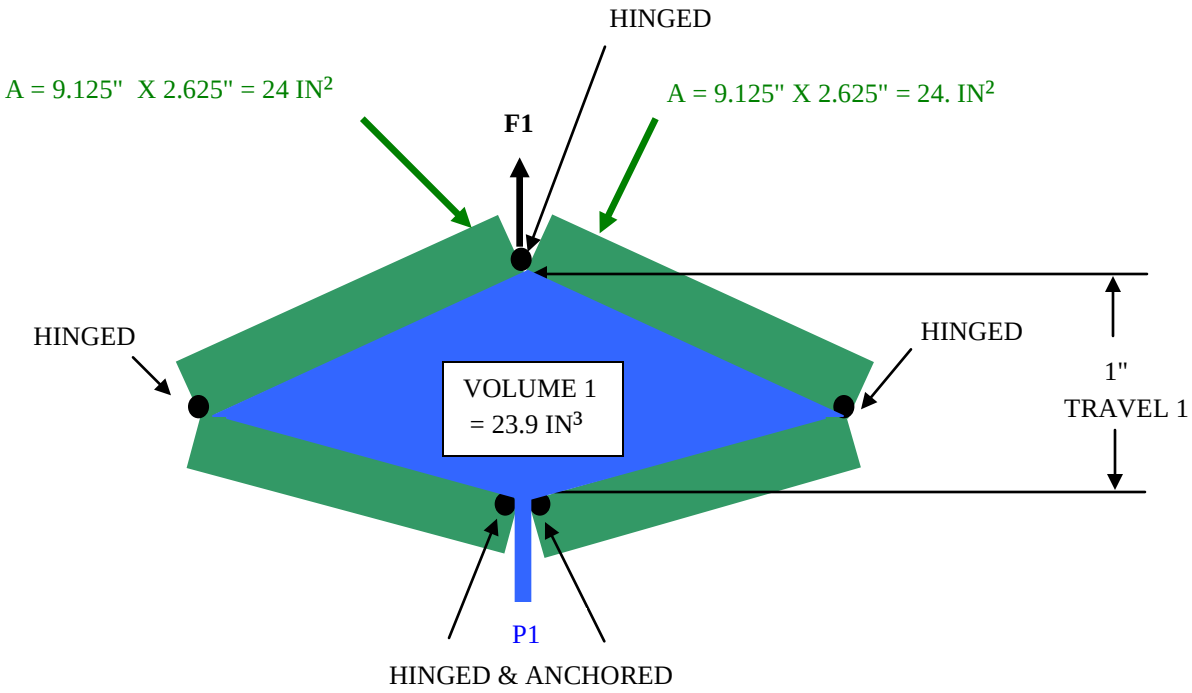
Page twenty illustrates the findings of Mr. Robert Blanchard, P.Eng.

Pages twenty-one to twenty-three contain the patent documentation from 1874 illustrating that mankind has recognized the efficiency advantage of configurations of the diamond-shaped actuator for at least the last 130 years. There are two more patents from 1886 and 1901 that recognized this advantage. This is the fundamental science of the Hydraulic Displacement Motor.

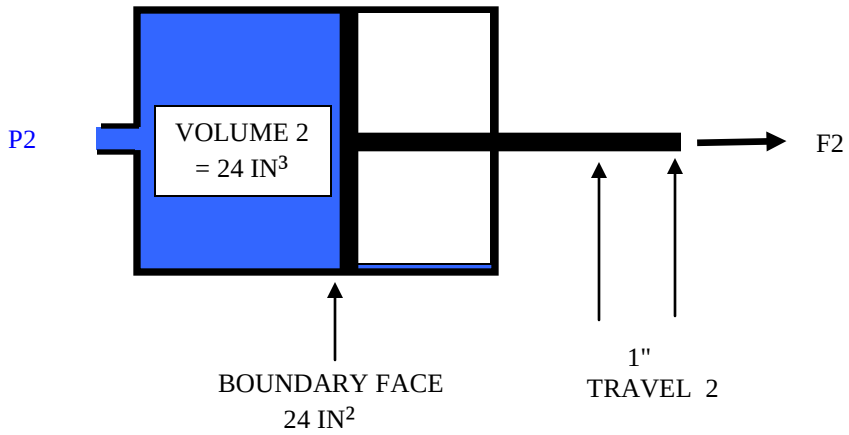
Page twenty-four is a drawing from 1999 of one of my experimental actuators. As you can see it is identical to the 1874 actuator of Mr. Reilly. (I did not copy him; it was simply a replay in history.) None of the three inventors from the 1800's identified the benefit of the using their inventions in the manner of the Hydraulic Displacement Motor. In fairness to them, the required control strategies had not been developed at that time.

Pages twenty-five and twenty-six illustrate the patent numbers for the granted patents regarding the USA and Europe. Page twenty-seven is the first page of the Canadian application.

DIAMOND-SHAPED ACTUATOR



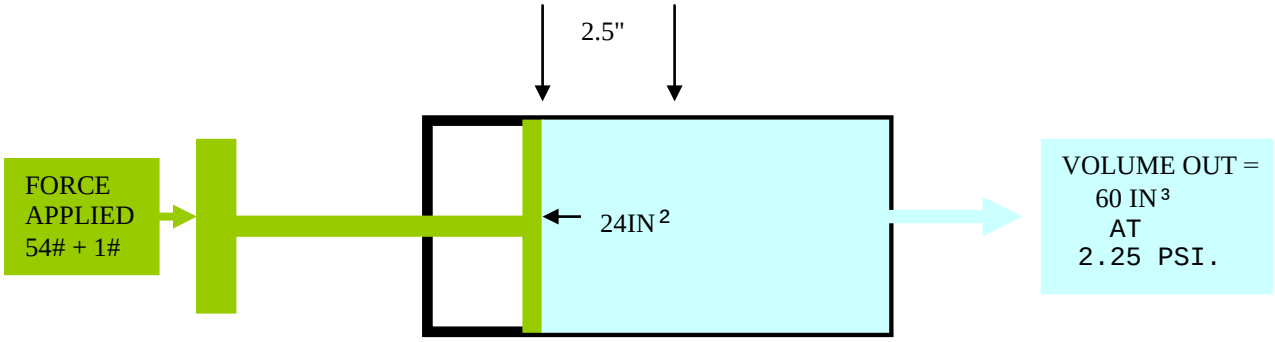
CONVENTIONAL PISTON



P1 = P2
VOLUME 1 < VOLUME 2
F1 > F2
TRAVEL 1 = TRAVEL 2

WORK GAIN ILLUSTRATION

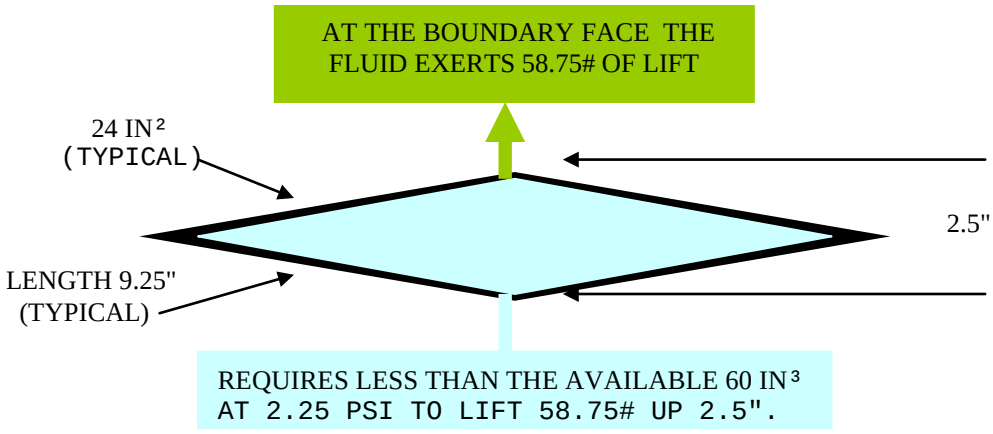
HOW MUCH WORK WOULD YOU HAVE TO APPLY TO FORCE 60 CUBIC INCHES OF FLUID OUT OF A CONVENTIONAL PISTON AT 2.25 PSI PRESSURE?



54# FORCE IS THE EQUILIBRIUM POINT; THEREFORE, 55# WOULD DISPLACE THE FLUID.

WORK DONE = 55# FORCE X 2.5" TRAVEL= 137.5 IN/LB.

HOW MUCH WORK CAN THE DISPLACED 60 IN³ **AT 2.25 PSI ACHIEVE IF FORCED INTO A DIAMOND SHAPED PISTON?**



WORK DONE = 58.75# FORCE X 2.5 INCHES TRAVEL = 146.875 IN/LB.

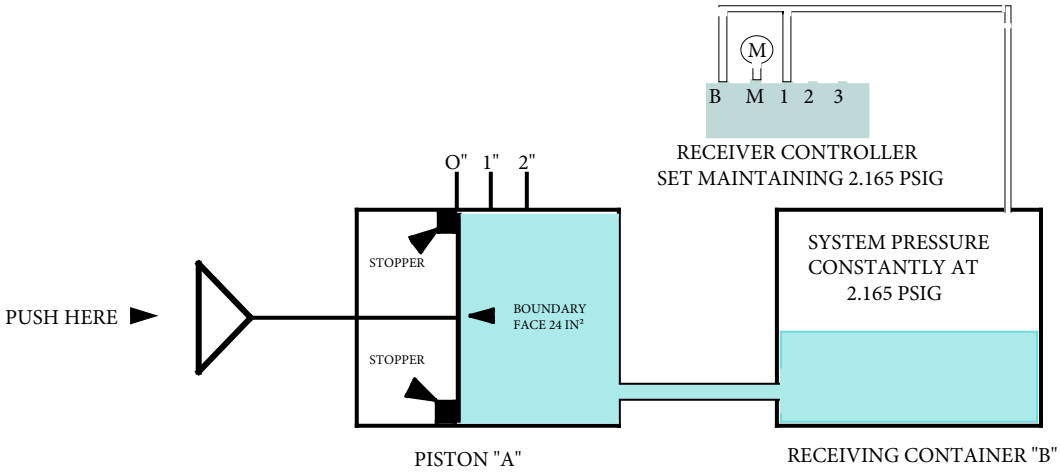
CONCLUSION

THIS ILLUSTRATION CONCLUDES THAT 137.5 IN/LB OF WORK CAN GENERATE 146.875 IN/LB OF WORK IF THE CHARACTERISTICS OF A CONVENTIONAL PISTON AND THE CHARACTERISTICS OF A DIAMOND SHAPED PISTON ARE COMBINED INTO ONE SYSTEM.

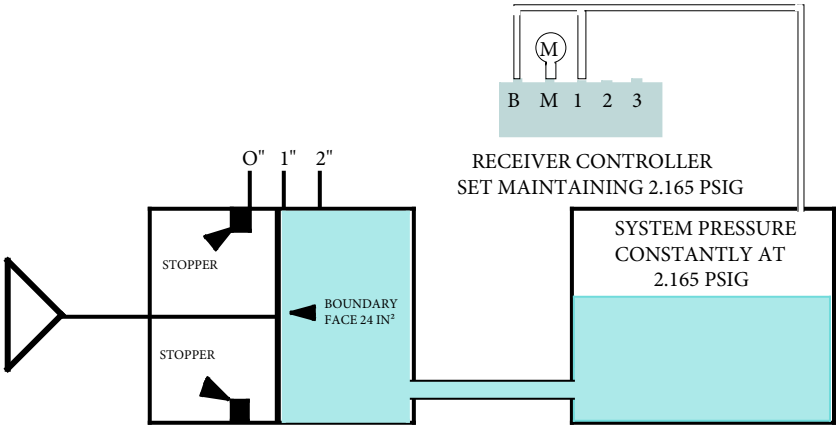
2:3

PRESSURIZED FLUID SOURCE

METHODS ILLUSTRATED PRODUCING PRESSURIZED FLUID REQUIRED BY OUR MODEL. YOU COULD MANUALLY AQUIRE THE REQUIRED VOLUME BY APPLYING 54# OF FORCE. THE DIAMOND-SHAPED ACTUATOR PRODUCES ITS OWN REQUIRED FLUID APPLYING ONLY PART OF ITS WORK POTENTIAL.



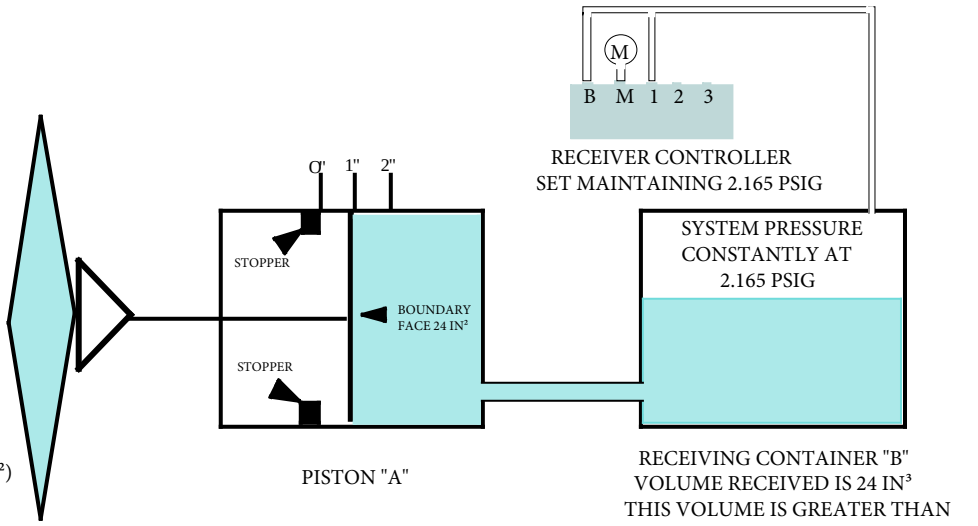
THE FORCE REQUIRED
TO DISPLACE THE 24 IN³
OF FLUID IS 51.96 + POUNDS
AT EQUILIBRIUM.
THEREFORE, 54 POUNDS
CREATES AN UNBALANCED
RELATIONSHIP FORCING THE 24 IN³
OF FLUID FROM PISTON "A".



VOLUME REQUIRED
TO DRIVE 1" IS 23.917 IN³

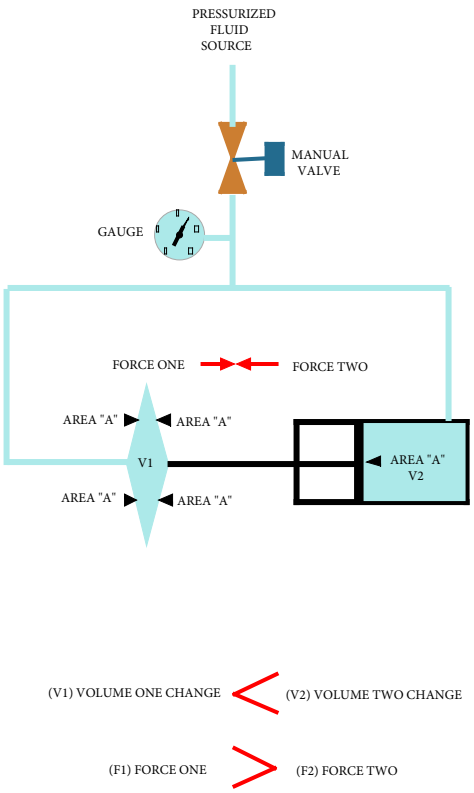
THE FORCE AT THE TIP
OF THE DIAMOND-SHAPED
ACTUATOR IS 59.75 POUNDS.

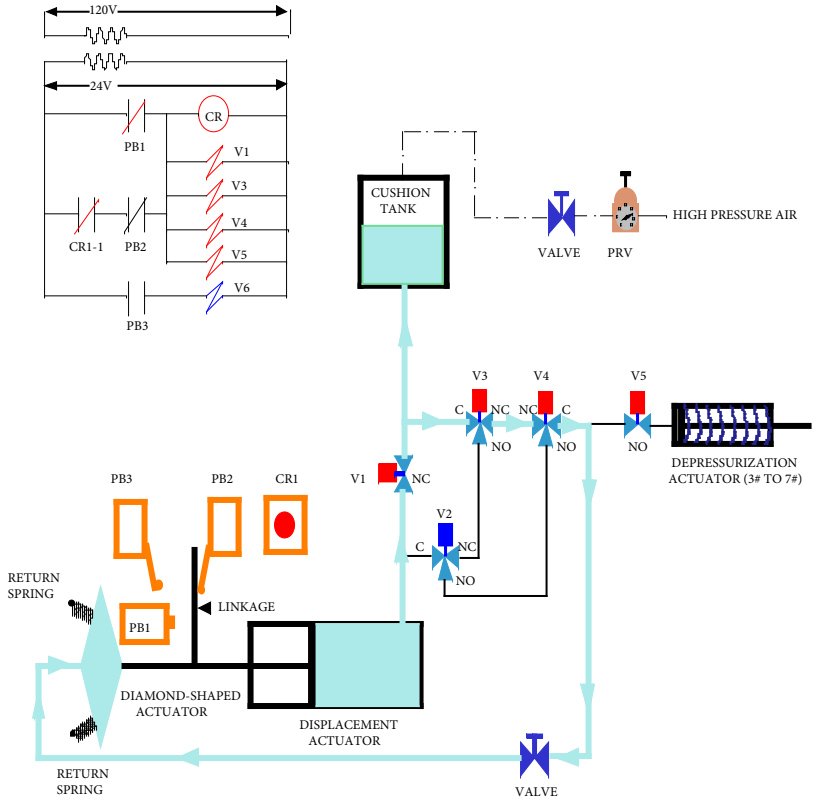
DIAMOND-SHAPED ACTUATOR
EACH WALL IS 9.125" X 2.625" (24 IN²)



DIAMOND-SHAPED FLUID POWERED LINKAGE, SYSTEM AND ENGINE

STEP ONE	STEP TWO
THE FUNDAMENTAL SCIENCE	APPLICATION OF THE FUNDAMENTAL SCIENCE





THIS DRAWING ILLUSTRATES THE DRIVING CYCLE. THERE ARE TWO MORE STAGES.

THE FORCE DIFFERENTIAL > THE FORCE REQUIRED TO OVERCOME THE TOTAL FRICTIONAL RESISTANCE

FUNDAMENTAL SCIENTIFIC POINT OF INVENTIONS

The fundamental scientific point relating to any invention is the initial understanding one must seek.

FOR EXAMPLE: THE INTERNAL COMBUSTION ENGINE

The fundamental science regarding the internal combustion engine is ***the reaction of vaporized gasoline when exposed to a spark.***

The resultant explosion produces the energy required to enable the engine to function. **With no explosion, the internal combustion engine could not exist.**

The directional control of the force produced by the explosion is simply the application of the fundamental science.

RELATING TO THE HYDRAULIC DISPLACEMENT MOTOR

The fundamental science regarding the hydraulic displacement motor is the differential in efficiency comparing a conventional piston to a diamond-shaped piston.

The diamond-shaped piston is more efficient than a conventional piston. The diamond-shaped piston achieves more work than a conventional piston when they both receive identical fluid inputs regarding volume and pressure.

The directional control of the differential in the two forces is simply the application of the fundamental science. With no differential in force, the hydraulic displacement motor could not exist.

The first step in proving the validity of the Hydraulic Displacement Motor concept is verification of the data that proves the diamond-shaped piston to be more efficient than the conventional piston.

The data collected by Robert Blanchard, P. Eng., with certified electronic test equipment, confirms the efficiency advantage of the diamond-shaped piston.

The test model is available to other Engineers or Scientists who wish to confirm the collected data.

Drawing twelve, in the patent application, illustrates the running model of the motor that produced the performance graph on page eleven in "A NEW VIEW OF THERMODYNAMICS RELATING TO THE WORKING CAPABILITY OF PRESSURIZED FLUIDS". The running example's intent is to prove that the application of the fundamental science functions properl**y.** It serves its purpose, but does not completely validate the invention. We compensated for the expansion in the rubber inner tube by releasing fluid in the first stage of recharging. The fluid is returned with compressed air. When proper hydraulic seals are installed, in later models, this will not be a problem.

THE SCIENCE IS THE DIFFERENTIAL IN FORCE OBSERVED WHILE COMPARING THE TWO PISTONS. THE MACHINE IS ONLY THE APPLICATION.

EMAIL FROM DR. OSTOJIC FROM NRC CANADA

Hello Dave,

I am sorry and apologize for replying so late. I was away from office for more than a month, attending to family matters in my home town in Bosnia.

In the meantime, we in IMTI had some administrative changes and you have not heard from Moe mainly because of that. Namely, I have moved into a new research group supervised by Dr. Gian Vascotto (Moe is director of research of a different division in IMTI).

Anyhow, let me summarize the current situation and possible next steps.

I have understood novelty of the diamond-shaped actuator and its potential advantages. Also, I do not question validity of experimental data that you and Mr. Blanchard collected. Quite contrary, I trust that the experiments and all measurements were conducted professionally.

Our views differ with regard to the system that uses the diamond-shaped actuator to produce useful mechanical work without spending any external energy. Even in this case I do not challenge validity of your experimental data (that is, I trust that the system worked at some point). I only think that the data is incomplete -- some part of the process went unnoticed. Thus, I trust that the system can work, but you/we do not have a proper explanation for how it works.

The project which IMTI proposed in July last year aimed to develop a mathematical model of the actuator and investigate its properties analytically. Using the mathematical model we could prove the observed properties of the actuator itself and simulate behavior of any system that uses it. Following that path we could also understand and explain behavior of your system that works seemingly by itself.

I hope this clarifies our (IMTI's) position. If you are still interested in pursuing the proposed project with us please let me know. Although I am currently occupied by a couple of big projects at IMTI, I think I could find time to work on the diamond-shaped actuator sometime during the Spring.

With best regards and wishes,

-Mile

Dr. Mile Ostojic, Senior Researcher
Integrated Manufacturing Technologies Institute
National Research Council of Canada
800 Collip Circle, London, Ontario N6G 4X8
Phone: 519-430-7114, Fax: 519-430-7064, Email: mile.ostojic@nrc.gc.ca

-----Original Message-----
From: Dave Strain [mailto:apscontrols@idirect.com]
Sent: Wednesday, February 26, 2003 3:30 PM
To: MILE OSTOJIC
Subject: MATH. MODELLING AGREEMENT

Hello Mile;

I hope you had a good holiday.

I have not received any communication from Moe regarding the math modeling for the diamond-shaped actuator to date.

The patent application is now posted on the USA web site.

Please let me know the NRC's position on this matter as soon as possible.

After witnessing the diamond-shaped actuator lifting the load on site, is there any part of the data collected by Mr. Robert Blanchard, P. Eng that you would challenge? The attachment is Mr. Blanchard's report. I am attempting to determine the point at which your opinion differs from mine. If your data regarding the diamond-shaped actuator differs from Mr. Blanchard's, could you please inform me of the differences?

Thank you for your time and concern.

Regards
Dave

From: "Dan McTeague, M.P." <dan@danmcteague.net>
To: <apscontrols@idirect.com>
Sent: Friday, November 29, 2002 12:17 PM
Attach: Dan McTeague.vcf
Subject: FW: Diamond -shaped piston

www.danmcteague.net

-----Original Message-----
From: Ostojic, Mile [mailto:Mile.Ostojic@nrc.ca]
Sent: Wednesday, November 27, 2002 5:26 PM
To: 'Dan McTeague, M.P.'
Cc: Salloum, Georges; Islam, Mahmud-Ul; Vascotto, Gian
Subject: Re: Diamond -shaped piston

Dear Mr. McTeague,

Thank you for your message. Regarding Mr. Strain's invention, I think we need to differentiate two things. One is the diamond-shaped actuator itself and the other is a particular system that was built from the actuator and several other hydraulic and pneumatic components.

The diamond-shaped actuator is Mr. Strain's original invention. It is a novel fluidic actuator which appears to have certain advantages over the conventional piston design, at least in a bounded region of its working space. Mr. Strain built a proof-of-concept and conducted many experiments on it to confirm his predictions. The experiments were successful and I had an opportunity to see the actuator working. Thus, I wouldn't question the validity of the diamond-shaped actuator as a concept. Actually, as a researcher at NRC-IMTI, I agreed to develop a mathematical model of it and analytically investigate its properties. A proposal was submitted for $12K to cover my time.

The situation is somewhat different with regard to the system that Mr. Strain built from the actuator and a set of other hydraulic and pneumatic components. I have seen that system too, but it was not operational at the time. I was told that, under certain conditions, the system can work (that is, produce useful mechanical work) even if no external energy is supplied to it. If that is true, this system would be a "perpetual machine", something that scientists claim does not exist. To be fair to Mr. Strain, he did not claim that he had a perpetual machine working. In fact, we agreed that we should analyze the system and try to explain how it works. So, the emphasis is on "explaining how the system works", rather than "proving that the system produces energy".

In summary, I do not see the diamond-shaped actuator as an energy producing device or as an alternative to fossil fuel use. Conducting an analytical investigation of its properties would be helpful for developing unique applications for the actuator. Promoting it in the context of the Kyoto accord, however, would be very tenuous in my opinion.

Financial assistance for a project to mathematically analyze the actuator may be available from several sources. Those that I am aware of include NRC's Industrial Research Assistance Program (detailed information is available at http://www.nrc.ca/irap/). Another option would be to work with the potential users of the diamond-shaped actuator. As far as I know, Mr. Strain is already working with the Organizational Design Group Inc. from Toronto towards that end.

I hope this will be helpful. Please contact me for any additional information which you may need.

Sincerely,

-Mile Ostojic

Dr. Mile Ostojic, Senior Researcher
Integrated Manufacturing Technologies Institute
National Research Council of Canada
800 Collip Circle
London, Ontario, Canada N6G 4X8
Phone: (519) 430-7114
Fax: (519) 430-7064

Email: mile.ostojic@nrc.ca

-----Original Message-----
From: Dan McTeague, M.P. [mailto:dan@danmcteague.net]
Sent: Friday, November 22, 2002 2:38 PM
To: Mile.Ostojic@nrc.ca
Subject: Diamond -shaped piston

Dear Dr. Ostojic,

I have once again met with Dave Strain over how we can get his invention to be recognized as the clear breakthrough alternative to fossil fuel use that it is, at least empirically.

I do not pretend to harbour any expertise in this area nor denounce it owing to any scientific prejudice.

What I am instead seeking is ways you believe I might be able to interest my government in assisting financially in the requisite tests and mathematical analysis to overcome its naysayers.

As Vice Chair if the House of Commons Industry Committee, I find it ironic that on the very day in which we are trying to find twelve thousand dollars to realize an energy source unlike any other, Ministers Rock and Stewart are contemplating subtantial financial reources to innovation in Canada to address as a priority, our Kyoto commitment.

What path can you send me on to make Canada live up to its latest commitment ?

Dan

Analysts of Pneumatic Systems Limited (APS)
35 O'BRIEN AVENUE - STOUFFVILLE, ONTARIO L4A 1G6
TEL: (905) 640-2333 FAX: (905) 640-2444

Siemens,
2 Kenview Blvd.,
Brampton, Ontario,
L6T 5E4
Att.- Mr. John Osmond
February 10, 2004

Dear Sir;

As per our discussion, we have invented a more efficient hydraulic actuator than the conventional cylindrical piston. The new actuator achieves **more** work than a conventional piston with equal fluid pressure, at a lesser fluid volume.

The efficiency differential gained acceptance by the scientific communities who have assessed the invention; however, understanding the main application of the new actuator requires one to possess a reasonable knowledge of control circuitry. We have built models proving the claims; however, a written expert collaborating opinion is required regarding the function of the illustrated control and fluid circuitry.

We request that Siemens evaluate the three drawings illustrating:

(1) the driving cycle,
(2) the first recharge cycle
(3) and the second recharge cycle.

Two facts are required to be assumed true:

(1) The diamond-shaped actuator develops approximately 10% to 15% more force than a conventional piston with an identical fluid source. Investigating scientists have accepted this fact.
(2) The force differential is more than adequate to over come all frictional losses in the running machine.

The accompanying graph illustrates the internal pressure changes of the model running over two hours at various fixed static pressures. The exact model that produced this graph is illustrated on the last page.

The basic question presented is: "If the differential in efficiency exists, will the mechanical system fluid patterns and control circuit perform as per the illustrations on the three accompanying CAD drawings?"

A meeting with the person performing the analysis may simplify their task.

Thank you for your consideration.

Sincerely,

Dave Strain

4.4

SIEMENS

May 06, 2004

Analysts of Pneumatic Systems Limited (APS)
Attention: Mr. Dave Strain
35 O'Brien Avenue
Stouffville, Ontario
L4A 1G6

RE: Diamond-shaped actuator

Your letter dated February 10,2004 requested a review of the control drawings by a controls expert. With 35 years industry experience, I feel I am qualified to do that evaluation. The evaluation is based on the diagrams supplied and the discussions in our office, March 31,2004 with Len Shaddock (Service Manager) and Mitch Proude (National Operations Manager SBT). It should be noted that we did not witness a live demonstration of the circuits depicted on the control drawings. No conclusions are made regarding the fluid flow. For this exercise it will be assumed the flows are as described and the switches are activated by these flows. For this to work, a 100 PSI air source and a 24volt AC power supply are required.

Drawing (Driving state)
The cycle is initiated by manually opening the isolation valve between the PRV and the cushion tank. When switch PB1 is closed, V1, V3, V4, V5 and CR1 are energized. CR1 latches through Normally Closed switch PB2. The valves switch positions as described.
It is not mentioned, but given the location of PB3, it is closed at this time, by the linkage and valve V2 will be energized for part of the "Driving State". PB3 closes before PB1 as the linkage travels to the left. When PB2 opens, V1, V3, V4, V5 and CR1 are de-energized. The valves return to their normal positions. (Start of "First Recharge Cycle")

Drawing (First Recharge Cycle)
Switch PB2 opens causing V1, V3, V4, V5 and CR1 to de-energize. The valves will return to their normal positions. When PB3 closes, valve V2 will be energized. (start of "Second Recharge Cycle")

Drawing (Second Recharge Cycle)
When PB3 closes, valve V2 will be energized

Drawing (Fig. 12)
This is supposed to be a depiction of a complete working model. This drawing shows an additional external air source and associated circuitry that is not mentioned on the "Driving State' , "First Recharge Cycle' or the "Second Recharge Cycle" drawings..

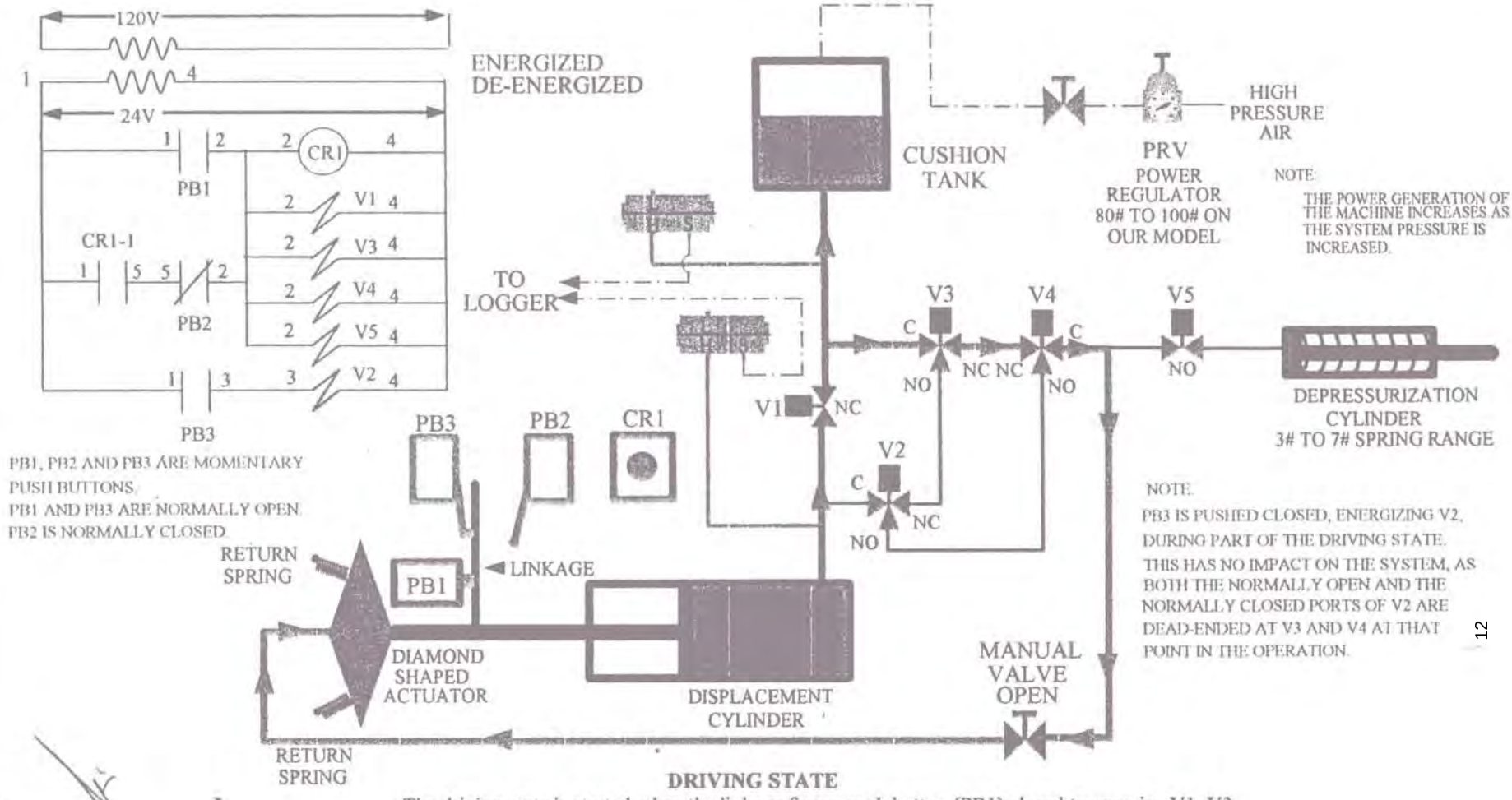
Please call if you have any questions.

Ed Komadowski
Service Operations Supervisor
cc: Len Shaddock, Mitch Proude

Siemens Building Technologies, Ltd.

2 Kenview Blvd.
Brampton, Ontario L6T 5E4
Canada

Tel: (905) 799-9937
Fax: (905) 799-9277
Toll Free: (800) 268-6831



12

DRIVING STATE

The driving state is started when the linkage forces push button (PB1) closed to energize V1, V3, V4, V5 and CR1. The contact of CR1 closes to lock power on these devices when PB1 re-opens as the drive movement starts.

When V1, V3, V4, and V5 are energized the flow pattern is as illustrated on this drawing.

The diamond shaped actuator, the displacement cylinder and the cushion tank experience the same pressure.

The diamond shaped actuator develops about 10% to 15% greater total force at its tip than the counter force developed in the displacement cylinder.

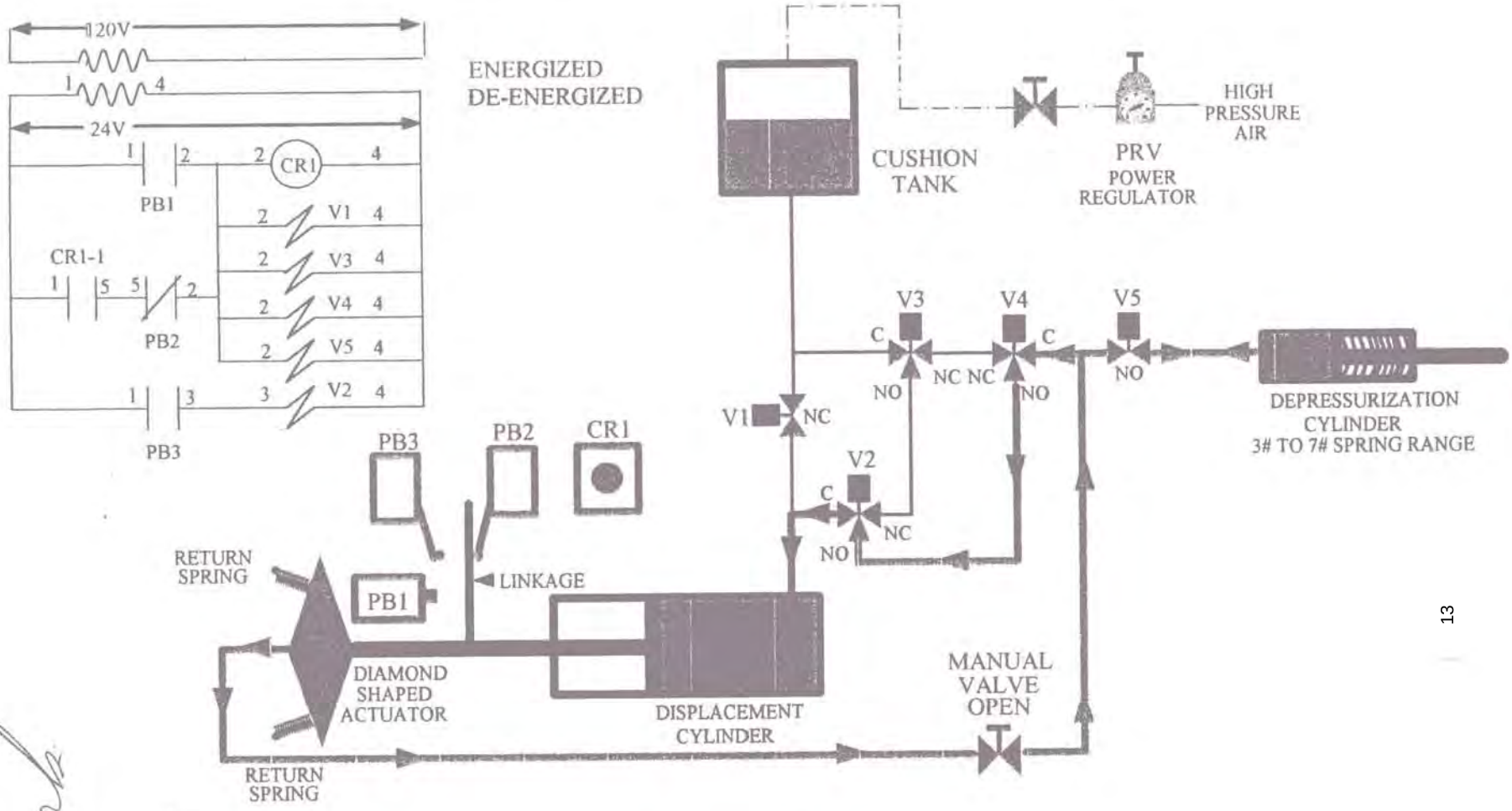
Each of the four faces of the diamond shaped actuator have the same area as the displacement cylinder's boundary face. This causes more fluid to be driven out of the displacement cylinder than is required to drive the diamond shaped actuator for the same linear travel.

About 99% of the fluid driven out of the displacement cylinder flows to the diamond shaped actuator and about 1% of the fluid flows into the cushion tank.

The differential in force between the diamond shaped actuator and the displacement cylinder may be used to drive a generator external to this machine.

When the linkage forces push button (PB2) open V1, V3, V4, V5 and CR1 are de-energized which causes the driving state to stop.

MAY 06, 2004
Edmund Kowalczyk



FIRST RECHARGE CYCLE

The linkage pushes PB2 open, which causes V1, V3, V4, V5 and CR1 to de-energize and the flow pattern illustrated on this drawing is established.

The pressurized cushion tank is isolated.

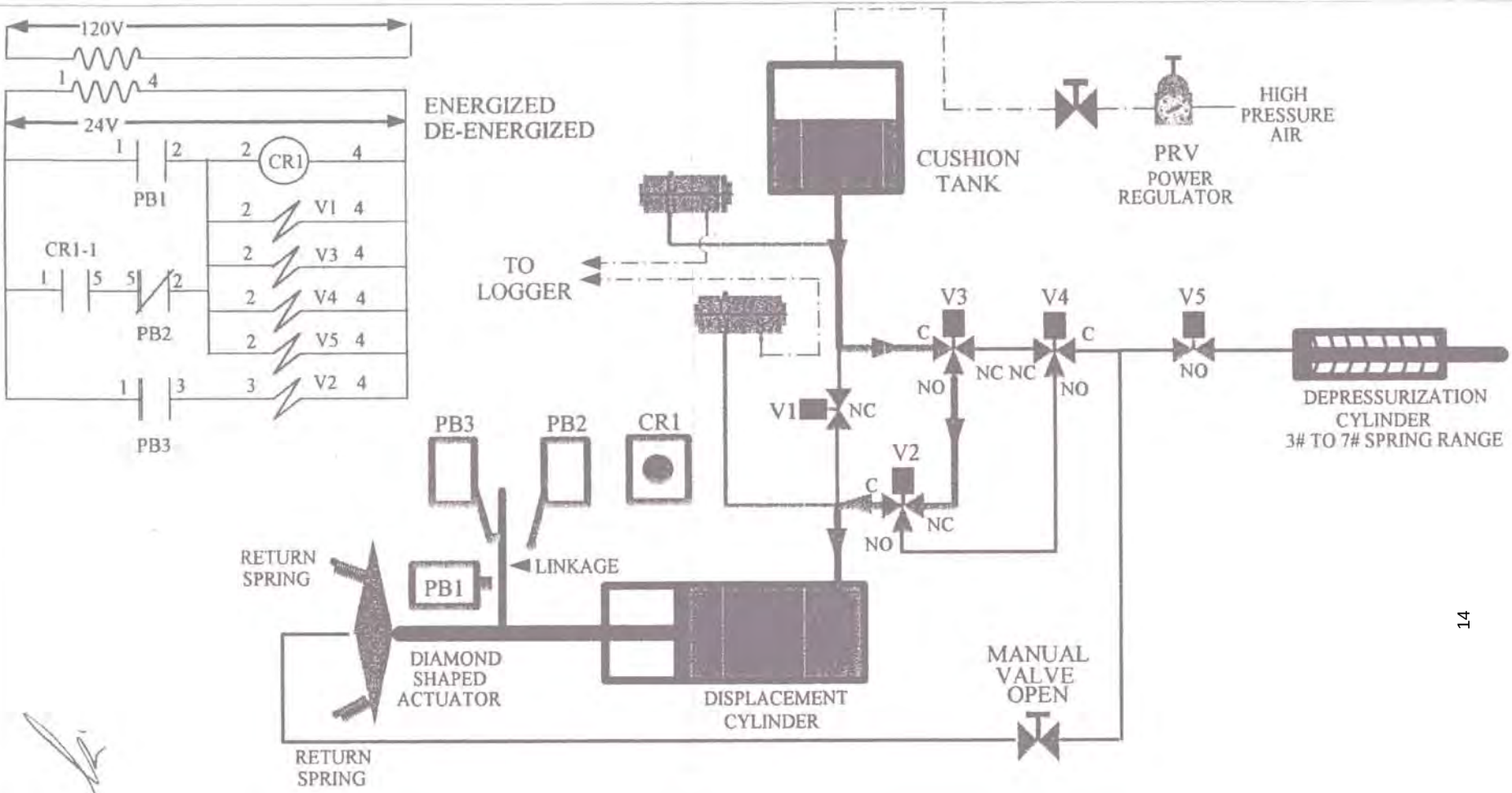
The diamond shaped actuator, the displacement cylinder and the depressurization cylinder all experience a common pressure.

The depressurization cylinder strokes, which de-pressurizes all three components. This removes the diamond shaped actuator's power advantage over the return springs. The return springs retract to force the fluid in the diamond shaped actuator back into the displacement cylinder.

When the common pressure drops below the spring range of the depressurization cylinder, the fluid is forced into the displacement cylinder from the depressurization cylinder.

When the 99% of the fluid that came out of the displacement cylinder has been returned to the displacement cylinder, the linkage forces push button (PB3) to close which energizes V2.

MAY 06, 2004
Edward Hradowski



SECOND RECHARGE CYCLE

The linkage pushes PB3 closed to energize V2. This establishes the flow pattern illustrated on this drawing.

The 1% of the fluid that was forced from the displacement cylinder into the cushion tank is forced back into the displacement cylinder from the cushion tank.

When the displacement cylinder is completely refilled, the linkage of the displacement cylinder pushes PB1 closed and the cycle repeats.

NOTE: The linkage is not mechanically connected to the diamond shaped actuator; therefore, there will be a temporary gap between them during the second recharging stage.

MAY 06, 2004
Edmond Ahmadzadeh

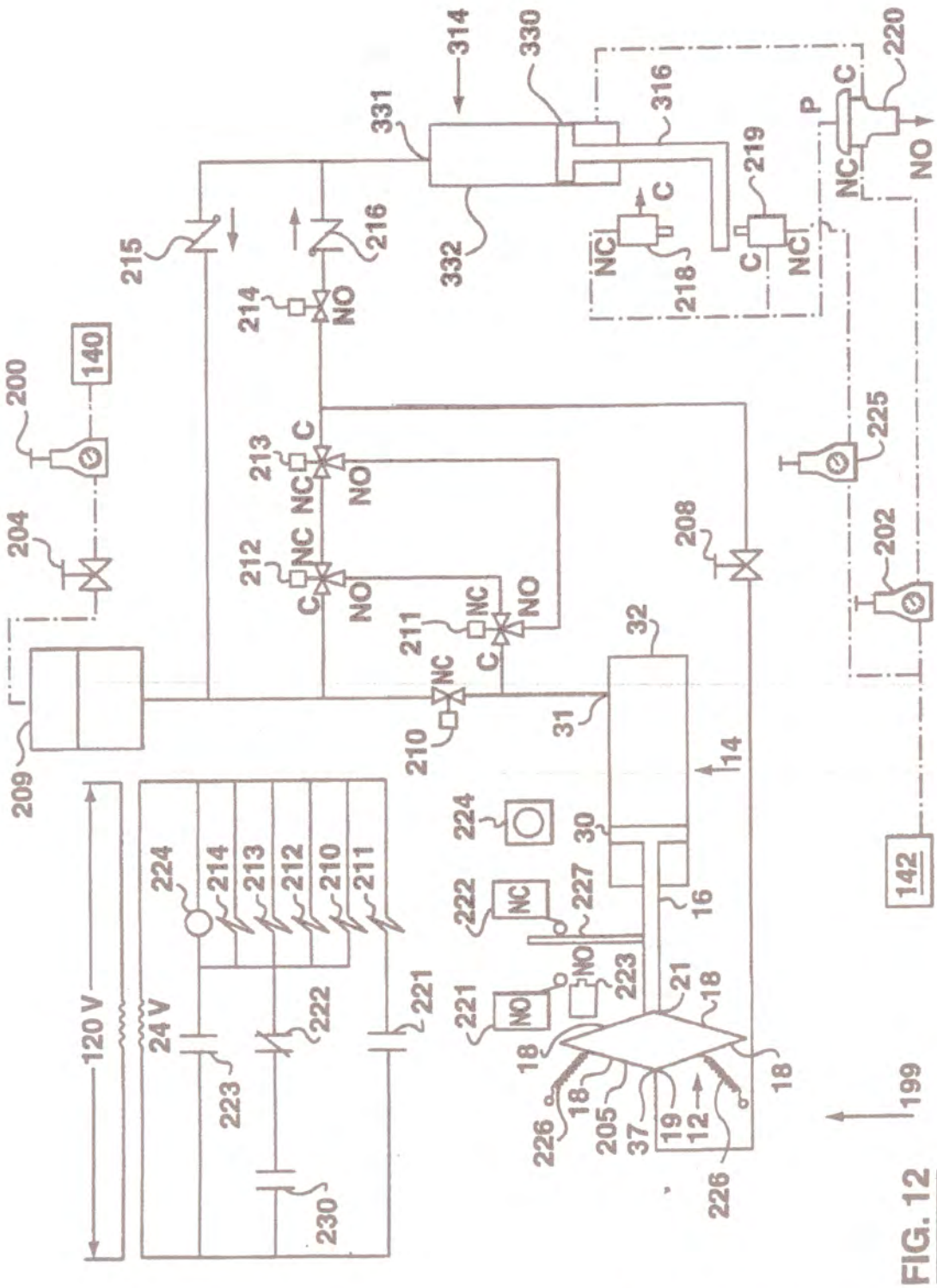


FIG. 12

MAY 06 2004

From: "Rosalie Bertell, Ph.D., GNSH" <rbertell@adelphia.net>
To: "Dave Strain" <apscontrols@idirect.com>; "Right Livelihood Award" <info@rightlivelihood.se>
Sent: Friday, January 25, 2002 11:00 AM
Subject: Re: Environmental Invention

Dear Dave and Kerstin,

I have examined this energy device invented by Dave and can attest to the fact that it is simple, appropriate for wide spread use, uncomplicated and a boon to small communities starved for energy. I would strongly recommend that you help him to find the right international audience for this invention. It would be a shame to have it fall into the hands of those who would either suppress it or turn it into personal profit. I see it as urgent that he be helped now with the next stage of marketing it for the sake of the larger global community good. As you probably know, I strongly favour a beneficial globalization in contrast to capitalistic global exploitation.

Best wishes,
Rosalie

----- Original Message -----
From: Dave Strain
To: Rightlivelihood Foundation
Cc: ROSALIE BERTELL
Sent: Thursday, January 24, 2002 7:13 AM
Subject: Environmental Invention

Hello Kerstin;

Thank you for your time and suggestion. I have downloaded information relating to Hunter and Armory Hunter. I will contact them later today.

The financial situation is not the only problem faced at this time.

The intent is to have all the financial proceeds, generated by the invention, directed into addressing environmental and social problems. I had planned to have a committee selected with global representation to face these challenges. I only have Canadian contacts; therefore, am unable to make an informed choice in selecting people. It was suggested to me that you may offer some input on this matter.

I understand the situation that prevents you from assisting financially; however, your scientific analysts may still wish to understand this invention. If so, please let me know and a package of information will be mailed to them.

The invention is a hydraulic displacement motor that generates more power per cycle than it requires to run itself.
It will significantly reduce global use of fossil fuels.

The escalating degradation of the environment demands a concentrated human effort now if future generations are to have a home. The invention will help environmentally simply by being used and the proper use of the funds it generates will hopefully turn the degradation around.

Thank you very much for your time.
Dave Strain

SENES Consultants Limited

121 Granton Drive
Unit 12
Richmond Hill, Ontario
Canada L4B3N4

Tel: (905) 764-9380
Fax: (905) 764-9386
E-mail: senes@senes.ca
Web Site: http://www.senes.ca

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.

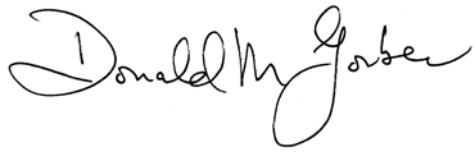
The work done through the stroke of the diamond-shaped actuator can push back a conventional cylindrical actuator. The displacement volume of conventional actuator is slightly greater than that volume of fluid required by the diamond-shaped actuator to accomplish the work. This indicates that the diamond-shaped 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

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?

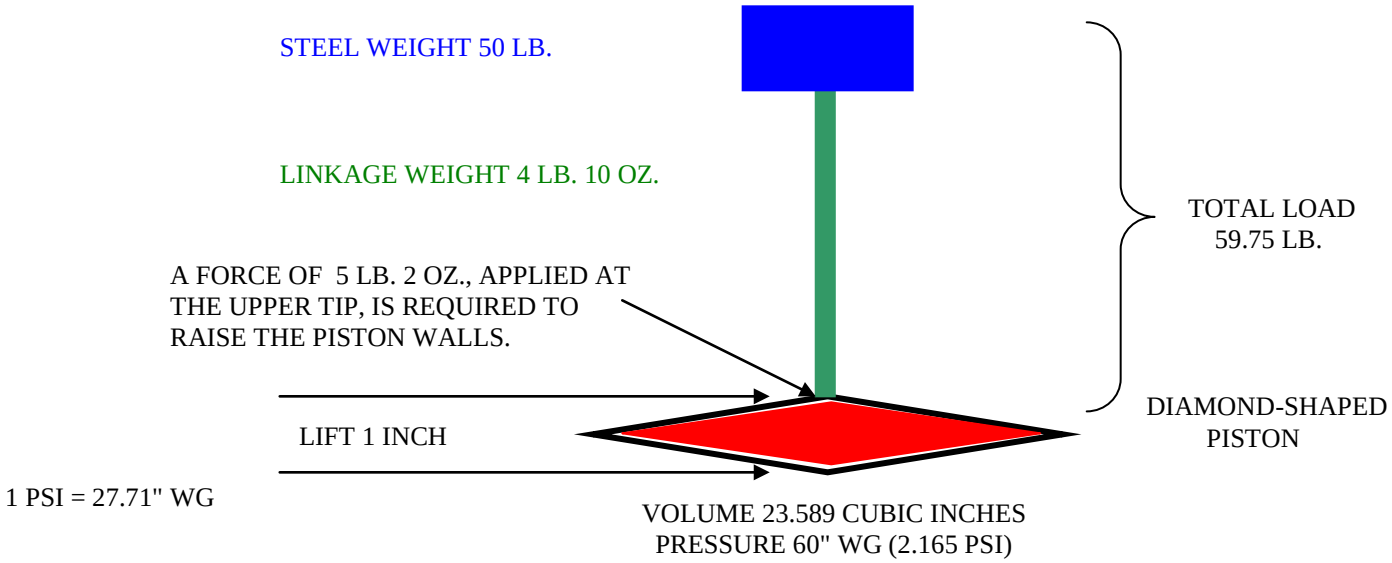
- The short diameter of the rhombus increased by 0.0858" from about 1" at 60" w.g.

(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.

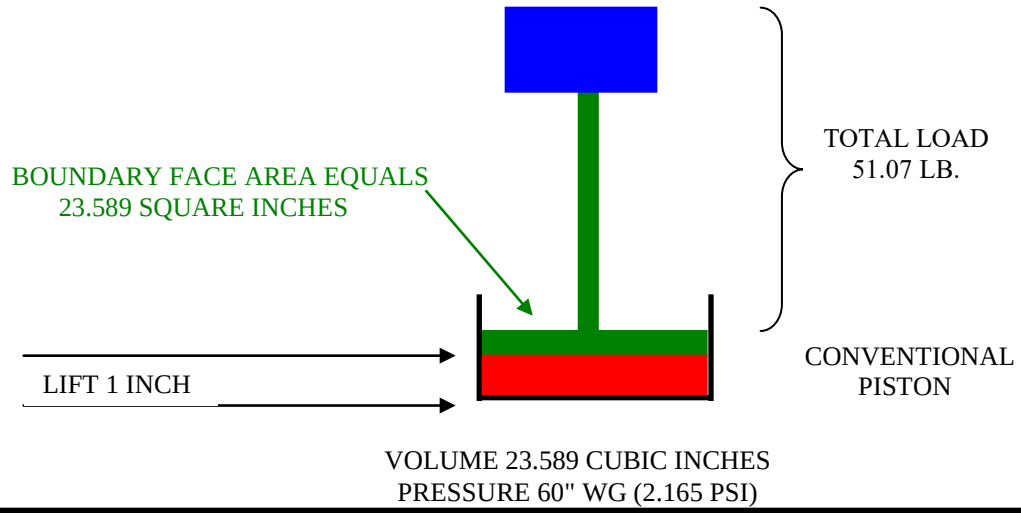
- When the air pressure exerted upon the diaphragm was increased from 60" w.g. to 62" w.g. the short diameter increased by 2.18mm (0.0858in).(Lifted the weight 0.0858). Using the previous data as a base, the new volume increases to 25.605in^3 a difference of 2.016in^3

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.

SECTION 5:0
5:1

T. F. REILLEY.

Reciprocating Steam-Engines.

No. 147,519. Patented Feb. 17, 1874.

Fig: 2.

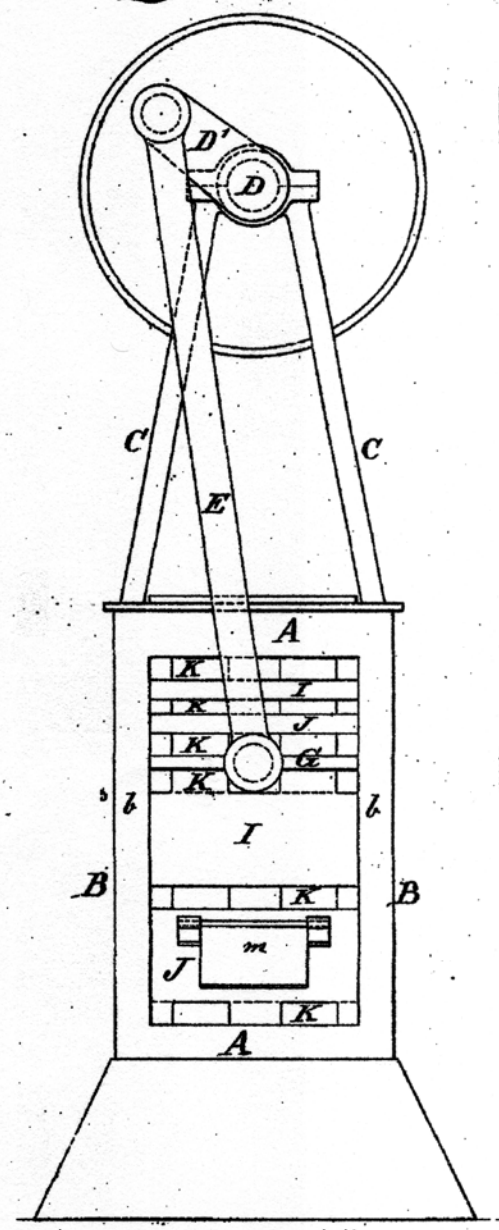
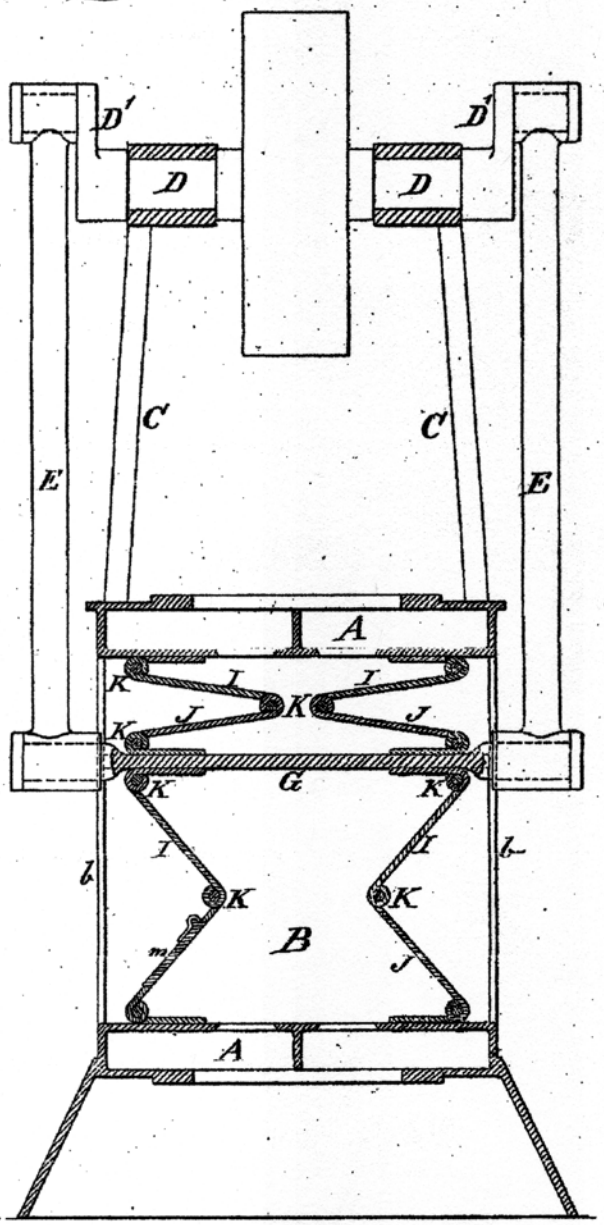


Fig: 1.



Witnesses:

Arnold Hornamann.

W. C. Dey

Inventor:

T. F. Reilley

by his attorney T. D. Stetson

UNITED STATES PATENT OFFICE.

TERENCE F. REILLEY, OF NEW YORK, N. Y.

IMPROVEMENT IN RECIPROCATING STEAM-ENGINES.

Specification forming part of Letters Patent No. **147,519**, dated February 17, 1874; application filed December 20, 1873.

To all whom it may concern:

Be it known that I, TERENCE F. REILLEY, of New York city, in the State of New York, have invented certain Improvements relating to Reciprocating Steam-Engines, applicable also to engines operated by gas or water, of which the following is a specification:

My improved engine is of the reciprocating class, which usually requires a cylinder and piston. I dispense with any parts having functions corresponding fully with those parts. My approximation to a cylinder or analogous inclosing-vessel is simply two stiff plates having their inner surfaces perfectly plain and parallel to each other. My approximation to a piston lies in a movable piece of rectangular form, extending across the space between the parallel plates, and fitting tightly to each by the aid of suitable packing, and connected to the valve-chest by means of tightly-hinged side pieces, which also extend across and fit tightly against the aforesaid parallel plates. The hinged side pieces fold and unfold in a manner analogous to the leather of a bellows, or more exactly to the stiff folding parts frequently employed in the construction of the musical instrument known as the accordion.

On the admission of the steam to the limited space below the piston and within the folding sides, the piston is pressed upward, and the sides are caused to expand. The admission of but little steam causes a large amount of motion in the piston at this stage of the movement. Later, in the upward movement of the piston, the steam is received much faster in proportion to the movement of the piston and near the termination of the strokes. The pressure of the steam against the folding sides causes the sides to act as toggle-levers to powerfully urge up the piston. In the latter portion of the stroke the steam is highly effective in three directions—upward against the piston and in both directions laterally against the folding sides. Earlier in the stroke the action against the folding sides contributes to move the piston, but in a less degree. The efficiency of the pressure against the side in urging up the piston increases as the movement of the piston progresses.

In the working of steam very expansively, the pressure of the elastic fluid varies in the reverse direction. It is very great at the commencement, and is reduced, according to certain well-known laws, as the piston moves. My invention tends to equalize the action of the engine in working steam with a high degree of expansion. The steam received at eighty pounds pressure at the beginning of the stroke works with little advantage. When it has been expanded until its force is nearly lost toward the close of the stroke, it still exerts a very effective action on the piston by reason of its toggle action on the folding sides.

I believe that my invention may be used with success in nearly or quite every situation where engines are required, as in the propulsion of vessels and locomotives, and in the driving of machinery for manufactories, &c., but it is more especially adapted for pumps. I can so proportion it, and so condition the pressure of the steam supplied, that its action shall be nearly equal throughout the entire stroke, as is required in pumping water, or that its force shall be much the greatest toward the close of each stroke, as is required for pumping air or other elastic fluids.

The following is a description of what I consider the best means of carrying out the invention in the form of a double-acting upright engine.

The accompanying drawings form a part of this specification.

Figure 1 is a vertical section in the plane parallel to the main shaft. Fig. 2 is an end elevation.

Similar letters of reference indicate like parts in both the figures.

A A are steam-chests, carrying suitable valves, with connections for operating them, which may be of any ordinary character, and need not be represented. In water-engines I employ additional valves to aid in the exhaust, which will be described further on. B B are parallel sides, which may be of cast-iron, smoothly finished on the inner faces, and stiffly braced with cross-webs on the outer surfaces. C C are upright frames, which support the crank-shaft D, from the cranks D′ D′ of which extend connecting-rods E E, which take hold of suitable bearings on the end of the stout flat piece G, which I denominate the piston. Its action is somewhat analogous to the piston

of an ordinary steam-engine, but working under very different conditions, inasmuch as it fits tightly only at the sides, and its ends are free. The several folding end parts I J are of a width exactly equal to the width of the piston G. Each pair, I J, are hinged together, and also to one of the steam-chests and to the piston. There are four sets of these hinged ends, I J, arranged as represented. Two sets form the ends of the steam-space below the piston, and two similar sets form the ends of the steam-space above the piston. Packing should be employed at the edges of the piston, and also at the edges of the parts I J. The joints or hinges K should also be tightly packed or formed, so as to not only be tight when new, but to allow of being set up or tightened to compensate for wear. The piston may be guided by inclosing its corners within the corners *b* of the side pieces B, as shown, or by any other suitable means.

When my engine is used as a water-engine, operating, for example, by the force of water in a pipe at the foot of a mountain, it is desirable to provide an unusually liberal passage for the escape of the fluid immediately on the completion of the stroke. The rapidity with which the folding sides are pressed inward during the early portion of the return movement of the piston renders this more necessary in my engine than with any ordinary style. I get over this difficulty by providing extra exhaust-valves, *m*, mounted in the lower portions J of the hinged ends. These valves are worked by suitable connections, (not represented,) so that they widely and promptly open at the commencement of the return stroke, and remain open during the whole of the return movement. They then close tightly, and the mechanism lies flat, so as to offer no impediment to the folding of the parts I and J together. The ordinary valves at the top and bottom may be slide or puppet valves, worked in the ordinary manner, and providing only the ordinary openings.

I have represented the parts as in the simplest form. It is obvious that they may be cast so as to match to each other very closely, and allow but little steam-space for what is denominated clearance or valve passages.

I have described the piston G as connected by the rods E to a cranked shaft, carrying a heavy pulley, which may serve as a fly-wheel, and also as a means of giving motion by a belt to any suitable machinery. It will be obvious that, instead of the crank-shaft D, the piston G may, if desired, be connected directly to the plunger of the pump, or to a beam which is connected to a pump or other resistance.

There may be additional discharge-valves, similar to the valve *m*, on the upper portion I of the folding sides.

I claim as my invention—

1. An engine for working by steam or other fluid, having the hinged ends I J, in combination with the piston G, side pieces B B, and valve-chests A, all substantially as herein set forth.

2. In combination with the folding ends I J, piston G, side pieces B B, and steam-chests A, the exhaust-valves *m*, adapted to allow a free discharge during the return movement, as herein specified.

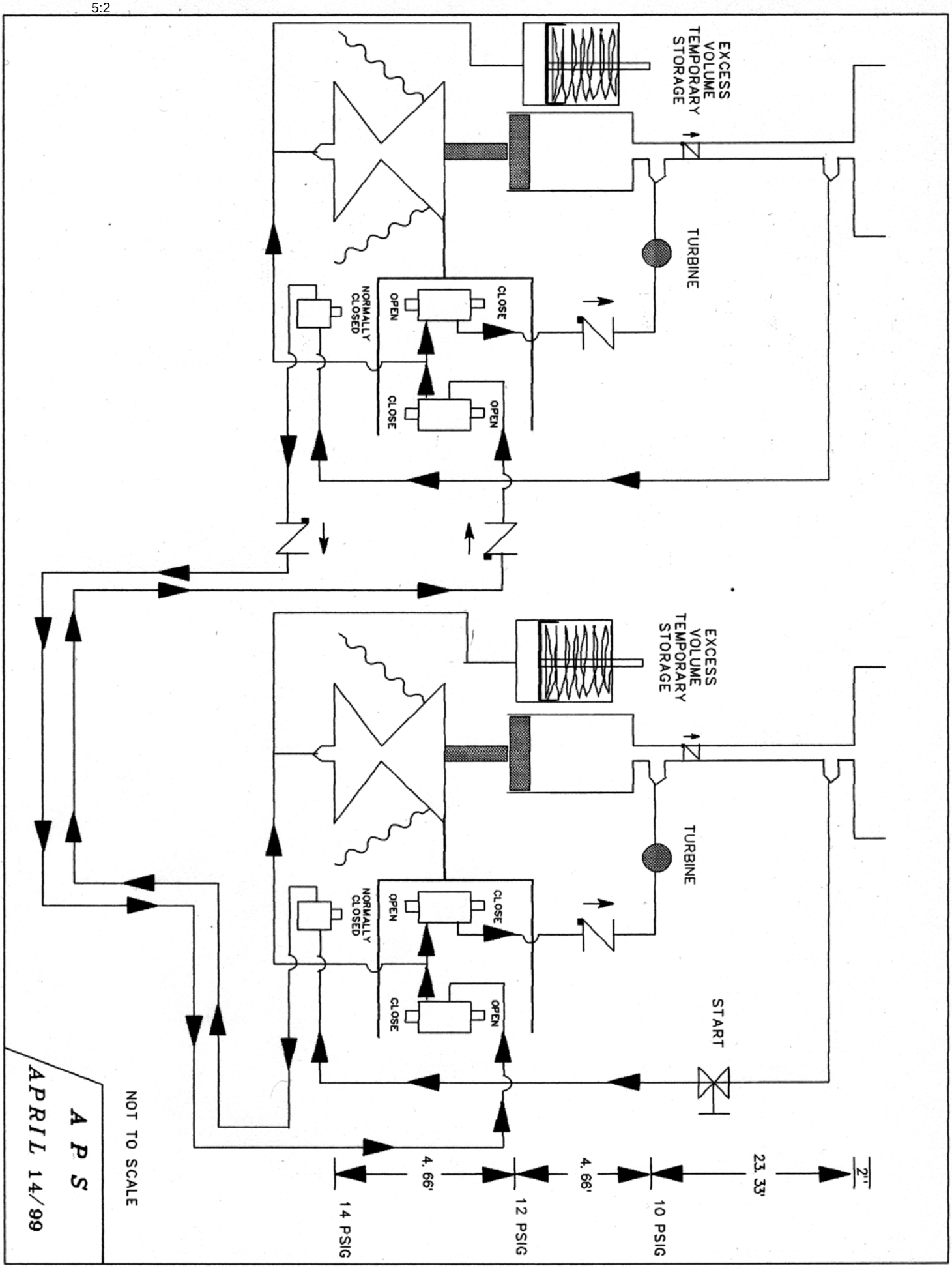
In testimony whereof I have hereunto set my hand this 17th day of December, 1873, in the presence of two subscribing witnesses.

TERENCE F. REILLEY.

Witnesses:

WM. C. DEY,

LUCIUS W. HOW.


EXCESS VOLUME TEMPORARY STORAGE
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NORMALLY CLOSED
OPEN
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START
NOT TO SCALE
A P S
APRIL 14/99
14 PSIG
4. 66'
12 PSIG
4. 66'
10 PSIG
23. 33'
2''

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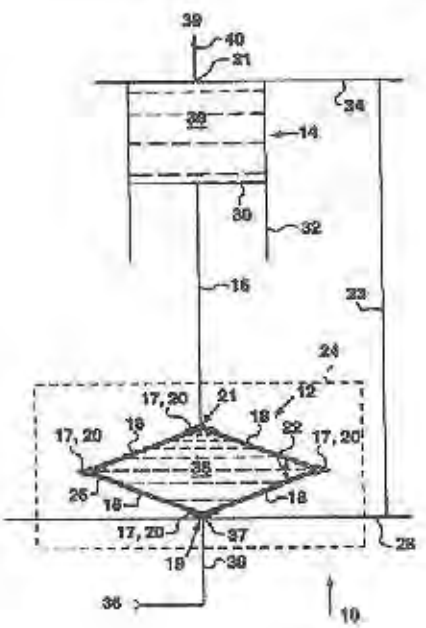
Primary Examiner—F. Daniel Lopez
(74) *Attorney, Agent, or Firm*—Bereskin & Parr

(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 appuratus 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



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**

Strain, David
35 O'Brien Avenue
Stouffville, Ontario L4A 1G6/CA

Alain Pompidou

Präsident des Europäischen Patentamts
President of the European Patent Office
Président de l'Office européen des brevets

München, den
Munich,
Fait à Munich, le 20.10.04

EPA/EPO/OEB Form 2031 07.04

Office de la propriété intellectuelle du Canada
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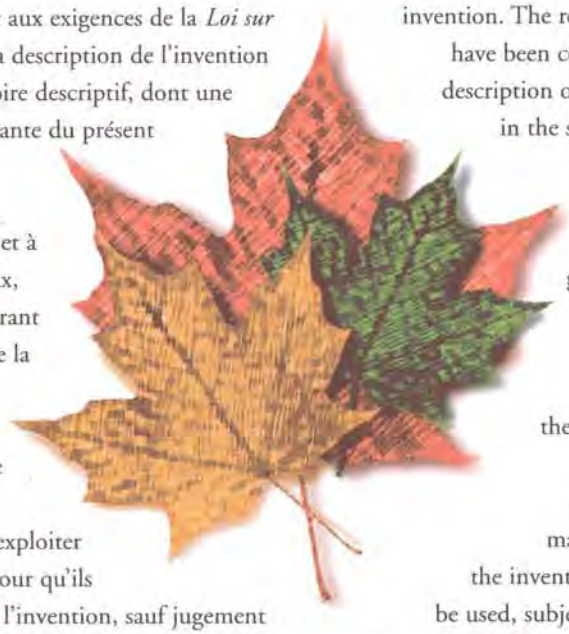
Brevet canadien / Canadian Patent

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

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