The STEAM AUTOMOBILE Bulletin

VOLUME 19, NUMBER 6 OCTOBER - NOVEMBER, 2005

1922 Stanley 740 A

PRESIDENT'S MESSAGE

The September 15-17 meet here in Berrien Springs, Michigan was a success. Success here is being defined as something that is over. About 45 people attended and everyone left happy. The main benefits of these meets are the opportunities to meet and visit with other steam people from all over the country. Some flew in from San Diego and Texas and some trailered steam vehicles in from California and Florida. We are sorry to report that Peter Barrett and his son Philip did not make it as Pete hurt his leg while on the way out and had to turn back. His VW conversion has been worked on and is reported to be running well. We all wanted to see it compete in the Time Trials. The SACA Time Trials were run safely. The results will be reported in another article.

We want to thank Jay Carter for putting up the $1,000 first prize for 8 years in a row for first place in the time trials. The Time Trials are a one vehicle at a time standing start timed run over a 660 foot, which is one-eighth of a mile, course. We do not use the word race anywhere in here because our insurance company does not like to see that word and besides that it takes more than one vehicle to have a race. For the first 6 time trials the club treasury put up a thousand dollars to be distributed among the participants. The Board voted two years ago to not use club monies for prize money. Last year $1,500 was raised and distributed among the 6 other vehicles and this year $810 was raised by donations from club members and $190 was contributed by the club treasury to make an even one thousand dollars for prize money. We want to thank the SACA-Northeast group for loaning us their electronic timer. This made for a much simpler event with much less human error than in previous events. We want to thank Bob Edwards for supervising the event this year.

We have found a volunteer in new member Frankie Fruge from Pompano Beach, Florida to head the Time Trials Committee. She will be contacting members to assist her and we urge you to respond positively. A significant investment has been made to the Time Trials project by Jay Carter and by the club itself. We want to build on this history to increase the contribution that the Time Trials makes to the general welfare of the club. The purpose of this event is to encourage the making of new steam powered vehicles and the attendance of old steam powered vehicles; to engender enthusiasm among our members, and publicity for the club to the general public. We will be widening the contributor base for the prize money. We will be encouraging steam vehicle development throughout the year. We will be sending out photos and reports of the Time Trials to other magazines. Our goal is always to have an event that is safe for the participants and spectators, that is inherently fair, and that is fun for all. For the last two years this event has been held at the GingerMan Raceway in South Haven, Michigan and it has been a success.

We want to thank Scott Haines for bringing to the SACA Archives several boxes of the late Al Reynolds's accumulated steam club related materials. There are audio tapes and old movies and rolls of blueprints. We plan on digitizing the movies and scanning the blueprints. An inventory of the club archives will be made as time allows. We also want to remember the years of work that Al devoted to the club in his role of club Treasurer, President, and Editor, as well as his hosting of the Chicagoland annual meet for many years in Danville.

Recently I have been reading and proof-reading the entire Steam Automobile volumes beginning in 1958 that we have scanned. As soon as that work is done the club will offer for sale the accumulated publications of The Steam Automobile, the Modeltec years, Steam Power, and Steam Calliope in both a digitized CD format and print form. There is a wealth of accumulated knowledge, along with some other material, in these publications. Much spinning of wheels would be avoided by acquainting one's self with this information. In the course of reading this historical material it is apparent that there is a disease that afflicts people beginning to work with steam power, and that is to design exotic and complex and novel ways to turn reciprocating motion into rotary motion. It is my personal suggestion to stick with crankshafts and connecting rods. To do so may appear to be mundane, but steam power is complex enough as it is. Thus it is with trepidation that I mention a new engine design illustrated in the August, 2005 Automotive Engineering International magazine on page 22. This is the official Society

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Walter Winship and his 1922 Stanley 740 A

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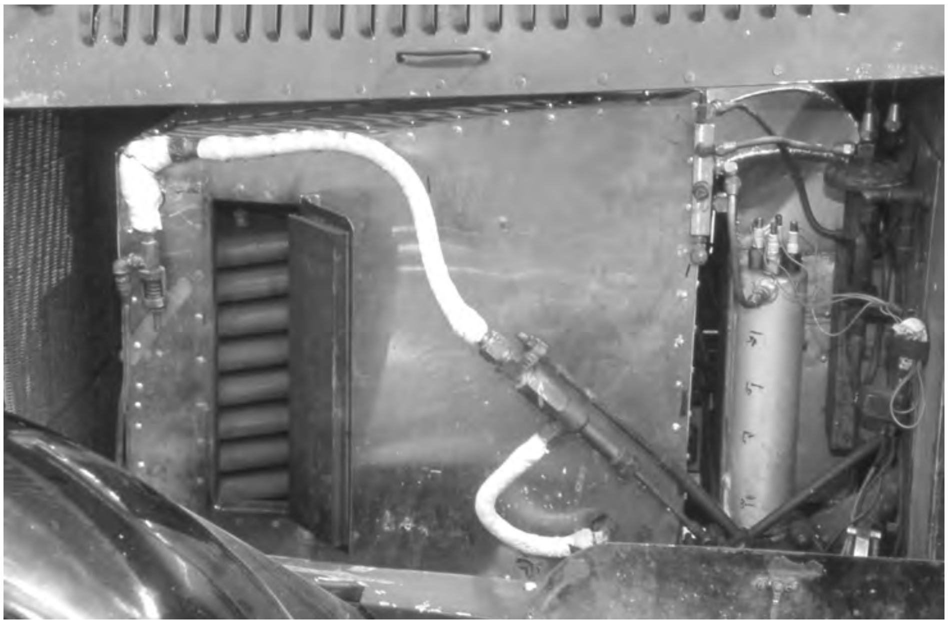


Walter Winship's homemade Derr boiler in his 1922 Stanley 740 A as featured on the cover

This article on the Derr boiler is copied from "The Modern Steam Car And Its Background" by Thomas S. Derr 1932 p. 71-73

The Derr Boiler

The water-tube boiler is the outstanding improvement in steam cars in the last few years. The design, it will be noted, is an adaptation of the well-known cross-drum type of water-tube boiler used throughout the world in many electric power stations and other large steam power plants. It eliminates boiler and super-heater difficulties. It steams up in less time than the old type boilers formerly used.

The boiler is made entirely of seamless steel tubing of a quality and thickness to meet the specifications of the American Society of Mechanical Engineers for boiler tubing.

All joints are electrically welded, making the boiler in effect a single piece of steel without flaw or imperfection. No welded joint in these boilers which has passed our inspection has ever leaked or failed.

The design has several advantages. Extremely high pressure may be carried,—1,000 pounds per square inch if wanted. The weight is small in comparison to the output. This type of boiler has great ability to withstand hard usage. It has even withstood determined efforts to operate it without water. There is a vigorous water circulation in it, with the result that the steam

Modern Automobile Water-Tube Boiler

delivered is almost entirely free from entrained moisture. Clean-out openings are provided opposite the ends of the tubes in the three bottom rows. Thus scale or sediment may easily be removed if necessary. There are also several clean-out openings in the mud drum. The sectional construction permits any section to be removed, repaired, and replaced, if it should be necessary after many years of use.

In accordance with modern practice, the superheater is so placed as to be protected from the most intense heat of the fire, consequently it will never burn out in the course of normal service. It has a large heating surface, consequently steam is delivered to the engine as hot as it is advisable to use, and at a *remarkably constant temperature.*

The boilers are built with a mud drum, located outside the burner, in which sediment collects. This may be blown out through bottom blow-off valves. The drum is provided with several holes for forcibly cleaning out the sediment if necessary with a swab.

Each boiler is equipped with a flexible three-point support which permits expansion without strain, and eliminates any possible twisting stresses from the frame of the car.

An Experiment with Old Boilers

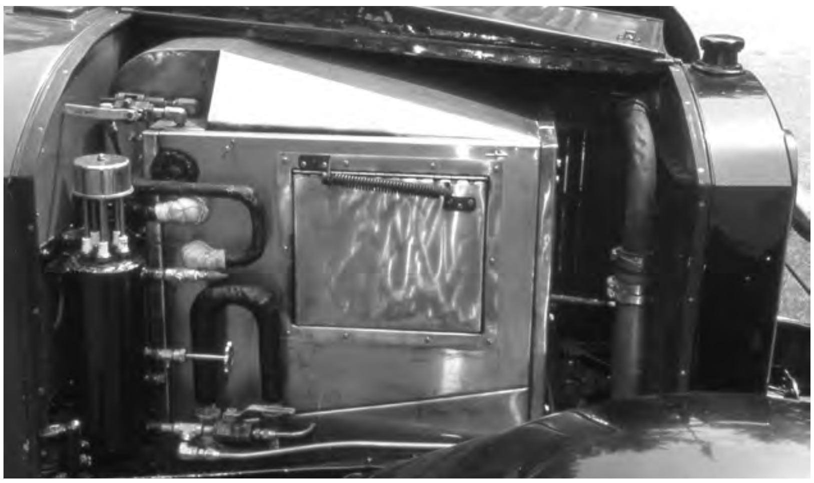
By David Nergaard

During the recent steam car tour in Lakeville, Connecticut, two of us were using old and tired boilers, beginning to leak in a serious manner. One of us, Ron Hardwig, had a copper tubed boiler and the other, myself, a steel tubed one. We both tried off the shelf radiator leak stop compounds in attempts to complete the tour. They were different brands of similar composition; they appeared to be suspensions of colloidal copper in a sodium silicate solution.

Ron Hardwig poured his treatment into a cold boiler before starting for the tour and drained the excess on arrival, with his car on a trailer, in Lakeville. I siphoned the compound into a warm boiler and made no attempt to drain the excess.

In both cases, a modest success was gained; approximately another hundred miles of trouble free steaming. However, serious leaking recurred soon. Thus, the procedure can be recommended, but only as a "last ditch" effort to drive the car home or complete an important tour. We can not advise using this method on any boiler one expects to repair at a future time.

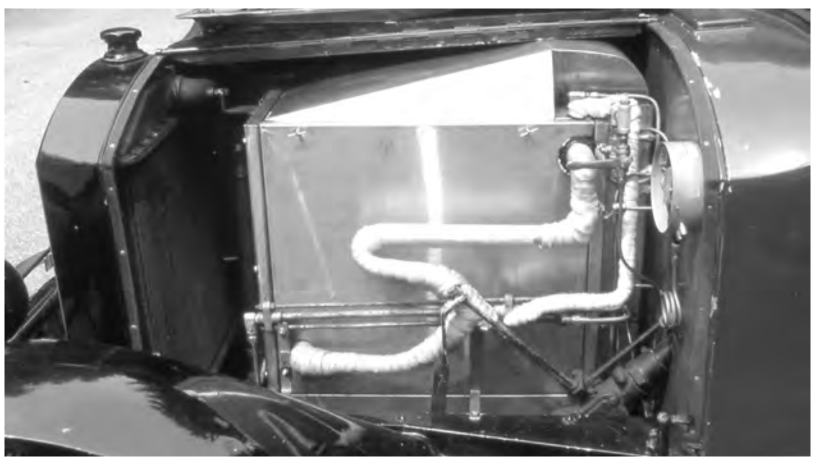
Rolly Evans and his 1920 Stanley with his modified Derr boiler at the August SACA-Northeast meet in New Hampshire



Derr boiler installation in Rolly's 1920 Stanley

Right side view

Left side view



The Derr Boiler

By Rolly Evans

I first became interested in the Derr boiler after seeing SACA-NE member Craig Standbridge build and use one for powering a 1982 S10 pickup truck. His boiler responded very well and the truck can maintain good speed of fifty to sixty miles per hour with a twenty horse power Stanley engine.

Another SACA member, Howard Langdon, has used one similar in size that most SACA members may be familiar with, The Green Monster, as written about in the Bulletin (See Vol 12-4). Howard's differs somewhat; he has a larger drum on top to collect the steam.

Craig built his boiler after borrowing an original old boiler from another member of SACA-NE Richard Dickey, and copying the size and construction using standard schedule forty pipe of the size nearest the original Derr boiler.

I asked if he made any drawings and the answer was no. I have never seen the actual boiler Craig built with the casing off, only a few photos.

I inquired from Richard Dickey the owner of the original boiler if I could see it and take some measurements. I was told come and take it home for as long as needed. This was great. One Saturday, my friend Richard Olivier and I went and got the old boiler and loaded it on my truck to take home. The boiler had a section cut from it and this made it easier to measure the wall thickness of the original pipe used in its construction. I measured everything I needed. Over the next several months I made AutoCAD drawings of this boiler.

The boiler weighs a little more than a Stanley boiler and carries about half the amount of water. Derr designed this boiler to be a replacement boiler for the Stanley and fit in the same place with little modification to the car. The original burner can also be used. This boiler is much safer then the original, although the original has a very good safety record. You can read about this boiler in The Modern Steam Car page 70 published by Floyd Clymer .

Richard Dickey's old Derr boiler

This boiler can be built to the ASME code by any holder of an S stamp and be certified for well over a thousand PSI. There are no leaking tubes to be concerned about and with proper maintenance it will last for forty years, or longer than most of us will be using the car. The owner of the original boiler Richard Dickey has, has two Stanleys fitted with Derr boilers and both perform very well. One boiler is well over forty years old and takes a twelve hundred pound hydro test. Forty years might be stretching it a bit, but you get the point.

One of the drawbacks to this boiler is the labor required to cut and prep all the pieces of pipe needed for its construction, and the extensive welding. If you had this built by a code shop with the price of labor, this boiler will cost more than an original Stanley designed boiler. But you would have a Code boiler that could be used anywhere in the country. The Stanley boiler cannot be built to the ASME code as designed. Wire wrapping of pressure vessels is allowed in some sections of the code but not for fired pressure vessels. To build the Stanley boiler to the ASME code for six hundred pound use, the shell for a twenty-three inch boiler would need to be around three-quarters of an inch thick. For an eighteen-inch high boiler just the shell would weigh three hundred pounds. This would push the total weight to around seven hundred pounds.

The Derr design is like a miniature power plant standard two-drum water tube boiler with ten grids of horizontal tubes sloped at ten degrees, only there is no upper drum that carries a water level, just a small drum to act as space to collect the steam. The water level is carried about half way up the grid nest and can circulate freely. The steam water mix rises up the front vertical tubes and the steam and water mixture separates as it flows back down the upper dry tubes to the rear vertical tubes. The steam rises in the rear vertical tubes and the water falls back to the bottom to circulate again. The steam is collected at the top drum very wet and goes to the throttle valve and then down into the super heater. The super heater is about sixty feet of three-eighths pipe located just above the first two rows of horizontal tubes. This is configured in three layers of tightly bent horizontal grids.

Super heater

The Derr boiler has about fifty square feet of gas cross flow heating surface (turbulent flow) and about one hundred square inches of free gas pass space up through the tubes. This is comparable with a twenty-three inch Stanley boiler. The Stanley boiler has about one hundred and fifty square feet that is low velocity laminar flow, much lower heat transfer. You cannot count all the tube area of the Stanley boiler nor can you count all the tube area of the Derr for total heat transfer. The Derr boiler can be forced much more than the Stanley boiler without damage. The one used in the S10 is fired with 6.6 gallons per hour and the Green Monster used over twenty gallons per hour. Craig and George Nutz reported that the S10 boiler exhibits excellent superheat temperature stability around 700 F. However, George also reported in his testing that the Derr may run with a higher flue temperature then a Stanley with the same firing rate.

I have a habit of not leaving things alone. I always ask myself can this be improved; in this case what would make the original Derr perform as a better boiler. There is so much labor involved in building this type of boiler I think Mr. Derr had to stay with a design that would be cost effective and still power the car at the original performance level.

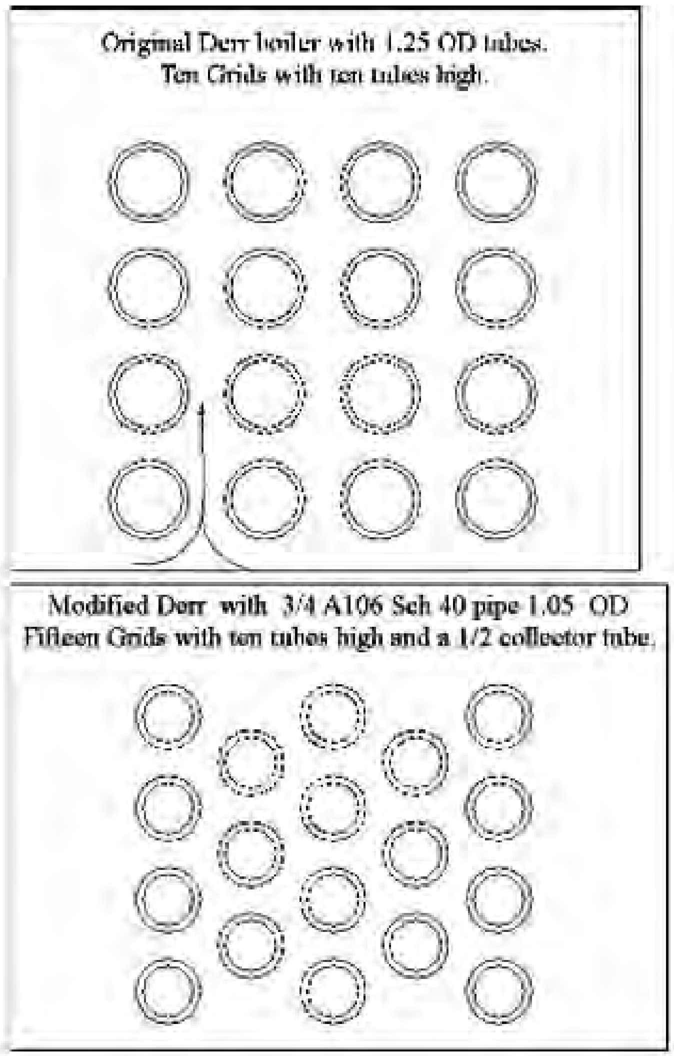
The original Derr only has about 100 sq inch of gas pass space. On the Craig boiler he runs a stack blower 12V fan to help with the burn rate, burning six gallons per hour. I think the gas pass space can be increased providing the flow area will do some work.

By staggering the arrangement of the grids, raising every other grid half the distance between two tubes we can improve the gas flow around the

Grid assembly

tubes. I started playing with tube arraignment in AutoCAD and found if I reduced the tube diameter I could get more square feet of heating surface in the same area, and also increase the gas pass area. This will increase the weight of the boiler somewhat.

I redesigned the boiler using standard Sch 40 & Sch 80 pipe not tube. High pressure A-106 pipe is more readily available then boiler tube such as A-178. I now have fifteen grids of smaller pipe in about the same configuration and dimensions as



the original ten grids. It is important if the boiler is going to be used in a condensing Stanley not to change the overall dimensions of the boiler, as the original Derr was a tight fit.

Every other grid has the tube layout staged vertically to force the gas to flow around the tubes instead of just between the grids. This should increase the heat transfer and efficiency of the boiler. Having more grids and smaller tubes increased the Square foot area.

The original Derr inside surface area of only the horizontal tubes was 45 square feet and my modified design has 56 square feet. This is an increase of 25% in heating surface. The volume of water has remained about the same–ten gallons. But the boiler is run only half full at between five or six gallons–the top half is steam space and circulation area.

The bottom ten tubes of the original Derr against the fire counting only half the inside area is 2.25 sqare feet. My modified Derr has 2.82 square feet. This direct radiant heat area or area directly exposed to the flame also increased by 25%. The gas pass area went from 100 square inches to 130 square inches, but with more turbulent flow.

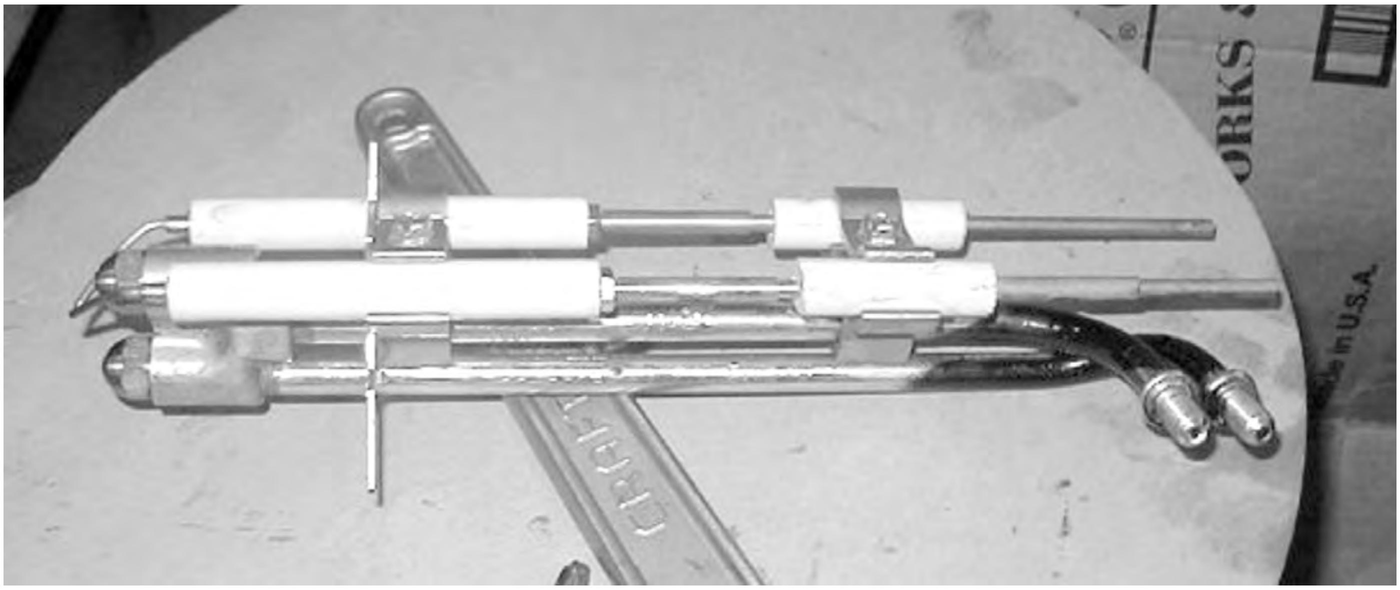
The radiant heat area or area directly exposed to the flame of the twenty-three inch Stanley boiler less 750 tubes is only 1.6 square feet.

I wonder with so much labor involved to build this type of boiler just how many Derr boilers were built.

My modified Derr boiler, pressure vessel, is now complete and Hydro tested at 2100 lbs. It was stressed relieved at a heat-treating shop and re-Hydro.

I built the casing of stainless steel obtained from a scrap yard. It is heaver than it needs to be using 18-gauge stock, but the price was only sixty dollars for two large sheets. I did buy a sheet of 310 SS for the combustion chamber, rather expensive.

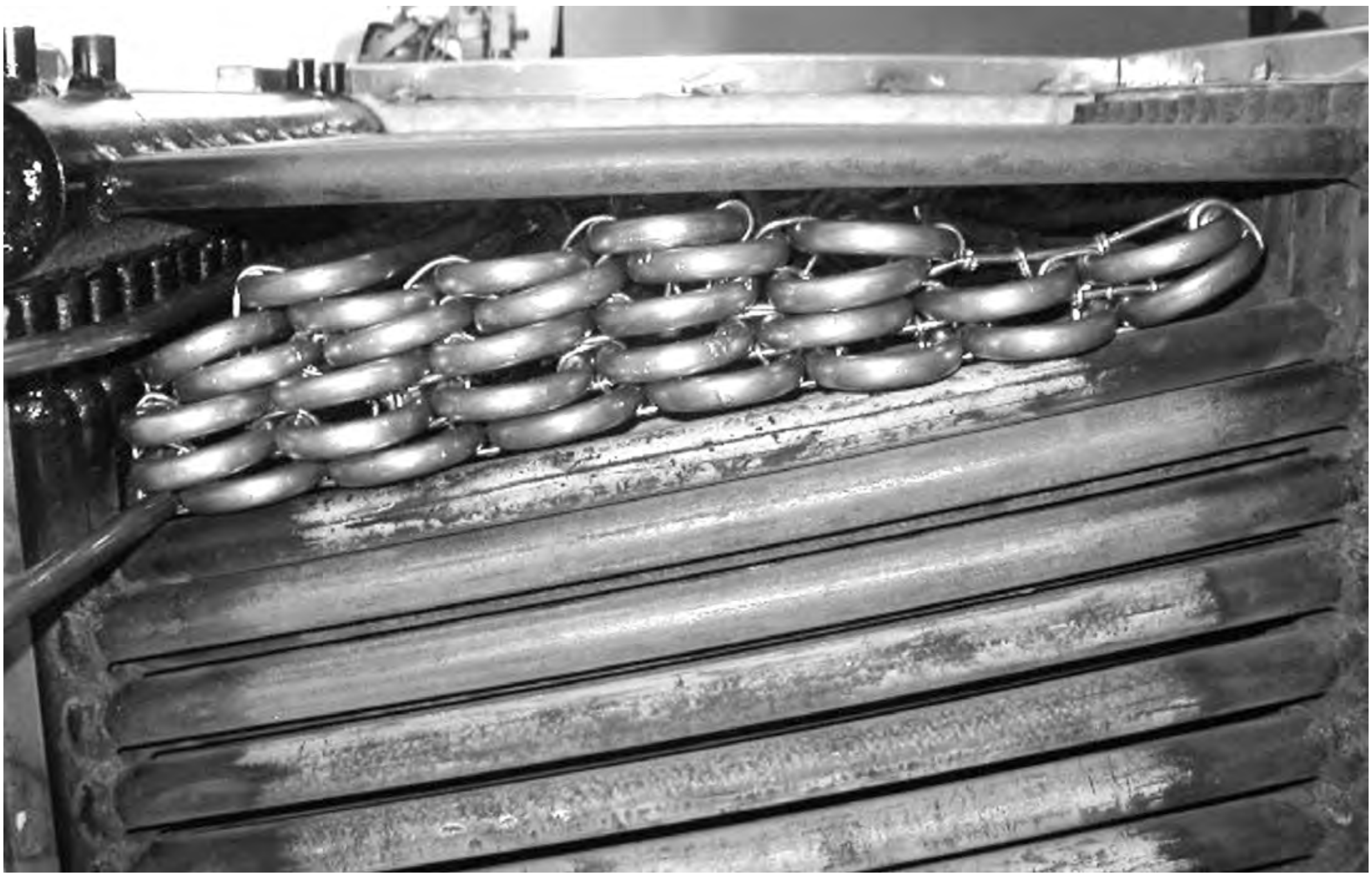
Combustion chamber



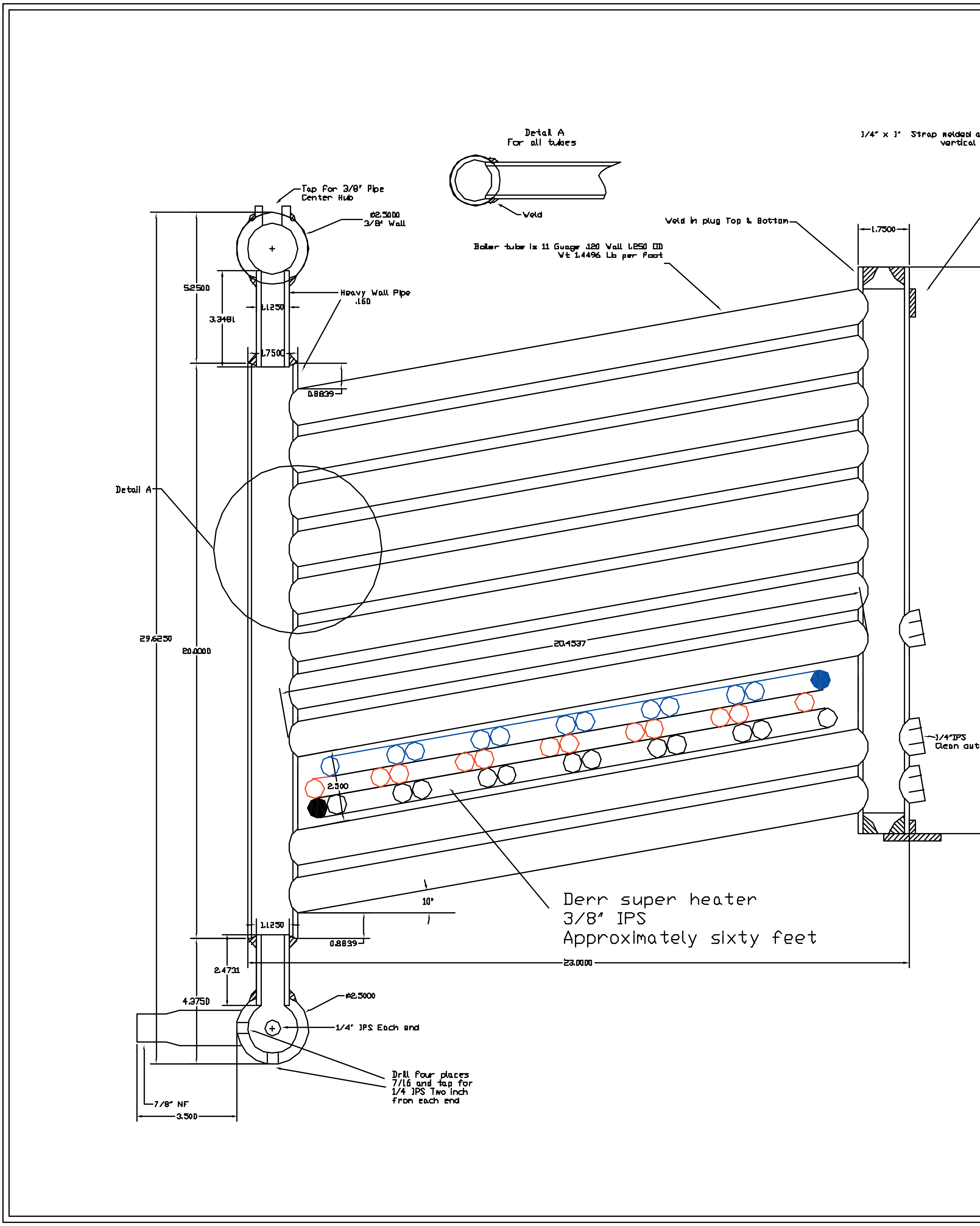
Oil burner nozzles

The burner is an oil burner of my design. It has two nozzles for a high and low fire. I start it on a two gal burn and after the steam pressure reaches 100 PSI, I switch to a complete burn of six GPH. This keeps the boiler from smoking till everything gets hot.

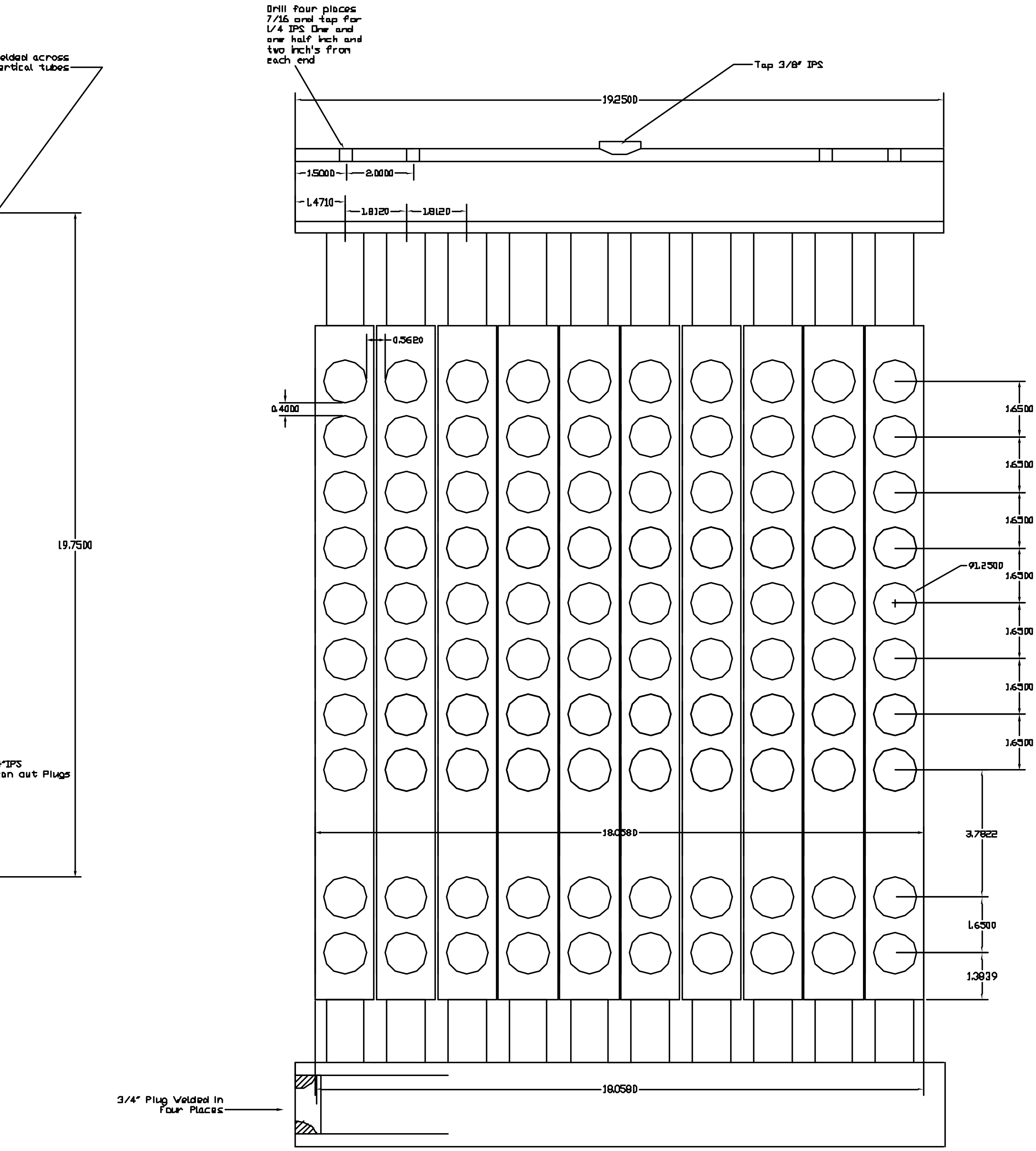
The boiler is now installed in my 1920 Stanley and is running rather well. I can maintain more steam than I can safely use. I am experiencing some problems with the pressure regulator, some times it sticks on relight, not starting till the pressure drops to 300 PSI. This needs to be changed.



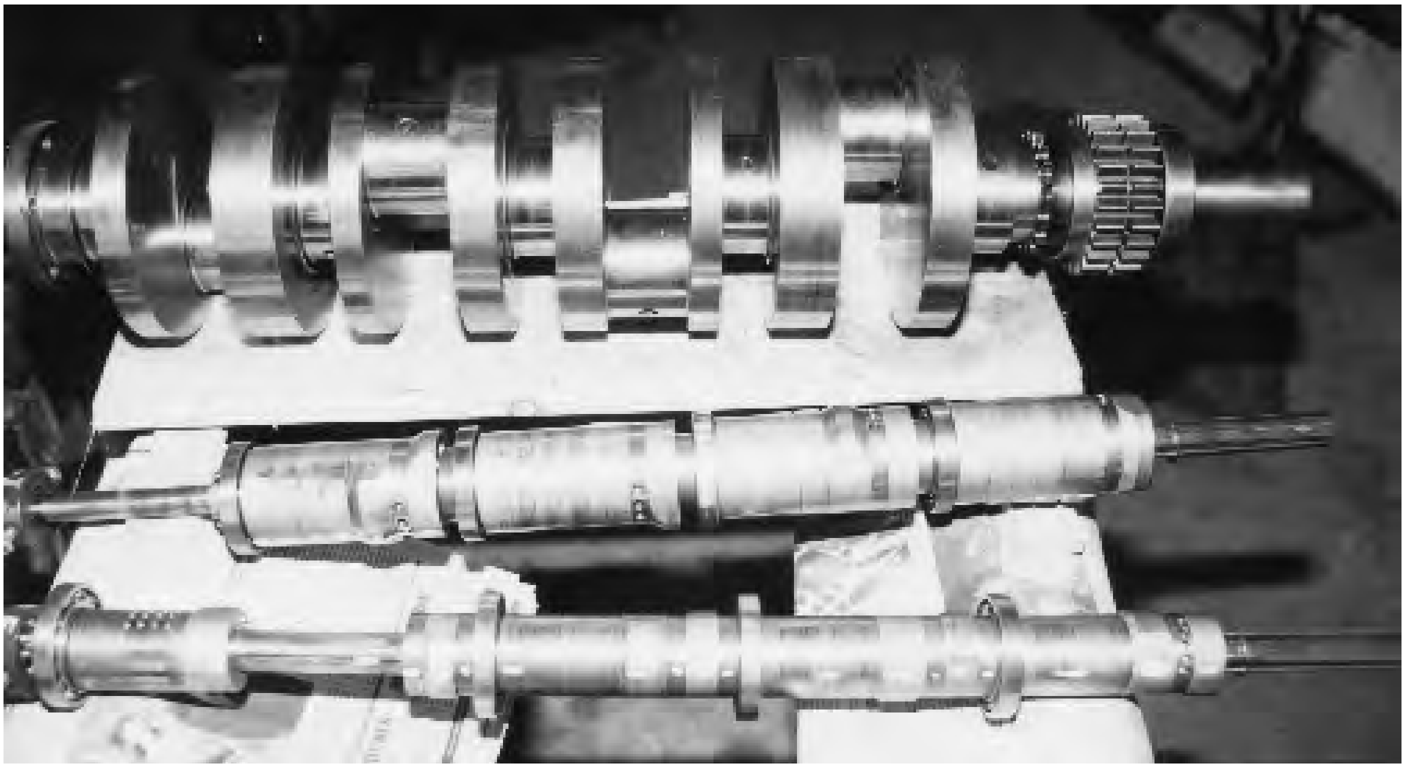
Economizer in place



Detail A
For all tubes
Weld
1/4" x 1" Strap welded a
vertical
Tap for 3/8" Pipe
Center Hub
Ø2.5000
3/8" Wall
Weld in plug Top & Bottom
1.7500
Boiler tube is 11 Guage .120 Wall 1.250 OD
Wt 1.4496 Lb per Foot
5.2500
3.3481
1.1250
Heavy Wall Pipe
.160
1.7500
0.8839
Detail A
29.6250
20.0000
20.4537
2.500
1/4"IPS
Clean out
10°
Derr super heater
3/8" IPS
Approximately sixty feet
1.1250
0.8839
23.0000
2.4731
4.3750
Ø2.5000
1/4" IPS Each end
Drill four places
7/16 and tap for
1/4 IPS Two inch
from each end
7/8" NF
3.500



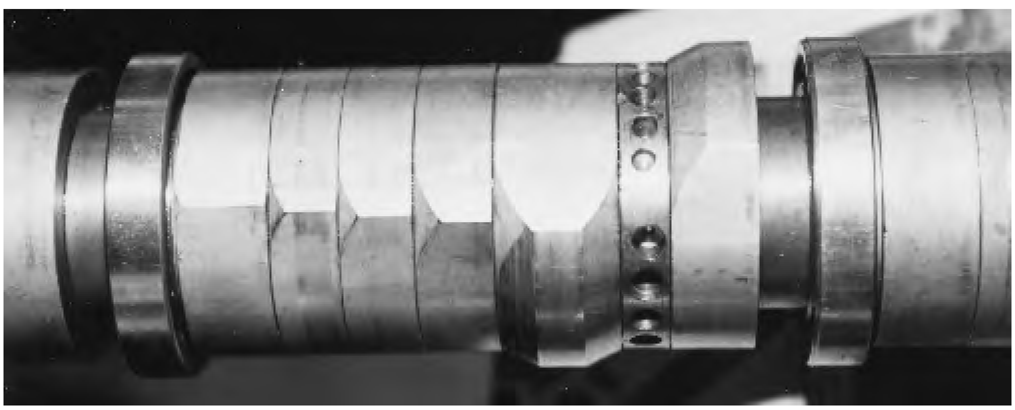
The Derr boiler drawn from an original
7-6-02 by Roland JF Evans



Williams 265 bus engine crankshaft plus two sliding camshafts

of Automotive Engineering magazine and thus a reputable publication. The one page article complete with full color illustrations is entitled "Slider Engine and the Scotch Yoke". This is a report on the development work of an Australian company, "Slider Engine Technologies". Of interest to steam people is the fact that the Scotch yoke engine has cross-heads. As a practical matter Scotch yokes have been useful as pumps and not as engines. This can be understood if one looks carefully at the geometry of this mechanism. The geometry generates maximum torque at the start of the pumping stroke when used as a pump whereas it generates significant stresses at top dead center at the beginning of the power stroke when used as an engine. It is not clearly explained in the article, but it appears that something else is added to this Australian engine to get over the bad geometry of the power stroke.

People who are smarter than I am and who have more experience with steam systems brought to my attention a mistake that I made in a previous article. I had interviewed Richard French who was giving an anecdotal account of riding in the Williams' Victress car, the one with the 105 c.i.d. engine. To illustrate the situation and the incorrect impression that I had left in the article please look at the accompanying photos. These are of the crankshaft, intake camshaft, and exhaust camshaft of the Williams' 265 c.i.d. bus engine. The enlarged photo is of the intake camshaft. These two engines are of identical exterior configuration and we are assuming of identical interior design. You will see that at long cut-off forward and reverse there is a long cut-off exhaust valve opening for counter-flow exhausting. Then there are 4 other forward cams on the camshaft giving shorter and shorter cut-off. As you will recall Dick French stated that there was a



5 forward cam lobes, 1 reverse lobe

lot of power generated by the engine when it was shifted from the auxiliary exhaust mode into the uniflow, high recompression, mode. As you can see from the photo the next cam to the starting cam gives a pretty long cut-off. The person who corrected my article said that at this first uniflow cam the engine was not working at peak thermal efficiency when on that cam lobe but was probably generating 3 horsepower per cubic inch and therefore the power that Dick French experienced came more from the long cut-off than from the "Williams' Cycle". Here are the photos of the cams and you can draw your own conclusions.

In reading the past issues of the club publications I became acquainted with the late Harry Peterson. He was a retired Detroit policeman and a constructor of over 50 replacement boilers of his own design for Stanleys. The stories are that these boilers were heavy and not that efficient but great steamers and very reliable. I think it would be instructive for us to print a good article on the design and construction of these boilers. So far I have not located either an actual boiler or a design print. If anyone has this information, or an anecdotal account of the Peterson Boiler, please contact me.

I have been asked by one of our members to locate the Alick Clarkson V-6 steam engine. Alick was the son of the Clarkson bus people from England. He was living on a large ranch in Douglas, Arizona in the early 1960's and working on a steam automobile with Carl Guth doing a lot of the fabrication work on the boiler. As has happened many times in the history of steam automobile development, Alick died just as this engine and boiler system was being perfected. Any information about it would be appreciated.

At about the same time period a person named Galliano, or of some similar spelling, up in the Northwest was making a small steam cart named the "Geni". As I understand it the design used a VW front end, a Harley-Davidson 3-wheeler rear end because it used a chain drive, and a Day-Land steam engine. This made for a very practical small steam powered vehicle. One of our long-time members has suggested to me that the plans for this vehicle would be of value to our club. Therefore any information on this vehicle or its plans or the history of why it did not go into production would be appreciated.

At our recent board meeting the board of directors discussed at great length and then accepted Editor Dave Nergaard's resignation. Dave will have more time to write articles for the Bulletin. You will notice his three short articles in this issue. Dave will have more time to work on his Stanley and White, both of which have boiler issues. One might conclude that the work on these steam automobiles might provide material for more hands-on practical experience articles for our education. Dave also has plans for a three-cylinder high speed uni-flow steam engine when he gets the time. Dave has one of the largest collections of steam literature in existence and one that I have seen with my own eyes while visiting his house. The literature collection fills the main floor of the house and the machine shop fills the basement and the steam cars fill the garage. We appreciate the work that he has done for the club, his engineer's insistence on getting the Bulletin out on time, his penchant for accuracy, and his practical knowledge of steam cars. Most of his practical knowledge comes from the fact that until recently he did not have a truck and trailer for his Stanley. When there was a steam tour he had to drive to it.
Dave continues as the Vice-President of the club and we are in regular communication. I can assure the club members that with Dave as Vice-President and Mark Cantor as Treasurer the club financial affairs are being closely watched. Not all of you have had the privilege of meeting these people in person and thus you will have to take my word for it that neither of them is bashful about voicing an opinion. They have the best interests of the club in mind.

We will soon be looking for an editor for the Bulletin. This can be a one person or a several person job. At the most it involves 4 different jobs. The basic material is generated by club members in the form of photos and reporting from meets, interviews with people who have made something or fixed up an older auto, a book review, or a "how I found an auto and worked on it" first person article. Someone is then needed to call, write, email, or otherwise cajole people into getting the article done and sent in. The editor needs to determine what to put in which issue and to get most of the information correct and people's names spelled correctly. There are basic decisions on length of the Bulletin, sizes of the photos, and amount of historical material to include. Some time is spent getting permission from people to print their photos and permission from other magazines to re-print articles. Then there needs to be a person who is a computer literate person who can use a scanner and an Adobe Photoshop software program. This person gets the photos gray-scaled and cropped and puts everything into the existing templates and then tells the editor how much room is left over. Once the magazine is in digital form it is either put on a CD or emailed to the printer. Then someone prints out the address labels and puts them and the postage on and takes them to the post office.

As you can see there can be 5 different people working on this project and all they need is a computer to communicate between them. Each of these different tasks is portable and can be done anywhere in the world. The basic function of the Bulletin is to advertise local SACA meets and to advertise steam automobiles for sale and to let the club membership know that we are all functioning and working with steam automobiles.

Other board business was to vote to form a three person nominating committee for the club. We are now looking for people for this committee. The qualifications, besides volunteering in the first place, are to be comfortable calling and talking to all of the club members to find out who is willing to do some club work. The club is always looking for people to work on committees and then to be nominated for board positions and from time to time staff positions will open up and need to be filled. All club work is done by volunteers. We plan to continue with this system.

Improving Performance in Condensing Steam Cars

By David Nergaard

For this discussion, I am limiting myself to touring performance, making the best average speed on long trips. One might define a long trip as one requiring more than one tank of fuel. I grant that this subject won't appeal to many of the readers as very few of us drive our cars TO as well as AT meets. (Even fewer of us succeed in driving home from meets!)

I have very limited experience with cars other than the condensing Stanley. So most of what follows will pertain to those cars. I invite those who have touring experience with other makes to write it up for these pages.

My own car is a much modified Stanley 735 which was hard pressed to maintain 30 mph. and needed water every 25 miles when I bought it in 1970. Through the years, I have tried to improve its performance in a number of ways, almost every thing but increasing the size of the boiler.

In fact, I have come to the conclusion that increasing boiler output would not only be an expensive and difficult way to improve performance, on long trips it might be counter productive! Even with the existing 20 hp. Stanley boiler and its very tired burner, my speed is limited not by how much steam I can make, but by how much I can condense. As the power required increases very rapidly with speed at any speed where air resistance is significant, but the condenser's capacity only increases directly with speed, there is a speed above which one can not condense all the steam used, even on perfectly level roads. Thus, once above that speed, the faster one drives, the more often he must make water stops.

Depending on how quickly one can make a water stop, it can easily happen that the faster one drives, the slower he gets there! In my experience, with my car in its present condition, the optimum speed seems to be about 35 mph., at which speed I usually get about 100 miles between water stops. At 30 mph. I could probably drive all day without needing a water stop, if one of the hundreds of frustrated drivers behind me didn't kill me first.

As the condenser on a Stanley is already about as big as it can get, how does one increase its capacity? Keep it clean, fit an oil separator! Getting the oil out of the condensate is a good idea in any event, but here is an additional benefit. My guess is that this alone increased my range by a fourth.

Make sure it gets the maximum air flow. The owner's manual makes a point of saying the license plate should not be mounted in front of the condenser, but this applies equally to anything behind it that can interfere with air flow. Fitting a good fan should be beneficial, but I have not had any luck with this so far. My fans have not been good enough, probably a result of trying to run 12 Volt flea market fans on a 6 Volt system. Ideally, an exhaust steam driven motor driven fan should be used, the fan will work hardest when it is most needed.

It is possible an improved core might increase condenser efficiency. I have measured the temperature of the air at the back of the condenser and never found it to be higher than 150 degrees Fahrenheit That implies that a better core would increase the capacity of the condenser; with a perfect condenser the exiting air temperature would be that of the steam being condensed.

Well, assume the condensing system has been brought to its limit, which might be half again as good as the original. Which, by the way, might be good enough to condense all the steam from a stock Stanley boiler. What can one do now to get more power without sacrificing range? The answer is obvious, and possibly the best choice from the start; an engine that needs less steam to make the required power!

The Stanley engine is a single expansion slide valved engine. It is unrealistic to call it efficient. The best test I have ever seen, published in the last Bulletin, showed it needed at least twenty pounds of steam per horse power hour, and that, only under nearly full throttle conditions. In normal driving, 30-40 pounds per horse power hour may be closer to the truth.

In 1906, a White engine under test used less than 12 lb/hp hr at full power and only about half again as much at one fourth power. Doble's compound engines under test conditions were slightly better, using about ten pounds of steam per horse power hour. Thus, fitting a compound engine to a Stanley would be of considerable help to the long distance driver. But, there are some problems. First, a compound engine is not necessarily self starting, some scheme of getting steam into both cylinders at the start is needed. White and Lane used simpling valves, converting the engine into a two cylinder single expansion engine for starting. Doble preferred receiver charging valves, which bypassed some steam around the high pressure cylinder into the low pressure one without altering the exhaust porting.

Also, a compound engine is not so smooth as a Stanley. To get smooth running, it is desirable to have the two cylinders make the same power. This is not difficult in an engine that always runs at one torque, like a marine engine at economical cruise speed, fitted with a valve gear that allows indivdual setting of the cut off in each cylinder. But a car seldom runs two minutes at the same power and to adjust the cutoff of each cylinder each time one alters the throttle setting doesn't seem practical, even if the engine is fitted with the independent reverse linkages required! I think the very expensive Doble "E" series four cylinder engine was an attempt to resolve this issue, and, possibly, get a self starting engine without extra gadgetry.

So some compromise is indicated. For example, design for smooth torque at the accelerations commonly used in city driving and accept any remaining roughness in highway driving. Be that as it may, a saving of about a third of the steam is likely if the Stanley engine is replaced with an appropriately sized compound. Or looking at it the other way, nearly 30 horse power performance from a 20 hp. boiler. Finding the appropriate size may be a problem, compound engines are not as flexible as singles. If the engine is sized to perform well in moderately rolling country, it may be unable to climb hills in many States. Yes, one can use the simpling valve to get more torque, but in this mode, will probably use more steam than a Stanley. It might run great in Kansas, but have to crawl from water stop to water stop in Colorado!

Or, if sized for mountain grades it may be too large to fit on a Stanley axle and have pistons heavy enough to shake your teeth loose at any speed above 40. Remember that balance in a two cylinder engine with cranks at 90 degrees is not possible, period. Okay, I admit that one could add a counter rotating shaft with extra counter weights. But that would probably make the engine too heavy for axle mounting. The Stanley answers to the problem were to run the engine slowly enough that the shaking forces weren't obvious, and, on early cars, use full elliptic springs all around so the engine could shake without shaking the body. This didn't work as well as it might have as the pumps were mounted in the body and the pump drive was at engine speed. Here is another reason for the Doble "E", with four cylinders; it could be configured to get good balance.

An alternative response to the lack of flexibility is to go the IC route; add a gear box. This, also, might preclude using a live axle mounted engine.

There is another efficient engine that could be considered, the uniflow. I have done a crude graphical analysis of a uniflow cylinder designed for 600 psi. service with 800 degree steam. At the very short cutoff intended for cruising on level roads, it theoretically needs less than 9 pounds of steam per horse power hour. In practice, one can not get the theoretical power, but 10 lb/hp. hr. is possible and better than 12 under cruise conditions is likely. If true, that would mean at least 35 hp. from a Stanley 20 hp. boiler, with the original burner. It would probably also mean 40-60 mph. with total condensation.

To be sure, there are problems. The uniflow cylinder generates high negative torque during the return or compression stroke of the piston. In fact, a two cylinder uniflow probably wouldn't even run at low speeds, the torque would be negative four times per revolution. For this reason, among others, Doble rejected his attempts to use the uniflow. He admitted that "a multiplicity of cylinders" would cure the problem, but never did the work to find what the required "multiplicity" was. Some three decades ago, several of us sat down with slide rules, steam tables and graph paper and worked it out. A "multiplicity" equals three. A three cylinder double acting uniflow should be smoother than a Stanley! It should be at its best at a cutoff of 12-15 percent, which is a good one for the torques used in city driving.

A three cylinder engine has an additional advantage; very good inherent balance. The acceleration forces on the pistons always sums to zero, including secondary forces (those due to the connecting rod being less than infinitely long). Thus, the fact that uniflow pistons are typically rather heavy is a bearing and rod design issue, but not necessarily a vibrational one. An unbalanced moment remains, but its effect on the car is likely to be smaller than the shaking of a Stanley engine.

As a uniflow engine should be run with full boiler pressure on the piston at the beginning of each stroke, with the power controlled by varying the cutoff, there are two serious issues for the designer. First, the engine must be strong, designed for an acceptable fatigue life under continuous pressures that a Stanley engine can barely take under static conditions. This, of course, means the engine will be too heavy to mount on a live axle. A new axle of the DeDion pattern is reccomended.

Secondly, the valve gear must be fast and able to handle hot steam. For example, consider an engine geared like a Stanley, 840 rpm (m for mile), running at 6 percent cutoff and 60 mph. For that cutoff, the valve must open and close in less than a twelfth of a revolution, and a revolution takes about a fourteenth of a second. The valve must be as fast, and about as hot, as the exhaust valve on a gas engine running at 11,000 rpm!

The point is that one wants the best possible efficiency at road speeds and power levels to get the longest range. And that will lead to the best average speed on long trips.

Every steam boiler ever fitted to a car had acceptable efficiency. It is hard to get even a ten percent improvement. It is also hard to fit larger or more effective condensers, a fifty percent improvement is difficult. But a better engine is definitely possible. Even keeping to the moderate pressures used by Stanley and White, double the cruising efficiency of a Stanley engine is possible.

I know of only four modern attempts to build steam cars that have directly addressed the issue of engine efficiency. Alphabetically, they are those of Barrett, Carter, Pritchard and Williams. Their work might be studied as the basis for new designs.

Balancing and the Lanchester Mechanism.

By Stan Jakuba

The last three issues of the Bulletin discussed ways to balance engines. The Lanchester mechanism was mentioned and several readers pointed out several other mechanisms that would produce balanced engines. Lastly, Ken Hemmick presented a complete picture of the inertia balancing issues in his Engine Balance article, explaining the forces and moments generated by the inertia of the reciprocating masses.

I would like to add to that material the description of the unique feature of the Lanchester scheme that makes it stand out among all the other ingenious mechanisms. Refer to the pictures to follow how it worked. For information, Frederic Lanchester, an English engineering genius, built mass-produced cars with this type of (gasoline) engines in the early 1900s.

His method has the crucial advantage over other methods in that it balances not only the usual inertia forces and moments but also smoothes the output shaft torque fluctuation. This eliminates the rocking moment on the block that results from the reaction to the acceleration and deceleration of the flywheel. This is the cause of the vibration most of us see with slow running engines or idling ones such the Harley-Davidson V–2s. The inertia vibration does not show until at much higher speeds as can be attested by steam car drivers who tried to run their Stanleys at really high speeds.

In the Lanchester scheme:

•All centrifugal and reciprocating forces (1st order) are balanced by the two counter-rotating masses.

•All moments caused by the moving masses are balanced (absent, really) due to the symmetrical arrangement of the moving parts about the central plane.

•The rocking couple caused by the torque fluctuation is balanced by the two counter-rotating flywheels.

•Of a lesser but not a negligible advantage is the mechanism's ability to eliminate also the unbalance resulting from the connecting rod swing (important at really high speeds).

•The swinging conrods forces are balanced by the symmetrical arrangement along the cylinder-crankshaft plane (providing all the conrods have the same inertia properties).

The penalty for having the Lanchester balancing lies in its complexity as is apparent from the sketch. The smoothness it can provide is generally not worth the cost in practice, where single cylinder engines are normally balanced by a rotating counterweight on the crankshaft only. Normally, the counterweight balances about 50 % of the reciprocating mass and 100 % of the rotating mass. This reduces (not eliminates) the vertical unbalance while introducing a horizontal one. (Nothing is done about the 2nd order, or the torque unbalance.)

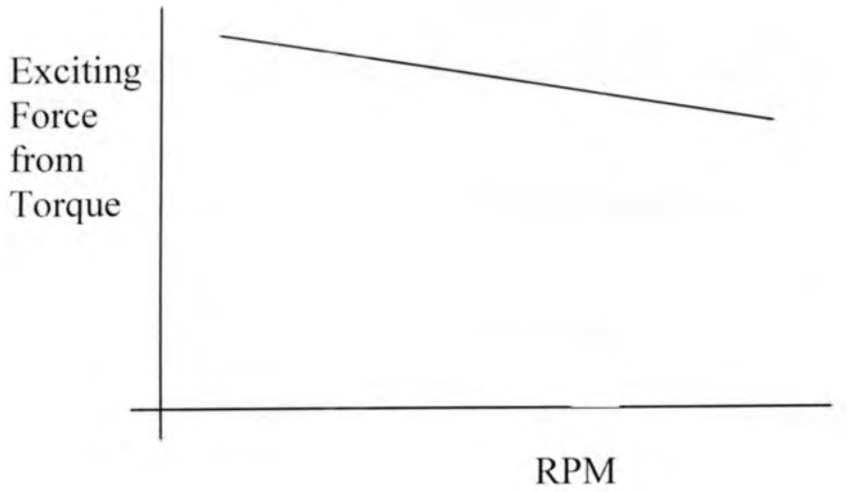
Essentially no production steam engine exhibited the Lanchester degree of balance. Actually, many were not balanced at all resorting instead to a mounting onto a massive foundation, large enough to constrain the expander sufficiently that no motion (vibration) of the engine frame occurred. Most also did not run fast enough to produce sufficiently high unbalance forces to show on the scale of the ever-present torque unbalance.

If a single cylinder expander needs to suppress vibration more than is commonly tolerated but still without the Lanchester mechanism, two methods are in use commercially today: (1) An addition of two counter-rotating masses; they are placed symmetrically about the cylinder axis, gear driven 1:1 from the crankshaft. They fully balance the reciprocating unbalance but do nothing about the torque unbalance. (2) Addition of only one such mass, also driven 1:1, but located such that it balances not only the force but also the torque-caused couple, albeit each partially only. Here, the rotating mass introduces a moment absent before; it is tolerable on the scale of the benefit gained by the two partial balances.

To justify the Lanchester balancing, there has to be a need for a high power-density, entirely vibration free, reciprocating engine of only one or two-cylinders that runs fast and is heavily loaded.

Then all the above four unbalances matter.

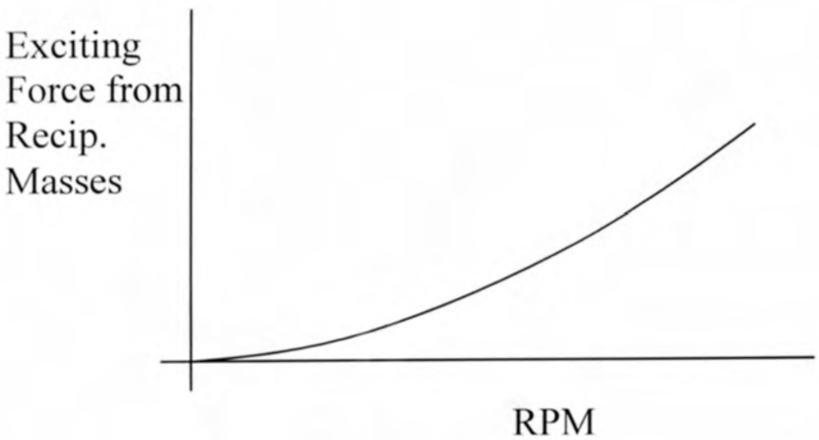
The rocking couple from the torque fluctuation in a uniflow (i.e., recompressing) engine tends to predominate over the other exciting forces and moments at low speeds. The Lanchester mechanism is the only one that succeeded in balancing it in mass production. As speed increases, the other unbalances grow, and the torque unbalance contribution keeps diminishing. The Lanchester balancing eliminates them all, at any speed and any load.



History demonstrates that the predominating solution for the balancing of stationary reciprocators was to mount them on a massive base and/or on vibration isolators. Although these after-measures do not eliminate the unbalance, they prevent the exciting forces to be felt in the surroundings, which is what matters ultimately. Aside from stationary applications, such as in cars, adding cylinders is usually the better solution to lowering vibration than the extra mechanism as that introduces other benefits such as higher volume and mass power density. The 4-working pulses per revolution inherent in the usual 2-cylinder 90-degrees cranks of expanders designed for vehicles inherently exhibit less torque vibration than a single cylinder double-acting engine. The worst offender of them all, and the one that benefits from the Lanchester scheme most, is the single-cylinder, single-acting, uniflow (i.e., recompressing) expander, particularly running against a high back pressure.

The first graph illustrates the decrease of the torque-induced vibration with speed. The dropping trend reflects the calming influence of the inertia of the reciprocating parts. This one line is for one cut-off (load). A set of parallel lines would reflect other loads, the high the load, the higher the exciting force. Similarly the bigger the flywheel, the more pronounced the rocking moment. It may seem counter-intuitive that the bigger the flywheel the bigger the vibration, but it is so.

The second graph illustrates the increase of the reciprocating-masses-induced vibration with speed. It shows how small the exciting forces are at the low speed and their exponential growth. Comparing the two graphs hints at the relative importance of each balancing. Note that the exciting reciprocating force is independent of load. On the other hand, it obviously depends on the combined mass of the piston, rod, crosshead, etc.



To provide some real numbers, a single-cylinder, single acting, crosshead-type, uniflow expander of 275 cm^3 has the reciprocating mass of 1.7 kg, and 50% of it is balanced. Of 60 mm stroke, the remaining, maximum primary force is then 70 N at 450 rpm, 280 at 900, 1130 at 1800 and 4500 at

3600. Notice the quick rise with speed.

As to the torque unbalance, it is in a fairly narrow band throughout the speed range averaging 90 N m peak and thus 3000 N maximum rocking force.

As a result, the ratio of the two exciting forces at, say 900 rpm is 3000/280 = 11, an order of magnitude bigger influence of the flywheel reaction than the reciprocating reaction. At high speed, say 3600 rpm, the ratio is reversed: 3000/4500 = 0.66, that is, the reciprocating unbalance.

On an engine without the 50% balancing, these ratios would be ½ as big.

2006 CENTENNIAL
The Stanley Land Speed Record

Ormond Beach, Florida---Jan. 24-28, 2006

Firing Up Banquet: Tuesday, January 24
Event Reception: Wednesday, January 25
Centennial Banquet: Thursday, January 26
Blow-Down Banquet: Saturday, January 28

TOURS

The Loop: Wednesday, January 25
St. Augustine: Friday, January 27
Ponce Inlet-Speedway: Saturday, January 28

Call Stanley Museum at 207-265-2729 for information and reservations.

Fiscal Year July 2004 to June 2005 Report

The club experienced a small profit for FY 2004/05. SACA's financial condition remains very strong, and we have nearly $35k in member equity. We have been able to maintain our strong position due to the fiscal responsibility of the board. While we implemented a modest dues increase this past year, we considerably improved the quality of *The Bulletin*, increased the publishing frequency to five issues in 2005, and will increase the frequency to six in 2006, offering more and better quality for our members and their dues. The SACA Storeroom continues to make a considerable contribution to the club's overall financial success.

Our membership declined by approximately 9 percent in aggregate in the past 12-months. However, during that period we considerably increased our rate of new membership with 44 new members joining.

SACA is positioned well for the future.

Respectfully submitted,

Steam Automobile Club of America
Profit & Loss
July 2004 through June 2005

		Jul '04 - Jun 05
Income		
Advertising-Bulletin		7.00
Interest Income		306.63
Member Dues		9,438.00
Store Income		
Refunds	-57.65	
Store Sales	4,264.10	
Total Store Income		4,206.45
Total Income		13,958.08
Expense		
Board Expenses		430.12
Bulletin		
Bulletin Postage	3,196.36	
Printing	5,413.42	
Total Bulletin		8,609.78
Insurance		1,979.00
Miscellaneous Expense		20.30
Office Postage		257.91
Office Supplies		218.23
Store Operations		
Miscellaneous	154.13	
Store Postage	624.55	
Store Stock & Supplies	787.35	
Total Store Operations		1,566.03
Taxes		71.00
Telephone		129.57
Time Trials		120.00
Total Expense		13,401.94
Net Income		556.14

Steam Automobile Club of America
Balance Sheet
As of June 30, 2005

	Jun 30, 05
ASSETS	
Current Assets	
Checking/Savings	
BOA Checking-Store	1,598.84
PCSB-Checking	5,204.99
PCSB-Savings	27,626.47
Total Checking/Savings	34,430.30
Total Current Assets	34,430.30
Fixed Assets	
Office Equipment	646.78
Total Fixed Assets	646.78
TOTAL ASSETS	35,077.08
LIABILITIES & EQUITY	
Liabilities	
Current Liabilities	
Other Current Liabilities	
Credit Balance on Foreign Accts	163.80
Defer Donations for Time Trials	165.00
Total Other Current Liabilities	328.80
Total Current Liabilities	328.80
Total Liabilities	328.80
Equity	
Retained Earnings	34,192.14
Net Income	556.14
Total Equity	34,748.28
TOTAL LIABILITIES & EQUITY	35,077.08

September 2005 Steam Meet
Berrien Springs, Michigan

Jim Tangeman watches Tony Grzyb making steam

J. Carter, Chuk Williams, Art Gardiner, Bill Gatlin watch Marcus Gollar making steam

Chuk Williams' dragster firing up with its auxiliary power unit, Scott Haines watching

Time Trials Results

Placement	Prize	Drivers	Time	Steam Vehicle
First :	$1000	Chuk Williams	10.3 seconds	Dragster
Second:	$400	Jim Tangeman	21 seconds	Garden tractor, wood fired
Third:	$300	Tony Grzyb	21.5 seconds	Motorcycle
Fourth:	$150	Ken Young	65 seconds	DeLaura Replica, Mason engine
Fifth:	$150	Chuk Williams	74 seconds	Model T Roadster, Lawler engine

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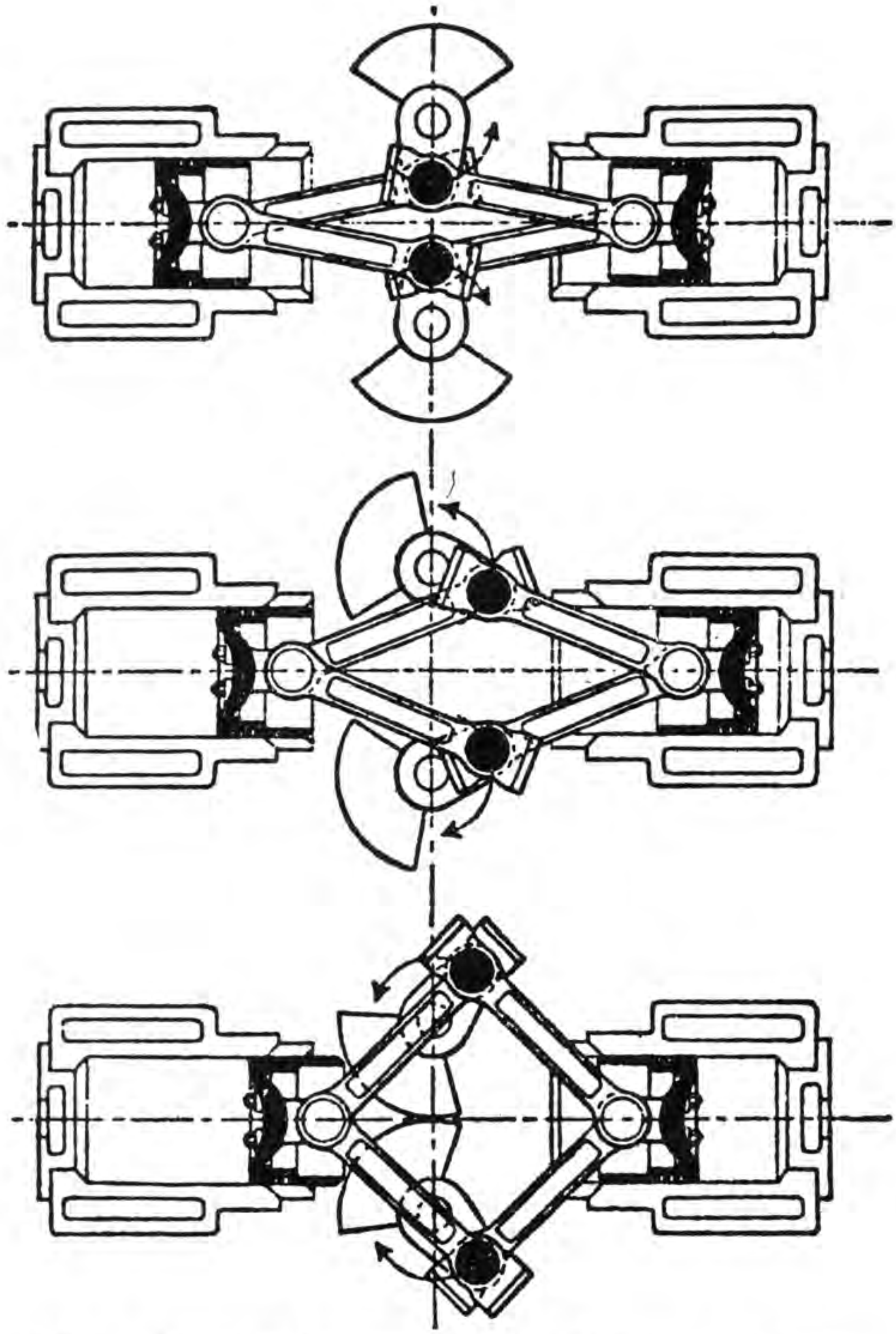
Lanchester Engine

By Tom Kimmel

Frederick Lanchester (1868-1946) was a brilliant pioneer designer and constructor of early automobiles in England. He was ahead of his time on most of his ideas and thus did not make any money in the automobile business. The quotes and illustrations are copied from the book: "Automobile Design, Twelve Great Designers and Their Work", 2nd Edition SAE Historical Series by Barker and Harding, published by Society of Automotive Engineers 1992.

The drawings of his horizontal opposed engine are taken from page 65 of the book and the description from page 60. The reason for bringing to attention this strange engine design is because it culminates our articles on engine balancing.

"The new engine was also balanced by reverse rotation, with the two cylinders horizontally opposed and the pistons coupled to the counter-rotating cranks by a 'lazy-tongs' parallelogram of six connecting rods. The center of gravity of the parallelogram, which had true harmonic motion, was always at a point half-way between the crankpins and was consequently neutralized by the center of gravity of the reverse-rotating crank balance-weights. The counter-rotation of the cranks and flywheels also ensured that the inertia forces were balanced within the engine and were not communicated to the car frame."



Three phases in the movements of pistons and connecting-rods in the Lanchester engine: (*top*) the rods nearest to horizontal centre line of the opposed cylinders, lift piston on power stroke; (*centre*) cranks at TDC for right piston, which is at end of compression stroke; (*bottom*) the left piston is on BDC and the rods are approaching their widest relative angle

The Market for a Modern Steamer

By David Nergaard

There has been some discussion of the appropriate market for a modern limited production steam car on the SACA web site Discussion Page in recent weeks. The concensus seems to be that a sports car would be the type to build. I agree that it would be the logical way to enter the consumer market, but don't think it is realistic for the current stage of automotive steam engine developement.

For the kind of money needed to build a steam roadster today, the customer could easily buy a Ferrari. While the bearers of the rampant horse logo are not known as reliable commuting machines, they would not need anything like the maintenance of what must be basically an experiment in progress, for at least the first few years of production. I call as witness Abner Doble; none of his designs, good as they may have been, ever reached production status.

Also, the very best performance to be expected from an economically built steam system will not come close to the acceleration Americans expect from low end SUVs today.

So what market should one aim for? Consider the attributes of a modern steam vehicle. Very low pollution, although not "pollution free". Quiet and smooth operation, probably better than an hybrid car. In city driving, fuel consumption less than an Otto cycle engined car of equivalent performance. This assumes an engine much more efficient than the Stanley, but not so esoteric as Doble's "Optimax" design. And the engine is what I will term "Panthermic", it doesn't matter what fuel it uses, burn whatever is cheapest.

On the down side, turnpike driving efficiency will not be as good as an Otto engined car. And, most important, the cars will require significantly more servicing than any currently available cars, perhaps daily in hard duty. The maintenance may be simple, and light, but it must be done or the car will not do its work.

As examples, if the steam system is not totally sealed, periodic boiler cleaning will be required. For the best pollution control and minimum combustion space, blue flame burners will be desired. And the only widely used blue flame burners are hardly known for reliable day in day out service; those found in Stanleys!

It must be remembered that the best likely steamer today will be at the stage of developement of the gasoline car of the late 1920s. At that time, weekly chassis greasing, oil changes every 500 miles and new tires every few thousand miles were the norm.

Where does one find vehicles that are routinely serviced daily, so some additional work would not be a major burden? Vehicles that are normally serviced at their own facilities which can have any special tools, equipment or skills needed? I can think of three types, all operated as fleets; the city taxi cab, omnibuses and local delivery vans.

All these services need engines of good but hardly spectacular performance. The above listed attributes of steam engines could be major assets in each case, especially the low pollution, in both the atmospheric and acoustic senses.

So, instead of trying to build a few very expensive roadsters for the outrageously rich, the designer of a new steam car might do well to consider making a hundred prosaic vehicles of modest performance. The resulting product need not be stylish in either appearance or performance so long as it is reliable. And the reliability need not be nearly the order seen in modern Otto engined cars, where annual oil changes can be skipped without serious harm. 'Buses and taxis get (or at least should get) a thorough cleaning and wash daily. Adding a boiler flush and a few other items to the ritual need not be a major concern to a fleet operator, who could have some of his staff trained by the vehicle's manufacturer.

Putting experimental cars in the hands of private owners, however, would limit the market to those who have a permanent staff to maintain their stable of cars. I can think of only one steam afficionado in this category, and I doubt that even he would spend a million on an experimental "one off".

New items from the SACA Storeroom

DLD The Day-Land Model SA Steam Engine, Designed by R. Day and A. Land. This engine, two cylinders, double acting, simple expansion, D-slide valves, Fink link valve gear, bore 2 1/2", stroke 3 1/2", may be constructed as an open or closed type. 5 Blue-Print Drawings with much detailed information. With thanks and permission from Errol Cramer of Errol's Steamworks and Antiques. $30.00 Wt. 2.0

SBD Steam Bicycle Plan Drawings and Detailed Information, by Richard J. Smith. Plans include friction drive adaptor for the Sirius flywheel, fuel and water tank mounting, water feed pump, steam throttle valve, steam pressure automatic valve, safety valve and compensating pressure flow control valve, fuel circuit and steam and water flow circuit, materials source list and general instructions. $18.00 Wt. 1.0

VDCN Vesuvius the Steam Bicycle Drawings and Construction Notes, Design by David Sarlin . Excellent detailed drawings and construction notes for; fuel and water capacity, bore and stroke, horsepower, fuel and heating surface, power unit weight and speed at rpm's. With thanks and permission from Errol Cramer of Errol's Steamworks and Antiques. Rolled in good quality tube for shipping. $50.00 Wt. 2.0

VCK Vesuvius Casting Kit, by Errol Cramer. To accompany the Vesuvius drawings and construction notes, per schedule of explanation of castings;

Casting Kit: $595.00 Shipping: contact Storekeeper
Boiler shell Material $ 79.00 Shipping: contact Storekeeper

F O R S A L E

F O R S A L E

This condenser Stanley is located in a garage in downtown Detroit, Michigan. It was found in storage when an old house was purchased. The boiler and much of the plumbing and the dash instrumentation are missing, as well as the two passenger side doors. The engine and pumps are still there and the engine turns freely. Much of the wood frame and roof is still good as it was stored inside. The missing parts have not been located. This car is for sale for $10,000 or best offer. Please contact **Mike Belcastro** at the following address for more photos and directions to view the car. **21019 Gratiot, Eastpointe, MI 48021, Phone: 587/873-9498, Email: belcastro1@comcast.net**

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