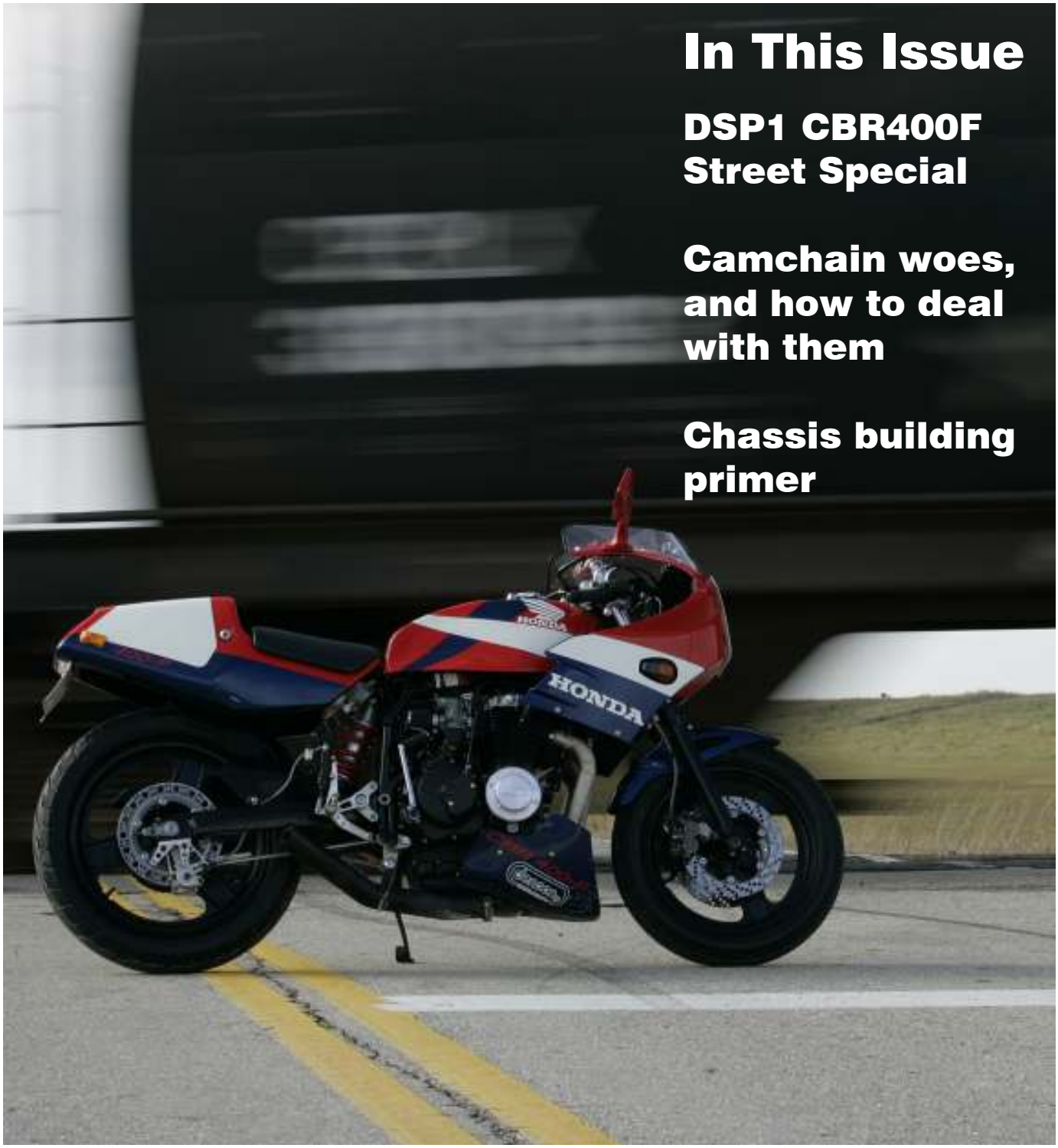
THE 400-4 FILES

Volume 1, Issue 1 February 2005



In This Issue

DSP1 CBR400F Street Special

Camchain woes, and how to deal with them

Chassis building primer

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Welcome

This is the first issue of The 400-4 Files, and as such I consider it to be a bit of an experimental project. I had originally intended to use my website, www.denoonsp.com as my main source of sharing information amongst the 400F faithful, but the logistics of maintaining and updating the website was just too much to keep it up to date.
So the idea occurred to me to do a newsletter, something that could be done every couple of months, and once the general layout and feel was established, it would hopefully be less work to generate than the web page.
The first issue will focus on some of the work that I have done in the past, and am doing around the shop right now. Hopefully the readership will respond with ideas and information to keep this going as something that the 400F enthusiast can collect, and look forward to receiving every couple of months.

Comments are appreciated, send to rdenoon@mts.net

Good reading,

Rick Denoon

Features

Technical

Regulars

Tony Foale to Visit Canada

Chassis Guru hosting seminars in Vancouver, BC, and Calgary, AB

Rick Denoon

Thanks to the efforts of Jessica Soodeen (www.jessicasoodeen.ca), a Mechanical Engineer from Calgary, noted chassis designer Tony Foale will be traveling from Spain for two 2-day seminars to be held in Vancouver on Feb 26 &27, and in Calgary on Mar 5&6.

Tony Foale B.Tech, M.Eng.Sc, C.Dip.A.F.

Educated in Australia, Tony graduated with a degree in electrical engineering, followed by a M.Eng.Sc. in nuclear engineering. He worked at a research establishment, creating mathematical models and subsequent computer programs for performance analysis of various mechanical and aerodynamic systems.

From his mid teens Tony has been a passionate motorcyclist, both on the road and in competition. He has ridden in road-racing, moto-X, enduros and trials events. With a natural instinct for building a better mousetrap he constructed (often with primitive facilities) several of his own machines, both engines and chassis. With a scientist's curiosity, during the 1960s. he used the facilities and experience of his work to develop mathematical models to provide him with an understanding of motorcycle behavior in excess of that to be found in the literature of the time.

In 1973 he succumbed to his passion completely and started a business making complete chassis etc. for racing machines. Many of these were highly successful, winning several championships in various countries. The range of machines built included championship winning sidecars as well. During the 1980's, he embarked on a series of experiments into the fundamentals of steering geometry, the results of which verified his long held beliefs that established practice had many failings. These experiments are detailed in his 1984 book "Motorcycle Handling & Chassis Design", the 2002 book "Motorcycle Handling and Chassis Design" and in some of his numerous magazine articles. Since that time many standard production models and particularly racing machines have gradually moved toward the use of steering geometries as suggested by Mr. Foale. He has also consulted on various motorcycle projects including successfully advising a police force in regard to measures needed to cure stability problems with a large fleet of motorcycles.

Further information can be found on Tony Foale, and the seminars by visiting his website, www.tonyfoale.com

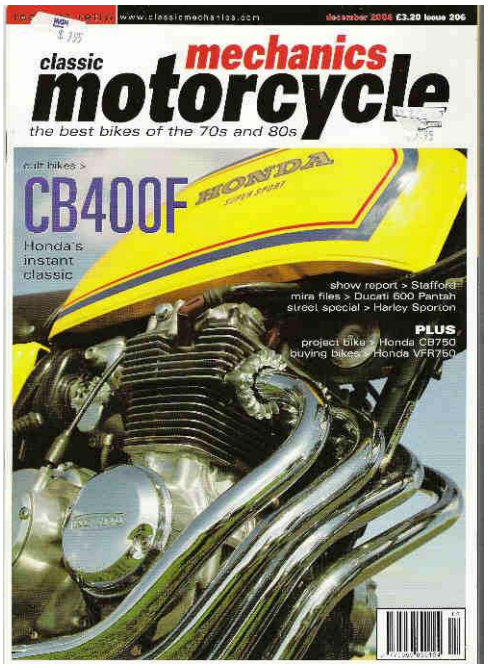
I will be attending the Calgary seminar, and will report back in a future issue.

denoonsp Hits The Stands

DSP1 Featured in April Edition of Classic Motorcycle Mechanics magazine

Rick Denoon

The bike shown and featured in the inaugural issue of The 400-4 Files will also be on the cover of the April issue of Classic Motorcycle Mechanics. The magazine specializes in the best bikes of the 70's and 80's. Along with the cover, there will be a 6-page feature.



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Editor's Comments

First off, let me apologize for what might appear to be a blatant advertising scheme for denoonsp. There is an old saying "Do what you do best", and keeping that in mind, I thought I should write about what I know the most about, and that is the things that I do around the shop every day.

Building my first custom frame for my CB400F (hereby known as DSP1) was a 3-year education in machining, building and maintaining CNC systems, CNC programming, TIG welding, and the design and construction of weld jigs. The actual building of the bike was really quite easy in comparison to the groundwork that was required, long before construction began.

There is no question that my background in Computer Aided Design was a huge benefit, but the truth is that anyone could have done what I did, with a little help from his or her friends. What I found interesting was the ability to establish and build friendships with people you never actually meet. The Internet has opened up opportunities that were unthinkable even as little as 5 years ago.

The process of researching the requirements of building a CNC system for my lathe/milling machine put me in contact with people who didn't know me from a hole in the ground, but were willing to take time out of their lives to answer questions, offer suggestions, and sometimes just sit and "chat" via email with someone thousands of miles away that they know they'll never actually see in person. Building a relationship with some of these people cut the learning time drastically, as some of them are established professionals in their particular field. Almost without exception you get better, faster service asking questions from these people on message boards/forums than you do dealing with local vendors and suppliers.
In kind, I try my best to offer the same level of response when people contact me with questions or problems.

I hope that in future issues I can shift some of the focus of the articles onto other peoples' bikes, but I'm only going to be able to do that if you, the reader, are willing to take the time to contact me and provide me with photos and information on your bikes.

Even if I get a great reader's response, you are still going to get your regular dose of "what's happening" in my shop. The process of building and repairing 400F's goes on regardless of what other things are vying for my time, (like writing a newsletter), so I'll be documenting most projects and using them as the basis for future articles.

Luckily, there seems to be a never-ending stream of projects going on in the shop, I hope you find some of it interesting, and educational.

Rick Denoon

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denoonsp at Daytona

denoonsp products to get trial by fire at Daytona in 2005

Rick Denoon

I recently received a phone call from Mike Porter, AHRMA #200, who was looking for some parts to get his CB400F based racer ready for Daytona 2005. He was kind enough to place an order for some race parts, and some carb work. I'll be keeping my eye on the results sheets to see how he fares, but he told me not to get my hopes up too high. He said he is fighting an uphill battle in the horsepower to weight ratio department against some of the "flyweight jockeys". I don't want to give away any secrets, but I take it Mike is scaling in closer to the 200lb mark than the 150lb mark.

What's interesting is that Mike has committed to traveling the country this year hitting as many AHRMA events as he can, this as his 60th birthday present to himself!

Good luck Mike, and let's hope we're all that active in on our 60th birthday.

Every CB400F project should look this good.

The owner lives in South Africa. The list of engine mods would make anyone weep, and the end result is beautiful, yes?

The final CHAPTER?

Is a project bike ever really finished? There's always one more thing that could be changed, something to tidy up, some new technology to be incorporated. This project is nearing completion, after 25 years it should be. But of course there are those CBR954 4 pot calipers and CBR600F1 rotors sitting in the corner, and the tach isn't working properly, and a test bed is required for the XR100 pistons….

The History

There was always that allure, the way the chrome pipes gleamed in the sun, the compact size that somehow seemed to make room for even a 6 footer, the look that was somehow, just right.
I caught my first good look at CB400F in the winter of 1980. I was in the Honda dealer, trading in a CB550K on a brand new 1981 CB750F. Heady stuff for a 17 year old.
Even though I was there for the Twin Cam 750 I couldn't help but notice an entire row of 400F's sitting in the showroom. (Oh, for a time machine) I studied them out of the corner of my eye, and wondered if I was making the right choice. For what I was paying for the DOHC 750F, I could take home a SOHC 750F, and one of the 400F's.
But it really wasn't much more than a passing thought, and I didn't really give it any more consideration until a year later when I was at a buddies house and he showed me a magazine article on the Yoshima/Ontario Moto Tech race bike.
With visions of a 13,000-rpm giant killer in my head, I embarked on a journey that would teach me many lessons, and devour bundles of cubic time and money.
That summer I started my search for a used 400F, unfortunately one landed right in my lap, and the education began.
I was working in a garage, and there was a guy who used to come in and wash his dirt bikes at the outdoor car wash. I used to talk to him, and I mentioned that I was looking for a 400F. He said that he had just picked one up from a friend, and it was sitting in his garage. He said it was rough, but if I wanted it "as is" it was mine for $150. I thought I couldn't go wrong for that kind of money so off I went with a pocket full of cash, and the next day he dropped the bike off at my place where I could get a good look at it.
And what a sorry sight it was. The list of bad parts was longer than the good. Bent forks, bent triple trees, bend frame, fried rectifier, dead battery, cooked sprockets and chain, cracked side covers, dented, rusted, and leaking tank, torn seat, bent fenders, missing signals/horn/mirrors, torn seat, the list went on and on. The motor itself had good compression, but the cam and rocker arms showed signs that it had received less than perfectly timed oil changes.
None of this deterred me, because I was planning on building "the ultimate café racer", and most of those items would end up being replaced anyway.
Then next time I ran into the

This is what I wanted. Ontario Moto Tech could supply an engine capable of propelling the sub 300lb. bike to speeds of around 135mph. The only thing faster on the track were turbocharged KZ900's.

seller, I quizzed him a bit on the bike's violent past, and he fessed up that the previous owner had clipped a semi coming at him in his lane on a two lane highway and had endoed the bike in the ditch. Made sense judging from the damage, so off I went to the wreckers where I returned with new frame, forks, triple clamps, and rectifier. This brought my investment up to a tidy little sum of $600, about what I could have bought a nice runner for. Lesson #1 learned; even if you are doing a project bike, start out with the nicest sample you can afford, it will be worth it in the long run.

And so the education began. I knew what I wanted, but I didn't think I could afford to do everything I wanted, so I would spend money in dribs and drabs over the next 10 years or so, always buying something that was "on sale" or available locally instead of sucking up and ordering what I wanted from the proper sources in the USA.

Hence lesson #2; decide what you want and do it. That way you only spend the money once. I ended up spending more doing things like bodywork two and three times instead of just doing things the right way the 1st time.

I rode the bike off and on over the next 10 years, mainly though I kept it stored in the closet of my apartment, and just pulled it out and used it when I didn't have a "real" bike on the road. I could assemble it from scratch in about 5 hours and disassemble it in about 2 hours.

Construction

Then in the summer of 1995 I was out riding around the countryside and decided to stop by the local wreckers to see what he had. I spied a rough looking VF500 Interceptor parked by the door and I asked the owner how much he would want for the wheels/forks/swingarm. It just happened that he had sold the motor that morning so if I agreed to show up the next afternoon the rolling chassis was mine for a reasonable price. Over the course of that summer I grafted the front and rear wheels, brakes and swingarm/single shock suspension onto a braced stock frame. At the same time I acquired an NS400 fairing, Fox twin clicker shock, and seat from a YZF750. The bike got its present paint job, and once bolted together I switched a plate onto it from one of my other bikes, and rode it around for 1 day, taking it around to show some friends and stuff, before returning home and parking it up on a shelf in the garage.

The bike sat like this for 4 years until the year 2000, when I was able to do something I had wanted to do for years, purchase a lathe and milling machine. Over the next 3 years, I learned how to use the new equipment, and added a TIG welder to the shop and learned how to TIG weld.

Using the equipment, I was able to construct a frame jig to accurately position the motor, steering head, and swingarm pivot points during construction, keep them there during the welding process. Actual construction time for the frame itself was probably

around 80 hours, but building and positioning all of the brackets for various electrical items, rear sets, fairing mounts etc. probably pushed that number closer to 200 hours. Adding in the time required to learning new software and machining all the other components, and the total is probably close to 2000 hours.

The frame design follows the Egli/Tony Foale school of thought, using a 3" diameter main backbone, and 1" OD x 0.045" and 0.063" wall tubing for the remainder of the structure. The seat subframe is a combination of laser cut and formed 18Ga mild steel, and welded 6061-T6 aluminum. All of the steel used was garden variety 1028 E.R.W. mild steel. I chose this style of frame because it could be made to work with the stock CB400F gas tank, thus I was able to save the existing (and paid for) paint job.

The list of machined/manufactured parts goes on and on, suffice it to say that you would be hard pressed to find a part or bolt that hasn't seen the lathe or mill before being attached to the bike. All of the allen head bolts had their heads tapered, and many of the larger ones were drilled thru to reduce weight, and in the same vein a couple of successful bids on E-bay resulted in a small lot of 8mm Titanium bolts that were used throughout the bike.

Above - Fabricated parts in this shot include top triple clamp, clamp/fuse box cover, clip-ons, fairing brace, kill switch mount, instrument panel in aircraft grade carbon fiber.

Below - At the rear, a Fox Factory Twin Clicker from an NS400, fitted with an NT650 Hawk spring separate the VF500 swingarm from the custom frame. Hours of machining and multiple set-ups resulted in adjustable rear sets.

Riding the Beast

I was waiting all summer for a couple of buddies to get their stock CB400F's on the road so I could have a direct comparison with mine in terms of acceleration, but they never got them going in time. I would have to bet that mine would be a bit quicker, but how much, I don't know. It should be making more HP than stock, the Ontario Moto Tech exhaust is a proven system, and when I made the switch from the stock carbs with pod filters to the 24mm bored carbs I was able to increase the main jet size from #80 to #95, so if it is using more fuel, it should be making more power. There are lots of people who say that you can't use individual filters on the 400F and get the jetting right, but I have been able to set it up with both the stock carbs and the bored carbs and get the jetting spot on.

I was really expecting an improvement in response and drivability with the installation of the Boyer electronic ignition, but I really couldn't tell the difference. Where I did notice a huge improvement was with the installation of the Dyna coils and silicone plug wires. I had been running the bored carbs with #100 mains out of a CB550, because I was having a hard time finding any other mains, and the bike was running grossly rich at full throttle. In fact it wouldn't take full throttle, you had to feather it at about 7/8'ths to get it to accelerate hard and I was thinking I would need #85 or #90 mains. Once the Dyna's were installed, there was only a slight stumble at full throttle, and I only went down one size on the mains to get the bike running perfectly. I would never

Tiny XL600 battery resides in a tray welded into the sprocket cover "ala" Yoshimura racers. Hand hammered knee cutouts on tank are matched by ones on the front to clear the clipons. Hella projector beam headlight looks innocent enough, but packs a strong punch at night, way better than the dim stock headlight.

have believed what a difference a set of coils would make if I hadn't experienced it myself.

The other big difference (even though it didn't make the bike any quicker) was the development and installation of a quick turn throttle. Going to full throttle is now a one-handful affair instead of having to regrip with the stock system.
As it sits there is a bit of a "powerband" from 7000 –10,000 rpm that is noticeable in the first 3 gears, and that is really the fun of riding a small bike like this. You can run thru a 20-30mph corner at 7000 rpm and then come out hard on the gas, shift it thru a couple of more gears at redline, and still only be going 60 mph. Do that on a modern 600cc sportbike and you are probably going 100+ mph. It is way easier on the driver's license. The easy thing to do at this stage would be to pick up a 458cc big bore kit, but I never seem to travel the easy path very often. A friend of mine, who was thinking along the same lines as I was, bought a piston from an XR100 to see if it could be used in the 400F. I think it can be made to work, but will require custom connecting rods, as the pin height and diameter are different than the 400F. The thing that keeps drawing me back to the XR100 piston is that it is a much newer design than the stock 400 piston, or the 458 kit pistons. The rings are about half as thick, the pin height is higher, skirt length shorter, and it is much lighter. I hope to continue to pursue this option over the winter. Even with the limited power enhancements, the bike will pull 10,000rpm in top gear on level ground, a calculated 112mph.

Braking

Next to the suspension, the biggest change someone would notice stepping off a stock 400F onto mine would be the brakes. Stopping from any speed this bike is capable of generating, requires nothing more than a two-finger squeeze on the front lever. The braided lines are off a Ducati 900SS, the pads are stock VF500 pads that were in the calipers when I bought the rolling chassis. I have never switched them out to a better set because I still have an entire brake system from a CBR954RR with remote reservoir master cylinder, and 4 piston calipers. These require bigger disks (which I have off of a CBR600F1) but the anti dive setup on the left fork leg really complicates the mounting. I did machine a bracket once, and after spending a week milling on the CNC, the bracket fit perfectly, but the caliper was hitting the wheel. Now that I have the bigger disks it will work, but I haven't been able to build up the energy to tackle the multiple setups and hours of machining required to make the brackets. The 4 piston calipers would really be overkill anyway, but it would be cool.
At the rear, the billet single piston caliper does little in the way of actual braking. You can press as hard as you want on the brake lever and it won't lock the rear wheel, but since there is so much weight transfer to the front end, it doesn't get used much anyway.

Handling

By comparing the chassis dimensions and weight distribution numbers from my "CBR400F" to a stock CB400F you can just about predict how the bike will handle, and you won't be far off.

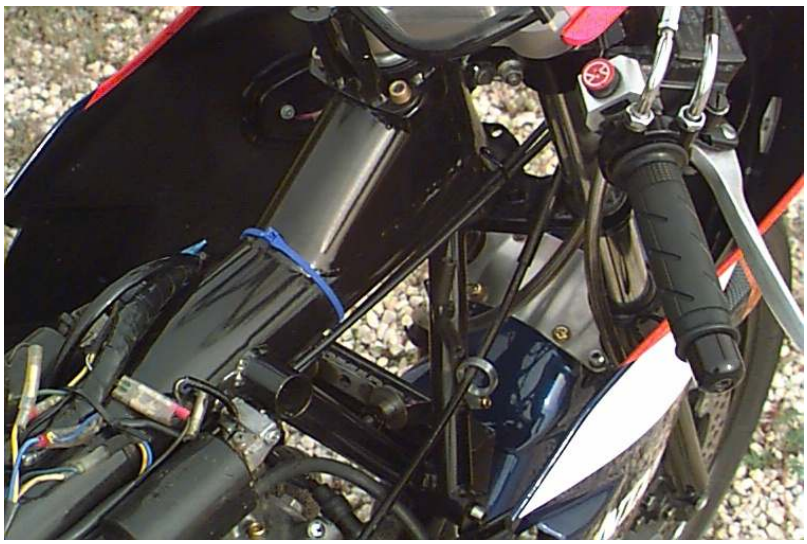
	My CBR400F	Stock CB400F
Wheelbase	54"	53.3"
Rake/Trail	25 degrees/90mm	26.5 degrees/83.3mm
Wet weight	355 lbs	400lbs
Weight distribution – F/R	53.5/46.5	47.4/52.6
Front tire	100/90-16	3.00-18
Rear Tire	130/80-18	3.50-18

Comparing the two, you would expect the 0.7" longer wheelbase combined with an extra 6.7mm of trail to slow down the steering, but offsetting this is 1.5 degrees less rake, 16" front wheel, and almost 50lbs less weight. I think the one factor that has the most influence on the overall handling of the bike is the weight distribution and tire sizes. The 53.5/46.5 F/R weight distribution is much more modern, and compares with many other current bikes. That front end weight bias coupled with the wider front tire and stubby clip-ons means that the bike holds it's line at all times and at all speeds. At parking lot speeds the steering is light and quick, but as soon as you start rolling it becomes very stable and is not easily influenced by bumps or unintentional steering inputs. It is very stable right up to redline in top gear (calculated 112mph), with no headshake, even decelerating with your hands off the bars.

Lockhart oil cooler is connected to adaptor plate with AN fittings and braided Stainless lines. Header wrap prevents the system from becoming an oil heating system

Suspension

The VF500 forks were a good choice for the bike in that the mass of the bike is similar to what they were designed for. They are air adjustable, but I run them at 0 PSI and they are very smooth. They are equipped with an adjustable anti-dive that was in vogue at the time, and like it or not, it does work. At it's lowest setting, the forks will dive to it's stops if you grab the front brake hard, but adding a click or two on the anti-dive keeps the fork from diving too fast, while still providing a nice comfortable ride.
At the rear, I patterned the single shock geometry off of my Honda NT650 Hawk,



A good look at the 3" main backbone, and heavily triangulated and gusseted steering head. The VF500 swingarm is about 2.5" longer than the stock 400F arm, but the distance between the swingarm pivot and the front axle is about 2" less. The result is a much more modern 56.5/43.5 F/R weight distribution.

A 40F degree-day was the best that could be arranged for a photo shoot. Cold tires, cold pavement, and cold fingers meant that the tire edges didn't get a workout, and try as we might, stoppies were out of the question too. A full size rider dwarfs the tiny bike.

which uses a similar setup. Initially the NS400 spring that came with the shock was too soft, so I switched it out for the stock spring off my Hawk and the result was almost perfect. If I gained any weight or was using the bike a lot on rougher roads at higher speeds, a stiffer spring might be in order, but for the riding I do, I prefer the slightly softer ride.

Quirks

The bike is really quite easy to ride. The only "warnings" that I would give to someone before sending them out on their own for the first time would be to watch out for the rear brake, (see braking), note that there is no high/low beam on the headlight (the projector beam only has one position), and to keep the tank full. The deep dishes in the rear of the tank have cut the fuel capacity down, and necessitated trimming of the reserve tube on the petcock. When it switches from main to reserve you have about 5 miles to find a gas station. (a fact that hasn't been without its consequences)

The motor will act up and stumble while steady state cruising in strong cross winds, I suspect the wind blowing thru the open filters and across the carb mouths cause momentary lean conditions. Opening the throttle a bit more helps, as does positioning your legs to shield the filters. I suppose building some permanent shields for the filters would be the best solution.

It is surprisingly comfortable to ride. Even though the clip-ons are below the top clamp, the bike is so small that you still end up sitting fairly upright with your weight pretty evenly distributed between your feet, hands, and seat. The rear sets are adjustable and in the position shown, they are not extreme enough to cause cramps in 40-year-old knees, and they still don't touch down in the corners. The only thing that needs to be redone is the seat. The foam I used is simply too hard, and I hope to fix that over the winter. Big thanks to my neighbor, Jack Krause, for covering the seat for me for a ridiculously low price, nothing. Even with the plywood seat I have done 400-mile days without complaint.

Initially the bike was allergic to rain. I didn't have the hugger fender installed so at the first sign of rain the rear wheel would throw water up onto the air filters. At that point the bike would run, but just barely. And keeping it going meant feathering the throttle as anything more would result in a huge stumble. Now with the hugger installed, you at least have a fighting chance if you keep your knees covering the filters as much as possible.

These are really small irritations, and to me they are no worse that the irritations of riding a stock CB400F, (harsh suspension, and mediocre brakes). The process of modernizing an old classic is part of the appeal of these bikes for me, and future plans include another, even wilder bike built around another 400F engine that is lying around the shop. Let's hope the next one takes less than 25 years.

Vital Statistics

Frame

Material	1018 E.R.W. Mild Steel
Wheelbase	54" (1372mm)
Rake – Degrees	25
Trail	3.54" (90mm)
Weight – W/1 gal fuel	355 lbs. (161.4 KG)
Weight Distribution F/R	52.5/46.5
Front Suspension	VF500 37mm Forks
Rear Suspension	NS400 Fox Shock
Front Tire	100/90-16
Rear Tire	130/80-18

Engine

Pistons	Stock CB400F
Cam	Stock CB400F
Carbs	Keihin 20mm bored to 24mm
Exhaust	Ontario Moto Tech 4 into 1

Misc

Fairing	NS400
Seat	YZF750
Belly Pan	Universal Fiberglass
Hugger fender	CBR600F1

Without question the CB400F engine is a typical Honda product. Major problems rarely occur, and if basic maintenance and oil changes are performed, the reward is years of trouble free service.
One problem that can and does rear it's ugly head regardless of service intervals has become legendary, and is probably considered the achilles heel of the engine, and that is the dreaded cam chain tensioner bolt. In this article we'll have a look at the theory behind the tensioning system, what goes wrong with it, what to do about it, and discuss a couple of methods of adjustment
This diabolical piece of engineering (and I use that term loosely) seems tailor made to give trouble. Thread a small 6mm bolt into bare aluminum casting, placed it at the front of the engine directly in line with the dirt, water, salt, and slime being slung off the front tire, and see how long it is before the bolt either a.) strips the threads out of the cases, or b.) seizes in place.
I experienced situation "a" about 15 years ago, when after a full engine strip down, blasting, and repaint, I reinstalled the engine in the bike and proceeded to fire it up to adjust the cam chain only to experience the sickening sensation of the bolt merely spinning in the cases. I just recently had the joy of situation "b", when a customer engine showed up at the shop with the bolt head snapped off about 4mm below the case surface. This one had a bonus factor too, in that the owner had snapped off an easy out inside the core of the bolt trying to remove it. Some days are meant to challenge, and this was going to be one of them.

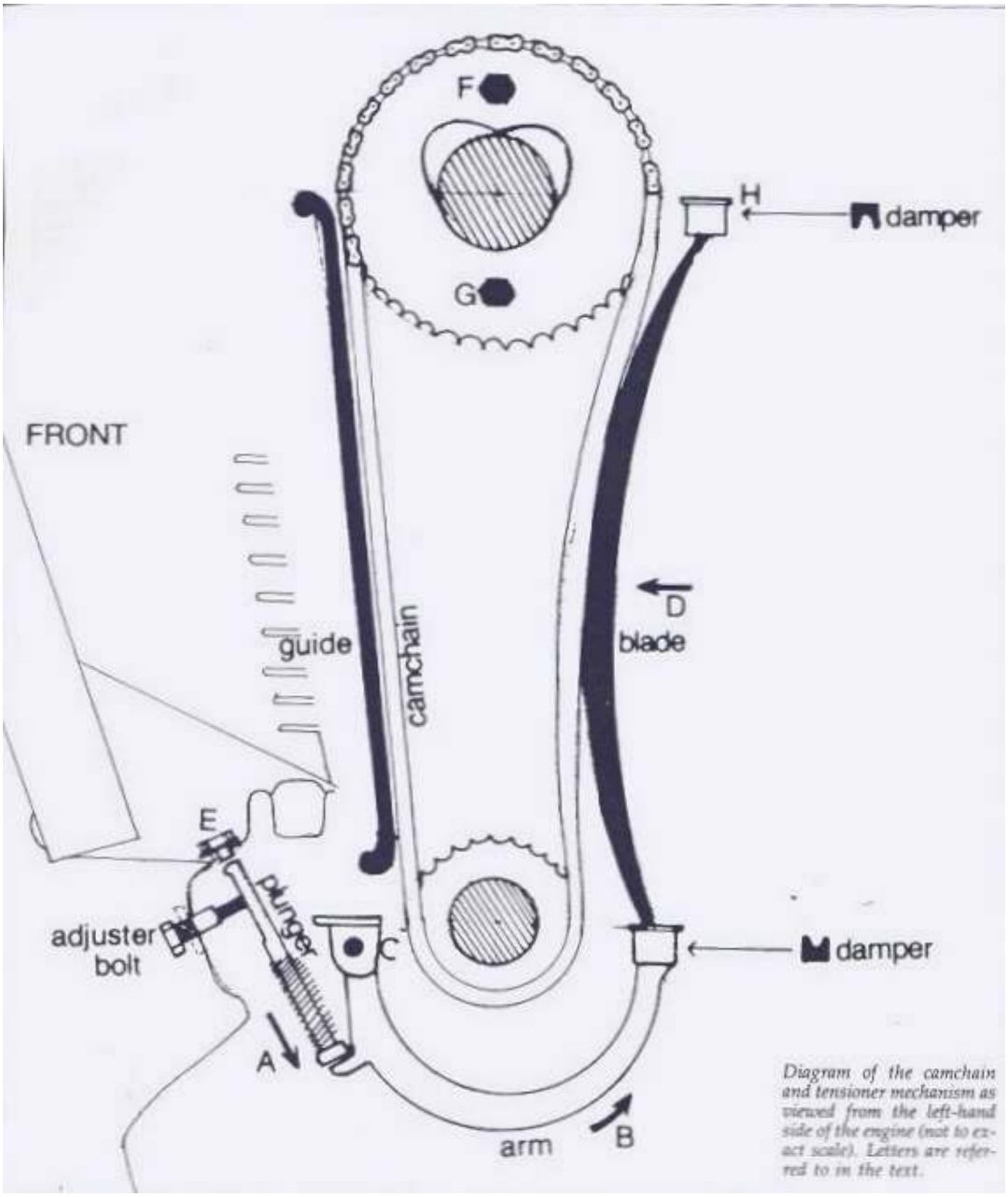


Diagram of the camchain and tensioner mechanism as viewed from the left-hand side of the engine (not to exact scale). Letters are referred to in the text.

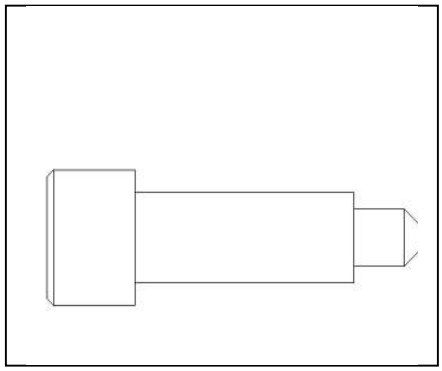
Bad Design, Bad Execution

First off, lets have a look at the system and how it operates. The 400F's camchain is tensioned by a blade which sits at the back of the barrels. It works like an archer's bow. Imagine taking a bow and placing one end on the ground while leaning on the top. The bow will bend and be forced outward. In the same way the tensioner blade is made to bend into the camchain.
The top of the tensioner blade is fixed and the adjuster force actually comes via a spring loaded adjuster (A) inserted into a drilling in the front of the upper crankcase just above the oil filter housing.
The force is

transmitted (B) via an arm which curves under the crankshaft from the front of the engine. The arm hangs on a pivot (C) at the front of the engine. This has the effect of forcing the blade (D) into the camchain. Once the tensioner locking bolt is loosened, the springs are free to push the arm harder into the rear blade, that's the theory anyway. The reality is that the 30 year old springs may not have enough life left in them to do their job, and the back pressure of the chain may actually straighten the blade, loosening the whole mess instead of tightening it.
If you haven't had any problems with the system up to this point, count yourself lucky, and here are a couple of tips to prevent problems from occuring.
1. Keep the area around the bolt head clean. Wash the motor down after riding in the rain/mud, and especially if you ride in the winter on roads that get salted. Aluminum doesn't rust, but it will corrode leaving behind a white powdery residue. Over time this will result in a weakening of the cases in the area surrounding the bolt. Keep this area clean, and even spray it down with WD40 or something similar, especially when putting the bike up for the winter.
2. Use an anti seize compound on the bolt every time you adjust the cam chain.
3. Be carefull tightening the bolt. Don't go attaching a 3/8" drive ratchet to the socket when torquing down that bolt. Use a ¼ ratchet , and tighten gently.

The worst had happened, now what?

OK, situation a) the bolt has stripped the threads out of the cases.
There are a couple of possible repairs. You may be able to use a Heli-Coil, or a thread insert. Assuming that the aluminum around the area is still sound, the heli-coil will probalby hold. In my case, on my bike, the aluminum was so porous that the heli-coil just pulled out too, and I was on to the next solution, a larger bolt.
I needed to find fresh aluminum that would be able to hold new threads. I eventually settled on a 3/8-16 course thread that required drilling out the hole enough to get into fresh aluminum. I happened to have access to a machine shop at work, and one of the guys turned me down a bolt to look like this;



The turned down section was about 4mm diameter, small enough to fit thru the opening and lock the adjuster. I packed the hole with grease during the drilling and tapping operation to prevent any errant chips from finding their way into the engine. This fix has worked now without a problem for the last 15 years.
These fixes work on the assumption that the lack of threads are your major problem. In the situation I had recently, the first hurdle was going to be getting the bolt out of the cases.
If the head has snapped off and there is any bit of bolt left sticking out of the cases, you might be able to cut a slot in the bolt with a hacksaw to form a slot that you can use to fit a straight blade screwdriver. But if the bolt was tight enough to snap off the head, it is unlikely that you will be able to generate enough torque without destroying your freshly made slot.
A better solution might be to try and back the bolt out by hitting it anti clockwise around the outer edge with a chisel.
If that looks like it is just destroying the bolt too, one of my favorite tricks is to thread a nut a couple of turns onto the remains of the bolt, and then fill the inside of the nut with weld from a MIG welder. You now have a fresh "bolt head" to put a wrench on.
It should be noted that at this point, things are getting pretty serious and you want to attack this thing with all guns ablazin! That means presoaking the bolt with Liquid Wrench, or some other type of penetrating solution for a couple of sessions before hand, and applying a large dose of heat from a propane torch wouldn't hurt either, as would a couple of sharp blows with a hammer before you attempt backing out the bolt. Remember, this might be your last shot at it, make it a good one.
In my recent case, I was at the point where my options were pretty limited. The high carbon content of the broken easyout in the bolt meant that the welding option was out, and the fact that the bolt was snapped off well below the surface of the cases meant there was no way to get in there with a chisel. I called around to a local tool and die machine shop with EDM (electro discharge machining) capabilities and was given a rough quote of 8 hours time on the machine at a reduced rate of $50/hour, and that would be after splitting the cases so I could just take the top half of the crankcase down.
At this point there was nothing to lose, if I couldn't get the bolt out, a full stripdown would be in order. My solution was to take a 10mm bolt and make a holesaw out of it. I cut the threaded end off, and drilled out the core of the bolt to 7mm dia by about 30mm deep. I then ground some teeth onto the end of the hollow bolt. As such it would fit

down over top of what was left of the bolt, and I used the bolt for a guide as I proceeded to drill out the aluminum surrounding the bolt.
After drilling down about 15mm I felt the bolt snap free, and I was able to pull out the bolt, and a thin layer of aluminum still clinging to the threads.
With the hard part done, it was now a matter of drilling and tapping the cases to accept a machined plug made from a coupling nut. Once permanently epoxied into the cases, the repair should be permanent, and leakproof.

The end of the "holesaw", and the cored bolt still encased in aluminum

The internally threaded coupling nut was available from McMaster Carr, I machined the outer surface round, and then threaded ½-13 threads on it, and a matching set into the crankcase. The plug will be "JB Welded" into the case for what should be a permanent, leak proof repair.

Adjustment Techniques

The established method for adjusting the camchain is to start the engine, let it warm up, and then loosen the adjuster bolt, wait a few seconds, and then tighten the bolt back up again,

One method that was used at the dealership was the recommended method for the CB500/550. Instead of running the engine, remove the points cover, and rotate the engine until the "T" (1.4) timing mark comes into view through the inspection hole in the contact breaker point base plate. Continue to rotate the engine another 15 degrees or so, until the spring plate on the advancer assembly is just past the timing mark. At this point the #1 cylinder is about 15 degrees after TDC, and any slack in the chain should be on the back side. Now, in addition to loosening the locknut, remove the plug (E) in the cases above the adjuster bolt. You can now fit a small screwdriver down into the hole, and push on the rod that forces the arm down and give the springs a little helping hand. Retighten the adjuster while keeping pressure on the rod, and you are done.

There is one last repair that can save some headaches, or cause some new ones depending on your degree of mechanical finess. If the thread have stripped out of the cases it is possible to just seal up the the hole with another shorter bolt, and some epoxy, and then substitute the plug (E), with a machined bolt that would reach down and push on the adjuster rod as it is screwed down into the hole. This provides a very positive tensioning method, but in the hands of the wrong person it is entirely possible to over tension the camchain to the point where it would be howling in protest, and you could very easily chew though the tensioner blades themselves. BE WARNED!

We are all limited in our area of expertise, but that doesn't mean that we can't overcome those limits and expand our knowledge and skill base. Most of the time it is just a matter of setting your mind to it, confident in the fact that if someone else can do it, there's no reason that you can't.

It was with this thought in mind that I started my initial foray into chassis building. Here is a little primer on some of the necessary steps to building your own frame, or modifying stock frames for racing, or building custom street bikes.

Step 1 – Do some research

I found two really good websites with a wealth of information on building motorcycle frames.

WWW.EUROSPARES.COM has tons of information, a forum for discussing frame construction methods/materials, and offers some books that although they are expensive, I would consider must haves. "The Racing Motorcycle – A technical guide for constructors" Books I & II by John Bradley, covers everything from general frame layouts, aerodynamics, and gearing, to detail calculations of spring forces required to select spring rates for the suspension. Highly recommended. Book II is just out and I haven't seen it yet, but it seems to cover the more practical aspects of frame construction. Don't let the prices scare you. There is not a lot of information available on this subject, and if you are going to do an original design, you can save a lot of time and effort using the information in these books.

WWW.TONYFOALE.COM is another site that covers many aspects of frame design and construction. He also offers a book, "Motorcycle Handling and Chassis Design", that is well worth having. Tony has been around for a long time and has built many custom framed bikes, including a frame for a CB400F.

I picked up another book while at Mosport this summer watching a round of the Canadian Superbike series. "Motorcycle Design and Technology" by Gaetano Cocco, (head Engineer at Aprilia). This is an interesting read as he breaks down a lot of the engineering calculations dealing with chassis forces, aerodynamics, weight transfer, gyroscopic forces, all kinds of information. There is even a section on why racebikes have moved away from single sided swingarms.

Even if you are not planning to build your own frame, I highly recommend visiting these sites, and if you can afford it, ordering the books. They really are an interesting read, and go into detail explanation on how a lot of the "facts" of chassis materials and design as we know it today is really a load of crap in some cases, developed by the manufacturers to sell new motorcycles.

Step 2– Establish some physical parameters

It was my intention from the start to use many of the components that I already had on hand to make my first attempt at building a bike. I knew it would be built around my CB400-F engine/carbs, I had an Ontario Moto Tech exhaust, I had the rolling chassis from a VF500 to provide wheels/brakes/forks/ swingarm, and I had existing body work that had a custom paint job that I didn't want to just throw away.

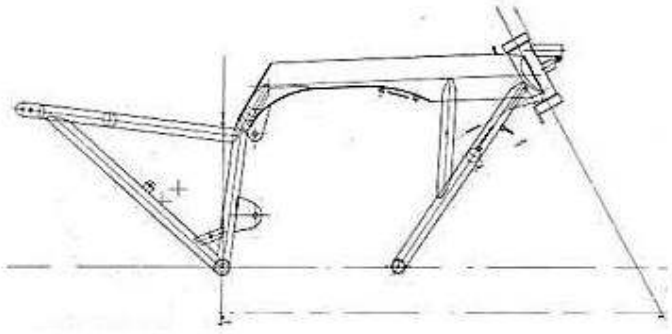
Using these existing components established most of the rough parameters for wheelbase, type of frame, and general layout and looks of the finished bike, but still left lots of detail decisions to be made. Exact frame layout and construction methods, rake/trail, and swingarm pivot location, all needed to be sorted before any construction could commence.

I made a fairly large decision very early on to go with an "Egli" style large backbone frame. This style of frame is well suited to using the engine as a stressed member, which simplifies the frame and engine mounts, offer good resistance to axial twisting, and would allow the use of the stock fuel tank. The last item being important to me to save an existing paint job. I also decided not to veer too far off the straight and narrow, and copied the existing steering geometry and swingarm pivot location of the VF500, which was renowned for it's light, neutral handling.

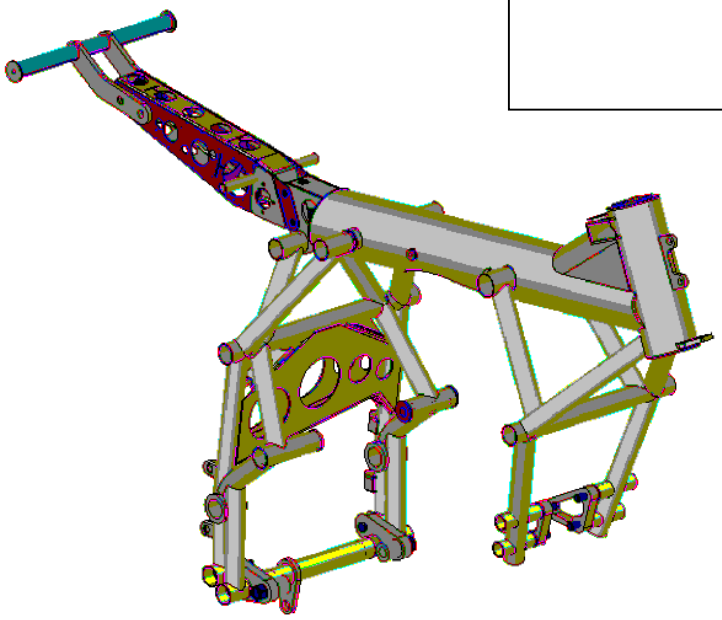
Step 3 - Model the existing engine and chassis components in 3D

I do design work for a living, so it was easy enough to measure the engine, wheels, forks, swingarm, etc. at home during the evening, and then enter them into the CAD system at work on lunch break, or before/after working hours. Once all the components were done, it is a fairly easy process to position all the components, and start designing the chassis around them. This step can be done in 2D on the computer, or even using paper cutouts of the components and moving them around on graph paper.
Most of the frames that were built in the past, probably right up into the late 1990's were not really "designed", but rather were built up on a jig around the engine, and then once complete, a production jig was built around the finished frame.

An actual Egli frame on a frame jig.



A Sketch of an Egli style frame.



CAD Model of frame, this step is not entirely necessary, but the work put in up front pays off in fewer problems during construction

There was no actual design work done. It has only been the last 10-15 years that the computer software has advanced to the point that it can be effectively used to develop 3D models.

Next issue – shop equipment