On the Problem of the XR200

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http://vincentcrabtree.web.officelive.com/XR200.aspx

Intro

This document is a review of the various options for people experimenting with the sub 250cc Honda 2 valve single overhead cam, single cylinder upright engines with built in gearbox, such as TL125, XL125, XR125 and CB125. This information may also be useful to the various Chinese clone engine builders.
The original motivation was to build an XR200 engine in the UK, as this engine is hard to find here. However, anyone building these engines for competitions, such as Trials, Road Race or just off roading in general, may find it useful.
The document began in 2002, but I have long since stopped developing these engines so can only offer general advice - all the information I have is in this document, and I have already forgotten most if it.
You are encouraged to make a small donation if you find this useful, especially if you are making money from this information, like the guy who asked me about the Yamaha pistons.
There is also a memoriam on this site for Hoyt, since it was Hoyt's website that got me interested in the prospect of modifying Honda single engines.
I never met Hoyt and only communicated by emails, but the internet and world will be a less rich place now he is gone.
If you see any obvious mistakes or can add useful information, let me know and I will credit you.
Whatever you glean from this article, make sure you are working within the spirit of your local club. If the rules say pre 1985 equipment and parts, they mean it. Although you will may *get away with* using later parts inside the engine, it's hardly cricket.
Thanks must go to David Chinn, Al Johnston, Trevor Hughes, Clint Wilson, Rusty P., Mike Claybrook, ‘Two Stroke Eddie’, ‘The Phantom’, Alan Barnes, Jeff in France, Tony Brooks, Jon Newlove, Daniel Manuge and Doug Simpson (in no particular order) for helping provide content for this article.
Finally, I have to say that any errors are accidental and I cannot be held responsible for anything as a result of reading this internet web page.

Synopsis

In the the 2-valve XR200 engine was never officially imported (AFAIK). This is unfortunate, since the forgiving characteristics of XR200 engine (Compared to two strokes), and relative power, made it very popular in the both for novices and, with several tuning options, for the more advanced riders.
This document details several options available to an engine builder wishing to achieve similar performance
This text is also of (lesser) use to people such as ATV and Trail/Trial riders, wishing to extract the maximum performance (both torque or power) from their Honda, such as ATC200, TL125 etc, for all kinds of racing - one of my favorites is Australian Bucket racing.

Introduction

The Honda XR200 engine has been in production for many years, basically in two forms:- the 2-valve engine, which follows the standard vertical cylinder engine format, and the RFVC four valve engine. The 4-valve engine was only produced for two years and can have reliability issues, and is not discussed further.
The 2 valve XR can trace its history back to before the 1980s, which is when the split head vertical Honda singles began to appear, themselves based on the one piece head designs which appeared in the early 1970’s. The XR200 appears to be a development of the 125 and 185 series engines, simply (if you are a manufacturer) by boring, stroking and changing head and cam specs.

XR200 Specs

The 200cc capacity is on the upper bound of the Honda small engine vertical cylinder format. The basic specs are shown below along with some other members of the same family.

	CB100N	XL125S	XL185S	XR185A[$]	XR200	TLR200R	CRF230F[#]
Bore	50.5	56.5	63	63	65.5	65.5	65.5
Stroke	49.6	49.5	57.8	57.8	57.8	57.8	66.2
Capacity,cc	99.35	124.11	180.18	180.18	194.76	194.76	223.06
Wrist Pin, mm	15	15	15	15	15	15	15
CR	9	9.4	9.2	10	10	9	9
Power, bhp/rpm		9.7 9500	14.3 8000	18 9000	19 9000	11.8 6500	18.4 8000
Torque, lb-ft		7.09 8000	10.34 6500	11.49 7500	11.51 7500	11.6 4000	13.87 6000
Carb bore, mm	22	22	22	24	26	22	28
Primary reduction	4.055	21/70 3.333	21/70 3.333	3.333	21/70 3.333	21/70 3.333	22/68 3.091
1st Gear	2.769	3.083	2.769	3.083	2.769	2.769	2.769
2nd Gear	1.882	1.941	1.722	1.941	1.941	2.062	1.941
3rd Gear	1.450	1.400	1.272	1.450	1.450	1.5	1.45
4th Gear	1.173	1.130	1.000	1.130	1.130	1.13	1.148
5th Gear	1.00	0.923	0.777	0.923	0.923	0.923	0.960
6th Gear	-	0.785	-	0.785	0.785	0.785	0.812

$ Thanks to Trevor Hughes - XR185/200A Twin Shock. Note XR200A has XR200 Top End, XR185A Gearbox.

Thanks to Darrin Mark & Honda EU

Notice that the 185 and the 200 engines use the same stroke. There is more commonality between these engines, as we shall see further.
All these engines use a 15mm wrist pin - earlier models of the CB100, one-piece head (possibly K) may have used a 14mm pin, and care must be taken when mixing pistons.
Cosmetically/practically, the 100 does not have the castings for an exhaust decompressor, as the crankcase does not have a bulge at the rear of the RHS crankcase, and the head does not have the decompressor linkage and internals. The 125 engines I worked on have a casting bulge and blanked off cover.
The 122cc engines (which *may* have one piece heads), also lack the decompressor
The TLR200R engine I owned had a short camshaft than the other engines, since it used an electrioc ignition, not points, and therefore did not need bob-weight points and points carrier.
However, these engines have a cam cover that supports or covers the left hand end of the cam, which is interchangeable. But, bob-weight points do not fit the short TL cam.
The Table below shows Honda Part numbers for the heads, valves and cams.

	CB100N	XL125S	XL125R[&]	XL185	XR200	TLR200R	CRF230F
Inlet Valve	14711-107-020	14711-437-000		14711-437-000	14711-437-000	14711-KY2-000	
Diameter,mm	27[*]	30		30	30	27[*]	
Exhaust Valve	14721-107-010	14721-437-000		14721-437-000	14721-437-000	14721-KY2-000	
Diameter,mm	21[*]	25		25	25	20.5[*]	
Cam	14101-383-000	14101-437-000	14101-KB9-000	14101-437-000	14101-446-000	14101-KJ2-000	14100-kps-900[@]
Inlet Valve Open	5 BTDC	10 BTDC	5 BTDC	10 BTDC	15 BTDC	0 BTDC[%]	10 BTDC[#]
Inlet Valve Closes	35 ATDC	40 ABDC	30 ABDC	40 ABDC	45 ABDC	30 ABDC[%]	40 ABDC[#]
Exhaust Valve Opens	30 BBDC	40 BBDC	35 BBDC	40 BBDC	45 BBDC	35 BBDC[%]	35 BBDC[#]
Exhaust Valve Closes	5 ATDC	10 ATDC	5 ATDC	10 ATDC	15 ATDC	0 ATDC[%]	10 ATDC[#]
Inlet Lobe Height	31.75[$]	31.7		31.7	31.91[*]	31.07[*]	
Exhaust Lobe height	30.99[$]	31.3		31.3	31.57[*]	30.67[*]	
Inlet Lobe base dia					25.1[*]	25.04[*]	
Exhaust lobe base dia					25.0[*]	25.17[*]	
RH journal		19.97		19.97	19.97	19.9[*]	
LH journal		33.96		33.96	33.96	33.95[*]	

* - Measured by Me $ - Thanks Al Johnston & - Thanks Trevor Hughes @ - Thanks Bill Todd

% - Thanks David Chinn @ 1mm Lift (shop manual) # - Darrin Mark, CRF Shop Manual @ 1mm Lift

It can be seen the XL125S, XL185 and XR200 use the same valves, which means they may also use the same head with the 125 using the non-decompressor cam cover (not available separately).
The TLR200 engine has substantially more finning then the other, with smaller ports, and the valves are marked specifically for the TLR200, whereas the CB100 engine uses valves also installed into the TL125 (78-79), CB125S (75-79), SL125 (76-78) i.e. 122cc engines.
Additionally, the 437 series of valves were also used on the CB125RS, ATC185-200 engines, and the TL200 76-78. The CB100 head is the only engine mentioned in the table that does not use a bush in the head.
The XL125S and 185 both use the same cam, whereas the CB100, XR200 and TLR200 use cams designed for that relevant engine. However, the cam journals are the same size and the lobe heights are similar, permitting cams to be swapped between heads to select the desired tune. For example, the TL cam fitted an old CB100 head I have in my garage.
The TL200 and XR200 engine uses a flat-topped piston with a large squish area The XL185 uses a slightly dished piston, whereas the CB100 uses a slightly domed piston.A useful list of Honda part numbers for these and other engines is available here, which cab be analysed to further understand these

these engines for the careful reader .
Any errors are accidental, and I would appreciate feedback if you spot them.

Implimentation

To develop a high power engine, the following sections must be considered.
Following the sound advice from the TL125 Big bore Page by Mark Worsfold, a builder can use the XL185 engine as a basis. The XL125S gearbox (6 speed) is most easily available in the UK (though getting scarce) and fits into the 185 cases. The 125 cases require the crankase mouth to be bored out for the 200cc cylinder spigot, but this intrudes into the cylinder head oilway.
One option is to weld up the oilway and use an external oilway to the head - ideal for a cylinder head oil cooler.
More details and further excellent advice on reboring and relinering 125 cylinders is available from given by Al Johnston available from the TL125 link above.
An XR200 cam and piston can then be fitted to the 185 engine with 6 speed box, using an XL125 or XL185 head depending if a decompressor is required.
Many builders people do not bother with the decompressor on such a small engine. My experience found that the cheap pattern kickstart lever kept bending when the decompressor was not used.
That is it, 6 speed XR200 Look-a-like in the UK.
If you want to get a ready made bottom end, a British Breaker who advertises in the back of Trials and Motocross News imports Honda TLR200s from Japan and breaks them. You could buy a complete bottom end from them, fit an XR200 or GL145 head (see below) and carb, and off you go. However, I was charged GBP£90 for a TLR200 alternator, so a complete bottom end will not be cheap.
Elleston-Breakers are/were on 0188-959-0186, UK.

Cases/Gearbox

There are several real options. Theoretically, the 57.8mm stroke crank of the XL185 and XR200 should fit the CB100N cases the crankwheel diameter is the same at about 111mm and the bearings are the same, but have not checked yet. However, a 185 Barrel spigot does not fit. The cylinder stud spacing is identical on all these engines, but the studs are different lengths, so 185/200 studs would be required.
Two Stroke Eddie reports that the XL125R and S (six speed remember), takes the XL185/200 barrel spigot directly, confirmed by David Chinn. Eddie preferred the shorter 125's 49.5mm stroke for a quick revving engine. The XL125S and R already have a 6-speed gearbox, but I don't think it is possible to fit a 6-speed gearbox to the CB100N.
If using the XL185 bottom end, then the 6 speed XL125S fits the cases described elsewhere.
David Chinn, investigated fitting the first gear of the XL125S into his TLR200, since it is lower. However, it seems the width across the gears of the two assembled gear clusters is different, as the table shows (provided by David).

Width, mm (inches)	125	200
Mainshaft (Input)	96.6978mm / 3.807"	101.8794mm / 4.011"
Countershaft (Output)	96.266mm / 3.790"	100.33mm / 3.950"

This ties in with other reports from Mark Worsefold and Trevor Hughes it seems the 5 speed XL185 cases will accept the narrower 6 speed XL125 gears, but the gears from the 200 engines (the TLR uses the XR200 gear shafts – confirmed since the TLR200 has 446 on the shift forks) will not fit the 185 or 125 cases. If you have a 200 Engine such as a TL/R or XR, then you already have 6 speeds, and do not have to worry.
Several people have whined to me that a TLR engine is not suitable for road use since it has a close ratio trial gearbox, but this is untrue - they may be confused with the TL125 which really has. The TLR200 has more of a trail gearbox and would be fine for green-laning and road use, but not short powerband road-racer (Australian Bucket) use.

Mike Claybrook reports that in his experience, the bottom end is the same between the 185 and the 200, whereas David found the opposite. I think this could be because of differences due to locale - Mike Claybrook is in the UK, whereas David Chinn is in the US.
It is therefore essential to thoroughly inspect both halves of the crankcase you are planning to use. On both (XR and TLR) my 200cc engines, the right hand crankcase had 437 cast into the right hand case at the front next to the mounting bolt holes, and 446 cast into the left hand case at the rear.
I believe (but haven't checked) that the 185 used 437 cases for both the left and right halves, which is why they accept the 6 speed xl125 gearbox. If your cases have 446 cast, then you don't have a lot to worry about anyway since you have a 57.8mm stroke crank with a 6 speed gearbox. If your cases say 437, then you should be able to fit the XL185 crank.
The CB100 uses 8mm mountings, whereas the 185 and 200 use 10mm mountings. Reaming the frame out is an option, but care must be taken, and the decompressor bulge must also be accommodated. Al Johnson recommend making a cardboard template which can them be used to modify the frame - saves grinding away too much then regretting it (as I did).

Crank

Options are limited for stock 57.8mm stroke cranks, and more so for oversize/long stroke cranks.

Stock Honda 200cc 57.8mm Stroke Cranks

The 57.8mm stroke crank of the 200 engine is relatively difficult to obtain in the UK. The only Honda engien which uses this crank is the scarce XL185 crank.
However, the Cranks seem to be made from the same blank for the CB100, XL185, XL125 etc so it should theoretically be possible to use the same stroking principle discussed on the TL125 Big bore to stroke a 49.5mm throw crank.
In the UK, the second option is to use the TL/R200 crank, which is even more difficult to find. However, the TLR200 has a heavier flywheel than the XL185/125/200, and the flywheel Taper is also larger on the TLR. This makes generator options more limited as discussed below. Additionally, the heavier TLR200 crank is therefore less suited to a fast revving engine. It would of course be ideal for a trials engine.
Also, check the TLR200 and XR200 LHS crank (main) bearings, as there seems to be some confusion as to whether the XR and TLR use the same left hand crank bearing.
I know from experience that the TLR200R and XR200 crank and cases are interchangeable, and may be mixed and matched - the TLR200 cases are stamped with 446 which is the XR200 ID number.

Honda 62.2mm Stroke Crank

The Honda CTX200 Bushlander has a long stroke 62.2mm crank default, and is also electric start. This is an 'agricultural' machine, so is not high performance, with 5 gears. However, it looks very interesting, and should be followed up further...

Stroked Standard Cranks

A stroker crank is a crank where the centre point of the big end pin has been moved further out from the centre of the crank. Powrol have a good overview Booklet. Powroll still/used to offer stroked cranks on an exchange basis, but are expensive, and you obviously need a crank to exchange in the first place.
One problem with the stroked cranks is to ensure that the top hat bush, as seen on the TL125 Stroke pager does not break out from the crank web. Also, any throw increase must be checked for clearance against the gears in the 446 engines I have looked at, there isn't much room between the crank outer edge and the gear clusters.
If you don't like the top hat bush option, then consider the Offset crankpin approach. MB Developments near Doncaster did this work to a Gilera 2 stroke scooter engine, which uses the same principle on pressed together cranks, including the TL/XR.
Things to consider when using offset pins are that the stroke increase is relatively small, since the offset must be small enough to allow the bearing and one piece conrod to be fitted - split conrod big ends

would permit a larger offset, but these require shell bearings, which in turn require high oil pump pressure, not to mention custom rods. Falicon can manufacture custom rods $100 (in 2003).
Spinning of the offset pin can also be a problem - oversizing the pin by 0.0001" is one possible solution, but this makes assembling and truing a pressed up crank more difficult, and can crack the crank web during assembly.
I prefer TIG welding the crank pin in place, but this makes rebuilding the crank more difficult as the weld must be ground out.
I think this is generally why top hat bushes, described above, are preferred.
Apparently, Powroll can 'Shrink' the con rod when using stroker cranks. They do this by pinning the top and bottom of the rod into a press and heating it until cherry red, then apply downward force with the press. It actually causes a bulge in the rod! I don't like this for two reasons - the rod is forged during manufacture, which increases rigidity and tensile strength by developing a layer of compacted metal crystals near the surface, which is better for hardening, and it sounds like this process will destroy this surface hardening. Secondly, the piston skirt must be cut away excessively, which reduces the life of the piston by both wear and also encourages piston rock.
Another option for 66.2mm cranks exists, to be discussed below.
Clint Wilson has experimented with a 6mm stroker crank on an XR200. In addition, he has experimented with a 3mm longer con rod from a TRX 4 wheeler on Stock Stroke for Trials engines - he says it makes a smoother power delivery. I feel it is also a good idea to use a longer rod on stroker cranks for two reasons, makes the engine less choppy for trials work (by restoring to some extent the stroke/rod length ratio) and reduces the amount of piston skirt needed to be removed (flycut) so the piston clears the crankwheels at BDC. If you are really interested in this stuff, you can look at the piston acceleration program in my programs page, which looks at the effect of acceleration on piston velocity when changing stroke and rod length. An interesting article on this theory is available at http://e30m3performance.com/tech_articles/engine-tech/rod-ratio . Clint says he would offer this kind of service to whoever is interested - email him on bianese@aol.com if interested.
It is conceivable that if you were to fit a longer rod, it may be possible to find one with a larger small end eye, which can then be bushed back to size, assuming you are using a Honda dimensioned piston, to fit the 15mm wrist pin. The phosphor bronze bush would then reduce the likelihood of the small end seizing at high revs, which is a weakness on these engines. In addition, a rod could be found which possesses a smaller big end eye, which when used with a smaller pin could allow a stroke increase without breaking out of the flywheel. Here is a drawing that tries to explain these points, but I'm no AutoCad expert, so it looks crude. Again, Falicon or Hoyt or Belfab could make a conrod for you if you really wanted one. If the conrod small end eye was slightly larger, then pistons with 16mm wrist pins could be used along with a small end needle roller. This will be discussed in the piston section.
The Phantom of the Australian bucket racers made his own high spec alloy con rods with a pressed in hard steel bush for the roller, which is one way but quite specialised. In addition a different piston could be used, but you run into dome and valve cutout problems, so would take a lot of investigation and possible machining.
One thing I haven't found any information on is balancing cranks. Static and balancing is easy, dynamic balancing is not. John Wood gives a description on Dynamic Balancing cranks in his Two StrokeTuning book that is excellent. I feel this is a big issue when stroking cranks increased vibes fatigue both the rider and the engine!

Other Crank Sources
Since this article was originally Written, Jeff in Frane contacted me about the Shineray/Lifan 200cc engine. This is available in both OHV and OHC form, both electric start, and is 62.3 stroke. Jef fitted the Shineray crank to his XL125S, pictures below:-


The only problem is the alternator taper is a little bit long, due to the electric start I guess. Jeff says this can be trimmed down, and will send more pictures.

And Finally...
Lastly, though obvious, I just thought I'd point this out - when stroking or increasing rod lengths, spacer plates are usually required to restore the piston deck height. As described, above, I feel these are best fitted underneath the cylinder barrel, for reasons discussed below. In addition, cam chains must be lengthened, which is not too difficult for the dedicated. An excellent article in general, but specifically discussing cam chains and barrel spacers, is on the Army of Darkness FZR400 Campaign website from 1995.
Honda themselves have used different part specs on differing applications. For example, one CB100N engine I had had a conrod marked 383, with a 36mm big end ID. 383 is the designation for CB125J whereas another engine had a conrod marked 437, 38mm big end ID. This is the designation for the XL125S. See TL125 Website for Part designation info.

Generator

The power system you require depends on your application if you want maximum power, fast revving and are only running for 15 minutes, you could consider using a total loss gel battery system, without a flywheel or stator race CBR600 engines I have seen have the crank shortened so it just pokes out from the bearing crank bearing, but this is extreme. Most people will require at least self-starting capabilities, and probably a brake light. If you only need marker front/rear lights for day or at most dusk work, then 6 volts systems are ample, but do not expect them to run turn signals without the headlamp *blinking* too. However, if you need to run comfortably at night without constant fear of running off a cliff, then 12V, preferably 3 phase systems are essential. This is especially true if you run an electric starter, discussed below.
The smallest system I can imagine would use a CB100N rotor (tiny and lightweight) on an XR200 the rotor fits straight on the crank taper, and the CB100 stator cover fits the cases no problem. The problem is that the XR cases don't have the mountings for the outer stator ring like the CB100N cases do but they could be easily added more on this when I get time to investigate fully. The CB100 uses a small central rotor and outer stator which looks like it could easily be rewound to 3 phase, or a 3 phase stator from a CB175 used, but I have not checked. Incidentally, 3 phase is the most efficient power generation method.
I suspect the TLR and XL/XR series use separate twin/triple coil systems, with one as the *power* coil and the other as the *lighting* coil, with a battery charging coil possibly. Trevor Hughes modified his XL185 based system for 12V lights. He gives full and comprehensive details Here and includes spreadsheet and contact details of a place in the UK who sell the appropriate connectors and wire bits all credit to him for providing this fully working solution.
However, this method is not recommend if you wish to run a halogen bulb, as Halogens require a steady 13.8V for best performance and longevity. I also feel that *burning* power from the alternator with a zener diode is a waste of the energy the engine is creating, which is better used to directing the bike forward. One option could be to look into using a CBR600 regulator (which I believe is a switching regulator) with 3 phase coils, but most people are afraid of electrics.

The XR and TLR engines use an outer flywheel system, with the rotor overlapping the coils, and the central stator mounted on the inside of the alternator cover. Trevor Hughes originally informed me the TLR engine uses larger tapers than the XR series, which I found out for myself later. The TLR also uses a crank mounted ignition pickup, but you can ignore this if you wish to use the conventional cam mounted points or CDI. Additionally, the TLR200 uses a flywheel mounted ignition pickup, and has extra winding on the stator gor HV and ignition advance since the centrifugal advance on the cam is not used on this engine.
In the past, I used self advancing points with no real problems on the XR engine. A Table is presented below which summarises this information, including the weight of a few rotors.

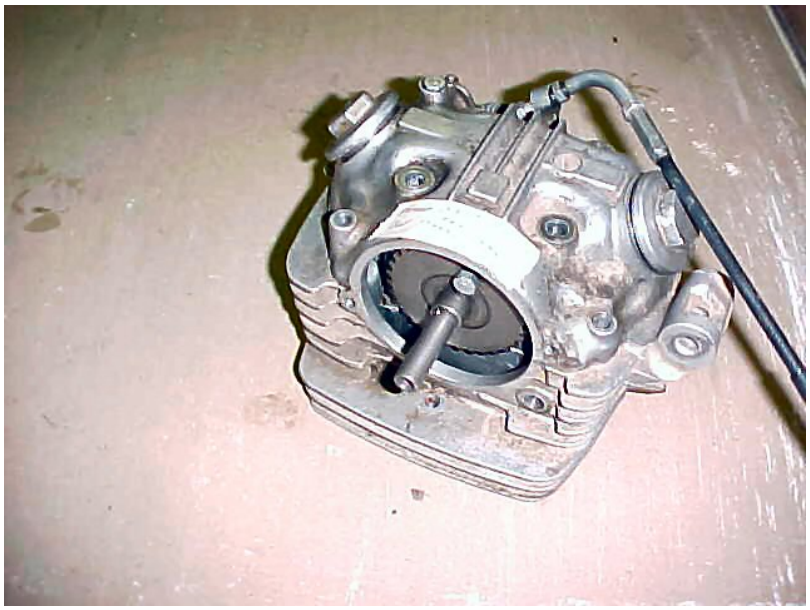
Machine	Rotor Weight	Rotor OD	Rotor ID	Voltage/Power	Notes
XL125R	1.3kg			12 volt	
XL185s	1.9kg			6 volt	can be modified to 12volt
TLR200 Reflex	2.4kg	126.8mm	86mm	12 volt	must be fitted with TLR200 crank
TLR200	2.85kg			12 volt	must be fitted with TLR200 crank
CB100N	~0.75kg	79.5mm		6 volt	Fits XR200 crank

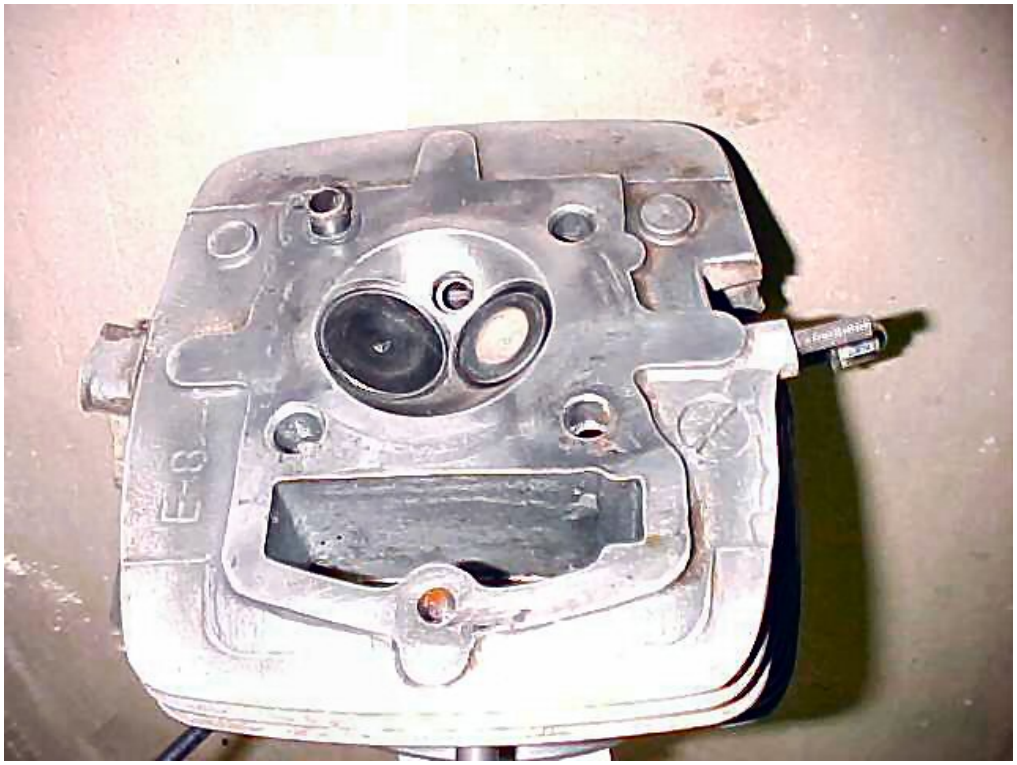
With help from Trevor Hughes.

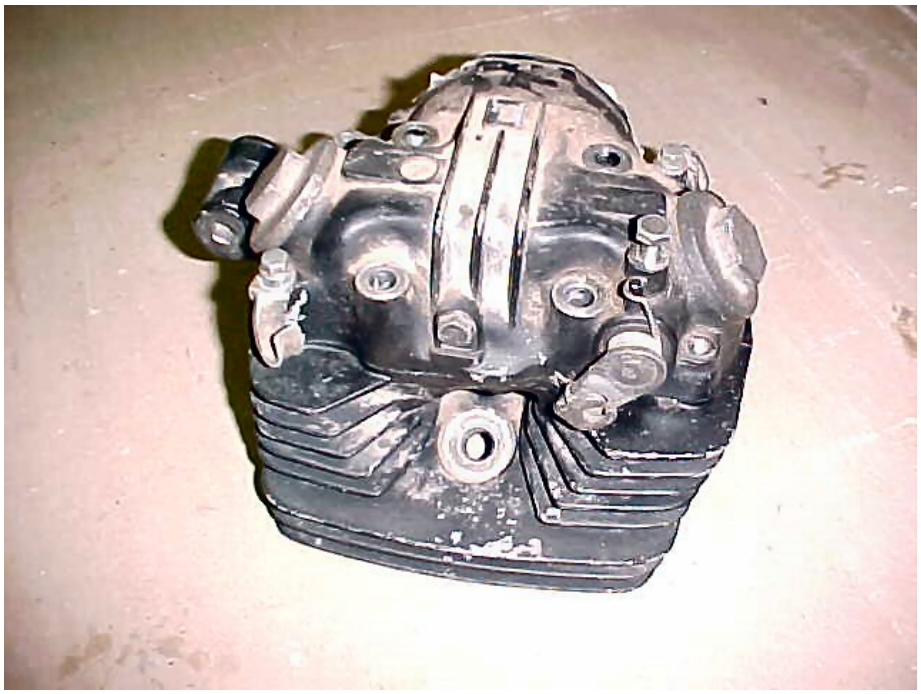
A trials engine builder looking for extra plonk might also consider a system similar to the Steahly Bolt on Flywheel Weights, which look interesting. The XR200 is not listed but you get the idea.
Two Stroke Eddie contacted me and says to use a CB125RS generator system since it has the greatest 12V output power, (but I have no information on flywheel sizes), with a CB250N regulator, which could be a useful solution.

Cylinder Head

XR200 Heads are not such a great problem - looking at the part numbers provided, the builder can use almost any XL/XR125/185/200 head throughout the year ranges. It is the cams that are different, discussed below.
For comparison, an XR200 head is shown along with a TL200 Reflex head. Externally, they look identical, apart from the more rounded finning, and the XR200 is usually bare or silver or black, depending on year, the TLR200 is usually black.
Careful inspection shows the TL head uses smaller valves and a radiussed squish area. Also look at the valve separation and spark plug clearance.




E-8



As stated, someone wishing to build a trial engine may consider any of the head with small valves in it - I believe the earlier TL125 one piece head had even smaller valves in it, but cant be certain. The only disadvantage in this respect is the TL engines generally have more finning than the road engines. Al Johnson says the ports and Valve sizes for the CB100 are the same for the TL125, but a slight radius must be matched to the piston dome when used on the 56mm bore piston. Apparently, the valves on the One piece heads are even smaller, but I cannot confirm if the head will fit.

One last point - when looking for large capacity increases, the head becomes a restriction, since it isn't designed to work with the new engine capacity. To rectify this, the valves and porting or the cam lift and porting must be changed if you wish to keep peak power in the same place - see the excellent AOD

article mentioned above, read the white paper on Valve lift by me and play with the programs I wrote to investigate this further.

On the subject of Big Valves, Alan Barnes uses a Honda GL145 head, Machine type KC02, model code KG2. He says it fits straight onto the usual studs and has 1 mm bigger valves than the XR200 standard. The GL145 uses points as standard, and Alan said simply machining the cam journal allows you to fit the XR200 CDI system. The GL145 also has a Roller bearing on the chain side of the cam and on the other, so looks good, but doesn't have the decompressor. The GL145 is available in NZ and I'm trying to confirm more details on it.
Clint Wilson says the Honda ATC200X 83-85 head bolts straight on uses the standard stud pattern, and has the best port design of the XR and XL series he has seen.I can confirm that it bolts up, but not sure if it has the best ports.
On the subject of Cams, the Jialing Chinese copy of the XL125, known as the JH125, has a roller bearing on the chain side of the cam.

Cams

XR200 cams may be obtained from David Silver spares for less than £50. Alternatively, due to the fact that the XR200 is so popular in the US, a used cam may be purchased on E-Bay USA. I purchased one for $20 plus $10 postage, but you must keep your eyes open.
David Silver Spares also lists XR200 cams for less than 50 GB pounds.
The *ultimate engine* builder has the option of using performance parts, such as available from Powroll, MegaCycle or Hot Cams, but getting the cam re-profiled is my preferred options - burnt cams may be obtained from breakers at low cost, hence the cost effectiveness of this method.
Phil Joy of Joy Engineering, who has lots of experience with Honda Singles, can regrind them very reasonably to a profile you suggest or to a profile known to work well. Look Here for an example of Phil Joy's work.

Phil Joy
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Telephone: 01279 730682
joy@essexcottage.freeserve.co.uk
Website: http://www.joyengineering.co.uk - Not working?

From outside UK call +44-1279 730 682. Tony Brooks had a scrap burnt cam reground for 75 British Pounds, which is less than US$120 and Euro 120, and kindly provided the Contact details.
Ivan Tighe Engineering sells cams for the Australian Bucket racers, but I dont know anything about them. Also, an Australian firm Waggots also regrind cams, but I have no details.
Finally, the valve lift and flow scenario, mentioned above, must be considered on large capacity engines.

Four Valve Head

Honda produced the XR200 RFVC in 1984, but it was an under/over design: over engineered, over heated, under-powered and unreliable.
A long time ago Alan Barnes and I discussed the possibility of fitting a 4 valve head on to a 2-valve bottom end. Apart from the hundreds of man hours required for TIG welding and milling, the main problem was thinking of a suitable donor. All we could come up with is a head from VT400 from a horrible custom thing and a head from an NTV400 Bros, but I think this is water-cooled.

Imagine my surprise when Daniel Manuge emailed me in Jan 2010 to show me he had done just that with VT250 cylinders! Daniel does not claim credit, saying he is repeated what he saw on another bucket racer.

Specs:

- VT250 DOHC Head
- Single Carb with siamese inlet ports
- Electric water pump
- Oil feed to head

Daniel said the most difficult part is the ignition as a crank trigger must be used.
You can just see that the XR200 cylidner is held in place from the bottom studs, and the top gasket face modified to accept the VT cylinder. A good thing about the VT is that you get two heads with each engine.
This will take some time to develop with cams etc, but I woudl like to see one of these on a CRF or SL230 bottom end with dyno.

Pistons/Cylinders

You will need a barrel/cylinder. These can be standard 65.5mm bore, to take a stock XR200 piston, or oversize.

Stock Bore

The Table below shows details of a few barrels I measured.

mm	CB100N	XL185S	TLR200R	XR200 - 82	XR200 - 96
Bore (Spigot ID)	50.5	63	65.5	65.5	65.5
Spigot OD	58.8	69.2	69.1	69.2	69.2
Gasket to Gasket	67.7	74.1	74.0	74.0	74.1
Spigot Length	25.5	32.4	32.3	32.1	32.2

Note: All measurements by Me with cheap Vernier Calipers.

Basically, the 185 and 200cc barrel are more or less identical, with only initial bore size differing. Someone in the UK could either use an XL185 and bore it out, or again buy an XR200 cylinder from E-Bay, not forgetting the TL which is more rare than the XL185. Even a heavily worn XL185 barrel will require serious boring for an XR200 Piston, so make sure whoever does the boring knows how to keep everything true and on the centre line of the barrel (some places who bore commuter bikes such as 50cc scooters and the like can be less than rigorous when setting the boring bar up).
XR200 pistons may be obtained from David Silver (I checked at £33 plus VAT (sales Tax) plus rings and wrist pin). The stock XR200 piston 65.5mm size is relatively rare in the UK - the ATC200 65.0mm piston may be used instead, but I believe the compression ratio is lower (dished crown), as used with the CG125 engine mentioned on the TL125 Big bore page. This would be the best approach for TL engine builders (using either the 125 or 200 crank), since a *low* compression ratio of 8:1 is preferred for trials engines to reduce the risk of stalling at low engine speed. However, we would be more interested in a high compression engine, such as 10.5:1 to get more power up top, so remedial work such as skimming or head reprofiling (or both) would be required for a high performance engine.
The ATC200X 1983 to 1985 barrel can also be used and is highly recommended. This barrel has the largest finning of all the engines I have seen, and would be excellent for a trials bike. This barrel is also best for oversizing with a liner as discussed below.

Oversize
Oversize barrels are designed to take pistons wider than the stock XR200. This is obviously to get a big bore engine. The liner on the stock XR200 is very thin at the bottom, so most people go to relinering.
Mark Worsfold used a novel approach when oversizing a CG125 engine for a TL125. Placing a spacer underneath the top lip of the liner on the top edge of the barrel extended the barrel of the CG125 donor engine, which is only around 50mm stroke standard. Mark used this approach because of the pushrod arrangement used by the CG125 engine, but since the XR200 engine uses a camchain, we can place the spacer underneath the barrel, which I believe is better for heat dissipation, since the cylinder fins are closer to the hot part of the engine.
If you wish to investigate pistons further, Rytech, a Malaysian Piston manufacturer, have allowed me to produce This page giving piston dimensions in order of bore size and wrist pin size, four strokes first.
Performance pistons, available from Wiseco or Powroll may also be used. Powroll produce a bore in piston of 66mm offering 12:1 compression, with Wiseco offering 10.25 CR and 4 rebore sizes.
However, these pistons are rather expensive, so a cost conscious builder may opt for the ditch pump engine piston of 67mm, mentioned on the TL125 page, giving a capacity of 203cc when used with the stock crank. The TL125 page says this piston should bore straight into the XL185 barrel, but the compression ratio should be checked and adjusted by skimming where required in the same manner as for the ATC engine. I also feel that there isn't a lot of meat left in the barrels I have seen, since the spigot diameter is only around 69mm. Al Johnston has some cautionary tales at the bottom of the TL125 page which illustrate my point.
Clint Wilson informed that a 70mm Yamaha piston fits the XR200 (but not which one!). I was worried about oilways and dowels, but he reckons it goes straight in with a new liner
He did not elaborate whether dome or valve cut-outs needed modifying for the XR combustion chamber, but I would assume they would.
However, I found that a 68.5mm Piston from a Yamaha Riva XC200T, 1987 fits nicely. This piston uses a short skirt, low compression height and a 15mm wrist pin. Part numbers are shown below:

	1XX-11631-00-A0		Piston (STD)
	1XX-11636-00-00		Piston (0.50MM O/S)
	1XX-11638-00-00		Piston (1.00MM O/S)
	1AA-11610-00-00		Ring Set (STD)
	1AA-11610-20-00		Ring Set (2ND O/S)
	1AA-11610-40-00		Ring Set (4TH O/S)
	25G-11633-00-00		Piston Pin
	93450-16068-00		Circlip (Get two)

The pictures above show the Riva piston between an XL185 piston on the left and a TLR200 on the right, with the wrist pin slid through. The top picture shows the shorter skirt and the lower compression height.This piston would be ideal in a stroker crank of a few mm since that would restore the piston deck height, and flycutting the piston skirt would be reduced or unnecessary.
Bill Todd has a Stroked and Bored TLR200 to 250cc using 70mm RTL250 piston and head gasket was used, and he has been kind enough to provide some of the part numbers - currently lost. (Dammit)

Exhausts

The Oz Bucket Racing Forum gave details for a Megaphone Exhaust - thanks to *The Phantom* for disclosing this info. The important bits are below.

> *I would advise you to get a header made 36mm inside diameter. The length will determine the shape of the torque curve. Shorter shifts the torque peak up in the rev range. 450mm will give a tuned length for peak torque at 10000 rpm, 500mm is tuned to 9000 rpm. On the end of the header put a megaphone starting at 36mm and expanding to 90mm over a 700mm length. Put a reverse cone on the end 12mm long at 60 degree included angle. It will be LOUD but fast.*
> *The Phantom, Sat Apr 12, 2003 1:56 am, Newcastle, Australia*

This gives an exit hole of 78mm. I drew this Autocad drawing if it is any use.
As for sourcing and locating supplied for custom exhaust development, an interesting website http://www.headersbyed.com is useful, informative and sells the required parts if you are in Minneapolis - USA.
Another source for performance exhausts exists from Japan, discussed in the next section.

CRF230F and Family

Honda (and other manufacturers) have been slowly dropping their two-stroke range of competition machines for some time, turning in favour to the more eco friendly four stroke engines. The upshot is the release of the CRF230F enduro/motocross in 2003.
Upon close inspection, the engine looks very similar to the XR200 available more than 22 years ago! I

originally though these were developed from the XR200, but in 2010 found that there was a Japanese only XLR200R in 1993, which had electric start. (Thanks for Jon Newlove for pointing this out.)

Looking at the specs, it seems Honda have been surfing the web, and they too have agreed the way to increase capacity is by stroking, since the engine bore and stroke is now 65.5 by 66.2mm, very similar to the big bore TL engine mentioned earlier.
Clint Wilson a CRF230F in his BBR and informed me it is possible to refit the kicker and have both electric and kick start.
This prompted me to look further, where I came across the following models; all related to the decades old XR200/XRL200R engine:

1. XLR200R - released 1993 (?)
2. SL230 - released in 1997
3. XL230 - released in 2002
4. FTR230,- released in 2002

The CRF230F does not appear to be a Japanese market model as I cannot find it on the Honda Japan website.

I are electric start, and the FTR and SL230 engines look to have a CV carb fitted as standard, but they can be easily changed if desired, see above.

Model Name	XR200	XLR200R	SL230	FTR223	XL230	CRF230F
ID			BA-MD33	BA-MC34	BA-MC36	
Engine ID & Type	ME09E	MD29E	MD33E air cooled 4 cycle OHC 2 valve single			
Displacement, cc	195	197	223			
Bore X Stroke, mm	65.5×57.8	63.5 × 62.2	65.5×66.2			
Compression ratio	10	9	9			
Max Power Bhp/rpm	19 / 9000	18 / 8000	19.73 / 7500	18.75 / 7000	17.75 / 7000	18.4 / 8000
Max torque lbft / rpm	11.5 / 7500	12.3 / 6500	15.5 / 6000	15.5 / 6000	14 / 6000	13.87 / 6000
Carburettor	26mm Khein	PD3C	VE3A	VE3DA	PDC7A	26mm Khein
Starting system	Kick	Electric	Electric			
Gearbox	6 Speed	5 speed	6 Speed	5 Speed	5 Speed	6 Speed
1st gear	2.769	2.769	3.083	2.769	2.769	2.769
2nd gear	1.941	1.722	2.062	1.722	1.772	1.941
3rd gear	1.45	1.263	1.45	1.263	1.263	1.45
4th gear	1.13	1	1.13	0.96	0.96	1.148
5th Gear	0.923	0.838	0.96	0.814	0.814	0.96
6th Gear	0.785		0.814			0.812
Primary Reduction	3.33	3.09	3.09	3.09	3.09	3.09

Clint Wilson told me that the mountings on the CRF230F are the same as the XR200 - he is fitting/fitted one to his BBR XR200. Clint does not think that much of the XR200 is interchangeable with the CRF, but he did let slip that it is possible to fit the SL/XL crank into a TL – removal of 5th gear to clear the flywheels, and much work/hassle with alternator tapers/flywheels was required however.
As for using the electric start, a quick glance at the left hand side cover shows its probably a bigger job than just swapping covers. It uses a one way clutch on the flywheel with an idler in the left hand casing (like an old CBR6) and has starter motor mounts on the right hand crankcase half. Additionally, the cam chain tensioner has a different design bolted to the barrel, like the CBR6, so it would be difficult to retrofit the electric start.
Wiseco already sell a High comp piston for these engines - Part No. 4816M06550, 11:1 compression, 65.5mm bore. The *Japanese Tuning* industry is working well. Takegawa have both a CRF camshaft offer a 67mm bore up kit for the above engines, giving 233cc with the stock 66.2mm stroke, with the compression ratio of 11.4:1 (!).
Babyface offer a 4mm over stock to 69.5mm big bore kit, which requires relinering, giving 10.5:1 compression and 251cc. It looks good, at 22,500 Yen, (GBP115 plus VAT plus excise duty plus postage), is a little expensive.
I particularly like the Left hand side cover mods, which are common on the FTR223. It would be trivial to do the same thing on the XR200. If the head supply was then blocked off (since the oil passage also feeds the gearbox) and a restrictor was used, an external oil feed to the head could be implemented, which is always one of the worries with the Single Series Honda Engines.

Used spares for these engines are available from Yahoo Auctions Japan via the OK!Shon Website - they act as intermediaries, re-posting items from Japan to you in your own country, even though the auction seller does not post outside Japan.
See (SL230 XL230) and (ftr223 crf230f) Yahoo Auctions Searches. Hopefully the CRF230F will be available on Ebay US now.
The range of performance exhausts offered in Japan for the XL, TL and FTR - a simple Google search reveals many, as does OK!Shon, which may be suitable for XR200 type specials here.
The Japanese websites can be translated using Babelfish.

CRF230 Compatibility with XR200

PowerSports Pro have recently put the CRF into their database, and Bill Todd also graciously sent over some CRF230F part numbers, below:

Part No	Description	Part No	Description
91001-kbw-941	bearing (6207)		
13101-kfb-750	piston	91001-kcn-003	bearing (28x72x18)
14100-kps-900	camshaft	23211-kps-900	mainshaft
14721-kbb-900	exhaust valve	23221-kps-900	countershaft
14711-kbb-900	inlet valve	15100-kps-900	oil pump
12191-kcn-000	base gasket	22100-kps-900	clutch outer
11393-kga-900	gasket right cover	11191-kha-940	Crankcase gasket

Looking at the CRF engine pictures, it appears there is little commonality between the young and the old. The parts numbers do not have any recognisable Honda Model Code part numbers, such as *446* or *383*. The cases are different to accept an electric start that sits on top of the cases, underneath the carb next to the barrel, and the camchain tensioner is different.

Less well Researched Avenues

The Honda RTL250S, pictures Here, Here and Here. The RTL250S appears to be the same engine, but with a 70 by 64.9 mm bore and stroke. The external oil feed is visible and as the engine is only stroked to 64.9mm shows how close it must come to the gear wheels.
David Chinn and Bill Todd first pointed these machines and the HRC TLR250 out to me. Mike Claybrook also thinks these are worthy of further investigation.
Some of the Honda scooters brought to my attention by Doug Simpson might also provide donor parts.
Finally, the Honda NX125 (introduced in 1998?) engine needs looking at, since it looks to be based on the classic vertical engine style, but revamped with six speed and electric start. The most recent XL125L looks familiar, but has 5 speeds. These could be good replacements for the XL125s which is hard to come by.
The old part numbers for this article were obtained from http://www.cmsnl.com, thanks to them.

CBR125R

The CBR150RR was introduced to me (by Col from Timebomb) in about 2003, then Honda released the CBR125R version in the UK.This engine look very interesting, but purely from a technical point since I doubt it will be backward compatible - electric start, water cooled etc.
The 125 seems to be SOHC but the 150 seems to be DOHC. Both have stroke of 47.2mm, 58 bore for the 125cc, 63.5 for the 150cc, water cooled and 6 speed.
Malossi produce a 166cc kit for the 125, and there is also a 150cc DOHC for the 125. I wonder is this is simply the 150 engine top end...
I am considering buying one of these 125's to play with...

As an aside, an excellent project was developed by Powroll before Honda started producing the CRF230. Basically, it’s a CR80 bottom end with a CBR600 head cleaved into a single cylinder format, then welded up giving a 150cc 4 valve 4 stroke, with a 6 speed transmission, i.e CBR600 divided by four. If you consider the technical problems, such as oil pump, big and little end lubrication, oil filtering, top end and piston lubrication etc, it is very impressive what you can do in a machine shop with a TIG welder and a skilled person at the wheel.
However, you can probably bet there will be Hondas, Yams and even Suzukis painted lime green with four valve single engines in the near future, as manufacturers shift from horrible smelly noisy two strokes to oil burners. *(Written in late 2002, apparently coming true with CRF250's etc, just wait for the 85cc four valve four strokes, just like the late 1960's Multi valve road racers!*

Honda CG125 How to Increase Engine Size

The information below is from someone who emailed it to me.

Big Bore CG125 Engines

I first found out that it is possible to overbore and over stroke small Honda OHC engines from a website called Kaila.net/TL125.

From this website I found that it was possible to raise the cubic capacity of TL/CB125 engines to 150cc by increasing the bore to 61mm and to go further by
altering the crank to get about 210cc.

Since the cg125 engine is similar to the OHC engines (But better because there is no cam chain and cam bearings to go wrong) I obtained cg125 top end to
overbore from a motorcycle scrapyard.

Options

piston	Bore (mm)	Liner	Engine size CC	Notes
CB550	58.5	Standard	134	Compression ratio about 7.5/1
CB750	61.0	CB550/CB750	146	Crankcase mouth needs opening 1mm
CBX550	58.5	Standard	134	Compression ratio about 9.5/1 (untried)
XL185	63	CB750	154.5	Low compression

All of the above pistons use a 15mm dia pin

As you can see from the above chart, the most sensible choice is the Honda cb550 or cbx550 route.

As the cg125 cast iron liner is only 71mm in outer diameter, boring out to 61mm or even 63mm leaves little in the way of metal behind and would probably fail.

The solution is to machine out the cg125 liner and press in a Honda 550 or750 liner coated with araldite, and then bore out to the correct bore for the piston.

According to Dave at PISTONBROKE (Dave does this sort of thing often) the mouth of the cg/cb125 crankcase needs opening by about 1mm to accommodate
the lower part of a cb750 liner, also by doing so risks breaking into an oil way on cg125 engines.

Pistons

The Honda cg125 piston has a 15mm gudgeon pin and a slightly domed crown, the CB550 also uses a 15mm gudgeon pin but the piston is flat toped and .5mm
smaller crown height meaning lower compression.

I have recently found out that Honda CBX550 pistons may have a domed crown thus making it a better option by keeping the compression ratio at about 9.5/1.

Higher compression means more power, but good fuel is needed.

Lower compression means slightly less power but poorer quality fuel works fine.

I decided to bore out to 58.75mm (all I could obtain from David Silver spares was a CB550 .25mm oversized piston kit)

How it was done

Because I work in an engineering factory I had the barrel bored out on an Dean Smith & Grace centre lathe.

A friend at work clamped the barrel in a four jaw lathe chuck, adjusted the jaws until the bore was true using a dial guage and bored it out to58.73mm.

Then using fine grade emory cloth, the tooling marks where polished out taking the bore size out to the desired 58.75mm.

The cylinder head was cleaned and the intake and exhaust passageways polished using a dremmel type rotary tool.

The valves where reground in using grinding paste.

The barrel, piston and head was fitted on to the engine using standard gaskets.

Teething Problems

I started first time but ran rough until I sorted out the carb.

The carburettor needle has 3 grooves with the circlip fitted to the middle one; I found that if I moved the circlip to the top groove the engine worked well.

Performance
I have found that there is a noticeable increase in power as the bike can climb hills better and where as before it would only do 55mph on the flat (I am quite heavy)
I now can get 63mph. A lighter rider may perhaps get 68-70mph but that would be quite scary on my 1978 cb100n with cg125 engine.
I consider the modifications to have been worthwhile because I can maintain a higher average speed when riding the bike.
In America, according to the tl125 website, they bore out the crank pin holes then press in offset bushes to lengthen the stroke of the engine.
An aluminium thick washer is fitted between the barrel and crankcase mouth so that with the extra stroke the piston does not kiss the valves.
I don't think this mod would make a reliable engine because a bush could come adrift and cause mechanical mayhem.
Someone else emailed me and says
The second line states the cast iron barrel is 71mm OD when its only 62.5mm OD measured from bottom of barrel.
The correct place to measure is at the bottom, not at the top.
There is a site where you can get CB550 pistons up to 1mm over size www.cmsnl.com page
http://www.cmsnl.com/products/piston-25-repro_06132374000p/
This will then give you the choice of going up to 59.5mm, 3mm over size.
You can increase the compression by having the head ground or if you wish to keep your head standard, use the head gasket off a W model (1998) onwards which all use a metal head gasket which is approx 0.5mm thinner.
I have 2 early cg engines 2 Brazil's, One W model, One M model, One ES4 engine.
All engines to M model (pre 2004) have 15mm gudgeon pin but the ES4 model (2004 on) has a 13mm gudgeon pin
The barrel (M and ES) (2001 onwards) has an oil way in the base, so you can not use an early barrel on these later engines.
Also the cylinder head has a different shape combustion chamber and will not fit on early models as the domed piston will hit the cylinder head.
2 oil way holes on the M model 2001 to date Picture
The new style flat top piston M model 2001 to date(please note 13mm gudgeon pin es4 models) Picture
The oil way in bottom of barrel M model 2001 to date Picture
The new style head reshaped to run with flat top piston M model 2001 to date Picture
Please note any engine mods can shorten engine life / if done wrong will break your engine.
Also note all pre 2004 models with drum front brake can be a bit lacking on stopping power,
even with new shoes and properly set up if you are in the 19 stone bracket.. It is like riding 2 up on the bike.

I'm in the lucky passion of having 3 cg125 and lots of spares.
To start with ill put an end to some of the myths 1976-80 approx models did not run bigger valve heads.
They did have a carb with a lot bigger slide which helped with performance at the cost of fuel if ridden flat out all the time. Fuel would drop to 75-80mpg.
The problem of doing a general guide of how to do mods and results is Honda over the years has changed air box intake size (more restrictive) and the jet sizes.
Slow running jet 36-40 Main jet 80-110, needle size and slide size.
Standard type carb, then carb with accelerator pump and back to standard carb for ES4 2004 model on.
The compression ratio also changes on years from 9:1-9.5:1.
The 1997-2003 W and M1 models had the most restrictive air box intake.

Mods done to my 1999 cg125 W model.

Cylinder head .010 ground off head, Head polished and ported, 1mm over size piston which gives you 128.5cc.
Needle lifted up one notch on slide.
A little harder to kick over. I weigh in at 19 stone so a lighter rider of 12 stone would probably get higher speeds.
After running in the bore will do 70mph/75mph on flat so if we allow 10% for speedo error would be more realistic 63mph-68mph.

The reason for myself to improve performance was to get a bit more lower down power (torque) as my 25 mile travel is 30-40mph limits with a couple of 50mph.
As a result of mods I can go down to 20mph in top gear on flat and pull away up to 40mph at half throttle in approx 8-10 seconds.
With added bonus of 135mpg+ winter riding, in summer 145mpg and the best ever of 155mpg. The lowest was 115mpg giving it some right stick..
My carb has slow running jet 36 and main off 82.

Remember any modes to improve performance if ridden hard will shorten engine life and ruin your fuel economy.
You may find this article of interest http://vincentcrabtree.co.uk/XR200.aspx
Please note the Chinese clone Honda CG125 overbore and big bore kits will not fit on genuine Honda CG125 engines.
I have emailed a few Honda CG owners who were disappointed when they bought their kits and did not fit.

The reason the Chinese CG150cc kit does not fit is the liner is OD 67.5mm (to big) and the Honda CG crank cases are only OD 64mm (to small).
So to be made to fit would take full engine strip and major machine work to crank case, and the danger of breaking into one of the oil ways.
Remember this work will not be cheap and not all Honda Cg125 crank case will be able to be machined bigger.
Honda changed the design of crank case over the years.