MODIFYING THE 348 AND 409

WHEN the "W"-engined Chevrolets were introduced in the Fall of 1957, little thought was given to the idea of hot options becoming immediately available, inasmuch as the 348 engine was itself an "option." But, shortly thereafter, there appeared a model incorporating a triple-carburetor manifold, utilizing three Rochester 2GC's and rated at 280 bhp. By Spring, a "Police Cruiser" engine (which could be ordered by anyone having as much to do with law enforcement as merely owning a Police Dog) was available. It also employed a more radical cam, revised pistons giving an 11-to-1 compression ratio and dual exhaust system. With this 315 bhp powerplant, were a larger four-barrel carburetor, solid lifters, Moraine 400 bearings, a centrifugal-only distributor and a different coil.

The pistons in the 315 had a slant on one side only, as opposed to the gabled roof of the 9.5-to-1 standard engine and cam timing was: IO 35° BTC, IC 72° ABC, EO 76° BBC, EC 31° ATC for a duration of 287° and overlap of 66°, compared with 18°-67°-68°-25° and 274° max duration and 44° of overlap for the standard cam. Lift at the valves was increased slightly from .398 to .405 inch at the intake and from .398 to .412 at the exhaust.

The average enthusiast might say at this point, "Oh, Chevy has two basically similar but essentially different engines, therefore they will give them distinctive names for easy reference."

Don't you believe it.

True, two good, strong names were coined for two engines: *Turbo-Thrust* and *Super Turbo-Thrust*, but did they apply to the standard (with hydraulic lifters, mild cam and low compression) and the "Police Cruiser" (with hot cam, solid lifters and high compression)?

No. Not at first.

In 1959 *Turbo-Thrust* designated the single four-barrel carburetor engine, *Super Turbo-Thrust* refers to the engines with three two-barrels! The Turbo-Thrust can have 11-to-1 or 11.25-to-1 compression, hot cam and solid lifters; so can the Super Turbo-Thrust. Later, the designations were changed to indicate either standard or hot cam.

This even confuses Chevrolet!

The accompanying charts will help to straighten the situation out, and if you will pick up on the RPO (Regular Production Option) numbers confusion is somewhat eliminated.

The most obvious thing is, of course, to bring the 348 up to "stock" with the last and best factory equipment. This is generally the most economical way to power. And many parts are even obtainable in good used condition from parts sources.

In 1959 and 1960, the standard TT engine stayed at 250 rated horsepower. The special cam versions were rated at 305 bhp or 320 bhp, depending on whether they were coupled to a conventional transmission or a heavy-duty Powerglide, respectively.

(Incidentally, finding a 348 hooked up to a four-speed box is no guarantee that it is a hot engine, the 250-bhp version could be had with any transmission, Powerglide, Turboglide, or gearbox.)

The 305 had 11-to-1 compression and this cam timing: 33°-74°-88°-19°, resulting in 287° duration, the same as the optional cam used in the 320, but with only 52° of overlap, compared with 66°. To achieve the 11-to-1 compression ratio, it used a half-flat piston with a 2.08-inch machined relief under the intake valve and a small relief under the exhaust. Solid tappets and Moraine 400 bearings were also fitted. A Carter 2816 carburetor, with 1 1/16-inch primary venturis and 1 1/4-inch secondary venturis, was used.

The 320 came with 11.25-to-1 compression ratio, the Duntov cam (as before), and three Rochester 2GC carbs. Of these, the front and rear had 1 1/4-inch venturis; the center jug, on which the engine operated at low throttle settings, had a 3/16-inch venturi.

The 280, three-carburetor version of the 250, was equipped with the same units, but with a different part number for the center carb because of automatic transmission linkage.

In 1959, a different head, drilled to provide for additional cooling around the spark plugs, was fitted to the "W" engine. A special gasket goes with this head, and it is necessary to use long-reach plugs with copper compression rings. Porting was improved over the original head and it was mated to an altered intake manifold which has different exhaust crossover passages.

In late 1960 and in the 1961 models, a new head was again the big change, with Chevy trying to get some more performance out of the upper rpm range. The advertised horsepower on the 320 and the 335 engines was increased to 340 and 350 with this head which had better porting and bigger aluminized valves: 2.07-inch intake and 1.725-inch exhaust. Pistons were notched out deeper to accommodate this change plus the slightly increased lift and timing of still a different cam. Moraine 500 bearings were used in the front four mains.

The 305-bhp in 1960 was an 11-to-1 compression model, as outlined, but in 1961, the same horsepower rating was assigned to a 9.5-to-1 compression engine with the standard cam. This was, presumably, because of improved efficiency of the head, since the 250 and 280 versions kept the small-valve type.

Carburetion on the 305 and 340 engines was a Carter four-barrel AFB with part no. 3772600, having throttle bore diameters of 1.56 inch for the primaries and 1.68 inch for the secondaries, and measuring 4 1/4 inches across the air horn. Three two-barrel Rochesters were again used on the 350-bhp engine of 1961.

1961 was the final year for the 348; it was supplanted by the 409 which was brought out the same year. However, there are a number of these engines in service and obtainable, and they can be made to perform in pretty acceptable fashion at not too great a cost.

BRING IT UP TO STOCK

By taking a cue from the factory's own hop-up efforts, we can direct our modification attempts in profitable directions without too much waste of time and energy. The crux of the matter is obviously in the head, combustion chamber and breathing, generally speaking. The accepted porting and relieving techniques are to be avoided, however, as far as the pre-1961 head is concerned. Nothing that can be done to it will accomplish as much as simply buying the factory head for the 1961 model.

Experiments with removing what appears to be the shrouding around the valves in the early head resulted in a definite horsepower loss. Although they seem to be masked in their small indentation in the flat head surface, the valves pop up high enough to let the indentation act as a deflector, increasing turbulence during the intake stroke.

By going no farther than this, you can add considerably to the engine's performance. The bigger valves and stiffer valve springs will let the engine breathe better and extend its range even with the stock mild cam. The head you want to specify, or find, is part number 3785085 for the alleged 11.25-to-1 compression ratio engine. And, at this point we might as well get into that factor.

Theoretically, the swept volume of the cylinder plus the volume of the combustion chamber taken in proportion to the volume of the chamber alone gives the compression ratio. In practice, manufacturing tolerances and the thickness of the head gasket enter into the picture and when a factory-advertised compression ratio is checked out by actual fill, it drops appreciably. The rated 9.5 "W" engines are nearer 8.8 and the 11.25 types come out just under 11. By specifying the 11.25-to-1 head, you get one with a recess around the valves of only 10.3 cc volume, whereas the 11-to-1 version has the same 15 cc recess as the 9.5-to-1 head. The 11.25-to-1 job will give your 9.5-rated engine an *actual* 9.2-to-1, with nominal piston deck height.

If you are trying to be frugal, you can stop there and have something to show for your money. The original four-barrel can be retained but should be re-jetted at least a step richer, otherwise the increased air flow will reach the limits of the standard .091-inch and .082-inch main jets and metering rod (no. 75-1424) and lean out in the upper range. Actually, the late manifold with the Carter AFB represents too good a buy to pass up if money is a primary consideration (and it usually is).

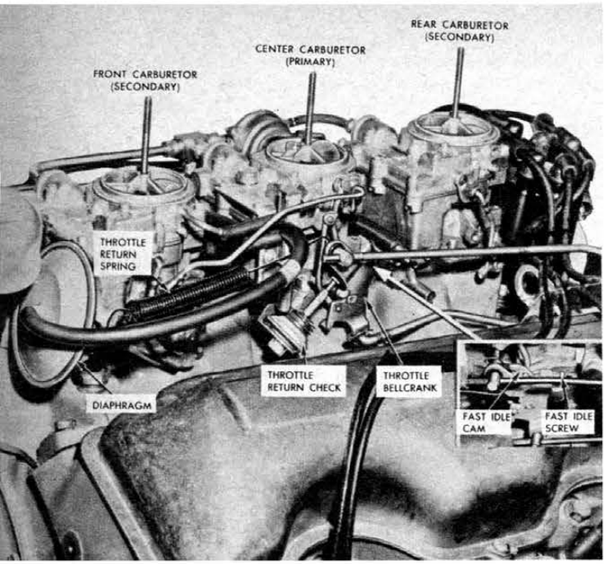
To realize the most from such a head and manifold swap, be sure that all springs are of the same tension and installed height. Maximum stock tension for the outer springs is 196 pounds, 86 pounds for the inner. Installed height, measured to the top of the cap, is 1 21/32 to 1 23/32 inch. If you are working without a shop manual, note that the intake valve pushrods are shorter than the exhaust. Be sure to coat all studs with a thread sealing compound, such as GM Perfect-Seal and tighten according to the sequence shown in the diagram to 65 lb./ft. Manifold bolts are torqued to 35 lb./ft.

At this juncture, some student of statistics is going to ask, "Why not get the 409 single springs and flat dampers which have much more tension?" The answer is that the 409 head has spot facing around the guides to accept the wear imposed by the stronger springs; moreover the normal cam won't give you enough action to make them necessary but it will wear out in a hurry.

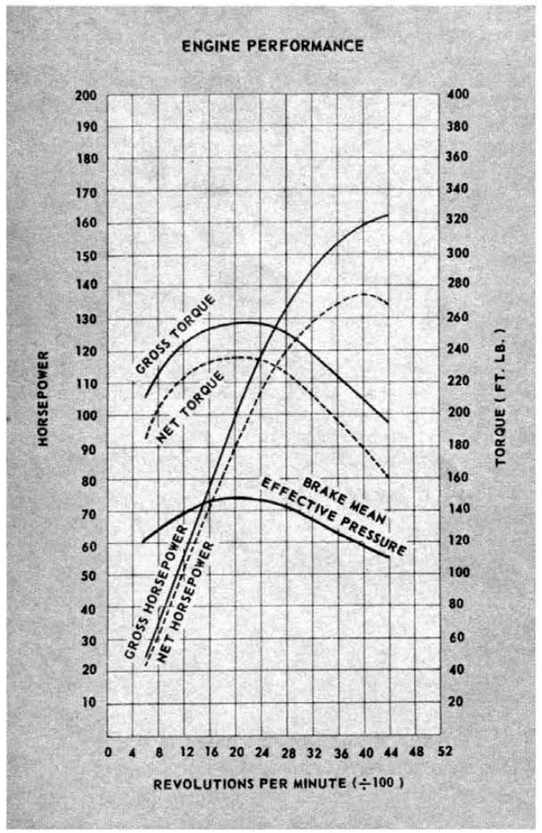
The next query, then, usually is: "Why not put a late 409 head onto the 348 block?"

Why not! It has the same configuration but has bigger valves and mates with an aluminum manifold with better ports (see 409 section) and provision for two four-barrel Carters.

The only problem (besides moving you out of Stock into Street Gas) is that the dimension across the valves calls for a bore the size of the 409. The 348 has been bored to 4.300, true, but it is a marginal arrangement which can lead to overheating and possible wall collapse. Not advised.

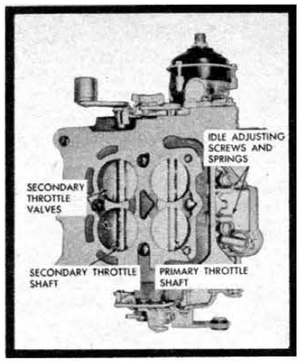


First high-performance option offered by factory on 348 was three carburetor manifold. Stock linkage can be improved upon.



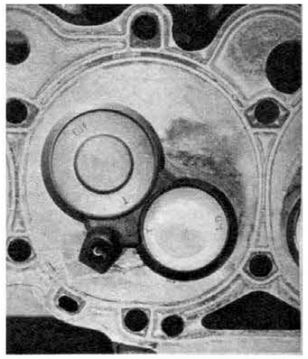
Graph illustrates output of original 348. While the torque is good in low range, it drops off sharply at medium speed range.

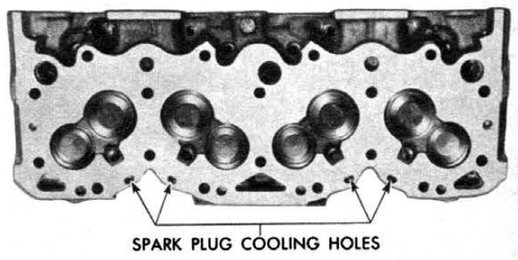
Important step in obtaining maximum efficiency and revs from 348-409 is establishing balanced valve action. Measuring installed height of springs is key.



RIGHT & BELOW: 348-409 heads have small pockets around valves, no proper combustion chamber. Spark plug cooling holes are in second series.

Four barrel carb with automatic secondary throttle, stock on 348.

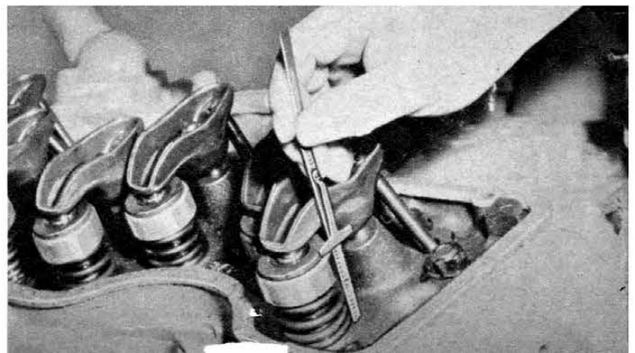




ALTERNATE CARBURETION

Although the 3x2 manifold is credited with considerable horsepower increase by advertising copy writers, it is given far less credit by those working with engines. However, the three two-barrels do offer increased venturi area for high speed while permitting low speed operation to proceed smoothly on reduced area. The problem, often stated with a V8, particularly a big engine, is in its scattered firing impulses which calls for linking certain cylinders together by common manifold passages, some of which get to be pretty long if we work with a single, centrally-located carburetor. On the other hand, you can't divide three into eight and come out with any even number, so the big four-barrel, with primary and secondary venturis has been a workable compromise. It, in turn, must be limited in venturi area if low speed airflow velocity is to be sufficient to accomplish the necessary inspiration of fuel.

Don't expect a miracle if you slap three two's onto your 9.5, mild cam "W" engine. It can't use the seven square inches of venturi offered by the three Rochesters nominally



fitted. If you have the hotter cam and higher compression engine with the 3x2 setup, by all means junk the factory linkage and obtain a progressive-or-all mechanical linkage such as that sold by Moon Equipment Company or a number of other suppliers. This is suitable for street or strip and is not expensive.

You may have heard that Stromberg two-barrels are better than Carter 2GC on this manifold. They are, in spite of having less venturi area, but unless you pick up the manifold bare in a wrecking yard and can get the Strombergs at a price, you'll never justify the substitution. The average rodder will get more performance by just being absolutely sure that the throttle butterflies are truly wide open at maximum throttle. In about 25% of the engines checked, as they come from the factory, this condition is not met!

Unless you have something more radical than the factory option camshaft (part no. 3755946), it will not pay you to go into a proprietary multiple carburetor manifold which costs around $100 plus the carburetors and linkage. If you are going through modification, yes. There are several well-designed manifolds for the 348 on the market. Edelbrock offers a good, low-profile four-carb type with 180° balanced passages, exhaust heated and entirely suitable for street or competition. Weiand's six-carb log and Edelbrock's similar six-carb set-up have also worked out acceptably with bigger bored and stroked engines in particular.

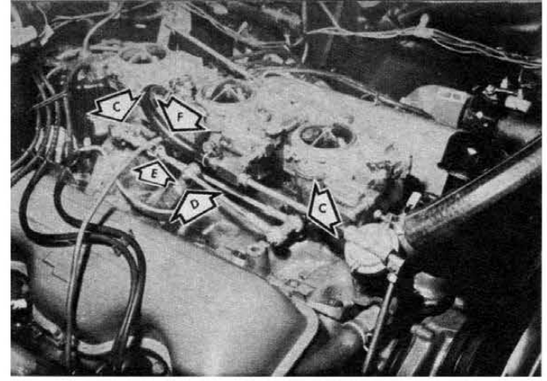
With either the 3x2 or anything of more fuel capacity, it is advisable to use the heavy duty fuel pump (part no. 5621665) found on fuel injected 283's and late 340-360 bhp "W" engines. This pump is a six-valve type delivering 65 gallons per hour, compared with 40 for the regular pump, through ¼-inch lines. Its use will require a rebuilding of any old carburetors, since the 10-pound pressure will find leaks in any sloppy gaskets or bad needle valves.

UP THE COMPRESSION OR GRIND THE CAM?

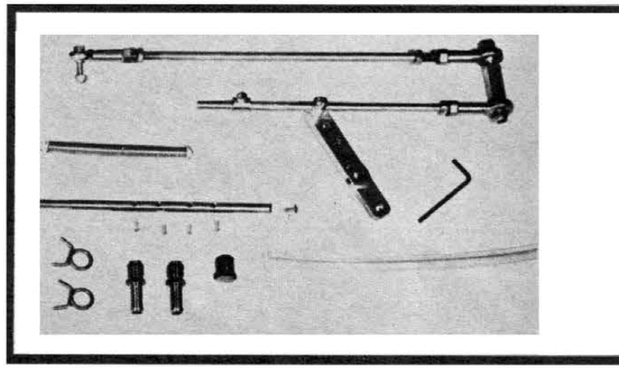
"Increased Compression-Increased Power," is a succinctly stated fact. However, achieving an increase in the 9.5 rated engine is not such a simple matter and if we are talking about increased performance for the modest income bracket, it is better deferred in favor of an optional cam which can be inserted at reasonable cost and without completely dismantling the engine.

Here are the facts: The 11.25-to-1 ratio pistons weigh slightly more than the gable-roof type, so when you substitute them the crank counterweights are just slightly on the light side and you have to spring for a complete balancing job. It may well be argued that anybody seriously inclined toward extracting performance from an engine will go through it, setting up maximum clearances and balancing it out to a "T" anyway. True, but in this happy era of bolt-on equipment, the majority of street engines, with plenty of go to satisfy their owners, survive with production line tolerances intact. Such engines won't win any competitions against the seriously-approached powerplants, but this is not to say they are not to be tolerated. We must settle for less than ideal at times. Ideally, the block would be machined to bring it into truth relative to the crank centerline and deck height of pistons established at the .025 inch nominal dimension, and so on, as outlined in the 265-237 chapter. But if you have to watch pennies, regard that this is fairly costly.

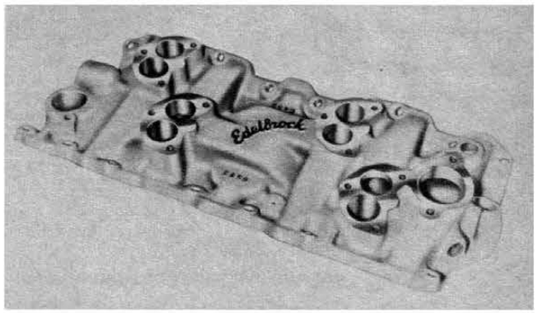
A cam bargain is involved in the purchase of any factory stick. Retail list price on the optional shafts is pegged at around $33.00, plus lifters, of course. The optional 340-350 bhp 1961 engine cam with 290° duration on exhaust and 316° on the intake with 80° overlap (part no. 3775946) represents a good buy for the owner of an earlier model.



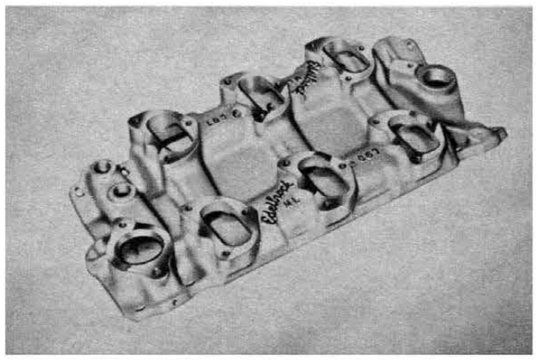
Positive-acting linkage with little free-play is necessary to smooth operation of three-carburetor manifold. Parts below.



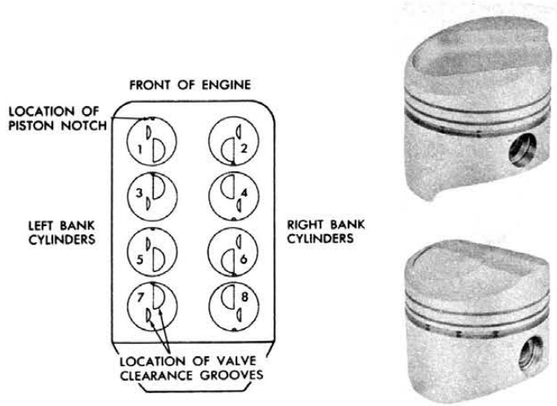
Adjustability of proprietary linkage for 348 is feature. One carb can be used alone, three progressively, or all at once.



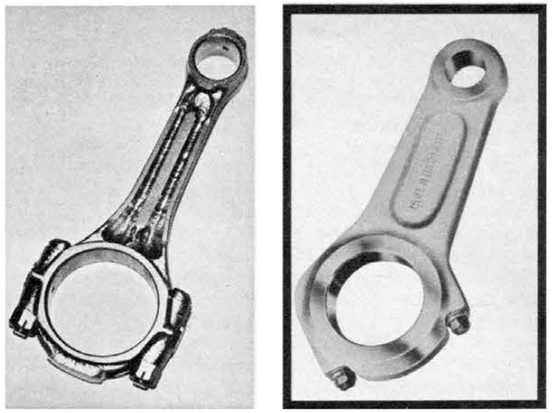
Staggered four 2-barrel intake manifold increases venturi area, improves port routing over 3-carb type to equalize distribution.



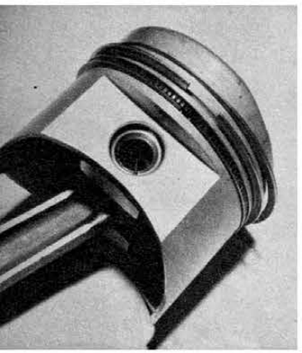
Six carburetor model is for big modified engine in competition.

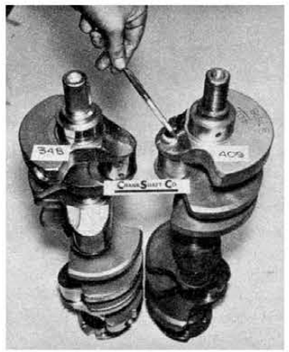


Right and left hand pistons required for 348-409 with valve cut outs. Two types of special pistons available include (top) Jahns "Powr Slot," with quench pocket, and normal high-comp. type.

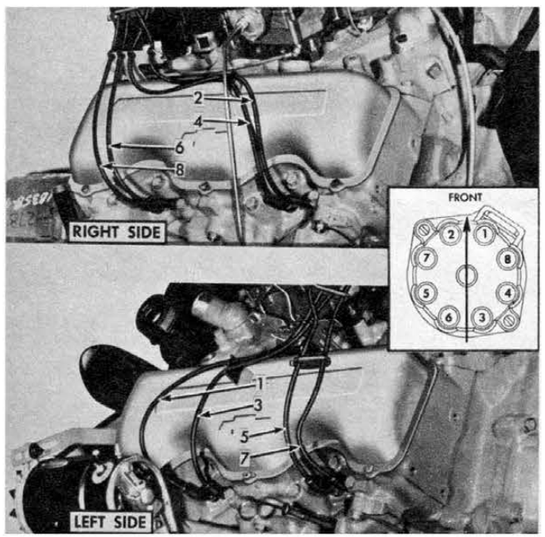


Higher output of modified 348 or 409 requires stiffer connecting rods in some cases. Improvements can be made to stock rods or alloy type substituted. Cap is offset for additional strength.





Full floating wrist pins are common practice, make piston changing easier, decrease drag. 409 crankshaft has longer counterweights, will not fit in 348 block without alterations.



Wiring of 348-409 is conventional V8. Rodders substitute copper-core high tension leads for resistor type used by factory.

It calls for stiffer springs and the breathing capacity of the later head, of course.

If you have an early 1960 11.25-to-1 engine, 1961 pistons with the larger flycut over the valves are necessary to keep the valves from getting mixed up with the pistons during the opening and closing cycle of a radical cam. Any cam giving more than 4.10-inch lift or opening earlier than 35° BTC should be checked for interference in the engine. You can use factory stock slugs in any modestly modified engine, but lighter, all-aluminum types are superior for hotter modifications. These can also be specified with full floating wrist pins.

A cam change in this engine is not difficult. Merely remove the front cover (timing gear cover) manifold, rocker covers, rockers, push rods and tappets (with the engine in the car if you take off the front sheet metal and radiator) and pull the cam out. Screw a $\frac{5}{16}$ x 18 bolt into one of the cam gear bolt holes and pull gently. In replacing, take care: The cam bearings are all of a size, not larger in front as in some engines.

BORING AND STROKING

You can't beat displacement, and the modifier's traditional recourse has been to the boring bar and the crank grinder. It works with the "W" engine, just like increasing compression or cam timing. But bear this in mind: The maximum overbore for the factory 11.25-to-1 pistons is only .030 inch, if you are planning to use them because of economy. And, .030 is just a clean-up honing to the displacement minded.

You can bore the 348 block .125 inch over (to 4¼) without any difficulty in the normal block. With stock stroke, this will give you 369 cubic inches, for practical purposes. It will not increase compression in a manner like that of boring the conventional engine inasmuch as the combustion chamber volume is increased at the same time. And, if you were planning to run the boring bar yourself, a moment's reflection will tell you that some kind of an adapter to achieve a 90° angle relative to the bore is going to be necessary. These plates are available and most re-builders or automotive machine shops have them.

Stroking the 348 could mean merely inserting the 409 crank with its 3.5-inch stroke, since the mains are the same size, but unfortunately, the thicker counterweights of the 409 shaft prevent it from fitting into the block. There is so much metal to be removed in order to provide clearance that it is too big a job for a hand grinder and calls for machining. This, in turn, is a difficult mill setup which takes all the joy out of the reasonable price on the 409 crank.

1961 PASSENGER "348" CU. IN. ENGINE CHART

ENGINE IDENTIFICATION					DRIVE OPTIONS AVAILABLE WITH ENGINE		ENGINE COMPONENTS PECULIAR TO ENGINE ASSEMBLY										
							GROUP NO. 0.619	GROUP NO. 0.033		GROUP NO. 0.269	GROUP NO. 0.296—0.297	GROUP NO. 0.469	GROUP NO. 0.529		GROUP NO. 0.006	GROUP NO. 0.616
RPO NO.	ENGINE SUFFIX NO.	COMP. RATIO	CARB.	ENGINE SALES NAME AND HORSE-POWER	TRANS-MISSION	REAR AXLE RATIO	CAM	BLOCKS: PARTIAL ENGINE	BLOCKS: FITTED CYL. BLOCK	CYLINDER HEAD	VALVE (STD)	VALVE LIFTER OR TAPPET	PISTON & PIN (STD): Cylinders 1-4-5-8	PISTON & PIN (STD): Cylinders 2-3-6-7	MAIN BEARING (STD)	CONNECT. ROD BEARING (STD)
576 (Base)	F — H	9.5 to 1	4 BC	TURBO THRUST 250	3-SPD 4-SPD — T.G.	3.36 3.08 — 3.88	Regular 3744901	3774975 — 3774976	3774977	3759254	(Inlet) 3747307 (Exhaust) 3747308	(Hyd) 5231475	3751995		Babbitt 3750710	Babbitt 3750698
575 (Hi-Perf.)	GD	9.5 to 1	4 BC	SPECIAL TURBO THRUST 305	H.D. P.G.	3.55	Hi-Lift 3764684		3782912	3750254	(Inlet) 3747307 (Exhaust) 3747308	(Mech.) 5231585	3781344	3781342	Babbitt 3750710	Babbitt 3750609
572 (Hi-Perf.)	FL — GE	9.5 to 1	4 BC	SPECIAL TURBO THRUST 305	3-SPD 4 SPD — H.D. P.G.	3.36 3.36 — 3.55	Regular 3744901		3774977	3785085	(Inlet) 3781155 (Exhaust) 3781156	(Hyd.) 5231475	3751995		Babbitt 3750710	Babbitt 3750699
590 (Spec. Hi-Perf.)	FJ	11.25 to 1	4 BC	SPECIAL TURBO THRUST 340	3 SPD 4-SPD	3.79 3.70	Hi-Lift 3755946		3781932	3785085	(Inlet) 3781155 (Exhaust) 3781156	(Mech.) 5231585	3781344	3781342	Premium Aluminum 3750715	Premium Aluminum 3750704
576 & 573 (Base plus 3/2BC)	FA — HA	9.5 to 1	3.2 BC	SUPER TURBO THRUST 280	3-SPD 4-SPD — T.G.	3.36 3.36 — 3.88	Regular 3744901	3774975 — 3774976	3774977	3759254	(Inlet) 3747307 (Exhaust) 3747308	(Hyd.) 5231475	3751995		Babbitt 3750710	Babbitt 3750699
560 & 573 (Spec. Hi-Perf.)	FH	11.25 to 1	3.2 BC	SPECIAL SUPER TURBO THRUST 350	3-SPD 4-SPD	3.70 3.70	Hi-Lift 3755946		3781932	3785085	(Inlet) 3781155 (Exhaust) 3781156	(Mech.) 5231585	3781344	3781342	Premium Aluminum 3750715	Premium Aluminum 3758704

A .250-inch stroke on the 348 crank, or more, means that the 409 connecting rods can be used, however, being ⅛ inch shorter in center-to-center dimension . . . helping to keep pin-to-crown distance down in the stroker pistons which must be used. (Boring .1875 over, which would be required to use the 409 pistons, is risky because of resulting wall thickness being on the minimum side.)

Added stroke of ⅜ inch, which can be easily accommodated in the block, combined with .125-inch overbore results in 411 cubic inches of displacement and an engine which compares with the 409. It will not be the same because of the bore/stroke relationship of the 409 is better and the late head with 2.195 inch valves is quite an improvement. However, at this displacement, the engine can utilize a multiple carburetor manifold much better.

It may be said that, at the prices involved, boring and stroking the 348 is better forgotten and a 409 short block obtained. Possibly, but if the owner has a considerable investment in his engine already but it needs boring to clean up a wear condition, it costs very little more to go to the maximum size (proprietary pistons vs. factory). Use the "500" bearings when rebuilding, of course.

Any non-factory pistons can be had with full floating pins, which are advised not only to simplify installation but for performance. All internal clearances should be established at factory maximum for street operation if you are a vigorous driver. For strip competition, add about .010 inch to rod side clearance and use the factory's maximum "worn" specifications.

STRIP TUNING THE "STOCKER"

The 348 employed three different Delco Remy distributors during its career, the 1110907, 1110948 and 1110919. These varied in the shape of the advance curve and in the fact that the optional cam engines did not use a vacuum advance. The 1110191 is a dual-point distributor, as optional on the 1961-1962 409. And, although Chevy is going back to the single-point type for this engine, it looks like the best stock distributor for the 348. Transistor ignition, or other special ignitions can be utilized with acknowledged benefits, but the same applies to any engine and has been thoroughly covered elsewhere.

With this ignition, a setting of 22° initial advance, give or take a degree, is best for acceleration. The nominal resistor-type wiring should be replaced with copper core cable

MAJOR SPECIFICATIONS: CHEVROLET 348—1958-1961

BORE	4.125
STROKE	3.250
COMPRESSION RATIO	9.5 to 1
CYLINDER NUMBERING	
Left Bank	1-3-5-7
Right Bank	2-4-6-8
FIRING ORDER	1-8-4-3-6-5-7-2
PISTONS	
Type	Peak roof, slipper skirt, autothermic
Material	Cast aluminum alloy
Weight	26.72 ounces
Number of rings	3
Skirt clearance	.0006 to .0010
Pin bore offset	.060 toward major thrust side of skirt
PISTON PINS	
Length	3.250 to 3.270
Diameter	.9895 to .9898
Locking method	Press fit in rods
Clearance in piston	.00015 to .00025
CONNECTING RODS	
Material	Forged steel
Weight	24.71 ounces
Length, center to center	6.134 to 6.136
Bearing type	Insert
Length	.882 to .892
Clearance on crankpin	.0007 to .0027
Endplay	.008 to .014
CRANKSHAFT	
Material	Forged steel
Endplay	.003 to .007
Main bearing journal diameter	2.4985
Crankpin diameter	2.199 to 2.200
Main bearings	Insert
Main bearing clearance	.0006 to .0032

CAMSHAFT	Int. opens	Int. closes	Ex. opens	Ex. closes
Timing	18°30′	67°30′	68°30′	25°30′
Material		Cast alloy iron		
Number of bearings		5		
Type of bearings		Inserts		
Drive		Sprockets and chain		
Crankshaft sprocket		Steel		
Camshaft sprocket		Cast alloy iron		
Chain width		.875		
VALVE TRAIN				
Lifters		Hydraulic		
Rocker arm ratio		1.75 to 1		
Pushrods		Tubular		
Diameter		5/16		
INTAKE VALVES				
Material		High alloy steel		
Head diameter		1.935 to 1.945		
Face angle		45 degrees		
Stem diameter		.3715 to .3722		
Clearance in guides		.0010 to .0027		
Overall length		5.095 to 5.115		
EXHAUST VALVES				
Material		High alloy steel		
Head diameter		1.655 to 1.665		
Face angle		45 degrees		
Stem diameter		.3710 to .3717		
Clearance in guide		.0025 to .0042		
Overall length		5.105 to 5.125		
VALVE SPRINGS				
Type		Single		
Pressure, valve closed		78 to 86 pounds at 1.626 inches		
Pressure, valve open		184 to 196 pounds at 1.230 inches		
LUBRICATION SYSTEM				
Type		Pressure		
Normal oil pressure		35 pounds at 2000 rpm.		
Filter		Full-flow		
Crankcase capacity		Four quarts		

and plug leads soldered. Make sure that point dwell measures 31° to 32° on each side, 28° total. A small piece of sponge rubber (cut from the door weatherstrip if you like) behind the points will help prevent float. A noticeable "slop," clearance in the distributor drive gears, is not undesirable. If too close, both the distributor shaft gear and the cam gear wear excessively. Timing is not adversely affected by a little play.

Altering the distributor advance curve to peak at as low as 2,200 rpm to 2,500 rpm or as high as 3,000 rpm has been tried with equally successful results, depending on the technique employed by the driver. This is a matter of cut-and-try until the best strip times are obtained.

Run the richest mixture the engine will tolerate without fouling plugs. You can re-jet for everyday driving pretty cheaply but burned valves are expensive. Competition will call for a colder plug than for normal running. Work around the AC 43-N Champion N-5 (or equivalent) heat range on an inspection basis.

And, that's about it. The 348 will stand up under a lot of abuse and give plenty of power.

MODIFYING THE 409

Because of the unprecedented popularity of Stock class drag racing, the current version of Chevy's "W" engine, the 409, has become one of those modern Detroit phenomena, a powerplant which is more popular in nominal form than as a base for hot rodding. It is not that the 409 cannot be improved considerably by accepted techniques, nor has it been completely ignored by the kind of enthusiast who has a GMC blower around and doesn't know what else to do with it. But, if you are going into that kind of money and operation, it is not likely you would select the 409 when there are other engines available which deliver more top-end whomp with less weight.

The main topic under this heading, then, should probably be "Prodifying," or extracting the most from the engine under strict NHRA rules which tie the powerplants to manufacturer's specifications. A secondary portion will concern the available bolt on equipment.

As noted in the dissertation earlier in this book, "Engineering the 'W' Engine," the 409 is a bored and stroked version of the 348.

The first move to be made toward experiencing maximum benefits from the 409's attributes is to update the rascal a-la-factory and assemble it in meticulous fashion.

Changes made for 1962 included an altered head with slightly larger valves, and more important, ports of greater area with a better contour. This head has now been superseded by a still more upswept port, higher compression type

MINOR SPECIFICATIONS: CHEVROLET 348—1958

IGNITION SYSTEM	
Type	Single coil
Distributor number	1110907
Dist. auto. advance	starts at 600 crank rpm, 12° @ 1600, 24° @ 4000
Dist. vac. advance	Starts at 8 inches
Initial spark lead	4 degrees
Spark plugs	AC 44
Plug gap	.033 to .038
FUEL SYSTEM	
Carburetion	Single four-bbl.
Fuel pressure	4.00 to 5.25 pounds
Fuel filter	2
Air cleaner	Oil bath

MINOR SPECIFICATIONS: CHEVROLET 348—1959

IGNITION SYSTEM	
Type	Single coil
Distributor number	1110948
Dist. auto. advance	700 rpm—11 @ 1600, 24 @ 4600
Dist. vac. advance	Starts at 8 inches
Initial spark lead	4 degrees
Spark plugs	AC 44
Plug gap	.033 to .038
FUEL SYSTEM	
Carburetion	Single four-bbl.
Fuel pressure	5.25 to 6.50 pounds
Fuel filter	2
Air cleaner	Dry

MINOR SPECIFICATIONS: CHEVROLET 348—1960

IGNITION SYSTEM	
Type	Single coil
Distributor number	1110948
Dist. auto. advance	700 rpm—11 @ 1600, 24 @ 4600
Dist. vac. advance	Starts at 8 inches
Initial spark lead	8 degrees
Spark plugs	AC 44N
Plug gap	.033 to .038
FUEL SYSTEM	
Carburetion	Single four-bbl.
Fuel pressure	5.25 to 6.50 pounds
Fuel filter	2
Air cleaner	Dry

MINOR SPECIFICATIONS: CHEVROLET 348—1961

IGNITION SYSTEM	
Type	Single coil
Distributor number	1110948, except 340, 350 hp, which are same as 409
Dist. auto. advance	700 rpm—11 @ 1600, 24 at 4600
Dist. vac. advance	Starts at 8 inches
Initial spark lead	4-10°, except 340, 350 hp, which are same as 409
Spark plugs	AC 44N, except 340, 350 hp, which are same as 409
Plug gap	.033 to .038
FUEL SYSTEM	
Carburetion	Single four-bbl.
Fuel pressure	5.25 to 6.50, exc. 340, 350, which are same as 409
Fuel filter	2
Air cleaner	Dry

409 ENGINE SPECIFICATIONS

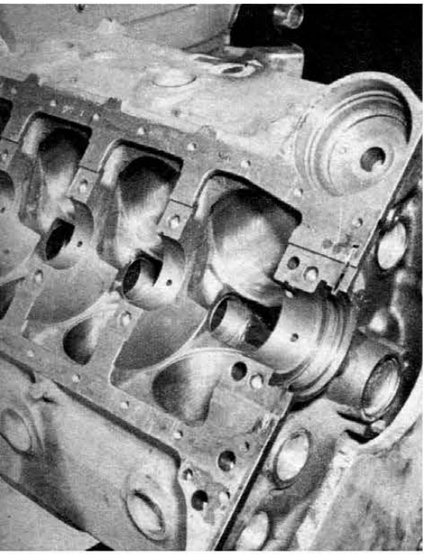
BORE	4.31
STROKE	3.50
COMPRESSION RATIO	11.25
PISTONS	
Type	Solid skirt
Material	Forged aluminum
Weight	31.0 oz.
PISTON PINS	Chrome steel
Length	3.25-3.27 in.
Diameter	.989 in.
Locking method	Pressed in rod
CONNECTING RODS	
Material	Drop forged steel
Weight	27.3 oz.
Length, center to center	6.01 in.
Crankshaft bearing type	Premium aluminum
Length	.885 in.
Clearance on crankpin	.0012-.0035 in.
CRANKSHAFT	
Material	Forged steel
Main bearing journal diameter	2.5 in.
Crankpin diameter	2.2 in.

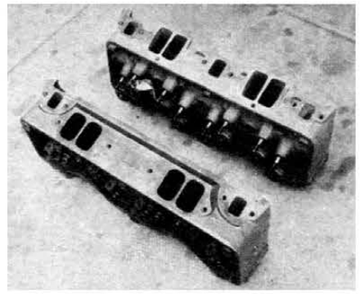
CAMSHAFT	Int. opens	Int. closes	Ex. opens	Ex. closes
Timing	59°12′	106°36′	97°54′	26°44′
VALVE TRAIN				
Lifters		Solid		
Rocker arm ratio		1.75		
INTAKE VALVES				
Material		High alloy steel		
Head diameter		2.07 in.		
Face angle		45°		
Stem diameter		.372 in.		
Overall length		5.1 in.		
EXHAUST VALVES				
Material		High alloy steel		
Head diameter		1.72 in.		
Face angle		45°		
Stem diameter		.372 in.		
Overall length		5.1 in.		
VALVE SPRINGS				
Pressure, valve closed		138 psi		
Pressure, valve open		285 psi		
LUBRICATION SYSTEM				
Normal oil pressure		45 @ 2000		
Filter		Full flow		
Crankcase capacity		Four quarts		
FUEL SYSTEM				
Standard carburetion		1 Carter 4-bbl.		
Fuel pressure		9.25-10.75 psi		
IGNITION SYSTEM				
Type		Coil and distributor		
Distributor number		1115157		
Dist. auto. advance		24 @ 4600		
Dist. vac. advance		None		
Initial spark lead		12° BTC		
Spark plugs		AC 43N		
Plug gap		.038 inch		

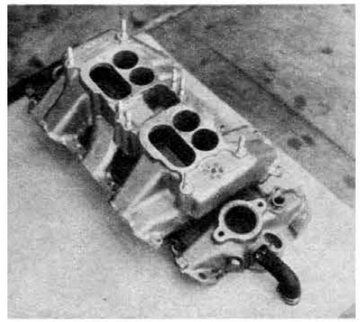
409 OPTIONAL ENGINES

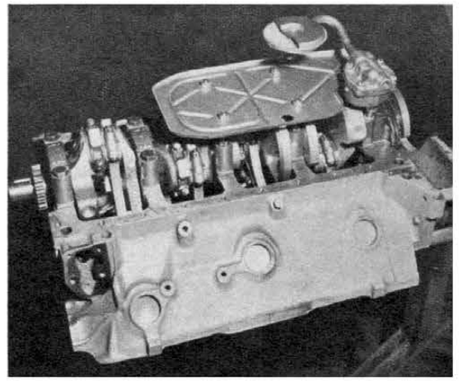
	1962			1963	
Adv. HP	380@5800	409@6000	340@5000	400@5800	425@6000
Adv. torque	420@3200	420@4000	420@3200	425@3600	425@4200
Comp. ratio	11.0	11.0	10.0	11.0	11.0
Carburetor	1 Carter or Rochester	2 Carter 4-bbl.	1 Rochester 4-bbl.	1 Carter 4-bbl.	2 Carter 4-bbl.
Int. valve dia.	2.20	2.20	2.07	2.20	2.20
Ex. valve dia.	1.72	1.72	1.72	1.72	1.72
Spring press. closed	140	140	146	146	146
Spring press. open	335	335	354	354	354

Machined main bearing web identifies 409 block when compared to 348 engine.









Oil pan baffle interposed above pickup tube helps control lubricant under competition conditions for track or road racing.

ABOVE LEFT: 1963 heads for 409 (bottom) have improved porting, water routing.

LEFT: 1963 manifold for 409 is departure from the previous type, rises high above block. Separate valley cover is also used.

which will be standard on 1963 models. If you are updating, the *late* 1962 or the 1963 is the one (part no. 3829973).

Late heads also have longer rocker studs pressed to a greater depth to withstand valve spring pressure, which was upped to 335 pounds maximum, in the first part of the year and is now specified at 354 pounds with valve open. It would probably not be wise to install these hefty coils in the early (1961) head unless you pin the studs as they are in this head. Pushrod angle through the head was also changed and the latest head has guide plates for the rods. The valves in this model have the same diameter but the intake stems are longer because of the altered port configuration.

Likewise, a dual four-barrel aluminum manifold with reworked mixture routing passages was available in the early part of the year, but it has also been improved upon. The latest type no longer serves as a valley cover; it rises above the block and a separate valley cover is used. This is a move toward improved performance, although a legitimate customer complaint of hard hot starting could be relieved in this fashion.

This manifold assembly is part no. 3830623, but it must be used with the late head to mate with the ports.

On the exhaust side, a pair of what amounts to tuned-length pipe headers cast in grey iron became available in the 1962. Having a primary length designed to aid extraction at the top end without scavenging the incoming mixture from the cylinder adjacent in the firing order, the manifolds are not as wicked looking as those on Dodge's Ramcharger, but they are quite efficient. A 2½-inch header pipe and a two-inch tail pipe are connected to each side with conventional mufflers.

Left hand manifold is part no. 3822923; right hand is 3822924, and the header pipes (manifold to muffler) are left, 3822963, and right, 3822964. Prices for these components are around $60 per side for the manifolds, approximately $10 per header pipe plus 30 cents each for four long ⅜ capscrews when bought over the parts counter, so you can let your conscience be your guide when considering fabricated headers.

The camshaft situation became a little clouded, at least as far as the NHRA was concerned, in 1962 when the factory announced an optional cam, part no. 3822930 with timing of 49°-93°-95°-45° and .480 inch lift, but which was not installed in production engines or showroom available. Cars so equipped ran in FX class, but results were not superlative so it failed to become an assembly line item. Current camshaft, part no. 3833125 with timing of 50°-94°-97°-47° is legal and valid according to NHRA. This is a lot of cam anyway and, for drags, seems to get the job done.

After several years of dual-point distributor experience, Chevrolet engineers have decided that the single point type can be just as efficient. They altered the breaker point cam to give a less drastic acceleration to the points to reduce high-speed float and to allow more primary current flow. The arcing which occurs shortens point life, but in a competition engine this is of secondary importance. Most 409 competitors however, stuck with the dual point distributor, having devised suitable methods of preventing excessive float up to 6,800 rpm independently of the factory. For those who may be interested in the new model, it is part no. 1111023. AC 43N plugs are factory equipment, fed by the conventional non-metallic high tension cable used to eliminate RF interference.

Pistons were changed in the 1962 year model to alter the quench area as a part of the effort to improve upper rpm performance. Instead of a milled slot straight across above the wrist pin axis, there is a fly cut (similar to the 348 type) for valve clearance. Compression ratio with this type of piston is much nearer the advertised figure because of reduced chamber volume (now 83.55 cc). As delivered, the engines are fitted with two head gaskets per bank, reducing compression to approximately 10.2-to-1 with maximum deck height. For competition, only one steel gasket is used and the minimum depth below the block is standardized on for each piston.

All of which brings us, logically, to Ray Crawford, who won the Mexican Road Race, the Carrera Pan Americana a few years ago. Ray used to say that he knew the Lincoln he drove to victory was stock because it cost him $5,000 to make it stock!

This is about the case with the winning competition cars. They are brought to optimum conditions and all of the plus and minus tolerances allowable under mass production are resolved. So the first step is a complete dis-assembly and measurement of the engine. If the piston deck height varies from one bank to the other or from end to end, the block should be trued by machining in a fixture locating on the main bearing centerline. This will also establish parallel mating surfaces for the heads when they are milled for truth. And having reassured yourself that the bores are 90° included angle, the time comes to insert the boring bar.

NHRA allows .060 inch overbore and the factory makes pistons available for this size. So don't knock it. The additional displacement so gained is approximately 10 cubic inches! Even if you don't care about NHRA, it still isn't too smart to overbore this block excessively. With combustion pressures as high as they are and as little water cooling available as there is, slimming down the nominal .200-inch wall thickness too great an extent is to be discouraged.

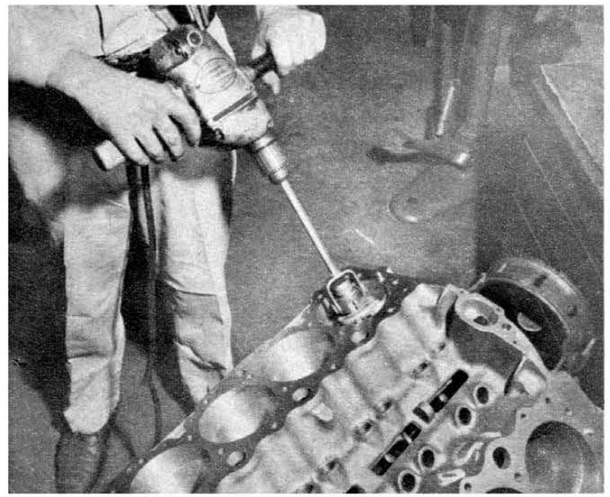
Any type of piston can be fitted, as long as it does not raise compression and you may prefer a proprietary brand. However the factory "impact extruded" (forged) type have proven to be satisfactory, but they are best revised for full floating wristpins. This is a moderate machining job consisting of enlarging the pinholes and cutting a groove for retaining circlips. You can balance these costs (plus stock piston price) against the price of piston and pin assemblies available from numerous supplies. Pin-to-crown height must be established exactly in each piston.

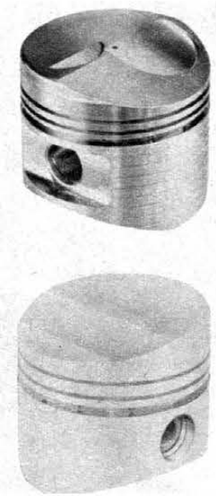
Skirt-bore clearance should be increased by honing the cylinder walls to give a total of .005 inch to .008 inch.

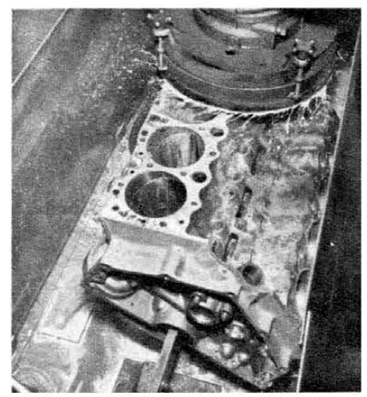
The crankshaft must be measured in each dimension, and the length of each throw made to agree exactly at 3,500 inches. Journals are ground undersize to increase bearing clearance to .003 inch on the mains, .00275 inch on the rods, and all surfaces micro-finished. The 90° relative placement of crankpins must also be established.

No excessive lightening is allowed under NHRA rules, so an overall cleaning up of rods is about all that can be done in this department. Rods should be checked for center-to-center distance and alignment, then trued as necessary. It is not going too far to have the big ends honed to improve insert seating. Assemblies are balanced separately and as a unit, of course. When installed on the shaft, approximately .035-inch side clearance is left.

The important areas of attention in the head are valve seating, spring tension and combustion chamber measurement. The time spent in lapping in valves on their seats is repaid in actual horsepower plus the number of hours an

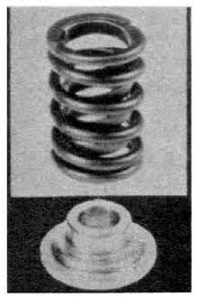




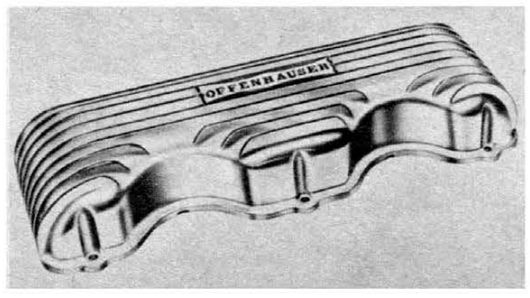


Establishing correct relationship between head-block mating surface and crank center line is part of bring-it-up-to-stock bit.

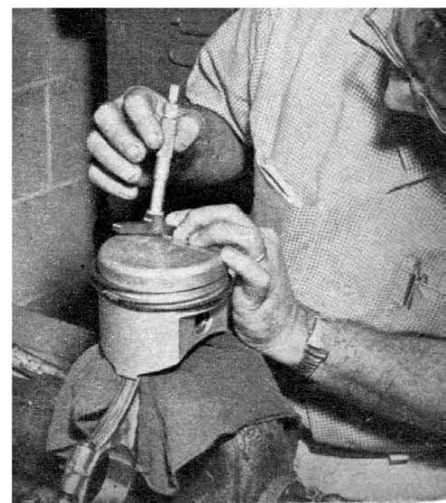
After 409 block is bored to .060 inch maximum allowed by NHRA it is honed by hand. Special pistons for 409, designed to improve combustion chamber shape, are offered.



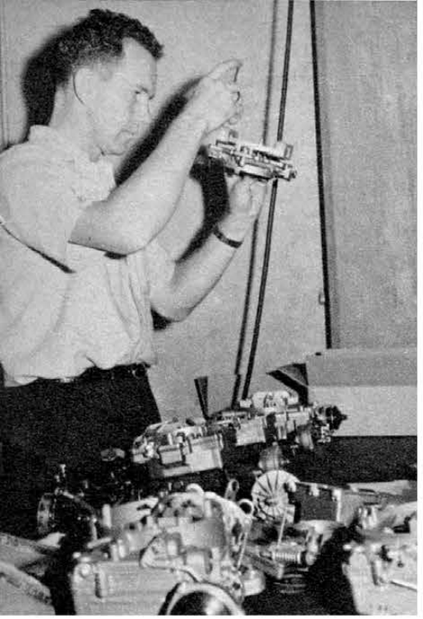
Heavy duty valve springs and alum. keepers are non-stock, O.K. for street classes.

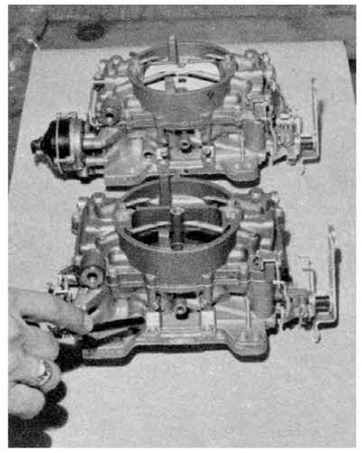


Popular 409 has not been ignored by manufacturers of dress-up accessories.



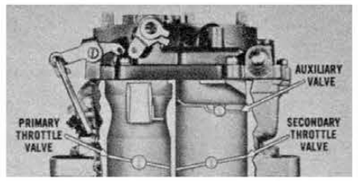
RIGHT: Bill Thomas, Chevy builder who has scored numerous successes in stockers, emphasizes precision.





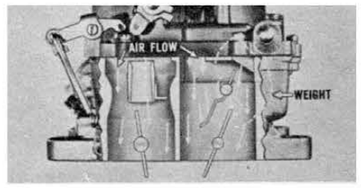
Front carburetor in 409 pair has no curb idle adjustment, all adjusting is at rear.

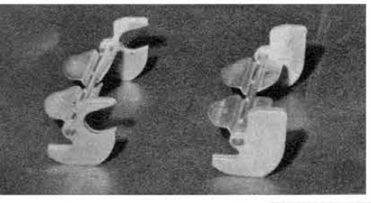
LEFT: Doug Roe, Chevrolet Contact Engineer and carb expert, works over 4-bbl.



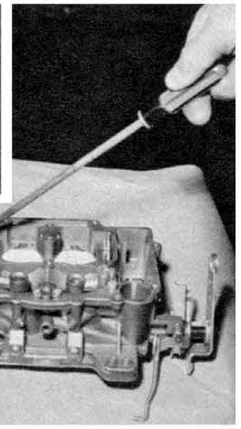
ABOVE: Cutaway of 4-barrel carb shows arrangement of primary, secondary bores.

BELOW: Aux. valve in secondary is opened by air flow. Weight resists pressure.





Altered counter-weight of late 4-barrel (L) changes opening rate of secondary.

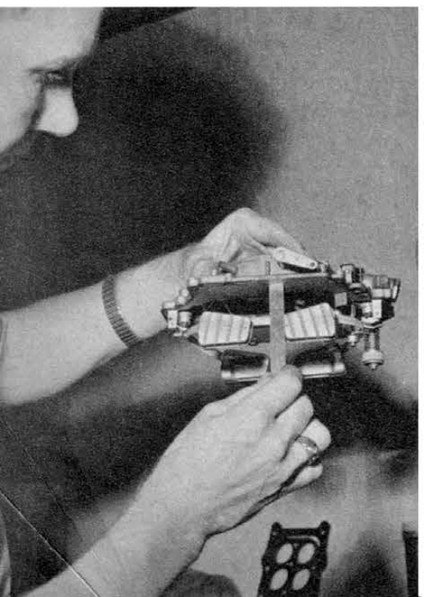


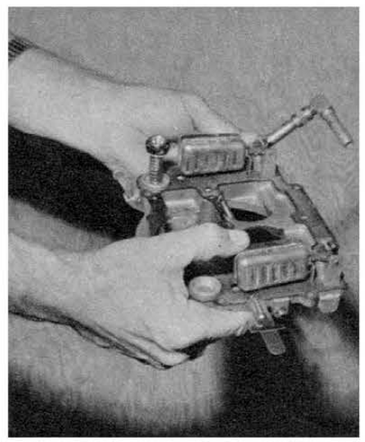
Fuel flash partition helps cure hot starting problem in big engine.

engine can be operated between overhauls. Seats should be reamed out to the actual valve head diameter and narrowed by using a 70° reamer to a width of .060 or .070 inch in the exhaust side, less on the intake side, say .050 inch. This naturally calls for meticulous lapping in.

To be sure that one valve is not going to float before the rest and that none of them are going to float before you reach the absolute limit in rpm, each spring should be at maximum permissible tension and correct installed height. It means going through a number of valve springs but the late 409 springs (part no. 3822931) have been shot peened and heat stabilized, plus being checked for tension at the factory to fall within a 12-pound range at installed height, so it isn't as much of a chore as with some other types. Equalizing valve weight is as important, and truing the stems is vital.

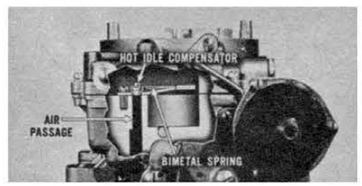
The matter of compression ratio is simple. Maximum allowed is the manufacturer's stated figure, 12.5 in this case for the latest head. It can be checked in two ways: By





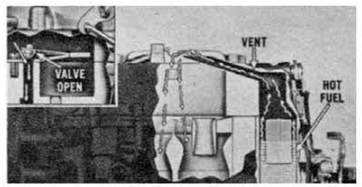
ABOVE: Setting float level by pressing floats down on pocket rule is hot rod trick.

LEFT: Carburetor tuning is essential part of 409 performance secret. Here Doug Roe sets float drop in Rochester 4-barrel.



ABOVE: Hot idle compensator is Carter carb feature. Bi-metal spring expands.

BELOW: As spring expands, passage opens to admit air to dilute fuel vapors.



filling a cylinder and filling a combustion chamber accurately, or by setting the piston deck clearance (depth of crown of piston below block at TDC) and measuring the volume of the head combustion chamber. The latter method is advised when building an engine. Minimal deck height, measured across the pin center line, should be .006 inch. The volume of the recess around the valves is exactly 7 cc. Safest way to establish this is, after grinding in the valves, bring all chambers up to the volume of the largest, and take a light mill cut across the head to restore the exact measurement and a total of 72.5 for the whole combustion chamber.

No porting or polishing is allowed in this league, so lay that flexible grinder down.

If yours is not a late '62, the improved clutch pressure plate assembly (part no. 3815758) giving more assurance against disintegration and higher spring pressures, should be installed. Or, as allowed by NHRA, any "heavy-duty" or explosion proof flywheel and clutch arrangement can be used, providing it does not weigh less than the stock component. A scattershield is an NHRA requirement with stick shift.

Now, if you have put the engine together as carefully as possible, it should be capable of being operated in the same ball park as those of the biggest names in drag racing. The difference from here out will be in tuning.

Right there, today, is where the trophies are being decided.

TUNING FOR ACCELERATION

The paucity of advice under this heading may be a disappointment to those who are looking for a blueprint for success, but tuning, aside from a number of generalizations to keep one in bounds, is a matter of the relationship between the driver and his car . . . especially where the big stocker is concerned.

The manner in which the driver prefers to get off the line, for instance, whether he prefers to rev high and slip the clutch or to pop the clutch and depend on the accelerator, will determine the advance curve in the distributor and initial timing. His style will also dictate how the carburetor linkage, manual or automatic, will be set up, and, how well he or some member of his crew can read spark plugs will spell the difference between a win or a loss at some strips.

On ignition, Hayden Proffitt, for example, after a year of experimenting, re-works the advance curve for a lot of initial advance and ultimate at 3,000. Some of his competitors, who can, on a given day, take his measure, run less initial, but achieve full advance at something like 2,200 rpm with exactly the same equipment. This is a cut-and-try proposition with each engine. Proffitt has also spent a lot of time analyzing spark plugs. Helped by Champion Spark Plug Company racing department representative, Bobby Strahlmann, Hayden has settled on three heat ranges which he will change at the drop of a thermometer or barometer, N61 Y, N62 T, or N64 Y, depending on weather and altitude. These plugs are gapped at .028 inch, considerably less than manufacturer's specs for normal operation.

CARBURETION

The other half of tuning, carburetion, is highly critical on the 409. And, to get the latest advice, I went to Doug Roe, Chevrolet Engineering Department Contact Engineer, a field liaison man between the factory and users of the equipment.

"You have to remember that any factory production carburetion is primarily for the street. To go beyond such uses is to ask the carburetor for performance it was not designed to give," says Doug. "This is not quite so obvious in drag racing, but when you put a stock car into oval track or road racing, conditions arise that are almost impossible to overcome. For instance, in a certain turn you can have both starvation and over richness at the same time!"

However, acceleration does impose a somewhat similar condition in that the liquid level over the secondary jets is higher than over the primaries and must be correspondingly leaner to achieve a balanced mixture.

The late 1962-63 two four-barrel setup consists of Carter AFB carburetors. The front is Carter 3361-S, rear 3362-S. Chevrolet part numbers are 3815403 and 3815404 respectively. These jugs have 1.56-inch primary throttle bores and 1.687 secondaries. The basic difference in the two is that 3361 has no choke nor carb idle adjustment. The holes occupied by tapered needles in the 3362 are plugged off and all curb idle mixture adjustment is carried out on the rear carburetor, which has an increased idle system. Although the 3361 has no adjustment there is an off-idle supply which begins to function just as soon as the throttle is cracked. For competition, both carburetor primaries should open simultaneously.

For 1963, the auxiliary valves have been altered to change the time and rate of opening. These valves, above the butterflies in the secondary venturis, are not connected to throttle linkage, but are counterbalanced by weights and open in response to the air flow through the throttle bore. As can be seen in the accompanying photos, portions of the valves are cut away to induce flow. The counterweights control both the timing and the rate of opening, since changing the disposition of the mass relative to the pivot point has just as much effect as changing the weight of the mass. Under NHRA rules, they cannot be altered, but for experimentation by the individual owner of a street-only machine, this additional venturi can be cut in at any engine speed and in any amount according to the shape of the counterweights. When fully open, the auxiliary valves should just touch the throttle butterflies.

One of the problems in competition is carburetor heat. The short, full throttle runs of drags and the slow return to the starting line contributes to heat buildup in the engine, which is absorbed by the carburetors, and reduces the weight of the fuel, which, in turn, changes the mixture ratio from run to run.

On the Carter, a new provision is a fuel flash partition, which contains the incoming fuel in a small area of the float chamber, which prevents gross vaporization and consequent flooding or poor running when the car is started hot. Don't tamper with this dam, and if you are re-assembling the carburetor, be sure that the tab on the cover goes on the recessed side of the dam. The hot idle compensator, a bi-metal spring which covers and uncovers an internal air passage to lean out the mixture when high temperatures vaporize fuel, likewise should be left untouched.

In jetting these carburetors for high performance, the basic premise is to go as rich as possible, consistent with power and spark plug readings. (Some strips won't allow the driver to stop at the end, but if you can, this is the place to do your plug checking. The run you have just completed is worth an hour on the dynamometer.) As a reference point, however, .104-inch primary jets, 16-124 metering rods, and .076-inch secondary jets can be installed in both carburetors. If it is necessary to lean the mixture, change the secondary jets in the rear carburetor.

Set the float drop to factory specs: $^{23}/_{32}$ inch, measured from the outer end of the float to the air horn casting with gasket in place. Float level is $^{7}/_{32}$ inch below the gasket.

And, with this, you are ready. Or, reasonably ready. The rest depends on what your experience tells you. Meanwhile, you should be in pretty good shape to learn. As the British mechanics tell their race drivers, "Go out and thrash it a bit, we'll see what comes adrift."

With the 409, it'll take a bit of thrashing. So, have a real go at it! ■