TUNE-UP TIPS: FORD'S 427

Ford's 427 runs good right off the showroom floor, but tune-up expert Les Ritchey tells how to make it run even stronger in the quarter-mile

by Don Francisco

Do you own a '63 Ford that has one of the new high-performance 427 engines, or do you plan to buy one? If the answer to either of these questions is yes, the following facts, figures and ideas from Les Ritchey may be of help to you. They could make the difference between your car's being a success or a failure in the type of driving for which you use it.

Les Ritchey is well known in drag racing as a Super Stock car and engine builder, tuner, and driver; in stock car track racing as an engine builder and tuner. He owns and operates a shop in Covina, Calif., that has the name of Performance Associates. The shop specializes in preparing Fords for drag racing, and this means the complete load, from "blueprinting" engines to setting-up chassis, and in tuning all makes of cars for best performance. Les is truly one of the best-informed Ford men in the country. What he tells you to do to get the most from your Ford isn't hearsay. He knows it will work because he has done it.

Ford builds their 427 engines in three types, one strictly for drags, another primarily for Grand National track competition and the third for either drag strip or normal driving. Basically, the engines are the same. Each has the sturdy cross-bolted main bearing lower end and the same crankshaft, pistons, rods, and other internal parts that determine their life. The difference lies in their compression ratio, camshaft and carburetion system.

The drag engine has a maximum compression ratio of 12 to 1, a 300 degree camshaft, and dual four-throat carburetors. The Grand National has a maximum compression ratio of 11.6 to 1, a 276 degree camshaft, and one four-throat carburetor. This last engine, with dual four-barrels instead of a single, is the third engine, the one you get in standard steel-bodied 427 Fords.

Also, the engines have different clutches. The Grand National clutch is larger and stronger than the one on drag or standard engines. It isn't suitable for drag racing because its action is too severe. The drag clutch has an 11½-inch Long non-centrifugal 2150-pound pressure plate assembly and a driven disc that has a solid hub but flexibly-mounted facings. The disc engages smoothly, which makes the clutch o.k. for normal driving, but under some conditions at low car speeds it will transmit a torsional vibration from the engine to the transmission that will rattle the driveshaft. This vibration doesn't hurt anything although it can be heard in the car.

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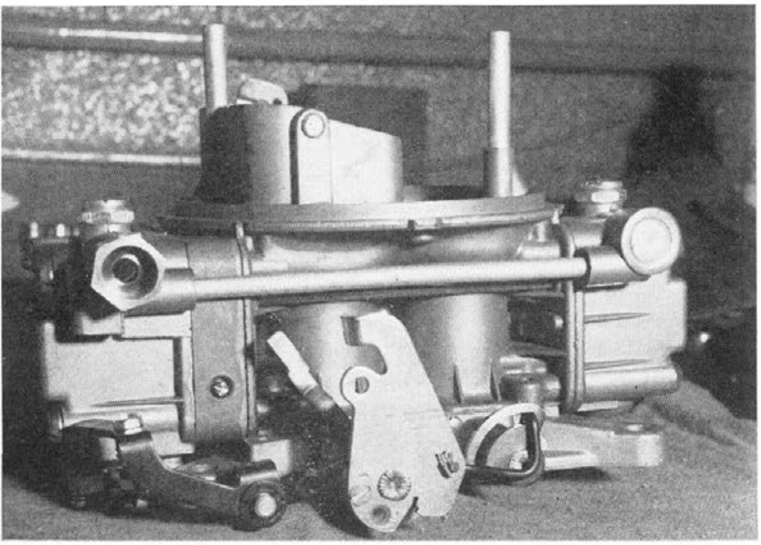
The 427-inch, high-performance Ford is one of the best-prepared engines to ever be mass produced but extra attention by experts like Les Ritchey, top of page, make a difference.



Ford four-barrel carburetors used on 427 engines have vacuum-operated secondary throttle valves. With primaries full open, demand signal to diaphragm controls secondaries.

FORD 427 TUNE-UP *continued*

All three engines are fitted with basically the same four-speed stickshift transmission as standard equipment but the one for the drag engine has an aluminum housing whereas the housing for Grand National and standard engines is cast iron. Standard with the aluminum-housing transmissions is an RC Products aluminum bellhousing-scattershield. A cast iron bellhousing is used with cast iron transmissions.

The transmission for the drag engine is similar to the standard unit except for its second and third gear ratios. It is recommended only in cars to be used for track or road racing. Its gears have ratios of 2.37 to 1 for low, 1.66 to 1 for second, 1.23 to 1 for third, and 1.00 to 1 for fourth, compared to 2.37 to 1 for low, 1.72 to 1 for second, 1.41 to 1 for third, and 1.00 to 1 for fourth in the close-ratio standard cast iron box. For track racing, the 1.23 to 1 third gear of the optional box can be a big help.

Engines built to drag specifications are available only in Ford's 3510-pound lightweight drag car that has fiberglass front fenders, front fender inner panels, hood and deck lid and aluminum bumpers and bumper brackets. The other engines are available only in standard all-metal cars that weigh 3800 to 3900 pounds, depending on their body model.

A man who plans to race his car as well as drive it on the street should understand at least one thing before he signs that long-term contract with the finance company: A car used for a combination purpose such as this won't be a winner at either application unless its owner has lots of money to spend for the rear axle gears and other parts that are best for each type of use. Or, he must have either the time to prepare the car or the money to have it prepared each time he wants to switch from racing to street driving or vice versa. By setting-up the car on a compromise basis he can have a lot of fun with it but it won't be a champion. Drag racing has become so competitive that cars that are consistent winners are used strictly for dragging and are towed to the strip or hauled on trailers. The preparation work that has been done on their engines and chassis makes them unsuitable, possibly to the extent of being undriveable, for any other use. A man who drives his car to work during the week and to the strip on Sundays can't compete with this type of equipment.

The man who wants to have a combination car for normal driving and dragging gets the most for his money from the correct rear axle ratio and chassis modifications. The ideal situation would be to have two rear axle third members, one with the ratio best for normal driving and the other for drag racing, but these assemblies cost money. A compromise that would let the car do well on the strip and not too badly on the highway would be a 4.11 to 1. If the engine were a good one that ran well at higher crankshaft speeds and the car wouldn't be driven on trips of over 200 or 250 miles, 4.29 gears could be used. These would improve drag strip performance but they also would let the engine churn a little faster on the highway, actually too fast for extended periods of time.

For a car to be driven more on trips than in town and not at all for dragging, a ratio of 3.89 to 1 would be good, and for a car used almost exclusively for long trips, 3.50 gears would be fine. With the 3.50 gears, third gear in the transmission could be used to provide a really high-performance passing gear. For drag racing only, a ratio of 4.57 to 1 is recommended. Gears with the 3.50 and 4.11 ratios are factory installed but any of the others would have to be installed by the dealer or the purchaser.

A necessity for drag racing and a valuable item for normal driving is a limited-slip differential. The one Les uses and recommends is the No Slip, manufactured by Detroit Automotive Products, Detroit, Michigan. This is not a factory item. Its list price is $165.00 and the usual installation fee is $26.10. The advantage of a unit of this type for drag racing is that it delivers equal torque to the rear wheels during severe acceleration. For normal driving it improves control of the car by guaranteeing driving traction to both rear wheels at all times.

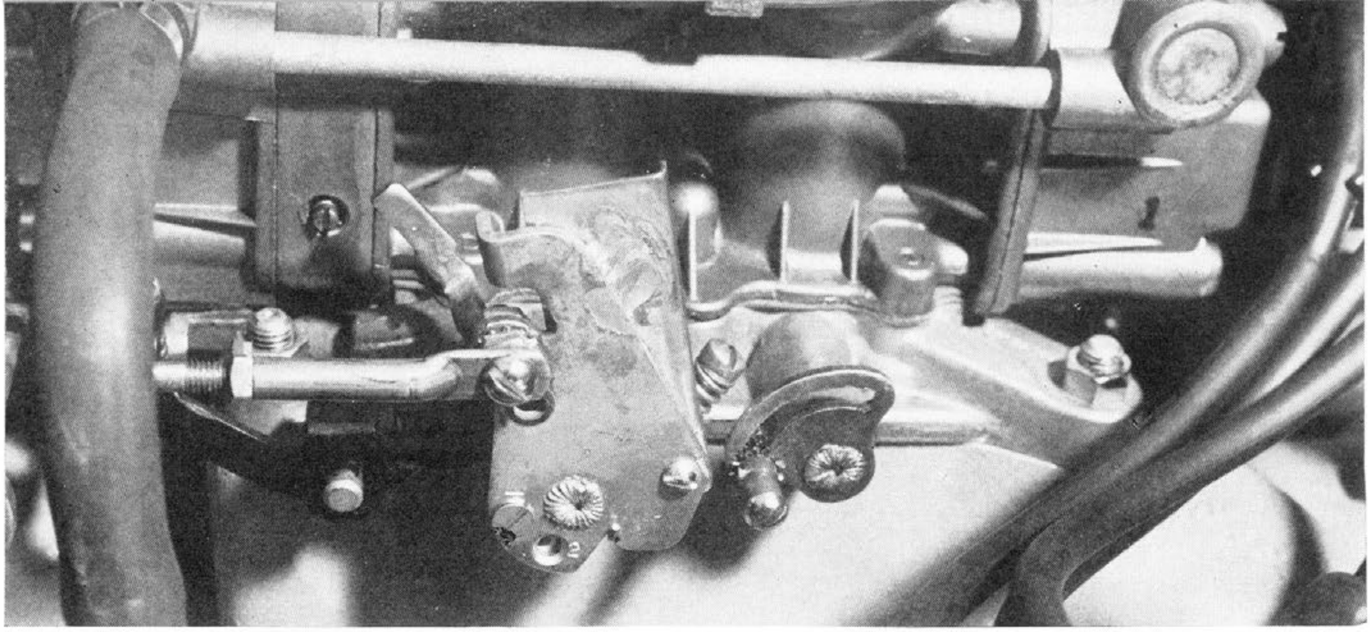
Chassis modifications consist of raising the front end of the car and lowering the rear, stiffening the rear springs, installing shock absorbers of the correct type, installing traction bars for the rear axle assembly, and aligning the front wheels correctly. Their purpose is to enable the car to get the best possible drive wheel traction on a drag strip and to roll easily. But these things are beyond the scope of this article.

To be a top runner, the engine will have to be removed from the chassis and be completely disassembled so all measurements can be checked against factory specifications and corrected, and some parts given additional clearance. This is a job that takes time and money but it must be done if maximum performance is the goal; a man with limited funds can't afford it.

Bringing an engine's measurements up to the specifications set down by the factory is what is referred to as "blueprinting" the engine. Measurements that are checked and corrected are the crankshaft stroke and crankpin spacing, connecting rod dimensions, piston dimensions, cylinder block deck clearance, cylinder head combustion chamber volumes, etc. The camshaft is checked against factory specs and valve timing is checked and corrected.

Minimum deck clearance, which is the distance from the top of the piston heads to the head gasket surface of the cylinder block when the pistons are at top center in their cylinders, is .0155-inch. Deck clearance has an influence on compression ratio. Increasing it lowers the ratio.

Minimum NHRA legal combustion chamber volume is 66.8 cc's. Chambers in most heads are larger than this. Volume must be reduced by milling the heads to bring it down to the minimum. This volume is another of the engine's features that affects compression ratio. The larger it is, the lower the ratio. Parts that are given extra clearance are the main and connecting rod bearings, pistons, and piston pins. Les recommends the following clearances for these parts: Main and rod bearings should have a maximum of .002-inch if the engine is to be raced immedi-



Ritchey modifies throttle operation so that secondary throttles in both carburetors are mechanically operated, improving engine response and throttle closing to prevent overspeeding engine. Addition to bell crank contacts pin on secondary lever.

ately and .0015-inch if it will be driven at least 1000 miles before being raced. Clearances greater than these can shorten the bearing's life. Because of the low expansion characteristics of the alloy from which Ford's extruded aluminum pistons are made, the factory gives their skirts a clearance of .004-inch to .005-inch. If the engine is to be raced immediately, hone the cylinders to increase this to .007-inch. If the car can be driven at least 1000 miles before it is raced, hone to increase the clearance to .0055-inch to .006-inch. Don't use more than .007-inch because with greater clearance the pistons will rock in the cylinders and break rings. They won't expand enough for their skirts to contact the walls. Piston ring end gap is .025-inch. Connecting rod side play on the crankshaft is .019-inch to .024-inch. Piston pin clearance is .0009-inch in the pistons and .0008-inch in the rod bushings. Stock main and rod bearings and piston rings are used.

The engine's valves have to be refaced and seats in the heads reground accurately, valve springs of the correct pressure have to be selected and installed at the correct length, and the engine has to be reassembled correctly. To minimize valve float, valve springs have to exert maximum specified pressure of 90 pounds when the valves are on their seats. Installed length must be 1.820 inches, which is the minimum length allowed by factory specifications and also test length.

Les says that one thing the factories do these days that can be depended on to be right is the balancing jobs on the engine's internal parts. Only if the weight of one or more of the reciprocating parts in the rod and piston assemblies is changed for any reason, or if the owner wants to double-check the factory job, is it necessary to rebalance.

Any engine, whether it is to be used for dragging or normal driving, must be tuned correctly if it is to produce all the power of which it is capable. Tuning, as the term is used here, involves valve lash clearances and adjustments and changes in the ignition and carburetion systems. Also, everything else that has an influence on the way the engine runs must be in perfect condition and operating correctly.

Standard valve lash clearance for both intake and exhaust valves is .025-inch but Les found drag strip performance to be better if it is reduced to .023-inch. The way the clearance is adjusted is important. It must be done with the engine hot and running and Les has found that an engine must run for at east 20 minutes before adjusting can be done accurately. The problem is with the exhaust valves. The engine must be run long enough for the heat of combustion to thoroughly heat them so their length will become normalized. Then, lash clearance will stay at the width at which it is adjusted. Les continues the adjusting procedure, moving from valve to valve so that each valve's lash is checked several times, until he doesn't have to change any of the adjustments.

Adjusting lash closer than the factory recommends effects a slight change in the valve timing. This reduces by a slight amount torque output at low engine speeds but it has the beneficial effect of increasing torque at high speeds. If everything else about the engine is right it will have plenty of low-end torque, even with closer lash clearances, but will be able to use more at the top end. For normal driving it is better to have maximum torque at the low end for good acceleration at low car speeds than to have more at the top end. Therefore, for normal driving the lash is left at the standard .025-inch, or even increased to .026-inch.

Changing the advance curve delivered by governor weights in the distributor gives the engine more low-end torque, which is good for both dragging and street driving. The weights' range of movement is limited so they can advance the timing only 10 distributor degrees, which is 20 crankshaft degrees, and then the distributor is given 16 to 18 degrees initial lead for a total of 36 to 38 degrees.

Because of the engine's high compression ratio and the shape of its combustion chambers, the ratio of advance provided by the distributor has to be slower than for most other engines. Les adjusts the weights to give 3 distributor degrees at 1850 crankshaft rpm's, 4½ degrees at 2000 rpm's, 7½ degrees at 3000 rpm's, and the maximum of 10 degrees at 4150 rpm's. The fairly high initial lead lets the engine accelerate briskly off idle and the slow curve lets it develop maximum power during acceleration but keeps ignition timing below the point that would cause detonation. Once the engine gets into detonation, its combustion chambers overheat and it is in trouble for the whole quarter-mile.

Actually, the only time an advance curve is required in a drag engine is when the car is coming out of the hole in low gear. Before the shift to second is made, engine speed

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could conceivabley drop into the range where the curve is effective, and this is when the curve is needed. After the shift into second, engine speed never drops to the speed below that at which the governor weights aren't fully extended and timing is maximum.

The 427 ignition distributor has dual overlapping breaker points that have more than normal spring pressure. The standard procedure when adjusting the cam angle of distributors with overlapping points is to place a piece of thick paper between the contacts of one set to make them inoperative by stopping the flow of current across them and then adjust the other set. If the points in this distributor are adjusted with this method the adjustment won't be correct because the spring pressure acting on the point arms is so great that the arms cause the breaker cam's shaft to take a different position in its bushings when both of them are running on the cam than it does when only one is running on the cam. Les disconnects the jumper that connects the points electrically and lets both arms function in the normal manner during adjustment.

Another thing that is important about point adjustment is that both sets open the same amount when the cam angle is correct. If either set doesn't open as much as it should there may be excessive arcing across its contacts when the set that stops the flow of primary current through the coil opens. Arcing of this nature can delay coil action, reduce the secondary voltage, and shorten point life. These can have bad effects on the engine's power output. If adjustment is made correctly, point gaps as wide as .021-inch can sometimes be obtained with the specified cam angle of 33 to 36 degrees. The wider points open, as long as the cam angle is correct, the better the coil will function.

The only improvement to the ignition system Les would recommend is the installation of a good transistor system. Of the seemingly hundreds of such systems on the market, he prefers the Prestolite 201 or the Autolite unit sold by Ford as an option.

The advantage of a good transistor system is its high secondary voltage capability. This lets it fire plugs that have spark gaps of .035-inch to .036-inch under any normal condition. The stock ignition systems on some engines and even some special systems won't fire plugs with gaps wider than about .025-inch. Les believes that a wide gap is an advantage to engine performance at all crankshaft speeds because the longer spark it creates ignites more of the air-fuel mixture in the cylinders than a shorter spark would. He says that in a 427 a wide gap can be good for as much as one mile per hour more top speed on a drag strip than is possible with a narrower one. With a stock 427 coil, plugs may have to be gapped as close as .032-inch but they should never be gapped closer than this. Spark plug wires on the 427 have metal conductors and are good for any type of competition or road use.

Standard spark plugs are Autolite BF 32. This is the best plug for normal driving but it is too hot for drag racing. It has to be hotter than a racing plug so it won't foul at the low engine speeds normal driving requires. For drag racing Les usually uses a plug that is one or two steps colder, which would be an Autolite BF 22 or BTF 1. The colder plugs won't run long on the street without fouling. Once they have been used on the street, don't use them for dragging.

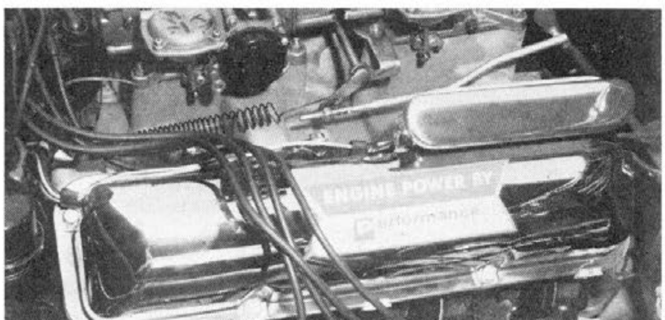
Standard carburetors are as close to perfect as they can be made for dragging, with the exception of changing secondary throttle valves from vacuum to manual control. Their main metering jets, which are .066-inch in the primaries and .065 in the secondaries, provide the best fuel mixtures for maximum drag racing power. They might have to be changed for certain altitude and atmospheric conditions but the maximum change that should ever have to be made shouldn't be more than .002-inch larger or smaller on the primaries and .003-inch larger or smaller on the secondaries. However, if one of these engines were to be operated at full throttle for long periods, considerably richer mixtures than those provided by stock jets would be necessary. Mixtures that provide best drag racing performance are too lean for sustained high power output.

The carburetor accelerating pump is satisfactory as is. The automatic choke is rendered inoperative by rotating the housing for the spring that closes the choke valve far enough so that the valve is held in full-open position at all times. The engine is started when it is cold by pumping the throttle a few times to let the accelerating pump force raw fuel into the intake manifold.

The main thing that isn't good about the vacuum-controlled secondary throttle valves is that the driver doesn't have positive control over them. When a shift is missed they don't start to close as quickly as they should when the driver gets off the throttle and the engine over-speeds to a much higher rpm than if they closed immediately. They don't close immediately because of a slight delay allowed by their linkage. Therefore, if for no other reason than better throttle control to help the engine stay out of the valve float range, secondaries should be mechanically controlled. However, mechanically-controlled secondaries will also improve engine performance for dragging.

Converting the carburetors to mechanical secondary throttle control isn't especially difficult but it is a critical job that must be done correctly if the result is to be satisfactory. In addition to reworking the throttle valve levers so the primary lever will open the secondaries, some fuel metering orifices in the carburetor have to be enlarged so there won't be a huge flat spot in the acceleration when the secondaries open. Les reworks carburetors that are brought or sent to his shop for $8.50 each. This is a low cost and the carburetors work efficiently.

In its standard form the progressive throttle linkage is adjusted so that the primary throttle valves in the rear carburetor start to open when primary valves in the front



Efficient header system can make a big power and weight difference on the drag strip. Stock cast iron headers weigh much more than these lightweight tube headers by Belanger.

carburetor are approximately one-quarter open. This is all right for dragging but engine performance and gasoline mileage for normal driving can be improved by changing the linkage so the rear carburetor primaries don't start to open until the front ones reach approximately half open. This is done by repositioning linkage holes on the throttle levers.

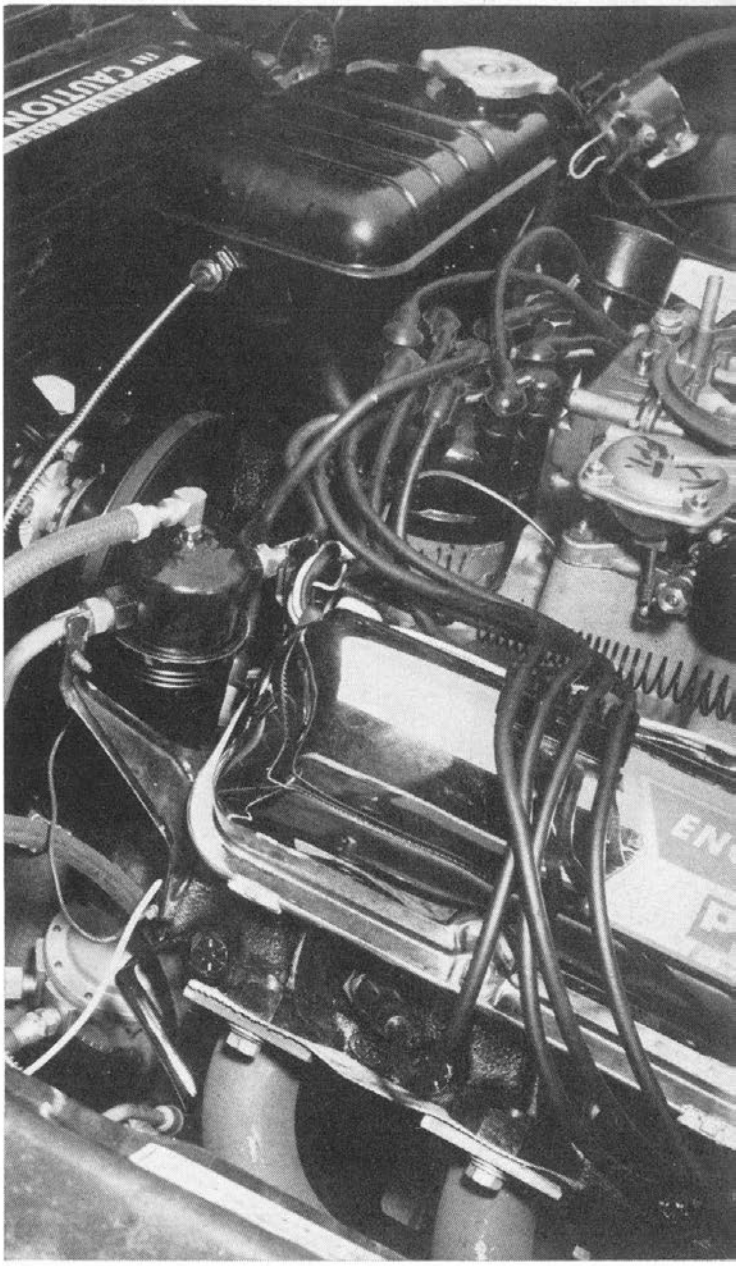
For normal driving, fuel mixtures provided by the carburetors are about 6 per cent rich. In most instances fuel mileage can be helped by installing smaller jets in the primary side of both carburetors. The actual amount jets can be reduced will depend on the altitude at which the car is usually driven and other factors but for most conditions, .063-inch jets should be usable. Don't change jets for the secondary throats. Also, the level of the floats in both primary and secondary sides of the carburetors can be dropped ⅛-inch without bad effect. This will cause the carburetors' high-speed fuel metering systems to come into effect 200 to 300 rpm's later than usual. After installing leaner jets or lowering the float level, or doing both, don't under any circumstances run the engine full throttle for long periods. Combustion chambers will overheat because of the lean fuel mixtures and cause detonation. The result could be serious internal damage.

Les checks fuel pumps on his engines for both dragging and normal driving to be sure they supply enough fuel and that fuel pressure isn't higher than 6½ pounds. If pressure is higher than 6½ pounds, carburetor floats can't close the needles that limit flow into the float bowls as effectively as they should. When this happens, the level of fuel in the bowls becomes too high and makes the mixture delivered by the carburetors over-rich. If mixture is too rich, the engine can't accelerate as well or deliver the fuel mileage it would with the correct mixture. For best performance, 7 pounds fuel pressure is on the critical side and with 8 pounds the carburetors can no longer function in the manner for which they were designed.

For dragging, the complete air cleaner and the filtering element in the fuel filter should be removed. For normal driving, these parts should be in place and maintained in a clean condition.

The cast iron headers that are standard equipment on 427's are fine for normal driving but a good set of fabricated headers is better for drag racing. Factory headers are designed to give zero back pressure at full throttle, which makes them good for long races. Correctly designed fabricated headers help scavenge the cylinders, which is better for acceleration and the short distance of drag racing. Les uses headers made by Belanger Bros. Muffler Co. in West Covina, Calif. They have 1⅝-inch passages compared to the 1¾-inch passages in factory headers. For a drag car they have the additional advantage of being about 70 pounds lighter than factory headers. They cost $110.00. Belangers will install them for $20.00 or the purchaser can make the installation.

Les is quite firm in his choice of lubricating oil for both drag and street engines. There are many excellent brands of oil on the market but Les has had good results with Valvoline for many years so that is his personal choice. The oil he uses is an aviation type that doesn't have detergent additives but does have an anti-foaming additive. The anti-foaming characteristic is an asset because in these engines the oil pan is so shallow that the crankshaft's counterweights hit the oil and keep it pretty well churned-up. Oil churned in this manner and splattered around the crankcase could become aerated if it weren't of the anti-foaming type. Highly-loaded rod and main bearings lubricated with aerated oil have a short life. SAE 30 is used in factory engines and SAE 40 in engines that have been blueprinted and given the extra clearances. The standard full-flow oil filter is used on all engines.



Fuel pressure is an important part of engine operation. Too much or too little means less than optimum performance. Extra line attached to top of filter leads to pressure gage.

Because of the tendency of valves to float at high engine speeds, care must be taken to not overrev these engines either before or during shifts. During some tests he made, Les found that although his shifts were taking less than .3 of a second, from the time the clutch disengaged to the time it engaged again, engine speed was jumping from the shift speed of 6200 rpm's to 7600 rpm's. On the basis of these tests, he recommends that a fellow who is an average shifter make his shifts at 6000 rpm's so the engine won't overrev into the valve float speed range while the clutch is disengaged. If shifts are made at 6300 and 6400 rpm's, as many fellows are trying to do, the engine will go sour because of bent valves, which is the result of pistons hitting the valves, before the day's running is completed. If the engine is a good one, making shifts at 6000 rpm's won't hurt the car's performance.

You take it from here.