FORD PERFORMANCE HANDBOOK

BY RAY BROCK
AND THE EDITORS OF
HOT ROD MAGAZINE

INTRODUCTION

By Ray Brock . . . Technical Editor . . . Hot Rod Magazine

THINK back through life and no matter what your age, the important events that come to mind are the firsts. Remember? No fish ever fought quite so hard as that first one you caught. And there was that pass you caught for your first touchdown, the one that won the important game. If you are married and have a family, the birth of your first child is the one you remember so vividly. And if you are like most normal American males, there's another first which you can recall with great detail. Remember your first car?

I'll bet it was a Ford. Almost everybody I know cut their driving teeth on a Ford. I remember my first car like it was yesterday. It was a 1930 Model A Ford coupe painted an awful shade of green by one of its many previous owners. I was sixteen years old and had earned the money to buy this 12-year-old gem by jerking sodas in a drugstore after school. The price I paid is still fresh in my mind too, $60. Since I was under legal age, my father had to go with me to sign the papers that memorable day. After the purchase, dad wouldn't let me drive the car until we had made a little side trip to see an insurance agent. Here I was relieved of another $65, five more than the car cost, in case I turned out to be a lousy driver or just plain accident prone.

The remainder of the day was spent giving demonstration rides to all my buddies and trying to get the hang of the transmission. Synchro-mesh gear boxes weren't used in the Model A's so shifting required precision team work between the right hand, the right foot and the double-clutching left foot. It was a disgrace to let anyone hear you grind unmeshed gears together so plenty of solo practice was needed on a lonely stretch of road before the proper devil-may-care attitude could be assumed while flicking the shift lever about.

The morning after I brought my first car home, I rushed through breakfast so I could hurry out to fire it up and see if everything still worked. After I backed the 'A' from the garage, I discovered a horrible sight; a three-foot diameter patch of black oil on the otherwise clean garage floor. The former owner hadn't told me about the bad rear main seal and leaky pan gasket. I found out the hard way.

That was the day my education started in automobiles. Every weekend Greenie got an overhaul. The money earned behind the soda fountain went for tools, gaskets, tires, spark plugs and dozens of other necessary parts. After several months of amateur but devoted attention, Greenie started to resemble an automobile in more ways than just its silhouette. The gang could actually make the 50-mile round trip to the beach and back on weekends without either engine or running gear acting up.

From that first tired Model A to the present late model family car, automobiles have been a very interesting hobby for me. Fortunately I have been able to enjoy my hobby more than most, for the last nine years have been spent working for the world's largest automotive magazine, HOT ROD, writing about automotive subjects, attending racing events and driving the latest offerings from Detroit.

Judging from the hundreds of letters that reach HOT ROD every month, things haven't changed much from what they were when I was in high school. That first car is still several years old by the tim[illegible] a teenager wor[illegible] drops to a level that fits the wallet of [illegible]neans lots of miles ing after school hours. Low price [illegible]ner out of necessity or and mileage means repairs. Wh[illegible] curiosity, most young fel- just out of plain mechanical just as I did twenty years lows make their own repairs

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Cover: 406 High Performance Ford Engine, courtesy Ford Division, Ford Motor Company.

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ago. So, we get letters, lots and lots of letters, asking advice on how to fix everything from A to Z.

All of the letters do not come from teenagers with their first car, though, an equal amount arrive daily from young or middle age men who own late model cars. This group wants to know how to modify or tune their cars for maximum performance, economy of operation, smooth idling or any one of hundreds of other things. We try to answer as many letters as we can, but answering them all is impossible so we have to hope that stories in the magazine will assist most of them.

A few months ago we visited the Public Relations Department of the Ford Motor Company in Dearborn, Michigan, and learned that here, too, letters asking for information arrived by the dozens every week. PR Director Walter Murphy showed us some of the letters and asked how we would answer them. The letters to Ford sounded exactly like those we receive every day with one exception; their letters asked questions just about Ford cars while our letters have questions about all brands of cars.

Walt Murphy's department makes an effort to answer these individual Ford owners but normal departmental duties leave insufficient time to answer them all. For quite some time, we discussed the problem and ways to solve it. Finally it was agreed that a book on Ford cars with emphasis on the subject matter of letters received both at Ford and HOT ROD would be the best solution. Later, after much correspondence and many discussions, an outline was finalized for a book which should be of assistance to Ford owners.

Trying to compile a book of information on all Ford cars would require about the same number of pages as used in Webster's Unabridged Dictionary so material has been limited to Ford cars using engine designs introduced within the last ten years and still in production. This, we feel, should cover the majority of Ford automobiles still running daily on the streets of America.

Several top automotive technical experts were called upon to assist in the writing of this book. We sincerely hope that the following pages will give the information you need to get the most enjoyment from your Ford automobile. Tips on tune-ups, economy driving, engine modifications, gear ratio selection, parts interchangeability and speed equipment are all ideas we've picked from your letters.

Whether you're driving a '55 T-Bird or a '62 Galaxie, we have plans for the future of your Ford. Just turn the page and get started.

Ray Brock

EVOLUTION OF THE FORD ENGINE

By Roger Huntington, SAE

THE GENERAL "image" of a certain automobile brand that exists in the public eye is perhaps the major factor in the depth and breadth of that car's market appeal. Car sales people have only come to realize this in recent years. Furthermore there is ample evidence today that a "youth image"—one that suggests flashing performance, bold styling lines, progressive engineering, exciting driving, etc.—can sell more total cars to all segments of the market than a more conservative image that appeals only to the upper crust. Crazy—but apparently true.

Ford products have had an enviable youth image for many years. The fact that the Ford people are trying all the time to enhance and improve that image is the only reason you're reading this book. But it wasn't always so. The image had to grow and evolve. It's a fascinating story . . .

HOW IT ALL STARTED

When Henry Ford brought out his fabulous Model T in 1908 I'm sure he wasn't concerned with any youth image. His idea was to bring practical road transportation to the mass market at the lowest possible cost. He literally put America on wheels. The Model T Ford was extremely simple, reliable, easy to service, parts were

Speed Demon Barney Oldfield took a resolute grip on the tiller-handlebar of Henry Ford's special "999" racer to win many races.

cheap and widely available, it would go anywhere on bad roads with its low gear ratios and high suspension—and, most important, you could buy a new one for as little as $340. He sold more than **15 million** of the things in the next 19 years, with relatively minor changes in the body and mechanism. It was the greatest success story of American industrial history.

But even for all its practical utility features the Model T **did** garner a certain youth image in those early days. Any car that popular, especially when there were no radical year-to-year changes, is bound to feel the touch of the hot rodder. You could buy as much special speed equipment for the Model T as you can for any modern car! Everything from rocker-arm cylinder heads, hot cams and beefed-up crankshafts to special gears, springs, shocks and wire wheels could be had from dozens of specialty companies around the country. The Model T hot rod was a common sight in the '20s. Professional racing men even used it as a base for their equipment for the County Fair circuits. Cut-down chassis with special racer bodies and "full-house" T engines could weigh as little as 1100 lbs. and pull over 100 hp at 3500 rpm! They even ran some Ford T's at Indianapolis in the early '20s, sleeved down from the stock 177 cubic inches to the 2-litre (122 cubic inches) limit. They couldn't stay with the 8-cylinder Millers and Duesenbergs . . . but it all helped the image.

We saw more of the same when the Model T gave 'way to the Model A in 1928. Modified Ford A engines, with rocker-arm heads by Frontenac, Miller, Crager, Riley, etc., were still winning on professional racing circuits in the late '30s and early '40s. You could buy nearly as much special performance and doll-up equipment for the A as the T. The more substantial Model A body didn't lend itself so well to the radical chopping of the T days—so car weights were up several hundred pounds—but the basic 201 cubic inches A engine had a potential of at least 125 hp at 4000 rpm with a full house on gas. (Some of the better track racing engines would pull 175 hp on alky.) This was very snappy performance 30 years ago.

The image was growing.

Ford, right, built the "999" in '02. Engine developed 70 hp.

ENTER THE V8

Despite all this emphasis on special hop-up equipment the early Ford T and A cars lacked a vital ingredient necessary to really build this youth image: You couldn't buy performance **off the showroom floor.** You had to buy a standard model and then modify it. This required a substantial extra investment, time, labor, and you needed tools and know-how to do it. Thus this superior performance was not really **available** to every Ford buyer.

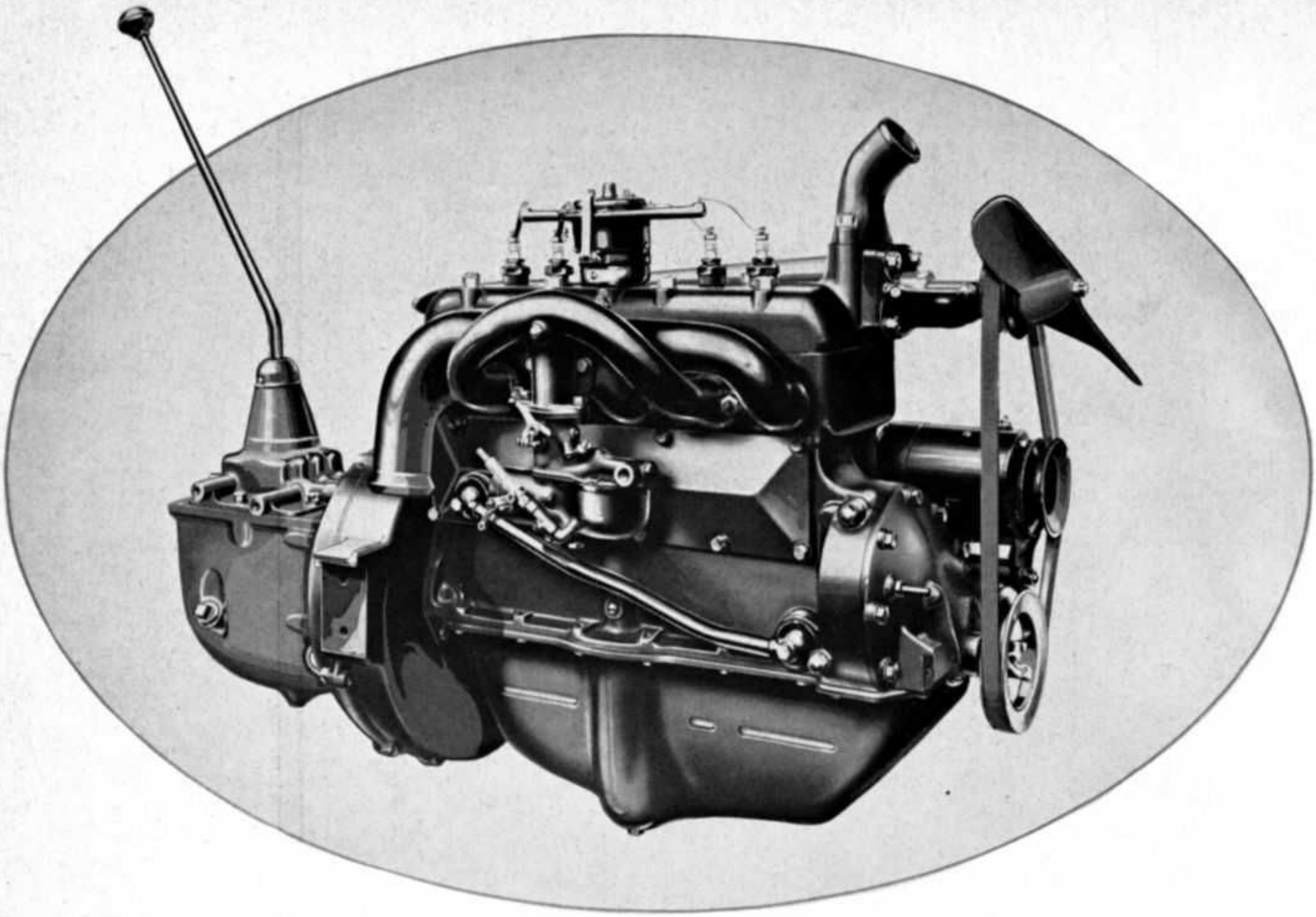
The little 1932 V8 took care of that!

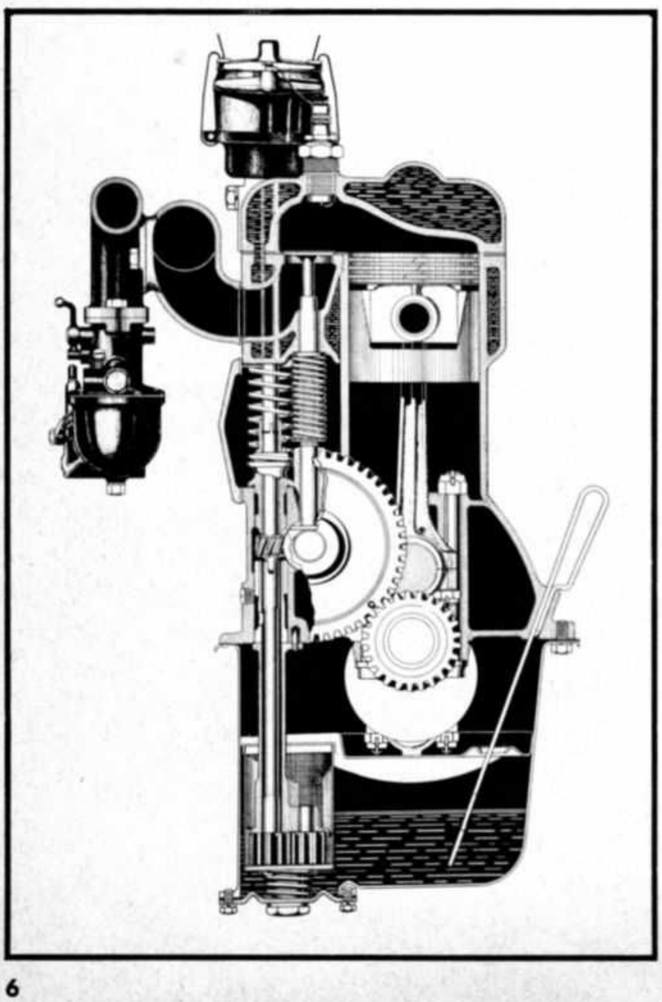
Henry Ford had been fascinated by the V8 cylinder layout ever since he bought out the Lincoln Motor Co. in the early '20s. Lincoln president Henry Leland had designed a beautiful 348-inch flathead V8 for these luxury cars that featured fork-and-blade connecting rods, polished interior and exterior surfaces, aircraft-quality materials, and precision construction throughout. Ford saw in the V8 layout minimum dimensions and weight in relation to horsepower, maximum smoothness and flexibility for street operation—and maximum performance potential with the compact manifolding layout. When it became obvious that the 4-cylinder Model A was not going to meet the demands of the more sophisticated American mass market of the early '30s he decided to throw in with the V8 for his all-new 1932 models.

It proved to be a very wise move. The unexpected performance of the little 221-inch flathead V8 gave acceleration figures that were unknown on low-priced cars in the mid-'30s—like 0-60 mph in 14 seconds, and top speeds exceeding 85 mph. Stripped 1934 Ford roadsters, with all stock equipment, were running a flat 100 mph on the straights in the Elgin Road Races! No other stock cars could touch them. They could even beat the very expensive 8- and 12-cylinder luxury sports roadsters of the day up to 70 or 80 mph. I'm sure this performance was as much a surprise to the Ford engineers who designed the engine as it was to auto enthusiasts who were used to 0-60 times over 20 secs.; but it was there just the same.

And the young people bought it. The V8 engine sold the Fords in the '30s. The young people bought it because it **went,** and the older people bought it because it was a Ford—and because it was smooth, flexible, reliable, and gave good gas mileage. It all added up to a vast special market that drew from every possible **segment** of the **total** market. And the youth image did it. What's more, Ford managed to hold tight to this youth market for over 20 years—up to the days of the horsepower race in the mid 1950's, when the market became much more diffused. It's an example of what horsepower and performance can do.

The famous Ford flathead V8 has an interesting engineering evolution. For instance, many enthusiasts don't realize that the early '32 and '33 Fords had single-throat carburetors and common-chamber intake manifolds, and developed only 65 hp at 3400 rpm. In 1934 they adopted the Stromberg 2-throat carb and now-famous "180-degree" manifolding, raised the compression ratio from 5.5 to 6.3-to-1, and boosted the output to a healthy 85 horses at 3800! The effectiveness of the dual-throat carburetor with in-line 8-cylinder engines had been known since the late '20s; but Ford engineers didn't think it was needed on the compact V8 layout. It was. The 180-degree manifold





Ford Model A and B engines were in production from 1928-1933, had 201 cubic inches, developed 40-50 hp at 2800 rpm.

permits successive-firing cylinders to draw mixture from separate manifold chambers, so overlapping suction pulses won't let one cylinder rob another. It can add 10-15% to peak hp and torque—as Ford engineers found! All Ford intake manifolds on V8 engines have used the principle since.

Ford introduced the Mercury car line in 1939, with ⅛" larger bore for 239 cubic inches, rated 95 hp at 3600 rpm. Otherwise the engines were basically similar. The Mercs were a little heavier cars, so the effect of the extra 18 inches was just about cancelled. But the important fact is that very few American cars could beat **either** of them. Minor changes were made in later years to improve performance and reliability. In 1949 the basic flathead V8 was extensively changed to match improvements on the all-new Ford car line (which featured the new "pontoon" body lines, coil-spring independent front suspension, Hotchkiss rear drive on leaf springs, etc.). The block was beefed up, conventional insert bearings were adopted, cooling system improved, and all-vacuum spark advance was first used. This basic design was continued until the engine was replaced at the end of the 1953 model year. At that time the Ford version had 239 cubic inches, 7.2-to-1 compression and 110 hp at 3800 rpm. The Merc had a whopping 255 inches and got 125 hp at the same compression with a single 2-throat carb.

During this period in the late '40s and early '50s the improvements in engine performance just about matched the increase in car weight . . . so the models around 1950 were not much quicker than those of the 1940's. However, this was also the period when the new "hot rod" sport was flourishing in America—and the flathead Ford V8 engine was getting most of the attention from the suppliers of special hop-up equipment. You could buy a fantastic amount of stuff for this engine in those days—multiple intake manifolds, high-compression heads, special valves, cams, magnetos, stroker cranks, pistons, superchargers, exhaust headers, etc. You could put about any kind of custom performance you wanted in your Ford. With maximum practical bore and stroke (296 inches) you could easily pull over 200 hp at 4400 rpm on gas with a reasonably practical street setup. They used to have some pretty wild rods in those days.

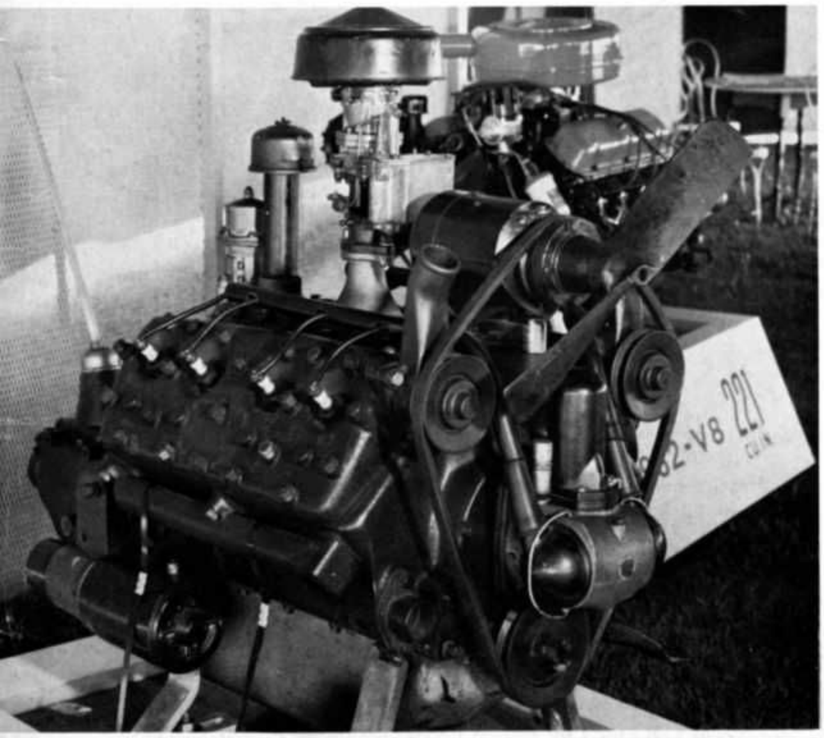
But already the handwriting was on the wall. The age-old placement of the valves at the side of the cylinder just couldn't give the efficient "breathing" demanded by the modern automobile engine; and the spread-out cylinder block, rods and crankshaft used with the small-bore-long-stroke layout didn't have the stiffness to take the pounding of really high compression ratios. The old flathead Ford V8 was completely obsolete by 1952. We needed overhead valves in highly developed combustion chambers, and compact short-stroke lower ends of maximum rigidity.

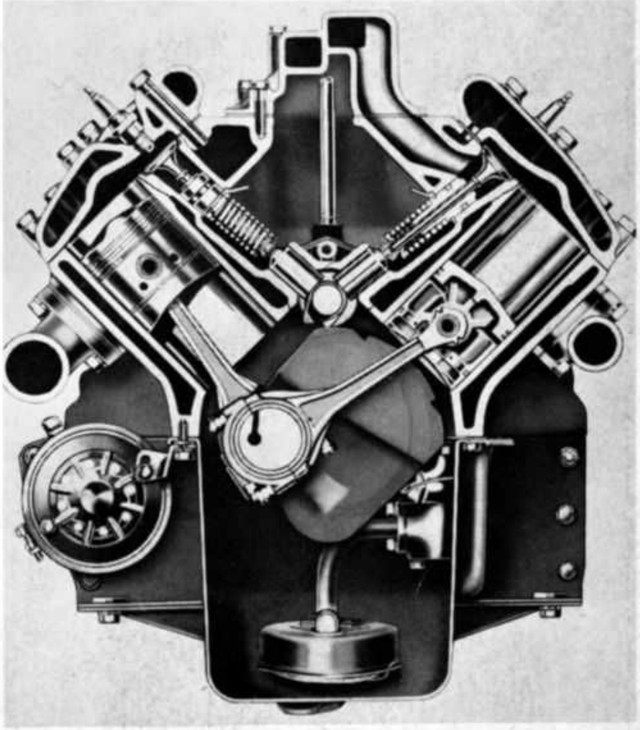
ENTER THE *MODERN* V8

Ford Motor Co. engineers tried their hand first with a modern V8 design on the 1952 Lincoln. This was a great engine. It featured Ford's original deep "Y-block" layout where the cylinder block casting is brought down below the center of the main bearings, to provide more bulkhead support around the crank. We also saw first use of the "integral" valve guide—actually complete elimination of the valve guide, with the valve riding directly on a bore in the cylinder head. Worked beautifully, saved costs, and the valves cooled better. Everybody does it now. This '52 Lincoln engine, with 317 cubic inches and 7.5-to-1 compression, put out 160 hp at 3900 rpm. It was eventually developed (in '57) to 368 inches, 300 hp and 10-to-1 compression.

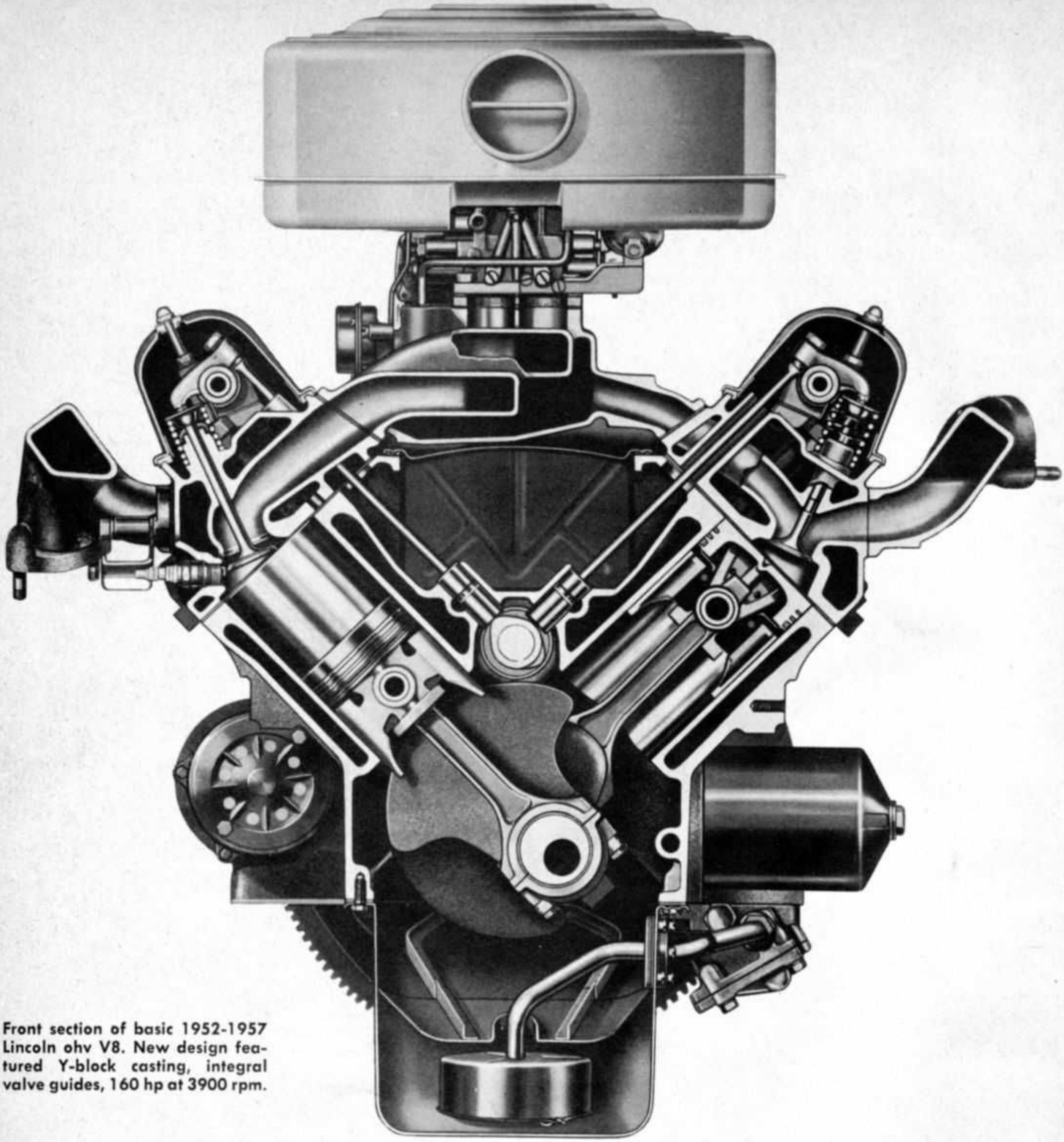
Some of our younger readers might not remember that those OHV Lincolns of the early '50s made pretty good racing cars. Those were the days when the annual Pan American road race across Mexico was just about as popular and widely publicized as Indianapolis or LeMans. Some of the Detroit manufacturers sponsored teams in the stock car division—including Lincoln. In fact the Lincolns literally dominated the go. Their superior chassis (first with front end ball joints) gave the cornering speed to get ahead in the mountains, then the big V8 took over on the straights to pull top speeds between 125 and 130 mph at crank speeds over 4700 rpm with the 3.31 gears! None of the other stockers could touch 'em. The Lincoln team won going away each time they entered—in '52, '53 and '54. It was an impressive beginning for Ford in the field of short-stroke OHV V8 engines.

And there was more to come. For the 1954 model year we saw brand new OHV V8's for the Ford and Mercury lines. It was the same basic engine, but had differences in bore and stroke, compression, carburetion, valve size, etc. for use in the two lines. The '54 Ford version had 239 inches, 7.2-to-1 compression, and put out 130 hp at 4200 rpm. The Merc version had 256 inches, 7.5 compression, and rated 161 hp. The basic engine itself was largely a scale-down of the earlier Lincoln OHV design. A look at cross-section drawings of the two show great similarity. Features like the deep Y-block, integral valve guides, etc. were retained on the smaller engine—while a unique porting arrangement was used, with intake head ports one above





Left: Original Ford 221 cubic inch flathead V8 of 1932 had small single-throat carb, common chamber manifolding, developed 65 hp at 3400 rpm. Right: Cross section of late flathead V8 of 1949-1953. Displacements of this engine ranged from 239 to 255 in.



Front section of basic 1952-1957 Lincoln ohv V8. New design featured Y-block casting, integral valve guides, 160 hp at 3900 rpm.

the other, rather than side-by-side. This allowed use of an H manifold layout that gave better mixture distribution by promoting some turbulence at sharp corners. Ford engineers also worked hard on weight control. The new '54 engines weighed only 610 to 630 pounds with all accessories (but no flywheel)—which classed them among the lighter U.S. auto engines.

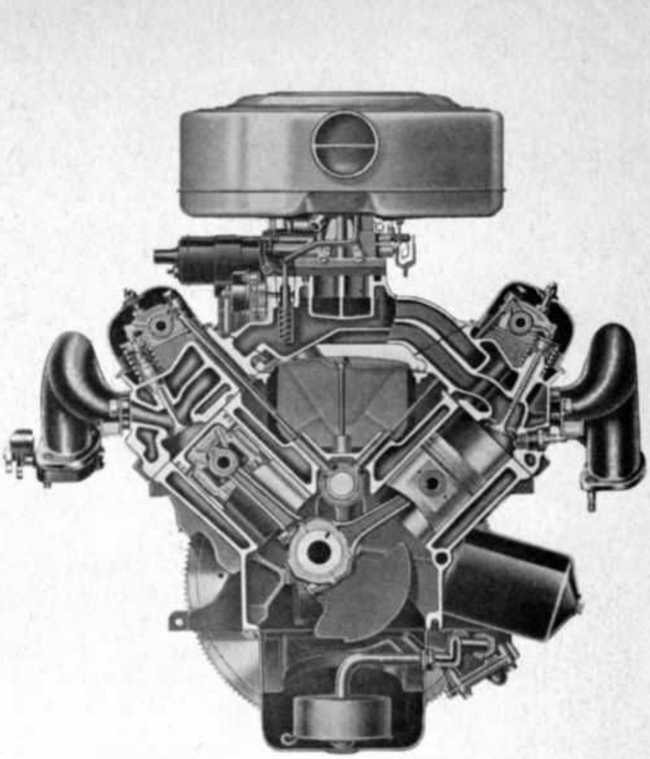
This basic Ford-Merc V8 had a checkered career in performance evolution. By 1957 the displacement was up to 312 inches, compression to 9.7-to-1, intake valve size was up from 1.65 to 1.93" (with ports to match), a dual 4-barrel carburetion system had been worked out as optional equipment—and the thing put out as high as 285 hp at 5000 rpm with the optional 290°-duration racing cam! You could order the big engine in all Fords, Mercs and Thunderbirds. Other cooler versions were available in 272 and 292 cubic inch displacement. (The 292 is still the standard Ford V8 here in 1962, but with considerably tamer specs than we saw five years ago!)

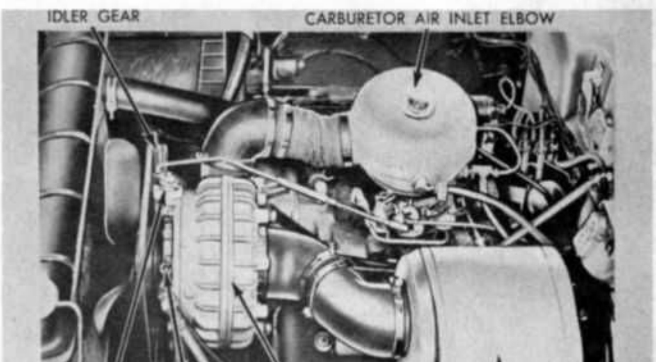
Certainly the peak of development on this basic engine was represented by the '57 supercharged job. Performance enthusiasts will remember that Detroit was in stock car racing up to its ears back in the mid-'50s. The horsepower race was in full swing then, and the sales people believed that racing victories in the hands of professional racing men were very effective in enhancing the youth image of a product. That is, they believed super performance in the hands of a few professionals was more effective in building total sales than a host of optional performance equipment off the assembly line for John Q. Whether this was actually true has never been proved. But it's a cinch that a number of companies—Ford included—spent millions of dollars in the '55-'57 period to win stock car races.

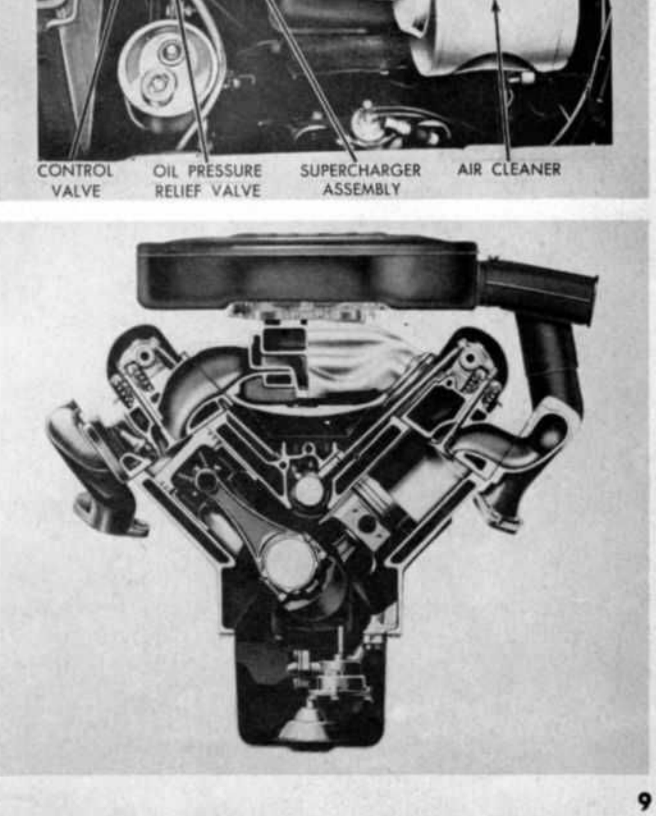
This is how come that '57 supercharged engine. When Chevrolet went to fuel injection, Ford turned around and grabbed the newly-developed Paxton-McCulloch centrifugal supercharger kit for their '57 "power pack." To say the "blower" did the job is putting it mildly. As you know this blower had a unique variable-ratio ball drive that maintained a constant 5-6 lbs./sq. in. manifold boost pressure from 3000 rpm on up—so mid-range torque was helped as much as top-end horsepower. It really put out. Ford rated the combo conservatively at 300 hp at 4800 rpm with 8.5-to-1 compression and the standard 256-degree cam. But the stock racing versions, with a little special tuning and the 290-degree cam, would put out an honest 340 hp at 5300 rpm for as long as you wanted to hold the pedal down. (This 5300 rpm was about the top limit in sustained operation because the ball drive would start to slip above that.)

The blown Fords ruled the roost in stock car racing in early '57. Nobody could touch 'em. Straightaway speed records up to 131 mph were set. One lapped the Indianapolis track at 117 mph average speed in Stephens Trophy trials. On the drag strips they were turning e.t.'s in the 14's and trap speeds of 95-100 mph. It was a great performance car. Unfortunately the honeymoon didn't last long. In June of '57 the Automobile Manufacturers Association worked out a sort of gentlemen's agreement to cut out advertising speed and horsepower and sponsoring factory racing teams. I think the deal was triggered mostly by pressure from Washington. Investigations were under way on safety aspects of American passenger cars, and there seemed to be growing public opinion that linked the horsepower race with the high accident rate on the highways. Whether Detroit agreed with the self-styled "experts" was beside the point. They figured it was the better part of valor to pull out of the performance business.

Of course this AMA decision pretty much put a stop to all-out performance development of passenger car engines. But, as it turned out, it hurt Ford more than some of the others. Reason: Ford had only recently joined the AMA, after years of abstention under the elder Henry Ford regime—and they were on their good behavior. Henry Ford II was determined to follow the new AMA ruling to the letter. Meanwhile some of the other companies retained modest performance programs in the '58-'59 period, under the guise of "police" engine development. This inevitably dropped Ford behind . . . and it has only been in the last couple of years that they have been able to catch up. (And, incidentally, that period of dead performance development did more to prove to Ford sales people that the youth image sells cars than all the professional racing victories in the wild '55-'57 period!)







Top: Front section of basic 1954-57 Ford-Mercury ohv V8. It is available in displacements of from 239 to 312 cubic inches.

Middle: Paxton blower kit on '57 Ford NASCAR power pack, rated 300 hp at 4800 rpm. Racing jobs, with 290° racing cams, put out about 340 hp at 5300 rpm, were hottest stock cars on strip or track until AMA ruling stopped factory participation.

Bottom: Front cross section of basic 1958-62 Lincoln V8 engine. Note huge ports and valves, and unique combustion chamber.

THE SITUATION TODAY

Ford brought out a new family of V8 engines in the 1958 model year. The smaller model for the Ford and Edsel lines started at 332 inches, while a larger design for Mercury and Lincoln started at 383 inches and went up to **430**—which makes it still the largest passenger car engine in the industry. They were entirely separate designs. Both retained most of the earlier Ford design features (Y-block, etc.), but had much bigger valves and ports, higher compression, beefier rods and lower ends, improved casting techniques to control weight, etc. Most unusual feature of the smaller Ford-Edsel version was a narrow head casting, with the pushrods going up through the intake manifold. This served to simplify the foundry processes and reduce weight. The new engine weighed only 640-660 pounds complete—very little more than the '54-'57 job. The big Lincoln engine featured combustion chambers **in the block.** The block faces were milled off at an angle less than 45°, so there was a wedge-shaped chamber between the roof-top piston and the flat head surface. The deal gave excellent combustion control, and breathing through the valves was improved because there were no chamber walls around the valve edges to shroud the opening. This is probably the smoothest, quietest, most reliable engine in the industry today.

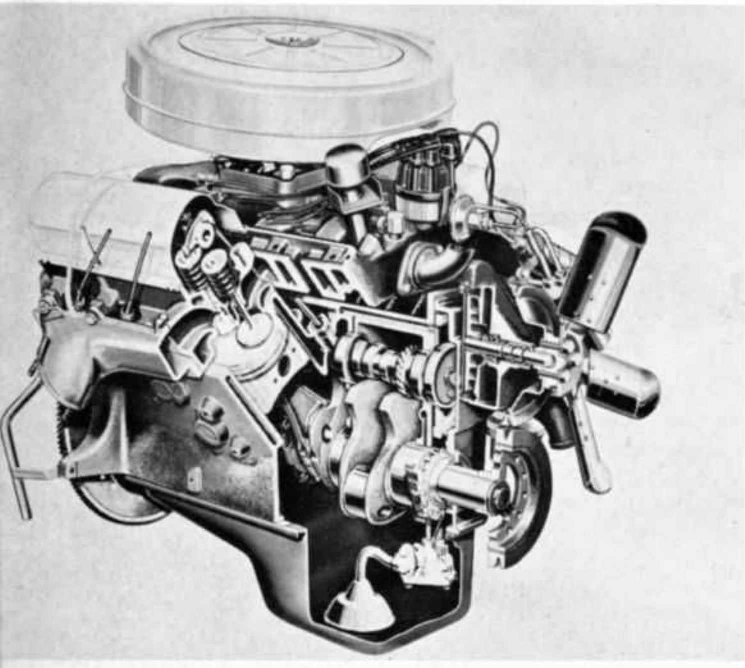
There has been very little performance development of the big V8 in the last five years (as it is now used only in the luxury Lincoln line) . . . but they've gone wild on the smaller Ford design. In 1960 a "high-performance" version of this basic engine was introduced. It had 352 inches, 10.6-to-1 compression, huge 4-barrel carb, on a big-port aluminum manifold, special streamlined exhaust "headers," hot cam with solid lifters and special valve springs, hot ignition, and various internal and external beef-up parts. Ford rated the combo at 360 hp at 6000 rpm—and that didn't seem to be optimistic, judging from the way they went on the drag strips and racetracks. And they've done considerable development of this engine since. The latest versions have 406 cubic inches, 10.9-to-1 compression, three 2-throat carbs on an improved manifold, new exhaust headers with split flow to prevent overlapping exhaust pulses from restricting adjacent cylinders, a new cam—and beefier rods, crank, block and bearings. Ford engineers have gone clear through the engine to give you more brute performance without losing any of the traditional Ford reliability and long life. And it goes. They call it 406 hp at 5800 rpm. The enthusiasts call it about 13 seconds and 105 mph in the standing quarter!

That two-year doldrum period in '58-'59, when Ford was being a good boy for the AMA decree, is forgotten now. The Dearborn devotees are right back up there with the front-runners on our nation's drag strips and racetracks. What's more, you can order a 4-speed floor-shift transmission with the hot engines, a choice of axle ratios—and Ford throws in heavy-duty suspension, 15" wheels, bigger brakes with heavy-duty lining, and a beefed-up drive line to complement the package. It's certainly a far cry from those old Model T days! This is an out-and-out **sports** car, with most of the handling and performance features of a sports car—but with all the comforts of home. This is Detroit **today.**

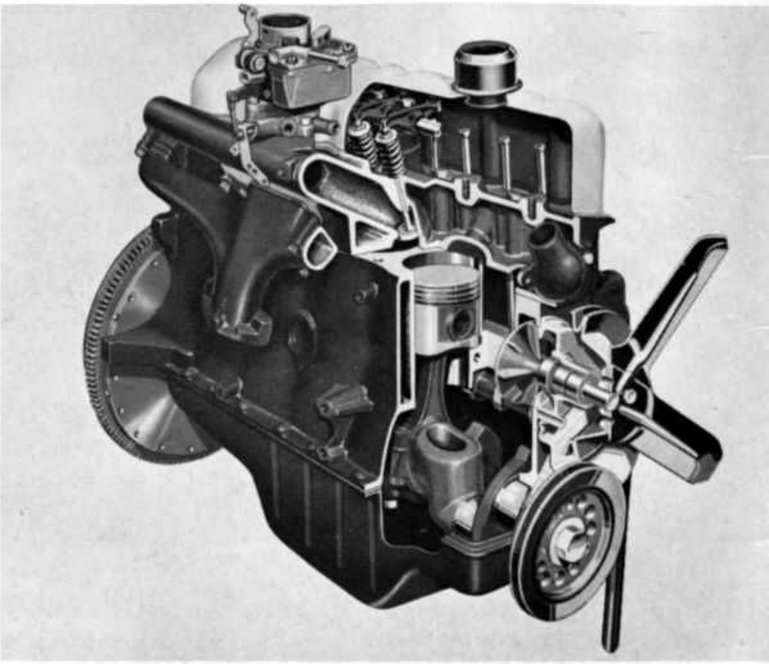
HOW ABOUT THE COMPACTS?

The "new" American car market of the 1950's ended up demanding smaller cars as well as the larger luxury-type vehicle. Detroit had to oblige—and there was no practical way to modify existing "big" cars to satisfy the demand. It meant a whole new tooling program and a new design concept. It was an expensive gamble. Fortunately it paid off.

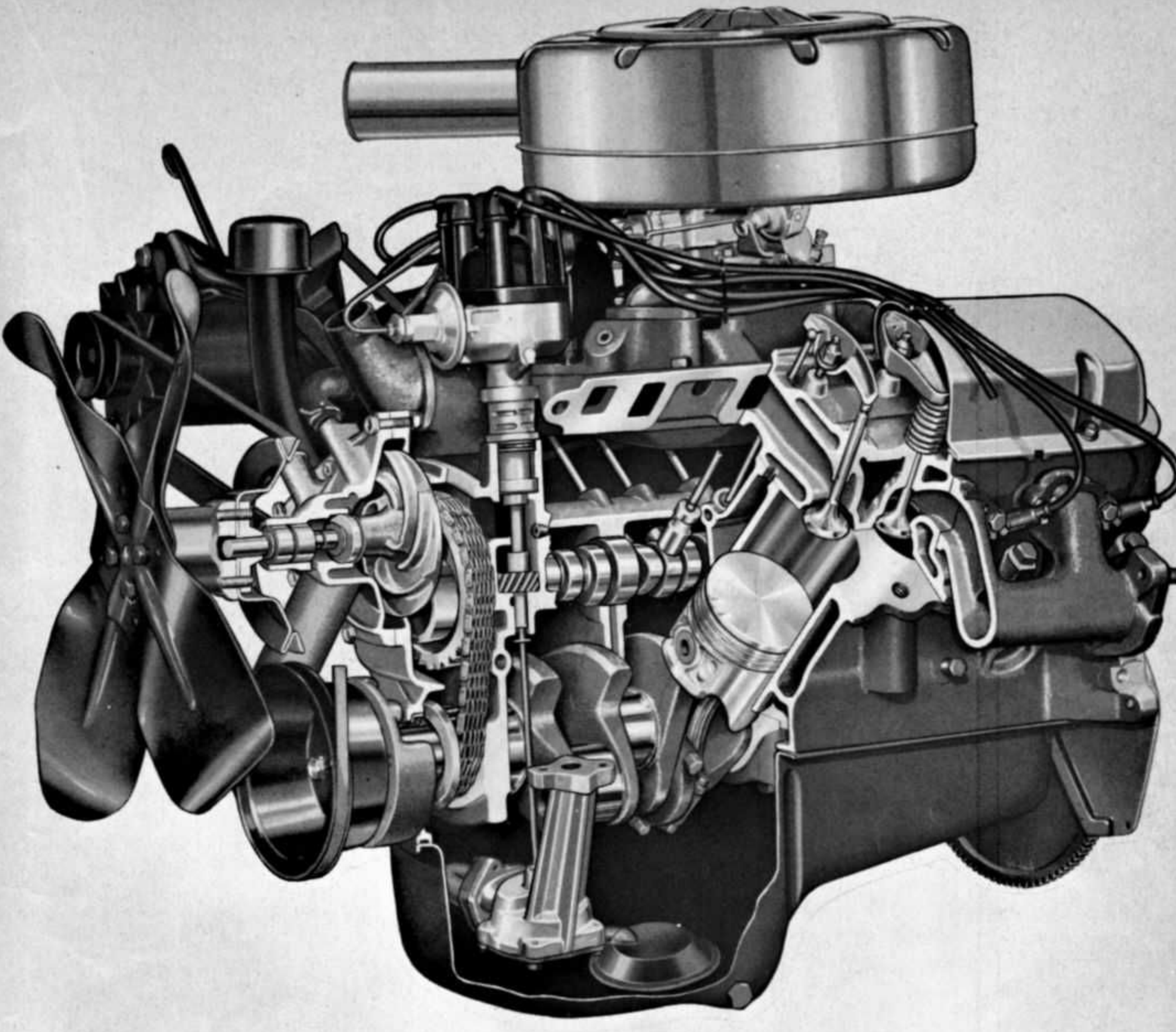
Ford's first entry in the new field was the 1960 Falcon. Here was a neat little 2400-pound package with a highly-advanced unit body and all the latest chassis developments. The overhead-valve 6-cylinder engine featured a very short 2½" stroke for maximum lower end stiffness and minimum dimensions, modern "thinwall" casting that cut the cylinder block weight to only 83 pounds, a cast crankshaft, intake manifold cast integral with the head for optimum fuel vaporization, and an advanced lubrication system with full-flow filtration. The whole engine weighed



Cutaway of 1958-62 Ford engine. Narrow head castings and manifold that houses pushrods reduces weight to 640-660 lbs.



Falcon engines come in 144 and 170 inches, up to 101 hp, yet weigh less than 350 lbs. Blown mill turned 238 hp on dyno!



Cutaway of Fairlane V8. This engine has a shallower block, doesn't use Y-block, is lighter and cheaper. Has good fuel economy.

less than 350 pounds with all accessories. The original design had 144 cubic inches and developed 85 hp at 4200 rpm on 8.7-to-1 compression. No significant performance development work was done (in view of the fact that this was supposed to be an "economy" engine)–though the following year a stroked 170-inch version was brought out at 101 hp at 4400. This gives considerably better acceleration, especially in the heavier Comet cars.

Just last fall Ford announced a new "senior compact" Fairlane series, to satisfy what looks like a considerable demand for a car size somewhere between the Falcon and the big Ford. It's an all-new car. Weight is up around 3000 pounds, wheelbase up to 115.5", but the designers hope the increased seating and trunk space (plus the higher build which makes it easier to get in and out) will be just what a big segment of the market wants.

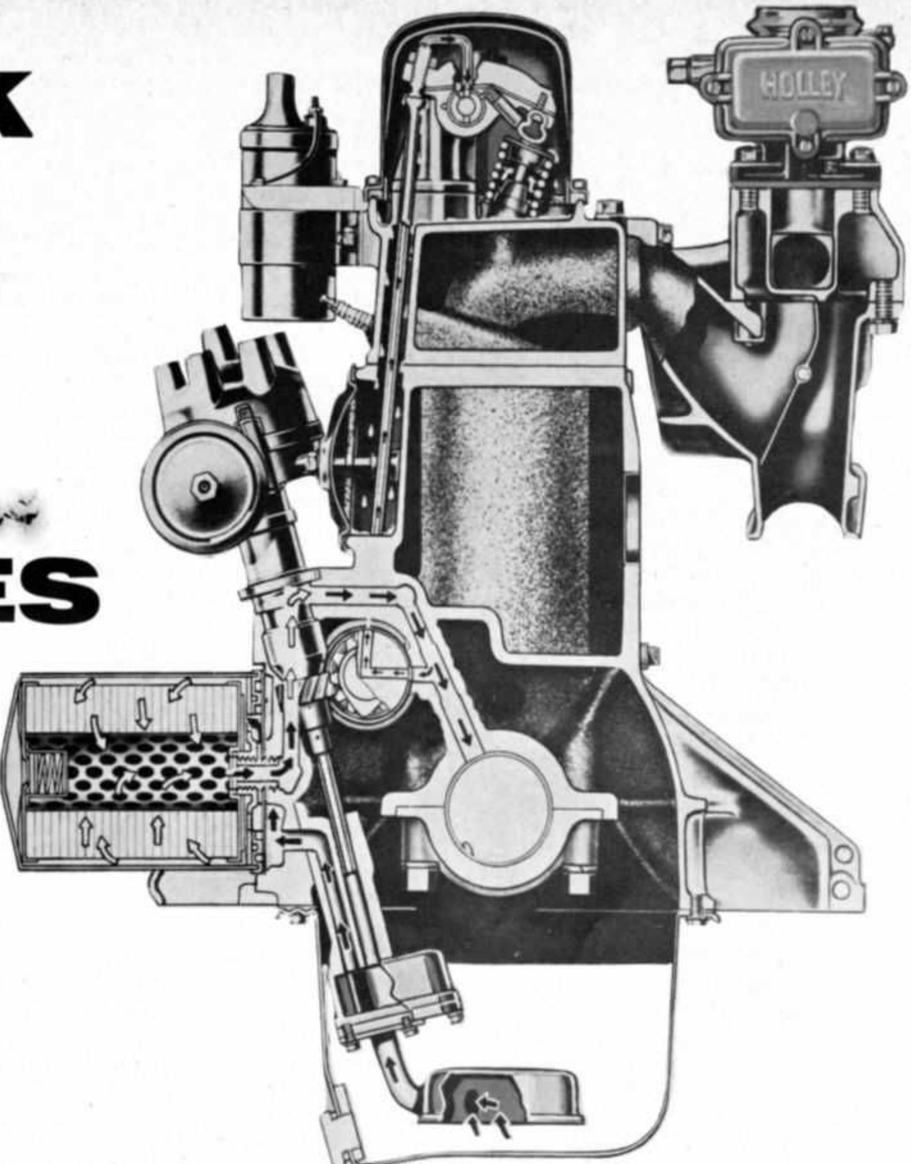
The standard engine for the new Fairlane is the 170-inch six mentioned above. But the Ford people felt they needed a more exciting performance option to retain that youth image we've been talking about. The result is a little compact V8 that has the whole industry buzzing. Not only are the dimensions very compact in relation to the cubic inches, but it features maximum use of the new thinwall casting techniques to cut weight and material cost to the bone. We can compare it with the prewar flathead V8 because they both have 221 cubic inches displacement. The old V8 weighed around 575 pounds and developed 85 hp at 3800 rpm. The new engine weighs 440 pounds with all accessories, and puts out 145 hp at 4400! In fact the latest version has a bigger bore for 260 cubic inches, and puts out 164 hp for the same weight! Is that progress?

Some features of the new Fairlane V8 (also used for the Mercury Meteor): Short stroke with minimum dimensions and maximum stiffness, stud-mounted ball joint rocker arms, all accessory drives in front for accessibility, etc. It's a great engine. And they say Ford engineers have already managed to get 1 hp per cubic inch out of it at 6000 rpm on the dyno, with a little tuning and a few special parts. Looks like this one will be able to hold its own when the youth image begins to demand all-out performance in the compacts!

Yes, it's been quite an evolution these last 54 years. We've come from 20 hp at 1600 rpm to 406 hp at 5800. And maybe this is only the beginning! ■

A LOOK AT THE FORD ENGINES

By Ray Brock



Cutaway of Ford six engine shown above. Block skirt extends below crank to give increased strength. This is a very good "workhorse" engine and produces fair power from 223 inches.

DESIGNING a new automobile engine and the costs required to develop this engine from blueprint stage to finished product is a very expensive proposition. Many millions of dollars have been invested when that first complete engine takes its place under the hood of a car. Obviously, hundreds of thousands or even millions of these engines must be built from the original basic design to divide the design and tooling costs into a relatively low price per unit. A successful engine will last for many years with only minor changes in displacement, camshaft, carburetion, etc., as the years go by and requirements for power or economy change.

Within the last ten years, Ford has introduced five different engine designs which we will cover in this section. The overhead valve I-block six made its debut in 1952, the Y-block V8 in 1954, the larger 332-352-390-406 V8 series in 1958, the Falcon six in 1960 and the Fairlane V8 in 1962. Each of these engines has a distinct niche within the Ford family of cars. Even the dean of the present group, the overhead valve six which is well into its eleventh year, would appear to have many years left to go as the economical workhorse of the full-sized line of Ford cars.

FORD OHV 6

Ford's first entry into the overhead valve field was the in-line six for 1952 cars. It was called an "I-block" engine because it used a deep skirt design which extended below the crankshaft center line. This engine had a 3.5625-inch bore and a 3.600-inch stroke for a displacement of 215.3 cubic inches. The crankshaft was made of a special nodular iron cast in precision molds that permitted exact counterweight placement for a smooth running engine.

Four main bearings were used with end thrust taken by number three main. Main journal diameter was 2.50 inches and rod journals diameter was 2.30 inches. Either steel-backed babbitt or steel-backed copper-lead inserts were used for both rods and mains. From 1952 to 1962, there have been only minor changes in this portion of the engine. Stroke and bearing diameters have remained the same.

The forged steel connecting rods have remained the same length since 1952, 6.260 inches center to center of bores, and only minor changes in weight have been made. They are fitted with a bronze bushing for the full-floating piston pin.

In 1952 and '53, the Ford six had a bore of 3.5625 but in 1954, an extra 1/16-inch was added to increase the bore to 3.625 (3⅝) and add another eight cubic inches of displacement. At the same time, chrome plated top compression rings and oil scraper rails were added for better oil control. The 1962 Ford six still has the same arrangement although there have been slight design changes to various components.

Originally, the Ford six had 1.647-inch diameter intake valves and 1.510-inch exhausts. When displacement was increased to 223 inches in 1954, the intake valve was enlarged to 1.780 inches for improved breathing. The same size valves are used in 1962 although, here too, there have been refinements in material and clearance specifications.

Several variations in camshaft timing have been used since 1952. In the early 215-inch '52-'53 engines, a cam of moderate timing was used. When displacement took a short jump to 223 inches in 1954 and the ⅛-inch larger intake valve was adopted, breathing was improved so the valve timing was made milder to attain the most desirable torque characteristics. In fact, maximum torque with the cam used in 1954-55 was at a very low engine speed of 10-1200 rpm. In 1956, lift was increased a few thousandths and duration shortened to raise both power and torque.

Another camshaft was released in 1957 engines and this version was used all the way to the early 1961 engines. Its lift was the same as the '56 cam and so was its duration, but opening and closing points changed slightly for improved efficiency. Late '61 and all '62 engines use the latest camshaft which has the same lift at the valve but a change in ramp design for use with a "zero-lash" rocker arm introduced in 1961.

The zero-lash mechanism consists of new rocker arms with a hardened steel eccentric pivoting in the end of the rocker arm to stay in contact with the end of the valve at all times. The eccentric is spring loaded and when the camshaft starts to open the valve, the lash adjustment of .025-inch is taken up as the eccentric pivots, compressing the eccentric spring. This zero-lash method has the same noise-dampening effect as hydraulic lifters which cannot be used since the six cylinder block was designed to use the small diameter solid lifters with mushroom contact face.

Pistons for Ford sixes are all pretty much the same from 1952 to 1962. The '52-'53 pistons were of course smaller for the 1/16-inch smaller bore but all pistons are cast aluminum with solid skirts, Autothermic expansion control, tin-plated and flat top. Ring widths are the same through all years though, as we mentioned earlier, chrome rings were not used in the first sixes.

Cylinder heads have changed very little over the years too. There was the change to larger intake valves in 1954 and at that time ports were also enlarged slightly. Otherwise, most of the slight changes have been restricted to combustion chamber volume as Ford changed compression ratios around over the years to match the regular grades of gasoline produced throughout the country.

Carburetion too has remained literally unchanged from 1952 to '62. A single barrel Holley or Ford carburetor has been used from the start. This type of carburetor has a 1.5625-inch throttle bore diameter and a manual choke. A series of vacuum passages within the carburetor provide the spark advance control.

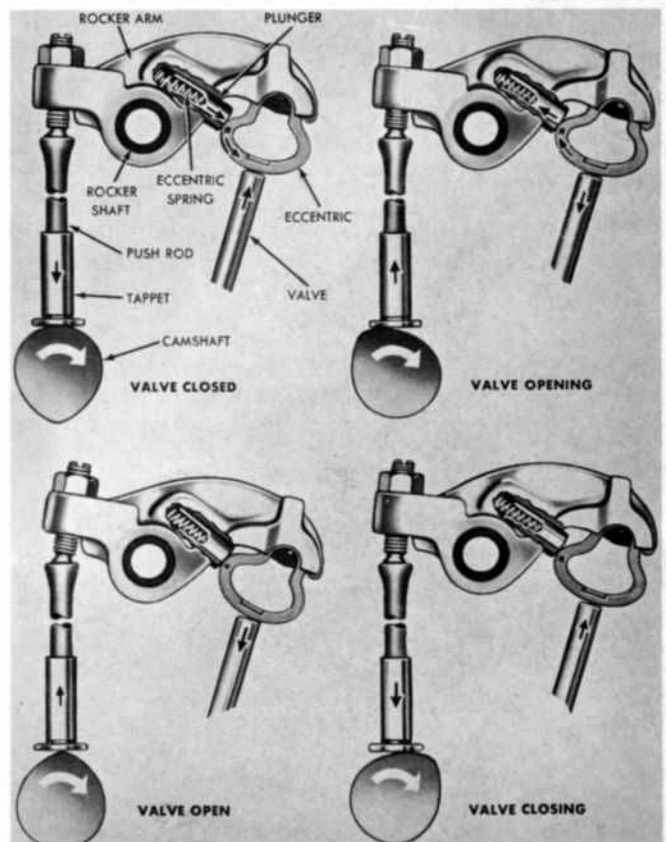
One of these small passages opens directly into the venturi throat of the carburetor and the other opens into the throttle bore just above the butterfly when it is in a closed position. The two passages operate as a balanced system to control the distributor vacuum advance mechanism. Ford sixes do not have centrifugal advance weights in their distributors. At cruise, when manifold vacuum is high, the passage just above the butterfly picks up the manifold vacuum and advance of as much as 32° maximum is demanded. When throttle setting is changed to demand power, manifold vacuum drops and distributor advance is less.

At high engine speeds and with wide open throttle, manifold vacuum is practically nil so cannot cause the vacuum advance diaphram to function. At this point, the fast rushing air flowing through the carburetor venturi creates partial vacuum on the venturi control passage of the balanced system to advance the distributor breaker plate the required amount for maximum power. This system is fixed and advance characteristics within the distributor can only be changed by spring tension. Needless to say, the vacuum diaphram on the distributor must not have any leaks if it is to function properly.

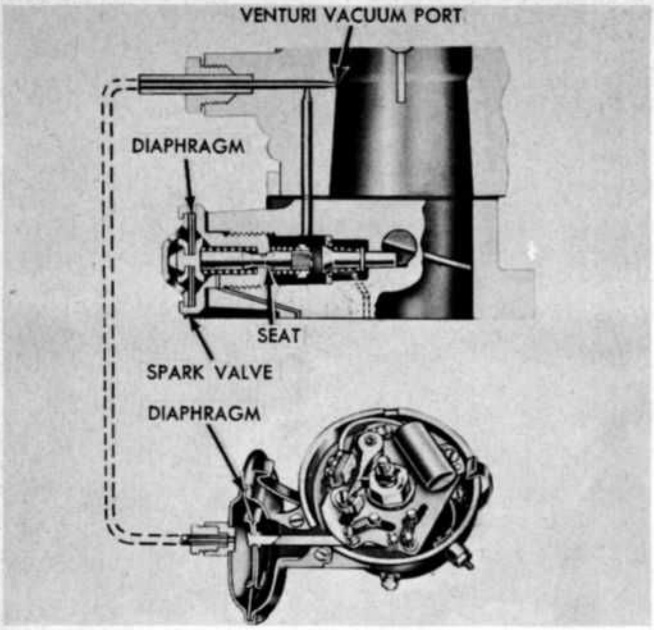
The first three years the OHV I-block six was produced, it used Champion H-10 spark plugs with 10 millimeter thread size. In 1955, Ford switched to 18 mm thread size with a tapered seat and original equipment then became Champion 870. In 1961, Champion 860 spark plugs were original equipment. With the purchase of Autolite by the Ford Motor Company late in the '61 model year, original equipment became Autolite BTF-6. These are also 18 mm plugs.

As you can see from the preceding rundown, the Ford six engine has been changed little in the last ten years. Minor refinements have taken place yearly but many of the parts used for the latest OHV 6 will fit the earliest engines. Millions of these engines have been built and a large percentage of the cars equipped with them are still in daily use. Because their original cost is lower than a V8, economy is better, durability is excellent and overhaul labor is cheap, the Ford six has been a favorite for fleet operation, taxi service and for the driver who seldom makes long trips and does not require the extra power of a V8.

If you should own a Ford several years old equipped with the six cylinder engine, you can take advantage of the good parts interchangeability the next time your engine



Silent lash rocker arms for Ford six have hardened steel eccentric which presses against plunger to take up lash clearance. Novel rocker has same silencing effect as hydraulic lifters.



The distributor advance control for the Ford six and Falcon engines is operated entirely by vacuum. The split system used manifold vacuum at cruise, the venturi vacuum at high speed.

FORD 6 CAMSHAFTS

YEAR	PART NUMBER	LIFT INTAKE	LIFT EXHAUST	HOT LASH	VALVE TIMING IO	VALVE TIMING IC	VALVE TIMING EO	VALVE TIMING EC
1952-53	B3A 6250-A	.329	.324	.015	27°	79°	65°	33°
1954-56	B6A 6250-A	.329	.324	.019	24°	46°	68°	2°
1957-61	B7A 6250-A	.370	.370	.019	17°	53°	61°	9°
1961-62	C1AE 6250-A	.369	.369	.025	23°	59°	71°	11°

NOTE: Early 1961 engines used conventional rocker arms and the B7A camshaft. Late '61 engines use zero-lash rocker arms and C1AE camshaft.

needs overhaul. If it's a pre-'57 223-inch model, the B7A-6250-A camshaft can be installed for better performance, but the later valve springs must also be used in place of the '54-'55 springs. Valve springs do not have to be changed on 1956 engines.

And if you own a six built prior to 1961 when the zero-lash rocker arm went into production and want to take advantage of the quieter operation of this later arrangement, it too can be installed. This requires more parts than just a cam change though. The '61-'62 cam, part C1AE-6250-A, is needed and so is the complete rocker shaft assembly. 1956 or later valve springs do not have to be changed.

Carburetors and distributors from late Ford sixes can also be used on earlier models although in theory, both carburetor and distributor of the same model year should be used together to get proper advance characteristics. Actually, the amount of advance and rate has varied little from '52 to '62 so one could be used without the other and performance would not be seriously changed.

Nearly all other parts for Ford sixes are interchangeable so working on these engines is quite easy. Given proper maintenance and periodic tune-ups, problems should be few and far between. The full-flow oil filter and paper pack air cleaner element are two valuable safeguards to an engine's health and, given the needed attention at prescribed intervals, can save countless overhaul dollars in the future. ■

FORD 6 OHV

YEAR	BORE & STROKE	DISPLACEMENT	COMP. RATIO	HP @ RPM	TORQUE @ RPM
1952	3.563 x 3.600	215.3	7.00	101 @ 3500	185 @ 13-1700
1953	3.563 x 3.600	215.3	7.00	101 @ 3500	185 @ 13-1700
1954	3.625 x 3.600	223	7.20	115 @ 3900	193 @ 1000
1955	3.625 x 3.600	223	7.50	120 @ 3900	195 @ 1200
1956	3.625 x 3.600	223	8.00	137 @ 4200	202 @ 1600
1957	3.625 x 3.600	223	8.60	144 @ 4200	212 @ 2400
1958	3.625 x 3.600	223	8.60	145 @ 4200	212 @ 2100
1959	3.625 x 3.600	223	8.40	145 @ 4000	206 @ 2200
1960	3.625 x 3.600	223	8.40	145 @ 4000	206 @ 2000
1961	3.625 x 3.600	223	8.40	135 @ 4000	200 @ 2000
1962	3.625 x 3.600	223	8.40	138 @ 4200	203 @ 2200

FORD Y-BLOCK V8

After twenty-two years of L-head V8 engines, Ford became the first of the "low-priced three" to introduce an overhead valve V8 when they marketed a 239-inch "Y-block" engine in 1954. The Y-block name was given the new engine to point out the fact that the new Ford overhead V8 block, when viewed from the end, looked more like a "Y" than the "V" of the past. The chief advantage of a Y-block is that the lower block skirt extends well below the centerline of the crankshaft with extra ribbing to ensure better support of the main bearing saddles than on blocks where the oil pan flange is at the center of the main bearing bores.

The first of Ford's Y-block V8's had the same displacement and compression ratio as the "flathead" model it had just forced into retirement, 239 cubic inches and 7.2:1, but that's where the similarity ended. Where the flathead had a bore-stroke ratio of 3.187 x 3.750, the new engine had a more efficient "oversquare" ratio of 3.50 x 3.10.

Advantages gained by the new engine design were great. The oversquare bore-stroke ratio meant less piston travel and less wear for a given displacement than with the long-stroke flathead; higher compression ratios could be used with the more compact and efficient chamber design; efficient intake breathing and exhausting of burned gases was possible through more direct, enlarged ports; engine cooling was improved; maintenance costs were much lower, and countless other benefits were gained merely by the fact that 22 years of V8 experience by Ford were used in the new engine design.

The first Ford OHV V8 was rated at 130 horsepower, 20 more than the '53 Ford L-head V8 of equal displacement. The crankshaft was precision molded nodular iron and had 2.5-inch main bearing journals, 2.188-inch rod journals, less clearances. Main bearing diameter was the same as it had been for '53 L-head V8's but whereas the latter only had three main bearings, the new OHV was equipped with five. Rod journals for the new engine were .050-inch larger in diameter than those of its predecessor.

In 1955, both bore and stroke of the Y-V8 were increased to raise displacement to two new figures, 272 and 292 cubic inches. The stroke was lengthened from 3.100 to 3.300 inches and the bore was made ⅛-inch larger (3.625 inches) for the 272 engine, ¼-inch larger (3.750) for the 292. The 272 was for Ford passenger cars while the 292 V8 was for the exciting new Thunderbird introduced by Ford.

The next year, 1956, Ford released another bore and stroke combination which totaled 312 cubic inches. The bore for this engine was 3.800 and the stroke was 3.440 inches. All three V8 engine displacements were offered in 1956, according to model and transmission; 272, 292 and 312 cubic inches. Again in 1957, these three displacements were used.

By 1958, car weight and power-robbing accessories had grown to such proportions that it was not practical to increase the displacement of the Y-block V8 for additional power some car buyers demanded. So, a larger sized, newly designed engine was released. The Y-block V8 was far from finished as a useful engine though. While some buyers wanted the power offered by more cubic inches, others were willing to settle for a little less power in return for lower initial cost and better economy of operation. The 292-inch Y-block V8 was retained for just this spot, falling neatly into the wide gap between the Ford six and the new, big V8's. The 292 Y-V8 is still in production in 1962 just for this purpose and has had good sales every year since 1958.

The reason we have taken a rather hurried step from 1954 to 1962 with the Y-block V8, discussing just the bore and stroke changes and the various displacements, is that we now want to retreat back to the start and show various other changes made within the engines and point out interchangeability of parts. Surprisingly, many of the original '54 parts will fit the 1962 292 engine and conversely, many of the latest parts can be used in earlier engines.

A look into the Ford parts catalog will reveal plenty of interesting facts about the various engines. Checking numbers shows that the '54 engine with 3.50-inch bore presents a problem if you try to update with later parts, especially if it is one of the earlier '54 blocks. One problem is a difference in camshaft bearing size when compared to all other Y-block V8's; we'll go into detail on this later.

The 272-292 crankshaft with 3.30-inch stroke will drop into the '54 block since the main bearings are the same. Also, rods for 239, 272 and 292 engines have the same physical dimensions and both the rod journal bore and the pin bore are the same for these engines. So, if you were inclined, a 239-inch V8 could be opened out to 272 inches by using a 272-292 crankshaft, the 239 connecting rods, 272 pistons and pins, and boring the 239 block an extra ⅛-inch to 3.625. In view of the large number of complete 272, 292 and even 312 engines that must be around, we doubt if anyone would care to invest so much labor and money in reworking a 239-inch '54 engine. Just thought we'd tell you though.

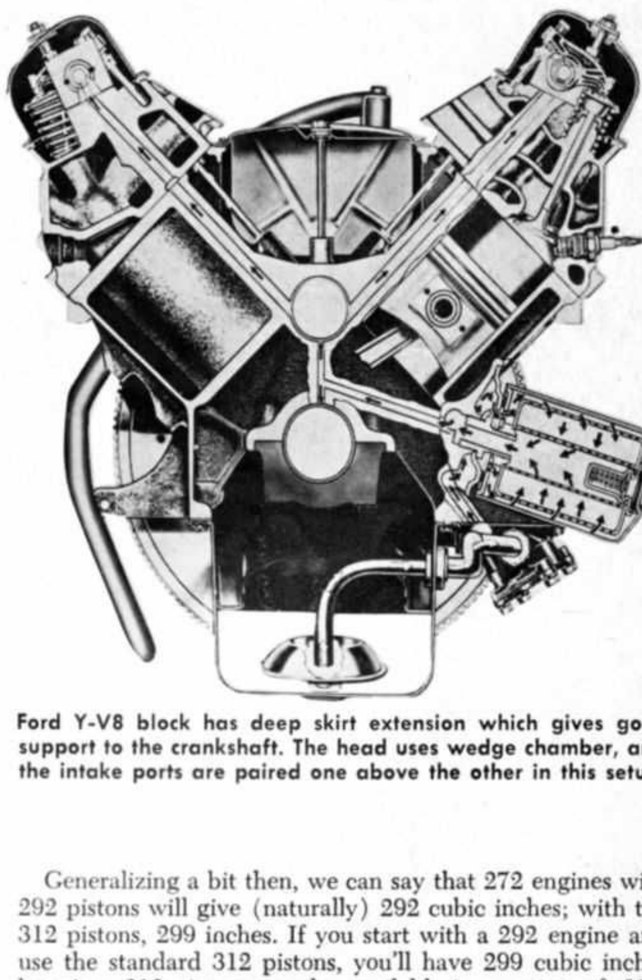
Many of the parts used in the manufacture of the latest 292-inch engines are for all practical purposes identical to the first 292 made in 1955 although part numbers differ. For example, the '55 292 block number was B5A 6010-A and the '62 block number is B5AE 6010-B, which also happens to be the replacement block for 1955 cars. The latest 292 connecting rods are replacement items for '55 272-292 and even the '54 239 engines with rod weight, length and bores the same for all years.

The only real difference between 272 and 292-inch engines during the years both were made, 1955-57, was in the bore size. The 292 used an ⅛-inch larger bore so the block water jacket cores were changed in manufacture to provide the desired .170 inch minimum wall thickness around each cylinder. 272 engines can be safely bored the extra ⅛-inch and 292 pistons installed with no problems. Both engines use the 3.30-inch stroke crankshaft, rods are the same, piston pins are the same, bearings are the same, etc. Piston weights were the same for both piston sizes too in 1955 and '56, so rebalancing the engine would not be necessary when enlarging the 272 to 292 if these pistons were used. 1957-62 292-inch pistons each weigh almost an ounce more, so if these are used in a 272 engine the crank assembly should be rebalanced.

In 1956 and '57, Ford's top engine option was a 312-inch version of the Y-block V8. Bore was enlarged .050-inch to 3.800 and stroke was an extra .140 (3.440). Here, the only difference between the 312 block and the 292 is the extra bore size and larger main bearing bores. Water jacket coring is the same as the 292 so with .050 larger bore, minimum wall thickness is .145-inch. The crankshaft had the longer stroke of course, but also used ⅛-inch larger main bearings. Theoretically, this should preclude anybody trying to use the 312 crankshaft in a 272 or 292 block but we have seen a few instances where it has been done and with relatively little trouble. A quick trip to a crankshaft grinding shop and the removal of the excess material needed to bring the main journals down to 272-292 size, and the 312 crankshaft will drop in place.

When the stroke of an engine is increased and the block height not changed, one of two things must be done to compensate. Either the pin hole in the piston must be moved up one-half the length of the stroke increase or the connecting rods must be shortened one-half the length of the increase. Ford shortened the connecting rods when they lengthened the stroke for the 312 engine. They are .070-inch shorter than 239-272-292 rods and an ounce lighter.

292 blocks will easily bore the extra .050-inch to accept 312 pistons and even the 272 could probably be bored the extra .175-inch, although general practice is to limit overbores to ⅛-inch. Many cylinder blocks will take 3/16-inch overbore. Should you wish to play safe or maybe keep expenses down, the original 272 or 292 pistons can be used with the 312 crankshaft if the shorter 312 rods are also used and the crankshaft assembly rebalanced.

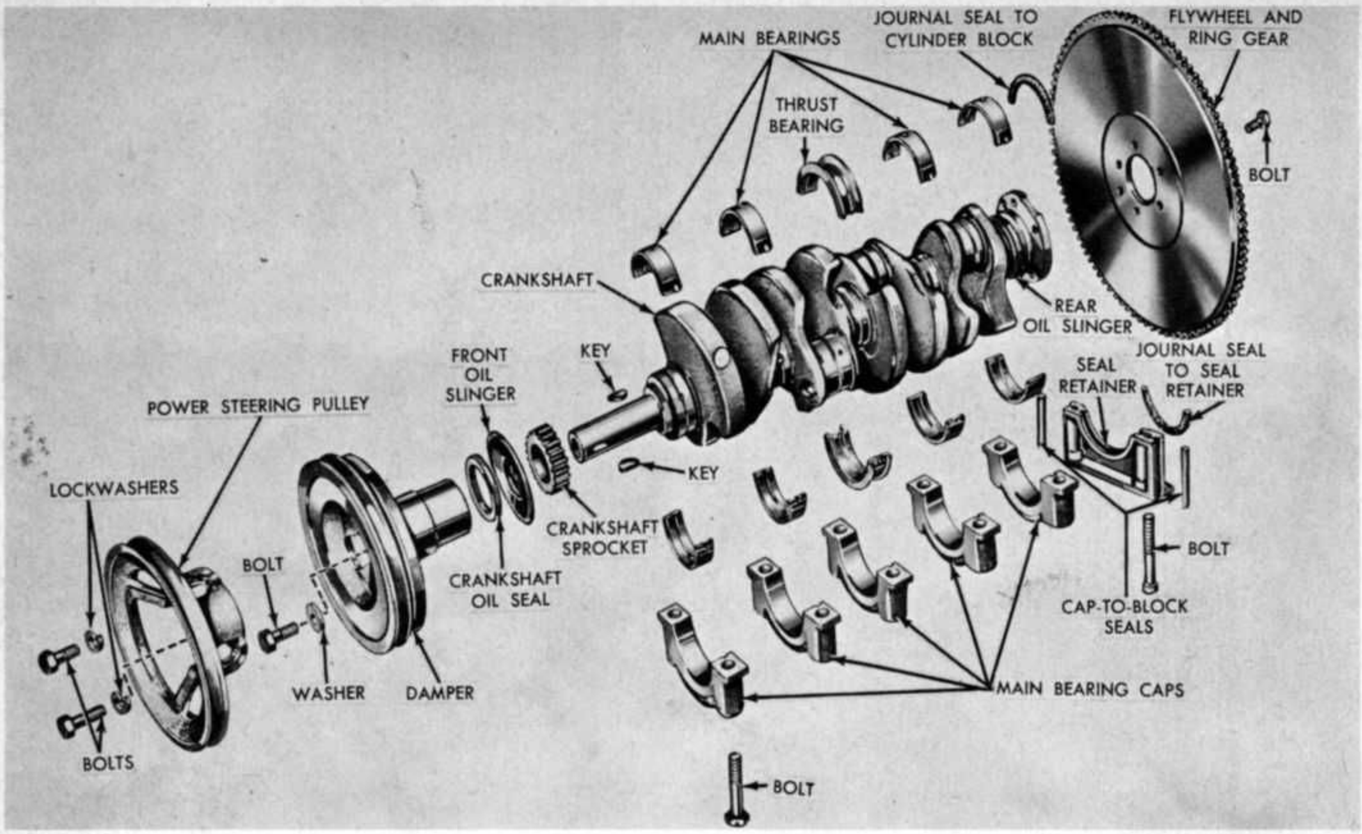


Ford Y-V8 block has deep skirt extension which gives good support to the crankshaft. The head uses wedge chamber, and the intake ports are paired one above the other in this setup.

Generalizing a bit then, we can say that 272 engines with 292 pistons will give (naturally) 292 cubic inches; with the 312 pistons, 299 inches. If you start with a 292 engine and use the standard 312 pistons, you'll have 299 cubic inches but since 312 pistons are also available in oversizes of .010, .020, .030 and .040, why not go for the .040-inch over standard 312 piston with the 292 block and bore .090 for a new bore size of 3.840? Combined with the 292 stroke of 3.30 inches, the new displacement will be 305.5 cubic inches. Each 312 piston is 2 ounces heavier that '55-'56 292 pistons and 1.1 ounces heavier than '57-'62 292 pistons so the whole crank assembly would need to be rebalanced.

CYLINDER HEADS

With the 239-inch '54 Y-block engine, there was only one horsepower rating offered for all model cars, regardless



Nodular iron crankshaft for Y-V8 engines are cast, have precision counterweight placement for proper balance.

of transmission used. This meant one compression ratio and one cylinder head. The next year, 1955, both the 272- and 292-inch engines were introduced with a total of four horsepower ratings and three compression ratios. Cylinder heads with three different chamber volumes were used. One head gave 7.6:1 compression with the 272 displacement and 8.1:1 when used on the 292-inch engine. A second head gave 8.5:1 with the 272 engine and a third head was needed to get 8.5:1 with the 292 engine.

In 1956, the 312 was added to the line, giving three different size V8 engines. Matched to these engines with various forms of carburetion were cylinder heads with four different chamber volumes. Out of this wedlock came Y-block V8's with eight different horsepower ratings. 272 engines were available with 8.0 or 8.4 compression ratios; 292 engines came with ratios of 8.0, 8.4 or 9.0; and the 312's also had ratios of 8.0, 8.4 or 9.0:1. Fortunately, casting marks on the lower corners of the heads as well as beneath the rocker cover identified just which cylinder head was being used. By checking the chart on page 19, you can determine engine year and by a bit of simple detective work regarding carburetion and type of transmission used, the original horsepower can be deduced. There will often be more than one part number shown but numbers are grouped together by chamber sizes.

By 1957, Ford had obviously decided that four different cylinder volumes in one model year was a bit confusing so they made one cylinder head volume only for standard production V8's and let the three engine sizes solve the problem of compression ratio in their own way. The chamber volume of the '57 head produced 8.6:1 when used on the 272 engine; 9.1:1 on the 292 engine; and 9.7:1 on the Thunderbird Special 312-inch engine.

There was an additional engine which had a separate cylinder head all its own; the 300 horsepower supercharged 312. Not too many of these engines were built so chances of stumbling across these heads are remote. The supercharger heads had a larger chamber than the standard '57 head to lower compression to 8.3:1 for use with the Paxton centrifugal supercharger. Another change in these heads involved water jacket core changes, providing additional support over the cylinder area to prevent blown head gaskets with the extreme pressure supplied by the blower.

In 1958 and '59, the cylinder head used with the 292-inch V8 was the same as for standard '57 engines. Compression ratio was advertised at 8.8:1. For 1960 and '61, a new cylinder head was used which incorporated smaller intake valves and smaller ports designed to increased volumetric efficiency for improved economy. Compression for the '60-'61 heads remained at 8.8:1. Again in 1962, compression was listed at 8.8:1 for the 292 engine but a change was made in cylinder heads. The latest head is identical to the '60-'61 head in all physical dimensions but has minor differences which require a new part number.

The path of development taken by the Y-block V8 over the past nine years is quite unusual when compared to other engines. It has been common practice over the years to introduce a new engine with room for expansion in the basic design. As demands for power increase come along, displacement is increased and, when the engine can no longer be enlarged to meet the demands, it is dropped and a new engine takes its place. This is essentially what took place in 1958 with the Y-block but instead of Ford dropping the engine after reaching a maximum displacement of 312 inches, they dropped back to 292 inches and turned it into an economy model.

At this point, nothing unusual is apparent but as you follow the Y-block V8 from 1958 to 1962, you note that the engine has been "detuned" to improve economy. The intake valve diameter is approximately .280-inch smaller in

'62 than in 1957, ports are smaller, valve timing is much milder and only a two-barrel carburetor is offered where once dual four-barrels and even superchargers were optional. From a maximum power rating of 300 in 1957, the Y-V8 has gradually been "economized" to a rating of 170 hp in 1962. This leaves us with a strange arrangement; if you wish to improve the performance of a late model Ford with 292-inch Y-block engine, your best chances are with parts from the "golden year" of 1957.

VALVES AND CAMSHAFTS

When first introduced in 1954, the Y-V8 had intake valves with a head diameter of 1.647 inches. The following year when the 272-292 engines came along, intakes were enlarged to 1.780. In 1957, performance was much in demand and Ford used 1.925-inch intake valves in the Y-V8 heads. This 1.925-inch valve was retained until 1959. In 1960, the intake valve was dropped back to the diameter originally used in 1954, 1.647 inches. Through all of the ups and downs of the intake valve, the exhaust valve has been unchanged in size and is the same in 1962 as it was in 1954, 1.510 inches. Porting has gone along the same pace as the valves so is best, from a standpoint of performance, on '57-'59 cylinder heads.

Camshafts and rocker arm ratios have also been changed around a bit over the years to get the desired performance, or economy as the case may be. The early '54 engines used a camshaft with ⅛-inch larger bearings than late '54 engines so none of the late camshafts can be used in this block. Cam bearing size for later '54 engines is the same as engines up to and including 1962. Late '54 and '55 camshafts used holes in the center cam journal to feed oil to the rocker arm shaft. In 1955, a groove around the center cam journal replaced the holes and a different center cam bearing was used. The later model camshafts will fit in late '54 and all '55 blocks but the late center cam bearing should also be used to prevent excessive rocker arm oiling.

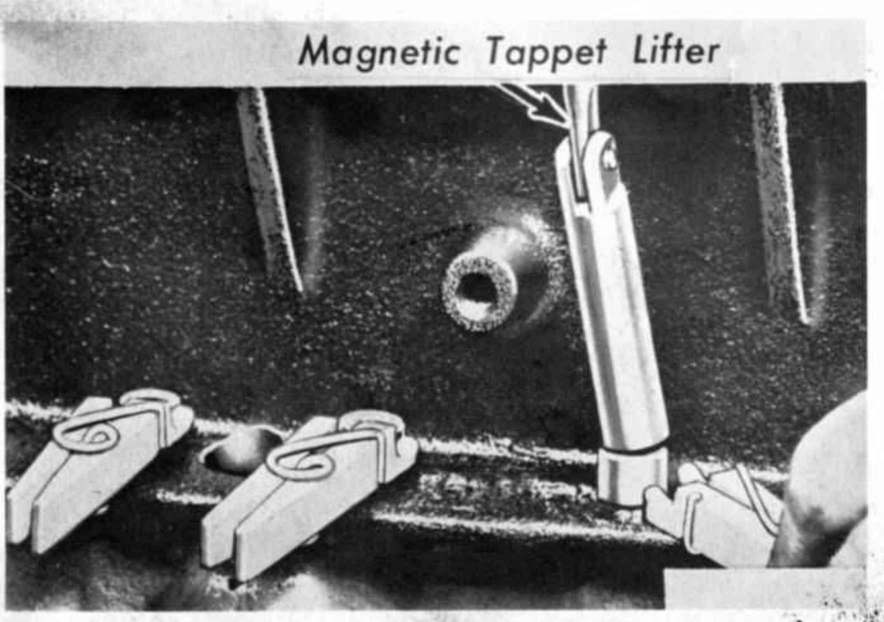
In terms of valve timing, the early '54 camshaft was quite mild and since later camshafts cannot be used in this block anyway, we'll forget it right here and now. The camshaft for late '54 engines was also retained for 1955 engines, and coupled with the larger '55 displacement, improved rated horsepower from 130 to 162 hp. Other versions of the same engine with more compression and increased carburetion registered as much as 198 hp.

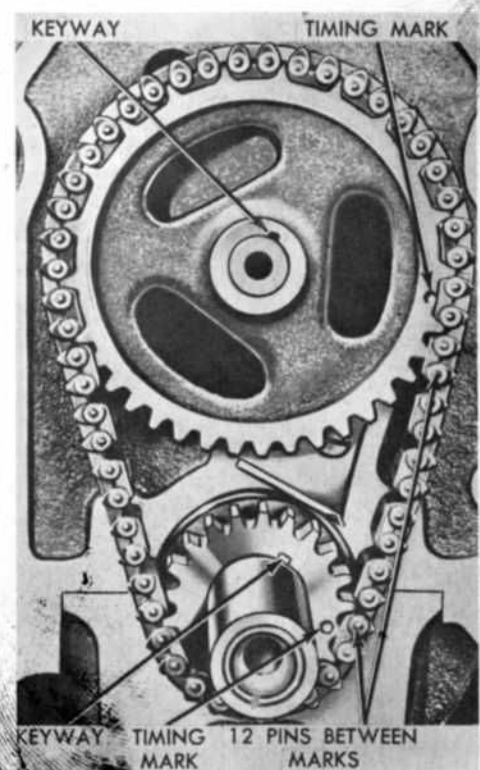
For 1956, the same camshaft timing was retained but a new part number assigned the cam which had been grooved around the center journal. Also, for '56 engines, a new rocker arm was used which had a ratio of 1.54:1 compared to the 1.43:1 used in '54 and '55. With the higher lift rocker arm, effective lift at the valve was increased approximately .025-inch with the same camshaft timing.

A new camshaft with longer duration and increased lift was used for all the '57 engines with the exception of the supercharged 312. This cam also used the high-lift 1.54 rocker arms and produced a very good combination, especially with the larger intake valve and higher compression used in 1957. Later Y-V8 engines returned to the 1.43 rocker arms and later parts manuals substitute the 1.43 rockers in place of the 1.54 when replacement is needed on '56-'57 engines. So, if you want to take advantage of the extra lift ratio on a late engine, you must locate the original part, number B6A 6564-A or B6A 6564-C. All superseding numbered rockers are 1.43:1.

The 1957 camshaft was the most extreme version ever offered with the Y-V8 engines, offering lift in excess of .400 at the valve and 256° duration. This camshaft in combination with the 1.54 rocker arms would definitely be the best bet for someone wishing to get top performance from a Y-V8. The '57 camshaft part number was B7A 6250-B. Late parts books will reveal that B8A 6250-C now supersedes the B7A camshaft but this is a 1958 version with less lift and less duration.

300 horsepower supercharged 312 engines were produced in 1957 and, although they were only built for a small portion of the model year, quite a few of them were purchased by the public. The camshaft used for this engine was purchased by Ford from an outside source but has the '57 part number B7A 6250-C. This camshaft had longer duration than the standard camshaft, was quite expensive to purchase and had a habit of wearing fast so they were often replaced by the standard '57 grind.





ABOVE—Lifters for Y-V8 and Ford six are installed from the bottom of the engine so they must be held in the block when changing camshaft. RIGHT—For Y-V8 and Ford six, timing marks do not align, but have 12 pins of timing chain between marks.

In 1958, the B8A 6250-C camshaft was used in the 292 engine together with the 1.43 rocker arms. The same cam is used in the 1962 292-inch Y-V8. This camshaft has the same specifications as the 1956 camshaft and late parts books call for it to supersede all earlier cams back to and including 1956. Except for the grooved center journal, they would also supersede late '54 and '55 camshafts.

So, if you are looking for maximum performance with your Y-block V8, the best bet in camshafts is the B7A 6250-B with 1.54 rockers. Next would be the B8A 6250-C with 1.54 rockers. In cylinder heads, the B7A 6049-A offers the larger intake valve and minimum chamber volume for maximum compression. These heads were used on '57 through '59 engines of all displacements. Avoid the supercharger heads with lower compression unless, of course, you plan to run a supercharger.

CARBURETION

As the demands of displacement, horsepower and economy have fluctuated throughout the life of the Y-V8 engine, so have the various types of carburetion. In 1954, a single two-barrel carburetor was offered on the 239-inch engine. The next year, 1955, either two-barrel or four-barrel carburetors were used. Again in 1956, two-barrel and four-barrel carburetors were used. In 1957, you could have your choice of two-barrel, four-barrel, dual four-barrel or supercharged four-barrel.

There have been numerous intake manifolds produced by Ford to cover all of the applications mentioned. As intake valve and port sizes were changed during the early years of the Y-V8, a matching intake manifold was needed for each type of carburetor used. By 1957, maximum valve and port size had been reached, so in theory at least, the '57 intake manifold should be the best for maximum performance. The single four-barrel manifold was part number B7A 9424-B, the dual four-barrel manifold was B7A 9424-D. The only basic difference between the manifold used with the supercharger and the regular four-barrel manifold was larger throttle bores in the former.

All of these manifolds just mentioned can be used with the large valve heads of 1957-'59. Two-barrel intake manifolds of the same years are also interchangeable. 1960 or later cylinder heads have smaller intake ports so will not readily adapt to the earlier manifolds.

Only two-barrel carburetors have been used on the 292-inch Y-V8's since 1958 so four-barrels from 1957 engines are the best bet if you are searching for maximum power. Carter, Holley and Ford four-barrels were used on 1957 312-inch engines and all are of approximately equal airflow capacity. If you wish to use the supercharger, the proper carburetor, air box and supercharger must be used as a unit. Special metering is required in the supercharger carburetor. For information or repairs on the '57 superchargers, contact Paxton Products, Santa Monica, California.

IGNITION

Prior to 1957, the distributor used on Y-V8 engines did not have mechanical (centrifugal) advance. A balanced vacuum system like that used on OHV Ford sixes provided the signal to a vacuum diaphragm on the distributor which advanced the spark as engine conditions changed. In 1957, a new type of distributor was adopted, one which is similar to that used by most other manufacturers. Centrifugal weights advanced spark as engine rpm increased and a vacuum diaphragm gave desired advance for cruising operation.

Several different model distributors were used in 1957, one for two-barrel carbureted engines, another for four-barrel, still another for dual four-barrels and a fourth for supercharged engines. The first three had both mechanical and vacuum advance, the fourth only mechanical. Advance curves for '57 and '58 distributors call for a total of 36° crankshaft advance in the centrifugal mechanism of 272-292 engines, 26° for 312 engines. In 1959, the 292 used 30° centrifugal and from 1960 to '62, the total centrifugal advance is 24°. Vacuum advance for all '57 and later distributors is approximately 24° at 20 inches manifold vacuum.

Similarity of the advance curves within these later distributors indicates that they are fairly interchangeable among each other. 1957 and later distributors can be used on pre-'57 engines but a '57 or later carburetor should also be used to get full manifold vacuum when the throttle is partially open, instead of the balanced vacuum system used prior to '57.

FORD Y-V8's

YEAR	MODEL & TRANSMISSION	BORE & STROKE	DISPLACEMENT	COMP. RATIO	CARBURETION	HP @ RPM	TORQUE @ RPM
1954	A	3.500 x 3.100	239	7.2	2-bbl.	130 @ 4200	214 @ 1800
1955	A	3.625 x 3.300	272	7.6	2-bbl.	162 @ 4400	258 @ 2200
	A Special	3.625 x 3.300	272	8.5	4-bbl.	182 @ 4400	268 @ 2600
	S (S/T)	3.750 x 3.300	292	8.1	4-bbl.	193 @ 4400	280 @ 2600
	S (F/M)	3.750 x 3.300	292	8.5	4-bbl.	198 @ 4400	286 @ 2500
1956	A (S/T & O/D)	3.625 x 3.300	272	8.0	2-bbl.	173 @ 4400	260 @ 2400
	A (F/M)	3.625 x 3.300	272	8.4	2-bbl.	176 @ 4400	264 @ 2400
	A (S/T & O/D)	3.750 x 3.300	292	8.0	4-bbl.	200 @ 4600	285 @ 2600
	A (F/M, S (S/T)	3.750 x 3.300	292	8.4	4-bbl.	202 @ 4600	289 @ 2600
	A, S (O/D)	3.800 x 3.440	312	8.4	4-bbl.	215 @ 4600	317 @ 2600
	A, S (F/M)	3.800 x 3.440	312	9.0	4-bbl.	225 @ 4600	324 @ 2600
1957	A	3.625 x 3.300	272	8.6	2-bbl.	190 @ 4500	270 @ 2700
	A	3.750 x 3.300	292	9.0	2-bbl.	212 @ 4500	297 @ 2700
	S (S/T & O/D)	3.750 x 3.300	292	9.0	2-bbl.	206 @ 4500	297 @ 2700
	A, S (F/M)	3.800 x 3.440	312	9.7	4-bbl.	245 @ 4500	332 @ 3200
	A, S (S/T & O/D)	3.800 x 3.400	312	9.7	2 4-bbl.	265 @ 4800	336 @ 3400
	A, S (S/T & O/D)	3.800 x 3.440	312	8.3	4-bbl. Supercharged	300	
1958	A	3.750 x 3.300	292	8.8	2-bbl.	205 @ 4500	295 @ 2400
1959	A	3.750 x 3.300	292	8.8	2-bbl.	200 @ 4400	285 @ 2200
1960	A	3.750 x 3.300	292	8.8	2-bbl.	185 @ 4200	292 @ 2200
1961	A	3.750 x 3.300	292	8.8	2-bbl.	175 @ 4200	279 @ 2200
1962	A	3.750 x 3.300	292	8.8	2-bbl.	170 @ 4200	279 @ 2200

Models: A, Passenger cars; S, Thunderbird. Transmissions: S/T, Standard; O/D, Overdrive; F/M, Fordomatic.

FORD Y-V8 CAMSHAFTS

YEAR	ENGINE	PART NUMBER	VALVE TIMING IO	IC	EO	EC	DURATION	LIFT INT.	EX.	LASH (HOT)	VALVE SIZE INTAKE	EXHAUST	ROCKER RATIO
1954	Early 239	B4A 6250-A	8°	44°	47°	5°	232°	.345	.345	.019	1.647	1.510	1.43
	Late 239	B5A 6250-C	12°	54°	58°	8°	246°	.360	.360	.019	1.647	1.510	1.43
1955	272, 292	B5A 6250-C	12°	54°	58°	8°	246°	.360	.019	.019	1.780	1.510	1.43
1956	272, 292, 312	B6A 6250-B	12°	54°	58°	8°	246°	.386	.384	.019	1.780	1.510	1.54
1957	272, 292, 312	B7A 6250-B	18°	58°	66°	10°	256°	.400	.420	.019	1.925	1.510	1.54
	312 Sup'r'chd	B7A 6250-C	32°	78°	78°	32°	290°	—	—	—	1.925	1.510	1.54
1958-59	292	B8A 6250-C	12°	54°	58°	8°	246°	.360	.360	.019	1.925	1.510	1.43
1960-62	292	B8A 6250-C	12°	54°	58°	8°	246°	.360	.360	.018	1.647	1.510	1.43

Note: Camshaft B8A 6250-C supersedes B6A 6250-B and B7A 6250-B when replacement is needed.

FORD Y-V8 CYLINDER HEADS

YEAR	ENGINE	HORSE-POWER	MODEL & TRANSMISSION	PART NUMBER	CASTING MARK
1954	239	130	A	B4A 6049-G	EBU-F, EBU-G
1955	272 292	162 193	A, S (S/T & O/D)	B5A 6049-D B5A 6049-H B5A 6049-D	ECL-A ECG-B ECG-D
	272	182	A (F/M)	B5A 6049-G B5A 6049-L	ECG-A ECG-C
	292	198	S (F/M)	B5S 6049-A B5S 6049-B	ECL-B ECL-C
1956	272 292 312	173 202 225	A (S/T & O/D) A (F/M), S (S/T) A, S (F/M)	B6A 6049-M	ECZ-C, ECG-T
	272	176	A (F/M)	B6A 6049-N	ECG-H, ECG-R
	292 312	200 215	A (S/T & O/D) A, S (O/D & F/M)	B6A-6049-P	ECZ-B, EDB-B
1957	272 292 312	190 206, 212 245, 265	A A, S (S/T & O/D) A, S	B7A 6049-A B7A 6049-D	ECZ-E, 5752113 ECZ-F
	312	300	A, S (Sup'r'chd)	B7A 6049-E	EDB-D, EDB-E
1958	292	205	A	B7A 6049-A	ECZ-E, 5752113
1959	292	200	A	B7A 6049-A	ECZ-E, 5752113
1960	292	185	A	COAZ 6049-A	
1961	292	175	A	COAZ 6049-A	
1962	292	170	A	C1AZ 6049-A	

Models: A, Passenger car; S, Thunderbird. Transmissions: S/T, Standard; O/D, Overdrive; F/M, Fordomatic.

FORD Y-V8 CRANKSHAFT ASSEMBLY

YEAR	ENGINE	BORE & STROKE	JOURNALS MAINS	RODS	ROD LENGTH CENTER-CENTER	ROD WT.	PISTON WT.	PIN LGTH.
1954	239	3.500x3.100	2.498	2.188	6.324	24.06	—	2.982
1955	272	3.625x3.300	2.498	2.188	6.324	24.06	18.70	3.023
	292	3.750x "	"	"	"	"	"	"
1956	272	3.625x "	"	"	"	"	"	"
	292	3.750x "	"	"	"	"	"	"
	312	3.800x3.440	2.623	"	6.252	23.04	20.7	"
1957	272	3.625x3.300	2.498	"	6.324	24.06	18.7	"
	292	3.750x3.300	"	"	"	"	19.6	"
	312	3.800x3.440	2.623	"	6.252	23.04	20.7	"
1958-1962	292	3.750x3.300	2.498	"	6.324	24.06	19.6	"

Exhaust manifolds for the Y-V8 reached their peak of efficiency in 1957 like so many of the other engine parts. Both single and dual exhaust systems have been used on Y-V8 engines since 1955. The first year only a single exhaust was offered. Single exhaust systems used in '55 and '56 had a crossover pipe from the left side manifold to the right side manifold. The outlet in the left manifold was at the front of the engine and the crossover pipes traveled over the top front of the engine to the right side where it entered the front of the manifold. The single exhaust system then tied into the rear of the right manifold.

Dual systems used manifolds on either side of the engine with outlet flanges angled downward at the rear of the engine. All of the manifolds used during the various years are interchangeable as far as bolt pattern but those used on 1957 312-inch engines have the largest area so are more desirable as performance items. Most of the exhaust manifolds used between 1957 and 1960 will provide fairly good exhaust flow.

By now you should have a pretty good idea of how to swap parts around if you have a 272- 292- or 312-inch Ford Y-V8 and want to get the maximum available power from stock factory components. Or, maybe you want economy? In that case pick out pieces from the economy models. Ford's Y-V8 has covered a lot of miles throughout the world and has a reputation for reliability even when badly abused. In 1957, Y-V8 Fords were nearly unbeatable in stock car races with the supercharged 312; today, the V-V8's are providing thrifty operation in the full-sized classification. With the flexibility already proven in this engine, who knows how long it will be a regular member of the Ford family?

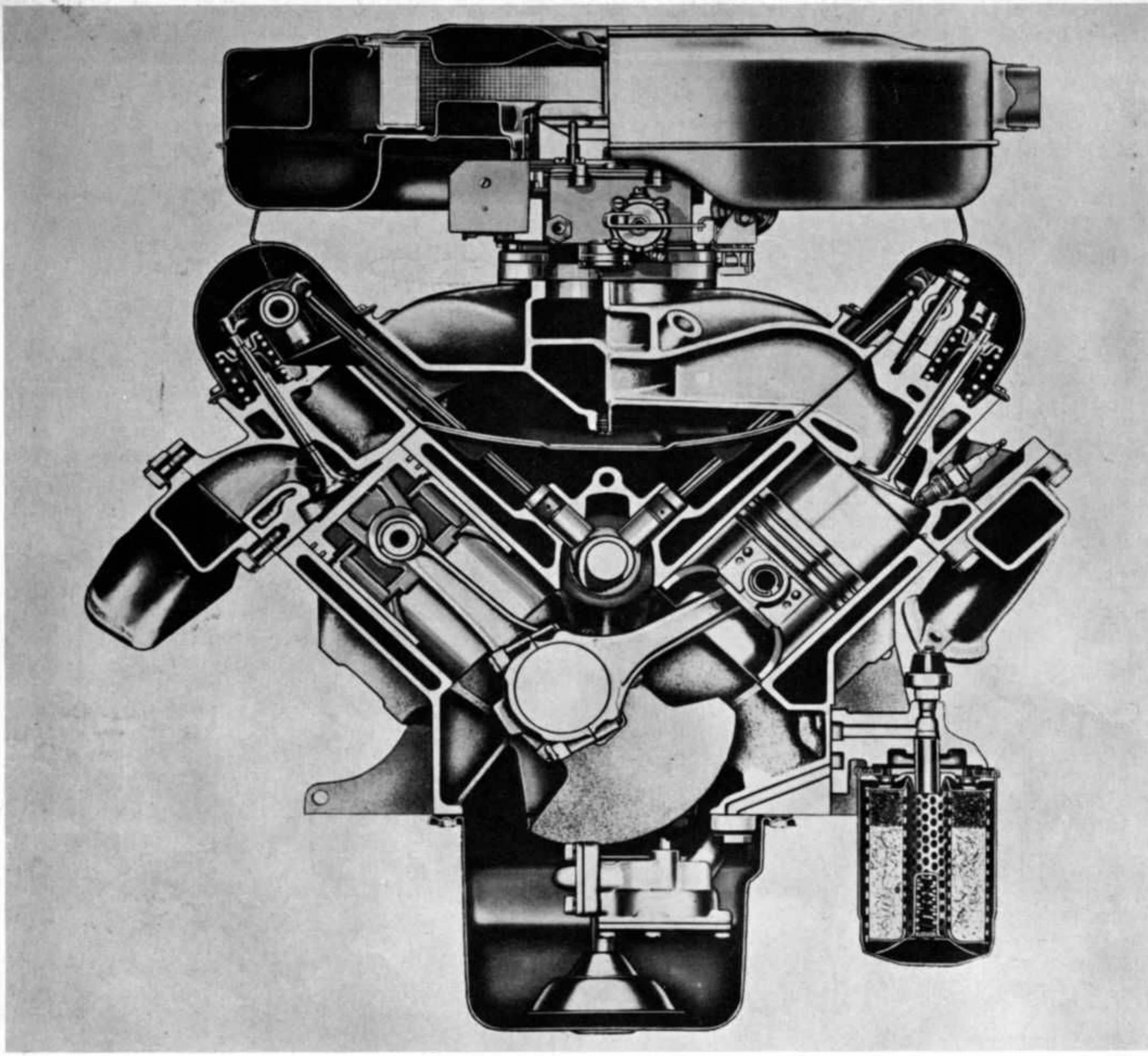
FORD'S BIG V8

In the preceding section discussing Ford's Y-V8 engines, we pointed out that this series reached its peak in 1957 with 312-inch engines using multiple carburetion and even superchargers to produce as much as 300 horsepower. In 1958, the Y-V8 was relegated to the position of an economy engine while a new, larger displacement V8 engine took over the performance title.

The new engine differed in many ways from the Y-V8 but it was also a Y-block, meaning that the block bottom skirt extended below the centerline of the crankshaft for maximum support to the main bearing webs. Since the overhead valve V8's prior to 1958 were referred to as Y-blocks long before the new engine came along, we will leave the term Y-V8 strictly to those engines with displacements of from 239 to 312 cubic inches and hereafter refer to the series introduced in 1958 as the "Big V8."

The big V8 was introduced with two displacements for '58 Ford cars, 332 and 352 cubic inches. The 352-inch engine was the standard powerplant for Thunderbirds and optional for Ford passenger cars. Two 332-inch models were optional for passenger cars. Both size engines had the same bore, 4.00 inches, but the 332 stroke, 3.30 inches, was .200 shorter than that of the 352, 3.50 inches. A two-barrel carburetor was used on one 332, a four-barrel on the other and the compression ratio for both was 9.5:1. The rating for the two-barrel 332 was 240 hp at 4600 rpm, for the four-barrel 332, 265 hp at 4600 rpm. The first had 340 lbs./ft. of torque at 2400, the latter 360 pounds of torque at 2800 rpm. The 352 engine used a four-barrel carburetor, 10.2:1 compression and was rated 300 hp at 4600 with 395 lbs./ft. of torque at 2800 rpm.

Again in 1959 the two-displacement big V8 engines were offered but compression was lowered slightly and a two-barrel carburetor only was used on the 332. The '59 332 engine had 8.9:1 compression and was rated 225 horsepower at 4400 and 325 lbs./ft. of torque at 2200 rpm. Compression was also dropped on the 352-inch engine, from



Cross section of 332-390 mill. The 406 is similar except that it uses adjustable rocker arms. Y-block gives rigid crankcase design.

10.2 down to 9.6, and although the horsepower rating was still 300, torque rating was dropped slightly to 380 at 2800 rpm.

The years of 1958 and 1959 were not strong years for Ford in the field of high performance. An Automobile Manufacturers Association edict in mid-1957 called for the abolition of factory-sponsored race teams that existed during the '55-'57 era. Ford complied too well and although the 352-inch V8 offered in '58-'59 had the same rated horsepower as the 300 horsepower supercharged 312-inch Y-V8, a large gap existed between the two in performance. Actually, the big gap was the result of the 352 being overrated while the blown-312 was underrated.

While Ford had the two "mild" horsepower years, some of their competitors were interpreting the AMA ruling with a little more freedom and producing some potent engines which appealed to performance enthusiasts. By the 1960 model year, Ford's engineers had been given the green light to develop a high performance power option for Ford cars and they answered the challenge with a 360-horsepower version of the 352-inch V8. At the same time, two milder versions of the 352 were also produced as standard passenger car and T-Bird engines. One had a two-barrel carburetor, 8.9:1 compression and 235 horsepower. The second used a four-barrel carburetor, had 9.6 compression and was rated at 300 horsepower.

For 1961, the two-barrel 352 was retained but power rating was lowered slightly to 220. The standard T-Bird engine and option for passenger cars had been bored .050-inch to 4.050 and the stroke lengthened .280-inch to 3.780, giving a displacement of 390 cubic inches. In addition to these two engines in the "big V8" family, a pair of high performance options were also offered for passenger cars. One was rated 375 horsepower with a four-barrel carburetor and the other 401 hp with three two-barrel carburetors.

Again in 1962, two "mild" big V8 engines were offered and their ratings were the same as in 1961, 220 hp for the 352 engine and 300 hp for the 390-inch V8. Early in the 1962 model year, two high performance versions of the 390 engine were produced and their ratings were the same as in 1961, 375 and 401 horsepower. Shortly after January, 1962, the 390-inch high performance engines were replaced by a version that had .080-inch larger bore and 406 cubic inches. With the larger displacement, horsepower ratings were also increased to 385 for the four-barrel engine, 405 for the one with triple carburetion.

As you are no doubt aware, Fords equipped with optional high performance engines produced in 1960, '61 or '62 are very lively cars. Ford regained a reputation for performance that slipped badly during 1958-59. Of special interest to performance enthusiasts who own '58-'62 cars with the big V8 engines is the fact that many of the parts from the latest high performance engines are interchangeable and can be used on the earlier 332 and 352 engines. If you desire improved performance but don't have the funds to go completely modern, or if you like your pre-'62 Ford so much you just don't want to part with it, take a look at what you can do with stock parts available through any Ford dealer's parts department.

CYLINDER BLOCKS

With both the 332- and 352-inch engines introduced in 1958 using a bore size of 4 inches and main bearing journals the same size, the same block was used for both engines. Minimum cylinder wall thickness for these blocks was .170-inch and maximum oversize pistons offered by Ford were .060-inch. It is quite common, however, to bore oversize as much as .125 or ⅛-inch with wall thickness such as Ford uses since only half of the extra bore applies to each wall. In the case of .125-inch overbore, only .0625 would be subtracted from the original .170 wall, leaving a minimum wall thickness of .1075-inch. A wall this thick is generally considered safe.

We point out the wall thickness of the stock 332-352 engine and what would happen if these engines were bored oversize because many of you might be interested in using piston and crank assemblies from 390- or even the 406-inch Ford engines. The 390 has a 4.050-inch bore, just .050 more than the 332-352 and the 406 has a 4.125-inch bore, ⅛-inch more than the 332-352.

For all practical purposes, the 332, 352 and even the 390 engine blocks used for standard passenger car engines are the same. High performance 390- and 406-inch engines use a beefed-up block with revised oil galleries and main bearing webs. As mentioned earlier, the cast iron block is of "Y" design, denoting the bottom skirt extends well below the crankshaft centerline. Extra ribbing ties into the main bearing webs from this skirt extension to provide a stiffer crankcase and prevent crankshaft distortion. Steel main bearing caps are used.

The oil pump bolts to the block skirt at the front left corner of the engine and is driven by a hex-shaped shaft that engages the bottom of the distributor. The pump body is die-cast aluminum and of rotor-type design. A spring-loaded pressure-relief valve in the oil pump housing by-passes pressure in excess of approximately 55 psi on 332, 352 and standard 390 engines. A fixed pickup tube extends from the pump to a point close to the bottom of the front-positioned sump in the oil pan. From the block flange where the pump assembly bolts in place, large capacity oil passages route the oil throughout the engine.

The first spot visited by the oil after leaving the pump is the full-flow filter unit which bolts to the lower left front of the block. After passing through the throw-away filter cartridge, the oil then enters the main oil gallery passages. The main oil gallery feeds the various parts of the engine in the following order: Number one main bearing, number one cam bearing and the distributor drive extension bushing; the main gallery along the floor of the tappet chamber then feeds cam bearing #2, the left head rocker assembly and main #2; cam #3 and main #3; cam #4, the right head rocker assembly and main #4; the two side galleries which bisect the lifter bores; and #5 cam and #5 main bearing. Oil from each of the main bearings flows through grooved upper main inserts to holes drilled in the crankshaft main journals and then on to the rod journals.

During the first year Ford transformed this basic engine into a high performance model, 1960, blocks used for the 360-hp engine were standard assembly line 352 blocks except that they were dye-checked to eliminate any possible small cracks. The only difference between the lubrication system for the high performance 352 and the standard 352 was a heavier pressure-relief spring, giving an extra 10 pounds oil pressure (65#) for the high performance V8. Also, the small "jiggle pin" at the front of the main oil galley which lubricated the timing chain and sprockets was replaced with a plug using a metered orifice. The jiggle pin used in '59 and later standard big V8's has a flutter valve to bleed air from the oil before it can reach hydraulic lifters and also lubricates the timing cover parts. The plug with metered orifice gives better oil control to the sprockets than the jiggle pin.

1961 390-inch high performance V8's and the '62 406-inch version did not use standard production cylinder blocks. They differ in many ways and the quality control is very precise. First of all, an entirely different set of patterns is used when casting these blocks. The bulkheads or main bearing webs between cylinders, are thicker and have extra reinforcing ribs to eliminate any possibility of bottom end flex. An extra boss is also cast between the fourth and fifth bulkheads just below the main oil gallery which runs along the floor of the lifter chamber.

This extra boss houses an oil pressure relief valve which is normally used only in the oil pump. The reason for this new location is that it places the pressure relief at the far end of the oil system to ensure adequate pressure to the entire engine. The pressure relief valve and spring fit into a bore in this new boss and a passage connects the main oil gallery to the new valve location with a 75 psi pop-off pressure. A plug in the rear of the block behind the flywheel keeps the valve and spring in place. Excess oil pressure through the valve is exhausted down over the rear of the camshaft and into the oil pan.

A pressure-relief valve is also retained in the oil pump but this one operates only on cold starts. It is set for 105 psi so that pressure over this figure will be bypassed back to the inlet side of the pump. In extremely cold weather starting, oil pressure will often exceed 150 psi and, without a pressure relief at the pump, could pop gaskets at the oil filter. All oil passages in these high performance blocks have been enlarged to aid distribution and, since hydraulic valve lifters are not used in this model, the oil galleries that run the length of the lifter bores on each side of the engine are blocked off completely. Like the 352-inch high performance engine, the jiggle pin is replaced by a metered plug.

Not only are the engine blocks special castings, they also must pass a thorough dye check before assembly starts to make sure that there are no cracks or weak spots. Minute cracks which would never cause trouble in 100,000 miles of regular passenger car use result in an immediate reject on the special assembly line. A couple of changes in the block which are also used in '61-'62 regular production engines are a redesigned rear bearing oil slinger groove and a change in head bolt holes. The oil slinger groove has closer tolerances to strip oil from the slinger on the crankshaft and larger passages in the rear main cap to return the oil to the pan.

Threads in the block for cylinder head cap screws were formerly chamfered to prevent the block surface from mushrooming up and possibly causing gasket trouble. All '61 and '62 big V8 engines use a method whereby an oversize bore for about the first half-inch of depth takes the place of the old-style chamfer and allows the head cap screws to place hold-down strain deeper into the block where there is more strength. This prevents block warpage and helps eliminate blown head gaskets.

Standard 332, 352 and 390 engine blocks cannot be modified to use the pressure bypass at the end of the oil gallery but this pressure relief device was installed strictly for sustained high rpm operation such as that encountered at Daytona or other high speed race tracks, so lack of this relief valve should not be cause for concern by the average Ford owner using his car in competitive events.

CRANKSHAFT

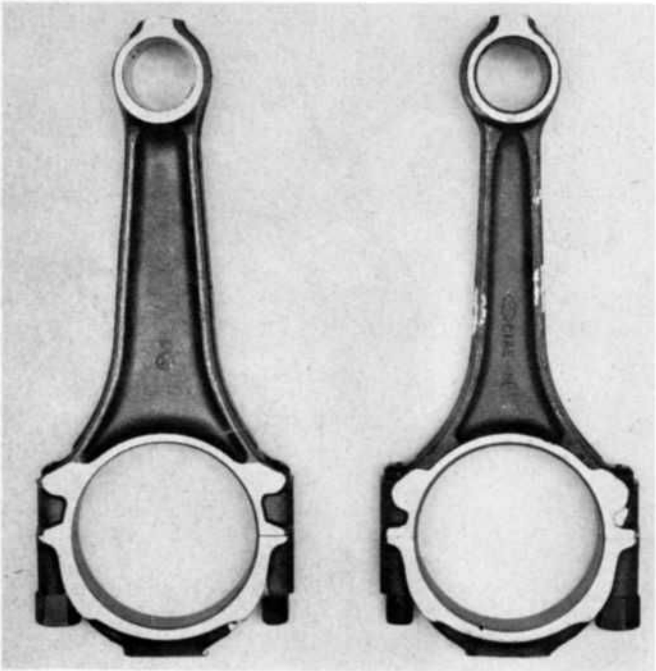
All crankshafts used for Ford's big V8's are of the same basic design and material. They are precision-molded nodular iron and this molded, or cast, method permits Ford to concentrate the counterbalance weight exactly where needed to ensure a properly balanced, smooth running engine. Methods used on forged steel crankshafts requires them to be forged in a flat 180° plane and then the two end journals twisted 90° so that they end up 180° apart and 90° from adjoining throws. Sounds confusing but it simply means that viewed from the end, one rod journal will be at 0° or 360°, another at 90°, a third at 180° and the fourth at 270°. After the forged crankshaft is so formed, excess material from oversized counterweights must be machined off to get proper size and balance.

Ford's casting method for their crankshaft permits the crank to be made in a 90° plane and the carefully sized cast counterweights do not have to be trimmed down, merely balanced. There have been many pros and cons aired on the argument of cast iron versus forged steel crankshafts but Ford engineers insist their method is best and we can't recall hearing of crankshaft failure in any of the big V8's, even when abused on the high-speed tracks in Nascar's racing circuit. The fact that many competitive manufacturers have adopted the cast type crankshaft seems to endorse its durability.

332-inch V8 crankshafts used a 3.30-inch stroke. The 352-inch crankshafts used a 3.50-inch stroke. When the 390-inch engine was released in 1961, an extra .280-inch was added to the stroke, making it 3.780 inches. This same stroke is used for the 406 engine. All crankshafts for the big V8's, from the 1958 332 engine to the 1962 406 engine, have the same size main bearing and rod journals. Mains are 2.750 inches and rods are 2.440 inches, less operating clearances. All '58-'62 big V8's use the same steel-backed, copper-lead, heavy-duty bearing inserts too. So, crankshaft interchangeability using late parts in earlier engines is quite simple, although matching rods, pistons and front harmonic balancer must also be used.

1960's high performance 352-inch engine used the same crankshaft as standard 352 engines but with extra bearing clearances for improved oil flow. In 1961, the crankshaft used for the high performance 390's was a special item with a ⅛-inch-wide groove around each main journal to increase the oil supply to rod journals. Also, grooved lower main inserts were used in addition to the standard grooved top inserts. The grooves in both crankshaft and inserts doubled oil flow to the rods.

The 406 crankshaft has the same physical characteristics as that used in the 390 high performance V8 but a heavier connecting rod is used in the 406 so counterweight size on the 406 is slightly larger to compensate. Front balancers for both the 390 and 406 high performance engines are heavier than the standard 390 balancer to take care of harmonics encountered well above the standard operating range.



LEFT—Connecting rods for the 406-inch high performance V8 (left) are much stronger, slightly heavier than those used in standard engines (right). ABOVE—Pistons for high performance 390 engine (left) have recessed top. 406 pistons have flat top but there is more clearance between the piston and block deck.

CONNECTING RODS

Although the 332 and 352 engines have a stroke difference of .200-inch, the same rod is used for both engines so the pin hole in the 352 piston is .100-inch higher in the piston to compensate for the stroke change. The rod for all 332 and 352 engines is 6.540 inches long from centers of the bores and average weight is 25.85 ounces. With the change in stroke for the 390 engine, a new rod was required which is 6.488 inches long and weighs 25.46 ounces. The 406 rod is the same length as that for the 390 but has been beefed up considerably and has an average weight of 26.92 ounces, almost 1½ ounces more than 390 rods.

All rods use the same diameter piston pins so the pin bores for all big V8 rods are the same with bronze bushing in the rods honed to take the full-floating .975-inch pins. The rod big ends are also the same for all engines and they use copper-lead heavy-duty inserts. Widths of the rod big ends vary slightly with standard engines having a total side clearance of .006-.016 for two rods on the journal and high-performance engines totaling .014-.024 for two rods.

Recommended bearing clearances for the connecting rods vary less than .0001 from 1958 to the '62 high performance 406. The production limits are from .0009- to .0029-inch and the smaller clearance is ideal for normal passenger car operation while the larger is best for high performance engines that operate under extreme conditions.

Permanent-mold cast-aluminum pistons have been used for all big V8 pistons from 1958 to '62. Those for the 332 and 352 engines were solid skirt, flat top design, cam ground with Autothermic heat control, tin-plated and with a 1/16-inch pin offset to the right side of the engine. Although both the 332 and 352 were the same bore size, pistons are not interchangeable because of a difference in pin hole location and also a difference in weight. The 332 pistons averaged 24.8 ounces while the 352 pistons weigh 24.3 ounces. The 352 high performance pistons used in 1960's 360-hp engine were identical to regular production pistons but were selected for extra clearance and X-rayed to make sure there were no imperfections.

Pistons for the 390 engine introduced in 1961 were of the same general type as used in the 332-352 engine but since the 390 had .280-inch more stroke, a few changes were necessary. The longer stroke meant that the piston would be pulled farther down in the cylinder bore on the bottom of the stroke so the solid design was changed to a slipper skirt for clearance with the crankshaft counterweights. Also, although the 390 connecting rod was .052-inch shorter than the 352 rod, this was not enough to make up for the change in stroke length by itself so the pin hole in the 390 pistons was raised approximately .090-inch nearer the piston top than it was for the 352.

Instead of the flat top design used for 332-352 pistons, the 390 pistons used a dished top so that the volume between the piston and the top of the block at top center is large enough to permit use of the same cylinder heads made for 352 engines without having a too high compression ratio due to the larger displacement of the 390.

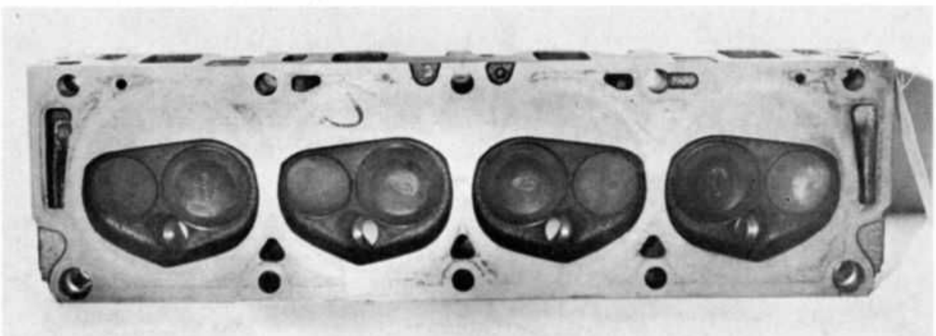
For the 390 high performance engines, standard production 390 pistons were selected for desired clearance and X-rayed to eliminate any possible weak pistons. The only other change made when using these pistons in high performance engines was to use Tru-Arc pin locks instead of the standard spring wire type.

Pistons for the 406-inch high performance engine use a flat top design instead of the 390 dished top design but the pin hole has been repositioned to drop the piston .035-inch lower in the bore at top center so that compression will not be too high. Other than this change and the fact that 406 pistons are .080-inch larger than the 390 pistons, other characteristics remained the same; slipper skirt, cam ground, heat control and pin offset.

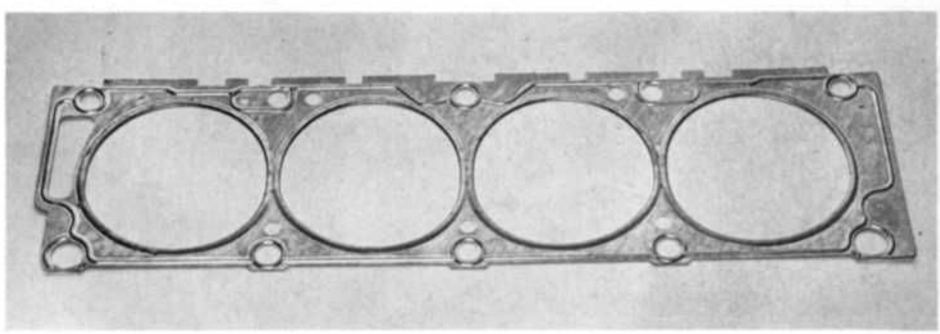
Late in the '61 model year, a change was made in cylinder heads for high performance 390's which increased the head chamber volume so at that time a new piston was also made to go with these heads. It used a flat top design to give less volume between piston and the top of the block. Very few engines were built with these pistons.

CYLINDER HEADS

When the big V8 was introduced by Ford in 1958, the cylinder head combustion chamber was machined instead of using the cast method. The smooth, machined surface was designed to eliminate irregularities which might cause hot spots and pre-ignition but this theory did not work out as hoped. As it turned out, premium grades of gasoline available throughout the country were not consistently good enough to permit the efficient compression ratio of 10.2:1 chosen for the 352 engine. So, during the middle of the '58 model run, compression was dropped to approximately 9.6:1 by enlarging the chamber.



High performance 406 cylinder head at left has wedge chamber, large valves and chamber is sand cast, volume carefully controlled.



The 406 engine uses a new type head gasket with double beading around cylinders. These improved gaskets can be used on other big V8 engines any time.

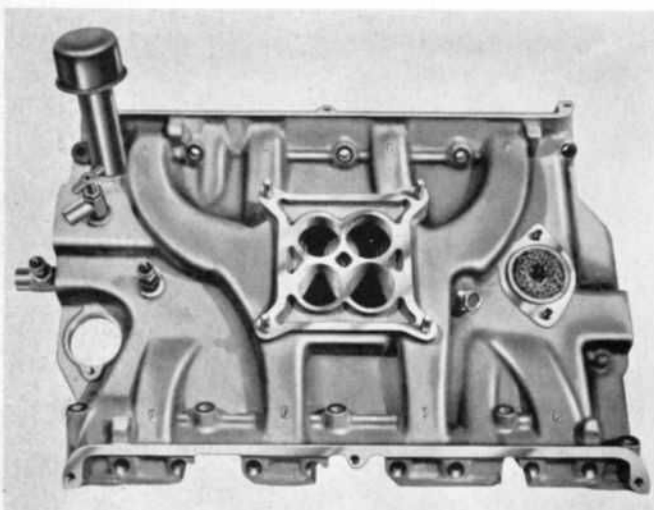
In 1959, the machined chamber was dropped from production since with lower compression a smooth machined surface was not needed. Cast chambers are cheaper to make and shapes can more easily be contoured to control flame travel.

Average chamber volume for late '58 and all '59 332-352 cylinder heads was about 69 cubic centimeters. Add to this the volume contained within the gasket, 6.2 cc. and that between the top of the piston and the cylinder deck at .040-inch clearance, and the compression ratio reached a mean figure of 9.6:1.

In 1960, the cylinder-head combustion chamber was reshaped slightly for standard 352 engines but the advertised compression ratio left the same, 9.6:1. A different chamber shape was used in the cylinder heads for the high performance 352 engines with less volume and a raise in compression ratio to 10.6:1. This '60 high performance head had volume limits of 59.7 to 62.7 cc. The same cylinder head, part number COAE 6049-C, was also used for 1961 and early '62 390-inch high performance engines.

The advertised compression ratio of 10.6:1 used for both '60 352 and '61 390 high performance engines was actually an average figure using the mean chamber volume, gasket volume and the mean deck clearance between piston and block. With the flat top 352 pistons, deck clearances could run from .030 to .050 and corresponding volume contained between piston and deck would be from 6.2 to 10.4 cc. Using the low limits of the specifications, or maximum volume, compression would be approximately 10.1:1 while "stacking" the high limits for minimum chamber volume gives about 11.1:1 compression.

With the same heads used on 390 high performance engines, more chamber volume was needed to offset the gain in displacement so the dished top piston gave the needed volume. With a minimum deck clearance of .010-inch, the 390 had 13.3 cc between piston and deck and, with maximum manufacturing limits of .030-inch deck clearance, the volume was 17.5 cc. Here again using maximum chamber volume, the compression can be as low as



High performance four-barrel intake manifold is cast aluminum and has large capacity branches to carry air/fuel charges.

10.1:1 while with the minimum volume compression can be as high as 11.1:1. Mean compression is 10.6:1.

The special heads released late in '61 for use with flat top pistons in the high performance 390 had chamber limits of 60 to 65 cc. and deck limits of .020 to .040 with volumes of 4.2 to 8.4 cc. Theoretically, these manufacturing limits permitted compression ratios from 11.1 to slightly over 12.1. Ford's advertised ratio was 11.5:1. These late '61 heads for use with flat top pistons are part number C2SZ 6049-A.

Cylinder heads for the 406 high performance engine are new with reshaped combustion chamber and a larger exhaust valve for improved breathing. Chamber limits for the 406 head are from 62.1 to 67.5 cc and the gasket contains 6.5 cc. Flat top pistons are used for the 406 but they have been dropped much lower in the bore than they were on either the 352 or 390 engines. Deck clearance limits are from .045 to .065. At .045-inch, volume between piston and deck is 11.7 cc and at .065-inch, the volume is 16.2 cc. Maximum chamber volume would give a minimum ratio of 10.25:1 while minimum chamber volume would give a maximum compression ratio of 11.4:1. The advertised compression ratio for the 406, 10.9:1, is a mean figure.

The reason we've given you all of these figures on cylinder head, gasket and block volumes is so that you will know what kind of compression ratio to expect should you start swapping heads, pistons, crankshafts, etc., between various engines. To figure compression ratio, add the cylinder head volume, gasket volume, block volume and you will have the total in cubic centimeters. Divide total cc's by 16.4 to convert into cubic inches. Add chamber volume (cubic inches) to swept volume of one cylinder (displacement divided by 8) and divide by chamber volume (cubic inches). Sample: 65 cc in head plus 6.5 cc in gasket plus 14.0 cc in block equals 85.5 cc total volume. Divided by 16.4 gives 5.2 cubic inches total. 406-inch engine divided by 8 equals 50.75 cubic inches per cylinder. 50.75 plus 5.2, divided by 5.2 equals 10.75:1 compression ratio.

The only real difference in cylinder heads from 1958 to 1962 is the chamber volume plus a new shape used with the 406 engine to take advantage of a .093-inch larger exhaust valve. Porting has been changed some with the later heads by all means the most ample in this department.

It is inadvisable to mill head surfaces of the big V8 engines to gain compression. The intake manifold acts as the engine top cover and also extends beneath the rocker arm covers of each head. So, if the heads are milled, both mating surfaces on the intake manifold will have to be trimmed one-half the amount taken from the heads and the bottom surface of the manifold will have to be trimmed .7 that taken from the heads. Even with these surfaces milled, everything is not perfect since the portion of the manifold which extends beneath the rocker cover will then be narrower by .7 of the amount taken off the heads and getting the cover sealed perfectly might present a problem.

CAMSHAFT AND VALVE TRAIN

The first '58 big V8 engines used mechanical valve lifters and adjustable rocker arms but early in the model year a change was made to a different camshaft with hydraulic lifters and non-adjustable rocker arms. All standard engines since that change, '58 to '62, use the 1.76:1 ratio non-adjustable rockers and hydraulic lifters. When the high-performance 352 engine was offered in 1960, the '58 adjustable rockers were again called into service for use with the high performance mechanical camshaft. They also have a 1.76:1 ratio and are used in all high performance big V8's from 1960 to '62.

The original '58 mechanical camshaft was strictly a passenger car mild grind and did not offer much in the way of high rpm or power. The hydraulic camshaft which superseded the early cam was even milder and gave a more smooth, quiet idle. This hydraulic cam was used for all '58-'59 332-352 engines and also for the two-barrel 1961 352 engine. A slightly different grind, part COAE 6250-A, was used in 1960 352's with four-barrel and in all standard 352 and 390 passenger cars to 1962.

Of more interest to those wishing improved performance though, the camshaft used for the '60 high performance engine is part number COAE 6250-B. This camshaft was also used in the 390 high performance engines for '61 and, with a very slight timing change which requires a new part number, is used in the '62 406 engine. The new part number is C2AZ 6250-A and this cam also supersedes the COAE cam mentioned. Lift at the valve with .025-inch lash setting checks out as follows: Intake opens 24° BTC, closes 72° ABC; exhaust opens 72° BBC, closes 24° ATC. Overlap is 48°, duration is 276° and valve lift is .479-inch for both intake and exhaust. The '62 camshaft is also induction hardened for increased wear resistance.

Ford has made countless experiments with camshafts since they started on their high performance program for 1960 and they have yet to find a grind which is better for all-around use than the cam just described. Solid lifters are the same for all high performance engines and also are the same ones used in the Falcon engines.

Single valve springs with dampers are used on all high performance engines and they should check out on a spring tester to the following specifications: 80-90 pounds at 1.82-inch installed length, 184-194 compressed to valve open length of 1.32 inches. These figures do not include the damper. These springs are the same for all years and the latest '62 part number will supercede earlier part numbers.

Valves for all big V8 engines, from 1958 to 1962, have remained the same size except for a .093-inch larger exhaust valve used in the '62 406 engine only. All intakes have an average head diameter of 2.030 inches while the exhausts for all but the 406 are 1.560 inches. A 1.653-inch exhaust valve is used in the 406 engine.

Stamped steel spring retainers are used for standard production engines and machined steel retainers for the high performance engines. Neoprene oil seals are used on both intake and exhaust valves.

INTAKE SYSTEM

Prior to 1960, only two-barrel and four-barrel carburetion was offered on the 332 and 352 engines and this was with cast iron intake manifolds which weighed about 80 pounds each. For the '60 high performance 352, an aluminum intake manifold was introduced which not only had a larger, more direct passage to the head ports, but also weighed only about half as much. It was designed to take a four-barrel carburetor of much larger capacity than the standard carburetor. The Holley four-barrel had an air flow rating of 540 cubic feet per minute.

For the 1961 high performance 390, a larger capacity aluminum four-barrel intake manifold was made and it was fitted with a carburetor rated at 600 cfm. Passages within the '61 manifold were made 10% larger to compensate for the approximate 10% displacement increase from 352 to 390. Also introduced in 1961 was an aluminum intake manifold for three two-barrel carburetors. These three Holley two-barrels had a total capacity of 840 cfm and caused a rating increase from 375 to 401 horsepower.

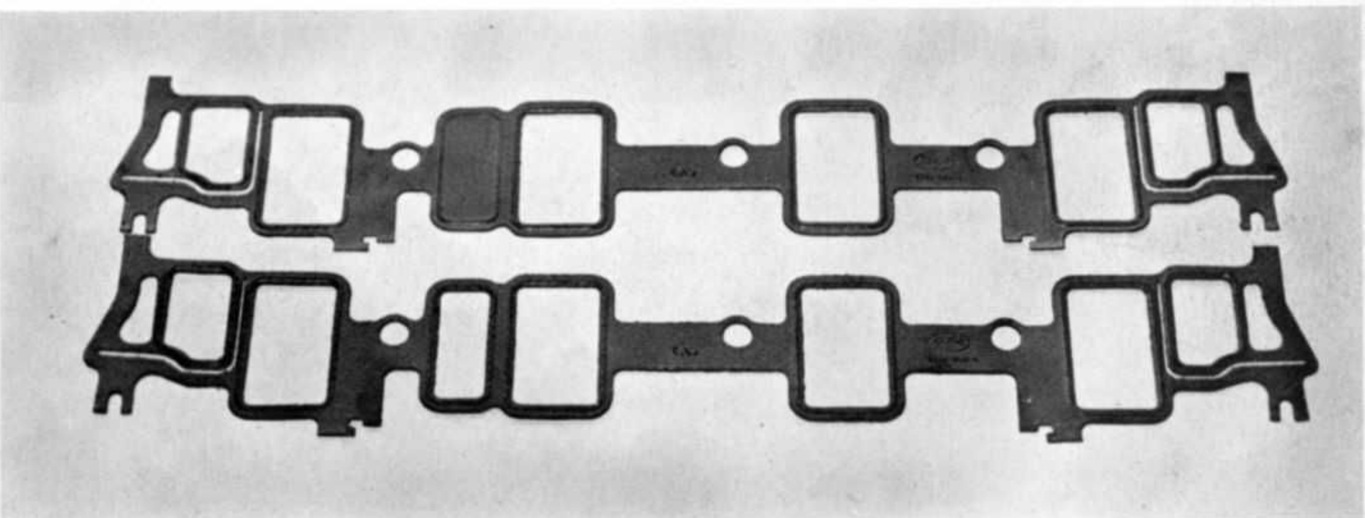
Again in 1962, both the four-barrel and triple two-barrel aluminum intake manifolds were offered for the 406 high performance engines. The four-barrel Holley was left the same capacity as it had been for the 390 engine but the three two-barrel Holleys were enlarged to give almost 10% more venturi area. Progressive linkage is used with the triple intake system so that only the center carburetor is used for average driving, giving a fair mileage potential for the high performance engine. At about half throttle, the progressive linkage starts opening the two end carburetors and their opening rate is accelerated so that all three carburetors reach a full open position at the same time.

Either of the two special aluminum manifolds, four-barrel or triple, will fit earlier big V8 engines. Some port matching might be necessary to make sure that intake ports in the early heads do not project into the manifold opening but this is a simple procedure. Special intake manifold gaskets are also available for use with the high performance manifolds. They do not have openings for the heat crossover passages. This eliminates exhaust heat from circulating around the bottom of the intake manifold so that a colder, more dense charge of air can be used for maximum performance. As delivered from the assembly line, all Ford high performance engines use gaskets which supply manifold heat, but the special gaskets should be used by those owners looking for the best results. Morning warmup will take much longer without the open heat risers.

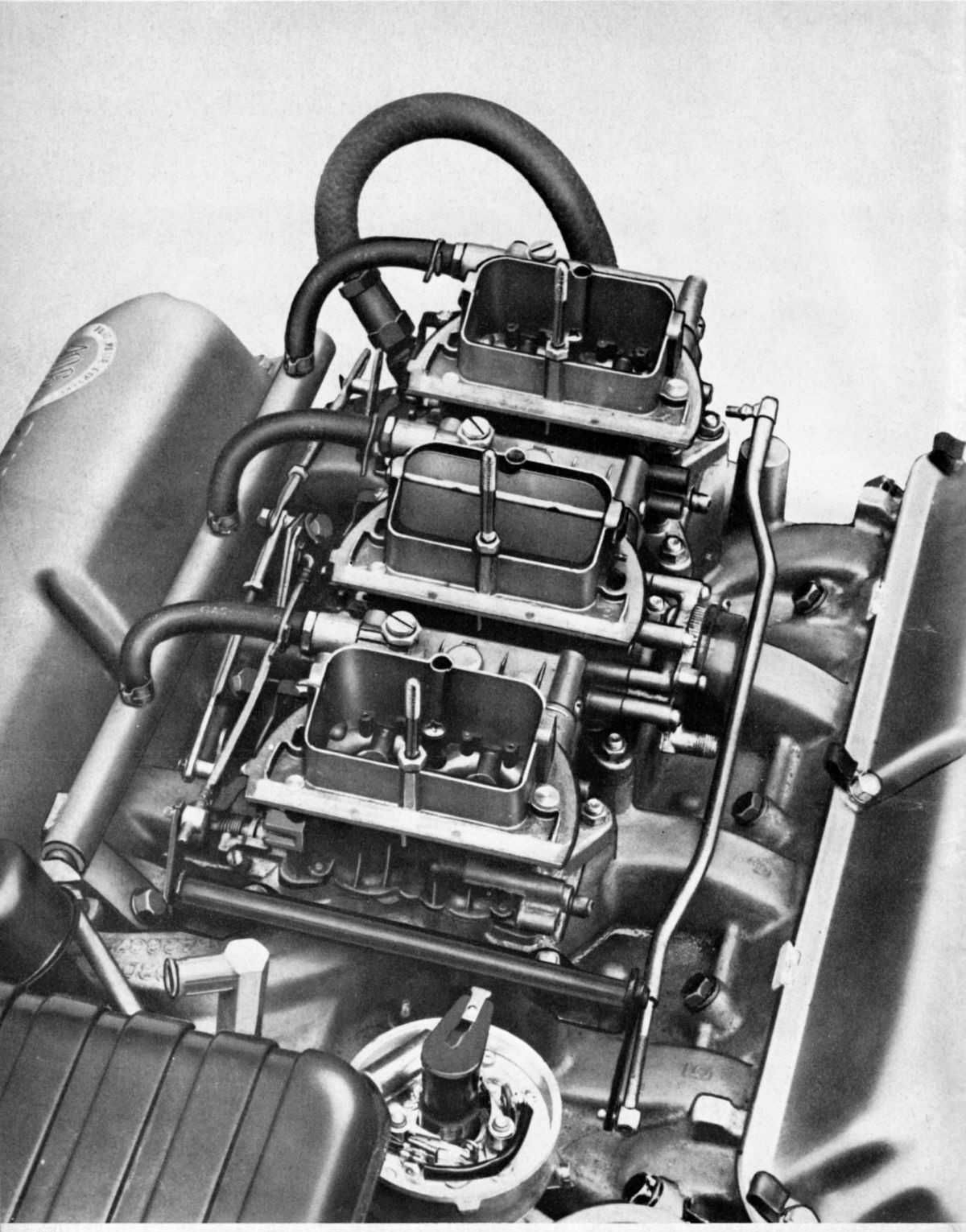
Ford designed a good-looking, effective set of cast iron exhaust manifold headers for their 1960 high performance engine, used them again in 1961 and early '62 and then made a new, even better set for the '62 406 engine. Unfortunately, neither of these exhaust header sets will fit in the '58-'59 Ford chassis so they can't be used in place of the standard log type exhaust manifolds. 1960 and later Fords used a two-inch wider front wheel tread and this places the upper front suspension control arms and frame brackets an inch wider on each side of the engine than in '58-'59. Ford's engineers used all the room at their disposal when designing the headers so they would have maximum efficiency. So, if you try to use these headers in a '58 or '59 car, they will not clear the suspension.

If you own a 1960 or '61 Ford car, the special headers can be used and if you plan to be really competitive, the later 406 headers will aid the 390-inch engines too. These latest headers have larger branches than the '60-'61 versions and they are also much longer before joining, so a certain amount of "tuning" is gained with them. The 406 head pipes should also be used between headers and mufflers since they are 2¼-inch in diameter and the larger than standard capacity is needed to carry away exhaust gases at the high rpms.

A release by Ford in late April '62 will also be of much interest to anybody participating in drag events with a late Ford. A pair of exhaust pipes are available as accessories which fit into the stock dual exhaust system on '62 Galaxies to bypass the mufflers for competition. These drag pipes carry the burned gases back to a point ahead of the rear wheels where it can be "dumped" to eliminate back



These two intake manifolds appear to be identical, but close examination reveals that the top gasket has a blocked off heat riser passage for competition use.



pressure in the exhaust system by uncapping an outlet on either side of the car. The exposed portion of the pipe and the cap are chromed. For street use, the extra outlets are capped and the exhaust then passes through the standard muffler system.

These pipes, although designed for use on '62 Fords, can certainly be fitted to '60 and '61 models easily, too, since chassis for the three years are quite similar. With some slight modifications, they will fit on earlier cars with big V8 engines too. Ford engineers have stated that a standard dual exhaust system designed to abate noise for street use can rob a big V8 engine of 30 horsepower or more, so for competition, open exhaust pipes are a cinch to improve performance.

IGNITION SYSTEM

All standard 332-352 and 390 engines use an ignition system designed strictly for street use and maximum economy. The distributor for these engines has a single set of points, both centrifugal and vacuum advance mechanisms. Secondary wiring between coil and distributor cap, cap and spark plugs has a carbon resistance core to suppress radio interference.

The ignition system for all 352, 390 and 406 high performance engines is designed for maximum performance, so an entirely different distributor and wiring set are used. The distributor has dual points and centrifugal advance mechanism only. Secondary ignition wiring has a steel wire core. The reason for the dual points is to gain increased dwell time so that a higher primary voltage can be induced through the coil. This gives a higher secondary voltage at high rpms. Also, a milder cam design used with the dual points permits higher speeds without point "float" or bounce.

The vacuum advance mechanism is eliminated from the distributor since its function is to supplement centrifugal advance on a standard engine during cruising conditions to give economy. With the high performance design of these engines, economy is secondary to performance so the desired total advance is obtained by centrifugal weights and initial timing setting. Also, not using the vacuum diaphram permits a stationary point plate to be used which ensures more constant alignment of the points at all times.

If any of the earlier big V8 engines are updated with later parts for improved performance, the ignition system should also be given serious attention. The distributor used for all '60-'62 high performance engines is the same and checks out to the following specifications. Centrifugal advance should be 0° at 800 rpm, 8°-10° at 1200, 12°-14° at 1400, 19°-21.5° at 3000 and a maximum of 24.5°-27.5° at 4400 rpm. Each set of points should be set at about 26°-28° dwell and the two sets working together should give 33°-35°. Initial advance should be set at 700 rpm with the 352 and 390 engines using 12°-14° at the crankshaft and the 406 9°-11°.

The steel core secondary wiring delivers a stronger voltage to the plug than the resistance wiring and is less apt to be damaged when changing plugs. Spark plugs recommended by Ford for their high performance engines are Autolite BF-32 with a .032 gap for street and drag strip, colder BTF-1 or BF-22 gapped at .025 if the engine is to be used at sustained high speeds.

ACCESSORIES

There are many other engine parts which will appeal to Ford owners who wish to get maximum results from their big V8 engines. To list all of the engine parts used on Ford's big V8's from 1958 to 1962 would take dozens of pages and since most of you are probably interested only in the high performance pieces, we will list part numbers of major components for the 1962 406 high performance engine.

Two complete 406 engines can be bought from Ford, the four-barrel carbureted 385 horsepower model (4V) and the triple-carbureted 405 horsepower model (6V). 4V and 6V are Ford's method of designating the number of carburetor venturii.

The two engines are identical except for their intake system so intake parts will be designated either 4V or 6V.

Parts classified "A" and "B" are generally available through the local Ford dealer's parts depot. Parts classified "C," "CA" and "CY" are available from Ford Division, National Parts Depot, Livonia, Michigan. Parts classified "V" and "VA" are shipped directly from the vendor. "L" is available by local parts depot through the nearest Ford assembly plant. ■

Ford Motor Company's triple intake system for big V8 gives 405 horsepower with the 406-inch high performance engine. The carburetors are Holley make, progressive linkage is used.

Late cast iron headers for the 406 engine are tuned to exhaust impulses, have large capacity branches. On left side, 1st and 3rd cylinders hook together, 2nd and 4th together. On right side of engine 1 and 2 are together, and 3 and 4 are together.

PART NUMBER	DESCRIPTION	CLASS
C2AE 6007-E 350A	Complete Engine Assembly 4V without Emission Reduction	L
C2AE 6007-D 351A	Complete Engine Assembly 6V without Emission Reduction	L
C2AZ 6009-B	Engine Assembly Cylinder Block and Crankshaft	C
C2AZ 6010-A	Cylinder Block Assembly (4.13 bore)	C
C2AZ 6303-B	Crankshaft	B
C1AZ 6316-A	Damper—Crankshaft Vibration	C
C1AE 6333-A	Bearing—Crankshaft Main, Front—Red	B
C1AE 6333-B	Bearing—Crankshaft Main, Front—Blue	B
C1AE 6337-A	Bearing—Crankshaft Main, Center—Red	B
C1AE 6337-B	Bearing—Crankshaft Main, Center—Blue	B
C2AZ 6200-A	Connecting Rod Assembly	A

COME 6212-A	Nut—Connecting Rod	C
CIVE 6214-B	Bolt—Connecting Rod	C
C2AZ 6211-H	Bearing—Connecting Rod—Red	A
C2AZ 6211-J	Bearing—Connecting Rod—Blue	A
C2AZ 6108-A	Piston (4.13 diameter)	CY
C1AE 6135-B	Pin—Piston	B
C1AE 6140-A	Retainer—Piston Pin	B
C2AZ 6148-A	Piston Ring Set (Partial) Std.	C
C1AE 6600-C	Pump Assembly—Oil	C
COAE 6881-A	Adaptor Assy.—Oil Filter	B
C1AZ 6731-A	Filter Assy.—Oil	A
C1AE 6675-F	Pan Assy.—Oil (6 qt.)	C
C2AZ 6250-A	Camshaft	A
B9TE 6500-A3	Tappet—Valve	A
B8A 6565-C	Rod—Valve push	A
B8A 6564-B	Arm Assy.—Valve Rocker	A
B9AE 6531-A	Support—Valve Rocker Arm Shaft	A
B8A 6563-A	Shaft—Valve Rocker Arm	A
C2AZ 6049-A	Head Assembly—Cylinder	C
C2AZ 6051-B	Gasket—Cylinder Head	C
C2AZ 6505-A	Valve—Exhaust	A
COAE 6507-N	Valve—Intake	A
C2AZ 6513-A	Spring Assembly—Valve Damper	A
C2AZ 6571-A	Seal—Exhaust Valve Stem	C
C1AE 6514-A	Retainer—Valve Spring	B
C2AZ 9430-C	Manifold—Exhaust R.H.	B
C2AZ 9431-C	Manifold—Exhaust L.H.	B
COAE 6023-D	Pointer—Timing	C
C2AZ 8501-B	Pump Assembly—Water	C
B5S 8546-E	Spacer—Fan	C
C1MZ 8600-D	Fan Assembly	C
C1TZ 10002-A	Generator Assembly (15v—30 Amp)	A
C1AZ 7563-C	Plate and Cover Assy.—Clutch Pressure	V
COAA 7550-B	Disc Assy.—Clutch	V
COAF 12127-K	Distributor Assembly	C
FDS 12171-A	Contacts—Distributor Breaker	A
B7A 12191-B	Spring—Distributor Weight—Secondary	C
B8QH 12192-C	Spring—Distributor Weight—Primary	B
B6A 12029-B	Coil Assembly—12 volt	A
B8S 12043-B	Strap Assembly—Ignition Coil	C
COAZ 12259-B	Kit—Spark Plug Wire	C
COAZ 12405-A	Spark Plug—Autolite BF-32	A
B8A 12405-A	Spark Plug—Autolite B F-42	A

4V CARBURETION PARTS

C1AE 9424-C	Manifold Assembly—Intake 4V	C
C2AZ 9441-A	Gasket—Intake Manifold to Cylinder Head (Manifold heat open)	A
B9JE9441-B	Gasket—Intake Manifold to Cylinder Head (pkg 2) (Manifold heat blocked)	CY
C2AZ 9447-E	Gasket—Carburetor to Intake Manifold	A
C1AE 9510-AM	Carburetor Assembly (HOLLEY 4V)	C
COAE 9600-K	Cleaner Assembly—Carburetor	C
C1AZ 9590-G	Kit—Carburetor Repair (HOLLEY 4V)	C
COAE 9601-C	Element—Carburetor Air Cleaner	C
COAE 9A589-A	Spacer—Carburetor to Manifold	C
B7Q 9155-A	Filter Assembly—Fuel	A
COAE 9180-A	Bracket—Fuel Filter Mounting	C
COAE 9A274-A	Tube Assembly—Fuel Filter to Carburetor	C
COAE 9350-E	Pump Assembly—Fuel	C

6V CARBURETION PARTS

C1AE 6B068-A	Kit—V6 Manifold and Carburetors	VA
C1AE 9424-E	Intake Manifold—6V	CY
C1AE 9510-AU	Carburetor—Secondary (2 Required)	CY
C1AE 9510-AV	Carburetor—Primary	CY
C1AE 9447-C	Gasket—Carburetor to Manifold (3 required)	C
C1AE 9600-E	Air-Cleaner Assembly	CY
EDJ 9601-A	Air Cleaner Element	C
C1AE 9654-A	Gasket-Cleaner to Carburetor—(3 required)	
C1AE 9D280-A	Carburetor Fuel Log	CY
C1AE 9D281-E	Carburetor Fuel Hose—5.08" long	CY
B7Q 2269-A	Fuel Filter Outlet Tubing	CY

FORD'S BIG V8's

YEAR	BORE & STROKE	DISPLACEMENT	COMP. RATIO	CARBURETION	HP @ RPM	TORQUE @ RPM
1958	4.000 x 3.300	332	9.50	4-bbl.	265 @ 4600	360 @ 2800
	4.000 x 3.500	352	10.20	4-bbl.	300 @ 4600	395 @ 2800
1959	4.000 x 3.300	332	8.90	2-bbl.	225 @ 4400	325 @ 2200
	4.000 x 3.500	352	9.60	4-bbl.	300 @ 4600	380 @ 2800
1960	4.000 x 3.500	352	8.90	2-bbl.	235 @ 4400	350 @ 2400
	4.000 x 3.500	352	9.60	4-bbl.	300 @ 4600	381 @ 2800
	4.000 x 3.500	352	10.60	4-bbl.	360 @ 6000	380 @ 3400
1961	4.000 x 3.500	352	8.90	2-bbl.	220 @ 4400	336 @ 2400
	4.050 x 3.780	390	9.60	4-bbl.	300 @ 4600	427 @ 2800
	4.050 x 3.780	390	10.60	4-bbl.	375 @ 6000	427 @ 3400
	4.050 x 3.780	390	10.60	3 2-bbl.	401 @ 6000	430 @ 3500
1962	4.000 x 3.500	352	8.90	2-bbl.	220 @ 4300	336 @ 2600
	4.050 x 3.780	390	9.60	4-bbl.	300 @ 4600	427 @ 2800
	4.050 x 3.780	390	10.60	4-bbl.	375 @ 6000	427 @ 3400
	4.050 x 3.780	390	10.60	3 2-bbl.	401 @ 6000	430 @ 3400
	4.130 x 3.780	406	10.90	4-bbl.	385 @ 5800	444 @ 3400
	4.130 x 3.780	406	10.90	3 2-bbl.	405 @ 5800	448 @ 3500

FALCON SIX

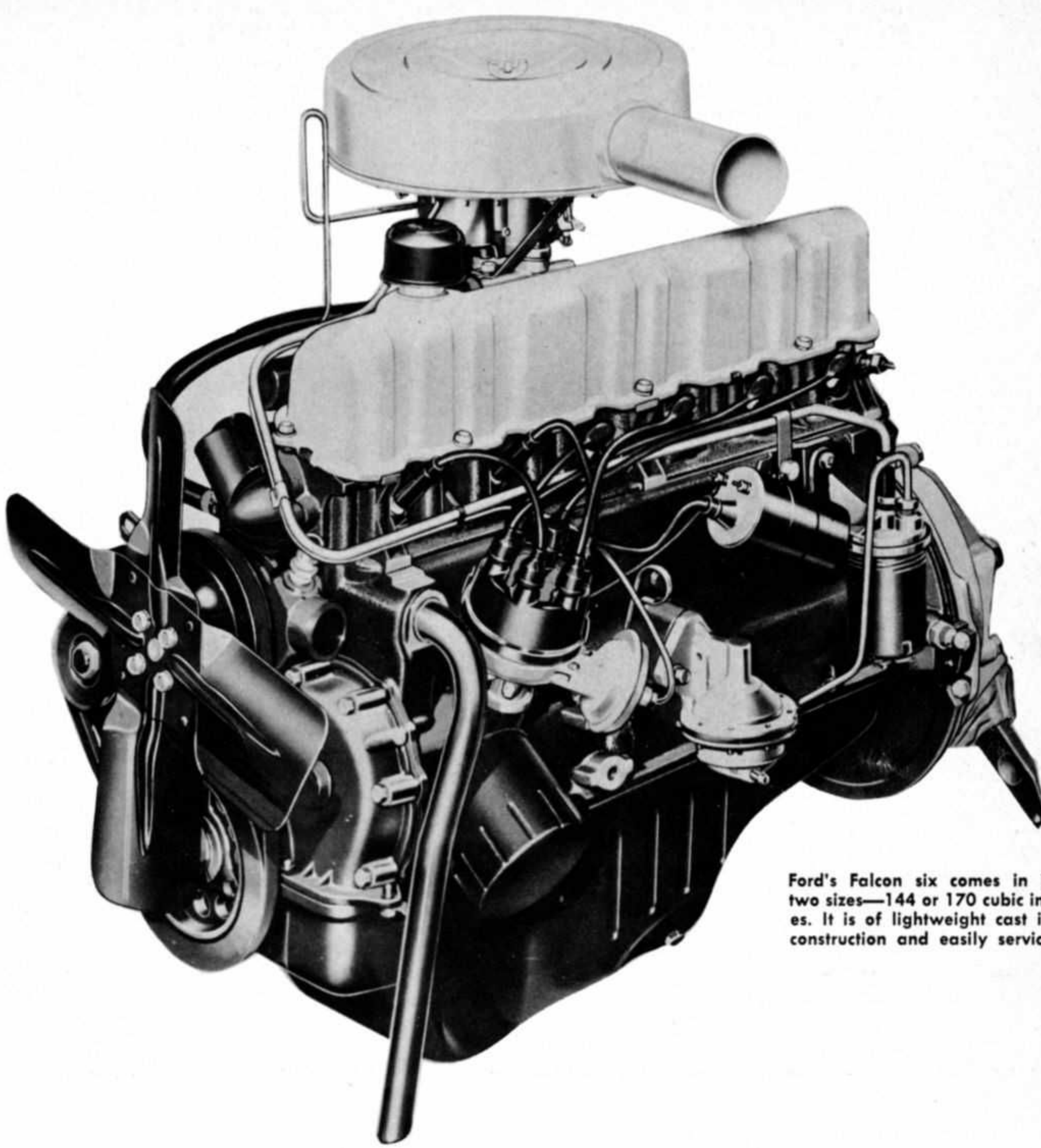
Automobiles in this country have undergone quite an evolution since they first started frightening horses off the road back before the turn of the century and there have been more model changes made in the last half-decade than in the previous half-century. One of the newest offshoots in this recent accelerated evolutionary process has been the economy car.

Ford's entry in the economy, or compact, class is the Falcon and it is the most successful American economy car both in terms of cars sold and economy delivered. First introduced in 1960, the Falcon sported a brand new overhead valve, six cylinder engine made with modern foundry techniques which permitted lightweight but durable cast iron components.

In its first year, the Falcon was offered with this new engine in a 144 cubic inch displacement. Although Americans bought Falcons at a fantastic rate during 1960, surveys revealed that many drivers used to larger, more powerful cars were apprenhensive about a sudden change to a car with much less response. So, for 1961, Ford added a 170-inch "stroker" engine option to the Falcon which gave about 20% more displacement and horsepower. This substantial boost, coupled with the lightweight Falcon body, proved to be what tens of thousands of Americans wanted and sales soared. Again in 1962, both the 144-inch standard six and the 170-inch optional engine were offered for Falcons. The 170-inch six is also the standard powerplant for Ford's Fairlane series introduced in 1962.

Differences between the 144- and 170-inch Falcon engines are only in the area of cylinder displacement and the necessary related components. Both have the same 3.50-inch bore. The 144 has an extremely short 2.50-inch stroke while the 170's stroke is .440 inches longer at 2.940. Both engines have a compression ratio of 8.7:1 for use with regular grades of gasoline.

Casting techniques which permit lightweight blocks and



Ford's Falcon six comes in just two sizes—144 or 170 cubic inches. It is of lightweight cast iron construction and easily serviced.

cylinder heads are used in the manufacture of these small sizes. These special techniques are the result of many improvements in core box design and metal flow by Ford's Engine and Foundry Division. In simplified terminology, a pre-heated core box is used so that when it is filled with the sand-binder core material, there is no warpage or cracking caused by an expanding core box as the core is heated for curing. An improved composition in the cast iron itself makes it possible to pour the molten iron into thinner sections without danger of fast chilling causing porosity.

With both the 144 and 170 engines using a 3.50-inch bore, the same cylinder block is also used for both. Since the engine was designed to power a lightweight economy car, minimum weight was stressed for the engine. The deep block skirt design used on previous Ford engines was dropped to save weight so the oil pan flange is in line with the center of the crankshaft.

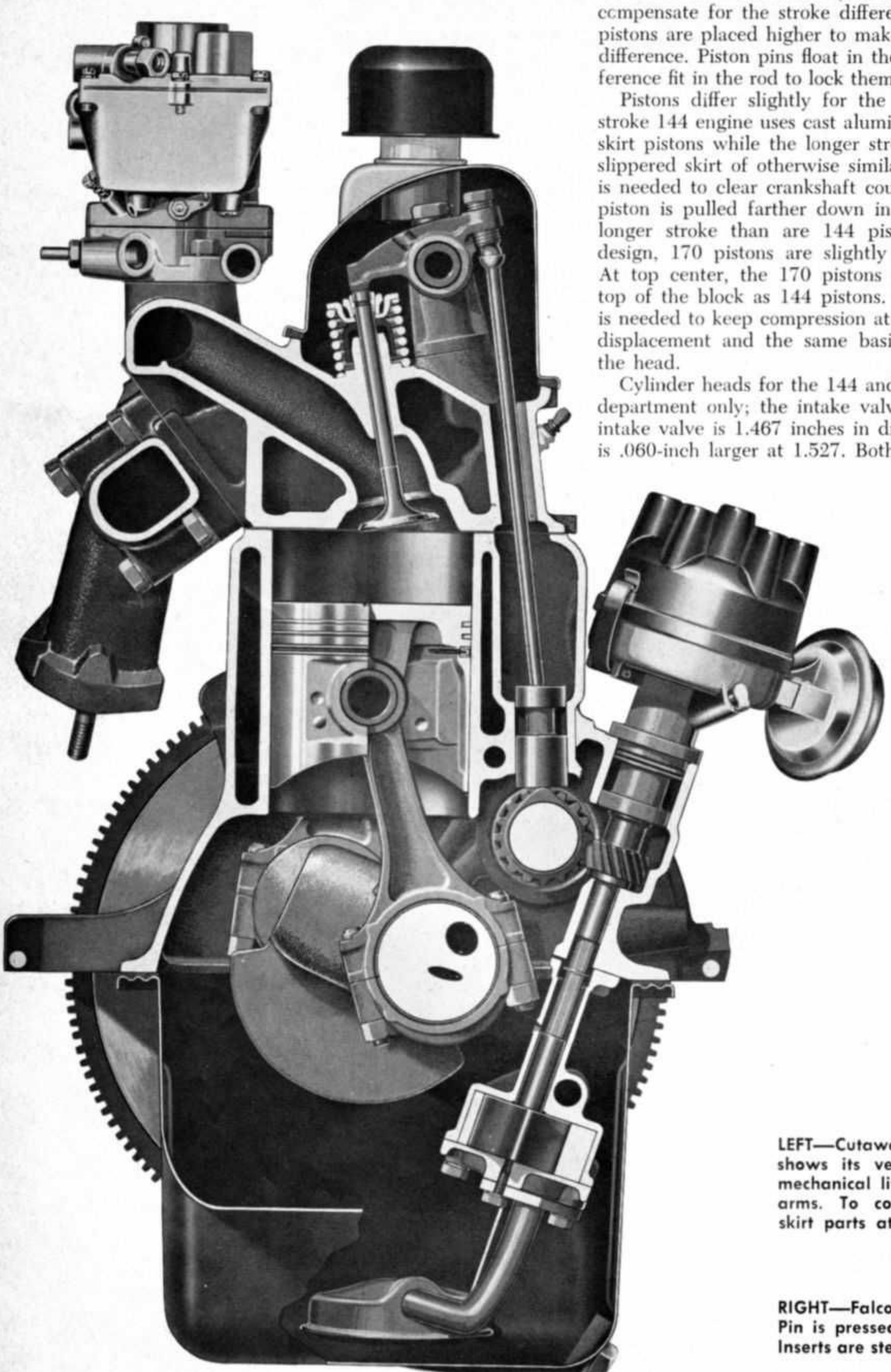
The crankshaft is cast nodular iron like those in all other modern Ford engines. Lightening holes pass through the counterweights between cylinders 1 and 2, also between 5 and 6. The design of the crank utilizes these holes to remove unneeded weight and also gives excellent strength to the cheek section between the widely spaced cylinders.

With the 170 crankshaft having a .440-inch longer stroke, it necessarily has heavier counterweights too. Journals sizes are the same for both crankshafts with the mains 2.250 and the rod journals 2.125, less operating clearances. Four main bearings are used for the six-cylinder engine with end thrust taken by bearing number three. Inserts for both rod and main bearings are steel-backed micro babbitt instead of the copper-lead material Ford uses in their V8 engines.

Forged steel connecting rods used for the two Falcon sixes weigh almost exactly the same, 18.5 ounces, but the 170 rods are .140-inch shorter (4.715 versus 4.855) to partially compensate for the stroke difference. Pin holes in the 170 pistons are placed higher to make up the rest of the stroke difference. Piston pins float in the pistons and use an interference fit in the rod to lock them in position.

Pistons differ slightly for the two engines. The shorter stroke 144 engine uses cast aluminum, heat-controlled, solid skirt pistons while the longer stroke 170 engine requires a slippered skirt of otherwise similar description. The slipper is needed to clear crankshaft counterweights since the 170 piston is pulled farther down in the cylinder bore by the longer stroke than are 144 pistons. Due to the slipper design, 170 pistons are slightly lighter than 144 pistons. At top center, the 170 pistons do not come as near the top of the block as 144 pistons. This extra deck clearance is needed to keep compression at 8.7:1 while using a larger displacement and the same basic combustion chamber in the head.

Cylinder heads for the 144 and 170 engines differ in one department only; the intake valve and port size. The 144 intake valve is 1.467 inches in diameter and the 170 valve is .060-inch larger at 1.527. Both use a 1.266-inch exhaust



LEFT—Cutaway of Falcon six engine shows its very simple design. It uses mechanical lifters and adjustable rocker arms. To conserve weight, the block skirt parts at the crankshaft centerline.

RIGHT—Falcon rod and piston is shown. Pin is pressed into rod, floats in piston. Inserts are steel-backed babbitt materials.

FAR RIGHT—Crankshaft for the 144 Falcon is made of cast nodular iron and has extremely short 2½-inch stroke. 170 Falcon engine has a .440-inch longer stroke.

valve. In this age of 400-inch V8's, the Falcon valves seem quite puny, even the "big" intake for the 170, but they do a good job in the engine for which they were designed.

Valve springs, retainers, rocker arm assemblies, pushrods and lifters are the same for both 144 and 170 engines. The rocker arm has a ratio of 1.5:1, meaning that lift at the valve is 1.5 times the lift at the cam lobe. These rockers are cast malleable iron and have a self-locking adjusting screw for lash setting.

The cylinder head and intake manifold are one common casting instead of the more conventional two pieces. The manifold section is a log along the right side of the head with port branches to each of the intake valves. Use of a common head-manifold casting has several advantages. Several machining operations are eliminated (i.e. head and manifold mating surfaces, attaching screw holes); heavy sections for attaching flanges are eliminated so weight is saved; no possible gasket leakage; and the manifold area can be carefully controlled for maximum velocity to ensure good economy.

The exhaust manifold is a separate bolt-on item but is also made with the modern "thin-wall" casting method, so is much lighter than conventional manifolds of similar dimensions. A single outlet is provided at the center of the manifold. The arrangement of intake and exhaust manifolds is such that a heat riser valve is not used for warmup so the exhaust is free of restrictions at all times. Morning warmup and fuel vaporization for economy are handled by a cast aluminum spacer between carburetor and intake manifold. Hot water from the cylinder head passes through the warmup spacer, then through a valve that feeds the heater and back into the water pump.

All accessories are easy to reach and service on the Falcon and Fairlane sixes. The oil filter is a disposable cartridge type that screws directly into the lower left front of the block by hand. This filter has a built-in relief valve to bypass oil around the element in event it becomes too clogged for the oil to flow fast enough. Only many thousands of miles without servicing could cause such an occurrence, however. Another diaphragm valve prevents drain-back of oil from block galleries when the engine is stopped.

The fuel pump is also located on the left side of the engine midway between cylinders three and four. Falcon sixes use a double chamber fuel pump with one chamber supplying fuel to the engine and the other section providing a vacuum booster for the windshield wiper motor. A sediment bowl on the bottom of the pump requires periodic servicing to eliminate foreign particles. A replaceable in-line filter fits in the fuel line just ahead of the carburetor. Fairlane cars use an electric windshield wiper motor so have a single chamber fuel pump with an in-line filter unit and disposable paper cartridge.

Ignition systems for both the 144 and 170 Falcon and Fairlane engines are similar but have tailored advance curves depending on engine displacement and type of transmission used. Like big brother I-block six, the Falcon six distributor has only vacuum advance control with a balanced system between carburetor venturi and throttle bore supplying the signal to the vacuum diaphragm on the distributor.

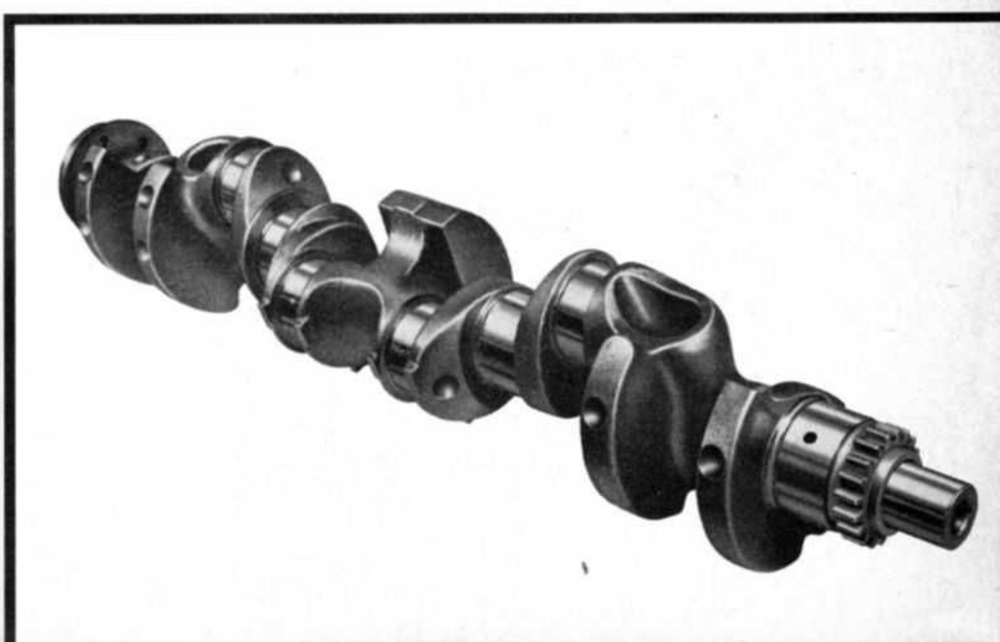
Carbon wick resistance wiring is used between distributor cap and spark plugs to eliminate radio interference. This type of wiring is quite adequate for the job it was designed to do and will generally last many years without any trouble whatsoever. However, care must be taken when removing the wires to change plugs because it can be damaged much easier than steel or copper cored wire.

Both Falcon six engines proved to be trouble-free powerplants from the moment they were produced. They do the job for which they were designed with ease. The smaller engine is a mileage champion and the larger version provides the extra "punch" many drivers want while still being just a shade behind the 144 in economy. This engine design will be a "regular" for years to come in the Ford family of cars. ■

FAIRLANE V8

The newest engine in the Ford family is a "compact" V8 used in the Fairlane medium sized car. This engine is available in two displacements, 221 and 260 cubic inches. With these engine displacements so close to the 239 and 272 Y-V8's of the middle 'fifties, you might wonder why Ford did not just pick up their seasoned Y-V8 for use in the Fairlane series cars. The reasons are many and once you become acquainted with the Fairlane V8, we think you'll agree that here is an engine with excellent design and great potential for years to come.

First of all, the Fairlane was to be a smaller car than previous full-sized Fords which used the Y-V8 engines so a lighter engine with better economy was needed. Designing improved economy in the Y-V8 could have been possible



but little could have been done to lighten its weight. So, the first item on the agenda when designing this Fairlane V8 engine was to make it light.

Ford had explored the possibility of production aluminum engines for a number of years and as long ago as the late 'forties, made several aluminum flathead V8 engines. Although much lighter than cast iron, aluminum presents many problems in casting, machining, handling, assembly and quality control. After their lengthy study, Ford decided that an engine employing aluminum block, cylinder heads, intake manifolds, etc., could only be built at a much higher cost than a similar cast iron engine. This extra cost would have to be passed on to the consumer in the form of a higher price tag on the finished automobile.

So, the idea of an aluminum engine was discarded and the design engineers told that they would have to use cast iron but still keep the engine light. Latest foundry techniques and casting materials which Ford originally used on the Falcon six-cylinder engines were adapted to the new V8 to produce carefully controlled wall thickness and eliminate undesired "heavy" sections in the engine. The latest "thin-wall" foundry method utilizes pre-heated core boxes which produce cores ready for use instead of the older method where sand cores from the boxes had to be baked before use. The latest method gives cores without warpage which can be fitted together in a precision method to carefully control wall thickness and eliminate excessive weight.

Ford's famous Y-block design was "scratched" in favor of a part line at the crankshaft center line. This eliminated the extra weight of the cast iron skirt below the crankshaft center line which provided extra main bearing web support and a flat oil pan gasket surface. Extra strength in the main bearing web compensates for the lack of a Y-block.

Specifications of the 221-inch Fairlane V8 are: Bore, 3.50 inches; stroke, 2.87; compression ratio, 8.7:1, horsepower, 143 at 4500 rpm; and torque, 217 pounds/feet at 2200 rpm. The 260-inch engine has .300-inch more bore (3.800), the same 2.87-inch stroke, 8.7:1 compression ratio, 164 horsepower at 4400 rpm and 258 lbs/ft of torque at 2200 rpm.

A high bore/stroke ratio was used with several benefits resulting. First, the short stroke gave a low rate of piston speed which promoted long engine life and lower friction losses. Second, the large bore gave ample room for large valve sizes and good breathing characteristics. Third, the short stroke plus a short connecting rod and small diameter crankshaft counterweights made possible a very compact cylinder block. This last item, small overall block dimensions, eliminated additional cast iron and trimmed weight. Using the intake manifold as the engine top cover also eliminated additional weight.

The crankshaft for the 221 is cast nodular iron like that used in all late Ford engines and weighs just 37 pounds. Instead of placing all counterweight directly in the crankshaft, weight was added to the ends of the crankshaft where it is both more effective and available for external balancing after the engine has been run. Weight is added to one point of the flywheel with offset bolt holes in crank flange and wheel to prevent mislocation. Also, a cast iron front damper with offset weight bolts to the nose of the crankshaft for balance weight. Both the flywheel and the front damper are drilled several points around their edge so that steel plugs can be installed after assembly to ensure balance to within one ounce/inch.

Bearing sizes for the crankshaft are very generous for engines with such displacement. The main bearing journal diameter is 2.25 inches with actual insert width of .938 inches for all but the center thrust main which is 1.125 inches wide. Steel-backed babbitt bearings are used for all mains. The rod journals on the crankshaft are 2.125 inches in diameter and the inserts used have copper-lead bearing material, are .840 inches wide. The Fairlane V8 lower end is rugged and has plenty of bearing area for increased loading through engine modifications or increased displacement.

There are a couple of new wrinkles in the piston and rod assembly for the new V8. The first, an interference fit pin in the rod, is not new but it is the first time Ford has used it in a V8 engine. Ford used pressed pins in the Falcon six for the first time. The forged steel connecting rods are 5.155 inches from center of the big end to the center of the pin bores with a pin diameter of .912 inches. The pins, which are a hand press into the pistons, are pressed into the pin hole of the rod which has been induction heated to permit easy assembly. When both the rod and pin are the same temperature, the pin is firmly locked in the rod and cannot move. This method eliminates the need for pin locks as used with floating pins and eliminates a total of eight bearings, the bushing in each rod end, which are possible wear points.

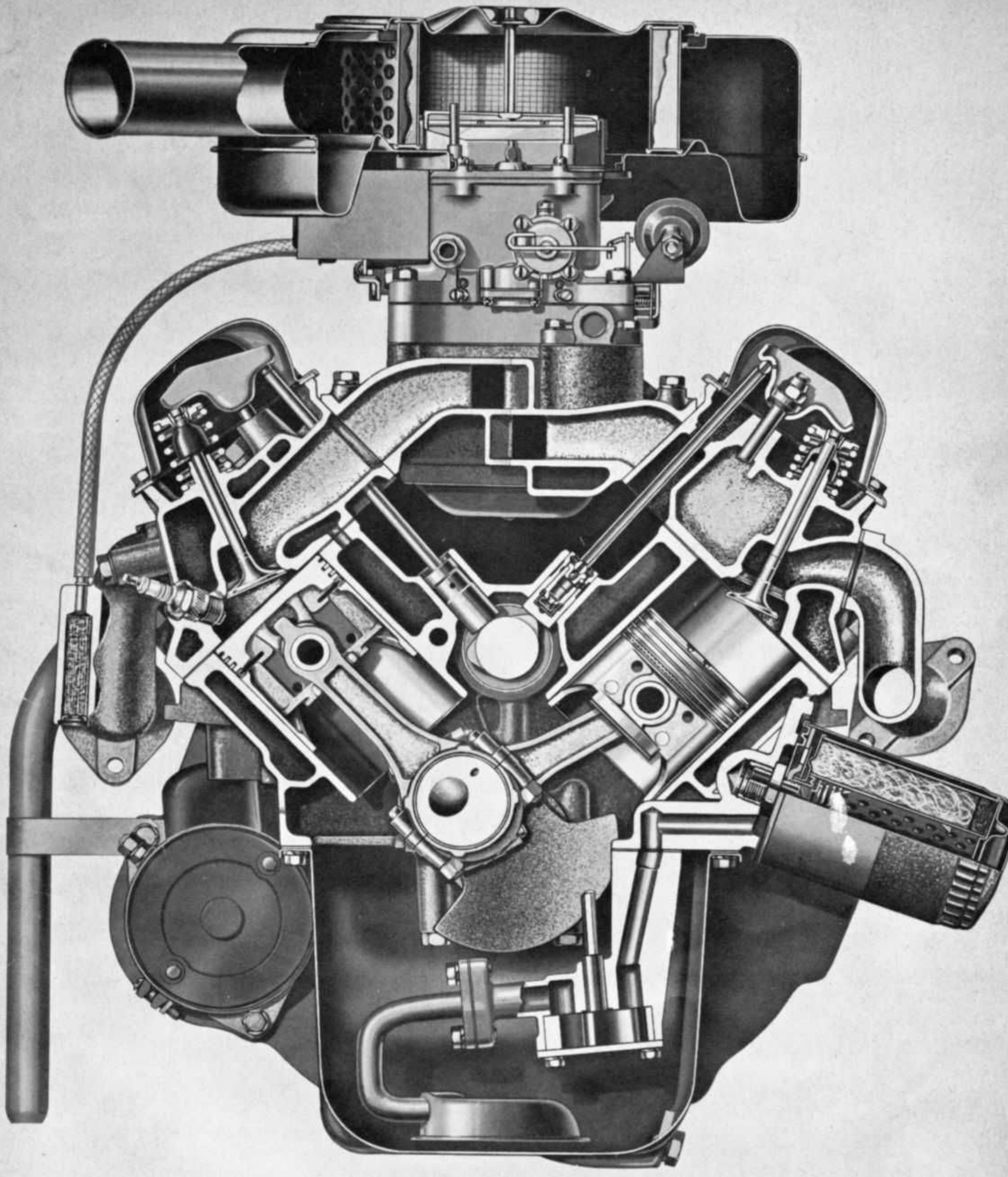
A second new wrinkle is in the piston itself. Although they are of flat top, slipper skirt design with steel inserts in aluminum castings and tin-plated for wear resistance, at first glance they appear to be of four-ring design instead of the more conventional three. There are four grooves around each piston but only the bottom three are for rings. The top groove functions as a "heat dam" and carries no ring. As heat from the combustion escapes by the top land of the piston it rushes into this extra groove which is full of gases that have been cooled by the surrounding cylinder walls and piston. This dam of cooler gas therefore blocks the high combustion temperatures before they can reach the top compression ring which in turn prolongs ring life, cuts oil consumption. The top compression ring is chromed, the second is cast iron and the oil ring is a three-piece ring with an expander and two chromed oil scraper rails.

Fairlane V8 cylinder heads are cast iron but employ the same thin-wall foundry techniques used in the block to eliminate excess weight. Combustion chambers are sand cast of wedge design with the wedge centrally located so that the valves can use the maximum width of the bore when open. Valve layout is such that no two intake, or no two exhaust valves are located together. This arrangement of intake, exhaust, intake, exhaust, intake, etc., improves cooling of the chamber and eliminates hot spots caused when two exhaust valves are together, so should make blown gaskets from head distortion a rarity. The valves are spaced well apart in the chamber so gas flow through each valve is unrestricted. Just as an item of interest, larger valves could be dropped in easily with such wide spacing, especially with the larger 260 bore.

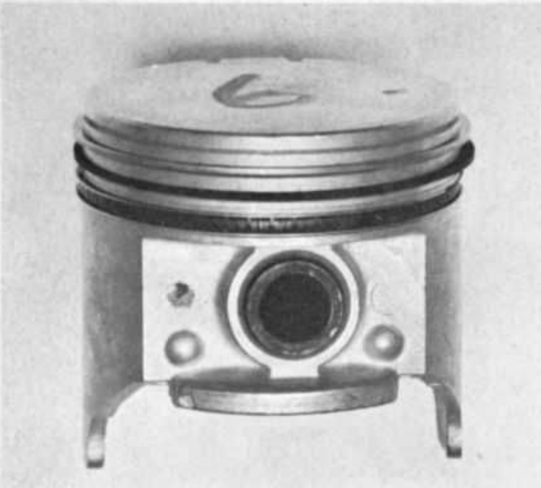
Standard valves are of good size with the intake of special forged chromium-manganese-nickel alloy and 1.680 inches in diameter. Exhaust valves are cast of austenitic steel and have a head diameter of 1.390 inches. Both valves use a neoprene umbrella seal over the stem and a single spring with stamped steel retainer. The springs are of variable rate design with closer coils at the bottom and have a seat pressure of 60 pounds, 180 pounds when open.

The new engine does not use rocker arms mounted on a shaft like all other overhead valve Ford engines. Instead, individual ⅜-inch diameter steel studs are pressed into special bosses cast in a row along the top of the head. Each rocker arm mounts on a stud with a pivot ball and adjusting nut on top of the rocker. An elongated hole through the edge of the cylinder head guides the upper end of the pushrod and this in turn, keeps the rocker arms aligned.

Special rocker arms were also designed for this engine. The rockers are first cast of nodular iron, then annealed so they are soft, and stamped with a coining die. The coining operation forms the stud ball socket, the pushrod socket and the radiused face which contacts the valve end. A single

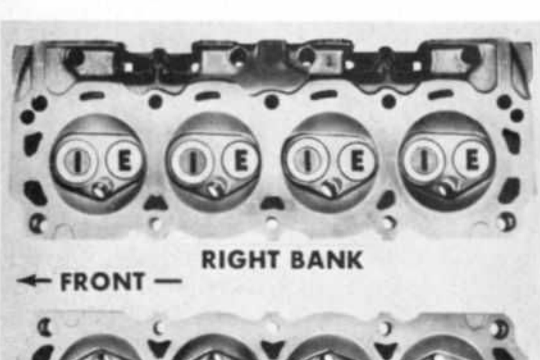


Here is a photo cross section of an engine with generous port areas displayed. The 221-260 V8 does not use Y-block design.



Fairlane V8 piston is cast aluminum, slipper skirt design. Top groove acts as heat dam to protect rings.

Valve train layout is shown for 221-260 V8. Push-rod tubes have ball bearing ends. Rocker studs press into head. The rocker pivot ball is sintered metal.



Cyl. heads for Fairlane V8 use wedge-shaped chamber. Intake, exhaust valves are alternated so no two exhaust valves are adjoining to cause hot spots.

small hole is drilled through the arm into the pushrod socket so that lubricating oil which flows up the pushrod can be fed to the stud ball. The final operation is to heat-treat the rocker arm. The rocker arm has a ratio of 1.6:1 and is much lighter than a conventional cast iron adjustable rocker arm. Additional benefits are the excellent oil retaining properties of cast iron to give good lubrication and the sound deadening qualities of cast iron versus steel.

Sintered iron rocker arm balls are used on the 3/8-inch studs to provide a pivot point for the rocker arms. Holding the ball in place is a self-clocking 3/8-N.F. nut which is installed at the factory to a specified height below the top of the stud to provide the proper operating range for the hydraulic lifter piston. Mechanical lifters are not available for these engines but when and if they are released, adjustment would be by the stud ball. All rocker studs are pressed into the head by 2500 pounds pressure so should never loosen but if some ambitious Fairlane owner decides to modify his engine, increase spring pressure and maybe turn the engine so tight that the valves float, the studs might loosen. In this case, a pin through the stud boss and into the stud should solve the problem.

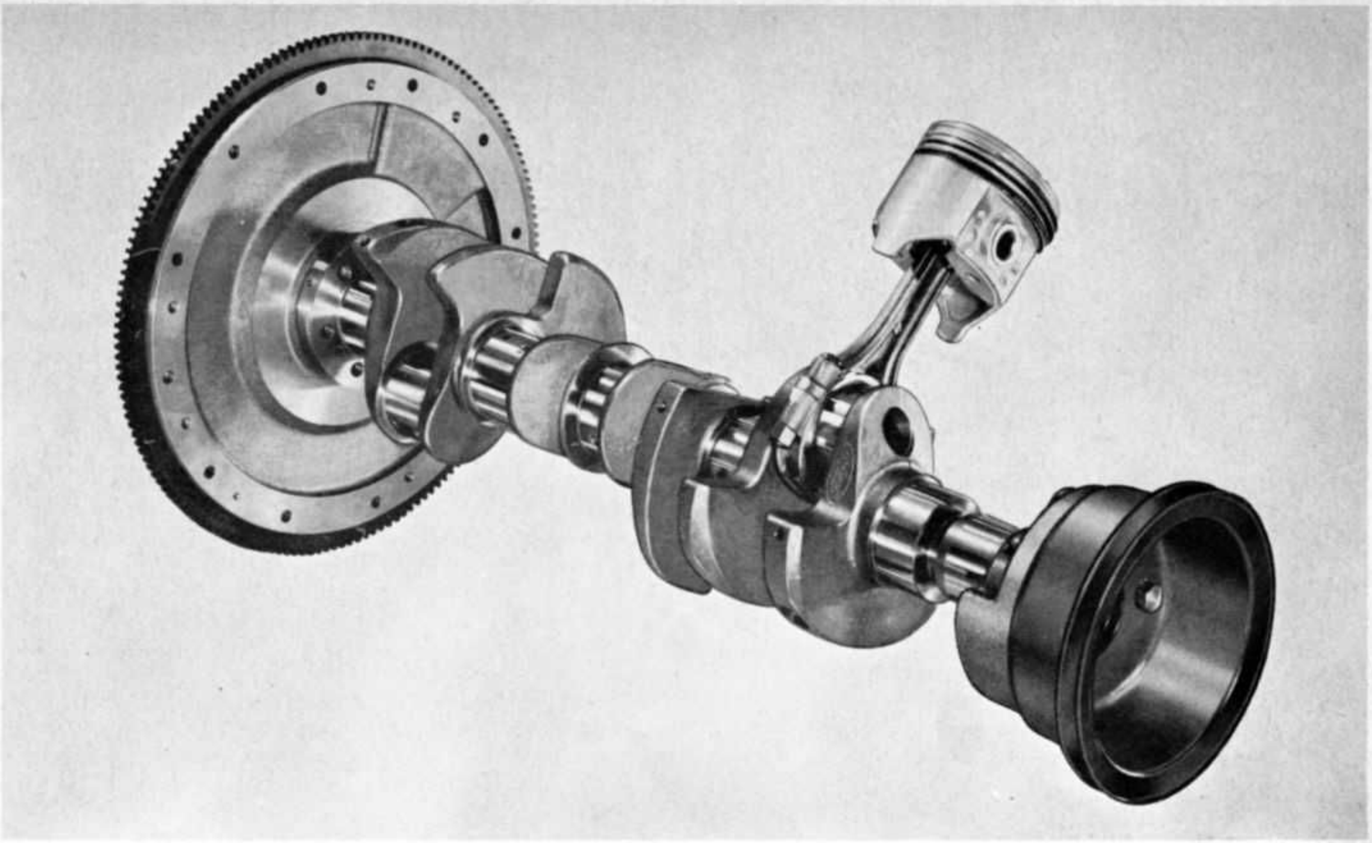
The pushrods are hollow and used to carry oil from the lifters to the rocker arms for lubrication. Instead of spinning the ends of steel tubing to form the pushrod rounded end, Ford uses a ball bearing. These 5/16-inch ball bearings are drilled prior to heat treating, then induction welded to the ends of 5/16-inch .055 wall tubing. This provides ends for the pushrods that should be absolutely wear resistant.

The lifters are hydraulic and have a drilled hole in each pushrod seat to meter oil to the hollow pushrods and subsequently the rocker arms, valve stems, etc. The camshaft is designed for low speed torque and therefore has smooth idling characteristics but mild top rpm performance. The camshaft uses a new induction hardening process which insures long cam life. Lobes are tapered slightly when ground to provide tappet rotation and prevent "spot" wear. The distributor and oil pump are driven from a gear just behind the front cam bearing.

The front engine cover for the 221 is a die-cast aluminum item which is both good looking and effective in dampening noise of timing sprockets and chain. A mechanical fuel pump bolts to the left side of the cover and is driven by a steel eccentric which bolts on the nose of the camshaft. An engine vent tube which also doubles as an oil filler tube is pressed into the upper right side of the front cover. A die-cast aluminum water pump housing bolts to the front of the cover and circulates water pumped by a cast iron impeller to each bank of cylinders.

The oil pump is driven from an extension of the distributor shaft at the front of the engine. The pump has an aluminum housing and uses a fixed screened pickup in the oil pan sump. The same pump eccentric and gear used in the 390-inch Ford V8's are used in this pump so it is no wonder that oil pressure is more than adequate at all engine speeds. At hot idle, in fact, the average pressure is 35 pounds. The pressure relief valve is set to bypass oil above 50 pounds pressure. From the pump, oil is routed through a full flow filter, then back into the block where it feeds three main oil galleries, one through the center of the lifter bores on each side and another through the length of the block just to the right of the camshaft to feed main bearings and cam bearings.

The intake manifold is cast iron and by virtue of the many jobs it performs, is quite heavy despite the modern casting techniques. The manifold is made to use a two-barrel carburetor so has two manifold risers. One riser feeds four cylinders 180° apart in the firing order while the other riser feeds the remaining four cylinders located 180° apart. All passages in each section of the manifold are designed to be the same length for smooth low rpm performance.



Fairlane crankshaft is cast nodular iron and very light. However, offset weight is added to flywheel and front damper to get smooth balance in operation.

Hot water from the engine is returned through the cylinder heads, then through passages cast into the front of the intake manifold. An additional passage in this busy manifold provides a heat riser passage between heads so that exhaust gases can pass beneath the floor of the main passages under the carburetor to speed vaporization. The final bit of business carried on by the manifold is an oil breather chamber on the bottom of the manifold which vents through a flange on the top rear of the manifold to eliminate moisture and internal pressure from the engine.

The carburetor is two-barrel with a rated capacity of 210 cubic feet of air per minute. An aluminum spacer is sandwiched between the carburetor and manifold with outlets so that hot water from the engine can be used around the base of the carburetor to promote complete fuel vaporization and produce maximum mileage. The carburetor is equipped with an automatic choke which pulls heat from a stove on the right exhaust manifold. The air cleaner is a pleated paper replaceable type in a steel silencer cover.

The cast iron exhaust manifolds have generous internal dimensions and dump into tubing exhaust pipes through flanged outlets at the rear of the manifolds. No heat riser valve is used with the Fairlane V8.

The 221 distributor has both mechanical and vacuum advance devices. A total of 30° crankshaft advance is available through centrifugal weights at engine speeds above 4000 rpm. Maximum vacuum advance is approximately 18° above 15 inches of manifold vacuum. Below 7½ inches, the vacuum diaphragm does not operate. Initial advance is 6° BTC with the vacuum line disconnected.

There were several definite requirements that had to be met when the V8 Fairlane engine was designed; light weight, economy of operation, smooth running, quietness of operation, compact package, etc., but the Ford engineers came up with all the right answers. There also seems to be plenty of room left to spread out in another direction—performance.

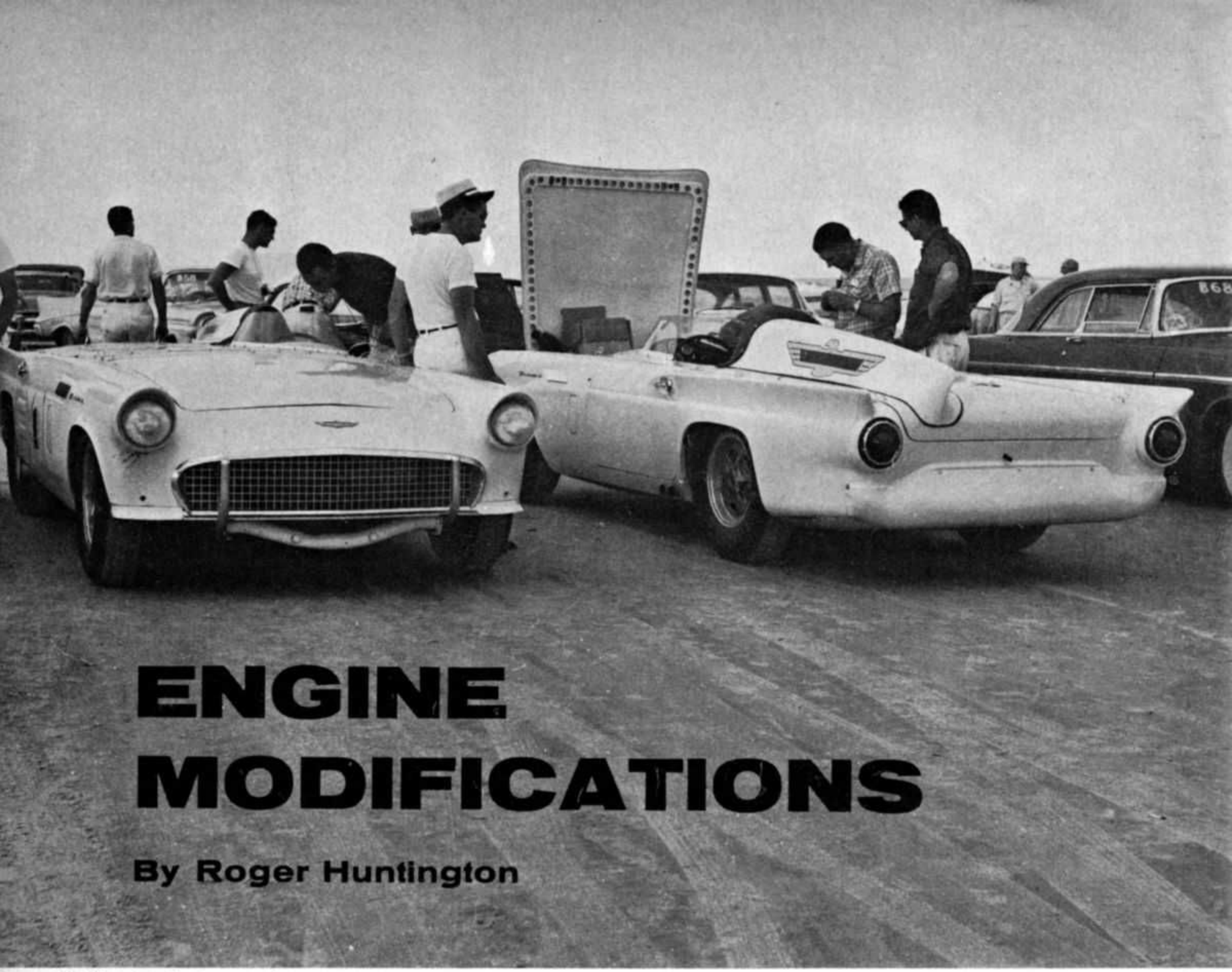
The engine is physically small by our American standards, being only 20 inches wide across the manifolds, excluding flanges. It is just 29 inches long from the bell housing face to the tip of the water pump shaft. Height is 28½ inches from the top of the air cleaner to the bottom of the oil sump. For a comparison, the 283 Chevy and Buick-Olds aluminum V8's are approximately 27 inches wide across the exhaust manifolds.

The engine is also a lightweight by cast iron standards. Aluminum engines of comparable size weigh less but this engine, complete with all accessories including bell housing, flywheel and clutch assembly, checks in on the scales at less than 475 pounds. The Y-V8 designed less than ten years earlier and with 239 inches displacement, weighed approximately 200 pounds more with the same equipment.

Bore spacing on the Fairlane V8 is 4.38 inches, the same as that used on the Y-V8, and the bore for the 260-inch version is 3.800, the same as that used for the 312-inch Y-V8. The engine has potential for future expansion in the stroke department.

Currently, high performance engines are not being offered in Fairlane series cars but a special 260-inch version is being built in limited quantity for the Cobra sports car marketed by famed racing driver Carroll Shelby. Shelby imports British-made AC chassis and then installs the high performance Fairlane engine he buys from Ford. These engines are delivered to Shelby with a four-barrel carburetor system, larger valves in new heads, high performance mechanical camshaft, higher compression ratio and many other special engine pieces. They produce in excess of one horsepower per cubic inch and some with additional modifications by Shelby, are reported well over the 300 hp mark.

Less than a year old, the Fairlane V8 is already gaining a reputation that will place it in the same elite category occupied by Ford V8's of both the past and present. Inch for inch, this engine does not have to yield to any V8 made. ■



ENGINE MODIFICATIONS

By Roger Huntington

Modification for increased power can progress along many routes. These two '57 T-Birds were specially built by DePaolo Racing team to compete in Experimental and Sports car classes during 1957 Daytona Speed Trials. One was fitted with a big injected Lincoln engine while the other had Ford's supercharged 312 engine. Both cars were very fast; Lincoln version turned 160.

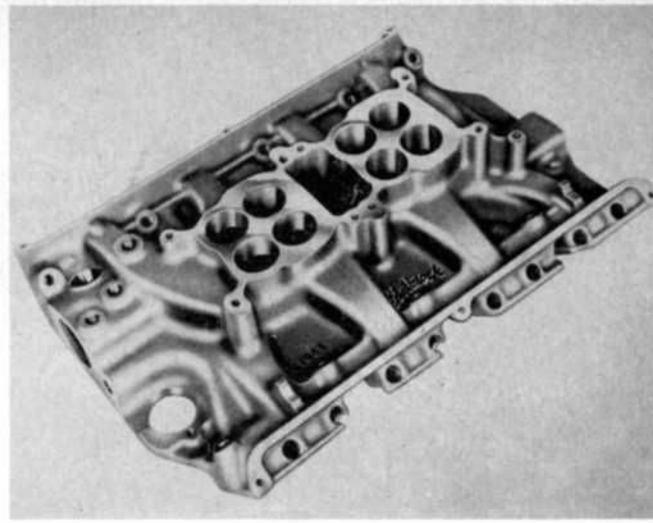
THERE will always be thousands of car enthusiasts who are never satisfied with the standard performance you can buy at the showroom. Even when some of the factories are building out-and-out **hot rods**—(which they definitely are these days)—they're still not satisfied. They insist on the right to engineer their own "customized" performance with special speed equipment and modification procedures that have been the lifeblood of the hot rod sport for 25 years. These fellows are hopeless hop-up bugs. Sometimes they can't do any better than factory engineers; I've seen many instances where a modified Super/Stock engine didn't go any better than a well-tuned **stock** Super/Stock! But no matter. The hop-up enthusiast is having a ball—and there's always the very good chance that he'll strike on just the right combination that will make a world-beater. The specialist still has every advantage over the mass-producer.

The purpose of this chapter is to bring you up to date on available special performance equipment for late Ford Motor Company engines, with some hints on the **application** of this equipment and other special procedures to get your best performance compromise. (And engine modification is **always** a compromise.) I think it would be best if we considered each basic engine model separately, as they all have special problems that don't apply to the others. These basic engines are as follows: (1) The '54-'57 Ford-Mercury-Thunderbird Y-V8—which is still used as a standard V8 in 292-cubic inch form; (2) the '58-'62 Ford big V8, also used in some Edsel and Mercury models; (3) the '58-'62 Lincoln, also used in some earlier Mercurys; (4) the Falcon-Comet Six; and (5) the Fairlane-Meteor V8. Here's a run-down . . .

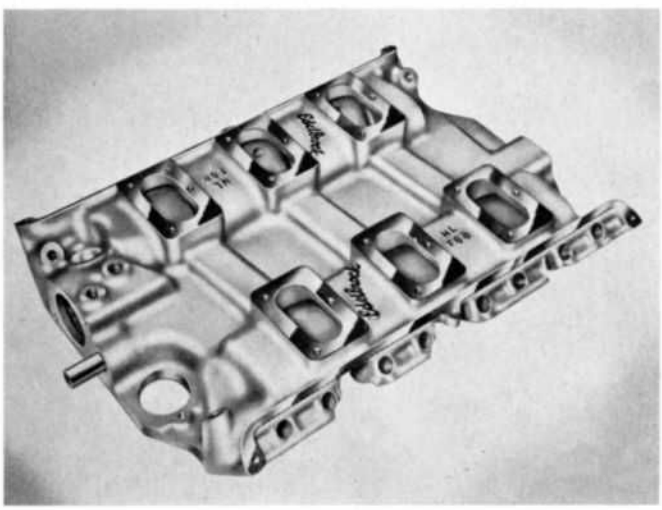
'54-'57 FORD-MERC

This engine lacks the cubic inch potential of some of our later designs (maximum stock displacement was 312 inches), but it has plenty of hop-up potential within its size class. The basic engine was available in stock displacements of 239, 256, 272, 292 and 312 cu. in. All these blocks will take an overbore up to ⅛" except the 312, which should be limited to 3⅞ total bore (.075" overbore). The 272 and 292 blocks will take a stroke increase of .340", but the 312 should be held to ¼" total stroke increase (to 3.690" total). It is suggested that the beefier 312 rods be used in all stroked en-

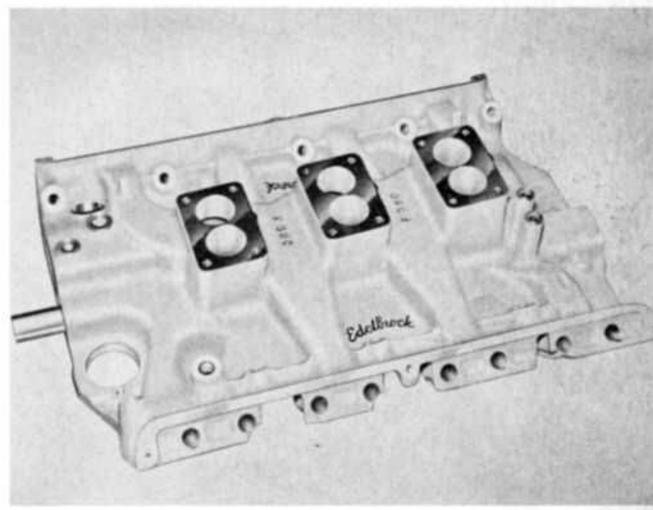
Newest Edelbrock intake manifold for 332- thru 406-inch Ford V8's takes two big bore Carter AFB carbs to give improved breathing. Progressive linkage hooks to stock Ford bellcrank.



Manifolds for the late Ford big V8's are difficult to make since they cover top of engine, also extend beneath rocker covers so require extra machining. Manifold has 180° layout.



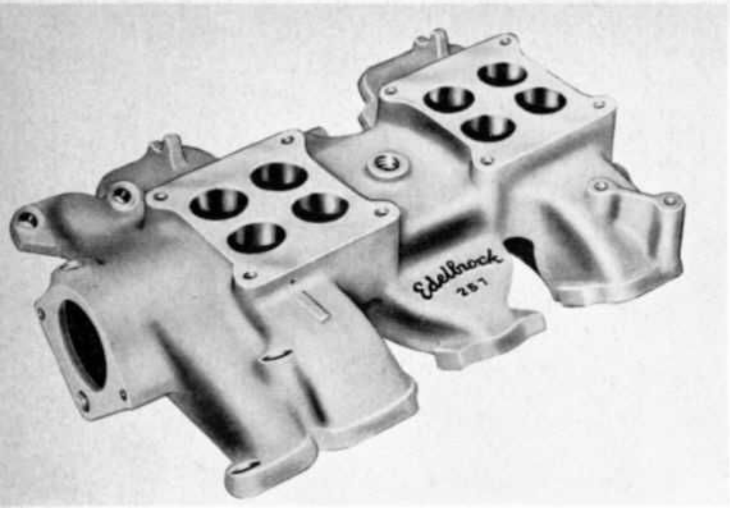
For all-out competition big V8, Edelbrock six carburetor log intake manifold provides maximum amount of intake volume. Several different types of two-barrel carburetors can be used.

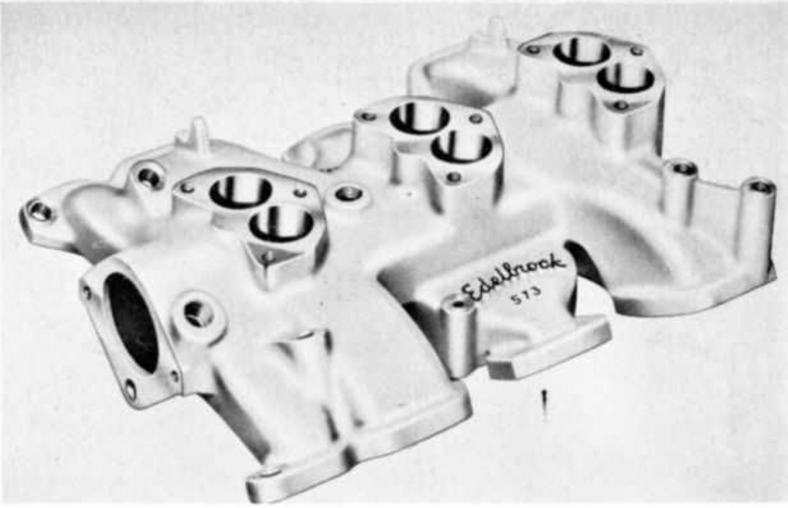


Forerunner to Ford's triple intake system in 1961 was this aluminum manifold made by Edelbrock in 1958. It uses Holley or Stromberg two-barrels, progressive or straight linkage.

Weiand three-carburetor intake manifold for Y-V8 Ford and Merc 272-312 engines has exhaust heat to the bottom of the passages to improve fuel vaporization, give smooth operation.

Weiand six-carburetor log manifold for '54 to '62 Y-V8 engines is basically for competition usage. It has no exhaust heat riser passage, water must be piped from outlet on each side.





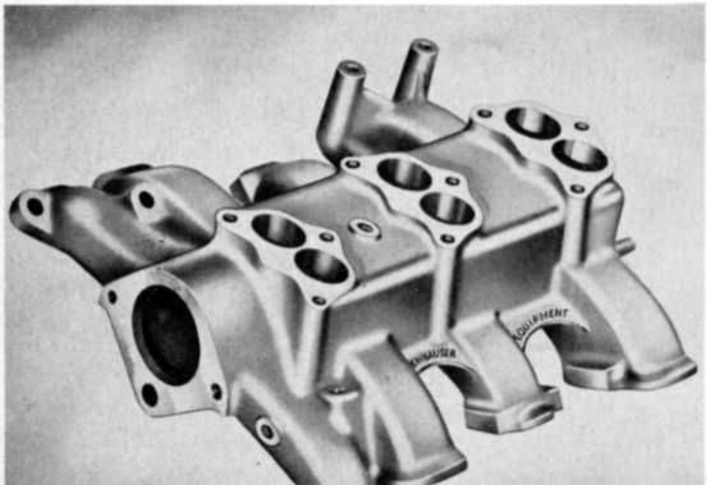
gines. The maximum recommended bore and stroke on the 312 block (3⅞x3.69") would give 348 cubic inches. That's the potential.

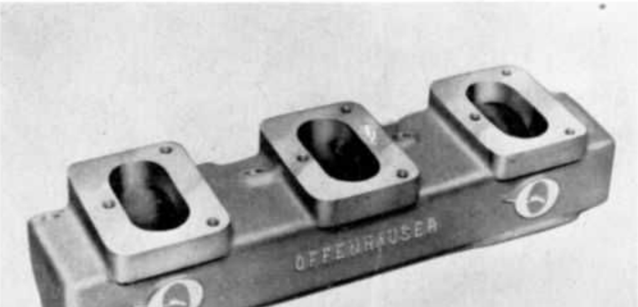
If you want to increase stroke the best practice is to buy a complete "stroker" kit, which includes oversize pistons (in any desired bore), rings, pins, rods, the stroked crank, bearings—and the whole assembly is dynamically balanced to a gnat's whisker. This is the only way to go on this. Several big companies (like Crankshaft Co.) can supply. If you just want to increase the bore there are any number of California outfits that specialize in pistons for all engines. Names would include Jahns, JE, Venolia, Forgedtrue, Grant, Thompson, etc. These special pistons are available in any desired bore size, sized to any desired clearance, with crown height for any desired stroke—and you can order them with special raised domes to give any desired compression ratio. You can't go wrong. This is a good way to increase displacement and compression with one blow.

No other precautions seem necessary in the lower end. Stock copper-lead bearing shells are strong. Stock oil pressure and capacity are adequate. Bearing clearances could be increased to .002-.003" for a freer engine if you wish. Rebalancing the lower end, especially when you change pistons that may have a slightly different weight, is always a good idea. Piston skirt clearance should be .003-.007" for the street, but can go to .012 for competition.

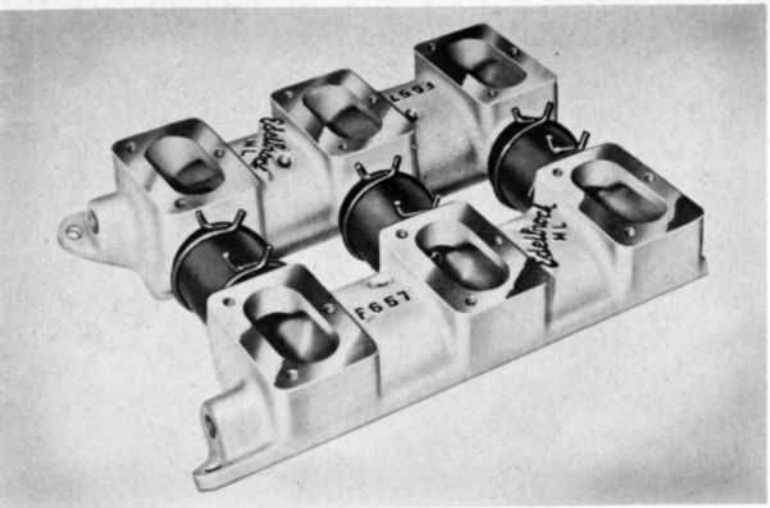
Cylinder heads are another area where we can do a lot for the output of this Ford engine. Fortunately all the heads for these '54-'62 engines are interchangeable, so we can do a little switching. The '57 heads for the 312 engine had 1.93" intake valves and much larger ports than the earlier heads. The boys who are really serious generally pick up a set of these heads, then start modifying from there. Ports are cleaned out a little, matched to the manifold openings, and generally they will run a 70-degree reamer down into the valve port (piloted in the guide bore) to open the port diameter out to a seat width of about 1/16" around the outside edge of the valve. This gives a substantial increase in breathing area without reducing seat width so much that valve life is affected. It is also practical to increase the size of the exhaust valve. Some fellows machine out the seat and port to take the '57 Lincoln exhaust valve (diameter increase from 1.51 to 1.64"), then chop and regroove the Lincoln stem to accept the Ford keepers. You can get some crazy breathing out of these heads with all the tricks.

One special word: Ford heads of this vintage had a considerable amount of restriction around the edges of the





ABOVE—Offenhauser's six-carburetor manifold for all Y-V8 engines consists of two of these cast logs. A pair of 1-inch neoprene hoses connect equalizer tubes not shown. LEFT—Offenhauser triple intake for Y-V8 engines is available in three styles; '54 Ford-Merc, '55-'56 272-292-312 and one for '57-later 312 and 292-inch larger heads.



FAR LEFT—Dual quad manifold was designed for use with '57 312-inch V8 with large intake valves and ports. Two Holley four-barrel carburetors were used with progressive linkage.

CENTER—Edelbrock triple intake manifold is available in three versions; early '54 model with small ports, '55-'56 272-292-312 and a larger capacity model for '57-later heads.

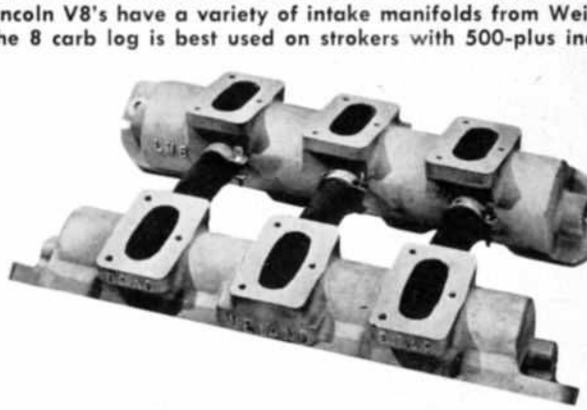
LEFT—Competition manifold made for the 272-292-312 V8's consists of two logs with three carburetors each and large connecting balance tubes. Logs are impractical for street.

valves caused by the walls of the combustion chamber being too close—so they actually shrouded the valve as it opened. Breathing can be considerably improved by getting in here with a grinder and cutting away this close restriction around the valves. Of course remember that any metal you take out of the chamber **reduces** the compression ratio. This can be restored by milling a little off the lower head surface. A maximum of .060-inch can be milled—though generally .030 is enough to compensate for combustion chamber "porting." (Incidentally, milling is a cheap way to increase compression. Keep in mind that a cut of .060-inch raises compression roughly one full ratio.)

Carburetion is one of your toughest problems on a modified engine. You need lots of venturi area and big manifold passages for minimum restriction at the top end (for maximum hp)—but if you go too far you lose a lot of throttle response and torque at low speed for the street. You have to compromise if you expect to have a nice driveable street machine. Fortunately there is a terrific variety of special manifold equipment available for this '54-'57 Ford engine. The factory has cast iron manifolds to carry a single 2-throat carb, single 4-barrel, or dual 4-barrels. Edelbrock has an aluminum dual 4-barrel with conventional "180-degree" passages, three different triple 2-throat manifolds to allow for the increasing port sizes through the years, plus a 6-carb log manifold (without heat) for competition. Weiand can supply triple 2-throat and 6-carb logs—and Offenhauser has three models of a 3 x 2 layout for the different port sizes. Edmunds has a 3 x 2 and dual 4-barrel in aluminum. There ought to be enough here to satisfy any need.

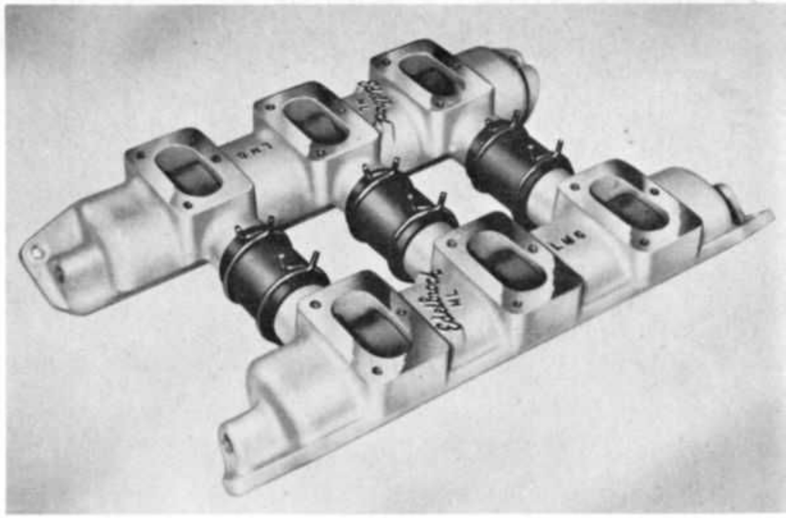
But which carburetion layout to choose for your particular needs? Personally I like either a single 4-barrel or triple 2-throat system for the street. This seems to be a good compromise on venturi area between high and low-speed performance. Ford 4-barrels have the secondary throttles controlled by the volume of air flow through the primaries, so there is no chance of overcarburetion when you suddenly open the throttle wide at low speed. Even a **dual** 4-barrel setup with this system isn't bad at the low end. Normally three 2-throat carbs would overcarburate at the low end. But by using one of the new "progressive" throttle linkages —where you run on only the center carb up to about two-thirds throttle, then the end carbs open at a faster rate to full throttle—you can get away from a lot of the response and gas mileage problems. (You still have to be careful about using full throttle at low speeds, however, as all six barrels will open wide.) The 6-carb log manifolds are great for maximum hp in competition. They're not very suitable for

Performance enthusiasts who choose the 383-430 Merc and Lincoln V8's have a variety of intake manifolds from Weiand. The 8 carb log is best used on strokers with 500-plus inches.



Six-carburetor log Drag Star by Weiand is also for 383-430 Merc and Lincoln engines. Extra carburetion will aid engines greatly but logs are not recommended for everyday street use.

And if you plan to go all out with one of the big Lincoln-Merc engines, Weiand also makes a blower manifold complete with popoff valves. GMC 6-71 blower bolts directly on top.



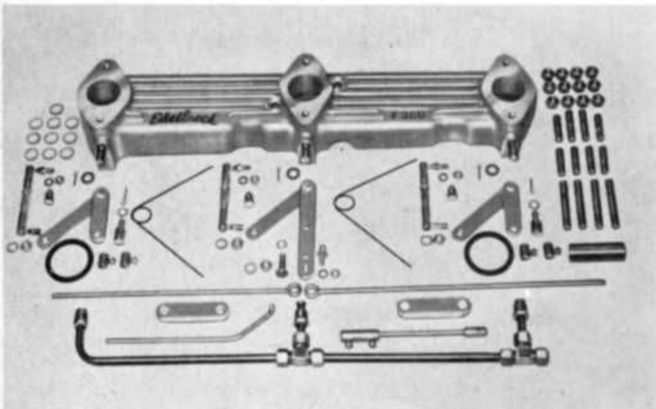
Designed for street use rather than all-out competition, this Edelbrock triple intake manifold for '58-'62 big Lincoln-Merc engines has balanced 180° manifolding. Return water from the heads passes under floor of log to assist vaporization. Edelbrock's competition manifold for the big Lincoln-Merc V8 is a six carburetor log with three equalizer tubes connected by neoprene hose. Special water return piping must be devised by customer to complete the circuit to the radiator.

the street, not only because of the excessive venturi area, but they don't have provision for exhaust heat to vaporize the fuel in cold weather. If you use your car for both street and competition, and are willing to put up with a little rougher operation, they're OK. But don't expect that luxury feel.

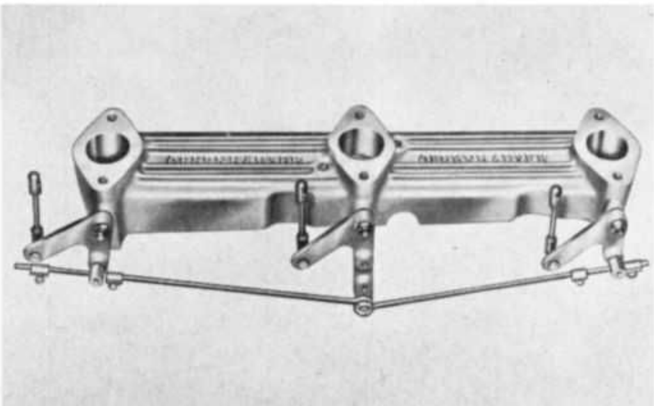
Camshafts and valve gear can make or break any high-output engine. It's much like the problem with carburetion. A long valve open duration (in degrees of crank rotation) and high valve lift, coupled with very quick opening and closing rates, are very effective in boosting top-end horsepower. But they also knock off torque at the low end. Also the high lifts and quick rates can overload your valve springs at high rpm, cause severe valve "float" that cuts power and ruins the valve gear. No, you've got to compromise carefully on valve timing, lift and rates—then get just the right combination in the valve gear.

You have a lot of equipment to choose from in the specialty market. The big cam companies like Iskenderian, Howard's, Racer Brown, Engle, Harman-Collins, etc., can supply complete kits that have every part engineered to match in performance characteristics, to give stable operation at the highest useable rpm. These kits generally consist of the camshaft itself, with any one of perhaps a dozen optional grinds—plus lightweight compatible solid lifters (either flat or roller type), light tubular pushrods, adjustable rocker arms, with special high-tension valve springs and heavy-duty spring keepers and locks. The whole assembly is "tuned" to work as a unit. I can't recommend highly enough that you spend the extra money and get a complete matched kit. Hot cams used with stock lifters and springs can often wear lobes in a hurry, float valves at low rpm, clatter, fail to pull their potential. Don't cut corners.

As for recommendations on specific grinds for specific situations, this is much too broad a subject to touch here. Your best bet is to outline your car specs to the cam grinder, tell him what kind of performance you want, how the car will be used—and he will give you the optimum grind for the job. As for the problem of flat-vs.-roller lifters, there seems to be little difference in top power output. You can use stiffer springs with the rollers, to turn higher rpm, without wearing out cam lobes—and they seem to give



Falcon and Fairlane six owners can also improve their car's performance with the installation of a triple intake manifold. This type clamps to the existing Falcon manifold with O-rings sealing around a pair of inlet holes for end carburetors.



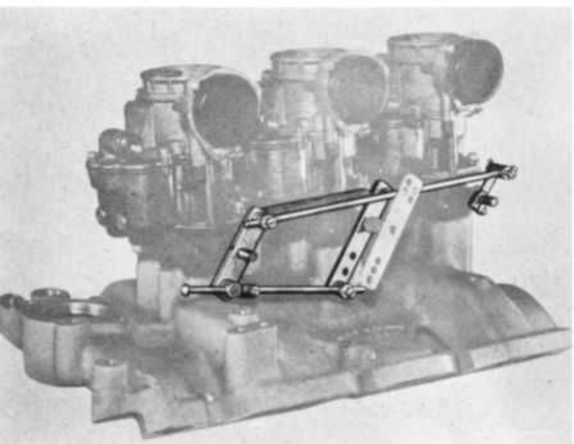
Offenhauser triple intake system for Falcon six is similar in design to Edelbrock's; both use O-ring seals between new log and existing cast iron manifold. Progressive linkage permits use of center carburetor only for average driving.

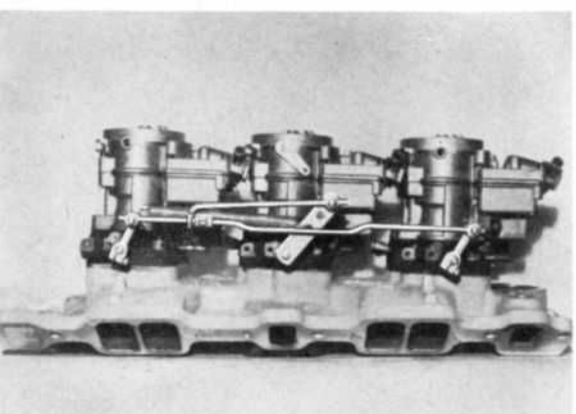
longer life on the street for this same reason. Some experts say the reduction of rubbing friction with roller valve lifters will add 15 to 20 hp to your net output. I don't know. I do know that roller cams are more expensive than flats . . . so you always have to balance the benefits against the cost.

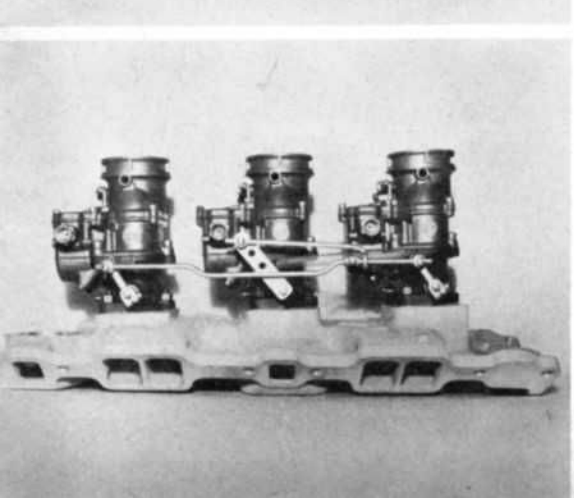
But I still recommend a complete cam **kit** rather than a piecemeal conglomeration of parts when you decide to go modified in this department.

There are lots of possibilities in special ignition equipment for late Ford engines. We have the well-known Mallory dual-point distributors, Magspark and Mini-Mag—and there are the dual-coil distributors by Jackson, W&H and Spalding. All have installations for all Ford engines. This is all high-quality stuff that will do the ignition job under the very toughest conditions. Actually stock ignition will do the job up to at least 5000 rpm, given the right spark advance curve. The special ignitions can take it from there —and, of course, they all feature custom advance curves that are tailored to a specific engine-car combination. This is a valuable feature. The optimum advance curve for dragging on these Ford engines seems to be an initial advance of 12-15 degrees (crank), with full advance of 36-40 degrees at a crank speed of 2000 rpm or so. Stock mechanisms can be modified to give it.

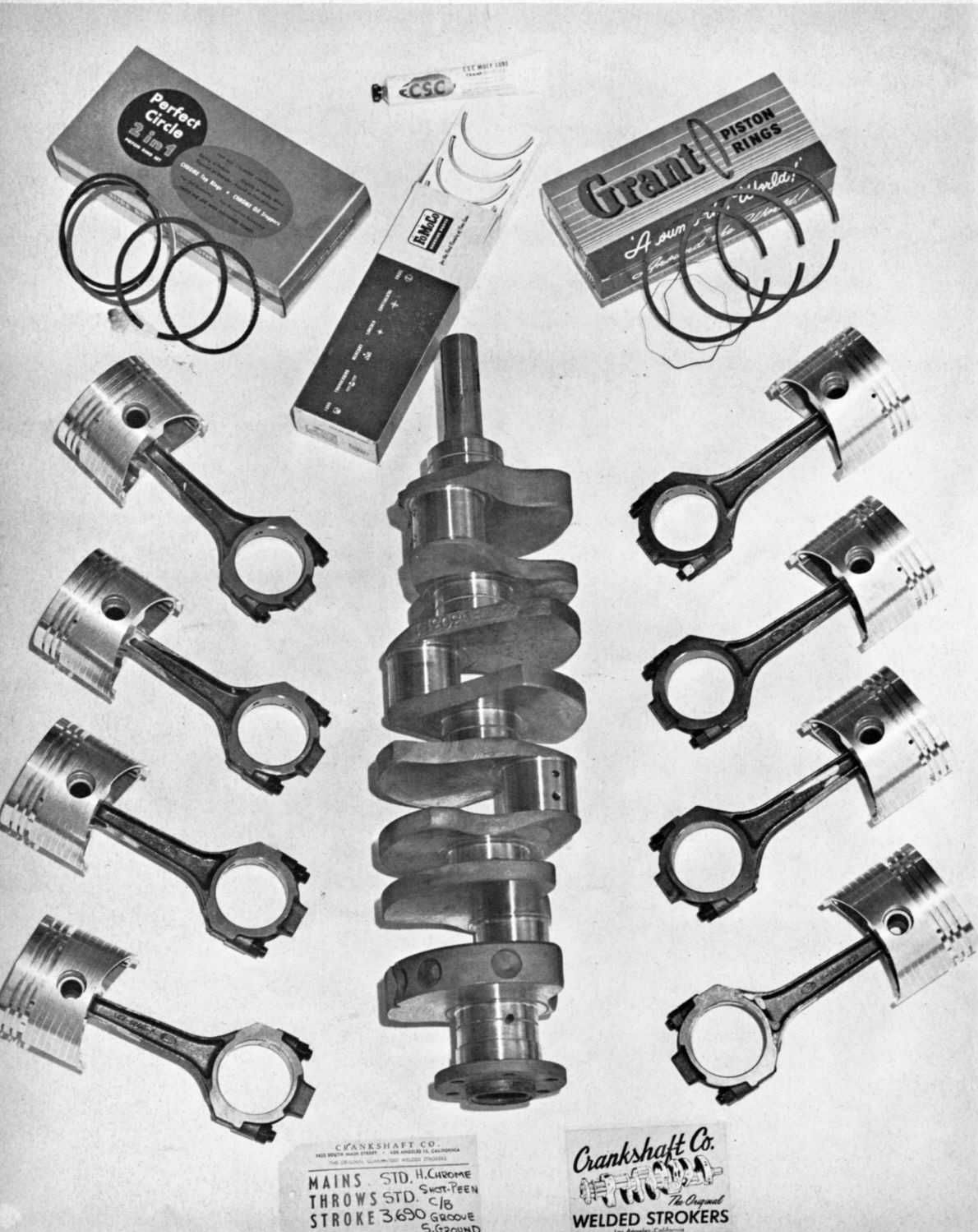
Superchargers are a very effective way to hop up any engine, since you're **pumping** the fuel-air mixture into the cylinder rather than depending on atmospheric pressure to force it in. As mentioned earlier in this book, Ford offered the Paxton "blower" as optional equipment in 1957 (300 hp); but only a few models were put out before the AMA anti-horsepower resolution put a stop to it. But those blown '57 Fords were the hottest thing in the Super/Stock class in those days. Paxton still offers that kit—and you can still go like that with it. Add the blower to a few other hop-up goodies like cams, big bores, etc., and you've got a wild machine. Latham Manufacturing also offers a

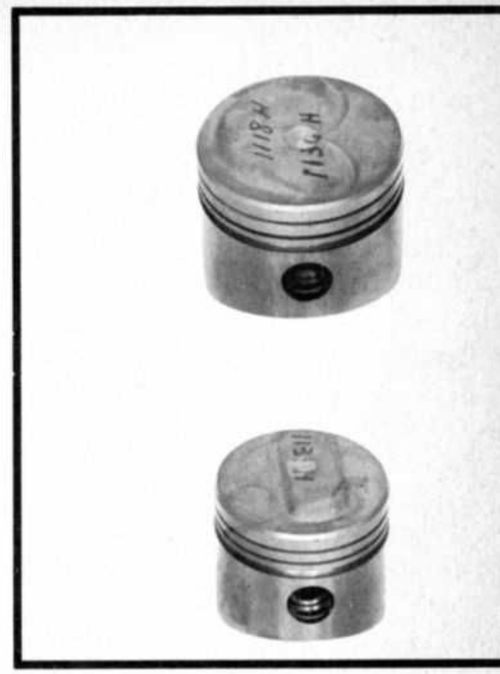






Stroker kits are a very popular method for gaining horsepower. This Crankshaft Co. kit for 406 Ford has 5/8-inch stroke increase, ribbed rods, forged pistons. LEFT—Three pictures show Edelbrock progressive throttle linkage used on different types of carburetors. Top, Holley; center, Rochester; bottom, Strombergs. In all three setups, the center carburetor acts as primary with two outboard carburetors starting to open at half throttle and all reaching full together.


Perfect Circle
2 in 1
CSC
FoMoCo
Grant
PISTON RINGS
CRANKSHAFT CO.
MAINS STD. H. CHROME
THROWS STD. SHOT-PEEN
C/B
STROKE 3.690 GROOVE
S.GROUND
Crankshaft Co.
The Original
WELDED STROKERS
Los Angeles, California



LEFT—406 rods are very strong but Crankshaft Co. adds a rib on either side for use in stroker kits or with blowers. CENTER—Aluminum rods are also popular among rodders. This one by Howard is made with forging process for high strength. RIGHT—Jahns Piston Co. makes any style desired for Ford.. Top, domed 12:1 piston for 390 Ford; bottom, 10.5:1 Falcon.

neat axial-flow blower kit for the '54-'57 Ford-Merc, driven by a flat belt from a special crank pulley. This is a larger unit, has a bit more pressure and air flow potential than the Paxton—but it costs more. You take your choice. But either one of them will make your Ford come alive in a way you never thought possible.

No hot engine can really flex its muscles if it can't get rid of the exhaust gas efficiently. Speed experts used to say we didn't have to worry so much about exhaust restriction because the gas was being pushed out under 60-100 pounds of pressure. That's true . . . but now we know that we **do** have to worry about the restriction even so. It'll kill an engine's performance. Notice the beautiful streamlined exhaust headers on the late Ford high-performance engines. Ford engineers have gotten the message. Unfortunately they hadn't received it in the '54-'57 period—so you have to depend on the special "California" headers fabricated from welded steel tubing. The Hedman company can supply a full line of headers for these cars. They're a **must** for any all-out combination. Then take your exhaust back through dual lines. You can use either straight-through steel or glasspack mufflers or conventional baffle type. The packs have a good sound and slightly less restriction; but the dual outlet lines themselves cut back-pressure by 75%—so you don't sacrifice much performance by using the quieter baffles.

Do **something** about your exhaust anyway.

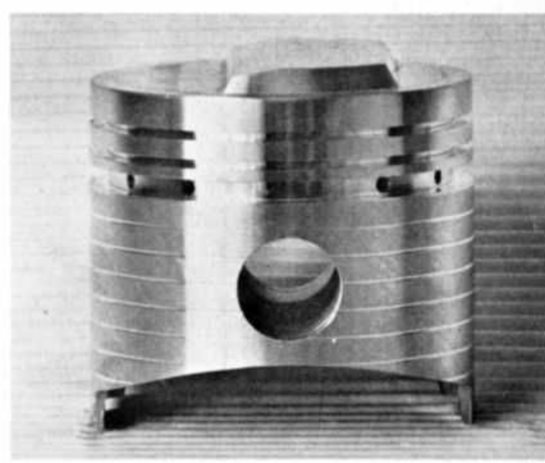
'58-'62 FORD

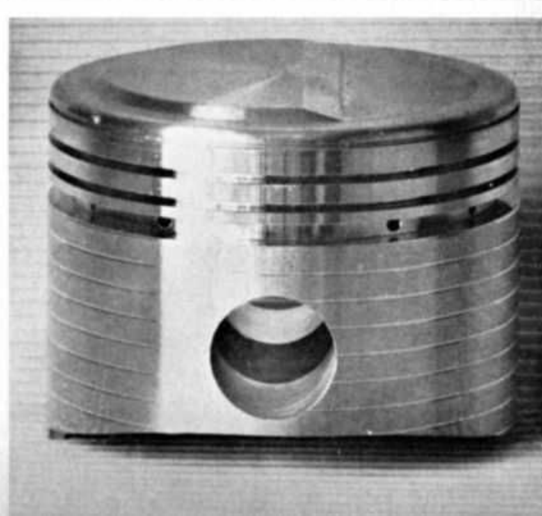
This basic engine is a little different kettle of fish than the earlier Ford-Merc design. For one thing, it has huge

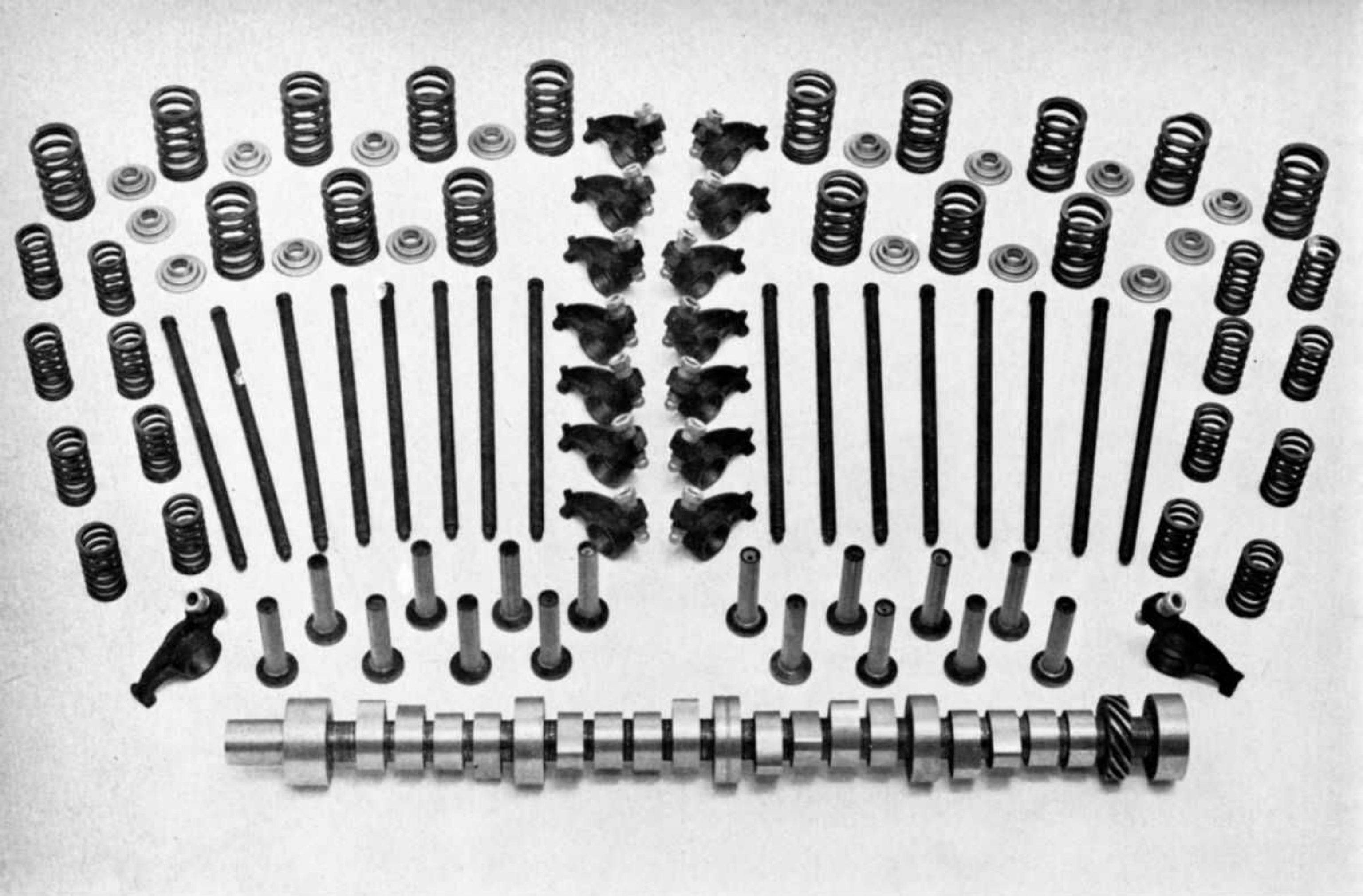
LEFT—Forged steel crankshaft for late 292-inch truck V8 is excellent for Y-V8 stroker kit. This has been lengthened .390-inch, mains grooved for increased oil flow, center counterweights added. Throws are hard chromed. Kit by Crankshaft Company also features forged pistons and ring sets of your choice. With 1/8-inch bore, displacement jumps to 348 inches.

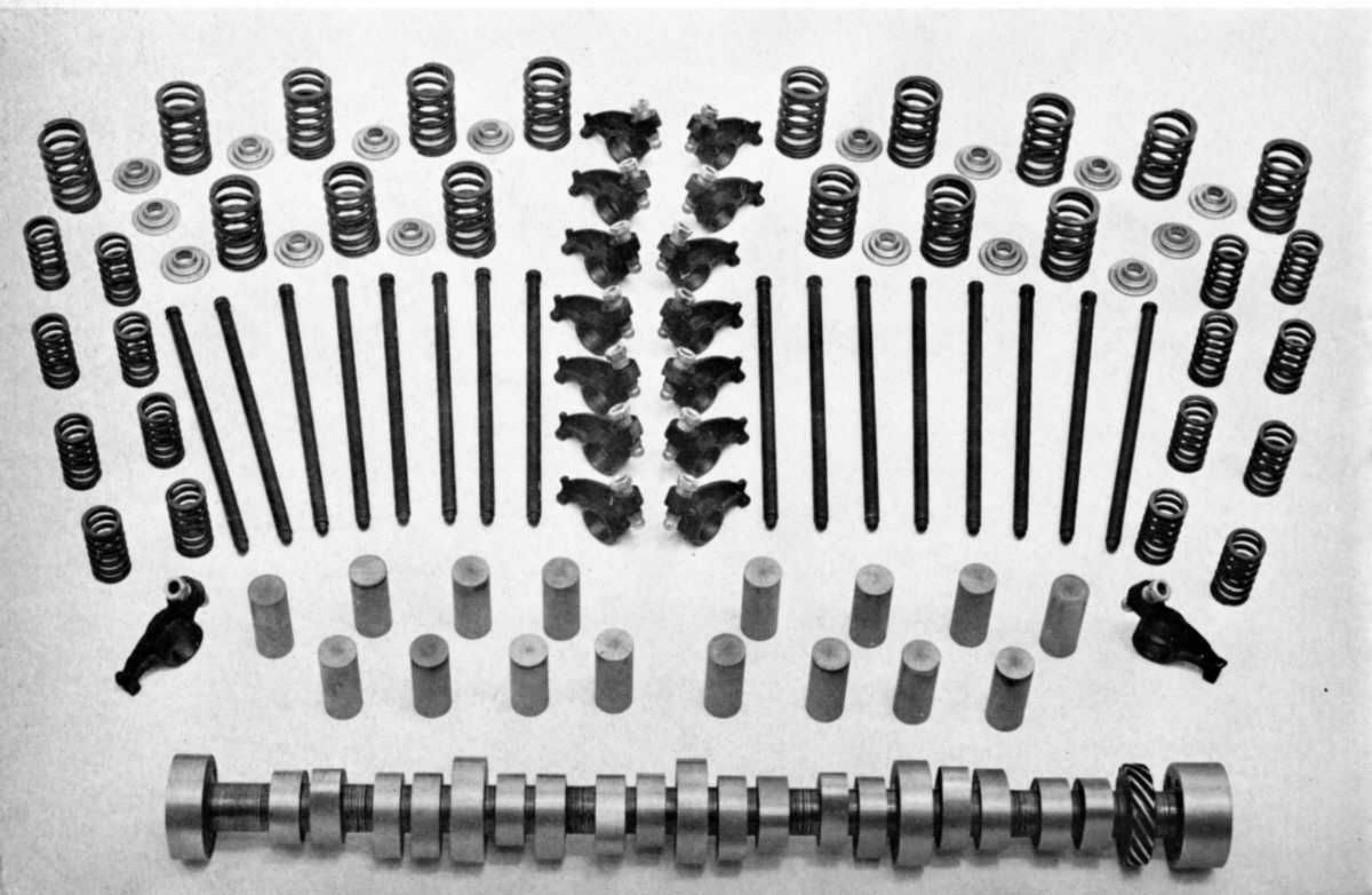
BELOW—Forgedtrue piston for 144-inch Falcon six has high popup dome to raise compression to 12:1. Compression can be juggled to fit customer's needs.

BOTTOM—Wide variety of pistons are available from Forgedtrue to fit other Ford engines. This dome top model for 406 gives a compression of 11.5:1.









valves and ports in stock form, so there's very little to be gained by doing a lot of head work. A little light porting, matching of head-manifold junctions, maybe some slight reaming out of the valve ports, and some grinding around the valve edges in the combustion chambers is more than sufficient for any demands. Compression ratio is already pretty high, so head milling is not promising.

The cubic inch potential of this engine is much greater than the earlier design, of course. It has been available in stock displacements of 332, 352, 390 and 406 cubic inches. The block can be safely bored to a total of about 4⅛"—which doesn't permit **any** safe overbore on the new 406 (as this bore is 4.130 to start with). Maximum stroke is ⅜ over stock. This would give a total of 473 inches on the 406 block! A full line of special pistons and crankshafts are available from the big companies, same as the smaller engine. If you're building up an all-out engine it might be a good idea to start with one of the '60-'62 high-performance blocks, as they have beefed-up bulkheads, main caps, rods, high-capacity oil pump, etc.

There is not quite as much special carburetion equipment available for this engine as the earlier Ford-Merc. Stock factory equipment includes cast iron manifolds for a single 2-throat and single 4-barrel carbs—plus special big-port aluminum manifolds for the late high-performance engines to mount one huge 4-barrel or three 2-throats. Edelbrock can supply an aluminum 3x2 with exhaust heat, a new dual four-barrel 180° aluminum manifold or an unheated 6-carb log. (This latter is more expensive than most log setups because of the unusual head layout of this Ford engine, where the pushrods come up through the manifold and the head castings are very narrow.) My recommendations for carburetion are about the same as on the smaller engine—that is, a single 4-barrel or triple 2-throats for the street and the dual four-barrel or 6-carb log for all-out competition.

Additional speed equipment pretty much follows the pattern of the earlier engine. A full line of camshafts with both flat and roller lifters are available (and don't forget the **factory** high-performance cam kits), Paxton and Latham supercharger kits, special distributors and ignition from all the big makers, and Hedman exhaust headers. In addition, the new Belanger and Jardine exhaust specialists are offering fabricated header sets that split the exhaust pulses from the rear two cylinders on the left bank, which fire successively in the firing order—so the pulse from the leading cylinder doesn't block the flow from the following (only 90 degrees crank rotation behind it) as the two pipes merge into the common outlet. The new Belanger and Jardine layouts pair cylinders 1-3 and 2-4 on the left bank, and use dual outlets to large collector chambers. No restriction at all. And, incidentally, the latest Ford factory headers for the 406 engine have the pipes divided to get away from this restriction. It's a new development in exhaust systems that can add 30 hp to your engine.

There's a lot of potential in this big Ford V8.

'58-'62 LINCOLN

Let's face it . . . this one hasn't exactly caught on with the hop-up boys. In the first place it was designed primarily for big, heavy luxury cars, with ultimate smoothness and silence as the prime design aims. It's comparatively big, heavy, and parts are expensive. But it **can** be made to perform. Several of the big-name dragster boys are going like crazy with it.

The list of available special equipment is not long. In carburetion you can get cast iron factory manifolds to mount a single 2-throat or single 4-throat carb. Edelbrock is there with an aluminum triple 2-throat setup with 180-degree porting and exhaust heat, plus an unheated 6-carb log. Most of the bigger cam companies can supply cam kits, and full lines of special pistons and stroked crankshafts are available. Maximum allowable bore increase on the big 430-inch block is only .030-inch; but the stroke can be lengthened out ⅝—which gives you a total cubic inch potential of a very fat **504!** Price for an exchange stroker kit: Around $670!

Or you can go exotic. Paxton and Latham have bolt-on supercharger kits for the Lincoln. These might prove to be the best way of all to hop one up for the street. The blowers leave the engine quiet and smooth, you don't have to tear it down to install them, and you get a good performance boost over most of the rpm range. This big FoMoCo ought to be right at its best with this kind of hop-up. Think it over.

FALCON-COMET SIX

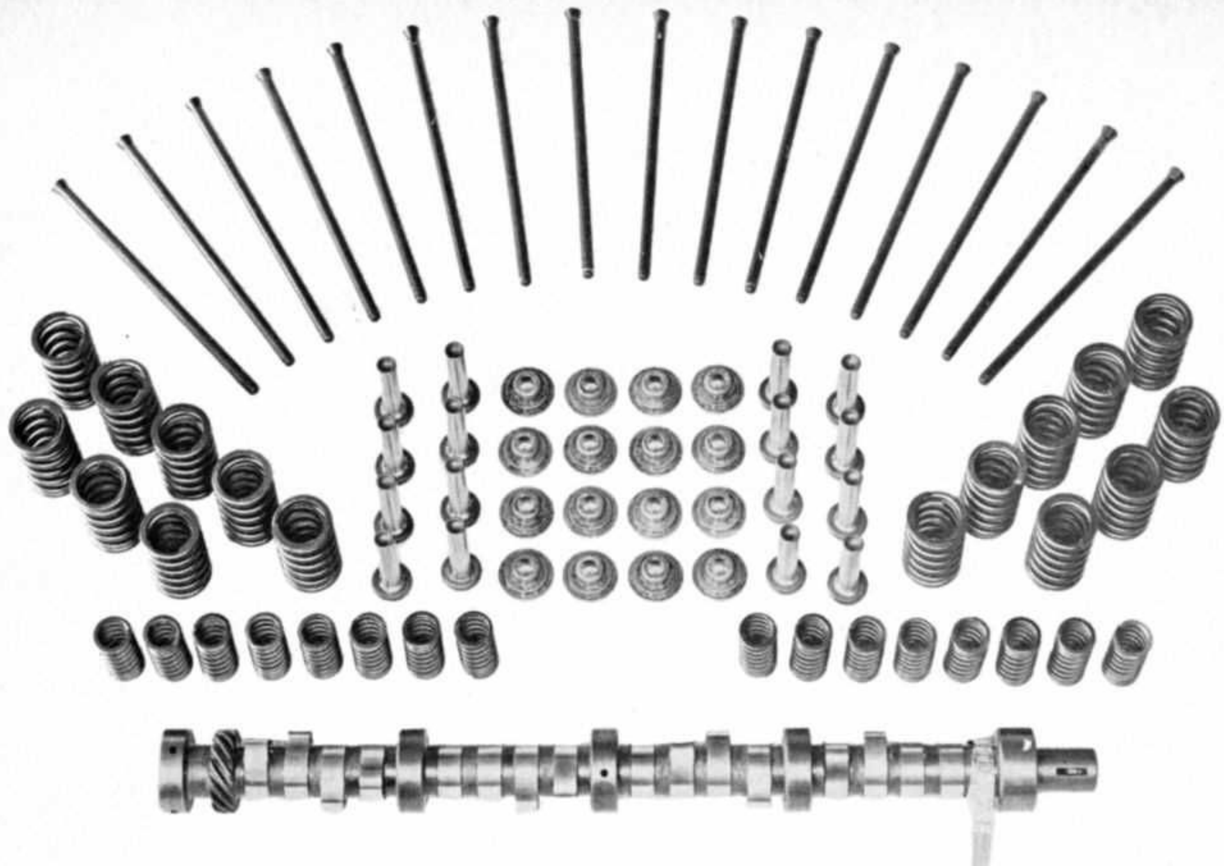
The little Falcon Six was designed with anything but performance in mind. It's strictly a utility engine—for practical, economical transportation with the least fuss and bother. But it was inevitable that some of the performance enthusiasts would see a challenge here. A few of them have performed miracles. Ford specialist Bill Stroppe got a dyno reading of 128 hp at 6000 rpm on gas with the original 144-inch displacement, compared with 72 hp in stock form! They pulled 187 hp on fuel in racing trim. The Granatelli brothers have achieved dyno figures above 200 hp from 156 inches. (⅛ bore) with their Paxton supercharger kit.) It **can** be done.

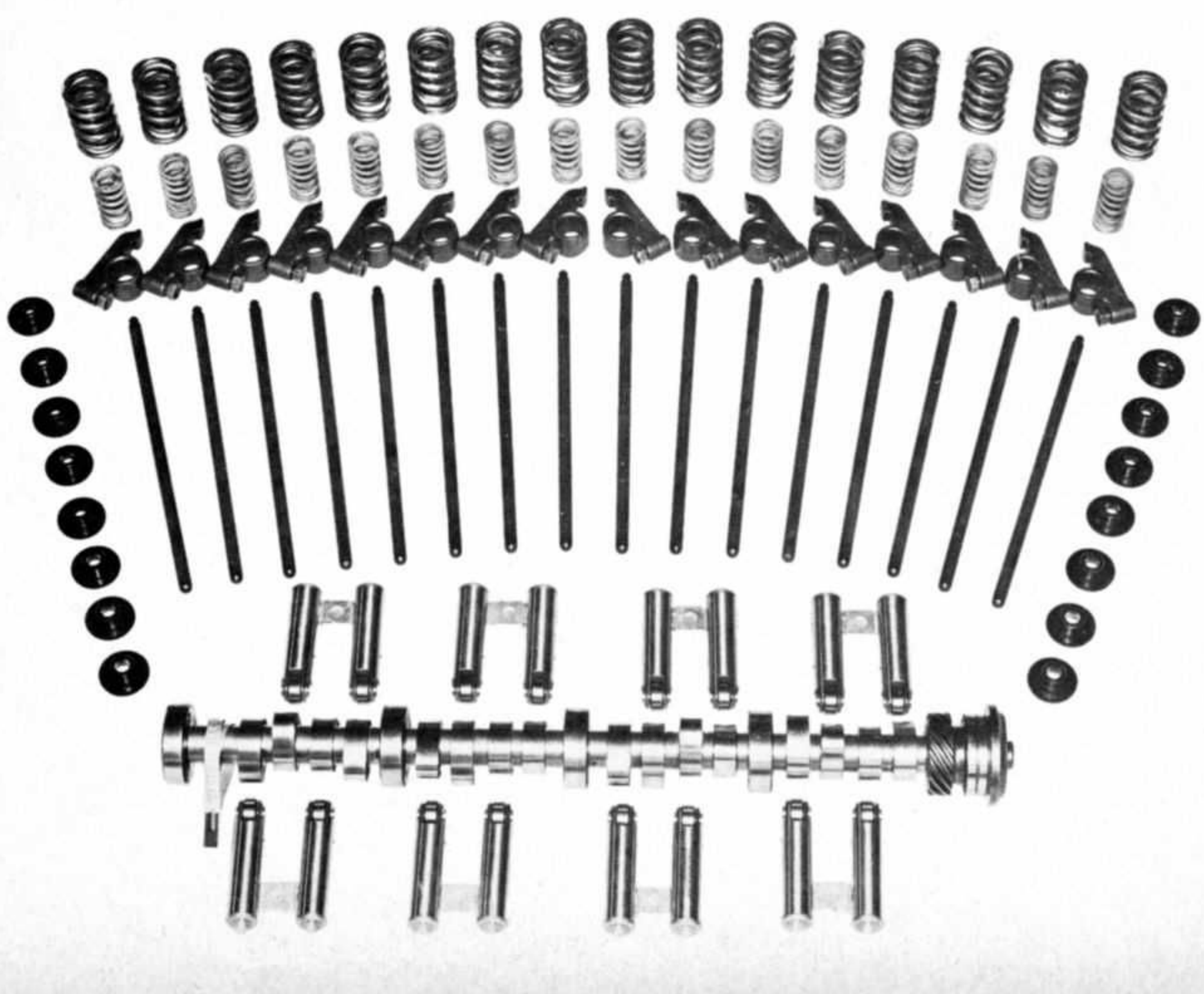
Biggest disadvantage of the Falcon engine from the hop-up standpoint is the intake manifold cast integral with the cylinder head. This makes it more difficult to add multiple carburetion. However the Edelbrock and Offenhauser companies offer special kits whereby you bore into the original manifold with a hole saw and mount three single-throat carbs on a special adaptor manifold through O-ring seals. It really works. Breathing can be further helped by opening up the valve ports a little with a 70° reamer (to narrow the valve seat to 1/16 or less), and it helps to grind out the combustion chamber walls around the valve edges a bit. Larger valves can be fitted, but it's hard to find replacement valves with the small .310 stem diameter. There is, however, quite a bit of meat in the head casting for milling. A cut of .070" will raise compression ratio from the stock 8.7- to 9.6-to-1. Or Jahns has special dome-top pistons (in stock bore or oversize) to raise compression over 10-to-1. No problems here.

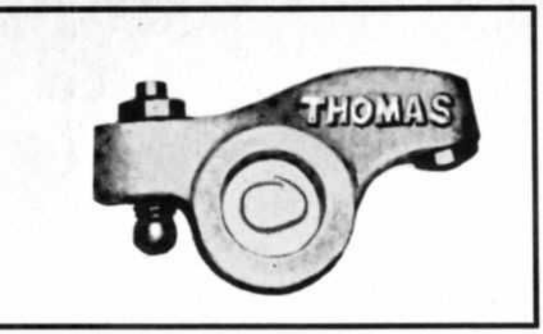
The Falcon block will take a maximum overbore of about ⅛". There's room in the crankcase for a longer stroke; but the 170-cu. in. engine already has .440 longer stroke than the 144—so most fellows find it cheaper to just start with the bigger engine. A ⅛ overbore on the big block gives a total of 182 cubic inches, just right for 3-litre class competition. There aren't too many special camshafts available for

TOP LEFT—Camshaft kit for '55-'57 Ford and Merc Y-V8 by Howard features a steel billet cam, hardfaced lifters, tubular pushrods and dual valve springs with retainers. Rockers are needed only if the 1.54 stock items are not available. Cam is available with several patterns.

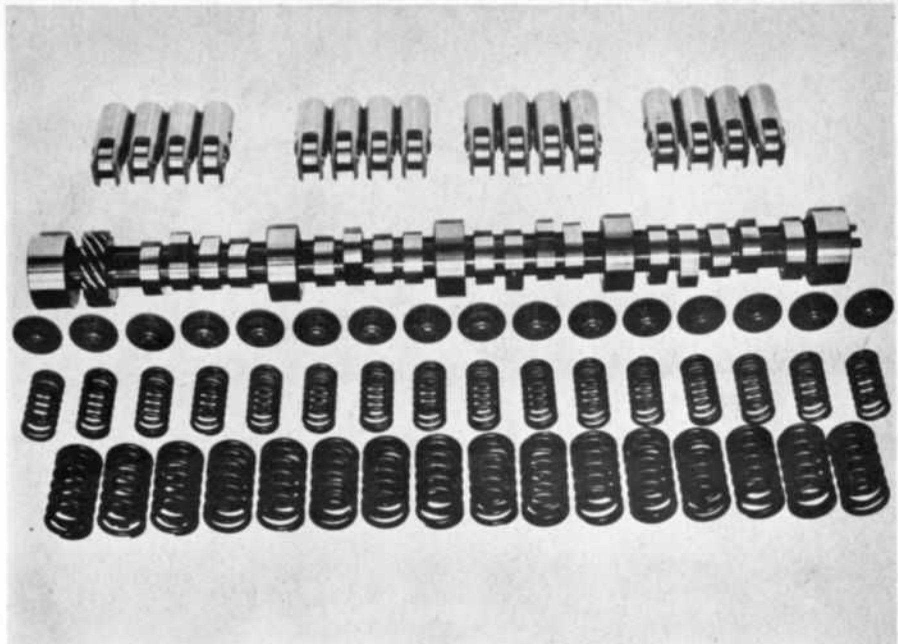
LEFT—Howard's cam kit for 383-430 Lincoln-Merc engine has steel billet cam, hardface lifters, pushrods, springs and retainers. Rocker arms are also needed. They are 1.54:1 Ford rockers bored out to fit Lincoln shaft. Standard 430 rocker is non-adjustable and has extreme ratio of 1.8:1.





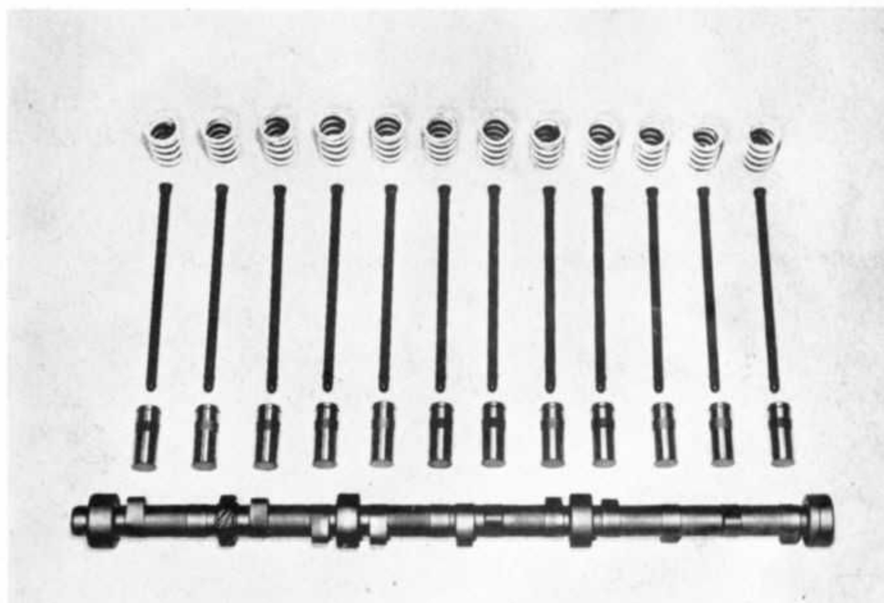


ABOVE—Thomas magnesium rocker arms for '54-'62 Y-V8 engines have 1.8:1 ratio for increased lift with stock camshaft. Hardened button contacts valve stem, slotted adjusting screws lock with jam nut.



RIGHT—Typical roller cam kit by Howard has billet shaft, dual springs, etc. Howard's rollers have extensions of lifter sides to guide on sides of lobe. Lifters have adjustment to change timing.

LEFT—Complete Iskenderian camshaft kit for Y-V8 Ford-Merc engines fits all models from late '54 to '62. Camshaft has hardface overlay in lobes to resist wear; special pushrods, lifters, etc.



RIGHT—Iskenderian kit for Falcon six has billet camshaft, special lifters, pushrods and springs. Stock rocker arms are used. As with other kits shown, a variety of lift patterns are available.

LEFT—Isky roller kit for 332-352-390-406 engines has all components needed to convert a hydraulic lifter engine. Isky rollers work in pairs with guide plates to hold proper alignment on cam.

this engine yet. The Isky E-2 seems to be the most popular —and adequate for any needs. The stock valve springs seem to be OK for 7000 rpm. One thing to keep in mind on ignition: The stock Falcon distributor has all vacuum spark advance. When you put on multiple carburetion there isn't enough venturi vacuum to operate this properly. Best way out is to switch to one of the special all-centrifugal distributors (Mallory, etc.). Also no special fabricated exhaust headers are yet available for the Falcon. With this small air flow headers are not as critical as on a big V8 . . . but if you're really all-out, better figure on building up a set

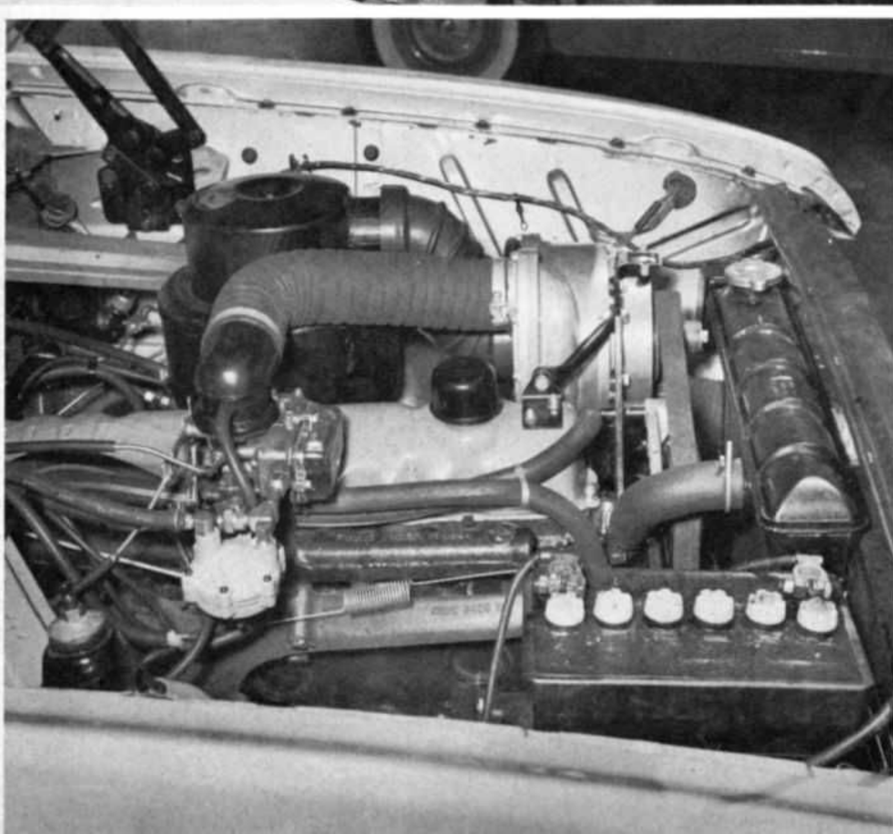
Here's hoping you can make that Falcon fly!

FAIRLANE-METEOR V8

This new lightweight V8 looks like lots of potential on paper. And apparently it's as good as it looks—as I understand Ford engineers have achieved one hp per cu. in. at 6500 rpm on the dyno with some special equipment and tuning. Unfortunately the engine is too new to have much of a variety of special "California" performance equipment available yet. The accessory houses usually lag about a year behind the industry because they have to see how popular an engine is going to be before they invest thousands in tooling for special equipment. Perhaps in six months it will be another story on the Fairlane V8.

But there are still some possibilities right away. These specialty piston companies can supply a piston to fit any engine. The crankshaft companies can stroke any shaft you send them. A good balance shop can re-balance the whole assembly. The big cam companies can regrind any shaft. Parts can be adapted, modified, substituted. The only place you're really in trouble is on carburetion. As this is written there are no multi-carb manifolds available for the Fairlane V8. But even that situation might be changed by the time this gets into print! Do some checking.

I'm sure the Fairlane-Meteor engine will prove to be one of our more potent compact powerplants in the next three years. Just give 'em time to do the developing and get the equipment out. ■



ABOVE—One sure way to improve the performance of any engine is to puff more air into the cylinders. This Latham axial flow compressor pulls its charge through four side-draft Zenith carburetors, then feeds into a special Latham manifold.

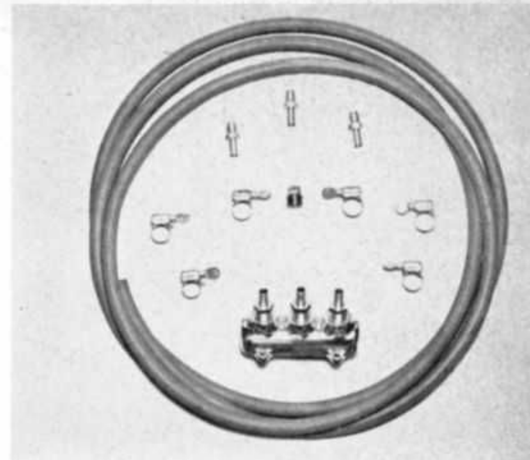
LEFT—Another popular blower installation for Fords is the Paxton-McCulloch centrifugal supercharger. It is driven by a V-belt, blows through the carburetor, giving 10 pounds manifold boost to this Falcon six. It is also available in other styles for larger Ford engines.

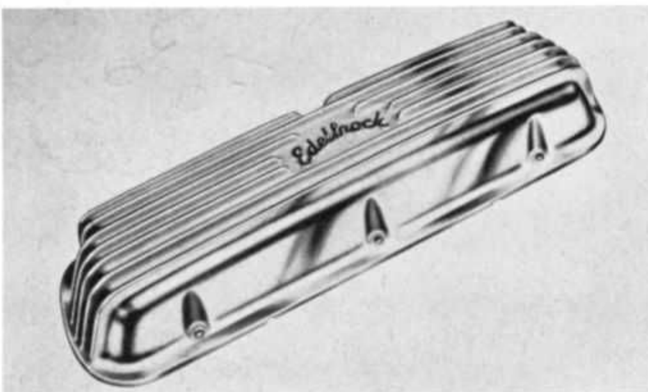
RIGHT—Custom steel tubing exhaust headers to replace conventional log type cast iron manifolds can often be the key to unlock hidden horsepower. These by Hedman are for big V8 engine in T-Bird.

FAR RIGHT—Specialty ignitions with improved high rpm voltage can also aid a high performance engine. This dual coil unit by Spalding features custom tailored advance curve to match engine.

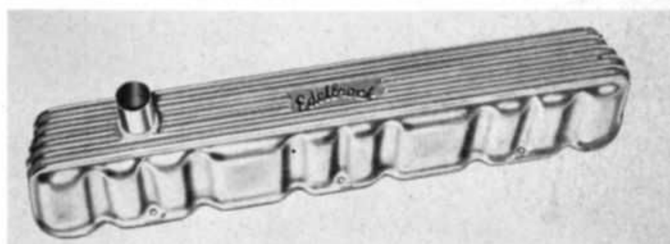
LEFT—Cast aluminum front cover for 430 Lincoln V8 converted to competition use has removable plate so that accessories can be driven from extension on camshaft.

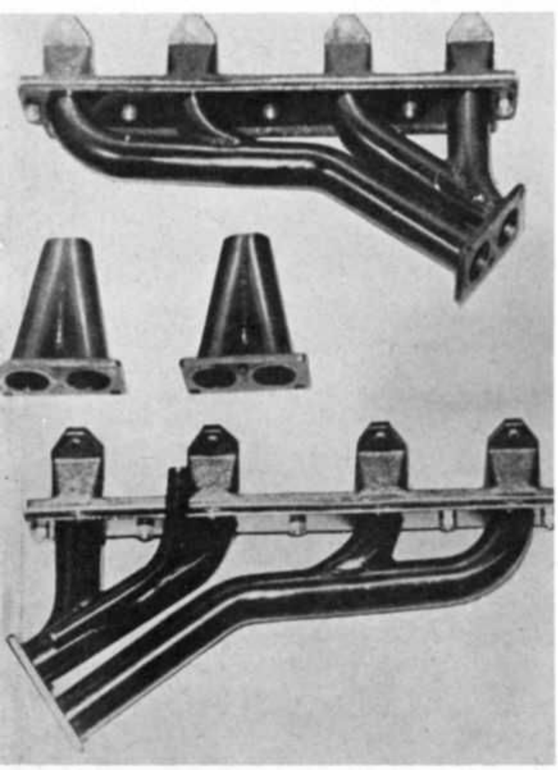
RIGHT—When installing multiple carbs, revised fuel lines must be used. A simple way to supply the carbs is through a fuel block. This by Offenhauser has three outlets but other models are available.

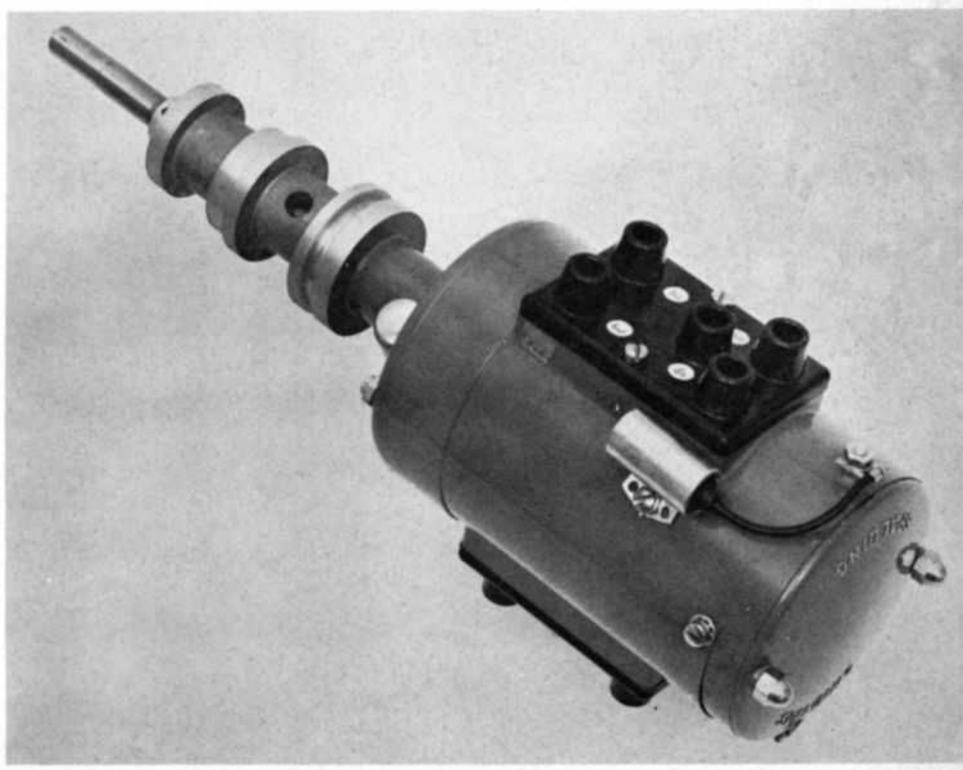




A popular item of dress for both stock engines and all-out competition versions is the cast aluminum rocker arm cover. Three models shown are: 221-260 Fairlane V8 covers by Edelbrock, above; '54-'57 Y-V8 covers by Offenhauser, upper right; and Falcon six cover, right. Besides nice appearance, the castings provide good dampening of noisy rocker arms.







CLUTCHES, TRANSMISSIONS AND OVERDRIVE

By John Lawlor

THE HOTTEST engine this side of an Atlas missile is useless if its power isn't applied effectively. To put your Ford into orbit, whether it's a mild little Falcon or a brutally powerful Galaxie, you have to match the engine with the right drive train.

A normal passenger car is engineered for comfortable operation, reasonable economy and adequate performance. But when it's prepared for competition, comfort and economy are forgotten. Performance alone becomes the goal. This means a good many components have to be reworked or replaced. Each part of the car should contribute to the overall purpose. And a clutch and gearbox that are ideal on the street may not do the job at all at the drag strip.

Obviously, greater strength is needed to absorb the punishment of competition. Heavy-duty materials should be used throughout. Still, the problem goes beyond beef. Actual design differences are important, too. The simple plate clutch in the Falcon, for example, is totally unsuited to the Galaxie. Conversely, the Galaxie 4-speed transmission would probably deliver rather sluggish getaway in the Falcon.

Taking the clutch and transmission in turn, let's examine how Ford equips its various models and then project what further changes might be needed for all-out competition.

CLUTCHES

Falcon, Fairlane and Galaxie clutches are all built to Ford's specifications by the Long Manufacturing Division of the Borg-Warner Corporation. Following the pattern of normal clutch design, they consist of two sub-assemblies. The clutch disc or driven plate is attached to and rotates with the transmission input shaft, while the flywheel, pressure plate and cover all revolve as a unit with the engine crankshaft. In a sense, the components form a mechanical sandwich. The disc is the meat, while the flywheel and pressure plate are the slices of bread.

When the clutch is engaged, the pressure plate forces the disc against the flywheel, creating a simple friction contact that locks the whole power train.

With engines of moderate power, the degree of this contact need not be great. In fact, the lighter and looser the assembly, the easier clutching and shifting will be. But as power goes up, the contact must be increased to prevent the clutch from slipping under the added load. Slippage causes power to be wasted in the form of heat. The temperature of the clutch goes up and, if allowed to become too high, it may cause some components to fracture or even blow apart.

Diameter and pressure are important here. The diameter of the clutch determines how much area is under contact and the pressure holding the disc and flywheel together establishes the actual strength of the contact.

Ford keeps both of these factors down in the Falcon so that clutch action will be as smooth and light as possible. Both are raised, though, to meet the power of various Fairlane and Galaxie models. The exact specifications are as follows:

	Diameter	Pressure
Falcon, Fairlane Six	8.5 in.	1200 lb.
Fairlane V-8, Galaxie Six	9.5 in.	1230 lb.
Galaxie V-8		
170-hp	10.0 in.	1278 lb.
220-hp	11.0 in.	1575 lb.
300- to 405-hp	11.0 in.	1710 lb.

The Falcon has a conventional assembly that relies on coil springs within the pressure plate to apply its 1200 pounds of force. The Fairlane and Galaxie, however, feature what is called a semi-centrifugal design. In addition to coil springs, which provide the figures quoted above, they have centrifugal weights on their pressure plates. As rpm goes up, these react to tighten the contact still further.

Thus, the hottest Galaxie V8's have a minimum of 1710 pounds. At extremely high speeds, the effective pressure is actually much greater than that. The pedal action becomes quite stiff, as you'll recall if you've ever tried a fast shift in a 390 or 406. But it also means that the contact is solid and slippage isn't likely. Yet, at moderate speeds, the pedal is light enough that the car can be driven in traffic without difficulty.

That, in brief, is what standard Ford clutches are like. As power is increased, so is clutch capacity. For competition, though, you may want to strengthen the contact still further. You have plenty of leeway, even in strictly stock classes.

The National Hot Rod Association, for example, allows any modifications to stock clutches as long as the overall weight of the assembly isn't altered.

But be forewarned. If you're going for performance, you'll have to forget driving comfort. Every change you make is going to affect operating ease.

If you don't mind a stiff pedal, you can boost pressure beyond the standard ratings by installing stronger springs. In fact, the simplest racing clutches offered by speed equipment manufacturers are merely stock assemblies with just this one modification.

But be careful. Too much pressure may warp the flywheel and driven plate. While you'll cut the possibility of slippage to an absolute minimum, you may go from the frying pan into the fire as far as the danger of fracturing is concerned. Generally speaking, you shouldn't exceed 3,000 pounds.

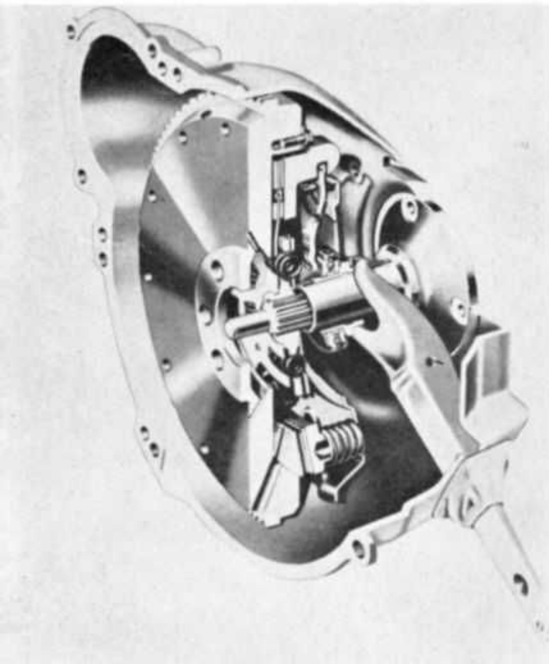
With the pressure—or strength of contact—carried to its maximum, let's consider the area of contact. It isn't practical to increase the area but we can improve its friction qualities considerably.

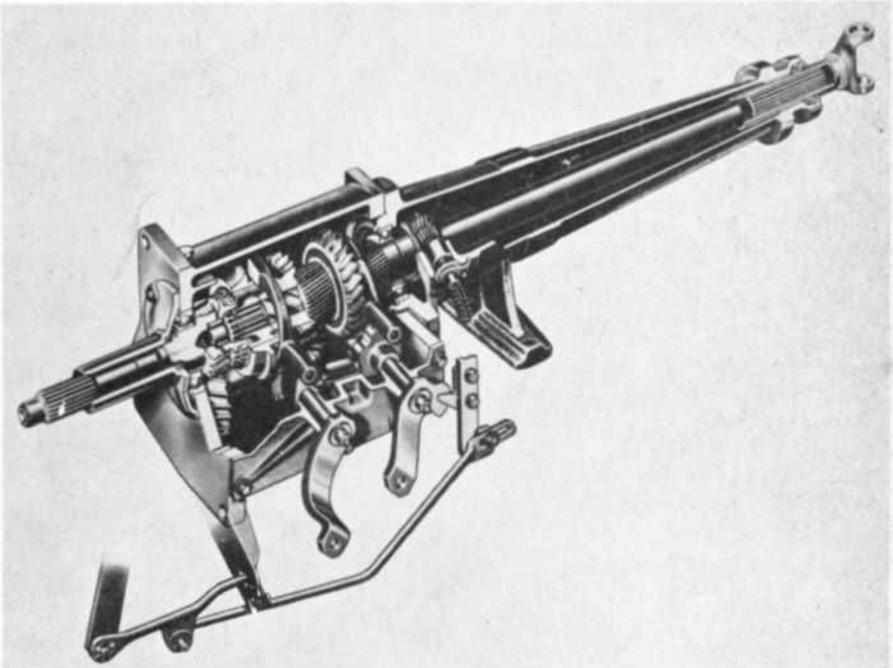
Except for the Falcon, which uses a molded material, all Ford clutches have driven plates surfaced with woven asbestos. This is an extremely good material for normal driving because it allows smooth clutch engagement, yet it's reliable enough for occasional racing. But if you're preparing your car for intensive strip activity, you should use a material with stronger bite.

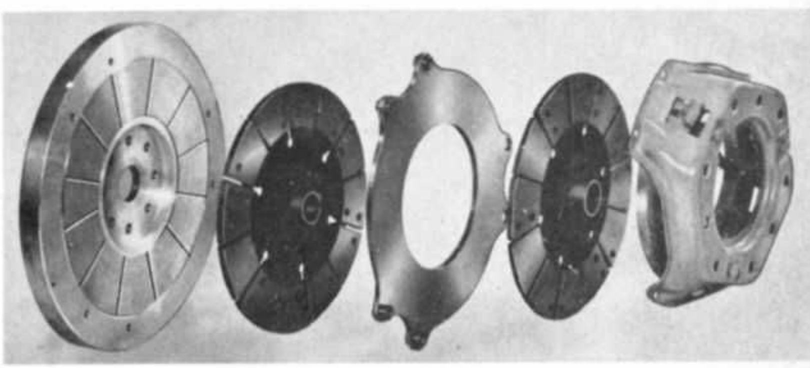
Probably the best known example is Velvetouch, which is a sintered bronze alloy. Also popular are cerametallic materials, which are blends of ceramic and metallic powders.

The flywheel and driven plate take a fantastic beating during fast, full-throttle shifts. If your Ford doesn't have heavy-duty versions of these components, get them. This is an area where you have to be careful about breaking the NHRA rule on weight. Many aluminum flywheels are available but they aren't legal in stock categories. Look for a good steel alloy unit, preferably one that carries an assurance from its manufacturer that it won't explode during the rigors of racing.

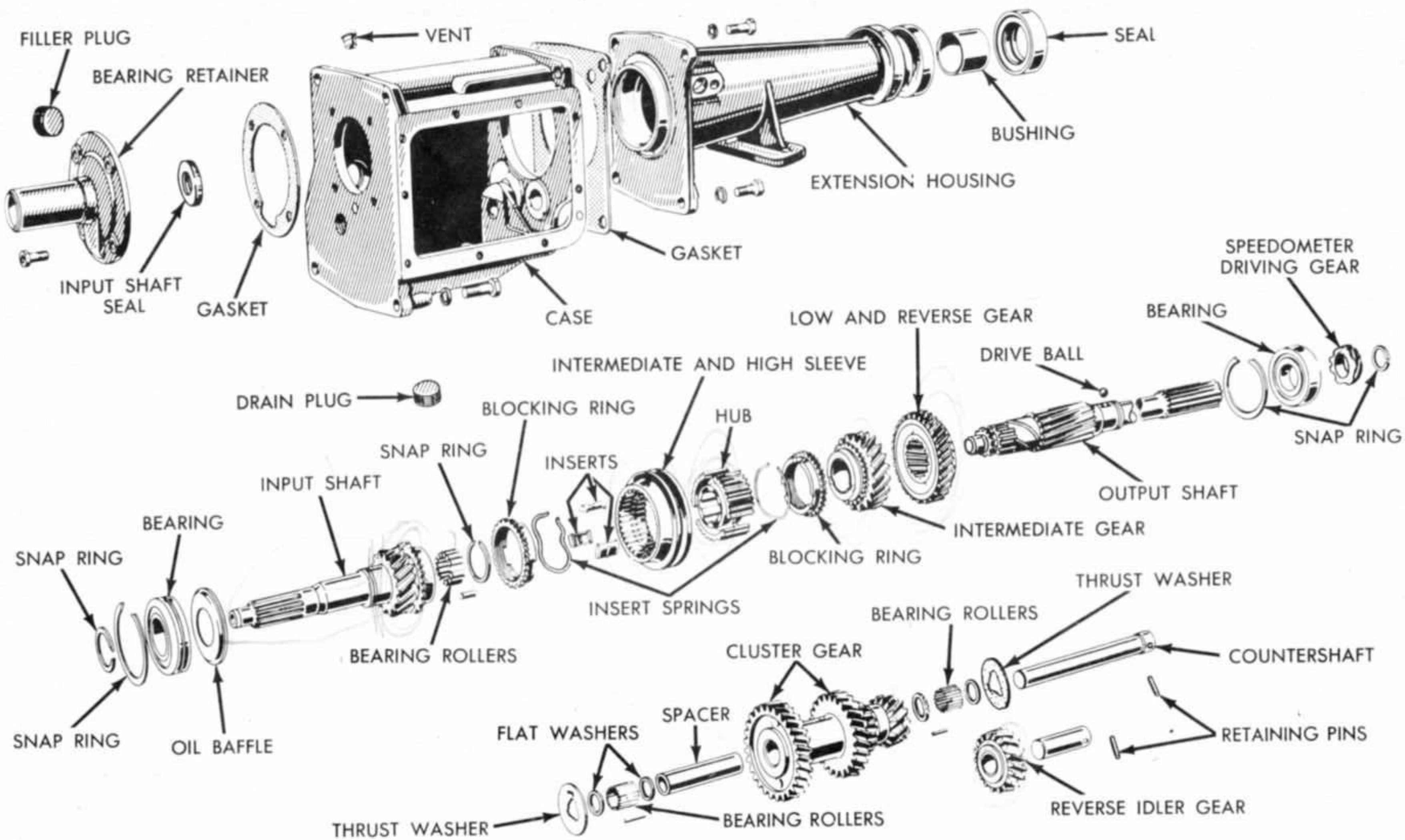
Actually, it isn't necessary to carry out these changes one by one. Just as stock clutches with stronger springs are offered by the speed equipment industry, assemblies incorporating all the modifications we've described are also available. They are based on standard Ford components, so they present no fitting or adapting problems.







ABOVE—Standard Ford clutch assembly. Function of clutch is to form solid friction contact between engine and transmission. Coil springs parallel to shaft are main source of pressure. ABOVE RIGHT—Standard Galaxie 3-speed transmission has interlock to prevent rolling shifts into 1st or reverse. RIGHT—Schiefer dual-disc assembly is ultimate in competition clutch, is based on standard Ford configuration. Floater plate in center provides extra surfaces for discs to grip hard.



Exploded view of Galaxie 3-speed. Standard Ford transmission as shown has been produced since '49 without major changes.

Once you've completed your clutch, the assembly should be dynamically balanced. This is the same type of operation as wheel balancing, with bits of metal removed here and counterweights added there. Usually, the flywheel and clutch are balanced separately, then put together and re-balanced as a unit.

The finishing touch is a flywheel shield, required by the NHRA in the top four stock classes. This is designed to protect you and everyone else at the strip in case your clutch blows. According to the rules, it should be made of ¼-inch steel plate and extend a full 360° around the bell housing. And it should be mounted securely to the frame, not to the housing.

That covers the major clutch requirements and possibilities for stock dragging. With a car for one of the modified classes, there are still further prospects. Most importantly, that weight restriction no longer applies. If you're building a car for really serious competition, whether it's a modest gas coupe or an all-out dragster, you can do almost anything you want to the clutch.

Here, one of those aluminum flywheels can be used to advantage. The flywheel should be as light as possible, consistent with strength. If its weight is kept down, the crankshaft is supposed to accelerate faster and the flywheel itself stands a better chance of holding together. The reason for the latter is that centrifugal force acts on the metal itself. The heavier the metal, the greater the force and the stronger the chances of a blow-up.

In the heyday of the flathead Ford, chopping the flywheel was popular. This was a method of lightening the unit by reducing its thickness. However, chopping also reduces strength and isn't recommended with extremely powerful modern engines like the 390 and 406.

The best bet is an aluminum flywheel designed expressly for competition. It does have one shortcoming, though it's purely theoretical as far as the individual enthusiast is concerned. The material requires special treatment for a proper friction surface. Three methods are used. First is the Sanford technique, a simple hardening of the metal itself into amorphous alumina. Next comes the use of a steel insert, bolted or riveted in place. Finally, there's a treatment developed by the Schiefer Manufacturing Company which involves spraying a molten mixture of bronze and steel onto the aluminum.

Clutch discs and even pressure plates of aluminum are also produced by some speed merchants, though here the weight saving isn't as valuable as it is with the flywheel. Once again, complete assemblies built to basic Ford designs are available.

Discs for competition are often made without one stock feature, a series of small springs around the hub that absorb torsional vibration and cushion clutch engagement. Without these, bite is that much more solid.

Earlier, we noted that there's no practical way of increasing the area of clutch contact. In a stock car, there isn't. But a full-blooded competition machine is something else. It can be equipped with an assembly that doubles the area by using two discs! A floater plate is set between the discs so they have something to grip besides each other.

Because a dual-disc assembly is stiff and heavy to operate, it isn't feasible to use one in a passenger car. But it's the ultimate in competition equipment. And it, too, is built in versions that match the normal Ford clutch configuration!

MANUAL TRANSMISSIONS

The closer our transmission ratios, the better chance we'll have to apply nearly maximum power over a broad range of road speeds. As we shift from a lower to a higher gear, the engine will lose less crankshaft speed. We'll keep rpm closer to the point of maximum power, so the average amount of power we apply to the road will be greater and acceleration will be faster.

There's just one problem. The closer our ratios, the higher-geared our transmission will be. High gear is usually direct drive or, in gearing terms, a ratio of one to one. To obtain closer ratios, we have to raise 1st and 2nd speeds. In 1st, this may not leave us enough power for the quickest possible breakaway.

Fortunately, this becomes less of a problem as power is increased or, more accurately, as the amount of power relative to the total vehicle weight is increased. If we boost engine output, we're going to have trouble setting the car in motion without excessive wheelspin, unless we raise 1st gear. And if we raise 1st, our transmission ratios will be higher and closer all the way through.

Ford's application of this principle is apparent in the selection of standard 3-speed transmissions offered in current models. All of them have direct 3rd speeds but their ratios in 1st and 2nd differ considerably. They are:

	1st	2nd
Falcon, Fairlane Six	3.29	1.83
Fairlane V8	2.78	1.61

This is Ford's 4-speed transmission in cast iron with aluminum side cover, by Borg-Warner company. It comes with ratios of 2:37, 1:78, 1:37 and 1 to 1. Shift lever has reverse lock out.

Galaxie	1st	2nd
Six	3.20	1.86
170-hp V8	2.78	1.61
220- to 405-hp V8	2.37	1.51

The higher the power, the higher the transmission gearing. It's that simple.

Where does this leave you if you start with an engine that came from the factory with a relatively low power rating and wider transmission ratios? If you soup it, will you have to install a completely different transmission in order to get faster, closer gearing?

Not necessarily. It may be that the particular transmission originally supplied with your engine is also built in a close-ratio version for use with hotter stock powerplants. If so, all you have to do is pull the gearset itself out of your present transmission and replace it with the higher-geared cluster.

Probably the best known example of this sort of swapping is the use of Lincoln Zephyr gears in older Ford boxes. From 1932 through 1948, inclusive, all Ford products used the same transmission design. In 1940, however, Lincoln adopted higher, closer ratios. The various gearsets were identified by the number of teeth on their driven clusters, as follows:

	1st	2nd
1932-48 Ford		
29-tooth	3.11	1.77
28-tooth	2.82	1.60
1940-48		
26-tooth	2.33	1.58
25-tooth	2.12	1.43

It didn't take hot rod enthusiasts long to discover that these Zephyr gearsets slipped right into Ford transmissions and were the perfect complement for hopped-up Ford powerplants.

Some rodders are still tempted to use an older Ford transmission with Zephyr gears behind a modern, overhead-valve V8, especially if they're dropping the engine into a 1932 through 1948 Ford. We'd advise against it. While it's a fine little gearbox, it wasn't meant to cope with the tremendous power of today's powerplants. A few fast shifts behind a modern 400-hp engine would tear the unit apart.

If you're planning to use a Ford 3-speed for any sort of rodding or racing, look for the heavy-duty unit the factory has been offering since 1956. This comes as standard equipment with the hottest production V8's and is easy to identify when attached to any other engine. Its side cover is curved at the bottom, while the standard transmission's side cover is squared off.

Returning to the close ratio question, there's another way to get a tight grouping and that's by using an additional forward speed. If we fill the gap between, say, a 2.36 low and a normal 1.00 high with two added gears, instead of just one, we'll obviously have a closer set.

That, of course, gives us a 4-speed transmission. Ford offers two units of this type, one for the Falcon and the other for the 220- to 405-hp Galaxie V8's. The lower three ratios in these are:

	1st	2nd	3rd
Falcon	3.16	2.21	1.41
Galaxie	2.36	1.78	1.41

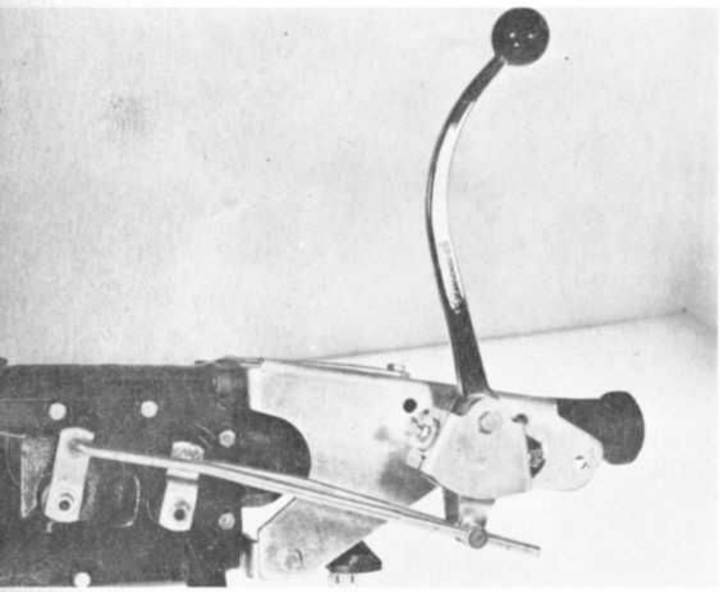
The principle of higher gearing in a hotter car again holds true. The Galaxie has much higher gearing in 1st and 2nd than the Falcon. More importantly, notice how much more tightly the ratios are grouped, compared with 3-speed units for the same cars.

The use of a 1.41 3rd in both boxes is a coincidence. They are completely different transmissions. The Falcon 4-speed is imported from England, where it's manufactured for the British Ford line. The Galaxie unit, on the other hand, is built in this country by the Warner Gear Division of the Borg-Warner Corporation. It's similar to the 4-speed units offered in several other U.S. cars, though the ratios in this particular application are Ford's exclusively. No competitive make has the same gearing.

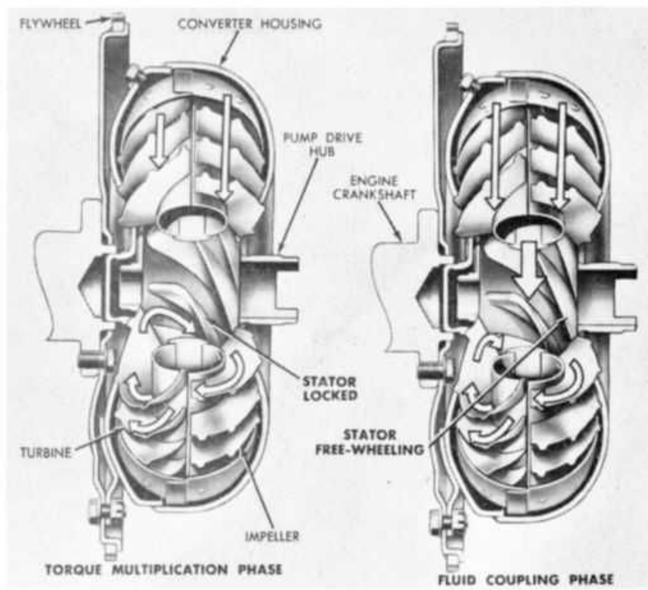
Ford has also made the Galaxie 4-speed available in kit form. This appeared during the 1961 season, so the NHRA recognizes it as a stock item for both 1961 and 1962 models.

There's an interesting possibility here, if you're not concerned with maintaining stock status. The various engines offered with the 4-speed as a regular production option differ considerably in size. They have displacements of 352, 390 and 406 cubic inches. But all of them are based on the same essential block and all accept similar clutch and transmission assemblies. Thus, the kit would fit any Ford engine of these sizes.

Furthermore, the basic block goes back to 1958, when it first appeared with a displacement of 332 cubic inches. Again, the 4-speed will fit. So, even though the kit appeared



For drag racing where severe pressures are put on shift linkage, it is recommended that a floor shift conversion kit be installed. This Hurst unit brackets neatly to all Ford transmissions and will always give much faster, trouble-free shifts.

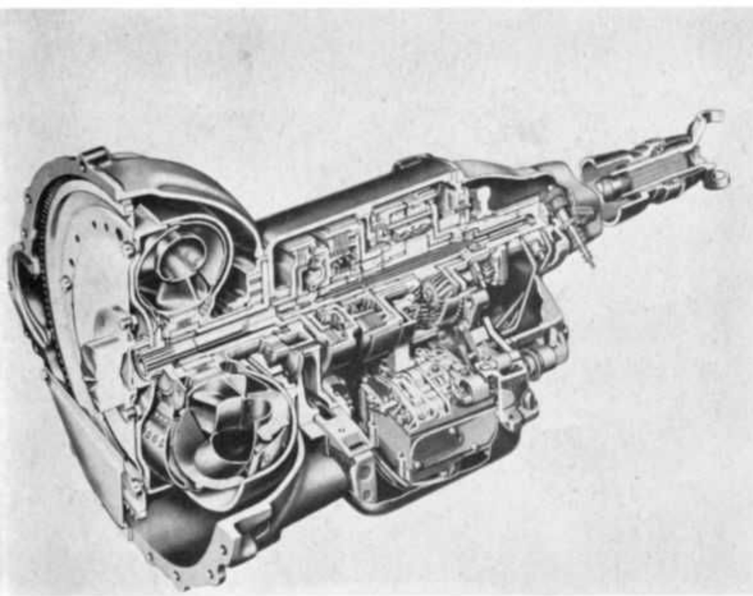


Principle of the torque converter is basically very simple. The impeller is driven by a flywheel and deflects oil to the turbine. Return flow to the impeller is controlled by the stator. Exploded views above show the working principles.

just last year, it can be fitted to Fords as much as four years old with a minimum of difficulty.

So far, no 4-speed has been offered with any Fairlane engine. The Galaxie kit can be adapted but considerable reworking is necessary before it'll fit. We know of at least two such installations, both of them combining the Galaxie 4-speed with the 260-cubic-inch Fairlane V8. One is Carroll Shelby's new AC Cobra sports car and the other Holman and Moody's special Challenger, built for the 1962 Sebring 12-hour race. The Challenger is a particularly intriguing machine. Its Galaxie box and Fairlane engine are mounted in a Falcon! That's the best answer we've heard yet to the Limelighters' question, "Which Ford will it be?"

In some drag race quarters, 4-speed boxes haven't won complete acceptance. There are enthusiasts who'll admit such a transmission has a distinct advantage in its closer ratios but who'll argue that the margin is cancelled by the extra shift necessary. The active 3-speed competitors at major strips seem to trounce their 4-speed rivals just often



This is the Ford Cruisomatic 3-speed automatic transmission, not normally available behind Ford High Performance V8 engines. Enthusiasts, however, have beefed it up and get excellent results from running it in the super stock automatic class.

enough to keep the debate alive, without really proving the point.

All things considered, though, we favor the 4-speed. It has a much more consistent record of success and, in skilled hands, it looks just as good in action at the strip as it does in figures on a spec sheet.

Still, the 3-speed advocates offer an interesting line of reasoning and, projected a little further, it does have some merit. It's possible to achieve a power-to-weight ratio so high that the ratios can be spaced almost on top of each other. They'll be so close that the advantages of three or four forward speeds will be lost in the time it takes to shift them. Under such conditions, there isn't any point in using more than one gear.

This happens to be exactly the case with the hottest dragsters. They have such tremendous power-to-weight ratios that they aren't shifted at all!

A dragster usually has a vestigal transmission, called an in-and-out box, which provides a choice between neutral and direct drive. It can't be called a gearbox, though, because there's no gearing to it. It simply uses a splined shaft that can be disconnected.

An interesting thing about in-and-out boxes is that many of them are based on Ford components. One offered by a West Coast manufacturer, in fact, consists of a normal Ford transmission housing with nothing inside but the shaft and bearings required for direct drive.

FLOOR SHIFTS

Both the Falcon and Galaxie 4-speeds are supplied with floor shift levers, while the heavy-duty Galaxie 3-speed can be fitted with a floor lever as an option. Other Fords with column shifts can be converted to floor control with kits offered by a number of accessory manufacturers. For the names and addresses of these firms, check their ads in recent issues of HOT ROD Magazine.

For dragging, a floor shift is a must. A lever going directly to the transmission can save up to half a second, compared with a complex linkage detouring along the steering column. And half a second can mean half a dozen car lengths at the end of a ¼-mile drag.

So, if your Ford doesn't have its shift lever on the floor, get a kit to put it there. These kits vary in price from $30 to over $100. If you want a floor shift for everyday driving pleasure, one of the cheaper units will do. But if you're going racing, plan to spend at least $50 or $60. The few extra dollars will buy a lot of added ruggedness.

AUTOMATICS

Just as the Ford buyer can have either three or four speeds in a manual transmission, he can choose between two and three in an automatic.

The 2-speed design is Ford-O-Matic and is the only automatic available in the Falcon and Fairlane. In addition, it can be fitted to three Galaxie engines, the Six and the 170- and 220-hp V8's. The 3-speed is Cruise-O-Matic and is offered in Galaxie V8's from 170- to 340-hp but *not* in the high-performance 375- to 405-hp models. In addition, it's the only transmission, manual or automatic, supplied in the Thunderbird. Both units are produced for Ford by the ubiquitous Borg-Warner Corporation.

Gear ratios in these two transmissions are as follows:

	1st	2nd	3rd
Ford-O-Matic	1.75	1.00	—
Cruise-O-Matic	2.40	1.47	1.00

These figures, however, do not represent the maximum gearing potential of either transmission. A device called a torque converter is used in place of the clutch and supplements the gearbox by providing varying ratios of its own.

The converter consists of three fan-like elements, the impeller, turbine and stator, which deflect oil to each other. The manner in which this oil is splashed transmits and multiplies the torque output of the engine.

The first of the converter elements, the impeller, is connected to the flywheel. As it rotates, its blades throw oil against the second component, the turbine, at such an angle that torque is multiplied. The turbine, in turn, drives the gearbox input shaft.

To prevent the increased torque from reacting against the impeller and cancelling itself, the third element, the stator, controls the flow back to the impeller. The stator must be held stationary to accomplish this. If it's allowed to free wheel with the impeller and turbine, torque multiplication will be cancelled and the converter will become a simple fluid coupling providing direct drive.

Thus, by locking and unlocking the stator, the converter can be made to "shift." And this is exactly what happens as the car accelerates.

The maximum converter ratio is obtained when the flywheel is turning the impeller but the turbine is held still. You force such a condition when you hold one foot on the accelerator and the other on the brake just before letting the car take off. As you release the brake, the maximum converter ratio is multiplied by 1st gear to provide extremely low overall gearing. The figures in various Ford models are:

	Maximum Converter Ratio	Maximum Overall Ratio
Ford-O-Matic		
Falcon, Fairlane	2.40	4.20
Galaxie	2.60	4.55
Cruise-O-Matic	2.10	5.06

An obvious question here is the degree of gearing. Why is the converter allowed to provide an overall ratio so much lower than 1st gear in an equivalent manual transmission? The answer is the slippage inherent in the converter. Torque is transmitted through oil, not through the solid contact we have in a normal clutch. And this slippage is greatest when the converter is developing its maximum ratio. Thus, Cruise-O-Matic's maximum of 5.06 doesn't begin to have the effect that a similar gear would provide in a conventional transmission. If it did, it would demolish the rear tires every time the car broke from the chute!

Also, it's important to note that the maximum overall ratio is obtained just at the instant of breakaway. As soon as the car's underway, the converter's gearing effect is decreasing toward direct drive.

A converter can be engineered to provide all the gearing a car needs but the job is complicated and expensive. For one thing, the deeper its gearing, the greater the slippage problem. For another, it's difficult to provide some sort of control that allows the driver to select a particular speed range. Therefore, converters are usually accompanied by gearboxes. These increase the mechanical efficiency of the transmission and they provide a simple method of driver control.

These boxes have little in common with most manual units. With the shift lever in the normal "drive" position, they select ratios automatically in accord with variations in speed or load. The actual shifts are accomplished through a complex hydraulic system.

There are two pumps, one driven by the transmission input shaft and the other by the output shaft. These supply pressure as long as the engine is running or the car is moving. A regulator keeps this pressure at proper levels and feeds it to a valve body which, in turn, actuates servo units. The servos control a series of brakebands and clutches to engage the gears themselves.

When the driver selects a particular range with the shift lever, he's actually blocking or relieving passages in the valve body that determine which gears will operate. Ford-O-Matic has only two forward ranges; "L" engages only 1st gear and "D" allows both 1st and 2nd to function. Cruise-O-Matic is more complicated and has three ranges. Again, "L" provides only 1st under normal conditions, while "D-1" supplies 1st, 2nd and 3rd, and "D-2" 2nd and 3rd.

Shifting for performance with Ford-O-Matic is a simple matter of holding "L" for 1st until you're ready for 2nd. Then, flipping to "D" gives it to you.

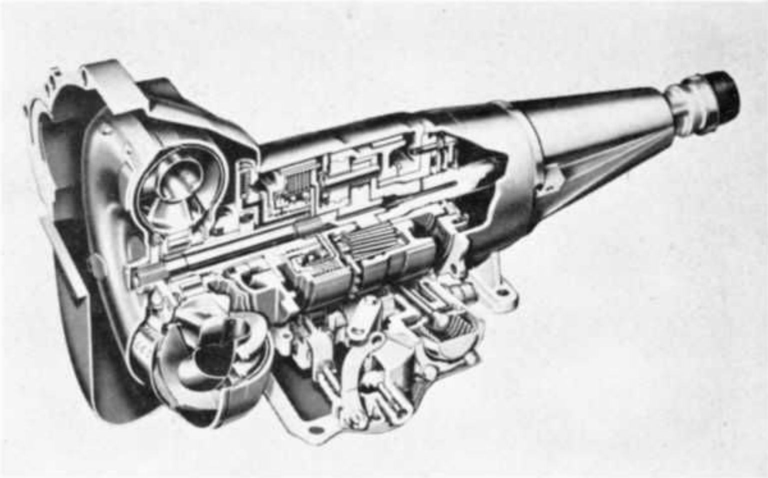
With Cruise-O-Matic, "L" does the same job. But upshifts to 2nd and 3rd are more difficult. If you're pushing the accelerator to the floor and you shift to either "D" range, the unit will hold 2nd only briefly or it may skip it altogether and go right from 1st to 3rd. However, if you shift to "D" and *immediately* pull the lever back into "L," you'll engage 2nd and hold it until you shift back to "D" to get 3rd.

Frankly, this is a rough way to treat Cruise-O-Matic and it's going to increase wear and tear. The factory winces every time it's suggested! But it's the only way to gain complete control over your upshifts.

With either transmission, it's best to make your move a few hundred rpm before you want the actual shift because all that plumbing in the gearbox isn't going to respond instantly.

In many ways, neither Ford-O-Matic nor Cruise-O-Matic is really suited for dragging. Between the converter's slippage and the gearbox's complex shifting system, power isn't transmitted as directly and precisely as the performance enthusiast would like. And racing gives an automatic a beating that shortens its life several thousand miles. It's easy to see why Ford has been cautious about releasing these transmissions with really hot engines.

Still, the situation isn't hopeless. If you have a Ford with either of these boxes, you can perform a few modifications that should put you among the leaders in the appropriate



The Fordomatic 2-speed automatic transmission is used with smaller Ford engined cars. Can be beefed up, but not suitable for higher hp engines.

stock automatic class. Two things should concern you most—beefing the transmission to stand the strain of ¼-mile racing and reworking the gearbox itself for quick, solid shifts.

We'd advise against tackling the chore yourself but, if you do, get the Ford shop manual on your particular transmission. It shows in elaborate detail how to take your automatic apart and get it back together again. Make sure the area where the job is to be done is spotlessly clean. This is a good rule for any work you do on your car but it's especially important with an automatic transmission. It's too complex to tolerate even the tiniest bit of dirt.

One of your first tasks should be to examine all seals in both the converter and gearbox. High rpm is going to slosh the oil about pretty fiercely and leakage can become a serious problem. If your transmission has accumulated very much mileage, replace any seals that don't fit snugly. And all mating surfaces should be checked for tightness.

The simplest method of beefing is the use of components from a heavier duty version of your transmission. The Falcon is a particularly good example. It has a simplified Ford-O-Matic but the design is the same as the 2-speed unit for bigger models. Using select pieces from the Galaxie Ford-O-Matic will strengthen it immensely.

Specifically, the Falcon has only two plates and two discs in its clutch assembly, while the Galaxie has five of each.

The difference in space is accounted for with a thicker clutch piston. Replace the standard Falcon plates, discs and piston with equivalent big car parts and you'll have a compact but beefy Ford-O-Matic.

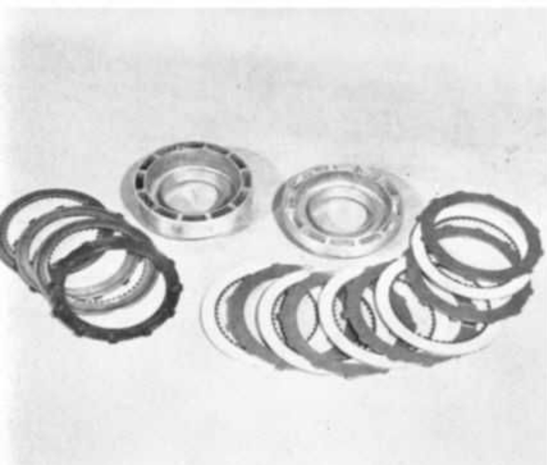
The same principle can be applied to Cruise-O-Matic. It's similar to an automatic used in the Ford truck line. To obtain really firm shifting action, substitute the pressure regulator and valve body from the truck for the stock components. This will provide higher, controlled pressure.

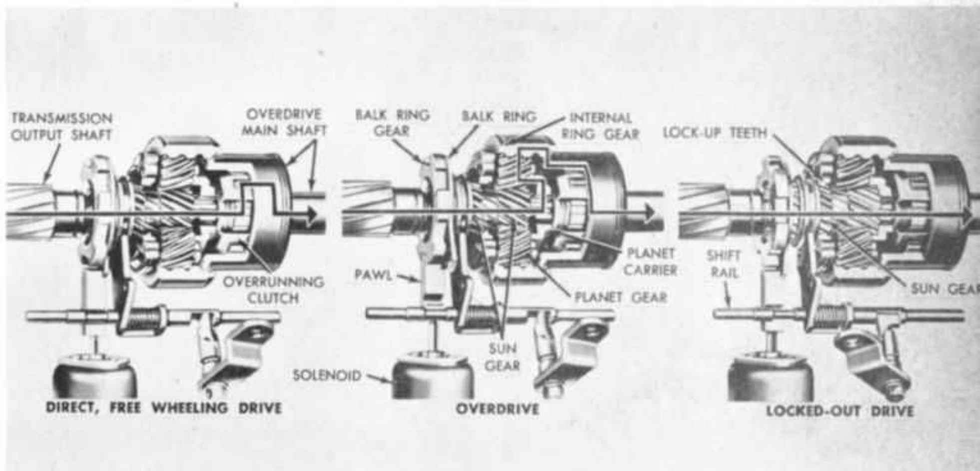
The truck pressure regulator alone would do the trick but your car would be a bear under idling conditions. With a simple increase in pressure, the bands and clutches would grab with a lurch as you moved the lever from neutral to a driving position. The truck valve body alleviates this problem, yet assures higher pressure during upshifts.

There's a moral in that tale. Modifications have to be coordinated. Any change you make may require another change somewhere else in the system. That's why we advised against reworking your automatic yourself.

maybe somewhere between 2.8- and 3.3-to-1 for cruising on the street and highway. This reduces the engine rpm and piston speed in relation to car speed. You get less engine noise, vibration, less engine wear—and gas mileage improves steadily as you reduce engine speed at a given car speed. There's no substitute for a 3-to-1 gear ratio out on the highway.

But here's where the problems start. If we divide our maximum overall gear ratio by the minimum—like, say, 12 divided by 3—we get an overall ratio *spread* of 4-to-1. No conventional transmission-rear axle combination provides this wide a ratio spread. Your conventional 3-speed and 4-speed stick shift boxes give a spread between low and high gear of generally between 2.3 and 2.9-to-1. A 3-speed automatic torque converter (like the Ford Cruise-O-Matic) gives an overall "torque multiplication" ratio of more than 4-to-1 just coming off the line; but the fluid torque effect dies out about 15 or 20 mph—and you lose quite a bit of punch in the vital 20-40 mph range.





Clutches and piston at left from Falcon automatic transmission. Those at right are from larger Fordomatic. Small auto. can be beefed by using Galaxie clutches, piston.

Drawing above shows power path of overdrive section of the Ford transmission when free wheeling, in overdrive and locked out for direct drive.

Your best bet is to seek out a mechanic experienced with Ford-O-Matic and Cruise-O-Matic. If you can find one at your Ford dealer's willing to handle performance modifications, so much the better. He'll be sure to have the proper understanding of what should be done to get the most out of your Ford, whether it's a Falcon, Fairlane or Galaxie.

Your whole object should be to improve your car, to tap the terrific potential Ford has built into it. So get the job done and get out to the strip!

HOW ABOUT OVERDRIVE?

BY ROGER HUNTINGTON, SAE

One of the toughest problems facing the car performance enthusiast is providing a wide enough spread in overall gear ratios to give optimum performance under all driving conditions. Think about it a second. For quickest possible getaway off the line a heavy full-bodied passenger car needs an overall gear ratio somewhere between 10- and 13-to-1. This will get you up to 30 to 40 mph in the shortest possible time—and it has been conclusively proved many times that this is by far the most important factor in your elapsed time for a short-distance acceleration run, like on the quarter-mile drag strip.

On the other hand, we would like an overall gear ratio

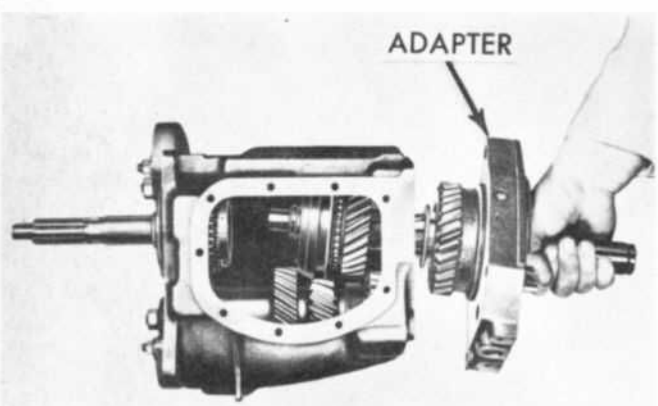
No, the *overdrive* stick shift transmission is the only combination available today that offers really optimum performance over the full speed and load range. And Ford is the only company that offers the overdrive option on a big-inch high-performance V-8 engine. This simple option, priced at only $108.40, can *double* the practical utility of these special high-performance engines in many applications. Here's the scoop . . .

HOW DOES IT WORK?

An overdrive unit is nothing more than a small planetary gearset, automatically controlled, that attaches to the back of a conventional 3-speed transmission—and acts to *step up* the speed of the drive shaft about 40% higher than the transmission output shaft. The effect is to *reduce* the overall gear ratio. The standard Ford overdrive unit multiplies the overall gear ratio by .70; the special heavy-duty unit used with the 352-406 cubic inch engines reduces the ratio by .72. In other words if you were running in high gear (1.00-to-1) with a 4.11-to-1 rear axle ratio, using the heavy-duty overdrive, your overall gear ratio would be $1.00 \times 4.11 \times .72 =$ 2.96-to-1.

You might even look at an overdrive transmission as a *4-speed* gearbox with very wide ratios. Consider the heavy-duty o.d. trans used with the big engines: If you considered the gearbox ratio in overdrive as 1.00-to-1, then your ratios would be 1.39-to-1 in direct-drive high, 2.21 in second gear, and 3.46 in low. You've got a wide-ratio 4-speed! Don't laugh. It works. (For comparison, the corresponding ratios in the regular Ford 4-speed trans would be 1.00-to-1, 1.41, 1.78, and 2.36.) See the difference? The overdrive gives you that wide ratio spread necessary for most economical and convenient operation over the full speed and load range.

And it's an *automatic* operation. When the Ford overdrive control handle is pushed in, the transmission is in automatic overdrive operation. Normally the central "sun" gear of the o.d. planetary is locked stationary by a pawl engaged by a solenoid. The drive goes through the planetary pinion gears, and the output speed is stepped up as it goes out on the external ring gear. (See drawings.) However, at car speeds below approximately 27 mph a governor circuit disengages the pawl, so the car is in a direct-drive regime. The only difference is that the car will *free-wheel,* or coast, when you let up on the gas. You can shift gears without using the clutch pedal in this regime. The overrunning clutch in the back of the o.d. unit disconnects the engine from the rear wheels when the torque is reversed—that is, when the rear wheels start driving the engine.



Ford heavy duty trans. with plate, shaft to adapt overdrive unit.

When car speed then goes above 27 mph you can get back into overdrive by merely lifting your foot from the gas pedal. If you want to snap back into direct-drive for extra acceleration above 27 mph, like when passing on the street or highway, you merely punch the pedal clear down. This automatically releases the o.d. pawl and breaks the ignition circuit for a split second—to reduce engine torque just enough so the pawl spring can jerk it back. You're then in direct drive until you lift your foot again to get back in o.d.

If you don't want the automatic overdrive operation for one reason or another (like when competing on the drag strip) you can lock it out completely by pulling the dash control handle out. Your transmission then works exactly like a conventional 3-speed stick shift. Very handy—and very versatile.

I'm not going to sit here and try to tell you that Ford's overdrive transmission will out-perform their floor-shift 4-speed on the drag strip, or on any short acceleration spurt up to 100 mph. It won't. Remember that you only need an overall gear ratio spread of around 2.5-to-1 for the short acceleration run. Like, say, 11-to-1 off the line and maybe something around 4.5-to-1 to cross the finish line at high rpm at around 100 mph.

In this situation four close ratios are better than three wide ones. Reason: With closer gear ratios you can hold your engine rpm in a narrower range right around the peak of the horsepower curve. With Ford's 4-speed you can hold the engine between, say, 4600 and 6200 rpm as you shift up through the gears. With their heavy-duty 3-speed (with or without o.d.) the range would be *4000* to 6200. Obviously the closer ratios are going to give a higher *average* engine output over the length of the acceleration course. Also you can shift gears slightly faster when the ratios are closer. Remember that your transmission synchronizers have to slow down the heavy clutch disc when you shift; the closer the ratio spread the less the disc has to be slowed down—and the quicker you can get into that next gear and start pulling again. Even when you install one of these special floor-shift conversion linkages on a 3-speed it still isn't quite as quick as a good 4-speed on the drag strip.

So if you're primarily interested in maximum possible performance on the drag strip, or for general short-distance acceleration spurts, by all means order Ford's optional 4-speed transmission at $188.

But now let's say your interests are a little broader. You like to take a whack at the drag strip now and then but you also want that quiet, easy cruising on the street and highway you get with an overall gear ratio around 3 or 3.5-to-1. You can never get this compromise with a 4-speed. You'd have to use an axle ratio around 4.5-to-1 to get maximum acceleration from the 4-speed—and this would never give you that easy cruising. You could *live* with it (lots of guys do), but it leaves much to be desired for overall transportation.

Overdrive is your answer here. You can go ahead and order that ratio around 4.5-to-1 in the rear end—which will give you the required 11-to-1 or so off the line—and then you can just shift into overdrive to drop the overall ratio to around 3.3-to-1 for cruising. How can you beat it? Admittedly the gear-shifting isn't quite so lightning fast, and the rpm range not quite so favorable, as with the 4-speed. But you get that very broad gear ratio spread you can't get any other way. This will be worth the slight sacrifice in all-out acceleration performance in many, many cases.

In my opinion probably at least one-half of the fellows who buy the current Ford high-performance engine options would be wise to consider overdrive very carefully.

WHICH AXLE RATIO?

Ford supplies 4.11-to-1 axle gears as standard equipment on all 1962 models using the 390 and 406-cu.-in. high-performance engines with overdrive. This is an excellent all-around ratio combination. You get an overall gear ratio of 10.23-to-1 in low for coming off the line, and 2.96-to-1 overall in o.d. for cruising. Your engine is only turning about 2400 rpm at 65 mph in o.d. You hit about 5200 rpm at 100 mph in direct-drive high gear. Good combination.

But you may be able to do better for some applications. Ford offers many optional rear axle gearsets for their high-performance packages. The whole list of available ratios runs as follows:

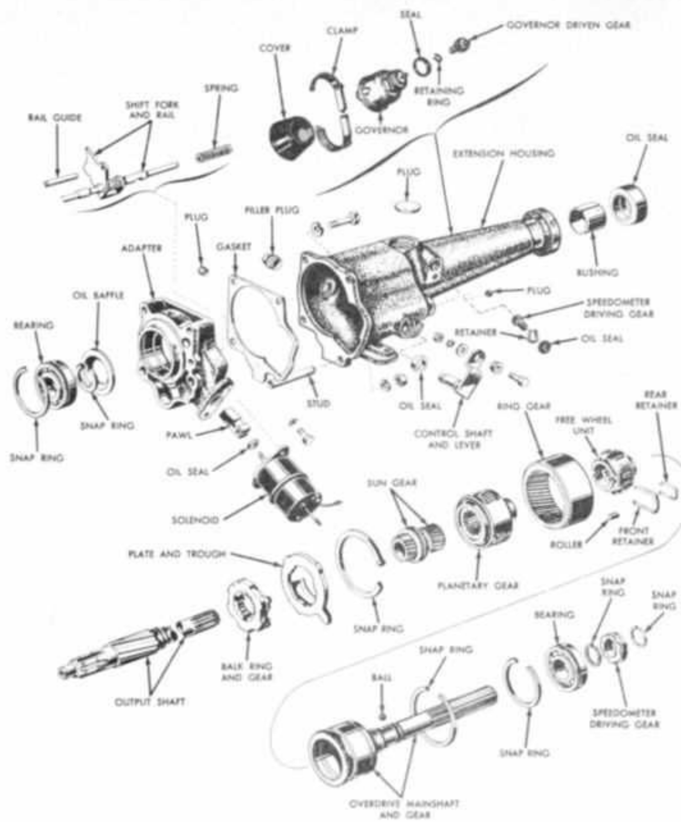


Photo drawing shows exploded view of Ford overdrive.

3.00	3.89	4.86
3.10	4.11	5.14
3.22	4.29	5.43
3.40	4.57	5.67
3.56	4.71	5.83

In selecting the optimum gear for the drag strip the whole idea is to get your 10, 11 or 12-to-1 overall ratio off the line—then select the axle gear so it will let the engine wind up a *little over the peak* of the hp curve at the finish line. The gear you select will depend on tire size, engine peak rpm, and your speed at the finish.

Your 1962 Ford high-performance 406 engines (385 and 405 hp), when set up right, will generally pull the car weight to somewhere between 95 and 105 mph at the drag strip finish line. (However this "trap speed" will vary a lot between cars and tune-up artists. Don't hold me to it!) Anyway if we use 6.70/15 tires and figure to hit 6000-6200 rpm at the finish, we will need an axle ratio around the optional 4.71 gearset for a speed of 100 mph. This is a good average figure for this engine. The top drag strip boys who are hitting 105-107 mph with the '62 Fords are generally using 4.86 gears and 7.10/15 rubber. The boys who want to take it a little cooler on their equipment usually settle for the 4.57 gears. The 4.71's, however, appear to be the best compromise for the strip. And, incidentally, these gears would also be pretty close to optimum for the "cooler" 220 and 300-hp optional engines that will be turning lower speeds in the lower stock classes.

Note that the 4.71 axle gears give 11.73-to-1 off the line in low gear, and 3.29 overall in o.d. This is an excellent all-around ratio combination, too. It will readily out-perform the standard 4.11 gears.

FACT AND FANCY

In closing, I want to clear up a couple of popular misconceptions about car performance with an overdrive transmission . . .

For one, you often hear fellows talking about fabulous performance in "overdrive second" or "overdrive low." What they're doing is to shift in o.d. by lifting their foot when the transmission is in low or second gear—then blasting off. If you think about it a second you'll see this is patent baloney. Your *overall* ratio in overdrive low would be quite close to the overall ratio in conventional second—actually 7.37 vs. 6.54-to-1 respectively (with the 4.11 axle gears). Those ratios are too close to pay you to take the time to shift. Same with the relationship between overdrive second and conventional high. There's nothing to be gained by fooling around in this area—though it *is* fun to experiment.

Another popular goof is that a car will invariably go faster in overdrive than in conventional high gear. Nothing could be further from the truth. Actually most late American stock cars will show their ultimate top speed with an overall gear ratio right around *3.4 to 3.6-to-1*. This will wind the engine a little over the peak hp curve at "terminal" speed, with average tire sizes. Thus a car with 3.56 axle gears will go faster in direct-drive high than it would with an overall ratio of 2.56 in o.d. A car with 4.11 gears might go nearly as fast in direct-drive (if the hydraulic lifters didn't pump up) as with the 2.96 ratio in o.d. Get the picture? It all depends on the *overall* gear ratio—not whether you're in overdrive or direct-drive.

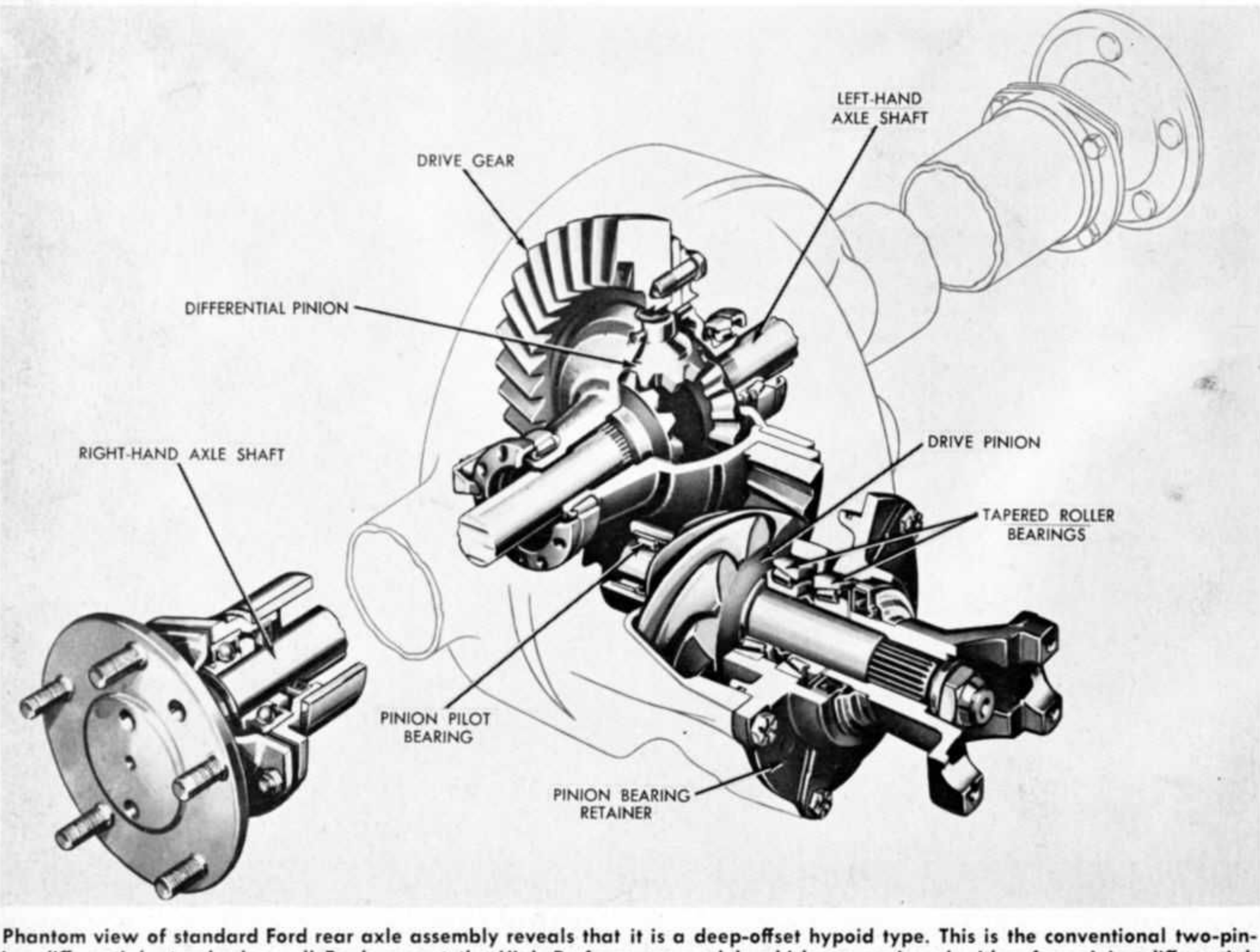
And that about covers it. Now let's see you fellows taking advantage of the fact that Ford is the only company to offer the convenience and utility of overdrive on an all-out high-performance engine! ■

REAR AXLE RATIOS FOR COMPETITION

By Wayne Thoms

IT IS doubtful that one motorist out of a random group of 50 would know his car's differential ratio—and that one knowing motorist would probably be a performance enthusiast. The fact is that most of us buy cars, new and used, without ever asking or caring what the rear end ratio is. We rely upon a factory engineer's judgment and experience to select a ratio that will give a combination of acceleration, high speed cruising and economy—a physical impossibility but one which we expect. The three elements just don't work happily together; something's got to give and it always does. It would make a lot of sense if more car purchasers would take the time to investigate rear axle ratios and what they mean, matching the correct ones to their needs. But this notable lack of interest on the part of the car buying public isn't terribly critical; the purchaser will get by and probably be very pleased with all the three key areas of performance.

Choice of proper rear axle ratios only becomes vital in competition and we do mean drag racing. It would seem that one good ratio could be worked out for the quarter-mile and every Ford at the drags could use it. If this were true, drag racing would be infinitely simplified for the thousands of drag fans who drive in the stock classes. Unfortunately, there are variables which must be considered, questions which must be answered: Which transmission—three-speed, three-speed with overdrive, four-speed or



Phantom view of standard Ford rear axle assembly reveals that it is a deep-offset hypoid type. This is the conventional two-pinion differential, standard on all Fords except the High Performance models which are equipped with a four-pinion differential.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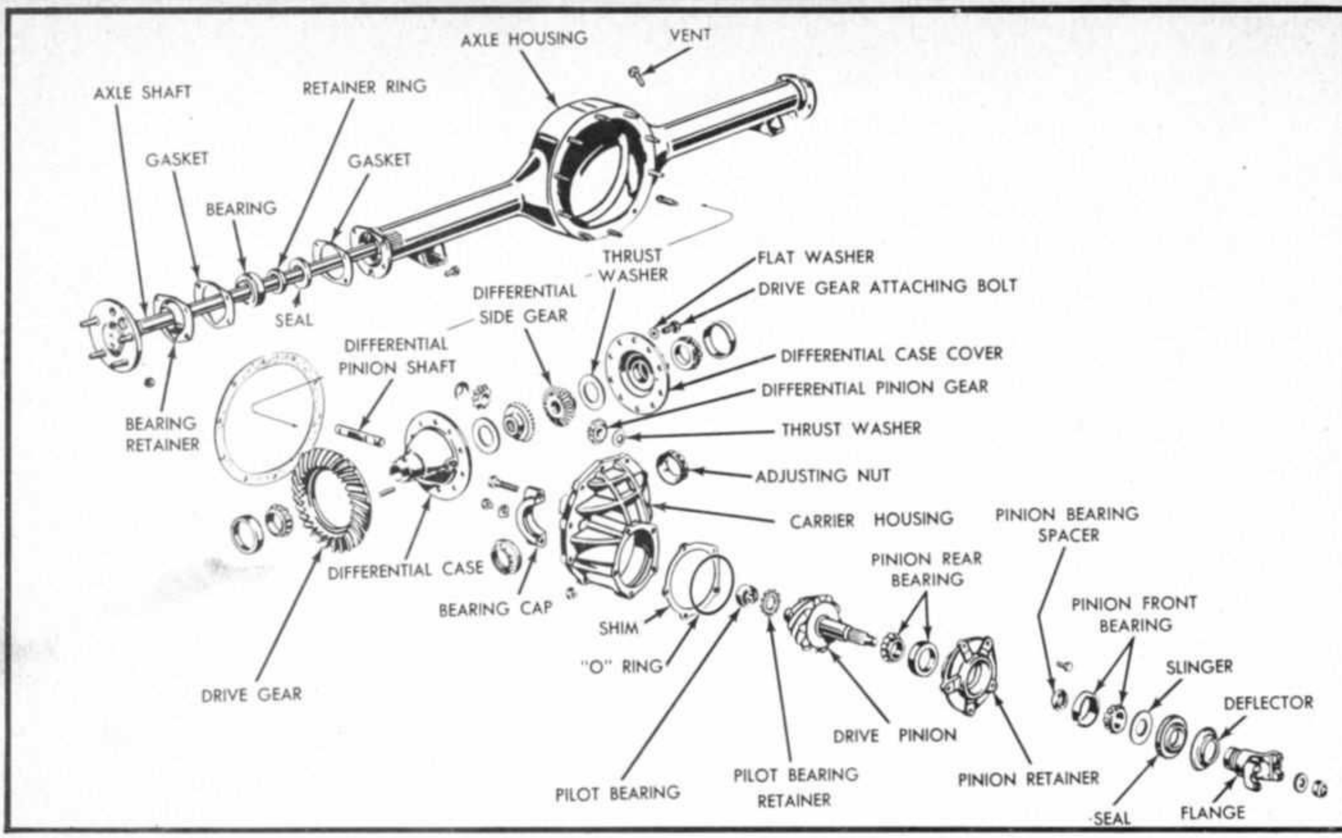
OMAHA, NEBR.



Exploded view of rear axle shows all components with proper names. Two pinion unit isn't recommended for drag racing.

Cruise-O-Matic—is in the car? Which differential—standard, four pinion, Equa-Lock, or will some other make of limited-slip be used? At what rpm does the engine develop its peak power? What size are the tires? Finally, how fast must the car run at the end of the quarter to be competitive in its class?

Accurate answers to all these questions influence axle ratio choice. It's a pity, but there is not yet an electronic computer which will digest all the facts and come up with an answer—although it could be done that way. The only route at this time is as much advance calculation as possible, then that great educator, trial and error.

It is not really as frightening as it sounds. The first decision to be made depends upon use of the car. If the object is primarily drag racing, then go all out. The end result will probably be a ratio around 4.57- to 4.86-to-1 (among the special service parts) or something very close to it. But bear one fundamental in mind: The lower the ratio (higher numerically) the faster the engine will have to turn during normal driving. Not only will gasoline mileage fall off drastically, but the engine buzzing at the required revs for decent highway cruising will be objectionable. And so comes the compromise for dual purpose street-drag use. A popular ratio that will do both jobs, at a sacrifice for each, is 4.11-to-1, a production ratio.

If cost is no object, then buy as many ring-and-pinion gearsets as needed and switch them as required. All the racing ratios will fit any Ford from 1957 through current models, so that swapping is not a major installation. The only difference in rear ends during those years is that there are two sizes of carrier bearings—3 and 3⅛ inches.

But it is plainly impractical to invest in a series of relatively expensive rear end gears. There is a simple answer—varying tire diameters—that will give a number of final drive ratios at modest cost. Let's take a hypothetical Ford down the strip and see how it works: Assume that the gear ratio is 4.5-to-1, rear tire diameter is 28 inches, the engine is turning 6000 rpm at the end of the quarter without great effort, and terminal speed is 110 mph. However, the car feels as though it would pull a slightly higher speed gear (lower numerically) for a better speed through the traps. Increasing the tire diameter only one inch to 29 will add about four miles per hour at 6000 rpm, presuming that the engine will still pull those revs. To get the same speed without changing rubber, it would be necessary to move to a gear ratio of about 4.3 to 1. There are mathematical formulae by which this may be computed, but the easiest way is to use a "dream wheel," actually a circular slide rule laid out as a ratio computer on which one sets tire diameter and gear ratio, then reads speed vs. rpm directly. They are invaluable at the drags. Several speed equipment manufacturers have them available and cost is about a dollar.

Use of the dream wheel tells us what should happen in theory. What happens in fact is always just a little different due to an error that invariably creeps in at the top end of the speed range. It is the product of rolling resistance, wind resistance, frictional power loss in gears and tire slippage. What to do about it? The starting point is to know the rpm at which the car's engine develops its peak power. On High Performance Fords, this means about 6000 rpm. Knowing this, actually tune for about 6200-6300 rpm. Why? That is the true rev range needed to go through the lights at the speed that theory tells us 6000 should give. The reason is our automatic built-in error—an error that can safely be estimated at about 200-300 rpm at maximum quarter-mile speed. More than one drag racer has calculated everything perfectly, run through the timing lights at his exact rpm, and been unable to understand why his true speed was three or four mph slower than what he felt it should have been. The error affects everyone and will remain quite constant no matter what gear ratio is used.

Don't shoot for the moon in estimating a desired speed.

It will only lead to disappointment. Be realistic in appraising the going speeds within a given class, and how fast it will be necessary to go in order to be competitive. Once an honest estimate of speed is made and engine peak is known, then pick a combination of gear and tires. A good rule is to select the highest possible gear (low numerically) and the smallest tire. The logic behind a high gear selection is simple: Higher ratios have less friction loss because they don't work as hard.

Selection of rear end type is a field unto itself. There are those who claim that a limited-slip differential is totally unnecessary—and they can back up the claim by beating limited-slip cars. It will be necessary to wedge the chassis very carefully to do this. In the absence of limited-slip, it is essential to use the four-pinion differential (part COAW-4953-A), a standard item on High Performance Fords. (Its case is part COAW-4204-A.) The four-pinion unit is a heavy duty part that has several advantages: It will stand up to the fierce strains imposed on it by dragging much better than the standard two-pinion unit; under load it has a semi-wedge effect; and it helps save rear-end gears.

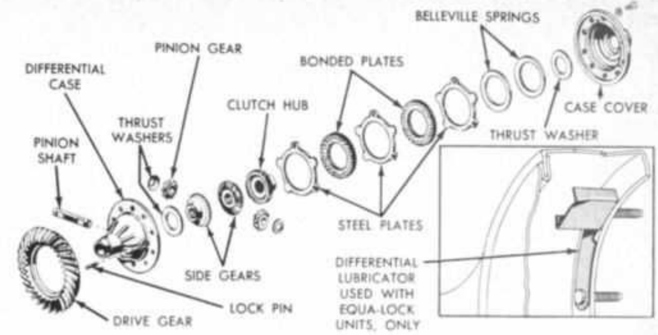
But many drag racers insist that some form of limited-slip is the answer. National Hot Rod Association rules permit any gear ratio and type of limited-slip differential which will fit into the original third-member case. This means that Ford owners are not limited to the Equa-Lock, which is satisfactory for racing but was not designed to take the stresses which severe take-offs impose. There are several other makes designed specifically for dragging, among them units manufactured by Dana and Getz, two reliable gear firms.

It is important to use care in setting up any of the racing gearsets. Some advantage may be gained by using slightly less pinion pre-load and a little more gear backlash to cut down friction. But use extreme caution in obtaining the desired tooth contact pattern between ring gear and pinion. There is one right lubricant to use with Ford's drag racing gears. It carries number C2AZ-19580-D, and has the proper amount of antiscore additives. It is available through Ford dealers. Proper rear axle break-in is important. The factory recommends at least 500 miles, following the same procedure listed for the High Performance engine. For the first 200 miles, accelerate from 30 to 45 mph at half throttle in high gear; then decelerate in gear on closed throttle to 30 mph. From 200 to 500 miles, accelerate from 40 to 70 mph (or whatever the law allows) at half throttle. Close the throttle and decelerate in gear to 40. Repeat until approximately 500 miles have been reached.

In the event of rear axle failure (scored ring and pinion), the factory has an excellent recommendation that should be carried out. Utmost care should be taken to clean the axle housing and steam cleaning is the only sure way to be certain that all the minute particles of metal are removed.

Which of Ford's four transmissions is to be used plays a major part in selecting an axle ratio. Even though the Cruise-O-Matic is not available on the High Performance 406, it cannot be overlooked because there are plenty of other Fords running in Stock Automatic classes at the drags. A C-O-M would be interesting in the 406, but its design limits preclude mating it with Ford's huskiest engine.

There are some good things to be said for racing with an automatic transmission. For one thing, rear end gear life will be substantially longer simply because the gears start out in a pre-loaded condition. They don't take the jolt that manual shifting puts out. For another, it is possible to utilize a more practical street ratio and still be effective on the strip. Due to torque multiplication, the Cruise-O-Matic is not in direct drive until the front pump shaft reaches seven-eighths engine speed. Experience has shown that a 4.57 rear end coupled to the automatic is roughly the equivalent of a 4.78 gear in a stick shift. In the same way, a 3.89 gear with Cruise-O-Matic is as effective as 4.11 in a four-speed. The point to be made is that the Cruise-O-Matic offers torque multiplication where it is needed—coming off the line. Drag races are won by the car that gets to the end of the quarter-mile first, regardless of speed. In some recent experiments at a West Coast drag strip, it was shown that two comparable Fords—one with Cruise-O, the other four-speed—had identical elapsed times for the quarter-mile, even though the four-speed model was traveling about four mph faster through the traps. Automatic transmission fans should not lose heart; just take a look at the stockers running in the automatic class at any drag strip and join in the sport.



Equa-Lock differential assembly has clutch plates which are forced together to oppose differential action. When car turns corner, clutch slips to allow normal differential action. But when one wheel has less traction, the friction between clutch plates will transfer a portion of the usable torque to the wheel with most traction, resulting in equalized force on both wheels.

In the stick-shift field, Ford offers a three-speed, three-speed with overdrive, and a four-speed transmission. Most of the drag racers who are serious about the sport are using the four-speed and chances are good that a check of ratios would find 4.57, 4.71 or 4.86 to dominate. However, as stated, they are not exactly ideal for street use. Another point, the latter two ratios will be most valuable only with such to-the-point drag preparation as heavy-duty clutch and cylinder head combustion chambers made identical in capacity. Use of the 4.11 gear with four-speed is about the best deal for street-drag use, juggling final drive ratios with tires.

One of the most practical all-around transmissions is the three-speed with overdrive, that is if you can get sufficient quarter-mile performance from a three-speed, and plenty of drivers do. Incidentally, Ford is the only firm currently building high performance engines to offer a three-speed plus overdrive transmission. Since the overdrive amount is .72, figuring the advantage is a matter of arithmetic. Use of a 4.57 axle, which is liable to win a few trophies on the strip, will give a happy highway ratio of 3.28 in overdrive —a clear case of having one's cake and eating it too.

With a little experience in matching gear ratio to transmission, tire size and peak engine revs, there is no reason for a drag racing Ford not to take home its share of stock eliminator trophies. ■

SPECIAL SERVICE REAR AXLE RATIOS

RATIO (to-1)	PARTS NUMBERS
5.83	WAB-4209-B
5.67	WAB-4209-C
5.43	WAB-4209-D
5.14	WAB-4209-E
4.86	WAB-4209-F
4.71	WAB-4209-G
4.57	WAB-4209-H
4.29	WAB-4209-J

CHASSIS TUNING FOR COMPETITION

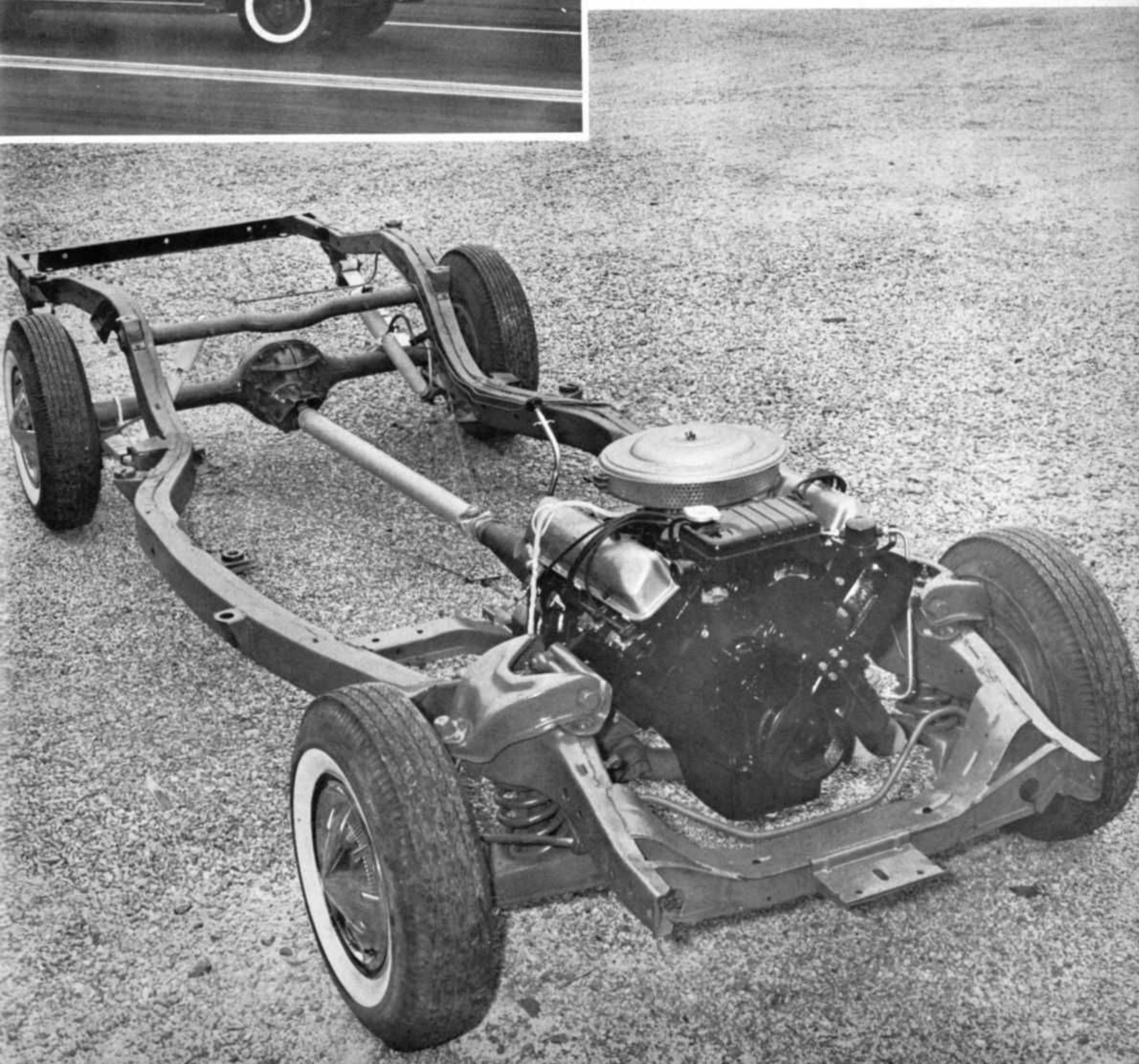
By Wayne Thoms

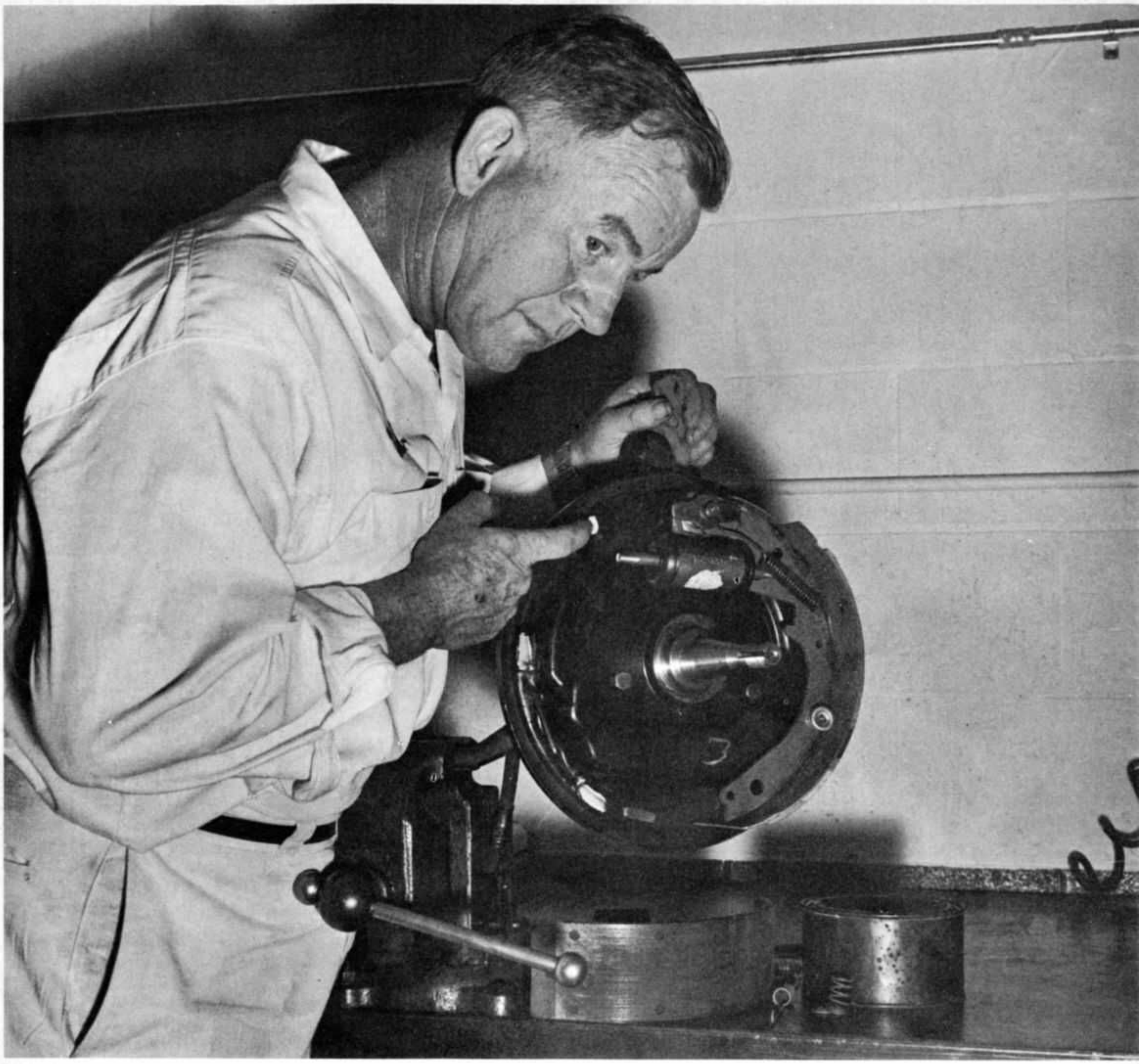
CHASSIS tuning is a science as complex and varied as engine tuning. And, what makes it more intriguing, considerably less is known about it by most people. Professional mechanics and owner-enthusiasts are alike in their general ignorance of chassis intricacies, but lack of knowledge in this area is nothing of which to be ashamed. The point is that normal Ford specifications, particularly in the High Performance versions, provide a car that handles and rides in a manner that suits most people for most purposes. From winding mountains to open roads and on through city traffic, the car gets the job done. But competition is another story. The potential is there. We shall explain some of the tricks used to extract it.

With a little chassis work and proper know-how, a late-model Ford (from 1957 to date) can be made to do just about anything required of it in competition. On the assumption that Ford owners who plan to go stock car racing are specialists who know what they want before they start, we will pass that facet and move immediately into how to go drag racing for fun and trophies. We must use a broad-spectrum approach. Many (in fact, most) owners need their cars for daily transportation and are reluctant to set them up solely for serious drag racing, for at this point unpleasant, noisy things begin to happen to ride. Generally, it is the wife who complains first. So let us explain tuning techniques applicable to the married, out-for-sport driver,

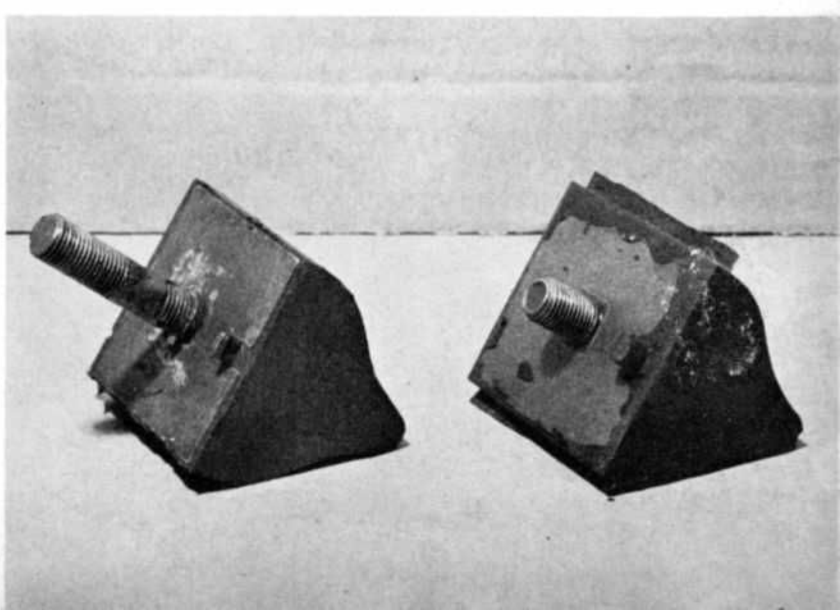
LEFT—The black super stock in the far lane is equipped with the high performance 406 engine and 4-speed transmission. It gets excellent traction from the starting line and, as seen here, shows its heels to many cars of competitive makes.

BELOW—This 1961 Ford chassis has the same basic suspension layout as all Fords from 1949 to date. Therefore, all tips for the drags in this text will apply to all models of this period. This chassis is set up with front spring spacers and heavy duty rear springs and shocks for running on the drag strip.





ABOVE—To insure complete retraction of brake shoes after application, and also to prevent drag, contact points on backing plates should be lightly lubricated fairly often.



RIGHT—The stock pinion snubber for late model Fords has short 3/8-inch stud, as at the right. By welding a longer bolt to it, it can be easily lengthened and spacers added.

FAR RIGHT—Ford front wheel alignment shims are stacked between snubber and steel shield to raise the snubber one inch. This leaves about 1/2-inch clearance for weight shifts.

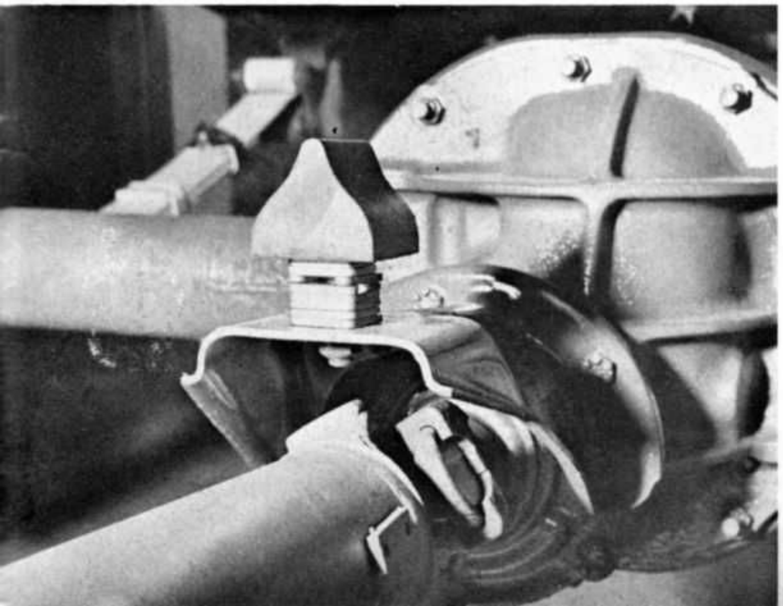
plus what is needed for the dedicated racer who is willing to sacrifice certain things in favor of winning consistently.

First, one specific comment: A portion of the parts list available for the 1962 High Performance 406 and the '61 390 High Performance model, lists Extra Heavy Duty Parts ('61) and Extremely Competitive Event Components ('62). These pieces are intended for stock car racing and have little or no application to dragging. Conceivably, some might be valuable for ultra-high-performance highway driving—the stabilizer bar (part C1AA-5482-A), or one of the three rates of front springs, 750 lb./in. (part AJ-5310-N); 900 lb./in. (part AJ-5310-R); 1200 lb./in. (part C2AZ-5310-A). But it is doubtful that heavy duty spindles or an oil cooler, for example, would be of value off the oval track, unless the Ford were traversing the Sahara. Certainly these parts will do nothing to help, and will more likely impede, drag race performance.

Drag racing actually presents only one problem: Get all the available horsepower transmitted into forward motion as rapidly as possible. Assuming a sharp engine that is producing all the horses needed, there are several variables to consider. One of the first is rear end gearing. Since this is discussed in detail in another chapter, we can further assume that the optimum gear ratio has been chosen to match transmission type and tire size. Also, let us pretend that no more power is being lost in tire slippage than any of the competition is losing, meaning that we have chosen the ideal tread width, tire diameter and rubber compound. (Tire selection will be discussed later.)

With these problems firmly under control, we can concentrate on chassis tuning. It is sometimes called wedging because one of the chief aims is to transfer as much weight as possible evenly to the rear of the car during acceleration for maximum tire bite. In other words, the front comes up, the rear goes down, and weight shifts rearward. It requires several changes to rear springs, pinion snubber, front springs and shock absorbers to accomplish this. Actually, a properly wedged chassis can be as effective as using a limited slip differential. There are, however, two strong schools of thought here, and such a statement can stir up a hot argument between recognized authorities who hold opposing views.

Initial step is to install the heavy-duty five-leaf rear springs (part C2AA-5560-J), standard equipment on High Performance models. Beginning in 1961, Ford rear springs were placed so that there is about seven inches more spring from the axle to the rear than from the axle to the front. This was done in the interests of a better ride, but it doesn't aid drag racing. It encourages spring wrap-up during acceleration, which promotes wheel hop, which is one possible reason for rear end gear failure. Wrap-up is simply caused by the torque of the rear axle trying to rotate the front of the axle housing up, and simultaneously twist the rear down. The best solution, and one that works very well, is to remove the fiber insulators from between the tips of each leaf. (These were placed there to give smooth, quiet spring action.) Then install extra clamps to inhibit leaf movement. Two extra clamps at the rear and one at the front are generally accepted as sufficient to stiffen the spring and resist torque.



Since National Hot Rod Association rules permit both front and rear of the car to be raised or lowered 2½ inches from stock, it follows that lowering the rear would help accomplish our aim of weight transfer. One method is to use a set of lowering blocks. But a good scientific argument against lowering blocks is presented by Les Ritchey, who operates Performance Associates in Covina, Calif., and is acknowledged to be one of the sharpest Ford drag race men in the country. His recommendation, and this is for serious drag racers, is to de-arch the rear springs. His logical contention is that lowering blocks effectively extend the height of the axle, changing the spring's fulcrum point, and aggravating wrap-up. Any good spring shop can de-arch a set of springs properly, but it must be noted that the NHRA has a stock dimension from the rear bumper to the ground. Don't take a set of springs that have settled slightly and de-arch the full 2½ inches; it will be more than is allowed.

On late Fords, there is a compression-type U-bolt that clamps the axle housing to the springs. This U-bolt has a shoulder which permits housing and spring to be clamped to a prescribed setting so that rubber insulating pads on either side of the spring will not be compressed so tightly that they transmit road noises inside the car. However, noise is secondary on the drag strip. Replace the stock U-bolts with bolts that have no shoulder, and compress the insulators very tightly to eliminate flexibility. Carrying this one step further, there is the theory that no matter how tightly compressed the rubber is, it is there and it must flex and react that micro-instant before the car actually starts to move. So, remove the rubber and place the spring metal-to-metal against the flange. Road noise will be high (a graphic explanation of why Ford engineers used the insulation) but it can make a slight difference if beating the best at the strip is a consideration.

Beginning in 1957, Ford added a shield at the top of the pinion housing which supports a soft rubber snubber. This snubber contacts a plate on the underside of the body to stop bottoming on dips. Normally it is about 1½ inches from the body when the car is not loaded. Since the pinion housing wants to move up toward the body during acceleration (a result of the wrap-up process), halting its movement should do a great deal to stop wrap-up and exert extra pressure on the rear wheels. This is done in an effective and simple manner by welding an extension to the ⅜-inch stud on the snubber, and adding shims (front wheel alignment shims do nicely) at the shield so that there is only about ½-inch clearance between snubber and car body.

There are almost as many views on rear shock absorbers as there are drag racers. The shocks included with the High Performance 406 are good, but not quite up to what is required for drag racing. Extra heavy duty shocks (parts C1AZ-18077-A and C1AZ-18097-A) can be installed. They are available on special order from local Ford dealers. And there are several proprietary brands that have been used with success. Without offering any endorsement, let us point out that one extremely popular brand is Cure-Ride. Specially valved, and guaranteed for 50,000 miles, they come in four grades—normal, high-speed, semi-competition and full-competition. The semi-competition model has worked out very well mounted at the rear of some of the leading Fords running at the drags.

Front shocks for the drags are diametrically opposed to what is required for good road handling. In order for the front end to come up quickly, the shocks should be as loose as possible. One method is to install a pair that have been run 30 or 40,000 miles. They will be worn and have much less dampening action than new shocks, thereby permitting rapid weight transfer to the rear.

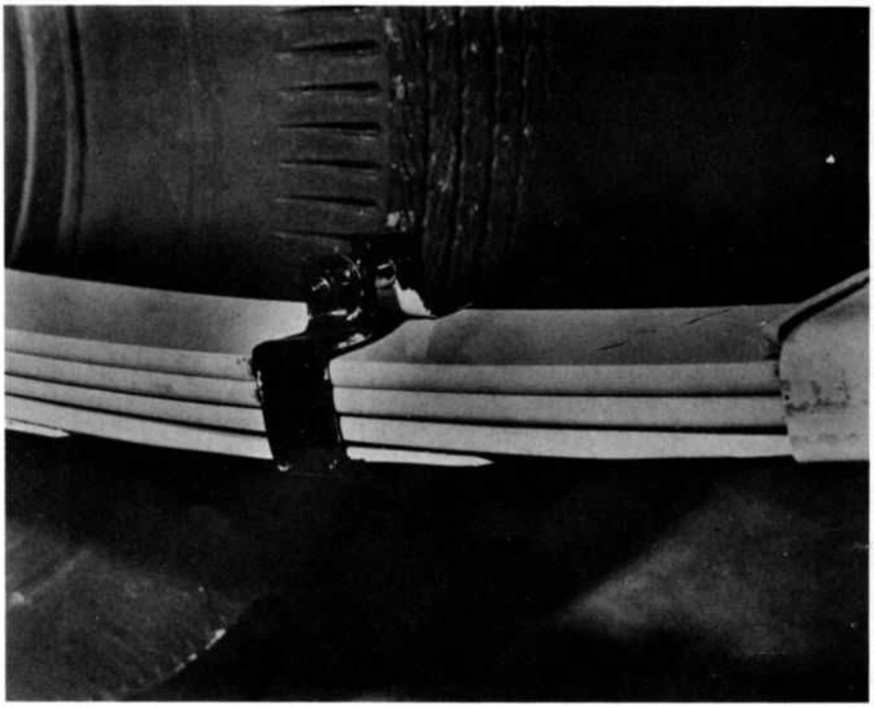
It is generally agreed that the stock coils do a satisfactory job but they can be aided for drag racing by installing a set of spacer rings as used on air-conditioned Fords. These rings are 5/16-inch thick and are installed on top of the front coils to raise the front by that amount. Again, an aid to the desired weight transfer.

Tires logically fall into chassis tuning, at least in how ing tire sizes can effectively (and inexpensively) change the ratio. Consequently, no hard and fast rule can be set down as to the exact tire size to use. This area is explored in detail in the chapter dealing with choosing rear axle ratios. Inflation will depend upon the strip and how it is surfaced, but with a typical butyl tire—Atlas Bucron, for one—24 to 28 pounds has been found about right. Sometimes less pressure is needed in the right rear tire due to differential action, unless the rear end carries some of limited-slip differential such as Ford's Equa-Lock.

For front rubber, choose a tire with minimum rolling resistance. The next size smaller, 6.40x15 or 7.50x14, should be used. A nylon cord tire is excellent because of its strength. Preferably it should be slightly worn to keep weight down, but in good condition. Front tire pressures should be 45 to 50 pounds for easiest rolling.

As for tread compound, tires with high butyl content have proved to have the best bite. And there are a num-

Standard U-bolts have shoulders which will prevent overtightening. Service bolts shown have no shoulder, can be tightened to compress rubber insulators.



This photo shows how waxed insulators used between tip of leaf and leaf above must be removed and extra clamps added so spring is less flexible and won't "wrap" under extreme pressure of competition driving.

they affect what has been done. In the stock classes, the NHRA allows considerable size latitude, but they do have some restrictions. From their 1962 rule book: "On-the-street-type tires with not less than 1/16-inch tread depth, using conventional tread pattern. Any conventional-type tread or recap compound may be used. Tread width may not exceed the following: 6.00 to 7.10—5½ inches; 7.50-8.50—6½ inches; 9.00 or more—7 inches. Any wheel-tire combination may be used that will fit in the original wheel well opening." The wheel option is one inch larger or smaller diameter than original equipment.

It is generally conceded that the next size (at least) larger is a good starting point for rear tires. In other words, the High Performance 406, which uses 6.70x15 tires, should carry at least 7.10x15. On Fords with 14-inch wheels, where 8.00x14s are standard, go to 8.50x14. The problem is that tire diameter is directly related to rear axle ratio, and vary-ber of recappers producing so-called "cheater slicks" which are permitted and perform very well. Trial and error is the best teacher here.

It is essential to check front wheel bearings and wheel alignment. Bearings should be lightly packed with a good wheel bearing grease, and adjustable nuts used to set a very slight pre-load. Front wheel alignment should be set at 0° caster, ½° positive camber and not more than 1/16-inch toe-in. These figures are not precisely as set forth in the Ford shop manual, but they will be found to be best for dragging.

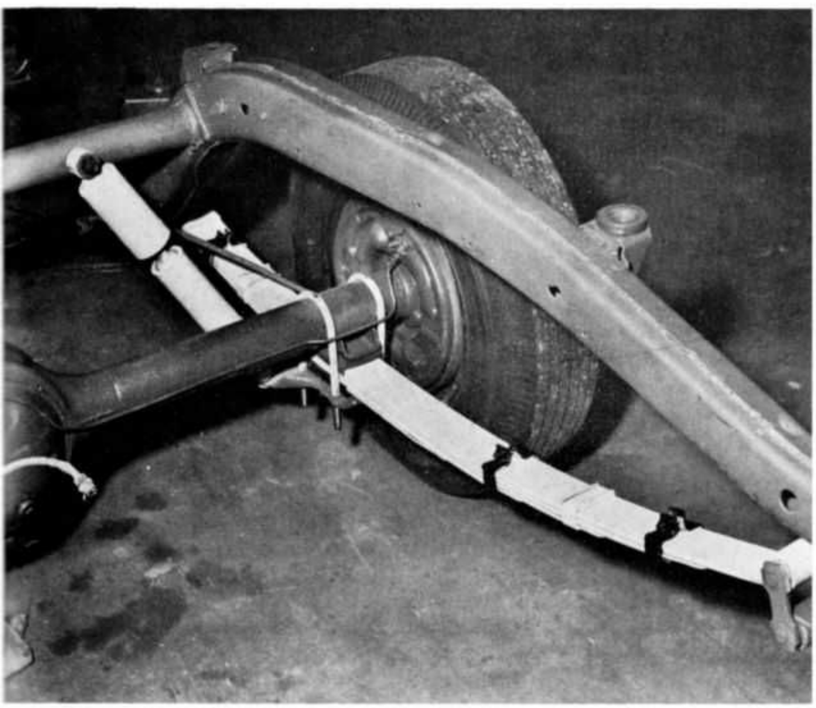
It is clear that brakes should not drag on the drag strip. The same rules apply front and rear. Pull the wheels and drums. With a heat-resistant grease, lightly lube the contact points on the backing plates that support the shoes to insure complete return of the shoes after each brake application. Fords with self-adjusting brakes also come in for some attention. The self-adjusting mechanism, which operates every time the brakes are applied when the car is in reverse, keeps the brakes close to the drums and might cause some drag. The adjuster mechanism should be removed and replaced with the standard springs and adjuster. Proper brake adjustment for the drag strip is to adjust the shoes to the point where they drag firmly, then back off 15 notches. There is no longer any chance of brakes dragging.

It is a matter of personal choice, but many drag racing owners prefer to lube their chassis oftener than the 30,000-mile interval specified for the late Fords. To do this, they have had conventional grease fitting installed so that critical points may be lubed more frequently. A Ford dealer can install fittings in the proper spots.

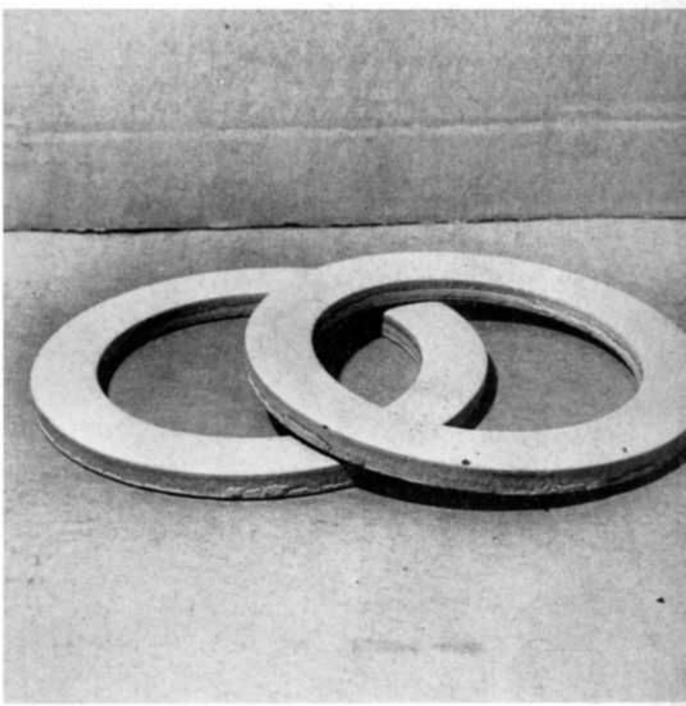
For the Ford owner who still wants to go drag racing, but doesn't want to make all the recommended chassis changes, there remains an out. It won't make him a consistent winner, especially against the dead serious drag boys, but it should provide many hours of drag strip fun. This owner will be the man who cannot choose an all-out-drag rear end ratio. Let us say that instead of a 4.78-to-1 gear, which might be optimum for his car, he has selected a 4.11 for reasons of preserving some of his highway economy. The simplest, quickest way home is to install a set of traction bars. There are several makes available and they all do essentially the same thing—transmit rear-axle torque to the frame to prevent rear-spring wind-up. The NHRA not only permits them, it recommends them as safety devices. And they help stabilize the rear of the car on the highway. Use of traction bars eliminates extending the pinion snubber, adding spring clips, de-arching the rear spring—all of the work at the rear of the car. They won't do the job quite as well as the all-out modifications, but they go a long way toward making the Ford an effective drag race machine without fouling up the street riding and noise characteristics of the car.

All that is left now, as far as the chassis is concerned, is to head for the nearest sanctioned drag strip and aim for the end of the quarter-mile. It is probable that slight adjustments will have to be made on the spot. For example, if the right rear wheel spins on starts, a little extra weight jacking on the left front will help solve the problem. This is accomplished by inserting small rubber blocks (sold in parts houses to help sagging coil springs) in the coils as needed. The increase in height at the left front will increase the load on the right rear, and tire pressure adjustments should complete the task of getting all the power on the ground.

Anyone who plans to get a little more fun from his Ford by taking a fling at drag racing would be well advised to make at least one trial run at the quarter before dipping into any chassis modifications. Remember the speed and elapsed time. Then make the changes and try it again. The difference will be astounding—and it's liable to come as an unpleasant surprise to some of the other stock class entries who might have been competing during that initial run. ■



Light colored pieces in this photo are either special or have been modified to improve the rear wheel traction under stress. The shock absorbers here are heavy duty export. Beefing chassis a must for drags.



Steel spacers used on Ford air-conditioned cars are 5/16-in. thick. When installed on top of front coils, they help transfer weight on those fast starts.

FOLLOWING IS A LIST OF 1962 HIGH PERFORMANCE CHASSIS PARTS:

C2AZ-2001-C	Brake shoe and lining, front
C2AZ-2200-C	Brake shoe and lining, rear
C2AA-4602-A	Driveshaft—Standard (3 speed)
C2AA-4602-B	Driveshaft—overdrive
C2AA-4602-A	Driveshaft—4-speed
COAW-4953-A	Differential—4-pinion
C2AZ-5230-A	Muffler—R.H.
C2AZ-5230-D	Muffler—L.H.
C2AZ-5A212-E	Ext. inlet pipe R.H. except 76B
C2AZ-5A212-A	Ext. inlet pipe L.H. except 76B
COAA-5310-E	Heavy duty front spring
C2AA-5560-J	Heavy duty rear spring
C2AZ-7003-F	Transmission—4-speed
C1AZ-18124-K	Heavy duty front shocks
C1AZ-18097-A	Shock absorbers—rear

ENGINE TUNEUPS

Author Les Ritchey is quite experienced at setting up Fords for drag racing. He's seen here making practice run at Pomona, Calif.

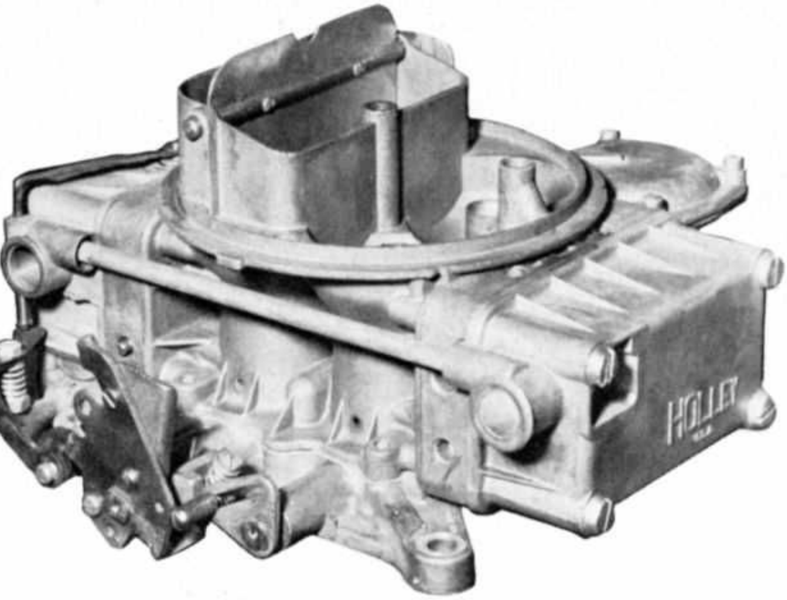
By Les Ritchey

GETTING the best out of any manufacturer's engine involves a lot more effort than most competitors are ready to give. The people who are giving the effort are usually the ones who are getting the most out of their equipment. This has no reflection on the manufacturer for the simple reason they are bound by cost, by management and by engineering tolerances uncontrollable due to cost. When a product is purchased, it is your responsibility as a purchaser to go from there. A lot of things can be done. The tuning end of it will be covered in the following paragraphs. Whether it's gas mileage, drag racing, track racing, hill climbing or just a good transportation car, each one has its own requirements. The manufacturer has given you an optimum automobile built a little for each. Now it's up to you to make what you want of it. A little thought, a lot of effort and persistence can make a winner out of your car.

Let's take first things first. It might pay to review what makes an engine run and produce horsepower. Actually, the biggest commodity is *air,* gas is incidental, but gas you pay for, air you do not. The density of air and the temperature, which are the end results of the actual weight of air, are the ingredients of engine horsepower. You have control over the amount of gas but certainly not the air. This then is one of the reasons why, in some areas of the country, cars run much better than in others. Obviously then, the more air you can get into the engine and the heavier it is at any given engine rpm, the more horsepower this same engine will put out without any other changes. Actually, to be concerned about what other people are doing in other areas is a gross waste of time. You must take your car almost as an individual, analyze its shortcomings and work on them one at a time!

CARBURETION

There is nothing any more limiting to performance than a carburetor which is not matched to your engine's displacement. I feel that Ford has done a fine job with carburetion in all respects, and no other carburetor works even as well as, much less better than, the original equipment. All



Four barrel Holley carburetor with modified linkage, making possible mechanical opening of secondary butterflies which are normally controlled by a vacuum diaphragm.

kinds of combos have been tried but Ford's always turns out the best from 1954 right on through '62 high performance setups.

Ford has a selection of manifolds and optional kits available from 1957 on, which will cover cars from 1955 and up. A dual 4-barrel setup which will fit all 272- 292- 312-inch Ford engines from '55 through '62 is a fine performing outfit giving maximum flexibility. A little jet work and float setting is all this setup needs. It came originally with the 1956 260 hp kit and advanced into 1957 270 hp rating. After many hours of dyno work, the jetting found best for this setup was .048 main jets, .055 secondaries and ½-inch distance from the top of the float bowl to the gas level–engine running. We've found the best place to jet any carburetor is on the dyno. These jet sizes will suffice in all cases but the extreme.

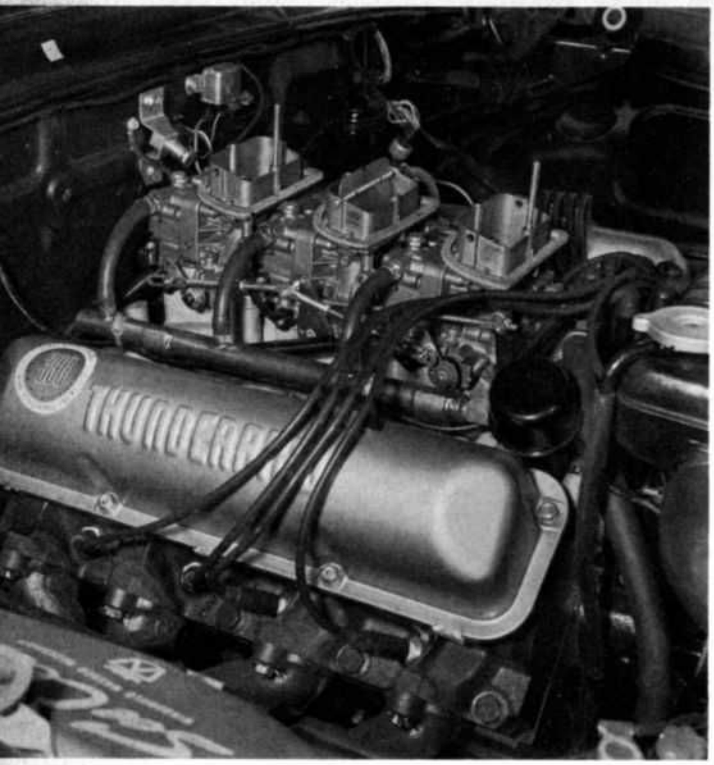
In 1957, Holley came out with the big venturi and end float bowl carburetor which for all intents and purposes is as good as you can buy for performance. This carburetor features .055 jets in the primaries and .048's in the secondaries. Drill secondaries to .050–this is all they really need. All other circuits are o.k. These carburetors are set up by the manufacturer for optimum in all ranges with a certain amount of reliability involved, so, as we have said, a variance in sizes can be advantageous for any desired condition. In 1957 also, Ford came out with a 300 hp supercharged engine, which was a real performer and still is a good bet to bring home a trophy in its class. This engine option ran a single 4-barrel concentric bowl Holley, which was actually made for the Lincoln engine, with changes in jets and secondary operations designed for the supercharger. After many hours of running, checking and changing both for street and strip, we found that .063 main jets and .110 secondary jets were the best performing combinations. This will not suffice for an unblown engine. It would run extremely rich so don't try it without the blower!

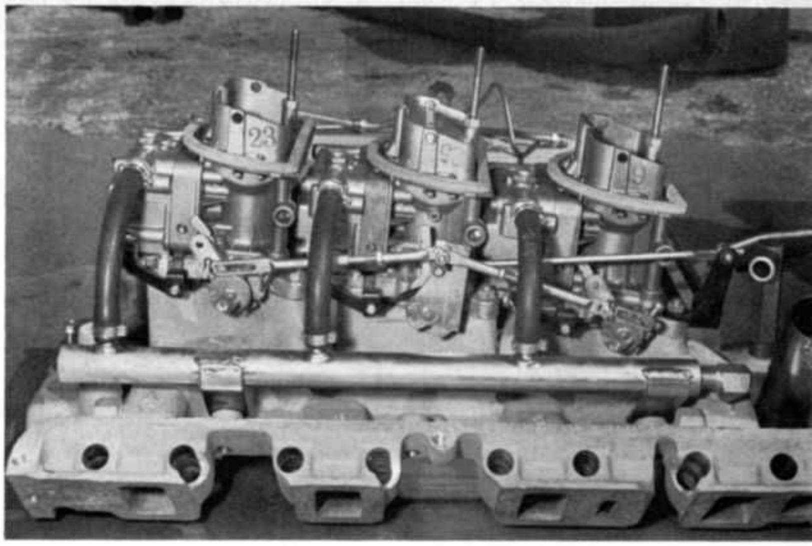
In 1958-1959, Ford just didn't build any units expressly designed for high performance, although these cars when set up do very well. We have found in these cars, the Ford 4-barrel will give top performance, although Carter and Holley carburetors are also used. As a rule of thumb, the stock jets should be retained and the circuit under full load enrichened by not more than .003 which, in this case, would be to drill the secondary jets only. The primary jets are considered to be o.k. We have found that quick acceleration is dependent on clean burning and, in order to accomplish this, the engine must be slightly lean. This will be true on all of Ford normal passenger car units built for general public acceptance from 1954 through '62, excluding the high performance options.

The two-barrel carburetors are not found too much in racing except for the drags in their respective classes. This carburetor is usually connected with mileage and normal driving. However, these also can be made to do a better job for either racing or mileage. For mileage, the factory-recommended, one- to two-step leaner jets can be installed, floats set at minimum low, the power valve actuation checked and set, idle screws adjusted as far in as possible along with a smooth idle and idle rpm's set with a tach for factory-recommended correctness.

For racing, the main metering circuit should be left alone and the power jet orifice drilled .003 larger. This will let the initial acceleration be clean and the mixture will richen up when load demands it. Float setting should be set at factory maximum height.

Don't sell the 6-cylinder Falcons and big Fords short–these same changes apply to them. In their classes, they can also be made to compete. In 1960, Ford engineered the 352-cubic-inch, 360-hp high performance engine to put them back into the top competitive events again. This engine option used a carburetor with oversize venturii compared to the regular passenger car carburetors and was built especially for this bigger breathing engine. The primary venturi is 1³⁄₁₆" and secondary venturi is 1¼". This carburetor is also of Holley end-bowl manufacture, having primary jets of .064 and secondary jets of .076, the secondary butterflies being operated by a venturi vacuum-actuated diaphragm. The jets in this carburetor are found to be just about right for all competitive events except the extreme, such as sustained full-throttle operation. In this event, the secondaries should be richened up .003. In 1961, Ford jumped the displacement to 390 cubic inches and horsepower to 375. A big brother racing Holley 4-barrel was released for this engine, having a primary venturi size of 1.250 and a secondary venturi size of 1.312. The jet size for this carburetor is .066 primary and .078 for the secondary,





Part throttle position. Center carb is half open, progressive linkage is starting to open rear carb. Front carb opens slightly behind rear carb, all three reach full open simultaneously.

In throttle closed position, the progressive linkage should appear as seen in the photograph at left.

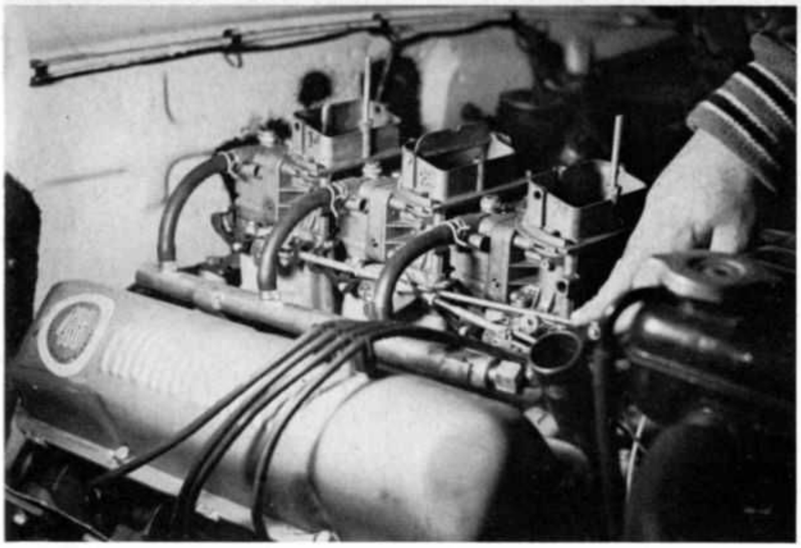
and the secondary diaphragm is also operated by venturi vacuum. The 1960 and 1961 Holley high performance carburetors look identical to the eye, varying only in venturi and jet size. These carburetors work well on all 352-390 engines from 1958 on up and not just a little performance can be picked up by their use.

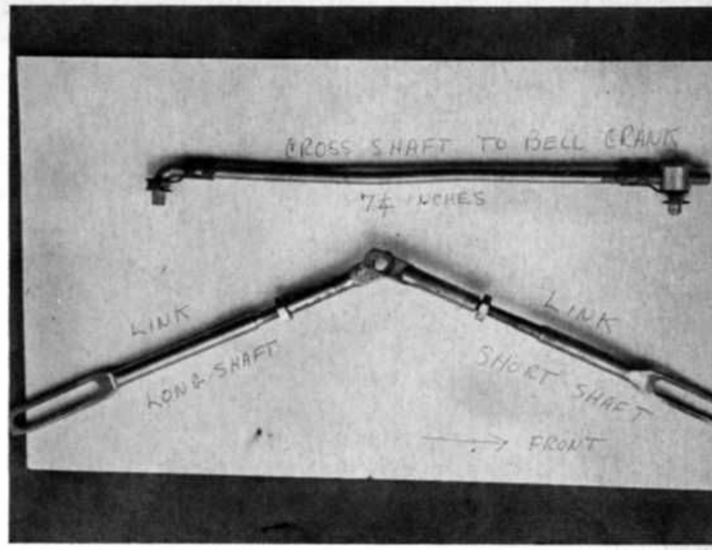
Then, also in 1961, along came Ford's tri-power carburetor setup, which really gave the competitors running Fords something to get excited about. This manifold houses three Holley 2-barrel carburetors having venturi sizes of 1⅛ in the center carburetor and 1³⁄₁₆ in the two outside carburetors. The jets are .066 in the two outside carburetors and .061 in the center carburetor. The two outside carburetors have no power circuits in them, only idle, acceleration and main jets. In early '61, the first manifolds were put out with power circuits in the two outside carburetors and had jet sizes of .061 in the center carburetor and .062 in the outside carburetors. The later carburetors with no power circuits are actually smoother-operating setups and will outaccelerate the earlier type, because they do not dump as much raw gas all at once. Engine rpm's have to be at a specified amount before fuel will flow, whereas in the earlier types the power circuits were governed by the engine vacuum and the outside carburetors could be made to get rich prematurely by engine load, rather than throttle opening.

Jet sizes for these carburetors are quite critical also. It definitely depends on your area and the air content. But, for all intent and purpose, the two outside carbs are too rich to really run clean. The early carburetors with power valve circuits should run .059 jets and the later '61 and '62 setups should run .064, again, with the exception of sustained high speed and load. The center carburetors on both units cannot be changed for any appreciable increase in performance.

The progressive linkage on these carburetors is important also, and should be set up with the utmost care. It's possible, you know, to get the long and short shaft reversed and still attain full open, but the opening of the primary carburetor is extremely premature and performance is greatly sacrificed by opening the two outside carburetors too quickly. The actuating arm from the center carburetor to the bell crank up front should be measured and adjusted to be 7¼ inches long, from hole center to hole center and installed. Then take the longer of the two link shafts and install it on the center and rear carburetors. Now open the center carburetor all the way and adjust newly installed link shaft so the rear carburetor is open fully. Repeat this procedure for the short front link shaft, all three carburetors should be fully open. After this is done, the idle should be set at 600 rpm's, to get away from stalling at stops and again to quicken acceleration. All four idle screws in the outside carburetors should be turned in until seated and the idle circuit of the center carburetor adjusted to give a smooth idle.

If there were any cut-and-dried way to have the best carburetor for mileage or performance, every manufacturer would be excelling in both, but this cannot be accomplished and still build a car for general consumption; it has to be an optimum. So, in tuning for either one or the other, it must be left to the individual or tune-up man to find its weakness and do what can be done about it. Now dyno's are few and far between, but this is probably the easiest way of finding out what you want to know. A mixture test will indicate which way you should go for either mileage or performance. If a dyno is not available, then road testing is the only other way. First, you have to acquaint yourself with the circuits in your carburetor, which are Idle, Acceleration, Main Metering, Power Circuit and Secondary, if the engine has a 4-barrel. Now each one of these circuits has a function and a time to operate. By studying this, you can soon pick out the places where detrimental changes are occurring. As an example, if the car accelerates very well until mid-range then gets sluggish, the *Power* Circuit would be the place to look. It could be coming in too soon, which would cause an overlap with the Main Metering jets, or it could be just too much gas, which would mean the orifice size should be decreased. If initial acceleration seems to be sluggish, too much *Acceleration* pump discharge is





Left: Position of throttle arms on Tri-Power is shown and proper procedure for checking full throttle opening, which is a must, can be double checked by having someone in car step on throttle. Right: Proper setup for cross shaft and linkage adjustment is shown.

usually indicated. This can be checked out by leaving the pump arm off. If the car accelerates well this way, then the arm action and distance of travel must be decreased. So, in trying to get the best from your carburetor, it takes a little study in its theory and function, then you can make changes to your advantage.

Here again on gas mileage, the most important thing to do is to make sure the carburetor is properly working—all its circuits at the right time. Adhere to the factory's recommended lean jet size changes, run floats at minimum low settings and drive sensibly. If these are done, mileage complaints don't occur.

Now for competitive events, such as drag racing and track racing which are two different breeds. Drag racing is usually a 13- to 14-second run, then let it cool. Track racing is sustained load and therefore carburetion jetting and operation is altogether different. For track racing, the carburetor has to have a high float level, within reason, and should run about 4% richer than the chemically correct mixture, which is not always what the manufacturer has for jet sizes. For dragging, this same carburetor could be run much leaner and with a lower float level, because the exactness of each working circuit and its occurrence is extremely important for this short distance. To get the best from your carburetor at any given event, from week to week, is to find out by trial and error where your engine runs the best in relationship to jet size on a normal 70° day. Then, according to the difference in the weather, you will know which way to go. As a rule of thumb, when the weather is dense and cool it calls for an increased jet size, when the weather is hot and dry it calls for a decreased jet size. Part of the success of this last statement depends on how sharp an individual is, but even he can be outdone by someone who wants to *work*. If time permits, two runs can be made with existing jets, then go .002 richer or leaner according to the weather. Then make two runs. If the times are faster you are going in the right direction, if they are not, go .002 the other way. If times slow down both ways, then you were right to begin with and the carburetion should be left alone until next race day. *Effort* is the key, go to it!

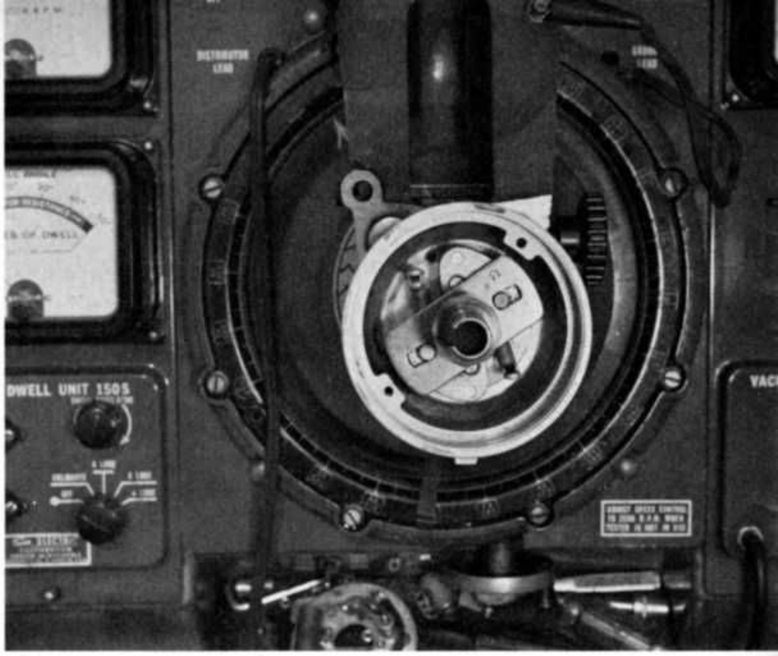
IGNITION

Here is the department where probably more performance can be picked up than anywhere else. The reason being you can sacrifice more here for one thing than another—if it's gas mileage you're after, a lot can be done to the ignition; if it's performance you want, another direction of changes can be made. A few peculiarities must be reckoned with, which we will try to show in the following paragraphs.

The manufacturer has built an optimum ignition—the rate of advance and the vacuum advance are predetermined and based on a lot of variables all over the country, such as octane difference, altitude, driving conditions and a host of others. It becomes quite obvious that if a person knows what he wants to use his car for and knows the limits on octane in his area, he can do a lot for himself and his car in the ignition and advance curve department.

Why do we need to advance the spark? Why not just advance it up to where it runs the best and leave it there? Well, it wouldn't start for one thing and low engine rpm range would be extremely rough. Actually, what we do when we advance the spark is to give the mixture a longer period of time to burn.This is due to an increase in engine rpm's which in itself decreases the time the mixture has to burn. What we are trying to accomplish is to cause maximum pressure against the piston head on the power stroke when the piston starts down the bore. If we are too far advanced, pressure is exerted against the piston before it reaches T.D.C. and if we are too late then the piston is past T.D.C. So you see how critical this becomes for any given load on rpm's. This advance curve adjustment is best done on a dyno, but in all except a few isolated cases, it can be done by trial and error. The complaint of a "good elapsed time and poor top time" or vice versa is usually due to an improper advance curve. The good elapsed time usually means the ignition has too much total advance with too much lead. The initial lead is giving you ample pull out of the hole, but when high rpm's are attained, the engine is in inaudible detonation. The thing to do here is to cut down the total curve and what you take off the top, add on the initial lead.

All this can be accomplished by counterweight spring changing. The rate of advance can be totally controlled by increasing or decreasing the spring pressure. Now, here again the purpose of your car enters into the procedure to



Left: A distributor Strobe is essential if exactness is to be accomplished. This is the only way to set the cam angle electrically, set proper advance rate, and check point bounce and condensor performance. Right: Centrifugal advance mechanism only is used on Ford high performance 352 to 406 engines. Return springs and weight action should be checked carefully on the distributor machine to make absolutely certain that the action is smooth and that the proper advance curve has been obtained.

use. In track racing, the total degrees of crankshaft advance is the only problem and this becomes quite simple because, usually, in this type of racing, you never fall below the maximum rpm's. The ignition centrifugal mechanism attains its maximum throw-out. In drag racing, unlike track racing, the rate of advance becomes all important. In Ford's high performance engines, you will find a distributor which has centrifugal advance, but the vacuum unit is non-existent, reason being that gasoline mileage is secondary. In these cases, you will find a lot of initial timing recommended and in most cases, a quicker rate of advance. Performance is the only thought. Couple this with a vacuum unit and light load work would no doubt cause excessive detonation. The combination of vacuum and centrifugal advance distributors as used on all normal passenger car units is an effort to give maximum mileage and optimum performance under all existing conditions. When the car is cruising and engine vacuum is high, the distributor is pulled into an extremely advanced position. When load increases and vacuum drops to "0," the distributor reverts back to centrifugal throw-out only. When setting up for top gasoline mileage, the centrifugal weight throw-out and vacuum pull curve maximum should be adhered to. Now in drag racing, the quicker you can get the distributor at its maximum the better the acceleration would be. This is within certain tolerances such as detonation and misfiring. The more initial lead, the better the car comes out of the hole, but this must be blended into a curve that is right for high gear power also.

There are certain things to be done when setting up your ignition other than just the curve to insure proper operation. The counterweights must be free, the shaft must be in good shape as well as the bushings, points must be lined up and the rubbing block must be trued. There are tools available to do all of these operations, and directions for their use should be adhered to rigidly if you are to have a good running car.

Cam angle or point gap is best at factory recommended settings, also condenser capacity. Cam angle is actually the period of coil saturation. Setting the points closer increases this time and setting them wider decreases the time. The coil is built with this in mind and too much cam angle can overheat the coil and decrease the actual voltage. Not enough cam angle will also cut down the coil voltage.

The condenser plays a much more important part in high performance work than most people realize. The wrong capacity condenser can cause premature point burning and sometimes minute misfiring under load. In any case, with your stock ignition setup, adhere rigidly to factory specifications. It would be a wise move to check the capacity even of the stock ones to make sure you get one that is up to spec's.

Proper point breaker spring tension is a must. To keep the rubbing block against the cam lobe all through the rpm range is a very tough job and must be accomplished for true cylinder firing. Therefore, spring pressure should be checked before the points are set in for use.

In 1957, Ford came out with a dual point system on the 300 hp blown engine. This ignition increased the coil saturation period by using a make and break two-point system, one point opened the circuit, the other point closed the circuit and had a total cam angle of 36° instead of 27°. This system works well if care is taken when the points are set. Under no circumstances for high performance work should one point be blocked off and the other set. This pushes the camshaft off center due to the point spring pressure and when the other points are released, the cam angle will change on the one set first. Just disconnect the wire connecting both points and set each one individually while both points work against the distributor cam.

In 1960, '61 and '62, high performance 352, 390 and 406 cubic inch engines Ford also used a dual-point ignition, using these components. A high performance ignition can be built out of the 1959 through '62 292-inch distributor that will fit all 272 - 292 - 312 engines from '55 through '62 and the method can also be used in the '58 through '62 non high performance distributors for 352 and 390 engines. The ignition must be disassembled and the existing breaker plate discarded; a ⅛-inch ring must be hand formed (welding rod can be used). This ring is installed at the base of the high performance plate. Remove primary and secondary counterweight springs and install primary spring B8QH-12192-C and secondary spring B7A12191-B. Next step is to install high performance distributor cam COAF 12210-B, which is a 13° stop cam. Then install breaker plate COAF-12152-A. Now, install the two heavy duty FOS. 12171-A points along with a 7RA12300-C condenser.

Align points, true the point rubbing blocks, set each point on the distributor strobe 25° cam angle for a total of 33°. If a strobe is not handy, .018 gap should be set with a feeler gauge. A distributor strobe must be used to finally set the advance curve; this has to be done precisely or you have wasted a lot of time. The recommended curve for these distributors to be used for high performance is as follows:

352 - 390 - 406 with factory high performance cylinder heads.

All components are available at your local dealer for making all 272, 292, and 312 engines from 1955 through 1962 and all 1958 through 1962 352, 332 and 390 CI ignitions into Hi-Performance units as described in the Ignition Section.

DIST. R.P.M.'S	DIST. DEGREES
500	1½°
1000	8½°
1500	10¾°
2000	13°
2500	13¾° MAX.

This curve is what we have found to be the best for drags and similar competitive events, using an 8° to 12° initial lead, depending upon strip and weather conditions.

On hydraulic valved 352 and 390 engines, a distributor cam 10°, COTF 12210-B can be substituted for the COAF 12210-B 13° cam and different curve set which will be more beneficial to these engines.

DIST. R.P.M.'S	DIST. DEGREES
500	5°
1000	8°
1250	10° MAX.

These curves can be accomplished with the same springs and by just bending the spring holding arms. This last curve lends itself very well to the new 145 and 160 hp Fairlanes V8's with a static lead of from 12° to 16° depending, again, on existing conditions.

For the wild ones, meaning engines with lots of compression, say over 11½ to one and with cams over 280° degree timing, another curve will work better. If cam timing is right for the engine, you will find a total of 40° or better will have to be attained at the crank. To improve the bottom end, an excess of static timing will have to be used. Install the 10° distributor cam COTF 12210-B instead of the 13° cam first mentioned. Set this curve:

DIST. R.P.M.'S	DIST. DEGREES
250	0°
750	0°
800	2¾°
1125	5°
2000	9°

Use from 18° to 22° total static lead at idle. This curve will only work with the compression and cam timing changes as listed above. Severe detonation will occur if used with high performance camshaft and matching cylinder head wedge.

The Falcon and Ford 6-cylinder engines have their respective curves also and appreciable amount of performance increase can be expected here too with ignition work. These have what is called pressure ignitions; the whole curve is governed by a control valve using both engine vacuum for light load work and venturi vacuum for full load work. These are two different quantities. Engine vacuum decreases with load and venturi vacuum increases with load. The relationship between the two is controlled by a spark control valve placed in the carburetor venturi section. To stop these distributors for a total of 10° advance, the plate must be drilled and tapped for an 8/32 screw and a plate must be installed to hit the stop pin at exactly 10°. It's a very simple job once the distributor is out of the car. When setting these distributors on a strobe, engine rpm is of no consequence, but the strobe must have a vacuum gauge calibrated in tenths of an inch to be correct. The complete curve is set at vacuum quantities instead of engine rpm's.

Falcon high performance curve is as shown on all year models:

DIST. DEGREES	VENTURI VACUUM
1°	0.43
2½°	0.76
6½°	1.50
MAX 10°	2.40

6 cylinder high performance curve is as shown on all year models starting overhead engines, 1952.

DIST. DEGREES	VENTURI VACUUM
1°	0.38
4½°	0.79
8¾°	2.85
MAX 10°	4.33

On both of these engines, a 12° to 14° static timing lead can be used, making sure initial timing is set with the vacuum line disconnected.

The 312 supercharged engine option curve can be attained by also using the 10° Cam COTF 12210-B and setting this suggested advance curve:

DIST. DEGREES	DIST. R.P.M.s
1°	300
4°	400
8°	600
10°	1500 MAX.

Use a 10° to 14° initial lead depending on weather and strip conditions.

The other options in 1956 and 1957 were 260 hp and 270 hp dual four-barrel carbureted engines of 312 cubic inches displacement. Use 10° plate again on '57 engines. Install '57 ignitions in '56 engines for an increase in performance. The distributor curves for both engines are as follows:

DIST. DEGREES	DIST. R.P.M.s
1½°	250
5°	400
8°	550
10°	725 MAX.

Use a 10° to 14° lead depending again on weather and strip conditions.

As you can see, a little hard work and forethought pays off greatly in the increased mileage or the performance department when working on the ignitions. A good conscientious job done on the ignition and a little experimentation on correct spark lead could make a different car altogether for you, one you will really enjoy driving!

SPARK PLUGS

The governing rules for finding the best spark plug for your engine again are in manufacturing design. These are as follows:

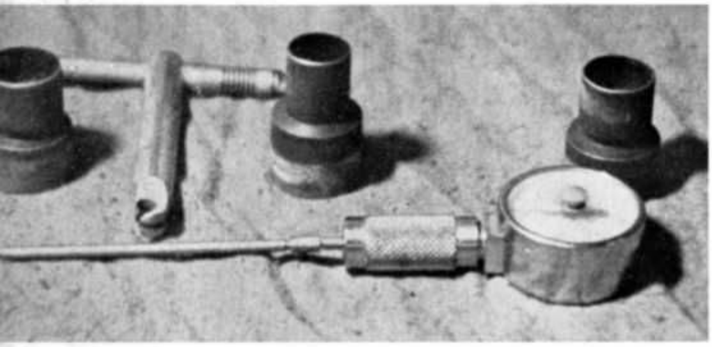
1. Combustion Chamber design
2. Compression ratio
3. Camshaft design
4. Carburetion effectiveness

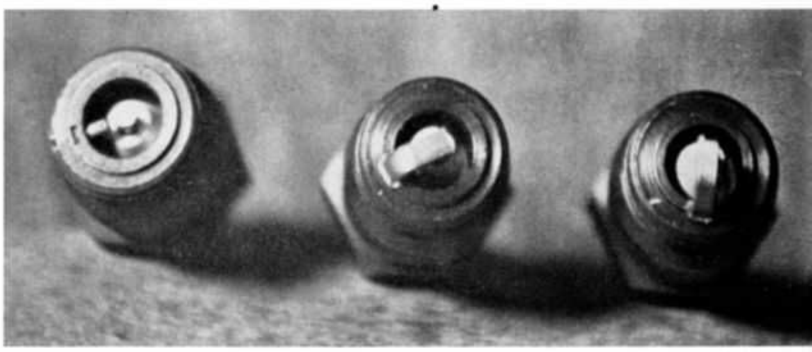
Last, but not least, the way in which you are to use your car. The same plug cannot be used for all racing events, nor can the same plug be used for street driving or maximum gas mileage.

Drag racing takes a semi hot spark plug for Ford engines because of a maximum amount of acceleration pump gas and short runs where the engine does not have a chance to sustain heat. Too cold a plug will foul and too hot a plug will misfire. For drag racing, we have found the best range of plug to use in the high performance engines, such as the 352, 390, 406, 312 supercharged, 312 260 hp and 270 hp, is between a BTF 1 and BTF 3 Autolite, assuming jetting is close and distributor timing is also close. Nothing can ruin a set of plugs quicker than too much spark timing or too rich a mixture! A certain amount of mixture richness can be overcome by installing a little hotter plug, but we have found no appreciable performance increase by doing so. If too much spark timing is used, the plugs will only last a short time because the intense heat built up in the cylinder due to the mixture being ignited when the piston is still trying to reach T.D.C. causes the plugs to glaze and misfire prematurely. We have also found that the engines pull better in short spurts by using a wider than recommended gap for racing, such as, .032 rather than .028. This actually causes a hotter spark requiring the coil to build a higher voltage to jump this wider gap.

For track racing, which ordinarily means sustained high engine rpm's and load, a cold plug is absolutely mandatory, also a closer gap should be used, because of an almost fixed load and continuous firing. Gaps of .025 to .028 could be used more effectively in this type racing rather than the wider gaps. The plug range recommended for this type racing is a BTF 601 and in some cases, such as short track racing, a BF 22 which is a power-tip racing plug. All are Autolite plugs.

Gas mileage is another area and has requirements all its own, of course, assuming the person trying to get maximum mileage is not at the same time trying to get there the quickest! Normally, a very hot plug could be installed with a very wide gap, such as .036. These plugs should be pulled at 3000 mile intervals, cleaned and regapped to get maximum service from them. A BF 82 could be used to advantage where mileage is the prime requisite. In any other case, factory recommendations should be strictly adhered to.





Left: Tools used for truing point rubbing blocks, aligning points, and setting breaker arm spring. Procedures are readily available through tool companies and are essential to proper ignition. Right: Plugs, from left to right, show different structures for different uses. First plug is a very cold side electrode design and would be used for long, sustained racing. Center plug is normal blunt nose cold design used to advantage in drag or short track racing. Power-tip plug at right is for street use.

Time was when a person could "read" a plug after it had been installed and run for a short period, but not so since the power-tip innovation, which puts the porcelain almost into the combustion chamber. With the additives now mixed into our premium gas, "reading" plugs has become quite complex. As a matter of fact, porcelain reading is impossible with less than 25 miles of good hard running on the plugs. If your engine will color a porcelain of a newly installed spark plug within six runs down a strip or within ten laps at the track, the carburetor is too rich. There is a way out though. Due to the actual plug casting dissipating heat quickly, the inside core casing, which surrounds the porcelain, can be read immediately; it will color quickly and should be a nice light chocolate color. This plug reading should be taken under full load operating conditions, the key should be turned off under load and the transmission slipped into neutral, the car brought to a halt and the plugs removed and checked for color.

Distribution problems can be picked out due to manifolding. Jet changes peculiar to each cylinder can also be accomplished or plug ranges per cylinder. The secret to many a fine running engine is attributed to not just a few spark plug experiments! This is another place to find out how to "make 'em storm."

For the other cars such as non high performance makes, a good rule in the plug department is to use a one step colder plug for racing and a one step hotter plug for maximum gas mileage. Check the manufacturer recommendations, then consult the plug manufacturers list and pick the plug best suited for the job. The gap recommendation would be the same for these cars as for high performance, using .032 for drag racing and street, .028 for track and .036 for mileage.

VALVES

Valve timing is quite critical to a specified car, so it is an important contributing factor in getting the best performance possible from your unit. In hydraulic valve engines, there is not much you can do in the way of adjustments because Ford engines do not have any rocker adjustment facility and you are governed here by factory engineering technique. These engines will rev 5000 rpm's and should be geared accordingly, but even to accomplish this, valve springs and heights must be absolutely *on the button!* The rest is up to you in the tune-up department.

On high performance engine options such as the 352, 390 and 406 engines, cams can be changed quite beneficially by adjustment only. Depending on the rear end gears used, adjustments all the way down to .021 have been used to better their performance. As a rule again, the closer you set the valves the better the top end and the wider you set them the better the bottom end. Then, it should be obvious that the higher the gear you pull in the differential (4.29 and numerically lower) the wider gaps will give better times and elapsed times. The cars using 4.57 and up will be able to set valves closer to an advantage, although .021 is about as close as you can go to be effective. Actually, what you are doing in effect is increasing the cam timing and overlap by setting them closer and vice versa when adjusting them wider. These engines are quite sensitive to cam timing so time spent here can be rewarding.

By way of explanation, the effective cam timing you accomplish is a direct reflection on your "feel" with a feeler gauge. Some people have it, others do not. I have found the only way to be exact regardless of your "feel" is to use a P & G Valve Gapper. This is actually the only way to be right. The engine, under any circumstance, should be run long enough to normalize, which takes a minimum of 20 minutes and sometimes over a half hour. Along with this procedure, you should keep adjusting the valves from one side to the other until no changes are required. This sometimes takes six or seven times around with the gapper. Actually, what you are doing is centering the camshaft against valve load in the cam bearings. Don't miss this trick nor the valve gapper!

Track racing is another department where valve adjustment can pay off handsomely. Track conditions and gear ratios can be greatly facilitated by varying valve adjustment. If low end torque is needed to pull you out of a soft track a wider setting can be used; if the track is hard and spinning is a problem, closer settings can be used. By the same token, if your gear is too low for the track, a closer setting can be used so you can wind a little tighter. If the gears are too high, a wider setting can be used to give you a little more torque at a lower rpm. Sometimes, in these races, time does not permit a gear change and these adjustments come in mighty handy.

The best valve settings found for the 352-390-406 engines for a maximum horsepower range is .025, hot. The best settings for Ford's blower camshaft 1957 312 engine is .014 intake and .016 exhaust; the best for Fords 390 Police Interceptor camshaft, '61 and '62 330 hp engines is .027. This covers all of Ford's own mechanical lifter camshafts, the others being hydraulic. All these settings should be made hot and after a minimum of 20 minutes running time. Don't sell the cam setting procedure short; spend some time with it, you won't be sorry!

The same things apply for the I-block sixes and Falcons

Author checks plugs after high rpm dyno run on late Ford.

in the racing department. The only variable would be in gas mileage where .002 excessive clearance has helped gas mileage but at an increase in engine noise. It's best on these cars to adhere to factory specifications but time spent with a valve gapper would help immeasurably.

SUMMARY

As you can see, there are many variables in carburetion, ignition, cam and valve department. But, the end results will be governed by the conditions under which you use your car. There are many angles to approach in this search for performance and your success will depend upon your effort! Go! ■

FORD SUCCESS STORIES

Karol Miller . . .

Bonneville Legend

By Ray Brock

Karol Miller's winning smile is the result of a winning performance in his '56 Ford at the '58 Daytona Beach Speedweeks trials.

OUR FIRST meeting with Karol Miller took place in the middle of the hot, blinding expanse of the Bonneville salt flats in August of 1956. None of the old-time hot rodders who had been participating yearly at the annual SCTA National Speed Trials knew anything about this soft-spoken Texan—he just drove in one day near the start of the week-long meet and asked for an entry blank.

Unlike most of the other Bonneville entrants, Karol wasn't towing the car he intended to race, he was driving it. He and a friend had decided to see what the famous salt flats looked like so they threw a couple of sleeping bags in Karol's 1956 Ford Victoria and left Houston for the 2000-mile drive to western Utah. Karol was used to long drives though for his full-time job was operating oil exploration teams for his father's Houston-based drilling company and the test locations might be all over the country, from Louisiana to North Dakota.

When the two Texans and the Ford arrived on the salt, there was already more than 25,000 miles logged on the odometer. A 3.23 rear axle ratio was fitted to the car and an overdrive transmission was used. The O-D was strictly for highway cruising, giving a 2.26 final ratio.

As Karol explained later, the 25,000 miles on the engine didn't hurt his chances at all; they made the engine nice and loose. During the few months prior to Bonneville, Karol had performed quite a few experiments with the car and knew that it was running good. The pan had never been off the engine but a fresh valve job had been given the cylinder heads. Ports and valve sizes remained stock. An Iskenderian E-2 camshaft and spring kit were installed and an Edelbrock dual-quad intake manifold was fitted with a pair of Holley carburetors. A Mallory ignition with centrifugal advance weights was used in place of the stock distributor which used only vacuum advance. Total spark advance was about 38°.

Karol used Ford cab-over truck carburetor bonnets on each of the four-barrels with flexible ducting to the fresh air vents which passed beneath the inner fender panels on their way to the passenger compartment. These ducts provided cool air directly to the carburetors for maximum induction efficiency. As the car speed increased, so did the air pressure through the ducts so jetting was complicated somewhat by the slight pressurization of the carburetors at high speed. Karol experimented with jetting quite a while before he found the right combination.

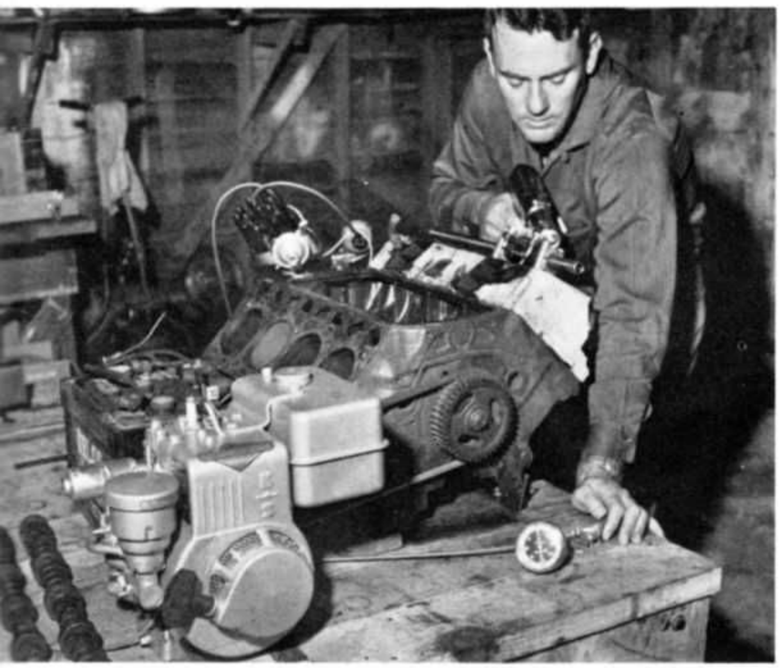
Stock '56 312 exhaust manifolds were used on the engine with a pair of cutout plugs fitted so the mufflers could be bypassed by uncapping the head pipes 24 inches downstream from the manifolds. The Ford chassis was stock except for a set of heavy-duty Monroe shock absorbers. The rear spring shackles were reversed from their normal tension position to a compression position, giving the rear of the car a noticeable forward rake. Stock street tires with most of the heavy tread rubber buffed off by a retreading shop were pumped up to 60 pounds at the front, 50 pounds at the rear.

In his first appearance at Bonneville, Karol surprised everybody by clocking almost 140 mph in his stock displacement '56 Victoria. To aid air flow under the car, rear shackles were reversed from normal position, giving the car a rake.

Since Karol Miller was an "unknown" to the predominantly West Coast entrants at Bonneville, no particular attention was paid to the orange and white hardtop coupe as it pulled away from the starting line on its first run. Some minutes later when the speed of almost 140 miles per hour was flashed back from the finish line 2¼ miles away, many thought that perhaps a timing mistake had been made. The speed was unheard of for a Ford sedan.

Hot rodders hadn't thought anybody would have much success using the Y-block Ford engine with the odd intake port arrangement but, all of a sudden, here was a Ford with 312 cubic inches running in a popular sedan class that permitted from 305 to 488 cubic inches and it was beating almost everybody. The only car that could hold its own was a '56 Chrysler 300 with a 400-inch stroker engine. These two cars battled for the whole week before the Chrysler emerged the winner at 141 mph with Miller's Ford runnerup at 139-plus. By the end of the week, everyone knew who Karol Miller was and they were also starting to revise their thinking about Ford's Y-V8 engine.

Although Karol Miller had been unknown to the regulars at Bonneville in 1956, he had already earned a reputation as a sharp tuner of Fords on his own home grounds around Houston. His first Ford was a 1949 coupe which he bought new and, in his own words, "just played around with it a little to see if I could make it run better." Among the changes made were the installation of Merc crankshaft and pistons to enlarge the displacement to 255 cubic inches. Carburetion, ignition and other changes made Miller's '49 the scourge of the area and all those who had tried unsuccessfully to take his measure on some of the long straight Texas roads were mighty happy to see him join the Army early in 1950.



Karol devised his own camshaft and valve gear test machine using an old Y-V8 block, one head, train for two valves, a stock distributor and timing light. Small utility engine turned camshaft to desired rpm, timing light stopped action.

After Army duty, Karol bought a 1953 Ford with the then new overhead valve six. A short time later Karol was back in the thick of things after he'd milled the head to up compression, installed dual carburetion, opened up the exhaust and a few other little Miller touches to aid performance. It didn't take the boys in the Houston area long to learn that Karol was back in circulation because the I-block six proceeded to show its taillights to all the hot flatheads in town.

The next Ford was a 1955 model with the 292-inch engine. Karol installed T-Bird heads which had been milled and ended up with a compression ratio of about 9.5:1. A four-barrel carburetor was also used. A few more Miller improvements and the '55 Ford attained its proper spot as top dog in the neighborhood. After the '55 came the '56 Vicky and that's where we came in.

After shaking up contestants and spectators at Bonneville, Karol went home, made a few minor changes to the engine and decided to take in the 1957 Nascar Speedweeks event at Daytona Beach, Florida, where speed trials were held on the hard packed sand each February. Since the car was not of current model year and not strictly stock, it was required to run in the Experimental class. Rough beach conditions held up the meet for several days before Karol got a chance to run but when the time finally arrived, the Vicky set sail for a two-way average of 140.070 mph over the measured mile. This speed placed Miller well up in the class standings ahead of many high powered entries from factory-sponsored race teams.

During the waiting period from Daytona to the 1957 Bonneville Nationals in August, Karol made a number of changes beneath the hood of his '56. First of all, he decided to play it smart and quit trying to compete against as much as 488 cubic inches in D class with his 312 and drop back to C class for gas coupes and sedans. The class limit was 305 cubic inches for C class. Karol took a 292-inch block and crank, bored .060-inch oversize and came up with 302 inches. 1957 cylinder heads gave the larger intake valves needed and Karol also fitted ⅛-inch larger than stock exhaust valves to the heads.

With larger exhaust valves, the combustion chambers in the head crowded the valve closely and would obviously cause restriction to gas flow. Karol opened the chambers out generously around both intake and exhaust valves to improve flow and the lengthened chambers were then wider than the cylinder opening. Carefully, the top of each cylinder bore was chamfered from the chamber outline to a point just above the top of ring travel. This eliminated the ledge at the top of the bore which extended into the enlarged chamber. All of the grinding to cylinder head and block gave an extremely large volume in the combustion chamber. To get the needed high compression for maximum performance, Karol used Jahns deflector head pistons and then milled the heads .100-inch to reach the desired ratio of 11:1.

Karol then selected an Isky cam for the engine but this time it was a "smoothie" grind with high rpm potential and less torque than the E-2. Karol devised his own stroboscopic test stand to check valve action at various engine speeds. In the single stall garage behind the family home, Karol mounted a Y-V8 block on an old kitchen table, installed a cam, tightened down an old cylinder head with single intake and exhaust valve in one chamber, used a pair of lifters and pushrods to drive rocker arms actuating these valves, dropped a distributor in place and then drove the setup by a small 3 hp four-cycle utility engine.

A battery supplied primary voltage to the distributor which operated in the conventional manner but with only one secondary lead which was connected to a timing light. A V-belt from the small engine turned the cam fitted with two sprockets to give a wider surface for the belt to ride on.

With this setup, Karol checked out dozens of combinations in cams, springs, valve weights, rocker ratios, etc. Advancing or retarding the distributor gave stroboscopic viewing through the timing light. By the time late summer rolled around and Karol was ready for Bonneville, he had come up with a perfect combination. Both intake and exhaust valves were lightened the limit; an Isky Ford inner spring and Isky Chevy outer, plus an Isky Chevy retainer and .060-inch shims under the outer springs made the valve gear stable in excess of 7200 rpms.

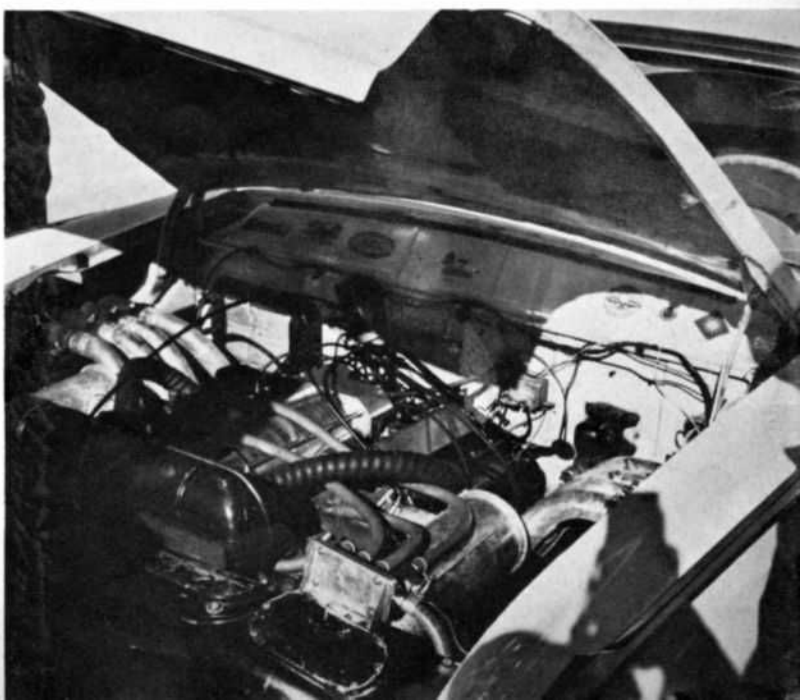
The Edelbrock dual intake manifold was retained with four-barrel Holleys, but had been carefully matched to enlarged ports. Fresh air to the carburetors was doubled in volume with two large flexible hoses to each carburetor bonnet from openings behind the grille. The exhaust system also came in for its share of attention as Karol attempted

For the second trip to the salt, a 302-inch engine was used to drop the car down to a more advantageous class. Tuned individual exhaust pipes from each cylinder were routed through holes in fenders. Top speed at '57 meet was 150.097 mph.

LEFT—Miller's latest Bonneville record was set in 1960 when he drove his '60 Galaxie Starliner to a new average speed of 157.902 mph.

BELOW LEFT—Interior of the Victoria coupe was stock except for the addition of tachometer, blower, fuel gages; vacuum gage for highway.

BELOW—During Nascar's 1958 Daytona Speedweeks, the Miller Ford was equipped with 292-inch engine, Latham blower. Car set fast time.



to "tune" for maximum power at about 6000 rpm. Individual 1½-inch pipes 32 inches long from each port extended almost straight out, through a long narrow opening in each front fender. A little rough on appearance but darned helpful for performance.

Since Karol still didn't have the finances needed for a second car to tow or trailer the Vicky, he again drove it to Bonneville for the '57 meet. Since the outer valve springs were almost coil bound with the high rpm setup, horseshoe shaped shims .060 thick which had been fitted under the outer springs were removed to lessen possible cam wear on the 2000-mile jaunt. Stock exhaust manifolds were also fitted for the trip.

When Karol arrived on the salt, the first day was spent installing the spring shims, headers, carburetor air ducting and setting the chassis up for minimum rolling resistance. Engine oil was used in the transmission, overdrive and front wheel bearings. Wynn oil was used to thin out the rear end lubricant. Rear shackles were reversed to raise the rear of the car for improved air flow beneath the car. Trimmed down tires with little tread rubber were used with high inflation pressures.

When everything was set to go, Karol drove the car up to the starting line and took off on his first run. This time, spectators and contestants knew who he was and all activity stopped while they watched. Through low and second gears, Karol twisted the engine up to a spine-tingling 7200 rpm and then shifted into high gear. 2¼ miles away at the finish line, the impressive sounding Ford approached rapidly and then roared through the timing traps at a speed of 149-plus mph. With the 3.23 gearing, engine rpm was about 6100 rpm.

The reason for the high rpm's through the gears was to keep engine speed up within the best power range after shifting. If shifted at less than 7000 rpm from second to high, rpm's would fall below 5000 rpm and the engine would not pick up speed.

Throughout the week of the '57 meet, the Ford ran consistently near the 150 mph mark. The only trouble encountered was a blown head gasket and once it was replaced, speed went right back to its normal. By the end of the week, Karol Miller had set a new C Gas Coupe/Sedan record two-way average of 150.097 mph for the flying mile. This speed was almost 13 miles per hour faster than the previous record held by a Chevy. The 302-inch Ford with the impressive 7000-plus exhaust tone was one of the sensations of the '57 Bonneville meet.

Again the following February, Karol took in the Daytona Beach Trials but this time he went to an even smaller engine displacement and then topped it off with a Latham axial-flow supercharger. The engine was a 272 fitted with Karol's special valve gear, reworked heads, an Isky blower cam, the tuned headers, Mallory ignition and the Latham competition blower with four side-draft Zenith carburetors. Running ten pounds boost, Karol shocked other contestants in the Experimental class by averaging 153 mph over a rough beach and walked away with the class win. The '56 Victoria was the fastest car on the beach in 1958.

After the success shown with the blower, it was only natural for Karol to retain the combination for the '58 Bonneville Nationals. Since the use of a blower automatically jumps cars one class under SCTA rules, the engine size was cut back even further so that it would fall under the B class maximum of 259 cubic inches. Then, the addition of the Latham blower would again raise the car into C class.

To drop the engine displacement to 259 inches, Karol used a '54 Merc crank with 3.100-inch stroke and then bored the block .010-inch over standard '54 Merc bore (3.625) to achieve the proper size. Again the engine was topped by the head, valve and cam setup worked out by Karol on the table in his garage. Compression was held to 8.5:1 for use with the blower. With a smaller engine displacement than he'd run at Daytona, Karol contacted Norm Latham for blower information and switched to a unit that had fewer vanes at a slighter pitch for use at Bonneville.

When Karol rolled onto the salt for the '58 meet, driving the car from Texas as always, the Ford was again the center of attention. After a day of engine and chassis setup, Karol proved that he still had the magic touch as the little 259-inch Y-V8 plus blower exceeded the 150 mph mark on the first run. By the end of the week, Karol had raised his C class record slightly to 151.997 mph and had a one-way qualification speed of 153.32 mph. At the 4300 foot elevation of Bonneville, the lower boost Latham did not put out the pressure Karol had hoped for so he actually went home unsatisfied although everybody else thought he'd done great.

The '56 Victoria was retired from competition after the '58 Bonneville meet and returned to strictly highway use with a 312-inch engine until late 1959 when with 120,000 miles on the odometer, it was sold to make way for a new 1960 Ford Starliner coupe. Karol really intended to quit racing when he bought the '60 Ford and it had the standard 352-inch engine with hydraulic lifters, power steering and even air conditioning. By the time summer rolled around though, Karol got the urge again and, in a matter of two weeks, put together an engine for another fling at the salt flats.

The 352 engine was bored .090-inch over to take stock Edsel replacement pistons. Edsels used a .050 larger standard bore for 361 inches and with .040-inch oversize, a total of 368 cubic inches was realized, placing the Ford in a newly established BX Gas Coupe/Sedan class with a displacement limit of 370 cubic inches. Karol then borrowed a few engine pieces from a friend who had purchased one of Ford's 360 hp high performance 1960 cars. The 360 hp heads were milled .030-inch to give a compression ratio of 11:1 and otherwise left stock. The four-barrel aluminum intake manifold was used and equipped with a '59 Lincoln four-barrel carburetor which had larger capacity than the standard Holley. An Isky RR8000 cam and spring kit was installed and these pieces were the only non-Ford parts used. Exhaust headers were the factory cast iron items; distributor and wiring were 360 Ford.

As always, the car was driven to Bonneville, this time with the added luxury of power steering and air conditioning. After arriving at the salt and passing through the inspection line, Karol drove it to the pit area, changed tires, removed the power steering and air conditioning belts and made a warm-up run. The car left the starting line with just a slight whisper from the stock dual exhaust system and a few minutes later word flashed back from the finish line that the Ford had registered a cool 150 mph—with mufflers.

After bypassing the exhaust system and performing a little tuneup, Karol qualified for a record run at 158.17 mph and then set a new record average of 157.902 mph. When the meet was over, Karol slipped the belts back on for power steering and air conditioning and headed back to Texas. Early in 1962, Karol sold the '60 Starliner with 95,000 miles on the odometer and it was still going strong.

We talked to Karol in May of 1962 and he was driving a Fairlane 500 with the 260-inch V8. He hadn't made up his mind just what he was going to do for the '62 Bonneville meet, if anything, but he did confess that he had looked the Fairlane engine over pretty good.

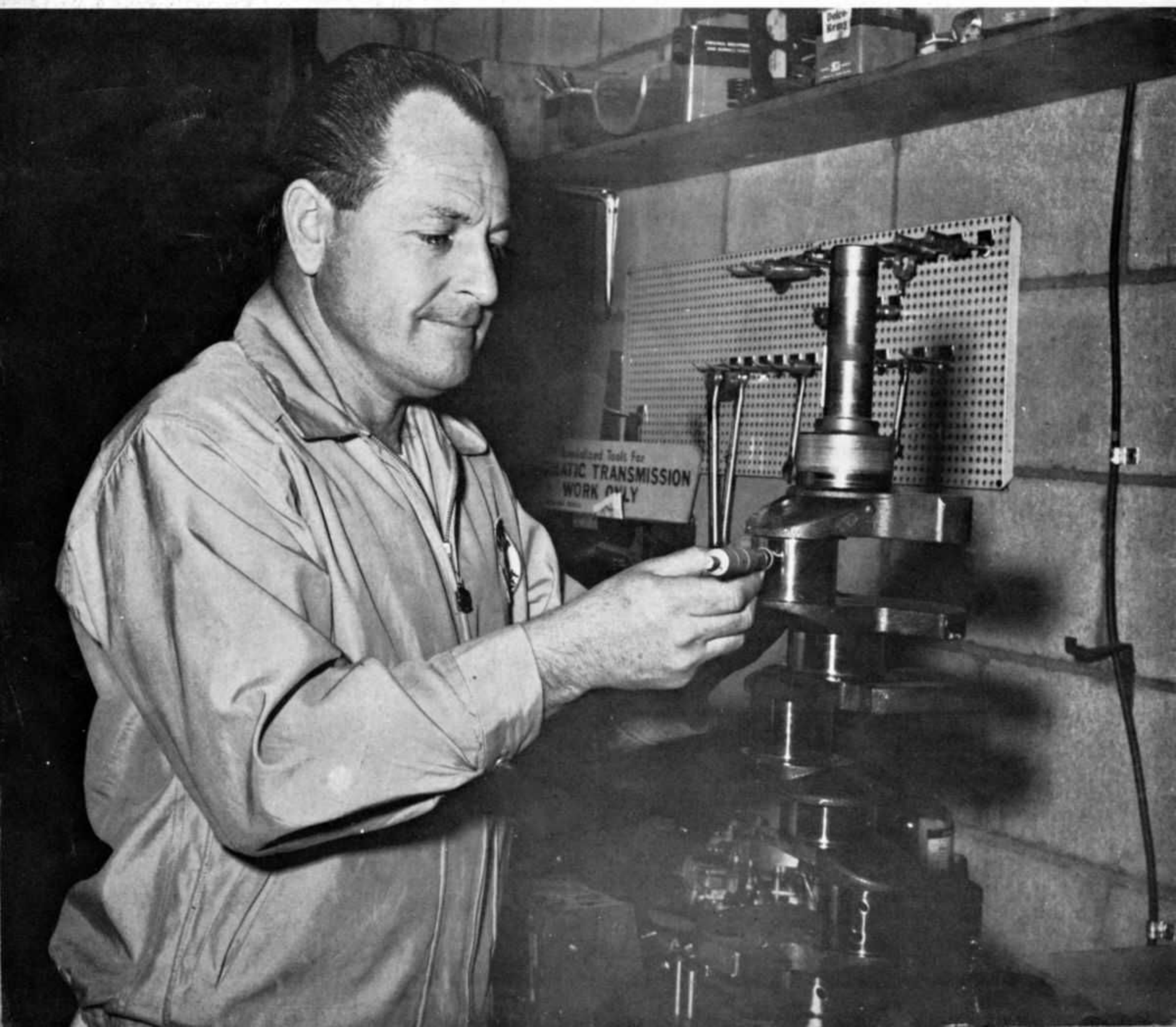
If Karol does show up at Bonneville this summer, you can bet that he'll be driving a Ford product of one type or another and you can also bet that whatever class he chooses to enter will have a new record hung up before the week is over. With his slow, Texas drawl, Karol doesn't make much noise—he lets his Fords speak for him and their voices are loud. ■

LES RITCHEY . . . HOT MAN IN THE DRAGS

LES RITCHEY of Performance Associates in West Covina, California, is one man who is certainly qualified to talk about Ford performance. He has been working on Ford products for the past 16 years for drags, economy runs and track racing. Although his success with Fords dates back many years, he says the last six years have been the most rewarding.

In five years of NASCAR track racing he and his boys have built and turned the engines used in Vel's Fords, driven by Eddie Gray, Marvin Porter and Parnelli Jones. During this period they achieved three Pacific Coast championships, copped two Grand Nationals, one being the Riverside 500-miler in 1959, and the Hanford Grand National 250 mile race in 1960. Proof of increased performance in these engines is the fact that Vel's Ford also won top point award for car owners three years in a row.

In 1960 Ritchey built the engine and tuned the Ford driven by Parnelli Jones at Daytona Beach, Florida, and accompanied the car as head mechanic. Parnelli started in 44th position and in 40 laps was in 4th position. He had



a four lap average of 152 mph when a rocker shaft failure retired the car from the race in the 51st lap.

In 1958 and 1959 the Ritchey cars won 21 main events in a row, all in NASCAR events. In 1960 Marvin Porter's engine for the NASCAR Short Track Circuit was built and tuned in the Performance Associates shop. In this '57 Ford he and Wes Roarke went on a cross-country tour, bringing back the National Short Track Championship, beating Rex White by six points. This engine ran 30 races without as much as an inspection teardown.

In 1956 Ritchey held every Super Stock strip record in Southern California with a '56 Ford 260 hp Victoria, winning 31 trophies without a loss. In 1957 Ritchey ran a Ranchero and over a period of three years won 46 trophies.

As Les puts it, "I've always had top running cars at the drags because they have been Fords. And, brother, competition is getting tougher every day."

Although Performance Associates is primarily a "tune-up" shop, Ritchey has recently opened another department where he can build and blueprint competition engines completely. He has a Chaissis Dyno and all complimentary equipment to go with it. He also has an engine dyno which is used for his own tests exclusively.

Recently Mr. "Hot Rod" Ritchey has been turning a candid eye on the drag boat field since building and tuning the 322 inch Ford engine for Doc Magan's Hallet ski boat which held the world's gasoline drag record for almost a years in 1960. ■

ABOVE—Ritchey tuned Fords showed great promise at the 1962 Winternationals in Southern California. Shop tuned cars give top performance on the drag strip, says Les.

RIGHT—Great popularity of Performance Associates is attributed to Ritchey's careful tuning of chassis and engines on dyno. Here he is working with a chassis dynamometer.

LEFT—Les Ritchey puts micrometer on a crankshaft journal preparatory to increasing clearances in Ford engine, which means increased performance on the street or track.

HOLMAN AND MOODY...
FORD HIGH SPEED SPECIALISTS

By Max Muhleman

IF THE writer may be opinionated, Ford's performance image is built upon two cornerstones: (1) An ever-improving, time-tested V-8 engine, and, (2) A team of Charlotte, N. C., racing specialists known as Holman and Moody—not necessarily in that order.

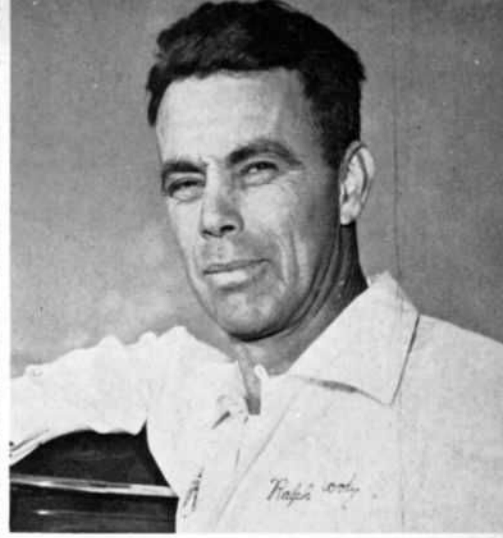
Holman and Moody is today perhaps the best equipped "speed shop" in the country. Although it owes its greatest fame—in fact, its very existence—to stock car racing, it now is by no means limited to the quest of checkered flags along the National Assn. for Stock Car Auto Racing's famed Daytona-to-Darlington circuit. Outboard boats, sports car specials, custom-styled trucks . . . you name it and Holman and Moody can, and probably has, built it—with a Ford engine.

The men behind this unique operation are John Holman, a 44-year-old Californian, and Ralph Moody, a 43-year-old Floridian, who first joined hands in Charlotte, N.C., in 1956 as standard-bearers for Ford's directly subsidized stock car racing team. With Holman heading the East Coast operations base and Moody as his right-arm mechanical expert and frequent driver as well, Ford piled victory upon victory. When the Automobile Manufacturers Assn. decided to withdraw the Detroit-backed teams in June of 1957, Charlotte-based Fords were winning a staggering 80 per cent of the late model stock car races from New York to Miami in three NASCAR divisions: Grand National (hard-top sedans), Convertible (open tops) and Short Track (involving races run on tracks smaller than half a mile.)

During this factory war, the Holman and Moody operation was not known by that name, however. It was "Peter DePaolo Engineering"; in fact, the East Coast branch of Peter DePaolo Engineering. Out west, DePaolo himself headed the smaller West Coast branch which kept Fords humming on the less active United States Auto Club and NASCAR West Coast stock car circuits.

The Charlotte operation was a marvel of organization. A staff of more than 40 employes was required to keep Fireball Roberts, Marvin Panch, Curtis Turner, Joe Weatherly, Jim Reed and Bill Amick in race-ready machinery. But it paid big dividends. One Monday morning, for instance, a check of the weekend scorecard revealed that Roberts and Panch had run first and third in a 100-miler at Shelby, N.C.; Roberts was first and Panch second in a 100-miler at Richmond, Va., and in a 150-mile race at Langhorne, Pa., Turner had run first and Weatherly second. In 1956, Turner set a late model record which still stands in NASCAR by winning 23 races, including the biggest of the year, the Southern 500 at Darlington, S.C.

But then, shortly after Roberts had captured the Rebel 300 at Darlington in May of '57 for Ford, came the edict from Detroit that the factory team days were over. Holman had no special yearning to return to California, where he had been a parts man and truck driver for Bill Stroppe & Associates of Mexican Road Race fame, and Moody saw no bright future in returning to the driving grind. The result was the formation of the Holman and Moody partnership.



LEFT—Lorenzen in Holman and Moody Ford (28) starting in pole position in 100-mile race at Charlotte Motor Speedway May, 1961. ABOVE—Holman, showing chassis reinforcements H & M makes when converting '62 Ford.

ABOVE RIGHT—Ralph Moody contributed greatly to field of increased Ford performance along with partner Holman.

RIGHT—Dan Gurney tools a Holman-Moody 406 Ford at '62 Daytona 500-miler. It had heavy duty chassis, engine.

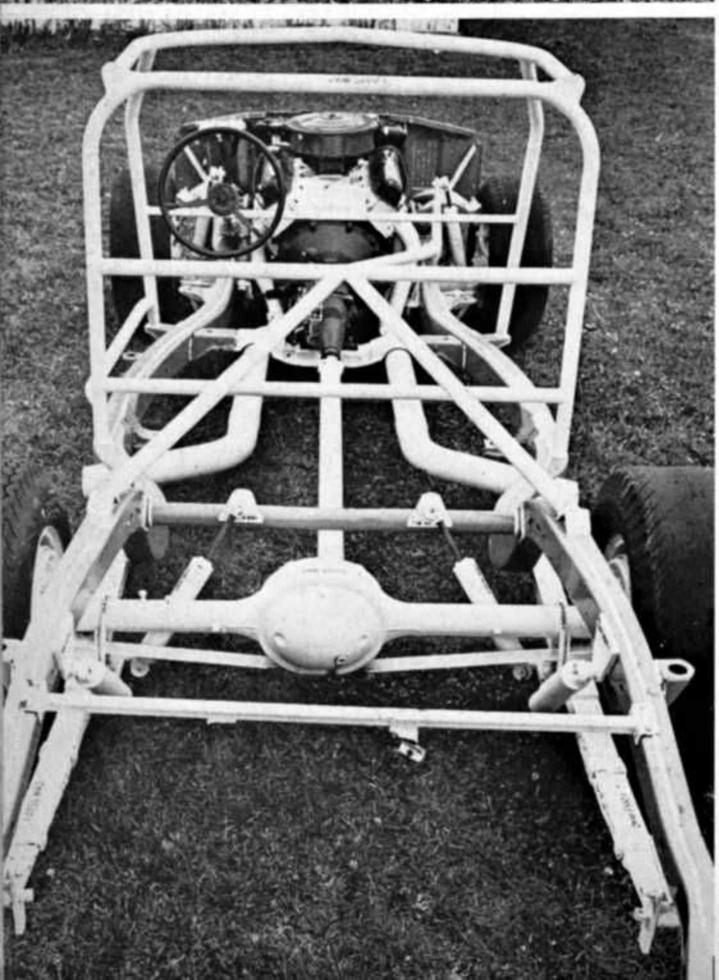
Thus joined, the two purchased Ford's bountiful stock of parts and equipment and opened their own private enterprise speed shop, called, appropriately, Holman and Moody.

The staff, of course, was greatly reduced—to a dozen of the top mechanics—but the same magic remained as other competitors soon learned. Moody himself attacked the USAC circuit with a Holman and Moody Ford and won all three late model stock car classics at Milwaukee, Wis., that year (1957).

Two more vivid examples of Holman and Moody know-how helped secure their reputation the following year. One saw Moody return to Milwaukee, but this time as a counselor for a little-known Elmhurst, Ill., driver named Fred Lorenzen, who had decided to seek Holman and Moody aid in his efforts to crack the USAC stock circuit, dominated by star Indianapolis drivers. Lorenzen almost duplicated Moody's unprecedented feat by winning two of the three Milwaukee races in a 1958 Ford and placed third in the other when a worn tire cost him too much time. The other example was the 1958 Grand Prix of Peru, a wild, 633-mile grind for stock automobiles over a 28-mile mountains-to-the-sea course. A wealthy Peruvian asked Holman and Moody to build him a car for Jim Rathmann to drive in the event only a few days before it was to be run. After a hurried construction job the car was flown to Peru and arrived the morning of the race. Rathmann had no time to practice, but hurled the HM Ford around the strange course 20 minutes faster than the second place finisher, lowering the race record 25 minutes in the process. As if further proof were necessary, Holman and Moody also took two new Fords to Darlington's Rebel 300 race in May of 1958 with old factory team hands Curtis Turner and Joe Weatherly driving. Result: Turner first, Weatherly second.

In early 1959, the eyes of the auto racing world were fixed curiously upon Dayton Beach, Fla., where Bill France's Daytona International Speedway, a steeply banked 2½-mile tri-oval, was to make its debut with the February Speed Weeks stock car races. France had predicted it would be the world's fastest race track, and one look at the breathtaking 32-degree banked turns and mile-long backstretch was enough to convince any skeptic. There was a question in many minds, however, as to how stock cars, even with the beefing up allowed by NASCAR rules, would fare on the huge layout. Obviously, there was room to wring out every mile per hour of which the hottest stock car might be capable. Never before had mechanics been faced with the problem of preparing an automobile to run 500 miles at absolute top speed.

While others were puzzling over what might happen, the Holman and Moody outfit was busy preparing something new of its own: a racing version of the Thunderbird, Ford's celebrated luxury car. Out came the padded dash, the pile carpeting and the fancy interior and in went roll bars, a precision-tuned engine and the dozens of reinforcements necessary to make a car battle-ready for Daytona. But Holman and Moody had no intention of being exclusive Thun-



derbird racers. Besides the one they built for themselves, there were six other 1959 T-birds put together with the same meticulous care and placed on sale for any other driver or mechanic who might be interested in the low-profile, high-powered bomb-on-wheels. All seven wound up at Daytona and ran with the fastest machinery entered, posting qualifying speeds of more than 140 miles per hour. In the 500-mile race, a near dead heat finish occurred between Johnny Beauchamp, driving one of the Holman and Moody-built Thunderbirds, and Lee Petty, in an Oldsmobile. Race officials first called Beauchamp the winner, but after studying finish line pictures for several days decided it had been Petty by inches. The two cars averaged 135.521 miles per hour, the fastest stock car race in history and only a fraction under the Indianapolis 500 record average speed at that time of 135.601.

The construction of Daytona International Speedway also helped further what has been the bread-and-butter business for Holman and Moody since its inception—the sale of Competition Proven, as they trademark it, chassis and high performance equipment for any type race car but especially Fords. A Holman and Moody building was one of the first structures to grace the infield pit area at Daytona Speedway. There, Competition Proven equipment is available to any driver or mechanic at every Daytona race. This equipment includes CP racing wheels, used by almost every top race car in NASCAR today; hubs; spindles; stabilizer bars; suspension parts; camshafts and an ingenious full-floating rear axle housing or "full-floater," as it is called in racing jargon. As Ray Brock explained it in a recent HOT ROD MAGAZINE article, "A full-floating axle carries only the driving force to the wheel while the weight of the car is supported by bearings on the housing. The obvious advantage of a floater is the fact that bumps and chuck holes are not absorbed by the axle shaft; the sturdier housing takes the punishment."

Fords built for competition of any kind by Holman and Moody include all these special items plus engine bolt-on equipment such as aluminum manifolds, high compression heads and header-type exhaust systems. Using the knowledge gained during the factory racing days and starting with the stock of high performance parts purchased from Ford when Ford discontinued its factory team, Holman and Moody has become the last word in getting the most out of any kind of automobile; particularly, of course, Ford products.

Under the skillful leadership of John Holman and Ralph Moody the company has steadily broadened itself to the point where it can now actually manufacture many of the high performance options it offers. More than $200,000 worth of equipment fills the Charlotte Holman and Moody shop and a staff of 25 employes keeps it humming—sometimes day and night. Performance enthusiasts from throughout the world have sought the services of Holman and Moody for anything from a new set of muscles for a family Thunderbird to out-and-out drag racing, stock car racing

In two photos at the right are shown (top) reinforced model of 1962 Ford from the front and (bottom) from the rear.

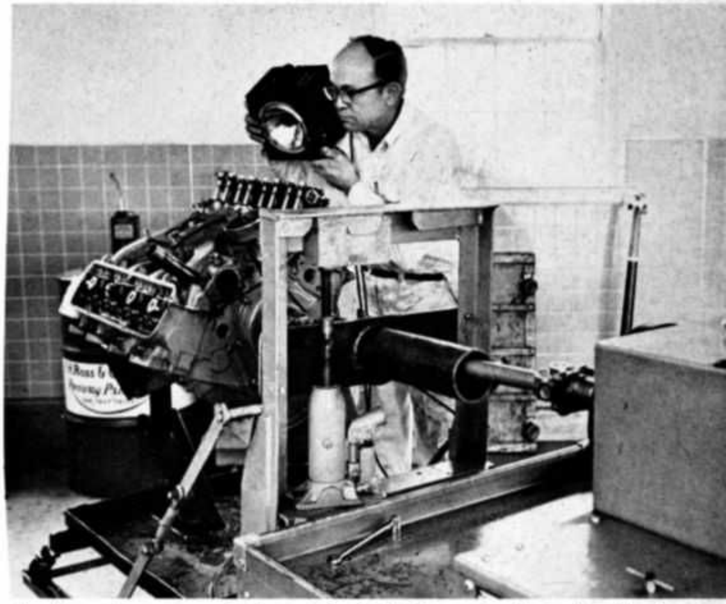
or sports car racing tune-ups.

Racing is a pleasurable sideline for Holman and Moody. Obviously, the only way to render a product Competition Proven is to compete and the competition end of the business is directed by old pro Moody. Since the company's formation there have been Holman and Moody entries at every major stock car classic, and always the cars are rated among the favorites. Perhaps their greatest success in racing has been at Darlington, S.C., Raceway, a 12-year-old mile and three-eighths plant regarded as the toughest major stock car track in the country. Holman and Moody Fords have won five of the six "Rebel 300" 300-mile races held there, including a '57 win when they were operating as the Ford factory team. The most recent was Nelson Stacy's triumph in a Holman and Moody '62 Ford this May. Stacy also won the 1961 Southern 500, oldest and most prestige-laden stock car race of them all, in a '61 Ford that was a Holman and Moody creation. Another Holman and Moody '62 Ford, driven by Fred Lorenzen, broke Darlington's qualifying record with one lap of over 130 miles per hour and placed third in this May's Rebel 300.

Some of the most interesting Holman and Moody racing endeavors have been off the stock car trail, however. In December of 1959 Holman and Moody was contracted to prepare and enter three Studebaker Larks in an international compact car race at Sebring, Fla. Matching Larks against machinery such as two of Briggs Cunningham's 3.4 Jaguars seemed an impossible task, but the Holman and Moody-prepared Larks ran with such gusto that only one of the Jags, driven by sports car champion Walt Hansgen, could beat them. Hansgen was first, Curtis Turner second in a H&M Lark despite running the last five miles on a flat tire, Ed Crawford third in the other Cunningham Jag and Fireball Roberts fourth in another H&M Lark.

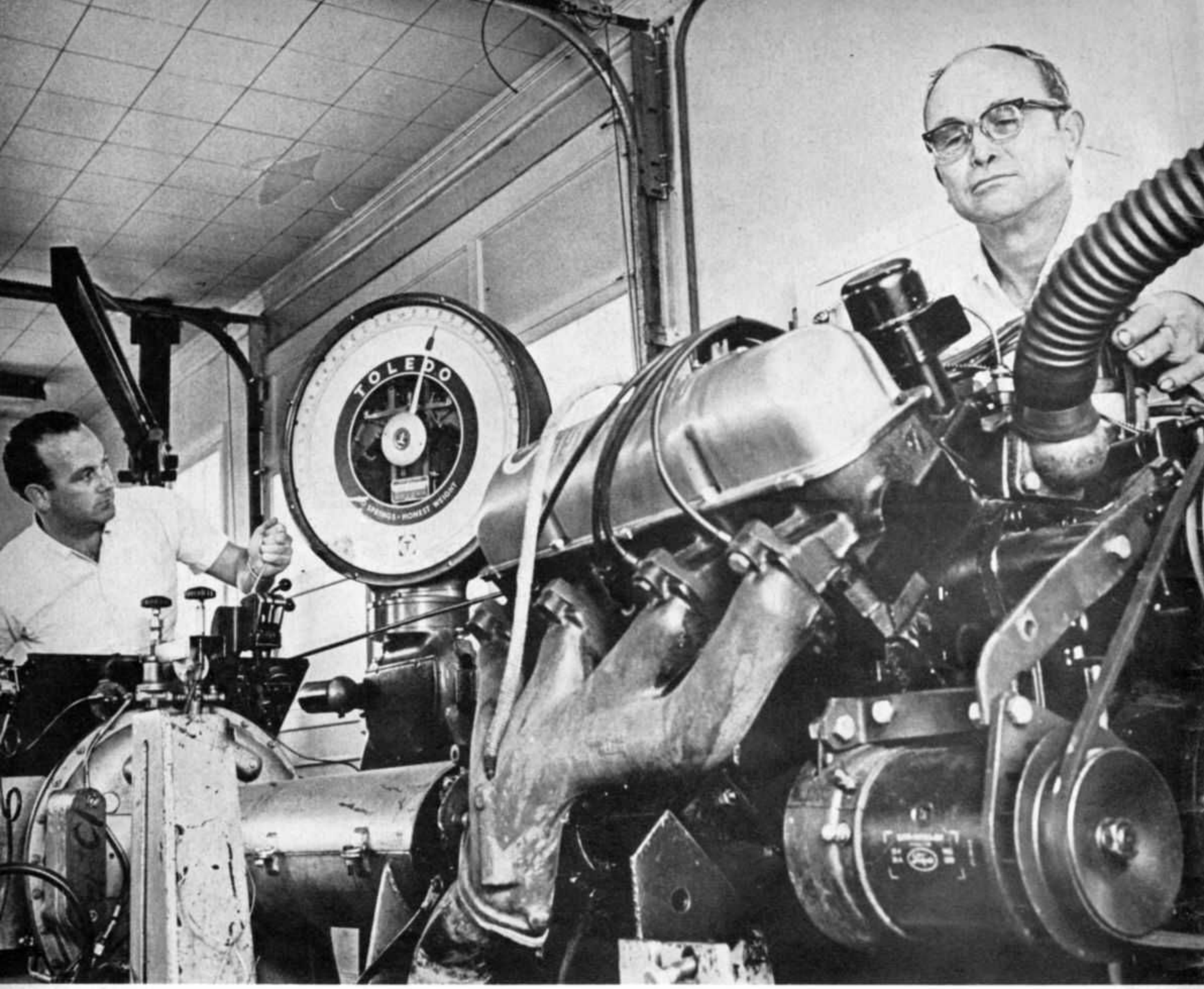
In fact, sports car racing may soon become a habit with Holman and Moody—with a Ford Falcon, no less. They entered this March's Sebring 12-Hour Grand Prix of Endurance with a Falcon special aimed at winning a new class for experimental cars. Dubbed "Challenger I," the Falcon was powered with a bored-out 221-cubic-inch Fairlane 500 engine, equipped with a four-speed Ford transmission and set up for road racing demands by chassis expert Moody. Despite a stop of more than three hours for a major engine overhaul ("We didn't have time to check the engine after putting it together"), Challenger I was second in the experimental class and was running at the finish. The good showing inspired Holman to build another Falcon version which he calls Challenger III. This one has six inches taken out of the body height to reduce weight and wind resistance and improve the handling characteristics, plus a streamlined rear roof line. "It should run 140 easily," says Moody. Holman and Moody is considering building 100 such Falcons, which would make them eligible for Grand Touring sports car competition. Yet another Falcon special called Challenger II is being turned out also. This one has only three inches taken out of the body and is aimed at the enthusiast who wants something different in a personal automobile.

This photo shows the H & M engine building room with Joe Rumph at work on a cam grinder in the rear of the room.



Joe Rumph uses a stroboscopic light to evaluate valve float in special H & M cam testing machine in fully equipped shop.

Over the years, Holman and Moody has carried out many special performance projects for Ford Motor Co., not all of them involving speed. A notable example was the 1961 Pure Oil Economy Trials at Daytona Beach, Fla. This time the goal was maximum gas mileage under everyday driving conditions. Pure Oil officials laid out a 3.7-mile course which included full stops and speed zones and which had to be negotiated at a minimum of 40 miles per hour. Nearly every American automobile manufacturer entered, with Holman and Moody handling the Ford entries. While others chose professional drivers to pilot their entries, Holman and Moody solicited the services of Florida and Illinois highway patrol officers. Their best showing was in Class I, with cars powered by the same big engines which H&M used in their racing stock cars of that year. In a class with 21 entries, Ford


TOLEDO

Galaxies with 390-cubic-inch engines placed first, second and third with the winner, driven by an Illinois patrolman, averaging 14.809 miles per gallon. Furthermore, the average mileage of Fords entered in Class I, for engines of 390 inches or more, was about 13.5 miles per gallon. Average mileage of Class I Chevrolet Impalas was less than 10 miles per gallon.

What Ford has learned from an outfit like Holman and Moody and what Holman and Moody has been able to do with the steadily improving Ford engine over the years is perhaps best illustrated in an occurrence at Daytona in February of 1961. In qualifying trials for a modified race, Frank Secrist of Oildale, Calif., blazed a new record speed for modifieds of 154.812 miles per hour in his 1953 Studebaker—but his engine was a stock Holman and Moody '61 Ford mill with a stock four-barrel carburetor. Modified racing allows almost any modification of an engine that a mechanic can cram under the hood. That Secrist could use a stock, single-carbureted Ford engine and set a record among machines which boasted bored-out, fuel-injected and supercharged engines was a distinct compliment to both Ford and Holman and Moody.

This year, a new field of exploitation for Ford engines and Holman and Moody know-how emerged: boat racing. Holman and Moody developed a marine version of the 406-inch 1962 Ford engine which former Gold Cup racing star Joe Taggert of Miami chose to power his 31-foot craft in the Around-Nassau sweepstakes. In fact, Taggert used three of the 406 engines and won the race handily. Holman and Moody now plans to go into the marine engine field on a large scale.

For word from the horse's mouth on how Ford engine performance now stands, hear John Holman's views:

"Ford is the only manufacturer at present whose top performing model can be taken off a showroom floor by anyone and yield performance results such as we at Holman and Moody obtain from our Ford race cars. There will be 15,000 or more of the 406 Fords built and sold this year—the same package exactly which we race. Other manufacturers turn out only a very few hundred units of the type that carry their colors on the racing circuits, which could easily be proved if figures were made available. This is something of which Ford may be justly proud and a major reason why we continue to utilize their products." ■

TOP LEFT—Kent Hoke, left, and Joe Rumph test an engine on dynamometer at Holman and Moody shop. BOTTOM LEFT—Ralph Moody, right, working with Fred Lorenzen under car in preparation for Daytona Beach stock car races recently. ABOVE—Stacks of racing wheels before being widened at H & M.

Ralph Moody (L) and John Holman with trophy Moody received for winning 150-mile USAC stock car race at Milwaukee in '57. Moody won all 3 USAC late model stock races that year.

Holman stands beside unfinished "Challenger III," a Falcon which is being chopped six in. and fitted with bored-out, 221-in. Fairlane engine which makes it eligible for G.T. road racing.

Danny Jones proved he had a light touch with the throttle foot by winning top honors in the 1961 Mobilgas Economy Run. He is equally talented in racing, has won many midget and sprint events.

ECONOMY DRIVING

By Danny Jones

PEOPLE often ask me if driving for economy isn't a tedious, nerve-racking job. A straight yes or no cannot be used to answer this question because there are many facets to economy driving. As an engineer for Ford Motor Company, running economy evaluation tests on all types of Ford cars can be very tedious. Hour after hour of steady throttle running, then changes to engine tune and the same thing all over again can become tiring. On the other hand, competition with other drivers and automobiles in an organized economy run, such as that staged each year by the Mobil Oil Company, can be quite exciting.

There is another type of economy driving which does not fall within the confines of engineering tests or organized economy runs, however, and this is the type which every driver in the country can practice any time he wishes. Many people falsely associate economy driving with a slow, road-blocking pace that causes other drivers to tear their hair and often take dangerous chances in attempts to pass. This is not always the case. There are many drivers on the road who can easily keep up with the normal flow of traffic and at the same time, save dollars on fuel and add months or years to the life of their car. Here's how they do it.

The first prerequisite for economy is of course a well-tuned, efficient automobile. A carburetor does not have to be "leaned out" to the extreme to give good economy; factory specifications for your carburetor offer optimum jetting and adjustments to give respectable economy if the car is driven properly. A carburetor has four basic fuel circuits; idle, accelerating, main and power. Any time the accelerating or power systems are called upon, excessive fuel is being used and economy will suffer. Of course, these "expensive" systems in the carburetor are necessary but the driver's throttle foot controls their operation.

A carburetor that looks dirty on the exterior surfaces can often be clean and efficient operating inside. Conversely, one that is clean on the exterior may be dirty inside or be improperly adjusted so as to waste fuel. Assuming the carburetor is clean and properly adjusted internally, about the only things you can do externally to aid mileage are to set the idle mixture and speed, check the automatic choke, make sure the air filter is clean and then watch the foot action. Idle screw adjustment should be set as lean as possible while still giving a smooth idle. The automatic choke is pre-set and should not be changed unless it doesn't open completely when the engine is warm. A clogged air cleaner causes the mixture to richen so this should be attended regularly, especially if the car is driven frequently under dusty conditions. With paper pack air filters used on all late Ford engines, an air hose can be used to remove dust from the pleated paper by blowing air from the inside out. If the filter is very dirty, it should be replaced. Never wet a paper air cleaner with solvent or light oil; this will clog it and restrict carburetor air flow just like a choke.

Mileage potential is also dependent upon the ignition section of an engine. The distributor should be periodically checked to make sure it meets factory specifications and any worn parts replaced. Contact surfaces do not necessarily have to be shiny bright but they should have the proper gap setting since their action governs the amount of primary voltage to the coil and this in turn controls the secondary output which fires the plugs. Both centrifugal (if any) and vacuum advance mechanisms must be in top operating condition to fire the plugs at the proper time. Follow factory specifications for the distributor adjustment to get best results.

Spark plugs should be of the proper heat range and periodically cleaned and regapped. New plugs at intervals of 10,000 miles or so ensure proper operation.

Assuming everything about the engine is in proper tune and maximum mileage efficiency is being realized, the next check point is in the chassis itself. Rolling friction is often responsible for as much mileage loss as a poorly tuned engine. It is hardly practical to disassemble the entire car to check for tight spots and fortunately, it isn't necessary in most cases; if a bearing or gear set are too tight, they will usually show up in the form of a failure. But, there are many tight spots which can cost horsepower and gasoline that you can do something about.

Today's modern car is designed to give a nice, smooth ride and to meet this end, some sacrifices have been made in economy. Soft, bump-absorbing tires take more driving power than those with higher inflation pressures and less area in contact with the road. So, if you are willing to listen to the thump of tar strips in return for better mileage, inflate tires to 32-35 pounds instead of factory recommended 24-26 pounds.

Also, make sure that those front wheels are both pointing in the same direction to cut down rolling resistance. Front wheel alignment must be precise, particularly toe-in and camber setting, if you are searching for top mileage. Another segment of economy is represented in front wheel alignment since you will get improved tire mileage and save tire dollars.

In case you are the do-it-yourself type mechanic and adjust your own brakes or even if you have a qualified mechanic do the job, make sure that the shoes release completely after application. Dragging brakes cost power and of course cost money in the form of early replacement.

Now, if your car is ready to go on a thrift binge, how about you? The most important thing to remember when you slip behind the wheel is that every quick move is going to cost money. Every time the foot throttle pedal is depressed,

ABOVE—Winning Falcon in '61 Mobil Run coasts easily over Chicago finish line with enthusiastic greeting from flagman J. C. Agajanian. Danny Jones drove Falcon to record 32.68 mpg win.

Route of Mobil Economy Run is kept secret until the day before the run starts. Danny Jones receives log book of first day's trip from USAC official Freddie Agabashian. Cars must follow prescribed pace, often hit speeds above 60 mph.

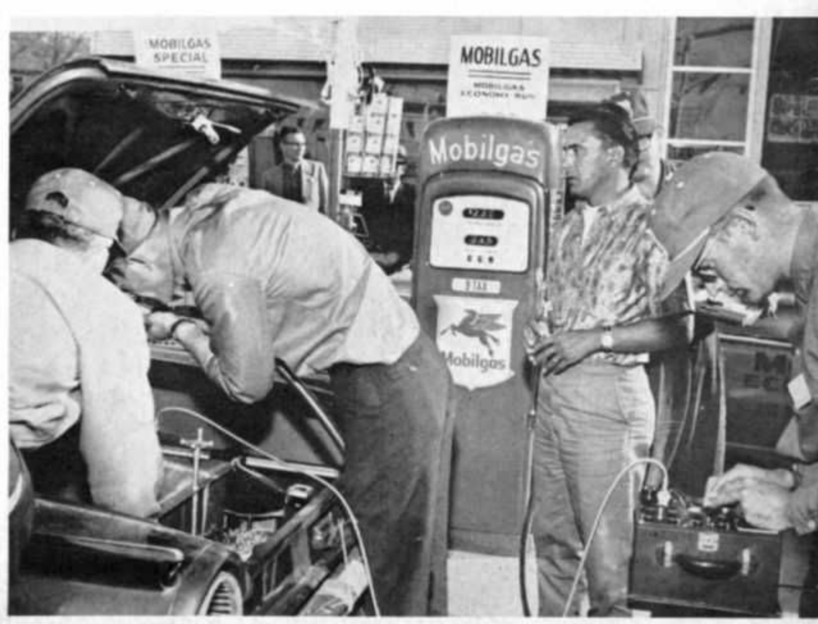
the accelerator pump shoots a stream of raw gasoline into the carburetor bores to increase engine speed. Also, if the throttle butterflies in the carburetor are opened wide enough to drop the manifold vacuum below about 7 to 10 inches of mercury, the power circuit opens and more fuel is added to the intake charge. If you are serious about attaining good fuel economy, mount a vacuum gauge on your steering column and watch the needle closely. You'll be surprised how those innocent little taps of the throttle help empty out the fuel tank.

Just remember that fast starts and frequent movements of the throttle foot are costing you money and you'll be on the way to improved economy. Oh yes, there's something else to remember too; don't make fast stops either because they cost you fuel. Now this last statement might sound funny because barring fuel slop-over from the bowl, the carburetor butterflies are closed once the foot is lifted and transferred to the brake. With the carburetor thus in idle position, why does it use extra fuel? The truth is that the carburetor is not using up more fuel, you've just wasted valuable coasting time by driving up to a stop and then applying the brakes hard. By anticipating stops well in advance, whether a red light, boulevard stop or a slow-moving truck on a blind corner, you can coast with closed throttle for extra free distance.

As we mentioned earlier, economy driving does not have to mean a road-blocking pace. Keep track of what's going on well down the road and you can anticipate when you are going to have to slow down or speed up. If it's a long truck and trailer you are overtaking, don't close the gap and then "tailgate" him until you have a chance to pass. This requires both the accelerator pump and power valve to get out and around in a safe distance. By "laying back" several hundred feet, you can have a better view of oncoming cars and then when you see an open spot approaching in traffic, increase speed slowly so that when the open spot reaches you, car speed is high enough to get around the truck and back in your lane in one easy motion. In most cases, the pass can be completed without using accelerator or power circuits.

The technique just described is of course not a big secret; you've all probably used it occasionally but the important thing is to use it all of the time and watch the mileage improve. The difference between careful economy driving

Economy of a car is the result of many variables and one of the most critical is altitude. Ranging from below sea level to many thousand feet above, Mobil Run puts all cars through rugged test. '61 Ford V8 averaged 21.33 mpg.



RIGHT—Special fuel tanks in the trunk of each entry permit exact measurement of fuel consumed. Technician at right uses thermocouple instrument to record fuel temperature so that all corrections can be considered.

RIGHT CENTER—Jones finds out that economy driving has more rewards than racing. He receives good wishes of a half dozen beauties in Little Rock, Arkansas. Most race tracks only furnish one queen to kiss the winner.

FAR RIGHT—Destination of the '62 Mobilgas Economy Run was Detroit, Michigan. Danny again drove 144-inch Falcon with stick transmission, averaging 30.49 mpg.

(not in competition) with highway speeds up to 60 mph and hard driving with speeds up to 70 mph can often make a difference of as much as 25% in fuel economy.

During preparations for the 1962 Mobilgas Economy Run, I made a test run from Los Angeles to Tucumcari, New Mexico, on route US 66. My car was a well prepared '62 Falcon with the 144-inch six cylinder engine and standard transmission. Duplicating average speeds usually found in the Mobilgas Run, the Falcon averaged almost 36 miles per gallon for the 1000-plus miles. On the return trip to Los Angeles, mileage was secondary to time so the Falcon was pushed at a fast clip back to the West Coast. Highly accurate figures were not kept but a rough breakdown at the completion of the trip showed that mileage had been whittled by about 12 miles per gallon. Let's see now, 36 mpg versus 24 mpg means that we used 50% more fuel on the return trip than on the way to Tucumcari. That also means 50% more cost for fuel plus increased tire wear at higher speeds, increased engine wear, etc. And the surprising thing about the round trip was that it took just three hours longer for the 1000 miles under Economy Run conditions than it did flat out.

Did you ever wonder how much difference there is in mileage potential between a standard transmission and an automatic? There are many factors that enter into the picture but assuming two cars are identical except for transmissions, the standard stick model will probably average 10-15% better mileage than the automatic. But, most modern cars use a higher (lower numerically) rear axle ratio with automatic transmissions and this means that the engine speed is less than with a standard transmission car using a lower axle ratio. So, in many cases, a car with an automatic can equal a stick model for mileage if driven carefully.

During economy test programs, Ford engineers keep a detailed log book on all test vehicles. We have found that the mileage ability of an automobile increases gradually from the time it rolls off the assembly line and the car is actually at its best mileage producing ability only after it has several thousand miles on the odometer. The break-in mileage needed for best results varies from car to car as no two are exactly alike. The amount of improvement in terms of mileage also vary but a general estimate would be to say that a car with 10,000 good break-in miles will improve 2 to 3 miles per gallon over the time it was new. This, of course, is assuming the car is in good tune, front wheels alignment is correct, etc.

Another item to keep check on if you are economy minded is the cooling system thermostat. This inexpensive little valve mechanism controls engine warmup and if you live in an area of the country that gets its share of cold weather, a faulty thermostat will cost you money just like a bandit with a gun. The faster your engine warms up to normal operating temperature, the sooner the automatic choke drops out of the system and also the sooner the intake charge gets needed heat to improve fuel distribution. With a faulty thermostat, engine warmup can be curtailed so that the automatic choke functions for an unusually long period.

You will find that if you develop an economy run technique of driving, even though you might be on a cross-country high speed trip, you will also have fewer instances where you have to apply brakes hard or swerve to avoid another car. This is due entirely to the fact that your attention is focused well down the road anticipating what other cars and drivers are doing or might be getting ready to do. Long range planning gives you more time to slow down from high speed just by lifting the throttle foot and coasting.

The pinacle of success for a professional economy driver is to win the oldest, most respected run of all, the Mobilgas Economy Run. I've competed in this run for the past several years and in 1961 took top mileage honors with a Falcon. This was the first time since 1954 that standard transmission cars were permitted and the 144 cubic inch Falcon with 3.10 rear axle ratio showed its heels to all other "stick" compacts in its class as well as setting top mileage for all cars in competition. Our Falcon averaged 32.68 mpg for the 2560-mile, six-day trip between Los Angeles and Chicago, at an average road speed of 41.5 mph.

Again in 1962, I drove a Falcon "stick" on the Mobil Run. This time, the course length was 2497 miles from Los Angeles to Detroit. Our mileage for the trip was 30.49 mpg and the average speed was almost 42.5 miles per hour. We just missed a class win with this mileage and took runnerup honors for top mileage among all cars.

You don't have to use the "featherfoot" technique we employ on Mobilgas Run to get good mileage, just keep a steady foot on the throttle, increase speed slowly and anticipate your moves well in advance. Of course the engine should be periodically tuned to factory specifications and rolling friction must be kept to a minimum. We can't guarantee you 30-plus miles per gallon but you can probably do a lot better than you are presently with just a little attention. ■

SPEED SHOPS AND PARTS SUPPLIERS

ALABAMA

Johnnie's Speed Shop
5213 Ave. P
Central Park
Birimingham, Ala.

Motor Parts Co.
229 Molton St.
Montgomery, Ala.

ALASKA

Alaska Auto Racing
Fairbanks, Alaska

ARIZONA

Slims Hot Rod Shop
4006 45th St.
Phoenix, Ariz.

Magee Motor Rebuilding
300 E. 6th St.
Tucson, Ariz.

ARKANSAS

Johnny's Auto Supply
516 Garrison Ave.
Ft. Smith, Ark.

Davis Cycle Co.
4201 Asher Ave.
Little Rock, Ark.

CALIFORNIA

Bell Auto Parts
3633 Gage
Bell, Calif.

Lucky Auto Supply
2301 Chester Ave.
Bakersfield, Calif.

Mills Auto Supply
28017 W. Main
Barstow, Calif.

Star Automotive Co.
13305 S. Alameda
Compton, Calif.

Speed-O-Motive
9714 E. Garvey
El Monte, Calif.

Lucky Auto Supply
801 Broadway
Fresno, Calif.

McGurk Engineering Co.
13226 Halldale
Gardena, Calif.

Vic Hubbard
Motor Pts. & Speed Eqt. Co.
21532 Meekland Ave.
Hayward, Calif.

Ed Iskenderian
607 No. Inglewood
Inglewood, Calif.

Weber Tool Co.
310 S. Center Street
Santa Ana, Calif.

Wil Cap Co.
2930 Sepulveda Blvd.
Torrance, Calif.

Weiand Racing Eqpt.
2733 San Fernando Rd.
Los Angeles 41, Calif.

Howard's Automotive
10122 S. Main St.
Los Angeles, Calif.

Edelbrock Eqpt. Co.
4921 W. Jefferson
Los Angeles 16, Calif.

Bill Stroppe & Assoc.
2180 Temple St.
Long Beach, Calif.

Clay Smith Engineering
1301 W. Gaylord
Long Beach, Calif.

Johns Quality Pistons
2662 Lacy St.
Los Angeles 31, Calif.

Offenhauser Eqpt. Co.
5300 Alhambra Ave.
Los Angeles 32, Calif.

Newhouse Automotive, Inc.
5805 E. Beverly Blvd.
Los Angeles 22, Calif.

Thomas Magnesium Racing
Equipment
8816 Crocker
Los Angeles, Calif.

Pine Auto Supply
115 E. Pine St.
Lodi, Calif.

Reath & Mailliard Auto
1945 E. 10th St.
Long Beach 13, Calif.

Buck's Auto Parts
17th & K Sts.
Merced, Calif.

Lucky Auto Supply
700 10th St.
Modesto, Calif.

C T Automotive
7253 Lankershim Blvd.
No. Hollywood, Calif.

Hot Rod Henry's
4133 Lankershim
No. Hollywood, Calif.

Gold's Auto Supply
337 South 'A' St.
Oxnard, Calif.

Lee's Speed Shop
1143 E. 14th St.
Oakland 6, Calif.

Forgedtrue Piston Corp.
1979 E. Colorado St.
Pasadena, Calif.

Mt. View Service
696 South Main St.
Portersville, Calif.

Allbright's
3889 8th St.
Riverside, Calif.

Capitol Speed Shop
1620 Broadway
Sacramento, Calif.

Moon Equipment Co.
10935 South Bloomfield
Santa Fe Springs, Calif.

Scotty's Muffler Service
831 N. Waterman
San Bernardino, Calif.

Auto-Torium Store
2947 Mission
San Francisco, Calif.

Mac Racing Equip. Co.
18 S. Eighth St.
San Jose, Calif.

Westside Auto Parts
1229 Monterey St.
San Luis Obispo, Calif.

Sports Car Center
Richards Bay Bridge H-1
Sausalito, Calif.

Knowles Auto Supply
102 South Wilson Way
Stockton, Calif.

Woody & Ken's Speed Shop
2222 4th St.
San Rafael, Calif.

Le Blanc's Speed Engr.
661 East Arques
Sunnyvale. Calif.

Norman Auto Supply
1400 South California
Stockton, Calif.

C & A Speed Shop
1780 San Juan Rd.
Salinas, Calif.

Quincy Auto Supply
2930 Wilshire Blvd.
Santa Monica, Calif.

Culbert's Automotive
4080 Market St.
San Diego, Calif.

Bob Joehnick Automotive
133 W. Figueroa St.
Santa Barbara, Calif.

J & L Mufflers Shop
920 North Ventura Ave.
Ventura, Calif.

Parigian Speed Shop
912 W. Houston Ave.
Visalia, Calif.

Thompson Speed & Custom
5743 Costello Ave.
Van Nuys, Calif.

Davis Auto Service
1511 Sonoma Blvd.
Vallejo, Calif.

Taylor Engine Rebuilding
545 S. Greenleaf Ave.
Whittier, Calif.

Akton Millers Garage
9225 E. Slauson Ave.
Pico-Rivera, Calif.

COLORADO

Kenz & Leslie V-Eight Service
1255 Delaware St.
Denver, Colo.

Pueblo Auto Parts
201 N. Santa Fe Ave.
Pueblo, Colo.

CONNECTICUT

Coopers Auto Supplies
2093 E. Main St.
Bridgeport, Conn.

Hartford Auto Serv. Co.
118 Albany
Hartford, Conn.

DELAWARE

The Speed Shop
3209 Concord Pike
McDaniel Hgts.
Wilmington, Dela.

FLORIDA

Crane Engineering Co.
20960 Dixie Highway
Hallandale, Fla.

Jim Rathmann, Inc.
2480 N.W. 36th St.
Miami, Fla.

Dons Speed Shop
12828 Nebraka Ave.
Tampa 4, Fla.

GEORGIA

Reeves Body Works
2667 Bankhead Hwy.
Atlanta, Ga.

Automotive Powerhouse
559 Broad St.
Augusta, Ga.

Brooks Garage
116 Ponce De Leon Ave.
Decatur, Ga.

HAWAII

Kalihi Auto Parts
1818 No. King St.
Honolulu 17, T.H.

IDAHO

Century Speed Shop
1021 E. Fremont
Pocatello, Idaho

ILLINOIS

Curleys Speed Shop
1202 W. Clark St.
Champaign, Ill.

J. C. Whitney & Co.
1917 Archer Ave.
Chicago, Ill.

Ray Erickson Speed Service
3049 W. Irving Park Rd.
Chicago, Ill.

Bill Von Esser
3307 W. Irving Park Ave.
Chicago, Ill.

Gotha Inc.
15301 Broadway
Harvey, Ill.

World Supply Corp.
653 Collins St.
Joliet, Ill.

Peoria Machine & Parts Co.
603 S. Franklin St.
Peoria, Ill.

Springfield Auto Sup. Co.
211 E. Washington St.
Springfield, Ill.

Speedway Auto Parts
Belvidere Rd.
Waukegan, Ill.

INDIANA

Arthur's Race Parts
1515 E. Rudisill Blvd.
Ft. Wayne 5, Ind.

A. J. Getz
4430 Carrolton Ave.
Indianapolis 5, Ind.

Downer's Speed Spot
3221 Pleasant St.
South Bend, Ind.

Central Auto Parts
10 N. Second St.
Terre Haute, Ind.

IOWA

Competition Accessories
704 Washington Ave.
Iowa Falls, Iowa

Lewis Motor Supply, Inc.
1801 Washington
Waterloo, Iowa

KANSAS

City Cycle & Speed Shop
1323 State St.
Salina, Kans.

Hall's Speed Shop
1209 E. Lincoln
Wichita, Kans.

KENTUCKY

O. B. Smith Speed Sales Co.
500 Rosemont
Lexington, Ky.

Clary Customotive Co.
208 Rochester Ave.
Louisville 14, Ky.

LOUISIANA

Ed Taussig Ford, Inc.
P.O. Box 860
Lake Charles, La.

Bill's Speed Shop
4038 Jefferson Hwy.
New Orleans, La.

MAINE

Auto Parts Supply & Exc.
192 Park St.
Lewiston, Maine

MARYLAND

Capitol Speed Shop
3032 So. Hanover St.
Baltimore 25, Md.

MASSACHUSETTS

New England Speed Equip.
169 Brighton Ave.
Boston 34, Mass.

Shawmut Motors, Inc.
99 Mechanic St.
Worcester, Mass.

MICHIGAN

Battle Creek Hot Rod Shop
166 Main St.
Battle Creek, Mich.

Remes Auto Parts
2601 Division Ave.
Grand Rapids, Mich.

MINNESOTA

Central Auto Parts
327 N. Central Ave.
Duluth 7, Minn.

The Northwestern Parts Co.
810 Lyndale North
Minneapolis, Minn.

MISSISSIPPI

J. P. Gandy Machine Co.
222 South State St.
Jackson, Miss.

MISSOURI

Paces Speed Shop
3430 Independence
Kansas City, Mo.

Custom Automotive Supply
4439 Easton Ave.
St. Louis 13, Mo.

Springfield Auto Parts Co.
1117 St. Louis St.
Springfield, Mo.

MONTANA

Dudley's Auto Parts
12 East Galena St.
Butte, Mont.

Palmer Bros. Auto Supply
809 First Ave. North
Great Falls, Mont.

NEBRASKA

Midwest Motor Parts Co.
1913 Leavenworth
Omaha, Nebr.

NEVADA

Southwest Auto Parts
10th & Fremont
Las Vegas, Nev.

NEW HAMPSHIRE

Capitol Speed Shop
285 So. Main St.
Concord, N.H.

NEW JERSEY

Newark Speed Spec. Co.
22 Heller Parkway
Newark, N.J.

Calif. Speed & Sport
298 Jersey Ave.
New Brunswick, N.J.

Marks Speed Shop
1136 Estate St.
Trenton 8, N.J.

NEW MEXICO

K & W Auto Parts
6413 Central N.E.
Albuquerque, N. Mex.

NEW YORK

Auto Parts Service
228 Central Ave.
Albany 6, N.Y.

Dickinson Auto Mach. Shop
106 Broad Ave.
Binghamton, N.Y.

Paramount Auto Access.
1146 Fulton St.
Brooklyn 16, N.Y.

Ted Kessler Speed Shop
317 No. Ogden St.
Buffalo, N.Y.

Speedway Parts
160-02 Linden Blvd.
Jamaica, N.Y.

Phillips Speed Equipment
P.O. Box 321
Middletown, N.Y.

S & M Automotive
149 Main St.
New Rochelle, N.Y.

Brand's
Canal & Varick Sts.
New York, N.Y.

Lafayette Motive Parts
220 Lafayette St.
New York, N.Y.

Motor Boys Auto Stores
1222 St. Nicholas Ave.
New York N.Y.

Bud's Speed Shop
2610 Pine Ave.
Niagara Falls, N.Y.

Remling & Sons
180 Valley St.
North Tarrytown, N.Y.

Nyack Auto Parts
267 Main
Nyack, N.Y.

Diesing Supply Co.
485 Main St.
Poughkeepsie, N.Y.

H & D Speed Service
1819 Ridge Rd. East
Rochester, N.Y.

Plane Boys
111 State St.
Schenectady, N.Y.

Valley Speed Parts
146 Walrath Rd.
Syracuse 5, N.Y.

Hi-Speed Power Equipment
79 East Merrick Rd.
Valley Stream, N.Y.

NORTH CAROLINA

Barber's Auto Supply
612 South Franklin St.
Rocky Mountain, N.C.

Brown Supply Co.
232 North Liberty St.
Winston-Salem, N.C.

Eikens Speed Shop
118 Pinecrest Dr.
Fayetteville, N.C.

Jerry's Speed & Custom
837 W. Marion St.
Shelby, N.C.

Joint & Clutch Serv. Inc.
1108 Hutchinson Ave.
Charlotte 1, N.C.

NORTH DAKOTA

Shep's Speed Shop
7 Lincoln Dr.
Grand Forks, N. Dak.

OHIO

Ohio Speed Center
1030 South High St.
Akron, Ohio

National Speed Equipt.
2077 Starr Ave.
Toledo, Ohio

Harry's Speed Shop
1325 College Ave., S.E.
Canton, Ohio

Midwest Racing Equip. Co.
13907 Mile Ave.
Cleveland, Ohio

Don Campbells Speed Shop
4240 Delhi St.
Cincinnati, Ohio

Tomahawk Speed Shop
1229 Meister Rd.
Lorain, Ohio

Raceway Equipment Co.
7708 Madison Ave.
Cleveland 2, Ohio

K N J Racing Equip. Supp.
875 Gray St.
Columbus 3, Ohio

Alberts Speed Shop
2345 Dawn Dr.
Dayton, Ohio

Herrick's Speed Equipt.
505 Main St.
Toledo, Ohio

Don & Charlie's Speed Shop
6619 Renwood Dr.
Parma 29, Ohio

Maedel's Speed Equipt.
3516 La Grange Ave.
Toledo, Ohio

Ray's Auto Repair & Hot Rod Shop
445 N. Main St.
Spencerville, Ohio

Bob's Speed Shop
Central & Pershing
Hamilton, Ohio

Kenny's Speed Power
1020 Prosperity Rd.
Lima, Ohio

Bob's Speed Shop
1072 Maxahala Ave.
Zanesville, Ohio

OHIO (Con't)

Youngstown Speed Shop
6007 No. Poland Rd.
Youngstown 12, Ohio

Hagen Speed Shop
969 Packard Dr.
Akron, Ohio

Miami Valley Speed Shop
Waynesville, Ohio

Smith Speed Shop
Crookshank Rd.
Cincinnati 38, Ohio

Hop Up Shop
628 North Main St.
Bellefontaine, Ohio

OKLAHOMA

The Speed Shop
1624 N.W. 34th St.
Oklahoma City, Okla.

Randell Accessory Supply
1000 N.W. 10th St.
Oklahoma City, Okla.

OREGON

Dicks Speed Shop
933 Washington St.
Klamath Falls, Ore.

Frank Castanzo Automotive
2221 N.E. Sandy Blvd.
Portland, Ore.

Blackie Blackburns Auto.
345 E. 28th Ave.
Portland 14, Ore.

Exhaust Specialties Bar
700 S.E. Belmont
Portland 14, Ore.

Willamette Speed Shop
3845 State St.
Salem, Ore.

Salem Speed Shop
340 Mission St.
Salem, Ore.

PENNSYLVANIA

Cooper Speed Parts
1126 Chew St.
Allentown, Pa.

George Hurst
Custom Automotive
Abington, Pa.

Speed Equipment
R.R. 13 Bristol Park
Andalusia, Pa.

Langhorne Speed Shop
Super Hi Way & Highland
Langhorne, Pa.

Custom Speed Eqpt. Svc.
323 South Mill St.
Lancaster, Pa.

Mark Lights Speed Shop
13th & Cumberland Sts.
Lebanon, Pa.

Almquist Engineering
Milford, Pa.

Brougher Speed Shop
5426 Mifflin Rd., Lincoln
Pittsburgh 7, Pa.

Northeast Speed Shop
1901 Torresdale
Philadelphia, Pa.

Ambler Race Parts
4912 Germantown Ave.
Philadelphia, Pa.

Poulesons Speed Shop
506-A Walnut St.
Reading, Pa.

Hollywood Speed Shop
1154 North Front St.
Reading, Pa.

Hollywood Speed Shop
531 North Fourth St.
Reading, Pa.

M & M Racing Specialties
409 Vincent Rd.
Willow Grove, Pa.

Marchman Racing Eqpt.
Yerkes, Pa.

York Speed Shop
363 Warren St.
York, Pa.

RHODE ISLAND

Packards Speed Equipt.
1162 North Main St.
Providence, R.I.

Mattys Speed Shop
598 Hartford Ave.
Providence, R.I.

SOUTH CAROLINA

Robinsons Speed Shop
4116 River Ave.
Charleston, S. Car.

Robinsons Speed Shop
134 Chestnut
Charleston, S. Car.

Nickles Speed Shop
2 Florida Ave.
Greenville, S. Car.

SOUTH DAKOTA

Green Sales Company
229 North Dakota Ave.
Sioux Falls, S. Dak.

O. A. Corbett
617 West 12th
Sioux Falls, S. Dak.

TENNESSEE

Union Auto Electric Svc.
1017 Union Ave.
Memphis, Tenn.

Talbot Bros. Speed Shop
Jocelyn Hollow Rd.
Nashville, Tenn.

TEXAS

Moss Garage
2009 W. 3rd
Amarillo, Texas

Schneider's Custom & Speed Shop
3205 Goodwin St.
Austin, Texas

Bobbs Hot Rod Shop
1227 Walnut St.
Abilene, Texas

C C Speedway Inc.
3901 Agnes St.
Corpus Christi, Texas

Carson Custom Engines
5515 Linsley
Dallas 23, Texas

Leach Auto Supply
2910 Commerce
Dallas, Texas

Jerry's Speed Shop
4264 W. Lovers Lane
Dallas, Texas

Hollywood Muffler & Speed Shop
1129 N. Zangs
Dallas, Texas

Highway Speed Shop
5505 University Blvd.
Dallas, Texas

A J Speed Shop
326 Carolina Dr.
El Paso, Texas

United Auto Supply
13th & Commerce
Ft. Worth, Texas

Burnards Custom Service
2229 E. Main St.
Grand Prairie, Texas

Alamo Auto Parts
4827 Ave. 'J'
Galveston, Texas

Ed's Speed & Custom
716 Oak St.
Highlands, Texas

Bryant's Speed Shop
922 W. Harrison St.
Harlingen, Texas

L & S Speed Shop
605 Henley St.
Houston 7, Texas

Ingalls Rod Shop
1326 N. 9th St.
Longview, Texas

Motor Machine Service
1921 A Ave. H
Lubbock, Texas

Eaton Auto Service
2001 E. Hwy. 80
Midland, Texas

Robinson's Speed Shop
751 Pine Bluff St.
Paris, Texas

Fillip's Speed Shop
1810 Volney
San Angelo, Texas

Langford Racing & Muffler Co.
2200 Harrison St.
Wichita Falls, Texas

UTAH

Bud's Speed Shop
587 Chester St.
Ogden, Utah

Dayton's Auto Supplies
665 E. 21st St. South
Salt Lake City, Utah

VERMONT

Lash Auto Supply
194 Bank St.
Burlington, Vt.

VIRGINIA

S & S Speed Shop
Glen Allen, Va.

Cavalier Speed Shop
1413 Avondale Ave.
Richmond, Va.

Hollywood Speed Shop
2009 Gordan Ave.
Richmond, Va.

Bob Kell's Speed Shop
2209 Fairfax Ave.
Richmond 24, Va.

WASHINGTON

Gene's Speed Shop
Rt. 2, Box 37
Port Angeles, Wash.

Mar-Ken Speed Specialties
2405 Sanford
Richland, Wash.

Al Cooper Speed Shop
1144 Eastlake Ave.
Seattle, Wash.

Schuck's Automotive Supply
7th Ave. & Bell St.
Seattle, Wash.

George's Speed Shop
3019 W. Kiernan
Spokane 14, Wash.

Hardemann's Speed Equip.
North 1624 Ash St.
Spokane, Wash.

Skaggs Racing Equipment
West 1107 Second
Spokane, Wash.

Jim's Speed Shop
4410 North 12th St.
Tacoma 9, Wash.

Gelli-Speed Shop
1210 V St.
Vancouver, Wash.

WEST VIRGINIA

G. R. Berthy, Jr.
Speer Equip. & Auto Access
Buckhannon, W. Va.

Webers Speed Shop
46 Cherry St.
Elkins, W. Va.

WISCONSIN

Jacks Speed Shop
220 2nd St.
Baraboo, Wisc.

Brookfield Speed Shop
19400 River Dr.
Brookfield, Wisc.

Hot Rod Supply Store
6132 22nd Ave.
Kenosha, Wisc.

Bobs Speed Shop
2617½ Milwaukee St.
Madison 5, Wisc.

Midwest Speed-Power Equipt.
2206 W. Walnut St.
Milwaukee 5, Wisc.

WYOMING

Macs Speed Shop
619 West 16th St.
Cheyenne, Wyo.