DYNO Part 1

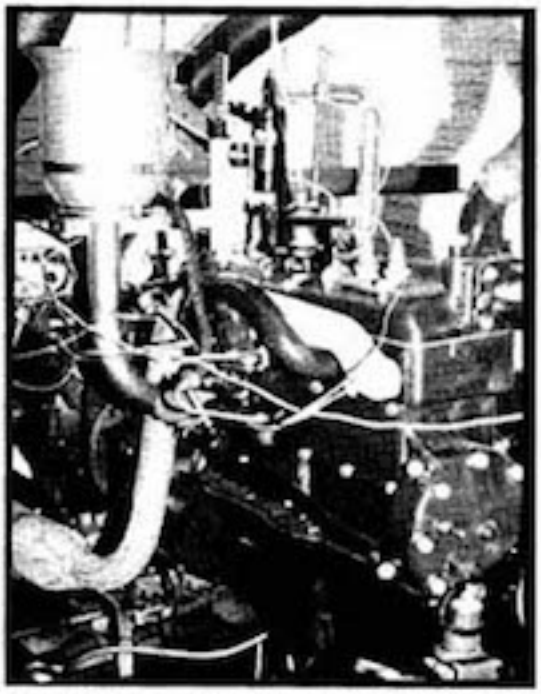
Ron Kelley Tests the Model "A" Engine

I wanted to find out how the engines I rebuild compare to a stock Model "A" engine. I decided that dynamometer testing would best show the improvements made to the engine.

The tests were done on a Super Flow 901 Dynamometer. It is a computer machine and is calibrated on a yearly basis.

Testing on the dyno is done at full throttle. The computer increases the load until it brings the RPM to a lower preset limit to start the test cycle. When the test cycle is started the computer eases the load to allow the RPM to increase. It then takes measurements at preset intervals until it reaches the upper preset RPM limit and then returns the engine to the lower limit. That completes the test cycle.

For these tests I needed an engine that was as near to stock as I could find in order to set a reliable base line from which to measure any improvements. I borrowed an engine from a past customer who had removed a rebuilt stock engine with only 2000 miles on it. This engine was in good condition and had been sleeved back to standard bore. The valve train was rebuilt using reproduction stock parts. The camshaft had been re-ground with a stock "A" grind. The crankshaft and flywheel were stock. This was what I needed for a base line comparison, a basic stock engine with no modifications.



Stock Model "A" on the dynamometer. This carefully rebuilt, completely stock Ford Model "A" engine produced only 35.6 HP @ 2250 RPM!

This engine will be referred to as engine #1.

I rebuilt two more engines for comparison testing at the same time. Engine #2 was rebuilt with insert bearings and my preferred parts list. Engine #3 was also rebuilt with inserts, but was stroked .360", which is almost 3/8".

Engine #2 was rebuilt using parts and services that I have found over time to work very well together in a Model "A" block. The engine had insert bearings in the rods and mains and a counter weighted crankshaft. It was dynamically balanced and had a lightened flywheel with a harmonic dampener installed. The pistons were from a Ford 351 ci V-8, which required a 4" bore. The valves were from a GMC truck with one piece valve guides from a Buick. The engine had a mild performance camshaft and the ports were enlarged and polished.

Actually engine # 3 is a teaser, because we will tell it's story in the next issue. The #3 engine had been stroked by offset grinding the rod journals on a Model "B" crankshaft by .180", which achieved a stroke of 4.610" verses the stock Model "A" stroke of 4.250". The engine had a pressurized oil system and I installed a Chevy 350 rear main oil seal. The block was bored to .06" over standard (3-15/16") and used 283 ci Chevy pistons. The engine had an aluminum Clings After market Products (Tempe, AZ) flywheel. The entire unit was dynamically balanced and had the same valve train and camshaft as engine #2.

I also wanted to test some other bolt on items such as: heads, distributors, carburetors, spark plugs, mufflers, fans and fan belts. I wanted to see how these things compared to the stock Ford equipment.

Cylinder Heads

I tested four heads: A stock 4.2:1 compression ratio Model "A", a stock 1932 Model "B" head with letter "C" cast in the top, a Brumfield-Finley reproduction 5.9:1 high compression head and a Dan Price Reproduction Thomas with a 7:1 CR. These heads were chosen due to their ready availability and common usage.

Distributors

For distributors I chose the stock Model "A" unit for the base line and the dual point Mallory because of its quality, adjustable timing advance ranges and easy availability.

Manifolds & Carbs

On each engine I used stock manifolds and a Zenith carburetor, again to establish the proper base line. Then I installed a Weber progressive 2 barrel carburetor fitted to an aluminum single down draft manifold. I chose these because my customers reported excellent results and because these items are easily obtainable new. Pete Westler of Auto Care and Restoration (Redding, CA) agreed to furnish these parts for the test.

Spark Plugs

Several brands of plugs were used. Please refer to the test charts for the specific plugs I settled on for each test. There was only one set of plugs in which I was severely disappointed. Spitfire brand plugs actually caused the engines in this test to lose two horse power. Their ads claim that these plugs will produce more power. I did not see that at all.

Mufflers, Fans & Belts

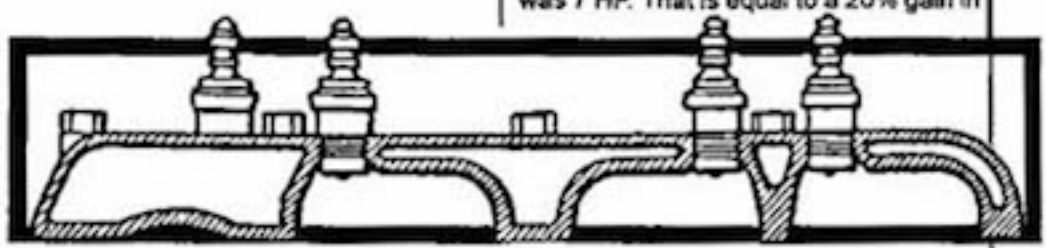
For the base line we used a standard reproduction muffler and compared it to an Aires brand muffler. The fans I used were: Stock two blade original Ford fan, a six bladed fan available from several new parts dealers and a six blade fan from Clings. The fan belts tested were: a 5/8" stock V-belt and a 5 groove serpentine belt and pulley set available from Clings.

The Testing -Test # 1:

The engine was Ford stock right down to the 3-X champion spark plugs.

Test #1 Stock Model "A" Engine			
SPEED RPM	TORQUE LBS/FT	POWER HP	AIRFLOW CFM
1000	77.30	14.70	41.10
1250	66.90	15.90	41.70
1500	60.50	17.30	44.70
1750	57.00	19.00	46.50
2000	64.30	24.50	50.70
2250	83.10	35.60	60.60
2500	61.10	29.10	70.60

Notes: Notice the torque jump around and the steady HP increase, but where is the 40 HP that Ford claimed? The best results were obtained using 31 degrees of timing advance.



Test # 2:

Changed to a Mallory Dual Point distributor. Timing was set at 15 degrees at 700 RPM and full advance of 31 degrees at 2000 RPM. Out of the box the Mallory had a preset range of 16 degrees when I received it.

TEST # 2			
SPEED RPM	TORQUE LBS/FT	POWER HP	AIRFLOW CFM
1000	115.00	21.90	42.30
1250	108.10	25.70	46.30
1500	97.50	27.80	50.30
1750	92.10	30.70	55.20
2000	91.80	35.00	63.10
2250	82.30	35.30	70.50
2500	65.70	31.30	73.60

Notes: The torque and HP increased at lower RPM.

Test # 3:

Replaced the stock intake/carb with the new Weber and manifold set.

TEST # 3			
SPEED RPM	TORQUE LBS/FT	POWER HP	AIRFLOW CFM
1000	111.80	21.30	41.40
1250	105.30	25.10	44.80
1500	104.90	30.00	51.00
1750	106.50	35.50	63.10
2000	110.50	42.10	74.00
2250	98.40	42.20	80.70
2500	86.20	41.00	84.90

Notes: Watch the torque/HP/airflow changes. When the Weber carb, intake and header set up was installed the gain was 7 HP. That is equal to a 20% gain in power. The torque also improved and remained flat all the way to 2000 RPM. At 2000 RPM the torque peaks. This shows the limitations of the stock camshaft grind and valve train. The CFM at this point is only about 10 CFM more than in test # 2.

The engine reaches 35 HP at the airflow of 63 CFM with both carburetors; The Zenith at 2000 RPM and the Weber at 1750. This is sign that the Zenith is reaching its limit. With the Zenith set up, it is harder to breath and doesn't develop as much torque as with the Weber carb and new intake manifold.

Tests 4-13 were run with engine #2. This engine had a mild cam and the intake ports were enlarged at the valve seat to 1-7/16" and polished. The block was bored to 4", the pistons were from a Ford 351 ci V-8 and they had 1/16" offset at the wrist pins which improves torque.

Test # 4:

Engine # 2 with a stock carb, manifolds and head that measured out to 4.1:1 CR, but actually was 4.5:1 with a 4" bore. I added a Mallory with timing at 5 degrees at 700 RPM to 30 degrees at 2250 RPM. Spark plugs were Champion C16C.

TEST # 4			
SPEED RPM	TORQUE LBS/FT	POWER HP	AIRFLOW CFM
1000	122.50	23.30	45.20
1250	119.10	28.30	47.70
1500	111.60	31.90	50.70
1750	116.50	38.80	56.90
2000	123.40	47.00	70.80
2250	111.30	47.70	74.90
2500	105.20	50.10	81.50

Notes: Look at the significant HP and torque changes between the stock engine #1 in test #2 and engine #2 in test #4. There is a 15 HP increase or 43% more power than the stock #1 engine and 35% more torque at 2000 RPM.

Test #5:

Engine #2 with Weber, intake and tube header set.

TEST # 5			
SPEED RPM	TORQUE LBS/FT	POWER HP	AIRFLOW CFM
1000	97.80	18.60	39.80
1250	94.20	22.40	41.80
1500	94.30	26.90	45.50
1750	101.10	33.70	50.70
2000	113.50	43.20	60.70
2250	122.10	52.30	88.50
2500	132.20	62.90	100.50
2750	121.40	63.60	104.70
3000	106.40	60.80	107.00

Notes: 63 HP at 2750 RPM and 121 pounds of torque at 104 CFM with a stock head! That is an 80% HP increase over test #2. Compare Test # 5 and #4 and discover that the Weber, intake and header set up is worth 13 HP.

Test # 6:

Changed to a stock 1932 Model "B" head and back to a stock intake/ exhaust manifold, Zenith carb and new Mallory with the timing set to 0 degrees to 25 degrees. Compression measured 5.4:1 with the 4" bore and a slight amount of milling.

TEST # 6			
SPEED RPM	TORQUE LBS/FT	POWER HP	AIRFLOW CFM
1000	124.80	23.80	41.20
1250	127.70	30.40	43.50
1500	123.00	35.10	47.00
1750	126.20	42.10	51.60
2000	131.90	50.20	67.90
2250	118.30	50.70	71.40
2500	112.40	53.50	77.10
2750	102.40	53.60	79.30
3000	92.00	52.60	82.80

Notes: Compare the peak HP in tests # 2, #4 and #6. The compression moved up almost a full point (.9:1) and only gained 3 HP. Torque gains were also small.

Test # 7:

Changed back to the Weber, intake and header set up.

TEST # 7			
SPEED RPM	TORQUE LBS/FT	POWER HP	AIRFLOW CFM
1000	134.80	25.70	41.80
1250	140.60	33.50	44.40
1500	132.40	37.80	50.40
1750	130.40	43.50	56.50
2000	142.60	54.30	68.70
2250	142.50	61.00	91.70
2500	138.10	65.70	98.10
2750	131.30	68.80	101.70
3000	120.30	68.70	98.10

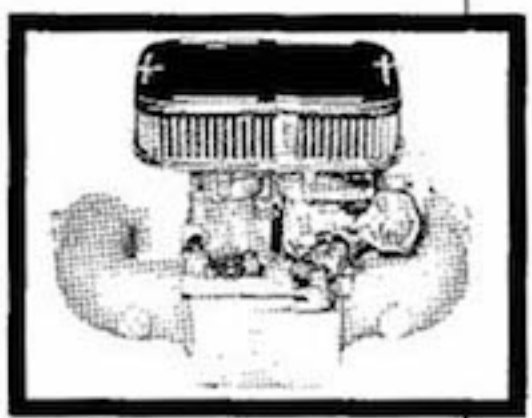
Notes: Peaked at 68 HP, which is a 96% increase over test #2 and 63% increase over test #3. The Weber set up is now worth 15 HP of BOLT ON POWER!!

Test # 8:

Changed to the Brumfield-Finley 5.9:1 head (actually 6.2:1 with the big 4" bore), Stock manifolds, Zenith carb and Mallory with timing set at 6 degrees to 31 degrees.

TEST # 8			
SPEED RPM	TORQUE LBS/FT	POWER HP	AIRFLOW CFM
1000	134.80	25.70	46.20
1250	122.10	29.10	46.60
1500	116.90	33.40	49.20
1750	116.50	38.80	51.90
2000	118.60	45.20	56.30
2250	122.90	52.70	80.60
2500	120.90	57.50	81.90
2750	112.70	59.00	86.70
3000	96.40	55.10	84.90

Notes: Compare the differences in CFM in Test #8 and Test #6:



AC&R's Intake with Weber two barrel.

COMPARE CFM TESTS	TEST # 8	TEST # 6
RPM	B-F HEAD	'32 "B" HEAD
2250	80.60	71.40
2500.00	81.90	77.10
2750.00	86.70	79.30
3000	84.90	82.80

In comparing the CFM between two different heads, using the same carb and manifolds; it shows which head is more efficient in the airflow category. It's beginning to appear that compression is less important than airflow to the performance of an engine.

Test # 9:

Changed to Weber carb, intake and headers.

TEST # 9			
SPEED RPM	TORQUE LBS/FT	POWER HP	AIRFLOW CFM
1000	134.80	25.70	42.10
1250	125.30	29.80	43.30
1500	119.60	34.20	46.30
1750	122.40	40.80	51.00
2000	133.60	50.90	59.40
2250	151.00	64.70	88.10
2500	150.90	71.80	97.30
2750	137.70	72.10	101.70
3000	124.30	71.00	105.20

Notes: Weber carb, intake and header set made a 13 HP (22%) improvement over the stock carb and manifolds. Test # 9 shows 102% more HP than test #2. Notice the torque peak of 151 lbs./ft. at 2250 RPM and the peak in airflow of 105.2 CFM at 3000 RPM.

For the next series of tests (#10-#13) I changed to the Thomas 7:1 CR head. This head has a 1/8" relief or "fly cut" milled in it for piston clearance. The resulting CR is still 7:1 due the 4" bore. The Mallory, Weber, Intake and headers set was used all four tests. These tests show the progression of improvements as different spark plugs, timing settings and fuel are tried.

Test # 10:

Timing was set to 6 degrees to 31 degrees. NGK (BPR6ES) spark plugs.

TEST # 10			
SPEED RPM	TORQUE LBS/FT	POWER HP	AIRFLOW CFM
1000	151.40	28.80	43.50
1250	144.10	34.30	44.90
1500	143.20	40.90	48.30
1750	141.40	47.10	53.90
2000	152.50	58.10	75.70
2250	146.10	62.60	81.70
2500	141.10	67.20	86.30
2750	130.60	68.40	88.70
3000	112.00	64.00	83.70

Test # 11:

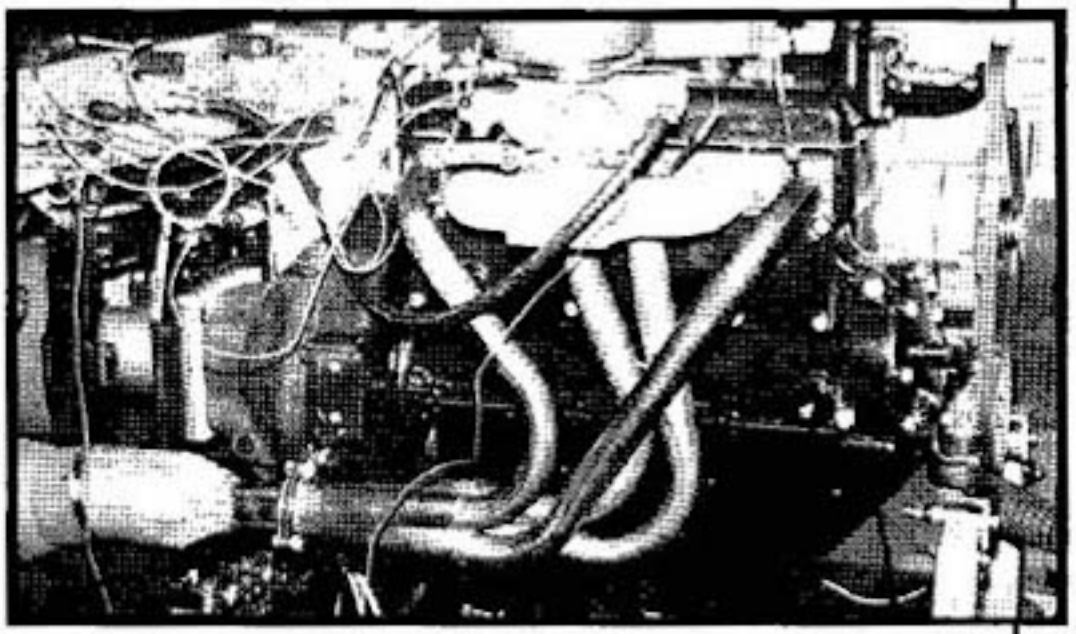
Timing was set 0 degrees to 25 degrees.

TEST # 11			
SPEED RPM	TORQUE LBS/FT	POWER HP	AIRFLOW CFM
1000	148.50	28.30	43.10
1250	149.00	35.50	45.80
1500	140.00	40.00	50.40
1750	138.40	46.10	54.90
2000	153.00	58.30	64.30
2250	151.40	64.90	82.70
2500	145.10	69.10	86.20
2750	133.40	69.80	88.20
3000	118.90	67.90	90.00

Test # 13:

Changed to Super unleaded gasoline.

TEST # 13			
SPEED RPM	TORQUE LBS/FT	POWER HP	AIRFLOW CFM
1000	146.70	27.90	43.30
1250	148.50	35.30	47.10
1500	141.10	40.30	51.10
1750	138.50	46.10	56.30
2000	152.10	57.90	65.20
2250	158.40	67.90	86.10
2500	153.00	72.80	93.30
2750	141.00	73.80	98.80
3000	103.20	58.90	97.00



Model "A" engine on the dyno: Tube headers, Westler intake, Weber progressive two barrel carb, Brumfield-Finley H.C. Head, producing 72.10 HP @ 2750 RPM.

Test #12:

Changed to AC spark plugs (R45XLS).

TEST # 12			
SPEED RPM	TORQUE LBS/FT	POWER HP	AIRFLOW CFM
1000	143.30	27.30	44.20
1250	146.80	34.90	46.90
1500	140.90	40.20	51.80
1750	141.80	47.20	57.20
2000	169.40	64.50	77.60
2250	157.40	67.40	85.10
2500	150.40	71.60	91.30
2750	138.20	72.40	95.70
3000	124.90	71.30	94.70

Notes: The Thomas head had very strong torque improvement in the 1000 to 2000 RPM range, which is your normal driving range. But at higher RPM ranges (2000 to 2500), the torque really starts to drop off considerably. Note the CFM of the Thomas head at 2500 RPM on all four tests. Compare these to the Brumfield-Finley head. At 2500 RPM the B-F has a better airflow of 97.3 CFM. The Thomas has the potential of producing more power if the airflow can be improved around the intake valve.

Muffler Tests:

Engine #1 was set up stock as in test #1 for the muffler testing. I first ran a base line test using the building's ex-

haust system, which a 6" tube about 15" long. I then ran tests of the ARIES brand and the standard reproduction mufflers. The differences in the three test results were insignificant.

Engine #2 was then set up for the same test with the 1932 head, stock manifolds, carburetor and a Mallory distributor. I first ran a base line using the house exhaust system. The base line results were 50.3 HP and torque of 117.3 LBS/FT at 2250 RPM. The Aries muffler test results were 52.2 HP and torque of 121.8 LBS at 2250 RPM. The standard repro version produced 48.4 HP and torque of 113.0 LBS/FT at 2250 RPM.

The Aries unit increased power by 1.9 or 3.7% when compared to the base line. The standard muffler caused a loss of 1.9 HP. The Aries muffler, compared to the standard repro, produced 3.8 HP more or a nice 7.8% increase.

The mufflers had no effect on engine #1 because of the stock valve train. As performance of the Model "A" engine is increased the exhaust pressure changes and the stock muffler can no longer handle the increases, causing a HP loss. Apparently the type of back pressure made by the Aries is beneficial to a modified Model "A" engine.

Fan belts & Fans:

Engine #2 was used with a stock carb, manifolds and head. The Mallory distributor was used and I changed to a Model "A" generator because of the serpentine belt and pulley set. Note that the base line test is slightly different from test #4 due to the alternator/generator change over.

Description:	HP
Base Line 5/8" belt no fan	50.40
5/8" belt, stock 2-blade fan	49.70
5/8" belt 6 blade black fan	49.40
Serpentine belt no fan	51.50
Serpt. belt 6 blade white fan	50.60

Serpentine belt wins that one!

Fan Drag	HP Used
Stock 2 blade	0.70
Black 6-blade	1.00
White 6-blade	0.90

Discussion:

All four heads that were tested did run well, but take note that bigger torque and HP gains were achieved from improving airflow and not increasing compression.

Of these four heads, my choice for a strong running tour car would be the Brumfield-Finley. You can bolt it on straight out of the box with no modifications. It performs well on the highway as well as in town. The B-F also has no negative effect on the idle and runs smoothly. It would be less damaging to the crankshaft and bearings than some other new or old high compression heads.

With the Thomas head you will notice some low end vibration due to high torque and low RPM. The B-F head has a more even power curve than the Thomas.

After running all these tests I feel that I have been told "The Big Lie" about how compression is the main HP increaser. The gains in power were smaller from compression increases and much greater from airflow improvements.

My goal was to find out what worked well on these engines and have the data to back it up. I ran over 150 tests. The results shown in this article are only the tip of the iceberg. I also ran tests with my #3 stroked engine. These tests will be published later. Thanks to Pete Westler for furnishing his Weber carb, intake manifold and tube headers.

SOURCES

Ron Kelley, "The Best Little Engine Builder in Texas", can be reached by mail: 1454 Blackland Road, Royse City, Texas 75189 and if you call, Beverly Kelley may answer the phone at 972-771-1911.

Pete & Vi Westler's Auto Care & Restoration is located: 3824 Alma Ave, Redding, CA 96002. Give Pete or Vi a call at 916-222-0228. They understand performance and have a bunch of bolt on power for sale.

The Brumfield-Finley cast iron 1928-1931 Model "A" 5.9:1 high compression cylinder head. Write to Larry Brumfield, P.O. Box 5598, Waco, TX 76708. Hot "Sleeper" heads for stockers & rodders designed to trick your friends and go fast.

Cling's Products for fans, pulleys, brakes, flywheels & more high quality aftermarket cool things. Ask for Dennis or Marie at 602-968-1778.

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