Cycle

70P JULY 1978

DUCATI DESMO 900 SS
ROCKET FOR A MOUNTAIN ROAD

HONDA XL250S:
THE TECHNO-FREAK's
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FOUR-STROKES:
SP370 & DR370

YAMAHA YZ125E: POWER
KING OF 125 MOTOCROSS

HANNAH SWEEPS
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PHOTOGRAPHY: DAVE HAWKINS, ROBIN RIGGS

YAMAHA SR500E HOP-UP PART 1

As a hop-up project bike, the Yamaha SR500E has much to recommend it: It's popular, the engine appears simple enough, and it could use more power. In Part One we look at carburetion and camming, and locate at least one real culprit: the air box.

By Gordon Jennings

● YAMAHA'S 500 SINGLE IS THE COMPLEAT, born-again classic banger. It has all of the original British version's slogging, steady appeal but is vastly more refined and reliable, and for the more sensible of its owners that's enough. What does it matter, really, that even the new improved Yamaha SR500 can't quite match the straight-line speed of Honda's now-discontinued CB500T, which surely is the most laggard 500cc twin of the modern period? Who cares that a Yamaha TT500 is no threat to two-stroke singles of half its displacement? Rational Yamabanger owners should understand that for these big singles, all considerations of sheer speed simply are beside the point. That's the sensible view, and we doubt that it will prevail.

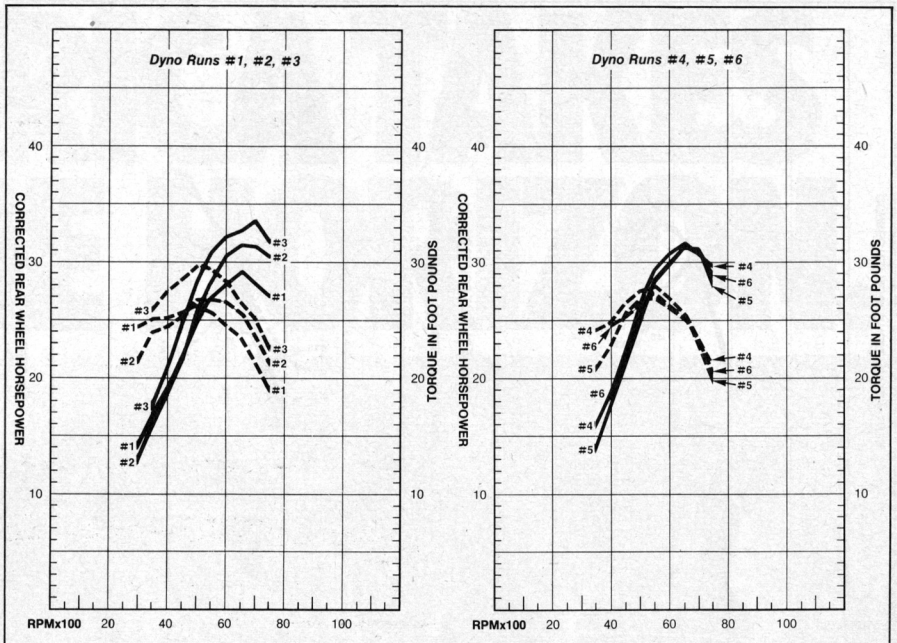
Motorcyclists are driven to tinker by the feeling that a bike isn't performing at full potential, and plenty of people feel there's more in the Yamaha 500 than it presently delivers. The brisk pace set by lightly cammed and ported Honda XL350s contributes to that notion, but our old-timers are responsible for raising it to an uncontrollable, do-something pitch. Mention the Yamaha single to a typical twenty-year-veteran biker and what you'll hear is, "Big damn deal! My old BSA (or Matchless, or Velocette) was a heap faster; it ain't worth the oil drops off a Gold Star's primary case." You'll hear that, and it will be said with utter conviction, and you will be powerfully motivated to join all those who have gone at the Yamaha 500 single with wrenches, grinder and speed equipment.

We know there's a lot of Yamaha single "improving" being done, and we've heard that for many the result has been an expensive disappointment. And it's not merely a bunch of shade-tree tuners; some real talent has been stymied by the Yamaha. Nothing in recent memory has offered us a finer opportunity to bite into

something too tough to chew. We had at hand a nicely broken in Yamaha SR500 to serve as a guinea pig; we have access to the Webco dynamometer and Jerry Branch's air flow test bench; and we have readers who own these singles and are trying to make them faster—however unwise that may be. So we've launched into a Yamahop project, which will be a search for those things that do improve the 500's output and reveal what it doesn't like.

One thing we knew before laying a wrench on the SR500 was that increases in horsepower wouldn't come easily. Five-hundred bangers in the classic pattern simply do not yield up extra horses without a struggle. The old-timers would have us believe the singles of their era were much more vigorous than the Yamaha, and that implies merely turning the technical clock back 15 years will do the trick. That belief has a touching, nostalgic appeal, but it's at odds with the fact that the SR500 holds a solid horsepower edge over all the old singles. Weight and drag-strip trap speeds are pretty good indicators of power, and that yardstick says the revered BSA Gold Star, as sold with megaphone exhaust system and open-mouthed Amal GP carburetor and no lighting, made fewer horses than a Yamaha single corked up for 1978 street riding. C. R. Axtell and a very few other racing tuners learned how to make the Gold Star perform, but the over-the-counter article operated at something less than the stellar level.

Experience has demonstrated that it's unnecessary for anyone to rediscover the whole of piston-engine technology in the course of every hop-up project. There are guidelines to use in establishing maximum safe engine speeds and valve sizes, etc., and though these are not absolutely precise they'll do a lot to keep you out of trouble. . . . The operative rule here is that piston speeds much above 4000 feet per minute are mortally dangerous in engines with bore/stroke ratios at unity. The 87 x



Dyno Run #1

Engine Speed	BHP	Torque
3000	13.95	24.43
3500	16.72	25.08
4000	19.10	25.08
4500	22.04	25.73
5000	24.94	**26.20**
5500	26.95	25.73
6000	28.12	24.62
6500	**29.08**	23.50
7000	28.14	21.12
7500	27.21	19.06

Test Conditions: Barometer 30.00 Temperature— 58°F Wed 71°F Dry Correction Factor 1.029 Date of Test: 4/5/78

Dyno Run #2

3000	12.75	22.32
3500	15.95	23.93
4000	18.71	24.56
4500	21.60	25.21
5000	25.52	26.80
5500	28.08	**26.81**
6000	30.45	26.65
6500	**31.59**	25.53
7000	31.47	23.61
7500	30.54	21.38

Test Conditions: Barometer 29.86 Temperature— 58°F Wet 70°F Dry Correction Factor 1.034 Date of Test: 4/6/78

Dyno Run #3

3500	17.26	25.89
4000	20.93	27.49
4500	24.39	28.46
5000	28.31	**29.73**
5500	30.81	29.43
6000	32.15	28.14
6500	32.84	26.53
7000	**33.66**	25.25
7500	31.97	22.38

Test Conditions: Barometer 29.84 Temperature— 58°F Wet 72°F Dry Correction Factor 1.036 Date of Test: 4/6/78

Dyno Run #4

Engine Speed	BHP	Torque
3500	16.03	24.06
4000	18.80	24.69
4500	22.66	26.44
5000	26.22	27.55
5500	29.19	**27.87**
6000	30.75	26.92
6500	**31.74**	25.65
7000	31.01	23.27
7500	29.62	20.74

Test Conditions: Barometer 29.94 Temperature— 55°F Wet 69°F Dry Correction Factor 1.026 Date of Test: 4/7/78

Dyno Run #5

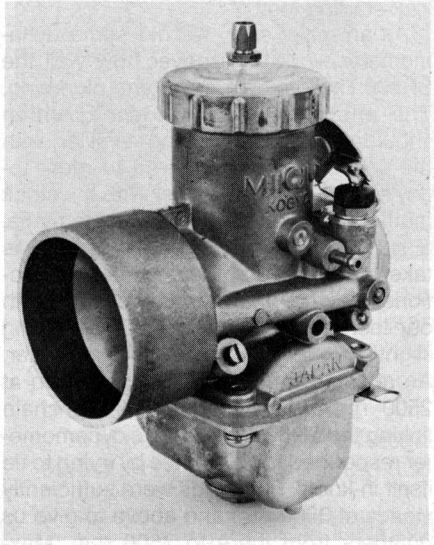
3500	13.97	20.96
4000	17.49	22.86
4500	21.99	25.57
5000	25.55	26.83
5500	28.11	**26.84**
6000	29.75	26.04
6500	**31.44**	25.41
7000	30.68	23.02
7500	28.35	19.85

Test Conditions: Barometer 29.90 Temperature— 56°F Wet 68°F Dry Correction Factor 1.029 Date of Test: 4/7/78

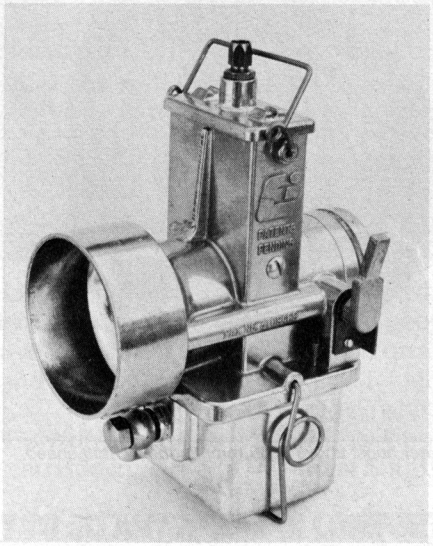
Dyno Run #6

4000	18.67	24.54
4500	21.58	25.19
5000	25.04	26.30
5500	28.55	**27.27**
6000	29.87	26.15
6500	**31.17**	25.19
7000	31.01	23.27
7500	29.14	20.41

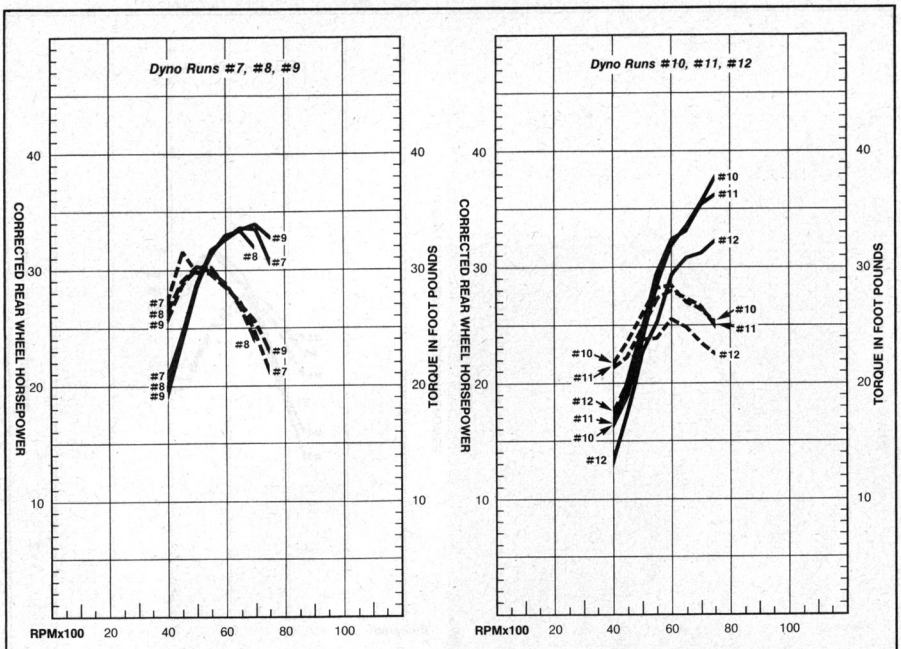
Test Conditions: Barometer 30.01 Temperature— 62°F Wet 73°F Dry Correction Factor 1.039 Date of Test: 4/10/78



Mikuni: a boost in output above 6500 rpm; inferior to the stock carburetor at all other engine speeds.



Edmonston: quick-starting, steady running and good throttle response . . . with a slight net loss of power.



Dyno Run #7

Engine Speed	BHP	Torque
4000	20.61	27.06
4500	24.43	31.40
5000	28.51	**29.95**
5500	31.21	29.80
6000	32.76	28.68
6500	**33.70**	27.23
7000	33.30	24.98
7500	30.88	21.63

Test Conditions:
Barometer 30.00
Temperature—
64°F Wet 76°F Dry
Correction Factor 1.038
Date of Test: 4/10/78

Dyno Run #8

Engine Speed	BHP	Torque
4000	20.00	26.26
4500	24.84	29.00
5000	28.67	**30.11**
5500	31.21	29.80
6000	32.94	28.84
6500	**33.30**	26.91
7000	32.02	24.02

Test Conditions:
Barometer 30.00
Temperature—
64°F Wet 76°F Dry
Correction Factor 1.038
Date of Test: 4/10/78

Dyno Run #9

Engine Speed	BHP	Torque
4000	19.63	25.78
4500	24.71	28.84
5000	28.67	30.11
5500	31.71	**30.28**
6000	32.76	28.68
6500	33.50	27.07
7000	**33.94**	25.46
7500	32.94	23.07

Test Conditions:
Barometer 30.00
Temperature—
64°F Wet 76°F Dry
Correction Factor 1.038
Date of Test: 4/10/78

Dyno Run #10

Engine Speed	BHP	Torque
4000	16.36	21.48
4500	18.96	22.13
5000	23.81	25.01
5500	28.55	27.27
6000	31.87	**27.90**
6500	33.53	27.10
7000	35.47	26.61
7500	**37.72**	25.01

Test Conditions:
Barometer 29.93
Temperature—
62°F Wet 73°F Dry
Correction Factor 1.039
Date of Test: 4/12/78

Dyno Run #11

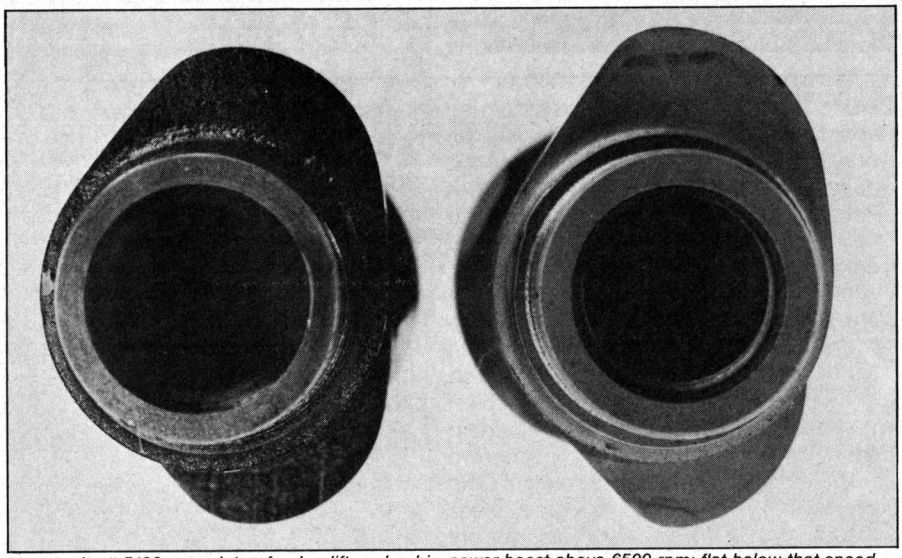
Engine Speed	BHP	Torque
4000	16.37	21.49
4500	20.20	23.57
5000	24.71	25.96
5500	29.36	28.04
6000	32.39	**28.35**
6500	33.01	26.91
7000	35.23	26.43
7500	**36.16**	25.32

Test Conditions:
Barometer 30.00
Temperature—
60°F Wet 71°F Dry
Correction Factor 1.032
Date of Test: 4/12/78

Dyno Run #12

Engine Speed	BHP	Torque
4000	13.24	17.38
4500	17.23	20.11
5000	22.63	23.77
5500	25.07	23.94
6000	29.17	**25.53**
6500	30.80	24.89
7000	31.26	23.45
7500	**32.13**	22.50

Test Conditions:
Barometer 30.00
Temperature—
61°F Wet 73°F Dry
Correction Factor 1.034
Date of Test: 4/12/78



Megacycle #5120 cam; lots of valve lift and a big power boost above 6500 rpm; flat below that speed.

SR500E

84mm Yamaha is close to that (at 1.04:1), and because it hits the 4000 ft/min limit at a crank speed of 7250 rpm, we thought it best to use no more than 7500 rpm as a redline. That's only 500 rpm above the maximum Yamaha recommends. While manufacturers frequently are ultraconservative in these matters, we think in this instance restraint is well justified.

Huge valves are widely presumed to be the *sine qua non* of high-output engines, and it certainly is true that increased valve sizes have played an important role in perking up some otherwise somnolent motorcycles. But there are limits beyond which added size merely takes up combustion chamber space and restricts what may be done with valve timing. It's fairly easy to calculate those limits, using guidelines set by England's Harry Mundy almost 20 years ago. And if anything, based on calculation, the Yamaha SR500 already has larger valves—especially on its exhaust side—than it needs at any crank speed it is presently capable of turning.

These preliminary calculations helped to narrow and define our Yamaha single project. Unless we wanted to pay Mr. Fred Carillo to custom-carve a connecting rod for the SR500 and in diverse other ways to strengthen the Yamaha's crank train with expensive components, there was no way to shift the engine's power peak much above 7000 rpm. With the power target area thus firmly fixed around 6500–7000 rpm, we could forget about oversize valves. What remained mostly was an investigation of the Yamaha's preferences in terms of valve timing and plumbing. A glance at an expansion ratio/air cycle efficiency table showed that a power improvement in the order of 5.5 per cent could be expected if we raised the engine's compression ratio from 9:1 to 11:1, all other things being equal. However, there is an intensely practical barrier to compression ratio increases in the Yamaha single: the limited strength of riders' kick-starting legs.

As an initial step, we did some dynamometer work to discover how well the SR500 likes its own ex-engine plumbing. The answer is that it doesn't, which shouldn't surprise anyone familiar with the sort of baffling required to meet today's statutory noise limits. With the stock muffler and antihonk intake box in place, a set of baseline power readings was taken, and the numbers came up fractionally higher than those we gave with our test report on the SR500—reflecting slightly higher mileage on the odometer. An attempt to check the power down at 2500 rpm was halted when the chain linking the SR500 to Webco's dynamometer responded to full throttle by trying to tie itself in knots, but things were sufficiently steady at 3000 rpm and above to give us numbers from there to 7500 rpm. Max-

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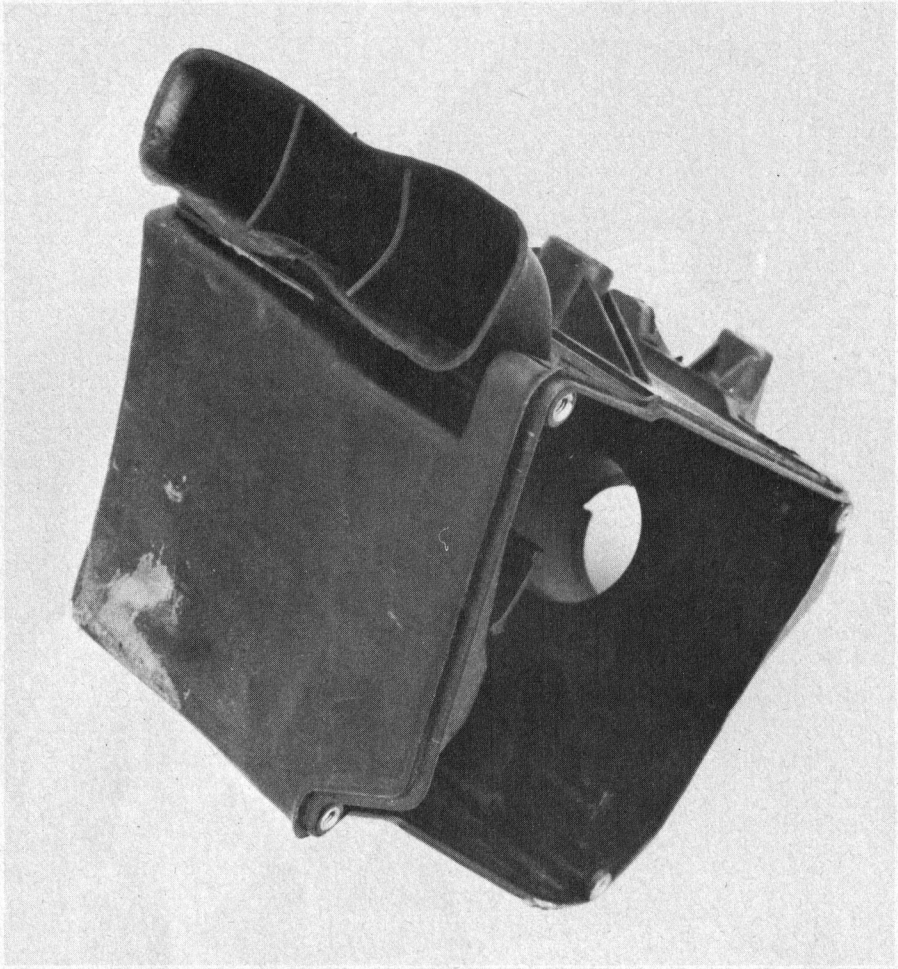

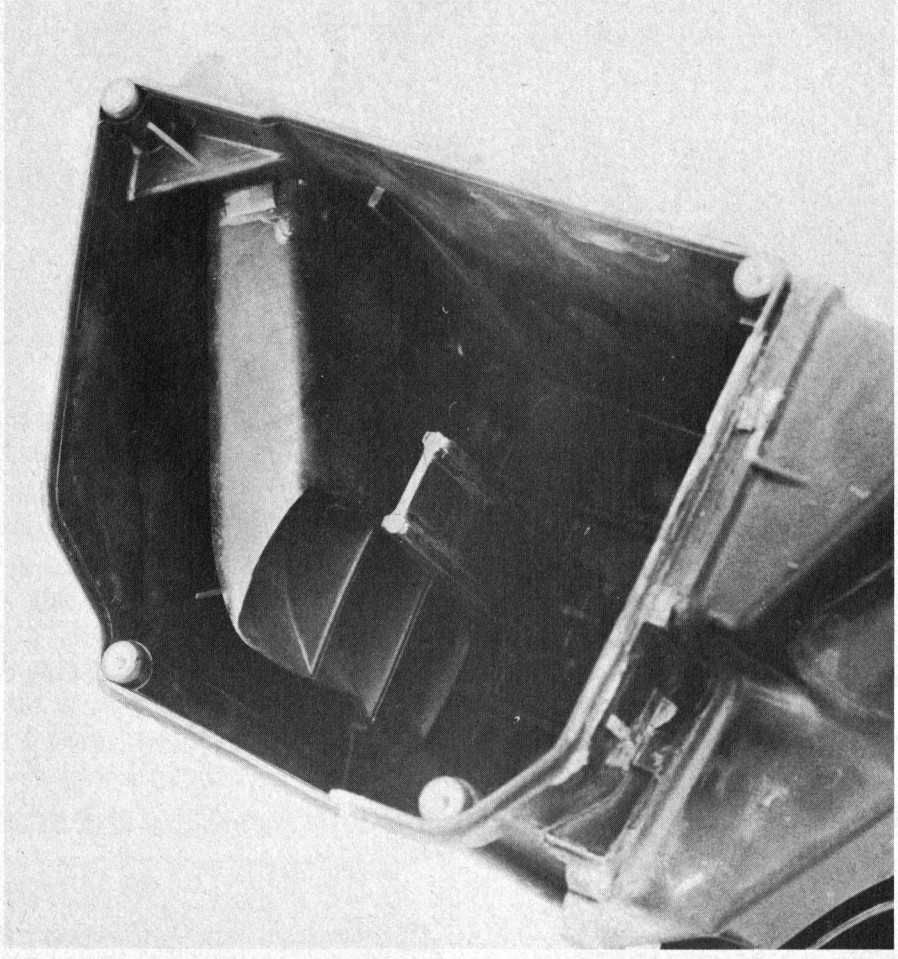

imum torque was at 5000 rpm, where it reached 26.2 lbs/ft, and there was an unruffled 29.08 bhp at 6500 rpm. People accustomed to thinking in Superbike terms may not consider 29 horsepower a stunning performance; we would remind everyone that it represents very nearly the one-horsepower-per-cubic-inch output only racing engines achieved not so long ago.

Step two involved the removal of the stock air box, which isn't as easy as you might suppose. It appears that the final assembly of the air box is done inside the rear frame section, and prying it out is a fight even after you've removed the rear wheel and fender. Still, if it's power you're after, and you can afford to be cavalier about the *basso* roar that's heard when the carburetor mouth is exposed, the air-box work will be rewarded. With no other changes made, the SR500's maximum horsepower surged upward to 31.59 bhp at the same 6500 rpm. Maximum torque was improved only slightly and actually fell at 4500 rpm and below, losing two lbs/ft down at 3000 rpm. The horsepower gain came because there was a matching improvement in torque at 5000 rpm and above, with a steady edge of two lbs/ft at all speeds from 6000 to 7500 rpm.

Now we regret not having taken time to try some flow-improvement work inside the stock SR500 air box, which was simply cast aside (nearly impossible to reinstall) in our haste to proceed to what seemed more interesting experiments. Webco's dyno room is essentially dust-free, and it has thick, noise-blocking walls; the outside world is gritty and populated with people who do not enjoy having their eardrums rattled. With a bit of modifying, the air box probably could be made to feed the engine more efficiently while retaining its ability to keep dust from coming in and noise from going out. It's a large-volume air box with a flexible entry duct of adequate size. Our guess is that the flow restriction derives from the smallish filter element which separates the carburetor mouth from the box's interior, and also from the square-edged carburetor/air box connection. The addition of an intake bell to smooth air flow into the carburetor would help, and a low-restriction foam filter could be installed at the mouth of the entry duct under the seat. Adding the intake bell would be easy; the external filter would require some ingenuity. In combination, they should be worth most of the 2.5-bhp gain we obtained through the crude expedient of elimination.

Step three, removal of the Yamaha's exhaust muffler, was approached with mixed feelings: we wanted to know how much power, if any, was being lost to the engine's outlet restriction; we do not, however, wish to encourage anti-social behavior. In the end, curiosity was too

(Continued on page 98)

SR500E HOP-UP .. *Continued from page 96*

strong. We unbolted the SR500's muffler, corked up our ears, and made another complete dynamometer run. We found that the bucking instability that prevented us from taking readings down at 2500 rpm had edged upward to infect the engine at 3000 rpm, but we'd gained about 1.25 bhp at 3500 rpm, above baseline, and recovered the low-end loss suffered when the air box was removed. The earlier modification had also shifted the torque peak 500 rpm higher, but pulling off the muffler restored it to the 5000 rpm point. Maximum torque, unmuffled, rose to 29.73 lbs/ft, and it stayed above the *highest* baseline number, 26.2, all the way from 4000 through 6500 rpm. This broad distribution of torque lifted the entire power curve and moved the peak output to 6500 rpm, where we had 33.66 bhp—a figure now almost 4.6 bhp or 16 per cent above stock.

Though the power improvement obtained by removing the Yamaha's muffler was impressive, it was somewhat overshadowed by the sheer, plaster-cracking racket from the open exhaust. So to preserve our hearing and sanity, the muffler was stuffed back in place for the series of carburetor tests scheduled to follow. We had ordered 36mm and 38mm Mikunis from Jerry Branch, and a pair of Edmonston International carburetors, which are Lectron-like but with a slide and needle arrangement more nearly in the conventional pattern. We'd asked C. R. Axtell to provide a 36mm Dell'Orto, and he eventually did, but reluctantly.

You don't just stuff non-standard carburetors on the Yamaha single without encountering installation problems. The stock 34mm Mikuni's throttle cables come back low, under the top frame member, and connect with a small pulley on the upper carburetor body, which has a shaft, lever and link connection with the throttle slide. Our alternative carburetors had the classic straight-down throttle cable connection, and to keep from bending the cable into a sharp 90-degree kink to clear the frame, you must move the whole carburetor aft about a half-inch. This could be done by installing a spacer between the stock neoprene mounting stub and the cylinder head, but Branch's 36mm Mikuni kit includes a manifold that's longer, and it was what we used. With the carburetors moved back, there was room to lead the throttle cable up above the top frame tube and forward under the tank.

Many engines show a marked sensitivity to intake tract length, so to avoid confusion between cause and effect we made one series of tests with the stock 34mm carburetor spaced off on Branch's manifold. Maximum horsepower, with the added length, was improved slightly at all points up to 6500 as compared with the stock intake/muffler/no-air-box setup, with an 0.15-bhp gain at the peak. How-

(Continued on page 100)

SR500E HOP-UP .... *Continued from page 98*

ever, the output at 7000 and 7500 rpm was depressed by 0.46 and 0.92 bhp, respectively. The greatest difference was found down at 4500 rpm where the longer manifold gave just over one horsepower extra. We made no jet changes during this test phase or when we pulled the muffler. It is possible that rejetting would have given us somewhat higher readings in both instances; we doubt the difference would have been great.

Bill Edmonston's El carburetors, like the Lectrons with which he was previously associated, are about two millimeters undersize with respect to their stated throat diameter. That is, the 36mm El actually measures 34mm at its flat throttle slide and tapers out to 36mm where it joins the manifold. He provided us with very accurate instructions about which metering needle (a rod, with a long ramp ground in its side) to use and its positioning in the slide. Edmonston said we should use his #7 needle but provided others in adjacent sizes; we tried #6 and #8 needles and the #7 was indeed correct. The testing also showed us that the El carburetor gives the SR500 quick, clean starting and steady running and excellent throttle response . . . but no improvement in power. After we'd substituted the El carburetor for the stock Mikuni, the Yamaha's peak output sagged back just a fraction, from 31.74 to 31.44 bhp at 6500 rpm. Unfortunately there were more appreciable weaknesses at other operating speeds: more than two horsepower at 3500 rpm, 1.3 at 4000, 0.67 at 4500 and so forth up to the power peak. The deficiency was 0.33 bhp at 7000 rpm and 1.27 at our 7500 rpm redline.

Perhaps the larger 38mm (36mm throat) El carburetor would have been better. Bill Edmonston said it wouldn't, and as he'd been exactly right about the needle selection—and as the clock was adding more and more minutes to our bill for expensive dyno time—we decided to take his word in the matter. In any case, we were not encouraged by the results given by the 36/34mm carburetor. The El mixer may give excellent results in the field, where the good response to throttle we noted could be used to effect. But there isn't anything wrong with the stock carburetor's throttle response, and that would seem to relegate the El to the category of an expensive oddity. We can say of the El carburetor, with some certainty, that it does not deliver a suitable full-throttle mixture over the whole engine speed range. That's not really surprising, considering its lack of the compensating air bleed system other carburetor manufacturers are at such pains to provide.

Dyno runs made with Branch's 36mm Mikuni carburetor and the muffler still in place reinforced the notion that the larger El would not have been better. Indeed, the larger passage in the Mikuni served only

(Continued on page 103)

Champion resistor plug types.

BMW			
1000	R100/7, R100S (gap .027")	RN-6Y	RN-3G
1000	R100RS (gap .027")	RN-6Y	RN-3G
900	R90/6, R90S	RN-6Y	RN-3G
800	R80/7	RN-9Y	RN-4G
750	R75/5, /6, /7 (gap .027")	RN-7Y	RN-4G
600	R60/5, /6, /7 (gap .027")	RN-7Y	RN-4G
600	R60 &R69 Series: ½" Reach	RL-78	——
600	R60 & R69 Series: ¾" Reach	RN-3	RN-3G
500	R 50/5	RN-7Y	RN-4G
500	R50 & R51 Series: ½" Reach	RL-82	——
500	R50 & R51 Series: ¾" Reach	RN-3	RN-3G
DUCATI			
900	1978 900GT (gap .032")	RL-86	——
900	1978 900SS (gap .032")	RL-86	——
900	1977 900SS (gap .032")	RL-82	——
860	1977 860GTS (gap .032")	RL-86	——
860	860	RL-86	——
750	750	RL-82	——
500	1977-78 500GTL (gap .020")	RL-82	——
500	1977-78 500SS (gap .020")	RL-82	——
HARLEY-DAVIDSON			
1200	1975-78 FLH, FX, FXE (.025")	RN-12Y	——
1200	Thru 1974 Electra Glide (.025")	RJ-12Y	——
1200	Thru 1974 Duo-Glide (.025")	RJ-12Y	——
1200	Thru 1974 Super-Glide (.025")	RJ-12Y	——
1200	Thru 1974 FL, FLH, FX, FXE (.025")	RJ-12Y	——
1000	1977-78 XL, XLCR (gap .030")	RH-8	——
1000	Sportster XL, XLH, XLCH, (.025")	RH-8	——
HONDA			
1070	CBX Super Sport	RA-8Y	——
1000	GL1000	RA-8Y	——
750	CB750, CB750F, CB750AT	RA-8Y	——
750	CB750A, CB750K	RA-8Y	——
550	CB550, CB550F, CB550K	RA-8Y	——
500	CB500 Super Sport, CX500	RA-8Y	——
500	CB500T	RN-3	RN-3G
KAWASAKI			
1000	1977-78 KZ1000Z1-R KZ1000LTD	RN-4	RN-4G
900	1976 KZ900A4, KZ900B-LTD	RN-4	RN-4G
900	1973-75 Z1, Z1A, Z1B	RN-4	RN-4G
750	1977-78 KZ750B2, KZ750B3	RN-4	RN-4G
750	1976 KZ750B1	RN-2	RN-2G
750	1972-75 H2, H2A, H2B, H2C	RL-82	——
650	1976-78 KZ650	RN-4	——
650	1967-69 W2, W2TT	RN-4	RN-4G
650	1966-67 W1, W1SS	RN-4	RN-4G
500	1976 KH500A8	RL-78	——
LAVERDA			
1200	1200	RN-3	RN-3G
1000	1000 Jarama	RN-3	RN-3G
750	750 GTL, SF	RN-2	RN-2G
MOTO-GUZZI			
1000	1978 1000L.A.P.D. (gap .024")	RN-9Y	RN-4G
1000	1977 1000A (gap .023")	RN-9Y	——
1000	V1000 Convert	RN-9Y	RN-4G
850	1978 850T/3F/B (gap .024")	RN-4	RN-4G
850	1978 850 LeMans (gap .024")	RN-4	RN-4G
850	1977 850T/3 (gap .023")	RN-3	RN-3G
850	1977 850LM (gap .023")	RN-9Y	——
850	Eldorado V-850, 850T	RN-3	RN-3G
850	LeMans	RN-9Y	RN-4G
750	Ambassador V-750 ½" Reach	RL-82	——
750	Ambassador V-750 ¾" Reach	RN-4	RN-4G
750	750 Sport	RN-9Y	RN-4G
700	V-700	RN-3	RN-3G
SUZUKI			
1000	1978 GS1000, GS1000E	RN-3	RN-3G
750	1978 GS750E	RN-4	RN-4G
750	1977-78 GS750B, GS750C	RN-4	RN-4G
750	1975-77 GS750, GT-750B	RN-3	RN-3G
750	Thru 1974 GT-750	RN-4	RN-4G
550	1978 GS550, GS550E	RN-3	RN-3G
550	GS550B, GS550C	RN-3	RN-3G
550	1975-77 GT-550, GT-550B	RN-3	RN-3G
550	Thru 1974 GT-550	RN-4	RN-4G
500	T-500, MkII, MkIII	RL-82	——
500	GT-500, GT500B	RL-82	——
TRIUMPH			
750	Trident (T150V), (T160), Hurr. (TRX75)	RN-3	RN-3G
750	Bonneville (T140V), Tiger (TR7RV)	RN-3	RN-3G
650	Bonneville 650 (T120),	RN-3	RN-3G
650	Tiger (TR6R), Trophy (TR6C)	RN-3	RN-3G
500	Daytona 500 (T100R), Trophy 500	RN-3	RN-3G
500	Trophy Trail (TR5T), TR5MX	RN-3	RN-3G
YAMAHA			
750	TX750, TX750A	RN-4	RN-4G
750	XS750D, XS7502D	RN-7Y	——
750	1978 XS750E, XS750SE	RN-7Y	——
650	TX650, TX650A, XS1, XS1B, XS2	RN-4	RN-4G
650	1978 XS650E, XS650SE	RN-7Y	——
650	1976-77 XS650C, XS650D	RN-7Y	——
650	1975 XS650B	RN-3	RN-3G
500	1978 SR500	RN-7Y	——
500	TX500, TX500A	RA-8Y	——
500	XS500B, XS500C	RA-8Y	——
500	XS500D, XS500E	RA-8Y	——
500	SC500, SC500A	RN-3	RN-3G
500	DT500E, IT500E	RN-7Y	——
500	TT500C, TT500D, TT500E	RN-7Y	——
500	XT500, XT500C, XT500D, XT500E	RN-7Y	——

SR500E HOP-UP *Continued from page 100*

to depress the output below that obtained with the stock 34mm carburetor. The 36mm Mikuni gave results substantially identical to those from the EI within the 4500–6500 rpm range but did not show the EI's low-end/high-end droop. The big Mikuni did boost the output above 6500 rpm; it was inferior to the stock carburetor at other speeds.

The next step was (wincing) to remove the Yamaha's muffler again. It seemed likely that allowing the engine to exhale freely might give it a chance to make better use of an increased intake flow capacity, and that assumption proved to be partly right. Fitted with the Branch manifold, 36mm Mikuni carburetor and banging through an open exhaust, the Yamaha gave us the highest output and best powerband we'd seen. Maximum horsepower was up only 0.04 bhp from what it had been in unmuffled, stock carburetor trim, but the peak was back at 6500 rpm, and the engine was significantly stronger above and below that peak. The banging and lurching was too severe down at 3500 rpm to take a reading, but the engine steadied at 4000 rpm, surpassed the "unplugged stock" mark at 4500 rpm and held its edge up to 7000 rpm, where it surprised us by sagging a bit, then declining to 30.88 bhp at 7500 rpm.

Yamaha's exhaust system for the 500 single uses about 27 inches of double-wall pipe to connect engine and muffler. The internal diameter of that pipe is, allowing for scale and fuel deposits, 41mm or 1⅝ inches. We did elect to work our experiments around this outlet length/diameter configuration in part because the pipe was there, and also because we have repeatedly encountered instances in which stock pipe dimensions have been best. Those big-company engineers aren't stupid. But we still wanted to see the general effect of alterations in exhaust system configuration and to that purpose ran the engine with both a megaphone and a straight-walled extension appended to the stock exhaust pipe. Having heard from several sources that a 33-inch exhaust pipe length was the hot setup for Yamaha singles, we made our extension to suit. And we got a very thin gain in the range from 4500 to 6000 rpm, with a 0.4-bhp loss at 6500 and no power worth mentioning beyond 7000 rpm. Indications were that the stock length is correct, at least for the engine as tested and at the stock pipe diameter. Most of the speed-shop pipes do have a larger internal diameter, and that probably accounts for the 33-inch-length recommendations we heard. Finally, a 38-inch exhaust length was tried, and the added reach did such awful things to the power that we didn't bother to take a complete output curve.

In the matter of a megaphone we were guided by availability, and what we found handy in a back room at Webco was an old reverse-cone fitting just like the short outlet funnels seen in photos of racing Gold Stars and Matchless G50s. You may think that grabbing the first thing that came to hand was contemptibly unscientific; the Yamaha liked it fine, except for developing a serious case of "megaphonitus" at 4000 rpm. Power came in solidly at 4500 and stayed above the bare-pipe line to 5500 rpm, dipped below it a mere two-tenths at 6500 rpm and continued upward to give a 7000-rpm peak a hair under 34 bhp. This brought us to the conclusion of our experimenting with externals, with a gain of almost five horsepower—a 17 per cent improvement. Did we feel pleased with ourselves? Yes, but not because we'd found five horsepower, which we'd merely stumbled upon in the fabled manner of blind hogs finding acorns. The power was there waiting like a genie in a bottle; we only pulled the cork. What we had accomplished was to lay a data foundation for further work and perhaps to keep people from wasting money on more carburetor than the stock Yamaha 500 single can use. The grapevine had told us a pipe and carburetor change would make these Yamahas run pretty strongly; the evidence says it's simple uncorking that does the trick. The people who go for bigger-than-stock carburetors probably are removing the Yamaha's air box to get them fitted, and it's that rather than 36mm throat sizes we'd credit for any perceptible improvement. Our results show less than a half-horse difference between the carburetors tested, including the stock 34mm Mikuni; removing the air box was good for 2.5 horsepower.

All manner of camshafts are being ground for the Yamaha single, and in the early conversation that led us into this venture we had talked about trying several. It seemed a terrific idea at the time, but it became less attractive when someone mentioned an intimidating practical difficulty: before changing the Yamaha's camshaft, you first must remove the engine from the frame. And some cams provide so much lift on intake/exhaust overlap that the valve clearance pockets in the piston crown have to be cut deeper. The matter was eventually decided in favor of letting events take over and simply doing what could be done and what seemed right, when we finally arrived at the cam-changing stage.

There was another practical difficulty we heard about and tried very hard to avoid. Apparently certain of the trick-cam suppliers have not yet hit upon a material compatible with Yamaha's chromed-face cam followers—which are themselves not always up to the loads imposed by the stock cam profile. We also heard that some cams try to bank the Yamaha's valves open at such high acceleration rates that they shatter the rest of the valve gear. Given the inordinate amount of time these drastic mishaps would require for

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correction—about four hours merely to remove and replace the engine's cylinder head—there was reason to be cautious. The one supplier who received a solid safety endorsement from our informants was Megacycle Engineering in San Rafael, California.

A phone call to Jim Dour at Megacycle got us two sample cams and Jim's best guess about which would come nearer being what we wanted, as well as some miscellany concerning valve springs. Dour recommended S&W springs and a couple of others; we went for the S&Ws. Then came a long, sweaty struggle while we extracted the SR500's engine from the close embrace of its frame and made the cam swap. The stock valve springs were checked for tension at their installed length and found to give a 60-pound seating pressure; a similar check of the S&W springs made us do a hasty recheck. The S&Ws seat the valves with a 115-pound pull. Thinking about those fierce S&W springs and the .476-inch lift provided by the #5120 camshaft Jim Dour had recommended (he also sent us his shorter-duration .480-inch lift #5140 cam), and noting that the Yamaha's follower faces were already looking a bit scuffed, we sent out for a case of Torco 50-weight racing oil.

More time was consumed by the process of checking valve/piston clearances and shimming under the valve springs to get their installed lengths to specification. What we found was the peakiest horsepower this side of a Yamaha two-stroke road racing engine. We'd stayed with the 36mm Mikuni and megaphone and just changed cams, but we might as well have changed engines. Maximum power had jumped up to 37.72 bhp at 7500 rpm, a 3.78-bhp improvement, and we might have seen close to 40 bhp if we'd been willing to forget prudence and let the engine spin higher. The power was still rising sharply at 7500 rpm, and it seems certain there was more power at 8000 rpm. The peak may have been at 8500; if so, we'll let others find it.

Frankly, except for delivering peak power, the #5120 cam was a flop, inferior to the stock cam at all speeds below 6500 rpm, and fully five horsepower down at 5000 rpm. Could the broad-range deficiency be compensated with intake and exhaust tuning? We tried that unsuccessfully. We played around with intake length to the extent permitted by room within the frame and shaved power off the peak without ever getting the midrange back to stock-cam strength; we tried extensions on the exhaust pipe with the same unpromising result. We even tried C. R. Axtell's Dell'Orto kit (which made an eleventh-hour appearance), and apart from making the unsurprising discovery that Ax knows how to jet a carburetor got

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exactly nowhere. Axtell's finely crafted intake manifold and the long-bell Dell'Orto carburetor had about the same length and effect as the 36mm Mikuni spaced full-reach on a long piece of hose: it clipped one horsepower off the 7500 rpm peak and added one down at 5000 rpm.

One last immediate question remained: what sort of output would the cammed and carbureted SR500 have if its Jerico-Leveler megaphone was replaced with the stock muffler, which (overlooking intake noise) would make it more or less street-legal? We tried that combination, and it didn't work: peak output, 32.13 bhp at 7500 rpm, was higher than that obtained with the stock cam, carburetor, muffler and no air box, but lower at all other speeds. Down at 5000 rpm, the cam/carb version showed a three horsepower deficiency, and at 4000 rpm the gap amounted to almost 5.5 bhp.

A scan of the numerous horsepower numbers we collected will tell you that the largest single improvement in output, overall, was made by simply removing the Yamaha's air box. That was a surprise: most of us would have predicted that the biggest impediment was the SR500's muffler. Only Jerry Branch, perhaps because of the nature of his business, appreciated that the Yamaha single's intake would be the most sensitive side of its nature. He'd been saying right along that the Yamaha has something akin to a deviated septum in its intake port and doesn't breathe properly. We had hoped otherwise. Yamaha's SR500 has an intake valve two millimeters larger than those in the older XT500 and TT500, and a slightly different cylinder head casting with deeper finning and an improved intake port. The improvement is not, it appears, as great as it looks.

Hindsight tells us we should have opted for the shorter-duration #5140 Megacycle camshaft, which presumably would be better suited to the 7500 rpm limit we set for ourselves. Despite our missteps, the warnings, good advice and all, we're still going to press ahead with our Yamabanger project. Now that we know something about the SR500's behavior with two kinds of valve action, we can go to Branch's flow bench and present it with more informed questions. Further, and more important, we can develop a better feel for the kind of valve action profile we should try when we are again ready to invade Webco's dyno facility. We'll keep working at it as time permits and let you know about any interesting developments. Maybe what we'll create will be too cantankerous, noisy and uncivilized for anything but a race track, but we'll all learn from the experimenting, and if we can get the SR500's output up in the mid-40's bhp range . . . well, even the sensible Yamabanger owners will be happier just for knowing it can be done. ◉