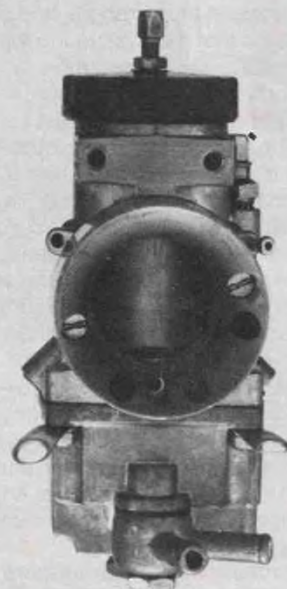
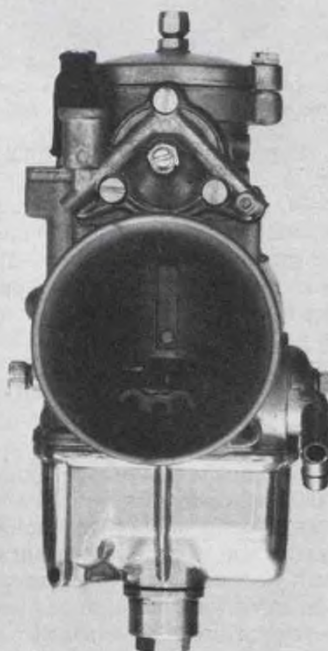
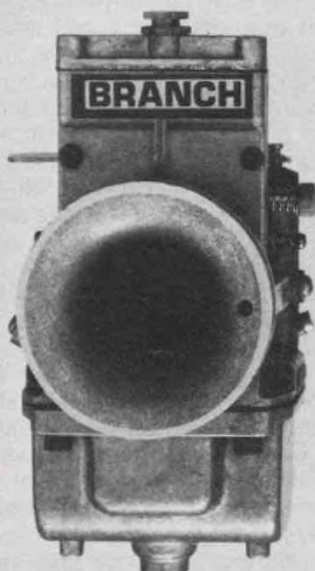
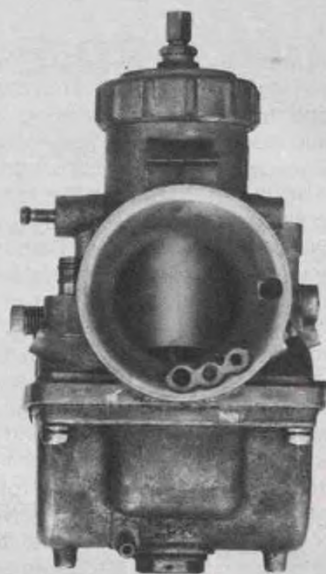
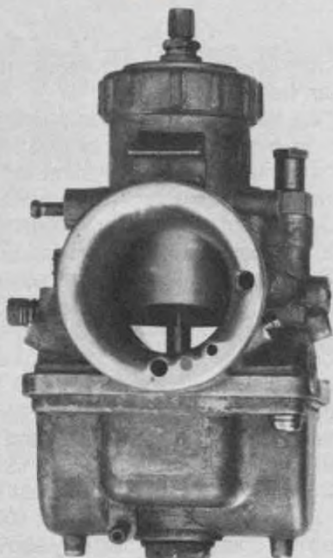


CARB FLOW



**A matter
of small and
unpredictable
differences.**

By Gordon Jennings

PHOTOGRAPHY: PAUL R. HALESWORTH

● ONLY YESTERDAY Mikuni carburetors were being touted as the miracle workers of motorcycling, capable of correcting everything from hard starting to brake fade. Now, the *avant guard* tinker-types are trying to persuade us that Mikunis have become old hat, and that some other make truly is The Only Way To Go. Well, friends, we didn't believe the tall tales of yesteryear and we don't believe those being spread around right now. What we *do* believe is that a Mikuni carburetor, correctly sized and jetted, gives excellent results—and that precisely the same is true of the Mikuni's resurgent rivals. With a single exception, all slide-throttle motorcycle carburetors employ the same system of fuel delivery controls and there is no reason to suppose one is more than marginally better than any of the others in producing an air/fuel mixture. These slide-throttle carburetors are rather crude instruments, as compared with the better

examples used in the automotive field, but all can be made to work with greater precision than is required to coax maximum power from an engine.

When pressed to the wall, most of the adherents of the "this one's better than anything else" philosophy will abandon the claim that their favorite carburetor delivers a more finely-tailored mixture and fall back to a second line of defense—a supposed superiority in its ability to flow air. "Oh, yes," they insist, "my dynamic, cast-kryptonite fuel-fogger moves more air at half-throttle than a dozen of the others with their slides yanked clean out." We never quite believed that story, either, but it was hard to argue against. Air in motion is strange and wonderful stuff, and there is enough difference in various carburetors' throat and inlet-bell configurations to allow for differences in air flow capacities, and in performance.

Fortunately, there was at hand the

means to resolve all but the die-hard fringe of air-flow arguments. Our long-time friend Jerry Branch has a flow-testing facility, and said we could use it to satisfy our curiosity about this aspect of motorcycle carburetors. Jerry's flow bench uses a big variable-speed, centrifugal blower to pull air through the carburetor, manifold or port being tested. There is instrumentation to let you very precisely adjust the vacuum working to move air through whatever conduit you're testing, and also to show with equal precision the volume of air, in cubic feet per minute, actually being moved. Individual flow-rate numbers have to be adjusted to reflect "standard atmosphere," as the viscosity of air varies with its density, and this is done using a correction factor derived from temperature and barometric readings taken when each test is performed. In this fashion you are able to develop valid comparisons for hardware (like our car-

CARB FLOW

buretors) even though the testing may have been spread over a number of days, and done under widely differing atmospheric conditions. The flow bench can't tell you anything about carburetors' ability to mix fuel and air, nor will it reveal anything like a sensitivity to vibration; its business is air flow, and if it say Carburetor A flows more air at a given pressure drop than Carburetor B, then that is at least one unarguable truth.

You may feel free to argue with our choice of test-carburetor size, which is one not commonly found as a subject of experimentation out in the real world of motorcycling. We have elected to test carburetors having a 34 millimeter throttle bore; most of the swapping involves 125cc or over-300cc off-road bikes, and the sizes mostly fall in the 30-32mm and 36-38mm ranges. Our choice of 34mm fits right between those ranges and could be justified on that basis, assuming that the middle ground is representative of carburetors only four millimeters larger and smaller. There is much to be said for that justification, but the truth (which now emerges) is that Yours Truly has a new Harley-Davidson RR250 road racing motorcycle, which uses 34mm carburetors and can use a little more speed. The RR250 seems to be, fresh from the crate, a bit faster than a Yamaha TZ250 that's also in standard condition, but there are some non-standard TZ250s around that are faster than speeding bullets—and stock RR250s. Speed being in large measure a function of horsepower, a search for more of the latter is underway, and the entry for fuel and air into the engine seemed like a good place to make a beginning.

So we made 34mm carburetors our choice, but choosing isn't always getting—and curiosity will lead you places you never planned to go. Our intention



You'd think this "streamlined" intake horn would improve a carburetor's flow capacity; it didn't.

was to flow-test a Mikuni, an Amal, a Dell 'Orto, a Lectron and a Bing—all of the same size, and all in their latest configuration. What we did was test all of these but the Bing, which (though promised) never arrived, then become so caught up in the things we were learning that we began to grab every carburetor within reach and finished the project by testing a few intake-horn configurations. Some of the differences found in the various test modes were so slight as to be insignificant; those have been excluded from the data tabulation presented here. Others were great enough to capture our attention, and when put together form a pattern we found highly interesting.

You can discount any stories you hear about one of the widely-available carburetors having better air flow characteristics than the rest. Not even the first-place Lectron, with its elaborately-belled air entry, was much better than the last-place Amal—the difference being 1.9 percent. The second-place Dell 'Orto was only 0.43 percent behind the Lectron and 0.99 percent ahead of the third-place Mikuni. These differences are much smaller than those arising from jetting that's almost right and a mixture that's right on target, which suggests that the range of jets, needles, etc., supplied for a particular

carburetor probably is more important than its rated flow.

We had considered the possibility that carburetors' flow characteristics might change fairly abruptly at some air velocity level. The intrusion of needles, spray nozzles and the like into carburetors' throttle bores should generate considerable turbulence, which might well result in the air flow increasing with applied vacuum up to a point—then stalling. And the possibility still exists . . . but stall does not occur below air speeds of 400 feet per second (272 miles per hour). We know that because we did our testing at vacuums corresponding to 5, 10, 15, 20 and 25 inches of water. The highest vacuum produced air speeds of about 400 ft-sec. and this speed is comfortably above those likely to be experienced by carburetors actually fitted on real-world engines. The flow numbers we obtained were plotted on a chart, and in every case these gave us an almost straightline relationship between applied-vacuum and flow. From this, one must conclude that if Carburetor A provides an engine with stronger full-throttle midrange performance than Carburetor B, and both have the same throttle-bore diameter, then the difference must be in mixture delivery, as their relative air flow capacities (already shown to be very close) remain the same over the entire engine speed range.

There is, we discovered, one aspect of otherwise very similar carburetors that does make a large difference: the position of the throttle slide in the "wide-open" position. As you may have noticed, carburetors' slides do not necessarily open fully just because you have cranked the throttle twist-grip back until there's no further rotation. Sometimes, due to adjustment problems or because the slide return-spring has reached coil-bind, the

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CARBURETOR FLOW CAPACITY

	5 in. H ₂ O	10 in. H ₂ O	15 in. H ₂ O	20 in. H ₂ O	25 in. H ₂ O	AVERAGE	COEFFICIENT
AMAL 34mm, STD.	92.3	133.9	165.2	190.8	213.6	159.2	113.10
MIKUNI 34mm, STD.	93.6	134.7	165.8	192.3	215.5	160.3	113.92
DELLORTO 34mm, STD.	93.1	136.0	168.1	193.9	217.5	161.6	114.82
LECTRON 34mm, STD.	94.6	136.7	168.3	194.8	217.1	162.3	115.32
MIKUNI 34mm, MOD.	96.1	137.2	169.8	196.1	219.9	163.8	116.41
KEIHIN 31mm, CR	87.2	125.7	154.4	177.9	198.0	148.6	127.02
MIKUNI 28/30mm, MOD.	74.0	107.3	132.0	152.1	170.4	127.2	116.05
AS ABOVE, W/HORN	75.7	109.6	134.8	155.5	173.9	129.9	118.56
MIKUNI 26mm, STD.	55.7	79.8	98.1	113.0	126.8	94.7	115.04
AS ABOVE, W/HORN	57.4	82.1	101.0	116.5	130.8	97.5	118.53
MCCULLOCH 36mm, MOD.	104.8	154.1	191.1	223.1	249.2	184.5	116.92

C = cu. ft.—min./sq. in.

CARB FLOWContinued from page 64

slide's lower edge will encroach slightly into the carburetor throat. We checked this condition on the flow bench, testing with the slide completely clear of the throat and then repeating the test with its edge extending only .050-inch into the airstream. That tiny slice of slide hanging down into the throttle bore caused a greater drop in flow, by far, than existed between the best and worse carburetors we tested. So you can sometimes get a bigger improvement in performance simply by correcting for a not-quite-open throttle than by swapping carburetors.

Appreciable differences were obtained with changes in air-entry configuration. Our stock Mikuni trailed behind the flatslide Lectron by 1.23 percent; we reworked the Mikuni's intake horn slightly, and it jumped to a spot almost one percent better than the Lectron. Other efforts at smoothing entry flow yielded improvements of up to three percent, but gains of that magnitude are possible only when a rather bad entry situation exists. And some of the intake fittings we tried were failures: a very neat-looking accessory trumpet made for Mikunis gave the kind of improvement that only made the instrumentation twitch like it *might* read higher; a trick-looking horn for the Amal, sold as a "performance" replacement for that carburetor's bolt-on intake funnel, produced an equally small downward twitch.

When we had more or less exhausted the possibilities with our selection of 34mm carburetors, and decided against trying to test with air cleaners fitted, (a variable that promised to confuse what we were doing, and one deserving its own test program) we turned to other sizes and kinds of carburetors. That led us away from direct comparisons, but did not entirely deprive us of a valid basis for comparing carburetors of unequal size: dividing flow by throttle bore cross-sectional area provided a "flow coefficient," which would tell us something about the relationship between throat shape and air flow irrespective of size. Further, the fact that flow had already shown itself to be tightly related to applied vacuum made it possible for us to take an average for all the test modes, from five to 25 inches of water, divide by throat area, and have a flow coefficient for each carburetor.

Reducing all the flow numbers to coefficients produced some very interesting patterns and conclusions. The range of sizes for stock carburetors tested was from 26mm to 34mm, a fairly large variation, yet the range of flow coefficients for all these carburetors spread very little—from a low 113.10 cubic feet-minute per square inch to a high of 115.32, averaging 114.44. These would be numbers interesting only to the obsessively fact-oriented mind, except that we did find one carburetor with a flow coefficient that made all the others look asthmatic, another that calls

to question our preconceptions about butterfly-throttle carburetors, and evidence that the one-size-fits-all approach to carburetor manufacturing can produce some big flow differences.

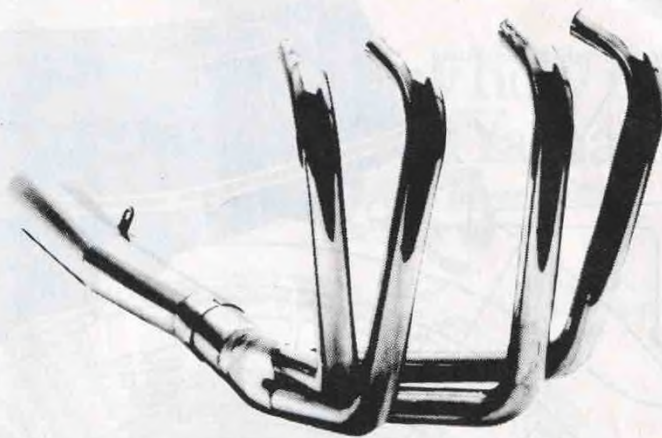
The big non-stock winner was a 31mm Keihin, type CR, which is a racing carburetor made by a Honda subsidiary. Most people have never even seen one of these beauties—known by the racing in-group as "slick-bore" carburetors. The Keihin CR differs from the typical "T-fitting" motorcycle carburetor in having a throat that is interrupted only by narrow slots through which the slide can move, and by the metering needle and spray

nozzle. Conventional slide-type carburetors have a far busier throat—one that includes a T-junction with sides wider than the nominal throat diameter where the slide cylinder joins the throttle bore, and is made taller, at wide open throttle, by the slide's recessed base. All this unstreamlined wideness and tallness produces drag and limits a carburetor's ability to flow air; the Keihin CR's throat is neatly faired, except for the clearance slots for the slide, and its flow coefficient is an amazing 127.02, a solid ten percent better than the highly-touted Lectron.

Another surprise was provided by an

(Continued on page 139)

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old McCulloch "pressure-pulse" kart carburetor. This one was a relic left over from the writer's road-racing 350 Bridge-stone—which was dog-slow until fitted with a pair of McCulloch pumpers, and very fast but explosively unreliable thereafter. We're not sure this rather peculiar air/fuel metering device is anything you'd want to try unless you know a lot about it already (it uses rectified crankcase pulses to control fuel flow, and is extremely difficult to get metered properly). Our McCulloch had a 36mm throttle bore and a radius carved into its intake—among its numerous modifications—and it surprised us by flowing air slightly better than the average slide-throttle carburetor. The modified McCulloch had a flow coefficient of 116.92 despite the presence of a butterfly and throttle shaft across its interior. It made us wonder about the wisdom of using slide-throttle carburetors on in-line fours, where the throttle mechanism does get complicated.

The last surprise was in the performance of an ex-KZ900 Mikuni bored out from 28mm to 30mm. This unit's flow coefficient was 116.05 when drawing air without the benefit of an air horn, placing it well ahead of a stock Mikuni ($C = 113.92$) and when its entry was fitted with a small radiused ring its coefficient rose to 118.56. We considered the implications of those numbers, and had another look at the Amal. The latter has an especially large slide, and correspondingly wide reliefs at the sides of its throttle bore, as though provision had been made to allow for boring it all the way to 36mm or even a tad larger. The Amal's flow coefficient was a lowish 113.10, as a 34mm carburetor; we suspect that it would improve two or three points if bored to 36mm, and that there would have been a similar improvement in our 34mm Mikuni if we'd opened it to 36mm (probably the limit, given the thickness of metal in the body).

A final point you must consider in swapping carburetors in the effect a change may have in terms of tuned intake length. We found, for example, that the Amal is effectively about 25mm longer than the Mikuni, and experience has taught us that changes in length as small as 5mm produce an effect easily seen in dynamometer readings. So you can switch from a Mikuni carburetor to one made by Amal, or *vice versa*, notice a big change in engine performance, and be fooled into thinking you did it with the carburetor when the same thing could be done by changing manifold spacers. You can be fairly sure that unless you've switched to one of the slick-bore Keihins, any improvement you can detect with the seat of your pants won't be a function of flow. There just isn't that much difference, in terms of flow, between the others. ●

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