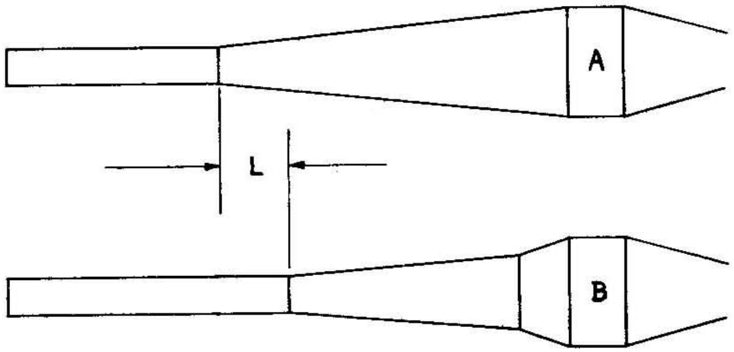


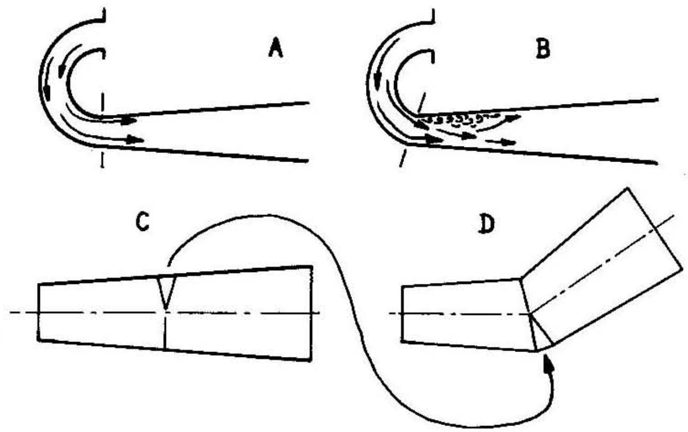
"Staged" diffusers (B) are shorter than those with a single taper (A) and make available extra length (L) to be used in the lead-in pipe to give power range or to increase volume for peak horsepower.

length. A diffuser proportioned 7°/12°, 70%/30%, is somewhat shorter than a diffuser having a straight 8-degree taper when both are constructed to the same 6.25:1 outlet/inlet area rule. This reduction in diffuser length may be added at the lead-in pipe, or at the chamber's parallel-wall section, where the diffuser and baffle cone are joined. In either case, with a longer lead-in pipe or added chamber volume, the overall effect is to increase power output below the power peak – with volume having its most pronounced effect high on the engine speed scale, near the power peak; length added to the lead-in pipe brings about a somewhat more serious drop in maximum power, but also lends a marked increase in low speed torque. These effects, it should be noted, tend to modify the choice of diffuser tapers, as a short, steep-taper diffuser provides room for a longer lead-in pipe or added chamber volume – both of these tending to offset the power range-narrowing influence of such diffusers.

Some departures from the 6.25:1 area ratio rule may also be desirable on occasion: when a lead-in pipe diameter is exaggerated, relative to exhaust port area and cylinder size, in the interest of low-range performance, you may find that following the ratio rule results in an expansion chamber of such monsterous diameter that it simply cannot be fitted on the motorcycle for which it is intended, and in that case an appropriate downward adjustment in diameter is indicated.

Should this consideration of inconvenient bulk lead you to depart from the dimensions required by my formulae, think twice before you succumb to the temptation to flatten the expansion chamber. In the first place, you'll upset all the area progressions through the diffuser; an 8-degree diffuser, flattened ever so slightly, is no longer an 8-degree diffuser. Moreover, even if you calculate the areas so that you have a rounded wedge with the correct inlet/outlet area proportions, wave energy recovery will still suffer. Those waves simply do not like being puffed through anything but a cone; even less do they like a cone that has been dented or notched to clear a frame tube or to provide ground clearance. They can "feel" every change in cross-section in the containing vessel. They are, however, willing to follow even the most abrupt jog in the system: you can resection the diffuser cone and kink it all over the place to make the expansion chamber fit the motorcycle, and the wave will never know the difference. Sonic waves may be able to feel even the most minute changes in section; they will make any turn you can build into the system without slowing or losing any of their energy.

The only part of the system where you must be careful to provide smooth turns is up at the lead-in pipe and at the entry to the diffuser. Through that section, gas velocity is very high, and while the *wave* won't care about sharp jogs, such jogs will have a bad effect on gas flow – which is a different matter entirely (gas flow involves the movement of matter; a wave is just energy, and



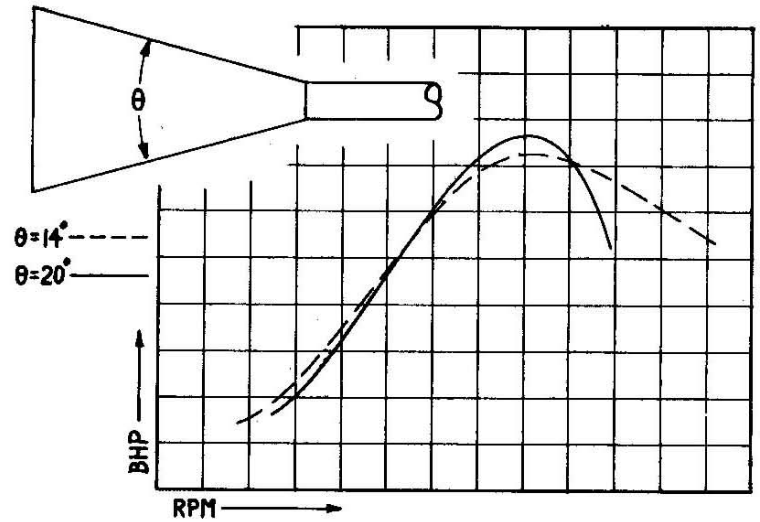
A smooth entry into the diffuser gives good flow (A) but a kink (B) creates turbulence. Sharp bends in the diffuser have little effect on power and may easily be made using the pie-slice method shown.

being without mass, is also without inertia and therefore cares nothing about sharp corners. At least, that is very substantially the case here, where the velocities, etc. involved are low enough to fall within the scope of Newtonian physics; Einstein's unified field work is hardly applicable at wave speeds of such limited magnitude).

If efficiency were the only consideration in current expansion chamber design, it would be possible to depart fairly substantially from the round cross-section back at the chamber's middle portion. Actually flattening the chamber is still not a good idea, but it can be squared off somewhat without greatly compromising its basic power-enhancing properties. Two years ago, I would have recommended precisely that sort of modification in instances where installation was a problem. Now, with the drive against noise well and truly underway, *any* departure from round is to be considered poor design practice. Why? Because those waves I have been talking about are very strong, and will make even a round-section chamber's walls ring like a bell (to be specific, a *cow*-bell) just like the engine is shooting marbles out its exhaust port. These pulses, which are strong enough to set up a ringing even in the relatively stiff walls of a round-section chamber, will make any flat areas in the expansion chamber's walls pant in and out like a drum-head. This vibration is of course transmitted into the surrounding atmosphere as a hellishly loud noise, and no matter how effective a muffler you may add back at the chamber's outlet pipe, the motorcycle's overall noise output will nonetheless be very high. The noise source just described can only be minimized by either making the chamber out of very heavy steel, or by giving it a shape that resists pulsing; the round-section chamber may ring somewhat, but it cannot actually pulse in and out even when made of very light-gauge material. This pulsing of the chamber's walls has another highly undesirable side effect: it makes the permanent attachment of a bracket or heat shield very difficult. Most fasteners will fairly quickly fracture from the severe vibration, leaving the heat-shield to drop away—which is bad, but not as bad as when the same vibration fractures a major mounting bracket and the entire expansion chamber comes adrift. For all these reasons, the round-section expansion chamber, although inconveniently bulky at times, really seems to be the best choice.

BAFFLE CONES

We have already noted that the baffled end of most expansion chambers is conical. This cone lends the chamber rather more pleasing lines than it would have with a flat end, but that is not its reason for being. The reason is that if we end the chamber very abruptly, with a flat plate, the wave reflections away from it will also be very abrupt: strong, but of a duration



Changes in baffle-cone angle primarily influence the shape of the power curve past the point at which maximum power is obtained.

too brief to provide the desired port-plugging effect except within extremely narrow limits in engine speed. A conical baffle, on the other hand, extends the wave reflection time (as reflection occurs down its entire length) and, because its effects are thus felt over a wider engine speed range, the engine's useful power band is broadened. Obviously, here, a long, gently tapered baffle-cone will extend an engine's power range more than a shorter, more sharply tapered cone in the customary trade-off between range and peak power. These tapers should be, in most cases, twice that of the diffuser used in the expansion chamber. Thus, in a chamber having an 8-degree diffuser, the baffle-cone should be tapered 16-degrees. That is the rule in general. However, wide variations are possible and may be employed to cope with a specific situation. The largest taper angle you should use is 20-degrees; the smallest, 14-degrees. And you may, to obtain a particular effect, "mismatch" diffusers and baffle-cones in any combination. The thing to remember is that there is a peculiar side to the power-range broadening effect of the baffle-cone: most of it is on the part of the engine's power curve *past the horsepower peak*. Thus, for an engine that has proven to be rather fragile when pressed beyond its rpm red-line, you may terminate the expansion chamber with a 20-degree baffle-cone, and rest assured that if the system's tuned length is established to place the horsepower peak, say, 500 rpm below the danger mark, the engine will resist very strongly any effort to get it spinning faster.