Air Racing News

WARMING THE 0-200

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R. R. 3
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THE RECENT UPSURGE in racing has brought a lot of new pilots and aircraft into competition and speeds of well over 200 mph are becoming the rule rather than the exception in the Formula-One ranks. It becomes obvious that, since competitors are limited to almost stock engines, it is necessary to eke out every bit of power possible within the framework of the rules.

In the Continental 0-200, as in almost any engine, a vast improvement in power output can be realized by allowing the engine to "breathe" easier. Since rpm's of 4000-plus are to be hoped for, the first step even before port matching is to have the engine properly balanced. Pistons or rods that are mismatched by even a few grams can create havoc through vibration, as well as to rob the engine of vital power that could otherwise be delivered to the propeller. It is not my intention here to go into the procedures involved in balancing except to suggest that it be done by someone who **knows** what he's doing. Figs. 1 and 2 show the areas on the crankshaft throws and rod caps that were ground away on our engine to bring things into balance. Rod No. 1 was untouched to be used as a "master," and all other rods matched (large and small ends as well as overall weight) to it.

The same applied to pistons and wrist pins. Keep wrist pins matched to their own pistons and balance as units. Again, No. 1 acted as a master. Care should be taken here as the rules state that pistons may weigh no less than 700 grams without wrist pins and rings fitted. If you're balancing for smoother running only, and not for racing, then you can ignore this criteria.

In the matching and smoothing of ports you should be warned that you're in for a lot of boring, tedious work, as well as a few skinned knuckles and sore fingers.

Start by taking a spare intake elbow and cutting off the end where it bolts to the cylinder. Cut it about 1/4-in. thick and dress it flat with a file. Take this piece and drop it into place on each of your cylinders. Two things become obvious: Ports vary between cylinders (Fig. 2A); you will also notice how sloppy the elbow fits the mounting studs — it can be aligned in various ways due to this slop.

Having proven to yourself what a precision piece of engineering the factory intake system is, proceed with the next step. Ascertain which cylinder or intake elbow has the largest opening and use this as a "master." Using a piece of 3/16-in. or 1/4-in. steel of an alloy that can be flame-hardened, cut and rough fit a template to the master. Fig. 3 shows the template cut and matched to the cylinder. It should be obvious that it will be necessary to eliminate the slop around the stud holes prior to matching the template to the master port. Our solution is shown in Fig. 4. The template was dropped into position over the studs and secured in position with nuts and washers. The template and cylinder was then drilled to accept 1/16-in. roll pins.

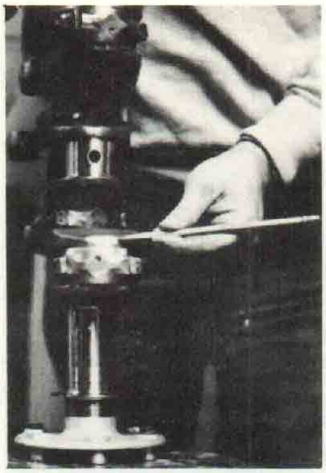

FIG. 1: Pointed out is the ground area on the crankshaft throw to balance the crankshaft.

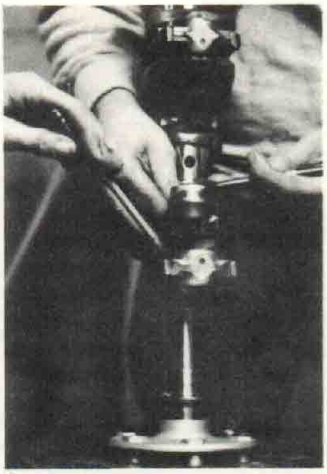

FIG. 2: The crankshaft throw and rod cap are ground, but the No. 1 rod cap (upper) was left unground to act as a master.

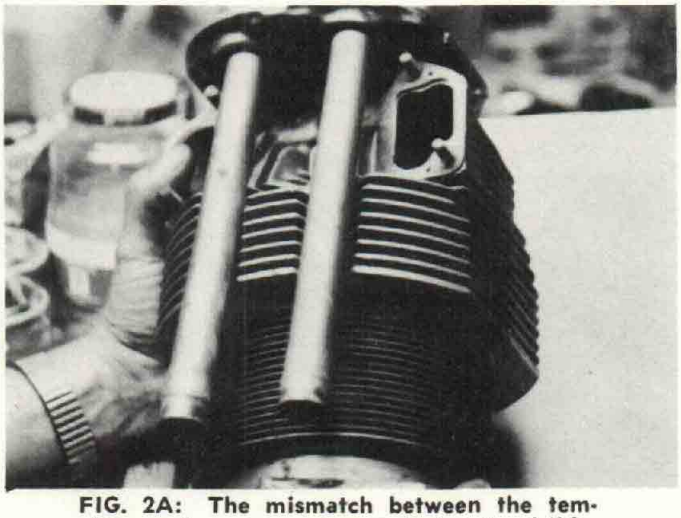

FIG. 2A: The mismatch between the template and a non-master cylinder is visible.

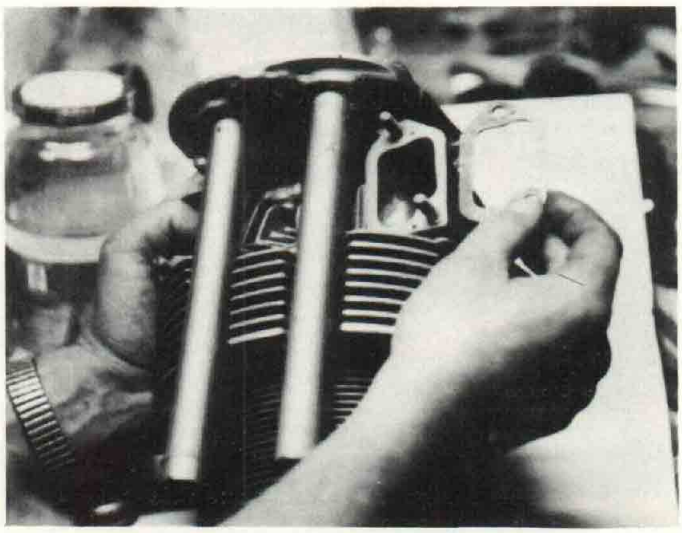

FIG. 3: The template is matched to the cylinder being used as the master.

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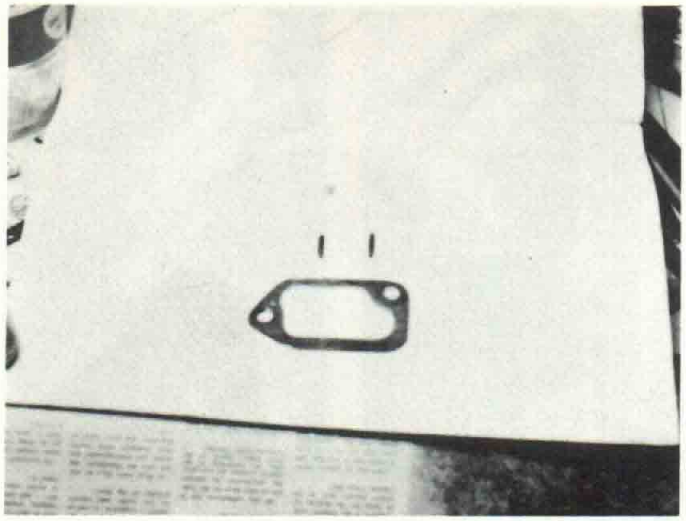

FIG. 4: The template, and the "roll" pins being used as dowels.

FIG. 5: The primer boss was removed from the elbow.

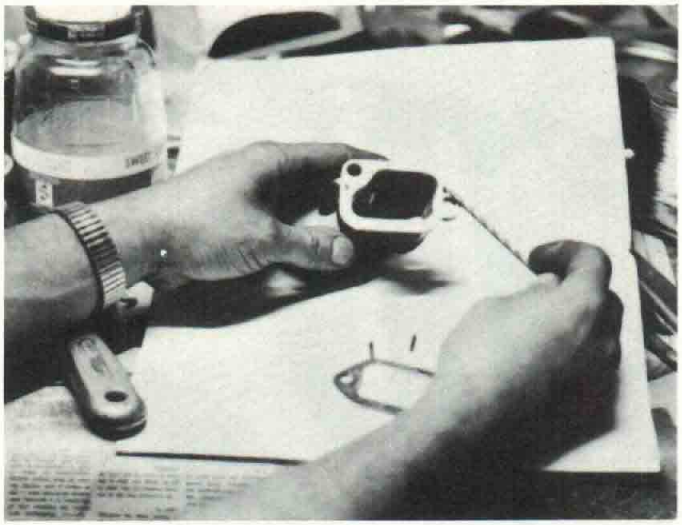

FIG. 6: The location of the dowel pins in the intake elbow is pointed out.

AIR RACING NEWS . . .

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These should be a tap-in fit to preclude slop and their dropping out, and care should be taken to locate them so that where the elbows are installed on the cylinders the roll pins will be clear of the nuts that hold the elbows in place. With roll pins in place and the template held snugly with nuts, open out the template until it matches exactly the master cylinder opening. We found that a high quality rotary file in a hand drill worked quite well, and we finished off with a fine file. The template should now be removed and flame-hardened to prevent wear while in use.

By using this template and locating it by use of the roll pins, all four cylinders can be matched. After the cylinders are matched to the template, lay them aside for a while and attack the elbows.

The first step in the reworking of the elbows is depicted in Fig. 5. This entails the removal of the primer boss and has two advantages: First, it allows a check to be made of the matching of the elbow to the cylinder; second, after reworking the elbow, an inset aluminum plug is welded into the hole, allowing a smoother interior contour and thus cutting down on mixture turbulence in this area.

Again, the template is brought into play and bolted to the elbow. Using the holes previously drilled in the template, the elbows are drilled and the template is pinned into position using the roll pins (Figs. 6 and 7). The elbow is now ground to contour and, voila!, a match fit between the elbows and cylinders. By checking through removed primer-boss area, any small discrepancies can be detected and corrected. Weld plugs into the elbows before proceeding further.

Now the work starts! Bolt the template to each elbow and cylinder in turn, and polish the interiors. If you're building up a racing engine you can only "smooth" the passages to be legal. Some mottled casting marks should be visible, but if you're going all out then the interiors and ports should look like mirrors. The template protects the edges from becoming rounded or enlarged, thus ruining your matching. There is no short cut from polishing. Just experiment with grinding stones, emery cloth, etc., until you're happy with the results.

The gasket should be cut from fresh gasket stock using a good sharp knife and the template. After all that matching, there's no sense in having the gasket hang out into the opening and ruin the whole effect.

Exhaust ports were treated in the same way except that four exhaust flanges were purchased and these were used as templates. Each was numbered to correspond to its cylinder and pinned in place, and the cylinder and flange matched to each other. The exhaust-system pipes were then welded in place on the flanges, and new exhaust gaskets made up from copper sheet.

Assembly of elbows and gaskets to cylinders should be done with care to ensure that the roll pins are properly positioned on final assembly. We numbered the elbows to match the cylinder numbers as a further precaution. The carburetor spider and carburetor body, as well as the air-intake box, should all match and be treated in the same way to allow the easiest possible flow through the complete induction system.

With a smoothly contoured, tuned exhaust system, you're well on your way to having a real "snarler" of an engine. As I said, it's a lot of tedious work, but well worth the effort when you "open the tap."

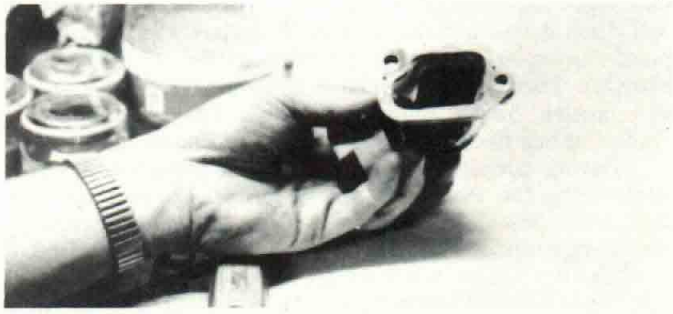

FIG. 7: The template is mounted on the elbow and the elbow is ready to grind to contour.