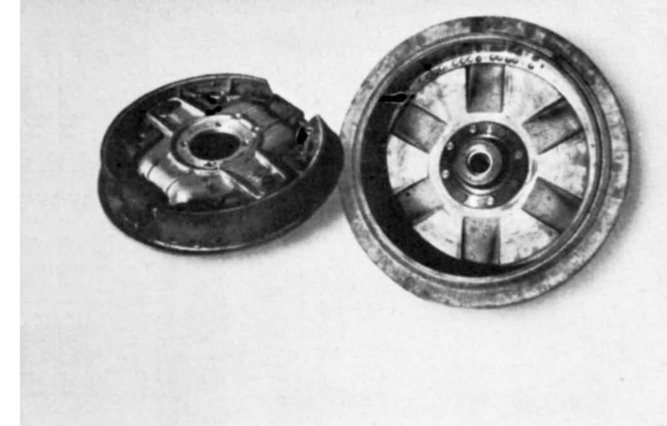


Brake assembly of Ferrari shows backing plate and drum. High temperatures developed on deceleration are distributed to entire unit which has large area for quick, even heat removal.

Are Spot Brakes the Answer?

By DEAN PARKER

ONE of the interesting behind-the-scenes stories of the recent Sebring 12-hour race was the close-up comparison it gave of various types of sports car *brakes.* Any road racing man will tell you that the 5.2-mile Florida circuit is probably the toughest on brakes of anything in the world. It's full of turns (not fast bends, either); the straights are just long enough to let a car build up some real momentum, but not long enough to cool the brakes much – and each one has a sharp, slow corner at the end of it. If there are any brakes left after about five fast laps, they'll definitely qualify as "sports car" brakes! A 12-*hour* race . . . well, it turns out to be pretty much an endurance marathon to see whose brakes will last the longest.

This year we had a good look at three general brake theories: (1) Drum brakes with more or less conventional asbestos-base linings; (2) Drum brakes with ceramic-metallic lining; and (3) spot-type disk brakes. Most of the cars, including the winning Ferrari, used the first type. The Chevrolet Corvette team were experimenting with drum brakes using Bendix "Cerametallix" aircraft lining . . . and the Jaguar and Aston Martin teams used the spot brakes (A-M used arc-segment spot pads, while Jaguar used the usual circular pads).

Frankly, the much-heralded disk brakes made their worst showing against the drums to date. Seems like the more we see of this type of brake in all kinds of competition, and the less it looks like the final answer to the braking problem, at least in terms of extremely heavy usage. The first appearance of the disks at Le Mans in 1953 was sensational; the swift, sure braking of the C Jags was a major factor in their relatively easy victory. But we must remember that Le Mans is *not* a hard course on brakes. The long straights give ample time for brake cooling. Short, twisty courses soon showed up some limitations – to be finally capped by Hawthorn's embarrassing departure from this year's Sebring go with his spot pads literally *welded* to the disks!

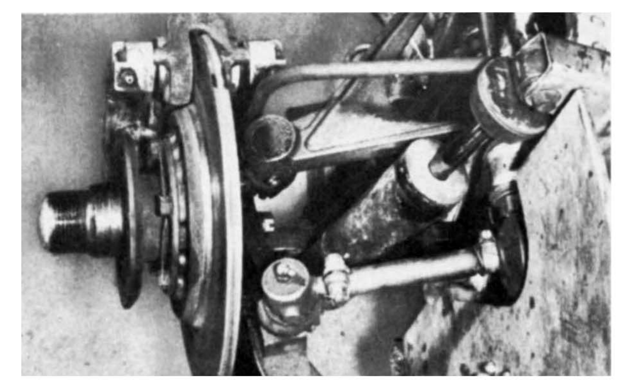
Apparently the disks have an "Achilles' Heel."

Look at it this way: A brake is nothing more than a device for converting the kinetic energy of a car's motion into *heat.* This heat, in turn, must be dissipated to the atmosphere – otherwise the brakes would just keep building up in temperature during prolonged usage until they disintegrated. The key point is this: The rate of heat input during a "panic" slow-down in a race – like when you're pulling down from, say, 140 to 30 mph for a sharp corner at the end of a straightaway – this momentary heat input rate is much too great for the brake to dissipate it as fast as it's pouring in. In this case, the brake must *absorb* the momentary heat overload, then get rid of it gradually when the brakes are released. You might even look upon brakes as simple thermal "shock absorbers."

Now obviously, when a given piece of material absorbs a given number of BTU's of heat, its temperature is going up. This temperature rise for a given BTU input will depend on the material of which the part is constructed and the *weight* of the part. In other words, regardless of how efficient a brake is in dissipating heat, it must have "meat" to absorb the terrific momentary heat overloads without getting an excessive temperature rise.

This is where the disk brakes fall down. They just don't have this "meat." A normal drum brake will have the drum itself, shoes, linings, hydraulic cylinder, wheel, etc. to absorb heat. It's not generally realized, in fact, that asbestos – the main ingredient of the linings – is a quite efficient heat-absorbing material, and the linings may take over one-third of the total heat input to the brake. With drum brakes, it's a simple matter to boost the thermal capacity per ton of car weight by merely using a larger drum diameter or wider (or thicker) linings.

Disks are another story. Here you have just a few square inches of pad area. The disk itself doesn't have nearly the capacity of a big drum. The caliper assembly has meat, but heat transfer conditions are poor here, and the meat doesn't do much work. You could keep adding more pads for thermal capacity, but this would radically reduce heat dissipation when the brakes are off. So what happens when you tromp 'em? The temperature of pads and disk skyrockets; that's what happens. When Hawthorn would jump his disk brakes on the "injector" Jaguar after dark in the Sebring race, they'd heat up to a cherry red in a couple of seconds – and then, just as suddenly, the glow would disappear when he got off the pedal. This certainly doesn't indicate very efficient thermal "shock absorbing!" Result:



The thin disk, and the small pad area, just do not offer enough body to take up the instant heat produced when braking down from top speed for slow corners.

Spot brakes on DB3S get 2½ minute change at Sebring during race. The pie-slice could be removed and replaced quickly during fuel stops.

Brake operating temperatures exceeding 1000° F., with fast wear and disintegration of the pads under hard usage.

Actually, it wasn't brake pad *wear* that got Hawthorn at Sebring. They were using a special pad material similar to the Bendix Cerametallix lining. This is a mixture of bronze and ceramic powders formed under heat and pressure (called "sintering"). The material has a half-way acceptable friction coefficient for brake use, and is still extremely hard and resistant to wear at high temperatures. It's brutal stuff; the disks take as much of a beating as the pads!

But we still have heat generation . . . and the Ferrari crew took advantage of Mother Nature to pull a fast one on the Jaguar boys. When the Jaguar team gave Hawthorn the signal to go after Fangio in the late stages of the race, the old Maestro used all his fabulous cornering technique to stay just ahead of Hawthorn – tantalizingly close enough to keep him right on the ragged edge. Fangio would even deliberately slow 'way down going into a twisty part of the course, forcing Hawthorn to ride his brakes hard to keep from ramming him, then calmly pulled away from him in the turns! The injector D-Jag had the superior acceleration, but Fangio could more than compensate for it in the corners.

So Hawthorn's brakes started to get really hot. Something had to give pretty quick . . . and it turned out to be the brake *fluid.* It started to boil, the brakes got mushy, and Hawthorn was forced to the pit. It was the stop itself that clobbered him. The man was frantic, forgot everything, came into the pit in all-out panic stop. Witnesses in the Corvette pit, three sections up from the Jaguar team, said he must have been doing nearly 100 mph when he went by them – with brakes full on, red hot, and streaming sparks! The terrific heat input of that last stop actually *melted* the pads, causing them to weld solid to the disks. They couldn't have budged the car with a crowbar after that!

And Fangio turned the car over to Castellotti who toured on to win.

Now the Aston Martin team played the song a little differently with their disk brake. They used a softer pad material and *planned* on fast wear. They had the Girling brakes arranged so they could quickly change the pads during a fuel stop. They could change the front pads, tires, and take on a load of fuel in 2½ minutes! The Salvadori-Shelby car used three sets of pads in the 12 hours, got good, consistent braking performance throughout, and finished fourth. (Aston Martin might have done better if Moss' transmission hadn't blown.)

The new Corvette competition drum brakes (now optional equipment) gave a real good account of themselves. These were special ribbed cast iron drums, standard diameter – 11 inches – but lining width is increased to 2½ inches. As I said before, that Cerametallix is brutal stuff. At the end of 12 hours on Fitch's car, they found ⅛ of an inch of wear on the cast iron drums, and only .010 of an inch off the linings! One can't help but wonder what would've happened if they had really flogged the car. Would the linings have eventually poked clean through the drums? At any rate, the new linings were apparently unaffected by temperature, showed no fade at all, and they said water and dirt in the drums had absolutely no effect on braking power. We may have found something in this expensive aircraft brake friction material. It wouldn't be suitable for the street, but it could make a fast 12 hours at Sebring just duck soup . . . if you have thick enough drums! Perhaps integral drum and wheel set-ups, a-la Cooper, are the answer.

Meanwhile, the way things look right now, the basic disk brake layout is going to have to hustle to stay with the latest developments in drum brakes. #