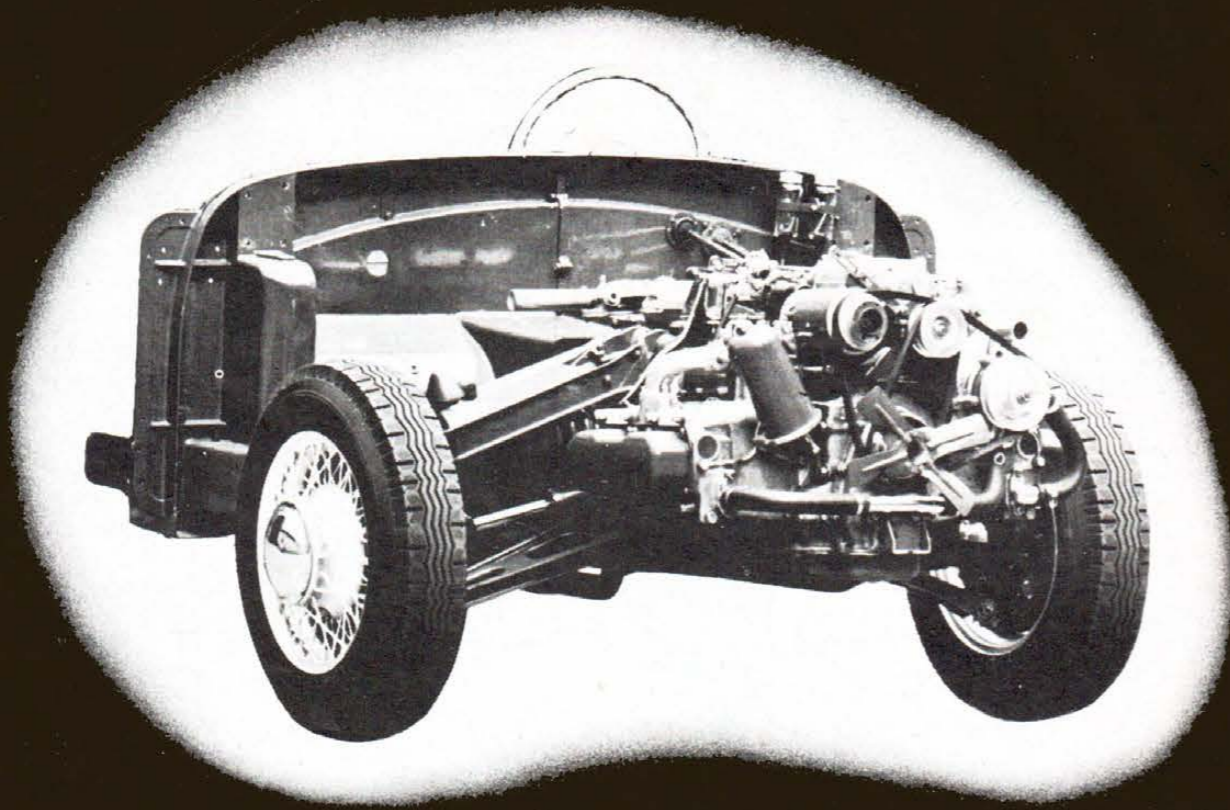


Hexed since the rabbit first grew its power in the wrong set of legs, the front wheel drive is fast coming into a new era of popularity.



Tracta constant velocity joint on the Gregoire Sport is a tricky bunch of yokes held in place by a lubed housing.

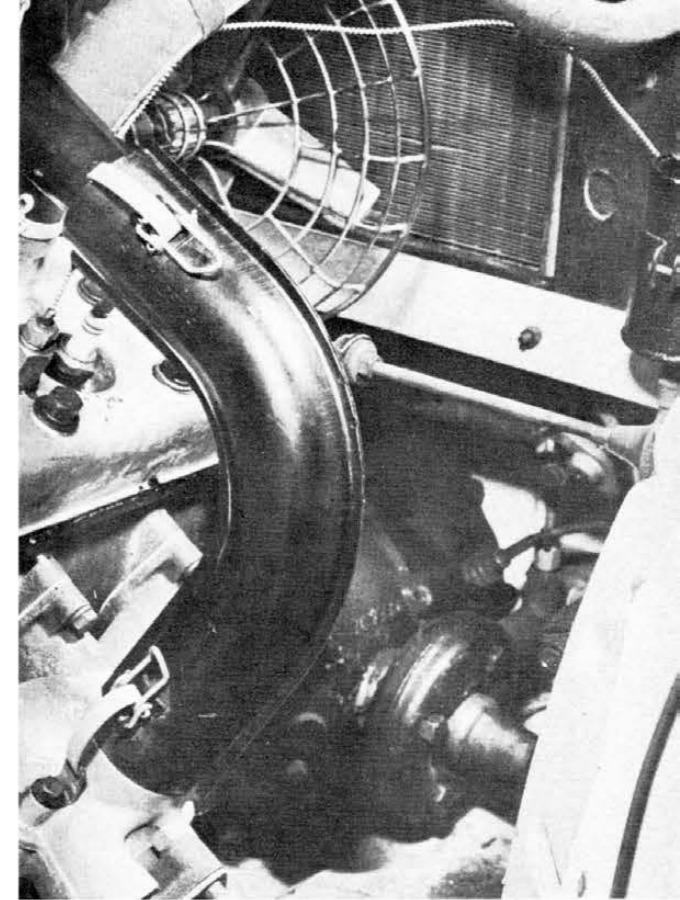
production policy; went from conventional drive to front drive, took a severe beating, and went back to the standard layout just as the vultures were circling to swoop.

B.S.A., long famous as motorcycle manufacturers, tried automobile manufacture with the front drive Scout. They are sadder but wiser motorcycle manufacturers today; the Scout is no more. Henry Kaiser was about to take the frequently fatal step in 1946, when he bought the blueprints of the prototype *Aluminum Français-Grégoire* for possible production in the U.S.A., but in the end even he shied off and produced the conventional article.

This is galling to engineers, for according to the slide-rules, pulling a car along the road with powered front wheels is in every way more efficient than powering the back ones via a wobbly transmission shaft and pushing it.

It is easier to understand what's right with front drive after a brief look at what's wrong with the normal system. To begin with, a good deal of the time the driving force of a rear-drive car isn't being applied in the direction the car is going. It is being applied at a tangent to the car's direction. Since the driving wheels are rigidly parallel to the chassis, whenever the front wheels are turned for steering there is an appreciable angle between the direction of drive and the direction in which the car is moving. This puts a severe strain on the suspension, steering, hubs, tires, and chassis, which leads to a lot of costly stiffening and strengthening, but doesn't prevent the car from turning over when taking a corner just too fast for the geometry of its design.

The wheels that drive a front drive car always point in the same direction as the ones that steer it. They have to:



Looking at SAAB 93 engine from the front, everything looks wrong-end-to. Final drive is just aft of engine, and transmission sits behind final drive. Fan assembly and radiator are behind engine.

The Jinx on The

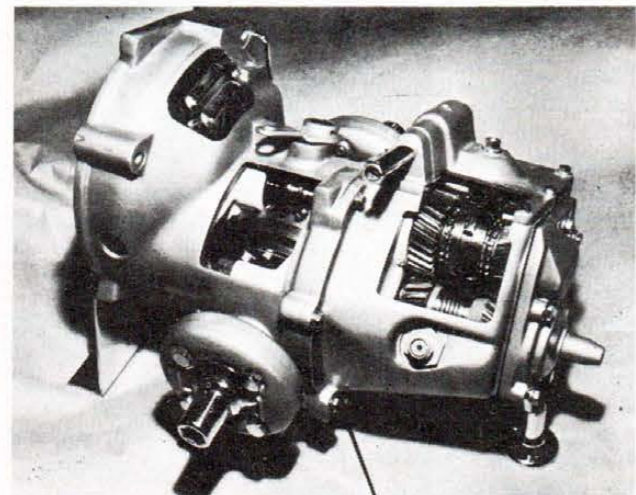
Front Wheel Drive

MERWIN DEMBLING

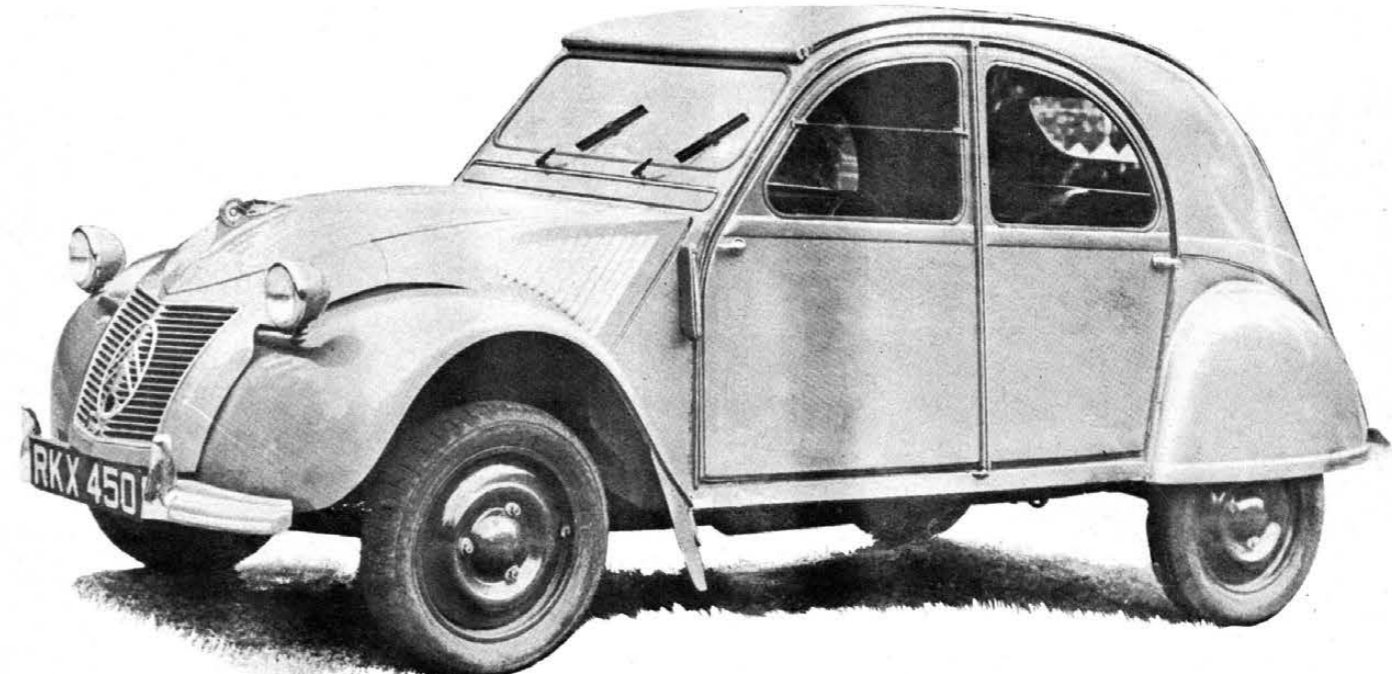
AFTER fifty years in the gloom of the doghouse, front drive is at last coming out into the sunshine of success.

Long regarded as an engineering freak, and superstitiously shunned as a shortcut to bankruptcy, the layout that puts the driving wheels up front where the power lives is now taking its rightful place alongside the rear-engine layout and the conventional engine-forward, drive-aft arrangement, as one of the accepted ways of moving an automobile over the road.

And about time, too, André Citroën died broke before he could see his *Traction-avant* become one of the most popular cars in France. Bucciali shot himself after he and his brother spent every last centime they had trying to perfect a front drive design. Even the magnificent *Supertraction* couldn't pull Lucien Rosengart out of the financial hole he was in — any more than the desperate measure of putting a front drive car on the market could restore the failing fortunes of Chenard and Walcker, Donnet, Voran, Derby, or our own Auburn-Cord. These are by no means the only front drive cars that failed to make the grade: they are only some of the more spectacular failures. In England, Alvis changed their



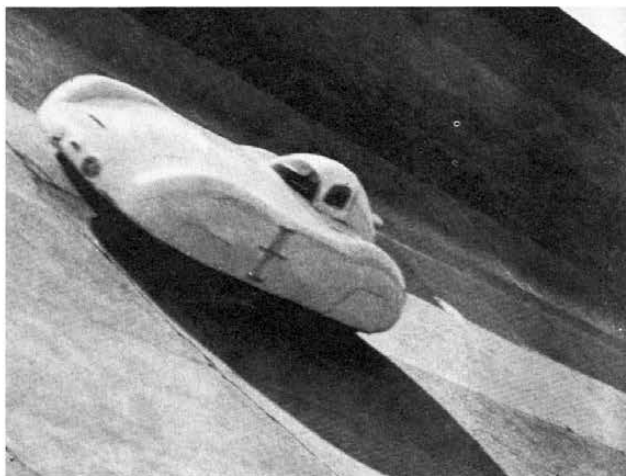
Clutch housing, final drive and transmission are contained in one unit on the SAAB 93. Inboard universals consist of two yokes bonded in rubber at right angles as in a Hooke joint but without trunion.



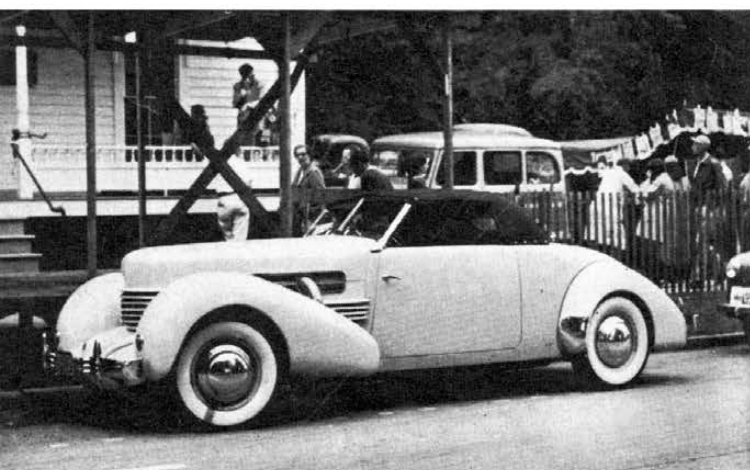
Unattractive but desirable, the Citroën 2CV offers economy, dependability, low power and front drive to motoring French.



The DS 19 Citroën manages a full turn in 36 feet despite its 123 inch wheelbase.



Lloyd streamliner scorches the bank at Montlhery. Car has 386 cc engine, and wheels that pull instead of push.



The Rzeppa constant velocity joint in the beautiful '37 Cord consisted of five steel balls in a machined cage.

they're the same wheels. Since the car is never in two minds about going in one direction, its structure can be lighter all around. And as for cornering at speed: even if the rear end starts to skid, a little more gas will drag the car back on course. It is possible to turn a front drive car over on a corner, but the feat is so difficult it takes a bigger-than-average dunce to manage it.

Not all the credit should go to the direction of drive. The fact that the concentration of doings is in the neighborhood of the front axle makes for better weight distribution, and so, a more stable vehicle.

In the conventional layout, a heavy engine on one end of the chassis and a heavy axle and differential on the other, make the car a crude sort of flywheel. A bump in the road, a sidewind, or even a sharp tug at the steering wheel lets momentum try to spin the car around its center of gravity. Normally the friction between the tires and the road is enough to damp this potentially nasty effect, but on unfriendly surfaces, such as ice, it can cause rear-end break-away and skid the car out of control.

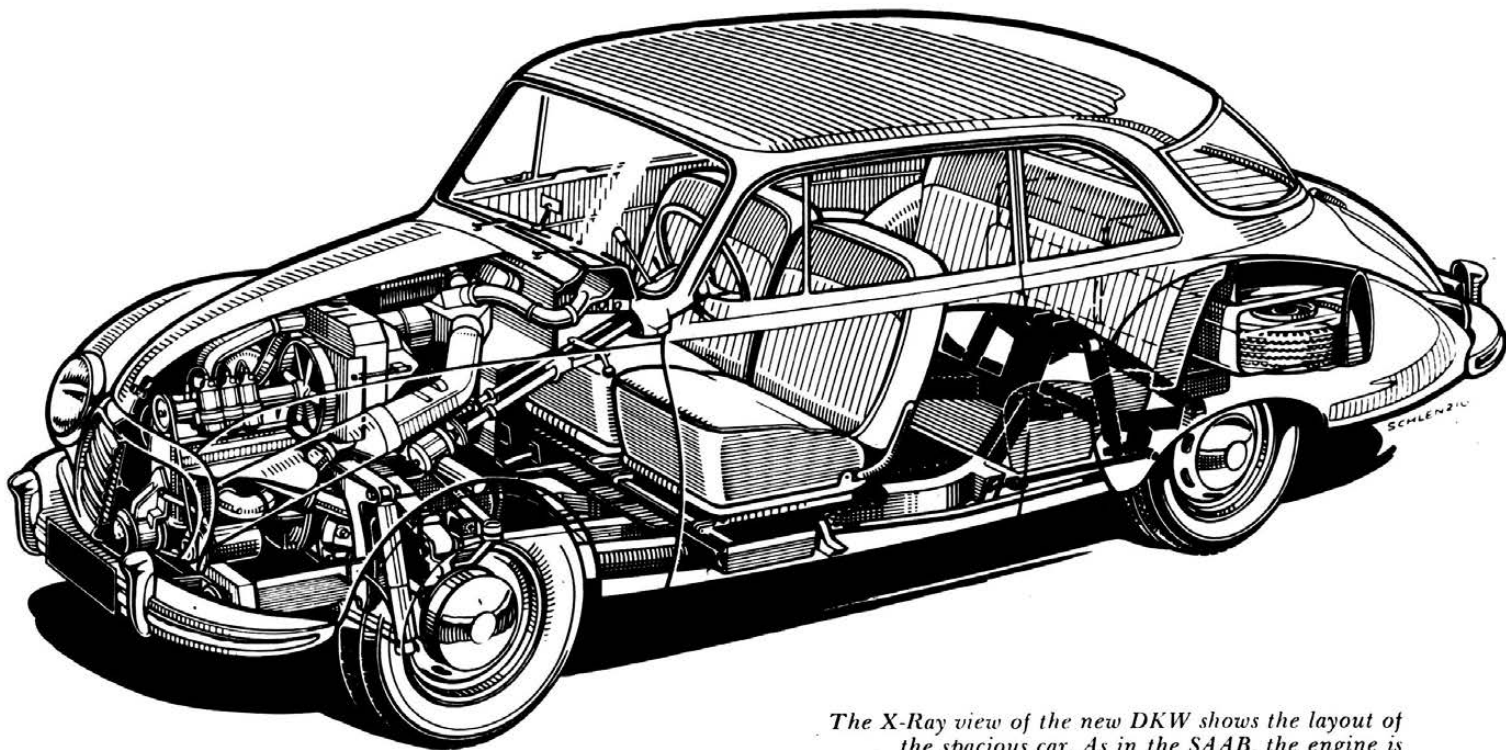
Flywheel effect can be held to an absolute minimum by concentrating the heavy parts of the car right at its center of gravity, but this ideal solution to the problem is impractical because of the extreme difficulty of persuading passengers that it's fun to scorch their bottoms sitting on a hot engine. The next best solution is to group the weights at one end of the car. As far as this goes, rear engine and front drive designs are equally good. Front drive, however, has a few bonus advantages.

Chief among them is the fact that a front drive layout automatically gives the car a center of gravity well to the front, which means better braking, more stability, and the ability to take sharper curves at speed. These handling qualities decrease as the center of gravity moves back, and theoretically might make a rear engine car difficult to control. However, the rear engine layout is used mostly in cars with very short wheelbase, and even then designers try to get as much weight as possible over the front axle by loading the nose-end trunk with the battery, spare wheel, tool kit, and jack, and tearfully begging drivers to cram whatever empty spaces remain with baggage.

Moreover, a front drive car's center of gravity is low. There is no need to raise the height of the passenger's compartment floor in order to accommodate the transmission shaft under it. There is no transmission shaft, so front drive cars can be built considerably lower than conventional ones and still provide enough room for full size people to sit upright in. Overall height is thus kept down, eliminating the upper reaches of bodywork that sway so annoyingly from side to side when cornering with a conventional car.

The automobile designed to take advantage of all the good points of front drive generally looks sleeker and sharper than the ordinary family runabout. It will generally be low slung, spacious, and long, and will have the extended, slender hood that marked the vintage sporting thoroughbred.

Looks aren't the only reason for the long hood on front drive cars. The hood has to be roomy enough to accommodate not only the engine and radiator, as in ordinary cars, but also bits and pieces that are normally kept under the car, such as the differential, or smuggled into the pas-



The X-Ray view of the new DKW shows the layout of the spacious car. As in the SAAB, the engine is mounted well forward of the front axle. Note the rigid steel chassis frame.

senger space, such as the clutch and gearbox.

The first glance into the engine room of a vintage front drive classic is apt to be a bit of a shock. Everything is wrong-end-to. Beginning at the radiator end — assuming that there is a radiator, and the car is not aircooled, which sometimes happened — there would be the differential, the gearbox behind it, and then the clutch — followed finally by the engine. Running the length of the engine would be a rod, which plunged into the gearbox at one end, and whose other end, carried through cowl and dashboard, sticks out horizontally in the driver's compartment as a more or less recognizable gear shift.

It is really quite remarkable the amount of hardware front drive designers manage to snuggle under the hood. The Tracta, a French example of the twenties, mounted a watermelon-size differential and two chunky brake drums under the radiator. On today's Citroën DS 19 the hood is the size of a small airport; opening it one must cross a vast expanse of spare wheel-mounted almost flat — before striking radiator or moving parts. But perhaps the most startling sight of all was the one revealed by opening the hood of the Stoeber, a German front drive creation of the thirties. There behind the radiator was a second radiator: one for water and the other for oil — but it didn't look any less odd when you knew the explanation. The Hoffman, an American contraption that never got past the prototype stage, was to be merchandized on the boast that its hood was no longer than the hood of an ordinary car. Why this was considered anything to boast about back in 1930 isn't clear, but in order

to bring it about, Mr. Hoffman combined the differential and gearbox in one housing, then smuggled the end of the engine into a hollowed-out space behind the dashboard.

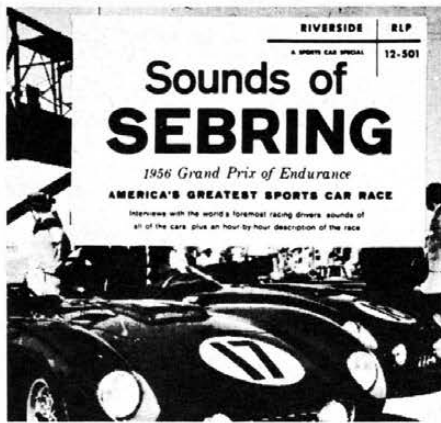
Front drive has so many virtues that it must have been the air drag on its halo that, until recently, kept it from getting to first base. Actually every front drive car that folded up did so for its own reasons, very few of which had anything to do with the peculiarly front drive parts of the mechanism. And every defect that front drive does have has been advanced as the reason for the failure of America's one and only front drive effort: the Cord.

For the benefit of the younger and greener, the Cord was the stepchild of the Auburn. It appeared in 1930, when the parent company was in hot financial water, and disappeared in 1937, leaving the company stone cold daid in de market. A beautiful, almost luxurious automobile, it was powered by a jumbo-size straight eight, and in later models a V8, Lycoming engine, and its electromagnetic gearbox was the last word in depression-days gadgetry.

A depression was a bad time for a shaky concern to risk everything on a queer automobile, but this is seldom mentioned by the kind of experts who know all about the Cord because their elder brother used to date a girl who later married a guy whose father's boss once had one. These experts go in for real colorful explanations of the Cord's unravelling.

Some claim dead pan that its distinctive lozenge-shaped hood was a bad mistake, since it looked so much like a coffin it scared off potential buyers. There is no answer to

(Continued on page 54)



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Jinxed Front Drive

(Continued from page 15)

that sort of thing except to suggest the expert take a couple of aspirins and lie down for a while.

Others, with a bit more upstairs, claim the Cord's steering was so heavy no lady could drive one. There is something to this, but not much. Cord steering was on the heavy side, as the steering wheels also transmitted the power. But it actually required no more spinach to turn the wheel of a Cord than to handle any other high performance car of the period. Girls seemed to manage all right. They may not have been ladies, but after twenty years that hardly matters any more.

Closer to paydirt are those who connect the Cord's unpopularity with the constant velocity universals that took the drive from the differential and passed it on to the wheels at no matter what angle the latter were turned for steering. Some of these gave plenty of headaches.

What is necessary for front-wheel-drive, with its sheer operating angles, is a universal that supplies power at a constant velocity. The principle was described by an English engineer named Robert Hooke, back in 1690, but since those innocent days the designers have got hold of the principle and simplified it to such heights of complication that one constant velocity joint is today more weird and wonderful than the next.

The trouble with the Cord's Rzeppas was that they had to be machined to infinitesimal tolerances and installed just right. Some Cords had good universals, well put in. Many of these are operating today without a hint of trouble. Others, a few thousandths off in machining, or set in a fraction out of line, soon wore, and before long at every corner made a noise as though the whole front end were being fed through a meat grinder. This accounts for the violent reactions people had toward the Cord. Those who knew cars with lucky universals swore it was a fine car done to death by the evil machinations of Wall Street; those who heard bad universals in action swore equally vehemently that it was a rotten car due to the evil machinery of front drive.

Universal trouble was what the Cord and the early Citroën *Traction-avant* had in common. Even good Cord universals had a distinctive death rattle at angles above 20°. Citroën universals couldn't work at all above 38°, which

gave the 114 inch wheelbase model a 45-foot turning circle, same as the Caddy with 15 inches more between the hubs. French wiseguys insist that Paris' wide avenues and broad squares were put there so Citroëns could make U-turns.

If the Citroën *Traction-avant*, which appeared in 1933, was inspired by another automobile it was probably the Adler *Trumpf*, which monocled World War I ace H. G. Rohr designed in Germany the year before. Unusual for its day was the *Trumpf's* all-steel body welded to a box-section chassis. This may have been a forerunner of Citroën's monoshell construction. The *Trumpf* itself was later manufactured under license in France as the *Supertraction*, by Lucien Rosengart, who had made a fortune through buying the rights to the classic British Austin Seven.

France, Germany, England, and Austria produced the bulk of the front-drive cars, but even little Belgium tried its luck with one called La Violette, which proved a bit too shrinking. Italy's contribution was the radial-engined Ninfea, which came out about ten years ago, but hasn't made anything like a splash yet.

Of course, in those years there was no shortage of screwball designs. Britain was especially unfortunate with the Hayes-Pennington, a lethal device that appeared about 1896, with front wheel drive and rear wheel steering. It was frequently found lying on its side. In the twenties some inspired gadgeteer produced the Stanhope, with chain drive to both front wheels. This gave the car the appearance of going backwards at all times except, of course, when it actually was going backwards.

Dr. Porsche, the Volkswagen genius, perpetrated a highly peculiar conveyance called the Porsche-Lohner Chaise, which made its debut at the Paris World's Fair of 1900 and is still to be seen among the oddities at the Vienna Technical Museum. Battery operated, the electric motors were located in the front wheels, and drove the car at a nine mph top. After three and a half hours of this mad pace, you had to stop and get the batteries recharged.

First prize for screwballery, though, goes hands down to the French Latil and Riancey, which really tried to replace the horse. Its front-drive unit could be unbolted from the chassis and hitched to a buggy!

The first of the early Continental successes was the DKW, a tiny, light, but peppy creation whose air-cooled twin-cylinder, two-stroke engine set crosswise on the chassis was the one used in the DKW motorcycle. First produced in 1929, the DKW is still

(Continued on page 58)

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Jinxed Front Drive

Continued from page 54

going strong today. It has even grown a radiator and an additional cylinder in the interim.

The *Traction* has almost as long a production record: 23 years. Now beginning to seem slightly old fashioned, with its top well under eighty, it still retains its peculiar notoriety as the French gunman's favorite getaway car. Slow as it is, it takes corners at a speed that sends conventional pursuers hurtling into the shrubbery, and what's more, it's good cover, for there are so many *Tractions* on the highways that a road check is a tedious business. French gunmen occasionally get caught, for the *Gendarmerie Nationale* uses *Tractions* too.

Intended to replace this old standby is the Citroën DS 19, which appeared early this year and immediately created a stir. On first glance its most startling feature is a safety steering wheel, fixed by the rim to a broad, flat, curved column end, in order to prevent one of the messier aspects of a high-speed accident. However, the real mechanical wonders are under the hood, where hydraulic clutch, gearbox, steering, disc brakes, and suspension combine to make the DS 19 the most up to the minute car on the market. Its two-litre four-cylinder engine, with aluminum head, hemispherical combustion chambers, and twin downdraft carbs, develops 75 bhp at 4500. Its makers claim a top speed of 87 mph. Old *Traction* hands note with envy that the DS 19 manages to do a 180° turn in a mere 36 feet one inch, though its wheelbase is 123 inches.

At the other end of the Citroën size and price is the tiny 2CV, designed to be only an improvement over the French peasant's horse and buggy, but without question the most desirable car on the French market today. No sports car — its air-cooled flat twin develops nine bhp at 3500 rpm, for a top speed of an optimistic forty, and fifty miles to the gallon of the cheapest gas available. (The company recommends the cheap stuff because its relatively low combustion temperature lengthens valve life.) Though the 2CV is slow and the ugliest vehicle to take up road space since the Chrysler Airflow, its economy, its ability to get along with no maintenance whatever, and its typically front drive handling qualities make the 200 that roll off the assembly

lines daily just a drop in the demand bucket. The factory is a year and a half behind on orders.

Inventor of the Tracta joint and the Grégoire variable-flexibility coil-spring suspension, J. A. Grégoire made his reputation as a sports car designer when his Tracta team finished one, two and three in their class at Le Mans in 1929. No genius in business, he claims he never managed to sell at a profit any of the several hundred Tractas he built.

Derived from a Grégoire design — the Aluminum Française-Grégoire — the Dyna Panhard and its modified sporting offspring, the D.B., give astonishing performance with an air-cooled 850 cc. flat twin. I.F.S. in front, torsion bars aft, and an ingenious engine mounting on what appear to be torsion bars as well, make the Dyna and the D.B. sweet to drive — even at their maximum of 80. It would have been interesting to see what Henry Kaiser would have done with the *Aluminum Française-Grégoire* had he gone through with his plans to develop and produce it for the U. S. market.

Though France has had almost her own way in front drive matters for the past twenty or so years, the German threat, always present in the D.K.W. is now getting stronger than ever. Beginning conventionally enough with the Hansa, Dr. Karl Borgward, the engineer-financier whose firm mushroomed in Germany since the end of the war, bit himself off several sizable hunks of the front-drive market, first with the relatively unexciting Goliath passenger cars and light trucks, and now with the really sensational little Lloyd. Cheapest car on the German market, it is still a record breaker: powered by a 386 cc. two-stroke engine it took the 500-mile title with an average of 87 mph, and averaged a highly respectable 77.3 mph in the 10,000 kilometer test. Makers' claims for untuned stock models are 45 mph for the little two-stroke, and 59 mph for the larger Lloyd, supplied with a 596 cc twin-overhead-cam four-stroke power plant.

With front drive successes coming relatively thick and fast these days, one might expect the traction addicts to feel the dawn is breaking at last. They don't. With the bulk of the motoring public still leery of front drive, the addicts refuse to be comforted by triumphs here and there. If not for prejudice, they insist, *all* cars would be dragged along by their front wheels. This prejudice extends from the showrooms to the design rooms, to the boardrooms of the great automobile factories. And even higher than that — the good Lord, front-drive fans feel, started it all when He put the rabbit's power in the wrong set of legs. *Dembling*