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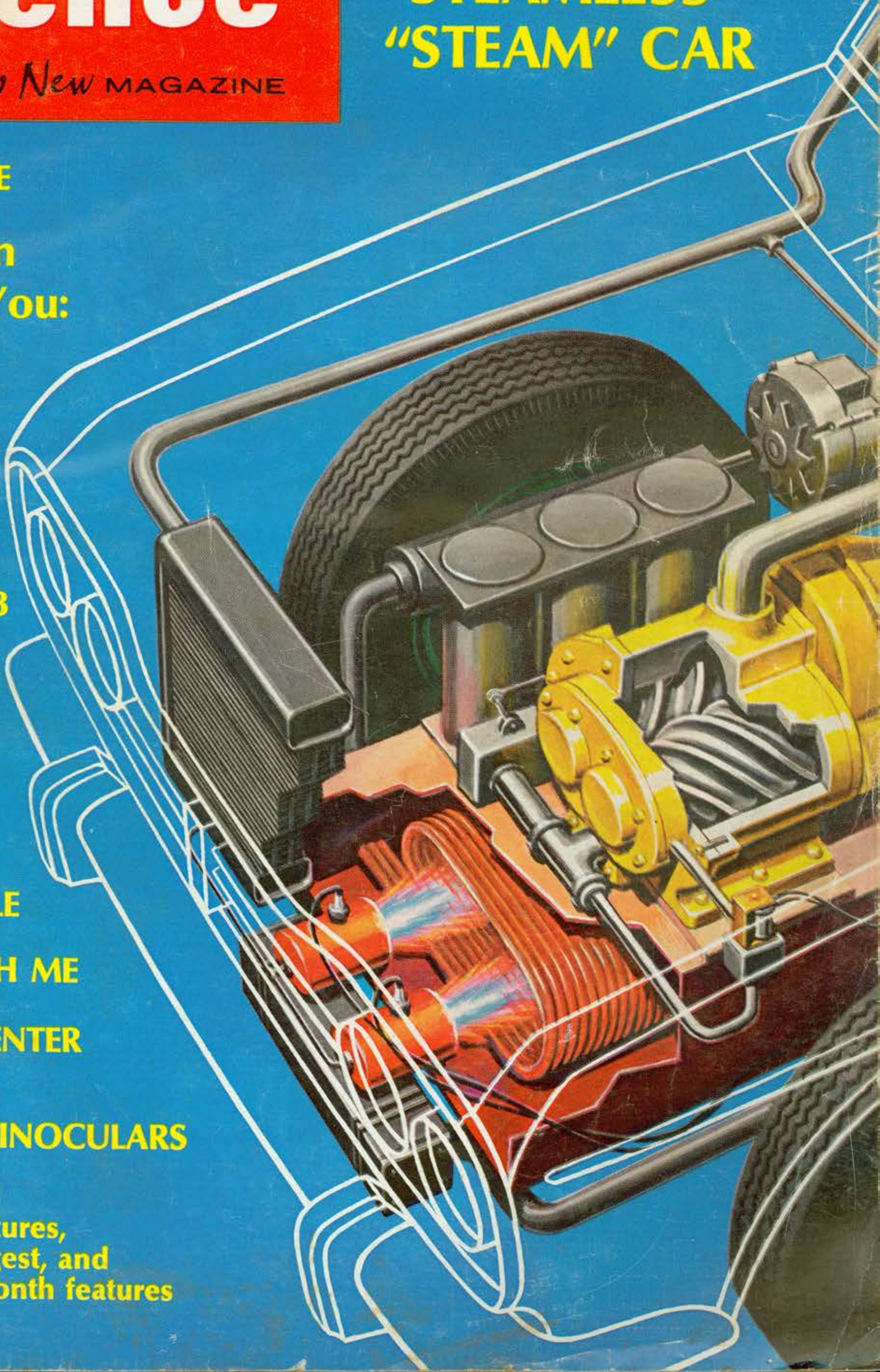
New! Minto's Unique STEAMLESS "STEAM" CAR



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THE *What's New* MAGAZINE™

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New: Minto's Unique Steamless "Steam" Car

This antipollution car uses an external-combustion engine with a refrigerant for a working fluid. Soon it will go into production—in Japan

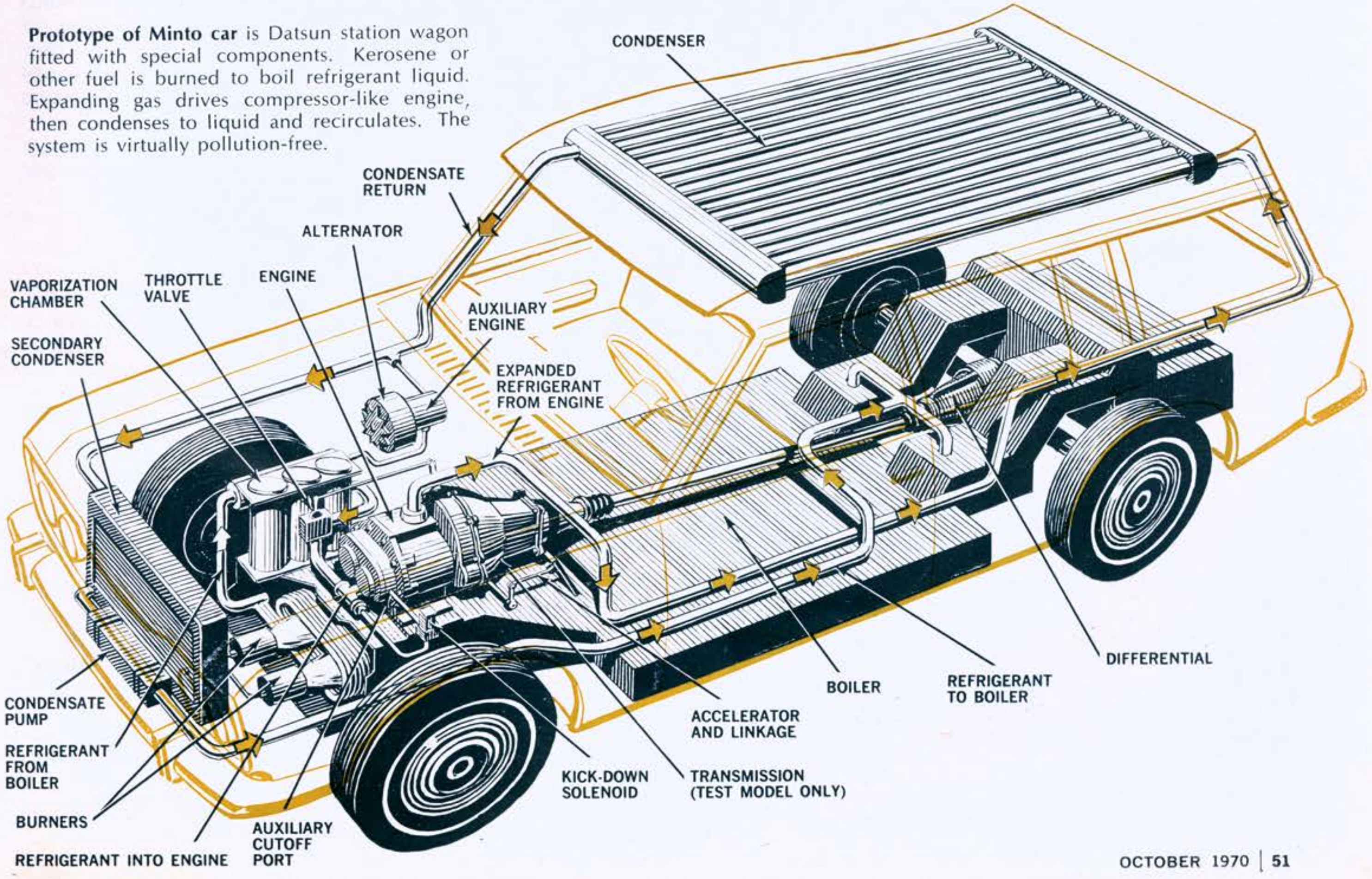
By E. F. LINDSLEY
ILLUSTRATION BY RAY PIOCH

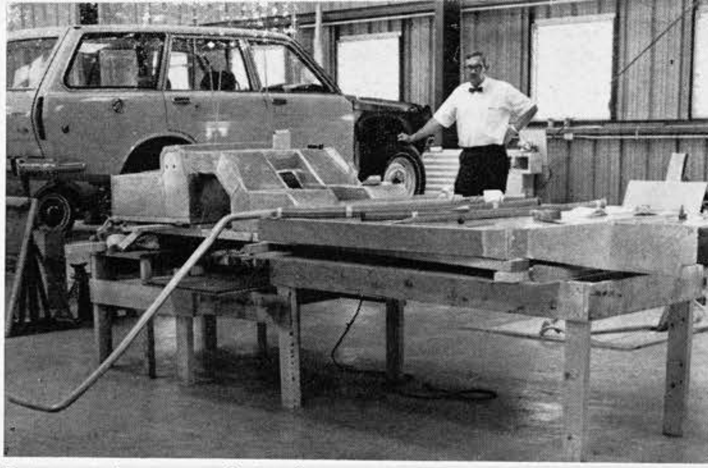
Just about now, if you happen to be a reader living in the Southeast, you may see a Datsun station wagon pull up to a stoplight: It will probably catch your attention because you won't hear the engine idling as the driver waits for the light. You'll also notice that the little wagon moves out briskly and almost silently—the only sound will be a soft whine. And you won't see any exhaust. You will be looking at the prototype of one of the first really pollution-free cars ever built—one that Datsun's maker has agreed to produce by 1972!

Under the hood will be a small, and unique, engine driven by expanding fluorocarbon. The heat to expand the R-113 fluorocarbon refrigerant will come from burning hydrocarbon fuel, probably kerosene (although almost anything will do). According to Wallace L. Minto, developer and President of Kinetics, Inc. in Sarasota, Fla., the secret is no secret—external combustion, properly engineered, of course, produces only carbon dioxide and water. Both are normal components in our atmosphere. The Datsun will emit no semiscavenged lead, no measurable oxides of nitrogen, and virtually no carbon monoxide.

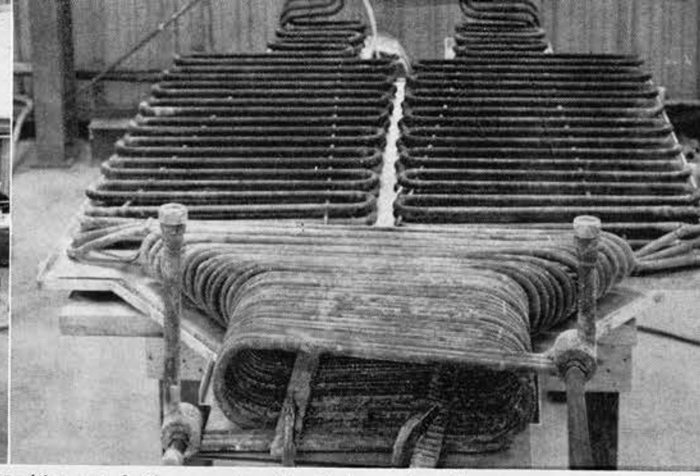
Steam-engine fans, aware of the merits of external combustion and the simplified mechanics and drive train made possible by expanding a nonburning gas, have long

Prototype of Minto car is Datsun station wagon fitted with special components. Kerosene or other fuel is burned to boil refrigerant liquid. Expanding gas drives compressor-like engine, then condenses to liquid and recirculates. The system is virtually pollution-free.





Datsun station wagon being fitted with refrigerant engine will receive the boiler housing seen in foreground. Housing looks oversize; actually, it fits precisely under the wagon.



Refrigerant boiler, made of coiled steel tubing, was set up as shown for testing. One like it will slip inside aluminum housing under the car. The burners fire into the front opening.

foreseen just such a car. But practical problems in applying steam have stalled, so far, even the biggest names. Some of the problems with steam are:

- Freezing in cold climates
- High pressures and superheat needed for efficiency
- Bulky size of boilers and piping
- Hazard from hot water and steam in an accident
- Large water volume, wasteful of heat energy on cool-down.

Wallace Minto thinks he has the answer in Ucon R-113 fluorocarbon, Union Carbide's name for a common, noncombustible refrigerant. (Du Pont's name for it is Freon.) R-113 vaporizes at 117 degrees F, a fact of overwhelming importance to safety. Moreover, R-113 has the thermodynamic characteristics needed; it doesn't freeze; it liquefies readily within a condenser of practical physical size; and, because of its high density, it can be handled in small pipes and valves. All of these qualities make for lighter, stronger, and less-expensive parts, which can be fitted into an automobile economically and practically.

A thorough engineer. "The numbers have to check out" is one of Minto's favorite expressions when he talks of the complex laws of gas expansion, entropy, and the work available from an engine. To prove his "numbers," Minto first built a test model using the unlikely combination of a VW minibus and a genuine Stanley Steamer engine. Burning propane as a convenient heat source, he cooked his batch of R-113 in a tubular boiler, fed it through the old Stanley engine very successfully, and condensed it in some cobbled-up cooling coils from conventional refrigeration equipment. This was the classic Rankine cycle, using the working fluid—in this case R-113 instead of steam—over and over. Unlike the dramatic bursts of exhaust steam from old-time locomotives, the Rankine cycle chills the engine exhaust back into liquid, collects the liquid, and re-injects it into the boiler for use again.

Inventor Wallace L. Minto points out rooftop condenser for ancient Stanley Steamer engine, driven by refrigerant fluid, that powers this VW minibus. Vehicle was a test bed to prove theory.

Unfortunately, the Stanley engine was a reciprocating-piston type, and efficiency was not very high. What was needed was a rotary engine with parts that kept turning without changing direction every 180 degrees. A turbine could be used, but turbines lack low-speed torque, work better when wound up tight at constant speed, and take some pretty hefty gear reductions to get down to the working range for a car axle. Minto sought a positive displacement power plant, one that started with high torque from a dead stall—as did the old piston steam engines—and that would eliminate clutches, gear shifts, torque converters, and the other heavy, expensive accouterments of ordinary drive trains.

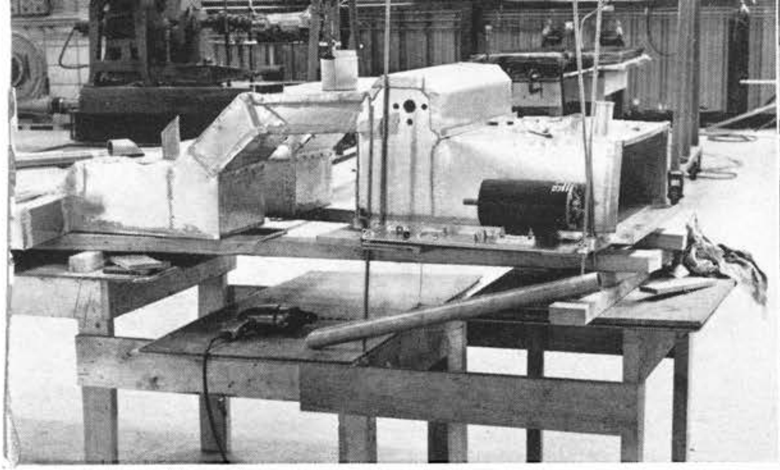
Vane-type engines, various exotic rotaries, and a host of others were checked out before coming up with two rotors, fluted somewhat like sections of a twist drill with the flutes intermeshing. Initially, the physical diameters and the pitch diameters of both rotors were the same. It worked, but not as efficiently as Minto thought it could.

Compressor in reverse. Eventually, he found what he was looking for in existing air compressors. Here were two fluted rotors, but the flutes were different. Although the physical diameters were the same, the pitch diameters differed. One rotor had six flutes, the other had four. They ran together, but the four-lobed male rotor turned 1½ times the speed of the six-fluted female. The device compressed air efficiently and simply, with only two moving parts.

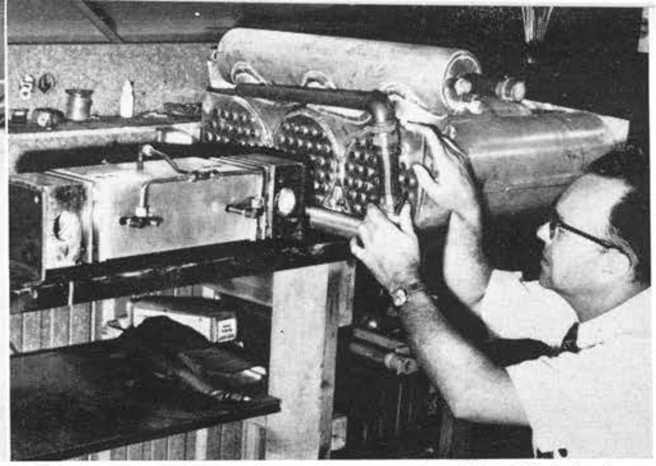
Minto's engine reverses the air compressor. Fluorocarbon R-113 gas, laced with a fluorosilicone lubricant, enters the space between the rotors, is trapped as the flutes turn and cut off the inlet ports, and expands with a wedging action between the flutes to rotate the engine. The expansion ratio is about 8:1. Starting from zero rotation, as with the car at a stop sign, simple expansion against the positive-displacement rotors starts the car rolling. At higher speeds, the velocity of the gas impinging on the rotors adds significantly to the power.

Mount engines anywhere. The engines, actually Swedish-built Sullair compressors (or, optionally, Japanese Myakawas of almost identical design) are powerful. Size for size, or weight for weight, they are much more powerful than electric motors. The present engines are not especially designed for weight saving, yet they are light compared with equivalent piston engines. Now weighing 55 pounds in cast iron, they will be made of aluminum. They can be mounted almost anywhere in the vehicle and run in any position; straight up, down, or sideways. Minto envisions final application with the engine mounted directly on the rear axle.

Since rotor speed may range from zero rpm up to 8,000-10,000 rpm, or even higher, the present axle ratios in the experimental Datsun are not adequate. For test purposes



Boiler circulating pump seen at left rear of boiler housing keeps refrigerant liquid moving in boiler to prevent hot spots. Dynamometer and boiler test equipment are set up in background.



Heat recovery and vaporizer unit is examined by Chief Engineer Leonard Keller. Refrigerant flashes into gas and is reheated by burner exhaust here. Box on left is the boiler feed pump.

he uses a conventional gear box behind the engine. Future engines will be direct reversing, but right now he uses the gears to back up and help test engine speed vs. car speeds.

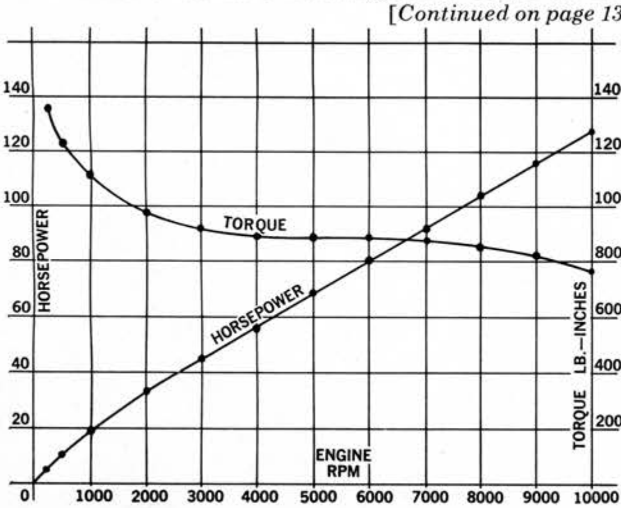
The hardware needed to run Minto's Datsun is necessarily "prototype." After all, adapting an external combustion engine to a vehicle designed for internal combustion can be expected to offer problems of size and shape. Later, a car designed around the fluorocarbon engine will make things easier. So will production components that really fit, rather than hand-fabricated assemblies. Even so, Minto has the following basic parts in workable form:

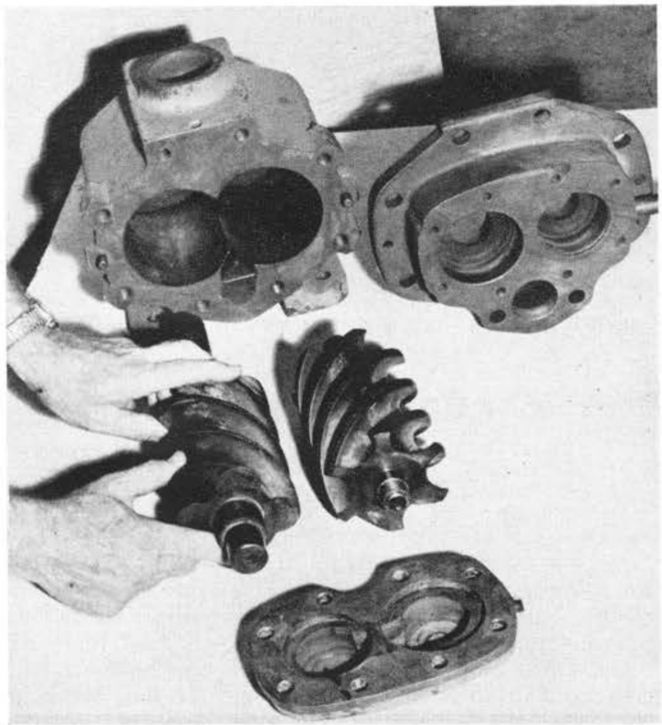
- Boiler, consisting of a shallow pancake of steel tubing coiled to fit in an insulated, double-walled, aluminum housing snugged up under the car.
- Burners (two) of conventional industrial oil-burner pattern, but highly modified for extremely clean, efficient burning.
- Engine—70 hp at 5,000 rpm, mounted conventionally. High horsepower is not needed because of the excellent torque characteristics.
- Condensers, consisting of a primary, flat, thin, multitube panel mounted in the car roof, and a secondary unit mounted in the usual radiator location.
- Vaporization chamber and heat recovery economizer, to flash the heated liquid to gas and recover part of the burner exhaust heat.
- Throttle, small auxiliary engine to drive alternator, boiler feed pump, fuel tank, and fuel pump.

Following the working cycle of the engine from the point where the liquid R-113 is cold in the boiler, here is what you'd see:

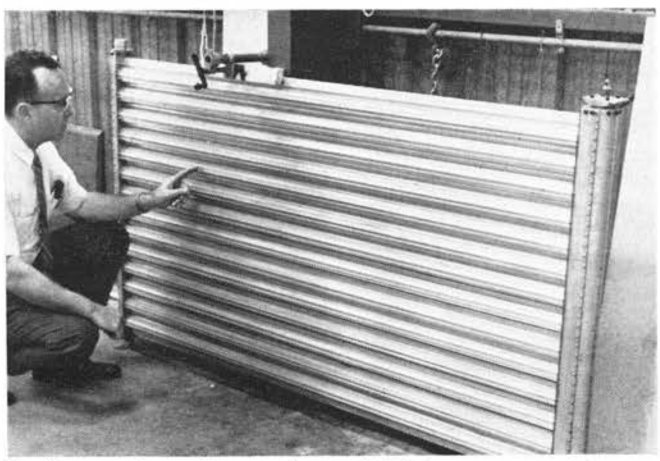
How the power flows. After burner ignition by the usual spark arc, the R-113 warms to a working level in about ten seconds. A circulating pump keeps the fluid

[*Continued on page 130*]





Gases enter engine through valve plate at front and wedge the rotors to develop high-speed rotation. Male rotor (piston) on left delivers 80 percent of power, turns 1½ times faster.



Rooftop condenser is one of several Minto car components production would improve in shape and other ways. Hand-built test unit shown here is made of aluminum tubing finned inside and out.

Power curves show maximum-load pickup ability when engine starts from dead stall, tremendous torque backup as load pulls engine down to stall.