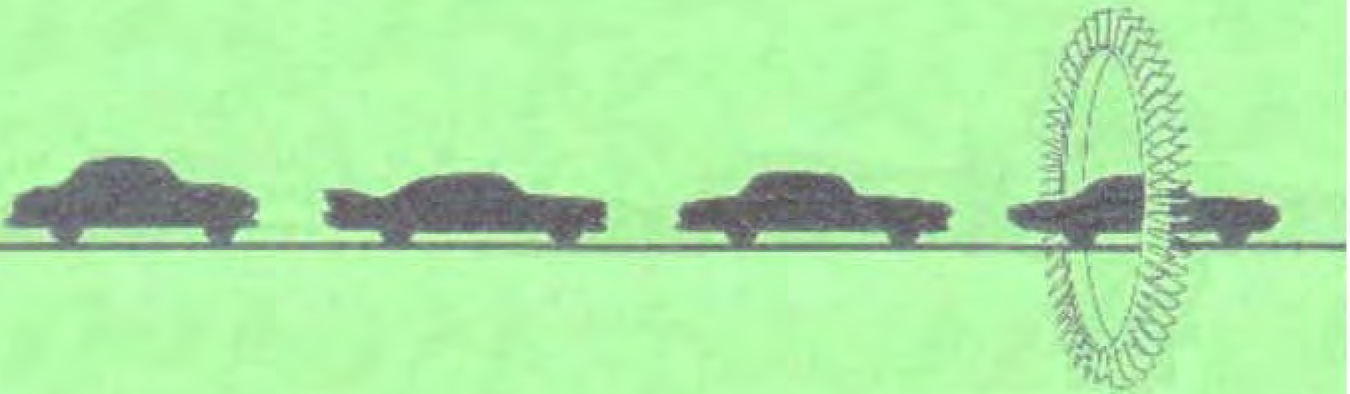

History of Chrysler Corporation GAS TURBINE VEHICLES

ENGINEERING OFFICE CHRYSLER CORPORATION

HISTORY

of

CHRYSLER CORPORATION GAS TURBINE VEHICLES

MARCH 1954 - JUNE 1966

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A review of gas turbine-powered vehicles shown publicly by Chrysler Corporation.

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CHRYSLER CORPORATION
ENGINEERING OFFICE
Technical Information

January, 1964
Revised: August 1966

HISTORY of

CHRYSLER CORPORATION GAS TURBINE VEHICLES

MARCH 1954 - JUNE 1966

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EARLY INVESTIGATIONS AND RESEARCH

At Chrysler Corporation, the earliest work on gas turbine engines dates back to before World War II, when an exploratory engineering survey was conducted. These studies showed that, although the gas turbine engine had strong possibilities of being an ideal automobile engine, neither materials nor techniques had advanced to the point where the cost and time of intensive research would be warranted.

At the close of World War II, studies of completely new concepts in gas turbine design were started. As a result of this work, Chrysler was awarded, in the fall of 1945, a research and development contract by the Bureau of Aeronautics of the U. S. Navy to create a turboprop engine for aircraft. This program--although terminated in 1949--resulted in the development of a turboprop engine which achieved fuel economy approaching that of aircraft piston engines.

Chrysler research scientists and engineers then returned to their original objective--the automotive gas turbine engine. In the early 1950's, experimental gas turbine power plants were operated on dynamometers and in test vehicles. Active component development programs were carried out to improve compressors, regenerators, turbine sections, burner controls, gears, and accessories.

Here they faced many challenges: fuel consumption had to be competitive with conventional engines; components had to be small and highly efficient; noise had to be in the tolerable range; engine braking was a necessity, and the acceleration time-lag had to be reasonable.

In addition, readily available and non-strategic high temperature materials had to be developed, exhaust gas temperatures had to be low, and development work had to meet the requirements of building an engine which would be light, compact, reliable, easy to maintain and, from the cost aspect, competitive with the conventional automobile engines.

In spite of these difficult requirements, Chrysler research engineers were convinced that the potentialities of the automotive gas turbine engine were more than sufficient to warrant intensive research and a full-scale design and development program.

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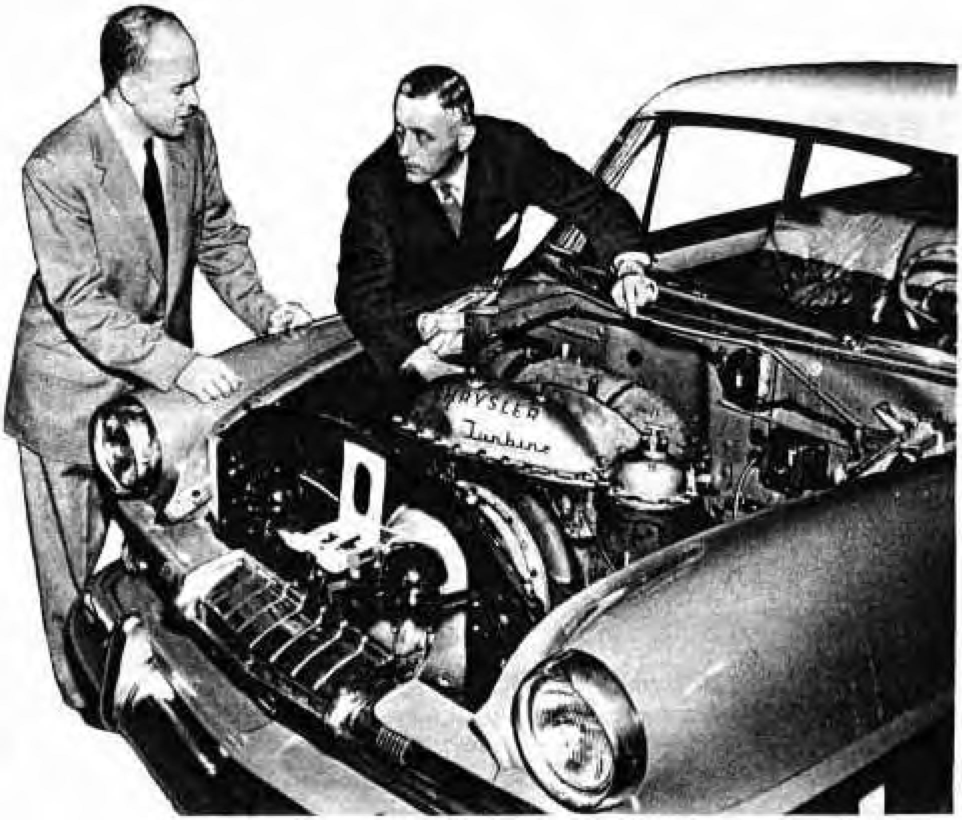
Today, it is obvious that the advantages of the gas turbine over the conventional engine are, indeed, real. Some of these advantages are:

- Maintenance is reduced considerably
- Engine life-expectancy is much longer
- Development potential is remarkable
- The number of parts is reduced 80%
- Tuning-up is almost eliminated
- Low-temperature starting difficulties are eliminated
- No warm-up period is necessary
- Antifreeze is not needed
- Instant heat is available in the winter
- The engine will not stall with sudden overloading
- Engine operation is vibration-free
- Operates on wide variety of fuels
- Oil consumption is negligible
- Engine weight is reduced
- Exhaust gases are cool and clean



TURBINE ENGINE FITS NEATLY INTO 1954 PLYMOUTH

A gas turbine engine without a regenerator would have required several times the amount of fuel normally used in a regenerator-equipped engine. The extra fuel would be required to heat the gases to operating levels.

The regenerator also performed another important function. It reduced the exhaust temperature from about 1200 degrees F at full engine power to a safe level of less th 500 degrees F. Even more important, at idle the temperature was reduced to 170 degrees F. By the time the gases pass through the exhaust ducts to the atmosphere, the temperature was reduced even further.

Even with these breakthroughs, a great deal of work and many development problems still remained. On the date of the original turbine disclosure (March 24, 1954), Chrysler Corporation stated: "Whether we ultimately shall see commercial production of gas turbines for passenger cars depends on the long-range solution of many complex metallurgical and manufacturing problems. There is no telling at this time how long it will take to solve these problems."

Almost a year later, the same basic engine was installed in a 1955 Plymouth. This car, although never displayed at public exhibits, was used for driving evaluation tests on Detroit area streets.

DETROIT TRAFFIC TEST FOR 1955 PLYMOUTH TURBINE

THE 1956 CROSS-COUNTRY ENDURANCE TEST

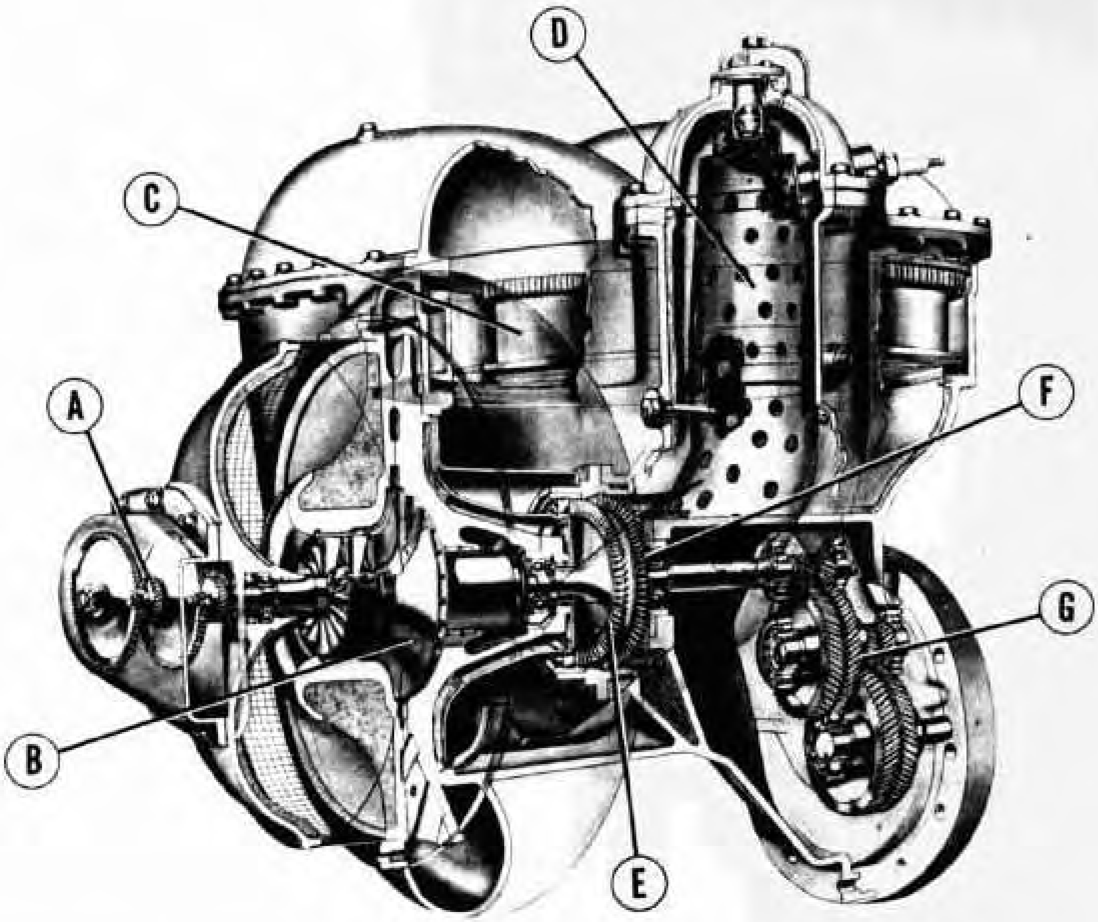
In March, 1956, another historic event took place--the first transcontinental journey of an automobile powered by a gas turbine engine.

1956 TURBINE SPECIAL EN ROUTE CROSS-COUNTRY

The turbine car--a four-door 1956 Plymouth sedan, a standard production model in every respect except for the revolutionary Chrysler-developed power plant--departed from the Chrysler Building in New York City on March 26. On March 30, four days and 3,020 miles later, it completed the cross-country endurance test when it arrived at the City Hall in Los Angeles, California. The purpose of the run was to test the turbine's durability, acceleration, fuel economy, control in traffic, action on steep grades, and operation under various climatic conditions. It marked another Chrysler Corporation "first" in the automotive record books and was considered a successful test.

Over the entire trip, fuel economy averaged approximately 13 miles per gallon using mostly "white" (unleaded) gasoline and some diesel fuel. The run was interrupted only twice for minor repairs which did not involve the turbine engine (a faulty bearing in the reduction gear and an intake casting were replaced). The engine itself and its basic components performed very well and without failures of any kind.

The experimental turbine engine was essentially the same as the one tested previously in the 1954 Plymouth. However, it reflected progress in the following major points: engine friction was greatly reduced; considerable work had been done with plain bearings instead of more expensive types of antifriction bearings; the combustion system was improved, and engine controls were developed further. Automatic controls allowed the driver to operate the turbine car just as he would a conventional automobile.



MAIN COMPONENTS OF THE FIRST GENERATION GAS TURBINE ENGINE were: (A) Accessory Drive Gears; (B) Compressor Impeller; (C) Regenerator; (D) Combustion Chamber; (E) First-Stage Turbine, which drives the compressor impeller and accessories; (F) Second-Stage Turbine, which supplies power to the transmission; and (G) Double-Stage Reduction Gearing to the transmission.

THE SECOND GENERATION TURBINE

Basing their calculations on extensive test data and performance results of the 1956 cross-country trip, Chrysler engineers designed and developed a second engine. After extensive laboratory tests, it was installed in a standard production 1959 Plymouth four-door hardtop.

1959 PLYMOUTH TURBINE SPECIAL READY FOR ROAD EVALUATION

In December, 1958, this latest Turbine Special made a 576-mile test run from Detroit to New York. The results showed significant improvements in fuel economy.

This second generation turbine (also a laboratory development tool) operated in the 200 horsepower range; and, although it was improved in almost every respect, two areas were particularly outstanding--efficiency and materials.

Three major engine components (compressor, regenerator and burner) showed significant improvements in operating efficiency. The compressor efficiency was brought up to 80 per cent, a 10 per cent increase. The regenerator or heat exchanger unit reclaimed almost 90 per cent of the heat energy in the exhaust gas whereas peak efficiency in the 1956 cross-country run was around 86 per cent. Burner efficiency also was improved so that it was approaching the point of ideal combustion.

Less apparent, but fully as important as the engine design advances, was the progress in turbine metallurgy. Prior to this time, automotive turbine metals were similar to those used in aircraft jet engines. Although these existing materials certainly were adequate for test engines, they would not be suitable for automotive production for two key reasons: cost, and the simple fact that neither production capacity nor the available world supply of the required alloying materials could support such a program.

Through Chrysler metallurgical research, new materials were developed which: contained plentiful and relatively inexpensive elements; could be fabricated by conventional means; and had excellent resistance to heat and oxidation at elevated temperatures. Applications for these new materials were combustion chamber liners, turbine wheels and blades, etc.

The accompanying illustration shows a three-inch disc of the new material (left), with a disc of high-grade stainless steel (right). Both samples were exposed in air to temperatures above 2,000 degrees F in an electric furnace for 150 hours. At the end of that time, the new Chrysler-developed material showed no distortion or disintegration, while the effect on the stainless steel sample is apparent.

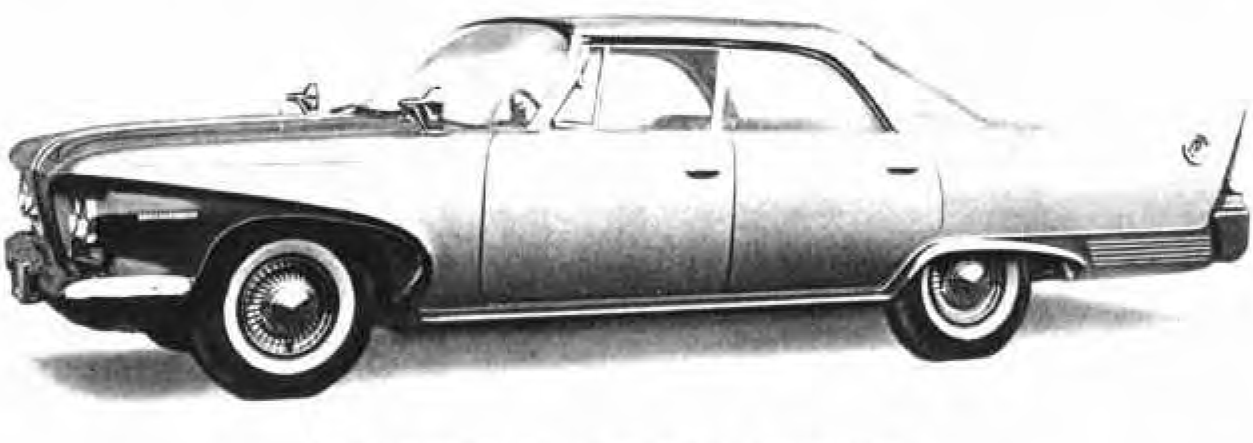
METALLURGICAL BREAKTHROUGH

A TRIO OF GAS TURBINE VEHICLES

Encouraged by previous progress, Chrysler engineers designed the third generation of the turbine and introduced it in three different vehicles. The initial showing was to newsmen on February 28, 1961. The vehicles were displayed publicly in Washington, D. C., March 5-9, 1961, in conjunction with the Turbine Power Conference of the American Society of Mechanical Engineers, co-sponsored by the Department of Defense.

TURBOFLITE--ADVANCED POWER, ADVANCED STYLING

The first of these gas turbine vehicles was an experimental sports car called the "Turboflite" (shown above). In addition to the engine, other advanced ideas of the car were the retractable headlights, a deceleration air-flap suspended between the two stability struts, and an automatic canopied roof. This "idea" car received wide public interest and was shown at auto shows in New York City, Chicago, London, Paris, etc.



1960 TURBINE-POWERED PLYMOUTH

The second of the vehicles was a 1960 Plymouth (shown on the previous page) which was standard in every respect except for the engine and minor exterior styling modifications.

The final member of this trio was a two-and-a-half-ton Dodge truck which was a standard production vehicle--except for its gas turbine engine. This application demonstrated the turbine's versatility and adaptability because the engine in this truck was basically the same as those in the passenger cars.

TURBINE POWER FOR 1960 DODGE TRUCK

AN IMPORTANT PHASE OF RESEARCH AND DEVELOPMENT

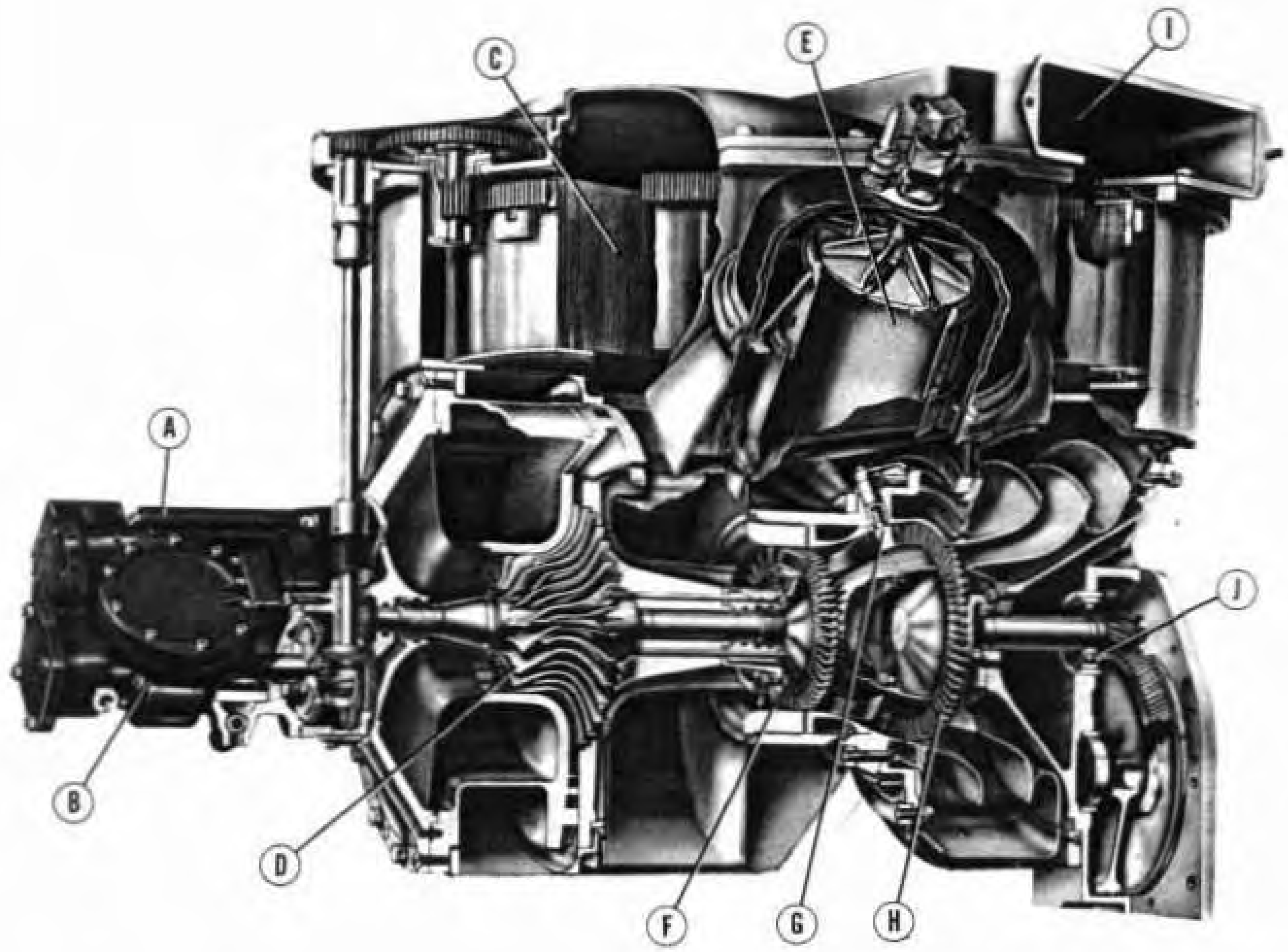
After months of test and development work, a CR2A gas turbine engine was installed in a modified 1962 Dodge.

Called the Dodge Turbo Dart, styling modifications to the car were adapted to reflect its radically different power plant. The bladed wheel motif of the grille and wheel covers reflected the appearance of the vital components of the gas turbine.

COAST-TO-COAST TEST VEHICLE—1962 DODGE TURBO DART

The car left New York City on December 27, 1961, to begin a coast-to-coast engineering evaluation. After traveling 3,100 miles through snowstorms, freezing rain, subzero temperatures and 25 to 40 mile per hour head winds, it arrived in Los Angeles on December 31.

The turbine had not only lived up to all expectations but had exceeded them! An inspection showed every part of the engine in excellent condition. Fuel economy was consistently better than a conventional car which traveled with the turbine car and was exposed to the same conditions.



MAIN COMPONENTS OF THE CR2A gas turbine are: (A) the starter-generator; (B) fuel pump; (C) regenerator; (D) compressor impeller; (E) combustion chamber; (F) first-stage turbine, which drives the compressor impeller and accessories; (G) variable second-stage nozzle; (H) second-stage turbine which supplies power to the driveshaft; (I) one of two exhaust outlets; (J) single-stage helical reduction gear of 8.53-to-1 ratio which reduces power turbine rpm of 39,000 to 45,730, to a rated output speed of 4,570 to 5,360 rpm.

SPECIFICATIONS OF CHRYSLER CORPORATION'S MODEL CR2A GAS TURBINE ENGINE

GENERAL

Type: Regenerative gas turbine

* Rated Output: Power - 140 bhp @ 4,570 rpm output shaft speed
  Torque - 375 lb-ft @ zero rpm output shaft speed

Weight: 450 lbs

Basic Engine Dimensions (without accessories): Length - 27 inches
Width - 35 inches
Height - 27 inches

With automotive accessories in place, the over-all length is: 36 inches

Fuels: Unleaded gasoline, diesel fuel, kerosene, JP-4, etc.

COMPONENTS

Compressor: Type - Centrifugal
Stages - One
Pressure Ratio - 4:1
Efficiency - 80%

First Stage Turbine: Type - Axial
Stages - One
Efficiency - 87%

Second Stage Turbine: Type - Axial
Stages - One
Efficiency - 84%

Regenerator: Type - Single rotating disk
Effectiveness - 90%

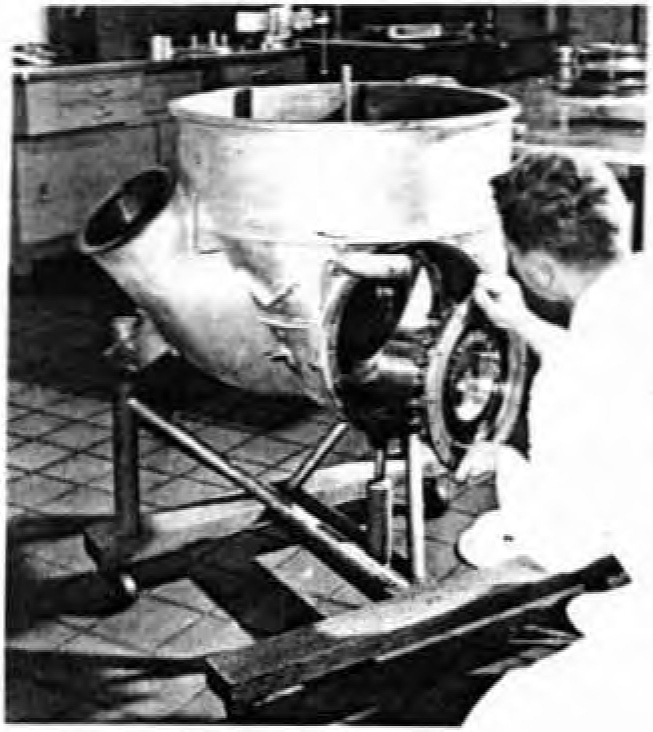
Burner: Type - Single can, reverse flow
Efficiency - 95%

* DESIGN POINT CHARACTERISTICS

Maximum Gas Generator Speed - 44,600 rpm
Maximum Second Stage Turbine Speed - 45,700 rpm
Maximum Output Speed (after reduction gears) - 5,360 rpm
Maximum Regenerator Speed - 17 rpm
Compressor Air Flow - 2.2 lb/sec
First Stage Turbine Inlet Temperature - 1700°F
Exhaust Temperature (full power) - 500°F

* Ambient conditions: Temperature - 85°F; Barometric Pressure - 29.92 in. Hg

The key to the excellent performance and economy of the third generation gas turbine (called the CR2A) was its new variable turbine nozzle mechanism.



THE VARIABLE NOZZLE MECHANISM is installed by a research engineer in the rear of the CR2A-turbine engine housing (left). The nozzle mechanism (right) acts in shutter fashion to provide engine braking, improve acceleration and increase fuel economy by controlling and directing the angle of the jet stream to the power turbine blades.

The automatic second stage turbine nozzles provided optimum results throughout the entire operating range of the engine. Thus, economy, performance, or engine braking could be maximized as required by the driver. For example, one area of performance is what is termed acceleration lag--the time it takes the compressor section to reach operating speed after the accelerator pedal is depressed. The first turbine engine had an acceleration lag of seven seconds from idle to full-rate output; the second engine required three seconds to achieve maximum vehicle acceleration, while this new engine required less than one and one-half seconds to accomplish the same performance.

CONSUMER REACTION TOURS

Another experimental turbine-powered car--the Plymouth Turbo Fury--joined the Dodge Turbo Dart, and the two turbine-powered cars began extensive consumer reaction tours at dealerships throughout the country in cities such as Los Angeles, San Francisco, Kansas City, St. Louis, Cleveland, Detroit, Chicago, etc. Two other turbine cars, a second Dodge and a second Plymouth, were added during the month of April in order to expand coverage of the tours. All four cars were powered by versions of the CR2A turbine engine.

1962 TURBINE TWINS

The tour schedule was similar in each area. When the cars arrived in a given city they were first displayed to members of the local press. The press events involved explaining the turbine and answering questions, giving each newsman a ride in one of the cars, and, in some cases, staging special tests. After members of the press hac viewed the cars, they were then displayed at various dealerships.

One of the key reasons for these tours and exhibits was to elicit and evaluate consumer reactions to the turbine. The cars were shown at Plymouth and Dodge dealerships in approximately 90 major cities in the United States and Canada.

STOPOVER POINTS ON CONSUMER REACTION TOUR

During this time hundreds of thousands of people came to see the turbine vehicles, and public interest was intense and serious. When asked, "if this car were offered for sale to the motoring public, do you think you would buy one?" 30 per cent of the turbine viewers said "yes" they would definitely buy one and 54 per cent answered they would think seriously of buying one.

As a result, on February 14, 1962, Chrysler Corporation announced that it would build 50 to 75 turbine-powered passenger cars which would be available to selected users by the end of 1963. Typical motorists would be offered an opportunity to evaluate turbine cars under a variety of driving conditions.

On February 14, 1962, in Chicago, Chrysler Corporation exhibited another gas turbine vehicle--the Dodge Turbo Truck. This medium-duty truck (also equipped with the CR2A experimental engine) had just completed a 290-mile test run from Detroit to Chicago.

TURBINE PULLING POWER TESTED IN 1962 DODGE TURBO TRUCK

From February 17 through 25, three gas turbine-powered vehicles (the Plymouth, Dodge, and Dodge Truck) were exhibited at the Chicago Automobile Show.

On March 7, 1962, George J. Huebner, Jr., Executive Engineer of Research for Chrysler Corporation, received an award from the Power Division of the American

GEORGE J. HUEBNER, JR. RECEIVES AWARD FOR
GAS TURBINE LEADERSHIP

Society of Mechanical Engineers "for his leadership in the development of the first automotive gas turbine suitable for mass-produced passenger automobiles." It was the first such award ever given to an automotive engineer.

A TURBINE CAR FOR PUBLIC EVALUATION

May 14, 1963, was an eventful day in the history of automotive design--the Chrysler Corporation Turbine Car was unveiled to newsmen at the Essex House in New York City. On the same day, a ride-drive program for the press was held on a two and one-half mile course at the Roosevelt Raceway on Long Island. On May 15, the car was viewed at the Waldorf-Astoria Hotel in New York City by Chrysler's Metropolitan New York dealers.

These events signalled the public launching of Chrysler Corporation's program of building 50 turbine-powered test cars and placing them in the hands of typical drivers for evaluation in everyday use.

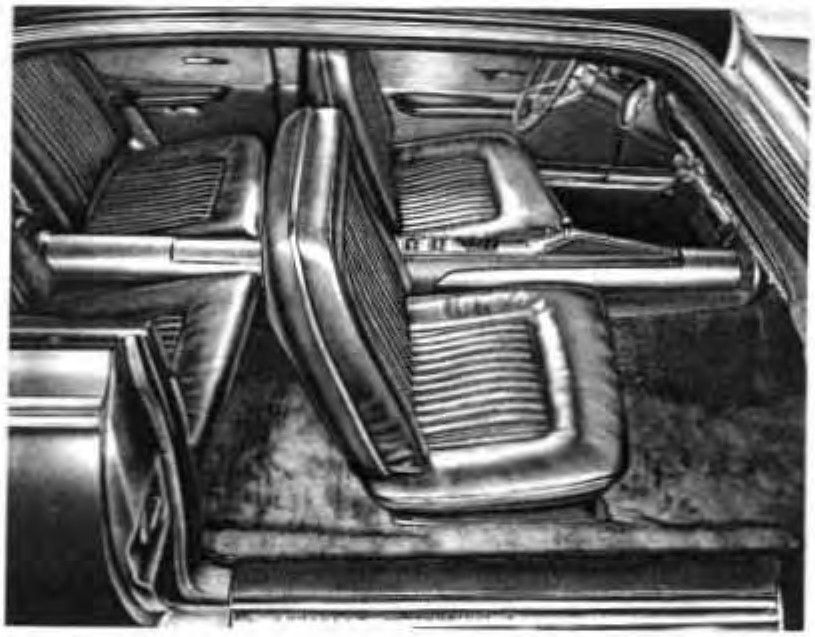
This program was an outstanding point in the history of turbine vehicles for two reasons: it was the first time any company had committed itself to build a substantial number of gas turbine automobiles; and it was the first time turbine-powered automobiles would be driven and evaluated by private individuals outside the corporation.

The Turbine Car was a completely new automobile. Since the sole purpose was to determine the reaction of typical American drivers to turbine-powered vehicles, the engine was placed in a family-type car designed for everyday use. This formed a familiar evaluation background for the driver. The styling theme provided an exciting setting for the vehicle itself, creating an over-all impression of fresh styling appeal with strong emphasis on a contemporary and luxurious appearance. Ornamentation was

A COMPLETELY NEW CAR

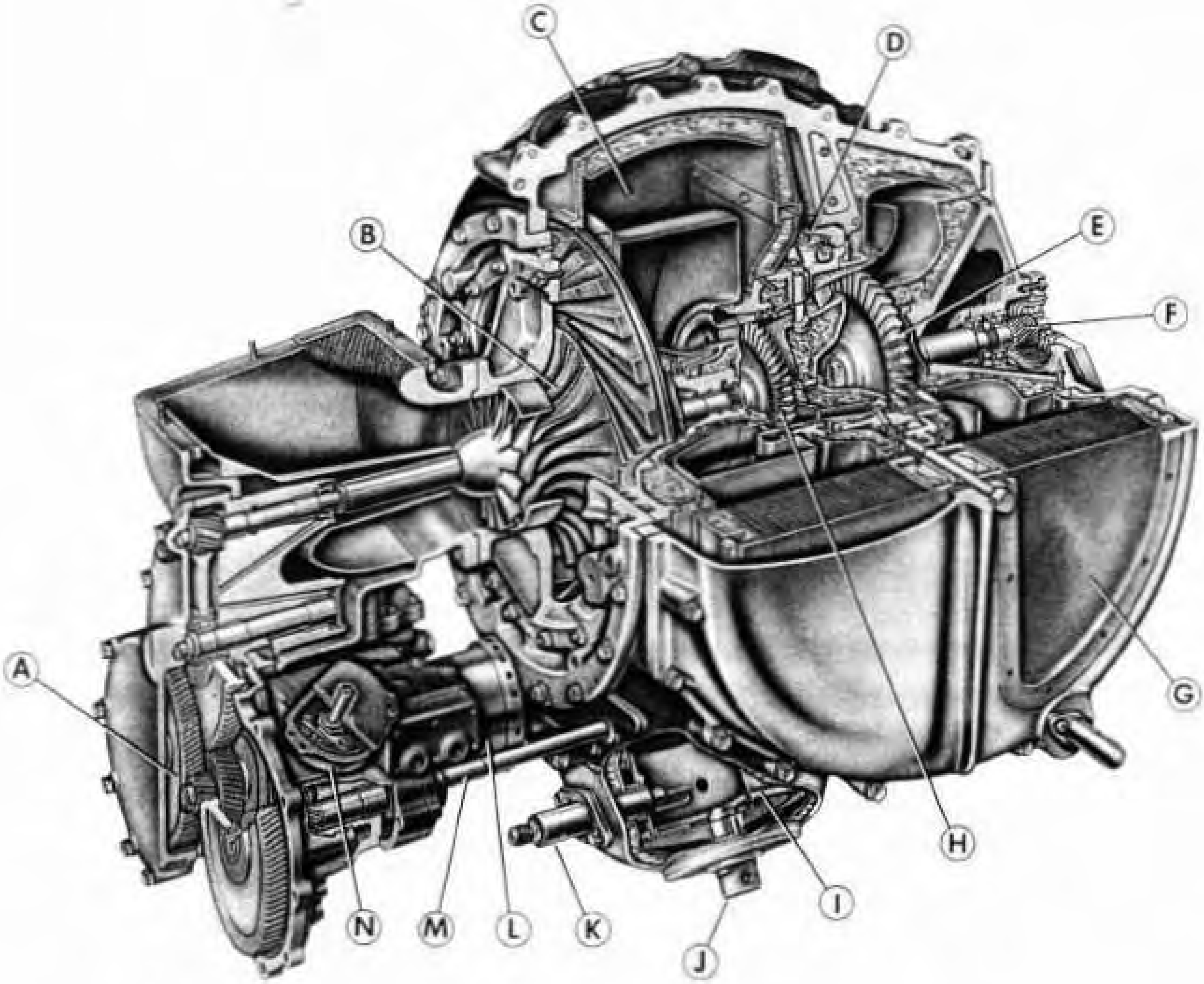
REAR VIEW EMPHASIZES AERODYNAMIC STYLING

based on the bladed turbine motif which is characteristic of the engine. The interior featured a full-length center console and extensive use of leather.



LUXURIOUS INTERIOR APPOINTMENTS OF THE TURBINE CAR

The limited-production Turbine Car was built in one body style only--a 4-passenger, 2-door hardtop. The exterior and interior color was Turbine Bronze. Power steering, power brakes, power window lifts, automatic transmission, and all other available equipment were standard.



MAIN COMPONENTS OF THE TWIN-REGENERATOR GAS TURBINE:
(A) accessory drive; (B) compressor; (C) right regenerator (D) variable nozzle unit; (E) power turbine; (F) reduction gear; (G) left regenerator; (H) compressor turbine; (I) burner; (J) fuel nozzle; (K) igniter; (L) starter-generator; (M) regenerator drive shaft; (N) ignition unit.

The turbine power plant for the car was an entirely new design, more advanced in concept than the previous Chrysler turbines, and more adaptable to production techniques. It was Chrysler Corporation's fourth generation turbine power plant design. Its most obvious feature was a new configuration with two regenerators rotating in vertical planes (one on each side) and a centrally located burner. Compared with the previous model CR2A, the new engine was more lively, lighter, more compact, and quieter.

SPECIFICATIONS OF CHRYSLER CORPORATION'S GAS TURBINE ENGINE

GENERAL

Type: Regenerative gas turbine

* Rated Output: Power - 130 bhp @ 3,600 rpm output shaft speed
Torque - 425 lb-ft @ zero rpm output shaft speed

Weight: 410 lbs

Basic Engine Dimensions (without accessories):

Length	-	25 inches
Width	-	25.5 inches
Height	-	27.5 inches

With current accessories in place, the over-all length is: 35 inches

Fuels: Unleaded gasoline, diesel fuel, kerosene, JP-4, etc.

COMPONENTS

Compressor:

Type	-	Centrifugal
Stages	-	One
Pressure Ratio	-	4:1
Efficiency	-	80%

First Stage Turbine:

Type	-	Axial
Stages	-	One
Efficiency	-	87%

Second Stage Turbine:

Type	-	Axial
Stages	-	One
Efficiency	-	84%

Regenerator: Type - Two rotating disks
Effectiveness - 90%+

Burner: Type - Single can, reverse flow
Efficiency - 95%

*DESIGN POINT CHARACTERISTICS

Maximum Gas Generator Speed - 44,600 rpm
Maximum Second Stage Turbine Speed - 45,700 rpm
Maximum Output Speed (after reduction gears) - 4,680 rpm
Maximum Regenerator Speed - 22 rpm
Compressor Air Flow - 2.2 lb/sec
First Stage Turbine Inlet Temperature - 1,700°F
Exhaust Temperature (full power) - 525°F
Exhaust Temperature (idle) - 180°F

*Ambient conditions: Temperature - 85°F; Barometric Pressure - 29.92 in. Hg

INSTRUMENTATION AND CONTROLS

The operation of the Turbine Car is much the same as that of a car with a piston engine and an automatic transmission.

To Start - Place the transmission shift lever in the "Idle" location and push down to engage the "Park/Start" position. Turn the ignition key to the right and release it. Starting is automatic. Within a few seconds, the inlet temperature and tachometer gauges on the instrument panel will read about 1200°F and 22,000 rpm, respectively, indicating that the engine is started.

To Drive - Place the transmission in "Low", "Drive", or "Reverse" (as with a conventional car), release the parking brake, and the car is ready to drive. Push the accelerator pedal to go, release it to reduce speed, and press the brake pedal to stop.

To Park - Bring the car to a complete stop, place the transmission lever in the "Idle" location and push it down to engage the "Park/Start" position, apply the parking brake, and turn the ignition key to the "off" position.

Performance and economy of the Turbine as demonstrated in proving grounds and highway tests were comparable to a conventional car with a standard V-8 engine. The engine operated satisfactorily on diesel fuel, kerosene, unleaded gasoline, JP-4 (jet fuel), and mixtures thereof. And, even more interesting, it was possible to change from one of these fuels to another without any changes or adjustments to the engine. The turbine engine has many other advantages, too (see summary list on page 2), and one of the objectives of the user evaluation program was to see just how much these advantages mean to the average motorist.

The Chrysler Corporation Turbine Cars were built at a rate of one per week until the last of the 50 cars was completed in October, 1964, The special facilities for building these limited production test cars were located at Chrysler Corporation's Engineering Research Laboratories in Detroit. At the assembly area, the Chrysler-designed car bodies, which were built by Ghia of Italy, were lowered onto the new engines and chassis components. The turbine engines were built and tested at Chrysler's Research Laboratories.

CHRYSLER PRESIDENT TOWNSEND VIEWS
THE FIRST TURBINE CAR ASSEMBLY LINE

THE CONSUMER RESEARCH PROGRAM

The objective of the program was to test consumer and market reaction to turbine power and to obtain service data and driver experience with the turbine cars under a wide variety of conditions. Each selected user drove one of the cars for a period up to three months under a no-charge agreement. The cars then were reassigned to other users to provide a broad consumer sampling base. In total, the cars were distributed to 203 motorists on a rotating system over a two-year period, from October 29, 1963, to October 28, 1965. The last user completed her three-month use period on January 28, 1966.

By retaining ownership of the cars, Chrysler kept in close touch with their performance and with the service experience on the engines; also Chrysler engineers were able to incorporate advances and modifications resulting from Chrysler's continuing research program. A period of three months was selected because it was felt this would give each driver ample time to try out turbine power under a variety of conditions. Limiting each driver to this period made it possible to obtain the reactions of over 200 users in a short space of time.

Users of the turbine-powered passenger cars were selected by the accounting firm of Touche, Ross, Bailey, and Smart. Under the user selection procedure, Chrysler gave the accounting firm the date and metropolitan area location of each planned delivery, which was geared to the turbine production schedule. Random selection of user candidates for each location was then made by the accounting firm according to the selection and distribution criteria specified by Chrysler to meet market test objectives.

The basic qualifying requirements were that a candidate must own a car (or, be a member of a household in which a car is owned by the head of the household) and must have a valid driver's license.

Turbine candidates were picked as follows:

1 - From Chrysler's letter inquiry file of 30,000 names. These applications were in the form of unsolicited letters from people in hundreds of cities in all 50 states (and 15 countries). Requests ranged from that of a 12-year-old boy asking that his father be given a car to that of an 83-year-old retiree.

2 - From 128 major population centers of the 48 continental states. Chrysler specified this to assure a high degree of market exposure to turbine-powered vehicles and to test the cars in a variety of geographical areas and in all kinds of weather and terrain. The number of trials in each population center was apportioned according to the number of cars owned in each area.

3 - In accordance with the make, price category, and age of the new and used cars owned by candidates at the time they wrote their letters to Chrysler. In this respect, the program intent was to select users whose car ownership pattern reflected the great variety of the types and ages of cars on the road today.

In return for the use of the turbine car, each user was asked to furnish Chrysler with information needed for the market evaluation program. Chrysler handled the service, insurance, and other costs involved in the use of the turbine car. Each user bought the fuel for driving it. The user also was expected to maintain the physical appearance of the car, exercise reasonable care to protect it from damage, and supervise its use by others.

The world's first consumer delivery of a turbine car took place October 29, 1963, in Chicago. Mr. Lynn A. Townsend, president of Chrysler Corporation, presented the keys of the turbine car to Mr. and Mrs. Richard E. Vlaha of Broadview, a suburb of Chicago.

FIRST CONSUMER DELIVERY OF
A TURBINE CAR

SUMMARY OF CHRYSLER CORPORATION TURBINE CONSUMER DELIVERY PROGRAM

OCTOBER 29, 1963—JANUARY 28, 1966

Number of turbine cars built for program	50
Number of selected users who drove turbine cars	203
Number of cities included in delivery program	133
Number of states included in delivery program	48 plus D.C.
Mileage collectively driven by turbine motorists	1,111,330
Average mileage driven by users during three-month period	5,474
Highest mileage driven by a user during three-month use period	14,046
Lowest mileage driven by a user during a three-month use period	1,025
Number of cars with no 3-month use period	4[1]
Number of cars with one 3-month use period	1
Number of cars with two 3-month use periods	2
Number of cars with three 3-month use periods	6
Number of cars with four 3-month use periods	11
Number of cars with five 3-month use periods	20
Number of cars with six 3-month use periods	6

Of the 203 turbine motorists, 90% (180) were men and 10% (23) were women. Their ages ranged from 21 to 70 years.

60% of these motorists had Chrysler products as personal cars at the time they applied for a turbine. The rest (40%) owned competitive makes.

There were over 30,000 applicants for participation in the test program. Each selected user drove a turbine for a three month period under a no-charge use agreement.

[1]Cars Assigned to national dealership Tour and World's Fair.

No.	Metro Area	Use Period	Total Mileage	User's Personal Car[2]		User	Age[3]	Occupation
1.	Chicago, Ill.	10/29/63— 1/29/64	3635	Dodge	1960	Richard Vlaha	25	Systems Engineer
2.	Columbus, Ohio	11/13/63— 2/13/64	2198	Chevrolet	1961	Estelle Center (Mrs.)	36	Housewife
3.	Detroit, Mich.	12/ 4/63— 3/ 4/64	7028	Valiant	1960	Charles Goebel	38	Banker
4.	Indianapolis, Ind.	12/11/63— 3/11/64	4063	Chevrolet	1952	Henry Johnson	51	College Coach
5.	Los Angeles, Calif.	1/ 7/64— 3/28/64	4990	Cadillac	1955	Charles Kendall	58	Minister
6.	San Francisco, Calif.	1/29/64— 4/30/64	4275	Oldsmobile	1960	Edgar Hills	58	President, Trucking Firm
7.	Chicago, Ill.	2/ 4/64— 5/ 4/64	6775	Chrysler	1962	George Ries	48	President, Metal Products Company
8.	Louisville, Ky.	2/ 5/64— 5/ 5/64	6669	Chevrolet	1962	Jack Goldberg	30	House Wares Salesman
9.	San Diego, Calif.	2/14/64— 5/14/64	4975	Valiant	1960	Max Bailey	46	Correctional Worker
10.	Toledo, Ohio	2/19/64— 5/19/64	1814	Plymouth	1962	Robert Bonasch	38	Fireman
11.	Houston, Texas	2/25/64— 5/25/64	5400	Chrysler	1963	Edmond Satterwhite	56	Office Manager, Chemical Co.
12.	Pittsburgh, Pa.	2/26/64— 5/26/64	3290	Chrysler	1953	Lawrence Young	59	Steelworker
13.	New York, N.Y.	3/ 4/64— 6/ 4/64	3235	Chevrolet	1951	Joseph Chiariello	51	Electrician-Mechanic
14.	Miami, Fla.	3/12/64— 6/12/64	5735	Ford	1957	Hubert Koch	36	Telephone Repairman
15.	Grand Rapids, Mich.	3/17/64— 6/17/64	5288	Ford	1958	Edward Tangenberg	36	High School Teacher
16.	Atlanta, Ga.	3/18/64— 6/18/64	5128	Plymouth	1953	Samuel Dinerman	43	Office Manager, Photo Service Co.
17.	South Bend, Ind.	3/20/64— 6/20/64	6780	Chrysler	1963	Walter Milovich	49	President, Tool and Die Firm
18.	Washington, D. C.	3/26/64— 6/26/64	2770	Dodge	1951	Raymond Hunter	55	Retired Rear Admiral
19.	Philadelphia, Pa.	4/ 3/64— 7/ 3/64	3482	Chevrolet	1953	Benjamin Kaplan	46	Junior High School Principal
20.	Denver, Colo.	4/ 8/64— 7/ 8/64	11815	Pontiac	1962	George Goodwin	42	Fabrics Salesman
21.	Albuquerque, N. M.	4/15/64— 7/15/64	3739	Plymouth	1957	Frank Hennigan	38	Service Station Operator
22.	Los Angeles, Calif.	4/22/64— 7/22/64	2819	Ford	1960	Adriana Zeydel (Mrs.)	40	Housewife
23.	Boston, Mass.	4/24/64— 7/24/64	3867	Plymouth	1957	Robert Dumont	33	Medical Service Representative
24.	Buffalo, N. Y.	5/12/64— 8/12/64	8489	Chrysler	1962	Edward Fornes	56	Exec. Vice Pres. Construction Firm
25.	Sacramento, Calif.	5/14/64— 8/14/64	8147	Chrysler	1963	Horace Tully	55	Service Station Operator
26.	Portland, Me.	5/20/64— 8/20/64	7508	Falcon	1962	Harold Alward	56	Interstate Bus Driver
27.	Pittsburgh, Pa.	5/21/64— 8/21/64	5166	Ford	1957	Jo Ann Diener (Mrs.)	34	Housewife
28.	San Diego, Calif.	5/26/64— 8/26/64	3630	Chevrolet	1959	Sander Garrie	38	Surgeon
29.	Peoria, Ill.	5/27/64— 8/27/64	6488	Dodge	1957	Walter Brunings	32	Steelworker
30.	Cleveland, Ohio	5/28/64— 8/28/64	8441	Plymouth	1953	Betty Emmett (Mrs.)	34	Junior High School Teacher
31.	Dallas, Texas	6/ 4/64— 9/ 4/64	9430	Dodge	1960	R. James Gambrel	32	Manufacturer's Representative
32.	Beaumont, Texas	6/ 9/64— 9/ 9/64	5650	Plymouth	1951	William Knoble	38	Sales Engineer
33.	Milwaukee, Wis.	6/10/64— 9/10/64	7468	Plymouth	1960	John Hennick	46	Public Relations Man
34.	Akron, Ohio	6/11/64— 9/11/64	3988	Dodge	1958	Robert Schmittle	34	Bank Manager
35.	Louisville, Ky.	6/16/64— 9/16/64	9396	Chrysler	1958	William Kinnaird	63	Retired Businessman
36.	New York, N. Y.	6/18/64— 9/18/64	4821	Imperial	1960	Beatrice McLean (Mrs.)	38	Partner—Industrial Design Firm

No.	Metro Area	Use Period	Total Mileage	User's Personal Car[1]		User	Age[2]	Occupation
37.	Minneapolis, Minn.	6/18/64— 9/18/64	9339	Ford	1954	Wallace Danson	32	Reliability Engineer
38.	Miami, Fla.	6/24/64— 9/24/64	4769	Plymouth	1961	James Shively	29	Employee Benefit Consultant
39.	Portland, Ore.	6/29/64— 9/29/64	10024	Chevrolet	1961	Andrew Corn	44	Business Machine Salesman
40.	Kansas City, Mo.	7/ 1/64—10/ 1/64	5487	Plymouth	1960	Don Suttles	47	Auditor
41.	Detroit, Mich.	7/ 1/64—10/ 1/64	7487	Chevrolet	1956	Leo Rahal	58	Barber
42.	Atlanta, Ga.	7/ 1/64—10/ 1/64	4380	Pontiac	1963	Herbert Kirschner	49	Businessman
43.	Washington, D. C.	7/ 8/64—10/ 8/64	4461	Dodge	1961	Margaret Vance (Miss)	54	Dietitian
44.	Indianapolis, Ind.	7/ 8/64—10/ 8/64	5815	Volkswagen	1959	William Montgomery	52	Surgeon
45.	St. Louis, Mo.	7/ 9/64—10/ 9/64	10502	Chevrolet	1963	Malcolm Stevens	48	Railroad Switchman
46.	New Haven, Conn.	7/15/64—10/15/64	2617	Plymouth	1959	Maurice Libson	45	Industrial Designer
47.	Philadelphia, Pa.	7/17/64—10/17/64	2784	Ford	1962	Stephen Marks	21	College Student
48.	Denver, Colo.	7/22/64—10/22/64	5492	Valiant	1963	Robert Ellingboe	24	College Student
49.	Cincinnati, Ohio	7/23/64—10/23/64	4287	Plymouth	1957	Jack Phelps	36	Fire Department Lieutenant
50.	Des Moines, Iowa	7/29/64—10/29/64	4201	Plymouth	1957	Harold Adams	47	Steam Fitter
51.	Seattle, Wash.	7/30/64—10/30/64	8407	Buick	1948	William Potter	52	Bank Trust Officer
52.	Raleigh, N. C.	8/ 5/64—11/ 5/64	5108	Plymouth	1959	Ferdinand Lemus	47	Operations Research Analyst
53.	Los Angeles, Calif.	8/ 6/64—11/ 6/64	4613	Dodge	1958	Robert Hall	46	Interior Decorator
54.	Boston, Mass.	8/ 7/64—11/ 7/64	2488	Plymouth	1958	Thomas Lawn	47	Telephone Repairman
55.	El Paso, Texas	8/12/64—11/12/64	2514	Dodge	1962	Alice Schultz (Mrs.)	40	Housewife
56.	Rochester, N. Y.	8/25/64—11/25/64	5602	DeSoto	1959	Elmer Youngjohn	61	Tech. Asst. to Gen. Mgr.—Button Co.
57.	San Jose, Calif.	8/27/64—11/27/64	7101	Chevrolet	1961	Bruce Stern	69	Manufacturer's Representative, Paper Products
58.	Albany, N. Y.	9/ 3/64—12/ 3/64	3739	Buick	1961	Arthur Rossdeutscher	44	Staff Accountant
59.	Pittsburgh, Pa.	9/ 8/64—12/ 8/64	4465	Pontiac	1961	Donald Slusser	56	Plastics Manufacturer
60.	Hartford, Conn.	9/10/64—12/10/64	6474	Ford	1958	Edward Golden	52	Postman
61.	E. St. Louis, Ill.	9/10/64—12/10/64	3494	Ford	1957	Killian Schuell	54	Railroad Electrician
62.	San Diego, Calif.	9/10/64—12/10/64	2342	Cadillac	1963	Stuart Bicknell	45	Dentist
63.	Providence, R. I.	9/17/64—12/17/64	5949	Dodge	1960	William Grunden	37	Minister
64.	Jackson, Miss.	9/17/64—12/17/64	7980	Chevrolet	1961	Connie Loyd	38	Employment Interviewer
65.	Dallas, Texas	9/17/64—12/17/64	4082	Volkswagen	1958	Joseph Foster, Jr.	28	Mortgage Loan Officer
66.	Allentown, Pa.	9/23/64—12/23/64	5041	Imperial	1954	Ray Fenstermacher	32	Machinist
67.	Canton, Ohio	9/23/64—12/23/64	11082	DeSoto	1954	Jack White	46	Minister
68.	Milwaukee, Wisc.	9/24/64—12/24/64	9913	Dodge	1963	Robert Jahnke	30	Sales Engineer
69.	Houston, Texas	9/24/64—12/24/64	11467	Plymouth	1963	Kenneth Froehner	51	Sales Representative, Chemicals
70.	Baltimore, Md.	9/29/64—12/29/64	3431	Chevrolet	1958	Edwin Yakubowski	37	Computer Systems Operator
71.	New York, N. Y.	9/30/64—12/30/64	3965	Dodge	1962	Albert Wurth	60	Chief Engineer—U. S. Public Health Hosp.
72.	Mobile, Ala.	9/30/64—12/30/64	2903	Plymouth	1963	Charles Brunson, Jr.	39	Q. C. Specialist—USAF
73.	Fargo, N. D.	9/30/64—12/30/64	9549	Buick	1962	Horace Whitman	68	U. S. Savings Bond Official
74.	Charleston, W. Va.	10/ 1/64— 1/ 1/65	7743	DeSoto	1956	Vivian Steahly (Mrs.)	49	College Professor
75.	Ft. Lauderdale, Fla.	10/ 6/64— 1/ 6/65	3800	DeSoto	1956	Blanche Metko (Mrs.)	63	Homemaker
76.	Richmond, Va.	10/ 8/64— 1/ 8/65	9658	Ford	1951	Keith Smith	39	Resident Manager Asphalt Firm
77.	Charleston, S. C.	10/12/64— 1/12/65	8244	Ford	1956	Norman Gilbert	39	Mechanical Engineer
78.	Flint, Mich.	10/14/64— 1/14/65	5219	Pontiac	1956	Louise Hensley (Mrs.)	33	Secretary
79.	Newark, N. J.	10/15/64— 1/15/65	5261	Chrysler	1953	Murray Holdman	42	Electrical Engineer
80.	Nashville, Tenn.	10/20/64— 1/20/65	7184	Lancer	1962	W. Arch Bratton	47	U. S. Commerce Dept. Official
81.	Paterson, N. J.	10/21/64— 1/21/65	2892	DeSoto	1955	Rose Dashow	—	Homemaker
82.	Ft. Wayne, Ind.	10/21/64— 1/21/65	3798	Plymouth	1954	Edwin P. Fox	24	Receiving Clerk
83.	New York, N. Y.	10/22/64— 1/22/65	2321	DeSoto	1955	Ralph Lewis, Jr.	35	Dept. Mgr.—Department Store
84.	St. Louis, Mo.	10/22/64— 1/22/65	3304	Plymouth	1961	Otis Stringer	38	Cost Accountant
85.	Cleveland, Ohio	10/28/64— 1/28/65	4803	Plymouth	1963	Elmer A. Kish	51	Consulting Engineer
86.	Philadelphia, Pa.	10/29/64— 1/29/65	2968	Valiant	1964	Angelo Perna	27	Mailer
87.	Wichita, Kan.	10/29/64— 1/29/65	5580	Renault	1959	James Lyle, Jr.	28	Electrical Engineer
88.	Tampa, Fla.	11/ 6/64— 2/ 6/65	3490	Buick	1955	George Goodwin	42	Civil Engineer
89.	Salt Lake City, Utah	11/ 9/64— 2/ 9/65	4799	Chrysler	1961	Gennaro Yannaccone	42	Safety Engineer
90.	Sioux Falls, S. D.	11/11/64— 2/11/65	4816	Ford	1930	Jack Kidder	38	Engineer—Telephone Co.
91.	Dayton, Ohio	11/12/64— 2/12/65	5721	Plymouth	1961	William Powe, Jr.	51	Logistics Support Officer (Defense Dept.)
92.	Winston-Salem, N. C.	11/18/64— 2/18/65	2358	Plymouth	1954	John Parker, Jr.	44	College Professor
93.	Worcester, Mass.	11/19/64— 2/19/65	9043	Plymouth	1959	Morgan Potter	52	Oil Company Salesman
94.	Newark, N. J.	12/ 3/64— 3/ 3/65	2823	Plymouth	1949	Walter Weberbauer	43	Shipping-Receiving Supervisor
95.	Columbus, Ga.	12/ 3/64— 3/ 3/65	7877	Studebaker	1961	Robert Corman	43	Manufacturers' Representative Foot Wear
96.	San Bernardino, Calif.	12/ 3/64— 3/ 3/65	9828	Dart	1963	Filon Beadle	37	Company Pilot
97.	Oakland, Calif.	12/ 3/64— 3/ 3/65	6436	Oldsmobile	1962	Robert Christoffersen	23	Dental Student
98.	Erie, Pa.	12/ 8/64— 3/ 8/65	4742	Chevrolet	1958	Marlin Milbron	31	Post Office Clerk
99.	Dallas, Texas	12/15/64— 3/15/65	4439	Pontiac	1963	Charles Rahn	39	Petroleum Technician
100.	Syracuse, N. Y.	12/16/64— 3/16/65	3547	Dodge	1963	Leo Fisselbrand	60	Organist-Choir Director
101.	Pittsburgh, Pa.	12/17/64— 3/17/65	3539	Volvo	1961	Ernest Vyrostek	55	Journeyman Steel Fitter
102.	Spokane, Wash.	12/17/64— 3/17/65	2133	Dodge	1949	Cecil Inns	45	Food Brokerage Salesman
103.	Davenport, Iowa	1/ 6/65— 4/ 6/65	3353	Chevrolet	1959	Lester Litscher	38	Machine Shop Foreman
104.	Phoenix, Ariz.	1/ 6/65— 4/ 6/65	7423	Chrysler	1962	Walter Miller	56	Beverage Salesman
105.	Manchester, N. H.	1/ 7/65— 4/ 7/65	4118	Dodge	1961	Ethan Howard, Jr.	43	Physician
106.	Fort Worth, Texas	1/ 7/65— 4/ 7/65	4953	Ford	1953	Byron Kress	44	Project Mgr. Missiles & Space Firm
107.	Los Angeles, Calif.	1/ 7/65— 4/ 7/65	6050	Plymouth	1951	James Link	38	Manufacturers' Representative
108.	Dayton, Ohio	1/12/65— 4/12/65	2802	Dodge	1963	Howard Lubow	37	Real Estate Salesman
109.	Houston, Texas	1/12/65— 4/12/65	7131	Ford	1960	George Evans	58	Vice President Engineering Co.
110.	New York, N. Y.	1/13/65— 4/13/65	3035	Lincoln	1956	Ethelbert Carrington	49	Physician
111.	Huntington, W. Va.	1/14/65— 4/14/65	7178	Volkswagen	1963	Howard McEachern	32	Minister
112.	San Antonio, Texas	1/14/65— 4/14/65	6195	Dodge	1957	Christine E. Blundell (Mrs.)	58	Telephone Operator
113.	Harrisburg, Pa.	1/21/65— 4/21/65	3098	Dodge	1961	Robert Young	31	Supervisor—Power & Light Company
114.	Milwaukee, Wis.	1/21/65— 4/21/65	6504	Dodge	1960	Clair Mueller	40	Staff Supervisor—Chainbelt Company
115.	New Orleans, La.	1/26/65— 4/21/65	4912	Plymouth	1955	Wilbert Waits	46	Pharmacist
116.	Camden, N. J.	1/28/65— 4/28/65	3400	Comet	1962	Robert Baker	33	Engineering Draftsman
117.	Atlanta, Ga.	1/28/65— 4/28/65	3702	Chrysler	1961	Thomas Gissy	45	Scheduling Coordinator
118.	Lansing, Mich.	1/28/65— 4/28/65	6521	Chrysler	1956	Arthur Churchill	59	Control Board Operator—Water & Light Company
119.	Minneapolis, Minn.	1/28/65— 4/28/65	7765	Chrysler	1961	Ronald Erhart	36	Product Engineer—Appliance Firm

No.	Metro Area	Use Period	Total Mileage	User's Personal Car[2]		User	Age[3]	Occupation
120.	New York, N. Y.	2/ 2/65— 5/ 2/65	3098	Dodge	1950	Robert Gueydan	60	Foreign Trade Consultant
121.	Bethesda, Md.	2/ 4/65— 5/ 4/65	3620	Oldsmobile	1960	Alfred Hedge	66	Engineer (Retired)
122.	Gary, Indiana	2/ 4/65— 5/ 4/65	6361	Lincoln	1957	Walberta Herndon (Mrs.)	42	Piano Teacher
123.	Fresno, Calif.	2/ 9/65— 5/ 9/65	7532	Chevrolet	1963	Eugene Winter	34	Accountant
124.	Norfolk, Va.	2/10/65— 5/10/65	5583	Chrysler	1956	Robert Adkisson	48	Payroll Supervisor
125.	Philadelphia, Pa.	2/11/65— 5/11/65	1734	Plymouth	1951	Niles Jaquay	44	Commercial Photographer
126.	Orlando, Fla.	2/16/65— 5/16/65	2866	Chrysler	1962	Seth Moorhead, Jr.	37	Missile Design Engineer
127.	Paterson, N. J.	2/18/65— 5/18/65	6640	Plymouth	1962	Irving Koetting	47	Sales Engineer
128.	Topeka, Kansas	2/18/65— 5/18/65	10324	Dodge	1961	Bill Krietemeyer	44	Traffic Control Engineer
129.	Boise, Idaho	2/18/65— 5/18/65	11935	Dart	1963	Thomas Sheehan	36	Sales Manager
130.	Cincinnati, Ohio	2/23/65— 5/23/65	5492	Chevrolet	1962	Newton Cross	58	Marketing Specialist
131.	Youngstown, Ohio	2/25/65— 5/25/65	2604	Ford	1963	Emanuel Catsoules	30	School Teacher
132.	Boston, Mass.	3/ 3/65— 6/ 3/65	5528	Chrysler	1964	Roland Whitman	64	Insurance Broker
133.	Madison, Wis.	3/ 4/65— 6/ 4/65	7831	Chrysler	1957	Raymond Penn	53	Prof. of Agricultural Economics
134.	St. Petersburg, Fla.	3/ 5/65— 6/ 5/65	5680	Buick	1958	Frances Willy (Mrs.)	35	Housewife
135.	Jacksonville, Fla.	3/ 9/65— 6/ 9/65	5438	Ford	1960	Martha Linton (Mrs.)	53	School Teacher
136.	San Bernardino, Calif.	3/11/65— 6/11/65	5286	Chevrolet	1962	Frank Pyle	24	Photographer
137.	Columbia, S. C.	3/17/65— 6/17/65	4514	Plymouth	1958	Joseph Byrd	44	Automotive Parts Salesman
138.	Charlotte, N. C.	3/18/65— 6/18/65	4580	Chrysler	1963	James Downing	50	Office Machine Sales Manager
139.	Buffalo, N. Y.	3/18/65— 6/18/65	3795	Dodge	1962	Stuart Kestee, Jr.	32	Chief Project Engineer— Plant Equipment
140.	Tucson, Ariz.	3/18/65— 6/18/65	6842	Ford	1960	Duane Doane	40	Truck Driver
141.	Birmingham, Ala.	3/24/65— 6/24/65	4361	Chevrolet	1962	William Russell	58	Floor Covering Salesman
142.	Oakland, Calif.	3/25/65— 6/25/65	2732	DeSoto	1960	Glen Coberly	65	Railroad Conductor
143.	Memphis, Tenn.	4/ 1/65— 7/ 1/65	5123	Plymouth	1959	Hugh Perkins	52	Appliance Salesman
144.	Little Rock, Ark.	4/ 1/65— 7/ 1/65	4801	Plymouth	1958	Paul Carlton	36	Pharmaceutical Salesman
145.	Tacoma, Wash.	4/ 1/65— 7/ 1/65	8098	Plymouth	1962	Marie Hindery (Mrs.)	41	Interviewer, Bureau of Census
146.	Oklahoma City, Okla.	4/14/65— 7/14/65	6126	Plymouth	1959	Arthur Forrester	67	Cabinet Maker
147.	Burlington, Vt.	4/15/65— 7/15/65	3114	Ford	1963	Raymond Baldwin	58	Petroleum Distributor
148.	Ft. Worth, Texas	4/22/65— 7/22/65	3775	Buick	1961	James Irion	33	Attorney
149.	Las Vegas, Nev.	4/22/65— 7/22/65	3874	Plymouth	1962	Thomas Schofield	70	Businessman
150.	Cleveland, Ohio	4/28/65— 7/28/65	10192	Plymouth	1957	Harold Buscher	50	Engineering Supervisor
151.	Scranton, Pa.	4/29/65— 7/29/65	6387	Imperial	1955	Raymond Baracaia	55	Carpenter
152.	San Antonio, Texas	4/29/65— 7/29/65	2698	Thunderbird	1958	Lawrence Pawkett	52	President, Air Conditioning Co.
153.	New Brunswick, N.J.	5/ 4/65— 8/ 4/65	4548	Plymouth	1963	John Moore	37	Scientist
154.	Covington, Ky.	5/ 4/65— 8/ 4/65	7332	Plymouth	1957	Mary DeMaria (Mrs.)	36	Housewife
155.	Chicago, Ill.	5/ 6/65— 8/ 6/65	5062	DeSoto	1960	Arthur Karnstedt	56	Business Manager
156.	Shreveport, La.	5/ 6/65— 8/ 6/65	4993	Chevrolet	1959	Ray Kelly	36	Store Manager, Furniture & Appliances
157.	Baltimore, Md.	5/11/65— 8/11/65	2555	Plymouth	1962	Gerald Herman	49	Vice President Plumbing & Heating Co.
158.	Columbus, Ohio	5/12/65— 8/12/65	5032	Falcon	1961	Garrell Spires	42	Bank Officer
159.	Newport News, Va.	5/13/65— 8/13/65	4043	Valiant	1962	James Langston	46	Real Estate Appraiser
160.	Duluth, Minn.	5/13/65— 8/13/65	12242	DeSoto	1958	Alden Olson	49	Welding Foreman
161.	Flagstaff, Ariz.	5/14/65— 8/14/65	6464	Chrysler	1963	Charles Ryciel	28	Service Station Owner
162.	Gary, Ind.	5/18/65— 8/18/65	7146	Plymouth	1960	Arvella Miner (Mrs.)	46	Housewife
163.	Chattanooga, Tenn.	5/20/65— 8/20/65	6930	Chrysler	1958	Wade Hampton	70	Hospital Supply Salesman
164.	Paterson, N. J.	5/25/65— 8/25/65	14046	Chrysler	1963	Edwin Schulz	51	Real Estate Broker & Builder
165.	New York, N. Y.	5/27/65— 8/27/65	8122	Plymouth	1963	David Poucher	47	Beverage Salesman
166.	Arlington, Va.	5/27/65— 9/27/65	4302	Pontiac	1963	Elmer Hobbs, Jr.	42	Hair Stylist
167.	Kansas City, Mo.	6/ 3/65— 9/ 3/65	4196	Triumph	1962	Charles Cleverdon	54	Bank President
168.	Stockton, Calif.	6/ 3/65— 9/ 3/65	5084	Valiant	1960	Daniel Halliday	41	Utility Company Employee
169.	Norfolk, Va.	6/ 8/65— 9/ 8/65	5548	Rambler	1964	Charles Hodges	47	Investigator—Naval Supply Center
170.	Wilmington, Dela.	6/10/65— 9/10/65	3923	Plymouth	1957	Newton Hunsberger	41	Chemical Engineer
171.	Bridgeport, Conn.	6/17/65— 9/17/65	3112	Mercury	1959	Stephen Ondeka	55	Production Foreman
172.	Omaha, Neb.	6/17/65— 9/17/65	9223	Dodge	1961	Helen Saunders (Mrs.)	40	Secretary
173.	Miami, Fla.	6/24/65— 9/24/65	7158	Dodge	1964	Marion Gray	49	Aircraft Mechanic
174.	Knoxville, Tenn.	6/24/65— 9/24/65	6366	Buick	1961	Leroy Gerard	32	Architect
175.	Cheyenne, Wyoming	6/24/65— 9/24/65	12546	Chrysler	1941	Charles Kline	42	Trade & Educ. Director State of Wyoming
176.	San Jose, Calif.	6/30/65— 9/30/65	1797	Plymouth	1963	James Guiffre	40	Auditor—U. S. Govt.
177.	Greensboro, N. C.	7/ 8/65—10/ 8/65	4392	Dodge	1961	Mary Parker (Mrs.)	44	Housewife
178.	Rockford, Ill.	7/ 8/65—10/ 8/65	10961	Ford	1963	DuWayne Winters	26	Executive, Tool and Die Firm
179.	Los Angeles, Calif.	7/ 8/65—10/ 8/65	2147	Dodge	1964	Alfred Kramer	52	Owner and Operator— Auto Electric Service
180.	Birmingham, Alabama	7/14/65—10/14/65	3867	Plymouth	1962	Ross Green	51	Secretarial Staff—Press Steel Company
181.	Great Falls, Mont.	7/15/65—10/15/65	8160	Rambler	1959	David Friedrick	42	Orthopaedic Surgeon
182.	San Francisco, Calif.	7/15/65—10/15/65	5984	Plymouth	1960	Oscar Watson	49	Parole Officer—State of California
183.	Memphis, Tenn.	7/22/65—10/22/65	6213	Volkswagen	1963	John Durschlag	50	Real Estate Builder
184.	Buffalo, N. Y.	8/12/65—11/12/65	3172	Plymouth	1963	Louis Rohrdanz	55	Health & Safety Supervisor— Chemical Company
185.	Los Angeles, Calif.	8/12/65— 9/15/65	1149	Rambler	1962	Walter Strikeleather	52	Plant Safety Supervisor Telephone Company
186.	Brockton, Mass.	8/24/65—11/24/65	4612	Dodge	1963	Joyce Young (Mrs.)	37	Housewife
187.	Baltimore, Md.	8/26/65—11/26/65	3200	Dodge	1960	Cline Otey	63	Assistant Treasurer— Spice Mfg. Co.
188.	Hartford, Conn.	8/31/65—11/31/65	4963	Plymouth	1964	Gerald Reynolds	36	Warehouseman
189.	Tulsa, Okla.	9/ 2/65—12/ 2/65	4989	Chevrolet	1950	Homer Williams	47	Textbook, Salesman
190.	Minneapolis, Minn.	9/ 8/65—12/ 8/65	2830	Chrysler	1962	William Varner	35	Hardware, Salesman
191.	Chicago, Ill.	9/ 9/65—12/ 9/65	8294	Dodge	1960	Donald Pearcy	39	Sales Engineer
192.	Baton Rouge, La.	9/ 9/65—12/ 9/65	8949	Buick	1963	William Oliver	51	President, Cement Products Company
193.	Newark, N. J.	9/14/65—12/14/65	2809	Chevrolet	1961	Harold Helies, Jr.	26	Parts Dept. Supervisor
194.	Reading, Pa.	9/16/65—12/16/65	4950	Morris Minor	1959	Curtis Hoyt	54	Electrical Engineer
195.	Los Angeles, Calif.	9/23/65—12/23/65	2818	Chevrolet	1960	Neil Diess	37	Physician—General Practitioner
196.	St. Louis, Mo.	9/30/65—12/30/66	3109	Hudson	1951	Charles Marsau	52	Paint Salesman
197.	Springfield, Mass.	10/ 7/65— 1/ 7/66	10076	Mercury	1958	Richard Remillard	38	Custom Home Builder
198.	Portland, Ore.	10/ 7/65— 1/ 7/66	4992	Dodge	1963	Robert Ford	52	Farmer
199.	New Orleans, La.	10/12/65— 1/12/66	1025	Buick	1955	Hazel Mabry (Mrs.)		Housewife
200.	Rochester, N. Y.	10/13/65— 1/13/66	5100	Chrysler	1963	John Ferranti	35	Accountant
201.	Cedar Rapids, Iowa	10/14/65— 1/14/66	8675	Plymouth	1957	Thomas Reilly, Jr.	33	Pharmaceutical Salesman
202.	W. Palm Beach, Fla.	10/26/65— 1/26/66	2767	Thunderbird	1960	Maximillian Crispin	50	Physician-Surgeon
203.	Chicago, Ill.	10/28/65— 1/28/66	2641	Corvair	1960	Patricia Anderson (Mrs.)	47	Executive Secretary

[2]Car owned at time letter was written to Chrysler requesting use of turbine car.
[3]Age of user at time of delivery.

THE TURBINE CARS WERE EXPOSED TO A WIDE VARIETY OF CLIMATE IN THE PROGRAM

Turbine users mentioned other advantages like good engine power, quietness of operation, and non-stalling characteristics. Mainly, though, vibrationless engine operation and the prospect of reduced maintenance were uppermost in their minds.

In commenting on disadvantages, about one person in three expressed some dissatisfaction with acceleration lag, primarily, when starting from standstill. It was not as noticeable when cruising. In fact, most people felt that the car had exceptional acceleration at expressway speeds.

About one person in four expressed disappointment with fuel economy. Most of the users had been driving lighter cars with less performance and relatively good fuel economy. They generally spent much time demonstrating the turbine car to friends, making frequent starts and stops, or simply idling the engine while people gathered to look at the car. Consequently their over-all fuel consumption could not be considered a true measurement of the car's fuel mileage capability. In this area, Chrysler regards its own proving grounds and road test experience as a more valid measure of the turbine's actual fuel consumption.

In reacting to the sound of the turbine engine, users tended to contradict each other. For every person who complained about the noise level of the engine, there were three or four who liked the sound of turbine power. The car was described as immensely more quiet, especially at high speeds, than the conventional piston-powered automobile.

Lack of fuel availability and lack of service facilities were cited by turbine car users as disadvantages at the present time. Users sometimes found it inconvenient to locate diesel fuel or unleaded gasoline, especially on long trips. However, they knew that this situation would be alleviated if turbines came into more common use.

Engineering Gains from the Users' Program

From an engineering standpoint, the program afforded an opportunity to observe and to judge the behavior of turbine engines under actual customer driving conditions--the first time that automobile turbine engines were tested to such a wide extent under such circumstances. The turbine car user program provided an engineering record of over one million miles by 203 different drivers, men and women, old and young, in 48 states.

ONE OF THE 22 WOMEN SELECTED IN THE USER'S PROGRAM

Chrysler was primarily interested in the life of engine parts and components, their performance and reliability, the degree and nature of maintenance required, and the amount of training desirable for service people. The program also made it possible for engineers to field test and compare different concepts and designs. This was important because not all of the 50 turbine engines were exactly the same. As a car was built and put into service, it sometimes incorporated a more advanced turbine engine component or fabrication technique that engineers wanted to test under field conditions.

Often these more advanced parts were installed when an engine was brought in for service.

Engineers were especially watching for problems that had not shown up in laboratory or proving grounds tests. For example, regular inspections showed that some engines had been subjected to temperatures much higher than normally would be allowed by the fuel control. The fuel control itself was found to be working properly, but finally it was noticed that some drivers by-passed the automatic starting system by shifting the gear selector quickly before the engine had reached idle speed. The trouble was cured by modifying the automatic starting system so that the driver could not override it.

Each engine in the 50 test cars had a combined starter-generator which had performed well in previous testing. But during the user program it was found that the starter-generator brushes would not stand up to a combination of high altitude and low humidity. It was concluded that until further progress occurs in brush design or materials, the best solution is to have separate starter and alternator units.

Early igniters showed rapid electrical erosion and oxidation of the electrodes. Modifications were made to the electrodes and the flow of air that cools them to improve igniter life to more than 20,000 miles during the program. However, this was not considered adequate and further improvement is sought. It is hoped that redesigned igniters will more than double this life.

The test proved-out one of the features of a turbine engine--that power loss over a period of time is small. Moreover, it was found that the turbine engine can be brought back to its original power rating by simply introducing cleaning compound into the engine intake.

The material used in compressor turbine wheels of all but three of the 50 cars was cast CRM-6D, one of the family of high-strength, high-temperature, low-cost turbine wheel alloys developed by Chrysler Research. Operating experience with this material was highly satisfactory. Other versions of the CRM-6D material proved adequate for the variable nozzle vanes of the second stage, and for the first-stage nozzle, which is subjected to metal temperatures in excess of 1800°F during vehicle acceleration.

In addition to these materials tests, the 50-car program was used as a means of testing progressive design modifications and exploring various turbine wheel fabrication techniques.

As viewed by Chrysler engineers, vehicle response and acceleration were surprisingly good during the program--when it is considered that the engine was rated at only 130 horsepower and the car weighed about 4100 pounds. Acceleration time from 0 to 60 mph was generally around 12 seconds with an outside temperature of 85°F, and better on cooler days. Chrysler engineers have since improved acceleration response by means of a faster-acting variable nozzle actuator. The nozzle blades snap into their acceleration position about three times faster.

Engine braking action of the variable nozzle also has been improved by causing the blades to switch to their braking position faster and by making it possible for them to go a little farther, also, without an increase in temperature that could cause damage.

Vehicle response and acceleration are related to the responsiveness of the gas generator (first-stage turbine and compressor) which must speed up whenever additional power is called for. (The maximum "response time" is the time it takes the gas generator to accelerate from idle speed to full power.) In the engines of the 50 test cars, the response time was from 1-1/2 to 2 seconds--a substantial improvement over earlier engines. The many miles and hours of engine operation in the program showed that acceleration temperature could be increased without damaging the engine. This, plus a reduction in the inertia of the gas generator rotor, resulted in eliminating another half second in the time it takes the gas generator to reach full speed. Thus acceleration "lag" was diminished and performance improved.

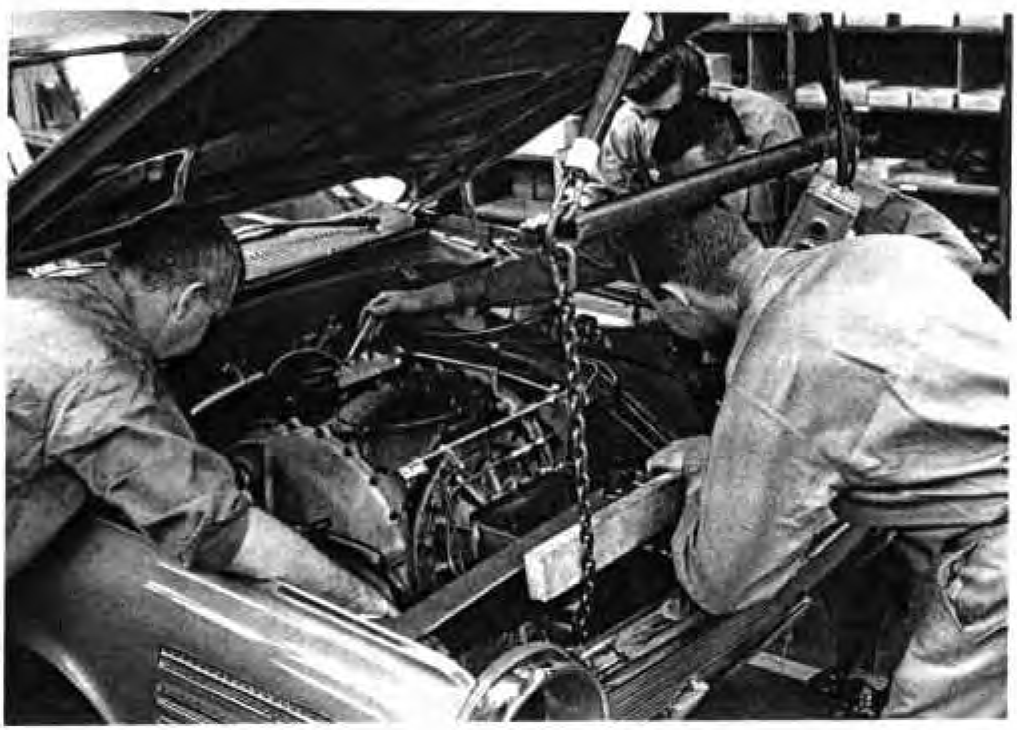
Located all over the nation, the turbine cars were exposed to wide ranges of starting temperatures. Some very cold areas required the use of a 24-volt battery system, as a temporary expedient. Since then, the accessory load and bearing losses in the gas generator have been reduced so that dependable starting is achieved in all climates with a 12-volt system.

As an outgrowth of the test program, noise is being reduced by modifying accessory drive gears, reducing the speed at which the accessories run at idle, and improving the intake filter-silencers.

The 1.1 million miles accumulated during the 50-car program have been a valuable, direct source of information on the daily, over-the-road behavior of gas turbine engines and components. The program was useful in judging the potential value and acceptance of the gas turbine as an automobile power plant, and the lessons learned will be useful in helping Chrysler engineers improve performance, reliability, life, and manufacturing methods.

The Service Aspect

An extremely beneficial aspect of the program was the experience gained in turbine engine maintenance and in the training of service personnel. For this program, Chrysler had five field service men and two supervisors who were charged with providing

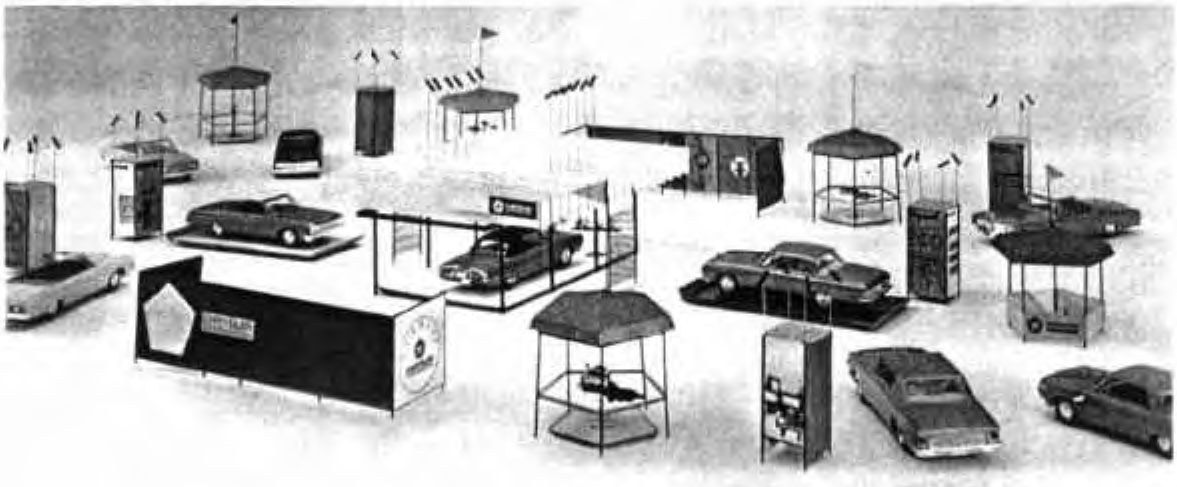


FIELD SERVICE WAS PERFORMED ACROSS THE NATION BY FIVE TECHNICIANS engine service and keeping track of the time during which engines could not be operated because of malfunction. The service required on 50 cars, scattered the length and breadth of the nation, was performed essentially by these five men.

During the early weeks of the program, operating time lost because of engine malfunction amounted to about 4 per cent. Eventually this was reduced to slightly more than 1 per cent. Considering that many of the lost days included travel time for service men and shipping time for parts--a situation that would not exist with a vehicle that is produced and sold in volume--this was a remarkable record for an experimental engine out on its own for the first time.

The experience of the 50-car program indicated that training of mechanics in the maintenance and repair of gas turbines would not present unusual problems. Mechanically, the turbine power plant is less complex than most piston engines and some other current automobile components, so that the trained mechanic would have no trouble performing any maintenance or repair operation that would normally be done in the field.

OTHER EXPOSURES OF THE TURBINE CAR



MODEL OF SHOPPING CENTER TURBINE EXHIBIT

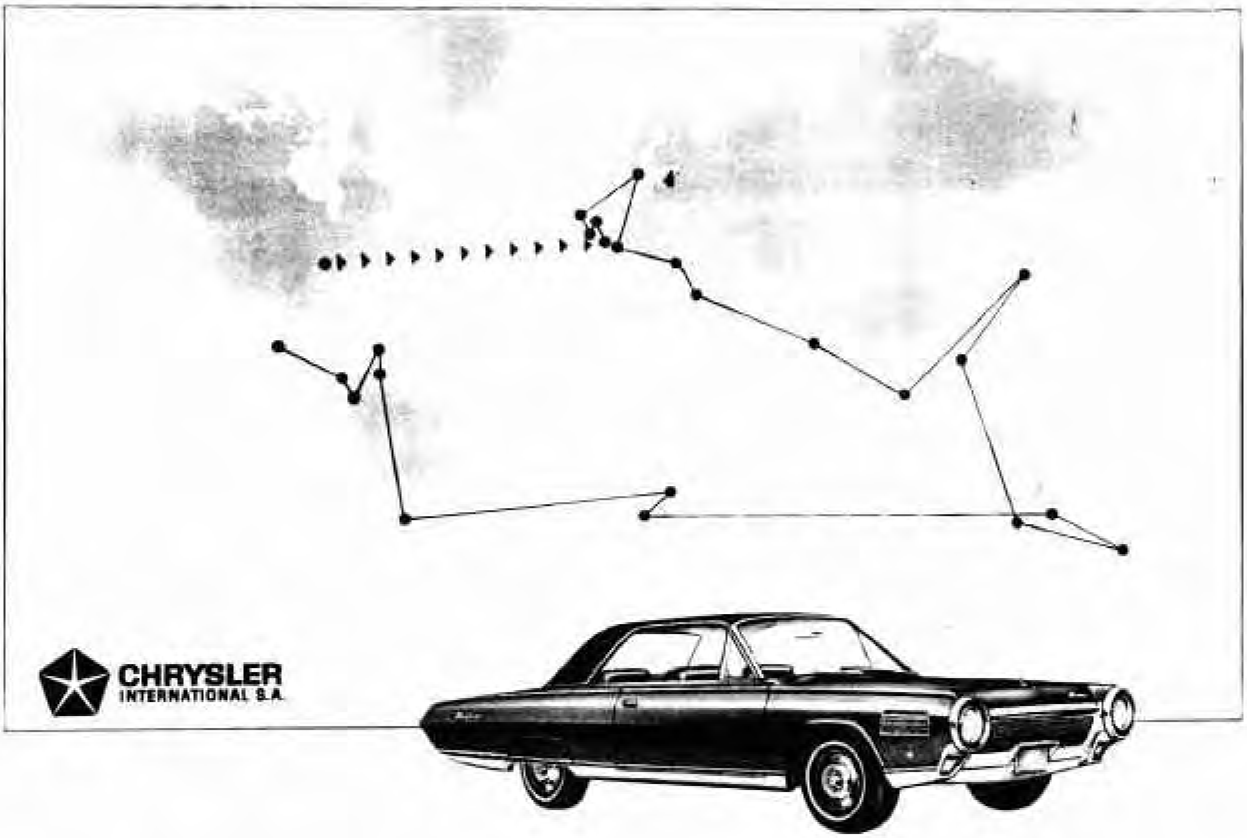
SHOPPING CENTER EXHIBIT

A traveling exhibit began visiting large shopping centers across the United States in January, 1964. The exhibits included a turbine car, turbine engine displays, and regular production Chrysler Corporation products. Each stop-over lasted several days or

TYPICAL SCENE AT SHOPPING CENTER EXHIBIT weeks. Chrysler representatives accompanied the exhibits and explained the turbine and Chrysler's program to interested visitors.

WORLD TOUR

A turbine car also was taken on a world tour. From September 12, 1963, through January 8, 1964, the car was shown in 23 cities in 21 countries. The 47,000-mile journey by a chartered aircraft included stop-overs in Geneva, Paris, London, Turin, Bombay, Singapore, Tokyo, Sydney, Cape Town, Buenos Aires, and Mexico City.



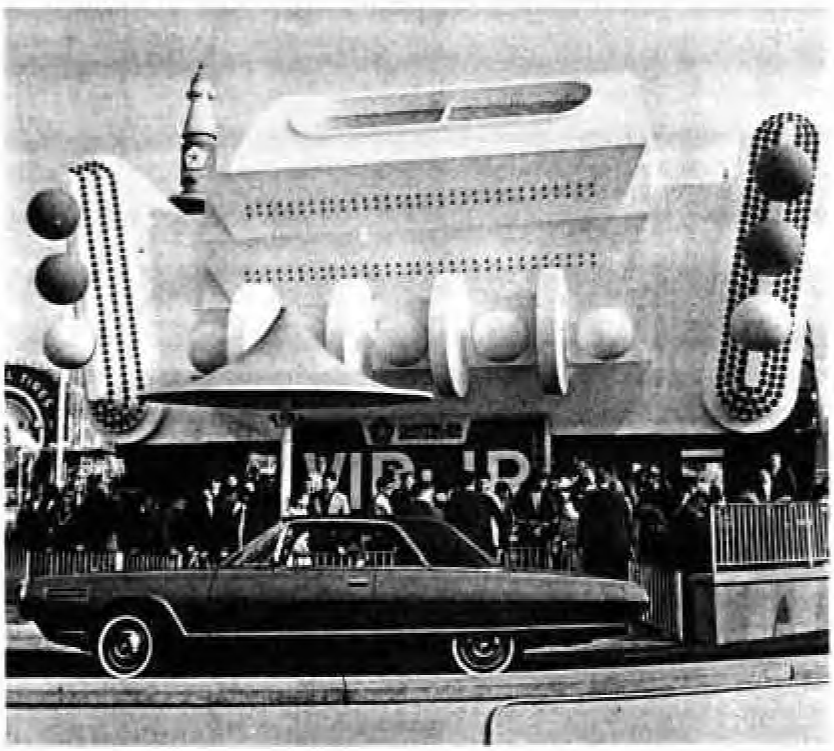
WORLD TOUR OF TURBINE CAR

THE TURBINE CAR AT THE WORLD'S FAIR

The Turbine Car was one of the popular attractions of the Chrysler Exhibit at the 1964-1965 New York World's Fair. One Turbine Car was shown in a static display and another was used for rides to Fair visitors who were selected on a random basis.

Over 350,000 enthusiastic people were given demonstration rides in the Turbine Car during the Fair's two-year existence. They rode on a small circular track fashioned on the five-acre site. The static display of the Turbine Car also included a separate cutaway version of the turbine engine.

Along with the other Chrysler attractions at the Fair site, the Turbine Cars were viewed by over 18,500,000 people.



GIVING RIDES AT THE
CHRYSLER FAIR EXHIBIT

TOUR OF COLLEGES

After completion of the user evaluation program in January 1966, several turbine cars toured college campuses. University lectures, classroom presentations and seminars were conducted by turbine research engineers who discussed pioneering development of the turbine engine.

THE TURBINE DREW CROWDS AT EVERY COLLEGE CAMPUS SHOWING

REMARKS

Throughout all aspects of the consumer evaluation, shopping center exhibit, world tour, and college tour programs, Chrysler has been obtaining reactions from the general public--from those who have driven or ridden in this new kind of car and from the millions who have viewed it. These programs have served as a continuing study concerning the size and characteristics of the potential market for this new kind of automobile.

A LOOK TO THE FUTURE

Now that Chrysler Corporation has completed its successful gas turbine car consumer evaluation program, the turbine has established itself as worthy of further serious consideration.

In the space of a dozen years, Chrysler Corporation research and engineering has been able to develop a power plant that can compete with and, in some respects, perform better than the piston engine which has been in automotive use nearly three-quarters of a century.

Moreover, although the progress of the gas turbine and its advantages are impressive, Chrysler Corporation engineers have by no means reached the full design potential of this engine. Additional progress in improved component efficiencies, particularly in the compressor, and the future possibility inherent in increased operating temperatures, are extremely promising. For example, a 400-degree increase in nozzle inlet temperature would mean a 40 per cent increase in specific output for a given-size power plant or, conversely, a corresponding reduction in size for a fixed horsepower. The same 400 degrees increase would improve fuel economy over 20 per cent without needing to take advantage of any further increase in component efficiency. Chrysler Research scientists, who are working with materials that may make this possible, consider the problems associated with these higher temperatures no more difficult than those already solved.

Based on the encouraging technical progress made thus far, as well as the enthusiastic response of 203 turbine car drivers, Chrysler Corporation is going ahead with the development of a new, fifth generation, turbine engine for possible use in future passenger cars. As with any new engine, it is impossible to predict how long the development process will take.

When Chrysler Corporation is satisfied it has a turbine design that is capable of being mass-produced at a suitable economic level, as well as being at least the equal of the piston engine in performance, fuel economy, and reliability, the design can be frozen and the complex process of developing the tools and facilities necessary for mass producing the engines can begin.

It must be recognized that truly major decisions still lie ahead. The adoption of a new type of power plant like the turbine for motor vehicles is a serious decision--with implications of great magnitude and far-reaching effects.

The determining factor in this decision will be an objective assessment of what benefit turbine power can be to the motorist and to the general public, coupled with an appraisal of the public's probable response if given an opportunity to buy turbine-powered automobiles. It is likely that initial reaction would be highly favorable. Yet, this does not obviate the fact that there must be some solid advantages to enable the turbine engine to compete on a purely functional and economic basis with other types of power plants.

Many people already are convinced that the gas turbine has great promise for propelling automobiles smoothly, economically, and dependably. Fulfillment of that promise rests on success in continuing turbine engine development progress.

What will be the outcome? What role will the automotive gas turbine play in the future? These are the central questions that still await a final answer.