Conceived by Pratt & Whitney Aircraft, and with the cooperation and collaboration of its parent corporation, United Aircraft Corporation, the Hartford Graduate Center of Renssalear Polytechnic Institute was established in South Windsor, Conn. Operating in a building purchased and given outright to RPI by UAC, the center opened in September. At present there are about 215 full-time engineers and scientists of UAC studying for advanced degrees under the direction of a faculty composed of RPI professors and instructors selected from the corporation's engineering staff.

A major expansion of the company's Andrew Willgoos Gas Turbine Laboratory was completed during the year. Five new test cells were added to the laboratory's original six. Three of the new units are capable of simulating both temperatures and other atmospheric conditions at extreme altitudes, and incorporate many improvements over the original cells including the ability to test gas-turbine engines of even greater power than those currently under development. Further expansion of the laboratory was authorized and started in late fall.

Pratt & Whitney Aircraft's licensing program to expand the production of its engines beyond the capacity of its own organization continued during the year. The Ford Motor Company's engine division at Chicago continued the production of P&WA's J-57 for a number of military installations.

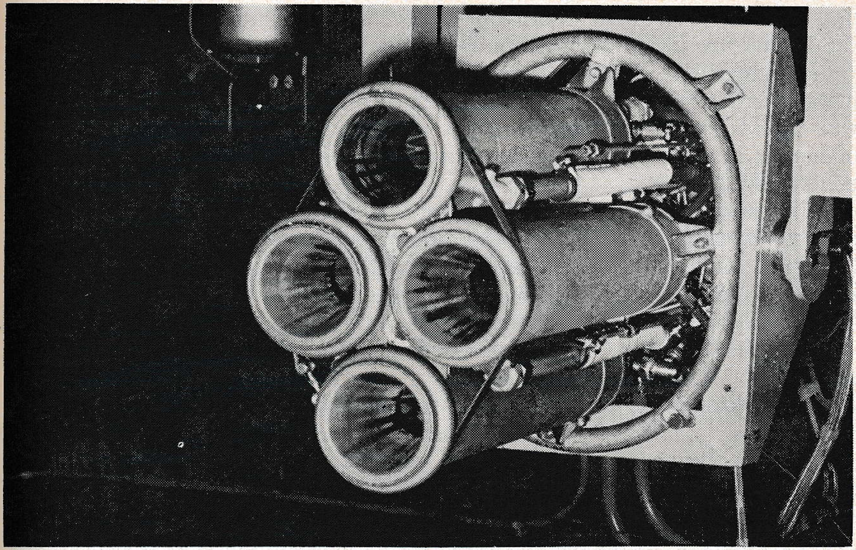
Reaction Motors, Inc.

The completion of a new $4-million rocket, engine development and production facility highlighted Reaction Motors' continued growth in the rocket industry during 1955. Built for RMI, this joint Navy-RMI facility includes over 200,000 square feet of working area, consolidates RMI's administrative offices, research, engineering and manufacturing operations previously divided between Rockaway and Lake Denmark, N. J., and expands the company's facilities in its extensive test areas.

The new RMI headquarters and Naval Industrial Reserve Aircraft Plant are located on a 50-acre site in the lake region of northern New Jersey. Built with future requirements in mind, the new plant is equipped with a well-rounded inventory of modern equipment and laboratories for all phases of research, design, development, fabrication and testing of rocket engines and their component parts.

In the middle of the year, a joint program of applied research to advance supersonic aircraft and missile propulsion was established by Reaction Motors, Inc., Marquardt Aircraft Company, and Olin Mathieson Chemical Corporation.

The new coordinated technical effort of complementary skills, known internally as the OMAR program, combines research, engineering, and production resources of the three organizations and, for the first time as part of an integrated plan, links mechanical experience in supersonic engine development with chemical experience in the manufacturing of special fuels.



Reaction Motors' rocket engine

A Marine Corps helicopter squadron was equipped with ROR (rocket-on-rotor) rocket power. The ROR system is the use of tiny-rotor-tip rocket engines that operate on hydrogen peroxide fuel and are working successfully in Marine Corps helicopters.

One of the newest RMI developments in rocket power was the preparation for the installation of a full scale aircraft launching catapult for field evaluations.

Now only in its second decade, Reaction Motors continues its mission of developing rocket power for aircraft, guided missiles, aircraft catapults and launching devices, and other military and industrial power requirements.

Westinghouse Electric Corp.

Continued expansion of research and development facilities geared to aircraft and airborne operations keynoted the 39th year of Westinghouse activity in the aviation industry.

Under construction were new jet engine research and development facilities at the Kansas City, Mo. Aviation Gas Turbine Division of Westinghouse Electric Corporation. Costing more than $12.5-million, the 230,000-sq. ft. laboratory will contain both high- and low-power laboratories and an engineering shop.

Also in full operation at the company's aircraft equipment department at Lima, Ohio, was a new high-altitude chamber designed for testing aircraft electrical accessories at altitudes up to 130,000 ft. Also in full operation was a permanent mock-up to permit simulating actual operating conditions for from two to four 60-kva alternators in parallel.

During 1955, Westinghouse completed its new multi-million-dollar metals plant at Blairsville, Pa. The main purpose of the new metals plant was to bridge the gap between research and the commercial application of metals in the fields of jet propulsion, atomic power, and electric power generation.

This plant provides equipment for the basic metal working processes of melting, forging, hot-rolling, cold-rolling, conditioning, pickling and heat-treating. Also installed are facilities for the newer foundry techniques of investment casting and shell-mold casting and equipment for limited manufacture of powdered metal parts.

Dynamic accuracy testing of bomber turret systems at a temperature of minus 50 degrees C, long sought by the armed forces, has been achieved and incorporated as standard test procedure by the corporation's air arm division.

Key to the accomplishment is a connecting chamber between a large conventional environmental test chamber and a microwave "free space" room specially constructed to complement the unit.

An electronic computer-simulator to help engineers design and develop better airborne armament systems has also been installed by the division.

The new computer, an IBM 650 magnetic-drum data processing machine, can "remember" 20,000 digits. It will be used on a number of important engineering projects such as the radar-controlled tail turret fire control systems being built for the Navy. Through the use of a highly developed radar and computer, this system automatically positions the tail guns of a bomber to the correct lead angle required to hit attacking aircraft. It is in production for the Douglas A3D Skywarrior, Navy's largest carrier-based bomber.

In addition, the computer-simulator will be used on other high priority projects including aircraft flight control studies, flight control data reduction, antenna design, and missile development.

Metallurgists at the Westinghouse Research Laboratories during the year conducted tensile tests on metals at temperatures as low as minus 452 degrees F. The metal specimens were stressed within a specially designed chamber which had been cooled wth liquid helium. Results of these tests will provide engineers with needed information regarding types of metals that are best suited for use under extreme temperature ranges.

The new testing temperature of minus 450 degrees is just short of *absolute* zero or minus 459.6 degrees F, the point at which, theoretically, all molecular motion ceases. The aims of these ultra sub-zero investigations are concerned with obtaining a better understanding of the strength of metals and the factors that cause embrittlement failures.

A new jet engine (PD-33) that is expected to have unusually low specific weight and fuel consumption was designed and built by Westinghouse in 1955. The new engine successfully completed a 50-hour flight substantiation test.

A new silicone lubricant with outstanding thermal and load bearing properties was developed by Westinghouse engineers during the year. The fluid satisfactorily passed thermal stability and viscometric tests ranging from minus 65 degrees F o plus 500 degrees F. Steel-to-steel bearing load tests showed the fluid to have execllent lubricating qualities up to 107,000 pounds per square inch bearing area.

The new lubricant was tested in a Westinghouse turbojet engine. At the completion of this test, the engine was completely torn down and examined. No evidence of wear was found by the gas turbine engineers and the system was entirely free of any sludge derived from the oil.

Westinghouse continued its work in the field of wind tunnel drive and control. One achievement in this field was the design and construction of large axial-flow compressors and drive motors (two 83,000 hp synchronous motors each started by a 25,000 hp wound rotor motor) for the Air Force's giant Propulsion Wind Tunnel at the Arnold Engineering Development Center, Tullahoma, Tenn.

The transonic tunnel was expected to be in operation by February, 1956, and the companion supersonic tunnel will be completed later. Each tunnel will be served by its own enormous axial-flow compressors and both will be driven by four motors totaling 216,000 hp, the largest concentration of motor horsepower on a single shaft in the world.

Westinghouse also designed and built precision wind tunnel components such as a sting support and a side-wall balance for the transonic loop of the PWT, and expanded its line of industrial air heaters.

Today's aircraft alternators require thorough testing under simulated flight conditions before being installed in actual planes. Westinghouse designed and built several electrical test stands to duplicate actual operating conditions as experienced by a jet-engine-driven alternator.

A new lightweight airborne a-c to d-c converter, lighter and smaller than its predecessors, was introduced by Westinghouse during the year. The new 200-amp. power pack converts engine-generated 200-v., 400-cycle power into 28-v. d-c, regulated to within one volt, and is capable of operating in ambient temperatures up to 120 degrees C. The new Westinghouse power pack, ATR-200A, owes its 55-lb. weight, high- temperature and close-regulation capabilities to the use of new high-power silicon rectifiers in combination with two-stage magnetic amplifier voltage regulator.

A new brushless, oil-cooled, a-c generator was developed by Westinghouse during the year. The fact that it is brushless and can be cooled by 300 degrees F oil means that it can operate at high altitudes and speeds without difficulty.

Companion to the new brushless alternator is a new Magamp voltage regulator and protective panel combined in one unit. This unit not only regulates the output of the a-c generator, but also protects it against grounds, and feeder and bus faults. In addition, it protects equipment utilizing the a-c power from overvoltage and undervoltage faults.

The new regulator and protective panel makes use of printed circuits and silicon power rectifiers, which are largely responsible for the decrease in weight over previous panels.

Westinghouse aircraft equipment engineers also developed a new a-c aircraft generator that is the lightest in its high-temperature class.

The new generator is a 20-kva, 3 phase, 120/208 v. unit that operates at 8,000 rpm, 400 cycles. It weighs only 44 pounds and is primarily intended for high-speed, high-performance aircraft. The unit consists of a class-H insulated alternator portion that receives its excitation from a similarly insulated integral d-c exciter generator.

A new series of gearhead and direct drive motors for aircraft were also introduced by Westinghouse Electric Corporation. The new motors were designed to drive such equipment as pumps, compressors, flaps, landing gear and armament accessories. The motors are supplied in frame sizes of 2½, 3⅛, and 4 inches, O. D. They are fan cooled, explosion proof, and totally enclosed.

The company also developed a new direct-drive explosion-proof fractional horsepower a-c motor for aircraft applications. It is equipped with a self-energized d-c electromagnetic brake. When current to the motor is interrupted, this brake can decelerate the rotating motor from 11,300 rpm to rest in less than one-fifth second.

Fan-cooled and totally enclosed, the new motor is available in ratings from 1/30 to ¼ hp and for seeds of 5,600, 7,500, or 11,300 rpm. Ratings apply from sea level to 75,000 feet.

During 1955, Westinghouse engineers developed a transistorized amplifier for controlling an electrohydraulic control valve in a high-performance servomechanism. It is the first step in the development of an all-transistor automatic pilot for aircraft.

A hermetically sealed, permanent-magnet rate gyro was designed by the company for use in arament control systems where extremely accurate angular rate measurements are necessary. The gyroscope wheel is mounted in a magnesium gimbal suspended on ball bearings. A current coil is rigidly attached to the gimbal, and free to rotate between two powerful permament magnets. When the assembly is turned (as if the aircraft were making a turn) the gyroscope resists turning with a force proportional to the rate of turn. The interaction of the permanent magnet and coil when a current flows in the coil creates a force in opposition to the gyroscopic force. Therefore, the current necessary to balance the gyroscopic force is an accurate measure of angular rate.

Radio transmitters, of the type used for long-range point-to-point communication service, can get a shot in the arm from a new linear amplifier developed by Westinghouse. When connected to the transmitter output, the amplifier will boost power to the antenna as much as 15 to 1. Maximum peak power output is 40 kw. The unit covers a range of 4½ to 30 megacycles.

Torturous treatment is taken in stride by a new aircraft lamp jointly developed by the company and by Kaman Aircraft Corporation. The new lamp withstands centrifugal forces of up to 1000 g. It fits in the tip of a helicopter blade, and is designed to give a distinctive identification feature to this type of aircraft. The lamp produces about 35 candlepower, but reflectors in the blade tips increase the effective light output about nine times.

Helicopters with blade tip lights are easily identifiable as far away as five miles, even against a background of city lights.

A small spot heater was also developed by Westinghouse. The resistance element heater has a rating of 100 watts and operates on 28 volts d-c. Electrical connectors consist of double nut terminals with the negative terminal grounded to the case. Over-all dimensions of the heater and two closely spaced mounting holes permit concentrated heating of flat surfaces as small as 1 x 1⅜ inches.

PROPELLER MANUFACTURERS

Aeroproducts Operation
Allison Div.

At Aeroproducts Operations, Allison Division of General Motors Corporation, Dayton, Ohio, a ten-year turbo-propeller research and development program was culminated in 1955 with the selection of Aeroproducts propellers for application on commercial turboprop aircraft. First installation of these propellers will be on the Lockheed Electra, now on order by leading U. S. airlines. With the Allison turboprop engine, this propeller-engine combination provides the commercial airlines with a power package having thousands of hours of successful flight operation.

During 1955 the MATS 1700th Test Squadron at Kelly AFB, with two Convair YC-131C aircraft powered by the Allison Turboprop engines and Aeroproducts Turbo-propellers flew over 6,500 propeller flight hours. Flight hours have also accumulated on other turboprop aircraft including the Navy-Convair R3Y Tradewind, the Air Force Lockheed C-130, and the Allison Turboliner. Successful flights of the Republic F84H were made at Edwards AFB which demonstrated the reliability of Aero-products supersonic turbo-propellers.

Aeroproducts has continued to supply propellers for reciprocating engine powered aircraft including the Air Force Fairchild C-119 Flying Boxcar, the North American T-28 Trainer, the Beech C-45, and the Navy's Douglas AD series carrier-based aircraft.

Aeroproducts self-locking hydraulic actuators incorporating an emergency electric overdrive were supplied during the year to control the horizontal stabilizer on the Air Force Republic F-84F jet fighter. In event of failure of the aircraft hydraulic system, the electric emergency overdrive enables the pilot to trim the "flyable tail" and safely land the aircraft.

Synchronized Linear Hydraulic Actuators were being used to control inlet guide vanes and for afterburner control. These actuators operate in synchronized travel regardless of the load differential at each actuator, and may incorporate a positive brake which holds the actuator in position in event of hydraulic power loss. This has made it possible to add the feature of an emergency pneumatic servo control to position the tail pipe doors should there be a failure of hydraulic pressure.

Aeroproducts Operations also supplied an undisclosed number of emergency ram air driven hydraulic pumps for installation on the North American F-100 Super Sabre.

The pump is driven by a two-bladed variable pitch propeller. A simple fly-weight type governor maintains a constant rpm of the pump drive shaft by mechanically changing the pitch of the propeller blades. The pump provides constant displacement of hydraulic fluid regardless of variations in power requirements.

In an emergency the air stream is diverted over the propeller blades, and in less than two seconds the pump will deliver sufficient hydraulic power to operate the flight control surfaces necessary to fly and land the aircraft.

Aeroproducts also delivered emergency ram air driven generators to Douglas Aircraft for installation on the Navy's Douglas A4D Skyhawk. As with the hydraulic pump, the generator is driven by a two-bladed variable pitch propeller incorporating a simple governor which maintains a constant rpm of the generator rotor. The power output of the generator is sufficient to operate flight control surfaces necessary to fly and land the aircraft, and to electrically operate instruments and other electrical equipment necessary for flight. Its practicability has been demonstrated many times in flight testing. Although it was designed to meet the aircraft industry's need for a dependable light weight emergency power source, this generator design is particularly adapted to other applications such as high speed tow targets and drones.

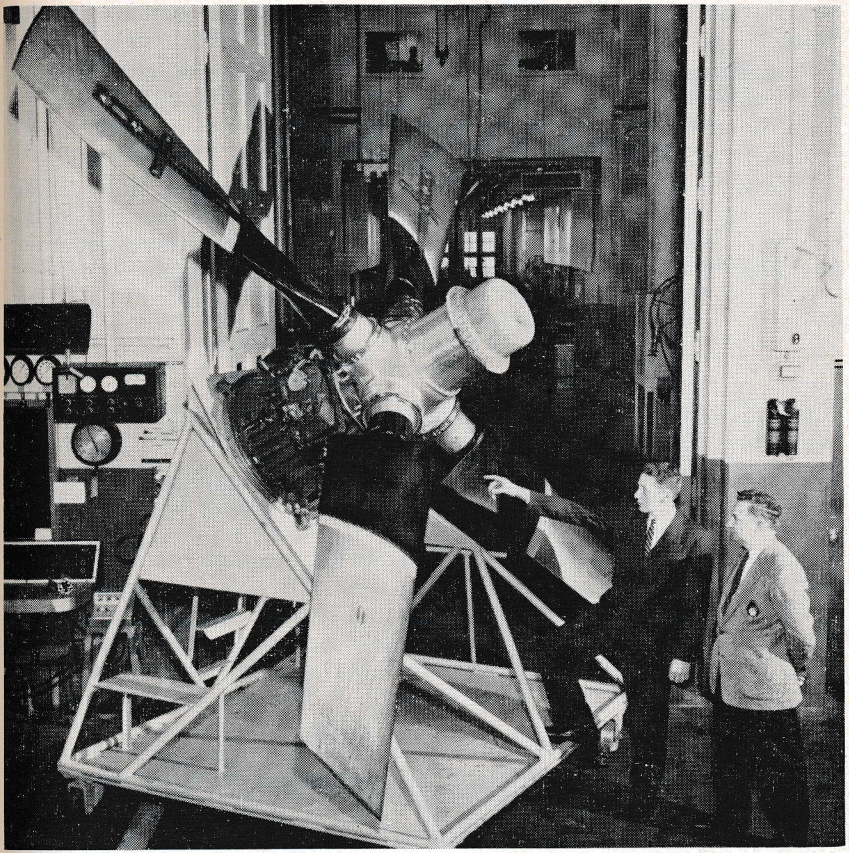
The experience which Aeroproducts has had in research and development in the field of aerodynamics and propeller governing systems has been directly applicable to the design of ram air driven power units.

A ram air driven emergency power unit with four automatically controlled variable pitch propeller blades has also been developed by Aeroproducts. This power unit has been specifically designed for application on a new high performance jet aircraft, and is capable of developing 44 hp at a constant driveshaft rpm. With propeller blades 22 inches in diameter, the unit is adaptable to driving either electric generators or hydraulic pumps.

Hamilton Standard Div.
United Aircraft Corp.

Hamilton Standard during 1955 continued producing aircraft equipment and Hydromatic propellers for commercial and military aircraft.

About one-third of the company's factory space was devoted to production of equipment during the year.



Hamilton Standard's turbo-hydromatic propeller

In the commercial propeller field, deliveries of the 43E60 reversing Hydromatic propellers continued for Douglas DC-6A's and DC-6B's, Convair 340's and Lockheed 1049 Super Constellations. Deliveries continued also on the 34E60 reversing Hydromatics for Douglas DC-7's and DC-7C's and 22D30 feathering Hydromatics for Beech D-18's.

In the military field, propellers were in production for the Lockheed C-121C, R7V and other versions of the Constellation; the R6D and C-118 versions of the DC-6; the Boeing KC-97F; the Fairchild C-123 and the C-119F version of the Packet; the North American AJ-2 and T-28B; Lockheed P2V; Grumman S2F-1, UF-1 and SA-16A; Convair C-131A and T-29B, C and D; and the Martin P5M. Conversion of Navy Beech SNB airplanes from Controllable Counterweight 2D30 propellers to 22D30 Hydromatics brought substantial production of the latter throughout the year. Similar conversion of Beech C-45 airplanes was completed during the year.

Production of the old 12D40 Controllable Counterweight propeller, which was resumed in 1954, continued during 1955. The 12D40 was first designed and produced in 1933 and the reorder was for replacements for Air Force and Navy Trainers.

Production of aircraft equipment items during the year included air conditioning systems, refrigeration units, starters, electronic and hydro-mechanical fuel controls, hydraulic pumps and pneumatic valves for major manufacturers of turbine engines and aircraft. Approximately 40 different aircraft models were using one or more of Hamilton Standard's equipment products.

Late in the year, the division announced that it was rounding out its coverage of the variable displacement pump field by placing in production a line of low-speed, light-weight pumps. Designed to satisfy installations which cannot use the high speed pumps now in production, the new line of pumps will use the latest hydraulic fluids. Already in production is a line of high speed pumps for operation at speeds up to 11,500 rpm and at temperatures of 275 degrees or more.

Turbine aircraft for which Hamilton Standard equipment was either in production or on order included: Boeing B-52, 707, C-97J; Canadair Sabre VI; Chance Vought F7U-3, F8U; Convair F-102, XC-131, R3Y; Douglas F4D, B-66, A4D, A3D-1; Grumman F9F-9; Lockheed F-94C, C-130; Martin XP6M, B-57; North American F-86D and H, FJ-2, 3 and 4, and F-100; McDonnell F-101, F3H; Northrop F-89D and H; Republic XF-84H.

Among the engine manufacturers using Hamilton Standard equipment were Pratt & Whitney Aircraft, Wright Aeronautical, General Electric and A. V. Roe.

Major changes in the production department were made during the year, chiefly as a result of the division's increased activity in aircraft equipment. About 17,000 square feet of production floor space were activated at a branch plant in Broad Brook, Conn. This space was filled with more than 120 pieces of machinery moved from the main plant at Windsor Locks.

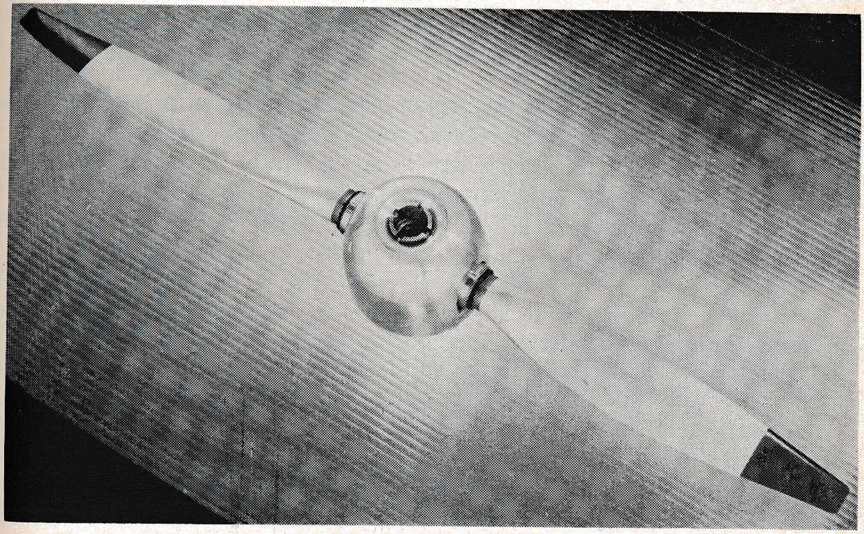
An analogue computer, which supplies in a matter of minutes answers to highly complex design questions, was installed during the year and was the latest electronic engineering tool to be placed in operation at Hamilton Standard. The new computer permits engineers to predict the performance characteristics of a new design under all possible conditions, even before the product is built. With the computer, engineers can simulate extreme conditions of altitude, speed, temperature, pressure and other factors difficult or impossible to set up otherwise.

Development of a large, four-bladed Turbo-Hydromatic propeller designed to operate through the subsonic and supersonic flight ranges was disclosed during the year. Completely new in concept, and in development for the past five years, the propeller attaches directly to the engine, thereby relieving the engine shaft of the propeller's weight and torque. The new principle of mounting was developed by Hamilton Standard and has become standard for all aircraft in the high-power, high-speed range. The installation saves several hundred pounds of weight per engine nacelle over a powerplant combination using the conventional propeller mounting system. The propeller derives its efficiency in the different flight ranges through use of different blade designs. It is intended for installation on large military transports using gas turbine engines of high power.

At the other end of the division's turboprop power range is its development of a Hydromatic type propeller suitable for medium-powered turbines in the 3,000-4,000 horsepower class.

Synchrophasing, a Hamilton Standard propeller innovation first developed more than ten years ago, was revived last year. Synchrophasing is a scientific system for keeping the propellers of multi-engined aircraft in step with split-second accuracy. It is an electronic method of controlling the propellers to turn at a specified relationship to each other and at the desired relative angle to the fuselage. Indications are that Synchrophasing will make air travel quieter for the passenger, as well as smoothing out the remaining sound to make it more acceptable to the ear. Thus far the development has been flight tested on a Lockheed Super Constellation, a Convair 340, and a Douglas DC-7, and is scheduled for test on a Pan American World Airways Boeing 377 and a United Air Lines Douglas DC-6. It was also scheduled for installation on Howard Hughes' executive 1049G Super Constellation. Its first airline application will be for a fleet of Lockheed 1649A Super Constellations ordered by Trans-World Airlines.

U. S. Propellers' constant speed propeller



McCauley Industrial Corp.

During 1955, McCauley Industrial Corp., the world's largest manufacturer of metal aircraft propellers for personal and business aircraft, manufactured five basic models. In October, the company announced production of its 50,000th aluminum propeller since 1948.

The fixed pitch McCauley models are for most engines with horsepower ranges from 65 hp to 240 hp, and the two-position aluminum propeller is for a 145 hp engine with a drilled shaft. The McCauley constant speed propeller is available on the Cessna 180.

U. S. Propellers, Inc.

Throughout 1955, principal aircraft propeller production at U. S. Propellers was in the field of target propellers. Large quantities of fixed pitch propellers for the radio-controlled target drones continued to flow from the U. S. Propeller specialized production lines. These propellers are made to government propeller specifications from company designs. Many other propellers were produced as well, such as blades for the Convair 20 ft. diameter wind tunnel, counter-rotating types for Hiller's flying platform, wind tunnel model propellers and special propellers such as for Custer's Channel Wing aircraft, Paul Mantz's World War I aircraft stable and others.

Two other major activities at U. S. Propellers resulted in substantial shipments during the year:

Honeycomb and sandwich construction division produced substantial quantities of contoured honeycomb parts, including adhesively bonded missile fins, aircraft control parts such as ailerons, rudders, tabs, and compound contoured aluminum and fiberglas honeycomb core sections for similar parts.

The maintenance and overhaul division was engaged in production type overhaul and repair of helicopter rotor blades under contract to the U. S. Air Force.

During the year U. S. Propellers expanded into a new building adding some 6,000 square feet of floor space.

Total sales for the fiscal year were somewhat over one-half million dollars, back log at the year-end being approximately $350,000.

During the year, the company developed a technique for compound contouring honeycomb materials by designing and manufacturing suitable machinery for this purpose. A method for rigidizing the honeycomb utilizing frozen water and fabrication in sub-freezing temperatures was perfected to permit actual production of such parts.

A completely self-contained constant speed propeller was produced and tested, and propeller designs for aircraft of higher performance in this field by year-end were in the detail stage for hydraulically controlled constant speed propellers promising the required low cost and high performance.

Completion and satisfactory operation of U. S. Propellers new giant G-4 machine, designed specifically for production contouring of aluminum and other types of honeycomb core material was a major event for the company in 1955. This machine makes available to the industry contoured honeycomb core in any size up to 4 ft. x 10 ft. High precision and high speed production characterize the design.

ACCESSORY MANUFACTURERS

In January of 1955 **Aerodex, Inc.** sold out its Aircraft Overhaul Facility and started a program of expansion on aircraft engine overhaul, modification, and sales; at which time a contract for the overhaul of R-2600 engines for the Air Force was in process at the rate of seven engines a day. In March a complete Accessory and Carburetor Overhaul Shop was installed. The Accessory Shop has received contracts from the Air Force, U. S. Navy and Coast Guard for the overhaul of various types of accessories.

During the first part of the year, additional conveyor systems and material controls were developed, resulting in Air Force contracts to Aerodex for the exclusive overhaul of their R-2600 and R-2800 CA and CB engines with a schedule that made this facility the largest Commercial Engine Overhaul Facility in the country.

At the same time, the overhauled engines for the Air Force were being produced, the commercial outlet for overhaul and sales increased over a hundred percent, and the company served both domestic and foreign airlines.

Marking its 27th year in the aircraft industry, in 1955 **Aeronca Manufacturing Corporation** of Middletown, Ohio, added two new divisions: the Industrial Research Laboratories (IRL), Baltimore, Md., and the Aircraft Maintenance Division, Ft. Rucker, Ala.

The IRL Division, engaged in basic and applied electro-mechanical research, had government contracts for research and development of flight simulators, electronic error indicators, telemetering and other electronic defense mechanisms. Among these were types which supply electronic "thinking" to govern the performance of guided missiles, determine errors, and reproduce flying conditions for elaborate training devices. In addition to its defense contracts, the new division was engaged in commercial contracts and held a number of patents on electronic devices.

Following the award of a contract for maintenance of U. S. Army aircraft at Ft. Rucker, Ala., Aeronca set up its new Aircraft Maintenance Division at the airbase, headquarters of the Army Aviation Center, in July 1955. The division was charged with maintenance of the approximately 300 fixed-wing aircraft and similar number of helicopters stationed there for training at the Fort's Army Aviation School.

Emphasis was placed on research and development at Aeronca's main plant in 1955, and facilities were expanded with the addition of a Research and Development Department where extensive research progressed on stainless steel honeycomb brazing. The company also added metal bonding to its production.

The bulk of the company's work, subcontracts for production of major airframe components, was done in the three Middletown, Ohio, plants where an approximate 2,000 people were employed. The two new divisions, with Aircraft Maintenance at Ft. Rucker adding 1,000 employees, swelled Aeronca's employment to over 3,000 in 1955. Construction was underway on a new manufacturing building of 50,000 square feet adjacent to the main Middletown plant.

Aeronca's backlog in 1955 was over $30-million with sales for the year of an estimated $20-million.

Air Associates, Inc., Teterboro, N. J., with three divisions engaged in the development and manufacture of electronic equipment and aircraft control mechanisms, and the distribution of aviation supplies, in 1955 established a fourth division, Facsimile Equipment Division, to manufacture the company's new facsimile communications machine. Known as the Electronic Messenger, the machine transmits-receives exact copies of typed, printed or written matter over telephone, closed, or micro-wave circuits to companion machines in other plants, offices, cities or states.

In its Aircraft Products Division, during the year a standardization program on fractional horsepower motors resulted in a new line of a-c and d-c motors for aircraft and related applications. Also, an electromagnetic a-c clutch-brake, a unique item that operates without rectifier or slip rings, was developed for use with 400 cycle a-c induction motors.

The Air Associates' aircraft seat belt, used by most major world airlines, was redesigned to incorporate a new personalized buckle and nylon rayon webbing. Other new products included a 2-inch diameter a-c generator, a twin-screw actuator and several new linear and rotary actuators.

The company also acquired rights as exclusive manufacturer of a new single-axis automatic pilot, the Dart I, a light-weight, low-cost, simple, compact unit for light and medium-weight aircraft. Dart I is dependent neither upon electronics or hydraulics for operation.

The Electronic Equipment Division in 1955 produced the following new products: a high-performance 1-kw, vhf-uhf amplifier, boosting 100 watts to 1,000 watts and used for ground to aircraft communication; a liquid-sensing control, an extremely sensitive device consisting of a probe (containing a tiny thermistor) and an electronic relay which detects the presence of liquid in less than one second and the absence of liquid in less than five seconds. Application is for aircraft and industrial fluid systems. Also developed by the company was the "Talking Beacon," a vhf navigational device.

In 1955, **Aluminum Company of America** announced: new forging facilities for producing one-piece aircraft structural members; widest hot sheet rolling mill in the aluminum industry; world's; largest aluminum plate stretcher and heat-treating equipment; a new high temperature alloy; and a new aircraft-airframes department to expand the development of aluminum and magnesium forgings and castings. During the year Alcoa's production of primary aluminum increased approximately 5.5 percent.

Probably the most important development of 1955 was the dedication at Alcoa's Cleveland works of the 35,000-ton and 50,000-ton presses, representing the first completed forging facility in the Air Force's heavy press program. Massive airframe parts, shaped to close dimensions for high performance aircraft, are forged in one piece on the giant presses. This advance in the production of large structural members greatly reduces the machining and assembly costs formerly encountered in building members from individually forged and machined components.

Installation of the widest hot sheet rolling mill ever designed and built for the aluminum industry was started at the Davenport, Iowa, works in May, 1955. The capacity to roll sheet 160 inches wide will permit the introduction of larger ingots, and will meet the demand for increased widths in aluminum sheet and plate required for modern aircraft.

Also at Davenport, Alcoa planned to install the world's largest aluminum plate stretcher. Capable of exerting a pull of 16-million pounds, the new stretcher will make possible the production of heavy, heat-treated aluminum plate in record-breaking sizes for aircraft. In conjunction with the stretcher, the largest heat-treating equipment in existence will be built to handle plates 60 feet long, 144 inches wide, and 6 inches thick.

In the field of new alloys, Alcoa developed X2219—a high temperature alloy offering improved properties in forgings and extrusions up to 550° F. Higher heat resistance makes this alloy valuable for applications in and near aircraft engines.

During 1955, Alcoa announced expansion programs for its works in Wenatchee, Washington, and in Rockdale and Point Comfort, Texas. This program was expected to increase the company's primary aluminum production by 5 percent during 1956.

A new aircraft-airframes department was created in the Cleveland, Ohio, sales development division to concentrate on the further development of aluminum and magnesium forgings and castings for the aircraft-airframes industry.

During 1955 **Avien, Inc.,** Woodside, N. Y., continued to manufacture capacitance fuel gages and fuel management systems, and accelerated its expansion into other fields of instrumentation for aircraft and industrial application.

In fuel gaging the year was marked by full scale production and volume deliveries of the company's two-unit lightweight gaging system. These advanced systems have been specified for a number of Air Force and Navy aircraft, including the F89H, A4D and the Army's H-34. In a number of these systems, Avien used its Thervel Liquid Level Switch to provide fuel level control, tank switching, CG control and overflow warning.

Early in the year, the company introduced its transistor fuel gage. Combining transistor circuitry with a new drag cup servo motor, the system offers further improvements in system weight and simplicity, featuring an indicator-amplifier measuring less than 5 inches in length, and providing a response time of only 5 seconds. In addition to application as a fuel gage, the transistor system has been specified for gaging oil quantity.

The company also moved into production of its integrating flowmeter. Measuring mass flow from tanks to engines, the flowmeter utilizes a velocity servo to integrate this measurement with time, indicating fuel remaining by means of a digital counter presentation. A second type of flowmeter, providing rate-of-flow indication and combined with a totalizing system for multi-engine aircraft was also introduced during the year.

Aircraft Radio Corporation, Boonton, N. J., manufacturer and designer of navigation and communication equipment, flight instrumentation, and related test equipment, for aircraft and ground use, extended its production activities in 1955 to meet the ever-increasing demands for lightweight, diversified electronic equipment.

During the year, the company introduced and put into production its Type CD-1 Course Director, a new instrumentation system which provides the pilot with steering information for precise instrument approaches, as well as highly accurate en-route-tracking on omni and vhf visual-aural ranges.

Also made available was the space-saving Type IN-10 Course Indicator. This is a single flight instrument which combines in an equal-size case the functions of ARC's No. 13310 Cross-Pointer Meter and its No. 15453 Course-Selector/To-From Meter. The compactness of the IN-10 makes it particularly suitable for use in dual-omni installations.

Aircraft Radio Corporation added to its Type 12 Equipment a uhf transmitter-receiver converter, designated as the TV-10 UHF Transverter; a K-13 Oscillator-Relay Unit, which permits precise tuning of a vhf receiver to a vhf transmitter crystal output frequency; and inverted-L vhf and uhf antennas for low-ground-clearance aircraft, with the added factor of use under heavy icing conditions.

An outstanding engineering development was the design of a lightweight, space-saving ADF system, to be known as the Type 21 Automatic Direction Finder; production is scheduled to start early in 1956.

A Beechcraft Twin Bonanza was added to its present company-owned, single-engine Navion and Bonanza airplanes. A complete complement of ARC navigation and communication equipment has been installed in the new airplane. With this addition, improvements in its on-the-premises flying field and hangar facilities have also been made.

In the process of construction, with completion expected in March, 1956, is a new engineering building of approximately 18,000 square feet. Upon completion, the present development and research area will be used to extend production facilities.

In addition to its activity in fuel gaging, the company also went into volume production of its Temperature Indication System for exhaust gas and turbine-inlet temperatures.

The company also entered the electronics components field with its "k-Volt Standard," a d-c reference voltage source for measurement and control circuits. Developed originally as the reference source for Avien's Temperature Indication System, the unit offers extreme stability of output with temperature and time.

In addition to four plants in the Woodside area, Avien operates a wholly owned subsidiary, Control Laboratories, Inc., in Great Neck, N. Y., where basic research and development work on instrument systems is carried out. A sales and service branch, Avien Service Corporation of California, is maintained in Culver City. At the year's end the company was completing an extension to its Woodside engineering and administration facility, adding 11,000 square feet to its plant area. The new wing will house enlarged test engineering and service school facilities.

The **B. G. Corporation,** Ridgefield, N. J., during the year received CAA approval for a new long life platinum electrode spark plug with an all weather top. This spark plug, Model RB39R, is approved for use in all Pratt & Whitney R-4360, R-2800, R-2000, and R-1830 engines. Development also continued on non-platinum long and short reach spark plugs.

During the year, the corporation continued to manufacture ceramic terminal sleeves, and spark plug and ignition harness test sets for use in conjunction with piston engine operations.

In the gas turbine engine field, the B. G. Corporation supplied all of the principal large and small gas turbine engine manufacturers with igniters, thermocouples, and thermocouple harnesses. Progress was made in the development of semi-conductor igniters for use in high energy low tension ignition systems.

In 1955 the firm expanded its line of special alumina ceramics for the electrical and electronics industries.

During 1955, Eclipse-Pioneer Division, **Bendix Aviation Corporation,** Teterboro, N. J., concentrated fully on the design, development and manufacture of products in the three major areas of aircraft systems, aircraft instrumentation, and components for aeronautical applications.

Highlight of the division's systems effort during the year was the completely transistorized Automatic Flight Control System. Although prototype systems had been flown successfully during 1954 in the division's B-25 Flying Laboratory, and a preproduction model had been delivered to the military for evaluation purposes, 1955 saw this new concept for control of high-performance aircraft go into production, backed by orders from the military as well as commercial airline operators. Whereas previous autopilots had been of more or less "stock" design and installed in an aircraft as accessory equipment, development of the PB-20 was coincidental with and very carefully engineered into the basic performance requirements of high-performance aircraft.

Progress was also made at Eclipse-Pioneer in the area of central reference systems for aircraft. One of the outstanding developments was the successful production design of a 3-Gyro Stable Platform weighing only 27 lbs. and consuming only a half cubic foot of space. Designed for use as a master gyro reference, the 3-Gyro Stable Platform was capable of replacing all vertical and directional gyros used for such functions as indication, auto-pilot control, fire control, radar stabilization, navigation. While designed for an application that required it to be slaved to vertical, it could also be used as a free platform.

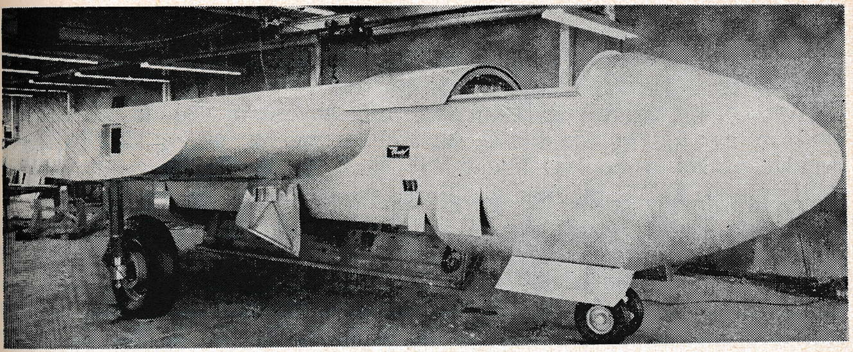
Work on Air Data Computers also was inspired by the increasing trend toward central intelligence centers. With the advent of supersonic speeds and more flight functions depending upon accurate measurement and use of air data, new obstacles to the old methods of obtaining this information were presented. And whereas such functions as Mach number, true airspeed and altitude were once adequate, many new functions such as relative air density and true angle of attack were additionally being demanded, as well as increased accuracy of all functions. Eclipse-Pioneer's development of an Air Data Computer System to satisfy all of these requirements was based on a modular design consisting of a basic unit with interchangeable multiple drive assemblies.

Another product announced during 1955 was the Bendix Flight Director System. Featuring two 4-inch diameter flight indicators, the system reflected latest requirements of the aviation industry for simplified and consolidated display of flight performance. One instrument known as the Flight Path Indicator combined omni-bearing selection, VOR or localizer and glide slope reference as well as compass heading, to replace three previously required indicators. The other, known as a Flight Director Indicator, provided attitude reference and coordinated turn indication, as well as computed pitch and bank command. The command function of this instrument could be used by a human pilot in flying his airplane to a radio reference such as an ILS approach system or an Omni-Range network, or could be used as a reference to monitor performance of an Automatic Flight Control System.

Many different types of navigational Computers were developed by Eclipse-Pioneer during 1955. One of these was a small, lightweight, compact Course Line Computer designed for console mounting. Another was a miniaturized dead reckoning type of Rho-Theta Computer. With distance and bearing of desination, plus wind force and direction set into the control panel at the start of a flight, an indicator showed ground track and miles remaining to destination throughout a flight. If destination was changed during flight, the human pilot merely set new data into the control panel and immediately obtained new bearing and range information on his indicator.

Also in 1955 the division produced a number of new corrosion-resistant, high-temperature, miniaturized devices. Most interesting of these were the "penny" size servo motors and motor generators. Further activity was also continued by the division in the components field.

An extremely unique product that was part of the division's output during 1955 was a B-57 Aircraft Loading Trainer. Built to conform precisely with B-57 electric and hydraulic systems as well as contour, it was destined to provide training for B-57 crews in preflight operation checks



Bendix Eclipse's loading trainer for B-57 aircraft

and bomb load installation procedures. A control panel, located at the outside rear of the fuselage, was used by an instructor not only to check operational technique of the trainee but to insert malfunctions into the loading operation for training the crew in the recognition and reporting of troubles.

Indicative of trends in aircraft systems and instruments other than those such as the central information centers already mentioned, was an increasing demand for integral lighting of individual instruments and a more widespread application of transistors in place of vacuum tubes. By the end of the year Integral Lighting was considered a must in the design of all new instruments and the Bendix design which provided white numerals and graduations against a black background by day, and Identification Red (the color science has proved best suited for sharp readability with a minimum effect on "dark-adapted" eyes) by night, was rapidly gaining recognition for its effectiveness in solving instrument readability under varying conditions of dusk to dawn flying.

The Hamilton Division of Bendix continued in 1955, to manufacture fuel controls for jet engines along with flow dividers, fuel pumps, and other aircraft accessories requiring precision manufacturing techniques and extensive testing. In addition, a program for the overhaul of jet engine fuel controls was expanded.

The Engineering Department continued to develop jet engine fuel controls for engines in the low thrust class and on fuel and hydraulic pumps for both aircraft and missile application.

Several new products were developed as a result of the cooperation between Bendix Engineering and the various aircraft engine and missile manufacturers.

The engineering facilities afforded by the division's new engineering building included complete and modern laboratory equipment for the development of engine and related components. The laboratory is equipped with a jet engine test cell for engines developing up to 5,000 pounds thrust and dynamometer equipment for pump development having power up to 150 horsepower.

Capacitance type liquid oxygen gages were put into production around the first of the year for the first time by the Pioneer-Central Division of Bendix.

Two new oxygen regulators were also placed in production in 1955. Both were the automatic diluter demand pressure breathing kind. Oxygen regulator 2894 is the MD-1 and MD-2 military types. Oxygen regulator 2881 is Type D-2A, the new Air Force standard oxygen regulator.

About 35,000 square feet of additional working space were acquired by Pioneer-Central during the year. In September, a large group of engineers moved into 12,000 square feet of office and laboratory space in a new wing constructed during the summer. Early in 1956, Pioneer-Central activities will expand into a recently purchased plant (the other 23,000 square feet) which lies adjacent to the main building.

Sales and service activities were also expanded in 1955. Previously handling sales and service on just oxygen equipment and ultrasonic cleaners, Pioneer-Central added complete responsibility for sales and service of all flight instruments and flowmeters it manufactures.

Bendix Products Division, South Bend, Ind., continued during the year to design and manufacture Fuel Metering Systems and components for all types of airborne engines, and landing gear shock struts, wheels and brakes for airframes.

Included in new facilities under construction in 1955 were two new fuel test modules valued at $2.5-million. The buildings, under design for a year and a half, will house equipment which will be capable of testing jet engine fuel metering controls and systems to be designed during the next five or ten years. The test cells of each module are designed to simulate conditions of engines of 20,000 pounds thrust and up and record them with laboratory precision.

Another new building nearing completion at year-end housed an extreme temperature test facility with equipment designed to test jet engine fuel systems and fuel system components in present day and future aircraft operation.

Bendix continued the complete fuel systems approach in their research and development activities in 1955. This included hydraulic-mechanical improvement, electronic, and magnetic applications and combinations.

During the year telemetering principles widely used to transmit temperatures and other data from a simple weather balloon or from a guided missile flying miles above the earth were used by Bendix fuel metering engineers as an aid in direct plotting of engine data while the airplane is in actual flight near the mobile ground station.

By means of suitable ground instrumentation housed in a special semi-trailer truck, which can be moved anywhere, and a transmitter in the airplane, dynamic measurement of the various engine parameters such as fuel flow, engine speed, engine temperature, compressor temperature and many others can be plotted instantly and accurately.

Voice radio communication is maintained between the transmitting location and the receiving location so that the test operation can be directed from the ground station. This permits coordination of the test on the basis of data already taken. This equipment designed by Bendix to measure aircraft engine parameters can be readily adopted for use in many other industries where the presentation of data on an instantaneous basis is desired.

In 1955 Bendix Radio Division became the only electronic manufacturer in the world to offer both X-band (3.2 cm) and C-band (5.5 cm) airborne weather radar systems in its product line. Addition of the C-band system this year gave Bendix Radio customers a choice of frequency dependent upon the operational requirements of the user and the nose configuration of the aircraft.

In November it was disclosed that more than 110 RDR-1 systems had been sold to business aircraft owners and airlines, including Panagra, National, Northwest, and Eastern.

Simultaneously, as a result of more than 14 months of evaluating performance of airborne radar in regularly scheduled flights and under all possible weather conditions, the Radio Division announced up-to-the-minute improvements in the equipment during the annual meeting of the National Business Aircraft Association, in Detroit. Included were a new ½-ATR synchronizer-power supply unit, 27 pounds lighter and using 13 tubes less than its larger predecessor, and a 30-inch X-band antenna which can be switched from pencil beam (for cloud probing) to cosecant squared beam patterns.

Bendix Radio also announced the marketing of a new ¼-ATR marker receiver and that Pan American World Airways had bought 15 units for installation in DC-7 aircraft. A crystal-controlled superheterodyne receiver which operates on a fixed frequency of 75 megacycles, the MKA-7 marker receiver features improved circuitry that greatly reduces the chance of television or FM interference and serves to stabilize gain under wide ranges of environmental conditions and line voltage fluctuations.

Another addition to the aircraft radio line was the TA-20 vhf airborne transmitter. Designed as a companion piece for the RA-18C communications receiver, the ½-ATR transmitter is designed to provide crystal-controlled operation on 360 channels spaced 50 kilocycles apart.

The first use of transistors in communications gear for airline and executive aircraft use was accomplished with the development of the CNA-2 audio control panels. Initially available in two models which differ only in configuration, the CNA-2A and CNA-2C units emphasize functional design through the use of three different types of switches: illuminated pushbuttons for transmitting, a rotary switch for filter selection, and toggle switches for receiving.

Within the year, a large number of airlines began the adoption of the RA-18 vhf airborne receiver for fleet installation. At one time, for example, four major U. S. air carriers—TWA, Northwest, Pan American, Northeast—ordered a total of 411 receivers, and had planned to order another 200 units within a six-month period. Capital Airlines also selected Bendix Radio equipment for fleet installations in their new Viscounts.

Also started was a new $2-million engineering building being built adjacent to the main plant, near Towson, Md. The two-story structure will provide Bendix engineers with an additional 100,000 sq. ft. of floor space for work on radar, communication and navigation devices, and other projects with heavy emphasis on commercial development as well as advanced military research and development.

During 1955 Scintilla Division of Bendix Aviation Corporation started construction of additions to both its engineering and manufacturing facilities totaling 27,000 square feet.

Several new developments in ignition analyzers, electrical connectors, and ignition equipment were introduced in 1955.

Ignition Analyzers Nos. 11-3398-1 and 11-4810-1 were placed on the market. The 11-3398-1 was developed primarily for use on Navy P2V-7 and P5M aircraft. The 11-4810-1 ignition analyzer was developed especially for use with small aircraft and helicopters.

The type "QW" electrical connector is a heavy duty, waterproof power and control connector. It was designed principally for missile and radar ground control applications. A potted connector was also developed. With the resilient insert common to Scinflex connectors this series provides excellent moisture and vibration resistance characteristics.

Miniature coaxial connectors were produced for critical signal circuits on miniature equipment. This line features soldered connections to the braid and conductor offering serviceability in this field for the first time.

The Scinseal protected wiring assembly was developed for a wide variety of applications. Scinseal, a thermo-plastic material, is especially effective in providing sealed junctions in leads and harnesses and to seal braided conduit.

A number of harnesses for jet engine controls and several new ignition systems for jet, turbo-jet, turbo-prop, and small gas turbine engines were also developed by the Scintilla Division.

During the summer of 1955 the Utica Division of Bendix, with the cooperation of Air Force personnel, arranged with the famed Thunderbirds to demonstrate their precision flying skills at Griffiss Air Force Base, Rome, N. Y. A total of 30,000 people attended the event. The Thunderbirds fly the Republic F-84F Thunderstreak which is equipped with one of the Utica Division's fuel air combustion starters as well as 29 other Bendix products.

During the year, the Utica Division had in production a new type combustion starter for the J-57 engine. A new fighter aircraft for the Air Force now in production will be equipped with this new member of the fuel air combustion starter family.

Also in production in 1955 was a new type constant speed air turbine driven alternator for a fightercraft, and a new type air turbine driven fuel pump for high speed missiles as well as high temperature 3,000 psi variable displacement hydraulic pumps. An air conditioning and pressurization system which will be incorporated into high speed aircraft was also under development.

In order to keep pace with both development and production engineering advancements, Utica expanded its facilities in 1955. The building covers an area of 11,205 square feet and increases its testing potential approximately 850 percent.

Pesco Products Division, **Borg-Warner Corporation,** Bedford, Ohio, in 1955 expanded its facilities by 25,000 square feet to provide additional space for the Service Department, and to house a new model shop for building prototype models of the various aircraft fuel and hydraulic pumps, axial flow blowers, and special application electric motors designed and manufactured by the company. The plant addition also provided a new location for the growing Research and Development group, with increased space and facilities.

A new line of axial flow blowers was introduced during the year. Designed by Plannair, Ltd., these blowers have been accepted and widely used by the British aircraft industry and are now manufactured by Pesco under an exclusive license. Presently engineered are models from 16 to 750 cfm, with larger sizes in development. The patented aerodynamic design results in higher flow and/or pressure than other blowers of comparable size and weight.

The development of plug-in and line-mounted booster pumps continued, and a line of 400 cycle a-c booster pumps powered by Pesco electric motors was developed for delivery of 1,000 to 40,000 pounds of fuel per hour.

Also developed during the year were a pump for propyl nitrate, one for red-fuming nitric acid, and a nuclear coolant pump.

Champion Spark Plug Company, Toledo, Ohio, for the eleventh consecutive year, sponsored its Aircraft Spark Plug and Ignition Conference in Toledo in 1955. Nearly 200 representatives of world airlines, the armed forces, aircraft engine manufacturers and suppliers to the aircraft industry attended the three-day session. Among discussion subjects were spark plug service experience, spark plug fouling, the effects of fuel and lubricants on spark plugs, reconditioning, tests and inspection of spark plugs, research and development in the ignition and spark plug fields, ignition analyzers and jet ignition.

The year 1955 also saw the development and the acceptance after tests of Champion's AA14S spark igniter for jet engines. Incorporating the latest developments in high temperature ceramics and heat resistant alloys, the AA14S has a unique construction designed to provide long operational life at lowest cost.

The 2,500 employees of the **Cleveland Pneumatic Tool Company** located in three plants, continued during the past year to design and manufacture aircraft landing gears and ball-bearing screw mechanisms for military and commercial use by major airframe companies.

A separate actuator division was established in a separate plant, exclusively engaged in the production of these products. During the past year, several new types of testing equipment were added to the present battery of testing devices in this division.

Cleveland Pneumatic was commissioned during the year to design and manufacture ground-handling equipment for the handling and loading of bombs and guided missiles. Two of these projects were completed and others are in production.

The company continued to supply many unique services for the aircraft industry in the field of flash butt welding, high heat treating, and precision machining. Progress was also made in the field of high heat treating. Parts can now be strengthened to 280,000 psi in alloys that only a few years ago were limited to 180,000 psi. Weights are being reduced without reducing strength, or strengths can be increased without "beefing up" the size and weight of parts.

The precision machining operations of the company which include every type and variety of machine needed for precision manufacturing of aircraft parts were supplemented by the addition of eight Kellering machines.

The company continued to search for new materials and following its initial research in the field of titanium which began in 1953, the company completed the country's first titanium landing gear. This work continued during 1955 and included the fabrication of other titanium air components.

During 1955, **Connecticut Hard Rubber Co.,** New Haven, Conn., produced de-icing units, aircraft seals and components at a rate slightly above 1954. The number of employees increased 11 percent. Backlog, dollar volume of sales increased and required considerable new equipment.

The company developed a new series of heat stable silicone rubbers with tear and tensile strengths nearly double commercial silicone rubbers for sale in 1956. Also developed was a line of fabric reinforced silicone rubber seals for pylon, body and external aircraft seals that have proved useful where abrasion is too great for plain silicone rubber extrusions.

Another major development was an inflatable silicone rubber canopy seal for a new day fighter that is in production and has proved to be the answer for low temperature service as well as its complete resistance to ozone cracking.

In production in 1955 were silicone rubber seals with a film of Teflon bonded over the surface which proved useful for sliding surfaces and gave protection to the rubber from fuels and hydraulic oils.

The **Dow Chemical Company** of Midland, Mich., in addition to being a supplier of primary magnesium metal and alloy ingot to various aircraft foundries and other magnesium fabricators, produces magnesium sheet, plate, extrusions and tooling plate. A new 13,200-ton extrusion press was being assembled by the company at year end.

In 1955 Dow introduced a new magnesium base thorium-zirconium alloy for use in the 300-700° F temperature range. It is available in the form of sheet, extrusions and castings. Prototype missiles, ramjet engines, highspeed aircraft and aircraft components have been built with this material, and the first quantities for initial production have been shipped.

Military use of Dow 17 and HAE anodize treatments during the year expanded the aircraft and radar applications of magnesium by providing superior corrosion protection. The development of chemical etchants for magnesium indicated it will be one of the easiest metals to chem-mill.

The growing importance of in-flight refueling in 1955 saw much of the development and production activity of refueling equipment centered at the new plant of **Flight Refueling Inc.** at Friendship International Airport, Baltimore, Md.

Entering the year with a backlog in excess of $7.8-million, production, engineering, and test activity was increased as rapidly as possible in the new facility of the company which had moved from Danbury, Conn., to Baltimore in 1954. By the end of 1955 employment had reached approximately 300 people including an engineering staff of 75.

Main production during the year was concentrated on the A-12 hose reel unit used by the Navy in the North American AJ tanker and to be used with B-50 tankers of the Tactical Air Force. Production was also stepped up on a variety of other equipment for refueling including the A-1 nozzles and A-3 couplings for Navy use and the MA-2 nozzles and coupling for the Air Force.

During the year the U. S. Navy announced that all of its new carrier-based fighters were being fitted to receive fuel in flight by means of the Probe and Drogue system developed by Flight Refueling Inc. The ability of the system to be used remotely on wing tips to permit multiple refueling of three fighters at one time also figured in TAC's decision to adopt Flight Refueling equipment for its tanker program.

Early in the year the company unveiled to the public its test facility where complete refueling systems can be tested under all types of simulated flight conditions.

Sales for 1955 totalled approximately $4.5-million.

The **Garrett Corporation** of Los Angeles continued, in 1955, to be a major manufactures of aircraft accessories and components, through its AiResearch Manufacturing Divisions in Los Angeles and Phoenix; but the corporation widened its activities extensively in the aviation field and elsewhere, by continuing a large scale expansion program.

The corporation as of Oct. 1, 1955, had increased in size from seven divisions and two subsidiaries last year, to nine divisions and three subsidiaries this year.

In 1955 at AiResearch Manufacturing in Los Angeles, the year saw a heavy 600 percent volume increase in the manufacture of transducers, which are used in air computing systems and other electronic systems necessary for the operation of present day turbojet aircraft. Among other items turned out in volume were electric actuators, cabin air compressors, cooling turbines, air data systems, oil temperature regulators and miscellaneous valves. At AiResearch Manufacturing in Phoenix, the dollar value of products shipped from Arizona, excluding those subcontracted for Los Angeles, amounted to a 76 percent increase over last year. Products included six types of gas turbines, seven types of air turbine starters, three types of air turbine motors as well as pneumatic valves and controls, electronic and electrical equipment.

Expansion, both in additional space and new facilities for the Garrett Corporation, was considerable in 1955. Outstanding was the vast new Production Test Facility at Sky Harbor Airport, Phoenix, Ariz. Here the major aircraft accessories and components manufactured by AiResearch are thoroughly mass-tested as they roll off production lines and go into service, after having been operated at simulated altitudes up to 70,000 feet and at temperatures varying from 80° below zero to 1,000° F.

A new Garrett Corporation headquarters was built—a $1.3-million project—in Los Angeles, adjacent to the AiResearch-Los Angeles plant and offices. The new headquarters occupies 82,000 square feet of floor space and gives an additional 258 feet of frontage to the AiResearch building as it has been constructed to appear as one building with AiResearch. These other facilities, includig the new giant test facility at Phoenix, plus additional office construction, are all part of a $5-million program of major additions planned by the Garrett Corporation, to be finally completed on or about June 30, 1956.

Consolidated sales for the corporation were $103,393,450, the highest in the corporation's history, and an increase of 2.2 percent over 1954's record high. The current backlog amounts to approximtely $98-million, having held fairly close to this figure for the past year. About 11 percent of this is for commercial products, and the remaining 89 percent is for military end use products.

Employment in the entire corporation stands at approximately 7,600 people.

General Laboratory Associates, Inc., Norwich, N. Y., through 1955 were consistent in their expansion of research, engineering and production of high energy ignition systems for turbo-jet and turbo-prop engines. 1955 was highlighted by design and production of a lightweight compact ignition system for use in the small turbine field. This ignition system has extended the high energy level to all turbojet and turboprop engines in practical size for each particular application.

The improvement of ignition devices for operation at extremely high temperature was a major activity of the company during the year. Special ignition devices for varied requirements were also engineered and produced to meet the needs of an ever expanding sphere of activity in the development of turbojet and missile engines.

Outstanding events and developments that occurred during 1955 for **Harvey Aluminum,** Torrance, Calif., included: entrance into the primary aluminum industry, installation of USAF Heavy Press facilities, over-all expansion of production facilities, new techniques for the production of extrusions in high-strength titanium and steel alloys.