Lycoming Afield
GAS TURBINE FIELD SERVICE
DIVISION OF AVCO CORPORATION
STRATFORD CONNECTICUT

VOLUME 1, NUMBER 3 JUNE, 1963

B. H. WARREN NOW VICE PRESIDENT, GENERAL MANAGER

The appointment of Beverly H. Warren as vice president and general manager of Lycoming Division has been announced by James R. Kerr, president and chief operating officer of AVCO Corporation.

General Warren has been vice president of AVCO's Defense and Industrial Products Group since April, 1961, and director of its Operational Missiles Subdivision since September, 1960. He is a veteran of more than 25 years service with the U.S. Air Force, and retired in 1960 with the rank of Major General.

In other organizational changes, General Warren announced the appointment of Dr. Anselm Franz as vice president and general manager, gas turbines, and of Paul A. Deegan as director of administration.

Dr. Franz in turn announced that Dr. Heinrich Adenstedt has been named to the position of vice president, gas turbines operations.

LYCOMING SALES DEPARTMENT ACTIVE

Sales promotion efforts during the Summer will be centered on demonstrations of the Bell 204B, commercial version of the Army's Iroquois helicopter, and sales proposals for Lycoming's T55 turboprop and turbofan engines to potential users in Europe, Canada, and the United States.

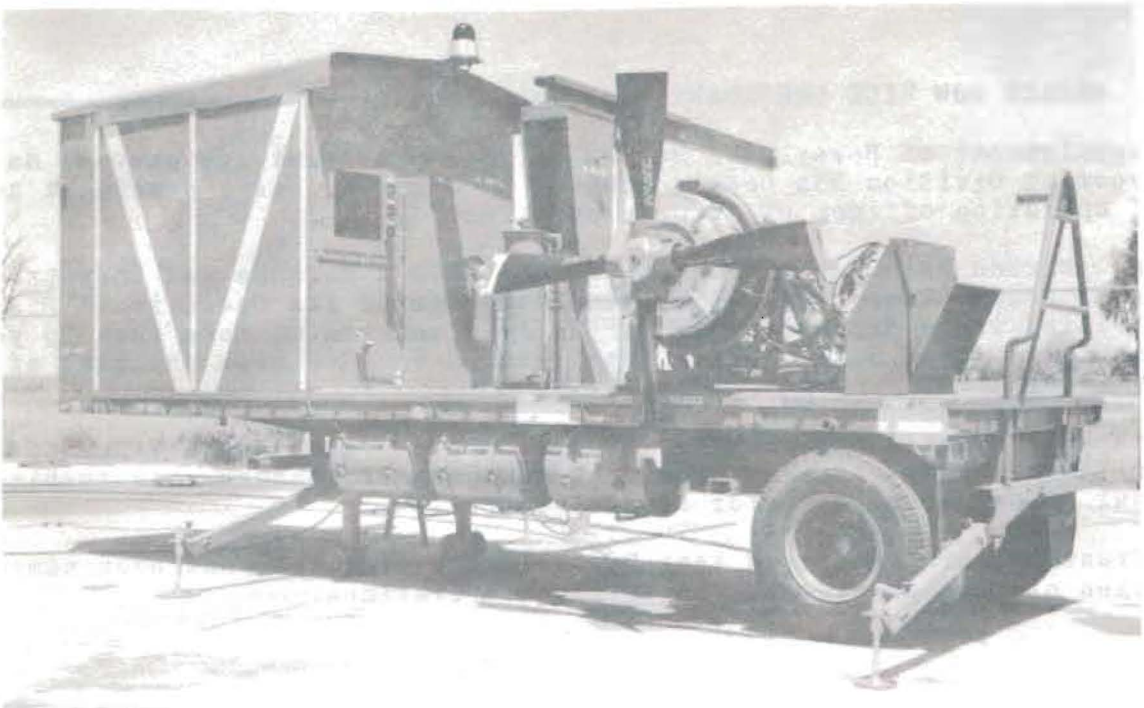
The Bell 204B helicopter is powered by the 1100 shaft horsepower Lycoming T5309 gas turbine engine which differs from the T53-L-9 military engine only in the use of fireproof fuel and oil lines. Two aircraft will make three month demonstration tours, one heading West, the other East. Customers will be invited to demonstrations by the Bell Helicopter regional sales manager in their area, who will be assisted by Bob McCalpin of Lycoming's sales staff.

The T55 turboprop, currently rated at 2535 ESHP, made its first flight in the Air Force YAT-28E Counter-Insurgency Aircraft in early 1963. The extremely high power to weight ratio of the T55 turboprop engine is expected to gain additional applications during the coming year.

The Lycoming turbofan engines were developed from the basic T55 shaft turbine and are designated the PLF1A-2 and the PLF1B-2. The PLF1A-2 is scheduled for demonstration late in 1963. The PLF1B-2 is an advanced version based upon a growth model of the T55 shaft turbine currently in development. The engines are the only turbofan engines that deliver a normal rated thrust in the 4000 pound range.

MOBILE TEST STANDS COMPLETED

Two mobile engine test stands for use at Army installations in Germany have been completed at the Lycoming plant in Stratford. Weighing nearly 11 tons each, they will be air lifted to Sandhofen before the end of June.
(cont'd on Page 4)



TURBOPROP ENGINE MOBILE TEST STAND

SERVICE SCHOOL RECORD ENROLLMENT

Under the able direction of Dick Blewett, Supervisor of the Training Section, Lycoming has instructed more than 750 men in the maintenance of our gas turbine engines during fiscal 1963. This is an increase of more than 600% over the average of previous years. The biggest factor in the increased enrollment is the inauguration of the Army Aircraft Mobile Technical Assistance Program (AAMTAP) training teams. Under the AAMTAP program, instructors from Lycoming have been active in the United States, Europe, and the Far East.

George Grant, with the help of Field Service Representatives, has held classes at ASMC in St. Louis, Fort Riley, Fort Worth Army Depot, ARADMAC at Corpus Christi, Atlanta Army Depot, Olmstead Army Depot, and Fort Carson. The team will be at Fort Benning for the rest of the Summer.
(cont'd on Page 3)

SWISS AWARD EARNED BY KAMAN AIRCRAFT

The Swiss Air Force recently awarded the Swiss High Mountain Badge to Kaman Aircraft Corporation for the superior performance at high altitudes of an HH-43B helicopter. This is the first U.S. aircraft to receive this award and is the result of demonstrations on Mount Jungfrau at an altitude density of 14000 feet. Lycoming Field Service Representative, Dick Kipphut, reported that the aircraft lifted 4500 pounds at a 3000 ft. density, carried a 3000 lb. payload from 2000 feet to the top of the mountain in nine minutes, and made approximately 20 battery starts at the top. During the 11 day demonstration, the aircraft was 100% available. The engine was operated approximately 20 hours, of which 15 hours were on JP-1 fuel, with no discrepancies noted during inspection. N_I rpm never exceeded 95% and E.G.T. stayed below 525ºC. The HH-43B lifted a third more payload than the other two aircraft in the demonstration, a Bell Agusta (English built T-58), and an Alouette (Atouste III-B).

FORT BENNING EVALUATION PROGRAM BEGINS

An evaluation of Army aircraft under conditions simulating war has been started at Fort Benning. The program, to last for more than two years, is a more specific evaluation of the Howze Board concept of Army mobility. Because it is to be primarily an evaluation of Army aircraft, Lycoming T53-L-3/7/9/9A/11 and T55-L-5 engines together will outnumber all other engines being evaluated. With a target of 75 percent availability of aircraft, the program should prove the superiority of Lycoming gas turbines over others in the field, particularly during a three month period of intensive activity during the Fall. Close liaison between Fort Benning and the Lycoming Service Department will be handled by Field Service Representatives Spero Jordanides and Bill Darling at Fort Benning and Service Engineers Al Wagher and Jim Moriarty working from Stratford.

SERVICE SCHOOL RECORD ENROLLMENT (cont'd)

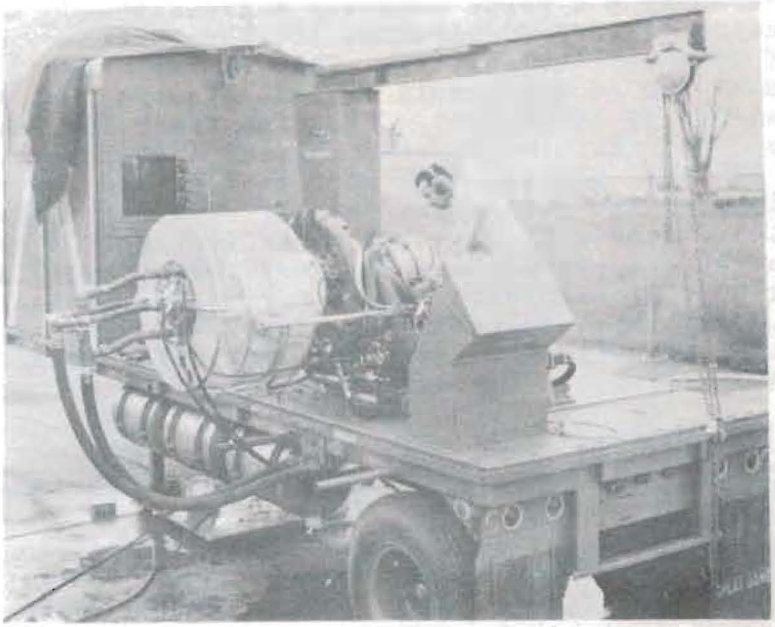
Paul Wolkovich and Joe Shafer, the European team, have had more than 15 classes at Army installations in Germany and Italy. They are now instructing German civilian employees at Sandhofen.

The Far East team has had classes in Japan, Korea, and Viet Nam, and will spend the next six months on assignment in Viet Nam.

In Stratford, the regular training school held classes on T55 engines until the middle of April and is now teaching T53 maintenance. The first Navy and Marine class was held, and in July a second Marine class will cover the industrial T53 engine to be used in the Lycoming hydrofoil vehicle.

The schedule for fiscal 1964 includes four Navy classes, three Luftwafe classes, and an advanced class for Bell Helicopter employees, in addition to the regular Army program. With the AAMTAP teams continuing the program, the 1964 enrollment is sure to pass the 1,000 mark. Lycoming Afield congratulates the Training Section for a job well done.

MOBILE TEST STANDS COMPLETED (cont'd)

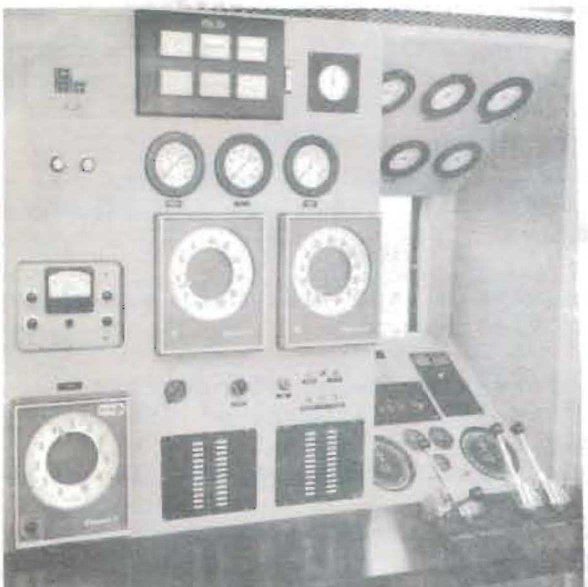


HELICOPTER ENGINE MOBILE TEST STAND

Each stand is a completely self contained test facility laid out on the flat bed of a 26 foot trailer. One is designed for testing T53 Series helicopter engines with a water brake. The other, using a club propeller, is to test turboprop engines.

Being completely self contained, they will require only a source of 110 volt ac electrical power. The water brake requires a supply of water, which is pumped through the brake by a gasoline engine powered pump mounted under the bed of the trailer. Engine starting is by a battery which is kept charged by a trickle charger in the control room. Engine fuel and oil is carried in tanks on the trailer, and engine handling is facilitated by a chain hoist on a jib boom.

The control room located at the rear of the trailer, contains an engine control panel with complete test indication facilities. It features recessed lighting, air conditioning, and a three inch thick bullet proof window to protect the test operator while observing the engine. In transit, removable side panels forward of the control room and a waterproof tarpaulin on top protect the equipment.



MOBILE TEST STAND CONTROL PANEL

Colonel Dyer, Commanding Officer of the Army Depot at Sandhofen, Germany, has long recognized the need for more refined test facilities to aid the program of increased maintenance capabilities in the European theatre. Under his administration the Depot has been working at nearly full overhaul levels. Delivery of the new equipment will facilitate the necessary engine testing.

T55 ENGINE DEVELOPMENT HISTORY

Prepared by Art Beaman, Field Engineer June, 1963

Our third Lycoming Afield insert dealing with Lycoming gas turbine engine history will outline the development and continuing advancement of the T55 series engine.

The T55 series were developed primarily to satisfy the demand for more power with better specific fuel consumption. Beyond that, the new requirements became an opportunity to develop a completely new basic engine having components that could be readily changed for helicopter or turboprop use. This interchangeability is called the universal engine concept. The development of the basic engine is continuing, with each new version able to produce more horsepower. The success of the design is now firmly established, and more applications, industrial as well as military, are being found for the newest of our family of Lycoming gas turbines.

YT55-L-1

An Air Force design competition for a 1500 shaft horsepower turboprop engine resulted in a development contract, signed in April, 1954 for two Lycoming LTC4A-1 engines. In April, 1955, only one year later, the new engine made its first test run. The 50 hour qualification test at 1600 shaft horsepower was completed in December, 1957, and the engine was designated the YT55-L-1. This particular engine configuration was not put into service until September, 1962, when one of the two development engines was delivered to the U.S. Navy as part of a package for the Marine Corps' Short Airfield Tactical Support (SATS) development program. The other YT engine is being held as a spare. Although the new engine was not used immediately, it demonstrated Lycoming's ability to design and qualify a gas turbine engine having a power rating much higher than the previously produced T53 series.

T55-L-3

Army interest in the new engine resulted in a contract in March, 1956 for further development under a Lycoming designation of LTC4B-2. This new 1800 shaft horsepower version, geared for helicopter use, made its first test run in December, 1957. The 50 hour qualification test, completed in March, 1958, demonstrated a shaft horsepower exceeding 2050. The engine was then designated the YT55-L-3 and was rated at 1900 shaft horsepower. In July a joint Air Force/Army team selected this engine configuration to power the newly developed multi-engined Army Chinook helicopter HC-1B, later designated CH-47A.

T55-L-5

A month after the selection of the T55-L-3 for the Chinook aircraft, the engine contract was changed to provide a Lycoming designated LTC4B-7 non-geared version of the T55, having an integral oil cooler and tank. With this engine, reduction gearing required for the aircraft is contained in the aircraft power transmission system. In January, 1960, after demonstrations of shaft horsepower exceeding 2500, the engine was rated at 2200 shaft horsepower. This greater power is the result of higher turbine inlet temperatures made possible by many small modifications. These modifications were suggested by the experience gained during the development of the YT55-L-1 and YT55-L-3 engines.

The 50 hour qualification test was completed in February, 1960 and the engine was designated the YT55-L-5. Deliveries began in August of that year. In September the engine completed its 150 hour qualification test and became the T55-L-5 production engine. Its weight of 570 pounds and its guaranteed shaft horsepower of 2200 gives it a power to weight ratio of 3.87:1, the highest of any engine in its class. Deliveries of the first group of 150 hour qualified engines were completed in February, 1961 and the Chinook helicopter made its first flight in October of that year.

In August, 1962 the T55-L-5 engine was chosen for the Curtiss Wright Corporation X-19 High Speed VTOL Tri-Service aircraft. This aircraft is a twin-engine, tandem high-wing aircraft with four tilt propellers mounted in nacells at the wing tips. The engines are intershafted with over-running clutches so that either or both of them continuously drive all four propellers. Only approximately 50 percent power from both engines is used for takeoff, and cruising requires approximately 30 percent power. This should result in an extremely long engine life.

LTC4G-3

The first demonstration run of the Lycoming designated LTC4G-3 engine was made in May, 1961. This engine uses the new Lycoming designed and financed split power turboprop reduction gearing, which is the lightest gear train yet developed for transmitting more than 2500 shaft horsepower. Weighing 799 pounds and rated at 2445 shaft horsepower (2535 equivalent shaft horsepower), this engine has the highest power to weight ratio, 3.21:1, of any turboprop engine in the free world. The new reduction gearing is a big factor in achieving this excellent power to weight ratio.

The high gearing efficiency is accomplished through the use of two paths for torque transmission from the engine to the propeller shaft. The engine power shaft directly drives a primary stage sun gear which is engaged with four primary stage planet gears, supported by and rotated with the propeller shaft. A primary stage ring gear, driven by the primary stage planet gears, is mechanically linked to the secondary stage sun gear. The secondary stage sun gear drives the secondary stage planet gears, which are supported in a fixed position by the engine inlet housing. The secondary stage planet gears engage a secondary stage ring gear that is mechanically linked to the propeller shaft and rotates with it. In this way engine power is transmitted at a gear reduction ratio of 11.72:1 from the power turbine to the propeller shaft. The propeller shaft is turned clockwise at 1270 rpm. (See schematic.)

After completion of its 50 hour qualification test in November, 1962, the first engines were delivered to North American Aircraft for use in the YAT 28E aircraft program. Although it is being used in an Air Force contract, it is purchased directly by North American and will retain its Lycoming designation until a military or commercial contract is signed with Lycoming. The engine is basically a T55-L-7 combined with the split power turboprop reduction gearing.

T55-L-7

This slightly modified, uprated version of the T55-L-5 engine completed a 150 hour qualification test at 2650 shaft horsepower in September, 1962. Although basically accepted, a few penalties remain to be demonstrated. The test increased the power to weight ratio of 3.87:1 for the T55-L-5 to 4.65:1 for the T55-L-7. During this testing, turbine inlet temperatures approached 1830 degrees. A 150 hour qualification test at 2500 shaft horsepower, with lower temperatures, is currently being completed. This engine delivers more power than any other Lycoming gas turbine engine.

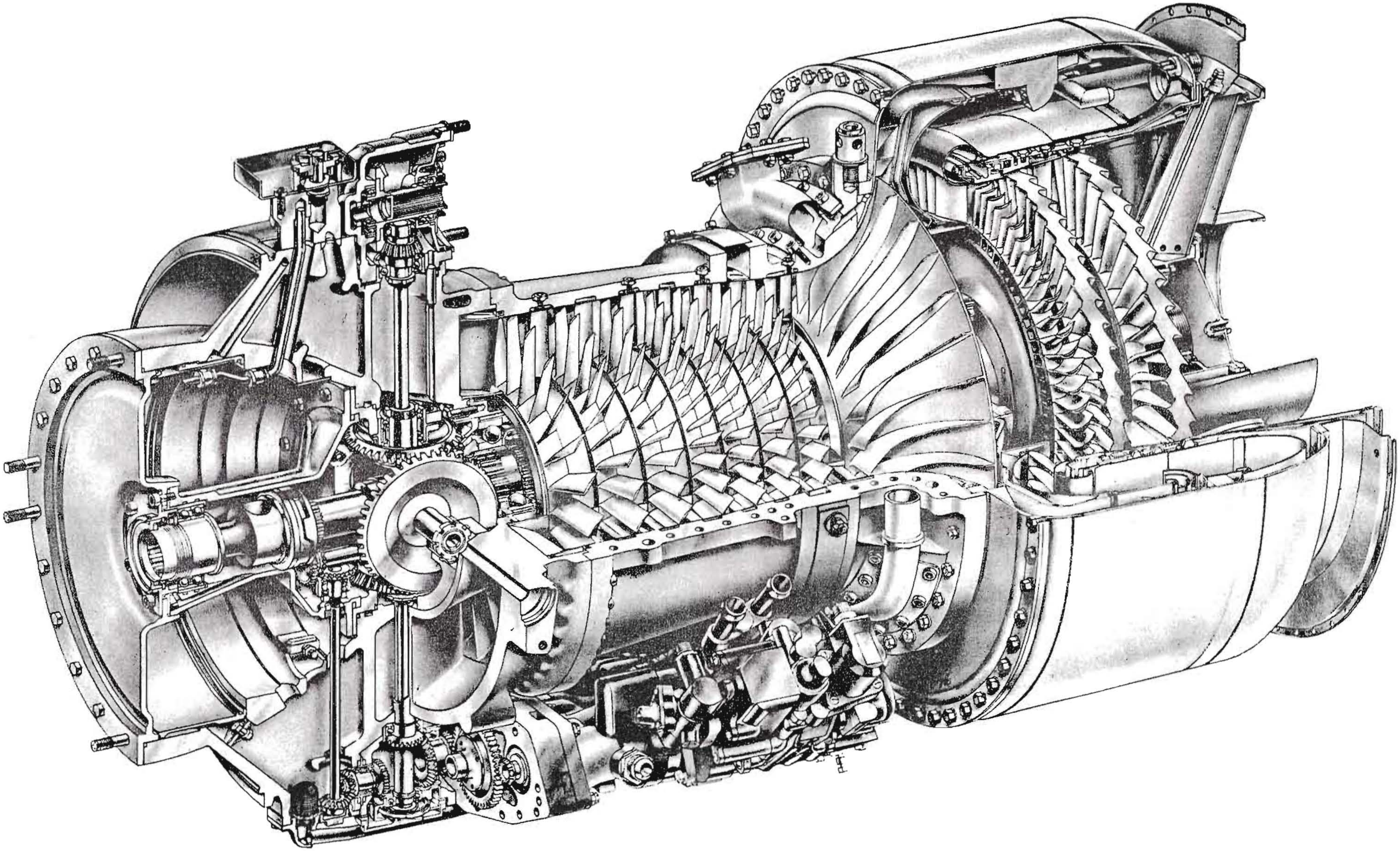
Summary

The T55 series of Lycoming engines were designed with the basic concepts of simplicity and universal design of primary importance. Development of the basic design has produced rugged, trouble-free engines, easy to maintain without extensive personnel training, and readily converted to helicopter or turboprop applications. Procurement of engine spares is, therefore, less costly to the using service. This results in maximum engine availability and full utilization of equipment. The series has developed into the most efficient aircraft power plant in its class.

COMPARISON OF T55 SERIES ENGINES

Military Designation	YT55-L-1	YT55-L-3	T55-L-5	T55-L-7	None
Lycoming Designation	LTC4A-1	LTC4B-2	LTC4B-7	LTC4B-8	LTC4G-3
Engine Type	Turbo Prop	Helicopter	Helicopter	Helicopter	Turbo Prop
Output Gearing	Single Stage	Single Stage	None	None	Split Power
Application	1)Early Prop Study 2)Navy SATS	HC-1B (CH-47A) Replaced by T55-L-5	CH-47A & X-19 VTOL	CH-47A	YAT-28E
Lube System*	A/C Supply & Mounting	A/C Supply & Mounting	Integral with Engine	Integral with Engine	A/C Supply & Mounting
Military Power	1600 SHP	1900 SHP	2200 SHP	2500 SHP	2445 SHP
SHP - NRP	1325	1700	1850	2200	2100
SFC	0.678	0.670	0.622	0.615	0.629
Dry Weight	695 lbs.	600 lbs.	570 lbs.	580 lbs.	799 lbs.

*A/C Supply includes tank and cooler not included in engine weight.
Integral includes tank and cooler with engine and included in engine weight.



T55-L-5

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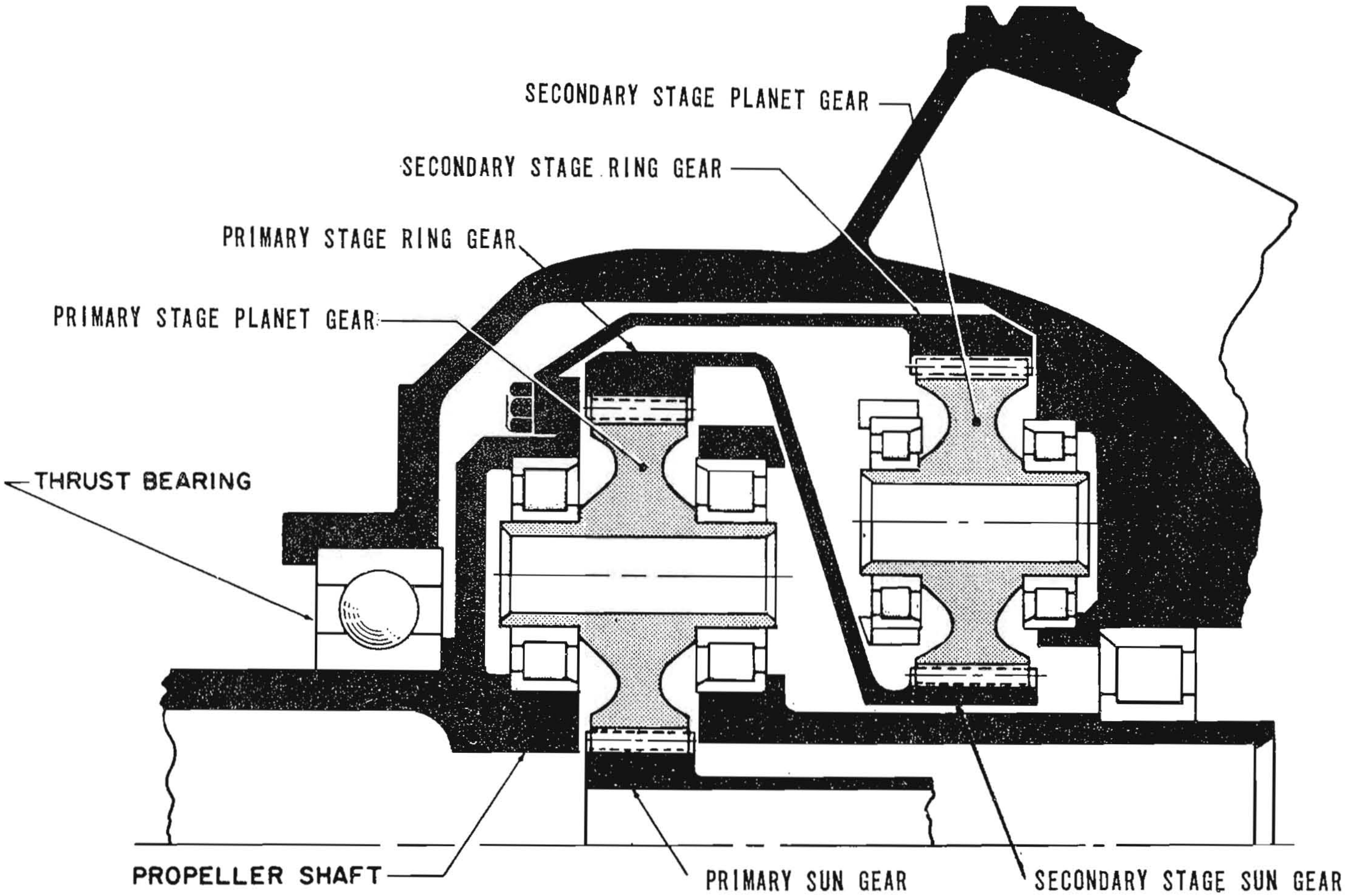

SPLIT-POWER PROPELLER GEAR