AVIATION WEEK
A McGRAW-HILL PUBLICATION
MAY 16, 1949

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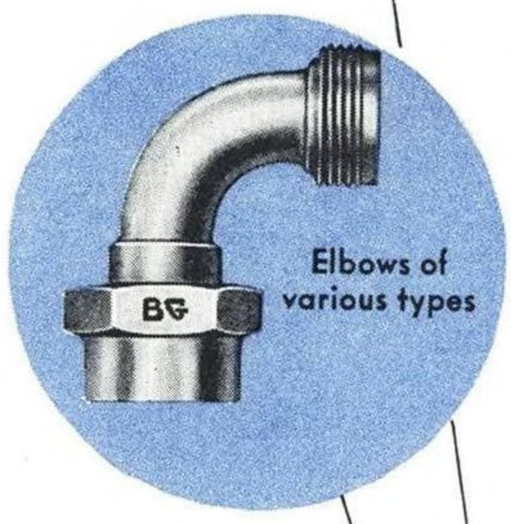

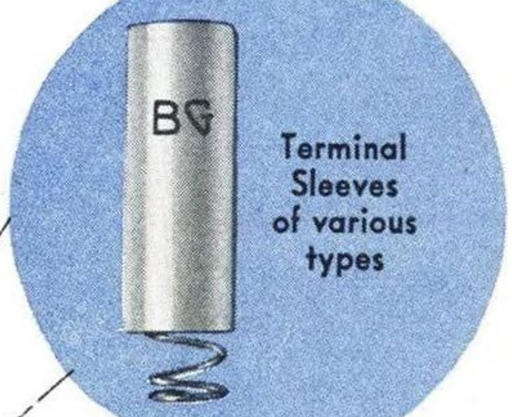

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AVIATION WEEK

May 16, 1949

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NEWS SIDELIGHTS

Unitary Plan

The "Unitary Plan" of the National Advisory Committee for Aeronautics and the National Military Establishment blueprints a ten-year program for transonic and supersonic wind-tunnel development. Total cost is estimated at $1.1 billion. NACA is anxious to move forward with the first phase of the program over the next fiscal year, which starts in July. This would cost $77 million and entail 13 transonic wind tunnels for university training and research; three two-foot supersonic tunnels, to be installed at the Ames Laboratory, Langley Field, and the David Taylor Model Basin; and two four-foot supersonic tunnels, at Ames and Langley.

Legislation introduced by Chairman Carl Vinson (D., Ga.) of the House Armed Services Committee and Chairman Millard Tydings (D., Md.) of the Senate Armed Services Committee would authorize a $311 million segment of the program, including $150 million to initiate construction on a USAF air engineering development center, likely to cost upwards of $750 million. Early committee action in both the House and Senate is expected.

Patterson's Charge

United Air Lines President W. A. Patterson amazed members of the Senate Interstate and Foreign Commerce Committee with his report that no member of the Civil Aeronautics Board, or its staff, charged by law with checking airlines' financial operations, "has ever crossed the thresholds of United's doors to study for himself the methods we are employing to produce the most efficient results.

"No one in the CAB has a first hand knowledge of what goes on behind the scenes at UAL."

The committee's chairman, Sen Edwin Johnson (D., Colo.) commented: "That is one of the most startling statements presented" at these hearings on the economic condition of the air transport industry. Patterson objected that "too many" CAB conclusions are based entirely on statistical data and "they have failed to observe the inside of an airline."

Hidden Arms Costs

The modest $1,130 million set by the Administration for the first-year arms-for-Europe program to implement the North Atlantic Pact is only a vague indication of the size of the program contemplated.

Chief of Staff Gen. Omar Bradley and Secretary of Defense Louis Johnson, badgered by Senators at hearings on the North Atlantic Pact, have conceded that the $1,130 million might represent only the cost of rehabilitating and transporting equipment now in storage.

Congressional sources anticipate that the original cost of the equipment will amount to many times $1,130 million.

Johnson's Errors

Aviation observers who read Defense Secretary Louis Johnson's recent speech to the U. S. Chamber of Commerce are wondering whether his ghost writers need a lecture on accuracy.

Johnson said there were six Boeing B-47s on order. U. S. Air Force has admitted that total of 15 on order. Indications are that committments have been made for many more although USAF is reluctant to discuss the details because of an appropriation snarl.

Johnson also lauded the extent of Boeing's subcontracts on the Stratojet. Shortly before the Johnson speech was delivered Boeing cancelled three of its major subcontracts on the B-47 with Martin, Curtiss-Wright and Bell and moved the work back to its Seattle plant.

First production model of the B-47 is now moving down the line at Boeing's Wichita plant.

Target: Landis

Favorite target of airline officials testifying before the Senate committee investigating industry finances is former CAB Chairman James M. Landis.

United Air Lines president W. A. Patterson said he likes the approach the present chairman, Joseph J. O'Connell, Jr., and other Board members are making in attempt to "clean up the mess they inherited."

Patterson declared that for 18 months (under Landis) dissension and discord existed in the CAB. This, he continued, was the result of "a brilliant but dominant mind endeavoring to mold the course of the air transport industry without a practical understanding and appreciation of the problems the industry faced."

Landis has remained a thorn in the side of many industry executives since he left CAB in January, 1948, when President Truman failed to reappoint him. Air Transport Assn. Executive Vice President Robert Ramspeck told the Senate committee that Landis is "largely responsible" for permitting nonscheduled lines to violate the law.

Landis previously had told the committee that air coach lines and all-cargo operators represent a valuable yardstick for determining proper costs for regular carriers.

Navy's Needle

U. S. Air Force is showing considerable reluctance to pit its Convair B-36 bomber against Navy fighters as suggested in AVIATION WEEK, Mar. 21.

Navy has made a formal request to USAF for use of a B-36 in making tests of the defensive capabilities of the Navy's Chance Vought F4U-5 powered by a Pratt & Whitney R-2800 piston engine and the McDonnell Banshee powered by two Westinghouse J-34 jet engines. Navy believes both these fighters are capable of successfully attacking the present model B-36 at altitudes around 40,000 ft.

Although USAF now has two full groups of B-36 bombers in service it has stalled on answering the Navy's request.

BuAer Problems

Cancellation of the super-carrier together with sharp cutbacks in fiscal 1950 development funds have forced Navy BuAer to curtail design and development of multi-engine attack aircraft in the 75-100,000-lb. gross weight class. But BuAer is accepting the situation as a challenge to design ingenuity in cramming the bomb, armament, fuel and radar equipment loads into smaller packages.

Problem of stiff takeoff and landing restrictions will be solved partially by changes in the carrier rather than in the airplane. Deck-strengthening of current Essex-class carriers is one part of the program. Major problem lies in hitting the right combination of aerodynamic characteristics in the new aircraft designs.

Basic ingredient of the new, big carrier aircraft is rocket power, both for takeoff and in-flight use. The Douglas A2D and North American A2J projects are currently being reexamined to determine if minor modifications, such as rocket power and nose flaps can qualify them for Midway- and Essex-class carrier operation, particularly in landing.

AVIATION CALENDAR

May 16-19—53rd annual meeting, National Fire Protection Assn., Hotel Fairmont, San Francisco.
May 17 — IATA technical conference, Switzerland.
May 19-20—NAS council meeting, Navy Building, Washington.
May 19-21—Society for Experimental Stress Analysis, spring meeting, Hotel Statler, Detroit, Mich.
May 21 — Aviation progress exposition, Baltimore Municipal Airport, Baltimore, Md.
May 22—Airport Open House at Wold-Chamberlain Field, Minneapolis.
May 23—ATC national meeting, Carlton Hotel, Washington.
May 23-24—NASC national meeting, Mayflower Hotel, Washington.
May 23-26—Eighth national conference, Society of Aeronautical Weight Engineers, Inc., Biltmore Hotel, Dayton.
May 24-27—Second joint conference of IAS, Royal Aeronautical Society, Hotel Astor, New York City.
May 26—IATA executive committee, Montreal.
May 26-27—Annual meeting, Society of the Plastics Industry, Edgewater Beach Hotel, Chicago.
May 27-30—Annual convention, Women's National Aeronautical Assn. of the U. S., Chase Hotel St. Louis, Mo.
May 28-30—National Negro Aviation Convention, Bleuthenthal Field, Wilmington, N. C.
May 29—Spring Air Regatta sponsored by Philadelphia Aviation Country Club, Wings Field, Ambler, Pa.
May 31-June 4—AWA annual convention, Statler Hotel, Wash., D. C.
June 2-5—Mississippi Goodwill Air Tour, Jackson, Miss.
June 3-12—Sixth annual Michigan Aviation week.
June 4-5—All-Woman Air Show, Amelia Earhart Field, Miami, Fla.
June 4-5—Fourth annual air fair and industrial exposition, Shawnee, Okla.
June 7—Third ICAO assembly, Montreal.
June 13-15—15th national applied mechanics division conference, American Society of Mechanical Engineers, University of Michigan, Ann Arbor.
June 16-17—Mid-year meeting, Aviation Distributors and Manufacturers Assn., Broadmoor Hotel, Colorado Springs, Col.
June 17-18—Annual Ohio aviation clinic, Bowling Green State University.
June 20-24—AIEE, summer general meeting, New Ocean House, Swampscott, Mass.
June 26-27—NAA 27th annual national convention, Akron, Ohio.
June 27-29—Formal dedication of Naval Ordnance Laboratory aeroballistics division, followed by five half-day technical sessions, White Oak, Silver Spring 19, Md.
July 2-10—National soaring contest, Harris Hill, Elmira, N. Y.
July 10-13—Annual meeting, Natl. Assn. of University Administrators of Aviation Education, Kent State University, Kent, Ohio.
Sept. 1-7—International conference of Federation Aeronautique Internationale, Wade-Park Manor, Cleveland, Ohio.
Sept. 3-5—1949 National Air Races, Cleveland.
Sept. 6-8—Annual spark plug and ignition conference, sponsored by Champion Spark Plug Co., Hotel Secor, Toledo, Ohio.
Sept. 12—LATA fifth annual general meeting, The Hague.
Nov. 9-11—Seventh annual meeting, Aviation Distributors and Manufacturers Assn., French Lick Springs Hotel, French Lick, Ind.

PICTURE CREDITS

15—McGraw-Hill World News; 16—Convair; 20, 21—General Railway Signal Co.

NEWS DIGEST

DOMESTIC

Republic Aviation Corp. XF-91, jet-rocket fighter, made its first flight at Muroc AFB, Calif., with company chief test pilot Carl Bellinger at the controls. Flight was made with only the General Electric J-47 jet engine, the rocket engine not having been installed.

Lockheed Aircraft Corp. announced sale of four 749 Constellations to South African Airways. Connie sales since end of the war total 179 to 13 airlines.

Dr. Hugh Dryden, director of aeronautical research of NACA, will repeat in Washington on May 19 the 37th Wilbur Wright Memorial Lecture he delivered in London Apr. 28 before the Royal Aeronautical Society. The meeting, sponsored by the Washington section of IAS, will be held in the Interior Dept. Auditorium at 8 pm.

Copter speed record for a 100-kilometer closed course was claimed for a Sikorsky S-52-1 which averaged 122.75 mph. between Milford and Westbrook, Conn. It is same craft, and same pilot, Harold Thompson, which previously set mark of 129.616 mph. over 3-kilometer course at Cleveland (AVIATION WEEK, May 9).

First helicopter port in New York City will be officially opened May 18 by Metropolitan Aviation Corp., formerly located at Teterboro Air Terminal, N. J. Company has leased from the city pier 41 on the East River. Operating permit stipulates that helicopters can fly only around perimeter of the city.

FINANCIAL

Curtiss-Wright Corp. reports consolidated net loss of $759,864 for three months ended Mar. 31 on sales of $27,513,797. Loss reflected retroactive price decreases of $420,000 applicable to shipments of Wright Aeronautical Corp. in 1948. For same period Wright Aeronautical reports loss of $1,093,020 on sales of $15,163,042.

Airborne Instruments Laboratory reports 1948 operations totaling $1,835,062, with 88.5 percent of work being for the Government. Employment was up nearly 100 from the preceding year, to a total of 334.

FOREIGN

Iceland Airways set scheduled service between Iceland and London. Company has one DC-4, fitted to carry 40 passengers in four compartments.

India plans to spend nearly $9 million this year on airport installations.

INDUSTRY OBSERVER

► **Lockheed has completed the prototype F-90, swept-wing jet fighter designed for transonic range. Major changes of F-90 over F-80 series: more pointed nose, flush air inlets, swept back wing and increased power. Initial test flights will be made at Muroc by test pilot Tony LeVier.**

► U. S. Air Force is to take delivery on first Lockheed F-94 sometime this month. This is night fighter version of TF-80 two-seater jet trainer fitted with special lightweight radar designed by Hughes Aircraft Co. F-94 will be used primarily as night fighter trainer although National Guard squadrons will be equipped with them for tactical use.

► **Watch for North American F-93 to pop back into Air Force procurement program for fiscal 1950-51. Major modifications of F-86 incorporated in F-93 are shift from nose air intake to flush air inlets and design of pointed nose on F-93. XF-93 prototype is scheduled for completion in August. Meanwhile F-86 production has increased to a point where both the First Fighter Group at March Field and the 56th Fighter Group at Selfridge are exchanging their F-80s for the swept-wing F-86.**

► Air France will buy six additional Lockheed Constellations for delivery this summer. New transports will be paid for out of ECA funds. ECA claims the Lockheed purchase will be final ECA-financed purchase of U. S. aircraft for foreign airlines until completion of a detailed survey by all Marshall Plan countries on their aircraft requirements and justifications for them. Meanwhile ECA will continue to finance purchase of U. S.-made aircraft parts and accessories to maintain American transports now operated by foreign airlines.

► **Republic is offering Air Force a swept-wing version of the F-84 Thunderjet. Meanwhile XF-91, powered by General Electric J-47 jet engine and four solid fuel Aerojet rockets, will function primarily as a research aircraft for USAF exploration of high speed performance data on the inversely-tapered wing.**

► Pratt & Whitney is now running its PT-2 turboprop (under development for Navy) on a ground test stand and plans to install it in nose of specially beefed-up B-17 for flight testing. Both Allison and Curtiss-Wright used the B-17 nose installation for testing their experimental turboprops.

► **Watch for increasing commercial interest in Pratt & Whitney variable discharge turbine (VDT) powerplant. All of the present generation of military transports are powered by P&W Wasp Major engines, basic unit in the VDT system. Switch to VDT powerplant would offer either a 20 percent slash in fuel required to cover any given distance or a 20 percent increase in range with same fuel. Boeing Stratocruiser and French SE 2010 now powered by Wasp Majors may be first commercial transports to switch to VDT.**

► North American is now turning out production models of the AJ-1, three-engine Navy attack bomber at its Downey, Calif., plant. AJ-1 is first of new type heavy carrier-based attack bomber. It is powered by two Wasp Major engines and an Allison J-35 turbojet engine. Navy has 40 of this type on order.

► **Initial helicopter passenger flight between London and Paris was made recently with a Westland-Sikorsky S-51. British-built, American-designed, the helicopter carried two passengers and pilot from a London garage to the Place des Invalides in downtown Paris in 2 hr. 20 min.**

► Primary factor in USAF decision to boost B-36 bomber groups from 18 to 30 planes was the maintenance experience of 7th and 11th Bomb Groups, the first equipped with Convair six-engine bomber. These groups reported that anticipated maintenance difficulties had failed to materialize and that nearly twice the number of planes could be handled without any substantial increase in ground personnel. Some re-adjustment of specialist types is required however since the B-36 requires more of some types such as electricians and less of others.

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AVIATION WEEK

May 16, 1949

How The Air Force Will Spend Its Money

Preliminary schedules indicating what the U. S. Air Force plans to buy with its record peacetime budget of $5.3 billion are now available from official sources. The USAF budget passed by the House last month still faces a Senate vote but is not expected to receive any major alterations.

Biggest item on the USAF proposed shopping list is the item of $2,217 million for procurement of 2550 new aircraft. USAF has prepared a breakdown only for the original item of $1,480 million it requested for this purpose in the budget submitted to Congress. How these funds will be spent is indicated in the following table:

	Planes	Spares	Total Cost
Bombers	$541,574,786	$171,456,362	$713,031,148
Fighters	221,526,521	124,571,606	346,098,127
Transports	182,279,717	55,308,745	237,588,462
Trainers	69,267,228	30,453,804	99,721,032
Other	22,753,258	6,878,034	29,631,292
Subtotal	1,037,401,510	388,668,551	1,426,070,061
Prior years items			26,236,939
Special modifications			27,693,000
Total			$1,480,000,000

The House added an additional $851 million to the original USAF budget. Of this sum approximately $740 million will be earmarked for additional aircraft procurement. No breakdown is available now on how this additional aircraft money will be allocated but it is expected that all but about $50 million of it will be spent for additional fighters, light bombers and transports.

Unless Defense Secretary Louis Johnson reverses present policy the Air Force will release a detailed aircraft procurement schedule for fiscal 1950 listing types and companies shortly after the Military Appropriation Bill is signed by the President.

Maintenance and operations funds for fiscal 1950 total $672 million. Breakdown of this item includes the following:

▶ Maintenance and Operation, Aircraft:	
Maintenance supplies and equipment	$120,000,000
Fuel and oil, aircraft	158,000,000
Depot aircraft maintenance personnel for replacement and overhaul	100,000,000
Contractual services for maintenance and salvage	12,000,000
Modernization of aircraft	40,000,000
Storage of aircraft	9,000,000
Depot-supply activities	50,000,000
▶ Organization, Base and Maintenance Supplies and Equipment:	
Air Force supplies and equipment	65,000,000
Medical-service supplies and equipment	2,200,000
Signal-service supplies and equipment	28,189,000
Quartermaster supplies and equipment	30,000,000
Engineer supplies and equipment	17,800,000
Ordnance supplies and equipment	40,000,000
Transportation supplies and equipment	115,000

Breakdown of the $65 million Air Force supply item includes the following:

Rubber material other than casings and tubes	$102,166
Watches, computers, and navigational instruments	67,562
Lubricants, corrosion preventatives, and hydraulic fluids	101,866
Enamel, paint, lacquer, compounds, paint remover	449,986
Electrical equipment	134,696
Airfield lighting equipment	2,300,479
Ground photographic equipment, supplies, film, and paper	2,027,937
Fuel- and oil-handling equipment	179,194
Clothing, parachutes, maintenance parts, and kits	1,429,890
Ground radio, radio equipment and maintenance parts, including test equipment	20,709,836
Shop and warehouse equipment power tools, hand tools, and laboratory and test equipment	4,302,669
Special tools and equipment	178,736
Flying field, hangar equipment, handling equipment, special purpose vehicles, marine equipment, and spare parts	11,440,918
Aerial delivery parachutes, containers, covers, and tarpaulins	571,956
Felt nylon cloth, webbing nylon, and cotton	168,012
Lumber, excelsior, fiberboard, cork, and plywood	5,900,116
Metals and composition material	52,878
Chemicals	1,251,154
Office equipment and supplies, including MATS terminal furnishings and equipment	2,270,022
Instrument, navigation, bombing and radar trainers, and related parts	576,755
Commercial hardware	1,608,626
Modernization of ground equipment	9,174,546

The $12 million for contractual services on maintenance and salvage will be spent on the following projects:

Technical representatives	$5,120,538
Maintenance of VIP airplanes	345,962
Repair of aircraft weighing kits	35,000
Plating of cylinders	10,000
Recharging of methyl bromide cylinders	6,500
Miscellaneous maintenance of production aircraft subsequent to acceptance but prior to delivery	208,000
Guarding or salvaging of aircraft	5,000
Maintenance of cargo-type aircraft	6,269,000

Under a special procurement allocation of $53 million, USAF plans to buy $28 million worth of general purpose vehicles and $25 million in special Air Force equipment. The special Air Force equipment includes:

▶ Photographic Equipment—$6,999,950:

	Quantity	Total Cost
Camera (T-11)	50	$600,000
Camera (K-40)	149	2,682,000
Mount (A-31)	40	$100,000
Finder, view (B-2)	50	450,000
Finder, view (A-6)	52	260,000
Recorder (A-1)	53	159,000
Camera (K-35)	39	195,000
Camera (K-41)	50	170,000
Fuse, photoflash	500	100,000
System, photoflash bomb	3	45,000
Bomb, photoflash (T-9)	500	50,000
Synchronizer, photoflash	52	39,000
Camera, strip 35mm	8	19,200
Camera, tri-metrogon	11	38,500
Cartridge, photoflash (T-12)	5,000	100,000
Intervalometer (B-8)	25	12,500
Machine, developing, 18½ inch	9	22,500
Washer, 24 by 30 prints	35	28,000
Dryer, 18½ inch film	9	9,000
Developer kit, 9½ inch by 400 feet	27	40,500
Printer, contact 24 by 30 inch	35	87,500
Printer, negative duplicating	8	120,000
Splicer, 9½ inch (B-1)	27	2,700
Printer, reduction stereo	6	30,000
Projector, continuous stereo 70-millimeter	22	66,000
Machine, continuous printing, 18½ inch	9	900,000
Printer, 9 by 18 inch (A-17)	9	6,750
Printer, continuous, 18½ inch	9	13,500
Camera, Zenith (D-1)	12	60,000
Height finder, stereo	19	47,500
Dryer, print 24 by 30 prints	35	24,500
Filter, identifying	77	38,500
Projector, 35-millimeter (G-1) (radar)	30	60,000
Projector, continuous stereo, 9½ inch	22	66,000
Machine, stamping (A-4A)	41	12,300
Camera, radar recording 16 millimeter (O-12)	150	244,500
Machine, color processing (K-7)	10	100,000

▶ Personnel Flying Equipment—$1,928,730:

	Quantity	Total Cost
Panel emergency signal	1,500	$37,500
Shirt, flying, heavy, type A-1	4,498	67,470
Trousers, flying, inner, type E-1	4,498	67,470
Parachute assembly, automatic back, type B-13	2,000	900,000
Kit, fighter, pilot, survival, seat type	1,500	150,000
Kit paradoctor, emergency, rescue aerial delivery	12	9,600
Jacket, aircraft, ground crew, heavy, hood attached, type N-3	6,000	390,000
Trousers, aircraft, ground crew, heavy, type F-1	6,000	270,000
Cap, aircraft, ground crew, heavy, type D-1	6,000	18,000
Kit, fighter, pilot, survival	267	18,690

▶ Airport and Hangar Equipment—$6,095,800:

	Quantity	Total Cost
Dolly, bomb hoist, type A-1	300	$90,000
Lift, mobile bomb, 25,000-lb. capacity	30	450,000
Plant, power, electric, gasoline-engine driven, 30 kilowatts, 120-volt direct current, and 22 kilowatts, 28-volt direct current	213	1,704,000
Plant, power, electric, gasoline-engine driven, 30 kilowatts, 120-volt direct current, 11 kilowatts, 28-volt direct current, and 20 kilovolt-amperes, 120-volt alternating current, 380-1000 cycles	12	96,000
Stand assembly, engine maintenance, enclosed, canopy type J-1	213	852,000
Stand, service, multilevel	131	$628,800
Dolly, aircraft radome handling	48	24,000
Plant, generating, liquid CO_2, air transportable B-1	4	200,000
Hoist, bomb; 2000-lb. capacity	164	82,000
Cradle, R-4360 engine nacelle	169	507,000
Hoist, engine or turret, portable, 10,000-lb. capacity, type J-2	49	98,000
Shelter, maintenance, jet fighter aircraft	200	1,000,000
Manifold system for hydraulic jacks	57	114,000
Demineralizer, water, portable, 100 gal. per hour, type A-1	100	250,000

▶ Laboratory and Test Equipment—$3,717,200:

	Quantity	Total Cost
Turntable, gyroscopic instrument	25	$75,000
Analyzer, portable, type A-1	27	10,800
Stand, test, alternator, constant speed drive, 400-cycle system with load bank	15	305,000
Tester, pressurized cabin leakage, bomber aircraft, gasoline-engine driven, portable, 110 to 320 CFM, type V-2	20	70,000
Tester, pressurized cabin leakage, fighter aircraft, 18 to 155 CFM, type V-1	70	245,000
Set, testing aircraft hydraulic system, electric, motor-driven, portable, 15-gal. capacity	9	40,500
Set, testing aircraft hydraulic system, gasoline-engine driven, portable	50	250,000
Tester, type A-1-B gun bomb rocket sight, type G-1	28	66,400
Manometer, mercury 240-inch multi-range	10	10,000
Stand, test, high range fuel flowmeter	10	30,000
Bench, aircraft instrument electrical repair	40	120,000
Detector, gaseous leakage	10	65,000
Set, field, instrument test, type C-3	110	1,110,000
Test stand, generator, aircraft 50-horsepower	20	300,000
Stand, propeller control test, self-contained units	18	72,000
Barometer, mercurial, type A-1	50	37,500
Overhaul and testing equipment for B-36, B-45, B-54 hemisphere type gun sights	1	300,000
Overhaul testing set for A-1 fire control system	1	300,000
Overhaul testing set for B-47 fire control system	1	300,000
Tester, fuel flowmeter	20	10,000

Other items to be purchased under this allocation:

Tools for overhaul of jet and R-4360 engine	$5,113,920
Automatic spark plug cleaner (vapor blast type)	24,000
Armament cleaning cabinets	60,000
Special propeller tools	60,000
Instrument repair tools	70,000
Nitric acid servicing trailers (1000 gal.)	900,000
Air conditioned trailers (N-1)	30,400

Total of $115 million is earmarked for purchase of electronic equipment as follows:

Ultra-high frequency conversion program	$22,931,424
Identification systems	10,229,884
Command communications systems	7,192,752
Aids to navigation	27,155,304
Tactical electronics systems	45,054,416
Communication security systems	2,436,220

Air Force Calls for New Fighter Designs

With present fighters lagging several years behind bomber performance, industry faces catching-up job.

By Robert Hotz

U. S. Air Force fighter development is lagging from three to five years behind current bomber performance.

This has dropped a critical problem in the lap of the aircraft industry:

To close the gap between fighter and bomber performance before foreign bomber development matches present U. S. standards.

▶ **Design Race**—U. S. Air Force has called a conference of all major airframe manufacturers to meet May 20 at the Pentagon, which will begin a concerted attack on this problem. From the design competitions originated at this conference will come a new breed of fighters that will eventually get the bulk of USAF fighter procurement funds.

Key factor in the new emphasis on USAF fighter development is performance of the latest models of the Convair B-36 bomber (AVIATION WEEK, Mar. 14) that boosted the air war above 40,000 ft. about three years sooner than USAF strategists anticipated.

▶ **Requirements Boosted**—Until recently USAF fighter requirements were aimed at maximum performance around 35,000 ft. Although the present operational crop of USAF jet fighters (F-80 and F-84) can meet that requirement, the urgent need now is for a fighter that can reach its peak performance between 40,000 and 50,000 ft.

USAF fighter experts believe that the problems of defensive operations between 35,000 and 45,000 ft. will be tougher to solve than the entire previous climb from sea level to 35,000 ft.

▶ **Basic Problems**—The job of producing a 50,000 ft. fighter involves four basic problems:

- **Improvement of airframe design** to permit transonic combat performance.
- **Redesign of turbojet engines** to produce greater efficiency above 40,000 ft.
- **Design and production** of an entire series of new accessories aimed at making navigation, control, and gunnery accurate and simple at the speeds and altitudes required.
- **Planning and organizing** a new type of ground fighter control system based on the tremendous increase in airspace cubage brought about by the extension of air operations to the 50,000 ft. level and transonic speeds.

Basic design limitation on present type jet fighters above 40,000 ft. evolves from the high wing loading of current fighters. Fighters that can take up to 7G stresses at 20,000 ft. will pull off their wings in 2½G turns in the thin atmosphere above 40,000 ft. USAF planners say that considerable basic research is required on the relations of wing loadings and power loadings above 40,000 ft. before much practical progress can be made on this problem.

▶ **RAF Tests**—Royal Air Force tests were made above 40,000 ft. with two Vampire jet fighters, one flying straight and level while the other tried to make passes at it. The attacking Vampire stalled and spun out every time a turn or even moderate bank was attempted.

This is basically the same difficulty encountered by highly wing-loaded fighters attempting to maneuver above 40,000 ft. against a lower wing loaded bomber flying straight and level. In an altitude record climb to 59,000 ft. by another RAF Vampire it was necessary to add six feet to the wing length to decrease the wing loading so that the plane would fly as high as its power would take it.

▶ **Need Research**—Lacking the basic research on aircraft performance and general conditions above 40,000 ft. USAF is proceeding cautiously into this new area. No really new fighter prototype contracts have been let since 1946.

Exploration of radical design changes is proceeding through use of special research aircraft of which Convair Model 7002 (aimed at exploring the delta wing) and Republic XF-91 (aimed at getting data on the inversely tapered wing) are typical. Other flight research is being conducted by the Bell X-1 and Douglas D-558-I and II. Until sufficient data is gathered from these and other high speed research planes now flying, the fighter design trend will continue to be evolutionary and represent moderate rather than substantial progress.

▶ **Design Trends**—Among design trends in the evolutionary progress of existing fighter prototypes:

- **Elimination** of the open air-intake nose and substitution of a sharp-pointed nose.
- **Substitution** of flush air inlets for jet engines replacing nose and wing-root ducts now in use.
- **Increased sweepback** of wings from the current 35-45 degrees to as much as 60 degrees merging into delta wing configurations.

Principal powerplant problem is licking for the turbojet the same basic problem encountered in getting satisfactory performance at altitude from piston engines—ramming enough thin air into the engine to support combustion and provide cooling.

▶ **Power Drop**—The best of current U. S. jet engines experience a power loss of up to 80 percent above 40,000 ft. USAF is pinning its hopes for solving this problem on a high density flow jet engine now under development.

Aircraft equipment and ground control problems are best illustrated by the experience of USAF fighter pilots, all with considerable World War II combat experience, who recently attempted interception of a B-36 at 43,000 ft. over Muroc AFB. They were flying F-86As, probably the highest performing production fighter turned out by a U. S. manufacturer, yet it did not make effective attacks on the B-36 at that altitude except from the tail zone.

▶ **Canopies Frost**—First the cockpit canopies frosted at 40,000 ft., cutting off visibility. That problem has since been solved. Another minor irritation was that when pilots twisted their heads sharply to keep the bomber in sight during maneuvers their oxygen masks twisted loose causing them to suffer severe blackouts.

The F-86A has a sufficiently fast rate of climb to get above the B-36 well within the limits imposed by present early warning radar. However, without detailed ground control, pilots were unable to plot accurate interception courses during climb despite perfect visibility conditions and clearly defined bomber contrails.

▶ **Wide Turns**—When making anything but tail passes the F-86As were restricted to shallow turns of 6 to 8 mi. radius. This meant that pilots had to line up for their passes on the B-36 at from 15 to 20 miles away. They were unable to judge course and speeds properly at that distance. Consequently the fighter attacks were wide of the bomber.

USAF planners believe that these critical interception problems will mean an increasingly important role for ground controllers who will be electronically equipped to make these computations for the pilot and accurately direct fighter planes in the air. It also means a revolution in aircraft armament and sighting equipment.

▶ **Needs Help**—Because of the increasingly high altitude operations and the increasing complexity of a jet fighter pilot's job, strenuous research is now under way on accessory equipment to relieve the pilot of many of his most pressing mechanical problems.

Lightweight auto-pilots are now in experimental use in fighters and will probably be a must in future jet fighters. Since visual navigation is impossible at extreme altitudes, lightweight radio compasses, better communications equipment and ground control radar are required to put the fighter where it must be within the time limitations of its fuel capacity.

▶ **Radar Required**—Because of speed and distance factors in modern air war the use of airborne radar for all types of fighters is becoming an increasingly urgent requirement.

USAF fighter experts readily admit that they badly need new equipment and techniques for fighting bombers above 40,000 ft. But they proudly point to the fact that it was increased fighter performance up to 35,000 ft. that drove the bombers above 40,000 ft., and they predict that the fighters will soon be back up there flying with the bombers again.

BRITISH BOMBER TRAINER

New British bomber trainer, developed from basic design of the Vickers Viking and Valetta, is expected to be in production before year's end. Most noticeable departure from transport versions is twin-wheel, tricycle landing gear and underslung bomb bay with bombardier's window shown in drawing. Powered by two Bristol Hercules engines, craft has overall length of 67 ft. 6 in., span of 94 ft. 11 in. and is fully equipped to train RAF personnel in day and night bombing (Aviation Week, Apr. 4).

CAA Eases Franchise Rule, Cuts Red Tape

Federal airport aid program red tape was sharply slashed last week. CAA eliminated five of the twelve forms which airport sponsors are required to fill out, simplified two of seven remaining.

Most far-reaching in effect on aviation users, however, was concurrent CAA action which authorized for the first time granting of exclusive franchises for gasoline and oil sales on airports aided by Federal funds. Airport operators have been pushing for such authorization, while scheduled airlines, through Air Transport Assn., have fought granting of exclusive franchises, as interference with their rights to contract individually for fuel.

▶ **Poll Taken**—Administrator D. W. Rentzel said the decision permitting exclusive franchises followed a poll of affected interests in February. It was decided many public airports would need the revenue from exclusive contracts for adequate operation and maintenance, and that a clause requiring fair, reasonable and non-discriminatory prices should offer ample safeguard against gouging airplane operators.

Many legal headaches relating to title which have previously irritated and delayed airport sponsors in applications are eliminated under the revised rules.

▶ **Title Search**—Detailed legal form showing clear title to airport property is no longer required, nor is special title search running back 75 years. CAA will now accept a sponsor certificate signed by an authorized official that statement of property described in application is correct.

Requirement for special survey map prepared by an engineer or surveyor, which sponsors some times were unable to provide, is now modified to accept a property map which need not be prepared by engineer or surveyor.

▶ **Blanket Responsibility**—The sponsor now assumes a blanket responsibility for any title encumbrances that may turn up later on, thereby protecting Federal grant funds against such encumbrance. The sponsor is thus relieved of trouble of sending title certificate in and having it bounce back for correction.

Limit on payment of grants to sponsors before final audit is now raised to 90 percent from 85 percent. Sponsors are allowed to award negotiated contracts for less than $2000 without competitive bidding.

▶ **Eliminate Abstract**—If sponsors conduct bidding competition, they need not submit abstract of bids, merely a bid tabulation and recommendation for award on forms used in local practice.

Federal-aid funds and local funds for an airport project can be deposited now with an official or depository authorized by local law to receive public funds.

▶ **Damaged Structures** — Requirement that sponsors replace structures damaged by fire or other disaster is eliminated.

Any type of permanent housing to be provided rent-free to CAA and Weather Bureau at the airport is to be specified in the grant agreement, according to determined space standards.

Possibly as an oblique result of the airport regulation stream-lining, CAA's office of airports is undergoing a personnel reduction, under Phillips Moore, Assistant Administrator for Airports. Washington office is down to 110 from 120 and is expected to level off at 100 by July. The eight regional and 43 district airport offices are undergoing a reduction of approximately 65 employees, to a strength of around 500.

SHACKLETON MAKES TEST FLIGHT

Prototype of Shackleton reconnaissance-bomber, heaviest British landplane ever flown and first four-engine craft with contra-rotating props, takes off on initial test-hop at Manchester works of A. V. Roe & Co., Ltd. Destined for over-water patrol duty with the Royal Air Force Coastal Command (Aviation Week, Apr. 25), Shackleton will be most powerful piston-engine craft to go into service with RAF. Its Rolls-Royce Griffon 57 engines develop nearly 10,000 hp. to lift the 94,000 lb.-plus gross weight of the plane. Shackleton carries crew of ten, has top speed of approximately 315 mph., and cruising speed of 215 mph. Length is 77 ft. 6 in., and wingspan is 120 ft.

Poor ILS Calibration Causes Two Mishaps

Preliminary reports on two recent non-fatal airline accidents during ILS approaches indicate that improperly calibrated ILS receivers and altimeters were primarily responsible for the mishaps.

One case involved an American Airlines DC-6 which struck a power line two miles northwest of Chicago Municipal Airport during an ILS approach at 7:26 pm. Mar. 26. Preliminary investigation by American Airlines disclosed that the flight was cleared for ILS approach and the aircraft executed a steep turn and a rapid descent in order to leave outer marker beacon at specified time.

►**Felt Jolt**—The DC-6 continued its rapid descent, estimated at 1300 fpm., without regard to glide path indications in an attempt to reach 300 ft. altitude over the middle marker beacon. Pilot stated that pull out was started at 350 ft. altitude, but that the DC-6 was slightly below 300 ft. when a jolt was felt.

Power was applied, and a missed approach procedure executed. Because Chicago weather was at minimum (300 ft. and ¾ mile) the American flight proceeded to the airport at Indianapolis and landed there.

Power line severed by the DC-6 was 132 ft. above airport level. Normal clearance between glide path and power line is 390 ft.

►**ILS Checked**—Preliminary check indicated the Chicago ILS was functioning properly. There were no indications of malfunctioning on the automatic monitoring system.

Check of the glide path received in the AA DC-6 revealed a defective tube that could cause intermittent failure of the glide path receiver and decreased sensitivity in reception that could result in 15 to 20 ft. error. Flight was approximately 390 ft. below the glide path when it hit the power line.

►**Altimeter Error**—Both altimeters were checked on the DC-6 showing that they were from 30 to 50 ft. in error above accepted tolerance limits. Chicago station ground altimeter was 30 ft. in error over limits.

According to the AA report, these errors, combined with glide path receiver trouble and normal altimeter lag of 50 ft. at a 1300 fpm. descent, could have been sufficient to put the DC-6 at an actual altitude of 132 ft. when pilot's altimeter indicated slightly less than 300 ft.

Chicago approach control advised pilot to listen on "channel Y" for radar monitor—the Chicago GCA unit. The American crew was unfamiliar with this type of radar operation, according to the report. GCA repeatedly warned the DC-6 crew they were below glide path, but the crew was unable to receive message properly because other receiver was tuned to a high volume. The co-pilot understood the final warning but was unable to take action before DC-6 hit the power line.

►**Receiver Error**—Second case involved Chicago & Southern DC-4 which struck trees and a pole at the middle marker beacon of New Orleans ILS during a simulated ILS approach in good weather. Flight check of the plane's ILS receiver indicated it was improperly calibrated, giving an exaggerated width to glide path. At tree top level over the middle marker the fly up indication on the ILS cockpit cross pointer instrument was only one and a half dots whereas it should have indicated full scale "fly-up."

ATTACK PLANE PROBLEM REVIVED

U. S. Air Force is digging deeply into its stock of existing planes and designs to come up with a low level attack plane that will meet requirements for tactical air support of the Army Field Forces. Among planes under consideration is the Convair XA-41 (above) built during the war. Prototype XA-41 is now owned by Pratt & Whitney which used it as a flying test bed for the Wasp Major engine. XA-41 was originally designed to carry four 37 mm cannons and 6400 lb. of bombs. It was designed for a maximum speed of 363 mph. and had a combat radius of 800 miles. Among other planes being considered to meet the attack plane requirement are the Douglas Skyraider and Martin Mauler, both Navy attack bombers, and the Republic F-84 jet fighter.

Canadair Gets Rights For Northrop Raider

Northrop Aircraft Inc. last week licensed Canadair Ltd. of Montreal to manufacture the three-engine Northrop Raider for sale to any customer but the U. S. Government. Northrop is now building the military assault transport under a USAF order which calls for 23 planes.

Designed to carry five-ton payloads in and out of short unpaved fields, the Raider is seen as having excellent commercial cargo sales possibilities as a large scale bush plane in undeveloped country.

►**Future Plans**—Stressed to carry heavy military equipment in its cargo hold which is 24 ft. long, 9 ft. wide, and has a minimum height of 6 ft. 6 in., the airplane is equally adaptable to hauling heavy industrial equipment.

H. Oliver West, Canadair president, said terms of the agreement provided for further development of the basic design by Canadair, and that the agreement was part of a "broader understanding" between the two companies expected to lead to other specific agreements. Northrop has also agreed to assist Canadair in an engineering consulting capacity.

►**Other Deals**—Northrop is the third U. S. company with whom Canadair has entered into licensing agreements. Arrangements for Canadair to build the North American F-86 Sabre jet fighter for the RCAF have been completed, and Canadair is currently a defendant in litigation with Douglas Aircraft Co. over license agreements to build Douglas transports.

John W. Myers, Northrop vice president and director of sales, said that his company's other commitments made it impossible to provide space and personnel for producing the Raider for foreign sales, and that Canadair's advantageous position in the world aviation market would make it possible to build Raiders for sale at attractive prices to foreign purchasers.

Principal advantages are the low labor rate in Canada as compared to aircraft labor rates in the U. S., and the Canadian preferred position in the world-wide British empire market, and greater availability of sterling for export trade.

Airport Executives

Members of the Assn. of American Airport Executives have taken action to prevent detailed information about United States airport installations getting into the hands of potential enemy nations.

The Association voted at its annual convention in Oklahoma City to set up a "Committee on Strategic Information" to make recommendations to the group and to advise individual members when specific problems rise.

The resolution approving the committee said that members of the AAAE have been receiving requests from foreign sources for "technological" information.

►**Officers**—Don Martin, manager of the Wilmington, Del., airport was elected president of the association, succeeding Douglas O. Langstaff, manager of New Orleans Airport.

Other new officers: Pat Moore, Fort Worth, Tex., first vice president; Cecil Meadows, Sacramento, Calif., second vice president; Walter Bettsworth, Waterloo, La., third vice president; and Mel Nuss, Reading, Pa., secretary-treasurer.

Members of the board of directors: Homer Hoskins, Pontiac, Mich.; Jack Bolton, Columbus, O.; Frank Hidenger, Cedar Rapids, Ia.; Peter Powell, Lexington, Ky.; Wayne Parks, Beaumont, Tex.; Francis Fox, Worcester, Mass.; David Leight, St. Louis, Mo.; Fred Alley, Charleston, W. Va.; and Emory Boelson, Evansville, Ind.

Sales Prospects Up

Douglas Aircraft Co. reported recently that sales prospects for the DC-6 four-engine airliner and the DC-6A freighter looked better than in many months.

DC-6 production line is reactivated with three DC-6s under construction in addition to the prototype DC-6A. The passenger transports are reorders from Philippine Air Lines, Panagra and Delta. A KLM DC-6 was delivered recently to Holland. Prototype DC-6A is due to fly in late summer.

With more than 100 DC-6s currently in domestic airline operation, the Santa Monica manufacturer is so hopeful for additional orders, from current users, and from companies replacing present equipment, that purchase of enough additional materials for ten planes has been ordered.

Meanwhile Douglas representatives are pushing for new business for their modernization programs both for the DC-3 and the four-engine DC-4. A pressurized cabin version of the DC-4 with Pratt & Whitney R-2180 engines rated at 1300 hp. is projected with cruising speed of 260 mph. at 17,000 ft.

LETTERS

Against Dinosaurs

Your editorial, "A Bigger and Better Dinosaur," was very much to the point. In these days when all of us ought to know better, any attempt to get real speed through a dense fluid like water is just plain asinine.

If the proposed new boat is to be better and finer than the existing "Queens," it can earn that doubtful distinction only by being still more fantastic and inappropriate in its basic conception. The major part of this prodigious effort would be for the purpose of adding a small percentage to a speed that is and still will be inherently low.

In terms of plain everyday transportation, it is amusing to consider how such a vehicle, scaled down in proportion, would compare with an ordinary automobile. Lacking technical data on the proposed boat, we can take the Queen Mary as probably a fair approach.

If, then, a five-passenger car were to have the same weights, power, etc., per passenger as the Queen Mary, it would require provision for three chauffeurs in addition to the five passengers; the engine would develop 526 hp.; the empty weight would be 270,000 lb., and it would go 0.7 mi. per gal. at about 35 mph. The initial cost of this monstrosity would be $92,000 at low pre-war European rates!

If the desired object is speed in a *displacement* type of craft (and there are real advantages in this general type), the ship should be floated not in the water, but in the air. For the estimated total cost of this one boat, a whole fleet of large airships could be built, carrying at least as many aggregate passengers, with less total horsepower and with well over double the speed.

If we are to pay our $70 million, let us at least get something of real use for the purpose in mind.

RALPH H. UPSON,
Professor of Aeronautical Engineering
University of Minnesota
Institute of Technology
Minneapolis 14, Minn.

Defends Dinosaurs

As long as I can remember, air transportation and surface transportation have been at each other's throats with unnecessary, silly arguments and rebuttals. . . .

No doubt your editorial, "A Bigger & Better Dinosaur," was written in good faith with the belief of furthering the cause of air transportation and national defense. . . . Being acquainted with John M. Franklin and Adm. William V. Smith, I also appreciate the views of the marine industry and of these gentlemen.

With almost equal years of experience in both fields, it is my opinion that each type craft has its place in the economic structure of the country and in national defense.

This reminds me of the silly argument in progress relative to the U. S. Air Force and Naval Aviation. Both components are needed and vital to all. Socialism and communism are born and thrive on industrial and governmental bickerings and dissension. Let's be reasonable about the other fellow's problems and work together for the best interests of the nation.

FRANK L. ARGALL
Argall & Associates
(Aircraft, Yacht & Ship Brokers)
Los Angeles 38, Calif.

(Reader Argall missed the point. This is not an argument between ship and air transportation. Both have their places. Ships are still necessary if they pay their way financially in peacetime and serve a vital need in war.

Our complaint lies entirely with the giant luxury liner that does neither. We can easily understand the points of view of ship men and the marine industry, but that does not mean their viewpoints are consistent with national welfare. The buggy and wagon manufacturers and the canal boat executives had their honest viewpoints too, but through no fault of their own, perhaps, progress marched on. We do not think this any unnecessary or silly argument.

Any democracy must have arguments to bring out the facts before it goes about the deadly serious business of appropriating millions of dollars for items of national defense. Neither is the controversy between the Air Force and the Navy "silly." It is one of the most vital struggles the century has seen. Many Air Force officers probably would agree that both the Air Force and Naval Aviation have their place. The fight is: Who is to do what, and who is deserving of the larger appropriations.—Ed.)

Superman?

Referring to your article of Apr. 25, 1949, page 14, "CAA Order Affects Continental Engines," we have a very nice offer to make to this Continental spokesman.

Since he can make the inspection on these generator drives in *fifteen* minutes work, which consists of lifting cowling, removing wires, removing the generator, inspecting the drive, reinstalling the generator, wires, cowling, etc., we are willing to pay him the rate of $10 per hour as he certainly must be a superman.

We sincerely wish some of these manufacturer's agents would become a little more practical in their estimates of time required for some of these jobs as it develops a conflict between the private owner and the shop operator.

JOHN J. DOYLE, President
Universal Aviation Corp.
Municipal Aairport
Worcester 2, Mass.

FINANCIAL

Sad Plight of Transport Builders

Stratocruiser, Convair-Liner and 2-0-2 projects all pointed to big losses. But DC-6 program shows profit.

Final testimony on the expense of introducing a commercial transport is revealed by the 1948 annual report of the Boeing Airplane Co.

Boeing now estimates that it will lose $10,500,000 on its commercial Stratocruiser program. Net earnings of $1,715,908 or $1.58 per share for 1948 was after a write-off of $7,200,000 of the estimated loss incurred by the company on the Stratocruisers.

Presumably, remaining $3,300,000 will be recorded against 1949 results. This total estimated loss is equivalent to more than $6.00 per share after Federal taxes.

▶ **Profit Expected**—Boeing fully expected to realize a profit on the Stratocruiser project when it was first launched in 1945. For one thing, much of the basic engineering development had been previously accomplished on the military version. Further, the company surrounded its commercial program with safeguards which are unusual for a manufacturer.

Unlike other aircraft builders, Boeing exacted substantial deposits and progress payments on its transport orders. Moreover, various protective provisions such as escalator clauses were incorporated in its contracts.

Firm orders for 55 planes were received from four American carriers and two foreign lines. Deliveries were first expected to start in 1947. Various modifications and comprehensive tests initially delayed this project. A major strike at the company's Seattle plant last year further postponed delivery schedules.

The first planes were delivered in January of this year. Trade reports have indicated that because of delivery delays and rising costs, at least one carrier attempted to break its purchase contracts with Boeing.

However, Boeing commitments were found too iron-clad to permit easy cancellations.

▶ **1948 Payment Small**—As of Dec. 31, 1948, Boeing showed accumulated charges on its Stratocruiser program at $60,968,052, after the $7,200,000 write-off.

As a partial offset, company had received total advances of $24,797,619 from its customers. A year earlier, advances amounted to $24,760,091, indicating hardly any progress payments during 1948.

As of Dec. 31, 1946, the advances on this business totaled $18,940,350 which reflects the initial progress and early delivery dates anticipated by the company.

At the 1948 year-end, Stratocruiser backlog aggregated $85,193,000. To finance this program, Boeing was forced to incur bank loans amounting to $35 million. The management anticipates that the bank loans will be retired in full this year as the Stratocruisers are delivered.

The drain of its commercial program may have been a major factor in forcing the company to seek advance payments from the government, in addition to progress payments, to help finance its military backlog, last estimated at around $275 million.

▶ **Loss May Be Larger**—Until the present Stratocruiser backlog is completed and every plane is in active service, there is no assurance that the loss on this project will be confined to the extent estimated. Experiences of other commercial transport builders raises the possibility that other costs, such as modification charges, may be absorbed before the manufacturer's responsibility is ended. By the same token, if Boeing succeeds in selling additional planes, its present indicated loss may even be converted into a profit.

A potential additional sale received a setback as a result of the British transaction with Scandinavian Airlines System. BOAC previously had ordered six Stratocruisers. The Scandinavian carrier, which held a contract on four planes, transferred its order to the British at a reported profit through the peculiar workings of foreign exchange. The British are reported to have paid for these four planes in blocked sterling and thus obviated the outlay of American dollars. Interestingly enough, the funds for the original British order of six Stratocruisers are being provided by the American taxpayer through the Marshall plan.

The final accounting on the Boeing Stratocruiser program may not be written until all of the results are in a few years from now.

▶ **DC-6 Example**—The Douglas DC-6 program started out with a huge loss but this was finally converted into a profit.

For example, in its 1946 annual report, Douglas wrote off $5 million in experimental and development costs, in addition to the $4 million lost on the delivery of six DC-6s made during that year. Under the company's system of accounting, early deliveries of the DC-6 assumed a much higher percentage of the development and the engineering costs.

Losses on DC-6 program continued throughout 1947 with the company providing a total of $4,591,628 at Nov. 30, 1947, as the estimated additional cost for modifications and other purposes on its delivered DC-6s. This was primarily responsible for Douglas reporting a loss of $2,140,579 after tax carryback credits for 1947.

The company's financial results changed materially for the better, however, when it reported net income of $5,829,206 during the fiscal year of 1948.

According to the Douglas management, this transformation arose "from the effect of the DC-6 program. Under this accounting treatment there were heavy charges against income in 1946 and 1947 for the development of the DC-6 . . . DC-6 production costs were reduced considerably from those incurred against 1947 deliveries, and 1948 sales were made at a modest profit compared with a large loss in 1947."

▶ **Less Fortunate Examples**—Less fortunate in their commercial transport ventures are both the Consolidated Vultee Aircraft Corp. and the Glenn L. Martin Co.

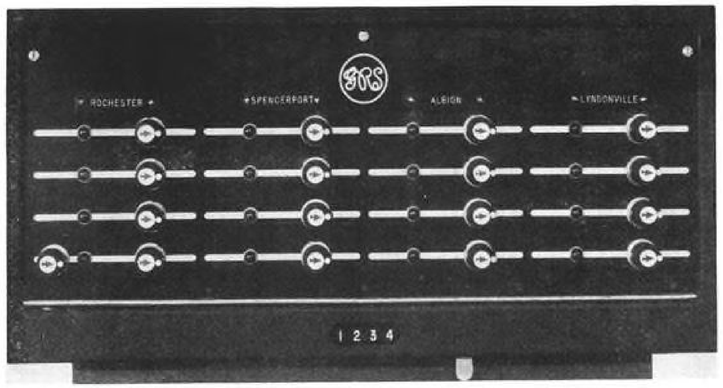
Convair, while it had firm orders for 178 of its 240s, has had a continuing series of losses on this project. At July 31, 1947, the company provided for $19,100,000 as a loss on this program at that time. At Nov. 30 of the same year, the management estimated an additional loss of $11 million would be incurred by the company if more planes were not sold.

Moreover, at Nov. 30, 1948, company provided a reserve for warranty amounting to $1,497,000 to cover charges against warranties issued against deliveries of this plane.

The Glenn L. Martin Co. took a loss of $22,089,497 on its 2-0-2 program during 1947. A further loss of $12,750,000 was taken during 1948, through the same method—a write-down of its work-in-process inventories covering this aircraft.

On the whole, recent experiences of the aircraft builders in developing transports for the commercial markets has not been very happy.

—Selig Altschul



ON THE GROUND, position of aircraft within blocks is indicated by panel, while . . .

. . . IN THE AIR pilot gets story from this.

Visual Signals Used in Traffic Control

New fixed airspace separation system, which operates without voice communication, gets intensive tests.

By O. S. Field*

An experimental air traffic control fixed airspace separation system which gives visual indications to a pilot and requires no voice communication has been developed by General Railway Signal Co. It has been in test operation for more than two years with promising results.

Developed in cooperation with Watson Laboratories of the Air Materiel Command, the system is one of the first attempts to perform automatic air traffic control, and is designed to meet the requirements for a "fail safe" block system established by Special Committee 31 of the Radio Technical Commission for Aeronautics.

In about 150 flights with two C-47s over an experimental airway near Rochester, N. Y., the system has been extensively tested by flight personnel of the Air Transport Assn. and the Civil Aeronautics Administration. The system detected double occupancy of the blocks no matter where the aircraft were located within the double-occupied volume element. This was true under severe conditions in which the two aircraft were within 100 ft. of each other.

In addition, radiation patterns were found adequate to operate the system even when the aircraft was at 12,000 ft. directly over the ground stations. The positions of the segment boundaries were stable to within a few hundred feet during the entire testing period.

► **Automatic and Safe**—Two ideas are involved in air traffic control. In the first place, the system must continuously, and without human intervention, issue clearances that will maintain safe separation. In the second place, when subjected to human intervention (dispatcher's control) the system must be incapable of issuing unsafe clearances.

In the discussions of the ultimate system of air traffic control, frequent reference has been made to two proposals. These are popularly referred to as fixed and moving block systems. In a moving block system, means are provided for establishing a zone of influence around each aircraft. These zones move with the aircraft and serve as buffers for preventing collision.

On the other hand, the blocks of airspace employed in a fixed airspace separation system (fixed block system) remain fixed with respect to the terrain and the aircraft fly through them in succession.

► **Fixed Block**—In a fixed airspace separation system, safe separation is maintained by dividing the controlled airspace into a pattern of volume elements, or cells, and permitting the occupancy of a given volume element by only one aircraft at a time.

In the case of an airlane, the pattern of volume elements is set up by first dividing the lane into segments by means of vertical planes transverse to the airway. The lengths of the segments may be ten or more miles, depending upon traffic density. The segments are then subdivided into altitude layers by a family of horizontal planes spaced nominally 1000 ft. apart. Finally, vertical planes are erected which contain the lane boundaries.

A volume element is then a block of airspace bounded on each end by consecutive segment boundaries, on its two sides by the planes that define the lane boundaries, and on the top and bottom by horizontal planes spaced 1000 ft. apart. The dimensions of a typical volume element in a high traffic density region would be ten miles long, five miles wide, and 1000 ft. thick. The geometry may be visualized by imagining the controlled airspace to be built of volume elements in the same way that a wall is built of bricks in the special case in which each brick is laid directly above the one beneath it.

► **Ground Control**—To exercise traffic control, an integrated control system is established on the ground. This control system must perform three vital functions. It must be able to:

- **Detect** continuously which volume elements are occupied.
- **Analyze** occupancy conditions and arrive at a set of safe, non-conflicting clearances for all aircraft under its control.
- **Transmit** these clearances to the specific aircraft to which they apply.

In addition, the system must be arranged so that in the performance of the second function it is responsive both to pilot requests and to the requirements of expeditious traffic movements.

The detection of the occupancy of a volume element is a vital function and must therefore be accomplished by the most direct and straightforward means possible. Likewise, as is the case with all vital information, the relaying of occupancy information must be kept to a minimum.

The heart of any traffic control system is the mechanism that anaylzes traffic conditions and arrives at a set of consistent clearances. In the design of such equipment, several principles are axiomatic:

- **Clearances** must be arrived at automatically. This substitutes mechanical certainty for human judgment, frees the controller of safety responsibilities, and permits him to concentrate upon flow-control problems.
- **Current position** is the guide, and safety must never depend upon the prediction of future aircraft positions. The hazards of prediction in view of variations in wind and flight conditions are obvious.
- **Space** for an intended movement must be reserved before clearance to execute it is granted. Thus, clearance to enter the next volume element along an airway is a guarantee that all other aircraft have been barred from that block of airspace and cannot receive clearance to enter it. Highly developed techniques in the form of interlocked relay circuits are already available for accomplishing this function in accordance with fail-safe and closed-circuit principles.

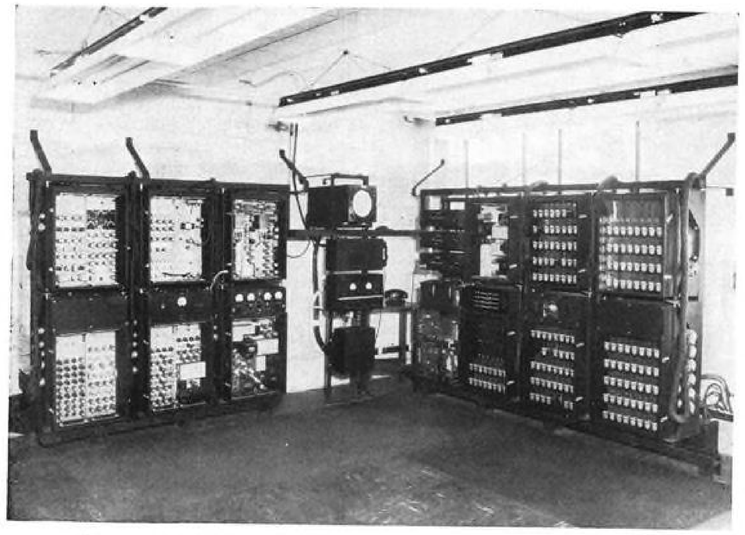
The transmission of clearances from the ground to the air must be accomplished in such a way that there can be no danger of an aircraft's accepting any but the clearance intended for it. Automatic repeat-back of the clearance for checking purposes, and the withholding of the clearance display until the check is completed, are necessary.

Furthermore, as the safety clearance for a given aircraft depends only upon the position of the aircraft, and not upon its flight number or other identification, it is desirable to address the safety messages directly to the volume element occupied by the aircraft.

► **Rochester Airway**—The present experimental fixed airspace separation system comprises four ground stations located at Rochester, Spencerport, Albion and Lyndonville, N. Y. These stations are approximately 15 miles apart along the northwest leg of the Rochester range station and serve to divide the single lane airway into four segments.

The boundaries of these segments are nearly half-way between stations, so that there is one segment approximately 15 miles long associated with each station. A general view of the master control station at Rochester is shown above. Cabinets on left house both 1000 mc. radio frequency equipment and electronic switching circuits for determining occupancy and establishing private line communication with the aircraft. The cabinets on the right house relay circuits that analyze the traffic conditions in the Rochester segment.

Also shown are relays that are concerned with transmitting the occupancy conditions in the Rochester segment to the adjacent station at Spencerport. This is accomplished by means of an 80 mc. tone-modulated radio link. The same interstation channel is also used to transmit to the field stations, for automatic check and transmission to the aircraft, flow control clearances inserted into the system manually at Rochester. Similar channels serve to carry back, for display on the master control panel, the occupancy condition of each volume element in the system.



Master control station at Rochester (see text in center column below).

► **Master Control**—Although the system is fully automatic and issues safe separation clearances without any human attention, a control panel (photo, page 20) has been provided at the master station to permit the insertion of dispatching or flow control clearances to expedite traffic.

As the experimental system comprices four segments and four altitude layers within each segment, there are sixteen volume elements shown on the master control panel in the Rochester station. The general system, of course, is not limited to the four altitude layers and four longitudinal segments of the experimental installation, but may be expanded as needed to meet actual airway operating requirements.

The board shown is a schematic representation of the overall traffic pattern. Each volume element is represented by a line on which an indicator light and a knob are mounted. These lines are arranged in stacks of four to represent the segments, and each segment is labeled with the name of the station with which it is associated. When a volume element is occupied, the corresponding light on the board is illuminated. Thus a controller has a convenient picture of the traffic before him at all times.

To send flow-control clearances to a given aircraft, the knob associated with the volume element occupied by that aircraft is used. For instance, by giving the knob a quarter turn counterclockwise, a clearance to ascend 1000 feet is transmitted to the aircraft. It is an important feature of automatic safety systems that clearances inserted manually, or otherwise, are transmitted only after the safety of the intended movement has been checked automatically by the interlocked relay circuits and then only after the required airspace has been reserved. An unsafe clearance is not transmitted.

► **Cockpit Indicator**—The pilot of an aircraft in the system receives clearances on the cockpit signal indicator (photo page 20). The running signals are indicated by means of the four lights arranged in the form of a cross about the light labeled "double occupancy". The lights on the vertical arm of the cross are green and those on the horizontal arm are red. It is possible therefore to tell both by color and by position what signal light is being displayed.

A green light is clearance to proceed. A red light means that it is unsafe for the aircraft to proceed at the same altitude across the boundary into the next segment. The pilot must then either hold within the boundaries of the volume element currently occupied, or request clearance to change altitude layers.

With proper flow control the occur-

* Director of Engineering and Research, General Railway Signal Co., Rochester, N. Y.

rence of a red indication is rare, and when it does occur holding will not necessarily result, since a change in altitude or lane will usually permit the setting up of a safe path around the conflicting traffic.

The position of the aircraft relative to the segment boundaries is displayed on the meter at the bottom of the indicator. When the nearest boundary is ten miles or more away, the needle is fully deflected to the right. As the block boundary is approached, the deflection of the needle decreases toward the first division at the left end of the scale, and as the boundary is passed the needle gives a sharp kick back to the right. Failure of the indicator circuits is shown by zero deflection.

► **Operation**—To make a request for clearance to ascend, to descend, or to enter the airway initially, the pilot uses the request knob located to the right and above the boundary meter. Clearance to ascend, for example, is requested by turning the knob to the "Ascent" position and pressing it.

If the movement is safe, clearance is granted within two seconds and the "Ascend" light with the arrow pointing upward goes on. Descent and entry are handled in a similar way. A button is provided below the request knob to permit the cancellation of requests. The same lights are used to display flow-control clearances originating on the ground.

In case violation of a clearance results in the occupancy of a volume element by more than one aircraft, all the aircraft concerned are notified of the emergency by the lighting of their double occupancy lights. Action is then taken in accordance with prescribed procedures.

► **Field Installation**—For the sake of flexibility during the initial testing period, the experimental field stations were mounted in 1½ ton trucks. Antennas for communicating with the aircraft are stubs located on flat plates on the roof of the truck. Yagi antennas are the radiating and receiving elements of the VHF information links between stations, and two parabolic reflectors near the top of a 100-foot mast belong to the ultra-high frequency synchronization links.

For simplicity in describing the operation of the system, it will be assumed that the stations are equally spaced and that the segment boundaries occur midway between stations. A master timing circuit at the Rochester station produces timing pulses at the rate of 1080 per second that are passed from station to station over a sharply beamed UHF synchronization link.

These pulses establish a common time base at all stations. Every one-sixtieth of a second all stations transmit

simultaneously over essentially nondirectional antennas a UHF framing pulse. As all four stations transmit over the ground-air link on the same frequency, the aircraft receiver picks up 60 groups of four pulses every second. The first pulse to arrive of each group must be the one transmitted by the nearest station because differences in arrival times are caused only by differences in propagation times. By providing circuits in the airborne equipment that reject all pulses except the first one of each group, reception is limited to the signals from the nearest station.

The framing pulse at each station is followed by a series of 16 altitude pulses at a rate of 1080 pulses per second. Sixteen pulses are used because the time cycles are designed to accommodate sixteen altitudes although only four are used in the trial system.

The first pulse of this altitude cycle is pulse-width modulated with information intended for the aircraft in the first altitude layer of the segment under consideration. The second altitude pulse carries information for the second altitude layer and so on.

When the framing pulse is received by the airborne equipment, a timing circuit is started that after a delay controlled by the altimeter opens a gated stage to accept the information intended for that altitude. For example, if an aircraft is flying at an altitude between 500 and 1500 feet in the Rochester segment, the altitude gated stage is opened a little less than 1/1080 second after the arrival of the framing pulse from the Rochester station. If the aircraft is flying between 1500 and 2500 feet, the timing circuit is conditioned by the altimeter to open the altitude gated stage a little less than 2/1080 second after the arrival of the framing pulse, and so on.

► **Automatic Query**—The reception of an altitude pulse by the airborne receiver serves to trigger the airborne transmitter which emits a pulse that is width modulated in accordance with information to be sent from air to ground. Thus the altitude cycle not only constitutes a time-division ground-to-air communication system, but also serves to interrogate the airborne transponder.

By keeping track of the interrogations that receive replies, the system is cognizant of occupancy conditions. For example, if the Rochester station receives a reply to the second pulse of the altitude cycle, the occupancy relay assigned to the second altitude layer in the Rochester segment is actuated. To limit the acceptance of replies to those that originate within its own segment, each ground station receiver is activated for only a limited time.

In order to obtain clean operation at the segment boundaries, the altitude cycles of adjacent stations are staggered in phase. Thus, for example, while the Rochester and Spencerport stations emit framing pulses simultaneously, the first altitude pulse at Rochester follows 1/1080 second after the framing pulse while the first altitude pulse at Spencerport follows 3/2(1/1080) second after the framing pulse. Subsequent altitude pulses at both stations follow at equal intervals of 1/1080 second.

The widths of the framing pulses at Rochester and Spencerport are 14 and 16 microseconds respectively. The width of the framing pulse thus serves to condition the airborne equipment to accept the altitude cycle of the nearest station. This means that the segment boundaries are defined by the surface along which framing pulses from the adjacent stations arrive simultaneously. The Albion and Lyndonville stations use the same time cycle and framing pulse widths respectively as Rochester and Spencerport.

► **Four Pulses**—A complete code to one volume element comprises four pulses. As one pulse of the code is transmitted during each altitude cycle, a signal cycle is made up of four consecutive altitudes cycles. Because one altitude cycle requires 1/60 of a second, it is evident that occupancy is determined 60 times per second and a complete code is sent to each aircraft 15 times per second. This high rate permits collation and insures signal continuity.

The air to ground signal circuits are so arranged that the position of the airborne decoding relays is repeated to the ground. Only when the decoding relays are in correspondence with the coding relays on the ground is a signal displayed in the cockpit. This ensures receipt of the proper clearance.

It should be noted that all ground stations operate on a common frequency and all the airborne equipments on another. Interference is eliminated by the time division characteristics of the system. As each aircraft proceeds along the airway, control passes from station to station automatically and no retuning of the airborne equipment is required. This is a desirable safety feature, as it eliminates the possibility of failure of the system because of improper tuning adjustments.

The principles upon which the experimental airspace separation system are based are of much greater generality than the techniques used to implement them. The maintenance of safe separation independent of human error is the basic concept. This involves automatic position determination, automatic analysis of position data, automatic reservation of space for intended movements and automatic transmission of safe clearances to the cockpit.

Evaluate Nitromethane for Rockets

Although suitability of this liquid monopropellant is controversial, its properties show much promise.

Many obstacles must be overcome before the rocket engine can be operated as simply and reliably as the reciprocating engine, but a majority of these difficulties are closely associated with the propellants themselves. Consequently, the search for better propellants is being pushed throughout the field of rocket research.

Nitromethane, considered the most promising rocket propellant of the nitroparaffin group, has been under study at the Aerojet Engineering Corp., Azusa, Calif.

Suitability of this fluid is being vigorously argued among scientists and engineers in the rocket field. The question as to whether the explosiveness of nitromethane will have a serious effect upon its general acceptance as a propellant will not be finally answered by any one person, but more statistical evidence and much more developmental experience with actual engines will facilitate a decision.

▶ **Program's Background**—Characteristics and advantages of this fluid, detailed below, were disclosed last month at the Aeronautic and Air Transport Meeting of the Society of Automotive Engineers in New York, by Dr. Fritz Zwicky, director of research at Aerojet and C. C. Ross, chief engineer, liquid engine department.

Theoretical and experimental research study of nitromethane was begun at Aerojet in 1943. Basic properties of nitromethane as a rocket propellant were investigated, with consideration given to use as a monopropellant and in combination with auxiliary propellants and catalyzers.

These investigations were performed in tests of rocket motors of various sizes and in experiments with gas generators of the type used in conjunction with gas turbines.

In 1945 an engineering project was initiated to study the practical uses of nitromethane in various propulsive powerplants. This work has definitely proven the feasibility of using the fluid as a monopropellant.

Total amount of development work done to date is small when compared to that done on the conventional bipropellants; hence, development of nitromethane rocket engines and components is still in an extremely early stage.

▶ **Propellant Distinctions**—In general, liquid rocket propellants may be classified as bipropellants or monopropellants. Bipropellant combinations usually consist of two liquids—an oxidizer and a fuel. These are introduced separately into the combustion chamber where, upon contact, they react chemically.

Monopropellants consist of a single liquid possessing, under controlled conditions, the ability to decompose in the rocket combustion chamber, liberating heat and gaseous products.

With bipropellants, the oxidizer usually determines the characteristics of the combination and exerts a major influence upon the design of the jet propulsion system.

At present there are three principal oxidizers which have been tested extensively—liquid oxygen, nitric acid, and hydrogen peroxide. Each has been investigated in conjunction with a variety of fuels. Some of the principal bipropellant combinations are shown in Table I, below.

▶ **Bipropellant Performance**—Specific impulses to be expected from these bipropellants are given in Table II. It is apparent that, with the exception of the liquid oxygen-liquid hydrogen combination, theoretical specific impulse obtainable from liquid bipropellants ranges from approximately 200 to 255 lb.-sec./lb., the corresponding range of effective exhaust velocities being 6890 to 8220 fps., respectively.

A consideration which must not be ignored is the density of the propellant combination. Impulse per unit volume is an important factor which dictates,

Table I—Liquid Bipropellant Systems

	OXIDIZERS		
	Liquid Oxygen (O_2)	Nitric Acid (HNO_3)	Hydrogen Peroxide (H_2O_2)
FUELS: Gasoline (C_8H_{18})		Aniline ($C_6H_5NH_2$)	Hydrazine Hydrate (N_2H_4—H_2O)
Ethyl Alcohol (C_2H_5OH)		Furfuryl Alcohol ($C_4H_3OCH_2OH$)	
Hydrazine (N_2H_4)			
Liquid Ammonia (NH_3)			

to a certain extent, size and weight of the jet propulsion system. A desirable performance criterion for certain applications is the product of specific impulse and average density (actually, specific gravity) of the propellants, designated by the symbol I_d.

If this density-specific impulse is used as the performance criterion, choice of bipropellants is limited to a range of 235 to 307 I_d (if the combination of liquid hydrogen plus liquid oxygen is excluded).

This narrow range of values is not great enough to serve as a basis for the favor of any particular combination if the physical and chemical properties of the oxidizer (and of the fuel in certain cases) are taken into account.

► **Oxygen Factors**—Experimentation and development have shown that, from the standpoint of practicability, the physical and chemical properties of the oxidizer are more decisive in judging suitability than are small variations in the density impulse or the specific impulse.

Liquid oxygen is the oxidizer used earliest in rocket propulsion. A variety of sizes of rocket motors employing this material have been operated successfully. Best known liquid oxygen powerplant was that used in the German V-2 missile.

Principal disadvantages are its handling and storage problems. It boils at —297 F., must be stored in specially insulated containers to prevent very rapid evaporation. Despite such precautions, there is an inevitable loss due to evaporation during storage.

The high vapor pressure at ambient temperatures (which are almost invariably above the low boiling point) complicates its handling in pumping units, and the low temperatures which must prevail during storage limits the choice of container material. Liquid oxygen is dangerous to handle, and in contact with the skin produces effects similar to severe burns.

Furthermore, although it and fuel used with it are relatively safe when stored in separate containers, they constitute a serious fire and explosion hazard whenever there is a possibility of contact, a condition which will occur, for instance, in the event of a crash landing.

► **Nitric Acid**—Second important oxidizer is nitric acid. This is used in several modifications such as red fuming nitric acid containing up to 6½ percent excess nitrogen dioxide, or as white fuming nitric acid containing no excess nitrogen dioxide.

Considerable experience with the various modifications of this oxidizer has been gathered in this country.

Nitric acid is less hazardous with respect to the temperatures which must prevail during handling and storage than is either liquid oxygen or hydrogen peroxide. However, because of its corrosiveness, containers employed for nitric acid must be made of stainless steel.

If proper handling equipment is used, its transfer from containers to the tanks of the jet propulsion unit involves no real difficulties.

In addition to corrosiveness, principal objection to nitric acid as an oxidizer are the toxic fumes it gives off and the fact that an immediate severe burn occurs upon contact with the skin.

As in the case of other bipropellant combinations, nitric acid propellants represent a fire hazard in the event of a crash, especially since it is normally used with a fuel spontaneously combustible on contact with the acid. Thus, nitric acid propellant combinations are perhaps better suited for missile powerplants and similar devices than for piloted aircraft.

► **Hydrogen Peroxide**—In high concentrations, this substance has also been employed as an oxidizer in bipropellant rocket motors which have been operated successfully. (The powerplant of the German ME-163 interceptor is a notable example of this application.)

Hydrogen peroxide does not have the severe storage temperature limitation of liquid oxygen, but it is more dangerous to handle. And its use in the rocket field is so new that the operating data essential to its widespread application are still incomplete.

Since the fluid will decompose under certain conditions, it may be classified as an explosive. Thus, small amounts of impurities such as those present in dirty containers or pipes, and also moderate heating, can start self-decomposition of the hydrogen peroxide and explode the container. Explosions of this sort have occurred as a result of merely exposing the container to sunlight. Hydrogen peroxide solutions of high concentration (above 87 percent) are sensitive to shock and may be exploded by gunfire.

In addition, the fluid itself constitutes a fire hazard, since it will initiate the combustion of cellulose materials (such as wood) upon contact with them. Fires have been caused during transport by leakage from containers or supposedly empty drums which have been allowed to rest on a wooden floor.

Corrosiveness is an undesirable property common, to some degree, to each of these oxidizers. This characteristic creates a difficult problem in the selection of construction materials, as noted above, and also limits the service life of parts, requires their frequent replacement, and necessitates extensive servicing operations.

► **Monopropellant Detail**—In contrast to the bipropellants, a monopropellant consists of a single liquid which has the properties, under certain controlled conditions, to decompose with the evolution of heat and gases. To compete with bipropellants on the basis of performance, total heat release (Btu/mole) of the monopropellant must be of the same order as that of the bipropellants.

A paradox is immediately presented in that the numerical value of the heat release must also be of the same order as that of a high explosive. Hence, a

Table II—Calculated Performance Characteristics of Liquid Bipropellants

Oxidizer	Fuel	Chamber Pressure (psi.)	Mixture Ratio (Oxide/fuel)	Exhaust Velocity (ft./sec.)	Specific Impulse (sec.)	Density Impulse (sec.)	Chamber Temp. (F.)	Mean Mol. Wt. lb./mole)	Specific Heat Ratio
Liquid Oxygen	Gasoline (Ref. 1)	300	2.5	7780	242	236	5470	22.7	1.22
Liquid Oxygen	100% Ethyl Alcohol (Ref. 1)	300	1.5	7810	243	235	5250	—	—
Liquid Oxygen	Ammonia (Ref. 1)	300	1.4	8220	255	249	4951	—	—
Liquid Oxygen	Hydrazine (Ref. 1)	300	.33	7920	246	256	3232	—	—
Liquid Oxygen	Liquid Hydrogen	300	.33	11,050	358	101	4290	—	—
Liquid Oxygen	15% Ethyl Alcohol 25% Water (Ref. 1)	300	1.3	7700	239	237	5080	22	1.22
Red Fuming Nitric Acid	Aniline (Ref. 1)	300	3.0	7090	221	307	5020	25	1.22
White Fuming Nitric Acid	Furfuryl Alcohol (Ref. 1)	300	1.9	6890	214	293	5020	—	—
Hydrogen Peroxide	Hydrazine Hydrate (Ref. 2)	350	—	—	200	—	2690	24.0	1.2

monopropellant might be classified as an explosive since all the required constituents are present in a single mixture and in the proper ratio.

This reasoning would appear to be a strong point against monopropellants, but there are other factors which invalidate the argument, with respect to rocket usage. Two of the most important of these factors are the shock sensitivity and the temperature sensitivity or, more generally expressed, the stability of the fluid.

Stability is a difficult property to evaluate, and a study of it requires more than a simple analysis. Toward this end, properties of ideal monopropellants can be considered and then it can be observed how closely the actual monopropellants (such as nitromethane) will approach them.

► **Conceptions**—One property of such an ideal fluid would be complete stability over the entire pressure-temperature range; complete stability meaning insensitivity to any condition of shock, temperature, and pressure or to any combination of the three. Decomposition might be accomplished by means of a hidden catalyst which might be brought into play under any condition desired.

Another possibility would be to imitate and to sustain the decomposition of our ideal monopropellant by means of irradiation with light of sufficiently shortwave length, such as ultraviolet.

A second conception of an ideal monopropellant, less desirable, but a closer approach to actual fluids, is one which either by catalytic action or inherent properties would have a definable boundary of instability on the pressure-temperature curve.

Fig. 1 (p. 37) represents such a case. Left of the curve, under any condition of pressure and temperature, complete stability is realized. Instability is present to the right of the curve to an increasing degree as the pressure-temperature conditions become more severe.

► **Pressure - Temperature Problems**—Nitromethane can be compared to the second ideal case by referring to Fig. 2, which shows various conditions on the pressure-temperature diagram. It should be noted that the addition of one to two percent catalyst is required to promote smooth decomposition of nitromethane in a rocket chamber. Effect of this addition is to reduce the stability slightly and is indicated by the two boundary curves shown in Fig. 2.

The sensitivity in the ranges investigated is essentially independent of pressure, hence nitromethane is usually spoken of as being temperature sensitive. The higher pressure ranges (above 1500 psi.) have not been investigated to determine whether pressure in that region is a factor in decomposition.

Boiling point of nitromethane at atmospheric pressure is 220 F., and the

decomposition temperature is on the order of 500 F. Because of the spread between these two temperatures, the fluid is safe to handle under ordinary conditions; temperatures of the magnitude of 500 F. are not ordinarily encountered and can be avoided with ease.

Also, the liquid must be well confined to prevent its boiling off before this temperature is realized.

Thus, it can be seen that pressure-temperature problems in connection with nitromethane are not severe, or at least can be handled by proper design and use with relatively large margins of safety.

► **Shock Sensitivity**—This is another property of such materials and must be considered as important as temperature sensitivity in the practical case.

Shock may affect nitromethane by initiating complete or partial decomposition, depending on the condition of confinement and the severity of shock. However, the evaluation of shock is most difficult and is usually made on a statistical basis. Some general observations of this nature are:

1. Nitromethane will not detonate in thin-walled containers when initiation is attempted with a No. 8 blasting cap.
2. It will not detonate in heavy-walled metal containers upon striking the ground with an estimated deceleration of 900G after being dropped from an airplane.
3. It will detonate in heavy-walled containers (confined) when initiated with liberal charges of tetryl or other high order explosives.

From these examples, it can be seen that under normal circumstances, the material is extremely stable from a standpoint of shock. However, in all tests to determine shock sensitivity in which detonations have been initiated, there is a question as to whether the initiation was accomplished by shock alone or by a combination of shock and the local heating caused by the initiator.

► **Explosion Types**—Inadvertent decomposition of nitromethane in bulk quantity by extreme temperature or shock conditions may result in one of two types of explosions.

More serious of these two explosions would be a complete detonation of high order and possible propagation of the detonation through all lines and fittings in the system. The other type is a localized, low order decomposition of a small quantity within the bulk.

The high order type of detonation had been produced only in experimental testing where the test sample was subjected to particularly severe conditions. There is much statistical evidence available to show that none of the types of mishaps which can occur in rocket engines can impose the extreme conditions necessary to initiate a complete detonation.

(*Continued on p. 37*)

Table III—Properties Of Commercial Nitromethane (Ref. 4 and 5)

Chemical Composition	CH_3NO_2
Molecular Weight (liquid)	61
Products of Decomposition	$CO_2 + CO + H_2O + N_2 + H_2$
Heat of Decomposition	1730 Btu./lb.
Specific Weight	70.96 lb./ft.³ at 70 F. 68.07 lb./ft.³ at 130 F.
Vapor Pressure	0.57 psi. at 70 F. 2.74 psi. at 130 F.
Viscosity	1.36×10^{-5} lb./sec./ft.² at 70 F. 0.951 lb./sec./ft.² at 130 F.

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A Lift and a Light for Berlin

"Aircraft's greatest achievement." That statement has been applied many times to the Berlin Airlift. And rightly so. The Airlift has changed all military logistic concepts . . . lessons learned from the operation will affect the future of all aviation.

Among equipment selected for this vital task, the Westinghouse name appears with significant frequency . . . particularly in those applications where dependable performance counts most. Typical examples are shown on these pages. A new cargo hoist—more powerful and with many times the life of former units. Flashing beacon lights—that flash with a brilliance 9 times greater than the sun's. Transformers—that can take a direct stroke of lightning without failure.

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Westinghouse engineering was put to test when asked to design a cargo hoist unit that would be dependable under all conditions . . . be completely explosion-proof. The answer is illustrated here. This unit can lift 4,300 lbs. of cargo at 24 feet per minute . . . weighs only ninety-two pounds. The assembly consists of a twenty-four volt motor, a triple planetary gear, a speed limiter and a magnetic brake. Because of its long life, no spare need be carried by the plane, saving weight.

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A major problem of the Airlift has been its flight-grounding fog. To combat this condition, Westinghouse Flashing Beacon Lights are being installed at seven Airlift fields for identification purposes. These lights make visual landings possible under worst weather conditions. Flashing 40 times a minute, the light can penetrate the heaviest fog for a distance of at least 1,000 feet. However, the peak flash does not blind the pilot because its apparent duration is so short. On clear or hazy days, or clear to light foggy nights, the intensity can be reduced.

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The "CSP" (Completely-Self-Protecting) transformer—long accepted as the best transformer under all conditions—protects itself against lightning, short circuits and overloads. At the Airlift, 414 "CSP" transformers are being used for approach and other airfield lighting.

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LEADER IN AVIATION EQUIPMENT

FIG. 1
PROPERTIES OF AN IDEAL MONOPROPELLANT

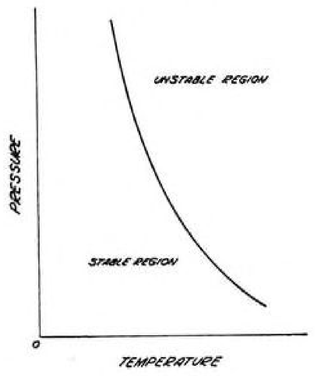

FIG. 2
PRESSURE TEMPERATURE DIAGRAM OF NITROMETHANE

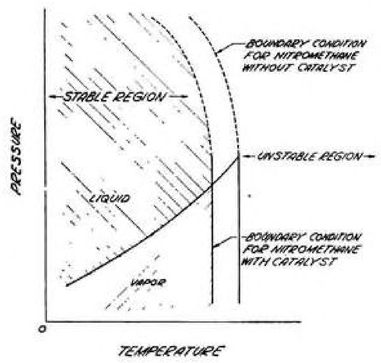

Table IV—Calculated Performance Characteristics of Liquid Monopropellants (Ref. 6)

Propellant	Chamber Pressure (psi.)	Exhaust Velocity (ft./sec.)	Specific Impulse (sec.)	Density Impulse (sec.)	Chamber Temp. (F.)	Mean Mol. Wt. (lb./mole)	Specific Heat Ratio
Nitromethane	300	7010	218	248	3980	20	1.25
Hydrogen Peroxide (100% pure)	300	4700	145	212	1790	23	1.25
Hydrogen Peroxide (90% pure, 10% water)	300	4250	131	186	1360	22	1.25

It is on this basis that nitromethane continues to be a desirable choice for a rocket propellant despite its explosive qualities.

► **Properties**—Nitromethane (CH_3NO_2) is a clear, colorless liquid having a slight, but not disagreeable, odor. It will decompose with the evolution of heat to CO, CO_2, H_2, H_2O, and N_2.

Table III shows a list of the general properties of nitromethane, and Table IV shows its rocket performance characteristics compared to hydrogen peroxide, which also may be employed as a monopropellant.

The relatively high specific weight of nitromethane (71 lb./ft.³) is advantageous and its low vapor pressure and viscosity make the material very easy to pump.

Most common metals and alloys are not attacked corrosively by it to sufficient degree to lead to structual failure. Practically all commonly used stainless and aluminum alloys show corrosion rates of less than 0.0001 in./yr., and mild steel has a corrosion rate of only about 0.0005 in./yr. Plastics such as Bakelite, chlorinated rubber, and polyethylene are unaffected.

This analysis reveals the extent to which nitromethane embodies the characteristics of an ideal monopropellant.

Major reasons for investigating the use of nitromethane in a rocket engine are not the particular rocket performance characteristics of the fluid nor the fact that simplified mechanical circuits might conceivably be used. Instead, the major attractiveness of this fluid lies in such factors as its excellent general handling qualities, its non-corrosive properties, and the ease with which it can be pumped.

Conventional bipropellant combinations, even though possessing one desirable component fluid, do not as a whole offer handling characteristics comparable to those of nitromethane.

Wider use of this monopropellant is expected as a result of current developments toward smaller combustion volume and simplified starting.

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6. H. S. Seifert, M. M. Mills, and M. Summerfield: The Physics of Rockets, American Journal of Physics, Vol. 15, Nos. 1, 2, and 3, 1947.

Jet Fuel Cools Oil

Air Force's J-47 jet engines are being equipped with new type oil coolers using jet fuel as a coolant instead of using air.

Only 3 in. thick and kidney shaped to fit snugly against the engine, new unit not only looks different from conventional round coolers but is designed to withstand greater pressure.

Current units being built by AiResearch Manufacturing Co., Los Angeles, Cal., for the J-47s are production tested at 100 psi. on the oil side and 1000 psi on the fuel side.

Need for new method of oil cooling was dictated by several factors: High ram temperatures attendant to high speeds makes air inefficient as a coolant; excessive drag on the plane caused by using air as a coolant; necessity of using a circulating oil system rather than an oil depletion system to increase operating range.

Principle of oil cooling in new unit is the same as in air-cooled types. In the latter, heat is transferred from hot oil through thin-walled tubes to cold air passing over them. In the former, heat is transferred through tube walls to relatively cool jet engine fuel circulating around them.

Altitude Conditioning Helps Aircraft Crews

A group of 27 men spent 13 days in Leadville, Colorado, altitude 10,200 ft., to determine if a relatively short time at a moderately high altitude would increase a flyer's "time of useful consciousness"—length of time between onset of oxygen-lack and incapacity.

Altitude experts at the School of Aviation Medicine, Randolph Field, Texas, believed that if air crews were acclimated to higher altitudes, all margins of safety from accidental reductions of oxygen would be increased. Acclimated individuals were expected to be more resistant to fatigue effects engendered by altitude.

The experts knew that a long period would help, but they wanted to find out if short term acclimatization would improve a flyer's capacity when working under reduced oxygen.

Tests were made continuously all during the period on respiratory rates and physiology, metabolism, liver function, blood and circulation, vision and muscular coordination. All showed a definite adaptation to the different conditions.

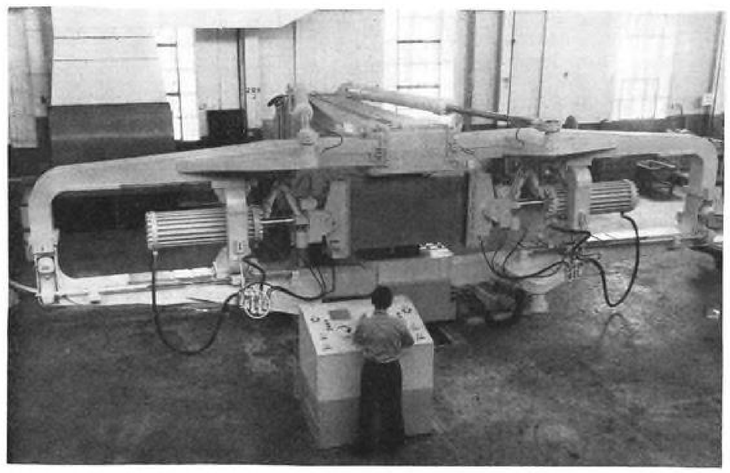
After return to near sea level (750 ft.), the researchers found that the physiological changes that had taken place during the stay at higher altitudes lasted for three or four weeks.

Time of useful consciousness (measured in runs in low pressure chambers at 25,000 ft. without oxygen) lengthened to double and even triple the time it was before the Leadville trip. Other reactions tested were correspondingly affected.

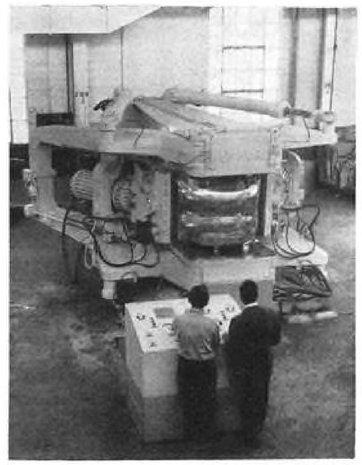
For practical application to long flights, it may be considered feasible to send a crew to such a site for about two weeks before a mission, so that the entire performance of the crew could be improved.

Such an increased altitude tolerance could mean survival of the crew and plane in event of emergency, and greater chance for success of the mission as a whole.

PRODUCTION



ALUMINUM SHEET is held in jaws of stretch press, pulled beyond normal limit and . . .



. . . WRAPPED on die to form cowl ring.

Stretch-Wrap Forming at NAA

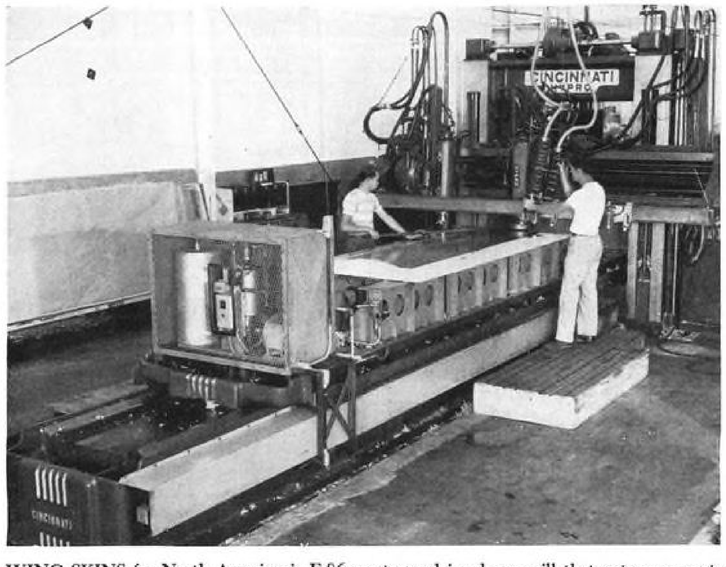
Manufacturing trend is toward heavier machines to handle heavier materials for high-speed aircraft.

By Alexander McSurely

INGLEWOOD, CALIF.—A technical revolution in airplane manufacturing techniques is still in an early stage in the opinion of J. L. Atwood, president of North American Aviation, Inc.

"Today's high speed planes could not be produced by methods used by our industry as recently as 10 years ago," Atwood states. "The trend is toward still heavier materials, heavier machine tools and more exacting tool design in the future."

Greater manufacturing precision is being forced by the use of the heavier materials used to take higher stresses of higher speeds.



WING SKINS for North American's F-86 are tapered in planer mill that cuts away material in areas where it is not needed for structural strength.

► **No Second Chance**—"You can't bend 75S alloys to fit so you can't make many mistakes," Atwood points out.

In making its two principal postwar production military planes, the F-86 jet fighter and the B-45 jet bomber, North American has put to more extensive use a "stretch and wrap" manufacturing technique which it first began to use during World War II.

The Inglewood plant has three sizes of stretch-wrap forming machines, products of the Hufford Company, Redondo Beach, Calif. They range from a machine with 100 tons stretching force down to one with 10 tons of stretch.

The smaller machines are limited to the forming of stringers, other narrow sheet metal parts and extrusions. The large machine handles sheet metal parts, including skin contours, fillets, scoops and wingtips.

► **Wrap-Around**—Forming process involves first stretching the sheet free of the die to near the yield point and then wrapping it around the die with a final additional stretch to set the material to the die contour.

Production analysis has indicated that the stretch-wrap process is superior to drop-hammer forming because the rate of forming can be controlled, and because the spring-back of the metal is eliminated when it is pulled beyond its yield point.

The machine holds the material in jaws at either end, which pull apart for the stretching action, and then pivot to perform the wrapping action.

J. H. (Dutch) Kindleberger, chairman of the North American board, has suggested a curved jaw arrangement for the Hufford machine which is expected to result in a savings of material.

► **Tapering**—Some of North American's other postwar machining processes now in use are expected to be supplanted by more specialized equipment. In this category is the method of tapering wing skins for the F-86 fighter.

Besides a taper from wingroot to wingtip where strength requirement is least, the design called for variations in thickness of skin in areas where the stresses were to be transmitted to bolts or rivets.

For example, an area about one-inch wide along each edge of the skin at the spar was designed to be thicker than the rest of the skin, in order to transmit load to the spar. To get the variations in skin thickness it was elected to mill the excess material from the skin sheet.

Cincinnati Milling Machine planer mills are used and the heavy skin sheet is handled for the milling operation by an interesting vacuum cup lifting device. A triangle-shaped frame with three vacuum cups, a small vacuum pump and a motor are attached to an overhead craneway. Cups are lowered against the sheet, at points which remain flat after the milling operation, and the sheet is lifted to the next operation.

Amount of milling required, and amount of material lost in this method of sking production suggests that an alternate process of skin tapering will eventually supersede it.

F.O.B. Less Tax

Taking delivery on Stratocruisers is going to be easier from here on in.

Before May 1, Boeing Airplane Co. had to deliver its commercial planes in Portland, Ore., across the Washington state line, to avoid a 3 percent sales tax. It made a nice 35-minute flight for the press and was worth the tax saving. Otherwise it was pretty much of a nuisance.

The last state legislature abolished the tax as far as airplanes are concerned, effective May 1. First delivery from Seattle was scheduled for last week.

PRODUCTION BRIEFING

► **Aero Affiliates,** machine products subcontractor at Tuckahoe, N. Y., plans to open a branch plant at Hicks Field, Fort Worth, to serve Chance Vought at Dallas. Company produces precision tools, dies, jigs, fixtures and experimental and production parts. Donald de Lackner, president, said he would take a dozen men to Forth Worth to open the new plant.

► **Eaton Manufacturing Co.,** Cleveland, has scheduled a $2.5 million expansion program for its valve plant at Battle Creek, Mich. Plant makes compressor blades for jet engines.

► **Scott Aviation Corp.,** Lancaster, Pa., has begun production of an oxygen inhalator for use in hospitals, doctors' offices and industrial first-aid rooms. The new device is based on an Air Force automatic-control oxygen mask development.

► **Beech Aircraft Corp.,** Wichita, received a $1 million contract from the Great American Farm Implement Corp., Chicago, to make several thousand units of a new-type corn harvester. Beech now is tooling for production that is expected to continue until next December. About 2600 additional employes will be hired.

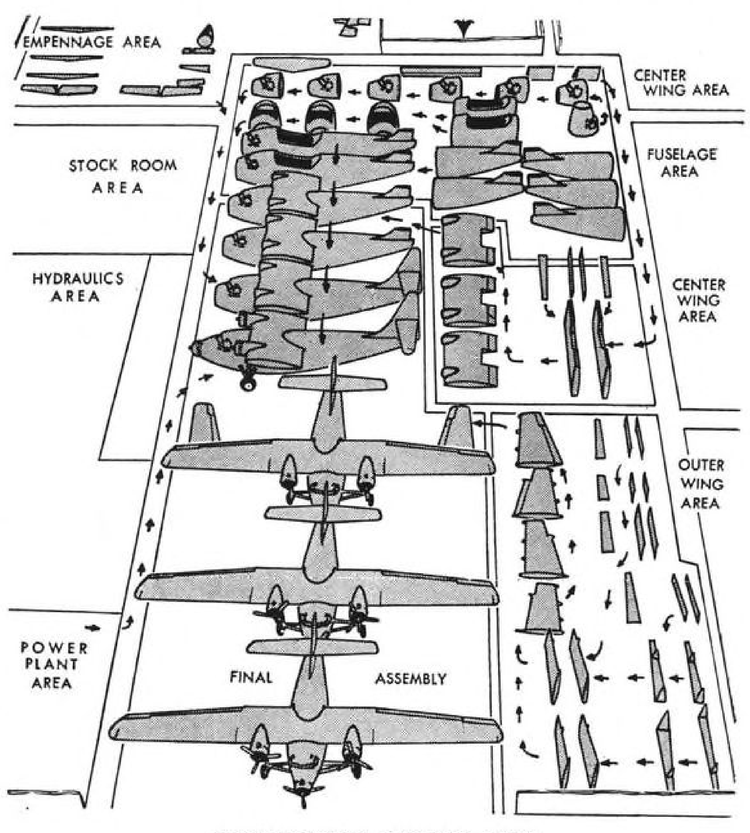
► **National Battery Co.,** Buffalo, received a $242,450 order for 5000 aircraft batteries from the U. S. Air Force. Batteries are for use in Douglas C-54 transports in use on the Berlin airlift.

► **United Helicopter Co.,** Palo Alto, Calif., now is turning out two Hiller 360s per week for commercial sales, and expects to step up production to four per week. Eight 360s have been delivered with an additional 60 on order.

► **Canadian Car & Foundry Ltd.,** Montreal, will make spare parts for the Canadian-built F-86 jet fighter at its Ft. William plant. Cancargo now is making buses in the wartime fighter plant. The F-86 will be built by Canadair, Ltd. under license from North American Aviation, Inc.

► **Gilfillan Bros.,** Los Angeles, is negotiating with the Canadian government for production of its CPN-4, air transportable two-man GCA equipment. The Dominion government will select a Canadian firm to manufacture the equipment under license.

► **Republic Aviation Corp.,** will close its plant Aug. 1-15 to give all employes a



NORTHROP'S RAIDER LINE

Schematic diagram of how Northrop plans to set up production line at its Hawthorne, Calif., plant for the Raider (C-125A) assault transport and Arctic rescue plane is shown here. Northrop has a USAF order for 23 Raiders. Main assembly line moves down the center of the plant with subassemblies feeding in from both sides.

two-week vacation with pay. Skeleton maintenance and plant protection crews will be on duty during the vacation shut-down.

WHO'S WHERE

Aeroproducts division of General Motors Corp., Dayton, Ohio, named Max M. Monroe general manager. With GM for 26 years, he has been acting general manager since the death of W. J. Blanchard in an airplane accident last December.

Thompson Products, Inc., Cleveland, Ohio, appointed J. D. Wright general manager. He is also vice president and secretary, and has been with company for 16 years. Thompson also promoted four division managers to vice president: Harry D. Bubb, Tapco plant, Euclid, Ohio; Len W. Reeves, special products division, Cleveland; Matt P. Graham, Detroit; and Paul D. Hileman, who has run West Coast plant, Los Angeles, since 1937.

Standard-Thomson Corp, Dayton, Ohio, appointed C. W. MacNeill director of a new chemical and metallurgical laboratory now being established by company. MacNeill formerly was associated with Fyr Fyter Co., Dayton, and Wisconsin Steel Works, Chicago. He was an Air force instructor during the war.

Lockheed Aircraft Corp., Burbank, Calif., has reorganized its sales staff to bring export sales under direct supervision of Leonard K. Schwartz, general sales manager in Burbank. P. K. Yost, Jr., former domestic sales manager in Burbank, becomes assistant general sales manager with headquarters in New York City. He also will assume duties of eastern district sales manager. R. H. Askew, former export sales manager, has been named sales representative for Australasia, India and the Far East. Although his home base will be Burbank, Askew will spend most of his time in the field. James E. Boyce, with Lockheed for many years in engineering and service branches, has been appointed sales representative for Europe, Africa and the Near East, with headquarters at Hotel Desbergues, Geneva, Switzerland. John Wagner continues as representative for South America, with headquarters in New York City.

G. M. Giannini & Co., Inc., Pasadena, Calif., manufacturer of guided missile and supersonic aircraft instruments, elected Rear Admiral Luis de Florez, USNR, to the board of directors. Florez is a winner of the Robert J. Collier Trophy for his wartime contribution to safe and rapid training of combat pilots and crews.

Latest Bid Awards to Industry by U. S. Air Force

Air Materiel Command procurement Division makes available to AVIATION WEEK the latest bid awards, shown on this page. Requests for further information should be addressed to Contracting Officer, AMC, Wright-Patterson AFB, Dayton, Ohio, attention: MCPPSX72, (AMC will resume in July the issuance of data on invitations for bids.)

Abstracts of Bid Awards

For capacitors (49-321):
Companies sharing—American Condenser Co., Chicago, on a bid of $247.25; Gudeman Co., Chicago, on a bid of $844; Tobe Deutschmann Corp., Norwood, Mass., on a bid of $1488, and Sangamo Electric Co., Springfield, Ill., on a bid of $445.

For 1759 pressure altimeters (49-334):
Square D Co., Elmhurst, N. Y., on a bid of $142,957.50.

For resistors (49-1088):
Companies sharing—California Electronics Supply, Inc., Los Angeles, on a bid of $77.28; Reiner Electronics Co., Inc., New York, on a bid of $2166.42, and Concord Radio Corp., Chicago, on a bid of $307.

For 1128 photographic timers (49-1102):
Companies sharing — Stanley Aviation Corp., Buffalo, on a bid of $273.75, and General Electric X-Ray Corp., Milwaukee, Wis., on a bid of $10,874.01.

For 202 antennas (49-1152):
Mercury Electric Corp., Kansas City, Mo., on a bid of $4969.20.

For 500 ammeter & voltmeters (49-1174):
Companies sharing—Western Electronic Supply Corp., Los Angeles, on a bid of $1151.58, and Realty & Industrial Corp., Bethlehem, Pa., on a bid of $2468.36.

For aluminum alloy tubing (49-1175):
United Wire & Supply Corp., Cranston, R. I., on a bid of $2991.42.

For 50 lift-pneumatic bus & trucks (49-1187):
Joyce Cridland Co., Dayton, on a bid of $31,675.

For 2,730,592 lb. trichlorethylene (49-1202):
Companies sharing — Octagon Process Inc., Brooklyn, N. Y., on a bid of $14,565.93; Detrex Corp., Detroit, on a bid of $47,785.80, and E. I. DuPont de Nemours & Co., Wilmington, Del., on a bid of $196,157.58.

For cone & roller assemblies (49-1270):
Timken Roller Bearing Co., Canton, O., on a bid of $9273.50.

For adapters (49-1273):
Companies sharing — Continental Electronics, Brooklyn, N. Y., on a bid of $2070.10; Comet Electronic Sales Co., Brighton, Mass., on a bid of $221; Frank & Warren, Brooklyn, N. Y., on a bid of $164.92; Perkins Machine & Gear Co., Springfield, Mass., on a bid of $55.08; Dayton Gear & Tool Co., Dayton, on a bid of $249.84; Coil Winders, Inc., Brooklyn, N. Y., on a bid of $381.20, and L. C. N. Corp., Middletown, O., on a bid of $269.35.

For adapters (49-1277):
Companies sharing — Kings Electronics Co., Inc., Brooklyn, N. Y., on a bid of $4793.25, and Industrial Products Co., Danbury, Conn., on a bid of $2516.25.

For counter type scales (49-1302):
Companies sharing—Johnson Scale Co., Newark, N. J., on a bid of $2964.60; Detecto Scales, Inc., Brooklyn, N. Y., on a bid of $5812.50, and Toledo Scale Co., Toledo, O., on a bid of $1266.

For 10 sealing machines (49-1307):
Automatic Scale Co., Inc., New York, on a bid of $13,900.

For fitting assemblies (49-1312):
Aeroquip Corp., Jackson, Mich., on a bid of $39,620.53.

For 228 navigator domes (49-1327):
Lunn Laminates, Inc., Glen Cove, N. Y., on a bid of $3755.16.

For 50,000 yd. waterproof fabric (49-1360):
Landers Corp., Toledo, O., bid of $58,000.

For photographic filters (49-1393):
Companies sharing — Malone Camera Stores, Inc., Dayton, O., on a bid of $21.35, and Ednalite Optical Co., Inc., New York, on a bid of $2618.37.

For 25 propeller shoes (49-1417):
B. F. Goodrich Co., Akron, O., on a bid of $34,325.

For 500 camera assemblies (49-1155):
Bell & Howell Co., Chicago, on a bid of $12,084.

For capacitors (49-1166):
Companies sharing — Bendix Aviation Corp., Towson, Md., on a bid of $810; Concord Radio Corp., Chicago, on a bid of $810; Sangamo Electric Co., Springfield, Ill., on a bid of $618, and Electro Motive Manufacturing Co., Inc., Willimantic, Conn., on a bid of $37.33.

For gasoline hose (49-1182):
Metal Hose & Tubing Co., Denver, N. J., on a bid of $3908.16.

For 1000 gasoline cans (49-1207):
Protectoseal Co., Chicago, on a bid of $3100.

For self-sealing cells (49-1329):
Companies sharing—United States Rubber Co., Mishawaka, Ind., on a bid of $2964, and Specialty Assembling & Packing Co., Brooklyn, N. Y., on a bid of $5100.

For battery clips (49-1332):
E. B. Latham & Co., New York, on a bid of $27,576.16.

For shellac (49-1346):
Companies sharing—Thomas C. Mee Co., Pawtucket, R. I., on a bid of $256.32, and Woodfinishing Products Co., New York, on a bid of $6395.16.

For six regulators & data (49-1379):
Lindberg Engineering Co., Chicago, on a bid of $4519.

For jackets, trousers & shoes (49-1427):
Irving Air Chute Co., Inc., Buffalo, N. Y., on a bid of $51,546.

For bolts (49-1431):
Companies sharing—Pittsburgh Screw & Bolt Corp., Pittsburgh, on a bid of $2262.95, and Michigan Bolt & Nut Co., Inc., Detroit, on a bid of $3118.25.

For 2900 lb. wool-aluminum (49-1435):
Brillo Manufacturing Co., Inc., Brooklyn, N. Y., on a bid of $4205.

For 300 adapter assemblies (49-1443):
Panhandle Machine Co., Inc., Lubbock, Tex., on a bid of $16,227.

For 10,000 gal. waterproofing cement (49-1445):
Companies sharing—Atlas Powder Co., Stamford, Conn., on a bid of $6125, and Commercial Chemical Co., Cincinnati, O., on a bid of $5750.

For 50,000 lb. zinc base alloy ingots (49-1502):
American Smelting & Refining Co., Cincinnati, O., on a bid of $9620.

For 10,600 gal. coating (49-1555):
Midland Glue Products Co., Inc., Detroit, on a bid of $33,920.

For 6000 thermometers (49-1592):
Western Electrical Instrument Corp., Newark, N. J., on a bid of $26,040.

For acid, nitric (49-1620):
Hercules Powder Co., Wilmington, Del., on a bid of $21,766.50.

For spare parts (49-1129):
Wilkening Manufacturing Co., Philadelphia, on a bid of $11,238.

For sealing compound (49-1319):
Companies sharing—H. H. Robertson Co., Pittsburgh, on a bid of $1356.19, and Atlas Powder Co., North Chicago, Ill., on a bid of $2706.

For mounting (49-1338):
Industrial Precision Products Co., Chicago, on a bid of $11,988.60.

For Aluminum alloy tubing (49-1367):
Companies sharing—Revere Copper & Brass, Inc., Detroit, on a bid of $4152.11, and United Wire & Supply Corp., Cranston, R. I., on a bid of $2251.88.

For 120,500 feet hose (49-1190):
Companies sharing—Goodyear Tire & Rubber Co., Inc., Akron, O., on a bid of $2630, and Gates Rubber Co., Denver, on a bid of $8047.20.

For 1500 coupling assemblies (49-1478):
Aeroquip Corp., Jackson, Mich., on a bid of $2525.

For 328 blade assemblies (49-1515):
Utility Industries Co., East Hartford, Conn., on a bid of $29,208.60.

For 10,000 anodes-cadmium (49-1547):
International Minerals & Metals Corp., New York, on a bid of $21,000.

For electric generators (49-1577):
Jack & Heintz Precision Industries, Inc., Cleveland, on a bid of $33,793.50.

For photographic equipment (49-987):
Companies sharing—Sun Ray Photo Co., Inc., New York, on a bid of $7192.50; Simmon Brothers, Inc., Long Island, N. Y., on a bid of $2474.10; Graflex, Inc., Rochester, N. Y., on a bid of $86.50; John M. Wall Inc., Syracuse, N. Y., on a bid of $75; Malone Camera Stores, Inc., Dayton, on a bid of $120; Burke & James Inc., Chicago, on a bid of $1015; Buhl Optical Co., Pittsburgh, on a bid of $4551.50; Bausch & Lomb Optical Co., Rochester, N. Y., on a bid of $3411.30; Eastman Kodak Co., Rochester, N. Y., on a bid of $320.85; James H. Smith & Sons Corp., Griffith, Ind., on a bid of $156.60; American Hard Rubber Co., New York, on a bid of $1838.

For 790 navigation kits (49-1000):
American Blueprint Co., Inc., New York, on a bid of $7900.

For subscriptions (49-1097):
Moore-Cottrell Subscription Agencies, Inc., North Cohocton, N. Y., on a bid of $3924.45.

For 2900 envelopes (49-1181):
Companies sharing—Kennedy Car Liner & Bag Co., Shelbyville, Ind., on a bid of $12,195; Western Products Inc., Newark, O., on a bid of $14,410, and Vanant Products Inc., Tomah, Wisc., on a bid of $12,255.

For 17,327 steel bars (49-1192):
Ohio Stainless & Commercial Steel Co., Cleveland, O., on a bid of $12,779.74.

For photographic equipment (49-1257):
Companies sharing—Pako Corp., Minneapolis, Minn., on a bid of $287; Da-Lite Screen Co., Inc., Chicago, on a bid of $173.53; Eastman Kodak Co., Rochester, N. Y., on a bid of $3032.96; Camera Shop, Rike-Kumler Co., Dayton, on a bid of $61.62; Bausch & Lomb Optical Co., Rochester, N. Y., on a bid of $405.99, and Semon Bache & Co., New York, on a bid of $112.50.

For 8625 receptacles & plugs (49-1260):
Cannon Electric Development Co., Los Angeles, on a bid of $7033.41.

For hair bound rubber material (49-1275):
Armour & Co., Chicago, Ill., on a bid of $7500.

For 38,350 valve assemblies (49-1349):
Rochester Manufacturing Co., Inc., Rochester, N. Y., on a bid of $8743.80.

For white lead paint (49-1318):
Companies sharing—Capitol Paint & Varnish Works, Inc., Brooklyn, on a bid of $9699; Dixie Printing Ink Co., East Point, Ga., on a bid of $15,711.27; W. P. Fuller & Co., Los Angeles, on a bid of $10,812, and Glidden Co., Cleveland, O., on a bid of $1841.64.

For aluminum sheet (49-594):
Reynolds Metals Co., Louisville, Ky., on a bid of $16,140.19.

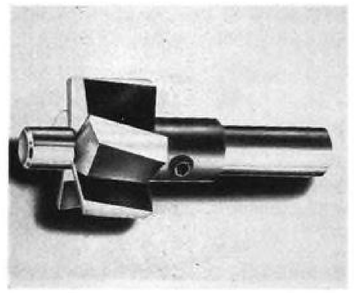
For acetone (49-1185):
Companies sharing — Octagon Process, Inc., Brooklyn, on a bid of $110.45; Publicker Industries Inc., Philadelphia, on a bid of $18,262.74; McQuire & Company, Emeryville, Calif., on a bid of $3869; Amsco Solvents & Chemicals Co., Cincinnati, O., on a bid of $3540.40; Shell Chemical Corp., New York, on a bid of $8786.34, and Carbide & Carbon Chemicals Corp., New York, on a bid of $10,773.84.

For 400 link connector snap (49-1201):
Capewell Manufacturing Co., Hartford, Conn., on a bid of $4020.

For 2000 bolts (49-1231):
Standard Pressed Steel Co., Jenkintown, Pa., on a bid of $21,240.51.

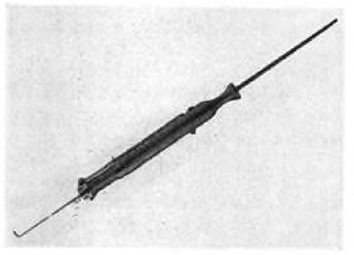
For 1060 coating racks (49-1238):
Nelson J. Quinn Co., Toledo, O., on a bid of $2660.60.

NEW AVIATION PRODUCTS



For Machining Jobs

New counterbore, AT 448, developed by **Aircraft Tools, Inc.**, 2306 E. 38th St., Los Angeles 11, Calif., is designed to give cleaner spotfacing of standard work and facilitate jobs not accessible with ordinary counterbores. Made of selected high-speed steel and only 2-in. long, tool permits faster feeding by dissipating heat quickly through thick cutting edge, gives cleaner and smoother cutting via more flutes, and is claimed to require resharpening only 1/10th as often as usual types. Tool has interchangeable pilots available in all sizes. It is produced in complete range of sizes with straight shanks for drill motors and drill presses and tapered shanks for spindles. This eliminates holders and adapters.



Tension Tester

"Push or Pull" scale made by **Pelouze Mfg. Co.**, 1218 Chicago Ave., Evanston, Illinois is intended to afford ease and simplicity in tension testing. Scale can be inserted into small openings, without removing installed units or parts, for quick, accurate measurement of tension in pounds and ounces. Push or pull rods are 6 in. long, threaded and detachable. Other lengths are also available. Suggested uses are for measuring small torques, spring tension, mechanical masses, and contact point breaker arm tension. Precision calibrated spring and adjustable head permit use in any position. Spring is specially treated alloy wire. Shell is seamless brass tubing with solid brass head. Scale is heavily nickel plated. Device is offered in 2-lb. capacity, graduated in ¼ oz. increments; 5-lb. capacity, graduated in 1 oz.; and 20-lb. capacity, graduated in 4 oz.

Communications Aid

New type of two-way VHF radio telephone, Type NEL-200 Utiliphone, is intended primarily to provide communication between airport control tower and ground units such as snow plows, crash or fire trucks, automobiles, or other ground mobile equipment. Frequencies of 121.7 or 121.9 megacycles are employed. Made by **National Electronics Laboratories, Inc.**, Alexandria, Va., device can be removed quickly from shock mount in the vehicle for servicing or interchanging and is stated to deliver exceptional power for clear loudspeaker operation. Signals from control tower are claimed to be heard with ease above pump, engine and other load noises in vicinity of unit. Range for reliable transmission and reception is reported as minimum of 5 mi. over average terrain. Receiver weight with power supply and shock mount, less accessories, is 31¼ lb. Overall dimensions are 20⅛ long x 8⅝ high x 7⅛ in. wide. Transmitter is 12 long x 4⅝ high x 2⅛ in. wide. Weight is 2 lb. Dynamotor is sealed unit supplying high voltage to entire equipment, and it's stated that it should require no maintenance for over 1000 hr. operation.

Depth-Hardener

Drills, chisels, reamers, dies, taps, cutting tools, and carbon or high speed steel may be hardened to desired depth in matter of minutes with new powder compound, "Hi-Speed-It", offered by **Wilson Carbon Co., Inc.**, 60 E. 42nd St., New York 17, N. Y. No special skill or equipment is required. Object is heated to cherry red color in torch, open forge or furnace, then dipped, rolled or stirred in powder. About 15 to 30 sec. are allowed for powder to fuse and form crust. Object is again dipped lightly in or sprinkled with powder, reheated to cherry red, then quenched quickly in cold water or brine. Depth of hardness is controlled by repeating steps before quenching. High speed steels are processed similarly, but at higher temperature, and quenched in oil. Compound contains no cyanide or other producers of toxic fumes.

Reversible Driver

Pneumatic Cleco A-1 screwdriver is designed to speed production jobs that require driving many small screws and other fasteners. Small size, 9¼-oz. weight, and freedom from torque, combine to make unit easy to handle. Made by **Cleco division, Reed Roller Bit Co.**, P. O. Box 2119, Houston 1, Tex., screwdriver is claimed to be only ⅓ as heavy as other tools of similar capacity. It is considered especially useful in reducing operator fatigue on jobs requiring continuous operation. Balanced impact mechanism absorbs driving torque, permitting fingertip control and there is said to be no possibility of tool twisting in operator's hand or jumping out of screw slot. Since throttle valve is opened by pressure on bit, wasteful "free running" is eliminated. Rotation is easily reversed, and external adjustments for power and reversing make disassembly of tool unnecessary.

For Radiation Studies

New high-sensitivity thermocouple, Hornig-O'Keefe type, is offered by **Farrand Optical Co., Inc.**, 4401 Bronx Boulevard, New York 66, N. Y. Instrument is claimed to be particularly suitable for thermal radiation measurements involving chopped or modulated radiation at frequencies up to 10 cps. It has active target surface of ¾ mm. square; spectral range, with KBr window, of 0.3 to 25 microns; resistance of between 6 and 10 ohms; and d.c. sensitivity greater than 6v./w., obtained for time constant of approximately 35 millisec. Dimensions of thermocouple case have been chosen to subtend approximately 10 percent of area of 60 mm. diameter spherical mirror when housed thermocouple is placed at its focus. Device is available compensated or uncompensated; mounted or unmounted; and evacuated and with charcoal trap serving to absorb gas which may leak into or be released from interior walls of thermocouple case.

Parts Cleaner

Improved Formula 504 for removing paint, sludge and light carbon from aircraft engines and parts, and for similar metal cleaning, is announced by **Kelite Products, Inc.**, Box 2917, Terminal Annex, Los Angeles 54, Calif. Material is claimed to be safe on all metals including cadmium and zinc, and will clean with much contamination. It has low evaporation rate, is used at normal room temperature, and will not burn up to 140 F. Material is packed in 55 and 15 gal. drums and 5 gal. cans.

"Give us the tools . . ."

The 81st Congress Can Halt the Administration's *SOCIALIST PROGRAM*

In his speech at Massachusetts Institute of Technology, Winston Churchill said that America's possession of the atomic bomb is all that has kept Soviet Russia from overrunning Europe and bombing London.

Our State Department knows that there has been another deterrent to aggressive warfare by Russia and a deciding one. That deterrent is the superior industrial strength of the United States. But once Russia approaches our industrial strength, then watch out! For Stalin or no Stalin, there will be trouble. Therefore, the simple table below is worth every American's careful reading. It shows in percentages what Russia did with her national income in 1948 and what we did with ours:

	USSR	USA
Civilian use	60%	79%
New capital equipment and public works	21%	12%
Foreign aid		2%
Defense	13%	5%
Building of inventories and war stock-piling	6%	2%

These figures for Russia come from *The* (London) *Economist,* Britain's influential economic journal.

These figures are estimates based on information from behind the Iron Curtain, and so cannot be checked directly. But they fit with what is known of Russian development.

The table shows that Russia is straining every resource to build up its industrial strength. When Russia's effort is measured in *dollars,* and compared to ours, the figures show:

Where we spent $20 to $21 billion for new industrial plants and equipment last year, the Russians spent $12 to $14 billion.

But while we used about $9 billion of this to *replace* old equipment, the Russians spent no more than $2 billion for replacing old equipment. The Russians had much less worn-out and obsolete equipment to replace. They could concentrate their efforts on expanding their industries and buying new equipment.

So—we used only $11 to $12 billion to *expand* our industries.

And the Russians used almost as much to expand theirs—$10 to $12 billion.

Russia is gaining industrial strength as fast as we are—and may soon be gaining faster. The more she gains and the faster she gains on us, the greater is the danger of war.

American industry is pushing modernization and expansion hard. It is doing an heroic job. McGraw-Hill's recent survey* shows that *industry* already has in hand plans to build plants and buy equipment in the next five years adding up to $55 billion. Industry plans that investment—*and much more—if it can get the money.*

On those plans of *industry* depend *our* national security.

If these plans of ours are cut back, the Russians will be years closer to their goal of industrial equality—the strength that they need to wage aggressive war successfully.

But more and more our industry's plans are being menaced by socialist policies in Washington. The President continues to urge a further increase in the tax on corporate profits, even though federal taxes alone now take 38 cents of every dollar of profit. He wants $3 billion more in taxes on corporate profits now, plus added personal taxes.

Last year corporations spent almost two-thirds of their profits—about $13 billion—for new plant and equipment. This year corporation profits will be lower than last year's $21 billion, perhaps by 20 per cent. Subtract a fifth or more from last year's profits. Then adopt the President's proposal and take $3 billion more in corporate taxes and you raise havoc with planned expenditures for new plant and equipment.

Approval by Congress of the President's tax program would cut industry's program of plant and equipment development by a third or more. That means a major blow to our prosperity as well as our national security. For as capital investment goes, so goes general prosperity.

Further serious damage would be done by Congressional approval of the President's industry-control bill. The so-called Stability Act of 1949 (the Spence Bill) would severely check industrial progress. That bill would put the federal government in the business of providing the added industrial capacity which the tax program would prevent private industry from doing for itself. It would be hard to conceive a better and surer way to dry up private investment in new plant and equipment. For every dollar of government investment will scare away many times more dollars of private investment. People will not want to risk their money in businesses competing with the U. S. Treasury. At the same time it will attack private investment in another way. It means that government would spend your income for you instead of allowing you to spend or invest for yourself. That is the high and quick road to socialism.

American industry needs right now great courage and incentives if it is to carry out its tremendous building program. It needs also a release from the program of a socialist administration in Washington with its systematic discouragement of enterprise and risk taking.

Above all, industry needs assurance by the actions of the 81st Congress itself that there is a future in this country for a system of dynamic capitalism, functioning in a free society. By acting now to strengthen the American people's faith in their industrial system, by providing needed incentives for management and investors, by protecting industry's capacity to buy new equipment, the 81st Congress can sustain American industrial progress and keep us united and strong.

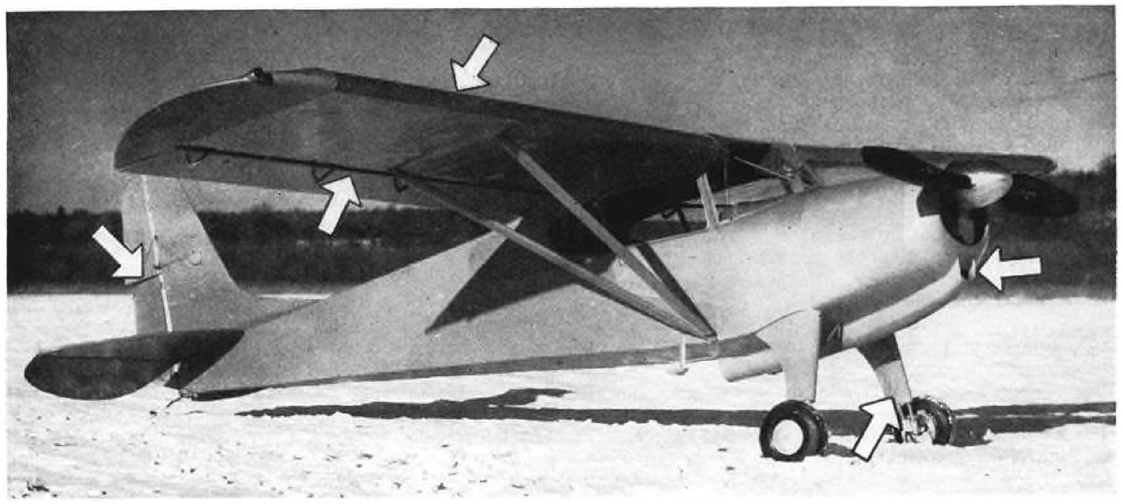
But if we kill freedom of industrial planning and action by unneeded taxes and government controls we put ourselves—and our friends all over the world—in dire peril.

Nothing would please the Communists more.

James H. McGraw, Jr.

President, McGraw-Hill Publishing Company, Inc.

***A complete report on our national survey may be obtained by writing McGraw-Hill Publishing Co., 330 West 42nd St., New York 18, N. Y. This is one of a special series of editorials on industry's needs for new plants and equipment.**



UNUSUAL FEATURES of Bollinger-Koppen plane: split rudder, full-span flaps, leading-edge slats, muffler, castering gear.

New Slow-Flying Plane Developed

Craft is designed to fly at 30 mph. without stall, cruise above 100 mph., take off and land in 100 ft.

A lightplane with such low-speed performance that it conceivably could open a new era in the personal aircraft field has been designed, built and test flown near Boston.

The plane is the result of secret development during the past year by Dr. Otto C. Koppen, noted aeronautical engineer of the Massachusetts Institute of Technology, and Prof. Lynn L. Bollinger of the Harvard Business School, nationally known for research in aviation.

► **Slow Flight**—Although the test program is not yet completed, AVIATION WEEK has learned the plane already has:

- **Flown** at approximately 27½ mph. for one mile under no-wind conditions.
- **Taken off** (minus passenger) before the pilot could fully open the throttle.
- **Taken off** in about 60 ft. in still air with approximately 73 percent power.

This performance is better than some of the goals set by Koppen and Bollinger. Design objectives included producing a plane which could be slowed down to 30 mph. without risk of a stall; which could take off with full gross and no wind in 100 ft. or less and clear a 50-ft. obstacle less than 300 ft. from a standing start; which could land in 100 ft.; and which would have a cruising speed substantially above 100 mph.

► **Helioplane**—Koppen and Bollinger do not maintain the plane has met or exceeded any of the design goals. They say they will make no performance claims until the test program has been completed with scientifically recorded data.

But they do state the plane will not stall and cannot be spun. Because it is intended for operations from the same size area normally used for a rotorcraft, they have named their craft the "Helioplane," and have established the Helio Corp. The craft is expected to sell—when its designers deem it ready—for about $500 more than conventional lightplanes.

► **New Wrinkles**—Presumably because a number of innovations responsible for the plane's performance are patentable, the originators are withholding some details of construction. But the craft is full of new wrinkles and adaptations in new forms of previously-known principles.

The mechanism which automatically coordinates a novel split rudder is one of these features. Lower part of the rudder is linked to the stick control, making the plane essentially a two-control aircraft. Upper portion of the rudder is operated by conventional pedals.

A special, two-bladed, constant speed, nine-foot propeller, with high thrust at low speeds, is another feature. It was built for the plane by Aeromatic Propellers department of Koppers Co.

Full span flaps and automatic, aerodynamically operated slats contribute to the slow-flight, high-lift characteristics.

NINE-FOOT propeller and Bollinger.

► **No Stall, No Spin**—"It is a genuinely stall-proof airplane," Bollinger told Avi-

ATION WEEK. "Since it is completely stall-proof, it is also spin-proof. At 30 mph. the wing is 14 deg. from stalling angle—further from a stall than a Cub in normal flight."

It is a quiet airplane with an engine muffler and the prop geared down. The partners have attempted to make it as noiseless as the airplanes developed under NACA sponsorship by the Aeronautical Research Foundation and demonstrated in Boston last summer. Although both men helped develop the Foundation's research aircraft and might properly have used the same type of four-blade quiet propeller, Koppen designed an entirely new arrangement.

► **Vagabond Start**—When they started the work more than a year ago Koppen and Bollinger had intended merely to modify a Piper Vagabond. Before they were through, nearly everything on the plane was new. Exceptions are the cabin frame tubing, spar, struts, windshield and rudder pedals. "It's all new from the cabin back, and from the firewall forward," Bollinger explained.

As the work progressed, the single door was discarded; there is now one on each side. About 45 inches have been added to the airframe length. The span is about 29 feet (7 inches less than a Piper Cub). It has Goodyear swivel gear, starter, generator, battery and two-way radio.

Powerplant is an 85-hp. Continental with fuel injection. A tank of about 20 gal. capacity was installed behind and below the side-by-side seats.

Other figures: wing area, approximately 150 sq. ft.; maximum allowable gross, 1350 lb. (it is stressed for heavier loads); empty weight, about 850 lb. (giving almost 500 lb. useful load); wing loading, about nine lb. per sq. ft.

Incorporated in the landing gear, which has been moved forward is a new, pneumatic-oleo arrangement. The landing gear requirements, however, are no different than on any conventional lightplane. Since this part of the airplane was considered "routine," they gave it no special engineering attention—and it is the only part of this novel airplane that has given mechanical trouble to date. A new undercarriage arrangement is being installed.

► **More Coming**—Koppen and Bollinger believe they have come up with a significant new technical advance—an urgently needed high-lift, slow-speed aircraft suitable for personal flying, agricultural work and military liaison. Development cost is believed to be less than one-half what an aircraft factory would have spent.

They expect to have a small number of these airplanes assembled in the Boston shops of E. W. Wiggins Airways, to be used for service test purposes. Only after the design is fully developed and thoroughly tested will they be willing to license it for manufacture and sale to the general public. Next steps: completion of test data and obtaining an Approved Type Certificate from CAA.

LEADING EDGE SLATS, aerodynamically actuated, contribute to plane's high-lift.

Reviewing the project, Bollinger told AVIATION WEEK:

► **The Why**—"We were convinced that the small airplane was failing, almost completely, to meet the real purposes for which most private owners were buying—or were willing to buy. The total market has been small. Potential customers don't buy for sport any more; they buy for transportation.

"With outlying airports, it has been determined that 300 miles is generally about the minimum distance which can be flown to save time. But on a trip of that distance it is cheaper to use the airlines. Secondly, on a trip of that length, the weather becomes . . . too unpredictable. Then there has been the lack of safety in the personal airplane.

"We were convinced that to solve the problem there would have to be airports located close to community centers, making trips practical over much shorter distances.

"The first objection to such close-in airports was noise. The Aeronautical Research Foundation's project on noise under NACA sponsorship demonstrated that it could be eliminated. We wanted a national model airpark in Boston, to be limited to quiet planes. Although the Massachusetts General Court heartily endorsed the project and passed enabling legislation in 1947 granting permission to use certain public property, the project later was blocked by conflicting interests.

"The quiet airplane was one step—an important step. Otto Koppen had been working for several years on ideas for shortening the space required for landing and takeoff. It seemed to me that his solution was more ingenious, effective and simpler than anything else.

"I tried—we both tried—to get the Civil Aeronautics Administration to sponsor this project. T. P. Wright, then administrator, was unable to obtain funds from Congress. So Koppen offered his design to the Aeronautical Research Foundation.

"The Foundation inquired as to possible sponsorship by the National Advisory Committee for Aeronautics. NACA representatives advised that such a complete airplane project was not proper for them. The Foundation itself had all the work it could handle and finance, so its trustees were also forced to turn down this project."

► **Private Venture**—Unable to obtain industry or public support, Koppen and Bollinger at this point decided to try to develop the airplane at their own risk as a private venture. They hired mechanics at Wiggins Airways in Norwood, near Boston. Koppen did the basic engineering—fundamental new research—and his associates helped him. Bollinger set overall specifications, based on his appraisal of market needs.

The objective was to maintain the existing cruising speed, payload and power requirements of the present-day, efficient lightplane, and in addition to be able to fly safely at low minimum speeds and to be able to land and take off in less than 100 feet.

A major difficulty which was encountered in all attempts to attain safe, ultra-slow flight with fixed wings has been the extreme difficulty of maintaining stability and control.

On the question of their plane's performance, Bollinger comments:

"If Koppen's design can take off in less than 100 feet with only 85 hp. and can maintain good control at less than 30 mph., a revolutionary technical advance will have been made in light plane performance."

The inside story, of course, is that this performance or better has already been achieved with the plane.

Presidents Argue Air Coach

Interstate and Foreign Commerce Committee hears NWA's Hunter defend it, UAL's Patterson oppose it.

Sharp differences over advisability of using low-fare coach services to develop the mass air transportation market were expressed by presidents of two transcontinental carriers in recent testimony before the Senate Interstate and Foreign Commerce Committee.

Croil Hunter, Northwest Airlines president, declared that 4-cents-a-mile coach operations (compared with 6-cents-a-mile luxury service) would be a big step forward in improving the industry's financial condition. He cited NWA's experience—the carrier's revenue passenger mileage on regular services (for the first half of April) was up only 1 percent over corresponding 1948 period; but its coast-to-coast and Seattle-Alaska coach service boosted systemwide revenue passenger mileage 26 percent over 1948.

► **Survey Disclosed**—A Northwest Airlines survey showed that 40 percent of its coach business comes from people who would not pay luxury air transport rates, Hunter continued. "The lower coach rates attract individuals who otherwise may not travel at all or, if they do, will travel by automobiles, buses, and coach rail service."

Air coach service, with a 60 percent load factor, "can be a good profit operation," according to Hunter. Airlines, he said, should offer different classes of service at different rate levels like other forms of transportation.

► **UAL Position**—United Air Lines President W. A. Patterson explained his company's refusal to launch low-rate service, declaring that "when the carriers are up against it financially, it is no time for them to experiment and explore." He said that if all of the airlines "jump in" with coach services, all of the operations would be on a deficit basis. "The traffic would be spread too thin."

Favorable financial results on coach services (now offered by Pan American, Northwest, TWA, Continental, Mid-Continent and Capital) are because "none of it is competitive yet," the UAL executive contended. Badgered by Sen. Edwin Johnson (D., Colo.), who suggested that airlines have an obligation to the public to offer low-rate service over their routes, Patterson finally conceded, "we may go into it."

► **Ray Testifies**—James G. Ray, aviation consultant, speaking for feeder airlines, also appeared before the Senate committee, which is conducting an investigation into airline finances.

Following are testimony highlights:

• **Subsidy Earmarking**—Both Hunter and Patterson endorsed in principle the proposal to separate "service" and "subsidy" mail payments to air carriers, but they urge caution in establishing equitable service rates. "Under fair service pay," Hunter predicted, "we might well find that the subsidy item is either very, very small, or amounts to nothing."

Patterson declared that with subsidy being identified directly as such, it would serve as an incentive for management to increase efforts to reduce and eliminate subsidy. UAL, he pointed out, is now receiving only about 66 cents per ton mile for carrying mail on which the Post Office Department receives about $2.30 a ton mile through stamp collections.

• **Mail Pay Basis**—Committee Chairman Johnson objected to Hunter's contention that the air transport industry, under good business management, "is entitled to mail pay sufficient to give us a fair return on our investment." It indicated, Johnson declared, an airline psychology that carriers are entitled to make up with government funds whatever deficits they incur.

• **Cost vs. Revenues**—Failure of airline revenues to keep pace with mounting costs during postwar years is crux of the industry's unstable financial condition, Hunter and Patterson agreed. While UAL's operating expenses are up 86 percent over 1939, Patterson reported, the carrier's passenger fare is only 4 percent over 1939, and its mail rate is 56 percent lower. Northwest's mail pay supplied 53 percent of its 1939 total revenue, Hunter pointed out, but only 14.7 percent last year, and will provide an estimated 12 percent for this year.

• **National Defense**—Patterson summarized the basic issue for Congress: We will have either a curtailed non-subsidized air transport system, or a system expanded "beyond natural acceptance" and requiring subsidies in various categories. He suggested that if the national defense requires a big fleet of transports, it would be in the public interest to put them into commercial service, offering cut-rate fares to fill the planes, rather than build them and put them in storage.

• **Feeders Commended**—During the appearance of James Ray, former vice president of Southwest Airways, Sen. Johnson observed that "the statistics are very encouraging" in the feederline picture. He noted that the feeder industry showed a $361,953 operating profit in 1948. Ray, who outlined the feederlines' developmental problems in detail, anticipated that "the upward traffic trend will continue in 1949." Ray vigorously contested Johnson's suggestion, however, that trunk airlines, through joint use of personnel and facilities, could do a more economical job of operating local services.

► **Smith's Views**—In advance of his appearance before the Senate committee, scheduled for late last week, American Airlines President C. R. Smith issued a statement warning of the danger of nationalization of airlines if the "cost-plus" basis of reckoning airmail payments continues. Smith was to favor separation of subsidy and service mail payments.

Smith declared there are too many carriers, but that "so long as the theory of cost-plus prevails there will continue

Some Capital Facts

Capital Airlines President J. H. Carmichael, whose company pioneered scheduled domestic air coach service last November, gave Senate Interstate and Foreign Commerce Committee members some facts about the low-fare operations during testimony last week.

As of May 1, Capital was operating about 5000 plane miles of coach service every night with the addition of only 32 employes to the company payroll. Gross revenues produced by Capital's three coach routes—New York-Chicago, New York-Twin Cities and Washington-Chicago—aggregated $802,871. Overall passenger load factor has been 71 percent.

While Capital has shown a continuous net profit on its "nighthawk" coach flights, Carmichael emphasized that they cannot be extended indiscriminately to run at all times of the day or between all points. He said the time is definitely coming when there will be two types of air travel—coach and luxury—but added that a general cut in fares to the 4-cents-a-mile level would be uneconomic.

to be insufficient incentive for logical merger."

He also criticized the administration of the "need" section of the Civil Aeronautics Act for ". . . repairing the consequences of . . . lack of diligence or mismanagement," and penalizing "management results which exceed the average."

"I am sure we must be concerned," Smith stated, "with what seems to be a growing number of managers who are willing to express the belief . . . that the government is expected to send the annual check, sufficient to recoup the losses sustained and provide a margin adequate for return on capital invested in the enterprise."

Air America Fears Nonsked Rate War

One of the best known transcontinental nonscheduled carriers believes it can survive under the Civil Aeronautics Board's "death sentence" revision of operating rules for irregular lines, provided the nonskeds themselves don't get into a rate war.

Fred A. Miller, president of Air America, Burbank, Calif., has announced his company will continue to operate on a "bare subsistence" basis rather than violate CAB regulations. But he made clear that he has no quarrel with other irregular operators who believe the Board's new restrictions are unduly harsh.

▶ **Flights Limited**—Between Apr. 20 (two days after CAB crackdown) and May 6, Air America made only four transcontinental roundtrips. During the latter part of 1948, the company's leased DC-4s were making almost daily coast-to-coast trips in both directions. The company suspended operations for several months early this year to establish a "pattern of irregularity" in keeping with CAB regulations.

Miller reports Air America is turning down five passengers for every one carried. He notes that his four roundtrips between Apr. 20 and May 6 with 65-passenger DC-4s grossed $50,000 "thanks to a 100 percent load factor."

▶ **Rate War Feared**—While Air America thinks it can stay in business under CAB's new regulations, it is fearful that a rate war will develop among coast-to-coast nonskeds. One irregular operator, Peninsular Air Transport, Miami Springs, Fla., has filed a tariff with CAB providing for $77 transcontinental "luxury service" fare and $66 "bucket seat" fare (AVIATION WEEK, May 2). The carrier uses high-capacity C-46 equipment.

Five other nonskeds joined Air America in asking CAB to suspend the Peninsular tariff. They are Airplane Charter by Mercer, Airline Transport Carriers, Great Lakes Airlines, Standard Airlines and Viking Air Lines.

Conventional transcontinental nonsked fare is $99. Miller cited a recent rate increase by one coast-to-coast independent formerly $88 as evidence that $99 is the minimum tariff that can be offered economically if CAB's legal limits on regularity of service are to be observed.

▶ **Coastal Protests**—Meanwhile, Coastal Air Lines, a nonsked operating on the New York-Miami run, has complained against roundtrip excursion fares which National Airlines and Eastern Air Lines plan to make effective between May 15 and Oct. 31 to stimulate off-season travel. The independent charges that NAL and Eastern "made a deal" and are "endeavoring to tap the market developed by the irregular carriers."

Coastal has been charging $50 one-way fare between New York and Miami on a year-around basis. Under the NAL and EAL 21-day excursion fares, the roundtrip rate between New York and Miami will be $102.

Significantly, one New York-Miami nonsked is planning to cut its one-way fare to $34.78—well under Coastal's rate.

World's Planes

U. S. supplies 77 percent of airline aircraft; Douglas is top builder.

American-built aircraft—and more particularly those manufactured by Douglas Aircraft Co.—are the mainstay of foreign airlines in all parts of the world.

A comprehensive survey of transport planes used by over 200 scheduled common carriers in the U. S. and abroad shows that 77 percent of the 3836 total were American-built and that 57 percent were turned out by Douglas. The study, made by the Foreign Air Transport division of the Civil Aeronautics Board, disclosed that the British manufactured 15 percent of the world's airline equipment and that the other nations combined—exclusive of Russia—the remaining 8 percent.

▶ **Comparison by Hemispheres**—In the Western Hemisphere, 92 percent of the transports were manufactured in the U. S., 4 percent in Great Britain and 4 percent elsewhere. In the Eastern Hemisphere, 62 percent were U. S.-built, 26 percent British-built, and 12 were produced elsewhere.

Were data available on equipment used behind the Iron Curtain, the percentages of American and British planes in the Eastern Hemisphere would be reduced somewhat.

Only continent in which U. S. planes do not dominate commercial air transport is Africa, where 52 percent of the 207 aircraft listed were British-built and 42 percent American-built. Of 577 airline aircraft in Asia, 78 percent were U. S.-built and 16 percent British-built.

The survey showed Australasia with 215 transport aircraft, 64 percent U. S.-built and 35 percent British-built; Europe, 959 aircraft, 56 percent U. S.-built, 24 percent British-built; Middle America (Caribbean and Central American area), 257 aircraft, 87 percent U. S.-built, 12 percent British-built; North America (Canada and the U. S.), 1187 aircraft, 95 percent U. S.-built, 1 percent British-built; and South America, 434 aircraft, 88 percent U. S.-built, 6 percent British-built.

▶ **Principal Manufacturers**—Of the 3836 world-wide plane total, nearly four-fifths were built by five manufacturers—three American and two British. Douglas turned out 2180, Lockheed 278, de Havilland 211, A. V. Roe (Avro) 169 and Consolidated-Vultee 118. If Russian-manufactured planes could have been included in the total, the Ilyushin-built aircraft undoubtedly would have been among these leaders.

CAB estimates that Russia's Civil Air Fleet Administration (Aeroflot) has about 200 twin-engined Ilyushin IL-12 aircraft, which accommodate 24 to 30 passengers. Russia also has a number of Douglas C-47s and other commercial aircraft ranging upward in size to the four-engined 70-passenger Tupolev TU-70.

▶ **No Standardization**—Lack of equipment standardization runs to the extreme among the majority of foreign airlines. Fleet of the Turkish State Airlines (DHY) includes 16 British de Havilland biplanes, 30 Douglas DC-3s, 5 German tri-motored Junkers Ju-52/3s, which accommodate about 17 passengers, and a British twin-engined, 9-passenger Miles Aerovan.

Further, the 16 de Havillands are broken down into 7 twin-engined, 5-passenger Dominies; a twin-engined, 4-passenger Dragonfly; 3 twin-engined, 5-passenger Rapides, a single-engined, 1-passenger Tiger Moth and 4 four-engined, 16-passenger Express aircraft.

▶ **Curtiss Condor Listed**—A Mexican carrier, Aerovias Latino-Americanas, S.A., (ALASA) had all U. S.-built planes in its fleet as of last fall. But the collection included a Bellanca; a twin-engined, 18-passenger Curtiss Condor biplane; a Curtiss Robin; a DC-3; a single-engined, 4-passenger Fokker Universal; a twin-engined, 6-passenger Lockheed Vega; 4 single-engined, 8-passenger Pilgrims; a Piper J-3; 3 Ryans; 4 Stinsons; 6 Travel Airs; a Verville and a Waco.

The Condor, Fokker Universal, Lockheed Vega, Verville and Pilgrims were the only planes of their type reported flying on a scheduled foreign airline. Four tri-motored, 13-passenger Ford

monoplanes are still listed as being in scheduled use over Central American routes of three different carriers.

Scheduled U. S. air carriers, both domestic and international, had 1055 planes in service on Apr. 15. They included: 109 DC-6s, 230 DC-4s, 463 DC-3s, 13 Lockheed-649 Constellations, 18 Lockheed-749 Constellations, 44 Lockheed L-49 Constellations, 12 Lockheed-18s, 6 Lockheed 10As, 24 Martin 2-0-2s, 5 Boeing Stratoliners, 5 Boeing Stratocruisers, 106 Convair-Liners, 7 Stinsons, 6 Beech D18Cs, 5 Sikorsky S-51 helicopters and 2 Curtiss C-46s.

Foreign Airline Equipment*

(Principal Types Only)

Manufacturer	Model	No. in Service	No. of Engines	No. of Pass.	Country of Mfr.
Douglas	DC-3	1093	2	21	U. S.
Douglas	DC-4	151	4	44	U. S.
Lockheed	Lodestar	89	2	18	U. S.
Vickers	Viking	89	2	24	England
DeHavilland	Rapide	83	2	5	England
A. V. Roe	Anson	71	2	6	England
Curtiss	Commando	65	2	40	U. S.
Douglas	C-47	63	2	..	U. S.
Lockheed	Constell'n	61	4	48	U. S.
Junkers	Ju-52/3	60	3	17	Germany
DeHavilland	Dove	49	2	11	England
Noorduyn	Norseman	48	1	8	Canada
A. V. Roe	Lancastrian	38	4	13	England
A. V. Roe	York	37	4	21	England
Bloch	Languedoc	36	4	32	France
DeHavilland	Dominie	34	2	5	England
Douglas	DC-6	31	4	52	U. S.
Consol.-Vultee	Convair	30	2	40	U. S.
Beech	C-45	27	2	6	U. S.
Lockheed	Electra	27	2	10	U. S.
Canadair	DC-4M2	24	4	40	Canada
Consolidated	Catalina	24	2	18	U. S.
A. V. Roe	Tudor IV	18	4	32	England
Airspeed	Consul	16	2	6	England
Caudron	Goeland-449	15	2	6	France
Cessna	C-78	15	2	4	U. S.
DeHavilland	Dragon	15	2	..	England
Fiat	G-12	12	3	26	Italy
Short	Solent	12	4	24	England
Short	Plymouth	11	4	22	England
Grumman	Goose	10	2	6	U. S.
Bristol	Wayfarer	9	2	34	England
Short	Sunderland	9	4	22	England
Airspeed	Oxford	9	2	8	England
Savoia-Marchetti	SM-95	8	4	41	Italy
Boeing	247-D	8	2	13	U. S.
Douglas	DC-2	8	2	14	U. S.
Lockheed	Hudson	8	2	14	U. S.

*Latest information available on Mar. 1, 1949.
Data on Russian transports incomplete and not included.

Overload and Ice Caused Charter Crash

The Seattle Air Charter DC-3 which crashed during takeoff from Boeing Field, Seattle, last Jan. 2 was 1501 lb. overloaded and had ice and frost formations on its wing surfaces.

This condition, disclosed in a Civil Aeronautics Board report, probably caused the mishap in which 11 of the 27 passengers aboard the plane and three crew members were injured fatally. No indication was found of mechanical or structural failure in the aircraft or any of its components. The plane had been chartered by a group of Yale University students for a Seattle-New Haven, Conn., flight.

Testimony during the CAB investigation showed that the plane had been parked on the field without wing covers when snow fell, melted and then froze on all surfaces. Three attempts were made to remove ice from the craft prior to takeoff.

► **Pilot Warned**—But one witness who inspected the plane just before takeoff found a layer of clear ice covering the underside of both wings and patches of rime and clear ice on the top surfaces of the left wing. He also noticed that heavy frost was forming rapidly on the top surfaces of the wings and advised the pilot: "If you intend flying the plane tonight, get plenty of speed before taking off."

One pilot who had been asked to make the flight examined the plane nearly three hours prior to the takeoff and refused to fly because of the ice on the wings. He returned home and notified a CAA aviation safety agent by telephone, but the accident occurred before CAA officials could act.

► **Takeoff Described**—The DC-3 stayed on the runway for nearly 30 minutes after being taxied out for takeoff because ground fog restricted visibility below the one-mile minimum for nonscheduled aircraft. Then, although the Weather Bureau reported one-fourth mile visibility, the pilot told the Boeing Field tower he could see green range lights 5700 ft. away and was going to take off. He received clearance from the tower.

The plane appeared to be making a normal takeoff for about 1000 ft. Then it began to swerve to the left, becoming airborne about 1800 ft. down the runway on a heading 35 degrees to the left of the runway.

Shortly after leaving the runway, the left wing dropped; and the tip dragged on the ground for a distance of 117 ft. The plane remained airborne for about 750 ft. and then made contact with the ground in a landing attitude, tail wheel first.

► **Plane Hits Hangar**—Power to the engines was cut upon contact with the ground. The plane rolled or skidded about 700 ft. into a revetment hangar and immediately became enveloped in flames. Nose of the craft was telescoped into the fuselage structure, and 80 percent of the passenger seats were found broken from their floor attachments.

CAB said the accident could not be attributed to the manner in which the CAA tower personnel performed their duties. The Board's investigation showed that the tower continuously advised the flight of existing weather conditions on the field and provided traffic separation for arriving and departing aircraft. According to existing Civil Air Regulations, no other duties are required of tower personnel; and the pilot in command of the aircraft is solely responsible for its safe operation.

Seattle Air Charter was a "large irregular" air carrier at the time of the accident. William F. Leland, owner and operator was killed in the crash.

Canada Tax Lifting Poses Problem

MONTREAL—Canada's lifting of the 15 percent transportation tax is helping some American travelers beat the levy on air travel in the U. S. The situation may not last long, but while it does, here's how it works:

An American writes to an established airline or travel bureau in Canada, asking them to mail him tickets for air travel between U. S. points. He pays in American dollars and for the cost of a 3-cent stamp saves the U. S. tax of 15 percent.

There's another way. Americans in cities on the U. S.-Canadian border can cross (bus fare at points is as low as 10 cents), purchase their tickets at U. S. airline ticket offices in such Canadian cities as Niagara or Windsor, and return with the 15 percent saving. On a round-trip New York-Los Angeles booking, for example, the saving is nearly $45.

► **Fine With Canada**—Canadian authorities apparently have no objection. The system means an increased flow of American funds into the country. U. S. tax officials, however, are studying the system in which everyone but the U. S. government stands to come out ahead.

There are two solutions, according to Canadian observers: Abandon the tax when the summer travel season reaches its peak; or make it unlawful for an American citizen to buy or order domestic route transportation outside the U. S.

► **Travel Up**—Lifting of the tax in Canada has brought a marked increase in air travel. Colonial Airlines reports traffic for April, 1949, showed a 35 percent increase over figures for that month last year. While the tax-lifting can not be wholly credited with the traffic upsurge, it has done its part.

For example, more people are buying roundtrip tickets, saving themselves the U. S. transportation tax. Colonial expects to feel the real impact of the tax-lifting this summer, and the carrier looks to as much as 50 percent increase in Canada-U. S. air travel.

Northeast Airlines traffic figures for April were up 30 percent over the previous month. Revenue was 42 percent higher. And revenue for April, 1949, was 55 percent over figures for that month last year.

One sign of Canada's response to air travel: When the tax was lifted in April, a travel bureau reported the immediate sale of air tickets to five honeymooning couples, as against no honeymoon excursion sales in 1948.

SHORTLINES

► **CAB**—Vice Chairman Oswald Ryan was sworn in as Board member for third term early this month.

► **Eastern**—Showed $1,298,065 first quarter net earnings compared to $1,121,144 in same period last year.

► **Flying Tiger Line**—Has asked CAB for special exemption to carry military cargo to and from twelve USAF and Navy bases in the U. S. Similar authority was previously granted Slick Airways and United Air Lines.

► **KLM**—Plans to inaugurate weekly trans-Atlantic DC-6 service May 20 linking Amsterdam with Paramaribo, Dutch Guiana, and Caracas, Venezuela, via Madrid, Lisbon and Dakar. . . . Of the 393 pilots in company's employ this year, 207 were Dutch, 72 British, 47 Canadian, 22 Australian, 19 American, 8 South African, 8 Swedish and 10 of various other nationalities.

► **Northwest**—Air coach service to Alaska along the "inside" route from the Twin Cities to Anchorage has been authorized by CAB and will start as soon as equipment is available. . . . Demand for $43-a-month wage increase for 250 NWA ticket and reservations agents will be arbitrated.

► **Pan American**—Has taken delivery on its eighth Stratocruiser. . . . Cargo ton miles flown on the Latin American division increased from 4,650,000 ton miles in the first quarter 1948 to 5,180,000 in first quarter 1949 despite more rigid international trade controls by Latin American governments. Exports were lower than 1948 level, but imports from Latin America gained.

► **Panagra**—Revenue passenger miles flown in first two months of 1949 rose 2 million over same 1948 period.

► **Peninsular Air Transport**—Has asked CAB for certificate to carry persons, property and mail on skycoach basis between New York and New Orleans via Atlanta and Washington; and between Chicago and Miami via Atlanta. The large irregular carrier, based at Miami Springs, Fla., plans to use presently-owned C-46s on the routes.

► **Swissair**—Has resumed its Geneva, Switzerland, to New York DC-4 service.

► **Trans-Pacific Airlines**—Plans to start its recently-certificated Hawaiian Island service around June 1.

► **TWA**—Reelected all officers at recent annual board meeting . . . Company will celebrate 20th anniversary of first transcontinental passenger service July 8. . . . Some functions and offices of the sales and traffic departments will shift from Kansas City to New York this summer because of growing importance of international traffic to total TWA revenue. E. O. Cocke, vice president-traffic, and administrative personnel of his staff will make the move. Consolidation of all major overhaul and maintenance at Kansas City base means transfer there of about 300 operations employes and supervisors from New Castle, Del., about June 1.

CAB SCHEDULE

May 16—Hearing on Los Angeles-Honolulu service in reopened Hawaiian case. (Docket 851 et al)

May 16—Hearing in North Atlantic route transfer case. (Docket 3589 et al)

May 16—Hearing on service to Newport News, Va. (Dockets 3238 and 3690)

May 25—Hearing on KLM's application for extension of its foreign air carrier permit, authorizing service between Carribean points and Miami. (Docket 3683)

May 26—Prehearing conference on extension of Expreso Aero InterAmericano's Havana-Miami foreign air carrier permit. (Docket 3717)

May 27—Prehearing conference in Western-Inland mail pay case. (Dockets 1374 and 2870)

July 18—Hearing on Hughes Tool Co. control of TWA. (Docket 2796)

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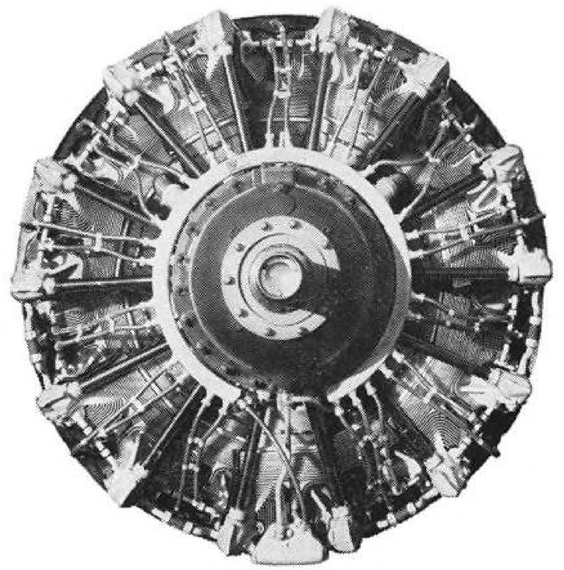

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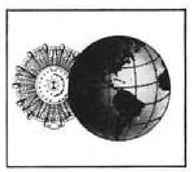

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AVIATION WEEK—MAY 16, 1949

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EDITORIAL

New Idea in Lightplanes

Congratulations are in order for Dr. Otto C. Koppen of Massachusetts Institute of Technology, Prof. Lynn Bollinger of Harvard Business School, and their group of associates and stockholders in the Helio Corp.

Elsewhere in this issue, we report the remarkable performance already achieved in preliminary tests of the Helioplane, a revolutionary two-place quiet, non-spin, non-stall craft. Takeoff and landing space is well under 100 feet. Although cruising speed of more than 100 mph. will be available, the plane can fly 30 mph. safely.

The first Helioplane is revealed at a crucial stage of personal aviation. Lightplane sales are off. Prices are rising. Flight schools and fixed base operators are going out of business in substantial numbers. The industry needs new and daring ideas desperately, but strained finances seldom encourage such an atmosphere. Perhaps private research companies like the Helio Corp. offer one of the answers to the demand for personal airplanes that utilize the latest technological developments.

Such a project also may become a guinea pig in modernizing the long outmoded requirements of the Civil Aeronautics Administration for approved type certificates, which in the past have served so often to freeze an aircraft type to the specifications in the original certificates. No company has ever been able to add all of the new features it wished because it could not afford the complete retesting CAA demanded for another certificate.

Even though the Helioplane being disclosed this week still lacks some refinements its sponsors hope to introduce in their efforts to create a high-utility, safe plane, we feel Messrs. Koppen and Bollinger have taken a daring and intelligent step forward. The Helioplane—even in its earliest test stage—appears to be the most important new idea in lightplanes introduced since the prewar Ercoupe.

Ignorance Is Not Bliss

Several airline executives who have appeared before Sen. Johnson's investigating committee have left the stand amazed at the lack of knowledge members of Congress have shown on aviation.

The United States Air Force met a similar problem and licked it. It has managed an effective information program on Capitol Hill and has made unusually good use of its dramatic accomplishments. The Air Transport Assn., on the other hand, has held off so long on any effective, directed information program that it is beginning to reap the inevitable results.

United Air Lines' President W. A. Patterson startled Sen. Johnson by disclosing that in the more than ten years the Civil Aeronautics Act has been in effect, not one member of the Civil Aeronautics Board, or one of its staff, had ever visited the airline headquarters to study United's methods.

This is a sorry state of affairs. It uncovers a clue to some of the unrealistic, pedagogical decisions of the Board in years past. But it also makes one wonder what has happened to management's sense of public relations. It is industry's obligation to publicize its own facts of life, honestly and directly and constantly. Injustice thrives on misinformation or lack of information.

But airline management has failed to realize the importance of industry-coordinated public relations. It has, instead —if it gave any thought to the matter at all—directed its public relations executives to stress only company developments and to blazes with the competitor. The result has been confusion for Congress, the public, and the Government, and a serious net loss to air transportation generally. Facts are avidly sought by everybody, but not hedging, exaggeration, half-truths and continual airing of individual company theories, alibis and special pleading.

It is time for some cooperative soul searching and statesmanship in air transportation public relations.

Fly the Masses

The airline presidents line up one by one urging trial on air coach service.

Mar. 28 we quoted Pan American's Juan Trippe: "The people want tourist class air service, and it is here to stay."

On Apr. 18, we quoted Capital's pioneering J. H. Carmichael: "Air coach service is profitable."

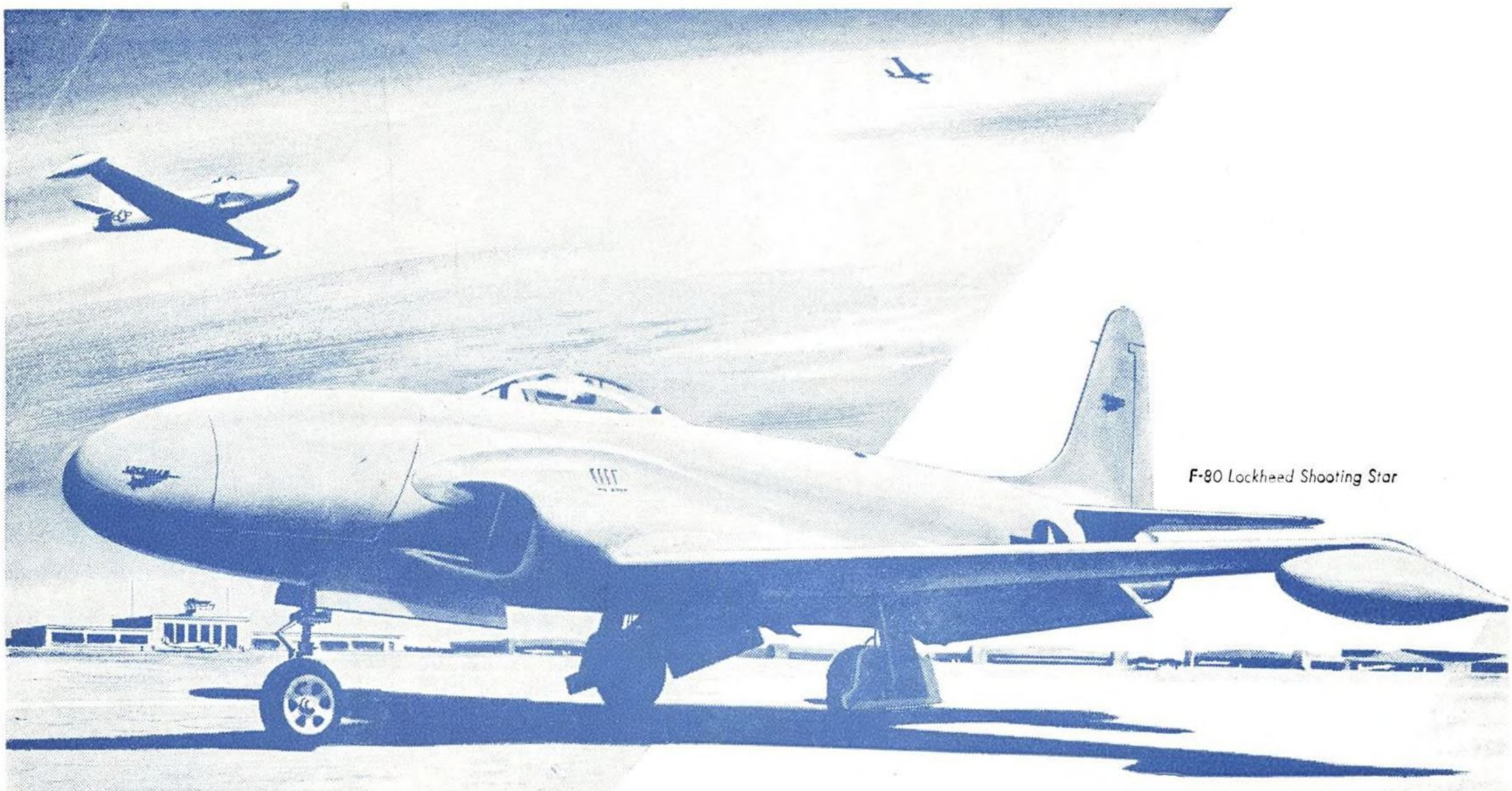
Now, Northwest's Croil Hunter tells the Johnson committee of the Senate: "It is my opinion the present passenger fares of the airlines have put them out of the mass travel market. Before the war our average passenger fare was slightly under 4½ cents per passenger mile. I believe passenger fares at this level would increase air travel immediately to such an extent that profitable load factors would be attained on all modern equipment—in fact, on all equipment presently being flown by the airlines, except the DC-3."

Hunter says further: "There is no reason why the airlines should not provide several classes of service with different fare levels. Present records indicate that there is a travel market sufficiently large to support a reasonable number of luxury flights on non-stop and limited schedules with modern pressurized fast equipment. . . . The lower coach rate will attract new business that otherwise may not travel at all or that which will be taken from automobiles, buses, and cheaper train service. In the last year fares have been increased at a time when the public was becoming very cost-conscious and the chart of the volume of passenger traffic shows clearly that when fare increases were put into effect, the volume of air travel started to go down."

Meanwhile, as sentiment grows within the industry, CAB turns down or delays new coach fare applications, fearful of a runaway competitive situation.

Some temporary caution is justified, and for a time it may be necessary to prohibit coach service with the most modern aircraft. But air so far has been the only means of transportation that has forced the public to travel in luxury or not at all. It is only a matter of time until the masses will demand a good service at second class fares, and the airlines and CAB must bow to it. Someday, just as on the railroads today, luxury schedules will be in the minority. But before that happens some segments of the industry will have to slice the fat out of their indirect costs or give up the ghost completely to smarter competitors.

ROBERT H. WOOD



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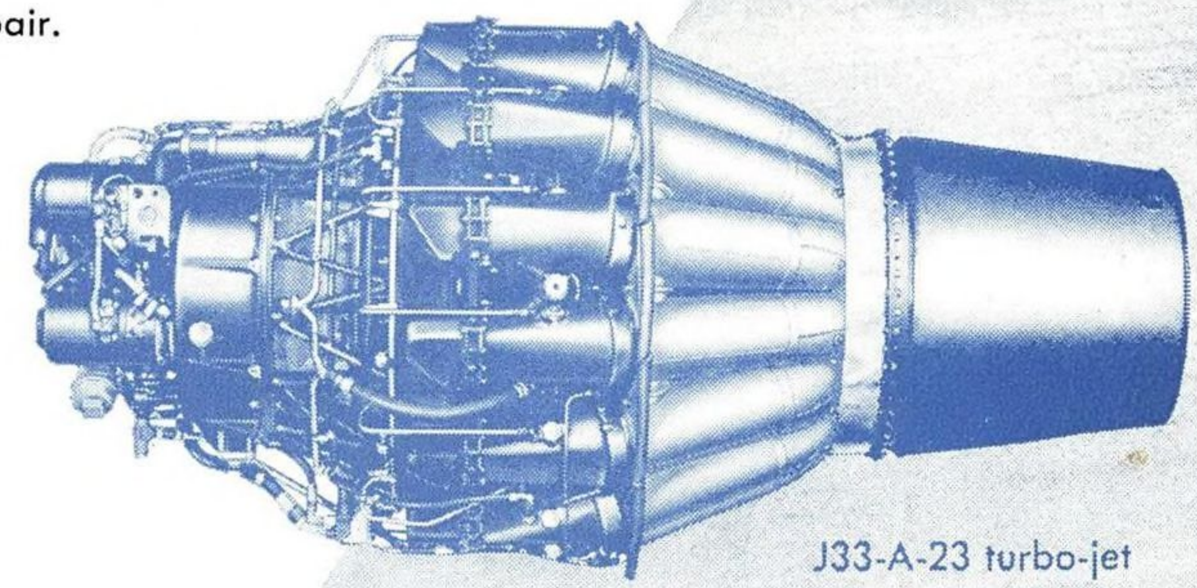

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