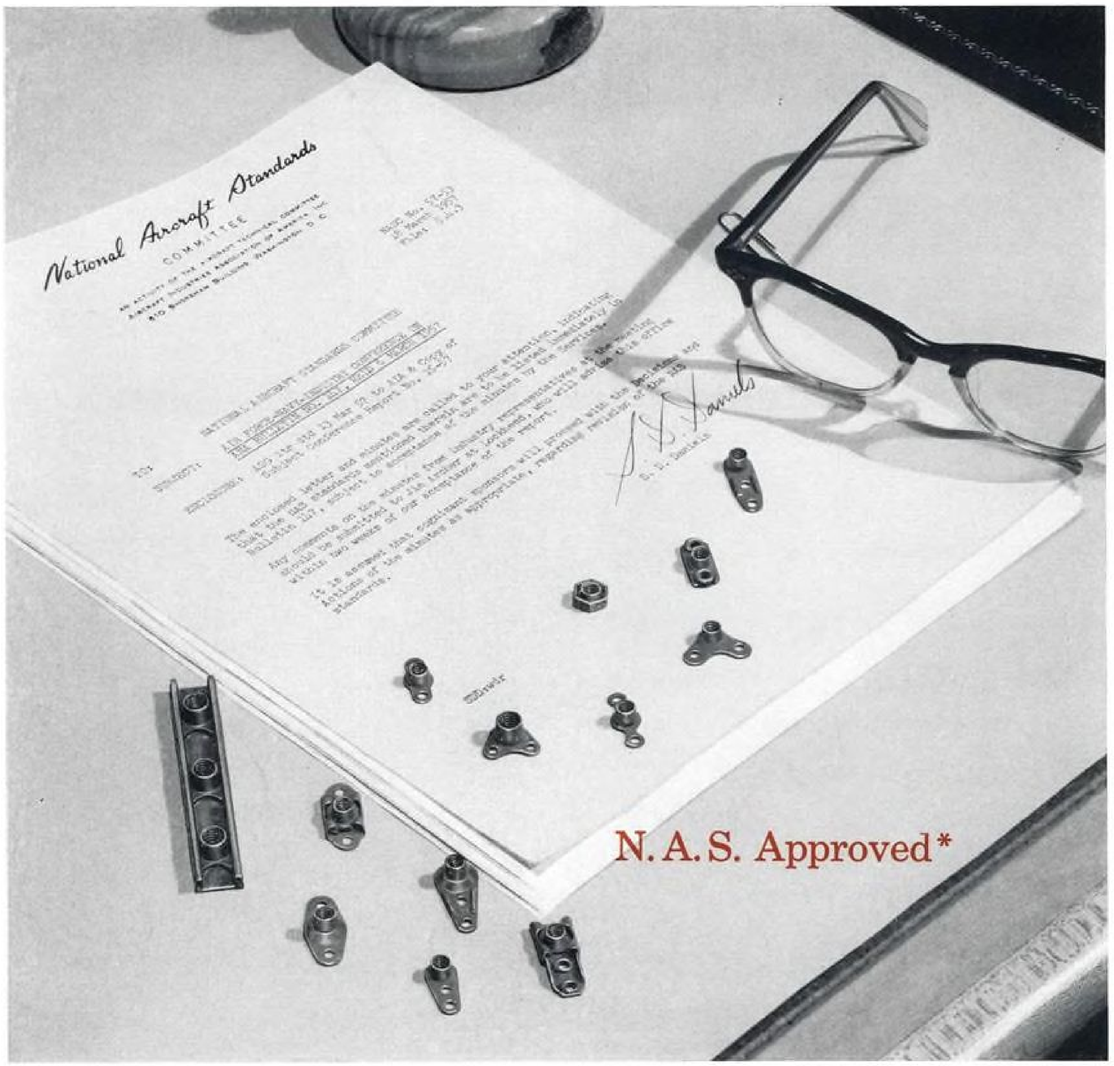
AVIATION WEEK
A McGRAW-HILL PUBLICATION

June 24, 1957 50 cents

USAF Will Switch Drives in B-52 to Hydraulic System

Chance Vought Regulus II Missile

Bluntness Shows Aerodynamic Virtues



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Trade Mark

For more information write The Kaynar Company, Kaylock Division. Box 2001, Terminal Annex, Los Angeles 54, California ©1957

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AVIATION CALENDAR

June 24-28—American Institute of Electrical Engineers, summer general meeting Sheraton Mt. Royal Hotel, Montreal, Canada.

June 27-29—13th Annual Meeting, Institute of Navigation, Sheraton-Park Hotel, Washington, D. C.

July 2-11—24th National Soaring Contest, Harris Hill, Elmira, N. Y.

July 6-10—Eleventh All-Women Transcontinental Air Race, from San Mateo County Airport, Carlos, Calif., to North Philadelphia Airport, Pa.

July 12-13—British Lockheed International Aerobatic Competition, the National Air Races (third round) and the King's Cup Air Race, Coventry Civil Aerodrome, Baginton, England.

July 28—Third Annual Jaycee Air Fair, sponsored by Portland (Oregon) and Junior Chamber of Commerce, Portland International Airport.

July 31-Aug. 4—Eleventh Annual National Convention, Air Force Assn., and Airpower Panorama, Sheraton-Park and Shoreham Hotels, Washington, D. C.

Aug. 1-2—Second Annual Exiborama and First Annual National Photo Instrumentation Symposium, Society of Photographic Instrumentation Engineers, Ambassador Hotel, Los Angeles.

Aug. 5-10—National Naval Aviation Meeting, Institute of Aeronautical Sciences, U. S. Grant Hotel, San Diego, Calif.

Aug. 10-11—Midget Airplane Races, Oshkosh, Wis.

Aug. 20-22—Bendix-Scintilla International Ignition Conference, Sidney, N. Y.

Aug. 20-23—Western Electronic Show & Convention, Cow Palace, San Francisco.

Aug. 26-28—Gas Dynamics Symposium, Transport Properties in Gases at High Temperatures and Pressures, Technological Institute, Northwestern University, Evanston, Ill.

Aug. 31-Sept. 1—Midget Airplane Races, Ft. Wayne, Ind.

(Continued on page 6)

AVIATION WEEK • JUNE 24, 1957

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AVIATION CALENDAR

(*Continued from page 5*)

Sept. 1-15—Sixth International Aeronautical Conference, Royal Aeronautical Society and Institute of the Aeronautical Sciences, Folkstone and London, England.

Sept. 2-8—1957 Flying Display, Society of British Aircraft Constructors, Farnborough, England.

Sept. 3-4—11th General Assembly, International Union of Geodesy and Geophysics, in conjunction with International Geophysical Year, University of Toronto, Canada.

Sept. 9—13th Annual General Meeting, International Air Transport Assn., Madrid, Spain.

Sept. 9-13—Twelfth Annual Instrument-Automation Conference & Exhibit, Cleveland Auditorium, Cleveland, Ohio.

Sept. 13—Third Pacific Area National Meeting, American Society for Testing Materials, Sheraton-Palace Hotel, San Francisco, Calif.

Sept. 15—1957 Garden Party and Flying Display, Royal Aeronautical Society, Wisley Aerodrome, Weybridge, Surrey, England.

Sept. 26-27—Fifth Michigan Aeronautics Conference, jointly sponsored by University of Michigan Transportation Institute, Western Michigan University, and The Aero Club of Michigan, Alpena, Mich.

Oct. 1-5—National Aeronautic Meeting, Aircraft Production Forum & Aircraft Engineering Display, Hotel Ambassador, Los Angeles.

Oct. 2-4—Tenth Annual Meeting and Forum, National Business Aircraft Assn., Cosmopolitan Hotel, Denver, Colo.

Oct. 7-9—13th Annual National Electronics Conference, Chicago, Ill.

Oct. 7-10—Triennial Inspection, Lewis Flight Propulsion Laboratory, Cleveland.

Oct. 7-12—Eighth Annual Congress, International Astronautical Federation, Barcelona, Spain. For details write: IAF, 35 Lowell Rd., Concord, Mass.

Oct. 9-11—National Fall Convention, Society for Experimental Stress Analysis, El Cortes Hotel, San Diego, Calif.

Oct. 21-22—Canadian Aeronautical Institute-Institute of the Aeronautical Sciences Meeting, Montreal, Canada.

Oct. 21-23—Conference on new developments in the field of power, American Society of Mechanical Engineers, Americus Hotel, Allentown, Pa.

Oct. 24-25—Fourteenth Annual Display, Aircraft Electrical Equipment, Aircraft Electrical Society, Pan Pacific Auditorium, Los Angeles, Calif.

Oct. 28-29—Third Annual Meeting, Association of the U. S. Army, Sheraton-Park Hotel, Washington, D. C.

Oct. 28-30—Annual East Coast Conference on Aeronautical and Navigational Electronics, Fifth Regiment Armory, Baltimore, Md.

Oct. 28-31—National Industrial Packaging & Handling Exposition, Atlantic City Convention Hall, N. J.

Nov. 5-7—Joint Military-Industry Guided Missile Reliability Symposium (limited to those with Secret security clearance), Naval Air Missile Test Center, Pt. Mugu, Calif.

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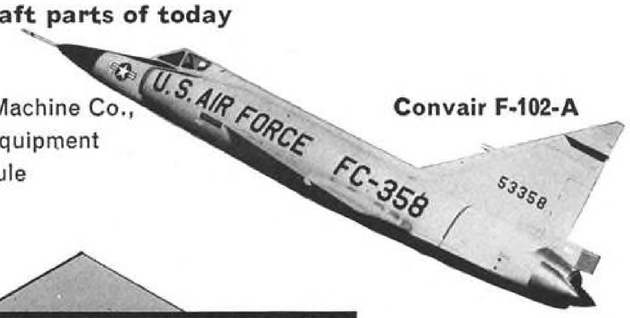

Convair F-102-A

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West Coast Division
Aircraft Parts
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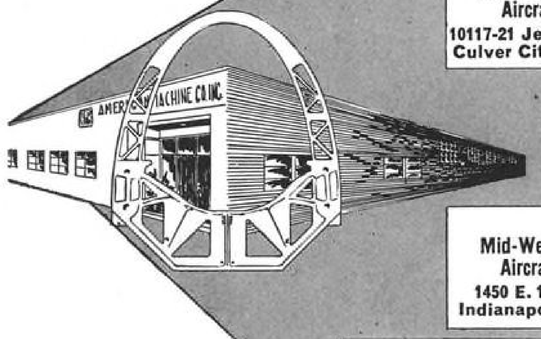
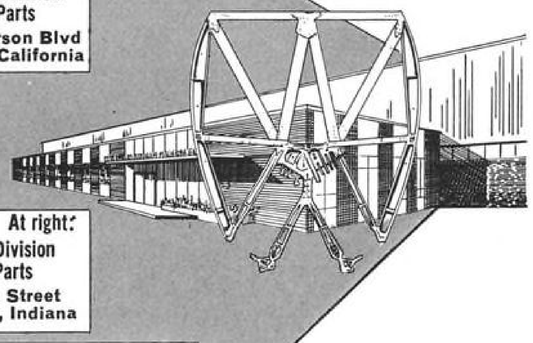
Culver City, California

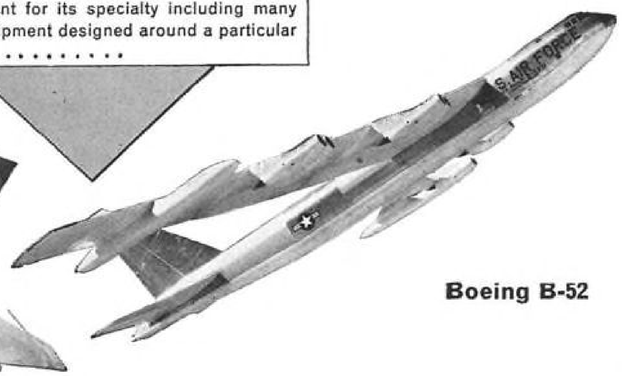




At right:
Mid-West Division
Aircraft Parts
1450 E. 19th Street
Indianapolis, Indiana

Illustrated above are typical structural machined aircraft parts and assemblies currently being manufactured in the two divisions. The aircraft divisions operate under Air Force approved Quality Control systems. Each division possesses the most up-to-date equipment for its specialty including many pieces of equipment designed around a particular part. . . . . .

Convair B-58



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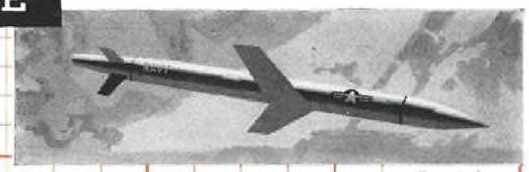

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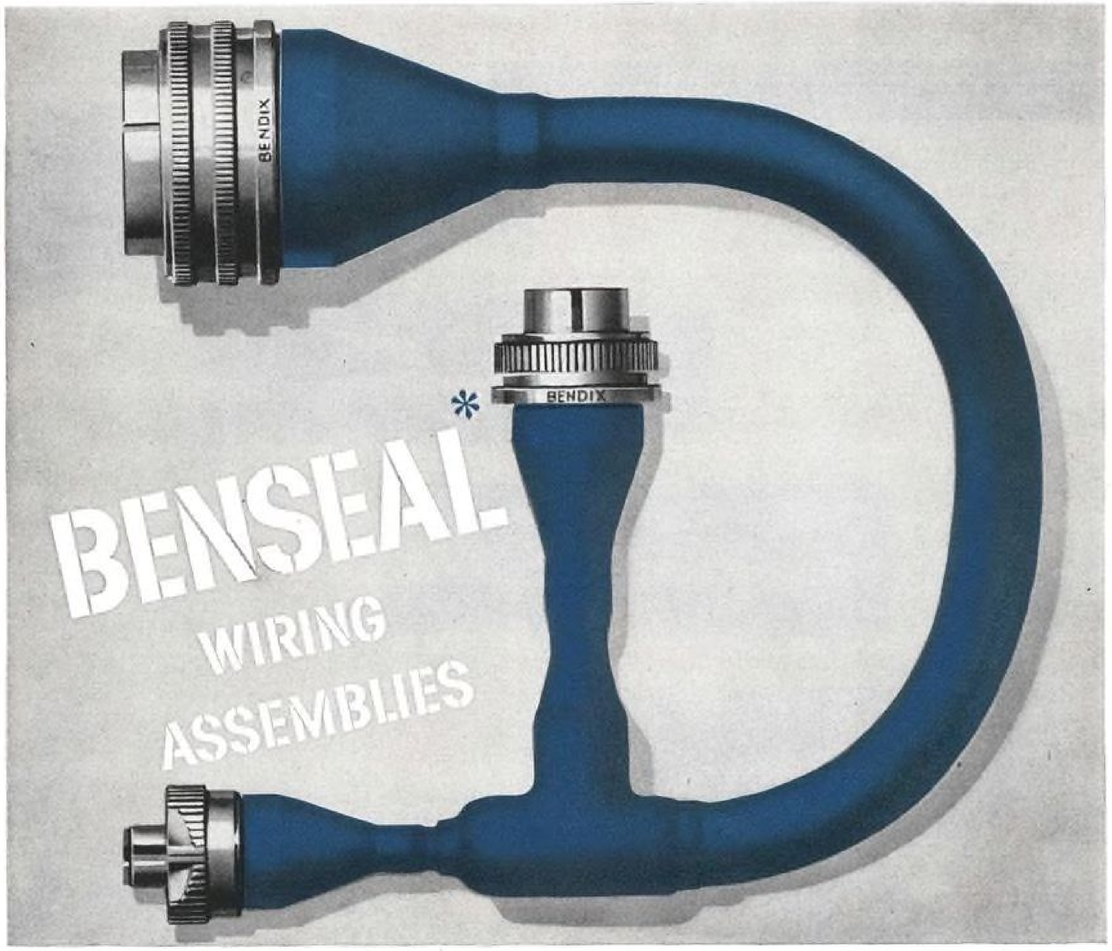

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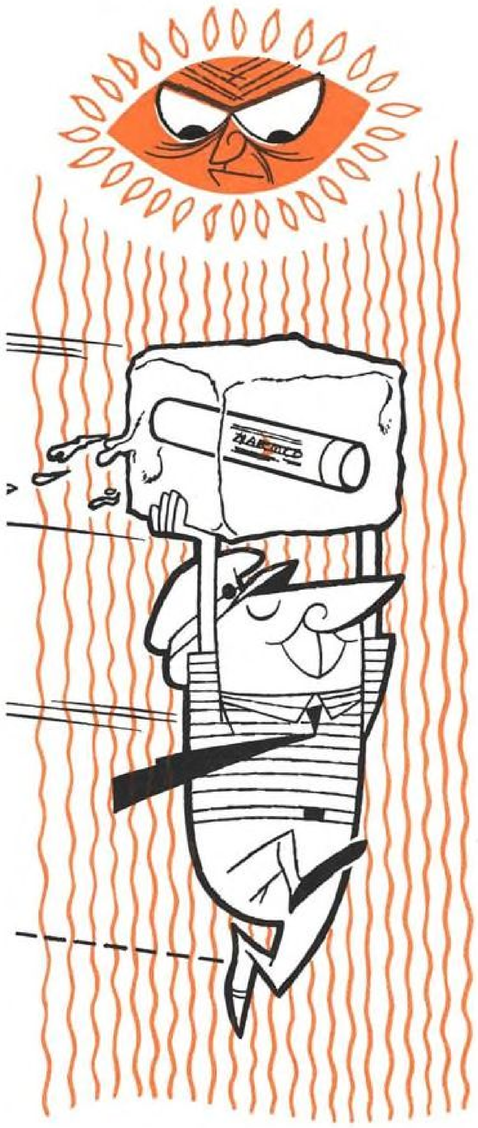

From Narmco's shipping department to your manufacturing facility, "Metlbond" structural adhesives and "Conolon" laminating materials are given every packaging and special handling protection. All Narmco products leave our Costa Mesa, California plants under scientifically-controlled conditions insuring Peak Delivered Quality.* This practice is consistent with Narmco's dominating philosophy of complete customer cooperation *from production line to flight line.*

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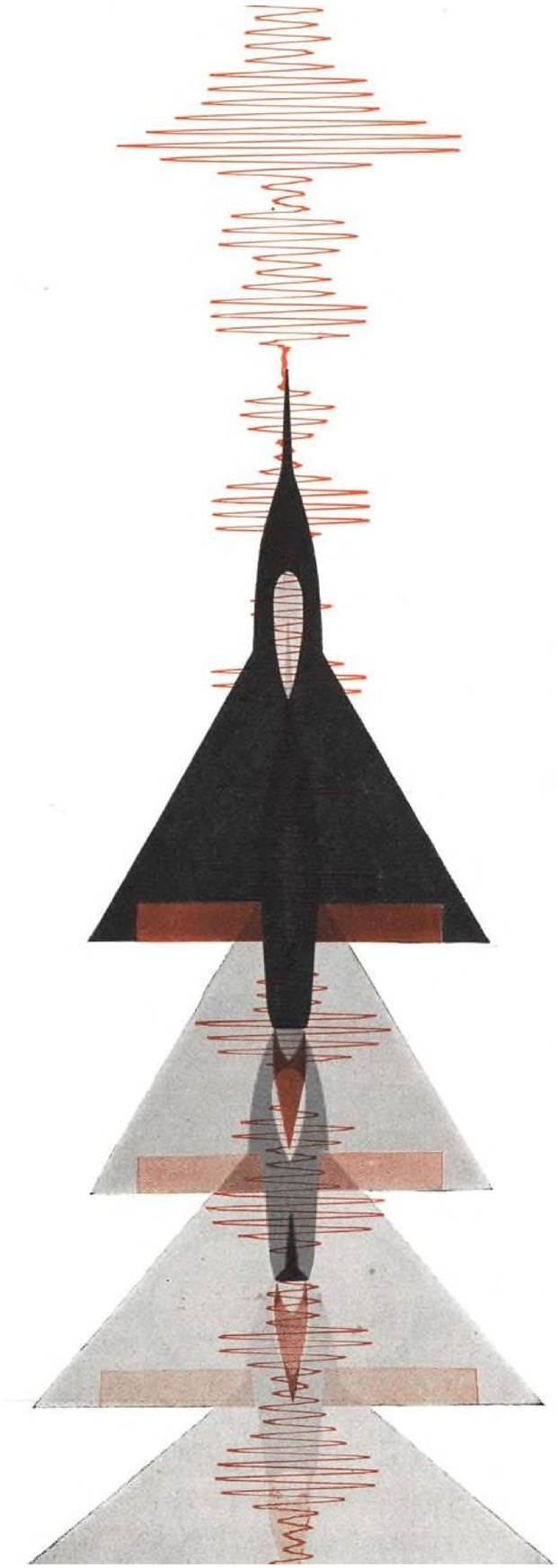

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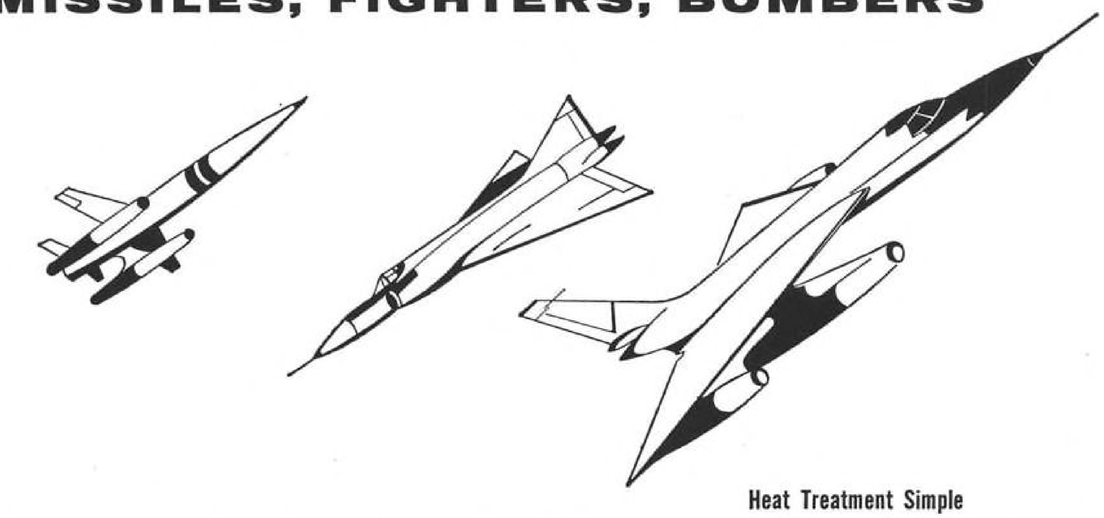

Designers specify forgings made of special Armco Stainless Steel for critical parts of airframes, power units, accessories.

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Elongation, % in 2″	12	10
Hardness, Brinell	420	330
Compression		
0.2% Yield, psi	178,000	——

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Armco 17-4 PH is readily forged by any of the standard methods. Heat treatment is simple. The high strength of 17-4 PH is fully developed by merely solution-treating at 1875 to 1925 F for ½ hour, then hardening at only 900 F for 1 hour.

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June 24, 1957

AVIATION WEEK

Vol. 66, No. 25

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COVER: Chance Vought Regulus II is fueled early in the morning on the baked mud surface of the Muroc Dry Lake, Calif. Elevation of sun casts a thin shadow from the canard control surface of the missile. Now powered by the Curtiss-Wright J65 turbojet, Regulus II later will be equipped with the General Electric J79. Landing gear enables vehicle to be recovered and reused.

Picture Credits
32, 33, 119—Wide World; 53—Howard Levy; 72, 73, 75—Russell Melcher.

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AVIATION WEEK • June 24, 1957 • Vol. 66, No. 25
Member of ABP and ABC

EDITORIAL

Courage to Face the Future

Last week we shared a delightful evening with several hundred members of the Institute of the Aeronautical Sciences in Los Angeles listening to the personal reminiscing of three titans of the aircraft industry—Donald Douglas, J. H. "Dutch" Kindelberger and Robert Gross. They were speaking as representatives of an industry that now employs 235,000 people in the Los Angeles area alone and has a weekly payroll there of $25 million.

But their tales were of the lean and hungry days when the aircraft industry first took root in the then smogless Los Angeles climate. The courage, determination and ingenuity of these pioneers in creating a new industry based on a new and then hardly acceptable technology should be a great source of inspiration for the younger generation of engineers and managers who are now the shock troops of the largest single manufacturing industry in this country.

Aviation Fever

There was Donald Douglas telling of how he was bitten so badly by the aviation bug that he left the Naval Academy at Annapolis to pursue this infant technology at the Massachusetts Institute of Technology in the classrooms of Dr. Jerome C. Hunsaker. Spending a graduate year operating the first academic wind tunnel in this country at MIT, he went on to become chief engineer for Glenn L. Martin and then struck out for himself in Santa Monica with capital of $600 to found the giant industrial enterprise that now has plants as well in El Segundo, Long Beach and Tulsa. In addition to its military contributions in aircraft and missiles, the Douglas name is the hallmark for superb transport aircraft.

There were friendly rude remarks about the first Douglas military product, the O-2 observation plane, by "Dutch" Kindelberger, who was then chief engineer for Douglas, and Ira Eaker, who as an Air Corps lieutenant made the first delivery flight of this aircraft. It had an uncontrollable desire to spin without any ability to recover from the maneuver. Eaker recalled how the Air Corps solved this problem simply by screwing a placard to the instrument panel saying, "This aircraft will not be spun." And "Dutch" Kindelberger recalled his engineering fix of placing a 400-lb. casting in the rear of the fuselage so that the pilot could jettison the casting with a bomb shackle release if he had stability trouble.

When "Dutch" came west to join the Douglas Company he could pack all of the existing technical literature on the state of the art in two condensed milk can cartons. He brought his family to California in a Model T Ford, camping out along the trail in a tent of his own design and construction. Ira Eaker, who was moderator for the panel, recalled that this was the only Kindelberger design that never went into mass production.

Bob Gross told of how he strayed from the banking business into the Varney Air Transport Co. that flew the sleek designs of the Loughead brothers up and down the West Coast, making friends and losing money. Gross chuckled at the impulse, then considered sheer insanity, that prompted him to buy the assets of the bankrupt Loughead company for $50,000 in the Los Angeles County Courthouse. And he noted that, in an era when mass engineering effort is the fashion, it was an extremely small group of Lockheed engineers led by "Kelly" Johnson that created the first Lockheed jet fighter—the P-80—in just 150 days.

There were tales of the tribulations encountered by managers in the accordion squeeze cycles of aircraft financing and military policy that called for more than the average managerial ingenuity. Typical was "Dutch" Kindelberger's recollection of VJ day when he found himself with 60,000 employes on his payroll and only 24 aircraft to build after cancellation of orders for 8,000 planes in 24 hours. Out of these ashes the phoenix of the post-war industry grew to new peaks of employment and profits and an increase of infinite magnitude as avionics, nuclear energy, missiles and hypersonic speeds entered its technical spectrum.

These pioneers who weathered so many technical, financial and political storms during the past quarter century knew they were speaking at the very time their industry is facing another major political-financial crisis. The details of this impending fiscal policy squeeze that threatens to cut the guts out of the nation's airpower program have been reported in detail in AVIATION WEEK in the preceding three issues. Some of the speakers and their listeners knew they would soon be on a Douglas or Lockheed transport winging east for a decisive showdown meeting in the Pentagon with Defense Department officials on just what the immediate future holds.

Crisis Is Real

There is no question but what the impending crisis is genuine. At this writing it appears that the aircraft industry will have to take some lumps as a result of a governmental fiscal policy of dubious value and wisdom. There is also no question that the aircraft industry will continue as a vital part of the nation's economic and military strength despite any temporary problems posed by bungling government fiscal policies.

Inevitably and properly there will be a weeding out of the weaker members of this industrial complex and only the technically sound and managerially efficient organizations will survive. As "Dutch" Kindelberger told his audience:

"It is better to have a few mighty oaks than a forest of weak saplings."

In this time of crisis it was interesting and significant for the younger generation of engineers and managers to see and hear these three successful veterans of the feast and famine cycles of the past 25 years, each of whom founded and led his own organization to steady growth and current prosperity. They offered a good exhibit of the qualities required for survival and growth in this technically exciting industry. The new generation can profit well in courageously facing the future.

—Robert Hotz

WHO'S WHERE

In the Front Office

John A. Robertshaw, board chairman, Robertshaw-Fulton Controls Co., New York, N. Y. **Thomas T. Arden** succeeds Mr. Robertshaw as president.

Robert M. Briney, president, Haynes Stellite Co., Division of Union Carbide Corp., New York, N. Y.

Harold A. Goldsmith, president, and **Herbert Herz,** executive vice president, Magnetic Amplifiers, Inc., New York, N. Y.

L. L. Waite, vice president-engineering and planning, North American Aviation, Inc., Los Angeles, Calif.

James C. Mabe, a vice president-manufacturing and engineering operations, Chicago Pneumatic Tool Co., New York, N. Y.

Dr. Myles L. Mace, management committee chairman, Litton Industries, Inc., Beverly Hills, Calif. **George Friedl, Jr.,** succeeds Dr. Mace as general manager of the Electronic Equipments Division. Dr. Mace and Mr. Friedl are company vice presidents.

Peter J. Wacks, assistant to the president for industrial relations, Bell Aircraft Corp., Buffalo, N. Y. Also: **Dr. Everett T. Welmers,** director of the Lawrence D. Bell Research Center.

Edward Foodim, assistant to the president, Consolidated Avionics Corp., Westbury, N. Y. **Ira L. Kasindorf** succeeds Mr. Foodim as chief engineer.

Richard W. Gilbert, assistant to the president, Alaska Airlines, Inc.

N. Blair Core, administrative assistant to the executive vice president, Trecker Aircraft Corp., division of Kearney & Trecker Corp., Milwaukee, Wisc. Also: **A. F. Balaban,** advertising and merchandising manager.

W. M. Hylton, assistant to the vice president and general manager, Rheem Aircraft Division, Rheem Mfg. Co., Downey, Calif.

Honors and Elections

Frank Pace, Jr., president of General Dynamics Corp., has been elected board chairman and president of the American Council on NATO, Inc., New York, N. Y. Mr. Pace succeeds Robert B. Anderson, now Secretary of the Treasury.

Vice Adm. Charles E. Rosendahl (USN, ret.), executive director of The National Air Transport Coordinating Committee, has been elected president of The Wings Club, Inc., New York, N. Y.

Miss Mary O'Connor, senior stewardess of United Air Lines, Inc., has received the Amelia Earhart Award from the American Women's Assn.

Changes

Glenn C. Bach, chief production test pilot, Republic Aviation Corp., Farmingdale, N. Y.

Donald G. Richards, chief-technical staff, and **Walter C. Shaw,** chief-preliminary design, Hamilton Standard, Division of United Aircraft Corp., Windsor Locks, Conn.

Herbert Meyer, chief engineer, Sperry Utah Engineering Laboratory (Salt Lake City), Sperry Rand Corp., New York, N. Y.

INDUSTRY OBSERVER

► New approach toward pressure drag reduction is scheduled for use on a new sweptwing attack aircraft. Sizable bump located on the fuselage forces high energy air over the aft portion of the wing. Drag of the bump is much less than the drag savings realized by creating positive pressures over the inboard trailing sections of the wing.

► **Cold-formable, high-strength titanium alloys—180,000 psi. at room temperature, 130,000 psi. at 800 deg. F.—are being sent to Boeing and North American in pilot lots for preliminary evaluation. Suppliers are Titanium Metals Corp. of America, Rem-Cru and Mallory-Sharon. Cold-forming will eliminate airframe manufacturing difficulties now involved in hot-forming titanium alloy structural parts.**

► Study of thermal stresses by use of photoelastic techniques is being conducted by New York University's Engineering Research Division under USAF contract. Plastic with one surface cooled by dry ice gives fringe patterns indicating how metals might react under sudden or prolonged application of heat. Projected for study are complex cemented plastic wing structures.

► **Engineering drawings are completed and parts for a prototype are being fabricated on North American Aviation's six place, jet-powered crew readiness trainer, which is also being projected as an executive transport. Full-scale fuselage mockup was recently shown to Air Force personnel. Plane is scheduled to be powered by General Electric's J85 now in the late development stage.**

► Lycoming is working on a twin T53 or T55 turboprop installation whereby two engines would be podded together to drive a single propeller. On takeoff, both engines would be used to provide maximum power; one engine would be cut off for cruise. In case of cruise engine failure, the alternate engine could drive the propeller.

► **Army interest in McDonnell XV-1 convertiplane is waning; the project probably will close down at the expiration of the present research contract. Insufficient power provides marginal performance in high temperature. In at least one demonstration, pusher propeller had been removed to reduce weight.**

► Navy is studying early warning possibility of Douglas' proposed 1906 turboprop STOL originally designed as a utility assault transport for aerial resupply of carrier task forces (AW April 1, p. 29).

► **Several aircraft manufacturers not now heavily engaged in avionics activities are considering the possibility of mergers with medium-size avionics manufacturers in order to increase their opportunities of obtaining future weapon system contracts. Likely candidates include firms whose radio-TV business is lagging.**

► Human engineering is being emphasized in design, logistics and operation of Thor intermediate range ballistic missile by Douglas and in Polaris IRBM by Special Projects Office of Navy's Bureau of Ordnance. Feeling is that human factor is still the prime consideration in continuing development leading to almost completely automatic missile system functions and associated equipment during readying and launching phases.

► **Design proposals for an advanced interceptor and at least two types of ground-to-air missiles have been completed by West German aircraft industry teams. Proposals are now before government agencies for necessary funding, with service dates for the weapons scheduled for the mid 1960s.**

► Messerschmitt A. G., of Munich, may build the Dassault Mirage interceptor under license from Dassault.

Washington Roundup

'We Know Not Where'

Look for pressure to end the Pentagon's ostrich-like policy of trying to ignore ballistic missile firings from Patrick AFB, Fla., even when they exploded in full view of hundreds of observers.

Current guideline is a memorandum from Assistant Secretary for Public Affairs Murray Snyder which says that Patrick's commander can confirm only observable firings, and that in the case of explosions, he is authorized to disclose whether there were any injuries.

Pentagon sources paraphrase the Snyder memo this way:

"We shot a missile into the air. It fell to earth we know not where."

Air Force—arguing that unclassifiable events should not be classified and worried about Army's aggressive sales campaign for its Jupiter IRBM versus bad publicity Air Force has received—will urge Defense Secretary Charles Wilson to relax restrictions and allow it to brief the press thoroughly on USAF missile programs.

USAF may urge that the press be allowed to visit Patrick and witness a firing.

House Government Information Subcommittee also will look into Pentagon's unrealistic policy on Patrick firings.

Censored

In another move, Information Subcommittee will probe Defense Department's censorship of speeches by top service brass—more often for policy reasons than for security.

The Subcommittee, headed by Rep. John E. Moss (D.-Calif.), will charge that in one year, Defense censored:

• **Sixteen speeches** by Army Secretary Wilber Brucker and five by Army Chief of Staff Maxwell Taylor. Army was told to make certain changes or scrap the speeches entirely. Bulk of the changes had nothing to do with security.

• **Thirteen speeches** by Chief of Naval Operations—all of them for policy reasons, either Defense Department or international policy.

Charges made last November by the Coolidge Committee on Classified Information that services sometimes "leak" information to the press also will be scrutinized.

One Coolidge Committee example was a list of ICBM contractors that appeared in Wall Street Journal. Subcommittee will show that contractors actually had been named earlier in a speech cleared by Defense and delivered by an Air Force general at an Air Force Assn. convention.

Nuclear Aircraft 'Down'

The Administration's up-and-down program for development of a nuclear-powered aircraft is again in a "down" period. The Research and Development Subcommittee of the Joint Congressional Atomic Energy Committee is holding hearings to find out why.

In March, Rep. Carl Durham (D.-N. C.), chairman of the committee, and Rep. Mel Price (D.-Ill.), criticized the Defense Department for "administrative confusion and indecision" on the project (AW Mar. 11, p. 30). In April, Durham and Price welcomed a report by Deputy Secretary of Defense Donald Quarles, then USAF Secretary, that the project had been put "on a definite timetable" and given a high priority (AW Apr. 22 p. 29).

Last week, however, Price told AVIATION WEEK that "we are once again in another period of delay. The project has not been given sufficient priority—and of course money is involved."

Airways Bill Outlook

Fast Senate action on the Airways Modernization Act of 1957 is expected with a better than 50-50 chance that the bill will pass the upper house without undergoing any major modifications. Senate Commerce Committee unanimously approved the bill with several amendments which members of the Aviation Facilities Planning Group say serve to "strengthen" the act. Principal amendment calls for establishment of a permanent Federal Aviation Agency to be presented to Congress by January 15, 1959. Edward Curtis, retiring head of the Planning Group (AW June 17, p. 25), had set a 1960 target date for the organization of the permanent agency.

The committee also added a new section to the bill requiring coordination between the Airways Modernization Board and both the Civil Aeronautics Board and Federal Communications Commission before any system is selected. Favorable House action is also expected despite some antagonism toward the bill by several House Commerce Committee members.

Gentle Cut For NACA

Congress is cutting the National Advisory Committee for Aeronautics Fiscal 1958 budget with a gentle knife. House has approved $105 million; the Senate $106 million. NACA requested $118 million (AW Jan. 21 p. 28). However, the program will be substantially higher than the $77 million budgeted for Fiscal 1957. The $1 million difference between House and Senate amounts is up for decision by a conference group composed of members of both houses. Also up for decision in the conference: Whether NACA can contract with universities and other institutions for research? The House banned this authority. The Senate agreed to continue it.

Security Review Revision

Watch for announcement to industry that Air Force has revised its security review procedures in an attempt to have a stronger voice in what contractor information may be released to public.

Until now, Army and Navy have reviewed manufacturers' proposed press releases for both security and service policy before submitting them to Defense Department's Office of Security Review.

Air Force, however, has used only its personnel who were assigned to Defense Department's Office of Security Review. Although they were Air Force Officers, they worked under, were paid by and were rated for efficiency by civilian chiefs of the Office of Security Review.

This led to charges by Air Force contractors and USAF itself that Defense was too strict on release of information. Conversely, Defense often charged that USAF officers on loan to it were acting more in USAF's interest than in Defense Department's.

Within 60 days Air Force will establish a separate security review office under its chief of public information, following the Army-Navy pattern.

—Washington Staff

USAF Prepares Industry for Cutbacks

Financial squeeze, missile transition accelerates attrition rate; engine firms to be hardest hit.

Washington—Death of some aircraft firms and closing down of facilities at many others will result from a combination of factors that already have led to contract deferrals and soon will lead to further stretchouts and some contract terminations.

Although the slowing down process will be made as gradual as possible, current financial problems facing the administration and the services already have accelerated the attrition rate and are certain to hasten the death of some manufacturers.

Contributing Factors

Among the contributing factors:

• **Money.** This is the most immediate problem and also a large factor in the long-range picture. The Administration does not have enough of it in the Treasury to let the Defense Department continue spending at its current rate, balance the budget and build the Treasury surplus toward a hoped-for tax cut all at the same time. Because costs are continuing to rise and the administration-imposed ceiling on spending is likely to stay at or near the same figure through Fiscal 1958 and '59, the only answer is to reduce the military program. As Defense Secretary Charles E. Wilson put it, "I haven't got any elastic dollars." In addition to these money problems, there is the possibility that Congress will cut the budget still further.

The possibility of future disarmament agreements also would reduce defense spending.

• **Transition.** Shift from manned aircraft to a mixture of manned aircraft and missiles already has changed the face of industry and will do so far more rapidly in the next few years. This would have been true to some extent even without ceilings on spending, but the transition might have been made slowly enough so that almost every firm could make the necessary adjustments.

Making the transition under budgets that are fixed at almost the same level year after year, however, accelerates the pace at which airframe and engine companies must adjust—and there is a widespread feeling among industry and military observers that not every company can survive.

Engines Hardest Hit

Bleakest outlook seems to be for the engine manufacturers and airframe firms not heavy in missiles. Air Force planners estimate that spending for engines will drop by 40% within next four years. Aircraft spending will decline about 50% over the same period.

At the same time, however, avionics and missile spending will double. Guided missile spending will jump from the $1.2 billion USAF is asking in Fiscal 1958 to roughly $2.2 billion over the next four years.

Spending for avionics equipment—largely ground based—is expected to go from $750,000,000 to $1.5 billion during the period. This does not include spending for avionics in missile systems, which accounts for approximately 50% of the missile's cost.

Pentagon Briefs Industry

A blunt warning of things to come was given to more than 100 top industry executives from 58 airframe, missile, engine and avionic firms and trade associations late last week at a Pentagon briefing.

The briefing was the first of a series of planned meetings with industry to explain what one USAF official described as the "tough situation" facing both the Air Force and its contractors. Another USAF spokesman said the meeting will "separate the men from the boys" in industry.

At the close of the four-hour briefing, missile and avionic executives who had attended seemed relatively unconcerned; the airframe and engine representatives obviously were.

A battery of USAF officials conducting the briefing included Air Force Secretary James H. Douglas, Assistant Secretary for Materiel Dudley C. Sharp; Gen. Thomas White, incoming chief of staff; Lt. Gen. Clarence S. Irvine, deputy chief of staff for materiel; Gen. E. W. Rawlings, commander of the Air Materiel Command; Maj. Gen. David H. Baker, AMC director of procurement and production, and Brig. Gen. H. M. Estes, Jr., director of systems management for the Air Research and Development Command. Secretary Sharp told the industry leaders:

"We are having to take drastic action to control and reduce the rate of our expenditures without reducing our capability to deter war or to defend the U.S." This, Sharp said, will place a challenging task upon USAF's prime and associate contractors. "They will have to produce improved hardware at less cost."

Among changes to come, Sharp said:

• **Many present facilities will not** be needed in the future.

• **Shifts in personnel employment** and perhaps an overall personnel reduction by industry are necessary. The time for such changes is becoming increasingly close, Sharp said.

Industry Musts

In meeting the future, Sharp asked industry's cooperation in affecting these specific steps:

• **Engineering departments must be** more realistically employed, streamlined and reduced.

• **Overtime costs must be reduced** still further in spite of much feeling to the contrary. USAF already has placed severe restrictions on industry use of overtime (AW May 6, p. 29).

• **Subcontracting practices** must be improved.

• **Much higher degree** of standardization must be obtained, not only to reduce costs but to alleviate logistic problems in the field.

• **Industry must keep in mind** that simplicity of design, as well as standardization, will reduce the critical technical manpower problem.

Secretary Sharp also warned that "these are only a few of the things which have come to my attention recently. They indicate the kind of action you must take if we are to obtain the greatest possible procurement within our available resources."

Air Force Secretary Douglas flatly told the industry group that "we have been in a period in which we could do almost everything in development and procurement that was desirable. In the future, we must be more highly selective in the pursuit of our development and production program.

"We are now at a point where we must exercise a great deal of ingenuity in order to continue certain essential programs at a relatively lower rate without unit costs being unacceptably high."

Douglas said the current problem is centered around the expanding missile program imposed upon the modernization of manned aircraft. Increasing complexity of both systems and the resultant high costs have brought on a severe dollar pinch, he said.

The Air Force Secretary said the Air Force has been developing many different strategic systems of delivery, and some of these will have to give way when selection for production is practicable.

USAF Reduction

Earlier last week Douglas told a Senate Appropriations Subcommittee that he has submitted a plan to Defense Secretary Wilson outlining "the areas for a $1.2 billion reduction" in USAF's Fiscal '58 program.

Douglas had warned earlier (AW June 17, p. 26) that strict interpretation of administration expenditure ceilings and Wilson's directive limiting partial funding of USAF projects could cause "major disruption of USAF's programs" and the elimination of some $4 billion in procurement.

Deputy Defense Secretary Donald A. Quarles told the same Senate committee last week that Defense will not interpret the ceilings and the directive that severely.

Nevertheless, the outlook is that the holdback on USAF expenditures for Fiscal '58 will be closer to $2 billion than to the $1.2 billion involved in Douglas' latest plan.

Navy's Bureau of Aeronautics and Army also will have to effect substantial stretchouts of their programs because of the spending ceilings. BuAer already is planning for this.

Rear Admiral James S. Russell, outgoing BuAer chief (AW June 17, p. 25), told the Senate subcommittee:

"We have been confronted with steadily rising prices, not only in connection with the planned 1958 procurement program but also in the procurement we have under contract from prior year programs.

"The magnitude of these increases is such that we cannot absorb them, and we are confronted with the necessity of making program reductions to compensate for these increased costs."

Gen. Maxwell Taylor, Army Chief of Staff, told a Command and General Staff College graduating class that Army's "fixed ceiling budget of something around $9.5 billion" for Fiscal '58 and '59 "would not be unreasonable . . . if we had no expanding programs." But he said at least two major programs—continental air defense, a large part of which is missile procurement, and reserve forces—are expanding. He added that "cost of our modern weapons is mounting, prices are upward because of the general inflationary trend, and we foresee, too, the need for pay increases in order to retain our highly skilled people. All of these factors will make it very difficult to live under a fixed ceiling budget."

Working for continued ceilings and against any likelihood of a Democratic rescue of the Defense Department is the Democrats' own desire to outdo the Republican economy program and bring about a tax reduction program in 1958.

No Help From Congress

The Joint Economic Committee of the Democratic-controlled Congress, weighing the prospects for tax reduction, heard both Treasury Secretary George Humphrey and Budget Bureau Director Percival Brundage stress the difficulty of holding down expenditures.

"Department of Defense expenditures are running substantially higher than was estimated," Brundage testified. ". . . Most of the increase is in the Air Force, reflecting largely the acceleration of our ballistic missile programs and higher rates of aircraft procurement than previously anticipated. In addition, the lead time has been shortened and payments to contractors have been accelerated."

USAF's Air Materiel Command already has been adjusting some procurement contracts to stay within the ceilings the Pentagon has presented. It says that this has been done bilaterally with the contractors, and it hopes that none of the deferrals will become anything more than deferrals—but this depends upon what is available in Fiscal '58 to continue programs.

Number of Pressures

Douglas points out that a number of pressures have forced USAF to take "important steps to match our program to our resources" in the Fiscal '58 budget.

"We are vigorous in our effort to defer or eliminate projects that are not based on urgent defense requirements," in addition to cutting the active force from 137 to 128 wings and holding down B-52 and KC-135 production to 15 a month, Douglas said.

". . . The greatest pressure toward higher expenditures has been exerted by the progress of our missile development program, which has now entered the stage of extensive testing and will soon call for equipping operational units.

"The difficulty of the Air Force program is to create strategic and defense missile forces and, at the same time, modernize the manned aircraft forces. This situation is unavoidable if our combat capability is to be retained during the period required for missiles to prove their operational effectiveness. It is costly but necessary."

Warnings of the impact of this aircraft-plus-missile program already have

Engineer Shortage

Washington—Mad scramble for engineers in the aircraft and avionics industry has eased sharply as a result of uncertainties over the planned USAF stretchouts and cutbacks. Indications are growing that aircraft-avionics companies now are recruiting only for top-notch engineers and simultaneously weeding out marginal personnel now on the payroll.

Aviation Week's survey on just what lies ahead for the aviation industry was written by Military Editor Evert Clark. Material for the survey was gathered and compiled by Clark, Managing Editor Alpheus W. Jessup, Congressional Editor Katherine Johnsen and Avionics Editor Philip J. Klass.

Fiscal Policies Endanger Airpower

Delusive fiscal policies set the snares which now threaten the U.S. airpower program.

Adroit financial footwork by the Air Force encouraged by Department of Defense protected the Administration from complete revelation of the two traps set by inadequate budgeting:

• Deep cuts in the airpower and defense programs, which have been defended as being the minimum required to maintain deterrent superiority over Russia.

• Sharp increases in defense appropriations to maintain the program which was much more expensive than the Administration would admit.

Avoidance of the snares was postponed by partial financing or incremental funding and by fund juggling.

Partial financing was the procedure, ruled out by Secretary Wilson's May 21 directive (AW June 3, p. 441), for applying funds only as these could be spent in the current fiscal year. This contrasted with previous policy of funding full programs in their initial fiscal year, regardless of anticipated completion date.

Although initially reducing the money which had to be requested for each weapon program, partial financing has contributed to higher later costs.

These rising costs combined with the inadequate initial appropriations led to the fund juggling. In order to keep all of its programs going, USAF more and more turned to the device of shifting money from one program to another and back again.

Just what the effect is can be judged from the typical experience on a major weapon system. On financial grounds alone, there have been more than 20 reworkings of basic contracts and a half-dozen recalculations of follow-on quantities. Contractor's agreements with vendors and suppliers have had to be canceled, reinstated, revised throughout these renegotiations.

Two results are that the price per copy of the weapon system has increased approximately 50% and deliveries are expected months later than necessary.

How Fiscal Juggling Hit F-105

Effect of the fiscal juggling was felt on the Republic F-105 fighter-bomber program earlier this year. Until then the Air Force program had indicated procurement of approximately 600 airplanes through 1960-61.

At that point, the program was cut at least in half. Now a further cut is in prospect, and the best Republic can hope for is stretchout of the original quantity through 1963. In addition some F-105s may be purchased out of MDAP funds for NATO and other allies.

Moreover, instead of airplanes for the varied missions of Tactical Air Command, the Air Force is tailoring the F-105 to "budget size." It has asked Republic how many aircraft can be bought for so much money. The present likelihood is that only simplest day version will be bought. Out may go the all-weather, the reconnaissance and other configurations. Still being considered are a very small number of the two-seat C models.

Republic is confident that the F-105B will not be scrubbed completely. It is the only Mach 2 aircraft ready for tactical air forces. Aircraft could have been delivered to tactical units late this year if the F-105 project had not blown hot and cold for nearly three years. Republic points out that the F-105 has been developed as a complete tactical weapon system.

Contracts for 175 F-105s with expected follow-on quantities would keep Republic operating into 1961, although on a reduced basis. In addition to the F-105, Republic will complete at least one F-103. This dual powerplant aircraft is due for roll-out next spring. The additional cost of continuing the project for the Mach 3 fighter will not look large when compared with what has been put into it so far.

been sounded, not only by Douglas but by Brig. Gen. Waymond A. Davis, USAF director of procurement and production (AW June 17, p. 26) and by Maj. Gen. David H. Baker, director of procurement and production for Air Materiel Command (AW May 27, p. 26).

Curtailments in USAF programs already have been spread to cover operations, construction, research and development and manpower, as well as procurement and production.

In addition, a large part of the money spent on research and development projects comes from production funds, construction funds, etc. Overlapping of research and development and production, especially in missiles, further obscures the picture as to what is a procurement cut and what is not.

"The elimination or deferral of development projects," Douglas said, "presents us with the very delicate problem of selecting the right weapon systems and equipment for development and production.

While the services have preliminary plans for curtailing spending and already have taken some steps, all three apparently are placing some hope on a remark by Secretary Wilson at the recent conference of service secretaries at Quantico, Va.

Asked if it was fair to say that the current financial situation dictated either a program stretchout or cutbacks, Wilson replied: "A stretch out, a change in the program or a revision of the estimated expenditures, and I think that, if Congress controlled the expenditures right now, I would have a great deal of trouble to get it raised over the $38 (billion) that went into the total budget plan last January; so I personally think that we are likely to do what is necessary to keep the expenditures within the 38, but I am not sure about it, and the one man in the country that will have to answer that is the President, and I expect to get the figures and the whole thing together and have a discussion with him about it."

Meanwhile, Deputy Secretary Quarles made these clarifying points on Wilson's partial funding directive:

- **Some partial** funding for pre-production will still be allowed. This is funding for production facilities or long lead time items such as engines, ahead of the funding for the aircraft or missile which will be the lead item. In Fiscal '59, USAF will require $650 million to completely finance the $250 million pre-production orders which it plans to place in Fiscal '58. Douglas said his final stand on the new policy will hinge upon whether USAF is granted the $650 million in the 1959 budget.
- **Funding for only the amount** involved in letter contracts is ruled out. Full amount of the "definitized" contract will have to be funded before the letter contract can be dispatched to a contractor.
- **Over-programming of communications** and electronics orders, now running at 15%, is prohibited. Earlier Douglas defended this practice on the basis that some projects are delayed or do not develop, and "we find that the only way we can keep the program going with anything like the obligational authority that is given us is to program more dollars for procurement than we have dollars." He said elimination of this practice will mean a slowdown in procurement.
- **Present practice** of giving "recoupments" to the service which makes them will continue. These include savings resulting from downgrading of contract prices, reductions from canceled contracts, reimbursements from Mutual Security Program sales, etc. USAF estimates it will recoup over $1 billion in Fiscal '58 and use it to finance new contracts. BuAer estimates recoupments of $165 million.

Crippling Buying Bill Faces More Opposition

Washington—House Appropriations Committee leaders this year are expected to once again kill off proposed legislation that would severely restrict armed services' procurement policies.

The measure, which already has passed the Senate and last week received approval of the House Government Operations Committee, would require Congress to only appropriate enough funds to cover anticipated expenditures for procurement in any one year.

Industry's main concern is that, if the expenditure estimates are not correct, the military services might be left without adequate financing before the end of a fiscal year.

Navy Told to Choose Between F8U-3, F4H

Washington—Chance Vought Aircraft last week received a $35 million contract for continued development of its Mach 2 interceptor, a follow-on project to the F8U.

Current designation of the aircraft, the F8U-3 (AW Feb. 25, p. 84) may be changed. The aircraft, which will be powered by Pratt & Whitney's 15,000 lb. thrust J75 turbojet engine with afterburner, is scheduled to begin flight tests in the summer of 1958. Fleet deliveries will begin in 1960.

A Navy spokesman said the Mach 2 aircraft represents a complete redesign from Chance Vought's F8U, Navy's present front-line interceptor. However, similarities include a sweptwing located well behind the cockpit and a sharper radar nose with the airscoop located below.

The order may mean an end to McDonnell's competing F4H program. The House Appropriations Committee already has told Navy it must decide between the F4H and Chance Vought's Mach 2 entry.

Civilian Managers Grow Sour on System

Los Angeles—Pattern established in USAF's ballistic missile program wherein technical staff aid is furnished a military group by a civilian contractor will seldom, if ever, be used again, according to Dr. Dean Wooldridge of Ramo-Wooldridge Corp.

Participating as a speaker as well as moderating a panel discussion on the systems concept at the National Summer Meeting of the Institute of the Aeronautical Sciences here, Wooldridge said his opinion was based on the low financial return of purely engineering contracts in comparison with the return from the same number of man hours invested in developing a production contract item.

Concurring with the Wooldridge opinion was R. R. Hough, vice president of Bell Telephone Laboratories, which did systems engineering for DEW line much as Ramo-Wooldridge is doing for the ballistic missile program. Hough said the return to stockholders would have been greater had his company's talent been devoted to developing production items.

Also concurring was Maj. Gen. David Baker, director of procurement and production for Air Materiel Command.

Opposite View

On the opposite side of the fence was Maj. Gen. H. M. Estes, Jr., director of systems management, Wright Air Development Center, who said future concepts may find USAF without the technical knowhow in its own house, again forcing it to seek contractor help.

As an example, he pointed out that development of an overall defense system for the United States might call for the services of a systems manager.

In discussing the weapon systems concept, Gen. Estes commented that one USAF problem is getting contractors to let the weapon systems project office know immediately when a problem is encountered which may take some time and effort to solve, so that proper planning can be initiated.

Gen. Baker said USAF needs to change its procurement concepts to match the weapon systems concept. He added there is nothing in the weapon systems concept which will cause disaster to an efficient producer, but noted that in coming days there will be a reduction in the number of what are today considered prime contractors.

Regarding subcontractors, Baker said that those who specialize in airframe subcontract work face a dull future, but electronic firms who are developing new components will have better days ahead.

Coverage of the National Summer Meeting of the Institute of the Aeronautical Sciences in Los Angeles was provided by Robert Hotz, editor, and Irving Stone, Richard Sweeney and Russell Hawkes of Aviation Week's Los Angeles bureau.

One necessity under the weapon systems concept for AMC is better financial reporting, Baker said, that is better information on how fast contract money is being used up. Another facet is better reporting by the weapon system contractor of problem areas which can effect the time span of the project so that AMC can plan properly.

Baker also warned that USAF no longer can support intricate and unreliable weapon systems. They are too expensive. Instead, the weapon system contractor who provides a simple, easy-to-maintain product will get the contract.

August Esenwein, vice president of Convair and general manager of its Ft. Worth Division, where the supersonic B-58 Hustler was developed under the weapon systems concept, pointed out that the concept calls for monitoring of subcontractor progress, not dictation of how the requirements be met in detail. He said that of 2,000 engineers on the B-58 project, 40 were engaged in monitoring subcontractors.

Concerning the weapon systems work on the ballistic missile program, Wooldridge said the establishment of parallel attacks on new areas encountered in missiles were necessary, but that they called for very close management lest the national resources be overstrained. He denied that the ballistic missile program has encountered delays.

Use of Engineers

In regard to use of engineers as administrative monitors, Wooldridge declared that increasing technical complexity makes engineering talent mandatory in administering and monitoring such activity, since only such talent can make valid decisions on technical questions.

In an exchange on requirements under the weapon systems concept, Hough said he feels that a thorough systems study is needed when requirements are being set up, leading to criteria which are practical. These should be within the state of the art at the time the system becomes operational and which are realistic and logical extrapolations of the existing state of the art.

Design competitions are wasteful of men and money, he added. Free interchange of information on the latest developments is restricted, leading to a weapon system which does not possess all the latest and best technical advances since no one contractor has all the newest and best answers.

Industry is failing its obligation to help the military in systems management, Hough said, in that military programs should be run the same as commercial projects, with less elaborateness and trimming.

Replying to this, Gen. Estes said to obtain the best possible weapon without resorting to the present system, paperwork would be mountainous and time consumed to analyze all data by military decision makers would preclude any other activity at all. He believes that present system of proposals by contractors coupled with USAF use of the source selection board, plus carrying at least two approaches through Phase II development, insures the best technical product for USAF.

Poor Communications

Poor communication between government policy makers, military and industry, will continue the three- or four-year elapsed decision time in every major weapon system warned Sherwood C. Frey, director of Military Operations Research Division, and Phillip R. Carlson, Air Force Studies Dept. manager, Lockheed Aircraft Corp.

Discussing the role of industry in weapon system planning, Frey, who delivered the paper, advanced as a solution honest objective operations research studies by industry to reduce the com-

Grumman Testing Spray/Dust Biplane

New York—Prototype of a new agricultural spray/dust type biplane is being flight tested by Grumman Aircraft Engineering Corp., Bethpage, N. Y., strengthening indications that the company is seriously considering diversifying its aviation market by re-entering the business and utility airplane field.

Grumman management is expected to reach a decision soon on committing itself to this and other civil projects. In addition to the spray/dust airplane, it has been working on a twin turboprop executive transport project (AW May 27, p. 23).

An announcement of Grumman's intentions to re-enter the civilian market may be made this week, Aviation Week learned.

plexity of the problem and the number of system alternatives so that high-level representatives of industry, military and government can sit around a conference table and arrive at basic planning decisions of optimum value.

Unless such a course of action is taken, systems will continue to be produced which the enemy has rendered obsolete before they can become tactically useful, Frey declared. Nearly every manufacturer has a small operations research team engaged in some sort of study work, but these studies must have factors brought into them to reflect the problems of all three partners—industry, military and government.

Interdependence of these three agencies has not been clearly recognized. Frey declared: "Studies have indicated that some Soviet weapon systems have been developed in approximately half the time that it takes this country, and that our long delays are primarily due to our present decision process. It has only recently been recognized that the reason for a slow decision process is that all three groups are involved, and that the process of intercommunication is exceedingly slow."

In an open discussion after delivery of the paper, Frey declared he was not as much concerned with the relationship between industry and military as he was with that between industry, military and the government, adding that there wasn't an adequate mechanism to deal with the problem.

Long-range weapon systems planning is based on "state of the art, state of the mind and state of the pocketbook," commented Lt. Col. C. R. Tosti, assistant executive officer to the commander, Air Research and Development Command, USAF. He cited the B-58 as an example where state of the mind played a big part. There was no sense of urgency, "no feeling to push, push, push," he said. "You find that the state of the art overtakes you. . . . B-58 is a fine plane but probably overtaken."

In the opposite vein, referring to the Thor intermediate range ballistic missile development under pressure, he indicated that in one year it was sitting on the pad as an operational configuration.

Time element must always be kept in view, declared Capt. D. J. Welsh, assistant chief, plans and programs, Navy Bureau of Aeronautics, but "there are a lot of masters to clear with before military can make a major decision." Even the cancellation of a program is a time-consuming job, he added.

Budget Problems

Budgetary problems are tremendous, he said, and a major mistake in a program today might mean that it may never get back on its feet again.

Emphasizing another aspect of technical requirements planning, Carlos Wood, chief engineer, Douglas Aircraft Long Beach Division, declared that industry must work with the using command early, that it is too late when system requirements are already generated.

Importance of establishing equipment requirement early with the operational user was stressed by Tosti, who said that often the weapon system includes equipment which the operator does not use. "We must eliminate a lot of frills in this day and age, when we can't afford them all."

Equipment reliability aspect was interjected by Capt. Welsh, who said "we must try to avoid what has happened in the past—delivery of a plane to the fleet with its fire control not working," he said.

Jet Flap Effectiveness Doubted

Los Angeles—Boundary layer control and jet flaps have little or nothing to offer the airframe designer who must select engines for maximum cruise efficiency, an audience at the summer session of the Institute of Aeronautical Sciences here was told by William T. Hamilton, staff engineer of Boeing Airplane Co.

Hamilton's example was a typical four-engined jet transport in the Boeing 707 class. He conceded that the "exotic high lift devices" might pay off in shorter field lengths for applications where larger thrust-to-weight ratios are justifiable, but denied their usefulness to subsonic, long-range jet transports. His consideration was directed mainly at takeoff ground roll and post-takeoff climb as representative critical performance areas.

He compared four types of lift increasing devices:

- **Mechanical flaps** (plain, single-slotted and double-slotted).
- **Boundary layer** control flaps (sucking and blowing).
- **Jet augmented** external flow flaps (engine efflux deflected through flap slot.
- **Pure jet flap** all engine efflux ducted through flattened, hinged tailpipes at wing trailing edge.

For heavy takeoffs from long fields he has found no significant advantage of the three-powered flap systems over the unpowered mechanical flaps. With an 8,000 ft. ground roll there is essentially no difference in the allowable takeoff weight. Thrust loss caused by ducting of the jet is assumed to wipe out any insignificant improvement the jet flap might otherwise show. It does, however, offer an advantage in weight lifting capability for shorter takeoff runs if no allowance is made for trimming out moment produced by full-span jet flaps.

His comparison does not show what this allowance would amount to in terms of performance loss. Other jet flap failings pointed out by Hamilton were weight increases caused by duct weight and structural beef-up of highly stressed wing members to cope with heat and space problems caused by displacement of fuel from the wing.

Flap effectiveness before separation is not significantly improved by slots or BLC since these are chiefly means of preventing separation. Hamilton said the best mechanical and BLC flaps have nearly identical lift and drag characteristics up to deflections of 50 or 55 degrees. At greater deflections, the mechanical flaps stall while flaps using boundary layer control continue to add lift and drag.

As with the jet flaps, BLC shows no weight lifting advantage for an 8,000-ft. ground roll as it does for a 4,000-ft roll. If it were economical to use bigger engines, BLC would have shown a bigger advantage, he said.

Magneto-Aerodynamics

Prospects for application of research results in magneto-aerodynamics were discussed by W. R. Sears and E. L. Resler, Jr., of the Cornell University Graduate School of Aeronautical Engineering. They reported that aerodynamicist may be introduced to two unfamiliar effects, electromagnetic body force and Joule heating. In some circumstances, use of electromagnetic body force to modify an ionized boundary layer may be nullified by Joule heat.

The body force upon a conducting fluid is created by the interaction of magnetic lines of force about a current flow in the fluid and those in a nearby magnetic field. Since it is proportional to the product of magnetic field strength and electrical current in the ionized air flow, conductivity of the flow and electromagnetic force must be high if electromagnetic body force is to be comparable in magnitude to viscous shear and pressure in the flow field. It may prove necessary to seed the flow with some easily ionized material like calcium to get a high enough ratio of free electrons to the original number of particles to produce good conductivity. A possibility to be considered is that the electromagnetic force self-induced in the ionized air might conceivably be large enough to be significant in producing the necessary current.

The authors reported that a magnetic wing has been discussed at Cornell.

The dynamics of flight instruments were studied by Victor Azgapetian of Servomechanisms, Inc. He said that while static instrument accuracies have improved, dynamic accuracies have deteriorated because aircraft responsiveness is being sacrificed for high performance, thereby demanding faster instrument response. He pointed out that since instruments tied to computers and control surface servos are taking responsibility for airframe stability, minute phase lags in the instruments have become vitally important.

An example of unsatisfactory dynamic response cited by the author is the typical airplane static pressure system which consists of pneumatic volumes connected by orifices and tubes. Measurement of a varying environment by such a system is seldom valid because the value of pressure drop through the pitot-static head orifices in a moving airstream is not thoroughly understood.

He said that time constants of static systems is much longer than commonly believed and vary approximately inversely with pressure. A typical system using standard instrument tubing with an inside diameter of ⅛ in. and typical lengths and volumes will have a sea level time constant of half a second at 80,000 ft. This will lengthen to 15 seconds. The danger of such a lag is obvious when compared with the rapid rates of climb and descent possible in high performance airplanes.

Solution is larger diameter pressure tubing. When tube volume is small compared to fed volume, the fourth power of diameter enters the equation and increasing it from ⅛ in. to ¼ in. will cut the 80,000-ft. time constant from 15 seconds to less than one second. The solution ignores the uncertain effects of flow over static head orifices and the validity of any curve is questionable.

Present static systems are producing undamped organ pipe resonances of about three cycles per second at normal ambient temperatures and six or 10 cycles per second in aerodynamic heating. Because no way has been found to stop these resonances without lengthening the time constant of the system, the time constant of the altimeter itself must usually be at least a half second. Application of servo balance or force balance principles enables the designer to eliminate lag error for a constant vertical velocity. Though such steady state errors can be compensated, transient errors cannot and these occur on entry, recovery and frequently during the maneuver.

The skill and knowledge of the instrument maker has little effect on dynamic inadequacies because the standard specifications ends his responsibility at the edge of the problem. Only the man with systems responsibility has the opportunity to correct them.

G Forces Challenge Engineers

Los Angeles—Included among prospects for high performance research airplanes are longitudinal accelerations and decelerations of 4 to 5Gs, Walter C. Williams and Hubert M. Drake of the NACA high-speed flight station at Edwards AFB told the National Summer Meeting of the IAS.

While such accelerations have been experienced in carrier aircraft, they said, the durations have not been of comparable length. Much research will be needed to solve control configuration and pilot presentation problems for the longer durations.

Though such aircraft as the X-15 will not be designed primarily for ballistic flight or extremely low dynamic pressures, they are the logical vehicles to prove much of the information needed in these regimes. First study of use of reaction controls at low dynamic pressures will be made with the X-1B.

Roll coupling must be studied. Critical frequency for coupling will be low, producing problems at roll rates as low as 20 to 30 degrees per second.

Aids to inertial navigation were discussed by Frederick Stevens and Frank W. Lynch of Northrop. They said that automatic star tracking and terrestrial check point tracking offer a solution to stable platform misalignment and excessive drift of stable platform gyros. Signals thus produced can be used to correct the position in inertial space or to realign the stable platform.

A combination of aids such as star tracking, velocity damping, radar checkpoint corrections and ground based tracking can show good results.

A panel chaired by J. Lee Atwood, president of North American Aviation Corp., brought out the various aspects of the engineer in management.

L. A. Hyland, vice president and general manager of Hughes Aircraft Co., said function of management is to:

- **Produce a profit.**
- **Achieve a balance** within the organization between all elements, sales, development, manufacturing.
- **Get all personnel** within his organization trained so that there are no surprises, that all function according to his principles when problems arise.
- **Train people** with marginal ability to produce superior products by letting them know other aspects of the business besides their own and building their confidence in their ability to solve their own problems.

Some 85% of an engineer's training is brought to bear when he functions as a manager, according to George Trimble, vice president-engineering, The Martin Co. This training teaches him to define clearly what the problem is; how to logically arrive at a solution; the practice of intellectual honesty in solving problems.

On the other hand, Trimble said, there frequently is not a right answer per se to a management question, and here horse sense is necessary to achieve the best possible answer.

Regarding a choice between pursuing technical specialization and management, Leo Carter, vice president and general manager of the Santa Monica Division, Douglas Aircraft Co., said that as a manager, an engineer uses people to multiply his efforts, while in technical specialization he creates using his own efforts alone. His natural inclination should be a guide in the choice, Carter said, since parallel financial paths and other gratifications now are available to the technical specialist on a par with the manager.

A requirement for the engineer desiring to improve his management skills, according to D. Gerdan, director-engineering, Allison Division of General Motors, is to become more familiar with the customer's end use of the product to be designed and produced, to learn to take a completely objective view of the customer's requirements for this product, rather than assess them from his personal engineering viewpoint. In addition to study of a pertinent field such as finance, learning to be articulate in expressing his own thoughts as well as teaching his concepts to others, the engineer should learn his own limitations thoroughly, learn to help others solve their problems and get proper help when necessary in solving his own.

Small Jet Liners

Los Angeles—First details of small jet transports being developed by Lockheed and North American Aviation to meet USAF's crew readiness trainer requirements were revealed at business aircraft session of IAS National Summer Meeting.

- **Lockheed CL-329 will be a 10-passenger swept low-wing layout with four jets mounted on the rear fuselage in side-by-side pods. Gross weight will** be 28,000 lb., cruise speed 500-550 mph. **at 25,000-45,000 ft.**
- **North American Sabreliner will seat four to nine passengers, have its GE J85 turbojets in the wing roots. Cruise speed will be Mach .76 at 39,000 ft.; top speed will be 540 mph. Maximum takeoff ground roll will be 2,300 ft.; single-engine takeoff roll to clear a 50-ft. obstacle will take 5,200 ft. Single-engine ceiling will be 23,000 ft.**

Efficiency of Greek Air Force Adds Strength to NATO Flank

By Claude Witze

Athens, Greece—Royal Hellenic Air Force is not large, but its top officers believe it is a vital segment of NATO's bulwark against Soviet aggression in the Eastern Mediterranean.

Considering the capability of RHAF equipment, there is little doubt the Greek outfit may be the most efficient unit of allied airpower. Combat readiness of RHAF jet fighter-bombers and interceptors runs in the neighborhood of 90%, highest of the NATO powers and 20% above the NATO standard.

Today Greece is putting $20 million a year into support of the RHAF. This is 24% of the entire defense budget. Another 56% goes to the Army and 20% to the Navy. Total for the three services takes 46% of the national budget.

On top of this, RHAF receives a substantial amount of aid from the Mutual Defense Aid Program and it is eligible for consideration under the Eisenhower Doctrine. There is no exact figure available on how much is contributed from outside Greece, because the aid comes in the form of equipment and such services as the training of RHAF pilots and technicians at USAF schools in Germany, Africa and the United States.

At Elefsis Air Base, a few miles outside Athens, there is evidence of a strong effort to improve combat efficiency further by raising the level of pilot proficiency. Home of the 112th Combat Wing, Elefsis is a small base by U. S. standards, but complete with all of the essentials for practice missions from the study of gunnery-range films to the Petty girls on the walls of the pilot's lounge.

Brig. Gen. Constantine Geranopoulos, RHAF deputy chief of staff for plans and operations, told AVIATION WEEK he is less interested in new equipment and more equipment than he is in developing a perfect operation with what he has. This refreshing approach stands in contrast to that of some other allied powers who are pressing for aircraft in the Century series before getting maximum capability out of what they have.

RHAF pilot proficiency so far is not as good as the combat readiness record of its existing planes—Republic F-84Fs, F-84Gs and North American F-86Es. However, the 31st Air Training Command as well as the three Combat Wings of the RHAF are working hard to make the pilots as good as the aircraft.

Gen. Geranopoulos views the task of defending Greece as the RHAF's prime mission, but emphasizes there is more than a selfish reason for this. He says the Western Powers have a vested interest in his success because Greece is a stronghold vital to all branches of the allied armed forces.

Occupation of Greece by the Russians, he points out, would have these devastating effects:

- **Ground forces** would be outflanked in Turkey and Italy.
- **Naval forces** would lose control of the east and central Mediterranean.
- **Air Forces** would lose lines of communication in the Mediterranean and bases in North Africa and the Middle East would be neutralized by enemies.
- **Middle East oil** would be a useless resource, constantly menaced by Soviet tactical air forces.

RHAF planning, and NATO planning, is based on the assumption that a future general war will be nuclear and that the initial phase will be decisive. If Greece escapes occupation, it will provide about a dozen bases from which to conduct air-ground operations over enemy territory. Only six of these fields are completed, but the rest will be available soon. The program started in 1953. The bases will be linked by 310 mi. fuel pipeline.

Equally important to the NATO defense mechanism are a chain of nine aircraft control and early warning stations now under construction. Locations have not been revealed, but some of them are high in the mountains. To reach them, the RHAF later this year will be equipped with one squadron of Sikorsky H-19 helicopters.

Top-ranking officers of the RHAF view the U. S. 6th Fleet in the Mediterranean as a strong segment of allied airpower, but they have reservations about how much help it will be in the initial phase of a nuclear war. If the fleet attempts tactical missions in the early part of a general war, they fear it will be lost. At best, it will need defense from land-based units if it is in this part of the Mediterranean area.

Later, they feel, the 6th Fleet could steam nearer the scene of conflict and contribute heavily to ground support.

Greek Air Strength

The Royal Hellenic Air Force is composed of three commands:

- **28th Tactical Air Command**
- **31st Air Training Command**
- **30th Materiel Command.**

In the event of war the 28th TAC would be assigned to the 6th Allied Tactical Air Force.

There are about 17,000 men in the RHAF, more than 300 of them pilots. Each combat aircraft today is flying about 20 hr. a month. The accident rate is 24.5 per 100,000 flying hours.

The training Command has an Air Academy with a three-year course and a Reserve Training Center where the course runs from 18 to 20 months. In addition, there is an Air Crew Center and an RHAF Engineering School with a four-year course to train maintenance officers.

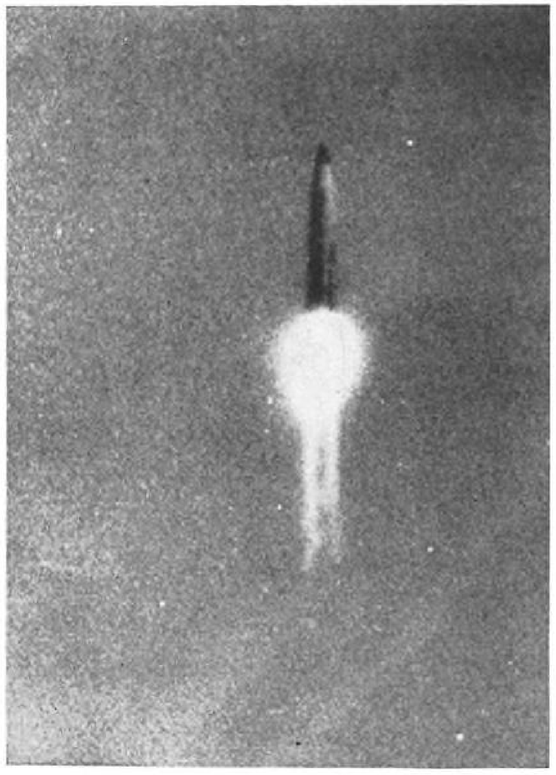
RHAF's contemporary history goes back only to 1950. From 1947 to 1949 it took part in the country's near-fatal war against guerilla Reds and was left completely out of business. The build-up started in 1952, after Greece joined NATO.

Cooperation with NATO and further continued support of defensive military activity still is a local political issue, but U. S. Ambassador George Allen is convinced it is not a serious one. The King of Greece holds a powerful hand in the national legislature and the majority party is strongly pro-NATO. In addition, Greece with its long history of wars and the sufferance of foreign invasion is not considered likely to condone any military reduction.

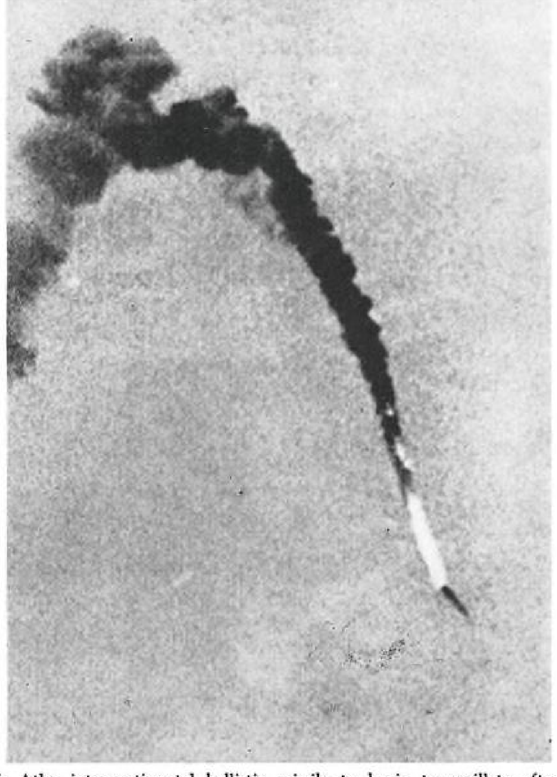
At the worst, the political opposition uses neutralism as a tool in its debates. Hottest issue is the fate of the island of Cyprus, off the coast of Syria and Turkey.

The opposition charges that Britain and France use the island as a base for imperialist activity and that the Greek government is guilty of complicity in this activity.

The island is populated by a mixture of Greeks and Turks. Greeks are building two NATO bases on it.



Atlas Traces Its Fall in Trail of Black Smoke



Malfunctioning of rocket motor gimballing control caused Convair Atlas intercontinental ballistic missile to begin to oscillate after launching at Patrick AFB, Fla. (AW June 17, p. 27). Range safety officer touched destruct button to destroy the missile. Photos show it arching into Atlantic Ocean. Atlas motor is composed of two 135,000 lb. thrust barrels and one 65,000 lb. sustained.

Athens Is USAF Mideast Gateway

Athens, Greece—Nearly half of the flying hours rolled up by USAF's Air Logistics System in Europe are used to haul passengers and supplies to this capital and reship them to North Africa, Turkey and points farther east in Saudi Arabia and Iran.

ALS operates all the way from Norway to the Middle East, sprawling its scheduled trunk and feeder service over an area five times as big as the United States. Yet cargo passing through the Greek terminal to more distant parts of the system accounts for 32% of the total ton-miles flown by the airline.

It may be that these figures disclose for the first time in concrete form the true magnitude of America's military effort in the Middle East. The staggering amount of goods and personnel coming from the west is fed to all our interests from the Royal Hellenic Air Force to the complex of U.S. bases across the Mediterranean and on to remote points like Dhahran.

There is no exact statistical breakdown of ALS traffic to provide a total of the load carried to Greece and points south and east. For the entire system, the 322nd Air Division has compiled this table:

	1955	1956
Cargo Ton-Miles Flown	16,665,138	33,911,336
Passenger-Miles Flown	31,404,015	61,483,613
Cargo Carried (Tons)	41,559	51,344
Passengers Carried	58,208	79,321
AME Patients Carried	7,625	13,384
Mail Carried	4,795,000	5,538,015
Flying Time Expended	110,716	123,252

Much of the increase between 1955 and 1956 is attributed to the addition of Douglas C-124 transports to the ALS system in that year. But indications are the 1957 data will show a continued growth in activity, particularly as emphasis increases on the Middle East.

There are 13 Fairchild C-119s based at the Athens municipal airport to fly feeder line service to Turkey and other eastern countries. Their loads are brought in on scheduled trunk line runs from air materiel depots in Burtonwood, England, and Chateauroux, France.

The C-119s are operated by the 7168th Air Transport Squadron of the 322nd Air Division, which has headquarters at Sevreux Air Base, France. In Athens, where USAF is a tenant of the airport, they are bolstered by the 7206th Support Group of the 17th Air Force.

Housed today in inadequate and scattered buildings, the 7206th is expanding and modernizing its shops and warehouses to meet the growing demand for shipment through Greece.

The Athens unit expects to handle about 15,000 traffic movements this year. Some time in 1957 ALS will augment the C-119 fleet with C-124 aircraft for scheduled operations in North Africa, Turkey and the Middle East.

Lt. Gen. William H. Turner, USAFE commander who is about to take over a new post as Deputy Chief of Staff for Operations in the Pentagon, indicates the traffic may grow if political conditions warrant.

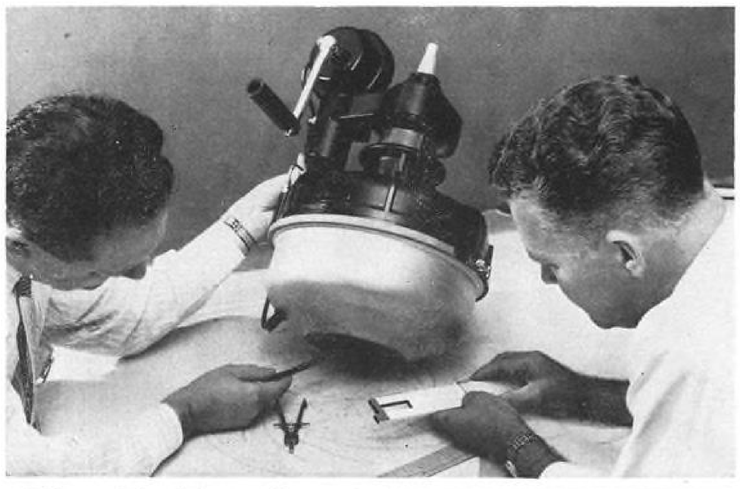
He has pointed out that airpower is an instrument of national policy in the Middle East and that it must provide or support any military strength contributed to the area under the Eisenhower Doctrine.

Gen. Turner says it is obvious that this area "does not lend itself to large garrisons of ground troops" but is "almost ideally adapted to the air age mobility and inherent capability of rapid concentration of decisive fire power."

USAF today is operating or using 11 major air bases in the Middle East and has 12,000 personnel in the area. Our investment in USAF facilities, equipment and supplies is more than $550 million.

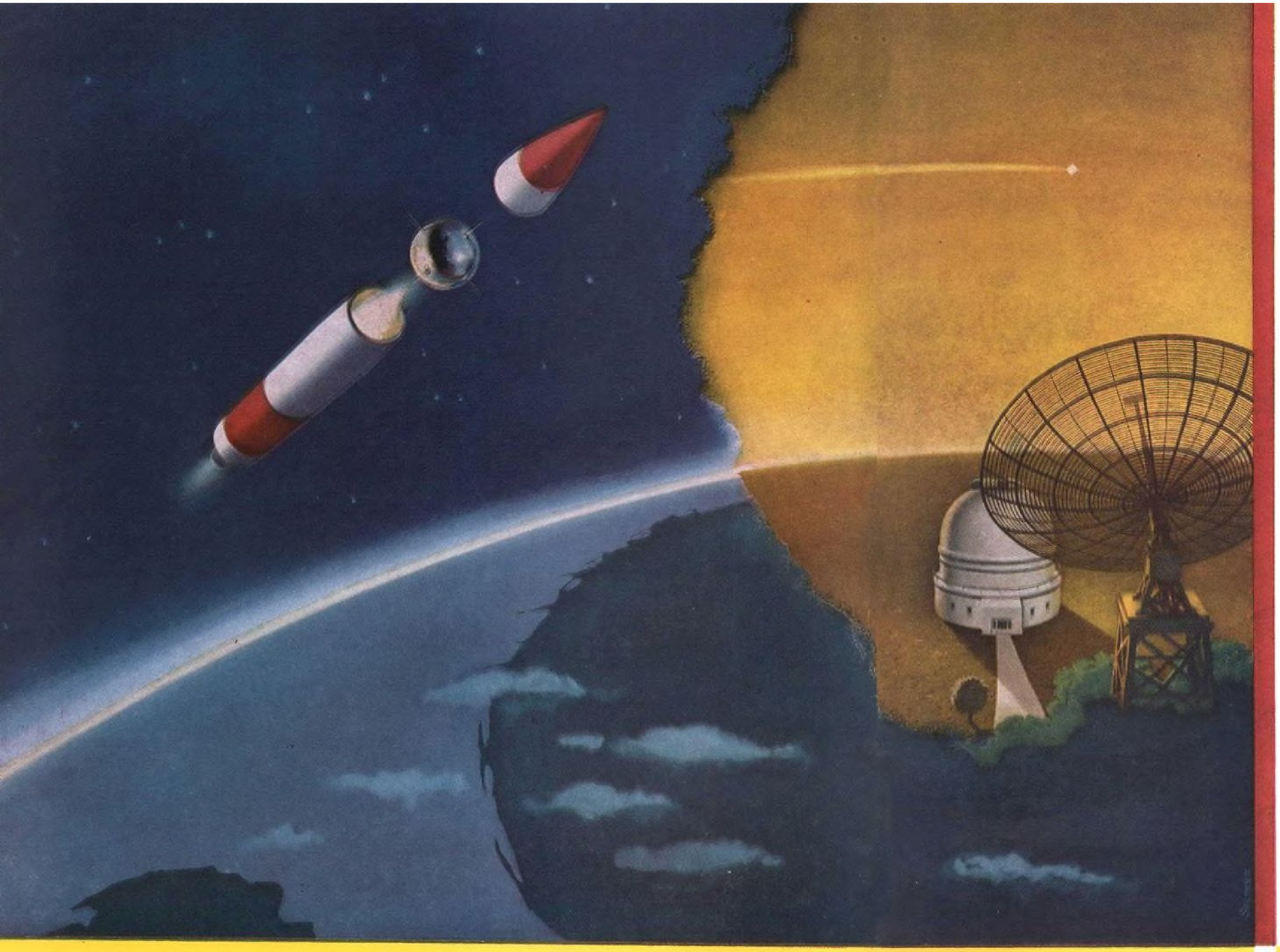
The 11 bases are in Libya, Turkey, Saudi Arabia, Greece and Morocco. They are supplemented by 10 more bases used only by ALS and administrative aircraft. More men and money can expand the capability on short notice, giving USAFE a transportation system with the same flexibility as the forces it supports.

Gen. Turner says the part of ALS which operates through North Africa and the Middle East has a monthly capacity of 2,500,000 ton-miles. Today it provides the sole means of air transport for all military personnel and cargo outbound from Dhahran to Iran, Iraq, Ethiopia and Eritrea.



Tiny Turbine for Small Helicopters

Planned for one-man helicopter applications, new Solar YT62 Mercury weighs only 50 lb., measures 20 in. high by 15½ in. maximum diameter and delivers 55 shp. plus 12 lb. residual thrust on a 100F day. Engine has a rotor speed of 57,600 rpm. and will operate on standard military fuels. Photos show mockup of YT62 which is financed by joint Army-Navy BuAer funds. YT62 is first engine produced by Solar specifically for aircraft applications. Solar has built more than 1,000 gas turbines with applications for ground support equipment, airborne generator sets, boat propulsion and shipboard power generation. Previous units range from 50 to 1,000 hp.



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Weapon Systems Concept Applied To Avionic Subsystem Firms

By Philip J. Klass

Washington—New Air Force policy applying the weapon system management concept to the development and production of major avionic subsystems was revealed here last week by Lt. Gen. C. S. Irvine, USAF Deputy Chief of Staff, Materiel.

First such contract—for an electronic countermeasures package for the Boeing B-52—was recently awarded to Sperry Gyroscope Division of Sperry-Rand Corp. Amount of the contract is believed to be between $50 million and $80 million.

Under the terms of the new USAF policy, Sperry is required to subcontract a substantial portion of the hardware development and production to other avionics companies.

Gen. Irvine, speaking at the first National Convention on Military Electronics sponsored by the Institute of Radio Engineers, said new USAF policy is expected to provide three major advantages:

- **Better coordination** of design and production engineering, "an absolute must in this era of highly complex equipment and the critical shortage of engineers," Irvine said.
- **More rapid development** through the use of engineering staffs from several companies, making use of the creative thinking of a larger cross-section of industry know-how.
- **Dispersal of government** business among more companies, making for a sounder industrial economy.

Selection of subsystem prime contractors under the new Air Force policy will follow the pattern for selection of weapon system primes. Gen. Irvine said:

"We make a comprehensive facilities survey, studying the company's organizational and managerial structure, its current commitments that could interfere with work completion, its production potential and, most important, its design and engineering approach to the problem."

He added that the sub-system prime is "required to establish a well-planned, coordinated subcontract structure and to farm out the production of as much of the work as can reasonably be done by smaller, specializing firms."

Gen. Irvine said the Air Force hopes to be flying rocket-powered manned aircraft at speeds approaching Mach 10 and at altitudes over 100,000 ft. within 10 years.

USAF is making "extensive studies" on both chemical and nuclear powered aircraft for supersonic, long-range bombers as a follow-on for the B-52 "to be used in conjunction with long-range ballistic missiles," Gen. Irvine said.

Gen. Irvine told members of the IRE that their efforts "will determine the true effectiveness of our military capability. We can neither defend ourselves nor retaliate" without avionics, he said. He warned, however, that avionics equipment required for future USAF weapons must be "more efficient, more reliable and far more simple to maintain than anything yet offered."

Speaking of Soviet technological progress in avionics, Gen. Irvine said the Russians have "a radar capability which implies a tremendous advance in the state of the art."

He challenged the avionics industry to move more quickly to convert its basic knowledge into useable military hardware but admitted that USAF must assist by simplifying and streamlining its own procurement procedures and specifications.

Gen. Irvine was particularly critical of the long time that it has taken to move promising new microwave tubes, badly needed by the USAF, from the laboratory into production. He cited as examples the carcinotron and traveling wave tube.

(Navy's Talos missile was displayed for the first time at the meeting. Pictures are on following pages, 40-41.)

Federal Group Pushes Airline Security Plan

A Federal Commission on Government Security last week recommended a security program for civil air transportation similar in scope and make-up to that now existing for seaport security. Overall responsibility for airport security would rest with the Civil Aeronautics Board and the Secretary of Commerce.

The commission, established by Congressional legislation, said sensitivity of civil aviation facilities and aircraft to sabotage represents a greater threat than that facing any other form of transportation. The group said little action has been taken by the airline industry toward security protection although basic legislation authority was enacted in 1950 (Civil Aeronautics Act of 1950).

The Commission charged that checking of applicants for employment by the air carriers is not standardized and that there is no coordination between the industry and the federal government.

The commission urged that standards for granting employment of persons who will have access to areas of airports classified as "restricted" by the CAB should conform to present government employment criteria. Such factors include treason, espionage or advocacy of revolution to alter the U. S. form of government. It also recommended the CAB should have final authority in granting admission to any facility it declares "restricted" at any airport under CAB jurisdiction. This security measure would not apply at military installations.

Security checks by a national agency of all crewmen on international flights or of persons seeking admittance to CAB "restricted" airport facilities were proposed by the commission.

The commission also warned that over-classification within the government hurts national security because it "retards scientific progress by confining knowledge." It therefore recommends:

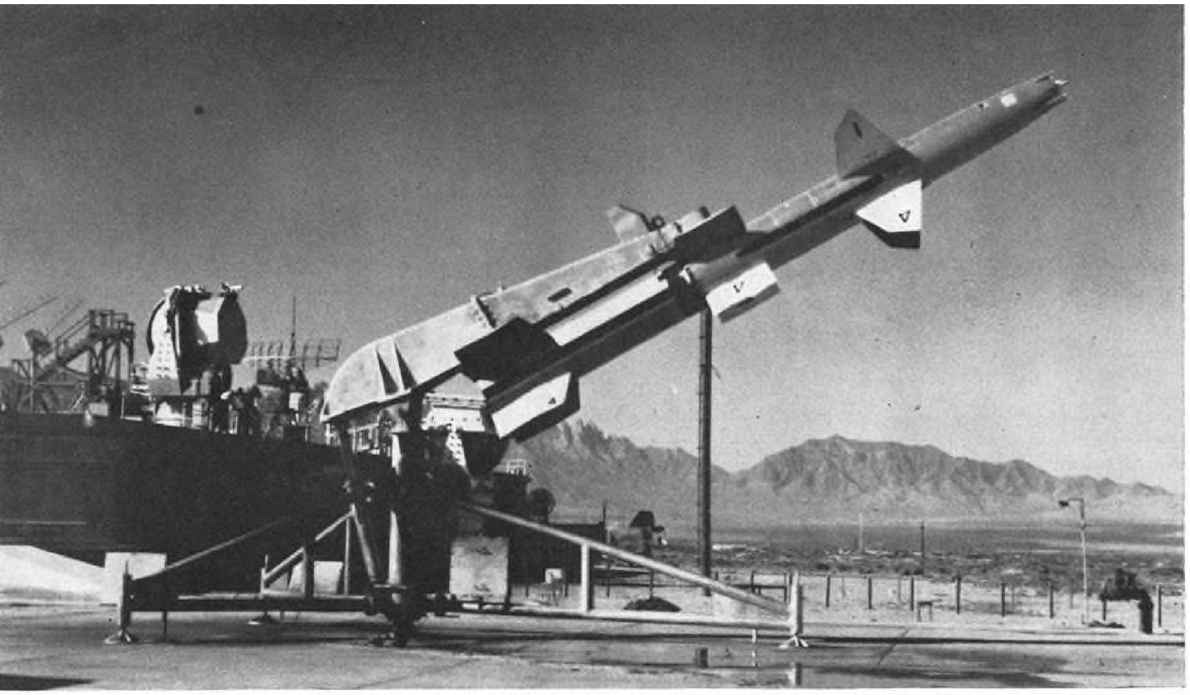
- **Abolition of "confidential"** classification, retaining only "secret" and "top secret" categories. Report recommends gradual declassification of present "confidential" material.
- **Government should remove** all restrictions on unclassified defense information dissemination. Commission concurs with recent Congressional action in abolishing Commerce Department's Office of Strategic Information.

The commission also warned that the "need-to-know" requirement, which restricts the flow of classified information to persons with security clearance, should be applied only when national security is clearly affected.

The report recommended enactment of a criminal statute that would penalize anyone, in or out of government, who makes public the contents of a secret or top secret document. At present, only government employes can be prosecuted for willful disclosure of classified information to unauthorized persons.

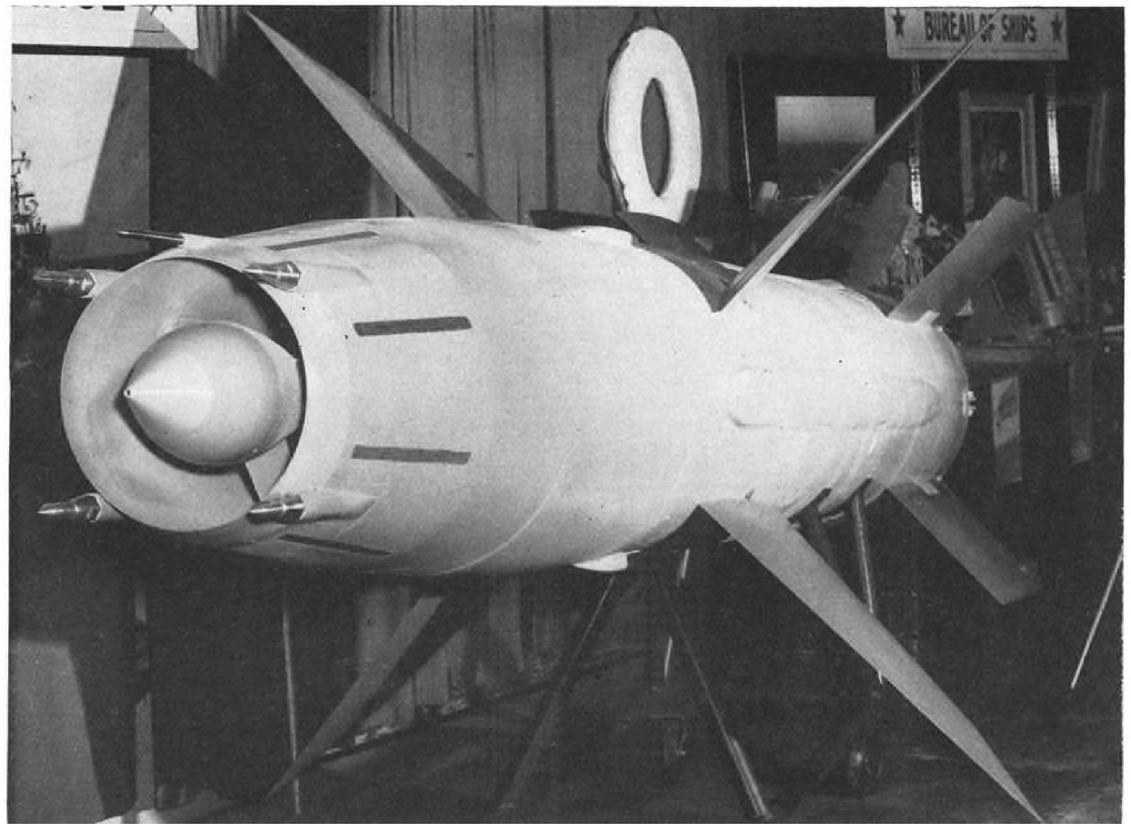
Creation of a Central Security Office within the Executive Branch, independent of any existing agency, was recommended to "correct the many weaknesses of past and present loyalty-security programs." The proposed agency would provide trained hearing examiners instead of volunteer panels now used, plus three-man review board to hear loyalty case appeals. At present there is no appeal beyond department or agency head.

It would also coordinate security requirements of various government agencies to achieve greater uniformity.



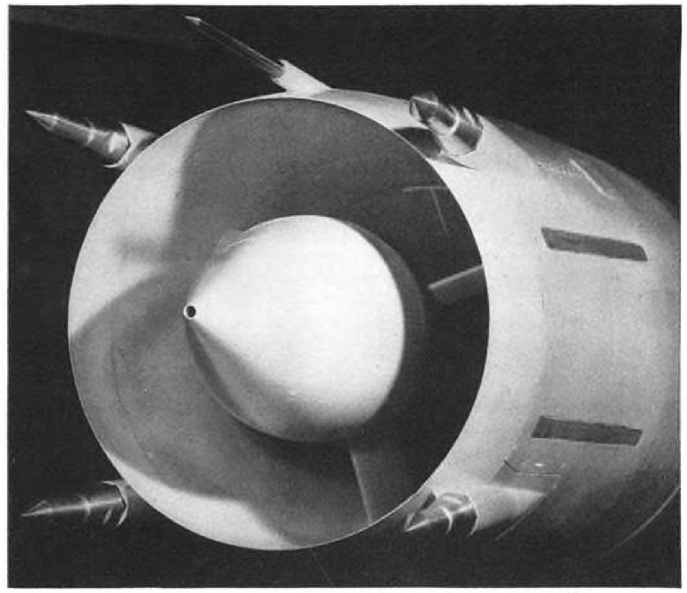
TALOS MISSILE, in launcher at Naval Ordnance Missile Test Facility, White Sands Proving Ground, N. Mex., will join the fleet next year. Surface-to-air ramjet powered weapon will form major armament of light cruiser Galveston, now undergoing conversion.

Navy's Talos Moves Into Operational Stage



TALOS is capable of delivering conventional or nuclear warhead at ranges of about 40 mi. It is a beam-riding missile, like the shorter-range Terrier, during initial phase of attack, guided by precision ground radar. Talos differs from Terrier in that it switches to a semi-active homing system for final phase of attack as on B-17 drone (right), possibly using ground radar signals reflected off the target. Talos is equipped with proximity fused warhead.

Talos was developed by applied physics laboratory of Johns Hopkins University, is being produced by Bendix Aviation Corp. at the Naval Ordnance Plant, Mishawaka, Ind. McDonnell Aircraft manufactures the airframe and ramjet power plant for the Talos; Radio Corp. of America produces the ground guidance radar. Solid propellant rocket is used during Talos launching (above), dropping away after a few seconds when vehicle has reached speed where ramjet engine can take over. Navy says Talos can be used against enemy ships and land bases in addition to its interception role. Two other cruisers will be equipped with Talos and it will be used on Navy's first nuclear powered cruiser, Long Beach.



GUIDANCE antennas include eight flush mounted strips around nose section (above and left), and four probe type antennas in nose. Steel spikes were installed in their place on model at IRE convention in Washington. Fifth nose probe appears to be angle of attack and angle of yaw sensor. Forward control surfaces of Talos are movable and provide directional control. Aft surfaces are fixed.

Capital Sees $2.5 Million Loss for '57

Earlier estimates of $2.1 million profit cut by $4.7 million on deferment of Viscount purchases.

By L. L. Doty

Washington—Capital Airlines' President J. H. Carmichael reported last week that his company has been forced to revise its 1957 estimate downward by a total of $4.7 million—from an earlier prediction of a $2.1 million net profit to an estimated $2.5 million loss.

The reason, Carmichael said, is Capital's poor prospects of finding available funds to purchase more Vickers Viscount turboprop transports. The airline already has been forced to defer the planned purchase of 15 Viscounts to add to its present fleet of 59 (AW May 13, p. 39).

Testifying before the Civil Aeronautics Board's Suspended Passenger Fare Case, Carmichael warned that the airline will be unable to expand any of its markets without more Viscounts. He added, however:

"I don't know where we are going to get them (Viscounts)" although "I am still optimistic."

No Market for 049s

He also disclosed that the company has been unable to dispose of its fleet of 12 Lockheed 049 Constellations and said "there has been absolutely no market for the airplane."

Carmichael explained there had been no purchasers at a $1.2 million asking price, adding that the last figure discussed with a potential purchaser was $900,000 per airplane.

Carmichael admitted that Capital is "very badly, critically" in need of net proceeds from such a sale but emphasized that disposal of the Constellation now would cause a serious shortage of equipment for the company.

"We must replace the Constellations to stop steadily rising costs," he said, but "we can't operate the Capital system with only 59 Viscounts and DC-3s and DC-4s."

The airline's original financial forecast, prepared in late 1956, was basically the same as that submitted to a banking group headed by the Chase Manhattan Bank of New York in support of a request for a $45 million loan to finance the 15 Viscounts and 14 Comet jet transports. Carmichael said he had "no plans of going forward with the financing program."

S. B. Goldthorpe, Capital's assistant vice president-finance and comptroller, said the forecast was based upon "purchaser interest" in the Constellations and the addition of new Viscount equipment. He said recalculation of the forecast was now necessary because neither of these asumptions were now "valid."

Principal changes incorporated in the new forecast:

- **Net profit of $2,102,000** originally forecast has been replaced by a net loss of $2,575,000, a drop of $4,677,000.
- **Operating profit of $8,702,000** was reduced by $7,978,000 to an operating profit of $724,000.
- **Total revenues of $95,070,000** are now forecast, a $13,175,000 decrease from the original estimate. Revenues in 1956 totaled $63,706,744.
- **Operating expenses** are now forecast at $94,346,000, $5,197,000 less than the original forecast. However, Goldthorpe pointed out that $1,617,000 of the decline in expense arises from lower depreciation and is not a cash expense savings.
- **Revenue plane-miles** for 1957 were reduced in the forecast by 4,111,000 to 57,924,000; revenue passenger-miles were cut by 208 million to 1,533 million. Load factor estimate for the system was sliced from 65.14% to 60.39%. Estimated load factor for the Viscounts is 62.6% as compared with 55.9% for the Constellations, 51.5% for the DC-4s and 56% for the DC-3s.

Deficit Balance

Goldthorpe warned that the cash balance at the close of 1957 is projected at $3,336,000, "considerably lower than necessary to properly service cash demands and maintain balances in depositories." He added that payments on equipment notes amounting to $10.7 million will exceed anticipated recovery from depreciation and amortization of $9.9 million by $755,000 in 1957.

Carmichael said the Viscount operated at a break-even load factor of 54.3%, or 23.9 passengers per airplane, during 1956. He said he anticipates no change in 1957. However, he forecast a break-even load factor climb in Lockheed 049 operations from 63.6% in 1956 to 67.5% this year.

Because of increased utilization of the DC-3 fleet, Carmichael forecast a decline in the DC-3 break-even load factor from 92.3% last year to 91.6% this year. DC-4 break-even load factor is estimated at 56.3% for 1957 as compared with 55.8% last year.

Carmichael said that, after full cost allocations, the DC-3 lost $3,052,000 in 1956; the DC-4, $1,846,000, and the Constellation 049, $1,548,000. The Viscount fleet showed a profit of $3,754,000 to balance the year's operating loss to $2,801,000.

Short Haul Curse

In a strong defense of the Viscount, Carmichael, said, "We'd be in sorry shape without it." He admitted, however, that the Viscount load factor has been "lower than anticipated."

Carmichael attributed many of Capital's weaknesses to its route structure, explaining that the "short-haul is the curse of Capital." He said Capital's average haul in 1956 was only 342 miles and added:

"I think we have reached the end of our rope without some change in our route structure."

He said the airline has discontinued plans to introduce 18 nonstop daily round-trips between New York and Chicago because of the deferment of the order for 15 additional Viscounts. Capital now operates nine nonstops daily over the route which Carmichael termed long-haul, affording the airline a 46% break-even load factor for Viscounts between the two cities.

Detroit-New York is another travel market Carmichael had hoped to exploit further with a greater frequency of Viscount flights. He also expressed strong interest in the potential of such markets on Capital's routes as New York-Atlanta, New York-Birmingham, New York-New Orleans, New York-Milwaukee and Washington-Buffalo.

Only modern equipment will successfully help penetrate these markets, Carmichael declared. Forecasts for 1957 were based on the additional equipment, he stated, adding that when he signed the contract with Vickers-Armstrongs for the initial order of 60 Viscounts, he told the manufacturers that "we are a 100 airplane customer eventually."

Carmichael said Capital still has a commitment with a "selling agent" through July 31 giving him exclusive rights to sell six of the 12 Constellations. He said this commitment has not been withdrawn despite unsuccessful attempts to dispose of the aircraft.

PROPOSED terminal for LaGuardia Airport features two-level passenger handling, 36 aircraft gates.

User Airlines to Pay Higher Fees As Share in LaGuardia Revamping

New York—Six airlines using LaGuardia Airport and the Port of New York Authority have come to terms on a $32 million rehabilitation program for the terminal, second busiest in the world. Included are:

- **Construction** of a $15.3 million passenger terminal three times the size of the present facility.
- **Expenditure** of $4.8 million to beef up runways, build a new control tower and improve and expand the taxiway system.
- **Revision** of roadway system and rehabilitation of utilities at a cost of $8.3 million.
- **Construction** of new parking facilities at a cost of $3.7 million.

Major Phases

Major phases of the program are scheduled for 1960 completion, with work to begin this year. Airlines planning to operate from the revamped short and medium haul airport will pay an additional $2.5 million annually in landing fees and rentals to handle the program costs. Carriers are American, Capital, Eastern, Northeast, TWA and United.

Austin J. Tobin, Port Authority executive director, did not rule out the possibility that jets would operate from the rehabilitated airport, providing their noise levels were acceptable. But maximum weight of aircraft using the rehabilitated runways will be restricted to 175,000 lb., Tobin said and TWA's Convair 880, smallest of the American jets, will gross 178,500 lb. maximum. Normal takeoff weight for the airplane is 150,000-155,000 lb.

Longest runway at LaGuardia is 6,000 ft., although Tobin said the possibility of extending instrument Runway 4-22 is being studied.

The new terminal building will be a curved two-story structure 1,100 ft. long with four two-story fingers servicing a total of 36 gate positions. An elevated roadway will bring departing passengers to second-story level airline areas and the passengers will use the upper decks of the fingers to proceed to their planes. They will have to descend to ramp level to board, but Tobin said the layout will be adaptable to use of finger-to-plane gangways or various other possible innovations.

Arriving passengers will use ground floors of the fingers and board their ground transportation at the lower-level roadway.

The plan eliminates the funneling of passengers through a central terminal area, with consequent long walks to their individual carriers, as is now the case at LaGuardia. Passengers will arrive at, and depart from, the street side areas of their ticketed airlines. The two-level arrangement is designed to end the football games between incoming and outgoing passengers.

Unused boat basin or lagoon at the airport will be filled and surfaced to provide an enlarged parking space for vehicles.

Terminal Construction

Terminal construction will begin with new wing buildings on either side of the existing terminal.

The final stage will be a new central building.

Airline executives who spoke briefly at the press conference announcing the plan—C. R. Smith of American, Thomas F. Armstrong of Eastern, R. J. Wilson of Capital, George E. Gardner of Northeast, and Carter Burgess of TWA—unanimously plugged the fare increase as needed to pay higher costs, such as the bigger bills at LaGuardia.

Last year, airlines at the field paid $370,000 in landing fees, $120,000 in hangar rentals, and $100,000 for counter space.

Mexico Awards Routes

Mexico City—Aeronaves de Mexico has been awarded the non-stop Mexico City to New York route and Compania Mexicana de Aviacion the non-stop Chicago route in decisions that have recently been announced by the Mexican government.

The Aeronaves award was predicted in Aviation Week (June 3, p. 438).

Tighter Traffic Control Rules Proposed for Adoption by CAB

Washington—New air traffic rules designed to tighten traffic control of all aircraft and increase minimum weather conditions for VFR flights have been proposed by the Civil Aeronautics Board for adoption early this fall.

The proposed regulations, which will affect eight major functions of the air traffic control system, stem from recommendations submitted to the CAB by military and commercial aviation groups in the latest drive for more positive control of all air traffic.

However, a recent air traffic rules conference held by CAB's Bureau of Safety for a review of the proposals disclosed that sharp differences of opinion still exist as to the degree increased control should be imposed.

Strongest protests against proposed VFR weather minimum requirements were registered by the Aircraft Owners and Pilots Assn.

Recommendations

Main changes in Civil Air Regulations discussed at the conference:

• **Minimum weather conditions** for VFR flights. Civil Aeronautics Administration, Army, Navy, Air Force, Air Transport Assn., Air Traffic Controllers Assn. and Air Line Pilots Assn. advocate an increase in present minimum VFR criteria which prohibits VFR flights when visibility is less than one-mile. CAA, ATA and ALPA want visibility limits in controlled airspace increased between three to five miles. The military urges that, in controlled airspace above 10,000 ft., visibility should be raised to five miles.

• **Definition of control area.** CAA wants floors of control areas raised where possible, and the CAB proposal would redefine "control area" to permit the Civil Aeronautics Administrator to designate floors at altitudes best suited to a local situation. Present floor is 700 ft. above the surface.

• **Aircraft lights.** Proposed rule change would require all aircraft to display steady position lights at all times on the ground and in the air between sunset and sunrise. In addition, aircraft equipped with anti-collision lights will be required to display these lights in conjunction with steady position lights. Present rules do not say when they should be displayed.

• **Expansion** of high altitude controlled airspace. Proposal would establish as a Civil Air Regulation CAA's desire to control all airspace within the continental limits of the U. S. above 24,000 ft. and to reduce that floor to 15,000 ft. next year. Minimum visibility for VFR flights in this area would be five miles; minimum clearance from clouds would be set at 1,000 ft. vertically and one-mile horizontally.

• **Operation within airport vicinities.** CAB wants to strengthen rules governing the control of traffic to and from airports and establish more uniform flight patterns within an airport area. AOPA called for a 180 mph. speed limit in controlled zones around civil airports and recommended that military aircraft unable to conform with such speed limits be restricted to military airports outside the zones. AOPA also wants rate of climb and descent held to a maximum of 1,000 ft. per minute below 3,000 ft. in all control zones.

• **Cruising altitudes.** Present rules call for two different requirements governing the selection of cruising altitudes—a quandrantal regulation for flights outside controlled airspace and odd-or-even thousand ft. altitudes for flights within controlled airspace. Proposed regulation would use a single system that would apply to all airspace through vertical separation of IFR and VFR traffic.

• **Instrument takeoff and landing minimums.** To eliminate current misunderstandings of the present regulations on instrument approach procedures, CAB proposes that revised rules specify that instrument approaches are required when visibility is less than three miles or when the ceiling is lower than the minimum initial approach altitude.

• **Altimeter setting.** To minimize "induced errors" in altimeter settings, Department of Defense has recommended the use of 29.92 hg. as a standard pressure setting of altimeters at high altitudes. CAB proposes adoption of this standard for all flights above 29,000 ft. For flights below 26,000 ft., it proposes altimeters be set to the current corrected pressure setting of stations no farther than 100 nautical miles from the aircraft. Intervening altitude area would serve as a transition zone to change from one altitude setting procedure to another.

The proposed regulations are likely to undergo some modification during the rule-making procedures before they are published within the next 30 days. However, such changes are expected to be slight, although opponents of any phase of the revisions will have an opportunity to submit further comments on the regulations during the 60 days following publication of the rules.

Oral arguments on the regulations will be held prior to their adoption.

Recommendations received by the CAB for minimum weather conditions for VFR flights called for a 1,500 ft. ceiling and five mile visibility for flights operating in a control zone without an ATC clearance. For flights operating in a control zone with an ATC clearance, the CAA has urged a ceiling of 500 ft. as the irreducible minimum for all VFR flights at all airports.

Air Transport Assn. called for a 2,000 ft. minimum clearance above clouds for VFR flights, although no other groups made any specific recommendation for increasing the presently prescribed minimum of 1,000 ft.

ATA also wants an increase in minimums below clouds from the present 500 ft. to a 1,000 ft. clearance for flights operating above 3,000 ft., and a 500 ft. clearance below clouds for flights operating under 3,000 ft. Most groups advocated a 1,000 ft. clearance below clouds. Army, Navy and Air Force called for a horizontal distance from clouds of one mile on flights operating above 10,000 ft. Air Traffic Control Assn. recommended one-half mile horizontal distance from clouds at all altitudes.

Two new terms were proposed by the ATA—forward cloud proximity and lateral cloud proximity. The group suggested that forward cloud proximity, which it defined as the minimum distance from clouds in a 90 degree quadrant centered on the nose of the airplane, be set at five miles. Lateral cloud proximity, or the minimum distance from clouds in a 90 degree quadrant on either side of the aircraft, was proposed as a two and one-half mile minimum.

Semi-Circular Routes

Proposed "semi-circular" rules for determining appropriate cruising altitudes would require that all VFR traffic in and outside of controlled airspace cruise at odd thousands plus 500 ft. when on magnetic courses of zero degrees to 179 degrees inclusive and at even thousands plus 500 ft. on courses of 180 degrees to 359 degrees.

IFR flights would be conducted at odd thousands altitude between zero degrees and 179 degrees and at even thousands on other courses.

In proposing the change, the CAB's Bureau of Safety said the new system would simplify the selection of cruising altitudes and "resolve the difficulties of determining cruising altitudes along airways, crossing airways and in large control areas that have previously been without any designated altitudes."

Regulations covering instrument takeoffs and landings, if adopted, would require an instrument approach when airport ceilings are less than the minimum initial approach altitude or the visibility is less than three miles. The rule also would prevent any takeoffs when the ceiling is less than 300 ft. or the visibility less than one mile at airports which do not have minimum standards.

Tentative Australia Bilateral Pact Strongly Opposed by U. S. Lines

Washington—U. S. airlines are privately expressing strong opposition to the tentative air agreement reached between the U. S. and Australia.

The bilateral will give Qantas, the Australian national airline, rights to fly across the U.S. from San Francisco to New York and beyond to London, thereby establishing a round-the-world route.

In exchange, the State Department has asked for a route from the U.S. to Australia via South America and the South Pole; a route from Sydney in New South Wales to Perth in the western part of Australia and beyond to South Africa, and a route from Sydney to Jakarta, Indonesia, to Bangkok.

Tipton Protest

Stuart G. Tipton, president of the Air Transport Assn. which is leading the fight, declared that the Australian airline has absolutely no business serving as a transcontinental U.S. airline or becoming a New York-London airline. In fact, the terms of the agreement as allegedly offered by the State Department represent continued State Department reluctance to follow established bi-partisan U.S. air policy which has been the basis for the development of U.S. air supremacy in commercial aviation.

"The alleged agreement would weaken U.S. air strength not only in the Pacific but across the Atlantic and across our own country as well. The alleged agreement—which is another example of giving something for nothing—makes concessions which are completely unnecessary and unwarranted."

Although the State Department has announced that negotiations with the Australians have been concluded, it said the agreement has not been signed, pending approval of the Australian government regarding U.S. requests.

Carriers Reaction

Representatives of U.S. international air carriers said they could see little value to the routes requested and doubted that the Civil Aeronautics Board would approve applications for service on the proposed routes because, at present, most of them appear economically unfeasible.

The route to Australia via the South Pole, for example, is several thousand miles longer than the routes now flown by Pan American World Airways and Qantas across the Pacific and, therefore, would attract little traffic.

In addition, the spokesmen said, even if the routes were economically feasible and the CAB did approve U.S. carriers on these routes, such service might never be inaugurated because authority also would be needed from other governments since other countries are involved. From past experience, it might prove difficult to receive such authority in some instances.

Domestic airlines say the reported exchange would allow Qantas to carry traffic from San Francisco to Europe that normally would travel to New York via domestic carriers.

A large portion of that traffic already has been diverted through the Scandinavian Airlines System's polar flights to Europe and the inauguration of British Overseas Airways Corp. service from the West Coast to New York and beyond to London.

A strong protest was made by American Airlines, which has long sought authority to fly nonstop from San Francisco to New York. Pan American has also protested that the State Department has offered to permit a foreign airline to fly across the U.S. for a round-the-world route when Pan American is not yet permitted to fly across the U.S. to link its global service.

BOAC, the British airline, also has authority to fly around the world. However, it has not implemented its Tokyo-Honolulu-San Francisco route.

Cuba also is reportedly seeking more extensive air rights from the U.S., including routes to both the east and west coasts and beyond to Canada and Europe.

Germany, Australia Sign Air Agreement

Bonn—German-Australian air agreement signed in Bonn gives Lufthansa the right to establish a route from Germany over Egypt and/or the Middle East to Darwin and Sydney.

Qantas Empire Airlines in turn can fly from Australia to Frankfurt and on to Holland and England under the agreement.

At the moment, Deutsche Lufthansa

Northeast's First Britannia Flies

First Bristol Britannia for Northeast Airlines takes off for its initial flight at Belfast, Ireland. Aircraft was built by Short Brothers and Harland, Belfast, and delivered after its first flight to Bristol for fitting out. Northeast has five on order.

cannot make use of this agreement due to their limited number of planes. But Qantas maintains one weekly flight Frankfurt-Sydney and return which will be continued under the new agreement.

Colonial's Integration Completed by Eastern

Integration of Colonial Airlines into Eastern Air Lines, approved June 1, 1956 by President Eisenhower, has been completed, Eastern announced last week. The Colonial Division of Eastern, as the new unit had been called since Eastern's acquisition, now has become the Northern Division of the carrier.

Eastern says it has invested $31.5 million in modernizing the former Colonial system and fitting it to Eastern's standards. Some $30 million of the total was attributed to improvement of flight equipment by retiring DC-3s and DC-4s and substituting Constellations, Super Constellations, and Martin 404s. Remainder of the money went into new ground facilities and personnel training, according to Eastern.

The airline's payroll has been increased by $400,000 annually, it reports.

Port Says Air Force Hinders Civil Growth

Portland, Ore.—Help in solving the problem of joint military-civil aircraft operations at Portland International Airport has been requested of the Airport Use Panel by the Port Commission here. In a letter to Civil Aeronautics Administration's Western Region asking for a recommended solution, the commission said the mixture of interceptor and commercial operations at Portland was not conducive to normal growth or safe operation of a civil airport.

The commission also protested to CAA Administrator James Pyle that the Air Force is holding up action on the port's request for partial release from certain government rights of seizure at the airport. Air Force, the commission charged, is delaying stating its position in the matter to CAA so the Air Force can use its answer in negotiating for additional requirements at the airport.

The problems of joint use and of recapture are not related, the commission pointed out. Seriousness of the airspace problem was pointed up in an AVIATION WEEK report (May 27, p. 40).

Concerning the alleged Air Force stalling in the seizure matter, the commission told Pyle "the Air Force delay is hindering the full development of civil aviation in this area."

AIRLINE OBSERVER

► United Air Lines representatives are considering purchase of turboprop transports from Douglas aircraft. Airline is reportedly considering 20 DC-7Ts powered with Rolls-Royce Tyne engines. Price quoted by Douglas is based upon an initial sale of 40 aircraft. Original DC-10 designation has been abandoned because Douglas hopes for quicker certification by continuing an established series (AW June 10, p. 40). Cargo version of the aircraft is DC-7D. Capacity will be increased by adding 120 inches on front end of fuselage constant section, 40 inches aft and by splitting fuselage down the middle and inserting six-inch sections on top and bottom. Vertical fin will be swept, primarily for appearance.

► **Allegheny-Mohawk merger possibilities have been revived, but most observers feel such a move may meet resistance from the Civil Aeronautics Board. The Board has issued no policy statement on its decision in the North Central-Lake Central merger case, but there is a good chance that it disapproved the proposed merger because of an unwillingness to allow too great an expansion of individual local service carriers.**

► Greater Miami Aviation Assn. has proposed the construction of second Miami airport for jet transport operations. Group recommends the filling-in of land in a part of Biscayne Bay between Miami and Miami Beach to permit over-water takeoffs as a means of eliminating the noise nuisance.

► **Civil Aeronautics Administration has let a $9,777,287 contract with Stromberg-Carlson Division of General Dynamics Corp. for 263 sets of Tacan test, monitor and control equipment. Target date for commissioning Vortac stations with the Tacan equipment is July 1, 1959. Transponder equipment, which the sets in the CAA contract will monitor, is under procurement by the Navy at an approximate cost of $10 million for 213 dual equipments and antennas.**

► Large irregular air carrier investigation has been reactivated by the Civil Aeronautics Board with a call for briefs by July 15. Scope of the case will be confined to the fitness of the individual carriers and determination of whether authorizations should be granted by exemption or certificate. Filing of briefs is the final step in the complicated case before oral arguments are heard.

► **Trans World Airlines President Carter Burgess has announced an end to personnel layoffs provided the airline continues to show improvements in operating results. Out of 20,000 employes, the airline has terminated 500 since January for a complement reduction of 2%. Burgess forecasts a profit for June and has reported a marked decline in operating losses during the first four months of the year. Percentage of scheduled miles operated led the industry in March with 99.5%. High trend continued in April and May with 99.1% and 99.7%. During May, on-time departures reached 92.3%.**

► Iberia Air Lines of Spain is operating a weekly charter service from Madrid to Canada as a means of maintaining an even balance of transatlantic traffic. Charter aircraft which carry Spanish agricultural migrants from Madrid to Canada are returned to scheduled service on New York-Madrid flights. As a result, Iberia is now operating two west-east scheduled flights weekly and three east-west weekly flights.

► **Defense Department has declassified a total of 13 AN/APN Doppler radar equipments for civil use.**

► Last ditch fight by U.S. carriers against award of U.S. routes to KLM Royal Dutch airlines is gathering momentum. In a surprise action, Pan American World Airways filed a petition with the Civil Aeronautics Board for permission to intervene in CAB proceedings covering the grant of a foreign carrier permit to KLM. No precedent exists for a board decision contrary to the terms of a bilateral treaty and there is little likelihood that the Dutch carrier will be denied its foreign carrier permit despite any action by U.S. airlines.

SHORTLINES

► **United Air Lines** reports a record May for passenger and cargo traffic with 400,674,000 passenger-miles flown, an increase of 6% over May, 1956. Freight totaled 5,452,000 ton-miles, up 36% over May, 1956; U. S. mail climbed 6% to 2,549,000 ton-miles.

► **American Airlines** also established new May records with 442 million passenger-miles as compared with 410 million during May, 1956. American set a new domestic industry record in cargo ton-miles for one month with 10,300,000 in May, surpassing the carrier's own record of 7,835,000 set last October.

► **Air France** has added Frankfurt to its Paris-Hong Kong route. Lockheed Super G Constellations are being used on this flight, which leaves Frankfurt on Tuesdays and returns from Hong Kong on Saturdays.

► **Ghana is the latest** nation to join the International Civil Aviation Organization. The new nation becomes the 71st member nation in ICAO.

► **Mohawk Airlines** reports that traffic operations for May were 9.7% and 14.6% above May of 1956 in passengers and passenger-miles respectively. The carrier carried 36,056 passengers and flew 6,742,472 passenger-miles.

► **Sabena** will offer helicopter tours from Paris through the Loire region of France beginning July 14. The Sunday tours will continue through the summer and will offer low altitude air views of many famous chateaus in the area including Chinon, Tours and Chambord. Sabena will use Sikorsky S-58s on the tours.

► **Michigan Municipal Finance Commission** approved the issue of $6,550,000 in revenue bonds to construct a terminal building at the Wayne County Airport near Detroit. Wayne County Road Commission will handle the bond issue.

► **Council** of the International Civil Aviation Organization recently approved three "forward scatter" radio stations and a new Atlantic cable to be combined to provide a direct voice and four teletype communications channels between Europe and North America. The cable will be laid between Prestwick, Scotland, and Reykjavik, Iceland. The forward scatter stations will be built near Narssaq, Greenland, and Gander, Newfoundland, to complete the network.

COCKPIT VIEWPOINT

By Capt. R. C. Robson

A Stitch in Time

Airline planning for the operation of turbine powered aircraft is, in some respects, moving ahead at a fast pace. In many airline departments there is considerable optimism over the prospect of the new fleet. But there is also a distinct feeling among many informed people outside the transport business that our airlines do not fully realize the magnitude of their new venture.

Considering the aircraft themselves, the DC-8, the 707, the 880, the Electra, etc., there appears no concern for alarm. Our manufacturers certainly have the know-how to produce safe vehicles. It is the fitting in of these aircraft to the existing traffic control and airport system that causes the greatest concern. Then too, jets are a new breed of cats to civilian operators and undoubtedly a certain amount of shakedown time will be required to iron out the kinks.

The length of our trial and error period could obviously be reduced if we knew where to look and what to look for. And, just as obviously, advance information can come only from those who have been operating jets—the military.

Much to Learn

It is true that airline and military operations are a somewhat different nature. But this does not minimize the fact that much could be learned from people who have flown jets for a decade or more. The services had to find things out the hard way since they were essentially pioneering. It would appear that the airlines might gain an insight into their own future problems by examining in detail the experiences of the military.

What can be learned? Possibly a great deal. There are many ground handling and servicing items which may require different techniques than in the past. There are runways and ground surface (ramps, taxiways, etc.) requirements which may need special attention; i.e. the problems of debris, noise and blast screening, etc. Airlines may find that flight planning techniques and dispatch practices will need revision. In-flight items include more—or different—knowledge about meteorological data, winds and temperatures aloft, turbulence and icing, etc. The operation of turbine engines is an entirely new field for many airlines.

To some extent the entire subject appears to be more a question of degree than of kind. While it may be true that the jet is just another type of aircraft it is also true that in some areas their demands are so much more exacting than those of their ancestors that past methods simply will not suffice.

Military Files

The next question is, "How do we gather this information?" One possibility recently brought to my attention is that the airline operators secure permission to examine the accident and incident files of the military. A joint committee composed of representatives from the various airline operating departments might be able to correlate the factors leading to military troubles with airline conditions and alert their managements to possible danger areas. It will, of course, be imperative that these investigators have a thorough practical knowledge of present airline operations in order for them to spot parallel situations.

The public, as well as the air transport companies, is looking eagerly to our jet future. One way to make this transition as smooth and safe as possible is to be prepared. How can we better prepare ourselves than by reviewing the trials and tribulations of others? An accident research program might be well worth the effort.

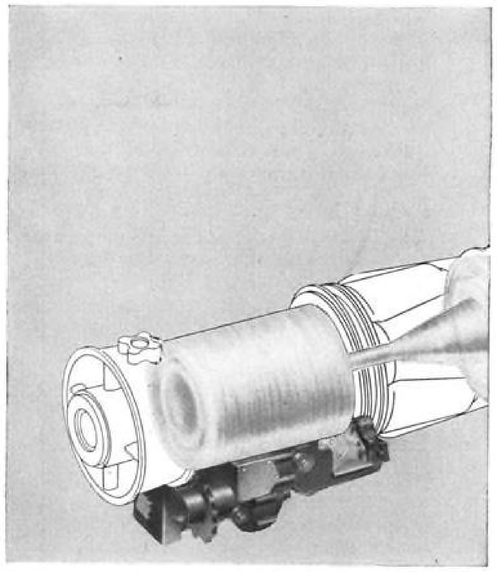
Here's Why General Electric's New

BEST POWERPLANT

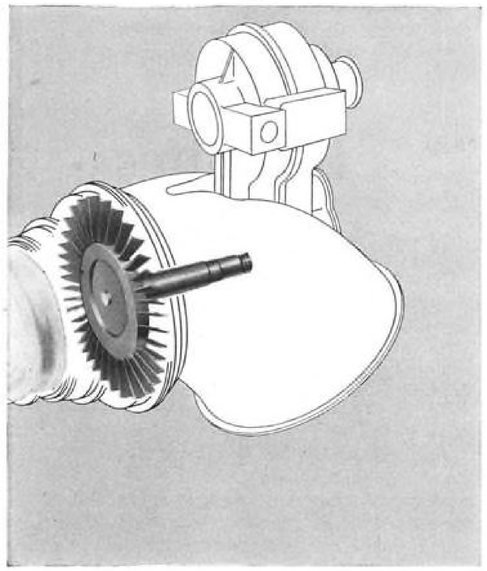
T58 Turboshaft Engine Is The

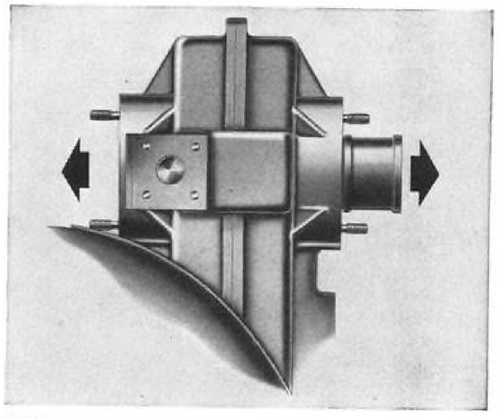
FOR HELICOPTERS

NOW BEING FLIGHT-TESTED in a modified Sikorsky S-58 helicopter, two T58 engines deliver more than 2000 horsepower, yet weigh only 650 pounds.

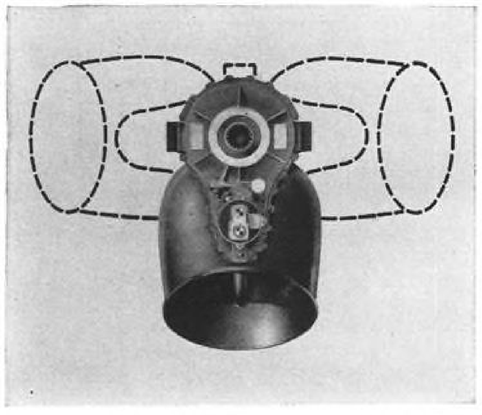


T58'S ADVANCED CONTROLS, FREE TURBINE DESIGN help simplify pilot duty; allow the helicopter rotor to operate at best speeds for climb, cruise, or hover conditions.





T58'S MAIN REDUCTION GEAR permits convenient fore or aft power extraction.



T58'S 3-POSITION EXHAUST NOZZLE mounts vertically or at 90-degree angles.

Offers unmatched performance capability; advanced mechanical design features

Over 3:1 Power-to-weight Ratio—Packing more power per pound than any other gas turbine engine of comparable output, the T58 delivers 1024 horsepower yet weighs only 325 pounds (including 75-lb reduction gear). What will the T58's low weight mean to future helicopters? Drastic reductions in their gross weight—up to 40% faster cruising speeds—greater endurance—and vastly increased ton-mile capacity. In addition, the T58's advanced aerodynamic and lightweight mechanical design promises the same high reliability that has been *proven* in G.E.'s J47, J73, and supersonic J79 jet engines.

0.69 Specific Fuel Consumption (normal, with gear)—The T58's turbine inlet temperatures, pressure ratios and the aerodynamic design of its major components have been balanced to provide the highest possible operating efficiency over a wide range of helicopter flight conditions. Result: a *proven SFC* that rivals the piston engine for economical operation.

Automatic Rotor Speed Control—The T58's revolutionary new constant-speed control eliminates the need for speed adjustments by the pilot during normal flight operation. Combined with the T58's free power turbine, this new control automatically regulates engine output to meet changes in load or flight attitude, thus permitting the helicopter rotor to operate at the most efficient speeds for take-off, climb, cruise and hover.

Small Envelope Size—Measuring only 59 inches long by 16 inches at maximum flange, the T58 makes possible more compact engine compartment design, additional cargo space.

Versatile Exhaust & Power Take-off Arrangement—The engine's 3-position exhaust and fore or aft power take-off arrangement also simplify problems of designing or retrofitting engine compartments in either single- or multi-engine helicopters.

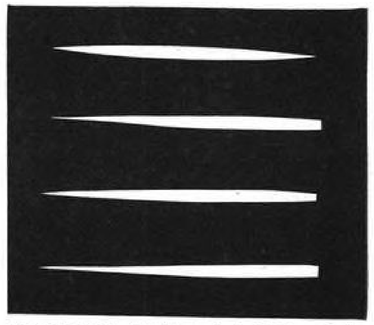
The T58 was developed for the Navy by General Electric's Small Aircraft Engine Dept. General Electric believes the T58's many features make it the best engine of its kind to transform the role and performance of helicopters into new levels of military and commercial usefulness. For detailed performance data, call your local G-E Aviation & Defense Industries Sales Office, or write: General Electric Co., Section 233-5, Schenectady 5, New York, for T58 brochure.

Progress Is Our Most Important Product

GENERAL ELECTRIC

ONE OF FIRST U. S. aircraft to have blunt ailerons was the Bell X-2 (above). The French Nord Gerfaut II and Sud Aviation Baroudeur also use blunted control surfaces.

CHANCE VOUGHT F7U (above) has blunt ailerons to improve transonic stability. NACA used modified F-86 (below) to obtain transonic flight test data on the basic concept.



SUPERSONIC airfoils typical of those being tested by the NACA. Each has the same thickness ratio. Upper airfoil is a conventional biconvex form which is compared with blunt shapes below. Differences among blunt trailing edge airfoils are due to varying design Mach numbers and structural requirements.

Bluntness

By J. S. Butz, Jr.

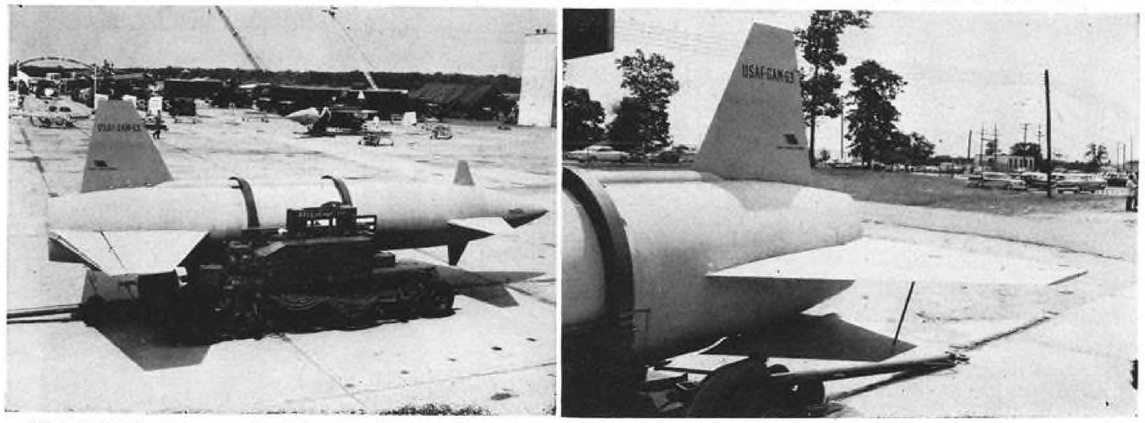
New York—Bluntness can be an aerodynamic asset. Contrary to conventional streamlining concepts and some early supersonic theory, blunt rather than sharp edged wings and rounded rather than pointed bodies may be the most efficient for supersonic and hypersonic flight.

Paradoxical as it may seem, NACA experimentation shows:

- **Minimum drag** airfoils have blunt trailing edges from Mach 1.5 to 5.0 and indications are that this is true at much higher Mach numbers.
- **Lift** is improved at all supersonic speeds by use of a blunt trailing edge airfoil.
- **Aerodynamic heating** of a wing may be reduced by rounding its leading edge. This is also true of an aircraft or missile nose.
- **Stability** of an aircraft may be improved at transonic speeds by using blunt trailing edge wings and control surfaces.
- **Blunt nose shape** is the most effective configuration for keeping aerodynamic heating low on very high velocity objects of the size and weight of a current ICBM warhead during re-entry.

Fundamental nature of this NACA information indicates its value to the aircraft industry by pointing the avenues of possible approach to aeronautical problems. The work on blunt trailing edge wings was led by Dean R. Chapman, and that concerning re-entry was directed by H. Julian Allen. Both are with the Ames Laboratory.

The latest display of its usefulness was at the Paris Air Show where blunt trailing edges appeared on French prototypes (AW June 10, p. 26). Blunted ailerons were on the Nord Gerfaut II and extruded angle plates on the Sud Baroudeur rudder.



BELL RASCAL air-to-ground missile shows blunt trailing edges on its forward and aft lifting surfaces to improve stability during high angle of attack maneuvering. Lower fin is folded during transport on dolly. Upper fin also will fold.

Can Add Efficiency to Aircraft, Missile

Blunt Trailing Edge

Several fundamental differences between subsonic and supersonic lifting and airflow characteristics make it possible for the blunt trailing edge airfoil to attain superior efficiency above Mach 1, in contrast to its poor subsonic lift and drag qualities.

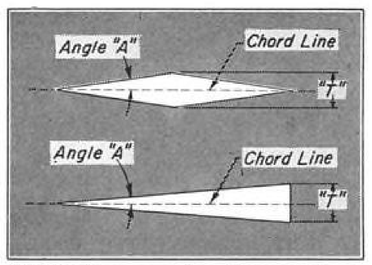
Zero-lift, or minimum, drag of a subsonic sharp trailing edge airfoil at Mach numbers well below one results primarily from skin friction. Pressure or wave drag of this airfoil is low because the long pointed afterbody keeps the flow separation point well back on the chord and reduces the wake. The only effect of blunting the trailing edge would be to create a base pressure and increase the total drag.

In supersonic flow the pressure drag of an airfoil depends to a great extent upon the magnitude of the angle between the surface and the chord line (Angle A, right). Angle A and consequently the pressure drag of an airfoil of given chord and strength can be greatly reduced if the point of maximum thickness is moved to the trailing edge.

Even though the use of this shape reduces the pressure or wave drag it obviously has the disadvantage of creating a large base drag. With careful design this disadvantage can be overcome, for it has been proven the added base drag can be less than the reduction in wave drag achieved by moving the point of maximum thickness aft. The supersonic drag savings realized experimentally with blunt trailing edge designs have exceeded 30% for 10% thick wings around Mach 2.

The problems inherent in choosing the best airfoil to meet a given set of design requirements are too involved to make general statements regarding the superiority of any given airfoil shape. Airfoil contour, position of maximum thickness, and base height are dependent on many diverse factors such as structural requirements, desired lift-drag ratio, design Mach number, pitching characteristics, heating rate, etc.

For this reason, experimental blunt base airfoils which the NACA tested were designed to simplified specifications which closely approximated current supersonic design requirements. In the typical test, comparisons were made of several sets of conventional biconvex and double wedge supersonic airfoils and blunt trailing edge shapes which were all designed to give minimum wave drag. Each airfoil in a set had the same thickness ratio and design Mach number and either a specified bending or torsional strength. Comparison of the drag coefficient of the various airfoils in a set was to indicate whether blunt trailing edge airfoils had application in normal design work.



PRESSURE or wave drag of supersonic airfoil is very sensitive to angle A (above). Moving maximum thickness to trailing edge results in reduction in total airfoil drag above Mach 2, according to NACA tests.

Test Confirmation

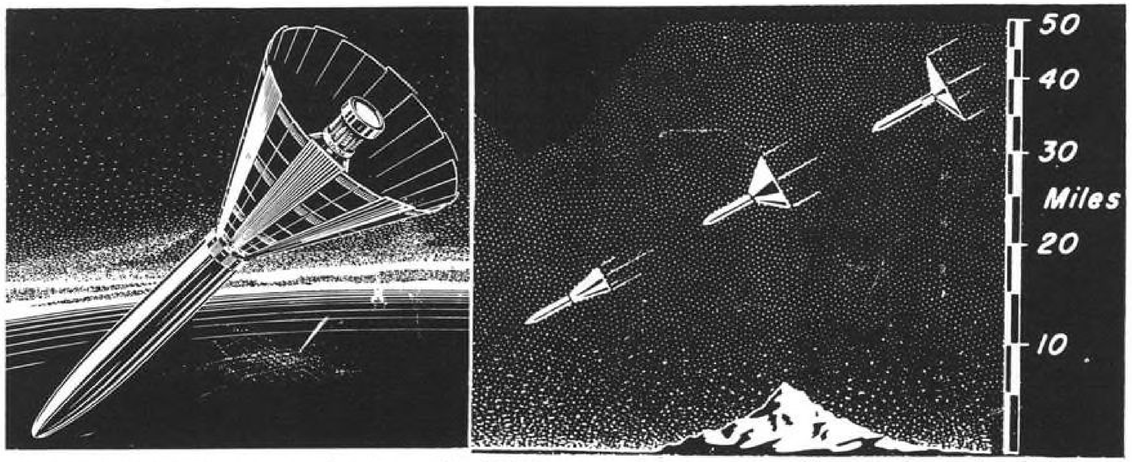
The results of these tests showed that definite drag improvements at supersonic Mach numbers were possible using blunt trailing edge airfoils NACA found that:

- **Drag reduction** achieved by blunt trailing edge airfoils decreases as thickness ratio decreases.

This is because the percentage of wave drag in total drag decreases with thickness ratio.

- **Possible drag reductions** grow smaller with increasing Mach number. This is apparently because the ratio of wave drag to friction drag decreases with Mach number. Successful reduction of aerodynamic heating and friction drag at high Mach numbers could still make blunt trailing edges attractive at very high Mach numbers.
- **Base pressure** is low and therefore airfoil efficiency high if the boundary layer at the base is turbulent and its thickness is large compared to the base height.

Particular care must be exercised in keeping base pressure low on blunt trailing edge airfoils for use below Mach 2. The base drag, the drag



VARIABLE GEOMETRY nose cone above is example of NACA re-entry design suggestions. This type of warhead could have controlled speed and deceleration history and eliminate the low terminal velocity and terrific deceleration of the spherical warhead. Aerodynamic heating could also be kept low enough for known materials and cooling systems.

behind any blunt base, could be 75% of the total drag of a 5% thick airfoil at Mach 1.5 if the base pressure were a vacuum.

The key to this whole design approach is to keep base drag low. Studies of the boundary layer at the trailing edge have been started to optimize its effect on base drag. Various boat tail arrangements are also being tried.

One of the most promising means of reducing base drag is bleeding air into the low pressure or dead-air area behind the airfoil. Results of this approach indicate that 50% reductions in base drag are possible up to Mach 2. Data beyond that speed are not presently available. Maximum alleviation of base pressure occurs when the total pressure of the bleed air is 75-90% of the ambient static pressure. The mass rate of bleed air flow required to achieve these results is not large and it discharges at subsonic velocity.

Trailing edge bluntness has just as beneficial an effect on lift as it does on drag at supersonic speed.

Here again basic differences between subsonic and supersonic flow principles indicate that a supersonic airfoil should have a wedge shape.

In subsonic flow the lifting efficiency of an airfoil depends on its camber or contour, its thickness ratio, and the condition of the boundary layer. None of these factors have a major effect on supersonic lift. In fact, the expression for lift curve slope at supersonic speeds can be reduced to a function of only trailing edge thickness ratio and Mach number, and it increases as these two factors increase. This expression for lift curve slope was postulated and proven experimentally in the 1930s by Busemann, later verified by NACA.

The advantages of blunt trailing edge wings, proven by the NACA, indicate that significant improvement in supersonic lift-drag ratios and consequently aircraft range is possible if not probable. The lift improving benefits of the blunt trailing edge continue to increase with Mach number. If means are found to decrease friction drag above Mach 5 then a usable extension of the blunt trailing edge's wave drag reduction is possible. Also, the structural advantages of a blunt trailing edge wing are obvious as it eliminates a sharp slender section which is most difficult to manufacture and design.

Trailing edge bluntness has also been of use in improving the stability of swept wing aircraft especially in the transonic region. NACA flight tests with a modified F-86 illustrate the advantages of blunt ailerons although blunt trailing edge control surfaces were used on other aircraft, two of them the F7U and the X-2.

Two of the stability problems occurring with a swept-wing aircraft are pitch-up and wing dropping or roll-off. Pitch-up occurs when the flow on the outboard portion of the wing separates and the wing center of pressure moves inboard and forward. Roll-off is usually due to asymmetrical flow separation on the outer wing and the reversal of aileron control for small deflections during separation.

NACA work towards improving the transonic stability of the F-86 is similar to industry efforts, and it also provides an interesting view of some of the flight limitations of the Air Force's best fighter until a few years ago. Tests with the F-86 showed that separation occurred initially on the forward part of the outboard wing up to Mach number of .86. At and below this Mach number, pitchup took the form of a virtually uncontrollable stall at moderate angles of attack. The solution was providing outboard leading edge extensions.

In the Mach number range from .85 to .94, pitch-up on the F-86 occurs because of separation on the aft portion of the outer wing. Several methods were tried to prevent this separation, such as wing fences, vortex generators, and leading edge extensions. Each device helped the situation but none were as effective as using blunt trailing edges on the ailerons, which are outboard and in the region of separation.

The blunt trailing edges prevent separation by the simple means of decreasing the trailing edge angle to reduce the build-up of the adverse pressure. The modified ailerons, though no panacea, greatly reduced the violence of the pitch-up, delayed it until a higher Mach number, and made it possible to keep control of the aircraft under higher accelerative loadings. They began to lose effectiveness in curing the F-86's pitch-up troubles in a region that was at the absolute upper limit of the airplane's capacity.

Roll-off, which was very bad on the original aircraft from Mach .9 to 1.0, was virtually eliminated by the increased effectiveness of the blunt ailerons. The aileron hinge moments were increased but not beyond the capacity of the original control system. The drag of the blunt ailerons amounted to about .0015 below Mach .9 and was zero above that speed.

The equilibrium temperature and the heat transfer rate of an airfoil surface in high speed flight may be reduced by delaying the transition from laminar to turbulent flow in the boundary layer. By rounding the leading edge in preference to keeping it sharp edged, this delay has been obtained.

Round nose shape creates a detached shock wave in front of the wing which increases pressure drag. However, it

also creates a low Reynolds number and low Mach number region near the forward surface of the wing which is a good environment for a laminar boundary layer.

NACA theory shows that the transition point moves downstream by a factor of 2 at Mach 3 by using the blunt nose. If the theory continues to hold true at hypersonic speeds, with its dissociated air flow and attendant boundary layer problems, the transition will move downstream by a factor of 30 at Mach 15.

The pressure drag created by rounding the leading edge is low at supersonic speeds if the roundness is moderate.

The great saving in friction drag possible with this design would indicate there is a possibility that hypersonic airfoils will have rounded leading edges and blunt trailing edges.

In their generalized report on heating problems and re-entry configurations, H. Julian Allen and A. J. Eggers, Jr., reached several basic conclusions. One concerns the shape giving the lowest total heat absorption for a missile nose cone at re-entry speeds up to 10,000 fps. The proper shape for a light nose cone which could be pushed by a current ICBM is blunt, in the nature of a sphere. A much heavier nose cone would require a long, slender shape. A thorough study of the problem at higher speeds is not possible because of insufficient knowledge of the properties of disassociated air (AW June 25, 1956, p. 50; July 2, 1956, p. 47).

Another aspect of the problem which they studied was the rate of heat input for each proposed configuration. This factor is very important because the surface of the nose cone skin can

Plan View of T-38

Further details of Northrop T-38 supersonic trainer are shown in this artist's conception of a formation. Plan view shows area rule fuselage and relatively straight wing set well back. Two turbojet engines will power the trainer.

reach high temperatures instantaneously while the inner surface of the skin is relatively cool. This creates large thermal stresses which must be kept low to prevent the failure of the missile nose cone.

The blunt shape has the lowest heat transfer rates, but the long slender shape was satisfactory. Intermediate shapes were the ones with the prohibitive rates (AW May 20, p. 31).

The blunt shape, which has more interest today in light of the capacity of current missiles, has many advantages. Some of them for a spherical shape:

- **Friction drag** only a small percentage of the very high total drag. Low friction drag means relative coolness.
- **Maximum volume** for a given surface area.
- **Continuously curved** surface inherently strong and stiff.
- **Large stagnation point** radius to distribute maximum thermal stress.
- **Stability** maintained while the sphere is rolled slowly, distributing the heat over the whole surface.

The sphere also has these disadvantages:

- **Low terminal speed,** allowing effective countermeasures.
- **Lower average speed** to target introducing larger wind drift errors.
- **Maximum deceleration** more than can be allowed.

Similar lists could be compiled for any proposed missile shape. A number of possible compromises to reach workable designs could certainly be offered for each proposal. An example of an attempt to overcome some of the disadvantages of the high drag shape was a variable geometry configuration proposal. Thus deceleration and velocity history of the missile could be controlled and kept within the allowable limits.

Historical Background

The first supersonic experiments performed with blunt trailing edge airfoils were conducted by Busemann and Walchner in Germany in 1933, as far as the NACA knows today. These experiments were made with a wedge shape for the purpose of proving that this airfoil had better lifting characteristics than one with sharp edges. They produced very little data about relative drag between sharp and blunt trailing edge airfoils.

After the war, Chapman of NACA became interested in this German work and certain conclusions reached by Antonio Ferri in Italy concerning the base drag of sharp edged supersonic airfoils. The study of both of these works left the suggestion that it might be possible to reduce the pressure drag of a supersonic airfoil by moving the point of maximum thickness to the

ROCKET POWER PROGRESS REPORT

Servicing Rocket Engines

Part II: Product Improvement

by Fred Barker

In this, the second of two articles describing the activities of service engineers and service representatives at Reaction Motors, Inc., Mr. Barker, Supervisor of the Product Service Department, illustrates how the technical "know-how" described in Part I is utilized by the department in the area of Product Improvement.

A good product can always be improved—particularly by those working closest to it. RMI's Product Service Department accepts this as a continuous challenge as it works with rocket engines and related components. The rewards of such a philosophy are three-fold: a superior, more easily serviced product, a pleased customer and the personal satisfaction of accomplishment.

At RMI we concentrate on four areas in the improvement of rocket engines: serviceability, reliability, safety and performance. For instance, in the area of reliability, initial ground runs on RMI's 6,000-lb. thrust engine in the Bell X-1A airplane frequently resulted in fuel pump cavitation upon starting the powerplant. Our service men traced the probable cause to the relocation, during installation, of the outlet port on the fuel diffuser case. It was found that air was being trapped in the case. This is a perfect example of how a seemingly minor change can radically affect engine reliability. To overcome this problem, the fuel pump was equipped with a bleed valve that automatically bled the entrapped air overboard during the liquid oxygen prime period prior to each engine start. Reliability was restored at the cost of adding another component, but installation demands could be satisfied only by this procedure.

Our service engineers and representatives often recommend design changes to improve products. A typical example of this is the way RMI worked with the National Advisory Committee for Aeronautics to improve the normal engine reliability of our 6,000-lb. thrust engine in the Douglas D-558-II airplane. The thrust chambers had failed to start on several random occasions. The trouble was traced to mechanical failures of the poppet retainer in the igniter oxygen poppet valve. This prevented the igniter from firing to start the thrust chamber. Service engineers in the home office then modified the poppet valve for greater mechanical strength. This improvement was proved successful by poppet valve tensile pull tests and igniter firing tests; replacement parts were obtained and installed in all engines in the field to prevent future failures from this cause.

Anxious to improve performance of the X-1E airplane, NACA considered the possibility of incorporating nozzle extensions on the thrust chambers of the X-1E's RMI rocket engine. After Service Department preliminary design work was accepted by NACA, installation problems were resolved with NACA by one of our service engineers. He then firmed nozzle extension design, assembly and installation details. This change proved so effective that now—for the same propellant consumption—thrust at altitude is appreciably greater. A good engine has been modified to perform even better.

Another function of the Service Department in its role to keep rocket engines going is the handling of engineering changes, all of which must be coordinated through and approved by the customer. Before any modification is made, RMI service engineers prepare "engineering change proposals" for approval by the customer. Upon this approval, the changes are incorporated into the affected drawings, and service bulletins are prepared to guide field personnel in effecting the change. Conversion kits are prepared, where needed, and service handbooks are revised.

Because the functions of RMI's Product Service Department are so varied, the men who make it up must be more than talented professionals. They must also have the traits of versatility and willingness to tackle new and different assignments. And—because our team is expanding—we would like to talk to *you* if you believe you have the professional qualifications and versatility that are so essential in good service men.

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If you desire reprints of this two-part article by Mr. Barker, or would like to receive additional information about RMI, write to our Information Services Coordinator, Reaction Motors, Inc., 14 Ford Road, Denville, New Jersey.

Power for Progress
RMI

trailing edge. The prerequisite to any theoretical study comparing airfoils with sharp and blunt trailing edges was better knowledge of the pressures existing behind a blunt base at supersonic speed.

Little Data

Very little data of this kind was available in the 1940s, so Chapman made this the subject of his doctorate thesis at California Institute of Technology. This thesis in 1949 indicated that in theory the blunt trailing edge was best above Mach 2. Subsequent work by Chapman and other NACA scientists has continued to give credence to the original idea. Studies have also been made in Sweden by Georg Drougge concerning the design of blunt trailing edge wings which have minimum pressure drag and also satisfy given requirements of bending and torsional strength.

Simple Blast Fence Cuts Noise 15-20 db.

Simple, low cost blast fences cut noise an estimated 15-20 db. by deflecting high energy boundary layer from parking area pavements up through the rest of the blast. The fence is a quarter-cylinder of corrugated iron with the inner surface facing the blast. It is mounted upon a structural iron L-section frame with the pavement tangent to the curve of the blast resisting surface. All attachments including the anchors to the pavement are made with a single size of bolt and nut for the sake of standardization. The fence is made by Lynn Engineering Co. of San Jose, Calif.

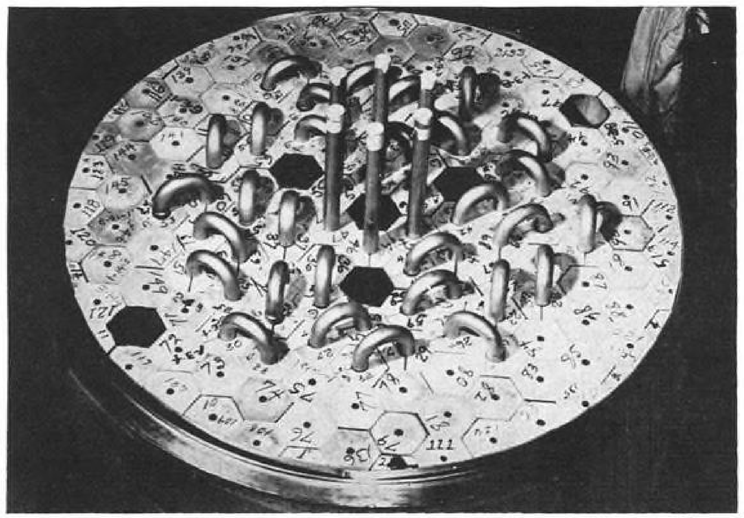
The design is based upon engineering studies showing that as blast expands in a conical area aft of the tail pipe, its bottom edge is redirected and accelerated by the pavement. In a distance of 20 feet, this boundary layer may reach three times the velocity of the blast at the centerline. The fence deflects the high speed layer through an arc of 104 degrees to blow back upon the greater part of the jet efflux and turn it upward.

End plates prevent pressure from spilling around the fence.

Water cooling heads are available if the rence must withstand the heat of afterburners.

Douglas Aircraft, El Segundo, is using one of the fences and reports that it works satisfactorily. The current price of fences that are six feet high at the upper edge is $36 per foot. The maker believes the price could be reduced to $26 per foot if sold in quantity.

Though height of the fences is not considered an important parameter, an eight-foot version is being studied.



AIRCRAFT POWERPLANT reactor from experiment 2½ years ago (AW May 27, p. 27). Large tube at top of 33 in. diameter reactor outlet (left) is for the sodium heat removal circuit while smaller extensions at outer rim probably provide access for flux measuring instrumentation to evaluate fission. The other pipes in the center are for regulating and control rods. The reactor, probably part of a joint Pratt & Whitney-Oak Ridge project, first became critical Nov. 3, 1954 when enriched uranium tetrafluoride concentrate was added to the molten fluoride salts being circulated around the power loop. Top of reactor core (right) shows the 66 tubes which circulated the molten fuel through the beryllium-oxide moderator-reflectors in serpentine loops. Six upright pipes in the center are fuel inlet tubes. The four hexagon-shaped holes around the fuel inlet pipes are for regulating and control rods, and two holes near the rim are for the neutron instrumentation.

Nuclear Airframe Designers Lose Conventional Load Tools

By Russell Hawkes

Los Angeles—Designers of nuclear airframes will lack many of the means by which structural loads of conventional planes are relieved and structural weight is saved, the chief of Lockheed Aircraft's WS-125A nuclear bomber program told Institute of Aeronautical Sciences members at a recent meeting here.

An important loss to the designers will be the present practice of distributing weight along the wing, impossible in a nuclear plane because of its fuselage-mounted powerplants and landing gear and little or no demand for chemical fuel, according to a paper by F. A. Cleveland, head of the bomber program at Lockheed's Marietta, Ga. Division and C. L. Johnson, the company's vice president, research and development.

Bomber First

This and other special considerations in the design of nuclear airframes were outlined in the paper presented by Cleveland, who said the strategic bomber is the logical first application for nuclear aircraft power.

According to the report, three characteristics of the nuclear plane create the peculiarities of its airframe design:

- **Concentrated** weight.
- **Radiation** field.
- **Absence** of any important range limit.

The first two characteristics raise a host of problems compensated by the obvious and overwhelming benefits of the third. A secondary benefit is the nuclear bomber's relative invulnerability to bullets due to the absence of the vast quantities of combustible chemical fuel carried by conventional aircraft.

Concentrated weight of reactor and radiation shielding can be mitigated by dividing shield so that part surrounds reactor and part surrounds crew with a large separation between to attenuate radiation with distance. Shielding also can be reduced by careful use of wing box, landing gear, payload and the small amount of chemical fuel which is likely to be carried because of special advantages in certain regimes.

The designer's approach to weight and balance is altered by the greater tendency of components and subsystems to compete for space in the fuselage near the center of gravity. Reasons for congestion of weight here are:

- **Reactor, shield assembly** and turbojets account for over half the equipped empty weight of the airplane.
- **Reactor must be near** the CG, because of its great mass.
- **Nuclear turbojets** must be mounted in fuselage as near as possible to reactor to ease the difficult problem of heat transfer from the reactor to the heat exchangers which replace combustor cans of conventional turbojets.
- **Much of heavy shielding** needed to protect crew and equipment from radiation must be located near reactor.
- **Thin wings** needed for high speed flight and absence of engine nacelles force landing gears into the fuselage where they must be located near CG to minimize weight of supporting structure and to control impact loads on nosewheel.
- **Wing must pass** through fuselage near CG unless it is designed with excessive sweep-back to carry the juncture forward. Cleveland does not consider this a sound engineering approach and showed a slide of a nuclear airplane with a low aspect ratio, straight wing planform reminiscent of the F-104.
- **Disposable weight,** which includes bomb load, must be carried near CG to limit CG travel.
- **Aircraft fixed equipment** tends to spread out in the fuselage and can't be of much help to the designer in rebalancing.
- **If shield is divided** with part near reactor and part near crew compartment in nose, the designer may vary weight proportions to control balance. Because of the density of shielding, this is a powerful tool, but one which the designer cannot use freely without affecting the primary purpose of shielding. The reactor shield assembly may weigh from 25,000 lb. to 100,000 lb. with a density of 100 lb./cu. ft. to 200 lb./cu. ft.

Shield division which also provides the best crew protection raises its own family of problems. The designer is not free to choose the best separation distance for crew protection. Carried to extremes, this would create insuperable aerodynamic and structural problems. The necessity of installing any shielding at all in the nose would hurt weight distribution along the fuselage from the structural standpoint and demand heavier structure to cope with static loads.

It would also cause low frequency fuselage vibration modes calling for yet heavier structure.

Stability Problems

Concentration of mass at two widely separated points along the fuselage could also be expected to cause worse moments of inertia in pitch and yaw. The effect of increases in these moments probably would not be great but must be considered.

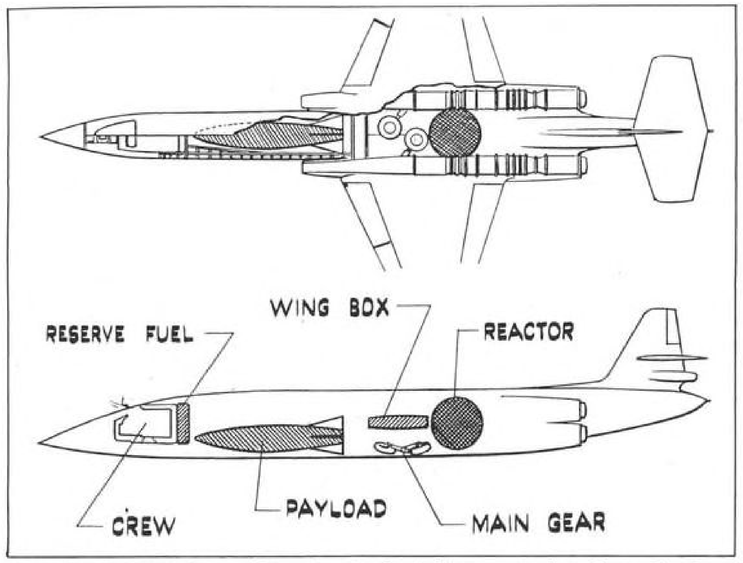
One result of the development of the nuclear propelled aircraft will be the loss of the means by which designers now relieve structural loads and save structural weight in conventionally powered aircraft by distributing much weight along the wing. This reduces rather than increases the bending loads on the wing root which would exist in flight if the weight were concentrated in the fuselage. Engine pods, internal wing fuel tanks, tip tanks, wing mounted armament and wing stowage of landing gear all contribute to this end.

The nuclear aircraft will not benefit from this approach.

Consumption of chemical fuels in flight and means to discharge them in emergency has been an important means of structural relief as the airplane can be designed to light landing weights rather than heavy take-off weights. There is no important difference between the two in a nuclear aircraft and landing loads must be figured on the basis of maximum take-off gross weight. Fuel consumption of a conventional bomber also offers a bonus at the target end of a flight in terms of speed, rate of climb and maneuverability.

Cleveland said it is likely that the engines of the nuclear aircraft will be designed to burn conventional fuel for some regimes of flight. Response time of the nuclear engine to changes of power setting may be too long to be relied on for takeoff or for a wave-off in the landing approach.

Two advantages accruing to the nuclear aircraft are reduced range of CG travel and smaller growth factor for an increase in useful load. The CG range of 12%-16% in conventionally powered airplanes should be cut to half that or less with the advent of nuclear power. The cost of an additional pound



INBOARD PROFILE of a possible nuclear bomber indicates congestion of around center of gravity. Most desirable layout, Lockheed believes, is to have engines close to reactor. Here four engines are mounted in pairs on each side of fuselage, one engine above the other. Wing box, landing gear also vie for positions at CG.

of payload or equipment in the nuclear aircraft should be 1.5 to 4 lb. of structural increase compared to 3 to 10 lb. of fuel and structure increase in a conventional airplane. The cost of an additional pound of drag can be analyzed in the same way and shows the same advantage for the nuclear powered airplane.

Many of the characteristics of the nuclear aircraft stem from the need to defend against the effects of radiation. Much of present research in the field is aimed at defining these effects precisely.

Protecting the human crew is perhaps the most critical factor in design. Engineering of efficient crew stations is made especially difficult by the conflicting demands for elbow room with protection and for rational limits on weight. Each cubic foot of cockpit volume costs from 50 to 500 lb. of shielding. Careful engineering has enabled engineers to shave the crew space allowance to 50-75 cu. ft. per man but movement in such a space is not easy. Limited space and the presence of the shield also make escape difficult in an emergency.

Shielding hampers visibility because some shielding is needed on all sides of the cockpit and good transparent shields are difficult to make. Radiation, whether of free neutrons or gamma rays, is highly directional and in a vacuum a flat plate shield between the source and the man would provide adequate protection. However, both types of radiation may be diffused as much as 180 deg. by air atoms or structure. Since the energy of radiation decreases as diffusion angle increases, the density of the shield required decreases from rear to front around the curvature of the nose. Intensity of diffused radiation remains great enough so that windows must be made of some transparent shielding material even in the very center of the windshield.

Human Limits

Setting human dosage limits appears to be the most difficult task in the research leading to the nuclear airplane. Aside from the difficulty of predicting the behavior of the radiation, it appears that various bodily organs are sensitive to it in varying degrees.

The hazard to the ground crew will probably be worse than that to the air crew. Present indications are that the ground crew will be limited to the Atomic Energy Commission Maximum Laboratory Dosage Rate of 7.5 milliroentgens per hour while the air crew rate may be 10 to 100 times as great.

The reason for this is that whereas shutting down the reactor cuts radiation by one order of magnitude or more, decaying radiation persists at a harmful intensity for a time which will be governed by the half-life of the radioactive products. Because of the rapid initial rate of decay, a wait of a few hours before starting maintenance operations will allow intensity to fall considerably. Finding good shielding materials for the ground crew is made easier by the fact that radiation after shutdown is almost exclusively gamma rays.

Better Solution

Remote controlled mechanical manipulators would eliminate hazard to mechanics but experiments have shown that a job takes five to 10 times as long even with direct vision. If closed loop television were used, it would be reasonable to expect a still longer time. A better solution may be to remove the engines to a special shop for maintenance work, leaving the airframe available for normal work methods.

Cleveland and Johnson divided material damage by radiation into eight fields:

- **Dimensional changes** independent of the stress on the part. The dosage levels required to produce these changes is such that it is a problem mainly within the reactor shield.
- **Acceleration of creep** due to high stress levels and high temperatures. If aerodynamic heating, radiation heating or heavy loads cause changes in the dimensions of structural materials, the designer must take care not to let these changes be accelerated by subjecting the materials to heavy radiation.
- **Hardening and embrittlement** by radiation. This may be an important design factor. Fortunately, work hardenable alloys in the hardened condition are not much affected, but for pre-stressed fittings and connectors near the reactor there is a possibility of greater notch sensitivity and reduced impact strength.
- **Micro-diffusion** of dissimilar metals at faying surfaces. This may cause embrittlement and other metallurgical troubles. It occurs because diffusion of atoms in metal is more rapid in the presence of radiation and is a special threat at riveted or bolted connections between dissimilar metals.
- **Accelerated stress corrosion.** This too is caused by accelerated diffusion of atoms in metal.
- **Transmutation** under bombardment by slow neutrons. Most metals are changed into others. Aluminum becomes silicon, copper becomes nickel and zinc and some metals become isotopes of the original metal. No structural materials become gas or liquid and the percentage of transmutation is probably less than the unknown impurities in the original metal.
- **Induced radioactivity.** To be a serious problem, the irradiated material must have four characteristics—it must

have a strong tendency to capture neutrons in its nucleus, the isotope produced must be unstable, radiation from the isotope must include a fair amount of medium or high energy gamma and the half life of the isotope must be fairly long. The basic structural materials such as aluminum, iron, titanium and magnesium are all safe because of deficiencies in one or more characteristics. Usually, it is the alloying materials that are troublesome. Zinc, molybdenum, tungsten, chromium and manganese are all prone to become hot.

• **Molecular structure changes.** These occur mainly in organic materials. Radiation breaks their molecular chains causing physical characteristics to deteriorate and often evolving gas. Rubber loses its elasticity and lubricating oils, hydrocarbon fuels and hydraulic fluids evolve gas and tend to gum. In some cases the effects are beneficial. The molecular chains cross-link without cleaving, producing greater strength and density and better heat stability.

It is possible that the sphere of air ionized by radiation and centered on the reactor may cause an extremely difficult problem for avionics engineers by attenuating radio propagation. If true, radio communication would be badly limited and radar ranges would be much reduced. No one knows whether this attenuation happens at all frequencies or what is the threshold ionization level for detectable attenuation.

Cooling-Off Period

Germanium transistors, electrolytic condensers, photo tubes and bias cells all become totally unusable in a high flux. Capacitors, tubes, relays and switches may require an unacceptable cooling-off period of several weeks. This situation can be relieved somewhat by placing avionic gear in the shadow of the reactor shield.

An important problem is protection of shielding from the heat generated outside the reactor by radiation. It may have to be cooled by some type of liquid to air heat exchanger as the amount of heat to be handled at the reactor shield may approach 10% of the total reactor power.

When the reactor is shut down, the decay of radioactive products still generates heat within the reactor and engines though fission has stopped. This "afterheat" disappears with time but in the first week or two after shutdown it is great enough so that without forced cooling an engine reactor core would melt itself and destroy the reactor. To prevent this the engine must be run continuously, even on the ground, plenty of auxiliary cooling air must be supplied, or the fuel must be taken out of the airplane. If an engine is stopped in an accident on takeoff or landing, its core will be ruined by the afterheat.

Nuclear Plane Crew Hazard May Be Less Than Supposed

Denver—Radiation hazard to the crew of a nuclear propelled aircraft may be less than originally estimated, but careful calculation of acceptable radiation doses will be needed to get best performance and utility from the crews, Aero Medical Association members were told at their annual meeting here.

Dr. H. L. Adams and Dr. C. M. Whitlock Jr. presented a paper which extracted material from Convair's official report on the current Navy-sponsored study of nuclear aircraft operational problems.

The study points out as a disadvantage of nuclear fuel that 15% of the energy released by fission is dissipated in the form of ionizing radiation which cannot be used for propulsion and which in sufficient quantities is harmful to living organisms and to materials.

The authors suggest that because the amount of radiation required to harm the human crew is less than that required to harm materials, the human factor will be the controlling parameter in design of a nuclear powered airplane.

Limiting Hazard

The three obvious ways of limiting the hazard are by shielding the crew from the radiation source, by stationing them as far as possible from the source, and by reducing period of exposure.

All three have serious disadvantages. Shielding may cause weight and balance limitations to be exceeded, distance may cause insuperable design problems, and limiting exposure may reduce range, duration and the utilization of hard-to-replace crews. These disadvantages demand the finest possible calculation of acceptable radiation dosage if performance and utility are to be optimized.

The National Committee for Radiation Protection recommends a 20 year career dosage allowance of 100 REM, which the authors believe may be too conservative.

There are three ways in which ionizing radiation affects the human body:

- By **disrupting** chemical bonds.
- By **spatially** dislocating atoms.
- By **imparting** kinetic energy to tissue causing spots of intensely high temperature.

Radiation effects take three forms—somatic, reproductive and psychological, which are completely interrelated. Results of the Convair study indicate that non-lethal doses should not cause sterilization of adult males. Less is known about the possibilities of sterilization in women.

The authors do not think a dose below the level considered lethal has any important genetic effects on succeeding generations. Statistical analysis of the reproductive history of radiologists who have received career doses of 1000 REM or more and of survivors of the Hiroshima and Nagasaki bombings shows no significant increase in the likelihood of bad mutations.

Decompression Sickness

Wing Commander W. Lockhard, RAAF, delivered a paper attributing deaths from decompression sickness to shock caused by embolism of fat from livers of the victims which is carried to the lungs and brain. He said that in the past 14 years 15 people have died after decompression in the United States and Britain and one person in Australia has suffered decompression sickness and survived. Nine of the fatalities occured after decompression chamber runs and six after actual high altitude flight. In 10 of the fatal cases and in the one non-fatal case the victims were found to have fatty livers. No clinical or post mortem findings were available in other instances.

Studies of the cases in which data were available indicate that the victims had low protein, high carbohydrate diet and low ratio of animal to vegetable protein.

In the single non-fatal case, an Australian pilot had been living on a starchy diet while serving in England and was accustomed to drink six glasses of beer daily. After decompression shock he was put on a high protein diet and gave up beer. He was later subjected to tank tests up to 37,000 ft. and returned to flying duty. A liver biopsy taken at the time of admission to the hospital showed unusual accretions of fat which had disappeared after the diet.

Landing Injuries

Capt. John R. Poppen, USN, suggested a new type of restraint harness aimed at reducing the number of spinal injuries suffered by pilots. He said the rising back injury incidences are caused by a relative increase in the vertical component of the force diagram of deceleration on landing. Often the vertical component is now three or more times that of the horizontal. Shoulder harness presently used protects against injuries due to forward deceleration but are ineffective against downward forces because they allow the body to slump enough to place high

impact loads on the lumbar vertebrae and permit the head to strike objects at knee level. Experiments have shown that a downward deceleration of 23 to 25G is likely to cause a compression fracture or crushing of the intervertebral discs. Even a subcritical acceleration in an elastic system like the spine may produce critical accelerations in parts of the system. This overshoot of acceleration at points in the spine is dependent upon rate of onset and is produced by dynamic response between the upper and lower parts of the torso made possible by different rates of acceleration.

Independent Support

The solution recommended by Dr. Poppen is independent support of the upper mass to insure that it is accelerated simultaneously with the lower mass. He said that design and testing studies have already begun on a harness providing this support and that preliminary results confirm the validity of the principles.

In the same field of acceleration injuries to the spine, John L. Hess of Douglas Aircraft and Charles F. Lombard, consultant, showed studies indicating that in a normal 20G seat ejection the spine is compressed about six inches. If rise times are less than 0.1 second, various parts of the body are subjected to considerably greater accelerations than the seat because of the dynamic response of the body.

Dr. Hubertus Strughold of USAF's School of Aviation Medicine, Randolph AFB, Texas, confounded science fiction writers by reporting that human habitation of Mars can only be exploratory and not permanent as atmospheric pressure and oxygen content will not support Earth-born life.

Pressure Suits

The necessity of wearing pressure suits or pressure breathing apparatus would prevent economic activity and procreation. He said that the Pamir Plateau in Tibet provides a reasonable simulation of many of the climate characteristics of Mars.

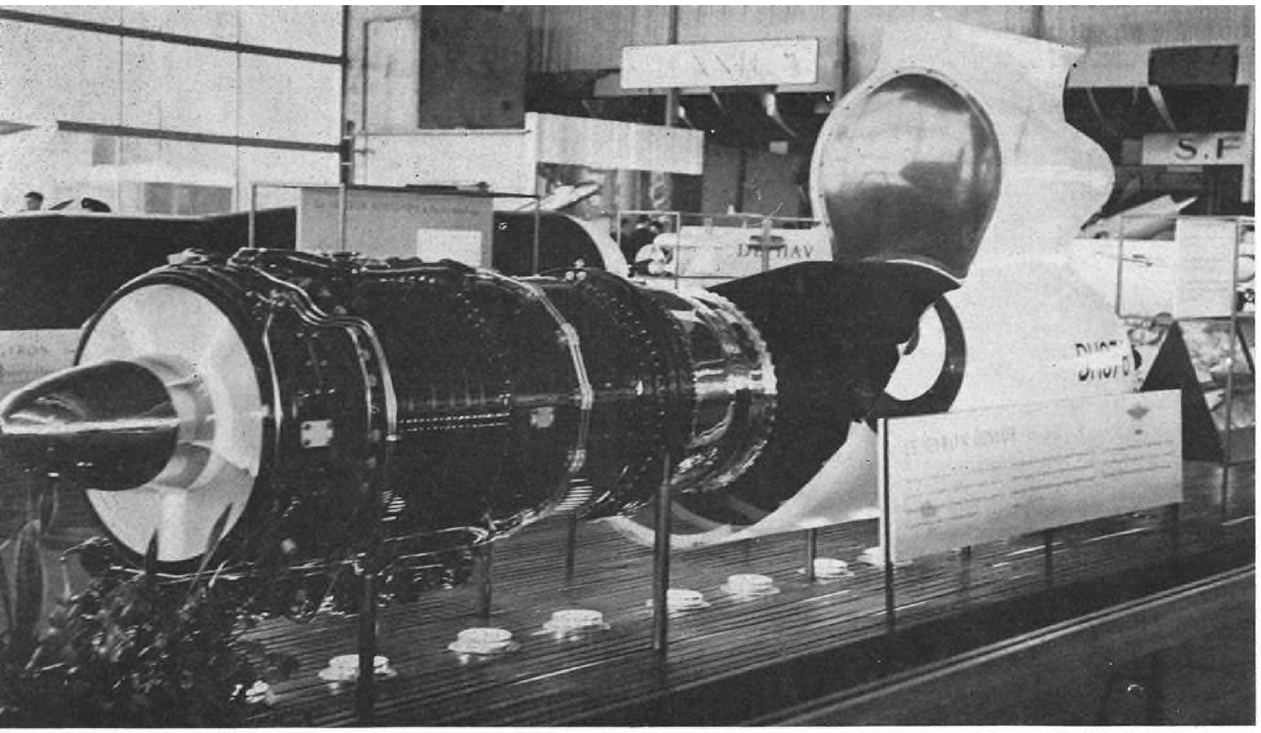
Cosmic radiation, temperature and humidity are all virtually identical. Atmospheric pressure on Mars is about equivalent to the Earth's atmospheric pressure at 55,000 ft.

Douglas Will Deliver Weather B-66 to TAC

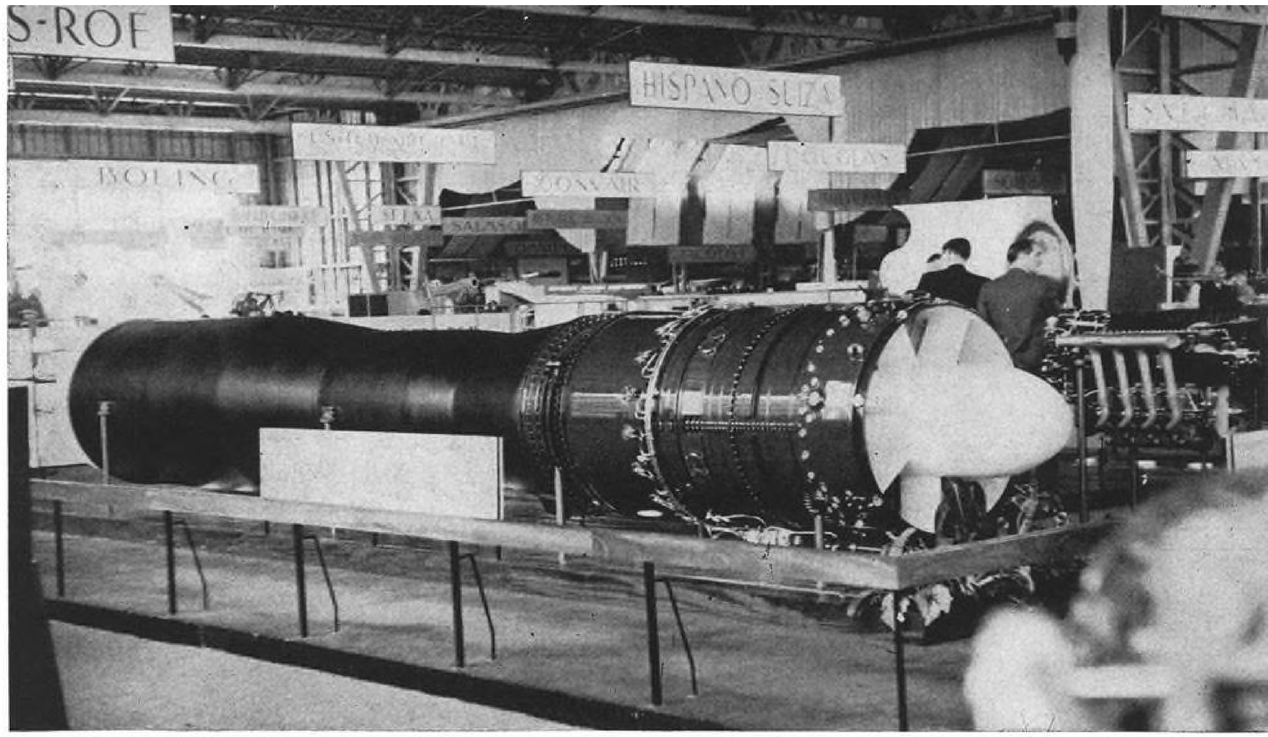
Douglas Aircraft Corp. will soon deliver first WB-66D, weather reconnaissance version of its B-66 jet bomber to Tactical Air Command. Airplane differs little externally from other versions.

Powered by Allison J71 engines, WB-66D is produced at Tulsa, Okla.

Continued

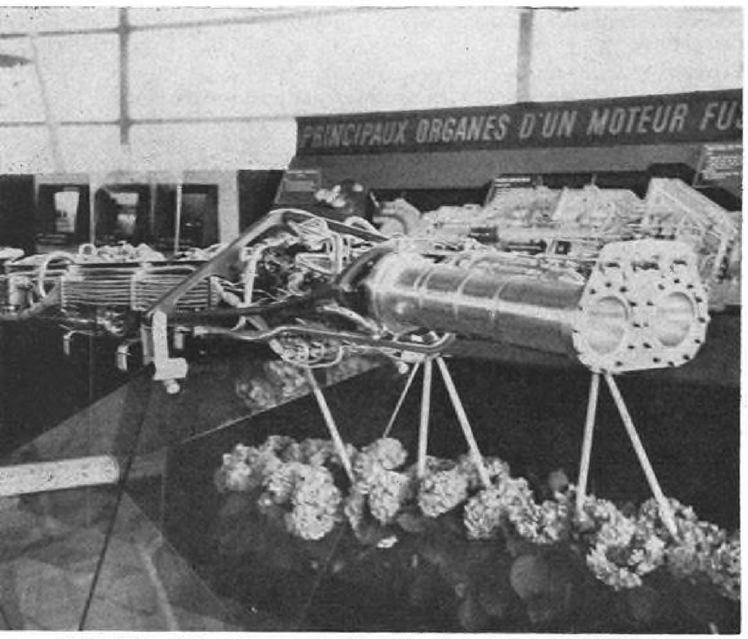


DE HAVILLAND GYRON JUNIOR plus afterburner was shown in simulated mixed-powerplant installation with a de Havilland Spectre rocket engine in small closed section above engine tailpipe. Installation closely parallels that of the Saunders-Roe S. R. 53 interceptor. Gyron Junior is rated at 8,000 lb. thrust.

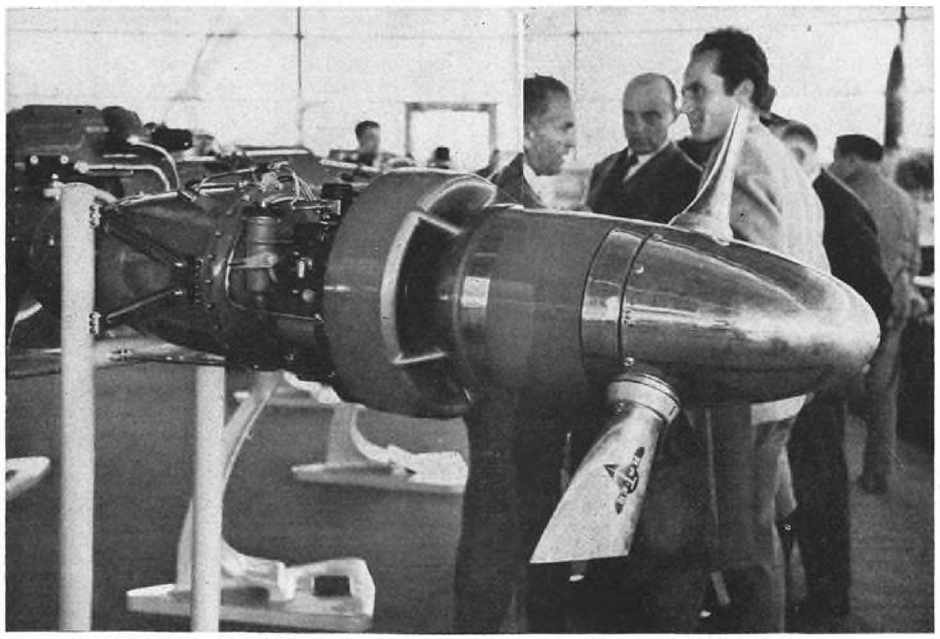


DE HAVILLAND GYRON with afterburner dwarfed every other engine at the 22nd International Aeronautical Salon at Le Bourget near Paris. Engine is running at 25,000 lb. thrust with afterburning, was designed for a dry rating of 20,000 lb. Length of afterburner suggests an installation requirement rather than an optimum-length unit. Thirty-segment variable-area exhaust nozzle is fitted to afterburner exit.

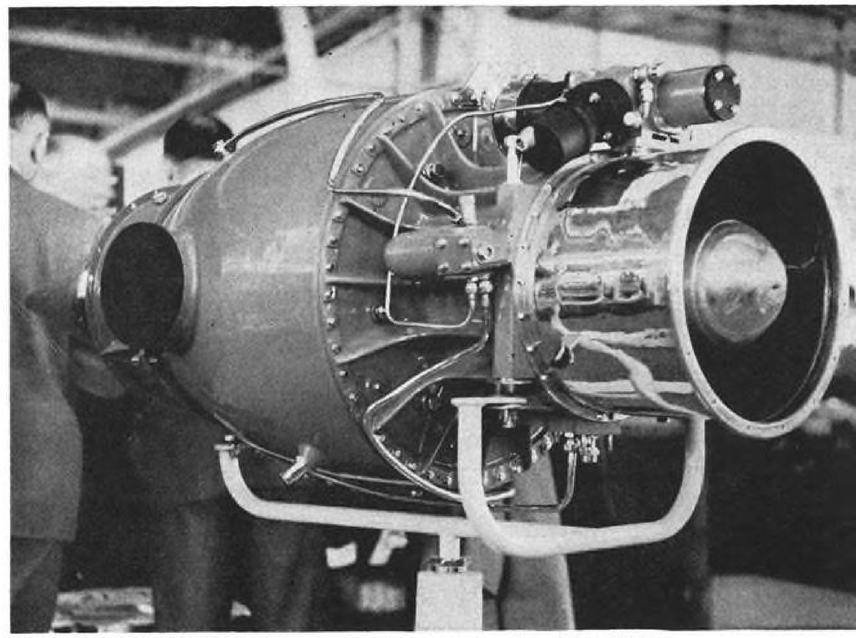
Paris Displays Include French SEPR Rocket for Mirage, British Combined Installation



SEPR 661 rocket engine was developed for Dassault Mirage 550 prototype, has been flown experimentally on Mystere IV B2. Thrust of the alcohol-acid powerplant is about 3,300 lb. Life of combustion chambers is now at 25-hr. level.



TURBOMECA ASTAZOU turboprop engine is rated at 320 hp., weighs about 243 lb. without propeller. Residual thrust for takeoff is about 90 lb. Fuel consumption at takeoff is 230 lb./hr.; cruise consumption is about 220 lb./hr.



TURBOMECA TRAMONTANE gas generator has a pressure ratio of 3.5, delivers about 5.5 pounds of air per second. Fuel consumption at rated delivery is about 680 pounds per hour. Generator weight is 375 pounds.

Wingtip Vortices Menace Light Planes

Ft. Rucker, Ala.—Tests by the Army Aviation Board have established that turbulent wingtip vortices left in the wake of highspeed aircraft are a menace to light planes, causing momentary loss of control and possible structural damage when intercepted in flight.

As a result of experiments conducted last winter at Eglin AFB, Fla., (AW Dec. 17, p. 32), the board has recommended that further tests and studies be carried out by other aviation agencies.

The board says its own efforts indicate a genuine danger from both the vortices and sonic shock waves generated by jets flying up to Mach 1.05.

What is needed now, the board said in a report on tests made with a QL-17 drone, an F-100 fighter and B-47 medium jet bomber, is a comprehensive study covering theory, engineering tests and flight tests to compile significant information. The work is considered beyond the capability of the Army Aviation Board.

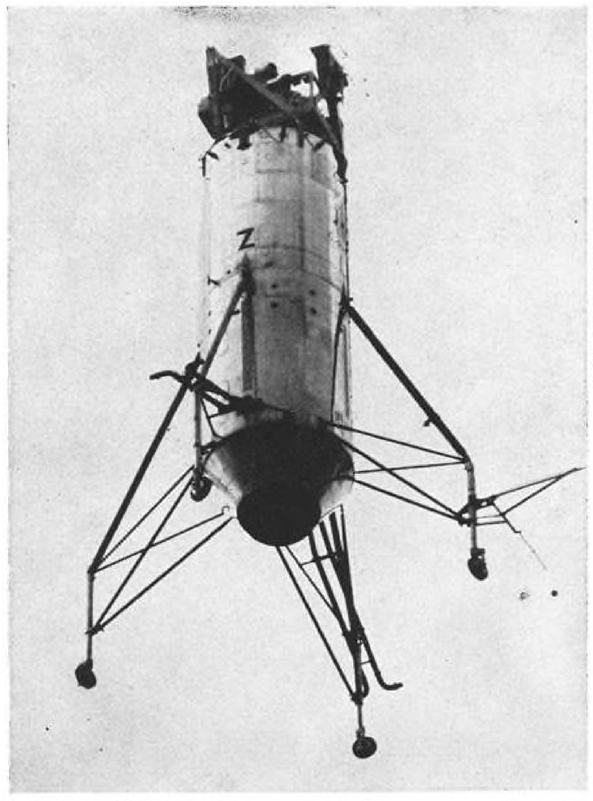
With the cooperation of experts from Beech Aircraft Corp., the board has made several significant observations:

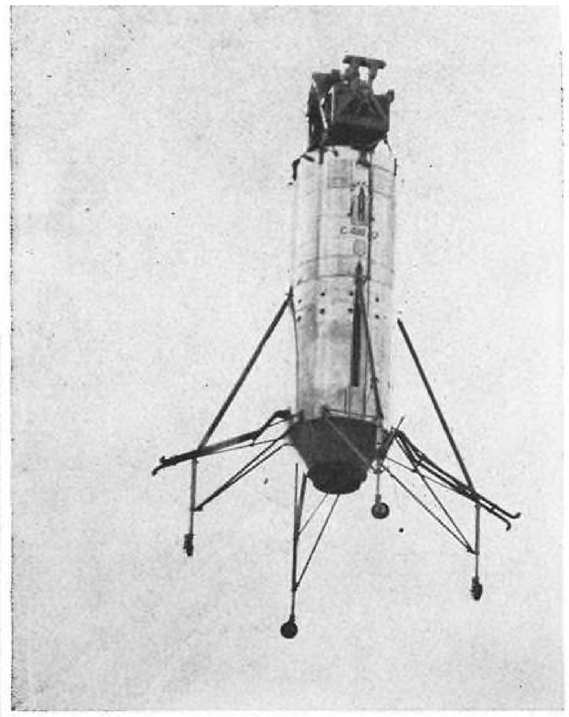
- **Duration** of wing-tip vortices is governed by the turbulence of the atmosphere in which it is generated. Turbulence or wind disperses the vortices quickly, abolishes the danger which remains in still air.
- **Greater** vortex disturbances are created when the generating aircraft is flown at low airspeeds. This phenomena would tend to add to the violence created during takeoff and climb, an area in which another light aircraft well may be following the flight path.
- **F-100 landing** at about 200 kt. leaves strong vortices that last as long as 30 sec. after the plane has passed a given point. Light aircraft at low speeds would not be controllable in this turbulence.
- **No structural damage** was suffered in the Eglin tests, but the board believes light planes flown at low speed in stable air could sustain damage in the vortices created by F-100 or B-47 aircraft.

Ryan Sales Increase, But Cost Cuts Profit

Ryan Aeronautical Co. sales were higher than wartime peak during first six months of 1957, but high costs of early part of production cycle for Boeing KC-135 and 707 transport fuselage sections reduced profit $100,000 below 1956 first half. First half 1957 sales totalled $30 million, net earnings $573,634 or $1.53 a common share.

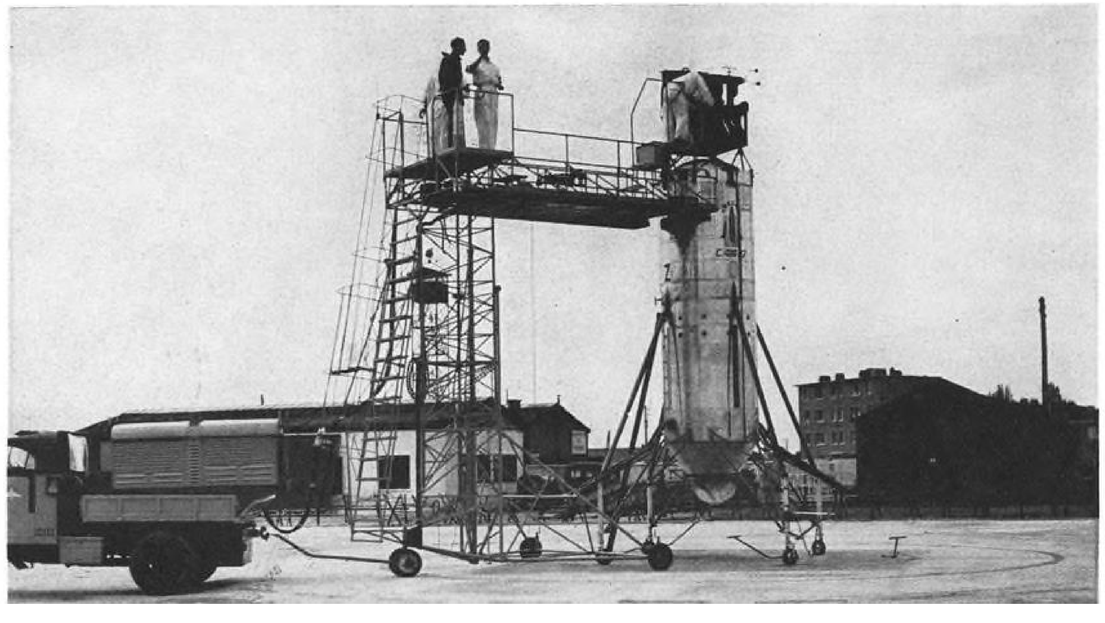
Paired Bleed Jets Control Flying Atar





Snecma Flying Atar is manned version of a VTOL test vehicle developed by the French nationalized engine firm. Designated C.400 P2, this vehicle is the third step in a multi-step program aimed at developing a family of VTOL aircraft around the coleopter principle developed by Helmut Zborowski. Servicing gantry and pilot access to the ejection seat mounted over the engine air intake are shown (below). Gantry and Flying Atar are completely mobile, can be towed by drawbar attached to truck.

Auguste Morel, Snecma pilot, demonstrated hovering and maneuverability of the vehicle (left and above) at the 22nd International Aeronautical Salon at Le Bourget. Note heavy trusswork structure around the pilot's seat. Stability and control comes from paired bleed jets visible above the nearest and farthest wheel (left). Engine air forced through the nozzles provide pitch, yaw and roll control and stabilizing, can tilt the vehicle so that the thrust vector is inclined and drives the vehicle in any direction.



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BY THOMPSON

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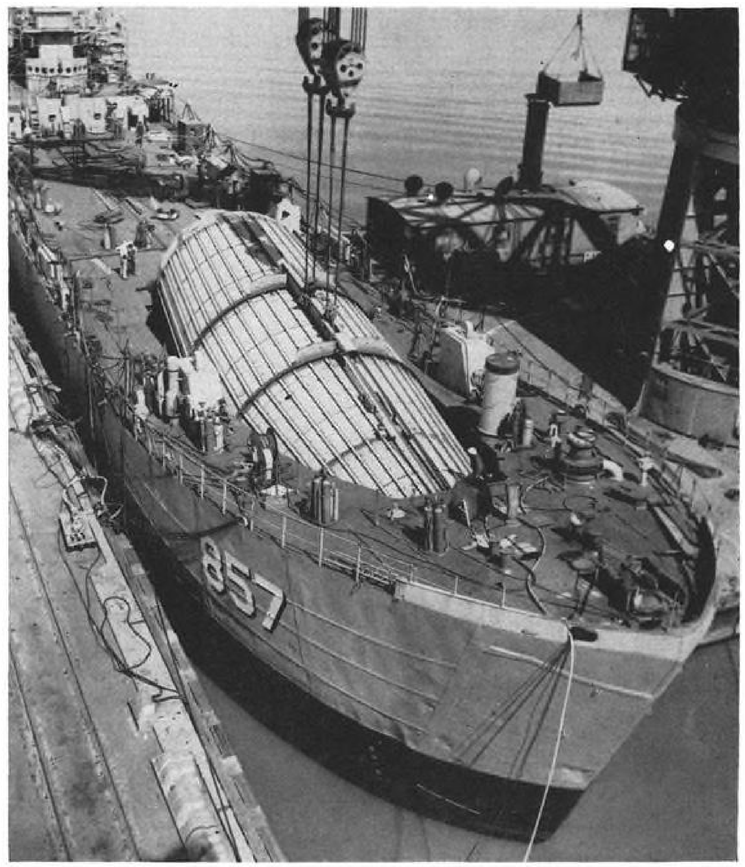
Navy Tests Missile Installation

Experimental installation for Chance Vought Regulus missile is moved from shop at Mare Island, Calif., (top) for testing on LST King County (below). Housing is for submarines.



Air Force Will Switch Drives in B-52

By Robert Cushman

New York—Strategic Air Command reluctance to carry high speed air turbines inside B-52 airframe will result in replacement of present pneumatic alternator drives with Sundstrand hydraulic drives.

Starting with airplane number 359, B-52 bombers will be equipped with 40 kva. Sundstrand direct-driven hydraulic alternator drives instead of the 60 kva. General Electric and Thompson pneumatic drives which are now being used to produce the bomber's electrical power. The change will be phased in with the introduction of Pratt & Whitney J57-43 turbojet to power the B-52. Deliveries of the 1,700-unit order will start in July.

SAC concern over the safety of the pneumatic systems, which duct hot engine compressor gases through the airframe to spin small alternator drive turbines at four points in the fuselage, has been given as the prime reason behind the change-over. The first B-52 crash near Castle AFB, Calif., last year, brought this feeling to a head. The crash was said to be the result of an overspeeding alternator drive, the turbine of which exploded in the vicinity of fuel tanks.

It is possible the hot compressor drive air ignited the fuel.

Some USAF sources also claim that up to 50 miles range will be gained from the change. In addition, maintenance and logistics considerations were mentioned.

Not Unanimous

However, USAF sources have indicated to AVIATION WEEK that there are divided opinions within USAF on this matter. The dissenters have felt that the decision against the safety of the pneumatic systems has been premature and that the gain in range is marginal at best.

Sundstrand claims that 1,800 lb. overall weight (including fuel) will be saved in the change to the direct-driven hydraulic system. Since 24 nautical miles additional range is gained for each 1,000 lb. weight removed, this should amount to 43 nautical miles extra range or about 50 land miles.

The original Boeing estimate which led to the choice of a pneumatic system at the beginning of the B-52 project was based on a 2,000 lb. overall weight saving over a hydraulic system.

Possibly the lower kva. rating of the Sundstrand units must play some part in this variation. The four Sundstrand 40 kva. alternators to be used in the replacement will put out a total of only 160 kva. per aircraft as compared to the 240 kva. now put out by the four 60 kva. alternators. The lower rating of the Sundstrand units is said to be a matter of expediency; no hydraulically driven 60 kva. units are now available. So far as the performance of the B-52 is concerned this means that most of the electrical power surplus has been pared. However, Sundstrand says its drives have better overload capacity.

One factor which may have worked to the favor of the direct-driven hydraulic system is that operational use of the B-52 has indicated that wing leading edge deicing is not necessary. This would mean that the weight of the hot air ducting along the wing leading edges cannot be subtracted from the pneumatic system total.

SAC View

Apparently SAC has been caught in turn by the developmental headaches of both systems. After being plagued with some of the growing pains of bomber hydraulic systems in B-36s, SAC has had to go through a similar evolution with pneumatic systems on their B-52s.

The picture has been further complicated by the crash of an experimental B-52 with the new drive at Tulsa, Okla., in March this year. One report on this crash said that loss of electrical power when the drive overheated and seized under negative G loading caused the accident. The accident occurred while porpoising the bomber from 40,000 ft. altitude to slosh test the fuel tanks which were redesigned when the pneumatic ducting was removed. Loss of spoilers caused the B-52 to exceed Machmeter redline in a dive, causing the aircraft to disintegrate.

Since souvenir hunters in the crash area were said to have taken the recording cameras, the nature of the crash has not been confirmed, even though the official report was recently submitted. The Sundstrand drives used on this plane were identical to those used on more demanding maneuvers on the F-101 fighter.

Though the alternators are being converted to direct-driven hydraulic systems on plane number 359, the pneumatic drives for the non-electrical portions of the aircraft system are being temporarily retained. For example the flight controls and the flaps are worked electrically off the alternators, but the landing gear, bomb bay, spoilers, wing tip protector wheels and guns are worked hydraulically. For these hydraulic actuators, pneumatic power is ducted to small drive turbines near the point of application.

Eventually, some time before the presently contemplated 11 wings or 603 B-52s have been built, the bomber will be completely hydraulic without any pneumatic links. About the only pneumatic system left will be the intermittent engine-inlet deicing systems.

There will be no retrofitting of direct drives on the present B-52s up to number 359. For the first time hard and soft drives will be flying side-by-side in the same type of bomber, which will mean that soon the service will be able to gather objective data on the relative merits of the two competing systems.

Two practical aspects which are intrinsic in the B-52 drive question are: Effect on engine-airframe performance and effect on airplane reliability.

Both systems take energy from the J57 turbojet engines on the B-52. Both are forms of fluid transmission which transform the engine energy, which varies from idle to maximum according to flight demands, into constant mechanical speed to maintain the alternators at a steady 400 cps. electrical output.

The difference lies in what form the two drives extract power from the powerplants.

System Differences

Pneumatic systems bleed air from the engine cycle as it leaves the high pressure compressor before it is heated up in the combustor. This 500-700F air is ducted to a small air turbine which drives the alternator. An integral control system in the alternator drive package valves the air coming to the turbine so that whatever the airflow and pressure put out by the engine compressor the alternator is kept within the required 1% of the required 400 cps. of the alternator.

In the case of the hydraulic drive, the power is subtracted via a shaft geared to the high-pressure spool of the J57 engine. This shaft turns the pump end of a hydraulic pump-motor variable speed transmission which drives the alternator.

In both cases the turbine on the high-pressure spool supplies the energy

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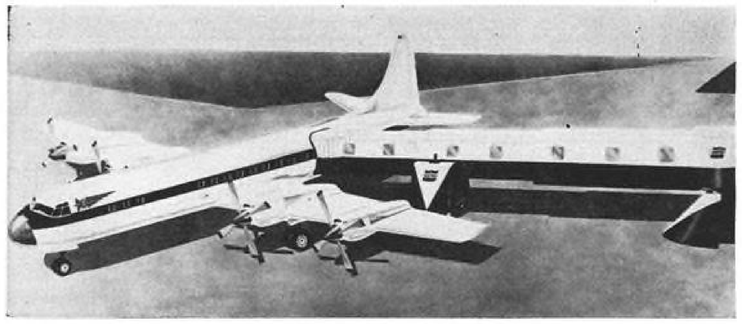

Aero-Gangplank

This new passenger boarding facility, called Aero-Gangplank, will be put into operation by United Air Lines at Chicago's O'Hare International Airport in October. It will provide all-weather protection for passengers entering or leaving a plane and is a direct, one-level link between plane and second story of the terminal concourse. Aero-Gangplank was developed by Lockheed Air Terminals, Inc.

to run the aircraft electrical system. But in the case of the pneumatic drive, the turbine never sees the airflow and therefore might be said to be robbed twice.

Vickers, Inc., Detroit, Mich., a hydraulic drive manufacturer, contends that a pneumatic drive cuts down the energy left for propulsion more than a direct drive.

Vickers calculates that air bleed drives can increase fuel consumption and cause thrust loss.

On the other hand, pneumatic drive advocates argue that in a pod mounted engine configuration the lower installed drag of the pneumatic system can more than make up for the fuel consumption. There is less drag with the pneumatic system because the air drive can be located remotely from the engine pod.

In addition, they argue that leading one-way air ducts to the point of usage is lighter than carrying two-way electrical power lines to the point of usage from an engine mounted alternator. These advantages are claimed to be most pronounced on the long cruise-type missions of the B-52.

The hydraulic counter-argument is that compact, modern, kidney-shaped hydraulic drives nestled in the waspwaist of a dual spool turbojet cause slight extra drag.

The remote location feature of pneumatic systems brings up the second phase of the question—safety. Pneumatic systems are sometimes criticized on this score because they tend to put equipment originally isolated in pod mounts back into the airframe.

Pneumatic drives, to be competitive on a B-52 installation, must place turbines spinning at high speeds at various locations in the fuselage or wing. These turbines must be fed with 500-700F air ducted through the engine pod strut, through the wing, past fuel tanks and equipment to the turbines. Since these ducts must be very light to maintain the virtues of low installed weight for the pneumatic system, they and their joints are susceptible to stresses with the working of the airframe under aerodynamic and inertial loads.

The switch to the direct drive in the B-52 has been a setback to the proponents of the pneumatic drives. GE, for example, has been advertising pneumatic drives in the B-52 as an example of things to come.

The recent reorganization of the GE approach to accessory drives (AW April 15, p. 85) is significant in this light. The Aircraft Accessory Turbine Division at Lynn, Mass., which makes the GE pneumatic drive, has absorbed another GE group, the hydraulic drive section at Schenectady, in order to present a united front to the airframe and service customers. GE's reorganized division has added a drive systems analysis group and hopes to be invited into a weapons system bidding in the early phases as the secondary systems prime contractor. With this chunk of the weapons system responsibility, GE hopes to make its own analysis and pick which of their two types of systems ought to be used.

Thompson Products, after removal from the B-52 program following the first crash, has improved its wheels and controls until one USAF observer told AVIATION WEEK that the Thompson product is now many times safer than the main powerplants. Both GE and Thompson worked to make the weaker links of the pneumatic system fail-safe.

General Electric now has a system in which the four alternators can be automatically paralleled similar to the capabilities of the Thompson drive. Speaking before a recent aircraft electrical equpiment conference in Dayton, Ohio, two of GE's engineers described the new GE 60 kva. pneumatically

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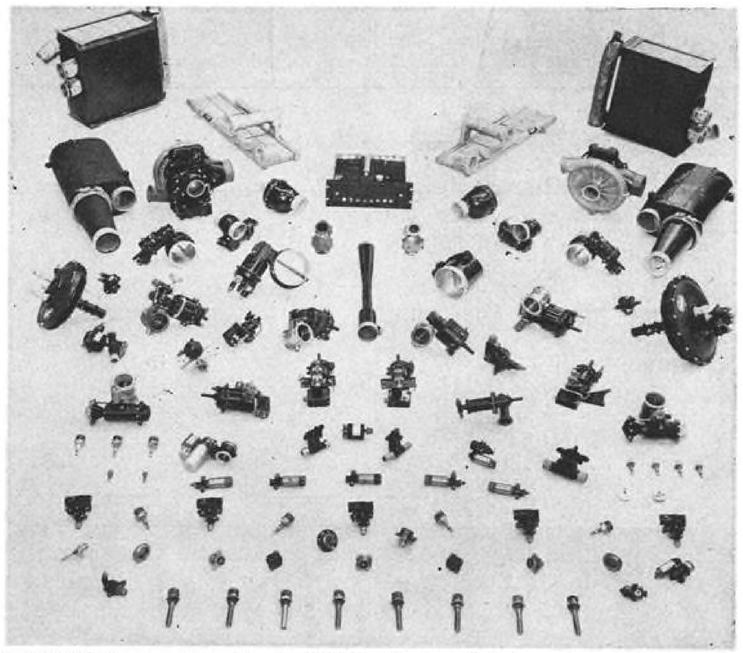
driven alternator system, which can be paralleled. This drive has an electronic-hydraulic control system which permits load distribution within 1/10%. At present this system is undergoing flight and qualification testing.

Despite this setback, experts in USAF and private industry do not feel the cause of pneumatics is by any means lost. Pneumatics ace-in-the-hole seems to be that it can withstand temperatures over 500F that no known hydraulic fluid can stand.

Hydraulic manufacturers as Vickers, which is working on hydraulic systems which use silicons, silanes, mineral oils and diesters in special blends to operate in the 500F region, admit that for 1,000F something like a "hot-gas" or liquid metal system will be mandatory.

Pneumatic systems which will withstand 1,000F are possible now. GE has recently released details on a small missile auxiliary power unit comprised of two 4½ in. cylinders 13 in. long and weighing only 35 lb. This self-contained unit uses a liquid rocket propellant to run a small turbine which supplies up to six minutes of shaft power which can then be converted into electrical or hydraulic power at ratings of 1½ hp. to 10 hp. Though not strictly a pneumatic system in the sense of those on the B-52, nevertheless it indicates a direction which present pneumatics can take.



ELEMENTS of a new, comprehensive B-58 Hustler air conditioning system which drops air temperature 1,000F in less than a second are displayed by maker, Hamilton Standard.

Versatile System Cools B-58

Tightly-packaged air conditioning system which drops air temperature 1,000F in less than a second is being produced for Convair's supersonic B-58 Hustler by Hamilton Standard, division of United Aircraft Corporation.

System, described as the most comprehensive ever developed for an aircraft, not only performs the standard jobs of cooling and pressurizing the crew cabin and defrosting the windshield, but also these less common tasks:

• **Redistributes** air at appropriate temperatures to cool the weapon system's ammunition, tires, equipment in external pods, extensive electronic equipment.

• **Clears** rain from the windshield with high pressure jets.

Large quantities of hot, compressed air from the Hustler's four General Electric J79 turbojets are supplied to the system. It achieves its high rate of cooling with heat exchangers and air cycle refrigeration units. Work done by the system is equivalent to making 160 tons of ice a day.

The complex cooling device incorporates over 120 operating components. Air flow is controlled by more than 50 valves, ranging in size from a tiny unit which controls air flow through a hole 60/1,000 in. dia. to a big 8 in. dia. valve. Completing the system are 35 electronic and pneumatic controls, water separators to dehumidify the air, and a maze of ducting throughout the aircraft.

Designing, developing and testing the system has required 550,000 engineering man hours to date.

Systems Trainers for 1649As Delivered

North Hollywood, Calif.—Animated schematic systems trainers in a class halfway between costly operational components and inexpensive static breadboard layouts have been developed by Meteor Enterprises here.

First nine trainers, built under contract with Lockheed Customer Training School, were to Lockheed specifications and drawings of the Model 1649A Jetstream Starliner and were delivered to Trans World Airlines earlier this year. Three more were done in French for Air France, also via Lockheed's customer unit.

Trainers are intended for classroom work; consist of varying size panels with components of systems made of varicolored transparent plastic. Mechanical linkages, drives are mounted on covered backside and are operated manually, electrically or mechanically. Components in some cases are complete units, such as on one trainer of the landing gear up-down lock system, in others are cross-sectional silhouettes as in the trainer for the airplane's master hydraulic pump.

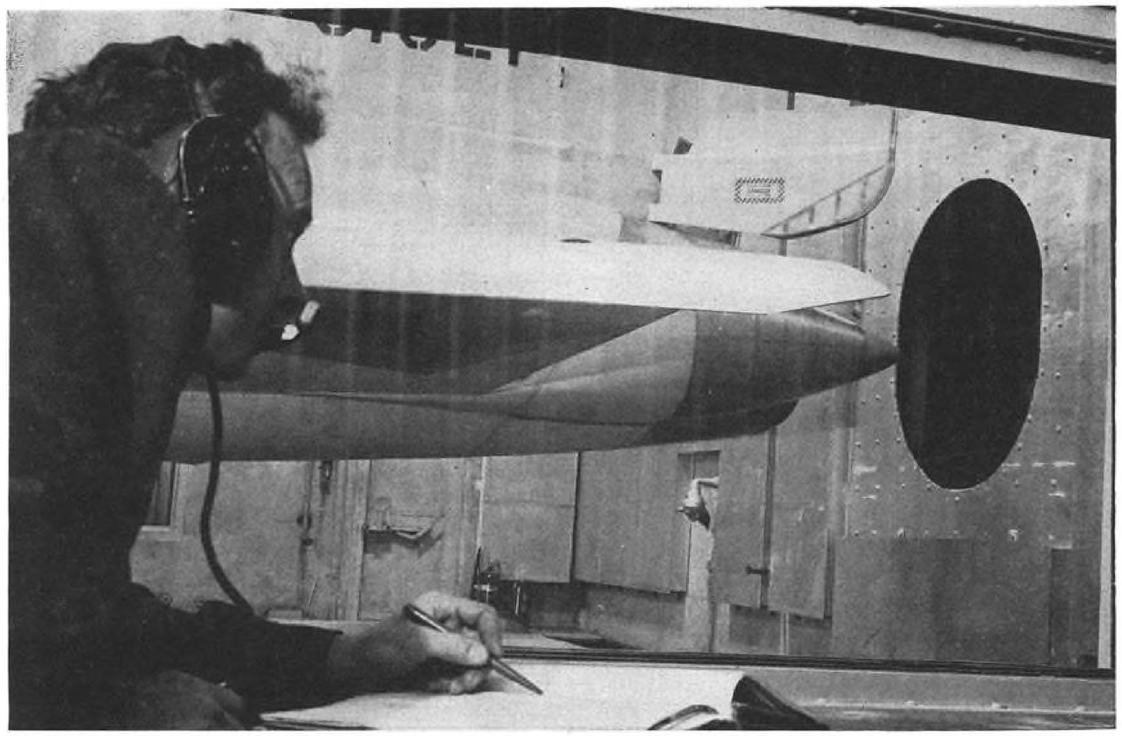
Units delivered to TWA included brake, flight control boost, landing gear up-down lock, air conditioning, generator, electrical, fuel and cabin pressurization systems, and the hydraulic pump.

Other units the company has fabricated include a mockup of No. 4 engine nacelle area with accent on the refrigeration package which is installed there. Nacelle skin was omitted to show location and routing of ducting, and cutaway sections show operation of the various butterfly and damper valves.

Also constructed for Lockheed's Customer Training School was a large photo panel of the plan view of the 1649A air conditioning system, which can be interconnected with other component trainers of this system. Actuation of the actual airplane controls on the trainer panel can operate components, while a system of indicator lights and specific colored, illuminated arrows will indicate air flow direction and temperature.

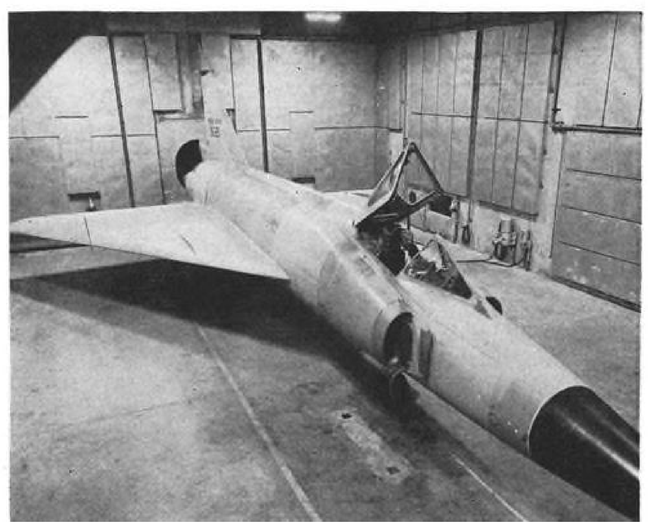
Meteor has constructed three shells of crew compartment procedure trainers. One is being completed for the 1649A airplane, the others are not yet confirmed for any specific Constellation interior.

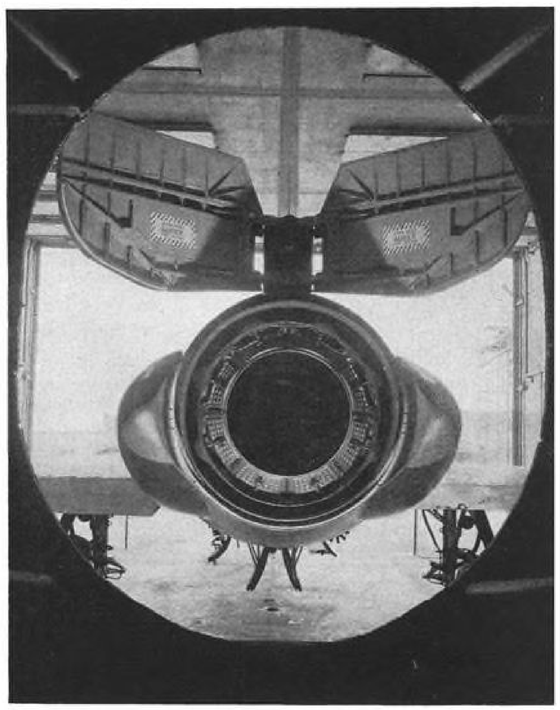
Company has discussed construction



Suppressor Muffles F-102A Engine Noise

Design details of Convair F-102A are accented in views in one of three sound suppressor buildings where the airplane is given pre-flight engine checks at San Diego plant. Degree to which conical camber is applied to wing leading edge is underscored (above). Other details are speed brakes and afterburner nozzle (below, right). Production test cell walls are one foot thick concrete, and buildings are 25 ft. high, 115 ft. long and 45 ft. wide. Cells also can accommodate F-106A. Exhaust blast from Pratt & Whitney J57 engine is passed into transition chamber where steel girders deflect blast, and then into 40 ft. high stack area and through a series of wave-shaped metal baffles which absorb sound as blast is deflected skyward. Water spray system turns on automatically when temperatures reach 400F in transition chamber. Fourth cell is used for engines only. Complex cost $1 million.





of trainers for German and Italian Air lines, in the 1649A configuration.

Also in the works is construction of a trainer on Hamilton Standard propellers, for TWA and the Flying Tiger Line. In addition, the company has discussed design and construction of trainers on other models of that company's propellers, with full Hamilton Standard cooperation promised, plus trainers for other manufacturers.

Trainers are in the $2,500 to $3,000 average price bracket.

Company employs 33 persons, including seven engineers. A 15,000-sq. ft. plant is currently in use, with expansion possible. Large number of employes formerly were building trainers with Lockheed Aircraft Service, but declined to move to Ontario when LAS activities were transferred there; instead. They started their own concern.

In addition to aeronautical work, company presently is designing and building three 3-dimensional trainers for Navy on submarine water distilling system.

$4.3 Million Contract to American Coleman

American Coleman Co., Littleton, Colo., has been awarded a $4.3 million government contract to produce 595 MB-4 towing tractors for the Air Force.

Tractor, powered by a Chrysler engine, weighs about 10,500 lb. and can reach speeds of 40 mph. Its main use will be to tow jet aircraft in excess of 100,000 lb. Firm previously built 55 of the new tractors for USAF.

WHAT'S NEW

Publications Received:

Three booklets published in the Electronic Tube Series of Philips' Technical Library, and available from N. V. Philips' Gloeilampenfabrieken, Eindhoven-Nederland, are as follows:

Vol. XI, UHF Tubes for Communication and Measuring Equipment – by Members of Philips Electron Tube Division. $1.50; 70 pp.

Describes in detail the tube range for UHF and SHF waves and deals with some applications of tubes for the measurement of the noise factor at these high frequencies.

Vol. XIII, Tubes for Computers–by members of Philips Electron Tube Dision. $1.50; 52 pp.

Describes the tubes that have been specially designed for rather unconventional application in the electronic computer.

Tube Selection Guide–Compiled by Th. J. Kroes. $1.50; 124 pp.

Aimed at enabling the user to determine quickly which tube is to be preferred in different cases. Illustrated and containing tables printed in English with translations of the text in French, German, and Spanish.

Physical Abilities to Fit the Job–by Bert Hanman, for Engineering Department, American Mutual Liability Insurance Co., 142 Berkeley Street, Boston 17, Mass. $2.50; 145 pp.

Written primarily for industrial physicians and engineers, it is an attempt to bring management, medicine and engineering closer together in an effort to adopt better methods for dealing with the medical aspects of job placement and adjustment.

A Technical Dictionary of Rockets and Astronautics–by Glauco Partel (A.I.R.) –Pub. by Instituto Poligrafico Dello Stato–G.C., Rome, Italy. 107 pp.

The Associazone Italiana Razzi, Piazza S. Bernardo, 101, Rome, has prepared this fully indexed dictionary in German, French, Italian, and English.

Electronic Components Handbook–Prepared for Electronic Components Laboratory, Wright Air Development Center–Ed. by Keith Henney and Craig Walsh, Technical Writing Service, McGraw-Hill Book Co.–Pub. by McGraw-Hill Book Co., 330 West 42nd Street, New York 36, N. Y. $9.00; 224 pp.

Furnishes data on resistors, capacitors, relays and switches as an aid in selecting and applying the best unit for a particular job so that maximum reliability of the end product results.

Aircraft Hydraulic Design–by George Keller–Pub. by Applied Hydraulics Magazine, The Industrial Publishing Corp., 812 Huron Road, Cleveland 15, Ohio. $3.50 the copy, $3.00 for ten copies or more.

Deals with hydraulic component and system design for high-speed, piloted aircraft and missiles.

The Renogotiation Guide–Pub. by Renegotiation and Termination Letter, 1420 New York Avenue, N. W., Washington 5, D. C. $25.00; 202 pp.

Makes available to defense contractors all of the important information and guidance, both official and unofficial, that has been produced over the past five years, beginning with the passing by Congress of the Renegotiation Act of 1951.

Industrial Engineering Handbook–Ed. by H. B. Maynard–Pub. by McGraw-Hill Book Co., 330 West 42nd Street, New York 36, N. Y. $14.50; 1504 pp.

Seventy-five specialists cover the fields

in which they are expert such as industrial engineering function, work measurement, predetermined elemental time standards, wage payments, plant facilities and design, and control procedures.

Testing of Weighing Equipment—National Bureau of Standards Handbook H37—by Ralph W. Smith—Order from the Government Printing Office, Washington 25, D. C. $1.25; 184 pp.

A reprint, it is one of a series designed to present in compact form, comprehensive information relative to weights and measures supervision.

Elements of Gas Dynamics—by H. W. Liepmann and A. Roshko—Pub. by John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. $11.00; 439 pp.

An addition to the Galcit Aeronautical Series, it presents a sound physical background for work in modern gas dynamics and high speed aerodynamics

Inventors and Inventions—by C. D. Tuska—Pub. by McGraw-Hill Book Co., 330 West 42nd Street, New York 36, N. Y. $3.75; 135 pp.

A manual that will encourage the reader's inventive tendencies, familiarize him with the psychology and methods of invention, and help him protect, patent, and market his inventions.

Bearing Design and Application—by Dr. Donald F. Wilcock and Dr. E. R. Booser—Pub. by McGraw-Hill Book Co., 330 West 42nd Street, New York 36, N. Y. $12.50; 470 pp.

Considers bearing design and application from three aspects: the design of the bearing, including its geometry, general configuration and tolerances; the materials from which the working parts of the bearings are made, and finally the lubricant used. The material included covers rolling element bearings, slider bearings, bearing materials, and trouble shooting.

Reports Available

The following publications are available from the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C.

Ultrasonic Soldering of Aluminum—by J. B. Jones and J. G. Thomas, Aeroprojects Inc., for Frankford Arsenal, U. S. Army. $1.75; 68 pp. (PB 121551)

Research and Development on the Welding of Aluminum Alloy Plate—by J. J. Chyle and I. Kutuchief, A. O. Smith Corp., for Frankford Arsenal, U. S. Army. $1.75; 69 pp. (PB 111850)

Plastic Materials for Vision De-

ARCTIC STUDIES—The only access to this arctic research outpost in Northern Greenland is by helicopter. The Red Rock Camp, Nunatarssuag, established by the U. S. Army's First Engineer Task Force to carry out ice cliff studies, receives food, mail, and passengers by Sikorsky S-55, designated H-19 by the Army. The versatile S-55 is an arctic veteran. It has seen grueling service in Greenland, Northern Canada, and Alaska.

AROUND THE WORLD WITH SIKORSKY HELICOPTERS

HELICOPTER HISTORY

FIRST TRANSATLANTIC FLIGHT

In July, 1952, two U. S. Air Force Sikorsky H-19s touched down at Prestwick, Scotland, after a record-making 920-mile flight from Iceland. This was the longest leg in the first and only helicopter flight across the Atlantic, from Westover Air Force Base to Wiesbaden, Germany. The pilots were Capt. Vincent H. McGovern and Lieut. Harold W. Moore.

ASSAULT EXERCISE—Marines at Camp Pendleton, California, launch a helicopter-borne vertical assault as a feature of a recent major exercise involving 15,000 men. A Marine Corps HRS, an S-55 type, is shown above after landing its assault troops. The Marine Corps also flies larger HR2S and HUS Sikorsky helicopters.

S-58s BOOST OFFSHORE OIL ACTIVITY—New Sikorsky S-58s able to fly 150 miles offshore and return without refueling are speeding up the progress of offshore operations in the Gulf of Mexico. Sikorsky helicopters—both the new twelve-passenger S-58 and its able companion, the S-55—are the acknowledged leaders in the transport helicopter field. In the Gulf of Mexico area they carry over 20,000 crewmen and specialists each month, shuttling on around-the-clock schedules between shore bases and rigs many miles offshore. Shown above on a delivery flight are two Humble Oil and Refining Company S-58s.

AERIAL PROSPECTING—Aero Service Corporation's Sikorsky S-55 equipped with instruments designed to locate minerals underground started survey activities early this year. On booms fore and aft are an electromagnetic detector, a scintillation counter, and a magnetometer. They work automatically as the S-55 closely follows contours over rough terrain.

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vices, Formal Report No. 1, and Final Report—Research conducted by E. A. Swire and others at the Armour Research Foundation for the Detroit Arsenal, U. S. Army. Formal Report No. 1, $1.00; 38 pp. (PB 121027) Final Report, $.50; 14 pp. (PB 121028)

Vapor Deposited Coatings: Final Report—by L. M. Schetky, H. S Spacil, and J. Wulff, Massachusetts Institute of Technology for Watertown Arsenal, U. S. Army. $1.75; 64 pp. (PB 121725)

Volume Change and Gas Evolution on Heating Electrolytic Chromium—by K. A. Moon and G. A. Consolazio, Watertown Arsenal, U. S. Army. $.50; 15 pp. (PB 121768)

Packaging and Integrating Printed Circuit Electronic Assemblies—by E. D. Alfred, L. G. Brodrick, C. W. Everhart, and M. E. Hinebaugh, P. R. Mallory and Co., Inc., for Signal Corps, U. S. Army. Part I, $1.50; 52 pp. (PB 121163) Part II, $3.75; 144 pp. (PB 111714)

Survey of the Literature on Antioxidants and Anticorrosion Additives for Lubricants at Elevated Teperatures—by J. W. Cole, Jr., A. Burger, and A. F. Benton, University of Virginia for Wright Air Development Center. $10.00; 830 pp. (PB 121726)

The Synthesis and Antioxidant Activity of Some New Polyfluoralkyl Sulfides and Selenides—by P. D. Faurote, C. M. Murphy, J. G. O'Rear, and H. Ravner, Naval Research Laboratory. $.50; 15 pp. (PB 121568)

Technical Manual on the Machining of Thermanol—The Duraloy Co. for Bureau of Aeronautics. $.75; 22 pp. (PB 121660)

Magnetic Properties of 6.4 Percent Silicon-Iron Sheet Material—by J. F. Nachman and W. J. Buehler, Naval Ordnance Laboratory. $.50; 20 pp. (PB 121545)

The Thermal Decomposition of Organic Nitrates IV. Isopropyl Nitrate, Secondary Butyl Nitrate, Normal Butyl Nitrate, and Ethylene Glycol Mononitrate—by J. B. Levy, Naval Ordnance Laboratory. $1.00; 31 pp. (PB 121179)

Development of Titanium-Base Alloys for Elevated Temperature Application—by W. F. Carew, F. A. Crossley, and D. J. McPherson, Armour Research Foundation of Illinois Institute of Technology for Wright Air Development Center. $2.75; 101 pp. (PB 121467)

The Combined Effects of Carbon, Oxygen, Nitrogen and Hydrogen on the Properties of Titanium Sheet Weldments—by J. F. Rudy, Wright Air Development Center. $1.25; 44 pp. (PB 121491)

Properties of Active Eutectoid Titanium Alloys—by R. F. Bunshah and H. Margolin, New York University Research Division for Wright Air Development Center. $1.75; 70 pp. (PB 121481)

Development of High Tenacity-Heat Stable Dacron Yarns—by R. J. Coskren and T. T. Constantine, Fabric Research Laboratories, Inc., for Wright Air Development Center. $1.50; 57 pp. (PB 121566)

A Study of the Effects of Chemicals on the Properties of Parachute Fabrics—by J. G. Templeton, School of Textiles, North Carolina State College, for Wright Air Development Center. $4.00; 216 pp. (PB 121679)

Evaluation of Rot-Resistant Treatments for Eleastomer-Coated Fabrics—by J. M. Ashcroft, Engineer Research and Development Laboratories, Corps of Engineers, U. S. Army. $1.25; 51 pp. (PB 121420)

Creep Buckling of Integrally Stiffened Aluminum Alloy Panels—by C. W. King, North American Aviation, Inc., for Wright Air Development Center. $1.75; 70 pp. (PB 121466)

NEW GENERAL ELECTRIC laboratory will speed evaluation of complete airborne electric systems and will allow close coordination of electric system development with the aircraft and related systems and components.

GENERAL ELECTRIC ANNOUNCES . . .

New Aviation Lab to Help Speed Development, Qualification of Complete Electric Systems

To provide thorough evaluation of complete electric generating systems in terms of specified performance under normal operating conditions, and safety under abnormal conditions, General Electric has established a new aircraft electric systems laboratory at Waynesboro, Virginia. This new lab complements existing component development facilities for generators, controls, hydraulic and air turbine constant speed drive equipment, and will help speed completion of current and future programs in these four basic areas:

1. Determination of component compatibility.
2. Development and evaluation of new systems.
3. Qualification testing and reporting on complete systems.
4. Co-ordination and assistance in developing components related to the electric system with customer personnel.

Capacity for future systems

To meet the requirements of these programs both now and in the future, the new lab incorporates advanced, high capacity equipment. Currently up to six systems rated to 60 KVA or three rated to 120 KVA can be evaluated.

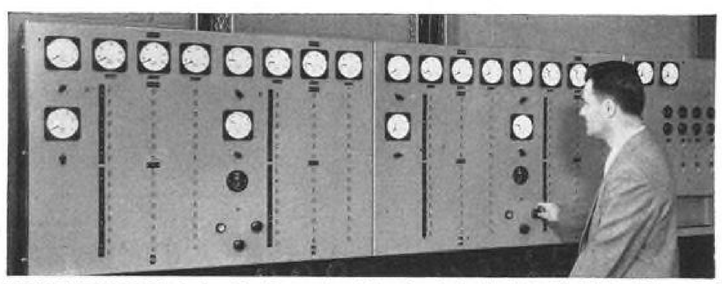
Three drive stands provide adjustable speed at rated power (200 hp continuous, 300 hp for 5 minutes, and 400 hp for 5 seconds) from 4000 to 12,000 rpm at the dual head output shafts. The horsepower varies linearly with rpm at lower speeds. A lab system supplies oil at adjustable temperatures up to 400°C to the hydraulic drives and oil-cooled generators mounted on the output pads.

A heavy flywheel serves to "stiffen" the drive, giving a truer representation of the high-inertia of jet engines. This flywheel is detached to allow evaluation of constant speed drives under conditions of high acceleration.

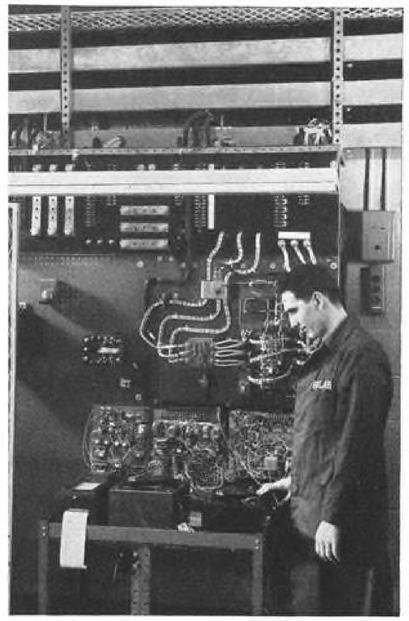
New drives help simulate jet engines

Each drive stand is equipped with a General Electric, current-controlled *Thymo-trol** drive. This advanced system can simulate the actual rate of change in engine speed or provide the response needed in component testing. Outstanding features include excellent speed regulation, high steady state accuracy, and wide speed range. Acceleration and deceleration rates are adjustable or can be preset from 0 to above 1500 rpm per second. Speed regulation from no load to full load is one percent of base speed. Line voltage variations of plus or minus 10 percent will cause a change in output speed of less than one percent of base speed.

*Reg. trade-mark of General Electric Co.



SYSTEM MONITORING during development and functional checks is facilitated by this control panel. Switches allow continuous adjustment of the load banks up to 120 KVA.



OVERHEAD ALUMINUM troughs help simulate aircraft conditions by duplicating feeder installation impedances. Control and protective units are mounted on peg board for easy access.

In addition to high efficiency, the new system provides regenerative braking for rapid slowdown. True reversing is possible without the addition of a reversing contactor. Other features of this all-electronic control include either constant horsepower or constant torque, and current, voltage, and acceleration limit protection.

Instruments speed evaluation

The control panel mounts instruments used to monitor system values during development and functional checks as well as providing drive stand control. Switches on the panel control the load banks which are rated 120 KVA at 0.75 power factor per section and are continuously adjustable. A separate panel is used to mock-up the instrument panel exactly as it is proposed for each airplane.

To simulate aircraft generator feeder installations, aluminum troughs are installed above the control mock-up board. Aircraft type cables are installed in the same manner as on the airplane with the trough acting as the skin of the airframe. This method has produced very satisfactory results. Measurements made of the positive, negative and zero sequence impedances of lab installations show close correlation to calculated aircraft installation values.

A high degree of flexibility for interconnecting buses and load banks is furnished by load breakers connected to each generator bus. High current capacity circuit breakers allow application of faults at numerous points in the system.

Current Results of Lab Tests

A typical example of determination of component compatibility through laboratory testing is the development of the parallel operated, 20 KVA Constant Frequency Power Packages. This system, including statically excited generators, exciter-regulators, hydraulic constant speed drives, and protective panels, is made up of all General Electric components, developed and manufactured to operate as an integrated system. The newly developed drive uses a governor with mechanical network compensation giving very fast speed responses. The exciter-regulator has proved capable of stabilizing the system under high governor speeds, load changes, and fault conditions.

Development of the high phase take-over voltage sensing principle is another example of progress through laboratory evaluation. Work in systems application problems showed a need for a new method of voltage sensing in order to provide a safer system without impractical system limitations. To meet this need a General Electric regulator was developed to sense and operate on the basis of the highest of the three-phase voltages for all abnormal system conditions and on the average for all normal system conditions. Laboratory system tests proved this method to be a practical solution to the problem and the design is now widely accepted and specified for many applications.

Qualification testing and reporting is another important phase of operations at the new lab. Among the systems currently being tested is the statically excited, 60 KVA, production system for the Lockheed Electra. This relatively small, light weight system eliminates the rotating exciter of conventional generators, allowing reduced maintenance costs, reduced fire hazards, and improved generator cooling and operating efficiency.

Rigorous tests conducted on the system included evaluation of voltage regulation, fault current, response times, protective and transfer functions and coordination of load and system protective devices. Also the lab conducted motor starting and transient tests and short circuit and open circuit examinations of all components.

Another important function of the new lab is to provide assistance in evaluating equipment associated with the electric power system during early stages of development. Typical examples of this service are application of utilization equipment that is unique in its power requirements such as large motor loads and regulated transformer-rectifiers, and the application of circuit protectors in coordination with the over-all protective system.

For more information on General Electric aircraft electric systems, components and development capabilities, contact your local G-E Aviation and Defense Industries Sales Representative. *General Electric Company, Schenectady 5, N. Y.*

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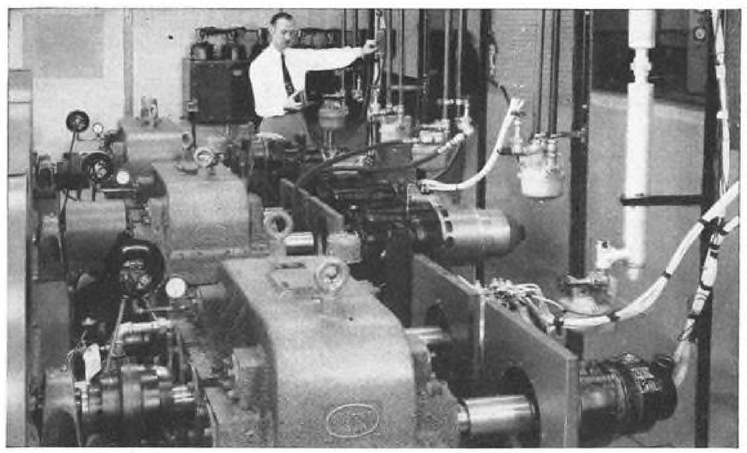
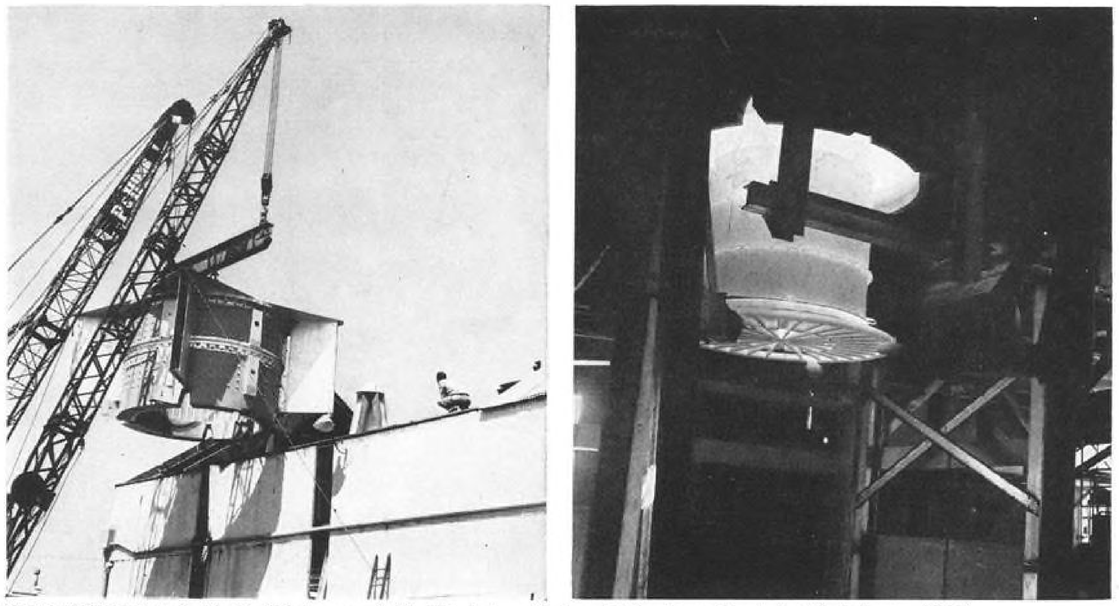
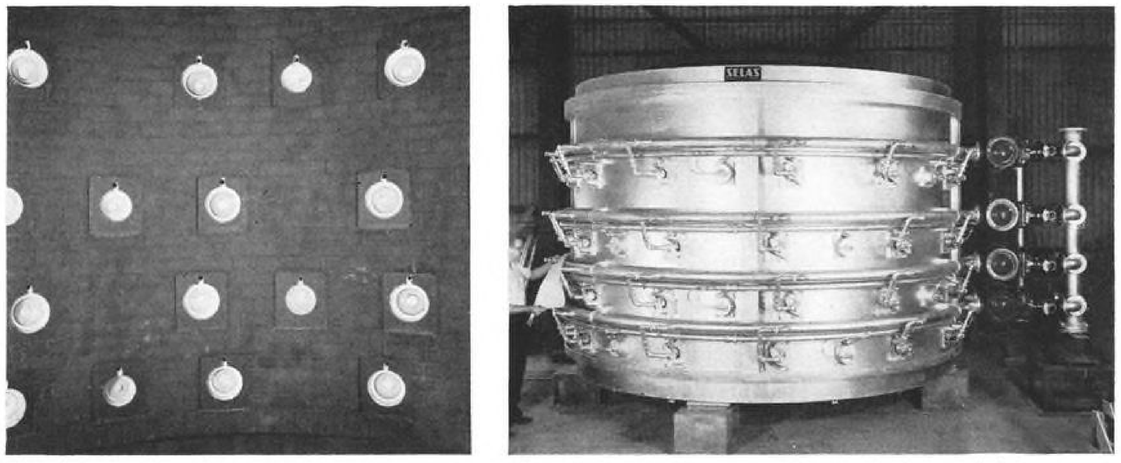


SYSTEMS RATED TO 120 KVA can be evaluated singly or in parallel on these drive stands which provide speeds up to 12,000 rpm. Flywheels simulate high inertia of jet engines.



SOLAR OVEN is installed in its high-bay area (left). Work in muffle-box is being lowered out of white-hot oven (right).



FAST AND SLOW gas burners inside the Twigg furnace (left). Outside view shows manifold system for burners (right).

Stainless Honeycomb Production Grows

Rapid movement of the stainless steel honeycomb structural panel out of the research stage is evidenced by the growing number of airframe and engine subcontractors who are investing in the plant equipment necessary for honeycomb panel production.

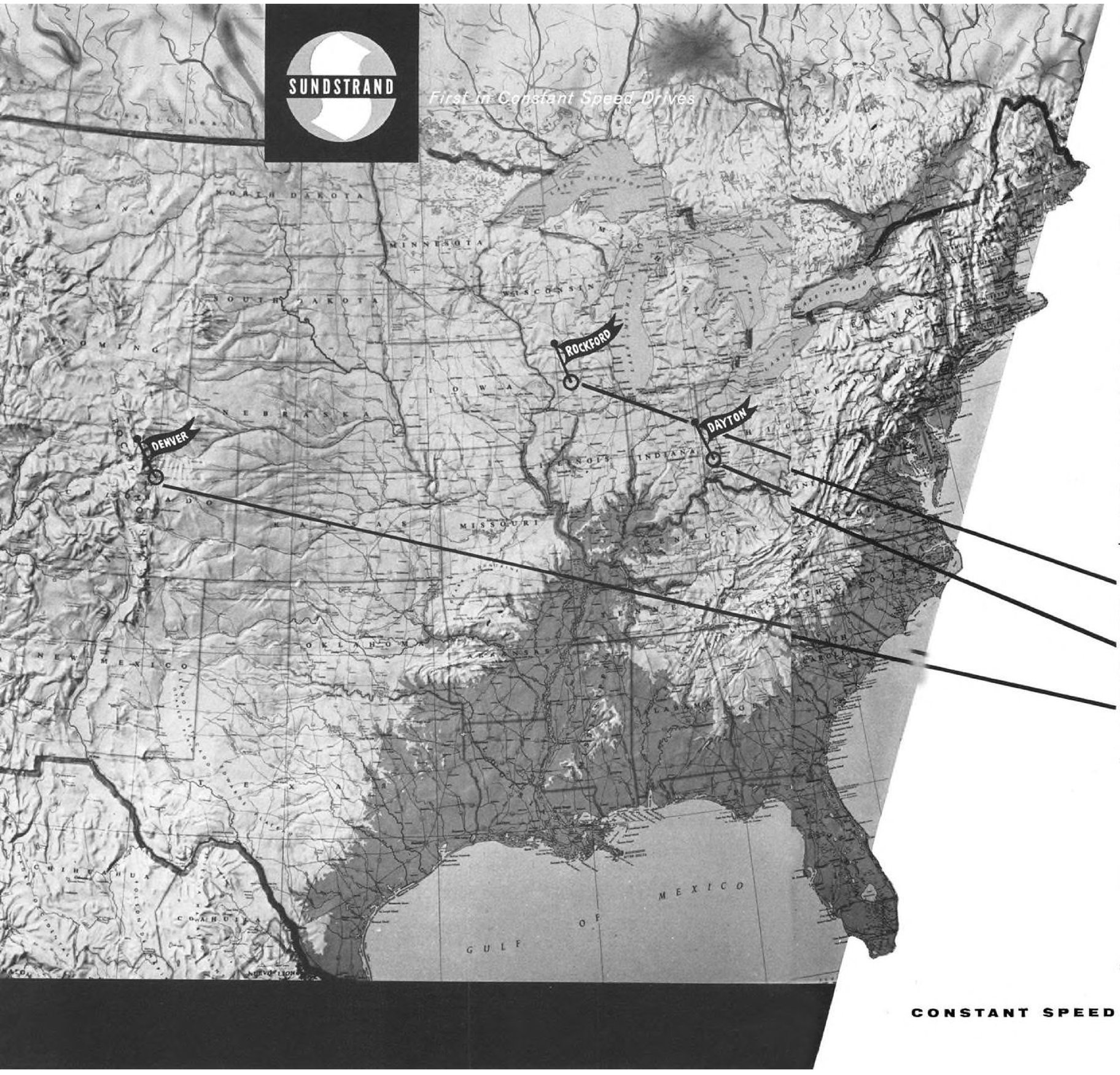
Among subcontractors for production of the Convair B-58 Hustler supersonic bomber—one of the first aircraft to use a considerable amount of the new structural material—are Twigg Industries, Terre Haute, Ind.; Solar Aircraft, San Diego, Calif.; Rohr Aircraft Corp., Chula Vista, Calif. and Aeronca Mfg. Corp., Middletown, Ohio.

Twigg has installed a gas fired brazing oven which can handle parts 8½ ft. in diameter and 7 ft. high. Costing in the $100,000-$200,000 range, the Twigg furnace was built by Selas Corp., Philadelphia, Pa.

It has achieved brazing temperatures of 2,250F and is believed able to reach temperatures of approximately 2,400F.

Solar has installed an electrically heated oven with inside dimensions of 8 ft. in diameter by 10 ft. high. The complete oven extends 35 ft. above the factory floor. Made for Solar by the Pacific Scientific Co., Los Angeles, the furnace has a 300-600 kw input and would normally use an inert atmosphere muffle box with a 6 x 6 ft. inside working space.

Aeronca plans to add a rectangular



Three-plant expansion meets growing demand for SUNDSTRAND DRIVES

Continued, growing demand for Sundstrand Constant Speed Drives to provide automatic 400-cycle electrical systems for the nation's top military and civilian aircraft has brought about a tremendous expansion in production capacity at three separate geographic locations. In addition, the Western District Office, located in Hawthorne, California, provides western aircraft firms with on-the-spot engineering assistance. More than 20 different Sundstrand drives have been produced, or are being developed—proof of the record for reliability and performance that make Sundstrand *first* in constant speed drives.

Sundstrand Aviation, Rockford, Illinois

Main plant has been expanded, two additional plants acquired, and a significant addition made to research facilities. The Rockford plant is the primary source for Sundstrand Drives.

National Cash Register, Dayton, Ohio

NCR's Defense Products Division is presently producing Sundstrand Drives under a licensing agreement. Set up in peacetime, this arrangement provides an additional, experienced, quality source in event of mobilization.

Sunstrand-Denver, Denver, Colorado

Sundstrand-Denver is set up as a complete second source for constant speed drives. Having its own management and engineering staffs, Sundstrand-Denver is in full production stride at the large new plant originally occupied about 18 months ago. Research, design, and development work on entirely new products is also being carried on.

SUNDSTRAND AVIATION

Division of Sundstrand Machine Tool Company • ROCKFORD, ILLINOIS

Sundstrand-Denver: Denver, Colorado • Western District Office: Hawthorne, California

CONSTANT SPEED DRIVES • AIRCRAFT ACCESSORIES

brazing furnace 12½ ft. long by 6 ft. wide to its present moderate sized brazing facilities. The new furnace is being built for Aeronca by General Electric Co. at Shelbeyville, Ind. Aeronca also plans to add a 50,000 sq. ft. high bay manufacturing building to take care of its brazing order backlog.

Last year's annual reports for Solar and Aeronca indicate that the subcontracting field is going through the same evolution as the rest of the aircraft industry as USAF converts to fewer, higher performance planes and missiles.

Both Solar and Aeronca suffered a drop in their gross sales in 1956. But they also entered 1957 with considerably larger order backlogs, largely attributed to their investment in stainless steel honeycomb brazing facilities. This situation has posed some financial problems to these companies.

Cost of preparing a subcontracting firm to compete in stainless steel honeycomb brazing business is difficult to estimate. Though the furnaces represent a large portion of the investment, expenses do not stop with the purchase of the furnace. Not only is suitable factory space needed, but the technical know-how to produce high quality panels without a disastrous percentage of rejects must be built. Much of the problem centers around controlling the brazing conditions inside the furnace. It is here that the manufacturers of the equipment can ease the subcontractor's production problem.

Brazing ovens must provide evenly distributed, accurately controlled heating, heat treating and cooling cycles. They must allow large shapes to be handled in the protective atmosphere of a retort, but with fast loading and unloading for a good rate of production.

Selas Furnace

The Selas gas fired furnace used by Twigg uses two sets of burners for fast heat rise and accurate dwell temperatures. Fast loading and unloading is provided on both the Selas and Pacific Scientific furnace by holding the furnace stationary and raising the hearth which holds the work inside the furnace by means of an elevator. Dual loading platforms permit new parts to be loaded while the oven is brazing the preceding parts. The older bell type ovens, which placed the work on a stationary hearth and lowered the furnace bell down over the work, are now practically obsolete for this type of application.

Twigg is making B-58 engine nacelles and wing elevons. The nacelles must be good for 600F temperatures from the engine and the elevons must be able to take the jet blast when they are lowered. Twigg is also in the program, making honeycomb seals for the B-58's General Electric J79 engine. These are made up of cylindrical honeycomb assemblies, without face plates on the inside surfaces. The open honeycomb thus substitutes for the conventional ribs of the labyrinth baffle seal which prevent the high pressures built up in the engine cycle from leaking out past the rotating parts.

When used around the engine turbine blades, the honeycomb is installed without clearance so that when the turbine starts rotating, the blade tips actually rub in their own clearances by smearing over the foil edges. As Solar engineers said in a paper before the Society of Automotive Engineers last year, this approach comes closest to giving gas turbine designers their ideal of zero tip clearance.

Brazing vs. Welding

Although brazed honeycomb now appears to be in the lead, there also is an interest in resistance welded stainless steel honeycomb. Proponents of this method of fabricating sandwich panels (Ryan Aeronautical Co. and The Martin Co.) claim it has these advantages:

- **Lighter,** more resistant to corrosion because there are no additional, dissimilar brazing metals.
- **Cold rolled,** non-heat-treatable stainless steels can be used because the fabricating cycle does not subject the sandwich to the high oven temperatures of the brazing cycle. Some provision for subsequent heat treatment must be made to realize the sandwich's full strength.

Disadvantages of resistance welding appear to center around the extreme difficulties of production fabrication and inspection. The fits between the many running edges of the honeycomb foil must be contoured within even closer tolerances than in the case of brazed honeycomb sandwiches, because there is no brazing metal fillet to bridge over slight misfits. This lack of fillets also makes it difficult to detect incomplete bonds between the core and panels in X-ray inspection.

Dr. Waters, head of the aircraft research division, The Budd Co., Philadelphia, Pa., believes that corrugated, waffle and other types of sandwich cores like bundles of tubes will integrate better into a resistance welded panel because they will not only permit more straightforward seam and spot welding techniques, but will permit more efficient panel attachment methods.

But Solar appears confident that the fact it can now produce brazed honeycomb panels which will withstand 1,600F continuously and 2,000F intermittently will insure the future of brazed honeycomb sandwich structures. Solar researchers also expect gains in the upper temperature limits for brazed assemblies from the use of new materials such as thermanol, molybdenum and the high strength, low alloy steels.

Roll-Former Will Speed Ramjet Work

El Segundo, Calif.—Refinements in roll-forming will be incorporated in a new machine specifically projected to meet new requirements in part size, materials and tolerances dictated by advances in engine and airframe technology. The machine will:

- **Handle** a part 60 in. in diameter and 60 in. long.
- **Work** thicknesses up to 1 in. of Type 321 stainless steel, reduce this thickness to half with a single pass.

Hufford Machine Works, Inc., will build the roll-former, which it designates "Spinforge," for Marquardt Aircraft Co. in a machine tool development program sponsored by Air Materiel Command and Aircraft Industries Assn. Work requirement for the roll-former was formulated by Marquardt, AMC and AIA. Machine's design concept was developed by Hufford, which was awarded the contract last month by Marquardt after a final consideration of designs submitted by Hufford and three other large machine tool builders.

Cost Over $500,000

Scheduled for delivery to Marquardt in 15 months, the machine, with accessories, will cost in excess of $500,000, and will be the forerunner of a new family of tools of increasing capacity. Compared with its projected 60 x 60-in. part-handling capacity, closest size of roll-former now used is the 42 x 50-in. Cincinnati Milling Machine Co.'s Hydrospin.

In addition to Marquardt, which will use the new roll-former for ramjet components, other engine manufacturers are slated to get machines in the 60 x 60-in. category, AVIATION WEEK has learned. It is anticipated that as many as 20 of this size may be in use within the next five years.

Other AMC-AIA projects anticipate 100 x 100-in. and 120 x 120-in. roll-forming machines within the next five years, AVIATION WEEK has learned. About 10 of these large size machines may be introduced during this period.

Hufford's 60 x 60-in. roll former is projected to meet design standards established by AIA for AMC for a unit capable of producing mechanically spun sections such as conical, tubular, venturi and parabolic configurations, with thin, heavy or tapered sectional thicknesses.

Component Stride

In the roll-forming of engine, aircraft and missile components, the machine will be able to apply 225,000 lb. force on each of two rolls, considered sufficient for all metals presently in the production picture. It will be able to produce components heretofore considered impractical or impossible to manufacture as a single piece, Hufford declares.

Key features in the Hufford design:

- **Rotating table** which supports vertical mandrel will move in and out from the forming position to give complete access for loading or unloading of tooling and parts. This feature will allow overall machine height to be substantially reduced, since clearance will not be required at the forming station for vertical part removal. Special handling devices integral with the machine will be eliminated, as for parts which must be removed from split-type mandrels.
- **Automatic variation of angularity** at which forming rolls meet the work during the forming cycle. Roll will be mounted on a curved way section driven by a vertical hydraulic cylinder, automatically programmed.

Forming rolls can be operated in unison from a single template or independently from individual templates.

Roll infeed, downfeed and angularity will be tracer-controlled off templates conforming to the outer surface configuration of the formed part. A multiple template indexing system will accommodate parts which require more than one pass to form.

Electrical Actuation

Template variations will be converted to electrical impulses which, in turn, will actuate hydraulic servo valves in a 3,000-psi. system, required because of the 225,000-lb. forming force for each roll.

- **Tail stock** will apply a force up to 200,000 lb. against the material on top of the mandrel to keep the part secure during forming.
- **Two Hallamore** closed-circuit TV cameras will be mounted on the machine frame to permit operator to observe all forming phases in safety, beyond a guard rail area. Cameras will give a closeup view of reaction of the metal at the point of forming.

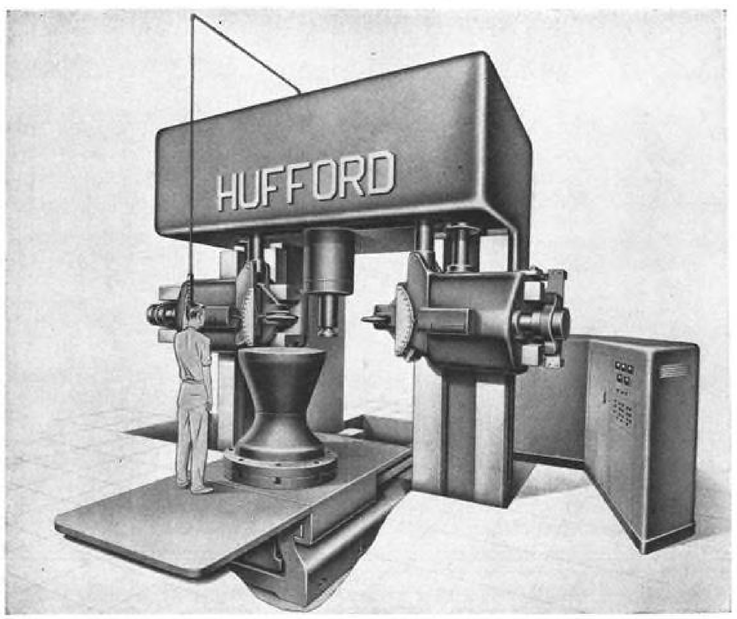
Because of the high inertial loads created by the rotating large mass of mandrel and part, an emergency braking system will be incorporated to bring the spindle to a quick stop in event of part failure.

Machine will be capable of tracing to within ±.003 and spindle will be true to within ±.001, under normal loading conditions. Other details:

- **Spindle speed** will be infinitely variable from 10 to 400 rpm.
- **Power** for spindle drive will be 200 hp.
- **Feed rates** will be 60 in. per minute.

Overall height of machine will be 14 ft.; width 21 ft. 8 in.; depth 14 ft. 2 in. Weight of machine will be about 425,000 lb.

Table will be designed to accommodate application of heat to the workpiece for those materials which may



ROLL FORMING machines offers advancements for use in ramjet production.

require hot forming. Provisions will be included to insulate and cool machine parts both for normal operation and for heated mandrel conditions.

Contract for the machine contemplates that Hufford initially will conduct a research and development program on the machine in heavy metal forming. This work will be carried out in conjunction with Marquardt production engineers, who will direct the program.

Long Periscope Used On Nuclear Project

General Electric has built what is believed to be the world's longest periscope which has been installed at the Atomic Energy Commission's National Reactor Testing Station to help in development work on an aircraft nuclear propulsion system.

The 90-ft. long aluminum tube incorporates an intricate mirror and lens system to allow atomic workers to watch performance of a nuclear reactor being tested while working safely behind heavy shielding. Used in conjunction with a smaller, 60-ft. periscope (which is still almost twice the length of submarine periscopes) the two optical devices permit observers to watch opposite sides of a reactor while it is in operation, or when it is radioactively hot.

Scanning heads at the reactor end of the periscopes are pointed away from the hot reactor into scanning mirrors to provide extra insurance against any dangerous radiation that might reach through the long tubes to the observers.

Scanning mirrors located insides the reactor are motor-driven to swing or tilt in any direction desired by the observer.

A small control console at his side enables him to move the mirrors.

Built-in magnification enlarges viewed images to approximately 1½ times life size.

A special, motor-driven assembly of three mirrors automatically keeps the image erect to the viewer.

A third periscope, also being developed by GE, is equipped with a built-in camera and is designed for high magnification.

With it, hot-cell technicians can perform parts assembly and disassembly jobs which compare in delicacy to threading a needle by remote control while using a mirror instead of direct vision.

GE is engaged in work on the government's aircraft nuclear propulsion development program at its Evendale, Ohio, plant and at the AEC's Idaho Falls test site under contracts with the AEC and the Air Force.

"Bernie" Fenwick, outside Friendship International Airport's Terminal Building. Directly behind him is a Constellation operated by Eastern Airlines, one of Pan-Maryland's airline customers.

"There's no ceiling on success when you fly with Shell!"

says G. B. Fenwick, Jr., President of Pan-Maryland Airways. P-M boosted its gallonage fiftyfold in six years as a Shell Aviation Dealer at Friendship International Airport, Baltimore

It's no wonder Bernie Fenwick is happy Pan-Maryland teamed up with Shell in April 1951. At that time, one truck was more than enough to handle their business. Three months later, thanks to Shell's help, they began making into-plane deliveries to the airlines.

Today, Pan-Maryland has 13 trucks busy fueling and servicing the airlines, private airplanes, jet fighters of the National Guard, police department aircraft, helicopters, military and government-owned aircraft and dozens of corporate aircraft.

"We've got an extremely diversified operation here," says Bernie. "Pan-Maryland handles everything from Cubs to F4D Navy jets—from Mites to B-52's.

"Consequently, we handle the complete line of Shell Aviation Fuels, including Shell Turbine Fuels for jet planes and commercial turboprop airplanes.

"Shell also provides us with a full line of AeroShell lubricants, fluids and greases to fit our customers' needs. What's more, we get up-to-date technical advice from our Shell representative who's always at our service."

When Bernie talks about the services Pan-Maryland gives its customers, he emphasizes that delays are almost nonexistent. All pilots have schedules to meet and what they want most of all is fast, efficient, on-schedule service.

A "Customer's Service Report" is mailed to every flier who stops at the field. It invites comments and criticism of service, workmanship and courtesy. Replies like "Best service I've ever gotten—anywhere," "Excellent in every way," "Keep up the good work," are received every week from all over the country.

Bernie points out that their CAA Certified Repair Station is going to be finer than ever. A big new hangar will be completed soon and he plans a Class 4 shop there, with service crews qualified to work on every type of plane.

Other plans for the future include branching out into airline ramp service, setting up an aircraft sales department, building more hangars *and boosting gallonage still further.*

"After all," says Bernie Fenwick, "the sky's the limit with Shell."

Private planes get first-class treatment, too. Every civilian pilot who uses the field receives a "Customer's Service Report" which requests suggestions for improving service.

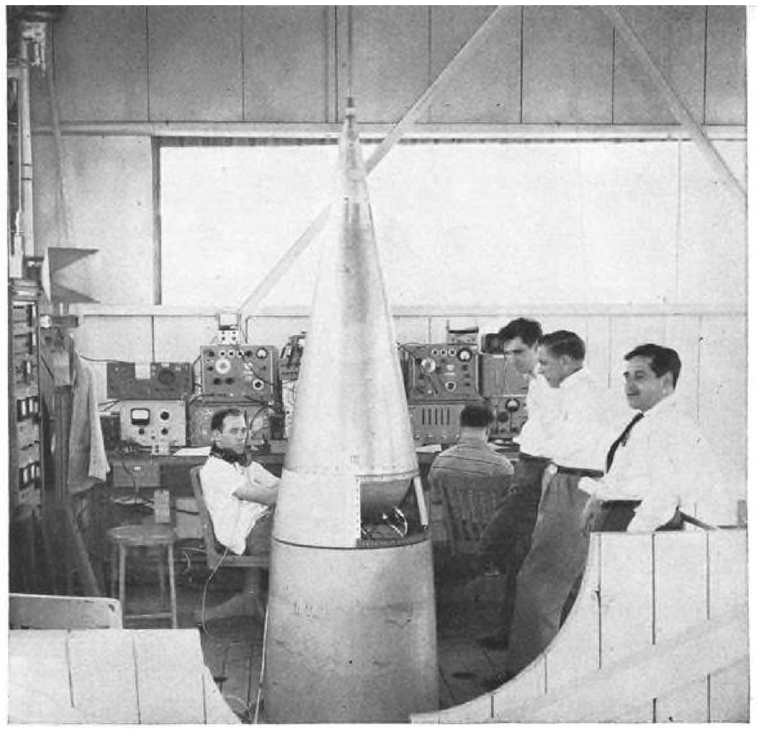
The Boeing 707 jet transport is fueled by Pan-Maryland with Shell fuel at Friendship International Airport after its recent record 3-hour, 48-minute transcontinental flight.

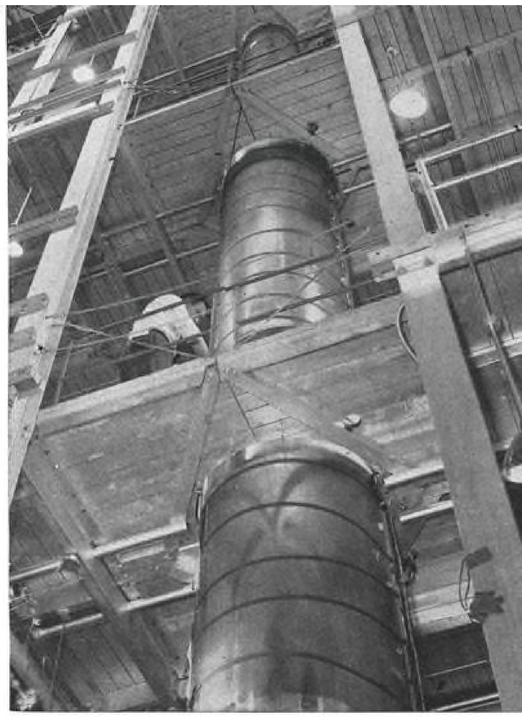
Bernie discusses plans for future expansion with Col. J. Colonna, Airport Director.

It pays to be a Shell Aviation Dealer

—and the Shell office nearest you will be glad to show you why

SHELL





Vanguard Takes Shape

Earth satellite Vanguard launching vehicle is shake tested in tower at Martin Co., Baltimore. Nose cone is at top of tower at fifth level (above). View from ground (right) shows part of the five levels. First and second stages join at third level (below). Latest specifications on the satellite vehicle:

* LENGTH:

First Stage	44 ft.
Second Stage	31 ft.
Third Stage	7 ft.
Overall	72 ft.

DIAMETER:

First Stage	45 in.
Second Stage	32 in.

PROPELLANTS:

First Stage	Liquid Oxygen and Kerosene
Second Stage	White Fuming Nitric Acid and Unsymmetrical Dimethy Hydrazine
Third Stage	Solid Propellant

THRUST:

First Stage (General Electric)	27,000 lb.
Second Stage (Aerojet General)	7,500 lb.

** VELOCITIES:

First-Stage Burnout	3,700 mph.
Second-Stage Burnout	9,000 mph.
Second-Stage Apogee	8,500 mph.
Third-Stage Burnout	18,000 mph.

RANGES:

At First-Stage Impact	275 mi.
At Second-Stage Impact	1,550 mi.

ALTITUDES:

At First-Stage Burnout	35 mi.
At Second-Stage Burnout	130 mi.
At Second-Stage Apogee	300 mi.
At Third-Stage Burnout	300 mi.

ELAPSED FLIGHT TIME:

Vertical Ascent	10 sec.
At Second-Stage Burnout	250 sec.
At Third-Stage Burnout	600 sec.

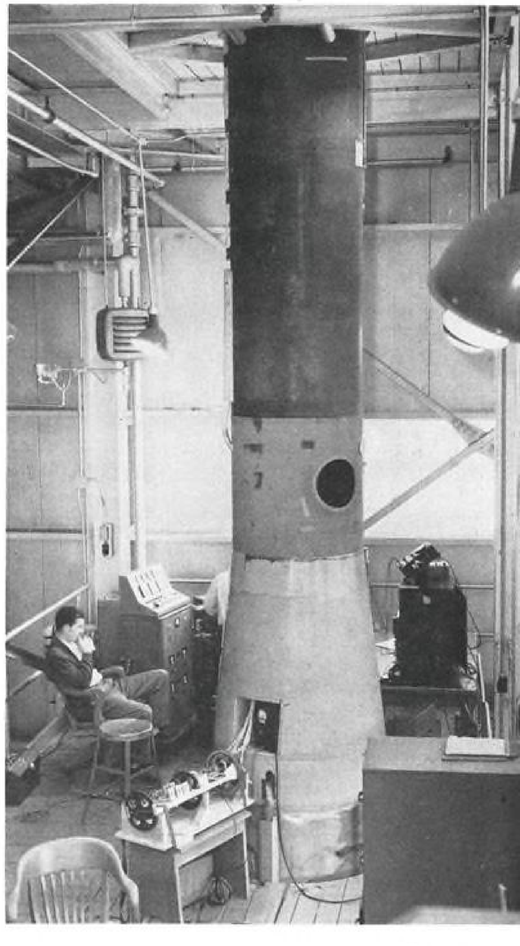
GUIDANCE SYSTEM COMPONENTS:

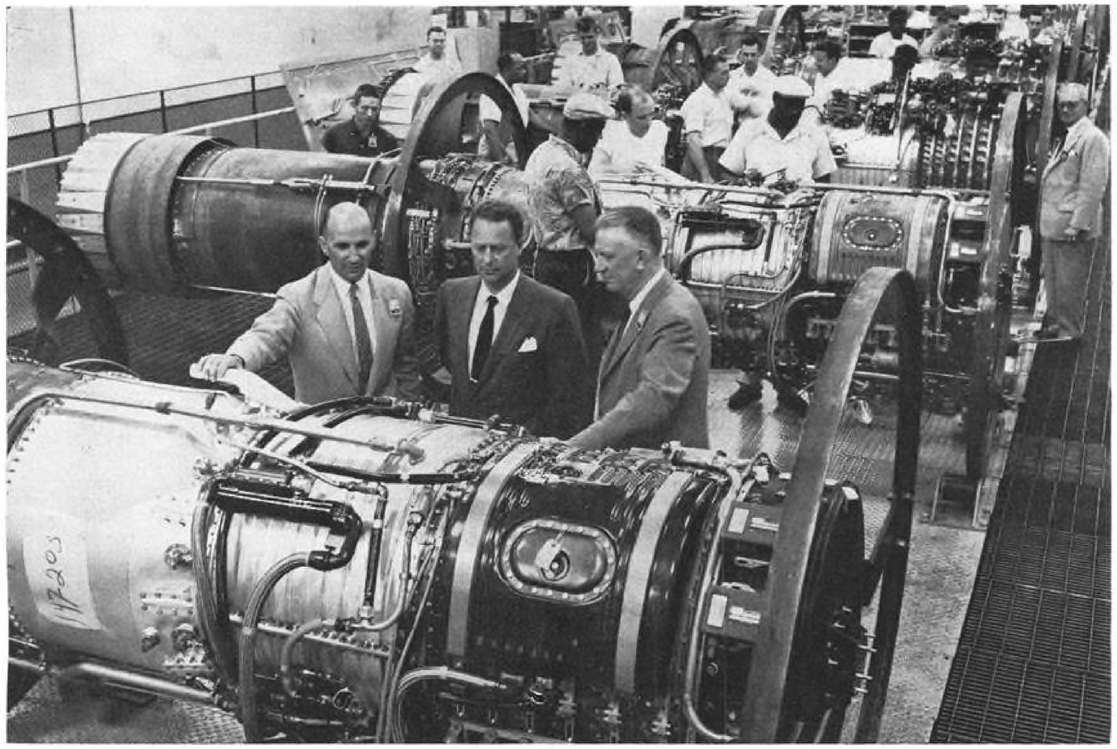
Pitch Programmer
Coasting Time Computor, With Integrating Linear Accelerometer
Three-Axis Gyro Reference System
Magnetic Amplifier Autopilot
Program Timer

SEPARATION TECHNIQUES:

First-Second-Stage Separation	Six explosive bolts
Second-Third-Stage Separation	Rocket powered turntable spins third stage, retro rockets slow down second stage as third coasts clear, delay fuse ignites third stage.

* Stage totals are not cumulative since portions of stage fit within each other.
** Includes velocity gained due to earth's rotation.





J79s on Final Assembly Line

Final assembly horizontal line at General Electric's Evendale, Ohio, plant shows J79 turbojet engines on stands. USAF has awarded series of new contracts for development of the high thrust-to-weight engine (AW May 27, p. 29), the latest this month totaling $4 million. In foreground (left to right) are Gerhard Neumann, general manager, jet engine department; J. B. Montgomery, general manager, production engine department, and C. E. Anderson, manager, assembly and spare parts section, production engine department.

AMC Contracts

Wright-Patterson AFB, Ohio—Following is a list of unclassified contracts for $25,000 and over as released by the Air Materiel Command:

North American Aviation, Inc., Los Angeles Int'l Airport, Los Angeles 45, Calif., install GFAE prototype MH-14B autopilot, GFAE MA-3 auto LAB system, effect the tie-in and perform a flight test program on F-100C bailment airplane, (PR PH-177887 and PH-236047), $1,070,511.

Airways Engineering Corp., 1212 18th St., N. W., Washington 6, D. C., architectural engineering services for the preparation of master plan for Warner Robins AFB, (PR 219894), $38,200.

Pathe Pictures, Inc., 33 W. 60th St., N. Y., N. Y., production of motion picture project 15209 entitled "Helicopter-Arctic Operations", 1 ea., (PR 669791), $30,384.

Mass. Institute of Technology, Cambridge, Mass., royalty payments for license rights, (PR 631880), $366,500.

Thompson Products Inc., Cleveland, Ohio, acquisition, rehabilitation and installation of machinery and equipment for the production of J57 engine components, (PR 749782), $225,000.

The Dayton Electronic Products Co., 320 Vermont Ave., Dayton, Ohio, audio analyzer, console for electric equipment, (PR 652266), $28,790.

Standard Coil Products Co., Inc., North Dighton, Mass., control 1A-16, 19 ea., control, K-3, 21 ea., Control, K-2, 50 ea., (Pr's 564657, 736382, 736380, 736381 and 736381-1), $30,718.

The General Tire & Rubber Co., 1708 Englewood Ave., Akron, Ohio, nose wheel assys, 9.50-16, (PR 787009), $115,914.

The Goodyear Tire & Rubber Co., Inc., 1144 E. Market St., Akron 16, Ohio, nose wheel assys for KC-135A acft, (PR PE-564360), $60,472.

Solar Aircraft Co., San Diego, Calif., acquisition, rehabilitation and installation of machinery and equipment for the production of J79 engine components, (PR PE-7-G-6018), $467,400.

The Rand Corp., 1700 Main St., Santa Monica, Calif., facilities for programming of AN/FSQ-7 and training of personnel, (PR 673190 and 673191), $223,000.

The B. F. Goodrich Co., 803-4 Winters Bank Bldg., Dayton, Ohio, wheel assys, for C-133A acft, (PR PE-564296), $54,749.

American Bosch Arma Corp., Arma Div., Roosevelt Field, Garden City, N. Y., MD-9 bomber fire control system for B-52 spare components, spare parts, (PR 604386 and 604386-1), $2,500,000.

Utica Div., Bendix Aviation Corp., 211 Seward Ave., Utica, N. Y., timer deicer for aircraft use, PR SA-639665 and SA-639666), $27,226.

General Motors Corp., Allison Div., Aeroproducts Operations, Dayton 1, Ohio, model A6341FN-196-B propeller, (PR PE-701136, FCR: MOHB-56-12-454), $260,000.

Fontana Aviation, Inc., Ford Airport, Iron Mountain, Mich., IRAN Maintenance, modification and Flight Test of L-19 type Aircraft. (UR OC-705536 and 705536-1) $71,685.

U. S. Hoffman Machine Corp., Intercontinental Mfg. Co., Inc., Garland, Dallas County, Texas., IRAN Maintenance, Modification and flight test of H-23 type Aircraft (PR SB-554264-1) $148,874.

Robert J. Brady Co., 3255 M St., N. W. Washington 7, D.C. Fire fighting transparency kits and accompanying transparency preparation kits (PR 669821) $79,460.

Atlas Film Corp., 1111 South Blvd., Oak Park, Ill., 15mm Eastman Color Motion pic. production entitled The Air Force Takes Care of Its Own Project SFF 409, (PR 669841) $25,447.

Air Products Inc., P.O. Box 538, Allentown, Pa., Type MA-2 Liquid Oxygen Generating Plant, packaging for domestic and overseas shipments, (PR MP-563490) $334,446.

Acme Precision Products Inc., 215 N. Findlay St. Dayton 3, Ohio., Type A-1A liquid oxygen generating plant, packaging for domestic and overseas shipments, spare parts for above plant, (PR MP-568489 and MB-623107), $5,888,851.

Western Electric Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J., indicator (used with radio receive set), (PR 670823), $220,656.

CAA Contracts

Washington—Following is a list of contracts as released by the Civil Aeronautics Administration:

Consolidated Diesel Electric Corp., Stamford, Conn., $220,785.05 for 23 diesel engine generators.

United States Motors Corp., Oshkosh, Wisc., $119,330 for 17 engine generators.

Hickok Electrical Instrument Co., Cleveland, Ohio, $74,883.84 for 512 tube testers and carrying cases.

Warner & Swasey Co., Lansing, Mich., $9,007 for one diesel engine generator.

Eldico Corp., Mineola, L. I., N. Y., $1,950 for one transmitter, one linear amplifier,

VISCOUNT used by Brazilian president carries auxiliary fuel tanks on undersides of wings outbound of Rolls-Royce Dart engines.

Viscount Plays Dual Role in Brazil

Rio de Janeiro—High rate of utilization is being achieved by the executive Vickers Viscount used by Brazilian President Juscelino Kubitschek, who is a confirmed user of aircraft for overseeing his large country.

In addition to being a highspeed transport for the president and other top government officials, the Viscount also is serving as a means of checking out Brazilian air force flight and ground crews in turbine transport operation.

Providing these tangible assets, the turboprop transport also serves as an important public relations conversation piece and a crowd collector wherever the president goes.

President Kubitschek has been averaging at least six flights monthly in his Viscount since he received it early this year; there are periods he will use it three and four times during a busy week.

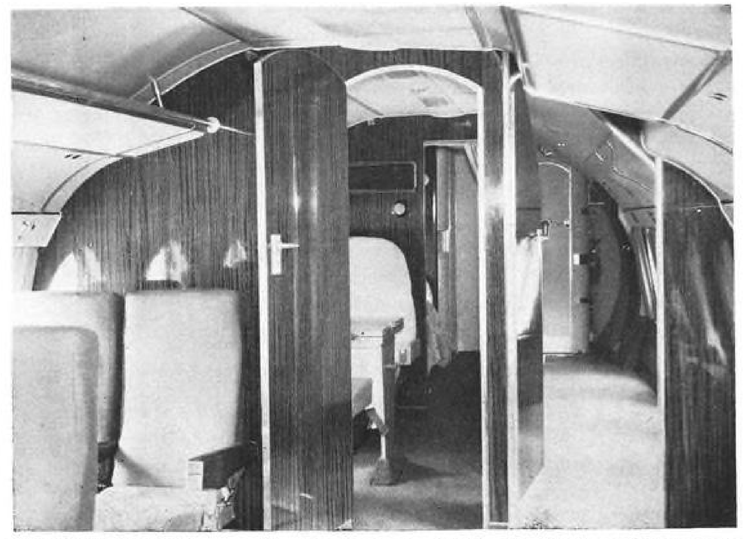
Because of Brazil's size and lack of adequate surface transportation, this country's politicians have to use aircraft instead of the traditional train in stumping the interior. Also, the president is promoting establishment of a new capital, located in the interior, called Brazilia, where he has had a special 2,400-ft. asphalt runway installed so that he can make frequent weekend trips publicizing the major relocation plan.

Operations cost of the Viscount is reported to be slightly over that of a Convair 240, but less than for a Convair 340.

The air force technicians, who fly and maintain the executive Viscount, say that it has an average cruising speed of 310 mph. and it can make flights to virtually any spot in Brazil or South America with only one stop. Performance is such that it can carry the president and a party of 24 in and out of small fields such as Santa Maria, Rio Grande do Sul, which has a 4,264-ft. runway, where a Douglas DC-6 or Lockheed Constellation probably could not operate safely.

Whenever the president wants to reach a spot in the interior where the field is too small for the Viscount, he flies to the nearest large enough airport and continues his journey in an air force Douglas C-47. He has found that by using the Viscount as a "trunkliner" and switching to smaller aircraft when needed, he gets in two or three times as much travelling as he previously did when using slower planes. President Kubitschek recently took delivery on a new Beech Super 18 executive twin, suited for short trips and small-field operation.

The executive Super 18 was one of five purchased by the Ministry of



CUSTOM INTERIOR has executive suite (center in photo) with private conference room and bedroom, lavatory separated from main cabin which has 24 passenger seats.

Helicopter Rescues Deer

Coast Guard Sikorsky S-51 begins evacuation of first of 500-750 deer starving on patches of land in Mississippi River delta. Only one deer could be lifted at a time.

Aeronautics for use by high civilian and military officials.

Brazilian air force now has 26 operational fields strategically located around the country capable of taking the president's Viscount. Of these, however, only 10 are equipped to fuel kerosene. From Rio, the Viscount has sufficient range to touch every major city in the country without refueling, with the exception of Manaus on the Amazon. Fuel capacity is sufficient to reach Manaus, but not the nearest alternate, so the Viscount must stop at Brazilia or Cuiaba, Matto Grosso.

Longest nonstop flight from Rio is to Belem, at the Amazon's mouth, where there are two good alternate fields, a distance of 1,500 mi. The Viscount recently covered this nonstop in five hours.

Hot-Weather Operation

Pilots say that the fields present a problem in that they must be clean of stones and other foreign objects. At Brazilia, for example, a stone nicked a propeller on takeoff, necessitating a propeller change. An airport paving program starts this month and at least 10 fields a year for the next four years should be paved, thus further expanding use of the Viscount.

Another problem, according to pilots, is hot-weather operation. Brazil's hot season sometimes lasts nine months. Pilots say that they can't get the Viscount over 20,000 ft. during hot weather and rarely get it over 22,000 ft. even in "cool" weather periods. They said that during the ferry trip from England they cruised at 24,000 ft.

The president uses the plane for considerable night flying since he hates to waste valuable daylight hours travelling.

It was thought that providing turbine fuel was going to be a major problem, but this has not developed. Shell and Esso supply the Air Force with kerosene for its jets and thus far have fuel dumps and trucks at 10 fields, will soon set up facilities at three more in other out-of-the-way locations. Air force advises the companies 48 hr. in advance to have fuel and oil supplies ready at destinations so that trucks and hoses that have been pumping gasoline can be cleaned and ready to service turbine fuel. This operation is providing the fuel companies with fueling know-how and equipped stations for the time when VASP airlines gets its five Viscounts late this year or early in 1958.

Destined originally for Braathens, a Norwegian shipping firm, the Viscount was picked up by the Brazilian government when the customer dropped out. Considerable rework was done on the interior to give the president a private suite with bedroom, conference room and private lavatory. Ahead of the presidential suite is the passenger area containing 24 seats. Flight deck was specially modified to provide room for a radio operator. A crew of five is carried: two pilots, a flight engineer, a radio engineer and a steward.

The air force has a second executive Viscount on order, which will be fitted with a belly fuel tank, similar to U. S. Steel's airplanes, to provide additional range.

Doman Has Orders For 3 More LZ-5s

Newark—Doman Helicopters, Inc., demonstrating its LZ-5 here, announced an order for three more from Pittsburgh Airways, Inc. Sale raises to 13 the total of commercial LZ-5s sold so far.

Flight demonstration at Newark Airport marked the opening of a sales campaign. LZ-5, which grosses 5,200 lb. and seats up to seven passengers, lists for $120,000 and is offered for nine months delivery.

Doman believes the commercial helicopter market is growing steadily and corporation interest is high. Company hopes to build about 25 commercial helicopters during the next year, double that volume the following year. First LZ-5 customer was Helicondor de Colombia, Bogata, with an order for 10.

Doman says proper development of the commercial-corporate market depends on availability of a suitable small turbine engine for single or twin engine configurations of a basic airframe.

LZ-5 is powered by a Lycoming SO-580-A1B engine developing 400 hp. at takeoff, 350 hp. at its continuous rating at 3,000 rpm.

Dutch Firm Completes New Spray/Dust Plane

Light agricultural airplane is being readied for flight tests by Hollandair, The Netherlands. Prototype will be powered by a 135-hp. Lycoming, but 150-hp. and 200-hp. engine installations may be made later, according to the company.

It estimates that production models will cost approximately $8,000.

Tandem-seat prototype will be fitted with two underwing Fiberglas tanks of 40 U. S. gal. capacity each for spray chemicals. A chemical dust hopper can be fitted in place of the rear seat.

Airframe is built up of welded steel tubing. Wings are of spruce, fabric covered. Calculated performance includes:

Takeoff and landing within 110 yd.; full load stall speed, 40 mph.; optimum spray speed, 56 mph.; initial rate of climb, 1,200 fpm. Cruise speed is estimated as 90 mph. The high-wing airplane will have a span of approximately 49 ft.

PRIVATE LINES

Cessna XT-37 Ser. 54-718, one of three hand-built prototypes of side-by-side USAF jet trainer, has been delivered to Air Force Museum, Dayton, Ohio.

Aircopter Transport, Inc., is new Santa Ana, Calif., charter operation using a Bell 47-G2 on industrial, forestry and geological survey assignments.

First approval for an air taxi operator to establish office on a military post has been granted Skyway Air Travel at Ft. Chaffee, Ark., by Military Traffic Management Agency, Washington, D. C. Military personnel on leave or with discharges can now use private charter air service for direct flights to off-airways destinations.

State of Washington officials are studying a proposal to buy at least one airplane for the state motor pool as a result of recommendation by Arnold Tjomsland, school building facilities director. Tjomsland reported he saved an estimated $1,233 in six months by renting and flying an airplane on official business in place of other forms of transport he formerly used.

Spare parts for Taylorcraft Models BC12D, D and 19 fabric-covered aircraft may be produced by Universal Aircraft Industries, (Univair), Denver, Colo., as a result of negotiations with Taylorcraft, Inc., Conway, Pa. Univair will also supply the factory and T-Craft

USAF Gets First Cessna 310s

U. S. Air Force using commands are now taking delivery of the first of 80 Cessna 310 light twin transports for administrative and light cargo duties. Designated L-27A, the military versions of the 310 business plane will go to Air Research and Development Command, Continental Air Command, Air Materiel Command, Air University, Air Defense Command, Air Training Command and Air Proving Ground.

distributors with spares for these early models.

Full-scale cabin mockups of new Beech business planes were displayed by manufacturer and its Wichita distributor during recent four-day Kansas Medical Society annual meeting in that city.

Italian government granted certification to Lycoming GO480 270-hp. air-cooled engine.

Spray equipment installations on three Curtiss C-46 aircraft have been made by Newark Air Service, Newark Airport, N. J. Contract included spray boom installation, fitting of 1,600-gal. chemical tanks and pumps in fuselages. Work was done for Lebanair, Inc., which has large gypsy moth control contract from Dept. of Agriculture for New York-Connecticut area.

Australian government purchased its third DH-Canada Beaver, for use in the Antarctic. Two Beavers will be stationed at base in Mawson. Last year one of the planes logged 500 flying hours and photographed 350,000 sq. mi. of territory and 1,200 mi. of coastline.

Bell helicopter sales and charter operation has been established in Northern Rhodesia, Central Africa by Autair, Ltd., England. Known as Autair Helicopters (Africa), Ltd., new company has received its first Bell 47G-2.

Score of industrial and business people in Detroit, Mich., are behind a plan to establish helicopter taxi service between area airports and downtown executive buildings of Chrysler, Ford and General Motors. To be called Helicopter Airways Service, Inc., operation has been approved by Michigan Public Service Commission and is awaiting approval of Michigan Corporation & Securities Commission, latter necessary so that firm can issue stock.

Van Dusen Aircraft Supplies opened Southern Division offices at Byrd Field, Richmond, Va., serving Middle Atlantic and Southern States.

New French Nord 3202 two-place trainer is undergoing initial flight tests. Powered by a Potez 4D 32 engine with a 240-hp. compressor, the N.3202 has a cruise speed of approximately 160 mph. and range of 600 mi.

Teterboro School of Aeronautics, Teterboro Airport, N. J., is building a $350,000 hangar and training facility at the field with completion scheduled for the end of this year.

Movie produced by Line Material Industries details methods of installing simple airstrip lighting kit developed by firm especially for Flying Farmers to extend operations to night time. "Tom Jones, Night Flying Farmer", is 16-mm. 15-min. sound and color film available on loan from LMI, McGraw-Edison Co., Milwaukee 1, Wisc.

Permission to import two Piper Apache light twins for rain making research by Australian Commonwealth Scientific & Industrial Research Organization is being sought from Australian government. Researchers complain types available are obsolete and make research work difficult.

Scottish Aviation Twin Pioneer has been purchased by Consolidated Zinc

Corp., for supply work in connection with mineral exploration surveys in North Country section of Australia. Firm also operates a Lockheed 12 and a Hiller 12-C.

Special 125-page color booklet for executive and airline pilots detailing principles, operation and application of Sperry Integrated Instrument System is available from Sperry Gyroscope Co., Division of Sperry Rand Corp., Great Neck, N. Y.

New charter plane service, Inland Empire Airways, Inc., has been formed at Sandpoint, Idaho, using four executive-type planes acquired from a group of Northwest lumber firms.

U.S. helicopter exports in first quarter of 1957 nearly doubled over same period last year, total of 64 units valued at $10,905,510 compared to 33 shipped in 1956 valued at $3,791,550. March 1957 shipments of 31 helicopters nearly equaled all of 1956 first quarter.

Beech licensed Canadian Car Co., Ltd., Montreal, to build its Model 73 Jet Mentor trainer. Jet Mentor was sent to RCAF station at Trenton, Ont., for a week of evaluation, was also scheduled for demonstration at the RCAF station at Ottawa.

Sierra Pacific Aviation Corp., is new charter firm using Twin Beech and Bonzanza aircraft based at San Jose, Calif. Daily flights are operated to Reno and Lake Tahoe and week-end service to Las Vegas, Mexico City and La Paz, Mexico.

Bank of Mexico will take delivery of a turboprop-powered Fairchild F-27 Friendship executive transport in September 1958.

Chicago Skymotive, Inc., Chicago, retained Design Dynamics, Inc., to develop and design personalized executive and personal plane interiors for its customers.

United Transports, Inc., Oklahoma City, Okla., will take delivery of a Howard Super Ventura executive transport in October; Kudner Agency, Inc., New York, recently received its Super Ventura. Bendix radar and Aerojet-General Jato were among the equipment on the latter.

Delivery of Bell 47J executive helicopter to Arthur Vining Davis, Miami, Fla., was made from Bell's Hurst, Tex., plant in 12 hr. 7 min.; average speed for the 1,275-mi. flight being over 106 mph. Four-place 47J replaces the former three-place Davis 47G-2.

CAB Accident Investigation Report:

Flaps Retracted, DC-6B Flew Into Ground

Canadian Pacific Airlines Flight 307, a Douglas DC-6B, CF-CUP, crashed following a missed approach at Cold Bay Airport, Cold Bay, Alaska, Aug. 29, 1956, at approximately 2045 BST.[1] Eleven passengers, including one infant, and four crew members were fatally injured. Three passengers and four crew members received injuries of varying degree. The aircraft was destroyed by impact and fire.

HISTORY OF THE FLIGHT

Flight 307, a regularly scheduled international flight, departed Vancouver, British Columbia, Canada, at 1347 (1747 Pacific daylight time), en route to Hong Kong, China, with a refueling stop at Cold Bay, Alaska, and an intermediate stop at Tokyo, Japan. On board the aircraft were 14 passengers and a crew of eight, consisting of Capt. Thornton A. Tweed, Capt. Phillip D. Iverson, First Officer Robert Love, Navigators William R. Hunter and William B. Short, and Stewardesses Evelyn Lee, Anita Wong, and Dolores R. Jordan.

An instrument flight plan, filed with Vancouver Airway Traffic Control, specified an altitude of 11,000 ft. via airways Green 10 and Amber 1 to Port Hardy, 10,000 ft. via Great Circle from 100 mi. out of Port Hardy to 160 deg. W. longitude, and 12,000 ft. direct to Cold Bay. The estimated time of flight was seven hours and 16 minutes, with Anchorage and King Salmon, Alaska, as destination alternates and Vancouver as a return alternate. The clearance issued was in accordance with the above flight plan.

Routine hourly position reports were received from the flight indicating that it was making good its track slightly ahead of the estimated time. The flight reported 100 mi. out at 2011, estimating Cold Bay at 2036. It reported being over the Cold Bay range station outbound on a standard instrument approach at 2035, and at 2042 as completing a procedure turn and proceeding inbound. This was the last transmission from the flight.

At approximately 2045 the aircraft was observed to descend from the overcast north of the airport for a landing on runway 14 and cross the field at low altitude to the intersection of the two runways. At this point a shallow left turn was started and the aircraft went out of sight southeast of the airport. Very soon thereafter fire was observed in that direction.

The 2045 Cold Bay weather observation was: Indefinite ceiling, 500 ft. obscured; visibility 1½ mi.; light drizzle; fog; temperature 46 deg.; dewpoint 46; wind west-northwest at 20 kt.; altimeter setting 29.89 in.

INVESTIGATION

Examination of the wreckage and ground marks disclosed that the aircraft first struck the ground at an elevation of 10 ft. on a heading of approximately 40 deg. magnetic and 4,300 ft. east-southeast of the approach end of runway 26. The physical evidence indicates that at the time of impact the aircraft was descending in a slightly nose-down attitude with the left wing down about 15 deg. Computed ground speed at impact, based on propeller governor settings and propeller cuts in the ground, was approximately 186 kt. The wreckage area, approximately 500 ft. by 1,500 ft., showed the scattering of components to bear a general heading of 40 deg. magnetic.

Examination of the aircraft wreckage disclosed no evidence, as far as could be determined, of an inflight structural failure of the airframe or systems malfunction.

There was no indication of inflight structural failure or malfunction of the engines, propellers, or their related accessories. Examination of the propeller and propeller governors indicated that the blades of all propellers were at a blade angle of approximately 40 deg. and that the engines were operating at an average speed of 2,460 rpm. at the time of impact. Computations show that each of the four engines was delivering approximately 1,385 hp. at impact, which is slightly more than cruise power.

Missed Approach

The Canadian Pacific Operations Manual, according to testimony of the chief pilot, specifies that, in the case of a missed approach, METO (maximum except takeoff) power is applied, the gear is retracted, and the flaps are retracted to 20 deg. for the climbout. METO power of the aircraft involved was 1,900 hp. and 2,600 rpm.

The landing gear and wing flaps were determined to be in the up, or retracted, positions at the time of impact.

Ground witnesses testified that the aircraft, during its pass over runway 14, was flying at an estimated altitude of 100-200 ft. above the ground, with the landing gear down, and landing lights on.

The company dispatcher, standing on the ramp east of runway 14, observed Flight 307 break out of the overcast, appear to be making a landing, and then he heard power applied. He next observed the aircraft turn to the southeast over the intersection of runways 14 and 26 in a shallow climb from its estimated height over the runway of 50 to 75 ft. The dispatcher held a microphone for VHF radio contacts with the flight and was on the point of asking if the pilot wanted the lights switched to runway 26 when he saw fire at ground level.

The surviving stewardess testified that she saw the runway lights a short time before the crash. None of the crew survivors recalled any aircraft operating difficulties prior to the impact. One flight crew member, who was resting in a crew sleeping compartment, stated that the approach from over the range station did not seem as smooth as usual, the power was changed frequently during the descent, and that the power applied for a missed approach seemed less than normal. He also said that he thought there was a feeling of "sink" just before the ground contact.

The duty navigator, who was unable to see either outside or the two pilots because of a blackout curtain between his seat and the pilots, testified that he overheard Captain Tweed say, "No, Phil" when power was being applied over runway 14. He also observed a reading of 160 ft. on his altimeter at this time.

This altimeter was set at 29.92 in., which produced a reading approximately 30 ft. higher than true.

The Cold Bay Airport is located on the Alaskan Peninsula, 572 mi. southwest of Anchorage, Alaska. Its elevation is 93 ft. The two runways, 14-32 and 26-8, are 7,500 and 5,000 ft. in length, respectively, and their intersection is on the south side of the airport. The control tower was not operative and there was no CAA Communications Station available. There were two private air-ground communications stations on the airport operated by Reeve Aleutian Airways and Northwest Orient Airlines. Canadian Pacific Airlines utilized the facilities of Northwest to relay position reports, and to receive traffic clearances, weather information, and local traffic.

Navigational facilities in operation at Cold Bay consisted of a low frequency range, without voice, equipped with a VHF station location marker. The range is located 2.2 miles northwest of the airport. A privately owned (Reeve) nondirectional beacon is located off the approach end of runway 14 and is operated on request only. Such request was not made by Flight 307. The low frequency range was flight-checked following the accident and found to be operating within allowable limits.

The airport is equipped with a rotating beacon and high-intensity runway lights that can be operated on only one runway at a time. During Flight 307's approach, the high-intensity runway lights were lighted on runway 14, as were the high-intensity approach lights to the runway. Runway 14 lights, and all other lights, were reported to have operated normally the evening of Aug. 29, 1956. In the vicinity of the airport, and in the quadrant in which the aircraft was flying when the accident occurred, there were few, if any, lights which would assist in orientation.

The ceiling and visibility landing mini-

[1] All times referred to in this report are Bering Standard and based on the 24-hour clock; all altitudes are mean sea level; distances are in nautical miles unless otherwise stated.

Nature's spectacular electrical forces, harnessed by man, advanced civilization to a new plateau

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Berets for USAF Guard

Uniforms for special protective guard for Strategic Air Command's new underground control centre at Omaha, Neb., include blue felt berets, chrome plated belt buckles and bone handled .38-cal. pistols in black cross draw holsters. Unit, making service test of the new uniforms, is only one in USAF so equipped.

mums for Canadian Pacific Airlines DC-6 flights at Cold Bay are 400 ft. and one mile for straight-in approaches at night, and 500 ft. and 1¼ mi. for circling approaches.

Capt. Iverson, who occupied the left seat at the time of the accident, had been qualified as a captain on Canadian Pacific Airlines domestic lines for over 10 years prior to assignment to the Overseas Division. He had made a number of round trips over the Vancouver-Hong Kong route including landings at Cold Bay, and the subject flight was in preparation for his checkout as captain on this route. His total flight time was 12,782 hours, which included 465 hours in DC-6 equipment. Company records showed that Capt. Iverson was qualified according to company policy and Canadian regulations as a captain in the DC-6B. At the time of the accident he was in the process of qualifying over the Vancouver-Hong Kong route. Company policy required that this include several flights under the supervision of a captain already qualified. This was being done under Capt. Tweed on this flight.

The weather briefing received by the crew of Flight 307 at Vancouver included a forecast for Cold Bay for the period 1200 to 2200, Aug. 29, 1956, as follows: Ceiling 800 ft., overcast; visibility 3 mi.; light drizzle and fog; wind west 16; after 2000, ceiling 1,200 ft., overcast; visibility 7 mi.; wind northwest 12.

The actual weather en route appears to have been quite close to that forecast at the briefing, with the exception of the lower ceiling at Cold Bay. The 2024 Cold Bay report was: Indefinite ceiling, 500 ft., sky obscured; visibility 1½ mi.; light drizzle, fog; temperature 47; dewpoint 46; wind west-northwest 21; and altimeter setting 29.89. This report was received by the flight before the arrival at Cold Bay.

The letdown for the approach to Cold Bay was through an overcast and the ceiling and visibility at that time were reported as 500 ft. and 1½ mi. The surface wind was reported west at 20 kt., and terrain effects may have produced light to moderate turbulence at altitudes below 2,000 ft.

It is probable that the intention of the pilot during the approach was to land on runway 14, a straight-in landing from the inbound overheading of the range station. The breakout, after descending through the overcast, may have been too close in and high and these factors, together with excessive ground-speed due to a quartering tailwind, may have caused the captain to decide to go around.

Whether the flight intended to turn and climb to 2,700 ft. on the north leg of the Cold Bay range, as the missed-approach procedure prescribes, or to circle under the 500-foot ceiling and land on another runway is not known. However, the company dispatcher, who observed the aircraft and was in radio contact with it, thought the decision was for the latter course as he was about to query the flight whether it wanted the other runway (26-8) lighted when the crash occurred.

Considering that very little altitude was gained after the application of power it is probable that a circling approach had been decided upon when the left turn from runway 14 was made.

Since the wing flaps during the circling approach would be extended 20 deg., and since they were found in the fully retracted position, it is believed that they were retracted shortly before impact. Fully retracted wing flaps at this time would explain the feeling of "sink" experienced by the off-duty flight crew member.

The Board believes that the airspeed of the aircraft at the time the flaps were retracted was approximately 130 to 140 kt. This is supported by several facts. According to company procedure it is normal on the downwind leg of an approach to a runway for the aircraft to fly at an airspeed of approximately 140 kt. with wing flaps ex-

tended 20 deg. Since the subject aircraft was in a clean configuration (gear and flaps up) immediately prior to the accident, with a tailwind of approximately 20 kt., it would be reasonable to assume that the speed of the aircraft increased during the final descent. In addition, when the aircraft passed over runway 14 it was in landing configuration. Since only slightly better than cruise power was applied at this time, and as the distance to the point of impact was approximately one mile, it is unlikely that the speed of the aircraft would have been much greater than 140 kt. when the flaps were retracted.

It is evident that the aircraft struck the ground while descending in a slight left turn and while all four engines were not operating at the prescribed power settings necessary to execute a missed-approach procedure.

FINDINGS

On the basis of all available evidence, the Board finds that:

1. The carrier, the aircraft, and the crew were currently certificated by the Department of Transport of Canada.
2. The gross load of the aircraft was within allowable limits.
3. The ceiling and visibility were at or near the carrier's minimums for Cold Bay.
4. There was no structural failure or malfunctioning of the aircraft or its components, so far as could be determined, prior to ground impact.
5. A quartering tailwind of 20 kt. was present for a landing on runway 14.
6. A circling approach was initiated during which the wing flaps were prematurely fully retracted.
7. The flap retraction, without a compensating increase in power, or change in attitude, or combination thereof, caused a substantial loss of lift resulting in a loss of altitude.

PROBABLE CAUSE

The Board determines that the probable cause of this accident was the full retraction of the wing flaps at low altitude during a circling approach without necessary corrective action being taken by the crew.

By the Civil Aeronautics Board:

/s/ James R. Durfee
/s/ Chan Gurney
/s/ Harmar D. Denny
/s/ G. Joseph Minnetti
/s/ Louis J. Hector

SUPPLEMENTAL DATA

The Civil Aeronautics Board's Anchorage, Alaska, office was notified of the accident at approximately 1030 Ast., Aug. 29, 1956. An investigation was immediately initiated in accordance with the provisions of section 702 (a) (2) of the Civil Aeronautics Act of 1938, as amended. A public hearing was ordered by the Board, and was held in Seattle, Wash., on Nov. 26, 1956.

AIR CARRIER

Canadian Pacific Airlines, Ltd., is incorporated in the Dominion of Canada, and maintains its principal place of business at Vancouver, B. C., Canada.

The company possesses an Air Transport Board license and an operating certificate issued by the Canadian Department of Transport.

It also possesses a Foreign Civil Aircraft Flight Permit issued by the United States Government authorizing the carriage of persons, property, and mail over the route described in this report.

FLIGHT PERSONNEL

Capt. Thornton A. Tweed, age 33, was employed as a pilot by Canadian Pacific Airlines on July 1, 1942. He held airline transport license No. 44, issued Mar. 10, 1953. Capt. Tweed had, according to company records, total pilot time of 9,522 hours, of which 2,906 were acquired in DC-6B aircraft.

His last instrument and en route checks were given May 15, 1956, and May 22, 1956, respectively. His last physical examination was taken on April 11, 1956. He had had 59:48 flight hours in the 30 days preceding the subject flight.

Capt. Phillip D. Iverson, age 37, was employed as a pilot by Canadian Pacific Airlines on May 1, 1942. He held airline transport license No. 478, issued Mar. 28, 1953, by the Department of Transport of Canada. This license was endorsed by the Department of Transport for DC-6B aircraft. Capt. Iverson had, according to company records, total pilot time of 12,782 hours, of which 465 were acquired in DC-6B aircraft.

His last instrument and en route checks were given May 17, 1956, and June 27, 1956, respectively. His last physical examination was taken on July 23, 1956. He had had 74:49 flight hours in the 30 days preceding the subject flight.

First Officer Robert Love, age 28, was employed as a pilot by Canadian Pacific Airlines on Feb. 22, 1955. He held airline transport license No. 734, issued Aug. 7, 1956. He had, according to company records, total pilot time of 3,471 hours, of which 938 were in DC-6B aircraft. His last en route and instrument checks were given Nov. 5, 1955, and July 16, 1956, respectively. His last physical examination was taken on July 16, 1956. He had had 70:51 flight hours in the 30 days preceding the subject flight.

Navigator William R. Hunter, age 32, was employed by Canadian Pacific Airlines on Sept. 26, 1949. He held flight navigator license No. 53, issued June 24, 1953. His total flying hours were 1,195. The date of his last physical examination was Feb. 1, 1956.

Navigator William B. Short, age 30, was employed by Canadian Pacific Airlines on June 4, 1956. He held flight navigator license No. 80, issued Aug. 13, 1956. He had had 230 flying hours with Canadian Pacific Airlines. His last physical examination was on June 6, 1956.

Stewardess Evelyn Lee, age 26, was employed by Canadian Pacific Airlines on Oct. 29, 1951, and began duty on overseas flights April 29, 1953.

Stewardess Anita Wong, age 25, was employed by Canadian Pacific Airlines on Aug. 23, 1954. She had been on duty with the Overseas lines since that time.

Stewardess Dolores R. Jordan, age 25,

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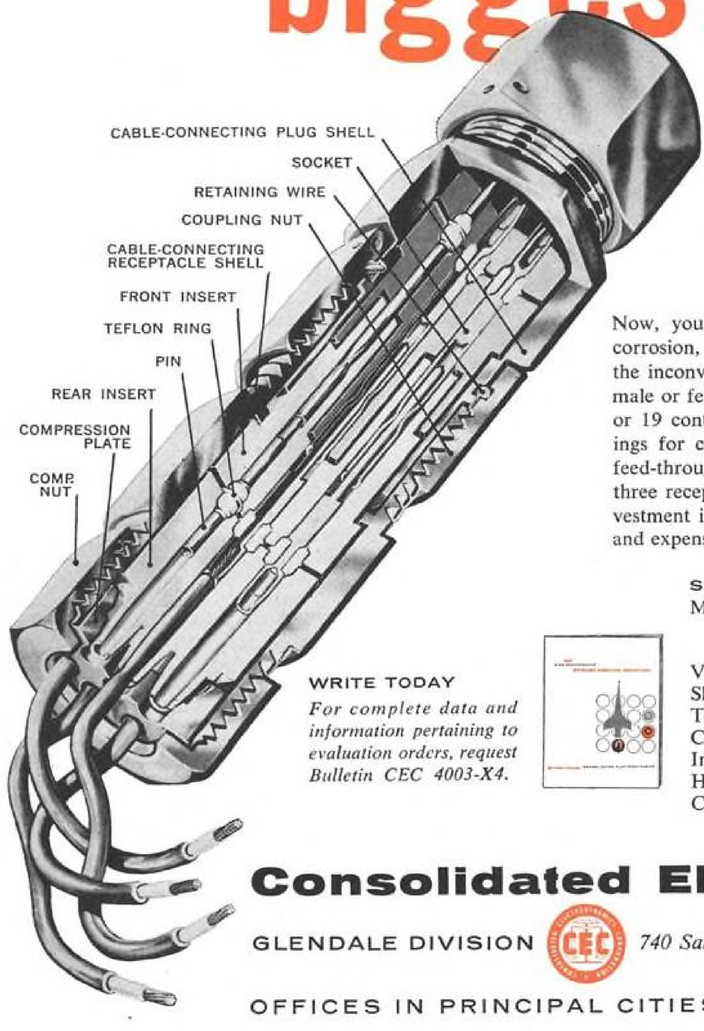

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1. Sea Level.....1800-v, a-c
2. 70,000 feet.....800-v, a-c

Vibration.....No resonances to 2000 cps
Shock.....>200 g's
Temperature.....−67° to + 400°F
Contact Voltage Drop...<25 mv at 5 amps
Insulation Resistance.... $>10^6$ megohms
Humidity.....160°F, 14 days, 95% RH
Corrosion.....Salt spray per QQ-M-151a

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OFFICES IN PRINCIPAL CITIES THROUGHOUT THE WORLD

was employed by Canadian Pacific Airlines on Aug. 2, 1954, and started on duty on overseas flights April 1, 1956.

Douglas DC-6B, CF-CUP, serial number 43843, was purchased new from the manufacturer Feb. 4, 1953. Total time on the aircraft at the time of departure from Vancouver was 10,507 hours, with zero time since the last No. 35 inspection and preflight. The aircraft was equipped with four Pratt and Whitney R2800-CB17 engines, and four Hamilton Standard, model 43E60, propellers. The propeller blades were model 6895-E8. Time on the four engines since overhaul was between 600 and 1,122 hours, the approved time between overhauls being 1,400 hours. Time on the four propellers since overhaul was between 450 and 1,651 hours.

Airman Absolved of Guilt in RAF Crash

London—British court martial found a Royal Air Force technician not guilty of neglect in connection with the crash of a Beverley transport plane near Abingdon, England, March 5 in which 17 persons died.

Chief technician William Henry Noel Griffiss was tried on two charges of neglect which alleged that he was responsible for inserting a non-return valve in the fuel system the wrong way around.

An accident investigator testified that the position of the valve was such that no flow of fuel was possible between two of the tanks in the aircraft.

A board of inquiry gave this report on the accident:

The aircraft took off normally on instruments. While the aircraft was climbing, what appeared to be a serious leak of fuel behind No. 1 engine was observed. The captain informed Abingdon control that he was returning to base and requested a blind approach let down. He reported that he was feathering No. 1 engine to reduce the danger of fire from an apparent fuel leak.

The air traffic controller gave the aircraft the let down procedure and alerted the airfield crash crew.

At an early stage in the let down procedure the gauge for No. 2 fuel tank showed an unusual loss of fuel and the fuel cocks and boosters for this tank were therefore turned off leaving the No. 1 tank cocks and boosters on.

As the aircraft turned to begin the return approach the captain ordered full power from the three active engines. No. 2 engine failed to respond. The aircraft began to lose height and speed. The captain tried to land the aircraft in an open space since it then appeared clear that it could not reach the airfield.

The aircraft became uncontrollable. It veered to port, struck some power lines about 30 ft. above the ground and subsequently some trees, severing the port outer main plane. The aircraft disintegrated and caught fire on hitting the ground, some 18 min. after takeoff.

Fifteen occupants of the plane and two civilians were killed. The three survivors from the aircraft and one civilian were seriously injured and another civilian sustained minor injuries.

The four fuel tanks on the port side of the Beverley feed into a collector box from which the two port engines are fed. From the evidence available, including inspections of part of the aircraft's fuel system which was found in the wreckage, it is clear that a non-return valve between No. 1 tank and the collector box had been fitted in reverse and that the fuel supply from Nos. 3 and 4 tanks were switched off throughout the flight.

The accident was due to loss of power on Nos. 1 and 2 engines which resulted in the aircraft being unable to maintain height. This loss of power resulted from No. 1 engine having been feathered as a precautionary measure when what appeared to be a fuel leak was observed by the cutting of No. 2 engine from fuel starvation. Fuel starvation of No. 2 engine was caused by the incorrect fitting of the nonreturn valve in the supply from No. 1 port tank, to the fact that the fuel supply from the other main tank had been shut off after No. 1 engine was feathered, and finally because the fuel supply from the two smaller port tanks was turned off throughout the flight.

The captain of the aircraft must bear some responsibility for the accident in that contrary to the operating instructions for the handling of the aircraft's fuel system the supply of fuel from the two smaller tanks on the port side was turned off throughout the flight although some fuel was available in these tanks. Owing to the nature of the flight the amount of fuel in the two smaller tanks was not large, and it can only be assumed that the captain had no reason to believe that both port engines would not operate satisfactorily off the two main port tanks individually. The captain lost his life in the accident.

No evidence was found of any malfunctioning or failure in the aircraft itself.

Pilot Error Cited In Viking Crash

London—"Error of judgment" by the pilot has been blamed for the crash of a Viking airliner at Blackbushe Airport on May. 1. Thirty-four persons died in the crash.

The Eagle Aviation Aircraft was on a military charter flight bound for Tripoli when it crashed shortly after takeoff. The pilot had reported a failure of one engine and was returning to land when the Viking struck the ground about a mile from the runway.

Following testimony that the aircraft could have maintained height and landed safely on one engine, a coroners jury held that the accident was the "result of an error of judgment on the part of the pilot bringing the plane in too low."

Certificates of Necessity

Washington—Office of Defense Mobilization awarded The Aluminum Company of America's Lafayette, Ind., plant a certificate of necessity for accelerated tax amortization in the amount of $9 million for aluminum extrusion facilities for military use with 75% of the amount certified allowed.

Thompson Products Inc., Franklin County, Va., was awarded a certificate for missiles components for military use in the amount of $6,480,000 with 70% allowed. Other certificates awarded:

Bendix Aviation Corp., Eatontown, N. J., military aircraft parts, $450,000 with 40% allowed.

General Electric Co., Fitchburg, Mass., turbine generator sets for military use, $1,492,710 with 50% allowed.

Curtiss-Wright Corp., Quehanna, Pa., research and development, $2,911,076 with 80% allowed.

The United Tool & Die Co., West Hartford, Conn., military jet engine parts, $98,264 with 70% allowed.

Crosley Division Avco Manufacturing Corp., Nashville, Tenn., military aircraft facilities, $31,443 with 65% allowed.

Kearfott Co. Inc., Little Falls, N. J., scientific instruments for military use, $7,999 with 65% allowed.

Bendix Aviation Corp., Sidney, N. Y., military jet engine parts, $205,267 with 65% allowed.

Electro-Mechanical Research Inc., Sarasota, Fla., military aircraft equipment, $465,630 with 45% allowed.

John Oster Manufacturing Co., Racine, Wisc., scientific instruments for military use, $64,543 with 65% allowed.

Cambridge Thermionic Corp., Cambridge, Mass., electronic components for military use, $8,395 with 70% allowed.

Motorola Inc., Riverside, Calif., research and development, $1,126,148 with 55% allowed.

Beech Aircraft Corp., Wichita, Herington and Liberal, Kansas, and Boulder, Colo., military aircraft, $403,978 with 65% allowed.

Raymond Engineering Laboratories Inc., Middletown, Conn., missile components, $45,000 with 45% allowed.

Welco Inc., Wellington, Kansas, military aircraft parts, $9,047 with 45% allowed.

Weston Hydraulics Ltd., North Hollywood, Calif., military aircraft parts, $11,872 with 70% allowed.

Fairchild Engine & Airplane Corp., Wyandanch, L. I., N. Y., guided missiles, $42,248 with 65% allowed.

American Non-Gran Bronze Co., Berwin, Pa., military aircraft engine parts, $35,904 with 65% allowed.

Fairchild Engine & Aircraft Corp., Hagerstown, Md., military aircraft engines, $76,800 with 60% allowed.

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P-5381, Aviation Week,
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RW-5428, Aviation Week,
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P-5356, Aviation Week
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MK-35 MPQ-4 VK T-160 TRD-8

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WORK ON ADVANCED PROJECTS LIKE THIS

As mach numbers advance, even fractional errors in inlet-air diffuser positioning reduce thrust tremendously.

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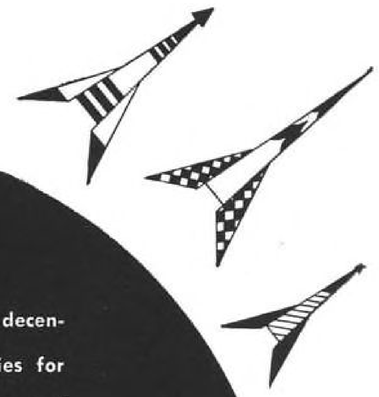

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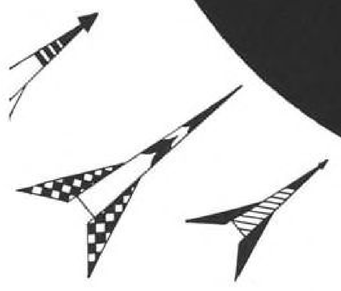

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ADVERTISERS IN THIS ISSUE

AVIATION WEEK, JUNE 24, 1957

CLASSIFIED ADVERTISING

F. J. Eberle, Business Mgr.

ADVERTISERS INDEX

LETTERS

Air-India Training

May we please refer you to the issue of AVIATION WEEK of Feb. 25, p. 164? Under the heading India, you have stated that Air-India International pilots and commanders "are still trained by Lockheed and KLM."

We would like to point out that your above statement is incorrect, in that our pilots and commanders are and have been trained by our own Training Organization manned entirely by Indian personnel. It was a fact that when Air-India International commenced operations in 1948, we had employed Check Pilots from Lockheed to train our commanders, but the system was discontinued in 1949 as soon as we were satisfied that we had sufficient trained personnel to run our airline. Similarly, with regard to KLM, in the past we used to send some of our pilots for 1st Officer's training, as with our expanding operations we were unable to give all training within the short time available in our own establishment. Even this has ceased some years now and, as stated above, we have at present a Training Organization under a Divisional Operations Manager assisted by a Flight Superintendent and Check Pilots—all Indian Nationals.

A. C. GADZAR
Technical Director
Air-India International
Bombay Airport
Santa Cruz (East)
Bombay 29

Pilot's Viewpoint

Many airline pilots, including myself, were deeply troubled after reading your article on the case of TWA Capt. Specht published some time ago (AW March 18, p. 30). Reading the partial transcript you published gives the impression that Capt. Specht acted like a spoiled child in arguing with the controller, and not only violated the Civil Air Regulations by changing altitude without a clearance, but put himself and Capital Airlines' passengers in considerable danger. It also appears from the published transcript that Capt. Specht DID NOT declare an emergency PRIOR to changing altitude, and also leaves considerable doubt as to whether an emergency actually existed.

As you are fully aware, the airline pilots of this country, as a group, are among the most self-disciplined men to be found anywhere. It does not seem reasonable to believe that an experienced TWA Captain of 15 years service would so lose control of himself.

The CAA Administrator has suspended Capt. Specht's license and until the case is settled Capt. Specht is without income. If it is proved that Capt. Specht did act arbitrarily, and DID NOT declare a justified emergency before changing altitude, the CAA should "throw the book" at him. The members of ALPA would be most unhappy if our money were spent defending a man guilty of the aforementioned violations.

Aviation Week welcomes the opinion of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42 St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

It goes without saying that with authority goes responsibility, and the use of emergency authority must be with good reason—but there can be no restriction on the pilot's use of that power.

It is my understanding that Capt. Specht DID declare an emergency BEFORE changing altitude, and that an icing condition was the reason. If Capt. Specht is cleared of the charges against him and reinstated, the only way he can recover his lost income is to sue the government—an almost hopeless task.

As I see it, a very fundamental point of law is here at stake. Under our legal system a man is presumed innocent until proved guilty, and yet in this case the man is suddenly grounded, his family cut off from their income until the "Mill of the Gods" grinds fine enough to determine his innocence or guilt.

Because you have sources of information denied the average pilot, and because yours is a respected voice in aviation, you will be doing all of us a service by going into this case in detail and publishing a complete report on it.

LEO KRILOFF
Captain
United Air Lines
San Francisco, Calif.

More on Specht

I wish to back up Mr. Marvel M. Taylor's invitation to Mr. Sayen (AW May 27, p. 118) to state the emergency, or at least state something more than his vague letter to you which you printed (May 6, p. 154).

At any rate, how about giving us the lowdown on that incident somewhere in AVIATION WEEK and clear up the question mark.

KARL W. POORBAUGH
Somerset, Pa.

(AVIATION WEEK will report the Specht case in detail as it is handled by the cognizant agencies.—Ed.)

Burning Issue

On p. 60 of the April 22 issue of AVIATION WEEK ("Radiation Increases Efficiency of Fuel"), is the interesting statement. "Intensely radioactive gold can increase the burning efficiency of fuel by 50%. . . . Other fuels would behave the same way as propane. . . ." This is particularly interesting in view of the fact that burning efficiencies of better than 90% can be achieved without radioactivity, even under such difficult conditions as exist inside a jet engine.

Possible applications stir the imagination. No need now to pursue work on atomic airplanes.

The plane of the future need have only enough fuel tanks to hold the fuel produced by the engines till a safe altitude is reached to begin dumping it. Similarly, if middle east canal and pipeline trouble persists, European countries could build very large jet engine plants to make jet fuel. This could be converted to other types of fuel in existing refineries with minor modifications.

Seriously now, wouldn't you like to tell us what you meant instead of "burning efficiency?"

DR. J. R. STREETMAN
Dr. John Romanko
R. L. Johnston
Ft. Worth, Tex.

(AVIATION WEEK referred this letter to Prof. Stuart W. Churchill of the University of Michigan, whose reply follows.—Ed.)

For the Record

This is in reply to your letter concerning the inquiry on the news item you printed on our work on the Effect of Radiation on Combustion (AW April 22, p. 60). Unfortunately your article was incorrect and Messrs. Streetman, Romanko and Johnson were somewhat justified in their sarcastic letter. I appreciate that the error was unintentional, but would be very appreciative if you would print a correction in an early issue.

The following are the facts.

We did observe an increase of 50% in the rate of propagation of flames irradiated with a 10,000-curie gold source, not an increase in burning efficiency. Our work indicates nothing whatsoever about the efficiency of utilization of the fuel. I am enclosing a copy of a summary which I prepared for the American Chemical Society News Service and also a copy of a release issued by the University of Michigan News Service. The latter release was issued in my absence and I did not have a chance to check it. Although the remarks concerning the performance of aircraft engines are an extrapolation on my actual remarks, the news release is essentially correct.

You will note that both releases refer to a 50% increase in burning speed. The University of Michigan News Service release extrapolated my remarks to say that "existing engines could be made more efficient." Although I would not have made this remark, it is conceivably possible in the sense of maximum fuel burned per unit mass of engine.

Thank you for calling attention to our work in AVIATION WEEK. And thank you in advance for correcting the misimpression that this item may have caused.

STUART W. CHURCHILL
Associate Professor
University of Michigan
Department of Chemical and
Metallurgical Engineering
Ann Arbor, Mich.

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