AVIATION WEEK

SEPT. 24, 1951

THIS ISSUE $1.00

A McGRAW-HILL PUBLICATION

PRODUCTION FOR AIR POWER

What! Land with the autopilot on?

Of course, landing with the help of the autopilot isn't accepted practice today. But it soon may be – if a new Honeywell experimental device, called "Easy Joe," lives up to its promise.

In flight tests, "Easy Joe" not only has shown the way to easier, safer landings, but has made many other phases of flight easier–including take-off, trim adjustment and instrument approach.

"Easy Joe" is an electronic steering device that works with the electronic autopilot. Built into the control column, "Easy Joe" preserves the natural feel of the airplane, even with the autopilot engaged. This means the pilot never has to "fight" the autopilot. Instead, when he indicates what he wants the plane to do, the autopilot jumps in and handles the heavy work. The result, test pilots say, is that "Easy Joe" gives them the feel of a top-notch power boost system combined with autopilot stability.

Another desirable feature of this remarkable new system is that it reduces cockpit space needed for autopilot equipment. This means "Easy Joe" will be ideal for installation in fighters and helicopters, as well as for larger bomber-type aircraft.

Experiments to improve aircraft control – like the "Easy Joe" project – are constantly being made by Honeywell engineers. We expect to conduct many others in the years to come – because *automatic control* is such an important part of aviation progress. And *automatic control* is Honeywell's business.

AERONAUTICAL DIVISION

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MINNEAPOLIS **Honeywell** *Aeronautical Controls*



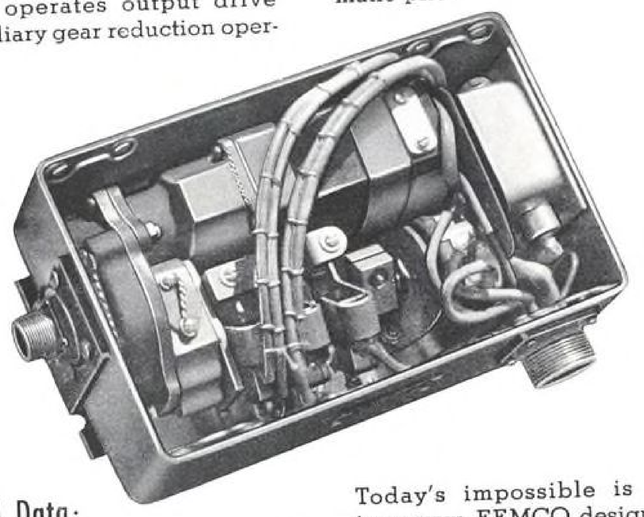
EEMCo technical bulletin

Rotary Actuator Package Advances Automatic Flight

This entirely self-contained rotary actuator package designed and built by EEMCO, combines compactness, high performance, and light weight.

Totally enclosed in a metal box equipped with mounting bracket, it incorporates motor, magnetic clutch and spring-loaded brake. Main gear reduction operates output drive shaft...auxiliary gear reduction operates three adjustable limit switches — two for limiting travel, one for neutral position indication light. Auxiliary reduction also drives potentiometer for position indication.

The unit provides continuous elevator correction on one of the latest jet fighters through the automatic pilot.



Technical Data:

Radio noise filter in accordance with AN-M-40.

Operates in ambient temperature of 250° F.

Output r. p. m. 2500 at 3 inch-pound load. Weight complete — 3¼ pounds.

Today's impossible is practical tomorrow. EEMCO design and production contribute to building electrical actuators thought impossible just yesterday.

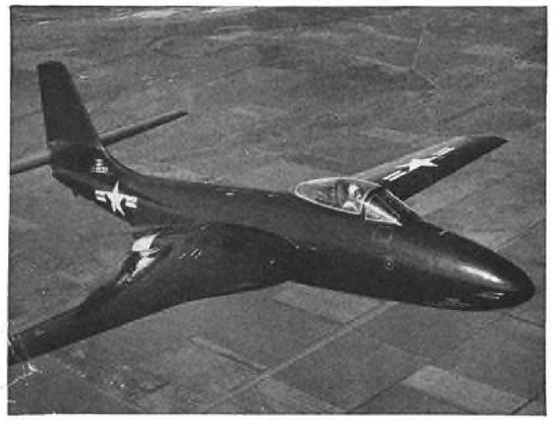
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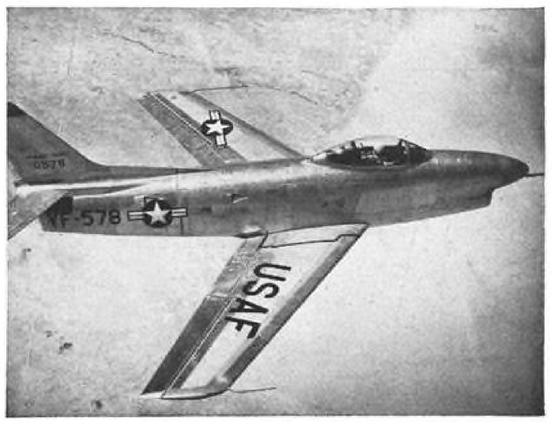
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B.F.Goodrich









8 miles high without bubble trouble

THE CANOPY BUBBLES on these fast military airplanes had to be safely pressurized at altitudes of 8 miles or higher. But ordinary inflatable seals between bubble and cockpit would burst under the severe effects of high pressures on the inside, low pressures on the outside.

B. F. Goodrich engineers, called on by the Navy, studied the problem. A really effective inflatable seal, they figured, should blow up like a paper bag instead of like a balloon—easier and with lower, safer pressures. Here's how they made a seal that would work that way: They took a special fabric, rubber-coated on both sides, and vulcanized it in collapsed position to a flexible rubber base. Inflated, the rubberized fabric simply lifted to sealing position with little or no stretching. Sealing was practically instantaneous, with pressure only a few pounds above that inside the canopy. Furthermore, it would inflate with less pressure at minus 65° than old-type seals required at room temperatures.

The new seal has other advantages, too. It has more resistance to wear and damage than ordinary seals. It fits complex curves better. It seals and unseals faster. Sliding wear and scuffing are minimized.

The new B. F. Goodrich seal is now used on more than a dozen makes of planes, including these Navy and Air Force jets: McDonnell Banshee, top left; Northrop Scorpion, top right; Chance Vought Cutlass, bottom left; North American Sabre, bottom right.

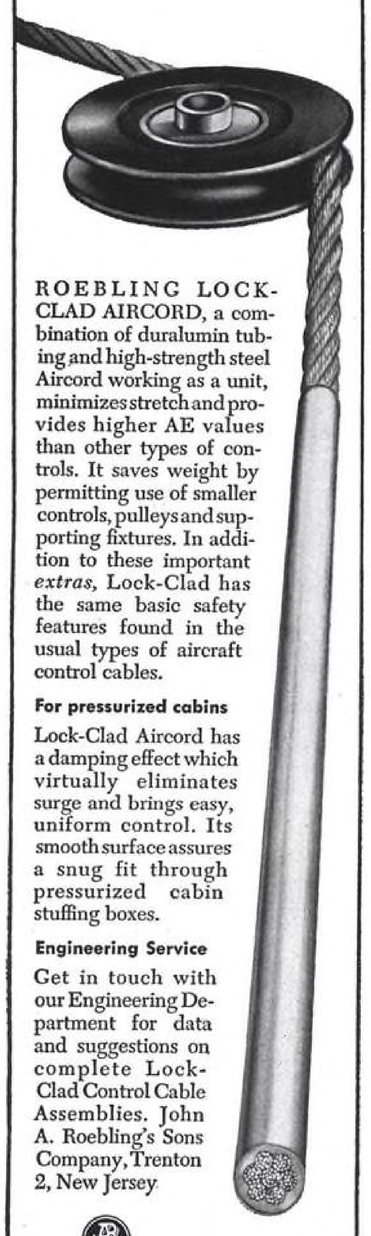
If you have a sealing problem—in canopies, movable walls, wind tunnel doors or elsewhere—the new type seal may be your answer. It's one of the many developments for aviation that has come from B. F. Goodrich rubber research and engineering. *The B. F. Goodrich Company, Aeronautical Division, Akron, Ohio.*

B.F.Goodrich

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Get in touch with our Engineering Department for data and suggestions on complete Lock-Clad Control Cable Assemblies. John A. Roebling's Sons Company, Trenton 2, New Jersey.

ROEBLING

Aviation Week

ABP Member ABC

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37,372 copies of this issue printed.

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September 24, 1951 — AVIATION WEEK — Vol. 55—No. 13

Member ABC and ABP

Published weekly by McGraw-Hill Publishing Company, Inc., James H. McGraw (1860-1948), Founder. **Publication Office: 99-129 North Broadway, Albany 1, N. Y.**
Executive, Editorial and Advertising Offices: McGraw-Hill Building, 330 W. 42nd St., New York 18, N. Y. Curtis W. McGraw, President; Willard Chevalier, Executive Vice-President; Joseph A. Gerardi, Vice-President and Treasurer; John J. Cooke, Secretary; Paul Montgomery, Senior Vice-President, Publications Division; Ralph B. Smith, Editorial Director; Nelson Bond, Vice-President and Director of Advertising; J. E. Blackburn, Jr., Vice-President and Director of Circulation.

Subscriptions: Address correspondence to AVIATION WEEK—Subscription Service, 99-129 N. Broadway, Albany 1, N. Y., or 330 W. 42nd St., New York 18, N. Y. Allow ten days for change of address.
Please indicate position and company connection on all subscription orders.

Single copies $1.00. Subscription rates—United States and possessions, $6 a year; $9 for two years; $12 for three years. Canada, $8 a year; $12 for two years; $16 for three years, payable in Canadian currency at par. Pan American countries, $10 a year; $16 for two years; $20 for three years. All other countries, $20 a year; $30 for two years; $40 for three years. Entered as second-class matter, July 16, 1947, at the Post Office at Albany, N. Y., under Act of Mar. 3, 1879. Printed in U. S. A.

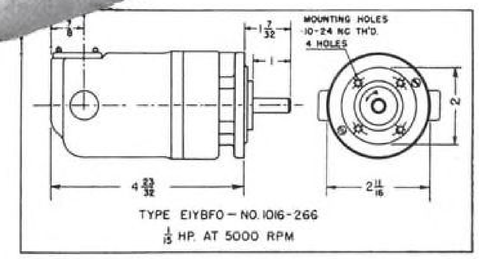
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it's NEW!



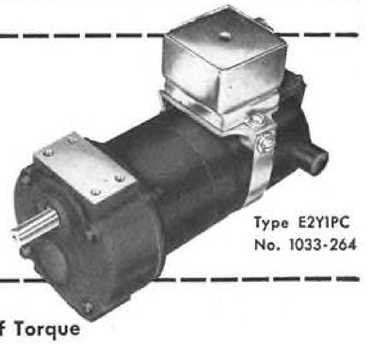
A Continuous Duty BLOWER MOTOR in an Intermittent Duty Frame Size . . .

A 1/15 H. P. at 5000 R. P. M., 27 volts D. C., now comes packaged in a totally enclosed, explosion proof case, 2-11/16 diameter . . . . . and without any troublesome external or internal cooling Fan. This Blower Motor, now Flying on a new Air Force camera, is typical of LUNDY "engineered" AEROMOTORS. If you need a motor, perhaps something a little "special," try LUNDY! Chances are we can be of some immediate help.

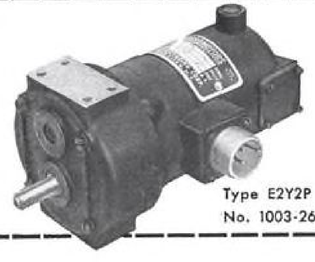


Combination Clutch and Brake . . . Geared Head . . . 1/6 H.P.

A brake for the output shaft, and a clutch to disengage the armature when torque limit is exceeded. A built in reduction unit with gear ratios available for 1500 or 200 RPM, Ratings up to 1/6 HP, intermittent duty. Special units offered with 9 minutes ON cycle. Thermal overload protector and Radio Noise Filter optional.



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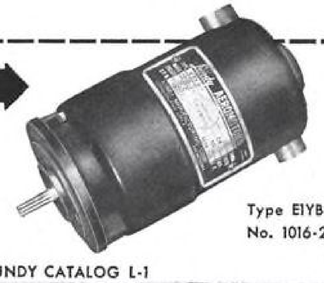
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40 Pound Inches of Torque available . . . .

1/8 H.P. at 200 RPM, 26 Volts D.C., with Series magnetic brake in a 2-11/16 Frame size. 3 lead, series reversible. Mounted AN connector. Other ratings available up to 1/4 H.P. Thermal protector, Radio Noise Filter optional.

1/8 H.P. at 10,000 RPM with a SERIES MAGNETIC BRAKE

Series wound, reversible rotation, intermittent duty, totally enclosed and explosion proof 2-11/16 diameter case. Fast acting brake stops output shaft within 12 revolutions under Full Load. AN approved. Thermal overload protector, Radio Noise Filter optional.



Type E1YBF
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AVIATION WEEK VOL. 55, NO. 13
September 24, 1951

Background for Production

Rapid Build-Up Clashes With Policy

"DON'T PUSH DEFENSE TOO HARD." This firm government policy is defeating government's own production goals set last year when the President declared an emergency.

The slow build-up should have been expected by government officials. It was by industry leaders who realized immediately the goals were unrealistic; and who realized also that government was not prepared to let industry even try to reach the goals.

Output trails schedules in all the things that make up first-class air power—airframes, engines, equipment; and in the resources needed to produce those: tools, materials, plants.

• **Airframes.** Less than 5,000 aircraft will be delivered this year. Government goal was about 15,000.

• **Engines.** Shortage is acute in both jet and piston high-power models. It will not ease before late 1952.

• **Equipment.** Time between order and delivery has doubled since the summer of 1950 on some items, it has increased one-third or one-fourth on nearly all.

• **Resources.** Machine tool shortage is slowing all production; relief is months away. All materials are short now; many will be more plentiful next year. Plant construction to increase capacity is lagging, but there is ample space for present production.

Those are the outstanding conclusions developed from the mass of information assembled by the staff of AVIATION WEEK for this issue; information garnered first-hand from the major production centers of the nation, and from diligent digging in the bureaucratic burrows of Washington.

Careful sifting of official actions and statements indicates that government policy makes rapid expansion impossible.

●

I. The Dual Economy

GOVERNMENT IS TAKING A CALCULATED risk in its plans for expanded defense production. It is not only a military risk. It is an economic risk. While the risk is frightening, at the same time it indicates a faith in American ability to produce.

Government planners are reported to believe we can top an ever-growing civilian economy with an enormous defense economy—and make the two compatible.

No other nation in history has ever been able to do that successfully. This policy means no severe cutbacks in civilian production now; eventually a rise in civilian output. At the same time defense production would increase. It is a bold and staggering plan.

●

A NATION ARMS FOR THREE REASONS: To wage a war in which it already is engaged; to wage a war it intends to start or has positive proof another nation will start; or to be ready for war if it ever comes.

The last is what the U. S. is doing now. Other nations have done that in the past. But formerly a nation could prepare its defenses and feel fairly secure.

Today—in the age of split-second air warfare—an offense is the only defense. The U. S. must prepare to fight an offensive as well as defensive war—with no proof it will ever have to fight either.

The realization in government planning circles that war may never come has dictated the "guns and butter" policy. If we built a huge defense/war machine at the expense of the civilian economy and war never came, we would lower drastically our standard of living and move inexorably toward a militaristic way of life.

●

THIS DUAL ECONOMY concept explains why the automotive companies are being permitted to use scarce structural steel to build new aircraft plants—when sufficient plants already exist. This is why government administrators are zealous—too zealous some aircraft people believe—in seeing that civilian firms get a "fair share" of critical materials.

If war doesn't come, if in some unanticipated manner we can be assured of peace, and reduce arms spending, official planners apparently believe we will need this extra productive capacity to take up the slack of the missing defense economy.

It is a breath-takingly ambitious scheme which may defeat itself because—

●

THE U. S. MAY BE PRICING ITSELF OUT of competition with Russia in building a war machine. The Navy states officially that the average cost of its planes now is $800,000 to $900,000 as against about $160,000 in World War II.

One piece of Air Force radar equipment costs three quarters of a million dollars. The World War II Norden bombsight cost about $2,500; a computing bombsight, admittedly far superior, now costs more than $250,000.

(*News of the Week on Page* 219)

How big an Air Force can we build at those prices? That's what top military and Congressional leaders are wondering. Significantly, Congressional appropriation committeemen this year asked more questions about cost than at any time since 1946.

One of the main reasons for the astounding prices is inflation—which the Air Force says has added 20% to its costs in only 12 months. Government officials say greater civilian production is the antidote to inflation. Production is increasing when measured in dollars. But they are inflated dollars.

The policy of a large civilian economy plus a large defense economy feeds inflation, many thoughful men in and out of Washington agree.

●

RUSSIA MAY WORRY about inflation, too. But it is doubtful if an expanding civilian economy figures in any Soviet inflationary trends.

Because of inflationary tendencies in the present policies, government planners may yet find the stakes too high in the gamble on the dual economy. If they do, they will curtail greatly civilian output in favor of rearmament. Some signs indicate they may be near this decision.

Meanwhile, here is how the dual economy concept has influenced aviation production:

●

II. Airframes

"THE RULE OF THREE" can't work out under present conditions. Manufacturers have claimed they can triple production the first year after expansion was ordered; triple again the second year, and so on.

But they were talking about tripling output of planes already in production; and they were talking about all-out expansion. Neither condition exists now.

By plan or by accident, the expansion of airframe production has coincided with a change-over to later model planes. Some planes important in the build-up are in quantity production.

But too many others—F-84F, F-94C, F-86D, B-47, B-57A, F9F-6, F7U-3, F3D, F2J, F3H—are in the very early stages of volume production.

And the expansion ordered is far from being "all-out." Rather, it is spread out, with new plants being opened to turn out planes already in production at existing plants. That broadens the productive base in accordance with government economic planning.

●

III. Engines

EXPANSION IN THE ENGINE INDUSTRY is being attempted in the same way as in airframes, with new production sources being opened. But there is a defense reason as well as an economic reason.

Output in existing airframe plants could be stepped up considerably, possibly enough to meet the higher schedules. But existing engine plants can't handle the new work load.

The military let itself get dangerously low in engine production resources. That's why the automotive plants have been called on for help.

Automotive plants manufacturing engines not only broaden the productive base; they are absolutely needed if planes next year and after are to have engines.

●

IV. Equipment

AVIONIC EQUIPMENT PRODUCTION is a bright spot in the manufacturing picture, military buyers say. They insist aircraft deliveries are not being delayed by avionics shortages.

But they also admit that in some categories the only avionic equipment they can get is obsolescent or does not meet high standards of reliability.

The plain truth is that equipment to do the job the military wants is little past the laboratory stage.

●

V. Production Resources

MACHINE TOOL SHORTAGES are with us again, just as in 1940-41. But this time the shortages are far more serious. Then we didn't have the plants to hold the tools, or the trained men to use them.

This time we have plants ready to produce, and there is a reservoir of trained labor that is being recruited rapidly. So the shortage of tools is felt immediately.

The tools stored in government warehouses after the war have been of immense help. But tooling needs have changed.

●

MATERIAL CONTROLS are still too new to have had much effect on the shortages in critical metals. Labor troubles are a great factor in the situation, too. The aircraft industry doesn't use much copper, for instance, but the little bit it does require is for vital components the lack of which means undelivered aircraft.

Materials are short for another reason. Because this is not an all-out mobilization, defense production is not getting all the materials it needs.

●

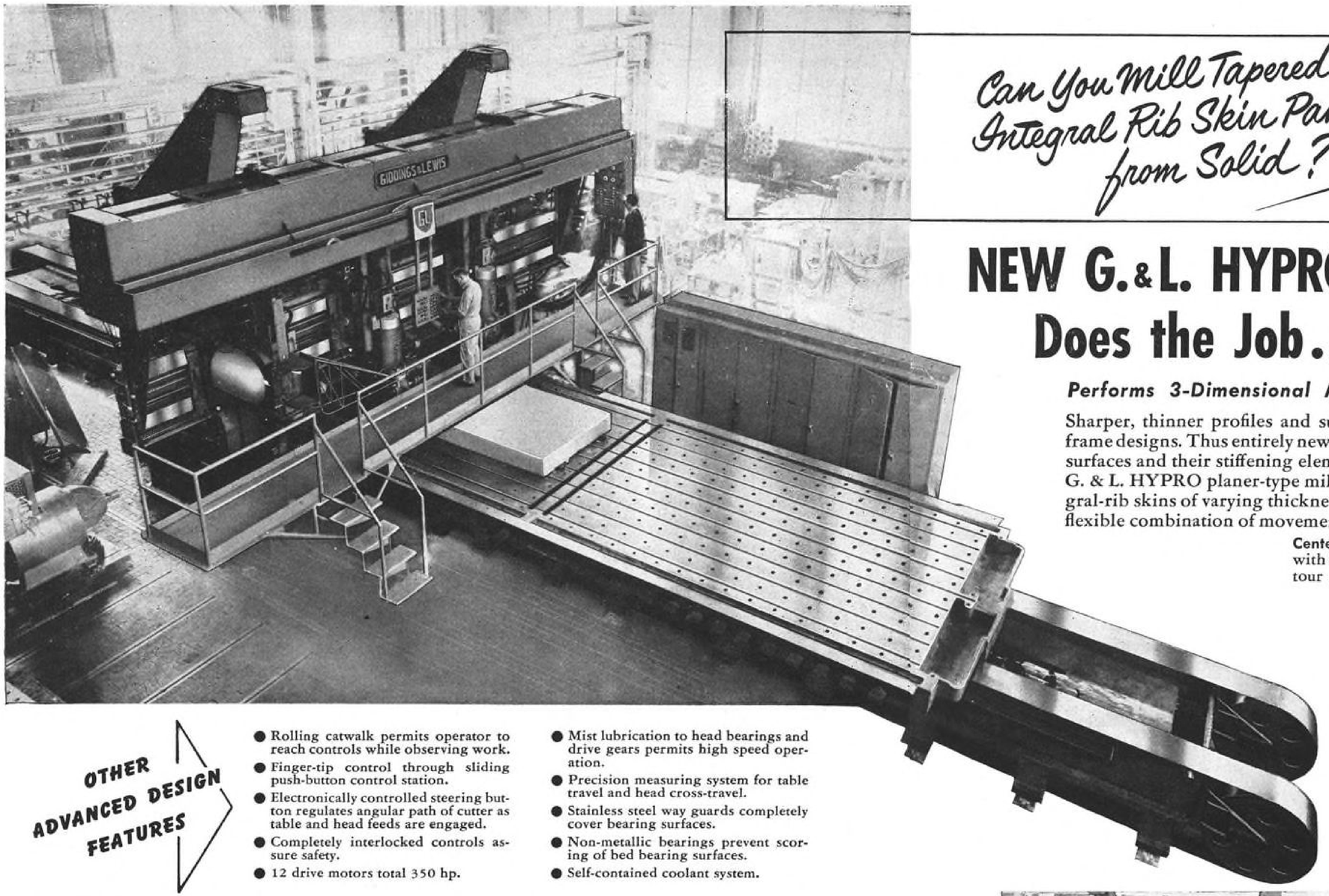
PLANT SPACE IS SHORT in one respect, not in another. World War II plants are not all adequate for today's production. We have ample floor space to produce a 95- or 160-wing Air Force.

But the plants themselves need additions, such as electronics buildings and jet engine test blocks that are peculiar to present-day aircraft.

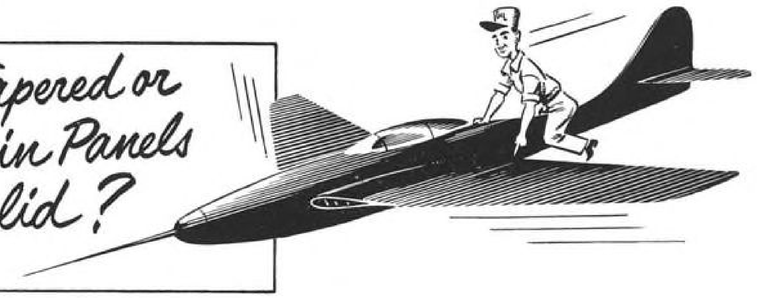
In the concept of the dual economy, we are very short of plant space. Without new plants, a war or further expansion would force defense work into the big consumer-goods plants and slash civilian production.

That is what government planners are trying to avoid.

(*News of the Week on Page* 219)



Can You Mill Tapered or Integral Rib Skin Panels from Solid?



NEW G.&L. HYPRO Aircraft Skin Mill Does the Job...Fast and Accurately!

Performs 3-Dimensional Machining with Unique Flexibility of Control

Sharper, thinner profiles and substantial weight savings are vital in advanced airframe designs. Thus entirely new concepts become necessary for production of aircraft surfaces and their stiffening elements. Operating in 3 dimensions, the new Type 100 G. & L. HYPRO planer-type milling machine can mill both tapered panels and integral-rib skins of varying thickness . . . from solid or rough forged aluminum alloy. A flexible combination of movements makes this possible —

Center and Right Hand Milling Heads—Have rise-and-fall slide with hydraulic tracer controlled 4 in. vertical movement for contour milling; also 12 in. vertical travel for cutter positioning. Spindle attachments swivel 90° to permit milling parallel or at right angles to table travel. Speed range: 1200 to 3600 r.p.m. 100 hp. water-cooled motors.

Left Hand Milling Head—Will profile 360° in a horizontal plane, using an electric tracer unit. 4 in. rise-and-fall movement permits lowering tool into work without complicated settings. Speed range: 2400 to 7200 r.p.m. 100 hp. water-cooled motor.

Table—Is traversed by HYPRO amplidyne drive over a range from ¾ in. to 150 in. per min., with infinitely variable adjustment. 4 mechanical ratios. 20 hp. motor. Work area: 10 x 34 ft. 100-ton load capacity.

This forward-looking machine tool helps solve urgent problems posed by present and projected airframe designs. Look into its possibilities—ask G. & L. engineers for the complete story.

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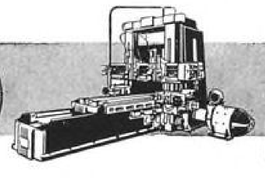
- Rolling catwalk permits operator to reach controls while observing work.
- Finger-tip control through sliding push-button control station.
- Electronically controlled steering button regulates angular path of cutter as table and head feeds are engaged.
- Completely interlocked controls assure safety.
- 12 drive motors total 350 hp.
- Mist lubrication to head bearings and drive gears permits high speed operation.
- Precision measuring system for table travel and head cross-travel.
- Stainless steel way guards completely cover bearing surfaces.
- Non-metallic bearings prevent scoring of bed bearing surfaces.
- Self-contained coolant system.

GIDDINGS & LEWIS MACHINE TOOL COMPANY

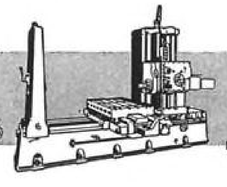
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HYPRO DAVIS

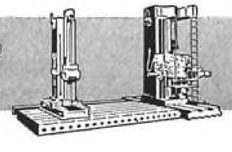
G. & L. HYPRO Double Housing Planer



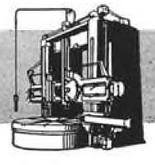
G. & L. Table Type Horizontal Boring Machine

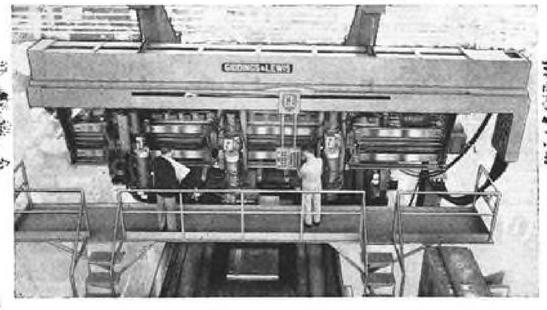


G. & L. Floor Type Horizontal Boring Machine

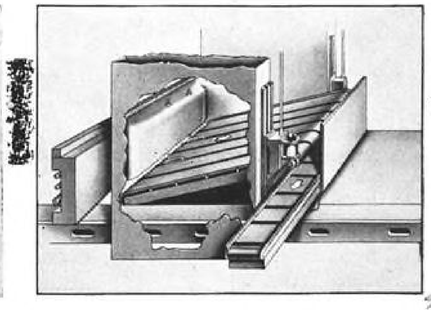


G. & L. HYPRO Vertical Boring and Turning Mill





FEED REELS automatically let out and take up hose lines, cable and conduit to heads and portable control station. Prevent fouling or interference as heads move across rail or up and down.



AUTOMATIC CHIP CONVEYOR carries chips back from cutters and upwards; then across table to disposal point. Machine capable of producing up to a barrel of chips each minute.

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PENNSYLVANIA AVIATION CORPORATION, operating at Harrisburg State Airport, New Cumberland, Pa., provides complete facilities for itinerant flyers—fast in-and-out service, hangar storage, dependable repairs and overhauls. In addition, P.A.C. operates an outstanding flying school and provides charter service. Texaco Aviation Lubricants and Fuels are used and sold exclusively.





OWNERS OF Pennsylvania Aviation Corporation are T. Foster Thomas (left) and Clarke L. Smith. Both served long aviation apprenticeships as barnstormers, air mail pickup and aerial survey pilots. They know what flyers want and need, and see that they get it. They say: "We give Texaco, with its nation-wide reputation, credit for helping us build a successful business."

...when backed by quality products–TEXACO

That's the advice you'd get if you talked to Foster Thomas or Clarke Smith, owners of Pennsylvania Aviation Corporation. They'd tell you: "We've been mighty successful here at Harrisburg State Airport. We give flyers fast and dependable service, and supply them with the best in aviation products–Texaco."

That's the experience of fixed base operators everywhere. Good service backed by Texaco quality *brings in the business.* And there's no question about Texaco leadership in the aviation field. That's amply proved by this fact alone—

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TEXACO Lubricants and Fuels
FOR THE AVIATION INDUSTRY

AVIATION CALENDAR

Sept. 26-28—Fall meeting of the American Society of Mechanical Engineers, Hotel Radisson, Minneapolis.

Sept. 26-28—Welding clinic, sponsored by Whitehead Metal Products Co., Inc., at the company's Buffalo, N. Y., warehouse, 2128 Elmwood Ave.

Sept. 27-29—Quarterly conference of executive board of Civil Air Patrol, Fairmont Hotel, San Francisco.

Oct. 2-4—Seventh annual aircraft spark plug and ignition conference sponsored by the Champion Spark Plug Co. of Toledo.

Oct. 3-6—Annual national aeronautical and engineering display and aircraft production forum, sponsored by Society of Automotive Engineers, Biltmore Hotel, Los Angeles.

Oct. 4—33d annual meeting of the American Ordnance Assn., Cincinnati, Ohio. Tour of Wright-Patterson AFB is included in meeting.

Oct. 8-10—Sixth annual convention, National Defense Transportation Assn., Plaza Hotel, San Antonio, Tex.

Oct. 8-10—Special conference on aircraft electrical applications, sponsored by the air transportation committee of the American Institute of Electrical Engineers and the Los Angeles section of the Institute, Hollywood Roosevelt Hotel, Hollywood.

Oct. 9—Air transport section, National Safety Council, Palmer House, Chicago.

Oct. 11-12—1951 conference on airport management and operation, University of Oklahoma, Norman, Okla.

Oct. 13-14—Air fair at Los Angeles International Airport.

Oct. 15-18—Society for Non-Destructive Testing, eleventh annual meeting, with symposium on jet engine part inspection, Hotel Detroiter, Detroit.

Oct. 16-17—Fourth annual New York State conference on airport development and operations, sponsored by the N. Y. State Dept. of Commerce, N. Y. Aviation Trades Assn., Assn. of Towns of the State, Conference of Mayors, County Officers' Assn. and the N. Y. State Flying Farmers, Onondaga Hotel, Syracuse, N. Y.

Oct. 29-30—Air Industry & Transport Assn. of Canada annual general meeting, Seigniory Club, Montebello, Quebec.

Oct. 29-31—National transportation meeting of Society of Automotive Engineers, Hotel Knickerbocker, Chicago.

Oct. 24-25—1951 annual convention of the National Assn. of State Aviation Officials, Arizona Inn, Tucson, Ariz.

Oct. 31-Nov. 1—Society of Automatic Engineers, fuels and lubricants meeting, Drake Hotel, Chicago.

Nov. 7—Annual Wings Club Dinner, Waldorf-Astoria, New York.

Nov. 8-9—Seventh annual national conference on industral hydraulics, sponsored by the graduate school of Illinois School of Technology and Armour Research Foundation, Sherman Hotel, Chicago.

Dec. 4-5—Transport aircraft hydraulic accessory and system conference, Hotel Sheraton, Detroit.



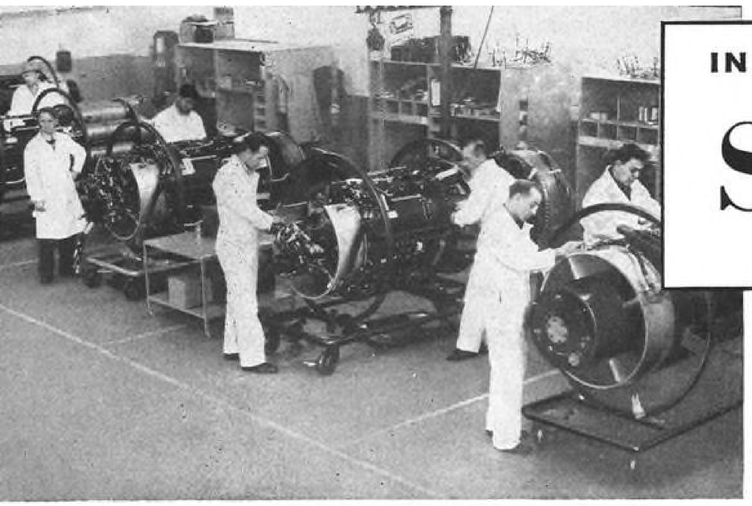
Here it is. One of the most compact aircraft actuators meeting all military requirements—the ROTORette, adopted for application on the F-84E, F-84F and F-94C. It is ideally suited for valve or damper operation. Compactness and light weight (little more than one pound) make its use mandatory where space or balance is critical.

Limit switches are load sensitive and adjustable for any value up to 50 pound-inches. *Externally adjustable* positive stops control motion between travel limits, causing a reaction on the load limit switches.

Operating on 26 volts D.C., the ROTORette is available in two models, one of which can incorporate either a position-indicating potentiometer or an intermediate position switch. Both models are qualified for compliance to Specifications AN-M-40 (Motor and Brake, including Filter), USAF-41065 (Environmental for complete actuator), and USAF-41251 (General Electro-Mechanical Actuator Specification).

Write for Bulletin 118.

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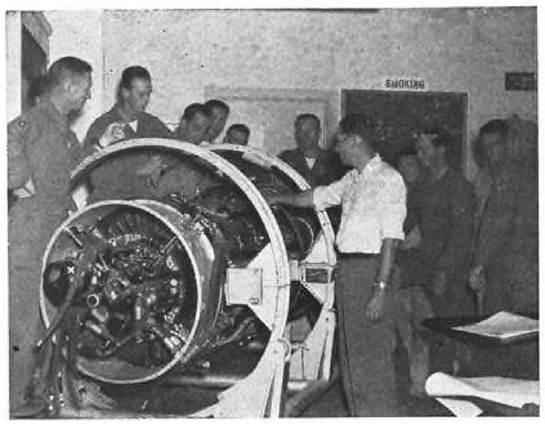


IN THE NEWS

SERVICE

Getting top utilization from jet engines requires many techniques. Here are a few of the means used by General Electric to help the Air Force get maximum use from its J47 engines.

To provide immediate service for General Electric apparatus, more than 30 G-E Service Shops are placed strategically around the country. Four of these shops are currently handling aircraft gas turbine work; more can be adapted as required. Skilled technicians provide rapid and complete repair and overhaul facilities.



At an Air Force base, a G-E representative shows Air Force personnel some fine points of jet engine servicing. To back up this field training, formal G-E jet engine schools have been functioning since 1942. Courses are now presented in familiarization, overhaul, flight test engineering, and line maintenance.



G-E service follows G-E equipment around the globe. Here, "tech reps" from General Electric and North American Aviation Inc. in Korea discuss combat performance of the G-E-powered, North American-built F-86 Sabre. G-E aviation field service representatives cover the vital spots in the world, are always available.

For quality products and dependable service, call on the company that pioneered the aircraft gas turbine industry. Telephone your General Electric aviation specialist or write General Electric Company, Schenectady 5, New York.

AIRCRAFT GAS TURBINES

GENERAL ELECTRIC

210-23

Money for Production

Air Force Will Obligate:

Below are obligations contemplated under the 1952 (current) fiscal year budget. The House has approved a $19,846,985,000 USAF appropriation for the current year; the Senate, $20,001,585,000. In addition, the lion's share of a proposed $5-billion "National Emergency Fund" will probably be allocated to USAF by the Secretary of Defense, bringing USAF's total availability of funds for obligation in the current fiscal year, ending June 30, 1952 to $23-$24 billion.

USAF's expenditures during the 1952 fiscal year will approximate $12,775,000,000, all of which will be covered by the $15,413,000,000 carry-over (from previous year appropriations) the USAF now has on hand.

Not included in the listing below are USAF obligations for administration, military personnel, and operation activities—such as training, aircraft and depot maintenance, medical supplies, etc.

The figures below include a comparatively small slice for overhead—such as personnel, travel, taxes, administrative supplies, etc.

	1950 (Actual)	1951 (Estimated)	1952 (Estimated)
Aircraft and related material	$1,527,948,283	$6,796,964,287	$10,452,620,000*
Guided missiles	12,242,684	150,150,026	130,000,000*
Industrial mobilization	14,615,861	80,338,610	9,380,000*
Weapons and ammunition	66,965,901	650,936,000	601,770,000*
Ground-powered and marine equipment	46,258,144	465,162,000	468,398,000*
Electronics and communication equipment	131,896,318	488,569,422	384,167,000*
Training equipment	11,023,743	86,447,000	93,085,000*
Other major equipment	38,690,087	330,100,000	252,580,000*
Construction of facilities	72,127,623	766,918,101	3,277,484,000*
Organization, base, and maintenance equipment	121,477,270	688,932,000	591,542,000*
Research	24,007,109	50,843,000	47,022,000
Development	132,130,051	250,330,538	308,103,000
Special R&D projects	10,092,071	21,336,000	12,800,000
Laboratory operations	34,253,042	45,510,000	57,075,000
ANG: Major procurement	8,972,143	20,568,500	31,296,000
ANG: Construction of operational facilities	14,384,686	7,709,500	15,872,000

*These categories are eligible for additional allocations from the $5 billion "National Emergency Fund."

Naval Aviation Will Obligate:

Below are obligations contemplated under the 1952 (current) fiscal year appropriation of $4,923,393,000 for Naval Aviation that has been approved by the House and Senate. In addition, all of the categories listed will be eligible for additional allocations from the $5 billion "National Emergency Fund."

Not included below are Naval Aviation obligations for flight and station operations and administration.

The figures include a comparatively small slice for personnel, supplies, and other overhead.

	1950 (Actual)	1951 (Estimated)	1952 (Estimated)
Aircraft procurement	$541,316,000	$2,771,434,000	$3,426,854,000
Ordnance for new aircraft	16,497,185	57,741,000	49,056,000
Guided missile and target drone procurement	11,700,000	101,261,000	33,425,000
Training equipment	1,450,000	4,735,000	10,938,000
Aircraft modernization	10,200,000	107,751,000	29,203,000
Research and development	80,000,000	130,262,000	159,729,000
Industrial mobilization	4,058,850	29,354,000	6,221,000
Aircraft overhaul: Regular Navy	136,303,043	218,568,000	247,483,000
Aircraft overhaul: Naval Reserve	39,338,043	49,005,000	34,185,000
Operational equipment and materiel	28,940,465	129,304,000	114,350,000

Army Will Obligate:

	1950 (Actual)	1951 (Estimated)	1952 (Estimated)
Aircraft procurement	$7,320,964	$134,055,793	$44,239,000
Research and development, largely guided missiles	56,036,900	171,476,000	242,263,000

Foreign Aid Obligations

(Aviation Equipment to be purchased by USAF and Navy)

	1950 and 1951 (Estimated)	1952 (Estimated)
Aircraft and aeronautical equipment:		
For Western Europe	$1,125,000,000	$1,425,000,000
For other areas	125,000,000	325,000,000
Electronics and signal equipment	625,000,000	250,000,000

The Buyers

U. S. AIR FORCE.....PAGE 16

U. S. NAVY.....PAGE 49

PRODUCTION FOR AIR POWER

The Pattern of U. S. Defense Expansion

● War in Korea, its cost in U. S. dollars still uncomputed, has at least been worth its salt on one count. It has rid this nation—and indeed the West—of indecision.

● Scared into a collective defense, the United Nations have finally joined in an integrated effort to ward off the onslaught of an antagonist whose intent has now been proven without doubt.

Fears by military and civilian government officials of a public lapse into complacency with the promise of an armistice in Korea has turned out to be without foundation. A reflection of this can be seen in Congress, which has indicated immediate approval of this nation's largest peacetime military budget. As a result, it is hoped that a burgeoning defense production will have a definite dampening effect on the global tinder-boxes in Berlin, Yugoslavia and Iran.

Indicative of Congressional enthusiasm for expansion of air power is the recent proposal by powerful House Armed Services Committee leader Carl Vinson to jump USAF from the authorized 95-group level to 163. He asks proportionate increase for Naval Air.

Who Gets What

While the military will take whatever the Congress offers—happy to get it and hungry for more—top Air Force and Navy officials predict, more realistically, a probable 25% increase for Air Force and 15% for Naval Air with schedules calling for those increases "in being" by December of 1954. This would mean approximately 119 groups for USAF—about one-half its peak World War II strength. Gain to Navy would probably result in an overall increase to its current strength by one-half. Its structure, not wholly comparable to USAF wing plan, consists today of some 12-15 air carrier groups, 50 patrol and anti-submarine squadrons, plus about 20 Marine air squadrons.

► **Air Force**—Lion's share of the $15 billion currently contemplated goes to Air Force to permit the already authorized build-up to 95 wings. Current strength of the Air Force is 87 wings. Air Force share of the fiscal '52 budget is $11,092,000,000, of which $4,957,360,000 would purchase 8,690 complete aircraft with another $4.2 billion programmed for initial spares and spare parts.

► **Navy**—Naval Air, on the other hand, contemplates a $4,497,869,000 aircraft procurement program during the fiscal year, including $450 million to finance prior aircraft procurement authorizations committed under fiscal 1951 4th supplemental budgets, and amounting to some 500 planes. These fiscal 1952 requests include funds for 3,700 aircraft, which is about 10% more than were ordered in fiscal '51.

► **Army**—The ground force remains as far as dollars are concerned, the have-not service as an aircraft user with only $44,239,000 requested in the basic '52 budget for plane purchases. Its progress, nevertheless, is diversified and indicates a continued trend toward obtaining a larger tactical aviation corps for itself.

Decision by the government to transfer role of first line of defense to Air Force in 1947 had an immediate and profound effect on Army and Navy.

Climb of USAF has been turbulent because of interservices rivalry for control of its various facets. Although plagued by internal disagreement as to application of its hard-won lead, USAF has managed to forge a nucleus of strategic, defensive and tactical equipment equal to, if not superior to, that of any nation in the world.

Despite hue and cry in various quarters of the great disparity between Air Force and Navy appropriations for aircraft, the fact is that Navy has fared well when overall roles and missions of Navy and its supporting air arm are assessed.

Prime mission of the Navy remains control of the sea lanes, with the naval air to enforce it, regardless of continued attempts by a few armchair mariners to project naval jurisdiction to encompass airlanes control in conduct of war.

► **Roles & Missions**—The very complexity of the global concept in modern war has been cause for some confusion and discord as to roles and missions due to overlapping needs. Each service has found urgent need for application of missions assigned to sister service agencies. That overlap as a result of the global concept has been chief cause for concerted attempts by each service to keep its lines of jurisdiction pointedly marked.

This has accounted for the long—and still fruitless—battle between Army and Air Force for removal of the weight limitation now holding Army to procurement of very light aircraft.

This has been cause for the battle for application of and control of tactical air support for ground troops.

This has been cause for the study now before the Joint Chiefs of Staff which would return Military Air Transport Service to full control by Air Force and its reorganization with Air Force command status.

Production Problems

Top problem confronting the United Nations today is the same as it was in World War II beginnings—"getting the show on the road"—production, and the associated bottlenecks of materials, know-how and machine tools. Bad enough at best, it is further complicated by increasing requirements in the still little understood field of electronics.

General consensus, however, in Air Force, Army and Navy for priority in bottleneck elimination, in order of urgency are: manpower, aircraft engines, machine tools, brick and morter for plant expansion and then electronics.

1. Manpower

Trained manpower, always in short supply, is becoming critical as industry expands. The shortage exists from bottom to top through all facets of the industry. Management is feeling the pinch directly as are technical, mechanical and research departments. Search for competent management for expansion is of growing concern to the prime contractor as he seeks to disperse production across the nation.

Unfortunately, industry is greatly at fault for its lack of trained personnel. It could do much to alleviate its growing pains by insisting that state and local governments expand the entire educational system. Therein lies the answer to this and all future manpower shortage.

The Defense Department is doing what it can to offset the shortage, in keeping with its military manpower needs. It has funded thousands of schools and colleges throughout the nation to augment technological training. It is not enough.

Qualified engineers are scarce. For example, Boeing virtually runs a commuter service for its engineers between Seattle and Wichita, as does Convair between San Diego and Ft. Worth. Republic Aviation, on the other hand, offers to take any brand of qualified engineer and convert him to its aeronautical needs, paying him the while.

Almost all aircraft companies have instituted their own schools to expand technical know-how. Convair, for one, has recently offered training to its employees at the plant which is acceptable for college credit in technical fields.

2. Engines

Being nipped in the bud by the Air Force and Navy is a trend toward dependency upon a single powerplant as prime mover for aircraft. During World War II the Pratt and Whitney R-4360 piston engine was design engine for almost all heavy combat and transport planes. Result—dangerous shortage.

Today the Pratt and Whitney J-57 is design engine for a considerable number of U. S. combat aircraft. But Air Force and Navy are pushing for parallel development of other turbojet engines with similar thrust power and fuel economies. There are several under way, including those of Allison, G. E. and Curtiss-Wright.

Additional bright spot in the engine planning picture is co-development of the turboprop engine along with the turbojet. Both Air Force and Navy have settled on the idea that most transports will ultimately be equipped with turboprop engines while the combat aircraft, excepting some bombers, will utilize the turbojet.

3. Machine Tools

Running third in magnitude of qualitative expansion is the machine tool industry. The average machine tool manufacturer states his industry is capable of meeting production schedules if the government would get together with itself, standardize, and above all, clean up new and stored tool distributions systems. Defense Department insists that such is not the case. It admits to a few inequities of distribution but states these are the exception.

Defense Department is at fault in that much of its cached tooling was inadequately prepared for storage and improperly catalogued. This situation is being rectified with the recent award of a $3-million contract to a New York firm for survey of the entire machine tool distribution program.

Top problem, however, is that machine tool manufacturers are few. Their ranks are due for expansion shortly, as government calls in the type-cast foundries with their vast numbers of employes trained in similar tasks to convert to machine tool manufacture. Officials concerned with machine tooling figure that the next 18 months will see capacity of the industry almost doubled. But its output will be trebled as non-essential tool production is cancelled. Further incentive to speed production is government authorization to net a 3-5% increase in profits.

4. Brick & Mortar

Plant expansion, with shortage of structural steel, is hitting primarily the small businessman who, of necessity, has had to wait until the last minute to expand. On the other hand, he is feeling the pinch of shortages across the board. Major contractors are not particularly hurt with the shortage of structural steel, except in isolated cases. Boeing, for example, as a result of the steel shortage, is hard hit for the time being in an urgent and needed plant expansion in Washington.

Proposals by some manufacturers for return to construction of large wooden plants such as the old Douglas-Chicago plant are being held in abeyance by Defense Department, the reason being that easement of the structural steel shortage is expected shortly with further curtailment of non-essential construction.

5. Electronics

Brightest picture on the aircraft production scene is that of electronics availability. Eighteen months ago, the military and the industry predicted dire shortages in the field. One year ago, technique had advanced but the overall production picture was not much improved. Today, although there are some shortages, electronics manufacturers are utilizing less than one-half of their total production capability, authorities declare.

Besides great strides in producibility of product, enormous strides have been made technologically. Similar advances have been marked both in quality of product and savings in weight through miniature and sub-miniaturization of components.

Hazard of an electronics system being rendered inoperable because of complexity of circuit has largely been eliminated through use of the printed circuit and complete packaged-in-plastic circuit systems for systems. Today, entire circuits of systems can be replaced in the field by comparatively untrained users in a matter of seconds.

Exceptions to the rule are found on occasion as in the case of the Boeing B-47s with tail weapons presently inoperable because of complexity of the electronics systems which control the turret.

For the most part, however, the electronics—components and systems—will be ready when needed, as the craft for which they are intended phase into major production. —BSL

Air Force Contracts

Following are the "uninvoiced dollar balances" (face values) of existing Air Force contracts as of July 31, 1951.

These figures do not necessarily correspond with a manufacturer's backlog as of that date as manufacturers use various methods of calculating backlog.

Central District	**$ 842,078,367**
Dayton Reg.	166,221,079
Kaiser-Frazer	86,476,883
Cleveland Reg.	99,850,665
Detroit Reg.	241,639,791
Cincinnati Reg.	239,278,786
East Canadian Reg.	8,611,163
Eastern District	**$1,808,734,716**
New York Reg.	263,663,831
Newark Reg.	105,648,210
Philadelphia Reg.	208,897,131
Bendix Radio	96,101,522
Chase Aircraft	1,651,270
Curtiss-Wright	75,596,204
Fairchild Aircraft	98,393,642
Glenn L. Martin	15,303,300
Republic Aviation	445,926,676
Sperry Gyro. Co.	116,681,911
Wright Aero. Corp.	380,871,019
Midcentral District	**$1,578,998,105**
Indianapolis Reg.	16,690,583
Chicago Reg.	98,490,565
Milwaukee Reg.	204,088,389
St. Louis Reg.	105,701,408
Minneapolis Reg.	43,545,656
South Bend Reg.	49,757,761
BOP Div. Kansas City	53,071,279
Allison	694,610,957
Ford	182,041,507
Studebaker	85,000,000
Nash Kelvinator	28,000,000
Fairchild	10,000,000
Ford—Kansas City	8,000,000
Northeastern District	**$ 716,154,735**
Bell Aircraft	39,278,808
Boston Reg.	154,922,968
Lynn Plant Office	227,674,878
Syracuse Plant Office	59,522,694
Schenectady Plant Office	73,175,553
Rochester Reg.	161,579,834
Southern District	**$ 416,831,699**
Atlanta Reg.	16,777,480
Dallas Reg.	11,988,876
Boeing—Wichita	152,972,880
Wichita Reg.	44,361,864
Convair Plant Off.	74,755,789
Tulsa AAP No. 3 (Douglas)	49,238,714
Lockheed GAP No. 6 (Marietta)	66,736,597
Western District	**$1,669,885,292**
Boeing—Seattle	341,688,352
Convair	49,701,516
Douglas Aircraft	235,696,039
Hughes Aircraft	67,121,628
Lockheed	271,463,317
N. A. Aviation	338,089,959
Northrop Aircraft	187,708,531
Glendale Reg.	75,922,817
L. A. Reg.	70,661,260
San Diego Reg.	23,712,006
San Francisco Reg.	7,300,854
Seattle Reg.	819,013
TOTAL	**$7,032,682,914**

How Combat Plans Determine Production

With more funds available, USAF can diversify its output instead of concentrating on strategic bombers.

● Type of Air Force production was settled several years ago with the necessary—and vital—decision to emphasize long-range bombing.

● That gave time to plan. Plans now are paying off with deliveries of all types only a little behind schedule and expansion plans settled.

● With more money, and the Strategic Air Command still buying time, the Air Force now can push production on varied types for well-rounded air power.

By Ben S. Lee

Strength of the U. S. Air Force two years ago was 48 wings. A year ago it had climbed to 68. Today it consists of 87 wings and because of thoughtful planning the nation's aircraft industry is supposed to have a dormant capability of doubling that figure within a year should it be called upon to do so.

During fiscal 1952, aircraft production schedules underwent major revision. Timetables calling for wings in being were stepped up from "as of Dec. 1954" to "as of Dec. 1952." The result has been a temporary slowdown due to the upward revision of requirements, still deliveries during the past fiscal year did not fall materially behind schedules. There was an actual deficit in aircraft delivery schedules to USAF of only 50 planes.

▶**Schedules Up**—During fiscal 1952, Air Force anticipates a production slippage of 11% by February, 1952. However, it expects the deficiency to be eliminated by June of 1952. On the bright side, Air Force figures that year-end 1952 will see aircraft production schedules about 33% ahead of presently programmed schedules. These statistics will hold true, Air Force states, barring unforeseen contingencies such as another prolonged shutdown as the recent strike at Alcoa.

Congress has so far appropriated slightly over $11 billion in fiscal year 1952 to assure, dollar-wise, the continued build-up to the 95-wing structure. Last week it had promised an additional $5 billion to continue build-up beyond that point. Informed military officials believe the Air Force share will approximate two-thirds of that amount. This would permit a build-up to 119 wings. This is about one-half the peak World War II strength.

Long-Range Weapons

After World War II, the Joint Chiefs of Staff were faced with a limited budget. To stretch the military air dollar as far as possible, strategic air was given priority over tactical air. For this decision USAF has been often and much maligned.

The decision has proved wise. United Nations officials are mutually agreed now that development of the U. S. strategic air arm, coupled with U. S. lead in atomic weapons, has been the prime deterrent to outbreak of a major conflict.

▶**Land & Money**—Emphasis on strategic air was and is based upon two simple facts: economics and geography. The larger a nation's land area, the more targets it has to protect. The economic and strategic problem, then, of an enemy is build-up of defensive air power—enough fighters, enough radar equipment and other anti-aircraft equipment—to make attack impossible. So far, cost of sufficient radar for early warning, fighter-interceptors and other weapons to accomplish such a defensive screen are prohibitive.

Our possession of the Consolidated-Vultee B-36 with its capability of immediate retaliation in delivering the atomic bomb to any strategic target in the world has stopped the potential aggressor for the time being.

As the B-36 obsolesces and phases-out by January, 1955, two new strategic bombers, the eight-jet engined Boeing B-52 and probably the Convair B-60, also powered by eight jet engines, will be in production and manning operational units of the Strategic Air Command.

▶**Missiles Near**—Augmenting these conventional strategic air weapons are air-to-ground guided missiles capable of attaining tremendous velocities and altitudes. Far more advanced than the public imagines, these weapons are here—not in developmental stages—and are now in production phases.

Both the Bell X-1 and Douglas Skyrocket, for example, could easily be converted to weapon status—equipped with automatic control and fitted with an atomic warhead—and carried to within a hundred miles of its target where it could be launched with lethal accuracy.

So far, there are seven major manufacturers of missiles producing weapons for the Air Force. Costing from $1,000 to $50,000 each, some will be in operational test by the end of the year and in full service use by end of 1952.

▶**Korea No Guide**—Mettle of the United Nations has been tested reluctantly in Korea and has not been found wanting. Though the Communist power has failed thus far to commit little more than verbal backing to Red China, the threat of more has made the West alert to its own weakness.

Because of Red China's failure to employ its air forces to the fullest, the United Nations by default has been able to hang on to the first tactical objective of air power—air superiority. As a result, our ground forces, after the order of battle was set, "never had it so good" as far as tactical air support is concerned.

While there have been a number of major air battles over Korea, it is generally conceded that Red China has not seriously challenged our supremacy. It could have. Intelligence has indicated irrefutable evidence that more than 1,000 enemy aircraft, mostly fighters, have been on hand but not committed to battle.

Therefore, war in Korea cannot be considered a fair measure of present potency of the Air Force. Neither may accurate conclusions as to the proper application of the Air Force missions be assessed in light of the limited scope of combat in that area.

There are those who read into the heavy procurement of the Boeing B-47 and RB-47 medium jet bomber a sign that the Joint Chiefs of Staff may have altered their planning as to the relative merits of long-range bombardment. Such is not the case.

During postwar years, USAF procurement—in addition to being made to enforce the peace—was aimed at maintaining a balance in forces which would provide a maximum amount of training with minimum amounts of equipment for all segments, in keeping with role and missions of the Air Force.

Medium Bombers

The long-range weapons and tactics of the Strategic Air Command have long been misunderstood by the general public in the overall employment of roles and missions of the Air Force.

In addition to being an "in-being force" ready to effect an immediate retaliatory blow when war comes, it is designed primarily to attack the enemy's source of strategic bombardment. Secondary mission, is of course, the popular conception of destroying the enemy's industrial potential.

In this latter mission, the employment of medium bombardment overlaps that of the long-range strategic bomber. While it would be ideal to manipulate war in the air from the home field, the economics and practical application of air war make it prohibitive.

To exploit capabilities of air power in saturation bombings of the enemy's heartland, USAF has embarked upon expansion of its medium bombardment forces for theater actions.

▶**Meaning of Mediums**—It is for this reason that this government has entered into agreement with most of the nations allied under the North Atlantic Treaty to forge a string of air bases southward from Wales, across France and Spain, the northern coasts of Africa to the shores of the Black Sea. This vast network will soon be home for hundreds of B-47s being built in three U. S. centers and soon to be built in England.

So far, the Boeing B-47 is the only modern medium bomber in the Air Force stable. To offset this planning liability, however, Air Force has ordered engineering studies of still another medium bomber and plans to have the plane in flight test in about 18 months from now. It will test the capabilities of the turboprop engine to bomber application.

Light Bombardment

The British-designed English Electric Canberra, recently ordered into production as the B-57 by the Air Force at the Glenn L. Martin plant, is being procured primarily for utilization as a light support bomber for tactical air.

Actually, however, its procurement is far more significant to the U. S. aircraft industry because it heralds return of USAF procurement to specialized aircraft.

During the postwar years, again as a result of economy edicts, USAF aircraft development trended towards all-purpose fighters, fighter-bombers and cargo planes.

▶**Single Purpose**—USAF has never been wholly satisfied with the dual and often multi-purpose concept of aircraft, but it was an expedient. This fact gave rise recently to false reports that the Martin B-57 would gain considerably in gross weight as USAF moved to make it all-purpose. The plane in production at Martin, except for minor changes enabling it to cope with U. S. standards, will be essentially the same in weight, performance and capability as its British counterpart.

Air Defense

Despite widespread opinion to the contrary, Air Force is not wholly adequate—nor modern—with respect to current production fighters. The Lockheed F-80, though performing admirably in Korea, is obsolescent and obsolete when performance is matched against Russia's second string MiG 15.

The Republic F-84 fighter, pulling fighter-bomber duty, has been so ornamented with weapons and other tactical equipment to meet the needs of ground support activity that it can hardly get off the ground. Sweptwing version, F-84F, more than adequate for its mission and scheduled for production both at General Motors in Kansas City and at Republic in Farmingdale, L. I., is still 18 months off.

The North American F-86 is the best fighter for day-operation by USAF but it will be superseded by the Northrop F-89 and Lockheed F-94 all-weather fighters just now coming off production lines in quantity.

▶**Two of Four**—So Air Force has only four fighters in production: the F-84, F-86, F-89 and F-94. Of these, only the last two meet USAF requirement for all-weather operation. And these are not in sufficient quantity to materially increase this nation's all-weather fighter potential for air defense.

Long aware of its inadequacies in the interceptor field, Air Force has finally gotten around to fulfilling this urgent requirement. Today we have none, although some aircraft are ambiguously referred to as interceptor types.

A year ago, Air Force issued requirements for an interceptor to the aircraft and electronics industry. Through competition, a design for a completely automatic supersonic interceptor has evolved which USAF expects to have operational—at least in service test quantity—by the end of 1954. Electronics control for the interceptor, whose human pilot will act as monitor, is in development by Hughes Aircraft. Design of three different test airframes is underway by Convair, Lockheed and Republic.

Military Transport

Current military enigma is the cargo plane. Pared to its absolute essential, the prime mission of the Air Force is logistical support of Army. In quantity, by comparison to the rest of USAF's strength structure, military transport is keeping abreast. Qualitatively it is not, except for a few notable exceptions such as the Fairchild C-119 designed for the military mission. For the most part, transports have developed willy-nilly to meet the demands of a civilian economy and not the military necessity.

The first long-range transport designed to meet the military need is still more than two years away. It is the Lockheed turbo prop transport, winner of USAF's recent competition for long-range logistical air movements.

▶**Favorites**—Of current production types, those in greatest demand are the Douglas C-124 among the heavies, and the Fairchild C-119 in the medium transport field. The C-124 is scheduled to replace the wartime famous C-54, while the C-119 is rapidly taking over the bulk of transport previously handled by the C-47 in the troop carrier field.

Other heavy transports in major production for Air Force are the Douglas C-118, military counterpart of the Douglas DC-6B, and the Lockheed C-121, counterpart of the Constellation. While both of these craft are being ordered in cargo version, in the main they are intended for personnel use.

Final heavy transport in production for USAF is the Boeing C-97 and KC-97 refueler. The latter is in forced production to increase the legs of the B-47 Stratojet bomber and is scheduled to replace the obsolescent tanker versions of the B-29 and B-50.

▶**Enter Chase**—In the medium transport field an important newcomer is the Chase C-123 just tooling for production at Trenton and later at Kaiser's Willow Run facility. Army expects it materially to increase its effective combat personnel potential in airhead assault by decreasing personnel and equipment losses in the para drop.

The Fairchild C-119 will continue to play an important role in performing aerial resupply as well as in initial paradrops of the inevitable shock-troop airhead establishments. But the very-rugged Chase C-123 assault transport will supplant much of the costly paratroop phase by moving men and supplies directly into the airhead with minimum loss to men and material. Production schedule of the C-123, presently pegged at just under 400, is already under re-examination with proposals to double planned output.

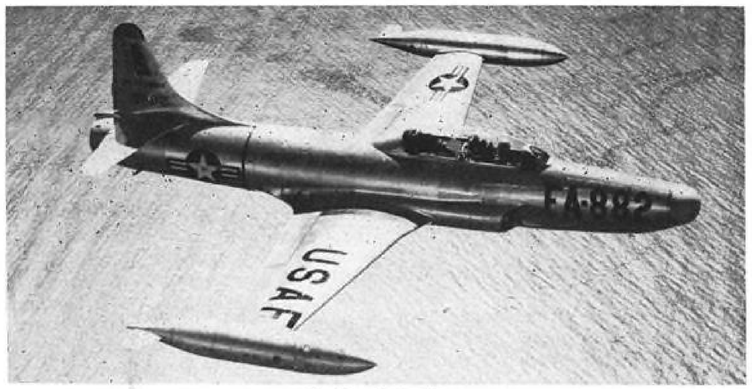
Helicopters

While its cause has been advanced from time to time, it remained for Korea to focus real attention to the merits and combat utility of the helicopter.

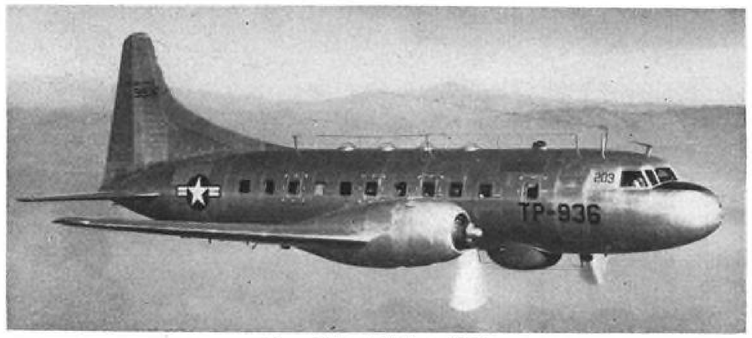
Capabilities of the helicopter, even yet not fully explored by the Air Force, which heretofore has been prone to ignore the copter because of its "inability to live in the air," is receiving high plaudits of Army, Navy and Marines.

▶**Double Order**—While most helicopter production is still relatively small in comparison to other USAF production inventories, fiscal 1952 procurement schedules nearly double copter business.

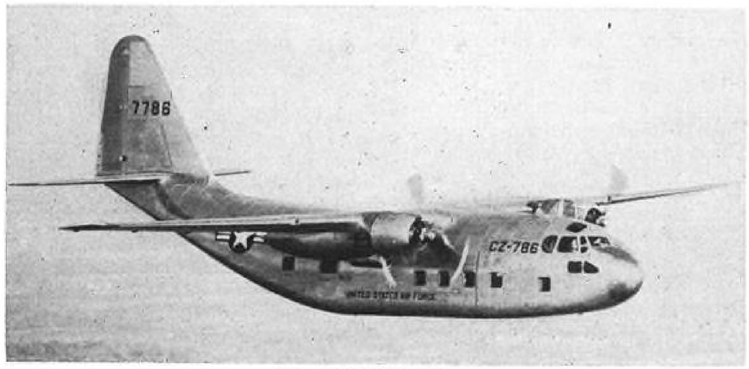
Chief objection to the helicopter, development of a practical autopilot, has been overcome. This makes possible a



Lockheed F-94B



Consolidated Vultee T-29



Chase XC-123 Avitruc



Cessna L-19A

development urgently pressed by Army for big transport helicopters such as the Piasecki XH-16, scheduled to fly early next year. Similarly, it will offer a complete re-evaluation of the entire mobility problem of Army as will other large helicopter such as the huge Hughes XH-17 twin-jet "flying crane."

Currently, Air Force has ordered production of only three types of helicopters from fiscal 1952 funds. These are the XH-12 being produced by Bell at Niagara Falls; the H-19 in production at Sikorsky's Bridgeport, Conn., plant and the Piasecki H-21 in production at Morton, Pa.

Trainers

The training production program of the Air Force is completely diversified and ranges from the light two-place North American T-6 in production at Canadian Car and Foundry, Ft. William, Canada, to the Convair T-29 (counterpart of the commercial 240) multi-place navigator trainer at San Diego.

Advanced trainer in production is the North American T-28, postwar development of the T-6. Considerable pressure to replace the 1938-designed T-6 with the heavier T-28 has been temporarily shelved.

Still another plane in major production as USAF moves towards an all-jet combat team is the Lockheed T-33 jet trainer. Developed as a two-place version of the F-80, the T-33 is in production at Lockheed's Burbank, Calif., plant.

Final procurement scheduled out of fiscal 1952 funds in the trainer field is the contract recently awarded to Beech aircraft for production of the twin-engine pilot trainer T-36. Scheduled production of the T-36, a few of which will find their way into service as multi-place transports, is underway both at Beech-Wichita and at Canadair's Montreal plant.

Liaison Air Rescue

Grumman aircraft is the only plant currently building aircraft specifically designed for the air-rescue mission. They are in production for USAF with the SA-16 multi-place amphibian.

Scheduled shortly, however, is a retrofitting program for C-47 aircraft to fulfill a Strategic Air Command requirement for a very long-range air evacuation aircraft. Douglas will program modification of obsolescent C-47 transports to F series until Chase Aircraft gets into production at Willow Run. At that time, some quantities of the C-123 will be equipped for the long-range air evacuation mission.

In the liaison field, Air Force has ordered slightly less than 200 de Havilland beaver light transports. These will be produced at de Havilland's Toronto plant.

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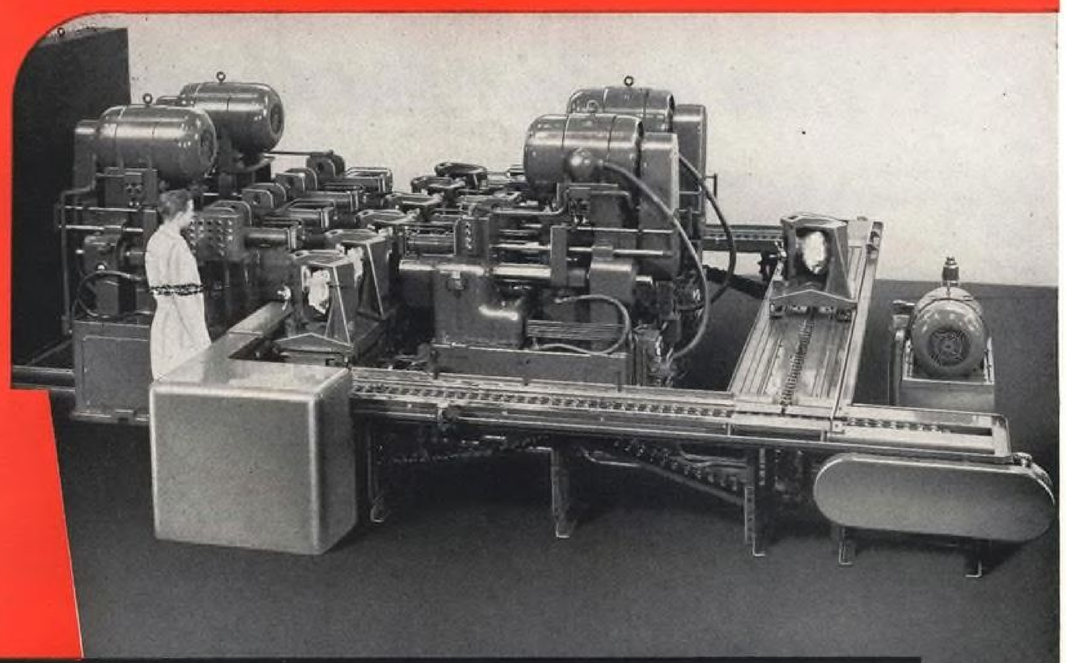
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• Speed is the watchword in Air Force buying, for the faster the buying, the faster you get production.

• So, a natural development at the Air Materiel Command has been intensified concentration on new production methods, as well as changes in buying procedures to get contracts in the hands of producers.

DAYTON, O.—With more than $7 billion worth of contracts being let, there is a distinct accent on production at Air Materiel Command, hub of the Air Force's gigantic buying machine.

This is reflected several ways, but principally by overall flexibility of the national production picture, and by new procurement procedures. Both are designed to function at peak efficiency—regardless of the number of wings to be scheduled in the immediate future.

Flexibility of the aircraft production structure is a result of intensive studies by a number of universities, the Production Resources Division of Procurement and Industrial Planning here and by industry itself.

▶ **Steps Forward**—Concentration is on two phases, first, a reduction in the use of critical materials by the free use of tested substitutes, and, second, the unceasing battle to achieve savings in production manhours. Typical examples include:

• **Boeing** is redesigning the B-47 bomber to reduce both critical material content and manhours. Approximately 20 parts are in process of being redesigned at the conclusion of Phase I of the project.

• **Republic and Lockheed** are making similar studies and have completed Phase I.

• **Cincinnati Milling and Machine** is designing milling machine type tools capable of 2,000 to 10,000 rpm. and surface speeds of 1,000 rpm.

• **Several basic aluminum fabricators** have established practical methods of producing tapered aluminum alloy sheet of aircraft size and quality. Experiments with cyclical tapers is progressing.

• **Beech** is fabricating jettisonable wing tip fuel tanks of magnesium.

• **Sylvania** has completed the design and has in production five of 15 subminiature electronic tubes.

• **Goodyear** has developed a durable magnesium forged wheel center calculated to prolong life and reduce spare parts.

These are but a few typical examples of efforts being carried on now to simplify production processes. Parallel projects are being carried out in virtually every pertinent fabrication used in assembly today's military aircraft.

▶ **New Sources**—In its planning for any production requirement, the Production Resources Division has not limited production sources. An example of this is the automotive industry which has been brought into the picture—particularly on airframes and engines. Another is the commercial television industry which is moving in on the electronic production field.

In both cases, the two industries had to be shown that aircraft component production is considerably more complicated—by reason of close tolerances—than the output of civilian goods.

Air Force production planners envision a production pace to match new requirements from first and second sources now active. It will encompass a general streamlining of production methods and adding new work shifts in many instances.

Although there is no definite word on the eventual number of wings to be built up, the Air Force has few plans for a "brick and mortar" increase in plant facilities for contractors. Efficient use of existing productive facilities will supply much of the production increase.

Need for additional space was one of the prime factors which led to the mass shipping of reserve machine tools stored at Marietta, Ga., and Omaha, Neb., storage depots. Both storage sites will be converted to production uses as soon as the machinery stockpile is exhausted. Shipments are being made at the rate of several hundred units each week.

▶ **Two Changes**—New procurement procedures include two important new methods—both aimed at facilitating production on Air Force contracts.

The latest is employment of a Facility Capability Report before the awarding of any contract in excess of $5,000.

Second is the throwing open of the negotiated procurement field to any manufacturer.

The Facility Capability Report is requested by the Procurement Division buyer after he has evaluated all bids or proposals from prospective contractors. The buyer obtains, from the Air Procurement District involved, the following information:

1—Are the firm's facilities satisfactory to perform the contract being considered for award.

2—Is the firm's financial stability suf-

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ficient to meet the requirements of the contract.

3—Does the firm have the necessary production capabilities in consideration of its present production load and past performance.

4—Are the business ethics of the firm above reproach.

5—What percentage of subcontracting is contemplated.

Obvious advantages to the Air Force, particularly in the cases of new bidders, are that delivery schedules will be honored and that it will not be necessary to re-do the entire procurement at a later date because of inability by the contractor to meet contractual obligations.

Throwing open all negotiated procurements to interested producers is the Munitions Board answer to criticism of the Armed Services for doing business with a "favored few" contractors. Practically all federal procuring agencies long have been under fire from manufacturers who contend they were "left out in the cold" on contracts that were awarded to competitors already over loaded with orders for large scale production.

▶ **Negotiations Made Easier**—Disadvantage to the "outsider" competing on negotiated bids lies in the time element —involving 18 days minimum between announcement and opening day. If the newcomer relies on the U. S. Department of Commerce "Synopsis of Procurement Information," he will have lost nine of the 18 days. He also will have to go to the nearest Air Procurement District or Regional office to abstract from a set of data on file there the information he needs with which to prepare a proposal.

There is no way under existing regulations that he can acquire a complete set of data to take to his plant for use in figuring out a proposal. Considering that he frequently must obtain quotations from his own subcontractors and the time involved in getting the proposal back to Wright-Patterson AFB prior to the deadline, he has precious little time to work out an accurate proposal.

In spite of the departure from the former system of negotiating purchases, the bulk of Air Force buying will be done by negotiation, rather than formal advertising. The latter method encompasses more lapse time from announcement to bid opening and is more expensive from an administration standpoint.

▶ **Advertised Bids**—The only practical method for a manufacturer to be sure he will receive opportunities to bid on advertised procurements is through registration on the Procurement Sources List at Air Materiel Command headquarters.

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2—Upon receipt of the request, MCPPXS will mail to the applicant an Index of Catalogs and a Facility Information Sheet which requires information on present production range, number of employees and other information on facilities. Complete instructions for executing the forms are enclosed.

3—When the completed index is received by MCPPXS, copies of the requested catalogs are mailed to the applicant, who can circle the code number corresponding to any item he can fabricate, identify his company on the cover and return to MCPPXS. Punch cards are prepared for each circled code number in order that the applicant will receive information or bid sets on any Air Force procurement for which he is listed.

Registration also is important from the standpoint that any buyer may request from MCPPXS a complete list of sources. This may be to answer a request for subcontract sources, or to include one or more of the new registrants in the list of those to receive requests for proposals in negotiated procurements.

Once registered as a source, a firm will retain that status until it ignores an advance notice or, having requested a bid set, fails to submit a bid without sufficient justification. In this case it is dropped from the automatic list.

Advance notices are used in a number of advertised procurements—notably where there is a large list of sources. The advance notice consists of a description of the item to be purchased, quantity, delivery schedule and a postcard on which is listed a date on which bid sets will be ordered by MCPPXS. The postcard must be in on or before the indicated date in order to insure that the bidder will receive a bid set. The advance notice system is a practical means of saving printing costs where past experience indicates, for example, that 50 or fewer bidders usually respond on an item for which the source list may contain hundreds of names.

Where the source list is small and active, the buyer may send bid sets to all registered sources on the premises that most of them will submit bids.

▶ **Small Business Aids**—Registration as a source is of special importance to firms in the Small Business category—still erroneously tagged with a blanket under-500-employe label. A steel, airframe or auto manufacturer with less than 500 employes obviously rates the small business tag. Just as obviously, however,

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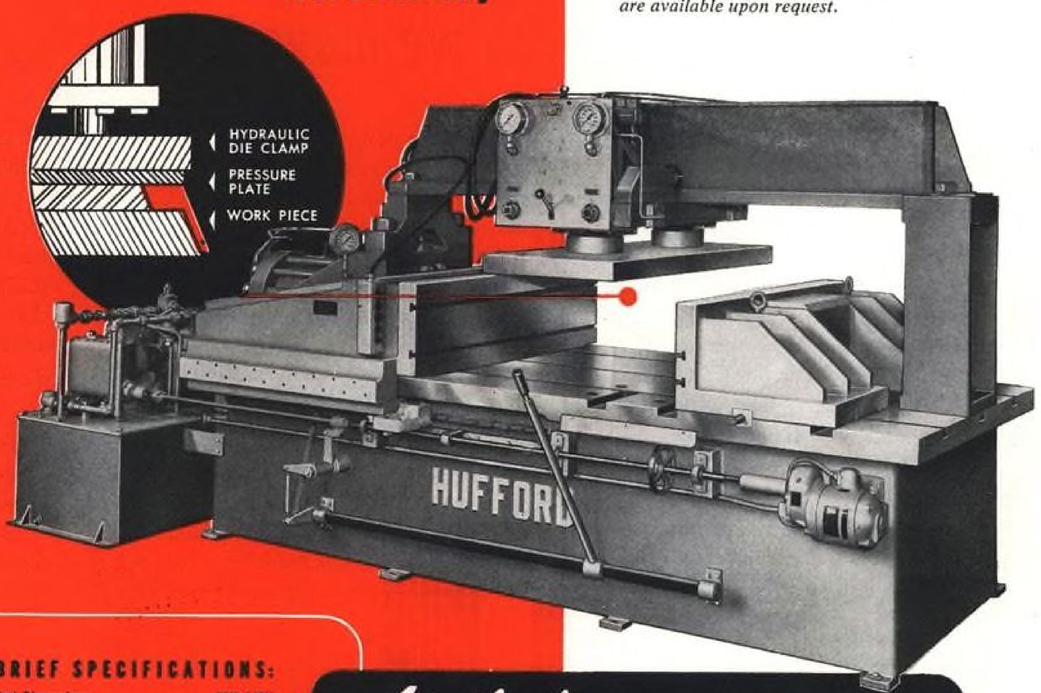
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Tonnage (each clamping cylinder)	25

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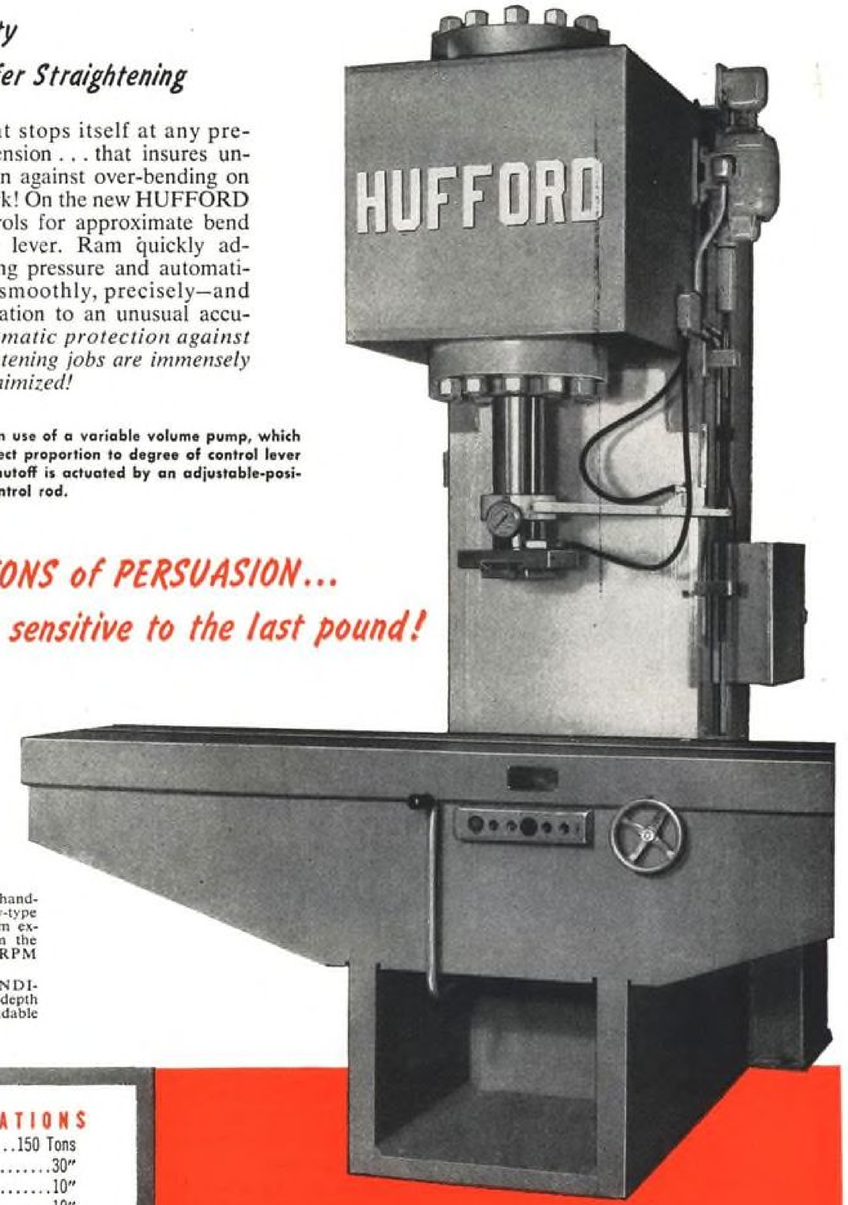
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there are any number of manufacturing fields in which 200 employes are in the big business class.

The Air Force has waged a lengthy campaign to enlist the facilities of more and more small business firms in the production of required materiel. Two basic reasons for this activity are the increase of production know-how and an honest desire to spread the Air Force dollar as far as possible in the interests of the national economy.

It is apparent that from a national security standpoint it is better to have 20 firms capable of producing a single item than to have only two or three because of possible bombing or sabotage.

In recognition of this, the Air Force has instituted a new procedure designed specifically to aid small business. It works this way:

Every proposed purchase emanating from Air Materiel Command headquarters is studied to determine suitability of production by small business firms. This, of course, does not apply to airframes, engines, propellers and major electronic devices. There are thousands of other items—remembering that the Air Force lists approximately 740,000 items in its catalogs—which can be fabricated efficiently and cheaply by small business.

Where a proposed procurement falls into the latter category, a group of small business analysts recommends that solicitation of bids be concentrated on that class of supply sources.

▶ **Subcontracting Aids**—From every practical standpoint, however, the principal roll of the average small business firm is in the subcontracting field. Here is a natural element which is becoming increasingly important in the program to aid small business.

Reasons for this recommended role are many and varied. Primarily, the small business operator does not have to become entangled with the various phases of a contract for which big business has specialized departments. The small business producer, assuming that his work is satisfactory, through subtracting can build up goodwill with a prime contractor that may result in valuable additional order on the production of peacetime products. Another factor is that he doesn't have to worry excessively about shortages of raw materials—that being the concern of the prime contractor who has priorities on the scarce materials necessary to fulfill terms of the contract.

Long ago, the Air Force began the release of information on major prime contracts so as to be able to steer potential subcontractors to major prime contractors.

This report has blossomed into the Department of Commerce's "Synposis of Contract Award Information" mailed free each week to Chambers of Commerce, manufacturers' associations and similar organizations.

The Air Force also initiated a series of subcontract shows—later taken over by Armed Forces Regional Councils to include Army and Navy prime contractors—in various of the industrial centers of the nation. Shows already have been held in New York, Chicago, Boston, Cleveland, Los Angeles, San Francisco, Fort Worth, St. Louis, Atlanta, Pittsburgh and Seattle among others.

What promises to be one of the larger shows is scheduled for the State Fairgrounds at Detroit from Oct. 31 through Nov. 2. Original planning for the Detroit show is that the exhibitors will be limited to those Armed Services contractors currently in quest of subcontract help. In many of the previous shows, numbers of exhibitors were merely registering potential subs because many of the exhibitors were awaiting tooling up work and erection of additional facilities before being able to let any subcontracts.

Practice at these shows is for the prime contractor to display "bits and pieces" he wishes to let out on a subcontract basis and to register subs for future investigation. The shows are a more practical media for getting quick results by reason of an unusual fact that many veteran production men can spend hours poring over specifications and blueprints—but know at a glance at an item whether or not they can make it in their shops.

Still another aid to small business is the appointment of a small business advisor in each of the Air Procurement District and Regional offices. Appointees generally are cognizant of the entire procurement program and are in a position to render valuable advice applicable to the local area.

Procurement Division officials have added a new clause in all contracts over $5,000, requesting the prime contractor to utilize to the limit subcontracting facilities consistent with efficient execution of the contract.

Industry's cooperation in behalf of subcontracting to small business has been solicited in the form of a request from Brig. Gen. Mark E. Bradley, Jr., acting director, Procurement and Industrial Planning. The general has asked contractors to appoint a small business liaison official to work directly with AMC headquarters and the appropriate Air Procurement District office.

The request asked that the appointee be on a staff level and that the individual concern himself with implementing the subcontracting program among the small business firms.

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AF Procurement Districts Ease Problems

Industry gradually is learning that it's cheaper, more convenient and just as satisfactory to take care of Air Force procurement matters through the far-flung Air Procurement District and Regional offices maintained by Air Materiel Command.

In all, there are six District offices and 23 Regional offices in the system, all located in major manufacturing areas for the express purpose of saving businessmen excessive expenses involved in trips to Washington or the Wright-Patterson Air Force Base at Dayton, Ohio.

Under the direction of Brig. Gen. Nelson S. Talbott, Dayton industrialist who was recalled to active duty to head the organization, the interlocking chain of field offices can provide a real savings to present and potential contractors if they will avail themselves of the services at each office. General Talbott has incorporated into the present system a practical knowledge of operations gleaned from World War II service.

▶ **Start at Home**—The newcomer to the ranks of Air Force suppliers should make the nearest Regional office his first stop. There, he will be channeled into the Contractors Relations office where he can obtain information on current procurements. If he is in the small business category, he will find a Small Business Officer ready to counsel him.

Those firms already holding contracts with the Air Force also find the Regional office a "must" place.

To begin with, the nearest Regional office has the responsibility of administering his contract in all its phases. Quality Control personnel check his inspection set-up to be sure that it functions in accordance with Air Force standards. They also conduct the inspection of finished products.

Production Resources personnel are available for conferences on materials, machinery, manpower and facilities needed in the execution of contracts.

Representatives of the Procurement Division are on hand for discussion and action on myriad factors influncing contractual obligations.

▶ **Quicker Pay**—Equally important is the fact that the six District offices now have installed finance offices that take care of disbursements, whether they are partial payments or final remuneration at the conclusion of a contract.

Some insight on the extent of operations in the field offices is gained from figures released by AMC headquarters which reveal that of the 12,000 employees, military and civilian, assigned to Procurement and Industrial Planning, approximately 9,000 are assigned to field offices.

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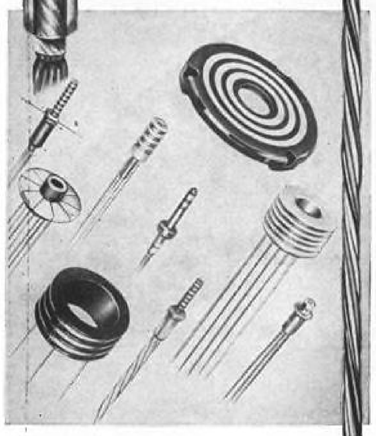
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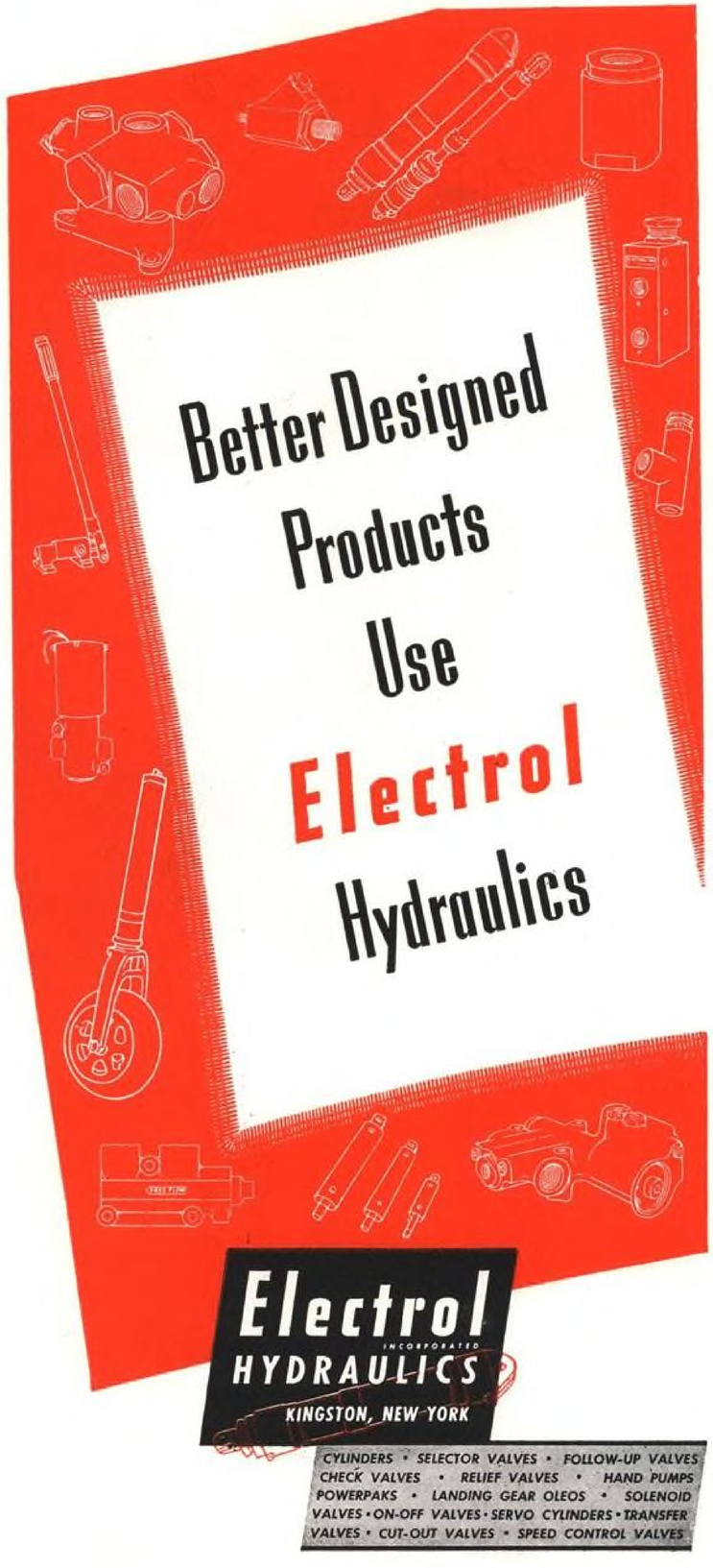
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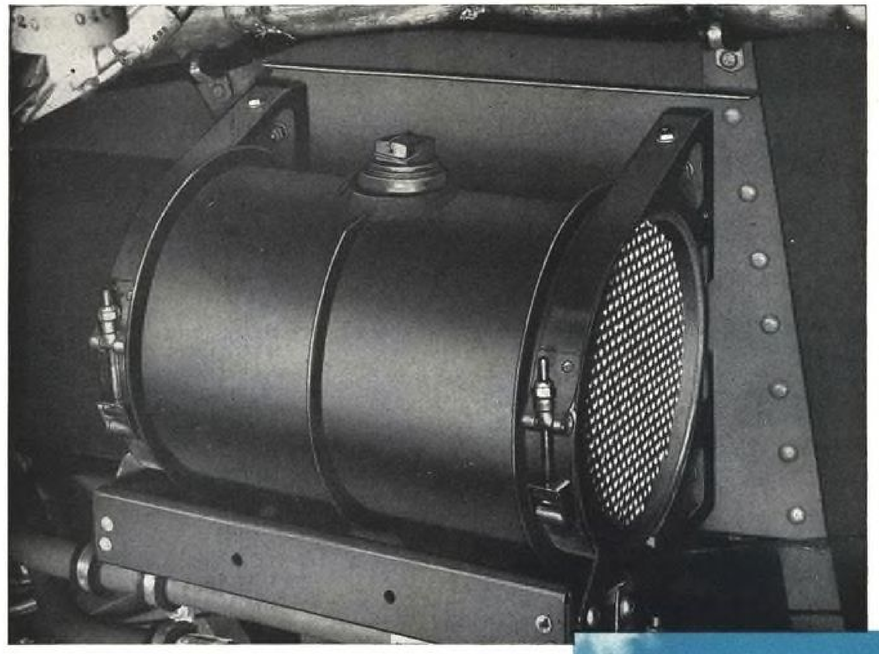
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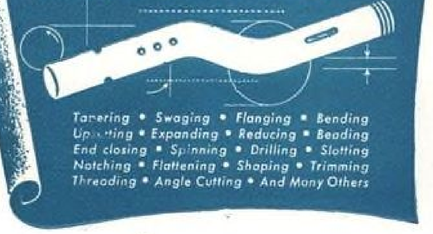
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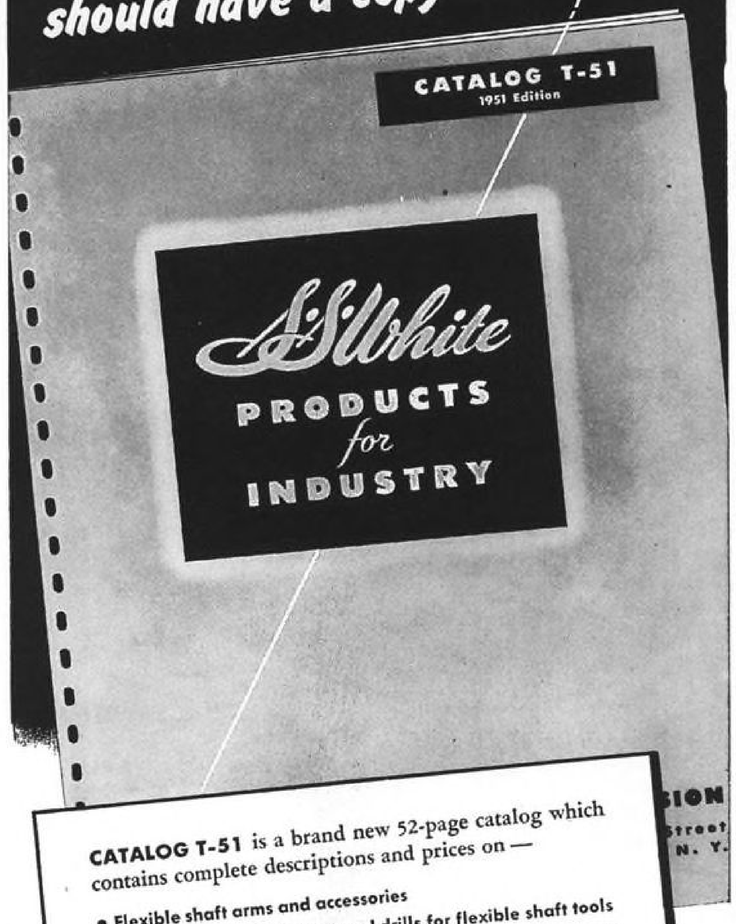
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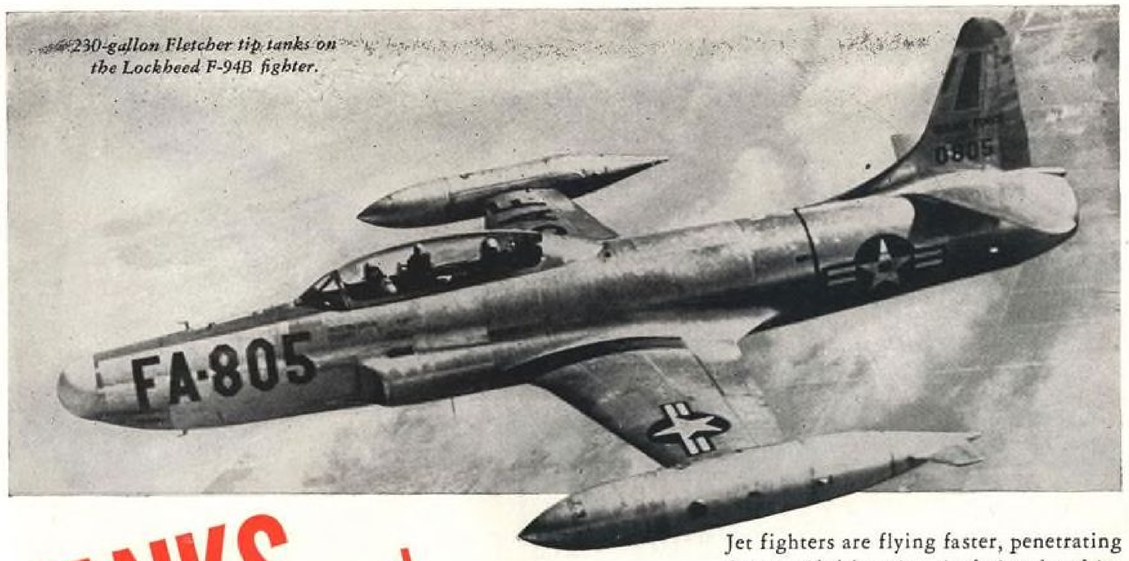
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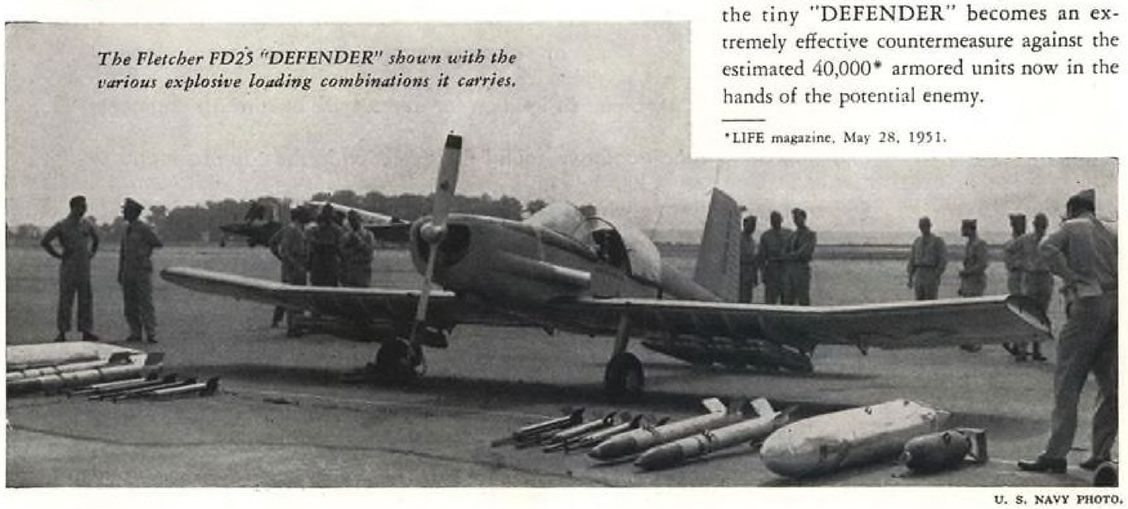
230-gallon Fletcher tip tanks on the Lockheed F-94B fighter.

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*LIFE magazine, May 28, 1951.


The Fletcher FD25 "DEFENDER" shown with the various explosive loading combinations it carries.

U. S. NAVY PHOTO.

Fletcher Aviation Corporation

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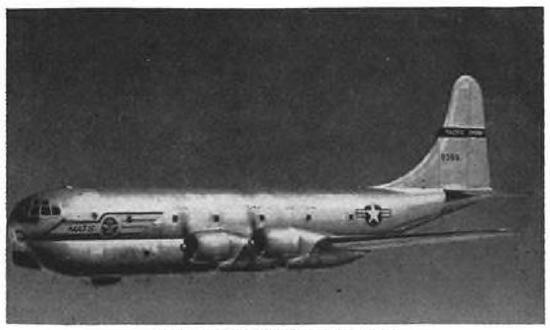
Putting Wings on the World

Aircraft the Air Force Buys . . .


Consolidated Vultee B-36D


Boeing B-47A Stratojet


Fairchild C-119C Packet

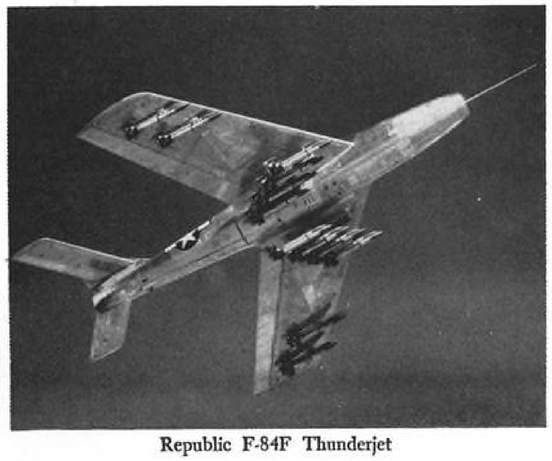

Boeing C-97A Stratofreighter



Republic F-84E Thunderjet

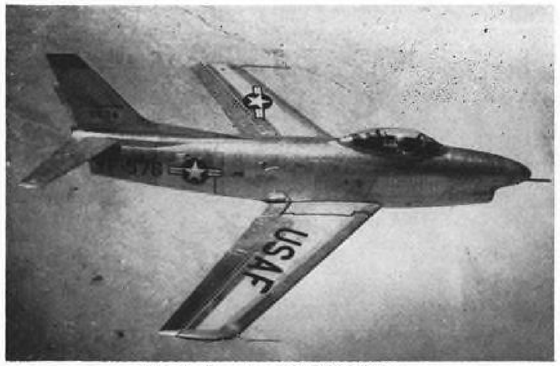


North American T-28A


Republic F-84F Thunderjet


Northrop F-89A Scorpion

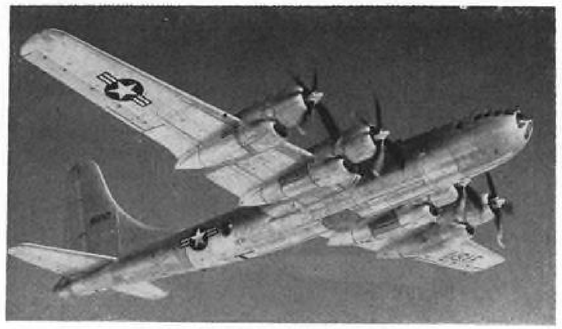
Aircraft the Air Force Buys . . .



North American YF-86D Sabre



North American F-86E Sabre



Boeing B-50D Superfortress



Martin-English Electric B-57A Canberra



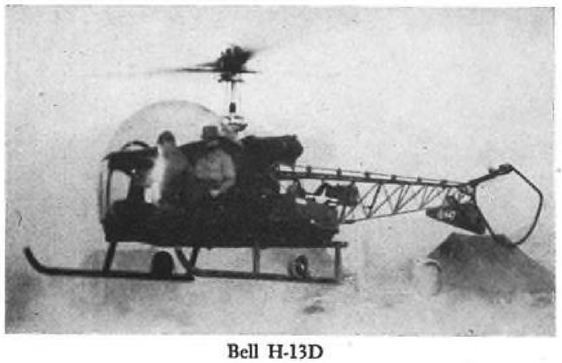
Sikorsky YH-18A



Sikorsky H-19



Piasecki XH-21



Bell H-13D





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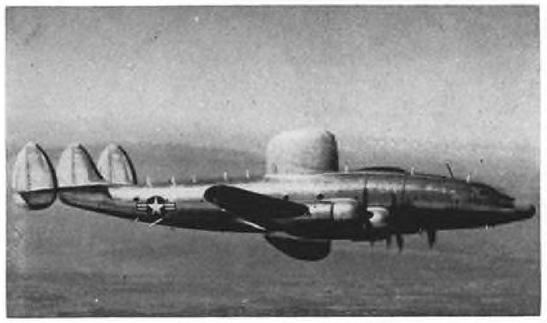
Aircraft the Navy Is Buying . . .



Vought F4U-5 Corsair



Grumman AF-2W Guardian



Lockheed PO-1W



Grumman AF-2S Guardian



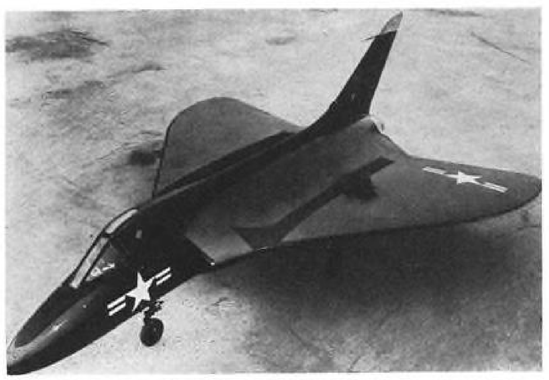
Hiller HTE-1



Douglas XA2D-1 Skyshark



Bell HTL-3



Douglas XF4D-1 Skyray

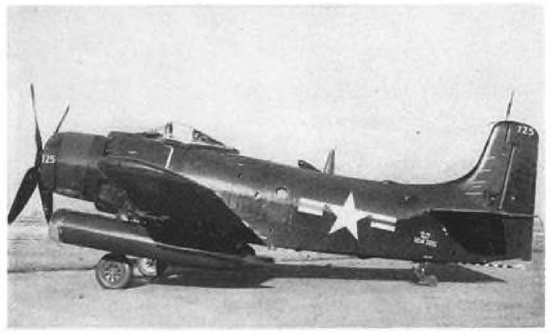
Aircraft the Navy Is Buying . . .



McDonnell F2H-2 Banshee



McDonnell F2H-2N Banshee



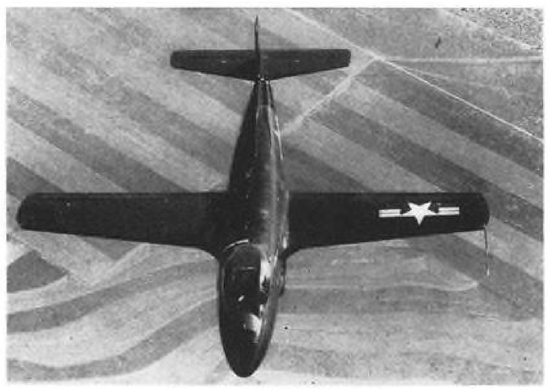
Douglas AD-4N Skyraider



Douglas R6D-1



Douglas AD-4W Skyraider



Douglas F3D-1 Skyknight



Piasecki HUP-1 Retriever



Bell XHSL-1

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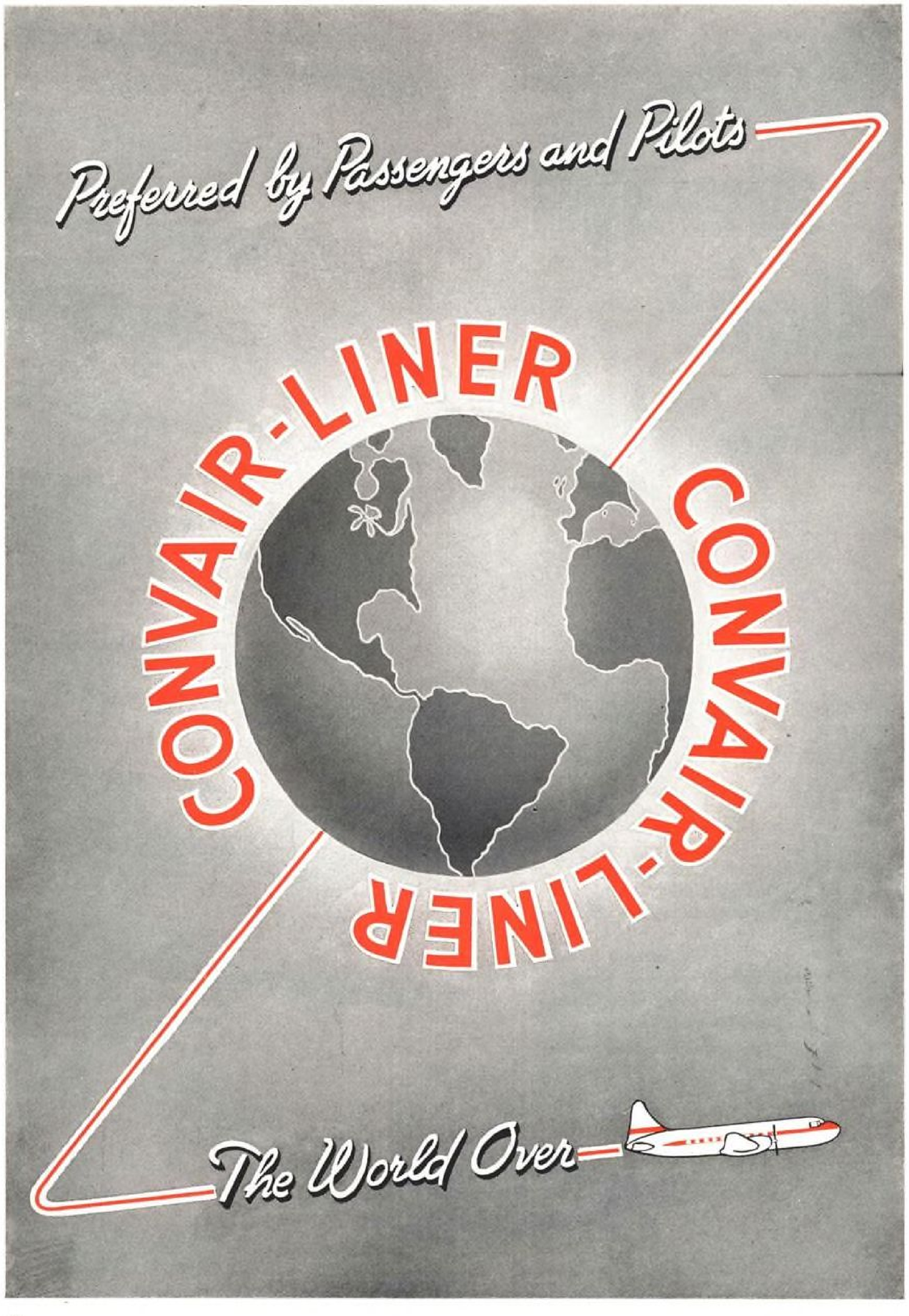
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Navy's Needs Changing With New Role

Production increase retarded until ships of the fleet are ready for the new types of aircraft.

• The Navy's role in warfare has changed. With no surface fleet to oppose it, Navy now finds its historic mission of keeping the sea lanes open means concentration on an air navy. • The kind of air navy is the question. The concept of building a navy around the carrier and keeping the sea lanes open with air power is still so new that Navy is proceeding with caution.

Aircraft production for Naval Aviation, though of urgent necessity, is geared to a somewhat slower rate than that of the Air Force, because its increase is dependent upon expansion of the fleet.

While contemplated 1952 budgets for aircraft production are scheduled to assure deliveries by December, 1953, that budgeting fails to modernize all of the Naval air arm.

These estimates call for an appropriation of $3,572,000,000 and would raise the current total operating aircraft inventory from approximately 8,700 aircraft for fleet and shore establishment to about 10,000. An additional $925,393,000 is scheduled for operating programs including research and development, while another $450,000,000 is scheduled to finance prior contract authorizations or procurement. Total funds thus far scheduled in the 1952 budget for Naval aviation is $4,947,869,000.

1. Strength

The recently promised $5 billion increase in funds for procurement of aircraft, to be distributed between the Navy and the Air Force, will probably see about two-thirds going to USAF and one-third allotted to Navy air procurement. Such a division, informed Naval officials believe, would add approximately 1,500 aircraft to the active Naval air inventory by year-end 1953.

Today, while precise accounting of Naval air strength is classified, approximate strength based on previous appropriations would peg Naval air at about 12 to 15 air carrier groups and 50 patrol and anti-submarine squadrons in addition to some 20 marine air squadrons.

Increase to the Naval air arm as a result of the fiscal 1952 budget, plus the promised upward revision by at least $2 billion, would increase overall operating strength by year-end 1953 by about one-half its present strength.

Meanwhile, despite the urgency with which it is pressing for an overall increase in strength, the fleet air arm and supporting shore based patrol and anti-submarine squadrons are expanding on a firm but conservative basis.

Decision as to procurement of aircraft is being deferred pending evaluation of combat and production experience of existing programs. As an interim measure, Navy is meeting its current deficiencies by operating obsolescent models. Admittedly a risk, Navy feels it a well "calculated-risk" taken to insure that the aircraft which are ultimately ordered into major production will represent the most modern and the most effective types available.

As a result, Naval air appropriations are based upon a planned balance between limited effective forces comprised of modern aircraft and a mobilization potential which will serve as a "well-conceived base of departure".

2. Planes

From its 1952 funds Navy will order 24 aircraft types to round out its needs in seven different fields: attack, fighter, patrol, transport, utility, trainer and observation.

In the attack series Navy is asking for major production of the Douglas AD; the Grumman AF and the North American AJ.

To round out its fighter strength to currently contemplated June, 1952 levels, Bureau of Aeronautics is ordering production of the Douglas F3D and F4D; the Grumman F9F; the McDonnell F3H; the North American F2J and the Chance Vought F7U. Of these fighters the F4D Skyray, F3H Demon and the F7U Cutlass are designated as interceptors.

Only two patrol bombers are currently programmed for delivery out of fiscal 1952 funds—the Lockheed P2V and Martin P5M. The former is land-based while the P5M is a flying boat.

In the transport field, Navy has committed funds to assure production of four transport types, three of which are land-based and one a water-based transport. The land-based transports, all of which have been ordered in moderate quantities, are the Douglas R6B (Naval designation for the DC-6B); the Lockheed R7O (Naval designation of the Super Constellation); and the Fairchild R4Q (Naval designation of the C-119).

Water-based transport which is to be ordered into production is the Convair R3Y turbo prop flying boat. Navy officials consider the Convair flying boat as the largest flying boat type contemplated by the service for some years to come.

In the fixed-wing trainer field, Navy is continuing production only on the Lockheed TO2 (Naval designation for the T-33) jet trainer. Considerable number of helicopter aircraft, however, are scheduled for training service.

In the utility transport field the only craft in continuing production from fiscal '52 funds is the Grumman UF Albatross.

Continuing exploitation of lighter-than-air craft for the role of submarine detection and coast patrol, Navy is continuing production of the Goodyear ZP4K blimp.

Evidencing its continuing faith in the helicopter for a variety of missions, including observation, training, utility transport and air-sea rescue, Navy is asking for vastly increased production of six types of helicopters.

These are the Piasecki HUP; Hiller HTE, Bell HTL; Sikorsky HO5S and HRS; and the Kaman HOK.

3. Plans

Following World War II, the United States Navy possessed the largest fleet the world had ever known. Today, as tonnage of its vessels continues to increase, Navy has a two-ocean fleet, each equal to any navy in the world. Because the Russian Navy is a negligible force except for its large number of submarines, the role of the United States Navy in future combat is considerably altered from that of World War II. It will not be called upon to engage an enemy surface Navy for the potential enemy has none. Therefore, the battleship, backbone of the pre-World War II Navy is relegated to a secondary place in the present Navy planning.

As a result, new strategy of the Navy is air power. The carrier has become the major ship. All other fleet units are there for its support and to provide



Vought F7U-1 Cutlass



Grumman UF-1 (SA-16A) Albatross



Lockheed P2V-5 Neptune



North American AJ-1 Savage



Martin P4M-1 Mercator



Martin P5M-1 Marlin

logistical support for the Army and the Air Force.

To satisfy this role, chief mission of the Navy is anti-submarine warfare. The problem is keeping open the supply lines to overseas establishments of the Army and the Air Force, and all others are subordinate.

In keeping with its prime role of maintaining the sea lanes, Navy is nonetheless exploiting the long-range capabilities of its patrol bombers. These aircraft are fully capable of carrying the atomic bomb and could easily augment the Strategic Air Command of USAF should it be called upon to do so.

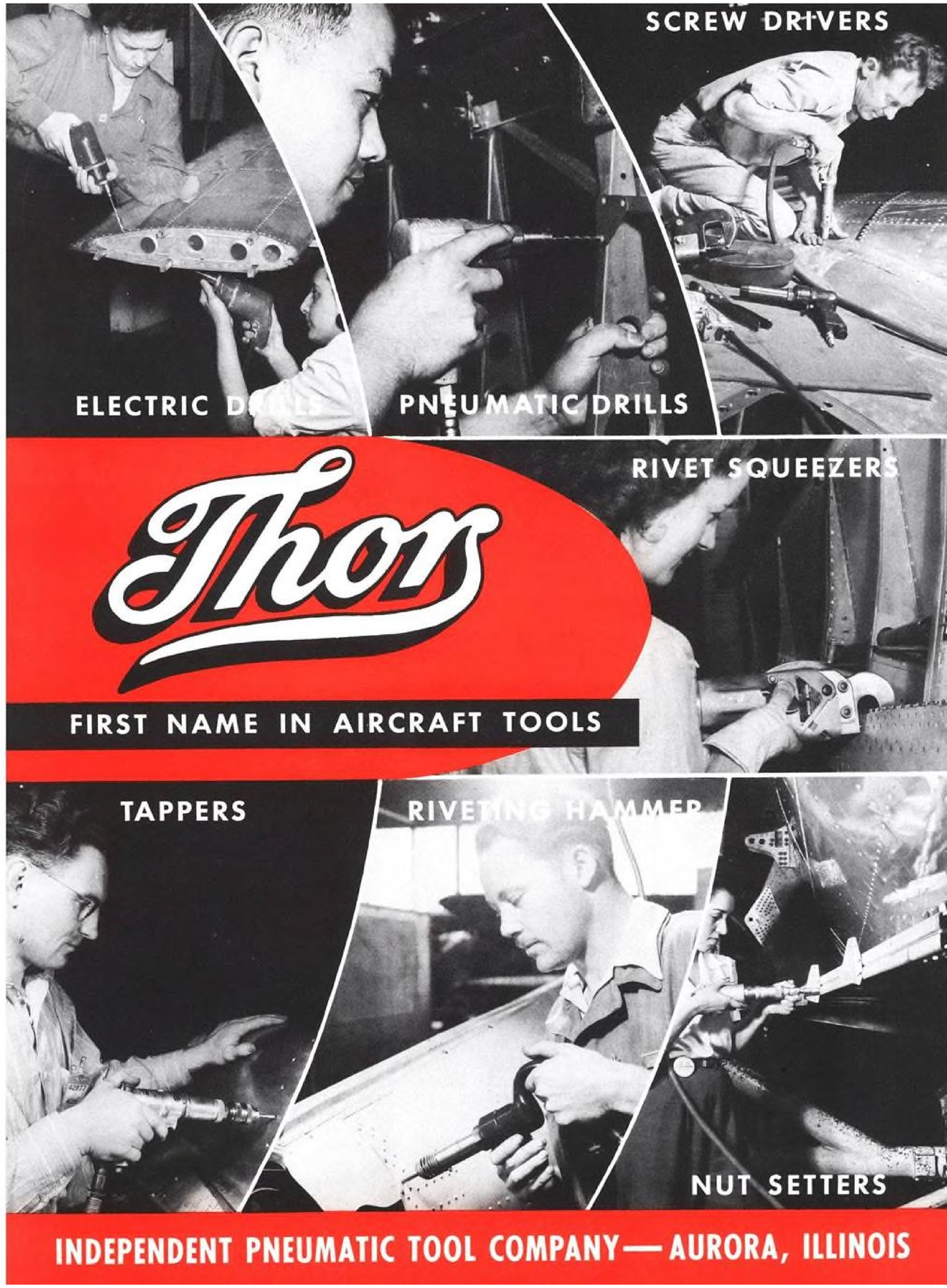
▶ **Powerplant Development**—The Navy is pressing development of the turboprop powerplant with considerable more urgency than is Air Force. The engine, with its capability for yanking a carrier-borne craft off the deck after a short run, is phenomenal. Additional value of the turboprop to Navy is its considerable better fuel economies for horsepower delivered over the turbojet, and increase to range and endurance.

Navy officials estimate that all of its transport and utility types, as well as many of its attack and bomber types, will convert to turboprop configuration as soon as the engine becomes practicable for all-out production. In fact, say some Navy officials, the turbojet will be the powerplant only for shipboard fighters and interceptors.

With Naval aircraft gross weights continually on the increase, the Bureau of Ships is continuing modification of aircraft carriers to meet the needs of the newcomers. Several carriers of the Essex class have already been equipped with strengthened flight decks.

▶ **Guided Missiles**—The Navy, as well as the Air Force, has diverted huge sums of money to the development of guided missiles. Navy development of these weapons has been primarily to exploit its anti-submarine role. Two types of surface-to-subsurface and air-to-subsurface missiles are in production and are now being delivered to the fleet for service test.

Ship-to-shore guided missiles are in advanced development stages and Navy is asking for production of this type for continued service tests this year.



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5 models available—"C" type yoke and four alligator type, providing reach of 3", 5", 7" or 9 1/8" for applications where it is necessary to reach considerably beyond the edge of the sheet and still clear obstructions. Capacities to 5/32" dural, aluminum or steel rivets.

Thor


Grip Handle
Offset Handle
Button Handle



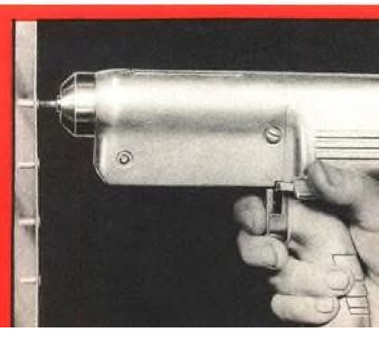
RIVETING HAMMERS

Thor offers a complete range of extra light riveting hammers especially developed for aircraft production . . . slow hitting or fast hitting . . . bore and stroke for every requirement . . . handle style to suit every need. Complete line of aircraft rivet sets, chisels and blanks.



Thor
RIVNUT DRIVER

Completely automatic power driver for installation of Rivnuts (manufactured by B. F. Goodrich Co.) Capacity to No. 10x32 aluminum rivnuts. Single trigger runs mandrel in, upsets rivnut, backs mandrel out and stops machine.



4 COMPLETE TOOL LINES — Thor — SERVING EVERY INDUSTRIAL NEED

In addition to the basic aircraft production tools—drills and riveting equipment—Thor manufactures over 1500 other portable power tools for every production and maintenance requirement. Four basic types are available: Industrial Pneumatic, Universal Electric, High Frequency (180 and 360 cycle) Electric, and Contractors Pneumatic. Catalogs are available covering each line.

INDUSTRIAL PNEUMATIC



Impact Wrenches
1/4" to 1 1/4" Capacity



Screwdrivers and
Nut Setters
58 Models



Grinders, Sanders
Wire Brush Machines
Die Grinders
47 Models



Hammers
27 Models



Tappers
Capacity to 1/4"



Industrial Pneumatic
Catalog No. 52B

UNIVERSAL ELECTRIC



Impact Wrenches
3/8" and 5/8" Capacities



Screwdrivers, Nut-
Setters and Tappers
62 Models



Grinders, Sanders,
Polishers



Saws and Hammers



Complete Valve
Shop Equipment



Universal Electric
Catalog No .39

HIGH FREQUENCY ELECTRIC

(180 and 360 cycle)



Impact Wrenches
3/8" and 5/8" Capacities



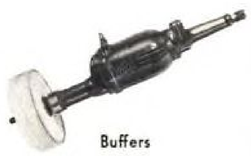
Screwdrivers and
Nut Setters
62 Models



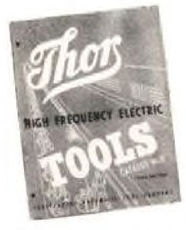
Grinders



Sanders and
Polishers

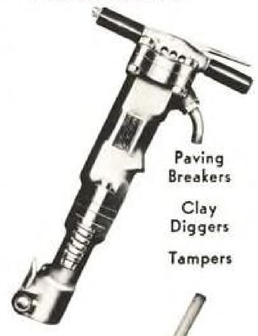


Buffers



High Frequency Electric
Catalog No. 61

CONTRACTORS PNEUMATIC



Paving
Breakers

Clay
Diggers

Tampers



Sump
Pumps



Rock
Drills



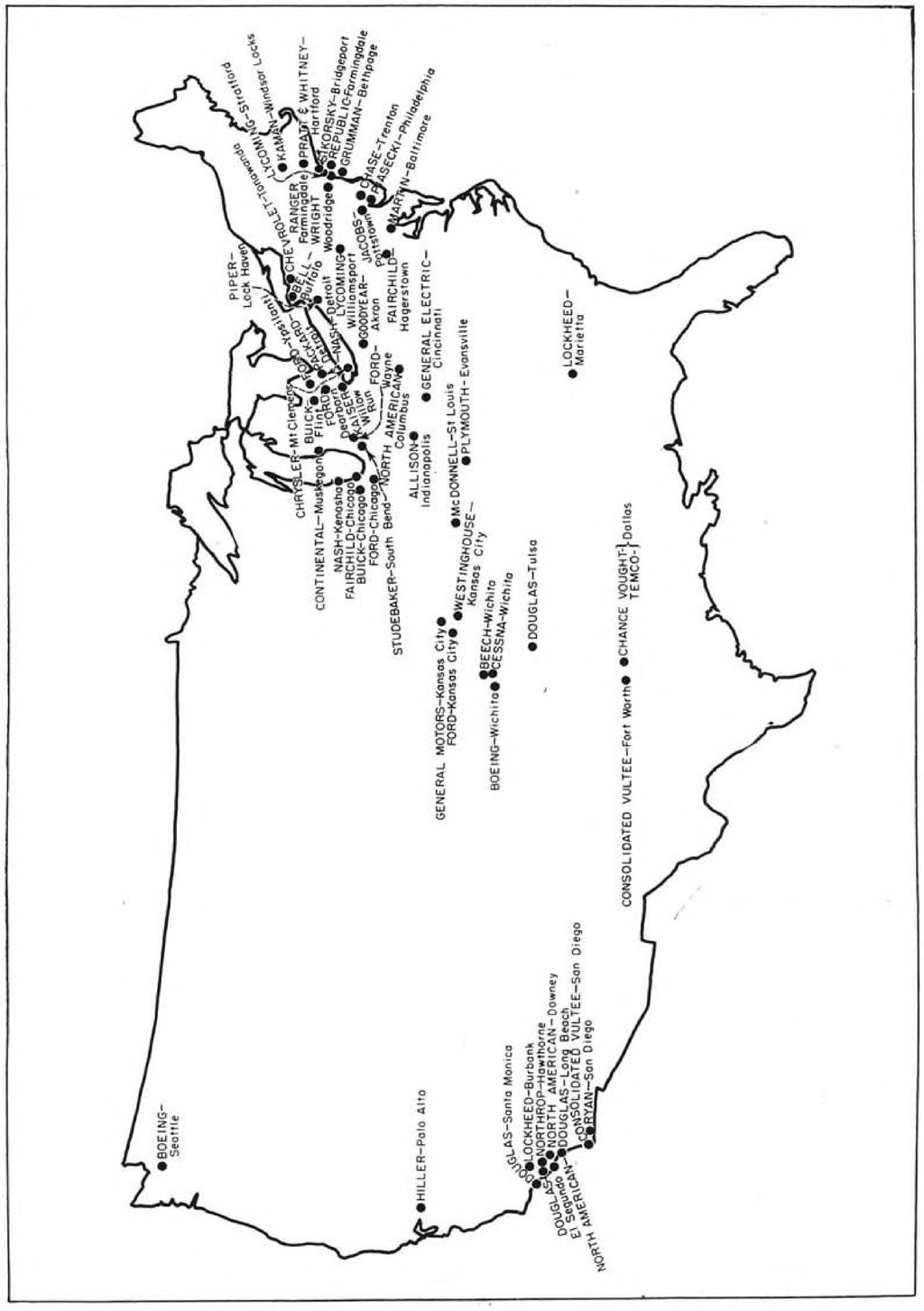
Contractors Pneumatic
Catalog No. 43

INDEPENDENT PNEUMATIC TOOL COMPANY — AURORA, ILLINOIS

EXPORT DIVISION—330 West 42nd St., NEW YORK, N. Y.—Cable Address THORTOOLS

BIRMINGHAM, ALA. CLEVELAND, OHIO MILWAUKEE, WIS. ST. PAUL, MINN.
LONDON, ENGLAND BOSTON, MASS. DENVER, COLO. NEW YORK (L. I.) N. Y.
SALT LAKE CITY, UTAH SAO PAULO, BRAZIL BUFFALO, N. Y. DETROIT, MICH.
PHILADELPHIA, PA. SAN FRANCISCO, CAL. TORONTO, ONT. CHICAGO, ILL.
HOUSTON, TEXAS PITTSBURGH, PA. SEATTLE, WASH. CINCINNATI, OHIO
LOS ANGELES, CALIF. ST. LOUIS, MO.

The Airframe Producers

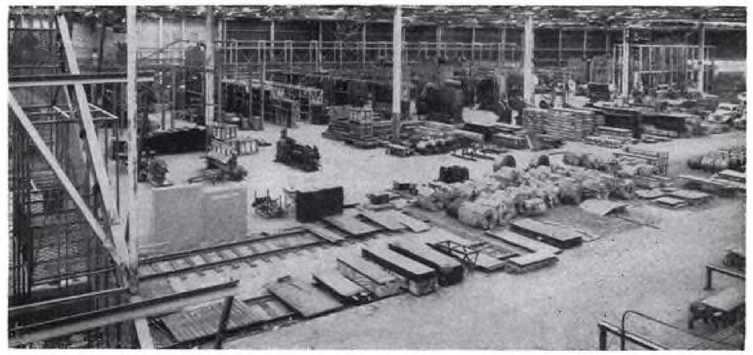


AIRCRAFT MANUFACTURERS . . Page 56
AUTOMOTIVE MANUFACTURERS. Page 86
AVIONIC MANUFACTURE . . . . . Page 101
GUIDED MISSILE MANUFACTURE . . . . . Page 125

Progress Report on Expanding Production

Essentials for higher output at hand, if properly put to use.

- **Your theoretical production capacity on any given date is your actual production on that same date. You can't hoard everything that goes to make up capacity.**
- **You can expand your capacity to produce; but if war comes you can't expand production over night. When you talk of production for air power, you mean production today.**
- **And production now—this year—will be less than 5,000 planes.**



COLUMBUS PLANT of North American is one reserve facility going back to work.

By Rudolf Modley

Two tasks have been given the aircraft industry by the President of the United States:

• **The first one** is to increase our air forces in being rapidly.

The objective is fairly clearly spelled out in dollar values and in number of airplanes.

Appropriations for aircraft procurement, for instance, are expected to increase from $2.1 billion in fiscal year 1950 and $11.3 billion in 1951 to $14.7 billion in 1952.

In submitting their estimated requirements to Congress, the military services tell just how many airplanes they expect to buy. Thus, the 1952 budget was to provide for 8,696 aircraft for the Air Force, 3,092 of which had been authorized in the previous fiscal year. Generally, the bulk of orders is delivered in the year following the year in which they are ordered.

Another indication as to just how many airplanes this country needs is given in the Congressional and public debate on the size of the U. S. Air Force. We have moved from a 48-group program to a 95-wing program and a 130-wing Air Force is now under serious consideration. The number of planes per group varies from 30 to 75 and the total number which such Air Forces would require can be calculated.

The objective of our production build-up is, therefore, fairly well known. The public expects that peak production will be reached some time in 1952 or 1953 and level off from there. If the Air Force expansion is carried out it may take well into 1954 or even longer before the new objectives can be reached. Nevertheless, the Department of Defense does not permit publication of monthly production data for military aircraft in any form. There are no more figures on numbers of planes produced, none on airframe weight produced and none on value of shipments.

Students, therefore, have to make estimates on the basis of production figures available before the "blackout," on the basis of known expansibility factors and on the basis of occasional isolated facts released by officials at various times. The report will develop some estimates of aircraft production on the basis of facts publicly known.

• **The second task** set by the President is the rapid expansion of our capacity for producing military aircraft. Here, the end objective appears to have been clearly stated. The President's 1951 Economic Message to Congress said: "Our present aircraft program calls for capacity to produce 50,000 planes a year." In further explanation it stated that we are not now placing orders for that many planes but "we are getting ready to produce them if we need them."

To build airplanes, three things are needed: facilities, materials, and men. The major problem with establishing aircraft production capacity is that these three elements can not be made ready and kept ready to equal degrees.

Materials such as aluminum can be produced and stockpiled.

Plants, as we shall see, may be kept in reserve to a considerable extent. However, the constant changes in modern aircraft call for special equipment which, in turn, requires special machines. These machines become obsolete as they get older—even if they have never been used. Newer and better machines must take their place. And in time even plants become less suitable to fit production of new types of airplanes. (AVIATION WEEK, July 7, p.37.)

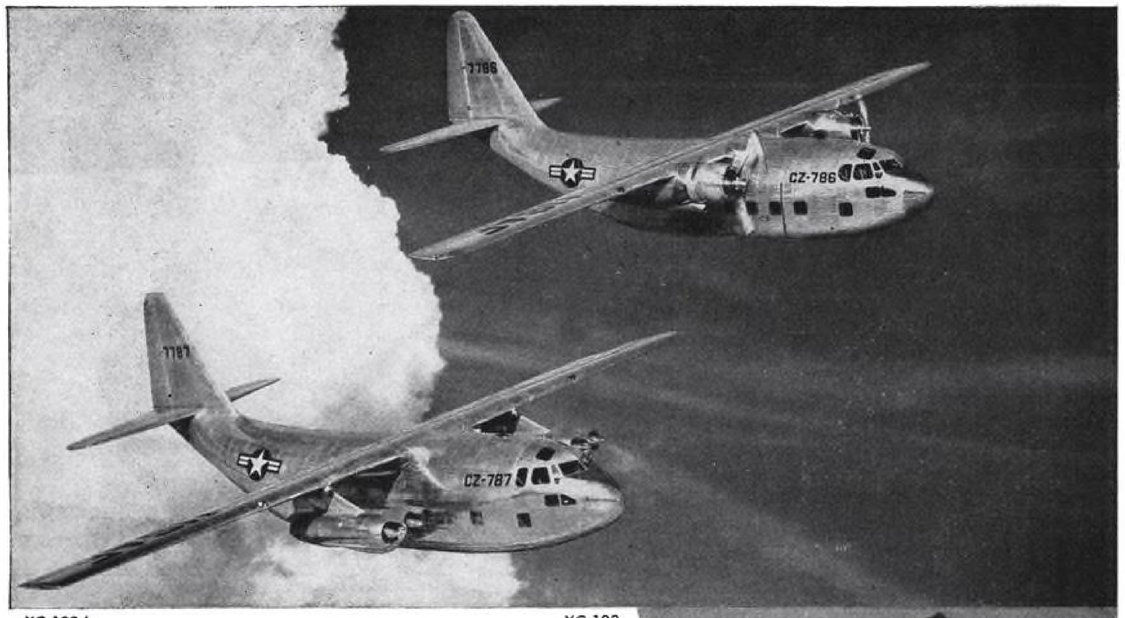
Manpower, of course, can be "hoarded" only at very high cost in money and morale.

▶ **Capacity Is Production**—Any claim that this country will have a 50,000 plane capacity—or any other capacity, for that matter—deserves critical scrutiny. Such claims are usually based on assumptions which hardly ever come true. One such assumption is that sufficient material will be available. In an emergency it almost never is. The other assumption may be that there will be sufficient supply of qualified labor. There never is.

Thus, true capacity is frequently not much above the current actual production and any expansion of that capacity towards the theoretical capacity takes plenty of sweat and tears. To be really usable any such "capacity" statement should be tied to a time limit, such as "50,000 planes per year *within six months*" after the "all-out signal is given."

"Production capacity" in case of a sudden war will, for quite a few months, differ very little from actual production. This is likely to be true in spite of a very concentrated effort by the military to "have a capacity of twice the production now scheduled."

This failure of theoretical capacity to differ from actual production is quite readily apparent from Under Secretary McCone's remark that "if we can put in the hands of the North American Aviation company all (sic!) of the material they need to build the famous F-86 jet Sabre in six months' time as contrasted with the present 12 or 14 months' time, we have made it possible



XC-123A XC-123

..for OUTSTANDING Engineering Achievement...

To meet the ever increasing need for rapid, efficient transport of troops and cargo into forward combat areas, Chase Aircraft in cooperation with the U. S. Air Force developed the C-123.

Combining the most rugged design features with utmost in passenger and crew safety, this plane came out on top in most gruelling Air Force evaluation tests last Fall — performing sucessfully both as glider and piston powered plane.

Michael Stroukoff, designer of the plane, then proposed installation of jet power on the glider version. The Air Force approved and the first American developed jet transport was born — first time in the history of aviation that one airframe design had flown as a glider, with piston power and jet power.



For this outstanding engineering achievement the New Jersey Wing of the Air Force Association presented to Mr. Stroukoff their 1951 Airpower Award.

Chase AIRCRAFT CO., Inc.
WEST TRENTON, NEW JERSEY
STROUKOFF AVITRUC



G-STRING for a GIANT

When the bomb bay doors of the giant CONVAIR B-36D snap shut, a thin extruded rubber section provides a positive seal. Fabricated by **STALWART,** this small component of the world's mightiest bomber has great demands made upon it.

The seal must perform its operational function in spite of continual abrasion, ozone and an extremely wide range of temperatures. In addition, it must withstand extreme weathering and temporary contact with oils and grease.

To meet these exacting requirements, **STALWART** used Dow Corning Silicone rubber No. 250. This new synthetic will withstand temperatures ranging from —110° to +400° F., and it features greater tensile strength than other Silicone rubbers as well as good elongation.

The little **G-STRING FOR A GIANT** is another outstanding example of **STALWART's** ability to convert the desirable characteristics of special rubber stocks into precision production parts for the aviation, automotive, machine tool, electrical, chemical processing and other original equipment industries.

For complete data on Stalwart's services, write today for 16-pg. **CATALOG 51SR-1.**

STALWART RUBBER COMPANY

310-SR

9362 NORTHFIELD ROAD • BEDFORD, OHIO

for North American to accelerate their production enormously."

Note that the time is still six months and that the IF is a very big one. Production one or two months after the outbreak of war is likely to be not much more than it will be on that day.

The above is not said in any way to belittle the effort now being made to have more plants, more tooling, more material, and more men ready. It is only a warning that on the day we have to go to war, our theoretical production capacity will about equal our actual production on the same day. Sabotage or bombing could actually make it lower. A detailed analysis of the major factors which further or hamper the production of aircraft is necessary to lead up to an estimate of 1951 aircraft production. These major factors are:

- **Facilities** which, in turn, are made up of plant; and machinery and equipment.
- **Materials together with machinery** are of vital importance not only to the aircraft industry but also to the evergrowing number of subcontractors. The time consumed by the aircraft industry and its suppliers to round up the raw and basic materials and supplies and to fabricate and assemble an airplane leads to the crucial problem of
- **Lead time and flow time** which is so much talked about today.
- **Manpower,** of course, is an essential element of any discussion of production. Several factors require analysis. They may roughly be broken down into company management; employment; working shifts and overtime; and several other factors.

And, finally, there is the question of the efficiency of

- **Government organization** and how it is set up to handle the problems.

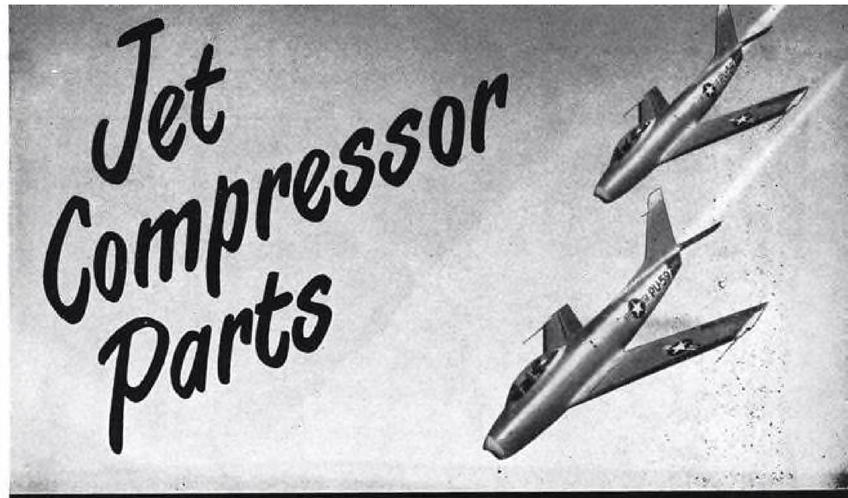
1. Facilities

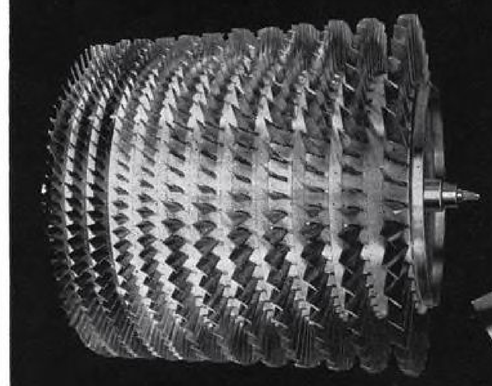
►**The plants**—Of all the thing needed to build more airplanes, it is the plants—the brick and mortar part of production facilities—which are the smallest problem.

If we assume somewhat more than 60 million square feet of floor space for the major airframe manufacturers and a possible output of 9 to 10 pounds of airframe weight per square foot per year, our plants are sufficient to produce about 550-600 million pounds of airframe weight. This weight, translated into airplanes of about 12,500 pounds, comes close to the capacity of 50,000 planes per year asked by the President. With a few exceptions noted below, it is more than sufficient for our present and planned actual production.

Some new construction will be re-

(Continued on p. 63)





Above: **Complete rotor assembly for turbojet engine, manufactured by the Robbins Engineering Company.**

Below: **Compressor blades for turbojet aircraft engines. Robbins Engineering specializes in the production of rotor components and complete rotor assemblies.**



Machined and Assembled to Rigid Specifications

The machining of jet compressor parts and the assembly of complete rotor units require an organization having specialized tooling and inspection equipment and plenty of aircraft know-how. Turbojet engine builders are enthusiastic about the work of the Robbins Engineering Company, a subsidiary of Ex-Cell-O Corporation.

The Robbins organization is cooperating whole-heartedly with the program to build up air power for the defense of our country. All its efforts will be directed toward this end in the present emergency.

ROBBINS ENGINEERING COMPANY
Subsidiary of
EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN

51-20

U. S. Aircraft Industry*

Company	Location	Plant Area Sq. Ft.	Number Production Workers	Total Employment	Number Women Workers	Backlog
Aeroproducts Div.—GM	Vandalia, Ohio	446,600	1,221	2,007	210	N.A.
Allison Div.—GM	Indianapolis, Ind.	4,000,000	10,000	14,000	1,250	$650,000,000
Beech Aircraft Corp.	Wichita, Kan.	1,329,182	7,060	7,300	1,400	100,000,000
Bell Aircraft Corp.	Buffalo, N. Y.	2,125,000	4,450	11,000	838	375,000,000
Boeing Airplane Co.	Seattle-Renton, Wash.	5,472,893	11,639	27,750	5,550	1,000,000,000+
	Wichita, Kan.	3,218,175	13,338	22,500	3,737	
Cessna Aircraft Co.	Wichita, Kan.	540,000	1,708	3,000	575	80,000,000
	Hutchinson, Kan.	135,000	260	400	25	
	Prospect, Kan.	160,000	371	600	50	
Chase Aircraft Co.	West Trenton, N. J.	4,100,000[1]	7,500[2]			100,000,000
Consolidated Vultee Aircraft Corp.	San Diego, Calif.	3,274,432	12,429	18,100	4,840	516,000,000[3]
	Guided Missle Div. San Diego, Calif.	238,975	167	745	179	
	Ft. Worth Texas	4,115,948	20,090	30,100	4,650	
Curtiss-Wright Corp.	Caldwell, N. J.	800,000[4]		4,500[4]		1,100,000,000[17]
	Wood-Ridge, N. J.	2,827,550[4]				
Douglas Aircraft Co.	Santa Monica, Calif.	2,622,403	12,853	14,479	3,628	1,000,000,000+[5]
	El Segundo, Calif.	1,750,095	8,733	9,796	1,739	
	Long Beach, Calif.	2,099,665	11,312	11,921	2,374	
	Tulsa, Okla.	2,041,401	1,421	1,528	286	
Fairchild E & A Corp.	Hagerstown, Md.	965,058	4,335	6,000	1,392	N.A.
	Long Island, N. Y.	1,000,000[6]	N.A.	2,300	None	
General Electric Co. (Aircraft Gas Turbine Div.)	West Lynn, Mass.	737,000		5,870		N.A.
	Everett, Mass.	239,000				
	Lockland, Ohio	4,000,000[6]		10,000[8]		
Grumman Aircraft Engineering Corp.	Bethpage, N. Y.	1,523,685[4]		6,800[8]		713,517,000[17]
Hiller Helicopters, Inc.	Palo Alto, Calif.	110,000[7]		800[8]		20,000,000
Kaman Aircraft Corp.	Windsor Locks, Conn.	98,000	300	600	90	18,000,000
Lockheed Aircraft Corp.	Burbank, Calif.	11,053,000	11,730[9]	25,826[9]	4,736[9]	845,438,000[16]
	Marietta, Ga.	4,371,000		5,012		
Glenn L. Martin Co.	Middle River, Md.	3,000,000	10,000	18,500	3,700	400,000,000+
McDonnell Aircraft Corp.	St. Louis, Mo.	1,590,711		8,424	686	275,000,000
North American Aviation, Inc.	Los Angeles, Calif.	3,116,773	10,350	16,466	2,539	510,207,542[14]
	Long Beach, Calif.	696,482	2,246	2,031	173	
	Downey, Calif.	996,500	1,711	5,579	783	
	Columbus, Ohio	2,500,000	5,820	7,299		
Northrop Aircraft, Inc.	Hawthorne, Calif.	1,510,000[11]	5,900	13,000	2,800	255,000,000
Piasecki Helicopter Corp.	Norton, Pa.	315,000[12]	1,800	3,000	350	125,000,000[12]
Republic Aviation, Inc.	Farmingdale, N. Y.	1,660,000[14]	9,696	15,400	1,400	550,000,000
Ryan Aeronautical Corp.	San Diego, Calif.	730,000[15]		3,200	800	42,000,000
United Aircraft Corp.	Pratt & Whitney Div.	4,421,000	16,700	22,000		1,185,000,000[16]
	East Hartford, Conn. (Hamilton Std. Div)	502,000	2,700	3,800		
	Dallas, Texas (Chance Vought)	2,128,000	4,700	7,300		
	Bridgeport, Conn. (Sikorsky Div.)	327,000	1,500	2,200		
TOTALS		88,797,528	214,058	371,133	51,290	$9,860,162,542

* Prime engine and airframe contractors for the services.
[1] Includes proposed additional construction in Trenton and space at Willow Run.
[2] Proposed.
[3] As of May 31, 1951.
[4] As published in AVIATION WEEK, Feb. 26, 1951.
[5] As of July 1, 1951.
[6] Estimated when expansion completed.
[7] Expects to have two plants by Dec. '51.
[8] Planned employment under future operations.
[9] Lockheed Aircraft Service included in total.
[10] As of June 30. Contracts for Marietta plant not included.
[11] Building expansion program in progress—will increase to nearly two million sq. ft.
[12] Additional 242,000 sq. ft. ready for use by Dec. '51.
[13] AVIATION WEEK estimate.
[14] Additional 86,000 sq. ft. to be available by Dec. '51.
[15] Production area.
[16] As of June 30, 1951.
[17] $625,000,000 of total is for letters of intent.



THIS IS
AMERICAN
PHILLIPS HEADquarters for
the Aviation Industry*

HERE'S YOUR TOP SOURCE FOR PRECISION FASTENINGS...

AMERICAN PHILLIPS SCREWS AND BOLTS

For high-speed, high-altitude aircraft, American produces close-tolerance screws and bolts of alloy steels, and A. N. fasteners of carbon steel, stainless steel, and selected brass and aluminum . . . to Air Force-Navy aeronautical standards.

The American Phillips Recess affords exceptional torquing strength, a feature which . . . added to precision manufacture and quality control . . . gives to all American products (like the screw shown above) accuracy of countersink angle, head thickness, and concentricity. This is American's contribution to uniform flushness in assembly.

. . . and "HI-SHEAR"* RIVET PINS

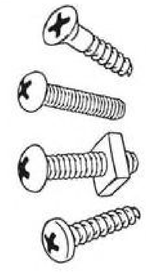
These rugged fasteners are made by American in alloy steels, to closest tolerances and highest standards of physical quality.

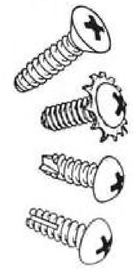
So on *any* of your fastening problems, it pays to "*ask American first,*" for then you get the know-how of American engineers and research experts . . . plus the modern facilities of one of the industry's high-volume production plants.

*Trademark Reg. U. S. Pat. Off.



AMERICAN SCREW COMPANY
PHILLIPS HEADquarters
WILLIMANTIC, CONNECTICUT





MARLOW pumps picked for important plane refueling service!



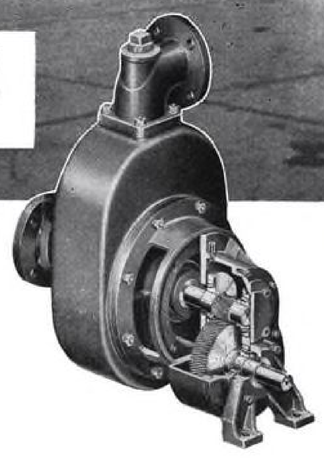
With a MARLOW Type G Power Take-Off Tank Truck Pump, Standard Oil Company of Kentucky refuels this big Delta Airlines plane quickly, easily, SURELY at the Atlanta, Georgia, airport.

Pump supplied by Equipment Sales Co., Atlanta, Ga.

At busy airports in Atlanta and seven other key cities in the southeast, Standard Oil Company (Kentucky) relies on Marlow Type G Self-Priming Centrifugals for refueling major airlines' planes.

Standard Oil, who knows plenty about petroleum products handling, finds the Marlow Type G Pump very satisfactory in performance and dependability. That's because Marlow engineers, in this pump design, have successfully converted truck engine idling speed to smooth, quiet, high capacity, *self-priming centrifugal operation* — the kind of pump operation that airlines and plane refuelers have so long sought.

Marlow's free-flow design and exclusive "diffuser" priming method enable this now famous Marlow to prime and purge itself automatically. It doesn't vapor lock. It has no auxiliary priming devices — nothing to get out of order. It can pump one compartment after another without attention. And Marlow's self-priming centrifugal eliminates rubbing surfaces and pumping system vibration . . . assurance of a long trouble-free life. Furthermore, the self-lubricating shaft seal — a Marlow exclusive — provides a safe, drip-proof closure. It's a pump that can't be beat for low maintenance.



An easily installed pump, it is the Marlow Type G's specially designed, built-in gear increaser that permits direct coupling to the truck's power take-off.

Take a tip from the seasoned veterans. Whether you're a major or independent, if you're interested in petroleum products handling, Marlow engineers will be glad to help you. Write for more facts.

MARLOW PUMPS

593 GREENWOOD AVENUE
RIDGEWOOD, NEW JERSEY

Manufacturers of the World's Largest Line of Petroleum Marketing Pumps

(*Continued from page 59*)

quired, particularly in the engine field. Other construction is required for flight testing, electronics buildings, office buildings, and plant dispersal.

But, in summary, plants are only a small problem in the production picture and except for a few sore spots plant capacity is probably sufficient for a production rate of 50,000 planes per year.

► **Machinery and Equipment**—The picture is entirely different when it comes to machinery. Here we find one of the most serious bottlenecks which holds aircraft production down.

This is due to several conditions.

While the plants that served in World War II can, by and large, serve again today, the machines which were usable in World War II are largely obsolete today. Today's airplanes, with higher speeds, greater firepower, higher operational altitudes, greater bomb loads, and different powerplants require many machines which did not even exist five or six years ago.

But here, where the need is great, the supply is pitifully slow. It takes from 22 to 36 months to get some machine tools. The situation in the machine tool industry corresponds roughly with 1940. Only in August, 1951 did Charles E. Wilson announce a program to break the machine tool bottleneck. This program grants a 12% increase in base prices, installs "superpriorities," and promises steps to assure adequate manpower.

This program appears to be partly the result of the new Aircraft Production Board headed by Harold R. Boyer.

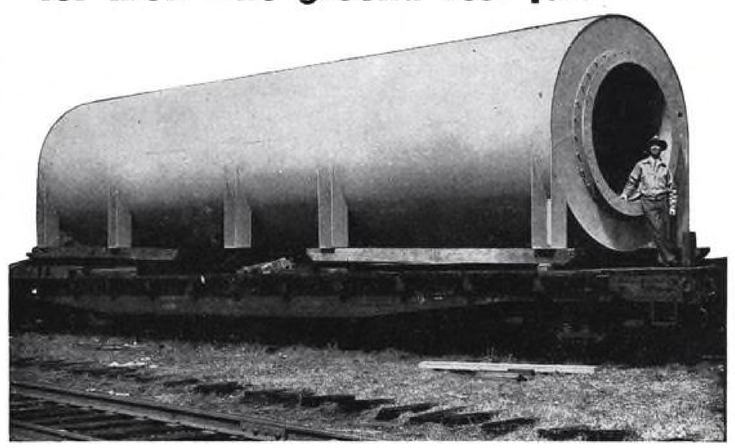
Until now, the lack of machine tools is reported to have kept the production of military aircraft more than 20% behind schedule. The effect of machine tool shortage appears more serious this time than it was during World War II. This is probably due to the fact that plants are available now while they were not in 1940 and 1941. In this way the shortage of machine tools is felt almost immediately.

The promised speed-up will take some time to materialize. Toolmakers predict a doubling of output within one year, possibly within six months, if subcontracting can be increased.

It is well to remember that machine tool shipments during World War II doubled between 1939 and 1940, and grew to almost seven times their 1939 size by 1942. This compares with a 1951 production only about 50% higher than 1950 and no higher than 1940.

The problems of the machine tool industry are largely due to the postwar shrinkage caused by the greatly increased number of machine tools in existence at the end of World War II. The industry now has to work extra

A CARLOAD OF COMFORT for men who ground-test jets



Here is another big Maxim Silencer ready to roll to the West Coast. Just as the one below is doing at the Lockheed plant in Burbank, this silencer will be used to eliminate the roar during jet run-up tests, so that the health and hearing of technicians can be protected during final adjustments and testing of the engine. Maxim is proud to have a part in making easier one of the great tasks undertaken by the aircraft industry today.





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shifts, work overtime and try to subcontract.

Without the release of most of the machine tools from the industrial mobilization reserve of about 37,000 machine tools, the shortage would be even more severe than it is today.

In both the airframe and engine industries the release of general purpose tools is not enough. In the airframe industry the need for very large fabrication equipment such as hydraulic presses and special purpose machines creates serious problems. And the engine industry is even more severely handicapped by equipment shortages.

In summary: General and special-purpose machine tools are a serious bottleneck. Slowness of machine tool delivery is delaying aircraft delivery schedules. Corrective steps are only now being introduced.

2. Materials

In World War II, materials did not become a serious problem for almost two years. It took that long until the facilities had been built and tooled up sufficiently to be able to consume materials at a rapid enough rate.

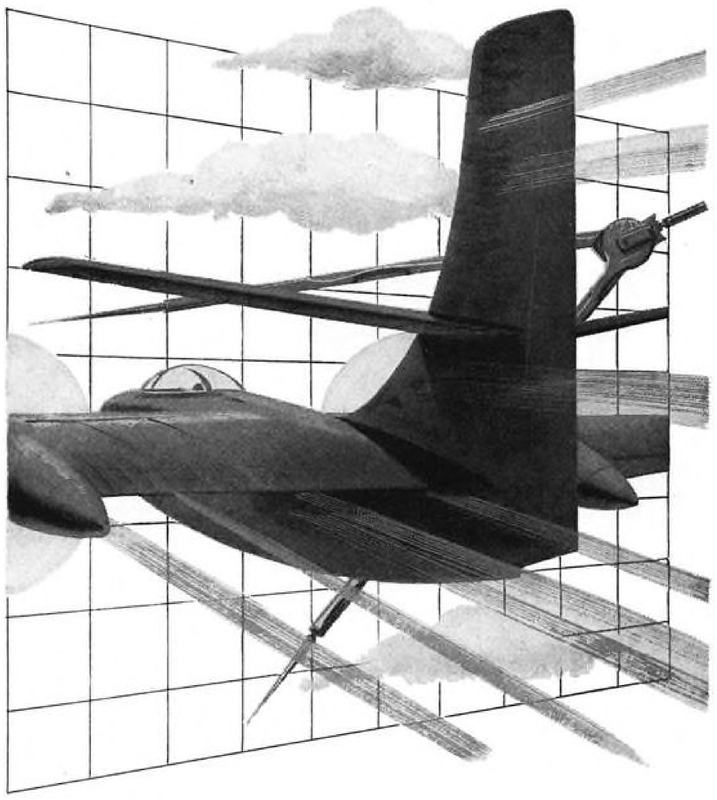
Today, with plants on hand and being tooled up at a fairly good rate the material problem has appeared earlier to plague us.

Material shortages may arise in an industry for several reasons. One may be that certain raw materials or products are not available to this nation in sufficient quantities. This, for instance, was true for natural rubber in the last war.

But material shortages may also beset an industry because the material, while on hand, is being taken away by others. Or worst of all, an industry can find itself short of material because it did not plan sufficiently well ahead to know its own requirements and failed to go out in time to get the materials it needed.

▶**The Past Helps**—With the World War II experience behind it and production requirements apparently spelled out more realistically, the aircraft industry can measure its own requirements better than last time. There should now be reliable bills of materials for each airplane and engine in production. And—within the limitations imposed by rapidly changing requirements—there should be more or less reliable schedules of monthly deliveries assigned to each manufacturer.

If the manufacturer knows his material requirements per unit and also knows the number of units which he is expected to deliver per month he can tell closely how much of what he will need at what time. Clear knowledge of material needs by the industry itself



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Products of over 60 years of Bristol pioneering in the field of precision instruments, they have proved their merit under exhaustive flight tests in extreme climates and at high altitudes.

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Thermoflex Blanket being applied to a jet engine exhaust cone. Special grooving assures precision-fit around cylindrical and conical surfaces . . . and allows for expansion at high temperatures.



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On one face of Thermoflex Blankets, the foil is specially grooved to insure precision fit around cylindrical and conical surfaces . . . and to allow for expansion due to intense heat without damage to the felt filler. To further assure proper fit, careful attention is given to the precise location of cutouts for mounting thermocouple leads, fuel, air, igniter and hydraulic lines . . . as well as actuator brackets, etc.

In addition to Thermoflex Blankets for insulating turbine casings, exhaust cones, afterburners and tail pipes of turbojet, turboprop and auxiliary power units . . . special preformed shapes are available to insulate, protect, and fireproof heating systems, de-icing ducts, fluid storage tanks, and many other assemblies.

For further information about Thermoflex Blankets, send for your copy of booklet AV-1A: "Johns-Manville Aviation Products." Address Johns-Manville, Box 290, New York 16, N. Y. In Canada: 199 Bay Street, Toronto, Ontario.

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will help the government control agencies in planning production of materials and in allocating them to the aircraft industry. There is little doubt that the industry, by now, knows very much better what it needs than it did in the early days of World War II.

It takes a lot of material to put one airplane into the air. Forgetting all the equipment furnished by the government—such as engines, propellers, and many other pieces of equipment—Lockheed consumes the following materials in producing a P2V which weighs about 25,000 lb. of airframe weight:

23,470 lb. of aluminum
15,000 lb. of steel and magnesium
2,540 lb. of rubber products
11½ mi. of electrical wiring
4,240 ft. of tubing

An all-weather fighter plane with an airframe weight of less than 10,000 pounds required 12,300 lb. of aluminum and 3,900 lb. of steel.

► **Control Faults**—The government appears better equipped to control the distribution of materials. Yet, the time span required for delivery of certain materials is much too long—and getting longer. While in some cases, such as aluminum forgings, this delay is partly due to lack to forge capacity, a good part of it is due to the inefficiency of material allocation by the government and the see-saw between civilian and military demands on materials.

The Controlled Materials Plan has been in effect less than three months and is not working too smoothly as yet. It applies to steel, aluminum, and copper only. Many other materials such as tungsten and cobalt are in 100% allocation control.

Competition between government agencies, conflicts of authority and constantly changing assignments of responsibility to different agencies are still a serious handicap to government product allocation control.

The problem is compounded by unrealistic government inventory limitations. Let us say a manufacturer gets an order for planes. His schedule calls for 140,000 lb. of aluminum sheet per month. The order is placed five months ahead of time to allow for delivery.

Within a few months it becomes apparent that one item of government furnished equipment is behind schedule. The entire schedule begins to slip. The item is expected to arrive any day—but will it? Should the manufacturer cancel all or part of his order for sheet? Can he possibly do it, considering all the thousands of items which are scheduled to arrive, and may arrive on time?

Should he send back his sheet or should he break one or more of the many inventory control regulations of NPA?

Adding to the manufacturers' prob-

UNBRAKO® SOCKET SCREW PRODUCTS

FLEXLOC® SELF-LOCKING NUTS



NAS SHEAR BOLTS . . . close tolerance, high strength, flush-head type. Dept. 678

STANDARD "SIX-DIGIT" ENGINE BOLTS . . . all listed diameters — hex and internal wrenching types . . . AN specifications . . . Information on request. Address Dept. 678.

"UNBRAKO" AND NAS INTERNAL WRENCHING AIRCRAFT BOLTS . . . latest NAS specs . . . threads fully formed by rolling after heat treatment . . . full range of sizes. Dept. 678.

HIGH-STRENGTH CLOSE-TOLERANCE FASTENERS for the AVIATION INDUSTRY

Several decades' experience in the manufacture of fasteners for the most critical applications is your assurance of complete reliability in every SPS Aircraft Product.

The finest equipment, workmanship and "know-how" are lavished on these vital aircraft parts. This has resulted in widespread acceptance and approval by government and civilian agencies alike.

For further information on parts shown in this advertisement please address departments listed. Inquiries on other aircraft parts should be addressed to Department 678.



"FLEXLOC" SELF LOCKING NUTS (REGULAR) . . . serve as both stop and lock-nuts . . . one-piece construction . . . resilient segments lock positively with uniform torque . . . aircraft approval of sizes from #4 to 1" inclusive in steel, brass, aluminum . . . since regular steel FLEXLOCS are approved for temperatures to 550° F, you need stock only one type locknut for this temperature range.



"FLEXLOC" THIN NUTS . . . less than regular height, yet conforms to accepted standards, since every thread, including locking threads, carries its share of load . . . has all "regular" FLEXLOC features . . . saves height and weight . . . sizes #10 to 1" . . . Write Dept. 51.



"FLEXLOC" EXTERNAL WRENCHING NUTS . . . incorporate famous FLEXLOC self-locking principle and one-piece, all metal construction . . . latest NAS specs . . . sizes from ¼" to 1½" NF Thread Series . . . approved for temperatures to 550° F . . . Send for samples. Dept. 51.



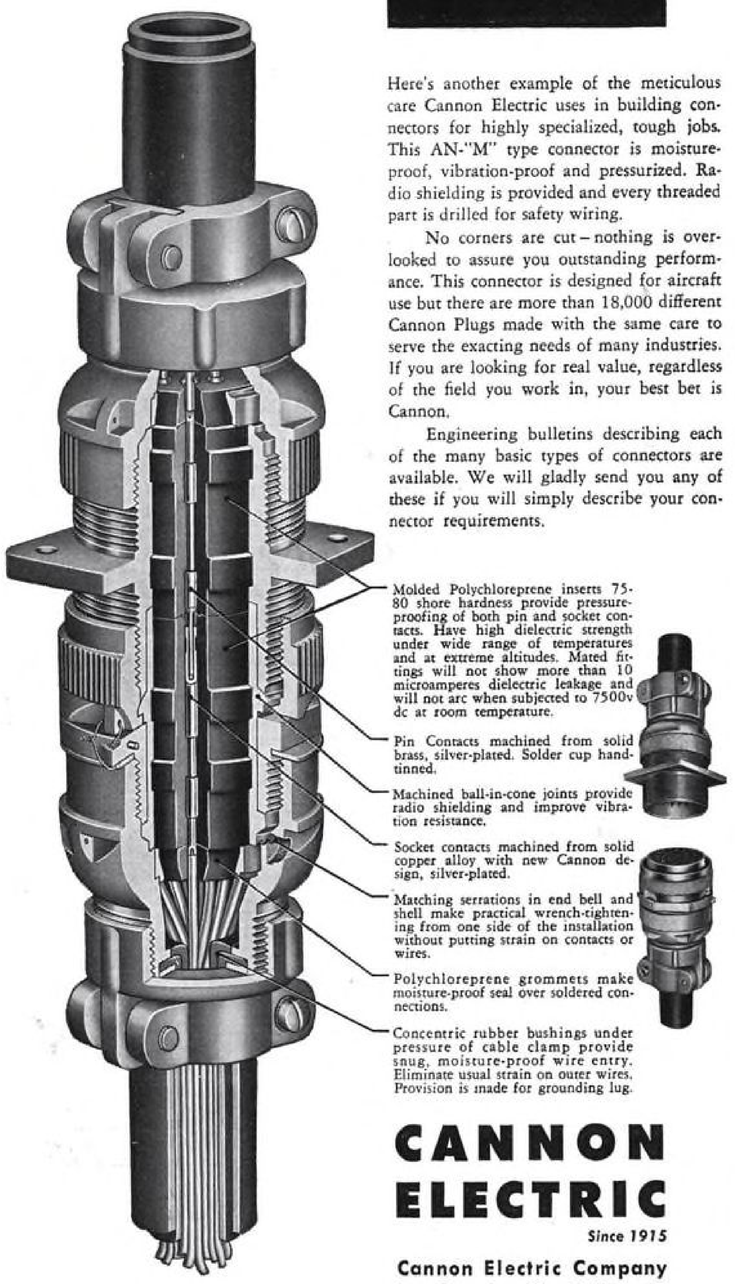
NAS INTERNAL WRENCHING LOCK-NUTS . . . superior safety nuts . . . sizes from ¼" to 1½" . . . Dept. 678.

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Here's another example of the meticulous care Cannon Electric uses in building connectors for highly specialized, tough jobs. This AN-"M" type connector is moisture-proof, vibration-proof and pressurized. Radio shielding is provided and every threaded part is drilled for safety wiring.

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Engineering bulletins describing each of the many basic types of connectors are available. We will gladly send you any of these if you will simply describe your connector requirements.

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lems, too, is the warehousing situation. With small quantities of thousands of items needed quickly, manufacturers have come to rely on warehouses for quick delivery. With the demand growing and warehouses limited to percentages of previous stocks, the purchasing department's problems become increasingly serious.

► **Availability**—How about the availability of raw materials and basic products?

The aim to provide our military needs without too drastic a reduction of civilian goods can only be accomplished by a great expansion of our productive capacity. This expansion, in turn, requires much material. In some cases it can proceed only slowly because of material or other limitations; in others it can move faster. Thus, supply gets out of balance. This is made even more serious because of certain raw materials which have to be imported and which are, therefore, not under the direct control of U. S. government regulatory agencies.

This is the picture in the metals field:

• **Steel.** It takes almost six pounds of steel to produce one pound of airframe weight of a fully equipped airplane. This is an insignificant quantity of steel, probably one-tenth of one percent of production in 1951.

Yet, when it comes to alloy steels the picture is different. In the second quarter of 1944 the aircraft industry consumed almost 10% of all alloy steel. And in 1951 the industry will consume probably 100,000 tons to alloy and stainless steel mill shapes and castings. More than 50,000 tons of these will be used by the engine industry. And it is in some of the alloys that critical shortages exist. Among the alloys the supply picture varies.

• **Columbian.** This metal inhibits corrosion in chrome-nickel steel. It is used in especially strong, high-temperature-resistant steels. Most columbium is imported from British Nigeria. National Advisory Committee for Aeronautics is now planning to substitute partly another alloy for columbium in jet engine production. The metal is under complete allocation control.

• **Cobalt.** This comes mostly from the Belgian Congo and Northern Rhodesia. It is used as alloy with steel, tungsten carbide, chromium, and molybdenum. It is very scarce and under 100% allocation control. Because of its use for turbine buckets it is of critical importance to the industry.

• **Molybdenum.** An alloy that is under complete control.

• **Tungsten.** This is used in the production of special alloy steels for cutting purposes and in specially hard alloys, and is also under 100% allocation control.

• **Nickel.** This is also of critical im-



SILASTIC* can be used to fry an egg or keep aircraft flying under icing conditions

Consider resistance heating elements embedded in Silastic. Among many present and potential applications are: the anti-icing of air intake doors on jet engines; deicing strips for aircraft wings, helicopter blades, and camera mechanisms; electric blankets and soil heaters. Such applications are practical because extreme temperature Silastic stocks are the only rubber-like materials that stay elastic at temperatures ranging from −100 to +500°F.

Certain Silastic stocks are also excellent electrical insulating materials. Dielectric strength and dielectric constant are practically unchanged by 4 months of accelerated aging at 175°C. (347°F.). High heat conductivity enables Silastic insulated coils to operate under the same load at temperatures as much as 50% below the temperatures of identical coils impregnated with electrical insulating varnishes.

And remember, Silastic also repels water and ice; shows excellent resistance to oxidation, outdoor weathering, ozone and to a variety of hot oils and chemicals. That's why Silastic is so challenging as a heating pad; so indispensible as a gasketing, sealing and electrical insulating material.

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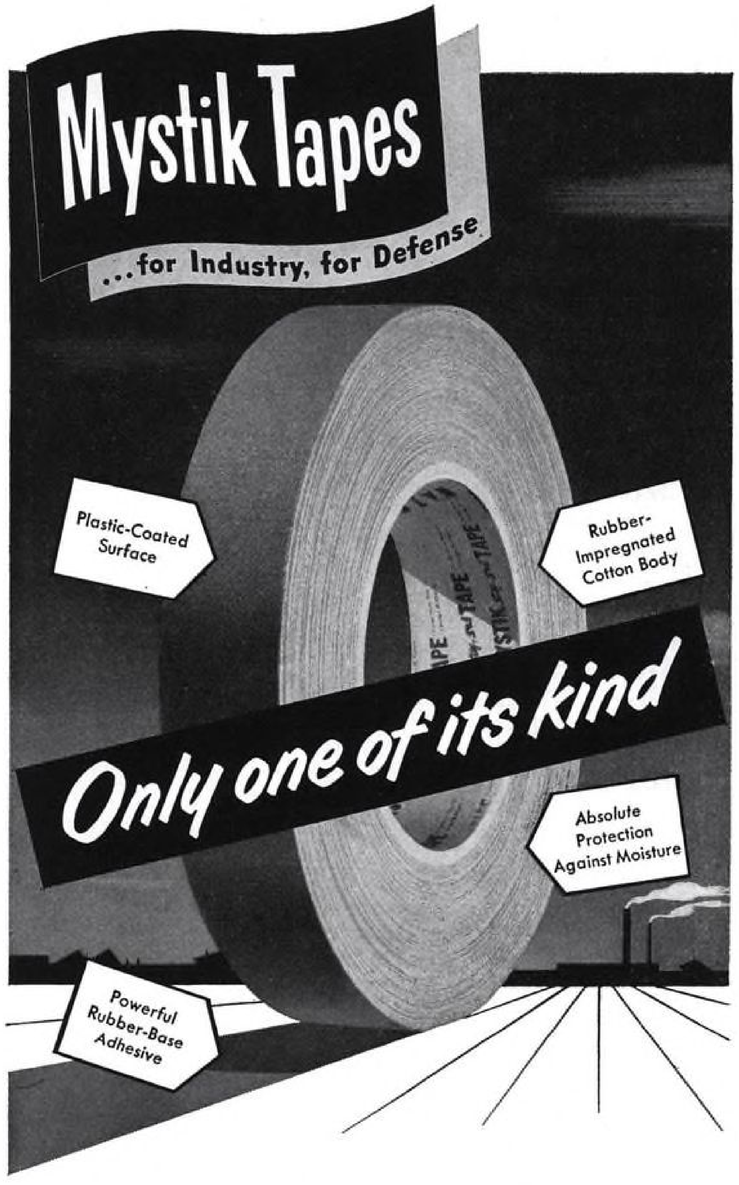
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portance to the industry and also under complete control.

• **Aluminum.** Between two and three pounds of aluminum are used by the aircraft and aircraft engine industry for every pound of airframe weight produced. The industry will thus probably use about 150 million lb. of aluminum in 1951. This is little more than 5% of the expected total supply (domestic primary production plus imports and scrap).

Even an expansion of the Air Force from 95 to 130 wings would require only about an additional 100 million lb. of aluminum.

Yet there are even now serious shortages in forgings and extrusions. While aluminum castings are being delivered to the aircraft industry within three to four months, aluminum extrusions take five months and forgings eight to 13 months for delivery. Aluminum rod and bar take half a year for delivery and sheet takes almost as long.

• **Copper.** This metal also is under CMP, is not used as extensively in aircraft production as aluminum. In 1944 only about 2½% of all copper and copper-base alloys were used for aircraft and engine production. The general shortage of copper, however, accounts for considerable delays in deliveries of essential raw materials and parts.

• **Magnesium.** Deliveries take from two to three months for castings and four months for extrusions and bar and rod, to almost a year for magnesium sheet.

3. "Lead Time," "Flow Time"

It usually takes two to five years from the time design on an aircraft is started until the fifth airplane is produced and accepted by the military. Even the pressure of war could not reduce this time span to less than 18 months for a few models.

If we add to this time another year which will elapse between the fifth and 1000th acceptance we get a realistic picture of how long it takes before a design becomes a fighting aircraft.

For the F-80, designed under the pressure of war, it took over two years from the time design work started until the 1000th airplane was produced. For the B-29 it was six years. For the P-47 it was 32 months, for the P-51 it was 34 months.

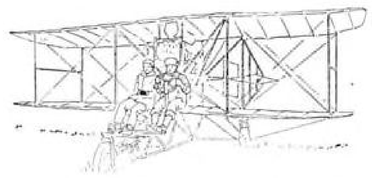
The fact that it takes so long a time between the beginning of design work and the quantity production of an airplane accounts for the fact that during World War II we were forced to use designs developed in peacetime.

None of the planes—or engines, for that matter—on which design was started after Pearl Harbor saw combat. The long time which it takes to design an airplane and get it ready for production makes it essential that an-



Flying Forgings—

THE MODERN AIRPLANE IS LARGELY MADE UP OF HAMMERED METAL PARTS



THERE WERE FEW FORGINGS IN THE BAMBOO-AND-VARNISHED-LINEN AIRPLANE OF 1911 BUT EVEN THEN THE PRIMITIVE AIRPLANE ENGINE HAD THEM

The original Wright plane that went into production—the Model B—had a high speed of 42 m.p.h., carried 2 people, had a little over 2 hours gasoline supply and a service ceiling at full load of about 8000 feet.

Today's plane—40 years later—has a high speed of 600 m.p.h., carries 125 passengers, has enormous gas capacity and ceilings up to 50,000 feet.

Tomorrow's plane, says Grover A. Loening, may cruise at 1200 to 1500 m.p.h. (N.Y. to Europe in 3 hours, California in 2 hours, Florida in 45 minutes) may land almost vertically and may be fireproof in crashes. And it, too, will be built largely of hammered metal parts.



IT is hard to associate flight through the air, —the flight of birds, the flight of planes— with weight, strain, stress, impact; yet the greater the size of the plane, the higher the speed, the heavier the load, the greater become the forces tending to pull it apart. That is why the toughness and strength of the metal parts that make up the modern plane are so important, why drop forgings and hammered sheet metal parts are essential in airplane construction—why the hammers built by Chambersburg are busy night and day in the aircraft industry, as in all other manufacturing industries which use metal parts that must not fail.

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You can't take your ground crew with you...



THE TESTING'S OVER when a jet takes off. It's got to be right or else. That's why a pilot depends so much on his mechanics—and they, in turn, count upon the accuracy of their test equipment. And that's why ground crews all over the world choose Greer.

Greer designs and manufactures machines for testing and servicing aircraft. Not only jet fighters but all kinds of planes, military and civilian. Greer equipment is famous for simple, rapid, dependable, and *absolutely accurate* operation.

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other emergency finds us with advanced designs of all types either in, or ready for, production.

► **Time vs. Buildup**—Another critical time element is the time required in the plant to build an airplane from the date it is ordered until the complete airplane is ready for delivery. Today, this time span controls the date of our build-up of air power. If this time is long our buildup will be slow. If we can shorten it, our rate of buildup will increase.

For fighter production the time from order to production is about 18 months, for bombers the lag is even greater, about 24 months.

The greater part of this time is consumed not in the actual fabrication of the aircraft but in the tedious process of getting together the necessary materials.

If a manufacturer requires 18 months to "produce" a fighter his factory must work on other jobs for twelve to fourteen months while his purchasing agents and expediters are collecting the materials his men and machines must work upon.

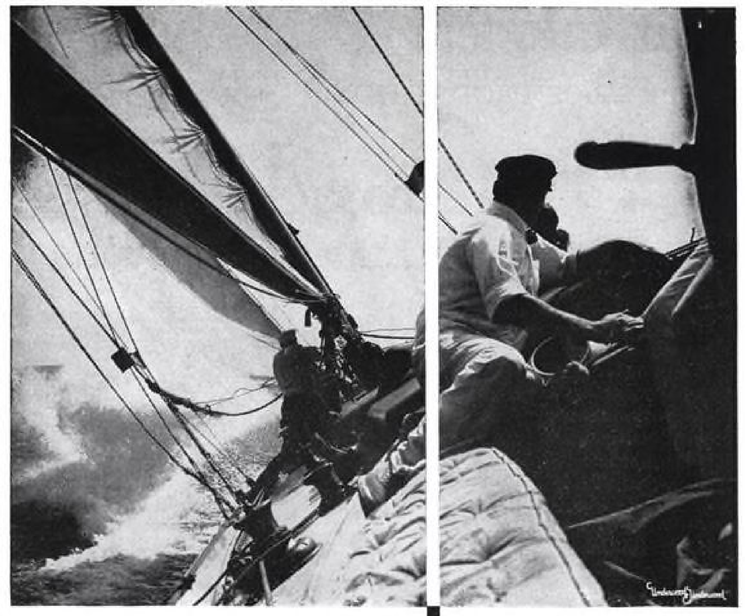
Unfortunately, this situation is still getting worse instead of better, despite industry and government efforts to cut down the time.

► **No Better**—This worsening of delivery times of equipment, parts and raw materials is apparent from the table below which is based on the experience of a leading aircraft manufacturer. Additional time must be allowed for die making, forgings, and fabricated assemblies, for which tooling must first be developed.

Delivery Time Required For Selected Items

	Summer 1950	Summer 1951
Special bearings (reorders)	7 mo.	12 mo.
De-icing pumps (new or changed designs)	6	12
Engines (reorders)	12	14
Exhaust equipment (new or changed designs)	6	12
Gun mounts(new or changed designs)	7	9
Instruments (excluding Zero Reader and automatic pilot)	4–7	7–12
Power transmission assemblies	6	11
Propellers (reorders)	9	12–28
Standard relief valves (new or changed designs)	4	10
Self-locking nuts (reorders)	4–5	6–7
Zero Reader (new or changed designs)	18	24

There are indications that the government plans to make a very special effort to cut delivery time. The CMP and other allocation controls are one step in that direction. The machine tool program is another one. But it will take time to show results. Up to now



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. . . so, with complete confidence that the gears would be delivered as specified, he went sailing. Such confidence is not misplaced! For over 25 years, Vinco has been delivering large and small jobs, meeting or surpassing the specified quality. Vinco "Metalworking Wisdom," applied to gearing, parts, assemblies or designing and making, has saved time and money for Vinco customers.

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the situation has not improved, it has been getting worse.

4. Manpower

► **Company Management**—Employment in airframe plants has almost doubled since Korea. Anybody who has ever gone through such an expansion knows just how many headaches it involves. Branch plants have to be staffed and engineering crews set up to inspect subcontracting plants. Training programs have to be started to give new workers their first knowledge of the job. Company executives spend days and weeks in negotiations and conferences in Washington.

Competent management during rapid change and expansion is a difficult job. But ten years ago this industry went through a process many times as hard and came out on top.

In the early 1940's the industry did not know how much it was to grow. And it did not have any experience in what problems a change-over from shop methods to line production would involve. Yet, many companies accomplished a thirty-fold expansion within five years. On the basis of this experience much preplanning has been done which makes today's job much simpler. And many of the old crew are still on the job and can take the problems in their stride.

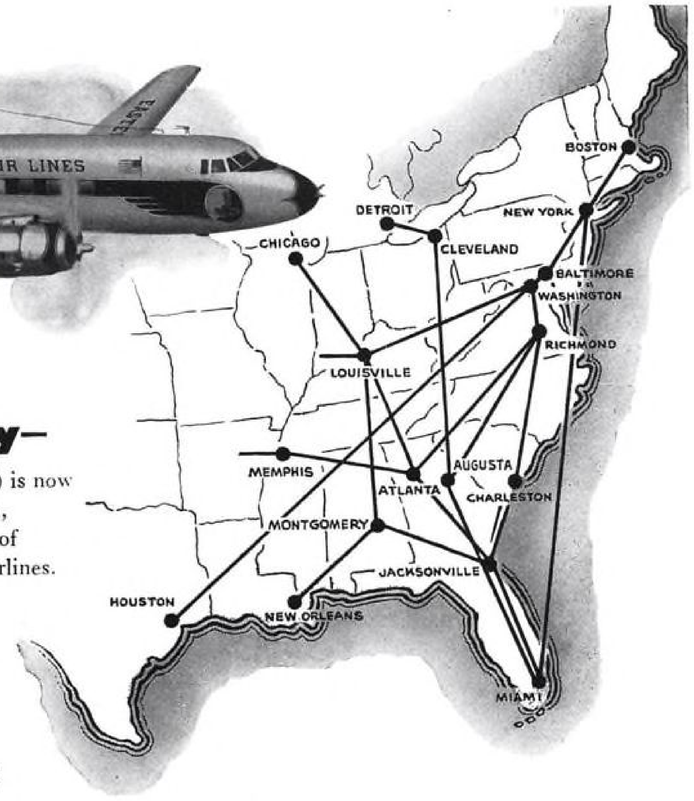
Naturally, we do not know what lies ahead. If we should be able to expand to a production rate of about 1,200 planes per month gradually before any emergency breaks out it is hard to conceive that management will again have to go through the terrific strains of the early 1940's.

But it is well to remember, as a Harvard report says, that the problems of company management in a period of rapid expansion constitute the "ultimate limiting factors on the peacetime aircraft industry's ability to expand during the war. These limitations were not so tangible and easy to understand as, say, a shortage of plant space or of aluminum forgings, nor could they be statistically measured. Nevertheless, when the companies were forced overnight into the vast wartime expansion, they could progress only as fast as the upgraded and outside management personnel could learn their new duties. The physical difficulties encountered were in large part simply evidences of the bottleneck of human abilities and experience."

At present, however, while management is under pressure, it is not under as severe a strain as it was in World War II.

► **Employment** – Has increased 85% since June, 1950. The increase





Newest in the Sky–

The new Martin Airliner (4-0-4) is now flying . . . soon to span America, north, south, east and west, along the routes of Eastern Air Lines and Trans World Airlines. Drawing closer the cities of these two great carriers with time-gaining speed . . . pleasing an ever larger segment of the American public with the comfort of pressurized, air-conditioned flight.

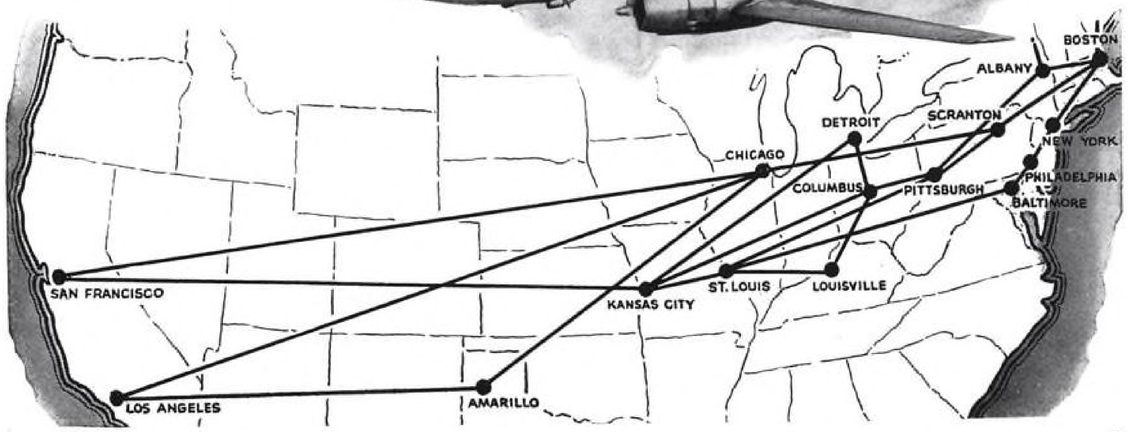
The new Martin Airliner is designed to exceed today's more demanding requirements of airline operation and dependability . . . to keep pace with future developments . . . to fill the broad, long-term needs of commercial and military transport.

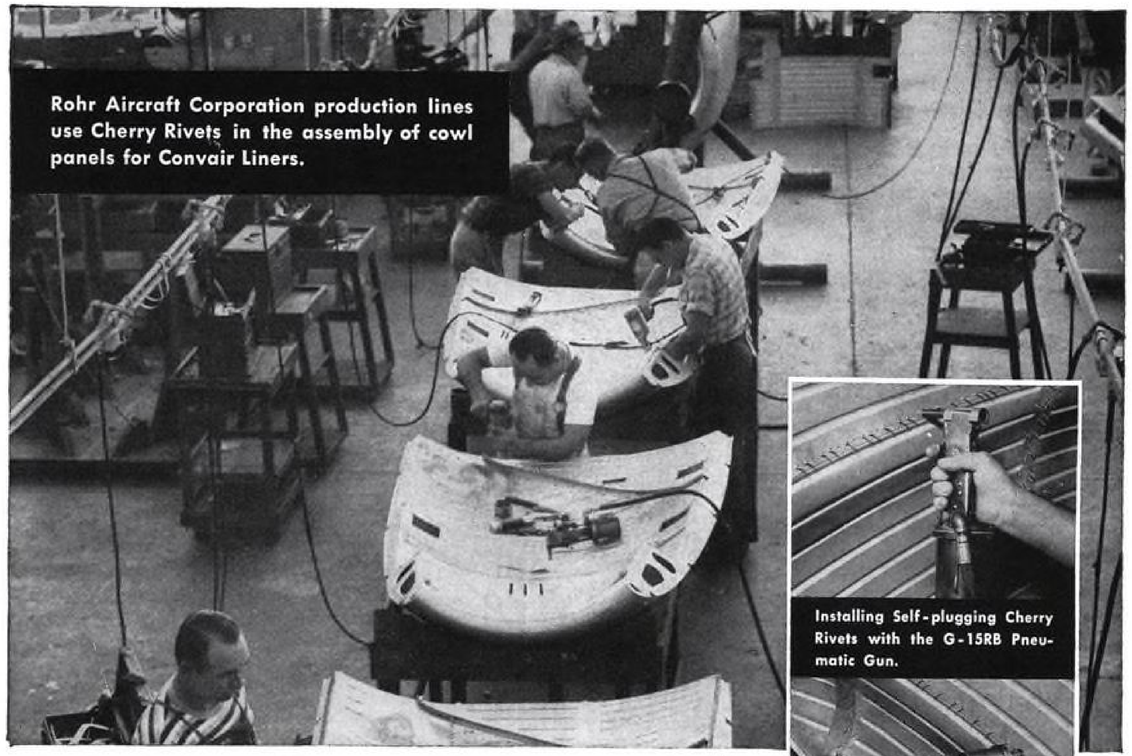
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has come gradually, never exceeding 8% per month.

By September, 1951 total employment in aircraft and parts (including engines, propellers, parts and equipment) has probably reached 475,000 people. This compares with 256,000 in June of 1950.

Major shortages of workers exist in the industry. The situation as to skilled mechanics, technical workers, and engineers is serious.

Many of the newcomers require training, many of them are employed in plants which are still in a tooling-up stage. It could therefore be a mistake to expect that these new workers produce as much as the group that was in the plants in June 1950.

While women are now being hired again in increasing numbers, the proportion is much below that of World War II when they made up almost 37% of total aircraft employment and 40% of airframe employment. The Director of Defense Mobilization reports that employment of women in aircraft factories in San Diego has risen from 12 to 23% in a year.

While employment has increased by 85% there are major shortages of production workers.

▶ **Working Shifts and Overtime**—The Secretary of Defense has come out against multi-shift operation or overtime in order to broaden the mobilization base of the country.

Nevertheless, average weekly hours in the entire aircraft and parts industry have gradually climbed up to 44 hours per week compared with 41½ in 1950 and 40½ in 1949.

This is obviously an emergency solution forced upon the industry because of the shortage of workers. The Director of Defense Mobilization has pointed out as recently as in July 1951 that "adding workers either in normal, staggered, or extra shifts . . . is preferable because more workers will be trained for all-out production in event of a global war" through such operations.

Yet, multi-shift operation is not yet widely used. In January, 1945, 40% of all direct employes worked on the second or third shift. Today the percentage is much smaller.

Recently, Lockheed Aircraft Corp. has published a discussion on the utilization of working shifts which brings out some reasons why this is so.

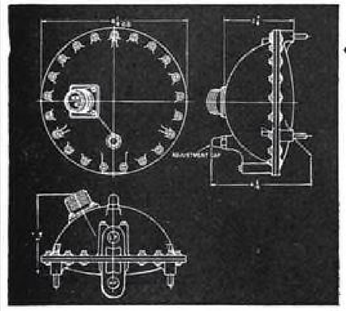
Lockheed points out that multi-shift operation is often desirable in fabrication operations where complex and expensive machines such as turret lathes, giant hydro presses and milling machines represent a hugh investment in capital and are frequently in short supply.

In assembly, however, there is more

AEROTEC **PRESSURE SWITCHES**

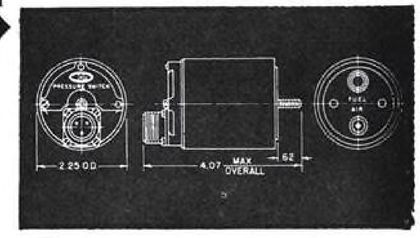
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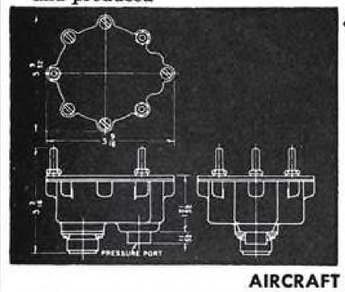
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Differential Type for Ram Air
Sensitivity: ⅒″ H_2O
Actuating Pressure Range: 1.50″ H_2O to 3 psi with differential of 20% of applied pressure
Electrical Rating: 28 VDC 5 Amp. inductive
Complies with A.F. environmental specification 41065-B
For stall and flap warning applications and as safety switch for cabin de-icing heaters.

PRESSURE SWITCHES SERIES M800
Gage, Differential, Types
Actuating Pressure Range 2.5 psi to 200 psi
Mediums: MIL Fuels, hydraulic fluids, air
Electrical Rating: 28 VDC 3 Amp. inductive to 45,000 ft.
Complies with A.F. environmental specification 41065-B
Over 80 different types designed and produced





HIGH PRESSURE SWITCHES SERIES T100
Actuating Pressure Range: 200 psi to 5000 psi
Mediums: MIL Fuels, air, hydraulic fluids
Electrical Rating: 28 VDC 5 Amp. to 45,000 ft.
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space, less expensive machinery and more workers. Assembly yield is dependent on manpower, tooling and efficiency rather than on machine output.

In **sub-assembly,** multiple tools and shifts are utilized to reach a desired initial production level, following which the continuing increase in worker efficiency is either applied to accelerated production or to reduction in tooling and shifts.

In **final assembly** where organization of worker skills is of prime importance only the day shift is utilized.

Lockheed's example clearly indicates that the use of multiple shifts is severely limited for economic reasons. Shortage of factory space or production schedule requirement may force uneconomical use of multiple shifts. But at present, the economic motives are the guiding ones.

In summary: Weekly hours have gone up about 10 percent since Korea. Most workers are still on day shift.

▶ **Other Factors**—Labor turnover is on the increase. For every three workers hired, two are leaving; housing shortages and high rents are a major cause.

Absenteeism through which more than 6% of man-shifts scheduled were lost during the second half of 1944 is again serious.

Until September, strikes affected the industry mostly indirectly through shortages of materials coming from other industries.

5. Government Organization

The Harvard Report on World War II says that an effective job of government management requires:

- **Adequate preplanning.**
- **Prompt setting** of adequate production goals.
- **Skillful government** administration of the job.

In the present emergency, government has undoubtedly done much better in preplanning and in the setting of production goals. Except for a short period, the setting of production goals has probably kept pace with readiness by the Congress to accept higher and higher budgets for aircraft procurement.

The two major problems appear to be an insufficient realization of the nature of the emergency, and a resultant unwillingness to impair production of civilian peacetime goods by more aggressive allocation of materials to the aircraft industry.

With a large amount of the defense effort being directed into expansion of "basic" production facilities it often appears as if production increases to have an air force-in-being were intentionally being delayed.

What is needed in the Defense Mobilization Agencies is a true will to

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2¾" DUAL INDICATORS

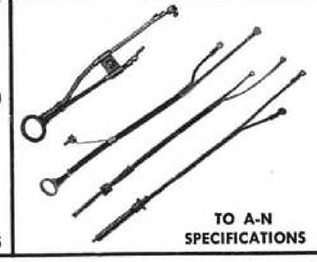


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STURDY . . . FAST-ACTING | ACCURATE . . . RELIABLE | AIRCRAFT QUALITY . . . FROM OUR OWN WIRE MILL



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TO A-N SPECIFICATIONS



TO A-N AND MILITARY SPECIFICATIONS

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produce more aircraft faster. The organization is on hand. So is most of the knowledge as to how much is needed and how it could be made available more quickly. What is lacking is the kick to get the ball really rolling.

6. 1951 Production

Guessing aircraft production rates is not easy. There are too many factors which influence each other to give the analyst any feeling of security. On the other hand, the multiplicity of factors give a fair opportunity to compare different estimates and see if estimates based on different approaches check fairly closely with each other.

▶Estimate based on the number of workers.

We may expect an average monthly employment of about 300,000 workers in the airframe industry during 1951. Many of these workers will be newcomers to the industry and their production will be low. Many others will work in new plants which are still in the tooling-up state. Therefore, their output, too will tend to be low. Subcontracting is still at a low percentage and will contribute little toward higher production per worker.

For all these reasons it seems safe to assume a production of not more than 200 lb. of airframe weight per worker, a figure somewhat below the estimated 1950 level of output per man.

This gives us a total of 60 million lb. of airframe weight for 1951. Allowing for a civilian production of 5 million lb. we arrive at a military production of 55 million lb.

Assuming an average weight of 13,000 lb. per military aircraft for 1951 production, we arrive at 4,230 planes.

▶Estimate based on statements by defense production authorities.

Defense Mobilization Director Wilson has made several statements in regard to aircraft production.

In his second Quarterly Report he stated that "aircraft deliveries are currently (probably in June 1951) about two-thirds higher than a year ago." He also said that "present schedules call for tripling the current rate of deliveries in the next twelve months or so. . . ." Taking into account the tendency of postwar schedules to fall behind with discouraging regularity we have accepted only the first part of his statement as factual and not used his schedule for plotting into the future.

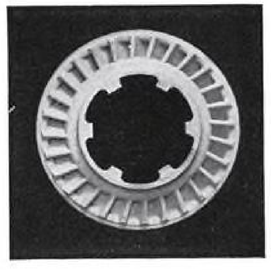
In a statement before a Congressional subcommittee, Wilson compared acceleration of acceptances in the first half of 1951 with expected acceptances in the second half.

Military deliveries in June, 1950 were 3,150,000 lb. Allowing for a two-thirds increase until June, 1951, we arrive at about 5 million lb. delivered in June,



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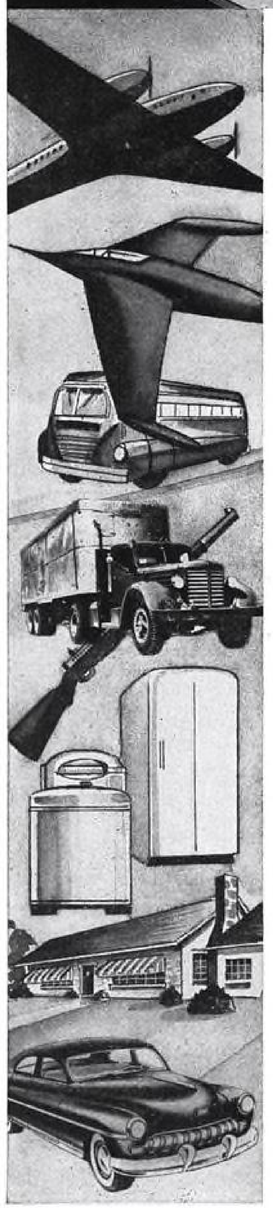
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1951. Allowing for an 8% per month increase since then we get to about 6 to 6½ million lb. accepted in September, 1951. Translated into aircraft we probably had less than 400 acceptances in June 1951 and 450 to 500 in September.

A rough estimate of total military deliveries during 1951 on this basis would be about 4,800 with a weight of about 63 million lb.

► **Estimate based on available sales of leading manufacturers.**

Presently available sales data indicate that 1951 sales of the leading aircraft, engine and propeller manufacturers will exceed $3 billion. This is a 50% increase over 1950 sales. Dollar "sales" are a very poor guide to production and should be used only with the greatest restraint.

Nevertheless, the 50% indicated increase in sales corresponds quite closely with the expected increase in deliveries from the 1950 level. Total military deliveries in 1950 were about 3,000. A 50% increase would point towards 4,500 deliveries in 1951, and a weight of military aircraft produced of about 58.5 million lb.

► **Estimates based on usual delivery rates of airplanes ordered.**

Only a few of the airplanes ordered in one fiscal year get delivered during the same year. The bulk gets delivered in the year following the year of procurement and the remainder almost always gets delivered in the second year.

The ratio of deliveries between the year of procurement and the first and second year thereafter varies according to type of aircraft, quantity of airframe weight ordered, state of industry, etc.

We have estimated the total airframe weight ordered as 30 million lb. in fiscal year 1950, 130 million lb. in fiscal year 1951, and 190 million lb. in fiscal year 1952.

Delivery rate estimates have been assumed as 15% in fiscal year 1950, 75% in fiscal 1951 and 10% in fiscal 1952 for orders placed in fiscal 1950, and slower delivery rates for orders placed in later fiscal years.

In calculating deliveries for calendar years the first half of a fiscal year was allocated 40% of the year's production, and the second half 60%.

A total of 11 million lb. of airframe weight undelivered from previous years' appropriations was assumed delivered in the first half of fiscal year 1951.

Taking all the above factors into account we arrive at a total production in the calendar year of 1951 of 61.3 million lb.

In summary, estimates arrived at by four different approaches point towards a production of 55 to 63 million lb. of airframe weight, or 4,200 to 4,800 aircraft.



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Cooling high-speed fighters or bombers is more than a matter of crew comfort...it's essential for survival. Cooling requirements of combat aircraft are severe. Highly efficient, compact and lightweight refrigeration units are needed to keep cockpit temperatures at desirable levels.

Stratos air cycle cooling units are *engineered* to meet these exacting demands. Extremely compact and very light, they deliver a high rate of flow of cooling air. Production models with air flow capacity ranging from 12 lb/min to 90 lb/min are standard equipment in combat aircraft of the U. S. Navy and the U. S. Air Force. Such high performance aircraft as McDonnell's F2H2 Banshee, Boeing's B-47 Stratojet, North American's AJ-1 Tornado, and the Douglas XA2D Skyshark are equipped with Stratos cooling packages.

Airlines, too, are using Stratos equipment in transport aircraft such as the Constellations of Pan American World Airways, and the Convair Flagships of American Airlines, in which Stratos equipment has proved its efficiency, low maintenance cost, and long period of service between overhauls.



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AUTOMOTIVE MANUFACTURERS

Planned Aircraft Production In Auto Industry

Company	Product	Plant	Sq. Ft.	Estimated Contract Value	Estimated Start Production	Percent Subcontracts Planned
Chrysler Corp.						
Chrysler Div.	Douglas C-124 tail surfaces	Los Angeles	NA	NA	NA	NA
Dodge Div.	Pratt & Whitney J-48	Mt. Clemens, Mich.	1,600,000	$140,000,000	Early '53	NA
Plymouth Div.	Grumman SA-16 hulls	Evansville, Ind.	NA	NA		
Ford Motor Co.						
Lincoln-Mercury Div.	Westinghouse J-40	Wayne, Mich.	1,500,000	NA	Early '53	
Aircraft Engine Div.	Pratt & Whitney R-4360	Chicago	6,322,619	$563,000,000	Mar. '52	
Aircraft Div.	Boeing B-47 wings	Claycomo, Mo.	1,000,000	$200,000,000		40
Equipment Div.	Wright R-3350 fuel injection systems	Ypsilanti, Mich.	400,000	NA		
Transmission Div.	Pumps for R-4360	Cincinnati	200,000			
General Motors Corp.*						
Buick-Olds-Pontiac	Wright J-65	Willow Springs, Ill.	1,400,000	NA	Summer '52	
	Wright J-65	Flint, Mich.	580,000 / 1,600,000	NA		
	Republic F-84F	Kansas City	1,700,000	NA	Nov. '52	45
Chevrolet Div.	Wright R-3350	Tonawanda, N. Y.	1,300,000 / 1,000,000	NA	Early '53	
Hudson Motor Co.	Martin B-57 (Canberra) aft fuselages & tails	Detroit	250,000	NA	NA	NA
Kaiser-Frazer Corp.	Fairchild C-119C	Willow Run, Mich.	1,000,000	$200,000,000	Nov. '51	35
	Chase C-123			$200,000,000		NA
	Wright R-1300	Detroit & Dowagiac, Mich.	740,000	NA	In 1952	39.2
	Lockheed P2V fuselage sections & flaps	Oakland, Calif.	100,000	NA	Started	NA
	Boeing B-52A parts	Richmond, Calif.		$6,000,000	Within 90 days	
Packard Motor Co.	GE J-47-23	Utica, Mich.	600,000 / 700,000	$500,000,000	Mar. '52	NA
		Detroit	250,000			
Nash Motor	Pratt & Whitney R-2800	Kenosha, Wis.	NA	NA	NA	NA
Studebaker	GE J-47-S-23	South Bend, Ind.	1,453,000			
		New Brunswick, N. J.	NA	NA	NA	NA
		Chicago				
Willys	GE J-47-23	Anderson, Ind.	NA	$63,000,000	NA	NA
TOTALS			23,695,619	$1,872,000,000		

*Oldsmobile Lansing & Delco-Remy Div., Anderson, Ind. are supplying jet engine sub-assemblies. GM list does not include Allison & Aeroproducts Div.
NA—Not Available

Auto Industry Returns to Its Wartime Job

Plants rising, tooling begun for planes and engines but things aren't the same as in World War II.

● The know-how in aircraft production obtained by the huge automotive industry in World War II is an industrial reserve as valuable as the stored machine tools and stand-by plants.

● Now that experience is being put back to work on the job of producing for air power. But it will be a long time before you can expect results that match the auto industry's reputation.

● This time the ground rules are different; and other complexities have risen to be-devil the individualists of Detroit.

By Alexander McSurely

Detroit—After five years of regular peacetime automobile mass production, the big U. S. automotive manufacturers once again are polishing up their micrometers, their gages and their closer tolerances, preparing to convert to the more precise job of building military airplanes and aircraft engines.

There are two reasons why the balance in volume of aviation military contracts won't be quite as one-sided as it was in world War II when three of the first four aircraft manufacturers in terms of war manufacturing expansion were the big three of the automotive industry—General Motors, Ford, and Chrysler:

• **One.** In this peculiar twilight era of half-peace-half-war now existing, the automobile companies are going on with their regular job, making cars with their right hand, while at the same time they are getting ready to make military materials, at some not too specific future date.

• **Two.** Meanwhile, most of the major regular airframe and aircraft engine companies are far larger and better skilled in production today than they were at World War II's start ten years ago. And they have been concentrating virtually full time on military aviation production and its expansion from peacetime status for the last year, since the start of the Korean war.

► **$3 Billion Plus**—Nevertheless, a conservative estimate indicates that the big U. S. auto companies already have more than $3 billion in military aviation defense orders and letters of intent and they aren't through yet, by any means. To produce the major part of this, more than 25 million sq. ft. of plant space, about half new construction, is being assigned.

The Problems

Several familiar unknowns govern just how soon the enormous industrial complex, which has headquarters in Detroit and spreads out into all sections of the continent, will get its machinery into

Aircraft Record of Auto Plants

POTENTIAL available in the automobile industry to increase aircraft production is indicated by the record in World War II when the 613 member companies of the Automotive Council for War Production delivered aircraft and parts valued at $11.2 billion to the Armed Forces.

A TABULATION of aeronautical products which the automotive manufacturers produced, leads off with **455,522 aircraft engines, 22,160 complete airplanes, 4,290 gliders and 219 helicopters,** *along with a large quantity of other aircraft products and related components and accessories.*

SOME of these include: aircraft propellers, 255,518; jettisonable fuel tanks, 981,350; buzz bombs (V-1 and similar type missiles), 1292; rocket motors, 1,177,000; rockets, 2,850,000; machine guns, 2,276,204; airplane landing mats, 50,136,000 sq. ft.; radar computers, 2,600; radios, 118,000; gyro compasses, 5,500; climb indicators, 5,400; heat exchangers, 304,577; electric motors, 5,059,000; aircraft bombs, 5,150,000.

low gear and start a tiny trickle of the vast military aviation flow which it proved it could launch in World War II.

• **Machine Tools.** Those aircraft and engine makers who have been singing the blues about machine tool shortages, can move over to make room for some lusty new voices in the chorus from Flint and Wayne, from Mt. Clemens and Utica, and many another auto town in and outside of Michigan, which is trying to get started on an aviation program, and can't find the tools.

• **Structural Materials.** Approximately half the manufacturing space now scheduled for the major airplane and engine programs of the automotive industry is plant space yet to be built. So the big auto companies have their worries, too, about structural steel and the building material shortages which are again plaguing the regular aviation companies.

• **Procurement Decision Lags.** But, probably the most exasperating thing about the present program and the one which most especially has the automotive production planners cursing fluently to each other, is the seemingly interminable lags on necessary government decisions which govern the timetables of their programs.

A large part of the fault, at least, does not lie with the Air Force and Navy procurement officials, the auto manufacturers are prompt to point out, but with the many peacetime regulatory safeguards and legal padlocks which have been added since World War II. These effectively block speedy procurement action and would never be tolerated in an all-out wartime situation, some embittered automotive analysts say. Especially lagging are the decisions on new plants and facilities, even after the services have definitely decided that they want these and have given the initial go-ahead. Decisions are made, but the necessary follow-through lags.

"For an example, look at the new Chrysler J-48 plant project at Mt. Clemens," was the comment of another manufacturer's executive. "Way back on last January 5, the Navy announced an agreement under which Chrysler was licensed by Pratt & Whitney to build the J-48 in a new plant outside Detroit. And just this month, September, 9 months later, Chrysler was permitted to break ground to start the plant. If Chrysler had been doing it, the plant would be almost finished by now."

The Causes

A brief examination into the causes for the delayed decisions for Chrysler and for other new plants being built for Ford, General Motors, Packard and other companies, seems to indicate that the new chains of command and superstructure set up as a part of Defense Department unification and the legislative safeguards which Congress has enacted are the principal barricades cutting off faster action.

No matter how efficient the administrators are in the Navy and the Air Force, and even at Secretary of Defense levels, they can't shortcut the legislative red tape.

It will probably take congressional action if procurement decisions are put

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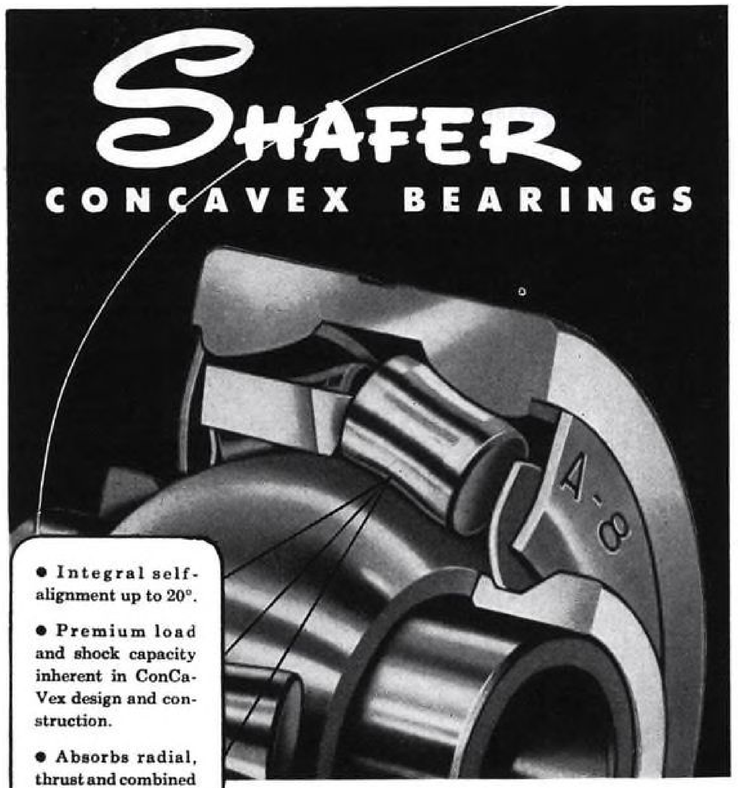
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on a business basis, some of the auto makers believe.

▶ **Slow Start, But**—If World War II experience is repeated the automotive manufacturers will start very slowly, feeling their way in the new job. But, once they catch on, the flow will mount rapidly.

The recent experience of the major auto companies and many thousands of their workers with aircraft and aircraft engine production in World War II, is probably as valuable a U. S. reserve asset as the thousands of machine tools which Air Force and Navy had in storage or the big aircraft reserve plants which have been put back into use.

Offset to their World War II aircraft training, in some cases, will be the advanced requirements for greater precision in production of the more advanced types of airframes and engines now required. It is true that several of the companies are making piston engines of essentially the same types as automotive companies produced successfully in World War II.

Production of high speed airframes, stressed to take the wallops of transonic flight and of high-strength alloy parts for jet engines, however, present some new technical problems for the auto makers. And they will need the added technical skill of their craft licensor companies to get rolling. Meanwhile the licensor companies, which are trying simultaneously to build their own larger production programs, are suffering from spreading their best executives and their know-how very "thin" to get their own and their licensee's programs underway.

▶ **More Engines Than Planes**—As in World War II, the auto companies' contracts, are more engines, than for air frames.

General Motors and Ford have each taken responsibility as a major source for one important piston engine and one jet engine (not including the Allison jets).

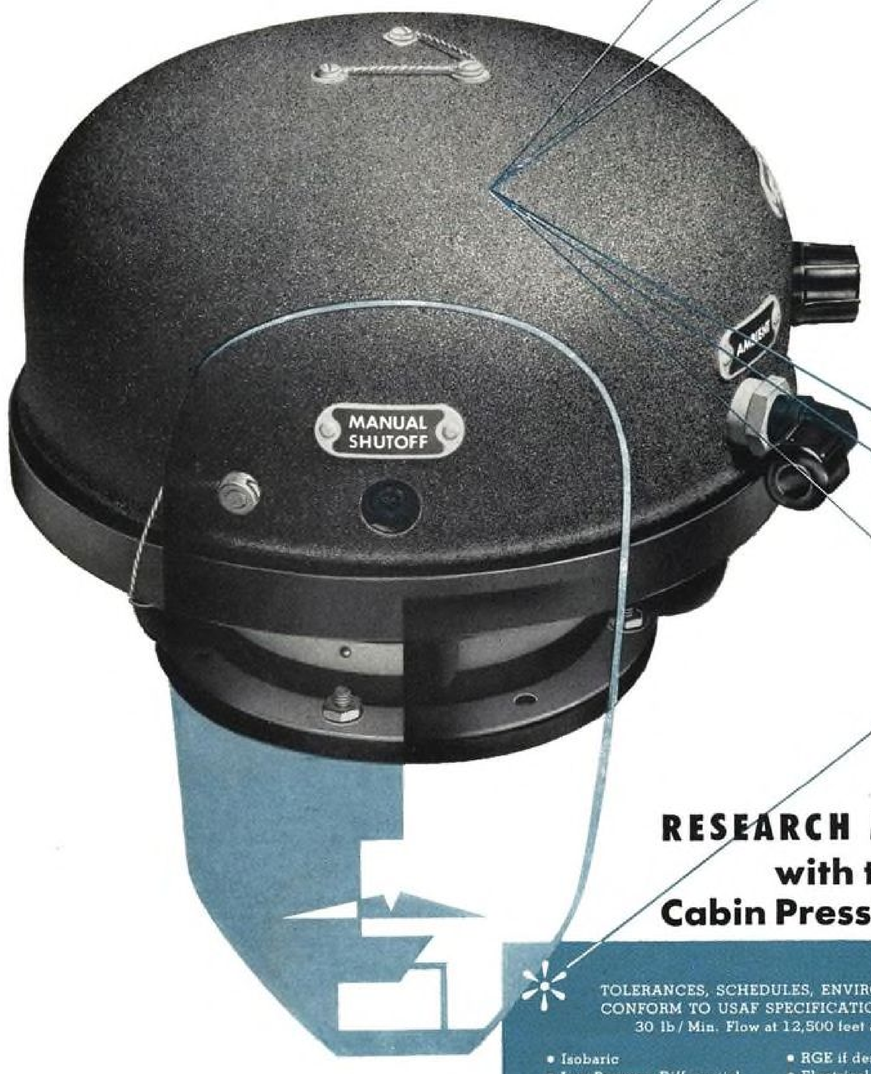
Chrysler, Packard and Studebaker also have licenses to build jet engines in large quantity production, while Nash and Kaiser-Frazer have taken on piston engine licenses.

▶ **Plant Reshuffle**—A hard-to-explain and presumably expensive reshuffle of government engine plant assignments from World War II finds only Nash building the same engine, the R-2800, at the same plant in Kenosha, Wis. where it produced it in World War II.

Where Dodge built Wright R-3350s at Chicago in World War II, Ford has been assigned to make Pratt and Whitney R-4360s. And, Chevrolet has been asked to build the Wright R-3350s at Tonawanda, N. Y., where it built Pratt & Whitney R-2800s and R-2000s six years ago.

Besides obvious waste in re-arranging

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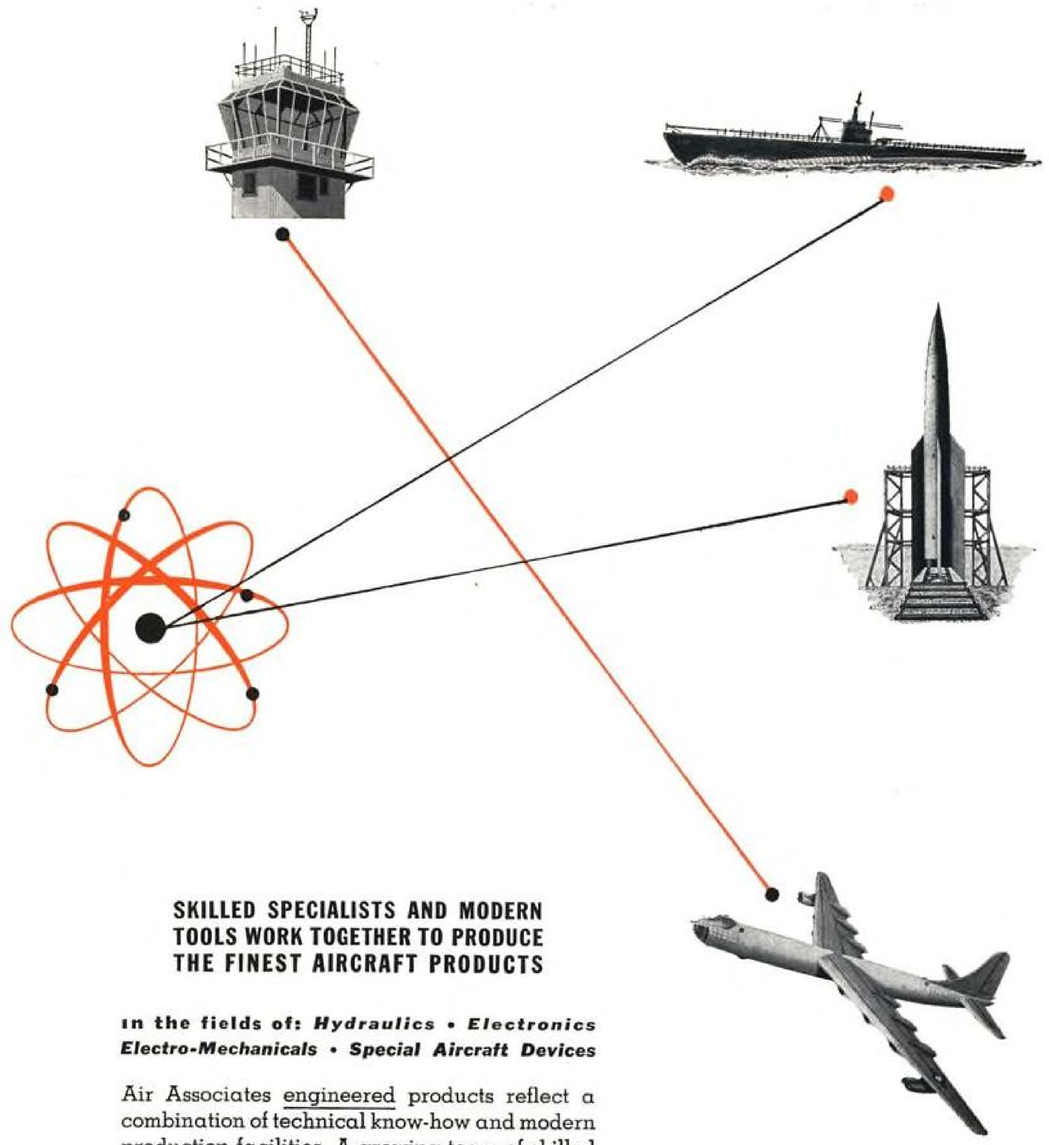
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these plants to make a different engine, the switch involves handicapping local workers who will obviously not be as efficient in beginning production of a different engine model as if they were returning to work on an advanced model of the same powerplant they had formerly produced.

▶ **Three Complete Planes**—Airframe contracts thus far call for three complete planes, the Republic F-94F jet fighter, and the Fairchild C-119C and Chase C-123 combat transports to be built by automotive builders, General Motors and Kaiser-Frazer respectively. Probably soon to be added to the list will be a contract for General Motors to make the Grumman F9F jet fighter in a new Texas plant.

Major airframe assembly subcontracts include a Ford program to build Boeing B-47 bomber wings, Chrysler to build tails for the Douglas C-124 transport, Hudson to make aft fuselages and tails for the Martin B-57 Canberra bomber, Kaiser-Frazer to make fuselage sections and flaps for the Lockheed P2V bomber, and the Chrysler-Plymouth program to build complete hulls for the Grumman SA-16 rescue amphibian.

Following is a more detailed roundup of the principal aviation projects of each of the larger automotive manufacturers.

Chrysler Corp.

Largest currrent assignment of Chrysler Corp. in aircraft work is the Dodge program to make the Pratt & Whitney J-48 turbojet at a new 1,600,000-sq. ft. plant to be built on a 306-acre site at Mt. Clemens, Mich. Estimated contract value of this project is $140 million. Engine powers the Grumman F9F-5 Panther and the Lockheed F-94C and F-94D interceptor and ground support plane.

Besides the assembly plant at Mt. Clemens, components of the engine will be made at other Chrysler plants, so that 6,000 employed at the assembly plant will be only a portion of the productive workers on the project. Second current project is the Plymouth division's Grumman SA-16 hull program at the Plymouth assembly plant at Evansville, Ind. This will employ about 1,800 persons at maximum capacity and will occupy about half the plant space. A third Chrysler project, details of which are not yet firm, calls for manufacture of Douglas C-124 tail surfaces in the Los Angeles Chrysler plant.

Ford Motor Co.

Biggest single automotive-aircraft project in dollar value, at least among those unofficially disclosed, is the $563-million Ford contract to build Pratt & Whitney R-4360 engines, at the huge 6.3-million sq. ft. Chicago plant where Dodge built Wright engines in World



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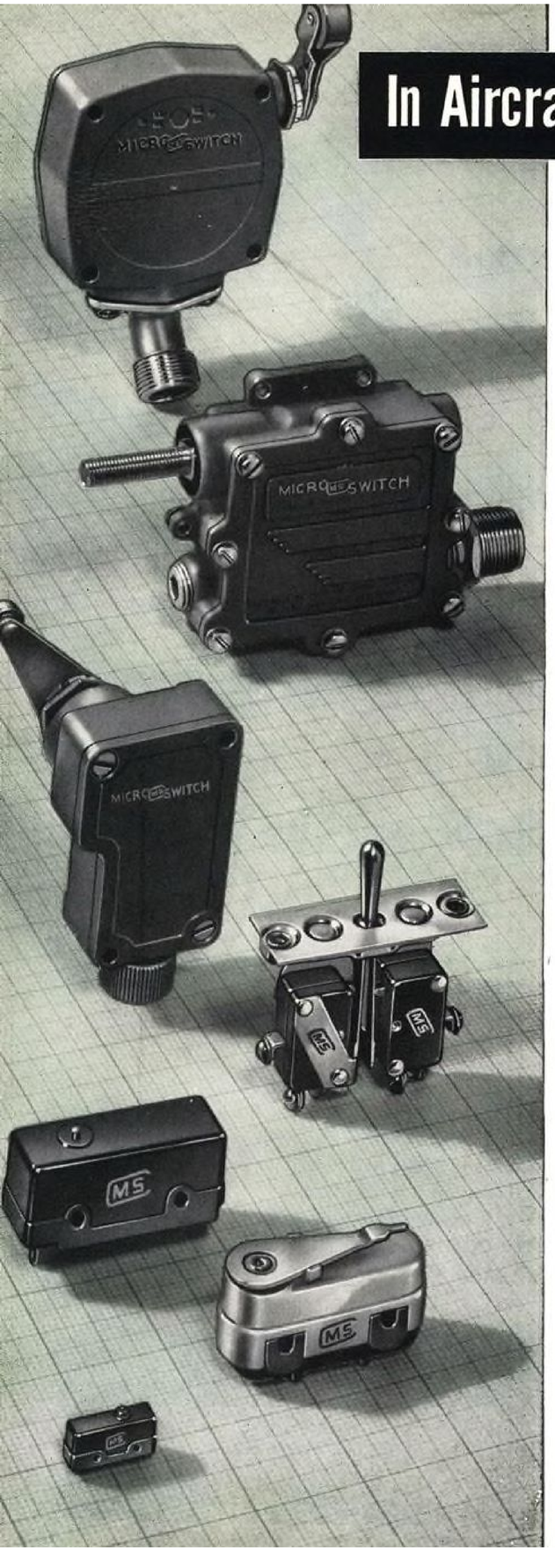
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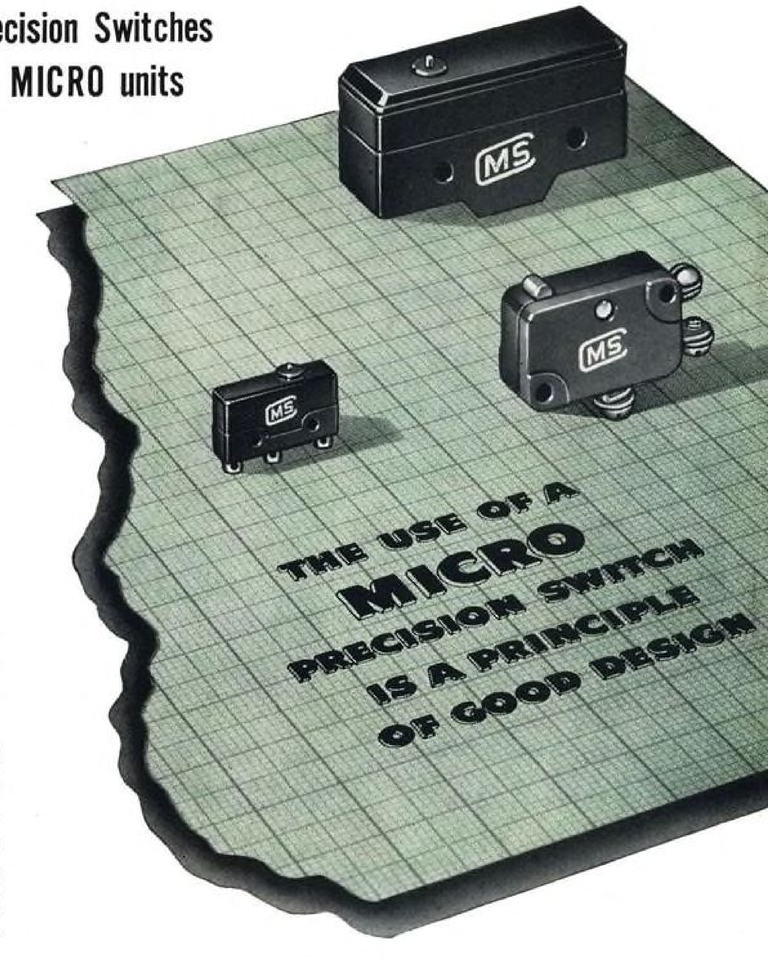
These three small MICRO Precision Switches are the basic switch in many MICRO units which meet exacting aircraft requirements.

Shown at the right in approximately actual size are three MICRO precision switches which are rapidly becoming standard for aircraft design when dependable switching components are indicated.

Larger of the three, the MICRO BZ-R31 (AN 3210-1), is but $1\frac{15}{16}$" long and weighs .059 lb. It has been successfully used for many years as a component of critical electrical sub-assemblies for aircraft.

Next size is the MICRO V3-1 (AN 3234-1). This small, dependable switch is $1\frac{3}{32}$" long and weighs .017 lb. It has a d-c rating for inductive and heater loads of 30 volts, 10 amperes at sea level; 30 volts, 6 amperes at 50,000 feet

Newest and smallest in the MICRO line of precise snap-action switches is MICRO 1SM1, the new Subminiature switch. It has but 1/15th the volume and weight of the larger BZ-R31. It has a d-c rating of 30 volts, 2 amperes (inductive) at sea level and 1½ amperes at 50,000 feet. Weight is .004 lb.

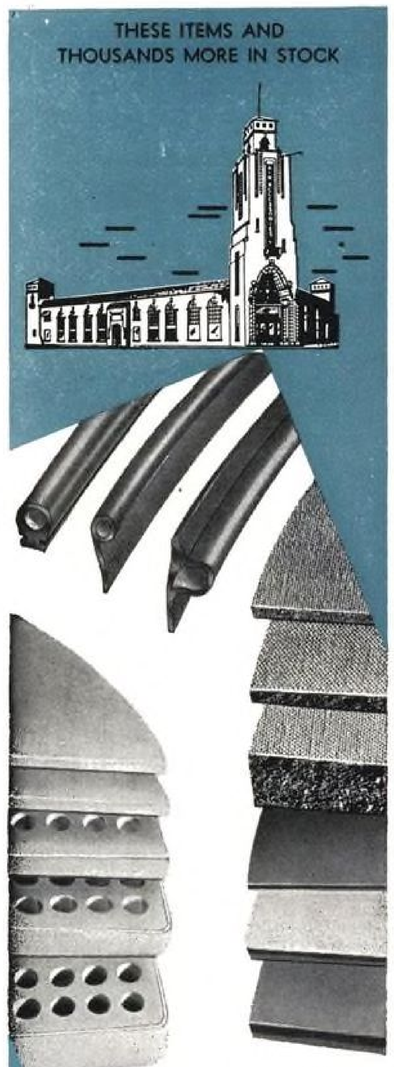


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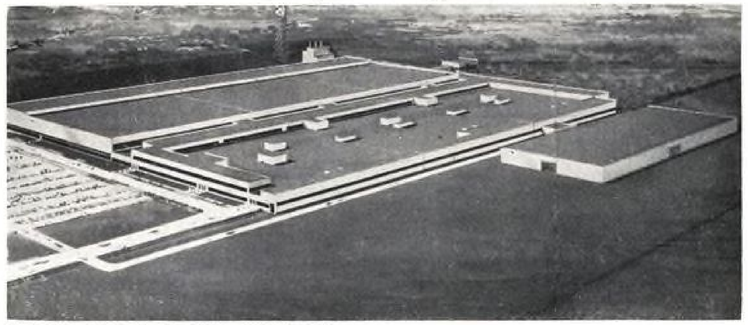
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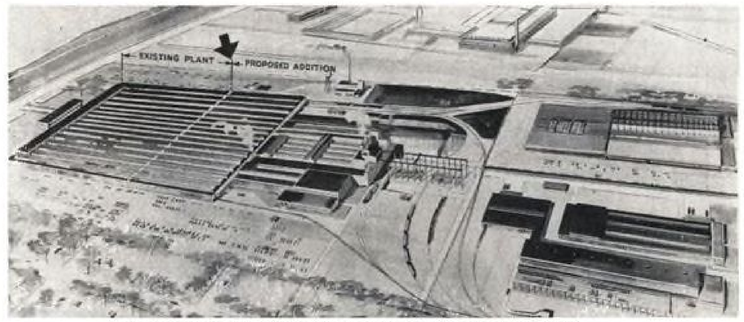
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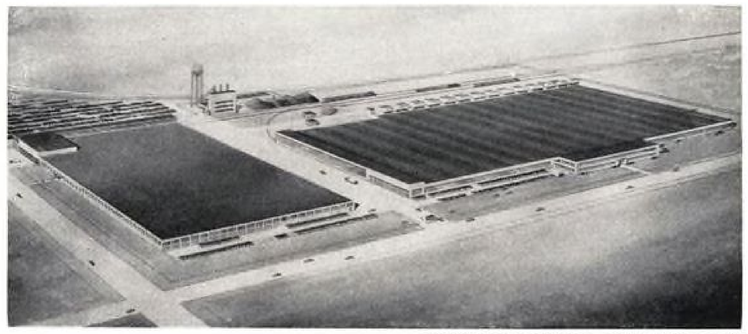
Automotive Plans for Engine Plants . . .



BUICK, CHICAGO FOR THE J-65 . . .



CHEVROLET, TONAWANDA, FOR THE R-3350 . . .



PACKARD, UTICA, FOR THE J-47.

War II. Plant includes 14 buildings, largest of which has 4.3-million sq. ft. Approximately 20,000 employes will work there and hundreds of subcontractors and suppliers, including many independents, as well as other Ford divisions, will make components when the engine gets in full production.

First production at Chicago is expected in March, 1952. This plant alone will use approximately 5,500 machine tools, but over half of these have been provided from the USAF machine tool reserves and are already delivered at Chicago. Ford has committed $132 million for engine parts and services and equipment for this plant to 1,636 other firms.

Lincoln-Mercury division is building a new plant for production of the Westinghouse J-40 engine on a 179-acre site west of Wayne, Mich. Started originally as an automotive assembly plant in August, 1950, the manufacturing plant is well along, but a Navy-built engine assembly plant scheduled nearby is still just an architects' drawing. It will be 1953 before any J-40s are rolling here.

In the Kansas City area at Claycomo, Mo., a new Ford assembly plant now under construction will get a structural steel go-ahead as a result of a contract to build wings for the very high priority Boeing B-47 bomber for the three airframe contractors, Boeing, Douglas and Lockheed. It will employ probably 6,000 at peak production in the 1-million sq. ft. plant. Other lesser Ford projects include a new plant to build fuel injection systems for the Wright R-3350 engine, at Ypsilanti, Mich., and the expansion of a Cincinnati transmission plant where parts for the R-4360 engine will be made.

General Motors Corp.

Three big programs are the major aircraft production assignments of General Motors plants.

About 3.5-million sq. ft. of floor space in three new plants under construction is allocated for the J-65 Wright Sapphire jet engine, at Flint, Mich. and at a large assembly plant at Willow Springs, Ill. near Chicago. Some production is expected on this engine as early as the summer of 1952 and approximately 14,000 employes may work in the three plants at peak production, with other GM divisions, principally Oldsmobile and Brown-Chapin plants, contributing components, and the Buick-Oldsmobile-Pontiac division operating the plants.

One of the few prime contracts on a military aircraft held in the automotive industry, is another B-O-P division assignment, to build Republic F-84F jet fighters at a 1.7-million sq. ft. plant at Kansas City. This plant was filled with 10½ ft. of Kaw River water during the recent floods, necessitating a major machine tool reconditioning program and plant clean-up, with consequent delays.

Forgings and machine tools are regarded as the princpal shortage problems at this plant where eventually some 15,000 to 20,000 employes may be at work in assembly and some production. About 45% of the program eventually is to be subcontracted.

Third major GM aviation project is Chevrolet division's scheduled production of Wright R-3350 engines (used in Lockheed Navy bombers and Fairchild cargo planes) at Tonawanda, N. Y. In addition to a 1.3-million sq. ft. government-owned aircraft plant here, 1 million sq. ft. of additional new plant space is being added to an already existing Chevrolet assembly plant. But the program is also being spread out to include component manufacture by perhaps as many as 14 other Chevrolet parts manufacturing plants. At this plant in World War II Chevrolet turned out some 65,000 Pratt & Whitney Aircraft engines, which gives some idea of potential output. Ratio of subcontracting is expected to be comparable to World War II when outside suppliers built two parts for each built by Chevrolet and GM divisions.

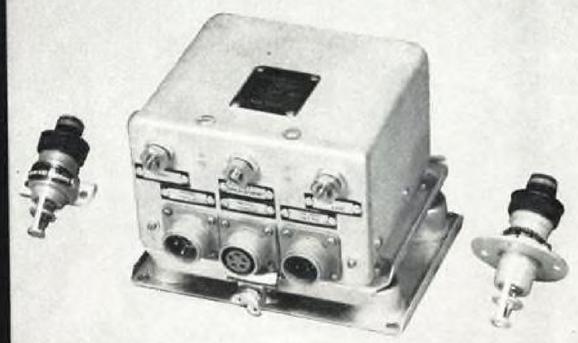
The huge GM organization has many other smaller defense contracts for the aircraft industry in its list, including equipment and components. And at least one additional major program is warming up and appears about to jell.

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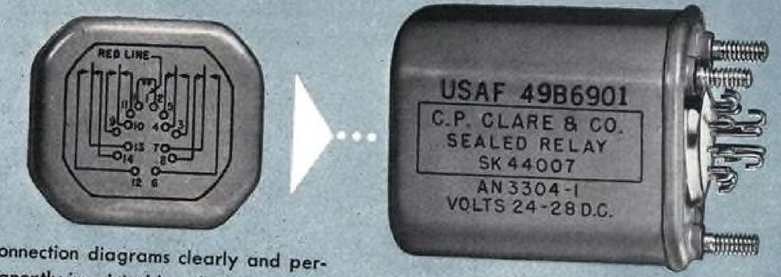


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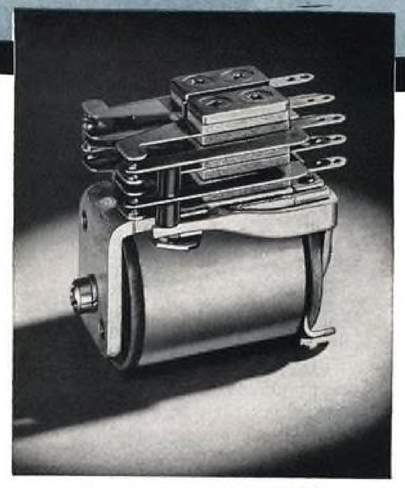
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Vibration Control Engineers

for a licensing agreement to make Grumman F9F jet fighters at a new plant at Arlington, Tex., where GM just acquired a 300-acre site. Neither of the manufacturers nor Navy has yet released any specific information on the F9F program, but it is common talk in Detroit that negotiations are under way.

Hudson Motor Car Co.

Hudson has probably more engineering know-how and manpower available for additional defense contracts than any other comparable auto company. This is because an Air Force engine contract switch lost Hudson a program to build the Wright R-3350 engine at a new plant and instead gave it to Chevrolet at Tonawanda. Principal Hudson aircraft business now is a substantial subcontract from Glenn L. Martin Co. to build aft fuselages and tails for the twin-jet B-57 Canberra bomber.

Kaiser-Frazer Corp.

With 1 million sq. ft. of space in the big Willow Run K-F plant assigned for airplane production, work is well along on setting tooling and fixtures, and the first detailed parts for the Fairchild C-119C transports are being put together. First 14 of the C-119s will be largely of parts built by Fairchild in a training program and the 15th will be the first product of Willow Run and its subcontractors. (For additional details on the Willow Run program, see AVIATION WEEK Sept. 10 issue p. 19-20.) Other K-F programs include manufacture of the Wright R-1300 piston engine, (used in the North American T-28 trainer) at plants at Detroit and Dowagiac, Mich. (total of 740,000 sq. ft.), and manufacture of flaps and fuselage sections of the Lockheed P2V Navy bomber at an Oakland, Calif. plant. K-F subcontracting on the airplanes is estimated at 35% and on the engine at about 39%.

Packard, Studebaker, Willys

Concentration of three of the other automotive manufacturers on production of the General Electric J-47-23 jet engine indicates the importance of this powerplant in the overall military picture, to power the B-47 jet bomber, the North American F-86 Sabre fighter and other current first-line craft. Packard's program goes into approximately 1.5 million sq. ft. of new plant space, most of it at Utica, Mich. for parts and assembly and 250,000 in a new forge plant at Detroit.

Value of the Packard program alone has been unofficially estimated at $500 million. Studebaker's program is spread to three plants, at South Bend, Chicago, and New Brunswick, N. J., utilizing for the most part already existing plant space. While Willys has purchased a plant at Anderson, Ind. to make J-47 parts for General Electric, with a value on the contract estimated at $63 million.

Nash

The remaining major aircraft assignment of the automotive industry goes to Nash to build the Pratt & Whitney R-2800 piston engine at Kenosha, Wis. Interest in the Nash production is keen in the air transport field, since this engine powers Douglas, Convair and Martin transports. It is also assigned for several key Navy and Air Force planes, and is probably the most widely used piston engine in both services.

Auto Firms at Work on Planes . . .



FORD BUYER looks at parts for fuel injection system at Bendix South Bend plant.



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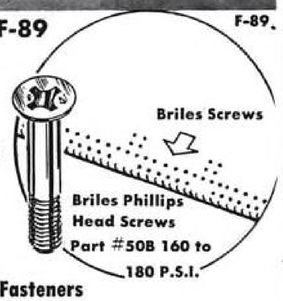
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Licensee Production Due to Be Smoother

Detailed postwar industrial planning will obviate many of the headaches suffered during World War II when automotive builders were brought into aviation production.

Cases like the Convair-Ford B-24 program are not likely to be repeated. Then, lack of sufficient production drawings not only caused a slowdown in getting started, but also created confusion in interchangeability of components on Ford and Convair built Liberators, since Ford prepared many of its own drawings to make the plane more suitable for mass output.

In the case of the Republic-General Motors F-84F fighter program, there is a constant interchange of personnel and data—GM will have the benefit of more than a year's cooperation with Republic before it begins its production. Each company builds tools for itself and the other, and subcontractors do likewise. Republic has furnished the auto-maker with some 2,000 basic tool drawings covering 30-40,000 tools needed to make the F-84F.

Also many of GM's personnel gained aviation experience in World War II.



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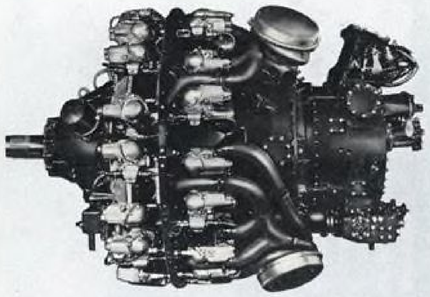




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Photograph courtesy of Wright Aeronautical Corp.



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Photograph courtesy of Stratos Division—Fairchild Engine and Airplane Corp.

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AVIONIC EQUIPMENT



MASS PRODUCTION of avionics is possible, as this line at AC Spark Plug shows.

New Industry, New Problems

Reserve production potential of consumer electronic companies may be delusion if ever put to test.

• There is no serious bottleneck now in avionic deliveries—despite what you may hear.

• In case of sudden expansion there might be. The television-radio industry has tremendous potential—but can it be used?

By William Kroger

The avionic equipment industry is meeting production schedules, government buyers and planners say, and can meet higher schedules, in the future, but—

The inevitable "but" comes from a doubting aircraft industry representative: "But for what kind of an Air Force—what we are producing today, or what we will be producing a year or 18 months from now?"

That question gets right to the heart of the production status of the avionic equipment industry.

• One, aircraft output now is so low in terms of military demands that undoubtedly the avionics industry can keep up with it.

• Two, even though planes being produced in quantity today require extensive avionics, planes only going into production or to go into production within 18 months will require far greater avionics production.

• Three, those planes will be in the Air Force in the expected critical years of the middle fifties, and they require avionics equipment not even in production yet.

►**Three Elements**—Any conclusions about the role of the avionic equipment industry in production for air power can't be based only on whether the industry is now meeting schedules and can produce to today's requirements. You have to examine three interrelated elements: military demands, the avionic equipment industry's production capacity and techniques, and technical development of avionic devices.

Weighing those three factors creates doubt that the avionic gear that is theoretically practical will be in volume production at the same time as the airplanes for which it is being designed. Balancing that impression is the supreme confidence that government people concerned with avionic equipment production have in the industry's ability to meet any goals imposed on it.

►**Faith & Hope**—Government men charged with wresting from the avionics industry the weird and wonderful devices that think and plan and act seem to have far more confidence in the avionics industry than aircraft planners have in the aircraft industry.

This could well be because avionics is a new industry. Both government and industry men think in terms of electronics, and millions of television and radio sets. When you're in that



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frame of mind, schedules in hundreds or thousands seem easy. Up to now the electronics industry has experienced in only a small measure the delays in production that can be occasioned by changes in military requirements and demands. They have had a taste of it, though, and should realize what may be ahead.

1. Military Demands

The total military electronics budget for fiscal year 1952—Army, Navy and Air Force—is $3,277,536,000, which will be spent over several years. (This amount may be increased by recent congressional action.)

Measure that against the 1950 commercial sales of electronics manufacturers of about $2.5 billion and the current annual rate of military production of about $1.5 billion, and you begin to see the reason for the feeling that the electronics industry can handle anything the military sends its way.

▶ **Half a Loaf**—Other facts, on the surface, heighten that impression. The avionic manufacturer produces only about one-half the value of the delivered equipment, the balance being the cost of items coming from subcontractors and suppliers.

Of the $3.2 billion originally budgeted for military electronics, somewhere between $1 billion and $1.5 billion will be spent on aviation electronics, or avionics. Using the higher figure as a guide, the avionics industry can meet its fiscal 1952 obligations with production worth to the manufacturers of only $750 million.

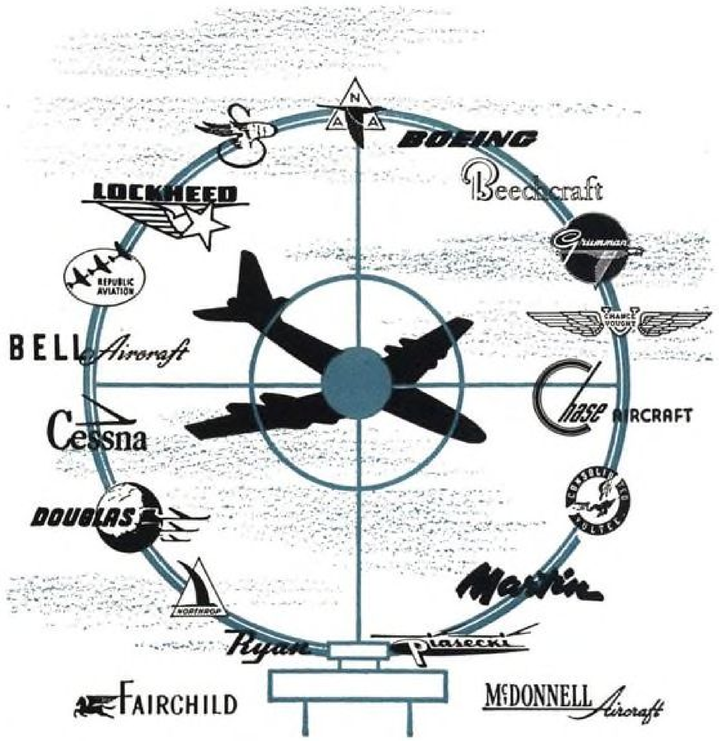
And the entire electronics industry—not just the aviation electronics firms—produced three times as much as that in commercial goods alone last year.

Then, there is the volume entailed in military orders, and the size of individual units. In 1950, the electronics industry produced more than 7 million television receivers and about 14 million home radio sets.

In contrast, Glen McDaniel, president of the Radio-Television Manufacturers Assn., recently told the West Coast Electronic Manufacturers' Assn., "The manufacturer of mass production radios and TV sets is likely to find that the biggest order he can get for a military item is 50,000 or 60,000 units. He could handle that job in ten or 15 days of production, but it takes him 18 months to prepare for the production run."

▶ **The Bigger They Are**—Whittling away at the tremendous production capabilities of the industry is the fact that not too much of the military business is suitable for mass production. McDaniel estimates only 20% can be mass-produced.

He cites as an example a radar set



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which might cost $400,000 and cannot be assembled on a production line. "Assembly might be done by a total of 60 people," he declared, "of whom half must be engineers."

There are even more striking examples. Bendix is producing a mobile search radar which costs the AF $782,798, weighs more than 90,000 lb. and requires fourteen 2½-ton trucks to transport.

This particular radar set, according to the Air Force, requires 35,000 production manhours. On the basis of 2,000 manhours a year, and using only one of many possible combinations, that could mean 50 men working about four months. A quantity of less than 100 of such units would be a large order in terms of AF expenditures—but not in terms of production manhours available in the avionics industry.

▶ **Meshing the Gears**—If money for expenditure can give a deceptive idea of the avionics industry's production potential, a study of schedules strengthens the misconception. Avionic production is geared to aircraft production, and manufacture of some avionic items is being carefully regulated to keep the two programs meshed.

Avionic items now generally arrive in an airframe manufacturer's plant about four weeks before installation date. Most airframe producers would like to have the avionic equipment in their plants about four months ahead of installation. Plans are eventually to meet that goal. But right now most airframe people aren't ready for such a schedule.

Not long ago, government procurement men made a test. They took the brakes off one particular item and let the avionic producer meet the delivery dates asked by an airframe manufacturer. The latter couldn't use the equipment fast enough, and had insufficient space to store it.

▶ **Slow to Get Tough**—That, however, is by no means the common situation. There are many other items which are not keeping pace with aircraft production. The Air Force insists it has not refused acceptance of any aircraft because of missing avionic gear. But it has had to accept planes without all the avionic devices programmed for those planes.

Such planes are operational only in this country and for certain purposes. Without the missing items, they are not ready for combat. More serious, perhaps, is that every day aircraft are being accepted with avionic gear that does not meet the latest Air Force specifications.

Those specifications are difficult to meet. Airborne avionic equipment should be hermetically sealed, have minimum size and weight and a minimum life of 1,000 hr., and operate with efficiency at 70,000 ft., and when subjected to temperatures between −60C and +200C, and shock of up to 50G for 10 milliseconds. Those specifications now are more than a year old. There is little equipment that meets them in the laboratory, and even less outside.

▶ **Take Tubes**—Meanwhile, the Air Force makes do with what it has. An example is vacuum tubes. Insufficient reliability of six types of tubes used in certain navigational, fire control and bombing systems has been one of AF's biggest headaches for several years. A recent Air Materiel Command report states that 50% of all aircraft mission failures are due to unpredictable failures of vacuum tubes.

To illustrate the problem, the report details that to mount a 40-aircraft B-50 mission, considering only the navigational system, requires that 10,000 vacuum tubes must operate for 15 hours. That equals 150,000 tube hours or the equivalent of a six-tube household radio operating continuously for three years. "In this case," reads the report, "a tube failure rate of only four-tenths of 1% could cause a complete mission abort."

When the Air Force considers tubes vs. a B-36 mission the figures are

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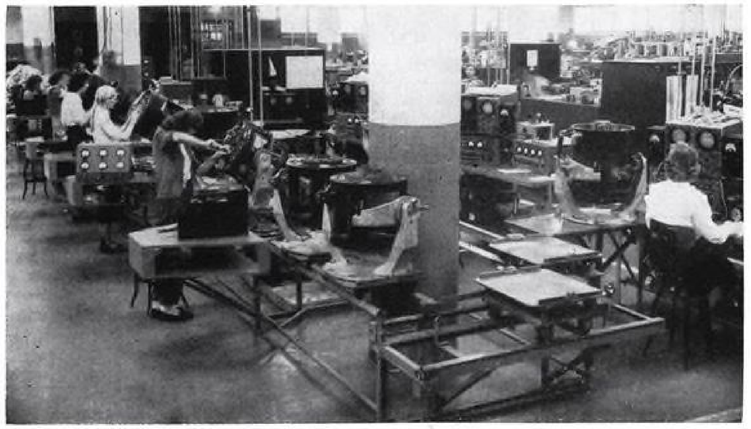
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GREAT SIZE of some units, such as these parts of a bombing navigational computer being produced by AC Spark Plug, complicate the mass production plan.

staggering. A 30-aircraft mission is equal to 1,500,000 tube hours, or the household radio set operating continuously for 30 years. Adds the report: To make the household radio set operating continuously for 30 years meet the same conditions as the tubes in the B-36 you would "also have to keep the set in an oven at 200 F and drop it on the floor every 10 minutes."

▶ **Development Problems**—Undoubtedly the avionics industry long ago could have perfected tubes to meet AF's requirements on reliability. But tubes are bought by the contractors; and the quantities needed for equipment being built for the Air Force are relatively so small that an avionic manufacturer couldn't get the tube manufacturers to spend the amount of money and time required to develop such tubes.

So the Air Force took over the project. At a meeting last January, the tube manufacturers estimated it would take two years to get volume production on tubes meeting the Air Force long-range specifications. Tubes meeting those specs now are under development.

But the Air Force can't wait two years. So interim specs were drawn up for tubes which are an improvement over the present ones, and could be on the production lines in six months.

The interim types of tubes now are being produced. As they are delivered, they replace the former types. But they still are not the tubes the Air Force says it needs fully to perform its functions. When tubes that meet the long-range specs are delivered, they will replace the interim types. The same system is being followed on other AF avionic items. The Air Force gets along as best it can until its "ideal" items are available.

▶ **If Time Runs Out**—Meanwhile, it is not a fully efficient Air Force. This "phasing in" of new equipment as it becomes available is the only answer to AF's present dilemma. If it held out for its super-high performance equipment, it would not be able to accept delivery of planes, and in addition existing production schedules of the avionic industry would be disrupted. It is the sensible way out of a bad situation—if war is really three or four years away.

At the moment, the Air Force has time for this phasing-in procedure; and because it has that time, it puts avionic output fifth on the list of bottlenecks in the expanding aircraft production program. If that time suddenly should run out, the avionic equipment industry's ability to expand overnight would become of far more importance.

2. Productive Capacity

The productive capacity of the avionics equipment industry largely depends on what kind of equipment you have in mind. If it is the 20% that McDaniel says can be mass-produced, there is no shortage of capacity. The Radio-Television Manufacturers Assn. made a survey of its members in June and the response indicated that only 50% of capacity was being utilized in military and civil work combined. Defense production used 11% of capacity. Confirmation came from Air Force officers who testified to a House Appropriations subcommittee that military work was using less than 50% of the electronics industry's capacity.

▶ **TV Talisman**—A look at the advertising pages of any daily newspaper is one index of the state of the mass production segment of the electronics industry. Television sets are gathering dust in dealers' warehouses. That, of course, curtails production in the manufacturing plants.

Last fall and winter the threat of imminent cuts in materials for television production sent sets cascading from plants to dealers. The production

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WHEN the Air Force and Consolidated Vultee, manufacturer of the B-36, decided it was necessary to have a pressurization booster on this king-size bomber, they really threw the design-book away. The requirements for the blower would cause any prospective fan supplier to have misgivings. Specifications called for three separate fan-duties:

a *1180 CFM at 32" W.G., with an air density of 0.044 lbs./cu. ft.*

b *700 CFM at 40" W.G., with an air density of 0.10 lbs./cu. ft.*

c *680 CFM at 26" W.G., with an air density of 0.070 lbs./cu. ft.*

Space and weight limitations were stringent. The fan had to operate without excessive horsepower requirements due to a critical load on the generators. In addition, the fan motor had to be protected from hot air in the duct system.

Just about when the job seemed impossible, it was turned over to Joy engineers . . . and not only was the problem solved to the complete satisfaction of both the Air Force and the manufacturer, but the prototype fan was in their hands only six months after Joy received the order.



Front View **(INLET)** *Rear View* **(OUTLET)**

The fan exactly meets the three duties specified. It is 10" in diameter and 17" in length. Because of its combination of magnesium and aluminum construction, the fan weighs only 54 lbs. It is a two-stage unit, driven by a two-speed, 400-cycle motor. The efficiency of vaneaxial-fan design permits using a motor rated at only 12.6 H.P. continuous duty. The stationary vanes which support the motor are hollow, so that cooling air can be continuously directed over the motor. Each stage of the fan has a set of straightener vanes. Casing and hollow vanes are a single casting for shock-resistant strength.

● We freely admit that this is one of the toughest fan design-problems Joy engineers have ever tackled. On the other hand we are just as sure that, in the future, even harder problems will be taken on and solved. Even if your aircraft fan problem is not a difficult one, it is a good bet that the incomparable vaneaxial-fan design know-how which produced *this* AXIVANE fan will give you the most for *your* money. If you need an aircraft fan for any purpose, call on JOY—the world's largest manufacturer of vaneaxial fans.

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cutbacks never came. But credit controls did; so did rising prices of consumer necessities. And the market was glutted. So dealers inventories of television sets remain high; until they are disposed of, production lines can't resume last year's tempo.

Result is unemployment in an industry that the public thinks is rushing into the air power build-up. McDaniel cited one case: RTMA members normally employ about 200,000; those companies have lost 50,000 workers. One union in Chicago that represents radio and television workers reports that one-half of its 26,000 members are unemployed.

▶ **Soft Foundation**—The significance of those facts is this: the electronics industry is the foundation of the avionics equipment industry in the minds of the military planners. The avionics industry—those firms whose normal business in peace or war would be manufacturers of aviation electronic devices—could never alone maintain the flow of gear necessary for a 130-wing or 160-wing Air Force. The producers of other military electronics and of civilian goods would have to augment greatly the avionic industry's production.

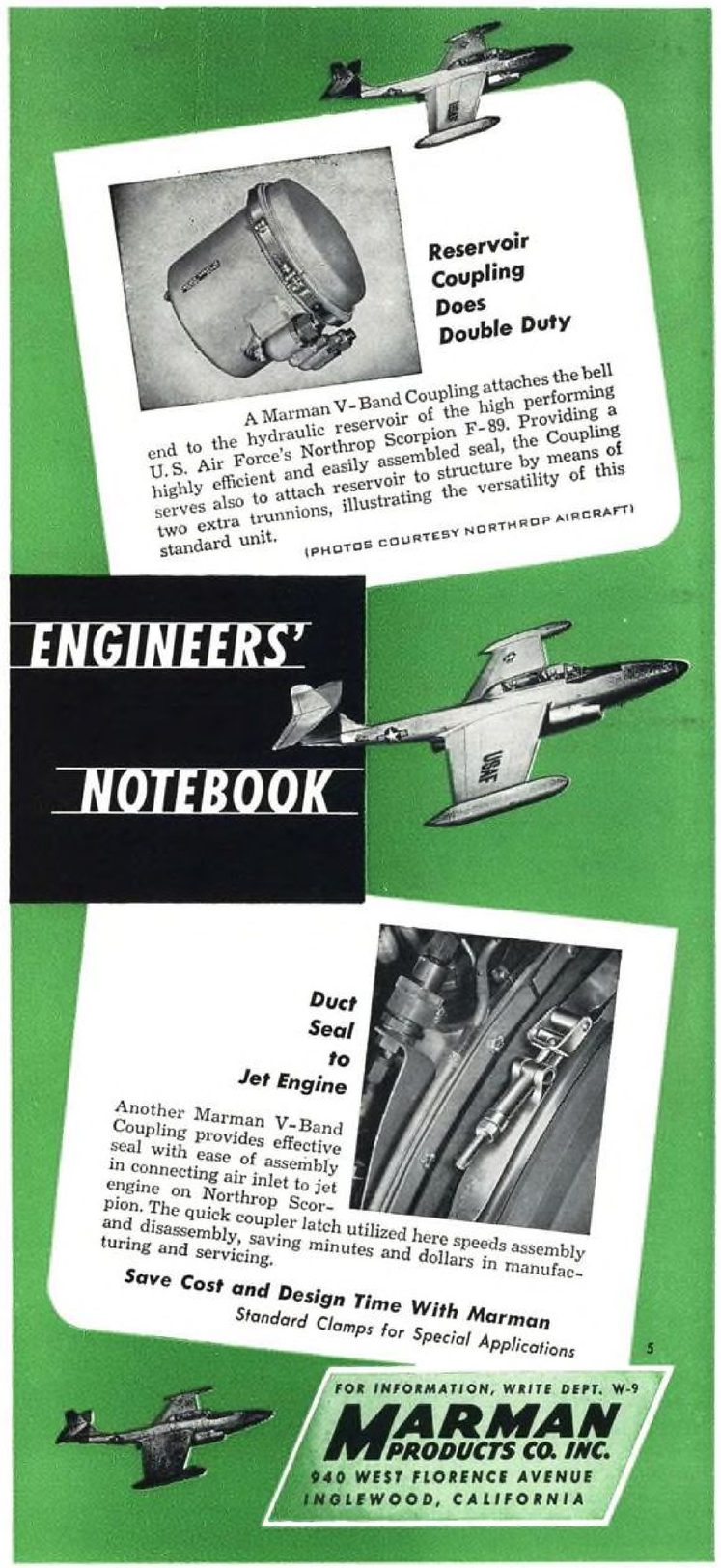
Such producers are ready, willing and—to an extent to be brought out later—able to start right now on that augmenting job. Every government official concerned with electronics or avionics says the electronics people are crying for government business. The business is not there. And what there is does not call for the immense capacity of the electronics industry.

While most avionic money is earmarked for production, most of the effort of the avionics industry is still going into development. Development doesn't necessarily require large production capacity nor large working forces.

The kind of equipment being bought, as McDaniel said, tends to limit the utilization of the electronic industry's capacity. Contracts are for not only compact and complex airborne avionic equipment, but for mammoth and complex ground avionic equipment that costs staggering sums of money.

AN/MPS-7A mobile search radar produced by the radio division of Bendix Aviation Corp. uses more than 500 tubes; 2,000 resistors; 1,500 condensers; 300 transformers; 10 miles of circuits; 30,000 lb. of steel; 2,000 lb. of copper; 10,000 lb. of aluminum. The entire system requires three 60kw. power units, each weighing about 5,000 lb. The equipment has 23,370 replacement parts.

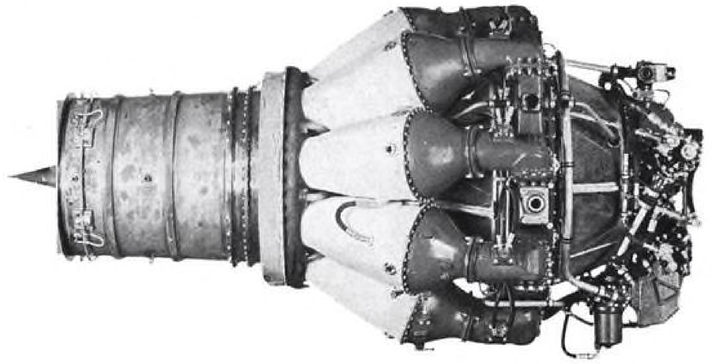
Semi-automatic telegraph switching equipment produced by Western Union uses 225,000 soldered joints; 20 tons of steel; 750 lb. of copper and copper





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alloy; 1,000 lb. of aluminum; 150 miles of copper wire; 1,400 removable units for telegraph purposes; 1,910 relays; 198 rotary switches; 305 signal relays comprising one, two or three relays each; 393 electrical motors; 236 polar and single current line relays; 114 electronic timers; 76 consoles and tables; 4,800 different types of parts.

Orders for such equipments are placed with avionic manufacturers; but those manufacturers are concerned more with assembly. And most of the present facilities of the electronics industry—which in a sense is the industrial reserve for avionics production—is most suitable for assembly.

▶ **Components Flow**—The rate of assembly, of course, is determined by the thousands of parts which must flow into the prime manufacturer. That is another clue to just what the government people mean when they say the avionics industry is meeting schedules. Actually, the assembly plants are on top of their own work schedules. But there are shortages of components.

Development, production and availability of components must be the nucleus of any assessment of the productivity of the avionics industry. One phase of the tube problem has already been examined. They are other components just as worrisome.

Perhaps the best analysis of this entire field was published more than a year ago under the title of "Electronic Equipment Construction"—a report by the Stanford Research Institute to the Office of Naval Research. Although the passage of 12 months is a very long time in an industry growing as fast as avionics, this report is still referred to as the "bible" by many government electronics people.

In discussing components, the report proceeds on the assumption: "Much of modern component design has been influenced by new equipment design trends. This has led increasingly to development of specialized components. Many recent instances are found in which equipment designers abandoned standard items and used components developed specifically for their requirements."

▶ **Many Into One**—This tailoring procedure, of course, contributes to the present bottleneck in some components. But over the long pull, it may also contribute to speedy production. One example is multiple component units, which contain several capacitors, resistors, inductors and other such parts.

With the advantages of multiple component units demonstrated, their development has accelerated to the point where some now are actually large subassemblies. The Stanford report cites the "Ampec" unit of Centralab which, while a multiple component, is transferred into a functional device by addition of three tubes, external gain control, batteries and output circuit.

Despite the growing complexity of multiple component units, they are more susceptible to line production methods. Says the report: "Mechanized fabrication techniques can be applied more readily to such elements than to an equivalent subassembly of individual components, thereby reducing production time, costs and the human error factor.

"The work of the manufacturer who fabricates finished products is simplified because the number of soldered connections, mounting strips, binding posts, and stray wires is greatly reduced."

▶ **Mechanization**—This development of multiple component units is only one of several encouraging production methods found by the Stanford researchers. Their report points out that for some years now U. S. electronics producers have used mechanized methods, and the multiple components idea fits right into that concept. Another branch of it is packaged subassemblies which are fed right into the final assembly line.

The Stanford report is blunt about the need for mechanization: "The labor force necessary to produce, by methods used during the last war, the much greater quantities of equipment that will be demanded in the event of future global war, simply will not be available."

But substantial progress in mechanization was found. In addition to the multiple components, these were prefabricated circuits, a start toward mechanized assembly of components, and mechanized connection of components to prefabricated circuits by techniques already developed to replace hand soldering.

▶ **Assembly Machine** — Dovetailing neatly with the U.S. defense planners' program of expanding the base of production is a technique of mechanized construction of electronic equipment that the Stanford report found was given a trial in England following World War II.

Sargrove Electronics Ltd. built a machine intended for the mass production of five-tube radio sets. Conductors, resistors and capacitors were fabricated directly onto the base panel as the latter passed through the machine. Tube sockets were automatically attached to the panel. Only hand work that had to be done was attachments of such things as the speaker and transformers.

The Sargrove machine was a pioneering effort which failed not necessarily because of the limitations of the machine itself, but because—as the Stanford report indicates—it was really ahead of its time. Its initial cost was $250,000. But it had to have a production run of at least 20,000 sets before it could compete with conventional manufacturing methods. And annual production rate was 500,000 sets. Tooling for a new model set requires eight to ten weeks—but after that the new model can be pouring from the machine in a few days.

▶ **Too Big**—Looking at the Sargrove machine from a standpoint of avionics equipment for air power, its most serious limitation would be the tremendous quantities necessary to make it economically worth-while. As has been pointed out, such quantities just aren't being contracted now. Neither the tooling time nor the initial cost is excessive when measured against present production techniques.

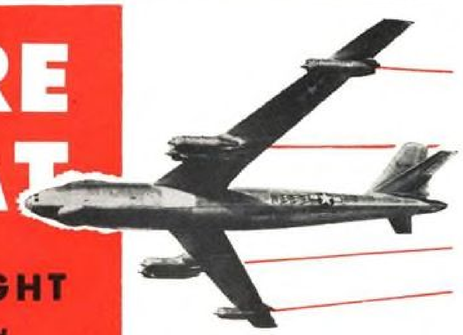
During the congressional hearings on the Air Force budget, it was brought out that tooling for production of an electric generator for starting the B-47 takes five months. Before that point is reached, it takes 30 days to make the production drawings. After the tooling is set up it will take another 60 days before the first five generators are produced. Five more months—bringing the total time to 13 months—will be required to attain full production.

The Air Force calculates that generally the lead time on avionic items is nearly 20 months. This almost two-

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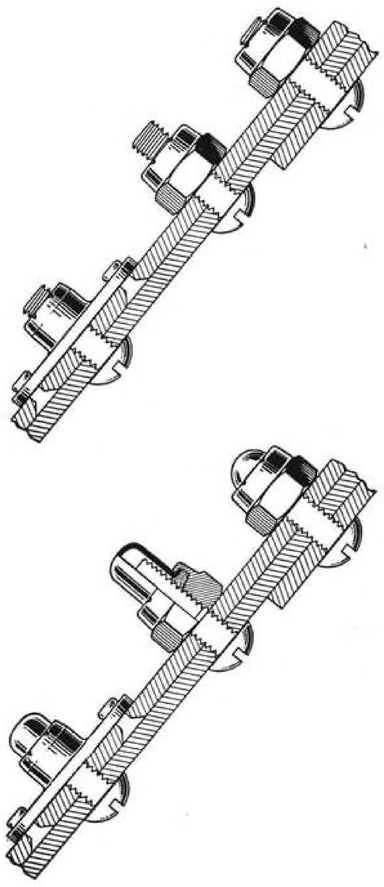
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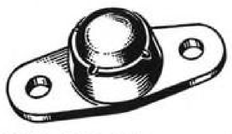
Fastener Problem of the Month

SEPTEMBER, 1951

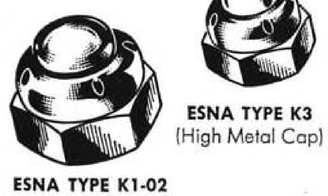


PROBLEM: Protection against rough, protruding bolt ends — whether for reasons of safety or to improve appearance — is frequently desirable and, in fact, a requirement, in many parts of an aircraft structure. A typical application is found on wing members where bolt ends project into fuel tank areas. To prevent abrasion of rubber fuel cells — current practice for some manufacturers calls out taping of bolt ends as a preventive measure. Another application is found in cockpits or hatchways where unprotected bolt ends can rip flying suits or injure personnel.

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year lag is intimately bound up with technical development of avionic equipment.

Technology vs. Production

Of all the limiting factors in expansion of avionics production, the most severe likely will be technological.

The Stanford report supplies a keynote: "It is fairly well established that the problems of building, transporting, installing, operating and maintaining the large quantities of complex electronic equipment required aboard today's military craft are incapable of satisfactory solution by methods in use today."

► **Pre-Production Investigation** — For that very reason, the Air Force has a number of projects to explore the new production methods that will be necessary. One of these, costing an estimated $4.3 million, is to redesign subminiature vacuum tubes and buy machinery and equipment for pilot production. This is an extension of the AF's new-tube program. After securing reliable tubes, the attempt will be made to subminiaturize those tube types with the same degree of reliability in operation. This project covers 20 of 125 tube types requiring attention—less than one-fifth.

Another of these "pre-production" projects is to develop a pilot production line for miniature relays. This is a new family of 28v. d.c. reliable, hermetically sealed relays which so far have been made in laboratories only. Now the Air Force proposes to try several different ways to design the relays, acquire tools and develop processes for a production rate of 500 a day.

Development of a pilot production line for another type of miniature relay will cost $525,000. A new type of potentiometer has been built in the laboratory, and the Air Force efforts to bring this along to the production stage are estimated to cost $100,000.

► **Small Market, Small Reserve**—Items such as these are critical in the avionic equipment picture because of the old fact—a limited market. Commercial tubes, relays, potentiometers, etc., need be neither subminiature, nor unduly rugged. The result is that military types are going to be very costly. They will be completely foreign to past production of the avionics industry and thus will require new tools and techniques; and because the demand for the items is relatively small, there will be no necessity for the over-all electronics industry to build up know-how in those new techniques. In case of sudden military demands, the reservoir of experienced producers just won't be there.

As the AF projects indicate, the accent is on miniaturization and subminiaturization. This is another reason



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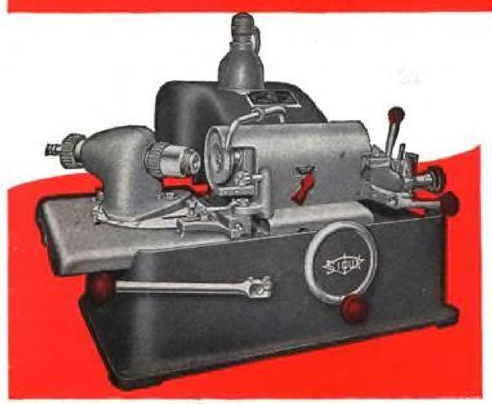
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to feel that the expansion of avionics production will not be as simple as just ordering the stoppage of television production and conversion of the lines to avionic equipment.

The Stanford report declares: "Contrary to the impressions of some, workers rapidly become skilled in the use of miniaturized hand tools in work on miniaturized equipment." Some manufacturers, notably Hughes Aircraft, are having signal success with women workers on avionic equipment production lines.

Still, it isn't solely a matter of workers. Government planners feel that the average electronic production line worker can be quickly taught to assemble the high-quality avionic devices. The difficulty is that in many cases it is not quite certain yet what the workers have to be taught.

▶**The Unknowns**—In the case of subminiaturized equipments or components, most are still in the laboratory and little is known about production methods for them. An example of both a design and production problem: Purpose of subminiaturization is to pack more components in the smallest possible space. Purpose of ruggedizing subminiature components is to obtain reliability at extreme altitude (among other conditions). When you compact the area of the installation, you also compact the area that would carry off the heat of the tubes. High temperatures affect reliability. To avoid ill effects of altitude on reliability, the installation should be pressurized and hermetically sealed.

How do you seal an installation and still carry off the heat? Until that question is satisfactorily answered, you do not know what your production workers will have to learn, or even whether the experienced worker can be taught any quicker than the tyro.

▶**How About Plants?**—But even assuming the problem of converting workers will not be too great, expansion planners have to contend with the possibility that converting the existing commercial plants to production of high-performance equipment may be a bottleneck. An inquirer gets conflicting reports on this aspect.

On the one hand, some experts say that most of the existing plants can be used with little or no changes. Others declare that equipments that meet the AF specs on altitude and temperature performance will be so sensitive that the plants producing them will be air-conditioned, with humidity control, and with working areas shielded from dust.

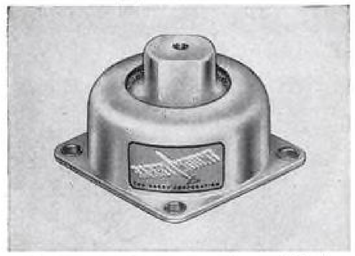
Here, as when you talk about schedules, it may be a matter of what kind of production you mean. If it is final assembly, existing plants probably can serve very well because chances are they

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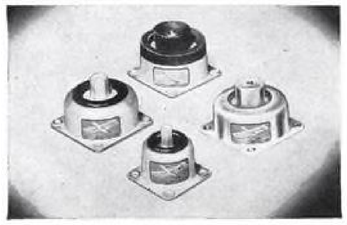
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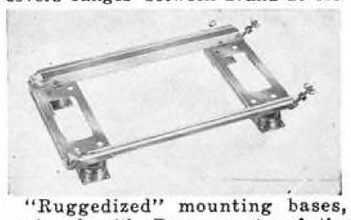
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will be handling multiple component units or other subassemblies that already are hermetically sealed. So that throws the problem back at the component manufacturer. It is generally agreed that if any specially treated plants are necessary it will be the component manufacturers who will need them.

A move in this direction already is discernible. Several avionic manufacturers who fabricate some of their own components—Lear, Inc., Minneapolis-Honeywell and Hughes Aircraft, for example—have portions of their plants specially treated.

► **The Unknown Again**—The technological development of avionics bears on this problem, too. As so many of the new high-performance devices are still in the laboratory stage it is not fully known how many of them will require special manufacturing facilities. One that does, it has already been determined, is the latest type of interphone communication set used in Air Force planes.

But it is readily apparent from the accompanying partial list of new facilities planned that there will be some new plants needed. The Radio-Television Manufacturers Assn. says that 300 firms have applied for certificates of necessity for expansion of production facilities.

Remembering that the same source is the authority for the statement that electronic manufacturers now are using only 50% of their capacity, it would be logical to deduce that the production lines that last year slithered forth 21 million radio and TV sets aren't all we need to push avionic production higher.

► **The Big Stuff**—Much of the debate over whether existing plants can be readily converted to avionic equipment production revolves around the airborne devices which, because they are airborne, have to be fairly small. When you consider ground avionic equipment you put the debate on a different plane.

The ground radar sets mentioned before are huge equipments. One is shipped to the installation site in 50 railroad cars. Completely assembled, equipments of this nature weigh 50 tons and more. Final assembly areas for such devices are going to have to be more comparable to assembly areas of aircraft and automotive plants than to the assembly lines of small radio and instrument manufacturers.

The final determinant of whether the existing labor and plants of the electronic industry will be sufficient for expanded production for air power probably will be the technological development of avionics. This will control what kind of equipment will be produced X years from now, and the kind



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of equipment will control the production methods.

As the situation stands now, Air Force and Navy fully believe that there is no avionics bottleneck in the new, high-quality equipment because planes that utterly depend on such equipment are several years from volume production. The military expects the avionic equipment to be flowing off the lines at the same rate as the airframes when it is needed.

▶ **How About Engineers?**—The only factor that casts doubt on that expectation is that development of the new equipment is lagging. The reason is familiar to everyone concerned: shortage of engineers.

The industry has gotten itself into a peculiar box on this matter. Several years ago, military agencies were beseeching electronic manufacturers to accept development contracts on avionic devices. But consumer demands for radios, television sets and other appliances had to be filled.

The old-line avionic equipment firms took on as much development work as they could handle, then new sources had to be found. Both for that reason, and because of the specialized nature of the devices, many airframe firms delved into avionics work. Other companies, such as the AC Spark Plug division of General Motors, found themselves with large-scale development and production contracts from the armed services for avionic equipment.

All this inevitably started engineers flowing away from the electronic companies. Without overlooking the fact that all companies—both newcomers and long-established firms—are short of engineers, the shortage likely will be most critical if it is ever necessary to try to tap the production potential of consumer goods electronic firms. Production of avionic equipment requires more engineers than, say, production of television sets.

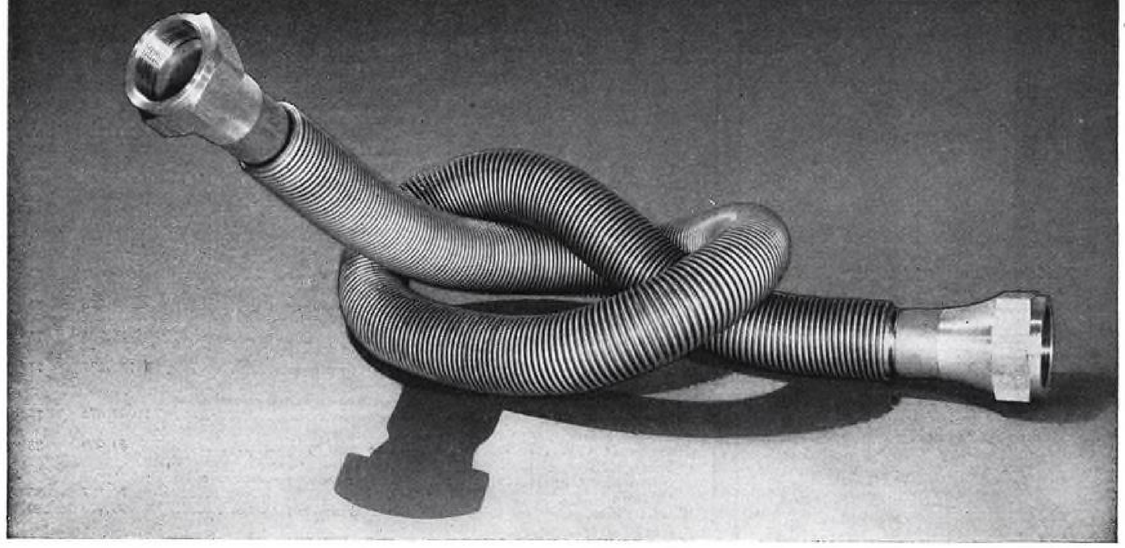
So you have unemployment in the electronics industry, and surplus capacity. You have business that perhaps the industry could handle, but you have a shortage of engineers.

And you have an avionic device, the Sperry-developed gun-bomb-rocket sight in production at a spark plug company, with further production scheduled at International Business Machines Corp., National Cash Register Co., Mergenthaler Linotype Co., Burroughs Adding Machine Co., and Victor Adding Machine Co.

That is the result of the technological advances in avionics that makes the equipment more adaptable for production by such companies than by the big consumer electronics industry that is supposed to be standing by ready to expand avionics production when given the word.

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flexible stainless steel hose



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CMH REX-FLEX flexible metal hose products are made in a variety of forms that include ducting, flexible connectors, bellows and braided and unbraided hose types that include C.A.A. approved fireproof fuel and oil line hose assemblies.

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Flexon identifies CMH products that have served industry for over 49 years.

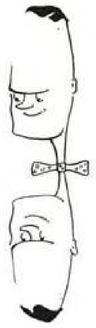
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two heads are
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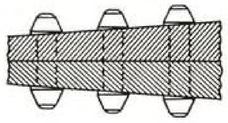


It features the closest tolerance of any aircraft fastener—one-half that of the NAS 334 bolt.



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It is lighter, stronger and easier to install than a taper pin.



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Plants and Equipment

PARTIAL indication of the facilities expansion taking place in avionic equipment production is furnished by the following list. These are certificates of necessity granted by the Defense Production Administration between Oct. 20, 1950, and Aug. 18, 1951, when issuance of such certificates was suspended.

THE dollar figures are the amounts DPA decided could be certified as necessary to spend for defense purposes. The percentage figure is that portion of the certificated amount that the firm will be able to write-off for tax purposes in five years.

Name of Company	Product	Amt. Cert.	Percent Allowed
Allied Control Co. Plantsville, Conn.	Relays and coils	$56,149	80
Allied Control Co. New York, N. Y.	Relays and coils	35,430	90
Arma Corp. Brooklyn, N. Y.	Control instruments, computing devices	173,718	80
American Electric Motors, Inc. Los Angeles, Calif.	Aircraft gyroscope motors	4,246	85
Aero Electronics Co. Chicago, Ill.	Velocity indicators	3,461	85
Airborne Instruments Lab. Mineola, N. Y.	Antennas	117,810	80
Airborne Instruments Lab. Hempstead, N. Y.	Antennas	738,380	80
Avion Instrument Corp. Paramus, N. J.	Fire control systems	63,000	75
Allen B. Dumont Laboratories. Clifton, N. J.	Electronic equipment	27,625	75
Allen B. Dumont Laboratories. Clifton, N. J.	Electronic detection equipment	11,755	75
Bendix Aviation Corp. Teterboro, N. J.	Aircraft instruments	1,138,237	75
Bendix Radio Division Bendix Radio Corp. Towson, Md.	Aircraft communications and radar equipment	1,008,474	75
Blaw Knox Co. Blawnox, Pa.	Radio, radar towers	50,900	85
Curtiss-Wright Corp. Caldwell, N. J.	Flight trainers, simulators, radio aid units	70,137	85
Chatham Electronics Corp. Newark, N. J.	Electronic and radar tubes	23,276	80
Collins Radio Co. Cedar Rapids, Iowa	Radar equipment		
Collins Radio Co. Arcadia, Calif.	Radio units	777,382	80
Doelcam Corp. Newton, Mass.	Gyroscopes	319,994	80
Electrons, Inc. Newark, N. J.	Electronic tubes	4,088,390	75
Electronic Associates, Inc. Long Branch, N. J.	Electronic instrumentation	8,709	85
General Motors Corp. Flint, Mich.	Navigational computers	6,512,500	75
General Electric Co. Owensboro, Ky.	Electronic tubes	336,306	85
General Electric Co. Somersworth, N. H.	Navy compass systems	278,600	75
General Electric Co. Bridgeport, Conn.	Electronic equipment	131,700	75
General Radio Co. Cambridge, Mass.	Electronic test equipment	725,000	75
General Instrument Corp. Elizabeth, N. J.	Electronic equipment	30,612	85
G. M. Giannini and Co., Inc. Pasadena, Calif. and Springfield, N. J.	Potentiometers	29,922	85
Holley Carburetor Co. Van Dyke, Mich.	Aircraft controls	13,587	75
Holley Carburetor, Co. Detroit, Mich.	Aircraft controls	152,340	85
Hytron Radio and Electronics Corp. Danvers, Mass.	Electron tubes	3,333,000	75
Hanson-Lynn. Burbank, Calif.	Throttle controls	14,965	80
Helipot Corp. South Pasadena, Calif.	Potentiometers	53,623	85
Hastings Instrument Co., Inc. Hampton, Va.	Electronic receivers and indicators	255,315	80
Hogan Labs, Inc. New York, N. Y.	Electronic research and development	14,205	85

For Avionics Expansion

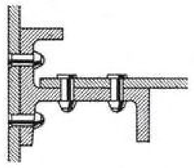
Name of Company	Product	Amt. Cert.	Percent Allowed
Jack and Heinta Precision Industries, Inc. Maple Heights, Ohio	Aircraft rotating electrical equipment	$410,900	90
Ketay Mfg. Corp. Unknown	Servo motors	278,670	85
Kearfott Mfg. Corp. Newark, N. J.	Instrument motors and synchros	59,358	75
Lewyt Corp. Long Island, N. Y.	Communication equipment	2,894,783	75
Lansdale Tube Co. Frederick, Md.	Electronic tubes	4,088,390	75
Molded Insulation Co. Philadelphia, Pa.	Cable connectors and radiosonde equipment	370,000	75
Monroe Calculating Machine Co. Morris Plains and Hanover, N. J.	Aircraft instruments	1,957,045	80
Matchlett Laboratories, Inc. Springdale, Conn.	Electronic tubes	60,600	90
National Electrical Machine Shops, Inc. Silver Springs, Md.	Electronic equipment and instruments	158,364	80
Pierce Governor Co., Inc. Anderson, Ind.	Aircraft controls	157,492	80
Radio Receptor Co., Inc. Brooklyn, N. Y.	Electronic equipment	455,000	70
Raytheon Mfg. Co. Waltham, Mass.	Magnetron tubes	2,007,720	80
Raytheon Mfg. Co. Quincy, Mass.	Electronic tubes	720,000	70
Raytheon Mfg. Co. Waltham, Mass.	Research and development	26,264	85
J. B. Seeburg Corp. Chicago, Ill.	Radio and radar apparatus	127,239	85
Sylvania Electric Products, Inc. Boston, Mass.	Electronic tubes	1,065,000	70
Sylvania Electric Products, Inc. Burlington, Iowa	Subminiature electron tubes	4,252,322	75
Sylvania Electric Products, Inc. Warren, Pa.	Electron tubes	790,695	80
Sylvania Electric Products, Inc. Boston, Mass.	Electronic tubes	47,688	80
Sylvania Electric Products, Inc. Warren, Pa.	Parts of electron tubes	427,533	80
Sylvania Electric Products, Inc. Seneca Falls, N. Y.	Thyratron tubes	844,604	75
Sylvania Electric Products, Inc. Salem, Mass.	Electron tubes	346,893	80
Sylvania Electric Products, Inc. Emporium, Pa.	Electron tubes	67,301	85
Sylvania Electric Products, Inc. Montoursville, Pa.	Electron tubes	216,756	80
Sylvania Electric Products, Inc. Radio and TV Division Buffalo, N. Y.	Electron tube production equipment	114,450	85
Sylvania Electric Products Inc. Warren, Pa.	Electron tube production	165,290	85
Summers Gyroscope Co. Santa Monica, Cal.	Gyroscopic aircraft instruments	70,844	85
Sangamo Electric Co. Springfield, Ill.	Sonar equipment	125,505	85
Stewart Warner Corp. Chicago, Ill.	Electronic Equipment	958,600	75
Sperry Corp. Great Neck, N. J.	Precision scientific instruments	1,519,790	75
Tungsol Lamp Works, Inc. Bloomfield, N. J.	Electron tubes	65,951	75
Tungsol Lamp Works, Inc. Bloomfield, N. J.	Electron tubes	60,600	90
Transicoil Corp. New York, N. Y.	Servo motors	137,285	90
Towle and Son, Co. Philadelphia, Pa.	Aircraft engine instruments	49,500	85
Technicraft Laboratories, Inc. Thomaston, Conn.	Electronic components	.....	.....
Transducer Corp. Boston, Mass.	Electronic equipment	11,177	75
Transducer Corp. Boston, Mass.	Research and development	11,376	75
Transformer Engineers. Pasadena, Calif.	Electronic equipment	13,453	75
Varian Associates. Palo Alto, Calif.	Radar tubes	2,455,933	75
Weston Electronic Instrument Corp. Newark, N. J.	Air radio course indicator	1,500,000	80
Wickes Engr. and Construction Co. Camden, N. J.	Electronic equipment	230,977	75
Westinghouse Electric Corp. Pittsburgh, Pa.	Electronic tubes	12,010,000	75
Western Electrical Inst. Co. Newark, N. J.	Course indicators	556,193	80
Total		$63,026,289	

having
fastener
problems?



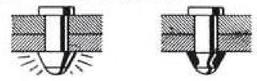
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THREE!

accessibility



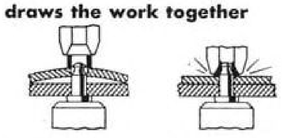
HI-SHEAR rivets simplify design and riveting problems. They are compact, require less tool clearance and have the smallest "headed ends" of any high strength fastener.

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*Navy Release, Aug. 1951
**Reaction Motors, Inc., Rockaway, N. J.

Marotta Engineering Company
BOONTON, NEW JERSEY

FOX

All Technology Not Mastered

Missile output lags not because we can't build them, but because basic policy decisions are not made.

● The announcement last week that the Air Force is forming its first guided missile squadron, to be equipped with the Martin Matador surface-to-surface missile, implies that the U. S. is ready to use missiles in quantity if necessary.

● The first thing that must be understood about missile production in the U. S. is that there isn't any quantity production of offensive missiles.

● The faults behind this state of affairs are many. They start in research laboratories and service directives run through the Research and Development Board, the individual contractors and designers and to the manufacturers.

● There is no reason we can't build missiles in any reasonable quantity. It's going to take a lot of planning and money and men and facilities. But it can be done.

By David A. Anderton

How do you build a missile?

Basically, that's easy to answer. You machine some parts, press others, cut and fit still others. You bolt, weld and rivet those parts together and you have missiles.

You do all this in a factory with or without windows, with a fairly comprehensive collection of machinery and an adequate quantity of skilled, semi-skilled and unskilled help.

You work from blueprints, from Ozalids and from engineering sketches on tissue, envelopes and the wall.

In short, you build missiles the same way you build airplanes—by shaping raw material into finished parts and assembling them.

It isn't really that easy, because the technology of missile production has not yet been mastered.

But part for part, a missile resembles a small aircraft, and perhaps that is the best way to think of it. There is of course one fundamental difference—instead of a standard, Mk. I pilot weighing 180 pounds, the missile carries around a number of black boxes housing its pilot—an avionic brain with conditioned reflexes, weighing practically anywhere from 1-500 lb.

When you consider missile production, you have to consider that there will be such a thing X months in the future when everybody connected with the program has decided just what types of missiles have to be built. Right now, it looks as if the United States is committed to three basic categories of missiles:

• **Air-to-air missiles** (AAM in Defense Dept. officialese). Probably the simplest form of this class of missile is the standard aircraft rocket. Small, lightly loaded and inaccurate, this solid-fuel rocket is nevertheless the progenitor of a long line of weapons for fighter aircraft. It will be followed by a series of larger and more complex guided weapons. These will bear intelligence in the form of a target-seeking brain either directed by the launcher (passive system) or completely self-contained (active). Warheads will be heavier, speeds supersonic. A typical size might be about 10 ft. long, 6 in. diam.

• **Surface-to-air missiles** (SAM). Someday, these will replace both the anti-aircraft rifle and the piloted interceptor. Pioneered by the Germans toward the end of World War II, SAM configurations are many. Typical missile might be 30 ft. long, with 3-ft. diameter. It would have wings for maneuvering and tail surfaces for steering. The pointed nose would contain a warhead and seeking gear.

• **Surface-to-surface missiles (SSM).** These could make Boeing's B-52 the last of the piloted bombers. For the most part still in experimental stages and still confined to tactical ranges, these missiles someday could be the United States' sole offensive striking force. Current layouts resemble aircraft with cockpits faired over; engines are turbojets. In times to come, there will be multi-stage rockets with ramjet engines for cruising. As for typical sizes, in this category they start at 50 ft. long for the tactical babies; in lusty manhood, a multi-stage rocket towers (says one expert) 200 ft. into the air.

These are the kinds of missiles which are going to be built.

Other important points are where and how to produce them.

Because missiles currently are a transi-

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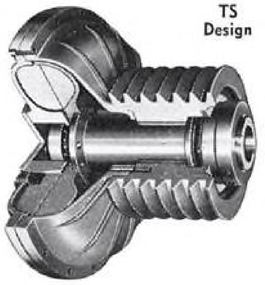
TF units, constructed of sturdy cast aluminum, are designed for direct mounting on standard Nema frame electric motors. Capacity ranges from 1½ HP at 1200 RPM to 25 HP at 1800 RPM.

TH Design



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TS units are mounted directly over the motor shaft to eliminate all excessive overhang of the sheave. Capacity ranges from 1½ HP at 1200 RPM to 25 HP at 1800 RPM. Sheaves are available from 2 groove, B section to 7 groove B section.

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tion weapon—that is, we are not ready to replace existing weapons by missiles in any single weapons category—and because so many of the original design proposals were developed at aircraft factories at the services' requests, the first production locations will be within the existing space of aircraft factories.

As the missile becomes more and more of a production item and begins to make inroads as a weapon, these aircraft factories will develop sources of supply among subcontractors; they will also open new plants, devoted entirely to missile production. Fairchild and Convair have already done just that.

But after a while, the missile industry will become like yesterday's avionics industry, which has already outgrown the confines of the parent aircraft firm and the separate plant.

Then, it will be anybody's product—and the aircraft people will be in a continuous competitive hassle trying to hold on to the business they believe to be rightfully theirs.

▶ **Facilities Needed**—Bridging the gap between the where and the how of missile production is some consideration of the type of facilities required. Right now, there is no indication that missile production is so large—or potentially so large—that it can't be fitted into existing or planned floor space of conventional type and reasonable size. In other words, there need be no Willow Runs for missiles.

Neither need there be anything as mammoth as a shipyard.

If a factory can handle the production of fighter aircraft, it can do the same for missiles.

As to tools, there was a time—and not too long ago—when opinion was that missiles would require tooling never even considered by the aircraft industry. Since then, aircraft design itself has become more and more complicated, and the necessary equipment to build planes has gotten larger and more complex.

So now, it would seem that the tooling which produces airplanes is the same sort of tooling that will produce missiles.

But with materials, the story is different. Aircraft are still in largest measure made of aluminum alloys and magnesium alloys.

Missiles are not. They are quite likely to be made completely of steel, and probably stainless steel at that. K-Monel will be used, titanium in some quantity, and low carbon steels. Some will still use small quantities of aluminum, but these will be in the minority.

Consequently, the technology of handling the transformation of raw material into finished parts will be different for missiles. It won't take too long to get used to the idea of using a completely new set of metals, but the

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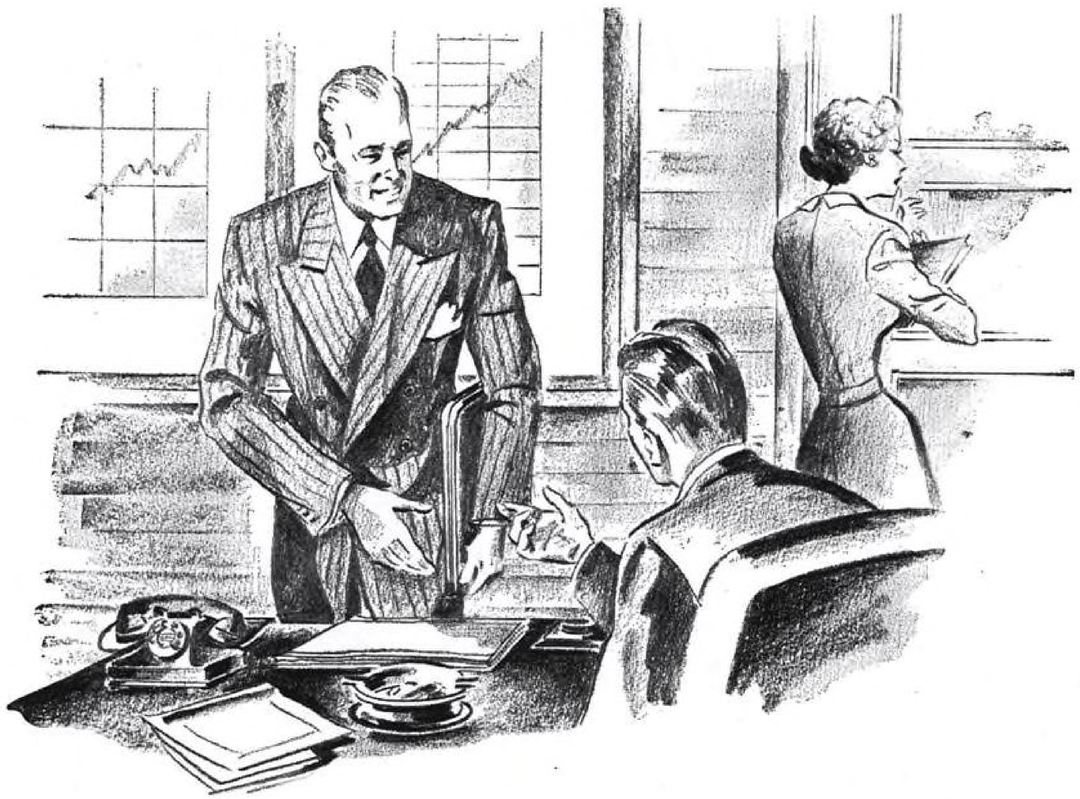
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users are going to have to outgrow the habits acquired during long years of aluminum handling. They'll have to memorize new values for minimum bend radii and springback. Welding techniques will be different, and so will feed speeds. But these are all small things, details which can be ironed out once some quantity production gets underway.

▶ **Materials Needed**—What will it mean once a missile gets into production? How much material will be required for production?

Answers to these questions, even if they were known today, would be heavily cloaked in security.

But there are answers to those questions for a typical missile, in some respects the standard of comparison for all missiles since the war. Data are available for the German A4 (V-2) rocket which could be considered a typical tactical surface-to-surface missile.

Its purpose was to carry 2,200 lb. of high explosive a distance of about 200 mi. to a target. To do this required a structure which was 45 ft. long, had a diameter of 5.41 ft. and weighed 28,400 lb. on the ground ready to fire.

Of that weight, 19,200 lb. was fuel, burned at the rate of about 273 lb. per second.

Primary structural material of the A4 was the German equivalent of our SAE 1020 steel. The body was formed of circular rings and stringers, covered with skin. Four fins were fabricated with ribs and stringers in what would be conventional aircraft practice.

Subassemblies were made all over Germany and the occupied countries and shipped to central assembly halls. One of these was located in a hill near Nordhausen which is now in the Russian zone.

The labor used for the assembly—and for much of the component work—was in large measure and at best, semi-skilled. The majority of the workers were slave laborers—Czechs, Poles and Russians—who had absolutely no aircraft experience before being given the job of assembling and manufacturing A4 rockets.

One of the arguments advanced for the production of the A4 rocket instead of an equivalent airplane—and it must be remembered that the A4 was a German Army ordnance weapon and that there was continual friction between the Air Force and the Army on the question of who got what material and priorities—was that the attrition rate on aircraft was terrific. Two or three missions over the channel was better than average.

But an A4 could be built for about one-sixth the cost and one-fifth the manhours of the equivalent bomber. Consequently, even though the A4 was



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SKYBLADE... Controllable CAA approved up to 165 hp.
TEST CLUBS up to 3,000 hp.

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AIRCRAFT SENSENICH PROPELLERS

expended every time, it was still more economical than an airplane which didn't reach five or six sorties.

►**A4 Production Data**—By the time peak production had been reached on the A4, man hours were down to somewhere between 3,000 and 7,000 per missile. The reason for the wide range stems from the varying times spent by the subcontractors, some of whom were more skilled than others making the same parts.

Somebody, probably Hitler, ordered the V-2 into production on a basis of 50,000 units yearly. But the quantity should have been set by the production of liquid oxygen, one of the propellants. Such a staggering number of rockets would have gulped down twelve times the total European production of liquid oxygen.

A restudy with cooler heads prevailing led to a suggested upper limit of 3,600 rockets per year. And the German production program was set up on that basis.

Actually, in the six-month period between August 1944 and February 1945 there were about 3,000 rockets delivered to field units.

Some data are available for an estimated production quantity of 5,000 missiles per year. For this quantity, the Germans would have had to pour in per month:

- 24,000 tons of steel,
- 244 tons of various alloys,
- 3.2 tons of silver,
- 5,200 tons of aluminum,
- 477 tons of copper.

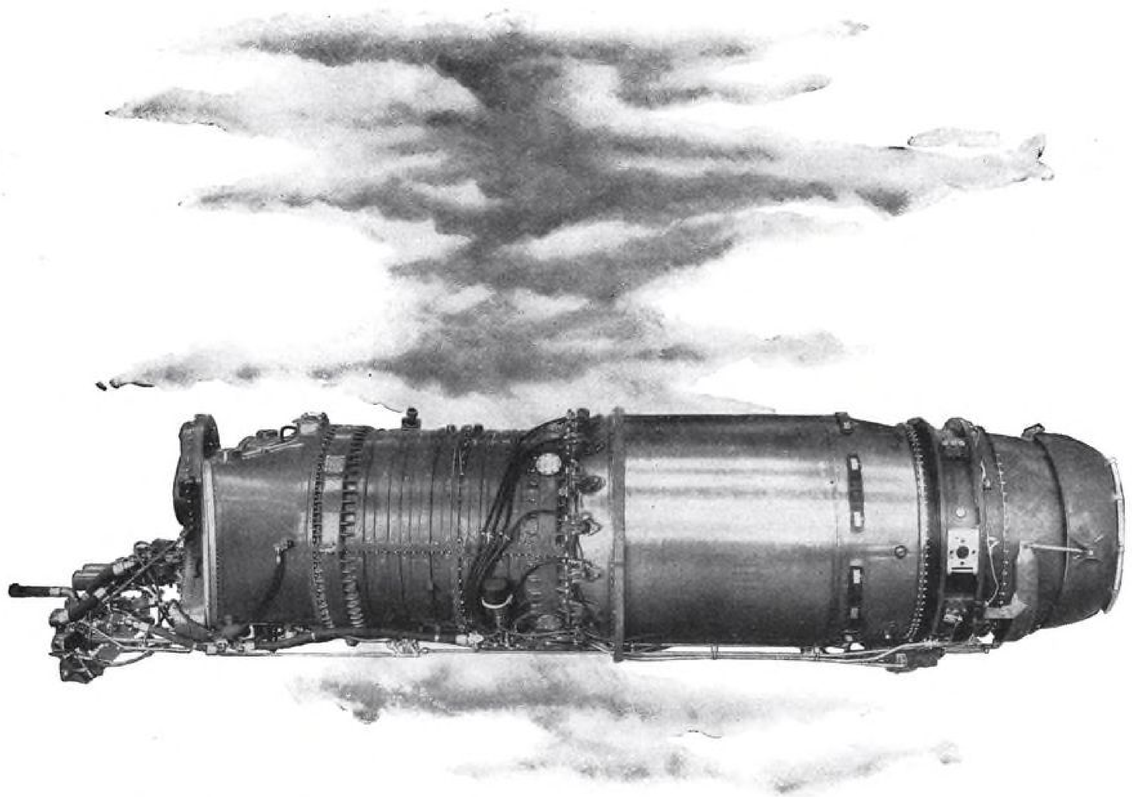
It was estimated that 6,000 construction workers would be required for the additional buildings needed for such quantity production. Actual processes of manufacturing would absorb another 70,000 men.

As we see it now, the A4 was a rather unsophisticated missile. Its structure was simple and, judging by the high percentage of missiles which never reached the target because of break-ups, the structure was also inadequate.

So in considering the table above, it should be remembered that the figures deal with a rocket which is obsolescent, simple and understrength. Our production program will be geared to complex, strong and new weapons. Therefore, the table can only serve as an indication of what would be required if we were building a weapon comparable to the German A4.

►**More Than Processing**—But production of any weapon is more than just the transformation of raw materials into finished parts. Planning production calls for considering the raw material sources as a starting point, and the distribution of weapons to field units as the end point. No lesser program is adequate.

So, just considering airframes is not



Outstanding NEW JET ENGINE

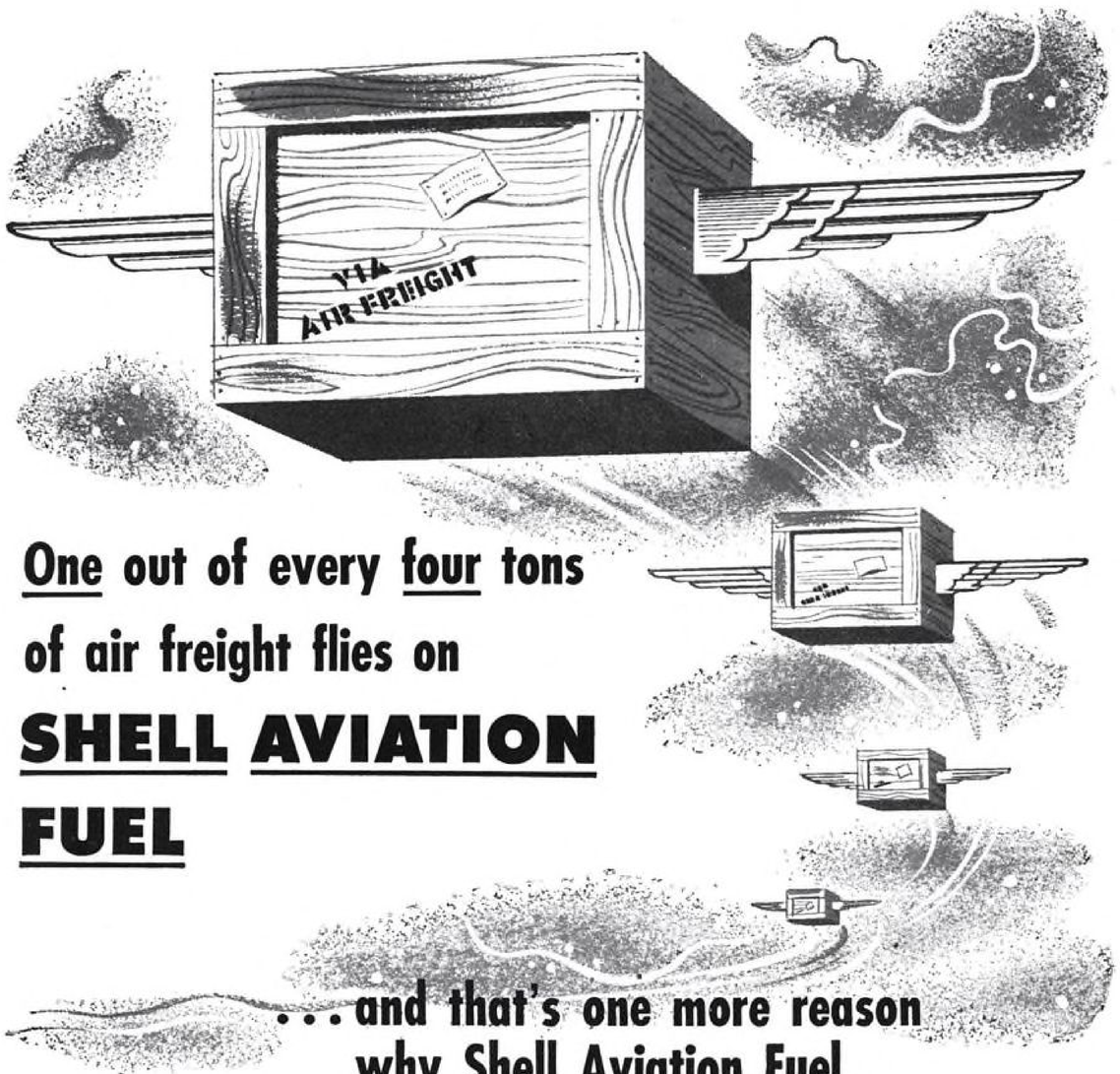
One of the most powerful turbojet engines in the world, the new Westinghouse J40 develops thrust equivalent to 14,000 hp at modern flight speeds. This power output will be approximately doubled by the addition of an afterburner.

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This is the first turbojet engine with a completely integrated, automatic electronic control system to pass the stringent type test of the combined U. S. Military Forces. Complete operation from standstill to top altitude and speed is accomplished with a single cockpit control—leaving the pilot free to attend to navigation, battle tactics—battle itself. This is only one of the many distinctions of the J40 which place it in the forefront of today's jet propulsion field.

Look for further developments about the J40... it will spark a whole new group of speedier, high-performance military aircraft. Look to Westinghouse research and engineering for constant progress in jet aircraft power. J-54011

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enough. In any typical missile, there are five basic components: Warhead, intelligence, airframe, powerplant and propellants. In addition, there is a welter of firing equipment, supplementary ground radar and radio gear, special vehicles and servicing trucks. (The German A4 had a total of 32 special wheeled vehicles—the majority being self-propelled—for transportation and handling.)

Warheads are supplied to field units by the ordnance branch of the particular service, and are therefore not a worry for the missile contractor. Fuses, casing and charge are built for the government by contractors, however, and in production quantities would take a reasonable bite out of supplies of materials and men.

Intelligence promises to be a bottleneck. In the first place, so much of today's war materiel is electronically controlled that existing production facilities for electronic parts could become overcrowded if all-out production began. In the second place, design and development of these units is behind schedule because of the lack of engineering talent. And in the third place, electronic brains are never easy to produce. Their very nature makes them complex, and to meet missile requirements of size, shape, strength, reliability and resistance to varied ambient conditions imposes design answers which are not easily met.

Airframes have been considered in some detail. And the problem of structural unit production can be dismissed —although not without realizing the enormity of the task—by saying that it can be handled by aircraft people in aircraft factories doing the job with aircraft tools.

▶ **Engines a Problem**—Powerplants are apt to be a little bit of a problem. For such of our missiles as require turbojets, there will be competition between them and the piloted aircraft for the country's output of high-thrust engines. In rockets, about the only possible difficulties would be continuing design changes which never permit true production methods to be used, or the actual machining of the complicated injector heads. Ramjets, in spite of their touted simplicity, are about as complicated to build as anything else which produces high powers, and require some trick techniques of their own. These should be solvable by aircraft methods.

Fuels are going to be a problem. Ramjets and turbojets will burn the same sort of fuel—kerosene- or gasoline-type. Solid propellant rocket motor fuels are of several varieties, one of the most common being a mixture of potassium perchlorate in asphalt. There are some fancier varieties also.

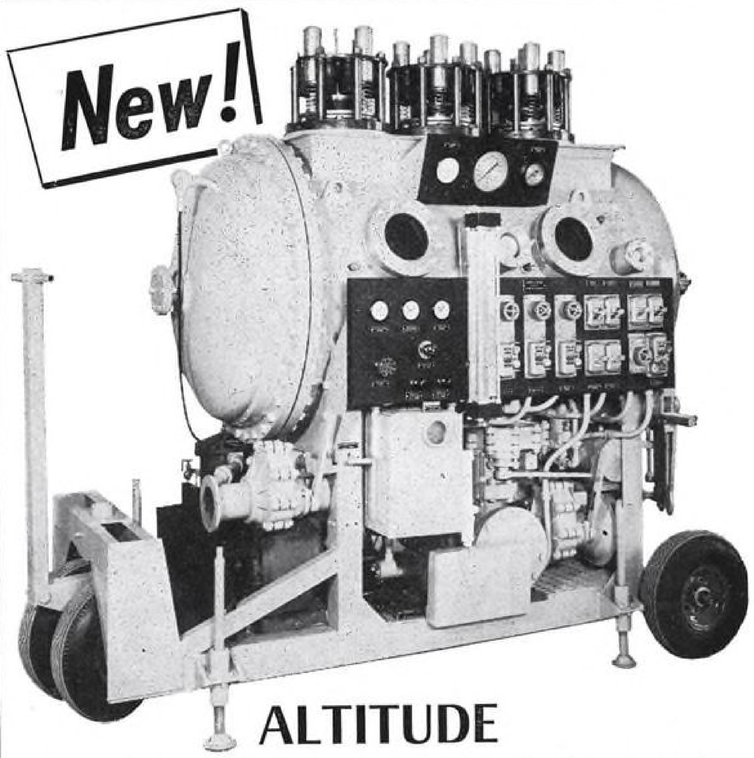
Liquid-fuel rockets are more or less standardized on two basic propellant combinations. One is ethyl alcohol and liquid oxygen; the other is nitric acid (red or white fuming) and aniline. In the event of an all-out missile production program and subsequent missile offensive, one or more of these ingredients could be well in short supply.

Supplementary ground radio and radar will be about the same problem.

Special vehicles for missile handling and transport are not now in production. They are likely to lag missile production by a considerable time, meaning that many field modifications will be made on standard trucks and trailers.

Looking at the overall picture, it is apparent that missile production and use is a manufacturing and logistics chore similar to that of aircraft production and use. But the cause for uneasiness lies in the fact that before that chore can be undertaken there has to be broad agreement that some missiles are ready for production.

While it is true that at least two types of missiles have been ordered into production, it is also true that the manufacturer of one of them privately has stated that he would like two more years for development before beginning production. It sounds like the old vaudeville recipe for rabbit stew—"First catch your rabbit. . . ."



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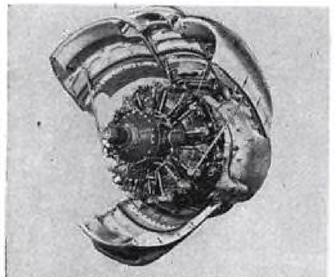
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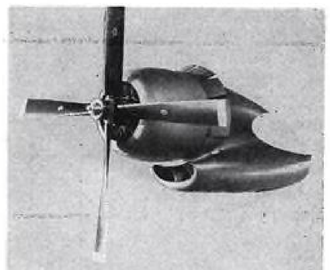
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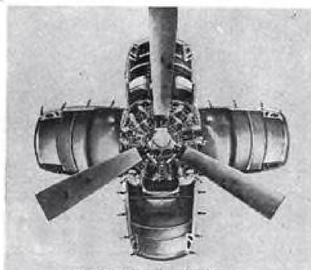
CHASE AVITRUC
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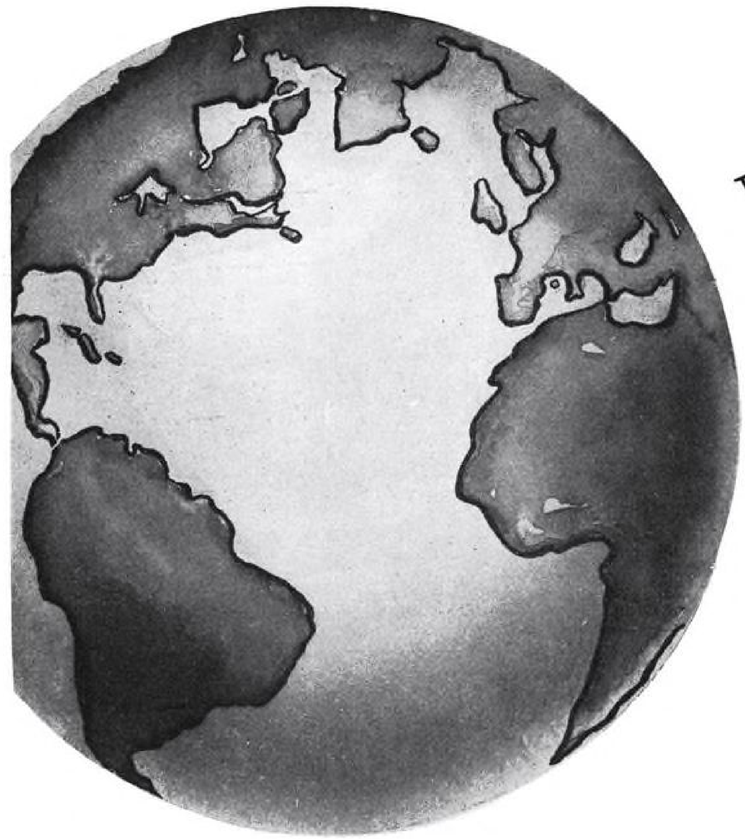


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Expanding Facilities

SOME conception of the tremendous expansion necessary in facilities for production of air power is given by the following list of projects on which the Defense Production Administration between Oct. 30, 1950 and Aug. 18, 1951 (when issuance of these certificates was suspended) granted certificates of necessity for accelerated tax amortization. And this total of $360,507,924 can be at best only a rough indication of the money being poured into new buildings and new equipment.

A MANUFACTURER wishing to expand his plant, build a new plant or buy new machinery, first gets an estimate of the cost. Then he decides how much of that he thinks is necessary for defense production. That is the amount he asks fast tax write-off on. But DPA generally decides that a lower figure is the true cost that should be certified as necessary for defense. Then DPA figures how much of the new facilities will be useful for civilian purposes after the war. It permits accelerated tax amortization only on the remainder.

THAT is why the following list can be only a partial gauge to the total facilities expenditure. The dollar figures in the list are the costs DPA decides are justified for defense expansion. The percentage column shows how much of the cost of a facility presumably will be of little civilian use after the emergency and therefore can be depreciated in five years rather than 20-25.

Company	Product	Amt. Cert.	Percent Allowed
Avco Mfg. Co. Williamsport, Pa.	Aircraft tappet guides	$23,468	90
Avco Mfg. Corp. Williamsport, Pa.	Throttle body assemblies	20,675	90
Avco Mfg. Co. Richmond, Ind.	Fire control systems	1,909,000	75
Aeroquip Corp. Jackson, Mich.	Flexible hose lines	367,367	80
Aeroquip Corp. Jackson, Mich.	Flexible hose lines	214,447	85
Aerojet Eng. Co. Nimbus, Cal	Ordnance	2,065,465	75
Aerojet Eng. Co. Azusa, Cal	Ordnance supplies	1,076,880	75
Austenal Laboratories, Inc. Rockaway, N. J.	Jet engine parts	292,850	85
Axelson Mfg. Co. Montebello, Calif.	Aircraft landing gears	655,000	70
Aircraft Fitting Co. Cleveland, Ohio	Aircraft hose couplings	124,506	90
Acme Industrial Co. Chicago, Ill.	Aircraft hydraulic parts	45,942	90
Aircrafts Products Co. Clifton Heights, Pa.	Aircraft machine metal parts	12,354	90
Aero Trades Mfg. Corp. Mineola, N. Y.	Aircraft parts assembly	30,000	70
Aero Supply Mfg. Co. Corry, Pa.	Aircraft hardware and parts	118,000	85
Aircraft Engineering Prod. Clifton, N. J.	Aircraft parts	52,464	90
Aerojet Eng. Co. Azusa, Calif.	Ordnance supplies	611,000	..
Aerojet Eng. Co. Azusa, Calif.	Ordnance supplies	1,076,880	75
AiResearch Mfg. Co. Phoenix, Ariz.	Aircraft parts	1,959,728	75
AiResearch Mfg. Co. Los Angeles, Calif.	Aircraft parts	608,777	80
Aircraft Tapered Sheets, Inc. Los Angeles, Calif.	Wings and fuselage fittings	499,204	90
American Non-Gran Bronze Co. Berwyn Pa.	Aircraft engine valve guides	60,413	85
Axelson Mfg. Co. Vernon, Calif.	Aircraft assemblies	230,688	85

Continued on p. 139 . . .



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Most models in the Jack & Heintz line of aircraft generators are adaptable to virtually any aircraft installation through the use of various mounting flanges and air-blast caps.

Take, for example, our widely used G29 Generator. Some generators in this series are equipped with standard 6-inch diameter, 5-inch bolt circle mounting flanges to fit AND 20002 standard pads. Others are equipped with keyhole slots to fit on the 11-inch diameter, 10-inch bolt circle pads per AND20006. The keyholes are designed for ease in assembling onto the driving engine. Adaptability is increased through the use of either an axial or radial-blast cap. Both types have a 3-inch diameter air inlet. The radial cap is adjustable to equally spaced positions. Soon, we'll have a third type incorporating a quick attach-detach flange which will greatly simplify installation and service.

All J & H G29 aircraft d-c generators have identical ratings—12 kw, 400 amp, 30 volt, 3000-8000 rpm.

The many adaptations of the J & H G29 indicate how far J & H will go to cooperate with aircraft manufacturers in order to meet specific needs.

Expansion of Rotomotive Devices To Be Doubled!

Jack & Heintz has expanded production to a monthly rate just twice that of a year ago. But even that is not enough! The defense program calls for *again doubling* our present rate of production.

Our partners in expansion at present include more than 60 companies. While the list includes such well-known names as Apex, Universal Wire, Evinrude and Whirlpool, 90% of the subcontrators in this group are classified as small businesses.



Above are typical generators in the G29 series. The G29-7A, at left, features an axial air-blast inlet and 6-inch diameter mount, while the G29-8B, at right, features a radial air-blast inlet adjustable to any of 12 equally spaced positions. Integral mounting flange is 11-inch diameter.

Chief Engineer's Corner

Many of the basic design improvements in today's d-c aircraft generators are the result of J & H being called in to solve particular problems experienced in aircraft operation.

The first of the so-called "barrel type" mounting flanges integral with the frame was on J & H Generators, as was the torsional disc vibration dampers.

Many other additional features are being incorporated in our more recent designs, to provide trouble-free operation under extreme operating conditions, ease of maintenance, and those extra features that make J & H Generators last longer in their applications.

J & H Generators are fully compensated with vacuum impregnated, baked and mechanically secured windings. They have high-altitude brushes and sparkless commutation. Dynamically balanced armatures are mounted on sealed pre-lubricated ball bearings and speed-tested. Blast cooling permits minimum size and weight for given ratings.

Since both the mechanical and electrical demands on generators vary widely, Jack & Heintz engineers are eager to work with manufacturers to select or design the right generator for the job. We also are in a position to furnish inverters and other accessories and controls best suited to the over-all system. In asking for specific data, please give as complete information as possible on service requirements . . . write JACK & HEINTZ, INC., Cleveland 1, Ohio.

JACK & HEINTZ *Rotomotive* EQUIPMENT



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means electrical, hydraulic or mechanical devices designed to solve unusual problems of developing power, controlling it, or using it.

Expanding Facilities . . .

Aluminum Co. of America, Cleveland, Ohio	Aluminum aircraft engine forgings	2,749,000	75
Aluminum Co. of America, Cressona, Pa.	Extruded shapes for aircraft	170,200	75
Aluminum Co. of America, Lafayette, Ind.	Extruded shapes for aircraft	600,000	75
Aircraft Hardware Mfg. Co, New York, N. Y.	Aircraft hardware	19,976	85
Aircraft Precision Products, Oak Park, Mich.	Parts for jet engines	52,211	90
Aermotive Equipment Corp, Kansas City, Mo.	Control panels	5,000	85
Anderson, Inc, Chicago, Ill.	Wheels-brakes for aircraft	17,987	90
Acme Electric Corp, Allegheny, N. Y.	Aircraft	165,427	75
Airquipment Co, Burbank, Calif.	Aircraft equipment	68,583	80
Agawam Aircraft Products, Inc, Sag Harbor, N. Y.	Hydraulic assemblies	60,590	75
Aviation Engineering Corp, Woodside, N. Y.	Aircraft fuel gauges	24,046	85
Archer Machine Products Co, Los Angeles, Calif.	Aircraft	70,636	90
Aircraft Products Co, Clifton Heights, Pa.	Aircraft	28,655	90
Aircraft Products Co, Delaware County, Pa.	Aircraft parts	83,985	75
All-Power Mfg. Co, Montebello, Calif.	Aircraft	19,472	90
Aircraftsman Co, Inglewood, Calif.	Aircraft	39,880	75
Aero-coupling Corp, Burbank, Calif.	Hose lines	72,230	80
American Bosch Corp, Springfield, Mass.	Fuel controls (aircraft)	434,453	80
Alloy Products Co, Marion, Ind.	Aircraft	97,037	80
Advance Die and Tool Co, Cleveland, Ohio	Landing Gear fittings	21,325	90
Aeronca Mfg. Co, Middletown, Ohio	Ordnance	12,311	85
Atwood Vacuum Machine Co, Rockford, Ill.	Aircraft parts	107,285	90
Borg Warner Co, Marvel Schebler Prod. Div. Decatur, Ill.	Aircraft parts	796,112	80
Borg Warner Co, Peseo Products Div.	Aircraft assessories	996,078	80
Blaw-Knox Co, Groveton, Pa.	Aircraft	240,000	75
Boeing Airplane Co, Seattle, Wash.	Engineering and aircraft production	1,405,000	85
Boeing Airplane Co, Seattle, Wash.	Aircraft	281,014	85
Boeing Airplane Co, Seattle, Wash.	Aircraft and accessories	4,941,916	85
Boeing Airplane Co, Wichita, Kans.	Airplane parts	15,577	75
Boeing Airplane Co, Seattle, Wash.	Aircraft spare parts	795,985	75
Boeing Airplane Co, Seattle, Wash.	Aircraft	8,515,000	75
Bart Laboratories Co, Belleville, N. J.	Airplane parts	8,454	75
Borg-Warner Corp, Mechanics Universal Joint Div. Rockford, Ill.	Joint assemblies for aircraft	150,000	75
Bell Aircraft Corp, Wheatfield, N. Y.	Research, development engineering	250,000	75
Bell Aircraft Corp, Kenmore, N. Y.	Ordnance	232,302	75
Bell Aircraft Corp, Fort Worth, Tex.	Helicopters	2,906,675	75
Bendix Products Division, Bendix Aviation Corp. South Bend, Ind.	Aircraft landing gear	1,183,668	80
Bendix Aviation Corp, Pacific Division Burbank, Calif.	Research engineering	24,463	75
Bendix Aviation Corp, South Bend, Ind.	Ordnance	184,119	75
Bendix Aviation Corp, Sidney, N. Y.	Aircraft magnetos	463,373	85
Benson Mfg. Co, Kansas City, Mo.	Aircraft gasoline tanks	511,127	80
Bridgewater Machine Co, Akron, Ohio	Airplane parts	56,051	85
Bill Jack Scientific Instrument Corp, Solana, Calif.	Reconnaissance cameras	139,303	80
Brooks and Perkins, Inc, Detroit, Mich.	Aircraft	43,243	85

Continued on p. 140 . . .

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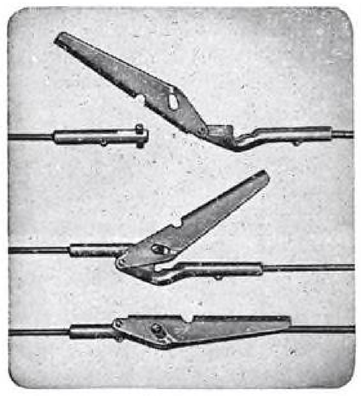


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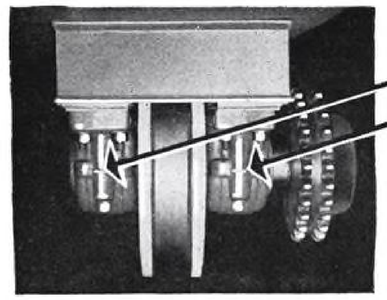
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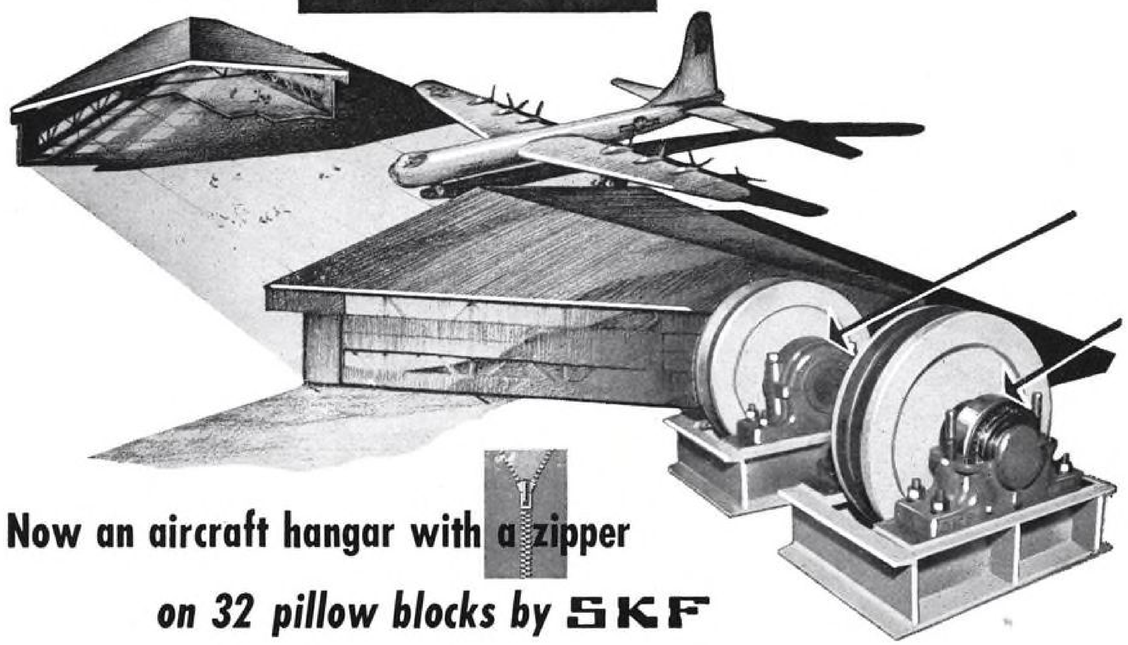
Expanding Facilities . . .

Buerk Tool Works Buffalo, N. Y.	Aircraft assemblies	17,517	90
Bard Parker Co. Danbury, Conn.	Aircraft parts	16,843	75
Beech Aircraft Corp. Herington, Kansas	Aircraft parts	2,230,979	75
Boots Aircraft Nut Corp. Stamford, Conn.	Nuts	399,967	80
Cagnon Plating and Mfg. Co. Colorado Springs, Colo.	Aircraft	1,875	75
Capewell Mfg. Co. Hartford, Conn.	Parachute fittings	31,537	85
Collins Engineering Co. Inglewood, Calif.	Aircraft hardware	95,000	80
Cook Electric Co. Chicago, Ill.	Aircraft relay assembly	267,043	85
Cablair Products Co. Culver City, Calif.	Airframe machine parts	64,935	90
Capital City Machine Co. Hartford, Conn.	Aircraft supplies	13,710	90
Consolidated-Vultee San Diego, Calif.	Airplanes	139,600	75
Consolidated-Vultee San Diego, Calif.	Airplane parts	1,511,838	75
Consolidated-Vultee Pasadena, Calif.	Wind tunnel testing	3,987,007	90
Consolidated-Vultee San Diego, Calif.	Aircraft	144,851	75
Consolidated-Vultee San Diego, Calif.	Airplanes	187,120	75
Cleveland Graphite Bronze Co. Cleveland, Ohio	Aircraft parts	561,699	80
Cleveland Pneumatic Tool Co. Cleveland, Ohio	Airplane landing gear	688,231	80
Cleveland Pneumatic Tool Co Cleveland, Ohio	Airplane landing gear	350,000	75
The Cornelius Co. New Brighton, Minn.	Aircraft air compressors	49,873	90
Clover Box and Mfg. Co. New York, N. Y.	Nose assembly for airborne searchlight	3,406	80
Chicago Aerial Survey Co. Chicago, Ill.	Aircraft photographic equipment	11,231	85
Canton Drop Forging and Mfg. Co. Canton, Ohio	Propeller extrusions	114,306	75
Canton Drop Forging and Mfg. Co. Canton, Ohio	Jet engine forgings	250,000	75
Canton Drop Forging and Mfg. Co. Canton, Ohio	Aircraft forgings	68,867	85
Camden Machine Co. New Haven, Conn.	Components for jet engines	14,500	85
Cessna Aircraft Co. Wichita, Kans.	Tail assemblies, aircraft components	940,536	80
Cessna Aircraft Co. Wichita, Kans.	Observation airplanes	1,172,348	75
Cessna Aircraft Co. Hutchinson, Kans.	Aircraft assemblies	106,139	75
Chicago Forging and Mfg. Co. Chicago, Ill.	Aircraft	130,232	85
Cutler-Hammer Co. Milwaukee, Wisc.	Aircraft	7,474,327	75
Crawford Door Co. Detroit, Mich.	Aircraft	256,019	75
Clary Multiplier Corp. Los Angeles, Calif.	Aircraft	35,512	75
Clary Multiplier Corp. Downington, Pa.	Packaging of aircraft bearings	68,617	80
Curtiss-Wright Corp. Caldwell, N. J.	Aircraft	1,126,818	80
Crocket Mfg. Co. Culver City, Calif.	Airframe parts	43,195	90
Cochran Foil Co. Louisville, Ky.	Aircraft equipment	32,056	75
C. M. Smillie and Co. Ferndale, Mich.	Aircraft	16,397	90
Caval Tool and Machine Co. Newington, Conn.	Aircraft parts	56,423	80
Chicago Aerial Survey Co. Melrose Park, Ill.	Aircraft cameras	399,325	80
Chicago Metal Hose Corp. Rock Falls, Ill.	Aircraft parts	8,928	75
Criterion Machine Works Beverely Hills, Calif.	Aircraft parts	15,983	90
Coleman Co., Inc. Wichita, Kans.	Airplane parts	347,135	80
Detroit Kellering Co. Detroit, Mich.	Aircraft engine mounts	103,970	85
Dresser Industries, Inc. Bradford, Pa.	Steel rings, jet engines	636,845	85
Deutsch Company Los Angeles, Calif.	Hydraulic fittings	354,179	90
Deutsch Company Los Angeles, Calif.	Hydraulic fittings	54,333	90

Continued on p. 143 . . .



Strobel & Salzman, Engineers
Petroff & Clarkson, Architects



Now an aircraft hangar with a zipper

on 32 pillow blocks by SKF

Here's the newest development in equipment for fast, time-saving, cost-cutting turnaround maintenance, inspection and emergency repairs for commercial aircraft. It's the Mitchell Mobilhangar*, built in two parts. Taxi aircraft into position—push-button controlled motors close the equipment to provide all the facilities of a fully equipped hangar. The Mobilhangar has every facility for servicing aircraft of any size. Tracks for it can be laid easily anywhere. Opening and closing operations are made smooth and easy by means of trucks equipped with 32 SKF Spherical Roller Bearing Pillow Blocks—a wise choice based on confidence in SKF's ability always to help put the right bearing in the right place, however unusual the service. 7215

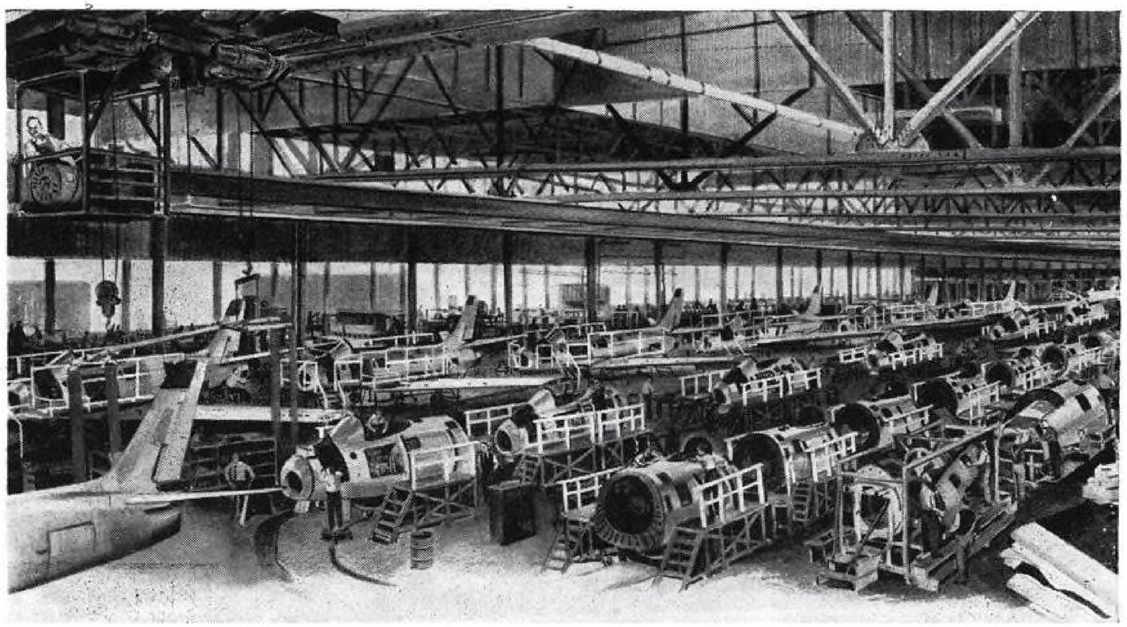
** For information—including startling cost analyses—write Mitchell Mobilhangar Corp., 509 Fifth Ave., New York 17.*

8 REASONS WHY SKF IS PREFERRED BY ALL INDUSTRY

integrity
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SKF INDUSTRIES, INC., PHILADELPHIA 32, PA.
—manufacturers of SKF *and* HESS-BRIGHT *bearings.*



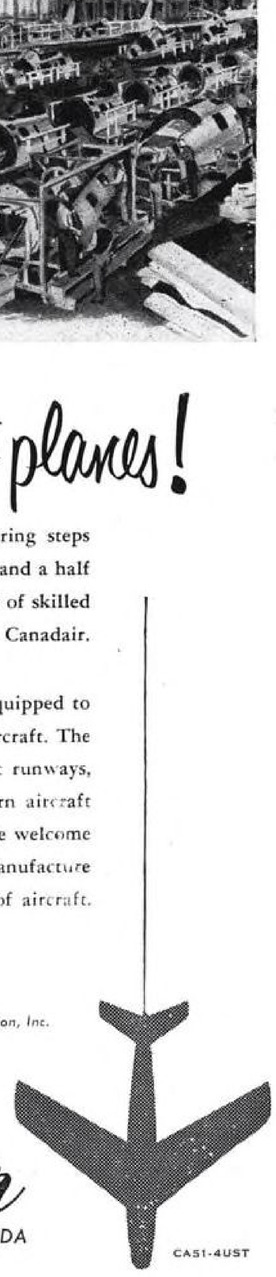
A portion of the F-86 assembly area.
Plant 2, Canadair Limited.
Montreal, Canada.

CAPACITY TO BUILD - *Thousands of planes!*

Moving steadily through thousands of manufacturing steps in 40 acres of modern factory space . . . passing along more than two and a half miles of assembly flow lines . . . through the hands of thousands of skilled workers . . . F 86 Sabre* jets are rolling out for delivery at Canadair.

From preliminary design to final assembly, Canadair is equipped to produce every type of military and civil aircraft. The plants at Canadair, with their adjacent runways, stand high among the most modern aircraft manufacturing facilities in the entire world. We welcome inquiries regarding the design and manufacture of any type of aircraft.

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Expanding Facilities . . .

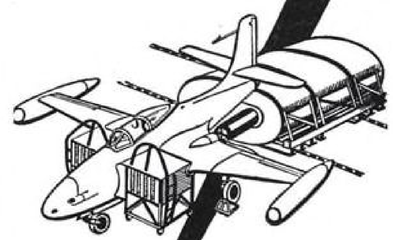
Karl Douglas Co., Inglewood, Calif.	Fabrication of aircraft landing gear	20,588	90
Douglas Tool Co., Hazel Park, Mich.	Ordnance, aircraft components	60,000	75
Douglas Aircraft Co., Santa Monica, Calif.	Airplanes	1,164,000	75
Douglas Aircraft Co., Santa Monica, Calif.	Airplanes	61,367	75
Douglas Aircraft Co., Santa Monica, Calif.	Airplanes	755,630	75
Douglas Aircraft Co., El Segundo, Calif.	Airplanes	453,221	75
Detroit Broach Co., Ft. Lauderdale, Fla.	Aircraft	27,680	85
Dial Light Co. of America, Inc., New York, N. Y.	Aircraft lights	12,430	90
Delevan Mfg. Co., Des Moines, Iowa	Nozzles for aircraft	36,497	90
Extruded Hinge Co., Ypsilanti, Mich.	Hinges and connectors	20,000	70
Eaton Mfg. Co., Battle Creek, Mich.	Blades for jet engines	848,318	75
Eaton Mfg. Co., Cleveland, Ohio	Compressor blades for aircraft	850,000	N.R.
Eaton Mfg. Co., Saginaw, Mich.	Aircraft engine parts	199,223	85
Elgin National Watch Co., Elgin, Ill.	Aircraft clocks	40,000	75
Elgin National Watch Co., Elgin, Ill.	Aircraft parts	60,812	75
Ex-Cell-O Corp., Fostoria, Ohio	Aircraft	1,684,642	75
Ex-Cell-O Corp., Highland Park, Mich.	Aircraft engine parts	857,175	80
Edmunds Mfg. Co., W. Hartford, Conn.	Aircraft parts	8,552	75
Fairchild Engine & Airplane Corp., Hagerstown, Md.	Airplanes	112,048	85
Fairchild Camera and Instrument Corp., Long Island, N. Y.	Aerial photographic equipment	4,395,292	80
Fairchild Engine & Airplane Corp., States Div., Farmingdale, L. I., N. Y.	Ground air conditioner	36,309	85
Fairchild Engine & Airplane Corp., Farmingdale, L. I., N. Y.	Ordnance	11,202	85
Fairchild Engine & Airplane Corp., Farmingdale, L. I., N. Y.	Aircraft engines	5,979	75
Fairchild Engine & Airplane Corp., Farmingdale, L. I., N. Y.	Aircraft engine parts	2,414	75
Fairchild Aircraft Div., Hagerstown, Md.	Airplanes	71,456	80
Federal Aircraft Works, Minneapolis, Minn.	Aircraft skiis	47,296	80
Foote Bros. Gear and Machine Corp., Chicago, Ill.	Aircraft	127,795	90
Foote Bros. Gear and Machine Corp., Chicago, Ill.	Aircraft	15,795	85
Frisbie Machine Co., Freeport, N. Y.	Aircraft	59,475	80
Fonn Mfg. Co., Hartford, Conn.	Helicopter parts	25,787	85
Fletcher Aviation Corp., Pasadena, Calif.	Aircraft fuel tanks	15,735	85
Grand Central Aircraft Co., Tucson, Ariz.	Reactivation of aircraft	25,011	85
Green Machine Co., Inc., Glastonbury, Conn.	Aircraft parts	18,877	90
General Scientific Corp., Chicago, Ill.	Aircraft camera mounts	26,520	75
Grumman Aircraft Engineering Corp., Bethpage, N. Y.	Airplane wing parts	88,825	100
General Laboratory Associates, Norwich, N. Y.	Aircraft ignition equipment	81,100	80
Gould-National Batteries, Inc., Chicago, or Detroit	Ordnance and aircraft batteries	1,051,500	70
B. F. Goodrich Co., Marion, Ohio	Aircraft type hose	2,401,516	75
B. F. Goodrich Co., Marion, Ohio	Aircraft	345,106	75
B. F. Goodrich Co., Watertown, Mass.	Airplane parts	41,850	75
B. F. Goodrich Co., Troy, Ohio	Airplane wheels	32,550	75
B. F. Goodrich, Co., Troy, Ohio	Airplane parts	107,285	90
Goodyear Tire and Rubber Co., Akron, Ohio	Aircraft parts	32,978	90
Goodyear Tire and Rubber Co., Akron, Ohio	Fuel tanks	216,694	90
Goodyear Aircraft Corp., Akron, Ohio	Aircraft parts	200,929	80
Goodyear Aircraft Corp., Akron, Ohio	Airplane wheels	269,690	85
Goodyear Aircraft Corp., Litchfield Park, Ariz.	Airship envelopes	568,584	85

Continued on p. 144 . . .

INDUSTRIAL SOUND CONTROL

Quiets Noise
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PUT AN END TO ANNOYANCE, COMPLAINTS, THREATS OF LEGAL ACTION



Industrial Sound Control Jet Aircraft Mufflers and Panels cut the roar of jets to the level of neighborhood noises.

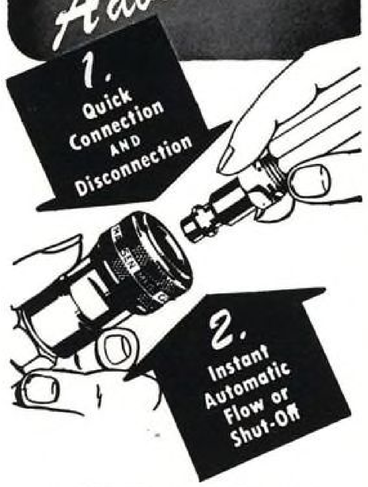
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Expanding Facilities . . .

Goodyear Aircraft Corp. Akron, Ohio	Aircraft	56,080	75
General Electric Co. Louisville, Ky.	Parts for jet engine aircraft	14,462,947	75
General Electric Co. Lockland, Ohio	Aircraft parts	25,695,911	75
General Electric Co. Lynn, Mass.	Aircraft parts	4,037,024	75
General Electric Co. Everett, Mass.	Aircraft parts	647,689	75
General Electric Co. Lynn, Mass.	Aircraft	44,326	75
General Electric Co. Everett, Mass.	Aircraft	33,389	75
General Motors Corp. Grand Rapids, Mich.	Aircraft engine parts	1,598,000	75
General Motors Corp. Vandalia, Ohio	Propeller assembly	180,655	90
General Motors Corp. Flint, Mich.	Assembly of Sapphire engine	22,856,200	50
General Motors Corp. Flint, Mich.	J-65 Sapphire engine	12,650,880	50
General Motors Corp. Flint, Mich.	J-65 Sapphire engine	33,074,570	50
General Motors Corp. Tonawanda, N. Y.	Aircraft	20,844,000	75
General Motors Corp. Flint, Mich.	Aircraft parts	15,246,000	75
General Motors Corp. Lansing, Mich.	Aircraft parts	9,155,000	75
General Motors Corp. Moraine City, Ohio	Propeller parts	4,108,230	75
General Motors Corp. Moraine City, Ohio	Aircraft	5,713,823	75
General Motors Corp. Vandalia, Ohio	Propeller assemblies	3,121,100	75
General Motors Corp. Vandalia, Ohio	Propeller assemblies	886,679	75
Gibson Refrigerator Greenville, Mich.	Tail cones—ailerons	2,746,123	75
General Brass & Machine Works, Inc. Hillside, N. J.	Aircraft	52,628	75
Great Lakes Mfg. Corp. Cleveland, Ohio	Aircraft	19,670	75
Haber Corp. Chicago, Ill.	Aircraft pumps	274,670	85
Howard Foundry Co. Chicago, Ill.	Jet engine cases	1,222,175	85
Hufford Machine Works El Segundo, Calif.	Metal aircraft parts	204,184	75
Heintz Mfg. Co. Philadelphia, Pa.	Aircraft parts	694,800	75
Hansen-Lynn Burbank, Cal.	Aircraft controls	2,200	90
Hotpoint, Inc. Milwaukee, Wis.	Aircraft parts	1,913,000	75
Hotpoint, Inc. Milwaukee, Wis.	Aircraft	2,251,700	75
Hotpoint, Inc. Cicero, Ill.	Aircraft	4,020,125	75
Hughes Aircraft Co. Tucson, Ariz.	Ordnance supplies	7,289,000	85
Hartford Machine Screw Co. Windsor, Conn.	Aircraft engine parts	426,213	85
Hydraulic Units, Inc. Glendale, Calif.	Hydraulic controls for aircraft	32,879	85
Harvey Machine Co., Inc. Terrance, Calif.	Rocket fuses, shells	1,670,000	75
Hardie-Tynes Mfg. Co. Birmingham, Ala.	Turboblowers	71,533	90
Hartford Tool and Die Co., Inc. Hartford, Conn.	Parts for aircraft engines	30,526	90
Hetherington, Inc. Sharon, Pa.	Aircraft	20,494	90
Hackensack Cable Corp. Hackensack, N. J.	Aircraft—wire rope	264,223	75
Hansen-Lynn Co., Inc. Burbank, Calif.	Throttle controls	14,965	80
Island Machine Co. Farmingdale, N. Y.	Aircraft assemblies	45,928	85
Indiana Gear Work, Inc. Indianapolis, Ind.	Aircraft gear units	92,835	85
Intercontinental Mfg. Co. Garland, Texas	Aircraft assemblies	12,428	85
Interstate Engineering Corp. El Segundo, Calif.	Aircraft parts	94,826	85
Johns Hartford Tool Co. Hartford, Conn.	Aircraft engine parts	8,038	90
M. W. Kellog Co. Jersey City, N. J.	Liquid rocket engines	127,733	85
M. W. Kellog Co. Jersey City, N. J.	Aircraft	71,782	85
Plastic Age Co. San Fernando, Calif.	Aircraft	22,000	75

Continued on p. 147 . . .

Positive protection *with* Fenwal *Dynamic fire and over-heat detectors*





Fenwal DYNAMIC fire and over-heat detector 17343-61. Complies well within CAA Technical Standard Order C-11 in accordance with SAE Specifications AS-401.

No lag — no false alarms.

Fenwal fire and over-heat detectors function when air temperature reaches the alarm point . . . provide warning *before* dangerous over-heating occurs. Built to withstand the extremely high and low temperature conditions of modern aircraft, these units are constantly on the job.

Their dynamic operating principle assures positive operation . . . always accurate. *The shell is the temperature-sensitive element.* Through proper selection of alloy metals, Fenwal engineers design both temperature control, fire and over-heat detection for any aircraft need.

Fenwal heater controls can be used as control units or limit switches for cabin and de-icer heaters.

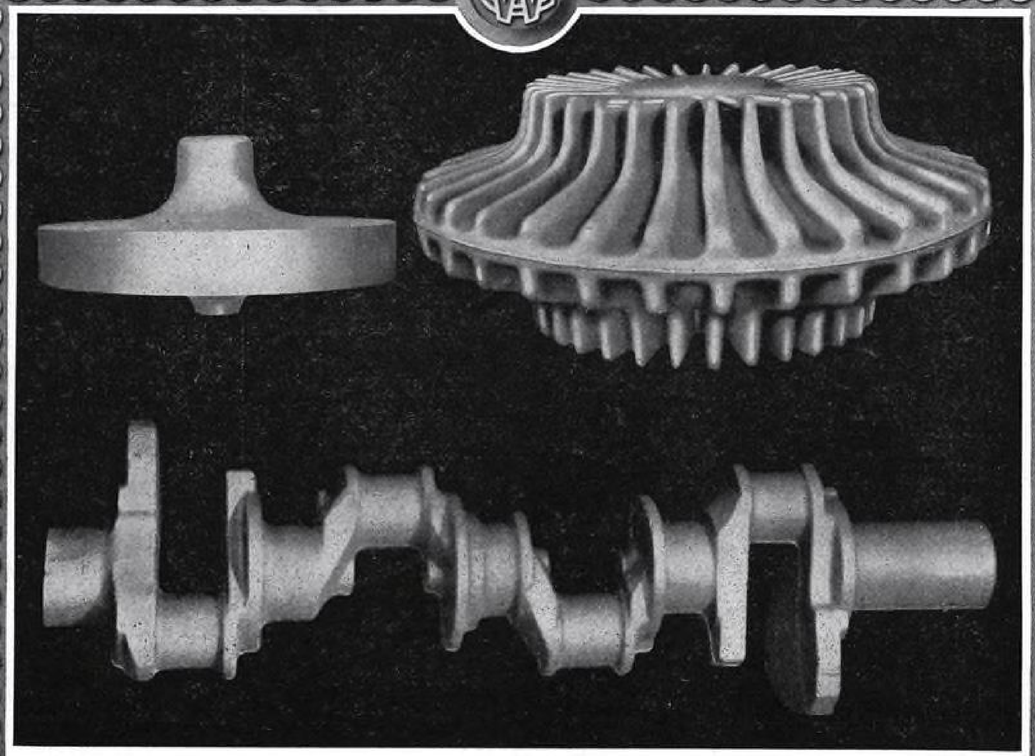
Plan now on installing Fenwal controls. Hermetically sealed, they are shock and vibration proof. Easily installed. Write now for complete details on how they can meet your specifications. Fenwal Incorporated, 129 Pleasant Street, Ashland, Massachusetts. 111 South Burlington Avenue, Los Angeles 4, California.

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Aircraft Fire and Over-Heat Detectors

Precise, Dynamic Fire Detection



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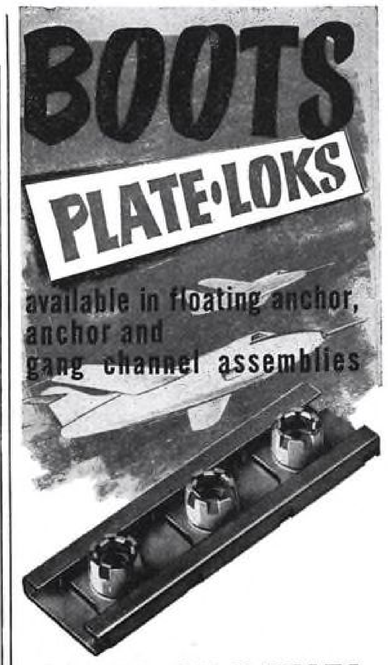
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HARVEY, ILLINOIS DETROIT, MICHIGAN

Expanding Facilities . . .

King-Seeley Corp. Dexter, Mich.	Aircraft	400,000	75
Kropp Forge Co. Cicero, Ill.	Hub and shaft, aircraft	347,549	75
Keystone Engineering Co. Los Angeles, Calif.	Aircraft parts	141,139	80
Lavelle Aircraft Corp. Newtown, Pa.	Engine mounts for airplanes	135,574	80
Lockheed Aircraft Corp. Burbank and Van Nuys, Calif.	Airplanes	3,371,238	85
Lockheed Aircraft Corp. Burbank, Calif.	Aircraft	1,077,745	80
Lockheed Aircraft Service, Inc. Burbank, Calif.	Maintenance of aircraft	37,629	85
Larson and Quigley Co. Chicago, Ill.	Aircraft engine parts	37,348	90
Liberty Products Corp. Farmingdale, N. Y.	Aircraft parts	186,070	90
Lundberg Mfg. Co., Inc. Jackson, Mich.	Landing gear parts	29,828	85
Lundberg Mfg. Co., Inc. Jackson, Mich.	Aircraft landing	61,906	90
Lord Mfg. Co. Erie, Pa.	Aircraft	29,030	90
Lyons Machine and Mfg. Co. Lyons, Kans.	Aircraft parts	34,879	90
Longren Aircraft Co. Torrance, Calif.	Wing attach fittings	12,402	80
Langdon Mfg. Co. Glendale, Calif.	Latch assembly, aircraft	6,495	90
Marcus Mason and Co., Inc. Westboro, Mass.	Aircraft couplings	83,071	85
Glenn L. Martin Co. Middle River, Md.	Aircraft	76,496	85
Glenn L. Martin Co. Baltimore, Md.	Aircraft	176,043	80
McDonnell Aircraft Corp. St. Louis Muni, Airport St. Louis, Mo.	Aircraft	1,115,922	85
McDonnell Aircraft Corp. St. Louis, Mo.	Airplane and aircraft parts	658,294	75
McDonnell Aircraft Corp. Robertson, Mo.	Airplanes	111,425	75
McDonnell Aircraft Corp. Robertson, Mo.	Airplanes	94,631	75
M. B. Mfg. Co. New Haven, Conn.	Aircraft engine mounts and fittings	108,240	90
McPhillips and Company, Inc. Trenton, N. J.	Pack—field and parachute	34,180	80
Menasco Mfg. Co. Burbank, Calif.	Hydraulic landing gears	663,634	80
Menasco Mfg. Co. Burbank, Calif.	Landing gears	350,000	75
Manlove Mfg. Co. Los Angeles, Calif.	Aircraft valves	10,989	90
Metal Fabricators Corp. Waltham, Mass.	Aircraft engine parts	29,000	75
Moynahan Bronze Co. Flat Rock, Mich.	Aircraft hinges	241,130	80
Murdock Machine and Engr. Co. Wichita, Kans.	Parts and assemblies for B-47-B airplane	88,548	80
Marquette Metal Products Co. Cleveland, Ohio	Aircraft windsdield wipers	92,929	90
Morris Bean and Co. Yellow Springs, Ohio	Aircraft	669,138	75
Michigan Steel Casting Co. Detroit, Mich.	Aircraft	15,510	75
Mid-Western Industries, Ltd. Wichita, Kans.	Airplane parts	25,653	80
Manning, Maxwell and Moore Stratford. Conn.	Aircraft	940,114	75
McCulloch Motors Corp. Los Angeles. Calif.	Aircraft engines	2,069,695	80
Marlin Rockwell Corp. Plainville, Conn.	Aircraft parts	1,104,965	85
New York Air Brake Watertown, N. Y.	Hydraulic pumps	748,870	85
National Water Lift Co. Kalamazoo, Mich.	Aircraft parts	47,803	90
Northrop Aviation, Inc. Hawthorne. Calif.	Aircraft	2,046,100	75
Northrop Aviation, Inc. Hawthorne, Calif.	Airplane parts	76,071	75
Nigg Engineering Corp. Covine, Calif.	Airplane flap tracks	13,905	90
W. H. Nichols Co. Waltham, Mass.	Aircraft engine pumps	202,934	85
North American Aviation, Inc. Los Angeles, Calif.	Aircraft	6,508,495	75
National Cash Register Co. Dayton, Ohio	Aircraft	5,000,000	75
National Water Lift Co. Kalamazoo, Mich.	Airplane parts	179,700	75

Continued on p. 148 .



GANG CHANNEL

The unique Plate-Lok Nut assembled into straight channels; removable or permanently attached nuts. Standard-length channels in a wide range of nut spacings are available; special lengths and spacings can be supplied to your order.



ANCHOR BASES

Plate-Loks in anchor bases to meet your every requirement—plain anchors, one-lug, corner, midget, right-angle. The all metal Plate-Lok is fully approved under AN-N-5 and AN-N-10. Its positive locking action is proof against vibration and structural breakdown due to radical temperature changes.



FLOATING ANCHOR

Now in one-lug, two-lug, and right-angle bases—for regular or countersunk rivets, for welding—permanently assembled or with removable nuts. For anchor applications where float is desirable—specify Plate-Lok!

PROBLEMS?

Tell us about your lock-nut problems. We'll supply experimental quantities free.

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BOOTS

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Aircraft designers have been specifying LORD Mountings for over a quarter of a century. There are sound reasons for such continued preference. LORD pioneered the shear type bonded-rubber mounting which opened the door to scientific isolation of vibration, and developed the world's most complete line of such mountings. A continuous program of research is maintained to make LORD Mountings the most effective . . . most dependable . . . most economical mountings obtainable. Designers appreciate the thorough training and cooperative attitude of the LORD engineers who help them find practical answers to their vibration problems.

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- Helicopter Rotors
- Helicopter Drive Shafts
- Engine Cowls
- Pilot Seats
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- Hydraulic Pressure Switches
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- Intercom Equipment

LORD MANUFACTURING COMPANY
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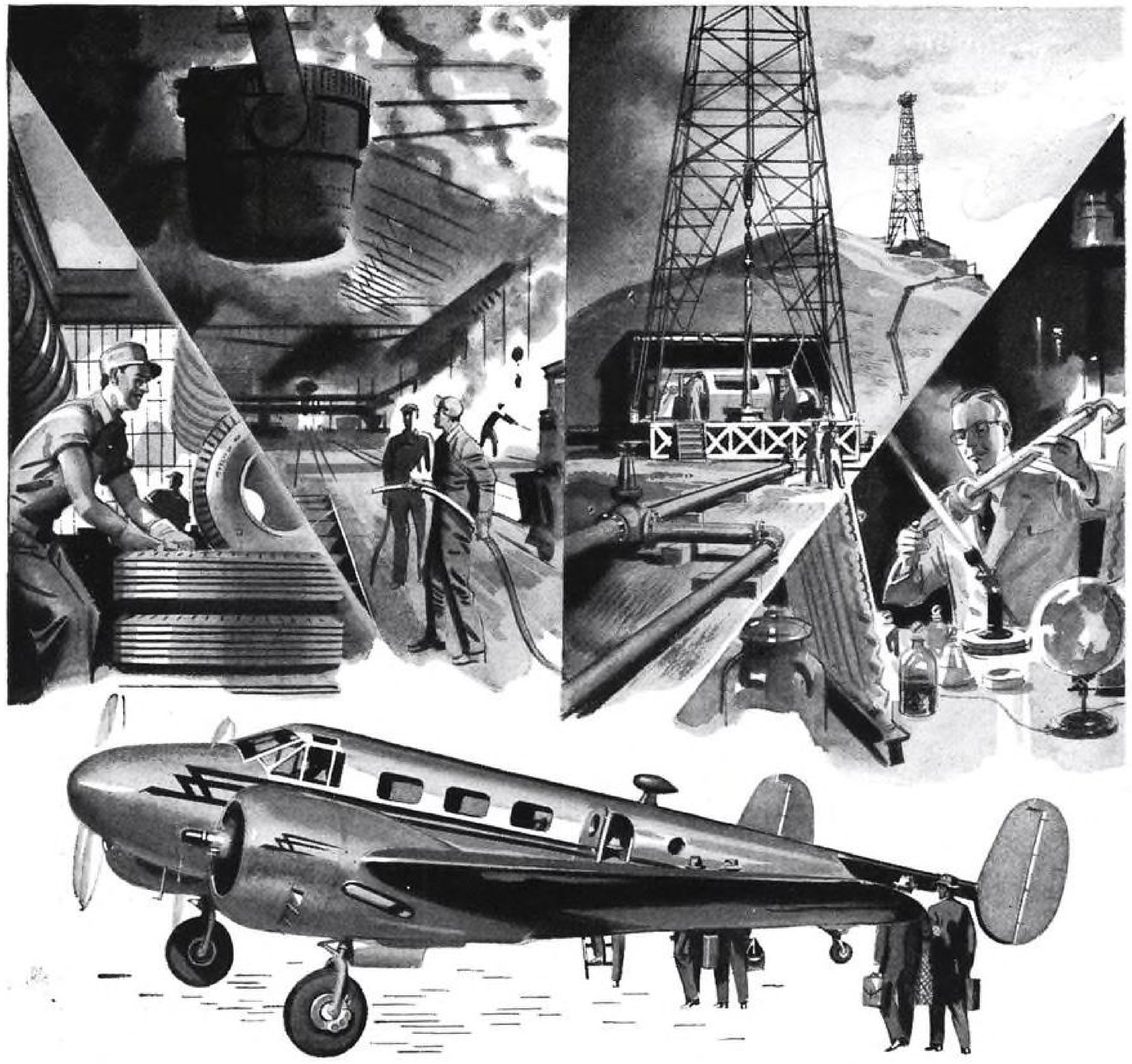
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Vibration-Control Mountings . . . Bonded-Rubber Parts

Expanding Facilities . . .

Oceanside Machine Shop, Plymouth, N. H.	Machining steel parts, aircraft	31,035	85
Oceanside Machine Shop, Oceanside, N. Y.	Machining steel parts, aircraft	12,584	85
Onsrud Machine Works, Inc., Chicago, Ill.	Metalworking machinery	26,629	90
Oro Mfg. Co., Adrian, Mich.	Aircraft seat assemblies	34,698	80
Peerless Tool & Eng. Co., Chicago, Ill.	Precision machining and fabricating aircraft engine components	149,087	90
Plainville Metal Works, Plainville, Conn.	Parachute hardware	14,663	80
Pacific Piston Ring Co., Los Angeles, Calif.	Aircraft valves	30,303	90
Plane Parts, Inc., New Haven, Conn.	Airplane parts	42,450	85
Phoenix Trimming Co., Chicago, Ill.	Parachute harness and webbings	400,000	60
Packard Motor Car Co., Macomb County, Mich.	Turbojet engines	15,244,800	75
Pacific Airmotive Corp., Burbank, Calif.	Overhaul services	8,096	75
Pacific Airmotive Corp., Burbank, Calif.	Overhaul services	34,102	75
Pattern Products Mfg. Co., Detroit, Mich.	Aircraft	47,589	80
Pantex Mfg. Corp., Central Falls, R. I.	Aircraft	29,407	90
Precision Piece Parts Inc., Mishawaka, Ind.	Aircraft assemblies	31,670	90
Piasecki Helicopter Corp., Morton, Pa.	Helicopters	4,767,020	75
Piasecki Helicopter Corp., Morton, Pa.	Helicopters	623,909	75
Parr Mfg. Co., Chicago, Ill.	Aircraft parts	10,060	90
Pioneer-Toledo Corp., Toledo, Ohio	Aircraft parts	90,000	90
Pioneer Parachute Co., Inc., Manchester, Conn.	Parachutes	61,066	60
Quaker Rubber Corp., Philadelphia, Pa.	Aircraft	256,198	75
Revere Corp. of America, Wallingford, Conn.	Aircraft equipment	694,552	75
Resistoflex Corp., Belleville, N. J.	Aircraft hose assemblies	37,500	75
Republic Aviation Corp., East Farmingdale, L. I.	Aircraft	76,496	85
Rohr Aircraft Co., Chula Vista, Calif.	Aircraft parts	83,887	65
Ryan Aeronautical Co., San Diego, Calif.	Ordnance	84,163	75
Research Welding and Engineering Corp.	Aircraft	16,500	90
REF Mfg. Corp., Mineola, L. I., N. Y.	Aircraft hatches	163,842	75
Royal Machine Works, Inglewood, Calif.	Aircraft parts	10,631	90
South Bend Screw Prod. Inc., South Bend, Ind.	Aircraft engine parts	75,551	90
Sundstrand Machine Tool Corp., Rockford, Ill.	Aircraft alternator drive	3,377,780	85
Star Tool and Die Works, Detroit, Mich.	Aircraft fixtures	230,000	80
Schaeffer Machine Co., Inc., Brooklyn, N. Y.	Aircraft fittings	21,385	90
Switlik Parachute Co., Trenton, N. J.	Parachutes	249,048	80
Skirvin Tool and Eng. Co., Indianapolis, Ind.	Assemblies for aircraft	129,500	70
Southworth Machine Co., Portland, Me.	Airplane parts	43,122	90
Solar Aircraft Co., Des Moines, Ia.	Aircraft engine parts	1,679,000	75
Solar Aircraft Co., San Diego, Calif.	Manifold banks for aircraft engine	23,486	85
Solar Aircraft Co., San Diego, Calif.	Hood for aircraft engine	1,250	75
Solar Aircraft Co., San Diego. Calif.	Parts for jet engines	109,347	85
Solar Aircraft Co., San Diego, Calif.	Aircraft engine parts	158,549	75
Solar Aircraft Co., Des Moines, Ia.	Aircraft engine parts	15,284	85
Solar Aircraft Co., San Diego, Calif.	Aircraft engine components	152,653	80
Slabe Machine Products Co., Cleveland, Ohio	Aircraft engine parts	23,885	90
South Bend Screw Products, Inc., South Bend, Ind.	Turbine engine parts	68,850	90
Steel Improvement and Forge Co., Cleveland, Ohio	Aircraft engine parts	169,162	75

Continued on p. 150

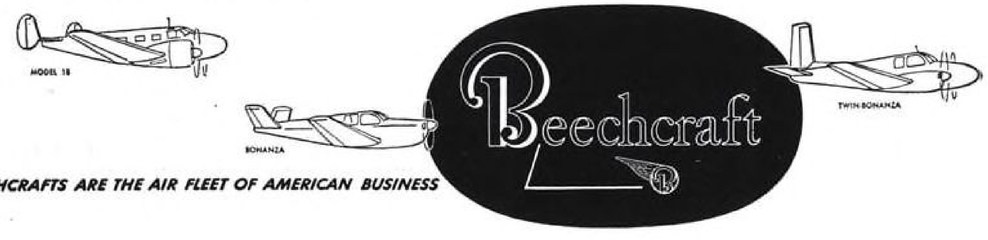


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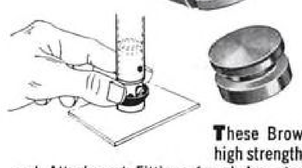
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40 G's



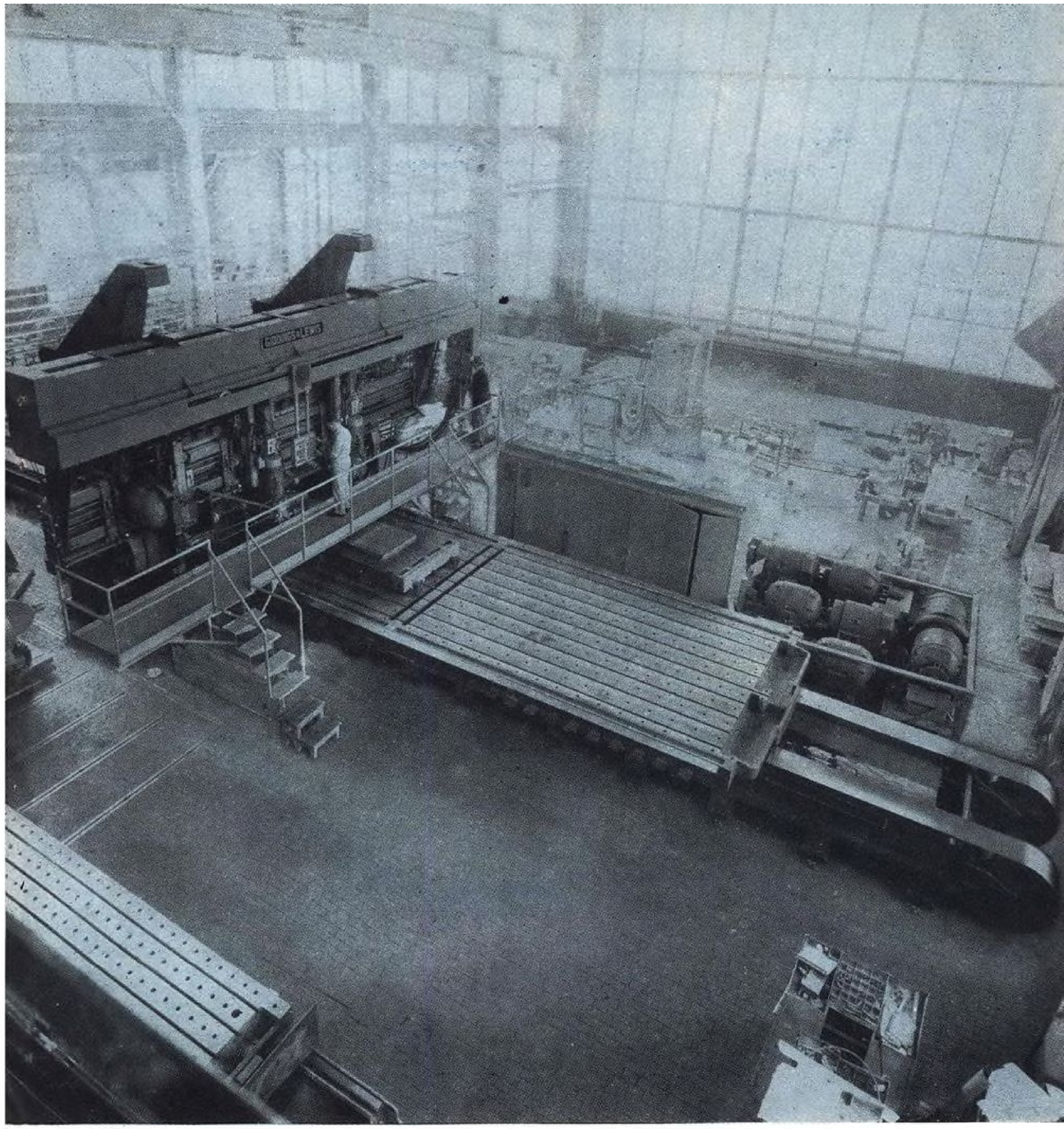


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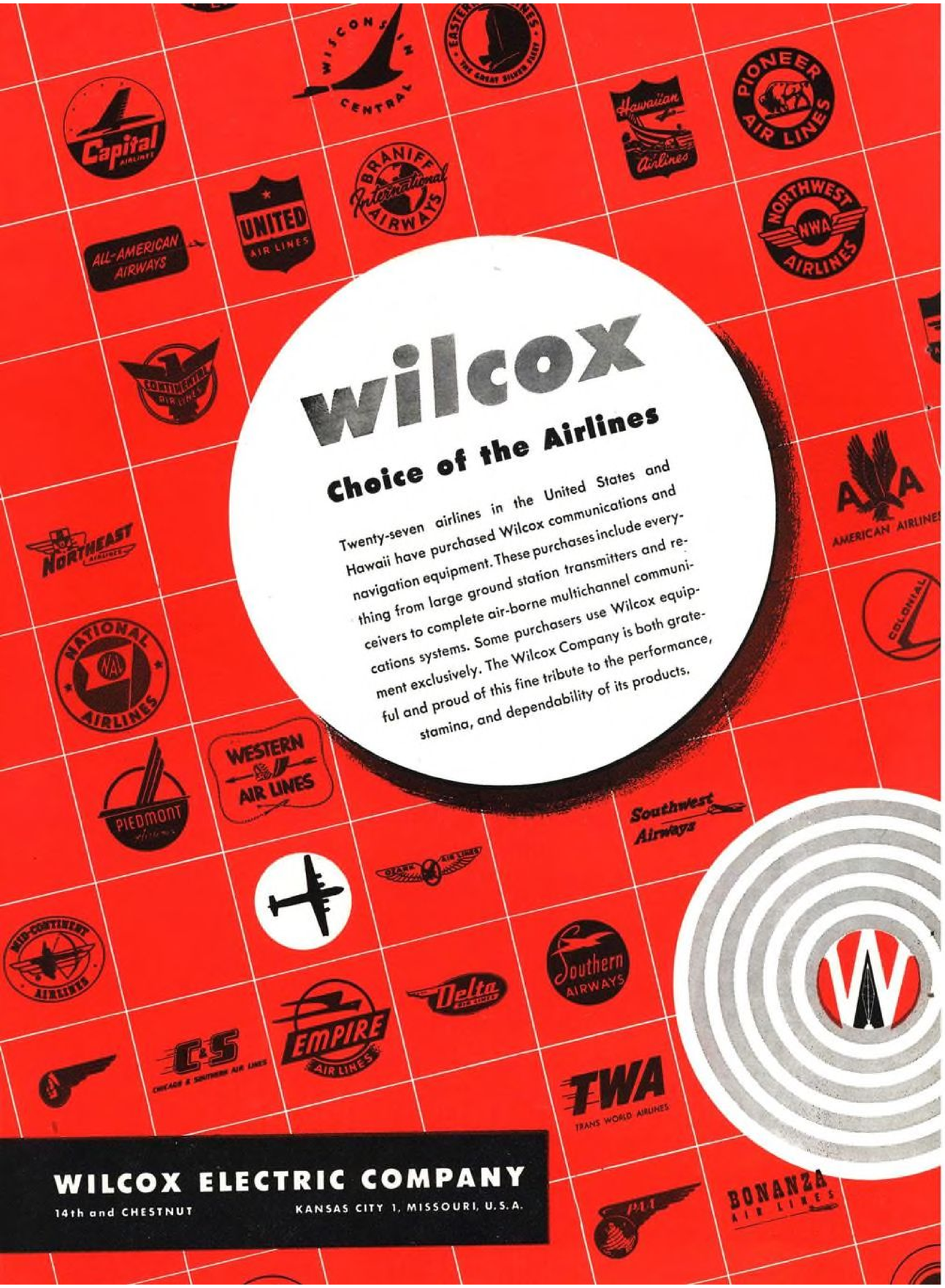
Servel, Inc. Evansville, Ind.	Airplane parts	1,231,000	75
Scovill Mfg. Co. Waterville, Conn.	Aircraft fasteners	30,834	75
Sturgess, Inc. Glendale, Calif.	Aircraft	147,866	80
Studebaker Corp. South Bend, Ind.	Aircraft	3,616,240	75
Schwien Engineering Co. Los Angeles, Calif.	Aircraft	350,000	75
Swallow Airplane Co., Inc. Wichita, Kans.	Aircraft	18,603	85
Standard-Thomson. Corp. Dayton, Ohio	Aircraft	31,791	75
Smith-Morris Co. Ferndale, Mich.	Aircraft	20,302	80
Wm. Steinen Mfg. Co. Newark, N. J.	Screw machine parts for aircraft	84,514	90
J. P. Stevens and Co., Inc. New York, N. Y.	Parachutes	10,329	75
Talley Machine and Mfg. Corp. Los Angeles, Calif.	Aircraft parts	5,607	90
Thompson Products, Inc. Cleveland, Ohio	Jet engine parts	4,930,000	85
Thompson Products, Inc. Cleveland, Ohio	Aircraft parts	1,742,857	75
Tube Processing, Inc. Indianapolis, Ind.	Fuel lines	12,425	90
Talley Machine and Mfg. Corp. Los Angeles, Calif.	Aircraft parts machine work	27,434	90
Tru-Ber Mfg. Co. Culver City, Calif.	Aircraft parts	71,158	80
Tools, Inc. Newark, N. J.	Aircraft ordnance	4,606	90
Telectro Industries Corp. Long Island City, N. Y.	Aircraft fuel gauge	61,600	75
United Aircraft Corp. Pratt and Whitney Div. East Hartford, Conn.	Aircraft engines	19,847,085	80
United Aircraft Corp. Sikorsky Div. Bridgeport, Conn.	Helicopters	2,691,105	85
United Aircraft Corp. Ham. Std. Div. East Hartford, Conn.	Aircraft propellers	2,369,460	80
United Aircraft Corp. Ham. Std. Div. Windsor Locks, Conn.	Aircraft propellers	16,800,000	75
United Aircraft Corp. Pratt and Whitney Div. North Haven, Conn.	Aircraft engines and parts	14,000,000	75
United Aircraft Corp. Pratt and Whitney Div. East Hartford, Conn.	Aircraft engines	8,400,000	75
United Aircraft Corp. East Hartford, Conn.	Ordnance	329,855	80
United Aircraft Corp. Dallas, Texas	Aircraft	578,032	75
Vahl Engineering Co. Brooklyn, N. Y.	Aircraft	75,048	75
Westinghouse Electric Corp. Pittsburgh, Pa.	Aircraft	134,840	75
Westholt Mfg., Inc. Wichita, Kans.	Aircraft	13,855	80
William R. Whittaker, Ltd. Van Nuys, Calif.	Aircraft fuel and hyd. valves	2,427,250	80
Worth. Mfg. Co. Los Angeles. Calif.	Aircraft parts	3,106	90
Western Hydraulics, Ltd. North Hollywood, Calif.	Aircraft hydraulic valves	67,117	85
Waco Aircraft Co. Troy, Ohio	Aerial delivery kits	12,476	85
Weatherhead Co. Antwerp, Ohio	Aircraft hose, assemblies	816,410	75
Wyman-Gordon Co. Worcester, Mass.	Aircraft	2,814,626	75
Wells Aircraft Parts Co. Los Angeles, Calif.	Machined aircraft parts	4,188	85
Wells Aircraft Parts Co. Los Angeles, Calif.	Aircraft parts	95,000	90
Westinghouse Electric Corp. Pittsburgh, Pa.	Aircraft supplies	24,500,000	75
Wright Aeronautical Corp. Caldwell, N. J.	Aircraft parts	578,600	75
Wright Aeronautical Corp. Wood-Ridge, N. J.	Aircraft parts	5,334,440	75
Wright Aeronautical Corp. Garfield, N. J.	Aircraft parts	6,124,000	75
Waldorf Instrument Co. New York, N. Y.	Aircraft parts	219,423	75
Wel-Met Co. Kent, Ohio	Bearings and parts, aircraft ordnance	412,534	85
TOTAL		$361,584,804	



Machine built for Lockheed for milling integrally stiffened skin (page 181).

The Production Methods

SUBCONTRACTING....PAGE 153
TOOLS AND TECHNIQUES....PAGE 180



SUBCONTRACTING

Why Industry Spreads the Work

Subcontracting may be real key to rapid expansion of production in an emergency—if we can afford it.

● Subcontracting has the power of government and industry behind it. It has the appealing advantages to both of broadening the industrial base, and keeping the home plant from getting unwieldy.

● So it will continue to increase, and push military work into thousands of small plants.

● But there is another side. It is not the cheapest way for the government to do business, and not necessarily the fastest way to produce airplanes.

In a recent negotiation for a follow-on contract on an all-weather fighter, the contractor proposed to increase subcontracting from 11 to 29%. In another contract, several hundred trainers are to be added by Supplemental Agreement. For the additional planes an accelerated delivery schedule calls for expansion of subcontracting from a negligible amount to 40%.

These are just examples of what happens all through the industry. Why this great increase in subcontracting? Is it the best way to greater production? What will the effects of more subcontracting be?

▶**Help Needed**—In 1950, one major airframe manufacturer placed 113,560 orders for $132 million worth of items. To help fill the 168,154 requisitions for material the file clerks went through the 350,000 cards which list all the material the manufacturer buys.

In 1951 the purchase orders placed by this manufacturer will probably increase three-fold over 1950. They may well reach half a billion dollars.

This is clear proof that our manufacturer is not, and never has been, able to provide all the material and do all the necessary work by himself. He always goes out and buys not only factory equipment and raw materials but also parts and equipment.

All electrical equipment, fuel tanks, hydraulic equipment, instruments, landing gear, radio and many thousands of other items are always bought on the outside. So are the parts—from bolts and nuts, bearings and bushings, chains and chairs, clamps and clips all the way down the alphabet to zippers. And so are, naturally, the raw materials—metal bars and rod, castings, extrusions, forgings, and sheets as well as rivets, tubing and wire.

▶**Purchases Climbing**—In 1950 it was estimated that roughly one-third of the money received from sales by airframe manufacturers went for outside purchases. Soon, with renewed emphasis on subcontracting, it is certain that more than half will ultimately find its way to subcontractors, vendors and suppliers of material (AVIATION WEEK Sept. 25, 1950, p. 12).

Why does our manufacturer let so much of his contract go to others? Why doesn't he try to do most of the work himself?

The answers are two-fold. First, and most of all, the government wants him to use subcontracting. And, second, there are some potent reasons why he wants to do so himself. Here is the background of both sides, and where subcontracting is leading us.

1. Government Reasons

The government wants to broaden our mobilization base. It does not want overtime and it does not want multi-shift operation to increase production because that would mean a greater use of the existing capacity than usual.

It wants to leave this unused capacity of manpower and facilities unchanged wherever possible so as to have it more or less ready in case of all-out war. It wants industry to use additional contractors so that additional facilities and workers are added to our defense capacity.

This principle goes far beyond gentle persuasion. On Dec. 18, 1950, the Secretary of Defense directed his Department "to encourage, or *if necessary, require*, subcontracting by prime contractors."

▶**Protective Instinct**—Part of this very strong emphasis on subcontracting is undoubtedly due to an Administration effort to protect overall business, caught between restrictions on materials and little voluntary subcontracting by some of the large companies.

The government hopes that subcontracting will take up the slack in industries facing cutbacks in their operations because of growing shortages of materials available for non-defense production.

Therefore, defense procurement

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agencies have made it a policy to bring into the defense effort qualified producers who can be used; to give the small manufacturers every help and guidance in getting prime or subcontracts; and to make prime contractors subcontract to small firms as much business as possible.

The examples of increased subcontracting cited at the beginning of this article were made at the insistence of the procurement agencies although the increased subcontracting meant a considerable increase in cost per plane produced.

2. Industry Reasons

Industry spokesmen say they are in favor of increased subcontracting because they agree with the government's policy of widening the nation's industrial production base.

Most of all, however, prime contractors feel that there are definite limits to how much parent facilities and parent company management can be spread out.

▶ **The Sociological Factor**—Through increased subcontracting they hope to be able to distribute the emergency load and keep the size of the parent plants from overexpanding. Rapid post-emergency shrinkage after World War II created many community problems in the home towns of the leading aircraft manufacturers. They are well remembered by the companies and workers alike. The violent fluctuations in aircraft employment keep many qualified workers from taking jobs with the industry. Poor housing conditions for newcomers have a similar effect. Thus, it appears to be more desirable to leave these workers in their peacetime employment where they have seniority and pension rights and housing and bring the aircraft work to them through subcontracts.

If and when the time comes to resume peacetime production in these subcontractors' plants only the type of work will change. There will be less unemployment, less moving of people. The economic life of the home town of the prime contractor will be disturbed very much less than if it had tried to do all the work.

▶ **More With No Increase**—The placing of a large part of fabricating and subassembly work to other plants frees floor space for increased final assembly and other critical jobs in the plant of the prime contractor and makes possible a very large expansion of output of the prime contractor without increasing his employment or his facilities too drastically.

By "farming out" much of the fabrication and subassembly, the government and the prime contractor also avoid to some extent the need for constructing new facilities which may otherwise become unavailable in some locations.

3. What Happened Before

After having heard the widespread current praise of subcontracting it is somewhat surprising to discover the lack of enthusiasm on the part of students of World War II production.

One authoritative source* says: "... In wartime ... many of the items being manufactured were new, experienced subcontractors were not available, transportation frequently slow and raw materials, tools, and manpower difficult to obtain. Spreading contracts meant bringing additional facilities into war production and up to a certain point meant speeding production. After that point was reached, however, further subcontracting meant delay because the difficulty of interpreting production outweighed the gains resulting from division of labor."

And the political aspect of subcontracting is made apparent in the following evaluation of the work of the Industry Cooperation Division which stimulated subcontracting: "If nothing more, it 'took the heat off' other parts of the Navy procurement and production organization."

▶ **The Harvard Report**—And the report by five Harvard University researchers to Maj. General E. M. Powers, postwar AAF director of materiel, says in its principal conclusions: "Subcontracting and licensing were extensively resorted to ... licensing ordinarily proved to be more helpful in alleviating management load than did subcontracting."

In a more detailed discussion of subcontracting the report says:

"In actual experience, however, subcontracting was not so successful in relieving the management load on the old-line companies as might have been anticipated. Disadvantages become apparent of which the following appeared to be especially important.

"1. The complexity of controlling the flow of subcontracted items placed an appreciable management burden on the prime contractors ... much paperwork ... many man-hours ... expediters ... inspection ... often duplicated.

"2. Subcontracting normally slowed the handling of design changes ... at one time or another the aircraft companies had to rework parts produced by almost all of their subcontractors.

"3. The subcontractors' original work frequently fell below aircraft standards, causing many rejections and duplicate inspections. ...

"4. Producing a single part or subassembly created less of a tangible incentive than did producing the finished product. ...

"5. Subcontracting caused much duplication of transportation in the form of cross-hauling of parts or subassemblies. ..."

These disadvantages have deeply impressed aircraft manufacturers. Many of the executives interviewed expressed the view that subcontracting was more trouble than it was worth."

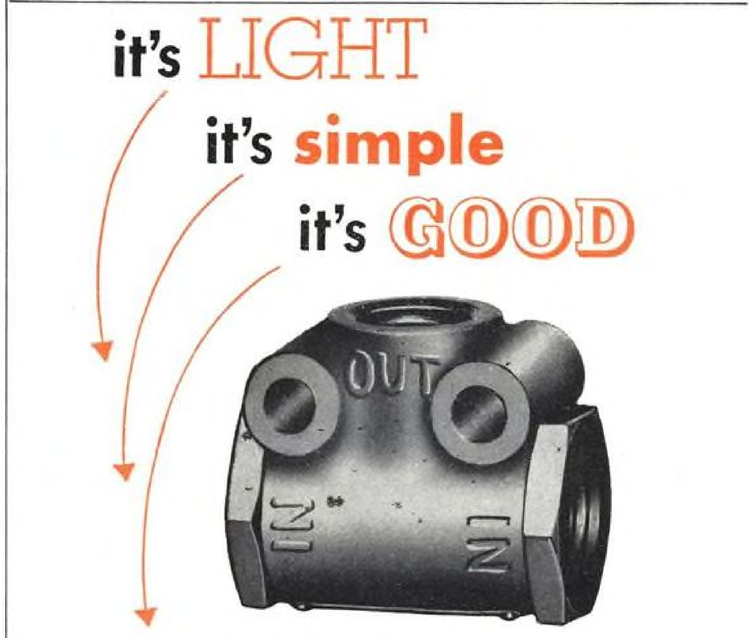
The report continued to say that this was probably correct for over-all parts but that the subcontracting of large sections enabled the companies to shift substantial portions of the management load without paying too high a price in terms of difficulties created.

▶ **Pattern of Past**—What was the pattern of expansion of the aircraft and engine companies during the war?

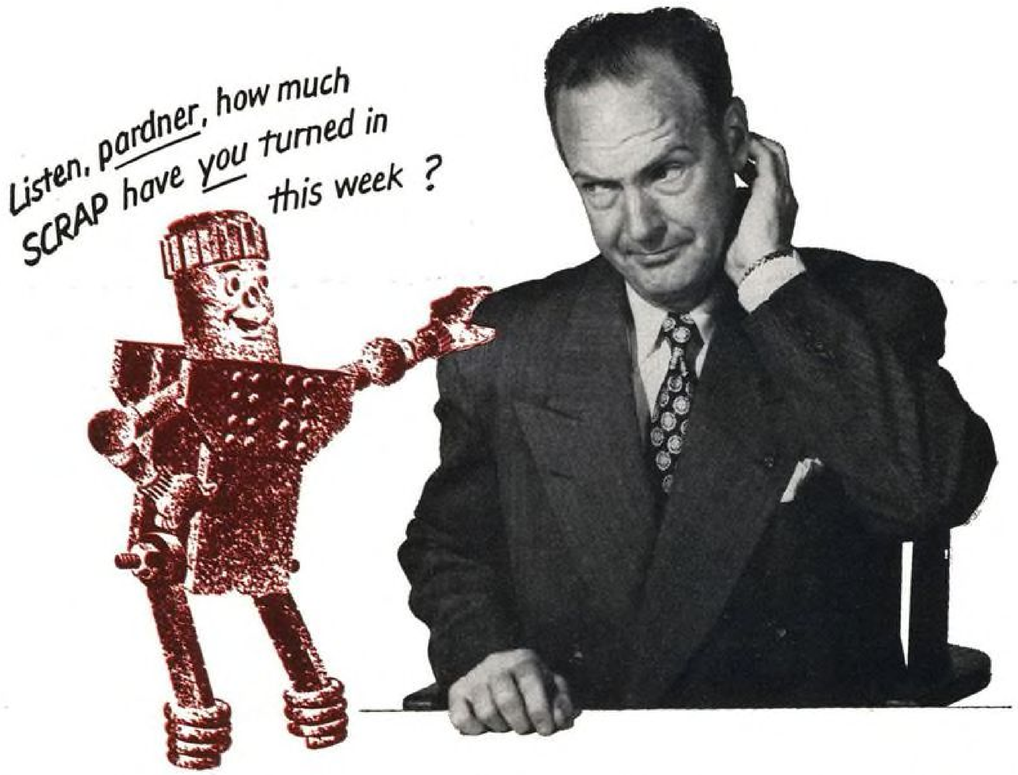
• **Airframe.** In aircraft, the expansion was carried on largely by the 13 aircraft plants which were in production in 1940 and by 16 branch plants of these companies constructed during the war. These companies were responsible for the bulk of wartime production. Only 10% of total aircraft poundage was produced in 1940-1944 by the four companies which had licensing arrangements for the assembly of complete air frames but which had not been in the aircraft business before 1940.

This was the production picture at

* Robert H. Connery, "The Navy and the Industrial Mobilization in World War II, "Princeton, 1951, p. 33-7.



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More scrap is urgently needed. Today the mills are turning out more steel than ever before. But they're scraping the bottom of the barrel as far as scrap is concerned. Defense and domestic demands for steel simply cannot be met unless at least 100,000 tons of "purchased" scrap roll into the furnaces—*every day*.

The bulk of this scrap must come from industry. That's why we're asking for your all-out help. That's why it's so important that you make the drive for scrap part of your daily operations. Make it your business to encourage every employee to report any obsolete, broken or worn-out machinery, tool or equipment that has seen its day. From this dormant "junk" must come the heavy melting scrap that the mills need most. Don't let your scrap lie idle; send it on its way. How about it, pardner?

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major plants, according to the Harvard Report:

Pounds of Airframe Weight Accepted
(Excluding spares)

	Million 1944 lb.	%	1940-44 Million lb.	%
Pre-1940 plants	394.2	43.1	1,020.0	55.4
New plants—aircraft co.-managed	381.7	41.7	635.0	34.5
New plants—non-aircraft co.-managed	139.2	15.2	184.6	10.1
	915.1	100.0	1,839.6	100.0

During the entire emergency period the heaviest burden was carried by the pre-1940 industry, first in the old plants and later with the help of the new branch plants. Licensee plants managed by non-aircraft companies became important only in 1944 when they produced 15% of the output.

The major contribution of the non-aircraft plants was made by their production as subcontractors of the aircraft assembly plants and as suppliers of purchased parts and components.

• **Engines.** The Harvard Report's preference for licensing is probably largely influenced by the excellent record of licensee plants in engine production. Here is the picture:

Horsepower of Engines Produced

	Million 1944 hp.	%	Million 1940-44 hp.	%
Prewar plants	101.6	24.0	376.4	38.3
Branch plants	74.1	17.5	141.1	14.3
Licensee plants	247.5	58.5	466.1	47.4
	423.2	100.0	983.6	100.0

Pratt & Whitney went all out for licensee plants while Wright Aeronautical preferred to handle all final assembly work itself. The Harvard Report remarks that "the relative increase in the administrative burden of the Wright company was far greater than that of Pratt & Whitney, and the consequent dilution of Wright management, was probably one of the causes of the greater expansion in the use of Pratt & Whitney engines."

In engine production the contribution of non-aircraft companies was also increased by subcontractors who furnished products equal to almost 30% of the total workload of the prime contractors in December, 1944.

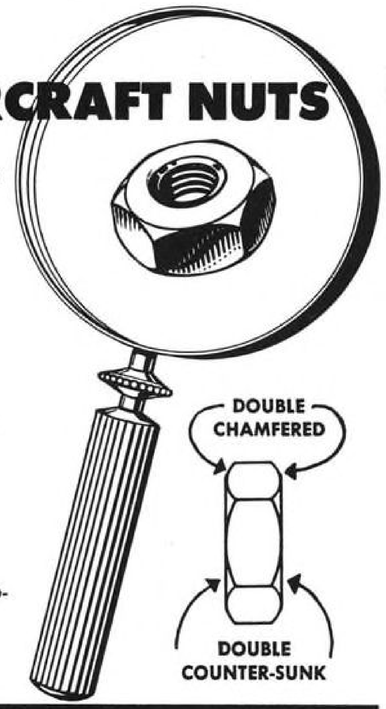
▶ **The Conclusion**—An analysis of World War II facts puts the contribution of subcontracting in its proper light: the major contribution to expansion is made by the "old-line" aircraft companies. Next comes the contribution of branch plants (mostly in airframes) and licensees (mostly in engines) and subcontractors.

The present emphasis on subcontracting tends to obscure the other factors of expansion.

(*Continued on p. 158*)

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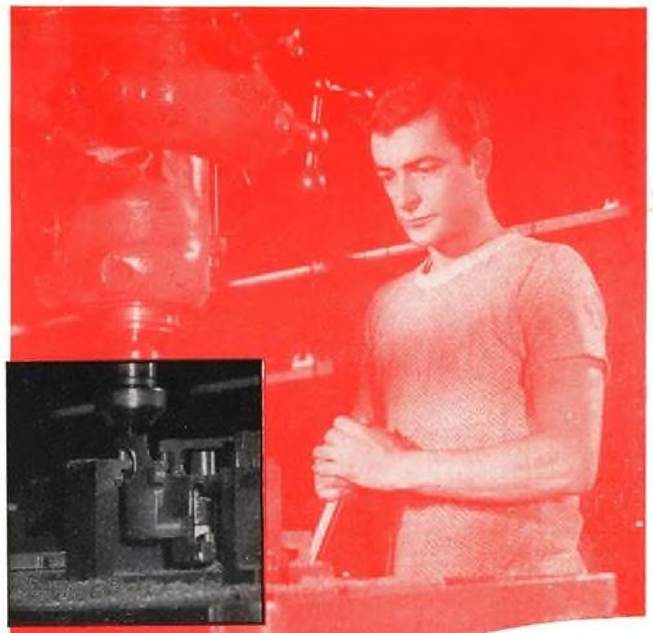
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PIERCE GOVERNORS

(*Continued from p. 157*)

4. Worth the Cost?

Industry sources point out that production integrated within one facility is naturally less expensive than any elaborate subcontracting.

Lockheed reports that its subcontract unit has to iron out thousands of engineering and production details, strip thousands of tools, turn over materials and run down sources of supplies.

▶ **The Drawbacks**—The increase in production costs through subcontracting is due to higher overhead costs, greater transportation charges, less efficient use of machine tools, duplicate inspection and testing. Modifications can be made less easily, too.

There is also a certain time lag between the award of a prime contract and the negotiations between the prime contractor and prospective subcontractors. Detailed specifications must be prepared, multiple copies of blueprints must be run off, and invitations to bid prepared and sent out.

Before executing a subcontract a prime contractor will also investigate the subcontractor's equipment facilities, inspection standards, financial responsibility and security clearance.

Other factors of additional cost in the aircraft industry arise from duplicate tooling and possible subcontracting after the prime contractor has reduced his own cost by progressing along his learning curve. It has been calculated that to start subcontracting an item after the completion of 300 airframes by the prime contractor increases the direct labor cost of this item by 25% on the next 100 airframes.

▶ **The Expense**—The increase of subcontracting from 11 to 29% on the follow-on contract mentioned earlier is expected to increase the direct labor cost per plane by $4,000 and the cost of tooling by more than $7,500.

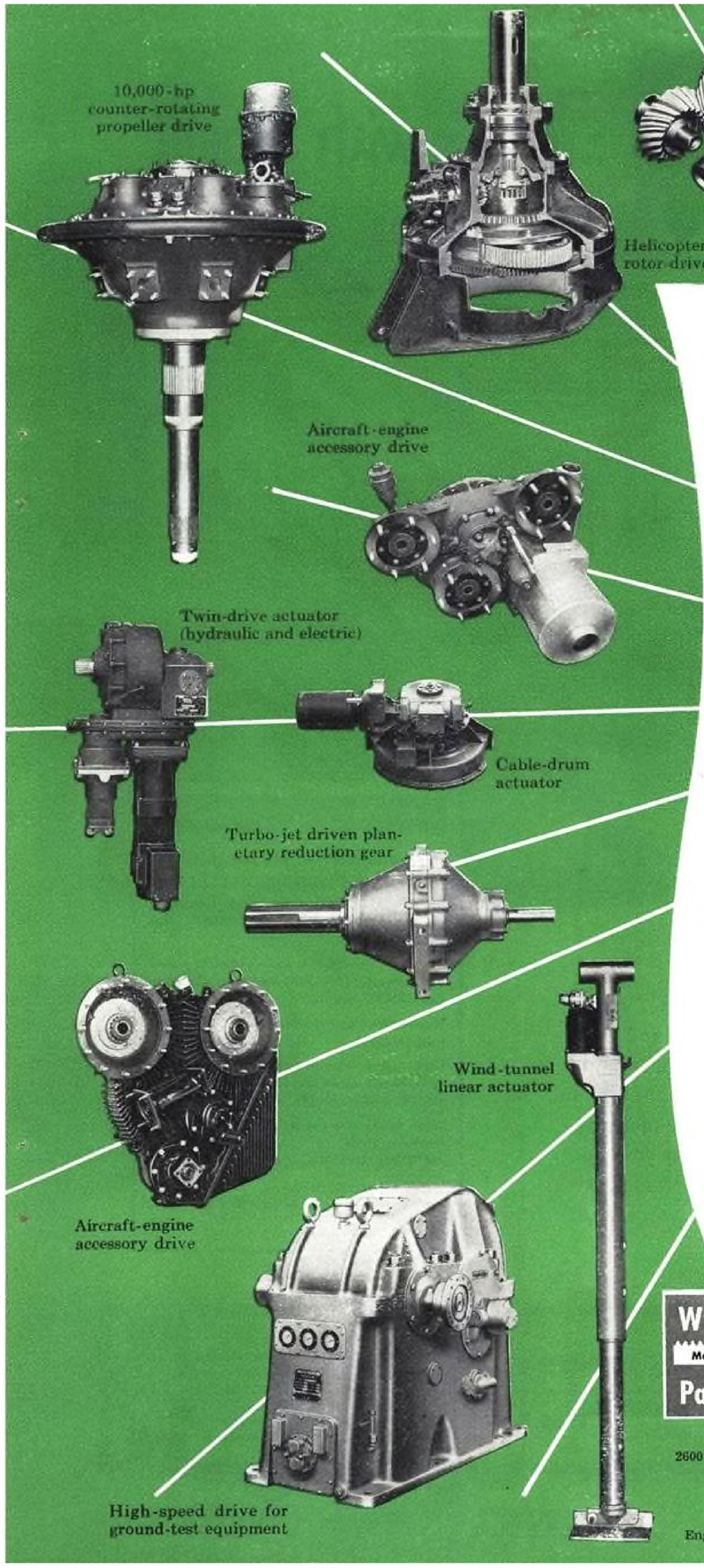
On other military aircraft, cost increases of 9% and 12% due to increased subcontracting are reported.

The present expansion job is very different from the one that took place under the pressure of war. We are trying to broaden the base of our entire industrial economy.

We are trying to build up our air forces to a very much larger size, as yet undetermined. To accomplish this goal will require a greater production of aircraft than it will take to keep these forces up-to-date later.

The present emphasis on subcontracting is undoubtedly due to an effort to carry out this expansion with less of a disturbance of the operations of the defense plants as well as these of the producers of civilian products.

Only the future can tell if the experiment is worth the cost.—R.M.



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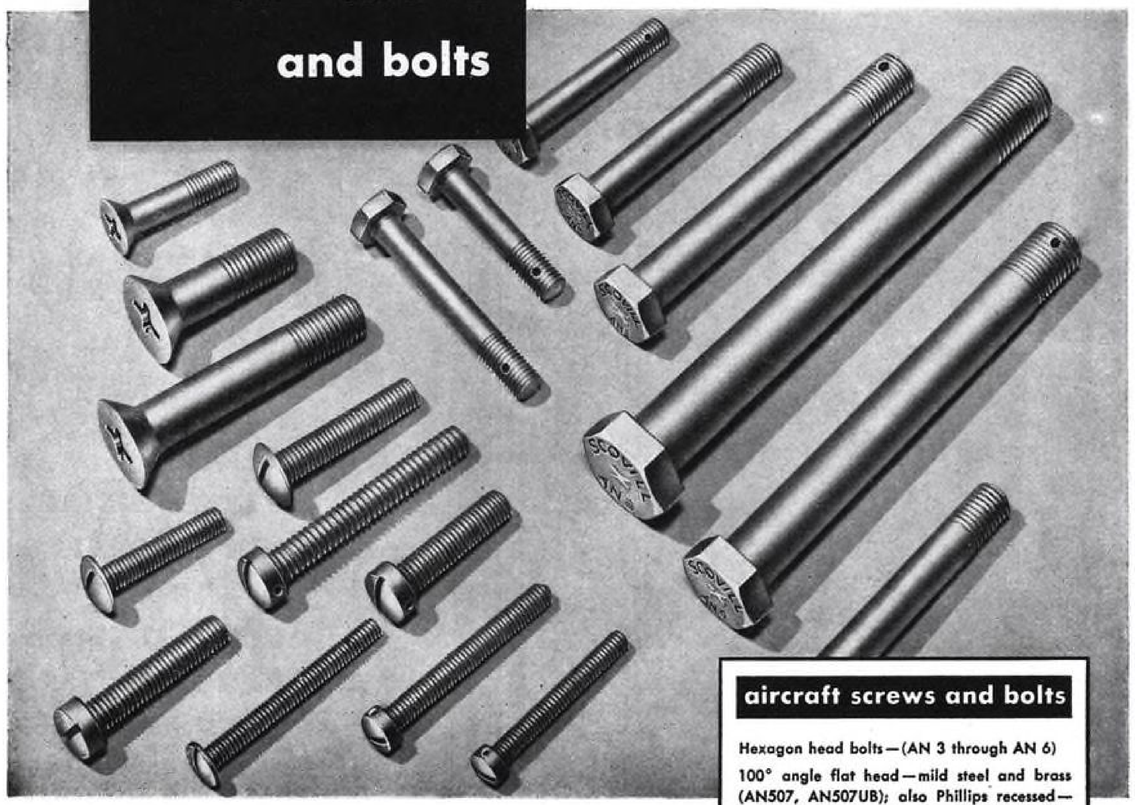
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100° angle flat head—mild steel and brass (AN507, AN507UB); also Phillips recessed—cadmium plated—carbon steel (AN507), alloy steel (AN509)

Drilled fillister head screws—cadmium plated—carbon steel (AN500A, AN501A); also alloy steel (AN502, AN503)

Washer head screws—cadmium plated—alloy steel (AN525)

Carbon steel machine screws—slotted or Phillips recessed—cadmium plated (AN500, AN501, AN505, AN510, AN515, AN520, AN526)

Brass machine screws—slotted or Phillips recessed—plain or oxidized (AN500UB, AN501UB, AN505UB, AN510UB, AN515UB, AN520UB)

Steel tapping screws—cadmium plated (AN530, AN531)

Scovill pitched in before to help the aircraft industry with top quality screws and bolts made to AN Specifications. Now we are ready to help again.

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A PRODUCT OF SCOVILL

Case Study

What subcontracting is, and what a plant needs is told by a large sub.

● Subcontract work has some attractive features for a manufacturer who is looking for defense work for his plant. He deals with other business men, rather than bureaucrats; his prime will help him get critical materials.

● There are some disadvantages in subcontracts, too. Big one is the paper-shuffling that slows down payments.

● Here's a case study of one of the most successful subcontractors.

Texas Engineering and Manufacturing Co., Dallas, today is one of the largest, if not the largest airframe subcontractor in the country.

With a current backlog of approximately $135 million, Temco is manufacturing major assemblies for four of the country's largest aircraft prime contractors—Boeing Airplane Co., Douglas Aircraft Co., Lockheed Aircraft Corp., and The Glenn L. Martin Co. Its subsidiary—Luscombe Airplane Corp.—is producing major assemblies for a fifth prime contractor—Consolidated Vultee Aircraft Corp.

In order to learn how Temco achieved its leading position in the subcontract field, and how other companies could get their share of subcontract work, AVIATION WEEK put the question to Temco President Robert McCulloch.

▶ **What It Took**—Temco's present position as a major subcontractor, McCulloch said, is due to a combination of factors, two of the most important of which were possession of a modern facility with over a million and a quarter square feet of floor space suitable for major assembly work, and a basic organization of experienced aircraft people with a pool of workers in the area who had previous aircraft experience on whom to draw for needed expansion. In addition, Temco had a good complement of machinery and equipment for aircraft production and was able to negotiate a facilities contract with the Navy for items lacking.

While all of the above items were necessary requisites to obtaining the type of subcontract work now being performed by Temco, McCulloch said, lack of them does not mean that a company cannot be a successful subcontractor.

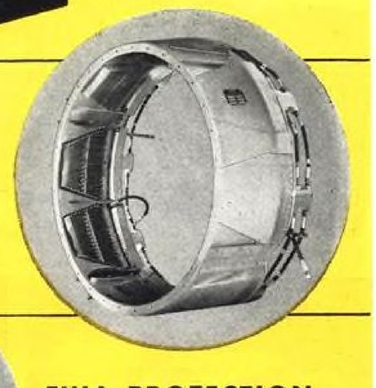
A great majority of subcontractors,

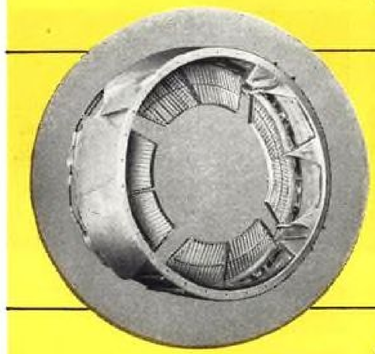
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FULL POWER

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FULL PROTECTION

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FULL CLOSING

For maximum range with engines inoperative. For ground protection.



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he pointed out, operate out of backyard garages or small workshops the size of a one- or two-car garage. Their total payroll may run only five or ten men, and equipment may consist of a standard milling machine, a production milling machine, and engine lathe, a turret lathe and one or two drill presses, as compared to the complex array of milling machines, stretch presses, hydro-presses, spar mills, drop hammers, etc., in a shop like Temco's. Actually, some subcontractors employed successfully by Temco have had only a single metal lathe and drill press.

▶ **What It Takes**—If a subcontractor is interested in sub-assembly work, McCulloch went on, he will have to have more floor space—probably between 10,000 and 100,000 sq. ft.—and will require small power tool such as pneumatic riveting guns, air screw drivers and air-driven wrenches, which in turn calls for air compressors, storage tanks and overhead air and electrical connections.

More important, McCulloch emphasized, the sub-assembly subcontractor must be able to supply detail parts support for his assembly operation, which in turn requires the latest and often the most expensive processing equipment. For example, what looks like a simple door assembly may require magnesium or aluminum anodizing, aluminum heat treat, heat aging, class A spot welding and class A automatic riveting. The processing equipment alone for these operations would cost many thousands of dollars, and would require highly skilled operators.

The assembly subcontract operation is no longer a small shop proposition, and in addition to the processing and assembly equipment required, necessitates a great deal of "know how" as to installation of jigs, their operation and maintenance for high production, etc. It generally takes from 50 to 500 employes.

Actually, McCulloch said, the small subcontractor, who is willing to take on subcontracts within the capabilities of his facilities, equipment and personnel, stands a better chance of obtaining subcontracts than the large subcontractor, if for no other reason than that he has a larger number of prospective customers. For example, McCulloch pointed out, most of the prime contractors subcontract direct to small business while, at the same time, the larger subcontractors such as Temco re-subcontract many items to small business firms.

Before calling on these potential customers, McCulloch cautioned, the firm seeking subcontracts should prepare a detailed inventory of his equipment, listing it by make, model and capacity, and at the same time indicate floor space available, number of employes and small tools such as electric and pneumatic hand and bench tools. He should also include with these lists a copy of his latest statements.

▶ **Why Re-Subcontract?**—As a major subcontractor, McCulloch said, Temco in turn lets out about 30% of its total volume in the form of subcontracts or orders for purchased items. This is due to many causes. Some items re-subcontracted are let out because their manufacture requires specialized equipment which Temco does not have. Others are let out because of equipment shortages; still others because the quantity required does not warrant utilization of high-production machines in the Temco shop. Peak loads which exceed the company's normal supply of highly skilled labor also are responsible for some subcontracting, and finally, there are some items which by their very nature can be produced better or more economically in a small shop than a large one.

▶ **Pros and Cons**—Turning to problems of the subcontractor, McCulloch said that one big advantage of being a subcontractor is that a majority of your dealings are with business firms who have experienced problems similar to your own and therefore are able to provide guidance and assistance.

Another big advantage is that in

aircraft tooling costs CUT with Rezolin Tool-Plastic

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PLASTIC MODEL air intake nose for North American Aviation has greater dimensional stability. Note metal locators installed using Rezolin Quick-Set.



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HYDROPRESS FORM BLOCKS cast overnight to standard scale eliminating blue blocking or Keller time for Hiller Aircraft.

For complete information write Dept. AW-9

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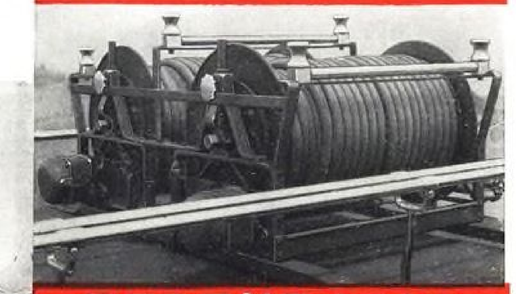
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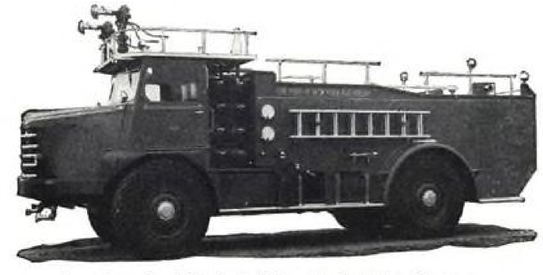
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A "Servicer" designed by the Technical Department of Esso Export Corporation for use in conjunction with a hydrant system for dispensing aviation gasoline. Three Hannay Hose Reels, powered by explosion-proof electric motors, are used in this "Servicer" which was built by Couse Manufacturing, Inc.



A modern Crash Truck, built by Maxim Motor Company, equipped with four Hannay Hose Reels powered by explosion-proof electric motors.

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4. Mass production techniques that assure quality control on hundreds of production sequences simultaneously.
5. Meticulous care in each assembly operation.
6. Supervision by personnel with wiring know-how.

COST REDUCTION and WIRING INTEGRITY are inherent in UNILECTRIC'S WIRING KNOW-HOW. They result from nine years of constantly serving hundreds of leading manufacturers of electrical and electronic equipment . . . and extensive current and World War II experience producing wiring systems for RADAR, RADIO, TANKS, FIRE CONTROL MECHANISMS, MOTORCYCLES, INSTRUMENTS and other Armed Forces equipment.

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many cases the prime contractor will procure all necessary materials, and where this is not done, the prime contractor will allocate priorities to the subcontractor for the purchase of necessary materials in accordance with NPA regulations.

There are disadvantages too, McCulloch pointed out, one of the greatest being that the additional paper work which must be done by the prime contractor tends to slow down the process of collecting receivables, which in turn places a strain on the subcontractor's working capital position and brings on additional costs in the form of interest on loans.

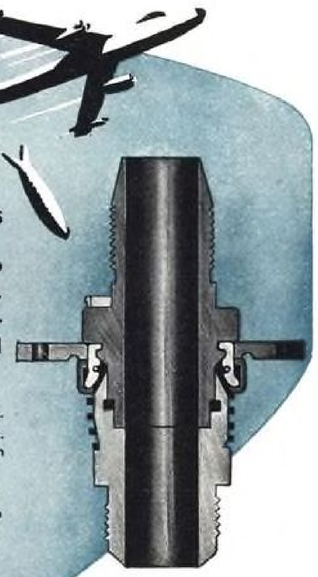
Another disadvantage is in the matter of renegotiation. Most subcontracts, McCulloch said, are subject to direct renegotiation by the government just as prime contracts are. However, these same subcontracts may also be subject to redetermination by the prime contractor, and cases can come up where the company is renegotiated in 1951 on the same contract which is scheduled for redetermination in 1952, resulting in a confusing situation.

The potential subcontractor on military contracts, McCulloch said, will do well to procure copies of the Renegotiation Act of 1951, the Vinson-Trammell Act, Fair Labor Practices Act and all National Production Authority Regulations, and to familiarize himself thoroughly with these documents as they apply to his business. He should also read all purchase orders carefully to make sure they do not contain provisions with which he is not familiar.

▶ **Distance Factor**—At the present time, two of the prime contractors for whom Temco is performing subcontract work are located on the West Coast, one is on the East Coast and one in Wichita, Kan. While this would seem to indicate that distance from the prime contractor has little bearing on obtaining subcontract work, McCulloch pointed out that distance becomes an increasingly important factor where less specialized facilities are required, and that the closest qualified source will be selected first because it permits faster and lower-cost liaison, simpler single part inspection, and reduced shipping costs and potential shipping damage. In addition to considering location in relation to the prime contractor, the subcontractor should also look into the possibilities of having either Air Force or Navy inspectors close enough to perform Governmental Source Inspection on items manufactured by his shop, as this can affect his ability to obtain subcontracts.

McCulloch said that the 30% of Temco's business which is passed on to subcontractors goes to approximately 500 sub-subcontractors and vendors. Of this number, approximately 75%

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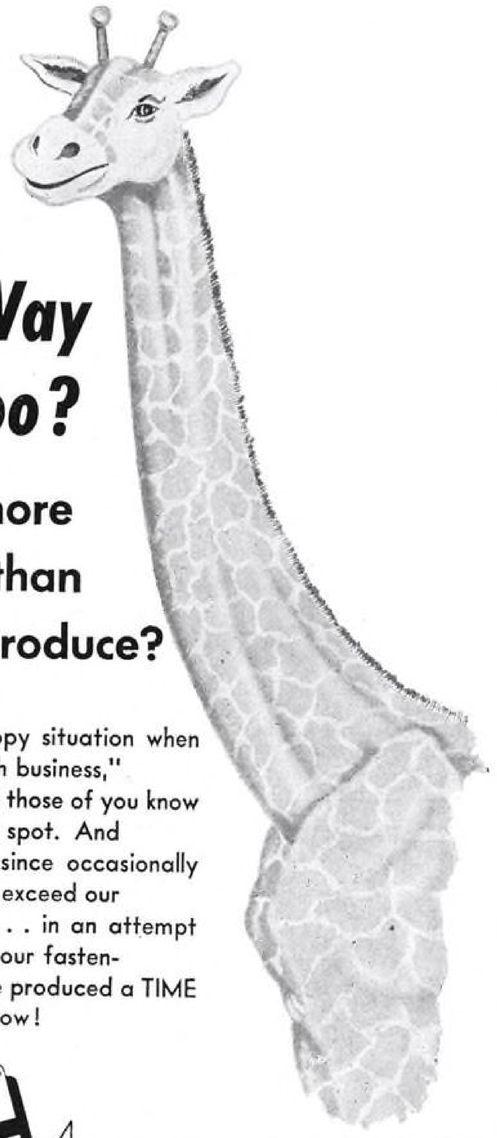
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Sounds like a happy situation when you say "too much business," but it sure isn't, as those of you know who are on that spot. And we're on it, too, since occasionally your requirements exceed our production. But . . . in an attempt to help you with your fastening problem, we've produced a TIME SAVER, shown below!



FREE—A-N Stainless Fastening Selector

This handy slide-chart instantly identifies A-N Nos. pertaining to stainless steel nuts, screws, bolts, rivets, cotter pins, washers; gives sizes and other data. Write for "Chart 51C" TODAY!

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fall in the same business category as defined by the Department of Commerce. A large majority of these sub-subcontractors are located in Texas and the Southwest, but their ranks include companies in all sections.

Temco has established its relationships with these firms in many different ways. Some have made their first contacts with Temco by direct solicitation. Others have been approached by Temco as a result of reputation, recommendation by prime contractors or the armed services, or advertising in business publications.

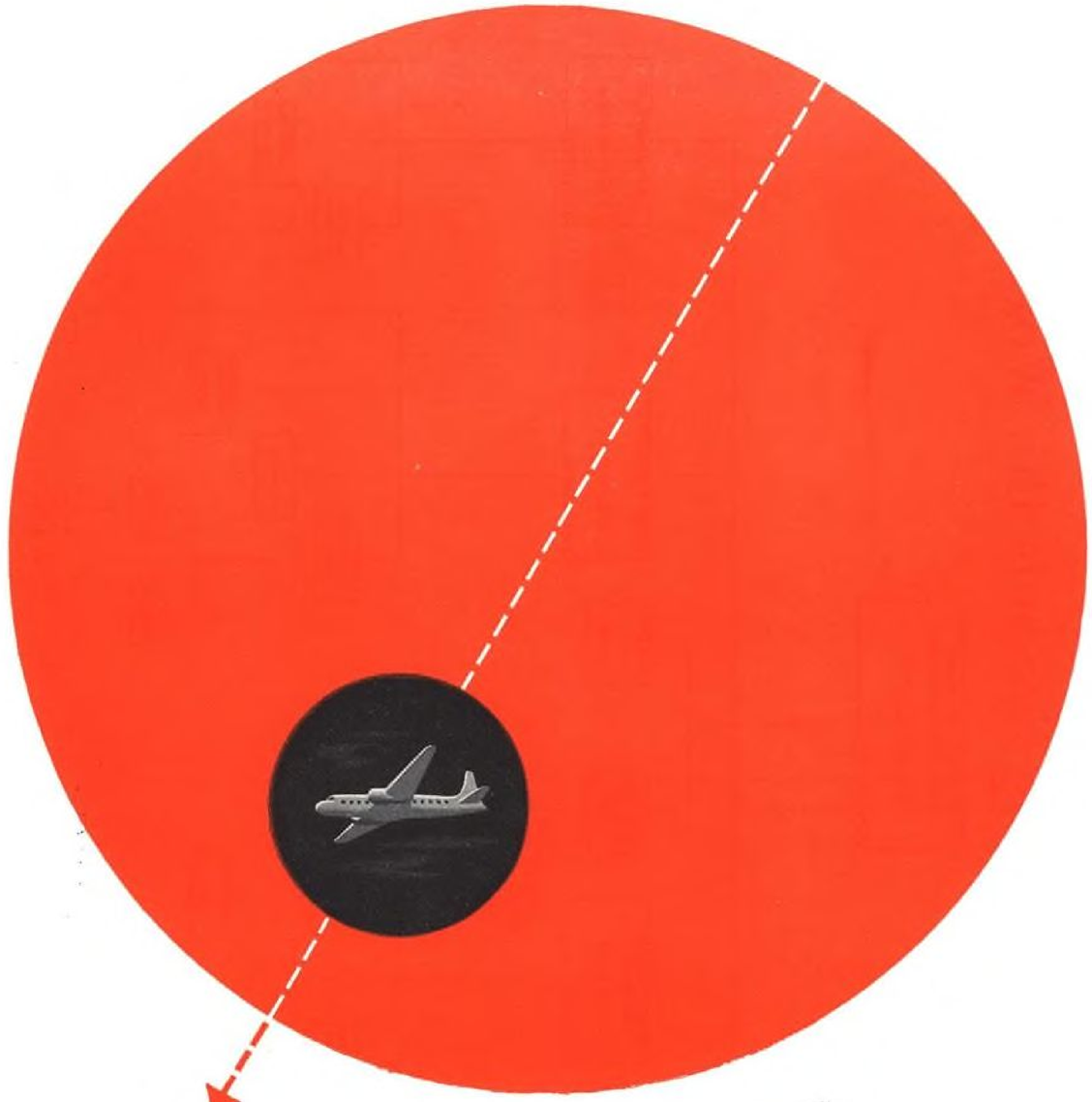
A large group of subcontractors was obtained by Temco at the recent Armed Services Small Business Procurement Clinic in Fort Worth, where 543 prospective subcontractors registered at the Temco exhibit. These firms have all been classified according to the type of work they can perform, and catalogued. Copies of the catalog have been given to all buyers and are referred to each time a new item comes up for outside production. Within 30 days after the Clinic, Temco had placed orders with 11 of these subcontractors and another 50-60 had been designated for future work.

Aircraft Industry Subcontracting

COMPANY	% OF FINISHED WORK BY WEIGHT OR VOLUME	VALUE
Aeroproducts	37.5	33
Allison	66.66	66.66
Boeing	....	42.1
Chase	15	20
Convair[1]	....	33
Douglas	....	46.5*
Fairchild	18	18
Ham. Standard	75	40
Hiller[2]	60	60
Kaman	60	....
Kollsman	....	15
Lockheed	30	24
Martin	2	....
No. Amer.	....	36*
P & W.	53	53
Republic	33	....
Ryan	....	43.8*
A helicopter firm	70	80
An airframe firm	....	32.2

* Includes materials purchases.
[1] Ratio increasing.
[2] Ratio decreasing.

Note: Companies surveyed, but which did not respond or cannot disclose percentages: Beech, Bell, Bendix, Chance Vought, Curtiss-Wright, General Electric, Grumman, McDonnell Northrop, Piasecki, Sikorsky, Sperry, Westinghouse. All of them subcontract work and Bell's activities in this regard are increasing.
Source: AVIATION WEEK Survey.



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THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia 2
Exide Batteries of Canada, Limited, Toronto

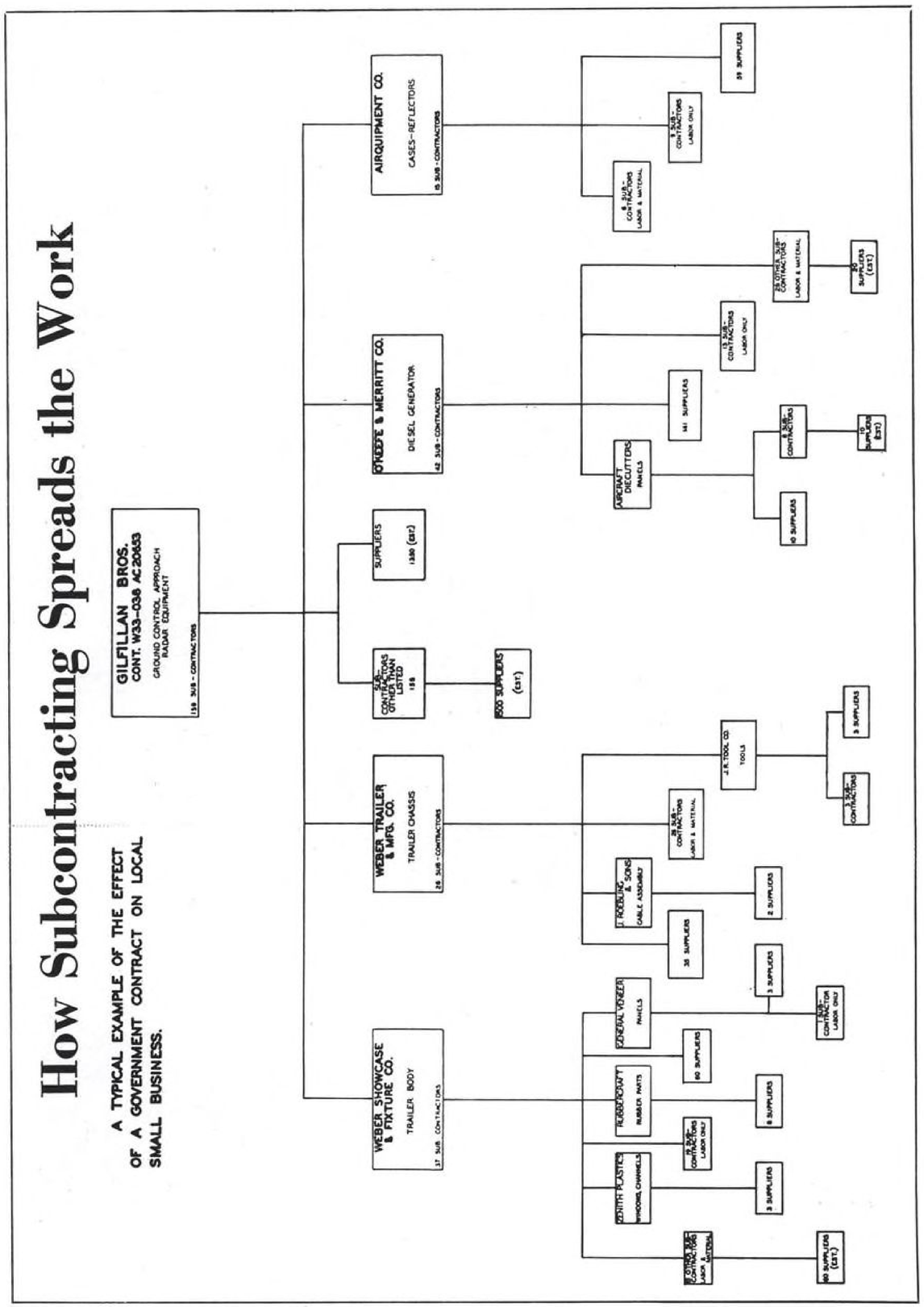


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How Subcontracting Spreads the Work

A TYPICAL EXAMPLE OF THE EFFECT OF A GOVERNMENT CONTRACT ON LOCAL SMALL BUSINESS.



For Example

One Gilfillan contract gives work to several thousand companies.

How far can you spread the work around from one contract? The answer to that question may be surprising. The Air Force was curious about it and performed an analysis which shows rather startlingly the extent of subcontracting. You can get a quick idea from the facing chart, which shows subcontracting on an item of avionics equipment.

Purpose of the Air Force analysis was to determine the benefits derived by industry as a whole from a government procurement contract. The analysis was limited to industry located in Southern California and covers all levels of subcontracting.

The definition of a subcontractor as used in the analysis is any industrial firm that is furnishing labor, or material upon which they have expended labor, which is to be used in the end product. A supplier as used in this analysis is any business firm supplying raw materials, government standard parts, catalog and brand name products.

The contract selected for this analysis is contract W33-038-ac-29653, held by Gilfillan Bros., Inc., 1815 Venice Blvd., Los Angeles, Calif. Under this contract Gilfillan supplies the Air Force with Ground Control Approach radar equipment and spare parts. This equipment is used on the ground and is housed in two large trailers.

In developing the analysis, a complete list of Gilfillan Bros. Inc. subcontractors was obtained for the first level. The list numbered 159 companies.

An analysis of the 159 companies showed the following:

- 47% of the companies have 25 or less employes.
- 20% have from 26 to 50 employes.
- 16% have from 51 to 100 employes.
- 11% have from 101 to 200 employes.
- 6% have over 200 employes.

From the list of 159 companies, four of the larger subcontractors were selected for a detailed analysis. These four were Weber Showcase & Fixture Co., Weber Trailer and Mfg. Co., O'Keefe and Meritt Co., and Airquipment Co. These companies were found to have respectively 37, 28, 42 and 15 subcontractors.

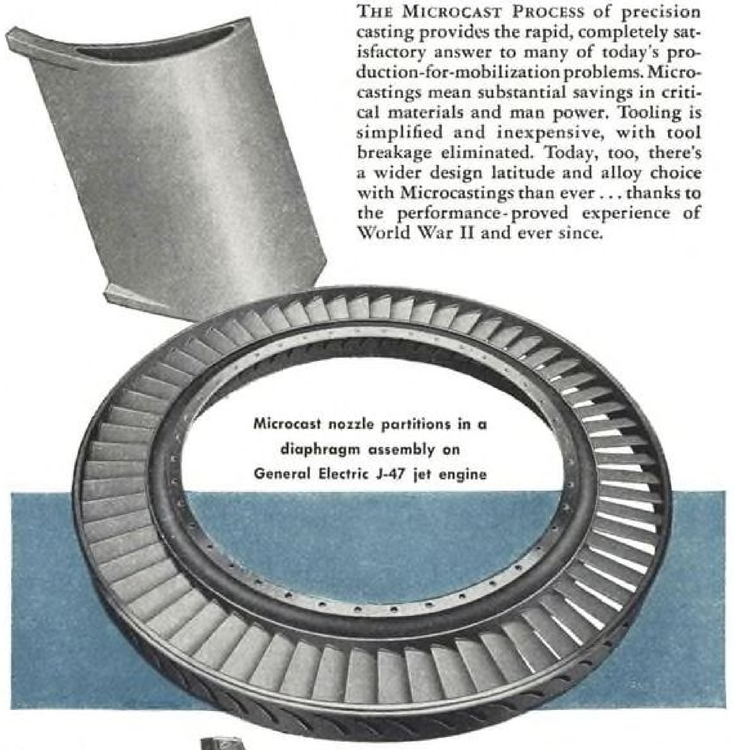
An analysis of these 132 subcontractors showed:

- 50% have 25 or less employes.
- 19% have between 26 and 50 employes.
- 12% have from 51 to 100 employees.
- 11% have from 101 to 200 employees.
- 8% have over 200 employes.

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SAVES Machine tools, Man power

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Microcast nozzle partitions in a diaphragm assembly on General Electric J-47 jet engine



Virtually every leading jet aircraft engine manufacturer uses Microcast power blading. Design engineers of these revolutionary power plants know Microcasting's outstanding advantages . . . features that may well fit into your present production program. Better write today for full information.

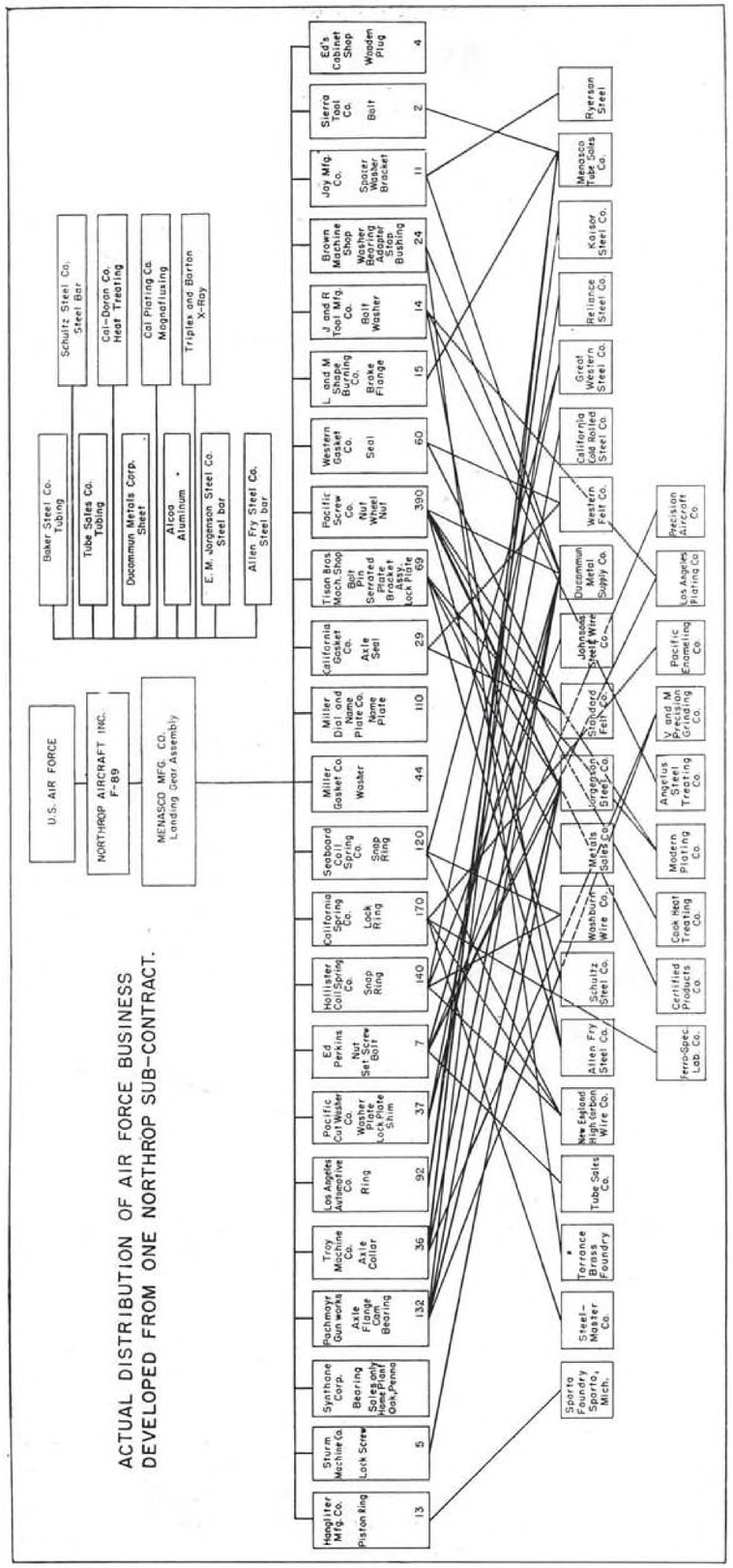
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ACTUAL DISTRIBUTION OF AIR FORCE BUSINESS DEVELOPED FROM ONE NORTHROP SUB-CONTRACT.

Of these 132 second level subcontractors, six typical subcontractors were selected for a detailed analysis. Three of these engaged in further subcontracting. They were Aircraft Die Cutters, J. R. Tool Co. and General Veneer Mfg. Co. They subcontracted respectively to 8, 3 and 1 subcontractors.

The Air Force analysis also showed the number of suppliers at each level. They were 2,850 at the first level, 398 at second level, and an estimated 16 at the third level.

Air Force also performed an analysis of the actual distribution of air force business developed from one Northrop Aircraft Inc. subcontract. This subcontract, for the landing gear assembly on the F-89, was let to Menasco Mfg. Co. It spread the work over quite an area, as can be seen in the accompanying chart.

Starting a Plant? Here's Wage Rule

What wage rates can you pay when you start a plant?

The answer to this question is of particular interest to the expanding aircraft industry. An idea of what you can do is offered by the Wage Stabilization Board in its approval of a wage schedule for the aircraft plant Lockheed Aircraft Corp. will operate for Dept. of Defense at Marietta, Ga.

Wages in new plants are governed by WSB General Wage Regulation 9. This regulation provides, briefly:

- Where the new plant is in the same general location as a company's existing plant, wages will be approved which are the same as those in the existing plant.
- In all other cases, the wages may not be higher than (1) those paid for similar jobs in the same industry in the same area; (2) if there are none, then those paid for comparable jobs in a comparable industry in the area; (3) if there are none, then those paid for comparable jobs in the same industry in the most nearly comparable labor-supply area.

Reports must be filed with the Wage-Hour Office or WSB before putting them into effect.

On government work—and this covers almost all aircraft—the Walsh-Healey Public Contracts minimum of $1.05 an hour also must be observed.

As a result, the Lockheed wage schedule approved for the Marietta plant begins at $1.05 minimum. There are 15 labor grades, the grade for the highest-skilled workers having a minimum of $1.80 and a top of $2.07.

On the average, the Marietta rates are slightly lower than those Lockheed pays at Burbank and substantially in line with rates being paid in aircraft plants in Dallas, Baltimore and Hagerstown and in Southern California.

UP THERE WITH THE BIG NAMES . . . CHAPTER NUMBER 7



SKYDROL plies American skies with the Flagship Fleet of AA

High in the skies over the United States, Canada and Mexico, passengers and crews travel in greater safety via the Flagship Fleet of American Airlines because Monsanto Skydrol is used in cabin superchargers.

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Skydrol brings greater safety to passengers, crews and planes in the air and on the ground. In addition, Skydrol means greater economy because its high lubricity reduces wear on working parts of hydraulic systems.

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SKYDROL is a proved superior lubricant. In most critical cases, lubricity is more than double that of other hydraulic fluids.

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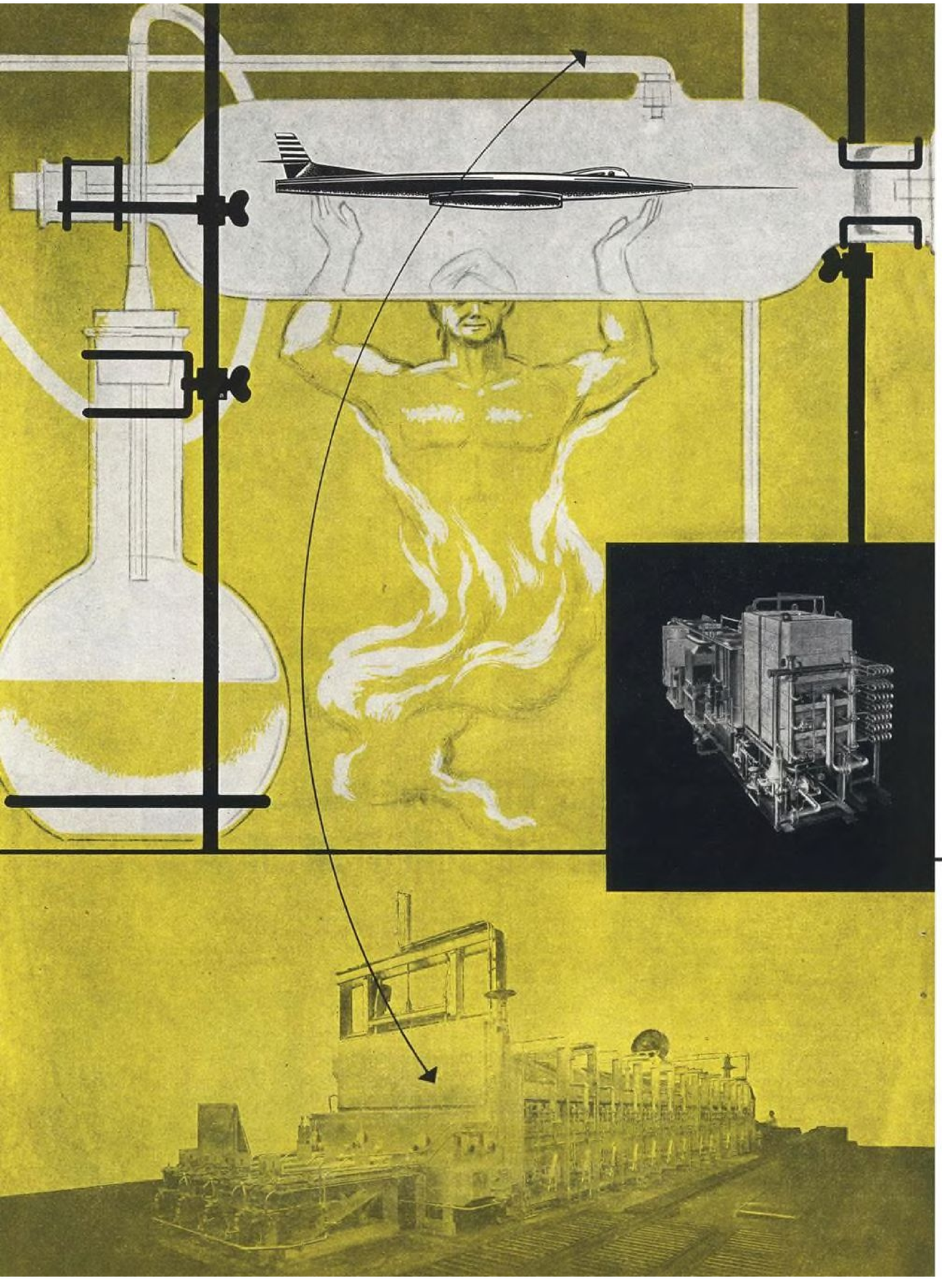
SKYDROL is noncorrosive to aircraft metals and alloys.

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The Military View of Subcontracts

Commanding generals of AF's largest procurement districts report on work loads in their areas.

● Manufacturers are heeding official urging to subcontract. But the plain truth is that there is not enough business to utilize the capacity of all the potential subcontractors.

● But there's a contradiction in the situation. There is still a shortage of subcontractors in some categories. Here's the way it looks to the commanding generals of the Air Force's two largest procurement districts:

Los Angeles . . . . .

Prime manufacturers of airframes and equipment in the Western Air Procurement District—the Air Force's largest such district—have gone all out to subcontract to maximum extent, Maj. Gen. William N. Morgan, commanding general, told AVIATION WEEK.

"If there has been any resistence to subcontracting, we sure don't know about it," he said. On the contrary, Morgan observed, the primes have subcontracted some projects to keep smaller plants healthy when their own facilities weren't half utilized.

General Morgan pointed out that while the Air Force from top level down encourages subcontracting to the maximum extent possible to meet its needs, it nevertheless is conscious that the "big fellows produce." He said, "In the wave of enthusiasm for subcontractors and small business, we don't want to lose sight of the fact that our large manufacturers have been doing a superb production job for us right along."

▶ **Growing Subs**—Morgan said the number of subcontractors is increasing all the time. As prime manufacturers get more orders and fill their plant capacity, and as schedules are stepped up, they have to subcontract more.

"Another reason is that we have one cardinal principle—we must use existing facilities first before spending a dime for expansion. One way is for the prime contractors to use their facilities to capacity, simply because it is economical to do so. The other way to avoid costly expansion is to take advantage of the smaller plants. And we are doing that more all the time."

Air Force desire, Morgan said, is to keep alive all the capacity we have. Further, the primes are constantly seeking qualified people. The combination means business for people who can meet the standards.

Potential subcontractors in the Western District have by no means been fully utilized. Many have not made themselves available. Actually, said Morgan, it would be dangerous to bring in all the small people. A small businessman may be doing all right

New York . . . . .

In spite of industry-wide shortages in materials and machine tools, subcontractors generally are meeting their end of Air Force production schedules, stated Brig. Gen. Arthur Thomas, Commanding General of the Eastern Air Procurement District, during an interview with AVIATION WEEK.

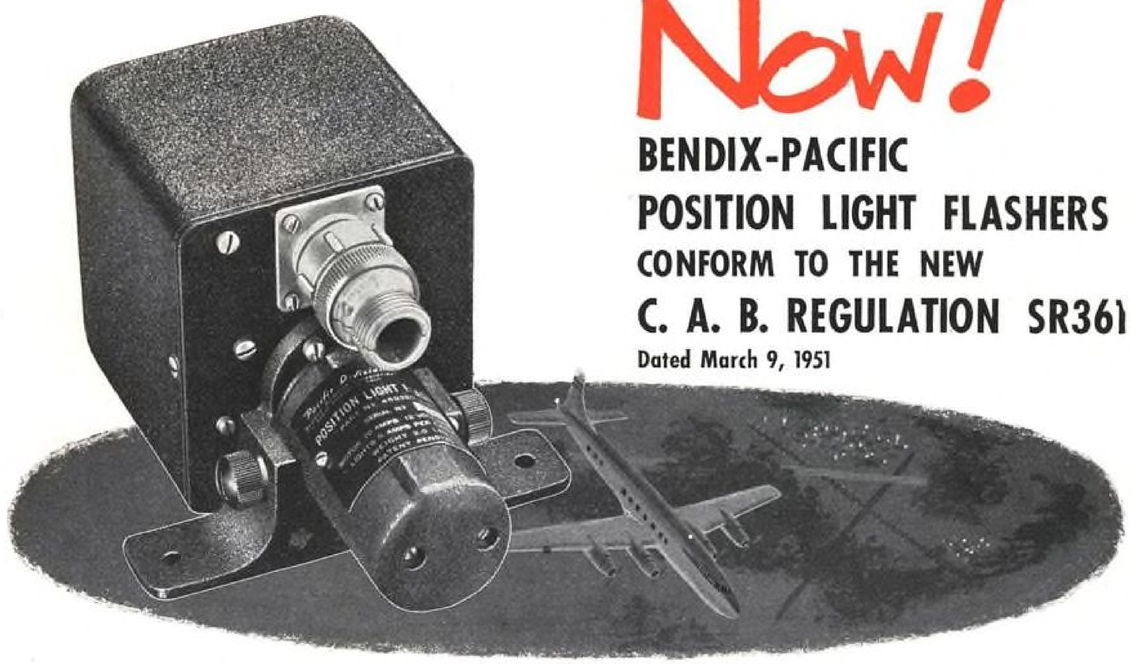
The big problem in the EAPD area, according to the general, is to get subs in the components field having the capacity and ability to produce highly precise items such as gyros, synchros, etc. Additional manufacturing capacity is also required, such as precision gear cutting, 2-in. capacity multi-spindle automatic screw machines, large size turret lathes, borematics, precision grinding and so forth. Forging capacity is also very much needed.

As a matter of fact, major prime contractors in this area have found it necessary to go outside EAPD's geographic boundaries to develop suitable subcontractors in those categories.

▶ **Billion-Dollar Business**—Some measure of EAPD's production responsibility—it administers an area stretching south from Fairfield County, Conn., to South Carolina and west to Ohio—may be garnered by looking at the last figures available (Aug. 31) which show it was overseeing 918 prime contractors holding 3,904 contracts. The District's uninvoiced dollar balance as of that date was $1,972,438,109 in contracts, biggest on that date of any AF Procurement District. The figures keep changing rapidly.

To break this responsibility down even further, EAPD figures that each of its prime contractors averages 20 subs, plus vendors supplying standard items such as hardware. Close to 50% of these subs are within 300 mi. of the primes they serve.

General Thomas said that there is an ample supply of the "run-of-the-mill" subcontractor (ordinary machine shops and manufacturers of non-precision standard commercial products). These are the companies who are just feeling the impact of defense expansion now and will notice it at an increasing rate



Now!

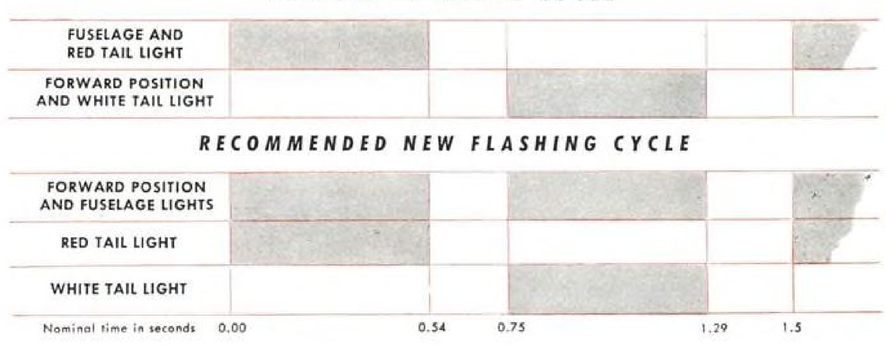
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now with the civilian work in his shop.

▶**More to Come**—He said the real need for more subcontractors is not here yet. "Remember, while trying to take care of Air Force needs, and the rest of the armed services, we still are running on almost normal civilian economy."

General Morgan said there is not enough business in the hands of prime contractors to keep all the "potential" subcontractors busy. "It would take an all-out war to do that. We haven't yet activated all our plant facilities left from World War II."

General Morgan's office encourages subcontracting wherever possible. "Though of course, we aren't in the subcontracting business." The district office maintains a list of potential subcontractors and contractors so it can readily refer them to a prime manufacturer, or vice versa, when bottlenecks arise. And the office registers the needs of the prime contractors. More than 10,000 manufacturers' representatives visited the offices last year.

"One thing we do is to show a small manufacturer trying for a prime contract, but who simply can't cut the buck, where he can do himself some good as a subcontractor."

Morgan said he only hoped that the small businessman who doesn't get an order is as fair-minded as the Air Force is in trying to get a fair spread of business.

▶**Business Tool**—Currently one of the biggest encouragements to subcontractors, Morgan says, is the Military Business Opportunity Display. The Western district will hold its display Sept. 18-24. Altogether 81 exhibitors have been signed, and latecomers have been turned down because of lack of space.

"We monitor attendance at these affairs so as not to waste the prime contractor's time," Morgan said. "We want to get out all the small business people we can. But we aren't running a show for the casual passerby. Neither can we accommodate anyone who has something to sell. In all cases prime manufacturers are showing the hardware they have available for subcontracting."

Morgan said he thought it should be emphasized again that a subcontractor must have something more than "the desire." The prime contractor he is going to deal with has responsibility for delivery of the end product. So he must be supercritical. He will scrutinize know-how, plant, financial status and so on of the prospective subcontractor very closely.

"We have to do the same thing ourselves with prime contractors. Our problem is delivery of the things we need on schedule. This is not always easy. For example, the general public might think any television "maker" could be

New York . . . . .

in the next six months. It thus behooves them, believes the general, to really get started on becoming involved with military business.

Then, too, due to the long manufacturing cycle, particularly on complicated Air Force equipment, the effects of any program are not felt for some time by the lower echelon subcontractor. Those that do want to get in on defense business will have to wait until the program gets in high gear, which Thomas says will be "in the immediate future."

▶**Thin On Top**—It's the major or "first tier" of subcontractors, and licensees with big facilities and sound manufacturing reputations, such as Singer and IBM, who are in critical supply, at least in the east.

But this doesn't mean EAPD is not going after the lower echelon firm. In fact the Military Business Opportunity Display program, or subcontracting clinic, had its origin in this area, where it was initially called the "Thomas Plan."

EAPD's Small Business Office has been increasing its office space and personnel right along, is handling some 30-40 daily visitors from small companies seeking contract information and data on how to get into the program. The office has built its Facility Reference File up to about 400 names of contractors in various industrial fields.

▶**Personal Touch**—One of its hot projects now is to establish a personal relationship with key personnel in the primes in the district, so that it can call them regularly and keep specifically informed of at-the-moment needs for subs; for instance shop capacities the primes are looking for, forging needs, special machining requirements. It can then lay these requirements out to its visitors, or suggest names from its facility files.

Another instance is the work it is doing in spreading the gospel on the possibilities of small firms getting together to handle prime or subcontracts by pooling their facilities. This setup makes it possible to take advantage of facilities, which by themselves can handle little or nothing, but collectively can successfully bid on Air Force business. Other advantages are that the pool has available the best management experience found in any of the member firms and can also draw on the membership's best engineering and accounting personnel. The combination can also deal more effectively with government procurement officers and prime contractors, with a fraction of the time and effort it would take individually.

Pools may be incorporated, so that contracts can be solicited and money borrowed in the name of the corporation and responsibilities can be closely



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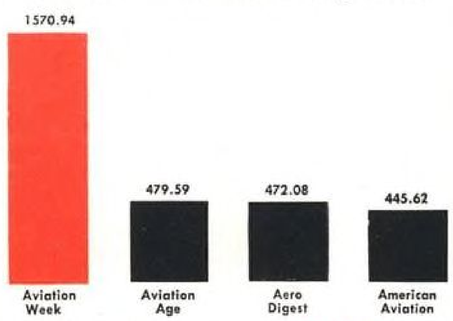
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1951 (8 Months) Advertising Record



AVIATION WEEK's gain for this period is 511 pages over the similar period of 1950. This *increase* alone represents *more pages* than any other aeronautical publication has carried in total advertising volume for the 8 months period (Jan.-Sept. 1951).

AVIATION WEEK

Los Angeles . . . . .

quickly converted to a manufacturer of avionics gear for airplanes. It seems logical, but it isn't so. Many of the TV people are assemblers. They buy nearly everything. They simply do not have the machines to meet the close tolerances we require."

▶ **Specialists Needed**—There is a great shortage in the Western area of subcontractors who can do specialized work, mostly jobs connected with the new manufacturing methods so essential to supersonic weapons. These shortages include skin milling, gear cutting, special bolts, lapping, and so on. Main reason for the shortages is the slow delivery of machine tools. While the machines are on order, people who have the machines are running full blast. In time, Morgan hopes, they'll catch up.

Morgan says he has heard no gripes from subcontractors. One reason, he thinks, is that the prime contractors all had effective machinery set up for working with subcontractors. World War II tested procedures which quickly and easily fitted the subcontractors into their present production pattern.

—Thomas M. Self

New York . . . . .

defined, or they may be unincorporated, in which case an executive committee controls and directs the pool's activities.

Pools are closely scrutinized by the government, particularly to avoid running afoul of the federal antitrust laws, Federal Trade Commission Act or the Walsh-Healy Act. Permission to form a pool must be obtained from the Pooling Section, Office of Small Business, National Production Authority, Washington 25, D. C., which will closely screen applicants.

Production pools must keep membership open to other manufacturers in their particular area, and must keep the Defense Production Administrator advised of all requests for admission to membership that are refused, together with reasons for such refusal.

Existence of the pool must end with termination of the immunity granted under Defense Production Act of 1950, unless sooner terminated by the dissolution of the pool, or by order of the Defense Production Administrator.

Each member of this group must periodically furnish DPA with detailed information on his production facilities and also provide financial data.

Less than half a dozen such pools are now active. EAPD is working with one such organization in its area comprising approximately 40 firms, each averaging 50 workers, which is interested in obtaining work from a "first tier" sub in its area.

—Erwin J. Bulban

FOR YOUR "AN" OR STANDARD

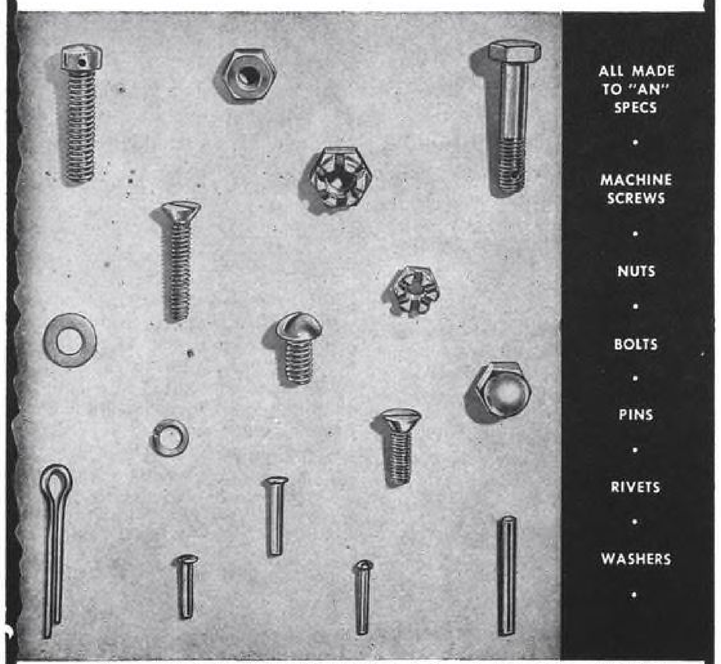
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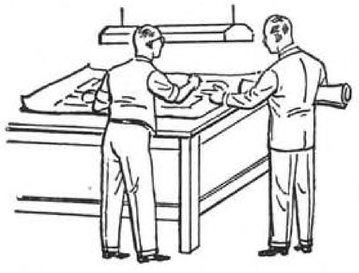
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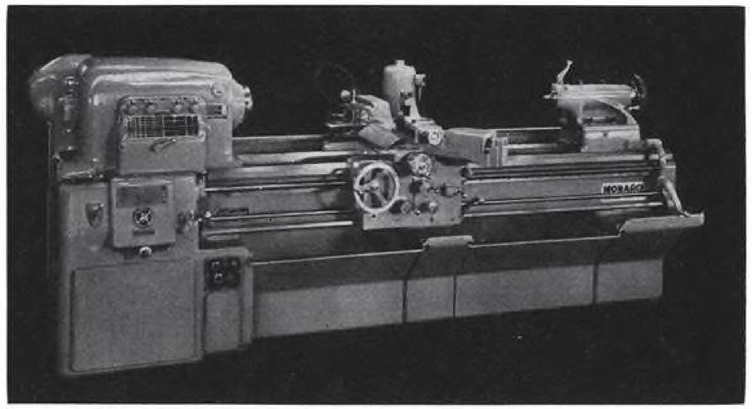


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Needed: Machines and Methods

Production calls for tools and techniques unknown in World War II, and just beginning to be known today.

● The same weary story of every expansion period is being written again: shortage of machine tools.

● **A plus, in the reserve tools stored, is perhaps cancelled by a minus, the fantastic demands made on machines by the requirements of metals needed for our high performance aircraft.**

Severe bottleneck created by the seriously inadequate productive capacity of the U. S. machine tool industry is testing the mechanical ingenuity and production know-how of the U. S. aviation industry and the related manufacturers who are adding their plant capacity to the job of expanding U. S. air power.

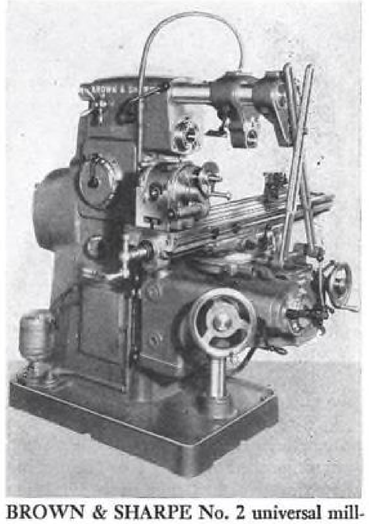
Conservative estimates are that it will be eight months to a year before any important expansion in the machine tool production rate can be expected. And meanwhile tool orders are piled up years ahead, with a number of companies refusing to accept additional orders.

1. Bottleneck Breakers

The well-publicized 40,000-machine tool reserve which the Air Force has called into action is far from a complete solution of the overall problem, although obviously the reserve tools help a situation which otherwise would have been completely impossible. But the reserves have now been virtually stripped of their best tools. And while they have met a sizeable part of the requirement for general purpose tools, there still remains a substantial additional unsatisfied requirement for these, in addition to the far more critical requirement for special purpose tools which obviously could not be stockpiled in advance.

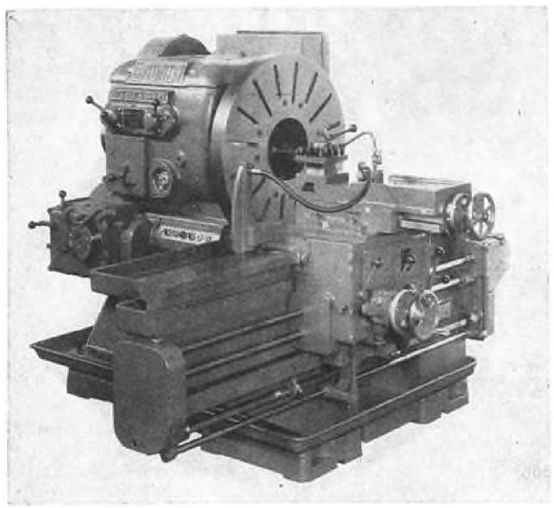
Production veterans of World War II in the aircraft industry are saying, "this is where we came in," as the cycle of machine tool shortages repeats itself. Short-sightedness of national de-

(Continued on p. 182)

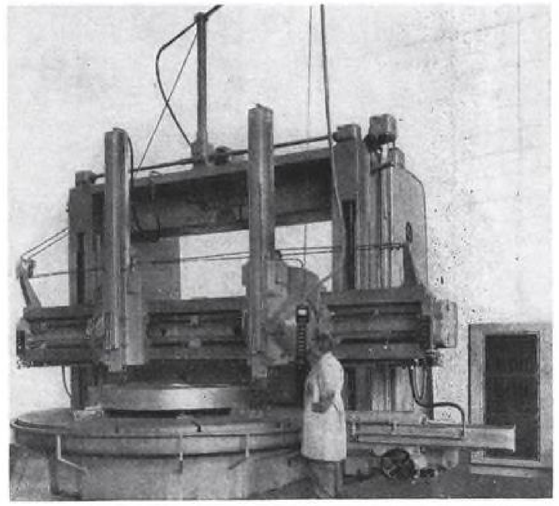


BROWN & SHARPE No. 2 universal milling machine (5 hp.) made by the Providence firm.

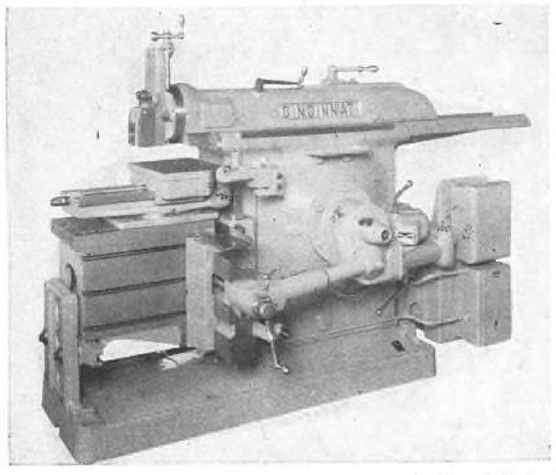
Machine Tools for Production . . .



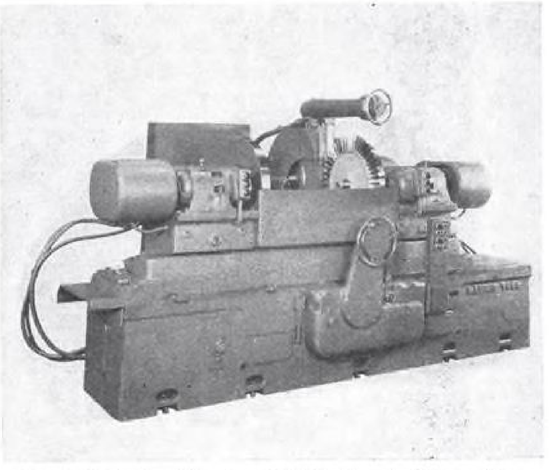
Lodge & Shipley 60-in. right-angle chucking lathe.



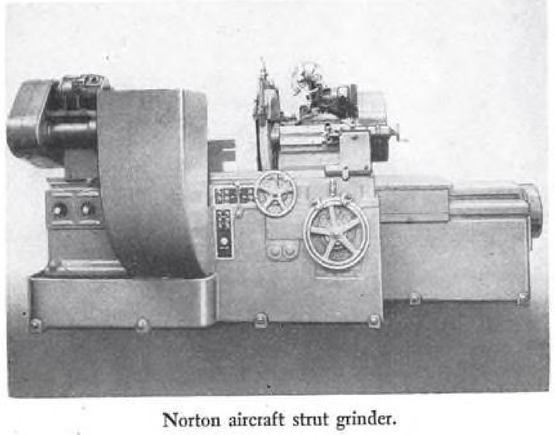
Cincinnati 12-ft. Hypro vertical boring and turning mill.



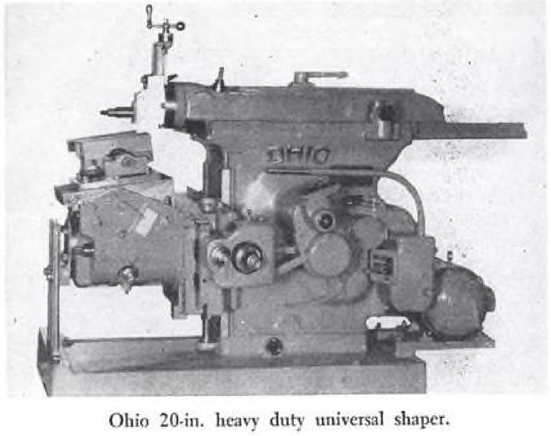
Cincinnati 24-in. shaper with electromagnetic clutch and brake.



Landis 30-in. by 48-in. type CHW plain grinding machine.



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(*Continued from p. 180*)

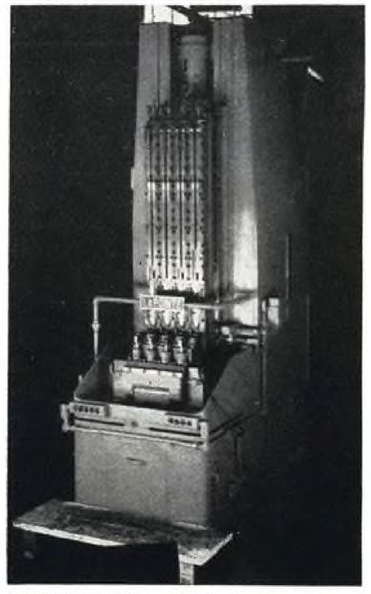
fense policy planners in letting the vastly expanded U. S. machine tool industry of World War II shrink so far to its present inadequate status is seen as a parallel to the myopic national policies which permitted similar contraction, if not quite so serious, in the aircraft industry itself.

► **Steel Priority**—Tooling capacity problems finally are being tackled earnestly by the Defense Production Administration, and as a result new machine tool plants to be built are getting the highest priority in the distribution of scarce structural steel and other critical building materials.

And revision of pricing regulations affecting the machine tool manufacturers to assure higher price levels, to accommodate increased production costs, has restored some incentive to production for the machine tool makers, which they contended had been largely destroyed by the earlier price restrictions.

► **Without Delay**—These two factors were behind the recent statement of DPA deputy administrator for procurement, Clay P. Bedford, when he said: "The road is now clear, the machine tool industry is steadily increasing its output, and we will get the machine tools we need without further delay." But you can still find tooling experts in many an aircraft plant who will seriously challenge Bedford's statement.

Such recriminations, however justified, are being shelved for the most part to get on with the job of making do with what is at hand and with what



LAPOINTE 15-ton 66-in. SRV machine is used by General Electric for broaching jet blades.

Two special nickel alloys

"D" NICKEL and LOW CARBON NICKEL

"D" Nickel and Low Carbon Nickel have the same general composition as Nickel. However, "D" Nickel has approximately 4.5 per cent of manganese added, which gives it extra resistance to atmospheric attack at high temperatures. Whereas the carbon content of Low Carbon Nickel is very low (0.01 to 0.02 per cent)—it is often referred to as "carbon-free nickel".

"D"® Nickel is somewhat superior to nickel under oxidizing sulfurous conditions at elevated temperatures. It oxidizes more rapidly at first, but better resists attack by sulfur. Under sulfur-free oxidizing conditions, nickel usually is to be preferred. "D" Nickel is not generally used under reducing conditions, either in the presence or absence of sulfur. "D" Nickel is highly resistant to electrical sparking.

The mechanical strength of "D" Nickel, both at normal and at elevated temperatures, is greater than that of nickel. It more nearly approximates that of Monel. "D" Nickel frequently is used in applications where nickel might serve the purpose, both to guard against the possible presence of sulfur and because of its superior mechanical properties.

"D" Nickel is used chiefly in the forms of rod, wire, tubing and strip. It is used extensively for spark plug electrodes, ignition tubes and for boiler refractory bolts, particularly in marine boilers.

Low Carbon Nickel is used instead of nickel for long-time service in the temperature range 700-1200°F.

It is used in the production and handling of molten caustic soda and caustic potash and in the handling of some other molten salts, where no sulfur compounds are present.

Low Carbon Nickel is also used in the manufacture of nickel crucibles and combustion dishes for laboratory use. Such articles must be capable of withstanding oxidizing furnace atmospheres, at temperatures up to 2000°F., without spalling or loss of ability to retain their shape. In the laboratory determination of the carbon content of steel, the sample must be retained in a vessel that resists the extremely high temperatures used in the oxidation of the steel; in addition these vessels must contain no carbon to introduce errors into the test.

Low Carbon Nickel is softer than nickel and does not work-harden as rapidly. Therefore, it is often used for spinning and for coining operations. The mechanical properties are lower than corresponding forms of nickel. This applies particularly to the yield strength and elastic limit of annealed material. The ductility is somewhat greater than that of nickel. It is produced chiefly in the forms of cold-rolled sheet or strip.

For technical help on specific metal problems, write, outlining in detail, to Inco's Technical Service Section.

Chemical Composition, Mechanical Properties and Physical Constants

MATERIAL	FORM AND CONDITION	AVERAGE MECHANICAL PROPERTIES				AVERAGE PHYSICAL CONSTANTS								
		YIELD STRENGTH (0.2% offset) 1000 psi.	TENSILE STRENGTH 1000 psi.	Elongation in 2 in., per cent	HARDNESS BRINELL	DENSITY lb./cu. in.	SPECIFIC GRAVITY	MELTING POINT °F.	Specific Heat (32°-212°F.) Btu./lb./°F.	Thermal Expansion Coefficient (32°-212°F.) 10^6 in./in./°F.	Thermal Conductivity (32°-212°F.) Btu./sq. ft./hr./°F./in.	Electrical Resistivity (32°F.) ohms/cir. mil ft.	Tensile Modulus of Elasticity 10^{-6} psi.	Torsional Modulus of Elasticity 10^{-6} psi.
"D" Nickel	Annealed Hot-rolled Cold-drawn	35 50 80	75 90 100	40 35 25	140 150 190	0.317	8.78	2600	0.11	7.4	335	110	30	11
Low-Carbon Nickel	Annealed	15	60	50	90	0.321	8.89	2615-2635	0.11	7.2	420	50	30	11

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y.

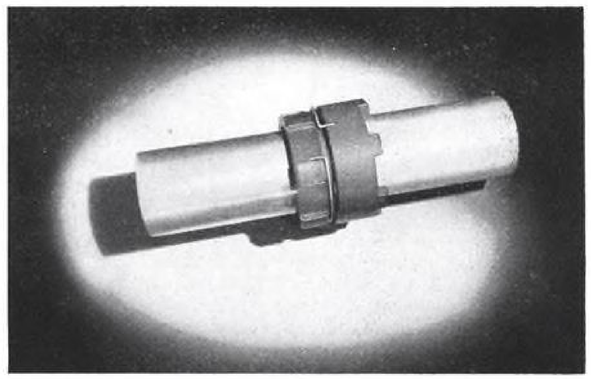
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ON THE *Convair*-BUILT
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IT'S THE FR
PIPE CONNECTOR*



One of the latest additions to the proud CONVAIR family, the XP5Y-1, will help maintain the U. S. Navy's command over the seas.

It is natural that the builders of the CONVAIR XP5Y-1 have sought to incorporate the best equipment available. We are proud that CONVAIR has decided to use FR Pipe Connectors throughout the aircraft.

The FR Pipe Connector is the product of over fifteen years' research and development in the pressure fueling field. Light in weight, yet rugged, the FR Pipe Connector has advantages not shared by any other pipe coupling method.

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Specialists in Aircraft Fueling Systems and Equipment
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PRESSURE REFUELING - NOZZLES, ADAPTERS, TANK FILLING VALVES, PIPE CONNECTORS

can reasonably be expected to be delivered in the early future.

2. What Is Needed

You can understand the critical requirements for tooling up the aircraft producers a little better if you take a quick look at one of the products which they are building and at what that product has to do.

A graphic comparison of what the aircraft makers have to do now to make planes flying at transonic speeds, with what they used to do in making World War II planes, was given to Congress recently by North American Aviation's board chairman, J. H. (Dutch) Kindelberger, recognized as probably the top production aircraft man in this country.

▶**Wing Skins**—Kindelberger took his own F-86 Sabre sweptwing jet fighter, capable of high transonic operational speeds, as his example in discussing the problem of making wing skins with a $150,000 skin mill, essentially a planer bed with a milling device above it operated by electronic controls. He said:

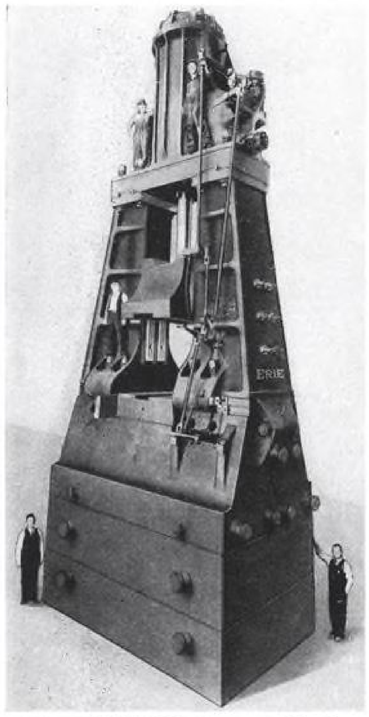
"These parts are much harder to make individually. . . because we are using different materials . . . The milling of the skin is a typical operation . . . The 75S alloy that we are now using is a very high strength aluminum alloy and without it we could not achieve the strength ratios we are now attaining. It is a very mean material to work. . . . That skin must be riveted and the end result must be a flush smooth skin. . . . On the 24S which we used to use it was possible to do a countersinking operation with a counter sink rivet.

▶**The Old Wham**—"In other words, you put it there and tried the old wham and there you had it. An automatic riveting device could punch a hole and you would put the rivet in and rivet it but on the 75S material, it is so brittle, in effect, that when cold it will split. So we developed a device known as the dimpler which preheats that area and then performs this dimpling operation. That is an operation we never used before. . .

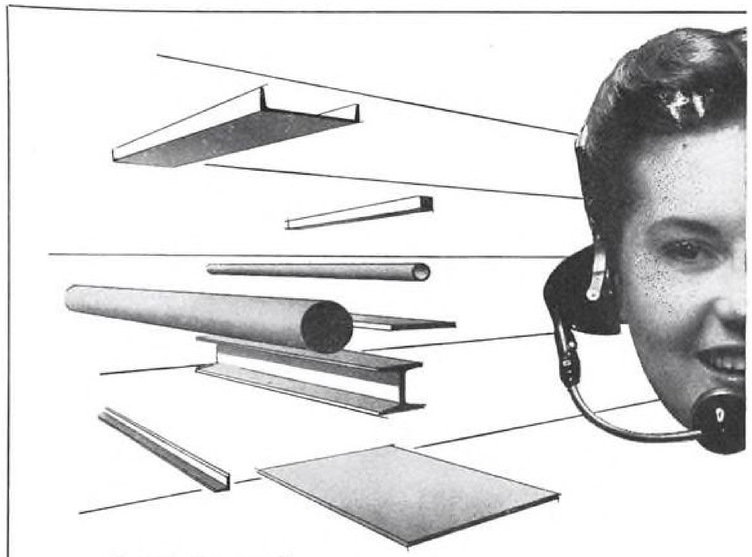
"We have to hold the contour of this wing absolutely accurate so we have to set up the skins first and build the skin completely smooth and also to the contour and then we adjust the structure inside. It used to be also true that, when the structure was stronger than the skin it would pull it down, but no more. The skin is stronger than the inside structure and this has to fit.

▶**Can't Lap**—"We used to just bring the skins together and lap them. We used to be able to do that because with

(*Text continued on p. 189, picture page on p. 186*)



ERIE FOUNDRY puts out this huge 50,000-lb. steam drop hammer for the USAF.



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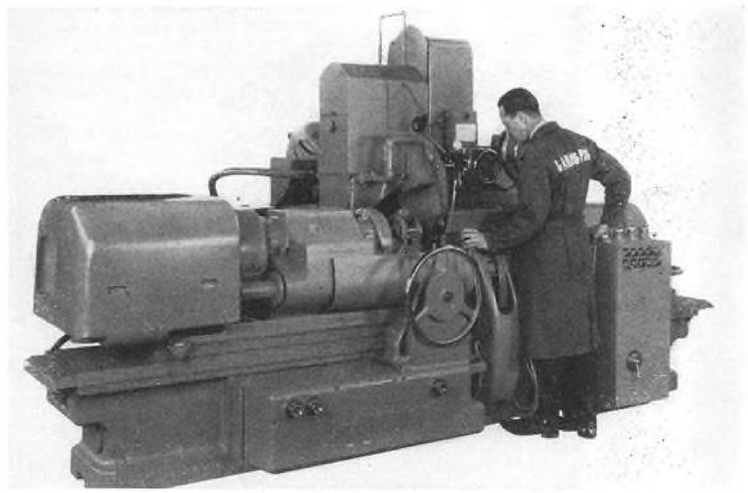
A self contained unit supplied complete with Model 216-C Pump, oil reservoir and necessary controls. Capable of providing output fluid pressures to 30,000 PSI from 100 PSI plant air supply. For oil service only. Other models available for water or other corrosive liquids.

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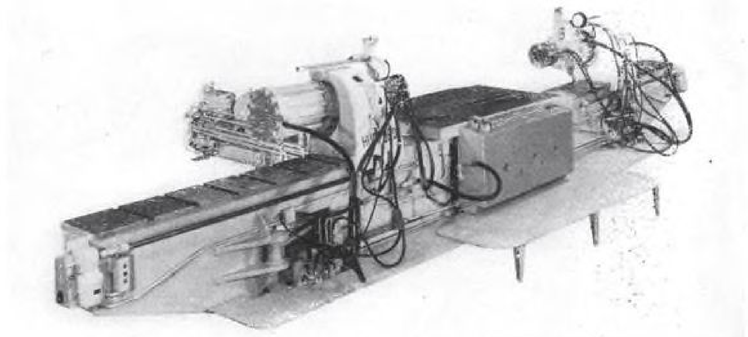
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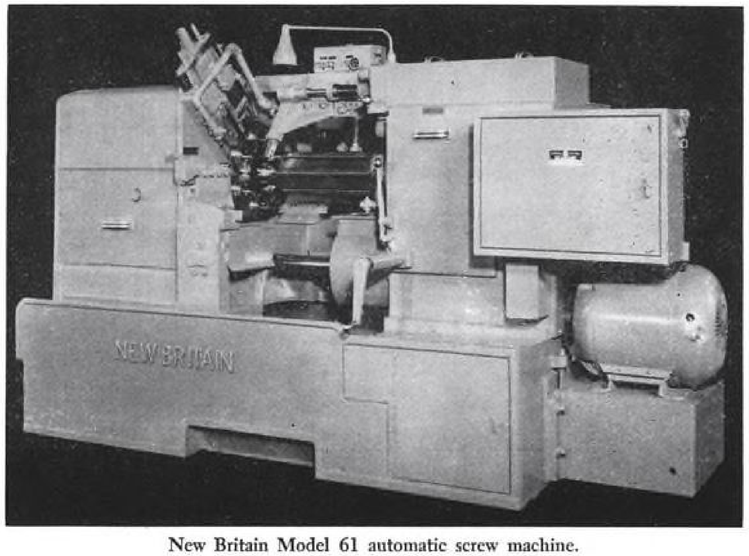
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Landis type DH hydraulic crank pin grinder.



Hufford A-12 semi-automatic stretch-wrap forming machine.



New Britain Model 61 automatic screw machine.



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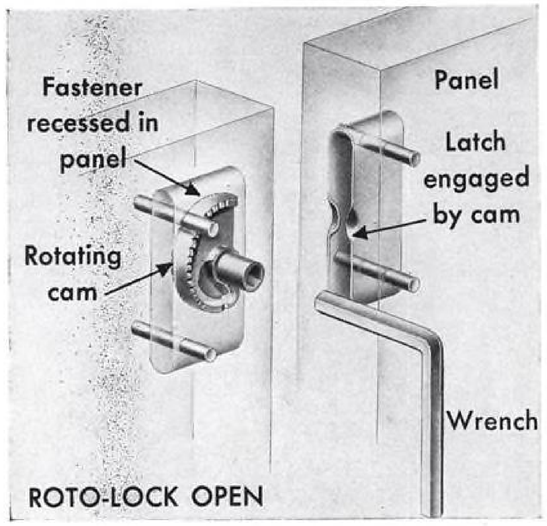
Above these hundreds of silken parachutes fly Fairchild planes...the best equipped "to-do-the-job" aircraft in the skies.

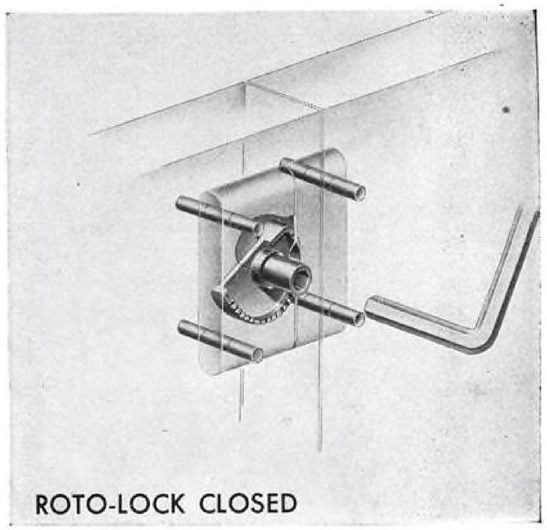
Fairchild leadership in the development of tactical airplanes is now playing a vital part in the vast production mobilization program. Like the airborne trooper, the C-82 Packet, the C-119 Improved Cargo and Troop Transport and the C-120 Detachable Fuselage Transport are parts of the United States Armed Forces Team.

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(*Continued from p. 185*)

that thickness differential it would not bother it. Now it raises hell with your airflow. They have to be fitted exactly together."

Contrasting tooling costs for the F-86 with that for the World War II Mustang P-51 showed a unit cost of $2,044 for the Mustang, as compared to $14,576 for the F-86, for the first actual 620 airplanes of each type produced.

► **Other Tools**—Other examples of elaborate new tooling needed to make the F-86 cited by Kindelberger included such machines as the Hufford stretch presses, costing about $250,000 each, the Drivmatic riveter, costing about $25,000 and hydraulic presses running up in cost as high as $500,000.

Some other examples of the new style tooling required to make new military plane types were cited recently by the Aircraft Industries Assn. They include tools like these:

• **Lockheed's** 8,000-ton Birdsboro hydraulic press on order at a $750,000 cost.

• **Sikorsky's** 5,000-ton Bliss hydraulic press recently installed for $410,000.

• **Hamilton** Standard's $155,000 tube reducing machine, a 90-ft. long Wallington apparatus used in hollow steel propeller blade production.

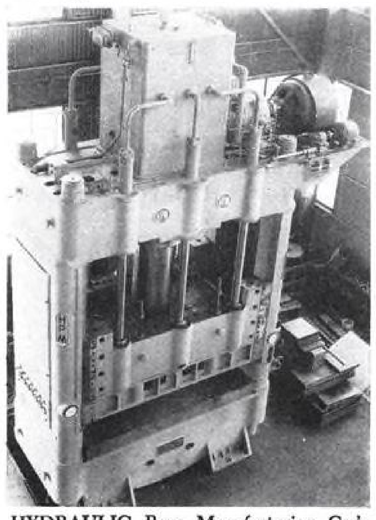
• **Boeing-Seattle's** Rotoformer, an $80,000 Cyril Bath machine tool used for bending aluminum or magnesium parts in semi-circular or circular shapes.

► **Fancy Mill**—One of the fanciest individual tools for metal cutting recently anounced was the $750,000 skin mill for fabrication of integrally stiffened sheet, which Lockheed has ordered from Giddings and Lewis Machine Tool Co. It weighs 200 tons, is 90 ft. long, 30 ft. wide and 18 ft. high, and will have cutting speeds up to 10,000 fpm. with maximum metal removal up to 600 cu. in./min.

Electronic controls supplied by General Electric include a two-dimensional electronic tracer to guide longitudinal and lateral cutting motions simultaneously and the machine will incorporate a vertical rise-and-fall cutting action for variations in web thickness. Cuts can be made in three dimensions with two feed motions, and the tool has a feed range of from ¾ in. to 150 in./min. with many intermediate speeds. A work area of 10 ft. by 34 ft. is provided with a table capacity of loads up to 150 tons.

► **Fighter Wings**—First use for the integrally stiffened sheet produced in this mill will be in the Lockheed F-94 jet fighter series, presumably in the very-thin straight wing which latest versions of that plane use. Integrally stiffened skin is also to be used on a large portion of the fuselages of the newest Super Constellations.

► **Automatic Welder**—Not all the new tools now coming forth are cutting devices, or forming machines. A new Sciaky Bros. resistance spotwelder machine costing about $50,000 has taken

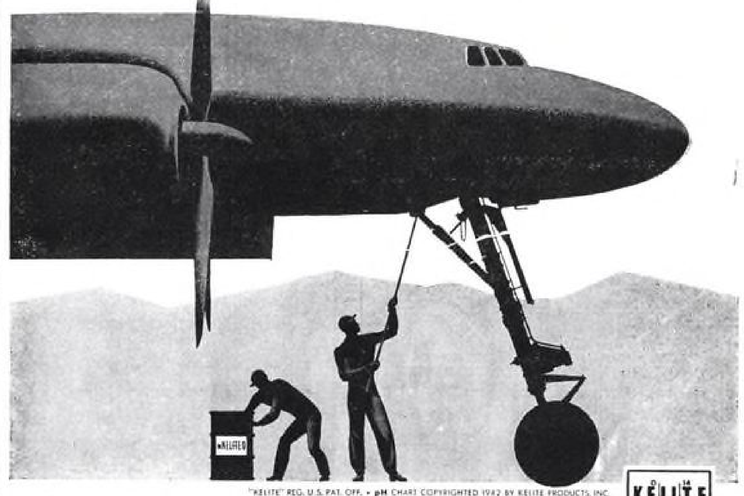


HYDRAULIC Press Manufacturing Co.'s 1,000-ton all-hydraulic double-action sheet metal drawing press has 144-in. x 84-in. pressing surface and is equipped with 250-ton hydraulic die cushion, 400-ton hydraulic blankholder.

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advantage of automaticity techniques, and the result is a complete automatic roll spotwelder. It does this:

Compresses two pieces of metal between its big copper electrodes at a desired psi; shoots current through the pieces to make the weld, and at the same time relaxes the holding pressure to avoid flowing the metal as it nears molten stage. Then, near the end of the cycle, the pressure is increased in a forging stroke and the metal is released. Two wheels in the welding machine head automatically roll the work on and the next weld is started at the proper interval from the preceding one. The cycle takes a fraction of a second under electronic control; all the operator does is feed pieces in, guide them through and take out the welded article at the other end.

Approximately 70% of Sciaky production goes to the aviation industry, and such welding is becoming more and more important for afterburners and tailpipes for jet engine production.

► **Forge Presses**—Just over the horizon in new aircraft manufacturing techniques are the giant forge presses which will turn out huge aircraft parts at a single lick. Wyman Gordon, Ladish Co. and some others have been experimenting with relatively small presses, the largest being an 18,000-ton Wy-

In the "Cutlass"...

CHANCE-VOUGHT F7U3



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Micropulse

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COCKPIT TEMPERATURE CONTROL
and ELECTRONIC COMPARTMENT TEMPERATURE CONTROL

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Light-weight Barber-Colman aircraft actuators and elements of the Micropulse system are used on the Hamilton Standard cooling package to provide close control of desired temperatures under all flight conditions.

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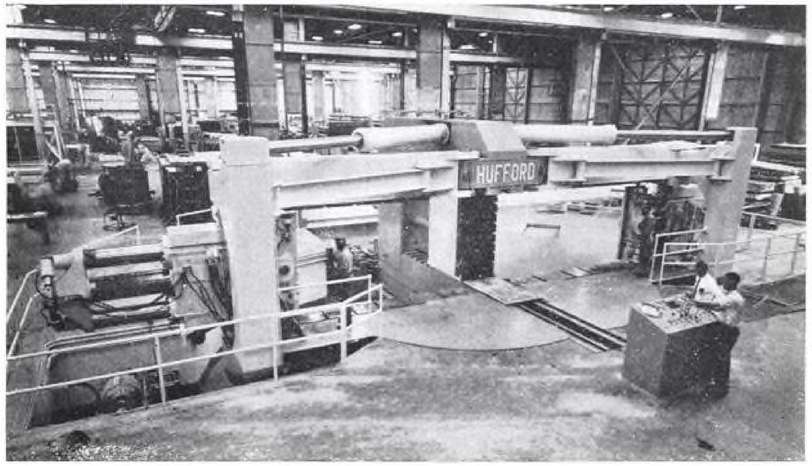
- proportional pulse duration automatically matches system response requirements and actuator speeds for accurate, STABLE control
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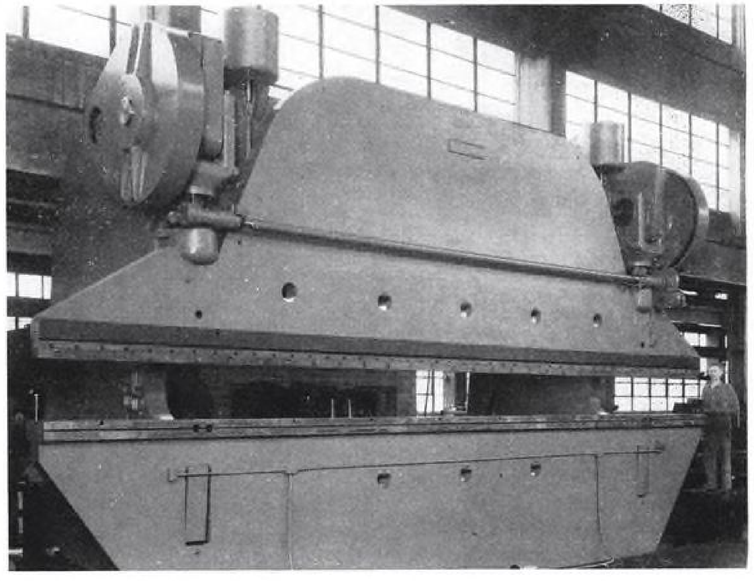
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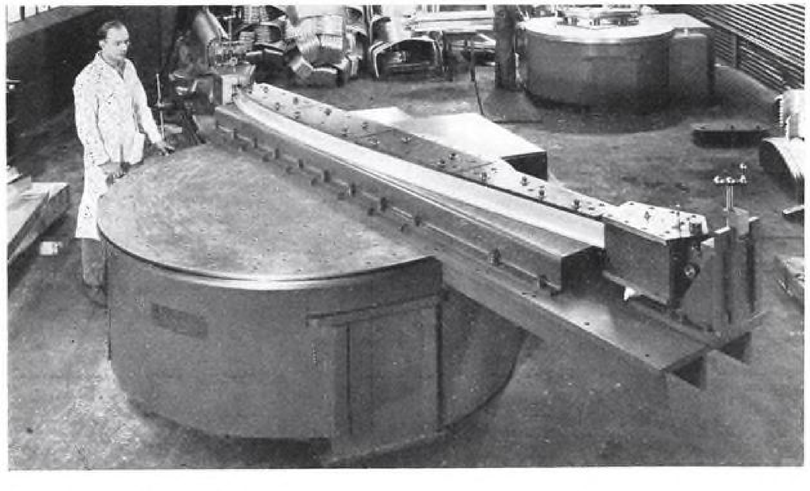
Machines at Work for Production . . .



HUFFORD MODEL 44 stretch-wrap forming machine, installed at Douglas Aircraft, Long Beach, can handle sheets 72 in. wide by 31 ft. 8 in. in length, can also accommodate extrusions. It has independent arm actuation, jaw rotation and oscillation features. The maximum tension provided at 2,000 psi. is over 406,000 lb. A massive production tool such as this costs well over $300,000.

CINCINNATI SHAPER CO.'s press brake is 20 ft. long between housings, weighs about 100 tons and has forming capacities of 500 tons and up. The aviation industry finds press brakes of this size valuable for doing volume work in the manufacture of sheet metal parts and air frames. A machine of this size uses some of the largest rolled steel plates that can be made.





CYRIL BATH universal contour former is seen handling an aluminum ring attach angle using the stretch principle, which assure minimum springback with resulting constant part-to-part duplication. The Bath former utilizes line contact rather than forming all surfaces simultaneously and can form parts in curves exceeding 180 deg. without need for expanding dies. Group of parts to rear of this machine are aircraft wing tank supports.

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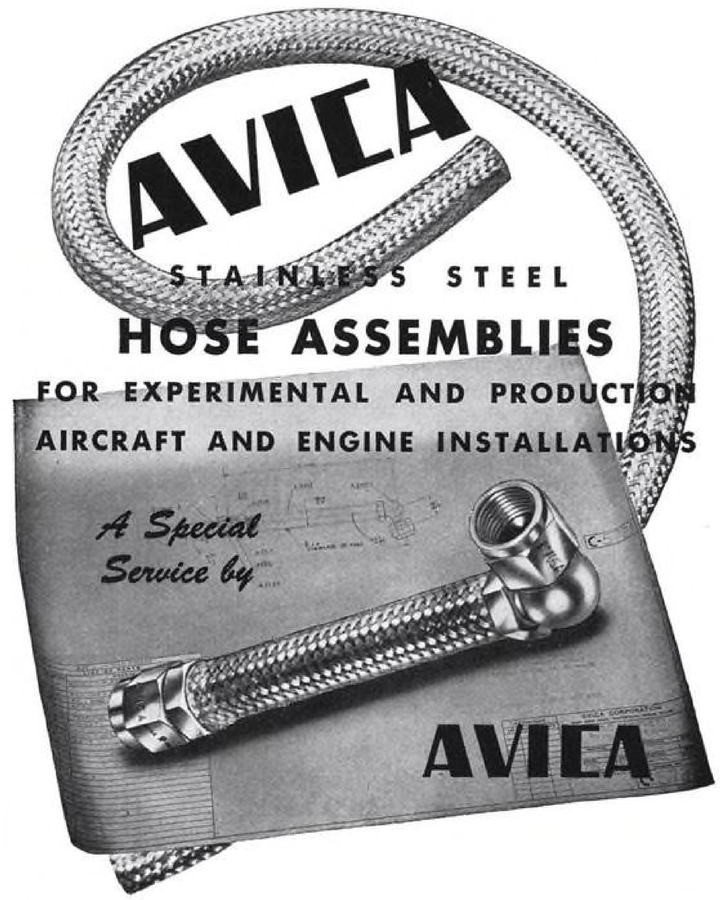
AIR SERVICE & ENGINEERING

P. O. Box 2715 Little Rock, Ark.

man Gordon Mesta, and bigger machines will be used at Adrian, Mich., under the Air Materiel Command heavy press forging program.

At the Adrian plant, currently operated by Reynolds Metals Co., there are now some 15 hydraulic presses, the largest of 5,500-ton capacity. Four forge presses from Germany, which formerly belonged to the I. G. Farben Co., are being installed at Adrian, the largest of 15,000-ton capacity. Others are 7,000-, 2,000- and 600-ton capacities. One such press used by the Germans in World War II production was a 30,000-ton monster. But even this will be small compared to the 50,000-ton and 75,000-ton presses which are scheduled for installation at Adrian, within the next several years. The 75,000-ton is expected to cost about $6 million. There are some reports that Russian industry now has some of the other German forge presses, possibly including the 30,000-ton press.

▶ **Saves Weight**—Main advantage of the new press forging techniques is in producing components that are difficult and costly to make by regular machining processes either involving excessive cutting or fabrication from a number of components. In most cases, forged components that have been successfully produced thus far are lighter than



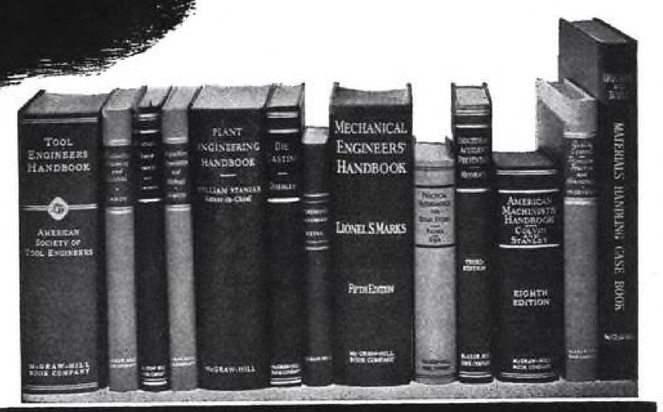
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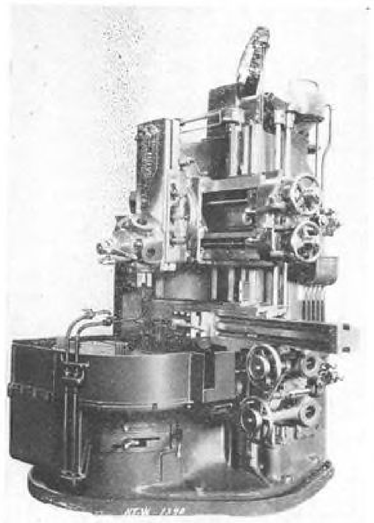
conventionally constructed similar parts of the same strength. Some of the most immediate applications are in forged integrally stiffened structures, such as wing panels and other skin sections, and in large plane components such as landing gear struts. Both the Ladish Co. and Wyman Gordon have produced single piece landing gear struts for the Convair B-36 bomber.

3. New Techniques

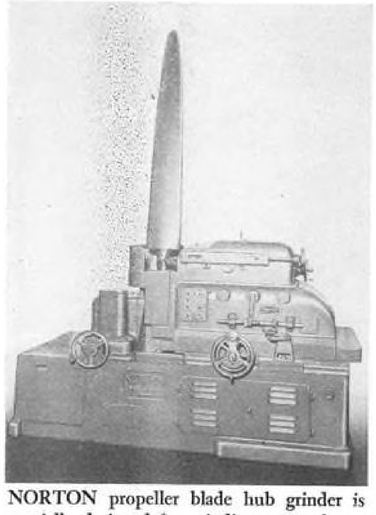
Not directly associated with machining raw materials, but closely associated with aircraft production are some of the new fixture alignment techniques which have been brought over from England and Germany and are now being applied to American airframe production. Under Air Materiel Command development contracts, Republic Aviation has taken the leadership in developing refinements of an optical tooling system from some original British fixture-alignment methods and German fixture-assembly techniques. And a German "hole" system of reference points for tooling alignment is also being studied for possible American aircraft production applications.

▶ **Republic Fixtures**—Republic has built four large fixtures for production of airframes for other aircraft builders, including the North American F-86D wing panel, Lockheed F-94 fuselage, Douglas C-124 tail assembly and Boeing B-47B wing panel. These fixtures can be torn down and reassembled, using clamps, and pipe frames which are accurately put together by a system of optical measurement which is an adaptation of a British Taylor-Hobson system, with Republic-developed accessories.

While tooling discussed thus far has been generally new and industrially revolutionary in type, the vast majority of tooling in the aircraft programs continues to be the general purpose lathes, milling machines, drills, grinders and



BALDWIN-LIMA-HAMILTON Niles 42-in. vertical boring and turning mill with side head has a 30-hp. constant speed motor, is 10 ft. 6 in. high.



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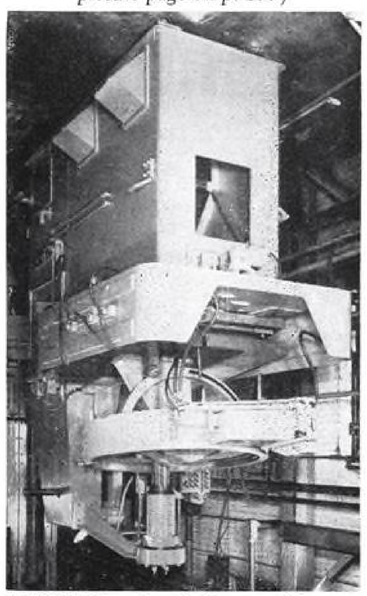
broaches that have built American industry into the largest productive complex in the world.

► **Refinements**—Aircraft and engine manufacturers who have not been able to get the ideal new machines for some of their operations, have refined existing machines to meet their special problems or are using several single-operation machines to do the work which admittedly one new machine with several operations could do more efficiently.

An example of a refinement of a conventional machine is a special three-head adjustable spindle circular type drilling unit which the New Britain Machine Co. has built to the order of Pratt & Whitney Aircraft division. The tool is designed to handle the large variety of drilling patterns required in the fabrication of jet engines, spread over diameters up to 48-in. and in some instances involving as many as 196 holes. The machine will drill, ream and countersink with one setup.

► **Bullard Modifications**—Two interesting special applications of a standard boring mill, a Bullard Cut Master vertical turret lathe, have been made by Ryan Aeronautical Co. One involves a raised bed, 24-in. higher than the standard vertical Bullard, for specialized machining on metal sections up to 84-in. tall. The other uses a Turchan hydraulic duplicator attachment which converts the machine into an automatic production tool. A tracer point follows the outline of a pattern and actuates

(*Text continued on p. 200, picture page on p. 199*)



LAPOINTE universal fixture on the company's ten-ton 54-in. SRV broaching machine is used for mass volume output of stator ring segments for General Electric turbojet engines.

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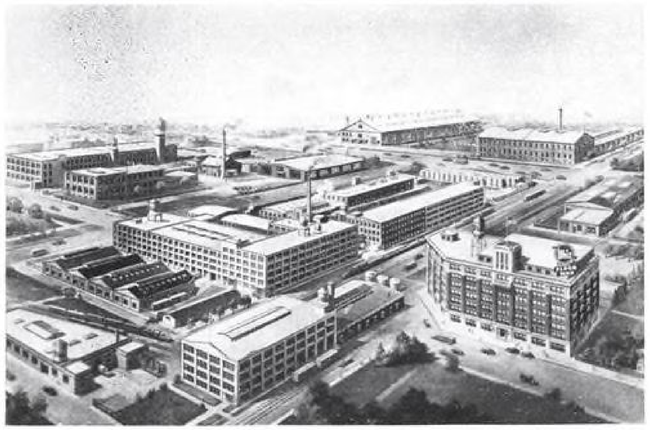
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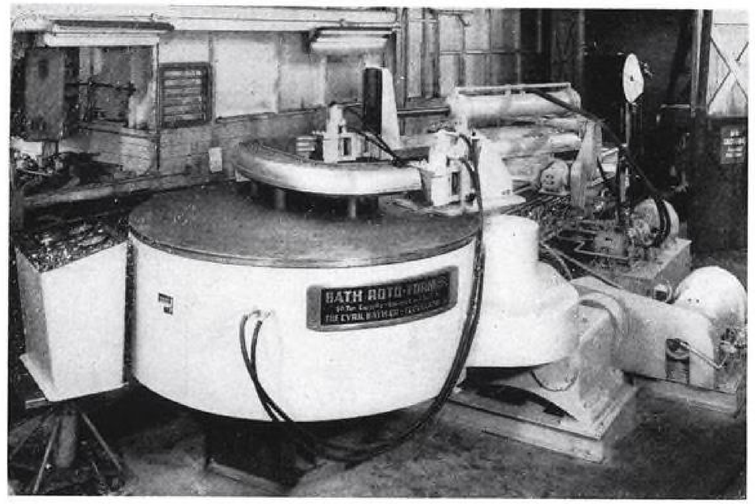
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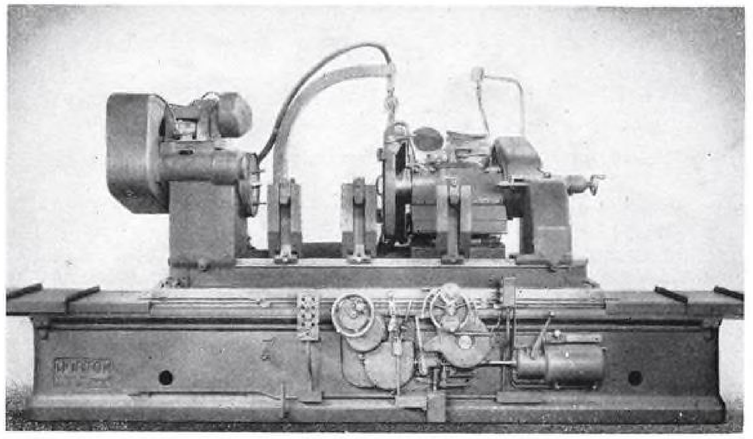
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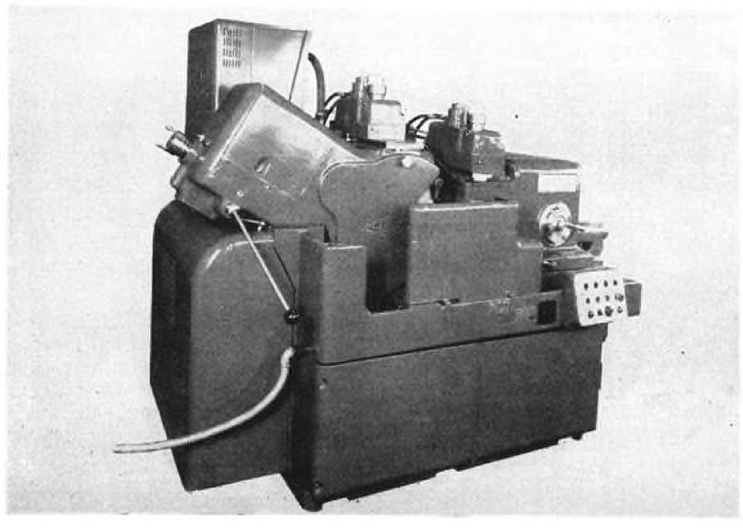
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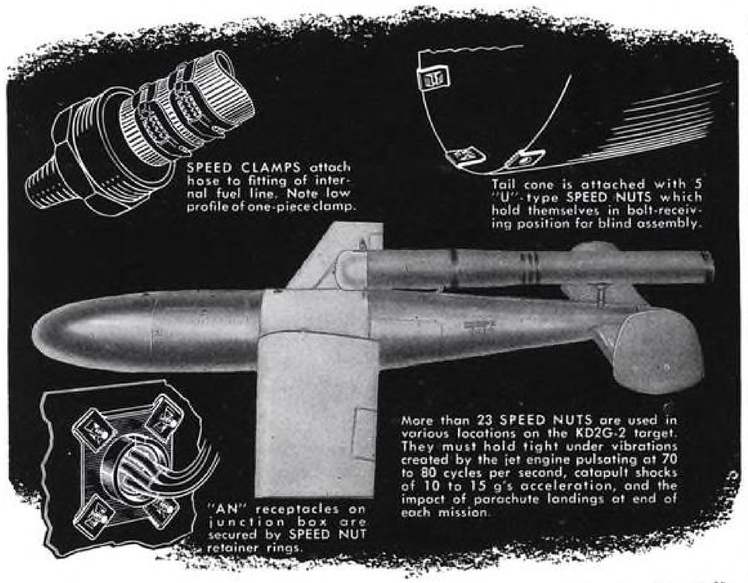
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NORTON 42-in. x 72-in. special universal grinding machine (right) is a heavy production item especially useful for grinding jet engine components.



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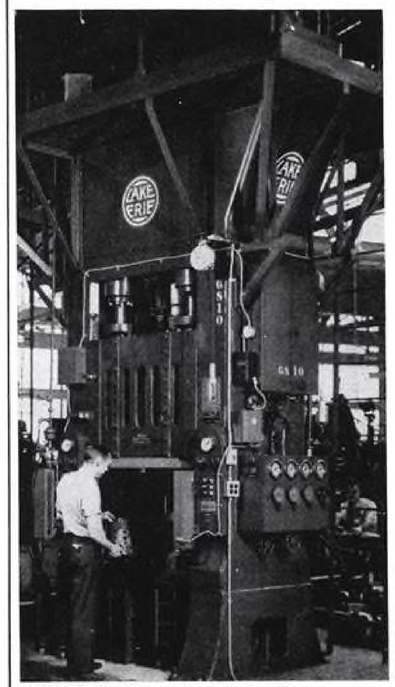


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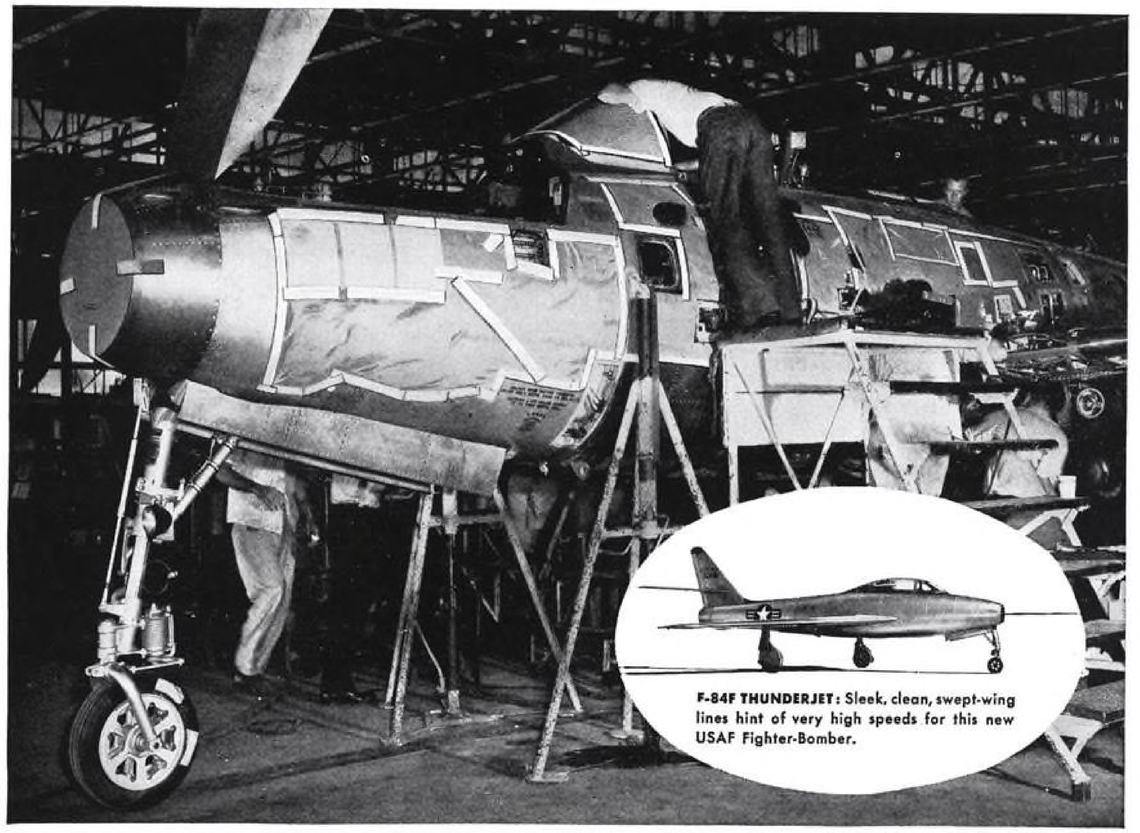
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ington, and in industry circles throughout the country.

▶ **The Reserve**—The general purpose machine tool reserve, rererred to earlier, has already helped tool a number of the new aircraft and engine programs.

Two of the earliest automotive industry programs on aviation products, the Ford aircraft engine plant at Chicago, which is making Pratt & Whitney R-4360 engines, and the Kaiser-Frazer Corp. at Willow Run, Mich., which is making Fairchild C-119C combat transports, got in early to get majority of their total tooling from the reserves at Marietta and Omaha, and many other manufacturers have received sizeable supplies of tools from these storehouses.

Some industry sources report that a large second-hand machine tool market, of very serviceable tools could be readily tapped to considerably ease the situation if there were some relaxation in the very low prices which government contractors were permitted to pay for used machine tools. These tools are being held off the market they say, by their owners pending price relaxation.

An effort to utilize some of the idle capacity of machine tools at Navy facilities has recently caused the Navy to announce a program which will make its tool capacity available to government contractors, by arrangement and at a compensation to be arranged by the contracting officer for whichever service the manufacturer is contracting for.

An inventory plan on government owned machine tools to be sure that they are being used to the best advantage on military contracts, has recently been announced by the Munitions Board, as another government effort on solving some of the machine tool problems.—A. McS.

'Gold Rush'

AF defense firms find badly needed machines at storage depots.

The Air Force surplus machine tool sites at Marietta, Ga., and Omaha, Nebr., are the sites of a new "gold rush" as USAF contractors prospect these facilities in a desperate search for critical tools needed to meet production schedules.

Until recently, the contractors were not too interested in the storage depots, when the procedure was to select desired tooling from lists without inspection and wait for clearances and special appointments to get to see them.

So the Air Force decided to throw open the doors on a first-come, first-served basis, depending on the contractor's priority.

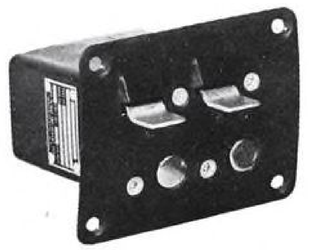
The new system began Sept. 10. In the first two days over 20% of the 6,546 tools available at Marietta were allocated, and there was a force of 600 working around the clock to start the machines on the way to their new homes. Some of the more than 300 visitors from defense plants found all the tools they needed at Marietta the first day, took off for Omaha, where a bigger and more diverse selection was waiting.

Said Col. R. A. Elliot, chief of industrial equipment, AMC, in briefing the contractors: "Let's stop fooling ourselves. It will be 18 months to two years, even longer in some cases, before machine tools ordered from builders are delivered."

Operation Gold Rush, as AMC has tagged it, has turned out to be a gold mine for many firms. Detroit-Broach found a deep-hole drill that will make it unnecessary to subcontract such drilling—at $140 per hole. New Process Gear spotted two $225,000 upsetters which otherwise would have been on order for months.

Some of the more fortunate AF contract holders, who availed themselves earlier of the storage facilities, had found the picking good. Take the case of Lycoming-Spencer division of Avco. Given a hugh contract to build airplane engines, L-S managed to tool up entirely from the reserve. It took five months—if the company had waited for new machines, it would have taken a couple of years.

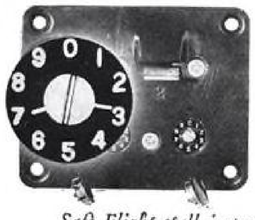
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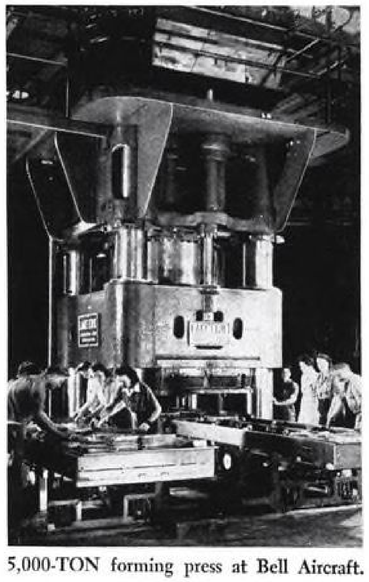
It's plain that visitors to the tool reserve depots are not finding the "obsolescence" previously reported. It's true they don't find custom-made machinery in many cases, but to offset this, they are having the tools returned to the original builders for adaptation. Some times the tool rebuilding companies send representatives along with the contractor to the depots.

Monitoring the project is the Production Resources Division of USAF's Industrial Equipment Section. Defense contractors are brought into the depots by chartered plane in groups—the first batch numbered some 400 representing 178 plants.

These men were briefed at the Hotel Atlantan by Anton Dekon of USAF, then driven the 18 miles to Marietta and permitted to shop through the huge plant.

There machines were set out, each bearing a tag on which the visitor could write his name if he wanted that particular tool.

Some of the machines bore several names. So a special priorities board of AF officers reviewed the selection and within 48 hours, the awards were made. That night three chartered Delta DC-6s took a portion of the party to Omaha. Meanwhile, another group was arriving at Marietta. This batch comprised some 200 more defense contractors, plus five Canadian firms, A. V. Roe, de Havilland, Canadian Car & Foundry, Canadair and Pratt & Whitney Aircraft. Wright Aeronautical Corp. sent eleven of its own men plus 30 from subcontractors to select for themselves and then charge the tools to Wright.



5,000-TON forming press at Bell Aircraft.

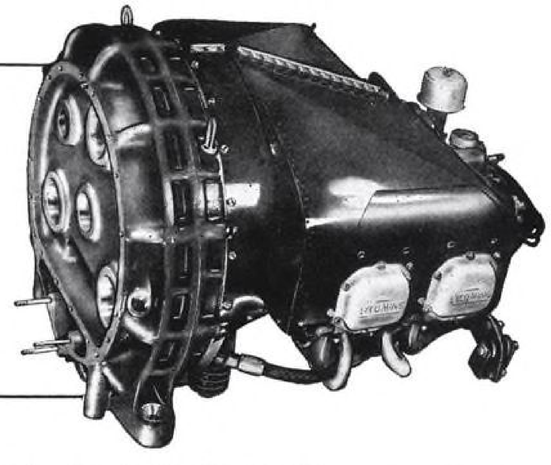


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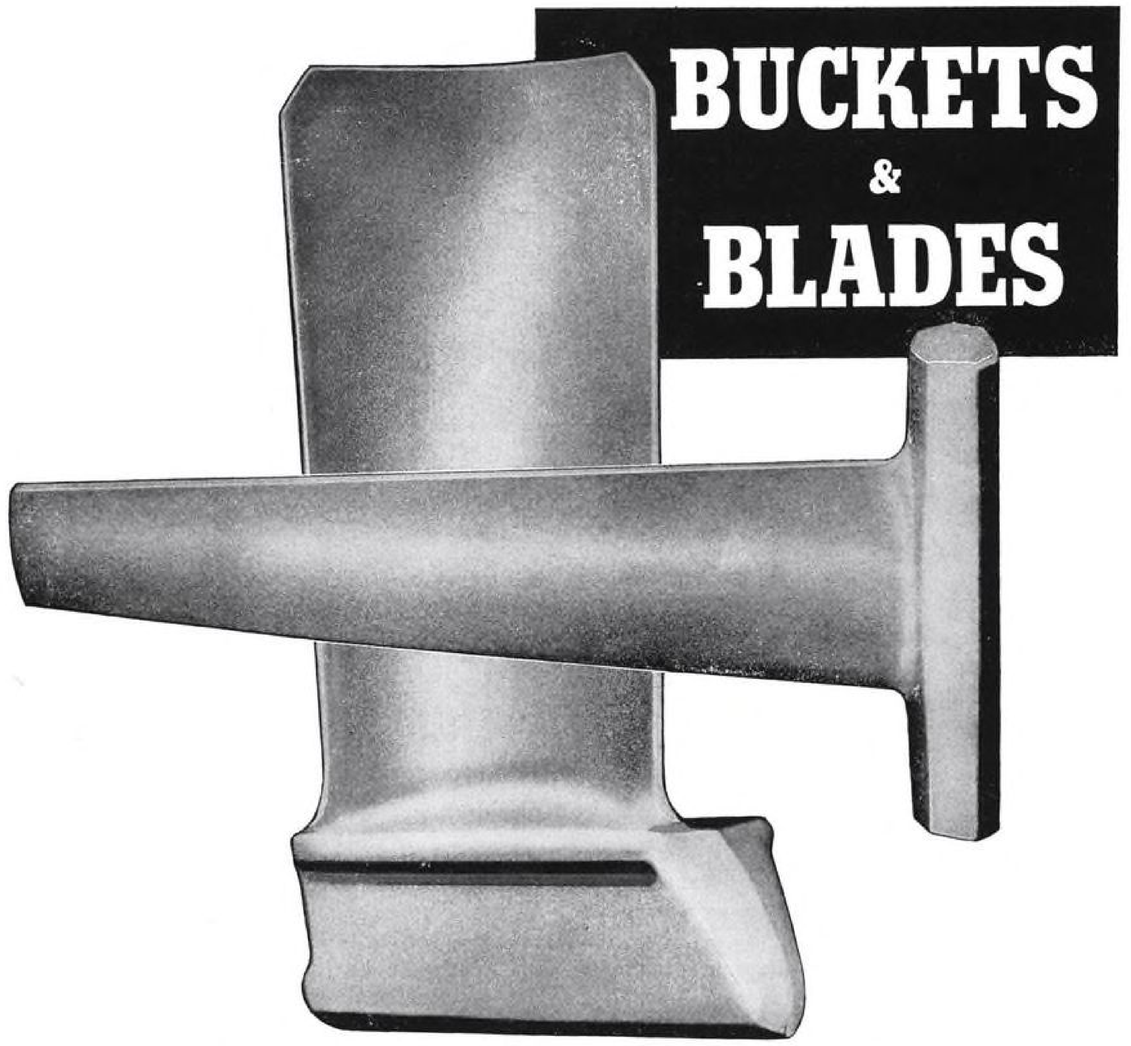
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Tools to Save Time and Money

The pressure on manufacturers to speed production and at the same time economize, has put the spotlight on simplified, time-saving tools. Some current examples of such tools are these:

Rugged Center

Ruggedness, accuracy and freedom from chatter are main advantages of No. 1490 center for holding work in machine tools, says Delta Power Tool division.

In "gruelling" tests, this center outlasted four similar units, according to the firm. To take heavy radial and thrust loads, it has a double row of sealed ball bearings. And to insure that it is accurate and runs true, the company drills and machines the center socket (mounted to the shank) after it is assembled to the shank, rather than before.

The unit is supplied with three replaceable centers and a wrench. The shank has a No. 2 Morse Taper. The center can be used on lathes, screw machine gear hobbers and similar tools.

Adjustable Rack

A mobile rack with adjustable pegs, designed to protect machined or polished parts and carry them from point to point in the factory, is being produced by Rack Engineering Co., Connellsville, Pa.

The rack brings work properly positioned for fast handling to the machine operator. It has steel pegs which can be spotted, like those on cribbage board, in holes anywhere on the face of the unit to support machined parts of practically any size or shape in the attitude desired.

Developed after careful study of production techniques, it is designed to ease floor congestion and meet the needs of fast-moving plant operations, the company says. With a relatively narrow base and rack which extends vertically, it takes up more airspace than floor space.

Versatility Keynoted

The new, Ekstrom-Carlson Vertimil (No. 5V) is a machine that "is and isn't" a vertical miller.

It is more than that. It is several machines rolled into one. As Ekstrom-Carlson describes it, the Vertimil combines "all the advantages of several different milling machines into one compact, vitally different unit." Like the "rubber-jointed" man at the circus, this versatile machine can be swiveled and tilted into position for precision milling not only of vertical, but flat, horizontal or angle surfaces. Adjustments for these diversified operations and setups can be accomplished simply and quickly, the firm says.

This all-around miller has production line application. But, also, it should serve well in the machine shop of the experimental department of an aircraft company. Here, aircraft parts and tools (in small quantities) sometimes have to be fabricated from scratch and require diversified operations in their construction. The Vertimil can be quickly adjusted to meet various milling needs, it is claimed.

The machine, says the firm, is the only vertical mill combining these features; a ram-type head, swivel head, sliding spindle, swivel table, four-way power feed mechanism.

A base and column casting mounts a horizontally adjustable ram. The ram supports a swivel sliding spindle head and spindle drive. A tilting work table is mounted on a saddle and knee assembly which is arranged to permit longitudinal, cross and vertical movement of the table. Adjustments are accomplished through power drive.



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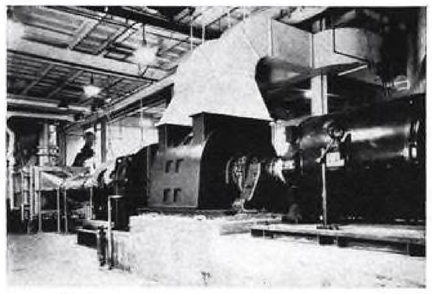
One way of speeding up production, of course, is by reducing down time on machines. Elmes Engineering div. of American Steel Foundries has attacked this problem frontally in development of a new hydraulic press.

The press carries no piping for the main hydraulic circuit. Instead, fluid is conducted through short, direct passages drilled in the structural members of the machine.

With this design, there are no high-pressure screwed joints to loosen, no oil dripping from loose fittings, no possibility of welded joints breaking, explains the company.

Only pipes in the entire press are the pilot, suction and drain lines, and of these, only the pilot line carries high pressure. For smooth operation a reversing type hydraulic pump is used. It is supported in a steel bracket flange-mounted to the press cylinder. An Elmes shifting and centering system—a miniature pipeless circuit itself—is mounted directly to the pump.

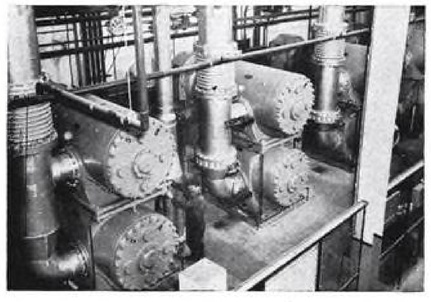
Heart of the new circuit is the pipeless valve unit. This contains all necessary provisions for pre-filling during rapid advance, changing to pressing speed by either pressure or position, and decompression prior to reversal. There is a wide range of valve sizes.



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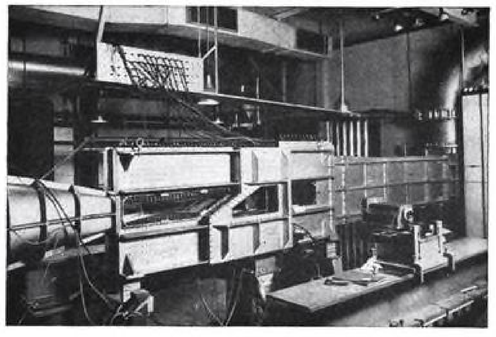
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53	48362	Shaft
175	48363	Shaft
56	48392	Sump
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231	D9530	Adel
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744	D18044	Adel
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88	572-3A	Eclipse
244	D10051	Adel

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12	47B22	Lewis Eng.	Temperature Ind.
20	47B23	Lewis Eng.	Temperature Ind.
36	47B24	Lewis Eng.	Temperature Ind.
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11	76B4	Lewis Eng.	Temperature Ind.
20	77C4	Lewis Eng.	Temperature Ind.
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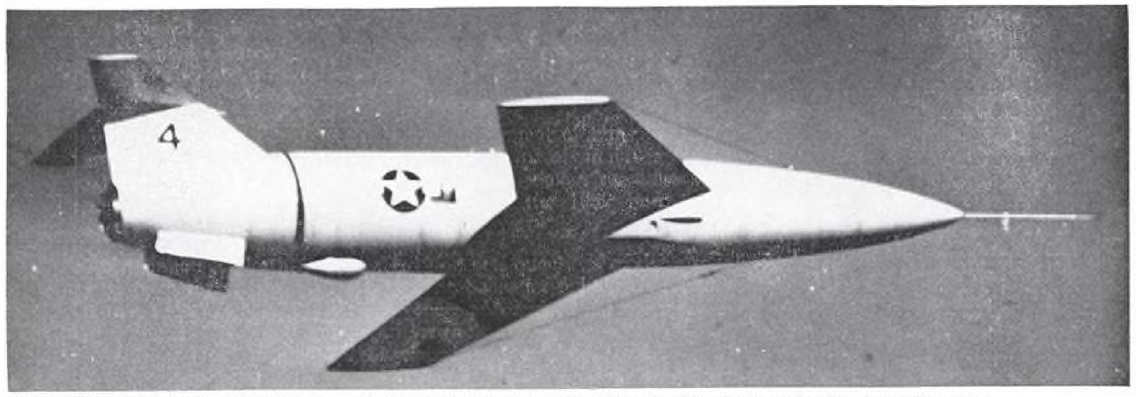
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NEWS OF THE WEEK



PILOTLESS BOMBER, B-61 Matador, gets takeoff boost from tail rocket. In this photo, rocket has just fallen clear.

Matador Opens Era of Missile Warfare

Air Force disclosure that service evaluation of the Martin Matador is being undertaken by USAF's newly established "Pilotless Light Bomber Squadron", Cocoa (Banana River) Fla., has ushered in officially an entirely new weapons system which will change the aspect of war.

It shed some light on the cryptic comments of the President and members of Congress about "fantastic new weapons beyond imagination" and also uncovered a brand new source of inter-service dissension.

► **Joint Project**—The Martin Matador guided missile has been under development by the Glenn L. Martin Co. for several years for both the Air Force and Navy. It represents the culmination of two separate guided missile projects, Matador and Regulus (AVIATION WEEK Jan. 8, p. 11). Known originally as USAF project MX-771, it was redesignated YSSM at flight test status.

The final production version, designated SSM, ordered by Air Force the first week in January, weighs approximately 12,000 lb.; has a range of more than 500 mi., and a speed approaching Mach 1.

The weapon was ordered into production following a survey made by Defense Department's Office of Guided Missiles Director K. T. Keller, who was ordered by former Secretary Marshall to expedite guided missile production.

First step by Keller in getting promising missiles into production was to cancel less promising projects and merge others to provide a few practical weapons which could be used jointly by all services. The Matador was nearest to service weapon evaluation status among those reviewed.

► **But Not for AF**—From a tactical point of view the Matador does not fall into the established roles and missions of Air Force because it is a surface-to-surface missile, not air-to-air or air-to-ground. While it could probably be launched from an aircraft much as the Douglas D-558 or Bell X-1 have been, and therefore used as an air-to-ground weapon, it will probably come into full service use by either Navy or Army.

Navy, for example, originally contemplated use of the Matador in its string of weapons designed for sea combat operations. As such it could probably be provided with folding wings and stored aboard submarines. This, again, somewhat alters the roles and missions of the Navy since it would project Naval jurisdiction into strategic air currently controlled by USAF. The Matador in this role could be launched against enemy shore installations from 500 mi. at sea or at enemy targets 500 mi. inland if the subs were operating close in-shore.

► **Bid for Ownership**—Designation of the Matador as "B-61" came less than an hour before release of the story of the weapon was made. Decision of the Air Force to give it "B", for bomber, nomenclature is a temporary expedient only. It would confuse the identification between piloted and un-piloted aircraft if held to permanently.

Main reason USAF stamped B-61 on the Martin Matador label is an attempt by the Air Force to identify missiles in the Air Force weapons stable.

The Matador is launched from a portable launching cradle carried aboard a flat-bed trailer truck. The launching mechanism can be aimed hydraulically to any desired angle of trajectory. Flexibility of the weapon in combat, of course, is presently limited to delivery of the missile to a combat area with its launcher.

The missile, itself has no landing gear and is an expendable weapon. Actual launching is accomplished through firing of a standard 1,000-lb. solid fuel rocket fitted under and aft the Matador fuselage. After the rocket booster is expended it is automatically cast off and the Matador continues on its own jet engine.

Convair and Republic Win Interceptor Bid

Two experimental contracts to proceed with design development of a "very high performance" interceptor prototype for the Air Force, have been awarded to Consolidated Vultee Aircraft Corp. and Republic Aviation Corp.

Presumably the orders are for the so-called 1954 interceptor, planned as a pilot-monitored aerial launcher of an air-to-air missile which would be "homed" on high altitude enemy attackers. (AVIATION WEEK, Feb. 19, p. 11).

The two companies were chosen from six firms which submitted 12 designs in the competition. Contracts call for them to proceed with wind tunnel studies, models and mockups of the interceptor prototype designs they had submitted.

Air Force announcement of the award confirms the AVIATION WEEK July 9 report, (page 11), that Convair and Republic were named winners.

Priority Rules—Good and Bad

New DX rating gives an over-riding materials priority to defense.

NPA directive gives equipment producers another hard blow.

Aircraft priorities trouble-shooters in Washington think that two new National Production Authority regulations can help aircraft production, if used right by NPA.

Here is what the two new amendments to NPA Regulation 2 and to Controlled Materials Plan Regulation 3, authorize NPA to do:

- Give a DX super priority to orders for components and materials (other than steel, copper and aluminum) if delay in delivery would jeopardize top-urgent defense programs.
- Give a special priority to military orders over non-military orders in cases where there isn't enough production available to meet delivery dates for all orders.

A new NPA amendment to CMP Regulation 1 permits aircraft manufacturers to order 40% of their quarterly allotments of controlled materials in any one month of the quarter. Formerly, the limit was 35%. The amendment gives users of aluminum, steel and copper somewhat more freedom in scheduling production.

The DX super priority is issued by the NPA priorities and directives division of the Policy Coordinating Bureau. Walton C. Groce is director of the division. He issues this super order on request of the agency interested in the material.

This is expected to provide a much-needed "screening" of DO-rated orders now on company books. Many "so-called **defense-supporting**" industries have DO ratings; now the DX super-DO rating will give priorities men a way to make some distinction between "vital" and "important" products.

NPA explains the military preference order this way: "DO rated orders bearing program identifications A, B, C, or E, (military identifications) which have been accepted and scheduled for delivery, are to be given preference in delivery if the supplier is unable to deliver on time all orders on his books. This change does not affect existing rules applying to acceptance of new orders."

The DX order is supposed to be an emergency rating only. But it is not the same as an NPA directive. The manufacturer can "extend" the power of a DX rating to his subcontractors or suppliers, whereas a spot-assistance "directive" merely gave first-delivery authority for a particular item from a certain plant.

Reports that several U. S. manufacturers of essential aircraft components for some of the Nations' highest priority fighters and bombers are getting an apparently unnecessary new pushing around on their materials requirements have been traced to a recent National Production Authority telegraphic directive to aluminum, steel and copper makers.

The directive called for the materials mills to give special automatic preference to makers of military products. Its effect was to shove back deliveries to manufacturers on the "B products" NPA list. However, NPA has classified virtually all of the components and equipment makers as "B list" manufacturers, regardless of the priorities of the programs which they are supplying.

In effect this would mean that a maker of hydraulic systems for a high priority interceptor might be unable to get the materials he needed, due to the new preference to military products. This could lead to a myriad of equipment shortages which might seriously delay some of the top programs.

Only remedy seen in Washington last week was for the makers and users of standard B-products to ask NPA for individual help and directives to get over the new barrier every time they run afoul of it.

▶**Good & Bad**—Asked about the automatic priority directive, officials at Aircraft Production Board and Munitions Board say they consider it a good thing for the prime aircraft industry contractors, although the components suppliers are not pleased with it. It is designed to avoid snarls on materials for the "end-item" producers, presumably overlooking the obvious fact that end-items are not completed without all their necessary components.

The reason why no automatic materials preference has been given to military-ordered components in a class is that they are largely standard items, which are used as components for both commercial and military products. It is almost impossible, the Defense planners say, to ear-mark materials for them as "military" and "non-military" because the finished component is a standardized item that may be used for either.

Aircraft production expediters in Washington say they would be glad to find a way to give automatic priority to defense-ordered components that are standard B items. So far, nobody has found an acceptable solution.

Navy Boosts F3H-1 Demon Production

Navy last week gave Goodyear Aircraft Corp. a letter of intent for a prime contract to build the new McDonnell F3H-1 Demon sweptwing jet fighter at the 1 million sq. ft. assembly plant at Akron where Goodyear produced 4,000 Vought-designed Corsairs in World War II.

The Goodyear contract will virtually double production of the Demon over the prime contract already given McDonnell for the plane. The contract also means that the Demon is definitely on schedule as a major replacement for current operational carrier fighters. No dollar value or number of planes was disclosed but obviously the overall Demon requirements are very large.

Navy leaders recently testified in Congress that earlier Banshee and Panther carrier jets, now operational, are definitely outclassed by the Russian-built MiG 15 sweptwing fighters, and will become second-line as soon as replacements are available. (See Industry Observer).

The first experimental XF3H-1 Demon made its initial test flight Aug. 7 at the McDonnell plant at St. Louis, and has made several more flights since that time.

▶**Aid to Westinghouse**—The big new production program for the Demon means heavy additional production requirements for its powerplant, the Westinghouse J-40, a 36-in. diameter 3,000-lb. turbojet which is reportedly up in the 10,000-lb. thrust class with afterburner.

Westinghouse is tooling to build the engine at Kansas City, and a later second source of production will be the Lincoln Mercury division of Ford, at a new assembly plant which is now going through official clearances for eventual construction at Wayne, Mich.

The extremely clean design of the Demon, indicated in photographs, and the high-powered engine scheduled for it, are clear indications that the plane will be well up in the transonic speed range, and probably supersonic at top speed.

K-F Gets B-52 Job

First indication that the production version of the Boeing eight-jet heavy bomber will be designated B-52A is in the announcement that Kaiser Manufacturing Corp., Kaiser-Frazer Corp. subsidiary, has been awarded a contract to machine about 90 different kinds of aluminum forgings to be used as structural parts in the B-52A. Work will be done in a Kaiser plant at Richmond, Calif.

Jet Copter

Navy gives McDonnell job of developing craft to lift heavy loads.

A powerful new jet-rotor helicopter designed specifically for lifting and lowering heavy equipment for ship-to-shore transfers will be developed by McDonnell Aircraft Corp., St. Louis, under a new Navy contract announced last week.

The new McDonnell Model 86 is expected to lift payloads up to 36,000 lb., unofficial reports say, for short range hauls. Yet it will be designed compactly for carrier-based operations, with folding rotors so that it can be handled in regulation carrier elevators designed for conventional aircraft.

Military service interest in the direct lift capabilities of jet-powered helicopters, for such short-range flying crane tasks, has been whetted by experiments with small jet copters such as the Air Force McDonnell H-20 Little Henry ramjet machine, the American Helicopter pulse-jet, and the Hiller ramjet Hornet.

These have shown very powerful lifting ability in relationship to the size of the machines, but it is usable only for relatively short distances because of the very high fuel consumption of the rotor-tip jets.

▶**Big Lift**—For a well-designed jet-powered copter (AVIATION WEEK Feb. 19, p. 11), the ratio of useful load to gross weight can be as high as 70%, probably the highest lift ratio yet achieved by any type of aircraft.

Reports are that Little Henry has lifted a 500-lb. useful load although its weight empty is 280 lb.

The Kellett-designed Hughes XH-17 flying crane utilizes a turbojet engine compressor arrangement at the fuselage. This shoots out compressed air to the rotor tips where it is mixed with fuel and burned. Performance reports on this larger craft have not yet been made available, and it was only recently returned to tethered flight test status after an accident early in the previous test period at Culver City, Calif.

▶**Hornet Heir**—Navy announcement on the Model 86 said the machine was fitted with a three-blade rotor with McDonnell-designed jet engines at the rotor tips, presumably developed from the ramjets used on the Little Henry two-blade 18-ft. diameter rotor.

The Model 86 will be fitted with power winch equipment and a retractable cargo sling in which to lift and carry heavy cargo. It will also be designed to pick up and carry aircraft cargo pods, and for this purpose offers competition not only to the Hughes machine but to the big tandem rotor Piasecki XH-16 now under development for the Air Force.

Senate Funds Bill Cuts Procurement

The 2.5% down-the-line reduction in the $61 billion defense bill for the current 1952 fiscal year voted by the Senate will cut sharply into aircraft procurement funds, but Senators claim it can be absorbed through increased efficiency in personnel utilization and by cutting out "trimmings".

The percentage reduction will:

- **Reduce by $280 million** the $11 billion approved for aircraft and related procurement this fiscal year by the Air Force.
- **Trim $60 million** off of the $4 billion earmarked for plane construction and related procurement by the Navy.
- **Trim $125 million** off of the $5 billion "National emergency fund" appropriated to the Secretary of Defense to "broaden the base" for an expansion of air power, both Air Force and Naval Aviation.

The overall percentage cut will reduce the $61 billion the Senate voted in defense appropriations for this year by $1.5 billion to a total of $59.5 billion.

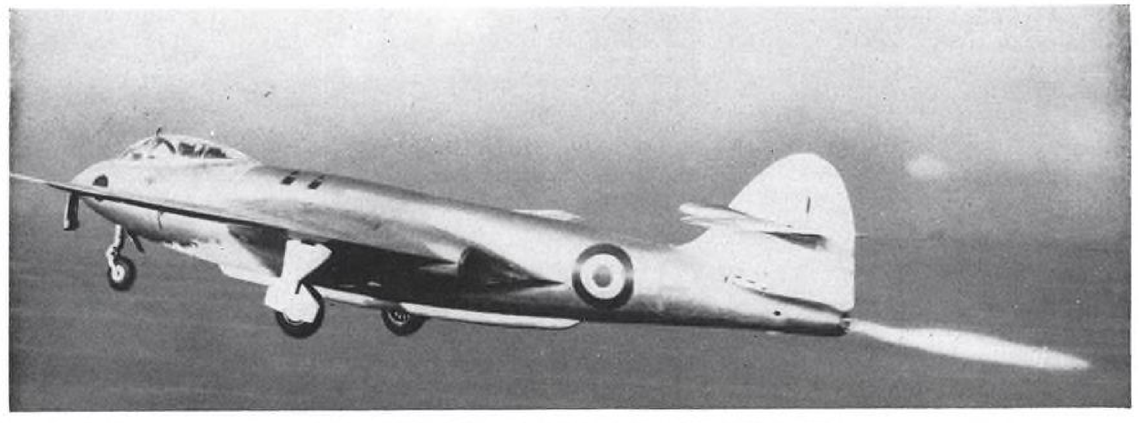
This still substantially exceeds the administration's original estimate of $56.2 billion. Still to be acted upon is a $4.5 billion appropriation for public works, including $2.4 billion for USAF bases and installations.

This appropriation, now under consideration by the House Appropriations Committee, will boost the total defense bill for this year alone to the $65 billion mark.

The 2.5% cut, voted by the Senate, was at issue before a joint conference committee to iron out differences between the House and Senate versions of the '52 military budget as this issue went to press.

Also at issue:

- The $5 billion "National Emergency Fund". This was recommended by Department of Defense after the House had passed the measure.
- A limitation on flight pay to personnel engaged in combat duty or assigned to duties entailing a minimum of 20 hours of flight a month voted by the Senate 49 to 31.
- A reduction of $70 million in the total $1.5 billion voted the Department of Defense for research and development activities. Under the terms of the Senate bill, this cut would have to be applied by the Secretary of Defense.



BRITAIN'S NEW SNARLER ROCKET MOTOR

Brought out from a blanket of security in time for the Society of British Aircraft Constructors' Farnborough exhibit, Armstrong Siddeley's Snarler rocket motor powers a Hawker P. 1072 fighter (modified P. 1040). The 215-lb. motor for takeoff or performance boost delivers 2,000-lb. thrust at sea level on its oxygen/water-methanol mixture. The motor can be turned on or off at will.

NEWS DIGEST

DOMESTIC

Convair has received an Air Force contract for an additional, undisclosed number of B-36F bombers. The planes are scheduled to be built at Ft. Worth. Also, Convair, San Diego has been issued a certificate of necessity by DPA for construction of a $2,658,000 development center to be completed by December. The center will have an electronics guidance section, research lab, instrumentation lab, and radar testing section.

Howard Hughes has been given an extension to Jan. 1 as the deadline for continuing flight tests on his huge eight-engined flying boat. Previous deadline was Sept. 1.

Frederick O. Muller, automotive and aviation executive, has been designated director of procurement for Republic Aviation Corp.

Robinson Airlines has purchased three DC-3s plus spare engines and parts from Ocean Air Tradeways, bringing to four the number of DC-3s purchased by Robinson from OAT.

UAL Stratocruiser crashed into San Francisco Bay mud flats on Sept. 12 while making an approach to San Francisco Airport following a series of instrument landings. The crew of three was killed.

Maj. Gen. F. M. Hopkins, Jr., USAF, retired, has joined Cleveland Pneumatic Tool Co., as vice president and assistant to the president. Gen. Hopkins' last AF assignment was as Deputy for Operations, AMC, Wright-Patterson AFB.

C-46 Commando, leased by Safeway Skycoach Airline Transport Co. of Chicago from Peninsular Air Transport, crash-landed on Sept. 16 in a field near Midway Airport, Chicago. All 55 persons aboard escaped serious injury. It is believed that the plane's left engine failed after takeoff.

Atomic warfare training to be conducted at Frenchmen's Flats, Nev., will involve approximately 5,000 USAF, Navy and Army men. The maneuvers will be held in connection with forthcoming tests of nuclear and conventional weapons at the site.

Purchase of 24 DC-6B passenger planes and six DC-6A cargo planes, at an investment of $35 million, for delivery in 1953 has been announced by American Airlines. AA already has 17 DC-6Bs.

INDUSTRY OBSERVER

►Navy Lockheed PO-2W four-engine long-range special search Constellations are pricetagged at $4.3 million each, recent testimony in Congress disclosed, with explanation that a large percentage of the cost was in special electronic equipment.

►Army decision to slow down on procurement of transport helicopters pending more complete evaluation of that type of aircraft is indicated in a statement to Congress that "a half billion dollars for helicopters of a transport type has been eliminated from the 1952 budget pending evaluation."

►As soon as North American Aviation gets quantities of the new F-86D interceptor version of the sweptwing Sabre jet fighter into service, the day fighter versions of the Sabre—the F-86A and F-86E—are scheduled for National Guard assignments under the program for replacement of day fighters by all-weather radar-equipped interceptors.

►British tests on molded plastic aircraft wings indicate that their scientists are still not producing pure plastics strong enough for primary aircraft structure, but the use of metal reinforced plastics is the aim of their current research.

►Northrop's rail-running highspeed rocket sled will be the launcher for the long-range missile Snark which is soon to be tested at the USAF Long Range Proving Ground, near Patrick AFB, Fla. Northrop is transferring 150 company personnel to Patrick, from Holloman AFB, N. M., where preliminary tests were run, and eventually will have about 300 assigned to the proving ground. Possible hint of the range and speed of the turbojet-powered Snark is found in the prediction of John K. Northrop, president of Northrop Aircraft, that pilotless aircraft will form the backbone of the USAF defense and offense by 1960, and his testimony in 1947 that "based on fairly complete design studies it is reasonable to expect that almost any competent aircraft manufacturer could in a modern design extend the speed of such missiles to 600 mph. and the range to 4,000 mi."

►Navy will make available open capacity on machine tools or forge or casting operations at Navy facilities to firms requiring such capacity to make schedules for urgent military contracts for any of the three services. Any contractor wishing to use such facilities can make arrangements with the contracting officer of the service which issued his contract, who will schedule the work at a Navy facility through the office of Naval Materiel, and arrange for reimbursement to the Navy for the work done. The announcement confirms an AVIATION WEEK forecast (Sept. 3, p. 13) that Navy tools would be so used.

►Watch for the experimental forge press plant operated for the USAF at Adrian, Mich., by Reynolds Metals Co. to go into actual production of big forgings for aircraft when it gets the press capacity. There is strong industry pressure to put the pilot production plant into actual production to meet requirements for such items at the big 75S alloy wing spars of the Republic F-84F.

FINANCIAL

Lawrence D. Bell, president of Bell Aircraft, recently sold his entire stock holdings in the company, as has Ray D. Whitman, first vice president and director. Bell and Whitman stated that they would reacquire, on a new tax basis, substantial interest in the firm.

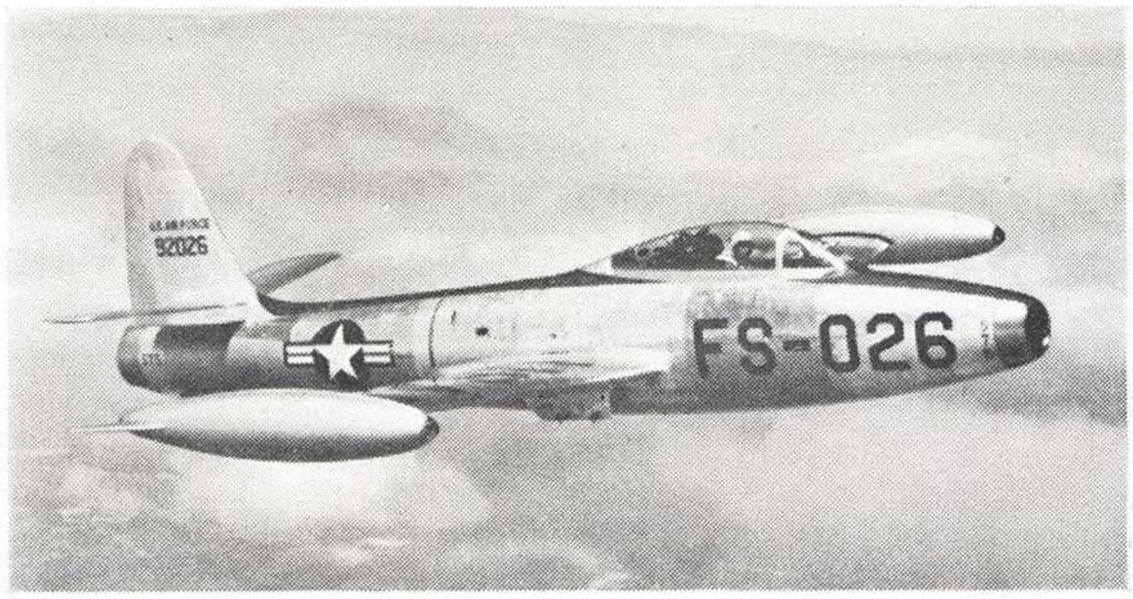
INTERNATIONAL

Scheduled flights between Prague and Brussels have been dropped by Czechoslovakia because of the Western allies' ban on Czech planes flying over West Germany. The Belgian carrier, Sabena, flies a twice-weekly service to Czechoslovakia.

Societa Italiana Ernesto Breda, long-time Italian aviation manufacturer has shut down its aircraft works and converted to producing agricultural and mechanical goods. The company also makes consumer items. Breda's last big ventures were the BZ-308 and BP-371 transport planes.



REPUBLIC F-84 THUNDERJET POWERED BY ALLISON J35 TURBO-JET



Experience where it counts most—in the air

The U. S. Air Force and U. S. Navy have accumulated more than 1,000,000 hours of actual flight operation with Allison Turbo-Jet engines in the airplanes shown on this page. This is more time in the air than the jet engines of any other manufacturer in the world.

Represented in this broad background of experience are thousands of hours of flight time on both J35 axial and J33 centrifugal flow engines—with and without afterburners—on the two models.

Navy sponsored Allison T40 twin Turbo-Prop engines are adding to Allison experience in two Navy planes. The T38 single engine Turbo-Prop in the Turbo-Liner, America's first turbine transport, is now undergoing tests at Edwards Air Force Base.

It's experience that counts—and these turbine engines have it where it counts most—in the air—in these airplanes.

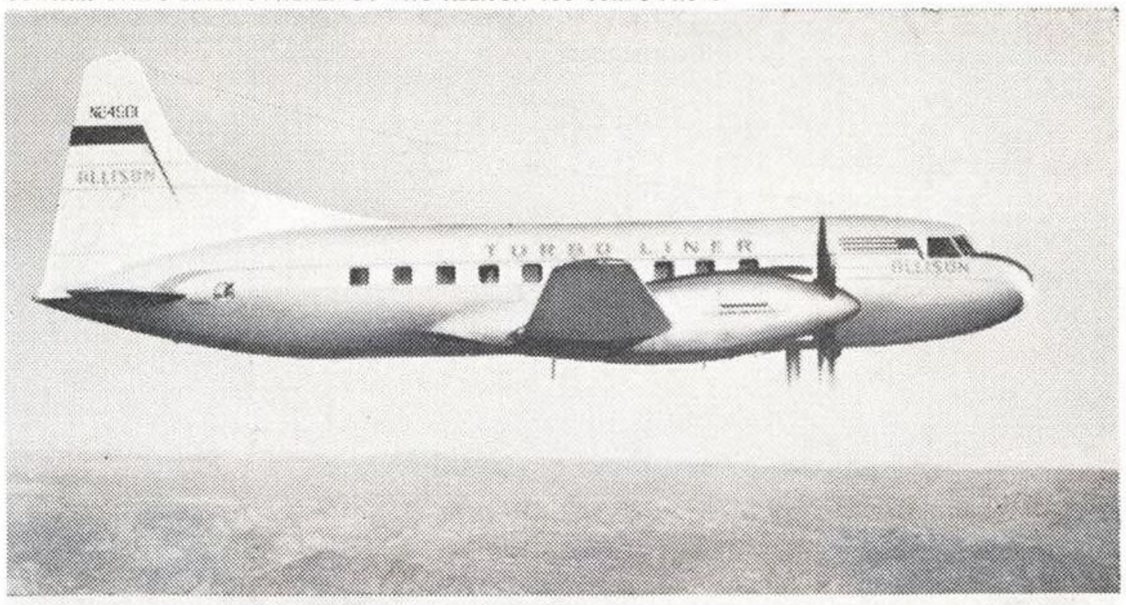
Allison J33 engines also lend assistance to reciprocating engines in the Martin P4M and North American AJ-1.

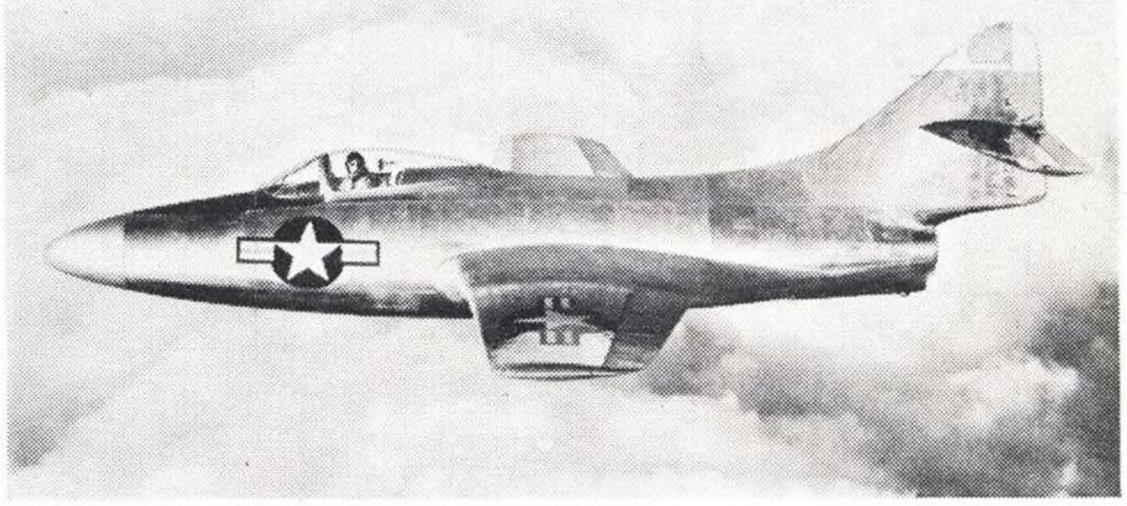
Allison

DIVISION OF GENERAL MOTORS
INDIANAPOLIS, INDIANA

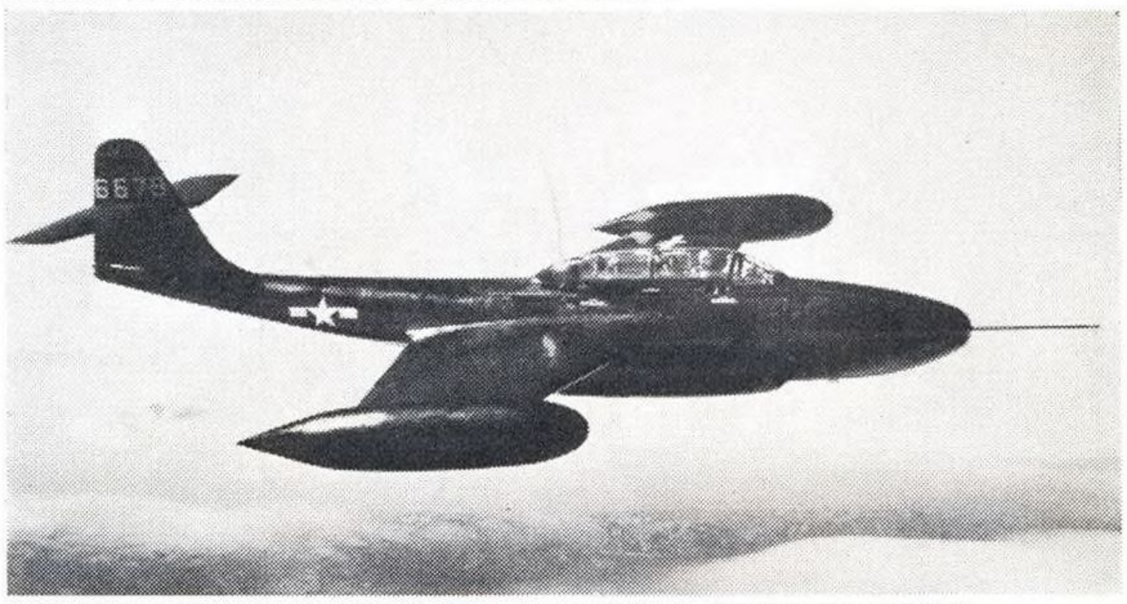
GM
GENERAL MOTORS

CONVAIR TURBO-LINER POWERED BY TWO ALLISON T38 TURBO-PROPS

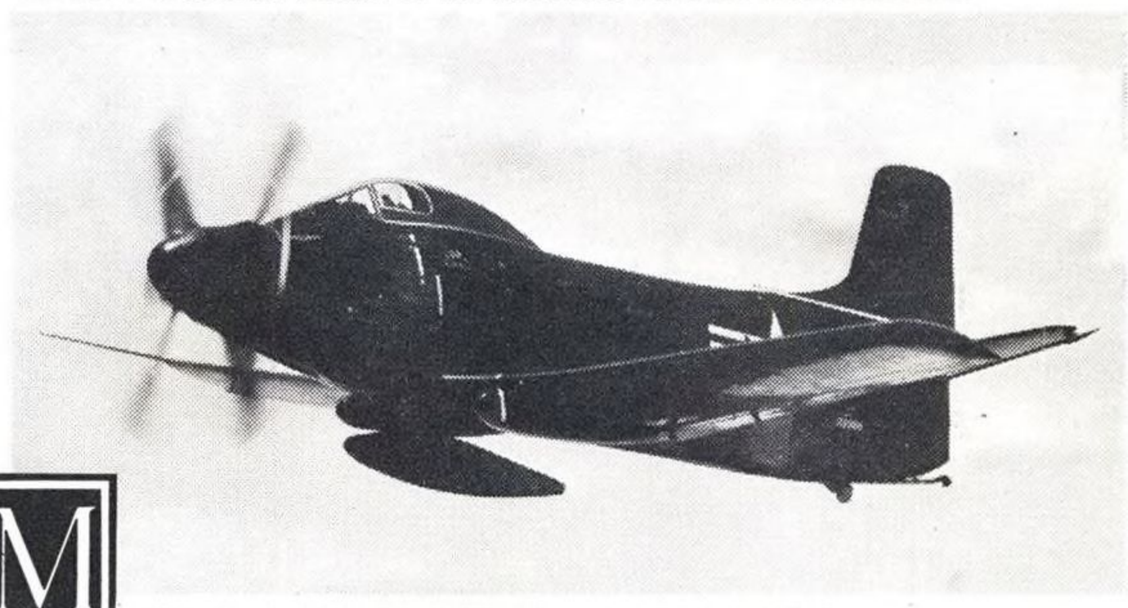




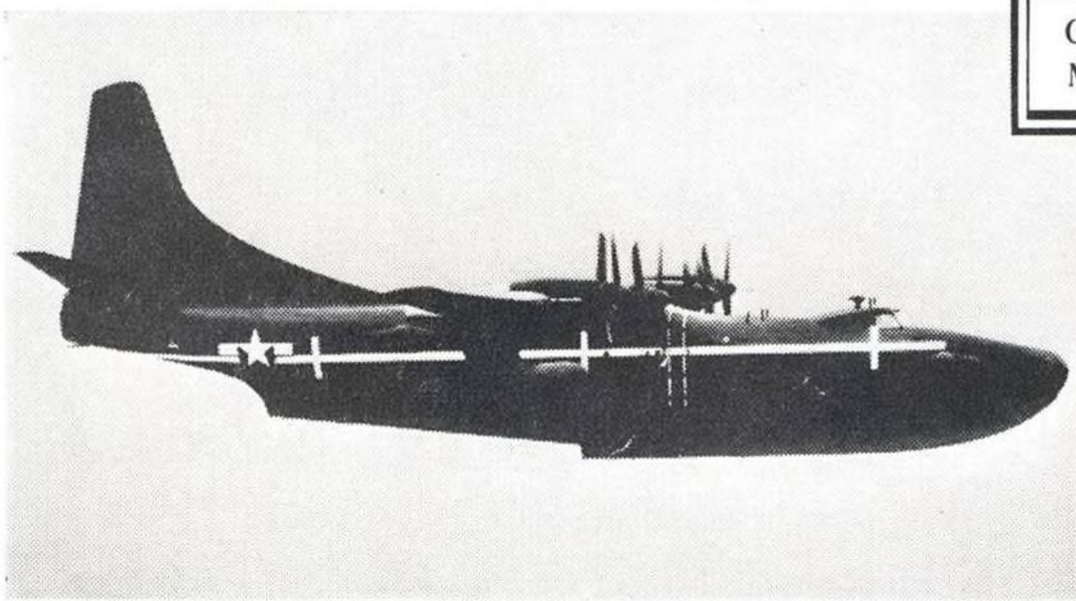
GRUMMAN F9F-3 PANTHER POWERED BY ALLISON J33 TURBO-JET



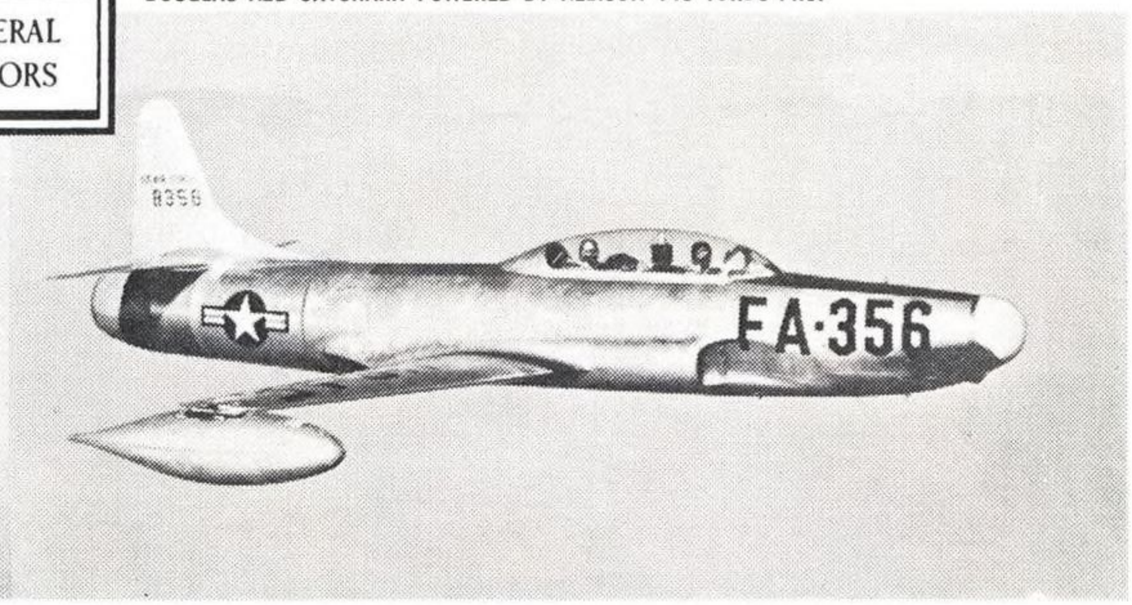
NORTHROP F-89 SCORPION POWERED BY TWO ALLISON J35 TURBO-JETS WITH AFTERBURNERS



DOUGLAS A2D SKYSHARK POWERED BY ALLISON T40 TURBO-PROP



CONSOLIDATED P5Y FLYING BOAT POWERED BY FOUR ALLISON T40 TWIN TURBO-PROPS



LOCKHEED F-94 ALL-WEATHER FIGHTER POWERED BY ALLISON J33 TURBO-JET WITH AFTERBURNER