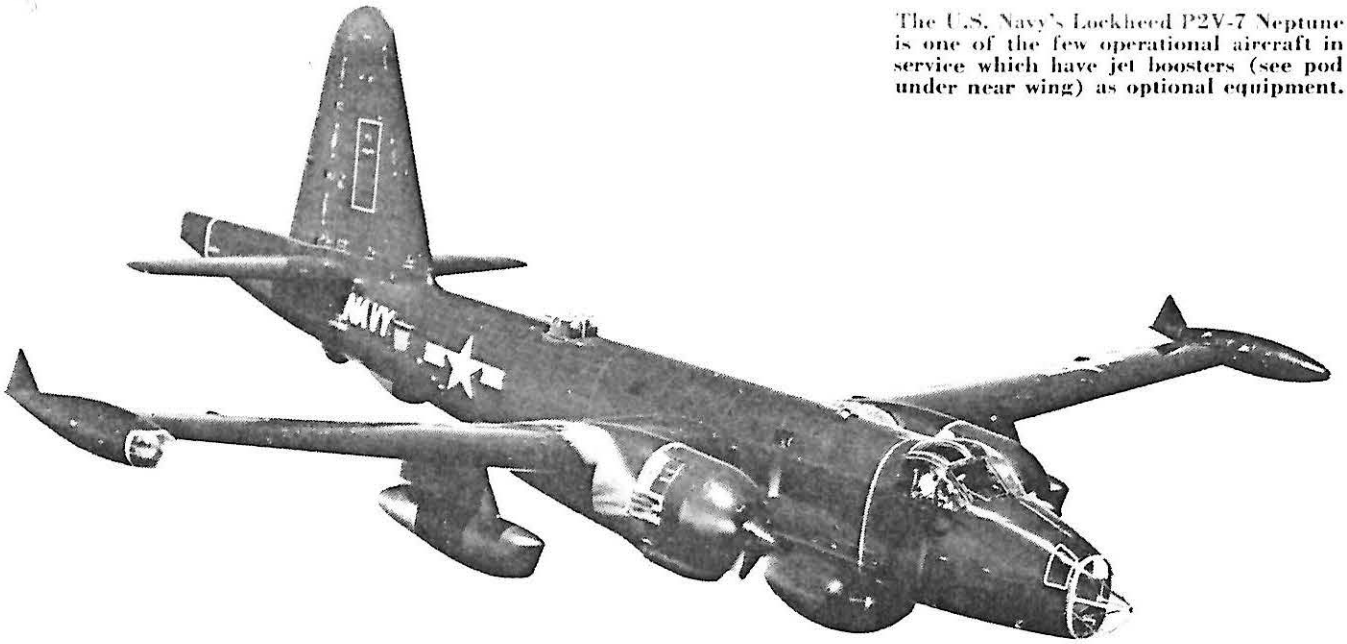


The U.S. Navy's Lockheed P2V-7 Neptune is one of the few operational aircraft in service which have jet boosters (see pod under near wing) as optional equipment.

# Jet Boost

**By GROUP CAPTAIN H. R. FOOTTIT**

"Nothing is ever good enough."
*Admiral DeWitt C. Ramsey, President, Aircraft Industries Association*

THE REICH Chancellery was a gutted ruin. Black smoke streaks stained the white marble where the bombs had taken their toll. This had been Hitler's Berlin headquarters until Allied bombers had driven him out. Now, in mid-January, 1945, he retired with his staff to his underground "bunker", where he was safe from this death from the air. In the meantime, World War II dragged on. Staff officers still came and went from the Fuehrer's den. Orders still flashed to the Nazi Army, Navy and Air Force. But in spite of the Reich Chancellery, a glaring example of strategic air power on his very doorstep, Hitler never demanded a bomber force. In fact, he went to his doom without really understanding the efficacy of this wartime tool.

In 1942, however, Hitler did plant a seed that might have altered the whole course of the war. For, in December of that year the prototype Messerschmitt Me-264, long range bomber, first took to the air. This was a four engined, propeller driven, twin tailed aircraft, resembling an overgrown Liberator. With continued development Goering and his Luftwaffe confidently expected that larger engines would be fitted and equipment and armament pared to the bone. He then hoped that the Me-264 would haul a bomb load to harry New York and other North American targets. To get the heavily loaded bomber off on its inter-continental mission, two BMW 003 turbo-jet engines, of 1,760 lb. static thrust, were to be slung under the wings. And an extra pair of landing gear wheels were to be fitted for take-off and jettisoned when airborne.

**Stillborn:** Fortunately for us in Canada the development of the Me-264 dwindled to nothing as the fortunes of war finally forced the Nazis back on all fronts. But now, some 15 years later, we are seeing one of Germany's ideas taking root—the jet engine booster. Lockheeds are installing two Westinghouse jet engine pods, one under each wing, on the U.S. Navy's "Neptune" patrol airplane. And Fairchild have prototyped jet boosters on their air freighter, the "Packet", and their assault transport, the C-123. Even a civil airliner installation has been made.

Do these jet-assist installations herald a new trend? Will many more of our propeller driven airplanes be fitted with jet boosters? I doubt it. When we dredge the details we find that this scheme is essentially useful for supplying extra thrust to power limited airplanes, for special circumstances. As A. M. Scott, Sales Manager (Aero) for Rolls Royce of Canada Ltd., says, "The use of auxiliary thrust power plants is based mainly on the requirement for improved take-off and initial climb performance, improved performance at combat conditions, and improve safety under one main engine failure conditions. *Its use can only be justified in those conditions where the requirement is of an exceptional nature* and not part of the everyday normal operation of an aircraft."

The place where the jet engine booster shows up to advantage is where a reasonable amount of extra power is required for a reasonably long period. The fuel consumption of the jet is low, under these circumstances, as compared to the rocket motor or jato unit. But there is always a payment for this extra performance. Rolls Royce, for example, have run such engines where the thrust to weight ratio is a phenomenally low 10 to 1. Yet even these small, light weight jets, when added to an airplane,

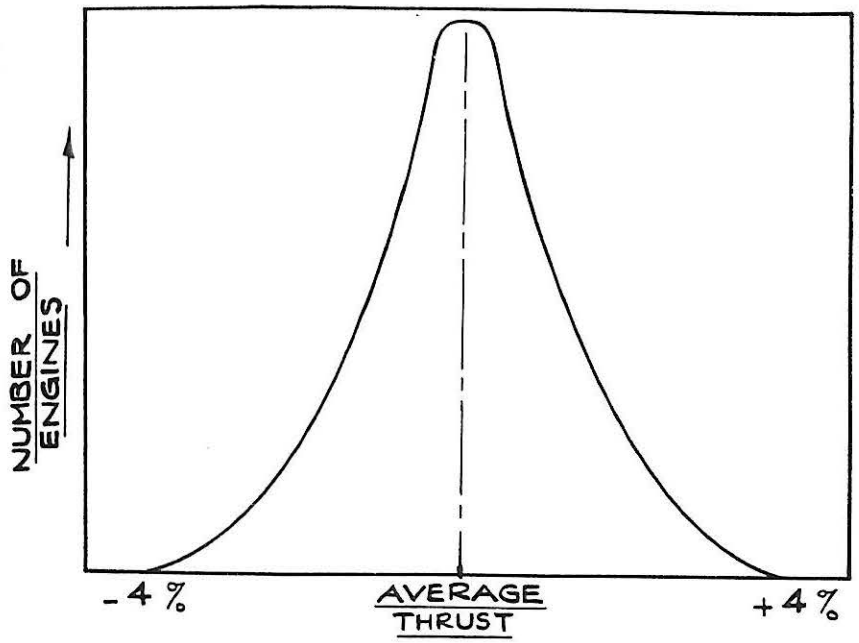



FIGURE 1
PERCENT VARIATION IN THRUST BETWEEN JET ENGINES

tote up extra weight and drag that result in poorer performance when the aircraft is operated with the booster engines shut down. In engineering, there is no such thing as something for nothing.

**Assistance:** The Lockheed P2V "Neptune" is an anti-submarine patrol airplane that is now in RCAF squadron use with Maritime Air Command. Here is a typical case where jet engine boosters have been added to the U.S. Navy version to take care of design deficiencies for specific operations.

In this day when "technical progress is going on with a rapidity that is breathtaking", as Thomas E. Murray of the U.S. Atomic Energy Commission said, the Neptune is a relatively old, though very useful, airplane. The attention of the aeronautical world was first attracted to this new aircraft from the Lockheed line late in 1946. On October 1st of that year one of the first U.S. Navy Neptunes, the "Truculent Turtle", headlined the news. With extra gasoline tanks installed the "Turtle" set a new world's record for a long distance nonstop flight. It took off from Perth, Australia, and spanned the South Pacific ocean and the North American continent until it finally touched down at Columbus, Ohio. All in all the "Turtle" flew nearly 12,000 miles and was in the air for over 55 hours.

During the following decade the Truculent Turtle picked up further publicity from further long distance flights. But over the spread of these years the production line Neptune was slowly being transformed to increase its combat efficiency. Different crew arrangements were tried and tested. New equipment, such as the Magnetic Airborne Detector, MAD gear—which is used to detect disturbances in the earth's magnetic field and so locate submarines below the surface of the sea—was tested and installed in a streamlined tail stinger. Thus new models flowed from the factory floor: the Neptune P2V-5 was replaced in production by the Neptune P2V-6; the P2V-6 by the P2V-7.

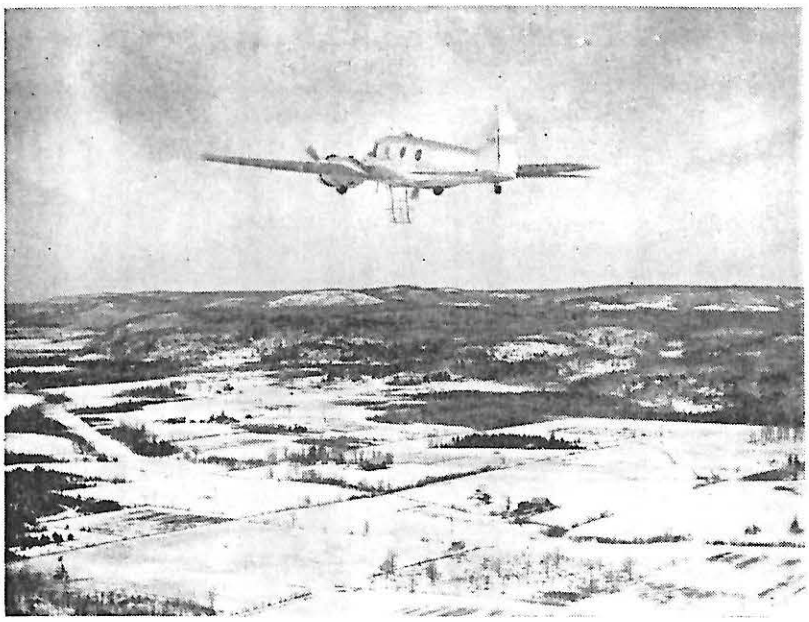
**Adding Up:** All these changes, however, were soon adding up extra weight, so that for certain operations the performance dropped to a new low. More power had to be provided. So the Lockheed company prototyped a pod installation of a Westinghouse J-34 engine, of 3,400 lbs. static thrust, and mounted one under each wing. The new Neptune was the P2V-7. It is still in production at the Lockheed plant.

Recognizing that the podded power plants would only be required for specific operations, and their existence under others may prove a detriment, the Lockheed company designed the installation for reasonably ready-removal. As the company states in its report: "Navy pilots will use this extra power when over the target or when taking off from short fields at high gross weights. The new provisions will enable Navy personnel at advanced bases to bolt on the engines as needed for specific missions. Each engine, weighing 1,600 pounds, is suspended from the Neptune's wing by three bolts. Installation or removal takes eight man-hours."

Just as the military have special operations that require extra thrust for aging airplanes, so have certain civil operators. It was recently reported that Brazil's Varig Airlines have just installed twin Turbomeca "Palas" jet engines, of 350 pounds static thrust each, on some wartime Curtiss C-46 transports that they are using for local operations. Faced with the frightening necessity of flying from short fields Varig had the jet boosters installed for better take-off performance. According to Varig's president, R. M. Berta, their passengers raise no objection to screeching down the runway with jets full open. "They've been educated to know that it improves take-off safety," he says.

**A TCA Opinion:** I asked Jack Dyment, Director of Engineering for Trans-Canada Air Lines, whether they had ever looked into jet boosters for their airliners for a specific operation. But it turns out that TCA are not handicapped by any runway or route that would really require added thrust on their aircraft. Says Dyment, "We naturally prefer that the airplane performance will be adequate to meet all operating conditions without undue loss of payload on the routes desired. If we did wish to operate a particular airplane over a route on which the conditions were marginal, we would have to analyze the advantages and disadvantages involved for either taking off at reduced gross weight, or using an auxiliary source for boosting take-off power. However, an appreciable loss in payload would have to be involved, plus the fact that we felt we absolutely had to operate into that place, before we would go for any auxiliary power plants."

Dyment's reasons for not being particularly enthusiastic about having to add jet boosters to a deficient airplane



# Aerophysics of Canada

Formation of a new company — Aerophysics of Canada Ltd. — to work with an advanced airborne mineral exploration tool, has been announced by three veteran companies engaged in air surveys and geophysics. The three participating firms are Spartan Air Services Ltd. and Canadian Aero Service Ltd., of Ottawa, and McPhar Geophysics Ltd. of Toronto.

Aerophysics of Canada will undertake contract exploration for base metals with a new high sensitivity airborne electromagnetic detector which was specially developed by McPhar under patents held by Dr. Stanley Davidson.

The airborne electromagnetic device is flown over the area under survey at 100 mph, compared with two or three miles per day surveyed by ground crews. Thus, an airborne survey is able to cover large tracts of land and indicate limited areas where ground work should be concentrated.

The function of the airborne EM survey is to localize rapidly the search for heavy sulphide bodies (principally copper and lead) in areas where such deposits are considered most likely to occur.

The electromagnetic system uses a coil of wire to transmit an alternating field. When a conductive body, such as massive sulphides of lead or copper, comes within range, it produces a secondary field. This secondary field is picked up by a receiving coil and the resultant signal is amplified and seen as an anomaly on the EM record.

In the Aerophysics airborne system, the transmitter is carried in an Anson (two of which have been fitted out; a third is also to be equipped). The receiving unit is towed in a bomb (upper photo) at the end of a 500 ft. cable. The aircraft flies approximately 500 ft. above the ground and the bomb trails about halfway between airplane and ground. Complete records are taken of the output of the EM equipment, the aircraft altitude, and simultaneously aerial photographs are taken of the ground below. The smaller picture shows an Aerophysics technician keeping check on the instruments and equipment which perform these tasks.

According to Aerophysics officials, their EM system has shown high sensitivity to sulphide ore and good discrimination against overburden. Under favorable conditions ore bodies can be detected to depths of 300 ft.

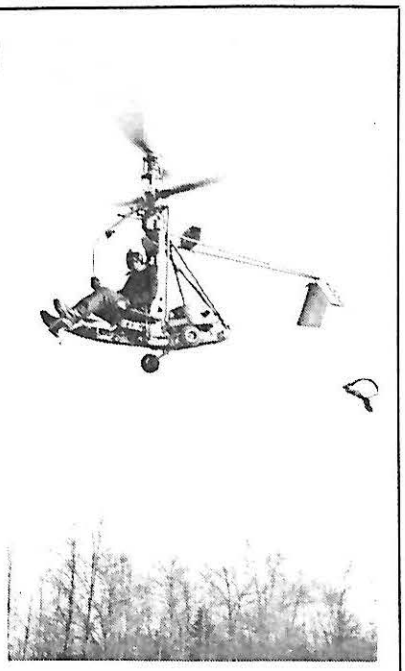
for a definite route are interesting. "Since the auxiliary engines would be different to the other four engines on the aircraft," he says, "we would have to train a whole batch of personnel so they are familiar with them. Moreover, they would require additional shop equipment for maintenance and overhaul. Engineering in turn would undoubtedly encounter a new crop of troubles associated with it. And all this, of course, costs the air line much more money than would appear on the surface."

There are other engineering aspects to the installation of jet boosters. The Fairchild Engine & Airplane Corporation made a trial installation of a Fairchild J-44 turbojet engine atop the fuselage of a C-82 "Packet". But it is more usual for structural, aerodynamic and jet exhaust clearance reasons, to mount the jet boosters on the wings. They may be stowed in pods below the wings, similar to the Neptune, or on the wing tips, similar to the J-44 jets prototyped on the C-123, the USAF's assault transport. The large offset thrust of these wing mountings may present problems. These problems certainly can be conquered, but the cost is additional complexity.

**Asymmetric:** Obviously the eccentric thrust of each engine is no problem when both power plants deliver the same power at the same time. It's when they don't that the trouble starts. Moreover, the offcentre thrust problems of wing engines grow more acute as the power in the booster pod increases, and the distance from the fuselage grows greater. What we could cope with using 1,000 pound thrust J-44's mounted close in on a large aircraft, may become impossible with 3,400 pound thrust J-34's mounted on the wing tips of a small aircraft.

In addition, jet engines often exhibit relatively wide thrust variations when new, even though they are pushed from the same production line. A typical curve showing the percentage variation of maximum thrust, from test bed trials on new engines, is shown in Figure 1. Part of the reason for this spread is the dimensional tolerance that is necessary to ensure the interchangeability of the detail parts. Consequently, even with new engines mounted on the wing tips, they may have a tendency to turn the aircraft on take-off owing to this built-

(Continued on page 80)



ONE MAN BAND: USN's XRON-1 Rotorcycle is shown in hovering flight during initial trials. Made by Gyrodyne Co. of America Inc., St. James, L.I., N.Y., miniature helicopter weighs less than 500 lbs. Developed under USN auspices, the Rotorcycles are intended for "escapes, evasion, and small unit tactical maneuvers."

through the addition of perhaps 800 pounds of soundproofing and additional structure. Equipment of phase synchronizing will add approximately 35 pounds to the airplane."

## Search Underway

The latest development in determining the exact location of the new Edmonton airport has been the awarding of a contract for an aerial photographic survey. A general site of about four miles square had been selected for the airport in the vicinity of the town of Leduc, ten miles south of the Edmonton city limits on Highway No. 2, and the aerial photography as well as ground surveys are scheduled to get underway as soon as weather conditions permit.

The present plans call for the construction of at least two 10,000 ft. runways and provision to be made for additional facilities as needed.

## Pioneer Dies

Pioneer aviation and automotive inventor, William Bushnell Stout died of a heart attack in his home at Phoenix, Ariz., on March 21. Bill Stout was the designer of the famed Ford tri-motor airplane, the first all-metal aircraft for the U.S. Navy, the first U.S. commercial monoplane. He also operated the first exclusively passenger air service in 1926.

## Plugging the Gap

In an attempt to prevent Canadian licensing of aircraft obtained by a Canadian operator for a temporary period of pre-determined duration, the Transport Department has made this stipulation: "Effective immediately, the procedure on application for the registration as a commercial aircraft of any aircraft having a maximum allowble gross weight in excess of 12,500 pounds will be altered so as to require the full disclosure of all agreements between the vendor and the purchaser and of all encumbrances in any case where the aircraft has been purchased from a person not qualified to be the owner of a Canadian aircraft."

## R-R's Last Piston

Rolls-Royce's Derby works has built and delivered its last piston aero engine, a Griffon for a Shackleton of the South African Air Force. Since December, 1915, the company has turned out 51,169 piston engines.

### JET BOOST

*(Continued from page 30)*

in variation in maximum thrust.

This condition, of course, can be catered for by selecting engines, before installation, that deliver approximately the same thrust. But this is usually undesirable from the logistics and maintenance viewpoints. A better solution, is the "black box" approach of synchronized throttle motors. These may be required in any case so that the boosters are opened up in unison on take-off.

**Stop and Go:** Just how the boosters are controlled depends on the design definition and the aircraft arrangement. For example, a take-off booster may be designed with set controls that only allow full throttle operation of the jet engines. With these engines far out on the wing, there may be detectors in the tail pipes so that if one engine fails, both boosters are automatically shut down. With this type of control there are engine overhaul aspects, too. We get used to thinking of jet engines with an overhaul life of, say, 300 hours. But this is based on running the engine at various throttle settings throughout its lifetime. If the jet booster is rigged as a jet assist for maximum thrust only, then it may run a mere tenth of this time, or in this case 30 hours, before it must be pulled out and shipped back to the overhaul shops.

From all these factors, then, the decision to install jet boosters on a flagging airplane, to pick up its performance for a particular operation, is not a quick and easy one. Unfortunately, we in the aircraft business are often faced with such decisions, since development moves at such a pace we must always strive to improve what we have, or be faced with the expensive job of replacement due to obsolescence. As Admiral Ramsey told the National Security Commission of the American Legion a few months ago, "We cannot freeze anything and build it in large quantities. Nothing is standard. Nothing is ever good enough. Even before a plane, or an engine, or component is placed in production, its builders have begun their ceaseless efforts to improve it . . ."

But when we are faced with improving aging aircraft designs by adding jet boosters, I can only underline the cautioning words of A. M. Scott of Rolls Royce of Canada, when he says, "In general I feel that there will certainly be applications for booster engines *in exceptional circumstances,* but they will not be in wide use either in the commercial or military field."

### HYPERSTEREO

*(Continued from page 55)*

tors, etc., and may be used to instruct woods foremen and field operators.

Industry has sometimes made use of models, when measurements are known and high cost is not prohibitive, as there is no method of reproduction as realistic as in the third dimension. With aerial hyperstereos in color the practical equivalent of an exact model in full natural color can be secured quickly, efficiently, and at comparatively low cost. Viewing the "color models" is simple for one or many persons. They can be used to advantage at management's desk or in the field, and a file of slides can be built which will contain immediately available information on many phases of an industry or operation which can be secured by no other method hitherto available.