PILOT SCANS PROBLEMS FLYING JET AIRLINERS

Note—This article was written by a TCA Captain who also is a member of No. 401 RCAF Reserve Squadron. In the latter capacity, the author has acquired considerable jet-flying experience. He wrote this comparison for the July issue of "The Airline Pilot"—The Editor.

By CAPT. L. MURRAY WALLACE

IN THE near future we all hope to see the appearance of gas-turbine-powered transports on airlines throughout the world. A great deal has been written about these new aircraft from the design and engineering point of view. However, very little has been said about the problems that may be met by the pilot in operating these aircraft.

The first thing in which we, as pilots, will be interested will be the actual differences in handling an aircraft on instruments at speeds more than twice as fast as the present equipment. The small amount of experience we have gained while doing instrument exercises in the RCAF Reserve has raised a few points that may well apply to the new jet transports. While the Vampire is a fighter aircraft, its performance compares pretty well with that of the two jet transport aircraft now flying so it should make an interesting comparison.

The first thing that impresses you while flying instruments at high speeds (over 400 mph) is the terrific lag in the instruments themselves and the small change in attitude necessary to cause a large gain or loss in altitude. A rate of climb or descent of 1,000 fpm can occur with no apparent change in attitude on the artificial horizon.

The lag in both the air speed and vertical speed indicators is so great as to make them almost useless except as a cross-reference during well-established climbs or descents. The altimeter seems to be the most reliable indicator of changes of attitude in the pitching plane.

As we all know, the angle of bank necessary to maintain a given rate of turn varies with the true air speed. For a rate one turn we need about 12.5 degrees of bank for every 100 mph of air speed. Consequently, at 400 mph we find ourselves with 50 degrees of bank to maintain the turn at this rate! This is a rather uncomfortable manoeuvre for the average passenger.

The critical Mach number of the new transports, at which the first effects of compressibility will be felt, is more than likely around .75 (or 75% of the speed of sound at a particular altitude and temperature). This means that we will have to exercise care during descents at high altitudes as it is very easy to exceed this speed and the resultant buffeting, snaking, control snatching, etc., doesn't help your flying precision, or the passengers' dispositions.

The present technique is to descend with dive brakes extended to increase the drag and thus allow a high rate of descent while keeping the air speed at a reasonable figure. The throttle can be very nearly closed as there are no cooling or loading-up problems with the jet engine. The descent is made at a constant indicated air speed, which gives a "flared out" flight path as the true air speed decreases with the decrease in altitude. Efficient pressurization is a necessity for a descent at this rate in a transport aircraft.

Once initial approach altitude is reached the speed is reduced to about the same figures as we are used to in present aircraft, so the only real problem here is the enormous fuel consumption at low altitudes. This is accentuated by the large amount of power needed to fly the aircraft with dive brakes, gear, and partial flap extended to maintain the low air speed.

Although it may seem that all this is going to make our already involved letdown procedures even worse, it will be offset by the fact that the aircraft will be much simpler to handle. The gas turbine engine requires only one power control and we'll get away from all the complications of operating a modern reciprocating power plant, with its propeller and mixture controls and all the other gadgets such as cowl flaps, blower controls, feathering buttons, ignition switches and dozens of other gadgets and instruments that clutter up the cockpit of the modern airliner.

The second thing that may interest us is the effect of atmospheric conditions at high altitudes and speeds. In general, except during climbs and descents, most flying even on the shorter routes will be done "on top." However, we will still have to get up there and down again.

A few years ago the Empire Flying School in England conducted some experiments in all-weather flying at high speeds and came up with some rather interesting facts.

The first condition they investigated was turbulence. They found that even in clouds with very little instability at speeds between 400 and 500 mph some very severe bumps were encountered. In clouds with any amount of vertical development at all, very severe loads were imposed on the aircraft. This is apt to become a serious problem in the everyday operation of high-speed transports.

At one time it was thought that at very high speeds the heat rise due to skin friction would prevent any ice formation. This theory has been pretty well disproved. It has been found that the rate of ice formation actually increases very rapidly with an increase in speed. Formation of clear ice at the rate of one inch per minute has been reported under what would normally be moderate conditions! Thermal de-icing, with all the aerials fully concealed beneath the skin, seems to be the answer to this problem.

Another minor consequence of weather is the damaging effect of heavy rain on the finished aircraft. This could be an expensive nuisance on any aircraft, which, like the Vampire, uses a thick coat of filler and a glossy finish to give a smooth surface on the wings.

Engine icing has proved to be no problem at all with the centrifugal-type of compressor. However, this may be a different problem in the axial-flow type engine. At the moment, considerable research is being conducted into this difficulty and no doubt the answer will be found.

From the navigational point of view a lot of differences are noticeable at the higher speeds and altitudes. At over 400 mph it seems very difficult to stay on a normal range leg. Also, at around 30,000 ft. the indications of fan markers, "Z" markers and the ADF are so broad as to be almost useless as accurate check

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points at high speed. It has also been found that our conventional maps and charts are too large and contain too much detail to be very useful. In this connection the United States Air Force has produced a series of Jet Navigation Charts to a scale of 60 nautical miles to the inch. Six of these charts cover the entire continental United States, compared to 43 of the World Aeronautical Services charts, which are the smallest scale now in general use. The instrument approach charts also have been simplified and cut down in size. I think we all agree that this is a step in the right direction.

As far as approach aids are concerned, the only method I have had any experience with has been GCA. It has been found that if any necessary holding is done at a high enough altitude to ensure a reasonable fuel consumption and a straight-in approach all the way down from the holding point made under GCA control, a very high ratio of successful landings can be achieved. There is no reason why the same should not apply to ILS, especially if Zero Reader equipment is fitted to the aircraft.

To sum it all up, when the day finally comes when those of us who have not been laid off because of the increased operating efficiency of the darned things are finally checked out in the jet transport, we won't have to change our ideas too radically to accommodate ourselves to the new equipment.

The new aircraft will climb, cruise and descend at much higher speeds than we are now accustomed to, and at high speeds may be a little more touchy on instruments. Areas of turbulence will have to be avoided unless we are able to slow the aircraft down very rapidly. We'll be able to ignore most forms of icing. The cockpit will be a much simpler place than it is today and engine handling will be no problem at all.

During descents and approaches we'll all develop clocks and flowmeters in our heads, and we'll certainly require much more accurate terminal forecasts than we have at present. This will partially be offset by the fact that it won't take us very long to get to where we're going. We'll literally be able, on some routes, to look at a sequence and be there before the next one is issued.