FLIGHT International, 4 January 1973

Canards for Tu-144

THE Tu-144 has sprouted retractable canard surfaces, which appear to be of the classic "moustache" type which first flew on a Dassault Mirage Milan in May 1969. Tupolev has also changed the brakes of the latest SST to incor-porate inboard disc units. Together with other changes already reported in Flight—movement outboard of the powerplants, incorporation of camber on the wing, exten-sion of the fuselage to take 140 passengers, a new undercarriage and removal of forward-vision panels in the visor—these new features mark a major re-design of the aircraft.

Incorporation of the canards and the new brakes pre-sumably reflects a higher gross weight and a need to maintain a reasonable airfield performance. Flight was told by project pilot Eduard Elyan earlier this year that even the prototype Tu-144 weighs 180 tonnes, 396,0001b (more than the production Concorde). The latter requires very advanced brakes and the Soviet Union's technology in this sphere has not been noted for its advanced nature, although this may be mitigated somewhat by six axles and possibly 12 brakes (but more likely six) per main bogie, as opposed to four brakes on each Concorde bogie. The prototype Tu-144 has no thrust reversers and relies heavily on twin braking parachutes. It is not clear whether later aircraft have thrust reversers.
The moustache canards should reduce take-off and land-ing speeds (brake energy varies as a square function of speed) and may improve manoeuvrability at low speed. On the debit side the canards are an additional complica-tion and must be quite heavy.
A delta planform requires a high angle of attack to generate sufficient lift at low speed. To enable this high incidence to be achieved, if the aircraft is fitted only with trailing-edge elevons, considerable up trim must be carried. This detracts from the overall lift and is thus self-defeating to an extent. The small canard surface can pro-vide the required trim change with a "correct" lifting force. It need only be small (the Milan unit represents 1-7 per cent of wing area) because it is mounted well ahead of the centre of gravity. The lift it provides is quite small relative to that of the wing, but it should enable down elevon to be carried at low speed, thus allowing the wing to generate a higher coefficient of lift at a given angle of attack. Alternatively it should offer a lower attitude and hence drag for a given amount of lift. The effect of a

positive-lift rotation could be particularly beneficial to take-off performance.
The very highly cambered moustaches of the Tu-144 appear to have extensible double-slotted trailing-edge flaps (movable to allow canard retraction) and a fixed leading-edge slat. They probably generate a coefficient of lift as high as three. Dassault devised a profile for the Mirage Milan which allows controlled flow separation such that the device operates at an essentially constant lift coefficient with changing angle of attack. If Tupolev has been suc-cessful in achieving the same objectives the reduction in longitudinal static stability of the Tu-144 should not be too great. An alternative method of alleviating this problem would be to use a variable-incidence canard, with atten-dant penalties of weight and complication. Lateral stability at high incidence might be adversely affected by the canards although the strakes on the Concorde nose, which are of a completely different shape, induce vortices which tend to be stabilising during sideslip. The upper-fuselage mounting of the canards on the Tu-144 may be beneficial in keeping their dirty flow out of the wing vortex systems. Possible low-speed performance gains available from moustache canards are illustrated by Mirage Milan figures, but whether similar gains would be applicable to the Tu-144 is uncertain. While a reduction in landing speed is theoretically possible, the aircraft could be limited by its zero-rate-of-climb speed. The Mirage Milan achieves a take-off run reduction of 2,000ft (35 per cent) and a take-off, speed some 25kt less than that of the Mirage 3 (12 per cent less). The landing run is reduced by 460ft (20 per cent) and the speed by 30kt (16 per cent). Prototype Tu-144 take-off roll at gross weight is just over 7,500ft under- normal conditions. Rotation speed is typically 182kt, 340km/hr. Approach speed at about 115 tonnes, 253,0001b is in the 152kt-157kt, 280km/hr-290km/hr range, decaying to 135kt, 250km/hr at the threshold. The limiting indicated speed of the Milan moustache is 325kt, with a Mach limit of 0-8. It is retracted forwards by an electric motor driving a worm gear. When deployed it has forward sweep ''and; dihedral. One would expect the devices on the Tu-144 to 4ePl°y

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that they have minimal
sweep-back, although the only photographs so far re-

Top, the highly cambered retractable canard surfaces are fitted behind
the cockpit of the Tu-144. Left, inboard disc brakes are fitted to the latest six-axle main-wheel bogies of the Soviet SST. It seems likely that
the units retract forward into the nacelles ahead of the engines