CAPTAIN W. P. MORAN, Director of Flight Training, American Airlines

TOTAL SIMULATION—A Near Future

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Optimized flight crew training

In 1967, American Airlines purchased the more modern digital computer simulators with visual and motion systems and redesigned all training techniques. By early 1968, the Company was convinced of the increased training capability of the new devices and of improved training methods.

The Company's concern with safety, economy, environmental conditions and air space utilized led to a need for increased simulator use. However, flight crew training in commercial aviation had followed a traditional pattern for many years. A 'strong case' had to be presented to justify training and checking in a simulator, particularly for exercises that were traditionally practised and checked in the aircraft.

To develop justification, American Airlines obtained an FAA 'Grant of Exemption'. A study was conducted that involved training 40 captains transitioning to the B727 aircraft. The simulator instruction program was increased to assure full competency, at type level proficiency, for *all* maneuvers. A Type Rating Check in the simulator was included.

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B747 training program

The February 1970 rule changes were opportunely announced, as they coincided with the training of initial B747 crew members. A majority of air carriers introducing the B747 relied extensively on simulation through use of their own equipment or through contract training.

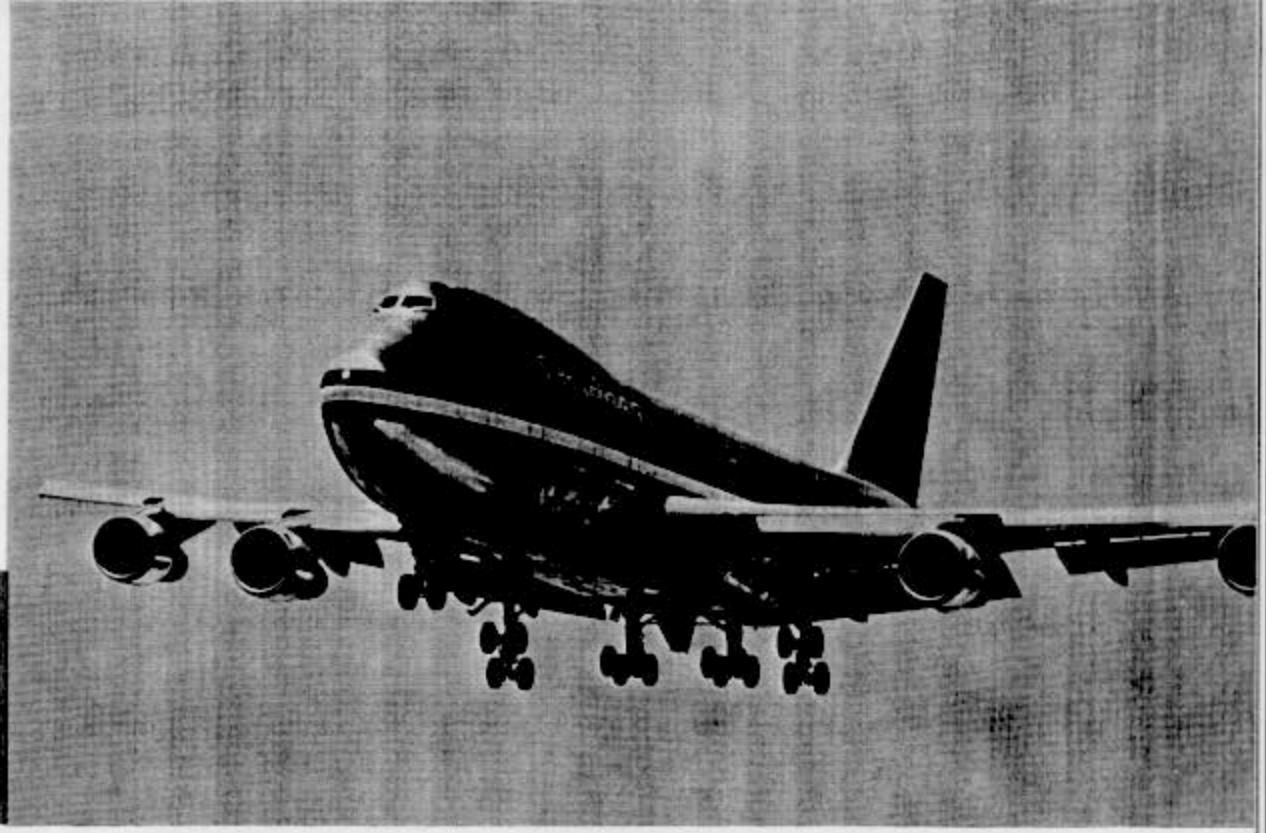
American Airlines is convinced that the greatest contribution to the unmatched jet safety record of the B747 was achieved through the use of simulators. This conviction is based on the improved training made possible by: the high fidelity of today's advanced simulators and visual systems; the ideal training atmosphere of the simulator, unhampered by traffic congestion; the ability to 'freeze' the problem to permit discussion; the elimination of unproductive flying by using position resets; and experiencing 'real world' emergencies that, in large part, must be simulated in the aircraft itself.

Training is also improved by the predictable availability of the simulator. This assures continuity of training to proficiency unfettered by monotonous pleas by Dispatch for return of the aircraft for scheduling purposes.

Improved fidelity

The major criticism blocking the use of simulators for *all* training is the feeling that realism is not sufficient for maneuvers involving 'sight' and 'feel'. Regulations still exist requiring that training in visual flight maneuvers at low altitudes be conducted in the aircraft. However, the modern simulators and the new rigid model visuals used by American Airlines have considerably improved realism.

This new system produces much clearer projections and provides the ability to recognize objects at greater ranges. Advanced projector systems that produce improved focus and multi-color definition help to create the necessary realism. Additionally, several improvements in modeling detail have been made. They are: the addition of random countryside lighting which broadens the scope of perceptibility during day and night operation; the installation of variable 5-step runway and approach lights; the addition of VASI,



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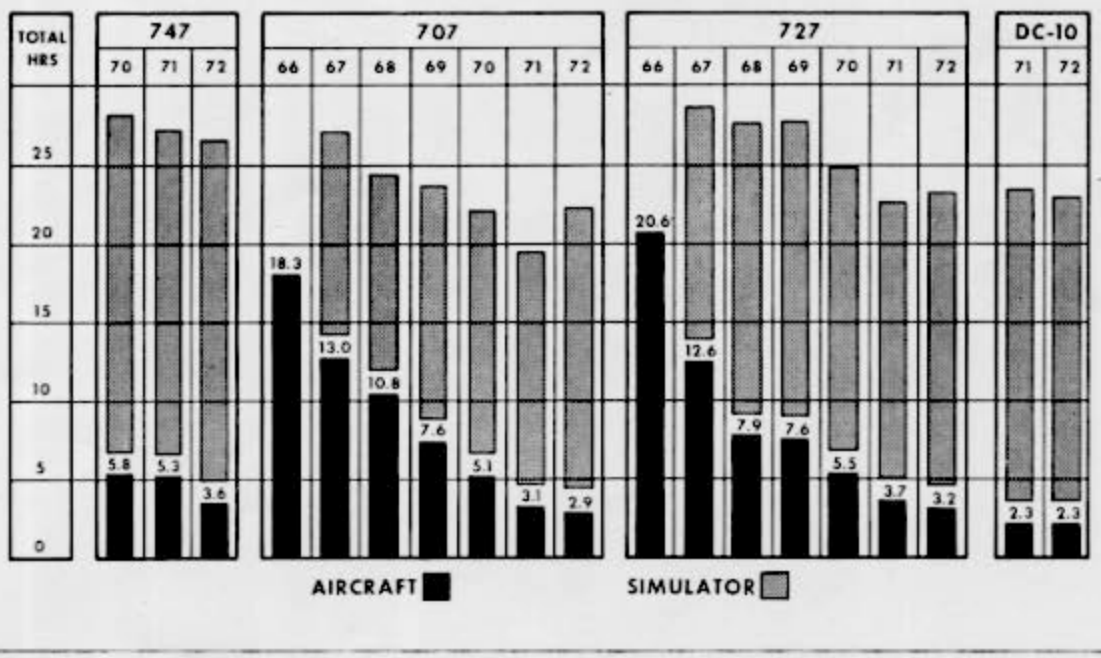
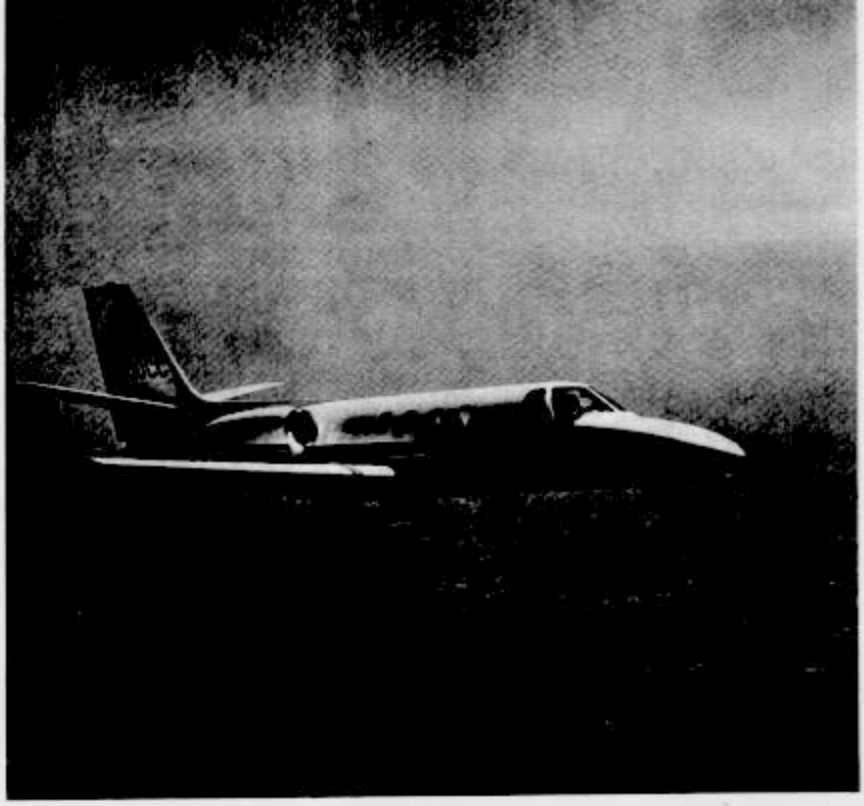
Evidence of learning transfer

Since the FAA rules were changed in February 1970, thousands of airline pilots have been trained and rated in visual simulators for all but seven of the required procedures/maneuvers. During this time period, American Airlines consistently confirmed that pilots were proficient as they commenced their aircraft training. This fact is corroborated by the minimal

FIGURE 1

FLYING TRAINING DIVISION AVERAGE HOURS PER STUDENT CAPTAIN-TRANSITION TRAINING





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With regard to those maneuvers that many believe require aircraft training, American Airlines has conducted two studies in recent months and also initiated investigation of one training maneuver that provides additional evidence of total transfer of training from modern visual simulators to the airplane.

The first study was one in which American jointly participated with seven other Air Transport Association members in conducting the 'Take-off Engine Failure After V_1 and Prior to V_2' maneuver. From September '71 to January '72, all American pilots involved in transition or upgrade programs in the B727, B707, B747 and the DC-10 were trained to proficiency on the maneuver in a visual simulator. The first time they were required to demonstrate their proficiency to execute the maneuver in an airplane was during their rating/check ride.

A total of 175 pilots participated, and all but three pilots were completely successful on the first attempt. The other three were equally successful after only one training exercise in the airplane. Results produced by the seven other participating ATA members were closely comparable. In consequence, a request for rule change has been forwarded to the Federal Aviation Administration requesting permission to train and rate/check for that maneuver in an approved simulator.

During 1970, American Airlines conducted a Co-pilot Upgrade Study under an exemption obtained from the FAA. Twenty pilots who had at least six months experience as first officers on the B707 airplane were upgraded to the B707 captain position without the benefit of airplane training. Each candidate was trained to proficiency on all required maneuvers and exercises in a visual simulator, and once proficient, was given a complete rating ride in the simulator.

With the rating ride accomplished, the pilots were then required to confirm the transfer of training by completing four representative maneuvers in the airplane while observed by an FAA inspector. The clear evidence of transfer was reason for our requesting a rule change in the near future to train and rate in a visual simulator for all crewmen upgrading to the captain position.

An investigation of the two-engine out approach and landing in the DC-10 airplane was initiated because American Airlines' flight instructors and management personnel had become concerned about the negative training being conducted and the increased safety hazard. The appreciable thrust produced by simulated engines out, because they can only be slowed to 'flight idle', provides an unrealistic amount of power during the maneuver. That fact, associated with concern for the possible loss or reduction in power of the 'good' engine during the maneuver, were cause to request the inquiry.

After the FAA conducted the maneuver in both the simulator and the aircraft they were convinced of the fidelity of the simulator. They also recognized the negative training aspect plus the high hazard realized in the aircraft. As a result, a rule change was made to permit training and checking on the maneuver in an approved simulator.

Corporate jet simulator training

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The program has been predicated on the same concepts used for training American's crew members. The simulator program is phased to introduce fundamentals under normal conditions before introducing the student to more complex emergency maneuvers and exercises. Additionally, each pilot is trained to a defined level of proficiency before proceeding to the next phase.

Of the 198 pilots, 168 have received a captain's jet type rating and 30 have been trained as co-pilots. The average airplane and rating/checking time has been three hours and two minutes. A fact that makes this time more dramatic is that less than one-third of the pilots involved had any previous jet flying experience.

Effective simulator use

The comments thus far seem to imply that the greatest contribution to the transfer of training is due to the precise realism provided by modern motion simulators with visual systems. This is only partially true. The *manner* in which the simulator is used is equally, if not more, important to the realization of its greatest benefits.

The selection and training of instructors who will conduct the simulator program is a prime consideration. Each instructor should be a technical expert as a pilot, with the confidence that demands the attention and respect of the student. Additionally, each should have knowledge of learning habits, understand patterns of student behavior, and possess ability to provide needed guidance and counsel. Through training, all instructors should be able to use the many capabilities of modern simulators and *be convinced* of the completeness of training that can be accomplished through their effective use.

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Conclusion

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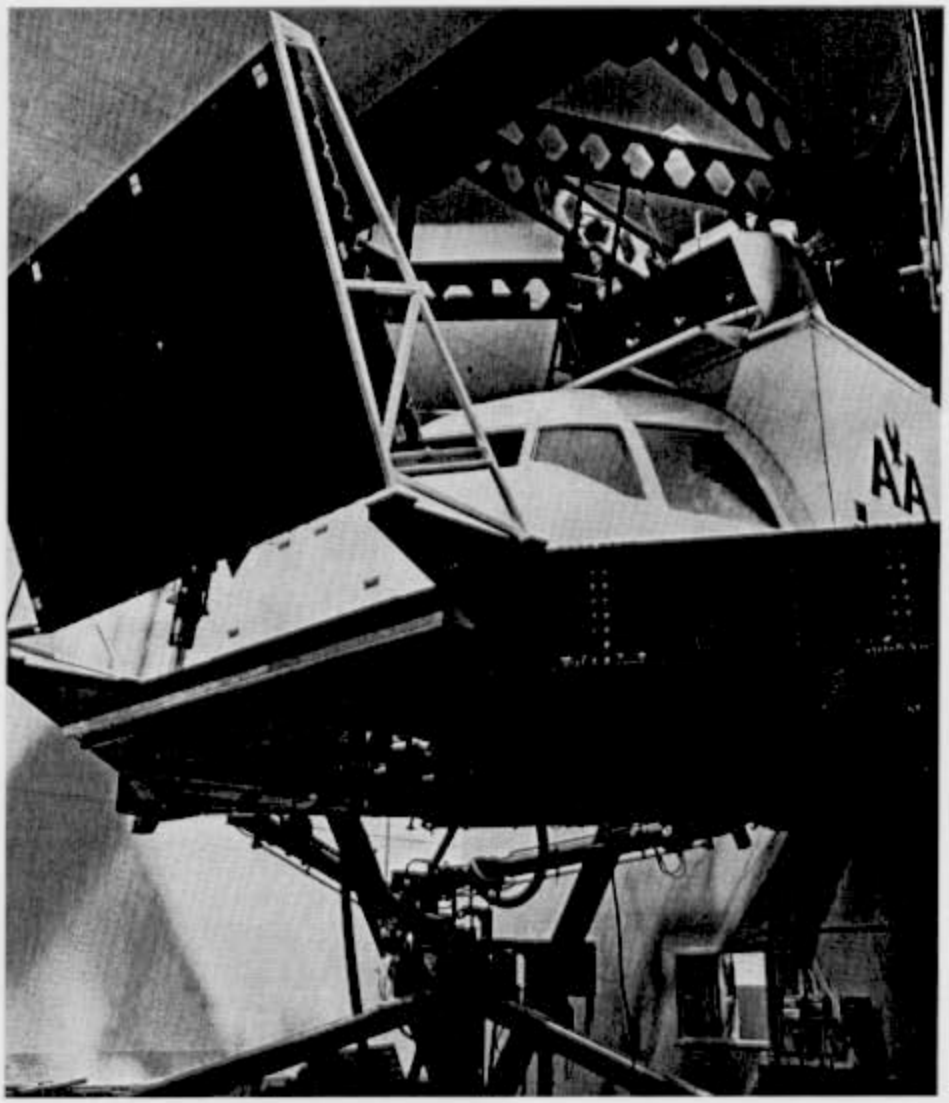

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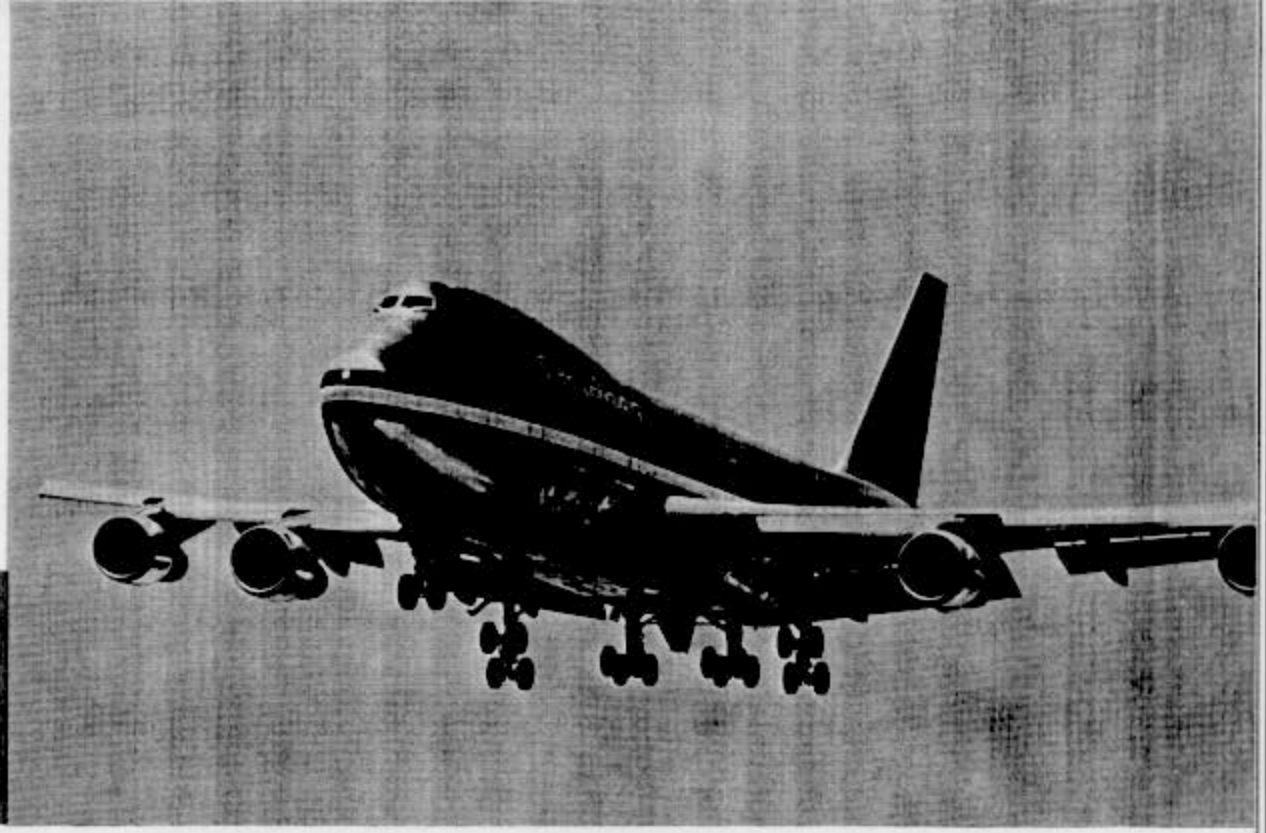

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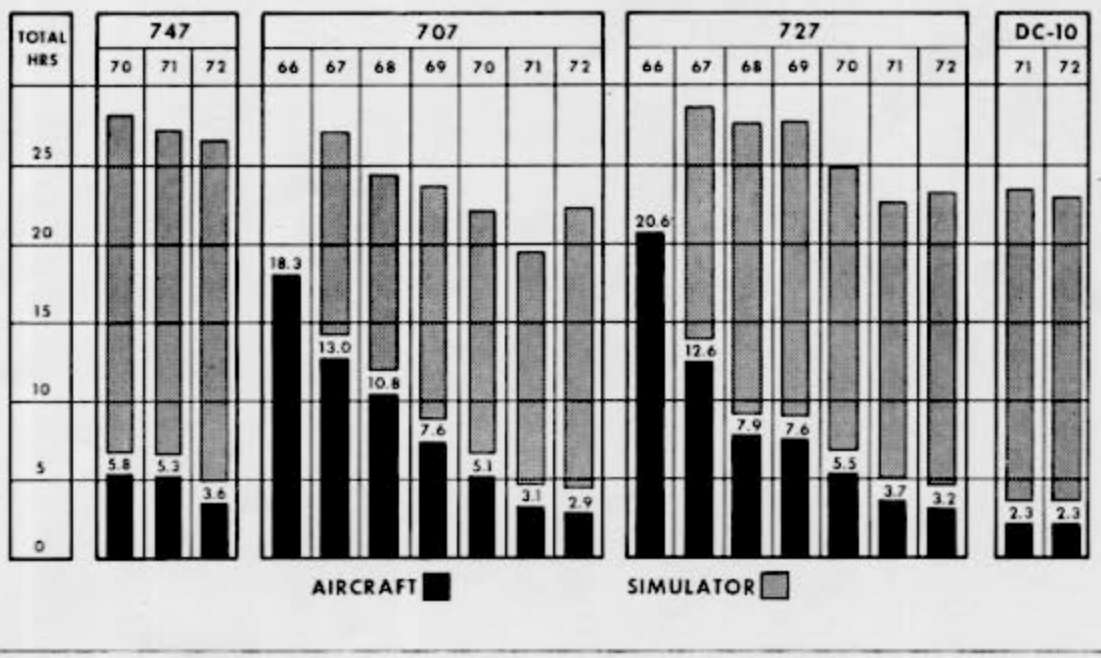

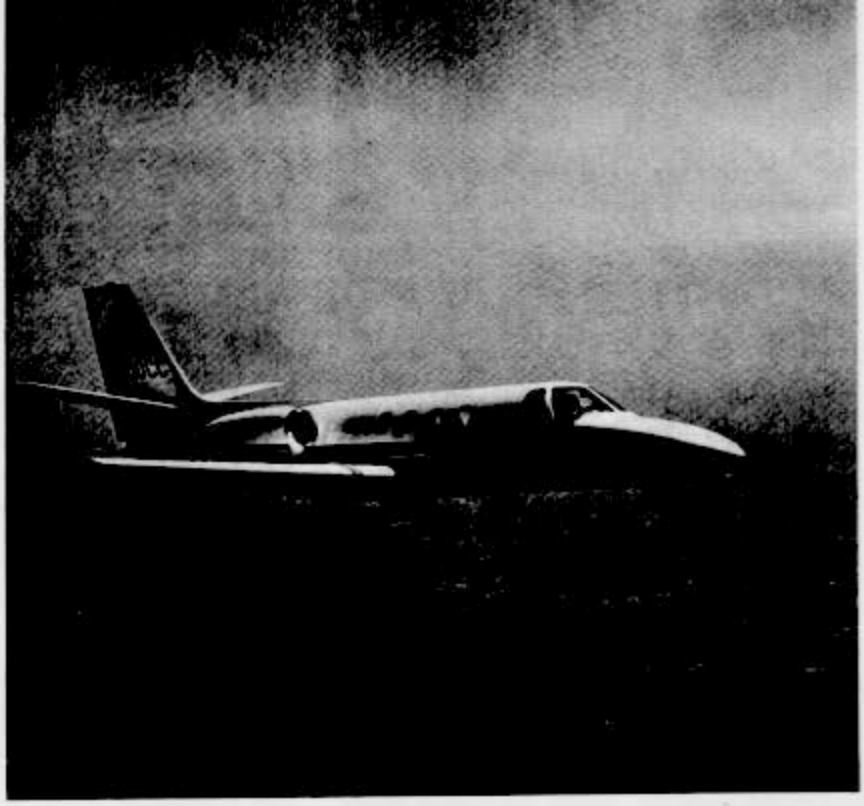

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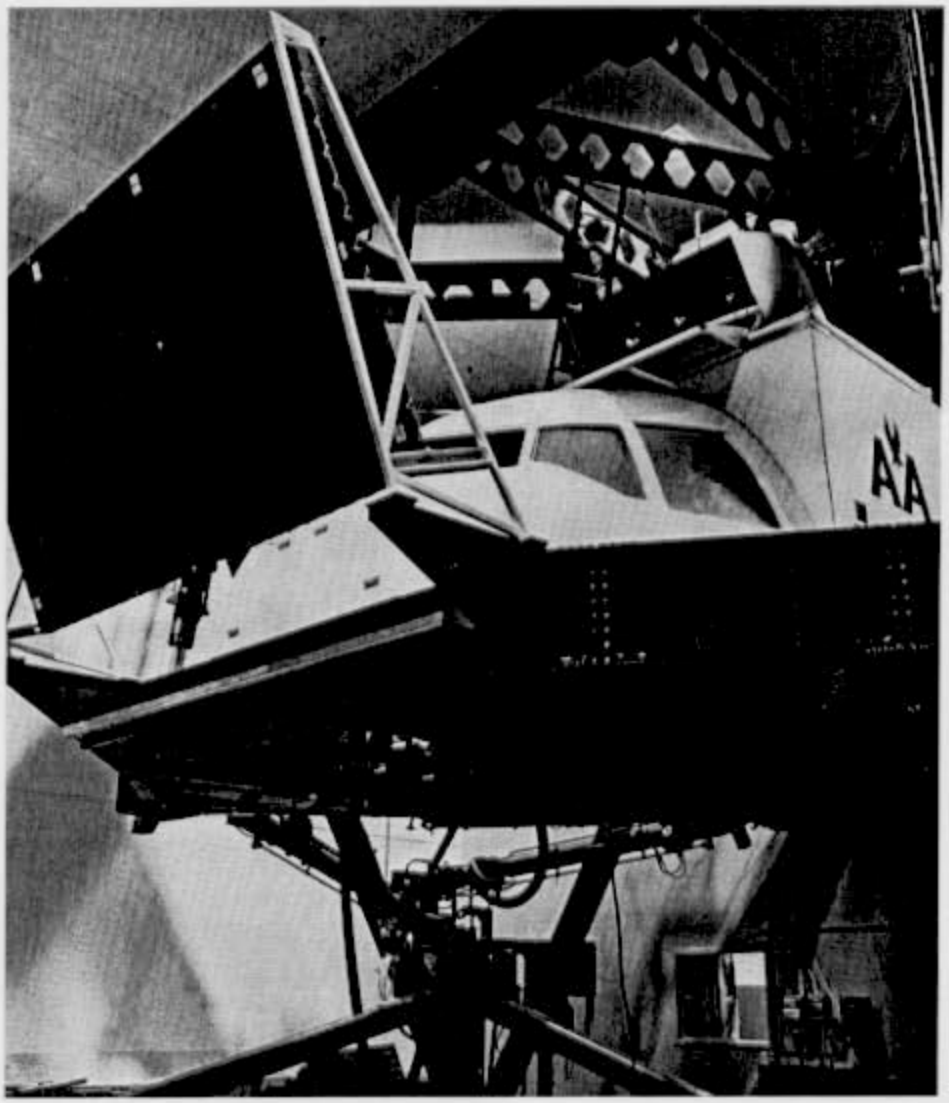

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