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COMMONWEALTH OF AUSTRALIA

AVIATION SAFETY DIGEST

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You too could survive!

SEE PAGES 1 & 2

Aviation Safety Digest

No. 18 June, 1959

Prepared in
the Division of
Air Safety Investigation
Department of Civil Aviation

CONTENTS

Head Protection is Important

Crash helmets have proved their life saving value for motor cyclists, racing motorists and military pilots. A fourth group they can help is agricultural pilots.

We have to face the fact that the nature of aerial agriculture operations is such as to increase the risk of a crash. We have had many agricultural accidents over the past two or three years and it is inevitable that there will be more. The agricultural pilot has to accept a greater than normal risk of a crash and — if he is wise — take out insurance against it in the form of protective equipment.

Some aircraft like the DH.82 provide a built-in protection in the event of a crash because most of the aircraft structure and weight is ahead of the pilot. In a crash this structure absorbs a lot of the energy of motion. On the other hand we know that the DH.82 has very little overturn protection. We know too, that the shoulder harness attachment is too low to give full effectiveness.

So there is a real risk — and we have accidents analyses on file to prove it — that in a crash the pilot's head can hit the ground or parts of the aircraft like the windshield or fuel tank.

The only way to give him reasonable protection against this danger is by the wearing of a helmet. A good helmet will protect him well.

The shell protects against penetration and abrasion, the suspension and lining absorbs a good deal of the shock.

In planes which have good overturn protection, the pilot's head can often be banged against the cabin roof or sides. Here, there is much less risk of fatal head injury, but there is always the chance of being knocked out. If the aircraft burns, unconsciousness for half a minute or even less may mean the pilot's death, even though he be practically unhurt by the crash itself.

Good imported crash helmets are available now. We hope shortly that a good Australian model will be on the market at a reasonable price.

When you wear a crash helmet on your next agricultural job, intelligent people won't think you are a man from Mars. They will know that you are a pilot who has his head well screwed on — and who wants to keep it that way.

Now Read On . . .

Late in the afternoon on 11th February, 1959, a DH.82 was engaged in spraying a tobacco crop in the Ovens Valley, Northern Victoria. Shortly after operations were commenced the aircraft flew into power lines, caught fire in the air and immediately crashed out of control into the open ground below. The aircraft burned out but the pilot escaped with minor injuries.

On arrival over the crop to be sprayed the pilot completed two circuits in order to locate the obstructions. He established the position of two power lines, one crossing the northern edge of the field and the other running down the eastern edge to a pump on the river. Taking into consideration other factors such as the adjacent terrain and trees, the pilot decided to carry out the spraying runs north and south, but before commencing in this direction, he completed two end runs parallel with the line at the northern end in order to ensure complete spray coverage. These end runs were carried out without incident and the pilot then flew to the southern end of the field and carried out the first of the working spray runs towards the northern power line. This consisted of three wires suspended some 30 feet above ground level. At the end of the first run he lifted the aircraft over the wires and then turned and descended over them for the second run. During the third run which was again towards the power line the pilot momentarily forgot about the obstruction but, when he suddenly remembered its existence and realised that he was close to it, he applied full power and pulled the aircraft up sharply. At this point he could not see the wires because of the background of dark forest on a nearby mountainside.

The aircraft made contact with the wires across the starboard wings, nose and undercarriage. Only one wire broke initially and the aircraft carried the other two at least 60 feet into the air where the aircraft turned over and dived vertically into the ground below. Fire broke out in the aircraft as a result of electrical arcing even before it struck the ground. At the top of the "zoom" after contact with the wires the pilot pulled the top straps of his harness very tight and crossed his arms over his face. The ground impact was heavy and the "hard hat" which the pilot was wearing struck some unknown projection in the cockpit very heavily. He was only momentarily stunned, however, and this condition quickly disappeared as he came into contact with "live" metal components of the aircraft and received severe electrical shocks. The aircraft became enveloped in flames but the pilot was able to release his harness and escape. Although he was only wearing a T-shirt and shorts the pilot escaped with severe bruising and two cracked ribs; the sleeve of his T-shirt was scorched by electrical arcing.

The pilot's flying experience amounted to some 4,400 hours, of which 3,700 hours have been gained on low level agricultural work. His record shows him to be one of the most experienced pilots engaged in the aerial agriculture section of the industry. He had flown only three hours in the preceding 24 hours, he had 8-9 hours sleep during the previous night and a further 3½-4 hours sleep during the afternoon immediately preceding the accident. It is quite apparent that physical fatigue was not a contributory factor in this accident.

There is no suggestion of any defect in the aircraft and the weather conditions at the time for this type of work can only be described as ideal, there being no wind, smooth cool air and good visibility. The nature and position of the obstruction was clearly established by the pilot before work commenced and he had devised a spraying pattern which recognised its existence. It would have been possible to fly beneath the power line which the aircraft struck but this pilot normally avoids such a practice since it considerably increases the risk of flying into the crop. The tobacco being sprayed on this occasion was at least six feet high. In the split second decision made when the dangerous proximity to the line was appreciated the pilot instinctively attempted to follow his normal and previous practices.

In his testimony, the pilot has made it patently clear that this accident arose solely from the fact that he forgot about the presence of the obstructing power line ahead until it was too late. It is probable that his attention was concentrated on the more immediate problems of the spray run but there were no unusual features of this run which might have engaged the pilot's attention to a greater degree than any other run. In operating circumstances such as these there is usually no means by which the pilot's consciousness of the danger ahead can be awakened and it is difficult to envisage any means by which this could be reliably or economically achieved. Even in the most careful pilot the dangers of human fallibility are ever-present and an acceptance of this fact will go part of the way towards preventing this type of accident.

We are not only concerned with preventing accidents but also with minimising injury. The pilot involved in this accident attributes his survival to the fact that he was wearing a protective helmet and his harness was tight on impact. Considering the force of the impact and the deep score on his "hard hat" his conclusions cannot be disputed. This pilot was a confirmed "hard hat" wearer prior to the accident and, needless to say, he now has a profound conviction of its value in agricultural flying.

In contrast to this outlook we have on record a recent accident in which an agricultural pilot succumbed to severe head injuries despite the fact that he owned a "hard hat", had it with him on the operating site, but for some unknown reason did not wear it.

We predict that in the not too distant future the hard-headed obstinates will be outnumbered by the hard-hatted converts and we strongly suggest that you, as an agricultural pilot, leave the ranks of the former right now so that you, too, might survive.

Engine Fire Leads to DC7 Crash at Miami, Florida

(Summary based on the report of the Civil Aeronautics Board, U.S.A.)

At 0006 on 25th March, 1958, a DC.7C on Flight 971 crashed approximately three miles west-northwest of the Miami, Florida, International Airport. The accident occurred soon after take-off at night under visual conditions. There were 24 persons aboard, comprising nineteen passengers and a flight crew of five. Nine of the passengers were killed and the captain and first officer were seriously injured. The aircraft, with an engine on fire in flight, was practically destroyed by impact and ground fire.

THE FLIGHT

The aircraft departed from Miami terminal at 2356, taxied to Runway 27R where engine run-up was made, after which a normal take-off was accomplished. Shortly after take-off a climbing right turn was started. During the turn the No. 3 engine malfunctioned and a fire developed in that area. The aircraft, still in a right turn, started to lose altitude rapidly. While travelling in a north-northeasterly direction it struck the ground in an open marsh containing scattered trees and underbrush.

INVESTIGATION

Ground impact marks revealed that the aircraft struck the ground with approximately 25 degrees of right bank while descending at an angle of approximately five degrees. The right wing tip made the first contact and the aircraft broke up immediately thereafter when the inboard right wing structure, the engines, and the fuselage struck the soft surface.

All four engines, found approximately 2,000 feet from the point of first impact, were removed from the swamp and examined by the Powerplant Group. A piston and a cylinder were found 1,350 feet and 1,550 feet, respectively, along the flight path. It was positively determined that these were the No. 11 cylinder and piston of the No. 3 engine. Investigation further disclosed that the other three engines were operating normally and developing considerable power at impact.

Inspection of the No. 11 cylinder of the No. 3 engine revealed that it had failed from fatigue approximately 1½ inches above the cylinder mounting flange on the thrust side. The cylinder flange attaching cap screws were intact. The cylinder wall contained evidence of scuffing and ladder cracking was in evidence. The No. 11 connecting rod had failed approximately six inches outboard of its knuckle pin. All knuckle pins, including No. 11, were free from indications of maloperation at the master rod end. Cylinder wall scuffing was also found on No. 2 cylinder of the No. 3 engine.

All major portions of the four propeller assemblies were recovered. Most blades were shattered by contact with the ground. The No. 3 propeller was feathered. The propeller dome settings and shim plate impact marks on Nos. 1, 2 and 4 were examined and found to be positioned for a blade angle of approximately 43 degrees, which is 15½ degrees above the low pitch stop and indicative that considerable power was being developed. Numbers 1, 2, 3 and 4 propeller governors were also recovered.

The flight instrument panels were recovered from the wreckage. Impact forces had caused some external damage to the panels and to certain of the instruments. All instruments were found to be operable.

The aircraft had been engaged on a ferry flight and arrived from Dallas at 1915 hours on 24th March, 45 minutes after official sunset. As the flight approached for landing the airport tower controller asked the flight "904 your No. 3 engine smoking a little bit," to which the flight replied "Well I hope not".

Another message from the controller stated, "Checking your position with the glasses, it seems to be leaving a very faint trail". The flight acknowledged these messages and landed without incident. When the crew reported in to company operations no mention was made of the smoking engine advisory from the tower. The captain reported the aircraft ready for Flight 971. He previously had signed the flight log which indicated no aircraft discrepancies. The ferry flight crew were passengers on Flight 971 of 25th March and were fatally injured.

Tower personnel stated that the aircraft made a climbing right turn shortly after take-off. When it had reached an altitude of approximately 900 feet a bright orange glow was observed on the right side of the aircraft. The aircraft was further observed to enter a descent, contacting the ground at 0006. Immediately prior to impact, tower personnel heard a call "Braniff 971". No other messages were received from the flight following take-off.

The first and second officers both stated that pre-flight preparations were routine and that no discrepancies were noted during the pre-take-off engine check. The first officer stated that the captain made the take-off from the left seat. He further stated that take-off power was applied and that he had adjusted the throttles to maintain a boost of 59½ inches of manifold pressure.

The first officer said that the take-off was extremely smooth and that the aircraft was off the ground shortly after reaching V2. The captain ordered the landing gear retracted, which the second officer accomplished. The flaps were then raised. The first officer further stated that just about the time the flaps reached full up position he felt a thud and immediately noticed a flash of light. He turned to his right, looked out his window and saw fire. He said the fire seemed to him to disappear so he looked back to the engine instruments to determine if they indicated an engine failure. At that time, he said, he recalls the captain saying, "Feather 3". He also remembered the captain telling him to call the tower and report that 971 was returning. He said he picked up the microphone but did not recall making any transmission.

The captain had been a captain for Braniff for over 18 years. His total flying time was over 20,000 hours. According to company records 241 of this had been in DC.7s and 117.55 hours were acquired in the 90 days prior to the accident. The remaining 123 hours were accumulated during the previous nine months. The captain had approximately 200 hours of scheduled operation in DC.7 equipment. He had also accumulated several thousand hours in other four-engine type aircraft.

A review of company pilot checks of the captain for a period of almost 10 years disclosed that he had been given more than the minimum required number of such checks. In several instances it was necessary for him to be rechecked by company check pilots because of his initial failure to receive passing grades. Some instrument flight checks reflected inability to maintain altitude during turns; however, he did pass rechecks and remained on flying status.

ANALYSIS

During the investigation of the accident the possibility was advanced that the captain intended to make an immediate off-airport landing because of damage to the airframe by the fire.

The Board was aware that fire in flight is extremely serious and unless quickly checked can affect the integrity of the structure. There is no doubt that a fire existed; however, it was so confined within the No. 1 zone of No. 3 engine that the aircraft structure was not affected. Actually, only blistering of the paint was evident to the rear of No. 3 nacelle, which substantiates the small area and duration of the fire. Unfortunately, the crew could not be certain that the fire was under complete control. Regardless of the effectiveness of the fire control procedure, an immediate return to the airport was proper.

The captain's order to the first officer to advise the tower that they were returning to the airport precludes any thought of landing at a place other than the airport. The first officer was only able to start his radio transmission ("Braniff 971") before the accident occurred.

Well qualified witnesses estimated the highest altitude of the aircraft during the flight to be approximately 800 feet. This estimate is consistent with the known performance of the aircraft under the conditions of power and configuration employed until the moment of engine failure. It is evident, therefore, that the aircraft descended rapidly from this altitude. Testimony of the flight engineer and statements of passengers showed conclusively that there was a sudden descent and an abrupt change in aircraft attitude.

The captain took positive action to break the climb attitude and established a shallow descent towards the airport. Nevertheless, the Board must conclude that he did not use proper technique and allowed the aircraft to descend to the ground. His injuries blocked all recollection of the flight despite his sincere desire to testify regarding his actions during the emergency. The first officer, also seriously injured, was able to recall some of his own actions during the flight. The second officer, although injured, did not lose consciousness in the accident and was able to describe events of the flight in more detail and better sequence.

Soon after passing the boundary of the airport on a heading of 270 degrees a right turn was started and the ground impact was on a heading of 23 degrees. It is obvious that the rapid descent occurred during this turn of 113 degrees.

The captain was under considerable stress during the emergency and despite his 20,000 hours of flight experience it is probable that this situation brought out his former difficulties in maintaining altitude and control during turns. The aircraft was not heavily loaded and there should have been little difficulty in returning to the airport with three normal operating engines and the fourth, an inboard engine, feathered. In fact, this aircraft, loaded as it was, and under the existing atmospheric conditions, should have been capable of climbing with one propeller feathered at a rate of about 470 f.p.m. The rapid and premature descent indicates that the captain displayed poor piloting technique by allowing his attention to be diverted from his flight instruments by the engine fire, objects on the ground, and the emergency procedures being taken by other crew members.

Visibility in the airport area was reported as eight miles by the tower. Since the scene of the accident was approximately three miles from the airport, patches of ground fog at the accident area would not have interfered with the return of the flight.

It is possible that, had the crew of the ferry flight entered the tower report of smoke trailing from No. 3 engine in the flight log, it would have led to an inspection which would most likely have detected the defective cylinder. It is difficult to understand why this was not entered as it would have required an inspection at Miami. Because of the fatal injuries to the crew of the ferry flight, the Board was unable to determine the reason for this incident not being written up in the aircraft log.

PROBABLE CAUSE

The Board determined that the probable cause of this accident was the failure of the captain to maintain altitude during an emergency return to the airport due to his undue preoccupation with an engine fire following take-off.

OXYGEN EXPLOSION

A DC.4 at Darwin was being readied for flight. Refuelling and pre-flight inspections were in progress as an engineer positioned the oxygen recharging trolley adjacent to the mid-section of the fuselage preparatory to replenishing the aircraft's oxygen system. The trolley carried four oxygen bottles and was fitted with a control panel, mounted on steel brackets, comprising a manifold with four inlet points, an outlet with a control valve and a pressure gauge.

The engineer connected the outlet to the aircraft's recharging point and opened the control valve. He then proceeded to open the valve on a bottle. As he opened this valve, there was an explosion accompanied by flame. Although suffering shock and burns to his right hand and arm, the engineer promptly closed the valve and the flame ceased.

Subsequent inspection revealed that the brackets carrying the control panel had separated from the trolley at the welded joints, the hoses from the cylinders had pulled off the manifold connections, the outlet pipe had fractured at the manifold and the hose to the aircraft had punctured approximately four inches from the valve. There were signs of severe burning at the manifold inlet connection and at the outlet pipe as well as burning and blistering around the necks of the bottles.

The cause of the explosion has not been determined but it probably occurred in one of the following ways.

(a) Either the outlet pipe connection fractured or the hose to the aircraft failed and the other damage was caused by the resultant reaction. Under these circumstances the flame could have been caused by the spontaneous ignition of some combustible material at the point of the failure, when subjected to oxygen under pressure.

(b) Spontaneous combustion of some finely divided combustible materials in the lines or manifold when the oxygen was admitted at a high pressure.

Immediately after this incident the following restrictions and requirements in respect of the use and maintenance of oxygen system recharging equipment were issued —

"Installed oxygen systems in aircraft shall not be recharged during refuelling or while the engines of the aircraft are operating.

Ground power supplies, motorised ground servicing equipment and all likely ignition sources shall be kept well clear (at least 50 feet) of oxygen system recharging equipment during recharging operations unless they are flashproofed.

Oxygen system recharging equipment shall be inspected regularly for condition and before use for freedom from foreign matter, particularly grease and oil.

Recharging equipment shall be clearly placarded with instructions for its use.

Flexible hoses forming part of oxygen system recharging equipment shall be maintained in accordance with A.N.O. Section 108.2.16.

Only flexible hoses shall be used for connecting oxygen recharging equipment to aircraft. Aluminium alloy shall not be used for plumbing of high pressure oxygen systems recharging equipment.

Brass plushing fittings shall not be used in oxygen recharging equipment unless they have been tested for leakage due to porosity at two and one half times maximum working pressure of system.

High pressure recharging equipment (over 500 p.s.i.) shall not be used for recharging low pressure systems (under 500 p.s.i.) unless it incorporates a pressure reducing valve.

Recharging equipment shall be fitted with an oxygen purifier and filter to separate moisture and coarse particles of any kind."

TOUCHE!

Returning from a flight, the pilot entered on the squawk sheet: "Something loose in the tail". The next morning when our pilot friend was handed the squawk sheet for initialling his acceptance of the work done, he found the following reassuring note: "Something loose in tail tightened".

Brevity is fine, but . . .

EXPLICITS ELICIT MORE EFFICIENT FIX-IT.

(Courtesy of Flight Safety Foundation Inc.)

Fatal Piper Accident at Masterton, N.Z.

(Summary based on the report of the Air Department, New Zealand)

A Piper PA.18A engaged in top dressing operations at Wangaehu, Masterton, stalled and spun off a steep climbing turn at low altitude and burst into flames on impact. The aircraft was destroyed and the pilot died from injuries received in the crash.

THE FLIGHT

The accident occurred on 15th February, 1958. At 0900 hours the farmers arrived on the strip with a movie camera and asked the pilot to make a dressing run parallel to the strip in order that a film might be taken. The take-off was normal and the aircraft was observed to turn on to a reciprocal heading and line up with the strip. The sequence of events from then until the aircraft struck the ground was depicted on the film.

The slope of the ground made it necessary for the pilot to climb throughout the dressing run. The fall of material from the aircraft was light and of short duration and immediately it had ceased, the aircraft started a climbing turn to the right which progressed until a nose-up attitude of 55 degrees was reached at an angle of bank of 50 degrees, the highest point of the turn being almost immediately above the loading area. At the top of the right hand climbing turn at a height of between 150 and 200 feet the aircraft flicked suddenly into a left hand spin. The pilot immediately applied full opposite aileron, one third flap, held the stick partially back and the rudder in the central position. After three quarters of a turn, when the nose was pointing vertically downwards, ailerons were centralized and the stick moved hard back, the controls remaining in this position with the rudder still central until the aircraft struck the ground, having completed $1\frac{1}{4}$ turns of a fully developed spin.

The aircraft caught fire on impact and in spite of severe heat from a concentration of flame in the engine bay, two farmers and a loader-driver succeeded in extricating the pilot from the wreckage. However, he had been fatally injured at impact.

INVESTIGATION

The unique film record revealed accurately and conclusively the sequence of events which culminated in the accident.

It was clearly evident from the nose-up attitude of the aircraft during the sowing run that an inadequate reserve of airspeed or power was available to terminate the run in a steep climbing turn. Having committed the aircraft to a situation which resulted in an incipient spin the pilot took incorrect recovery action and at no time during the event was correct recovery action taken. From examination of the film record it appeared likely that if instant and resolute correct recovery action had been taken at the onset of the stall, the steep nose-down angle of impact, with consequent fatal results, could have been avoided.

The pilot obviously knew the correct spin recovery action and yet, when faced with this emergency, his immediate reaction was to apply full opposite aileron and partial flap. At no time was opposite rudder applied, nor was the control column moved sufficiently forward to unstall the wings. The action taken in the application of opposite aileron would aggravate the autorotation by introducing a measure of aileron drag. Any effective contribution towards recovery that might have resulted from the application of flap was more than offset by the delay introduced in selecting at a time when every instant was of vital importance.

The mild stalling characteristics of the PA18A in the unladen condition is in marked contrast to the extremely rapid development of the spin observed in this aircraft. Investigation into the loading operation disclosed the possibility of the mixture piling on the rear sloping wall of the hopper, which could result in up to a 2 inch rearward movement of the C. of G. If this had occurred the C. of G., which was already 0.9 inch beyond the aft limit, at take-off would have been at 26.9 inches aft, i.e., 2.9 inches beyond the aft limit. During the sowing run prior to the accident the nose of the aircraft was held well up and the discharge from the hopper was light and of short duration. With the attitude of the aircraft it is probable that the material came from the front of the hopper and that the mixture at the rear of the hopper was not dislodged. This would accentuate any C. of G. aft condition. Moreover, there is a possibility that in a steep climbing turn the mixture may fall to the rear of the hopper particularly if such a turn is unbalanced.

The solution to the problem is the avoidance of steep climbs or semi-stalled turns in a loaded aircraft. For as long as some pilots take these unnecessary risks there will be some unnecessary accidents.

The pilot held a commercial pilot licence endorsed for Piper PA18A. He had flown a total of 867 hours of which 260 hours were on the Piper PA18A. He had been involved in two previous topdressing accidents, the first in August, 1956, when the aircraft failed to become airborne and struck a concealed post, and the second in December, 1957, while attempting to take-off diagonally across the strip in a high gusting wind, the aircraft overturned.

CAUSE

It was considered that the aircraft stalled and spun into the ground through the failure of the pilot to maintain airspeed during a steep climbing turn at a low altitude.

In-Flight Emergency

(Reproduced from "The Mats Flyer")

Relying on his professional knowledge, the experience of Major Samuel Tyson (Aviation Safety Digest, No. 13, March 1958) and with the help of what he called "the pilot upstairs", Major William P. Armstrong and crew joined the ranks of Pacific "runaway propeller specialists" and turned in a Good Show by nursing a PACD Stratocruiser 700 miles to Hilo, Hawaii, alternately on two and three engines.

This Tokyo turn-around, which had originated at Travis, had been routine. (A slight overspeed on No. 2 had occurred on the last take-off, but it came back immediately to limits when toggled.) Major Armstrong, Commander of the 75th Air Transport Squadron, and Captain Ted H. Mahoney, both aircraft commanders, had taken turns at the controls. They were on the last leg—the long over-water run from Hickam to Travis. They had been airborne three hours and twenty minutes. Altitude was 9,000. Everything was serene. The seven-man crew, quietly and efficiently, worked at their respective duties. The monotony of the long flight was no novelty to them. The gentle vibrations that coursed through the transport, the smooth, slightly undulating hum of the four powerful engines and the multitude of gauges on the flight deck told them everything was normal.

Suddenly, and with no warning whatsoever, number two propeller ran away. Almost instantaneously it whirled up to 4,000 r.p.m. A rising, unforgettable, metallic scream permeated the airplane.

Captain Mahoney reacted immediately. He pulled the throttle back on No. 2 and punched the red button with "2" on it.

No. 2 refused to feather.

Power was pulled off all the engines, 55 per cent flaps were lowered, and the airspeed slowed to 150 miles per hour. Holding airspeed, a descent was started into denser air near the surface in an effort to further reduce the speed of the uncontrollable propeller.

Repeated attempts were made to feather the propeller during the descent, with propeller oil replenished during each attempt.

No luck.

The crew reversed course and headed for Hilo, the nearest suitable landing field.

Major Armstrong contacted Hickam via HF, reported the emergency, and requested recording services to make a running commentary of the emergency and actions being taken to overcome it.

At 500 feet the plane was levelled off. Windmilling speed had dropped to approximately 1800 r.p.m., but drag was terrific. Due to the high power settings required on the three good engines and the possibility of No. 2 propeller coming off, jettisoning of cargo was decided upon. Hatches were opened and 9,000 pounds of general cargo were thrown overboard.

Experimentation disclosed that an airspeed of 145 m.p.h. and a flap setting of 35 degrees seemed to work out best. This configuration provided the best balance of safe control airspeed, drag and windmilling r.p.m. No. 2 had slowed to between 1600 and 1800 r.p.m.

Maybe they could make it.

Replenishing of oil to No. 2 was continued periodically to assure lubrication. The flight was continued under these conditions until it became apparent the aircraft would not reach Hilo with the engine windmilling since oil consumption had increased to a point where all the oil available for replenishing would be consumed before the aircraft reached land. Indications from the cockpit were that No. 2 had suffered external damage.

No. 2 was smeared with oil (Oil was coming out the breather.)

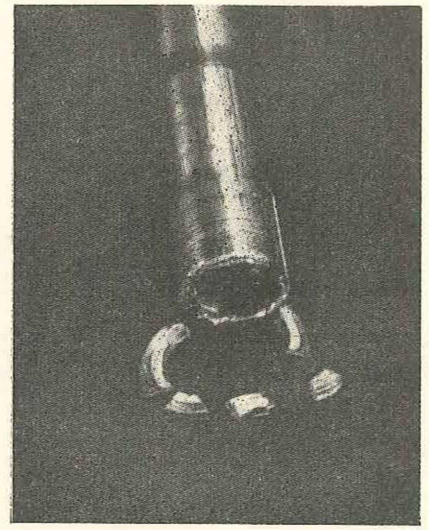
The aircraft commander decided to freeze the engine. Freezing procedures were discussed with the engineer and it was decided to reduce the r.p.m. as much as possible by intermittent freezing in order to reduce the possibility of losing the prop when the engine froze. The engineer reported that he had been on a number of other flights where engines had to be frozen; in each case this procedure was followed successfully.

Because of the possibility of the No. 2 prop separating from the aircraft, No. 1 was feathered and the prop turned to an "X" position in an attempt to reduce the possibility of damage should No. 2 come off.

At this time the No. 2 engine r.p.m. was 1800 and oil pressure 55 p.s.i. The oil shutoff valve was closed until the oil pressure dropped to 5 p.s.i., then the oil shutoff valve was opened. During this sequence the r.p.m. slowed to 1300. When the r.p.m. started to rise the oil shutoff valve was again closed. Oil pressure had risen to 40 p.s.i. and the shutoff valve was left in the closed position until the pressure dropped to 5 pounds again. This time r.p.m. dropped to 900. The sequence was repeated with r.p.m. dropping to 500, then, slowly and smoothly, to zero.

During the freezing sequence altitude had slowly dropped until the aircraft was flying at an estimated 65 to 75 feet over the waves. The entire crew was braced in ditching position.

As soon as No. 2 froze, No. 1 was unfeathered and a climb initiated to 1,000 feet. A cruise configuration was set up using 35 to 39



inches of manifold pressure and 2200 r.p.m. on the three good engines, zero flaps. Airspeed increased to 170 m.p.h. and flight was continued to Hilo.

The rescue fleet that had been set in motion at the onset of the emergency wasn't needed.

There is an old adage that starts, "For the want of a nail a shoe was lost . . . " and goes on and on until a kingdom has been lost. Investigation of this incident disclosed that, thanks to this crew's ability to successfully handle an inflight emergency, a modern day paraphase doesn't apply. If it had it would begin, "For the want of a lock wire . . . "

Removal of the No. 2 engine propeller dome cap revealed the flyweight assembly lying loose with the retaining nut lock wire missing. Loosening of the flyweight assembly resulted in vibration of the oil transfer tube with subsequent failure of the tube flange. This resulted in an aft movement of the oil transfer tube, allowing the inboard and outboard oil to mix. Lack of counteracting pressure in the dome allowed the slipstream to move the blades to low pitch (18°) resulting in an overspeed and complete lack of control.

How did Major Armstrong feel after the C-97 settled to safety at Hilo? "You get awfully tired in a hurry", he said.

Stick to AVGAS

In the highly competitive automobile fuel business it is essential for the various distributors to keep the name of their product before the public by intensive advertising.

This advertising material is prepared by some of the best exponents of the art and the persuasive powers of such advertising may tend to influence even aviation people to whom it is not directed.

Now don't let all this advertising tempt you into trying automobile fuel in your aircraft. It certainly won't give you any improvement over the correct grade of aviation fuel—on the contrary, its use can be positively dangerous in some conditions.

In brief, here are some points where automobile fuel and aviation fuel differ significantly:

KNOCK RATING

Aviation fuels are graded in terms of their knock rating and every precaution is taken to ensure that the fuel supplied is true to grade.

On the other hand the knock ratings of motor fuels are not normally disclosed and all claims are purely qualitative.

The use of a fuel with a knock rating lower than the minimum specified for your aircraft engine will quickly lead to engine failure as the result of detonation.

VAPOUR PRESSURE

The vapour pressure of automobile fuel is considerably higher than that of aviation fuel. In consequence, there is a very real danger that the use of automobile fuel in aircraft will lead to vapour locking of the fuel system under high ambient temperature conditions and at altitude.

TETRA ETHYL LEAD

The lead content of automobile fuel (both standard and premium grades) is relatively high and may exceed 2 mls. per gallon in some cases. As many light aircraft engines are designed to use a low lead fuel, the use of automobile fuel may result in spark plug fouling and could also lead to a rapid deterioration of the condition of the combustion chamber.

Remember, aviation fuel is produced against exacting specifications and handled under a strict quality control system and the end result is a uniform, high quality product which will produce the optimum performance from your engine.

Propeller Safety

Precautions against Malfunction of Engine, Propeller or Control Systems

In the development of fixed-pitch propellers the question of safety could be confined to examination of the structural integrity of the design, but with variable-pitch propellers it becomes necessary to consider the effects of malfunction or failure of both engine and propeller-control mechanisms, as well as structural safety of the propeller itself.

The consequence of a failure in a variable-pitch system depends on the nature of the occurrence and the conditions obtaining at the time, but it is always possible to visualize circumstances in which such a propeller could operate as a windmill, thus giving rise to excessive rotational speed or large windmilling drag. Except for instantaneous structural failure of the propeller, with the consequent probability of damage to the aircraft, these are the two dangers most to be feared, since excessive r.p.m. may subsequently cause disintegration of engine or propeller, while excessive drag may, in extreme cases, render the aircraft uncontrollable or may alternatively necessitate a forced landing due to the reduction in aircraft performance.

The essential condition associated with such disastrous consequences is the assumption by the blades of a lower pitch than that appropriate to proper functioning of the engine/propeller combination at the given conditions. Thus the v.p. propeller, by its very nature, admits potential dangers of this type, and therefore merits unusual attention to all aspects of design affecting safety.

The structural design of a propeller is based upon widely accepted standards of permissible steady and vibratory stress-levels, considered in relation to short- and long-term operating conditions. A design is subsequently approved on the basis of tests which include subjection to loads considerably in excess of those to be applied in normal service. With this background it can be said that the possibility of major structural failure in normal service can be discounted. The designer must therefore concern himself with the provision of appropriate safeguards to ensure that malfunctioning of the propeller, engine or control system cannot result in loads being applied to the propeller which are outside the accepted design limit, or result in excessive loads being transmitted to the engine or aircraft.

Characteristics of Windmilling Propeller

It has already been stated that the principal dangers arising from the malfunction of a variable-pitch propeller are associated with windmilling. This is explained in Fig. 1, which shows vector diagrams for a typical blade element (a) in normal operation, and (b), (c) and (d) in a windmilling condition after engine failure. In case (a) the blade is shown to be operating at a small positive angle of incidence to the resultant direction of airstream upon it. The lift and drag forces on the blade resolve to give a thrust in the direction of flight, and a torque force opposing and absorbing the power delivered by the engine. In (b) the blade is shown at a lower pitch than that appropriate to the normal flight condition of (a), so that the angle of incidence of the blade element is now negative. The lift and drag forces on the element now resolve to give a net drag in the direction of flight, with a torque force tending to turn the engine in its normal direction of rotation. The propeller is now absorbing power from the airstream to assist in rotating the engine, instead of absorbing the power from the engine to produce thrust.

The exact shape of the vector diagram in a windmilling condition will depend upon the resistance of the failed engine to rotation. This resistance is known as the motoring power of the engine. If it is high as in the case of a large two-spool turboprop after a failure of the fuel supply has occurred, and if the propeller is still under the control of the constant-speed unit, the blades will be driven to take up a large negative angle of incidence in order to provide the windmilling torque necessary to maintain the governed r.p.m. dictated by the constant-speed unit. The drag will then be very large, as shown by the proportions of the vector diagram in (b). If the engine motoring power is low (as in the case of a free-turbine engine) or, alternatively, in the case of a reduction-gear failure which leaves the propeller shaft free from its coupling to the engine, a small negative angle of incidence suffices to provide the windmilling torque necessary to maintain the governed r.p.m. scheduled by the constant-speed unit. This case is illustrated in Fig. 1 (c), from which it may be seen that the drag will then be relatively small. If in such a case, however, the propeller is no longer under the control of the constant-speed unit, owing to some failure of that component or its drive, then in the absence of suitable safety features the blades will reduce pitch under the action of the centrifugal and aerodynamic forces imposed upon them, until this motion is arrested by the presence of a mechanical stop in the pitch-change mechanism.

This reduction in blade pitch at first creates a higher negative angle of incidence than that shown in Fig. 1 (c), thus causing the windmilling propeller to extract surplus power from the incident airstream and to accelerate itself to a much higher r.p.m. The system will eventually stabilize in the manner shown in Fig. 1 (d) with the blades on the fixed mechanical stop and producing sufficient windmilling power to rotate the assembly at very high r.p.m., possibly several times the normal take-off r.p.m. of the engine.

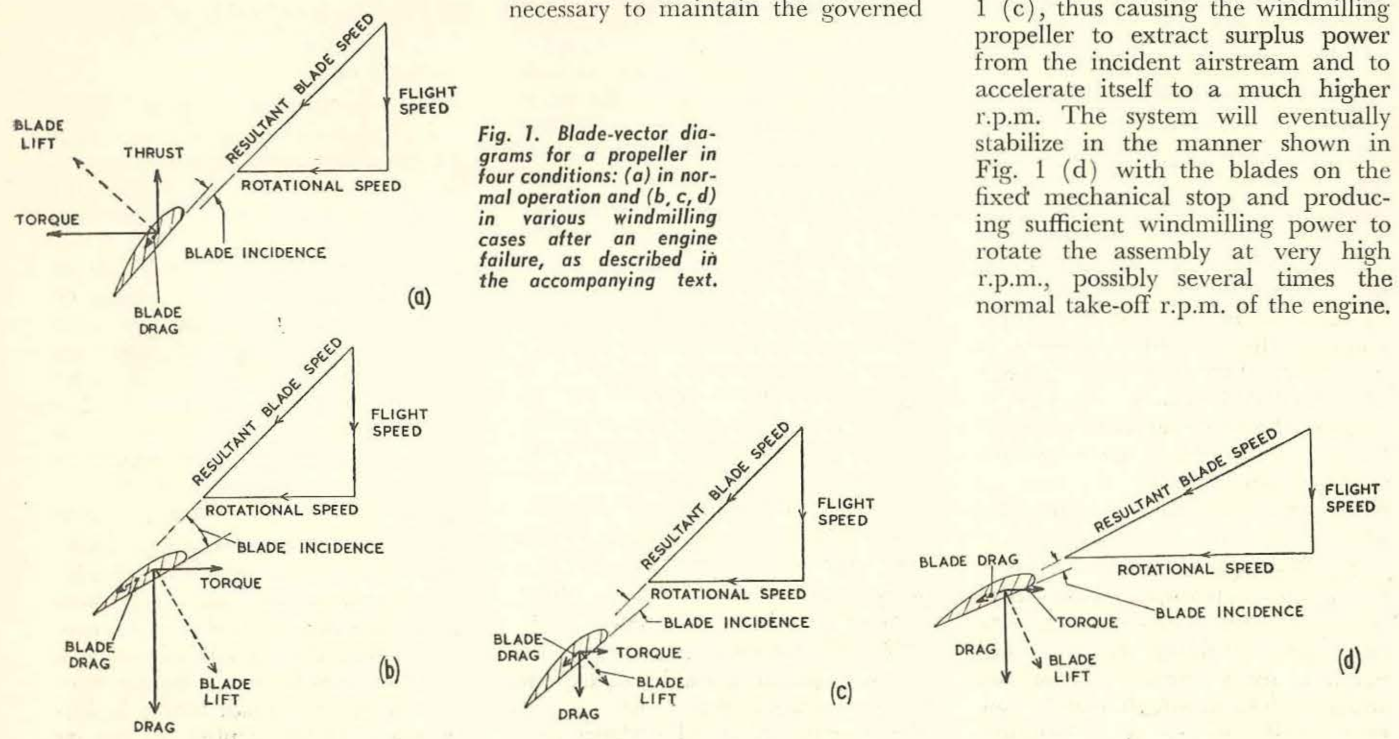
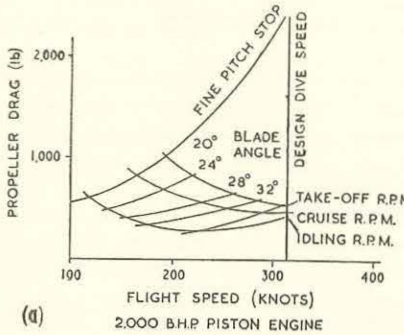


Fig. 1. Blade-vector diagrams for a propeller in four conditions: (a) in normal operation and (b, c, d) in various windmilling cases after an engine failure, as described in the accompanying text.



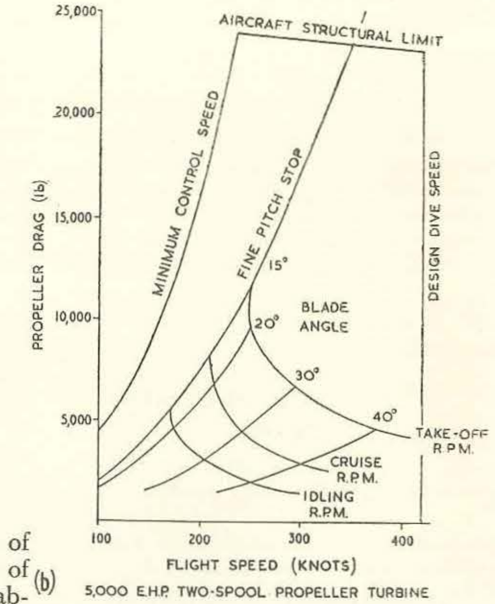


Fig. 2. Variation of windmilling drag with aircraft speed for (a) medium-size piston engine and (b) large two-spool turboprop.

The windmilling power which a propeller may extract from the airstream increases with the speed of the aircraft and the size of the blades, and the amount of windmilling power actually developed in any given case is dependent upon the type of engine and the nature of the failure. Typical figures for motoring power at cruising r.p.m. are as follows: 2,000 h.p. piston engine, 200 motoring h.p.; 4,000 e.h.p. free-turbine turboprop, 300 m.h.p.; 3,500 e.h.p. single-shaft turboprop, 1,000 m.h.p.; 5,000 e.h.p. two-spool turboprop, 3,000 m.h.p.

From this may be seen the way in which the problem of propeller safety has been accentuated by the advent of large propeller-turbine engines, due to the high motoring powers combined with the larger propellers and higher aircraft speeds associated with these engines. Fig. 2 shows variation of propeller windmilling drag with aircraft speed for (a) the case of a medium-size reciprocating engine and (b) the case of a large two-spool propeller-turbine engine such as the Tyne, after failure of the fuel supply.

In the event of failure of the fuel supply alone, the propeller control system would normally cause the blades to take up a pitch sufficiently low to maintain the preselected governed r.p.m. which may be that appropriate to take-off, cruise or flight idle depending on the part of the flight at which the failure occurred. In the event of an additional or related failure of the control system, and in the absence of any special safety features, it may be possible for the blades to reduce pitch down to the setting of a mechanical stop in the pitch-change mechanism. Fig. 2 (b) shows that the drag in this case may be very large indeed at high aircraft speeds.

Safeguards against Excessive Drag and r.p.m.

The values of drag of the order shown on Fig. 2 (b) would, at best, severely penalize the performance of the aircraft, and may in some cases be sufficiently high to cause complete loss of control or structural failure of the aircraft, as shown by the typical limiting lines included on the diagram. Where a failure can give rise to conditions of this type, it is clearly essential to incorporate safeguards to prevent the assumption of an abnormally low pitch in any circumstances, whilst yet retaining the ability for the propeller to perform its normal function of automatic engine r.p.m. control over the whole speed range of the aircraft.

In the case of the piston-engine installation, protection is provided by the presence of the fine-pitch stop in the pitch-change mechanism, which is set at a blade angle just below the minimum value used in normal constant-speed operation of the propeller. This angle is normally determined by the take-off conditions of the engine/propeller combination, and is in the region of 15 deg to 25 deg.

The stop also serves as a positive barrier to inadvertent entry by the blades into reverse pitch, as the stop cannot be withdrawn except by deliberate action of the pilot after touch-down.

With increase of aircraft speed and engine motoring power resulting from the use of turbine engines, however, the flight fine-pitch stop no longer gives adequate protection against excessive drag as evidenced in Fig. 2 (b), nor is it possible to increase the blade angle setting of this fine-pitch stop, or to introduce one or more additional stops set at a higher angle, without placing upon the pilot the additional burden of manual withdrawal of these stops at the correct time, simultaneously on all engines, to allow the propellers to continue their governing function in all flight conditions.

If stops set higher in the blade-angle range were used as a protective feature, failure to withdraw these stops at the appropriate flight condition would result in the propeller under-speeding, whilst inability to withdraw the stops, caused by

a failure of the withdrawal system, would seriously affect the performance of the power plant during final approach and landing, particularly in the event of a baulk necessitating rapid acceleration of the engines.

The system adopted by de Havilland Propellers in the design of the Tyne propeller to ensure the limitation of drag and r.p.m. following engine or propeller malfunction is, therefore, based upon the provision of means for immediate automatic detection of any failure, followed by quick remedial action to prevent dangerous conditions being attained. In this way the flight fine-pitch stop can be retained at a conventional setting to provide a positive barrier to inadvertent selection of braking pitch, while the entire range of blade angle used to maintain governed r.p.m. during flight is left unobstructed.

In order to give protection against excessive drag or r.p.m. the safety system must first sense the occurrence of a failure, and then prevent the assumption of an excessively low pitch by, if necessary, overriding the normal functions of the constant-speed unit. The dangers to be protected against are essentially drag and r.p.m.; it would therefore be logical to use signals based on these quantities for the failure-sensing system. In the case of overspeed detection this is in fact done, but in the case of the drag-limiting system it is inconvenient to derive a mechanical signal which is directly sentitive to drag. However, it has been noted that the amount of drag developed after a failure is dependent upon the negative or windmilling torque present in the system. An effective control of windmilling drag is therefore obtained if a limit is applied to the negative torque which can be developed in the propeller shaft, which thus provides the basis for a failure-detection mechanism for the prevention of excessive drag.

Automatic Drag Limiting System

Propeller drag-limiting systems based upon an engine torquemeter signal have been in service for some years.

Up to the present time the main purpose of the feature has been to provide automatic reduction of propeller drag after an engine failure at the critical point of the take-off, for which credit may usually be taken in the certification of the aircraft. In such installations, the system is set to operate at a low positive value of torque; should the torque in the shaft fall to this value, a valve is operated in the propeller controller which transfers all the incoming oil supply to the coarse-pitch line, thus feathering the propeller. Such a system must be cancelled at low throttle settings, since the normal torque transmitted by the engine shaft would then be similar to, or lower than, the torque setting of the safety system. To provide complete protection over the whole flight range for Tyne installations, this system has been extended by varying the torque setting with throttle position to maintain the setting at a value somewhat lower than that appropriate to normal engine operation.

The torque signal is transmitted from a movement of the annulus gear of the engine-reduction gear box by a mechanical linkage to a servo valve in the propeller controller, which operates the coarse-pitching valve. It is to be noted that the independent electrically driven feathering pump is not brought into action by this automatic drag-limiting system, thus rendering the system entirely hydro-mechanical, and that the coarse-pitching valve is so positioned in the hydraulic circuit that it overrides any contrary signals that may exist in the constant-speed unit.

The response in terms of propeller drag is shown in Fig. 3. With the engine power lever in positions from low cruising power to take-off, the setting of the drag-limiting system is at a slightly positive value of torque. Thus in the event of engine failure in this range the propeller feathers. With the engine power lever at flight idle, the torque setting of the drag-limiting system is 3,900 lb. ft. compared with a normal torque of 1,000 lb. ft. delivered by the engine at flight idle. In the event of engine failure with the power lever in the flight idle position the engine torque will at first drop below the setting of the drag-limiting system, thus causing the blades to coarsen until a value of 3,900 lb. ft. is restored. The blades will then continue to move to govern the torque to this value under the varying flight conditions.

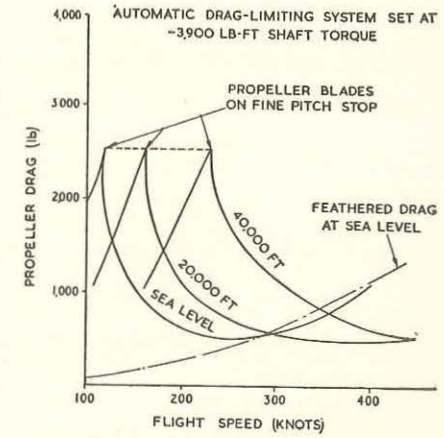


Fig. 3. Response values for an automatic drag-limiting system.

The drag is thus automatically limited to the values shown on Fig. 3, which may be compared with the unrestricted values given in Fig. 2 (b). Manual feathering can, of course, be accomplished at any convenient time to reduce the drag to an even lower value.

Hydraulic and Mechanical Pitch Locks

Although the automatic drag-limiting system provides a valuable first line of defence, it is clearly dependent upon the continued existence of oil supply to the propeller. It is therefore necessary to arrange for more positive protection against this failure. It is also desirable, in cases in which the unrestricted propeller drag or r.p.m. would be dangerously high, to provide protection against the occurrence of a contributory failure of the automatic drag-limiting system at the same time as a primary failure such as fuel supply failure.

One means by which protection is provided against loss of oil pressure is the hydraulic lock, which ensures that when pressure is lost the oil present in the fine-pitch side of the pitch-changing piston is trapped, thus arresting any further movement in the fine-pitch direction. This lock has been in use on de Havilland propellers exclusively for several years, and has proved its worth on a number of occasions. Due partly to the difficulty of checking the functioning of a hydraulic mechanism of this kind, however, the Tyne propeller also incorporates a mechanical pitch lock, which on engagement mechanically precludes any further movement of the blades towards fine pitch.

This lock consists of two rings of ratchet teeth mating in steps of approximately 2½ deg. of blade angle, one attached to the rotating pitch-change cam and the other to the hub. The rotating ratchet is free to move axially on splines in the cam and is mechanically engaged by multiple springs, being held out of engagement by the normal operating pressure in the pitch-change mechanism. The lock is brought into engagement either directly by loss of oil pressure or through a signal indicating the existence of an overspeed. This signal is derived from an overspeed governor mounted on the propeller (in order that it may directly sense propeller r.p.m., and not engine r.p.m. in the event of a failure in the transmission between the propeller and the engine). When the propeller r.p.m. exceed the setting of the overspeed governor, the governor valve releases the oil pressure holding the lock out of engagement, thus allowing it to engage under the action of the peripheral springs.

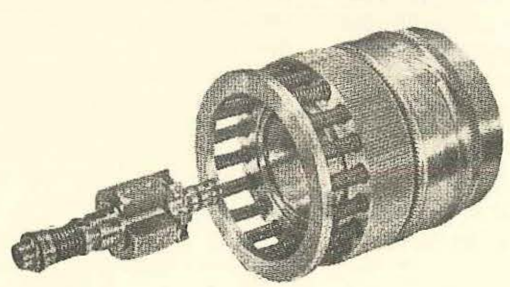
It is clearly essential that the overspeed governor shall transmit its signal and engage the mechanical lock before the blades have moved to a low pitch, and it is therefore desirable that the operating setting of the governor shall be only slightly above the normal r.p.m. in use at the time. This condition is met on the Tyne propeller by providing two datum settings on the overspeed governor, the choice of setting being coupled with the engine power lever to ensure that the setting in use at any given time is that which is nearest to the normal operating r.p.m. at that time.

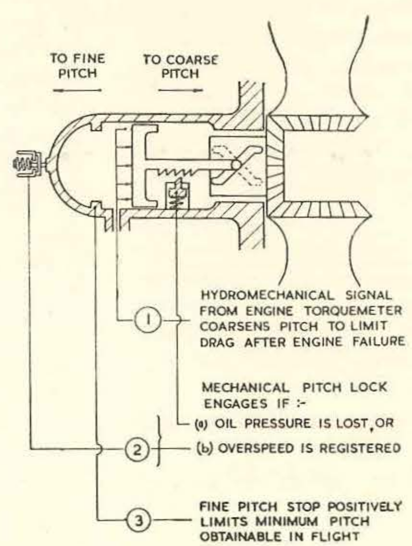
The change in datum from the low to the high setting of the overspeed governor is effected by bringing into operation a second governor spring by means of a servo-piston connected to a separate oil feed line in the engine shaft. When the engine throttle lever is advanced above the cruise position high pressure oil is fed to the servo-piston via this third oil line, thus bringing into operation the second governor spring and raising the governor datum. This feature also provides a method of checking the functioning of the pitch lock, for by providing a manual override it is possible to select the lower overspeed governor setting at a time when the propeller r.p.m. exceeds this setting, thus causing the lock to be engaged. Indication to the pilot of the correct functioning of the lock is then provided by the fall in r.p.m. of the locked-pitch propeller occurring when the engine power is reduced by the use of the fuel-flow trim lever. The action of all these features is summarised in diagrammatic form in Fig. 4.

Fig. 5 shows the behaviour of the propeller in terms of thrust, blade angle, and r.p.m. following the primary failure of the control valve in the constant-speed unit, with a contributory failure of the automatic drag-limiting system. Detailed studies of the effect of various single and double failure causes involving the engine and propeller have shown that a failure of the constant-speed unit control valve in a manner which permits a continuous fine-pitch signal (e.g., seizure of the valve in the maximum fine-pitch delivery position) is potentially the most dangerous type of failure which can occur.

Fig. 4 (right). Schematic diagram illustrating operation of mechanical pitch lock.

(Below) Part of the mechanical pitch lock assembly for the Tyne propeller, showing ratchet teeth which are forced into engagement by multiple springs following loss of oil pressure or overspeeding.





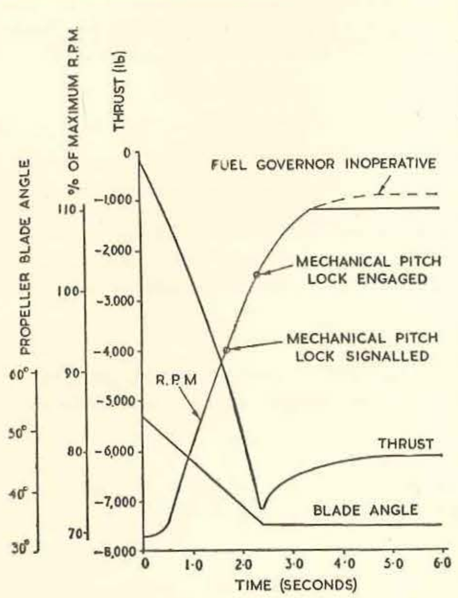


Fig. 5. Behaviour of a propeller following failures in c.s.u. and drag-limiting system.

The combination of such a failure with an unrelated contributory failure of the automatic drag-limiting system may be claimed to be an extremely remote possibility, but is nevertheless considered here in order to illustrate that the mechanical pitch lock still prevents the occurrence of catastrophic drag or r.p.m., although permitting a higher order of drag than the very low values provided by the automatic drag-limiting system. In Fig. 5 the failure is assumed to occur at a true airspeed of 370 knots at sea level with the throttle in the flight-idle position (e.g., at the end of a long, fast descent). After 1½ sec. the r.p.m. have risen to the setting of the overspeed governor, which signals the engagement of the mechanical pitch lock. The lock is engaged ½ sec. later. With the blades locked at this angle, 18 deg. finer than the initial operating angle, the engine cannot accelerate up to an r.p.m. greater than 10 per cent above normal maximum, with an associated drag of 5,900 lb.

The design of the safety features described in this article has been founded on a comprehensive series of analyses of the above type, covering various combinations of single and double failures of the power-plant and its control system. The inclusion of these features in the latest De Havilland propellers assures complete protection against the particular dangers associated with those failures of high-speed propeller-driving engines affecting the propeller system.

(This article written by a DeHavilland Propellers Engineer, extracted from "Flight" 25th April, 1958)

Do You Still Know!

1. **The procedures to be applied when two-way communication with Air Traffic Control cannot be maintained.**
2. **That the word AIREP shall precede all position reports that will include in-flight weather data.**
3. **That flight by public transport aircraft will not be approved at cruising levels below control area except on certain listed air routes.**
4. **That when commencing a change in level you should report leaving the original level.**
5. **The dimensional units approved for use in Australia.**
6. **The various S.A.R. phases that are introduced if you fail to report your position.**

Bristol Wayfarer Strikes Hill near Manchester, England

(Summary based on the report of the Ministry of Transport and Civil Aviation, United Kingdom)

On the morning of 27th February, 1958, a Bristol Type 170 aircraft (Wayfarer) flying from Ronaldsway Airport, Isle of Man, to Ringway Airport, Manchester, crashed near the summit of Winter Hill, which is about nine miles off the intended track as shown on the map. The captain and the first officer were among the seven survivors of a total of 42 persons on board.

The Court found that the accident was caused by the first officer tuning the radio compass to the incorrect beacon, and the neglect of the captain to check the radio compass was cited as a contributory cause.

A synopsis of the Report on the Public Inquiry is presented here together with our comment on certain points contained in the report which we consider to be of particular significance.

THE CIRCUMSTANCES

Forecast Weather Conditions

The route forecast for the flight was:—
Cloudy with periods of rain.
Wind—300°/25K.
cloud—Stratus $\frac{1}{8}$ - $\frac{3}{8}$ base 600-1000 feet. Strato-Cumulus-amount not given, base 2-3000 feet.
Visibility—3-6 miles. 1-3 miles at Ronaldsway.
Q.N.H. Ronaldsway—1024 mbs.

The forecast for Ringway Airport for E.T.A was:—
Rain.
Cloud—Stratus 4/8ths base 800 feet.
Strato-Cumulus 8/8ths base 1500 feet.

The Flight Plan

The flight plan was made out for a flight from Ronaldsway to Ringway along advisory air route ADR-159, to Wigan NDB and then to Ringway as directed by Manchester Control. The cruising height selected by the captain was 3,500 feet but just before departure the traffic situation dictated a choice of either a 15-minute delay or a change in the flight level to 1,500 feet. The latter was chosen and the time for the flight was estimated at 38 minutes. The first section of the flight was to be under Preston Control which required the aircraft to report abeam of Blackpool.

The Flight

The aircraft took off at 0915 hours with the captain occupying the left-hand seat. Other than a little cloud near the airfield the visibility was good and improved as the flight progressed. When approaching abeam of the Morecambe Lightship the captain obtained a bearing from Ronaldsway which placed the aircraft slightly port of track. He then handed over the controls to the first officer and went into the cabin to talk to the passengers.

The first officer then did a gentle "S" turn to regain track and tried unsuccessfully to set up the Decca equipment. He then tuned in the radio compass, as he thought, to the Wigan NDB. The captain returned to his seat after five minutes in the cabin and noticed the radio compass operating. The first officer indicated to him that it was tuned to Wigan beacon and the heading shown by the magnetic compass appeared to be consistent with this. At 0938 hours, one minute before E.T.A. at the reporting point abeam of Blackpool, the first officer advised Preston Control that the aircraft was at that point and estimated Wigan at 0943 hours. At 0939 hours Preston cleared the aircraft as far as Wigan NDB at a height of 1,500 feet with instructions to maintain "contact" or "visual contact". At Wigan NDB a clearance to Ringway was to be obtained from Manchester Control.

At 0942 hours Manchester Control requested the aircraft to confirm the previous E.T.A. Wigan, which it did. At 0942$\frac{1}{2}$ hours another aircraft in the vicinity, flying at 2,500 feet in cloud, advised the crew not to forget about the television mast. At 0944 hours Manchester Control asked, "Have you checked Wigan yet please " The reply was "Negative". At 0944$\frac{1}{2}$ hours Control asked, "Are you in visual contact with the ground," The reply to this was also "Negative".

At 0944$\frac{3}{4}$ hours Manchester Radar, through Control, instructed the aircraft to "Turn right immediately onto a heading of two five zero. I have a faint paint on radar which indicates you are going over towards the hills." The aircraft immediately acknowledged with "Two five zero right Roger." The aircraft made no further transmission.

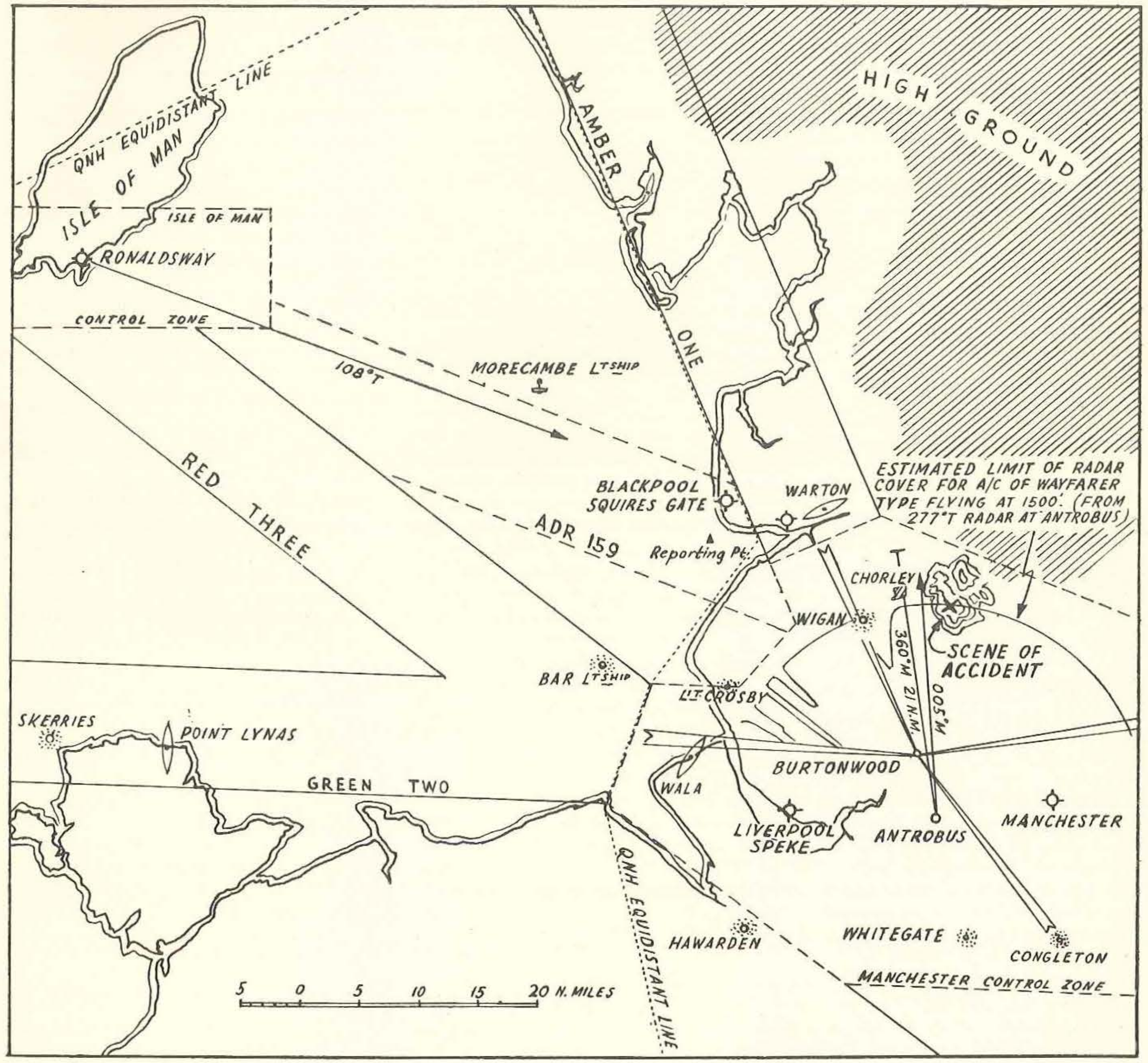
At 0945 hours while turning in dense cloud, the aircraft struck the north-east slope of Winter Hill about 40 feet below the summit.

THE INVESTIGATION

The Crew

The captain had flown over 6,000 hours and 625 hours of this had been on Bristol Wayfarers. He had proved competent in tests, responsible on duty, and was a company check captain. He had flown this route several times previously at heights above 2,500 feet and on one occasion at 1,500 feet.

The first officer had a total of 1,740 hours of which 1,250 hours were as second pilot in Wayfarer aircraft. On his three previous flights with this captain he had proved himself fully competent. Several times before he had flown from Ronaldsway to Manchester via route Red Three but not via advisory route ADR159 and Wigan beacon.



Condition of the Aircraft

The Certificate of Airworthiness was in order and the owners and operators had complied with all regulations concerning the maintenance of the aircraft and its equipment.

Load and Trim

Several errors were made by the Traffic Clerk when calculating the all-up-weight and the centre of gravity before departure. These included an incorrect statement of the ballast carried and the omission from the calculations of one entire row of passengers. In spite of this, it was later proved that the load and trim had been within the permissible limits.

Decca

The Decca equipment had been unserviceable on this aircraft for several weeks. On the morning of the flight the first officer noticed that it had been repaired on the previous day and he, therefore, tried to set it up for flight but was unable to do so before departure.

The Weather

In retrospect, the Court was of the opinion that the forecast issued for the flight was accurate and should have given the captain ample indication of the weather he would encounter.

Tuning of the Radio Compass

Examination of the aircraft wreckage showed the radio compass to have been tuned to Oldham Beacon at the time of impact. The tuning dial indicated 344 Kcs., the equipment was internally set to 344 Kcs. and the orientation of the loop aerial was consistent with such a setting. Oldham Beacon operates on a frequency of 344 Kcs. with an identification code of MYL and Wigan operates on 316 Kcs. with a code of MYK. When subsequently informed of this the first officer stated that he was positive that he had intended to tune to Wigan when he referred to the Aerad Flight Guide to obtain the frequency. When giving evidence he could recall checking the identification of the beacon after tuning the compass, but had no recollection of the identification code group which he heard. He agreed that he must have, in fact, tuned the compass incorrectly and to make the error, had probably looked up Wigan in the Aerad Flight Guide then, due to some distraction, read off the frequency and code group for Oldham. It is perhaps significant that Oldham appears four lines above Wigan and, of the ten beacons listed on the relevant page, all identification code groups begin with the letter "M". In four cases the second letter is "Y".

Adjustment to QNH

When an aircraft is about to cross the Q.N.H. Equidistant Line* it is required by regulations to change the altimeter setting to the Q.N.H. currently stipulated for the area which it is about to enter.

This new setting should have been given to the aircraft by Control when it reported at the position abeam of Blackpool. This was not done, due to a misinterpretation of the regulations by the Air Traffic Control officer. The captain, however, should have requested this information but the evidence did not reveal why he had not done so. The original setting of 1024 mbs. was set for the entire flight whereas it should have been changed to 1021 mbs. for the later section. In this regard it was pointed out that Winter Hill is 1,498 feet high and the aircraft crashed 40 feet below the summit with the altimeter overreading by approximately 90 feet.

Clearance to Wigan Beacon

In the terms of the clearance to Wigan Beacon given to the aircraft when abeam of Blackpool, the words "Contact" or Visual contact" were used. Although definitions of these two expressions could not be found it was revealed that they had been in use for many years and some degree of meaning had apparently been conveyed by them. The captain said he took them to mean flying with visual reference to the ground and to have sufficient all around visibility to avoid collision.

* The QNH Equidistant Line separates areas in which the standard altimeter setting used is the QNH prevailing at a specific meteorological station within each area.

OUR COMMENT

By finding the incorrect tuning of the radio compass as the cause of the accident the Court has, beyond question, selected what was the initial or fundamental error in a fatal sequence. It seems to us that other circumstances combined with this error to produce the final result and it would seem that the most significant of these was the action of continuing the flight in weather which precluded the terms of the flight clearance being met.

The conditions of the clearance to Wigan NDB as the captain understood them, included that he should be able to navigate by visual reference to the ground and have visibility sufficient to avoid collision. It seems indisputable that these conditions were not only reasonable but were a well-recognised requirement for a flight of this nature.

KEY TO DO YOU STILL KNOW!

1. AIP/SAR/1-5
2. AIP/RAC/1-9-4
3. AIP/RAC/1-7-8
4. AIP/RAC/1-4-1
5. AIP/GEN/5-1
6. AIP/SAR/1-13

TWO Accidents — ONE CAUSE

As readers of this Digest will have observed, accidents for the most part follow a pattern as to circumstance and cause. Occasionally, however, as in other fields of endeavour, an accident occurs which is outside the usual pattern and which is interesting for that reason alone. The following is an account of two accidents which we believe are quite unusual, if not incredible, and are published more for that reason than any lesson to be learnt from them.

During a dual training period in a DH.82 aircraft the student pilot taxied out, took-off and flew around the circuit making an approach and landing. The aircraft touched down to the right of the centre-line of the strip and then commenced a swing to the right. The student pilot did not straighten up and so the instructor took over when the aircraft was getting close to the runway lights and applied power in an attempt to take-off again. He lifted the aircraft at a slow speed to avoid the lights and it then swung to the right. Even though the instructor had full left rudder applied the aircraft continued to turn to the right, so he closed the throttle and touched down again on an adjacent runway which was under construction. The aircraft scraped both wing tips before coming to rest.

After the accident the instructor noticed that the luggage locker door was open and thought that this might have been the reason for the aircraft failing to respond to the rudder. When the repairs were finished he assisted the engineer to test the rudder controls from the rear cockpit.

Early on the following morning, the aircraft was flown solo by a club member and then the same student pilot and instructor who had been involved in the minor accident of the previous day boarded the aircraft. The student fitted the control column in the front cockpit and later when occupying the rear cockpit conducted a careful check of controls having in mind the previous day's experience. The take-off was commenced by the student pilot but, at 300 feet, the instructor observed the aircraft to be turning to the right. He tried to correct this turn by applying left rudder and in doing so he found his left rudder pedal fully forward. He asked the student "Is your left rudder fully out?" and the student answered in the affirmative intending to imply that he was exerting some pressure on the left rudder pedal. The instructor immediately took over, realising that they were experiencing a repetition of the trouble of the previous day, and from that stage on the student pilot did not again touch the controls.

The instructor attempted to stop the right turn by applying left bank after confirming that use of the rudder pedals was ineffective. The right turn continued, however, and he decided to endeavour to control the rate of turn with opposite bank and the rate of descent with engine power, having ascertained that the right turn continued even with all power off. This method helped to avoid numerous power lines which traverse the area but could not prevent eventual heavy contact with the ground on the right wing and nose; fortunately this occurred clear of residential areas and in light scrub approximately one mile beyond the upwind end of the runway used for the take-off.

The pilots were unable to provide the investigator with any reasonable explanation for these accidents but in the course of his examination of the wreckage it was discovered that the rudder bar connecting the rear rudder pedals to those in the front cockpit was not installed. Further inquiries revealed that the connecting bar had been removed two days prior to the first accident and that it was not subsequently replaced. It was also learned that no check was carried out either during repairs or in pre-flight preparations to see if the rudder was operative from the front cockpit.

DC.3 Survives Mountain Strike in Cloud, Arizona

(Summary based on the report of the Civil Aeronautics Board, U.S.A.)

A DC.3 aircraft struck a mountain ridge approximately 40 miles north of Phoenix, Arizona, and lost approximately 12 feet of the outer portion of its left wing. The aircraft, although substantially damaged, landed safely at Phoenix and the 26 occupants were not injured.

THE FLIGHT

The aircraft was engaged on a scheduled service from Denver, Colorado to Phoenix, Arizona, with intermediate stops. Prior to departure from Prescott, Arizona, the pilot elected to change the flight from I.F.R. to V.F.R. for the final stage of the flight to Phoenix. During the approach to Prescott, he had looked towards Phoenix and considered that weather in that direction warranted a continuance of V.F.R. flight. Departure from Prescott was made at 1321, hours. Following takeoff the aircraft was climbed to a cruising altitude of 6,500 feet and proceeded to a point 35 miles from Prescott where the latest Phoenix weather was requested at 1335 hours. The Phoenix weather report at 1330 hours was given as: 1,500 scattered, 3,000 broken, 10,000 overcast, visibility 12 miles, wind west 18 to 30 knots; light rainshowers. The flight acknowledged this message at 1339 hours and said that it was approaching the Knob intersection and requested an Air Route Traffic Control clearance to Phoenix. Five minutes later the flight was cleared from Knob intersection to Phoenix omni and to maintain 7000. As there was no acknowledgement of the clearance, the radio operator called the flight again. The flight answered and said "Just hit a downdraught, declaring an emergency, changing to tower frequency". Following this transmission the flight contacted Phoenix approach control and received the current Phoenix weather and approach clearance.

At 1400 hours the flight advised the company that it was coming in and had lost a portion of its left wing and aileron. After this message the flight again changed to approach control frequency and was given the appropriate approach instructions and landing clearance. The aircraft landed at 1405 hours without further incident.

INVESTIGATION

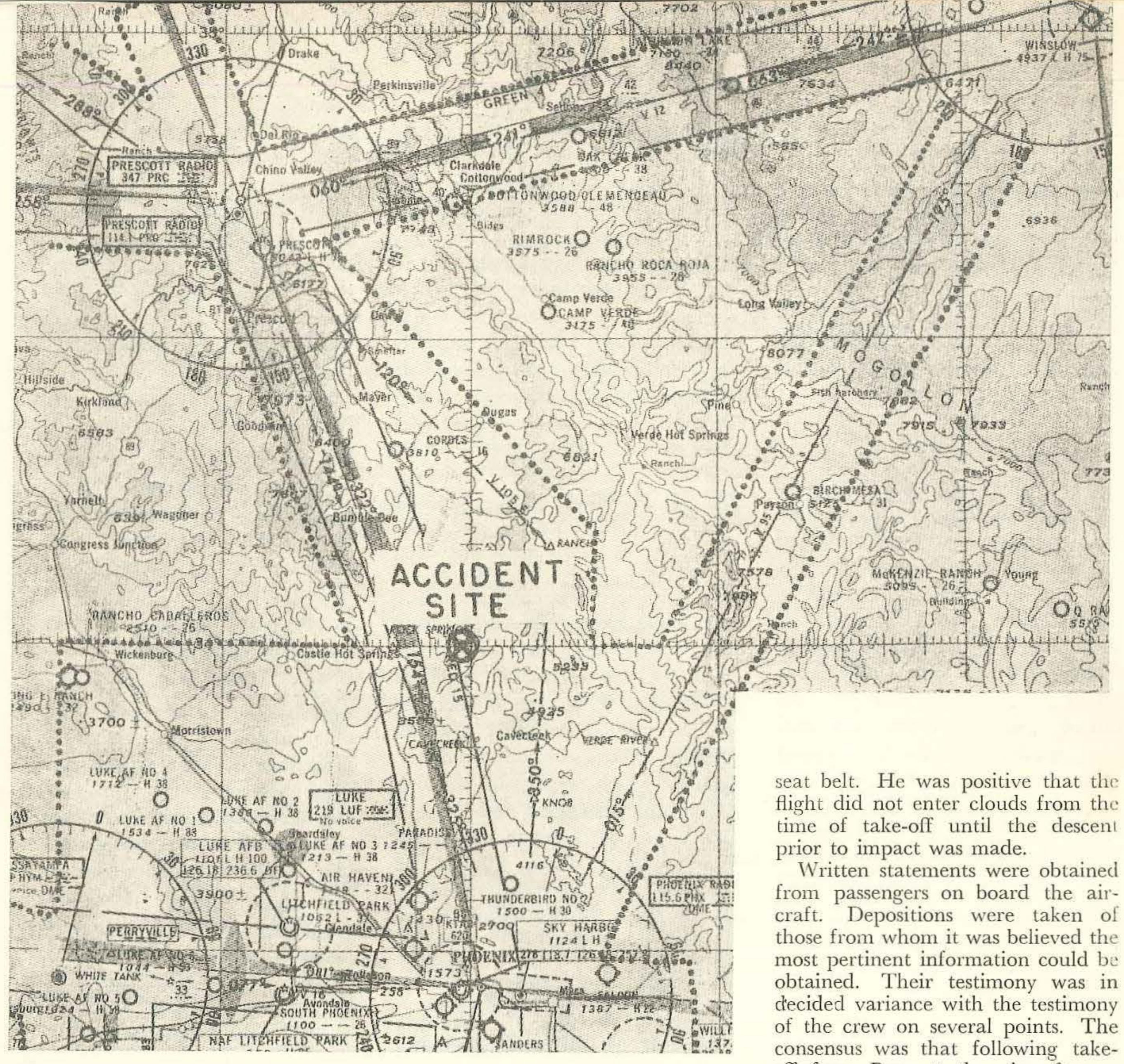
The separated portion of the left wing was located at an approximate elevation of 4,600 feet on the west ridge of a mountain, the peak of which is 5,000 feet (see sketch). The examination of the terrain at the scene of the accident, and the wreckage itself, showed that the left wing of the aircraft had struck a small tree, some large rocks and large cactus plant. Investigation revealed that the aircraft struck the mountain in a nose-up attitude.

A thorough examination of the entire aircraft showed that all damage was confined to the left wing and aileron assembly.

According to the testimony of the crew at the time of departure from Prescott there was an overcast of 8,200 feet, scattered clouds at 1,800 feet, and it had been raining intermittently. The aircraft was climbed to a cruising altitude of 6,500 feet, and a course was taken toward Phoenix following the Black Canyon Highway, which lies east of the Bradshaw mountains. The flight continued beneath the overcast and free of all clouds until in the vicinity of Rock Springs, Arizona (approximately 45 miles south of Prescott). There was only mild turbulence throughout this portion of the flight. Nearing Rock Springs the weather ahead appeared to be worsening. The captain said that the overcast was definitely lowering and the scattered clouds which had been beneath them appeared to be forming an almost solid cloud deck. The cloud layers were converging and in the distance ahead there were large cloud buildups. Because of this weather condition it was decided that an I.F.R. flight plan should be requested. Accordingly, the flight called the company at Phoenix and requested the latest weather. This was given them. The crew then tried to call Phoenix approach control to obtain an I.F.R. clearance and being unsuccessful in reaching them again called the company and said that it was approaching Knob intersection and wished an instrument clearance from ARTC. This latter transmission was made at 1339 hours. At this time the flight changed its course to a heading which would intercept Knob intersection.

The captain said the decision to fly to Knob intersection and then to Phoenix was made because the flight could be made over this route at a lower altitude, thereby saving time. At 1344 hours the flight received its clearance to fly from Knob intersection to the Phoenix omni and to maintain an altitude of 7,000 feet.

The crew further testified that immediately following receipt of this clearance the climb to 7,000 feet was begun. As climb power was applied the aircraft began to settle. At first this settling was not seriously considered; however, as it continued, additional power was applied. The fact that the aircraft was settling became known to the crew first by a drop in airspeed from 130 knots to approximately 115 knots. The rate-of-climb indicated a gradual rate of descent; but, as the settling continued, a rate of descent of approximately 1,000 feet per minute was observed. As it became increasingly noticeable that the added power was not stopping the descent, even more power was added. Since this power was also not effective the throttles



were placed in the full open position and the propellers at full low pitch. By this time the aircraft was in a snow squall which seriously impaired visibility. The airspeed at that time indicated 90 knots and the mountain peak below was hazily visible through the storm. Despite all efforts to the contrary, the settling continued until the left wing of the aircraft struck the ground. According to the captain, immediately following impact the aircraft staggered, rolled to its left, and continued to settle. Power was immediately reduced on the right engine and full right rudder was applied. With the return of full power to the right engine the aircraft regained airspeed and slowly returned to level flight and, although aileron control was seriously restricted, the aircraft was climbed to its assigned altitude and the flight to Phoenix was continued. The crew said that instrument weather prevailed from the time of impact until the final descent at Phoenix.

The captain described the air through which the aircraft descended 1,900 feet as a "soggy airmass". He said the downdraught was not precipitous and caused little or no pressure of the body against the seat belt. He was positive that the flight did not enter clouds from the time of take-off until the descent prior to impact was made.

Written statements were obtained from passengers on board the aircraft. Depositions were taken of those from whom it was believed the most pertinent information could be obtained. Their testimony was in decided variance with the testimony of the crew on several points. The consensus was that following take-off from Prescott the aircraft was flown near the base of the overcast and for the first few minutes of flight was free of all clouds; that as the flight progressed southward clouds were intermittently flown through which completely obscured vision; and that four or five minutes prior to impact the aircraft was flying in dense clouds. None felt or sensed any downdraught nor did they hear application of power beyond that which was used in cruise configuration. Some passengers, especially those who were accustomed to flying as airline passengers and two who flew their own aircraft, testified that the cloud deck beneath which the aircraft was flying appeared to be lowering as the flight progressed southward and that although they were not able to determine definitely the altitude of the aircraft they believed that it was flying lower than usual. They based this belief on the fact that when free from clouds they were able to clearly see and identify objects on the ground. Several passengers said they believed that just prior to impact the aircraft was flying in level flight.

ANALYSIS

The flight was eleven minutes late departing Prescott because of en route headwinds. Whether this in any way affected the captain's decision to fly V.F.R. to Phoenix is not definitely known. The two airway routes from Prescott to Phoenix, V-105 (Red 51) and V-105E, have minimum en route I.F.R. altitudes out of Prescott of 10,000 and 9,000 feet respectively. Since the elevation of the Prescott airport is 5,042 feet an I.F.R. clearance using either of these airways would necessitate a time-consuming climb. Considering also the possibility of additional delays as a result of I.F.R. flight it is probable that these factors did contribute to the captain's decision not to file an I.F.R. flight plan.

In the original preparation for this flight the captain decided, after studying all the available weather data, that a cold front would be in the vicinity of Winslow en route to Prescott when the flight arrived there. The fact that he did not encounter the cold front as expected, combined with the continuing rain at Prescott, should have forewarned the captain that a front might be encountered between Prescott and Phoenix. A check of the sequence weather reports would have confirmed this probability. A study of the available weather information at Prescott should have further indicated to the crew that V.F.R. flight would be extremely marginal.

The captain stated that he did not at any time during the flight fly through clouds prior to impact except during the uncontrolled descent caused by the downdraught. The passengers aboard the aircraft, and the stewardess, testified that the aircraft intermittently flew through clouds and that for a few minutes before impact it was flying in solid instrument weather. It is recognised that the view which the passengers have from their windows would differ greatly from the view which the crew has from the cockpit. However, the testimony that the aircraft at times was flying in clouds was so clear that the Board believes this condition existed.

The request for an ARTC clearance was made at 1339 hours. The clearance was given the flight at 1344 hours. One minute later the station agent at Phoenix acknowledged a transmission from the flight in which the captain acknowledged the clearance and advised that he was declaring an emergency. The captain also said that at the time the flight first encountered a downdraught it was either at an altitude of 6,500 feet or was between 6,500 and 7,000 feet. Since the elapsed time between the last two messages was approximately one minute the aircraft must have descended approximately 1,900 feet during that time. It is not reasonable to believe that the crew, the stewardess, or the passengers would not have sensed a rapid descent of this magnitude. The captain described this unusual downdraught as being associated with a "soggy" air mass and that such an air mass would readily explain why no one felt the precipitous descent. The captain stated that throughout the descent, power beyond that needed for cruising, was added three times and that the final application of power was made by placing the throttles fully forward. Again, none of the passengers in the aircraft cabin heard any additional power being applied. It is understandable that if power was applied some of the passengers might possibly have heard it but paid no attention. However, the two passengers who are pilots and whose ears are sensitive to changing engine sounds were seated in the aircraft where they could hear these sounds and did not.

In conclusion, the Board believes that the flight after departing Prescott attempted to fly beneath the overcast. The Board further believes that the overcast lowered as the flight progressed towards Phoenix and that intermittently the aircraft flew through clouds ultimately going on solid instruments several minutes before the crash.

Also, meteorological conditions were not conducive to the presence of a sustained downdraught of the magnitude described by the captain. The low-level winds were westerly and therefore crossed the mountain ridge in a manner actually more likely to produce updraughts rather than downdraughts. Added to this, the Board believes that a downdraught of this proportion, occurring in such a short time, would have been apparent to the passengers. The Board believes therefore that the aircraft was being flown at a dangerously low altitude over mountainous terrain.

PROBABLE CAUSE

The Board determined that the probable cause of this accident was the attempt by the pilot to fly over mountainous terrain by visual reference to the ground in weather conditions which severely restricted forward visibility and necessitated a descent to a dangerously low altitude.

Reluctant Dragon

Shortly after taking-off from Katherine, Northern Territory, the pilot of a DH.84 found that, although full power was applied, the aircraft would not climb above 100 feet and also that any attempt to increase speed caused the aircraft to lose height. He landed the aircraft three miles from the aerodrome in the only available clear area but the aircraft overturned after running 160 feet. The pilot and two passengers received minor injuries and the aircraft and a quantity of freight were substantially damaged.

The aircraft had flown from Darwin to Katherine to pick up two passengers (the hirers) and a quantity of freight to be transported to an outstation. After refuelling, the payload available was 605 lb. plus the two passengers. The freight which was not weighed consisted mainly of glass louvres. The investigation revealed that 1,002 lb. of freight was actually loaded, that is, the all-up-weight was 397 lb. in excess of the maximum permissible. Due to the careless manner in which the aircraft was loaded, it was not possible to positively establish the distribution of the load or the position of the centre of gravity.

Take-off was made on the sealed runway 5,000 feet in length, the wind conditions being light and variable, temperature 95°F, and the weather fine. The tail came up after running about 900 feet and the aircraft became airborne after using 4,000 feet of runway. When the pilot commenced to turn right at about 50 ft. the airspeed started to drop and he was obliged to continue almost straight ahead. Level flight was maintained at about 100 feet with full power but the airspeed fluctuated around 55-60 knots and the aircraft was in a nose high attitude. It is apparent that the aircraft had become airborne because of the increased lift associated with ground effect, and once beyond this effect the aircraft was unable to climb.

After continuing in this manner for three miles the pilot considered it was unsafe to continue the flight and decided to attempt a landing in the only clearing available—a cultivated area 320 feet wide divided into three paddocks 600 feet, 900 feet, and 600 feet in length. The aircraft touched down in the three point attitude in the second paddock about 80 feet beyond the fence. After 23 feet the tailwheel left the ground and after a further 140 feet the aircraft overturned. It was apparent from the wheel marks that braking had been applied almost from the point of touchdown until the undercarriage collapsed and the aircraft nosed over.

The cause of the accident was a load condition which lowered the performance of the aircraft to the extent that the pilot deemed it necessary to land immediately and this resulted in a landing on an unsuitable area.

COMMENT

This accident would have been avoided had the pilot taken the care to load the aircraft within acceptable limits. Action has now been taken by the operator to ensure that all freight is properly weighed and load charts drawn up. There was no need to learn this lesson the hard way, as there is a wealth of information freely available on proper loading practices and procedures. It so happens in aviation that the commonsense rules for the protection of life also protect the financial interests. The surprising thing is that this point is so frequently overlooked.

A Distorted Vision

A student pilot on his first solo flight at Archerfield in a DH.82 touched down on the main wheels and bounced some two or three feet into the air. Believing that he had bounced much higher than this he pushed the stick forward and opened the throttle with the intention of landing again further down the strip. The aircraft struck the ground again and turned over on its back.

Although this student had had a little difficulty in reaching the required standard during the dual training period, his instructor was at a loss to explain such a poor performance even on first solo. The training school was on the point of dismissing it as another case of first solo nerves when it was discovered that the student's goggles had correcting lenses although his vision was normal. The effect of wearing these goggles was to cause a big change in depth perception and, considering this handicap, it is amazing that the student did so well in his earlier training.

The goggles had been purchased as a disposals item and were RAF MK.X issue fitted with angular lenses, the front lenses containing a correction and the side ones being normal. The student had noticed their effect on his vision but was reluctant to blame the goggles for his training difficulties fearing that this complaint would be regarded as a weak excuse. There is little doubt, however, that his misconception of the height to which the aircraft bounced in this landing was due to the effect of these unsuitable goggles.

Although more than one incident of this nature is not likely in a lifetime, this occurrence points very strongly to the continuing need for an instructor's interest in his student's flying equipment to ensure that it is both adequate and safe.

What's The Use!

Perhaps you are one who has tried the incident reporting system and found the delays difficult to understand. Maybe your correspondence was not acknowledged simply because you did not indicate on the report form your desire to be informed, or was it that our final words reached you well after your interest had died?

Of course, it doesn't take months to investigate and process all reports but some of them do take considerable time for they are not treated lightly. The story of the investigation of a relatively simple report that was received may serve to show you the interest that is taken in the reports you submit.

A pilot reported as follows :—
"At 0714 hours we set course . . . . from Sydney on the 244° diversion and at 0715 hours we were cleared to Sydney aeradio. Repeated calls were made to Sydney aeradio endeavouring to notify them of our departure but without success. At 0718 hours the tower was contacted again and we advised that we were unable to contact aeradio. It was suggested by the tower to "try again". We switched back to aeradio and received them loud and clear. This business of not being able to receive Sydney aeradio has occurred to me and many others repeatedly when very close to the station. I suggest that investigation be made re the above to clarify the position so that we will know if Sydney aeradio can't be bothered listening out on 122.9 mcs. or if it is local conditions."

Immediately on receipt of the report a check was made of the relevant tape recordings, all frequencies, and the air traffic control intercommunications system, being recorded on the one multi-channel tape.

On the playback:

(a) the initial call could be heard very faintly but it was necessary to replay the recording six times before the details could be copied,

(b) the next two calls from the aircraft were similarly faint,

(c) air traffic control were heard to ask aeradio if the aircraft had been received, the communications officer replying that he thought he had heard an aircraft but he couldn't read the transmission,

(d) the aircraft then called aeradio again and contact was established.

In checking the recorded transmission the marked difference between the loud and clear signal received by the tower on 118.1 mcs. and the weak signal received by aeradio on 122.9 mcs. approximately a minute later, was readily apparent. It was also noticeable that each of the recorded transmissions from the aircraft to aeradio was stronger than the previous call.

Further checks of the recordings revealed that two other aircraft which had departed from Sydney 30 minutes earlier than the subject aircraft exhibited a similar difference in the recorded signal strength of 118.1 mcs. and 122.9 mcs. A fourth aircraft, after leaving 118.1 mcs. inadvertently called on 122.1 mcs. This transmission was loud and clear. The aircraft then called on 122.9 mcs. and was barely readable until it was some distance from Sydney.

At this stage it was clear that the incident report was not the result of the communications officer not bothering to listen out. It appeared that the 122.9 mcs service was definitely inferior to that of the other frequencies although no previous complaints from pilots had been received nor had the equipment been declared faulty by the communications staff.

For the next week pilots who would normally work 122.9 mcs. after departure were briefed to use 122.1 mcs, immediately any difficulty was experienced in working Sydney on 122.9 mcs. During the same period, communications officers operating 122.9 mcs. kept a special record of all signals received. During this period departure calls from 215 aircraft were logged — in 202 instances the readability was recorded as "four or five" and the difficulties in making contact experienced by the other 13 aircraft were traced to aircraft equipment faults. Concurrently, a sample survey of pilots' views was made but although this indicated there were occasional difficulties it was not conclusive.

No fault could be found with the equipment or aerial system. As the 122.9 mcs. aerial was at the same location as the 122.1 mcs. aerial and, as no difficulty was being experienced on 122.1 mcs., aerial siting was obviously not involved.

About two weeks after the completion of the survey it was noted that departure signals received on 122.9 mcs. were again weak and distorted. It was thought that the strong signals on departure may have been blocking the RF stages of the receiver but a check indicated that the aircraft would normally have been a fair distance from the aerodrome. The receiver was again thoroughly checked and a faulty resistor was found in the audio limiter but no fault was found in the RF section. The faulty resistor would have adversely affected strong signals but it was not a type of failure which would have resulted in intermittent operations. Therefore, it is questionable if this resistor could have been responsible for the previous poor reception.

What has been achieved? Nothing positive to date in relation to the difficulties reported. Certainly we haven't received any more reports of poor communications concerning 122.9 mcs. at Sydney but that needn't mean very much for we hadn't received any other reports of difficult communications prior to the submission of the incident report.

OUR COMMENT

The scope of the investigation makes it clear that the incident report was not pigeon-holed or given only cursory consideration. Every incident report or suggestion submitted through the incident system receives similar treatment.

If you have a problem, or if you consider facilities or procedures can be improved, we would appreciate your suggestions, and the opportunity to review the situation with the aim of achieving a higher standard of service and consequently a higher standard of safety.

Abandoned Take-off from New Haven Airport, Connecticut

(Summary based on the report of the Civil Aeronautics Board, U.S.A.)

A Convair 240 abandoned its take-off at the New Haven Municipal Airport, Connecticut, on March 1, 1958. The aircraft, with the landing gear retracted and the left engine nacelle and wing burning, skidded to a stop on the runway. Considerable damage resulted and two of the five passengers received minor injuries; the three crew members were uninjured.

THE FLIGHT

The aircraft was engaged on a scheduled passenger flight from Boston to New York with stops at New Haven and Bridgeport. The flight to New Haven was uneventful and the aircraft was prepared for the second stage of the flight to Bridgeport. There is no air traffic control tower at New Haven, and the aircraft moved onto the runway and take-off was initiated from a taxi start without delay. This segment of the flight was being flown by the first officer but the captain, seated on the left, maintained directional control during the initial acceleration of the aircraft. Before the aircraft reached the intersection of the runways, the landing gear was retracted and the aircraft skidded down the runway near its centre and came to rest 1,050 feet from the far end. The crew and passengers left the aircraft through the right emergency escape hatch and the partially opened front entrance. Fire around the left engine and the left outboard wing area caused considerable damage and was extinguished by the local fire department.

INVESTIGATION

The captain testified that just before reaching V1 speed he saw the left engine fire warning light come on and simultaneously heard the fire warning bell. He was watching the runway and terrain beyond, occasionally glancing in the cockpit for airspeed indications. His left hand was on the nosewheel steering control, his right hand at the landing gear selector location. He further said that following the observation of this fire warning, he looked back at the left engine and saw fire in the vicinity of the outboard residual heat door. He immediately called this to the attention of the first officer, remarking, "we're on fire, put it back down" or words to that effect, and then retracted the landing gear for a fast deceleration. The left firewall shut off valves were then closed and the CO2 fire extinguisher for this engine was discharged. Retracting the wing flaps and accomplishing the remaining engine shut down duties continued until the aircraft came to rest.

The first officer testified that he observed the airspeed indicator at 85 knots, at which time everything was normal and the aircraft was in a nose-up attitude ready to become airborne. He further testified he saw the left engine fire warning light and heard the warning bell after the captain remarked that the engine was on fire. At this time he had back pressure on the control yoke and was preparing to increase the angle of attack of the aircraft in anticipation of V2 speed. He held back pressure on the control yoke until the captain informed him of the fire, at which time he retarded the throttles, pulling them into the reverse position. Immediately thereafter the aircraft settled to the ground.

None of the five passengers observed fire until just before the aircraft stopped. Only one of the four ground witnesses said he saw fire during the early part of the take-off roll. Another ground witness, positioned near this witness, said that he first saw smoke and fire when the aircraft passed the runway intersection, several hundred feet further on.

The first impact marks on the runway were made by the tail skid and the bottom skin of the fuselage immediately forward of it. These marks started 1,380 feet from the beginning of the take-off roll and continued for a distance of 1,686 feet. Propeller slash marks started about 120 feet beyond the initial impact marks and continued for a distance of 343 feet and 378 feet for the left and right propellers, respectively. Initial slash marks were spaced 2 feet 6 inches apart. The calculated ground speed of the aircraft at the time of ground impact, based upon the propeller slash marks and r.p.m. governor settings, was approximately 93 knots, 7 knots below the V1 speed of 100 knots.

The left wing and the outboard side of the nacelle of No. 1 engine were extensively damaged by fire.

The left engine was removed intact from the aircraft and installed on a test stand where it was operated at 1,000, 2,200, and 2,800 r.p.m. These three r.p.m. settings were selected because they represented, in order, an average slow engine speed, an r.p.m. giving a manifold pressure equal to the standard barometric pressure, and the maximum take-off r.p.m. All temperatures and pressures were found to be normal.

During the entire test stand operation, which totalled approximately 1 hour and 40 minutes, there were no indications of fluid leakage, engine roughness or below normal performance.

The fire warning system on the left engine was checked for continuity and was found to be intact and capable of normal operation. All tests of the fire warning system showed it to be capable of normal operation.

During the functional testing of the fire warning system in the cockpit, the landing gear safety solenoid was observed to be continuously energised. The solenoid is normally de-energised when the landing gear is extended and the weight of the aircraft is on the landing gear. The function of the safety solenoid is to prevent inadvertent retraction of the landing gear when the aircraft is on the ground. The safety switch cover plate was removed and it was found that the circlip on the switch shaft, which positions the switch actuator arm, was missing. This missing clip allowed the actuator arm to move 7/16 of an inch from its normal position, permitting the switch contacts to remain closed. In this condition, the defective safety switch energised the landing gear safety solenoid withdrawing the latch pin, thus allowing the gear selector handle to be placed in the "UP" position and the landing gear to retract even though the weight of the aircraft was on the gear. Normally, the landing gear cannot be raised while the landing gear strut is compressed by the weight of the aircraft on the ground unless the latch pin, which protrudes through a hole in the landing gear selector handle, is depressed manually, permitting the handle to be raised. Neither the captain nor the first officer was aware of this unsafe condition.

ANALYSIS

The captain said that before reaching V1 speed in the take-off roll he observed the fire, heard and saw the fire warnings, and decided to scuttle the aircraft to bring it to a quick stop. It is difficult to reconcile these statements with at least three facts. The first is that having been the captain of Convair aircraft for more than two years and having acquired a total flying time of 4,600 hours on this type, of which 1,322 were acquired as captain, he should have known how the landing gear retraction system functioned; also, he should have known that under normal operating conditions, the landing gear selector handle could not be raised to retract the landing gear until the gear no longer carried the weight of the aircraft.

The second fact is that the statements of passengers and eyewitnesses, which are substantiated by the examination of the physical wreckage, do not support the presence of fire prior to ground impact. The third and equally important fact is that at the time of gear retraction more than ample runway remained to brake to a successful stop and even had there been a fire in the left engine no necessity existed for scuttling the aircraft.

The testimony of the captain is inconsistent with the clear and substantiated evidence on record in this investigation. Under the circumstances, the Board could not accept the statement of the captain. The Board therefore concluded that fire did not occur until after the aircraft settled; that the captain, instead of intentionally raising the gear as he stated, not knowing that the safety switch was malfunctioning, actually caused the gear to be raised unintentionally. Poor piloting technique was displayed by the captain in placing and keeping his hand on the landing gear selector handle and by his uncalled for action in applying an upward pressure on this lever in anticipation of the first officer's command to raise the gear. The accident would not and could not have occurred without the captain's improper procedure in applying upward pressure to the landing gear selector handle and malfunction of the landing gear safety switch.

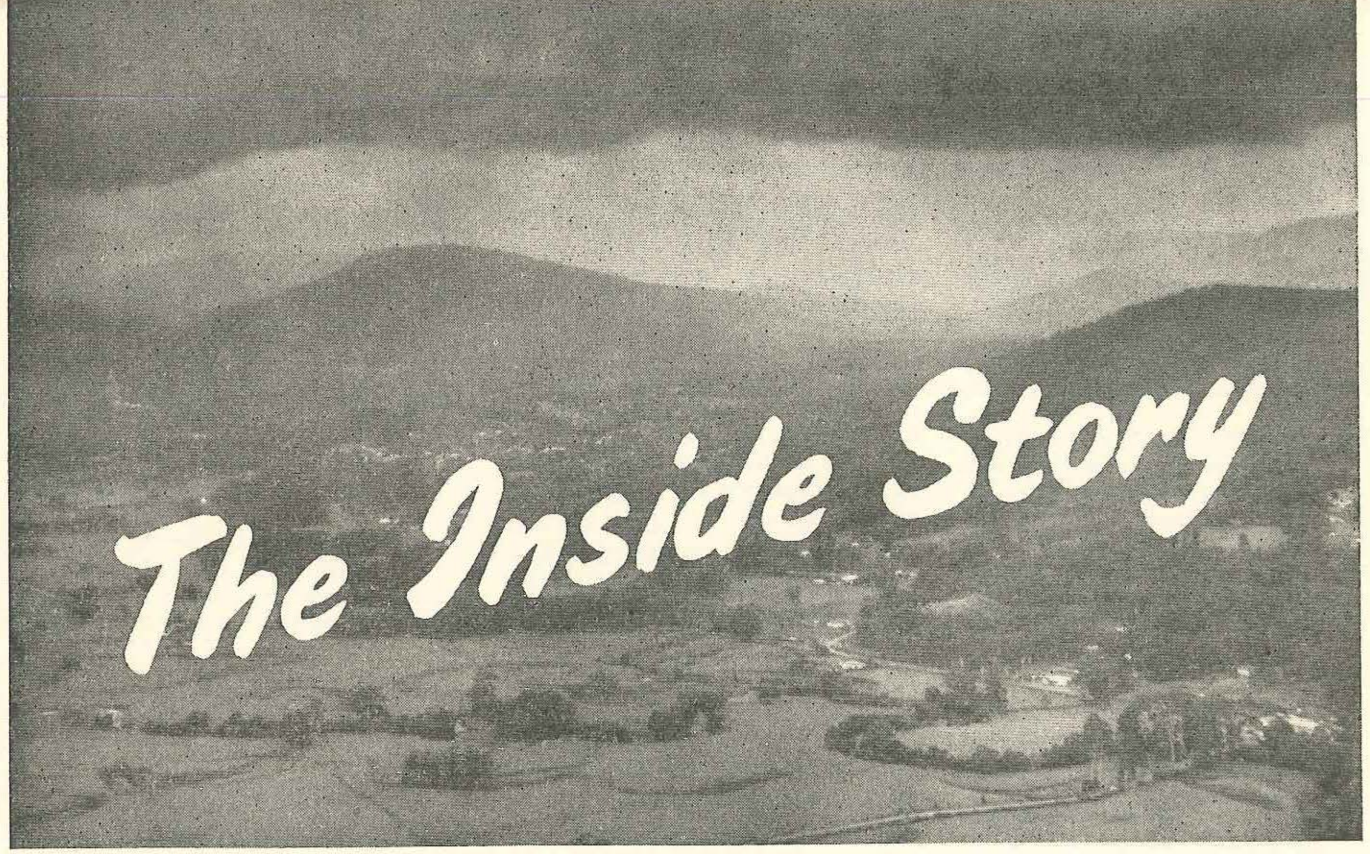
PROBABLE CAUSE

The Board determined that the probable cause of this accident was the improper technique of the captain resulting in the unintentional retraction of the landing gear prior to V1 speed, which was made possible by a malfunctioning left gear safety switch. A contributing factor was inadequate inspection by the operator.

Correct Weight?

The following report is offered without comment except to say that a number of similar reports are received each year —

"DHC.3, VH-—, was loaded in preparation for a charter flight; the load consisted of tractor parts and as these were too heavy to be weighed on the company scales the weights provided by the charterer were accepted. The aircraft was loaded and the station engineer noticed that the tail strut was very low and the main wheel tyres were distorted. The load was removed and taken by truck to the Government weighing bridge where it was found to be 799 lb. in excess of manifested weight. This amount was off-loaded and the flight proceeded.



The Inside Story

Last winter when on a cross-country flight in New South Wales, a private pilot encountered difficulty in maintaining VFR whilst attempting to fly over mountainous terrain. After climbing to over 7,000 feet to get on top of the cloud—and thereby entering a busy control area — he was forced to descend when fuel was down to about three gallons. Fortunately he found a break in the cloud and was able to carry out a precautionary landing in a paddock without damage to the aircraft.

In Australia during 1958 thirty-two people lost their lives as a result of aircraft accidents. Of these, eleven died as a result of pilots attempting instrument flight when they had not been trained or were not proficient in the art.

Now that winter is again with us, the following frank account by the pilot involved in the above incident conveys an important message.

"I had recently obtained my private pilot licence, having flown some 88 hours, of which only 20 minutes was instrument flying. As I was anxious to obtain my commercial pilot licence I hired an aircraft from the local aero club for a period of five days — this being during my annual leave. During these five days it was my intention to fly around the country to build up my hours, and to take a friend as a passenger for company.

"After departing from my base we were delayed for one day at the first stop and another day at the second stop. Naturally I was anxious to get an early start the following day. As I was in a hurry I did not bother to obtain a weather forecast or briefing, besides the weather at the aerodrome was fine and calm, there being no clouds in the sky. Flight details were not mandatory for the next leg of the flight so I did not bother to submit them.

"I took off at some time after 0800 hours and set course for our destination, a distance of about 150 miles. Approximately 45 minutes later I arrived over the first township of any consequence

and I pinpointed myself about one mile to port of my course. The altimeter read somewhere around the 4,000 feet mark. Patches of cloud were observed but these were by-passed as I began to climb to get over a wall of strato-cumulus cloud that lay ahead. Having reached about 7,000 feet I found that we were surrounded by cloud and decided to head to starboard of track and hope for some large breaks in the cloud around the coast. Knowing the coast I decided I was "pretty right" as I had the choice of a number of aerodromes situated in the coastal area if there was insufficient fuel to reach my destination.

"On first encountering the cloud I did not give the slightest thought to turning back. I had every confidence that I would find breaks out towards the coast, or even fine weather. Even though some 15 minutes later the weather had not improved I decided to continue.

"When I became worried it was too late to turn back. Due to worry I found I could not concentrate properly and my standard of flying fell off rapidly. For instance, when descending through a break I put down full flap and used partial power. I passed through scud on the way down and on arriving at the bottom I saw that I had no chance of flying below the cloud due to the high terrain. I immediately began to panic and worry as I was faced with a probable crash landing if no suitable fields could be found through cloud breaks. I climbed back to the top of the clouds, levelled-off and headed again towards the coast. I had been flying for about five minutes when I glanced at the airspeed indicator and saw that it was at least 15 knots below normal cruising speed. I immediately applied maximum power and carried out several hasty cockpit checks in an endeavour to find the cause of the reduced airspeed. I was still puzzling over this when my passenger, who had become airsick with worry, asked me if I was going to pull the flaps up. This is only one example of poor flying that occurred due to worry.

"Few breaks in the cloud were encountered but on two occasions I decided to descend through breaks in the hope that I could continue the flight underneath the cloud. Both times I came out over high country in heavy rain and observed the cloud to be on "the deck". Finally, after flying for about two hours forty-five minutes and when fuel was down to three or four gallons, I found a break over fairly level terrain — due mainly to good luck rather than good judgment. My only thought was to get down. At this stage I was about to throw in the towel. I had no thought whatsoever for the aircraft provided I could walk away from the landing. Fortunately, the landing was successful and the aircraft was undamaged.

"This flight provided ample opportunity for me to learn and I can assure you I have learnt but in retrospect, the experience should have been unnecessary; it could have been costly and it could easily have been fatal.

"My advice to pilots is to always put a good deal of preparation and time into flight planning. Always obtain a meteorological forecast. Keep clear of cloud. Don't be afraid to turn back, remember it is better to make the decision too early rather than too late. If you are running short of fuel it is better to attempt a precautionary landing while power is available rather than stay in the air and run out of fuel hoping for something better to turn up."

OUR COMMENT

The pilot concerned contributed this article because he would like others to benefit from his experience. It isn't easy to tell a story like this against oneself and, apart from his unselfishness in trying to help others, his frank account of what happened is most commendable.

As is evident from this story, only fortuitous circumstances kept the pilot and his passenger from becoming another unit in our fatal accident statistics. Carefully digested, the lessons of his experience could do the same for you.

Landing Accident, Boca Raton Airport, Florida

(Summary based on the report of the Civil Aeronautics Board, U.S.A.)

A Fairchild C.82, engaged in a fruit spraying operation, was destroyed by ground impact and the ensuing fire when it crashed during a "go-round" after an attempted landing at Boca Raton Airport, Florida, at approximately 0505 hours on 8th August, 1956. The occupants of the aircraft, namely the pilot, co-pilot, and three company insecticide-mixer personnel, were all fatally injured.

THE FLIGHT

The aircraft departed Masters Field, Miami, Florida, accompanied by another C.82 at 0448 hours on 8th August, 1956, and proceeded at an altitude of 500 feet on a direct 36 mile flight to Boca Raton Airport, from which the spraying operation was to be conducted.

Arrival over the airport was made as dawn was breaking—sunrise was at 0550 hours—and the runways, although unlighted, were plainly visible. The subject aircraft, which was leading slightly below the accompanying aircraft, selected the northeast runway, made a right turn and then commenced the approach. After passing over more than one-third of the length of the 5,000 foot runway, a go-round was initiated. The aircraft immediately went into a climbing left turn. During this turn the aircraft stalled and crashed. Fire occurred immediately. The other C.82 landed normally after circling the airport several times.

INVESTIGATION

The position of the wreckage was found to be 1,540 feet to the left of Runway 4, measured from a point on the runway 3,020 feet from its approach end. The aircraft struck the ground in a steep nose-down right wing-low attitude on a heading of approximately 130 degrees. It then rotated to the left and came to rest on a heading of approximately 60 degrees. Both engines were torn from their nacelles, the right engine remaining a few feet from the point of impact and the left engine going 42 feet to the north-west.

Examination of both engines revealed no evidence of fire in flight. Teardown of the left engine revealed a failure of the rear master rod bearing. Oil holes from the rear main bearing journal to the rear crankpin were completely plugged with hard sludge. The progressive failure of this master rod bearing had resulted in piston damage which permitted crankcase oil to enter the combustion chamber and exit through the exhaust ports. This condition caused oil deposits on the left side of the aircraft. There was no evidence of oil deposits on the right side of the aircraft and examination of the right engine revealed no evidence of malfunction or structural failure.

The No. 1 propeller was not feathered and all blades remained unbroken in the hub with no indication of high rotational forces at impact. Examination disclosed no defect in the feathering system. The No. 2 propeller gave indications of high rotational forces at impact. The shaft splines were twisted an estimated six degrees opposite to the direction of rotation. Two propeller blades, broken off at their shanks were bent forward more than 35 degrees and one of these blades had a bend of approximately 20 degrees opposite to the direction of rotation.

The aircraft structure and controls were examined for possible inflight malfunction or failure; none was found.

The crew of the C.82 accompanying the subject aircraft testified that puffs of blue smoke, about a minute apart, were observed coming from the aircraft about five minutes before reaching Boca Raton. Interplane radio contacts, although possible, were not made. When the aircraft was over Boca Raton, ground witnesses observed an increase in this smoke trail as well as a change of colour to reddish. These ground witnesses also heard the sounds of uneven operation of one engine. The sounds were described as spluttering or backfiring. None of the witnesses observed actual fire.

With reference to the runway alignment, the captain of the accompanying aircraft testified, "I proceeded around my turn to the left and observed him to be approximately lined up for the runway but he could have been about 10 degrees to the left. He appeared to be in a three-point landing position about one-third of the way up the runway. Then I observed him to start a left climbing turn at a normal rate. Approximately over the point where the wreckage was later found I observed the aircraft to fall out over the top viciously to the right."

ANALYSIS

It appears that failure of the left engine rear master rod bearing was progressive and occurred during the last few minutes of flight. It probably did not become serious until the aircraft was at the south side of the airport. The cause of the bearing failure could not be determined owing to the physical damage that had occurred. However, the presence of sludge in the lubricating oil ports suggests that inadequate lubrication caused by this condition may have initiated the failure. When the aircraft was southeast of the airport over Boca Raton it was in a good position to land straight ahead on the northwest runway. The wind was calm and the only reason for continuing west to land on the northeast runway was that the landing roll would have ended near the company insecticide mixing station at the northeast corner of the airport. Because the opportunity to land northwest was passed up, it may be assumed that the left engine operating difficulty was not as serious then, as it became very soon afterwards.

The engine manufacturer recommends a reduction of 100 r.p.m. for each one-inch reduction of manifold pressure. It is doubtful if the practice was always maintained during spray operations which require frequent power changes. If so, the master rod bearing may have been excessively loaded at these times which contributed to its failure.

It is believed that the crew did not become aware of a serious engine malfunctioning until the go-round was started. The final approach had resulted in poor runway alignment, necessitating a go-round. The left propeller was not feathered during the attempted go-round, resulting in additional drag.

Contact with the ground came from a stall "over-the-top" while in a left turn, as observed by the captain of the accompanying C.82. A tendency for the aircraft to turn left, because of a malfunctioning left engine and low airspeed, would be resisted by the pilot's use of top rudder and this action is one way that an "over-the-top" spin will occur.

Although the landing gear was observed to have been in the extended position while the aircraft was approaching the airport, examination of the wreckage revealed that the landing gear was retracted at the time of impact. C.82 landing gear retraction tests indicate the average retraction time to be 12 seconds. This amount of time would allow the gear to be retracted during the left turn which covered approximately 2,400 feet.

PROBABLE CAUSE

The probable cause of this accident was loss of power on the left engine and the drag-induced effect of the unfeathered left propeller; resulting in loss of directional control during an attempted go-round.

Learning About FIRE

A military jet containing 2,420 gallons of JP-4 fuel was being tested on a ramp at a "joint-usage" airport recently when an explosion occurred. The explosion ruptured a fuel line on the discharge side of the fuel pump and since the pump continued to operate, fuel under pressure was flooding the ramp area and a fire was instantaneous with the explosion.

Fire fighting equipment arrived on the scene promptly and while the vehicles could keep the fire under control and prevent it from spreading to other aircraft, they were not successful in stopping the flow of fuel or the flames which were around the aircraft initially involved. The hole in the severed fuel line and the pressure of the fuel discharge were handicaps and efforts to pinch the fuel line or to insert rubber plugs to slow down the rate of discharge were unsuccessful. The splashing fuel made working in the area most hazardous.

A city fire department fire fighter suggested that a 55-gallon drum be brought to the scene and filled with foam. This drum (cut approximately in half) was pushed under the aircraft and the severed line inserted so that the fuel was being discharged beneath the foam blanket in the drum. The fire was immediately extinguished. Up to the time that the suggestion was made and used, some 41,000 gallons of finished foam had been expended without being able to extinguish the fire which involved a total of about 1,600 gallons of JP-4 fuel. In contrast, following the fire fighter's suggestion, the fire was extinguished with a cut-off drum and 15 gallons of foam liquid.

COMMENT

Any one of us could be confronted with a similar situation sometime before we are retired and the lesson could pay off if stored away for use at the critical moment.

Undoubtedly, the fire fighter whose suggestion brought about the control of this fire was a person who was thoroughly seasoned to emergency situations of this nature and thereby able to think quickly and clearly.

There is a right and wrong way of dealing with emergency situations. Are you fitted to act in the right way?

LANDING GEAR –
Wheel Assem; Main

Sharp-Edged Washers Cause Fatigue Failures

the Situation

Serious accidents have occurred due to breakage of landing gear wheel castings and forgings. Fracture usually is preceded by small fatigue cracks starting, and spreading rapidly until the weakened wheel collapses when landing loads are applied.*

the Hazard

Cracks are found wherever tie-bolt washers have been improperly installed. Washers, carelessly placed with their sharp edge against the corner radius of the spotface, dig into the metal when nuts are tightened. This creates points of high stress concentration where fatigue is likely to begin. The danger is intensified by the cracks being hidden under the washers until serious damage becomes evident.

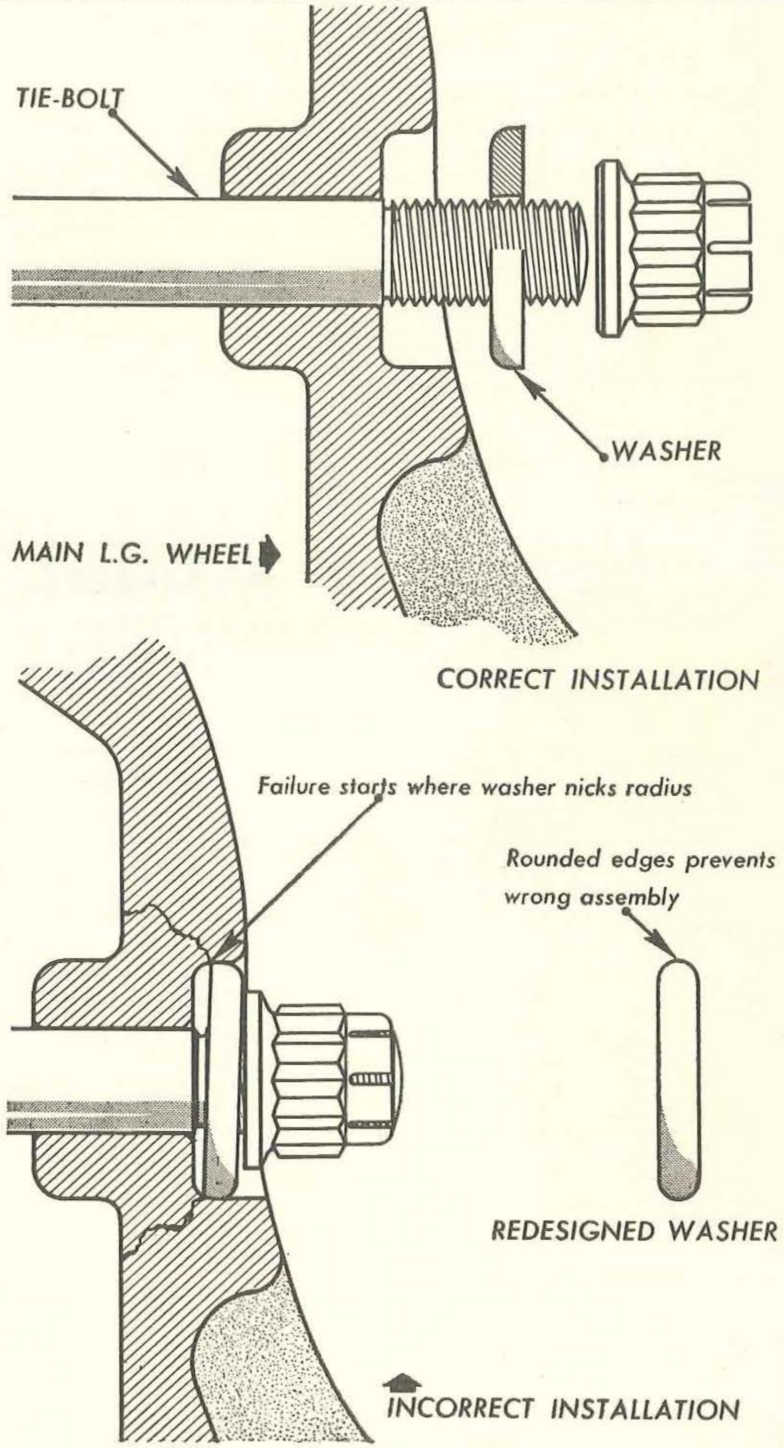
Main landing gear wheels of large aircraft have 18 tie-bolts, 36 washers and nuts, all of which are removed when tires are changed. The relatively large number of parts, and the washers being unsymmetrical, increases the possibility of errors being made in assembly.**

the Fix

Washers having both edges rounded to fit the spotface radius eliminates the possibility of a wrong installation of washers being made.

* Ref: Directorate of Flight Safety Research, USAF, Norton AFB, Calif.

**Murphy's Law: "If an aircraft part can be installed incorrectly, someone will install it that way."



(By Courtesy Flight Safety Foundation, Inc.)