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CONTENTS

(Prepared by Division of Accident Investigation and Anaysis. Published by authority of Director-General.)

News and Views

Flight Instruments and Electrical Power Failure Warning

(Reproduced from Pilots' Safety Exchange Bulletin 57-104 issued by the Flight Safety Foundation, New York, U.S.A.)

A recent investigation of an air transport accident involving a "sudden and surprising" crash landing almost immediately after take-off, disclosed inadequacies in the present-day electrical power failure warning system, particularly as it affects flight instruments. While actual in-flight instrument failures are not commonplace, they have happened and have been attested to by highly qualified and experienced pilots. For example, while on an ILS approach, the captain of a twin-engine transport reported his horizon slowly indicated a bank. The first officer, who was flying the plane from the left seat, tried to keep the airplane in relation to what the horizon was telling him. The horizon on the right side, however, was indicating just the reverse, so the captain corrected the manoeuvre. Investigation subsequently disclosed that the horizon on the left side had failed with no warning light indication. The trouble was found to be in the Phase C circuit — the 115V Phase Circuit breaker had popped out. This incident proves a point that may not be well known to any one except electronics specialists, namely, that the inverter failure warning lights may not give warning where there is loss of only one phase of AC power.

In the light (or lack of it) of this most recent experience, the results of electrical tests performed on a sister-ship of the one involved in the crash landing may be of interest, particularly to those who operate aircraft employing only electrical flight instruments.

Those doing the tests included a C.A.A. aviation safety agent, a C.A.B. electrical systems specialist and three airline captains.

Following are the facts of their report —

At the beginning of the tests, the aircraft was parked with engines off and d.c. power supplied by a ground power unit. The d.c. bus voltage was measured to be 28 volts. Magnetic compass heading read 170°. Captain's and first officer's Collins Course Indicator compass cards read 175°.

Main inverters were turned on. Captain's selector switch was placed in 'Up' position; engine instrument selector switch was in 'Up'; first officer's selector switch was in 'Down' position. Output voltage of each inverter was measured to be 115 volts a.c.; frequency 410 c.p.s.

Compass Card Reaction

As inverters were turned on, compass cards of the two Collins Course Indicators were watched closely. Neither changed position. Slaving knob of captain's C-2 gyrosyn was rotated to displace the dial. Captain's course indicator compass card slaved to C-2, while first officer's course indicator card was unaffected.

After turning on inverters, time for gyro horizons to erect were: captain's horizon — 8 seconds; first officer's horizon—3 minutes.

Phase A—Upper Inverter

After allowing the gyros time to reach operating speed, Phase A circuit breaker of upper inverter was opened:

1. Captain's inverter warning light did not light.

2. Captain's gyro horizon tumbled 2 minutes later. Bar moved up and to the left, then over to the right. C-2 gyrosyn slaving knob was turned and captain's course indicator compass card followed gyrosyn card.

3. Cabin pressure control could not be checked while unpressurised.

4. Fuel quantity: no reading.

5. Engine Analyser: not installed.

6. Zero Reader: Vertical main pointer of the indicator and heading arrow of heading selector slaved with C-2. When heading selector setting was changed, vertical main pointer responded.

7. VOR No. 1: went off.

8. VHF No. 1: went off.

9. Glideslope No. 1: went off.

10. ADF No. 1: Receiver went off and there was no needle movement.

Phase C — Upper Inverter

Phase A circuit breaker of upper inverter was closed and time allowed for gyros to reach operating speed. Phase C circuit breaker was opened:

1. Captain's inverter warning light came on at once.

2. Captain's gyro horizon tumbled 3 minutes later. Bar moved up and to left, then to right and down to centre in level attitude, then moved up. C-2 slaving knob was turned, but captain's course indicator compass card would not follow gyrosyn card.

3. Zero Reader went off. Flag came up for vertical main pointer of indicator and it would not receive heading information from C-2.

4. ADF No. 1 came on, but no pointer indication.

Phase A — Lower Inverter

Phase C circuit breaker of upper inverter was closed; Phase A circuit breaker of lower inverter was opened:

1. First officer's inverter warning light did not come on.

2. First officer's gyro horizon tumbled 2 minutes later. The horizon bar lowered with slight tilt to left, then raised with slight tilt to right. It reached top and rested in level attitude. When instrument was tapped by hand, bar fell off to left.

3. Pedestal lights stayed on.

4. Power to A-12 gyro pilot was off. With aircraft at rest, slaving of co-pilot's course indicator card to A-12 gyrosyn compass could not be checked.

5. Radio Altimeter: not installed.

6. Loran: not installed.

7. ADF No. 2: Receiver was off and indicator was inoperative.

8. Glideslope Receiver No. 2: This unit was on. (Inspection disclosed this unit was equipped with d.c. power supply incorporating dynamotor).

9. VOR No. 2: This receiver was off.

Phase C — Lower Inverter

Phase A circuit breaker of lower inverter was closed and time was allowed for gyros to reach operating speed. Phase C circuit breaker of lower inverter was opened:

1. First officer's inverter warning light came on at once.

2. Power to A-12 gyro pilot was on. With aircraft at rest, slaving of co-pilot's course indicator card to A-12 gyrosyn compass could not be checked.

3. First officer's gyro horizon tumbled 6 minutes later. Horizon bar moved up while tilting to left. It then moved down while still remaining tilted to left.

Phase C circuit breaker of lower inverter was closed and time was allowed for gyros to reach operating speed.

Captain's Instrument Transformer

Fuse in Phase A of primary of the captain's instrument transformer was removed. The captain's inverter warning light did not come on at once. However, it did come on 5 minutes later while the group waited for gyro horizon to tumble.

Phase A fuse was replaced after allowing gyros to reach operating speed; Phase C fuse of primary side of same transformer was pulled. Captain's inverter warning light came on immediately.

Fuse was replaced. Following a similar procedure, Phase A and Phase C fuses of secondary side of transformer were individually removed. In each case the warning light came on as soon as fuse was removed.

All instruments were then operated from the upper inverter and its circuit breakers individually opened to observe the behaviour of the inverter warning lights. When Phase A circuit breaker was opened, neither the captain's nor first officer's warning light came on. When Phase C circuit breaker was opened, the warning lights came on at once.

With the inverter selection again set so the captain's flight and engine instruments were on the upper, and the first officer's flight instruments on the lower, checks were made; Secondary voltage of the captain's instrument transformer was measured between Phases A and C and found to be 26 volts a.c. Allowing time for the gyros to reach operating speed, the Phase A circuit breaker of the upper inverter was opened. The secondary voltage rose from 26 to 29 volts and remained constant while being observed for 1.5 minutes.

Transformer Fuse Removal

This check was repeated by removing Phase A fuse of the captain's instrument transformer primary instead of opening the Phase A circuit breaker of the upper inverter; voltage in the secondary immediately fell to 25 volts and began to slowly fall from that value After 5.5 minutes, captain's inverter failure warning light came on. At that instant the secondary voltage was 22.9 volts. The gyro horizon had not yet tumbled.

A check was made to determine what effect the C-2 gyrosyn would have on the secondary voltage when Phase A circuit breaker was opened. Fuses to the C-2 were removed and the test repeated wherein Phase A circuit breaker was opened. No difference in secondary voltage was noted. The voltage increased from 26 volts to 29 and remained there.

With same inverter selection, Phase A and Phase B circuit breakers of upper inverter were individually opened. Check was made to see if C-2 would slave to flux valves: with either circuit breaker open, there was no slaving action. Slaving of vertical main pointer of Zero Reader indicator was checked. When Phase A circuit breaker was opened, it slaved to C-2 gyrosyn. When Phase C circuit breaker was opened, it did not slave. Phase A and Phase C fuses of first officer's instrument transformer secondary were individually removed to see effect on first officer's inverter warning light. In each instance, the light came on immediately.

Emergency Inverter

No. 2 engine was started and its generator brought on the bus. Ground power was turned off and inverters on (Captain's flight and engine instruments on upper, first officer's flight instruments on lower). The emergency inverter was turned on by gang bar, and flight instruments operated properly with these exceptions:

1. Compass card of captain's course indicator was jumpy and would not rest on a heading.

2. Vertical main pointers of Zero Reader indicators moved continuously back and forth, right to left.

The Phase A fuse of the emergency inverter was removed and neither inverter failure warning light came on. Fuse was replaced and Phase C of emergency inverter removed. Both inverter failure warning lights came on at once. The emergency inverter was turned off.

Heading Indications

Remaining engines were started and aircraft was taxied to new location for further tests. As aircraft heading changed, compass card of first officer's course indicator rotated and indicated new headings in agreement with captain's course indicator compass card.

On same inverter switch selection, Phase A circuit breaker of upper inverter was opened. Engine instrument operation remained normal and captain's inverter warning failure light remained off. Fuel quantity indication ceased. A hard right turn of 360° was made and only a one-half needle width turn was indicated by the captain's turn and bank indicator. The gyro horizon tumbled after 1 minute and 45 seconds with the horizon bar falling and tilting to the left. At this time it was noted that the C-2 operated only as a directional gyro. It was not slaving to its flux valves.

The Phase A circuit breaker of the upper inverter was closed. The Phase A and Phase C fuses of the Zero Reader were removed and this had no effect upon the operation of the C-2 gyrosyn compass. The Zero Reader fuses were replaced.

The Phase A fuse of the captain's instrument transformer primary was removed, and the captain's inverter warning light did not come on at that time. After waiting about 30 seconds, a hard right turn of 360° was executed. The needle of the turn and bank did not respond to the turn. The C-2 and the course indicators worked properly. The captain's inverter warning light came on after 4.5 minutes. The horizon tumbled 7 minutes after removing the fuse. The horizon bar fell off to the left.

Phase A fuse was replaced. The inverter switches were unchanged and all Phase A loads were removed from the upper inverter except the captain's turn and bank and gyro horizon. The Phase A circuit breaker of the upper inverter was opened. The horizon bar tumbled to the left after 10 minutes and the captain's inverter warning light did not come on.

The circuit breaker was closed and the Phase A loads were re-installed. After allowing time for the gyros to reach operating speed, the Phase A circuit breaker of the upper inverter was opened. Forty seconds later the aircraft was taxied straight ahead. The gyro tumbled 1 minute, 10 seconds after the circuit breaker was opened. The horizon bar tilted to the left. The captain's inverter warning light did not come on. The circuit breaker was then closed. The testing was concluded at this point.

Until answers are found to the question of reliable performance of electrical flight instruments, adequate warning of power or instrument failure, etc., it would appear that an alternate means of flight instrumentation is desirable. For example, an air-driven flight group or non-electrically operated gyro instruments for primary use rather than utilizing only electrically driven instruments.

Comment

Most power failure warning systems sense a loss of power at the distribution bus-bars or at some other appropriate point as close as practicable to the take-off point for the feeders to the flight instruments. The failure of a flight instrument, or an open circuit in a feeder between that instrument and the take-off point for the power failure warning device, generally will not result in a warning of power failure.

The only method of obtaining a positive indication of an instrument failure under all conditions is to have a warning device built into the instrument itself to indicate that the gyro rotor is below the normal operating speed. Until such instruments are available and installed, it should be borne in mind that the failure of a flight instrument will not necessarily be indicated by the power failure warning device.

Tests are being conducted on all aircraft having a.c. flight instruments to determine the effects of various faults in the distribution system to those instruments. The appropriate operators will be advised of the results of these tests, and where necessary, the systems will be reviewed with the object of improving the reliability of the power failure warning devices.

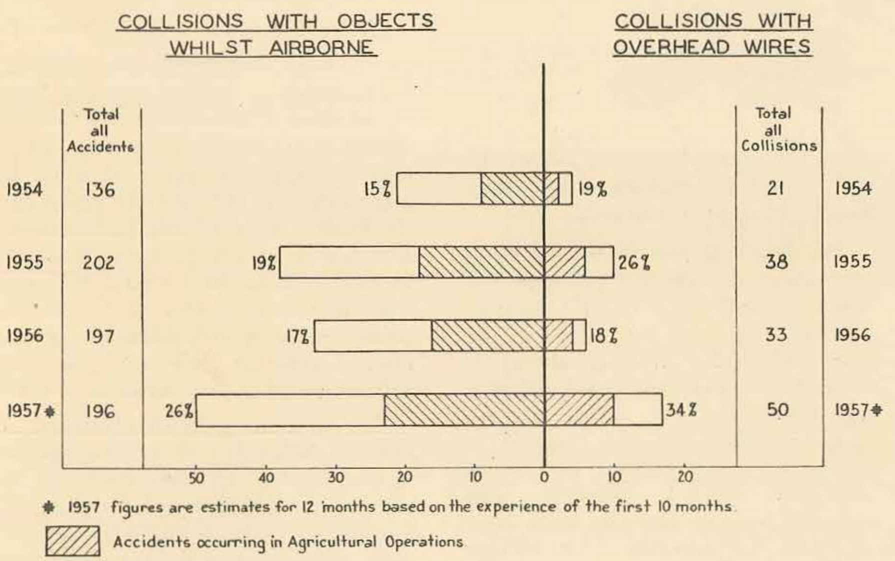
Collisions With Overhead Wires

During the first ten months of 1957 aircraft in flight struck overhead wires on 15 separate occasions. Five people lost their lives in these accidents, eleven others were injured and thirteen aircraft were either destroyed or substantially damaged. Clearly, this type of accident is avoidable and this waste of lives and aircraft is disturbing in a country which has an accident rate among the lowest in the world. Here is an obvious avenue for reducing it even further.

Let us add some perspective to these bare figures. The following bar chart summarises the Australian experience, since 1954, of airborne aircraft striking stationary objects.

The left hand side of the chart refers to collisions with all manner of stationary objects; a general trend for these occurrences to increase both in numbers and as a proportion of all accidents is evident. The increasing activity of the industry could be one explanation but the

AIRBORNE COLLISION ACCIDENTS



total of all types of accidents has remained at a fairly constant level over the past three years and this suggests that the change in the pattern of accident types is a reflection of the changing pattern of the industry's activity. Low level agricultural operations have increased sharply in the past three years and, in the very nature of this work, there is a propensity for airborne collisions. This by no means contains the whole story of the rise in the collision accidents as the bar chart illustrates. The shaded portion of each bar represents the proportion of these accidents occurring in agricultural operations and the remaining portion represents collision accidents in flying training and private operations. You will notice that both groups have contributed almost equally to each year's accidents in this category and to the increasing proportion of the category in the whole pattern of accident types. It is not easy to explain the increased number of collision accidents in private and training operations but the circumstances of this year's accidents suggest that private pilots are not maintaining the careful watch for obstructions which flight at low level demands.

The right hand side of the table refers to collisions with overhead wires both in numbers and as a proportion of all airborne collisions with stationary objects. Here again the trend of increase is repeated both in training and private operations and in agricultural operations. Slightly more than half of the collisions with overhead wires occurred in agricultural operations but each group has contributed to the annual increase in accidents of this type. It is also interesting to note that, of the eight deaths which have occurred in the past four years from collisions with overhead wires, only two have occurred in agricultural operations whilst the remaining six, including five deaths this year, have occurred in private or flying training operations.

Twenty-six percent of all accidents this year have involved an airborne collision with a stationary object and over one-third of these have been with overhead wires. Some of these accidents are publicised elsewhere in this or in other Digests but, for convenience, in the following table we put them all together including some preliminary information on accidents still under investigation.

1. **DH.82 at Lithgow—13.1.57**

An aero club pilot found himself out of reach of an aerodrome near the end of a cross-country flight and with the light rapidly fading. He was forced to land his aircraft on the outskirts of a provincial city and, during his approach to a sports field, he collided with telephone wires lining a suburban road. The aircraft was substantially damaged and the pilot and passenger suffered facial injuries.

2. **DH.82 at Gilgandra—24.2.57**

During a period of dual instruction at a country aero club, the flight instructor took the aircraft into the authorised low flying area and it was observed carrying out simulated forced landings followed by low flying practice. The aircraft was flying at about 35 feet when it collided with power cables carrying 11,000 volts. The cables were stretched across a cleared area but the wooden supporting poles were partly obscured by scrub. Both instructor and pupil were killed in the impact and the aircraft was destroyed by fire.

3. **DH.82 at Gatton—25.2.57**

A pilot, who had received substantial training in agricultural flying methods, was engaged in dusting a small field of potatoes. A power transmission line 30 feet high on wooden poles ran along its eastern boundary and the pilot carried out his runs heading north or south. The final two runs along the headland strips had to be made east and west and, on the first of these, the pilot misjudged the pull up point and hit the cables with the port interplane struts. The unconscious pilot was pulled from the wreckage just before the aircraft was consumed by fire.

4. **DHC.1 at Casino—23.3.57**

A private pilot took an aero club Chipmunk aircraft from a country centre and did a low level "beat-up" of a friend's house on a country property. He had indulged in this dangerous practice at the same spot on previous occasions but this time, on the third pass, he clipped the top of a fig tree near the house and collided with power cables. The pilot was killed on impact with the ground and the aircraft was burnt out.

5. **DH.82 at Lowood—2.4.57**

A pilot well experienced in agricultural operations, was engaged to dust a field of potatoes with sulphur. Power cables 26 feet high were suspended across one corner of the field and in the early runs the pilot flew in over the cables and out beneath them. After a number of such runs had been completed the aircraft struck them whilst descending into the field. The aircraft cartwheeled and burst into flames. The pilot was seriously injured.

6. **DH.82 at Gatton—17.4.57**

Before commencing to spray a potato field in a DH.82 aircraft a pilot noticed a line of power cables across one end. He did not inspect them closely but commenced spraying with the intention of passing beneath them on each run. In some of the spans single cables had drooped close to the ground and the aircraft struck one of these causing damage to the wing tip, but fortunately, no injury to the pilot.

7. **DH.82 at Nanangroe—16.5.57**

An experienced agricultural pilot had been spreading superphosphate on a large country property for over four weeks. The property, being close to a hydro power generating station, was criss-crossed with power lines carried at quite a variety of heights above ground level. At about mid-afternoon he was returning to the landing field flying at about 50 feet above the general level of the terrain in order to minimise the effect of slight turbulance. Close to the strip he had to cross power cables strung on poles, 35 feet high and 1,200 feet apart. He saw the cables too late to avoid them and the aircraft crashed heavily to the ground. The pilot was very fortunate to escape with minor injuries.

8. **DH.82 at Bungendore—22.5.57**

When two experienced pilots arrived at a station property to commence superphosphate spreading in DH.82s, they carried out both an aerial and a ground survey of the area. Three power cables 30 feet high crossed the southern approach to the landing strip 700 feet from the threshold. It was decided to conduct all take-offs towards the north and landings towards the south to avoid these cables. For three days, operations were continued without incident and the pilots then departed in opposite directions for night accommodation. On the following morning one pilot approached the landing strip from the south with a following wind and he decided to land in this direction. Not only did he make a low approach but, when he was a mile out and about 50 feet high, he noticed the other aircraft approaching the northern threshold of the same strip. He elected to continue the approach at about 45 knots with sufficient power to maintain level flight until the other aircraft had landed and cleared the strip. It was during this stage of the approach that the pilot suddenly saw the power cables immediately in front of him but too late to avoid them. The aircraft was badly damaged and the pilot received facial injuries.

9. **DH.82 at Binnaway—29.5.57**

An agricultural pilot commenced his first take-off for the day. The strip was dry, hard, 2,400 feet long and there was a headwind of 5 knots. The aircraft was loaded with superphosphate and failed to clear a power line 10 feet high crossing the south western end of the strip. The mainplanes struck a supporting pole and the aircraft was extensively damaged. The pilot escaped without injury.

10. **DH.82 at Derrinallum—1.6.57**

A pilot of limited experience in low level agricultural work was engaged in spraying weed killer along the boundaries of country properties to create grass fire breaks and to limit the spread of noxious weeds. As might be expected, many of these boundaries were lined with power and telephone cables and this pilot flew along and over these cables many times. On one run alongside cables 20 feet high and towards rising ground topped by cables 30 feet high he left the pull-up until too late and the aircraft struck the cables and crashed to the ground inverted. The aircraft was substantially damaged and the pilot received serious head injuries.

11. **Ryan S.T.M. at Corowa—3.8.57**

The pilot of a Ryan S.T.M. descended to a low height in the late afternoon to inspect a field for landing. He flew across the field at 20 feet into the sun, closely inspecting the surface conditions and, as he commenced to pull up over the trees along the boundary, the aircraft struck power lines suspended on wooden poles crossing the field. The aircraft crashed to the ground on its back but the pilot and passenger were only slightly injured.

12. **DHC.1 at Kellerberrin—26.8.57**

A flight instructor landed a Chipmunk in a large open field and later took-off in the same direction commencing at the end of the landing run. The aircraft ran into soft ground retarding acceleration and although it cleared the boundary fence the aircraft ran through a telephone wire which the pilot did not see. Minor damage was caused to the mainplanes and the pitot/static tube was pulled off but the aircraft continued with the flight to its destination without further incident.

13. **DH.82 at Narrandera—4.10.57**

This aircraft, in the hands of an experienced agricultural pilot, struck power lines on the final run of a crop spraying operation. The aircraft was extensively damaged and the pilot seriously injured.

14. **DHC.1 at Canberra—20.10.57**

An aero club Chipmunk flown by a private pilot with a passenger aboard struck overhead wires in the Club's training area and crashed to the ground. Both the pilot and passenger receive fatal injuries.

15. **DH.82 at Gawler—26.10.57**

The aircraft struck power cables whilst crop spraying. The aircraft was badly damaged but the pilot escaped with minor injuries.

Comment

These accidents emphasise that it is almost impossible to see overhead wires in flight in sufficient time to avoid them. If you must fly at danger height, survey the area first from a safe height looking for poles or towers which might carry wires. We can't bury the wires but they can bury you.

Hard experience has taught many agricultural pilots to survey operating areas carefully before getting down to work. Careful preparation of this sort is being nullified by forgetfulness or by deliberately flying too close to the wires—better to dust or spray those last few yards from the ground than risk your neck and aircraft in this way.

Private pilots and instructors must also appreciate the value of flying at a safe height or alternatively carrying out a preliminary survey of the area before attempting flight at low levels. It is wise to profit from the other fellow's experience—you may not have the chance of profiting from your own.

A Lesson Learnt

Do you recall the article "Ground Effect" which appeared in Aviation Safety Digest No. 9? It was a reprint from "The MATS Flyer" the United States Military Air Transport services safety magazine. The appearance of that article in "MATS" was directly responsible for preventing a C-97 Transport aircraft from ditching—the Captain has said so. The following quotation from a Flight Safety Foundation Bulletin refers to the incident.

"Proof of the value of 'The MATS Flyer' if additional proof there need be, was evidenced in the recent accomplishment of Major Samuel Tyson and his crew who brought their great C-97 safely to Hilo, Hawaii, after more than 1,000 miles of flying on just two engines. Soon after passing the point-of-no-return on a flight from Travis Air Force Base, California to Hickham Air Force Base, Oahu, Major Tyson experienced a runaway prop on No. 1 engine. The prop broke free and damaged the No. 2 engine, thus forcing two engines out of operation. Despite that, Major Tyson brought his limping C-97 to lower altitude and flew the 1000 miles to Hilo at an altitude of 100 to 150 feet.

"In an interview, Major Tyson credited an article in 'The MATS Flyer' for his awareness of the benefits of ground effect and his decision to take advantage of those benefits to bring his aircraft, crew and fifty-seven passengers to a safe landing at Hilo."

The sole purpose of "The MATS Flyer" and other safety magazines is that of education. In this one "save" The MATS Flyer has proved its value. If you are a "light reader" we would recommend that you carefully read all safety publications that come your way. There may be a save in them for you too.

Overseas Accidents

Crash Following Missed Approach

On 29th August, 1956, at approximately 2045 hours, a Douglas DC.6B crashed following a missed approach at Cold Bay Airport, Alaska. Eleven passengers, including one infant, and four crew members were fatally injured. Three passengers and four crew members received injuries of varying degree. The aircraft was destroyed by impact and fire.

The Flight

The aircraft was on a regular scheduled international flight from Vancouver, British Columbia, Canada, to Hong Kong, China, with a refuelling stop at Cold Bay, Alaska, and an intermediate stop at Tokyo, Japan. The aircraft, which departed from Vancouver at 1347 hours, carried 14 passengers and a crew of eight.

A clearance was issued in accordance with an instrument flight plan filed with Vancouver Airway Traffic Control. Position reports received from the flight indicated that it was making good its track slightly ahead of the estimated time. At 2035 hours it reported its position over the Cold Bay range station outbound on a standard instrument approach, and the last transmission from the flight was at 2042 hours when it reported completing a procedure turn and proceeding inbound.

At approximately 2045 hours the aircraft was observed to descend from the overcast north of the airport for a landing on runway 14 and cross the field at a low altitude to the intersection of the two runways. At this point a shallow left turn was started and the aircraft went out of sight south-east of the airport. Very soon thereafter fire was observed in that direction.

Investigation

Examination of the wreckage and ground marks disclosed that the aircraft first struck the ground at an elevation of 10 feet on a heading of approximately 40 degrees magnetic and 4,300 feet east-south-east of the approach end of runway 26. The physical evidence indicates that at the time of impact the aircraft was descending in a slightly nose-down attitude with the left wing down about 15 degrees. Computed ground speed at impact, based on propeller governor settings and propeller cuts in the ground, was approximately 186 knots.

The aircraft wreckage disclosed no evidence, so far as could be determined, of an in-flight structural failure of the airframe or malfunctioning of its systems. There was no indication of in-flight structural failure or malfunction of the engines, propellers or their related accessories. Examination of the propellers and propeller governors indicated that the blades of all propellers were at a blade angle of approximately 40 degrees and that the engines were operating at an average speed of 2,460 r.p.m. at the time of impact. It was computed that each of the four engines was delivering approximately 1,385 horsepower at impact, which is slightly more than cruise power. The landing gear and wing flaps were determined to be in the up, or retracted, positions at the time of impact.

The operator's manual, according to testimony of the chief pilot, specifies that, in the case of a missed approach, METO power is applied, the gear is retracted, and the flaps are retracted to 20 degrees for the climb-out. METO power of the aircraft involved was 1,900 h.p. and 2,600 r.p.m.

Ground witnesses testified that the aircraft, during its pass over runway 14, was flying at an estimated altitude of 100 - 120 feet above the ground, with the landing gear down, and landing lights on.

The company despatcher observed the aircraft break out of the overcast, appear to be making a landing, and then he heard power applied. He next observed the aircraft turn to the southeast over the intersection of runways 14 and 26 in a shallow climb. The despatcher held a microphone for V.H.F. radio contacts with the flight and was on the point of asking if the pilot wanted the lights switched to runway 26 when he saw fire at ground level.

None of the crew survivors recalled any aircraft operating difficulties prior to the impact. The surviving stewardess testified that she saw runway lights a short time before the crash. One flight crew member who was resting in a crew sleeping compartment stated that power was changed frequently during descent, and that the power applied for a missed approach seemed less than normal. He also said that he thought there was a feeling of "sink" just before the ground contact. The duty navigator, who was unable to see either outside or the two pilots because of a black-out curtain between his seat and the pilots, testified that he overheard one pilot say, "No, Phil" when power was being applied over runway 14. He also observed a reading of 160 feet on his altimeter which being set at 29.92 produced a reading approximately 30 feet higher than true.

The Cold Bay Airport has an elevation of 93 feet. The two runways 14 - 32 and 26 - 8 are 7,500 feet and 5,000 feet in length respectively, and intersect on the south side of the airport. The control tower was not operative and there was no C.A.A. Communications Station available. The facilities of one of two private air-ground communications stations on the airport were utilized by the operator to relay position reports, and to receive traffic clearances, weather information and local traffic conditions.

Navigation facilities in operation at Cold Bay include a private owned (Reeve) non-directional beacon, which is located off the approach end of runway 14 and operated on request only. No such request was received from the aircraft.

The airport is equipped with a rotating beacon and high-intensity runway lights that can be operated on only one runway at a time. During the flight's approach the high-intensity runway lights on runway 14 and approach lights to the runway were lighted and operating normally. In the vicinity of the airport, and in the quadrant in which the aircraft was flying when the accident occurred, there were few, if any, lights which would assist in orientation. The reported ceiling and visibility at Cold Bay at the time of the let down were the specified landing minima for the operator's DC.6 flights, viz. 500 feet and $1\frac{1}{2}$ miles.

The pilot had been qualified as a captain on the operator's domestic lines for over 10 years prior to assignment to the Overseas Division and his total flight time was 12,782 hours, which included 465 hours in DC.6 equipment. In accordance was Company policy, this flight was being accomplished under the supervision of a captain already qualified over the Vancouver - Hong Kong route.

Analysis

It is probable that the intention of the pilot during the approach was to land on runway 14, a straight-in landing from the inbound overheading of the range station. The breakout, after descending through the overcast, may have been too close in and high and these factors, together with excessive ground speed due to a quartering tailwind may have caused the captain to decide to go around.

Although the missed approach procedure at Cold Bay prescribes a climb to 2,700 feet on the north leg of the range, the company despatcher, who observed the aircraft and was in radio contact with it, thought that the flight intended to circle under the 500 feet ceiling and land on another runway. He was about to ask the flight if they wanted the other runway (26 - 8) lighted when the crash occurred.

Considering that very little altitude was gained after the application of power it is probable that a circling aproach had been decided upon when the left turn from runway 14 was made. It is believed that the wing flaps were retracted shortly before impact. This would explain the feeling of "sink" experienced by the off-duty flight crew member.

The investigating authority believes that the airspeed of the aircraft at the time the flaps were retracted was approximately 130 to 140 knots. This is supported by several facts. According to company procedure it is normal on the downwind leg of an approach to a runway for the aircraft to fly at an airspeed of approximately 140 knots with wing flaps extended 20 degrees, also when the aircraft passed over runway 14 it was in landing configuration. Since only slightly better than cruise power was applied at this time, and as the distance to the point of impact was approximately one mile, it is unlikely that the airspeed of the aircraft would have been much greater than 140 knots when the flaps were retracted. As the subject aircraft was in a clean configuration (gear and flaps up) immediately prior to the accident, with a tailwind of approximately 20 knots it would be reasonable to assume that the speed of the aircraft increased during the final descent. Therefore, the initial speed of 140 knots plus the speed gained during the descent, together with the 20 knot tailwind, would result in a speed on impact approximately equivalent to that deduced from the propeller cuts on the ground.

It is evident that the aircraft struck the ground while descending in a slight left turn and while all four engines were not operating at the prescribed power settings necessary to execute a missed approach procedure. The flap retraction without a compensating increase in power, or change in attitude or combination thereof, caused a substantial loss of lift resulting in a loss of altitude.

Probable Cause

It was concluded that the probable cause of the accident was the full retraction of the wing flaps at low altitude during a circling approach without necessary corrective action being taken by the crew.

Martin 404 Strikes Mountain

(Based on report of Civil Aeronautics Board, U.S.A.)

A Martin 404 struck Sandia Mountain, near Albuquerque, New Mexico at 0713 hours on 19th February, 1955. All 16 occupants were killed and the aircraft was destroyed.

The Flight

The aircraft was engaged on a scheduled flight from Albuquerque to Baltimore, Maryland, with a number of scheduled stops, the first of which was Santa Fe, New Mexico. The aircraft took off at 0705 hours and permission was sought for a right turn which the tower immediately granted. There was no further radio contact with the aircraft.

The tower operators last saw the aircraft south of the airport at an altitude of 500 - 600 feet. Take-off appeared normal.

One highly qualified observer, at his residence about three miles north (magnetic) of the airport, saw the aircraft proceeding directly toward the middle of Sandia Ridge. This man, an Air Force Officer-Pilot, thought the course was so unusual that he watched the flight with binoculars. It passed over the eastern part of Albuquerque, near him, at an estimated altitude of 3,000 feet (8,300 feet m.s.l.) in a high-speed shallow climb. He noticed that the upper portion of Sandia Ridge was obscured by clouds. The aircraft continued its heading, toward the ridge, and was lost to his view as it entered the cloud, within two or three miles of the ridge crest, still in shallow climb. The engines sounded normal.

One other witness, who observed the aircraft at about the same time and place, watched until it disappeared in the cloud, headed toward Sandia Ridge. There were no known witnesses to the crash.

When the flight did not report over the Weiler Intersection, shortly after 0712, the tower asked the flight if it was northbound on the back course (of the ILS localiser). There was no answer. Repeated subsequent calls were unanswered.

A search was started by 0830. Clouds hampered search for the remainder of that day. About 0942 the following morning the wreckage was sighted from the air just below the crest of Sandia Mountain.

Investigation

Shortly after the aircraft was assumed to be down all C.A.A. radio facilities that could have been involved were flight checked. All were found to be functioning normally, including Albuquerque Omni Range and the Albuquerque Localiser.

The crash site was about 13 miles northeast of the Albuquerque Airport and almost directly on a straight line course of 30 degrees magnetic from that airport (elevation 5,340 feet m.s.l.) to the Santa Fe Airport (elevation 6,344 feet m.s.l.). Elevation of the site was 9,243 feet m.s.l., some 1,439 feet lower than the crest of the ridge a mile or so directly ahead.

At 0708, about five minutes before the crash, the Albuquerque weather was officially recorded as: 4,000 feet scattered, 7,000 feet thin broken clouds; visibility 40 miles; wind S.S.E. 6; altimeter 29.82; mountains obscured northeast. The Santa Fe 0628 regular sequence weather report gave: Estimated 3,000 feet broken; 20 miles visibility; wind southwest 9. Before departure the pilots had been briefed on the weather, which was generally clear and would have permitted visual flight over nearly the entire route, with only short instrument flight probable. This condition was actually encountered by another aircraft over the same route that departed Albuquerque 11 minutes later.

The TV towers on the highest point of Sandia Ridge had been visible from the Albuquerque Airport at 0625, approximately 43 minutes before the crash, by official Weather Bureau observation. However, at the time of the crash the upper portion of the ridge was obscured by cloud.

Fire followed impact, which is believed to have occurred while the aircraft was in a left climbing turn. Wreckage was widely spread over the extremely rugged mountain in the general direction of about 320 degrees magnetic. One wrist watch was recovered: it was impact-stopped at 0713. One altimeter was recovered: its setting was correct for the time and place of take-off.

Initial investigation at the scene was greatly handicapped and curtailed by deep snow and inclement weather and had to be abandoned. Careful planning went into the organisation of another expedition, which reached the site on May 3. The results of their findings, and later study of some of the recovered components of the aircraft, showed no evidence of fire or structural failure prior to impact, nor of malfunctioning of either engine or either propeller. A study of recovered radio components disclosed that No. 1 VOR Navigation Receiver was tuned to the frequency of the Albuquerque Omni Range Station; No. 2 VOR Navigation Receiver was tuned to the frequency of the Albuquerque ILS Localiser. Other navigational instruments were either not recovered or were so extensively damaged that they could not be tested nor their settings learned.

This aircraft was equipped with a Hughes Terrain Warning Indicator, which simultaneously flashes a light and sounds an alarm when the aircraft is 500 feet, 1,000 feet, or 2,000 feet from any obstruction, as set. The obstruction may be anywhere downward from within about 5 degrees of the horizontal in all directions — ahead astern, or to either side. In other words, it covers a space of almost a complete hemisphere below the aircraft. On the last previous flight of this aircraft the Terrain Warning Indicator had been functioning and it was one of the items checked, and found to be working properly during the preflight inspection just before the final take-off.

Analysis

The aircraft took off at 0705 and the only indication of the actual crash time is the watch found impact-stopped at 0713. If we assume that this tells the duration of the flight as eight minutes, it is evident that the aircraft was flown straight from the airport to very near the crash site for there was not time to do much more than traverse the intervening 13 miles. The testimony of ground witnesses confirms this straight course.

The magnetic course from Albuquerque to the crash site (and to Santa Fe) is about 30 degrees and the wreckage was strewn in a manner indicating a direction of flight at the moment of impact of about 320 degrees magnetic while in a left climbing turn. This means that the aircraft was turned to its left about 70 degrees from its original heading and climbed just before the crash, as if to evade an obstruction.

The pilot must have suddenly realised that he was practically at the precipitous wall of the mountain and acted quickly. We can only conjecture as to whether this realisation was spontaneous with the captain, or the first officer, or induced by a warning from the Hughes Terrain Warning Indicator of an obstruction ahead, below, or both. The realisation of the mountain ahead may, of course, have been brought about by something other than the Terrain Warning Indicator, possibly a glimpse of terrain close below, or ahead, or both. Obviously an evasive manoeuvre was started.

The course flown was off airways and was neither authorised by the Civil Aeronautics Administration nor sanctioned by the company. The correct and only permissible course is via Victor 19 airway, which skirts Sandia Mountain to the west by several miles. The airways distance between Albuquerque and Sante Fe is 53.5 miles; the direct course is 43 miles. This difference of 10.5 miles would amount to only about 3 - 4 minutes' difference in flying time. However, the flight departed Albuquerque on schedule and if it had been flown according to the flight plan would have arrived at Santa Fe on time.

Wind velocity over the Sandia Mountain was indicated to be too light to produce an important "mountain effect" such as severe turbulence, down draughts, and erroneous altitude indications. Furthermore, such effects when present are manifest over the crest and lee slopes, whereas this accident occurred on the windward slope.

The captain in command of the flight was well experienced over the route Albuquerque to Santa Fe. In addition, the weather was such that visibility along the airway was good for many miles ahead to the north. The base of the mountains was clearly visible from the airport although the crest was obscured. The flight took off from runway 11, circled the airport to the right, and picked up a north-east heading directly toward Sandia Mountain instead of pursuing a course along the airway to the west and north of the mountain. It was contact during the turn around the airport and for approximately five minutes thereafter before entering the clouds obscuring the top of the mountain.

The possibility of malfunctioning of navigational instruments having caused or being contributory to this accident was considered at great length. In scrutinizing this possibility it is necessary to keep in mind a number of factors. One is the excellent visibility prevailing from the take-off to a point where a competent witness saw the aircraft enter an overcast near the area of the crash. Under these VFR conditions, crews are required by Civil Air Regulations to be visually alert. There is no understandable reason why the pilots should have failed to detect, by reference to conspicuous terrain features, that they were flying other than the planned course, had they been alert. If we are to believe that undetermined malfunctioning of the aircraft's navigational equipment led the flight into the crash area we must presume a number of instrument failures — failures which would be more or less simultaneous, of similar magnitude, and in the same direction. Furthermore, this extreme unlikelihood would have to be accompanied by the crew not looking beyond the cockpit. And further, all these conditions would have had to prevail continuously from the very start of the flight up until it was within two or three miles of the crash site. This situation is thus based on improbabilities compounded to such an extent that the Board must reject it as being too tenuous to warrant serious consideration as a possible contributing factor of this accident.

It is difficult to understand why the flight took the heading it did from the airport to Sandia Mountain. However, there is no question that if the flight had followed the prescribed clearance to the Weiler Intersection the accident would not have occurred. The evidence is clear that if an instrument malfunction occurred during the VFR portion of the flight it should have become quite evident to the crew and by looking out they would have been sufficiently forewarned that the previously planned and approved course was not being followed.

Probable Cause

The Board determined that the probable cause of this accident was a lack of conformity with prescribed en-route procedures and the deviation from airways at an altitude too low to clear obstructions ahead.

ILS Approach Accident at Blackbushe

(This summary, prepared by the Ministry of Transport & Civil Aviation, London, is based on the report of the Public Inquiry into the Causes and Circumstances of the Accident)

Shortly before midnight on 5th November, 1956, a Handley Page Hermes aircraft crashed while approaching to land at Blackbushe Airport, Hampshire, at the conclusion of a flight from Idris Airport in Tripoli. The captain and two other members of the crew of six, and four children from among the 74 passengers, were killed.

The Flight

Early on 4th November, the aircraft had been flown from Blackbushe to Malta where, immediately on its arrival at 1000 hours, the crew, which was to complete the remainder of the forward flight and the return flight to Blackbushe, came on duty. Departure for Nicosia, Cyprus, was delayed for over 4½ hours by magneto trouble and, following rectification of this, by closure of the airfield. The aircraft remained at Nicosia for 1½ hours and then left for Idris, arriving at 0515 hours on 5th November. The crew had then completed a continuous period of duty of over 19 hours.

At Idris it was necessary for the crew to occupy emergency accommodation on the airfield where the men's sleep was broken by noise and, in some cases, by cold. They were called at 1200 hours and the captain prepared for departure which took place at 1525 hours. Consequently, the crew had only ten hours' "rest period" following the duty period of 19 hours, whereas the operating company's operations manual specified the minimum rest period following 19 hours' duty as at least 15 hours. Company representatives stated that they would expect the captain to exercise discretion in disregarding the precise requirements of this instruction under abnormal circumstances, along lines similar to the instructions which allowed extension of the previous day's duty period beyond the normal 16 hours. It appears that the captain wished to complete the flight without undue delay, and that he shared the view of surviving members that a longer stay offered little prospect of real rest.

The flight from Idris proceeded normally until the aircraft was approaching Blackbushe after being cleared there by the Southern Air Traffic Control Centre, shortly after 2300 hours. The flight was in radio communication with Blackbushe Airport from about 2334 hours to 2351 hours, during which time the aircraft was passed QFE.1021 millibars, made routine reports of descent to 1,500 feet and interception of the outer marker and was cleared to land on runway 08 after reporting the runway lead-in lights in sight. The captain was almost certainly using the I.L.S. (Instrument Landing System). The aircraft undershot the runway and hit a beech tree 3,617 feet short of the threshold at a stage of the approach when it should have been 197 feet above the tree. Its port wing was damaged by this impact and it swung sharply to port and finally came down among pine trees some 3,000 feet from the beech tree.

Fire broke out in the front of the aircraft and began to spread into the fuselage. Considerable panic ensued in the cabin, but most of the passengers were safely evacuated through the rear door, emergency exits being little used, although passengers had been properly instructed in their use. Children passed through an emergency exit on to a wing, in the belief that they would be safer outside, were burned to death. Fire and rescue services responded promptly and efficiently in attending the scene of the accident, extinguishing the fire and bringing the survivors to safety.

Investigation and Analysis

The accident occurred on a night when the visibility at Blackbushe was poor. Arrangements had been made for the ascertaining of R.V.R. (Runway Visual Range) i.e., the distance along the runway that a pilot should be able to see the runway lights at the point of touchdown. The method depends on a line of goose neck flares situated on the south side of the runway which are observed from an observation point just north of the runway. The observer notes how many flares he can see, multiplies the figure by 100 and so obtains the R.V.R. in yards. After the accident, tests disclosed that the system at Blackbushe did not give an accurate result, due partly to inaccurate placing of flares, and partly to some other factor, possibly diminished intensity or altered beaming of the runway lights. The effect of the discrepancy in this case was that the R.V.R. was given as 1,200 yards when it should have been 920 yards. However, a reduced minimum of 800 yards had been approved just prior to the accident and, although his company's operations manual had not been amended, the captain of the Hermes was almost certainly aware of the reduction. An improvement in visibility noted by the R.V.R. observer found no parallel in other visibility observations and indicates that there was probably patchy and shifting mist or fog which made visibility variable and uneven.

The I.L.S. transmitters and beacons were found to be in order both before and after the accident. On the day after the accident a flight check was carried out in relation to the glide path transmitter and the angle was found to be correct to within 0.13 degree, an error within acceptable limits which would have caused a pilot following the indicated glide path to be slightly above the three degrees glide path.

The flight engineer was the only survivor able to offer information regarding the management of the aircraft during the approach. He heard the captain inform control that he would make an I.L.S. approach. The descent from 4,000 feet to the airfield was at 1,800 r.p.m. and 30 inches of boost. The captain subsequently called for 2,100 r.p.m. and then for 2,400 r.p.m., the latter being considered normal for an approach. The captain then asked for 35 inches of boost, and later for 25 inches of boost, after which he took over the throttles from the flight engineer and increased the boost to 30 inches for a few seconds, then to 37 inches. A few seconds later the initial impact occurred.

The r.p.m. and boost called for were considered to indicate nothing exceptional, except that 25 inches of boost is rather a low figure and would result in a steeper descent than is usual when using I.L.S. However, the higher rates of boost called for later are not such as to indicate that any emergency action was being taken. At no stage did the captain indicate that he thought that anything was amiss as the flight engineer would have expected of him from previous experience.

Wreckage investigation showed the captain's altimeter to be too much damaged for any conclusion to be drawn from it. The first officer's altimeter was set to 1,023 millibars, the navigator's to 1,022 and the flight engineer's to 1,023. It is considered that these last three altimeters were set very close to these figures before the accident although all were damaged and the shock may have altered the settings slightly. So far as could be ascertained from examination of the altimeters, the captain's airspeed indicator and climb and descent indicator, and the I.L.S. control unit and indicators, all the damage sustained was consistent with impact or shock damage.

The flight engineer's evidence pointed to the aircraft having come considerably below the glide path for some appreciable time before the accident rather than to a sudden dive. The magnitude of the eventual departure from the glide path was such that, if the captain had been aware of it, he could hardly have been indifferent to it, and it seems most likely that he was unaware of it. The I.L.S. indicator and the altimeter, if they were working properly and the altimeter was correctly set, must have given warning to the captain or the co-pilot. It is not known whether any arrangement existed for a division of duties between these two, and there is no evidence that any company procedures existed to cover the nature and extent of the assistance to be given the captain by his first officer.

The critical height below which the pilot should not have come without having the airfield lights clearly in view was 400 feet. The R.T. log indicated that the captain had, or believed he had the approach lights in sight when he was still about two miles from the threshold. It is likely that very soon after this he would see the threshold and runway lights and believe that he was getting from them a good indication of his height and direction. The variations in visibility in different directions, and in the same direction within short periods, are consistent with the existence of a layer of fog or very low cloud, not very dense and not evenly spread, on or near the ground. This possibly caused the pilot to see the lights as being further away and at a greater distance below him than they really were.

It is probable that the captain (or the first officer, depending on the allocation of cockpit duties) made one or more of the following errors:—

(i) failed to set his altimeter correctly when given the Q.F.E.;

(ii) gave up reference to his I.L.S. indicator before he had a sufficiently clear view of the lights;

(iii) did not check his height by glancing at his altimeter.

If any of these errors was made it was probably due, at least in part, to some loss of alertness brought about by fatigue. The evidence suggests that, while the officers were not suffering from any extreme degree of fatigue, they were probably tired enough to make their mental reactions slower and less accurate than they would normally have been. In view of the circumstances which preceded the return flight, it is impossible to say that the captain was to be blamed for his decision to take off without further rest, or even that it was the wrong decision to take off in the circumstances.

Probable Cause

The Court concluded that the most probable cause of the accident was that, in difficult conditions and while suffering from a degree of fatigue above the normal, the captain, relying on his vision of the airport lights to assess his height, judged his height to be higher than it actually was.

Martin 404 Crash

—Las Vegas, Nevada

(Based on report of Civil Aeronautics Board, U.S.A.)

On 15th November, 1956, a Martin 404 aircraft crashed at McCarren Field, Las Vegas, Nevada, during an attempted single engine go-around. The captain, the hostess and 14 of the 35 passengers received minor injuries and the aircraft was damaged beyond repair.

The Flight

The aircraft took off from McCarren Field, Las Vegas, at 1456 hours Pacific Standard Time on a regular public transport service from Las Vegas to Los Angeles, California. The weather in the vicinity of Las Vegas was fine, unrestricted visibility and wind calm. Some two to three minutes after take-off the port engine began to malfunction. The engine difficulty was in the form of an appreciable loss of power, back-firing and engine roughness. Attempts to correct the trouble were unsuccessful and when heavy and visible vibration began the port propeller was feathered. Single engine operation was established, McCarren Field was notified of the emergency and the aircraft turned towards the airport.

The aircraft entered the circuit on base leg and as it turned on to long final the undercarriage was lowered and approach flap (24 degrees) was extended. The airspeed at this time was 120 - 125 knots. As the aircraft passed over the runway threshold its alignment and altitude seemed good; however, to nearly all observers excessive speed was apparent.

The aircraft floated down the runway a few feet above it. The captain made several attempts to force the aircraft on to the runway but each time it bounced off. After the aircraft had travelled well over half the runway the captain decided to carry out a go-around. At this stage the aircraft was in the air and at an indicated airspeed of 100 - 105 knots. Take-off power was promptly applied, the undercarriage raised and the flaps retracted to the take-off position, 12 degrees. However, as the flaps were raised the aircraft settled and the airspeed decreased. The aircraft commenced to veer to the left and its left wing lowered. Seconds later the aircraft struck the ground left wing low.

Investigation

Ground marks showed that the left wing tip of the aircraft made the initial contact with the ground and this was followed closely by the left engine nacelle and aircraft fuselage. The aircraft then slid on its belly in an upright position for 225 feet turning left around its vertical axis through about 120 degrees. The aircraft received unrepairable damage from the ground impact and the subsequent sliding forces. The fuselage was nearly separated parallel to the fifth row of passenger seats. Elsewhere, it was twisted and buckled. The empennage was relatively undamaged. Both wings of the aircraft were buckled and the right wing was broken chordwise just outboard of its engine nacelle. The left engine was found turned outboard 40 degrees by forces which bent and broke its engine mounts. The right engine was turned out during initial forces as the aircraft slid forward on the ground. This engine was rolled inward towards the fuselage. It then struck and penetrated the right side of the fuselage door. This unit was found lodged in the cabin flooring just ahead of passenger seat No. 2. The main and nose components of the landing gear were found fully retracted. The wing flaps were found in a slightly extended position; however, numerous fractures in the hydraulic lines would have allowed the flaps to move from the position which existed at the impact.

To protect the wing and flap structure, the wing flap system of the Martin 404 incorporates a wing unloading valve. This valve will not permit a flap extension beyond 35 degrees with full flap selected and throttles fully retarded unless the airspeed of the aircraft is at 120 knots or less. As airspeed is decreased, the flap extension is progressive until full extension, 45 degrees, is reached at or below 104 knots with the throttles fully retarded. Whilst the approach flap setting of 24 degrees can be obtained at 120 knots, 10 degrees more flap extension can be attained at the same airspeed by positioning the cockpit flap control in the full flap position.

The captain stated that he did not call for full flap prior to reaching the runway threshold as the speed was in the order of 120 knots and he was under the impression that the flaps would not extend appreciably beyond the approach position until the airspeed reduced to about 105 knots. Following the series of attempts to force the aircraft on to the runway the captain believed he would be unable to stop the aircraft within the remaining runway and decided to go-around. It was not possible to establish the point at which the landing was abandoned and for this reason it could not be determined whether or not the aircraft could have been brought to rest within the length of the runway.

The captain testified that at the time he decided to discontinue the landing and execute the go-around he was firmly convinced that the performance of the Martin 404 on single engine would enable him to do so. He believed that such a go-around was possible provided the airspeed of the aircraft was appreciably above minimum control speed. He stated that the airspeed, when he initiated the go-around, was 100 - 105 knots and the minimum control speed of the aircraft under the existing configuration was 91 knots.

The performance characteristics of the Martin 404 are such that in the configuration existing at the time of the go-around it would be necessary to retract the flaps to the take-off position in order to allow the aircraft to accelerate. Further, 300 feet of altitude would have to be sacrificed during the flap retraction. Thus, it is evident that on single engine approach with full flaps, the aircraft is committed to a landing when below 300 feet. The company's flight operations manual did not contain a baulked landing procedure and very little training or information was given to pilots regarding a go-around on one engine. A company instructor-pilot testified that perhaps the company pilot training did not stress the single engine baulked landing situation enough prior to the Las Vegas accident. He added that this was probably because the programme intended to teach pilots to make the single engine approach and landing without overshooting. He stated that this proficiency and ability was expected of a line captain and that in all the transitions he had given in the Martin 404 over a period of several years he had never seen an overshoot on a simulated single engine.

Analysis

Examination of the port engine revealed that there had been a failure of the No. 2 cylinder exhaust valve push rod. The ball end assembly of the push rod was found to be loose and the space between the push rod and the ball end was broken into several pieces and completely displaced. The end of the push rod was worn with pieces broken away. The end socket was belled out and polished. This evidence indicated that the push rod failure occurred where the ball end is press fitted to the push rod and it was the failure of this component which caused the port engine to fail shortly after take-off. It was established that the push rod failure probably resulted from an improper fit made by the company's overhaul department.

The push rod failure would cause the exhaust valve to remain closed thereby trapping exhaust gases under pressure which would normally be dissipated through the exhaust port. Therefore, when the intake valve opened these exhaust gases would enter the induction system of the engine causing loss of power, back-firing and engine roughness.

The captain stated that the aircraft crossed the runway threshold at an indicated airspeed of 115 - 120 knots, which was excessive and that 95 - 100 knots would be normal at the threshold. It is not unusual to maintain a higher than normal approach speed in a single engine approach. However, this speed must be dissipated at a point when the landing is assured and in time to preclude overshooting. The Board concluded that the captain did not properly judge his position. As a result he continued with excessive speed beyond a reasonable position for a safe landing. Contributing to his misjudgment he believed that with 115 - 120 knots he could not get additional flaps beyond the approach extension. Although only about 10 degrees more extension could have been attained, this difference and its cumulative effect might well have been the difference between an overshoot and a safe landing.

When the captain decided to go-around he believed the performance of the Martin 404 in single engine would enable him to do so. He thought that 10 - 15 knots above the minimum control speed was sufficient although the aircraft was on one engine, it was in a decelerating condition, and the landing gear and 45 degrees of flap were extended. All of these conditions existed with no altitude to sacrifice. Based on these factors the Board is of the opinion that the captain's belief was unreasonable.

The Board concluded that the training programme of the company with respect to the single engine baulked landing situation was inadequate prior to the accident. This was reflected in the captain's decision and the Board believes this was in a substantial degree responsible for the decision. It is considered that the type of situation which confronted the captain should have been foreseen by the company and the performance capabilities of the aircraft in such a situation fully covered as a training subject.

The importance of training in this potential accident cause area is reflected by the Board's air carrier statistical data. This showed that there have been nine accidents since 1946 involving an engine out or engine malfunction during which the pilot attempted to go-around after overshooting. This data also showed 80 accidents during the same period in which overshooting was the principle causal factor.

Cause

The probable cause was that during an emergency situation the captain failed to reduce speed during the latter portion of a single engine approach; this excessive speed resulted in an overshoot and an attempted go-around which was beyond the performance capability of the aircraft under the existing conditions.

Dove Accident

—New Forest, Hampshire, England

(Summary based on report compiled by Ministry of Transport and Civil Aviation, London)

The Flight

A De Havilland Dove took off from Cardiff Airport at 0825 hours on a July morning for Southampton and 25 minutes later, when at or about its cruising altitude of 5,500 feet, the engines became unsynchronised causing considerable vibration. The port propeller then stopped rotating and the aircraft lost height. When it had descended to an altitude of approximately 200 feet the port engine was restarted and almost immediately afterwards the aircraft flew very low over a line of high tension cables. With increased vibration the aircraft continued at low speed over undulating country and, after climbing slightly to clear a ridge, lost height and descended into a densely wooded area. When very close to the tree tops it banked to the left and the port wing tip struck a tree. After travelling a further 400 yards and striking the tops of several other trees the aircraft crashed. The pilot was killed instantly and the six passengers were injured to varying degrees.

Investigation

The port wing-tip was the first part to become detached and was found 400 yards from the main wreckage. The cockpit was crushed and the passenger compartment had been ripped open. The starboard engine had been torn out and was lying about 15 yards from the fuselage. The port engine remained in its mounting. Both propellers were attached to their respective engines but only the port propeller showed evidence of being under any power on impact. There was no evidence of fire.

The engines were salvaged and sent to the manufacturers for detailed examination. After replacing certain components which had been damaged in the crash the port engine was mounted in a test bed and given a thorough testing. Subsequently it was stripped for detailed examination. The results of the test and strip examination showed that the engine was in sound working order.

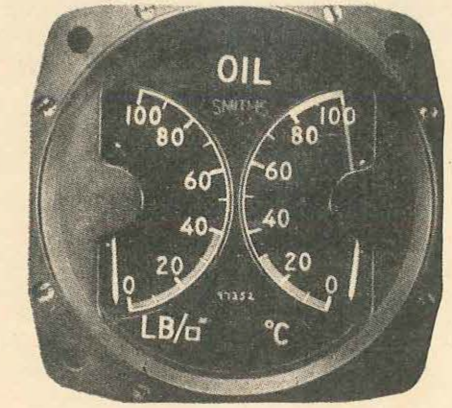
The starboard engine had sustained considerable damage. When dismantled it was found that the crankshaft had broken at No. 3 crankpin. This failure had occurred before the crash as a result of a fatigue crack which had developed at a plugged hole in the rear web of No. 3 crankpin. Heavy scoring on the faces of the crankcase web and cap of No. 1 main bearing showed that Nos. 1 and 2 cylinders continued working after the crankshaft had failed. The crankshaft had run for a total of 1,205 hours since manufacture including 619 hours since the last overhaul when a modification designed to prevent failures of this nature was embodied.

Both propellers were subjected to a strip examination, including the units connected with the system for feathering the starboard propeller, but no evidence of any pre-crash defect was found. The blades of both propellers were in fine pitch.

Analysis

The evidence indicated that the pilot shut down the port engine instead of the starboard engine which had developed serious mechanical trouble. The pilot was experienced and had completed over 500 hours flying as pilot-in-command of this type. A factor which might give rise to this mistake is the use of combined oil pressure/temperature gauges. These instruments are duplicated, one for each engine, and normally mounted side by side. Each instrument is marked "OIL" at the top centre and, although annotated "LB/□" and "°C", respectively, at the bottom, the marking of adjacent pressure and temperature scales are not dissimilar (see photograph). A fall in oil pressure in the starboard engine would be recorded by the left-hand pointer of the starboard gauge. It is possible that a pilot, seeing the left-hand pointer of the starboard gauge falling could, in the stress of the moment, associate "left" with "port" and in consequence shut down the sound port engine instead of the failing starboard engine.

In this accident the pilot appears to have realised his mistake and re-started the port engine. Unfortunately, by this time the aircraft was down to a very low altitude. Even then, had the starboard engine been shut down and its propeller feathered, the accident might have been avoided. Why this was not done could not be determined.



Cause

The accident was the result of the pilot mistakenly shutting down the port engine instead of the starboard engine in which a serious mechanical fault had developed. This led to a rapid loss of height and although the pilot re-started the port engine the starboard engine was not shut down. In this configuration satisfactory single-engine flight could not be achieved.

Comment

Dove aircraft are the only known aircraft with this type of instrument. A.N.O. 105.1.14.13.5.9 requires the instruments to be rotated 90° so that the oil pressure gauge is at the top. The dial lettering is to be suitably changed to allow easy reading.

DC.4 En-route Collision With Terrain

A DC.4 was totally destroyed when it crashed and burned 3½ miles east of Blyn, Washington, at approximately 1719 hours Pacific Standard Time on 2nd March, 1957, while en-route from Fairbanks, Alaska, to Seattle, Washington. The aircraft carried a crew of three and two passengers, all of whom received fatal injuries.

The Circumstances

The aircraft departed Fairbanks for Seattle at 0958 hours with an A.T.C. clearance to proceed via Snag, Haines, Annette and Port Hardy at flight levels between 120 and 95 on the various sections. The estimated time interval was 7 hours 44 minutes. The forecast indicated that the weather would be fine for most of the route with cloud increasing around Seattle.

Routine position reports were passed and at 1240 hours the aircraft reported over Haines and cancelled its IFR flight plan; informing A.T.C. that it would proceed VFR to Annette and file D.V.F.R. (Defense Visual Flight Rules) after Annette and before entering the C.A.D.I.Z. (Canadian Air Defense Identification Zone). At Annette, a VFR clearance was obtained for penetration of the C.A.D.I.Z. and U.S.A. Western Security Identification Zone.

From Annette onwards the aircraft passed routine position reports on schedule advising that it was flying at 1,000 feet. At 1717 hours the aircraft passed a position report to Seattle as "Dungeness at 16 VFR estimating Seattle at 34". This was the last contact with the aircraft.

Investigation

The aircraft crashed in heavily timbered mountainous terrain approximately in the centre of the "on course" zone of the northwest leg of the Seattle low frequency radio range, about 11 miles south-east of the Dungeness fan marker. This leg of the range defines the centre of Amber Airway 1 (controlled airspace) between the Dungeness intersection and the range station. The terrain in the vicinity of the range between this marker and Seattle rises to 2,100 feet.

The path of the aircraft during the final seconds of the flight was clearly defined in the heavy timber growing on the steep slope against which the aircraft crashed. The aircraft's first contact with the trees was at a point 650 feet from the wreckage. From this point it cut a level swath on an easterly heading, the width of its wing span, into the steeply rising wooded slope at an elevation of 1,500 feet above mean sea level. The terrain immediately ahead of the aircraft rose to an altitude of 2,000 to 2,100 feet.

The airframe and engines were severely damaged as a result of impact followed by intense fire. The wings were torn from the fuselage in its passage through heavy timber. Parts were scattered from the point of initial contact with the trees along the entire flight path, and as much as 75 feet beyond the main wreckage area.

Examination of the wreckage did not reveal any evidence of mechanical difficulties during the flight. It was established that the aircraft was intact prior to contact with the trees. Also, that no inflight fire occurred and that all the burning occurred after the aircraft came to rest. No defects or evidence of malfunctioning was found in the examination of the engines and it was quite conclusive from the nature of the damage to the propellers that substantial power was being produced by all engines at the time of impact. It was concluded from the examination of the wreckage that the aircraft was being operated in the cruise configuration.

A number of persons saw the aircraft shortly before the accident. All these witnesses state that the aircraft apeared to be operating normally. The aircraft was in regular radio contact up to within a few minutes of the crash. Had anything been amiss with the aircraft up to this time, it is expected that it would have been reported. From the evidence of the eyewitnesses, absence of reports from the aircraft of any malfunctioning or emergency and from the examination of the wreckage, the investigating authority considers it reasonable to presume that no inflight emergency existed and that the aircraft was operating normally until it struck the ground.

Along the route segment from Point Hardy to Patricia Bay, the aircraft reported its altitude as 1,000 feet. In order to have been at this altitude, the flight path would have had to follow a meandering course over water at times as much as 25 miles off course. Radar determination and qualified eyewitnesses place the aircraft approximately on course and at an altitude of 2,500 to 3,000 feet above mean sea level. It is, therefore, obvious that the aircraft was reporting its height above the ground. This was contrary to C.A.D.I.Z. regulations as flights in a defense zone, as this was at that time, are required to report height as above mean sea level. The captain had flown this route for a considerable length of time and knew, or should have known, of this requirement.

In one of the reports, the aircraft gave its position as being 30 miles west of Comox, British Colombia. At that instant, R.C.A.F. radar showed the aircraft to be ten miles south of Comox. The investigating authority have been unable to rationalise the reported position with the known position and, therefore, can only conclude that the captain was unaware of his precise position. Examination of the flight log revealed that it had not been properly completed. This was contrary to company regulations which require this log to be filled out completely while en-route.

A number of eyewitnesses in the Dungeness area saw the aircraft just prior to the crash flying at a height of 1,000 to 1,500 feet underneath a low overcast. All these witnesses stated their attention was drawn to the aircraft because of its unusually low altitude. The witnesses all describe a distinct line of clouds below the overcast and lying directly across the flight path of the aircraft. This cloud was described as obscruring the tops of foothills which rose to 2,100 feet ahead of the aircraft.

Two of the eyewitnesses stated that the aircraft entered the cloud obscuring the hills. One of these witnesses reports that he heard and felt an explosion several seconds after the aircraft had entered the cloud. At this time the aircraft was in a controlled airspace and should have requested an A.T.C. clearance before entering IFR conditions in this area. No such request was made.

Both pilots had been employed by the company for many years and had considerable experience on DC.4 aircraft and were well qualified over the route involved. Prior to the subsequent flight they had received a rest period of 26½ hours.

Analysis

From the evidence that the altitude was incorrectly reported, that the Comox position was incorrect, that the flight log was not properly completed and that the aircraft entered instrument conditions, in a controlled airspace without requesting an IFR clearance, it is the opinion of the investigating authority that the conduct of the flight was haphazard and certainly not equal to that expected from an airline captain.

In its efforts to determine the cause of this accident the investigating authority studied the terrain in the area between Dungeness and Seattle. This route segment passes over the Miller Peninsula which is located between two bays three to four miles apart on the southern shore of the straits of Juan de Fuca. While these two bays do not appear to be similar when projected on a chart, it is believed possible that at low altitude and in a slightly hazy atmosphere a pilot in a casual glance, seeing only one or portion of one of these bays, could mistake it for the other.

It was found that if the aircraft had been approximately three miles east on a parallel course it would have passed over Port Discovery, the more eastern bay. It was also noted that the terrain over which the flight would have flown from this point on the way to Seattle was much less than 1,000 feet. It was further noted that the terrain between Washington Harbour, the more western bay, and Seattle rose to an altitude of about 2,100 feet, a fact of which the captain was undoubtedly well aware.

It is, therefore, considered probable that the captain mistakenly identified Washington Harbour as Port Discovery and thinking he was three miles east of his actual position entered the overcast at an altitude which he thought was sufficient to clear the ground. The investigating authority concluded that the laxity and inattention exhibited by the crew throughout the flight, lends substantial credence to this presumption.

Probable Cause

The probable cause of this accident was a navigational error and poor judgment exhibited by the pilot in entering overcast in a mountainous area at a dangerously low altitude.

Australian Accidents

DC.4 Damaged in Undershoot

A DC.4 operating a scheduled service between Auckland and Sydney on 9th December, 1956, landed at Norfolk Island, an intermediate stop, at 1643 hours local time.

The landing on runway 04 was described by the pilot, in a report submitted at Sydney, as a heavy landing without dropping onto the ground but more in the nature of flying onto the ground. The landing was concluded in a normal manner. On arrival at the terminal area a member of a supernumerary crew aboard the aircraft reported to the pilot the presence of a skin wrinkle on No. 3 engine nacelle cowling. The wrinkle was drawn to the attention of the maintenance engineer in attendance and an instruction to inspect dents on both sides of No. 3 engine nacelle cowling was entered in the maintenance record. The maintenance engineer cleared this entry in the appropriate column of the record with a comment that an inspection of the cowl revealed no fractures. He also apparently advised the pilot that he had noticed the wrinkle when the aircraft passed through Norfolk Island on the outbound flight earlier that day. While the aircraft was being refuelled the pilot examined the main landing wheel tyres and found no marks on them indicating that the landing had been heavy.

The flight continued to Sydney in a routine manner but, during an inspection carried out there prior to further flight, extensive damage to the internal structure of the inner wing was discovered. Some deformation of the nosewheel-well structure indicated by skin buckling was also discovered.

The two runways at Norfolk Island are situated on bisecting ridges and the ground off the ends of the strips containing the runways falls away steeply so that final approach in each case is made over ground lower than runway level. At the south-west end of the 04-22 strip the ground falls away first in a steep faced embankment some ten feet high and then in a gradual natural slope until, at a distance of 200-300 feet from the embankment, the ground is 20 feet lower than runway level. This approach area is overgrown with vegetation which extends up the embankment and the presence of the almost sheer face may not be readily apparent from an approaching aircraft. Runway 04 and its surrounding strip are grass covered and, therefore, offer little contrast with the general appearance of the surface in the approach area. The runway was defined by cone markers commencing 200 feet from the embankment and spaced at 300 feet intervals on each side. Corner markers, comprising a pair of eight feet long gable markers set in the form of an "L", one group each side of the runway at the first cone markers, defined the end of the runway and the landing threshold. The effective operational landing length available was 5,300 feet which was 760 feet in excess of the required length determined from the DC.4 landing weight chart. The markers were painted white and were clearly visible against the green of the grass covered strip and runway. There were no markers between the runway corner markers and the embankment.

The pilot, who had almost 10,000 hours flying experience, including 2,400 hours on the DC.4, had landed at Norfolk Island on four previous occasions but this was his first landing on runway 04. Weather conditions at the time were fine, visibility 12-15 miles, hazy and wind 070 degrees 6-7 knots. The approach path was apparently normal until shortly after lowering the final 15 degrees of flap. At this stage the pilot realised he was lower than intended and instead of commencing to flare out over the threshold markers he would need to do so over the beginning of the prepared area, that is the embankment. No corrective action was taken as he judged the touchdown would not occur until the aircraft had passed the threshold markers. After flare out when at a position judged by the pilot to be just beyond the embankment but short of the threshold markers, the aircraft touched down.

An examination of the embankment, made after the damage to the aircraft was discovered, showed that the starboard main under-carriage wheels had contacted the face of the bank 12 inches below the top. These wheels had torn through the lip of the bank and for a further 24 feet had left heavy depressions in the strip surface. The port wheels and nosewheel had contacted the bank about two inches and one inch from the top respectively.

The extent of the damage to the aircraft suggests, on first consideration, that the landing impact must have been of such magnitude that the pilot should have suspected that damage had occurred and should have ensured that a detailed examination of the aircraft was carried out at Norfolk Island. However, the forces applied to the aircraft in this occurrence would have a large horizontal component whereas a pilot judges landing impact primarily by the vertical loads experienced.

It is apparent that the pilot misjudged the approach, probably due to an illusion created by sloping ground off the approach end of the runway, resulting in the landing wheels striking a bank short of the runway threshold.

Comment

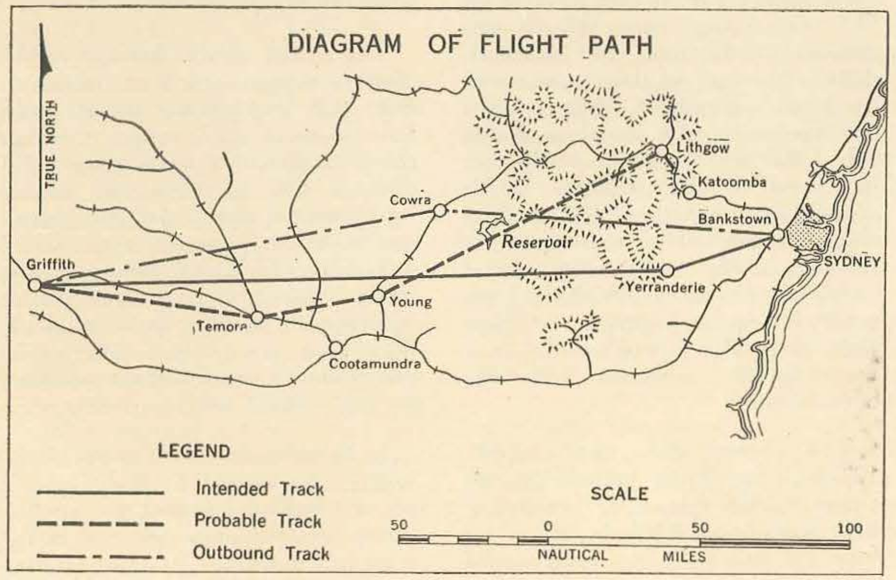
In the larger type airline aircraft currently in use, and flown in accordance with the accepted technique for the type, the point of touchdown cannot be determined in advance by the pilot with the degree of precision that will permit landings on the end of the usable area to be attempted with safety. If a pilot always aims to touchdown as close as possible to the threshold it is inevitable that on some occasions he will touchdown short of it.

It is not only unsafe to try to land neatly on the threshold, it is unnecessary. The required runway length as determined from the landing weight chart allows for an aircraft to cross the threshold at 50 feet at 30 per cent. above its power-off stalling speed and still pull-up with only 60 per cent. of the runway used.

Procrastination in a DH.82

An aero club pilot in New South Wales obtained his private licence late in 1956 and was soon undertaking long travel flights from Sydney to country and interstate centres. The third of these travel flights, with a friend as passenger, was to be via Cowra, Griffith and Deniliquin to Wagga, returning to Sydney on the following day. They departed Bankstown in a DH.82 at 0920 hours but the passenger soon became very airsick. At Griffith it was decided to return to Sydney immediately without covering the remainder of the intended route.

The return flight was commenced from Griffith at 1645 hours and, although the pilot asked a bystander to phone the aircraft's departure time to the Wagga control centre, he took no other steps to ensure that his route, height or time interval would be known in the air traffic control centre. The aircraft had been refuelled to full tanks and it was the pilot's intention to proceed to Bankstown aerodrome via Yerranderie (see diagram). En-route he pinpointed himself at Temora and Young, which are both well south of the desired track, and the next point recognised was the large reservoir on the Lachlan river just east of Cowra and ten miles north of the desired track. Although this should have indicated that a substantial starboard alteration of course would be necessary, the pilot continued in the same direction, hoping to find Katoomba and thence approach Bankstown over familiar terrain.



At 1900 hours with only 31 minutes of daylight left the aircraft reached a large town which the pilot identified as Lithgow. Then he set off to find Katoomba 16 miles to the south-east, following a road. Unfortunately, he selected the wrong road and when he became aware of this he returned to Lithgow, reaching there with only 5 minutes of daylight left. A hurried search for a suitable emergency landing ground resulted in an approach to a sports field, in the course of which the aircraft struck overhead telephone wires and a pole lining a suburban road. The aircraft fell onto a post and wire fence and was substantially damaged, whilst the pilot and passenger escaped with only minor injuries.

Departing Griffith at 1645 hours, the aircraft would have had to maintain an average groundspeed of 89 knots, without deviation from the most direct route, to reach Bankstown aerodrome by last light (viz. 1931 hours on this day). This would have required a tailwind component of about 20 knots, whereas a slight headwind component was forecast for the route. It is appreciated that this return flight was a departure from the pilot's original intentions and, then again, the care of an airsick passenger can be quite a distraction. These are, perhaps, mitigating circumstances but it is apparent that the pilot gave very little thought to the planning of this stage of the flight and his failure to submit flight details to the Wagga ATC centre probably signifies more than just a notification oversight.

The pilot's navigation of the aircraft, once the flight commenced, was hardly better than his flight preparation. Apparently he followed the Cootamundra railway line for 72 miles to Temora and then altered course to port and crossed his intended track without fully appreciating his position until he saw the reservoir on the Lachlan River. This induced him to alter his intentions and, incidentally, to lengthen his route to Sydney despite the fact that there was only 50 minutes of daylight still remaining. The aircraft arrived over Lithgow 20 minutes later and set off for Katoomba with the pilot apparently still intending to reach Bankstown aerodrome. Not until the sun had set did he commence to plan a landing in daylight, after realising the impossibility of reaching Bankstown. At this stage he was over mountainous terrain and by the time he reached a more suitable area in the vicinity of Lithgow there was insufficient time to properly plan and carry out a forced landing.

It is most likely that the pilot's judgment and caution were affected in the approach to the area chosen, by physical and nervous fatigue, coupled with a realisation that the area was not really suitable for a landing. There was no time to search elsewhere and the fading light would make it difficult to discern telephone wires from any great distance.

The accident to this aircraft came as the culmination of a series of errors and omissions by the pilot. The flight was badly planned, the aircraft was poorly navigated and, finally, the pilot failed to appreciate the dangers of approaching darkness until there was insufficient time left to find and land on a suitable emergency landing area. When the aircraft returned to Lithgow shortly before it became dark an accident of some degree had become almost inevitable.

Agricultural DH.82 Strikes Fence During Take-off

On 13th February, 1957, at about 0910 hours a DH.82 taking-off from a field near Goulburn, New South Wales, on the first flight of a superphosphate spreading operation failed to clear the boundary fence. The aircraft was extensively damaged but the pilot was not injured.

The field was situated in undulating terrain at an elevation of 2,000 feet above mean sea level. Only a comparatively narrow section of the field was suitable for take-off and landing and the maximum run available on this area was 1,583 feet. The final 200 feet at the western end of the take-off area sloped down appreciably and the combination of this slope and electricity wires suspended on 25 feet high poles across the eastern end dictated that take-off be made into the west. The wind at the time of the attempted take-off was east at about three knots, constituting a tail wind.

The hopper was loaded with 336 lb. of superphosphate and there was about 12 gallons of fuel on board. The resultant all-up-weight of the DH.82 was approximately 31 lb. in excess of the maximum of 1825 lb. permitted by the certificate of airworthiness.

The superphosphate loading point was set up about 400 feet from the eastern end of the landing area and it was from about abeam of this position that the take-off was commenced. The aircraft became airborne and when the pilot realised he would not clear the fence he operated the hopper dump valve but there was insufficient time to discharge enough of the load to materially improve the climb performance. It was considered that the accident was caused by the pilot attempting to take-off under conditions of aircraft load, length of run and tail wind which precluded a safe margin of clearance over the fence being obtained.

The pilot's flying experience was 265 hours and in the ten weeks since he had taken up agricultural flying he had flown about 40 hours on that work, all of this time in the DH.82.

That Check for Water Needs Careful Thought

A Bristol "Sycamore" helicopter, working under charter to a mining company in Western Tasmania, left Queenstown one morning last January to carry out a camp shift in a survey area 40 miles to the south. It had been refuelled to full tanks before departure and, when the task was completed late in the same morning, the aircraft set course back to Queenstown with the pilot and one passenger aboard. About half-way along the route and at a height of 2,000 feet the pilot decided to transfer fuel from the auxiliary to the main tank preparatory to landing. Soon after the transfer pump was switched on, the main engine power failed and the pilot had to carry out an autorotation landing in rugged mountainous country. He did this very successfully but, unfortunately, the front wheel sank into marshy ground soon after touchdown and the helicopter slowly tilted onto its port side damaging the rotors and the rotor head.

The escape of both the pilot and passenger from serious injury and their subsequent rescue were very largely due to the pilot's skill and resourcefulness both in the period of emergency and again after the landing. In the very short period of time between power failure and landing the pilot informed his base of the emergency, its probable cause and the position of the aircraft.

After the landing he again used the radio to report the condition of the aircraft and occupants and to co-ordinate the rescue operation. A ground rescue party reached the helicopter 29 hours later, after traversing some very rough country on foot. An R.A.N. helicopter was used to lift out the rescued and the rescuers on the following day and to fly in equipment and personnel for the repair work. Eight days after the accident the aircraft was flown out under its own power.

When the aircraft was lifted back onto its undercarriage a complete examination of the fuel system was carried out. Approximately 3 pints of water were drained from the main tank which also contained a substantial quantity of fuel. The auxiliary tank was found to be almost empty but ground staining indicated that the fuel had escaped from the filler cap whilst the aircraft had been lying on its side; a quarter of a pint of water was recovered from this tank. The main fuel filter was full of water and a considerable quantity of water was found in the fuel injector and fuel metering units. When the system had been drained, flushed and refuelled, the engine was started and ran satisfactorily without further significant mechanical adjustment. There seems no doubt that the loss of power occurred when a quantity of water in the auxiliary tank was transferred to the main tank and entered the induction section of the engine. The aircraft auxiliary tank was used during the day prior to the accident, and so it is apparent that the water causing the power failure was introduced into this tank during the last refuelling operation.

It was established that the last refuelling was carried out before the first flight on the day of the accident. The responsible maintenance engineer personally carried out the refuelling from drums by means of a hand pump from two separate drums, each of which had been sampled for water by using a pipette and a one-pint glass milk bottle. When the main tank became full, about seven gallons remained in the first drum. This was put into the auxiliary tank and then a second drum was opened and, after testing, the auxiliary tank was filled by adding another 17 gallons. One pint of fuel was then drained separately from each of the two main tank drain cocks into the same bottle as had been used for the drum sampling checks. After each drain, the engineer visually inspected the contents of the bottle and, having satisfied himself that no water was present, disposed of the contents. Lying on his back under the aircraft, he then unfastened a cover plate in the under surface and drained a full bottle of liquid from the auxiliary tank drain cock, inspected it visually and, being again satisfied that water was not present, emptied it as before. The aircraft fuel filter was then checked, reassembled and pressure tested. Water detection paste was available, but was not used. The hand-pumping unit incorporates a filter and water trap on the delivery side and the trap was drained before refuelling commenced. It was next used by an R.A.N. mechanic who found the trap to be full of water.

The part empty drum which had been used in the refuelling was quarantined immediately after the accident and examined three days later by the investigating officers. They found approximately a quarter of an inch of water in the bottom of the drum and this level would be equivalent to about three pints. The amount of water originally in the drum could not be determined, but it was not less than seven pints (i.e., the amount recovered) and could have been more considering the loss of liquid from the aircraft tanks whilst it was lying on its side. Other possible sources of the water have been suggested such as rain water entering the tanks by way of the vents but the quantities of water involved rule these out. Since the drum had been delivered to the operator only seven days prior to the accident it is improbable that the accumulation of such a quantity of water was related to the fuel storage conditions at Queenstown, particularly as the bungs were sealed and secure with no signs of leakage.

Whatever may have been the origin of this water and however it may have got into the drum or into the aircraft tanks, it remained undetected despite the carrying out of the normal water contamination checks before flight. There is no evidence that the engineer concerned carried out his checks carelessly and the procedure he followed was one commonly used and approved within the operator's organisation. How, then, did it occur?

The engineer checked the fuel drums for water with a length of copper tube, open at both ends. This is not a satisfactory piece of equipment for such work because, despite the greatest care in its use, water can be present in the drum and yet go undetected. This arises from the fact that, without a valve at the lower end, the whole of the sample cannot be retained as the tube is withdrawn. When the drum was checked on this occasion the engineer could see no line of demarcation in the sample he drew and assumed that there was no water contamination. If the sampling had been carried out with sufficient care to ensure that the sample was drawn only from the bottom of the drum then it is quite possible that it consisted wholly of water; if the sample was not so carefully drawn then water may have been lost during withdrawal and only fuel retained. In either case, no line of demarcation would be evident despite the presence of water in the fuel drum.

In the drain check of the aircraft tanks, the engineer again looked for a line of demarcation between fuel and water. It seems most likely that he drained a full bottle of water from the auxiliary tank and this visual test procedure was inadequate to detect such an event. His failure to detect the water by its appearance, feel or smell is, perhaps, surprising considering his experience, but these sensory tests are not always reliable. In this case the check of the auxiliary tank was made whilst he was lying on his back under the aircraft on wet ground. Rain was falling and, in addition, the glass of the bottle had the not unusual green colouration. He carried out the refuelling and the tank drain checks without assistance.

The most careful attention to detail in fuel contamination checks is quite useless if the procedure followed is weak in itself and it is now clearly evident that the procedure followed in this instance was inadequate. Furthermore, there is something of a psychological hazard here, since the tester is expecting and almost always does get a negative result. It seems that the frequency of the checks coupled with the rarity of actual contamination induces a state of mind which does not promote that thoughtful application, so necessary, if the purpose of the check is to be achieved.

At the time of this accident both company and departmental instructions required a tank drain check before the first flight on any day and after each refuelling, but the methods of detecting water in fuel were not prescribed. Since this accident the Department has revised Air Navigation Order 20.2.5 and it now suggests two satisfactory but alternative methods of detecting water in the tank drain samples. viz., by placing a quantity of known fuel in the container before draining and then checking visually for any line of demarcation which would be created by the presence of water; or by checking the drainage samples by chemical means such as water detecting paste or paper. It should not be necessary for the Department to prescribe in minute detail how these checks must be carried out; it is the responsibility of every individual concerned to ensure that he follows carefully a procedure which has no loop holes.

Agricultural DH.82 Collides With Electricity Wires

A DH.82 engaged on a pesticide dusting run over a field of potatoes near Gatton, Queensland, on 25th February, 1957, collided with electricity transmission wires at about 0810 hours while pulling away at the end of the run. It crashed in a nearby field and caught fire and was destroyed. The pilot was rescued from the wreckage in an unconscious condition but he suffered only minor injuries.

During the morning the pilot had dusted several fields and he described the weather prevailing as "overcast, dead calm and virtually perfect dusting conditions". Visibility was not restricted.

He had 278 hours of pilot time of which 167 hours were gained in the DH.82, 40 hours being flown in the 90 days immediately preceding the accident. His experience on agricultural flying was approximately 65 hours. This 65 hours included 23 hours training and 36 hours on field operations under the supervision of an experienced agricultural pilot after which he was certified by his employer as a competent agricultural pilot. The accident occurred during his sixth hour of operations following certification.

The field being dusted had a row of 30 feet high wooden poles spaced about 150 feet apart along the eastern boundary on which were suspended four electricity transmission wires. The Company operating the aircraft required its pilots to inspect the area of proposed low level operations before commencing flying and record the nature and disposition of obstructions on a sketch plan. The pilot did this four days before the accident.

The field had been covered in North-south runs, parallel to the electricity wires, and only the "stripping" run along the north and south boundary headlands remained to be done. The run along the northern headland was then commenced, flying into the east towards the electricity wires and it was on this run that the accident occurred. The pilot said he could see the line of poles clearly and, in fact, before hitting the wires he thought he had commenced the pull-up too early.

The port interplane struts were dislodged by the impact with the wires and the aircraft continued on in a banked turn left and struck the ground on the left wing and nose, 145 feet from the wires. Fire broke out in the engine area but, fortunately for the unconscious pilot, a rescuer was able to keep it under control long enough by throwing earth on it for others to pull him clear.

It was determined that this accident was caused by the pilot misjudging the point at which to commence pull-up to clear the wires.

Fatal Accident in Authorized Low Flying

On 24th February, 1957, at 0945 hours a DH.82 aircraft flew into high tension power cables, crashed and burnt, whilst engaged on low flying in an authorised low flying area. The aircraft struck the cables whilst in level flight about 33 feet above ground level. It then struck the ground in a near vertical attitude, overturned, and was destroyed by fire. Both pilots were killed on impact. There was no evidence of any pre-crash defects or malfunctioning which may have contributed to the accident.

The aircraft, which was owned by the Gilgandra Aero Club, New South Wales, departed from the local aerodrome at 0930 hours being flown by an instructor and a private pilot who was in the process of obtaining a DH.82 endorsement. The purpose of the flight was to practice forced-landings and low flying. The aircraft was flown to the authorised training area where it was observed performing a practice forced-landing, from which a baulked approach was executed. The aircraft then proceeded in a north-westerly direction flying close to the ground. About ten minutes later the aircraft was observed in the same area proceeding in a southerly direction flying at tree-top level. It was flying over cleared land when it was observed to suddenly dive into the ground.

The aircraft had flown into the centre of the span of two steel high tension cables carrying 11,000 volts. The cables were suspended between two 35 feet high poles which were approximately 300 feet apart with the area between the poles quite clear of trees or scrub. Although the country was fairly open the two supporting poles would have been obscured by trees when approaching from the direction flown by the aircraft. Also, the cables were a light grey colour and probably almost indiscernible against the background of grass and trees.

Apparently this high tension line had been erected subsequent to the approval of the area as a low flying area and, although its existence was generally known by club members, it is not known whether this particular instructor, who had only recently commenced flying with the club, was aware of its existence. The accident again demonstrates the need for the highest degree of vigilance when low flying, and it should be well noted that an area designated and approved as a low flying area carries no guarantee that the area is free of obstructions which can be hazardous if ignored. It also highlights the necessity for training organisations to prominently display an up-to-date large scale map of the training areas with all obstructions, including power lines, clearly marked on it.

Agricultural DH.82 Collides With High Tension Power Cables

At approximately 0845 hours on 22nd May, 1957, an agricultural DH.82 flew into high tension power cables and crashed, when approaching to land on "Gidleigh" Station strip near Bungendore, New South Wales, at the completion of a ferry flight. The pilot received minor injuries to his face and the aircraft was substantially damaged.

Six days prior to the accident this and another pilot had proceeded to "Gidleigh" in separate aircraft for the purpose of spreading superphosphate. Both pilots stated that on arrival over the prepared strip two complete circuits were flown and a number of cables observed, particularly a line of poles and cables to the south of the strip. On this occasion both aircraft were landed to the north over the cables. After landing both pilots walked along the strip and discussed these high tension cables which were 25 - 30 feet high and 700 feet from the south end of the landing strip. It was agreed that all take-offs would be made to the north away from the cables. It also transpired that until the time of the accident all landings except when the aircraft first arrived, were made to the south, thereby avoiding the approach over the cables.

Shortly after arriving at the strip operations were commenced and continued throughout the following day. On the next two days the weather was unsuitable for the dropping of superphosphate and no work was done. On the morning of the fifth day operations were recommenced but were abandoned about mid-day due to high winds. The pilot concerned in this accident then flew about 14 miles to his working base at Queanbeyan—a normal procedure on completion of the day's flying. The other pilot flew to Goulburn, his home town, intending to return to "Gidleigh" the following morning.

On the sixth morning the pilot departed Queanbeyan about 0830 hours and flew to "Gidleigh", flying at 1,000 feet. Although he noticed there was a southwesterly wind of about ten knots, he decided to carry out a straight-in approach on the strip landing into the north-

east with a downwind component. Apparently, the strip was in a shallow valley and, as the aircraft descended on a long straight-in approach, it was maintaining almost a constant height above the ground over which it was flying. The pilot stated that it was not until he was very low that he realised he was undershooting, the position of the aircraft at this time being about one mile from the strip 50 feet above terrain.

About this time he noticed that the other DH.82 was about to touch down on the strip but in the opposite direction and this surprised him as he was not expecting the other pilot to return until two hours later. He stated that he then elected to continue the approach at a reduced airspeed in a nose-up attitude with sufficient power to maintain level flight, thereby gaining time for the other aircraft to clear the strip. During this stage of the approach he saw the cables immediately in front of the aircraft but too late to take any avoiding action. The undercarriage struck the cables causing the aircraft to nose into the ground after travelling a further 150 feet. After bouncing 18 feet it came to rest standing in a vertical attitude 530 feet south of the landing strip.

On a normal approach from the south, the poles and the gap cut in the trees to take the cables would be clearly visible, but when approaching at a low altitude the poles would be camouflaged by trees and the gap would not be apparent. In addition to this, the approach was being made into the sun.

It would appear that there was no question of the pilot having misjudged his height above the cables. He elected to land with a downwind component of ten knots on a strip with an effective operational length of only 1,320 feet, as well as making the approach into the sun, and flying the last mile of the landing approach at a height of approximately 50 feet above terrain with the aircraft in the "precautionary" attitude. The cause of the accident was assessed as the pilot's failure to exercise the degree of care demanded by the circumstances.

In looking for an explanation for the pilot operating as he did, his log book was examined and it was discovered that he had logged 408 hours 50 minutes in the 90 days preceding the accident. Although it is impossible to say to what extent fatigue contributed to this accident, it was certainly a factor of some significance.

A point to remember is that fatigue is not just a matter of being tired. Quite often it is a state of mind and body, probably induced over a long period, which results in mental and physical performance much below normal. Perhaps the most insidious thing about fatigue is that quite often the symptoms go unrecognised by the person concerned.

CORRECTION

Aviation Safety Digest No. 10 contained an account of a DH.82 which became lost on 10th November, 1956, during a flight from Jamestown to Waikerie, South Australia. A forced landing was carried out and the position of landing which read "150 miles west of Jamestown and 122 miles northwest of Waikerie" should have read "150 miles east of Jamestown and 122 miles northeast of Waikerie".

INCIDENTS

It Would Have Been Much Closer In Cloud

At 2108 hours E.S.T. on 26th September, 1957, a DC.4 and a DC.3 arrived over Nhill in the Melbourne Control Area, flying on opposing tracks and at the same altitude. The crews were unaware of each other's position until the aircraft were dangerously close when each captain sighted the other's navigation lights. Both took abrupt evasive action to avoid a collision.

The Circumstances

The DC.4 departed Adelaide for Melbourne *2016 hours, cleared to cruise at flight level 80. This aircraft reported over Tailem Bend, the last reporting point before entering the Melbourne Control Area, at 2034 hours flight level 80, estimating Nhill 2110 hours. The aircraft passed this position to Adelaide A.T.C. who relayed it to Melbourne A.T.C. at 2037 hours.

The D.C.3 departed Melbourne for Adelaide 1946 hours, cleared to cruise flight level 90. At 2047 hours it reported over Lubeck 2046 hours, flight level 90, estimating Nhill 2108 hours, and requested permission to descend to flight level 70. This message was passed to Melbourne A.T.C. through Nhill Aeradio†. At 2049 hours, Melbourne A.T.C. advised Nhill Aeradio that this aircraft was cleared to descend to flight level 70. Nhill aeradio passed this message to the aircraft and received an acknowledgment. At 2053 hours, Nhill Aeradio advised Adelaide A.T.C. of the amended flight level and estimated time of arrival over Nhill of this aircraft.

At 2108 hours, the captains of the DC.4 and the DC.3, when in the vicinity of Nhill, sighted each other's navigation lights, switched on their landing lights to alert the other and simultaneously took abrupt evasive action to avoid a collision. The DC.4 promptly asked Nhill Aeradio for information on "west bound" traffic and was advised that a DC.3 was due over Nhill at 2108 hours at flight level 70. The DC.3 promptly called and said "that is not right. I was cleared further back to descend to flight level 70 but was not advised of any east bound traffic". At the time of the incident the weather was fine and the aircraft were flying below broken cloud.

Analysis

The separation standards applicable to aircraft operating in control areas are specified in AIP-RAC/1-4-4. Paragraph 8.1.2.2.2 of that section states that for aircraft on the same track in the opposite direction "vertical separation will be applied for at least ten minutes before and after the aircraft are estimated to pass or are estimated to have passed". The minimum vertical separation specified in a control area up to 19,000 feet is 1,000 feet (AIP-RAC/1-4-6, paragraph 8.2). From the E.T.A.'s of the aircraft at Nhill, the estimated time of passing was 2109 hours and consequently the DC.3 had to be at flight level 70 by 2059 hours for the standard separation to be maintained. From the recording of the Melbourne Air Traffic Control communications for the relevant time, the Nhill Aeradio log and the testimony of the crew of the DC.3 it has been established that the DC.3 received the clearance to descend from flight level 90 to flight level 70 at 2050 hours.

AIP-RAC/1-4-1, paragraph 1.2, states that "aircraft (operating in a control area) shall commence a change of level immediately on receipt of instructions unless a later time is approved by A.T.C." and "aircraft shall effect changes of level at the rate of 500 feet per minute unless otherwise approved by A.T.C." The descent clearance issued to the DC.3 did not specify a later time for the descent to be commenced and no variation from the prescribed rate of descent was approved. As mentioned earlier, the clearance was passed to the DC.3 at 2050 hours and the estimated time of passing was 2109 hours; thus, the descent to flight level 70 should have been completed by 2054 hours, 15 minutes before the estimated time the aircraft would pass.

The captain and first officer of the DC.3 state that the descent was commenced immediately on receipt of the clearance. As the clearance was received at 2050 hours and the aircraft was only at flight level 80 by 2108 hours, it is evident that the average rate of descent was in the order of 56 feet per minute. The captain readily admits that he adopted a slow rate of descent. He has stated that, when he asked the first officer to request permission to descend to flight level 70, it was his desire to make a slow descent but apparently omitted to instruct the first officer to request approval to depart from the prescribed rate. The captain made it clear that, whilst he was aware that he had no approval to descend at a slow rate, he believed it would be in order to do so because he had received no advice of conflicting traffic.

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* Nhill Aeradio exists to relay messages between aircraft and Adelaide A.T.C. centres when the aircraft cannot communicate direct with these places.

† The direct track from Melbourne to Adelaide is inside a control area and the division of responsibility between Melbourne and Adelaide A.T.C. centres occurs at the South Australian-Victoria border, 37 miles on the Adelaide side of Nhill.

The captain's belief that he should have been advised of the movement of the DC.4 was in error. The circumstances under which traffic information will be passed to aircraft in a control area are specified in AIP-RAC/1-4-3. Briefly, these are when the separation falls below the minima, in V.F.R. conditions when separation is not provided between departing aircraft and arriving aircraft, and when requested by the pilot. The captain of the DC.3 did not request traffic information and the other conditions for passing traffic information to the aircraft did not apply.

It is clear from the evidence that this incident arose simply through the captain of the DC.3 effecting the change of level far slower than that specified in AIP-RAC/1-4-1.

Action Taken

Because of the seriousness of this incident and the possibility that there were other pilots who did not fully appreciate the significance of the change of level requirements, Operations Letter ATC.220 was issued a few days after this occurrence. There is an important message in this letter and its contents should be well digested.

A Lively Spark

During a flight in a Dove it was found that the starboard engine was running roughly when the right-hand magneto was selected. After a ground test which confirmed this report, the aircraft was pushed just inside a hangar, nose outwards, and chocked at the nosewheel only. The throttle was left in the full open position and the fuel was left selected ON. The defective magneto was removed and the replacement magneto — which was fitted with an impulse starter — was offered up to the engine coupling. It was not secured but was held by an engineer. The magneto switch leads had been disconnected from both magnetos for the subsequent timing adjustments and a magneto synchronising test set consisting of lamps and a buzzer was connected to each magneto. The high tension lead from the distributor was also connected to the replacement magneto. During the action of synchronising the magnetos the propeller was turned, this caused the impulse mechanism on the right-hand magneto to operate and the engine to start. The right-hand magneto came adrift, being retained in the hand of the engineer, and the engine continued to run on the left-hand magneto.

The aircraft, being chocked at the nosewheel only, moved forward, jumped the chock, and careered out of the open hangar. In so doing the port wing contacted the edge of the door, and this, combined with the thrust from the starboard engine, caused the aircraft to swing to the left. The starboard wing passed over a low fence, brushed the tops of some parked cars, and the aircraft finally stopped with the port wing jammed against the corner of the hangar with the starboard engine still running. The engine was finally stopped by closing the throttle and short circuiting the operating magneto. The accident resulted in four maintenance engineers being injured, fairly extensive damage to the aircraft, and damage to fencing, the hangar, and two private cars.

After the accident the magneto in question was connected to the same test and intermittent sparking was obtained whilst turning the impulse starter by hand. The intensity of the spark was similar to that which could be expected from an impulse starter magneto with slightly dirty contact points, or a weak coil or condenser. This lower efficiency was due to the loading or damping effects of the test set on the primary winding, and was the sole effect of the test set.

This accident illustrates the danger associated with the use of a magneto timing or synchronising device which will allow a sufficiently rapid collapse of the primary current when the points open, to produce a spark at the plugs and thus possibly result in an inadvertent engine start. Apparently a number of maintenance engineers believe that the magneto is earthed (i.e. the primary winding) once the leads from a synchroniser test set are connected to the magneto in lieu of the normal switch leads. This is incorrect. The majority of test sets do not earth the magneto but apply a relatively high resistance across the primary winding. This provides a certain amount of damping but it will not necessarily prevent the magneto from producing a spark of sufficient intensity to start an engine.

It should be remembered that whenever the switch lead is removed from a magneto installed on an engine, precautions must be taken to prevent an inadvertent engine start. Particular care is necessary with magnetos having an impulse starter as only a slight movement of the engine crankshaft is required to trip the pawls of a "wound" starter and thus allow the magneto armature to flick over and produce a very healthy spark. Any one of the following precautions will ensure that an inadvertent start will not occur.

(a) disconnect the primary winding from the contact breaker points,

(b) remove the distributor cover,

(c) disconnect the high tension leads from the plugs,

(d) earth the magneto primary winding at the magneto.

Note: In some types of magneto this is accomplished automatically when the switch lead connector is removed.

Remember that a magneto will be "alive" if the magneto switch lead is broken or has a high resistance connection. Similarly, a poor contact in the magneto switch or in the earth return path from the switch to the magneto (often through the bonding system of the aircraft) may result in a live magneto. And last, but not least, as this incident demonstrates quite adequately, a magneto is not necessarily rendered inactive when a synchroniser set is attached in lieu of the switch leads.

Rudder Control Cable Failure

During a period of dual instruction on circuits and landings in an Auster J1, the port side rudder control cable broke whilst the aircraft was on final approach. The cable failed at a point about one foot from the rudder pedals where it passed under the change of direction pulley, immediately beneath the cockpit floor. The landing was effected without damage to the aircraft.

The cable was of 7 x 7 construction, that is seven wires per strand, seven strands per cable; the starboard cable of similar construction was found to be fully serviceable with no strands broken. As the aircraft log book covered 960 hours of operation and no entries had been made referring to replacement of control cables, it is probable that these cables had been in use during the whole of that period. The aircraft had flown 16 hours since the previous 50 hourly inspection and, during this period, the daily inspections had been performed by a commercial pilot holding a certificate of maintenance approval.

Under microscopic examination many of the wires exhibited fatigue failure whilst others exhibited necking; a characteristic of tension failures. The wires of many strands had made elliptic impressions on the surface of adjacent wires indicating local overloading and a proportion of wire failures in the strands.

The cable was work-hardened in the immediate vicinity of the break as shown by the general brittleness of the wires in this area, the brittleness diminishing with distance from the break. Although the amount of grease present on the cable had prevented any wire failures from tarnishing with age there is no doubt that the failure was progressive and many wire breaks were present for some period before the complete failure of the cable occurred. It seems probable that the strands had not unravelled sufficiently for the wire breaks to have been observed in the normal course of an inspection, although they probably would have been discovered if the cable had been cleaned down and a cloth run over the cable to pick up any broken wire ends which otherwise would not be readily visible.

The history of Auster rudder cable failures indicates that the majority have occurred in the vicinity of the pulleys. Many proposals for increasing the life of the rudder cables have been tested. These have included modifying the circuit to a "closed-loop" system, the introduction of larger diameter pulleys, and the binding of the cable in the pulley area with cord. These schemes have not resulted in any appreciable improvement and it is now considered that short of redesigning the entire rudder control system, the problem will not be easy to solve. In the meantime meticulous periodic inspections to locate any damage to the cable before complete failure occurs are essential. Such inspections are called up in Air Navigation Orders, Section 105.1.3.0.2.6, Issue 2, the inspections to be performed at initial installation, after 100 hours flying time and thereafter at intervals not exceeding 50 hours flying time. It is considered that if these inspections are performed as required there is little danger of a complete cable failure occurring before broken wires or strands are discovered. This is borne out by the fact that this is the first complete failure of an Auster rudder cable for quite a long time.

If you should experience a rudder cable failure in flight, directional stability will depend on the engine power being used at the time, the direction of engine torque relative to the broken cable, and/or the airspeed. Directional stability can be achieved by setting cruising power, assuming a laterally level attitude and by allowing the rudder to streamline. The Auster rudder control system consists of two independent cables operated from independent pedals. Attached to each pedal is a light spring which applies approximately four pound tension to the cables. In the event of a cable failure the spring tension on the remaining cable may be sufficent to apply a small amount of rudder, but this can be overcome by pulling the rudder pedal towards you with your toe, thereby permitting the rudder to streamline. With care the aircraft can then be manoeuvred to a landing using elevator and aileron controls.

Too Close

At 1608 hours on 22nd April, 1957, a DC.3 set course on the 247° diversion from Sydney Airport for Wagga cleared to climb V.F.R. to flight level 60. One minute later a DC.6 set course for Melbourne on the same diversion, cleared to climb V.F.R. to flight level 120. The aircraft were advised of each other's movements. There was no other significant traffic.

Some seven minutes after setting course and when at an altitude of approximately 4,500 feet, the DC.6 passed 50 FEET below the DC.3. The crew of the DC.6 did not see the DC.3 at any stage.

The weather was fine with a slight haze and 2/8ths to 3/8ths cloud at 16,000 feet. However, on the 247° diversion, both aircraft were heading directly into the sun. The pilots later reported that their ability to see another aircraft ahead was considerably reduced by sun-glare. This was evidently the reason why the crew of the DC.6 did not see the DC.3.

Following this incident Head Office Operations Letter ATC.207, 25th June, 1957, was issued summarizing the rules applicable to V.F.R. flight in control areas with advice to air traffic controllers and pilots on points to be observed on such flights. The suggestions to pilots in that letter are reprinted below to emphasize their importance.

"(a) Use reasonable restraint in adopting the V.F.R. procedure if doubt exists as to your ability to remain V.F.R. — Visibility and distance from clouds are minimum conditions and allowing a greater margin in certain instances reflects good judgment. This applies particularly to the V.F.R. departure which, although initiated by ATC, will be immediately cancelled if some factor affecting the ability of the pilot to fly V.F.R. is advised to the controller.

(b) When approaching the descent position, give careful consideration to whether V.F.R. flight can be maintained to the destination, before electing to proceed V.F.R. In marginal conditions it is advisable to obtain an aerodrome weather report before making this decision. In certain conditions whether a flight can be completed under V.F.R. is strictly a matter of judgment but the choice to remain I.F.R. in doubtful cases reflects good judgment.

(c) If forward visibility is reduced due to the position of the sun or during precipitation, advise A.T.C., to obtain alternative instructions. Although the rules do not prohibit V.F.R. flight under such conditions, the chances of sighting other aircraft are greatly reduced and it is preferable to fly under I.F.R.

(d) Note carefully the disposition of aircraft advised as essential traffic by A.T.C., and if possible obtain a sighting. Passing information on other aircraft which are operating in proximity to you will enable the controller to relay this information to the aircraft concerned. If you are in doubt concerning the relative position of another aircraft advise A.T.C. accordingly.

(e) If for any other reason, you doubt your ability to maintain adequate separation with other aircraft, whether temporarily or for the whole manoeuvre, the safe course would be to request alternative instructions from A.T.C.

(f) Be alert at all times especially when the weather is good — Unlimited visibility may encourage a sense of security not at all justified."

SURFACE CONTROLS
Stabilizer Actuator

Wrong Screw Fouled Stabilizer Actuator Control

the Situation

FIRE DESTROYED a jet fighter shortly after it was seen to go into a steep dive from level flight and crash. The pilot was killed.

An identical type aircraft which experienced sticking controls led to a thorough examination of the tail surface control system. Probable cause of the fatal accident was found to be a misplaced machine screw in a fairing attachment strip. The fairing was attached by seven screws; one was required to be shorter than the others to avoid interference with movement of a lever in the control system.

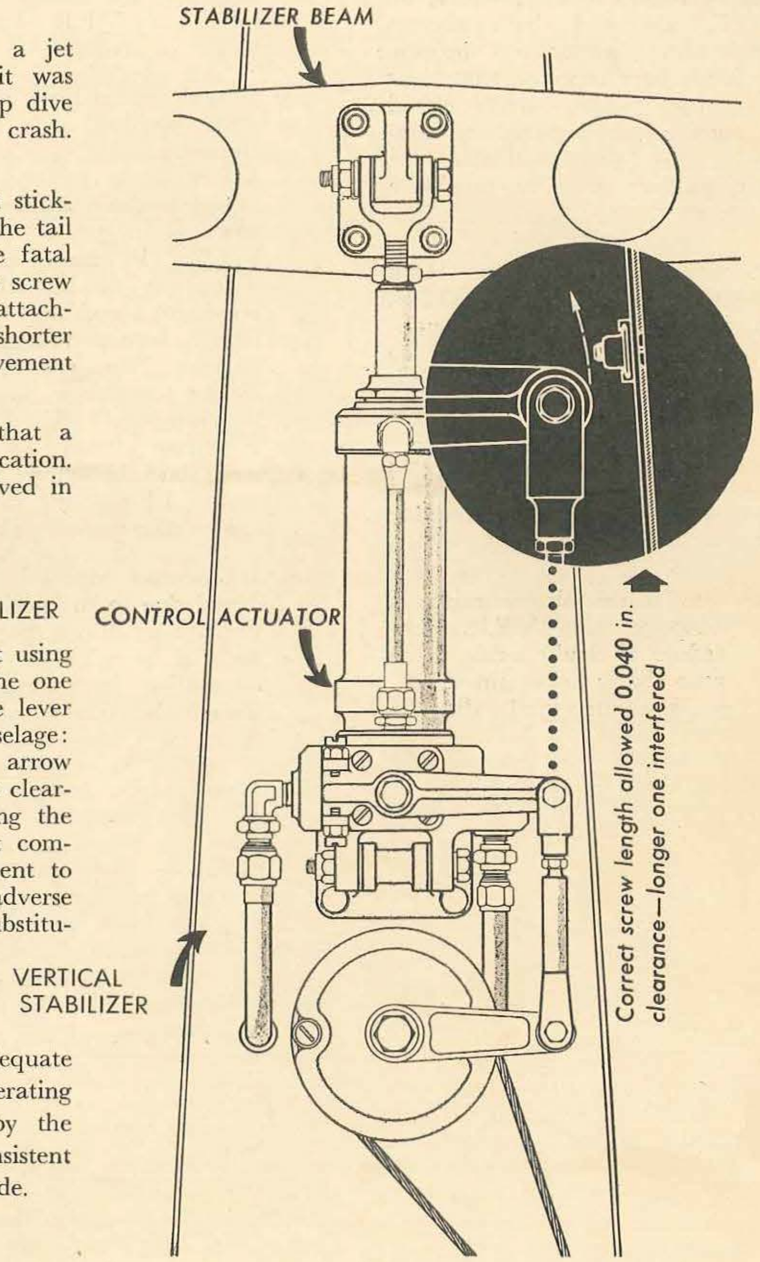
The reason for the sticking controls was that a longer screw had been installed in the critical location. This may have occurred on the aircraft involved in the fatal accident.

the Hazard

Sole precaution against using a screw longer than the one which would clear the lever was a notice on the fuselage: "USE A SHORT SCREW ONLY", and an arrow pointing to the critical fastener hole. Since the clearance margin was a mere .040 inch when using the correct length screw, the question as to what comprised "a short screw" was not readily apparent to a mechanic, especially were he working under adverse circumstances. Consequently, the inevitable substitution of the wrong screw occurred.

PRECEPT

Procedures for adequate maintenance and operating practices established by the designer should be consistent with average human effort, ability and attitude.



(By courtesy Flight Safety Foundation Incorporated)

Ref: Davis, RC, Group Captain, Dir. of Flight Safety, R.C.A.F. "AIRCRAFT ACCIDENT INVESTIGATION", IAS Reprint No. 575.