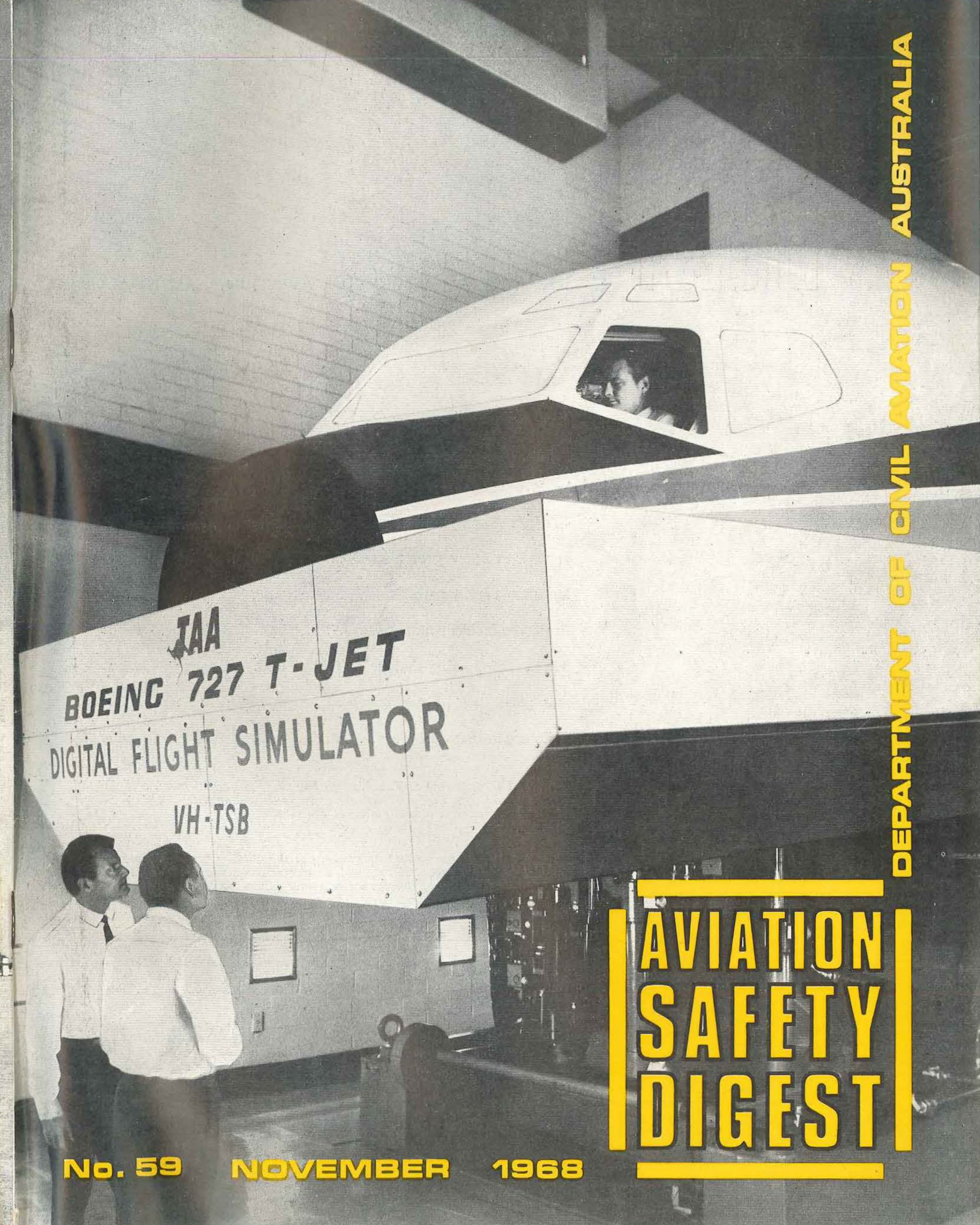

DEPARTMENT OF CIVIL AVIATION AUSTRALIA

AVIATION SAFETY DIGEST

No. 59 NOVEMBER 1968

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Contents

FRONT COVER: One of T.A.A.'s two Digital Flight Simulators "in flight" at the Company's Flight Training Centre at Essendon Airport, Victoria. A DC-9 simulator is also installed at the Centre.

BACK COVER: Auster tugs aerotowing at the Gliding Club of Victoria's base at Benalla. A Kookaburra, with instructor and student aboard, begins a take-off in a cloud of dust as a two seater Blanik passes overhead.

AUSTRALIA

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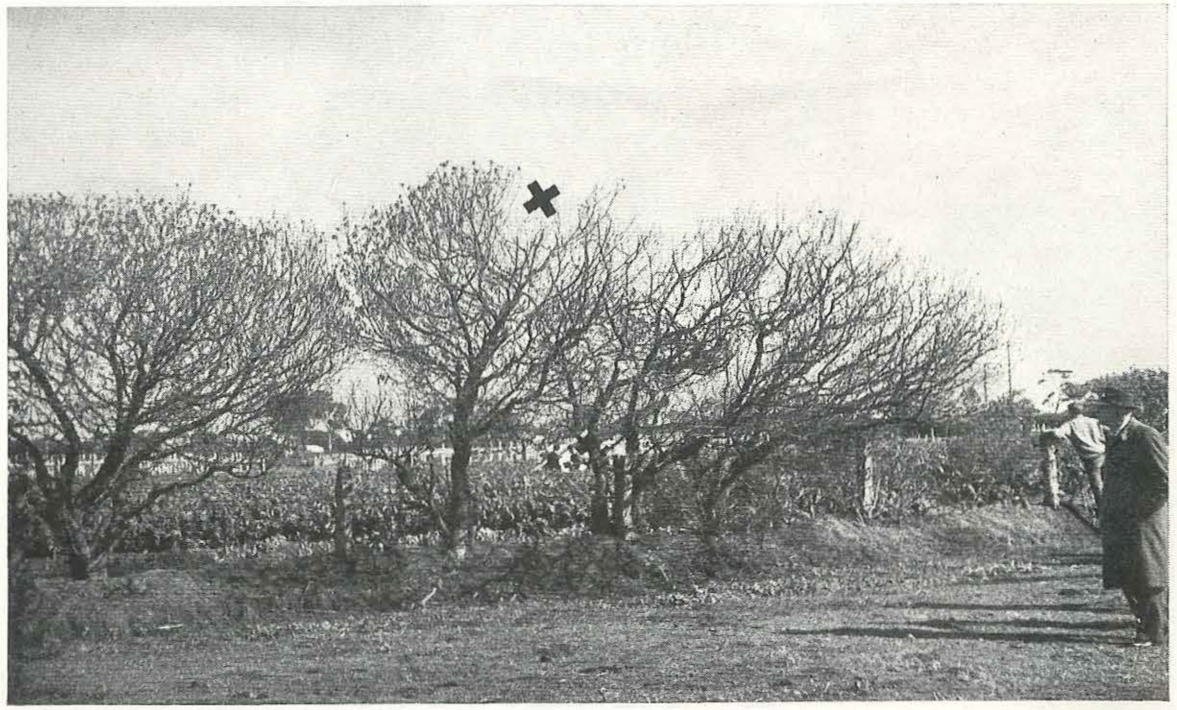
LUCKY ESCAPE IN MISJUDGED FORCED LANDING

As a Victa Airtourer was rejoining the circuit for a landing at Moorabbin Airport, Victoria, after the student pilot had completed some solo flying exercises in the training area, the engine failed completely. At the time, the aircraft was over a built-up suburban area, and the pilot, seeing an open area some distance to the left of his flight path, turned towards it to try and make a straight-in forced landing approach into wind.

The pilot lowered two notches of flap early in the approach, then full flap as he neared the field, but the aircraft overshot the nearer boundary of the field. The pilot had no alternative but to continue his approach and when about half way across the field, realised that the aircraft's glide path would take it into a line of small trees on the upwind boundary. At the last moment the pilot lifted the aircraft over the trees but as he did so, the port wing struck an upper branch and almost immediately the aircraft stalled. As the nose dropped, the aircraft rolled to the right on to its back, then fell upside down into a market garden adjoining the paddock which the pilot had chosen for the forced landing. The main impact was taken on the starboard wing and nose and, although these sections of the aircraft sustained severe damage, much of the impact force was cushioned by the very soft ground of the market garden. As a result the pilot escaped with only minor abrasions.

* * *

Examination of the wreckage showed that the engine should have been capable of normal operation at the time of the accident. Although the master ignition and generator switches were turned on, the fuel selector was in the off position, and

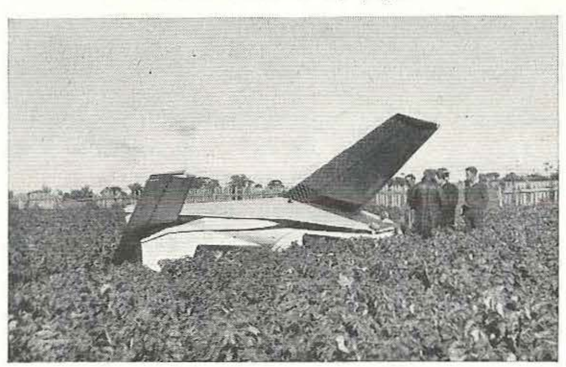


The line of trees over which the pilot attempted to lift the aircraft. The cross indicates where the port wing struck an upper branch.

the small amount of fuel in the carburettor and fuel line was consistent with the fuel cock having been turned off while the engine was running at cruising power.

Describing the events leading to the accident, the pilot admitted that he had not carried out any cockpit checks after the engine failed, but said he had made a normal pre-landing check on his downwind leg shortly before the engine failed. The pilot also said that he had not turned the fuel

The aircraft upside down in the market garden, looking in the direction of flight.



off before leaving the aircraft after the crash. Because the investigation was unable to uncover any satisfactory explanation for the fuel cock being in the off position, the possibility that the pilot had inadvertently turned the fuel off during his pre-landing downwind check was considered. When questioned about this, however, the pilot said that although he thought it was possible for him to have done so, he believed it highly improbable. As well as this, his description of the engine failure itself was suggestive of a carburettor icing problem. The pilot said he had made use of the carburettor heat control during his exercises in the training area, but that he had not done so while descending to rejoin the aerodrome circuit shortly before the engine failed. The investigation established that weather conditions at the time of the accident were favourable to the formation of carburettor ice but, against this, it was found that several other pilots, who were flying Victa aircraft in the area at the time of the accident, experienced no symptoms of carburettor icing.

The evidence obtained during the investigation, while compatible with either explanation for the loss of engine power, was thus not sufficiently definite to refute one of the possibilities in favour of the other. It was therefore not possible to finally determine the actual cause of the loss of engine power.

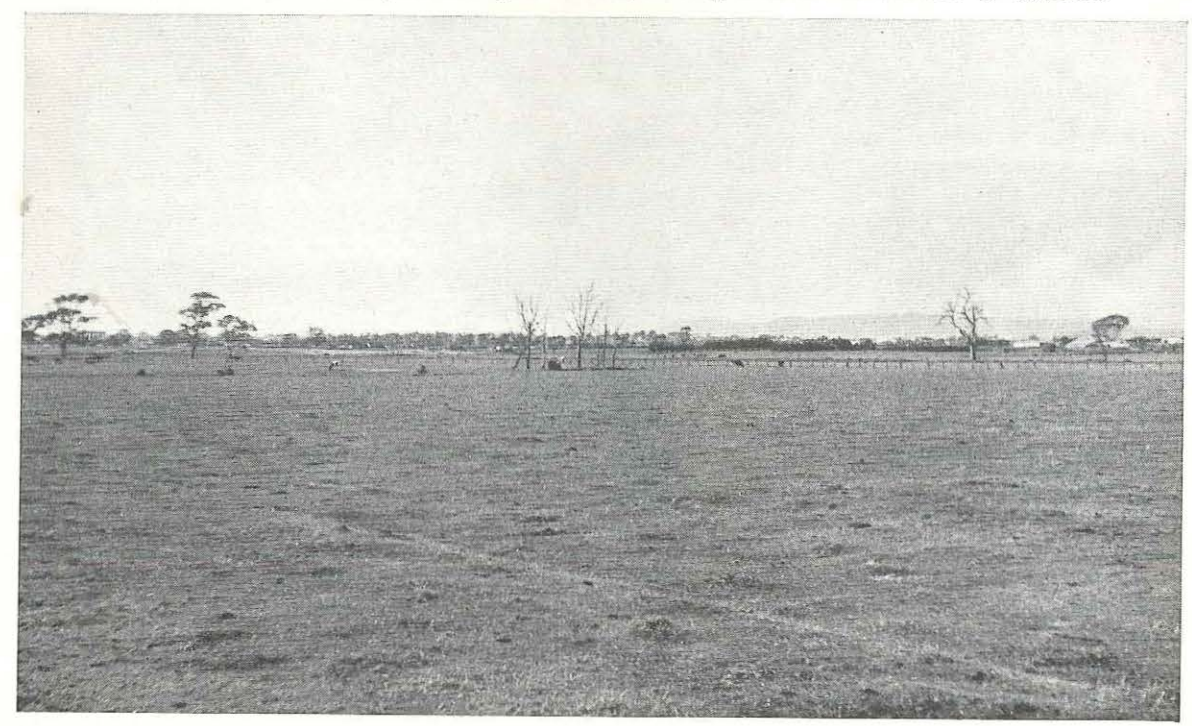
* * *

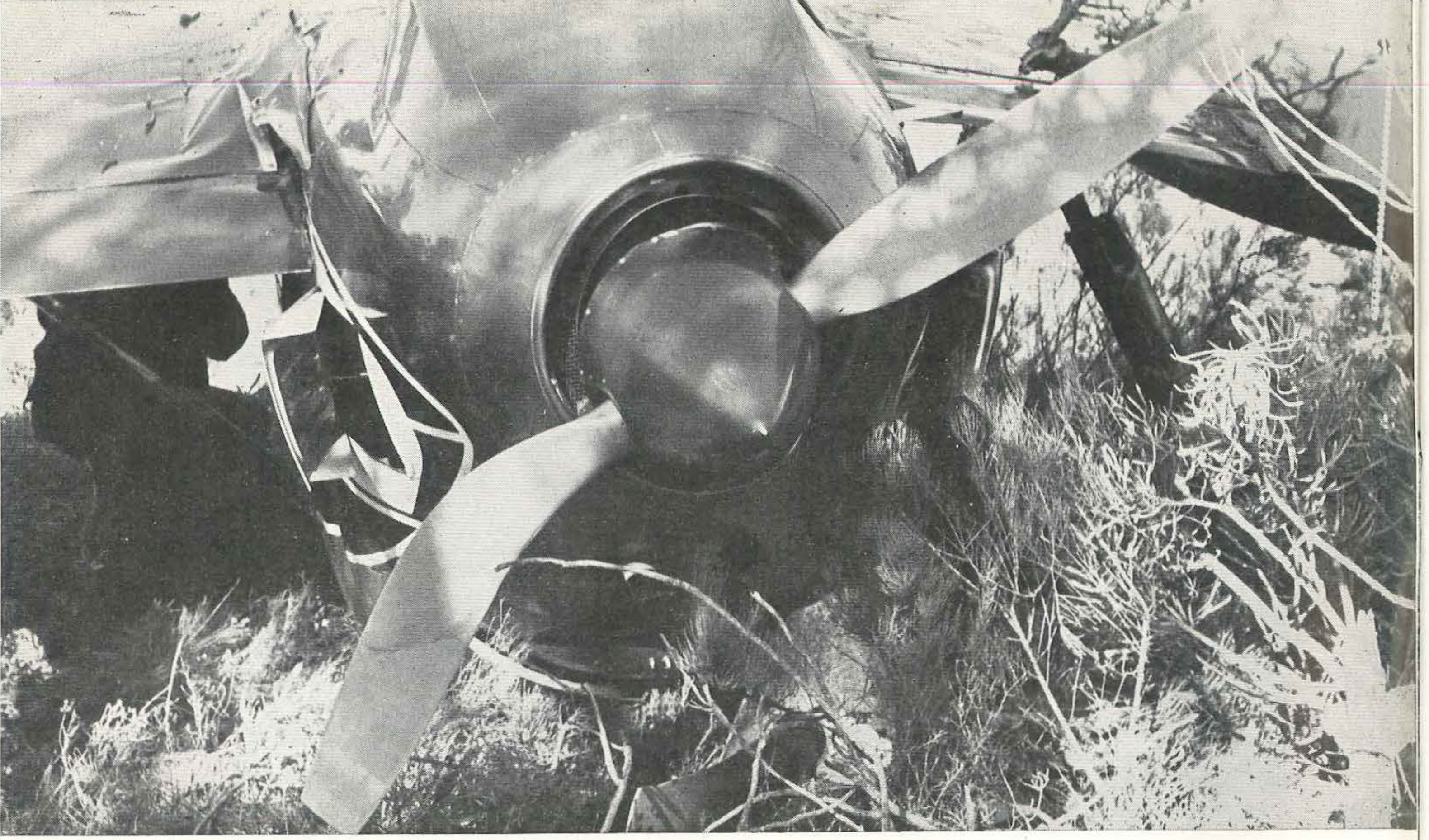
Although the reason for the engine failure could not be pin-pointed in this instance, the accident is nevertheless of interest for the object lesson it provides in forced landing procedures. When the Victa's engine failed, the distance of the aircraft from the nearest clear area was such that the pilot was obliged to make a straight-in approach which, with no power available to adjust to the aircraft's descent path, would have required extremely fine judgement. In addition to this, the field the pilot had selected, though the best forced landing area available, was far from ideal. The length it afforded for the landing run was barely enough and though it was well grassed, it contained a number of small undulations and soft areas, to the extent that care was necessary when driving a motor car over it. Taking into account the pilot's limited experience, the circumstances in which the engine failure occurred were such that an accident of some sort was almost inevitable. As it turned out however, with the pilot losing all control of the aircraft during the final stages of the forced landing approach, the accident that followed had all the makings of a disaster and the pilot was fortunate indeed to have emerged from the crash comparatively unscathed. But for the softness of surface of the market garden where the aircraft struck the ground, the accident could very easily have had fatal consequences.

Statistics extracted from the Department's accidents records show that almost invariably, losing control of an aircraft while carrying out a forced landing, results in an accident involving serious injury or death. Accidents such as the one under discussion in which control is lost but only minor injuries result, are very much the exception. On the other hand, the Department's records show clearly that if control of the aircraft is maintained, even though the landing is being carried out on unsuitable terrain, the occupants usually escape with only minor injuries. There is an old saying in aviation that "gravity is more deadly than inertia". Notwithstanding the pilot's lucky escape in this instance, a glance at the photographs on page one is sufficient, considering the circumstances of the accident, to confirm the truth of this statement!

The other point which this accident brings out is of course the importance of carrying out the correct drills when an emergency develops. Had the pilot done so on this occasion, it seems quite possible that the necessity for a forced landing would have been avoided.

The paddock in which the pilot attempted to land, looking back in the direction of approach.





ENGINE FAILURE UNRECOGNISED

At Jandakot, Western Australia, a private pilot had arranged to carry out some solo flying practice in a Cessna 337. The pilot, who had nearly 200 hours flying experience, had been endorsed on the type some seven months before, but following this, did not fly at all for six months. He then underwent a check flight of some 25 minutes duration in the 337, after which he did 35 minutes solo flying. The flight under discussion was his next flight and took place two weeks later.

After the pilot had carried out a pre-flight inspection and checked the fuel tanks for water, he started both rear and front engines and taxied out for take-off. When he reached the runway holding point, he braked the aircraft to a stop and went to adjust both throttles to bring the engines up to 1,000 r.p.m. He then saw that the rear engine had stopped while he was taxi-ing. He restarted the rear engine without difficulty, and carried out a satisfactory pre-take-off engine run up.

The pilot then took off normally on runway 06. After carrying out a circuit, the pilot approached to land again on runway 06, but as he was on final approach, another aircraft was on the runway and he was required to go around. Towards the end of the second circuit the aircraft's approach to land was again baulked and once again the pilot had to go around.

On the third circuit the runway was clear and the aircraft approached to make a touch and go landing. As the aircraft flared and touched down, the pilot of another aircraft who was taxi-ing after landing saw the 337's rear propeller slow down and stop. About the same time as the propeller came to a stop, the 337 began accelerating again as the pilot applied power to take-off. The rear propeller remained stationary as the take-off run continued and, with the front engine operating normally, the aircraft eventually became airborne towards the end of the runway and climbed away slowly. When it reached a height of about 100 feet, the undercarriage was seen to retract and, at that point the aircraft began to lose height and began turning to the left away from the runway heading. With

the aircraft still losing height, it continued turning until it was over a timbered area adjacent to the aerodrome and heading in a direction almost the reciprocal of take-off. Finally, flying slowly in a pronounced nose-up attitude, with the front engine still developing full power, the aircraft struck the tops of the trees and descended into a scrub-covered, timbered area alongside the aerodrome. The aircraft was damaged beyond repair but the pilot received only minor injuries.

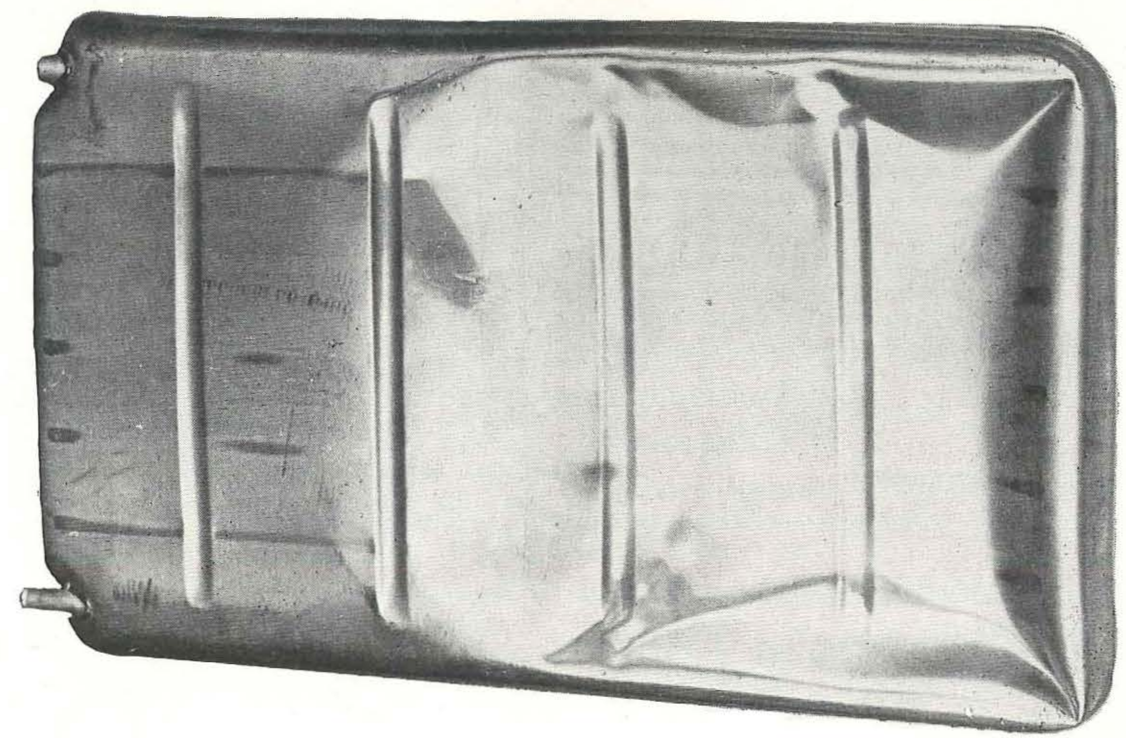
The pilot said after the accident, that when he opened both throttles after the touch and go landing, the aircraft seemed to gather speed satisfactorily on the runway. It was not until the aircraft was 10 feet or more off the ground that he felt that something was wrong and looked at the manifold pressure gauges. The rear engine needle was indicating 12 inches and the front engine 27 inches. The airspeed at this stage was more than 80 knots.

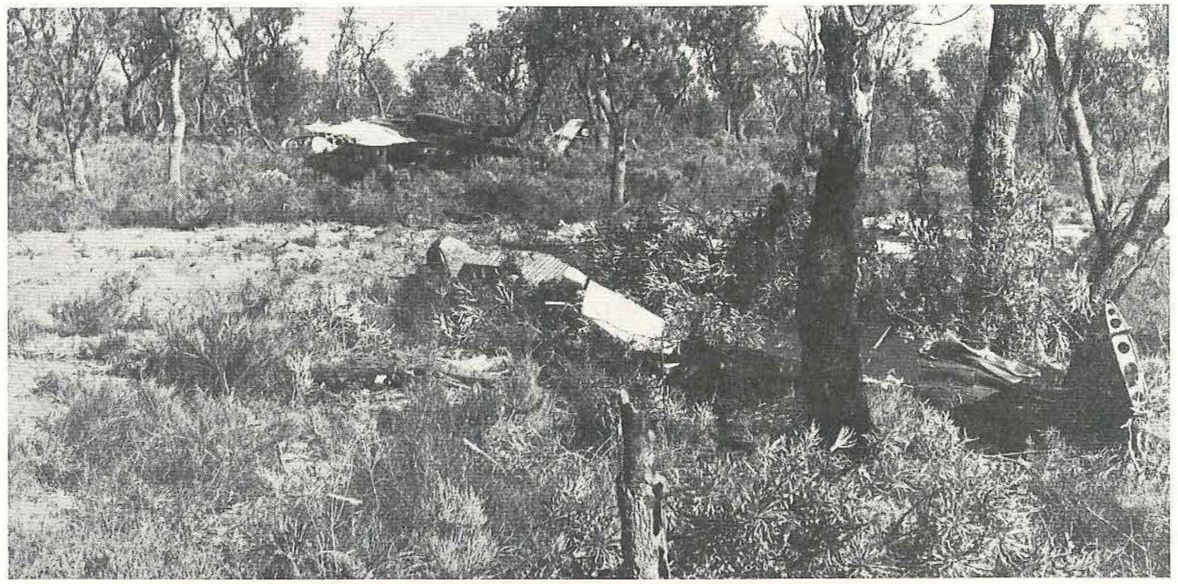
By the time the pilot looked up from the instrument panel, the aircraft had veered to the left off the runway heading. The pilot said the aircraft continued to climb, but only very slowly and, at about 200 feet, because the rate of climb was so slow, he decided to retract the undercarriage. By then, although he had not intended turning, the aircraft had turned to the left through about 70 degrees from the direction of take-off. Although the aircraft was losing height by this time the pilot did not feather the rear propeller because he hoped the engine would "pick up". Soon afterwards, he realised he would not be able to maintain height and, at about 20 feet above the trees, the stall warning began to blow. A few moments later the aircraft struck the trees and crashed into the undergrowth. When it came to rest the pilot turned off the master switch and ignition and escaped from the aircraft through the side window of the cockpit.

* * *

When the aircraft was examined after the accident, it was found that while the two inter-connected starboard main fuel tanks were almost full, and selected to the rear engine, the fuel system for this engine, from the fuel cock to the fuel discharge nozzles, was completely devoid of fuel, and it was evident that this part of the system did not contain fuel at the time of the accident. An examination of the starboard main fuel tanks themselves showed that both units had partially collapsed inwards in a manner suggesting the tanks had been subjected to reduced pressure internally. This could occur if the tank vent had become blocked and the fuel pump con-

One of the two inter-connected starboard fuel tanks, showing the degree of collapse.





A section of the swathe which the descending aircraft cut through the trees and scrub. The wreckage of the tailplane is at the base of the broken off tree in the foreground.

tinued to draw from the tanks.* The reduction in the capacity of the tanks resulting from the collapse, was very much greater than the quantity of fuel that the rear engine could have consumed during the short period of operation on the flight on which the accident occurred. It was evident that the tank venting system had become blocked some time before the flight on which the accident occurred and led to the collapse of the tanks, and that on this last flight, the rear engine had failed as a result of fuel starvation. A close examination of the rear engine fuel lines was made to determine whether on this occasion, any blockage or contamination might have been responsible for the fuel starvation, but no such evidence was found.

The vent valve for the starboard fuel tanks, situated in the starboard wing tip, was next inspected and was found to be installed correctly. (See diagram on this page). The vent valve assembly itself was then dismantled and examined and it was found that the hinged plate which forms the valve was firmly stuck to the body of the valve. In this type of valve, the valve plate is hinged at the top, so that when the valve assembly is correctly mounted, the weight of the plate causes it to close. The plate is sealed against the body of the valve by a rubber 'O' ring attached to the valve plate, which contacts a flat face on the body of the valve. It was evident that the valve plate had been stuck in the closed position for some time. During much of this time the fuel tanks had, no doubt, been venting through the small by-pass bleed holes in the body of the valve. However, because the bleed holes are very small in diameter, they could easily become blocked by foreign matter. Such a blockage had no doubt occurred, and been responsible for the collapse of the fuel tanks on an earlier flight, and on the aircraft's last flight, had resulted in fuel starvation of the rear engine. Although the bleed holes were clear when examined after the accident, it was likely that the blockage had been forced out when the starboard wing collapsed (see photographs) allowing the fuel in the tanks to impose a considerable head of pressure on the valve at the wing tip. Fuel was actually escaping from the valve by-pass holes when the aircraft was first examined after the crash.

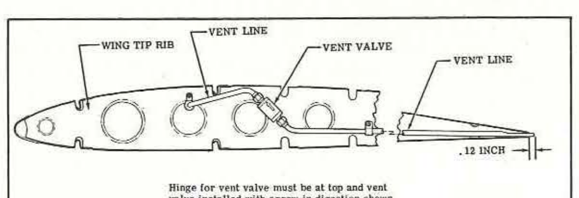


Diagram showing fuel tank vent arrangement inside the fibre glass wing tip.

* * *

Although the pilot had been adequately instructed in emergency procedures during his conversion training on to the Cessna 337 seven months before the accident, it is obvious that, with his lack of recent experience and limited flying experience generally, he was unable to cope with the unusual emergency situation that developed. The pilot admitted that he did not check the engine power indications when he opened the throttles for take-off after the touch and go landing, and it was not until after the aircraft was airborne that he saw that the rear engine manifold pressure indication was abnormal. Even then, his instrument scan must have been very cursory and apparently did not include checking the tachometer readings, for he still did not appreciate that the engine had stopped. On his own admission the pilot's reason for not feathering the rear engine was that he hoped it would "pick up". Obviously, if he had known that the engine had actually stopped, he would hardly have placed so much store on this hope.

In the existing conditions, and at the weight to which it was loaded, the aircraft should have been fully capable of safely climbing away and completing a circuit on the front engine only. The pilot's failure to feather the rear engine reduced this capability considerably, but even so, the circuit should still have been possible even if the margin of performance was small. However, the "last straws" to defeat this possibility were finally provided when the pilot failed to maintain directional control and a normal climbing attitude and, then on top of this, with the aircraft barely climbing, decided to retract the undercarriage.

Notwithstanding that retracting the undercarriage is the recommended procedure for a circuit with the rear engine inoperative (assuming of course, that the other engine-out of emergency procedures have been correctly carried out), there is a very considerable penalty in drag while the undercarriage doors are open during the retraction process. According to the Owner's Manual for the Cessna 337, the rate of climb penalty with the undercarriage retracting is minus 240 feet per minute compared to minus 110 feet per minute with the undercarriage fully extended and the doors closed. Though the pilot would have been fully justified in retracting the undercarriage after clearing obstructions, had he recognised the engine failure and feathered the rear propeller, there is no doubt that it was this additional drag penalty which resulted in the aircraft failing to maintain height and finally set the seal on the accident.

The wrecked aircraft as it came to rest. Note the position of the starboard wing.

Cause

The cause of the accident was that, during the take-off run, the pilot did not detect that the rear engine had stopped.

Comment

Although the stuck condition of the starboard tank vent valve was not the cause of this accident, the emergency from which it developed would not have occurred if the valve had been functioning properly. The case therefore provides a warning to operators of all aircraft to ensure that vent lines and valves are thoroughly checked for operation and freedom from obstructions at the prescribed inspection intervals.

*Readers may recall an incident reported in the September, 1966 Digest in which a fuel tank of a Cessna 337 collapsed when wasps built a nest in the air vent line. The damage to the tank was discovered after the fuel gauge was reported to be giving inaccurate readings.

What else could you expect?

THE pilot of this Cherokee set out to fly to Woodvale near Bendigo, Victoria, late in the afternoon. As the flight progressed, the flight plan he had submitted before leaving Moorabbin proved to be somewhat over-optimistic and the pilot realised he would not arrive over Woodvale until several minutes after the end of daylight. Because he knew the area, however, the pilot was not unduly dismayed at this prospect. As he arrived over the strip in the dark, a vehicle emerged from a nearby property and drove to the end of the strip to shine its headlights from behind the threshold, and the pilot decided he could land safely.

After descending and making a low run along the length of the strip, the pilot made a normal approach to land, using full flap, and touched down in the area lit by the vehicle's headlamps. The pilot had switched on the aircraft's landing lamp as he approached, but it was not until the aircraft rolled beyond range of the vehicles' lights that he realised that the landing lamp was not working. In the darkness, the aircraft ran off to one side of the strip, struck a line of motor tyres marking an area around the windsock, then collided with the steel windsock pole. The propeller was bent and the leading edge of the starboard wing was severely damaged.

* * *

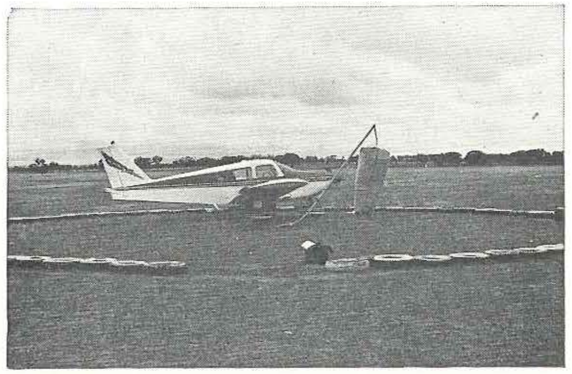
During the investigation of the accident, it was found that although the aircraft had not swung during the landing roll, it had run off the strip because the vehicle's headlights had not been aligned with the direction of the strip, as the pilot had assumed they were, but were angled slightly towards the position of the windsock. It was eight minutes after last light at Woodvale when the aircraft landed, and as the sky was overcast at the time and there was no moon, it would have been almost completely dark. The strip at Woodvale has no lighting facilities for night operations and, as the aircraft had no landing light, the vehicle's headlights had provided the only guidance for the landing.

In these circumstances it is hardly surprising that the pilot's attempt to land was not crowned with success — especially as he had no previous experience in night flying! Indeed, the possible consequences of landing under these conditions with trees, fences and no doubt overhead wires in the vicinity, are positively frightening and the pilot can be considered very lucky to have got off so lightly. In addition to the hazards of the actual landing, on a totally dark night with little or no ground lighting reference, there is a very real danger of a pilot with no instrument flying experience becoming disoriented in flight — as when deprived of all visual reference in cloud — and losing control of the aircraft. This has actually happened on a number of occasions, both in Australia and overseas, inevitably with fatal results to the occupants of the aircraft.

Asked why he persisted with the flight when he realised he would not be able to reach his destination before the end of daylight, the pilot said he knew he would not be able to return to Moorabbin before last light and because he knew the Woodvale area well, he believed he could find the strip and land without difficulty.

It became evident during the investigation that the pilot's whole attitude to the flight, both before and after take-off, placed it in the category of an "accident going somewhere to happen". It is evident too, that in his planning of the flight, the pilot paid scant attention to the sound advice in the Visual Flight Guide, that E.T.A.'s for destination aerodromes must be at least 10 minutes before dark, as determined from the end of daylight graph. Even if the pilot's pre-flight planning had been correct, the margin of daylight available to him at the destination would have been very slim—especially as the weather was overcast. As it was, the time interval for the flight calculated by the pilot was twelve minutes in error even though the distance is only 97 miles. But still the pilot did not appreciate his situation until well over half way to his destination!

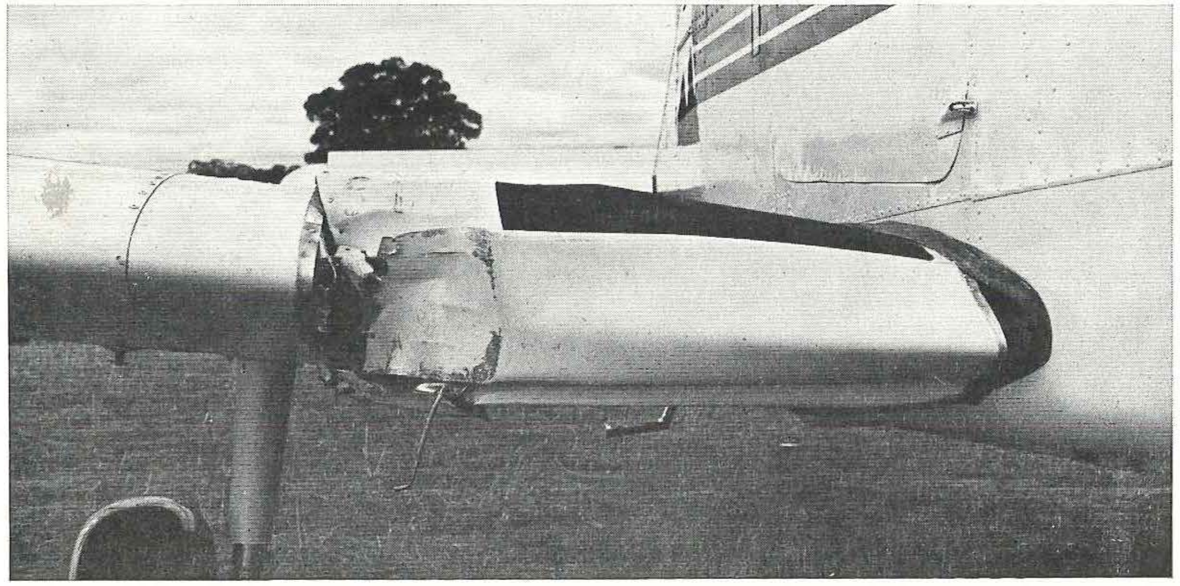
Altogether, it is impossible to escape the conclusion that the pilot, determined as he was to complete the flight, chose to disregard all indications that it would be impossible for the aircraft to reach Woodvale in daylight. In a situation such as this, when the margin of daylight was so slender, the pilot, once airborne and on his way, should have been constantly checking the progress of the flight to ensure that it was progressing according to the flight plan. He should also have determined the point where the flight would have to be abandoned, if it did not progress as planned, to allow time for the aircraft to return and land before the onset of darkness.

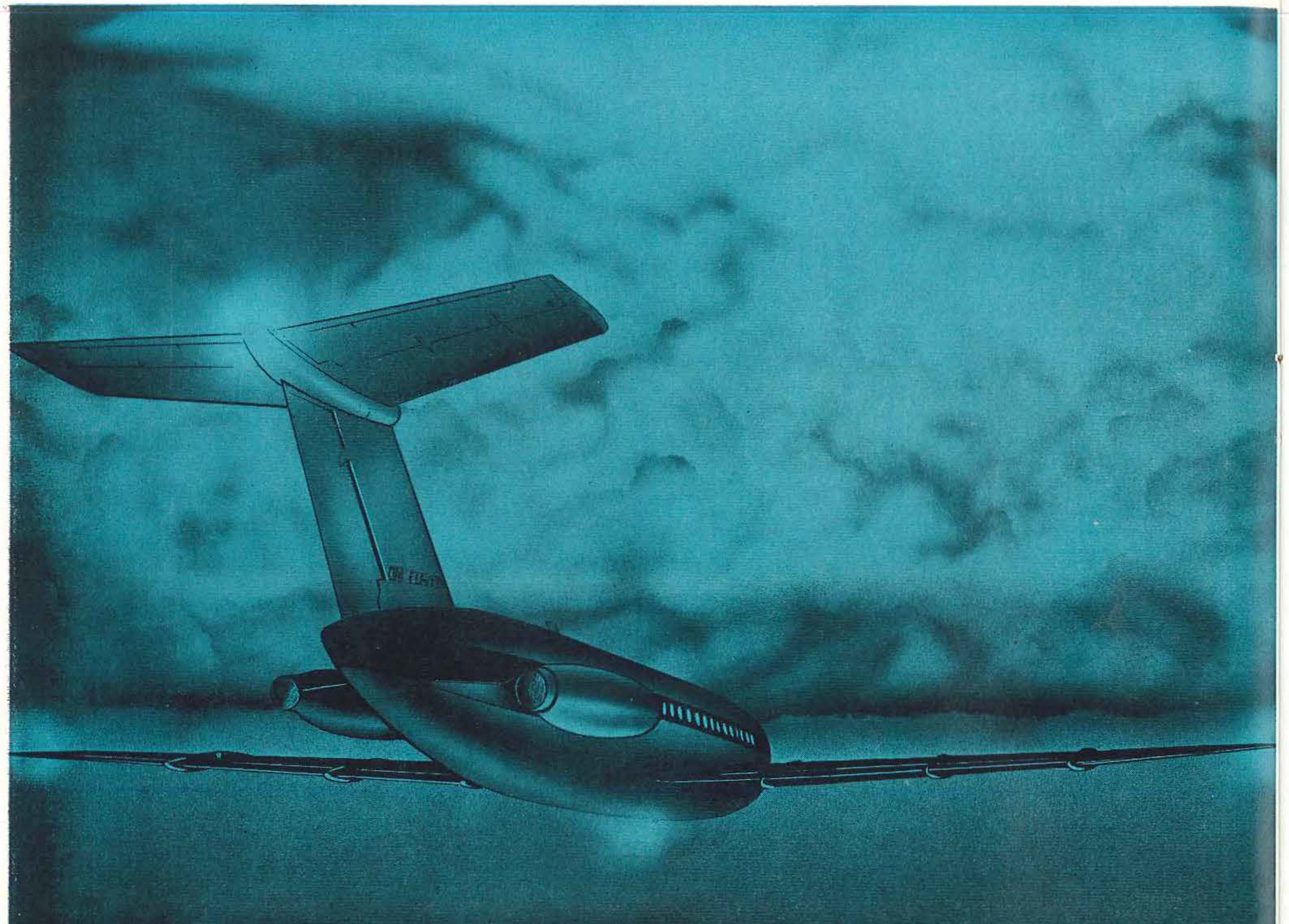


Cause

The cause of the accident was that the pilot failed to plan and conduct the flight to ensure that the landing could be effected in daylight.

Damage to the leading edge of the wing resulting from the collision with the windsock pole.





Fourteen months ago, in Aviation Safety Digest No. 52, September, 1967, we re-printed an article from "American Aviation", which discussed a new theory of turbulence in thunderstorms. The theory, developed by Dr. T. Fujita of the University of Chicago, came to notice during the investigation of an accident to an airline BAC-111 in Nebraska, U.S.A. The article mentioned the circumstances of this accident briefly, but did not describe it in detail.

As the article predicted, the investigation of the accident to the BAC-111 has created widespread interest in aviation circles in the United States of America. Following the publication of their official report on the accident recently, the United States National Transportation Safety Board stressed the importance of using airborne radar for thunderstorm avoidance, rather than as an aid to thunderstorm penetration, and drew attention to a forthcoming F.A.A. Advisory Circular on thunderstorms. This circular, which contains the latest information on severe storms and their avoidance, has been prepared because of the Federal Aviation Agency's concern with the effect such storms can have on safe and efficient flight. It is intended to include a summary of this circular in the next issue of the Aviation Safety Digest.

In the meantime, we believe it is important that airline pilots in Australia should have the opportunity to study the circumstances of this accident and the findings of the investigation. Aviation Safety Digest therefore offers the following summary, based on the official report issued earlier this year by the National Transportation Safety Board in the United States of America.

BAC-III Destroyed in Turbulence

WHILE attempting to penetrate a line of thunderstorm activity lying across its route during a night flight in the mid-west of the United States of America, a BAC-111 broke up in flight and crashed. All 42 occupants of the aircraft were killed.

The aircraft, which belonged to a domestic airline, was flying a regular scheduled service from New Orleans, Lousiana to Minneapolis, Minnesota with a number of intermediate stops. The last two en route stops were Kansas City, Missouri and Omaha, Nebraska. The aircraft departed from New Orleans at 1835 hours, local time and the flight proceeded normally as far as Kansas City.

At the time of the flight an extensive cold front lay across the aircraft's route north of Kansas City. The front was moving south-east and an aviation forecast issued by the Weather Bureau at Kansas City at 1845 hours predicted isolated severe thunderstorms, with hail and gusts to 65-70 knots, over the area between south-western Kansas and north-eastern Nebraska until 2200 to 2300 hours. Turbulence was forecast to be moderate in showers and severe near thunderstorms.

Before departing from Kansas City, the captain, who was concerned about the weather between Kansas City and Omaha, discussed the situation with a captain of another aircraft which had just arrived from Chicago. This pilot told the captain of the BAC-111 that there was a "solid line of very intense thunderstorms . . . with no apparent breaks" and that he "didn't feel the radar reports gave a true picture of its intensity". The BAC-111 captain replied that he hoped to be to the west of the line.

The aircraft departed Kansas City at 2255 hours on an IFR clearance to Omaha and at flight level 200, but was then restricted to 5,000 feet because of conflicting traffic. When the aircraft was twelve miles north of the city, it was cleared to climb to flight level 200 but after some discussion about the weather, the crew then said they would like to maintain 5,000 feet to Omaha. Shortly afterwards, the flight requested permission to deviate to the left of track. This was granted, and the Kansas City controller cleared the aircraft to maintain 5,000 feet and instructed it to contact the Chicago Air Traffic Control Centre.

After some discussion of the weather as displayed on the Chicago controller's radar, during which the controller advised the aircraft that the radar showed no holes in the line and that it extended from west of Pawnee to Des Moines, the flight was informed that another aircraft of the same airline had departed Omaha for Kansas City only a few minutes before and was at 10,000 feet, climbing to 17,000. The crews of the two aircraft then exchanged weather information, the Kansas City-bound aircraft advising that they had encountered "light to moderate chop" from about 15 miles south-east of Omaha Airport and from their radar observations it appeared that they would be out of it in another ten miles. The Omaha-bound BAC-111 concluded this conversation at 2308 hours. This was the last transmission from the aircraft.

At about 2312 hours, witnesses living in the area some seven miles from Falls City, saw the aircraft by moonlight, flying north-west towards a shelf of clouds preceding a line of thunderstorms approaching from the north-west. The aircraft appeared to fly into or over the shelf of clouds, then there was an explosion in the sky. What appeared to be a ball of fire then fell out of the clouds and the burning aircraft crashed to the ground. Two large pieces of the aircraft, later identified as major portions of the starboard wing and tail assembly, were seen falling separately from the main part of the aircraft.

The site of the crash was in rolling farmland, seven and a half miles north-north-east of Falls City. Portions of the starboard wing and the tail assembly, which had separated from the aircraft before impact, were found within an area of a square mile to the south-east of the main impact site (see diagram on page 14). Except for the cockpit area, where there was no evidence of fire, the fuselage from the nose wheel well back to rear pressure bulkhead was severely damaged by fire. The port wing, which was still attached to the fuselage, was also extensively damaged by fire, as was the broken inboard stub of the starboard wing, but the separated main portion of the starboard wing showed no fire damage. No evidence of hail damage, lightning strikes or static discharges was found on any portion of the wreckage. The aircraft's undercarriage flaps and spoilers were all in the retracted position. The tailplane trim actuator was in a setting corresponding approximately to that required for an airspeed of 260-280 knots at 5,000 feet. Examination of the aircraft's radar controls revealed that the weather radar was turned on with "full gain" selected.

Detailed examination of the wreckage showed that the starboard wing had broken off in downward bending while the tail fin had failed in bending to the left. The upper part of the fin was intact with the port tailplane and portion of the starboard tailplane still attached. The starboard tailplane itself had failed in upward bending. The elevators and the rudder had all separated from their attachment points on the tail assembly. Both elevators exhibited evidence of having over-travelled in an upward direction and the rudder in both directions. The flying control cables all exhibited tension failures with reduced cross-section at the breaks. Examination of all the aircraft's control surfaces revealed no evidence of flutter or any significant pre-impact distress or malfunction. There was similarly no evidence of any pre-impact malfunctions of the engines or any of the aircraft's systems. Metallurgical studies carried out on the fracture faces of the failed sections revealed no evidence of fatigue, corrosion or previous damage, or any deficiency in the material used in the construction of the components.

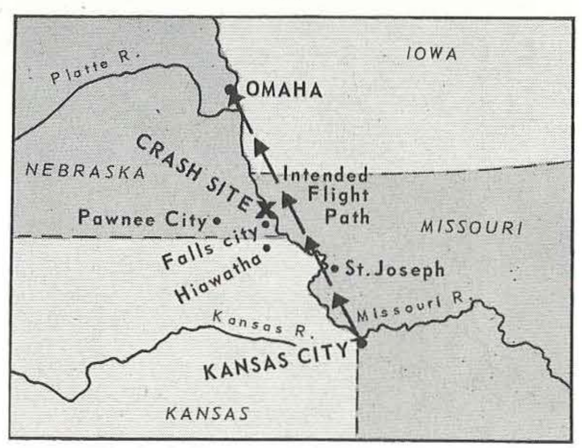
Voice Recorder

The aircraft was equipped with a flight data recorder but this was so badly damaged that no reliable data could be derived from it. The aircraft's cockpit voice recorder, however, yielded a satisfactory record of voice transmissions from the pilots and from the cabin speaker. The recording showed that after the crew's request for a clearance to maintain 5,000 feet to Omaha, there was a short conversation between the pilots concerning a hole in the line of clouds, and at 2304 hours the crew requested permission to deviate to port of track. Two minutes later, in response to a query from the aircraft, the Chicago controller said that the line of thunderstorms was "pretty solid all the way from west of Pawnee to Des Moines". Intermittent cockpit conversation concerning a diversion to Pawnee followed for several minutes, ending with the words "We're not that far away from it. Pawnee is one hundred and twelve four if you want it". Half a minute later, at 2311.23 the tape recorded the words "Ease power back". This was the last intelligible voice transmission on the tape and at 2311.42, 25.8 seconds before the end of the tape, a "rushing air" sound began. Eight seconds later another noise was heard which could not be identified, then the stall warning horn sounded four times in succession, the recording of the last sounding being terminated by ground impact.

Eye witness evidence was obtained from some 300 people located in the area of the accident. All the witnesses interviewed were certain that the aircraft, though it was heading towards a "light spot" in the wall of cloud, did not actually reach the main line of thunderstorms further to the northwest. Those located near the accident site believed that the aircraft entered cloud before the in-flight fire occurred, but witnesses further away said the aircraft was above the cloud and more or less in the clear when the initial fire began. The weather ahead of the squall line was clear to partly cloudy, until overcast by a shelf of clouds preceding the thunderstorms. The base of these clouds was estimated to be about 1,000-2,000 feet above the ground. The clouds in the area of the accident were described as "rolling" or "boiling", in a circular motion forwards, from top to bottom. Some witnesses said that shortly after the accident the wind changed from the southerly to a northerly or north-westerly direction, and increased in strength from light to as much as 50 knots.

An analysis of the likely trajectories of the various pieces of wreckage was carried out to attempt to determine the sequence of the in-flight break-up of the aircraft. As a result, it was concluded that the break-up had occurred in a very short period of time, probably of the order of two seconds, and that the tail assembly probably separated before the starboard wing. The study also

Sketch map showing flight planned route and crash site.



indicated that the time between the initial in-flight failure and the aircraft's impact with the ground was 25 to 28 seconds.

The cockpit voice recorder tape was also carefully examined for any evidence it might provide on the sequence of the in-flight break-up. A test flight showed that the ambient noise level on the tape varied with airspeed and that the noise level recorded shortly before the time of the in-flight break-up could be reproduced at an airspeed of 270 knots. It was also found that the "rushing air" noise recorded later on the tape could be reproduced by increasing the airspeed by about 50 knots and adopting a large angle of sideslip.

It was also found that the speed of the tape recorder could be affected by accelerations applied in different directions, but it was not possible to separate the effects of the various accelerations to which the recorder was subjected at the time of the in-flight failure. Nevertheless, the tape analysis showed that the aircraft was at or near its recommended turbulence penetration speed of 270 knots at the time of the accident and that there were no significant abberations in the tape speed until the onset of the "rushing air" noise, when a relatively large, abrupt variation occurred. It was at this point, approximately 29 seconds before impact that the aircraft was subject to some sudden violent manoeuvre. Although the nature of this manoeuvre will never be known exactly, the tape speed variation indicated that it could have been caused by a roll to the left, an upward acceleration, or very possibly, a combination of both these accelerations.

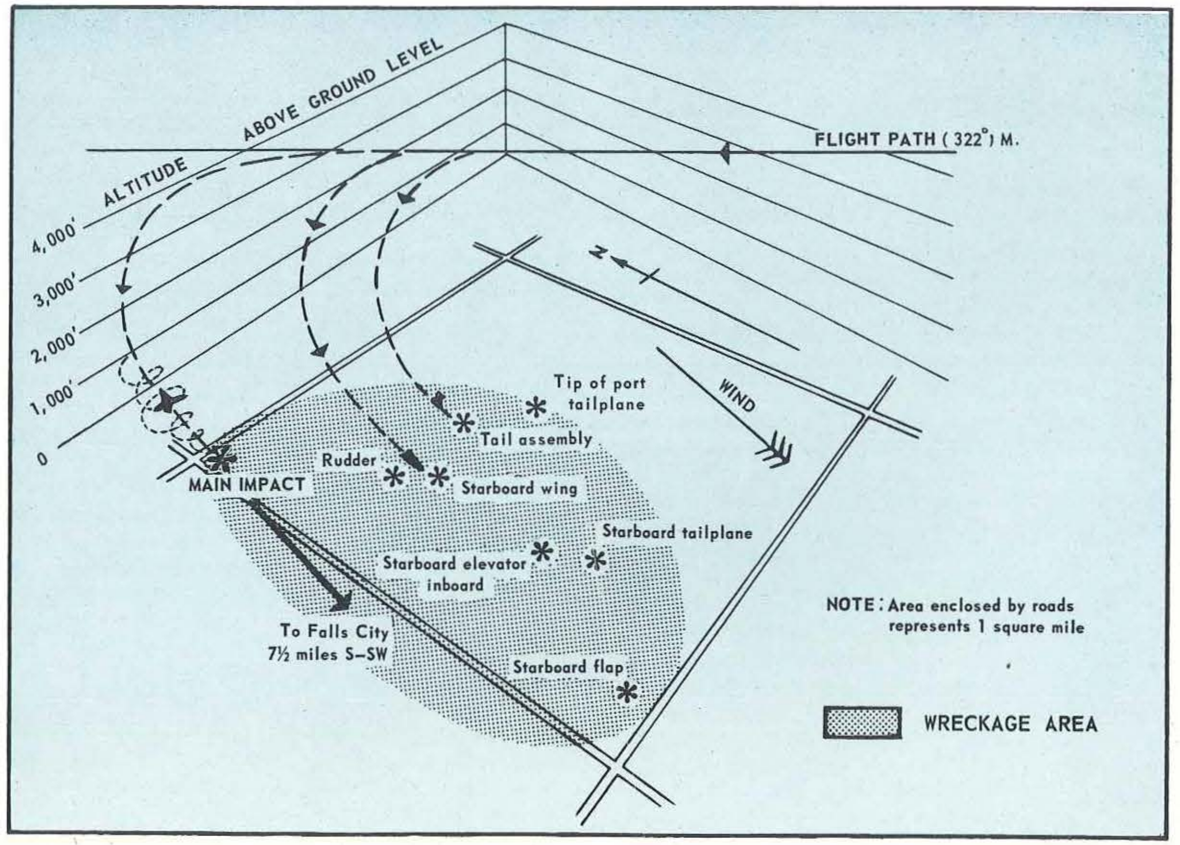
Turbulence

Because of the proximity of the squall line to the accident site and the witness reports of a roll cloud in the immediate area, aerodynamic studies were made of the possible effects of turbulence on the aircraft to determine the nature of the forces required to cause the structural failures that had occurred. The results of this study indicated that any of the primary failures could have been caused by an encounter with a very large, abrupt gust. The lowest gust which could cause both the fin and the tailplane to fail was calculated to be a 140 ft. per second gust applied at a 45 degree angle upwards to the left, and perpendicular to the longitudinal axis of the aircraft. The gust would be required to reach its maximum velocity in 0.125 seconds. The studies supported the trajectory analysis finding that the tail assembly had failed before the starboard wing and it was finally concluded that the aircraft, while flying straight and level, was suddenly subjected to forces which caused it to respond violently, accelerating upward and in roll to the left. The starboard tailplane and the fin failed, and the aircraft pitched nose-down until the starboard wing reached its negative ultimate load. The total time for this sequence was of the order of one to two seconds. The rupture of the integral fuel tank in the starboard wing released a large quantity of fuel into the surrounding atmosphere, which then ignited, creating the ball of fire observed by witnesses. The aircraft probably then began a random tumbling motion which stabilized some time before impact into a flat, spinning attitude.

Although the aircraft was five to ten miles south of the nearest precipitation when it disappeared from the Chicago radarscope, it is apparent that the cold outflow of that system had advanced to the accident site at the time the aircraft arrived in the area. This was confirmed by the evidence of eye witnesses who said that the aircraft flew into, or over, a roll cloud. A study conducted by the Weather Bureau indicated that conditions at the time and place of the accident were conducive to the formation of pronounced low-level turbulence, and a study by an independent meteorologist revealed conditions which were favourable for both roll and column circulations at these levels. The convective overturning in this circulation would have been violent, with large and sudden changes occurring in very short distances. A review of the various data relating to gust velocities shows that the 140 ft. per second gust calculated to fail the tail assembly is beyond, but not far beyond, the limits of measured experience. Although the precise gust velocities present in the system encountered by the BAC-111 could not be computed, the Board considers that extreme turbulence was present and was, in fact, encountered by the aircraft.

Radar

The Board has no reason to believe that the initial part of the flight was conducted in a manner appreciably different from many other flights in similar conditions. However, the intensity of the weather system which crossed the intended route of the flight appears to have been under-rated by airline personnel responsible for forecasting the weather and dispatching the aircraft. The dispatcher is by regulation, jointly responsible with the pilot for the safe conduct of the flight but it appears that, since the advent of the airborne weather radar, the pilot is often relied upon to observe and evaluate the weather situation, and then to make the final decision regarding his course of action. In this case, the cockpit voice recorder shows that, after the aircraft had deviated from its original course towards what appeared to the crew as a hole in the line of clouds, the first officer suggested deviating to Pawnee City to circum-



Three dimensional diagram illustrating distribution of wreckage and trajectories of major sections of aircraft after the in-flight break-up.

navigate the squall line. There is no evidence, however, that the captain ever intended to deviate. Rather, it is the opinion of the Board that the captain was planning to penetrate the squall line in the area of the hole which he observed on his radar.

The Board believes that if any good is to be derived from this accident, it must take the form of increased knowledge relating to the design and operation of aircraft in turbulent conditions; of the nature of the turbulence which may be expected, especially at the lower levels; of the proper operational procedures to be followed if such turbulence must be penetrated; and of the forces and accelerations which may be produced on an aircraft by that turbulence.

The emphasis on low level phenomenon may seem incongruous since nearly all the experience derived from earlier airline operations has been gathered in the lower altitudes. However, it is the Board's opinion that operations in such conditions may be more critical today than in the past. Obvious operational differences are the increased operating speeds of aircraft and the increased reliance on airborne weather radar to enable the crew to avoid turbulent areas. Since the advent of the airborne weather radar, aircraft have been dispatched in marginal weather with the pilot having the primary responsibility for avoiding any severe weather. However, with the present limited knowledge of turbulence characteristics, too much reliance may be being placed on an instrument which cannot "see" the turbulence to assist in avoiding it. In this case, the aircraft was approximately five miles away from the nearest echo observed on ground radar.

Design Requirements

It is the Board's opinion that aircraft design requirements should be reviewed in the light of recent findings on turbulence. The Board believes that some existing design requirements may be outmoded and suggests that design requirements which more realistically specify the aircraft's atmospheric environment should now be adopted.

The Board believes that the turbulence which caused the failure of the BAC-111 was such that it would have caused the failure of any modern civil transport. While weather of this nature is rare, it is more prevalent than most statistics would indicate. This is because the means of measuring the turbulence experience of the air transport fleet in the United States, reflects the turbulence avoidance procedures that have been employed in the past. However, the probability of encountering a gust of a particular magnitude is increased many times when an aircraft is flown in a known turbulent environment. Also, because of the tremendous increase in miles flown yearly by today's jet transport fleet, the vast gap which once existed between the statistical number of miles an aircraft must fly to encounter an ultimate gust, and the number of miles actually flown by the fleet every year, has been considerably reduced. This increase in the probability that an aircraft will encounter an ultimate gust, comes at a time when the average passenger capacity of transport aircraft has risen from about 30 to near 100. Seen in this light, turbulence avoidance procedures should assume even more importance today than in the past.

PROBABLE CAUSE

The Board determines that the probable cause of this accident was in-flight structural failure caused by extreme turbulence during operation of the aircraft in an area of avoidable hazardous weather.

IT PAYS TO KNOW YOUR AIRCRAFT

On three separate occasions in recent months, emergencies have been declared at airports because pilots of retractable undercarriage light aircraft reported that they were unable to obtain a green "Down" undercarriage warning light indication before landing.

The first incident developed when a Piper PA.23, crewed by two very senior and highly experienced pilots, was preparing to land at Essendon. After lowering the undercarriage, although all other indications were normal, the three green "Down" lights were not showing. The crew requested a fly-past to enable the tower to check that the undercarriage was fully extended, but because of the traffic situation at Essendon, the aircraft was first diverted to Moorabbin and a check was carried out by Moorabbin tower. A normal landing was then made at Moorabbin.

A careful check of the aircraft on the ground afterwards revealed that the rheostat switch for the "post lamp" instrument lighting was not fully in the off position. As the owner's handbook for the Aztec points out, the undercarriage indication lights automatically dim when the post lamp switch is turned on.

The other two incidents both involved Piper PA.24 aircraft, one at Bankstown, New South Wales, and the other at Archerfield, Queensland. In both cases the pilot concerned advised the tower that the undercarriage "Down" lights were not showing. An emergency was declared by the tower and the aircraft carried out a fly past while the undercarriage was inspected. Normal landings followed in each case, with the airport fire services standing by.

In the Bankstown incident, the cause of the difficulty was not evident until the aircraft was inspected later at the Piper distributor's hangar, when it was found that the undercarriage indication lights are automatically dimmed when the navigation lights are turned on. At Archerfield, however, at least one person was more alert and knowledgeable. A local PA.24 operator, who had been called to the tower for advice during the incident, examined the aircraft's undercarriage as it flew past then, turning to the tower controller said, "Tell him to switch off his navigation lights." Almost immediately afterwards the pilot advised that the undercarriage indications were now normal!

It is hardly necessary to point out that all these emergencies could have been avoided had the pilots' knowledge of their aircraft been as good as it should be. Similar electrical circuits are installed on some other types of light aircraft and have been the source of the same sort of difficulties in the past. Altogether, such incidents suggest that periodic readings of Owner's Handbooks might be good insurance for some pilots!

Unsuitable spray path traps Pawnee

AT Biloela, Queensland, a Piper Pawnee was spraying a crop of sorghum in a large paddock. The paddock was divided into wide strips by rows of sudan grass which had been allowed to grow to a height of nine feet to provide protection for the sorghum plants. The crop of sorghum itself was four feet high.

A power line, twenty-three feet above the ground, crossed the paddock at right angles to the rows of sudan grass. The pilot, who had planned to fly his spraying runs beneath the wires, was aware of the marginal clearance that would exist beneath the wires if his spraying runs placed the aircraft directly above the sudan grass rows. He therefore made his spraying runs parallel to and between the rows of sudan grass.

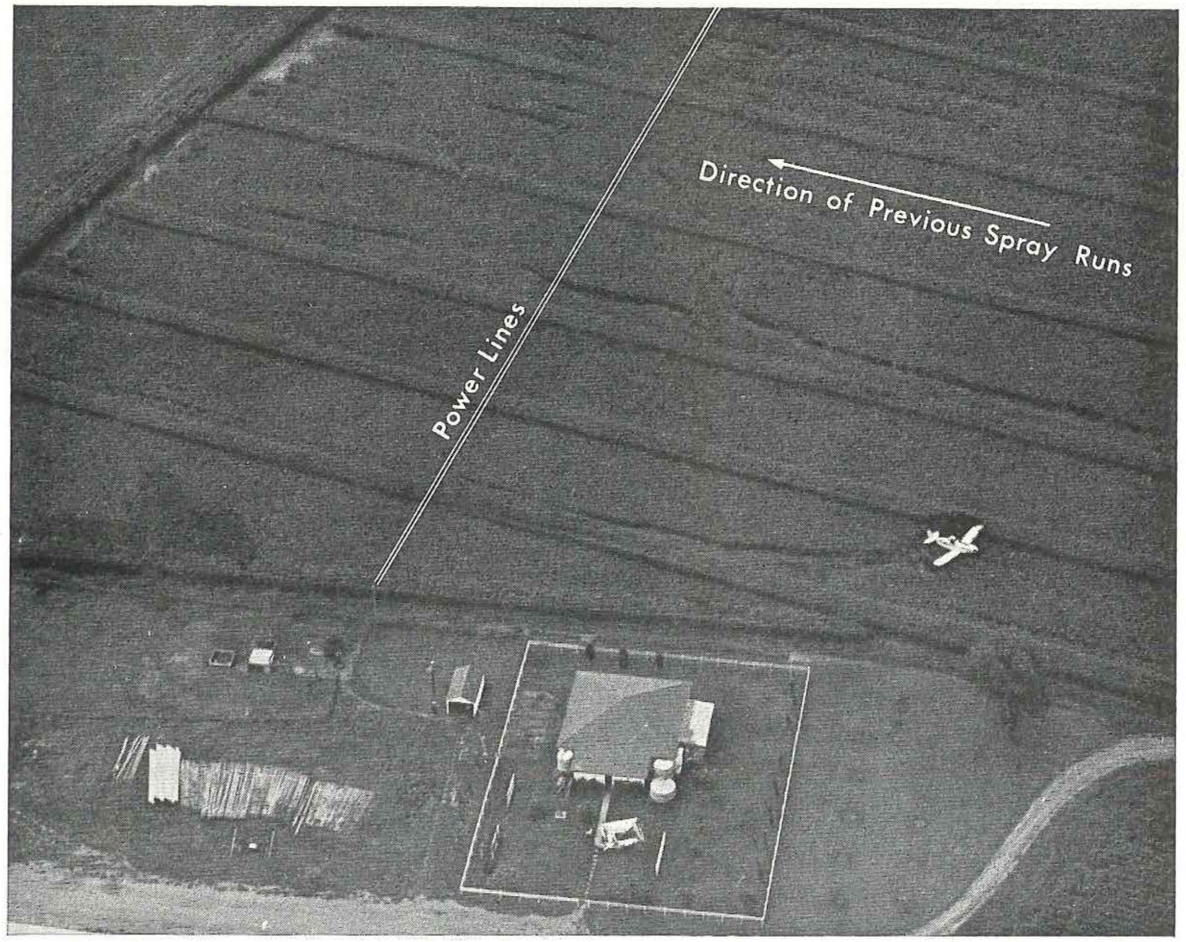
After successfully completing the main portion of the paddock in this way, the pilot turned his attention to a small triangular-shaped corner of the paddock which the power line also crossed. The

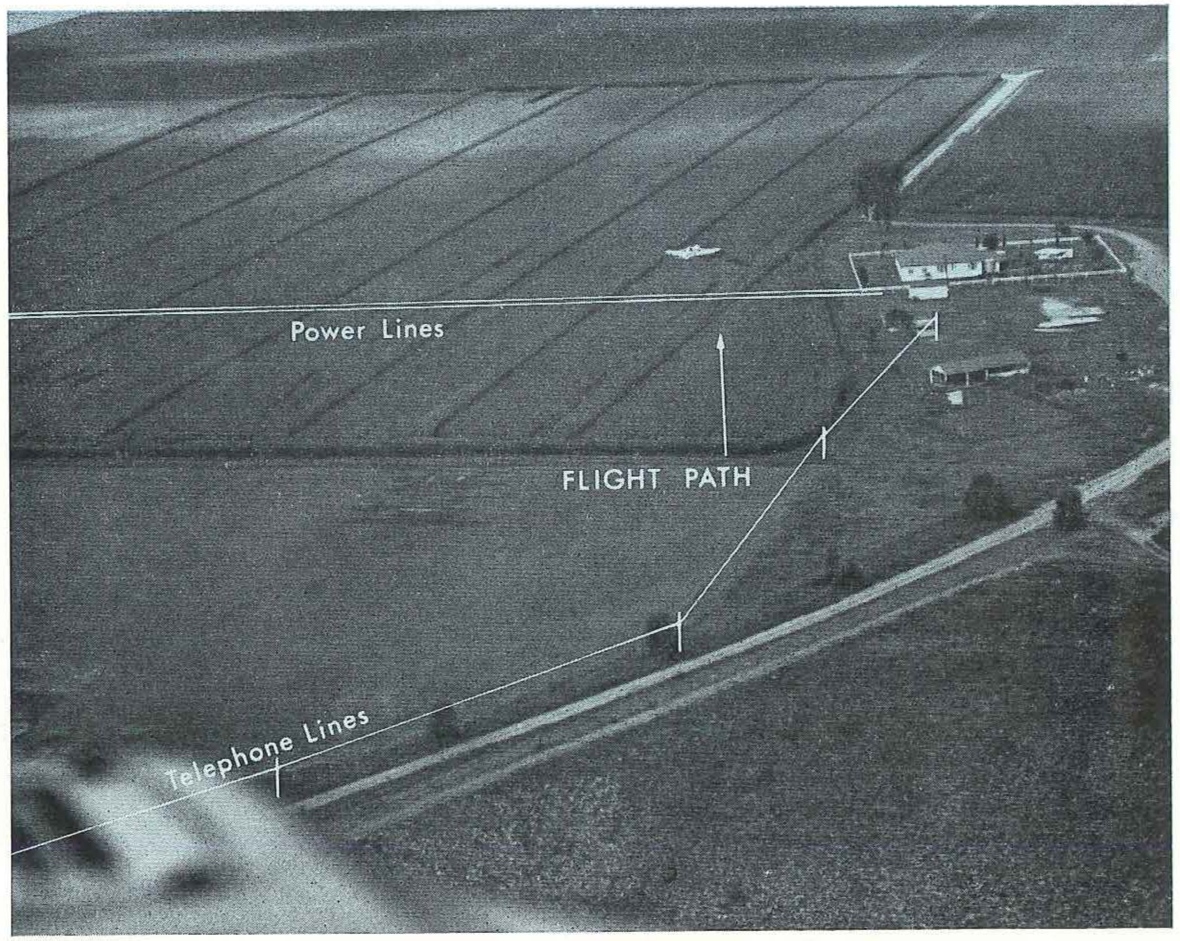
shape of this portion of the paddock was such, that to spray it effectively, the pilot was forced to fly his spraying pattern at an angle which converged on the row of sudan grass (see aerial photographs). Unfortunately, the way in which he planned the spraying pattern for this section of the paddock, also meant that the flight path of the first run crossed the row of sudan grass at the very point at which the aircraft would have to pass beneath the power line. To add to the pilot's difficulties, telephone wires situated on the approach path prevented him from making a low level approach to the field when commencing this run, and the pilot apparently did not appreciate the situation in which he had placed himself until too late to turn away. By then, the aircraft was in a position where any backward pressure on the control column to ensure adequate clearance over the top of the row of sudan grass, would have brought the aircraft into collision with the power line. The pilot was therefore committed to continuing the run at the same height and, to ensure the aircraft remained clear of the wire, had no alternative but to accept the fact that it would probably strike the top of the sudan grass growth.

Just before reaching the position of the power line, the aircraft's port wing and undercarriage and propeller came into contact with the row of sudan grass. The aircraft lost flying speed, yawed to the left and fell heavily to the ground. It then ground-looped to the right and came to rest bogged in the sorghum crop 200 feet further on. The aircraft sustained substantial damage but the pilot was not injured.

Inspection of the accident site showed quite clearly that because of the relationship of the

Aerial view of area showing relationship of power lines and sudan grass rows, and the way in which previous runs were flown.





Aerial view looking in direction of final run. The flight path intersects the row of sudan grass immediately beneath the power line.

power line and the row of sudan grass, this particular section of the paddock was not suitable for the type of spraying operation proposed by the pilot. As the photograph on this page shows, it should have been apparent to the pilot that a spraying run in the only direction available would place the aircraft in the very situation which on his earlier runs he had been at pains to avoid.

It is evident, that when confronted with the prospect of spraying this particular area, the pilot should have considered operating at an increased height above the power line or, if this would have rendered the spray application ineffective, informed the farmer that this section of the paddock was unsuitable for aerial spraying.

It is ironical that the power line which figured so largely in this accident had been out of use for eleven years. Apparently, the farmer had not considered it to be a hazard to aerial agricultural operations and had not bothered to dismantle it. This accident, as well as demonstrating that some areas may not be suitable for aerial spraying operations, serves to draw attention to the fact that some of the hazards to aircraft that exist on properties, may be unnecessary ones, and could possibly be removed before aerial agricultural operation begin, if representations were made to the persons responsible.

Cause

The cause of the accident was that the pilot decided to continue spraying into an area which, by virtue of the obstructions present, was unsuitable for this type of agricultural operation.

FROM THE INCIDENT FILES

LOSS OF CRUISING SPEED EXPLAINED ..... AT LAST

During the final leg of a cross country flight to Perth, which had involved several landings at uncontrolled country aerodromes, the pilot of a Beech Bonanza noticed a drop of about 10 knots in cruising speed, which he was unable to account for.

The take-off and climb from the last landing point had seemed perfectly normal, with the undercarriage warning light and mechanical indications showing the usual "up" indications, after the pilot had moved the selector to the "up" position. When first he realised the airspeed indication was lower than normal, the pilot double-checked all control and power settings without finding any reason which could explain the apparent loss in speed. Later on, during the flight, while still looking for the source of the trouble, he found that the airspeed indicator was responding sluggishly to changes in aircraft attitude.

After landing at Perth the pilot carefully examined the exterior of the aircraft for any condition which could have induced abnormal drag. This included an inspection of the undercarriage doors for any evidence of malfunctioning.

After further discussion with the maintenance engineer responsible for servicing the aircraft, the airspeed indicator itself and its associated pitot static system were checked before the aircraft was cleared for further flight. As there was still nothing to be found which could in any way account for the drop in airspeed indication, it was concluded that some undetected obstruction had probably formed in the pitot head, but had since cleared itself.

The next time the aircraft flew, however, immediately after it had taken off for a flight to Caigura, 500 miles east of Perth, the tower controller saw that the nose wheel remained extended after the main wheels had retracted. He immediately advised the pilot and the aircraft turned back and orbited at 1,500 feet.

The pilot checked that both the undercarriage warning light and mechanical indicator were showing "up," then selected the undercarriage down. The undercarriage appeared to lower satisfactorily, both the green "down" light and the mechanical indicator operating normally. The pilot then retarded the throttle momentarily and there was no sound from the undercarriage warning horn. He then flew the aircraft past the tower at 200 feet while the tower controller inspected the undercarriage through binoculars, and as all three undercarriage legs appeared to be extended normally, he made a precautionary landing. During the landing and taxi back to the aircraft's hangar no further abnormalities could be detected.

Inspection of the undercarriage mechanism revealed that the nose leg had failed to retract because a shear pin linking the two sections of the nose leg retraction rod had failed, disconnecting the nose leg from the retraction mechanism. In later model Beech 33/35, 55 and 95 aircraft, such as the one concerned in this incident, this means that, although the nose leg can still be extended from the retracted position, it cannot be retracted from the extended position. Because the undercarriage position indicators in the cockpit are actuated from the main undercarriage mechanism, however, the pilot has no positive way of knowing that the nose leg has not retracted.

It was then seen that the drag created by the extended nose leg was undoubtedly the reason for the apparently inexplicable loss of airspeed during the previous flight. Although the failure of the shear pin did not directly affect the safety of the aircraft in this case, it could conceivably present an operational problem. In a situation where such an aircraft was undertaking a long flight over difficult terrain, or over water, the loss in cruising performance, coupled perhaps with winds less favourable than forecast, could reduce the aircraft's range to the point where the fuel available for the flight would be extremely critical, or even insufficient.

Pilots of retractable undercarriage light aircraft which are not fitted with separate position indicators for each undercarriage leg should be alert to such a possibility if ever they have reason to believe their aircraft is not performing as it should.

HAVE YOU A SCREW LOOSE ?

Case I

In a country area in Western Australia, a commercial pilot was operating a Cessna 205 in joy riding operations.

As the aircraft was making yet another approach to land after operating continuously for about three hours on flights of short duration, the starboard fibre glass wing tip fell off. The pilot continued the approach and landed without difficulty. The fairing was later recovered undamaged from an adjoining paddock. It was obvious that the fairing had come off after all its PK type retaining screws had vibrated loose and fallen out.

The pilot said that he had not noticed any looseness in these screws when he carried out a daily inspection of the aircraft earlier in the day. The paddock from which the aircraft was operating was 3,500 feet long and the surface was good except for a corrugated area in the centre. It was necessary to taxi the aircraft across this area before each take-off and after each landing and there was little doubt that the vibration induced by the rough ground had been responsible for the screws working out. Inspection showed the screws in the other wing tip fairing to be loose also.

Case II

After a Cessna 206 had arrived in Lae after a flight from Indagen in the New Guinea Highlands, the starboard fibre glass wing tip was seen to be missing. Scratches on the underside of the wing near where the tip is mounted, indicated that it had been carried away in the airstream while the aircraft was in flight, after most of the retaining self tapping screws had worked loose and fallen out.

According to the pilot, the wing tip appeared to be securely in place during the pre-flight inspection before leaving Indagen. It was learned however, that the aircraft had made 27 take-offs and landings in the course of the day's flying, many of them at hinterland airstrips. It was apparent that the wing tip retaining screws had worked loose in the course of these operations. Once a few of the screws had been disturbed, the resultant "working" of the wing tip would probably loosen the remaining screws in a comparatively short period of time.

These two incidents underline the necessity for being particularly thorough when making a pre-flight inspection of an aircraft that is being flown at frequent intervals from rough surfaces. They also suggest that an occasional stop during the day's operations might be desirable to check that the aircraft has suffered no damage as a result of the pounding it is receiving during operations "in the rough".

CHECK THOSE TANKS

Approaching Mount Gambier, South Australia, at the conclusion of a cross-country flight which involved landings at several country aerodromes, the pilot of a Cessna 182 reported 10 miles east of the aerodrome. Landing information was passed to the pilot, who advised he would be making a long, final approach to runway 18.

Two minutes later the aircraft transmitted a Mayday call, the pilot reporting he was out of fuel and making a forced landing. The Distress Phase was declared and the aerodrome crash alarm sounded, but before further action could be taken the pilot called again to report that the aircraft was safely on the ground in a paddock three miles east of the aerodrome. The aircraft was undamaged and the passengers uninjured.

The Distress Phase was cancelled and the aircraft was later refuelled and flown to the aerodrome.

It was subsequently found that the aircraft had flown a total of 297 minutes for the day up to the time of the forced landing. It had been refuelled to capacity immediately before being hangared the night before, and should have had an endurance of 350 minutes.

Ground checks of the aircraft's fuel system failed to detect any indication of leakage, and extensive in-flight tests showed that the engine's fuel consumption was perfectly normal. It was finally agreed that fuel must have been stolen from the aircraft either while it was hangared overnight or while it was parked at one of the intermediate stops during the day's flying.

The pilot admitted that he had not physically checked the tanks during the daily inspection he made before beginning the day's flying. The pilot had also continued with the flight in the latter part of the day, despite what must have been alarmingly low fuel gauge readings—apparently assuming that as he had not flown the aircraft's theoretical endurance, he MUST have adequate fuel left.

The incident emphasises the importance of making physical checks of the fuel tank contents before flight, and of intelligently interpreting fuel gauge readings in the light of what is KNOWN to be in the tanks.

Are You Still Heeding This Warning ?

(See Digest No. 50, May 1967)

At Sydney Airport, a Cherokee 140 waiting to depart for Bankstown, was held at the run-up bay while a Boeing 727 taxied past to the runway and was cleared for take-off. The Cherokee was then cleared to line up behind the departing 727.

The pilot waited a few seconds for the jet's wake to dissipate, then taxied on to the runway. The 727 by this time was some 300 feet down the runway. As the Cherokee turned to line up, it was suddenly lifted completely off the ground, its port wing dropped, and the aircraft fell back on to the runway, damaging the port wing tip and bending the propeller.

Describing the mishap later, the very experienced pilot who was at the controls of the Cherokee, said that as pilot-in-command, the onus of responsibility for the happening was entirely his. He summarised his feelings on the matter thus:

"Don't get behind 727s which are on full thrust even at a distance of some 150-200 yards. The effect is equivalent to a gust of 60 m.p.h. or better."

We couldn't agree more!

THE FORCED LANDING THAT NEEDN'T HAVE BEEN

AT a country flying school in Victoria, a student pilot was authorised to make a solo training flight in a Piper Tripacer. The sequences the student was to practise in the school's training area included forced landings and precautionary search and landing procedures. Both the aircraft's fuel tanks were about half full, each containing approximately eight gallons of fuel and the student was briefed to use each tank in turn. The average fuel consumption of this aircraft is six and a half gallons per hour.

After carrying out some general flying practice for about 35 minutes, including two forced landing sequences, operating on the starboard fuel tank, the pilot began a precautionary search and landing procedure. He then attempted to change over to the port tank, but found he was unable to move the fuel selector past the off position. The pilot therefore moved the selector back to the starboard tank position, and after checking the fuel contents gauge, considered that there was sufficient fuel for him to complete the search and landing sequence before he returned to the aerodrome.

This he did normally, then again examined the starboard tank fuel gauge. Seeing that it was still showing nearly a quarter full, the pilot decided that it was not necessary for him to return to the aerodrome immediately, and that there was sufficient fuel in the starboard tank to carry out one more precautionary search and landing procedure. On the downwind leg of the circuit, he again tried to move the fuel selector to the port fuel tank but when this was also unsuccessful, he continued his approach towards the field he had chosen, descending to 200 feet and reducing the airspeed to 60 knots. On reaching a position from which he could have landed, the pilot applied climbing power, held the aircraft level to increase speed to 70 knots, then began a climbing turn to the left. About 30 seconds later, when the aircraft had climbed to almost 300 feet, the engine failed completely without any warning.

The pilot straightened out of the turn, lowered the nose and selected what he believed was the only forced landing path available to him, in a paddock directly ahead, that was dotted with dead trees and tree stumps. The pilot lowered full flap and, because the length of run was very short, descended as steeply as possible and touched down in long dense grass about 70 knots. He immediately applied full braking and attempted to steer the aircraft between the obstructions, but while still rolling at about 30 knots, the port wing tip struck a tree trunk, yawing the aircraft to the left and it broadsided to a stop 100 feet further on, just before the starboard wing tip would have contacted another tree.

Immediately after the aircraft came to rest, the pilot turned the fuel off and in doing so, found he was able to move the selector through to the port tank position. On returning it to the off position, the selector jammed again and he was unable to reselect the starboard tank.

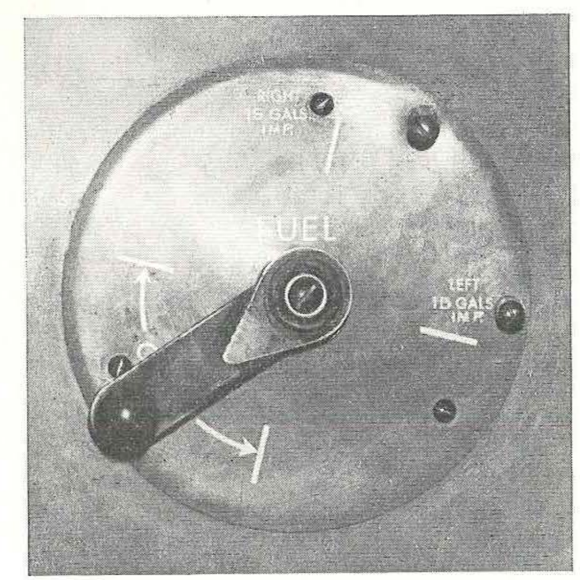
*   *   *

The fuel tank selector was still in this condition when the aircraft was examined several hours later. With firm pressure, it was possible to select the port tank but not the starboard tank. The fuel system was then checked at all three drain points and no evidence of contamination was found.

With the selector positioned to the port tank, the engine was started and proved capable of running normally at cruising power. The port tank contained about eight gallons, approximately the amount in it when the aircraft took off. Three gallons of fuel was drained from the starboard tank. The fuel selector valve was then removed from the aircraft and dismantled, and it was found that a washer in the assembly had fractured, causing the selector to jam. Movement of the valve could change the position of the pieces of the washer, causing the selector to jam in different positions.

It was probable that the loss of power which led

The Piper Tripacer fuel selector. The selector is in the 'Off' position in the photograph.



The aircraft as it skidded to a halt after the port wing had struck a tree. The starboard wing is almost brushing a second tree.

to the accident had been caused by temporary fuel starvation. Despite the fact that there was still three gallons of fuel in the starboard tank, this was apparently insufficient to cover the tank's two outlet pipes while the aircraft was in a climbing attitude and, as a result air entered the fuel system. It was learned from other operators who have had considerable experience with this type of aircraft, that air locks in the fuel system are possible in such circumstances and that they have made a practice of not using the starboard tank during manoeuvres when its level is low.

At the time the engine failure occurred, the position of the aircraft was such that an accident of some sort was almost inevitable. The only courses open to the pilot were to turn to the left through about 90 degrees and land downwind in a crop of oats, or to continue ahead and land in the restricted space that lay almost straight in front of the aircraft. In view of the aircraft's low altitude and the pilot's lack of experience, his decision to land straight ahead was undoubtedly the correct one, but it necessitated a rapid descent and touchdown in an area where a collision with an obstruction could hardly be avoided.

Although the jamming of the fuel selector could not be said to have been the actual cause of the accident, it is very likely that if the pilot had abandoned the training exercise and returned to the aerodrome as soon as he detected the fault in the selector, the accident would have been averted.

Cause

The cause of the accident was that the pilot, who was inexperienced, was not conscious of the need to terminate the exercise when a serious defect was detected in the aircraft.

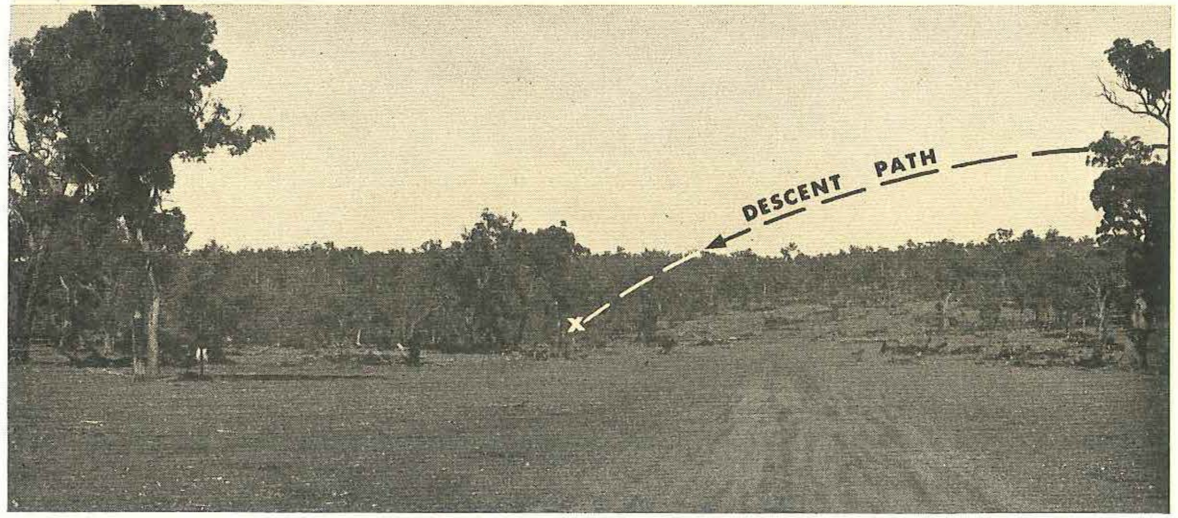
SUN GLARE . . . . CAN BE DANGEROUS

In the last issue of the Digest, we described an accident in which an agricultural Pawnee landed short because, in the glare of the early morning sun, the pilot was unable to see clearly. The aircraft's undercarriage collapsed and the aircraft ground-looped (see page 27, Aviation Safety Digest No. 58).

The photographs on these pages depict a much more serious accident that occurred in similar conditions. Fortunately, although the aircraft was completely wrecked, the pilot escaped uninjured.

The pilot had arrived at an agricultural airstrip in Western Australia early in the morning to begin superspreading operations. The strip is situated on the edge of a heavily timbered plateau. There are trees up to 80 feet in height growing on either side of the strip and a short distance to one side of the strip, the terrain drops steeply into a valley 800 feet below. Because the glare of the early morning sun was reducing visibility on the approach to the strip, the pilot delayed starting until conditions improved. Soon after 0700 hours, however, a cloud formation obscured the sun, and spreading operations began. After dropping the first load, the pilot climbed higher than usual on the return leg to the strip to survey the dropping site. He then closed the throttle, selected full carburettor heat and lowered 20 degrees of flap, and began a gliding approach back towards the strip. As the aircraft was turning on to final the engine, which was still idling, showed symptoms of carburettor icing and the pilot reselected full carburettor heat. Just as the aircraft was completing the turn on to final approach, the sun broke through the bank of cloud directly ahead, temporarily blinding the pilot. He immediately opened the throttle to go around again but the engine spluttered and failed to respond. Forced to continue his approach, the pilot lowered full flap but as he did so, he saw trees to right of the strip immediately in front of the aircraft.

Realising he had no chance of avoiding the trees, the pilot yawed the aircraft so that the initial impact was taken on the port wing. The aircraft struck a large tree on the edge of the plateau and tumbled into the undergrowth on the slope below the plateau's edge, coming to rest 150 feet down



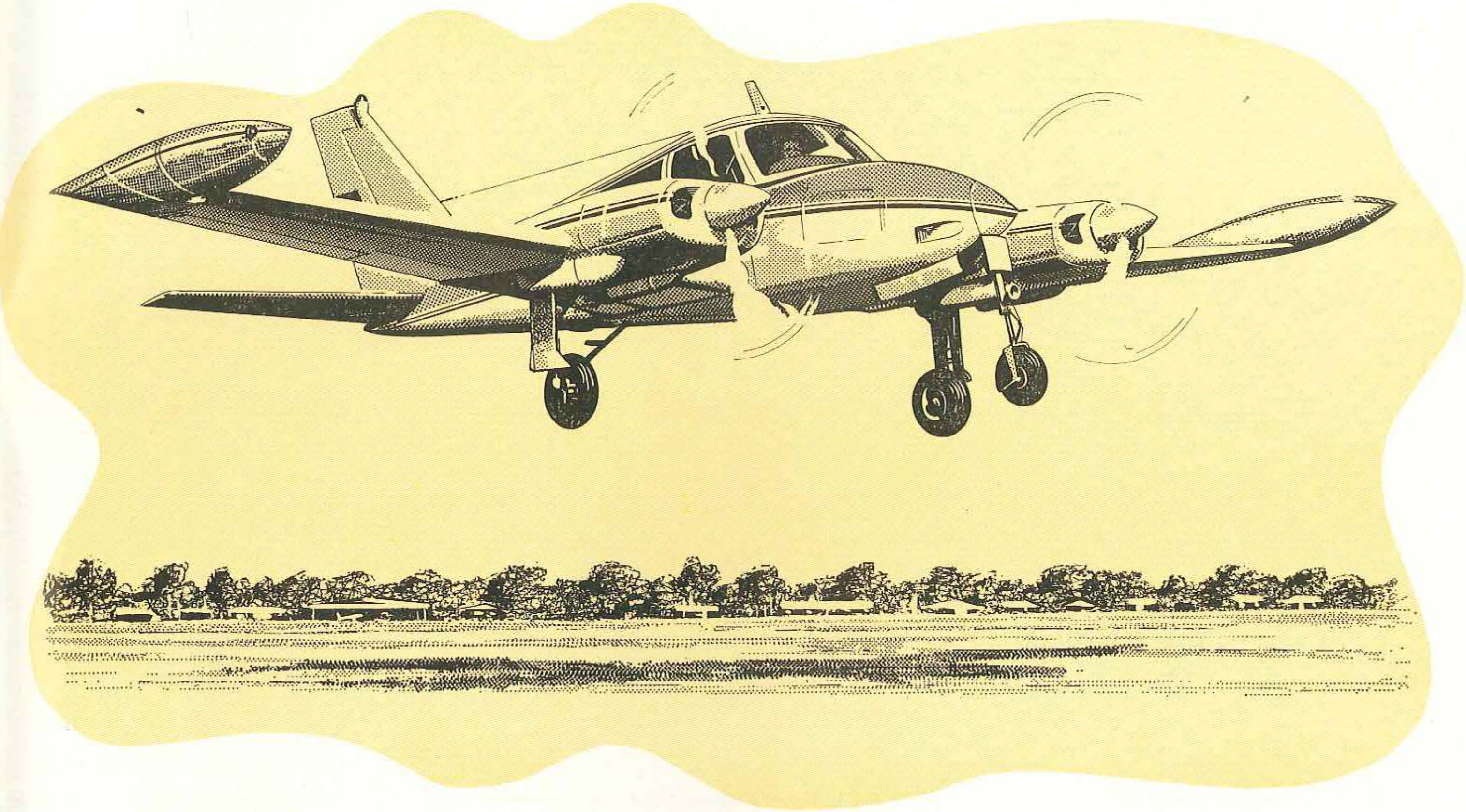
ABOVE: View from up-wind end of strip, looking back in direction of aircraft's approach. Blinded by sun as he was turning on to final, the pilot was unable to prevent the aircraft colliding with trees at the side of the strip.

the hillside. As the picture below shows, the aircraft was almost a total loss.

Examination of the aircraft's engine revealed no defect and it seems probable that carburettor icing was responsible for the lack of power when the pilot attempted to go around. Even so, this was not the real cause of the accident. The accident actually occurred because the pilot was deprived of forward visibility when he was committed to a forced landing.

Both this accident and the one described in our last issue occurred in the early morning. Similar situations could however develop whenever the sun is low on the horizon—late afternoon glare can be just as dangerous to a pilot attempting to land into the west.

BELOW: The jack-knifed wreckage lying on the rock-strewn slope below the edge of the plateau.



Trim Controls Reversed

ARRIVING at an airport in Western Australia, the pilot of a Cessna 310 left his aircraft at an authorised workshop for a 100-hourly inspection. He also requested the workshop to adjust the elevator trim controls because the trim position indicator in the cockpit was not indicating neutral when the trim tab was centralised.

At the completion of the inspection the aircraft was returned to the pilot, a maintenance release was issued, and soon afterwards the aircraft departed on a cross country flight to Caiguna. As the aircraft was climbing after take off, the pilot, feeling that the trim was set too much nose-up, adjusted the trim wheel in a nose-down direction. Instead of correcting the tail heavy condition however the pilot's trim adjustment worsened it. The pilot brought the trim wheel back to the central position and the aircraft's nose-up tendency lessened again. Continuing to rotate the trim wheel in the normal nose-up direction, the pilot found that the aircraft began to assume a nose-down attitude, and he realised that the elevator trim was working in the reverse sense.

The pilot notified the tower of the trouble and was given priority to land. The airport fire service was alerted and the aircraft returned and made a normal landing.

Not Qualified

An investigation of the cause of the error in adjusting the aircraft's controls was begun immediately. It was found that the engineer who had actually carried out the work on the aircraft's control system, though he had recently passed an examination for an aircraft maintenance engineer's licence, was not qualified to assume responsibility for the work and would not in any case have been licensed to work on the Cessna 310 airframe. Asked what he had done to the elevator trim control system to make the required adjustment, this engineer explained that he undid the control cable turnbuckles at the rear end of the fuselage, reset the chain on the trim tab actuator, then reconnected the turnbuckles and checked the operation of the system. When asked however, in which direction the trim wheel should be turned to obtain nose-down trim, the engineer, to the very considerable surprise of the investigating officer and others present, indicated that it should be turned backwards not forwards!

Error Repeated

The licensed engineer who had accepted responsibility for the duplicate inspection of the control system, as required by ANO DCA/General 26, said that after checking the locking of the turnbuckles and the assembly of the clevis pins, he sent the engineer who had carried out the work, into the cockpit and called for nose-down trim. He then checked that the movement of the control tab itself was satisfactory and in the correct sense, then called for nose-up trim and again checked that the tab was moving as it should. The engineer explained that he did not enter the cockpit himself because he knew that the adjustment had been made only in the tail section of the aircraft, and he assumed the other engineer would be operating the trim control wheel in the correct sense. Although the two engineers concerned then signed the duplicate inspection certificate, as required by ANO, DCA/General 26, it is quite obvious that because the inspection was made by two engineers working in conjunction with each other and one of them had been responsible for the assembly and re-rigging of the trim control system, the two independent inspections required were not in fact conducted.

This incident occurred because the inadequately trained engineer who was conducting the first inspection made an error, then repeated the same error during the duplicate inspection in which he participated as an assistant.

In another incident, which involved two engineers working on a larger aircraft, communication difficulties were responsible for the error. In this case the two engineers who actually assembled and rigged the controls, cross checked each other's work, but neither of them performed a complete independent inspection. If the whole aircraft control system had been verified by a third, independent engineer, the error would surely have been discovered.

These incidents are but two of several involving misrigged control systems which have occurred in recent years. Investigation has shown without exception, that in every case the independent inspections called for in Air Navigation Order DCA/General 26 had not been properly performed.

In most aircraft it is not usually possible to observe the movements of all the trim tabs from the pilot's seat in the cockpit. For this reason it has become common practice for a maintenance engineer carrying out a control system check, to have an assistant watching the movements of the trim tabs for sense and range while he himself operates the trim controls in the cockpit. Because of the difficulty in communication which usually exists under these circumstances, together with the fact that trim tabs operate in the opposite direction to the main control surface to which they are attached (e.g. aircraft nose down—elevator down —trim tab up), confusion often exists as to the direction of movement that is being checked at a particular time. If the person assisting in such an inspection is also the engineer who has carried out the work on the control system, there is every chance that any errors in the sense of movement he may have made during assembly, will be made again during the inspection and the error will be perpetuated undetected. Obviously therefore, it is bad practice for the person who has performed the work to be involved in the final inspection. It is for this reason that the word "independent" was included in the instruction when the Air Navigation Order was framed.

Equal Responsibility

In light aircraft workshops it is common practice for one engineer to rig the controls and then to satisfy himself that the operating range and sense of movement of the control surface is as it should be. The final or duplicate inspection is usually then made by a qualified engineer who was not himself engaged in that particular assembly and rigging operation. However, in order to ensure that this duplicate inspection is truly independent, it is essential that the person who assembled and rigged the controls in the first place and who provides the first certification, is not included even as an assistant in the second inspection. It is apparently not appreciated by some engineers that the duplicate inspection, performed and certified by a second engineer, carries equal responsibility with that of the first inspection for the correct functioning of the aircraft's control system.

The most positive method of avoiding errors while checking for sense and range of movement of control surfaces is for each engineer carrying out the inspection to operate the pilot's controls himself in the desired direction, then to personally inspect the trim tabs for movement in the correct sense. This method of inspection may take a little longer to complete but, if performed in this way by two independent and competent persons, it is obvious that the chances of an error remaining undetected will be very greatly reduced.