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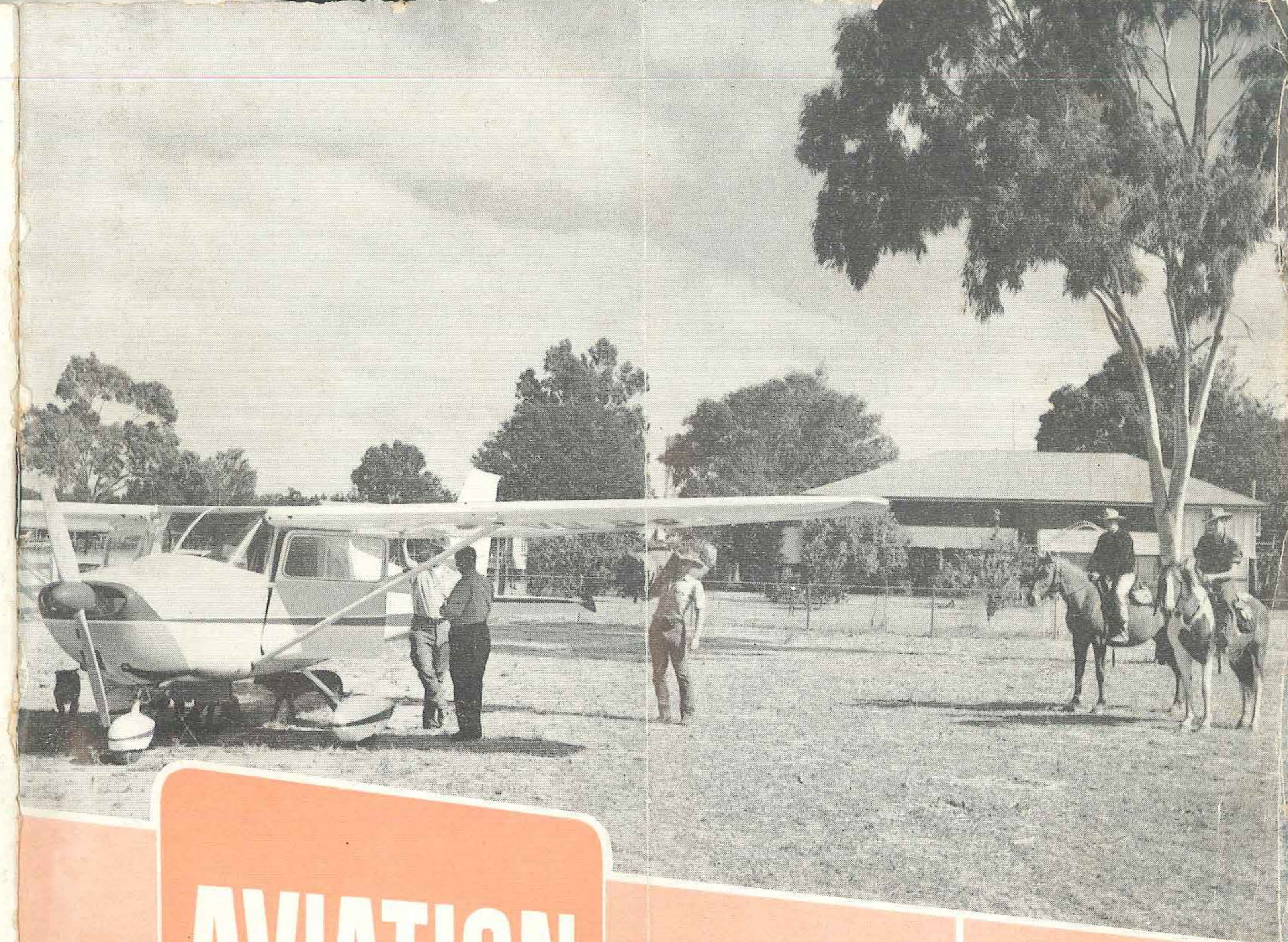


AVIATION SAFETY DIGEST

No. 36, DECEMBER 1963

DEPARTMENT OF CIVIL AVIATION

AVIATION SAFETY DIGEST

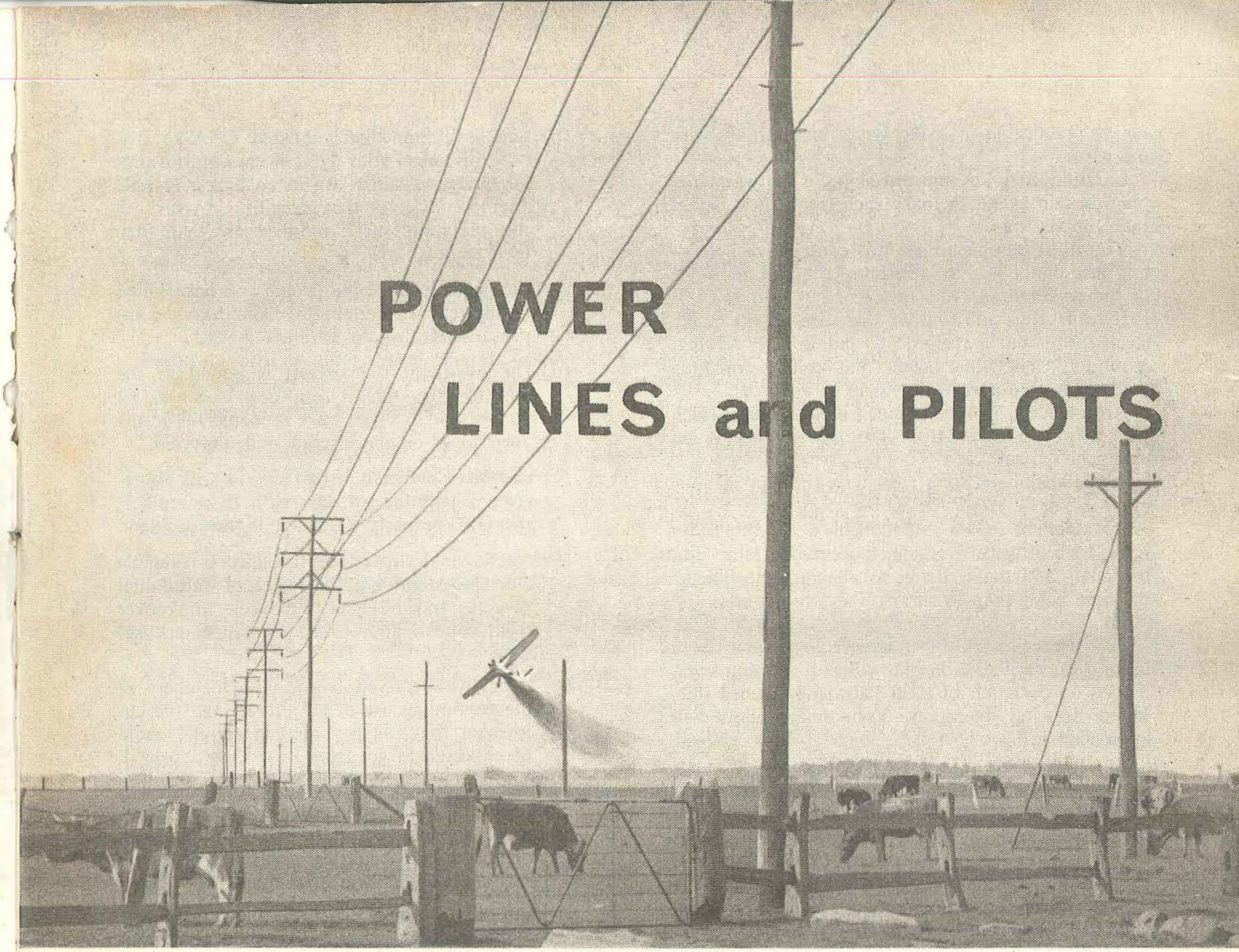
No. 36 **DECEMBER, 1963**

Prepared in the Division of Air Safety Investigation
Department of Civil Aviation, Commonwealth of Australia

Contents

A Bush Pilot's Airways Cessna calling at Dotswood station in North Queensland.

(Australian News and Information Bureau)



POWER LINES and PILOTS

Collisions with power and telephone lines unfortunately continue to be a regular and far too frequent feature of aircraft accidents in Australia. **In the last five years there have been 90 occasions of collisions with overhead wires** and, in this Digest alone, we carry the stories of two such accidents.

The same problem exists in New Zealand and, because of this, the Accidents Investigation Branch of the Civil Aviation Administration of New Zealand produced an interesting little book entitled "Powerlines and Pilots". The book concludes with two short summaries the first—mark these lines—being directed to agricultural pilots and the second to Clubs and Private Pilots. We believe that they are worth repeating.

MARK THESE LINES

Plot the position of all power lines on your area master map.

Before leaving base, ring the Power Board and find out what power lines are in the area and whether any new ones are being erected there.

Survey the area from a safe height before you land at the strip and begin the day's work.

Make a ground reconnaisance and note the run of the power lines.

Ask the farmer about the power lines in his area. He may be able to tell you about other collision hazards you are not aware of.

Plan the whole operation in advance and try as far as practicable to make your runs parallel with the wires.

Carefully note any upward slope in the wires and plan, in that event, to make each run a little higher than the last one.

You must be able to see two consecutive poles—not just one pole—to determine the run or slope of the power lines.

If your runs must cross the wires don't make steep turns onto a reciprocal heading after sowing. You may stall, lose height and collide with the wires on your return to the strip.

Always have a predetermined escape route which will take you away from the power lines if an emergency arises.

Avoid making sowing runs with the sun in your eyes.

If you cannot see or you suddenly realise that you have been forgetting about those wires, stop immediately and think. Better to abandon the job for the time being than to carry on and forget once too often.

Between strips and when proceeding to and from base, fly at regulation height—not top-dressing level.

Pass on every bit of local knowledge gained during a dressing operation. Your fellow-pilots will appreciate it.

FOR CLUB AND PRIVATE PILOTS

Regulations governing flying activities are such that if you abide by them it is difficult for you to have a collision with power lines, even if you want to. But just consider this for a moment. You have broken the rules deliberately by flying low and have had an accident. Where do you stand now?

(a) If you have not been killed yourself, you may have killed or injured others and/or involved third parties.

(b) You have immediately invited CAA to suspend or cancel your flying licence and to prefer charges against you in an action at law. And don't forget that penalties imposed on the guilty are much more severe than they used to be.

(c) The dependents of the people you have killed or injured are certain to claim heavy compensation from you for their losses.

(d) The owner of the aircraft is bound to sue you for the replacement cost because, by your stupid act, you have rendered the insurance cover on the aircraft null and void.

(e) You have invited third parties to seek to recover legally the cost of repairs to or replacement of property damaged in the accident.

(f) You have destroyed or damaged a valuable asset, so depriving its owner of substantial revenue and he may well seek to recover from you an appropriate sum in compensation.

(g) You have deprived fellow club members of the continuing use of an aircraft and the enjoyment they, as law abiding people, could be expected to get from it.

(h) It may be next to impossible for the owner, on account of import restrictions, to replace or repair the aircraft at all—and the small one-plane club could easily go into recess on account of what you have done.

(i) You will, if you have survived, carry an unpleasant stigma with you for the rest of your flying days. But you may not have any more—you may be incapacitated for life, or completely broke, or both.

THINK THESE THINGS OVER, THEN — STICK TO THE RULES

COMMENT

These summaries have been written in the context of New Zealand operations, e.g., the letters CAA stand for the New Zealand Civil Aviation Administration. Some of the details may not be totally relevant to Australian operations but the principles are completely valid and applicable. The Fundamental principles are:

- If you are not engaged in aerial work operations which require low level flight and in relation to which low level operations have been authorised then **don't engage in low flying** except in the particular circumstances of authorised training over an approved low flying area.
- If you are carrying out aerial work operations for which low level flying is necessary and authorised then, to use the words of our New Zealand friends—

  STOP and think — plan every flying operation ahead.

  LOOK before you tackle the job—and all the time you are flying.

  LISTEN to sound advice from older hands and those with local knowledge.

SEARCH AND RESCUE ALERTING

In the follow-up of incidents which have involved the declaration of a SAR phase we have occasionally been queried by pilots and operators as to whether the circumstances of the particular event warranted declaration of a SAR phase. This same thought may have crossed the minds of other pilots.

The objectives of the Search and Rescue organisation are to assist aircraft in distress and to locate and rescue survivors of aircraft accidents. The key to the effective realization of these objectives is in the efficient operation of an alerting service which will ensure the earliest practicable recognition of the possible need for SAR action.

To this end, a precise table has been prepared covering the nature of emergencies which may occur and the relative times at which action should be taken. These actions are implemented through the declaration of "SAR Phases" — Uncertainty, Alert and Distress — which reflect successive degrees of concern, namely, doubt, apprehension and a certainty of the need for assistance. The declaration of each successive phase carries with it the responsibility for execution of actions appropriate to that phase and the service is thus progressively geared to meet a real emergency.

Inherent in this system is the belief that it is better to treat every case of abnormal operation as a potential SAR event rather than to underestimate the situation even though, as a consequence, the SAR service must necessarily suffer a large number of false alarms in ensuring that it does not miss out on one real emergency.

Within this context it must be appreciated that the "uncertainty phase" merely indicates that the situation is not completely clear, that doubt therefore exists as to the safety of the aircraft and that, consequently, the SAR organisation should keep a close watch on the developing situation. It does not necessarily mean that someone has committed some error or that there is, in fact, an established emergency. ATC and Communications Units becoming aware of any abnormal situation are required to assess the situation and declare the appropriate phase, thus alerting the SAR organisation, but, by the same token, when doubts are eliminated the same units will immediately cancel the phase.

In summary therefore, even though knowledge of other factors may tend to promote the belief that all is well, the appropriate SAR phase will be declared as the first step of the SAR procedure, unless there is positive knowledge that the aircraft is safe. This is in the best interests of the pilot (and passengers) and ensures that, in the abnormal situation, the SAR service is promptly geared to provide the assistance which is its objective.

In all of this we have laid stress on the part played by the ground organisation. However, it must be appreciated that, in their own interests, pilots can play a part by themselves declaring a state of emergency or, at least by providing the ground organisation with sufficient information to permit assessment of the position and declaration of a phase, if appropriate.

While the system accepts that there will be a high proportion of "false alarms" it is too much to expect that we should happily condone those false alarms which are due entirely to thoughtlessness or carelessness. We therefore take this opportunity to remind that, when a report is not received prior to an agreed SARTIME, the appropriate SAR phase is declared and checking procedure instituted.

Next time you are at an ATC or Communications Unit you may care to discuss the SAR organisation as we believe that you would be interested in the measures taken to ensure the safety of your operations. For the statistically minded, we find that approximately 10 per cent of all declared phases progress through to the Distress Phase.

Disabled Constellation ditches in North Atlantic

On 23rd September, 1962, a Lockheed 104H "Constellation" ditched into rough seas approximately 560 nautical miles west of Shannon, Ireland. Three of the eight crew members and forty-five of the sixty-eight passengers survived.

The aircraft was engaged on a flight from New Jersey to Frankfurt, with an intermediate stop at Gander. Some three hours after departure from Gander, when eight minutes past the pre-computed equal time point, a fire warning occurred on No. 3 engine, and its propeller was feathered. Whilst the flight engineer was carrying out the shut-down procedure on No. 3 a stewardess informed the captain that fire was visible in this engine, so the engineer was instructed to inspect it from the cabin. He reported that a residual fire was burning in a power recovery turbine stack, but he considered that it would burn itself out. Meanwhile, approval had been obtained for the aircraft to descend to a lower level where height could be maintained on three engines.

Shortly after the engineer resumed the shut-down drill on No. 3 engine, No. 1 engine oversped without warning to 3,300 R.P.M. The captain immediately closed all throttles, pulled the nose of the aircraft up to reduce speed and feathered No. 1 propeller.

Maximum except take-off (Meto) power was set-up on Nos. 2 and 4 engines and an escort was requested. Weather conditions rendered Keflavik unsuitable for landing, so Gander was advised that the aircraft would proceed to Shannon at flight level 50.

Although there was no stated intention to ditch the aircraft at this stage, the flight engineer reviewed the company ditching procedures and computed the ditching airspeed. The senior stewardess was called to the flight deck, briefed on ditching procedures and instructed to prepare the passengers in case ditching became necessary. She, in turn, briefed the other three stewardesses by reference to the company manual. Radio contact was maintained with Gander and Shannon and all transmissions were monitored and recorded by Prestwick Oceanic Radio. Sea conditions were given to the aircraft as: wind from 260 degrees at 28 knots; primary swell from 260 degrees true, eight to twelve feet high; secondary swells from 300 degrees true, eight feet high.

About an hour later a fire warning occurred on No. 2 engine. Power was reduced and the warning ceased, whereupon power was again increased to just below METO setting. The passengers were instructed to don life jackets and the aircraft heading was altered for Ocean Station Vessel "Juliett", some 480 nautical miles distant. Approximately 20 minutes and again 40 minutes after the initial fire warning on No. 2 engine, the fire warning was repeated a second and third time—in each case the warning ceased when power was reduced. Repeated attempts were made to restart No. 1 engine, both with the starter and by unfeathering, but these were unsuccessful because the engine had seized. No. 3 engine could not be considered for restarting because its oil supply was found to be depleted.

Some short time later a fourth fire warning occurred on No. 2 engine and the warning bell could not be silenced by reducing power. The engine then failed abruptly and fire was seen trailing back over the wing. The propeller was not feathered because the captain believed that by its windmilling action it would provide hydraulic pressure for the aircraft control boost system.

After announcing that the aircraft was ditching, the captain obtained a radio altimeter reading and changed his altimeter to coincide with that reading. Two escort aircraft which were then standing by were informed of the situation and the aircraft was turned to the left to ditch on a heading of 265 degrees. Halfway through the turn the flight controls "froze" and the captain commenced to disengage the hydraulic boost system. The flight engineer immediately actuated the hydraulic crossover switch and restored boost pressure with the secondary hydraulic system, whereupon the controls responded normally. The aircraft was lined up on the desired heading and power was reduced on No. 4 engine so that directional control could be maintained.

Flap was used throughout the final approach; with the selection of first 60 per cent, then 80 per cent and finally 100 per cent. The weather conditions were clear, with the cloud base about 2,000 feet and no moon. The captain subsequently stated that depth perception and visibility were excellent during the final descent. Just before impact he put the landing lights on and cut No. 4 engine. The nose of the aircraft was brought up to parallel the face of an approaching swell, into which the ditching was accomplished.

PREPARATION AND DITCHING

Upon return from the briefing given by the flight engineer, the senior stewardess conducted ditching drill, drawing the attention of passengers to a ditching instruction folder which was contained in the pocket of each seat. Whilst the senior stewardess explained the procedure, the three assistant stewardesses circulated amongst the passengers, assisting them to don their life jackets and explaining the drill. For some reason, the instructions given by the stewardesses differed from those in the ditching folder, consequently some passengers became confused and when the aircraft ditched they did not assume the correct ditching position. They were also instructed regarding the use of the life jacket and warned not to inflate them until clear of the aircraft.

The door between the flight deck and cabin was removed and stowed and the emergency life raft was tied in position near the main exit door. Passengers were requested to discard shoes and dentures, and to remove pens, pencils and other sharp objects from their person. Knives and flashlights were collected and given to certain passengers who had been allotted specific duties, such as opening exits and launching life-rafts. The life jackets were not equipped with lights and the stewardesses were not in possession of knives or flashlights. Prior to ditching, the stewardesses assumed strategic positions close to exits and the navigator took charge of the 25-man emergency life raft.

In addition to the emergency raft, the aircraft was equipped with four 25-man life rafts, two in each wing. These could be released and inflated in sequence, by a control located in the jamb of each of the raft over-wing exits, or alternatively by mechanisms at each stowage location. The two rafts in the left wing could also be released by a control in the cockpit, but it was subsequently learned that the captain was not aware of this latter provision.

Approximately five minutes prior to impact the captain informed the passengers that the aircraft was ditching. The cabin lights were turned down so that the passengers' eyes would become accustomed to darkness. A final signal to "brace for water contact" was not given, consequently a number of the passengers and the stewardesses were not properly prepared for ditching at the moment of impact.

There was only one deceleration, which was described as "severe". Many of the rearward seats failed at their floor attachments and piled up, with the result that some passengers experienced difficulty in extricating themselves. Some difficulty was encountered in opening the main cabin door, after which the raft was pushed out. It immediately floated away because the navigator had neglected to secure the lanyard to the aircraft or to his person. Evacuation was therefore delayed whilst the raft was retrieved and inflated. No difficulty was experienced in opening the over-wing exits, except that access to one of these exits was blocked by a failed seat, which had first to be removed.

It was established that the left wing had separated from the aircraft at impact, whilst there was conflicting evidence whether or not the right wing remained attached. In any case, none of the four wing-stowed rafts were ever sighted by the crew or passengers. These four rafts were subsequently recovered, fully inflated, but there was no evidence to suggest that they had been used by any of the non-survivors.

The passengers left the aircraft through the main door and the overwing exits, some later testifying that they could see clearly, whilst others stated that they found the exits only by following other people. After entering the water they kept moving round until those that survived eventually found the emergency raft. Some saw a light, but it was not known whether they saw the automatically actuated lights on the raft or the captain's flashlight. Fifty-one persons, including the captain, navigator and one stewardess, boarded the one raft grossly overloading the 25-man unit. Although every effort was made to save those who did not find this raft, three of the 51 died either on the raft or shortly after being rescued some six hours after ditching.

Apart from a cut on the forehead which the captain received at impact, the crew were not injured and all vacated the flight deck. The captain ascertained that no persons were visible in the cabin before abandoning the aircraft through an over wing exit. The water was approximately waist deep in the cabin at the time the last of the survivors left the aircraft, but the length of time that it remained afloat was not known.

POWER PLANT FAILURES

A thorough check of the maintenance records did not reveal any evidence to suggest that the engine failures were related to improper maintenance or overhaul, or to contamination of the fuel.

All four power plants were operating normally until No. 3 was closed down. The fire warning which led to the feathering of this engine ceased immediately the extinguishant was released and it is known that a residual fire did exist for a short period in a power recovery turbine exhaust stack. Apart from the fire warning, none of the No. 3 engine instruments gave any indication of malfunctioning, but there was some inconclusive passenger testimony of sparks trailing rearward from the engine prior to the fire warning. These circumstances suggest failure of a power recovery turbine. Although such a failure does not satisfactorily account for the subsequent discovery that all of the oil supply had been lost, a turbine failure is considered to have been the most likely cause of the fire in No. 3 engine.

The immediate actions to be performed in the shut-down of No. 3 engine included the closing of the associated emergency shut-off valves. Although there appears to have been time for the flight engineer to have completed this action before he was instructed to proceed to the cabin and inspect the fire in No. 3 engine, there is strong evidence to support a conclusion that he did not actuate this control until after returning from the cabin. There is also strong evidence to show that he actuated the shut-off valve lever for No. 1 engine instead of that for No. 3, thus shutting off the oil and fuel to No. 1 engine. He apparently realized his mistake as soon as No. 1 engine oversped, for he was seen to return the No. 1 engine shut-off valve lever to its normal operating position at this time.

Interruption of the oil supply to the type of engine involved results in incipient damage to certain bearings within seconds, minor damage after 20 or 30 seconds and gross damage after one or two minutes. The oil supply to the propeller governor would be interrupted very soon after the valve was closed, hence loss of propeller control would follow almost immediately after the shut-off lever was actuated, due to inherent leakages in the oil circuits concerned. The exact time which would elapse before the propeller oversped to 3,300 R.P.M. would depend upon a number of variables, but the fact that the engine did not exceed this speed before feathering was accomplished indicates that the propeller pitch lock functioned correctly to prevent an engine-damaging overspeed. Although it is not known what damage had in fact been done to the engine before the oil supply was restored, there is no reason to believe that it would have been capable of further operation had the captain been aware of the safety features of the pitch lock system and not feathered the engine immediately. Once the engine was closed down it apparently seized, thus precluding a restart.

Showers of sparks were seen to be coming from No. 2 engine, concurrent with each operation of the fire-warning system. Apart from these symptoms, the engine instruments indicated normal operation up to the final violent failure and the visible fire. The final failure in this engine is believed to have been due to some kind of gross cylinder fracture, which was aggravated by repeated and progressive damage from a leaking exhaust assembly.

ANALYSIS

In analysing the circumstances that led to and resulted in this accident, the investigating authorities noted that it was not intended to criticise individuals who did all that was possible commensurate with the time available for action. They were, however, obliged to draw attention to a number of deficiencies in the crew's knowledge of published company operating procedures, in the company training and in the emergency equipment.

There were evident deficiencies in the crew's knowledge of emergency procedures and also in coordination during the execution of the feathering drill on No. 3 engine. Commenting upon the immediate feathering of No. 1 engine when there was no evidence of failure apart from a sudden overspeed which was arrested by the pitch lock system, the investigating authorities felt that the captain was not fully aware of the safety features of the pitch lock system. They also found evidence to support the view that training was inadequate in this particular area. Accordingly, they strongly recommend that crew training should encompass all features of all equipment which is designed to cope with in-flight emergencies.

No. 2 engine was not feathered when it failed violently in the latter stages of the sequence of events, because the captain believed that its rotational speed would provide hydraulic pressure for the control system. Nevertheless, hydraulic pressure was lost and the captain was in the process of disconnecting the hydraulic boost when the engineer restored hydraulic pressure by activating the hydraulic crossover switch. Whilst recognising the magnitude of the critical situation which confronted the captain at this time, the authorities found difficulty in understanding why, in view of his training and experience, he would attempt to disconnect the hydraulic boost rather than use the crossover system.

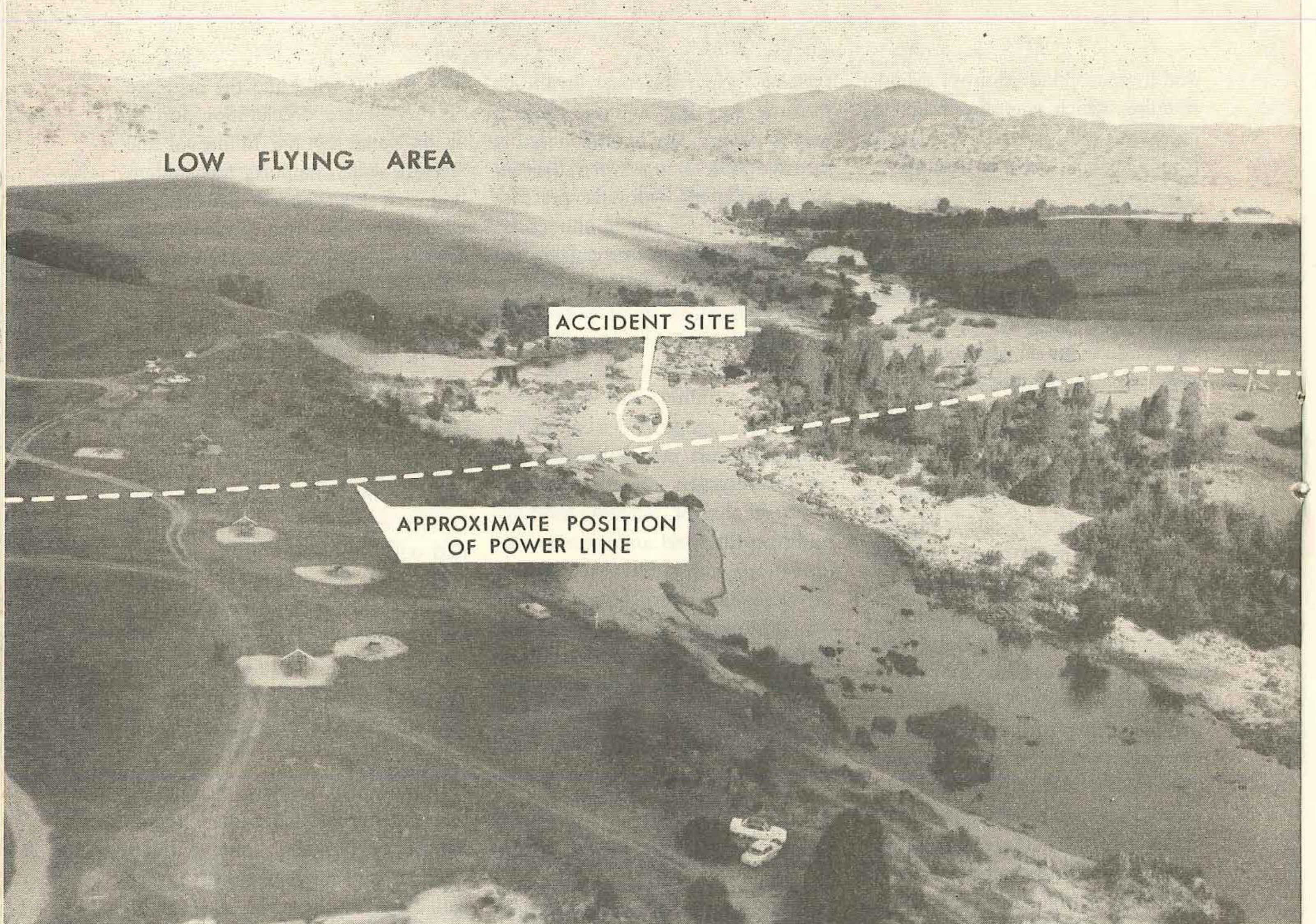
The choice of ditching heading, based on the wind and sea state information, was not in accord with the company instructions or with the procedures recommended by appropriate authorities. The captain stated that he chose a heading of 265 degrees magnetic to land into the wind, which had been given to him as 260 degrees (true) at 28 knots. No allowance was made for the local magnetic variation of 20 degrees which exists in this area, therefore the ditching was neither into the wind as the captain desired, nor parallel to the anticipated primary swell as recommended. The captain was aware that the company instructions specifically stated "Never land into the face of a swell (or within 45 degrees of it)" but he elected to ditch into the face of the swell on the basis that, in his opinion, the interval between swells offered a better ditching situation than the procedure specified in his company manual. The procedure he used is, in fact, warned against because of the extent of the aircraft destruction that can result from such ditching. The absence of at least the left wing and the evidence of very severe deceleration forces, as indicated by the failure of the aircraft seats, supports the contention that high impact forces were encountered in this ditching and reflects adversely on the choice of ditching heading.

The performance of the crew during the ditching indicated that a low degree of efficiency had been gained from the training carried out to meet an emergency such as was encountered on this flight. Detailed preparations, which were either necessary or desirable, were not carried out. Differences in the instructions given to passengers concerning the correct ditching position, failure to give a warning to "brace" for impact, and failure to remove the over-wing exits prior to impact, indicate that the preparations were incomplete.

In their final analysis, the authorities noted that under the circumstances of darkness, unfavourable weather and high seas that prevailed at the time, the survival of 48 occupants of the aircraft was miraculous. It is believed, however, that had lights been provided on life jackets, even more persons might have survived. The accident also led to recommendations to improve the basic design and location of essential survival equipment.

PROBABLE CAUSE

It was determined that the probable cause of this accident was the failure of two of the aircraft's four engines, and improper action of the flight engineer, which disabled the third engine, thereby necessitating a ditching at sea.



Powerlines claim another Cessna

On 16th March, 1963, a private pilot and his passenger were killed when the Cessna 172 in which they were flying struck an electric power transmission line and crashed some 10 miles south-west of Canberra, A.C.T.

THE FLIGHT

During the morning the aircraft was flown from Goulburn to Canberra Airport where an aerial pageant was to be held that afternoon.

At 1214 hours the pilot notified Canberra Tower of his intention to carry out a 30 minute flight in the Canberra Flying Training Area south-west of the airport. Some nine minutes later, just after the aircraft had taken off for this flight, the pilot acknowledged an instruction from Canberra Tower to report "operations normal" at 1255 hours. This was the last communication heard from the aircraft.

Following unsuccessful attempts by Canberra Tower to obtain the overdue operations normal report a search was commenced.

It was subsequently established that at approximately 1231 hours, the aircraft was observed within the flying training area, at a position some two miles north-west of the accident site, flying from the direction of Canberra at a height of approximately 150 feet above the Murrumbidgee River and heading towards the accident site. No other sighting reports were received.

The wreckage of the aircraft was seen from the air at 1350 hours following a report that an electrical power failure had occurred in the area.

THE INVESTIGATION

The wreckage was located on the northern bank of the Murrumbidgee River within an area known as Pine Island Picnic Reserve which is some 1750 feet above sea level and approximately three-quarters of a mile outside the north-western boundary of an area approved for low flying training.

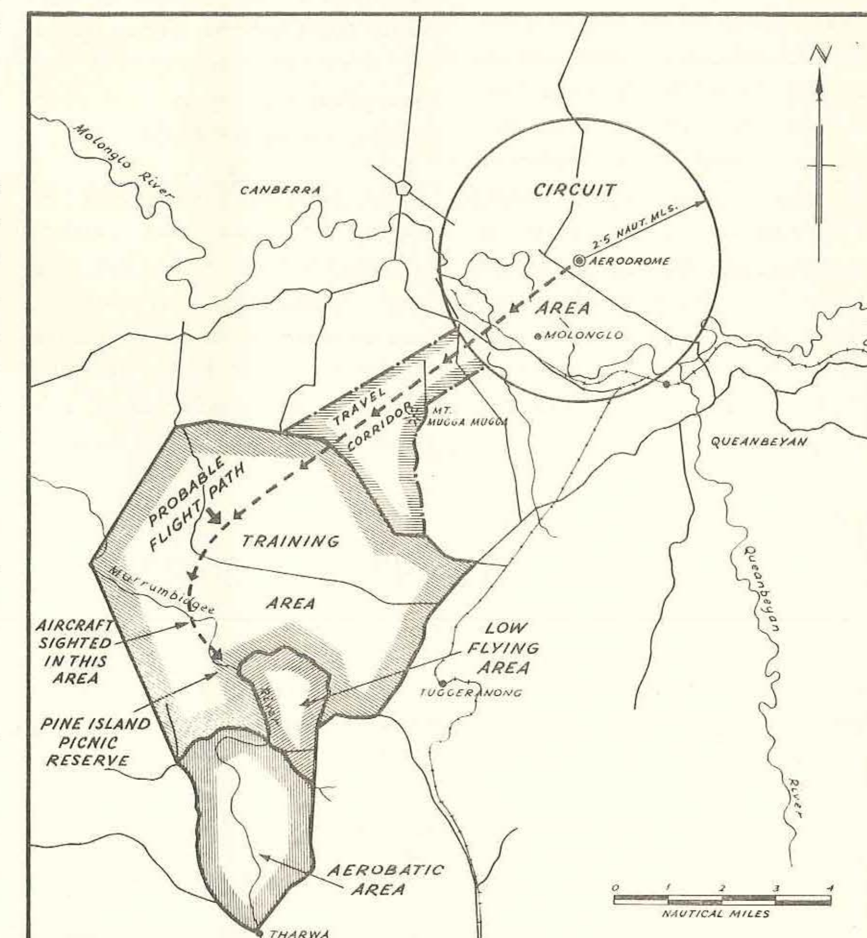
There was 2/8 strato-cumulus cloud at 6,000 feet, the surface wind was from the east-north-east at 5 to 10 knots and visibility was unrestricted.

The aircraft fuel tanks had been filled prior to departure from Goulburn and it has been estimated that some 25 gallons remained in the tanks when it took off from Canberra. The aircraft all-up weight was then some 300 lb. below the maximum authorised and the centre of gravity of the aircraft would have been within the specified limits.

Examination of the wreckage and the accident scene revealed that the starboard wing had struck the three steel cables of an electric power transmission line some 70 feet above the river at approximately the middle of a 900 foot span which crossed the river almost at right angles. The impact broke the cables and the aircraft dived into the river's edge. It came to rest in an inverted attitude against a large formation of rock some 500 feet east-south-east of the point of impact with the cables. Short sections of the cables were found in the wreckage. No fire occurred.

The starboard mainplane had been grooved and cut near the central leading edge section in a manner consistent with contact with all three power cables. There was also evidence of scoring by the cables along the top and bottom surfaces of the mainplane towards the wing tip. One cable had cut through the leading edge to the wing spar before breaking and the wing tip was almost severed.

The propeller was detached from its shaft due to torque failure at the



attachment flange. Both blades were deeply scored, the tips were bent forward and there was evidence of considerable abrasion on both forward faces of the blades due to rotation against the rocks.

A thorough examination of the engine and airframe failed to reveal evidence of any pre-impact defect or malfunctioning which might have contributed to the accident.

The pilot of the aircraft was 18 years of age and held a current private pilot licence endorsed for Cessna aircraft. He had gained all of his 58 hours flying experience, some 29 hours of which were as pilot in command, on Cessna 172 aircraft. All of his training as a student pilot was carried out with the Canberra Aero Club between June and December, 1962 and he then commenced flying as a member of the Goulburn Aero Club. During his training he received instruction concerning the boundaries of the approved low flying, aerobatic and general flying training areas contained within the Canberra Flying Training Area. During October, 1957 a Canberra Aero Club aircraft struck this power line during unauthorised low flying over the Pine Island Picnic Reserve. (See Aviation Safety Digest, No. 15 of September, 1958.) The charts depicting the areas approved for training, which were displayed in the club rooms, were then annotated with a warning that low flying was not to be carried out in this vicinity. The location of the Pine Island Picnic Reserve and the electric power transmission line struck by the aircraft were clearly shown.

ANALYSIS

There is no evidence to indicate that this flight was intended to be other than a local sight-seeing flight within the Canberra Flying Training Area. No authorisation had been given for any type of flying training during the flight.

The pilot had completed his training to private pilot standard with the Canberra Aero Club some three months previously and had been instructed as to the boundaries of the Canberra Flying Training Area and the specific areas contained therein which had been approved for use for low flying and other flying training. It is not unreasonable to assume that the pilot was aware of the hazards associated with low flying in the viciniity of the Pine Island Picnic Reserve.

When last observed, the aircraft was at a low height, but otherwise appeared to be operating normally. No evidence was found of any in-flight emergency condition such as engine failure or loss of control, and there was nothing to suggest that a practice forced landing was being attempted during the latter stages of the flight.

The evidence strongly suggests that the aircraft was intentionally flown contrary to the provisions of Air Navigation Regulation 133 and that the pilot failed to observe obstructions until it was too late for effective avoiding action to be taken.

CAUSE

The probable cause of the accident was that the pilot failed to maintain an adequate look-out whilst engaged in low flying.

CARELESS CLEANING — CORRODED CONNECTION

An aircraft became the object of search and rescue procedures twice in a period of one week, due to loss of HF communications. On the first occasion five ground stations and two other aircraft spent 45 minutes trying to make contact, which was eventually established on VHF, through relay by one of the other aircraft. On the second occasion four ground stations were involved for 27 minutes before contact was made, again on VHF.

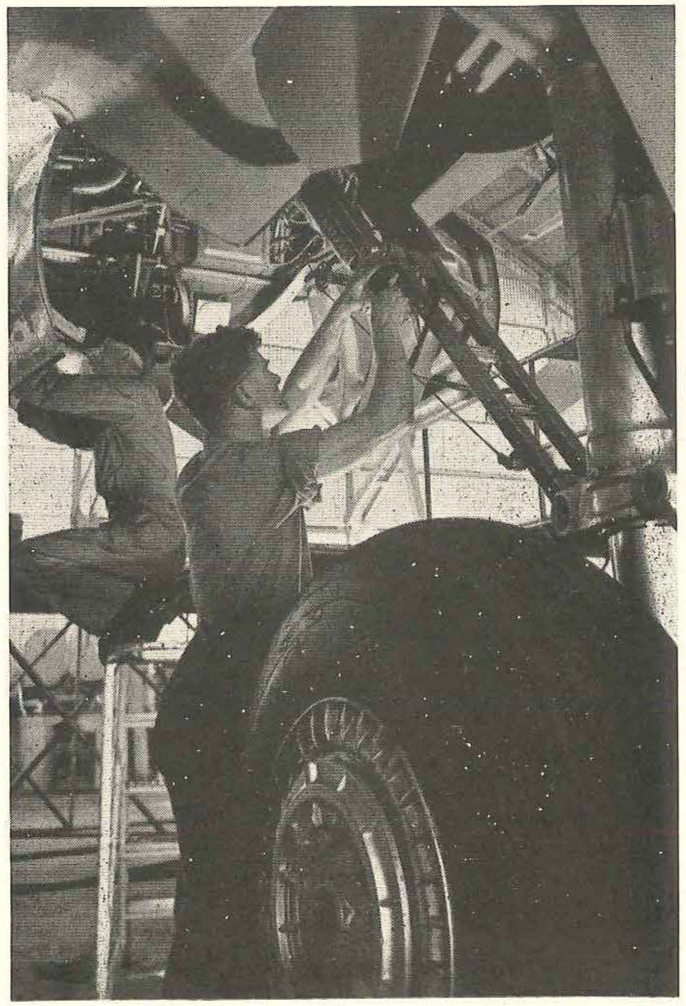
Investigation disclosed that some time prior to these two incidents paint stripper had been used to remove paint from the aircraft in the vicinity of the HF aerial connector. Careless cleaning had failed to remove all of the paint stripper, which corroded the aerial and caused intermittent malfunctioning of the HF equipment.

Complete removal of all traces of a paint stripper is an elementary precaution on any type of surface.

DON'T BE A HERO

The following article has been extracted from the Aviation Mechanics Bulletin. Its applicability to maintenance personnel is quite evident. We hope that it is equally evident that the circumstances under which such "heroes" are born are present in all other fields of aviation activity, including piloting.

Someday it will happen to you. Someday you will be handed a job that is just a bit over your head. It may be a job you have never done before. Or something you helped with two or three years ago and haven't touched since. Perhaps it was covered in that course you took on systems, but that was back when the company got the new equipment. So you are not at all sharp on this particular job, but it has been given to you. Well, don't be a "hero".



We were recently reminded of this hero business when a friend mentioned an accident that occurred a few years ago. It was a maintenance accident, an avoidable accident in which many people died. It was set up when a mechanic accepted a job he was not qualified to do, and it was triggered when he blundered ahead without telling anyone he needed help. He might have made out, but he never opened the Manual.

It is hard for us to understand this rushing in to save the day, this "hero" bit. It takes more guts to say you don't know than to clam up and hope no one discovers it. Actually, no one expects you to know all the details of a complex airplane.

It is much easier to use the help available—the Manual and the experience of others—than to stumble along alone. Why take the hard way?

No bravery is required to gamble with the lives of others. If you want to bet your own life, O.K., try drag racing or highway driving on a three-day weekend.

We have great compassion for "heroes". They are sadly mistaken and not too bright. They are afraid to confess their weaknesses to themselves. Probably they don't sleep very well.

Don't be a "hero". Be an aviation mechanic.

(Aviation Mechanics' Bulletin)

Engine Controls

THE INSURANCE VALUE OF GOOD MAINTENANCE

Occasional in-flight engine failures in light aircraft are inevitable. However, this philosophy is no excuse for complacency in relation to those failures which are preventable and in this class we can place most cases of loss of engine power or loss of adequate power control caused by jamming or disconnection of one or other of the engine controls—throttle, mixture control or carburettor heat.

Air Safety Incidents resulting from in-flight failure of engine controls occur with a regularity that is almost predictable and a common feature of the great majority is evidence of inadequate maintenance. The purpose of this article is to illustrate some of the more common types of engine control failure and to show how proper inspection and maintenance could have prevented such failures. There are many different types of engine controls, but systems involving either flexible elements moving in an outer sheath, or jointed rods, are the types most commonly used in light aircraft and the remarks are therefore primarily directed to these two types.

Single Wire Flexible Controls

The type of engine control most commonly seen in light aircraft of American manufacture consists of a single wire cable with a flexible outer casing, very similar to the conventional choke control used on most motor cars. Controls of this kind are very simple and relatively cheap, but their continual efficiency in service is dependent on careful installation and subsequent regular detailed inspections.

For example, a control installation which includes excessively sharp bends is likely to suffer from fretting and wear of the wire inside the casing. A more common fault, which can easily be introduced accidentally during normal service adjustments, is to place the final clamp or attachment of the outer casing right at its forward end. In that case, normal movement of the control lever on the engine may cause undue flexing of the control wire, with consequent risk either of a metal fatigue failure of the wire or of excessive abrasion against the open end of the casing. (See Fig. 1.)

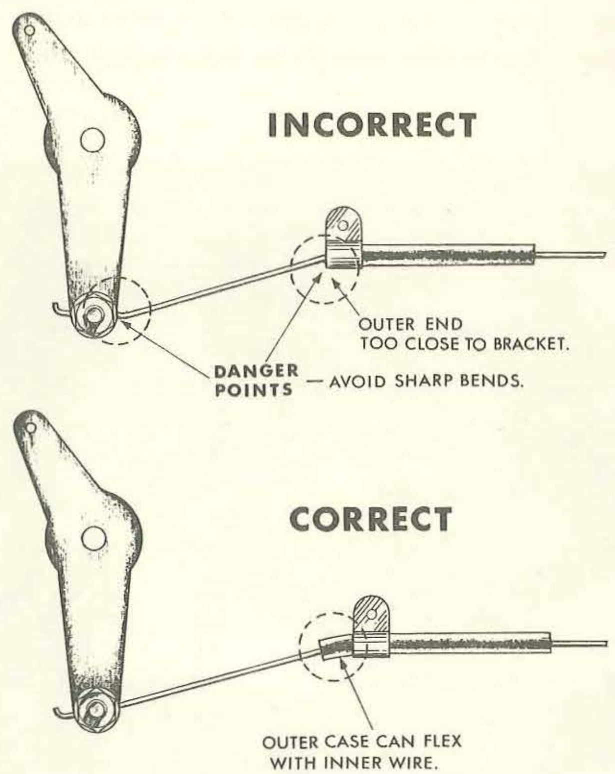


FIG. 1

An incident has also been reported of a rather different problem with a throttle control of this kind. We will let the pilot speak for himself:—

"This incident occurred whilst conducting a flight examination of a private pilot licence candidate.

"Shortly after take-off the throttle was closed suddenly for the purpose of simulating an engine failure after take-off. Height approximately 200 ft. The candidate under test was then instructed to overshoot at a height of 15 feet above the ground and approximately 100 yards from the end of the strip. The pupil had difficulty in getting the throttle open. I took over immediately and managed to open the throttle partially by applying considerable pressure. A close circuit of the drome was then carried out with 2100-2200 r.p.m. indicated on the tachometer. On base leg it was possible to open and close the throttle only by use of 'brute' force.

"Examination of the throttle control on landing revealed that the key which guides the push-pull rod had apparently become worn and broken off and had fouled the throttle cable with the outer sheathing."

This case is of special interest since controls of almost identical design are used in many different types of light aircraft flying in this country. The "key" consists of a tab which engages with a longitudinal groove in the cockpit control rod, its purpose being to prevent any rotation of the rod and cable as the control knob is moved in and out. If a check on your own aircraft shows that a control knob can be freely rotated more than a few degrees it is evidence that the key may be worn and that remedial action may be urgently required to avoid fouling.

Stranded Wire Flexible Controls

With the flexible, stranded cables used in the engine control systems of some British aircraft the main risk is of "hammering", fraying and eventual jamming of the control inside its casing due to engine vibration.

A bad feature of some early controls of this type was that they could not be disassembled for inspection without severing the inner cable, which would therefore have to be replaced regardless of its condition. As a consequence controls of this kind were seldom given proper inspection and reports of in-flight failures became quite common.

The situation has been greatly improved by the introduction of re-designed controls having a detachable fitting on one end of the cable. Non-destructive inspection of the inner cable is now quite simple and all incipient failures should be detected at an early stage if the appropriate degree of care is exercised during inspection.

Jointed Rod Controls

Control rods, as such, are almost entirely trouble free. The embarrassing failures occur at the joints,

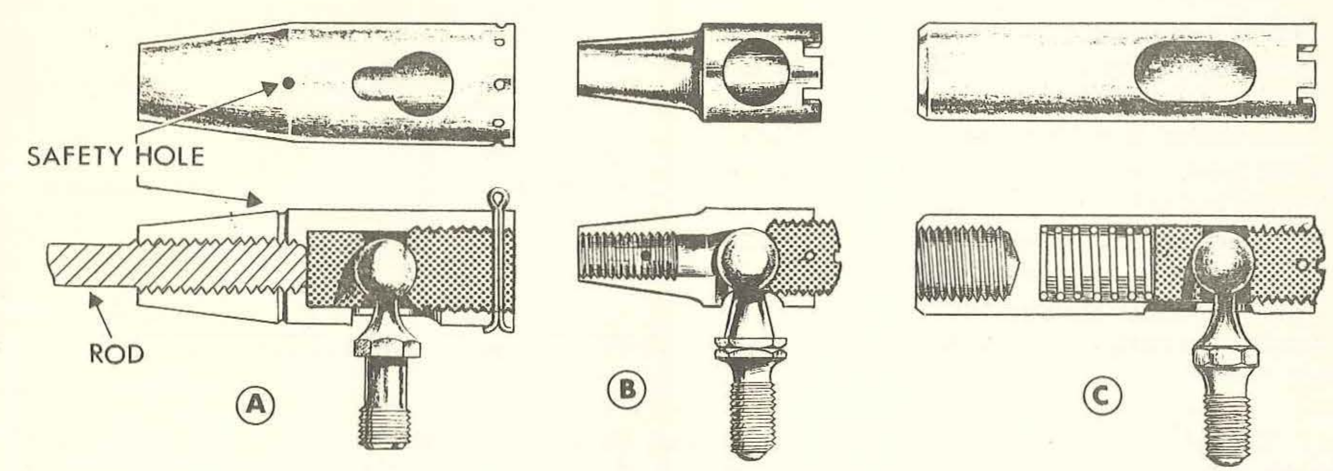


FIG. 2

(A)
1. Rod end must not be screwed in too far.
2. Neck of ball must be in narrow section when correctly adjusted.
3. Adjust ball clearance with pinned nut.
4. Correctly adjusted ball cannot slip out with normal wear.

(B)
1. Socket hole larger than ball end. Excesive wear on ball and pads will allow rod to come adrift from ball.

(C)
1. Wear is normally compensated for by spring but broken or damaged spring will allow rod to come adrift from ball. Modified version has slot in end fitting narrowed similar to Fig. (a).

of which there are several different types in general use. Probably the worst offender is the common ball-and-socket joint with its tendency to wear and come adrift in service—usually at a very awkward moment. This type has its short-comings even though modified versions have been brought out over the years to improve serviceability. (See Fig. 2.)

The clearance which must be allowed between ball and socket to permit free movement of the joint may also allow the ingress of dust unless the joint is adequately shrouded, which is not usually the case. The resulting abrasion, aggravated by engine vibration, and the absence of effective lubrication often results in a high rate of wear in such joints.

Regular, careful inspections are thus essential if trouble is to be avoided. When checking for signs of undue looseness or wear, the checks should be made over the full range of travel of the control and not merely in the fully open and fully closed positions. Since engine controls spend most of their actual operating life in the cruise power range, it naturally follows that the danger signal of excessive looseness at joints can often be most readily detected when the controls are in this intermediate position.

Faulty installation can also cause trouble with the ball and socket joint. For example the rod can be screwed too far into the body socket, where it causes fouling of the ball and consequent binding of the joint. Some socket bodies are blanked off between rod and ball head to prevent this happening. Conversely, care must be taken to ensure that the rod is screwed in sufficiently far for safety and there is normally a safety hole for this purpose. Another installation aspect is the correct arrangement of the controls in relation to the angular movements of the rods. Excessive side or twisting loads on a ball joint will cause rapid wear of both ball and socket body or may even cause fracture of the ball end through the narrow neck.

Control joints consisting of a fork end with clevis pin or bolt are somewhat simpler and easier to inspect than the ball and socket type, but are just as likely to experience deterioration in service. Joints of this kind can fail due to shearing of a weakened connecting pin. They can also become disconnected as a result of failure of the pin retention device, permitting the pin to work out of engagement with the fork end.

A superior, if somewhat more expensive type of control rod joint makes use of a self-aligning bearing. Such joints more than justify their cost in heavy duty applications involving high control system loads and severe vibration, but they can also be justifiably employed in many light aircraft applications. They are not infallable however, and a programme of careful inspection is still essential. As a "get you home" device in the event of in-flight failure of a control system self-aligning bearing, it is common practice in such controls to fit a large diameter safety washer on the outer side of the bearing. (See Fig. 3.)

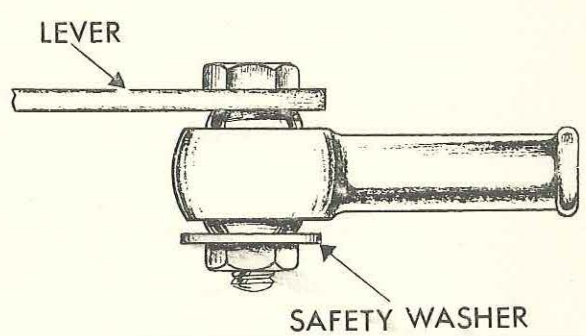


FIG. 3 SELF-ALIGNING BEARING

Your aircraft engine controls are called upon to work for lengthy periods in a fairly tough environment, which is bound to have its effect sooner or later. Because they happen to work satisfactorily at the moment, don't assume that these controls will be good for all time unless they receive the care and attention which is their due.

Failure of an engine control on your motor car is merely an annoyance. A similar failure in your aircraft could easily spell disaster.

CROSS-MONITOR TAKE-OFF AND APPROACH

Many accidents can be laid to a series of coincidental failures, any one of which when taken alone would not be critical. These are apt to occur during the most critical part of the flight—take-off for example, when one pilot should be doing the flying and the other one should be cross-checking the instruments as well as visually checking outside for other aircraft.

Too often the non-flying pilot becomes so occupied with his non-flying duties he neglects to do either of these, thus the take-off becomes a solo or single-pilot operation.

Some of the disstracting non-flying duties are: (1) raising the gear, (2) retracting flaps to 20°, (3) answering a radio call to change frequency (all too often this occurs at an altitude of 50 feet), (4) with head down, changing the frequency, (5) trying to contact Departure Control, (6) determining an error was made in selecting frequency, (7) head down again to correct the error, (8) finally contacting Departure Control, and (9) jotting down departure directions, (10) then retrieving the microphone you just dropped.

It is essential and even crucial to the flight that the non-flying pilot carefully cross-check all aspects of the take-off up to an altitude of at least 500 feet, and preferably higher. Nothing must distract the non-flying pilot from this important responsibility.

To emphasise it all again:—

1. Great stress must be placed upon requiring the non-flying pilot to always check the climbout procedure to at least an altitude of 500 feet, by referring to the instruments and, when possible, by visual reference as well. This is done consistently on approaches to landings, and it should be consistent on take-offs.
2. The ASI, Director Horizon, and Altimeter must be monitored constantly; and reliance on any one instrument avoided.
3. Except in emergency, tower operators should not call taking-off aircraft until that aircraft is at least 400 feet up. This is probably the greatest and most serious distraction the flying crew suffers, and it comes at a most critical time.

Alertness to these distractions may help eliminate them.

(Flight Safety Foundation Inc.)

Pilot Reporting of "Hazards"

The Aeronautical Information Publication calls on pilots, becoming aware of any operating irregularity in any navigational facility or service or of any other hazard to navigation to report the details to the appropriate ATC or COM unit—the report being made by radio, if possible, or otherwise in person after landing (AIP/RAC/OPS 1-21 para. 9.4 refers).

This report will permit early corrective action, where this is possible, or alternatively it will enable advice of the irregular operation or hazard to be immediately included in the flight information service made available to other pilots.

One good example of the "other hazard" category was contained in a recent air safety incident report relating to an occurrence at Hughenden in Queensland. On this occasion there was a heavy infestation of grasshoppers at the airport and, during take-off, a grasshopper lodged in the co-pilot's pitot head causing a gross error in the indicated airspeed.

Grasshopper swarms are fairly common at certain times of the year in areas of Queensland, New South Wales and Northern Victoria. Not only do these swarms constitute a hazard in themselves to aircraft but, by virtue of their attraction to birds, the possibility of a bird strike in these areas is increased. If pilots can be forewarned of the presence of swarms on or near airports they will be better prepared to cope with any potential hazard during the approach phase. This forewarning can be accomplished through the flight information service provided that the ATC or COM unit is given the necessary information by the first pilot who becomes aware of the situation.

We hasten to add that the pilot concerned in this incident did lodge an early written report, and, as a result, an appropriate NOTAM was issued. In this case the take-off circumstances warranted the full incident report that was received but it is also worth pointing out that if advice relating to the presence of the grasshoppers had been passed over the radio it would have expedited the service to others.

Attempted Three-Engine Go-around proves Fatal

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

(All times are Hawaiian standard)

HONOLULU, HAWAII

At 2319 hours on 22nd July, 1962, a Bristol Britannia crashed while attempting a three-engine go-around following a landing approach to runway 8 at Honolulu International Airport. Except for the rear portion of the fuselage, and attached tail section, the aircraft was destroyed by impact and fire. Thirteen of the 40 persons aboard survived the crash.

The aircraft was engaged on a regular service from Honolulu to Sydney with intermediate stops. The flight was issued an IFR clearance in accordance with its flight plan and was cleared for take-off on runway 8. Take-off was commenced at 2238 hours and approximately two minutes after the aircraft became airborne, and during the climbout, a fire warning indication for the No. 1 engine was received in the cockpit. The No. 1 propeller was feathered and the fire warning indication ceased. The crew then advised the tower controller that the No. 1 engine had been shut down and they would return to Honolulu for landing. The flight was advised that all runways were available and the wind was from the northeast at six knots. Runway 8 was requested and the flight advised that an over-gross landing weight condition existed and fuel jettisoning would be required in order to lighten the aircraft. Radar approach control vectored the aircraft to an isolated area over the water approximately 20 miles south of Honolulu at an altitude of 4,000 feet and fuel jettisoning was initiated at 2253 hours and completed at 2306 hours.

After completing the jettisoning operation two-way radio communication was resumed and the flight was vectored west of the outer marker to intercept the ILS final approach course for runway 8. The flight reported departing the outer marker and after receiving the clearance to land, reported the landing gear down. After passing the low frequency radio range station, it was again cleared by the tower to land. The acknowledgment of the landing clearance was the final transmission received from the flight and occurred approximately 50 seconds prior to impact.

The flight was first observed when its landing lights were turned on. The aircraft was then on final approach over Pearl Harbour Channel. Witnesses stated that the aircraft passed over the approach end of runway 8 in what appeared to be a normal approach attitude at an estimated altitude of between 50 and 100 feet. The No. 1 propellor was feathered and the landing gear extended. After continuing above the runway for a short distance, a go-around was attempted and the aircraft banked and veered sharply to the left. Initial ground contact was made by the left wing tip approximately 550 feet to the left of the runway centreline. The aircraft progressively disintegrated as it moved across the ground, then struck heavy earthmoving equipment parked approximately 970 feet from the runway centreline.

ANALYSIS

As far as could be determined, approximately 35,000 pounds of fuel was jettisoned in the prescribed manner. Following the completion of the operation the aircraft was in flight for approximately 13 minutes before the accident occurred. It can be assumed that during this time the crew had sufficient opportunity to ensure that the remaining fuel load was symmetrically distributed and that the aircraft trim was set accordingly.

The gross landing weight of the aircraft at the time of the attempted landing has been estimated at 134,005 pounds. This was computed by subtracting both the 35,000 pounds of jettisoned fuel and the 5,000 pounds of fuel estimated to have been consumed in flight from the recomputed ramp gross weight of 174,005 pounds. At the estimated landing weight the c.g. during approach would have been 18.2 per cent MAC which is within the approved aircraft landing limits.

All available evidence indicates that the three-engine approach was conducted under night visual conditions and in a satisfactory manner up to the time the aircraft crossed the threshold of runway 8.

From the probable approach flight path, based on observations of survivors and witnesses, in conjunction with the wreckage distribution pattern, it was determined the go-around was initiated at a point approximately 600 feet beyond the runway threshold and at an altitude of between 20 and 40 feet above the runway centreline. This was further substantiated by the fact that the landing gear was observed in the extended position as the aircraft crossed over the runway threshold but was found in the retract position in the wreckage area. The average landing gear retraction time for the Britannia is 8½ seconds. Thus, using a target threshold speed of 115 knots it would require eight seconds to cover the distance of 1,600 feet from the go-around initiation point to the general wreckage area. The minimum threshold speed of 115 knots used in this computation is undoubtedly high considering that the pilot had most likely reduced power below that necessary for approach and was in the process of flaring the aircraft when the go-around was initiated. However, it does sustain the conclusion that the landing gear retract position had been selected at the initiation of the go-around and that sufficient time was available to attain retraction prior to impact.

The Board is unable to determine the reason why a go-around would have been attempted at so late a stage in the approach and with the aircraft still in the full landing configuration. There was no evidence to indicate a go-around was required in order to avoid any obstacles, vehicles or pedestrians that may have been on the runway. Consideration was given to the possibility of a fuel inbalance condition resulting from a fuel jettison system malfunction, also the possibility of receipt of an unsafe landing gear warning horn and/or light in the cockpit when the throttles were retarded. However no evidence was found to substantiate these possibilities.

From all the evidence available, the Board concludes that a go-around was attempted shortly after the aircraft had crossed the runway threshold and while it was still in a full landing configuration. The abruptness of the aircraft's veering from the runway, in conjunction with the evidence of a shallow angle of bank at impact, confines the responsible factors necessary for this manoeuvre to those which would produce a condition of asymmetry about its vertical axis. It can be assumed that an airspeed of 115 knots (target threshold speed) or above was maintained until the aircraft crossed over the threshold. From this point and until the go-around was initiated, engine power was reduced and the aircraft was flared in preparation for landing, thus decreasing the airspeed to or below V_{mcl}. Because the aircraft was operating at a speed below V_{mcl}, it could not have responded to the application of primary flight control so as to accomplish the described manoeuvre. The existence of a split-flap condition was ruled out by the position of the flap jackscrews which evidenced the symmetrical full down flap configuration. However, an asymmetric thrust condition could have produced the necessary yawing moment the manoeuvre required. The Board believes that this condition was developed by the sudden application of take-off power in the three operating engines.

CAUSE

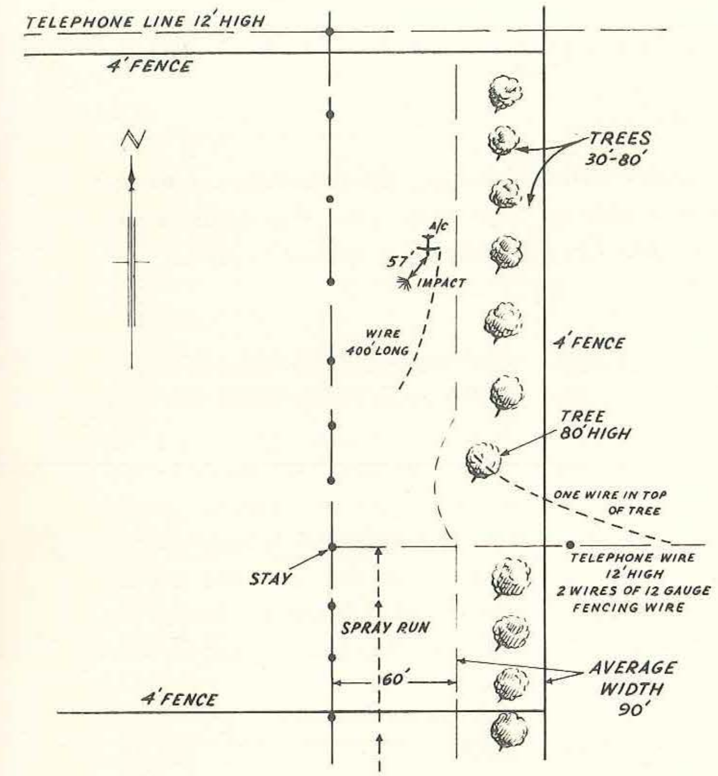
The Board determines that the probable cause of this accident was the attempted three-engine go-around, when the aircraft was in a full landing configuration, at insufficient airspeed and altitude to maintain control.

A Spraying Aircraft and Telephone Wires

Title picture was taken soon after the accident and the crashed aircraft is just visible in the distant centre. The main telephone line is made relatively conspicuous by the line of poles. The branchline (now missing) extended from the pole in the left foreground to the trees on the right and would obviously have been very inconspicuous.

Shortly after completing the morning programme of a spraying operation over some 470 acres of crop on a property in New South Wales the pilot of a DH-82 agreed to spray an additional 50 acres on an adjoining property. The owner of this property briefed the pilot concerning telephone lines obstructing the northern and eastern boundaries of the field and provided him with a rough sketch of the area. The owner told the pilot that he did not think that there would be sufficient room to spray between a line of trees bordering the eastern side of the field and the main telephone line which ran some 20 yards inside and parallel to the tree line. He believed it would be satisfactory to spray this area from above the level of the telephone line, but he did not refer to a branch telephone line which crossed the southern end of this confined corridor at right angles.

The pilot took off and, during an aerial inspection of the new area, located the two main telephone lines referred to by the owner but he did not see the branch line obstructing the corridor. As the spray markers were not yet in position the pilot completed an end run along the northern and southern boundaries of the field and then commenced a run to the north to spray the confined corridor along the eastern boundary from below the level of the telephone wires. It was his intention on reaching a large tree



near the mid-point of the spraying run to pull up to the left above the telephone line and then to resume spraying at low level as before. During this run and just as the pilot commenced the manoeuvre around the tree, the aircraft struck the two wires of the branch telephone line. The pilot immediately attempted to climb the aircraft away but, after reaching a height of approximately 80 feet, the aircraft was pulled downward and to the right in a sideslipping attitude and crashed to the ground on the starboard mainplanes. It was subsequently found that the wire had become entangled in the port mainplanes and a 400 feet length trailing behind the aircraft had snagged in the branches of a tree.

The pilot has stated that, as he was under some pressure of time to carry out this additional work, he did not conduct an inspection from the ground for obstructions in the vicinity of the treatment area as was his usual practice; he relied instead upon the information provided by the property owner in conjunction with an aerial inspection. There is nothing new about this accident. It conforms to an oft-repeated sequence of events. Clearly a more thorough aerial inspection of the particular area or a ground inspection could have prevented the accident.

'TROUBLE COMES IN ONES'

Maybe you've heard the remark, or possibly you've quoted the old adage yourself on occasion: "Trouble (accidents) comes in threes". The quotation is usually prompted by the occurrence of a second accident/incident within a relatively short span of time. Thereafter, often long afterwards, the adage-quoter awaits the fulfilment of his prediction.

Now, most of us are inclined to regard this sort of gloomy soothsaying as being long on superstition and short on statistical validity. We submit that trouble comes, not in "threes" but in "ones", and in support thereof offer, not tea leaf reading data nor astrological surveys — merely the record. Test it yourself.

Nearly all of our troubles in aviation stem from "ones"; one missed check-off list item; one missing cotter pin; one unattached lock-wire; one inadequate inspection; one short-cut; one violation of standard procedure; one error directly traceable to lack of training and indoctrination . . . the list is long, but the facts impersonally pinpoint almost every accident/incident to have its basic cause in one act of commission or omission — usually initiated by one person.

Nope, clairvoyance has nothing to do with the problem, or the solution; the significance of second-sight is zilch. We offer a more positive means of predicting improved flight operations. Namely: for second sight substitute a second look — at the ways you and your people do things. Rather than resign yourself to the inevitability of trouble, assign yourself to the elemination of that one error, by one person, and prevent trouble. Therein remains one major source of safer, more effective flight operations. Are you one for it?

(Extract from the U.S. Naval Aviation Safety Review, "Approach", August, 1963.)

Co-incidental Defects cause Emergency Landing

Recently an F.27 made an emergency landing at a country airfield following the occurrence of mechanical defects in both power plants. Apart from showing that such an improbable event can occur, a description of the manner in which the crew dealt with the incident will no doubt be of interest to pilots.

The aircraft was engaged on a direct flight from Tamworth to Melbourne and set course from Tamworth at approximately 0945 hours E.S.T. The weather conditions were fine and clear, except for some patches of valley fog in the mountainous area over which the flight was proceeding. When the aircraft was fifteen miles north of Mudgee, cruising at 15,000 feet, the crew noticed momentary illumination of the port accessory gear box oil pressure warning light. One or two minutes later the warning light flickered ON again, so an immediate decision was made to divert to Sydney. Whilst advice of the change of flight plan was being passed to Sydney the oil pressure warning light was again illuminated and the port engine was immediately feathered. The flight was cleared to proceed to Sydney via Katoomba at 13,000 feet.

On receipt of advice of the impaired operating efficiency of the aircraft, Sydney instituted the "Alert" phase of Search and Rescue procedures, thus alerting the services and facilities necessary to provide assistance in the event of any further deterioration in operating efficiency.

Some twelve minutes later a loud thump was heard throughout the aircraft and the several failure warning lights associated with the accessories driven from the starboard engine accessory gearbox illuminated. Recognising a complete failure of the gear box drive shaft, the crew immediately restarted the port engine and feathered the starboard. Sydney were again advised of the circumstances and that an emergency landing would be made at Mudgee, an unattended country aerodrome, some 20 miles to the north of the aircraft's position.

On receipt of this latter advice the already alerted Search and Rescue organisation took steps to assist the aircraft. Arrangements were made for police, the local civil fire services and an ambulance to be in attendance at Mudgee aerodrome. An airline aircraft which was on the ground at Mudgee was requested to ensure that the landing area was clear and, if time permitted, to take-off for the purpose of providing an escort. This aircraft was airborne some ten minutes before the approaching F27 landed and it remained in the circuit area in VHF contact with the F27.

After the port engine of the F.27 was restarted the port gear box oil pressure warning light remained ON steadily until the engine speed was increased to approximately 14,000 r.p.m., after which the light went off but came on again at intervals of about 30 seconds. The frequency of illuminations gradually increased and became continuous about the time the aircraft arrived over Mudgee. During the flight to the Mudgee circuit area 14,500 r.p.m., with a J.P.T. of approximately 520°C, was maintained on the port engine and the aircraft entered the circuit area at about 12,000 feet at which time it was depressurised.

Whilst on the return flight to Mudgee the pilots planned the approach and decided upon the actions that would be taken in the event of failure of the port engine at various stages up to and during the landing. The crew were at the time wearing shoulder harness and other persons aboard were instructed to assume emergency landing positions. The descent was made in the circuit, with the landing gear lowered at 3,000 feet above aerodrome level and 16½ degrees of flap being selected on base leg. Final approach was commenced from 2,000 feet and was planned as a no-power approach to guard against the possibility of undershooting if the port engine failed completely. The airspeed was maintained at between 105 and 110 knots and full flap was selected at about 1000 feet when a no-power landing on the aerodrome was assured.

Despite the continuous warning from the accessory gearbox oil pressure warning light throughout the approach, the port engine continued to operate satisfactorily and a normal asymmetric landing was completed some 20 minutes after the port engine had been restarted. The police, fire and ambulance services were standing by on the aerodrome when the aircraft landed.

Only a little over a pint of oil remained in the port gear box when the aircraft was inspected at Mudgee. A small circumferential crack had developed at the base of one of the flared ends on the tungum oil pressure pipe between the gear box and the pressure warning switch, through which almost all of the gear box oil had been lost. Laboratory examination established that the crack was caused by metal fatigue, which in turn was probably due to vibrational stresses. It was also confirmed that the starboard accessory gearbox drive shaft had failed first at the rear universal joint, after which the shaft broke at the designed shear point immediately aft of the forward universal. It is of interest to note that in this case no secondary damage was done to the engine combustion cans, as has occurred in other cases where there has been failure of a gearbox drive shaft universal joint. If the combustion cans are punctured the risk of an engine fire is considerably increased.

Laboratory examination of the rear universal joint established that the drive shaft failure was due to seizure of the two roller bearing assemblies in the aft yoke of the universal joint. This was followed by complete disintegration of the bearing rollers, cages and cups, which in turn allowed the spider arms to separate from the yoke assembly. Unfortunately, the extent of the secondary damage suffered by the bearings and associated parts was such that it was not possible to determine the reason for seizure of the bearings.

In cases where independent mechanical defects affect both powerplants in a twin engined aircraft, the margin between "incident" and "accident" is small. Under less favourable circumstances, this "emergency" landing could have developed into a "forced" landing, perhaps on unsuitable terrain where substantial damage, with its attendant risk of injury or loss of life, would have been inevitable. Had such an accident occurred, it would have been one more illustration of the fact that most accidents are the result of an unusual coincidence of unexpected or unfavourable events. In addition to the occurrence of two defects which were unrelated except that they both affected the accessory gear boxes, there were several other events, each of no great individual significance but which, nevertheless, were part of the overall chain of circumstances.

Fatigue cracking of the oil pressure warning switch pipe line was a known type of failure in service and a more robust pipe line was currently being fitted on all F27s. It had previously been planned that this modification would be incorporated on the particular aircraft at the next major maintenance inspection, which was scheduled to be carried out concurrently with several "blocks" of a progressive overhaul. Because the aircraft could not be fitted into the maintenance workshop at the time previously programmed, the major maintenance service was not carried out as planned, but was deferred, under approval, until the aircraft returned from the flight upon which it was engaged at the time of the incident. A routine inspection and a lubrication service were performed prior to this flight but the oil pressure pipe was not changed as was originally planned.

The starboard accessory gearbox drive shaft had completed 981 hours of its approved 1,000 hours "overhaul life" at the time that it failed. Had the major maintenance service and progressive overhaul "blocks" been performed as planned, the drive shaft too would have been removed from this aircraft prior to the flight on which the double failure occurred.

At completion of flying on the day before the emergency landing, a maintenance engineer travelling on the aircraft noticed a slight "weep" of oil on the gear box case in the vicinity of the dipstick, which on a port gear box is adjacent to the oil pressure pipe fitting. He also found that about one-third of a pint of oil was needed to bring the lubricant to the required level. Although the loss of this small quantity of oil was not abnormal, having regard to the time flown during the day, the engineer inspected the gear box installation in an attempt to locate the source of the oil "weep". In the absence of an obvious cause and unaware that previous fatigue failures had been experienced with the oil pressure pipe, he concluded, not unreasonably, that the small amount of oil discernable on the gear box case was escaping past the dipstick seal. Had he had prior knowledge of the earlier pipe line failures, the pipe would certainly have been removed for closer inspection at this time and the crack would have been detected, thus obviating the subsequent need to feather the port engine.

None of these unrelated events contributed directly to the defects which subsequently occurred. The decision to defer preventive action in one case and rectification in the other were reasonable under the circumstances existing at the time they were made. The fact that they ultimately culminated in an emergency landing is, however, a clear indication that such decisions should not be lightly taken. It is obvious also that safety can be served by ensuring that field servicing engineers are made aware of known defects.

In providing an illustration of the statistically improbable double engine shut-down this incident will have been useful if it shakes complacency where complacency exists. When an engine is feathered in a twin-engined aircraft the probability of a power loss in the remaining engine is by no means reduced. In some ways the chances of a second failure are increased because of the greater demand imposed on the remaining good engine. When it is necessary to shut one engine down, pilots should firmly resist any temptation to proceed to a distant destination when there is available a closer operationally suitable aerodrome.

The incident demonstrates that the Search and Rescue organisation is capable of rendering significant assistance to a partially disabled aircraft even if the emergency occurs in an area remote from the operational control centre. The incident also provides an example of competence by the aircraft crew and the ground organisation, each in their own field of responsibility and in co-operation with each other.

FROST

Frost does not change the basic aerodynamic shape of the wing but the roughness of its surface spoils the smooth flow of air thus causing a slowing of the airflow. This slowing of air causes early air flow separation over the affected airfoil, resulting in a loss of lift and early wing stall.

REMEMBER

A heavy coat of hard frost will cause a 5 per cent to 10 per cent increase in stall speed.

An airplane with frost may not become airborne at the normal take-off speed because of premature stalling.

It is also possible, once airborne, that the aircraft could have insufficient margin of airspeed above stall that moderate gusts or turning flight could produce incipient or complete stalling.

REMOVE ALL FROST FROM WINGS BEFORE TAKE-OFF

(Civil Aeronautics Board Safety Alert)

SUCCESS STORY

(Extract from "Approach" the U.S. Naval Aviation Safety Review)

There is no substitute for training and a dramatic example of payoff of survival training took place recently aboard a carrier in the Mediterranean. An RF-8A (F8U-IP) was taxied forward off the catapult with the nosewheel and starboard main wheel on the slippery cat track. The ship's tight starboard turn produced a marked heel to port. A third possible factor aggravating the situation was the 100% turn up of at least one other aircraft with jet blast directed toward the plane in question.

The Crusader began to slide laterally across the angle deck toward the port side. As the port main wheel contacted the No. 4 cat track the nose swung more rapidly to port and the plane continued skidding over the side, nose first at a 70-degree angle to the deck. As the aircraft left the deck edge, the pilot ejected, well outside the escape system's envelope.

The plane was in an approximately 50-degree nose-down attitude at the time of the pilot's actual exit from the cockpit. His trajectory described an arc outboard, away from the ship, and rose to an estimated height of 15 to 20 feet above flight deck level. Witnesses state the controller and stabilizer drogue chutes deployed before the pilot entered the water and that the personnel chute was beginning to stream as he entered the water face first, apparently separating from the seat.

After entering the water, the pilot reached for the emergency seat release handle but found that he was free of the seat. He inflated his Mk-3C flotation equipment and swam to the surface. After reaching the surface, he released his rocket jet fittings easily. A helicopter lowered the rescue seat within his reach, he straddled it, was hoisted aboard and was returned to the carrier.

What makes this story so unique? Two things. . .

One: Over and above the routine training procedures carried out in all squadrons, this pilot along with several squadron mates took part in a personal project to practice operating parachute canopy release rocket jet fittings. These pilots, as they later reported to Headmouse in the September 1962 *Approach,* practised releasing the fittings while hanging normally in the harness, while in abnormal and unusual positions, and finally with one riser free and all tension exerted on the remaining riser. More important, in light of subsequent events, our pilot practised operating the rocket jet fittings with his gloves on, with his gloves off, and while wearing gloves that were wet and very slick. In the accident, wearing gloves, he experienced absolutely no difficulty in releasing his parachute canopy. He gives a large measure of credit to his previous practice sessions.

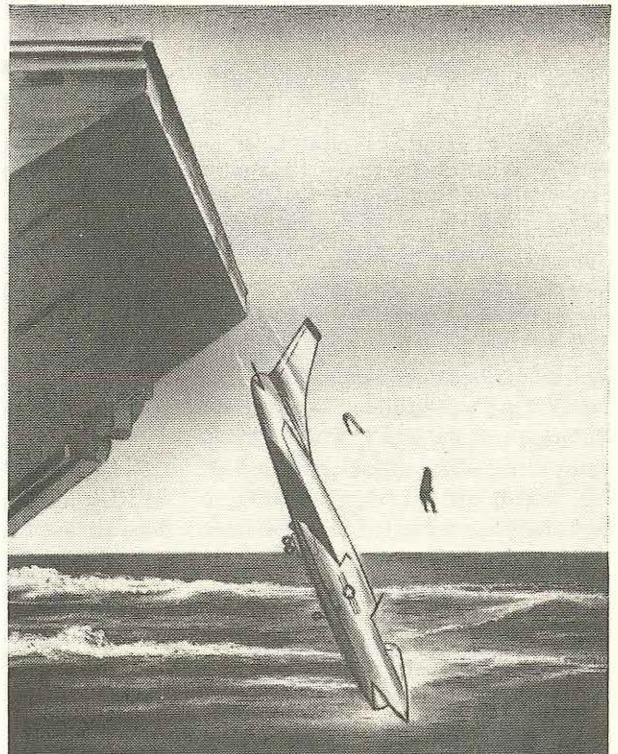
Two: And this is the thing that makes this case even more remarkable: During the survival episode the pilot was stunned and almost blind. As he hit the water face first, his helmet visor shattered and inflicted severe eye injuries. Nevertheless, his survival training and his ability to quickly execute well-planned survival and escape procedure under the most adverse conditions, coupled with what was described as extraordinary performances by the rescue helicopter pilot and crewmen, resulted in his spending a total of only 52 seconds in the water following the accident. He was returned to a flying status at the end of 10 days.

This is a story for each of us to think seriously about, asking ourselves "WOULD I HAVE DONE AS WELL?"

COMMENT

Why did we include this article which appears to be completely unrelated to circumstances which could be reasonably anticipated in civil flying?

We did so because we believe that the principles of preparedness and intimate knowledge of your aircraft and equipment, which are so well illustrated by this article, are valid for all classes of flying.



Faulty Fuel Management causes DC4 Crash

DUBLIN, IRELAND

(Summary of a report published by the U.K. Ministry of Aviation)

(All times are G.M.T.)

Late in 1961 a Douglas C54-A Skymaster (DC4) made an emergency wheels-up landing in a field near Dublin Airport, Ireland, following failure of Nos. 1 and 2 engines and partial loss of power from one or both of the starboard engines. None of the 73 persons on board received serious injury, although a number were subsequently treated for minor injuries and shock. The investigating authorities concluded that incorrect management of the fuel system was the probable cause of the accident.

The aircraft was fitted with a four-tank fuel system, the total capacity of which was 1878 U.S. gallons. The two inner tanks each had a capacity of 508 U.S. gallons and the two outer tanks 431 U.S. gallons each. The system incorporated four cross-feed valves, which allowed fuel to be cross-fed between the tanks on the same side when one pair of valves were opened, or from any one tank to the four engines if all valves were open.

The aircraft was engaged on a charter operation which involved a ferry flight from Liverpool, England to Lourdes, France, where it picked up 69 passengers bound for Dublin. The flight to Lourdes took four hours five minutes and was completed without incident. The captain assumed a round figure of 250 U.S. gallons per engine as the fuel consumption for the flight and asked the refuelling agents at Lourdes to put 100 U.S. gallons in each tank. The total quantity of fuel on board at departure from Lourdes was recorded as 1250 U.S. gallons and was distributed as follows:

No. 1 tank, 230; No. 2, 370; No. 3, 330 and No. 4, 320 U.S. gallons. These figures were based on dips carried out by the refuelling agency and corresponded approximately with gauge readings, taken during the "pre-starting check", which registered a total of 1280 U.S. gallons. Both pilots noticed that No. 1 tank contained considerably less than the others but did not consider that this warranted steps being taken to redistribute the fuel. The planned flight time to Dublin was 3 hours 40 minutes. The total quantity of fuel was sufficient for the planned flight to destination or to the diversion airport, and allowed reasonable reserves, assuming normal operation. There was no apparent consideration given to the possibility of No. 1 tank becoming exhausted before completion of the flight.

The aircraft departed Lourdes at 1710 hours and arrived over Dublin at approximately 2100 hours. Operation was normal throughout the flight at cruise altitudes of 6,000 and 6,500 feet with each engine drawing fuel from its own tank.

No cross-feeding was carried out. The aircraft was cleared to make a night visual approach which commenced at 2103 hours. The prelanding check, which included checking the fuel quantities, selector position, crossfeed OFF and boost pumps ON, was completed. The co-pilot checked the fuel quantities and believed that No. 1 tank gauge registered 80 U.S. gallons. The captain noted that all tanks totalled about 400 U.S. gallons and he too thought that No. 1 gauge registered 80 gallons.

As the aircraft turned onto final approach loss of power occurred on the port side and the captain noticed that No. 1 engine manifold pressure and fuel pressure dropping. He opened Nos. 1 and 2 cross-feed valves, assuming that fuel starvation during the turn had affected No. 1 engine. As the turn was completed, and about five to six seconds after Nos. 1 and 2 crossfeed valves were opened, No. 2 engine lost power, causing the aircraft to swing sharply to port. The captain called for Nos. 3 and 4 cross-feed valves to be opened, but as this did not restore power on the port side, power on the starboard engines was increased to the take-off rating. In this condition, with both port propellers windmilling, control of the aircraft became critically difficult even with the co-pilot assisting. Despite the application of full right rudder, the nose of the aircraft continued to swing to port. At some short but undetermined time after the opening of Nos. 3 and 4 cross-feed valves, the already serious situation was further complicated by symptoms of power failure in the starboard engines.

At the time No. 2 engine failed the aircraft was about 300 feet above aerodrome level. The circumstances were such that maintenance of even partial control involved a high rate of descent and a forced landing became inevitable. The visibility was sufficient for the co-pilot to see a clear stretch of field ahead and to the left of a lighted group of hangars and airport buildings. He pointed this out to the captain, who allowed the aircraft to swing further left, narrowly clearing several buildings, until it was lined up with a field where a wheels-up landing was successfully completed. The aircraft slid to a stop astride a main road. There was no fire and the passengers were evacuated without panic.

The evidence available at an early stage in the investigation indicated that fuel management would be a vital factor in the final assessment. Particular attention was therefore given to the examination of the fuel system. It was established that No. 1 tank was empty at the time of the accident and that the other three tanks held a combined total of 422 U.S. gallons. Comprehensive tests confirmed that there were no defects in the fuel system and that the fuel was free from contamination. No. 1 tank gauge was found to be reading low, the gauge showing 10 U.S. gallons when 60 U.S. gallons were placed in the tank.

The fuel content of 230 U.S. gallons in No. 1 tank at the commencement of the flight was such that there was barely sufficient fuel in the tank for the planned flight time of 3 hours 40 minutes without "balancing" of tanks in flight by cross-feeding, which was not done. The actual flight exceeded the flight plan time by 15 minutes, consequently the emptying of No. 1 tank at about the time of the first engine failure was a foreseeable occurrence, without intervention from such factors as inaccuracy in tank dipping or high fuel consumption by No. 1 engine.

In analysing the events which culminated in this accident, the investigating authorities pointed out three significant shortcomings in fuel management which were major contributing factors.

The dip reading for No. 1 tank should have aroused suspicion as being a "wrong figure" due to either incorrect use of the dipstick, an engine or fuel system defect, or to the tank not having been refuelled.

The need to "balance" the fuel system would have been obvious if proper in-flight checks of fuel contents and consumption had been made by the crew. Even a pre-flight application of known engine fuel consumption rates against dip figures and gauge readings should have alerted the crew to the possibility of No. 1 tank becoming exhausted before the end of the flight.

The emergency action taken in an attempt to restore fuel supply to No. 1 engine when it failed was incorrect. The position of the booster pumps in the physical layout of the fuel system is such that if cross-feeding has to be resorted to as an emergency measure consequent upon lack of fuel in any tank, it is essential to close the tank selector of the exhausted tank as soon as possible, and preferably before opening the cross-feed valve concerned. If this is not done air will be drawn into the fuel system from the empty tank by the combined suction from the engine driven pump and booster pump. If the cross-feed valves are open, not only will the in-drawn air prevent restoration of fuel supply to the failed engine but it can also induce fuel starvation, through aeration, in any engine to which the open cross-feed valves allow access. It was concluded that failure to close the No. 1 tank selector valve when the cross-feed valve was opened was the immediate cause of the multiple power failure which led to the accident.

The crew were unaware of the vital necessity of isolating a suspect tank when cross-feeding in emergency. This was largely because their previous experience of DC4 type aircraft had been confined to models other than the four-tank C54A. On the other models the different physical layout of the system, especially in regard to boost pump position, is such that cross-feeding is possible without closing individual tank selector valves.

The captain did not think of No. 1 tank being exhausted of fuel and did not feather No. 1 propeller because he believed that momentary fuel starvation had resulted during the turn onto final approach. He was also confident that opening No. Nos. 1 and 2 cross-feed valves would assist in recovery by allowing No. 1 engine to draw fuel from No. 2 tank. Had he feathered the propeller, there is little doubt that a successful landing could have been completed without difficulty. His decision not to feather was based on an expectation that the engine would pick up again almost immediately and this expectation would have been fulfilled if the fuel controls had been correctly used. Under these circumstances the investigating authorities observed that it would be improper to consider his decision not to feather as an error of judgment, but noted that his choice of emergency action, incorrectly carried out, led to such a critical deterioration in the situation that he had neither time nor opportunity to reconsider the decision.

COMMENT

It should have been obvious, very early in the sequence of events, that the quantity of fuel in No. I tank did not allow a safe margin for the landing phase. By neglecting to calculate the endurance available from each tank, and manage the fuel system accordingly, the crew ignored one of the basic requirements of safe operation. Correct management of a fuel system requires that during the approach and landing each engine is drawing fuel from a tank which contains an adequate supply and the situation should never arise where a pilot is faced with the problem of deciding whether loss of power during approach is the result of the relevant tank becoming exhausted.

In the C54A fuel system the boost pumps are installed in the wing leading edge and are on the engine pump side of the respective selector valves. In later models of the DC4 the boost pumps are adjacent to the respective fuel tanks thus being "upstream" of the selector and cross-feed valves. Although this different physical location of the boost pumps in the later models renders the system less vulnerable to multiple power failure from indrawn air when cross-feeding without closing off individual selector valves, such a practice is not recommended. In fact, a placard fixed to the control pedestal in DC4 aircraft states: "When using cross-feed, tank selector OFF for tanks not in use." Another placard displayed in the cockpit repeats a cautionary note contained in the Douglas DC-4 Operation Manual, which, in part, reads: "To avoid possibility of air entering entire system, tank selectors and cross-feed valves must be OFF except when flow is expected through them." This is a basic principle of fuel system management that applies to all aircraft with selectable sources of fuel supply.

SAFETY HARNESS INERTIA LOCKS

Aircraft adapted for agricultural work have cockpit layouts which are not designed with shoulder harness in mind, so that there are almost always some necessary controls that cannot be reached with the pilot wearing a properly adjusted shoulder harness. Remarkable to say, even some special purpose agricultural aircraft have controls located outside the reach distance of a pilot wearing shoulder harness.

One approach to this problem has yielded spring-loaded mechanical reel devices which can be locked or unlocked by the pilot. The function of these locks is to hold the occupant securely in the seat, in the event of a crash, by restraining the shoulder straps of the safety harness. When the devices are unlocked, a cable attached to the junction of the shoulder straps can be pulled out a distance of up to some eighteen inches when the wearer leans forward. When he sits back the reel retracts the cable through the action of a spring.

Even with a snugly fastened harness a surprising amount of forward head movement can take place under crash loads, as a result of neck flexion, taking up of slack in straps, compression of clothing and soft body tissues and stretch of the webbing itself. Thus it is most undesirable to have to fly with a slack shoulder harness.

Unfortunately, most accidents occur with little or no warning, so that the pilot who happens to have the harness release unlocked at the critical moment is left without any upper body restraint if a crash occurs.

FIG. 1. TYPICAL PILOTS INERTA REEL-SHOULDER HARNESS INSTALLATION.

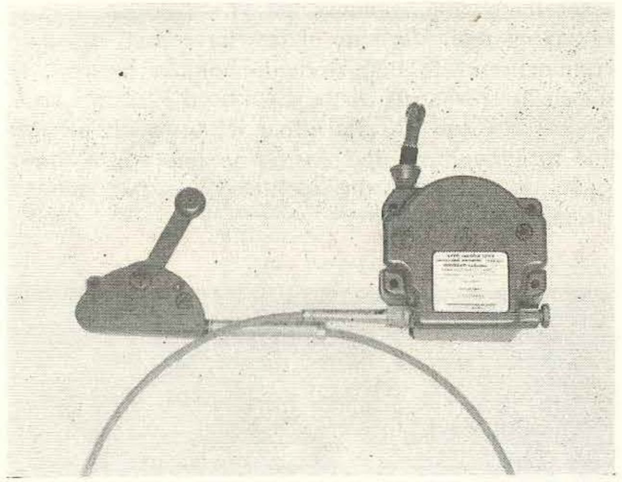


FIG. 2 MA-1 UNI-DIRECTIONAL INERTIA REEL

To provide automatic protection at all times, reels have been developed—originally for military aircraft—which have *automatic inertia-locking mechanisms.* These fall into two broad classes, those which operate on *rate of pay out* and those which operate when a *deceleration is applied to the drum mechanism* itself.

Some reels in the second category are "uni-directional", i.e., automatic locking occurs only under longitudinal g forces. Other designs are "multi-directional" and lock automatically under all probable directions of loading which might be experienced in a crash. Fig. 1 shows a typical inertia reel installation for an agricultural aircraft. Fig. 2 is a photograph of a typical uni-directional deceleration reel showing the manual control which has two positions, MANUAL LOCK and AUTO-LOCK. In MANUAL LOCK the reel will not pay out but will take up slack. In AUTO-LOCK the reel will pay out and take up slack under normal pilot movements but will lock automatically when a longitudinal deceleration of 2 to 3 g is applied to it.

A widely accepted design standard for inertia reels in U.S. Specification MIL-R-8236 (B) which specifies six designs, MA-1 to MA-6. These include reels of both deceleration and rate-of-payout type, both types catering for various installational configurations.

For example, Figs. 1 and 2 show the MA-2 and MA-1 designs, in that order. These uni-directional deceleration reels are intended for installation with their drums in a vertical and horizontal plane respectively. Fig. 3 shows the MA-6 design, a rate-of-payout reel. Variants of this have been fitted, in conjunction with high-strength-shoulder harness, to the flight crew seats of the Lockheed Electra L-188, Boeing 707 and 727 and other jet transport aircraft and to agricultural and Army Cessnas. Fig 4 shows such an assembly, the reel in this case being a British-made Teleflex.

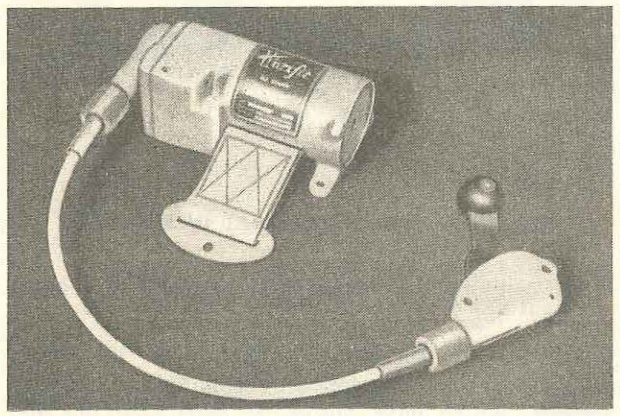


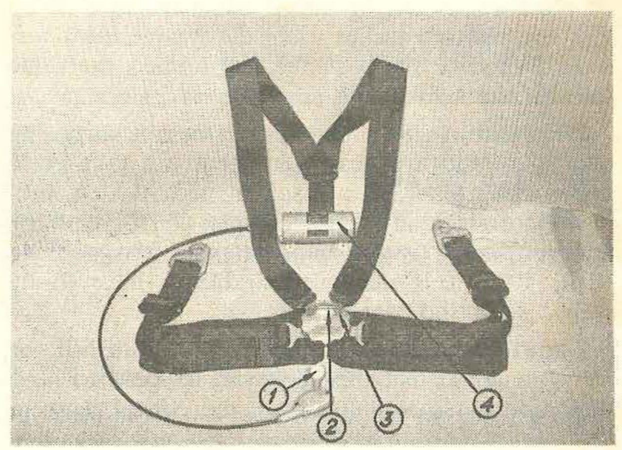
FIG. 3 MA-6 SPOOL TYPE INERTIA REEL

Following current British practice, the Department of Civil Aviation has been considering making the fitment of shoulder harnesses to all flight crew seats in transport aircraft a mandatory requirement. In some aircraft such harness installations would require inertia reels because controls are located outside normal reach boundaries for a crew member wearing an ordinary harness. At the time of preparation of this article a draft requirement on this subject is being circulated within the industry and several operators have already commenced evaluation of harness installations incorporating inertia reels.

It will be noted also that Air Navigation Orders Part 100.20 already makes provision for the installation of shoulder harnesses in agricultural aircraft together with the fitment of inertia reels whenever the latter are necessary to allow all controls to be reached with the harness fastened snugly.

The Department has noted expressions of concern by some pilots and owners of aircraft over the reliability of inertia reels. This concern can be dispelled in the light of the current experience of the U.S.A.F., R.A.F. and other large scale users of such equipment, which has now had some 18 years of development by the military services. The use of inertia reels in tens of thousands has shown that, provided proper attention is paid to maintenance, they provide an extremely high level of reliability. The majority of current service aircraft types use inertia reels as part of the flight crew safety restraint system.

Engineering and medical evaluation of shoulder harness—inertia reel combinations recently undertaken at the Royal Aircraft Establishment, Farnborough, amply demonstrated the ruggedness of current assemblies. Dummies and live subjects on pendulum test rigs and high-speed rocket sledges were subjected to over-all decelerations up to 25g, the highest peak deceleration recorded in a harness being 42g. Although in this particular test the maximum stretch of the harness webbing under load was 7 inches, no webbing or mechanical failure occurred, and the reel mechanism remained fully serviceable.



1 OPERATOR UNIT
2 SHOULDER STRAP RELEASE PAWL
3 RELEASE BUCKLE
4 INERTIA REEL

FIG. 4 HIGH STRENGTH SHOULDER HARNESS AND INERTIA REEL

In conclusion, a word about pre-flight checking of inertia reels. In rate-of-payout reels (for example, the Pacific Scientific Co's reel installed in some agricultural Cessnas) with "auto-lock" selected, a sharp tug on the payout cable or shoulder strap should cause locking. In deceleration reels (for example, the American Seating Co's reel fitted to some "Pawnees"), a tug as above will *not* produce locking as the actuating g must be applied to the reel itself. If, with "auto-lock" selected, the reel body is given a sharp slap in a rearward direction, locking should occur. The location of reels is often such, however, that pre-flight checking in this way is not possible.