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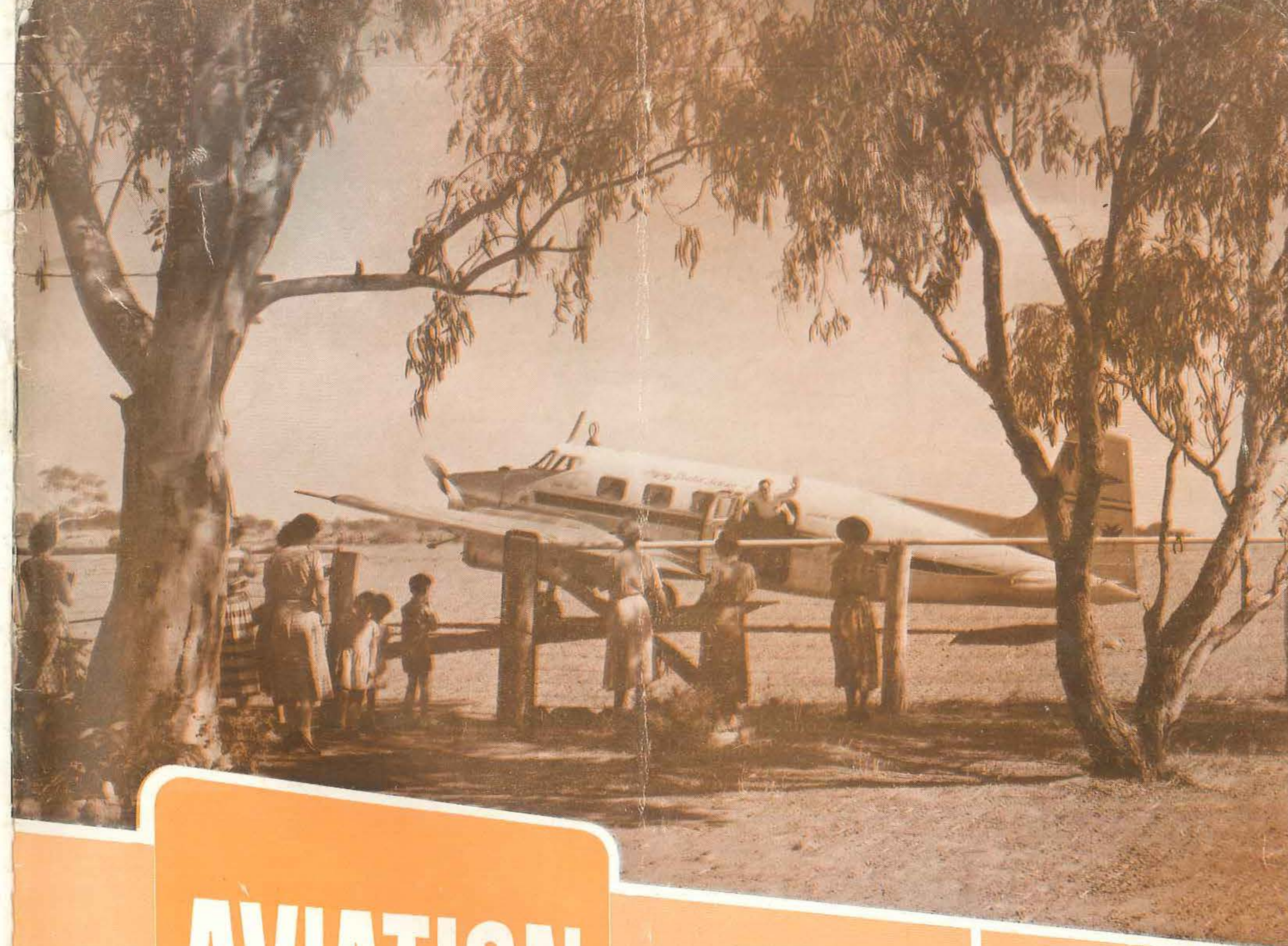


AVIATION SAFETY DIGEST

No. 27, SEPT., 1961

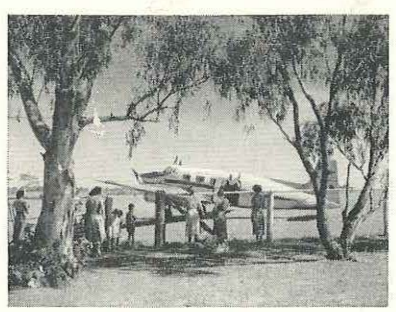
DEPARTMENT OF CIVIL AVIATION

AVIATION SAFETY DIGEST

No. 27 SEPTEMBER, 1961

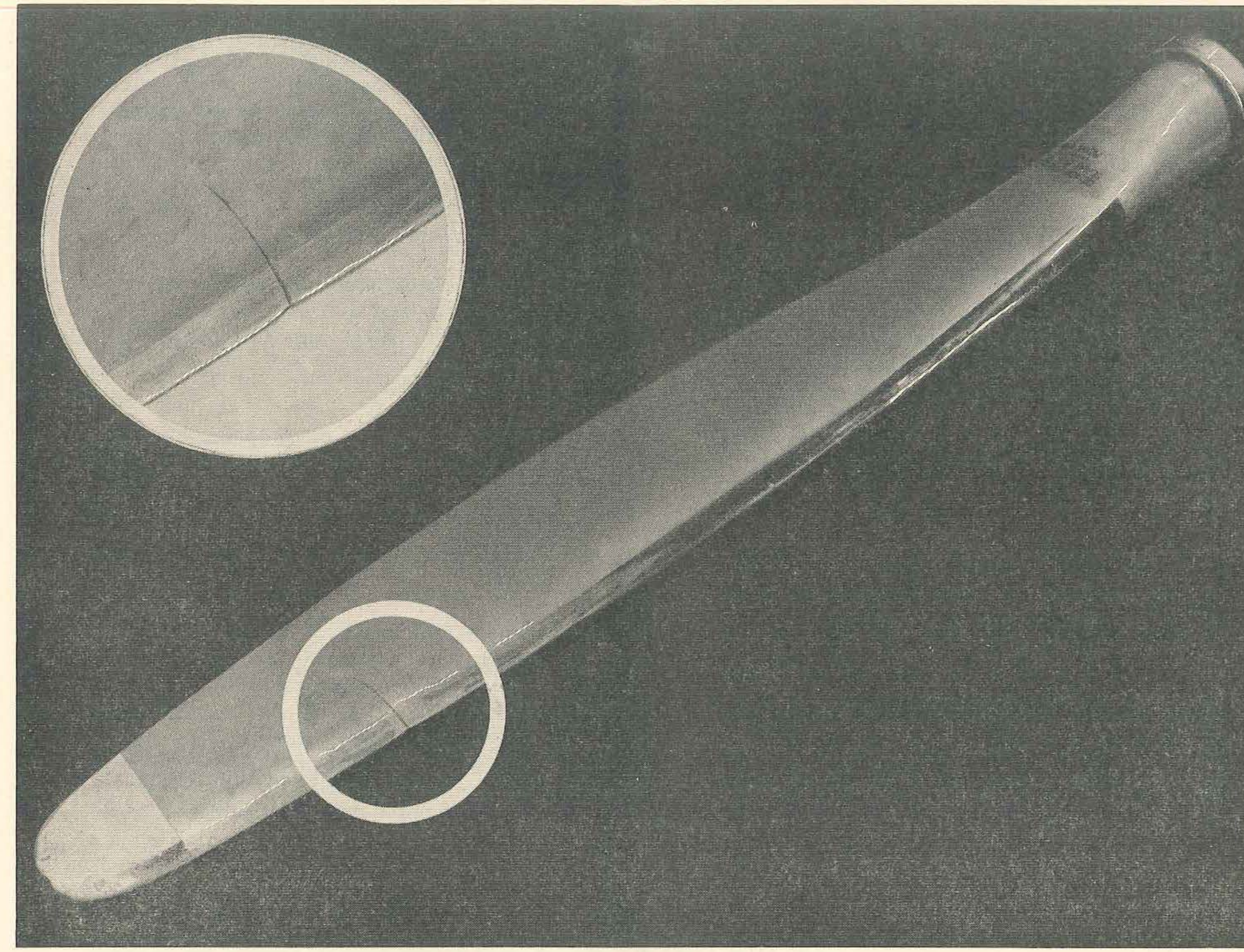
Prepared in the Division of Air Safety Investigation
Department of Civil Aviation.

Contents



Flying Doctor arriving at Mayfield Station near Windorah, Queensland, in a Trans Australia Airlines Drover.

Commonwealth of Australia.



BLADE FAILURES -- METAL PROPELLERS

There have been cases in Australia of fatigue failure of metal propeller blades which result from causes identical to those described in the following United States Federal Aviation Bureau of Flight Standards Release No. 440 of December 23rd, 1961. This article is repeated for the information of all concerned :—

"Although the design of modern metal propeller blades provides for a high margin of safety against failure, nevertheless failures frequently occur. The increasing number of reported failures, which are not peculiar to any one airframe/engine/propeller combination, are of great concern to us. We believe this hazard to safety can be greatly reduced by an added emphasis being placed on propeller maintenance.

The National Bureau of Standards has conducted an investigation of a representative number of propeller blades of small aircraft. Their examinations and tests showed the failures occurred because of fatigue cracks which started at mechanically formed dents. Blade material samples that they analysed did not reveal any evidence that failure was caused by material defects or surface discontinuities existing before the blades were placed in service.

This points up the necessity for prompt and correct maintenance of metal propeller blades. The propeller blades should be given a thorough visual inspection before each flight. Any dent, nick or stone bruise, regardless of how small, should be considered a potential stress raiser at which a fatigue failure may start.

Often fatigue failure occurs at a place where previous damage has been repaired. This may be due to the failure actually having started prior to the repair having been made or the repair may have been improperly performed. Failure may also occur due to the metal being overstressed by too many blade straightening or blade repitching operations being performed. Civil Aeronautics Manual 18 and the blade manufacturers have established how much a blade may be deformed and still be straightened. Any repairs beyond these limits may lead to propeller failure.

Service experience indicates fatigue failures usually occur within a few inches of the blade tip. However, failures are also occurring in the blade near the blade shank and at the propeller hub well out of the usually critical areas. Therefore, no damage should be overlooked or allowed to go without correction.

A deviation from the normal failure pattern sometimes occurs in that an apparently serviceable propeller blade may fail while an identical installation that may have had proper propeller maintenance may operate satisfactorily with no apparent failure. The reasons for these occurrences are not entirely clear to us.

The propeller manufacturers specify methods and limits for propeller repair in their service manuals and service bulletins. CAM 18 also contains information on propeller repair. These repairs must be properly accomplished by qualified personnel.

We have been handicapped in our evaluation of most propeller blade failures by lack of information of the circumstances involved. To aid us in developing more effective maintenance, operation, and/or design techniques to eliminate metal propeller blade failure on general aircraft, we need the full co-operation of the aircraft owners, operators, pilots, and maintenance personnel who have knowledge of these happenings. Prompt reporting of all propeller blade failures is very important. Information that has usually been very sketchy and would be of great value to us in these investigations includes:—

1. A brief maintenance and operation history of the airframe and engine, including any incident of sudden engine stoppage due to the propeller contacting the ground or other objects;

2. Complete history of propeller, including any previous damage, all repairs and alterations, operating time in service since any repairs or alterations have been performed, total operating time, and whether or not the propeller has been used on other aircraft;

3. Information relative to any instance of rough engine operation at any time during the life of the installation;

4. On engines which incorporate dynamic dampeners on the crankshaft, the wear that has accumulated in the dampener and attaching parts may be significant.

Fortunately, in most cases of propeller failure, a safe landing is accomplished with little or no other damage. The Federal Aviation Agency Engineering and Manufacturing Division has indicated that in many of these cases the propeller manufacturer would like to install a new propeller on the aircraft on which a blade has failed, and conduct tests before any other repair or adjustment is accomplished. Your co-operation with the manufacturers in this respect will prove to be beneficial to all.

We solicit the co-operation of the aviation industry in the investigation of propeller fatigue failures."

Words To Rest On

(With acknowledgement to Leonard M. Greene, president of Safe Flight Instrument Corporation.)

"The measure of a successful aircraft trip is not its safe completion but whether it would have had a safe completion if an emergency had occurred."

Manoeuvres at Excessive Speed

Structural Damage to CESSNA 150

(Summary based on report from Department of Transport, Canada)

The following is a report of two similar accidents involving Cessna 150 aircraft, both resulting from excessive speeds when the aircraft were in unusual attitudes.

On 21st April, 1960, a Cessna 150 with the pilot and one passenger departed from Cartierville Airport, Montreal, for a pleasure flight.

The flight was routine until, in the vicinity of Piedmont, the pilot decided to return to Montreal. While executing a steep turn to the right he felt a light blow followed by severe vibration and the projection of the aircraft into a steep dive. The pilot was able to regain control and made a successful emergency landing on a highway.

On 11th June, 1960, a Cessna 150 departed on a solo training flight from Cartierville Airport, Montreal, for the purpose of practising steep turns and other manoeuvres.

The first manoeuvres of interest occurred when the pilot made three steep turns to the left. During the second of these turns, a sharp crack was heard in the rear of the aircraft when power was applied to prevent loss of altitude. The pilot proceeded to make a third turn and then executed a three turn spin to the left. The spin seemed normal, but during recovery there was a loud noise and the controls started to vibrate. The pilot regained control with some difficulty, and by maintaining a speed of 50 m.p.h. he was able to make a successful emergency landing in a field.

INVESTIGATION

In the former accident the aircraft had flown 372.10 hours since new and 30.15 hours since the last periodic inspections. Preliminary examination showed that the only damage was to the tail section. The vertical stabilizer and rudder were found to be buckled and bent about 28 inches from the top and the NARCO antenna was thrown completely out of the vertical stabilizer tip fairing. The aft fuselage was buckled and some rivets were sheared between stations 135 and 175.

The latter aircraft had flown 799.35 hours since new and the last periodic check was during a C. of A. renewal 16 days prior to the accident. Similarly the only damage evident was to the tail section. The vertical stabilizer was buckled to the right; the rudder was slightly damaged; the left horizontal stabilizer, elevator and elevator tab were broken downward at an angle of 40° from the horizontal; the right hand plastic antenna was pulled off and there was some buckling of the fuselage between stations 135 and 175.

In both instances the vertical stablizer tip, rudder and rudder tips were removed and subjected to tests. The tests consisted of static loading of the vertical stabilizer, and proved the point of failure to be in excess of 130% of the design maximum. The failures incurred were in a general sense similar to those sustained in flight. The areodynamic aspects of the factors producing the failures were also examined in an attempt to ascertain if the flight and static loading varied significantly, but no significant divergence was found.

The air loads experienced were assessed as being those which would result from a high speed spiral dive, the recovery from which would entail use of the rudder in a check manoeuvre and/or a high speed rolling pull-out.

The most probable explanation is that during the manoeuvres in which damage was sustained the pilot unconsciously applied control movements which resulted in the loads required to produce failure.

CAUSE

It was considered that in both accidents the structural damage was the result of the aircraft being manoeuvred at speeds in excess of the designed limiting speeds.

COMMENT

In considering this question of design limiting speeds for manoeuvres it is MOST IMPORTANT to realize that the MAXIMUM SPEED for manoeuvring is CONSIDERABLY LESS than for the straight dive. Consult your Owner's Manual for the correct figures. The article "Stretch and you" at page 9 in this issue is pertinent to this subject.

SEAL THOSE FUEL TANK CAPS!

(Summary based on report from Department of Transport, Canada.)

On 2nd December, 1960, a Cessna 180 seaplane experienced engine failure in flight and forced landed among trees at Pasadena, Newfoundland. The pilot, the sole occupant, was not injured but the aircraft was substantially damaged.

FLIGHT

At 0905 hours the aircraft departed from South Brook, Newfoundland, for Roddickton, Newfoundland, where it landed at 1015 hours. Two passengers were picked up and the aircraft took off at 1030 hours for Gander where it landed and disembarked the passengers. At 1215 hours the aircraft was airborne for the return flight of 140 miles to South Brook. As the fuel selector was on "both" tanks on the leg to Roddickton and on "right" tank on the leg to Gander, the pilot elected to re-select to the "right" tank and drain it completely on the last leg. According to the pilot, when the aircraft was about half-way to South Brook, the electric fuel gauges were indicating more than "half full" for the left tank (12 to 15 U.S. gallons) and on the "red line" for the right tank.

The destination was in sight when a power loss occurred. The pilot, assuming that the right tank was empty, selected the left tank, at which time there was a complete engine failure. A forced landing was made and the aircraft came to rest in a normal attitude among some small trees about 2½ miles from its destination.

INVESTIGATION

The speed on impact is considered to have been low since the damage was confined to the leading edge of each wing as far back as the front spar. The propeller was not damaged and was resting against some trees which indicated that it had stopped prior to impact.

An examination revealed that both fuel tank cells were completely dry, the glass sediment bowl was empty, and the fuel content gauges indicated empty with the electrical power on. Five gallons of fuel were then pumped into each tank and the system checked for leaks but none were found, the sediment bowl filled and the fuel gauges indicated similar amounts in each tank. The engine was then started without difficulty and showed no indication of malfunction, operating equally well from each tank separately , and from both tanks together. The fuel gauges were checked and both functioned properly, the lack of fuel being clearly indicated as the cause of the engine failure.

Inspection of the fuel system revealed that the locking lever of the filler cap for the left tank was broken. The result was that the cap, while locked in place, could still be raised sufficiently to provide a gap between the cap seal and the tank filler neck. Fresh fuel stains extended rearwards in straight lines from the fuel tank filler neck to the trailing edge of the wing as might occur in flight.

The usable fuel contents of the aircraft is 55 U.S. gallons which is sufficient fuel for a five-hour flight at normal cruising power. The aircraft was airborne for a total of four hours and, therefore, at the time the engine stopped one hour's fuel should have been left in the tanks.

Investigation determined that the mechanism of the sealing lever of the left fuel cap had broken a few days prior to the accident and that it was not replaced because a spare cap was not available. It appeared, however, that the pilot was not aware of this misfitting cap.

CAUSE

The aircraft was permitted to fly with a defective fuel cap as a result of inadequate maintenance.

(All times herein are Newfoundland Standard)

COMMENT

At the time the above report was received at our office we were preparing to publish the salient features of two recent local incidents dealing with the same subject. We can, therefore, assure you that such occurrences are not isolated and a carelessly installed or ill-fitting tank cap can quickly dispose of considerable quantities of fuel.

In one case a Cessna 180 took off with full tanks, the system being selected to the port tank at the completion of the climb. Eighty minutes later the engine lost power and cut out. It was then noticed that the port tank was indicating EMPTY despite the fact that about one hour's fuel should then have remained in the tank. The starboard tank was selected and power was immediately regained. The original flight plan was abandoned and the aircraft was flown to the nearest point where fuel was available. Subsequent investigation revealed that the tank cap was not properly installed, permitting fuel to be lost past the cap. A little more attention to detail at the time the tank caps were replaced would have ensured safe completion of the intended flight. In addition, periodical checking of fuel usage may have prevented the situation developing to the stage where engine power was lost.

The second incident revealed a condition potentially more hazardous, for the reasons that the fuel loss was not reflected on the gauge and there was no obvious reason why the tank cap would not effectively seal the filler neck. Soon after take-off in a Beech 95 the pilot noticed that fuel was escaping freely from the port main tank cap and landed immediately. The tanks were re-filled, a cap from another similar aircraft was fitted but again fuel escaped freely after take off. The problem was finally overcome by fitting a new cap, carefully adjusted to ensure positive sealing.

Though the gauge for this tank was found to be serviceable it did not register the loss of fuel, which in both flights worked out to be at a rate of three gallons per minute. This condition is apparently brought about by the rate of flow of fuel out through the filler neck affecting the contents indicator float to the extent that it tends to remain in approximately the "full" position.

Wear at the cam, on the heel of the die-cast cap handle, resulted in insufficient pressure being exerted on the sealing ring of the two caps which proved to be defective on this occasion. The operator has now overcome the problem by replacing the die-cast cap handles with a locally manufactured steel type and carefully adjusting each cap assembly to suit the respective tank filler necks.

Similar tank caps are in use on a number of modern light aircraft and owners, pilots and engineers are urged to ensure that not only are the caps replaced after each re-fuelling but that they will also provide positive sealing under flight conditions. **Serviceable seals and proper adjustment of tank caps are essential if this is to be achieved.**

Schedule is **Important**

Safety is **Paramount**

Incidents are still occurring which require return to the tarmac of airline aircraft either prior to or just after take-off because some item of the maintenance and servicing routine has either not been done or not checked by those responsible for doing so.

In far too many of these incidents the excuse given conforms to the very thin and much worn pattern "we had to rush the work through to get the aircraft away on time."

"On time all the time" may be a good slogan but it should never be allowed to become a fetish at the **expense of safety.** The responsibility for dispatching an aircraft to schedule is undoubtedly an onerous duty which must finally rest with some individual but the importance of it should never overshadow the importance of airworthiness and safety matters. Those responsible for seeing that an aircraft is airworthy and safe for flight carry the heaviest responsibility by far and should never, under any circumstances, allow pressures to influence their actions and decisions to the **detriment of safety.**

The excuse "time did not permit the job being done properly" would certainly not justify an error and would not constitute good defence in any action which may be taken against the licence or certificate of an offender.

Remember, to be questioned because of a delay is far better than being questioned because of an accident.

Constellation Crashes During Precautionary Landing

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

CHICAGO, ILLINOIS, U.S.A.

At 0535 hours on 24th November, 1959, a Lockheed Constellation crashed into a residential area about one-fourth of a mile south-east of Midway Airport, Chicago, killing all three crew members, demolishing the aircraft and fatally injuring eight persons on the ground.

INVESTIGATION

The aircraft was engaged on a scheduled cargo flight from Chicago to Los Angeles. The flight was scheduled to depart from Midway Airport at 0310 hours, but departure was delayed until 0530 hours because of the inability of the ground crew to complete loading of the aircraft due to a breakdown in loading equipment. Evidence indicated that at departure the aircraft was properly loaded to a gross weight of 126,606 pounds. The allowable gross weight for take-off computed for this flight was 127,400 pounds, and the allowable landing weight about 115,000 pounds.

The flight received its ATC clearance to the Los Angeles Airport and its take-off time was logged by Midway Tower as 0531, two hours and 20 minutes behind schedule. The communications between the flight and Midway Tower were tape re-recorded.

The take-off appeared normal to the tower operators and after 1 minute 13 seconds the crew advised that they were starting a left turn. Seven seconds later the crew informed the tower of a fire warning on the No. 2 engine, that the engine had been shut down and that the flight would return and land. During the next 25 seconds Midway Tower gave landing clearance to the flight for runway 31 or any runway it desired to use. The crew told the tower they would use runway 31 and eleven seconds later the flight rejected an offer from the tower to call out the emergency equipment.

Midway Tower asked the flight if it desired a localizer approach or if the crew wanted to make it VFR. To this question they answered, "I think we'll make it VFR O.K." Forty-five seconds had elapsed since their last transmission. Six seconds later, the flight acknowledged its clearance to land on runway 31L with an "O.K." Total elapsed time since take-off was then 2 minutes and 47 seconds. Forty-three seconds later the tower operator transmitted, "NO . . . NO!!" which he later explained was a spontaneous exclamation upon seeing the flight crash into houses and burst into flames. A total time of 3 minutes and 30 seconds had then elapsed since take-off.

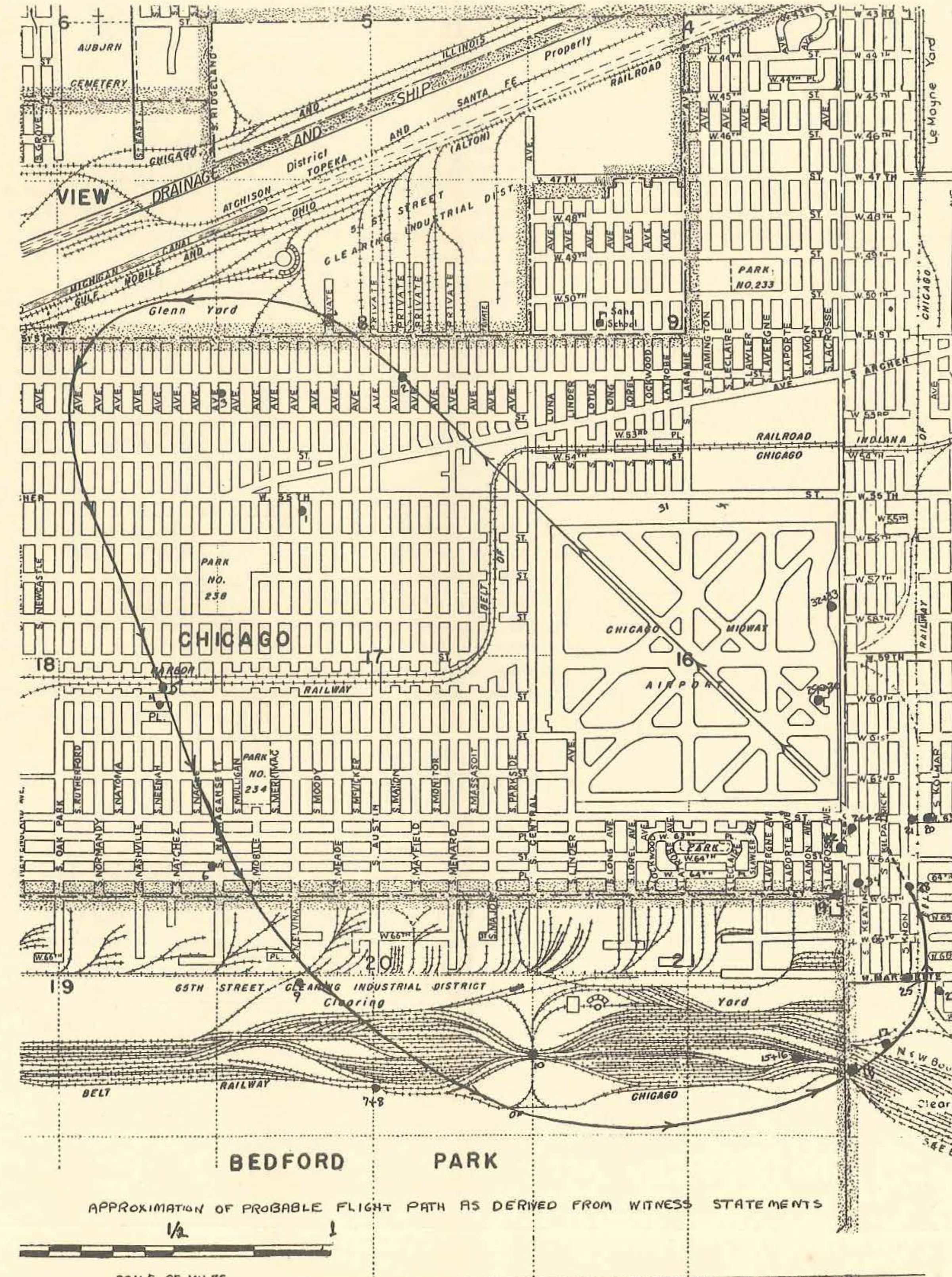
Ten minutes prior to the crash the United States Weather Bureau reported the Midway weather as follows: Partial obscuration, scattered clouds at 600 feet, measured 900 feet, overcast; visibility 3 miles with light rain, fog, and smoke.

The total distance the flight travelled over the ground from the beginning of its take-off roll to the point of impact was about eight statute miles. This flight path was elliptical in shape and at no time was the aircraft more than two miles from the airport (see sketch).

According to witnesses, including tower personnel, the aircraft banked in excess of 45 degrees during the left turn to the final approach heading. It lost altitude as the turn progressed and when it reached an altitude described as just above the tops of the trees the wings were almost level and the nose was raised slightly to a climbing attitude; however, the rate of descent continued until the aircraft struck the trees and buildings. Statements of witnesses along the flight path and within one mile of the impact area indicated that the engines sounded as if they were labouring to keep the aircraft airborne.

Investigation of the wreckage indicated that the left main and nose gear assemblies were up but unlocked and the right main gear was up and locked. The wing flaps were extended symmetrically about 13 inches or 24 per cent of their full travel, and the wing flap control valve and follow-up mechanisms were positioned for flap movement toward the "up" position. The wing flap control lever was about one-eighth of an inch aft of the full forward position and bent over 80 degrees toward the captain's seat. It was jammed in that position as a result of the impact and appeared to have been in that position prior to impact as there was no indication of the lever having been forcibly moved to or from the jammed position. The wing flap control lever is located on the top, right side of the centre control stand. There are four placarded positions on the quadrant: "Take-off" (60 per cent extension), "Approach" (66 per cent extension), "80 per cent" (80 per cent extension) and "Landing" (100 per cent extension). There are lever-position detents at the abovementioned settings except

(All times herein are U.S.A. Central Standard Time)



APPROXIMATION OF PROBABLE FLIGHT PATH AS DERIVED FROM WITNESS STATEMENTS the "Approach" position. There is also a detent at the full forward (fully retracted) position. The wing flap control lever will remain in any selected position until moved whether in the detent or not. The wing flap control unit allows pre-positioning of the flaps and changing direction of the flap movement at any time without completing the selected cycle. Retraction time for the wing flaps from a setting of 60 per cent to fully retracted is about 15 seconds provided the landing gear is not retracted at the same time.

Examination further revealed the No. 2 engine had been shut down and its propeller feathered. There was no evidence of any in-flight fire; however, the fire extinguisher had been activated in the No. 2 engine. The ground fire and impact damage precluded any testing of the fire warning system serving the No. 2 engine. Engines No. 1, 3 and 4 appeared to be in good condition apart from impact damage.

On January 23, 1960, a test flight in the same type aircraft was conducted at Los Angeles, California. Conditions surrounding the fatal flight were simulated as nearly as possible. Definite stall warnings were apparent to the pilot in all the test runs and recoveries from the stall buffet zone could be made with a loss of no more than 200 feet of altitude. On one of the runs the aircraft was banked up to 42 degrees and the airspeed allowed to drop to 108 knots indicated. A fairly rapid rate of sink developed and the aircraft was not yet in the stall buffet zone. Not enough power was available to keep the aircraft in level flight and a loss of several hundred feet was necessary to acquire enough airspeed to recover from this sinking condition. The pilot described the aircraft as being on the backside of the power curve.

The crew assigned to the flight was off duty from November 20 until the morning of November 24. Rather than spend their layover in Chicago each of the three crew members returned to his home in California. The captain returned to Midway at 1645 hours on November 23, checked into the crew lounge at 2140 hours and then retired. The first officer arrived at Midway Airport at 0720 hours on November 23 and checked into the hotel. The flight engineer returned to Chicago at 2115 hours on November 23, and checked into the crew lounge at Midway Airport at 2345 hours. At 0050 hours on the morning of the 24th the first officer was alerted for the flight and then at 0200 hours the same morning, the captain and flight engineer were alerted.

ANALYSIS

The flight had progressed from New York to Chicago in a normal manner. Ground handling of the aircraft at Midway Airport was properly conducted but difficulty with equipment caused a delay in the loading of the aircraft cargo compartment which, in turn, caused the flight to be behind schedule.

The crew's training and proficiency records indicate that the crew members were properly qualified for the flight as planned. The company provided ample opportunity for them to obtain sufficient rest prior to their flight, however, as the captain had rested for 4 hours 20 minutes and the flight engineer 2 hours 15 minutes immediately prior to the flight it appears questionable that these officers took full advantage of this opportunity.

The aircraft was operating in a satisfactory manner until the fire warning shortly after take-off. The captain had successfully coped with the emergency and engines No. 1, 3 and 4 were in good operating condition and capable of sustaining the aircraft in properly conducted flight.

The control tower operators offered their assistance to the flight by giving them clearance to land on any of the runways and offering to have the emergency equipment and crew stand by. The flight's rejection of the offer to alert the emergency crews indicates that they were not extremely concerned for their safety and had the situation pretty well in hand. It further suggests that the crew was certain there was no actual fire in the No. 2 engine.

For the flight to have made a localizer approach would have necessitated their climbing to an altitude which would have put them in the overcast and consumed considerably more time. Their decision to stay VFR below the clouds was reasonable; however, this did make it necessary for them to fly at an altitude between 400 and 600 feet above the ground.

Analysis of weather conditions existing at the time of the accident showed that the flight should not have encountered structural icing or significant turbulence during its short flight.

In anticipation of landing, a gear-down, flap-extended configuration was established on the downwind portion of the traffic pattern. The wing flaps were at least in the take-off position of 60 per cent and had been allowed, presumably, to remain so extended since take-off, because less than one minute had elapsed from start of take-off roll until the fire warning, and at that time the captain planned to return to land. The track over the ground on the "downwind" curved toward the runway. When the aircraft was positioned to start the turn to final approach a sharp turn was needed to avoid overshooting the extended centre-line of runway 31L.

The Board believes the captain attempted such a turn, and in doing so combined a very steep bank with high gross weight and three-engine aircraft configuration in such a manner that the aircraft entered a regime of flight describable as being on the backside of the power curve. More power and altitude than was available to him was needed to safely recover the aircraft. At some point in this turn the captain very probably decided to discontinue the landing approach and attempted to "go-around." Hence, he called for gear up at or near this same point, but for an unexplained reason the wing flap controls were positioned for flap retraction.

The Board believes an accident such as this is a certainty when at low altitude an excessive rate of sink is coupled with the additional loss of lift caused by the simultaneous retraction of the wing flaps from 60 to 24 per cent. The flap setting of 24 per cent was their intransit position as the aircraft struck the ground.

CAUSE

The Board determines the probable cause of this accident was the manoeuvring of the aircraft in a manner that caused it to develop an excessive rate of sink while in the turn to final approach.

S-T-R-E-T-C-H and YOU

Many modern light type aeroplanes are frequently built on what is known to aircraft structures designers as "stretch" design techniques. These techniques completely eliminate the inherent strength margins which were built into older types of aircraft because of the conservatisms in stress analysis method used. The general principle of stretch technique is to design a structure below the required strength level by an amount corresponding to that which is known to be conservative in the stress analysis method used and then demonstrate by load tests that the desired strength level can be reached.

This approach enables the structures designer to proportion his chosen type of structure to the absolute minimum strength and weight necessary to meet design requirements. An example of this is a very popular all metal aircraft in which the designer even took the beam strength of the pilot seat rails into account when designing the fuselage for bending loads. As a consequence, the maintenance manual for this aircraft states that the seat rails are considered as part of the basic airframe structure itself and places very stringent inspection on them.

The structural limits on modern light aircraft expressed in terms of placard speeds and load factors leave little margin for abusive handling and the inadvertent, deliberate or careless disregard to these speeds and load factors have dire consequences.

Recently in an overseas accident (see page 3 this issue) a student pilot whose total flying time was some 27 hours was practising steep turns in a modern light type aircraft when he caused serious structural damage through unconsciously applying control movements which produced the loads required to cause failure. The vetrical fin was buckled, the rudder was damaged and the left horizontal stabilizer, elevator and tab were broken downward at 40 degrees from the horizontal together with some rear fuselage buckling before the pilot made a successful emergency landing.

In Australia not so long ago, another pilot exceeded the limitations placed on a light aeroplane resulting in it shedding the wings with fatal consequences.

What are the lessons to be learned from this? Firstly, aeroplane structural limits are very carefully determined, they are not amenable to arbitrary S T R E T C H and the modern light aircraft can be broken in flight by the pilot. Secondly, don't ignore placard speeds or load factors as specified in flight manuals, and thirdly, man must be master of the machine and at all times control it so that it operates within the limitations imposed by design.

Know the limitations of your aircraft and **"watch those clocks,"** if you desire to be a permanent reader of the Safety Digest.

SHARE YOUR EXPERIENCE

It May Prevent an Accident

We have been concerned for a considerable time that many incidents which occur are never reported. Appeals have been made to our readers to assist in accident prevention by reporting all incidents but the results are still very disappointing.

Fortunately many members of the aviation industry are safety conscious and the following account, which was not reported as an incident by the pilot concerned, was forwarded by a person who gained the information from a casual conversation.

During a flight in a light aircraft, an ashtray which was secured to a perspex window by a suction cup became dislodged and was mislaid on the cabin floor. After finishing a cigarette and being unable to find the ashtray, the pilot looked for something on which to stub the cigarette butt. He eventually used a celluloid protractor for this purpose whereupon the protractor started to burn and gave off dense smoke to an extent that the pilot was unable to see out of the cabin or to find anything inside the cabin.

The pilot knowing the aircraft to be trimmed to fly "hands off" removed his hands and feet from the controls and allowed the aircraft to fly itself. An urgent search was made for the fire extinguisher with the object of aiming it at the seat of the fire, but the pilot could not remember where it was located and groped blindly about the cabin. Eventually the protractor burnt itself out and as no other material had ignited the hazard was removed when the smoke cleared. Fortunately the aircraft was at an altitude of about 5,000 feet so that there was no imminent danger of collision with terrain.

It is not difficult to imagine this incident becoming an accident if the aircraft had been at a low altitude, if the protractor had been in contact with some other combustible material, or if the aircraft had been trimmed for other than level flight or if there had been other aircraft in the immediate area during the period when the pilot was "flying blind."

The pilot for some reason did not report the incident and it was only by his chance conversation with one of our more safety conscious readers that you are able to profit from his experience. It is surely much easier to live with your conscience when you know that by the prompt reporting of your incident you have done the best you can towards the prevention of accidents involving others. It is beyond our understanding that any pilot would fail to see that this experience was worth passing on for the benefit of all. Maybe there was some reason for this pilot not doing so, and perhaps on reading this article he will write, and tell us about it.

BLIND FLYING

During agricultural spreading operations a DH.82 aircraft collided with a tree and was extensively damaged when it struck the ground. The pilot was seriously injured.

The investigation revealed that the aircraft had been engaged in spreading finely powdered rock superphosphate. A film of dust had accumulated on the inside of the pilot's goggles impairing his vision so that he did not see the tree until it was too late to avoid it. His crash helmet was worn outside the goggles so that both would have to be removed to clean the inside of the goggles.

If the pilot had taken the trouble to perform this action before the last take-off, it is more than likely the accident would not have occurred. To have an accident is a drastic way of learning the importance of good vision during low flying. It is not only easier but far less dangerous and costly to read articles like this and then resolve to change your habits accordingly.

The OLD and The BOLD

Several months ago an aerial pageant was held at a country aerodrome in Victoria. It was attended by a very experienced commercial pilot who had flown a light aircraft from Melbourne for the occasion. Late in the day this pilot departed for another country aerodrome, but he failed to locate his destination and was forced by approaching darkness to make a precautionary landing in a paddock.

The lesson to be learnt from this incident is made clear by the following frank account written by the pilot especially for the old, the not so old and the bold.

"During the pageant the committee requested the use of my aircraft for a parachute demonstration but strong winds delayed this flight until fairly late in the day. Whilst airborne I received a message that the owner of the aircraft had requested that I depart Warracknabeal immediately and pick him up at Bendigo on the way to Melbourne. The limited amount of daylight remaining meant that I had no time to waste so I landed, refuelled, replaced the aircraft door and picked up a road map which was to be my nav. gear for the flight; I had no time to either plan the flight or to check the map.

"On setting course by using the "about over there" method, I opened the map and discovered that it was incomplete, and that I held the portion which covered the alpine section of Victoria. This did not dismay me in the least, as having flown over this country for better than ten years I had no need for a map.

"With this superior and over-confident thought I then settled back, lit a cigarette and wafted off in a state of semi-trance. The aircraft trimmed out nicely and everything in the garden was rosy. Some little time later I identified St. Arnaud, but how much later this was I really couldn't say, as we experienced blokes don't have to worry about details like that.

"Eventually the town of Maryborough went past on the starboard side and I knew Bendigo should be somewhere ahead and would appear at any old tick. Many old ticks came and went, but not Bendigo, and as darkness approached the impossible case of being lost occurred to me.

"At this stage I had my first real look outside the cabin since the beginning of the flight, and recognising the irrigation country as being beyond Bendigo, realised that the town I had cast a glance at and dismissed as Maryborough had in fact been Bendigo. In my great wisdom I had "boobed".

"I am glad to be able to say that at this juncture a little common sense and past training managed to surface through the placid surface of my over-confidence, and I decided to land on a suitable paddock in daylight rather than continue my series of blunders by risking an after dark landing at Bendigo. After the successful completion of this landing and the subsequent tying down of the aircraft, I realised that next time I must navigate to Bendigo."

COMMENT

Although this victim of over-confidence had, as he put it "the natural reticence about propagating my more doltish pieces of finger trouble to the rest of the aviation fraternity" he readily agreed to the use of his story in the interests of aviation safety, and for this and the frankness of his report, he is to be commended.

The story makes it clear that for a cross country flight to be safely conducted, even an experienced pilot must make adequate pre-flight preparation, ensure that a suitable map covering the route is carried and practise the art of pilot navigation whilst in the air.

An incident of this nature is very costly in terms of pride and in this case these costs were greatly increased in your interest. We would like to think the effort has been worthwhile. We are even hopeful that others might be inspired to contribute in a similar way.

THOSE FOREIGN OBJECTS AGAIN!

Fatal Agricultural Accident at Waipu, North Auckland

(Summary of a report by the Air Department, New Zealand)

On 5th February, 1961, a Fletcher FU24 dived vertically into the ground from an altitude of 150 feet during topdressing operations at Waipu, North Auckland. The pilot was killed instantly and the aircraft was destroyed.

FLIGHT

The pilot commenced operations at 0600 hours and 25 flights were completed before he halted for breakfast. At 0830 hours, operations were recommenced and after the tenth load, the pilot reported that the elevators were sticking and tending to jam when the control column was near its aft position. No defect could be discovered from an external inspection so the loader-driver crawled down the interior of the tail and requested the pilot to operate the elevator controls while he inspected the rear lower pulley. During this inspection, he discovered a strip of 16 gauge metal about 1/16th inch wide and curled into a ¼ inch diameter circle. He retrieved the object and the pilot advised that the controls appeared to be satisfactory.

Operations were resumed and at 1015 hours, on the fifth flight after the interruption, the loader-driver realising that the noise from the engine had ceased, looked about and saw the wrecked aircraft on the summit of a ridge.

(All times are N.Z. local time)

INVESTIGATION

The nature of the damage, the attitude of the aircraft at point of impact, the absence of evidence of any movement of the aircraft in the rolling plane, and the position of the wreckage in relation to the sowing run, gave an immediate impression that the aircraft had dived straight into the ground in a manner consistent with sudden loss of fore and aft control. This impression automatically focussed attention on the elevators, which were found to be capable of full and correct movement. Of the elevator controls, the upper cable was intact and correctly adjusted, but the lower cable was severed at a point 12 inches from the eyebolt attachment to the counterbalance. In considering this failure the following points appeared significant:—

(a) Both the rudder and elevator cables had been subjected to equal impact forces but only the lower elevator cable was broken.

(b) That portion of the lower cable between the control column and the fracture point was tangled in the wrecked cockpit area. This indicates clearly that the portion of the cable referred to must have been free to move forward before the aircraft struck the ground.

(c) All strands of the cable had been broken at a common point in the pulley groove area by a combination of cutting and tension. Relatively little unravelling of the strands had occurred, a feature characteristic of cable severance by cutting and not by progressive abrasion and fraying.

In view of the foregoing and the pilot's assertion that the elevator controls were stiff and tended to jam in one position when the control column was moved back, the discovery by the loader-driver of a curl of metal in the rear lower pulley becomes of extreme significance in the establishment of the cause of the accident.

Detailed inspection of the cable shows marks of friction beginning 10 inches from the upper eyebolt attachment, culminating in the complete severance of all strands of the cable, by a cutting action, at a common point 12 inches below the eyebolt attachment. No evidence of abrasion was apparent beyond the cut. The only conclusion that can be drawn from the nature and position of the failure is that the cable was severed by the cutting action of a foreign object which had found its way into the pulley groove.

In regard to the curl of metal found by the loader-driver in the rear elevator cable pulley, there is sufficient evidence to indicate that it was a coiled 1/16th inch-wide strip of aluminium alloy. Such an object can be associated with major repair work carried out on the aircraft following an accident in December, 1960. During these repairs a hole was nibbled in the hopper. The use of a nibbler tool removes a strip of metal about 1/16th inch wide which curls as the cut progresses. It is apparent that a small portion of this metal fell on to the floor of the aircraft and worked its way towards the tail where, by some means which cannot with certainty be explained, it eventually became jammed in the rear pulley, coming to rest in the pulley groove at a point where a solid lump of superphosphate, reinforced by strands of sacking, was already lodged.

After the curl of metal had been removed by the loader-driver, and after making an inspection and rocking the elevators satisfactorily through their full range of travel, the pilot could certainly be expected to assume that this curl of metal was the only cause of the stiffness and jamming of the elevator controls. But examination of the pulley after the accident indicates that a second case of jamming occurred. This is certain because the curl of metal could only have severed the cable by causing abrasive action with the guard pin and such a failure would have been accompanied by considerable fraying of the cable. The strands of the cable, however, showed clear evidence of a distinct cut, as opposed to fraying, at a common point. It was necessary, therefore, to look for some other foreign object which had become lodged in the pulley after the curl of metal had been removed. Three 2BA nuts, three No. 6 ⅜ inch PK screws and one ⅜ inch 2BA bolt all coated with superphosphate had been found on the floor of the rear fuselage. Detailed examination then revealed a positive indentation in the pulley groove and flanges into which a No. 6 ⅜ inch PK metal screw could be fitted perfectly. It showed that this PK screw, with the thread downward, had been forced into the pulley groove by the elevator control cable and that the cable was eventually severed by very severe compression between the sharp edge of the screw head and the upper guard pin. The point of cable fracture indicates that when the jamming occurred the aircraft was flying in a slightly nosedown attitude.

It can be confidently stated that when the loader-driver removed the curl of metal and the pilot rocked the elevators through their complete range of travel the cause of the jamming first noticed by the pilot in flight was removed. It therefore follows that, since the elevators were then operating freely and satisfactorily, the PK screw became lodged in the pulley groove on the later flight.

CAUSE

The accident was caused by an irretrievable loss of elevator control following severance of the lower elevator cable by the cutting action of a metal screw lodged in the pulley groove.

COMMENT

This accident shows only too clearly how vital it is for meticulous care in cleaning up after working inside an aircraft. The frequency of this sort of happening causes one to think that some people have accepted that human life is cheaper than good housekeeping. One wouldn't ask a pilot to share the cockpit with a taipan so why leave him with something equally deadly.

FASHION-WISE

Fashions change, even in regard to simple gadgets like circuit breakers. In the aircraft of yesteryear only a brief glance was needed to check the setting of the toggle-type circuit breaker. The push-in-pop-out type could, with just a little extra care, also be checked visually.

Checking by appearance alone, however, is no longer enough because in modern aircraft some of the breakers used in essential electrical circuits do not alter in their external appearance when they trip. One of these, in the F27 flap system, has caught several pilots during recent months.

When in doubt about a circuit breaker of the press-to-reset type, trust more to the hand than to the eye. A suitable push tells all and in this regard remember that the reset pressure increases with the size of the breaker. Some large circuit breakers require considerable pressure before they reset.

People Don't Understand Me!

(Extract from "Mats Flyer," June 1961)

Extract from MM 55-1 51.4.4.1 . . . The pilot not flying the aircraft will call out passing each 5,000 foot level. This will be done to 5,000 feet above level off, after which altitudes will be announced at each 1,000 foot down to level off altitude. The pilot not flying will call out 100 feet above and when reaching minimum instrument altitude.

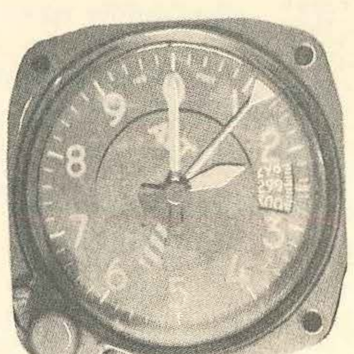
"It seems unlikely that a pilot of such experience as Captain P——— would so misread his altimeter as to mistake a reading of 100 feet for 1,100 feet. While this may be possible for the uninitiated, it is difficult to attribute such an error to an experienced pilot . . . . . . "

That's a verbatim quote from an aircraft accident report. And not a very correct thought, I fear. This particular accident happened on another continent to a non-military aircraft, but this is not important because the ability to misread an altimeter is not confined to any experience level, any country, or any class of people. I'll prove that in just a minute.

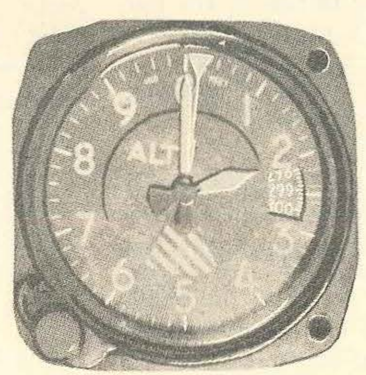
What am I? I'm what the Air Force instrument flying experts now call a performance instrument. I occupy a prominent place as part of any flight instrument grouping and if you read me right, I will assist you greatly in keeping your aircraft at a safe altitude above the ground. If you read me wrong . . . well, suppose you read a selected group of accidents/incidents involving misreading of altimeters. In some of them, the aircraft collided shockingly and suddenly with the ground and people died. In others, a couple of scared pilots realized in time where they were, pulled up to altitude and tried to keep their shaking knees from throwing the aircraft into unusual attitudes.

Error 1.

During a routine test flight of a four-engine commercial turboprop, the aircraft descended to 2,000 feet mean sea level without the pilots appreciating the fact. This altitude placed the aircraft just above a cloud layer. When the captain requested clearance to 3,000 feet MSL, he thought he initiated his descent from 12,000. The aircraft crashed while descending at an estimated 750 feet per minute. Nine people died in this one. The captain was a most highly regarded veteran of over 9,000 flying hours.



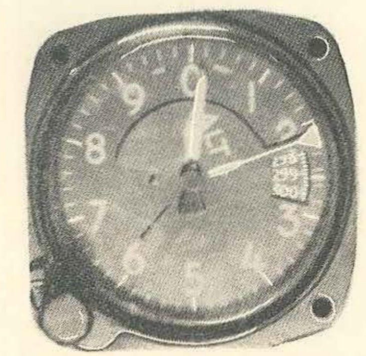
. . . what the pilot thought he saw



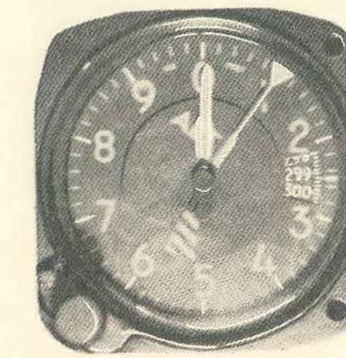
. . . what the altimeter actually read

Error 2.

A multi-jet bomber crashed at an elevation of 4,500 feet MSL approximately two minutes after reporting leaving 20,000 feet. From the observations of another aircraft and mathematical computations it was conclusively proved the aircraft started its descent from 10,000 feet. The using command regards the probability as excellent that the crew misread their altimeters 10,000 feet. No crew members are alive to testify.



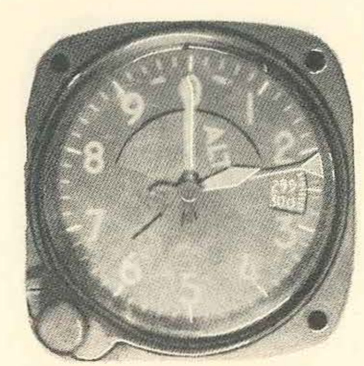
. . . what the pilot thought he saw



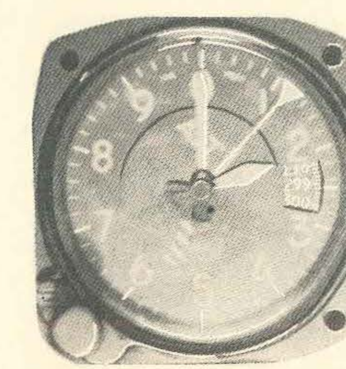
. . . what the altimeter actually read

Error 3.

After making a missed approach, a multi-jet bomber climbed to —the crew thought — 22,000 feet. A seat change was made and a second penetration started. Going through what was thought to be 13,000 feet, the AC remarked that the ground looked awfully close. A recheck of the gauges revealed that it was — about 10,000 feet closer than the crew thought. Quite obviously the climb was made to 12,000 instead of 22,000



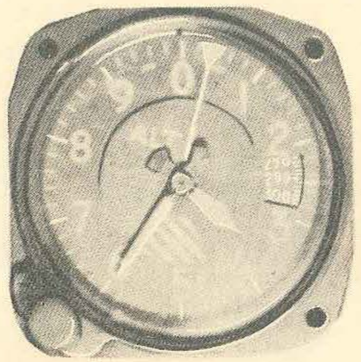
. . . what the pilot thought he saw



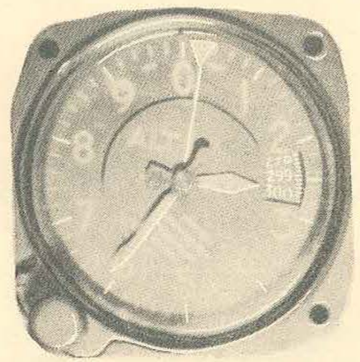
. . . what the altimeter actually read

Error 4.

This multi-jet bomber was making a terminal VOR penetration at night. The aircraft touched down 10.5 nautical miles short of the runway. The crew made a recovery, climbed the damaged aircraft to 1,600 feet, intercepted the GCA glide slope, and landed without further incident. The runway was wet, permitting the rear gear, which was cocked 30 degrees left, to slide, and the crew was able to maintain directional control. The pilot misread his altimeter by 1,000 feet — reading 3,600 feet MSL, when the aircraft was actually at 2.600 feet MSL.



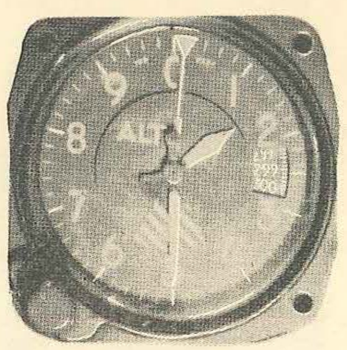
. . . what the pilot thought he saw



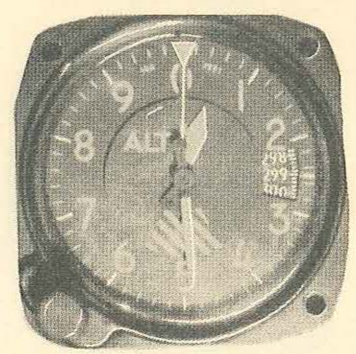
. . . what the altimeter actuall; read

Error 5.

A four-engine MATS transport was making an instrument approach to a Middle East base. The aircraft commander, who had 7,200 flying hours, misread his altimeter 1,000 feet and the co-pilot failed to catch the error. Twelve people died in the ensuing crash.



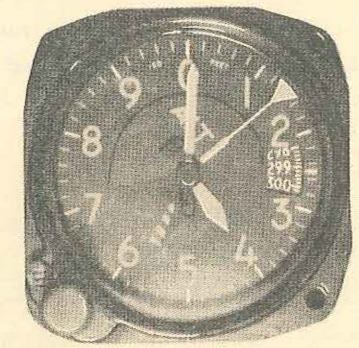
. . . what the pilot thought he saw



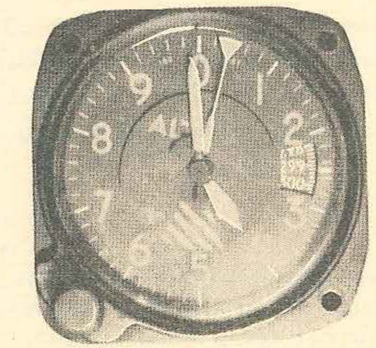
. . . what the altimeter actually read

Error 6.

Another four-engine turboprop was approaching destination after a routine ferry flight at 24,000 feet. The aircraft was cleared for an approach, to report leaving 14,000 feet. A very short time after reporting out of 14,000 feet, the aircraft struck the ground in a wings level, descending attitude. The investigation conclusively proved the captain misread his altimeter by 10,000 feet and the co-pilot failed to catch the error. Incredibily enough, both pilots survived the crash.



. . . what the pilot thought he saw



. . . what the altimeter actually read

Now what was that about the experienced pilot not misreading his altimeter? None of these people were by any stretch of the imagination greenhorns at the business of driving airplanes on the gauges. And yet they all managed to misread an extremely vital instrument by 1,000 or 10,000 feet.

These accidents/incidents have no set pattern to them. Some of them though, are quite obviously akin to that old bugaboo which often fails to get my old friend, the landing gear, in the down and locked position. In a word, DISTRACTION.

I note, for instance, that in one of the above cases, the crew was running through some out-of-routine test flight procedures. In another, a change of seats was accomplished. Others had less obvious breaks in the instrument scan.

Of course, what happens after the instrument cross-check is interrupted is painfully obvious. When the pilot returns to the scan, the altimeer may be reading considerably different from anticipated. And yet, since one or two needles on the altimeter dial are in thir expected location, the eyes don't notice that one needle is dangerously out of position.

I'll offer the following suggestions which may help:—

1. Follow the new procedure in MM55-1.
2. Make an extra special check prior to starting any descent.
3. When your instrument cross-check has been interrupted take a real good look at the altimeter when you resume the scan.
4. Make full use of the navigator to monitor altitude.

None of these, of course, will guarantee that there will never be another pilot who will misread an altimeter; any more than any combination of warning horns and other safety devices will ensure that all pilots will always put the gear handle in the down position prior to landing.

There is a difference in any case. Pilots who forget to put the gear handle down usually walk away from the wreck—greatly chargined, perhaps, and headed for a co-pilot job for a while, but alive and walking. Pilots who misread altimeters and a lot of people riding with pilots who misread altimeters — frequently don't come through crashes alive. So please read me right. I'm a true friend only to the professional pilot who understands and uses me correctly.

COMMENT

It is now a mandatory requirement in Australian airline operations that all operators adopt and prescribe altimeter checking procedures to guard against errors due to misreading of the instrument. Particular emphasis is applied to the most common error of 10,000 feet, which experience has shown to be the most potentially dangerous.

Confused Air Traffic Control at Philadelphia, Penn., U.S.A.

(Summary of the report of the Civil Aeronautics Boards, U.S.A.)

At approximately 1430 hours on 30th September, 1959, a Cessna 140 on final to runway 15 at the North Philadelphia Airport collided with an Aeronca L-16A. The Cessna crashed to the ground killing the pilot, but the pilot of the Aeronca was able to regain control of his damaged aircraft and effect a successful landing.

INVESTIGATION

At 1355 hours, the pilot of the Aeronca departed from North Philadelphia Airport for a local solo training flight. The aircraft was not fitted with radio and received a green light from the tower for take-off. After take-off the aircraft departed from the field area for 10 to 15 minutes, then returned and began making touch and go landings utilizing runway 15.

At 1400 hours, a Cessna 140 departed from Lake Susquehanna Airport, New Jersey, on a flight to North Philadelphia Airport. At 1420 hours, a radio call was received from the aircraft requesting landing instructions and the aircraft was cleared to enter the landing pattern and to land on runway 15.

The field elevation of North Philadephia Airport is 120 feet; the recommended traffic is left, to be flown at an altitude of 1,000 feet above the ground.

The pilot of the Aeronca said that after returning to the airport he was on his third or fourth touch-and-go approach to runway 15 and had not received any light signals from the tower since receiving a green light for the original take-off. Several aeronautically experienced ground witnesses, who were seated on a bench directly in front of the tower at the time, observed the aircraft making touch-and-go landings. According to these witnesses, both aircraft were observed to be in close proximtiy to one another while they were on their downwind, base and final approach. These witnesses place the Aeronca inside of, ahead of, and at approximately the same altitude as the Cessna when observed on the downwind leg.

After clearing the Cessna via radio for landing on runway 15, the tower operator located the aircraft visually on the downwind leg. He also observed another aircraft which he identified as the Aeronca, which, he states was outside of, above and behind the Cessna. He did not observe the Aeronca practising touch-and-go landings prior to this time.

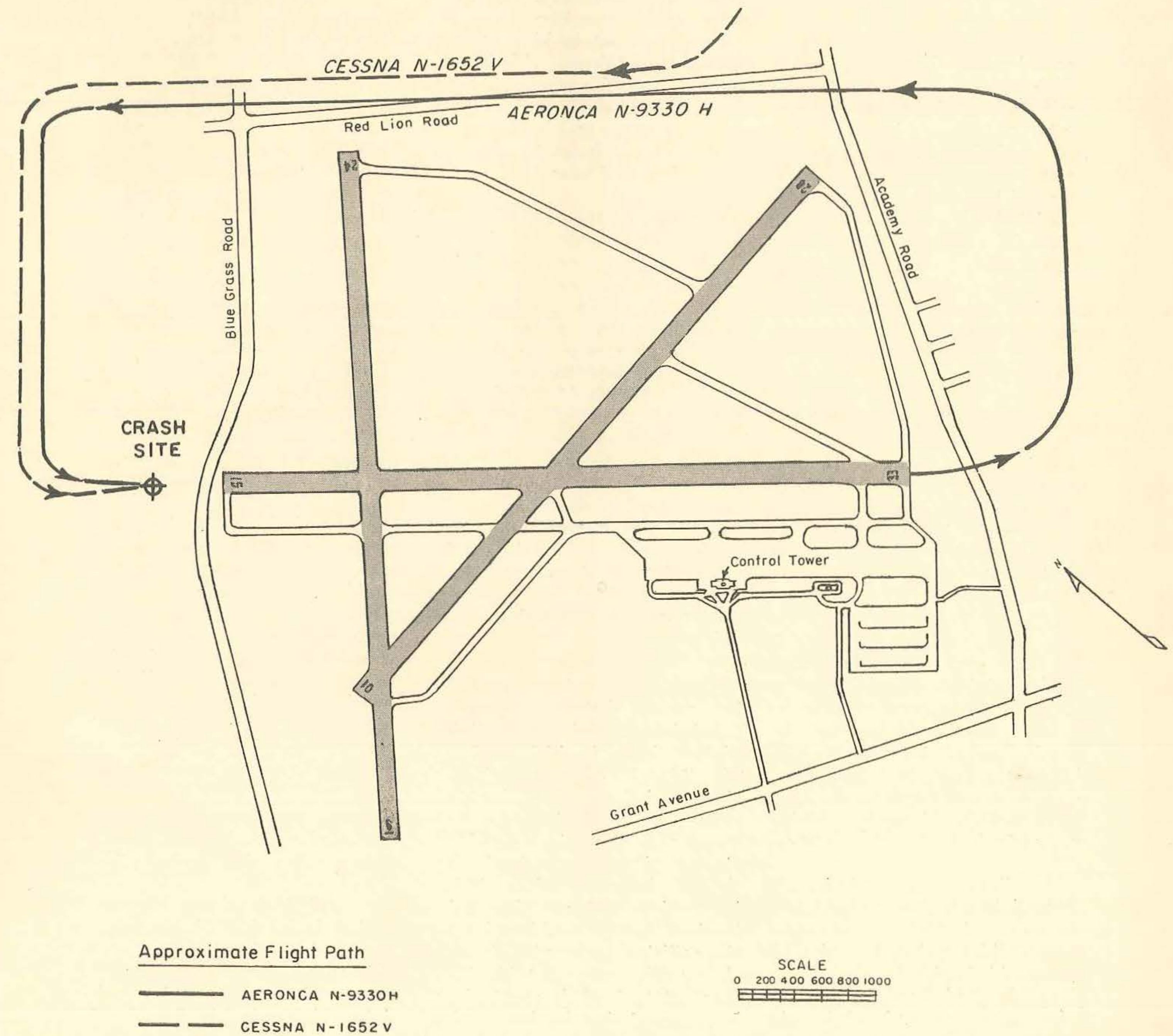
The following testimony was given by the two tower operators on duty: An alternate green and red warning light was given to what they believed to be the Aeronca while it was on the downwind leg and while the aircraft was turning onto the base leg. No instructions or advisories were issued via radio to the Cessna pilot as he traversed the downwind and base leg. The light was changed to steady red which was directed toward the Aeronca until the aircraft collided. No subsequent radio contacts were made with the Cessna pilot, following the initial issuance of landing instructions, until just prior to the collision when the Cessna pilot was told, "Do not land." An exchange of conflicting traffic or reason for cancellation of the original landing clearance was not given to the pilot of the Cessna. The Cessna then acknowledged the message,. levelled off, and continued straight ahead.

According to the Aeronca pilot, no lights from the tower were observed by him at any time during this approach, nor during any of his previous approaches and touch-and-go landings. The only light signals transmitted by the tower during his previous touch-and-go landings was the green light for the original take-off clearance.

The midair collision occurred approximately 500 feet from the approach end of runway 15 while both aircraft were lined up on their final approach. The Cessna was directly below and a little to the right of the Aeronca. The Aeronca continued to descend after the Cessna levelled off and initial impact occurred between the forward left wing tip of the Cessna and the underside of the Aeronca right aft lift strut midway at the strut brace position. The Cessna proceeded under the Aeronca's wing and the leading edge of the Cessna's vertical stabilizer contacted the Aeronca's right aileron, bending the Cessna's stabilizer and rudder 90 degrees to the right to a flat position. Both aircraft momentarily locked together and entered a bank to the left. The Aeronca managed to turn inside the Cessna and pull up. According to the pilot of the Aeronca, the Cessna then pulled up and struck the Aeronca a second time, again in the area of the right wing struts. The Cessna pilot lost control of his aircraft and it plunged to the ground. Collision impact caused binding of the Aeronca's right aileron and subsequent partial loss of control. However, the pilot succeeded in landing on runway 15 with no further damage. Ground impact of the Cessna occurred 75 feet from the approach end and 375 feet to the left of the centreline of runway 15 (see sketch).

(All times are U.S.A. Eastern Standard)

Weather at the time was scattered clouds at 4,000 feet, high broken clouds; visibility 15 miles; temperature 83°F; surface winds from the south-southeast at 13 knots.



A witness in an automobile approximately 2,500 feet from the end of runway 15 observed the aircraft pass over his position just prior to the impact. He stated that at this point the Cessna was directly below and to the right of the Aeronca with a vertical separation of approximately 200 feet. All witnesses, including the North Philadelphia Airport tower personnel, agree on that relative position of the two aircraft just prior to impact.

The North Philadelphia Airport Control Tower is an FAA tower which operates on a 24-hour basis. It is staffed by a chief controller and three air traffic control specialists, all of whom had control tower operator certificates with senior ratings. No scheduled air carriers land or take-off from North Philadelphia Airport, and traffic consists mainly of light single or twin-engine transient or locally based aircraft. The tower makes no recordings of radio transmissions or receptions.

The tower is equipped with a portable traffic light which is directional and emits an intense, narrow beam of light. Signals may be discernible to the pilot of any aircraft visible to the tower operators and to which the light is directed.

A small extension from the lamp glows when the light is actuated by a trigger, indicating that the light is operating. The tower controller could not remember whether he saw this indication when he directed the light toward the Aeronca. However, he stated the light did function correctly when checked immediately following the accident.

The disadvantages of the use of the light are that the pilot cannot constantly look at the control tower while flying his aircraft and could inadvertently miss a signal directed towards him; the information transmitted by the light signal is limited; and no accurate sighting device is provided.

ANALYSIS

Although it is recognised that there was conflicting evidence as to the positions of the aircraft in the traffic pattern, the Board believes that the actual positions of the aircraft were as follows: The Cessna entered the landing pattern behind, to the right of, and below the Aeronca. The Aeronca pilot could not have seen the Cessna without looking back to his right and down. This is quite unlikely since his attention would have most likely been directed to the airport and runway which was to his left as he flew the downwind and base leg.

Considering the relative speeds of the two aircraft, with the Cessna being somewhat faster, the Board believes the two aircraft could maintain this position throughout the traffic pattern until turning onto the final approach. The fact that the Aeronca was on the inside during the turns onto the base and final approach, and therefore travelling the shorter distance, was compensated for by the relatively faster speed of the Cessna. The two 90-degree turns that each made, served to close the gap between the two aircraft and placed the Cessna under the Aeronca on final approach just prior to collision.

The Aeronca pilot stated that because the air was rougher than usual, he was flying at a slightly higher airspeed which tended to give his aircraft better landing characteristics. When both aircraft were on final approach the tower operator instructed the Cessna pilot not to land. The Cessna pilot acknowledged these instructions and was observed to level off. It was at this point that the collision occurred. Since the Cessna pilot was not told why he was not to land, it can logically be assumed that having received this instruction he levelled the nose of his aircraft and applied power for an aborted landing. The Cessna pilot, having altered his glide angle to level flight and increased his airspeed, overtook and collided with the Aeronca which was descending. The damage to the aileron of the Aeronca and the rudder of the Cessna attests to the fact that the Cessna was moving faster than the Aeronca at the moment of collision.

The tower operator stated an alternating green and red warning light was given the Aeronca pilot while the aircraft was on the downwind leg and while turning on the base leg, and a steady red light was directed toward the Aeronca until the aircraft collided. Whether or not a warning light or signal to give way or whether such signals were directed to the right aircraft is questionable. The portable traffic lamp was checked immediately after the accident and determined to be in proper working order. It is possible that a warning light was given while both aircraft were on the downwind leg. With both pilots at this time concentrating on the land end of the runway and with the tower positioned off to the rear of each pilot's left shoulder, it is reasonable to assume that a light given while the aircraft were in this position could have been missed by both pilots. When both aircraft turned onto base leg, their positions would have enabled their pilots to see the warning light if given, which, according to the tower controller, was meant for the pilot of the Aeronca which he believed was the second aircraft.

When the two aircraft turned onto final approach, the possibility of either pilot seeing a light signal from the tower is greatly increased. Yet neither pilot took action indicative of his having seen a light signal. It is reasonable to assume that had the Cessna pilot seen a red warning light shining in his direction he would have used his radio to inquire whether it was meant for him. Had the Aeronca pilot seen the light he would have discontinued his approach and circled to the left.

It is entirely possible that the reason for neither pilot seeing a light was because the tower operator directed the light to the second aircraft, which was the Cessna, while mistakenly thinking it was the Aeronca. Since the Cessna pilot was receiving his instructions by radio, it is unlikely that he would be observant of a light signal from the tower.

If the Cessna pilot had observed the Aeronca he no doubt would have asked the tower whether there was other traffic in the landing pattern. If the Aeronca pilot had seen the Cessna he no doubt would have been particularly observant for a light from the tower and would probably have circled to put himself at a farther distance from the Cessna. It is evident that had either pilot observed the other aircraft while in the traffic pattern he would have taken some action to ascertain whether the other aircraft was also in the pattern. It is further evident that each pilot continued his landing approach unaware of the presence of the other and without accurate visual or timely verbal warning from the tower until too late to avoid a collision.

The Board concludes that the Cessna pilot, after being cleared by radio, entered the traffic pattern outside of, below and slightly behind the Aeronca which was already in the traffic pattern accomplishing touch-and-go landings. The Aeronca was hidden from the view of the Cessna pilot by the left wing of the Cessna, the Cessna being below and to the right rear of the Aeronca. Each pilot continued his landing approach unaware of the presence of the other and without accurate visual or timely verbal warning from the tower until too late to avoid a collision. Visual light indications that were given were mistakenly directed to the Cessna which the tower controller believed was the Aeronca. The Cessna pilot had the best opportunity to observe the Aeronca as he traversed his 45-degree entry to the downwind leg. He remained behind, slightly below, and to the right of the Aeronca throughout the remainder of the traffic pattern. The Cessna's pilot's failure to observe the Aeronca was due to either a blind spot caused by a portion of the Cessna blocking out his view of the Aeronca or his failure to adequately clear himself as he entered the downwind leg, and as he made his left turns to the base leg and final approach. After the Cessna pilot received the warning from the tower not to land during the final approach he levelled off, overtook the Aeronca which was descending, and collided with it.

PROBABLE CAUSE

The Board determines the probable cause of this accident was the failure of FAA tower personnel to issue accurate visual and timely verbal air traffic advisories and the failure of the pilots of the two aircraft to maintain proper vigilance to avoid collision.

All Is Not Lost!

In aircraft which require a two-pilot crew it becomes necessary for both members to be able to select the various radio receivers in the aircraft independently of each other. This cannot be achieved with simple switching and a system of isolation is necessary. This system operates by first attenuating each signal prior to mixing and then amplifying the composite signal to restore it to the original level

Should these amplifiers or the associated power supply fail, no audio will reach the crew members' head-phones. To correct this situation, a switch usually marked "NORMAL-EMERGENCY" is provided on each selector box and when it is thrown to "EMERGENCY," the attenuating network and amplifier are by-passed and the selected receiver is then connected directly to the head-phones.

A situation was recently experienced where the radio system was supplied from two circuit breakers. One circuit breaker which supplied part of the radio installation and included the isolating amplifiers mentioned above, tripped and could not be re-set. With the isolation amplifiers inoperative, no audio from any receiver could be heard by the pilot or co-pilot and so it was assumed that all radio navigation and communication facilities had been lost and the aircraft proceeded on the basis of this assumption. If the "NORMAL-EMERGENCY" switch had been thrown to the EMERGENCY position, in this case VHF communications and two nav aids would have been available to the pilots.

The lesson from this incident is:—"IF ALL RADIO RECEIVERS APPEAR TO BE 'DEAD' DO NOT FORGET TO TRY THE 'NORMAL-EMERGENCY' SWITCH IN THE EMERGENCY POSITION." IF YOU DO FORGET WE GUARANTEE YOU A RED FACE.

Faulty Glider Assembly — Loss of Control

During the initial stages of a towed take-off at Wigram, an Eon Baby Glider appeared to be out of control. At approximately 150 feet, the tow rope broke and the glider dived into the ground in a steep left-hand spiral. The pilot was seriously injured and died shortly afterwards on his way to hospital.

Fatal Accident at Wigram, N.Z.

(Summary of report of Air Department, New Zealand)

FLIGHT

On 2nd April, 1960, the pilot received two dual winch launched flights from the duty gliding instructor in the gliding club's dual controlled glider trainer. He completed the flights satisfactorily and then flew the glider solo.

Some time later the pilot was observed assembling the Eon Baby at the threshold of the landing area. H's was assisted by two club members who merely held the various components in position while the pilot himself inserted the appropriate locking pins. Some 20 minutes before the flight the duty controller a qualified glider instructor proceeded to the launching site and noticed that the Eon Baby, with the exception of its main wing fairing had been rigged ready for flight. He was immediately approached by the pilot and asked to check the pins connecting the ailerons and dive brakes in order to confirm that those pins had been correctly inserted. An assurance was given on this point.

The pilot obtained assistance to pull the glider to the launching point after which he climbed into the cockpit and started to fasten his safety harness. The ground controller noted that the pilot assembled the harness straps in the wrong sequence and this error was pointed out to him. The pilot then reassembled the straps correctly.

The ground controller noted also that the altimeter had not been adjusted to zero and that it was reading 300 feet. He therefore set the instrument correctly while the pilot was seated at the controls, placed the canopy over the cockpit and went to bring the tow rope. On his return he inserted the tow rope attachment in the quick-release hook of the glider, tensioned the tow rope, and requested the pilot to test the quick-release mechanism for correct operation. The controller was obliged to address the pilot on two occasions before the latter operated the quick-release and formed a momentary impression that the pilot was either not thoroughly familiar with the mechanism or was preoccupied with something else.

The tow rope was re-connected after the quick-release test and the controller left the aircraft. At no time prior to this moment had he or anybody else actually observed the pilot testing the flying controls by appropriate movements of the control column, but it could have been done when the controller had turned his back to the glider and was procuring the tow rope.

The tow began and during the take-off run, the glider appeared to witnesses to be running rather heavily on the main skid and to remain in contact with the ground for a longer time than is usual for this type. On becoming airborne, it appeared initially to climb satisfactorily, but almost immediately afterwards rose rapidly to a height of about 20 feet. The glider then appeared to recover from this abnormal position and to descend, but almost immediately it rose again at a steep angle which placed it in an even higher position above the towing aircraft which had itself become airborne when the glider had previously descended to a favourable position. Once again the glider appeared to recover only to repeat the climbing evolution, this time rising very steeply at an angle estimated to be at least 45°. At this juncture, and at a height of at least 150 feet above the ground, the tow rope broke. The glider immediately stalled at an exceptionally high angle of attack, the left wing dropped, and the glider entered a left-hand spin. An instant before it struck the ground, the duty instructor had a fleeting impression of the dive brakes having opened about one-third of their range of travel.

The erratic undulating climbing and diving of the glider during the take-off led watchers on the ground to expect the pilot at every moment to release the tow rope. However, such release, if it had in fact been resorted to, was ineffectual.

INVESTIGATION

The Eon Baby is a single seat glider in which the landing gear comprises a single centrally mounted ash skid with a built-in wheel and a half leaf spring tail skid shaft.

Like most gliders, it is designed for ease of transportation by trailer and therefore for rapid dismantling and reassembly in the field. In view of the circumstances associated with the accident, it is desirable to explain how dismantling and reassembly apply to the elevator control system. The elevator cable incorporates a double plate yoke in which the elevator control horn is inserted between the plates. A spring loaded pip pin is passed successively through the hole in one plate, the hole in the elevator horn, and the hole in the other plate, thereby effectively connecting the control cable system with the elevators themselves. There is a 3 inch diameter hole built into the port side of the fuselage to allow personnel assembling the glider to line up the hole in the elevator horn with the holes in the cable yoke by sight and then to insert the pip pin. To dismantle the system, the pip pin is extracted and the elevator horn and cable yoke then fall apart. The tailplane with elevators attached, may then be removed from the aircraft, leaving the elevator cable system intact within the fuselage.

The pilot held a Glider Pilot's "C" Certificate and had obtained an Instructor's "B" rating which permitted him to give dual instruction. His most recent logbook entry recorded his total gliding time as 66 hours. He had flown the Eon Baby four times and had accumulated 1 hour 16 minutes experience on the type.

The wreckage lay on a heading 280°M and 2,200 feet distant from the point where the tow started. The initial impact was taken by the port wing tip, a small portion of which was buried in a deep incision in the ground. The further effect of the wing-tip impact was to pivot the nose of the aircraft heavily into the ground, the port wing simultaneously being partially broken away at the centre section and carried rearward until it lay roughly parallel with the fuselage. The nose impact resulted in a complete disintegration of the wood structure as far back as the leading edge of the mainplane.

The elevator control cable, incorporating the double plate yoke, was found intact within the fuselage and with the spring-loaded pip pin inserted through the appropriate holes in the yoke and locked. The horn of the elevators themselves however, was completely disconnected from the yoke. Apart from this, no other pre-impact defect could be discovered.

The behaviour of the glider during the short time it was airborne was entirely consistent with complete absence of elevator control. That such absence did exist is confirmed by the fact that, immediately after the accident, both the duty instructor and the ground controller found the elevator horn and elevator yoke control cable disconnected. Absence of elevator control resulting from a failure correctly to connect the horn and yoke is therefore the obvious primary cause of this accident, but it is necessary to consider certain circumstances which made the accident possible.

The method of attachment of the elevator horn to the control cable yoke is quite common in most of the older-type gliders and the average pilot is thoroughly conversant with the procedure. An experiment conducted after the accident showed conclusively, however, that incorrect assembly could occur in at least two ways.

First, it is possible to connect the elevator horn to the tapered end of the pip pin at a point where the pip pin projects beyond the yoke, i.e., on the far side of it. If the horn is accidently placed in that position there is just sufficent friction provided by the pip pin to hold the horn in place. Only a small amount of vibration however, is sufficient to shake the horn off the projecting end of the pip pin. Loss of elevator control then immediately results.

Secondly, it is possible to insert the elevator horn between the plates of the cable yoke but aft of the pip pin. In this case, the pip pin passes correctly through the holes in the yoke plates but misses the hole in the elevator horn entirely. If horn and yoke are held half an inch out of alignment during control assembly, this type of error can occur.

It is difficult to believe that the pilot completely and utterly forgot to connect up his elevator controls, though the possibility cannot be ruled out. It seems far more probable that, despite the fact that he was in no hurry to become airborne, the pilot committed one of the two possible assembly errors suggested above. Such possibility is enhanced by a number of important factors: First, the hand hole in the side of the fuselage is only 3 inches in diameter and permits only a limited vision to the person connecting yoke and horn. Futhermore, the interior lighting is poor since the hand hole and fuselage interior are shaded by the tailplane and in this case this situation would be accentuated by the pilot wearing dark glasses at the time he assembled the tail unit. It must therefore remain a possibility that he either missed the elevator horn when inserting the pip pin or placed the horn on the protruding end of the pip pin beyond the yoke plates.

Though the pilot completed two satisfactory dual flights prior to this accident, his faulty drills carried out in the Eon Baby just before the fatal take-off, viz. an incorrect assembly of his harness, a failure to zero the altimeter and to appreciate the necessity for testing the tow rope quick-release mechanism, suggests that he was either preoccupied or inattentive when the fatal flight began. Yet another instance of his apparent laxity is that, after having assembled the Eon Baby, he omitted to sign the daily flying sheet certifying that he had carried out the mandatory daily inspection of that aircraft.

It is very difficult to offer an explanation for the pilot's failure to operate the quick-release before the situation became really critical. The absence of elevator control must have been obvious to him at a stage when release of the tow rope would have resulted in the glider coming to rest undamaged or, at worst, in a heavy landing or a minor mishap. It would appear, however, that he allowed the situation to develop to a stage where the angle of the tow rope to the quick-release hook, together with the tension on the rope occasioned by the acute angle of attack of the glider, made it physically impossible for him to operate the easily reached release. It was indeed fortunate that at this stage the tow rope broke: otherwise the towing aircraft would almost certainly have been involved in an accident as well. There is a possibility that the pilot, on being confronted with an unfamiliar situation, did remember having connected up all his flying controls and therefore dismissed control failure as being a cause, hoping that that situation would resolve itself within a matter of moments. Nevertheless, it is considered that any glider pilot, immediately anything wrong was noticed, would instantly resort to release of the tow, an operation which would have no detrimental effect upon the towing aircraft, or, at least, in the initial stages of the take-off, on the glider or himself as its pilot. No satisfactory explanation as to why the pilot failed to cast off the tow rope can however, be advanced.

CAUSE

The accident was caused by a total loss of elevator control as a result of an omission on the part of the pilot correctly to connect the elevator horn with the elevator cable yoke before the glider was towed off the ground.

How Is Your Torqueing ?

(Extract from Business Pilots Safety Bulletin.)

Improper torqueing procedures are accounting directly or indirectly for more than their fair share of the accident rate. Are you up to snuff on torqueing procedures? A study was completed recently on failures of aircraft component parts and it was discovered that a large percentage are caused by improper torqueing of threaded fittings. This, of course, can be prevented by supervision and education. Utilizing pertinent technical publications and complying with correct procedures cannot be over-emphasized where lives and large sums of money are concerned.

Presented here are some of the errors of torqueing uncovered by the study:—

1. Frequently, fasteners that have been over-torqued have then been "backed-off" and re-torqued to the proper values.
2. Motor-driven impact wrenches with capacities higher than the desired torque values have been used in preliminary tightening
3. Many torque handles are misused as hammers, crowbars and doorstops. Others are not thoroughly inspected and recalibrated after they have been dropped or banged about.
2. Some forget to inspect torque handles periodically and calibrate them in accordance with pertinent tech. publications. And too often they are not readily available to maintenance personnel.
5. A common error is failure to lubricate before insertion and there have been numerous cases of fittings being installed with damaged threads and other defects.
6. Wrenches other than torque handles have been frequently used to torque thread fasteners that have assigned torque values.
7. Extensions are sometimes used on the drive ends of handles. This gives a false reading.

SPILT TILT

The Safety Digest of June 1956, contained an article entitled "Liquids in the Cockpit" in which there were accounts of incidents of local and overseas origin showing the dangers of spilling liquids in aircraft flight compartments.

As the popularity of coffee, soup, alkaseltzer and other beverages is not likely to have waned in the meantime it may be timely to include a further reminder at this juncture.

Here reproduced from MATS Flyer, is a verbatim account of an actual occurrence that could have had dire consequences.

"The captain was having some trouble trimming the aircraft pitchwise, because it appeared to 'change balance,' just after he had trimmed out. As we had 103 passengers on board, we thought large groups of them were wandering about the cabin. At 16,000 feet the autopilot was engaged. At 18,000 feet feeble turbulence was encountered. At 19,000 feet the aircraft suddenly assumed a very nose high attitude. The autopilot was disengaged, and although maximum forward trim was applied, a firm forward positive pressure was necessary to keep the nose from climbing up.

"First reaction was a runaway trim motor. However, as the trim was contrary to aircraft tendency change, the reaction changed to one of jammed stabilizer. Shortly thereafter we thought of a change of location of freight, caused by turbulence, severely aggravating the 30.6% MAC with which we had started, in fact to such a degree that even maximum trim would not compensate for it.

"Later on the engineer noticed that two circuit breakers of the pitch trim compensator had popped out. The pitch trim compensator over-ride was selected, and immediately the trim forces on the stabilizer returned to more or less normal, and a normal trim condition was selected.

"An examination of the pitch trim compensator computer followed and a large puddle of coffee was found on the floor by the captain's briefcase.

"Apparently, a lot of coffee had been spilt in this area, before the aircraft arrived at . . . . . and had been slowly penetrating into the computer base. When the pitch trim compensator was checked in . . . . . . before take-off, it was working properly, but about 10 minutes after take-off it started working erratically for a short time and finally shorted completely in the fully extended position."

And here is more "fluid for thought."

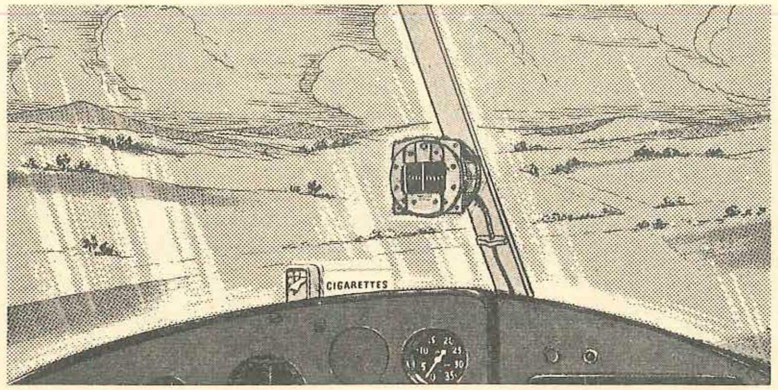
"An overspeed condition occurred on all four propellers of a transport carrying 65 passengers on an overwater flight. The overspeed condition resulted from a short in the electrical circuit caused by coffee spilled on the turbo over-ride switches. In this particular type of aircraft, our report shows, other mechanical as well as communication malfunctions have been caused by the spilling of coffee, fruit juices, soups and other liquids on control switches.

* "The first officer of a European transport requested a glass of a well known effervescent, stomach tranquillizer type concoction shortly after take-off. At the precise moment of transfer of the drink from the hand of the hostess to the hand of the first officer, turbulence caused a small amount of the liquid to be spilled on the pedestal. The captain immediately asked for a cloth, but, before the spillage could be mopped up, one inverter switch had shorted out, blowing the fuses. Surface moisture was wiped up and the second inverter turned on. It promptly shorted out also blowing more fuses. Flight conditions at this time were instruments, with moderate turbulence. The captain made a turn back toward his point of departure and the emergency inverter was turned on. This inverter also shorted out. Fortunately, the departure field was sighted through a break in the clouds and a landing made without further incident."

The following conclusions, made four years ago, would appear even more valid today:—

Here is a case where prevention is the cure. But should it ever happen, it might hurt our vanity to write "coffee spilled on pedestal," but it won't hurt our flying safety to have it written up. It is easier to clean coffee off a wiring terminal than an airplane off a hillside.

***This account seems to bear more than a chance resemblance to the Australian incident which appeared in the Digest referred to at the commencement of this article.**



Another HAZARDOUS INFLUENCE

An article entitled "Hazardous Influence" which appeared in Aviation Safety Digest No. 22 of June, 1960, contained the results of tests conducted with a popular type of photographic light meter which, in common with portable radios and similar objects, was proved to cause a compass deviation varying from 5 degrees at a distance of 20 inches to 90 degrees at two inches.

As a result of recent similar investigation, even greater deviations are found to be caused by a magnetic based cigarette packet holder which is now on sale. It is made of fabric covered with a plastic material but has a powerful magnetic base.

Tests conducted with one of these holders showed that a 15 degree deviation was induced into the B20 compass when the holder was approximately 12 inches from the compass. With the pilot's seat of a Boeing 707 in its rearmost position, the action of passing the holder from pilot to co-pilot introduced a three degree deviation in the B20 compass. At this time the holder would be approximately six feet from the compass.

Further tests showed that error could be introduced into the Polar Path compass when the holder was brought near the Polar Path compass transmitter, one of which, in the Boeing 707, is situated in the main cabin.

This problem could be even greater in light aircraft due to the fact that these aircraft, in the main, have only a magnetic compass as a directional reference and the cigarette holder could be placed in the windshield vee.

The main danger with these magnetic based holders and also magnetic based hand torches is that the items in themselves appear innocuous and therefore offer no alert to this danger potential. The cigarette holder particularly could be carried in a shirt pocket by a pilot and cause large magnetic compass deviations without its influence on the compass becoming apparent.

VERTICAL SEPARATION DURING DESCENT

Evidence obtained in recent investigations into incidents in which the minimum vertical separation for aircraft has been transgressed indicates that some pilots may not be aware of the requirements for the rates of change of level which have been specified in A.I.P's to ensure maintenance of vertical separation, particularly during stepped descents.

During a stepped descent sequence involving two or more aircraft, it is normal for an aircraft to be cleared to the next lower level when that level is vacated. One thousand feet is the minimum vertical separation permitted between any two adjacent aircraft. The A.I.P. prescribes that the last 1000 feet of a level change shall be made **AT 500 FEET PER MINUTE.** Provided this rate is accurately maintained by all aircraft under these circumstances, the minimum permitted vertical separation of 1000 feet beween aircraft will be maintained. Conversely if the higher aircraft descends at a rate of 500 feet per minute and/or the lower aircraft descends at a lesser rate, separation could be seriously reduced.

Don't Be A Crowd Pleaser

Anybody who has attended any contest of human skill will agree, that irrespective of any additional dangers that may be involved, some of the participants go to extremes to provide spectacular excitement for the onlooker and thus become a subject for "hero worship." It is not difficult to recall names of many of these famous crowd pleasers who have ultimately suffered serious injury. It is natural that we all like to be praised at some time for our ability to do something better than the other fellow, but in aviation this urge to excel can have fatal results if any unorthodox manoeuvre is performed at an unsafe height.

Over the years accidents of this nature have occurred, the most common type being the attempts to show flying ability by flying low over houses occupied by friends or relations. All too many of these exhibitions have resulted in a tragic loss of life.

Unfortunately spectators on the ground cannot always gain a full appreciation of spectacular aerobatics performed in light aircraft above 3,000 feet and this fact causes pilots to succumb to the temptation to perform their aerobatics at unsafe heights. The spectators have certainly received their share of excitement from this source but not without the grim reaper taking his share. We also have on record, exhibitions of crazy flying at an extremely low height which have resulted in disaster.

The pilot concerned in a recent accident was assessed as above average in his flying capabilities but he had a reputation as a crowd pleaser. Following a period of aerobatics over an aerodrome in a DH82 aircraft, he returned for landing and in making a long high approach, descended the aircraft in a nose high attitude with the airspeed reduced to near the stall. At about 400 feet, finding that he was overshooting, he commenced a side-slip without increasing speed and almost immediately the aircraft stalled and entered a spin. There was insufficient height for recovery to be completed and when the port mainplanes struck a tree the aircraft plunged to the ground. Fortunately the pilot escaped with minor injuries but the aircraft was extensively damaged.

There was no valid reason for the pilot to attempt a sideslip at such a low speed whilst flying so near to the ground, and it can only be assumed that he was trying to impress spectators at the aerodrome. If the aircraft had been flown in a similar manner at a safe height no accident would have resulted, but the combination of low speed and low height reduced the safety margin to zero, and very little reduction in airspeed coupled with a turning moment was required to induce a stall and spin at a height which made an accident inevitable.

Remember when you have an audience on the ground, you may experience a temptation to fly the aircraft in an unusual manner to attract attention. Don't yield to this temptation unless your proposed manoeuvre can be performed in accordance with common sense and the rules of the air. Above all retain adequate margins of safety.

Look Before You Leap

Two private pilots took a Cessna 172 on a cross country flight and landed at a country aerodrome late in the afternoon. They stopped the aircraft six feet short of an underground refuelling point, hoping to be refuelled in time for an early take-off the following morning. The flush fitting lid of the refuelling point, measuring 26" x 20" was removed to help the fuelling agent, but he could not be located. The two pilots then boarded the aircraft, and started the engine with the intention of taxying to the main parking area, but after the aircraft had moved six feet, the nose wheel entered the uncovered pit. Very costly repairs were necessary involving a fractured engine crankshaft as well as a damaged propeller.

A moment of caution and thought could have saved two very red faces and considerable expense.

Mental Dead-Reckoning

(Extract from Flight Safety Foundation Bulletin)

Here are some rules of thumb which may be of interest:—

1. Flying at 20,000 feet the reading on the Mach meter can be directly interpreted as your true airspeed in (nautical) miles per minute flown —

   e.g., 0.6 Mach at 20,000 feet is 6 nm per minute=360 k

2. At 40,000 feet, the IAS is almost exactly one-half true airspeed — e.g., 250 k IAS at 40,000 feet is 500 k TAS

3. To compute time for distance to go, there is a simple technique which avoids the use of tables. The idea is to convert your known (or estimated) ground speed into miles per minute flown — e.g.,

   Distance to next fix: 72 nautical miles

   Ground speed: 360 k

   Miles per minute: $\frac{360}{60} = 6$ mpm

   Time for 72 nm: $\frac{72}{6} = 12$ min.

   If you are flying at some speed which is not an increment of 60 k, there is a method of getting around this to avoid mental computations of fractions of miles per minute—

   e.g., Ground speed: 270 k This lies half-way between 4 and 5 mpm (240 and 300 k)

   Distance to go 20 nm

   Time at 4 mpm = 5 minutes

   Time at 5 mpm = 4 minutes

   Since 270 k lies between the two speeds, the time for 20 nm is $4\frac{1}{2}$ minutes.
   This may appear a bit complex at first sight, but after a little practice it is effective.

4. Also useful is the "1 in 60" rule. An angle of 1 degree subtends a distance of one mile over a distance of 60 miles. From this it follows that over 30 miles the distance off for 1 degree is $\frac{1}{2}$ mile, etc.

   e.g., You are flying an airway for which the VOR radial is 270 degrees. Your VOR is in fact indicating 260 degrees (To), and by D.R. (or DME) you have 30 miles to go. You want to know your position relative to the airway centreline:

   30 miles = $\frac{1}{2}$ mile for 1 degree

   VOR error = 270° – 260° = 10°

   Track error = 10 x $\frac{1}{2}$ = 5 miles N

   In this example the rule is, of course, subject to VOR errors, but apart from this it is accurate up to angles of 15 degrees over 60-mile distances."

COMMENT

All pilots will find these simple rules of thumb invaluable for pilot navigation and for preventing gross errors at the time of flight planning.

All navigators will find that the application of these rules of thumb will largely eliminate gross calculation errors.

CHECKING GUARDED SWITCHES

Although many of the switch guards in our cockpits are intended to operate the switch into the desired position when the guard is snapped down, there is a possibility that full movement of the guard may not properly position the switch. Make it a habit always to check that the switch has operated as desired. If time permits, position the switch first and then drop the guard down.