FLYING SAFETY

INSPECTOR GENERAL · U. S. AIR FORCE

DESIGN FOR SAFETY—THE C-124

MAY 1952

ARE WE A GOOD RISK?

THE American people believe that Airpower is needed to guarantee their country's security. They have asked for a strong Air Force—not one bigger than the preservation of our democracy requires, nor one so expensive that it will bankrupt the country. Americans are paying heavily to provide the budget out of which such an Air Force can be built. They have faith that we in the Air Force will match their sacrifices with efficient and economical operation. In effect then, the Air Force has the mission of getting the maximum Airpower for the minimum funds expended.

In carrying this mission to its goal there is one factor which we must bear in mind constantly. America's resources are not unlimited. Therefore, we must be aware of the danger in squandering any part of them. Otherwise economic suicide could defeat us. By eliminating unnecessary waste in our operations not only will we be able to forego the shadow of economic suicide, but we will also be able to live up to the expectancies of the people who support us.

The question, then, is this: Are we a good risk? Or, are the people, our partners and supporters in this Air Force, being cheated? Let's look at the facts.

A pilot puts on a private air show (even though he knows such an act is contrary to regulations) so his home-town folks can see the fine new fighter they helped buy and the fine training thousands of dollars provided. When they gather around the smoking wreckage after a neat buzz job, they are faced with the fact that tax money and resources, perhaps of a higher valuation than the entire village, have been wiped out—squandered.

Was this pilot serving the people?

A mechanic lets a faulty fuel line go until the next inspection. Later the plane bursts into flame and crashes.

Was he aware that every man who wears our country's uniform is in partnership with the American people?

A commander fails to brief his crews properly on procedures to be used during a formation flight. Two planes collide, three others crash-land after becoming separated from the squadron.

Was he trying to help give the American people an Air Force within the price they can afford to pay?

It would be a startling thing to question a man about his loyalty to the country after he had caused an aircraft accident.

Without a doubt he would insist that he as much as anyone else was concerned that this nation be provided with the most powerful air arm possible. Unthinkable that anyone would hint that he had betrayed the trust of his nation or the mission of his service.

General Bradley once said: "A democracy such as ours cannot be defeated in this struggle (for freedom); it can only lose by default. It can only lose if our people deny through indifference and neglect their personal responsibilities for its security and growth.

"Our danger lies not so much in a fifth column whose enmity is avowed. It lies in a first column of unconscionable men who are 100 per cent citizens in their daily routine of neglect."

Our people are buying an insurance policy. In it there is no room for the squanderer, the waster, the careless, or the neglectful. We must strive to see that we do not betray the trust of our nation as a whole or of ourselves as individual servicemen and citizens.

We must be a good risk!

THIS MONTH

Few flyers will dispute that good, standardized flying procedures can be very valuable in flight safety. The difficulty has been that too many of those same flyers have been most reluctant to do anything about instituting a standardization system. Not so with MATS. In that Command, standardization and pilot proficiency most certainly are emphasized. Beginning on the next page is an article on the MATS Chief Pilot system which is credited with helping that command become one of the safest "airlines" in existence. Possibly, the principle of the system might be used by other organizations.

We seldom brag up our editorials, but the one in this issue, on the facing page, is worthy of mention. It was originally written in 1949 by Maj. Homer P. Andersen, who was then Editor of FLYING SAFETY. Since that time the United States has become involved in a shooting war which makes the editorial even more pertinent today than when it was written. The answer is obvious—fly safely.

Beginning on page 21 you will find an article on the Air National Guard Gunnery Exercise which took place at George AFB, Victorville, Calif., during the week 31 March-4 April. Obtaining the article and photographs in time for this issue of FLYING SAFETY entailed a considerable amount of scurrying on the part of a couple of our staff members, inasmuch as the printing deadline was 5 April. The story was written by Lt. Ed. Hogan and all photographs were taken by Capt. Ben Newby. The exercise itself was very well planned and executed with safety receiving its full share of attention. The fact that two of the gunnery teams had to receive F-51 transition before they could participate, and that they were then accident-free and even compiled respectable scores, indicates that safety was an integral part of the exercise. It also indicates, of course, the fact that our Air National Guard pilots are pretty capable men. We salute them.

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SHARE IT

It's impossible for us to supply sufficient copies of FLYING SAFETY for each person to have a personal copy. Please, cooperate with us in our efforts to get this magazine before the eyes of as many people in the Air Force as possible. FLYING SAFETY officers or others who make local distribution of this publication are requested to emphasize this to all personnel. Possibly a small poster style sign would do the trick.

THE COVER

The C-124 shown on the front and back covers is an airplane which was designed with safety in mind as well as operational performance. For the story on its outstanding features, see "Design for Safety," page 18.

Flying Safety

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The printing of this publication has been approved by the Director of the Bureau of the Budget, June 4, 1951.

Facts, testimony and conclusions of aircraft accidents printed herein have been extracted from USAF Forms 14, and may not be construed as incriminating under Article 31 of the Uniform Code of Military Justice. All names used in accident stories are fictitious.

No payment can be made for manuscripts submitted for publication in FLYING SAFETY magazine. Contributions are welcome as are comments and criticisms. Address all correspondence to the Editor, FLYING SAFETY magazine, Deputy Inspector General, USAF, Norton Air Force Base, San Bernardino, California. The Editor reserves the right to make any editorial changes in manuscripts which he believes will improve the material without altering the intended meaning.

A Chief Pilot System Insures Standardization of Procedures and Highly Proficient Pilots for MATS. More Than That, It Leaves

NO ROOM FOR GUESSWORK

THERE IS A STORY of a pilot who decided one day during a particularly tight landing situation that a go-around was more discreet, if less valiant, and called "takeoff power" to his copilot. At this point, the story continues, the gentleman in the right seat reached for the throttles and did just that—took off power.

No record exists of a copilot's having been beaten to death with a throttle quadrant, which makes the tale suspect on the face of it. But undeniably it could happen, although the likelihood that such a comic opera bit would occur in the transport divisions of the Military Air Transport Service is slim indeed.

MATS' 100,000 miles of scheduled transport represent a global concept. The scope of the job to be done is so vast as to defy measurement. At the moment a planeload of whole blood takes off for the Far East, there is a requirement for high priority cargo or manpower in Europe, in North Africa, or at the top of the world. As the postman does not let mutations of nature interfere with the swift completion of his appointed rounds, MATS does not gamble that it will fail to meet its worldwide commitments because of guesswork in the cockpit. The Military Air Transport Service is confident its Chief Pilot program has eliminated the element of chance.

Essentially, the Chief Pilot program aims at insuring that MATS will meet its global obligations through complete standardization of flying techniques. Col. Raymond L. Curtice, World War II combat commander who went to MATS via Strategic Air Command and now bosses the Chief Pilot Division of MATS Headquarters, defines it thus:

"Within transport operations, we are seeing to it that a crew from the Pacific Division flies exactly the same as a crew from the Continental or Atlantic Divisions and, therefore, all are interchangeable."

There are three branches in Colonel Curtice's Chief Pilot Division: standardization, procedures and navigation. The greatest of these, as the "Good Book" might say, is standardization. Techniques and practices are worked up by the standardization branch in concert with the Chief Pilots of the divisions, groups and squadrons. These are translated into manuals which dictate the manner in which equipment will be flown and which are published by the procedures branch.

Maj. Patrick B. Houser, of the Standardization Branch in Colonel Curtice's division, believes that one need look no farther than Korea for proof that the Chief Pilot program works.

A wartime B-25 pilot who flew three postwar years with American Airlines before returning to the Air Force, Major Houser recalls that Continental and Atlantic Divisions were tapped for aircraft and crews to join Pacific

Division in conducting the vital airlift to the Far East. "Because we had standardized techniques," says he, "it was possible to schedule a copilot from Wiesbaden with an aircraft commander from Hickam and know that the flight would get through safely because both would fly by the book."

The record speaks for itself. From 1 July 1950 to 1 December 1951, MATS and its assigned Troop Carrier units flew more than 29,000 passengers, more than 9,000 tons of cargo and almost 2,000 tons of mail on the Pacific airlift. In almost the same period MATS airlifted almost 28,000 battle casualties and more than 9,000 other military patients. But important as the Pacific Airlift was—and is—it represented only one-fourth of MATS transport operations between 1 July 1950 and 1 November 1951. Overall, in this time, MATS flew approximately 597,000 passengers and more than 97,000 tons of cargo and mail.

In these extensive operations, MATS compiled a safety record unmatched in the Air Force. This record, most MATS people believe, could never have been established without the Chief Pilot system.

The Chief Pilot system in MATS is mandatory only in the transport divisions—Atlantic, Pacific and Continental. It is not found in the services MATS operates, such as Air Rescue and Air Weather. Last year the transport

Capt. Carroll Bracy (left) and Capt. George Schmidt of the 1255th Transport Sqdn. Bracy is chief pilot of squadron.

Array of gages and switches before M/Sgt. Frank J. Osborne, of 1252nd Transport Sqdn., is the engineer's panel of a C-97.

Of course, all the credit for the excellent flying safety record of MATS can not be credited to the Chief Pilot program. Hard working conscientious maintenance men contribute.

divisions flew three times as many hours as all of these other services combined, yet the overall accident rate for the three was only one-third that for the services.

Exclusive of those in Colonel Curtice's shop, there are 39 chief pilots responsible in large measure for the MATS record—12 in the Continental Division, 10 in the Pacific Division and 17 in the Atlantic Division. They are not necessarily selected on the basis of the flying time shown in their Forms 5.

Selection of a chief pilot is a command function. In general, commanders choose not only pilots who are thoroughly wrapped up in the transport business but who are also able to temper the "old college try" with sound judgment. Lt. Col. John H. Hudson, who heads the Chief Pilot office in the Atlantic Division, sees the average chief pilot as one with five or six years and between 5,000 and 6,000 flying hours behind him, "who has the ability to evaluate crews objectively and make intelligent reports to his commanding officer."

The Chief Pilot idea is not new but as presently applied in MATS, flesh and muscle have been added to the skeleton. The system had its origin in the civilian airlines and entered the military via the old Air Transport Command when that organization began to attract airline pilots and executives.

In the beginning it was set up rather informally as part of flight operations. Colonel Hudson recalls a time when the South Atlantic Division of ATC had a few senior instructor pilots whose functions were similar to those of today's Chief Pilots. But whether termed check pilots, senior instructor pilots, or any other name, it is generally accepted that they were concerned primarily with proficiency level and upgrading of crews.

The MATS concept of today's Chief Pilot is extremely broad. MATS Regulation 36-1 of 17 July 1950 establishes the position and defines the responsibilities. The document directs that an officer be assigned primary duty as chief pilot at squadron and division level and additional duty at group and wing level. And it brings the Chief Pilot squarely into the overall operations picture with this proviso:

"With the implementation of the new MATS training program, the need for close supervision of training, proficiency and currency of MATS transport pilots is essential to maintain our high safety standards. To insure the highest possible standardization of pilot technique, the Chief Pilot functions are established at squadron, group, wing and division levels."

Colonel Hudson thinks of this regulation as a Magna Charta of sorts because it gives de facto recognition to the program and substance to the Chief Pilot's responsi-

Prime concern of this MATS Chief Pilot group is safety. With Col. Raymond L. Curtice, MATS Chief Pilot, seated, are: Left to right: Lt. Col. Paul Thorson, Navigation Branch; Maj. Charles Weber, Standardization Branch; and Maj. John Phillips, Procedures Branch.

bilities as a staff officer, obliged to keep his commanding officer abreast of all matters which concern aircrews.

A Chief Pilot is suited well for this task. He is the one person who is always conversant with problems affecting crews. The very nature of his duties requires that he review all flight check and trip reports, in addition to taking an active part in standardization board meetings and flying safety programs.

Typical is Capt. R. C. Hausler, chief pilot for the 1251st Air Transport Squadron, operating in the Atlantic Division out of Westover AFB, Mass. His status board tells at a glance the flying record of each pilot assigned. He is not concerned with crew assignments except to insure that a first pilot who needs an original line check is not signed out as an aircraft commander. The trip reports he monitors form the basis for recommendations he makes at the standardization board meetings. Then there is the matter of the check rides he conducts personally; in nine months last year he gave 60.

It is a popular misconception among pilots that standardization, as practiced in the MATS Chief Pilot system —or in the civilian airlines—penalizes personal initiative. On the contrary, says Major Houser, it does just the opposite; it places a premium on individual initiative.

"It is true," he says, "that when any specific flying technique is agreed upon, the directive comes down from the top. But the important point is that a standard procedure is adopted only after it has been discussed among the aircrews themselves, at standardization board meetings in the lower echelons and after discussions with all concerned, including Air Materiel Command, airframe manufacturers, engine manufacturers, and so forth."

A comparative newcomer to MATS, Col. James M. Johnson, Commanding Officer of Atlantic Division's 1600th Air Transport Group, believes that in daily operations the Chief Pilot system will supply standardization to its maximum potential.

Colonel Johnson, who served previously in Training Command and SAC, thinks of standardization in terms of two things: flying safety and the level of proficiency for which the aircraft was designed.

"Air Force," says Colonel Johnson, "is always faced with new operating conditions and changing procedures. In my opinion, the Chief Pilot system provides a central authority which can screen a multitude of problems and come up with a single solution rather than multiple answers."

One result of the system, although generally overlooked, is the contribution it makes to maintenance efficiency. Protagonists point out that crews who fly the equipment in standardized fashion see eye-to-eye on discrepancy reports. This means that maintenance people receive one version, instead of the many it might get if everyone flew the equipment differently. Thus, engine and equipment life is prolonged and utilization is boosted.

The system of checks and reports devised by MATS chief pilots themselves guarantees adherence to standardized techniques. For example, an aircraft commander makes a report on each crew position at the end of every over-water flight. His report on the copilot covers the widest range of items, from personal qualifications to the manner in which he controls the aircraft. In like manner the aircraft commander is required to grade the navigator, flight engineer and even the flight attendant. These reports, when screened by the squadron Chief Pilot, give him an insight into the proficiency of assigned crewmembers.

Each crewmember is required to undergo a line check every six months. The proficiency flight check designed by the MATS Chief Pilot Division for all pilots comes as close as possible to eliminating individual opinions of the instructor plane commander conducting the check. There are 17 sections in this check, beginning with equipment familiarization and ending with a no-flap landing. Performance is graded as the pilot flies through each maneuver and each section is completed before the next one is begun. Thus, a pilot who flubs an instrument takeoff does it properly before he is permitted to get on with the next step, a range letdown.

Since MATS operations are so vast and depend upon aircrew proficiency for safe and successful conduct, Chief Pilots are out in the field almost constantly monitoring flying techniques. A four-man team from the standardization branch at MATS headquarters makes a monthly trip to each division. In turn, division, group and squadron Chief Pilots are required to make check rides over the runs for which they are responsible. The schedule drafted

MATS transport aircraft carry passengers and cargo to all parts of the world on regularly scheduled flights. Cargo loading procedures shown in this photo are typical.

by Colonel Hudson puts a representative from his office over every route operated by the Atlantic Division each month.

The Chief Pilot, however, is not exclusively an agent for inspection. He is part of an idea workshop, which distills the suggestions made by those who are flying and maintaining the equipment. Such important items as flight logs and range control plans, which pinpoint pilot technique and aircraft performance, came out of the Chief Pilot laboratory. At the moment, in the interest of cutting down senseless radio chatter, the MATS Chief Pilot Division is experimenting with a standardized voice control plan which can be printed on the reverse side of the Form 175. Tests being conducted between Andrews AFB and Westover indicate, says Colonel Curtice, that the idea is sound. The Chief Pilot Division maintains close liaison with airlines and civilian agencies and currently is coordinating a "minimum systems program," which would permit flights even though certain, non-essential items were not operative.

In 1951 MATS increased its flying time by 34 per cent over 1950 and accompanied this increase with a respectable decline in its accident rate. It is worthy of note that MATS transport flights operate primarily on an individual basis. A squadron commander's crews are spread out over the runs for which he is responsible. Unlike a commander in a tactical organization, he cannot place himself in a tail-end aircraft and observe a formation of his assigned aircraft. Standardization becomes increasingly important with the understanding that a MATS commander cannot cut himself into fractions to oversee the flying. He must depend on common procedures embodied in the Chief Pilot program.

Despite the fact that the Chief Pilot system has paid rich dividends in safe operations, MATS makes it a subject for continuing study. At the moment a new regulation is being considered which would increase the Chief Pilot's responsibilities and tie the various services into the program. It would require Headquarters AACS, Headquarters ARS, Headquarters ARCS and Headquarters AWS to establish standardization boards which would develop crew and flight procedures for each model aircraft assigned units under their operational control.

The proposed regulation indicates the great store that MATS sets by a system it has weighed over the years and found tailor-made for its mission. Lt. Col. Frank Wagner, Executive of the 1600th Group, recalled recently the impact the program has even on veteran MATS pilots.

"I was on my way to the office," he said, "when I ran into one of our most experienced pilots. We talked for a minute before this captain said to me, 'Guess I'd better start boning up. I've got a line check due in a month.'

"When a flier as able and experienced as he starts thinking of a check a month before it's due, I'd say it proves the value of our Chief Pilot system," Colonel Wagner observed.

So far as MATS is concerned its Chief Pilot system, like the airplane, is here to stay.

Here are the functions of the MATS Chief Pilot:

★ Development and standardization of MATS flight policies and procedures governing operation of specific type aircraft assigned to the Military Air Transport Service.

★ Preparation and publication of MATS manuals, regulations, aircraft checklists and other directives designed to further the flight principles of safety, efficiency and uniformity throughout the MATS global system.

★ Continuous monitoring of field units application of prescribed flight policies and procedures to assure prompt solution of problems encountered by operating agencies and to effect necessary amendments and revisions to published directives.

★ Establish standards of aircrew experience, proficiency and currency at a level designed to achieve utmost operational efficiency in combination with the highest possible degree of Flying Safety.

★ Maintaining close liaison with MATS operating units, manufacturers field service representatives and other transport operating agencies to assure an up-to-date technical knowledge of the aircraft operated by MATS units throughout the scope of activities for which the Military Air Transport Service is responsible.

★ Perform as the MATS Air Safety Officer and, in that capacity, exercise close personal supervision of the Air Safety Branch in the investigation of aircraft accidents, accident prevention measures and the command-wide dissemination of information pertinent to Flying Safety.

NOTHING EVER HAPPENS TO A "GOONEY BIRD"

chutes on. It was wasted breath, since we were doing same with the utmost speed. Then he pulled the emergency door jettison handles on the cargo doors. The handles came off but the doors stayed in place.

About the time he got the paratroop door open, I had finally gotten my chute on. It was one of those four-way quick release gadgets that take a little time to put together when you're shaking as badly as I was. And guess what I discovered then! I'd pulled the leg straps straight up and locked them, neglecting to pull them through the straps provided at either side of the harness. Big morale factor, that. But no time to take the harness apart and start all over again.

The copilot had left the cockpit and the plane was spiralling crazily to the right. As the spiral grew tighter, the G forces built up and forced the crew chief and myself to the floor. The pilot gave the bailout order, and when the rest of us seemed reluctant to be the first out the door, he jumped out head first.

The crew chief seemed to be stuck in the door by centrifugal force, so, I, being of generous nature, put my feet behind him and assisted him out. I could have said I kicked him out, which is true, but then, you might suspect that this action was prompted by a knowledge that if he didn't get out of my way, I couldn't get out either, rather than by generosity.

Next out was the other fighter jockey, a brand new 2nd Lt., who seemingly had not heard of RHIP and age before beauty. And then my turn. Grasping the outsides of the door, I gave a mighty heave—and out into the black. If the chute opened I was fat. If not, I guess, flat. I saw the horizontal stabilizer pass over me and started fumbling for the "D" ring. Recalling previous training, I kept my legs close together as I pulled the ring.

The chute opened with a terrific jolt, momentarily stunning me. A few seconds later I discovered that, at least for the moment, I was OK. The chute was oscillating back and forth, but not too wildly, and rather than try to stop the swinging by pulling on the risers, I figured I had best leave "well enough" alone. I didn't want to take a chance on pulling the wrong riser and collapsing the canopy.

At this time I perceived that the aircraft had spiraled again and seemed to be heading straight for me. Luckily, it passed below me about 150 yards away, and continued to spiral and burn. Very spectacular sight.

Not knowing what sort of terrain I might hit, I prepared myself for a possible tree landing by relaxing my legs, and covering my face with one arm. I hit in a swamp, partially on my back and left side in about two feet of water, swamp grass, rushes, and saw grass. The canopy dragged me about ten feet before I was able to turn the quick release button and get out of the harness. What happened the next eleven hours in the Everglades before we were rescued is another story.

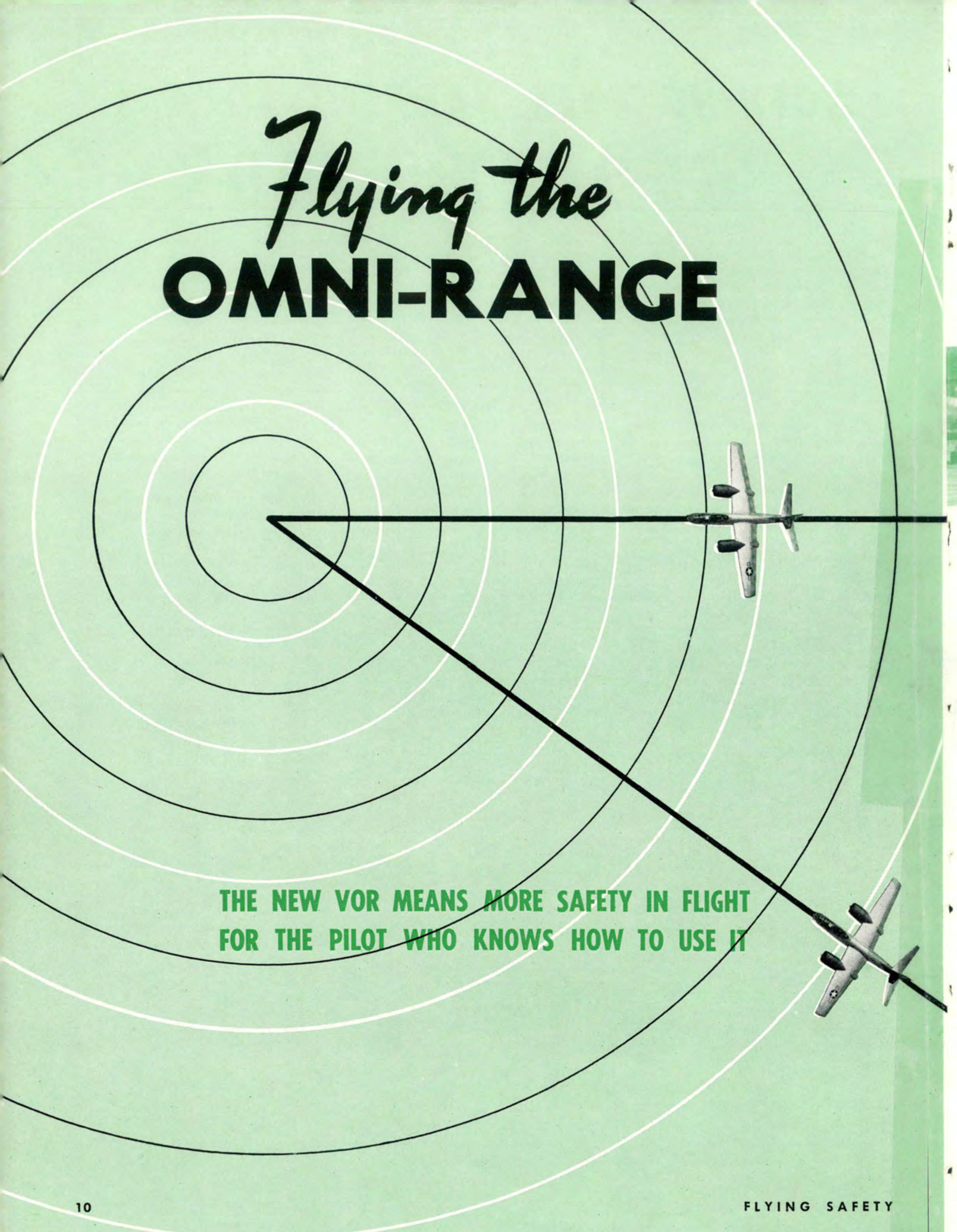
The members of our ill-fated flight estimated that we were in the aircraft no longer than from 1½ to 3 minutes after the fire broke out. And the aircraft disintegrated in the air very soon after we bailed out. If there had been passengers aboard who had not had thorough training and a lot of practice in the act of donning a parachute in a minimum length of time, someone would have been killed. Aircraft commanders should rigidly enforce the proper wearing of parachutes, both by passengers and other rated personnel aboard.

I made several mistakes. I didn't wear a parachute or detachable harness. When the emergency arose, I didn't strap a parachute on correctly, and was pretty well bruised as a result of that. Because I knew that the harness was improperly adjusted, I was reluctant to leave a ship that I knew I couldn't ride down, and thus lost precious seconds when even one second might have meant the difference between life and death.

And all of this because I'd always heard that nothing ever happens to a "Gooney Bird." Don't you ever believe it!

Wear that chute!

Flying the OMNI-RANGE



THE NEW VOR MEANS MORE SAFETY IN FLIGHT FOR THE PILOT WHO KNOWS HOW TO USE IT

AS MILITARY AND CIVIL weather flying has made progress, due to better instrumentation, increased knowledge and proficiency of pilots, the airways have had to control an ever increasing number of aircraft with antiquated, or at least inadequate, radio facilities.

Not only has "airspace" become saturated in many metropolitan areas, causing air traffic control problems, but communication facilities have been taxed to the limit of their effectiveness. The need for new air traffic control procedures and facilities has long been recognized and now with the advent of a new "radio aid," a far-sighted and well planned program is getting under way.

The nucleus of this program is VOR (VHF Omni-Range). With VOR, both the pilot and the traffic controller gain many advantages over today's low and medium frequency ranges and the visual aural ranges.

To the pilot, VOR means: no more ear-numbing "dit-dahs" and crashing static; elimination of time-consuming orientations to determine his position; simple *visual* indication of his location and corrections necessary to reach any desired position; and a significant reduction of weather-induced troubles such as swinging beam legs, inaudible signals, and lightning-deflected indications.

The traffic controllers will be able to move large numbers of aircraft along parallel multiple airways with the assurance that the pilots know more accurately their position, distance and bearing from the VOR's at all times. They will be able to communicate with pilots over uncongested radio channels and be assured of reliable, one-time transmissions; no more delaying repetitions.

Since VOR is soon to be the primary point to point radio navigational aid, and L/MF and VAR ranges are to be replaced by VOR, it is obvious that you, as a military pilot, must become proficient in all aspects of its operation.

Obviously, the radio range would have much greater utility as a navigational aid if it could furnish exact directional information to the pilot *at all times*, regardless of the position of the aircraft with respect to the range station. This objective has led to the development of the Omni-Range.

The Omni-Range, derived from the Latin "OMNIS," meaning "all," produces a theoretically infinite number of courses which radiate from the station like spokes from the hub of a wheel. Directional information is thus generated at the station and transmitted to the aircraft. Airborne omni-range equipment intercepts this signal and converts it into a visual directional indication for use by the pilot.

The VHF omni-range is designed to operate within the 108-136 mc band, which is relatively free from atmospheric and precipitation static. The power output is approximately 200 watts. Since the facility utilizes Very High Frequency, it is subject to the same line-of-sight restrictions as the Visual-Aural Range. Although the VOR may normally be received 150 miles from the transmitter at high altitudes, its operating range for providing dependable signals at minimum instrument altitudes is considerably less. Consequently, VOR facilities are being spaced approximately 100 miles apart.

In the same way that an intervening hill or other obstruction will block or reflect a light beam, such objects will interfere with VHF reception, and the actual location of VOR sites present a critical problem. For dependable operation, it has been found necessary to locate VOR sites on "high ground" and remove nearby obstructions.

Any selected VOR course is considered to be approximately the same width as the visual course of a VOR facility, normally four degrees, from one-point right to one-point left deflection of the localizer pointer.

The VHF omni-range is equipped with a simultaneous voice facility. Except during voice transmissions, the station identification is transmitted intermittently by means of 1020-cycle keyed tone. Plans are for automatic recorded voice identification to be used for identification. In addition, weather and notams are transmitted at intervals.

The principle of the omni-range is based on the comparison of the phase difference between two radiated audio frequency signals, the difference in phase varying with change in azimuth.

One of these signals is non-directional. It has a constant phase throughout its 360 degrees of azimuth, and is called the REFERENCE phase. This signal is radiated from the center antenna of a five element group. In order to separate the two signals for comparison in the receiver, a 10 kc FM subcarrier is used to carry the reference signal. The center antenna is also used to carry the voice transmissions.

The other signal rotates at a speed of 1800 rpm, varies in phase with azimuth, and is called the VARIABLE phase. It is produced by a group of four stationary antennas, which are connected in pairs to a motor-driven goniometer. As the goniometer revolves, the RF voltage fed to each pair of antennas varies sinusoidally at the rate of 30 cps to produce the rotating field.

The rotating signal is initially set so that at magnetic north the reference and variable signals are exactly in phase. In all other directions, the positive maximum of the variable signal will occur at some time later than the maximum of the reference signal. The fraction of the cycle which elapses between the occurrence of the two maxima, at any point in azimuth, will identify the azimuth angle of that point.

For an analogy to help visualize the method of determining bearing from the transmitter, let's use the case of an airport beacon. Suppose the identification flasher "can" is so adjusted that the green airport identification light flashes each time the light beam sweeps past magnetic north, and the beacon rotates clockwise at 6 rpm, one revolution each 10 seconds, or 36 degrees per second.

If the pilot wanted to determine his direction from the beacon, he could use a stop watch, starting the watch at the instant he saw the start of the green flash and stopping it when the rotating beam swept past. Then multiplying the number of seconds shown on the stop watch by 36, he would obtain a magnetic bearing from the beacon.

Suppose that exactly five seconds elapsed from the start of the green flash until the rotating beam flashed past you; $5 \times 36 = 180$ and his bearing from the beacon would be 180 degrees.

It is evident that the same time would elapse and the same bearing be obtained should the plane move directly toward or away from the beacon without changing direction with respect to the beacon, regardless of distance. If the plane should move to the right, approaching the beacon, less time would elapse between the green flash and the beacon flash; if the aircraft moved to the left, the interval would be longer. In effect, the reference and variable voltages of the omni-range provide the same information electronically that the flasher and beacon supply visually in this example.

The navigation circuits are connected to a manually-operated course selector, a deviation indicator, which is the familiar localizer pointer of the ILS indicator, and a special device known as a sense, or To-From, Indicator.

THE COURSE INDICATOR

The rotating compass card, being a repeater of the Gyrosyn compass, continually presents the aircraft's magnetic heading under the fixed lubber line at the top of the case. When a VOR is tuned in, the double-barred needle points to the station, in the same manner as the present compass. However, since the compass card rotates to keep the magnetic heading under the lubber line, the indication of the double-barred needle is the *magnetic bearing* of the aircraft to the station. If the pilot desired to use the information in fixing his position, the aircraft-to-VOR magnetic bearing would be under the tail of the needle. The single-barred needle is identical in operation. It is provided in event a dual VOR receiver is installed, in which case two-station bearings could be taken simultaneously. The single needle may be connected with a conventional radio compass if desired.

If the pilot wished to proceed to the VOR tuned and indicated by the double-barred needle, he would merely "turn into the needle." When the needle was under the lubber line he would be headed toward the VOR.

For clarity, the following should be understood. With VOR, magnetic bearing, course, and track are synonymous. The pilot selects a magnetic bearing from a VOR, which is in effect, a course or track. For example: the 90° radial is the course line, or track, which starts at the VOR and extends magnetically east at 90°. The aircraft may be flown to or from the VOR on the 90° track. The course indicator furnishes the pilot with course and direc-

tional information. With the aircraft headed for the VOR, suppose the pilot desired to fly a certain track to it. He could select any radial (with the bearing selector) within 90° right or left of his heading, and his to-from indicator on the course indicator instrument would indicate "TO."

A radial selector over 90° right or left of the heading, directly to the VOR would cause a "FROM" indication, telling him that flying that selected radial would take him away from the VOR. If the aircraft was not headed at the VOR, and a radial selected, the TO-FROM indicator would give an immediate indication whether flying that radial would take him to or away from the VOR.

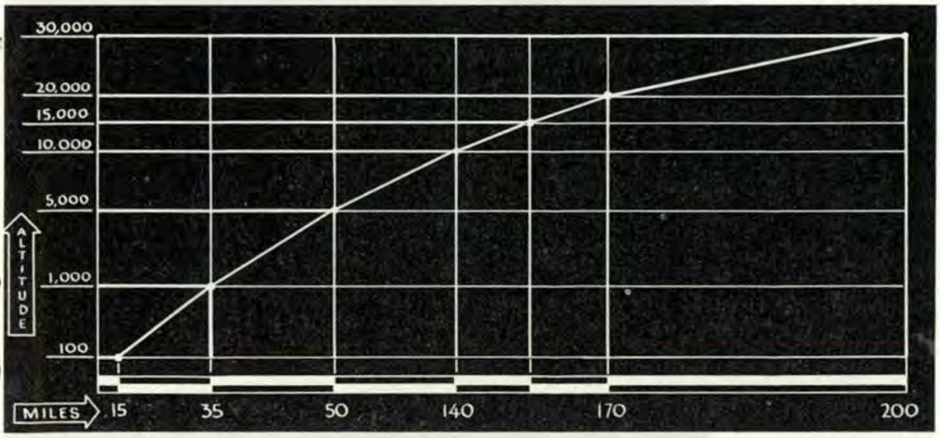
If the pilot desired merely to determine his magnetic bearing TO or FROM the VOR with the Course Indicator, he could rotate the bearing selector knob until the localizer needle was centered and the bearing in the window would be his bearing TO or FROM the VOR as indicated by the TO-FROM indicator.

An example of flying a course to the VOR is as follows: The course has been selected in the window, the indicator reads TO. The localizer needle is off the right; indicating that the course is to the right. At this point the pilot would consult the heading pointer. It gives him *a pictorial presentation of the aircraft's heading with respect to the selected radial.* If the pointer is left of center (straight up) the aircraft is flying away from the course; if it is centered, the aircraft is paralleling the course; if it is to the right, the desired course is being approached.

To make the most expeditious interception of the track he would merely "turn the heading pointer" by turning the aircraft toward the localizer needle until it was directly under it. From that point on he would keep the pointer and needle together as they moved back to center and when they were both centered, the aircraft would be on the selected course. This technique results in a gradual reduction in the angle of bank so that when both needles are centered the aircraft wings are level, with a no-wind condition.

From this point on, the pilot would keep the localizer needle centered by "turning to it." If there were cross winds, of course his heading would be changed from his bearing in order to remain on the track. This change of heading would be reflected by the heading pointer, and when he was established on his wind-corrected track, his drift correction would be indicated right or left by the pointer.

Station passage is indicated by the TO-FROM indicator moving to the "FROM" position and the double-barred needle of the RMI swinging 180°. After passing the station, if flying the same course from the VOR, or any other course "FROM" the VOR, the pilot would continue to follow the localizer needle. With present Course Indicator equipment, the same situation exists with VOR as when flying the ILAS localizer needle; whenever the aircraft is turned to the *reciprocal* of the selected bearing, the pilot cannot follow the localizer needle. He must turn *away* from it to return to track, or the radial. At the same time his TO-FROM indicator will not indicate properly; it, too, will indicate the reciprocal of his flight direction in relation to the VOR.



Besides a small control panel, omni instruments include a course indicator which provides the facilities of a cross-pointer, course selector and magnetic and marker beacon indicators; the RMI is used for obtaining "heading-Sensitive" bearings on omni stations. At right is a graph of approximate receiving distances for VHF at various altitudes.

The heading pointer, when on this reciprocal of the selected bearing, will be in the lower half of its operating radius, pointing behind the aircraft. Because of the pictorially false indications to the pilot, the better procedure to use when flying a reciprocal of the originally selected bearing, to avoid confusion and possible misinterpretation, is to select the reciprocal bearing in the bearing window. When this is done, the localizer needle and the heading pointer may again be flown directionally and the TO-FROM indicator will again indicate the proper flight direction in relation to the VOR.

The Omni-Range is a big step forward in radio aids to navigation and in the near future when the Distance Measuring Equipment and the Offset Course Computer become standard, it will then be possible and practical to fly a straight line course between two points neither of which is served directly by an Omni-Range.

FUEL SENSE

THE HIGH RATE of fuel consumption in jet airplanes makes it mandatory that jet pilots be very fuel conscious. With them, it's strictly a matter of survival, and they give a very high priority to figuring fuel consumption in their flight planning.

But jets aren't the only planes which can run out of fuel. Every flying machine so far invented depends upon an exhaustible fuel supply to keep it in the air. And this applies to airplanes which have been with us for ten years as well as those we've had for only ten months or ten days.

Yet, pilots will neglect the important fuel consumption factor in planning their flights . . . and they will have accidents because of it. The pilot of a B-26 recently proved this point. And the B-26 is not a newcomer to the Air Force stables; in fact, it is rapidly becoming, if it has not already become, one of the USAF's "old reliables."

This pilot was flying VFR at night on the last leg of an extended cross-country flight when things went wrong for him. If he had figured his maximum time in the air correctly, based on previous experience during the cross-country, he would have found that he had fuel for five and a half hours; instead, he decided for some reason that he had fuel for six hours. Actually, the engines quit of fuel starvation after five hours flight. He, the crew chief and a passenger in the front all bailed out successfully, but a passenger in the rear of the plane could not be alerted, possibly because he was asleep. He was killed when he crashed with the plane. The crash occurred, incidentally, only 40 miles from the destination.

This pilot flew over another base where he could have landed, only 150 miles from his destination. At a range station 90 miles from home, he noted that he had 50 gallons in each main fuel tank according to the gages. He figured that was sufficient to get him in . . . and it probably would have been, though with no reserve, if he hadn't got lost in the last 90 miles. Poor radio and navigation procedures entered into it, but the big point is that he just didn't consider that the airplane won't fly on fumes.

Accidents like this can be so easily avoided. But you have to take a few pains with your flight planning. Give yourself plenty of fuel reserve to complete the flight normally. Then add on some more for unlooked-for things such as getting lost or having your landing delayed at the destination. Remember that an engine quits when it runs out of fuel . . . make sure you aren't flying the plane at that time. (AF Reg. 60-16 gives fuel requirements for all types of flights.)

Airfield

The Myriads of Lights Around and On Airfields Can Be Confusing —But If You Understand Them, They Are Mighty Helpful

TWENTY YEARS AGO any pilot who had the temerity to make a landing after dark had his choice of two evils. He could either land on a blacked out field, or buzz the town until the citizenry, either in anger or a spirit of helpfulness, drove out to the airport and ringed it with car headlights. This completely confused the intrepid aeronaut, who, often as not, ended the flight by picking his cabane struts off the hood of a Chalmers Six.

In those days the poorest navigator had the most night time. If you were up after dark, you were usually lost.

Runway lighting has progressed through the eras of lanterns, flare pots, individual electric light standards, and contact lighting to the modern system of high intensity lighting. To runway lighting has been added other visual aids such as rotating beacons, lighted wind direction indicators, and obstruction lighting.

These four elements: the runway lighting system, the rotating beacon, the wind indicator, and the obstruction lighting system are the four basic facilities for an airfield. If the airfield is to be used under IFR conditions, a taxi-way lighting system, high intensity runway lights, and over-run (approach) lights must be added.

The pilot who flies at night should be familiar with the color and layout of runway lighting, approach lighting, taxi-way lighting, and of course, the rotating beacon, which flashes a green and white alternating light to mark the airdrome site. On approach and taxiing, familiarity with obstruction lighting, not only on the airport, but also on surrounding commercial buildings and radio towers can lead to a long and uneventful life.

The wind direction indicator, or landing runway indicator, commonly known as the "Sock," the "Tee," or the "Tet" is important, especially if the pilot is old-fashioned enough to plan an upwind landing. If the "Tee" is flashing on and off, the field is under IFR conditions.

Runway marker lighting, as used by the USAF is divided into two types: Medium Intensity Lighting and High Intensity Lighting. Medium intensity lighting is usually confined to runways which because of impaired clearances, inadequate length, or other operational factors are not suitable for use under IFR conditions. Many of the older USAF airfields have installed the "Type I and II" runway marker assembly, which resembles an inverted glass soup bowl. This light can be classed as medium intensity only by a stretch of the imagination, as any installations officer will tell you.

High intensity runway lighting is usually confined to runways used for instrument approaches, either standard letdown, GCA or ILAS.

The high intensity fixture sends out a controlled light beam, directed parallel to the runway, and so confined as to not blind a pilot making a landing at night or under restricted visibility.

The brilliancy of the high intensity light is controlled from the tower by a rheostat which permits five steps of intensity. The brilliancy setting depends upon the airport visibility at the time of the approach. For periods of extremely restricted visibility the pilot should ask the tower to turn the lights to "Step 5," which is maximum brilliancy. "Step One" is the normal CAVU setting.

Occasionally, pilots have complained that high intensity lights have blinded them upon sudden transition from IFR to VFR when breaking contact. From a design standpoint it is impossible for the high intensity fixture to blind a pilot, particularly if the brilliancy setting is at the proper step for existing visibility. If the lights look too bright to you, call the tower and ask them to turn them down a step. Difficulty in making IFR to VFR transition at night is a common aviation problem. The air carriers solve this problem by having one pilot make the approach on IFR. On the break-through to contact, the other pilot takes over and makes the landing. His eyes, not having been concentrated on the gages, can more easily adjust themselves to a sudden change in light values.

The lenses of the runway marker light are clear glass, to distinguish them from the approach lights, which are red.

Over-run (approach) lighting is a term applied to a system of lights installed along the edges of the 1000-foot clear zone area at each end of a runway. These lights are red, to distinguish them from the runway lights which are clear. Pilots should use these approach lights as a landing reference, but should keep in mind the fact that the terrain within these red lights is suitable for emergency landings only, and the approach should be planned

Lighting

By Maj. Richard A. Harding, Facilities Branch, Directorate of Flight Safety Research

accordingly. At some airports the approach lights are strung along the left side of the approach zone only. The standard installation, as recommended by the Directorate of Installations USAF (Plan AL 2310) is a system of red lights in clusters of three at the left-hand side of the runway; and a string of single red lights along the right-hand side of the runway. Each light, or cluster of three lights is spaced 100 feet apart. The pilot or copilot, by checking the number of red lights ahead of him, can, under emergency conditions, ascertain how much over-run he has ahead of him before reaching the runway end.

Between the approach lights and the runway lights are installed the "threshold" lights. These lights, eight in number, define the actual end of the runway.

The threshold lights are green, and should be used as a reference point on the final approach, in conjunction with the red approach lights, and the runway lights themselves. By flying directly between the two clusters of green threshold lights, the pilot will line up with the center of the runway.

The definition of a taxiway is a path on an airfield for taxiing aircraft. Taxiway lights mark the safe taxiing area, and show the pilot a way to reach various portions of the airdrome. Taxiway lights are equipped with a blue lens, and are spaced every 200 feet along the taxiway. These lights are controlled by the tower, and the pilot can be guided to parking areas. However, the pilot should always check with the tower by radio to be sure he is not only on a lighted taxiway, but also on the right one.

Obstruction lights are red, and mark objects that are considered to be hazards to aircraft engaged in normal ground or flight operations. For instance, hangars, poles in the proximity of approach zones, radio towers, and tall buildings are obstruction lighted. The Civil Aeronautics Administration requires all tall structures surrounding airports, or on the civil airways to be obstruction lighted. On tall buildings and radio towers, these lights are flashing, and in general should serve as a warning to change course, especially when flying at low altitudes.

The proper operation of field lighting is a command responsibility, through the Operations Officer. The installation and maintenance of field lighting are a responsibility of the Air Installations Officer.

The Operations Officer should coordinate with Air Installations at regular intervals to make certain that the systems are not only in working order, but that lamps and lenses are cleaned, water is drained from the fixtures during periods of wet weather, and that the lighting system as a whole is operative.

As Marc Antony once said, "Fiat Lux," or, "It's better with the lights on!"

FOR OPERATIONS OFFICERS

Here are a few tips which should be on every airdrome officer's nightly S.O.P.:

- **Check runway marker lights for brilliancy.**
- **If high-intensity, have tower run through all five brilliancy checks.**
- **Report any lights inoperative.**
- **Check approach and threshold lights for operation and brilliancy.**
- **Check all obstruction lights on or near the field for operation. (This can be done from the tower position.)**
- **Check taxiway lights for operation and brilliancy.**
- **Be certain that tower controllers on duty are familiar with field lighting system, rheostats, and direction-change switches.**
- **Be certain that tower operators are familiar with the taxiway net and the taxiway lighting system.**

FOR PILOTS

A knowledge of the various colors used in airport lighting may save your neck some day. In general, they are:

Runway Markers ..	**White**
Threshold Lights . .	**Green**
Taxiway Lights . .	**Blue**
Approach Lights . .	**Red**
Obstruction Lights .	**Red**
Beacon (Airport) . .	**Green and White Flashes**
Beacon (Landmark) .	**Red and White Flashes**
Hazard Beacon . .	**Red Flashes**

DESIGN FOR SAFETY— THE C-124

Here Is an Airplane Which Provides Flying Proof That Safety as Well as Operational Performance Can Be "Built In"

THE MAMMOTH C-124, now being used by MATS, SAC and TAC as a global transport plane, is well known for its size and cargo carrying capacity. Its designed gross weight of 175,000 pounds makes it possible to carry either 200 fully equipped troops, more than 125 litter patients or about 50,000 pounds of cargo in the 10,000 cubic feet of usable cargo space. Less well known are the many safety features that were built into the original design and those that are being continually incorporated into the production models.

The plane's size—span 173 feet, length 127 feet, height 48 feet—make it mandatory that some system of communication be developed for ground operation to enable the crewmembers to contact ground and service unit personnel without clambering in and out of the aircraft. Headset and mike plugs are externally installed at various stations on the aircraft so that it is a simple matter to communicate with the pilot or flight engineer while the plane is being readied for flight or prior to engine shutdown.

A takeoff warning device is built into the throttle controls. If the plane is not in proper takeoff configuration when the pilot attempts to advance the throttles, lights on the pilot's and flight engineer's panels go on and a warning horn sounds. Specifically, the flaps must be down 20 degrees, all main doors must be closed, the snubbers off and the inverter on. Until this is accomplished, the throttles can't be opened together, though they can be run up individually or in pairs on opposite sides for pre-takeoff procedure checks.

In spite of the size of the C-124 there is no independent hydraulic boost system needed for the rudder and elevator. They incorporate aerodynamic boost in the form of linked tabs which reduce pilot forces on the controls. An over-ride is built into the tab system to allow for failure or improper functioning of the tabs.

Takeoff and landing characteristics are comparable to any large cargo plane despite its size and weight. The C-124 is relatively stable on all three axes and pilots report that the control forces are well balanced and reasonably light, with control effectiveness throughout the full range of allowable speeds and CG travel, comparing favorably with the C-54.

Stall characteristics of the plane are good in allowable CG and gross weight ranges, with all controls effective in recovery. Stall warning is ample; buffeting ranges from mild to moderate during the approach to a stall with some structural vibration as the stalling point is reached.

Performance with one or two engines out is adequate for an airplane this size. With any reasonable load, altitude and directional control can be held with two engines out, even if two are out on the same side. If either an outboard or inboard engine is lost on takeoff, rudder control and effectiveness can be maintained and a climb-out effected.

In landing, the pilot has good forward visibility during the flareout with positive elevator control available throughout. Landing speeds are relatively low, commensurate with the varied gross landing weights of the aircraft. An emergency stop is built into the flap travel action. If the flaps get more than three degrees out of synchronization they stop and remain positioned. Ordinarily no trouble is encountered if the aircraft is landed without flaps, with three degrees down on one side only, or at any setting with three degrees difference in the flaps.

A snubber system, installed on the rudder and elevator controls, is automatically activated when the throttles are brought back from idle position into reverse pitch. The snubbers are used to reduce the effects of turbulent air flow over the control surfaces during reverse thrust operations and while taxiing in gusts and strong cross winds. A switch is provided to activate the system for taxiing and after landing when the props are brought forward again while an emergency release valve is available to deactivate the snubbers if they malfunction. The snubber system is wired into the takeoff warning system to preclude the possibility of takeoff while the snubbers are engaged.

The aircraft is provided with emergency air brakes in case of hydraulic brake failure. Several full applications and releases can be made if needed or the brakes may be used selectively.

An outstanding safety feature is an engine analyzer system. An indicator tube is mounted on the flight engineer's panel. This instrument enables the engineer to isolate and identify malfunctions and imminent engine failures during operation in flight and on the ground. If repair is possible or inspection needed, the engine accessory sections are accessible in flight through a walkway in the leading edge of the wing. The accessibility to the engine section proved itself safety-wise on several occasions when dead engines were re-started after repairs had been made. Another advantage to the wing compartment entryway is that cowl flaps and oil cooler doors can be operated manually in flight, if necessary.

Other areas that can be entered while airborne are the tail section and the areas containing the electrical and hydraulic equipment. A door in the aft end of the main cabin compartment affords entry into the tail section for emergency maintenance work while doors along the side of the cabin provide for access to the hydraulic and electrical equipment even with full cargo aboard.

The hydraulic power panel is so designed that if the engineer inadvertently leaves it in "by-pass," operation of either the flap or landing gear handle will automatically throw it out. The emergency hydraulic pump is electrically driven, and can be powered from the engine driven

(Above) Ground evacuation ropes are necessary at all emergency exits due to the C-124's height. (Below) The heater pod, installed in the newer C-124's, provides additional heat for wing anti-icing.

[redacted] independent of the electrical system, now being developed by the Wright Air Development Center to improve the safety of the propeller reversing controls. When completed it will be a retrofit item for all models.

Cockpit lighting for night or instrument flying is excellent. All instruments are equipped with individual lights and 30-degree Grimes light shields. Newer models of the aircraft have the lower instruments on the panel tilted up approximately 15 degrees to improve the pilots' visibility. These newer models also have Nesa glass windshields to increase anti-icing performance.

If complete electrical failure occurs while on instruments, the pilot will be able to use the turn and bank indicator to maintain proper flight attitude. The turn and bank indicator will continue to function for approximately 12 hours under light electrical load conditions as it is wired directly to the batteries.

[redacted] in the designing and building [redacted] was to provide adequate protection for [redacted] crew during a crash landing. The main [redacted] the C-124 is designed for loads up to [redacted] The compartment below the main deck [redacted] stressed so that together the two decks [redacted] protection for the passengers in case [redacted] landing. If the main load is cargo, the [redacted] ride on the auxiliary deck six feet [redacted] deck. This insures that they won't be [redacted] of the load that might break loose on a [redacted] In the same way the crew compartment is [redacted] main deck level so that they too will be [redacted] that breaks loose and is thrown forward.

[redacted] or elevator, which is raised and [redacted] loading, can be jettisoned in flight [redacted] cargo not too heavy to move. By jetti- [redacted] is possible to eliminate much of the hazard [redacted] breaking loose during a crash landing.

[redacted] and thought that went into the aircraft [redacted] proved to be satisfactory during a [redacted] tests conducted recently. The tests [redacted] time needed for 200 passengers and 14 [redacted] the aircraft ranged from one minute, [redacted] three minutes.

[redacted] ground evacuation include one at the [redacted] one through the astrodome emergency [redacted] the main or auxiliary cabin emergency [redacted] the great height of the plane, all cabin [redacted] with ropes to enable the personnel [redacted] safely.

[redacted] chutes are located in the elevator well [redacted] exit of passengers. They can be put into [redacted] prior to landing and greatly reduce the time required to leave the plane.

The C-124 has a unique installation to speed up crew bailouts in an emergency. In the floor of the flight compartment center aisle immediately behind the pilot, an escape hatch is located. When opened it jettisons a "barber pole" which drops down and becomes anchored in the walkway on the cargo door. When the crew is ready to leave the plane they open the hatch, slide down the pole and go out through the emergency exit in the clamshell door. A static line is placed beside this exit for the use of injured personnel.

All these safety features in conjunction with the aircraft's performance combine to give the Air Force another plane designed to fulfill specific operational support work. The C-124 is proving to be a prime example of how performance and safety can be tailored to Air Force specifications by this country's technical and production people.

EXERCISE GUNNERY—A.N.G.

Air National Guard "Weekend Warriors" proved last month vocation and avocation can be interchanged. Only one accident marked the week-long shoot, which California's two squadrons dominated. Right, men behind winning 195th admire trophy with Capt. W. C. Putnam, Ops Officer. Top maintenance kept in-commission rate of the venerable F-51's above 90%.

Air National Guard Pilots Prove You Don't Have to Take Chances to Get High Gunnery Scores

FIGHTER PILOTS from 18 Air National Guard squadrons not on active duty with the Air Force raced a perfect safety record right down to the wire in their second annual gunnery exercise last month and lost by exactly 60 minutes.

In the final hour—and on the last panel gunnery mission—an F-51 quit cold coming off the target. The pilot bellied the Mustang in on the Mojave Desert, tearing it up considerably but walking away unhurt.

Except for this single mishap, the week-long event at George Air Force Base, Victorville, Calif., was accident-free—a condition that represented five months of planning.

The first steps toward conducting the exercise for the squadrons, which hail from 10 states, Hawaii and Puerto Rico, were taken last November in the Air Division of the National Guard Bureau. The 1951 program was held at Eglin AFB in Florida, drew only 12 squadrons, and weather was so bad that the aerial gunnery phase never did get completed. Hence, the selection of Victorville with


LEFT: Crew Chief of Maryland's 104th Squadron makes final runup to assure engine will carry Mustang through day's missions without malfunction. RIGHT: Judges kept sharp eye on passes Air Guard pilots made on targets at Goldstone Lake range.

its reputation for good weather almost every day of the year.

As in 1951, California dominated the exercise. Last year, the 194th Fighter Squadron of Hayward, Calif., took three of four trophies and Capt. Milton Graham posted the high individual score. The 194th registered high team score this year and Graham finished second in individual scoring to his teammate, Capt. Billy C. Means. The 195th Squadron of Van Nuys, Calif., was second.

The 131st Squadron of Massachusetts finished third and 169th of Illinois fourth. Lt. Willard G. Erfkamp and Lt. Robert E. Drew, both of the 195th Squadron at Van Nuys, Calif., were third and fourth, respectively, in the individual scoring. Means had the highest single target, registering 176 hits for 84%, which, although fired with the help of a factor, compares favorably with the high target of 64% fired by Lt. Jack Schwad from an F-84 in the USAF 1950 gunnery meet at Las Vegas.

Goldstone Lake, one of the many dry lakes found in the California desert, was the site of the ground gunnery range. Minimum altitude of 2500 feet above the terrain was established for approach and no aircraft was permitted to fire without first contacting range control by radio. After initial contact, pilots were required to identify the flight by letter designation, mission number, individual name and aircraft number.

After complete identification of all members of the flight and after receiving clearance to begin the mission, flights were required to fly over the main control tower and check the range panels. Missions were not permitted to begin until the white panel indicated the range was open.

Pilots flew 12 missions at Goldstone, broken down into three panel gunnery, three low angle bombing, three rocket and three dive bombing. A 600-foot foul line was established for panel gunnery. A pilot violating the foul line was fined 10% on his first offense and disqualified on his second. Disqualification also faced the pilot who fired on a closed range and the second time he fired on the wrong target.

Minimum release altitude of 2000 feet was set for bombing and any bomb released below that height scored as a miss. A 2000-foot slant range was established for the rocket missions and a 600-foot foul line set up for the low angle bombing. Disqualification in both phases awaited the pilot who made a pass on the wrong target or outside the limits of the spotting towers.

A six-hour briefing preceded the first mission with a representative of the Directorate of Flight Safety Research covering the flying safety aspects.

On all missions, aircraft were required to skirt communities in the vicinity of Victorville. Once on the range, patterns were established which permitted only one aircraft on final at one time. Pilots were not permitted to turn on gun, rocket or bomb switches until after they had completed their turn on to final. They were required to turn switches to the "off" position immediately after pulling up from the target.

Four aerial gunnery missions were fired, two at 12,000 and two 20,000 feet. Pilots fired four guns, loaded with 60 rounds each, at aerial targets attached to 700 feet of cable and towed by F-51's at 170 MPH indicated airspeed. Only the first 26 feet of the 6 x 30 standard acceptance target counted in the scoring.

Dangerous tendencies, such as firing below 15 degrees angle off, were judged from tow aircraft. A pilot was permitted to continue firing the mission on the first warning but was disqualified on the second. One identification and sighter burst pass was allowed.

Safety on the ground was stressed to the utmost. Aircraft were armed only at the takeoff end of the runway and crews inspected each Mustang including tow ships when it returned at the far end of the landing runway to assure that it did not return to the parking ramp with live ammo.

Pilots were allowed 10 passes in the panel gunnery phase, including one dry run if they desired. Four passes were permitted on both dive and low angle bombing and six in the rocket phase.

Emergency landing procedures were covered at great

LEFT: Maj. Otis May, of USAF Gunnery Research School of Nellis AFB, checks hits scored by Capt. Milton Graham of Calif., who finished second. RIGHT: This tower was the heartbeat of the air-to-ground phase of the ANG gunnery exercise.

length but only one was required in the entire exercise. An oil leak forced Lt. John Hammer of the 164th Squadron, Mansfield, Ohio, into Bicycle Lake while on an aerial gunnery mission at 12,000 feet. The landing was made without difficulty.

Each squadron, including Hawaii and Puerto Rico, sent eight airmen and four pilots to the exercise. Pilots from the latter squadrons, which are equipped with F-47 Thunderbolts, were transitioned in the 51's several days before the firing began.

Nine Air Guard C-47's accomplished an accident-free major airlift hauling men and supplies to and from the California base. Major Walter Flagg of the National Guard Bureau acted as project officer, and Capt. William C. Putnam, one of the first Air National Guard pilots to compete 100 missions in Korea—with Arkansas' 154th Squadron—directed operations.

A team of three officers from the USAF Gunnery School at Nellis AFB, Las Vegas, acted as arbitration committee and technical advisors on the aerial gunnery phase. It included Major Otis May, Capt. John Roberts, 1950 USAF gunnery champion: and Capt. Russell J. Brown, who shot down the first MIG-15 in Korea.

Eleven observers from Continental Air Command and five senior Air Force instructors representing numbered Air Forces were on hand for the exercise as were Maj. Gen. Earl T. Ricks, Chief of the National Guard Bureau's Air Division and his predecessor in that post, Maj. Gen. George G. Finch.

The squadrons which took part are:

198th, Puerto Rico; 199th, Hawaii; 101st and 131st, Massachusetts; 137th, 138th and 139th, New York; 194th and 195th, California; 146th and 147th, Pennsylvania: 162nd and 164th, Ohio; 169th, Illinois; 152nd, Rhode Island; 104th, Maryland; 119th, New Jersey; and 181st, Texas.

Captain Putnam attributed the almost-perfect safety record to superb maintenance, which kept an average of 92% of the fighters in commission at all times, and to the fact that there was no deviation from established Air Force gunnery procedures and flying patterns.

A Mustang is readied for dive bomb mission. Each pilot dropped six practice bombs. Foul altitude was 2000 feet.

Armament safety had highest priority. Here, guns are charged near end of runway and pointed out across desert.

Almost but not quite. About one foot made difference between hit and miss for this pilot. Note bomb over target.

☆ CROSS FEED ☆

POLICE DETAIL—When the snow and ice started thawing this spring, many foreign objects were uncovered which would obviously have been hazards to taxiing airplanes, particularly jets. Sweeping all ramps and taxi-ways would have taken 120 hours with the one sweeper available, so a Saturday morning "police detail" was decided upon. In three hours, including two coffee breaks, a three-hundred man "skirmish line" formation cleaned the entire airfield. The rule was "if it isn't fastened down, pick it up." Every other man carried a cardboard container which was emptied frequently into a pick-up truck which drove up and down the line. The results were very satisfactory, as the photo shows.

Maj. Harry R. Cassleman
FSO, Hq. 4706th Def. Wg.
O'Hare Internat'l Arpt., Ill.

"Police detail" cleaned up runways, taxi-strips, and ramps after spring thaws at O'Hare. Below is the result.

CREDIT LINE—During the spring of 1948 while on duty with the Air Inspector, I wrote to Mr. Gill Robb Wilson to ask permission to publish a poem which he had written entitled "The Last Bouquet," in FLYING SAFETY magazine. At that time, permission of the author was received to publish the poem, but for some reason it was not used.

I am happy to see that four years later the poem has appeared on page 28 of the February, 1952 edition of the FLYING SAFETY magazine. I thought you might like to publish a statement giving the correct name of the poem and credit to the author.

Col. Paul T. Hanley
Air Attache
American Embassy,
Rome, Italy

The poem appeared under the title of "The Sensation of the Station" and, as we stated, the author was not known to us. Our thanks to Col. Hanley for helping us give credit where it is due. Mr. Wilson is now Editor and Publisher of FLYING *magazine.—Ed.*

QURUQ—I am writing about the article, "Alphabet Soup" which appeared in the February, 1952 issue of FLYING SAFETY. The author points out that the code QURUQ means that the runways are covered with ice.

I would appreciate information regarding the International Notam Code, inasmuch as I learned the code to mean that runways are hazardous due to repair or construction. Has this code changed since I learned it, or could this be an error on the author's part?

Thanking you, I'm listening out.

Capt. Harry R. Lewellyn
3700 M-S Gp, Lackland AFB
Texas

We're caught. For ice and snow, the code should read QURUO.—Ed.

ENGINE CHECKS AGAIN—Since my organization has recently converted from jets to F-51 aircraft, the problem of engine conditioning has come up. In FLYING SAFETY, of August, 1951, there appeared an article "How to Check an Engine." This article states on page 2: "A power check should be made using the same manifold pressure as that which the manifold pressure gage showed when the engine was at rest before starting (This is field barometric or pre-start MP). The propeller governor control should be in the 'High RPM' position and the carburetor preheat control in the 'full cold.' Unless there is some engine malfunction this will give the same RPM, plus or minus 50 RPM on a given engine and propeller combination regardless of the outside air temperature, field elevation, or barometric reading."

Now, this is my question: If that statement is true and I believe from past experience that it is true, why does not the Air Force set up standards for each prop and engine combination in service at the present time. Example: All the C-47's in service at the present time having similar prop-engine combinations should all check out at field barometric pressure to the same RPM plus or minus 50. To my knowledge there never has been a Norm setup for this but it is left to individual stations to determine. As your article points out, this is not general knowledge among pilots and it seems to me that it could best be brought out permanently to them and to mechanics by establishing these RPMs and affixing a placard to the instrument panel adjacent to the tachometer similar to the placard denoting the radio call letters or numbers of the ship.

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We can't answer your question, of course, but will see that the suggestion gets the proper attention.—Ed.

FUEL SYSTEM MODIFICATION—I believe I have an idea that can possibly make a C-47-A, C-45, T-11, and T-7 just a little safer and I wish you would direct this to the proper agency for consideration.

This minor change in a fuel system could be applied to any twin engine craft having a crossfeed and no electric booster pumps. By adding a restrictor orifice in the crossfeed line, the crossfeed could be left on during takeoff and landing without the danger of both engines going out if a line should break downstream of the engine pump. (Pertinent, "Note." under Par. 4, Sec. II of AN 01-90KA-1, 29 Jan. 51, Rev.)

This restrictor orifice could either be of fixed size or a valve that could be adjusted by mechanics whichever may prove best. In either case the flow of fuel permitted to pass should be on or somewhere a little below full power requirements of one engine. With this set-up, the pump of one engine could supply that engine and all the pressure would not be lost through a break on the other side, and at the same time enough fuel could pass to run an engine, in the case of a fuel pump failure.

Naturally, I realize, in the case of engine pump failure, all a pilot has to do is hit the Wobble Pump, but it would be better at any time and especially at critical moments during takeoff and landing, if the emergency has been eliminated automatically.

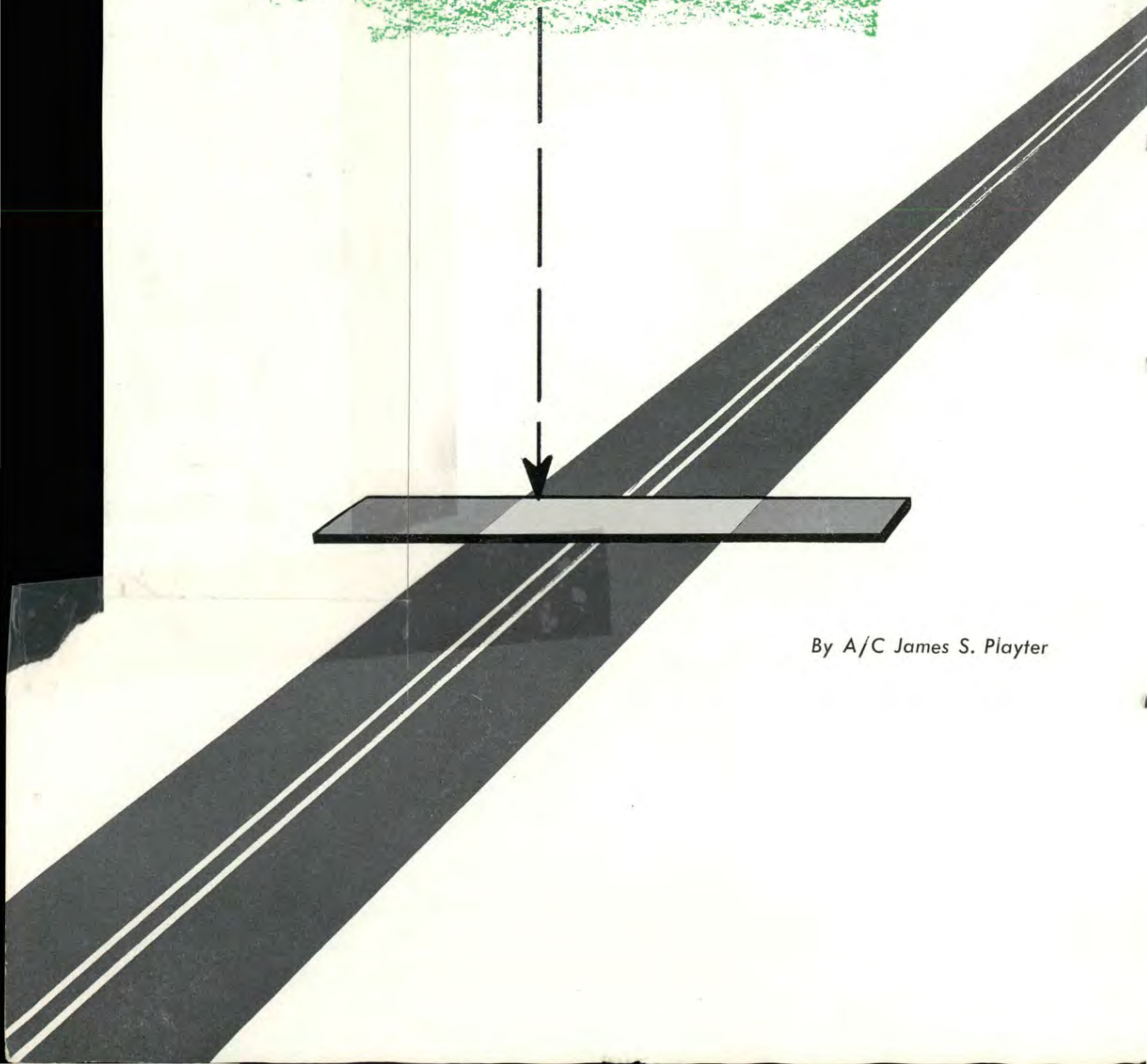
The thought may come up of fire hazard if fuel should continue to flow with a line broken. This is no worse than having a fuel line break in a system with no crossfeed and using a booster pump. The procedure would be to turn off the crossfeed as a booster would be turned off in a system using one.

1st/Lt. Eldon L. Parsons, Jr.
Gunter AFB, Alabama

The interconnecting fuel line forward of the engine driven fuel pumps is of a diameter calculated and tested to cover the most critical fuel system condition which may be encountered. Therefore, addition of any restricting device in this line would be a restriction of fuel system performance during operation of both engines from one pump.

Although Lt. Parsons' idea must be rejected he is still to be commended for his initiative.—Ed.

THE YELLOW LINE



By A/C James S. Playter

Many basic flying schools in the Air Training Command use a broad yellow line painted across runways to denote a point beyond which landing touchdowns are not to be made for obvious reasons. Violators are punished in various ways. Recently A/C Playter landed beyond the yellow line at Bartow Air Base, Florida. His punishment was to write an essay on the subject of yellow lines. The essay turned out to be an excellent flying safety article which we are happy to print here. —Ed.

THE T-6 turns final. Flaps are late coming down and the plane is high and "hot" coming in. The pilot elects to set up his landing, however, and comes back on the stick. The "6" loses some excess speed. Runway Control goes by, and the pilot begins to ease out his landing. Two bumps later and the plane is in—and Control has taken his number, for the pilot had crossed the Yellow Line.

Throughout the history of mankind there have been Yellow Lines. To preserve his way of life, his country, his community—even his very life, man has arbitrarily drawn Yellow Lines, so that somewhere, at one or another definite point, a line of demarkation between safety and danger could be made. These lines, when obeyed, have served to save and prolong human life—when broken, they have proved to be belated forewarnings of catastrophe.

From Adam and the Forbidden Fruit to the temperature warning gauges on jet aircraft, Yellow Lines have been adhered to and they have been flaunted. They have been in countless and varied guises, and they have been called by many names.

For instance, there is a Yellow Line at almost every ocean beach in our country. It is a cable, or a buoy placed at a certain distance from the shore, beyond which lay hidden danger. What myriad swimmers have relied upon their prowess and ability to swim and return from great distances to challenge the restricting influence of the "go no further" buoy —only to be caught in the sudden and lethal tow of an unknown riptide? How many sailing boats have been torn apart in the ocean or dashed against boulder-ridden shores, or had their hulls ripped open by razor-sharp corals—merely because their pilots have not heeded the warnings of dominant winds?

In World War I, there were innumerable Yellow Lines, some unwritten by-laws against the logic of which there was no doubt. One of these was a Yellow Line applicable to combat, an obvious sort of truth that forbade fliers to engage in combat over enemy lines low to the ground. Lenoe George Hawker, a ranking Ace of the Royal Flying Corps, allowed himself to mix in a dog-fight with a German flier way behind the German lines. The crack English Ace and the German flew in an ever-diminishing spiral until the Englishman was faced with

collision. He sets up his approach and landing properly or else he goes around. Perhaps it is easier for this flier to visualize the rigidity of the rules concerning his Yellow Line than it is for the pilot addicted to landings on terra firma. However, the personal discipline incorporated in complete compliance with the Yellow Line is exactly the same for one as for the other and the symbolic paint of the Yellow Line is just as bright for the T-6 at Bartow as it is for the Corsair on the carrier.

Once a pilot becomes accustomed to breaking Yellow Lines, regardless

[redacted]

yond the Runway Control trucks is one of these, not the least nor the greatest, but being one, must be obeyed if the life-saving insurance of man's eternal Yellow Lines is to pay off.

Nor can Yellow Lines be extended. The old, old story of generals extending their supply lines has resulted in total capitulation for nation after nation. The British did it in Africa, the Germans did it in Russia. How many pilots have extended their gliding distance, only to fall short and meet disaster? How many pilots must have extended their landings beyond Yellow Lines on runways, only to have an uncontrollable aircraft ram helpless planes or personnel? Perhaps we might have more conscience about extending Yellow Lines if we think of them in terms of just that—where, merely to avoid a go-around or inconvenience, we hazard the lives and equipment of our comrades because we are indifferent or "yellow" concerning the absolute red light sign of the Yellow Line!

Looking still further into the question of by-passing the runway lines, we might seek to understand the reasons behind such an action. Of course, there are many contributing factors but basically most all of them can be boiled down to one of two things: too high (too much altitude) or too "hot" (too much airspeed). These contributing faults can at once be ascribed to improper gliding speeds, insufficient attention to proper altitude positions, or poor judgment of distance. Possibly a fourth major cause would be poor control of flaps.

Considering all of these, it is obvious that no one of them constitutes a very complicated problem, but rather one that might be easily rectified by nothing other than a bit of earnest effort and attention. Some day, it is easily conceivable that a similar Yellow Line would figure in an emergency landing as the last possible point to "touch down" and still effect a safe landing before crashing into an obstruction. Weeks, months, or years of devoting strict attention to familiar Yellow Lines might then prove invaluable to help the pilot successfully recognize a very important mental Yellow Line on the approach to his emergency landing.

There is seemingly no end to the analogies which may be called upon to demonstrate the imperative nature of the Yellow Line, but one which I think well serves us is the account of Custer's Last Stand. To begin with, a Yellow Line of military tactics was crossed when he split the forces under his command into three components, himself taking the third into the battle of the Little Big Horn from which there were none to return.

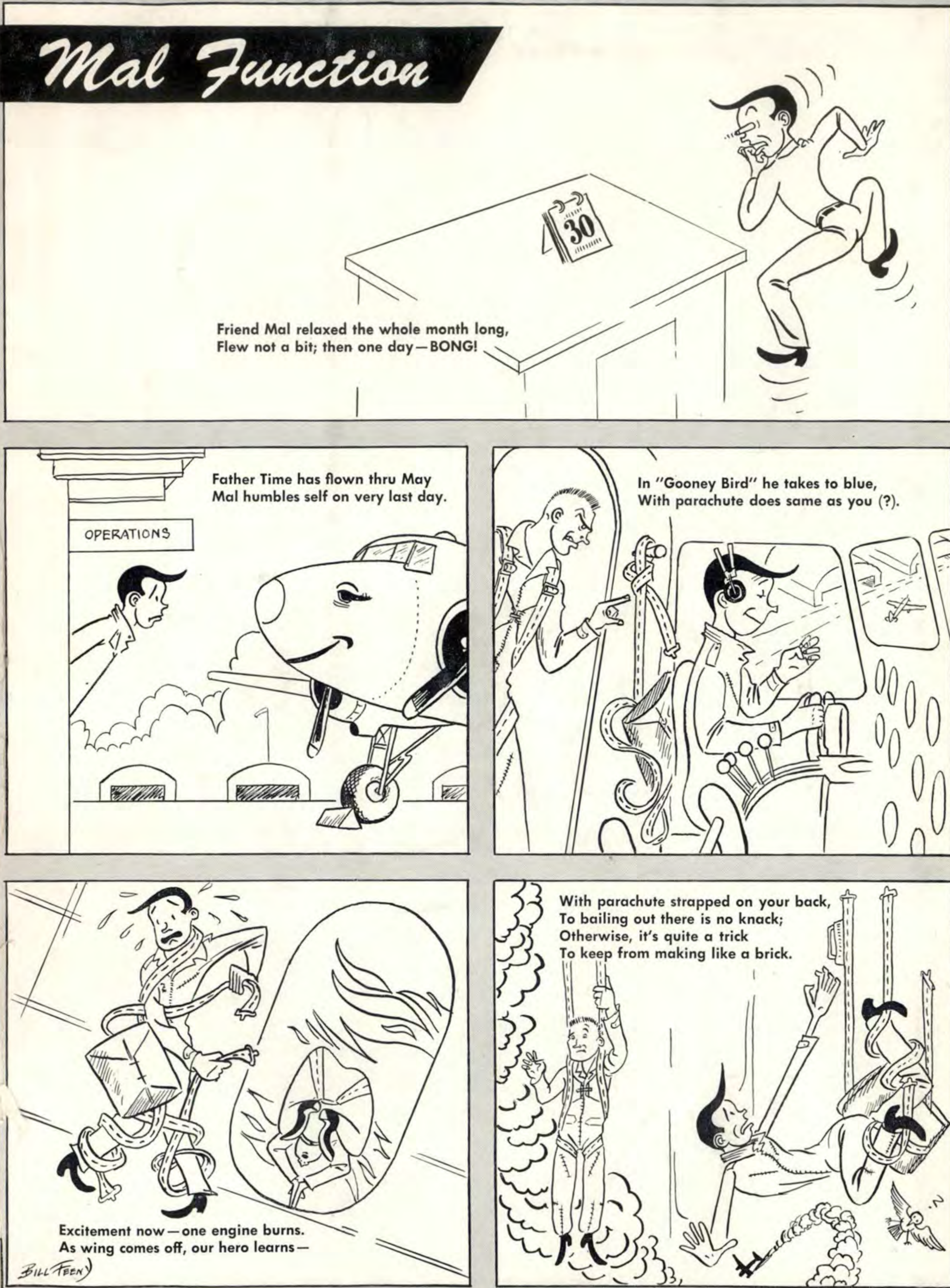
By thus setting up an improper approach, Custer let himself and his men in for unnecessary dangers. Secondly, when a decoy of a small number of Indians allowed him to see them, he did not recognize what was to become the last Yellow Line granted to him, and gave chase—charging headlong into the midst of an overwhelming danger. Public sentimentalism has chosen to think of this as the last heroic deed of one of the Civil War's most dashing cavalry officers. Honest historians, on the other hand, have recorded this event as the bloody result of intense blundering by a general who should have had the sense to recognize and heed the Yellow Lines along the "Base," "downwind," and "final" approach to a useless and unforgivable sacrifice of men and materiel.

Perhaps the true historian has been a trifle hard on Custer, yet how much more stern would contemporary recorders be on a pilot employing the General's tactics—charging into danger and possible destruction—when, for the pilot the signposts, the Yellow Lines, are even more numerous and exact? The calibrations on an airspeed indicator are not as difficult to interpret as the number of Indians by the fires and trails they left, nor the altimeter as vague as dust rising over distant hilltops. Yellow Lines were simply not devised for pilots to cross, and for the pilot who crosses enough of them, there will lie beyond a Little Big Horn.

I suppose it is difficult to be serious when we magnify the thin strip of yellow paint on the runway to such great proportions, yet I imagine that to every pilot, his own life is fully as important to him as were the lives of illustrious generals, to them, and the preservation of a T-6 as important to a Cadet as the preservation of men and materiel was to the generals of old. In showing and acknowledging the presence of Yellow Lines throughout man's endeavor and conflict, I don't believe that some deviation from the little physical Yellow Line on the strip causes any great continuity loss in the theme.

Perhaps it takes a great many words to point out a very small but infinitely important truth—that being the tried and proven truth that to live safely, to protect his own life and the lives of others, any person must not only develop in himself the ability to search out the cautionary Yellow Lines of safety, but he must give himself over to the most exacting adherence to them, whether they be philosophical Yellow Lines governing thought and behavior, or the small Yellow Line which warns the student pilot:

Touch down before you cross this point.


Mal Function
Friend Mal relaxed the whole month long,
Flew not a bit; then one day—BONG!
30
Father Time has flown thru May
Mal humbles self on very last day.
OPERATIONS
In "Gooney Bird" he takes to blue,
With parachute does same as you (?).
Excitement now—one engine burns.
As wing comes off, our hero learns—
With parachute strapped on your back,
To bailing out there is no knack;
Otherwise, it's quite a trick
To keep from making like a brick.
BILL FEENY

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PHYSICAL ORIGINAL PAGES

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OR
MISSING