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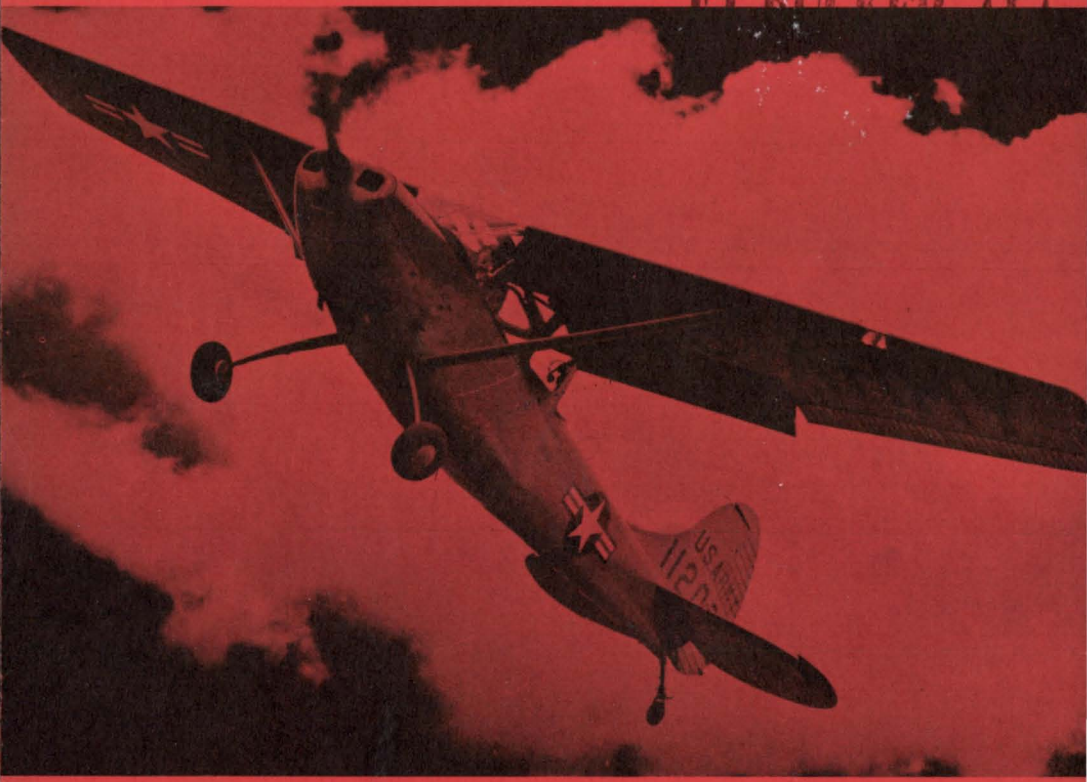

ARMY AVIATION SCHOOL
FORT RUCKER, ALABAMA

JANUARY 1956 VOLUME 2 NUMBER 1

ARMY AVIATION SCHOOL

COMMANDANT
Brigadier General Carl I. Hutton, USA

ASSISTANT COMMANDANT
Colonel Jules E. Gonseth, Jr.

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ARMY AVIATION
DIGEST

VOLUME 2 JANUARY, 1956 NUMBER 1

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Cover: Aerial observation post, the Cessna L-19.

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PLEASE READ IT AND PASS IT ALONG

EDITOR-IN-CHIEF

Captain Weyman S. Carver

ASSISTANT EDITOR-IN-CHIEF

Captain Richard W. Kohlbrand

EDITOR

LeGene Lott

The printing of this publication has been approved by the Director of the Bureau of the Budget, 13 August 1954.

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Manuscripts, photographs, and other illustrations pertaining to the above subjects of interest to personnel concerned with Army aviation are invited. Direct communication is authorized to: Editor-in-Chief, ARMY AVIATION DIGEST, Army Aviation School, Fort Rucker, Alabama.

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THE COMMANDANT'S COLUMN

Brigadier General Carl I. Hutton, *USA*
Commanding General, The Army Aviation Center

The views expressed in this article are the author's and are not necessarily those of the Department of the Army.—The Editor

No More Pilot Error

FOR a long time, in our accident investigation reports, we have been taking refuge behind the expression "pilot error." We say "pilot error" as if it were a solution to the investigating board's problem of finding out what caused the accident. Reflection upon the needs of Army Aviation will make it clear that the term "pilot error" is largely a dodge by which we evade the burden of analytical thinking.

It has been said that we should make an effort to reduce the percentage of "pilot error" accidents. On the contrary, it can be argued with a good deal of force that a legitimate objective of the safety program would be to achieve the goal of having 100 percent of our accidents due to "pilot error." This would mean that our equipment, supervision, discipline, maintenance, and procedures were perfect. Everything would be eliminated except the human element. It would then be possible to take summary corrrective action against any pilot who became involved in the accident.

The record shows that our present approach is not accomplishing its purpose. Our accidents are going up in numbers, rates, and dollar costs. Perhaps we have been ignoring the basic reason for investigating an accident: *Why did the pilot make the error?* Improper training? Inadequate equipment? Lax supervision? These three cover many, although not all, of our accident cases.

Improper training includes both the service school courses and unit training. It includes the scope of the instruction as well as the quality. Any program of instruction is a compromise between conflicting demands, and everything cannot be taught at The Army Aviation School. We must graduate our classes in the framework of a given number of weeks. Nevertheless, a finding by an accident board that the pilot suffered the accident because the training he had received was improper could be appropriate in many cases. It then becomes a matter of command action as to whether the instruction is to be changed, the course lengthened, or, finally, the risk must be accepted.

Our missions in Army Aviation are constantly expanding. Much of our equipment was bought with more limited missions in view. Our radios tend to be "peanut-powered;" we have no pilot-assist devices, and we have no oxygen. We are beginning to tackle bigger weather with little weather equipment. There is a tendency for our ground equipment to be makeshift. When we analyze why a pilot made an error, let us not neglect the effects of the limitations of the equipment.

Lax supervision is apparent in many, many accidents in the worldwide file. Of course, the accident boards frequently are agents of the supervisory level, and they tend, therefore, to slight or overlook the elements of supervisory responsibility. What should the supervisor have done to prevent the pilot's error? Usually, the supervisory error has been going on for a long time, but this must be read between the lines of the submitted reports. The supervisor cannot escape sharing the errors his pilots make.

Our objective is to reduce the numbers, the rates, and the costs of Army aircraft accidents. We can only do that by finding out what the basic causes of the accidents are, and then by tracing the basic causes to their sources. To accident investigation boards, I would suggest discontinuing the use of the expression "pilot error." Instead, describe exactly *what* the pilot did wrong, and then seek the reason *why*. In this way we have a chance to get at the source of accidents, and if we can find the source we can reduce the number.

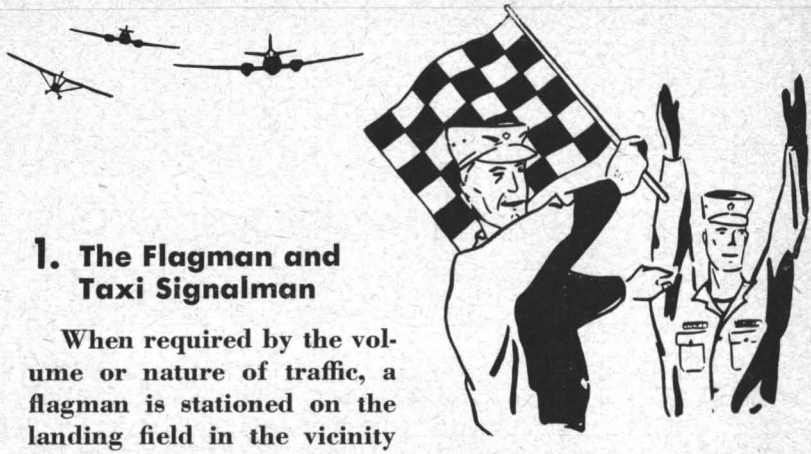
HAND SIGNALS

STANDARD hand signals for fixed-wing aircraft operation and movement on the ground have long been outlined in military regulations. SR 95-85-5 is currently being rewritten as an AR to include hand signals for helicopter movement. The necessity for thorough familiarization with prescribed signals by pilots and consistent use of them in every air section cannot be overemphasized.

For the sports referee, hand signals of the game are second nature. An experienced referee knows them so well that he gives the proper signal at a particular time without conscious thought. Correspondingly, the accuracy and definiteness with which he executes these signals make important contributions to the safety, fairness, and harmony of the game. Properly executed and consistently used hand signals make an equally important contribution to the safety of flight line operations of any air section. (See *The Gray Hair Department*, page 41, this issue.)

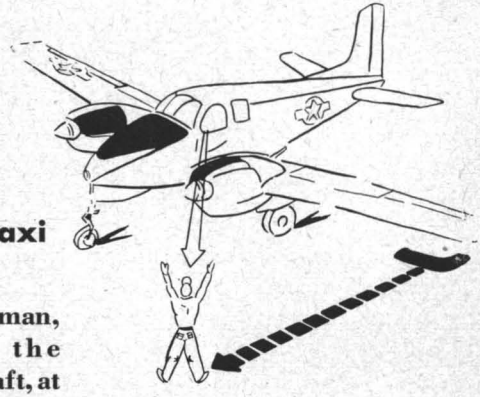
Pilots and ground crew members must be thoroughly familiar with both executing and receiving all standard hand signals. Because these signals can never be too well known to either flying personnel or ground personnel, they are described and illustrated for your review on the following pages. Included are the fourteen standard hand signals agreed upon by the U. S. Army, Navy, Air Force, and Marine Corps and the Royal Air Force and Navy. Additionally, there are two signals for use in directing helicopters which have been recommended for inclosure in the new AR which will replace SR 95-85-5.

This article was compiled by the ARMY AVIATION DIGEST staff with the cooperation of the Department of Publications and Nonresident Instruction, The Army Aviation School.—The Editor.



1. The Flagman and Taxi Signalman

When required by the volume or nature of traffic, a flagman is stationed on the landing field in the vicinity of the parking area where he will be clearly visible to the pilot of approaching aircraft. With a distinguishing flag of black and white checks, the flagman directs the pilot to the taxi signalman. The taxi signalman indicates that he is ready to assume guidance of the aircraft by extending both arms perpendicularly at full length above his head, palms facing each other.



2. Position of Taxi Signalman

The taxi signalman, when directing the movement of aircraft, at all times assumes and maintains a position from which he can see the eyes of the pilot. The position is generally on a line extending directly forward from the left wing tip, except when the assumption of this position is rendered inadvisable by special conditions of the parking area.

3. Rise to Hover Signal

The signalman directs the pilot of a helicopter to rise to a hover by raising both hands before him to chest level, with elbows flexed, palms turned upward and indicating a rising motion.

4. Come Ahead Signal

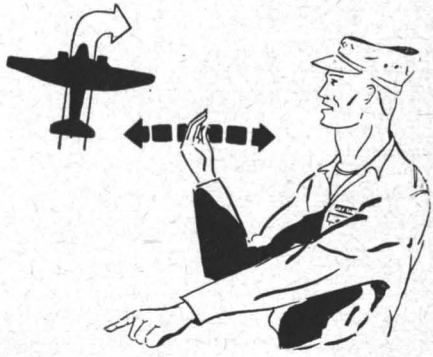
The taxi signalman directs the pilot to taxi or hover forward by raising both hands before him to eye level, with elbows flexed and palms turned toward face, and executing beckoning motions. The rapidity of the hand motions indicates the taxi speed desired.

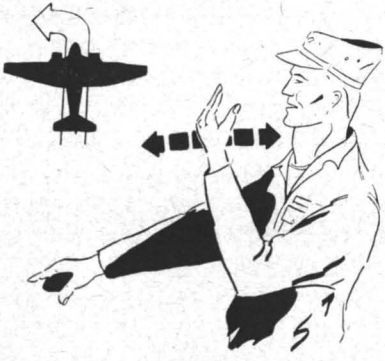
5. Land from a Hover Signal

The signalman raises both hands before him to chest level, with elbows flexed, palms turned downward and indicating a settling motion.

6. Right Turn Signal

The taxi signalman executes the "Come Ahead" signal with his right hand and at the same time points with his left hand to the wheel which is to be braked (right wheel of aircraft).





7. Left Turn Signal

The taxi signalman executes the "Come Ahead" signal with his left hand and at the same time points with his right hand to the wheel which is to be braked (left wheel of aircraft).

8. Stop Signal

The taxi signalman raises both hands before him to eye level, elbows flexed and palms turned toward the aircraft, in a "policeman's stop."

9. Emergency Stop Signal

The taxi signalman raises his arms above his head, palms turned toward the aircraft, and moves his arms from side to side, crossing them above his head.

10. Cut Engines Signal

The taxi signalman draws the extended forefinger of one hand across his neck in a "throat cutting" motion. If it is desired that a specific engine of a multiengine aircraft be cut, the taxi signalman executes the above signal and, at the same time, points with the other hand to the appropriate engine.

11. Insert Chocks Signal

The taxi signalman sweeps fists together at hip level with thumbs extended and pointing inward.

12. Start Engines Signal

Before starting engines, the pilot must insure that the aircraft will not move unintentionally, i.e., that it is chocked, braked, moored, or otherwise secured. He then indicates to the taxi signalman which engine will be started either verbally or by extending the number of fingers indicating the engine desired (1 or 2) in the direction of the engine. The taxi signalman responds by pointing the same number of fingers at the proper engine and rotating the other hand before him in a clockwise circling motion if all is clear.

13. Pull Chocks Signal

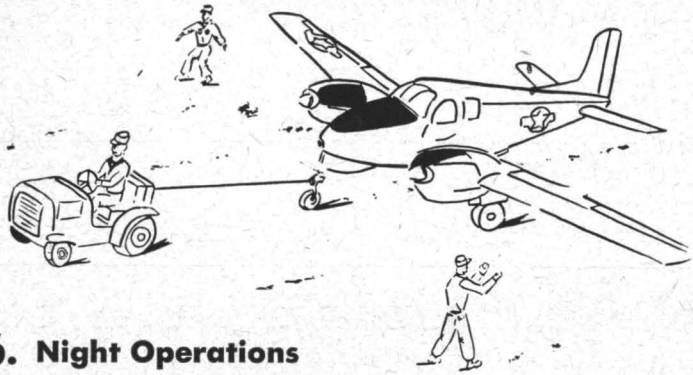
The pilot first rechecks to insure that the brakes are securely applied. He then signals for the chock removal by an outward sweeping motion of the fist, with the thumb extended and pointing outward. The taxi signalman acknowledges the signal with a sweep of the fists away from each other at the hip level with the thumbs extended and pointing outward.

14. All Clear Signal to Taxi

The pilot initiates the all clear signal to indicate his desire to begin taxiing. He makes it by touching the tip of the index finger with the tip of the thumb and extending the remaining fingers. The taxi signalman responds with a similar gesture if chocks have been pulled and all is clear to taxi.

15. Towing

The taxi signalman assumes the position for taxiing aircraft as described in illustration 2, keeping the eyes of the pilot and the driver of the towing vehicle visible at all times. When necessary, an additional crewman is properly positioned to assume lateral clearance. This crewman remains visible at all times to the taxi signalman and directs all necessary signals to him.



16. Night Operations

Where field illumination permits, the taxi signalman stations himself in a lighted area and executes the standard aircraft signals as just described. In the absence of suitably lighted area, the signalman uses illuminated wands (or flashlights, if the wands are not obtainable), one held in each hand. Signals used when employing wands or flashlights are identical with those prescribed for daylight conditions, except that the "Emergency Stop" signal is made by crossing the wands or the beams of the flashlights before the face of the signalman. *Care must be exercised throughout to avoid flashing lights in the eyes of the pilot.*

OMNIGATION

LeGene Lott

The views expressed in this article are the author's and are not necessarily those of the Department of the Army or of The Army Aviation School.—The Editor

THROUGH the very high frequency omnirange, Army pilots in the continental United States have a system of "air roads" comparable to the net of super highways crossing the nation's terrain. Further, this system of "air roads" can be used to equal advantage by the Army aviator flying IFR and the Army aviator flying VFR. All that is necessary for a pilot to be able to use omni under VFR conditions is familiarization with the cockpit omni equipment, an understanding of how the system operates, and a little practice navigating with omni equipment. The Army aviator, whether instrument qualified or not, should understand omni and how to use it. Although the L-19 is not at present equipped with omni, the L-20, L-23, U-1, LC-126, and H-19C are.

Omnirange is part of a farsighted, well-organized program to solve the problem of instrument navigation and traffic control, which has increased tremendously in the United States over the past decade. Omni has been in operation approximately 6 years, and other components of the program are DME (distance measuring equipment) and the offset course computer. Omni and DME are at present operational, with omni being widespread and rapidly becoming the primary radio navigational aid.

The term "omni," means "all," referring to the fact that the range gives all 360 magnetic courses to a station or all 360 courses from the station and thus provides an infinite number of courses from a single transmitter. The range operates within the 112-118 mc. band. It is often referred to as "VOR," a contraction of "VHF omnirange."

To eliminate confusion as to whether a course is to or from a station, all magnetic courses from the station are called "radials." They radiate from the station like spokes from the hub of a wheel.

Feet above Ground Station*	Reception Distance** in Statute Miles
500	30
1,000	45
3,000	80
5,000	100
10,000	140

*No physical obstruction intervening.
**Based on zero elevation of the facility.

Table 1. Omni reception distances.

The course to a station is the reciprocal of the radial, or the radial plus 180 degrees. Thus, an inbound course of 90 degrees would be on a radial of 270 degrees.

Being VHF equipment, omni is subject to line-of-sight restrictions, and its range varies with the altitude of receiving equipment and the nature of enroute terrain. From an altitude of 1,000 feet above terrain, reliable signals from a VOR station can be received for approximately 50 miles, depending upon enroute terrain. Thus, omni stations can be expected to be approximately 100 miles apart. Table I shows the relation of reliable omni reception to the altitude of receiving equipment.

On a designated station frequency, a pilot can receive air traffic control instructions and weather information. Understandable voice signals can be received at about the same distance as usable navigational signals. Omni stations transmit three-letter station identifiers in Morse code (printed on WAC's, sectional charts, and Jeppesen avigation charts) at intervals of approximately 7 seconds. Some stations transmit a voice identification such as "Montgomery Omni," in conjunction with the Morse code identifiers, with the latter coming between Morse code identifiers. Code and

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Miss LeGene Lott *is editor of the Army Aviation Digest. Prior to joining the Digest staff, she served 3 years as a writer of Army Medical Service instructional material at the Army Medical Service School, Brooke Army Medical Center, Fort Sam Houston, Tex., and 8 months as an editor in the Publications Division, Chemical Corps School, Fort McClellan, Ala. Miss Lott's journalistic background also includes several years of trade magazine editing and advertising work. She holds bachelor and master of journalism degrees from the University of Texas.—The Editor.*

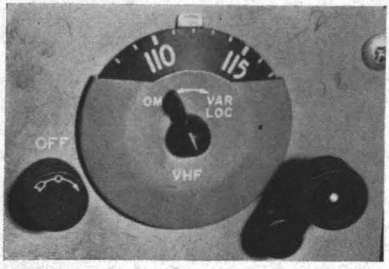
voice identifiers cease when a voice broadcast, giving traffic control instructions or weather information, is being made.

Transmission Principle

Technically, the transmission principle of the omnirange is simple and will be covered here only briefly since the purpose of this article is to emphasize use of omni rather than its electronic makeup. Transmission is based on the creation of a phase difference between two radiated audio frequency signals. Magnetic north is used as the baseline for measuring the phase relationship. One of the two signals transmitted is nondirectional and has a constant phase throughout its 360 degrees of azimuth. It is the reference phase and is radiated from the center antenna of a five-element group. The second signal is a rotating signal with a speed of 1,800 rpm; it is termed the variable phase and is radiated from four stationary antennas. These antennas are connected in pairs to a motor-driven goniometer or inductor. As the goniometer revolves, the RF voltage fed to each pair of antennas varies sinusoidally at the rate of 30 cycles per second, thus producing the rotating field. The two signals are initially aligned so that they are exactly in phase at magnetic north, but out of phase in all other directions. The difference in phasing between the reference signal and the variable signals is measured electronically and translated by the omni receiving equipment, or airborne equipment, into terms of azimuth angle from magnetic north.

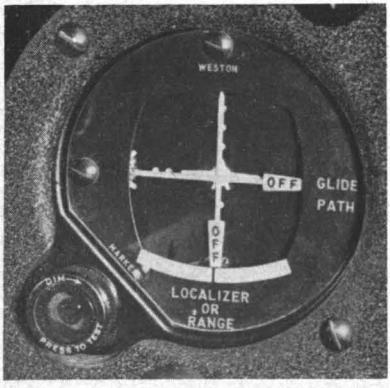
Cockpit Equipment

Although the above explanation of electronics involved in omni may sound somewhat complicated to one more accustomed to using radio ranges than to designing them, cockpit operation of omni equipment is very simple. This simplicity is one advantage of the range. Omni cockpit, or receiving equipment, has three components: (1) the radio receiver, (2) the course selector, and (3) the deviation indicator. The tuning dial of the radio receiver (left) contains all frequencies in the 112-118 mc. band. The course



The omni dial, showing all frequencies in the 112-118 mc. band.

The course selector is manually operated, has all 360 magnetic courses to or from a station.



The deviation indicator as it appears in a plane on the ground. The "off" flag at bottom retracts from view when a usable omni signal is received. The deviation needle (vertical needle shown here along center line) moves to the left or right to indicate airplane off the course set on the course selector.

selector (left) is manually operated, with the large arrow of the needle used to indicate the course desired. Combined with the course selector is a special device known as a sense indicator, which shows whether the course set on the course selector is a course to the station or from the station. The vertical needle of the deviation indicator (left, below) shows how accurately the pilot is maintaining the course set on the course selector. The horizontal, or "glide path," needle is designed for use in ILS approaches to indicate whether the pilot is maintaining prescribed let-down altitudes, but it is not functional on present Army aircraft. The deviation indicator is also provided with an "off-alarm" flag which retracts from view when a useable signal is being received.

Advantages under VFR

Now exactly what are the advantages of using omni in VFR flying? One of the main advantages is that omni is a very high frequency radio system and will, therefore, have less static and interference than a low-frequency radio system. Omni's 360 radials give any number of approaches directly to the station instead of only the four available with low-frequency radio. With omni, the pilot has a cockpit picture of the course he desires to fly and the relation of his airplane to this course. At all times he can see at a glance his position in relation to his desired course. With omni, the

pilot has the advantage of instantaneous orientation and does not have to work a complicated bearing problem. If he rotates the course selector until a "to" reading is obtained and the deviation needle centers, the large arrow of the course selector then indicates his most direct course to the station tuned. In addition, omni courses are more accurate and are not subject to split beams as are low-frequency courses. These are only some of the more important advantages of using omni as a radio navigational aid. As you become more familiar with the system, you will find that it has a number of other advantages and an infinite number of uses as an aid to pilotage.

Problem Cross-country

The best way for a pilot to become well acquainted with omni is to use it as his primary radio navigational aid on a cross-country flight. So, let us assume that you have never used omni, but are going to try it on a cross-country flight in an L-20 from, say, Meigs Airfield (Sheridan Air Force Base) in Chicago to Fairfax Airport in Kansas City, a distance of 369 nautical miles. You would, of course, plan your flight, determining in advance the course from each omni station to the next and the distances between each station. Omni stations on our course, in order of passage, will be Naperville, Bradford, Burlington, Kirksville, and Kansas City. Why not take chart 12 from your Jeppesen Manual and follow our omni course from Meigs to Kansas City? *For the purpose of figuring time and distance on this flight,* we will assume that you maintain a true airspeed of 105 knots under "no wind" conditions.

A look at chart 12 tells us that Meigs does not have an omni station, but that Naperville omni is on a direct course to Bradford omni. You, therefore, plan to clear Meigs by VHF radio and pick up Naperville omni as soon as possible. From Meigs, what will your heading into Naperville be? You see that the radial from Naperville omni to the center of Meigs Airfield is 25 degrees. Your course inbound to Naperville will be the reciprocal of this radial (25 degrees plus 180 degrees), or 205 degrees.

Tune before Takeoff

While you are still on the ground at Meigs, tune Naperville omni in and set the 205-degree course on your course selector.

The large arrow should point to "205." The omni localizer selector switch on the tuning dial of your omni equipment must point to "omni" before the set is operational. The Naperville frequency is given on chart 12 as 115.9; tune for maximum signal by volume, rotating the crank on the dial until you get the best reception. If the signal you receive is strong enough to make the "off-alarm" flag disappear from sight, it is a usable signal. Occasionally distance involved, intervening terrain, or lack of sensitivity of receiving equipment will make it impossible to tune a station on the ground; in such case try again to get a usable signal as soon as possible after you are airborne. When you have a usable signal, you will hear the Morse code identification of Naperville at 7-second intervals. Listen a time or two to be sure these are the letters you are hearing.

By the time you have reached an altitude of 1,000 feet over Meigs, your omni reception from Naperville should be reliable. Notice the deviation needle (vertical needle) on the omni deviation indicator. The course selector needle points toward the desired course of 205 degrees to the station. If the deviation needle is to the left, make a correction to the left so that you will intercept the desired course. If it is to the right, make a correction in that direction. When the needle centers, you know that you are *somewhere* on the desired 205-degree course (25-degree radial). Notice the "to-from" indicator on the face of the course selector. It reads "to" the station and means that, if you fly a course of 205 degrees, it will take you to the station. However, omni is position-sensitive equipment and not heading-sensitive equipment. Signals are generated at the station and transmitted into space; the antenna receives the same signal on a given radial regardless of the direction of flight. At a distance of several miles from the station, an aircraft can do a complete 360-degree turn and an "on course" reading remain on the deviation indicator and a "to" reading remain on the "to-from" indicator. So, as soon as the needle centers, turn your airplane to the heading of the desired course. You are then on the desired radial to Naperville omni and will continue on it as long as the needle remains centered.

Tracking

Under actual flight conditions, you must take into consideration your angle of drift in order to fly a desired course in as straight

a line as possible. Using your compass heading in conjunction with the deviation indicator facilitates making an accurate drift allowance. If you fly only the deviation indicator, endeavoring to keep the needle centered at all times, you will be weaving back and forth across your track rather than flying in a straight line. Therefore, after you pick up the 205-degree course, fly the same compass heading for a few minutes without watching the omni deviation needle. When you again look at it, the needle may be a few degrees to the right or left. Notice that six dots form a vertical center line on your deviation indicator. The instrument has a range of approximately 10 degrees on either side of this center line. When the needle is to the right of center, you are to the left of course; when it is to the left of center, you are to the right of the course.

Suppose in this instance you figure on a 10-degree drift correction. Fly back toward the needle, until it centers. Immediately turn to your heading, plus or minus the 10 degrees, to try to maintain the desired course. However, you see that the 10-degree correction is going to take you off the desired track because, as you continue on the corrected heading, the needle begins to swing to the other side of center. You can then assume that about one-half of your original correction will be enough to keep you on the desired course. Turn your airplane back toward the needle to the original heading. This will allow you to drift back to course. When the deviation needle is centered, turn to your new heading of either 210 degrees or 200 degrees, depending upon wind direction. You now have a 5-degree bracket on your course, and only minor corrections in this heading will be necessary to maintain your course. As you continue on your cross-country trip, it will be necessary to make similar corrections as wind conditions change. The accuracy with which you calculate the heading necessary to keep you on the desired radial becomes more important the closer your approach an omni station. The deviation indicator apparently becomes more sensitive, and you will be led into over-correcting. This apparent increased sensitivity results from the narrowing of the radial as it approaches the station. By accurately predetermining a correction which should keep you on the desired track, you can avoid chasing the needle. If you are maintaining the corrected heading as you approach an omni station but the needle shows you 2 or 3 degrees off course, your heading should still bring you well within sight of the omni station.

Course out of Naperville

Meigs Airfield is 30 nautical miles from Naperville; so you calculate that in 17 minutes you should be directly over the Naperville omni station. In the meantime, let's take a look at our course out of Naperville. On chart 12, find your most direct course from Naperville to the next omni station, which is Bradford. It is 239 degrees. By using the nautical-mile scale along the edges of chart 12, you determine the distance between the two stations to be 76 nautical miles.

Station Passage

As you approach Naperville, your omni deviation indicator apparently becomes more sensitive as pointed out above, and begins to register the slightest deviation from course. Try to keep the needle centered, but avoid chasing it by flying your heading as accurately as possible. Any corrections made at this time should be small. During station approach and passage, there are usually three different times at which the deviation needle will swing back and forth: just prior to passage, at passage, and just following passage. The time interval between these swings depends upon the altitude at the time of station passage. Following these deflections, the needle will again settle down and the "to-from" bar will go to the "from" position and remain there. This is your most positive indication of station passage.

You are now ready to change from the 205-degree course to the 239-degree course. But you stay tuned to Naperville omni at the 115.9 frequency. As you get the station passage indication over Naperville, rotate the course selector to your outbound course (239-degree radial) and start turning the airplane to the same heading. The deviation needle will probably give an off-course indication at this time. Allow it time to settle down; then proceed to get on course in the manner described under tracking. When you are able to keep the needle centered, you are again on the desired course. Your radio is still tuned to Naperville omni. Every 7 seconds since you tuned the station in at Meigs you have heard the "API" Morse code identification. You may have received a weather broadcast also. These are normally made every 30 minutes, 15 and 45 minutes past the hour.

"Midway" Rule

Midway between Naperville and Bradford (about 20 minutes out of Naperville), switch your radio to the Bradford frequency. Whenever you use omni, this "midway" rule is a good one to follow. That is, fly the station just passed until you are halfway to the next station, even though the distance from the midway point to your inbound station is considerably less than the dependable-reception limits of your omni equipment. The reason for this practice is twofold. In IFR flying, the pilot is required to make regular position reports. These are made to the nearest station having voice facilities. In both IFR and VFR flying, maximum accuracy is thus obtained from both the "outbound" and the "inbound" station. Remember that changing frequencies on a direct course between two omni stations does not require any major change in your course selector. Your course to Bradford is still 239 degrees as indicated by the big arrow. The small arrow points to the 59-degree Bradford radial, which is the reciprocal of the 239-degree course. So, simply change your radio dial to 114.7 mc., the Bradford frequency as given on chart 12; adjust the volume and listen carefully to identify the Bradford code.

Accurate tuning and identification are prerequisites to proper use of omni. Final tuning is best accomplished while listening to the station identification signal with reduced volume. Sensitivity of the deviation indicator is independent of volume control. However, the station frequency must be tuned very accurately for the identification signal to be audible with very low volume; this in turn results in greater accuracy of the deviation needle. With your change in station, the "to-from" bar on the course selector again registers "to."

From Bradford, our course into Burlington is 244 degrees. As you get station passage at Bradford, rotate the course selector to the desired heading and start turning the airplane to the same heading. Allow sufficient time for the deviation needle to settle down; then get on course by the tracking procedure. You will now be getting a "from" reading on the course selector. Notice that on this 244-degree course you are picking up a Victor airway, V-10, which will take you directly over Burlington, the next omni station. In fact, you can fly V-10 all the way to Kansas City. Remember that on airways, it is generally considered good practice to fly altitudes prescribed for IFR conditions. When you are ready to

switch to Burlington omni (midway between Bradford and Burlington), tune the indicated frequency of 117.9 mc. and adjust volume for accurate tuning. Your course is now "to."

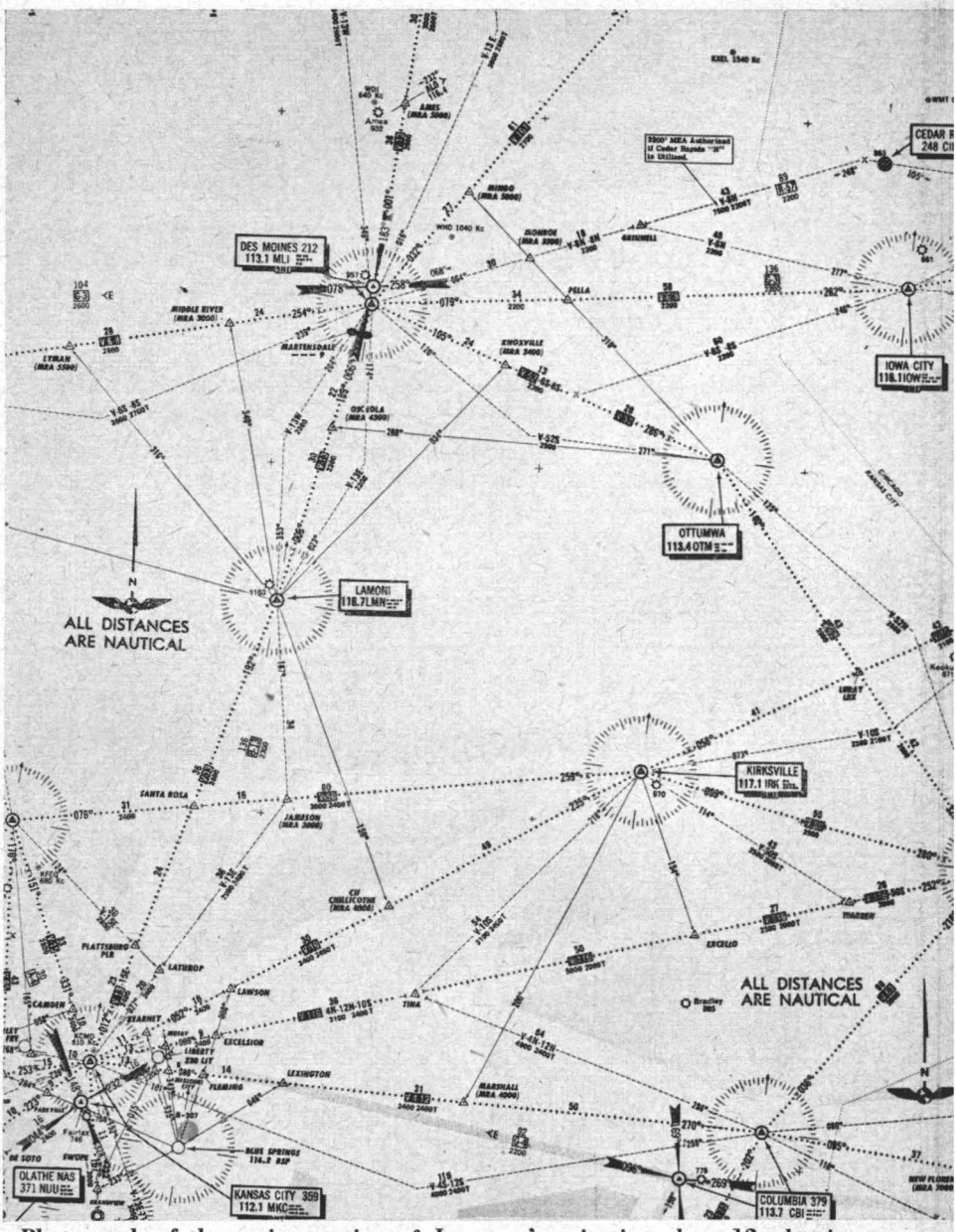
Radial Variations

In a cross-country flight directly between two omni stations, you will frequently find that, when a new station is tuned in, the omni deviation indicator moves to the right or left even though you have not changed your course. This variation can result from any one or a combination of three things: (1) the natural change in the magnetic field as it moves west, (2) a slight shifting of radials at the omni station, or (3) inaccurate setting of the course selector. Normal magnetic field changes are taken care of on aeronautical charts. For example, on chart 12, check the radial east from Kirksville and the one west from Burlington, both on V-10. Check a similar difference in the east radial from Burlington and the west radial from Bradford on V-10. The shifting of radials at an omni station is corrected as soon as possible through the omnirange monitoring procedure. However, when course deviation is encountered with a change in radio frequency, continue your flight direct to the new omni station by doing either of two things: (1) rotate the course selector to center the needle and fly the needle to the station or (2) center the needle by turning your aircraft toward it and fly the needle to the station.

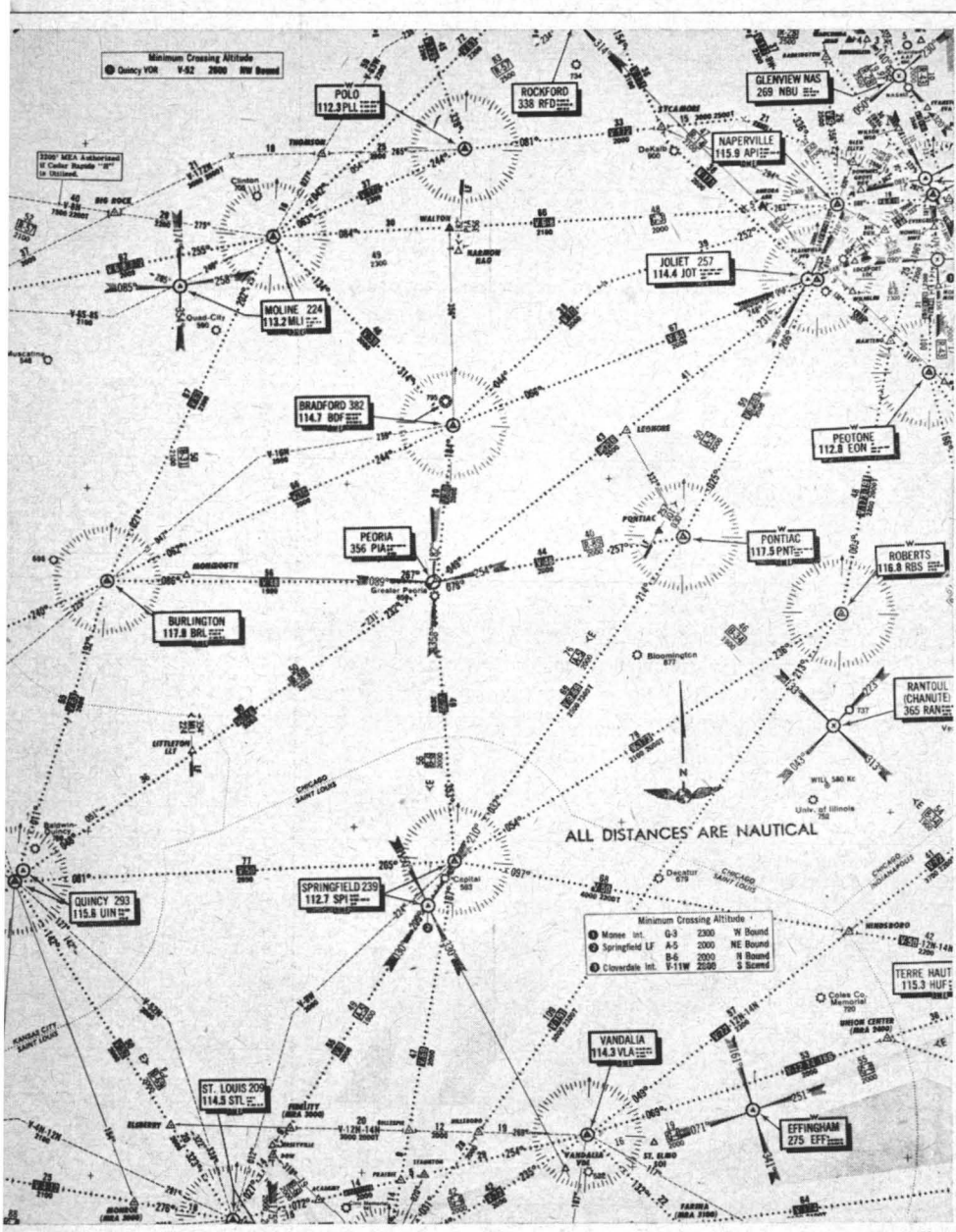
Thus you see that all you do to fly omni on predetermined courses from one station to the next is keep your radio accurately tuned to the nearest omni station, set the new course on the course selector at station *passage* when necessary, and fly this course by keeping the deviation needle centered. From Burlington you fly a 240-degree course into Kirksville, changing to the Kirksville frequency midway between the two stations; and from Kirksville, a 235-degree course with a change to the Kansas City frequency midway.

Victor Reporting Points

Notice on chart 12 that there are two noncompulsory Victor reporting points on V-10 between Burlington and Kansas City. One is "Luray," midway between Burlington and Kirksville, and the other is "Chillicothe," 49 nautical miles out of Kirksville. As you fly V-10 on omni, you can use these reporting points as check



Photograph of the major portion of Jeppesen's avigation chart 12, showing the problem cross-country route from Meigs Airfield (Sheridan Air Force



Base) to Fairfax Airport in Kansas City. Meigs Airfield, the point of takeoff, is located in far upper-right corner.

points on your position and on your true ground speed. For example, when you are about 20 minutes out of Burlington, you can fly your compass heading to maintain your course and change your omni radio to the Quincy (southwest of Burlington) frequency. With this change in frequency, the deviation needle will swing sharply, indicating you way off course. Rotate the course selector to 320 degrees, the radial from Quincy to "Luray." The point at which the deviation needle again centers is the location of reporting point "Luray." You can then check your ground speed by noting the difference in the time you got station passage over Burlington and the time you were over "Luray." "Chillicothe" can be used in the same way by tuning the Lamoni frequency and checking your time out of Kirksville.

A look at chart 12 tells you that Fairfax Airport in Kansas City is 7 miles south of Kansas City omni. On a radial of 180 degrees from Kansas City omni, you should be over Fairfax in 4 minutes.

Return Courses

On the return trip, you fly the omni range in exactly the same manner. However, your courses back will be the reciprocals (with a 1- or 2-degree allowance for changes in the magnetic field) of your courses to Kansas City. Note on chart 12 that these courses are given as follows: 052 degrees out of Kansas City, 058 degrees out of Kirksville, 062 degrees out of Burlington, 060 degrees out of Bradford, and 025 degrees out of Naperville.

Course Interception

The foregoing cross-country problem has illustrated the basic principle of flying directly from one omni station to another. Now suppose on your return flight, that you are about 30 minutes out of Kirksville when you get a weather report that a front has dropped ceilings at Bradford to 500 feet and at Burlington to 1,000 feet. Because of a strong headwind, you are now only 41 miles out of Kirksville, and it should take 35 to 40 minutes more to reach Burlington. The ceiling at Quincy is reported as 1,200 feet; so you decide to swing your course to the south. How would you intercept the most direct course into Quincy? In this instance, your solution would be very simple because, at 41 miles out of Kirksville, you would be directly over the "Luray" omni reporting

point. You would tune in the Quincy frequency, set your course selector at 140 degrees (the 320-degree radial), and make a turn of approximately 90 degrees onto course. When the deviation indicator needle centers, you are on V-52 to Quincy. However, suppose you are about 15 miles out of Kirksville when you change your route from Burlington to Quincy. How would you intercept the most direct omni course into Quincy? You know that Quincy is southeast approximately midway between Kirksville and Burlington; so you tune the Quincy frequency on your omni radio and start a turn toward Quincy. As you turn, rotate the course selector on your omni equipment until the needle of the deviation indicator centers. When it centers you are on course to Quincy. When your airplane heading reads the same as the course selector, stop the turn and follow this track into Quincy omni.

One of the finer points of using omni is intercepting a specific magnetic course, known as a radial. For example, airway traffic control may specify the radial an aircraft must fly. Often the specified radial is not the one on which the aircraft is flying at the time, and the pilot must work a course interception problem. Suppose he is flying into Kansas City, and Kansas City control tells him to come in on a radial of 045 degrees. He then works his problem and intercepts the 045-degree radial in six steps. (1) He first turns to a heading parallel with the 045-degree radial, (2) then to determine what radial he is on, rotates the course selector until the deviation needle centers and the "to-from" indicator reads "to" the station. The angular difference between the radial the aircraft is on and the desired radial can now be observed on the course selector by determining the difference between the setting of the course selector and the number representing the desired radial. (3) The pilot then doubles this angle to determine the angle of interception required to intercept the desired radial. However, doubling the angle of difference to arrive at the angle of interception holds true only so long as the former is 40 degrees or less. Course interception to a station is impractical if the angle of interception exceeds 90 degrees. (4) To arrive at his interception heading, the pilot either adds the angle of interception to the course heading (when the desired course is to the right) or subtracts the angle of interception from the course heading (when the desired course is to the left). (5) The pilot then rotates the course selector back to the desired course, or radial, to be intercepted. On a radial of 045 degrees, what will his desired course heading be? Or, where

should he set the big arrow of the course selector? At 225 degrees, the reciprocal of the radial on which his course is located. (6) As the last step, he turns the aircraft to the interception heading, which is the desired radial plus or minus the angle of interception. If the aircraft is to left of course, the needle will be deflected to the right of center and will start moving toward center as the course is approached. With experience a pilot can judge from his speed, or rate of movement, the amount of lead to employ in turning to course heading.

Determining Position

Another way in which omni can be used is to determine your position at a given time. This is particularly helpful on a cross-country when omni stations do not fall along the desired course. Procedures used are similar to those used in plotting bearings with loop antenna; however, one advantage of omni is that magnetic bearings can be read directly. Suppose you are flying directly from Kirksville to Moline, a distance of 142 nautical miles with no omni stations directly between the two points. After 40 minutes enroute, you estimate your position to be west of Burlington but wish to plot an accurate fix. Simply tune in the Burlington station and center the deviation needle by rotating the course selector. Make sure that the position of the big arrow is such that you have a "from" indication on the "to-from" bar. With a straight edge, draw a line out from the Burlington compass rose that corresponds to the radial shown on the course selector. Then repeat this procedure with Ottumwa omni (also a "from" indication), and the point at which the two radials intersect is your position. By repeating the procedure a time or two during your flight, you can determine whether you are maintaining the correct course. In addition, you can determine your ground speed by noting the time at which you plotted the first bearing, plotting another in 30 minutes, and measuring the distance between the two positions.

Time and Distance

There are other methods of using omni to determine time and distance to station. One method is based on the same formula (60 multiplied by the minutes, or seconds, flown divided by degrees

(Continued on page 43)

UR HIGHLIGHTS

Major Fred R. Reed, *Transportation Corps*

The views expressed in this article are the author's and are not necessarily those of the Department of the Army or of The Army Aviation School.—The Editor

A NEW year, with the usual New Year's resolutions, is ahead of us. We hope that your resolutions included prompt submission of unsatisfactory equipment reports. Our resolution is to process and answer your UR's as rapidly as possible.

Why is it so important to report discrepancies through the Unsatisfactory Report system? What good does it do? Does anyone ever investigate the report? Does anyone do anything about it? These are some of the questions that are asked concerning the UR program, and particularly since the initiation of this column. They are good questions. To answer them, and to illustrate how the submission of only one UR can "pay off," the summary of events concerning an L-17 fuel pump failure is presented.

A pilot and his passenger made preparations for a flight in an L-17 aircraft. After a thorough check of the aircraft, the pilot taxied to the end of the runway and proceeded to take off. At approximately 150 feet, the engine failed. Emergency starting procedures were attempted without success, and a wheels-up landing was made a short distance from the field on an unimproved road. Investigation revealed that the drive pin in the fuel pump had sheared. The auxiliary fuel pump was also found to be inoperative because of several broken wires at a cannon plug. As a result of the fuel pump failure, an emergency UR was submitted.

Upon receipt of the UR, the Transportation Supply and Maintenance Command initiated a message to the field recommending immediate inspection of the drive rotor in L-17 fuel pumps to disclose worn parts which might lead to in-flight failure. This message also requested that UR's be submitted on all unsatisfactory items found during this inspection. *Twenty-four* UR's citing badly

worn parts were received. All items reported were and are being completely investigated. In addition to the Transportation Supply and Maintenance Command message, an "urgent action" interim technical order was published and distributed.

The "pay off" on the original UR is yet to come, but the following precautionary action has already been taken as a result of it:

1. TO 1L-17A-6, Handbook of Inspection Requirements, has been revised to require that the pump be inspected for worn drive parts at the second periodic inspection after installation and each tenth periodic inspection thereafter.
2. The feasibility of installing a different type of fuel pump is being investigated.
3. The possibility of modifying the present fuel pump is being considered.

The originator of the first UR in this case may not realize it, but, as we have seen, his report instigated considerable action. More important, we wonder how many of the additional 24 discrepancies reported would have resulted in in-flight failures.

To emphasize our point, remember that the UR which you are preparing right now may be one which will initiate changes that make aircraft safer to fly.

The following items have been selected for highlighting this month:

Fixed Wing

Problem: Reference: TO 1L-19A-231, Modification of Landing Gear Bulkhead Assembly, L-19 Series Aircraft.

UR's reported that, with enlargement of the bolt holes in the landing gear bulkhead to 3/16 inch as prescribed in the TO, there was insufficient edge distance to meet required standards. As a result of the UR's, TO 1L-19A-231 was redesignated as "information only," and technical order compliance was suspended. This information was furnished Department of the Army activities by TWX. The TO has been rewritten and is now being coordinated prior to publication.

The UR Highlights department, *prepared by Major Fred R. Reed, is compiled from information contained in Unsatisfactory Reports received by the Transportation Corps Supply and Maintenance Command, 12th and Spruce Streets, St. Louis 2, Mo. Major Reed is Chief of TSMC's Publication Division.—The Editor.*

This particular problem was selected for highlighting to show that Unsatisfactory Reports on items other than equipment are important. In this case, a publication was in error and is being corrected as a result of UR's.

Problem: Pressure Fluctuation, Auxiliary Fuel Pump, L-19.

This project was closed but has been reopened because of the receipt of additional UR's. In every case where exhibits were available, the "tear down" investigation revealed that the cause was the old "bugaboo," foreign matter, or *dirt,* in the fuel system.

Figure 4-80, page 136, TM 1-1L-19A-2 traces the fuel lines from the tanks to the auxiliary fuel pump. How much filtration takes place before the fuel passes through the auxiliary fuel pump? At the tank is a "finger strainer" preceding the fuel selector valve. From the fuel selector valve *through* the auxiliary fuel pump, there is no additional filtration. The fuel passes through the main fuel strainer of the system *after* it has passed through the auxiliary fuel pump. You can rest assured that the little "finger strainer" at the tank is not going to prevent all the foreign matter that many enter the tank during servicing operations from getting into the auxiliary fuel pump.

As stated previously, this project remains open. As long as UR's are received, they will be investigated, but *keep the fuel system clean!*

Rotary Wing

Problem: Rough Bearing in Sleeve and Spindle Assembly, H-19.

The majority of the UR's received on this condition were from units operating under dusty and sandy conditions. Disassembly Inspection Reports revealed that the damper yoke housing bearings were rough. The rotor hub inspection disclosed that the bearing cones in all three damper yoke housings were slightly brinelled. Transportation Supply and Maintenance Command requested that grease samples from each of the damper yoke bearings be analyzed. This analysis did not reveal any appreciable amount of dust or dirt, and the exact cause of this discrepancy remains unknown. However, it is considered that operations under abnormal conditions of dust, sand, and moisture subject the bearings in the main rotor assembly to contamination. This may be indicated by binding and ratcheting of the bearings. It is recommended that more frequent

purging be utilized to lengthen the service life of the bearings. The following may be used as a guide:

1. Use of a hand type grease gun or a mechanical grease gun with not more than 100 psi of pressure.
2. Insert a .020- to .030-inch thick feeler gauge at the joint from which the grease will be forced out.
3. Rotate the damper arm housing 180 degrees at each 25-hour purging to aid in preventing brinelling.
4. Rotate, or oscillate, all bearings at each purging to aid in removing any contaminated grease and to provide a better distribution of the lubricant throughout the bearing.

Problem: Main Rotor Transmission—Failure of Needle Bearing, H-13.

Investigation of the condition revealed that, in most cases, the needle bearing had been installed incorrectly in the lower sun gear, either at the time of manufacture or during overhaul. It is possible to install the bearing (P/N GB16164) in an inverted position. Both contractors and overhaul facilities have taken steps to prevent recurrence.

This is a good example of UR's providing a means of correcting a manufacturing procedure.

Problem: Leakage in Seals of the Pitch Bearing Housing, H-21.

On receipt of the first UR on this condition, an immediate investigation was made. It was found that the contractor was being supplied by two vendors. Further investigation revealed that one vendor's product was more susceptible to failure than the other's. The contractor is now using only the preferred seal, and no further trouble is anticipated. However, any additional UR's received will be given immediate attention.

Power Plant

Problem: Starter Housing Broken, 0-335-5, H-13 and H-23.

Investigation of this discrepancy indicated that the rollers in the clutch assembly became worn, causing excessive vibration when the clutch was in the over-running position. Failure to promptly disengage the starter when the engine begins to run allows the

vibration to reach a frequency high enough to crack the clutch housing. New clutch assemblies are now being installed during overhaul. To insure that a cracked housing will not be reinstalled, the overhaul procedure now includes magnafluxing of the housing. Personnel in the field can help alleviate this condition by observing the following:

1. Avoid over-running of the starter when starting the engine.
2. Make frequent inspections of the starter to detect cracks in the clutch housing before the housing breaks.

Problem: Cylinder Head Seals Leaking, 0-470-11.

Many UR's have been received on this condition, reporting oil seeping through to the outside where the cylinder head and barrel are joined together. Information available at this time indicates that loss of effectiveness of the seal is undoubtedly the result of overheating. The sealing compound used in this assembly, however, will maintain its bond up to temperatures well above maximum allowable cylinder-head temperatures. The first step indicated is to adhere to the cylinder-head temperature limits outlined in TM 1-1L-19A-1. The second step is to continue submitting UR's if seals leak despite this precaution.

This particular project is still under investigation. Frankly, UR's have been received that report the leak where maximum allowable cylinder head temperatures have not been exceeded. On this problem, we need lots of help, lots of UR's. Particularly, we need UR's indicating that seepage still exists when maximum allowable cylinder-head temperatures have not been exceeded.

That does it for this month. We in St. Louis wish you all a Happy, Prosperous New Year and ask you to remember: *Don't live or perhaps die, with an unsatisfactory condition. REPORT IT!*

New Mission for L-17's

Six L-17's, among some 150 declared surplus to other Army needs, are being modified for use as aerial drones, according to Ryan Aeronautical Company. The aircraft will be subjected to a series of tests conducted at Fort Huachuca, Ariz., to evaluate the use of drones in photographic and picture assignments. Three planes are being equipped with television facilities and two with still photo cameras. The sixth is being fitted for use as a general utility drone.

BOOKS

For the Army Aviator

AERODYNAMICS OF THE HELICOPTER—*Gessow, Alfred, and Myers, Garry C. Jr., (The McMillan Company, 60 Fifth Ave., New York 11, N. Y., 1952. $6.00)*

Although not a recent release, this book is one which every helicopter pilot will find helpful and interesting reading. The authors have provided a complete, practical guide to all the basic factors affecting the aerodynamic behavior of rotary-wing aircraft, including the most reliable and up-to-date test data.

An initial chapter describes, in practical terms, the mechanisms and general flight and operating characteristics of the helicopter. The aerodynamic theory of the rotor is then developed and applied to the prediction of helicopter behavior for all steady flight conditions, both power-on and in autorotation. In all cases, theory is checked with flight-test data obtained from the National Advisory Committee for Aeronautics.

To provide an understanding of the phenomena associated with forward flight, a thorough discussion of the physical concepts of flapping and feathering is presented. Basic force and movement equations which are then developed for the rotor in forward flight lead into a simple and logical method of performance prediction.

Various design parameters, such as disk loading, rotor solidity, and blade twist, and the limiting effects of blade stall and compressibility on high-speed flight are also discussed. The authors present means by which helicopter design can postpone these limits and achieve high forward speeds. Finally, the physical aspects of helicopter stability and vibration are covered in detail to give an understanding of the parameters that influence flying qualities of the helicopter.

The greater part of the author's training and experience in helicopters has been gained in the Flight Research Division of the Langley Aeronautical Laboratory of the National Advisory

Committee for Aeronautics. The vast background of experimental and theoretical rotor work done by NACA during the past 15 years serves as a sound basis for the aerodynamic material developed in Aerodynamics of the Helicopter.

ATOMIC ENERGY RESEARCH AT HARWELL—*Jay, K. E. B., (Philosophical Library, Inc., 15 E. Fortieth St., New York 16, N. Y., 1955. $4.75)*

This book from the United Kingdom Atomic Energy Authority covers developments at the British Government's Harwell research establishment from 1952 through 1954. Changes in international agreements concerning release of atomic information have made it possible for the author to discuss in detail subjects which have heretofore been classified secret.

Part I of the book discusses general progress in the Authority's main programs, including the production, reactor, and isotope programs, the development of electronic instruments, and advancements in the engineering and allied services. Part II deals in more detail with selected research in physics, chemistry, chemical engineering, and metallurgy. In addition, the book is provided with a non-scientific glossary to acquaint the reader with technical terms used. A comprehensive collection of line drawings and half-tone illustrations are used to clarify the text and to lend general reader-interest.

For those interested in acquiring a well-rounded knowledge of the field of atomic energy, including international and nonmilitary aspects, *Atomic Energy Research at Harwell* is an informative and interesting report by one of Britain's outstanding scientists.

NEVILLE DUKE'S BOOK OF FLYING—*Edited by Lanchbery, Edward, (British Book Service, Ltd., Kingswood House, 1068 Broadview Ave., Toronto, Canada, 1954. $2.25)*

This entertaining and enlightening book is a "must" for Army aviators who have not read it. The English authors, Mr. Duke and

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Book reviews are compiled by the ARMY AVIATION DIGEST staff. Views expressed are not necessarily those of the Department of the Army or of The Army Aviation School.—The Editor.

Mr. Lanchbery, combine their flying and writing talents to present exceedingly interesting accounts of past, present, and future aviation.

The book opens with an "arm chair" flight lesson in the Vampire jet trainer. The authors point out that in the R. A. F. all pilots under training are now required to qualify in jets before they are awarded wings. Subsequent chapters cover the first 50 years of flight, the breaking of the world speed record by the Hunter in 1953, dawn patrols during the early war years, the first 1000-bomber raid, early developments of the helicopter, test flying, and carrier-based planes. A final chapter previews aircraft and aeronautical developments to come. The authors ask: Will the test pilot of 2003 A. D. be flying at 77,000 miles an hour? In answer, they discuss exploitation of other-than-propeller-driven aircraft, including atomic propulsion, rocket-powered aircraft, and various other means of vertical lift and vertical takeoff.

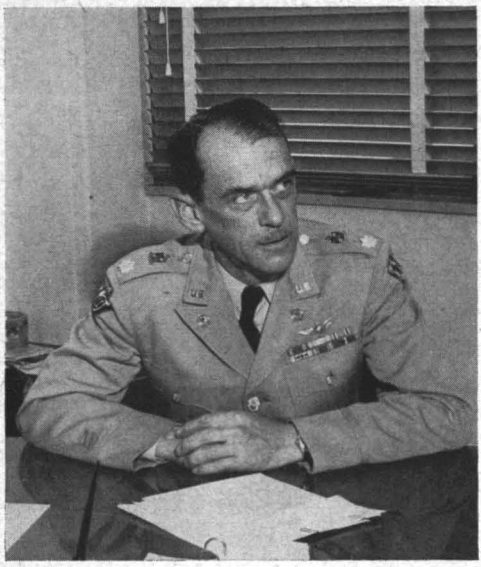
Its easy-flowing narrative style and the host of illustrations combined with its interesting subject matter, make *Neville Duke's Book of Flying* highly recommended for a few hours of light, enjoyable reading.

GAS TURBINES AND JET PROPULSION—*Smith, Geoffrey, (Philosophical Library, Inc., 15 E. Fortieth St., New York 16, N. Y., 1955. $15.00)*

This is the sixth, and enlarged, edition of a technical book generally recognized as the standard work in its field since initial publication as a small volume in 1942. Since the death of author G. Geoffrey Smith in 1951, revision and expansion of material has been assumed by F. C. Sheffield, a long-time associate of Mr. Smith.

At the time of original publication of the book, jet propulsion for more than a few military aircraft still seemed an improbable prospect. Today, the historical, current, and future aspects of this field provide a background which makes the Geoffrey-Sheffield book a comprehensive coverage of the subject of the gas turbine.

Principles and history of jet propulsion and the most important technical aspects of the field, including design and performance, components, fuels and fuel systems, metallurgical problems, research, testing, and maintenance, are covered early in the book. Subsequent chapters discuss the various types of American and foreign aircraft, gas turbines, and application of the gas turbine to rockets and helicopters.



The Gray Hair Department

MANY aircraft accident reports received by the Army Aviation Safety Board incorrectly state the primary cause and contributing factors of the accident concerned. One of the main purposes of the report is to provide a basis for corrective action which will prevent similar accidents. Without accurate reports, and with-

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Lieutenant Colonel Edwin L. Harloff, *the very senior Army aviator pictured above, is Chief, Aviation Department, Transportation School, Fort Eustis, Va. His career in Army Aviation began in 1943, when he graduated from Liaison Pilot Course Number 17 at The Artillery School, Fort Sill, Okla. He is qualified in both fixed- and rotary-wing aircraft and is instrument rated. During WWII, he served as division artillery air officer with the 11th Airborne Division through the New Guinea, Leyte, and Luzon campaigns. In 1946 he returned to the Air Training Department as Senior Instructor in the Department of Tactics and General Subjects.*

In 1948 he was assigned to the Joint Military Mission for Aid to Turkey, where, for 2 years, he supervised the establishment and operation of the Turkish Army Aviation Program. In 1950 he returned to Fort Sill to become Director, Department of Aviation Maintenance, in the Department of Air Training. He remained in this position until 1954, when he received his present assignment. In addition to completing all Army aviation courses, Colonel Harloff is a graduate of the Coast Artillery Anti-Aircraft School's Battery Officer Refresher Course and of the Associate Transportation Officer Advanced Course.—The Editor.

out accurate findings as to cause, improper corrective action may be taken.

Accident investigation boards appear increasingly reluctant to place the responsibility for an accident where it really belongs. The boards are quick to say "pilot error" since the pilot is always involved to some extent. This has become such a school-solution type answer that other causes are often not given proper consideration, and especially when the error is in the realm of supervision. The following accident, with a reported primary cause of *pilot error,* is indicative of the reluctance to consider supervisory error.

The situation: With the exception of a 3-hour checkout two days before the accident, the pilot had not flown during the approximately 2½ months since he graduated from the Army Aviation Tactics Course. The 3-hour checkout consisted of a map orientation before takeoff, 1 hour of high work, and 2 hours of low work which consisted largely of landings and takeoffs. At the end of the 3-hour period, the pilot completed three solo landings; then the instructor cleared him for operational flights.

His first scheduled flight was an administrative mission, consisting of transporting another officer cross-country. The weather conditions 1 hour before the flight was scheduled were winds calm, visibility 1 mile in fog. The weather 10 minutes before the pilot took off was winds calm, visibility ½ mile in fog. The same weather conditions prevailed over other airstrips in the vicinity of the pilot's home strip. Weather along the route was *below VFR minimums,* but the destination reported winds calm, ceiling 1000 feet overcast, and 7 miles visibility.

About 5 minutes after the second weather observation, the fog dissipated over the field, and *the operations officer cleared the flight for takeoff.* As the pilot broke traffic and started his climb-out, the fog rolled in rapidly under him. He continued climbing until he was 2000 feet on top then began circling the field after he saw that all the surrounding area was covered by the heavy fog. He called the tower and informed the operator of the weather conditions. A few minutes later, the tower informed all aircraft that the field was closed until further notice. The tower personnel then heard the pilot call other Army airstrips in the local vicinity in an at-

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The Gray Hair Department *is prepared by the ARMY AVIATION DIGEST staff with information obtained from the files of the Army Aviation Safety Board. The views expressed in this department are not necessarily those of the Department of the Army or of The Army Aviation School.—The Editor.*

tempt to find a field that was clear. However, he received negative answers. Apparently under the impression that if they did nothing they could not be blamed for the wrong action, no instructions or suggestions as to the best course of action for the pilot were made by supervisory personnel on his home strip.

Finally, the pilot saw a small opening in the overcast not far from where he was circling and decided to let down underneath the overcast. This did not prove to be a good solution, because as he went under the overcast, the opening closed and he found himself restricted to a valley.

He decided to land. Fortunately, there was an unimproved road approximately 19 feet wide and clear of obstructions, with the exception of a small tree 1061 feet from the intended touchdown point. He lined up the aircraft with the road, but was too high and too fast to land on his intended touchdown point. Although he realized that he had to make a go-around, he delayed doing so in order to double check the rapidly lowering ceiling. In those moments, his aircraft was slowing and he was approaching the tree. He finally added throttle for the go-around but the plane settled, the left wing struck the tree, and the aircraft spun to the left and crashed.

The accident investigation board attributed the primary cause of the accident to "an error in judgment by the pilot in attempting to break through a heavy, broken condition into an unknown condition in unfamiliar terrain." Was this the *primary* cause? The board continued by listing the contributing factors are: "(1) Delaying a go-around, (2) Unusual weather phenomena, and finally, (3) The pilot had been in a flying status in this Command for only two days." The action taken to prevent similar accidents was stated as: "Pilots of this unit have been directed to observe complete caution when encountering marginal weather. A review weather course for pilots will be conducted during non-flying weather." Recommended further action was, "Recommend 8th Army stress the importance of a complete Korean weather checkout for new aviators."

If this accident report were added into the Army aircraft accident statistical picture verbatim, it would cause the picture to be out of focus since pilot error was not the *primary* cause. The *primary* cause was supervisory error. To begin with, the pilot was on his first operational flight in his first assignment as an Army aviator. He was not familiar with the terrain or weather conditions peculiar to the theater, but he was eager to perform his job, and when the operations officer said "go," he went. Why

did the operations officer clear this flight into extremely marginal weather conditions, especially in view of the pilot's limited experience? Second, when the pilot found himself forced on top, he informed the tower immediately, but the only aid he could get from his home airstrip was that the field was closed, a condition which was very obvious. Why did not the operations officer do something to help the pilot? Why did he not tell the pilot to fly south until breaking out in the open and to land at the first airstrip he came to? In the report, it was indicated that fields were open to the south.

After allowing an inexperienced pilot to undertake a VFR flight in below VFR minimums, the supervisors folded their hands and remained silent when trouble began. Supervisory personnel allowed an inexperienced pilot who was not familiar with the terrain, was not instrument rated, was without radio navigational aids, and who was unfamiliar with the weather phenomena of the theater to flounder around above an overcast and offered no solution although they had radio contact throughout the entire flight.

The accident report did not state if the operations officer made an attempt to determine the weather conditions outside the boundaries of his own airstrip. But, even without a weather report, the conditions around the field should have indicated to him that the weather would be marginal throughout the immediate area. Why was flying not suspended until the weather stabilized VFR?

Certainly the pilot made some mistakes but it is in the concluding paragraphs of the Army Aviation Safety Board's analysis that we find the *primary* error which caused this accident. The analysis states in part:

"c. . . . supervisory error on the part of the Aviation Officer and the Operations Officer for allowing a young pilot, new to the Command and the terrain, to be cleared for a flight when the weather was marginal at takeoff and below VFR minimums enroute to the destination.

"d. . . . Further supervisory error on the part of the Operations Officer or his representative is indicated as contributing to this accident in that they did not take action to advise the pilot to proceed south and land at the first clear airfield when the pilot reported by radio that the entire area was obscured. Other contributing factors to the accident are attributed to improper landing technique by the pilot after he elected to make an emergency landing."

"Pilot error" is the popular, easy-way-out solution for the

accident investigation board in many cases but it is not always the right one, and when the primary cause is so glaringly "supervisory error," as it was in this accident, and as it is in a large percentage of the accidents reported to the Army Aviation Safety Board, it should be duly noted.

Another point brought out by this accident that seems to be a growing problem in Army aviation is the need for a definite unit training program. Such programs are needed especially for newly graduated pilots. Although newly graduated pilots have met the requirements for rating as Army aviators, they do not have the airmanship of pilots with 1000 hours since they have not had the opportunity to develop such judgment. They do have the fundamentals and basic background with which to adapt themselves to unit flying situations if given proper training. The first 4 to 8 weeks in an air section should be a transition training period, a period during which the new pilot is taught how to apply his school training under practical, operational conditions. He needs cross-country experience, practice in using radio navigational aids (when available), a working knowledge of weather, and instruction in how to apply his flying techniques to the terrain and the strips which his unit is using.

A 3-hour checkout, a map orientation on the ground, and a mission into hazardous weather conditions is not the answer.

Proficiency Needed

A pilot was flying an H-13 on a local proficiency flight in high, mountainous terrain. He selected a landing spot on top of a very narrow ridge lying approximately 6,200 feet above sea level. The width of the ridge varied from 4 to 10 feet, with 45-degree slopes on both sides. Weather at the time of the accident was clear, with a south, southeast wind at 14 knots, temperature 67° and dew point 36°.

The pilot made a steep approach to the ridge and landed. After a short period on the ground, he picked the helicopter up to a hover, but drifted backward off the ridge and lost rpm. He found that he did not have sufficient power to regain the lost rpm. He attempted to increase the rpm by resting the front part of the skids on the slope, thus decreasing the load on the main rotor.

He hovered with the skids pressed against the slope for several seconds but he could not build the rpm above 2900. Suddenly, the

right skid cracked at the forward strut and collapsed, causing the main rotor blades to strike the top of the ridge and break off about 3 feet from their roots. The helicopter fell on its right side. Fortunately, it did not roll down the hillside, and the pilot crawled, unhurt, from the wreckage.

The pilot had flown 42 hours in this type of helicopter since completing the Army Helicopter Tactics Course. He was flying in high terrain and had selected as a landing area a narrow ridge 6,200 feet above sea level. Flying under these circumstances requires an extremely high degree of skill, which a pilot recently out of helicopter school would not have a chance to acquire. The density altitude could not be computed exactly from the data given in the report, but the 67° temperature suggests that the density altitude was between 7500 and 8000 feet.

Hovering above such a narrow landing area is not safe procedure, especially in high density altitude conditions. The narrow ridge does not afford a solid foundation on which to build up a ground cushion, thus additional power is required in order to hover. The present school teaching recommends a creeping takeoff from a very low hover, gaining air speed over altitude. In this way a pilot utilizes his initial power in gaining translational lift before the rmp drops off. With this type of takeoff, if rpm is lost after clearing the ridge, the pilot has sufficient altitude in which to reduce collective pitch, start a descent, and regain rpm.

When the helicopter began drifting backward off the ridge, the pilot might have increased his speed to the rear, turned away from the hillside, and reduced pitch while gaining forward speed. He had the lateral space and the altitude in which to execute such a maneuver. Perhaps he could have quickly increased the rpm to normal, but this maneuver borders upon acrobatics and is not recommended except as a desperation procedure.

This accident can be best summed up by quoting the last two paragraphs of the Army Aviation Safety Board's Aircraft Accident Brief, " . . . b. This board takes exception to the recommendation of the investigation board that pinnacle landings not be attempted at the altitude at which this accident occurred. The employment of the procedure taught at The Army Aviation School permits safe operation of helicopters in and out of sites at the altitudes and nature of the one described in this report of accident.

"c. The pilot concerned in this accident had been rated in rotary-wing aircraft only 4 months when this accident occurred

and, therefore, could not be considered an experienced pilot. For this reason, it is the opinion of this board that supervisory negligence contributed to this accident in permitting an inexperienced pilot to operate in and out of a 6,200 msl pinnacle. Evidence contained in the report of accident is insufficient to determine the degree of unit training received by the pilot in flights of this type or the degree of proficiency which he is considered to have obtained in pinnacle work. In view of the fact that he had a total of only 42 hours rotary-wing flight time, since graduating from helicopter school, it can be logically assumed that sufficient proficiency and experience for flights of this type had not been obtained."

The best prevention for accidents of this nature is a good, well-planned unit training program, conducted by qualified, experienced instructors.

Hand Signals

The following is an example of an accident caused by the *lack* of attention to or supervision of pilots' utilization of ground crews in moving aircraft from the parking area. The accident cost $27,804.32, which included the loss of one aircraft and extended grounding of another.

A pilot in an H-23 helicopter, accompanied by a passenger, was preparing to take off on an authorized training flight. The crew chief of the helicopter was standing by to direct the pilot, by arm and hand signals, out of the parking area. The H-23 was facing north, in a wind from the south at 15 to 20 mph. The accident report stated than an L-20 was parked 60 feet directly behind the helicopter, and a wind-sock pole was located 100 feet to the east of the L-20.

The pilot indicated to the crew chief that he was ready to go, and the crew chief gave him the up signal. However, an L-19 was preparing to take off on the active runway nearby, so the crew chief signaled the pilot to land. After the L-19 had taken off, the crew chief again gave the up signal. The H-23 pilot picked up to a hover, looked over his right shoulder, began moving backward, and started a turn as if to make a 180-degree turning takeoff to the south. In spite of the frantic efforts of the crew chief to signal the pilot of imminent danger, the pilot continued moving and rammed the tail rotor of his helicopter into the right wing of the L-20, breaking off the rotor blades. The helicopter turned

to the right and the main rotor blades shattered as they struck the already-damaged wing of the L-20. The helicopter then rolled over and crashed on its right side.

After the accident, the pilot stated that he knew the L-20 was parked directly behind him but that he misjudged the distance, thinking he could clear it by 20 feet. His intentions were to make a "torque turn" takeoff by maneuvering between the L-20 and the wind-sock pole. He further stated that the reason he attempted this type of takeoff was to keep from creating too much dust from prolonged hovering.

In his statement, the crew chief said that he was under the impression the pilot was going to take off to the north. Statements of eye witnesses agreed that the pilot indicated he desired a signal from the crew chief for clearance to take off; but, after indicating that he desired such help, the pilot chose to look over his shoulder and clear himself for takeoff.

This accident could have been prevented had the pilot used proper takeoff procedures, informed the crew chief of his intentions, *then utilized the crew chief as a signalman.* The pilot, under direction of the crew chief, should have brought the helicopter to a hover, made a hovering turn to the takeoff direction, and then executed his takeoff.

Corrective action initiated by the air section to prevent similar accidents included: holding a series of ground school classes for pilots and ground crew personnel in the proper use of arm and hand signals, and amending the SOP to read, ". . . pilots and ground crewmen will maintain visual contact with each other until the aircraft is clear of all obstructions . . . and hovering backward in helicopters will be held to a minimum."

The corrective action is excellent, but the point is it should have been standard operating procedure with this as well as all other Army Aviation Sections.

The original form of the word *helicopter* was coined in 1863 by Viscount Gustave D'Amecourt, an early French helicopter pioneer. He combined the Greek words *helicos* (helix) and *pteron* (wing) into *helicoptere.* The final "e" was retained for a time, but was dropped before the word entered English dictionaries.

(OMNIGATION continued from page 26)
of bearing change) that you use with your low-frequency radio. However, greater accuracy can be obtained with omni because the equipment is more sensitive and a small error in heading while working the problem does not, for practical purposes, introduce appreciable error. Another method, also often used with low-frequency equipment, is the one based on the isosceles-triangle principle.

Conclusions

While complete mastery of the omni is a valuable asset to your career whether you are instrument rated or not, its dependability, convenience, and simplicity are in themselves reward enough once you have acquainted yourself with the system and have become accustomed to flying omni. Perhaps this article has stimulated enough interest that you will experiment with its use at the first opportunity. Or, perhaps it has clarified for you some specific point in omni usage. So . . . what is your desired course? On what radial will you be?

Winter Flight Tips

1. Watch carburetor heat, particularly when the humidity is high and the temperature is between 20° and 60° F. Carburetor ice can form when the air temperature is well above freezing.
2. Drain all sump tanks during preflight checks. Water in the gasoline is hazardous in winter and summer, but it shows up most frequently when cool air encourages condensation.
3. Remove frost, snow, or ice from a plane before takeoff. Harmless-looking frost and ice on the wings and tail surface greatly reduce lift.

Straight And Level

TO: Editor-in-Chief

. . . I note on page 2 of the magazine that manuscripts may be sent direct to the Editor-in-Chief. Must a security clearance be obtained on an article before sending it to you?

JOHN DELEGAL
1st Lt. Artillery
USAR

The *Digest* does not publish classified information nor should material about which there is any doubt of classification be forwarded to the *Digest* for possible publication. However, it is not necessary for writers to obtain a Department of Defense security clearance as the *Digest* staff secures such a clearance on all material prior to publishing it.—*The Editor.*

TO: Editor-in-Chief

We have enjoyed the few copies of the *Army Aviation Digest* which we have been able to obtain. However, since you have opened the *Straight and Level* department and invited correspondence, I have a couple of questions. First, what is the possibility of units here receiving more copies? The other question is about the statement which you print with each article and which I have also seen in other service publications concerning the fact that the views expressed are not necessarily those of the Army. I realize that it is a small point, but why could not one statement be used to cover the entire magazine?

JAMES D. LITTLEMAN
Captain, Infantry
KOREA

We anticipate that distribution of the *Digest* will be increased beginning with the February 1956 issue. The proposed increase should make copies available to all personnel concerned with Army aviation. With regard to your second question, there is more than appears on the surface. We have received a number of inquiries, both written and from students at the Center, concerning the authentication statement. First, we find that many individuals are reluctant to produce material for the magazine if they feel that their personal views may possibly be interpreted as those of the Army. Second, in a publication in which *all* is not official, a single statement can be used in the masthead or in some other portion of the magazine concerning the authenticity of the material. However, in a publication in which we have mixed official and unofficial information being disseminated, it seems that the only solution is to tag each piece, at least each piece which might be interpreted as being Army policy.—*The Editor.*

Letters of constructive criticism are welcomed by the ARMY AVIATION DIGEST. To appear in this column they must be signed.—The Editor.

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For explanation of abbreviations used see SR 320-50-1.

ARMY AVIATION SCHOOL CREST

When reproduced in full color, the colors red, blue, and yellow are used in the crest to indicate representation of all branches of the Army in The Army Aviation School. The school's aviation training mission is symbolized by the perched falcon denoting the art of falconry with its patient training of swift, keen birds for hunting. The mailed fist depicts the military ground arm which exercises the control, training, and direction of the flight.