FAA AVIATION NEWS

JANUARY 1968

COVER

An ASR-4B airport surveillance radar at Dulles International Airport. FAA has 173 radar antenna towers constantly scanning the sky for aircraft. For radar's role in air safety, see page 8.

FAA AVIATION NEWS

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The new compact, transistorized tower at Reid-Hillview Airport, requiring no equipment storage floor, squats close to the ground.

solid state towers:

FAA Finds a Solution to the High Cost of Terminal Control

"Instant" airport traffic control towers are the latest contribution of the Federal Aviation Administration to air safety. Like instant coffee or mashed potatoes, the new towers will have the same outward appearance as their conventional counterparts. The only difference is that they will have solid-state, transistorized electronic equipment.

The new towers will provide the same traffic control services as facilities with vacuum tube equipment, but they can be built in half the time, at one-quarter the expense, and require far less expensive maintenance. Installation of solid-state communications and recording equipment can be done in one-tenth of the time required for a conventional installation.

First Tower at San Jose

FAA's first solid-state tower went into service at Reid-Hillview Airport on October 11, 1967, just nine months after the contract was let. (The average length of time required for completion of a conventional tower is 18 to 24 months.) Reid-Hillview is located at San Jose, Calif. 40 miles south of San Francisco, in the booming Santa Clara Valley, where new aerospace industries are flourishing alongside venerable vineyards. The economy of the valley is benefitting from an expansion of air traffic, now served by the Reid-Hillview tower.

The concept of transistorized communications equipment arose in 1965, following a field survey of FAA regional offices on ideas to economize and speed up tower construction. The Western Region, which has the largest wide open spaces to cover, came up with the suggestion of using solid-state equipment. FAA's research and development service in Washington, D. C., proceeded to develop the necessary hardware and design a new "type L" tower to contain it.

The "L" tower, which can be built for less than $100,000, has no need for a separate floor to house equipment. The solid-state equipment is so compact and light that it can easily be contained in the tower cab itself.

Communications for the "instant tower" are powered by a 12 volt DC system. The battery power supply is maintained by a "constant trickle charger." In case of a power failure (to the commercial source), the batteries have from four to six hours of operational reserve. If an extended commercial power failure occurs, a car or truck with a 12 volt ignition system can be driven up to the base of the tower and jumper cables can be run to the alternator of the vehicle. Thus there is a completely fail-safe system protecting terminal traffic.

Additional Towers Planned

Additional towers using solid-state equipment are now being planned or constructed at low and medium density airports in the Western Region.

On the basis of the successful operation at Reid-Hillview Airport, FAA is now looking also into the feasibility of using solid-state electronics at flight service stations. For a beginning, a new operating console for the flight service station at San Diego, Calif., will be built with transistorized control circuits.

—*Frank King*

(Reid-Hillview is one of four airports recently named to receive honors for improvements under the FAA-sponsored Airport Beautification Awards Program. Complete details on the program, and the other airports selected will be carried in the February FAA Aviation News.)

Above—Standard 3,000 foot approach lights mounted on pilings, Washington, D. C.
Right—Sequenced runway alignment lights used alone at Atlantic City, N.J. in test of low cost approach lights

A New Approach to Lighting for Instrument Approaches

The Federal Aviation Administration has approved a basic concept for new simplified types of approach lighting for instrument approaches for all aircraft up to but not including four-engined jets. The new concept will make several hundred airports eligible to apply for FAA installation of relatively inexpensive approach lighting systems.

Of the more than 10,000 airports in the United States, about 700 have some form of approved instrument landing systems, but only about 200 of these have a standard approach lighting system (ALS), which is required for all precision instrument approaches when the runway visibility is less than one mile. The standard lights cost in the neighborhood of $175,000.

New Systems Slash Cost

The new simplified lighting systems designed for lower activity airfields will range between one-fourth and one-third of the standard cost.

The standard array consists of five-lamp barrettes of white light a hundred feet apart, beginning 3,000 feet out from the threshold of the runway and terminating 300 feet from the threshold: additional bars of red and green lights precede the runway. The white barrettes are augmented by flashing strobe lights (runway alignment lights) in the center of each barrette—which gives the appearance of a stream of light flowing toward the runway.

There are now about 500 airports with instrument landing equipment but no approach lights, which offer either precision or non-precision approaches. A precision approach requires an instrument landing system with horizontal and vertical descent electronic guidance (ILS); a non-precision approach utilizes either very high frequency omni-directional range (VOR), distance measuring equipment, automatic direction finders or airport surveillance radar. In either case, the installation of approach lights would reduce the minimum visibility required for landing.

Prices Start at $15,000

The new lighting concept includes a less expensive *runway alignment indicator lighting* (RAIL), which consists of sequenced flashing strobe lights leading toward the runway and spaced up to 300 feet apart, with a minimum of five lights. Estimated cost is $15,000. (The standard approach lighting system requires 28 flashing lights.)

In place of the 28 barrettes of steady burning white lights in the standard system, the new concept also reduces the requirement to 7 barrettes, spaced approximately 200 feet apart. These will be either medium intensity lights (5,000 candle power), or high intensity lights (15,000 candle power—the same as those used in standard lighting). The cost will be $35,000 to $45,000.

Whereas standard lighting installs the runway alignment indicator lights together with the steady burning barrettes, for the entire length of the system, the simplified systems use the alignment lights, in the outer portion, preceding the barrettes. Or, they may use the barrettes alone, the alignment lights alone, or in combination. At airports where a pilot may have difficulty locating the runway because of excessive ambient lighting, the strobe alignment lights alone may prove most effective in guiding aircraft in for a landing.

The flexibility of this new concept makes it possible to develop the approach lighting of an airport in stages. With either runway alignment or barrettes installed, the runway visibility minimum requirement at an instrument approach airport drops from one mile to three-quarters of a mile. When both the simplified alignment lights and the barrettes are used in combination, the visibility requirement drops to one-half mile, the minimum for all Category I instrument approaches.

Curved Approach Lights

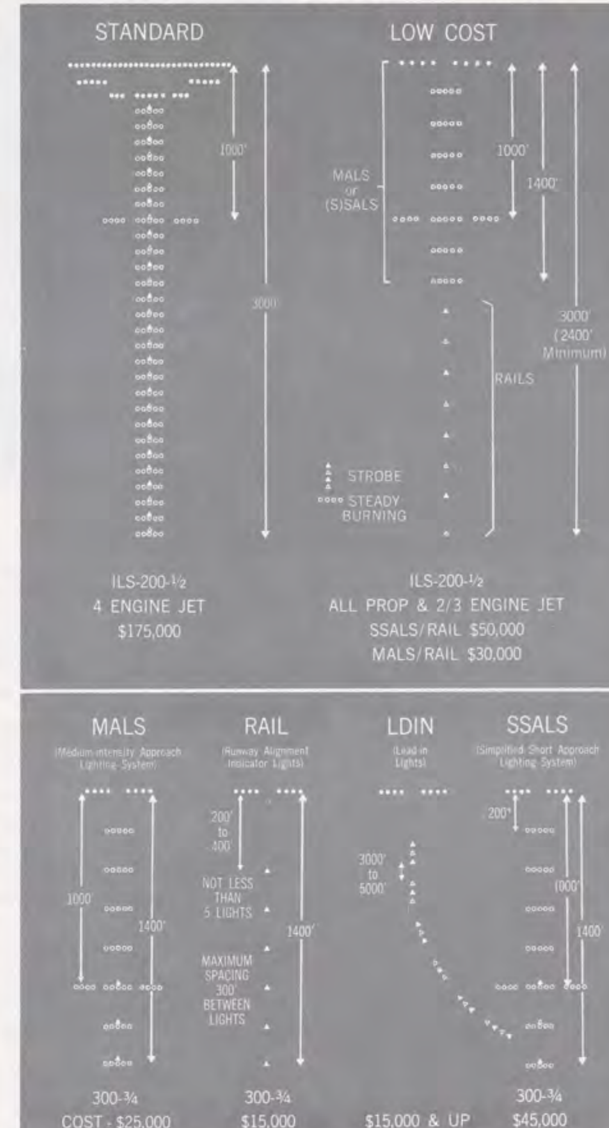
A special purpose approach light system has also been approved by FAA for airports where straight-in approaches may be operationally impracticable. This is *"lead-in" lighting* (LDIN), which consists of groups of three or four flashing strobe lights curving toward the runway and stopping about 300 feet short of the threshold. Overall cost would be in excess of $15,000, depending on local operational requirements.

Practical guidelines are now being worked out to establish the criteria for selecting which airports will be eligible for the various components of the simplified lighting systems. Traffic growth potential will be the key factor in determining priority of need.

Approach lighting at airports with approved instrument landing facilities is provided at Federal expense by the Federal Aviation Administration whenever the volume of air traffic justifies the cost of increasing the instrument landing acceptance rate, or reducing the runway visibility minimums. FAA will continue to install the standard lighting system at large airports without modification of design. ■

Alignment lights are wired to flash consecutively "flowing" toward runway.

COMPARISON OF STANDARD & LOW COST LIGHTING SYSTEMS



Mechanic readies **Gulfstream** prop for removal. Centrifugal force on hub and shank can amount to as much as 50 tons.

What's Up Front

Second in a series on aircraft engine components, how they work and how to prevent their failure—

PROPELLERS

A better day for flying would have been hard to find. Visibility and ceiling were unlimited. The 90° temperature was normal for July. Homeward bound from a pleasant afternoon cross country flight to upstate New York, the two men aboard the single engine aircraft noted the hour was 5:45 p.m.—they'd be home in plenty of time for dinner. Long Island Sound, 2500 feet below, showed scarcely a ripple.

About five miles offshore, the plane began to vibrate and shudder uncontrollably.

"While throttling back," the pilot recalled, "I looked out over the nose and distinctly saw two separate propeller arcs. I called a 'May Day' and shut the engine down completely, hoping to glide to a safe landing on the beach."

Try as he did, the glide ended 200 feet offshore and the plane slowly sank in 15 feet of water. Both men escaped uninjured, but the water landing damaged a wing, and shattered the windshield.

When the aircraft was retrieved from the water, the cause of the rough engine operation and the "two separate propeller arcs" was at once evident.

A blade of the one-piece metal propeller had broken off 21½ inches from the centerline of the hub. Subsequent laboratory analysis focused the blame on a tiny pit on the blade surface which had started a fatigue crack that led to the rapid, dramatic destruction of the blade.

This was but one of the 31 in-flight accidents in 1966 in which propeller failure was cited as the direct or contributing cause. Two of these accidents claimed four lives. Incomplete figures for 1967 showed an equally serious toll of in-flight propeller-related accidents.

Sources of Stress

Considering the stresses placed upon them, the remarkable thing about propellers is their amazing durability and reliability. The whirling action of a medium sized prop will create an outward "pulling" centrifugal force on the hub and shank of the blade of some *50 tons*.

As if this were not enough, the blades tend to rotate in their socket, seeking automatically to return to low pitch. This is called *centrifugal twisting moment* and can amount to 7,500 inch-pounds of pressure on each blade of a medium sized propeller. A third force, *thrust*, bends the blades forward in a bow-like manner. Fortunately, the tremendous centrifugal force of the rotating propeller acts as a "stiffener" holding the blade reasonably straight.

This contest between centrifugal force and thrust is anticipated by the designer. The prop bends forward and tends to return to its flat plane, depending on engine rpm and the load put on the propeller by varying conditions of flight—takeoff, climb, cruise, etc. Alternately, the metal is compressed and stretched. In a constant speed propeller, these stresses are greatly reduced as the prop control mechanism changes blade pitch to maintain a more even load on the engine and blade.

In a fixed pitch metal propeller, stress on the blade mounts as the rpm go up. Careful design is required to develop a blade to hold the maximum value of these stresses below 7,500 pounds per square inch. This is about one-fourth the yield strength of aluminium alloy 2025, heat treated to Specification T6—the metal almost universally used in the light-plane propeller industry.

Another source of stress within a rotating propeller is caused by the piston engine which drives it. As finely tuned as it might be, this output is never an uninterrupted smooth flow of power, but rather a series of rapid, closely spaced impulses. These constitute an alternating or vibratory stress which tends to stretch and compress the metal blade. The rapidity with which this occurs is called the frequency of vibration.

Metal propellers have a set of natural frequencies of vibration which are determined by the shape, length, distribution of thickness and width of the blade. When one of the natural frequencies of the propeller matches one of the shaking force frequencies of the engine, a resonance peak occurs which could produce destructive results.

In designing a propeller to match a particular engine, every effort is made to tune the propeller so that dangerous resonance peaks fall outside the operating range of engine rotational speed. Before a type certificate is granted for a metal propeller, it must demonstrate satisfactory stress level performance with whatever engines are expected to be used with it.

Propeller failure is often traced to insignificant appearing nicks and notches in the blade which create a stress concentration point capable of changing the design values of the blade. This local stress point may increase to a level at which very little additional flight time would be needed to create a crack that would spread rapidly and result in blade destruction.

Propeller Repairs

Propeller blade alteration or major repairs should only be done by authorized propeller repair stations or by the manufacturer. In this area the do-it-yourselfer should keep his hands in his pockets.

Similar to cuts, nicks and dents of the propeller surface, in destructive potential, is *corrosion pitting*, which affects the interfaces of the grain structure of the metal. The external evidences are tiny deep cavities which may tunnel under the surface and create damage from the pit entrance.

Left—General aviation props include fixed pitch wood and aluminum (left, on table) and ground adjustable steel props. Full feathering hydromatic prop hangs from sling. Above—Prop is tested for oil leaks after assembly.

Above—Magnafluxing for hidden cracks is standard practice in prop overhaul. Right—"Dead" props often come to life.

The destructive process in corrosion pitting is chemical but the mechanical effect on the strength of the metal is the same as the sharpest possible "v" notch caused by the blade striking a hard object.

The tip-off on corrosion pitting is the appearance of tiny, innocent-appearing black specks. These must be removed as soon as detected because their destructive effect progresses rapidly. Grinding out the corrosion is the only permanent cure but this should only be done by a fully qualified mechanic, well aware of the critical nature of propeller repair.

Prevention of corrosion pitting is not difficult and depends mainly on keeping the propeller clean. The first line of defense is to insure that the anodized finish of the propeller is intact. Under no circumstances should this finish be polished off the blade. A highly polished blade is an open invitation to corrosion. While seaplane and amphibian aircraft propellers are most subject to corrosion, particularly if they operate in a salt water environment, all metal propellers are vulnerable. Corrosion has been traced to wind blown mist from highways salted for snow removal, to acid bearing perspiration on the hands, and even to some *solutions used to clean the blades*.

Propeller demands and the designs to cope with them have come a long way since Dec. 17, 1903 when Orville Wright opened the age of powered flight. The two propellers, mounted on the *Kitty Hawk* and rotating in opposite directions to offset gyroscopic effects, were each 8½ feet in diameter and had a takeoff rpm of 350.

A typical modern light aircraft will turn up 2,450 rpm on takeoff and a turboprop, 2,000 rpm. Tip speed, of course, varies with the diameter of the propeller. Light plane propellers weigh an average of 60 pounds, and some turboprops weight as much as 621 pounds.

Propellers have been made of a variety of materials—wood, steel, various aluminum alloys, plastics, and most recently fiberglas blades over a steel core.

Evolution of Props

Over the years, propellers have gone through an evolutionary process of refinement. The fixed pitch propellers of the Wrights were followed by ground adjustable propellers and later by two-position propellers which could be shifted from low to high position and back again in flight for more efficient performance. From this it was only a short extension of ingenuity to develop a constant speed propeller that automatically changed pitch to suit flight conditions. Full feathering propellers, reducing the drag on a dead engine, a major advance in flying safety, soon followed. When aircraft grew in size and weight, the reversible pitch propeller was developed to assist the aircraft's brakes in slowing down and stopping the plane.

Fixed pitch propellers are by no means *passe;* about half of the new aircraft delivered last year had fixed pitch propellers, but ground adjustable and two-position propellers are seen only on aircraft made in the '30's and earlier. The demise of the two-position propellers can be laid to inefficiency—and the constant work involved in shifting from "high" to "low" numerous times in a routine flight. The two-position propeller also had a built-in accident potential. If the pilot forgot to move the propeller into takeoff or landing pitch, disaster could follow.

Constant speed propellers work in conjunction with a propeller governor which regulates the flow of high-pressure engine oil to the propeller dome, where it acts upon a piston controlling the propeller pitch. The flow of oil to and from the dome is controlled by engine driven flyweights inside the governor which open and close oil entry and exit ports. In some systems, oil pressure is used on both sides of the piston—pressure on one side moves the propeller into low pitch; pressure on the other side, into high pitch.

Propeller Governors

The heart of the propeller governor is the system of flyweights geared to the engine. By moving the propeller control lever, the pilot sets tension on a speeder spring within the governor, which imposes a restraining force on the flyweights. This has the effect of making the flyweights heavier or lighter. As the propeller spins, the flyweights move the valve to increase or lessen oil pressure, thereby adjusting the blades through any pitch setting from high to low pitch, until they find a setting which absorbs the engine power. When this balance is established, the flyweights move the valve into a neutral or constant speed position.

When an increased load, as in a climb from level flight, is put on the engine, and the power setting remains unchanged, the engine will slow down—unless the propeller is moved into another pitch. The governor does the job. With the decrease in engine rpm, the flyweights slow down, moving the oil valve to allow oil to flow to (or from, depending on the design) the piston which in turn moves the propeller blade into a lower pitch. Engine rpm then returns to its original setting.

Letting down to a lower altitude from cruise allows the engine to speed up because the propeller blade angle is too low. The speeded-up engine spins the flyweights faster, causing them to fly outward and lift the oil valve to admit oil (or release it, again depending on the design) to act on the piston. The piston pushes a linkage which twists the blade into a higher pitch, slowing down the engine to its original setting.

Moving the propeller pitch into feather and reverse is merely an extension of changing pitch. ■

(Next month: pilot propeller maintenance.)

RADAR

The Magic Wand of Air Traffic Service

"November 7469 Foxtrot, *radar contact.*"

It is difficult to think of a phrase more reassuring to the ear of an airborne pilot than "radar contact." It tells him that he is now being provided with the maximum assistance possible for safe separation from other aircraft. To the FAA air traffic controller, in the airport tower or in the en route center, it is also a very satisfying expression. It means that he has identified a small blip of light on his radar scope with a particular aircraft, and that he can now (with the aid of flight strip data and voice communication) establish the altitude, airspeed, heading and intended flight path of the aircraft. What exactly is this magical device called radar, and how does it work?

In very simple terms, radar could be described as a combination of radio and television. The radar transmitter sends out a signal very much like a radio transmitter. (The word radar is an acronym of the World War II phrase, "*Ra*dio *D*etection and *R*anging.") Instead of being received by another instrument, the signal is reflected or bounced back directly to the sending source, as soon as it strikes a solid object in its path. The returned signal is then electronically converted to display an image on a cathode ray tube, somewhat like a television screen, the radar scope.

The radar scope differs from the television screen in that the light signals do not present a continuous pattern, but appear momentarily, fade and reappear at regular intervals. If the reflecting object (the "target", in military phraseology) is moving, the light blip will also appear to move across the screen.

Tracking Aircraft

This is because the radar antennae transmitter is rotating continuously in a complete circle, scanning the entire horizon. It may be compared with a flashlight mounted on a rotating disk in the center of a darkened room: Whenever the moving beam of the flashlight strikes an object, it gleams momentarily. If the object has moved by the time the beam comes around again, the reflected light is seen at a different point. On the radar scope this repeated shift of position is known as the track the aircraft is taking, and it can be followed by using small clear plastic markers (shrimp boats). Electronic tracking has been developed and will replace "shrimp boats".

Radar contact is made when the controller is able to determine the identity of a light blip moving over his scope. At any given moment he may have as many as 100 blips moving in various directions, converging, crossing, disappearing; 20 of them may be of interest to one controller. VFR traffic will be interspersed with IFR flights. Information from flight plans, forwarded to the controller in the form of data strips; or radio communication with the pilot or telephone coordination with other controllers will help provide an identification of the blip that is his responsibility. At times the controller may call for specific directional turns, in order to positively identify the aircraft.

Radar Beacon

A secondary type of radar, also known as radar beacon, speeds up the identification process. Radar beacon transmits a coded signal which is not merely reflected from the aircraft as is primary radar but is also automatically picked up by a received in the aircraft (the transponder). A coded signal is returned to the ground and a distinctive double or single slash may appear on the radar scope at the geographical location of the aircraft. Transponders may be "tuned" so that only aircraft in a specific altitude block will appear on the radar scope. The controller may also ask the pilot to "ident" his tranponder so that the double slash merges or "blooms" into a prominent, enlarged blip, as easily identified on the scope as the moon might be picked out of a night sky full of stars. Radar beacon speeds the process of pinning down the identification of an unnamed blip of light with a specific aircraft, so that the reassuring announcement, "radar contact", can be made.

Both primary and secondary radar are used in the two main radar systems in air traffic control, air route surveillance radar (ARSR) (center radar) and airport surveillance radar (ASR) (terminal radar). Virtually the entire United States is covered by some 90 center radar systems with about 200 mile detection ranges, which sweep the skies day and night, feeding information to FAA's 28 air route traffic control centers, (ARTCC) for the benefit of aircraft enroute. Microwave-linked transmitter sites relay signals from remote radars to the traffic control centers.

Above—The parabolic antenna transmits and receives primary radar. The horizontal bar mounted above is the interrogator for radar beacon. Below—Air Traffic controllers monitoring the course of aircraft on instrument flight plans. Flight data strips in rack are sequenced according to the latest flight information transmitted by teletype or radio.

More than 115 terminal radars provide coverage for arrivals and departures at 212 major terminals. Normally, terminal radar has a maximum detection range of no more than 60 miles, but it has a faster detection than center radar. (Terminal radar antennas rotate 13 times each minute, whereas center radars sweep the horizon 6 to 8 times each minute.)

Two other radar systems are in use, to a lesser degree, by the Federal Aviation Administration. One is precision approach radar (PAR), sometimes utilized by terminal controllers for directing precise landings or for monitoring an approach. Another is airport surface detection equipment (ASDE), radar used by tower operators for ground control when visibility is poor.

While radar's most valuable service is its ability to "see" objects at great distances, this remarkable vision is not automatically selective. It is important for pilots to remember that radar beams travel pretty much in a straight line, and that they will bounce back from the first solid or opaque object they encounter. Ground obstacles, mountains, heavy clouds and rain or snow may reflect radar waves and clutter up a scope, masking out aircraft. FAA's air traffic service employs various electronic devices to provide selectivity.

In common use is the moving target indicator, which wipes out returns from most stationary objects. Occasionally this device will also wipe out an aircraft, if that aircraft is maintaining a course and speed which keeps it at a constant speed in relation to the antenna. The phenomenon is rare, and generally of short duration.

Radar Interference

Interference by mountainous terrain is compensated for by the installation of multiple radar sites. Sufficient altitude, however, remains the pilot's best assurance against loss of radar contact.

All but extremely dense weather clutter can now be removed from the scope by circular polariaztion, an electronic device which produces a spiral corkscrew pattern of radar signals. The modified signal has a tendency to roll around spherical objects, such as rain drops, and bypass them.

As far-sighted as radar is, the image that shows up on the scope is nevertheless, affected by the shape and appearance of the target. A small, fabric-covered plane, or a sleek jet fighter, will reflect a far less distinct image than an airliner or bomber, for example. Also, abnormal atmospheric phenomena, such as temperature inversions, can sometimes cause a distortion of radar waves and interfere with range or reception.

The Federal Aviation Administration is currently researching means of enhancing radar returns. For the present, secondary radar or radar beacon is the most valuable means of overcoming the shortcomings of primary radar. Radar beacon from transponder-equipped aircraft, produces a stronger, more reliable return than primary radar.

Radar beacon also increases the selective ability of the controller to display simultaneously on his scope a number of aircraft in which he may be interested—not only aircraft at a given altitude, but aircraft in a descending or climbing altitude, military, IFR or VFR, etc. The several codes to which the transponder can be set, by the pilot, at the request of the controller provide this capability.

Tomorrow's Radar

In a matter of a few years, radar beacon will be able to provide this information with printed readouts on the scope (two facilities have this capability now), and a closer scrutiny of air traffic movements by radar will be possible. In the meantime it is important to remember that simply because an aircraft is within radar coverage is no guarantee that air traffic control is responsible for providing separation.

On a clear day the sky over a major terminal will often be filled with planes and some of them may not be under surveillance by the tower. Aircraft not under air traffic control may be frequently passing in and out of radar coverage at altitudes and airspeeds unknown to controllers. Radar contact, however reassuring a phrase, should never become an excuse for the pilot to relax his vigilance or ignore his responsibility for maintaining visual separation when appropriate.

The controller's ability to give complete information to advise an IFR pilot of VFR traffic in his vicinity will also be limited if no information regarding unknown aircraft is available, or if the volume of traffic and workload prevent his issuing VFR traffic information. First priority is given to establishing vertical, lateral, or longitudinal separation between aircraft flying IFR under the control of Air Traffic Service.

The rapid growth of general aviation makes it certain that more and more pilots, both IFR and VFR will be using the radar systems of FAA. All pilots can contribute importantly to air safety by filing flight plans and by keeping air traffic service fully informed of their conditions of flight, and—by understanding the limitations of radar and air traffic control assistance. ■

(An excellent short course in air traffic procedure is contained in Part I of the Airman's Information Manual, published quarterly by FAA. Annual subscription is $2. Send check or money order to the Superintendent of Document, Government Printing Office, Washington, D.C. 20402. Advisory Circular 90-32, Radar Capabilities and Limitations, is available free of charge from the Federal Aviation Administration, TAD-484.3, 800 Independence Ave., S.W., Washington, D.C. 20590.)

Second
in a series on
Ground Accidents

the Hazards of Handling AVIATION FUELS

Truck is grounded to sunken post, airplane is bonded to truck, wing is bonded to nozzle.

The high volatility of aviation fuels means that a fueling fire is always waiting to happen, whenever the right mixture of chance, carelessness or ignorance come together. Pilots who pump their own gasoline, as well as service mechanics and attendants, should never forget that aviation gasoline ranges from 80 to 145 octane; in this range an incredibly small spark can transform a peaceful service line into a raging conflagration.

The three basic types of aviation fuel each have different flash points, which all handlers of fuel should know. (The flash point is the temperature at which a petroleum fuel first gives off enough flammable vapor to ignite.) The fuels are familiarly known as Avgas (aviation gasoline), Jet A (kerosene), and Jet B—formerly JP-4—(blends of Avgas and Jet A). Avgas is color coded according to octane grade; the jet fuels are colorless or straw-colored.

Some idea of the flammability of Avgas can be seen from its —50°F. flash point. By way of comparison, the flashpoint of Jet A ranges between + 100°F. and + 150°F. In fact, Jet A will freeze at —40°F., unless specifically treated. Jet B, the mixture of kerosene and gasoline has a flash point ranging from —10°F. to + 80°F. Because spilled jet fuels have a relatively low volatility, they create a prolonged fire hazard.

Fuel fires often appear to have mysterious origins, but the vital components are no mystery: fuel vapor, oxygen, and heat. During fueling operations some vaporization always takes place; some oxygen is always present; and heat may be supplied from any number of sources—from open flames, cigarette ash, exhaust streams, electronic engines or static electricity.

The danger of smoking in a fueling area is obvious although it can never be overemphasized. Less apparent is the danger from flame lights or cutting torches, or open flame heaters. No such device should operate within 50 feet of a fueling operation. Similarly, no fueling should be done within 150 feet downwind of an operating jet engine (75 feet downwind of a turboprop), because of the heat emission.

Electrical circuits frequently arc when turned off or on, or when not operating properly. For this reason batteries should not be installed, removed or charged during fuel servicing. Ground power units should be kept as far from the fueling nozzles as possible. Aircraft radar and radio should not be operated at this time and no electrical aircraft switches should be used except in an emergency. Only those photographic flashlights specially designed for hazardous areas can be used near fueling operations and not in the immediate vicinity.

Probably the most insidious (because least understood) source of fuel fires is static electricity. This is the kind of electricity not guided by electrical circuts, but which accumulates everywhere in nature essentially as a result of friction between unlike substances. The most familiar experience is walking across a rug in dry weather: touch a door handle and you feel a shock; if it is dark enough you will see sparks fly.

An equally common, but lesser known phenomenon is the accumulation of static electricity by the flow of fuel through a hose, or in or out of a tank. Also, the friction of dust and dirt against the skin of an airplane builds up static charges. A man doing work builds static electricity, especially if he is wearing synthetic or plastic clothing.

Electricity, like water, constantly seeks a lower level; it seeks to move to a substance carrying a lesser charge. If the differential is high, a static charge may jump a considerable gap of space, creating a spark very similar to the engine's ignition sparks. If sufficient vapor is present, a disastrous fire may follow.

The only reliable safeguard against such sparking during fueling is through grounding and bonding all materials involved in the process.

Grounding is a means of conducting electricity into the earth; bonding is a means of equalizing the static charges in a local area, so that contrasting charges are not present. The aircraft, the fuel source, and the nozzle itself must all be protected against sparking.

Hose should be checked for wear.

Open flames, such as those from welder's torch, should never be permitted in the fueling area. Concentrations of vapor may occur at some distance from the airplane.

1.

2.

3.

1. First step (above) is attaching cable from truck to ground post. 2. Second cable goes to aircraft to wheel or strut. 3. Third cable from home nozzle is snapped on wing clip.

A trailing strap or chain on a service truck is not a proper ground. The safest equipment consists of a chain from the parked truck connected to a ground post—a metal rod driven three or four feet into the ground, or deep enough to reach below the moisture level point. A similar chain-and-ground post combination should be used for the aircraft: the landing gear axle or any other convenient unpainted metal part (except the propeller or radio antennae) is suitable.

Before the tank cover is opened, a bonding cable should be connected between the dispenser and the aircraft, as well as between the nozzle and the aircraft. When fueling from cans or drums, an additional bonding cable should link the drum with the nozzle. When fueling on ice or other terrain where it may not be practicable to secure a good ground, the bonding procedure should be carried out with extra care, for it becomes the only means of preventing a discharge of static electricity.

The fueling hose should be examined frequently for deterioration. Inadvertent misting, or atomization of fuel, can occur when a tiny pinhole develops in a hose; under pressure the pinhole may atomize fuel into the air, creating a highly combustible mixture requiring only the faintest spark to ignite.

Many persons are lulled to a false sense of security about plastic materials because they are known to be poor conductors of electricity. But precisely because of their non-conductive properties, it is not possible to ground or bond them safely. The use of plastic fuel containers, spouts, etc., or the wearing of plastic aprons or other clothes while fueling, is an open invitation to disaster.

Another good reason for not attempting to mix plastics and fuel is that some of the plastic may be dissolved by the fuel and deposited in the engine. By the same token, the solvent action of sloshing fuel can thin plastic container walls to the breaking point.

Gasoline is such a ubiquitous servant of man that we tend to forget the violent side of its nature. It may help to remember that a five-gallon can of gasoline contains enough energy to destroy a $5 million airplane, or immolate a dozen men.

Respect for this dangerous power should be shown by clearly labeling all fuel containers, and painting them red. (This reduces the chance of someone frantically trying to put out a fire with a water bucket containing drained fuel.) Gasoline should never be poured into cans used for other purposes; it is too good a solvent, as noted above and could deposit unwanted sludge in the combustion chamber.

Incidentally, makeshift substitutes for lost container lids are a bad bargain. Stuffing the opening with rag waste, for example is much like providing a wick for a homemade bomb.

Fuel spillages, of no matter what type fuel, are potential fire hazards. The fire department should be notified if an area greater than six feet in diameter is contaminated. In any event the spillage should be carefully removed and the area marked off until all source of vaporization is dissipated.

Fuel spilled on clothing may be an unsuspected cause of tragedy. A mechanic who observes every safety precaution during his work may stroll off duty and absentmindedly light a cigaret while wearing gasoline-contaminated gloves or jacket. The panic that accompanies one's efforts to stifle flaming clothing can hardly be exaggerated.

There are other health reasons why gasoline should not be used as a cleaning solvent or to wash grease from the hands. Gasoline irritates the skin, causes rashes and may actually provide an avenue for infection. Inhalation of the fumes should also be avoided; excessive exposure can be harmful to the liver and other vital organs. Good cleansing soaps or solvents are available.

More extensive data on aircraft fueling may be found in Joseph Chase's booklet, "Aircraft Fueling Up To Date," published by the Flight Safety Foundation, 468 Park Ave., South, New York, N. Y. 10013. ■

OPERATION RAIN CHECK

School for Rainy Day Flying

A four session night school for pilots who want to know exactly what goes on in the darkened IFR rooms inhabited by air traffic controllers has been started in the San Francisco-Oakland Bay area by the Federal Aviation Administration.

FAA's Oakland Air Route Traffic Control Center at Fremont, Calif., (22 miles south of Oakland) is the site of the short course on the principles of air traffic control. Open without charge to all instrument-rated or instrument training pilots, the 12 hour course (Monday through Thursday, 7-10 pm) is known as "Operation Rain Check." Since last September, approximately 475 pilots have graduated with an honorary degree as "Associate Air Traffic Control Specialists."

The course was designed to help IFR pilots understand and make better, safer use of the air traffic control system. By observing the operation of a control tower or en route center from the controller's seat, watching how aircraft are vectored on radar scopes, handed off from sector to sector and center to tower, and learning what causes delays in the system, why some aircraft have to be rerouted, and dozens of other problems which beset the controller unknown to the average pilot, the short course attendees gain a new perspective on the use of air space.

Although designed primarily for general aviation pilots, Operation Rain Check has caught the interest of airline representatives who feel that familiarization with the air traffic control system will result in more efficient IFR operations for all types of aircraft.

FAA's Western Region Director, Arvin C. Basnight, believes that a first-hand acquaintance with air traffic control operations from the "inside" may result in lifesaving benefits to the IFR pilot who frequently navigates his aircraft with virtually complete dependence on instrument readings and communication with a control tower or center. Seeing the "blip" or target an aircraft makes on a radar scope, observing the sequencing of aircraft in and out of terminal areas—all of this adds up to an enlightened understanding of the vast technical complex of men and electronics which stand behind the calm voice of the controller responding to the pilot's call.

The course was designated "Operation Rain Check" because the Oakland Center believes that an education in air traffic control may have, like the parachute, safety potential for the instrument pilot. The course will serve to encourage more pilots to become instrument rated and thus become eligible to receive the full services provided by FAA's air traffic control system.

A radar scope serves as a study desk for instrument pilots attending four-session night school on air traffic control at Oakland Center. Plastic markers on scope indicate aircraft positions.

Classes are made up of 24 persons, who apply in advance on application forms available at airports or flying schools or local FAA facilities. Subjects covered include the national airspace structure (types of controlled airspace); terminal and en route control operations; clearances, transmission phraseology, separation standards; and a glimpse into the future of air traffic control as seen on the planning boards of the Federal Aviation Administration.

The Oakland Center, which provides the instructors, classrooms, and written material needed in the course is one of the busiest of FAA's 28 Air Route Traffic Control Centers; the staff handles about 2,000 instrument operations a day. Oakland center handles (Pacific) oceanic traffic as well as transcontinental traffic.

The popularity of Operation Rain Check with pilots has already resulted in the establishment of a second similar course, at the Los Angeles ARTCC in Palmdale, some 40 miles northwest of Los Angeles. Under discussion, are Rain Check schools at the other three ARTCCs in the Western Region.

The Western Region, headquartered in Los Angeles but covering nine Western states, is looking into the possibility of a traveling school using radar simulators, for the benefit of pilots who would find it inconvenient to attend courses at a center or tower where radar control could be observed.

Other FAA regional offices are watching the Western Region's program with a view toward setting up schools where their own pilot population can "come in out of the rain," provided there is sufficient pilot interest.

—David Gelfan

Joe Basham, Oakland Center radar controller and "Rain Check" instructor, explains the intricacies of the NAS system with the aid of an overhead projector and blackboard analysis.

BRIEFS

• FLYING IS NO FLIGHT OF FANCY at Yale University where increasing numbers of students are broadening their horizons as well as their educations under a flight training program now in its third year and growing. Started in 1965 with one aircraft and 35 students, the program is not part of the university curriculum but instruction is carried on at the school's traditional high standard of excellence. Of the 35 original applicants, 22 soloed and ten won private pilot ratings. During the second and third year, 150 students participated, and two aircraft, one a gift from an alumnus, were added.

• THE HISTORY OF FLIGHT SAFETY REGULATION in the United States is included in a new book by Robert Burkhardt, "The Federal Aviation Administration" (Frederick A. Praeger: New York). Beginning with the safety standards established by the Wright brothers, the book traces the origins of Federal aviation regulations from an Aeronautics Branch in the Department of Commerce down to the present status of FAA.

Burkhardt

• THERE WERE FEW IDLE MOMENTS for the controllers at the Fort Lauderdale-Hollywood International Airport during the five days that the Aircraft Owners and Pilots Association conventioneers made it home base October 17 through 21. In commission only since last June, the 24-hour tower normally handles about 1,300 operations a day. During the five day period, the "handle" came to 10,787 landings and takeoffs. The count on October 19, the peak day, was 3,002. During a one-hour period, tower personnel presided over 377 take-offs and landings. Between 7 am and 9:30 am, October 22, approximately 400 conventioneers departed, using the parallel east-west runways.

• "OSCAR" FOR FAA "DENSITY ALTITUDE" film, naming it outstanding in the category of non-theatrical films produced in 1966, was awarded by the National Committee on Films for Safety and presented at the National Safety Congress annual meeting in Chicago. "Density Altitude" describes the effect of altitude and temperature on aircraft performance. Unlike most technical films, "Density Altitude" has a story line, the cross-country flight in a light plane by a young couple that takes them from the sea level terrain of New Orleans across the Rockies to the High Sierras. Veteran pilot Donald Houghten, FAA Film and Exhibit Coordinator, developed the story idea and flew the airplane used in the film. "Density Altitude" is color, 16mm sound and may be borrowed for general public viewing and technical pilot meetings from the FAA Film Library, FAA Aeronautical Center, Oklahoma City, Okla. 73125. Ask for film No. FA-603-A. There is a waiting list.

• STRIKE ONE, ADD ONE. Airport owners and operators planning construction, alteration, activation or deactivation of an airport must file their intention on FAA Form 7480-1, an up-to-date, streamlined version of FAA Form 2681, which it replaces. Specific instructions on the use of the form are contained in FAR Part 157. Persons maintaining files of Part 157 are instructed to make appropriate pen and ink changes reflecting the new form number.

Crew of NE DC-6 examine the gaping hole caused by a decompresion incident en route from Boston to New York. For their skill and resourcefulness in bringing the aircraft down without injury to the passengers, FAA presented Distinguished Service Awards to the entire crew. From left to right: Theresa Ulbin and Margaret Dunn, stewardesses; Paul J. Kurts, Flight Engineer; Daniel Pranka, First Officer; and William J. Donahue, Captain.

NE AIRLINES CREW WINS DISTINGUISHED SERVICE AWARD

When an explosive decompression blew a gaping hole in the cabin of their DC-6 as it cruised at 15,500 feet, a Northeast Airlines crew coaxed the crippled plane to a safe landing.

For this feat of professional airmanship, the FAA recently presented the crew with its second highest honor, the Award for Distinguished Service. Honored for their roles in averting a major air tragedy were Capt. William J. Donahue, Saugus, Mass., 1st Officer Daniel Pranka, Winchester, Mass., Flight Engineer Jeffrey Kurtz, Winthrop, Mass., Stewardesses Margaret Dunn, Hialeah, Fla. and Theresa Ulbin, Lawrence, Mass.

The aircraft, Northeast Flight 648, enroute from Philadelphia to New York in February, 1967, had just reached 15,500 feet some 15 miles southwest of the JFK VOR when a rupture occured in the fuselage. Violent decompression followed, tearing a hole approximately eight feet high by four feet wide on the right side, just aft of the crew access door.

The aircraft shuddered under intense vibration, caused by the airstream entering the fuselage and the pounding of the damaged engines on the right wing. The pilots shut down both starboard engines but were unable to feather the inboard engine, which complicated the control problem by adding drag.

The aircraft was subsequently landed at Kennedy International Airport without injury to crew or passengers, who were calmed and kept seated by the stewardesses.

The letter recommending the award stated that except for the "superior airmanship, firm leadership under extreme emergency conditions, and the thorough adherence to emergency procedures . . . by Captain Donahue and his entire crew, this destructive decompression rupture could have resulted in a tragic accident.

Specific "probable cause" has not yet been announced by the National Transportation Safety board, the government agency which investigates aviation accidents.

Debris from the ruptured cabin knocked out the starboard engines, complicating the control problems brought about by the rush of air into the cabin.

Tech Reports Cover SST Traffic Control, Zero Visibility Taxiing

Three new technical reports on aviation problems ranging from zero visibility taxiing to handling supersonic air traffic, are now available to the general public for $3 each from the Clearing House for Federal Scientific and Technical Information (CFSTI), Springfield, Va. 22151.

> Reports should be ordered by title and "AD" number and include a check or money order payable to CFSTI.

"ATC Concepts for Supersonic Vehicles, Part II-1" (AD 658-166) concludes that electronically generated alpha-numeric tags on the radar scope would facilitate the handling of supersonic commercial aircraft in the early 1970's. Improve radar systems now being installed at FAA air traffic control facilities are equipped with alpha numeric capabilities.

"Radioactive Taxi Guidance Test Category III Ground Guidance Equipment" (AD 658 742), describes a method for guiding taxiing aircraft under zero visibility weather conditions using radioactive gas piped under the centerline of taxiways and high speed turnoffs. The system enabled an aircraft to remain within 5 feet of the taxiway centerline at speeds up to 15 miles per hour on the straightaway, but some difficulty in maneuvering was experienced because there was no indication of ground speed in the cockpit.

"Evaluation of Centerline Lighting for Runway-Distance Remaining and Taxiway Exits" (AD 656 594), discusses the effectiveness of colored centerline lights for indicating remaining distance on takeoffs and landings and for marking high-speed taxiway exists in low-visibility conditions.

SPECIAL VFR CLEARANCE ENDED

"Special VFR" operation of fixed-wing aircraft in airport control zones when the weather is below VFR minimums is a thing of the past, according to a recent FAA ruling.

The growing number of high-performance aircraft, and the continuing increase in air traffic at airports across the nation, are given as the reasons for eliminating special VFR clearances. In instrument weather, pilots no longer have a sufficient margin of time to effectively "see and avoid" VFR aircraft in the congested air around many airports.

VFR flights in airport control zones will adhere to basic VFR minimums—visibility, at least three miles; separation from clouds of at least 2,000 feet horizontally, and 1,000 feet above or 500 feet below all clouds.

FAA Aviation News welcomes comments from the aviation community. We will reserve this page for an exchange of views. No anonymous letters will be used, but names will be withheld on request.

• Popular Item

Where can we purchase the DENALT computer mentioned in the article "It Takes a Lot of Hot Air to Keep You Up There" in the September 1967 *Aviation News?*

Holdredge, Neb.

DENALT computers are available for 50 cents each from the Superintendent of Documents, Government Printing Office, Washington, D. C. 20402. Specify whether for use with a fixed pitch or variable pitch propeller.

• Steady with That Pencil

We've been batting this one around and thought you might have the answer: pilot flies from point "A" to point "B" on an IFR flight plan. Time of flight—2 hours, 30 minutes. Only 30 minutes of the flight were in actual instrument conditions (on the gauges). Does the pilot log 30 minutes or 2 hours, 30 minutes "actual instrument" time?

Orlando, Fla.

The pilot may log 2:30 hours as pilot in command, and 0:30 hours actual instrument time. FAR 61:39 says: ". . . the pilot manipulating the controls of an aircraft during the time it was flown solely by reference to instruments under instrument weather conditions or simulated instrument flight conditions may log only that time as instrument flight time."

• Rhymester Runs Rampant

Got a kick out of your cartoon on the back of the October 1967 *Aviation News.* It's an excellent message, too. May I offer another along the same theme: "Wings Icing Over? Caught In the Soup? / Call Your Controller! Give Him the Scoop!"

Holmdel, N.J.

Glad You Read Us, Loud and Clear/From Our Readers We Like to Hear/If it Rhymes and if it Scans/We'll Applaud With Both Our Hands.

• Substitute Numbers For Words

I have a suggestion that might reduce transmitting time from plane to tower. At present my call to the tower is "Sky Harbor tower this is Aircoupe 3727H, a mile north of Camelback Mountain at 3,000 feet. I have information Alfa, over." This could be condensed to an alphanumeric group—"Sky Harbor tower Aircoupe 3727H, 2-10-30-Alfa, over."

The 2 would mean I am about 20 degrees from the tower. This would be the magnetic bearing of the tower to me; I would have little difficulty getting this from my chart. The 10 would mean 10 miles from the tower, and the 30 would indicate 3,000 feet, and Alfa, that I have info Alfa.

Phoenix, Ariz.

Although numeric coding would abbreviate the voice transmission now used to give bearing, distance and altitude, it would add to the proliferation of numbers that pilots and controllers are already required to use in exchanging information on aircraft identification, type, time, radio frequencies, etc. FAA's air traffic service, after studying your suggestion, feels that additional numbers could lead to confusion.

• FSS To The Rescue

I would like to commend Eugene F. Valentine and Russell Danks, flight service station specialists at Lufkin, Texas, for their splendid assistance when I ran into rain and turbulence recently.

I had trouble with my "omnis" and difficulty in locating the field. I called 123.6 and it was a great relief to me and my family to receive the competent and congenial help I obtained from these two men. By having me key my mike twice they put me on course and my landing was uneventful.

I have quite a few practice hours under the hood and can fly indefinitely on my instruments, but I think it should be emphasized that making a 180° turn in bad conditions is not easy.

It was obvious that I needed more practice under the hood on this type turn. Even with positive control I did get my nose down into a pretty steep dive before I caught it and corrected it. I think a little publicity along these lines would be enlightening to a lot of people.

Again my thanks to Mr. Dank and Mr. Valentine.

I have never met a flight service station man yet who wouldn't do anything he could for you whenever he was called upon. Keep up the good work.

Richard M. Osborne
Houston, Texas

• Correction on VFR Ceiling

Your September issue contains a question about VFR flight and an answer which I believe to be erroneous. The question is, what is the highest altitude at which a VFR pilot can fly legally? The answer states that area positive control extends from flight level 240 (24,000 feet) upward to infinity, and that a VFR pilot must not fiy higher than 23,000 feet.

Isn't 23,500 feet the correct figure? Isn't it also true that the positive control areas lie between 24,000 feet and 60,000 feet, and that VFR flight can be conducted *above* that altitude level, as well as below?

Moody AFB, Georgia

You are quite correct, and our hats are off to the sharp eyes of the Air Force. The highest flight levels that can be used under VFR beneath most positive control areas are FL 225 and 235, depending upon the magnetic course flown. Technically speaking, a VFR pilot practicing maneuvers could fly up to 23,999 feet without violating the rule. As of November 9, 1967 the positive control area over northeastern and central United States was lowered to 18,000 MSL. The highest altitude for VFR en route flight below that area is now 17,500.

Incidently, it may be useful here to note that the terms "area positive control" and "positive control area" are not synonymous. The latter term is used to describe airspace; *area positive control (APC) refers to FAA* air traffic services.

• Recent Experience Requirements

Maybe I've looked too long and hard at FAR Part 61.47a (recency of experience) but it seems to me this can be interpreted to read ". . . an aircraft of the same category, class and type." Or, must the recent experience be acquired in the same make and model of aircraft, as indicated in the definition of "type" given in Part 1?

New York City

The requirement spelled out in FAR 61.47a provides that the flight time involved shall have been in the "specific make and basic model of aircraft, including modifications thereto which do not change its handling or flight characteristics."

For example, the Cessna 172 and the Cessna 182 are of the same category, class and make of plane, but they are different basic models. So recent experience in one does not meet FAR 61.47a requirements for carrying passengers in the other. However, the Piper Cherokee *PA-28 models 140, 150, 160 and 180 are all the same basic model, and recent experience in one which meets FAR 61.47a requirements satisfies the "recent experience" requirement for all the others.*

• In Quest of Old WACs

Perhaps you can help me locate four of the old WAC charts which are no longer published, having been replaced by the ONC series. I do not intend to use them for navigation.

The WACs I need are numbers: 1072, 1073, 1135 and 1136, all for an area in Peru, South America.

Las Vegas

The WACs you seek are no longer available, save for a set in the archives of the U.S. Coast and Geodetic Survey, publisher of all official Government charts. The area under discussion is now covered by ONC chart N-25, which can be obtained for 50 cents by writing to the U.S. Coast and Geodetic Survey, Distribution Division (C-44), Rockville, Md. 20852. Perhaps Aviation News *readers can supply the WACs you need.*

• More on Traffic Patterns

In spite of all I've read, and heard from other pilots, I'm still not sure of the FAA-preferred way to leave the traffic pattern.

Walnut Creek, Calif.

FAA establishes traffic patterns at only a few airports where special problems, such as obstructions, terrain, traffic separation or noise abatement impose special conditions not covered by FAR part 91.

Where such a problem does not exist, FAA does not spell out any particular procedure to be followed when leaving the pattern. The large number of airports in the U.S. precludes a rigid formula. It is a good policy to check with local pilots on established patterns.

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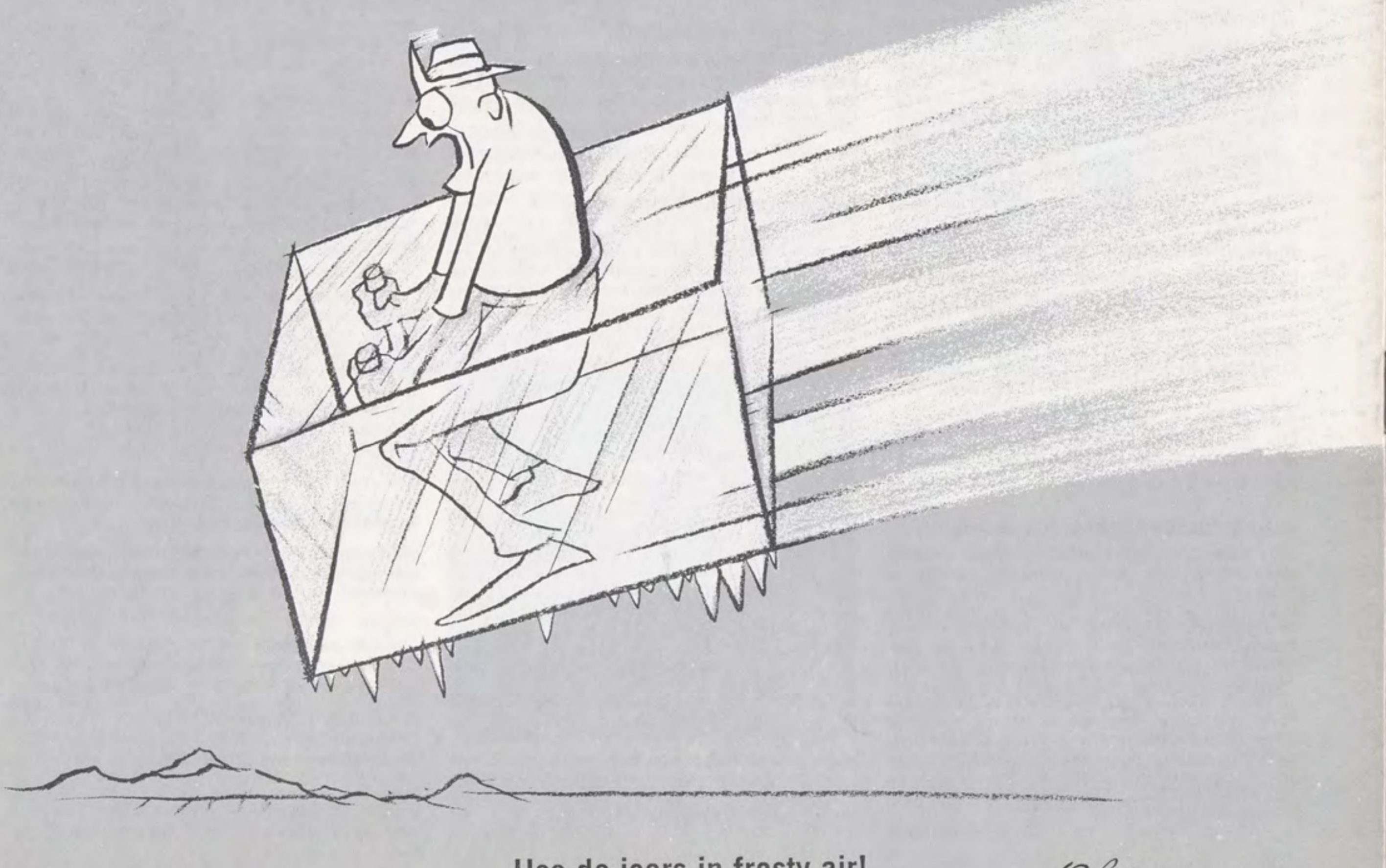

Use de-icers in frosty air!