KAMAN

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THE KAMAN AIRCRAFT CORPORATION

PIONEERS IN TURBINE POWERED HELICOPTERS

KAMAN

Rotor Tips

MARCH, 1961

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Cold Weather Testing

THE COVER

Grease guns and oil cans against a gear and bearing background are used by artist to emphasize helicopter's need for proper lubrication.

— PLEASE SHARE THIS COPY —

LUBRICATION

by C. W. JENKINS
Service Analyst

A grease gun used improperly on a helicopter can be potentially as dangerous as a loaded rifle... at the very least, it may mean needless work for maintenance personnel. The importance of the man with the grease gun and the care with which he does his work cannot be overemphasized.

The use of grease and other lubricants is a necessity in any aircraft, but with the helicopter there are additional factors to be considered—the high centrifugal and rotational forces involved and the missions this type aircraft is called upon to perform.

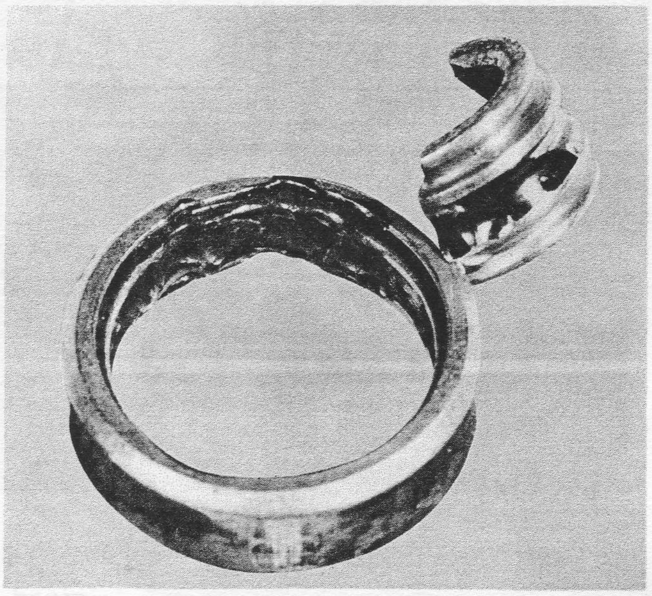
Helicopters have landed in deserts and swamps, on beaches, mountain tops, islands and even sea-swept reefs in order to carry out rescue missions. Rotor downwash, especially in arid areas, tends to contaminate the lubricant used on the heavily loaded thrust and other special bearings in the helicopter which are not found in fixed-wing aircraft. This downwash causes sand and dust to be circulated through the rotor system; therefore, special care must be taken to see that these areas are always properly lubricated and that any accumulated foreign material is purged. This foreign matter can be destructive for it may act as an abrasive which increases the rate of wear on metal-to-metal surfaces. It may also set up a chemical reaction within the lubricant, causing it to "break down" and lose most of its lubricating qualities. This may also allow corrosion to take place.

Another factor to be considered when comparing the lubrication requirements of helicopters with those of other type aircraft, is the high reduction ratio of the engine rpm to the rotor rpm. In conventional aircraft the reduction ratio between the propellor and the engine is, at most, three to one. The helicopter transmission gear train, however, reduces engine output rpm at least 10 times before power is absorbed by the rotor system. This means that the oils and greases used in this area must be capable of functioning efficiently in the high temperatures

and loads caused by the turning speeds of the gears working together to produce the needed 10-to-1 reduction ratio. Also, oils must not deteriorate under heat because, in addition to reducing friction, they must perform a definite cooling function as well. Obviously a lack of lubrication or the wrong kind of lubrication could cause a serious failure.

There are three major types of lubricant—grease, oil and dry film. These, in turn are broken down into many subdivisions, each with a specific job to do. Kaman Aircraft is well aware that it is not only a nuisance, but highly impractical, for a mechanic to load himself down with a dozen assorted grease guns before beginning a lubrication job, therefore every effort is made to keep the number at a minimum. Research is constantly being directed by lubricant manufacturers toward the development of one grease, encompassing as many applications as possible. This is difficult to accomplish because of the many things which must be considered. For example, in order to get a grease that will operate well at -65°F temperatures, it must be made with a synthetic base since mineral greases are only effective down to approximately -20°F. On the other hand, mineral base greases or oils are effective in higher operating temperatures due to a thicker body consistency which preserves the lubricating qualities at these temperatures.

There is no iron-clad rule by which to determine low and high temperature greases but usually low temperature greases carry the letter "G" on the container and high temperature is designated by the letter "L." Ordinarily these two greases will not mix, for when greases of different base materials (synthetic and mineral) are used together, there is a tendency for the mixture to emulsify and possibly dry out, due to chemical action or deterioration effect, thus losing any lubricating qualities. Obviously, this can be as bad as no lubrication at all. There is no need to amplify what could happen to a high-speed bearing carrying a heavy load if this occurred. In applications where such heavy loads are encountered, there is an additive known as EP (extreme pressure) incorporated in the grease to prevent it from "breaking down."



THE WRONG LUBRICANT, combined with failure to follow the time compliance instructions, led to this failure and damage to integrated parts dependent upon the bearing's load-carrying function.

There is another important point to remember when considering synthetic and mineral base greases. Most synthetic-base greases will attack paint and rubber, therefore, whenever neoprene seals are utilized, synthetic-base greases SHOULD NOT be used. Seals containing BUNA N or VITON A will not be harmed by synthetics. If the wrong grease is used, it will cause seals to deteriorate and they must be replaced. This raises the down time of the helicopter and also means unnecessary work for the mechanic. The aircraft manufacturer has specified the grease or oil that should be used, taking into consideration the types of seals he has used. Always check the handbook or lubrication chart if in doubt and make certain the lubrication times specified are complied with.

Because of the drying-out factor when two unlike greases are mixed, it is necessary to purge the old grease when changing from one type to another (when preparing for cold-weather operations, for example). To completely purge a bearing or rod end, it should be removed and thoroughly washed in solvent. Care should be exercised when repacking the bearing with grease afterward. As most mechanics know, merely wiping a handful of grease on the outside of the bearing does not accomplish proper lubrication as this may later be thrown off when the bearing is in use.

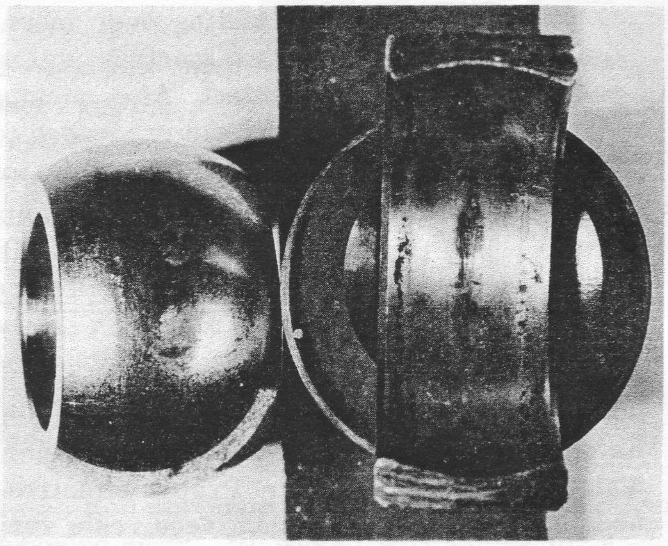
Purging by application of a new grease pushing out the old is fine as long as the new grease is the same specification as the old and provided care is taken that all the contaminated lubricant has been removed. Grease guns should be marked to show which grease they contain and, for obvious reasons, only this grease should ever be used in refilling the gun. Cases have been reported where a mech filled an unmarked grease gun with the proper lubricant for the job at hand but neglected to first clean the gun thoroughly. This left a small amount of grease of another type in the nozzle of the gun. Result—the first two or three grease fittings received the wrong type of grease, the others were serviced with the proper grease.

Excess grease should always be wiped from the fittings after greasing, otherwise moving parts may later sling it onto portions of the helicopter. This not only detracts from the aircraft's appearance, but also presents a safety hazard as personnel may fall on the slippery surface. In addition, the excess grease may affect some of the helicopter's components. For example, if the rotor head fittings are not wiped off, and if MIL-L-3278 lubricant is used, grease will be thrown out onto the rotor blades and may cause the painted blade fabric to deteriorate. When working on the rotors, care should be taken not to get grease on friction type dampers. If these become greasy the friction quality is lost; this could lead to an unequalized damping action between the two blades causing a small degree of aerodynamic instability and vibration.

Failing to properly clean grease fittings both before and after greasing, or using grease which has become contaminated with foreign matter because the lid was left off the container, can defeat the original purpose of lubrication. In all three cases dirt, sand and other abrasives may be lodged in the excess or contaminated grease and work into the bearings. Excessive wear and eventually possible failure of the part may result if this abrasive/grease mixture is not detected and removed.

Care should also be taken to purge bearings and other lubricated parts after cleaning solvent has been used near them. This action should be taken even though it is not yet time for the required greasing since solvents will dilute or thin grease and much of the lubricating quality is lost.

What has been said of greases holds true of oils, particularly engine oils, in that each has a specific job to perform and a specific place to be used. Only the oils with which an engine design has been qualified may be used in that engine. Again—check the handbook if any doubt exists. No one would knowingly turn up a helicopter with no oil in the transmission, but using the wrong type oil could accomplish the same disasterous result.



CONTAMINATION by sand and dirt led to the scoring and flaking shown and resulted in the elimination of this part from service. Using a cleaning solvent without proper purging afterward could lead to a similar condition.

As mentioned above, oil has another important function beside lubrication, it acts as a cooling agent. Cases are recorded where the wrong oil in certain high-temperature applications has actually boiled away in minutes. Other non-specified oils thicken up or become stringy and the mechanism seizes or "freezes up." Many costly parts have been ruined by failure to use the correct oil, and hazard to life is always a threat. Lubrication requirements are the result of intense research, and the need for compliance with regulations concerning their uses cannot be overemphasized.

The use of dry <u>film</u> lubricant is relatively

SCROLL OF HONOR

Capt. Richard E. Skinner, USMC, and his crew chief, Sgt. C. R. Hern, of VMO-6, Camp Pendleton, Calif., have received Scroll of Honor awards from Kaman Aircraft for flying their HOK-1 through fog and over mountainous territory to evacuate a marine seriously injured in an accident.

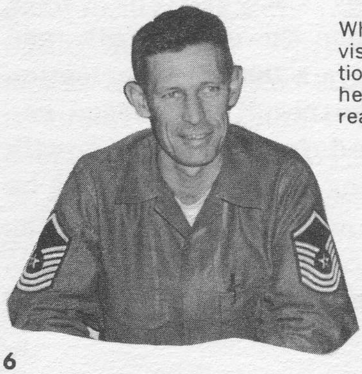
When Captain Skinner and Sergeant Hern left the air strip at Camp Pendleton on the mission, the ceiling was approximately 670 feet. About a mile out the helicopter ran into a blanket of fog and visibility dropped to almost zero. Only by air taxiing over mountainous terrain were the two marines able to reach the scene of the accident. After picking up the litter patient, they again proceeded to air taxi back to the hospital. The mission was accomplished in record time.

H-43A HELICOPTER CREW HONORED—Capt. Charles R. Pinson, S/Sgt. Donald L. Baker and A1/C Robert C. Birch examine Kaman Scroll of Honor as R. D. Moses, KAC Project Manager of the H-43 Program looks on. The promptness with which Captain Pinson and the two firemen delivered an airborne fire suppression kit to the location of a crash-landed KC-97 near Randolph Air Force Base, and the efficiency shown in utilizing the kit were credited with preventing the destruction of the aircraft by fire. (USAF Photo)

new. One form is a graphite suspended in some kind of quick-drying vehicle such as Ketone, which is similar to lacquer thinner, and applied by spray bomb. Proper effectiveness of this type of lubricant requires a very thorough cleaning of the part to be lubricated. Unless directions for applying are complied with, it will not be entirely successful due to poor adhesion. This lubrication is used in hard-to-get-at areas or where the use of oil or grease would tend to collect dust and dirt, such as flap bearings in the blades, and the tail isolator spring bolts. Dry lubricant, such as graphite powder, gives corrosion protection but does not adhere well and should be used with this in mind.

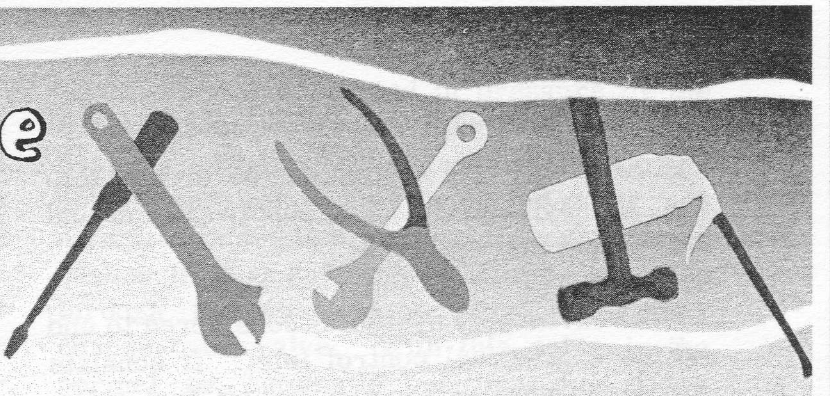
This necessarily brief article has made no attempt to discuss the "lubrication story" at length but to point out the importance of what is sometimes regarded as a strictly routine job. Please write to Rotor Tips if you have any questions regarding lubrication or suggestions for further discussion on the use of a specific lubricant.

REMEMBER——Good lubrication practices aid in assuring full service life of components, reliability, and safe utilization of the helicopter. K



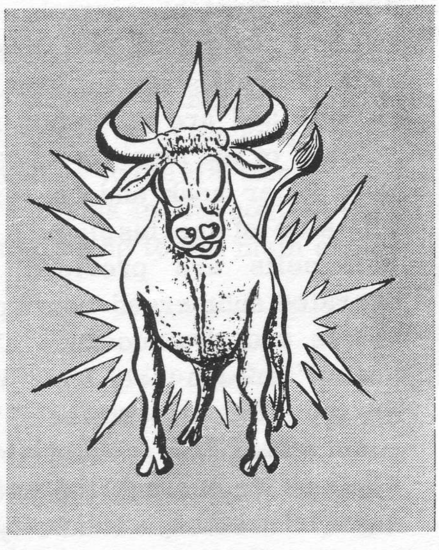
When Sen. M/Sgt. Dwight B. Sexton of the H-43B Mechanics School at Sheppard Air Force Base was visiting Kaman Aircraft he was asked to suggest the subject for a Rotor Tip's article. Without hesitation the veteran sergeant came back with—"Tell them about lubrication." We hope that similar helpful suggestions for other articles such as the one appearing in this issue will be made by our readers —Ed.

Maintenance Mailbag



Dear Red,

It was good to hear from you and I'm glad you are getting the H-43Bs. I'll send along maintenance dope from time to time and would appreciate your doing the same. Before I start "tipping" though, I've got to tell you about Thorneycrofte Bentwhistle, the guy I introduced you to that time in Mike Malone's Bird Sanctuary.



Thorney hasn't made it down to the line for the last few days 'cause he's being treated for bull kicks. The way I get the story, Thorney went to town a couple of nights ago on his motorcycle to pick up that best-selling book, "Pursuing the Purple Pipit Through Field and Forest." All six copies at the base library were out and there was a long waiting list for it. Anyway, Thorney's glasses fogged up during the ride and somehow he got off the road and onto a little lane that led right into a beat-up barn. Thorney was straining over the handlebars trying to see when, all of a sudden, he found himself looking the stern end of a big bull right in the face. Then....WHAMO!

The bull got pretty excited and even though it was tied up, managed to get in a couple of real good thumps with its hind feet before Thorney crawled away. He wasn't hurt except for a lot of bruises but the motorcycle sure took a licking. Just to add to Thorney's troubles, he is being sued for giving the bull a nervous breakdown. The farmer says Herman, the bull, keeps backing into corners and then stands there kinda' shaking and looking over his shoulder.

Now about the H-43B. I understand some mechs have been trying to run the azimuth bar out with the cyclic jig installed over the co-pilot's friction bell housing. This will cause excessive aft cyclic and make it necessary to lengthen the cyclic fore and aft rods beyond the safety holes before approaching a flat azimuth. Remember, the bell housing must be removed in order to seat the cyclic jig positively in the stick socket.

Another thing. Be careful when you have the engine on the stand for hot end inspection. Last week a steel washer got hung up between the tip of the blades and the axial compressor housing. This caused the N1 turbine wheel to seize. We figure the washer probably entered through the centrifugal compressor when the engine was in a vertical position and ended up under the fifth stage blade tips. Always be careful of foreign object entry.

Gotta' go now...just heard Charlie Flamingo say he turned in his copy of the Purple Pipit. Man, he's still blushing!

Joe.

The H-43B fuel system can be divided into two sub-systems: (1) fuel supply system and (2) engine fuel system.

The fuel supply system is considered to end at the engine fuel control inlet. It consists of interconnected forward and aft fuel cells, boost pumps, check valves, vent valves, fuel quantity tank units, compensator, fuel low-level warning unit, expansion standpipe or relief valve, filter, solenoid operated shutoff valve, a fuel pressure transmitter, indicators and the system controls. The two rubber interconnecting, non-self-sealing, bladder-type fuel cells have a total capacity of 198 gallons and are mounted in the lower rear section of the fuselage under the floor. The tank filler neck and cap are located on the left side of the fuselage. The double sump fuel cells are provided with electrically operated submerged boost pumps with check valves and draincocks. The fuel cells are vented through three vent valves attached to the top internal sections of the cells. These vent valves are vented to the surrounding atmosphere through the bottom of the fuselage. Three capacitance-type electrical fuel quantity tank units are used for fuel gauging. A compensator that is an integral part of the forward fuel cell adjusts the indicating system to variations in the dielectric-constant of the fuel being used. The fuel low-level sensing unit is mounted on the forward fuel quantity tank unit at a fixed height above the bottom of the forward fuel cell. Operation of the fuel-level sensing unit is independent of the fuel quantity gauge system. Whenever the fuel in the cell falls below the level of the sensing unit, the warning light in the cockpit will glow. The expansion standpipe, or relief check valve, allows fuel thermal expansion after engine shut down. The expansion standpipe and the filter are located on the aft left side of the cabin area. The solenoid-operated shutoff valve is mounted in the forward section of the left tailboom. Draincocks are provided for draining the filter, fuel control, and engine combustion drain through a hose vented to the bottom of the fuselage.

Fuel is delivered by the four interconnected boost pumps through their check valves into the outlet line of the fuel cells; it by-passes the expansion standpipe through the filter and fuel shutoff valve into the engine-mounted fuel control inlet (see figure 1 Fuel Supply System). Check valves prevent reverse flow of fuel back to the tank. Fuel pressure transmitter is tapped off at the fuel control inlet housing. The fuel shutoff switch and the fuel boost pump switch are all located on the console panel. The fuel quantity and fuel pressure indicators are mounted on the pilot's instrument panel.

The engine fuel system consists of the fuel control unit, starting fuel solenoid valve, starting and main fuel manifolds, self-purging igniter nozzles, vaporizer tube assemblies, combustion drain valve, and system controls. The fuel control unit is a hydramechanical control incorporating a preselected fuel flow schedule. This control is capable of governing the gas producer (N1) rpm and the power turbine (N2) rpm as well as providing compensation for outside air temperature and altitude.

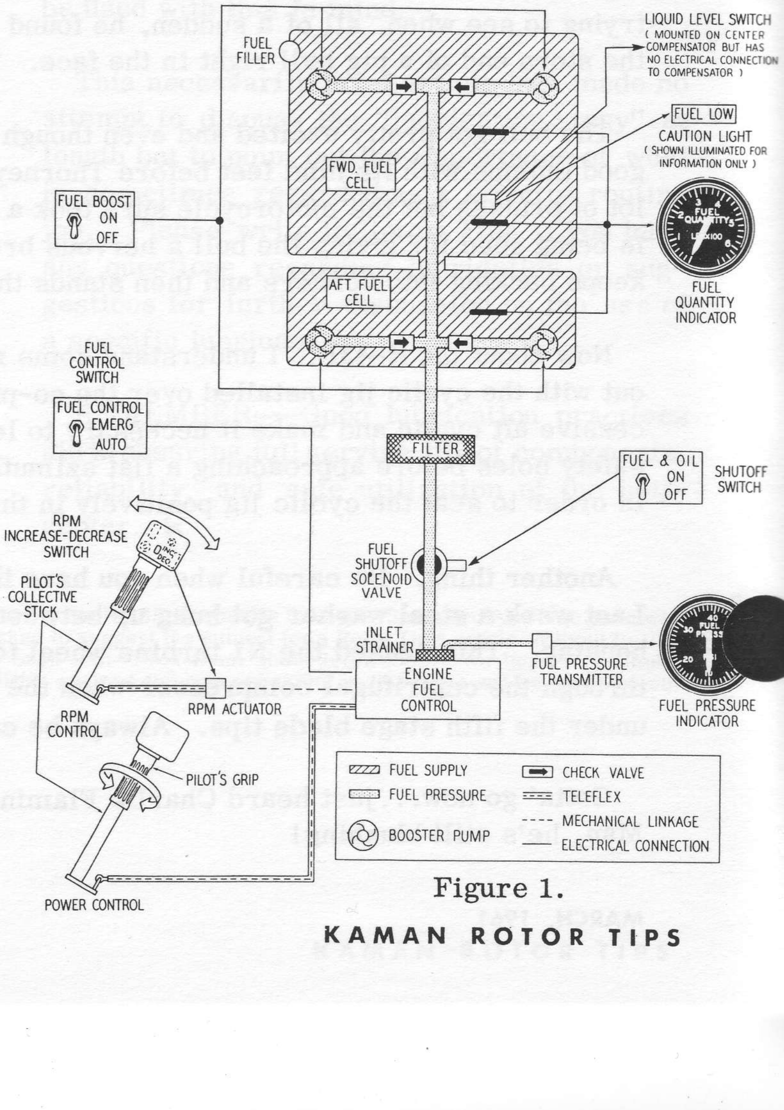


Figure 1.

The starting fuel solenoid valve is a three-way control valve, wired in conjunction with the engine starting circuit. It allows fuel flow to the starting manifold during engine starting cycle and purges the line when the starting system ceases to operate. The starting and main fuel manifolds conduct the fuel flow to their respective fuel discharge. Starting fuel is discharged through the five self-purging igniter nozzles. The vaporizer tube assemblies provide the outlet for main fuel flow to the combustion section. The combustion drain, an automatic pressure actuated valve, removes any residual fuel within the combustion chamber after shutdown.

The collective stick throttle twist grip, through mechanical linkage, allows the pilot to manually vary the gas producer (N1) speed. The engine speed governor switch (Beeper) mounted on the collective stick, permits selection of desired power turbine (N2) rpm. The engine fuel control switch located on the console switch panel, governs the fuel control metering system. When this switch is in automatic (auto) position the change-over valve allows fuel flow to the main metering valve only; with the switch in emergency (emerg), all fuel flow is to the emergency metering valve.

Fuel from the fuel supply system enters the control unit and passes through a 100 mesh strainer, and is boosted in pressure by the dual element pumps (see figure 2 Engine Fuel System). High pressure fuel for the starting nozzle and servo system of the control is diverted immediately after the dual pump, passes through a 25 micron filter, and then through the solenoid actuated emergency change-over valve. With this valve in the normal or automatic position, fuel flows through the main metering valve, its position controlled by the computer section of the fuel control.

The metered fuel now flows through the open stopcock, which is part of the emergency system metering valve, and the minimum fuel pressure valve to the fuel manifold. During engine starting, the minimum pressure valve permits fuel to flow only to the starting nozzles and to the servo systems in the control unit, blocking fuel from flowing to the main engine manifold.

With the change-over valve in the "emergency" position, fuel flows through the path indicated by the broken line in the sketch, to the emergency metering valve, then flows through the open stopcock and minimum pressure valve to the discharge port. For emergency operation, the throttle twist grip directly controls the flow of fuel to the engine.

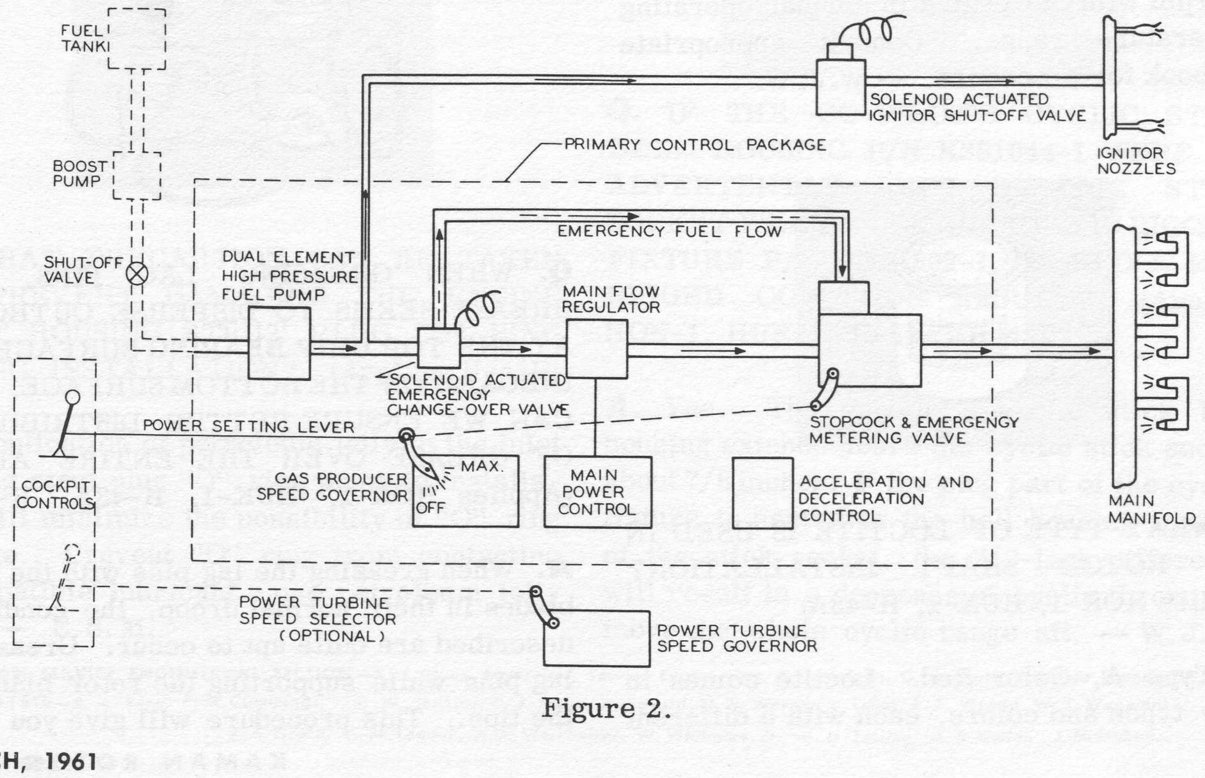
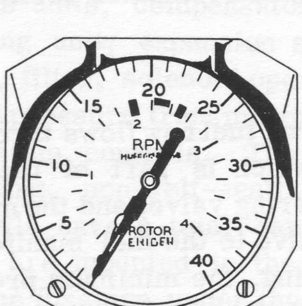


Figure 2.

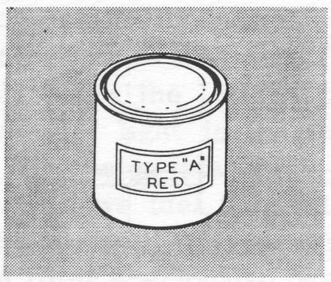
Q's AND A's

If you have a question regarding Kaman Aircraft maintenance, send it along to Rotor Tips. The Service Department's analysts will be glad to answer it.



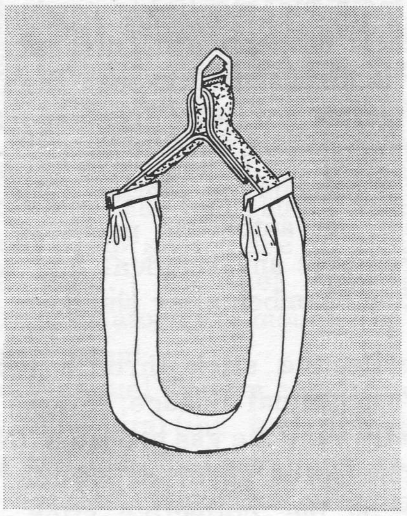
Q. WHAT IS A COMMON CAUSE OF HIGH IDLE RPM AFTER A CARBURETOR CHANGE? (Applies HOK-1, HUK-1, H-43A)

A. When a carburetor is changed the original idle rpm setting is sometimes made before the engine temperature is up to normal. This results in good idle rpm at below normal engine temperature, but as the engine temperature increases the idle rpm will also increase. Since a high idle rpm can affect clutch disengagement it is advisable to adjust the engine idle rpm with the engine in normal operating temperature range. Consult appropriate handbook for procedure. — W. J. W.



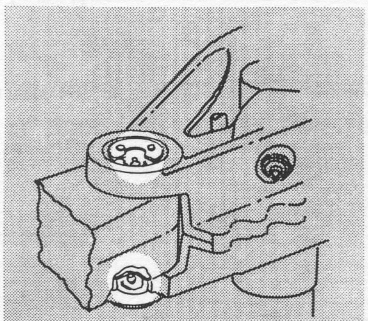
Q. WHAT TYPE OF LOCTITE IS USED IN THE ROTOR SHAFT INSTALLATION? (Applies HOK-1, HUK-1, H-43A)

A. Type A, Color Red. Loctite comes in many types and colors, each with a different set of characteristics. The only one approved for use in this application is Type A. Other types have a lower break-loose torque value and are therefore not satisfactory. FSN is 8030-705-8530. — L. L.



Q. WHAT IS THE FEDERAL STOCK NUMBER FOR THE RESCUE SLING? (Applies HOK-1, HUK-1, H-43A, H-43B)

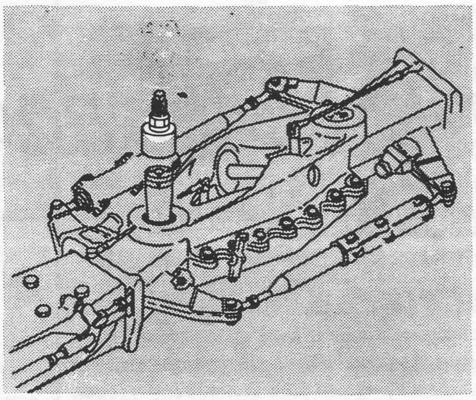
A. The Federal Stock Number is R1680-511-2712-LA20. — A. D. C.



Q. WHEN GREASING LAG PINS, THE GREASE SEEMS TO DISPERSE OUTBOARD AT THE TOP GRIP BEARING SURFACE AND INBOARD ON THE BOTTOM SURFACE. HOW CAN WE ENSURE BETTER DISTRIBUTION OF GREASE OVER THE ENTIRE AREA? (Applies HOK-1, HUK-1, H-43A, H-43B)

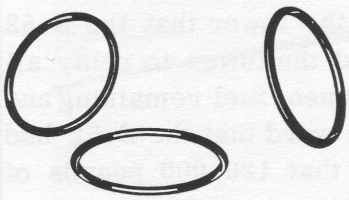
A. When greasing the lag pins with the rotor blades in their normal droop, the conditions described are quite apt to occur. Grease the lag pins while supporting the rotor blades at the tips. This procedure will give you 100%

grease dispersion over the top and bottom grip-to-hub bearing surfaces. — N. E. W.



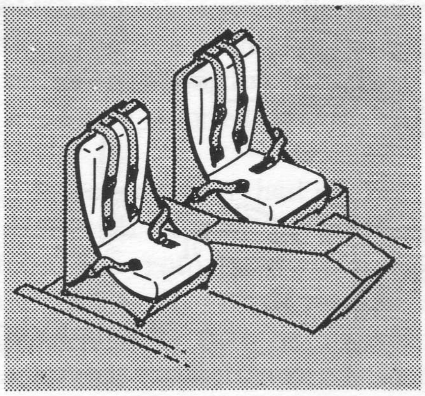
Q. WHEN USING THE TAPER PIN PULLER TOOL NUMBER K304714-3 TO REMOVE THE LAG PIN, IS IT NECESSARY TO ALWAYS USE THE WASHER PROVIDED UNDER THE NUT? (Applies HOK-1, HUK-1, H-43A, H-43B)

A. Yes. This washer is designed as a thrust washer and spacer to permit the tool to lift the lag pin clear of the upper lag bearing. Without it, the lag pin would still partially engage the upper bearing even after the puller had lifted the pin to its full limit. The subsequent tapping would impart an end loading on the inner race which would undoubtedly spring the retainer and make a bearing replacement necessary. — N. E. W.



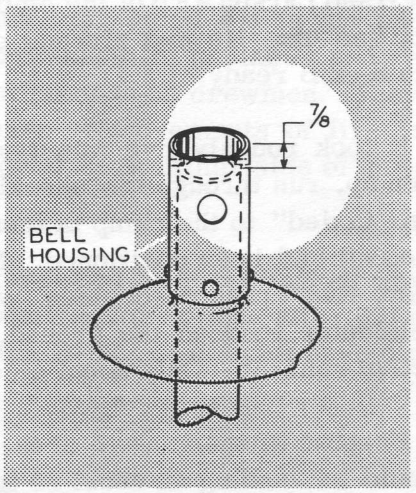
Q. WHAT PRECAUTION CAN BE TAKEN TO PREVENT DAMAGING THE ENGINE INLET HOUSING STRUT PLUG "O" RING DURING INSTALLATION? (Applies H-43B)

A. Application of petroleum jelly to the inlet housing strut plug "O" ring prior to installation will minimize the possibility of "O" ring damage. Prevent "O" ring from contacting incompatible lubricant - use petroleum jelly only. — E. S. M.



Q. HOW SHOULD THE NYLON SEAT CUSHIONS BE CLEANED? (Applies H-43A, H-43B)

A. The nylon seat cushion covers should either be washed by hand with a mild detergent or dry cleaned. A standard washing machine will abuse them and may cause unraveling of the fibers and render the covers unusable. —A. D. C.



Q. IF THE CO-PILOT'S CYCLIC STICK BELL HOUSING P/N K351044-1 WERE INADVERTENTLY LEFT ON THE STICK SOCKET WHEN USING THE CYCLIC RIGGING FIXTURE P/N K304802-1, WOULD A MIS-RIGGED CONDITION RESULT? (Applies HOK-1, HUK-1, H-43A, H-43B)

A. Yes. The co-pilot's cyclic stick bell housing extends above the cyclic stick socket about 7/8 inches. If the plug part of the cyclic fixture is seated in the bell housing instead of the stick socket, the 7/8-inch difference will result in a decrease of cyclic throw and move the whole cyclic range aft. — W. J. W.

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Report FROM THE READY ROOM

RUNWAY RESCUE at LARSON AFB

The January issue of Rotor Tips briefly described how the efforts of helicopter personnel in an H-43B aided in saving the lives of 10 crewmen aboard a B-52 which crash landed at Larson Air Force Base in Washington. As a means of aiding other rescue units in their programs, Capt. Howard J. Cochran, USAF, agreed to a Rotor Tips' request for a personal account of the mission describing the conditions encountered and the action taken.

I was in base operations with my copilot, 1st Lt. Donald R. Couture, when Capt. William Dysart, base ops officer, received word about the B-52. An alert Federal Aviation Agency controller had notified Fairchild AFB and Larson AFB of the emergency and Captain Dysart notified us. He had already called maintenance to get the H-43B ready.


CAPT. H. J. COCHRAN
Larson Air Force Base

It took roughly five minutes to reach the helicopter, fire up, run through the checklist and get airborne. We "air taxied" to the ramp in front of base operations where the fire suppression kit had been positioned. M/Sgt. Samuel R. Hoar and T/Sgt. Henry M. Ivey, fire/crash rescuemen, were waiting and jumped aboard as soon as the helicopter touched the ground. We picked up the kit and headed out to the active runway. Only about nine minutes had elapsed since we got the word.

Enroute to the runway area, we were notified by the tower that the B-52 would be landing in about 20 to 25 minutes. I asked the tower to relay all available information... particularly number of crewmen, fuel remaining and if weapons were aboard. The tower came back with word that the B-52 had 10 crewmen aboard, no weapons were carried and that 126,000 pounds of fuel still remained. There was no accurate information available as to extent or severity of damage to the B-52.

We reached the runway and started orbiting at about 300 feet, left of the active runway, and continued this orbit until the B-52 started its landing approach. During this time I briefed the rescue team to stay out of any wreckage until they were sure the rotor wash and fire suppression equipment would hold the flames back. We also went over the location of escape hatches and information received from the tower.

The final orbit was paced to allow join-up with the B-52 at approximate touchdown point and at approximately the same speed. We were successful in the maneuver and paralleled the plane down the runway until the end of the landing roll. While moving down the runway we descended to about 150 feet above the ground.

Since we had no word about location of damage, we had remained on the left of the runway. This worked out perfectly, because about 300 feet before the plane stopped, we observed fire break-out on the right side of the fuselage. This meant we would be on the proper side to blow smoke and flames away from the cockpit while the crew evacuated.

When the B-52 stopped we were about 300 feet away, to the left of the nose. We moved in to about 80 feet and dropped the suppression kit. We had already decided to go on with our work without landing the helicopter rescuemen. Base fire trucks were moving in and they could supply much more foam and the ground rescue crews could assist the aircraft crew. We would concentrate on trying to direct smoke and flames away from the cockpit and not lose valuable time unloading our rescuemen.

The wind was almost calm, four mph, and wasn't a deciding factor in positioning the helicopter. We pulled up to hover about 18 to 20 feet above the ground and kept a position so the rotor wash would angle across crew escape hatches back toward the main part of the flames. The fire hadn't spread to the nose yet and we were in position just a few seconds before crewmen started leaving the plane.

During the evacuation I had to alter position slightly, several times, to gain maximum effect from the rotor wash. Larson AFB Fire Chief Arthur R. Ribail told the accident investigation board that he considered the rotor wash from the helicopter held back the flames and allowed the crew to escape safely. Maj. Wayne D. Waller and Capt. Clifford L. Ponsness, members of the B-52 crew, both said later that they hardly felt the heat from the flames until they got out of the rotor wash from the H-43B and that they felt the work of the helicopter saved the crew from serious burns or death.

Lieutenant Couture, Sergeant Hoar and Sergeant Ivey aided me in the operation by spotting movement of flames and reporting on evacuation of B-52 crewmen. They also kept me aware of movements of fire trucks that had moved up on either side of us to fight the fire.

Couture and I have been asked why we stayed in position for so long after the men were out of the B-52...we didn't have direct com-

THE TEAM THAT DID THE JOB—Left to right, T/Sgt. Henry M. Ivey, M/Sgt. Samuel R. Hoar, rescuemen; 1st Lt. Donald R. Couture, co-pilot; Capt. Howard J. Cochran, pilot. (USAF Photo) munication with the Fire Chief or other ground units and we just didn't know for sure that everyone was out. By the time the fire had engulfed the cockpit and we decided further efforts were useless, the crew had evacuated the plane and were on their way to the hospital.

Staying in position so long did have a good result; a fire truck was surrounded by burning fuel and we were able to blow the flames away and thus help ground personnel save the truck from destruction.

The question of hazards created by explosions has also been asked on several occasions. Explosions, if very severe, could be a hazard to the helicopter and crew. They weren't hazards in this particular operation. We were moved back out of position but no drastic recovery actions were necessary, and we were able to return to our original position almost immediately. Chief Ribail reported that having the helicopter move out of position did create a hazard for his firemen because the fire immediately rushed forward into the area the helicopter had been keeping clear with the rotor wash.

I don't feel the lack of direct communications with the ground units hampered this particular operation, but it could have an adverse effect on other rescues. We coordinated our work with ground units by visual means and by the transmissions received from the tower. Actually, the people on the ground were busy enough with their own work without having the added responsibility of trying to provide guidance for us. The addition of direct communications capability is desirable and I believe necessary. Fire/rescue units on the ground will have to include a specific person to stand by the radio and relay information and instructions both ways.

Larson AFB received the H-43B s, first in the Northwest, in October of 1960. Sergeant Hoar, Sergeant Ivey and I attended the Stead AFB, Nev., training school during August and September. Lieutenant Couture went to the school during September and October. The helicopter section's procedures and operations are just like the ones taught at Stead, and as we found by experience, are both workable and practicable.

About training; we had conducted approximately a dozen practice operations of various types before the B-52 accident. Some of these were for helicopter flight and fire/rescue crews, some included base fire department crews and some included both of us, plus base hospital personnel. The 829th Medical Group at Larson AFB has a very active training program and they welcome every opportunity to get more training for their people. Another phase of training that has been important to our unit is the technical training given flight crews and maintenance personnel by John Elliot, Kaman technical representative. Elliot has gone out of his way to give assistance, day or night, where needed. The training classes he conducts for base flight maintenance men has given them the "know how" necessary to ensure our helicopters get the best maintenance and are ready to answer any call. K

CAPT. HOWARD J. COCHRAN, Pilot, was born in 1926 and is from Tacoma, Wash. He is assigned to the 4170th Combat Support Group, 4170th Strategic Wing (SAC), Larson AFB. A veteran of 15 years Air Force service, Captain Cochran has 3,500 hours flying time with 650 logged in helicopters.

1st LT. DONALD R. COUTURE, Copilot, was born in 1934 and is from New Bedford, Mass. Lieutenant Couture entered service in 1953 and was commissioned a second lieutenant through the Aviation Cadet program in 1954. He is a qualified pilot, navigator, bombardier and radar operator with 1,500 hours flying time.

M/SGT. SAMUEL R. HOAR, Rescueman, was born in 1912 and is from Akron, Ohio. He has 17 years service and is a professional firefighter. Sergeant Hoar attended several firefighting schools including the H-43B Firefighting School at Stead AFB, Nev. He is currently assigned as NCOIC of the Base Fire Department at Larson AFB.

T/SGT. HENRY M. IVEY, Rescueman, was born in 1920 and is from Fairmont, N.C. Sergeant Ivey entered service in 1943. He attended several firefighting schools, both military and civilian, including the Atomic Age course at Portland, Ore., the Fire Marshal course at Texas A&M and the H-43B school at Stead.

DEVELOPMENT OF THE H-43B MAIN LANDING GEAR

by ROBERT JONES
Vibration Group Leader,
Dynamics Section

ENGINEERING

The main landing gear of the H-43B was developed from tests made on a Kaman Aircraft HOK-1 grossed at the design weight of the H-43B. The purpose of these tests, which were correlated with analytical studies, was to develop a gear which would further improve the sidehill landing characteristics of the HOK-1 and H-43A helicopters. The tests were also aimed at ensuring freedom from mechanical instability for all gross weights for the H-43B throughout the new helicopter's operating rotor rpm.

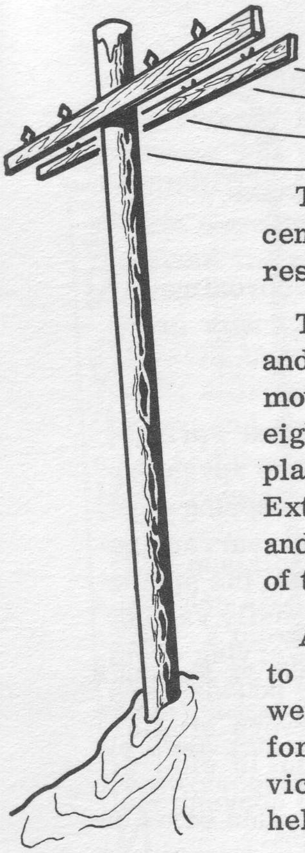
It was determined that a very low extended pressure in the H-43B's strut gives the sought-for sidehill landing characteristics. The purpose of this low extended pressure is to obtain fast compression for approximately the first six inches of strut travel in response to a very light vertical force on the gear which is on the uphill side. Because of the low extended pressure in the strut, less lateral cyclic input control movement is required to make a sidehill landing.

Since the low extended pressure in the strut reduces the load-carrying capacity of the strut, it is necessary to incorporate a taxi spring, or rubber shock mount, in the design. With the H-43B gear at static position, the air column in the strut carries approximately 500 pounds and the taxi spring approximately 2,000 pounds. These loads vary with gross weight and c.g. position.

For the testing done on the taxi springs, belleville washers were used. The advantage of using these dish-shaped, spring-type washers in the tests was that by rearranging the washers in series and parallel, the spring rate of the taxi spring could be easily varied. Spring rates of the taxi spring varying from 8,000 pounds-per-inch to 980 pounds-per-inch were tried. All of these were similar in that there was an improvement in sidehill landing characteristics over the conventional gear used on the HOK-1 or H-43A.

However, in checking both the conventional and taxi spring configurations on an HOK-1 helicopter grossed at 6,500 pounds, it was found that both gear designs were susceptible to mechanical instability; but of a non-destructive character, completely unlike classical ground resonance. It was found in these tests that the most critical condition was with application of aft cyclic stick in which the forward gear becomes very light or leaves the ground completely. In these tests, the vibration was found quite difficult to excite, and when obtained, relatively gentle, of low frequency, and could be eliminated by appli-

LOW EXTENDED PRESSURE of the Huskie strut design is shown in this view of a sidehill landing. The first weight of the helicopter has compressed the uphill strut while the downhill strut is still only partially compressed, thus keeping the angle of inclination to a minimum.



OPERATION ICICLE

The helicopter unit at Larson Air Force Base in Washington recently added a "collateral duty" to the H-43B's primary one of rescuing personnel from downed aircraft.

The Huskie, with Major J.R. Halpin, Capt. Howard J. Cochran and S/Sgt. Lester J. Flint aboard, was dispatched to aid in removing ice from the power lines at nearby missile sites. From eight to ten pounds of ice per foot had gathered on the wires in places and many areas were without electricity due to breakages. Extra personnel hired by the power company were working sixteen and eighteen hours a day using long poles to clear the wires. Many of the homes in the Northwest are heated electrically.

After a tour of the missile sites, the helicopter crew proceeded to a nearby town and continued the ice-clearing work until they were fogged in. Then the helicopter was landed and bedded down for the night. The battery was removed and taken to a nearby service station and stored in a warm place. The following day the helicopter returned to base—"Operation Icicle" completed.

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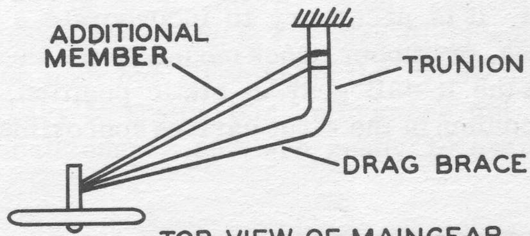
cation of forward stick. However, if the oscillations were allowed to continue for too long a period, (10-15 seconds), it then became necessary to take off.

The first series of tests were done with a taxi spring of 8,000 pounds-per-inch and it was thought at that time that a reduction in spring rate would eliminate the problem. However, spring rates as low as 980 pounds-per-inch were tried with negligible effect on mechanical instability. Analytical studies were made to determine the cause of the mechanical instability. From results of the analysis it was determined that lateral stiffness of the gear and tire were of primary importance and that the probable cause of the mechanical instability being obtained in the tests was the softness in the lateral direction of the gear and tire.

Tests were then made on the helicopter to verify the analytical results. Increasing the tire pressure from 90 psi to 160 psi showed an improvement in the results, but was not sufficient. Side plates were then added to the wheel and tire to further increase the lateral stiffness of the tire; again improved characteristics were obtained. However, in this series of tests it was noted that appreciable lateral deflection of the gear still occurred. Tests were then made with a stiffened gear which was accomplished by adding a third member to the gear as indicated in the following schematic. Results of the tests made on the stiffened gear and with 160 psi in the tires showed that no mechanical instability occurred.



TOP VIEW OF MAINGEAR

Using the information obtained from the tests, and in conferences with Cleveland Pneumatic Tool Co., the present H-43B main gear was designed. Tests on the production gear showed improved sidehill landing characteristics over the type gear used on the HOK-1 and H-43A helicopters. The H-43B helicopter with proper servicing procedure for tire and interblade dampers was found to be free of mechanical instability for gross weight conditions well above the 6,500 pounds design weight condition. K

TRAINING

The introduction of the turbo-jet engine into the rotary-wing field has also introduced "jet-talk," a language with which many of our readers are probably already familiar. However, as an aid to those who are, or soon will be, making the transition from reciprocating to turbine powerplants, some of the terms will be reviewed from time to time in this section of Rotor Tips. Questions from readers are always welcome.

TURBINE TALK

THRUST: This word is used to describe the propulsive forces developed by a gas turbine engine. It is expressed as "pounds of thrust," and is a measurement of the force with which the engine pushes against its attachment points. This force is the energy of captured gas pushing against the walls of the chamber in which it is confined. When there is one small opening in this chamber, there is no pressure at that point and all the surrounding pressure forces the confined gas out the small hole. If this internal pressure is great enough, it will cause the chamber confining the gas to move in a direction opposite from the place where the hole is. A balloon filled with air does this when the neck is released and all the confined gas escapes.

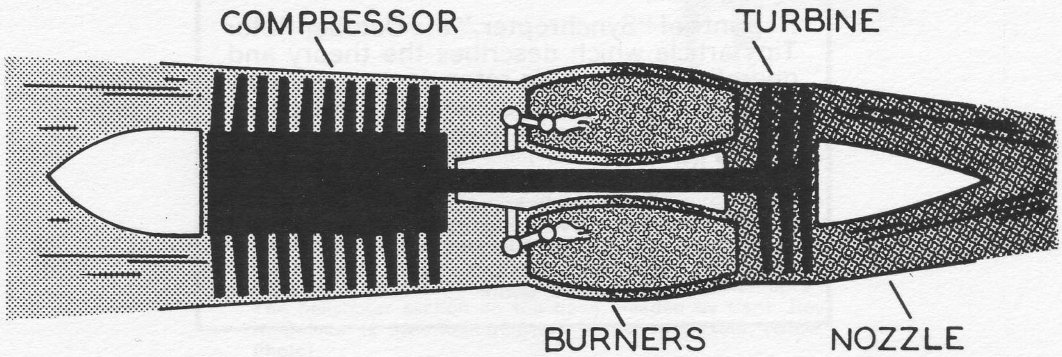
GAS TURBINE: A jet-engine which depends upon the controlled compression and release of gasses is a gas-turbine. This has nothing to do with the kind of fuel used to heat the air which causes it to expand and drive the turbine as it passes through the turbine vanes. Some turbines are driven by steam or by forcing a liquid through the turbine vanes. A jet-engine uses air (gas) instead.

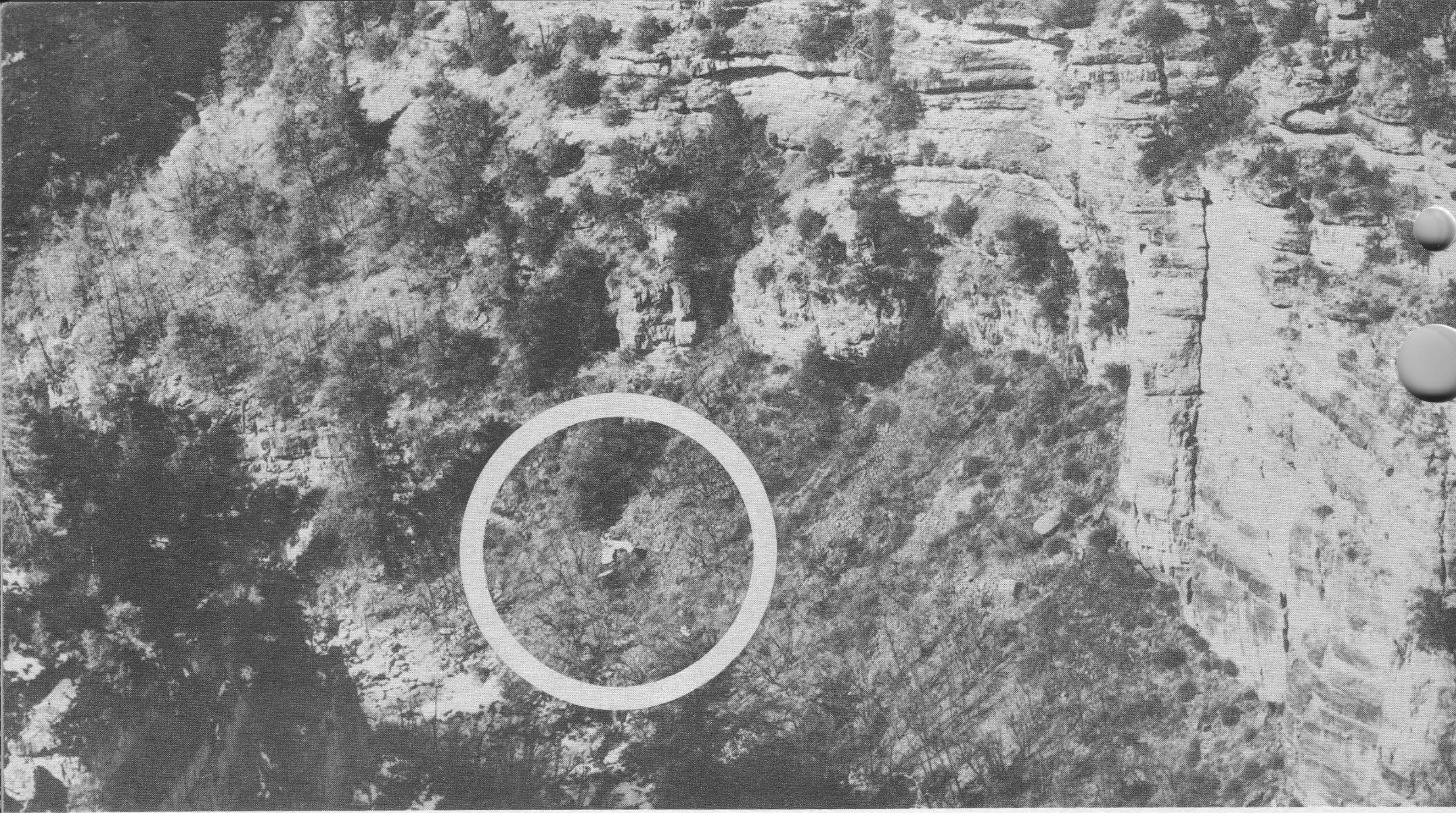
All jet-engines have a compressor section and a turbine section which essentially serve as "lung-power" to fill the confined space of the engine as one does that of the balloon.

TURBINE: A wheel designed so that the spokes constitute angled blades, like those of a common fan, which is inserted in the airstream near the rear of the engine. This wheel is fitted to a shaft and when the confined gasses pass through the blades in escaping through the opening at the rear of the engine, they cause the turbine wheel to turn and the shaft revolves accordingly.

COMPRESSOR: The first part of the sequence in providing pressurized, confined gasses to the interior of the jet-engine takes place in the forward end of the engine. Fixed to the opposite end of the shaft which carries the turbine wheel (described above) is another wheel whose blades are set so that when it is rotated it sucks air into the engine. In practical design, several such wheels are arranged on the shaft. The amount of air sucked into the engine is very great in comparison to the size of the interior, so that the air is compressed. This entire section of the engine is called the compressor.

BURNER: The burner is the inclusive name given the area where fuel is burned in the airstream of the engine. When the compressed air being driven through the engine by the compressor is heated in the burner area it expands. This generates very large values of internal pressure and furnishes the major portion of propulsive energy. The burner apparatus may be a ring or can-shaped device, but is always so designed that it sprays vaporized fuel into the burning zone. The system is relatively simple compared to a reciprocating engine and once the burning has been started by an igniter, combustion is continuous as long as fuel vapor and air is supplied in proper balance. K





RUGGED CANYON WALLS LOOK DOWN ON WRECKAGE OF LIGHT CIVILIAN PLANE WHOSE INJURED PILOT WAS AIRLIFTED TO SAFETY BY H-43B HELICOPTER CREW FROM LUKE AIR FORCE BASE.

An injured teen-age civilian pilot whose light plane crashed in a rock-strewn canyon southwest of Flagstaff, Ariz., was airlifted to safety afterward by personnel from Luke Air Force Base flying an H-43B.

The wreckage, located at an altitude of approximately 6,800 feet, was at the bottom of the 100-yard-wide canyon and 600 feet below the canyon rim. Pine trees 60 to 80 feet high covered the entire area. Since there was no place to land, a hoist pickup had to be made. The helicopter pilot, Capt. Walter C. McMeen, hovered the turbine-powered H-43B below the branch of a large tree almost 20 minutes before the pickup was made utilizing a stokes litter. The pilot of another helicopter circling overhead said he could look down through the branches and see the blades of the H-43B.

Captain McMeen, commanding officer of the Helicopter Rescue Unit at Luke, was accompanied on the mission by 2nd Lt. Richard Laine, T/Sgt. William Eckert and Cecil Richardson, Coconino County sheriff.

The rescue mission began after the light plane, piloted by Gary Duff, 18, of Loma Linda, Calif., entered the canyon and then failed to gain sufficient altitude to clear the rim. Duff suffered a broken leg in the crash. Albert Tweedy, 19, of Cottonwood, who was accompanying him, suffered a serious eye injury, scratches and bruises. He walked for five hours in order to get help. A ground rescue party followed Tweedy's tracks back to the wreckage. K

Reprints of "Synchropter," the October Rotor Tips article which describes the theory and operation of this twin-rotor design, are now available. They may be secured from either a Kaman Field Service Representative or by writing to:

Customer Operations Section;
Field Service Department;
The Kaman Aircraft Corp.,
Old Windsor Rd.,
Bloomfield, Conn.

CURRENT CHANGES

TIME COMPLIANCE TECHNICAL ORDERS (USAF)

Applies - H-43A

T.O. 1H-43A-515, 27 December, 1960
Magnetic Chip Detector and Caution Light Installation.
H-43A Helicopter.

T.O. 1H-43A-516, 21 February, 1961
Installation of Cabin Door Retention Cable.
H-43A Helicopter.

Applies - H-43B

T.O. 1H-43B-538, 24 February, 1961
Modification of Tail Configuration on H-43B Helicopter.

T.O. 1H-43B-531, 6 January, 1961
Addition of Forward Facing Opening in Faring Assembly
Part No. K732502-5. H-43B Helicopter.

FIELD INFORMATION DIGESTS (KAMAN)

Applies - HOK-1 HUK-1

No. A-59, 24 February, 1961
Alignment of Cable Cutter Housing.

Applies - H-43B

No. B-35, 24 February, 1961
UHF Command Radio AN/ARC-34 Compliance of Correct Operating Procedures.

Applies - H-43A

No. C-7, 24 February, 1961
Alignment of Cable Cutter Housing.

SURVIVAL TRAINING at Minot Air Force Base, N. D., includes "rescue" by H-43B of "downed" pilots from 5th Fighter-Interceptor Squadron during intensive 60-hour training course on the methods and means of surviving under semi-artic conditions. Most of the morning on the third day is spent preparing signaling devices to attract fixed wing search aircraft from the base (L-20) and later the actual rescue helicopter. The helicopter section on the base, headed by Capt. Roy K. Baliles, is S&R headquarters for North Dakota. (USAF Photo)

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England AFB
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