Hattie Meyers Junkin Papers - Writings: "Let's Go to the Elmira Soaring Meet", US Air Service, 1931-08

Lightning Investigation as Applied to the Airplane

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In the following important paper by Mr. Austin, the references by number to several illustrations are permitted to remain, because of the value of the accompanying explanatory remarks, although it is not possible to reproduce all of the photographs shown, at Baltimore, when this noteworthy contribution to an interesting subject was read by the author before a meeting of the Society of Automotive Engineers. Mr. Austin is chief engineer of the Ohio Insulator Company, at Barberton, Ohio. - EDITOR's NOTE

WHILE the hazard to airplanes or any aircraft is very small compared to many everyday risks, this hazard receives much attention. Although lightning has caused a few fatalities, it would seem that many cases of trouble due to other causes have been unjustly charged to lightning. Once the effect of lightning upon the pilot or plane is recognized, steps can be taken to materially reduce if not eliminate the hazard, although this may be small at best.

The studies made in the high voltage laboratory of the Ohio Insulator Company for Ward T. Van Orman in testing out his protection for free balloonists, and the series of tests run on planes and other equipment furnished by Popular Mechanics, provide some rather interesting information. An attempt will be made to cover some of these studies briefly. Since the tests tin in connection with free balloons illustrate certain phases of the subject to better advantage than those upon airplanes, this matter will be treated first.

In running the series of tests balloon baskets, small size balloons, model airplanes as well as full size airplanes were placed between a large electrostatic condenser and ground on the test field. The condenser may be regarded as a charged cloud with a discharge taking place between this cloud and ground can be made to strike the equipment under test. Figure 1 shows a discharge taking place from this condenser to ground, the photograph being taken by a synchronized camera.

In general the hazards from lightning may be divided into two classes:

(a) Electrical or physical shock which may affect the pilot and passengers.

(b) Those hazards which damage the plane or aircraft.

It would seem that the hazard due to the direct electrical or physiological effect of lightning upon the pilot or passengers should receive first consideration, rather than the damage to the aircraft. Unfortunately it is very difficult to obtain information upon this point owing to the variation in the personal element itself, and the hazard of making studies in which may be exceedingly dangerous. It may be said, however, that as the size of aircraft increases, the direct danger to pilot or passengers tends to decrease providing ordinary precautions are taken in the design and construction of the aircraft. This is due to the greater distance of the crater of point of contact of the lightning from the pilot and passengers.

HAZARDS TO THE PLANE OR AIRCRAFT

These hazards may be classified as follows:

1. Fire hazard due to ignition of combustible material used in the construct of the plane.
2. Fire hazard due to ignition of explosive gases.
3. Weakening or destruction of metal or other parts due to current in the discharge.
4. Break-down of insulation in the ignition system.
5. Back-fire or pre-ignition.
6. Damage to instruments.

7. Damage to rotating parts due to passage of current.
8. Sudden change in pressure on adjacent surfaces.

ELECTRICAL OR PHYSIOLOGICAL SHOCK TO PILOT OR PASSENGERS

THE experience of free balloonists throws considerable light upon the hazard due to shock, and means of protection. The fatalities in Belgium and Pittsburgh of recent years caused Van Orman to give this matter considerable attention.

In the Pittsburgh race Van Orman's balloon was struck by lightning while at an altitude of 3,000 feet and set on fire, and Morton, who was with him in the basket, was killed by the stroke. The No. 26 R. C. A. portable loop radio set which between Van Orman and Morton appeared to be badly damaged. However, an investigation showed that the set was not damaged electrically. Van Orman was apparently conscious for a short time after the stroke. He then lost consciousness and apparently remained in a stunned or dazed condition for five or six hours after the parachuting balloon struck ground.

Wollam and Cooper in the City of Cleveland had a somewhat similar experience, the stroke of lightning apparently passing over the surface of Cooper's leather jacket or suit which was wet at the time. The shunt path provided by the suit apparently saved Cooper's life, although he was badly burned by the stroke. Wollam escaped uninjured and attempted to lift Cooper and his parachute out of the basket, but was unable to do so. Cooper apparently is the only known person to suffer a heavy direct stroke and still live to tell about it.

These incidents show that a stoke of lightning may be very close to a person without causing any serious injury. Had the pilots been subject to the same condition while flying an airplane, it is possible that they might have lost control of the plane causing it to crash.

Figure 2 shows the basket used on the City of Cleveland balloon which was struck while the balloon was at least 5,000 feet in the air. The photograph shows the basket with a dummy in place being subjected to an artificial lightning discharge. The steel cables from the ring to the basket were not bonded to the reinforcing wires which were used in making up the basket. It is possible that had bonding been carried out, the results might have been quite different. In the tests shown in Figure 2, the collapse of the electrostatic field caused an induced potential of over 25,000 volts between the dummy nand the lower part of the basket. While the energy is not large, the discharge might tend to frighten or startle one similar to a shock one receives in coming in contact with a metal object after picking up a charge in walking over a carpet in cold dry weather. Figure 3 shows the metal reinforcing wire fused due to the discharge of lightning. It will be noticed that the horizontal wire crossing the vertical wire has been burned in two, as well as some of the basket material. An examination of the based showed a large number of