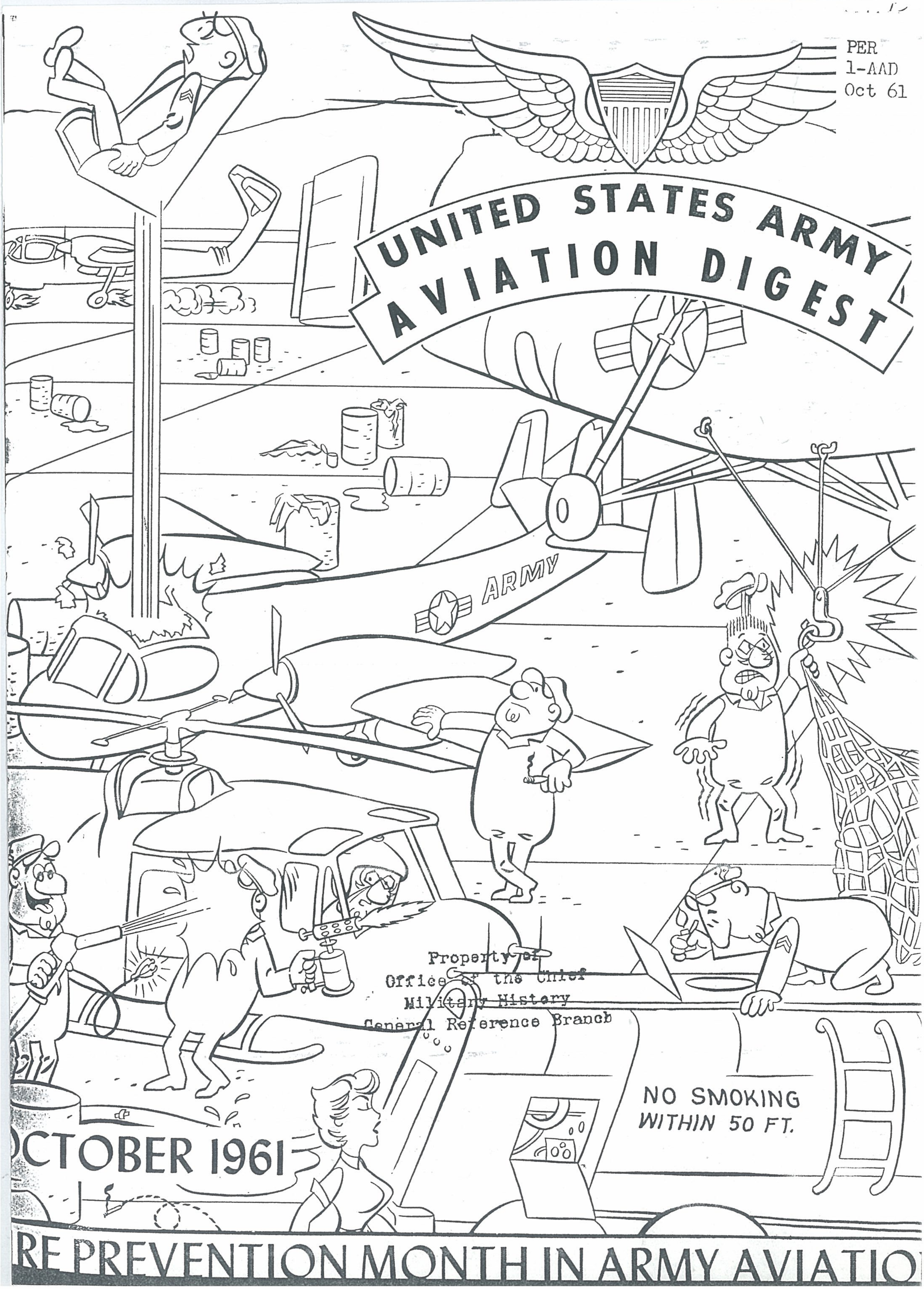
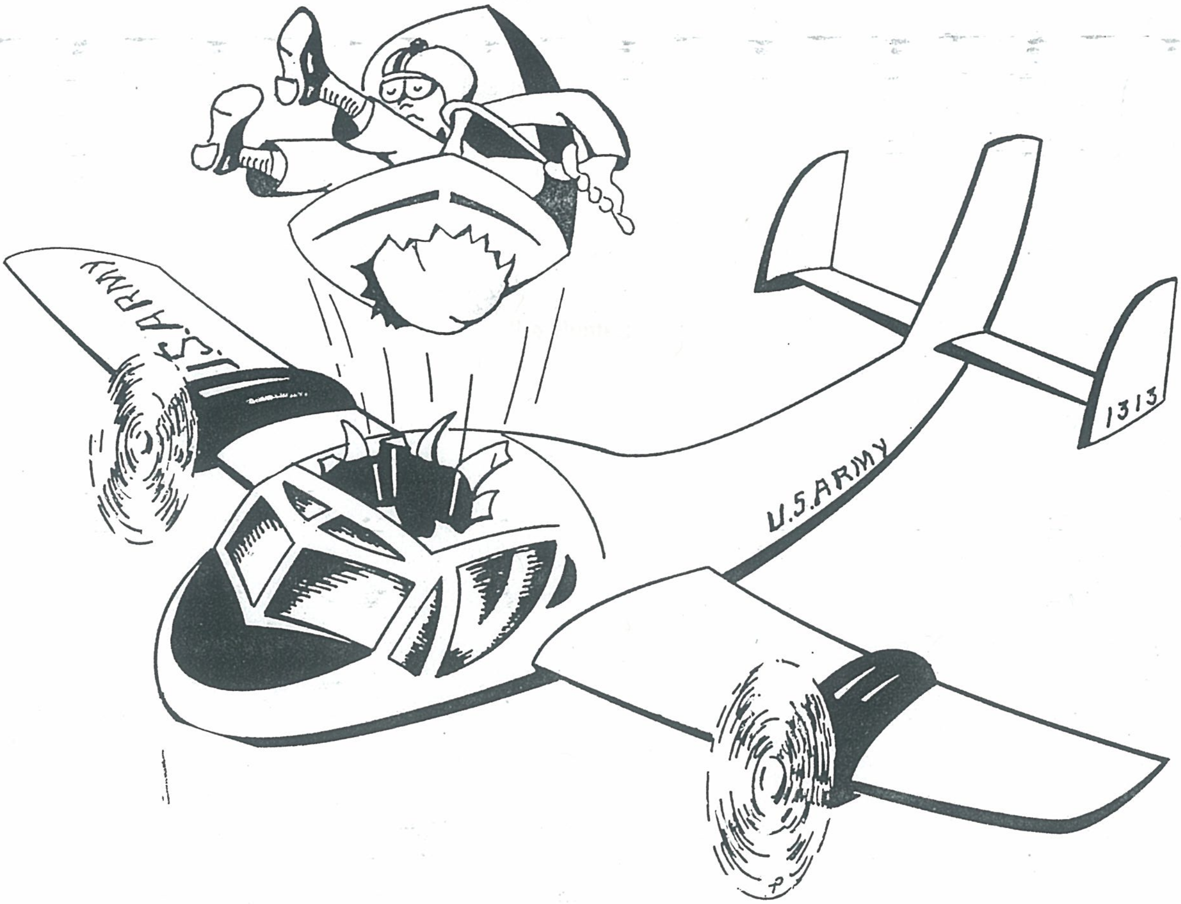
UNITED STATES ARMY AVIATION DIGEST



OCTOBER 1961

RE PREVENTION MONTH IN ARMY AVIATIO



The Mohawk's Martin-Baker Seat

Arthur M. Heiniman

WITH THE ADVENT of the AO-1-AF MOHAWK into the Army's inventory (DIGEST, Sep 1960), part of its equipment included the Martin-Baker ejection seat. The seat's arrival prompted an ambivalent reception. Comments ran good, bad, indifferent, comical, severe, concerned, and, last but not least, unbelieving. This article is devoted to the proponents of the latter.

Back in 1944, the British Air Ministry took heed of the increased difficulty experienced by their pilots in effecting normal over-the-side bailouts from that era's aircraft. Slipstream forces and adverse g conditions were growing greater than ever before in their Spitfire and Hurricane aircraft. Rapid development in fighter aircraft, especially jets, only promised an aggravated situation. Thus, the Ministry invited the Martin-Baker Aircraft Co. Ltd., to investigate the feasibility of an assisted escape system.

An initial design concept was prepared and a drawing submitted which presented a swinging arm mounted atop an aircraft fuselage (fig. 1). The aft end of the arm was attached and pivoted just forward of the fin and its forward end was provided with a U-shaped piece which engaged rings on the pilot's parachute harness. This swinging arm, actuated by a powerful spring, was intended to raise the pilot out of the cockpit and clear of the aircraft structure. Although

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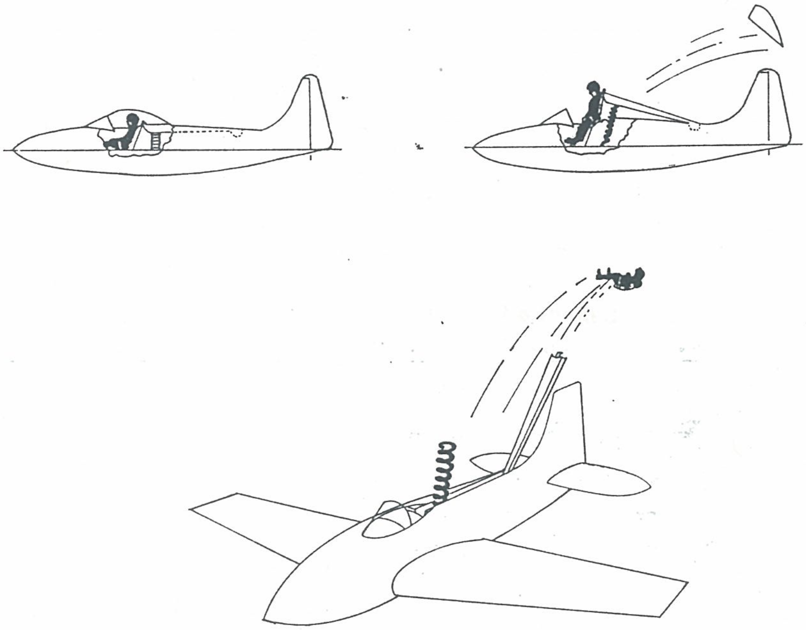


Figure 1

well received, this theory fell by the wayside when it became clear that the most attractive method of emergency egression would be forced ejection of the seat with the occupant still sitting in it.

The manufacturer began to explore areas of mechanical design and physiological reaction about which relatively little was known. Thousands of hours were devoted to development work and subsequent dummy firings on test rigs. Eventually a human spine and a cadaver were acquired for mechanical tests in order to more fully learn the effect ejections would have on the spinal region of the body. Conclusions reached were that the human body could withstand relatively high accelerations without physical injury, providing the spinal vertebrae were square to each other, that the peak accelerations were limited to about 26 g, and that the g came on relatively slowly. (These factors have now been universally accepted as design criteria for ejection seats.)

The first Martin-Baker ejection was made in July 1946, in England. It was a planned and completely successful ejection, executed from a Meteor aircraft at 8,000 feet and 278 kt. American interest was stimulated about this time and a test rig was erected at the Philadelphia Naval Yard. A Martin-Baker seat was also installed in the rear cockpit of an A-26. A series of dummy ejections from both rig and aircraft culminated in a successful live ejection in November 1946. Back in Britain the seat was further developed, successfully demonstrated, and put into production in 1947. The Meteor, Attacker, Wyvern, Canberra, and later the Sea Hawk and Venom aircraft were successfully outfitted.

During succeeding years the Martin-Baker seat underwent further transformation. The need arose for pilot protection during high altitude and high g ejections. The seat necessitated lightening for lighter aircraft and demanded a higher trajectory for higher tail surfaces. It was further realized that ejections around the world which were made at under 2,000-foot altitudes were all too unsuccessful. As a result ancillary equipments were added and refinements introduced out of which was born an automatic low-level ejection seat capable of runway ejections.

In August 1957, an RAF Flying Officer successfully ejected from a Grumman F9F-8T at the Patuxent River Naval Air Test Center, Patuxent River, Md. The ejection was made at 110 KIAS, zero foot altitude before a large group of Naval personnel and press representatives. This writer witnessed the ejection and was very favorably impressed. Others were equally impressed, for the Martin-Baker representative spent the following days measuring current Naval aircraft for possible installation of his product. (Between spots of tea he depicted the "illustrious tailor" as he went about his work with the tape, pad, pencil, and chalk he had so thoughtfully brought along.)

The Martin-Baker seat has since been fitted to nearly 20 types of American aircraft and is in service with aircraft in 35 nations throughout the world. Just under 400 successful ejections have been recorded over speed ranges up to Mach 1.7 at 40,000 feet and at altitudes from ground level to 56,000 feet.

This article is not intended as a thesis on Martin-Baker seats nor as a supplement for formal indoctrination. However, it is befitting to undertake a cursory description of the seat installed in today's Mohawk and its principle of operation.

As an occupant seats himself in the Mohawk, he will be wearing a B5 quick fit harness and will place a fabric garter around the calf of each leg (fig. 2 and 3). The garters will attach to two leg restraint cords by quick release fittings (fig. 2). Similar fittings (fig. 3) located about the shoulders will secure the occupant's quick fit harness to his personnel parachute and harness inertia reel (fig. 2), which are attached to the seat. Two vertical support straps (fig. 3), sewn to the quick fit harness, will be slipped over the male lap bolt fitting (fig. 3) and the conventional lap belt will be fastened.

With the occupant so restrained, he can lock or unlock his inertia reel using a lever on the left side of the seat bucket (fig. 5). His seat can be raised or lowered by actuating a toggle switch (fig. 4) located on the right side of the seat bucket. Forward of the seat position switch is a yellow and black stripped knob (figs. 2 and 4, manual override lever) which, when moved up and aft, will release the pilot from the seat with his parachute and seat pad. Provided are the usual microphone and oxygen pickups and the traditional "green apple" (fig. 4) for actuating the emergency oxygen bottle (fig. 4).

A normal ejection is accomplished by pulling the face blind (fig. 6 and 7) by the handle located directly over the pilot's head (fig. 5). An alternate or secondary handle (fig. 2 and 3) is located between the pilot's legs on the forward portion of the seat pan. This alternate handle is provided in the event the occupant cannot raise his arms under excessive g conditions. Both handles are yellow and black striped and each is equipped with a ground safety lock (fig. 3 and 4) which is readily accessible to the occupant.

Each handle is capable of firing the seat. When either is pulled, a sear is extracted from the firing pin for the primary cartridge in the ejection gun. Once the primary cartridge is fired, the seat starts its ascent. As the seat initially moves upward, two auxiliary cartridges attached to the side of the ejection gun are uncovered and flame fired, adding to the propellant force. As the seat rises, the occupant's legs are drawn against the seat bucket and restrained by the leg restraint cords to prevent flailing as the seat leaves the aircraft.

The trajectory of the occupant will be 60 to 80 feet. (It is likely that the heavier indi-

Figure 2

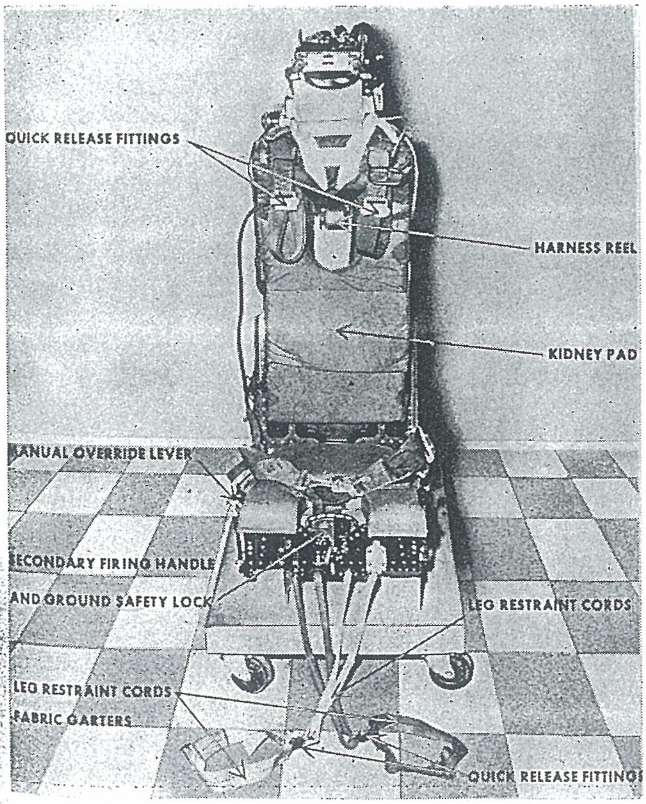
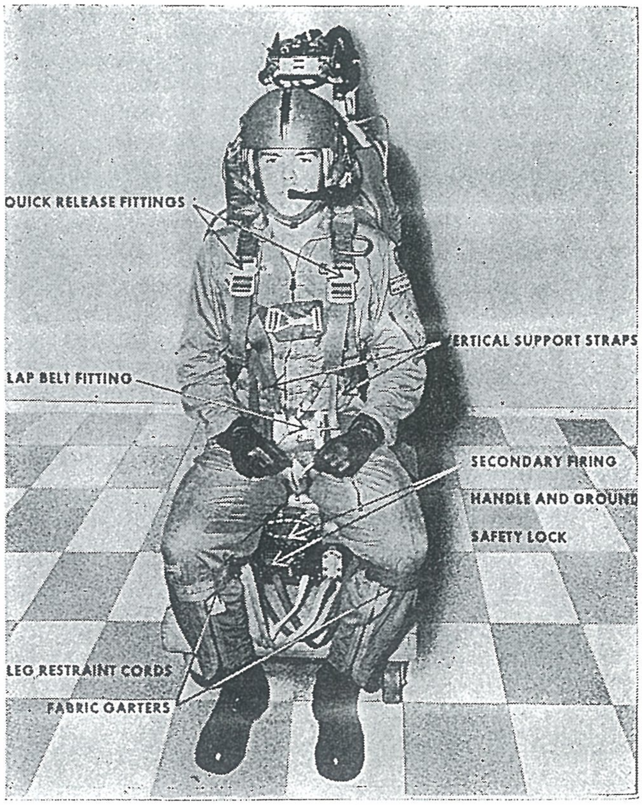


Figure 3



vidual will experience a lower apogee.) The average ejection gun velocity is approximately 83 fps, and the average g force imposed on the individual is approximately 16 g's. (The highest g loading encountered during Mohawk tests was 21 g's. This was imposed on a 5 percentile or very light dummy.)

As the seat leaves the aircraft a trip rod will pull a sear from a drogue gun (fig. 5) and from a time release mechanism (fig. 4) mounted to the seat. The drogue gun fires one half second after its sear is extracted and thus propels a piston or slug which withdraws a 22-inch controller chute by means of a connecting line. The controller chute in turn unfolds a 5-foot stabilizer chute which terminates at a shackle held in a restraining scissor at the top of the seat. The occupant in his seat is thus stabilized and decelerated in preparation for the deployment of his personnel parachute and subsequent separation from the seat.

The time release mechanism, triggered at the same time as the drogue gun, is delayed 1½ seconds, at which time the movement of its two plungers—

- Allows the drogue chutes to extract the **24-foot personnel parachute** (fig. 4) by opening the scissor at the top of the seat.
- Releases the occupant's harness and lap belt from their seat attachment points.
- Frees the leg restraint cords from their sockets.
- Releases the face blind, preventing the occupant, whose hands might be "frozen" to it, from dragging the seat behind him.

Temporary restraint for the occupant in the seat is maintained after the harness and lap belt is unlocked from the seat by two spring loaded sticker clips. This prevents collision with the seat during the separation process, and ensures positive separation of the occupant from the seat when the "jolt" of the personnel parachute occurs. Once the personnel parachute blossoms and a clean separation is made from the seat, the rate of descent is 23 fps and a normal parachute ground contact can be expected.

In the case of a zero feet altitude ejection at 100 KIAS, the elapsed time from curtain pull to ground contact is approximately 5 seconds.

Figure 4

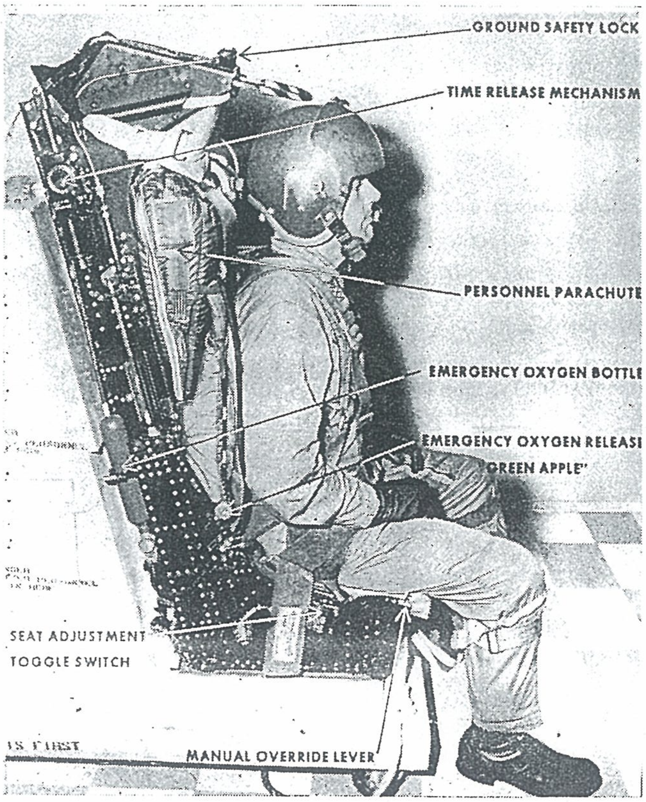
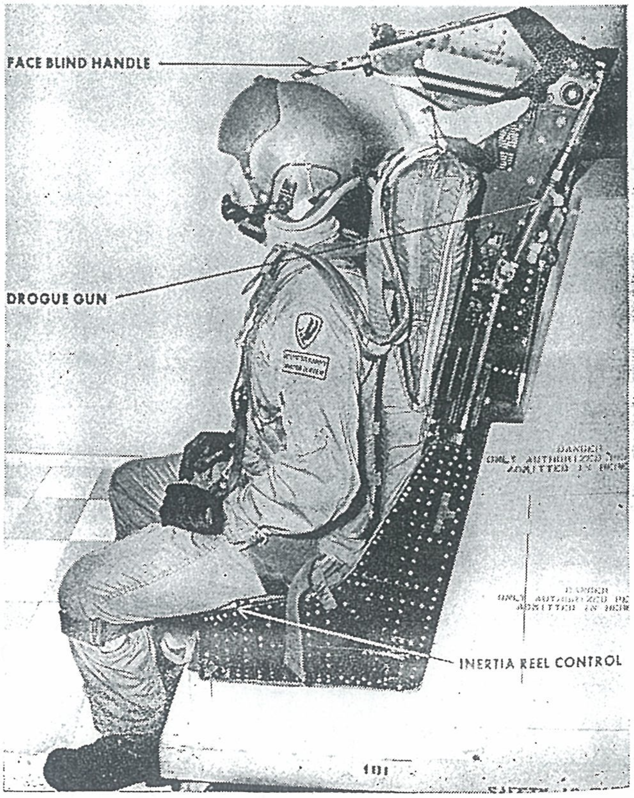


Figure 5



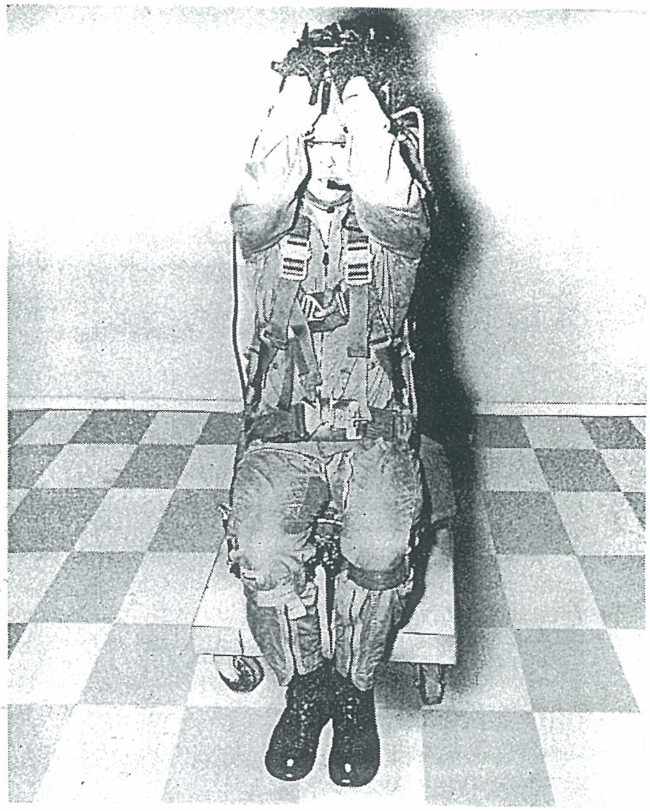


Figure 6

Figure 7

If an ejection is executed above 15,000 feet, or when a force of four g's or more is acting upward and parallel to the main vertical axis of the seat, the time release will be delayed allowing the occupant to remain attached to the seat and stalling the deployment of the personnel parachute. This will assure a rapid stabilized descent to approximately 15,000 feet in the event of high altitude ejection and will preclude damage to the personnel parachute and harness should high velocities be encountered during ejection.

It is difficult to anticipate queries regarding the Martin-Baker seat, but there is one subject to which Mohawk pilots refer most often. It is that of discomfort derived during and lingering after long flights. This discomfort appears more pronounced in the lower, forward portion of the occupant's pelvic promontory. In defense of the cushioning of the Martin-Baker seat, if the seat were any softer it would greatly deteriorate the chances of an ejectee escaping spinal injury. Physiologists have been and are now working towards an improvement in the comfort aspect of the seat. The introduction of an adjustable kidney pad (fig. 2) is their latest contribution.

The betterment of the Martin-Baker seat continues. The feasibility of a 0/0 capability is currently being explored in the form of a rocket equipped ejection gun which would accept the present configuration of Martin-Baker seats. Some American manufactured seats already employ rocket features, and these seats are constantly being improved.

With VTOL aircraft on the horizon and as nap of the earth techniques gain proximity to the earth, more and more Army Aviators must become keenly inquisitive about their cockpit environments. The improved mission capability of the Mohawk and its successors can only be enhanced by the survival equipment installed.

In closing, we would suggest that those anticipating flying in the Mohawk know their seat well. If you ever have cause to eject, the statistics bear out that a precise documentation of the ejection should be compiled and a "thank you" note sent to the manufacturer. **Most important,** both papers would be autobiographical. ☐