FIG. 1. 70-mm camera and mount with accessories.

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# Aerial Camera Mount for 70-mm Stereo

**The equipment and operating procedures are straight forward for an economical system.**

*(Abstract on page 580)*

## INTRODUCTION

THERE ARE many applications where 70 mm aerial photography may be economically and operationally advantageous. Testing film and filter combinations and photographing relatively small areas are two examples. All of the standard black-and-white and color aerial films are available in the 70-mm format. This article describes a camera mount, accessories, and procedure whereby high-quality aerial stereophotos can be obtained after a little practice.

Previous articles (Ulliman and others, 1970, and Marlar and Rinker, 1967) described mounts for assembling four 70-mm cameras for multispectral aerial photography. A single camera is adequate for many purposes and much less expensive. By using interchangeable magazines and repeating a flight line, film and filter combinations may be evaluated almost as effectively as with a multiple-camera setup. Our single-camera mount is rugged, compact and versatile, having been used in several different aircraft in numerous locations.

The mount was designed and built at Chevron Oil Field Research Company by my colleagues C. C. Koopmans, G. R. Porter, and F. E. Sleep.

## EQUIPMENT

### CAMERA

We use the Hasselblad 500 EL electric camera with a 90° prism viewfinder extension (Figure 1) which enables us to use the reflex viewfinder for a drift sight and to de-

ABSTRACT: *For many applications which do not involve large survey areas, 70-mm aerial stereophotography is valuable. Specifications are given for a rugged and versatile camera mount which provides leveling and aircraft crab adjustments. A reticle is described that converts the camera reflex viewfinder for two purposes: (1) a drift sight to correct for aircraft crab and (2) an intervalometer to determine time between exposures for correct overlap of successive frames. This equipment has been used to produce mosaics of areas as large as 100 square miles.*

termine intervals between exposures as described in the section on "Operation." The 50-mm lens with 70° field of view has been most useful for our work. One important note of caution is that the camera focusing ring does not lock at the infinity position and will rotate to other positions due to aircraft vibration. A piece of adhesive tape on the focusing ring will secure it in the infinity position.

CAMERA MOUNT

The camera mount illustrated on Figure 1 was designed and fabricated at Chevron Oil Field Research Company. It is rugged and versatile, having been used in a Cessna 206, Pilatus Porter, De Haviland Turbo Beaver and Twin Otter. Engineering scale drawings are shown on Figures 2 and 3. The fixed lower ring has three adjustable legs fitted with shock mounts for attachment to the aircraft floor over the camera port. The legs are pivoted so they can be adjusted to span ports of different diameters. The camera is attached to the upper ring which may be rotated 90°. The two rings are separated by Teflon washers on the three bolts that fasten them together and are secured by wing nuts for fast adjustments. The rings are made of ¼-inch aluminum plate. A bracket on the upper ring is attached to the mounting shoe of the camera with a bolt. A light metal strap around the viewfinder housing provides additional camera stability. Felt pads at points of contact on the upper ring prevent scratching

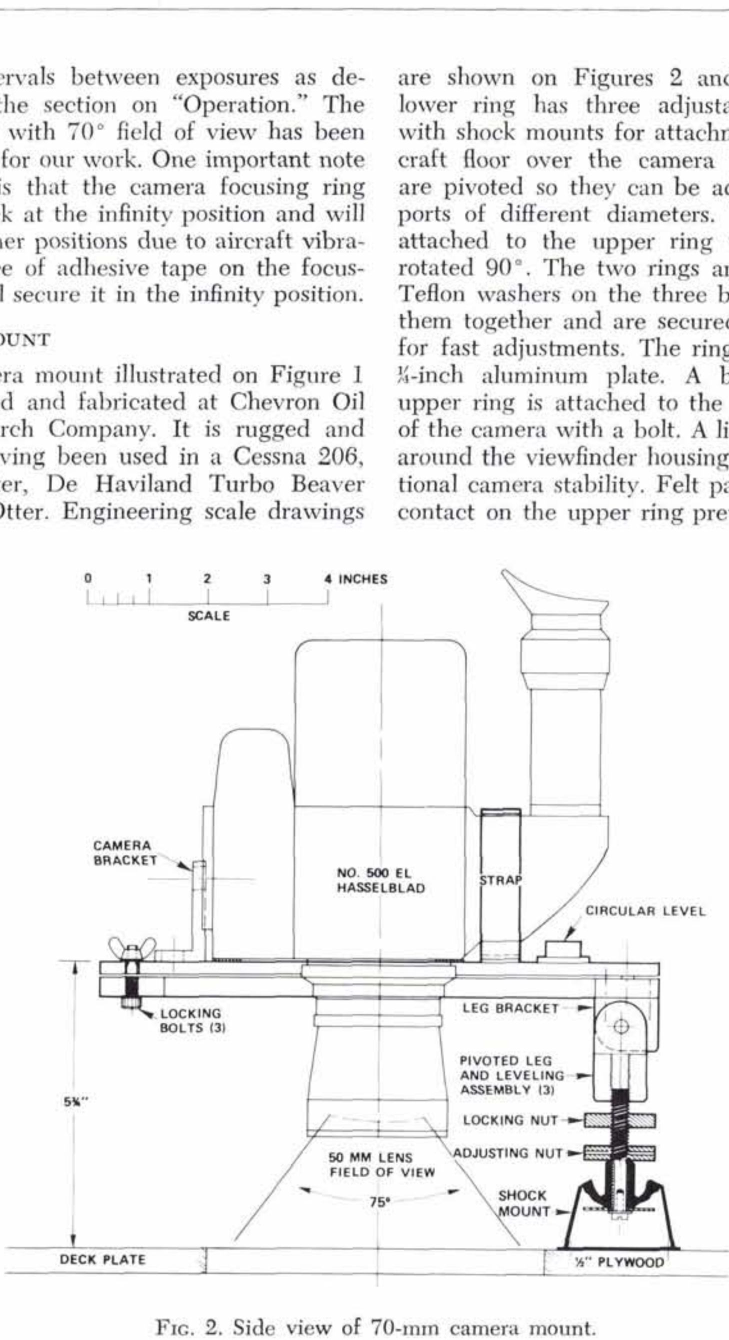


FIG. 2. Side view of 70-mm camera mount.

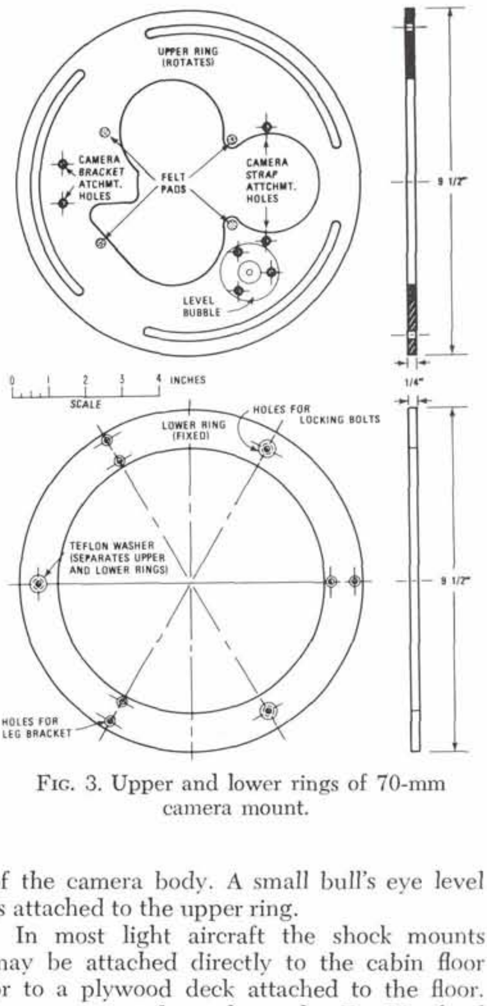


FIG. 3. Upper and lower rings of 70-mm camera mount.

of the camera body. A small bull's eye level is attached to the upper ring.

In most light aircraft the shock mounts may be attached directly to the cabin floor or to a plywood deck attached to the floor. In some aircraft, such as the De Haviland Turbo Beaver and Twin Otter, the camera well is 18 inches deep between the floor and outer skin causing vignetting if the camera with wide-angle 50-mm lens is mounted on the cabin floor. This is corrected by installing a plywood subfloor near the bottom of the camera well to which the camera mount is attached.

### ACCESSORIES

The standard Hasselblad timer (Figure 1) is used to time the interval between exposures and trigger the camera to obtain correct overlap of successive frames. The timer automatically repeats the cycle. The camera has self-contained batteries, but the timer requires an external source of 110 volt AC power. This can be supplied by an inverter using the aircraft 28 volt DC power or a self-contained battery and inverter combination illustrated on Figure 1.

In some aircraft the camera installation is such that the counter on the film magazine is difficult to see. The auxiliary film counter (Figure 1) was designed and built at Chevron Oil Field Research. It plugs into the accessory outlet on the timer and triggers with each cycle of the timer.

Film exposures are determined with the Honeywell Pentax spot meter. The Kodak aerial exposure computer (Sorem, 1967) is a useful check on the exposure. We have also found it useful for advance planning in high latitudes at seasons when solar elevation is marginal for photography.

## OPERATION

For stereoscopic viewing and mosaic construction, air photos must have the proper overlap (normally 60 percent) and be free of noticeable aircraft crab (yaw). This section describes our approach to these objectives using the equipment already described.

### AUXILIARY CAMERA RETICLE

The through-the-lens camera viewfinder is used for two purposes:

1. As a drift sight to correct for aircraft crab.
2. To determine the interval between exposures for correct overlap of successive frames.

These functions are accomplished with an auxiliary reticle printed on clear plastic film and installed over the ground glass of the viewfinder. If viewed through the prism telescope, the reticle is superposed on the terrain scene. As shown on Figure 4, the reticle is 55 mm by 55 mm which is the frame format of the photographs and the size of the ground glass. For drift correction, lines are provided parallel with the flight direction which are

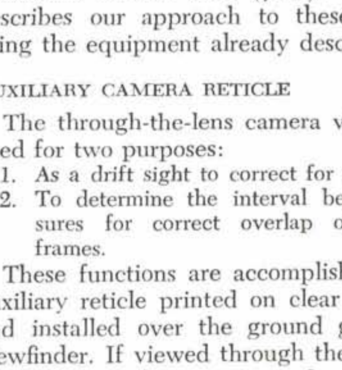


FIG. 4. Reticle for exposure interval and drift correction. Install over viewfinder groundglass with drift lines parallel with flight direction.

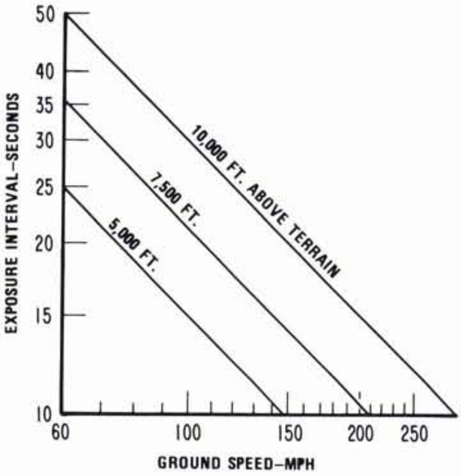


FIG. 5. Chart for determining exposure intervals to obtain 60-percent overlap.

called *drift lines.* For determining 60-percent frame overlap, two parallel lines 22 mm apart (55 mm × 0.4 = 22 mm) are drawn at right angles to the flight direction and are called *interval lines.* The interval lines can be spaced for any desired overlap.

### PROCEDURE

Once the aircraft is at the photographic altitude, final adjustments are made on the camera-mount legs to center the level bubble. Based on the flight elevation above terrain and estimated ground speed, the chart on Figure 5 is used to obtain an approximate interval between exposures which is entered on the timer. This time is checked by the interval lines on the reticle in the following manner. As the camera goes through the exposure cycle the reticle field of view is dark for an instant. When it is again illuminated the operator spots a terrain feature along the upper interval line. When this feature reaches the lower interval line the camera should cycle again. If the cycle occurs early or late the timer interval is increased or decreased. Within a few frames the exact interval is correctly established. If a timer is not available, the camera may be manually cycled, but this requires the operator to monitor the viewfinder continually.

Correction for aircraft crab is made by tracking a terrain feature as it passes from top to bottom of the reticle and rotating the mount so that the drift lines are parallel with this track direction.

### EXAMPLE

Figure 6 is a mosaic of part of the Coachella Valley, California, north of Palm Springs, flown with the camera and equipment described in this report. The photographs were obtained from a Cessna 206 in May 1969. A pronounced turbulence and winds aloft were caused by a strong flow of coastal air through nearby San Gorgonio Pass. Although these were not good flying conditions, they were ideal for demonstrating the capability of the 70-mm system. Good picture orientation and consistent overlap were maintained throughout the seven flight lines. The altitude was 7,500 ft. above terrain producing a negative scale of 1:45,000 with the 50-mm lens. The overlap was 60 percent, but only alternate photos were used to compile the mosaic of Figure 6.

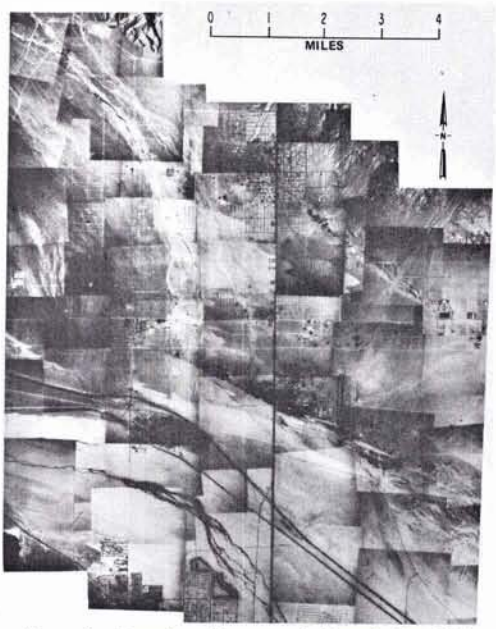


FIG. 6. Mosaic of part of Coachella Valley, California, photographed with 70-mm camera and equipment described in this article.

### REFERENCES

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