

THE FAIRCHILD CARTOGRAPHIC CAMERA

By G. J. Podeyn, Jr.

AS THE techniques of aerial photographic surveying have improved, the demands for more precise cameras have increased. To meet these increasing demands for precision mapping cameras, Fairchild has designed the "Cartographic Camera" which meets the specifications for precise mapping as set up by the U. S. Department of Agriculture, the U. S. Geological Survey and other mapping agencies. Although built to the most exacting specifications, this new camera also incorporates every practical consideration for efficiency, ease of operation and convenience. The requirements of commercial aerial photographic contractors and military mapping agencies dictate the need for ruggedness and simplicity. To accomplish this rugged simplicity in design, many war time developments and lessons have been applied to advantage.

The evolution of precise mapping cameras began many years ago and the first Fairchild camera of this type was released from the shops in 1938. This was the F-51 photogrammetric camera. As the first of the F-51 cameras was being released to the market, a new design was already in the early stages of development. This was the T-5 camera which was delivered to the Army Air Forces and the U. S. Engineers during 1942. Both the F-51 camera and the T-5 camera are still in use and are giving excellent service. However, intense use during the recent war indicated many improvements in the fundamental concept of design for such a camera. To give the benefits of this experience to photogrammetrists and survey contractors, the Cartographic camera is offered. The basic design premise followed was "a satisfactory precision camera can and must be easy to service and have a minimum of gadgets." Other precision cameras manufactured by foreign and domestic designers including ourselves have attempted to record such information as the horizons, the altitude, the precise time, and other odd bits of information the designer "thought" were needed by photogrammetrists. During the war it became very apparent that precision photography is of paramount importance and that these bits of information were of doubtful value. The complexities they added to the camera design and maintenance were costly frills. The new Fairchild Cartographic camera purposely stresses the good photography desired for best operation of the multiplex aero projector. Design and manufacturing methods assure a high degree of accuracy which is opening new possibilities for the most exacting photogrammetrist.

The general designation, "Cartographic Camera," really covers cameras of three focal lengths. The three focal lengths available are 5.2", 6" and 8 $\frac{1}{4}$ " and this range is provided in order to cover the needs for topographic and planimetric maps needed in crop control, soil conservation, flood control, geological exploration, highway expansion, municipal and rural improvements, coastal defense, and other wide spread aerial mapping programs. A more specific description of the camera elements will, perhaps, best illustrate how reliable precision and simplicity have been accomplished.

GENERAL DESCRIPTION

The camera consists of outer and inner cones and interchangeable magazine. The design provides for fully automatic electric operation or for manual control, whichever the mapping project should dictate. The film drive is contained in the magazine and is supplied with power by a motor in the outer cone. The lens is mounted in the same frame which carries the focal plane and the front and rear elements are bolted to this inner cone in seats which are accurately machined

to guarantee precise alignment of front and rear elements at the best separation for optimum optical performance. The inner cone is symmetrically shaped in order to provide equal expansion of the specially heat treated alloy from which the cone is cast. Great care was taken with this portion of the design in order to maintain collimation accuracy over a wide temperature range (minus 40° F. to plus 120° F.). The whole inner cone assembly with lenses in place is a unit. This unit can be removed or installed without in any way affecting the accuracy of collimation, since the entire accuracy is concentrated in this one section of

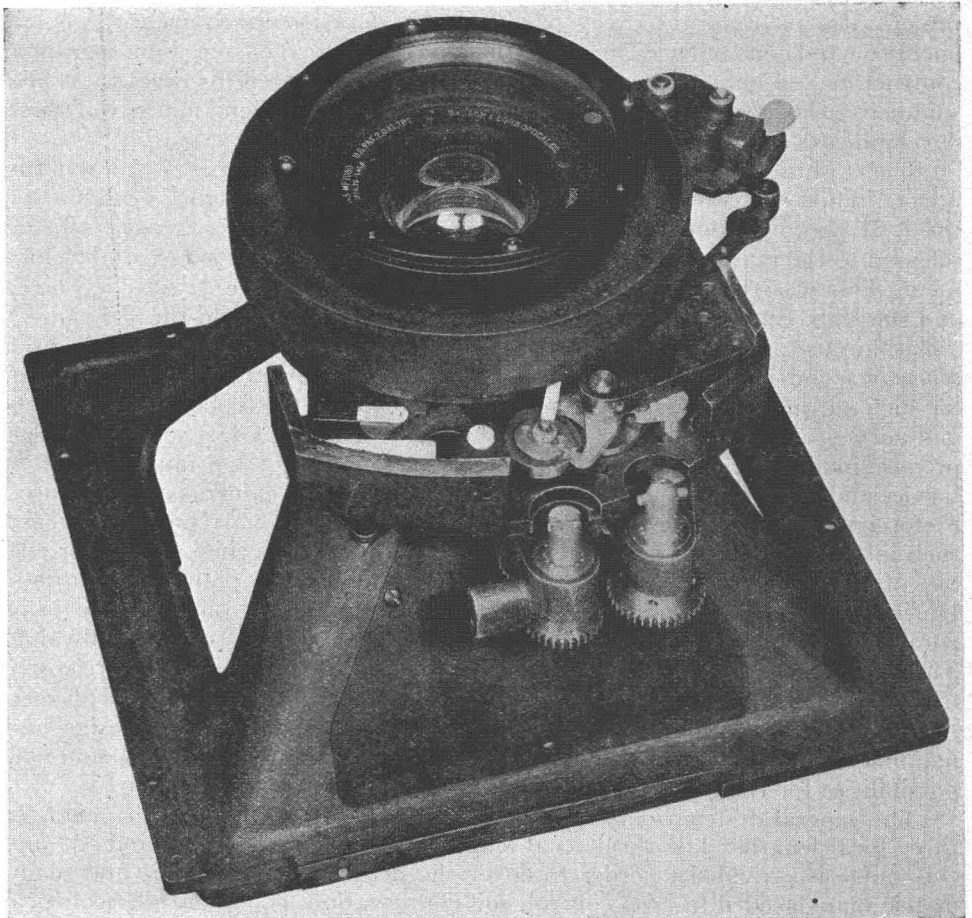


FIG. 1. The inner Cone of the Cartographic Camera, showing shutter and lens mounted in place. The Inner Cone maintains an accurate relationship between the lens and the focal plane.

the camera. This inner cone is designed so it can be easily collimated by the Bureau of Standards in their equipment or any similar equipment designed for calibrating the optical system of a camera. To simplify the problem for measuring agencies, provision is made for locating-pins. These are used in mounting the glass plates used during collimation. The controls, stop watch and levelling bubbles are concentrated along the operator's side of the camera for convenience.

ACCURACY

Collimation accuracy of this camera is as follows. Fiducial marks form an angle of intersection within the focal plane which is 90° plus or minus one

minute of arc and the focal plane platen is flat within .0005." Fiducial marks indicate the principal point within plus or minus .00025". Fiducial mark designs are of the type approved by Government mapping agencies and one large fiducial mark indicates the direction of flight. The lens quality equals or exceeds the requirements of all Government agencies for focal length, distortion, and resolution.

SERVICING

Of the greatest importance for commercial survey contractors, is the easy servicing of this camera. In order to service between the lens shutter, for

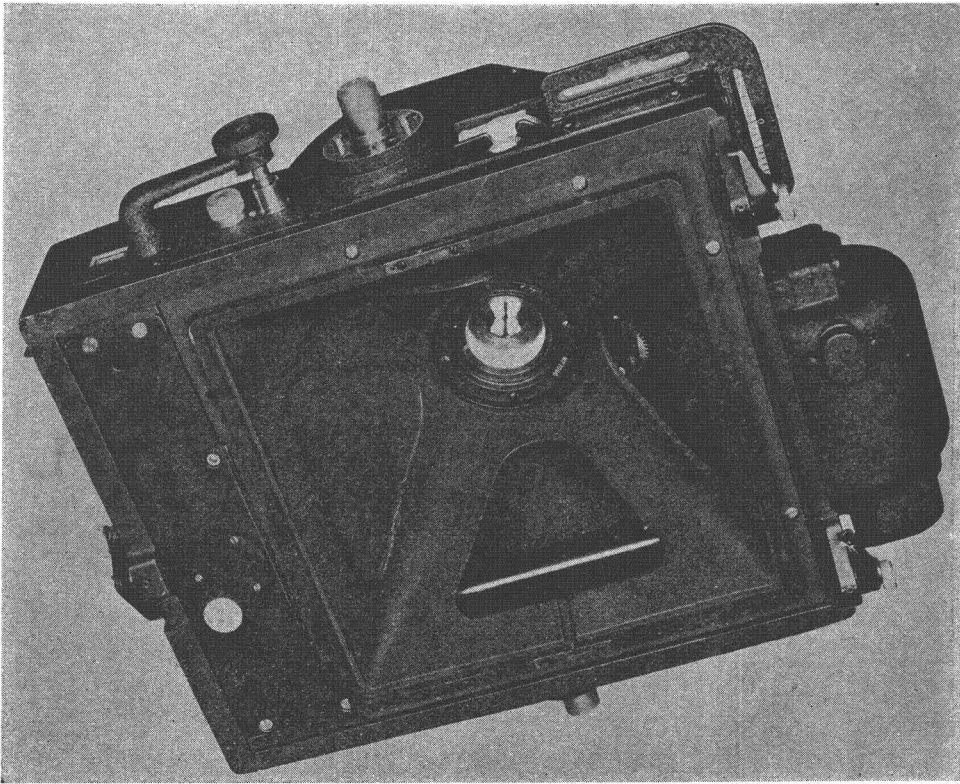


FIG. 2. The Cartographic Camera with the magazine removed, looking down into the inner cone. Note the four fiducial marks which are doweled in place.

example, the inner cone may be removed and both lens elements detached from the inner cone without jeopardizing the calibrated focal length or the indication of the principal point. Access panels are provided in the side of the outer cone for lubrication and adjustment of shutter speed and diaphragm controls. The case drive mechanism is easily removed by means of a separate plate which forms a portion of the upper wall of the outer cone. Mechanism parts are fully interchangeable between cameras.

LENSES

Individual cameras are provided for each focal length and the following lenses are offered:

Bausch and Lomb, *f*6.3 metrogon of 5.2" focal length.

Bausch and Lomb, *f*6.3 metrogon lens of 6" focal length.

Goerz aerotar *f*6.8 lens of 8½" focal length.

SHUTTER

The shutter is a Fairchild high efficiency between the lens type shutter which can be operated at 1/100 second, 1/200 second, and 1/300 second. At the two slower speeds the accuracy is plus or minus 15% of the placarded speed and at 1/300 of a second it is accurate within plus or minus 10%. The efficiency of the shutter at 1/100 second is approximately 85%, at 1/200 approximately 71%, and at 1/300 approximately 70%.

FOCAL PLANE

The focal plane surface is machined to establish the best conditions for resolution for each particular lens. The fiducial marks are fastened to this focal

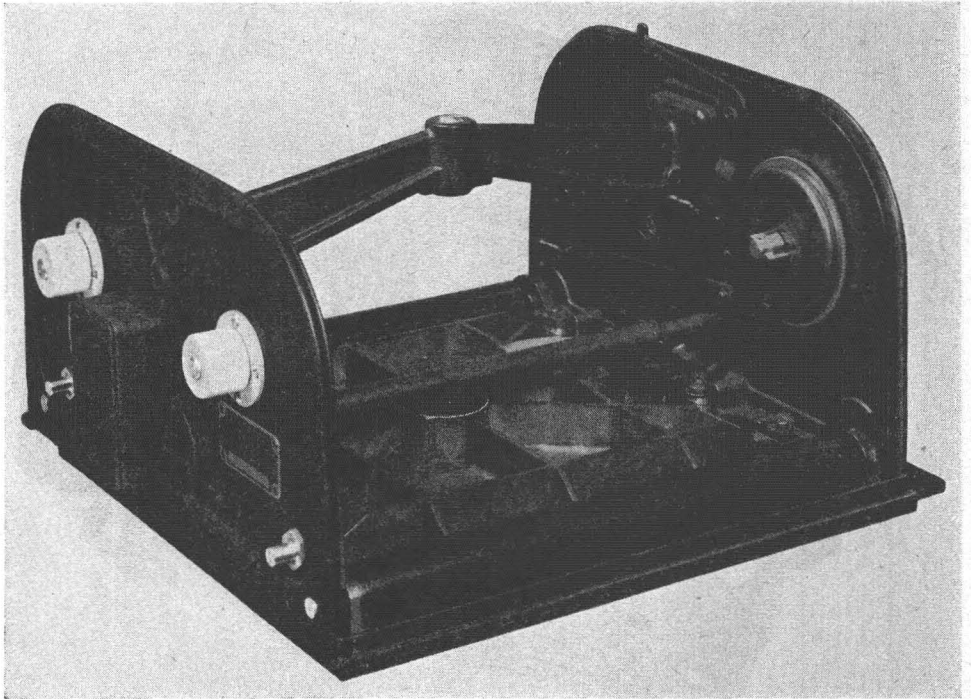


FIG. 3. The magazine of the Cartographic Camera with cover removed. Note the heavy ribbing of the pressure plate which prevents even slight warpage. The magazine has a capacity for 250 9"×9" exposures.

plane and can be individually adjusted by means of a special type of fine tangent screw which has been designed to aid in the original adjustment of these fiducial marks. This tool is used only for adjustment and is then removed before the unit is assembled into the camera. After the principal point is established, the fiducial marks are then dowelled in place. Once set the relationships will change only if the camera is destroyed. No change is ever necessary.

MAGAZINE

The magazines for use with Cartographic cameras are fully interchangeable regardless of the focal length of the camera, and a newly developed focal plane platen utilizes very deep ribs to maintain perfect flatness of the focal plane. Without these ribs, the pressure applied to the platen would cause a

bending of the plate and such a deflection, even though minute, would cause a serious error in a precision camera. The film is positioned by the inner cone although the platen in the magazine acts as the focal plane. Magazines are clamped on the cameras and are positioned by means of a specially machined seating surface. A cover is provided to protect the surface of the platen when the magazine is not attached to the camera. Vacuum is used to flatten the film and this need only be $2\frac{1}{2}$ " of mercury due to new valving and vacuum back designs.

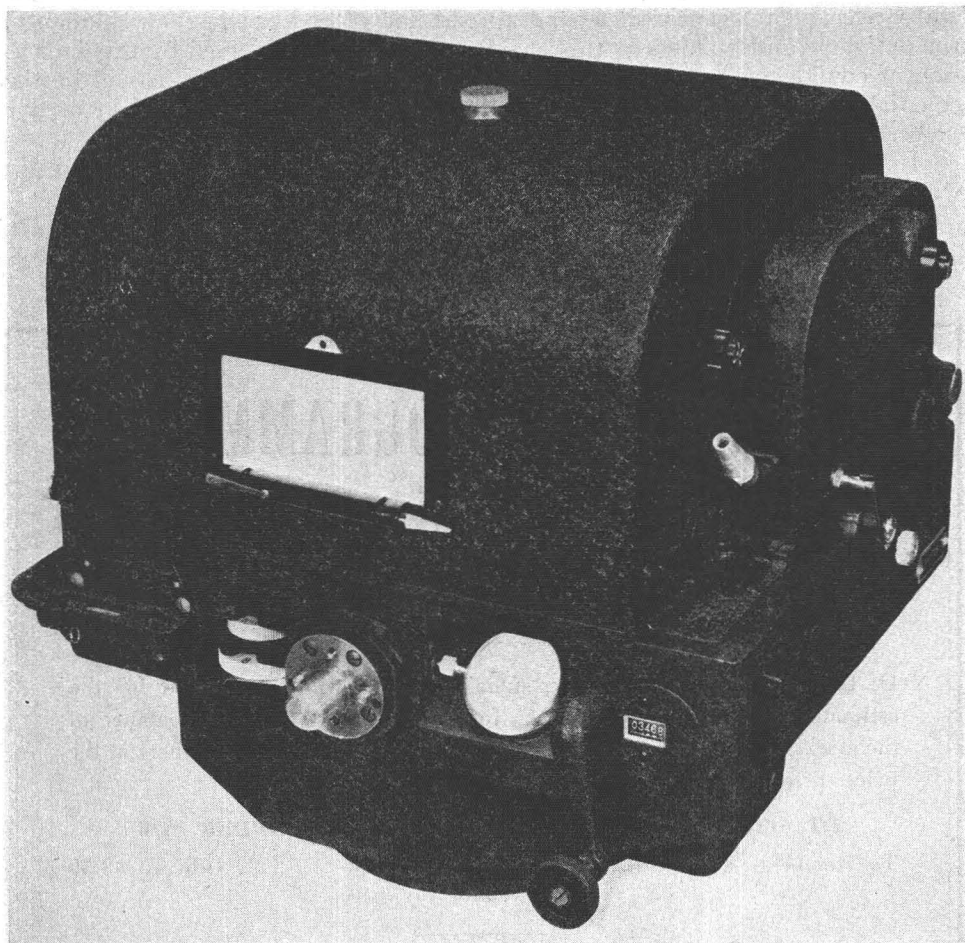


FIG. 4. The Cartographic Camera.

WEIGHT

Fully loaded the weight is 58 pounds without mount.

CAMERA MOUNT

A new camera mount has been especially designed for the Cartographic camera. This design exactly matches the weight and vibration characteristics of this camera and will therefore guarantee unusual stability. Very easy adjustment and leveling are accomplished through a simple set of hand wheel controls.

FILM

Standard $9\frac{1}{2}$ " wide film is used and the negative size is $9" \times 9"$, free and clear, with the fiducial marks indicated but appearing outside of this $9" \times 9"$ area. A maximum load is 200 lineal feet which will produce approximately 250 exposures since the film is metered through the camera at a rate of $9\frac{1}{2}$ " plus or minus $\frac{1}{4}$ of an inch.

The Cartographic camera represents painstaking effort and the culmination of nearly thirty years of experience and striving to produce the finest aerial mapping equipment. Before the designs were completed, several contractors and Government agencies here and abroad had placed orders. Very humanly, the designers and builders of this new instrument were gratified by this indication of confidence and esteem. However, they know that great as will be the contribution of this camera, others even finer will be available in four or five years.

Improvement is perpetual and a long range development program, already well started, will meet this challenge.

MANUAL OF PHOTOGRAMMETRY

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