THE FAIRCHILD CAMERA TRANSIT (*)

SPECIFICATIONS

The Fairchild Camera Transit consists of a Type 5078-E 30-second reading Keuffel & Esser surveyor's transit which has been reworked by the Fairchild Camera and Instrument Corporation to carry a specially designed and built camera (fig. 1 and 2). To provide sufficient mounting space for the camera, the telescope and standards are removed from the transit, and a wide aluminium base plate fitted around the base of the compass box and fastened to the upper limb of the transit. This new plate permits the standards to be separated so that the camera can be mounted between them on the axis normally occupied by the telescope. The telescope itself is mounted on the top of the camera with the optical axis parallel with the optical axis of the camera. In this form, the transit can still be used in the majority of cases for the same purposes that it would ordinarily be used if the camera were not involved.

The camera is made of such materials that the needle of the compass will be unaffected, and is equipped with a very high quality 8-1/4" Goerz aerotar lens, having an f/6.9 aperture. This lens gives exceptionally sharp photographic resolution and is remarkably free from lens distortion which could be a source of error if not carefully controlled.

The Fairchild Camera Transit, like many precision mapping cameras, contains fiducial marks in the focal plane, adjusted to locate the principal point of the photograph within the specified accuracy. These are the reference marks from which all measurements are made in the course of the mapping from the photographic information. A level bubble within the camera is photographed on each negative, as a check to indicate whether the transit was leveled properly at the time each photograph was taken. A counter is also registered on the film to simplify identifying any one of the 12 photographs taken at a given station. The station number and the focal length of the camera are also recorded on each photograph.

The angle of view is such that in taking 12 exposures at 30° interval the entire 360° of the horizon can be covered with .2 inch overlap on all negatives.

The complete transit camera has a carrying case, and a carrying case for the plate holders.

Lens : 8-1/4 inch f/6.8 Goerz Aerotar ; Diaphragm adjustment : f/6.8 to f/32 ; Shutter: between-the-lens; Shutter speeds: 1/50, 1/25, 1/10, 1/5, 1/2 sec., time and bulb; Negative Size : 4 by 5 inches (glass plates); Weight : 28 lbs (12.7 kgs); Weight with carrying case : 47 lbs (21.3 kgs); Operation : manual.

Accessories.— Carrying Case for Camera Transit, filters, plumb bob, etc. ; Filters : red, yellow, minus blue; Plate Holder Box, with seven glass plate holders.

The photographs are taken on glass plates in order to preserve the images from any possible error which might ordinarily be caused by the shrinkage of ordinary film in the course of developing, or as a result of change in temperature or humidity.

OPERATION

In order to load the camera the rear door should be in an open position as shown in fig. 2. The plate holder should be placed so that the fiducial marks will set directly on the dark slide. Then the door should be closed and the knurled screw should be tightened to prevent any movement. Next the dark slide nearest the lens should be removed. The proper filter should be selected and screwed in. Also the diaphragm and speed settings should be adjusted as can be seen in fig. 1. The transit should then be brought into a level position by adjusting the four knurled thumb screws on the base of the transit. Now, if horizontal pictures are desired, the camera should be adjusted about its trunnion so that the level on top of the camera is in a zero position. Now the camera is ready for taking a picture.

This is done by means of the cable release shown in fig. 1. In order to reinsert the dark slide a small crank arm should be turned so as to raise the plate holder a slight amount.

(*) Manufactured by the Fairchild Camera and Instrument Corporation, 88-06 Van Wyck Boulevard, Jamaica, 1, N. Y.

Now the dark slide should be inserted and at the same time a button should be depressed to permit the full insertion of the dark slide. At this point the rear door may be opened and plate holder reversed to make use of the second plate and the same operation as stated before repeated.

MAINTENANCE

A spare shutter is supplied with each camera in case the one in the camera should become inoperative. In order to remove the shutter from the camera, the three screws shown in fig. 1, should be removed. This enables one to remove the housing which contains the front element of the lens. Now the shutter can be removed from its mount simply by unscrewing it in a counter-clock-wise direction and the new shutter can now be put in place. This same procedure with the exception of removing the shutter may be necessary to clean the lens occasionally.

An occasional check on the levels should be made with respect to the levels on the transit. If there is an error in these this can be easily corrected by the adjusting of nuts. An occasional check also of the optical axis of the telescope with the optical axis of the camera lens should be made. This is done by viewing some distant object (about 2500 feet) and using a ground glass which is supplied making sure that the cross-hairs line up with the fiducial markers. The intersections of the cross-hairs should show the same object as seen in the telescope. If realignment is necessary this too can be done by the adjusting nuts provided for this adjustment.

Photogrammetry has received so much impetus in the last ten to fifteen years by the advances of aerial photography that it is often forgotten that the principles of photographic surveying on the ground have been known for a much longer period of almost half a century. The word " photo-theodolite " has, in the case of the instrument recently produced by the Fairchild Camera and Instrument Corporation, been changed to the very plain but descriptive name of " camera transit ". There is the possibility that the use of this old and proved method of surveying and mapping, under proper circumstances may bring about the following important advantages :—

(a) Effect considerably reduced costs in field work and decrease costs to a lesser extent in office work ;

(b) Enable larger areas to be mapped at greater speed than by conventional methods, particularly in rugged terrain where usual ground methods of surveying are difficult, and where there is physical difficulty in getting from one place to another, carrying equipment and measuring lines.

The camera transit eliminates the need for stadia rod men to scramble around rugged country in the painstaking and often dangerous manner now necessary. Instead, the positions, both horizontally and vertically, of objects or contours can be located in the drafting room by a method of intersecting direction lines drawn on photographs of the particular point in question taken from two different positions ;

(c) Provide a more even flow of office mapping work by virtue of the fact that as little as one day of photography can produce enough work to keep an engineering staff occupied for a considerable length of time. This levels out the slack periods which often arise due to a protracted stretch of inclement weather that brings field work to a halt.

Ground photogrammetry, or terrestrial photogrammetry, as the Europeans call it, which is restricted to relatively small areas, became somewhat neglected in favour of the more spectacular aerial photogrammetry, because of its connection with the aviation age which contributed to the decline of interest in ground photographic surveying.

However, terrestrial photogrammetry has been constantly used in Europe up to the present time. The Canadians also have consistently used terrestrial photogrammetry and even today are making good use of this method.

In the United States, in the course of research and development along the lines of aerial photogrammetry, American engineers have developed very much simplified equipment for reducing photographs into maps. Further, they have developed graphic methods requiring only a knowledge of the system, plus the usual drafting room supplies of pencils, scales, triangles, etc. So the possibility of side-stepping the use of the costly European map-plotting devices immediately brings the art of terrestrial photogrammetry into the reach of the engineering surveyor.

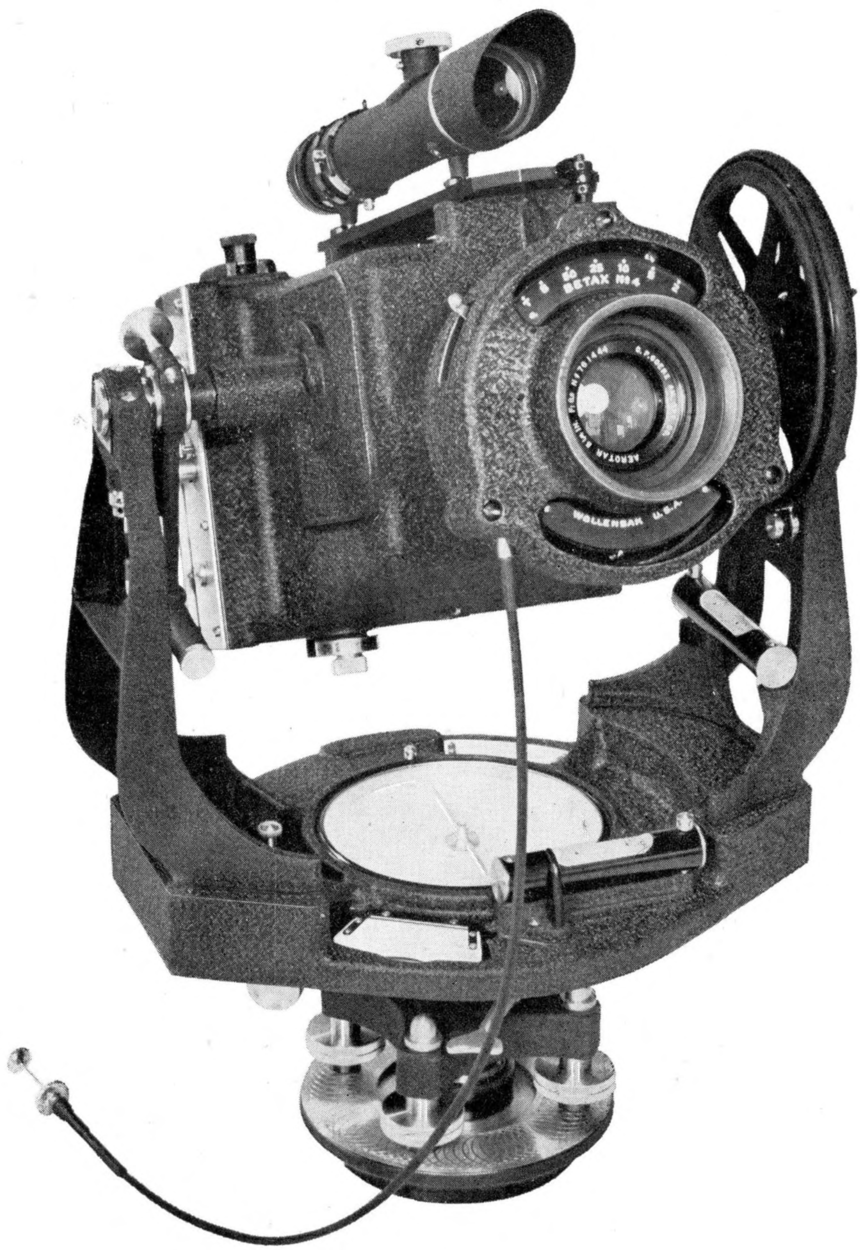

FIG. 1
The Fairchild Camera Transit.

FIG. 2
The Fairchild Camera Transit.

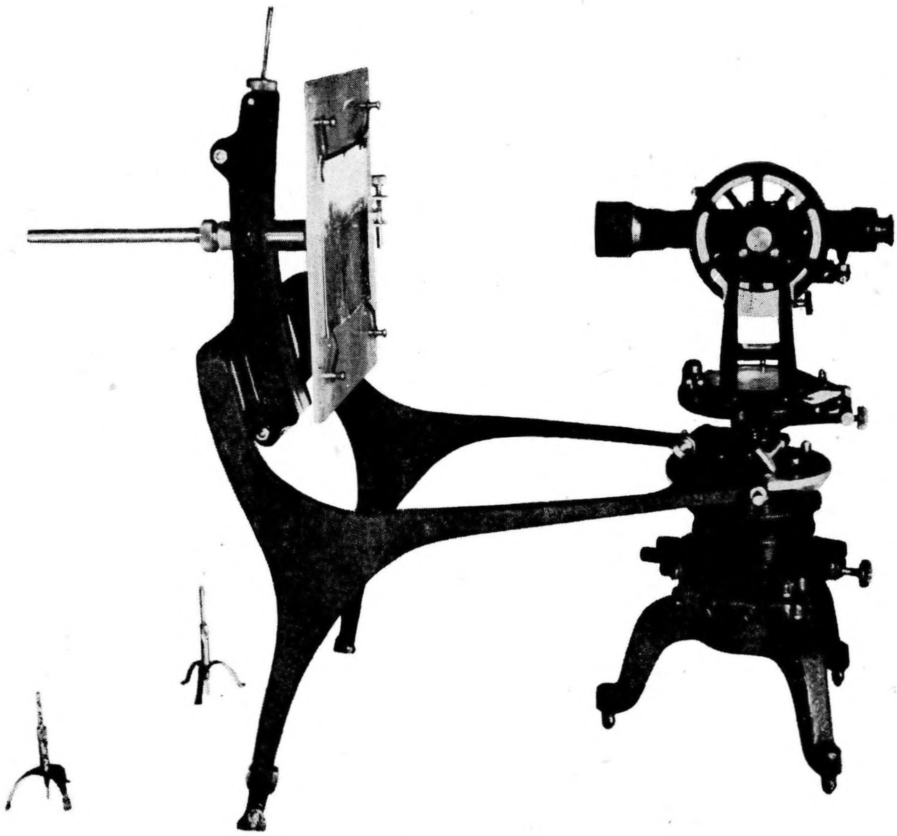

FIG. 3
The Photo Transit.

The field work connected with a terrestrial photogrammetric survey consists of selecting stations from which all portions of the terrain to be mapped can be included in at least two photographs. This portion of the work calls for a certain amount of judgment which comes with experience of the method.

These camera stations are tied in one with the other by triangulation, using either a conventional transit or using the transit portion of the camera transit. It is impossible with the installation of the camera to transit the telescope for the purpose of taking back sights. Nevertheless, horizontal and vertical angles can be read with as much ease as with the ordinary transit. The elevations of the stations must be determined and the lengths of the lines between camera stations must also be known.

The photography itself is not difficult. The camera is pointed by means of the transit in the desired direction both horizontally and vertically and locked in that position. The horizontal angle and vertical angle are recorded for future use in the office. The diaphragm of the lens and the speed of the shutter can be set using ordinary photographic experience, or by resorting to the use of light meters which most people are familiar with handling or exposure meter of the photo-electric cell type. Glass plates are used in preference to film because of their dimensional stability and optically flat surface. Panchromatic, orthochromatic, and infra-red emulsions in combination with various filters were tried, and it was concluded that in general the best results were obtained with a panchromatic emulsion and a red filter. The infra-red plates gave excellent results from the standpoint of haze penetration, but the distorted color values associated with this emulsion made image identification difficult. Back in the office, the mapping work can be done most readily by working from contact prints made from the glass plate negatives.

THE PHOTO TRANSIT

For this phase of the work, i.e., the transfer of horizontal angles from photograph to compilation sheet and the measurement of vertical angles on the photograph, the Wilson-Photo-alidade is available. However, the photo-alidade was replaced by a new instrument, the photo-transit (fig. 3), which was constructed especially for work with the camera transit data.

It is similar in principle to the photo-alidade, but a horizontal circle with vernier takes the place of the fiducial rule of the alidade. Horizontal angles may be transferred from photograph to compilation sheet either graphically, by means of the vertical hair of the telescope, or by reading angles and computing geographic positions in the conventional manner. The instrument consists of two main parts : (1) the transit and base; (2) the target for holding the photograph.

The base is a buff and buff heavy metal trivet about 7 inches in height, with a shifting head adjusted by x and y slow motion screws. The transit is a small Keuffel and Esser mountain type instrument, adapted to photographic work by modification of the optical system of the telescope, and provided with a new and extremely convenient plumbing device. The telescope was revised by removing the objective lens and replacing the focusing lens. A focus of from three inches to infinity and a magnification of approximately 2 1/2 diameters are provided by the new optical arrangement. The instrument is centered over a point with the plumbing device mentioned above, which consists of a 3/16 inch hole drilled vertically through the pivot point of the compass box and the inner center. With this provision the instrument can be placed over a point by making the telescope vertical and sighting directly at the point. The final centering is easily accomplished by means of the delicate x and y motions of the shifting head.

The target is a cast aluminium framework designed to place the photograph and transit in the same relationship as the camera and its positive plane. A flat aluminium plate having a small needle projecting from its center is the base on which the photograph is mounted. This plate has four spring clips for holding the corners of the photograph when it is placed with its principal point on the needle in the center on the plate, and can be revolved by means of a tangent screw on its right side. It is mounted within the framework on a threaded metal shaft, along which it can be moved to correspond with the focal length of the camera lens, and it can be moved in the vertical plane with a slow motion screw and clamp arrangement on a segmental arc. The radial motion given by the segmental arc does not disturb the focal length adjustment, as the arc is centered on the horizontal axis of the telescope. The threaded shaft is fixed within the arc so that its longitudinal axis coincides with a radius from the center of the horizontal axis of the telescope at any position in the vertical plane, and the photograph plate is mounted transversely to the shaft with its center falling on the longitudinal axis.

Consequently, a perpendicular from the center of the plate will meet the point defined by the intersection of the horizontal and vertical axes of the transit at any position on the segmental arc, making it possible to reproduce quickly the origin relationship of positive plane and camera.

A final and precise adjustment for focal length is made by moving photograph plate until the proper horizontal angle is turned between the left and right fiducial marks on the photograph ; this adjustment eliminates any error due to dimensional changes on the print. The photograph is leveled on the plate with the tangent screw motion until the horizontal hair of the telescope will cut both right and left fiducial marks, and the vertical angle at which the exposure was made is set off on the vertical circle of the transit and the photograph plate raised or lowered until telescope hairs rest on the principal point of the photograph. When the adjustments are complete true vertical and horizontal angles are turned between images on the photograph.

Orientation of the photograph is provided for by the method of attachment of the target frame arms to the transit. This is effected by means of two concentric metal rings or collars fastened to the levelling head of the transit which permit the entire frame to pivot about the vertical axis. Ball bearing feet carry the weight of the target assembly and allow easy motion over the compilation sheet. The final adjustment of the target to the correct azimuth is made with a tangent screw.

The pointings of the photo-transit positions were transferred to the compilation sheet by depressing the telescope and lining in a needle point held in a small metal tripod (fig. 3) and using the horizontal circle on the photo-transit.

Accuracy checks on this operation compared with those established by field triangulation or by radial line plot show maximum discrepancies of 17 feet in latitude and 22 feet in longitude.

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