

THE UMK SYSTEM IN THE YEAR 1984
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One of the advantages of an ingeniously designed modular system is to replace single units by improved modules in case of need and to add new functional modules, if necessary. Under the condition of a perfect compatibility users thus have the possibility of optimizing their existing instrumentation without being compelled to purchase the complete equipments.

In the course of the development of the UMK 1318 Universal Measuring Camera this fact can be verified through all the years since the creation of the camera system in 1973 at the latest (1)(2).

With the increasing requirements arising in the users' area and with the realizability of new technical approaches the system was largely adapted to the conditions of industrial and architectural photogrammetry to mention only the two most important fields of application. It has now reached a state which suggests a provisional end of the development.

On the other hand, the upgrade of such a system from a certain extent on leads to problems of intricateness for those who for the first time want to familiarize themselves with such an equipment complex and its application possibilities.

Therefore, the diagram in Fig. 4 shows all interrelated important functional units. There are basically fine instrument complexes from which the appropriate units are chosen for building up a camera equipment system. In addition, the outfit includes small accessories which need not be mentioned in detail.

The basic instrument complexes are (from top to bottom in the diagram):

- voltage source
- release unit (electronic)
- cassette
- camera (lens cone)
- mount

It depends on the measuring task itself and its boundary conditions which of these units will in the particular case satisfy the parametric requirements for the setup of a special equipment. Major aspects are in most cases:

- the field angle of the camera (or the focal length);
- the type of the emulsion carrier;
- the type of mount.

Voltage source and release unit depend more or less on the type of the emulsion carrier.

1. Photogrammetric cameras

Compared with the configuration existing at the XIVth ISPRS Congress in 1980 the complex of the photogrammetric cameras has gone through the most conspicuous modification. It must, however, be emphasized once more (and this applies to all further descriptions) that the compatibility with instruments from 1973 on has fully been preserved.

The series of focal lengths (or field angles) was supplemented by a camera 6.5/1318 (Fig. 1) with a Superlamegon PI 5.6/64 super-wide-angle high-performance lens (3). Its main field of application will primarily be in architectural photogrammetry, where frequently real problems arise in choosing a proper station, if economically justifiable model areas shall be covered, although the possible object distances are small (4). The new camera whose data can be taken from Table 1 is invariably focussed to 8 m, since on the one hand the short focal length entails a relatively large depth of focus and on the other hand the applications entering into question will scarcely necessitate very short or very large object distances. Apart from this, with a fully stopped down lens a region from 2 m to ∞ is still imaged with sufficient sharpness.

The standard camera 10/1318 had so far been available in two types, which differed in the distortion characteristics of the two lens types Lamegon 8/100 and Lamegon 8/100 N (1). Both lenses have now been replaced by a single lens Lamegon 8/100 B, which on both ends of the focussing range exhibits standard distortions below 10 μ m. Thus, the previously necessary assignment of the lens type to the object distances of the main field of application is dispensed with, if no analytical correction of distortion was made. The new lens is part of the new 10/1318 U camera, where "U" stands for "Universal" not only because of the distortion behaviour. This lens cone is also intended to be used on the UMK for special photographs from the air. So as to exclude detrimental influences of vibration on the focussing elements, the movable inside tube of the lens can be arrested in the ∞ stage after focussing.

With the lens cone 10/1318 U and the appertaining special mount (see below) an aircraft variant of the UMK was produced meeting the demands of many users for a system combination suitable for photographs from low flying heights. It had not been the intention of creating a camera which with regard to its parameters would be comparable to the LMK aerial camera. However, the "aircraft UMK" provides the possibility in special cases to photograph small objects from helicopters or small aeroplanes. An attendant advantage is that when the corresponding modular units are purchased the same lens cone may be used also for terrestrial photographs from a tripod.

The 20/1318 and 30/1318 cameras were left unchanged in their equipment system.

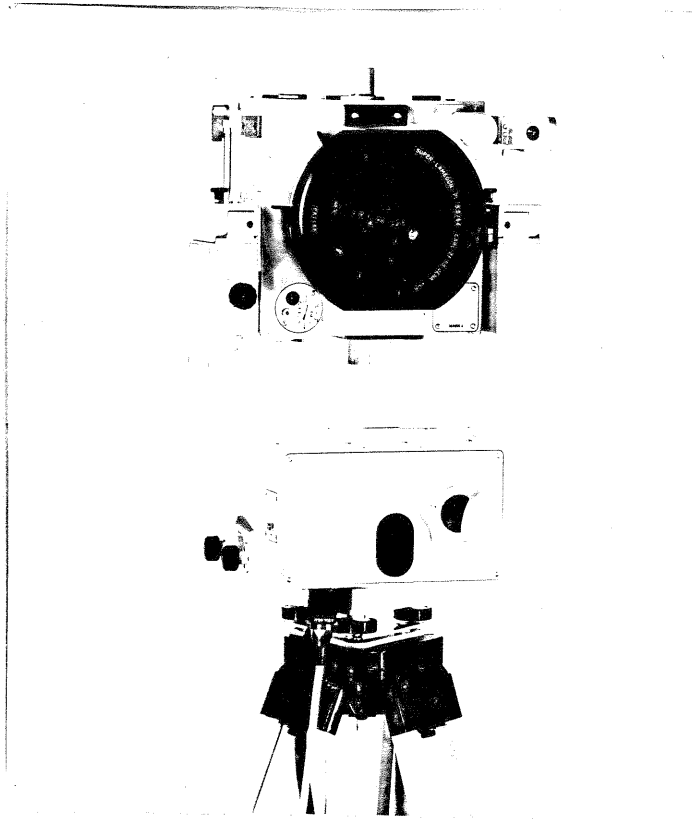


Fig. 1 UMK 6.5/1318 Universal Measuring Camera

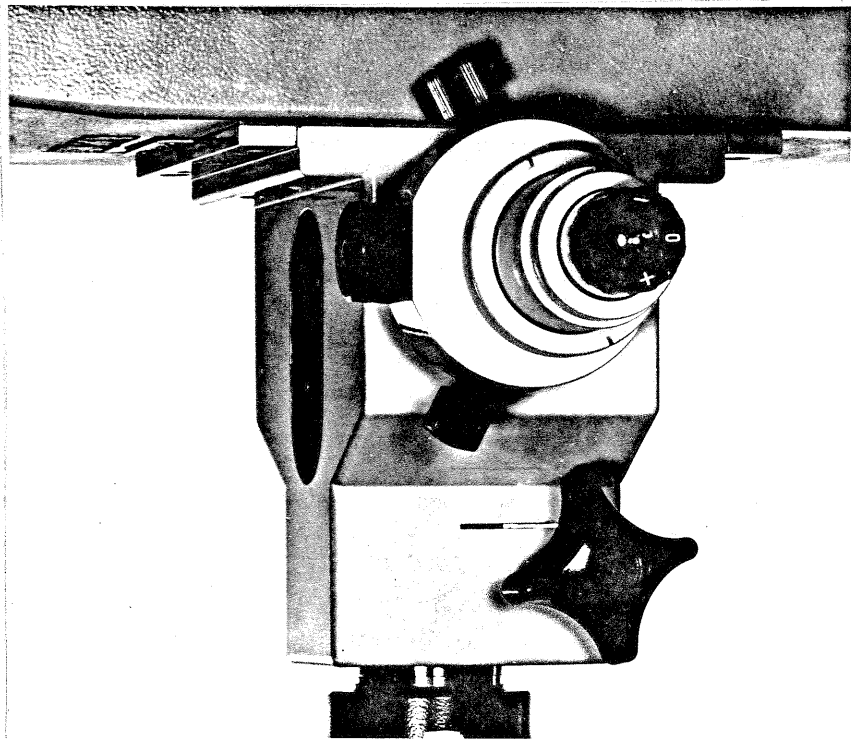


Fig. 2 Orientation telescope for double mount

2. Mounts

The group of mounts was supplemented by a modification of the vertical mount with damping device for the reduction of vibrations during the flight. As an accessory a special viewfinder is supplied in the form of an optical sighting device, which with appropriate levelling allows the operator to locate the terrain point, on to which the camera axis is directed; any possible drift angles can be estimated and eliminated by hand on the aerial mount of the camera.

Another novelty concerns the terrestrial double mount. Here an orientation telescope (Fig. 2) is involved, which by means of a swivelling prism describes a vertical plane parallel to the base with its sighting beam. When a reference line is marked on the ground or when test patterns are laterally arranged being related to the object coordinate system the base can be oriented to this.

The proven types of terrestrial mounts, viz. orientation system, single mount, and vertical mount have been left unchanged and are still available in the system.

On the basis of our practical experience gained in the last years we can say that with the latest supplements most of the occurring mounting variants can be implemented by optimum mounting types.

3. Cassettes

The original concept of the UMK was to use merely photoplates; later a rollfilm cassette for serial exposures was added (1). This also rendered possible the use of emulsions which were not available on glass (especially colour material).

The precarious situation in the sector of the photoplates now led to the adoption of a third category of emulsion carriers in the system, namely sheet film in the standard format 13 cm x 18 cm.

Same as with the plate cassettes, there are two sheet film cassette types, which differ by their flatness quality. In their outside dimensions the two types correspond to the comparable plate cassettes, so that the respective adapter frames can be used. The relations are illustrated by the diagram shown in Fig. 4.

The sheet film cassette 10 (i.e. 10 mm thickness of the metal sheet casing) contains a suction plate with a flatness of $\pm 10 \mu\text{m}$, while the sheet film magazine 13 has a plate with a flatness of $\pm 5 \mu\text{m}$.

The vacuum required for film flattening is produced by a suction pump.

There have recently been problems in procuring 19 cm broad rollfilm needed for the rollfilm cassette which is still in the program. Therefore, a simple film cutting device is now supplied, with which films of 24 cm width can be cut to the required size.

Another accessory is the changing bag, being useful especially for loading the sheet film cassette.

4. Releasing units and voltage sources

The switching device (1) employed for the plate cameras was replaced by the handy cable button switch (Fig. 3). It can be used for all plate and sheet film cassettes. An interesting feature is that the graduated circle illumination of the orientation system can be separately switched on or off.

Another switch allows the permanent illumination of the fiducial marks and side images for control and adjustment purposes. With the illumination switched on the electromagnetic release of the shutter is blocked.

For the rollfilm cassette the control unit is still available, though now in a variant with smaller dimensions.

The NC accumulator was provided with a charge control indicator.

For taking photographs on plates or also sheet film a battery rod (Fig. 3) was added, which is fitted with eight 1.5 V monocells and suspended in a tripod rod. An advantage of the battery rod is apart from the reduction of weight the system's independence of the mains network. However, it is not intended to operate the rollfilm cassette with the monocells of the battery rods.

Finally, a switching mode power supply belongs to this group, which is needed for connecting the aircraft UMK to the 27V aircraft mains system.

5. Miscellaneous

The range of accessories includes as a novelty an infrared filter with a wavelength cut-off at 690 nm which is made available for all four focal lengths.

The frosted screen frame of the UMK 10/1318 can be used for the new 6.5/1318 camera. However, a second type with changed focal length of the Fresnel system on the camera's side is offered for the focal lengths 20 and 30 cm.

On the basis of good experience gained in connection with the LMK system the transport cases of the UMK system are with few exceptions likewise made of glass-fibre reinforced plastics (polyester).

6. Applicabilities

Since the creation of the first universal measuring camera barely 15 years ago it has been proved that for the purposes of precision photogrammetry with a large range of applications an image format of 120 mm x 166 mm provides optimum conditions. The miniature format common especially for stereometric cameras involves amenities regarding weight and dimensions, but because of the necessarily short focal lengths and hence

relatively small image scales it raises problems concerning accuracy and interpretability; with a further magnification as it is known for special equipments with a narrow field of application, a further increase of accuracy must be gained at the expense of light weight and easy handleability which are important for transportable field instruments.

Therefore, the above-mentioned format has been left unchanged since 1969 and there is also no reason to supplement the modular system by cameras with other formats.

As far as the image scale is concerned, the planned use has to adhere to certain field angles, if a change of the taking distance is not possible or not desired. On the other hand, the economy requires the best possible filling of the format, or better, of the stereoscopic space by the object, in order to keep the number of models as small as possible, i.e. it is up to the capability of the operator to keep the balance between both possibly conflicting requirements. In any case the focal length scale 6.5 : 10 : 20 : 30 provides now more favourable conditions.

With regard to the processing of photographs in conventional analogue plotting machines the standardization in the sector of the 10/1318 wide-angle cameras entails advantages, since it is after all the economy of the total system which benefits from the versatile application of the standard focal length.

The various types of mounts for terrestrial photography has essentially been left unchanged which may testify to the correctness of the original system conception. The orientation system still represents the main part of the mounts used.

Certain correlations exist between camera type and type of mount, which however leave ample scope for individual combinations. For example, it makes practically no sense to combine two 30/1318 cameras on one double mount, because in this case there is a true discrepancy between base ratio, field angle and object distance.

The decision regarding the cassette types has become uncomplicated, since the new sheet film cassettes eliminated the scruples about the rather voluminous rollfilm variant for the case where the application requires emulsions which are not available on plates. The future will show in which direction (apart from serial photographs) the development will generally tend - the old question of close-range photogrammetry: "film or plate" is still open.

A few considerations on the "aircraft UMK" may conclude this article. As already mentioned, this special combination is not intended to be competitive with the LMK. The idea rather was to give users the possibility to employ the same instrumentation not only for terrestrial applications but with appropriate modifications also for photographs from the air. For

this purpose merely the UMK 10/1318 U with the new lockable Lamegon 8/100 B lens had first been selected. Whether as emulsion carrier rollfilm, sheet film or even a plate are to be used depends on the type of application. In most cases photographs will be concerned which can individually be positioned so that an image sequence cycle is not absolutely necessary. Deviations from the accustomed photography technology for "genuine" aerial cameras result also from the rectangular image format (which with appropriate arrangement and 72 % forward overlap still gives a quadratic model area!) and especially from the rather small maximum apertures as used for photography from moving aircraft; these small apertures are a consequence of the constructional size of the lenses satisfying the requirements of field use.

Experience will show how the UMK system will stand its test also in low-altitude aerial photogrammetry.

In the 15th year of its existence the UMK is presented in a further upgraded stage which will open up more possibilities for the application of photogrammetry in close ranges.

Summary

Since the presentation of the first design variant, the UMK 10/1318, in 1969 the UMK 1318 universal camera system has continuously been upgraded and tailored to the requirements of close-range photogrammetry. The further development of the system was favoured by the fact that on the one hand the design of the camera as a modular system offered favourable conditions for compatible modifications and new designs of individual functional units; on the other hand, the efficiency of this large-format camera has internationally sufficiently been proved for precision tasks, so that it appears to be fully justified to continue our technical approach by intensive research work.

Since the world congress of the ISPRS in 1980, where especially the new camera types 20/1318 and 30/1318 were presented, the system has seen further upgraded.

The improvements essentially involve three complexes. The demand for a measuring camera with a larger field angle repeatedly placed by users in the area of architectural photogrammetry was met by the new design of the UMK 6.5/1318 superwide angle camera. On the whole, the new camera completes the focal length series 30/20/10 cm. The choice of a lens with 64 mm focal length allows the unconditioned restitution of photographs in particular also in the TOPOCART, which has more and more proved its value as a stereoplotter especially in architectural photogrammetry.

The second complex concerns the extension of the system to aerial photographs within the technical potentialities. For this purpose we optimized the 10/1318 camera in addition to a vibration-isolated mount and a viewfinder. The known variants of the Lamegon 8/100 with distortion minimum in the close and distant ranges were replaced by a simple lens type which additionally allows the locking of the focussing motion.

Finally, the third complex involves the development of a sheet film magazine to counter the problems which become more and more felt in processing photoplates.

The range of novelties is completed by some smaller accessories and new features.

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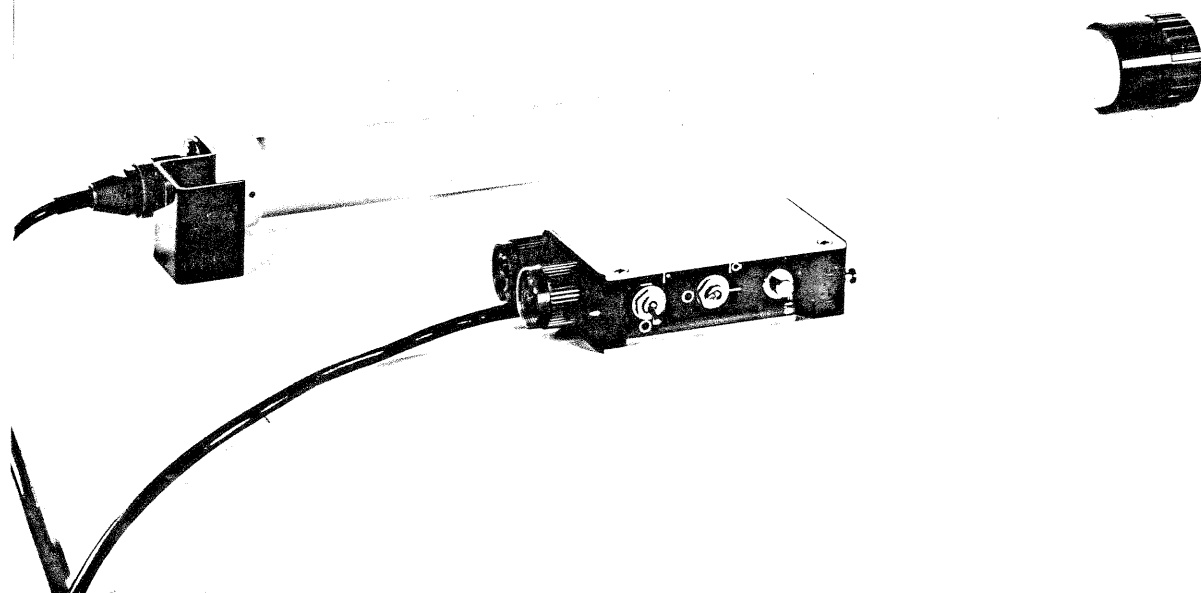


Fig. 3 Cable button switch and battery rod

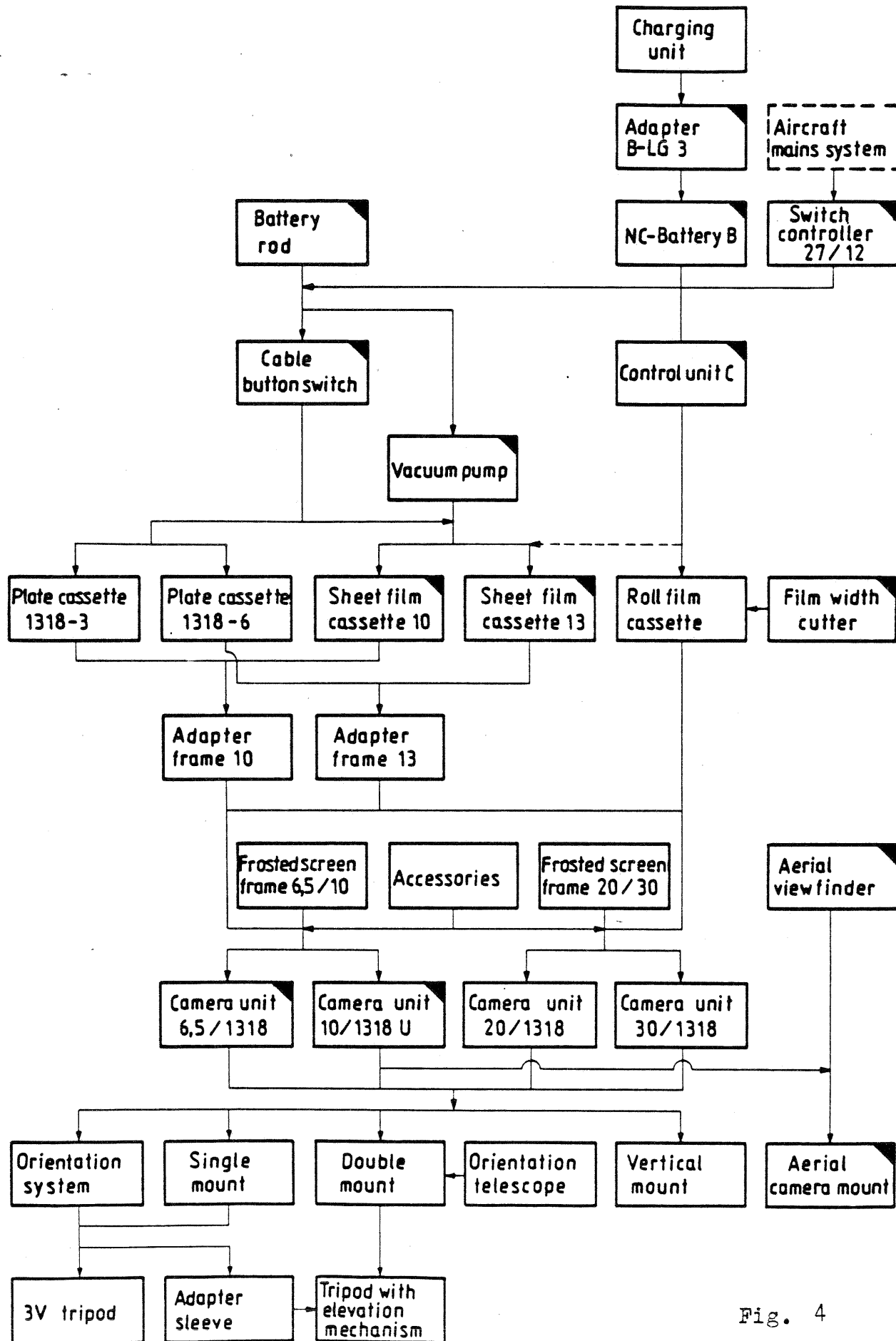


Fig. 4

UMK 1318 Universal Measuring Camera System, total diagram (configuration as of 1984). New system components: ▲

Camera	6.5/1318	10/1318 U	20/1318	30/1318
Lens	Superlamagon PI 5.6/64	Lamegon 8/100 B	Lametar 8/200	Lametar 11/300
Focal length	64 mm	99 mm	200 mm	300 mm
Max. standard distortion	$\pm 4/\mu\text{m}$	$\pm 5/\mu\text{m}$	$\pm 4/\mu\text{m}$	$\pm 2/\mu\text{m}$
(up to $r' = 90$ mm) for focussing distance	8 m	3.2 m	full range	50 m
		$\pm 9/\mu\text{m}$		$\pm 5/\mu\text{m}$
		1.4 m; ∞		5 m
Shutter	T, B, 1...1/400 s			
Exposure time	f/5.6...f/32			
f-stop	f/8...f/32			
Focussing	8 m	∞ ...1.4 m (19 steps)	∞ ...5.8 m (13 steps)	50 m (standard)
Useful frame size	120 mm x 166 mm			
Useful angle of coverage, max.				
Long side of the format	116 gon (104°)	88 gon (79°)	50 gon (45°)	34 gon (31°)
short side of the format	95 gon (86°)	68 gon (61°)	37 gon (33°)	25 gon (22°)
Diagonal	124 gon (112°)	97 gon (87°)	56 gon (51°)	39 gon (35°)

Table 1 UMK camera parameters