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PHOTOTELEVISION EQUIPMENT FOR SPACE INVESTIGATIONS,(U)
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FOREIGN TECHNOLOGY DIVISION

PHOTOTELEVISION EQUIPMENT FOR SPACE INVESTIGATIONS

by

A. S. Selivanov, G. M. Aleshin,
et al.

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PHOTOTELEVISION EQUIPMENT FOR SPACE INVESTIGATIONS

By: A. S. Selivanov, G. M. Aleshin, et al.

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U. S. BOARD ON GEOGRAPHIC NAMES TRANSLITERATION SYSTEM

Block	Italic	Transliteration	Block	Italic	Transliteration
А а	*А а*	A, a	Р р	*Р р*	R, r
Б б	*Б б*	B, b	С с	*С с*	S, s
В в	*В в*	V, v	Т т	*Т т*	T, t
Г г	*Г г*	G, g	У у	*У у*	U, u
Д д	*Д д*	D, d	Ф ф	*Ф ф*	F, f
Е е	*Е е*	Ye, ye; E, e*	Х х	*Х х*	Kh, kh
Ж ж	*Ж ж*	Zh, zh	Ц ц	*Ц ц*	Ts, ts
З з	*З з*	Z, z	Ч ч	*Ч ч*	Ch, ch
И и	*И и*	I, i	Ш ш	*Ш ш*	Sh, sh
Й й	*Й й*	Y, y	Щ щ	*Щ щ*	Shch, shch
К к	*К к*	K, k	Ъ ъ	*Ъ ъ*	"
Л л	*Л л*	L, l	Ы ы	*Ы ы*	Y, y
М м	*М м*	M, m	Ь ь	*Ь ь*	'
Н н	*Н н*	N, n	Э э	*Э э*	E, e
О о	*О о*	O, o	Ю ю	*Ю ю*	Yu, yu
П п	*П п*	P, p	Я я	*Я я*	Ya, ya

*ye initially, after vowels, and after ъ, ь; e elsewhere. When written as ё in Russian, transliterate as yё or ё. The use of diacritical marks is preferred, but such marks may be omitted when expediency dictates.

GREEK ALPHABET

Alpha	A	α		Nu	N	ν	
Beta	B	β		Xi	Ξ	ξ	
Gamma	Γ	γ		Omicron	O	o	
Delta	Δ	δ		Pi	Π	π	
Epsilon	E	ε		Rho	P	ρ	
Zeta	Z	ζ		Sigma	Σ	σ	ς
Eta	H	η		Tau	T	τ	
Theta	Θ	θ		Upsilon	T	υ	
Iota	I	ι		Phi	Φ	φ	
Kappa	K	κ		Chi	X	χ	
Lambda	Λ	λ		Psi	Ψ	ψ	
Mu	M	μ		Omega	Ω	ω	

PHOTOTELEVISION EQUIPMENT~~/DEVICES~~ FOR SPACE INVESTIGATIONS.

A. S. Selivanov, G. M. Aleshin, G. A. Golenko, M. K. Narayeva, I. F. Sinel'nikova, A. G. Shabanov.

Pages 3-12.

Beginning from 1959, when was for the first time obtained the photograph of the far side of the moon [1], photctelevision technology had extensive application in space investigations, since the combination of the photographic memorization of the large volumes of video information and television method of its subsequent transmission makes it possible to construct the instruments, which most completely satisfy at present all requirements, presented to onboard equipment for automatic scientific stations. During the development of the phototelevision equipment/devices (FTU), intended for the investigation of planets, appears a series of complex problems in the

provision for their reliable functioning under the conditions of prolonged space flight and qualitative image transmission from the distances, measured by dozens and hundred of million kilometers. These problems it was solved in equipment/devices, the principles of ccnstruction and fundamental characteristics of which were examined in present article.

The first to FTU, which it was assumed to utilize for photographing of masthead and Venus, was developed into 1960. Figure 1 shows appearance FTU, established/installed cn automatic interplanetary space station "Mars-1" (1962). [2]. The fundamental technical specifications of this equipment/device are given in table. Its construction contains the united with the aid of bearer frame autonomous node/units and the blocks, which fulfill independent functions. The camera, equipped with twc objectives with different focal lengths, produces cyclic photographing to the perforated/punched photographic film 70 mm wide. In each cycle were utilized square small-scale and rectangular large-scale the perscnnel/frames (Fig. 2). For the agreement of the cyclic course of film in camera and its continuous motion in adjacent blocks it was established/installed intermediate storage/accumulators.

Into composition to a ~~ftu~~ FTU of the type ~~"masthead-1"~~ "Mars-1", besides the blocks, intended for photography and development of film, for a power supply and a control of the drive of tape-drive circuit and scanner, entered also the blocks of the coding of signal, modulation of sub-carrier frequency and synchronization.

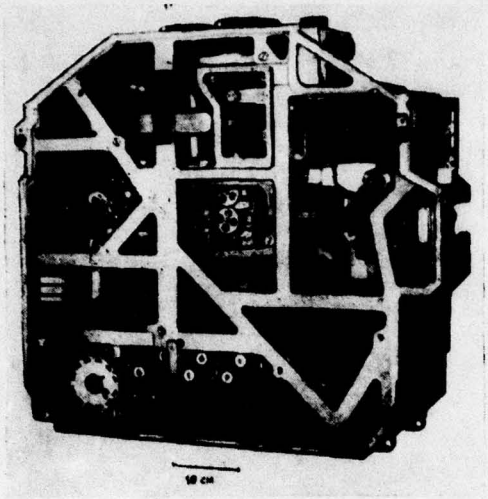

Fig. 1.

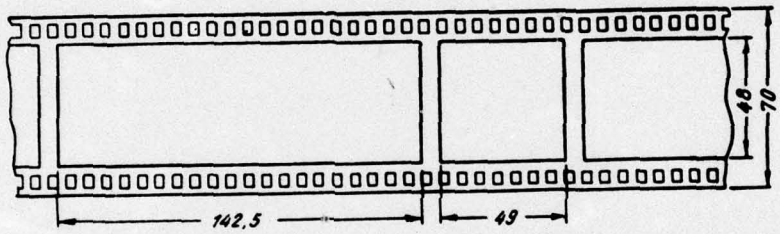

Fig. 2.

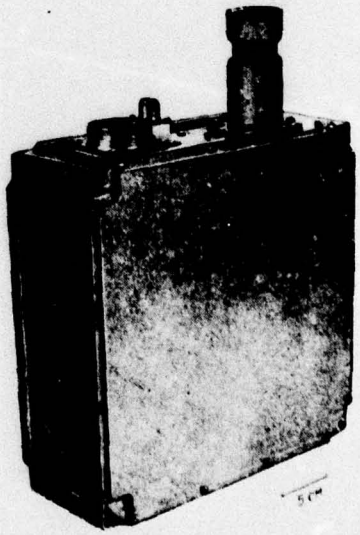

Fig. 3.

For an increase in the reliability of work the scanner and all electrcnic components were duplicate/backd up/reinforce. Thus, the described FTU was autonomous and sufficiently complex photographic and radio engineering complex. It realized reception/procedure, memorization, reproduction and repeated conversicn of video information.

A ~~ftu~~ FTU of the type ~~"masthead-y"~~ "Mars-1" completely satisfied the stated requirements, and many principles, placed in their construction, they turned out to be fruitful and they served as basis/base for the further developments of space phototelevision systems [3]. From contemporary point of view these FTU had large dimensions and a weight, insufficient universality they consumed a comparatively large energy content. Subsequently on the basis/base of the accumulated experience of constructicn and operation, it was developed more advanceed FTU (Fig. 3), which passed ispytaiya at automatic interplanetary space station ~~"probe-e"~~ "Zond-3" into 1965 [4].

~~"probe-e"~~ "Zond-3" it simulated flight toward masthead, and as the object of photographing was selected moon. In this case was placed the problem to obtain the image of that part of the reverse/inverse ystorony of the moon, which was not filmed into 1959 from station ~~"moon-e"~~ "Zond-3". FTU of this type were establish/installed also on artificial lunar satellite ~~"moon-12"~~ "Luna-12" [5] (for large-scale photographing of the equatorial sections, lunar surface from altitude 100 km) and on automatic interplanetary space station ~~"Venus-e"~~ "Verera-3" [6]. These equipment/devices, in difference from FTU of the type ~~"Mars-y"~~ "Mars-1",

have the single beznakopitel'nyy tape-drive circuit, in which the motion of film in all mode/conditions conducts from one drive mechanism. Zdel' with the preservation/retention/maintaining in practice of the same definition (see the Table) is utilized narrower (25.4 mm) neprforirovannaya film, and the composition of electronic components is limited only by those, that directly provide the work of the instrument: power supply, the amplification of signal and control of drive.

(1) Наименование параметра	(2) Тип ФТУ	
	(3) «Марс-1»	(4) «Зонд-3»
(5) Вес, *кг*	32	6,5
(6) Мощность потребления при съемке, *вт*	90	25
(7) Мощность потребления при передаче, *вт*	50	20
(8) Темп съемки, *мин*	4	1÷4
(9) Количество объективов, *шт.*	2	1 (10) (сменный)
(11) Фокусное расстояние объективов, *мм*	750 и 35	106 и (12) др.
(13) Ширина пленки, *мм*	70 (14) (перф.)	(15) 25,4 (неперф.)
(16) Формат кадра, *мм* × *мм*	48×49÷ 48×142	24×24
(17) Объем памяти (в квадратных кадрах)	112	40
(18) Число строк в квадратном кадре	1440, 720, 68	1100, 550, 67
(19) Скорость передачи (*стока/сек*)	1÷1/16	4÷1/4

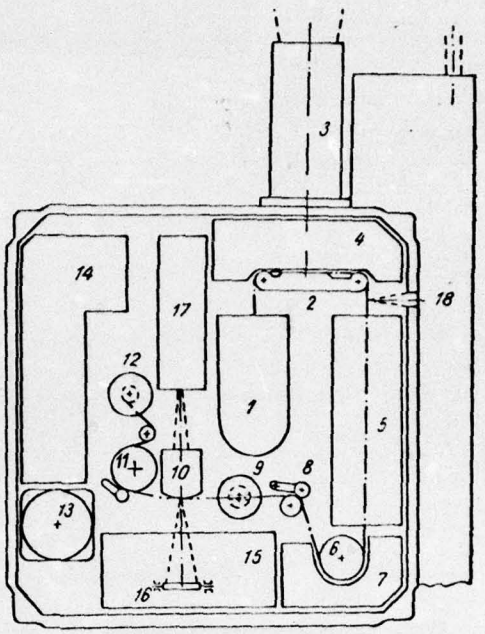

Fig. 4.

Key: (1). Naimenovaiye of the parameter. (2). Type FTU. (3). "Mars-1". (4). "Zond-3". (5). Weight, kg. (6). Power of consumption with photographing, W. (7). Power of consumption with transmission, W. (8). Rate of photographing, min. (9). Amount of objectives, pcs. (10). interchangeable. (11). Focal length of objectives, mm. (12). and. [redacted] etc. (13). (14). Width of film, mm. (15). perf. (16). neperf. (17). Aspect ratic, mm x mm. (18). Volume of the memory (in square personnel/frames). (19). Number of rows in square frame. (20). Speed of transmission (stoka/sek).

Instrument units are not duplicate/backup/reinforced, and each instrument is equipped only with one legkosmenyaemym objective. The new konstruktivye solutions made it possible substantially to simplify instrument and, therefore, tc raise its reliability. They led also to a sharp reduction in its weight (to 6.5 kg), which with need makes it possible to duplicate/back up/reinforce instruments at space station.

1. Operating principle of FTU of the type "Zond-3".

The examination of the work of separate/individual block/module/units and their interaction in the process of functioning it is convenient to besti, using the diagrammatic representation of instrument from tape-drive circuit (Fig. 4).

In section 1 is stored the working section of the photographic film, virtually insensitive tc those doses cosmic radiation, which can te obtained during endurance flight toward the subject of investigation. The length of working section is designed for photographing of 40 square personnel/frames. Into tape-drive circuit is charged the sectien of film, not covered yemul'siyey, is charged leader tape. In camera the film is arrange/located on stand 2, established/installed in the focal plane of objective 3 after gate 4. Next to camera is located equipment/device of khimikofotograficheskoy treatment/working plank 5 and, further, the drying section, which consists of drum 6 and meisture-absorbent hclder 7. Tape-drive circuit are also: slave/servo rollers 8, the recovering cassette with internal slot 9, the film window of scanner 10, drive shaft with

pressing roller 11 and takeup reels 12.

After the inclusion of instrument first is put to action the system of thermostatic control of equipment/devices of treatment/working and drying and, when is reached the necessary temperature, begins film transport. It conducts with the aid of the drive shaft, which has power drive 13. Film passes through the slot in plugged cassette 9 and is coiled around takeup reel 12. In this case its working section enters camera.

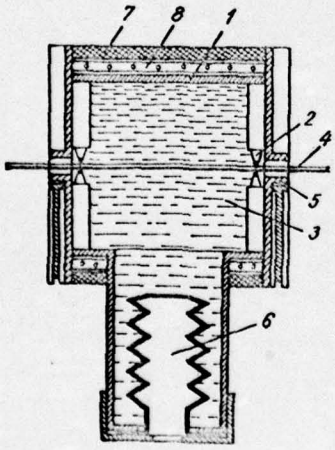

Fig. 5.

Command/crews to the function of the gate of camera are supplied from the program-time mechanism, connected with drive shaft and which assigns the rate of photography and the amount of the personnel/frames exposed. Part of the film can be exposed not through the basic objective and the gate, but through the lateral window in the housing of the instrument, to which is connected spectrographic equipment/device 18.

The development of the film exposed conducts in section 5 simultaneously with the process of photography and at the same rate.

When the end/lead of processed film emerges the drying section and passes sledyashchiyea rollers 8, special mechanism it record/fixes it within cassette 9, and *odovremenno this* cassette, earlier motionless, it obtains possibility to rotate. Thus, in the further work of instrument, connected with image transmission, the motion of film occurs between cassettes 9 and 12.

Image transmission conducts with the aid of the scanner, separate cell/elements of which (10, 15, 16, 17) are shown in Fig. 4. There are visible electronic control units of drive and the formations of videosignal 14.

2. Camera.

In camera is utilized the blinds zattvor, which it makes it possible to most simply provide the ustanovku of objectives with the

different parameters, which expands the possibilities of using an instrument in space issledovaiyakh. Gate is set and wear/operates from governing electric pulses, exposing film by two automatically alternating holdings (nominally 1/100 and 1/300 s). By means of the adjustment of gate it is possible to change the values of holdings approximately 1.5 times both to the side of an increase and to the side of decrease.

Instrument is designed for photographing at the uniform rate of 0.5-1 frames into minute, i.e., the average speed of the motion of the film through the camera does not exceed 24 mm/min, which makes it possible to conduct photographing to the driving film without the lubrication of image. It is really/actually, for time of the longest holding - 1/100 s - the film is moved only to 4 μ, which is 1/6 cell/element of resolution and it does not manifest itself the quality of transmission.

The equalization of the driving plank in the focal plane of objective conducts because of its tension on the surface of supporting/reference stand. The framework of gate restricts frame 24 x 24 mm in size/dimension. Simultaneously with photographing of object gate exposes to film the image of the calibrated half-tone wedge, intended for the through monitoring of the channel of treatment/working and transmission of information. Half-tone the wedge, which has in the instruments of the first specimen/samples krugulyu form, was subsequently was replaced rectangular, which

zaimaet the less part of the effective area cf frame.

Camera is entered in the construction of entire equipment/device; it is simple and reliable. Weight of the gate of the chamber, including the built-in in it drive, the cell/elements of automation and calibration, 400g.

3. Working equipment/device.

For the development of film in instrument is applied the equipment/device, which consists of three identical chamber-mcdule/moduli (Fig. 5). Each chamber has: a). tsilindricheskiykorpus 1, prepared from chemically stable titanium allcy; b). knife rubber jaws 2, which seal the chamber with solution/opening 3 during the motion through it of plank 4 during treatment/working; c). controlled from separate/individual drive packing/seals 5, which hermetically seal the chamber to and after treatment/wcrking; d). bellows 6, which compensates for tempeyeraturnye changes in the volume of solution/opening and its carrying out obrabatyvtsemoy film, and also preventing emergence in the chamber of overpressure so on changes in the ambient pressure; e). heat-insulating jacket 7 and the heating element of 8 system of germostabilizatsii.

The capacitance/capacity of each chamber 28 ml. The operating temperature of solutions +35±2.5°C. Duration of each operation of treatment/working 90 or by 45 s depending on the selected rate of photographing. Dry construction weight is 540 g.

The gObrabotka of film conducts by means of its uniform transpcrtirovaiya through the chambers with viscous solutions. Expansion bellows and intrcduced into soluticns surface-active and binders provide the reliable contact of solutions with film, they prevent the appearance of effects of the directed proyavniya and mechanical damages of emulsicn layer.

for the development of film is applied the special process, which ensures stable obtaining the assigned parameters of film after prolonged (several mcnths) storage of soluticns in on-board conditions and stump requiring the rigid regulation of the temperature and time behavior of treatment/working. This prccess possesses all advantages cf single-stage process, but, in difference frcm it, it makes it possible to obtain under the conditions of weightlessness the qualitative images, not contaminated by the reaction products of the emulsicn layer of film with solution. A change in the sensitometric indices obrabotyvaemoy film is not connected with the need for the agreement of the rate of fixing and manifestatien as during single-stage process. Process does nct require also the forced circulation of solutions in the working chambers.

By means of the selection of the formula of solutions it is possible within wide limits to vary the sensitometric indices of film, by establish/installing them depending on the solved problem - in photosensitivity within limits from 20 to 100 sing. ~~Gosts~~ GOSTs 0.2; in the contrast ratio from 0.8 to 1.8 with fog density not above 0.25 and the resolution of 80-90 min/mm.

After the passage of the chambers the plank enters the section of drying and moisture absorption of the working equipment/device. Here humid film is led to contact with svobodnovrashchayushchimsya drum, magretym to +70 - 80°C. The isolating in this case moisture is absorbed by the sorbent, placed in special holder in immediate vicinity of the emulsion layer of film. The temperature drying regime and condition of moisture absorption they chespchivayut the vitrification of the reagents, which remain in the emulsion layer of plank after treatment/working how is reached the high stability of the obtained images with prolonged storage under on-board conditions.

4. Scanner.

Into described the ftu of the perechacha of image it conducts with the aid of the optical-mechanical scanners of the type "scanning beam" - for line scanning - in combination with the precision drawing of the plank, utilized for frame scan. The selection of the optical-mechanical transmission media of the images was caused by

their high accuracy/precision, stability and cost-effectiveness/efficiency, which especially are exhibited in work on the low sorostyakh of scanning/sweep, necessary for an image transmission from large distances.

Into a ~~ftu~~ FTU of the type ~~"probe-z"~~ "Zond-3" the line scanning is realized with the aid of the small razmertyvayushchego equipment/device, made according to autocollimating diagram [7], shown in Fig. 6. The here diminished image of sperturnoy diaphragm 1, illuminated by lamp 2, is projected by microscope objective 4 into the focal plane of basic objective 6. The basic objective together with autocollimating mirror 7 transfers the image of diaphragm, which is the scanning cell/element, into another point of the fkal'noy plane of objective 6, where is arrange/located film 8. The luminous flux, passed through the plank and film window 9, is assemble/collected by condenser 10 on the photoelectric cathode of light receiver 11. Zrkala 3 and 5 serve for a decrease in the dimensions of equipment/device.

In this equipment/device as razver.tyvayushchego component/link is utilized autocollimating mirror 7, set in motion by cam gear. This mechanism obespchivaet the relatively slow uniform rotation of mirror around axle/axis through preset angle (20°) and its rapid return to starting position. The special feature/peculiarity of the construction of the described scanning/sweep lies in the fact that the rotary motion of mirror 7 causes the translation of the scanning cell/element - ssvetovogo spot of approximately 20 μ in diameter - in

the focal plane of objective 6, because of what the defocusing of the scanning cell/element along row virtually is absent.

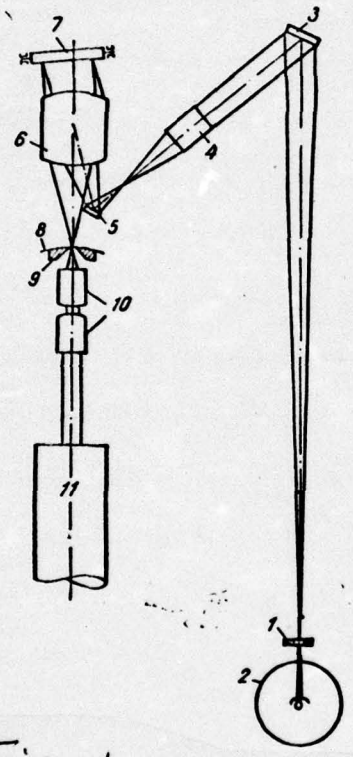

Fig. 6.

The length of row 24 mm; line scanning occurs across plank. The scanner provides the necessary for the selected standard of resolution aperture characteristic: the depth of mcdulaticn at the konrol'noy pcint, soovetstvuyushchey 1200 by cell/elements in row, is 40-50o/o in the center of field even 25-30o/o - at edge.

The basic cell/elements of scanner are united into the easily removable node/unit, within which is located the drive zeerkal6no- of cam gear and objective with focal length 35 mm and relative aperture 1:2. Drive is a dvukhsk (orcstnoy, with the relationship of velocities 1:4. The values of scanning speeds are determined by the selected type of reducer, but maximum speed does not exceed 4 lines/s. Weight of all cell/elements of scanner 620 g.

Film transport (frame scan) conducts synchrcnously with line scanning and v.sootvetstvii.s by the selected mcde/conditions of transmission in speed and in definition. Besides the oosnovnogc mode/conditions of transmission with the maximum definition of 1100 cell/elements in row, is provided the wcrk with the definition of 550 cell/elements in the strokepri of 550 strokaz in frame even 1100 (or 550) cell/elements in row with 67 rows in frame. The last/latter mode/conditions is official and is intended for a rapid survey and the preliminary evaluation of entire informaticn, obtained on film, which makes it possible subsequently to be restricted to the transmission cnly of the selected secticns of film, which have better/best quality or carrying the most valuable informaticn.

5. Construction of tape-drive circuit.

Taken during the design of the construction examine/considered to the ~~ftu~~ FTU of the kontseptstsiya of the beznakopitel'nogo tape-drive circuit, which acts from one drive mechanism, required to develop the economical and reliable multiple-speed drive, ocbespechivayushchiy the mction of plank in all operating modes of instrument with fotograafirovanii, image transmission and rewinding. The minimally necessary number of mode/conditions on the speed of drive in this case equal tc 5-8 is establish/installed depending on the specific conditions of using an instrument, whereupon in the majority of the cases the relationship of the extreme values of the velocities must prevyshaat' 100:1.

Comparative analysis showed that the placed trebovaiyam most completely satisfies the intermittent drive, which allows without any mechanically changed over gearboxes to change the velocity in of very wide predelkh with purely electronic path. For this target/purpose into a FTU of the type ~~"probe-2"~~ "Zond-3" is applied the small two-phase step-by-step motor ~~AD~~ ShD-1EM, developed specially for this equipment/device (similar engines of larger power were utilized re into a FTU of the type "Mars~~-1~~-1".

Let us examine more minutely the work cf tape-drive circuit, by using its kinematic scheme, shown in Fig. 7.

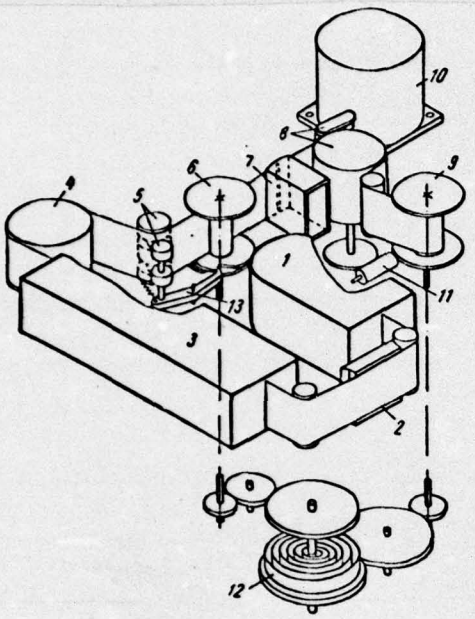

Fig. 7.

The structural/design basis/base of circuit and entire instrument it composes very rigid housing from the magnesium alloy, to which are fastened the basic cell/elements, which determine the motion of the film: feed reel 1, the stand of camera 2, working equipment/device 3, drying drum 4, slave/servo rollers 5, ulavliivayushchaya cassette 6, film window with condenser 7, that drives vals by the pressing roller 8, takeup reel 9. The remaining assemblies of instrument, not shown in Fig. 7: the objective, the gate, that works and scanners and some block/module/units - are easily removable, they are assemble/collected and are adjusted autonomously. After their installation into common/general/total housing for providing a normal operation of instrument is required the minimum number of operations.

Into the composition of the drive of the tape-drive circuit, besides drive shaft 8, connected with step-by-step motor 10 through reducer 11, enter also the cell/elements of braking and winding of plank. In that part of the circuit, where is arranged feed reel 1, film stretches itself in the basic because of frictional torque/moment kassetyi of the sealing jaws of small tanks with solutions. Thereby is provided the adjoining of plank to the surface of the stand of camera and drying drum. The torque is not constant and stable, but this is not required. It is necessary only in order that its changes into both sides would not exceed the determined sufficiently wide limits.

The winding of plank to priyemuyu cassette 9 is solved otherwise. The methods of frictional winding are here unreliable, that more that

in rezhimeperedachi the motion of film can occur in two directions and in each cassette necessary to have both winding and the braking. Requirements for tension and evenness of the motion of film in the mcde/conditions of transmission, it is natural, are very high, but the rate of drawing is low: it is measured dozen microns in second. At such operating speeds fricticnal mechanisms are inclined to an abrupt change in the torque.

Problem is solved by the known methcd, proposed for on-board magnetic recorders [8]. In this case the axle/axes of cassettes 6 and 9 , to mezhduu by which rewinds itself film, in the mode/conditions of transmission are linked through mounted spring mechanism 12. The latter attempts to untwist cassettes for oppcsite sides, creating opreddelennoye tension of plank in circuit. With the peromtke of film by drive shaft 8 cassette, which at the given torque/moment serves receiving, reels film, simultaneously attenuate/weakening spring, and feed reel is braked, stretching it. Therefcre in first approximation the torque/moment of tension remains constant. In reality, it somewhat changes, uvelichvayas' to the end/lead cf the film; these changes depend on its length and the parameters cf spring mechanism. The mechanism provides the smooth motion of film independently of velichinyskorosti and the automatic exchange of winding for braking in each cassette during reversing motion. The described mechanism acts during image transmission, when plank rewinds itself between the receiving and that which recover the cassettes, connected by spring equipment/device.

In the performance of photography the recovering cassette is plugged, and spring affects cnly the takeup reel, providing the winding of film. In this case to the end/lead of the performance of prizhina it is attenuate/weakened, but the remaining torque/moment sufficiently for a normal operation in the mode/conditions of transmission.

The output/yield of the end/lead of the film from slave/servo rollers 5 leads to the function of lever/crank equipment/device 13, which free/releases the plugged cassette and tempers the lock spring, which fixes the end/lead of the film within it.

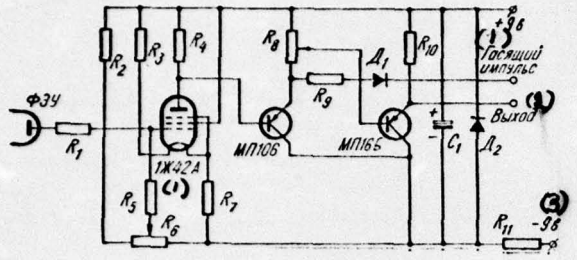

Fig. 8.

Key: (1). Extinguishing momentum/impulse/pulse. (2). Output/yield. (3) V.

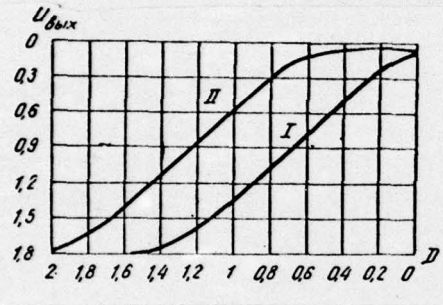

Fig. 9.

6. Electronic part and automation.

For the conversion of the luminous flux, passed through the film, into videosignal is utilized end type photomultiplier photomultiplier-54 in combination with amplifier on lamp ~~yzhya2a~~ 1Zh42A (Fig. 8).

Lamp ~~yzhya2a~~ 1Zh42A is a low-voltage highly economical pentode of direct heating with substantially nonlinear anode-grid characteristic. The operating mode photomultipliers and of amplifying tube is selected so, that the signal at the output of amplifier is proportional to the logarithm of the brightness of the analyzed izobrazheShchniya, i.e.,

it depends linearly on the photographic densities of film. This method of the transmission of videosignal as izvvestno, leads to a decrease in the effect of the noises of the communication channel on picture quality [9].

The practice of work with the automatic station "probe-z" showed, that it is expedient to have the command control of the amplitude characteristic of instrument, that it makes it possible to optimally transfer the personnel/frames with different density, which are obtained, in particular, due to the presence of two holdings (1/100 and 1/300). This control conducts by a discrete/digital change in the brightness of the translucent lamp and mode/conditions of preamplifier. The typical amplittudnye characteristics, which correspond to two operating modes on signal, are shown in Fig. 9 by the curves I and II.

The brightness of the translucent lamp (is utilized the lamp of nakalivaiya) is stabilized with accuracy/precision to 1o/o with the aid of pulse stabilizer with feedback in world/light. Here photoresistor regulates the pulse width of voltage the neposredsstvenno of that applied on lamp. In this case the lamp, which has sufficient thermal inertia of heater, reacts only to constant component the feeding momentum/impulse/pulses whose frequency is equal to 512 Hz, and the brightness modulation of lamp virtually is absent. With scanner and tape-drive circuit are connected two block/module/units of electronics, intended for a engine control of

line scanning and of the step-by-step motor cf drawing. For line scanning is utilized the direct-current motor of the DPM-20 whose velocity is stabilized with high accuracy/precision with the aid of the scheme of imul'snoy phase self-alignment. By the changeover of reference frequency and some elements is achieved a fourfold change in the velocity of line scanning.

The control unit of step-by-step motor creates on the basis/base of steering impulses the two-phase right-angled stress, applied to the windings of engine. Depending on the operating mode of FTU upraavlyayushchiye momentum/impulse/pulses are supplied to this block/module/unit from different sources. Into seanseye the photography as in the mode/conditions of rapid survey, engine goes with maximum speed - 128 spaces of second. Togda momentum/impulse/pulses 128 Hz frequency approach block/module/unit from on-board timer. In the mode/conditions of image transmission with high definition it turned out to be more convenient to utilize an internal pulsed source - the brush-contact cllector/receptacle, established/installed on one axle/axis with the cam/catch/jaw of line scanning. A collector/receptacle have two path/tracks, from which are remove/taken with respect to 16 and 32 momentum/impulse/pulses in one revolution, i.e., step-by-step motor it makes 16 or 32 spaces for the duration of transmission of one row.

The first case corresponds to the definition of 1100 rows in frame, in the second - 550. This discreteness of drawing, of course, in any way does not manifest itself the picture quality.

The drive of the lentoproyatzhnogo circuit of pribra can be considered sufficiently economical, its consumption on exceeds 3.5 W.

tav the automation of equipment/device in questicn is the large number of diverse cell/elements, detailed opisaiye of which would engage too much place. Therefore ograichimsya only by the short enumeration of the basic functions, which this automation fulfills.

In the performance of the photography: a). the stabilization of the temperature of the working solutions and drier; b). opening and the mkhanizma of the sealing/pressurization of the working equipment/devices; c). the obespcheniye by the predetermined program of the rate of photographing and amount of the personnel/frames exposed; d). the vvklyucheniye of the drive of drawing in preset time and at given speed; e). the programmed control of another ppriborami - by spectrograph, the orientation system of station, etc.; f). the fikatsiya of the end/lead of the film and the disconnection of instrument; g). the telemetric monitoring of the performance of program and work of mechanisms and block/module/unit.

In the performance of the transmission: a). the performance of

ccntrol commands on the selection of the mode/conditions of scanning/sweep (changeover steering impulses, etc.); b). the bilateral limitation of the motion of film with rewinding from cassette to cassette; c). the telemetric konrol' of the position of film in film window; d). the performance of control commands on the selection of the half-tone characteristic of analyzer.

The power supply of electrcnic components and equipment/devices of automatien originates from the aircraft electl wiring system, which has stress 14 ± 2 V. Part of electronic components is supplied from ccmmon/general/total stabilizer. Average pcwer, poreblyaemaya by instrument in the performance of photography, is 25 W, in the mode/conditions of transmission it is 20 W.

7. Results of the wcrk of FTU on the automatic stations ~~"probe-z"~~ "Zond-3" and ~~"moon-12"~~ "Luna-12".

The FTU, established/installed at automatic station ~~"probe-z"~~ "Zond-3", it transmitted the images of that range of the hidden side of the moon, to toraya it was not remove/taken earlier. Thus was obtained the material, necessary for the completion of lunar globe. Partially was taken and the visible side of the mccn, which facilitated the cartographical joining cf photographs.

The high quality of the obtained images, especially in the pershedache of the structure of relief and half-tones, made it

possible to reveal/detect/expose not only fact of the existence of the bol'shogochisla of parts, but also the researcher of the special feature/peculiarity cf the structure of lunar surface [4].

Tc ~~Ftu "probe-z",~~ FTU "Zond-3", osashchennoye by objective ~~and-24ca~~ I-245A (f = 106 mm) and by light filter ~~oc-14,~~ OS-14, it produced from distance 11 km of the surface of moon photographing of 28 small-scale personnel/frames, three of which were exposed from the ultraviclet spectrograph, working in the range of wavelengths 2700-1900 ~~a.~~ Å. The investigation of these spectra brought the valuable information abcut the reflecting properties of lunar surface in the ultraviolet rays, which are absorbed by earth's atmosphere [10].

The images, exposed with holding 1/100 s, it was better/best, especially for the zcne, clcse to terminator. They served as material for treatment, that on the whole did not decrease the useful information, since between them was very large overlap, and were transferred only those of them, that noticeably were distinguished between themselves.

Scme personnel/frames, which contain the most valuable information, peredavais' repeatedly. Preliminarily film was examine/scanned in rapid mode/conditions on the low standard of definition at speed 1 frame for by 2 min 15 s. This made it possible to evaluate personnel/frames on the density cf the obtained on film image, to define the zones of the surface of the moon, seized by each

frame, and to explain thereby, which personnel/frames are most interesting on subject and are subject tc transmission in the first turn.

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To obtaining good images contributed several the factors: selection optimum geometric uslovoy photcgraphing, making it possible tc determine the relief of surface; the high quality of the chemophotographic on-board treatment of plank and the conformity of pckazaley film to the characteristic of the cbject of photographing; linear conditions of transmission plostnostey image; high relaticnship signal/noise in radio communication link.

Work to ftu on to the edge of the space vehicle ~~"probe-z"~~ "Zond-3" was checked by a series of telemetric sensors. Each function of gate together with oscillogram time marks was record/fixed in the on-board memory unit, that pozovlilo after conducting the performance of telemetry data to obtain the necessary data cn the joining of the torque/moments of photography to the flight trajectory. Along telemetering link were transferred also the numbers of personnel/frames and the temperature of the working solutions.

The photographs, obtained with ~~"probe-z"~~ "Zond-3", are processed and published in second Toma's form "atlas reverse/inverse are moved moon" [11].

The equipment, established/installed on the nizkoletyaem artificial satellite of the moon ~~"moon-12"~~ "Luna-12", unessentially differed from to the Ftu ~~"probe-2"~~ FTU "Zonda-3". The basic problem of this experiment consisted of obtaining the fragments of the equatorial belt of the visible side of the moon the increased authorization (to 4 m to television cell/element), unattainable for ground-based telescopes. The minimum flight altitude of station ~~"moon-12"~~ "Luna-12" in the zone of photographing was approximately 100 km. Photographing conducted with the aid of two FTU, equipped with objectives with focus f = 106 mm (I-24CA) and f = 500 mm (MTO-500CA).

In this case long-focus instrument played the decisive role in experiment, and to short-focus was entrusted the problem of data finding for a joining large-scale images to the available map/chart l!uny.

In comparison with to ~~ftu~~ FTU ~~"probe-2"~~ "Zonda-3" the amount of removed personnel/frames was increased from 28 tc 40 speed of transmission of image it increased 2 times it comprised in basic mode/conditions 1 stroka/sek. Several times was increased the sensitivity of film in view of the fact that for the illumination of the object of the condition of rabotybyli by much less favcrable, since the range of photographing of the nakhodilas'vblizi of terminator.

Conclusion.

The obtained results attest to the fact that the phototelevision equipment/devices, developed on the basis/base of the principles presented, according to their design characteristics and qualitative indices completely satisfy the requirements, produced on contemporary onboard equipment, and sufficiently reliably they work in space flight ccndition.

These equipment/devices have the limited volume of the memcrized information and are most adapted for one-time phctographing from span space stations. However, they possess the determined universality and flexibility at part of the selection of optical equipment, rate of photographing, sensitometric characteristics of the photographic materials, and also the speed of transmission and definition of the transferred image. This makes it possible tc utilize similar instruments for the solution of different prcblems on the first stages of the study of the planets of the solar system.

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