

DESIGN REVIEW
J-3 CAMERA SYSTEM

23-24 AUGUST 1966

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9232-BOS-COR-66-133A

I A. Crown

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Copy No. 15*COR-4044-661A*
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DESIGN REVIEW
J-3 CAMERA SYSTEM

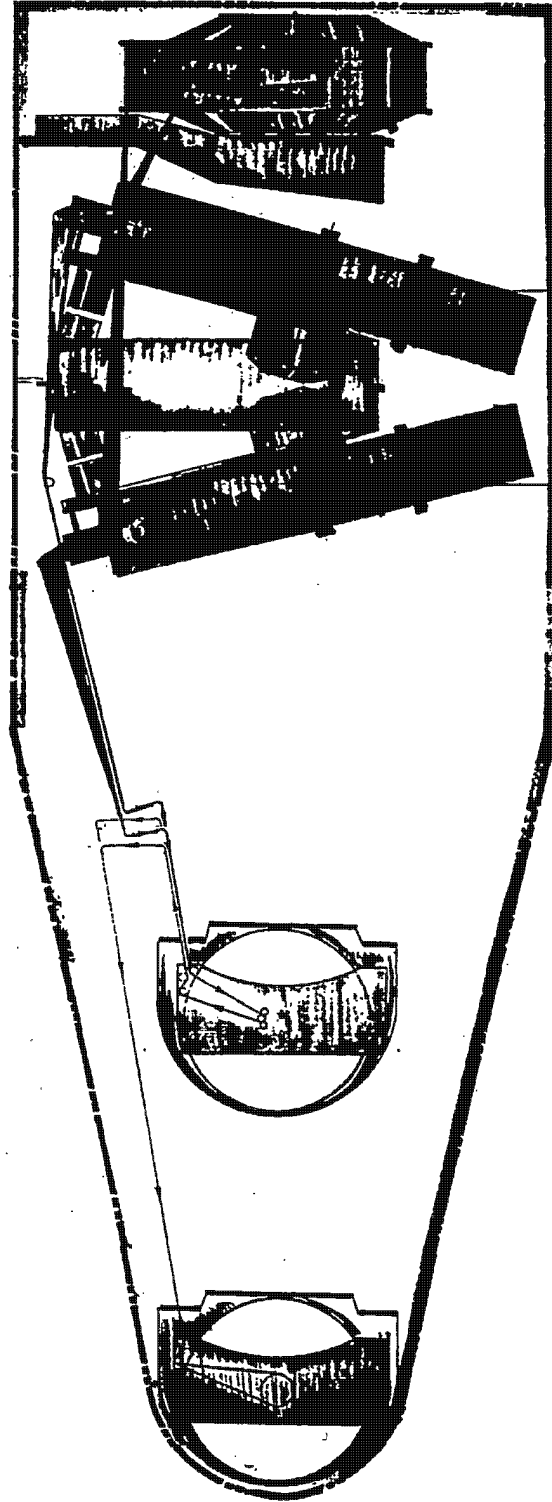
23-24 AUGUST 1966

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J-3 CAMERA SYSTEM



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SYSTEM SPECIFICATION SUMMARY

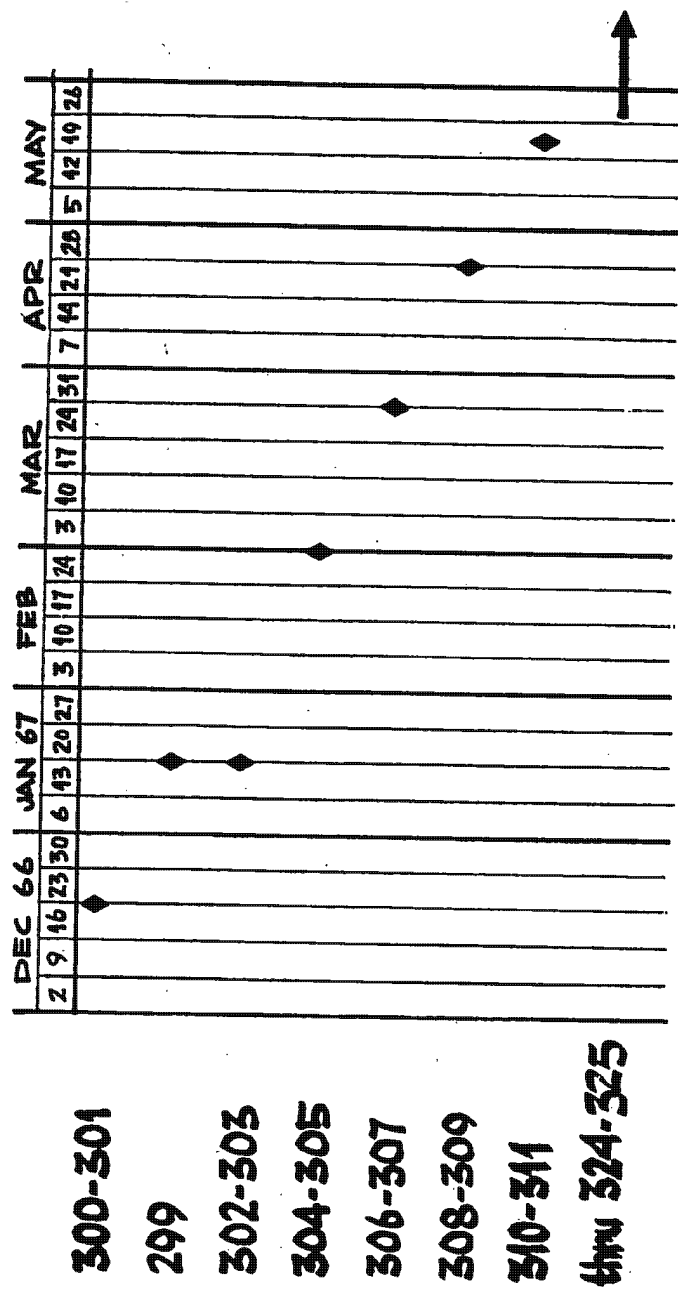
CONFIGURATION	30° CONV. STEREO PANORAMIC
LENS	24-INCH, f/3.5 PETZVAL
FILMS	3404, 180*, 380*, 362*, 121
SUPPLY CAPACITY	15,600 ft/CAMERA
FORMAT SIZE	2.147 X 29.323 INCHES USEABLE
ALTITUDE	80-200 N.M.
SWATH WIDTH	116-290 N.M.
TOTAL FORWARD COVER	7.73-19.33 N.M. (7.6% OVERLAP)
CYCLE RATE	3.74-1.47 RAD/SEC
SYSTEM PERFORMANCE	110 L/m m (2:1 CONTRAST)

* DESIGN GOAL

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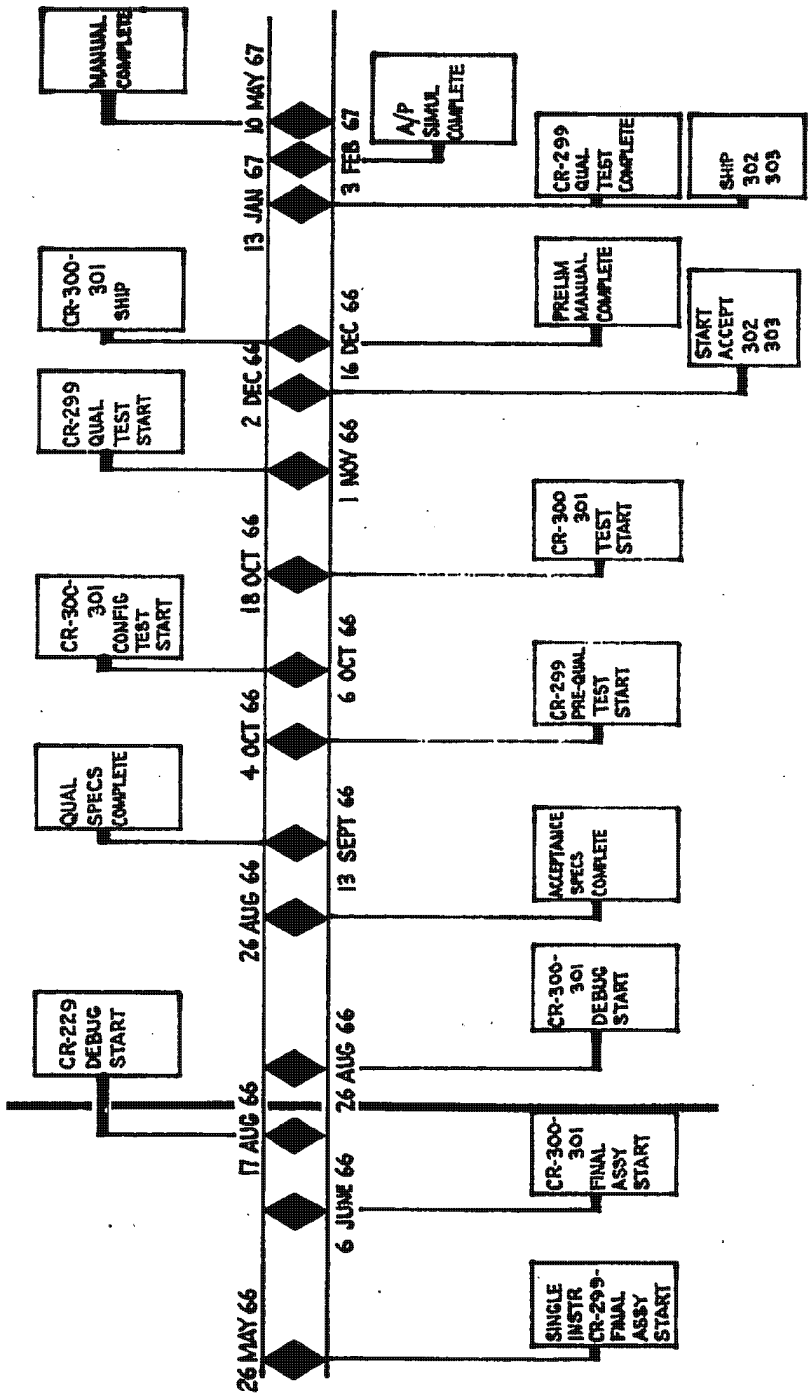
TOTAL PROGRAM DEL. SCHEDULE



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MAJOR MILESTONE DEVELOPMENT SCHEDULE



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DRAWING STATUS AS OF 8/15

	DESIGN	DET & CHECK	RELEASED
MAIN INST	46	58	611
SUPPLY ASSY			101
SUPPLY SPOOL			8
T/UA			130
T/UB			134
I.R			16
GSE	31	30	224
ETL		30	202
AUX STRUCT			33
TOTALS	77	118	1459

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REMAINING MAIN INST DRAWING

AS OF 8/15/66

	DESIGN	DETAIL	CHECK
MAIN ELEC BOX			16
AUX ELEC BOX	46	2	
LIGHT SEAL			1
KAPLAN DRIVE		1	14
AUX OPTICS EXP COMP		19	
LIST MATERIALS		1	
ASSEMBLY		1	1
FAMILY TREES		2	
	46	26	32

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GATING ITEMS

AS OF 8/15/66

MAIN STRUCTURE	UNIT 302 - 8/17, UNIT 303 - 8/22
THEODOSYN BEARINGS	DUE 10/7
THEODOSYN	1ST BERYLLIUM DUE 11/11 1/WK AFTER
CAPACITOR	DUE 8/22
AUXILIARY STRUCTURE	1ST - 8/15, 2ND - 8/19, 3RD - 8/23

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SYSTEM ANALYSIS

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ALONGTRACK IMAGE BLUR - MICRONS

VEHICLE AND INTERFACE	TYPE	BLUR	BASIS
ORBIT MATCH ERROR	R	2.23 COS θ	3 %
V/h COMMAND VOLTAGE	R	2.23 COS θ	3 %
ROLL ATTITUDE	R	0.72 SIN θ	34.3 MIN
ALIGNMENT	F		
PITCH ATTITUDE	R	0.49 COS θ	43.4 MIN
ALIGNMENT	F		
PITCH RATE	R	0.10 COS θ	0.004°/SEC
YAW RATE	R	0.10 SIN θ	0.004°/SEC
TERRAIN HGT VAR	R	0.36	3,000 FT.

NOTES : 80 N.M. - 2.44 M SEC EXP. -30°

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ALONGTRACK IMAGE BLUR - MICRONS

CAMERA	TYPE	BLUR	BASIS
VIBRATION	R	2.0	ASSUMPTION
SERVO ERROR	R	2.23 COS θ	3 %
IMC ERROR (CAM)	F	2.23 COS θ	3 %
UNCOMPENSATED IMC	S	1.85 *	FORMAT WIDTH
LENS DISTORTION	S	0.013 COS θ *	5 μ @ EDGE

* AT EDGE OF FORMAT

NOTE: 80 N.M. - 2.44 M SEC EXP. - 3 σ

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CROSSTRACK IMAGE BLUR - MICRONS

VEHICLE & INTERFACE	TYPE	BLUR	BASIS
ROLL ATTITUDE AND ALIGNMENT	R	0.18 SIN ² θ	34.3 MIN
	F		
YAW ATTITUDE AND ALIGNMENT	R	1.14 COS ² θ	51.6 MIN
	F		
PITCH ATTITUDE AND ALIGNMENT	R	0.43 SIN 2θ	43.4 MIN.
	F		
ROLL RATE	R	0.12	0.005°/SEC
YAW RATE	R	0.03 COS 2θ	0.004°/SEC

NOTES: 80 n.mí, 2.44 MSEC EXPOSURE, 3σ,

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CROSSTRACK IMAGE BLUR, MICRONS

<u>CAMERA</u>	<u>TYPE</u>	<u>BLUR</u>	<u>BASIS</u>
VIBRATION	R	2.0	ASSUMPTION
NODAL POINT LOC.	F	0.22	± 0.001"
I.M.C. CROSS-COUPLING	F	0.11	5 MIN. MISALIGNMENT
CROSSTRACK I.M.	S	9.8 SIN 2θ	UNCOMPENSATED
LENS DISTORTION	S	0.83 *	5 MICRONS AT EDGE
FILM LIFT	S	1.11	0.005" FILM LIFT

* AT EDGE OF FORMAT

NOTE: 80N.M.-2.44 M/SEC EXP.-30°

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BLUR AND GROUND RESOLUTION
ALONG PRINCIPAL AXIS

	ALONG TRACK 0° 30'	ACROSS TRACK 0° 30'
80 NAUTICAL MILES		
BLUR MICRONS	3.28	2.64
GROUND RESOLUTION FT.	6.3	6.1
100 NAUTICAL MILES		
BLUR MICRONS	2.52	1.79
GROUND RESOLUTION FT.	7.6	7.3

NOTE: 2.44 M/SEC. EXP-3404-2:1 CON-20

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OPTICS

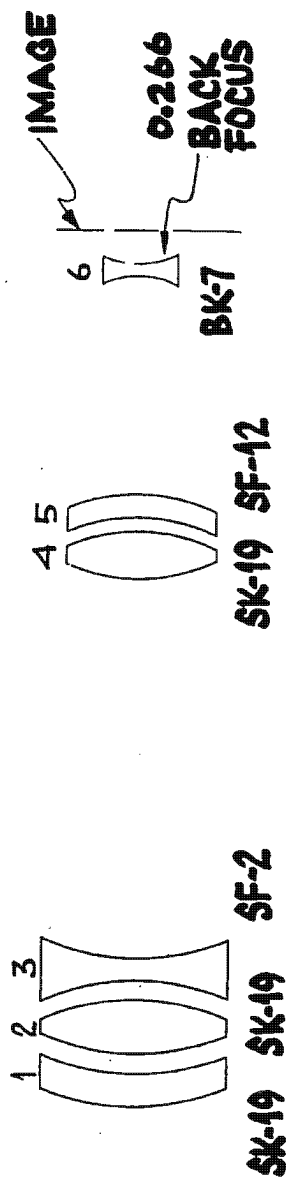
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FIRST GENERATION OPTICAL DESIGN

24 INCH FOCAL LENGTH
 $f/3.5$
 6° FIELD

GLASS WEIGHT $\approx$ 15 POUNDS
 SPECTRAL RANGE 0.5461-0.6900

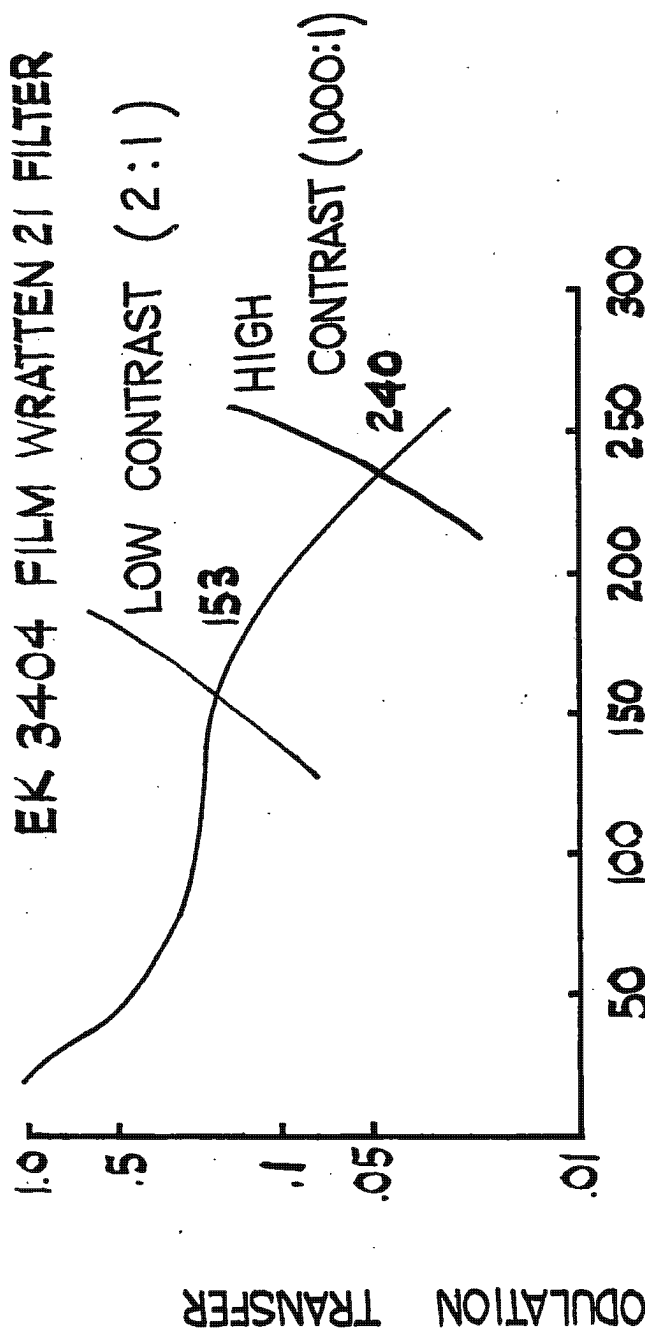


- ELEMENTS 1 AND 3 RELATIVELY THIN
- ELEMENT 3 SMALL DIAMETER
- R.Q. QUALITY GLASS
- 1ST 12 LENSES (INCLUDES QUAL UNIT)

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FIRST GENERATION M.T.F.



ACTUAL PERFORMANCE

DISTORTION $\approx$ 5 MICRONS
 RESOLUTION 140 λ /mm LOW CONTRAST MEASURED
 ON MANN BENCH WITH EK 3404 FILM

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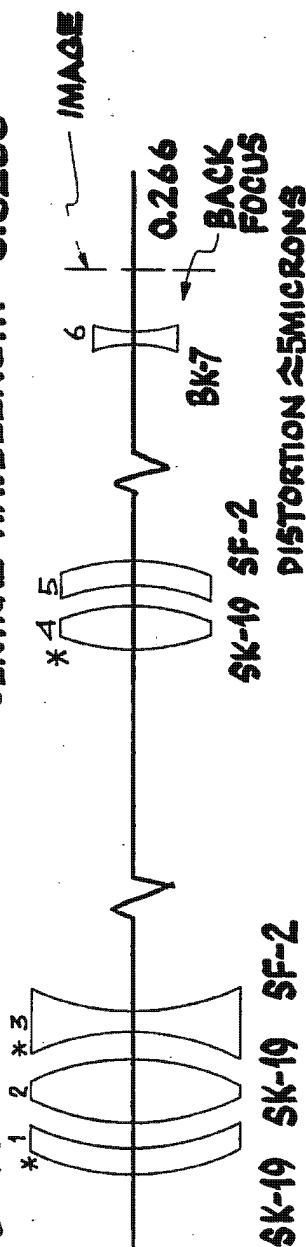
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SECOND GENERATION OPTICAL DESIGN

DESIGN NO. 65-020-03-D3

24 INCH FOCAL LENGTH
 $f/3.5$
 6° FIELD

GLASS WEIGHT $\approx$ 17 POUNDS
 SPECTRAL RANGE 0.5461-0.6900
 CENTRAL WAVELENGTH - 0.6200



SK-19 SK-19 SF-2

SK-19 SF-2

0.266

BACK FOCUS

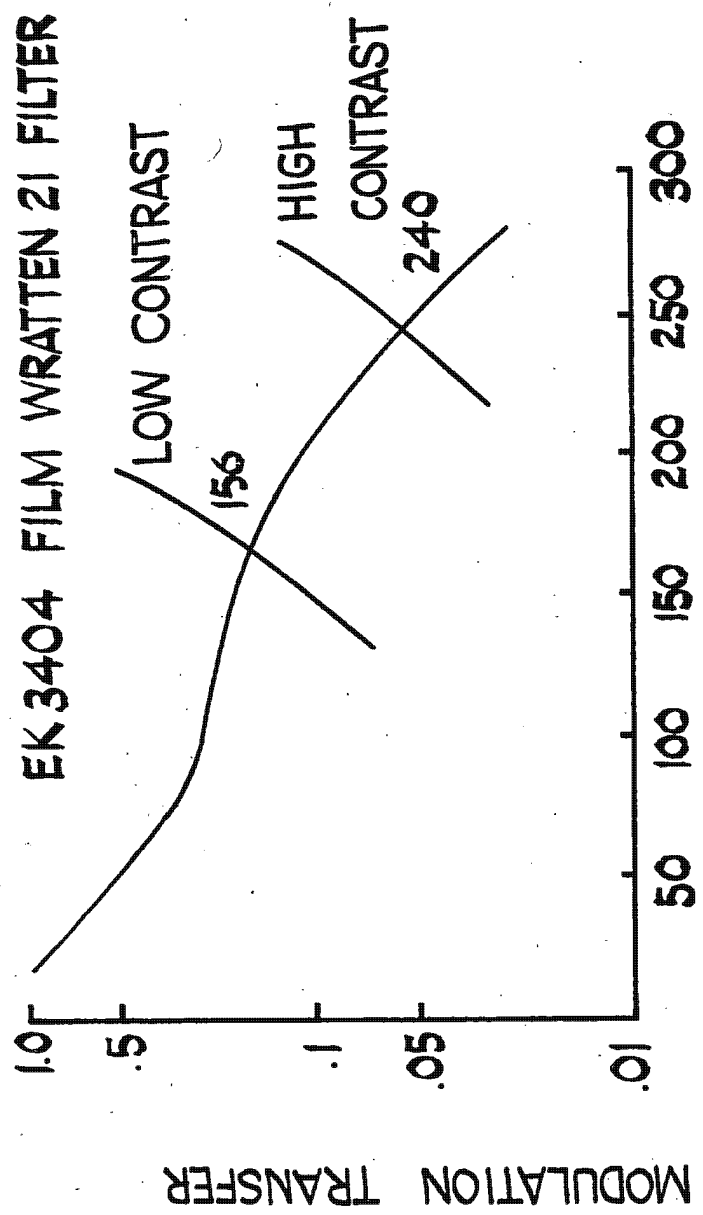
DISTORTION $\approx$ 5 MICRONS

- FIRST THREE ELEMENTS SAME DIAMETER
- ASTRONOMICAL OBJECTIVE QUALITY GLASS
- SF-2 REPLACES SF-12 IN ELEMENTS
- * INDICATES THICKENED ELEMENTS
- 21 LENSES (TOTAL 33 LENSES)

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SECOND GENERATION M.T.F.
EK 3404 FILM WRATTEN 21 FILTER



LINES PER MILLIMETER

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THIRD GENERATION OPTICAL DESIGN

24 INCH FOCAL LENGTH
f/3.5
6° FIELD

GLASS WEIGHT ≈ 17
SPECTRAL RANGE 0.6000 - 0.7100
CENTRAL WAVE LENGTH - 0.6500



DISTORTION ≈ 5 MICRONS

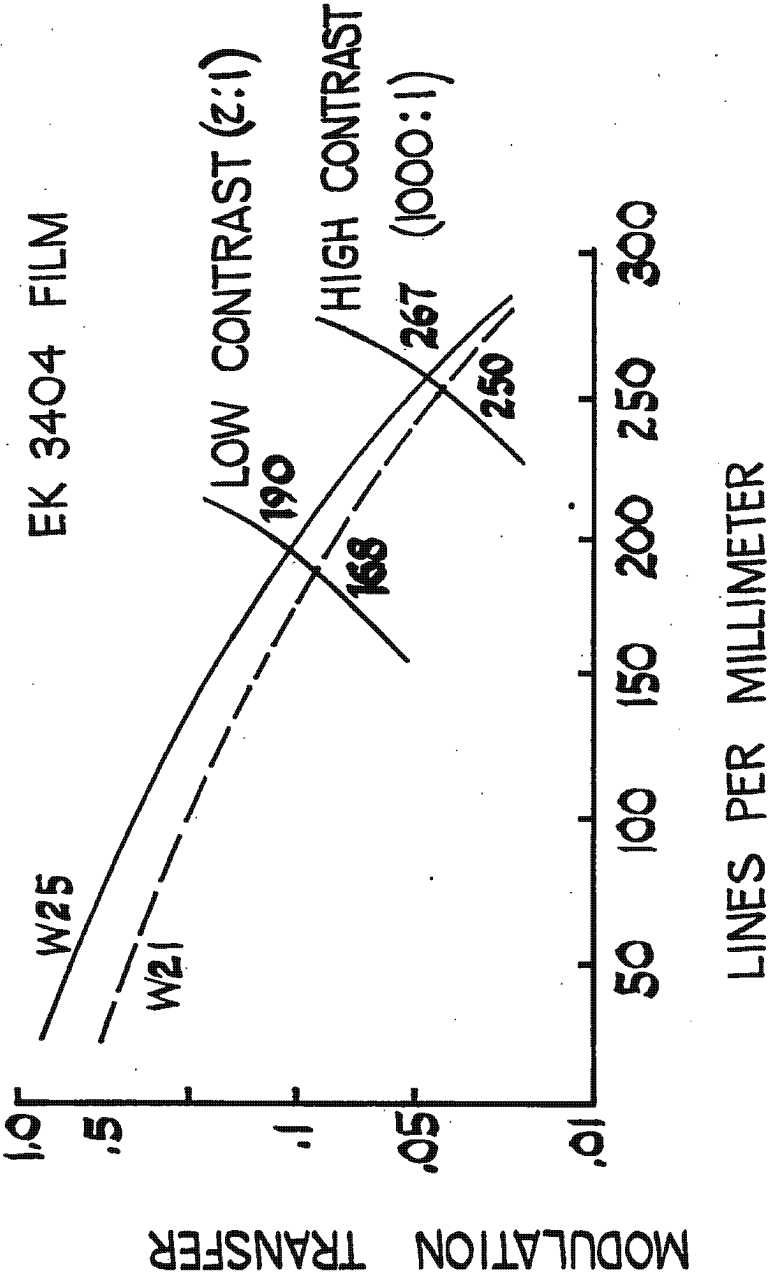
- SAME GLASS TYPES AND QUALITY AS SECOND GENERATION DESIGN
- SAME ELEMENT THICKNESS
- SLIGHTLY DIFFERENT RADII, AIRSPACES
- CENTRAL WAVELENGTH RAISED TO 0.6500, TO MATCH WRATTEN 25 FILTER RESPONSE

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THIRD GENERATION M.T.F.

EK 3404 FILM



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RESOLUTION, I-162, I-164

	I-162	I-164
LOW CONTRAST RESOLUTION	146 μ /mm	150 μ /mm
DISTORTION	3 μ	2 μ
VACUUM FOCAL SHIFT	0.016* INCH	0.016* INCH
VACUUM NODAL SHIFT	0.016** INCH	0.016** INCH

* EMPIRICALLY CONFIRMED ** NOT CONFIRMED

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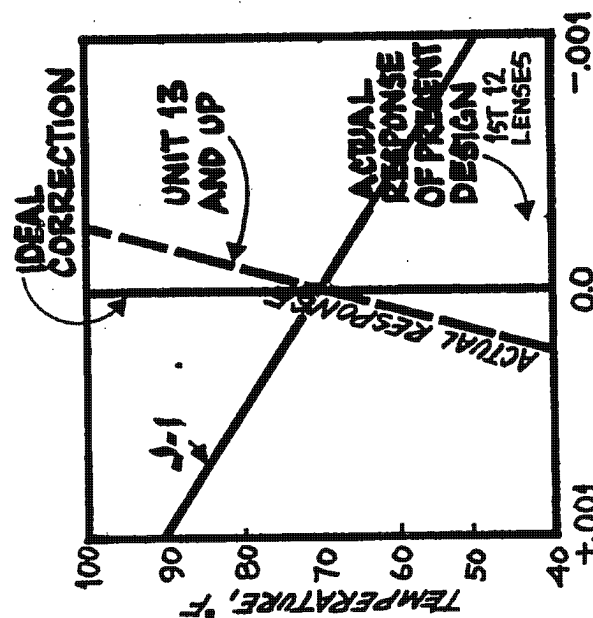
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THERMAL SENSITIVITY (UNIFORM EXCURSIONS)

DESIGN NO. 65-020-03-D3

- MAGNESIUM PETZVAL CELL WITH TITANIUM TAIL CONE MOUNTED AT NODAL POINT

- DESIGNS EXHIBIT SAME DEPARTURE FROM IDEAL
- TOLERANCE OF ± 0.060 " BETWEEN POSITION OF NODAL POINT AND JUNCTION
- ELEMENT THICKNESS, AIRSPACE CHANGES, CURVATURE CHANGES, AND INDEX CHANGES CONSIDERED

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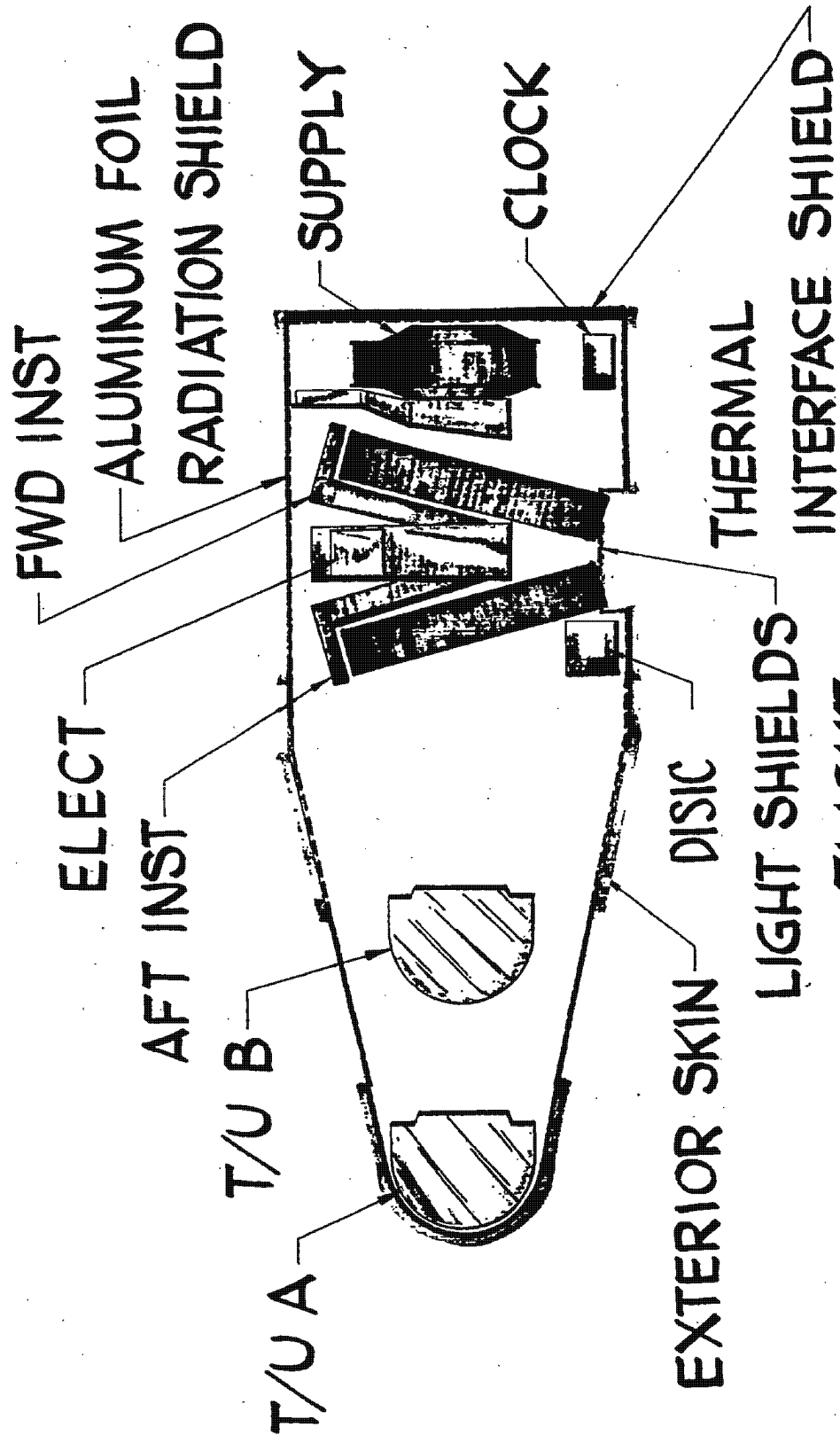
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THERMAL ANALYSIS

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THERMAL DESIGN SUMMARY

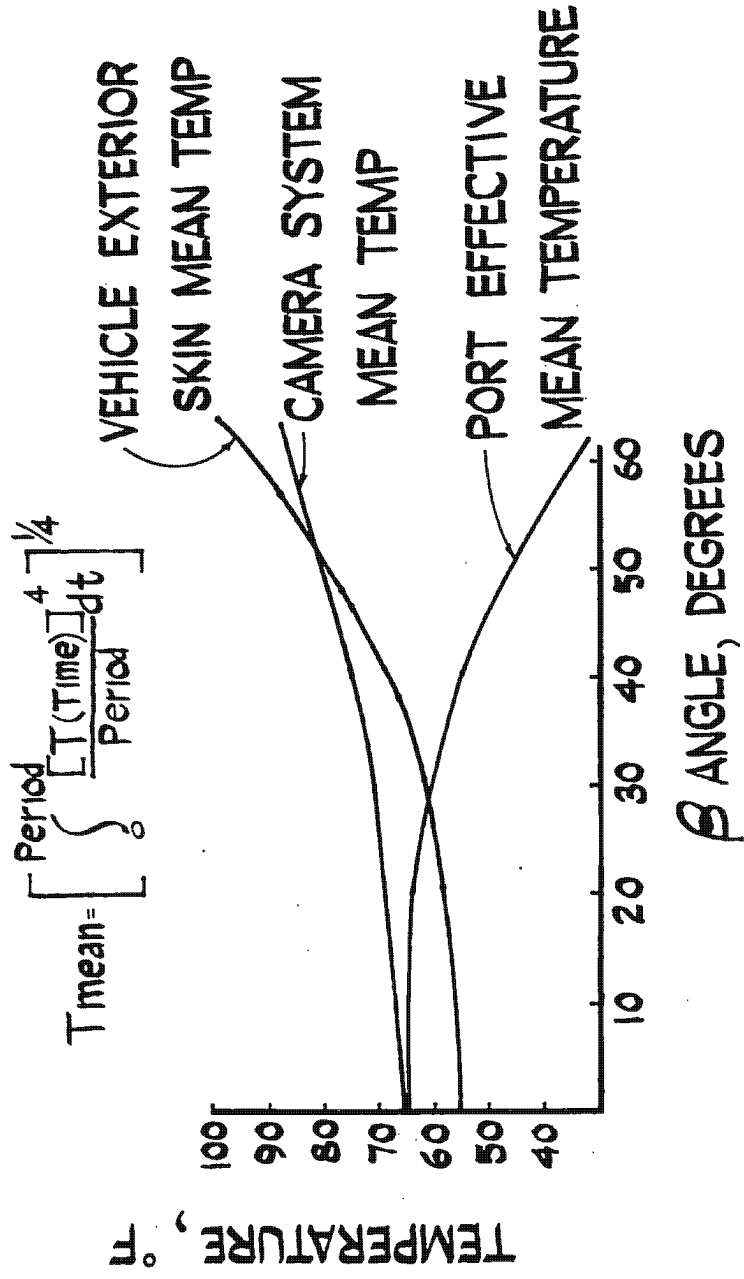


← FLIGHT

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THERMAL ANALYSIS PHILOSOPHY & APPROACH
VARIATION OF TEMPERATURE WITH β ANGLE



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THERMAL MATH MODEL

- THERMAL MATH MODEL DEVELOPED
USES STANDARD NODAL HEAT BALANCE TECHNIQUES
FOR DIGITAL COMPUTER SOLUTION
- SYSTEM REPRESENTED BY 180 NODES; LENS CELL BY
14 NODES
- TEMPERATURE-TIME RESPONSE PREDICTED FOR
ORBITAL CONDITIONS
- PREDICTED LENS TEMPERATURES WITHIN
 $\pm 10^{\circ}\text{F}$ OF NOMINAL

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DETAILED COMPONENT THERMAL DESIGN

- MAIN DRIVE SYSTEM
ISOLATED FROM LENS CELL
- SERVO ELECTRONICS
REMOVE HEAT FROM DIODES

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THERMAL TESTING

	°F	(NON OPERATE)
ELECTRONIC COMPONENTS	0 &	250
ELECTRONIC SUBSYSTEMS		
NON RECOVERABLE	40 &	100 *
RECOVERABLE	40 &	100 *
OPTICAL SUBSYSTEMS	60 &	80 *
MECHANICAL ASSEMBLIES		
NON RECOVERABLE	40 &	100 *
RECOVERABLE	40 &	100 *

* ENG EVAL TO BE RUN AT GREATER LIMITS

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FLIGHT DATA THERMAL ANALYSIS

- ANALYZE 6 FLIGHTS
- FLIGHT SELECTION BASIS
 - FIRST TWO FLIGHTS
 - FLIGHTS WITH TEMPERATURE ANOMALIES
 - FLIGHTS WITH ERRATIC PERFORMANCE
 - FLIGHTS LOGICALLY SPACED THROUGH PROGRAM DURATION
- COMPREHENSIVE ANALYSIS REQUIRES TEMPERATURE/TIME HISTORY DATA

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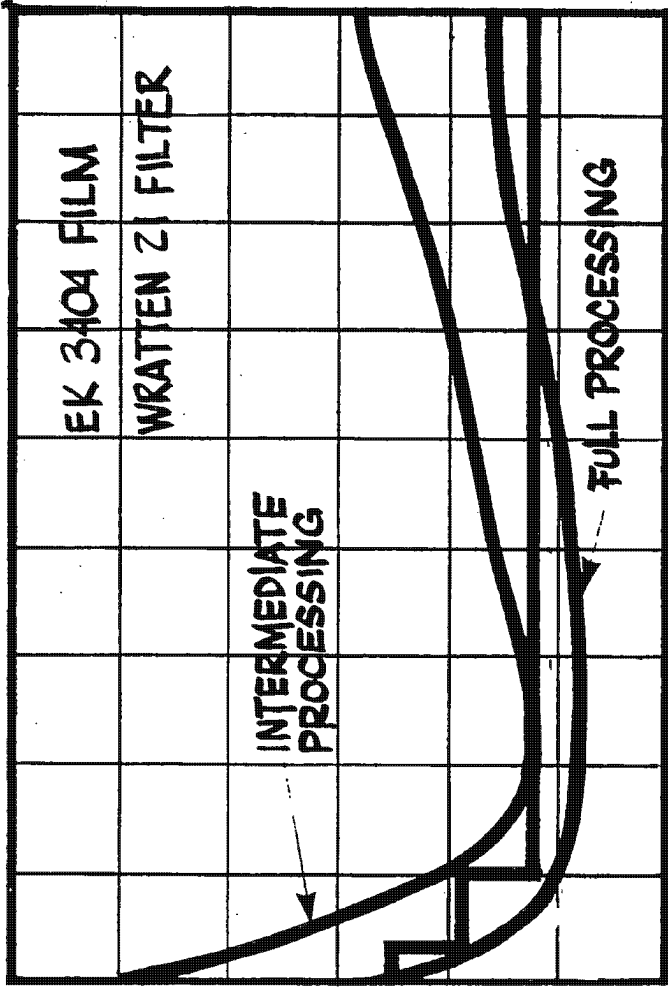
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EXPOSURE CONTROL ANALYSIS

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EXPOSURE vs SOLAR ALTITUDE B & W

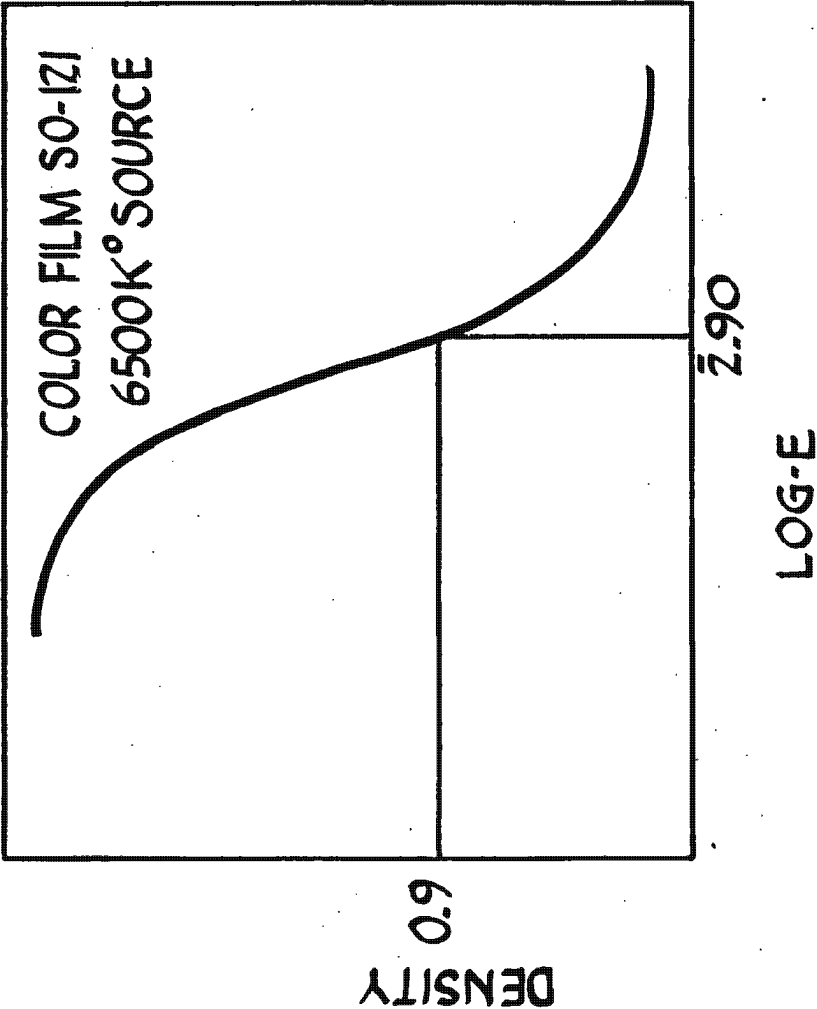


EXPOSURE TIME, MSECS

SOLAR ALTITUDE, DEGREES
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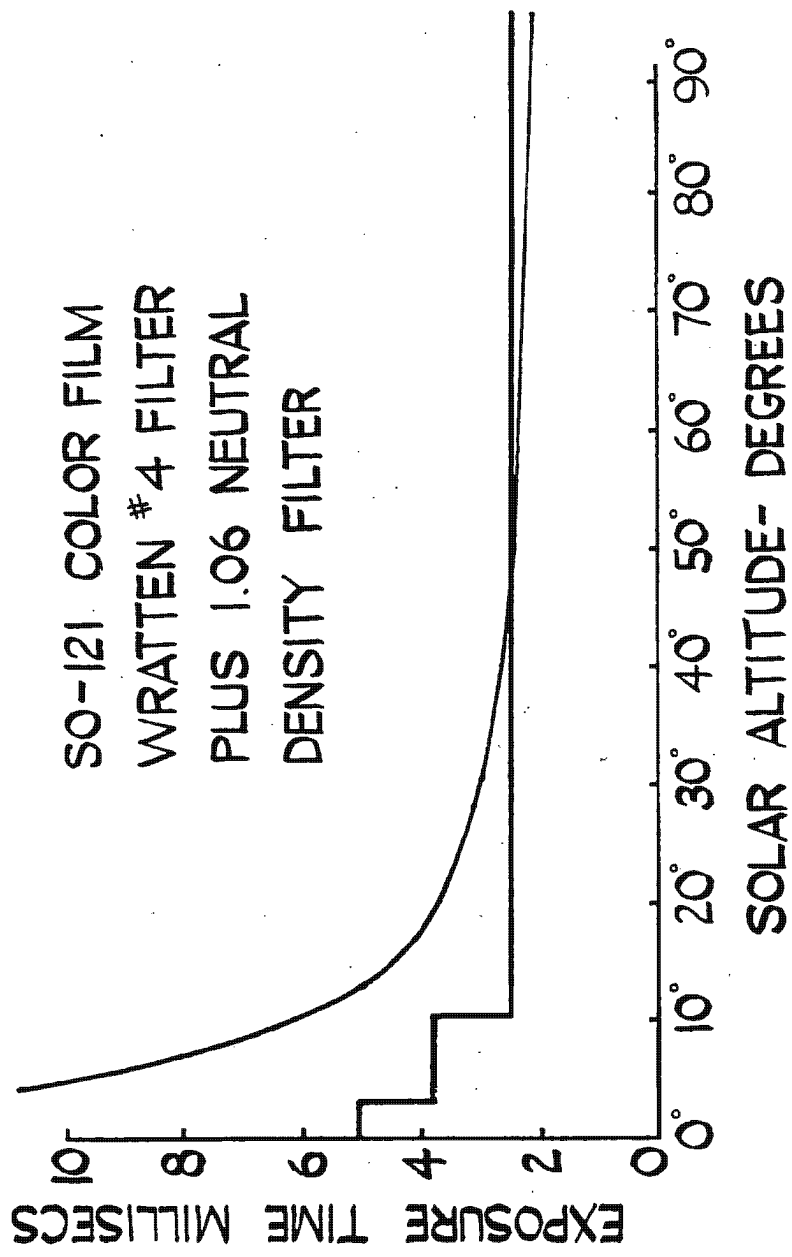
LUMINOUS DENSITY VS LOG-E



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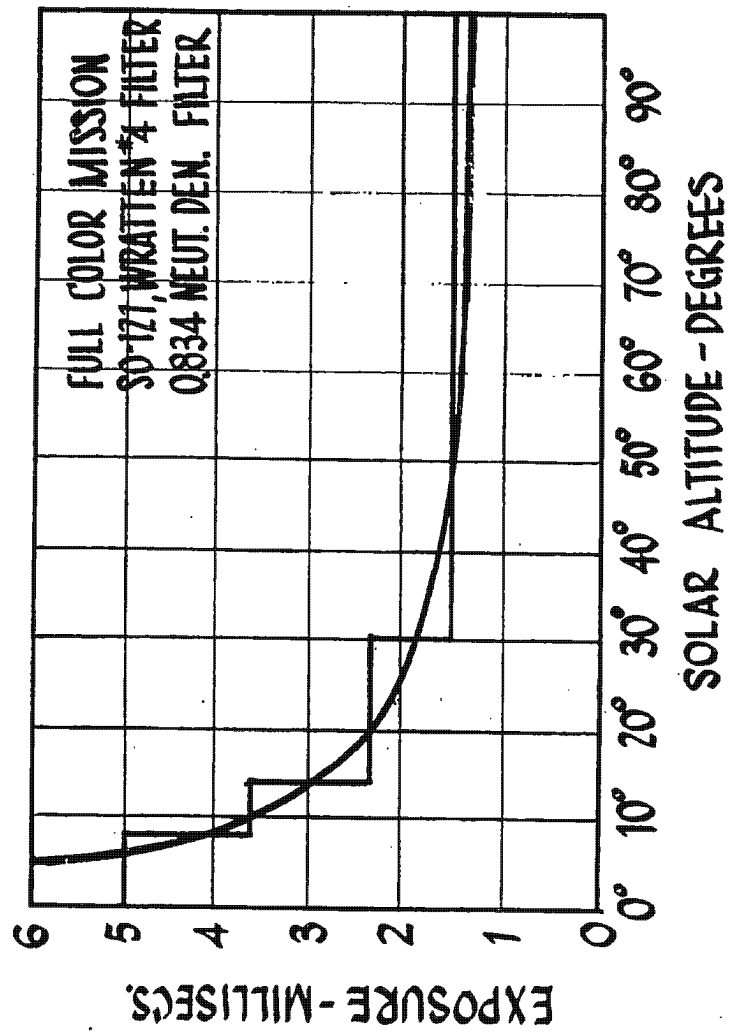
EXPOSURE TIME VS SOLAR ALTITUDE



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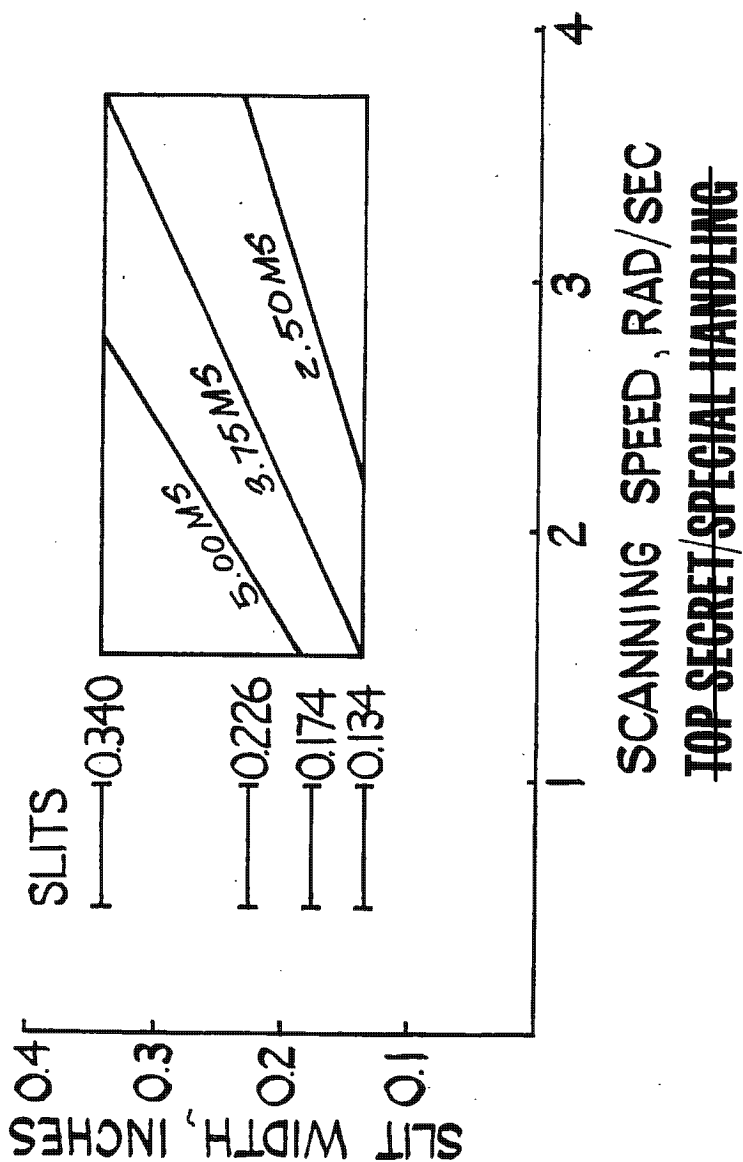
EXPOSURE VS. SOLAR ALTITUDE



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SLIT WIDTH VS SCANNING SPEED
FOR VARIOUS EXPOSURE TIMES



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FLIGHT TEST PROGRAM

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EKJT FLIGHT TEST PROGRAM

BASIC PURPOSE

TO USE SIMILAR CAMERA SYSTEM IN A
HIGH FLYING AIRCRAFT TO EVALUATE
TECHNIQUES THAT WILL ENABLE USE
OF FLEXIBILITY INHERENT IN J-3

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MODEL TESTS

USING MODEL TO COMPARE FILMS UNDER
CONTROLLED CONDITIONS

1. SO-362 VS. 3404

2. SO-121 VS. KODACHROME II VS.
ANSCOCHROME D50

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FLIGHT TESTS

LOW SOLAR ANGLE WITH SO-121

BI COLOR

SO-362 VS. 3404

NIGHT CONTROL

NIGHT DETECTION

FILM / FILTER COMPARISON

EXPOSURE LEVEL WITH 3404

COLOR COMPARISON

INDEX

POLARIZATION

M LAUNCH DETECTION

METRIC TESTS

LOW GAMMA

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EKIT SCHEDULE

	FLIGHT TEST	ANALYSIS REPORT
1. SO-121	COMPLETE	7 SEPT
2. BI-COLOR	COMPLETE	20 SEPT
3. 362 VS 3404	COMPLETE	
4. NIGHT CONTROL		
5. NIGHT DETECTION		
6. FILM/FILTER		
7. INDEX		
8. EXPOSURE LEVEL	COMPLETE	
9. COLOR COMPARISON		
10. POLARIZATION	COMPLETE	
11. M LAUNCH DETECTION		
12. METRIC TEST	16 AUG	
13. LOW GAMMA	18 AUG	

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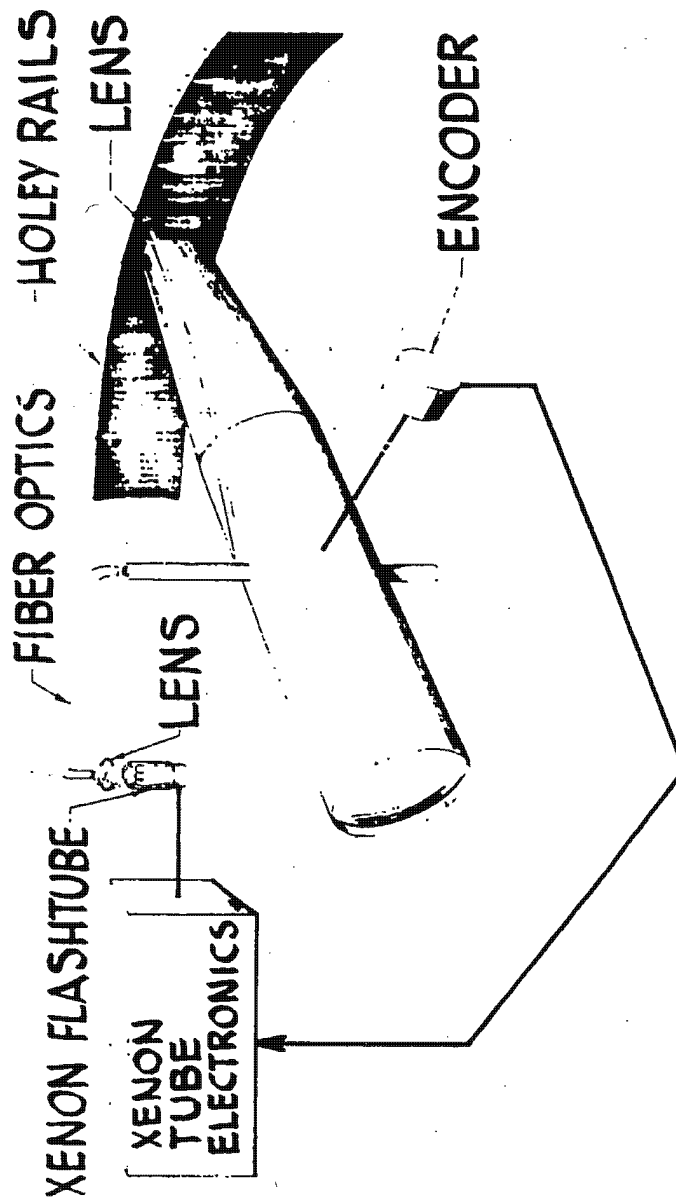
P.G. CALIBRATION

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NOD TO SCAN CALIBRATION

PRIMARY TECHNIQUE (RAIL)



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30 DISTORTION (ACROSS TRACK)

CALIBRATION OF RAIL HOLES	9 MICRONS
FILM FLATNESS	NEGLECTIBLE
RANDOM FILM SHRINKAGE	6.6
RAIL HOLE IMAGE MEASUREMENT	5
CAMERA RESOLUTION	1
FILM LIFT	5
THERMAL DRIFT ($\pm 10^{\circ}\text{F}$)	28
VIBRATION	NEGLECTIBLE
IMAGE POINT MEASUREMENT	5
LENS DISTORTION	NEGLECTIBLE
FOCAL LENGTH ERROR	4.3
	<u>31.7</u>
RSS	

ALLOWABLE ERROR 36 MICRONS

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30 DISTORTION (ALONG TRACK)

CALIBRATION OF RAIL HOLES	9 MICRONS
FILM FLATNESS	1
RANDOM FILM SHRINKAGE	6.6
RAIL HOLE IMAGE MEASUREMENT	5
CAMERA RESOLUTION	1
FILM LIFT	5
SCAN SHAFT BEARINGS	4
THERMAL DRIFT ($\pm 10^{\circ}\text{F}$)	9
VIBRATION	3
MEASUREMENT	5
LENS DISTORTION	3
	RSS 17.8

ALLOWABLE ERROR 36 MICRONS

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CHARACTERISTICS OF DATA

- NOD DOTS - 0.001 - 0.002 DIA
- SOLID LINE - 0.002 WIDE
- DASHES (TIME MARKS) - 0.007 x 0.045
- SIZE IDENTICAL FOR ALL FILMS
(3404-S0380-S0362-S0180-S0121)

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WASHINGTON DATA CENTER

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WASH. DATA CENTER DATA REDUCTION

- MEASUREMENT OF ALL IMAGES - RESEAU, HOLES, TRACES, NOD PULSES, ETC.
- TRANSFORMATION OF MEASUREMENT TO COMMON SYSTEM CORRECTED FOR FILM SHRINKAGE
- CAMERA AXES ORTHOGONALITY DETERMINATION
- SCAN-NOD ANGLE RELATIONSHIP DETERMINATIONS
- FINAL FORMULATION OF RESULTS

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ACTIVITIES WASH. DATA CENTER

A.O.

- ANALYSIS PROGRESSING ON CAMERA CALIBRATION TECHNIQUES FOR PRINCIPAL POINT DETERMINATION

P.G.

- MENSURATION FORMAT ESTABLISHED
- TRANSFORMATION METHODOLOGIES FORMULATED AND PARTIALLY PROGRAMMED
- PRELIMINARY ANALYSIS FOR DETERMINATION OF CAMERA AXES ORTHOGONALITY COMPLETED
- CUSTOMER REQUIREMENTS CURRENTLY BEING INVESTIGATED

A.O.-P.G.

- ANALYSIS COMPLETED AND RESULTS PARTIALLY PROGRAMMED FOR DETERMINATION OF SYSTEM RELATIVE ORIENTATIONS

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TYPE AND SCHEDULE OF REPORTS

QUALIFICATION TEST DATA REDUCTION

- INTERIM P.G. CAPABILITY EVALUATION

(30 OCT 1966)

- FINAL QUAL. DATA EVALUATION (15 FEB 1967)

ACCEPTANCE TEST DATA REDUCTION

- (30 DAYS AFTER ACCEPT. TEST)

OPERATIONAL MATERIAL DATA REDUCTION

- (30 DAYS AFTER RECEIPT OF MATERIAL)

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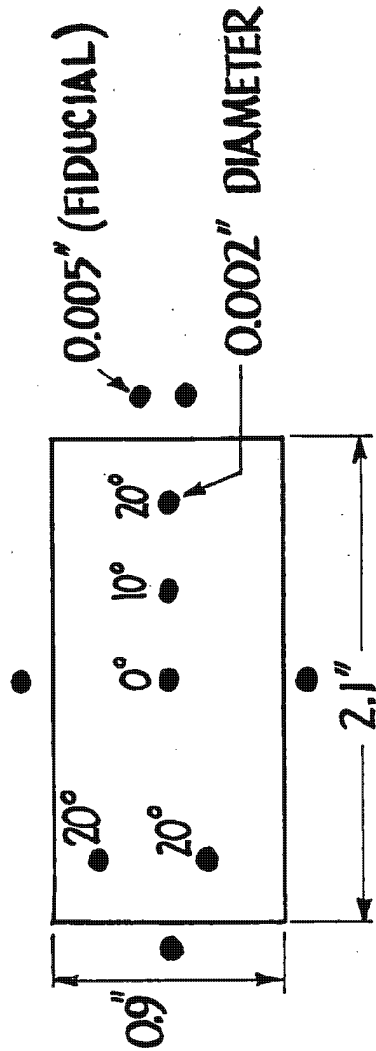
A.O. CALIBRATION

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HORIZON OPTICS CALIBRATION (55MM, f/6.3)

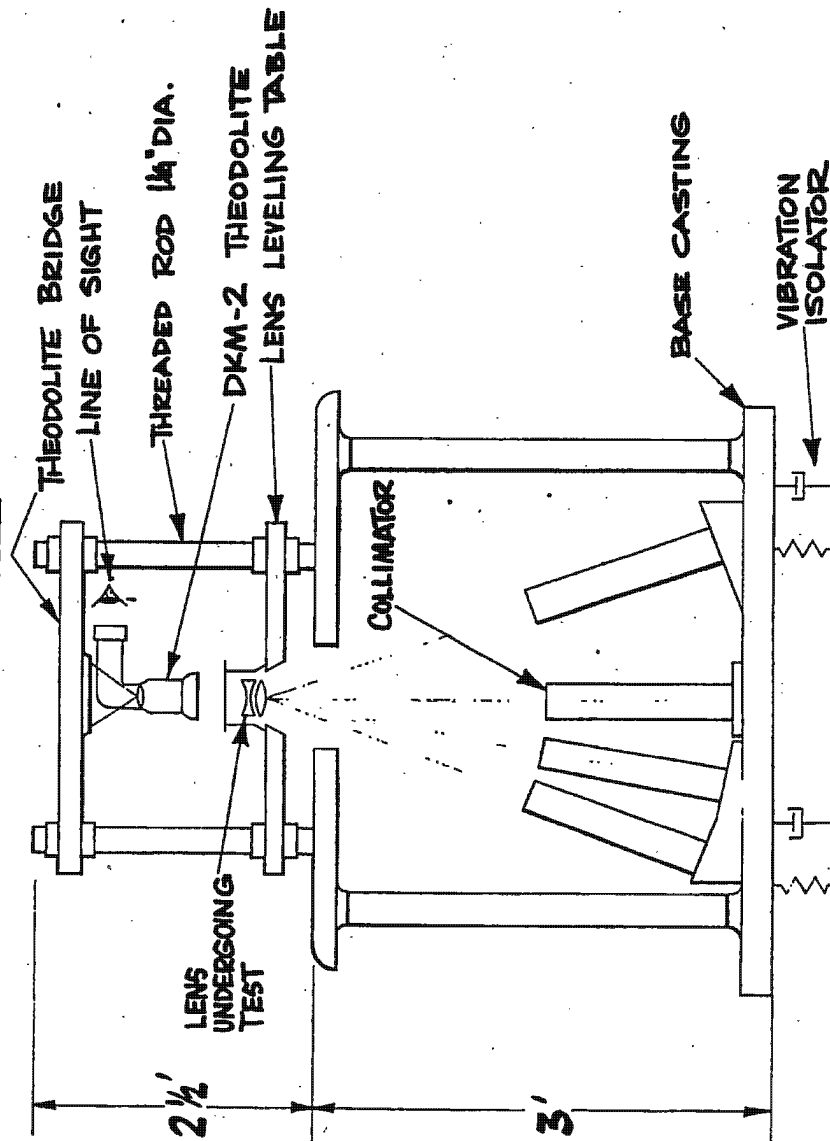
- DETERMINE EQUIVALENT FOCAL LENGTH 25 μ
- DETERMINE PRINCIPAL POINT AUTOCOLLIMATION 10
- DISTORTION CHECK (3 POINTS) 10



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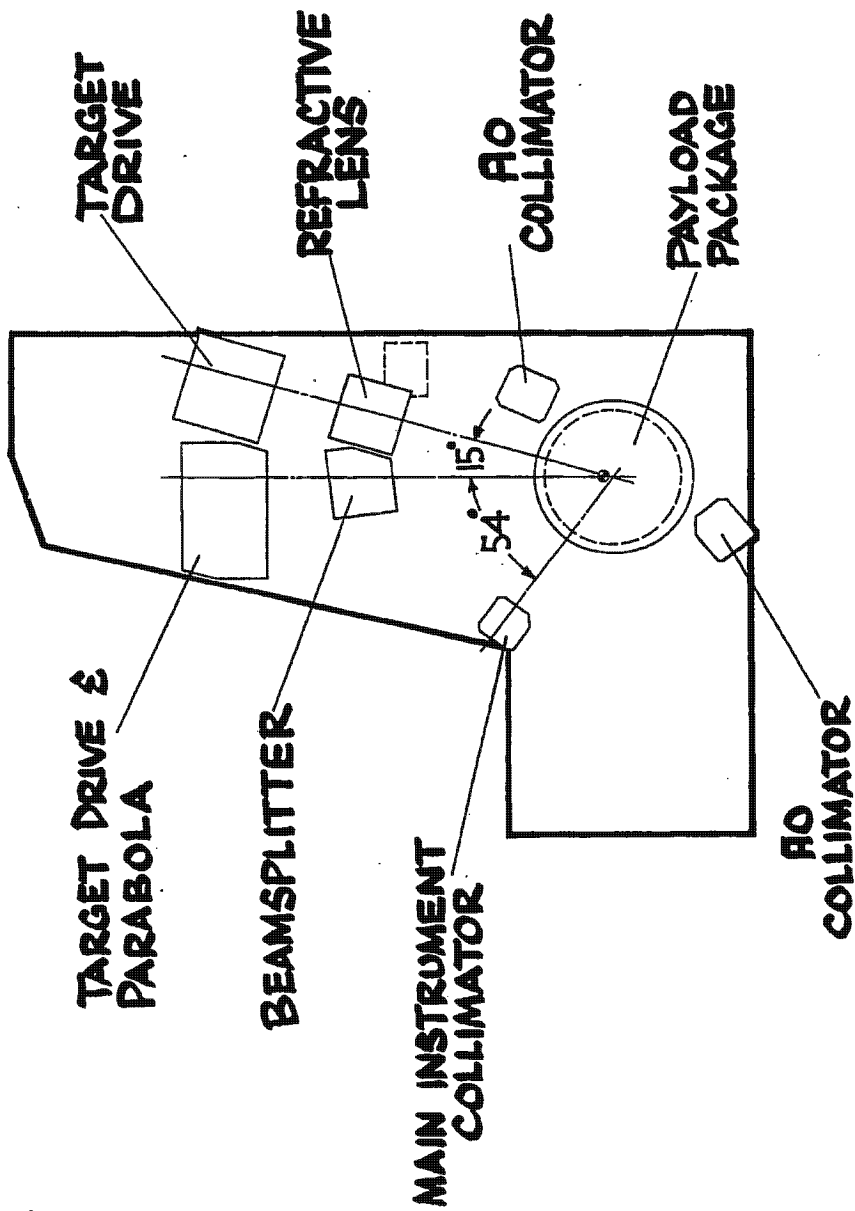
A.O. CALIBRATION DEVICE



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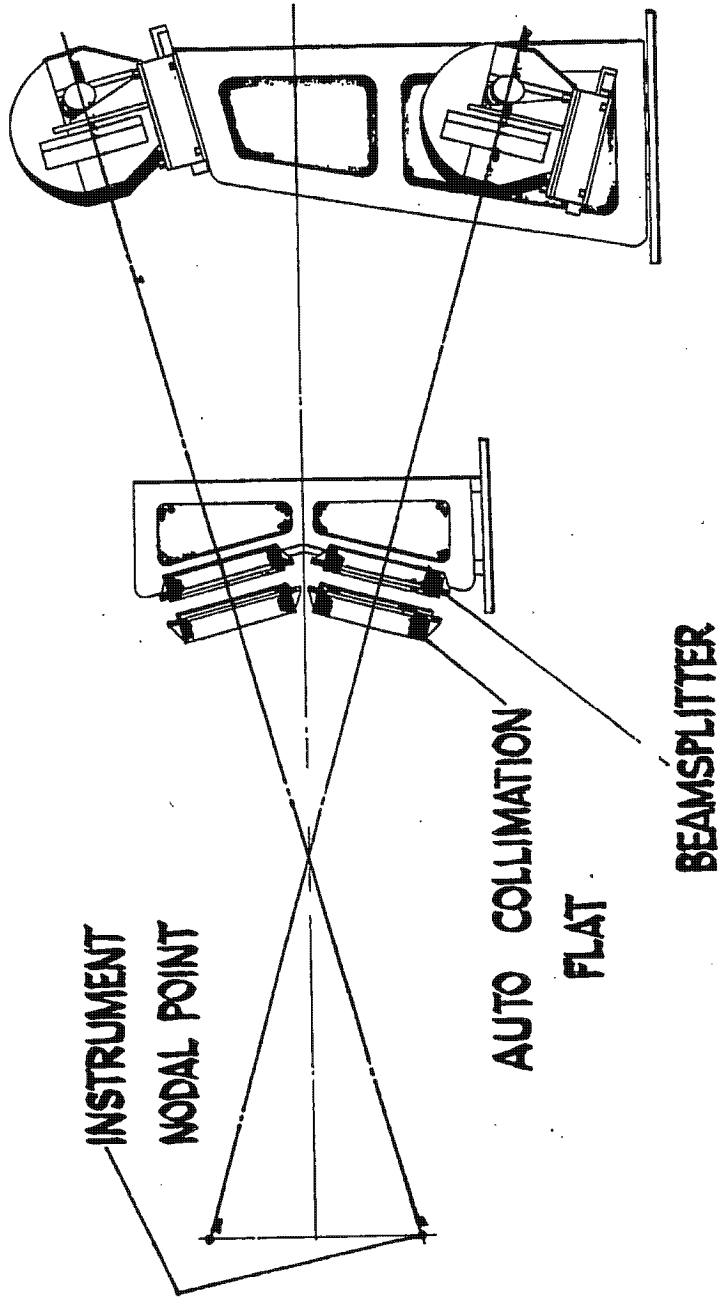
A/P SIMULATOR PLAN VIEW



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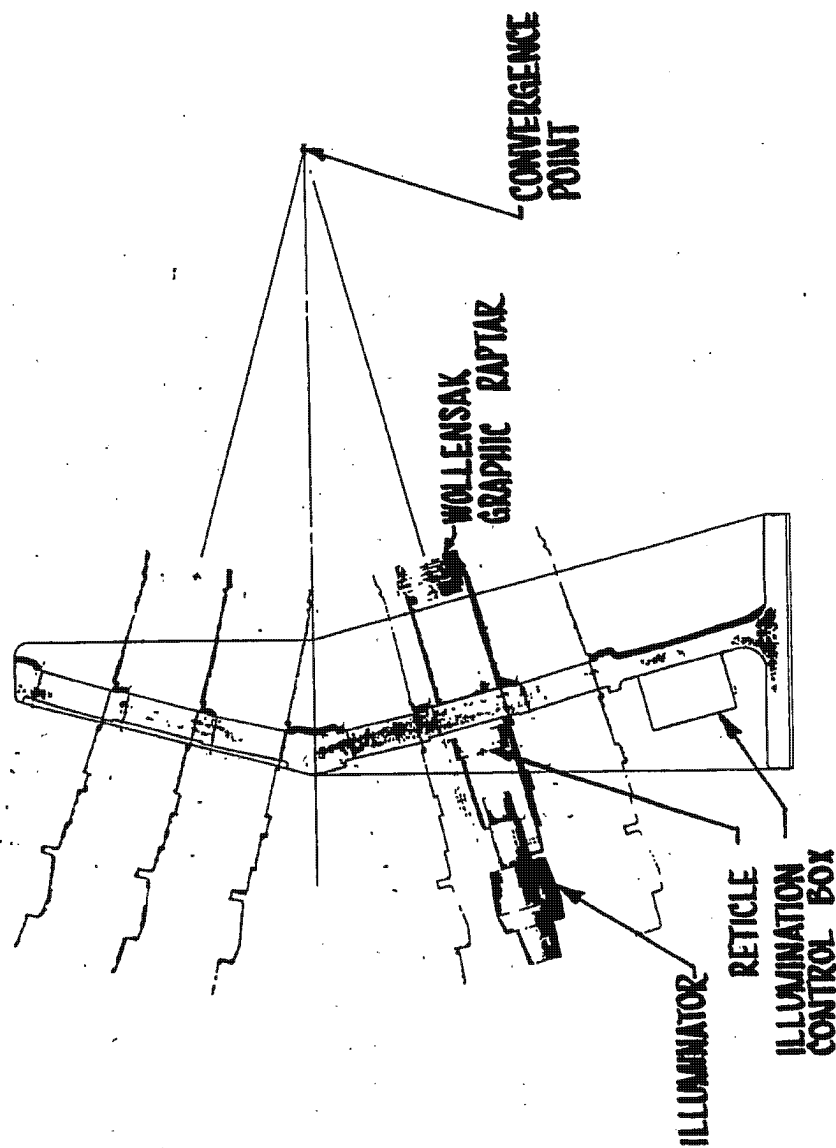
RESOLUTION COLLIMATOR SYSTEM



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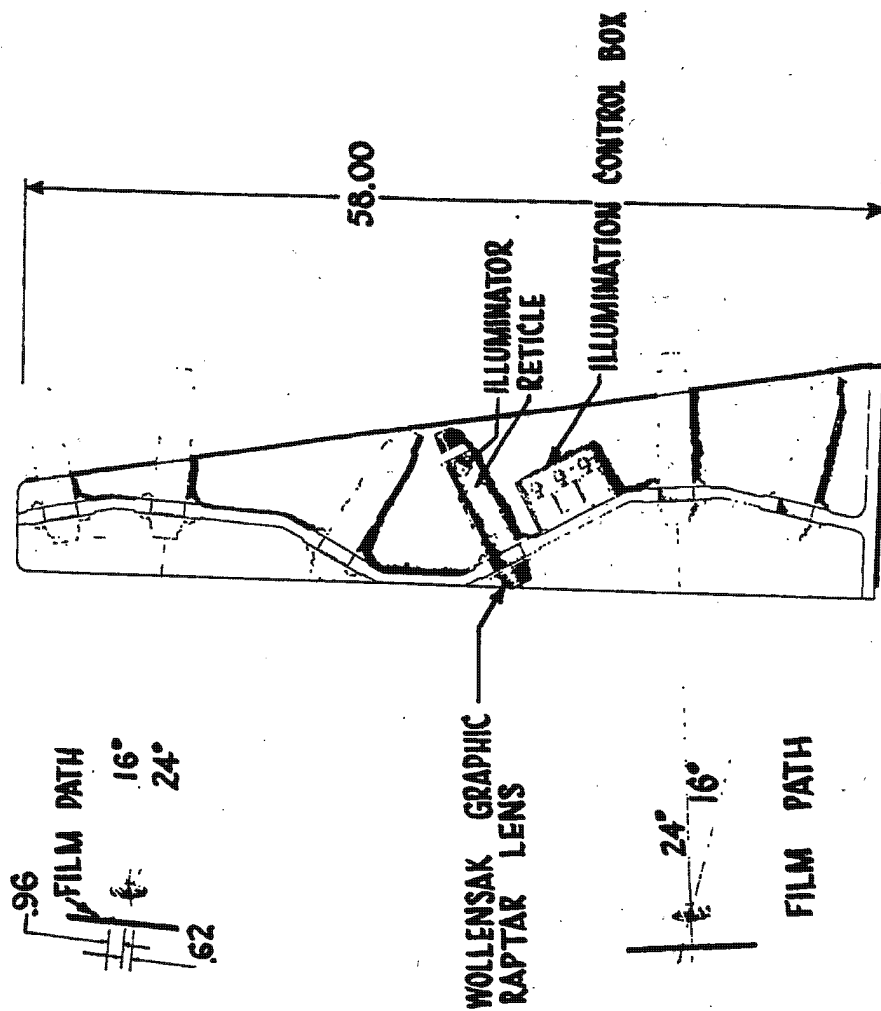
MAIN INSTRUMENT CALIBRATION SYSTEM



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~~TOP SECRET/SPECIAL HANDLING~~

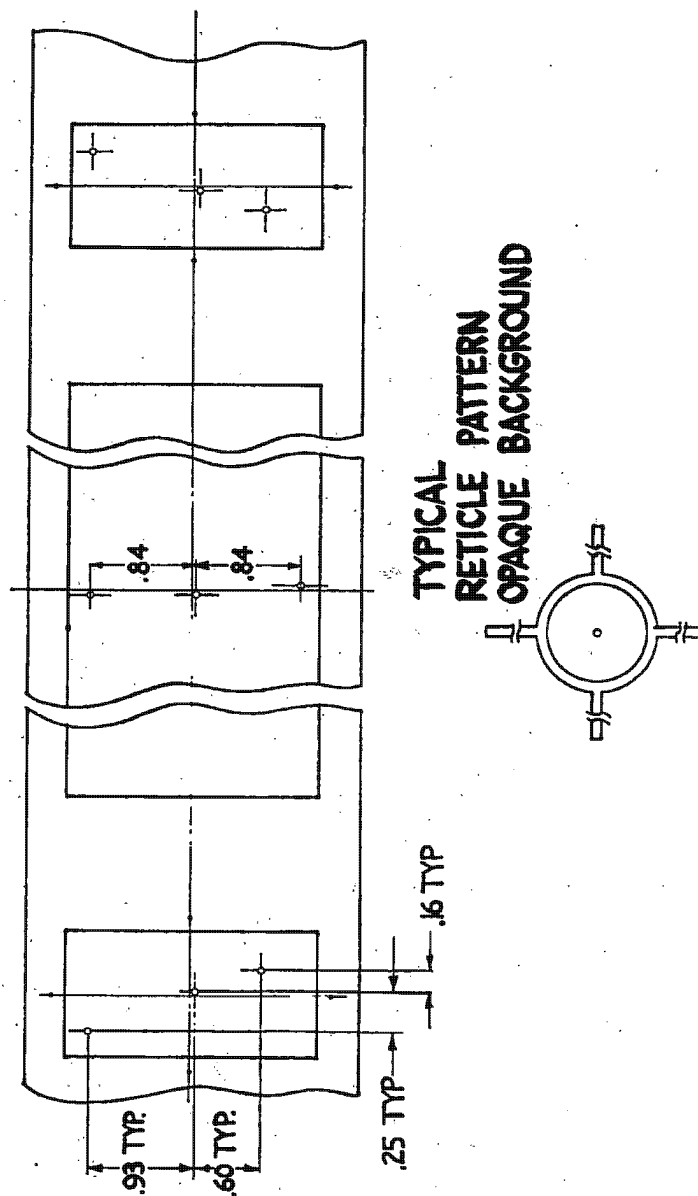
A.O. CALIBRATION SYSTEM



~~TOP SECRET/SPECIAL HANDLING~~

~~TOP SECRET/SPECIAL HANDLING~~

CALIBRATION FORMAT



~~TOP SECRET/SPECIAL HANDLING~~

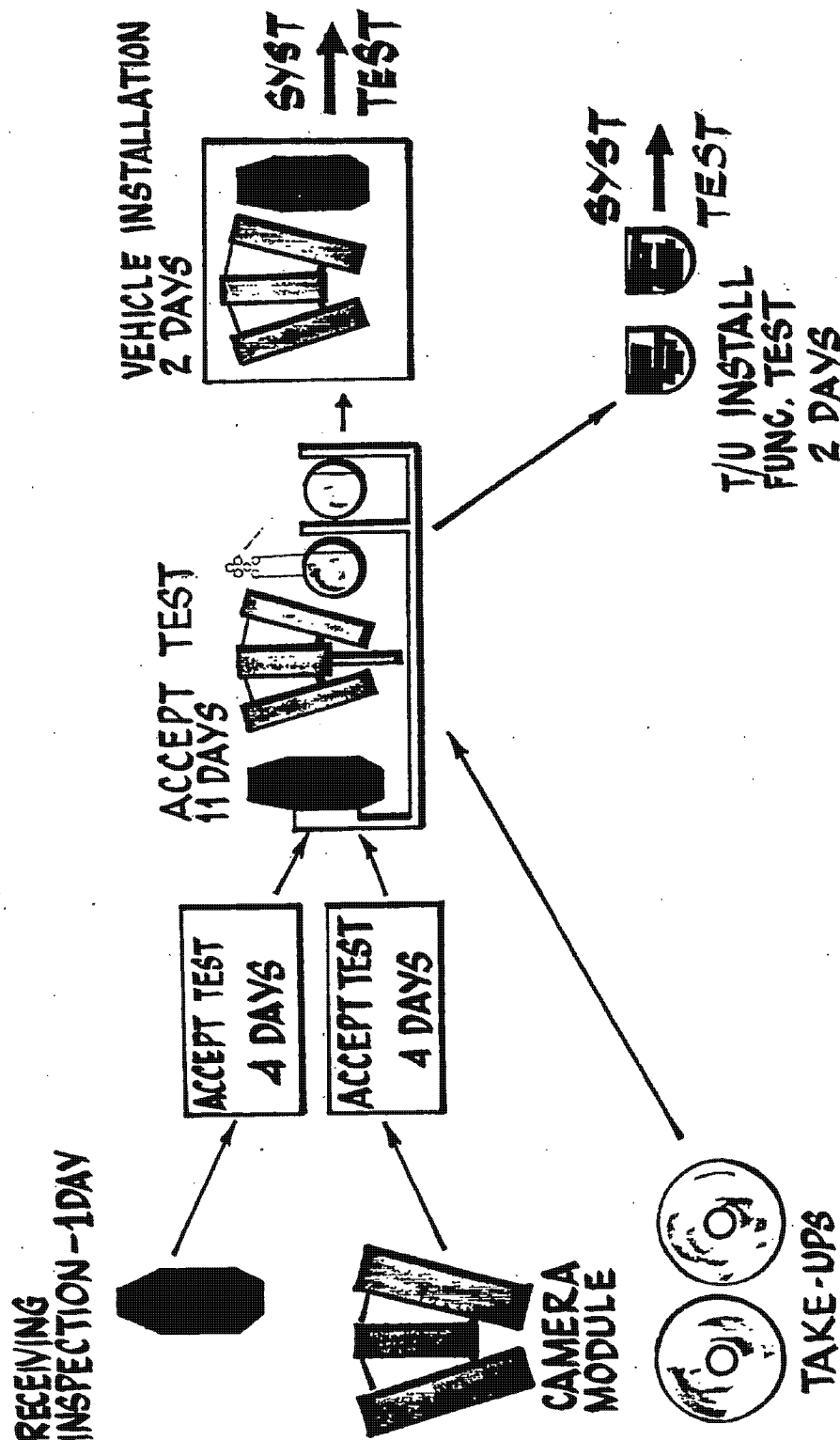
~~TOP SECRET/SPECIAL HANDLING~~

A/P TEST PROGRAM

~~TOP SECRET/SPECIAL HANDLING~~

~~TOP SECRET/SPECIAL HANDLING~~

COMPONENT TEST FLOW THRU A/P



~~TOP SECRET/SPECIAL HANDLING~~

~~TOP SECRET/SPECIAL HANDLING~~

QUALIFICATION TESTING

~~TOP SECRET/SPECIAL HANDLING~~

~~TOP SECRET/SPECIAL HANDLING~~

SINUSOIDAL VIBRATION

SUPPLY AND STRUCTURE

X 5-15 cps	0.18 in (DA)	LIMITED TO 4.0 g AT LOADED
15-20	2.0 g (O-PEAK)	SPOOLS EXCEPT IN 15-20 cps
20-400	1.5 g	" RANGE
400-2000	3.0 g	"
YZ 11-2000 cps	1.0 g	"

ENGR. EVALUATION AT 0.38 in (DA), 4.0, 3.0, 3.5 g's ON X AXIS
AND 2.0 g's ON Y,Z AXES

~~TOP SECRET/SPECIAL HANDLING~~

~~TOP SECRET/SPECIAL HANDLING~~

SINUSOIDAL VIBRATION

CAMERA MODULE W/DUMMY

X	5-15 cps	0.18 in (DA)	LIMIT TO 4.0g AT CELLS
	15-20	3.0g (o-peak)	EXCEPT 15-20 cps RANGE
	20-400	2.0g "	
	400-2000	3.0g "	
Y,Z	11-400	1.0g "	
	400-2000	3.0g "	

~~TOP SECRET/SPECIAL HANDLING~~

~~TOP SECRET/SPECIAL HANDLING~~

T/U SINUSOIDAL VIBRATION

EMPTY

X	5-15 cps	0.5 in (DA)	
	15-20	7.0 g	(O-PEAK)
	20-400	5.0 g	"
	400-2000	7.5 g	"
Y,Z	11-2000	3.0 g	"

~~TOP SECRET/SPECIAL HANDLING~~

~~TOP SECRET/SPECIAL HANDLING~~

RANDOM VIBRATION

	CPS	G ² /CPS	g's RMS
SUBSYSTEMS < 250 [#]	20-400	0.05	14.5
MAJOR SUBASSEMBLIES	400-2000	0.12	
MINOR SUBASSEMBLIES	20-400	0.05	17.5
	400-2000	0.18	

~~TOP SECRET/SPECIAL HANDLING~~

~~TOP SECRET/SPECIAL HANDLING~~

SHOCK AND ACCELERATION

SHOCK, (6-8MS)			ACCEL. **	
MAIN INST	NOT REQD.		- X	11.0g } COMB.
			+ Z	2.0
* FULL T/U	X -20 g		X	11.5
	Y,Z ± 5		+ Z	2.5
EMPTY	X ±20		- X	11.0 } COMB.
	Y,Z ±10		- Z	2.0
FULL SUPPLY	X ±15		- X	11.0 } COMB.
	Y,Z ±10		+ Z	2.0

* NO FILM OR OFF-SPOOLING DAMAGE ALLOWABLE
* * 3MIN EACH DIRECTION AT C.G., CONTINGENT ON AVAILABILITY
OF OUTSIDE FACILITY

~~TOP SECRET/SPECIAL HANDLING~~

~~TOP SECRET/SPECIAL HANDLING~~

QUAL. LEVELS FOR STRUCTURES

SINE VIBRATION		ACCELERATION
AUX STRUCT g SUP STRUCT	X 5-15 cps 0.5 in (DA	-X 11.0g
	15-400 5.0g	COMBINED
	400-2000 10.0g	
MAIN INST STRUCT	YZ 15-2000 3.0g	+Z 2.0g
		-X 11.0g
		+Y 3.0g
		+Z 3.0g

* BY STATIC
LOADING

*TEST COMPLETED-RESULTS FACTORED INTO DESIGN

~~TOP SECRET/SPECIAL HANDLING~~

~~TOP SECRET/SPECIAL HANDLING~~

QUALIFICATION TEMP TEST LEVELS (°F)

	HIGH SOAK	LOW SOAK	HIGH OPER	LOW OPER
CAMERA MOD*			100**	40**
T/U Z			100	40***
SUPPLY			100	40
LENS & CELL	100 (4hr)	40 (4hr)	80	60
ELECT ASSY'S			100	40
MECH ASSY'S			100	40

* ENG EVAL AT 105 AND 35

** IN TOLERANCE 70 ± 10° F ONLY

*** ACCEPTANCE TEST - ALL FLIGHT UNITS

~~TOP SECRET/SPECIAL HANDLING~~

~~TOP SECRET/SPECIAL HANDLING~~

VIBRATION SPECIFICATION WAIVERS

		PLANNED	T3-6002A *
SUPPLY	LONG	5-15 cps	0.18" (P-P)
		15-20	0.38 (P-P)
		20-400	4.0 g (O-P)
		400-2000	3.0 g (O-P)
			3.5 g (O-P)
LAT		15-2000	1.0 g
			2.0 g

* ENG EVAL TO BE PERFORMED AFTER QUAL.

~~TOP SECRET/SPECIAL HANDLING~~

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ACCELERATION SPECIFICATION WAIVERS

PLANNED TEST T3-6-002A REQUIREMENT

LOADED T/U	LONG +11.5g	LONG -15 g
	LAT ±2.5g	LAT ±65g
	3.0 MIN.	10 MIN

NON- RECOVERABLE }
STRUCTURE

+11 +20
± 2 ± 3

ENG. EVAL. TO BE PERFORMED AFTER QUAL.

~~TOP SECRET/SPECIAL HANDLING~~

~~TOP SECRET/SPECIAL HANDLING~~

ITEMS VIBRATION AND SHOCK QUALIFIED

RESISTORS/CAPACITORS/RELAYS/POTS	19 OF 156
INLAND TORQUE MOTOR	1
THEODOSYN ENCODER	1
GLOBE GEARHEAD MOTOR	1
CLUTCH	1
SPINDLE	1
ROLLERS	2
INTERMEDIATE ROLLER ASSEMBLY	1
T/U ASSEMBLY	1
SUPPLY ASSEMBLY	1

~~TOP SECRET/SPECIAL HANDLING~~

~~TOP SECRET/SPECIAL HANDLING~~

INTERFACE

~~TOP SECRET/SPECIAL HANDLING~~

~~TOP SECRET/SPECIAL HANDLING~~

INTERFACE DOCUMENT STATUS

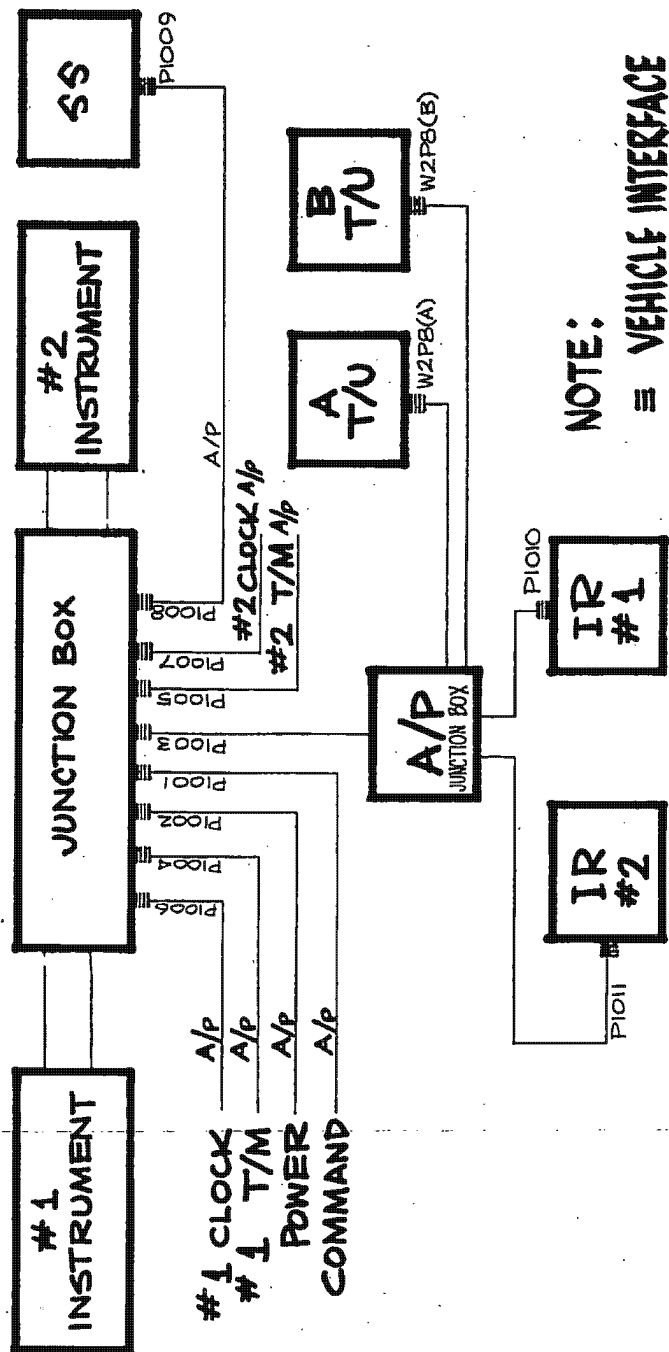
T3-5-019B	ELECTRICAL	APPROVED
T33-100	PAYLOAD COMP	NOT RECEIVED
T33-101B	N/C STA O-86	* APPROVED
T33-102D	N/C STA 86 AFT	BEING REVIEWED
T33-112	EXIT T/U & IR	NOT RECEIVED
T33-113A	MAIN DOOR BOOT	* APPROVED
T33-114A	M.I. ELECT CONN	* APPROVED
ITEK 78900	T/U	* APPROVED
6K636	T/U (A/P X D02)	* APPROVED

* REQUIRE SIGNATURES

~~TOP SECRET/SPECIAL HANDLING~~

~~TOP SECRET/SPECIAL HANDLING~~

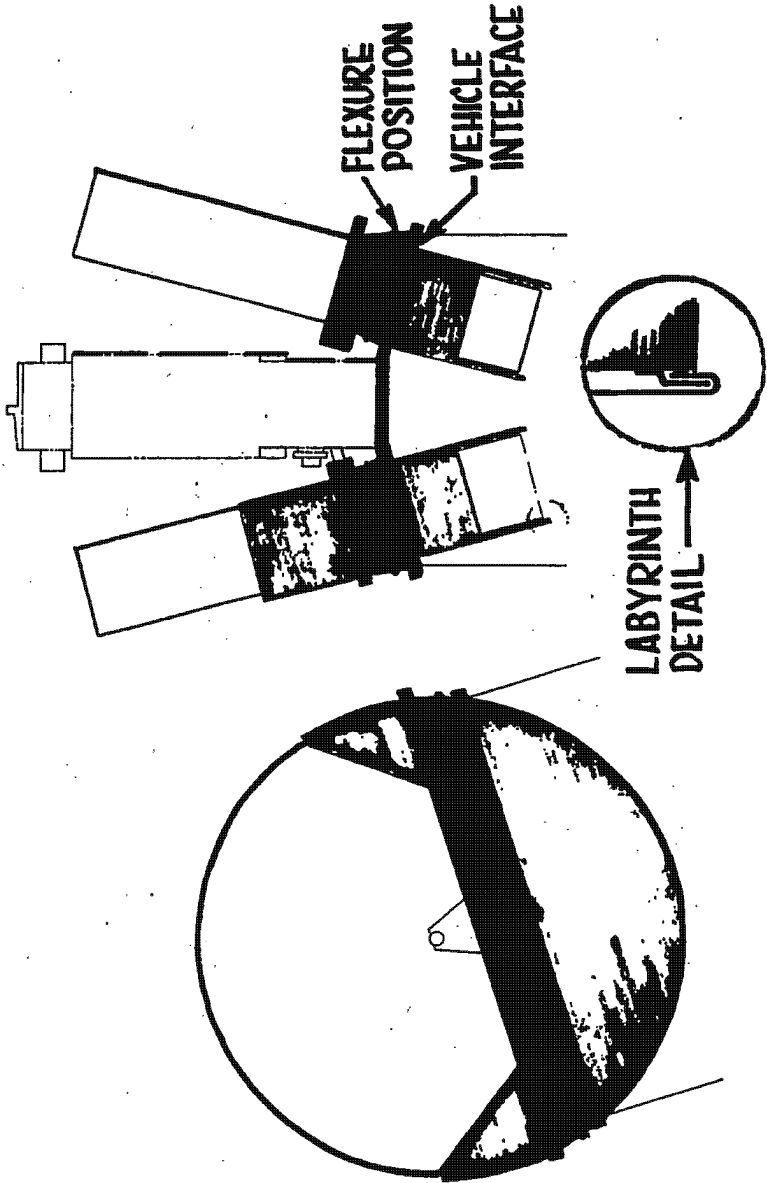
ELECTRICAL INTERFACE



~~TOP SECRET/SPECIAL HANDLING~~

~~TOP SECRET/SPECIAL HANDLING~~

LIGHT SHIELDING



~~TOP SECRET/SPECIAL HANDLING~~

~~TOP SECRET/SPECIAL HANDLING~~

THERMAL INTERFACE

- OPTICAL TRAIN DESIGN GOAL $70 \pm 10^{\circ}\text{F}$
- STRUCTURAL COMPONENTS 70 ± 30
(BASED ON COMMON TEMP. GROUND RULES)

~~TOP SECRET/SPECIAL HANDLING~~

~~TOP SECRET/SPECIAL HANDLING~~

WEIGHT SUMMARY AS OF 8/15

MAIN INSTRUMENT	329
UNIT 1	128
UNIT 2	128
STRUCTURE	26
ELECTRONICS	47
SUPPLY	74
TAKE - UPS	36
MISC. (I.R.)	3
TOTAL	442

~~TOP SECRET/SPECIAL HANDLING~~

~~TOP SECRET/SPECIAL HANDLING~~

POSSIBLE WEIGHT SAVINGS

- MAIN INSTRUMENT STRUCTURE
- RE-DESIGN ALL FIXTURES
- RE-EVALUATE AUXILIARY STRUCTURE

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~~TOP SECRET/SPECIAL HANDLING~~

BRASSBOARD TESTING

~~TOP SECRET/SPECIAL HANDLING~~

~~TOP SECRET/SPECIAL HANDLING~~

BRASSBOARD TESTING RESULTS TO DATE

- SERVO DRIVE SYSTEM PARAMETERS ESTABLISHED
- ECCENTRIC GEAR INPUT METERING SYSTEM TESTING
- FILM FRAMING MECHANISMS TESTING
- FILM TRACKING INTEGRITY ESTABLISHED
- TESTING OF I.M.C. MECHANISMS
- INVESTIGATION OF SYSTEM DYNAMIC EFFECTS

~~TOP SECRET/SPECIAL HANDLING~~

~~TOP SECRET/SPECIAL HANDLING~~

BRASSBOARD TESTING FUTURE PLAN

- FILM FLATNESS INVESTIGATIONS
- PAN GEOMETRY AND DATA READOUT INVESTIGATIONS
- ELECTRICAL CONTROL SYSTEM CHARACTERISTICS

~~TOP SECRET/SPECIAL HANDLING~~

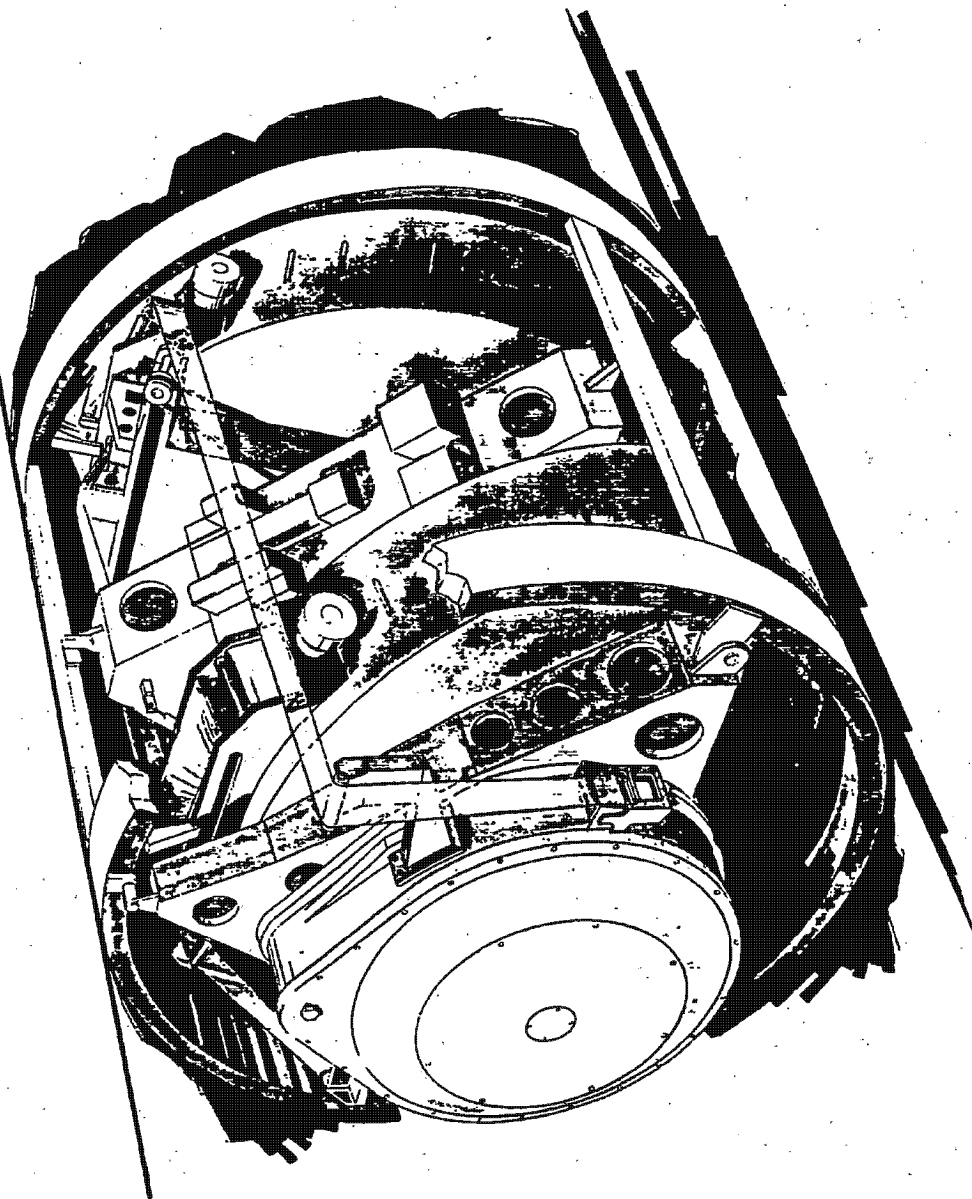
~~TOP SECRET/SPECIAL HANDLING~~

MAIN INSTRUMENT

~~TOP SECRET/SPECIAL HANDLING~~

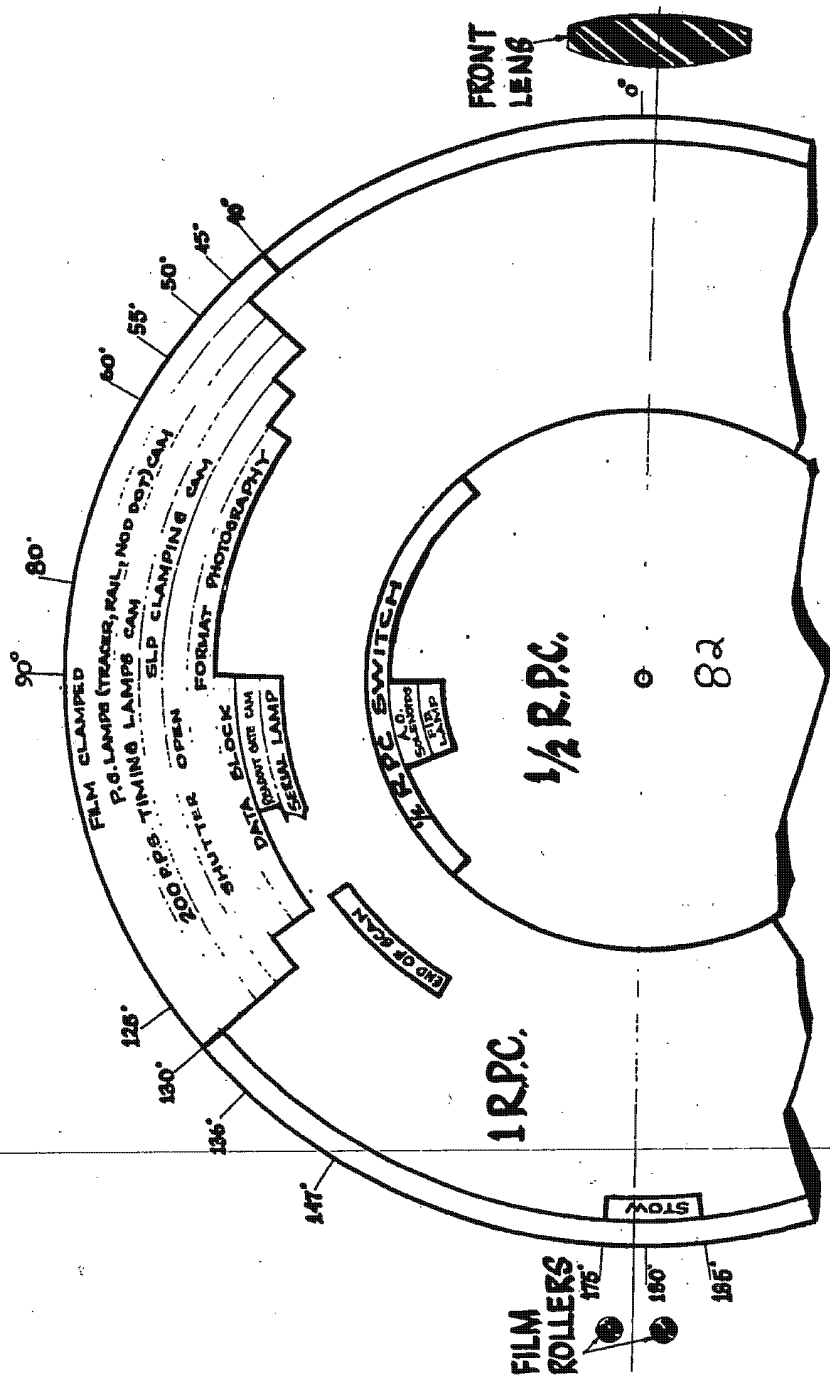
~~TOP SECRET/SPECIAL HANDLING~~

CAMERA MODULE



~~TOP SECRET/SPECIAL HANDLING~~

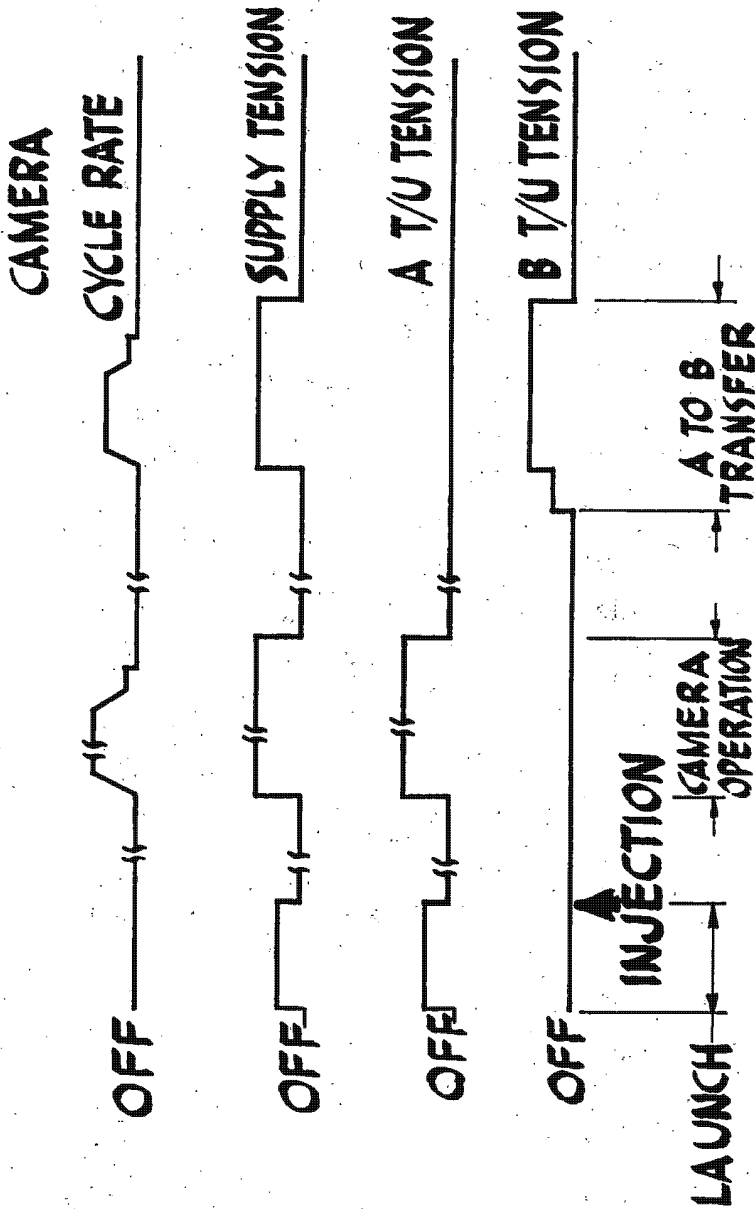
CAMERA EVENTS



~~TOP SECRET/SPECIAL HANDLING~~

~~TOP SECRET/SPECIAL HANDLING~~

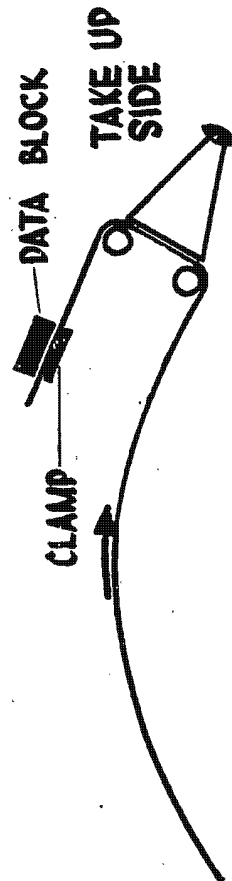
SYSTEM SEQUENCE



~~TOP SECRET/SPECIAL HANDLING~~

~~TOP SECRET/SPECIAL HANDLING~~

TIME RECORDING



FEATURES

- UTILIZES SILICON LIGHT PULSE BLOCK (SLP)
- PRINTS TIME ON PRECEDING FRAME
- MOUNT AND CABLE INTERFACE ONLY

PROBLEMS

EMULSION DUST SENSITIVITY

DISC CORRELATION

NONE PROVIDED

~~TOP SECRET/SPECIAL HANDLING~~

~~TOP SECRET/SPECIAL HANDLING~~

EXPOSURE CONTROL

~~TOP SECRET/SPECIAL HANDLING~~

~~TOP SECRET/SPECIAL HANDLING~~

DESIGN FEATURES

SLIT WIDTH

- PREDETERMINED FAILURE WIDTH (MID RANGE)
 - FOUR SELECTABLE SLITS PLUS FAILURE WIDTH
 - INTERCHANGEABLE CAMS ON INSTALLED SYSTEM
 - RTC REQUIRED FOR FAILSAFE
 - CAPABILITY OF RTC RESET AFTER FAILSAFE SIGNAL
- ### FILTER SELECTOR

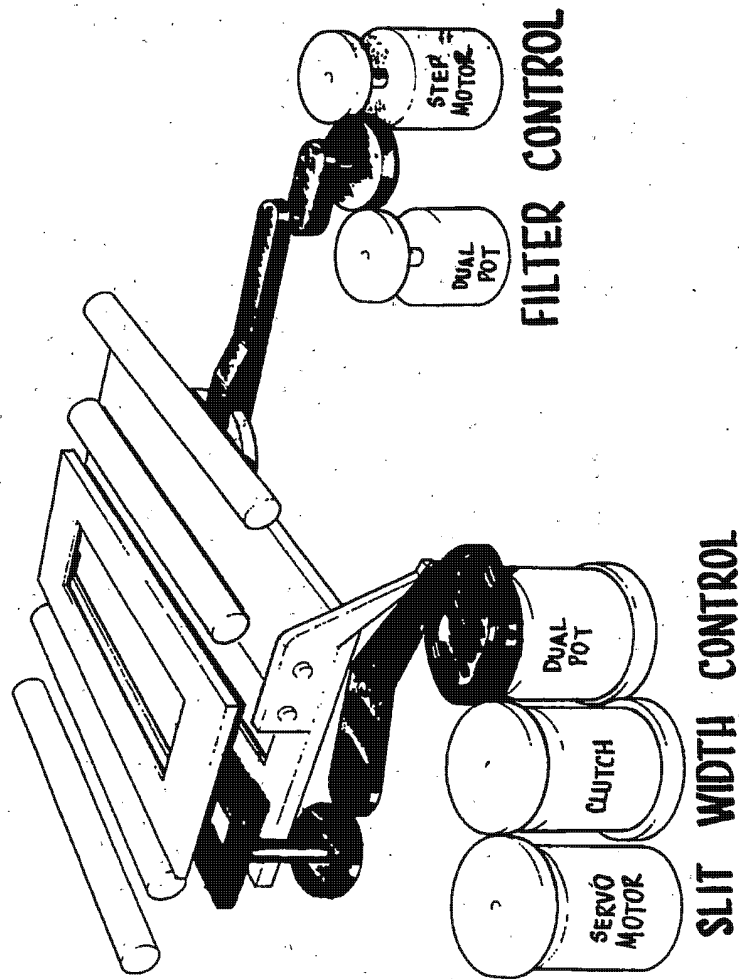
- REMOTE CHOICE OF 2 FILTERS
- INTERCHANGEABLE FILTER CARRIERS ON INSTALLED SYSTEM

- FILTER PLUS NEUTRAL DENSITY ELEMENT AT SAME STATION

~~TOP SECRET/SPECIAL HANDLING~~

~~TOP SECRET/SPECIAL HANDLING~~

SLIT WIDTH CONTROL



~~TOP SECRET/SPECIAL HANDLING~~

~~TOP SECRET/SPECIAL HANDLING~~

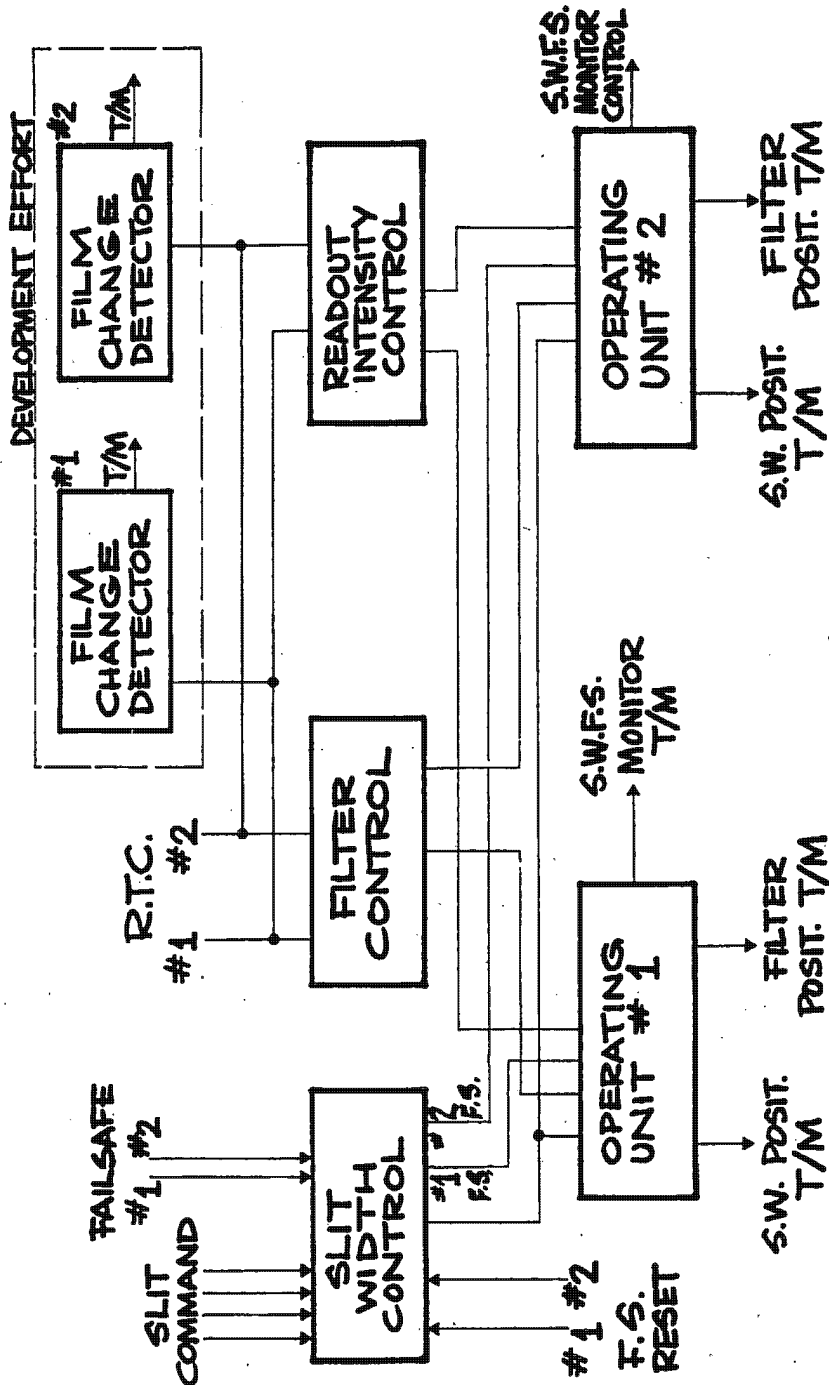
EXTERNAL COMMANDS

- FOUR LINE SLIT WIDTH COMMAND
(ONE OF FOUR ENERGIZED CONTINUOUSLY)
- TWO LINE - SLIT WIDTH FAIL SAFE
- TWO LINE - S.W.F.S. RESET
- TWO LINE - FILTER, A.O., + READOUT CHG.

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~~TOP SECRET/SPECIAL HANDLING~~

EXPOSURE AND READOUT CONTROL BLOCK DIAGRAM

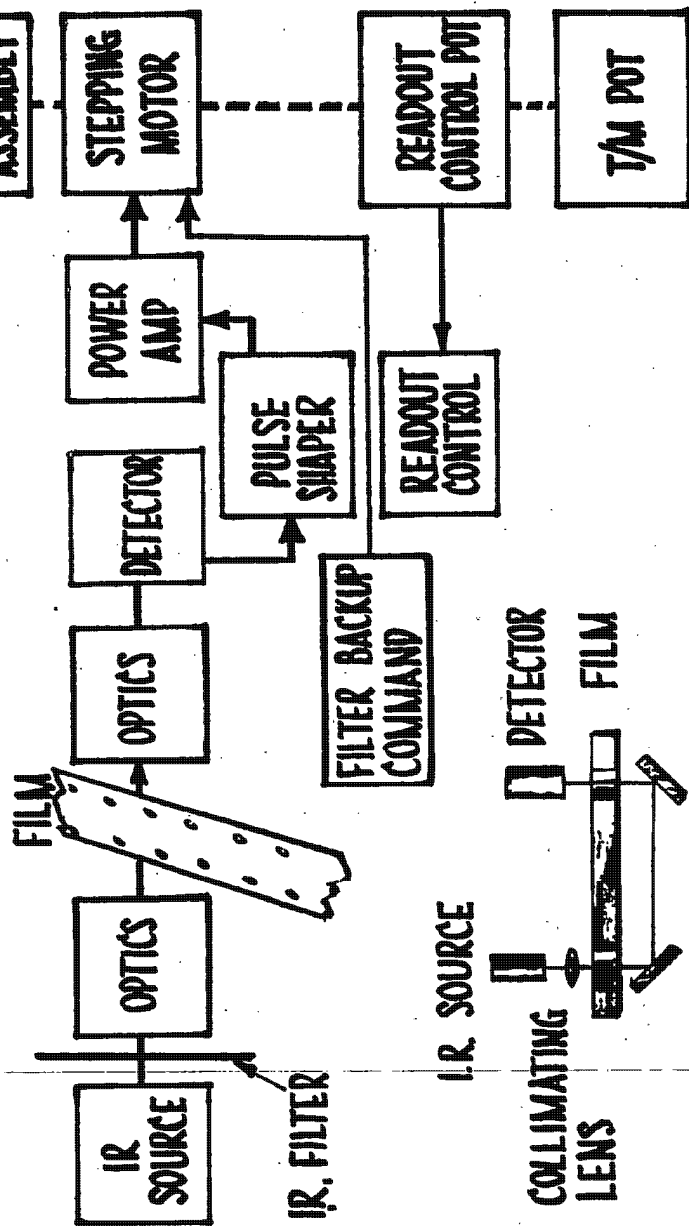


~~TOP SECRET/SPECIAL HANDLING~~

~~TOP SECRET/SPECIAL HANDLING~~

FILTER CONTROL SYSTEM

(MATERIAL CHANGE DETECTION)



~~TOP SECRET/SPECIAL HANDLING~~

~~TOP SECRET/SPECIAL HANDLING~~

ADDITIONAL CONSIDERATIONS

- COMPENSATE HOR. OPTICS EXPOSURE FOR FILM TYPES
 - ADJUST DATA EXPOSURE FOR FILM TYPES
- HOR. OPTICS FIDUCIALS
P.G CALIBRATION(XENON FLASH & INCANDESCANT)
TIME MARKS
SLP BLOCK
BEGIN PASS, SERIAL,

~~TOP SECRET/SPECIAL HANDLING~~

~~TOP SECRET/SPECIAL HANDLING~~

SUMMARY-FAILURE RECOVERY MODE

- SLIT WIDTH DRIVE TRAIN ELECTRONICS
R.T.C. TO NOMINAL SLIT WIDTH
- MATERIAL CHANGE DETECTOR
R.T.C. TO STEPPING MOTOR

~~TOP SECRET/SPECIAL HANDLING~~

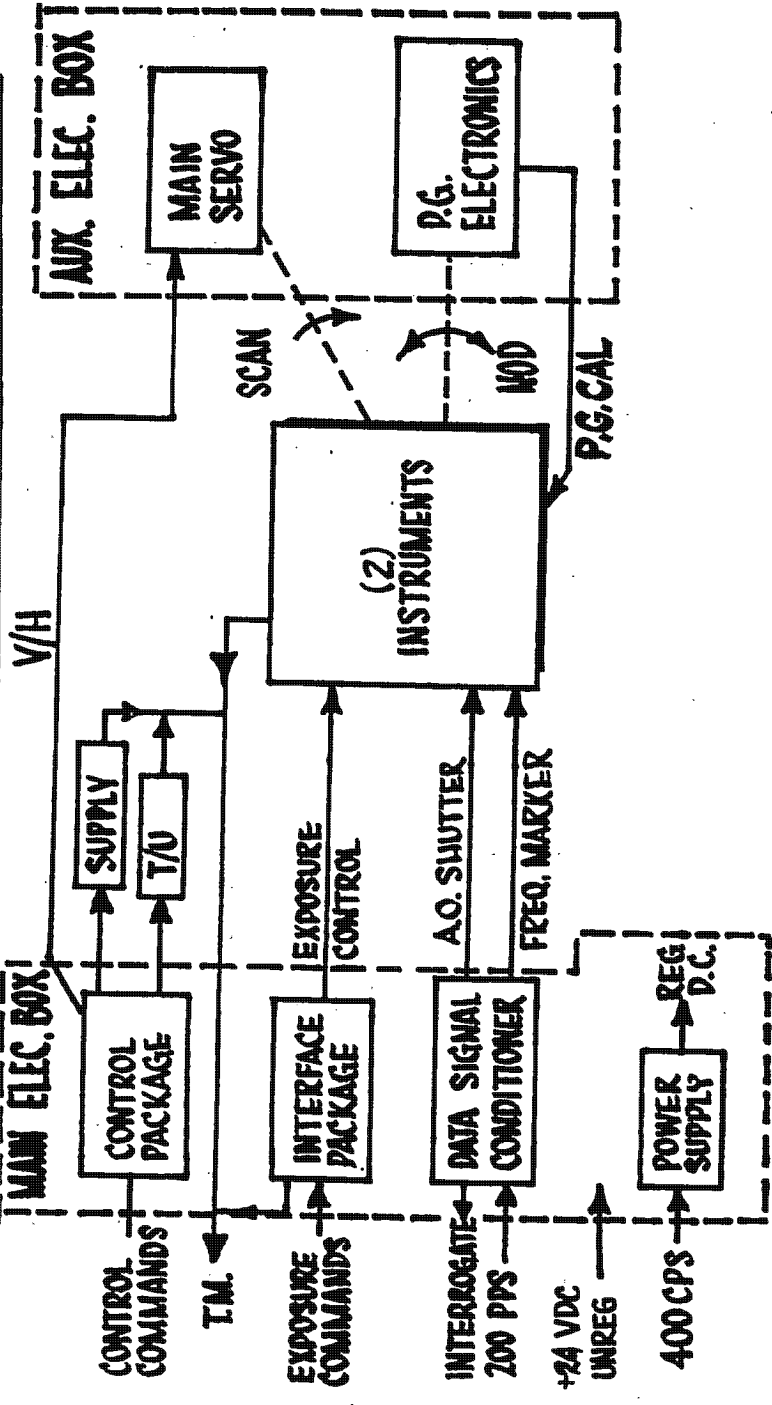
~~TOP SECRET/SPECIAL HANDLING~~

CAMERA ELECTRICAL SYSTEM

~~TOP SECRET/SPECIAL HANDLING~~

~~TOP SECRET/SPECIAL HANDLING~~

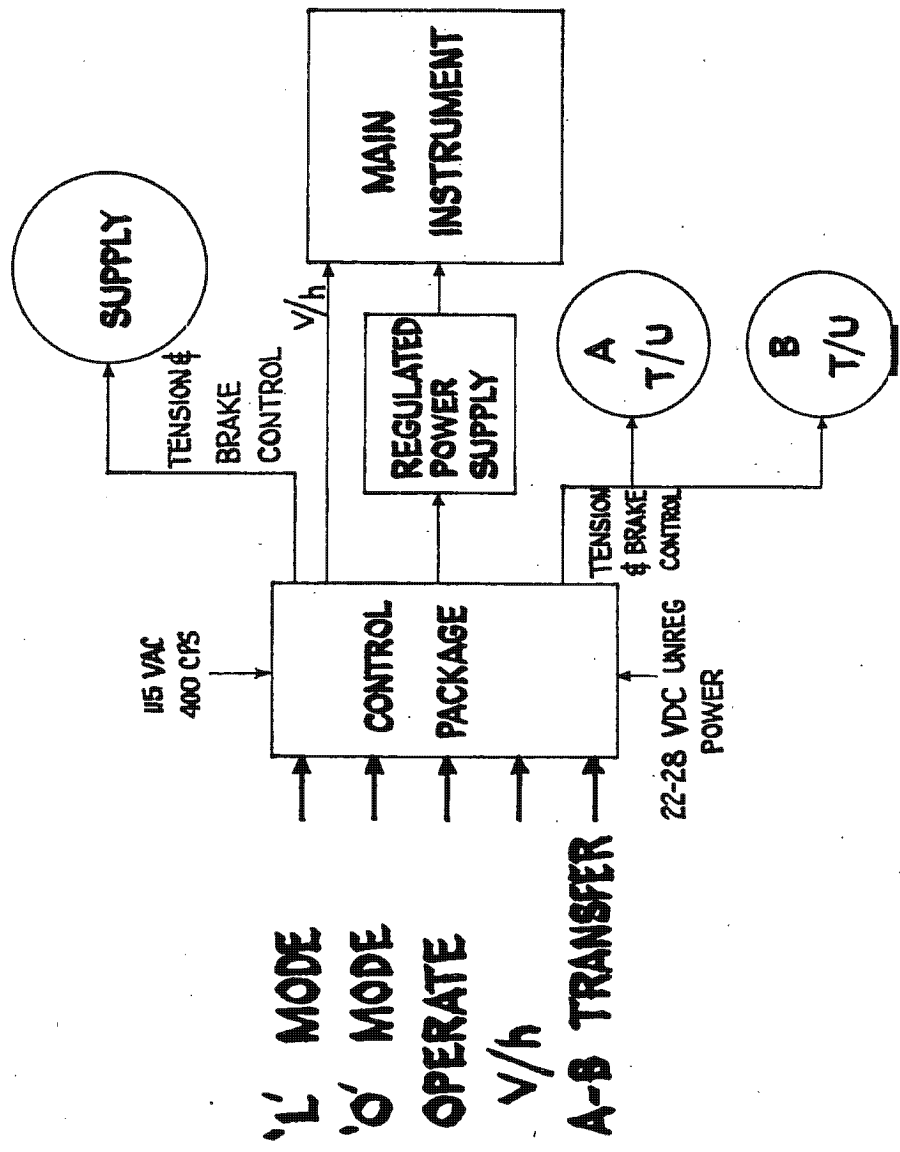
ELECTRICAL SYSTEM BLOCK DIAGRAM



~~TOP SECRET/SPECIAL HANDLING~~

~~TOP SECRET/SPECIAL HANDLING~~

ELECTRICAL SYSTEM CONTROL



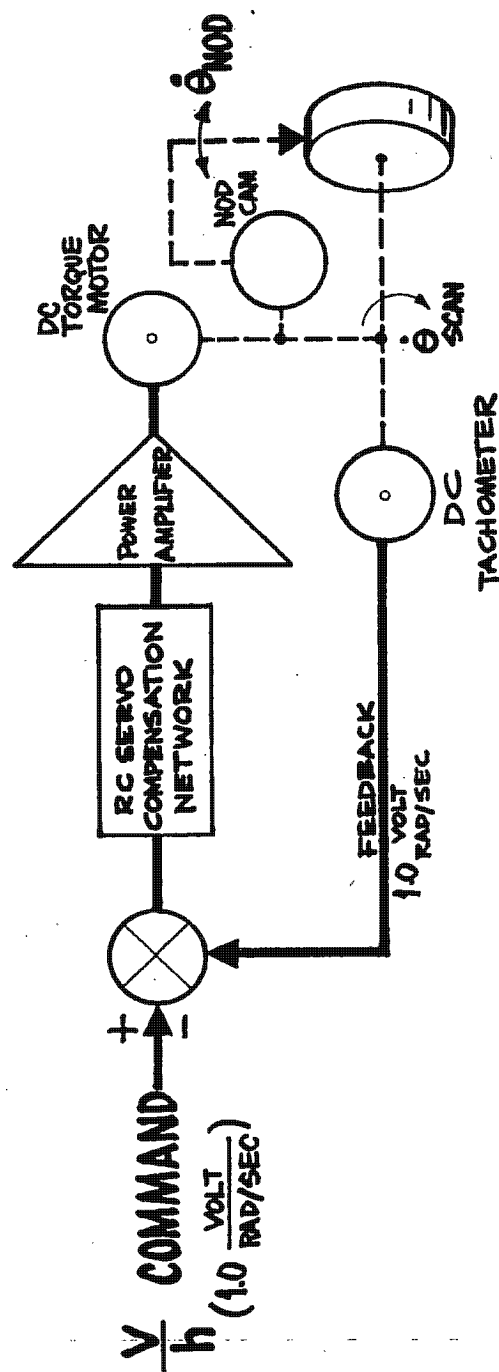
~~TOP SECRET/SPECIAL HANDLING~~

~~TOP SECRET/SPECIAL HANDLING~~

MAIN SERVO CHARACTERISTICS

REQUIREMENTS: (SCAN PERIOD)

$$\frac{V}{h} \rightarrow \dot{\theta}_{\text{SCAN}} \rightarrow 1\% \text{ SERVO ERROR } (1\sigma)$$

~~TOP SECRET/SPECIAL HANDLING~~

~~TOP SECRET/SPECIAL HANDLING~~

MAIN SERVO DESIGN STATUS

- BRASSBOARD AND ENVIRONMENTAL TESTS → $\Delta \dot{\theta}_{\text{SCAN}} < 1\%$
- CONVENTIONAL AMPLIFIER INEFFICIENT → THERMAL UNCERTAINTIES AND POWER LOSSES
- HIGH EFFICIENCY AMPLIFIER DESIGNED → UNDER EVALUATION

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~~TOP SECRET/SPECIAL HANDLING~~

ESTIMATED POWER REQUIREMENTS

	WATT-HRS @ 3.75 rad sec	WATT-HRS @ 2.5 rad sec	WATT-HRS @ 1.4 rad sec
24VDC UNREG	1140	1700	3040
115 VAC 400CPS	134	200	357
	1274	1900	3397
BUDGET	1957	1957	1957

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~~TOP SECRET/SPECIAL HANDLING~~

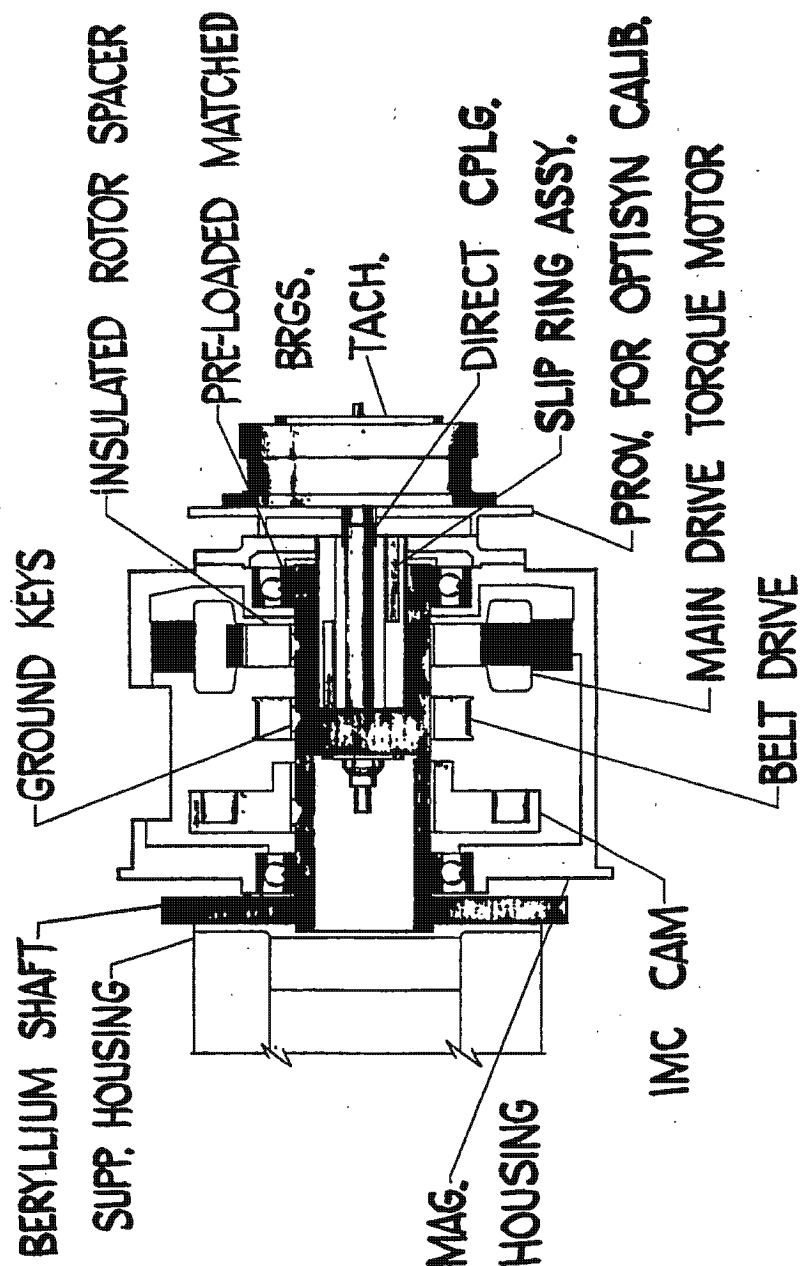
CHMERA MECHANICAL DESIGN

~~TOP SECRET/SPECIAL HANDLING~~

101

~~TOP SECRET/SPECIAL HANDLING~~

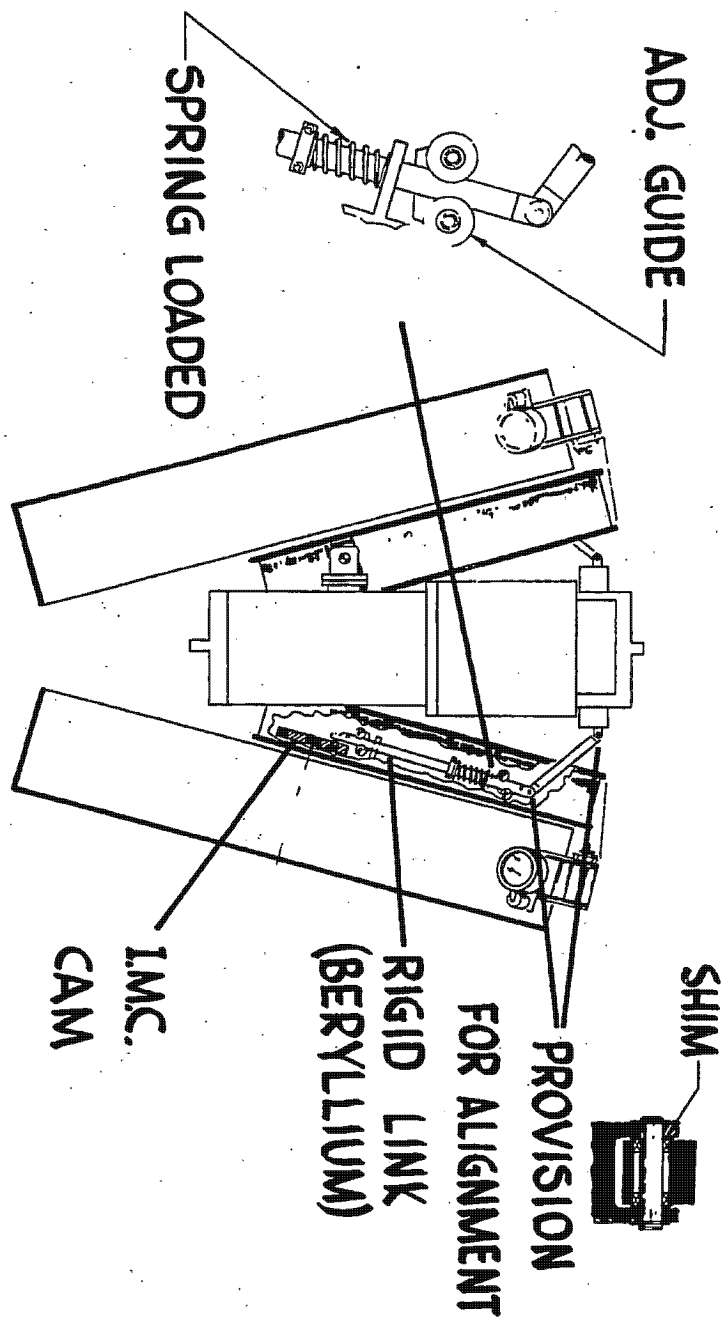
MAIN DRIVE ASSY.



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~~TOP SECRET/SPECIAL HANDLING~~

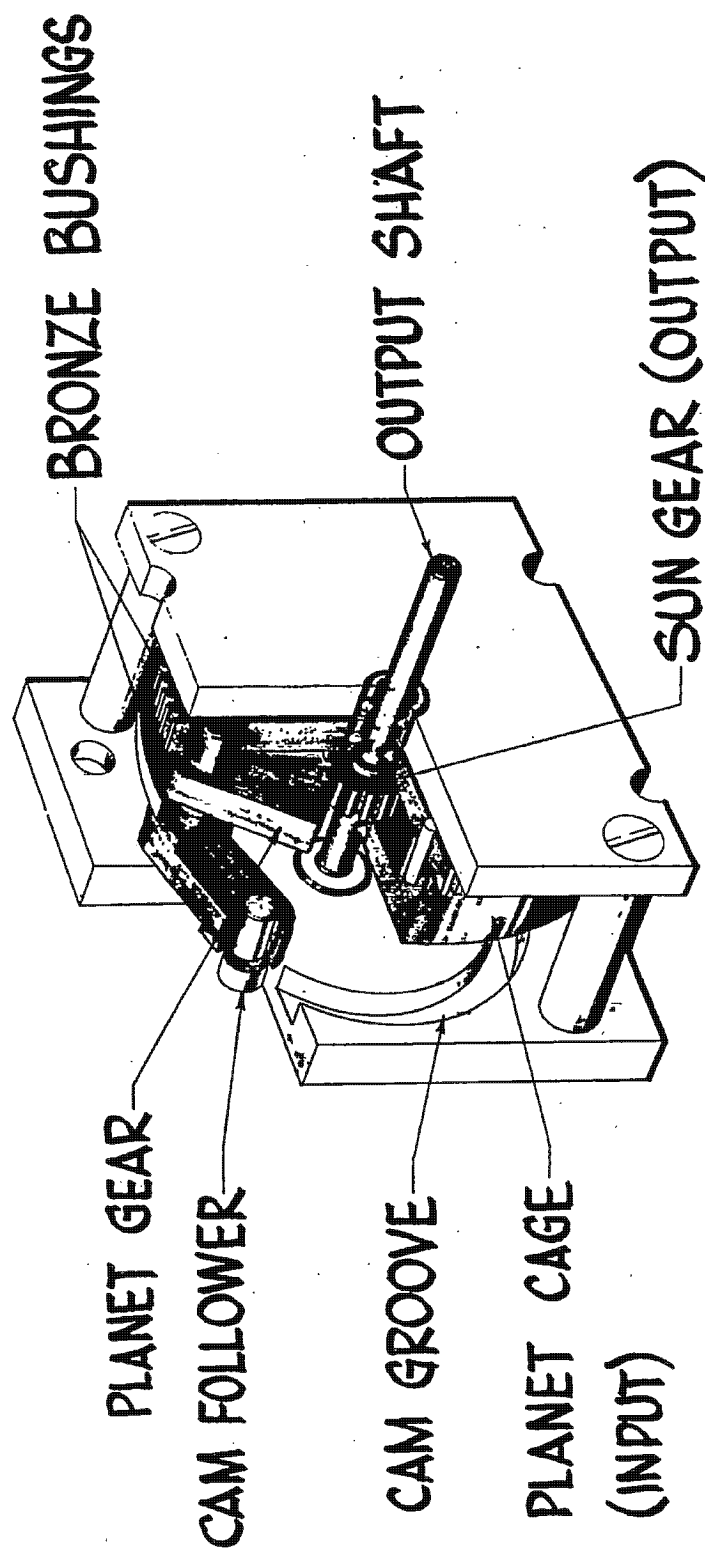
I.M.C. MECHANISM



~~TOP SECRET/SPECIAL HANDLING~~

~~TOP SECRET/SPECIAL HANDLING~~

KAPLAN DRIVE



104

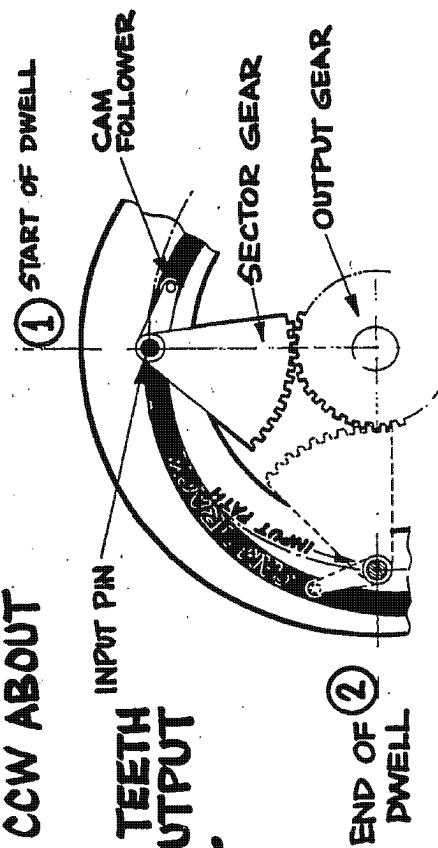
~~TOP SECRET/SPECIAL HANDLING~~

~~TOP SECRET/SPECIAL HANDLING~~

DWELL GENERATING PRINCIPLE

DURING DWELL (POSITION ① TO POSITION ②)

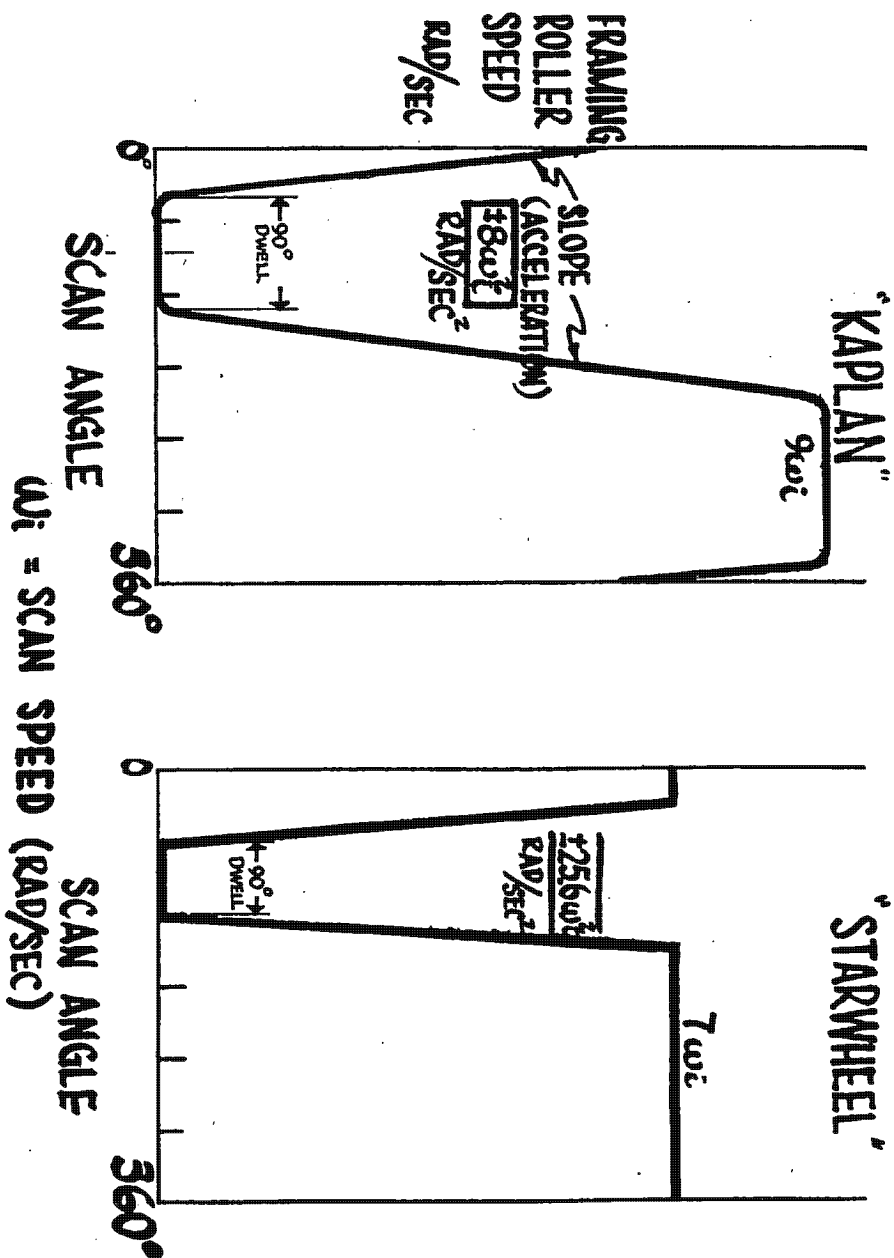
- INPUT PIN IS DRIVEN CCW AT INPUT SPEED AROUND CIRCULAR PATH CONCENTRIC WITH INPUT SHAFT;
- CAM FOLLOWER MOVES RADIALLY OUTWARD AT CONSTANT RATE;
- SECTOR ROTATES CCW ABOUT INPUT PIN;
- NET ADVANCE OF TEETH IN MESH WITH OUTPUT GEAR CANCELS.



~~TOP SECRET/SPECIAL HANDLING~~

~~TOP SECRET/SPECIAL HANDLING~~

FRAMING ROLLER DRIVES



~~TOP SECRET/SPECIAL HANDLING~~

~~TOP SECRET/SPECIAL HANDLING~~

SUPPLY

~~TOP SECRET/SPECIAL HANDLING~~

~~TOP SECRET/SPECIAL HANDLING~~

SUPPLY REDESIGN

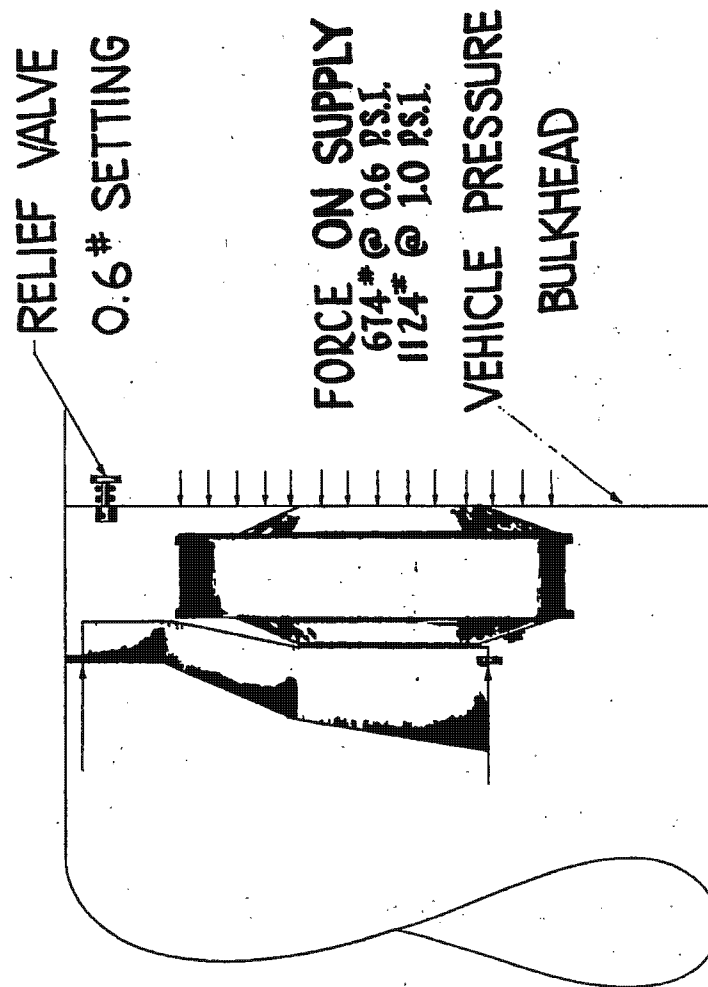
CORE ASSEMBLY (LIGHTENED)
FLANGE ASSEMBLY (SINGLE TAPE ADHESIVE)
COVERS (CHEMICALLY MILLED)
CENTER SECTION (CHEMICALLY MILLED)
WING BRACKETS REDESIGNED
ROLLER BRACKETS RESIGNED
CONNECTOR RELOCATED

TOTAL WEIGHT SAVINGS = 9[#]/ASS'Y

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~~TOP SECRET/SPECIAL HANDLING~~

PURGE PRESSURE LOADS



~~TOP SECRET/SPECIAL HANDLING~~

~~TOP SECRET/SPECIAL HANDLING~~

TAKE-UPS

~~TOP SECRET/SPECIAL HANDLING~~

~~TOP SECRET/SPECIAL HANDLING~~

TAKE-UP DESIGN IMPROVEMENTS

- SPOOL SEPARATION INCREASED BY 0.06
- ROLLER SHAFTS STIFFENED
- MECHANICAL LOCKS SECURE SPOOL BEARING RETAINING RINGS
- RUBBER HUB ROLLER REPLACED WITH METALLIC ROLLER
- HUB ROLLER CLEARANCE INCREASED TO 0.008/0.011
- ROTORS AND DRIVE GEARS HAVE IMPROVED BEARING SUPPORT
- CO-AXIAL RATCHET USED IN ANTI-BACK-UP SYSTEM
- COMPONENTS RELOCATED PER SYSTEM REQUIREMENTS

~~TOP SECRET/SPECIAL HANDLING~~

~~TOP SECRET/SPECIAL HANDLING~~

SENSOR ARM ASSEMBLY IMPROVEMENTS

- SENSOR ARMS REDESIGNED
- FILM TYPE POTENTIOMETERS USED
- ANTI-BACKLASH GEARING INSTALLED
- RADIUS READ-OUT TO BE LIMITED TO
TM SENSITIVITY

~~TOP SECRET/SPECIAL HANDLING~~

~~TOP SECRET/SPECIAL HANDLING~~

T/U THERMAL REQUIREMENTS

MECHANICAL ANALYSIS

- GEAR PITCH LINE LIMIT 0 - 140°F
- BEARING PACKAGING LIMIT 55-105°F

REQUIRED SPEEDS FOR 1.5 SEC/CYCLE

- EMPTY "A" SPOOL 110 RPM
- 0.175 RADIUS BUILDUP 100 RPM
- 0.300 RADIUS BUILDUP 95 RPM
- 0.425 RADIUS BUILDUP 90 RPM

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~~TOP SECRET/SPECIAL HANDLING~~

T/U THERMAL TESTS

A/P TESTS	F°
• LOW LIMIT (J-30)	13-15
• HIGH LIMIT (J-31)	95-100
ETL TESTS (RPM AFTER 3 SEC)	
LUB-NYE 180 LUB ASTRO OIL	
• 19-25 52-73	20
• 40-50 107-109	30
• 60-80 123-120	40
• 80-100 125-125	50
• 120-(UP TO SPEED) 125-123	70

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~~TOP SECRET/SPECIAL HANDLING~~

INTERMEDIATE ROLLER ASSEMBLY

~~TOP SECRET/SPECIAL HANDLING~~

~~TOP SECRET/SPECIAL HANDLING~~

INTER. ROLLER ASSEMBLY REDESIGN

- SIMPLIFIED FILM PATH
- INDIVIDUAL ASSEMBLIES
- ROTATION POTS MONITOR T/U FUNCTION
- SHORT CHUTE SECTION ELIMINATED
- INSIGNIFICANT WEIGHT INCREASE (3 OZ.)

Δ TENSION SENSING DEVICE

~~TOP SECRET/SPECIAL HANDLING~~

~~TOP SECRET/SPECIAL HANDLING~~

TEST & CHECK CONSOLE

~~TOP SECRET/SPECIAL HANDLING~~

~~TOP SECRET/SPECIAL HANDLING~~

T&C CHARACTERISTICS

- SIMULATES VEHICLE ELECTRICAL INTERFACE
- PROVIDES READOUT OF ALL T/M AND SELECTED CAMERA ELECTRICAL FUNCTIONS
- READOUTS VIA 367 POINT PATCH PANEL TO DIGITAL VOLTMETER, VISICORDER OR DIGITAL PRINTER
- PROVIDES READOUT OF SCAN OR NOD VELOCITIES 0.07%

~~TOP SECRET/SPECIAL HANDLING~~

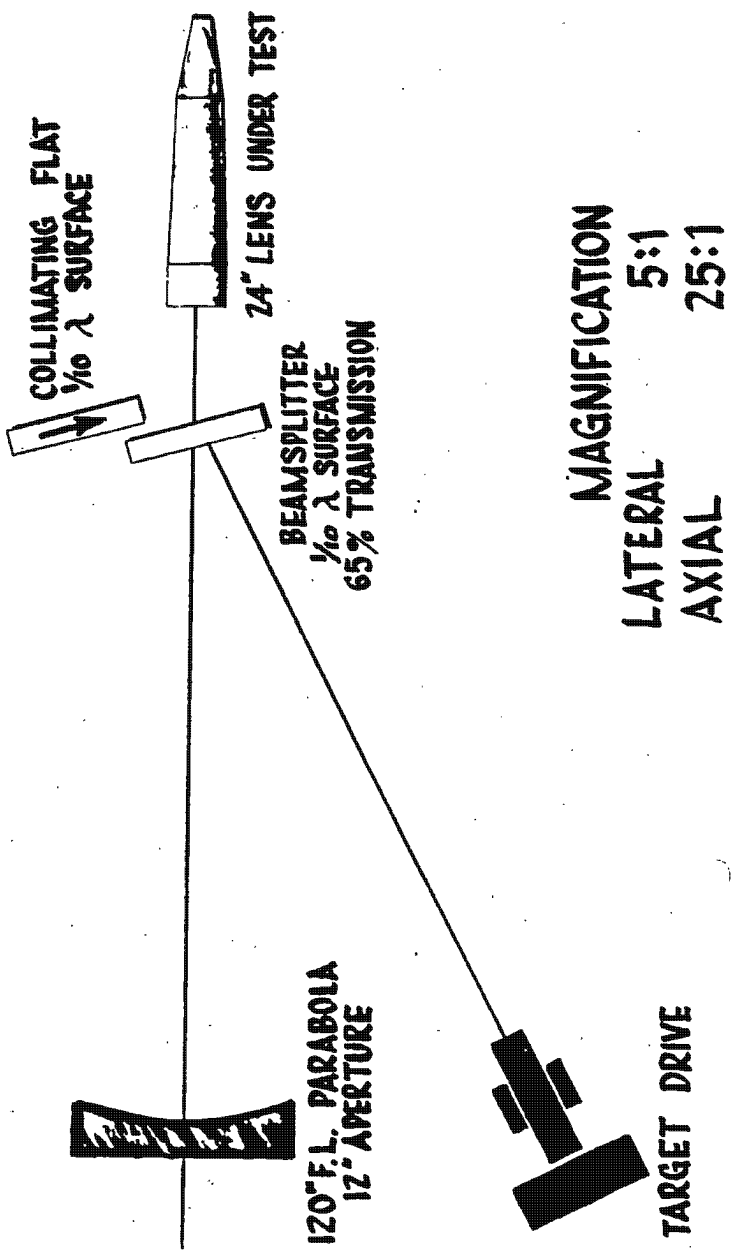
~~TOP SECRET/SPECIAL HANDLING~~

DYNAMIC TEST FACILITY

~~TOP SECRET/SPECIAL HANDLING~~

~~TOP SECRET/SPECIAL HANDLING~~

DYNAMIC OPTICAL TEST SYSTEM



~~TOP SECRET/SPECIAL HANDLING~~