MEMO ROUTING SLIP

NEVER USE FOR APPROVALS, DISAPPROVALS, CONCURRENCES, OR SIMILAR ACTIONS

1 TO Ray		INITIALS	CIRCULATE
		DATE	COORDINATION
2 [redacted]	STAT		FILE
		X	INFORMATION
3			NOTE AND RETURN
		X	PER CON-VERSATION
4			SEE ME
			SIGNATURE

REMARKS

- Per telecom 25 May 65 –
- I'd be glad to answer any questions if I can.

Declass Review by NGA.

[redacted]

STAT

ROME AIR DEVELOPMENT CENTER
GRIFFISS AIR FORCE BASE
NEW YORK

4 December 1964

Purchase Request Continuation Sheet

For: Rectifier, Electro-Optical, Photogrammetric BM-31A

Continuation Sheet No. 1 For P.R. No. 64-948

DESCRIPTION OF SUPPLIES OR SERVICES TO BE PURCHASED

ITEM	QUANTITY	DESCRIPTION
1	2 each	ENGINEER, FURNISH AND INSTALL a Rectifier, Electro-Optical, Photogrammetric BM-31A, in accordance with Rome Air Development Center Exhibit RADC-5157 dated 4 December 1964 including those modifications cited under Item 2 below. Installation shall be considered complete when the following test problems have been processed through the rectifier and witnessed by the procuring activity:
		a. Oblique frame problem
		b. Prepared panoramic problem.
2		ENGINEERING SERVICES AND MATERIALS for the modification of the two Rectifier Units at ACIC as follows:
		a. Decoder
		(1) Remove all DELTA-V cards and filter cards (5)
		(2) Remove DC amplifiers (3)
		(3) Simplify circuitry and increase reliability
		(4) Improve cooling of critical heat areas
		(5) Replace all I/R cards and relays for reliability (flip/flop)
		(6) Remove delete circuitry
		(7) New gain/phase network and control

THE INFORMATION CONTAINED HEREIN SHALL NOT BE REVEALED TO UNAUTHORIZED PERSONS PRIOR TO RELEASE OF THE INVITATION FOR BIDS (IFB) OR REQUEST FOR PROPOSAL (RFP), AFPI 1-465 (d) (1)

b. Rectifier

(1) Copy Carriage

(a) Remove filter mechanism and servo

(b) Increase lamp output-new power supply. Add lamp-condenser adjustment - new lamp housing.

(c) Clean - renovate optics (elliptical mirror, etc.)

(d) Clean, adjust/replace, realign all mechanical parts

(e) Install setup lights

(f) Decoder interlock switch

(g) Install new platen mechanism

(2) Lens Carriage

(a) New lens turret with lens adjustments

(b) New lenses (f5.6 or f6.3)

(c) Add filter - manual set

(d) Renovate/clean mechanical parts

(3) Recording Cylinder

(a) Install speed matching control

(4) General

(a) Realign instrument

(b) Renovate/replace servo

(c) Renovate ball screws and bearings

(5) Install Light Shields

P.R. No. 64-948

3 | 1 kit | INTERIM SPARE PARTS consisting of only those parts approved by the contracting officer after review of the list of replaceable parts required under Sub Item 4.5. Spare parts shall be interchangeable with the corresponding parts used in the equipment furnished under Item 1 and shall be delivered concurrently.

4 DATA ITEMS shall be delivered as listed on the attached DD Form 1423 entitled: "Contractor Data Requirements List" and shall be prepared in accordance with each (AFLC/AFSC Form 9) as referenced in Column D by TSAF (Typical System Acquisition Flow) numbers or proposed numbers. These data items are numbered as sub items, of this item and are hereby incorporated by any references to this Contract or any part thereof to this Item unless specifically excepted. The specific data requirements are contained under Preparing Information on each Form 9. The AFLC/AFSC Form 9's, as listed, are contained in Volume II, AFSCM/AFLCM 310-1. Where data standards are not published in Volume II of AFSCM/AFLCM 310-1, the minimum essential requirements for each new data item is contained on an AFLC/AFSC Form 9 which is attached to the aforementioned DD-1423 and made a part hereof.

NOTE 1: The modifications to the rectifier units now at ACIC and the prototype models being procured shall operate by a control drive mechanism (decoder) that is completely compatible with the present rectification program tape, designated R-1, Index No. 1000R100, of the present program library for the RCA-501 computer.

AJM/do

AIR FORCE SYSTEMS COMMAND
ROME AIR DEVELOPMENT CENTER

Exhibit RADC -5157
4 December 1964

RECTIFIER, ELECTRO-OPTICAL, PHOTOGRAMMETRIC, BM-31A

1. SCOPE

1.1 This exhibit covers the requirements for the fabrication and installation of the Rectifier, Electro-Optical, Photogrammetric, BM-31A, hereinafter referred to as the "rectifier".

2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on the date for invitation for bids, form a part of this exhibit to the extent specified herein.

SPECIFICATIONS

Military

MIL-E-4158	Electronic Equipment, Ground General Requirements For
MIL-M-26512	Maintainability Requirements For Aerospace Systems and Equipments

STANDARDS

Military

MIL-STD-831	Test Reports, Preparation Of

(Copies of documents required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications.- The following documents form a part of this exhibit to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids shall apply.

Office of Technical Services (OTS)

PB 161894	RADC Reliability Notebook RADC-TR-58-111

(Copies of OTS documents may be obtained from Office of Technical Services, U. S. Dept. of Commerce, Washington 25, D.C. 20331)

Exhibit RADC-5157

3. REQUIREMENTS

3.1 General specification.- The requirements of MIL-E-4158 apply as requirements of this exhibit. Where the requirements of the general specification and this exhibit conflict, the requirements of this exhibit shall govern. Exceptions and additions to the general specifications shall be as follows.

3.1.1 Service conditions.- The rectifier shall operate under the following service conditions.

3.1.1.1 Climatic

a. Operating: 21°C (69.8°F) to 24°C (75.2°F)

b. Non-operating

(1) Installed - 4.4°C (39.9°F) to 54°C (129.2°F)

(2) Packaged for shipment- -29°C (-20°F) to 54°C (129.2°F)

3.1.1.2 Relative humidity

a. Operating 45 to 55 percent

b. Non-operating

(1) Installed - 0 to 95 percent

(2) Packaged for shipment - 0 to 100 percent.

3.1.2 Mechanical.- The rectifier shall not suffer damage nor fail to give required performance when subjected to shock and vibration encountered in transit and handling. Vibration data shall be furnished to the Government by the contractor. This data shall be used to determine the nature and characteristics of vibration ~~test equipment~~ isolaters that will be installed at some future date. The data shall contain but not be limited to the following information:

a. Displacement and acceleration tolerance of the equipment.
b. Mass distribution of the equipment.
c. Running speeds of any motors, with rotation direction clearly defined.
d. Any out-of-balance forces of all motors.
e. Natural frequency of moving parts.

3.1.3 Electrical.- The rectifier shall operate from an alternating current (AC) source of power within the following ranges:

a. Potential and phase

(1) 208 volts alternating current (VAC), plus 26V to minus 8V, four wire, three phase or

(2) 120 VAC, plus 6V to minus 6V, single phase

b. Rate of change of voltage - plus or minus 2 percent per second.
c. Frequency - 60 CPS plus or minus 1 CPS.
d. Rate of change of frequency - one tenth (1/10) CPS.
e. Harmonic content - 0.5 percent.
f. Cabling for power lines shall be supplied as part of the rectifier.

3.1.4 Reliability and maintainability.- The rectifier shall possess a mean time between failures (MTBF) of no less than 500 hours, with a mean time to repair (MTTR) of no greater than one hour. The RADC Reliability Notebook PB-161894 shall be used as a guide in the fabrication of the equipment.

3.1.4.1 Reliability and maintainability analysis.- The contractor shall prepare an analysis of the MTBF and MTTR of the rectifier. Mean time between failure shall be determined from failure rate data given in the RADC Reliability Notebook PB161894 or from past failure rates determined from the contractors experience with similar equipment. Mean time to repair shall be determined from an analysis of the maintenance tasks required and the expected frequency of occurence as shown in Appendix A of MIL-M-26512. Should the analysis indicate the MTBF or MTTR will not meet the required figures the contractor shall accomplish the necessary changes to insure that the equipment meets these requirements.

3.1.4.2 Service life.- The rectifier shall be designed and constructed to operate for 4000 hours per year with recommended maintenance without major overhaul. (Is defined as any malfunction that constitutes more than 4 hours down time or 500 dollars to repair).

3.2 Performance.- The rectifier shall prepare high resolution photo transformations free of distortions due to tilt of the aerial camera and technique used. It shall accommodate various input materials and parameters as described below. The rectifier operates on a principle whereby rectification is accomplished by a line-scanning technique. The length of each line recording is varied optically to accomplish scale change along the line and change in scale normal to each line is achieved by varying the rate of line scanning to line recording. A digital decoder is electrically connected to the rectifier and through a servo system controls the various elements of rectification. The accuracy of the rectifier shall be such that the maximum error in position of any point in the rectified print, relative to the principal point as compared to the theoretically correct position, shall not exceed 0.25 millimeter (mm).

Exhibit RADC-5157

3.3 Component construction

3.3.1 Plug-in units.- To facilitate maintenance, miniaturized replaceable package units shall be used in the electronic portions of the rectifier, except where a greater reliability and superior service life would result from a permanently wired construction.

3.3.2 Active components.- All electronic and control sub-assemblies of the rectifier shall be transistorized where this type of circuiting is practical and feasible.

3.3.3 Equipment protection

3.3.3.1 Stops.- Mechanical and/or electrical stops shall be provided so as to prevent damage to the equipment in the event of improper operation.

3.3.3.2 Alarms.- Visual or aural fuse alarms shall be used to protect electronic sub-assemblies from damage in the event of malfunction.

3.3.4 Controls

3.3.4.1 Electrical.- Suitable electrical controls shall be provided and laid out in such a manner so that they are within easy reach of the operator and can be easily located in subdued room lighting.

3.3.4.2 Mechanical.- Mechanical controls suitable for easy operation shall be provided for necessary mechanical adjustments and control.

3.3.5 Cooling.- Forced air cooling, wherever necessary, shall be filtered by means of replaceable air filter elements. A guard shall be installed around the lamp cooling fan. The decoder unit shall have a cut-off switch installed so the exhaust fan power is switched off when the door is opened.

3.4 Performance requirements

3.4.1 Input

3.4.1.1 Photography.- The rectifier shall accept the following types of transparent aerial photographs:

a. Oblique - conventional single frame and strip

b. Vertical - conventional single frame, strip, and panoramic.

Approved For Release 2005/02/17 : CIA-RDP78B04770A001400040003-1

3.4.1.1.1 Formats

3.4.1.1.1.1 Width.- The rectifier shall accept all film widths from 70 mm to 9-1/2 inch.

3.4.1.1.1.2 Length.- The rectifier shall have a minimum frame length of 13 inches for 70 mm film and 9-1/2 inches for 9-1/2 inch film.

3.4.1.2 Resultant tilt angle.- On all types of photography outlined in 3.4.1.1 the resultant tilt angle, including roll, pitch and yaw will not exceed 60 degrees. The amount of tilt shall be predetermined and presented to the operator in textual form.

3.4.1.3 Programming.- The rectifier shall operate from a perforated paper tape, suitably programmed, to perform the rectification operation.

3.4.1.4 Initial settings.- Initial positions of the motion axes shall be set by the operator from predetermined data, using suitable manual controls.

3.4.1.5 Focal lengths.- The rectifier shall accept photography taken with camera focal lengths from 5 inches to 100 inches inclusive.

3.4.2 Output.- The rectifier shall output corrected aerial photography having a uniform scale.

3.4.3 Optical system.- The rectifier shall have an optical system with the following characteristics.

3.4.3.1 Resolution.- The minimum high contrast photographic resolution, when tested on SO 213 emulsion, shall be 100 lines per millimeter on the axis, falling to 80 lines per millimeter at 25° off the axis. These results shall obtain at the short conjugate at any magnification throughout the range from 1/2 to 9 times.

3.4.3.2 Magnification range

3.4.3.2.1 Scale.- The range of scale change shall be from 1/2 to 3 at the isoline.

3.4.3.2.2 Rectification range.- The range of continuously varying magnification shall be three times that of the scale change, resulting in a total magnification range of 1/2X to 9X.

3.4.3.3 Number of lenses.- Two lenses shall be required to yield the desired performance over the entire range of 1/2X to 9X. The range overlap of these lenses shall be such so as to permit a magnification change of 7 to 1 minimum without requiring a change of lenses during rectification.

3.4.3.4 Slit projection system.- An illuminated rectangular slit .005 mm wide and 324 mm long shall be projected by a suitable optical system onto the focal surface of the transparent copy. The degradation of the projected image shall be such as to meet the requirements of 3.4.3.1.

3.4.3.4.1 Illumination.- The slit shall be suitably illuminated so that exposure time is at a minimum. The lamp shall be a high pressure mercury arc type suitably housed and cooled.

3.4.3.5 Filter.- In order to compensate for varying exposure conditions the lens shall be equipped with a suitable neutral density filter system.

3.4.3.6 Optical path length.- The maximum optical path length shall be 2300 mm.

3.4.4 Mechanical system

3.4.4.1 Copy carriage.- A copy carriage shall be provided to mount the object plane, carriage and illumination equipment. The carriage shall be traversed by a servo system so as to fulfill the focus requirements of the rectification process.

3.4.4.2 Object plane carriage.- The object plane carriage shall be mounted on the copy carriage and shall suitably mount the photographic negative to be rectified. The platen shall be attached to the carriage in a positive, easily operated system, avoiding the designed stud alignment system. The carriage shall be traversed by a servo system so as to fulfill the rectification requirements.

3.4.4.2.1 Object plane platen .- The platen shall be transparent and of such flatness and parallelism so as to hold the copy in a plane perpendicular to the optical axis.

3.4.4.2.2 Adjustments.- The following adjustments must be provided.

3.4.4.2.2.1 Swing.- Provisions shall be made to rotate the platen plus or minus 180° about a point corresponding to the principal point of the arterial photograph, so as to align the principal line with the coordinate system of the rectifier. This angle shall be manually set within plus or minus 30 seconds of arc.

3.4.4.2.2.2 Initial setting.- The initial position of the negative carrier shall be set by suitable means relative to the principal point to within plus or minus 0.0005 inch of the required calculated dimension.

3.4.4.2.4 Locating mechanism.- Means for locating and positioning the principal point of the copy negative and the mechanical center of the copy platen to within .0005 inch of each other shall be provided. This fixture shall locate the principal point of the copy photography by means of the fiducial marks. The mechanism shall be so designed to allow removal of the glass stage for cleaning.

3.4.4.2.5 Light protection.- Baffles shall be installed to block stray light from the light source and prevent fogging of high speed films.

3.4.4.3 Lens carriage.- The lenses and filter mechanism shall be mounted on a lens carriage. A servo system shall traverse the carriage so as to fulfill the autofocus conditions required by the rectification process.

3.4.4.4 Recording cylinder mechanism

3.4.4.4.1 Recording cylinder.- The recording cylinder shall be capable of supporting 36 by 36 inch, 9 by 36 inch and 9 by 9 inch cut film. The film shall be held to the drum by mechanical and/or pneumatic techniques which shall not dimensionally or optically distort the copy film.

3.4.4.4.2 Drive motor and speed reducer.- The recording cylinder shall be driven at a constant velocity past the exposure point by a motor and speed reducer combination. No cogging or intermittent motion of the combination is permissible. The drive combination shall have a controlled speed variation of at least ±10 percent of nominal.

3.4.4.5 Servo system.- Separate servo systems shall drive the carriage of the three motion axes with the following characteristics.

3.4.4.5.1 Accuracy.- The dynamic positional accuracy as compared with the programmed data shall be:

a. Object distance (p) - plus or minus .0127 mm

b. Image distance (q) - plus or minus .1000 mm

c. Copy distance (v) - plus or minus .0127 mm

3.4.4.5.2 Speed.- The maximum speed of the servo system shall be .5 inches per second under manual control.

3.4.4.5.3 Input.- Input to the servo system shall be electrical signals from a digital decoder.

3.4.4.6 Digital decoder.- The rectifier shall be provided with a suitably designed digital decoder unit, to control the servo mechanisms.

3.4.4.6.1 Inputs.- Input to the digital decoder shall be on 7 level perforated tape, similar to that prepared by an RCA 501 computer. The programmed information punched into the tape will provide point to point digital positioning instructions for three axes plus:

a. Identification number of copy

b. Initial positioning of each axis.

3.4.4.6.2 Outputs.- The outputs shall be electrical signals suitable for inputs to the servomechanism controlling the motions of the three axes.

3.4.4.6.3 Axes.- The decoder shall accept the inputs and provide outputs for the following three axes of motion of the rectifier.

a. Copy platen - 14 inches, total travel

b. Lens position - 60 inches, total travel

c. Object distance - 55 inches, total travel

3.4.4.6.4 Operating speeds.- The maximum operating speeds of the three axes shall be:

a. Copy platen - 0.2 inch per second

b. Lens position - 0.3 inch per second

c. Object distance - 0.05 inch per second

The rectifier shall be capable of two-speed operation. The low speed operation shall be used for high resolution output as outlined in 3.4.3.1. The high speed operation shall be used for low resolution output and will have a speed three times that of the high resolution operation.

3.4.4.6.5 Clock.- Timing of the decoder and rectifier shall be obtained from the AC line.

3.4.4.6.6 Checking.- In order to reduce the probability of undetected errors, parity checking shall be employed. When parity is not obtained the machine shall shut itself off. Parity shall be, selectively, odd or even.

3.4.4.7 Base.- The various elements of the rectifier shall be mounted on a basic structure, so as to minimize all vibration propagation from the mechanisms. The supporting structure of the base shall be designed, so as to provide ducting to guide forced air, to cool mechanical and electrical components wherever the need of this cooling is indicated.

3.4.4.8 Linkages.- The linkages between intra-connected components shall be of the highest quality. Backlash, or lost motion, shall be 0.0002 inch maximum.

3.4.4.9 Interior lighting.- Interior lighting of the rectifier shall be provided so as to facilitate set up by the operator. The light shall be automatically turned off when the unit is operational. This includes a safelight within the portion of the housing containing the recording cylinder.

3.4.4.10 Operating time.- The maximum operating time to produce a 36-inch wide recording shall not exceed 12 minutes.

3.4.5 Information outputs.- The following is a description of output information from a computer which shall be introduced in program form, on punched paper tape, into the rectifier.

3.4.5.1 Transformation equations.- The following are the rectification equations for transforming the various types of photography outlined in 3.4.1 where

V - distance in scan direction on recording

$\dot{V}$ - surface speed of recording cylinder

v - distance in scan direction on copy

$\dot{v}$ - surface speed of copy platen

t - resultant tilt angle of vehicle

n - Nodal separation of rectifier lens

Exhibit RADC- 5157

f - focal length of camera lens

F - focal length of rectifier lens

S - Scale change of rectification

B - lens to recording cylinder distance

$\dot{B}$ - Velocity of lens carriage

L - Copy platen to recording cylinder distance

$\dot{L}$ - velocity of copy carriage

3.4.5.1.1 Oblique single frame photography

$$v = Vf \cos^2 t \,/\, Sf + V \sin t \cos t$$

$$B = F\left[\frac{Sf}{f \cos t - v \sin t} + 1\right]$$

$$L = \frac{F\,(Sf + F \cos t - v \sin t)}{Sf(f \cos t - v \sin t)} + n$$

$$\dot{v} = \frac{\dot{V}}{Sf^2}\,(f \cos t - v \sin t)^2$$

$$\dot{B} = \frac{SF\dot{V} \sin t}{f}$$

$$\dot{L} = \dot{B}\left[1 - \frac{(f \cos t - v \sin t)^2}{S^2 f^2}\right]$$

3.4.5.1.2 Strip photography

$$v = \frac{vf \cos^2 t}{Sf + V \sin t \cos t}$$

$$\dot{v} = \frac{\dot{V}}{Sf^2} (\cos t - v \sin t)^2$$

$$B = F (S + 1)$$

$$L = \frac{F}{S} (S + 1)^2 + n$$

3.4.5.1.3 Vertical panoramic photography

$$v = f \tan^{-1}\left(\frac{V}{Sf}\right)$$

$$\dot{v} = \frac{\dot{V}}{S} \cos^2\left(\frac{v}{f}\right)$$

$$B = F\left[\frac{S}{\cos (v/f) + 1}\right]$$

$$\dot{B} = \frac{\dot{V}F \sin (v/f)}{f}$$

$$L = \frac{FS + \cos (v/f)^2}{S \cos (v/f)}$$

$$\dot{L} = \frac{\dot{V}F}{Sf} \sin (v/f) \left[S^2 - \cos (v/f)\right]$$

3.4.5.2 Corrections.- The following are the corrections to the rectifier equations that the computer must make.

3.4.5.2.1 Earth curvature.- The computer shall adjust for the effects of earth curvature when computing copy speed by use of the approximation

$$h = \frac{S^2}{2R}$$

where h = departure of the earth from the datum (computed to four (4) significant figures)

S = distance from the point of tangency of the datum

R = earth radius.

3.4.5.2.2 Atmospheric refraction.- The computer shall correct for the effects due to total atmospheric refraction. The atmospheric model for this computation shall be that contained in The ARDC Model Atmosphere, 1959, Air Force Surveys in Geophysics 115, Geophysics Research Directorate. AFCRD, ARDC, August 1959.

3.4.5.2.3 Film shrinkage.- Correction for film shrinkage distortion shall be entered for each of the "B" and "v" values respectively and independently.

4. QUALITY ASSURANCE PROVISIONS

4.1 The supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own or any other inspection facilities and services acceptable to the Government. Inspection records of the examination and tests shall be kept complete and available to the Government as specified in the contract or order. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Classification of tests.- The inspection and testing of the rectifier shall be classified as acceptance tests.

4.3 Acceptance testing.- The rectifier shall be subjected to acceptance testing to determine compliance with the requirements of this exhibit. The acceptance tests shall consist of :

a. Preliminary acceptance tests.........(See 4.3.1)
b. Final acceptance tests...............(See 4.3.2)

4.3.1 Preliminary acceptance tests.- The preliminary acceptance tests shall be conducted by the contractor at the contractor's plant and witnessed by authorized representatives of the procuring activity. The preliminary acceptance tests shall consist of the following tests as described under 4.4 "Test methods" of this exhibit:

a. Mechanical inspection tests..........(See 4.4.1)
b. Electrical tests.....................(See 4.4.2)
c. Performance tests....................(See 4.4.3)
d. Reliability tests....................(See 4.4.4)
e. Maintainability tests................(See 4.4.5)

4.3.1.1 Preliminary acceptance test report.- After the contractor completes the preliminary acceptance tests, he shall prepare a preliminary acceptance test report according to MIL-STD-831 and furnish three complete copies of the report to the procuring activity.

4.3.2 Final acceptance tests.- The final acceptance test will be conducted by the Government using Government personnel and facilities. The final acceptance tests shall consist of all tests described under 4.4 "Test methods".

4.3.3 Previous acceptance or approval.- Previous acceptance or approval of material by the procuring activity shall in no case be construed as a guarantee of the acceptance of the finished product.

4.4 Test methods

4.4.1 Mechanical inspection tests.- The rectifier shall be given a thorough mechanical and visual inspection and test to determine that the quality of all materials and workmanship is in compliance with the requirements of this exhibit. Particular attention shall be given to the following:

a. Completeness
b. Nameplates, identification markings and labels
c. Ease of operation of gears, adjustable and sliding parts, thumb screws, controls and switches.
d. Finishes
e. Welded joints
f. Check of solder joints
g. The fit of components in their respective positions
h. Check of mounting means
i. Check of lubrication and rust prevention
j. Check of safety features and interlocks
k. Loose fastening and securing devices or parts
l. Accessibility of components and parts for servicing
m. Cable runs between components including plugs and receptacles
n. Grounding connections
o. Over-all dimensions check
p. Weight check
q. Other visual defects.

4.4.2 Electrical tests.- The rectifier shall be given a thorough electrical test to determine that all circuits are inherently sound and that the overall performance of the electrical components is in compliance with the requirements of this exhibit. The electrical tests shall include at least the following:

a. The operating voltages at all important points shall be checked for conformance with those shown on the circuit labels and related schematic drawings. This test shall be accomplished with all controls set for first, minimum and then, maximum operation.

b. Each control button, switch and indicator shall be tested to insure that it performs its assigned operation or function.

c. The rectifier servo system will be tested to insure that it will follow the input commands accurately.

4.4.3 Performance tests.- The rectifier shall be given a thorough performance test by means of precomputed problems to determine compliance with the requirements of this exhibit.

4.4.4 Reliability tests.- The reliability of the rectifier shall be demonstrated by the operation of the rectifier for no less than 1000 hours. The rectifier shall be accepted as meeting the required MTBF if no more than one failure occurs in this interval.

4.4.5 Maintainability tests.- The maintainability of the rectifier shall be demonstrated in accordance with the method described in Appendix A of MIL-M-26512, no less than 30 repair actions shall be simulated.

5. PREPARATION FOR DELIVERY

5.1 Preparation for delivery shall be in accordance with instructions from the procuring activity.

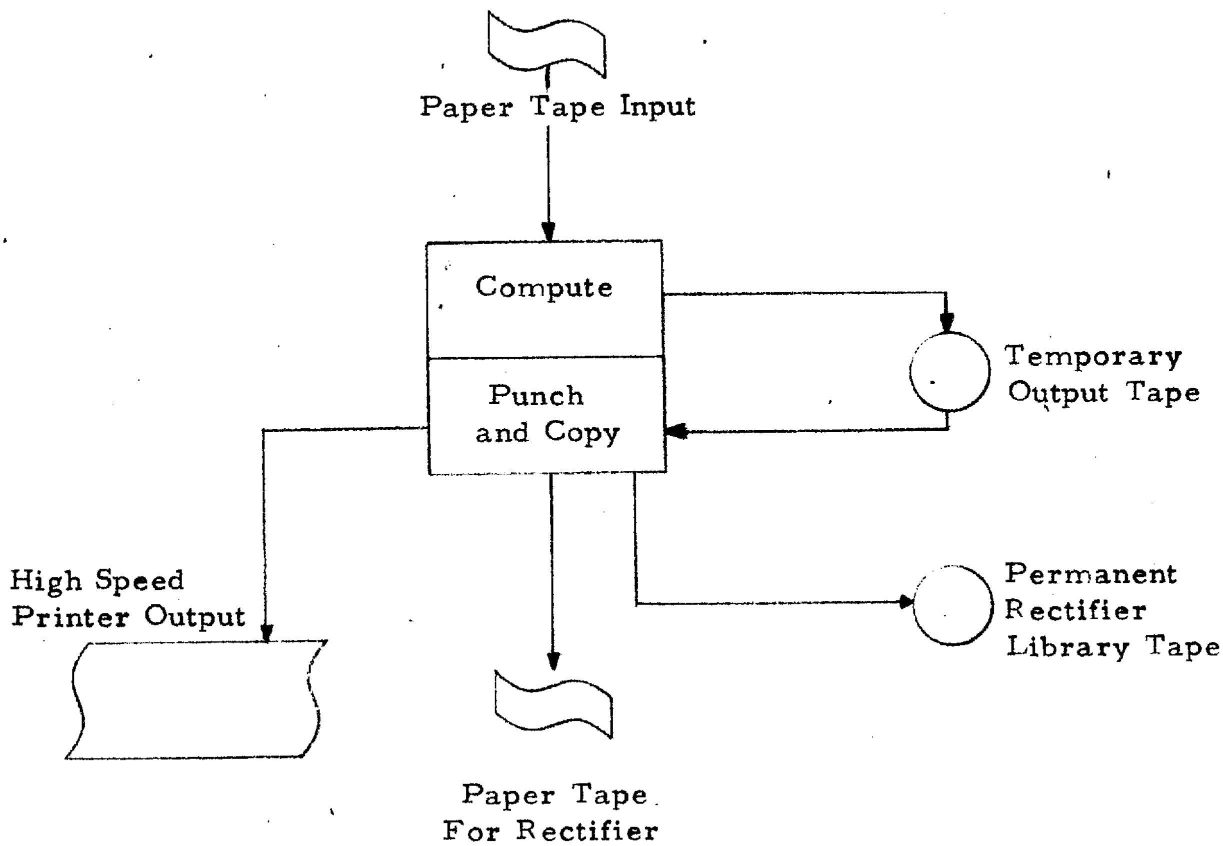
6. NOTES

6.1 Intend use.- The rectifier covered by this exhibit is intended for use to produce photographic copy from original aerial negatives containing known degrees of tilt from a vertical axis. Oblique frame, strip, and panoramic photography can be accommodated, producing a new copy free from displacement due to tilt and format curvature.

AJM/acs

SECTION 14
RECTIFIER PROGRAM R1

14.0 Basic Flow Diagram



14.1 INTRODUCTION

This computer program generates a punched paper tape which drives the servos on the electro-optical rectifier. The rectifier processes oblique frame, strip and vertical panoramic photography. It works on the principle that all lines perpendicular to the principal line have a constant scale (neglecting the effect of terrain relief). The swing angle is set prior to rectification, so that the principal line is perpendicular to the scanning slit. See Figure 1. As the copy is moved past the slit, the scanned information is projected to a recording cylinder by a high resolution imaging lens. The rate at which the copy is scanned is controlled by the paper tape to correlate with the constant rate at which the recording cylinder is rotating.

The computer program calculates the position and velocity data required by the rectifier servos for each scan. The following basic terms are required:

- V, the position (rectangular coordinate in inches) on the recording cylinder.
- $\dot{V}$, the constant velocity of the recording cylinder.
- v, the position (rectangular coordinate in inches) of the "line" to be projected.
- $\dot{v}$, the velocity of the copy platen carriage in the direction perpendicular to the slit.

STAT

$\Delta\dot{v}$ the change in $\dot{v}$ from one scan to the next.

B, the distance between the lens and the recording cylinder.

$\dot{B}$, the velocity of the lens carriage along the optical axis.

$\Delta\dot{B}$, the change in $\dot{B}$ from one scan to the next.

L, the distance between the copy platen and the recording cylinder.

$\dot{L}$, the velocity of the copy carriage along the optical axis.

$\Delta\dot{L}$, the change in $\dot{L}$ from one scan to the next.

T, the position of the variable density filter.

The procedure for rectification requires that the initial position of the copy platen, v_o, be input to the computer program. The other initial positions (V_o, B_o, L_o, T_o) are computed and printed for use in the initial coarse adjustment of the rectifier carriages. The computer then proceeds to "scan" the copy and punch the paper tape which will drive the servos to the computed positions.

14.2 Input

The input to this program consists of only two messages for each photograph which is to be rectified.

1) The identification message, which will be written to the Monitor Printer and the magnetic tape.

2) The input data message:

$\langle v_o, v_f, t, S, f, h, R, TD, AD, \Delta V, \dot{V}, T_r,$ photo size $\rangle$

where,

v_o (inches); the initial (maximum) position of the copy platen.

v_f (inches); the final position of the copy platen.

t (degrees); the resultant tilt of the photograph.

S the scale change from the original photo to the rectified photo.

f (inches); the focal length of the taking camera.

h (N. M.); the height of the camera station above the ground.

R (N. M.); the radius of the earth at the latitude of the photograph.

TD ; the average of the measurements across the fiducial marks on the copy film.

AD ; the average of the measurements across the same fiducial marks on a theoretically non-shrink base.

ΔV (inches); the increment of V, i. e., the distance between scans on the recording cylinder. (ΔV is a positive number)

$\dot{V}$ (inches/sec); the constant velocity of the recording cylinder.

T_r; the transmission input.

Photo Size (inches); the size of the photo which is to be rectified.

The input message must contain 13 quantities. There are several instances, however, in which dummy input may be inserted. The tilt of the photo, t, is not required by the panoramic program; the radius of the earth, R, is not required when the corrections for earth curvature are not needed, i. e., if $h \lesssim 50,000$ft (8.2^+ N. M.); the photo size is not required if the initial and final magnifications clearly indicate which rectifying lens will be used. All other quantities are always required.

14.3 Oblique Frame Photography

The computations for each type of photography may be divided into two sections; the first part is computed only once for each photograph, the second part is an iterative loop computed many times for each photo. The procedure for oblique frame photography involves the following computations.

A. Preliminary Calculations

1. Breakpoint 0 must be set for oblique frame photography.

2. The input is read and the tilt is checked. If $t < 3°$, no rectification is required; if $t > 60°$, rectification is not possible.

   Thus, in order to continue,

$$3° \leq t \leq 60° \quad (1)$$

3. A correction is applied to the focal length of the taking camera to adjust for copy film shrinkage.

$$f_{corrected} = \frac{TD}{AD} f_{input} \quad (2)$$

   This corrected value of f is used in all subsequent calculations involving f.

4. The initial and final values of the optical magnification of the rectifier lens are calculated.

$$M_o = \frac{Sf}{f \cos t - v_o \sin t} \qquad (3)$$

$$M_f = \frac{Sf}{f \cos t - v_f \sin t} \qquad (4)$$

5. These magnifications must satisfy the conditions,

$$.5 \leq M_f \leq M_o \leq 9.0 \qquad (5)$$

If they do not meet these requirements, the program stops at PES and a new value of S must be used as input.

6. The proper rectifier lens is determined. Two lenses are available, with focal lengths of approximately 7.85" and 14".

If $M_o > 4.0$, $M_f \geq 1.3$ (6)

the 7.85" lens is used.

If $M_o \leq 4.0$, $M_f < 1.3$ (7)

the 14" lens is used.

If $M_o \leq 4.0$, $M_f \geq 1.3$ (8)

either lens may be used, and the choice depends on the size of the photo; if the photo size is less than

7", the 7.85" lens is used; if the photo size is equal to, or greater than 7", the 14" lens is used.

If

$$M_o > 4$$

$$M_f > 1.3 \qquad (9)$$

the photo cannot be rectified with the given input, and the program stops at a PES. Such a photo may be rectified in two parts; each section must be treated independently both in the computer and in the rectifier.

When the proper rectifying lens has been determined, two additional quantities, which are functions of the lens, are specified; η, the nodal separation of the lens, and f_n, the ratio of F to the diameter of the aperture. The quantity C_n, which is used in the calculation of the position of the variable density filter, is calculated.

$$C_n = \frac{I_s \; T_r \; t'}{E \; f_n^2} \qquad (10)$$

where I_s, t', and E are program constants.

7. The height of the photograph is compared with h_r, a program constant equal to 50,000 feet (8.2^+ nautical miles). If $h \leq h_r$, it is not necessary to correct for earth curvature; if $h > h_r$, the corrections for earth curvature are required.

8. The initial position of the copy platen, v_o, is given as input. The corresponding initial position of the recording cylinder, V_o, must be computed.

a. For $h \leq h_r$,

$$V_o = \frac{v_o \; S \; f}{f \cos^2 t - v_o \sin t \cos t} \qquad (11)$$

b. For $h > h_r$,

$$V_o = \frac{S R f}{h} \left(\theta_o - \theta_p \right) \qquad (12)$$

Where

$$\theta_p = \sin^{-1} \left[\frac{R + h}{R} \sin t \right] - t \qquad (13)$$

$$\theta_o = \sin^{-1} \left[\frac{R + h}{R} \sin(\phi_o + t) \right] - (\phi_o + t) \qquad (14)$$

$$\phi_o = \tan^{-1} \frac{v_o}{f} \qquad (15)$$

B. Iterative Calculations

The following formulae are evaluated until the entire photograph has been scanned ($v_k < v_f$), or until 3600 scans have been completed.

1. Given the position of the recording cylinder, V_k, calculate the corresponding position of the copy platen, v_k, and the velocity of the copy platen carriage, $\dot{v}_k$.

a. For $h \leq h_r$,

$$v_k = \frac{V_k f \cos^2 t}{S f + V_k \sin t \cos t} \tag{16}$$

$$\dot{v}_k = \frac{\dot{V}}{S} \left[\cos t - \frac{v_k}{f} \sin t \right]^2 \tag{17}$$

b. For $h > h_r$,

$$v_k = f \tan \phi_k \tag{18}$$

where

$$\phi_k = \tan^{-1} \left[\frac{R \sin \theta_k}{h + R(1 - \cos \theta_k)} \right] - t \tag{19}$$

$$\theta_k = \frac{h}{S R f} V_k + \theta_p \tag{20}$$

$$\dot{v}_k = \frac{h \dot{V}}{S R} (1 - \tan^2 \phi_k) \times \left\{ \frac{[h + R(1 - \cos \theta_k)][R \cos \theta_k] + R^2 \sin \theta_k}{[h + R(1 - \cos \theta_k)]^2 + R^2 \sin^2 \theta_k} \right\} \tag{21}$$

2. Calculate the distance, B_k, between the lens and the recording cylinder for this scan. Also calculate the velocity of the lens carriage along the optical axis.

$$B_k = F \left[\frac{f S}{f \cos t - v_k \sin t} + 1.0 \right] \tag{22}$$

$$\dot{B}_k = \frac{\dot{v}_k F S f \sin t}{(f \cos t - v_k \sin t)^2} \tag{23}$$

3. Calculate the distance, L_k, between the copy platen and the recording cylinder. Also calculate the velocity of the copy carriage along the optical axis.

$$L_k = \frac{B_k^2}{B_k - F} + \eta \qquad (24)$$

$$\dot{L}_k = \frac{B_k \dot{B}_k (B_k - 2F)}{(B_k - F)^2} \qquad (25)$$

4. Calculate the position, T_k, of the variable density filter for exposure control.

$$T_k = \frac{C_n}{\left[\frac{f\,S}{f \cos t - v_k \sin t} + 1.0\right]^2} \qquad (26)$$

5. The changes in the velocities, $(\Delta\dot{v}_k, \Delta\dot{B}_k, \Delta\dot{L}_k)$, are computed.

$$\Delta\dot{v}_k = \dot{v}_k - \dot{v}_{k-1} \qquad (27)$$

$$\Delta\dot{B}_k = \dot{B}_k - \dot{B}_{k-1} \qquad (28)$$

$$\Delta\dot{L}_k = \dot{L}_k - \dot{L}_{k-1} \qquad (29)$$

when k = 0, the servos are given the initial velocities,

$$\Delta\dot{v}_o = \dot{v}_o \qquad (30)$$

$$\Delta\dot{B}_o = \dot{B}_o \qquad (31)$$

$$\Delta\dot{L}_o = \dot{L}_o \qquad (32)$$

in order to give the carriages the initial velocities to which subsequent changes may be applied.

6. The quantities,

$v_k, \Delta\dot{v}_k, B_k, \Delta\dot{B}_k, L_k, \Delta\dot{L}_k, T_k$

are coded into the message required by the rectifier.

7. The position of the recording cylinder for the next scan, V_{k+1}, is computed.

$$V_{k+1} = V_k - \Delta V \qquad (33)$$

14.4 Strip Photography

The procedure for strip photography is nearly identical to that for frame photography, and only a few of the formulae are different.

A. Preliminary Calculations

1. Breakpoint 2 must be set for strip photography.
2. The input is read and the tilt is checked (eq. 1).
3. The focal length of the taking camera is corrected (eq. 2).
4. The initial and final magnifications are computed (eq. 3, 4).
5. These magnifications are checked (eq. 5).
6. The proper rectifier lens is determined (eq. 6, 7, 8, 9) and C_n is computed (eq. 10).

7. The height of the photo is examined to determine whether or not the corrections for earth curvature are required.

8. The initial position of the recording cylinder, V_o, is computed (eq. 11, or 12, 13, 14, 15).

9. The distance between the lens and the recording cylinder, B, is constant for the entire photo in strip photography.

$$B = F\ (S + 1.0) \tag{34}$$

Thus for the velocity of the lens carriage,

$$\dot{B} = 0 \tag{35}$$

10. The distance between the copy platen and the recording cylinder, L, is also constant for the entire photo in strip photography.

$$L = B\ (1 - \frac{1}{S}) + \eta \tag{36}$$

Thus for the velocity of the copy carriage,

$$\dot{L} = 0 \tag{37}$$

11. T, the position of the variable density filter for exposure control, is also constant for the entire photo.

$$T = \frac{Cn}{(S + 1.0)^2} \tag{38}$$

12. The changes in the velocities of B and L are zero.

$$\Delta\dot{B} = \Delta\dot{L} = 0 \qquad (39)$$

B. Iterative Calculations

The following procedure is followed until the entire photograph has been scanned ($v_k < v_f$), or until 3600 scans have been processed.

1. Given the position of the recording cylinder, V_k, calculate the corresponding position of the copy platen, v_k, and the velocity of the copy platen carriage, $\dot{v}_k$, (eq. 16, 17, or 18, 19, 20, 21).

2. The change in velocity ($\Delta\dot{v}_k$) is computed (eq. 27, 30).

3. The same quantities,

   $$v_k,\ \Delta\dot{v}_k,\ B,\ \Delta\dot{B},\ L,\ \Delta\dot{L},\ T,$$

   are coded into the message required by the rectifier. There is no change in the format of the message and all seven quantities must appear in each message, although only v_k and $\Delta\dot{v}_k$ are varying from scan to scan.

4. The position of the recording cylinder for the next scan, V_{k+1}, is computed (eq. 33).

14.5 Vertical Panoramic Photography

The following procedure applies to vertical panoramic photography. Tilted panoramic photos may be rectified in two steps by first processing them as oblique frame (to remove the tilt) and then as vertical panoramic.

A. Preliminary Calculations

1. Breakpoint 4 must be set for panoramic photography.

2. The input is read and the correction is applied to the focal length of the taking camera.

$$f_{corrected} = \frac{TD}{AD} f_{input} \tag{40}$$

This corrected value of f is used in the subsequent calculations.

3. The panoramic sweep angle, v_o/f, is computed and tested. The condition

$$\left| \frac{v_o}{f} \right| \leq 60^\circ \tag{41}$$

must hold for rectification.

4. The initial and final values of the optical magnification of the rectifier lens are calculated.

$$M_o = S \tag{42}$$

$$M_f = S/2 \tag{43}$$

5. These magnifications must satisfy the conditions,

$$.5 \leq M_f,\ M_o \leq 9.0 \qquad (44)$$

M_f is obviously less than M_o.

If equations 44 are not satisfied, the program stops at a PES and a new value of S must be used as input.

6. The proper rectifier lens is determined in the same manner as for oblique frame photography (eq. 6, 7, 8, 9). C_n is also calculated (eq. 10).

7. The height of the photograph is compared with h_r (as in oblique frame photography) to determine whether or not the corrections for earth curvature are required.

8. The initial position of the copy platen, v_o, is given as input. The corresponding initial position of the recording cylinder, V_o, must be computed.

a. For $h \leq hr$,

$$V_o = f\,S \tan\left(\frac{v_o}{f}\right) \qquad (45)$$

b. For $h > h_r$,

$$V_o = \frac{SRf}{h}\left[\sin^{-1}\left(\frac{R+h}{R}\sin\frac{v_o}{f}\right) - \frac{v_o}{f}\right] \qquad (46)$$

B. Iterative Procedure

The following procedure is followed until the entire photograph has been scanned ($v_k < v_f$), or until 3600 scans have been processed.

1. Given the position of the recording cylinder, V_k, calculate the corresponding position of the copy platen, v_k, and the velocity of the copy platen carriage, $\dot{v}_k$.

   a. For $h \leq h_r$

$$v_k = f \tan^{-1}\left(\frac{V_k}{fS}\right) \tag{47}$$

$$\dot{v}_k = \frac{\dot{V}}{S} \cos^2 \frac{v_k}{f} \tag{48}$$

   b. For $h > h_r$,

$$v_k = f \tan^{-1}\left\{\frac{\sin \frac{h\ V_k}{SR\ f}}{\frac{R+h}{R} - \cos \frac{h\ V_k}{S\ R\ f}}\right\} \tag{49}$$

$$\dot{v}_k = \frac{h\ \dot{V}}{S\ R}\left\{\frac{\frac{R+h}{R}\cos\frac{h\ V_k}{S\ R\ f} - 1.0}{\left[\frac{R+h}{R} - \cos\frac{h\ V_k}{S\ R\ f}\right]^2}\right\} \tag{50}$$

2. Calculate the distance, B_k, between the lens and the recording cylinder for this scan. Also calculate the

velocity of the lens carriage along the optical axis.

$$B_k = F \left[\frac{S}{\cos \frac{v_k}{f}} + 1.0 \right] \quad (51)$$

$$\dot{B}_k = \frac{F\, S\, \dot{v}_k \sin \frac{v_k}{f}}{f \cos^2 \frac{v_k}{f}} \quad (52)$$

3. Calculate the distance, L_k, between the copy platen and the recording cylinder. Also calculate the velocity of the copy carriage along the optical axis.

$$L_k = \frac{B_k^2}{B_k - F} + \eta \quad (53)$$

$$\dot{L}_k = \frac{B_k\, \dot{B}_k\, (B_k - 2F)}{(B_k - F)^2} \quad (54)$$

4. Calculate the position, T_k, of the variable density filter for exposure control.

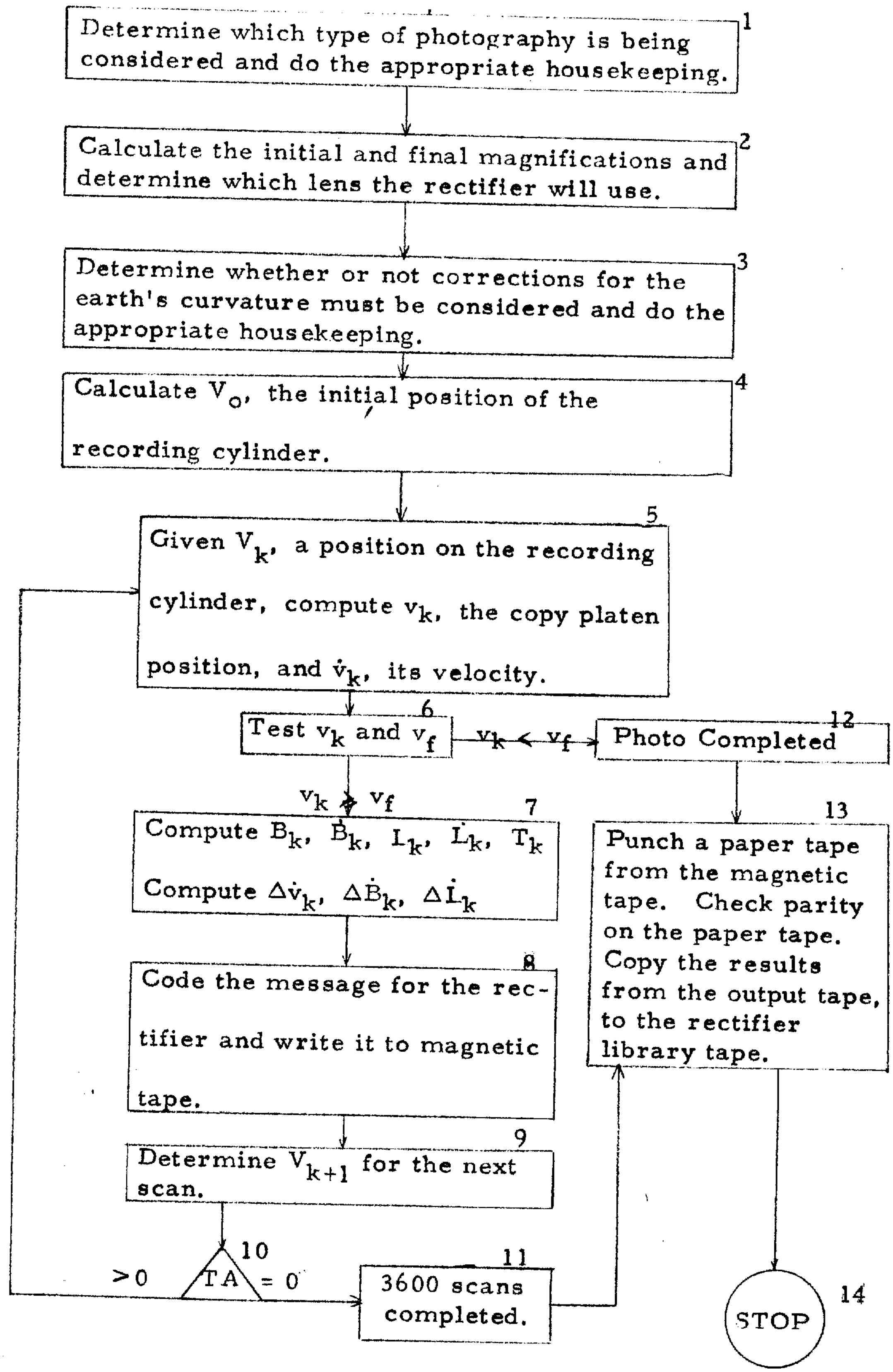
$$T_k = \frac{C_n}{\left[\frac{S}{\cos \frac{v_k}{f}} + 1.0 \right]^2} \quad (55)$$

5. The changes in the velocities ($\Delta \dot{v}_k$, $\Delta \dot{B}_k$, $\Delta \dot{L}_k$), are computed as in oblique frame photography (eq. 27, 28, 29, 30, 31, 32).

6. The rectifier message is formed as in frame photography.

7. The position of the recording cylinder for the next scan, V_{k+1}, is computed as in frame photography.

14.6 Schematic Flow Chart - Program R 1



14.7 General Procedure of the Program

The three types of photography are treated in a similar manner in the program, with the equations varying with the type of photography. In the schematic Flow Chart, the general procedure for any type of photography may be followed.

(1) The program determines, by breakpoint settings, which type of photography is being processed, and it performs the initial housekeeping. The input is read and the tilt (t), or the panoramic swing angle (v_o/f), is checked for machine limitations.

(2) The initial and final magnifications are calculated and the proper rectifying lens is determined. If either lens may be used, the size of the photo determines the proper lens.

(3) The input value h, the height of the photograph, is compared with h_r, a program constant. If $h \leq h_r$, it is not necessary to correct for earth curvature; if $h > h_r$, the corrections for earth curvature are required. The appropriate switches are set depending on the value of h.

(4) Using the input value of v_o, the position of the copy platen, the value of V_o, the initial position of the recording cylinder, is calculated.

The program is now ready to start the iterative loop, which will be continued until the entire photograph has been processed, or until 3600 scans have been completed.

(5.) Given V_k, the position on the recording cylinder for this scan, the program computes v_k, the corresponding position on the copy platen for this scan. The formulae used vary with the type of photography and the height of the photograph. The velocity of the copy platen carriage perpendicular to the slit, $\dot{v}_k$, is also computed.

(6.) v_k is compared with v_f, the input value for the final position of the copy platen. If $v_k < v_f$, the photograph has been completely processed in less than 3600 scans. Control is transferred to (13).

(7.) If $v_k \geq v_f$, the remaining quantities for this scan are computed: B_k, $\dot{B}_k$, the position and velocity of the lens carriage; L_k, $\dot{L}_k$, the position and velocity of the copy carriage; and T_k, the position of the variable density filter for exposure control. The changes in the velocities, $\Delta\dot{v}_k$, $\Delta\dot{B}_k$, and $\Delta\dot{L}_k$, are then computed.

(8.) The following quantities,

$$v_k,\ \Delta\dot{v}_k,\ B_k,\ \Delta\dot{B}_k,\ L_k,\ \Delta\dot{L}_k,\ T_k,$$

are processed into the format required on the paper tape for the rectifier. The message for this scan is written to magnetic tape.

(9.) The value of V_{k+1}, the position of the recording cylinder for the next scan, is computed.

(10.) When 3600 scans have been processed, control is transferred to (13). Until this time, control returns to (5) to compute v_k for the next scan.

(13.) In most cases, the entire photograph has been processed. In some cases, however, 3600 scans have been computed, but the photograph is not completed. In either case, the message for each scan has been written to magnetic tape. Now the entire set of messages is punched on paper tape, the paper tape is checked for parity errors, and, if the tape is satisfactory, the output (photo identification and scan messages) is copied to the rectifier library tape for permanent storage.

14.8 Format of the Punched Paper Tape

The three carriage positions, (v, B, L), the three changes in velocity ($\Delta\dot{v}$, $\Delta\dot{B}$, $\Delta\dot{L}$), and the position of the variable density filter, (T), are calculated for each scan of the photograph. These seven quantities are in floating point format when they are calculated and they must be transformed into binary integers and punched on a paper tape which will be interpreted by the digital decoder of the rectifier.

A. The carriage positions (v, B, L) are transformed into 12 binary bits. This is equivalent to an accuracy of .0002 inches. This is exactly 2 rows on the punched tape and can be expressed as 4 octal digits. Therefore the positions must be transformed into octal integers between 0 and 7777. The carriages are coarsely positioned, prior to rectification, using the initial positions which are calculated in the program and written to the Monitor Printer. The punched paper tape thus requires only the fractional part of the positions in each scan message. Thus if we say that each quantity (v, B, or L) is composed of an integer part (which may be zero), and a fractional part, we have

$$v = v_I + v_f \qquad (56)$$

Thus we may say that on the punched paper tape,

$$v = v_f \qquad (57)$$

The program drops the integer portions of the 3 positions and retains only the fractional portions which are still in floating point format. The positions B and L must always be positive, but v can be either positive or negative. After dropping the integer portions we have,

$$|v|, B, L < 1.0 \qquad (58)$$

The three fractional positions are now changed to fixed point and multiplied by 4095. The results are rounded to the nearest integers, so that

$$0 \leqslant |v|, B, L \leqslant 4095_{10} \qquad (59)$$

These decimal integers are converted into octal, so that

$$0 \leqslant |v|, B, L \leqslant 7777_8 \qquad (60)$$

The 4 octal digits for each position are punched on the paper tape as 2 rows of 6 binary bits each.

If v is a negative number, its value is complemented before being punched. This is the 10's complement if equation 58 is considered, the 8's complement if equation 60 is considered, or the 2's complement if the 12 bit binary integer is considered.

B. The change in velocity data ($\Delta\dot{v}$, $\Delta\dot{B}$, $\Delta\dot{L}$) are not required to as much accuracy as the position data, and are given only 6 binary bits each. This is exactly 1 row on the punched tape and can be expressed as 2 octal integers. Therefore, the delta velocities must be transformed into octal integers between 0 and 77.

Before the delta velocities are transformed into octal numbers, "velocity constants" are introduced. In other words, $\Delta\dot{v}$, $\Delta\dot{B}$, and $\Delta\dot{L}$ are multiplied by a factor, K, the purpose of which is to increase the range of these velocity changes, so that the expression,

$$0 \leq |\Delta\dot{v}| \;,\; |\Delta\dot{B}| \;,\; |\Delta\dot{L}| < 1.0 \qquad (61)$$

is a realistic equation.

Forcing the quantities to span the entire range from zero to one increases the accuracy of the final binary result which has an accuracy of $\frac{.016}{K}$ inches/sec. The K value now being used for $\Delta\dot{v}$, $\Delta\dot{B}$, and $\Delta\dot{L}$ is 50, (the 3 velocity changes are basically less than .02). It is likely that experience in the rectification of actual photographs will indicate a change in this constant for one or more of the velocity changes.

These modified velocity changes may be either positive or negative and are still in floating point format. They are now changed to fixed point and multiplied by 63. The results are rounded to the nearest integer, so that

$$0 \leq |\Delta\dot{v}|, \quad |\Delta\dot{B}|, \quad |\Delta\dot{L}| \leq 63_{10} \tag{62}$$

These decimal integers are converted into octal, so that

$$0 \leq |\Delta\dot{v}|, \quad |\Delta\dot{B}|, \quad |\Delta\dot{L}| \leq 77_{8} \tag{63}$$

The 2 octal digits for the magnitude of each of the changes in velocity are punched on the paper tape as 1 row of 6 binary bits.

The signs for these quantities are translated into 3 binary bits (1 indicates -, 0 indicates +) which are also punched on the paper tape.

C. The position of the variable density filter (T), which controls the exposure is given in 7 binary bits. This is equivalent to an accuracy of .008 of a revolution of the filter. This is 1 row plus 1 bit (on the next row) on the punched paper tape and can be expressed as 3 octal digits (the first of which is a 0 or a 1). The value of T is transformed into an octal integer between 0 and 177.

Since T represents a fractional part of 1 revolution (360°) it holds that

$$0 \leq T \leq 1.0 \tag{64}$$

This value is multiplied by 127 and rounded to the nearest integer, so that

$$0 \leq T \leq 127_{10} \qquad (65)$$

This decimal integer is changed to an octal integer, such that

$$0 \leq T \leq 177_{8} \qquad (66)$$

T can now be expressed as a 7 bit binary number. The first 6 bits are punched on one line and the last bit is punched on the next line, followed by 2 positions which are not used, and then the 3 sign bits for the delta velocities. It must be stressed here that this binary integer must not be treated as the other 6 quantities in regard to the transformations from octal to binary and vice versa. When the length of a binary number is divisible by 3 (as in 12 bits for v, 6 bits for $\Delta\dot{v}$), it is possible to translate binary to octal starting with the 3 left-most digits. The proper way, however, for any length binary integer, is to start the right and work backwards. Thus the array,

010 110
1XX

must not be read as 264 (the X's are the 2 unused bits and would appear to be the 0's on the tape), but rather the correct value of T is 055. If it should be necessary to punch this number in the required format, the following procedure may be used:

1) write the number (55) in binary, 101 101
2) add 2 zeros to the right hand side, 1010100
3) add leading zeros to make 9 bits, 010110100
4) transform into a 3 digit octal number 264
5) punch these numbers on tape

    010 110
    100

D. Consider the following quantities as a set of results which must be formed into a scan message for the rectifier.

$v = -1.5682$

$\Delta\dot{v} = -.00921$

$B = 31.0759$

$\Delta\dot{B} = .00158$

$L = 42.7476$

$\Delta\dot{L} = -.00572$

$T = .213$

After the integer parts of the positions have been dropped and the "velocity constant" of 50 is introduced, we have

v = -.5682

$\Delta\dot{v}$ = -.4605

B = .0759

$\Delta\dot{B}$ = .079

L = .7476

$\Delta\dot{L}$ = -.286

T = .213

These values are now multiplied by the appropriate scaling constants (4095, 63, or 127) and the results are rounded to the nearest integer.

These decimal integers are then changed to octal and then to the proper number of binary bits. Since v is negative, its value is complemented. (The binary result would be the same if the 10's complement had been used, i.e., v = +.4318)

v	=	-2327	=	(+3351) -4427	=	011 011 101 001
$\lvert\Delta\dot{v}\rvert$	=	29	=	35	=	011 101
B	=	0311	=	0467	=	000 100 110 111
$\lvert\Delta\dot{B}\rvert$	=	05	=	05	=	000 101
L	=	3062	=	5766	=	101 111 110 110
$\lvert\Delta\dot{L}\rvert$	=	18	=	22	=	010 010
T	=	027	=	033	=	0 011 011

The signs of the 3 velocity changes form the binary number

101

This data would appear on the punched paper tape as in Figure 2, with a start message preceding v and an end message following the sign bits. Parity, the left bit, is even on paper tape. Note, especially, the manner in which T is punched.

E. The rectifier carriages are coarsely positioned, prior to rectification, by the operator using the positions written to the Monitor Printer in the computer program. It has been determined that a special initial message should be formed to fix the exact initial positions of the carriages before the initial velocities are introduced. Thus, the very first message written to magnetic tape (and punched on paper tape) will contain the initial positions, but the delta velocities will be zero.

$$v_o,\ 0,\ B_o,\ 0,\ L_o,\ 0,\ T_o.$$

The second message on the tape will be the normal message for k = 0, in which the velocities themselves will appear (see eq. 30, 31, 32)

$$v_o,\ \dot{v}_o,\ B_o,\ \dot{B}_o,\ L_o,\ \dot{L}_o,\ \dot{T}_o.$$

All subsequent messages will be as previously described. The last message is followed by an ED.

14.9 Output

A. Punched Paper Tape

This is the primary output of the program. The tape contains up to 3600 scan messages in the format described in section 14.8. The last message is followed by an ED. The computer program includes a procedure for checking parity on this tape.

B. Monitor Printer

The photo identification and the photo input are written to the Monitor Printer after they are read. The initial rectifier settings (v_o, V_o, B_o, L_o, T_o) are written after they have been computed. The proper rectifying lens is also written to the Monitor Printer, as are operator instructions and messages accompanying any programmed error stop.

C. Magnetic Tape

As each scan message is formed, it is written to a magnetic tape, on which the photo identification has also been written. After the last scan message, and ED is written. This magnetic tape is used to punch the paper tape, and then the contents of the tape are copied to the end of the rectifier library tape for reference if the paper tape for this photo should ever need to be repunched.

D. High Speed Printer Output

If breakpoint 1 is set, a hard copy output is obtained on the High Speed Printer. There are 6 lines of printing for each scan message.

1. Line 1 contains those quantities which are not coded for the rectifier, but which have been calculated; V_k, $\dot{v}_k$, $\dot{v}_{k-1}$, $\dot{B}_k$, $\dot{B}_{k-1}$, $\dot{L}_k$, $\dot{L}_{k-1}$. These quantities are printed in floating point format.
2. Line 2 contains those quantities which are to be coded for the rectifier; v_k, $\Delta\dot{v}_k$, B_k, $\Delta\dot{B}_k$, L_k, $\Delta\dot{L}_k$, T_k. They are printed in floating point format. These 7 quantities are printed on all the remaining lines in the various steps of the rectifier coding procedure.
3. Line 3 contains the fractional portions of the positions (v_k, B_k, L_k, T_k) and the changes in velocity after the introduction of the velocity constants. These values are also in floating point.
4. Line 4 contains the fixed point equivalents of line 3.
5. Line 5 contains the same quantities after having been multiplied by the scaling constants (4095, 63, or 127). The integer portion of the number will be changed to octal (i.e., .5 has already been added for rounding).
6. Line 6 contains the octal value of the binary integers which have been punched on the paper tape.

If breakpoint 1 is not set, the only printer output occurs if any of the velocity changes exceed 1.0 after the velocity constant has been introduced.

STAT

14.10 Operating Instructions

The first part of the operating instructions would be common to any program but is repeated here so that the operator can develop the proper housekeeping techniques.

1. Mount a work tape, with a ring, on tape station 10. Mount a copy of the permanent library store tape, with a ring, on tape station 20. If for any reason tape station 10 is not in operating order, the console operator should read memory at 00 12 10 and place the number of a working tape station in the last two digits. If tape station 20 was not in operation order the operator would read memory at 00 12 20 and place the number of a working tape station in the last two digits.
2. A TLT library tape should be mounted on any other available working tape station (with no ring).
3. The operator should type up the following paper tape message.

   <• 1000 R1 00 •, FL>
4. Clear the computer memory.
5. The operator should now block read forward into 130000 from the TLT library tape station, set the "P" register to 13 00 00, set an "X1" status level and depress and release the start button. The above operation will bring in the rectifier program from the TLT library to the computer memory.

6. The operator can now depress and release the start button which would automatically place the computer to the first instruction of the rectifier program. The operator could also have placed in the "P" register the machine address of 00 50 00 which is the first instruction of the rectifier program.

7. The monitor printer will now print out.

   "Program R1. -Lyon - Dobbs"

   "Rectification of Oblique Photography"

   "Set Break Points as follows - Frame BPO-Strip BP2-Panoramic BP4".

8. The operator will now set one of the three break points in order to rectify the given photograph and hit the start button.

9. As a check the monitor printer will now print out the type of rectification program that will be used.

10. The monitor printer will now print.

    "Mount paper tape with photo I. D."

    The photo identification message should be no longer than 260 characters and must be in message format.

11. Mount the paper tape message on the paper tape reader and hit the start button.

12. The monitor printer will now print.

"Set BP No. 1 for on-line print out"

If break point 1 were set the results of every calculation per rectifier scan would be printed out on the on-line printer.

If break point 1 were not set there would not be any print-out of results. During the program the operator can put break point 1 on and off, if so desired, to obtain print outs of blocks of calculated results.

13. The monitor printer will now print out.

"Mount photo input of PTR"

Just as a review the photograph input should consist of the following terms written in 12 digit floating point format.

A. Start message followed by a 3 digit serial number XXX

B. ISS followed by starting position in inches with sign

C. ISS followed by final position in inches with sign

D. ISS followed by the tilt of photograph in degrees with sign

E. ISS followed by the scale change with a sign

F. ISS followed by the focal length of the taking camera in inches with sign.

G. ISS followed by the height of the camera station in nautical miles with a sign.

H. ISS followed by the radius of the earth at the latitude of the photograph in nautical miles followed by a sign.

I. ISS followed by the average of the measurement across the fiducial marks of the copy film in inches followed by a sign.

J. ISS followed by the average of the measurements across the same fiducial marks on a theoretically non-shrink base in inches followed by a sign.

K. ISS followed by the distance between scans on the recording cylinder in inches followed by a sign.

L. ISS followed by the constant velocity of the recording cylinder in inches per second followed by a sign.

M. ISS followed by the transmission input given in percent followed by a sign.

N. ISS followed by the size of the photo which is to be rectified in inches followed by a sign followed by an end message.

14. Mount the photo input on the paper tape reader and hit start.

15. The monitor printer will now print out all the data that was on the photo input tape. The operator should check these values to be cer-ain that he is processing the proper tape.

16. The computer will now test the tilt value or in the panoramic case v_o/f. It then calculates the initial and final magnification values in order to determine the proper lens to use for the rectification of this photograph. These values are then printed out on the monitor printer with the initial magnification first followed by the final magnification.

17. The computer will now determine the proper size lens for the magnification values calculated. The selected lens will be printed out on the monitor printer. There is a common area in which either lens may be used so that only the format size would determine the size lens that is best suited. If this were the case the print out would be as follows:

"M1 and M2 in Common Area. The size of photo will determine proper lens."

If the computer had only one possible lens the print out would be as follows:

"Use 7.85 lens to rectify this photo." or

"Use 14 inch lens to rectify this photo."

18. The next print out would be the computed results of the initial starting points of the rectifier. This would be 5 floating point numbers which represent the starting positions for

(1) The copy platen (v_o)

(2) The recording cylinder (V_o)

(3) The lens carriage (B_o)

(4) The copy carriage (L_o)

(5) The variable density filter (T_o)

19. The computer will now begin its iteration cycle. For each succeeding position of the recording cylinder the computer computes and writes out in message format, to the output magnetic tape the new positions and velocities of the servos.

20. The iteration cycle will continue until we have reached v_f or 3600 scans. If we have reached v_f the monitor printer will print out the following message.

"Rectification completed. Ready to copy from magnetic tape to paper tape."

"Set BP 5 for parity check instructions"

If we had reached 3600 scans first before v_f the monitor printer would have printed the following:

"Exceeds 3600 scans"

"Floating point number which gives the last calculated position of v_k"

"Rectification completed. Ready to copy from magnetic tape to paper tape."

"Set BP 5 for parity check instructions"

21. It is recommended that for the first couple of times the operator put on break point 5 in order to familiarize himself with the parity check procedure.

22. The operator will now hit the start button and the monitor printer will print the following message.

"Copying to paper tape"

The information that has been stored on magnetic tape will now be punched out on the paper tape punch. When this operation is completed the monitor printer will print

"Copying Completed"

This would be followed by parity checking instructions if break point 5 were set.

23. When parity checking instructions have been completed the operator should hit the start button. The monitor printer will print out "Are you ready for parity check".

24. The operator will now hit the start button which will start the paper tape reader checking parity on the paper tape.

25. If too many parity errors are detected, the operator can unwind the paper tape, remove and destroy it. Mount a new paper tape on the paper tape punch and set break point 3. The operator will now follow the by pass procedure which would allow the computer, after it prints out on the monitor printer instructions on break point settings, to punch out a new paper tape.

26. When the tape completes its parity checking stage the monitor printer will print

"P. T. has been parity checked"

"Rectification program completed"

27. The program will now copy the results that it has just calculated and place it on a permanent library tape which was mounted on tape station 20. (Or if 20 was not in working order the location of a tape station trunk that was placed into the last two digits of machine address 00 12 20).

28. The operator should now remove the paper tape from the paper tape reader and on the leader of this tape should write down the following information.

    a. The photo identification number

    b. The focal length of the lens to be used (as stated in step 17)

    c. The five initial starting positions as described in step 18 of this section.

29. If the output exceeds 3600 scans as explained in step 20, the balance of the program will have to be completed as follows.

A new photo input tape has to be punched with the only change being the starting position (v_o) which should be the position the computer had processed on the 3600th scan. This position was written on the monitor printer as described in step 20. The balance of the new photo input tape should be the same as the old tape. The rectifier program will have to be started from step 1 of this section if the computer was disturbed from the last run. If the computer was not disturbed then the operator can start from step 6 where the "P" register was set to 005000 and the start button was depressed and released.

Approved For Release 2005/02/17 : CIA-RDP78B04770A001400040003-1

14.11 PROGRAMMED ERROR STOPS

Using the Section 14.10 as a reference, the error stops will be introduced in this section as they would appear in the operating instructions.

1. If the operator had forgotten to set one of the three possible break points for the rectification of the photograph, the computer would automatically return to the instruction:
"Set Break Points as follows - Frame BPO, Strip BP2, Panoramic BP4"
The operator would then set one break point and continue.

2. If the operator resets one of the above break points during the operation of the program the computer would go to a program error stop (PES).
The operator would then have to restart the rectifier program from the beginning in order to continue.

3. The computer compares the input tilt value to 3 degrees. If the input value is below 3 degrees the monitor printer will print the following:
"No rectification required on the photo".
The computer would then go to PES and the program would be completed.

STAT

4. If the computer had determined that the tilt was above 3 degrees it would then compare the tilt to 60 degrees. For the case of the tilt being greater than 60 degrees the monitor printer would print the following:

"Tilt too large photo cannot be rectified."

The computer would then go to PES. The tilt value on the input tape would then have to be changed and the program restarted from the beginning in order to continue.

5. The computer program will now branch out into one of three paths, (i.e., Frame, Strip or Panoramic) This writeup will assume we were going through the frame and strip program first and then the panoramic error stops will be covered later. In the frame and strip program, the computer will calculate the following values:

$$M_2 \text{ (initial)} = \frac{Sf}{f \cos t - v_o \sin t}$$

$$M_1 \text{ (final)} = \frac{Sf}{f \cos t - v_f \sin t}$$

The above values are tested to be sure they are within the limits of the rectifier lens design. M_1 is compared to 0.5 and if it is found to be below 0.5 the following print out will result:

"M_1 is less than 0.5. Determine a new scale factor "S"".

The computer would then go to PES. In order to continue the program

STAT

the operator would have to determine a new value of "S", punch up a new input tape and start the rectifier program from the beginning. The operator is free, if so desired, to change any other values but he must be careful that when M_1 is to be calculated it will be below 9. (This test is done later on in the program).

6. If M_1 is greater than 0.5 the next test would be to see if M_2 is greater than M_1. If M_1 is greater than M_2 the following error print out would result:

"M_1 is greater than M_2."

The computer would then go to PES. In order to continue it would have to be determined why this occurred and a new data input tape developed. The program would then have to be started from the beginning.

7. If M_1 was less than M_2 the computer would then compare M_2 to 9. If M_2 was greater than 9, the monitor printer would print out the following:

"M_2 is greater than 9. Determine a new scale factor "S"".

The computer would then go to a PES. In order to continue the program, a new value of S or the other parameters that govern M_2, must be determined. A new input tape must be produced and the program started from the beginning.

STAT

Report No. SME-AA-76
15 March 1962

8. Another check that is made with the calculated magnification values would be to determine if M_1 is less than 1.3, and M_2 is greater than 4. If this condition is present the monitor printer will print the following.

"M_1, M_2 error condition."

The computer would then go to a PES. In order to continue the program, the values of M_1 and M_2 must be changed so that this error condition no longer exists. A new input paper tape must be produced and the program started from the beginning.

9. The computer will now generate the control tape for the rectifier. The program is so arranged that if any delta velocity exceeds the maximum velocity of the servo the monitor printer will print:

"xxx Over limits".

where the x's represent the number of the scan that exceeded the maximum servo velocity.

10. As stated in step 5 of this section, the rectifier program could have gone down one of three paths. The error print outs were the same for the frame and strip as shown above. For the panoramic program the tilt value is calculated instead of being given as in the frame and strip program.

STAT

The value $\frac{v_o}{f}$ is calculated and compared to 60 degrees. If this value exceeds 60 degrees the following print out occurs.

"v zero f too large for rectification".

The computer would then go to a PES. In order to continue, the starting point v_o must be changed so that when divided by f its result should be smaller than 1.0472 radians (60 degrees). The operator would then produce a new input tape and restart at the beginning.

11. The panoramic program would have the same error restart procedures as the frame and strip for the following print outs:

"M_1 scale too small. Determine new S" on the panoramic program would be identical to "M_1 is less than 0.5. Determine a new factor S" as shown in step 5 of this section for the frame and strip program.

12. The error print out of:

"M_2 scale too large. Determine new S"

for the panoramic program would use the same restart procedure as:

"M_2 is greater than 9. Determine a new scale factor S".

in step 7 of this section for the frame and strip program.

13. The panoramic program has the same error print out and restart procedure as step 8 of the frame and strip program.

STAT

14.12 Machine Requirements

1. Memory Required

Memory Required	2489 instructions
Instructions	005000 - 055167
Data and Work Areas	134470 - 137767

2. Subroutines Required

Scientific	FPT2
	SQT2
	SIN2
	ATN2
	ENCO
	DECV
	QERY
System	N(FLX 2)

3. Input/Output Requirements

   a. Input is on paper tape

   b. Output is to the monitor printer and magnetic tape.

   c. An optional output can be made to the high speed printer by the application of break point 1.

14.13 Timing

The rectifier program running time will depend on the input parameters. The longest possible program will be one in which the taking camera is located above 50,000 feet and a combination of its other parameters such that it would require more than 3600 scans to complete the scanning of the negative. For the above case it would require approximately 4-1/2 hours to complete the program and punch out the control tape. In the 5 months we have produced rectifier tapes, for the testing of the rectifier, we have found that the shortest program was about 1/2 hour. The average time we have estimated would be about 1-1/2 hours per program.

Approved For Release 2005/02/17 : CIA-RDP78B04770A001400040003-1

RECTIFIER

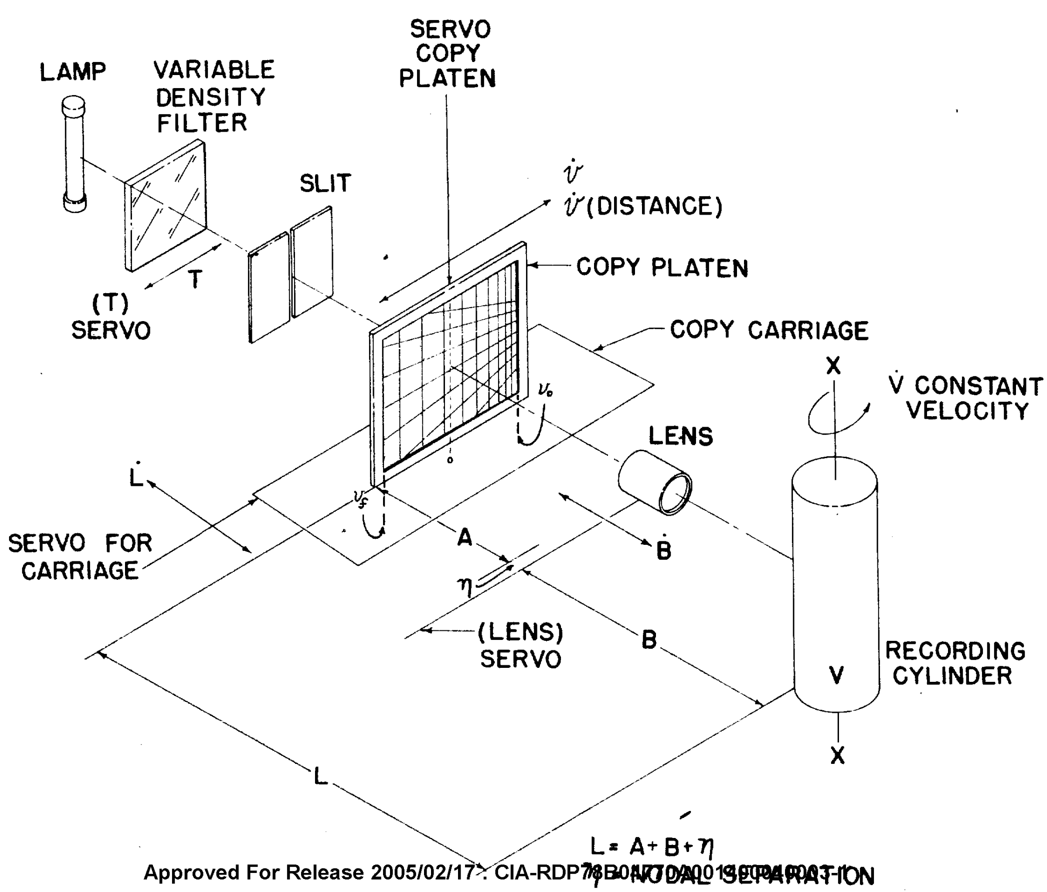
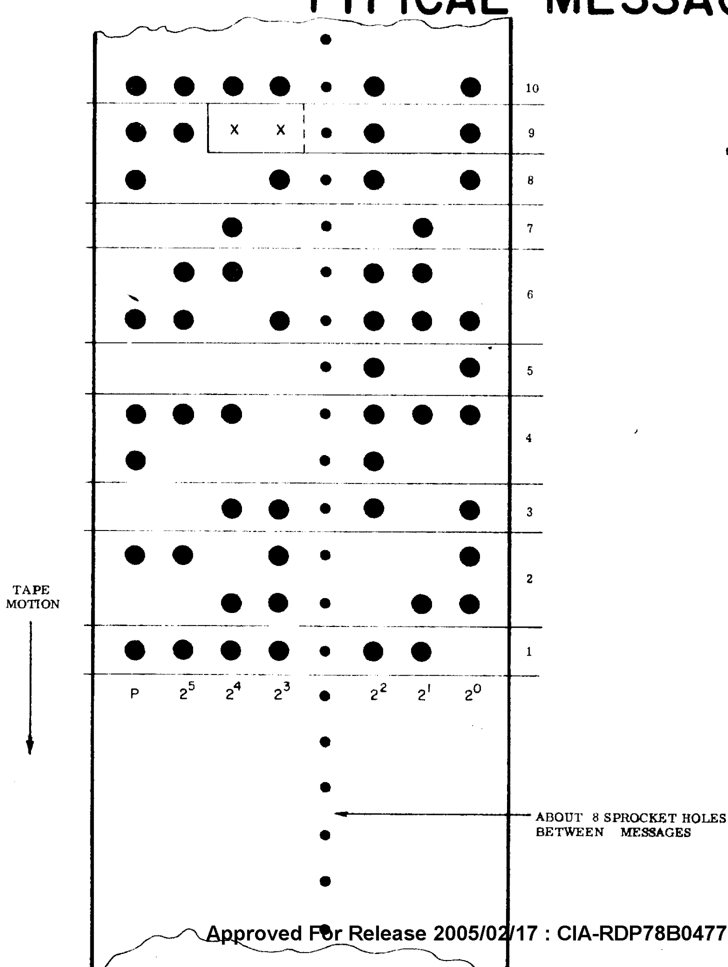


FIGURE 1

TYPICAL MESSAGE



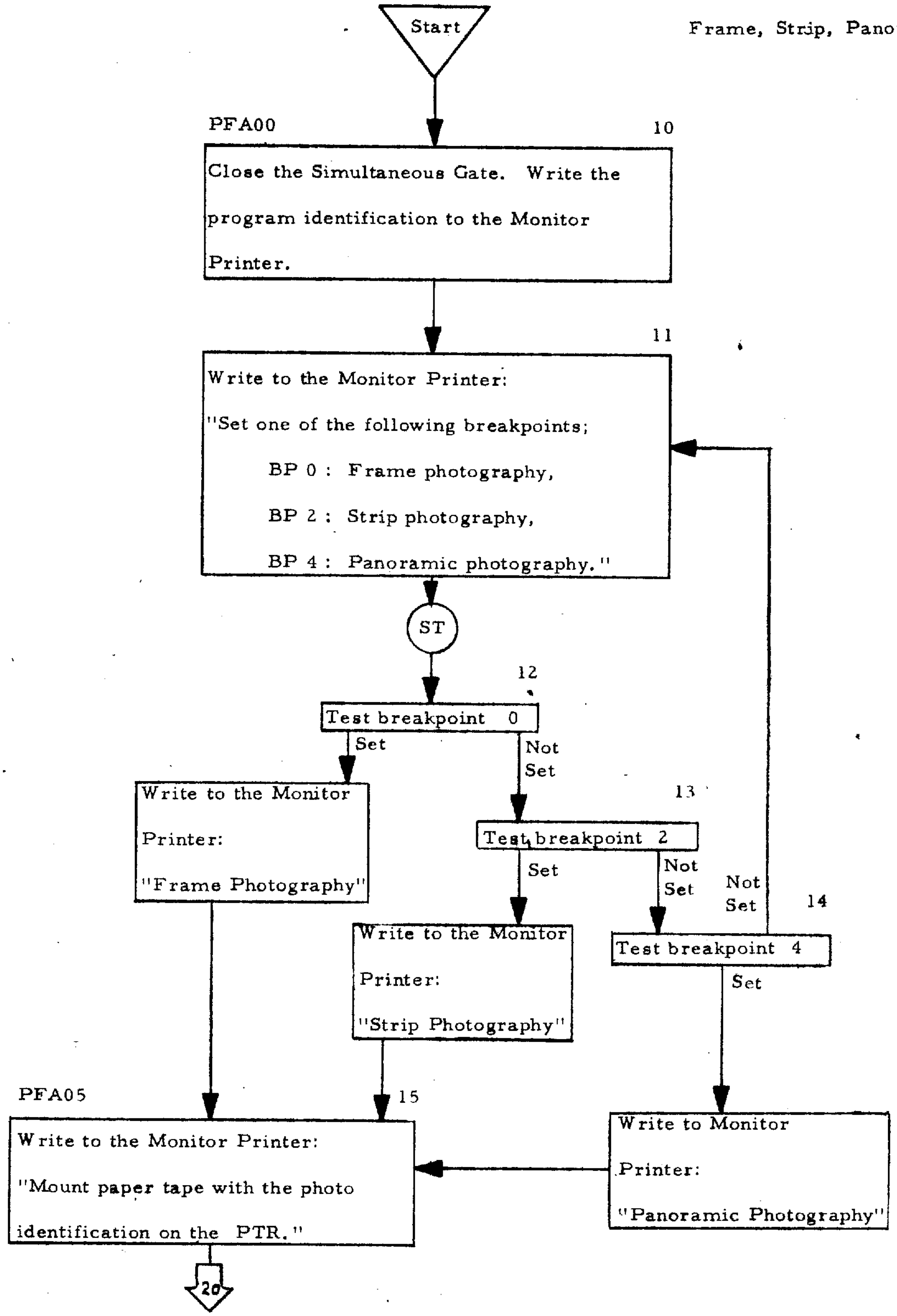
NUMBER	TITLE	VALUE
1	RCA CHARACTER	START MESSAGE
2	(v) POSITION OF COPY PLATEN	3351
3	(Δv) CHANGE IN VELOCITY OF COPY PLATEN	35
4	(B) DISTANCE BETWEEN LENS AND RECORDING CYLINDER	0467
5	(ΔB) CHANGE IN VELOCITY OF B	05
6	(L) DISTANCE BETWEEN PLATEN CARRIAGE AND CYLINDER	5766
7	(Δ L) CHANGE IN VELOCITY OF L	22
8	T EXPOSURE POSITION	033
9	SIGNS FOR 3, 5 and 7	− + −
10	RCA CHARACTER	END MESSAGE

X X 2 UNUSED BITS WHICH ARE NEVER PUNCHED

FIGURE 2

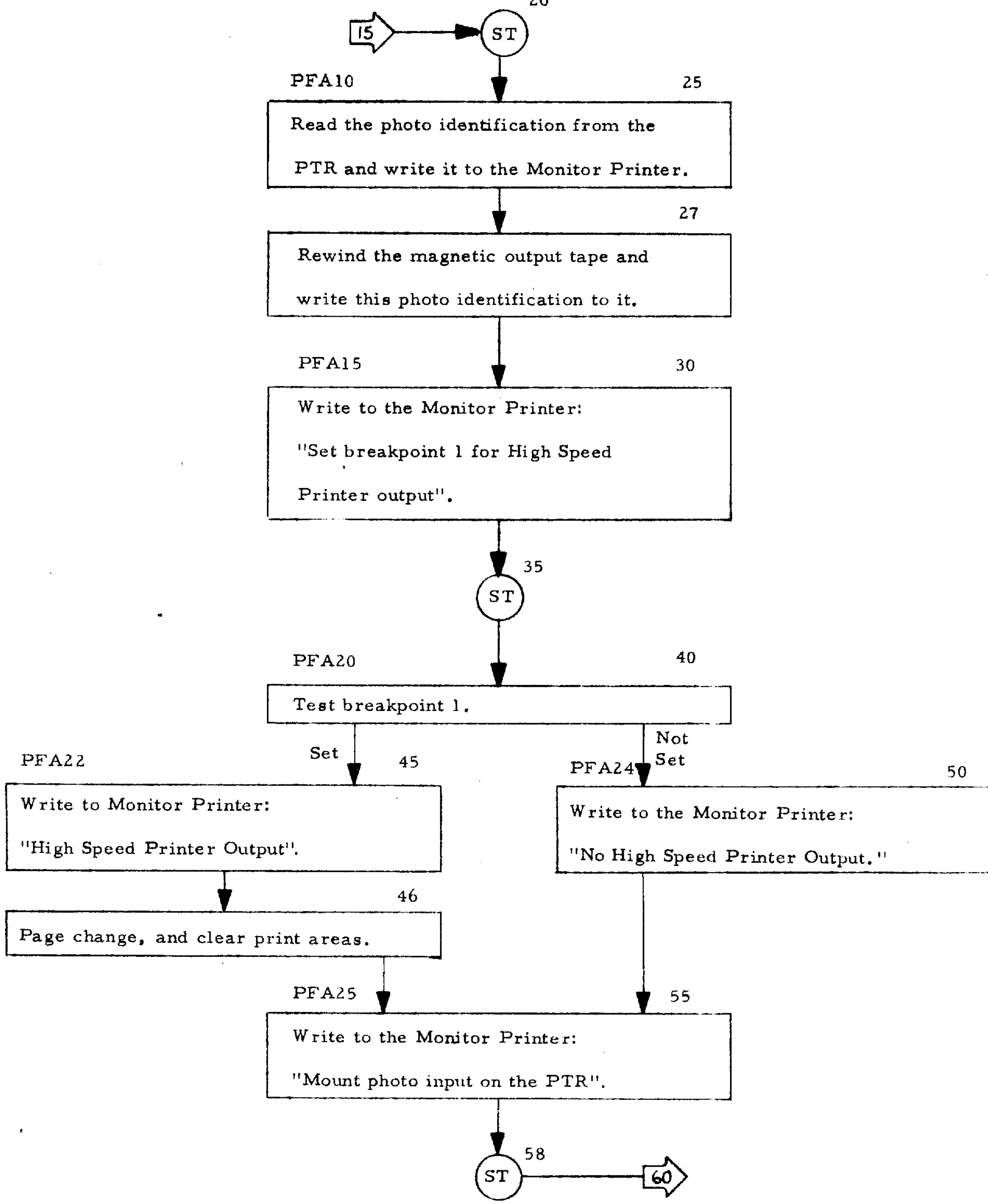
14.14 DETAILED FLOW CHARTS FOR PROGRAM R1

Frame, Strip, Panoramic



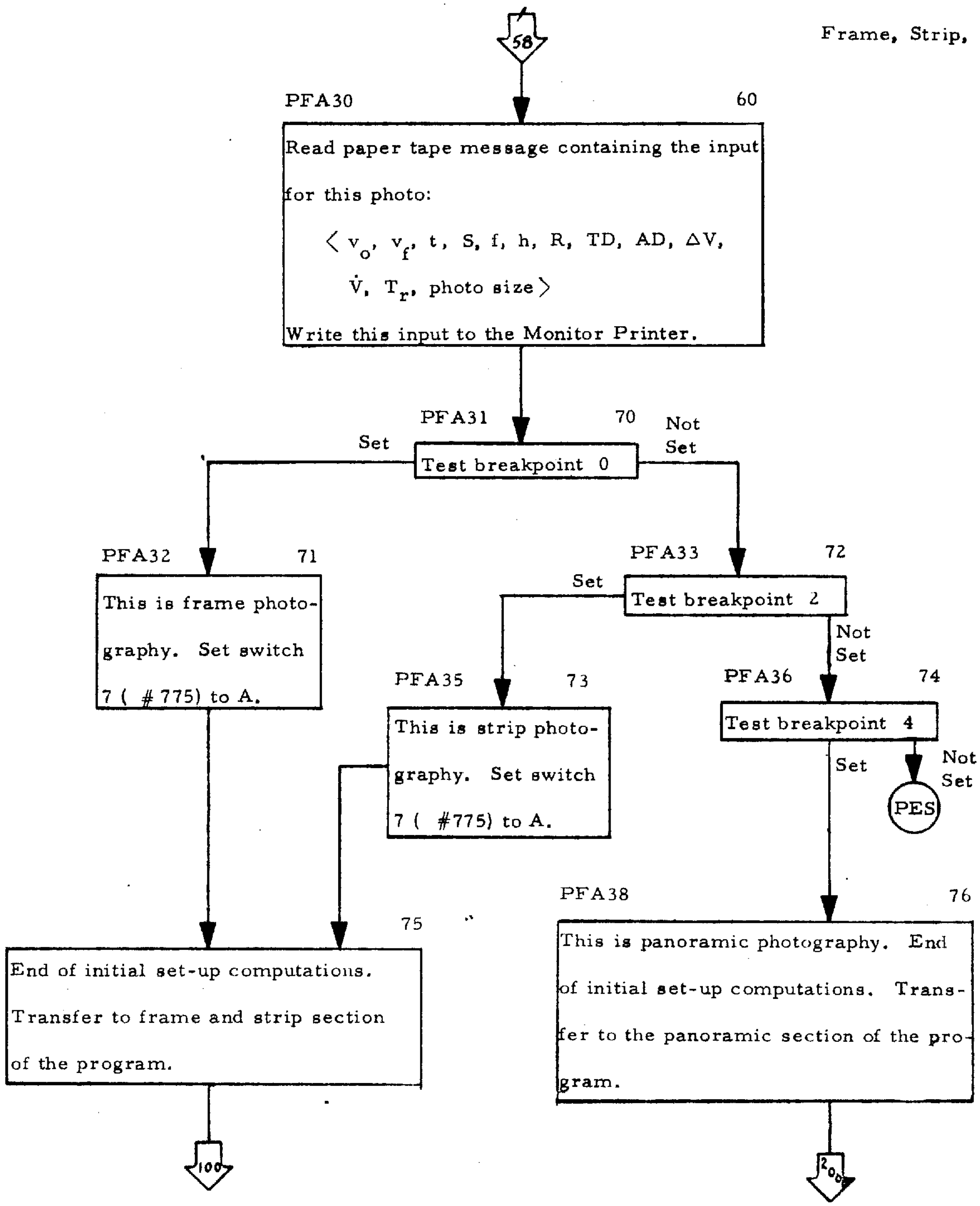
14.14 DETAILED FLOW CHARTS FOR PROGRAM R1 (cont.)

Frame, Strip, Panoramic

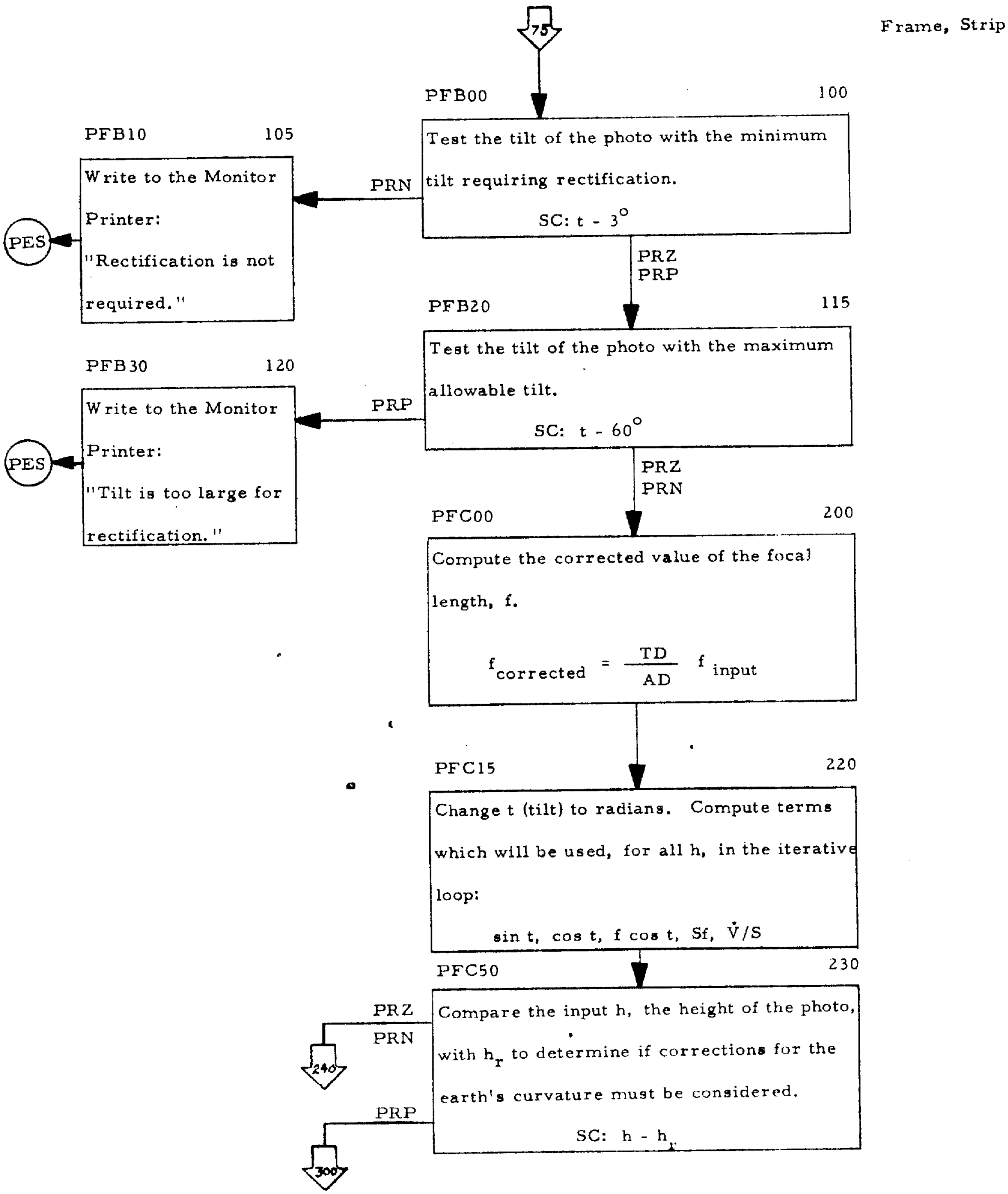


14.14 DETAILED FLOW CHARTS FOR PROGRAM R1 (cont.)

Frame, Strip, Panoramic



14.14 DETAILED FLOW CHARTS FOR PROGRAM R1 (cont.)



14.14 DETAILED FLOW CHARTS FOR PROGRAM R1 (cont.)

Frame, Strip

(230)

PFC60 — 240

$h \leq h_r$

Corrections for the earth's curvature are not required.

Compute additional terms for use in the iterative loop:

$f \cos^2 t$, $\sin t \cos t$, $(\sin t)/f$

PFC65 — 245

Compute V_o, the initial position of the recording cylinder.

$$V_o = \frac{v_o S f}{f \cos^2 t - v_o \sin t \cos t}$$

Set V_o in the proper location for subsequent calculations.

PFC80 — 260

Set switch 1 (# 380) to A

(345)

(230) →

PFD00 — 300

$h > h_r$

Corrections for the earth's curvature are required.

Compute additional terms for use in the iterative loop:

R^2, $\frac{h\dot{V}}{SR}$, $\frac{h}{SRf}$

PFD15 — 310

Compute the angles required in the calculation of V_o;

$$\phi_o = \tan^{-1}\left(\frac{v_o}{f}\right)$$

PFD20 — 320

$$\Theta_p = \sin^{-1}\left(\frac{R+h}{R} \sin t\right) - t$$

PFD40 — 330

$$\Theta_o = \sin^{-1}\left[\frac{R+h}{R} \sin(\phi_o + t)\right] - (\phi_o + t)$$

PFD45 — 340

Compute V_o, the initial position of the recording cylinder:

$$V_o = \frac{SRf}{h}(\Theta_o - \Theta_p)$$

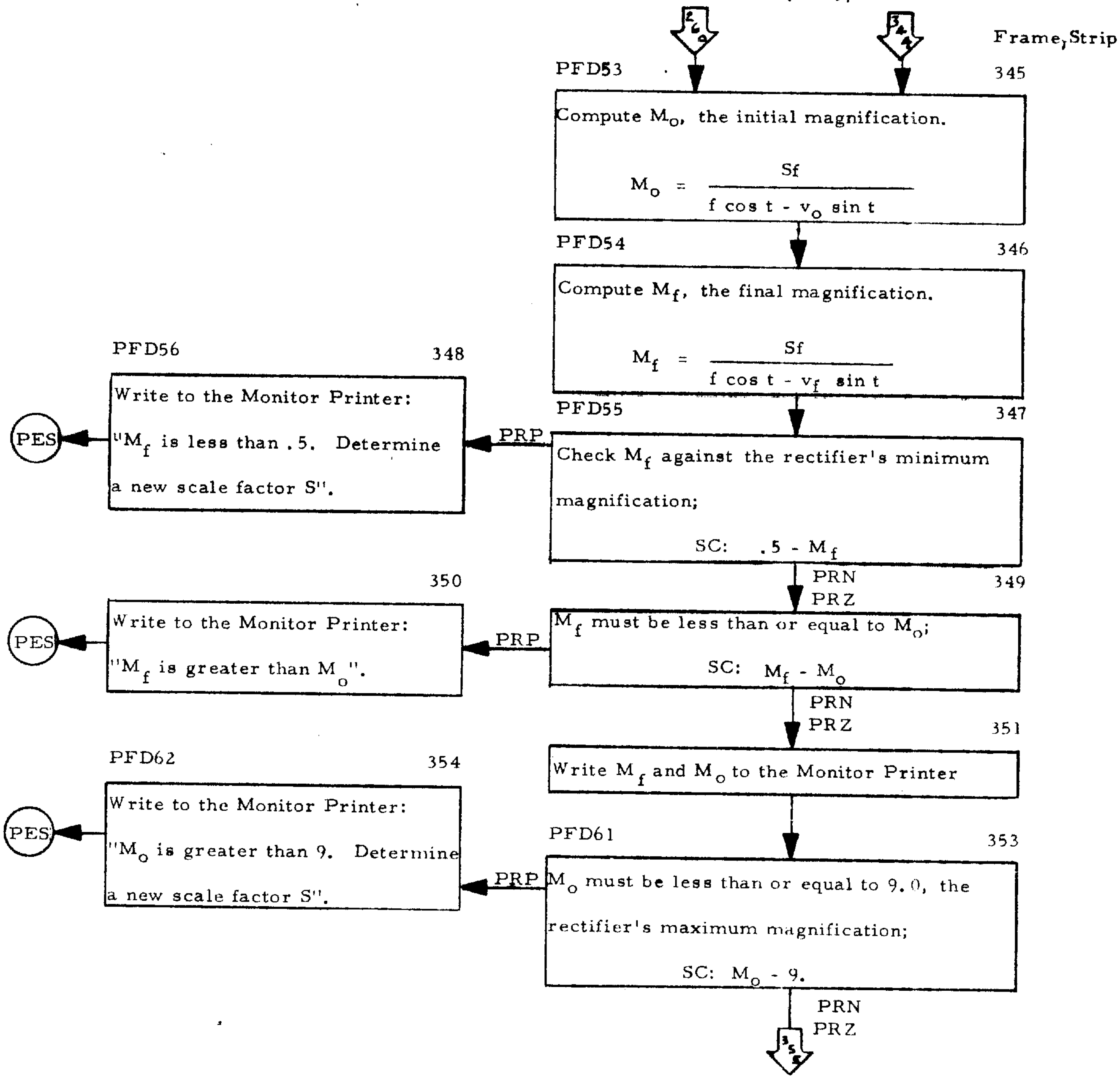
Set V_o in the proper location for subsequent calculations.

PFD52 — 344

Set switch 1 (# 380) to B

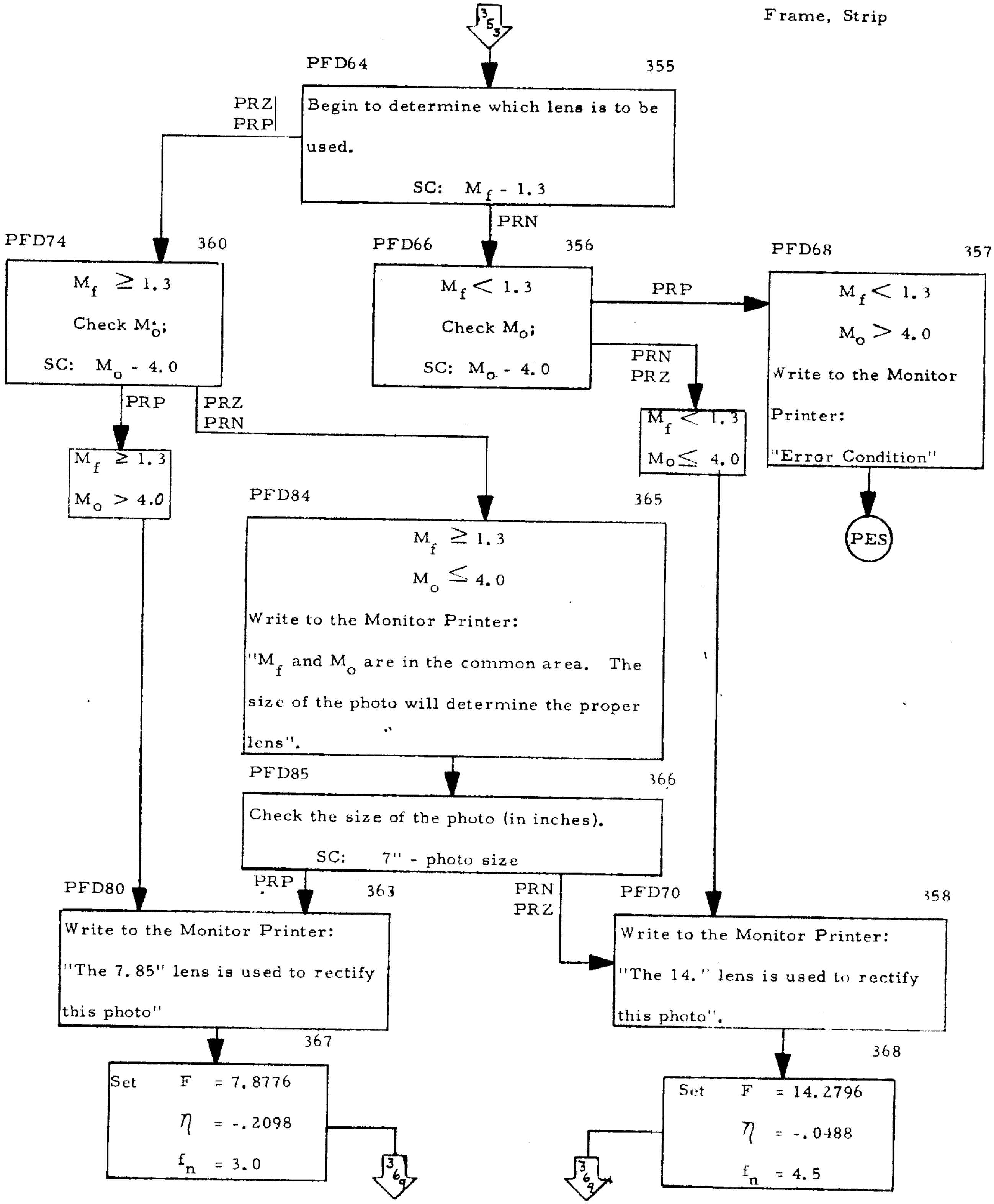
(345)

14.14 DETAILED FLOW CHARTS FOR PROGRAM R1 (cont.)



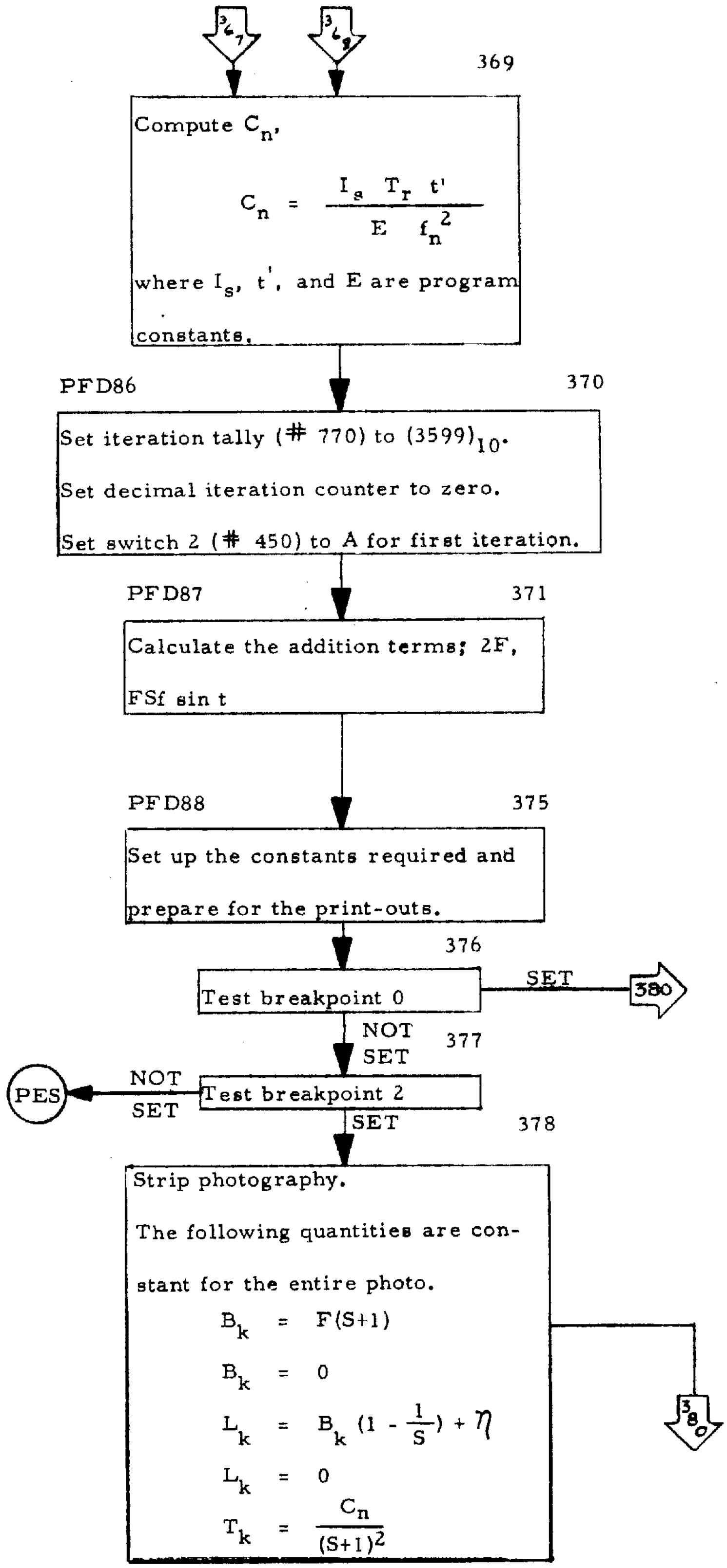
14.14 DETAILED FLOW CHARTS FOR PROGRAM R1 (cont.)

Frame, Strip

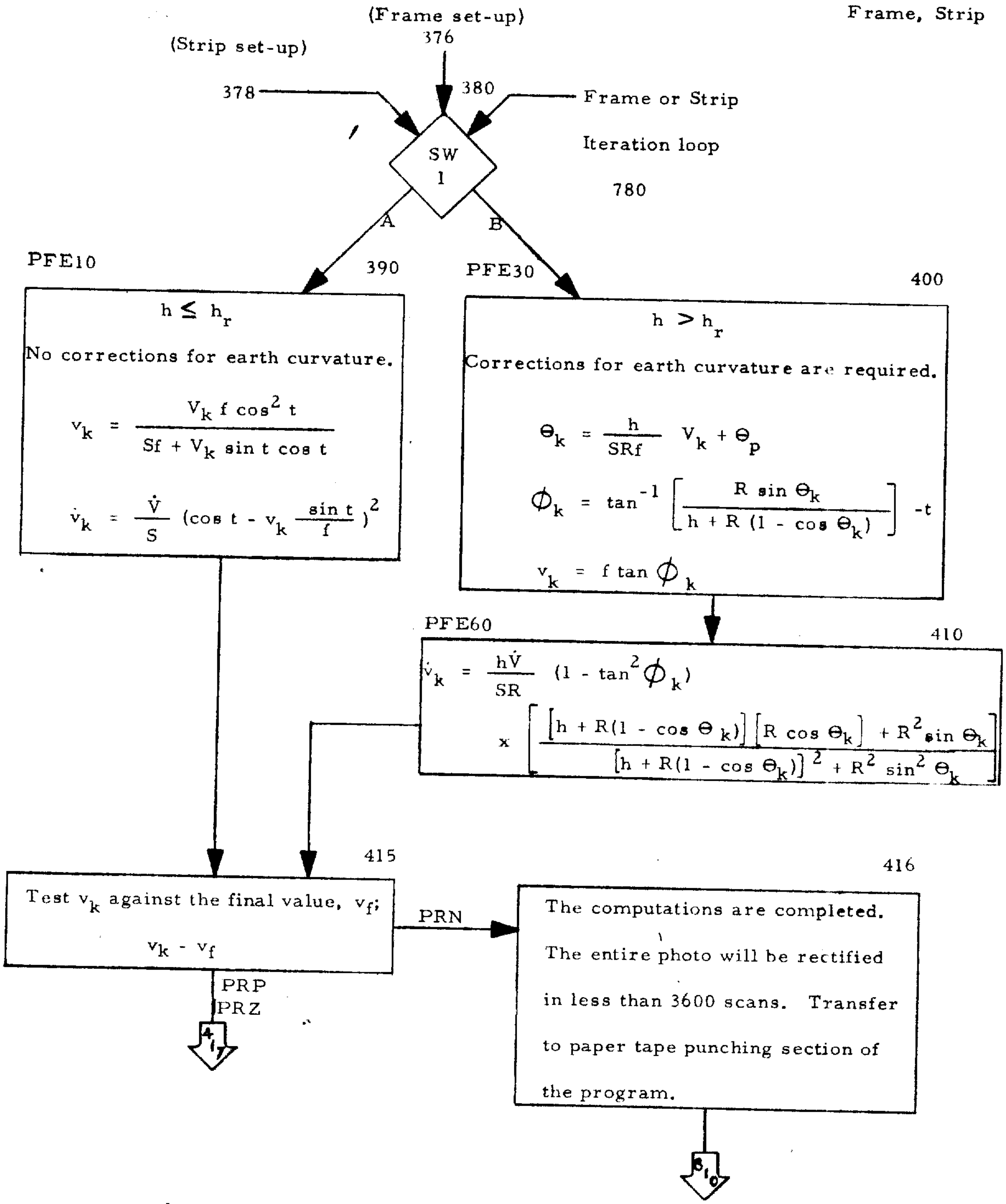


14.14 DETAILED FLOW CHARTS FOR PROGRAM R1 (cont.)

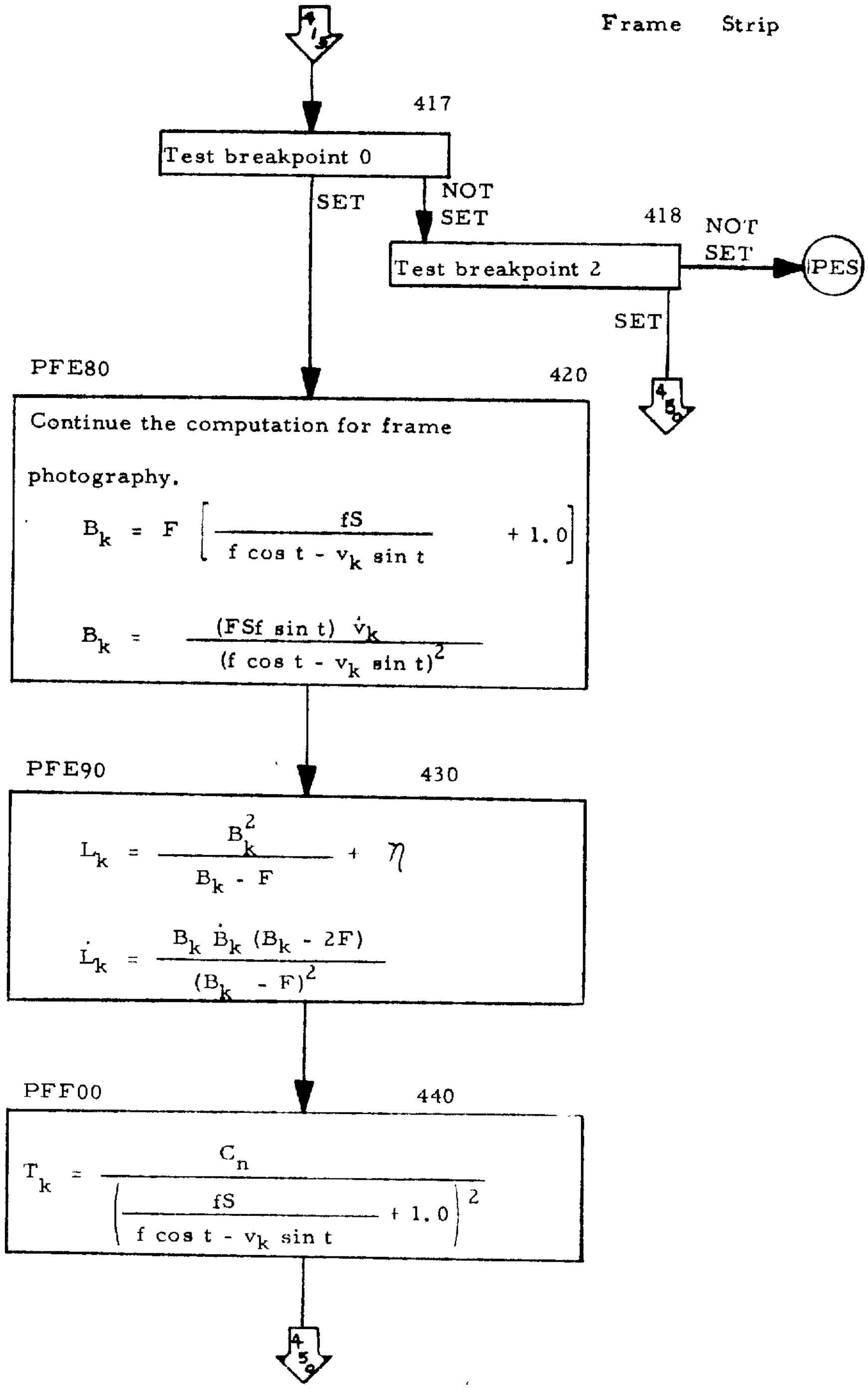
Frame, Strip



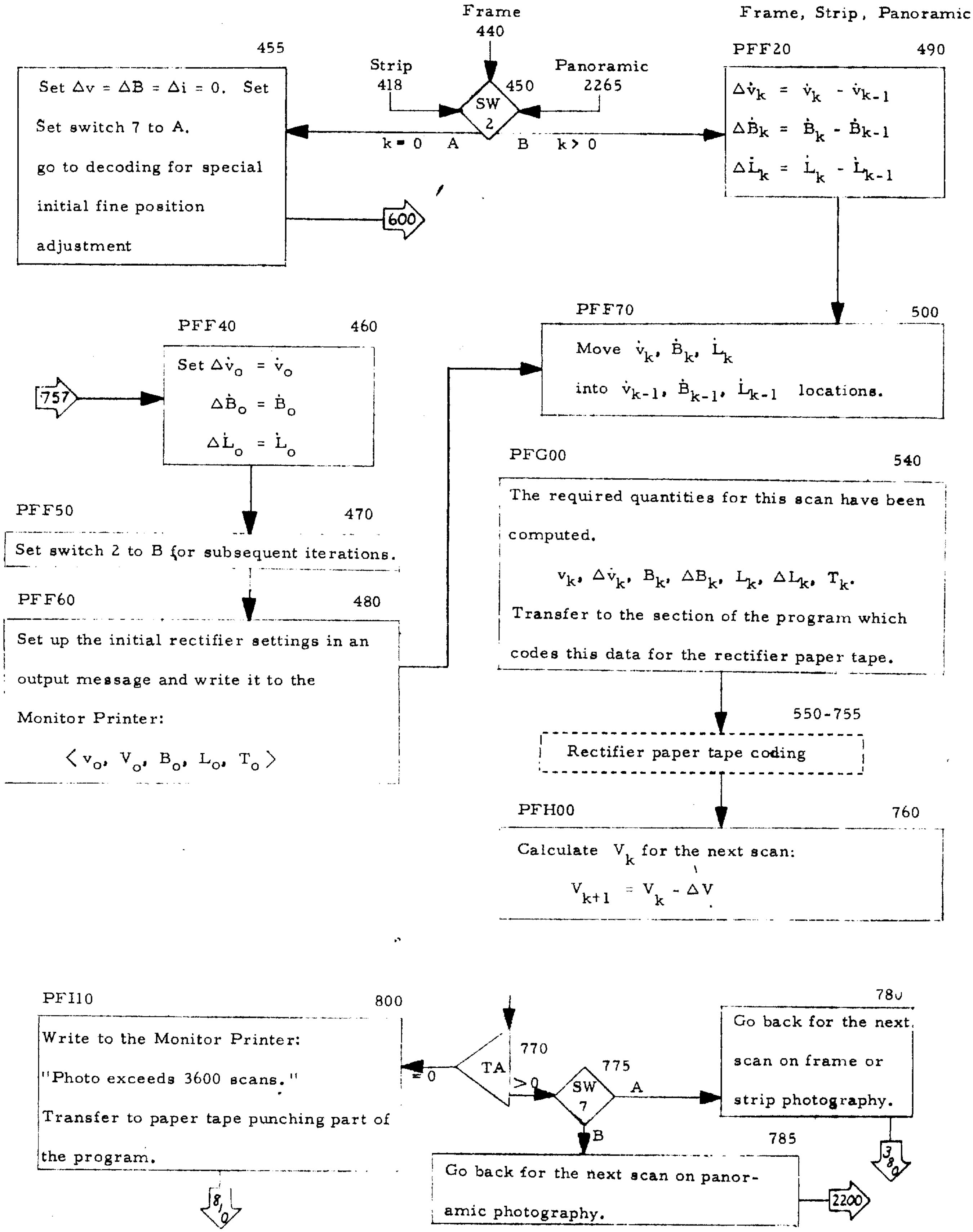
14.14 DETAILED FLOW CHARTS FOR PROGRAM R1 (cont.)



14.14 DETAILED FLOW CHARTS FOR PROGRAM R1 (cont.)

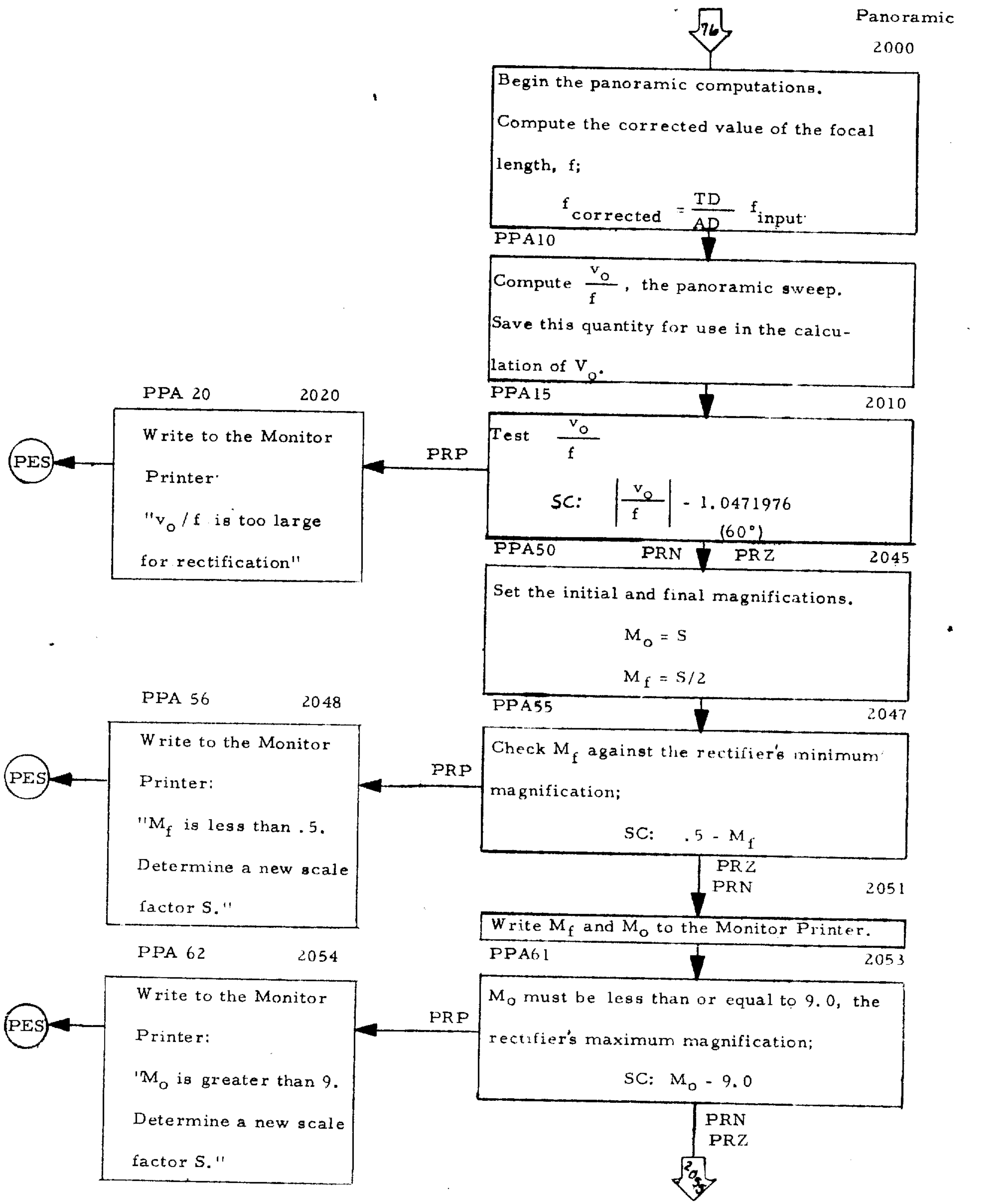


14.14 DETAILED FLOW CHARTS FOR PROGRAM R1 (cont.)

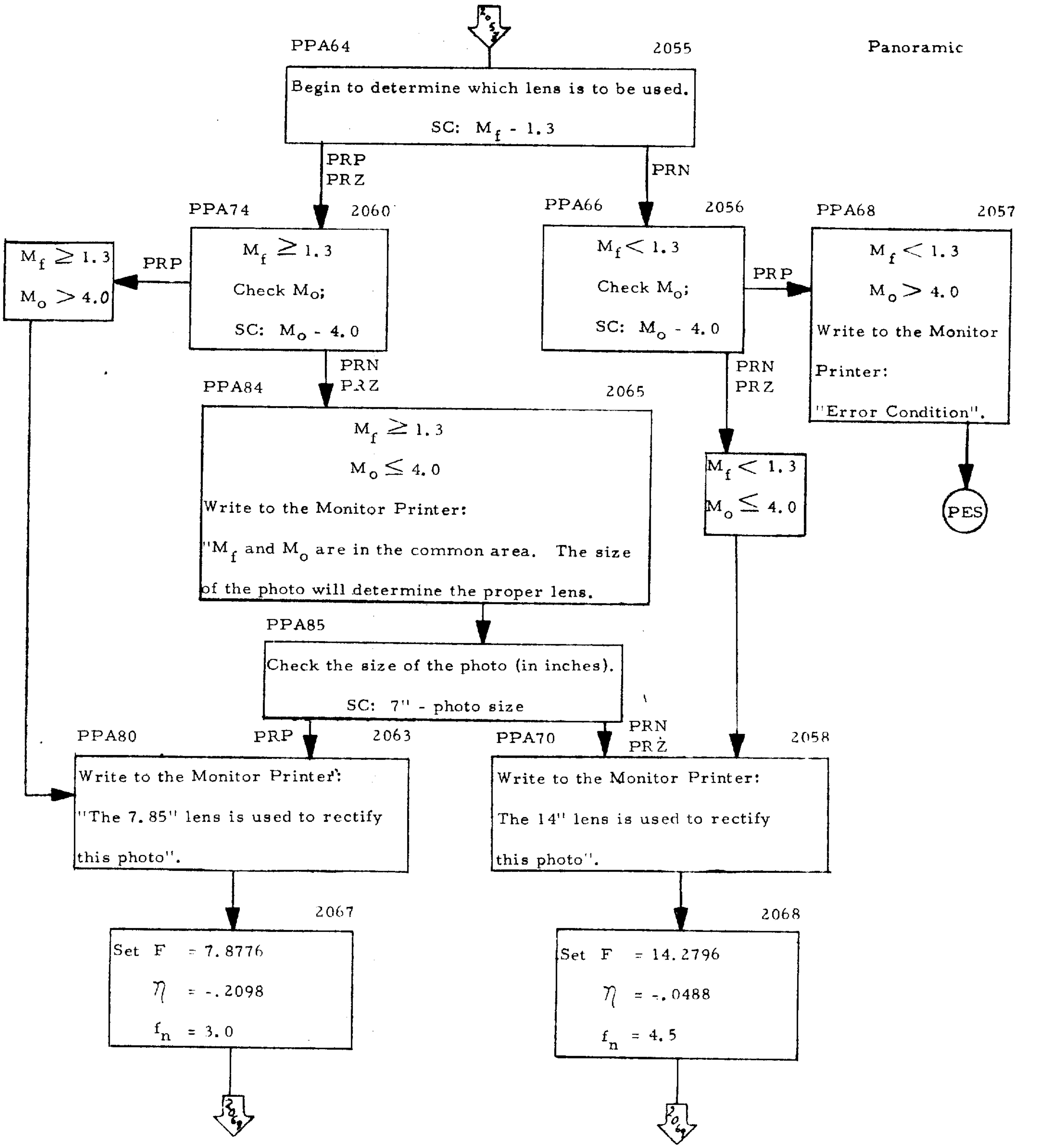


STAT

14.14 DETAILED FLOW CHARTS FOR PROGRAM R1 (cont.)



14.14 DETAILED FLOW CHARTS FOR PROGRAM R1 (cont.)



14.14 DETAILED FLOW CHARTS FOR PROGRAM R1 (cont.)

Panoramic

2069

Compute C_n,

$$C_n = \frac{I_s \; T_r \; t'}{E \; f_n^2}$$

where I_s, t', and E are program constants.

PPA86 — **2070**

Set the iteration tally (# 770) to $(3599)_{10}$.

Set the decimal iteration counter to zero.

Set switch 2 (# 450) to A for the first iteration.

Set switch 7 (# 775) to B for panoramic.

PPA87 — **2071**

Compute terms used in the iterative loop:

$$\frac{FS}{f}, \; 2F$$

PPA88 — **2075**

Set up the constants required and prepare for the print-outs.

PPB00 — **2080**

Compare the input h, the height of the photo, with h_r to determine if corrections for earth curvature must be considered.

SC: $h - h_r$

PRZ / PRN →

PPB10 — **2090**

$h \leqslant h_r$

Corrections for earth curvature are not required.

Compute additional terms used in the iterative loop:

$$fS, \; \frac{\dot{V}}{S}$$

PRP ↓

PPB40 — **2120**

$h > h_r$

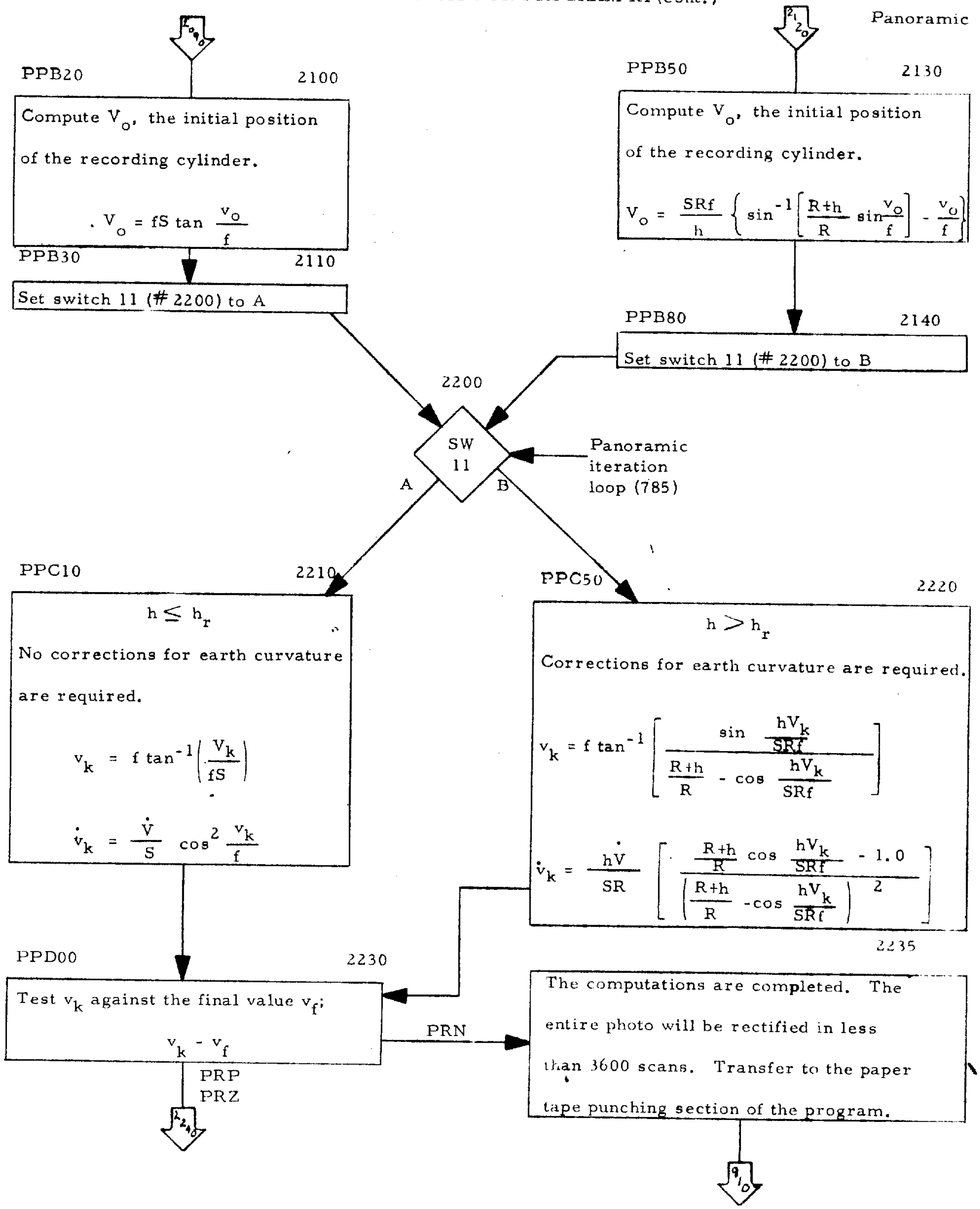
Corrections for earth curvature are required.

Compute additional terms used in the iterative loop:

$$\frac{R+h}{R}, \; \frac{h}{SRf}, \; \frac{h\dot{V}}{SR}$$

→ 2130

14.14 DETAILED FLOW CHARTS FOR PROGRAM R1 (cont.)



14.14 DETAILED FLOW CHARTS FOR PROGRAM R1 (cont.)

Panoramic

(from 2230)

PPD10 — 2240

Continue the computations for this scan.

$$B_k = F\left[\frac{S}{\cos\frac{v_k}{f}} + 1.0\right]$$

$$\dot{B}_k = \frac{FS\,\dot{v}_k\,\sin\frac{v_k}{f}}{f\cos^2\frac{v_k}{f}}$$

↓

PPD30 — 2250

$$L_k = \frac{B_k^2}{B_k - F} + \eta$$

$$\dot{L}_k = \frac{B_k\,\dot{B}_k\,(B_k - 2F)}{(B_k - F)^2}$$

↓

PPD40 — 2260

$$T_k = \frac{C_n}{\left(\frac{S}{\cos\frac{v_k}{f}} + 1.0\right)^2}$$

↓

2265

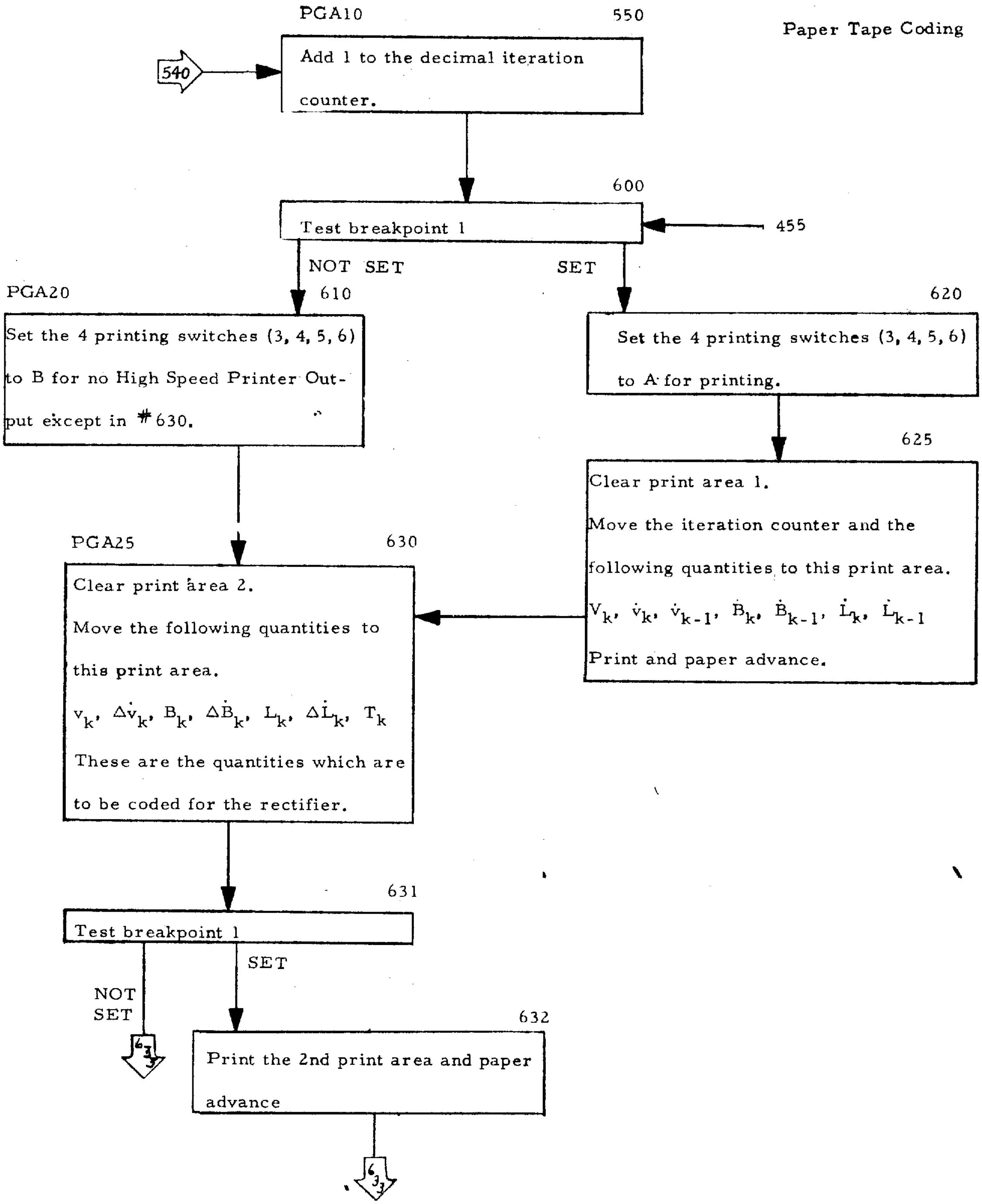
Transfer to the section of the program which computes the final quantities and does the paper tape coding for all photography.

↓

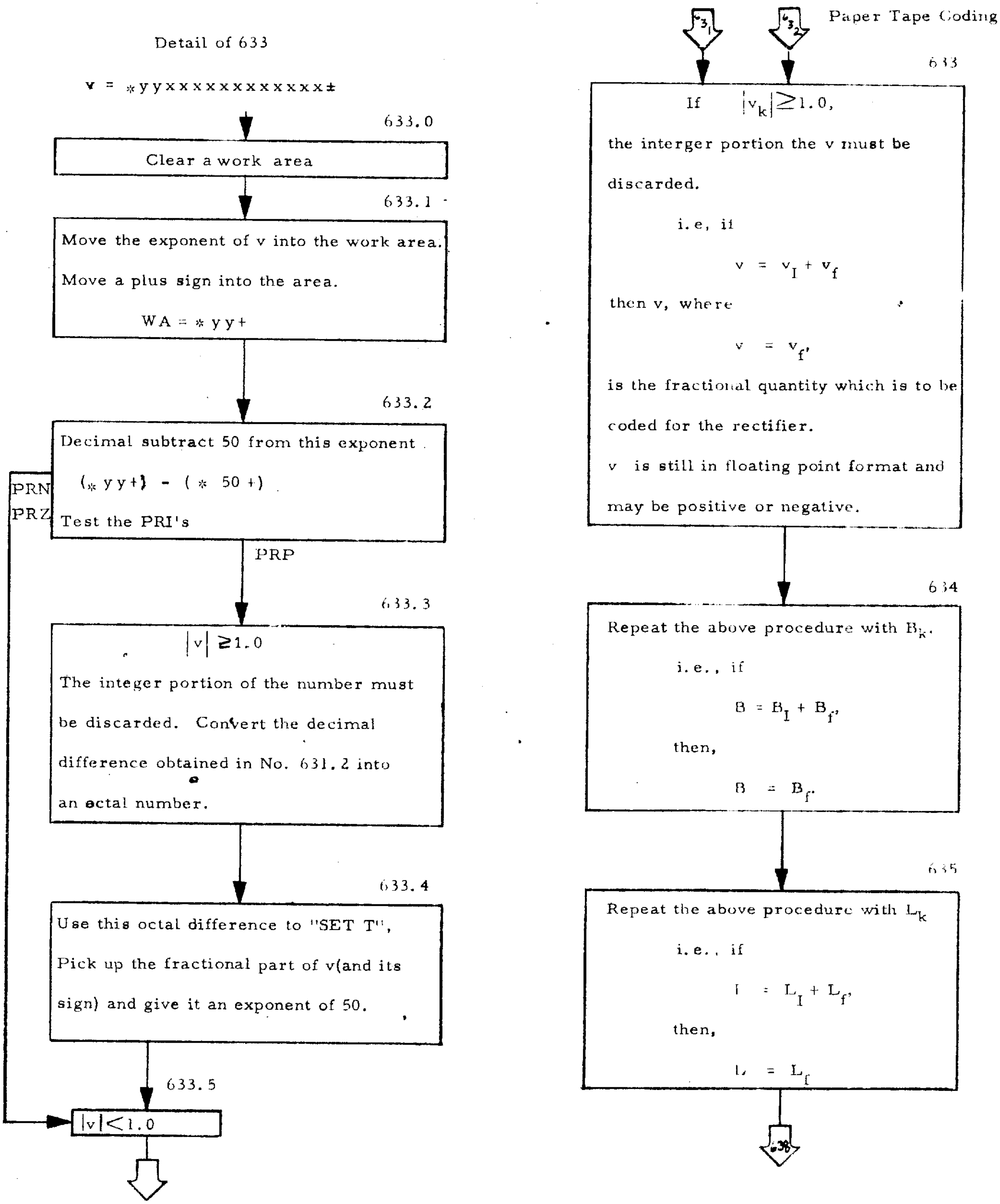
(to 450)

14.14 DETAILED FLOW CHARTS FOR PROGRAM R1 (cont.)

Paper Tape Coding

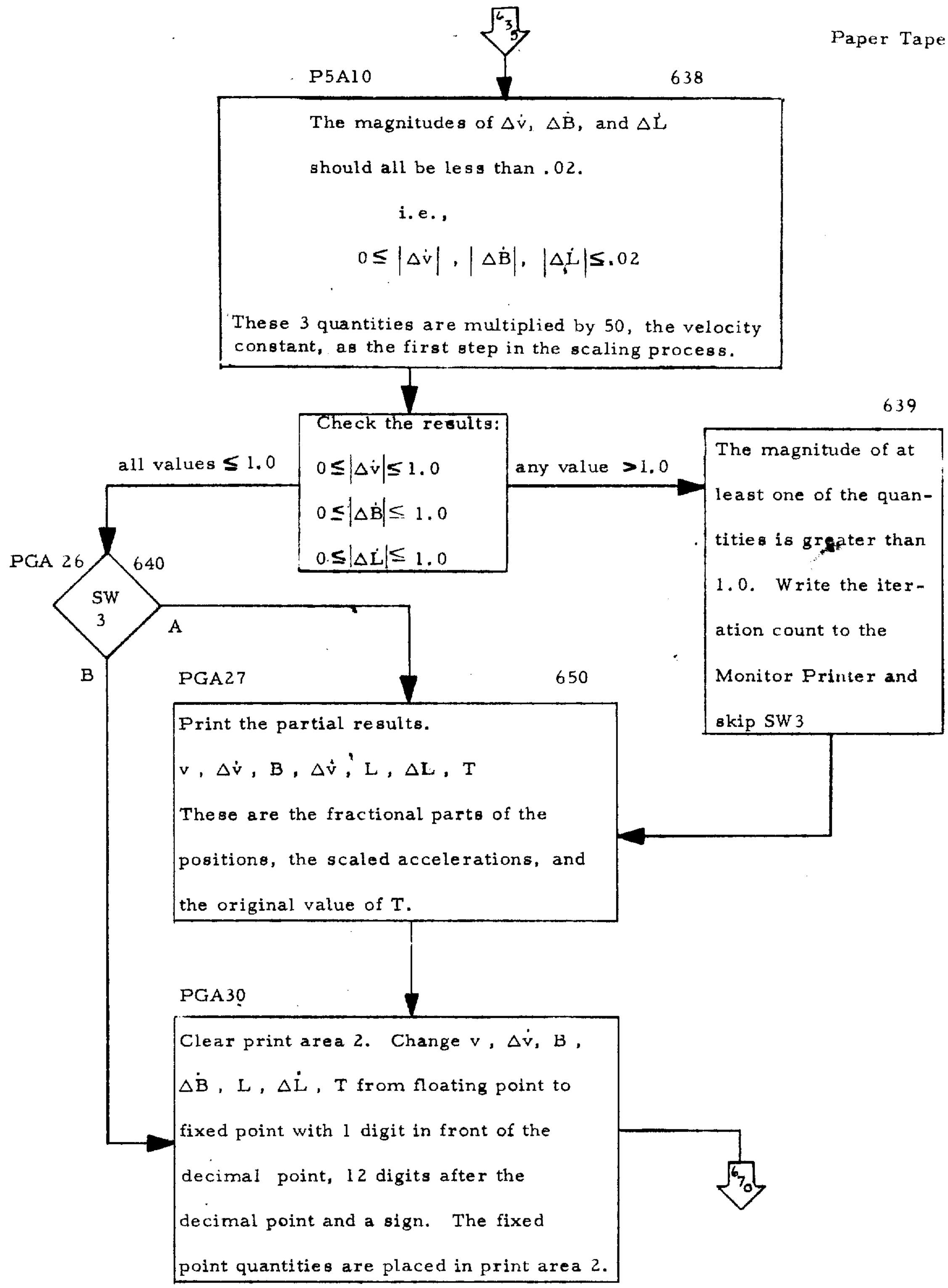


14.14 DETAILED FLOW CHARTS FOR PROGRAM R1 (cont.)



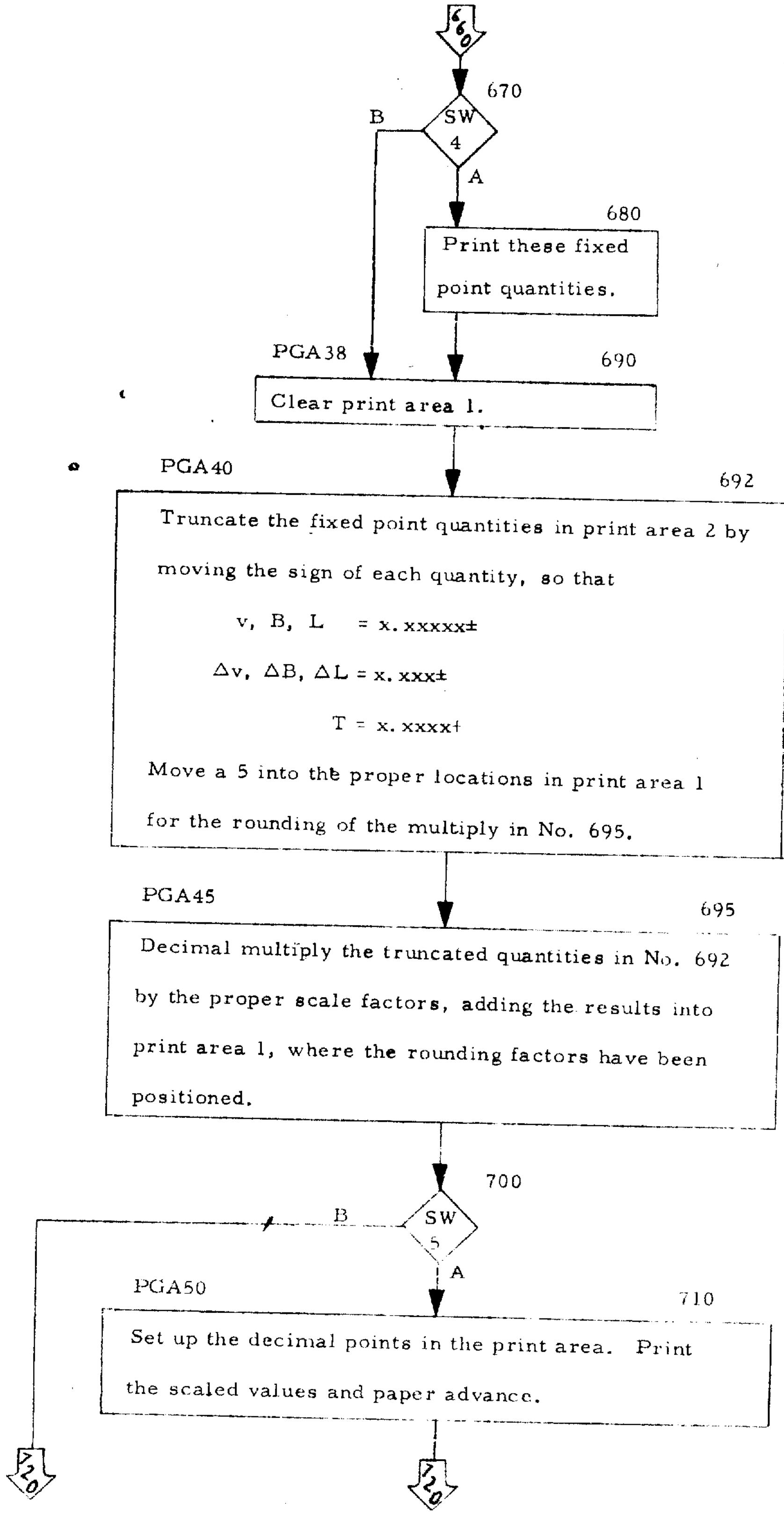
14.14 DETAILED FLOW CHARTS FOR PROGRAM R1 (cont.)

Paper Tape Coding

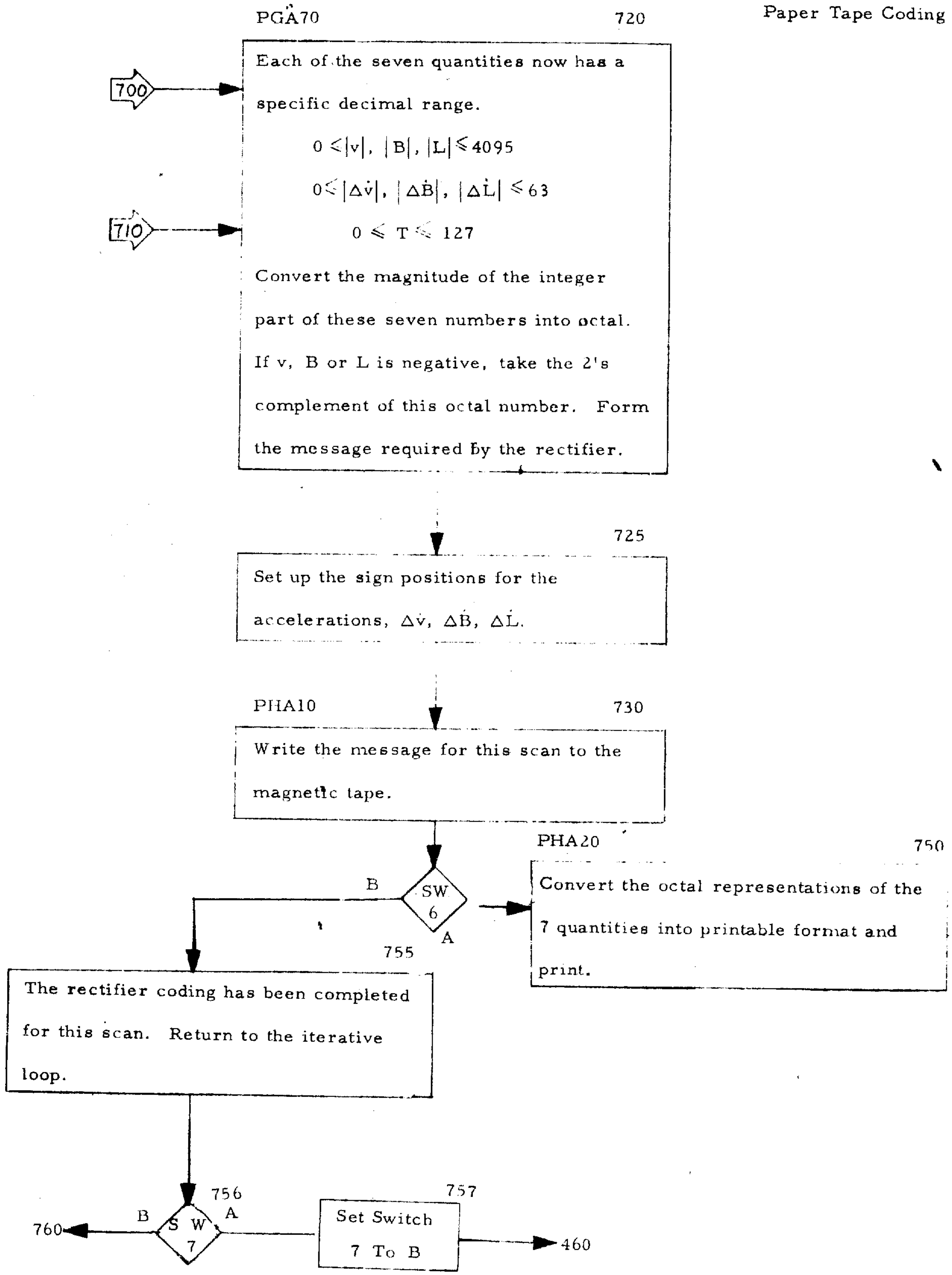


14.14 DETAILED FLOW CHARTS FOR PROGRAM R1 (cont.)

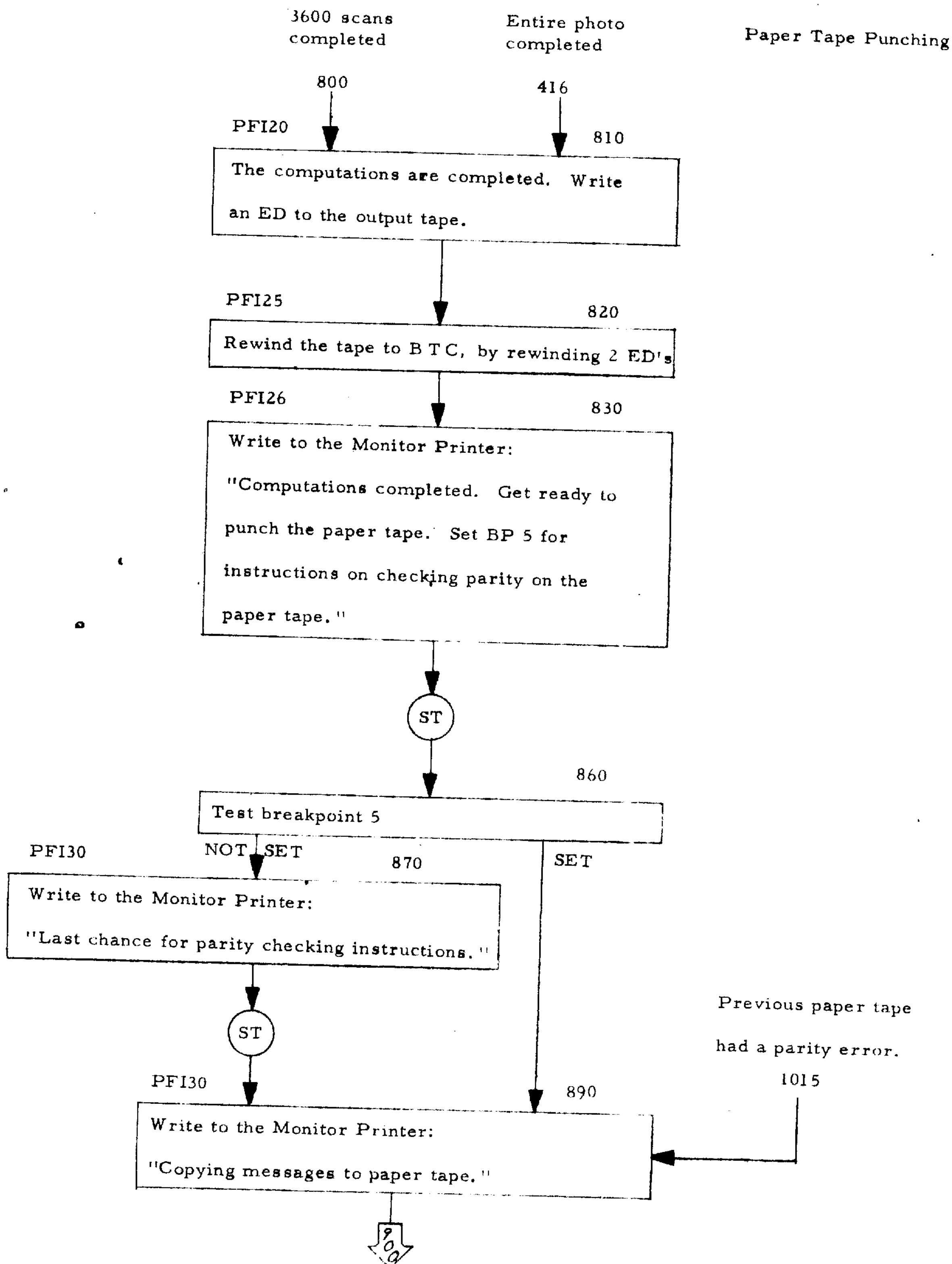
Paper Tape Coding



14.14 DETAILED FLOW CHARTS FOR PROGRAM R1 (cont.)

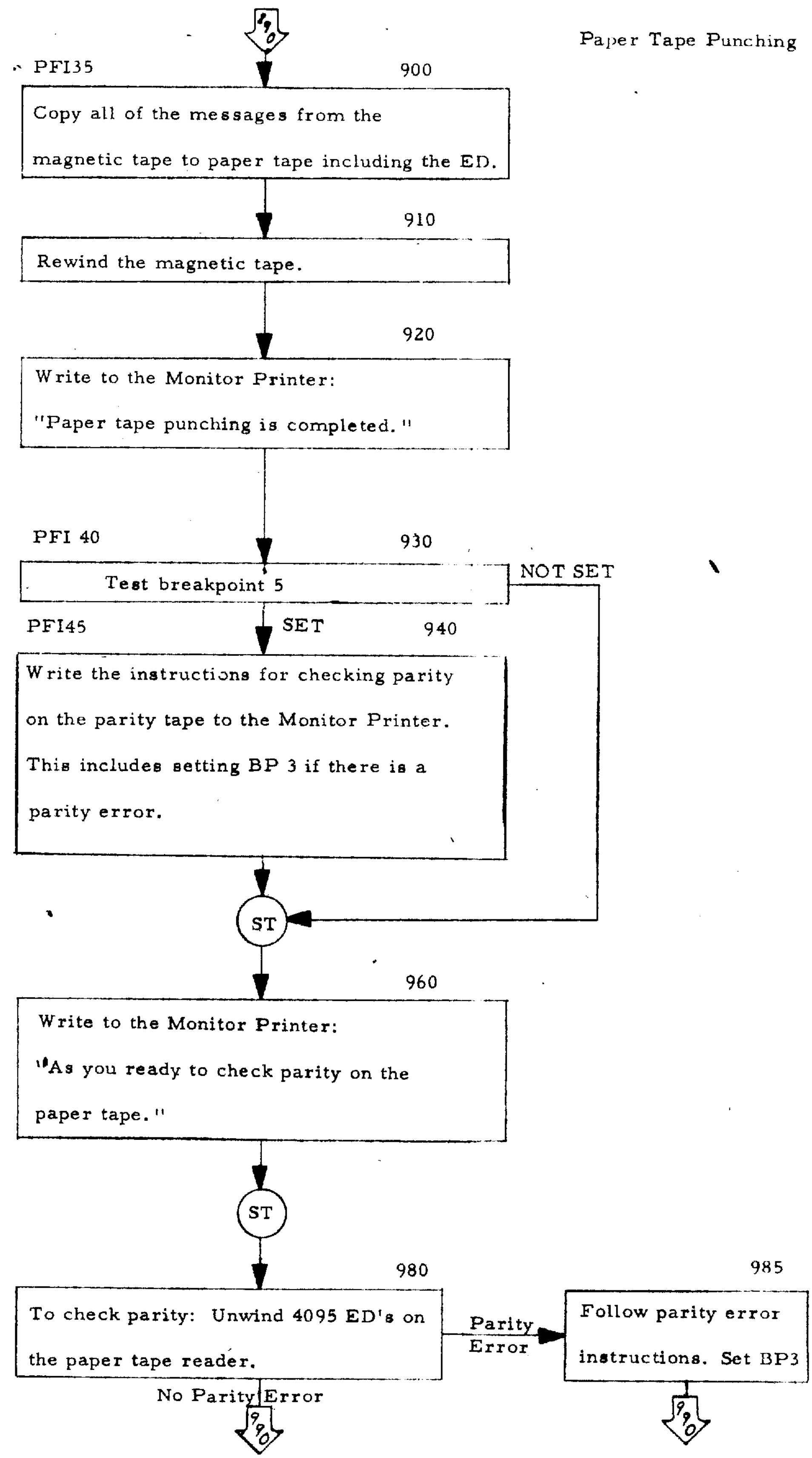


14.14 DETAILED FLOW CHARTS FOR PROGRAM R1 (cont.)



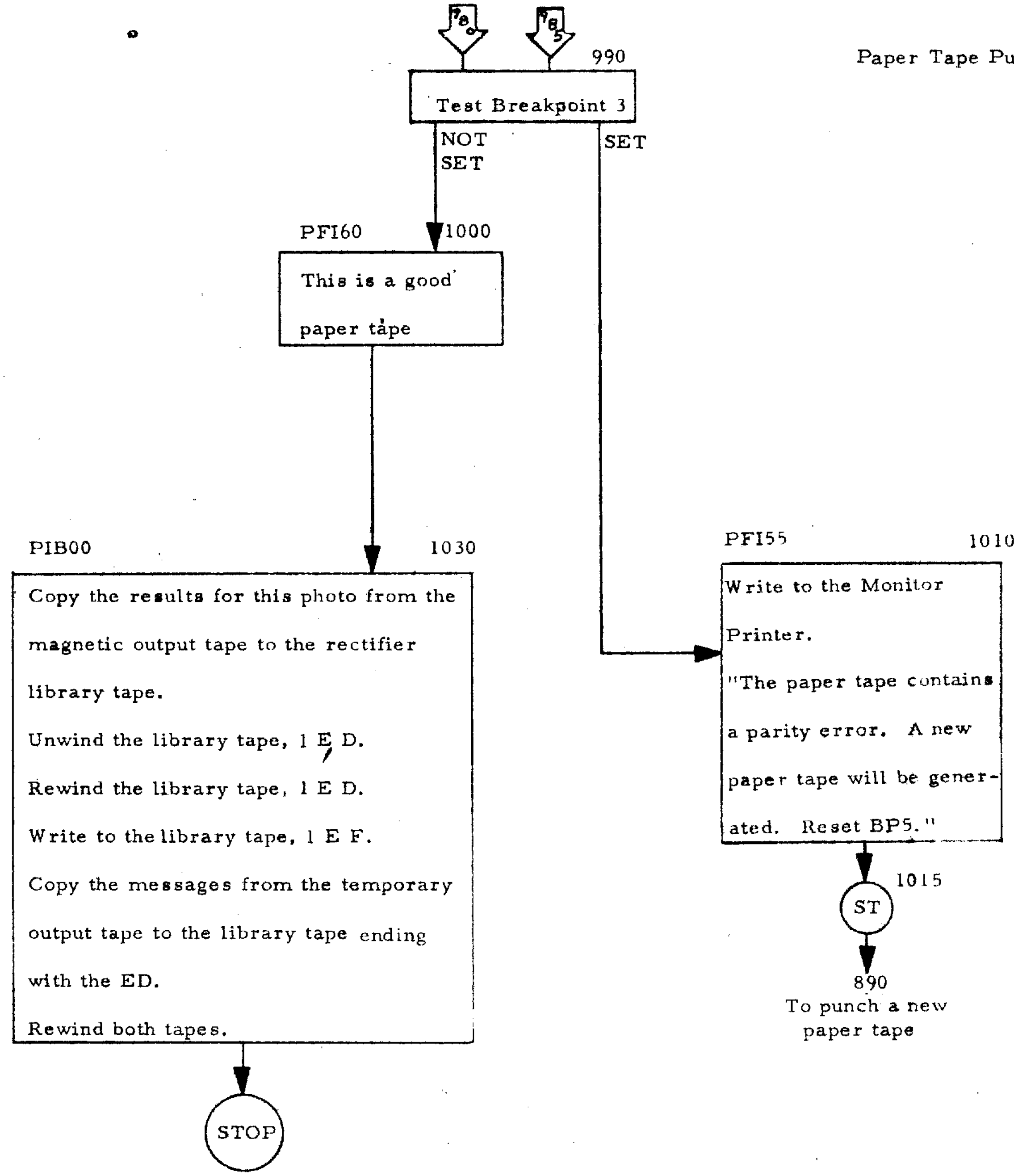
14.14 DETAILED FLOW CHARTS FOR PROGRAM RI (cont.)

Paper Tape Punching



14.14 DETAILED FLOW CHARTS FOR PROGRAM R1 (cont.)

Paper Tape Punching



UNIVERSAL PHOTO RECTIFIER AND PRINTER

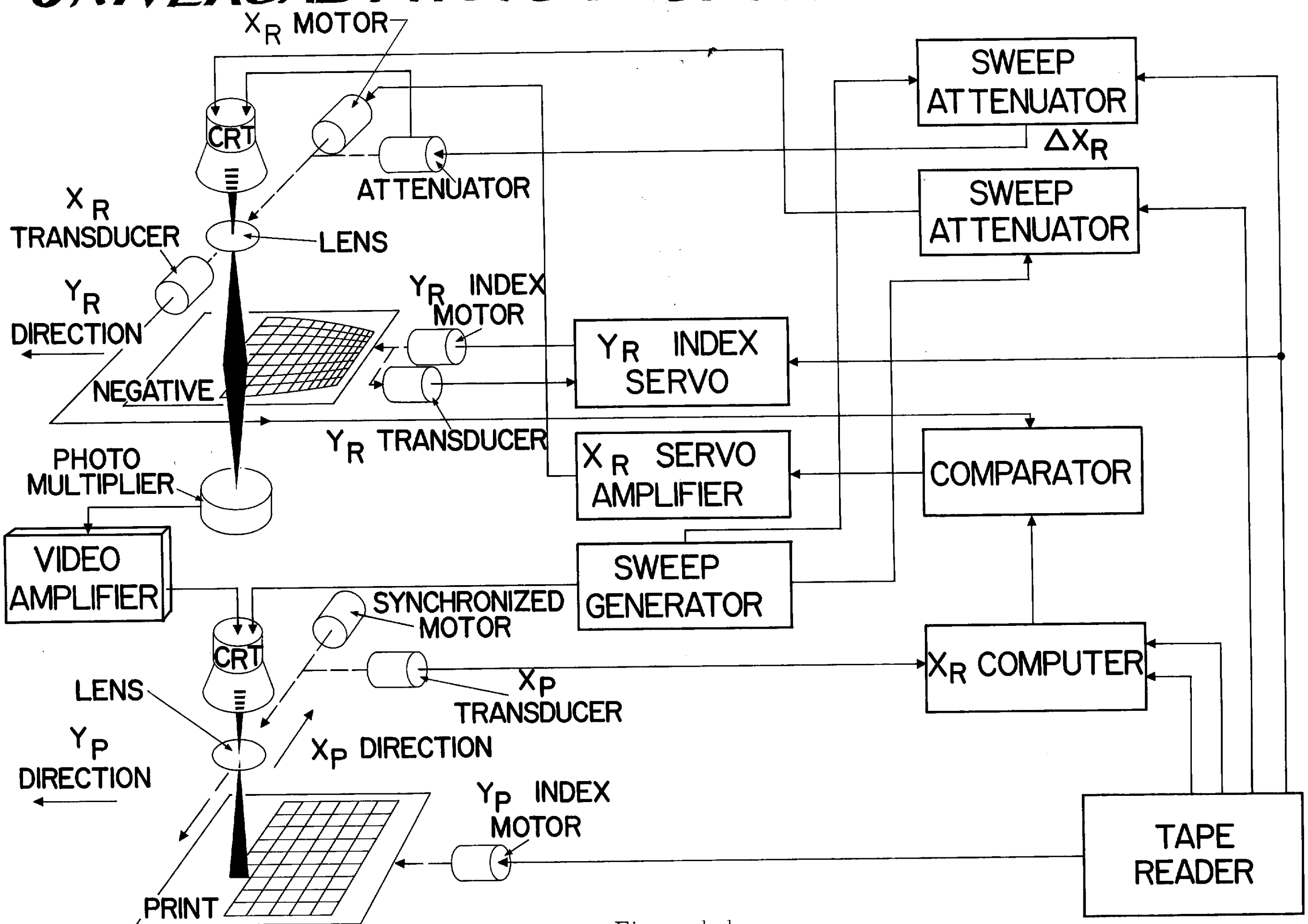
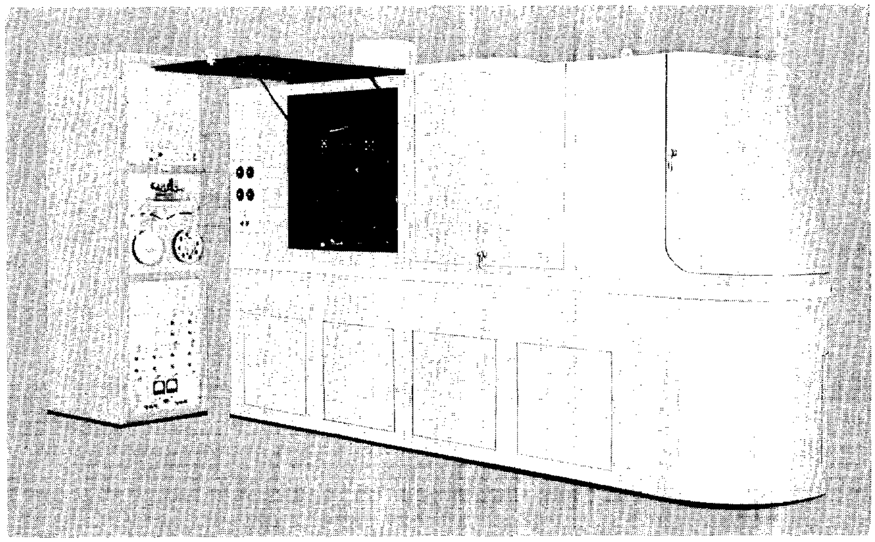


Figure 1-1.

ELECTRO-OPTICAL RECTIFIER



The Electro-Optical Rectifier was designed and developed by the [redacted] under the sponsorship of the Air Force Systems Command, Rome Air Development Center, Griffiss Air Force Base, New York.

The apparatus shown corrects the displacements in oblique and panoramic aerial photographs caused by the tilt of the taking camera. The tilt is the angle at the perspective center of the photograph between the photo perpendicular and the nadir line. The process of correcting these displacements is called rectification. In order to rectify a photograph, it is necessary to transform two dimensions into the rectified print.

The instrument accomplishes the rectification by a line scanning technique. Copy is translated past a projected line of light which results in a lateral dimension change. At the same time a constantly varying magnification change results in a longitudinal dimension change.

The process is controlled by a perforated tape prepared by a digital computer. The control tape is processed by a digital decoder which converts the digital information on the tape into electrical signals which control the servo system of the rectifier.

SPECIFICATIONS

Dimensions (inches)		Power Requirements (input)		Weight (pounds)	
Rectifier	117 x 35 x 72	Rectifier	10,000 watts	Rectifier	4,000
Decoder	30 x 24 x 78	Decoder	from Rectifier	Decoder	1,000
Fixture	48 x 24 x 16	Fixture	350 watts	Fixture	100

Transparent Copy Size (inches) .... 70 MM x 13 in., 5 x 12; 6-1/2 x 10; 9-1/2 x 9-1/2
Recording Film Size (inches) .... 9-1/2 x 9-1/2; 9-1/2 x 36; 36 x 36
Operating Conditions .... 21°C (69.8°F) to 24°C (75.2°F) .... Copy Rotation .... ± 180°