GEORGIA INSTITUTE OF TECHNOLOGY
Engineering Experiment Station

PROJECT INITIATION

Date: May 30, 1969

Project Title: Offset Paraboloidal Scanning Antenna (U)

Project No.: A-1181

Project Director: Mr. R. M. Goodman

Sponsor: Air Force Armament Development & Test Center; Eglin AFB

Effective . . . . 23 May 1969 . . . . Estimated to run until: . . . . 22 May 1970 . . . .

Type Agreement: A.F. Contract No. F08635-69-C-0202 . . . . . . Amount: $ 252,981.00* . . . .

*Now only partially funded at $109,841.00 (Phase I).

Reports: Monthly Status Reports; Final Engineering Report

Other Data: Range Instrumentation Data; Acceptance Test Data

Contact Persons:

Technical
Physical Sciences Branch (ADTVE-53)
Armament Development & Test Center
Eglin AFB, Fla. 32542

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Assigned to . . . . . . Electronics . . . . Division

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GEORGIA INSTITUTE OF TECHNOLOGY
Engineering Experiment Station

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PROJECT TERMINATION

Date 11/3/71

PROJECT TITLE: Offset Paraboloidal Scanning Antenna

PROJECT NO: A-1181

PROJECT DIRECTOR: Dr. E. K. Reedy

SPONSOR: Air Force Armament Development & Test Center (AFSC); Eglin AFB, Fla.

TERMINATION EFFECTIVE: 10/15/71*

CHARGES SHOULD CLEAR ACCOUNTING BY: 10/31/71

*Due date for last deliverable Data Item.
Work period ended 7/15/71.

Contract Closeout Items Remaining:

Final Invoice & Closing Documents.
Final Inventory of Government Property.
Certificate of Proper ... Disposition - Gov't Prop.
Classified Material Certificate.

Electronics (Sensor Systems) Division

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GEORGIA INSTITUTE OF TECHNOLOGY
EXPERIMENT STATION

225 North Avenue, Northwest · Atlanta, Georgia 30332

25 July 1969

Department of the Air Force
Headquarters, Armament Development Test Center (APGC)
Eglin Air Force Base, Florida 32542

Attention: ADTC Physical Services Branch (ADTVE-53)

Reference: Contract F08635-69-C-0202

Subject: Monthly Technical Status Report No. 1
Covering the Period from 23 May to 22 July 1969

Gentlemen:

The initial progress summary covering (in this case only) the two-month period from 23 May to 22 July for the referenced contract is contained herein.

During this period preliminary designs for the lower dish have been made for both aluminum and fiberglass construction. Bids have been requested from Prodelin, Inc., and Structural Technology, both in California, for the fiberglass type and from Ainslie Corporation of Braintree, Mass., for the aluminum type. Bids for the making of templates for the construction of both antennas have also been requested.

During this time, on 19 and 20 June, Mr. Wayne Novak made a trip to California to discuss fabrication of the lower dish with both California firms mentioned above.

Also, on 14 July, Mr. Robert M. Goodman, Jr., visited Braintree, Mass., and discussed fabrication details with Ainslie relating to the aluminum type lower dish.

A study of feed horn design has been made and three experimental feed horns have been built for laboratory testing.

Various organ-pipe feed arrangements are under study and shop fabrication is underway on selected components for laboratory evaluation.

Work will continue during the next report period on the tasks which have been initiated. In addition, a theoretical study of the feed path will be initiated.

Respectfully submitted:

R. M. Goodman, Jr.
Project Director

GEORGIA INSTITUTE OF TECHNOLOGY
EXPERIMENT STATION

225 North Avenue, Northwest · Atlanta, Georgia 30332

22 August 1969

Department of the Air Force
Headquarters, Armament Development Test Center (ADTC)
Eglin Air Force Base, Florida 32542

Attention: ADTC Physical Services Branch (ADTEC-53)

Reference: Contract F08635-69-C-0202

Subject: Monthly Technical Status Report No. 2
Covering the Period from 23 July to 22 August 1969

Gentlemen:

A progress summary covering the report period from 23 July to 22 August for the referenced contract is contained herein.

During this period work has continued on the design and construction of the breadboard feed components. Some material has been received and other items, including the rotary joint, are on order.

Laboratory testing and evaluation of feed horns is underway.

A computer program has been initiated toward the determination of far-field patterns to be expected from the reflector. Evaluation of feed paths will follow.

During this time on 8 August Mr. R. M. Goodman, Jr. and Dr. R. C. Johnson visited Eglin AFB in regard to the program.

The time required to obtain delivery of the lower dish has made it advisable to make a temporary plaster dish in order to speed up the evaluation of feed components and the confirmation of the feed path. The design of the temporary dish has been completed and shop work has begun on the fabrication.

Arrangements have been made with Southern Tech in Marietta, Georgia (a Georgia Tech affiliate) to use tape-controlled milling machine facilities in the cutting of certain calculated shapes.

Work in the next period is expected to be an extension of the work now in progress.

Respectfully submitted:

L. A. Stapleton
Associate Project Director

Approved:

R. M. Goodman, Jr.
Head, Sensor Systems Branch

GEORGIA INSTITUTE OF TECHNOLOGY
ENGINEERING EXPERIMENT STATION

225 North Avenue, Northwest · Atlanta, Georgia 30332

26 September 1969

Department of the Air Force
Headquarters, Armament Development Test Center (ADTC)
Eglin Air Force Base, Florida 32542

Attention: ADTC Physical Sciences Branch (ADTVE-53)

Reference: Contract F08635-69-C-0202

Subject: Monthly Technical Status Report No. 3
Covering the Period from 23 August to 22 September 1969

Gentlemen:

A progress summary for the referenced contract for the period 23 August to 22 September 1969 is contained herein.

Work during this period has continued on the design and construction of components for the breadboard feed arrangement.

Three feed horns have been tested in the laboratory, and two have been approved for further testing with the antenna. A computer program for feed path evaluation has been written and this study is underway.

Mr. R. M. Goodman, Jr., and Mr. G. W. Ewell visited Eglin AFB on September 11 in regard to the program.

Also during this period a plaster lower dish was made. A high degree of accuracy was obtained, and it is believed that this plaster dish will be adequate for breadboard testing.

On 9 September a request was received from Mr. Frank Kabase, Chief of the Engineering Division, ADTC, for the calculation of certain lens coordinates. This work is in process and is being expedited. It is anticipated that delivery of these coordinates will be made to ADTVE-53 during the first week of October.

Work in the next period will be a continuation of work in progress. In addition, the plaster dish will be fitted out for breadboard testing of single and multiple feed horns.

Respectfully submitted:

L. A. Stapleton
Associate Project Director

Approved:

R. M. Goodman, Jr.
Head, Sensor Systems Branch

GEORGIA INSTITUTE OF TECHNOLOGY
EXPERIMENT STATION

225 North Avenue, Northwest · Atlanta, Georgia 30332

28 October 1969

Department of the Air Force
Headquarters, Armament Development Test Center (ADTC)
Eglin Air Force Base, Florida 32542

Attention: ADTC Physical Sciences Branch (ADTVE-53)

Reference: Contract F08635-69-C-0202

Subject: Monthly Technical Status Report No. 4
Covering the Period from 23 September to 22 October 1969

Gentlemen:

A progress summary for the referenced contract for the period 23 September to 22 October is contained herein.

During this period the lower dish was fitted out for range testing and has been installed on the test range tower. Initial tests with a point source feed horn are promising.

The tape-controlled milling machine work on the multiple channel breadboard scanner has been completed and final machining is underway. The fabrication of waveguide components for the scanner is in process. The design of the multiple channel scanner drive system is complete and shop fabrication is proceeding. The rotary joint for the scanner has been received and has been checked for mechanical alignment.

The calculation of certain lens coordinates requested by Mr. Frank Kabase, Chief of the Engineering Division, ADTC, were completed and were forwarded to the attention of Mr. Don Brown on 1 October.

During this period on 16 October Mr. Don Brown visited Georgia Tech in connection with work on the referenced contract.

In addition, during this period on 10 October Georgia Tech Drawing A-1181-42-M5 (S) showing a proposed lower dish arrangement for pedestal mounting was forwarded to the attention of Mr. Don Brown.

During the following period further range testing will be conducted with both point source feed horns and multiple channel scanner. It is also expected that feed path calculations will be compared with range test results.

Respectfully submitted:

L. A. Stapleton
Associate Project Director

Approved:

R. M. Goodman, Jr.
Head, Sensor Systems Branch

GEORGIA INSTITUTE OF TECHNOLOGY
ENGINEERING EXPERIMENT STATION
225 North Avenue, Northwest · Atlanta, Georgia 30332

26 November 1969

Department of the Air Force
Headquarters, Armament Development Test Center (ADTC)
Eglin Air Force Base, Florida 32542

Attention: ADTC Physical Sciences Branch (ADTVE-53)

Reference: Contract F08635-69-C-0202

Subject: Monthly Technical Status Report No. 5
Covering the Period from 23 October to 22 November 1969

Gentlemen:

A progress summary for the referenced contract for the period 23 October to 22 November is contained herein.

During this period tests with the breadboard antenna to determine the optimum feed arc along which a pyramidal horn could be moved to obtain the desired scan characteristics were completed. Scan linearity for the selected feed path arc is considered excellent. Also the 3 dB beamwidth remained reasonably constant at about 1.5° over the scan sector. Test results indicated that the present antenna/feed combination is well within design requirements. The liklihood of obtaining simular results from a group of sectoral horns stacked along the same feed arc appears favorable.

During this period a purchase order was placed for an aluminum reflector and back-up structure with Ainslie Corporation of Braintree, Massachusetts.

Fabrication of the multiple channel breadboard scanner has not been completed and tests, of course, have not yet been made using this feed arrangement. It is expected that these tests will get underway during the following period.

Respectfully submitted:

L. A. Stapleton /
Associate Project Director

Approved:

R. M. Goodman, Jr.
Head, Sensor Systems Branch

GEORGIA INSTITUTE OF TECHNOLOGY
ENGINEERING EXPERIMENT STATION 225 North Avenue, Northwest · Atlanta, Georgia 30332

23 December 1969

Department of the Air Force
Headquarters, Armament Development Test Center (ADTC)
Eglin Air Force Base, Florida 32542

Attention: ADTC Physical Sciences Branch (ADTVE-53)

Reference: Contract F08635-69-C-0202

Subject: Monthly Technical Status Report No. 6
Covering the Period from 23 November 1969 to 22 December 1969

Gentlemen:

A progress summary for the referenced contract for the period 23 November to 22 December is contained herein.

During this period the multipath channel breadboard scanner was completed and a mounting and positioning structure was designed and partially completed.

In addition, further breadboard work was done on the scanner drive mechanism with test work pointed toward achieving acceleration and deceleration rates to within the rating of encoder components.

Laboratory tests of the multiple channel breadboard scanner were completed with good path length agreement and satisfactory performance when coupled as a partial scanner.

Range tests of the multiple channel scanner are expected to be underway during the next period.

Respectfully submitted:

L. A. Stapleton
Associate Project Director

Approved:

R. M. Goodman, Jr.
Head, Sensor Systems Branch

GEORGIA INSTITUTE OF TECHNOLOGY
ENGINEERING EXPERIMENT STATION 225 North Avenue, Northwest · Atlanta, Georgia 30332

29 January 1970

Department of the Air Force
Headquarters, Armament Development Test Center (ADTC)
Eglin Air Force Base, Florida 32542

Attention: ADTC Physical Sciences Branch (ADTVE-53)

Reference: Contract F08635-69-C-0202

Subject: Monthly Technical Status Report No. 7
Covering the Period from 23 December 1969 to 22 January 1970

Gentlemen:

A progress summary for the referenced contract is contained herein for the period 23 December 1969 to 22 January 1970.

During this period laboratory tests of the multiple channel scanner have been made and preliminary range tests of the multiple channel scanner with the breadboard antenna have been made. Additional tests are underway to confirm predicted performance and good results are expected.

Mr. R. M. Goodman, Jr., visited Ainslie Corporation of Braintree, Massachusetts on 16 January during this period with regard to fabrication of the lower dish. This work is progressing satisfactorily and should be completed during the next report period.

Further work was done on the breadboard drive mechanism and the present approach seems to have good possibilities.

It is expected that work in the next period will consist of range tests of the breadboard scanner, further development of the drive mechanism concept and investigations of stress, deflection and vibration aspects of the boom.

Respectfully submitted:

L. A. Stapleton
Associate Project Director

Approved:

R. M. Goodman, Jr.
Head, Sensor Systems Branch

GEORGIA INSTITUTE OF TECHNOLOGY
ENGINEERING EXPERIMENT STATION 225 North Avenue, Northwest · Atlanta, Georgia 30332

10 March 1970

Department of the Air Force
Headquarters, Armament Development Test Center (ADTC)
Eglin Air Force Base, Florida 3254

Attention: ADTC Physical Sciences Branch (ADTVE-53)

Subject: Monthly Technical Status Report No. 8
Covering the Period from 23 January to 22 February 1970

Gentlemen:

A progress summary for the referenced contract for the period 23 January 1970 to 22 February is contained herein.

During this period further range tests of the breadboard multiple channel scanner and antenna were made. Results indicate the scanner-reflector combination performance conforms to design goals for beam width, sidelobes and scan reflector.

Drive mechanism components have been determined and final design of the assembly of these elements is underway. Acceleration and deceleration values are within the required ranges.

Delivery of the lower dish from Ainslie is now expected during the month of March. A shortage of special rivets caused a minor delay in the assembly of the antenna components. A satisfactory substitute rivet was used.

Work during the next period is expected to consist of additional range tests to determine the effect of organ-pipe scanning on scan linearity and further design work on the scanner, and scanner housing. Included will be completion of the boom design with respect to strength, deflection, and resonant frequency of vibration. Compatability of vibration period and pedestal servo characteristics will be assured. Also design work on the structure to adapt the dish and boom to the Eglin supplied pedestal will be in progress.

Respectfully submitted:

L. A. Stapleton
Associate Project Director

Approved:

R. H. Goodman, Jr.
Head, Sensor Systems Branch

GEORGIA INSTITUTE OF TECHNOLOGY
ENGINEERING EXPERIMENT STATION 225 North Avenue, Northwest · Atlanta, Georgia 30332

24 March 1970

Department of the Air Force
Headquarters, Armament Development Test Center (ADTC)
Eglin Air Force Base, Florida 32542

Attention: ADTC Physical Sciences Branch (ADTVE-53)

Subject: Monthly Technical Status Report No. 9
Covering the Period from 23 February to 22 March 1970

Gentlemen:

This is a progress summary for the referenced contract for the period 23 February to 22 March 1970.

The lower dish was received in good condition from Ainslie during this period. Factory inspection reports indicate that the active surface is well within required tolerances. Workmanship appears to be very good.

Design work has been done during this period on the structure to adapt the dish and boom to the Eglin supplied pedestal. In addition, design work has continued on the final arrangement of drive and indexing mechanism and the scanner housing and radome.

During this period Mr. R. M. Goodman, Jr., visited Eglin AFB on 8 February in connection with the project.

Work will continue during the next period on design work now in progress and on shop fabrication of scanner components. Scan linearity tests and laboratory tests of radome materials will also be included.

Respectfully submitted:

L. A. Stapleton
Associate Project Director

Approved:

R. M. Goodman, Jr.
Head, Sensor Systems Branch

GEORGIA INSTITUTE OF TECHNOLOGY
EXPERIMENT STATION 225 North Avenue, Northwest · Atlanta, Georgia 30332

30 April 1970

Department of the Air Force
Headquarters, Armament Development Test Center (ADTC)
Eglin Air Force Base, Florida 32542

Attention: ADTC Physical Sciences Branch (ADTVE-53)

Subject: Monthly Technical Status Report No. 10
Covering the Period from 23 March to 22 April 1970

Gentlemen:

This is a progress summary for the referenced contract for the period 23 March to 22 April 1970.

Work has continued during this period on the fabrication of waveguide components for the organ pipe scanner. Also during this period an N/C milling machine was installed at Georgia Tech and programs for machining organ pipe waveguide channels have been checked out.

Design work on the organ pipe and indexing mechanism has been emphasized during this period and work has also been underway on the design features of the boom, scanner housing and attachments.

Negotiations for a satisfactory rotary joint design from mechanical and electrical performance standpoints have been concluded, and an order has been placed with Microwave Development Laboratories. Efforts are being made to expedite delivery.

On 16 April Mr. R M. Goodman, Jr., visited Ainslie Corporation in connection with the project. Also, Mr. Don Brown of Eglin AFB visited Georgia Tech on 21 April in regard to the project.

Scan linearity tests were performed on a multiple channel organ pipe scanner during this period. The results indicate that no fluctuations in main beam scanning occur as the organ pipe horn moves across adjacent waveguide divisions in the scanner.

During the next period emphasis will be placed on concluding phases of the detail design work and an increased effort on component fabrication will be made.

Respectfully submitted:

L. A. Stapleton
Associate Project Director

Approved:

R. M. Goodman, Jr.
Head, Sensor Systems Branch

GEORGIA INSTITUTE OF TECHNOLOGY
ENGINEERING EXPERIMENT STATION

225 North Avenue, Northwest · Atlanta, Georgia 30332

26 May 1970

Department of the Air Force
Headquarters, Armament Development Test Center (ADTC)
Eglin Air Force Base, Florida 32542

Attention: ADTC Physical Sciences Branch (ADTVE-53)

Subject: Monthly Technical Status Report No. 11
Covering the Period from 23 April to 22 May 1970

Gentlemen:

This is a progress summary for the referenced contract for the period from 23 April to 22 May 1970.

Work has continued during this period on detail design of scanner, boom, support structures and drive and indexing system.

Fabrication is underway on scanner components. Waveguide channel plates have been machined on the N/C milling machine and are ready for assembly.

An extension of the contract from 22 May to 22 August with no increase in cost has been requested. Work is proceeding on this basis.

Work in the following period will be a continuation of the present effort on design and shop fabrication.

Respectfully submitted:

L. A. Stapleton
Associate Project Director

Approved:

R. M. Goodman, Jr.
Head, Sensor Systems Branch

GEORGIA INSTITUTE OF TECHNOLOGY
EXPERIMENT STATION 225 North Avenue, Northwest · Atlanta, Georgia 30332

23 June 1970

Department of the Air Force
Headquarters, Armament Development Test Center (ADTC)
Eglin Air Force Base, Florida 32542

Attention: ADTC Physical Sciences Branch (ADTVE-53)

Reference: Contract F08635-69-C-0202

Subject: Monthly Contract Technical Status Report No. 12
Covering the period from 23 May to 22 June 1970

Gentlemen:

This is the twelfth monthly progress summary under the subject contract and covers the period 23 May to 22 June 1970.

Electroforming and machining of horn feeds have continued throughout this reporting period. Preliminary electrical matching of the individual horns is performed as they become available. By using a swept-frequency matching technique, excellent broad-band matches for single horns have been achieved.

Interfacing and assembly of the scanner body and waveguide channels have also been completed. Electrical length measurements (without feed horns) are in progress on the scanner-waveguide subassembly. Results at one frequency indicate good agreement with design tolerances.

Final design of the drive system has been completed; however, electrical and mechanical endurance tests of the indexing and drive mechanism breadboard model continue. Fabrication and assembly of the operational drive and indexing mechanism are now underway and will continue concurrent with endurance testing of the breadboard model.

Mr. R. M. Goodman, Jr. of Georgia Tech visited Ainslie Corporation on 11 and 12 June for technical discussions relating to work on this contract.

During the forthcoming reporting period, continuing emphasis will be placed on fabrication, integration, testing, and final assembly of the system subcomponents. Final range testing is tentatively scheduled for the first week of August.

Respectfully submitted,

E. K. Reedy
Associate Project Director

Approved:

R. M. Goodman, Jr.
Head, Sensor Systems Branch

ENGINEERING EXPERIMENT STATION 225 North Avenue, Northwest · Atlanta, Georgia 30332

27 July 1970

Department of the Air Force
Headquarters, Armament Development Test Center (ADTC)
Eglin Air Force Base, Florida 32542

Attention: ADTC Radar Branch (ADVEG-3)

Reference: Contract F08635-69-C-0202

Subject: Monthly Contract Technical Status Report No. 13
Covering the period from 23 June to 22 July 1970

Gentlemen:

This is the thirteenth monthly progress summary under the subject contract and covers the period 23 June to 22 July 1970.

During this reporting period, primary emphasis has been placed on matching of the entire scanner subsystem from rotary joint through the rotating feed horn to the flared horn output. A mock-up of the housing, flange, and radome structure was fabricated to investigate possible perturbations in the system VSWR when this structure is placed around the scanner body. Voltage standing wave ratios obtained were well within contract specifications under all simulated conditions.

Electrical path-length measurements of the scanner-waveguide subassembly have been completed. Measured channel-to-channel path-length variations were less than ten degrees.

Two rotary joints have been delivered by the manufacturer, Microwave Development Laboratories. However, only one of the joints marginally meets our power-handling specifications. The joint having the worst break down characteristics has been returned to MDL for necessary modifications while the other will be retained by Georgia Tech to continue system testing with modification of this joint to be performed after the first joint is returned.

Fabrication and assembly of the scanner drive and indexing mechanism has continued throughout this reporting period with completion of this system subcomponent expected by the end of July.

On 9 July 1970, Georgia Tech representatives R. M. Goodman, Jr., S. T. Alford, and E. K. Reedy visited Eglin AFB for technical discussions relating to work on this contract. Also Don Brown of ADTC visited Georgia Tech on 17 July 1970.

During the forthcoming reporting period, final system assembly and check out, including measurement of the scanner phase and amplitude patterns and range testing of the complete antenna system, will be performed.

Respectively submitted,

E. K. Reedy
Project Director

Approved:

R. M. Goodman, Jr.
Head, Sensor Systems Branch

GEORGIA INSTITUTE OF TECHNOLOGY
ENGINEERING EXPERIMENT STATION 225 North Avenue, Northwest · Atlanta, Georgia 30332

25 August 1970

Department of the Air Force
Headquarters, Armament Development Test Center (ADTC)
Eglin Air Force Base, Florida 32542

Attention: ADTC Radar Branch (ADVEG-3)

Reference: Contract F08635-69-C-0202

Subject: Monthly Contract Technical Status Report No. 14
Covering the period from 23 July to 22 August 1970

Gentlemen:

This is the fourteenth monthly progress summary under the subject contract and covers the period 23 July to 22 August 1970.

Fabrication and assembly of scanner-drive and indexing mechanism has been completed. However, initial testing of this system subcomponent indicated that the indexing pawl was not properly seating in the rotating cam. Modification of the pawl to force correct seating is underway.

One boom has been received from Ainslie Corporation, checked for mechanical flaws, accepted and is presently being mated to the reflector mounting assembly in preparation for antenna range tests.

Scanner housing castings have also been received and are now in the final stages of machining.

Two rotary joints were delivered by the manufacturer, Microwave Development Laboratories, but these joints failed to meet Georgia Tech power-handling specifications and, consequently, were returned. MDL has modified one joint and now "believes" that it will handle the required power. This joint has been shipped from MDL; however, to date, it has not arrived at Georgia Tech.

Initial scanner phase-amplitude patterns were measured during this reporting period. The measured characteristics met or exceeded all specified design goals for the scanner patterns.

It is expected that during the forthcoming reporting period, final system assembly and check-out, to include verification of mechanical performance of the drive and indexing mechanism and range testing of the complete antenna system, will be performed.

Respectfully submitted,

E. K. Reedy
Associate Project Director

Approved:

R. M. Goodman, Jr.
Head, Sensor Systems Branch

ENGINEERING EXPERIMENT STATION 225 North Avenue, Northwest · Atlanta, Georgia 30332

18 September 1970

Department of the Air Force
Headquarters, Armament Development Test Center (ADTC)
Eglin Air Force Base, Florida 32542

Attention: ADTC Radar Branch (ADVEG-3)

Reference: Contract F08635-69-C-0202

Subject: Monthly Contract Technical Status Report No. 15
Covering the period from 23 August to 18 September 1970

Gentlemen:

During this reporting period, the complete antenna system, with the exception of drive motor and cover, was assembled and mounted on the Georgia Tech antenna range. Several patterns were taken at different relative locations of scanner and reflector to determine an optimum placement of the focal point of the parabolic reflector with respect to the phase center of the feed horns.

E-plane patterns recorded at selected frequencies and one-degree increments across the scan sector indicated that the antenna radiation pattern remained well-formed with 3-dB beamwidths, scan linearity, coma-lobe levels, and gain variations which meet or exceed system specifications.

Selected H-plane patterns were also measured. No degradation of the radiated pattern in the H-plane was expected nor was any observed.

A modified rotary joint was received from the manufacturer, Microwave Development Laboratories. Previous models of this joint have failed to meet our power-handling specifications; however, high-power testing of the modified joint indicates specification compliance with approximately a thirty percent safety margin. This joint suffered from some degradation of VSWR at the high end of the frequency band when compared with MDL's previous design, but is still within specification and will be acceptable.

Mechanical checkout of a slightly redesigned indexing pawl and cam has been performed. Correct operation of the indexing mechanism was achieved by varying the face angles of the indexing pawl.

During the forthcoming reporting period, final scanner mechanical tests, high-power tests and additional antenna pattern measurements will be performed.

Respectfully submitted,

E. K. Reedy
Associate Project Director

Approved:

R. M. Goodman, Jr.
Head, Sensor Systems Branch

A-1181

GEORGIA INSTITUTE OF TECHNOLOGY
ENGINEERING EXPERIMENT STATION 225 North Avenue, Northwest · Atlanta, Georgia 30332

27 October 1970

Department of the Air Force
Headquarters, Armament Development Test Center (ADTC)
Eglin Air Force Base, Florida 32542

Attention: ADTC Radar Branch (ADVEG-3)

Reference: Contract F08635-69-C-0202

Subject: Monthly Contract Technical Status Report No. 16
Covering the period from 19 September to 22 October 1970

Gentlemen:

During this reporting period, final assembly of the entire antenna system was completed. Acceptable performance of the indexing mechansim was confirmed and run-up and run-down times measured, both of which were well within specifications. Electrical output signals from the encoder and the magnetic pickups were observed to ensure that these components were operating correctly.

High-power testing verified that all RF components could handle approximately 400 KW. Apparent breakdown above 400 KW occurred in the rotary joint.

Also, final VSWR tests indicated that a match of better than 1.4:1, measured at the end of the boom, was achieved across the required frequency band.

All required static antenna patterns have now been taken. E-plane patterns recorded at selected frequencies and one-degree increments across the scan sector indicated that the antenna radiation pattern remained well-formed with 3-dB beamwidths, scan linearity, coma-lobe levels, and gain variations which meet or exceed required pattern specifications and in many cases exceed design goals.

Don Brown of ADTC visited Georgia Tech on 22 and 23 October to observe preshipment acceptance testing of the antenna system. These tests were completed to Mr. Brown's satisfaction.

During the forthcoming reporting period, the antenna system will be prepared for shipment to ADTC with a delivery date to be determined by the availability of ADTC's site for installation of Georgia Tech equipment. Also, work will continue on the second scanner and boom.

Respectfully submitted

E. K. Reedy
Project Director

Approved:

R. M. Goodman, Jr.
Head, Sensor Systems Branch

A-1181

GEORGIA INSTITUTE OF TECHNOLOGY
ENGINEERING EXPERIMENT STATION 225 North Avenue, Northwest · Atlanta, Georgia 30332

1 December 1970

Department of the Air Force
Headquarters, Armament Development Test Center (ADTC)
Eglin Air Force Base, Florida 32542

Attention: ADTC Radar Branch (ADVEG-3)

Reference: Contract F08635-69-C-0202

Subject: Monthly Contract Technical Status Report No. 17
Covering the period from 22 October to 23 November 1970

Gentlemen:

During the week of 1 November, Georgia Tech delivered and installed at Site A-13A, Eglin AFB the Offset Paraboloidal Scanning Antenna which was developed under this contract. Additional installation of counterweights and modified mechanical stops was completed on 19 and 20 November.

Work has continued during this reporting period on final fabrication and preliminary assembly of the second scanner and boom. For the most part, fabrication efforts have now been completed and presently waveguide runs are being soldered in preparation for final assembly and testing. It is now anticipated that this subsystem will be ready for delivery by the first of the year.

Preparation of the remaining documentation is currently underway and will continue throughout December and January.

This report represents the last scheduled monthly contract technical status summary.

Respectfully submitted,

E. K. Reedy
Project Director

Approved:

R. M. Goodman, Jr.
Head, Sensor Systems Branch

EKR/lb

A-1181

GEORGIA INSTITUTE OF TECHNOLOGY
ENGINEERING EXPERIMENT STATION 225 North Avenue, Northwest · Atlanta, Georgia 30332

6 January 1971

Department of the Air Force
Headquarters, Armament Development Test Center (ADTC)
Eglin Air Force Base, Florida 32542

Attention: ADTC Radar Branch (ADVEG-3)

Reference: Contract F08635-69-C-0202

Subject: Monthly Contract Technical Status Report No. 18
Covering the period from 24 November to 24 December 1970

Gentlemen:

Final demonstration, on-site at Eglin AFB, of the operational model of the Georgia Tech Offset Paraboloidal Scanning Antenna developed under this contract has been delayed until certain Tasker supplied equipment can be tested and accepted by ADTC. A no-cost extension to the present contract has been completed changing the date for completion of the demonstration phase of the contract to now read—on or before 7 April 1971.

Work continues on the spare scanner and boom. The drive and indexing mechanism has been assembled and is now undergoing final testing. Also all waveguide runs have been soldered and tested to insure that they will carry the required power levels with an acceptably low VSWR. Mounting of the waveguide runs on the scanner body is presently underway.

Final assembly and preshipment testing of the second scanner will continue throughout the forthcoming reporting period. Preparation of the remaining documentation required on this contract will also continue.

Respectfully submitted,

E. K. Reedy
Project Director

Approved:

R. M. Goodman, Jr.
Head, Sensor Systems Branch

EKR/lb

GEORGIA INSTITUTE OF TECHNOLOGY
ENGINEERING EXPERIMENT STATION 225 North Avenue, Northwest · Atlanta, Georgia 30332

28 January 1971

NOV 1971

Department of the Air Force
Headquarters, Armament Development Test Center (ADTC)
Eglin Air Force Base, Florida 32542

Attention: ADTC Radar Branch (ADVEG-3)

Reference: Contract F08635-69-C-0202

Subject: Monthly Contract Technical Status Report No. 19
Covering the period from 26 December 1970 to 24 January 1971

Gentlemen:

Work during this reporting period has been devoted to completing the spare scanner and boom and the remaining documentation. Present status of the effort in these two areas is summarized below.

(1) Spare Scanner and Boom: Preshipment testing of the drive and indexing mechanism is essentially complete. Also all electronics associated with the drive, indexing, and signal pickoff functions have been assembled, checked, and intergrated into the system. The waveguide runs have been mounted on the scanner body and all flared horns soldered and epoxied into a single unit. Remaining work on the spare scanner consists of completing final microwave tests and assemble of individual components.

(2) Documentation: The Range Instrumentation Operation, and Maintenance Manual is in the final draft stage. A preliminary draft of the Final Engineering-Acceptance Test Report has been completed and is presently being revised. Both of these reports are expected to be completed within the next four to six weeks.

Final assembly and preshipment microwave testing of the second scanner will continue throughout the forthcoming reporting period. Preparation of the remaining documentation required on this contract will also continue.

Respectfully submitted,

E. K. Reedy
Project Director

Approved:

R. M. Goodman, Jr.
Head, Sensor Systems Branch

EKR/lb

ENGINEERING EXPERIMENT STATION 225 North Avenue, Northwest · Atlanta, Georgia 30332

1 March 1971

Department of the Air Force
Headquarters, Armament Development Test Center (ADTC)
Eglin Air Force Base, Florida 32542

Attention: ADTC Radar Branch (ADVEG-3)

Reference: Contract F08635-69-C-0202

Subject: Monthly Contract Technical Status Report No. 20
Covering the period from 25 January to 24 February 1971

Gentlemen:

Current status of the remaining items to be completed under this contract is summarized below.

(1) Spare Scanner and Boom: Preshipment testing of the drive and indexing mechanism is complete. All electronics associated with the drive, indexing, and signal-pickoff functions have been assembled, checked, and integrated into the system. However, final assembly and testing of the microwave subsystem has been delayed due to the non-availability of Georgia Tech's N-C milling machine. This machine has now become available for work on this project, which will allow the uninterrupted completion of the microwave component assembly phase and microwave tests.

(2) Documentation: Revision and editing of both the Range Instrumentation, Operation, and Maintenance Manual and the Final Engineering- Acceptance Test Report continue.

It is expected that final assembly and preshipment microwave testing of the second scanner will be completed during March, with shipment to ADTC by the first of April.

Respectfully submitted,

E. K. Reedy
Project Director

Approved:

R. M. Goodman, Jr.
Head, Sensor Systems Branch

EKR/bbw

ENGINEERING EXPERIMENT STATION 225 North Avenue, Northwest · Atlanta, Georgia 30332

2 April 1971

Department of the Air Force
Headquarters, Armament Development Test Center (ADTC)
Eglin Air Force Base, Florida 32542

Attention: ADTC Radar Branch (ADVEG-3)

Reference: Contract F08635-69-C-0202

Subject: Monthly Contract Technical Status Report No. 21
Covering the period from 25 February to 24 March 1971

Gentlemen:

Current status of the remaining items to be completed under this contract is summarized below.

(1) Spare Scanner and Boom: Final assembly of the complete spare scanner unit has been completed and preshipment VSWR and high-power test performed in a static configuration. Results of these tests indicate that the microwave performance of this unit meets or exceeds contract specifications. Design, fabrication, testing, and installation in the scanner control housing of a waveshaping circuit for the magnetic-pickup electrical signals has been completed. The electrical characteristics of the shaped magnetic pickup signals are:

pulse amplitude $\approx$ 10 V (into 50 Ω)
pulse width $\approx$ 10 μsec.
rise/fall time < 0.5 μsec.
pulses serially on a single line.

Primary phase amplitude patterns, the final microwave tests, are presently being measured, after which the scanner and boom will be mated and the unit shipped to ADTC.

(2) Documentation: Preparation of both the Range Instrumentation, Operation, and Maintenance Manual and the Final Engineering-Acceptance Test Report continues.

It is expected that all preshipment tests and final mating of boom and scanner will be completed early in April and the spare scanner unit shipped to ADTC shortly thereafter.

By mutual consent of both ADTC and Georgia Tech, the performance period for this contract has been extended to 15 July 1971.

Respectfully submitted,

E. K. Reedy
Project Director

Approved:

R. M. Goodman, Jr.
Head, Sensor Systems Branch

GEORGIA INSTITUTE OF TECHNOLOGY
ENGINEERING EXPERIMENT STATION 225 North Avenue, Northwest · Atlanta, Georgia 30332

5 May 1971

Department of the Air Force
Headquarters, Armament Development Test Center (ADTC)
Eglin Air Force Base, Florida 32542

Attention: ADTC Radar Branch (ADVEG-3)

Reference: Contract F08635-69-C-0202

Subject: Monthly Contract Technical Status Report No. 22
Covering the period from 25 March to 24 April 1971

Gentlemen:

Current status of the remaining items to be completed under this contract is summarized below.

(1) Spare Scanner and Boom: This unit was completed and shipped to ADTC on 26 April 1971. Also at this time, on-site demonstration of the electrical performance of both the complete scanning antenna system, delivered 1 November 1970, and the spare boom and scanner was successfully completed. While on-site at Eglin AFB, Georgia Tech personnel also demonstrated the exchange of boom and scanner. Approximately forty minutes were required for this operation.

(2) Documentation: Personnel previously committed to finishing work on the spare system and preparation for delivery and demonstration have now been diverted to completing the Range Instrumentation, Operation, and Maintenance Manual and the Final Engineering-Acceptance Test Report. It is anticipated that both reports will be completed within thirty days.

Respectfully submitted,

E. K. Reedy
Project Director

Approved:

R. M. Goodman, Jr.
Head, Sensor Systems Branch

ENGINEERING EXPERIMENT STATION 225 North Avenue, Northwest · Atlanta, Georgia 30332

31 May 1971

Department of the Air Force
Headquarters, Armament Development Test Center (ADTC)
Eglin Air Force Base, Florida 32542

Attention: ADTC Radar Branch (ADVEG-3)

Reference: Contract F08635-69-C-0202

Subject: Monthly Contract Technical Status Report No. 23
Covering the period from 25 April to 24 May 1971

Gentlemen:

Two items of documentation remain to be delivered on this contract, the Range Instrumentation, Operation, and Maintenance Manual and the Final Engineering - Acceptance Test Report. Most of our efforts during this reporting period have been devoted to completing the Maintenance Manual, which is presently in the final stages of preparation with only a small amount of photolab work and some final retyping remaining.

A rough draft copy of the Final Engineering Report has been completed and is currently being revised and edited. After completion of the Maintenance Manual, a concerted effort is scheduled for completion of the Final Report.

It is anticipated that line Item B002 of the Contract Data Requirements List (Maintenance Manual and drawings) will be delivered during the forthcoming reporting period. Work on the Final Report will continue.

Respectfully submitted:

E. K. Reedy
Project Director

Approved:

R. M. Goodman, Jr.
Head, Sensor Systems Branch

EXPERIMENT STATION 225 North Avenue, Northwest · Atlanta, Georgia 30332

2 July 1971

Department of the Air Force
Headquarters, Armament Development Test Center (ADTC)
Eglin Air Force Base, Florida 32542

Attention: ADTC Radar Systems Branch (TSGGR)

Reference: Contract F08635-69-C-0202

Subject: Monthly Contract Technical Status Report No. 24
Covering the period from 25 May to 30 June 1971

Gentlemen:

During the preceding reporting period, the Range Instrumentation, Operation and Maintenance Manual has been completed and delivered to ADTC. Copies of all Georgia Tech drawings generated on this contract are now being prepared for shipment. Contract Data Requirement Item B002, specifically number and type of drawings required, was discussed and clarified during a conference at Eglin AFB on 25 June 1971. By mutual agreement GIT will deliver to ADTC one (1) set of reproducible masters (Sepia) and four (4) sets of nonreproducible copies (Ozlid) of all drawings.

Work on the Engineering and Test Results Report continues. A rough draft copy has been completed and is currently being revised and edited in preparation for final draft typing.

The performance period for this contract terminates on 15 July 1971 with an additional two months available for completion of the Final Engineering Report. Therefore, this is the last scheduled status report on this contract.

Respectfully submitted:

Edward K. Reedy
Project Director

Approved:

R. M. Goodman, Jr.
Head, Sensor Systems Branch

PRESHIPMENT TEST PROCEDURES REPORT
PROJECT A-1181

AN OFFSET PARABOLOIDAL SCANNING ANTENNA

E. K. Reedy, J. W. Cofer, and G. W. Ewell

Contract F08635-69-C-0202

Placed by
Armament Development Test Center
Department of the Air Force
Eglin Air Force Base, Florida 32542

14 August 1970

Engineering Experiment Station
GEORGIA INSTITUTE OF TECHNOLOGY
Atlanta, Georgia

GEORGIA INSTITUTE OF TECHNOLOGY
Engineering Experiment Station
Atlanta, Georgia 30332

PRESHIPMENT TEST PROCEDURES REPORT

PROJECT A-1181

AN OFFSET PARABOLOIDAL SCANNING ANTENNA

by

E. K. Reedy, J. W. Cofer, and G. W. Ewell

CONTRACT F08635-69-C-0202

14 August 1970

Placed by

ARMAMENT DEVELOPMENT TEST CENTER
DEPARTMENT OF THE AIR FORCE
EGLIN AIR FORCE BASE, FLORIDA 32542

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I. INTRODUCTION

This report describes Georgia Tech preshipment test procedures which will be employed prior to actual hardware shipment to verify that the deliverable equipment under this contract, an offset paraboloidal scanning antenna, meets or surpasses Armament Development and Test Center Technical Specifications. It is implicit in the following test descriptions that the accuracy obtained by recalibration of oscilloscopes, power meters, and other instrumentation at six-month intervals will suffice, as will manufacturer's calibration of such items as attenuators, frequency meters, and directional couplers, and on-site calibration of antenna range instrumentation equipment. Furthermore, the tests described herein are based on the assumption that conventional waveform, frequency, and power measurement techniques are acceptable.

II. MECHANICAL MEASUREMENTS

The reflecting dish will be carefully measured to determine and document deviations from an off-axis section of the desired paraboloidal surface. Peak-to-peak variations from the desired contour will be calculated as will Root Mean Square (RMS) errors. Standard mechanical tolerance checks continue throughout system fabrication and assembly to ensure correct alignment and interfacing of all mechanical components.

III. SCANNER-DRIVE TESTS

A. Run-up and run-down times

With the scanner running at the nominal scanning speed, the required indexing signal will be applied to the drive system, thereby forcing the scanning mechanism to stop at center of scan. By using the encoder output signal to drive a linear frequency-to-voltage converter, stopping or run-down time, defined as the elapsed time interval necessary for the converter output voltage to drop from ninety-five percent to within (and remain within) five percent of the nominal full-speed voltage, can be measured. Starting or run-up time, defined in an analogous manner, is determined by reversing the above procedure, but making the same measurement.

B. Encoder output

Using conventional instrumentation, the electrical characteristics of the incremental encoder output signal will be measured to verify that they meet the following specifications.

i) pulses per revolution	-	10,000
ii) voltage swing	-	0 to at least +10 volts
iii) pulse width	-	2 microseconds
iv) 10% to 90% risetime	-	Not more than 0.1 microsecond across a 200-ohm load

C. Magnetic pickup electrical signals

Output signals from each of the three magnetic pickups which provide electrical indications of start, center, and end of scan will be checked for correct polarity, consistent performance, sufficient output-voltage amplitude ($> +3$ volts), and proper risetime (10% to 90% risetime $< 250\ \mu$sec).

IV. HIGH-POWER MEASUREMENTS

The high-power-handling capabilities of the RF path from the rotary joint and rotating horn through the waveguide channels to the radiating horns will be tested by generating, in the laboratory, RF signals having the specified peak and average power at selected frequencies across the frequency band of interest. With the radiating system operating in both the scanning and searchlighting modes, the RF energy must be applied to the scanner for a continuous test period of at least fifteen minutes without obvious breakdown effects. Also, the VSWR, measured before and after high-power testing, must remain essentially unchanged.

V. MICROWAVE TESTS

In addition to the tests described above, the following microwave tests will be performed in the order discussed.

A. Electrical path length

At a convenient time during final assembly of the scanner, measurements will be made to establish that all waveguide channels have approximately identical electrical lengths from the aperture of the rotating feed horn to the output of the stacked radiating horns. Since all flared horns were machined to extremely close mechanical tolerances, only the electrical lengths of the waveguide channels out to the radiating horns need be measured. A knowledge of the absolute length of each waveguide channel would be of no particular value; therefore, only the relative differences in their lengths will be examined.

Relative channel path-length differences can be measured at a number of discrete frequencies by using a dual-channel, phase-sensitive receiver in a reflectometer configuration. After a metal shorting block is placed in the center cavity of the organ-pipe scanner, a signal is sent down each individual waveguide channel and reflected from this block. The reflected signal and a reference signal from the source are used as inputs to the dual-channel receiver. One waveguide channel is selected as a reference. The phase of the source signal is then adjusted to give a receiver phase indication of zero degrees for the reference channel. Phase readings for another channel will directly indicate the two-way phase difference between the two channels.

For well-formed antenna patterns, no two contiguous waveguide channels should have a one-way phase difference of more than approximately twenty electrical degrees. Also, channel-to-channel phase differences should be random and not form a linear phase taper which would steer the beam in an undesired direction.

B. VSWR

Instrumentation required for measuring VSWR consists of a reflectometer arrangement in conjunction with a sweep generator and an oscilloscope display. The magnitude of the VSWR, when looking into the scanner rotary joint with all radiating horns in place, is displayed versus frequency on the oscilloscope. Matching of the RF system is then accomplished by placing reflecting objects at such key discontinuities as the rotating-horn organ-pipe interface and the radiating ends of the stacked horns and instantaneously observing their effects on the oscilloscope display. A VSWR of 1.5:1 or less over the frequency band of interest is acceptable.

C. Scanner radiation patterns

Amplitude and phase measurements necessary to characterize the scanner radiation pattern will be taken on a small indoor antenna range consisting of a fixed platform, on which the scanner body is mounted, and a receiving probe, fixed to the end of a ten-foot swing arm, which is rotated about the scanner. The amplitude and phase of the scanner's radiated energy will be recorded versus angular position of the receiving probe in each of the principal (E and H) planes.

Previous tests on a prototype system indicated that the scanner should produce amplitude tapers at the E- and H-plane reflector edges of 14-20 dB and 10-15 dB, respectively. Also, the E- and H-plane phase centers should coincide.

D. Antenna range tests

Although the approximate location of the scanner with respect to the reflector and the patterns generally expected are known from previous phases of this project, extensive range testing will be conducted to provide adequate pattern documentation and to investigate certain second-order effects such as small changes in the scanner pointing angle and adjustments of the scanner phase centers.

All aspects of the antenna radiation pattern will require attention; however, certain characteristics of the scanned E-plane beam such as 3-dB beamwidth, scan linearity, coma lobe levels, and gain variations will be the governing factors when making the final adjustments. The rotating organ-pipe feed-horn will be step-scanned an amount sufficient to shift the far-field radiation pattern, in one-degree increments, completely across the specified scan sector. E-plane radiation patterns will be recorded at each step. Previous scan-linearity tests on a breadboard model of the scanning antenna system indicated that a one-degree shift in the far-field pattern requires that the rotating horn be moved the equivalent of approximately two waveguide channels. Once an acceptable family of scanned E-plane patterns is obtained, H-plane patterns will be measured at several points in the scan sector to ensure that the beam remains well-formed and maintains the required beamwidth at the 3-dB points. The rotating feed-horn will also be scanned, in a stepwise manner, across a minimum of two contiguous waveguide channels in small increments (approximately one-eighth of a waveguide channel) and E-plane radiation patterns will be recorded after each scan increment. These measurements will indicate any "cogging" effects (perturbations in the gain or scan angle of the radiated energy due to waveguide sidewall blockage of the feed-horn) which might exist. Although not a contractual requirement, cross-polarized patterns will probably be taken at various points in the scan sector, primarily to ensure that the antenna has no inherent anomalous polarization properties.

Since the antenna range pattern measurements represent the last and most important series of tests to be performed on this antenna system, notification will be given to ADTC sufficiently in advance of the scheduled test period to allow ADTC personnel to visit Georgia Tech for observation of the range testing.

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13. ABSTRACT		

This report describes preshipment test procedures which will be employed to verify that the deliverable equipment under this contract, an offset paraboloidal scanning antenna, meets or surpasses contractor technical specifications.

RANGE INSTRUMENTATION OPERATION
AND MAINTENANCE MANUAL

OFFSET PARABOLOIDAL SCANNING ANTENNA

Prepared for
HEADQUARTERS
ARMAMENT DEVELOPMENT TEST CENTER
EGLIN AIR FORCE BASE, FLORIDA 32542
UNDER
CONTRACT F08635-69-C-0202

L. A. Stapleton and G. W. Ewell
with
E. K. Reedy, R. M. Goodman, Jr.,
and S. S. Wilson

Project A-1181

31 May 1971

1971

Engineering Experiment Station
GEORGIA INSTITUTE OF TECHNOLOGY
Atlanta, Georgia

GEORGIA INSTITUTE OF TECHNOLOGY
Engineering Experiment Station
Atlanta, Georgia 30332

RANGE INSTRUMENTATION OPERATION AND MAINTENANCE MANUAL

Project A-1181

OFFSET PARABOLOIDAL SCANNING ANTENNA

by

L. A. Stapleton and G. W. Ewell
with
E. K. Reedy, R. M. Goodman, Jr.,
and S. S. Wilson

31 May 1971

Prepared for
HEADQUARTERS
ARMAMENT DEVELOPMENT TEST CENTER
EGLIN AIR FORCE BASE, FLORIDA 32542
Under
Contract F08635-69-C-0202

PREFACE

This manual provides general information about the maintenance and operation of an Offset Paraboloidal Scanning Antenna developed for Armament Development Test Center (ADTC), Eglin AFB, Florida, by Georgia Institute of Technology under Contract F08635-69-C-0202.

In addition to containing a general description of the antenna system including the theory of operation of the electrical subsystem, this manual also contains detailed instructions on installation, troubleshooting and maintenance, operation, and assembly-disassembly. Pertinent engineering data, parts list, and detailed drawings are either included in or provided as a supplement to this manual.

If maintenance problems occur which are beyond the scope of this manual, specific assistance should be requested from the Sensor Systems Branch of the Engineering Experiment Station at Georgia Institute of Technology.

DISCLAIMER

The citing of trade names and names of manufacturers in this report is not to be construed as endorsement or approval of the commercial products referenced by either the Georgia Institute of Technology or the United States Government.

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I. GENERAL DESCRIPTION

A. Physical Description

The offset paraboloidal scanning antenna is shown in Figure 1 and consists of six major items, as discussed in the following paragraphs.

1. Reflector

The reflector has the form of a sector of a paraboloid of revolution; its projected aperture is seen in Figure 2. The reflector is made of two spun-aluminum shells separated by vertical ribs and spacers and is bounded with aluminum sidewalls. Riveted construction is used. A mounting flange is permanently attached to the back surface near its lower edge.

2. Scanner

The scanner comprises an organ-pipe scanning device enclosed in a cast-aluminum housing. It is motor driven and can be stopped very quickly in "searchlight" position with the beam at the midpoint of scan. The scan direction is vertical, bottom to top in the far field. In order to minimize corrosion and moisture accumulation, a small amount of dry air should be circulated into the scanner body through the waveguide input port; this air will leak to the atmosphere through normal leakage. CAUTION: THE SCANNER BODY SHOULD NOT BE PRESSURIZED. PRESSURE IN EXCESS OF 2½ psig MAY DAMAGE THE RADOME. If the waveguide feeding the antenna is pressurized, a pressure window should be used. (The antenna is designed to function at atmospheric pressure; it has been routinely subjected to high-power rf testing beyond the 350 kW level with no sign of breakdown.)

3. Boom

The boom is made from an aluminum tube ten inches in diameter and serves to support the scanner at the proper position in front of the reflector. It also acts as a housing for electrical leads and waveguide between the main antenna pedestal and the scanner.

4. Intermediate Support Structure

A box-like aluminum weldment ties the boom and reflector together and assures correct alignment between the two. The end of the boom which attaches to this structure has aligning pins that fit into guide bushings in the base of the support structure. Both boom/scanner units being supplied have been fitted to this structure so that the aligning pins and guide bushings will assure proper relationship between scanner and reflector for either unit.

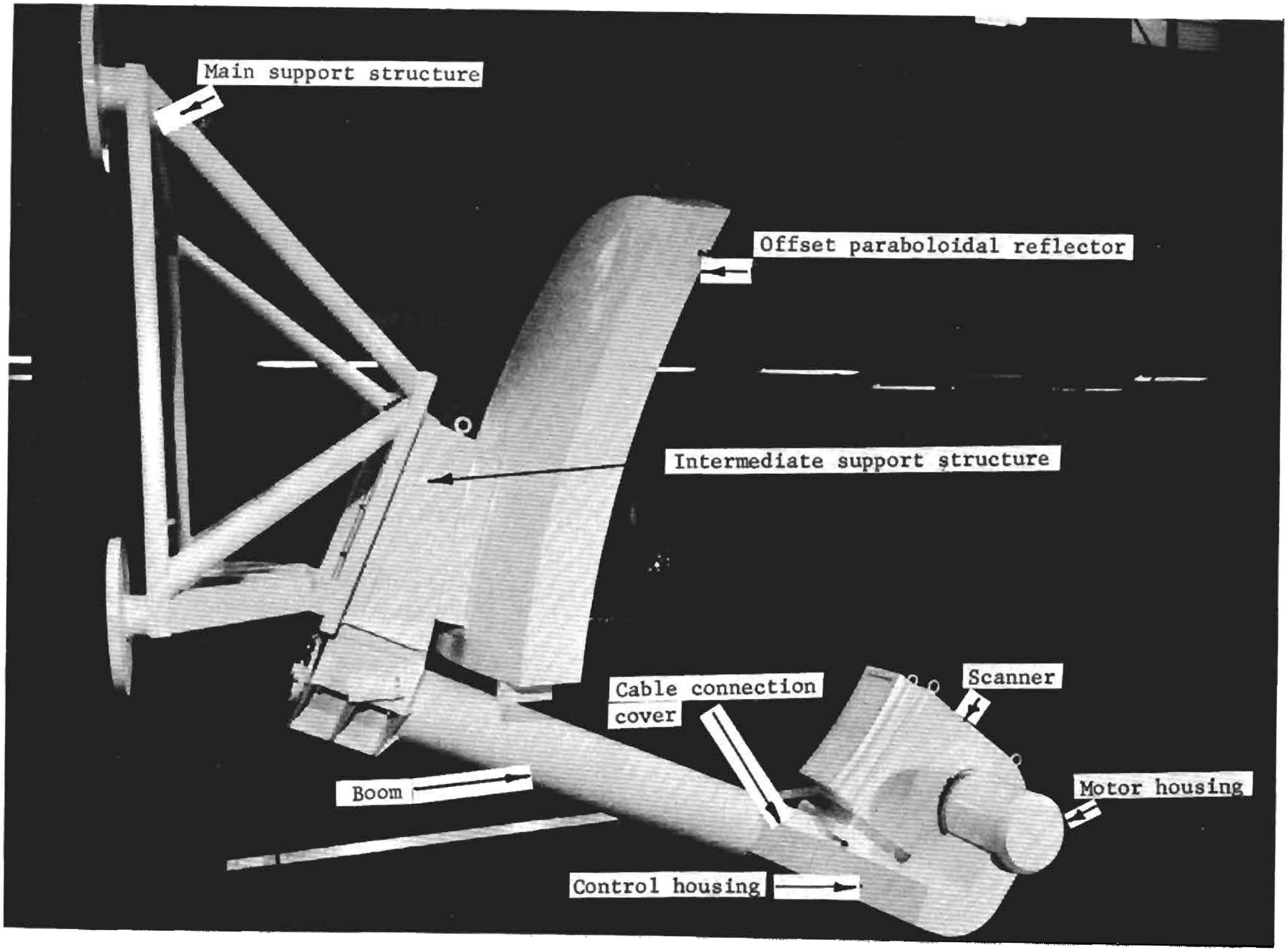

Figure 1. Lower-dish assembly.

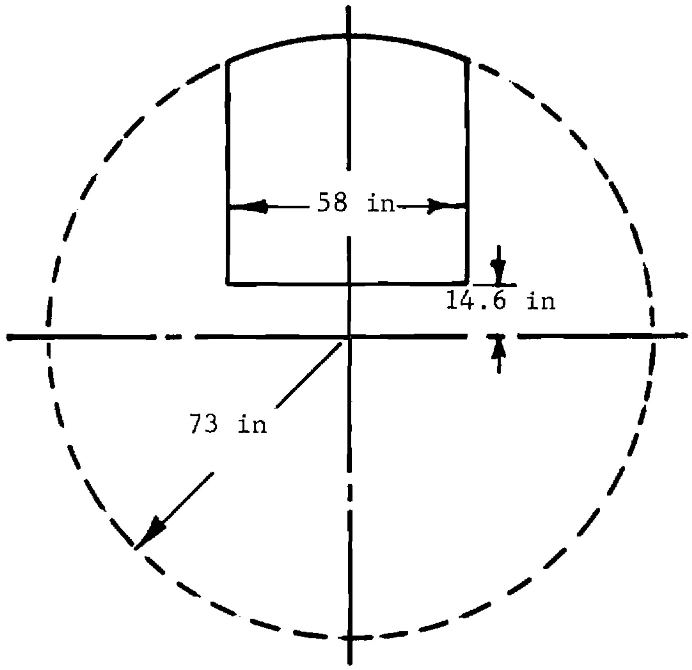

Figure 2. Lower-dish projected aperture.

5. Main Support Structure

A tubular steel truss-like frame carries the weight of the other members through its attachments to the intermediate support structure. It is the connecting link between the entire lower-dish assembly and the pedestal on which the assembly is mounted. The mounting interface is between four steel flanges on this structure and four mating flanges on the pedestal.

6. Control Housing

The control housing is an aluminum box attached to the cover plate of the scanner housing. It contains electrical equipment associated with the operation and control of the scanner. Removal of the cover plate on the top of the control housing provides access to the electrical equipment inside.

B. Electrical Description

The electrical equipment associated with the lower dish is located mainly in the control housing which attaches to the access cover of the scanner. Cables run from the control housing through the boom to the input connectors located on the plate at the end of the boom. Wires also run up through the control housing into the scanner and connect to components located within the scanner housing. Two general types of electronic circuitry are associated with the lower-dish scanner--control circuits and signal circuits. The control circuits are concerned with stopping and indexing the rotating horn, while the signal circuits serve to generate, process, and transmit signals describing the position of the rotating horn.

The control circuits perform the operations that are necessary in order to stop, start, and index the rotary horn. Stopping and indexing are accomplished by appropriate operations of the drive motor, cam, and pawl, as shown schematically in Figure 3. While the feedhorn is rotating to scan the antenna beam, the pawl is raised, and the cam and horn are driven at constant speed by a three-phase induction motor through a timing-belt speed reducer when the "stop" command is given, the pawl is dropped (see Figure 3), the motor

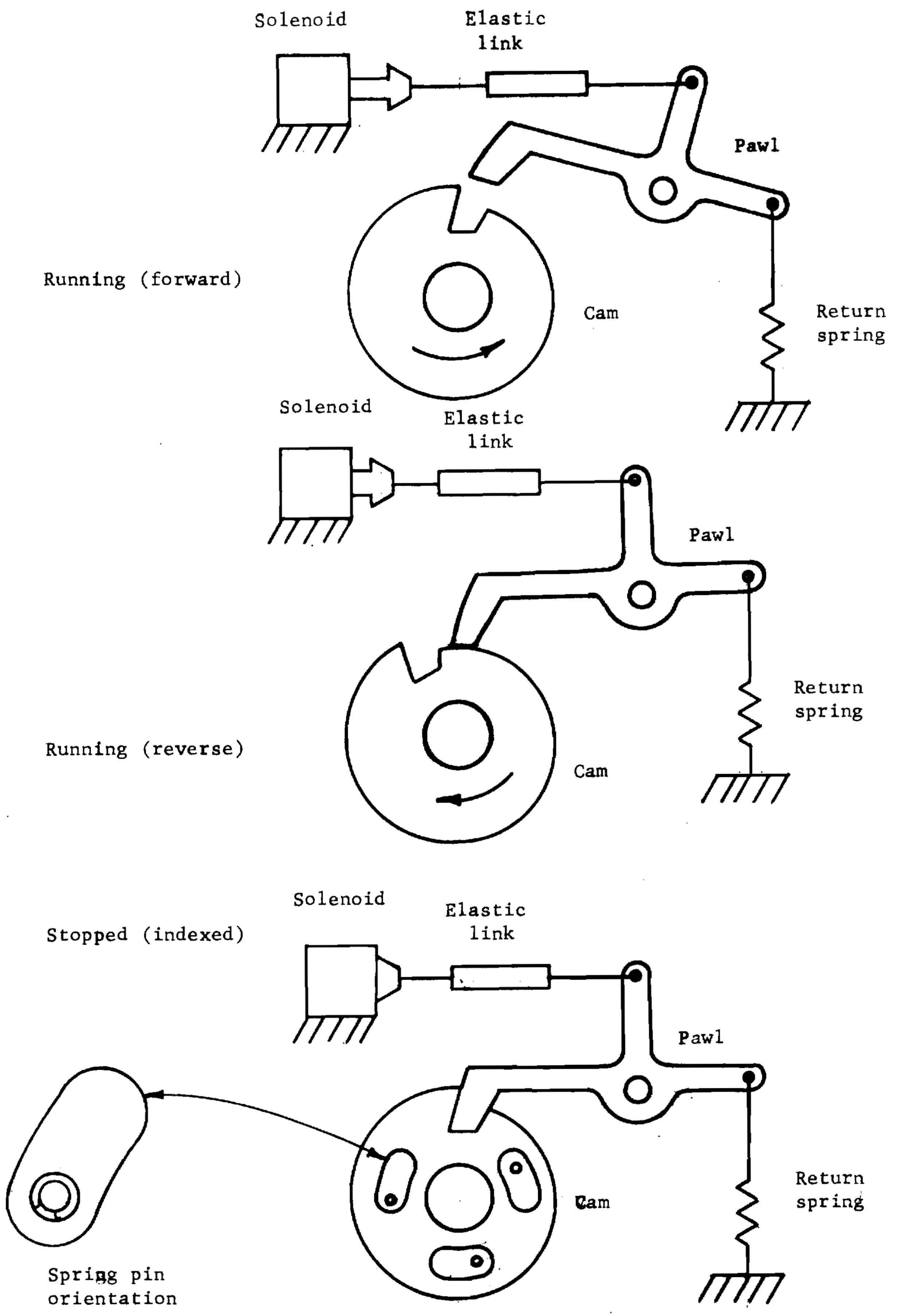

Figure 3. Cam/pawl relationship.

reverses, and a brake is momentarily applied. Once the cam stops and reverses, the pawl drops into position. When the "start" command is received, the pawl is raised and power is applied to the motor, thereby accelerating the cam and horn to operating speed. Run-up time is typically 0.2 second and run-down time less than 0.4 second.

The signal circuits generate, process, and transmit two types of signals: encoder output and magnetic pickup signals. The encoder generates 10,000 pulses per revolution of the feedhorn; appropriate encoder power supplies and circuitry necessary to shape its output pulses are contained in the control housing. Three magnetic pickups produce signals corresponding to the start of the scan sector, the center of scan (searchlight position), and the end of scan. The signals generated by the magnetic pickups are processed differently in the two units. In one unit the pulses are coupled directly out of the unit without further processing, whereas pulse shaping circuitry for the magnetic pickup outputs is included in the control housing of the other unit.

Details of these circuits are contained in Section II of this manual and suggestions for troubleshooting procedures are contained in Section IV.

II. OPERATION

A. Motor Drive and Indexing Mechanism (Control Circuits)

1. Principles of Operation

The feedhorn of the organ-pipe scanner is driven by a three-phase induction motor through a timing-belt speed reducer. When the control switch is placed in the "stop" position, the motor is reversed, an electromechanical brake is applied, and the pawl arm is lowered against the index cam (see Figure 3); once the cam reverses, the pawl drops into the indexing slot, thereby positioning the horn and removing power from the drive motor. The circuitry which accomplishes this operation is shown in Figure 4. In order to examine this stopping sequence in more detail, assume the control switch is in the "scan" position, the motor is running in the forward direction, and the pawl arm is raised. Under these conditions Relay K2 is closed, Relay K3 is actuated, and the pawl-actuated microswitch S1 is not actuated.

When the control switch is placed in the "stop" position, the pawl solenoid is actuated, dropping the pawl. Relay K3 is deactivated, opening Relay K2 and closing Contactor K1. K1 reverses the drive motor through 10-ohm resistors (R1, R2, R3) in series with the motor windings. Capacitor C1, which was charged through Diode CR1 and R4, is connected across the windings of the electromechanical brake.

The cam and feedhorn now reverse direction of rotation, allowing the pawl to drop and index the feedhorn. Relay K4 is energized during this reverse cycle, actuating the brake and reducing the maximum speed in the reverse direction. When the pawl indexes, S1 is actuated, opening Contactor K1 and removing all power to the drive motor. The feedhorn has now stopped and indexed in position, and will remain there until the control switch is placed in the "scan" position.

When the control switch is placed in the "scan" position, the pawl solenoid is deactivated, Relay K3 is activated, disconnecting the electromechanical brake and closing Contactor K2. The drive motor now accelerates

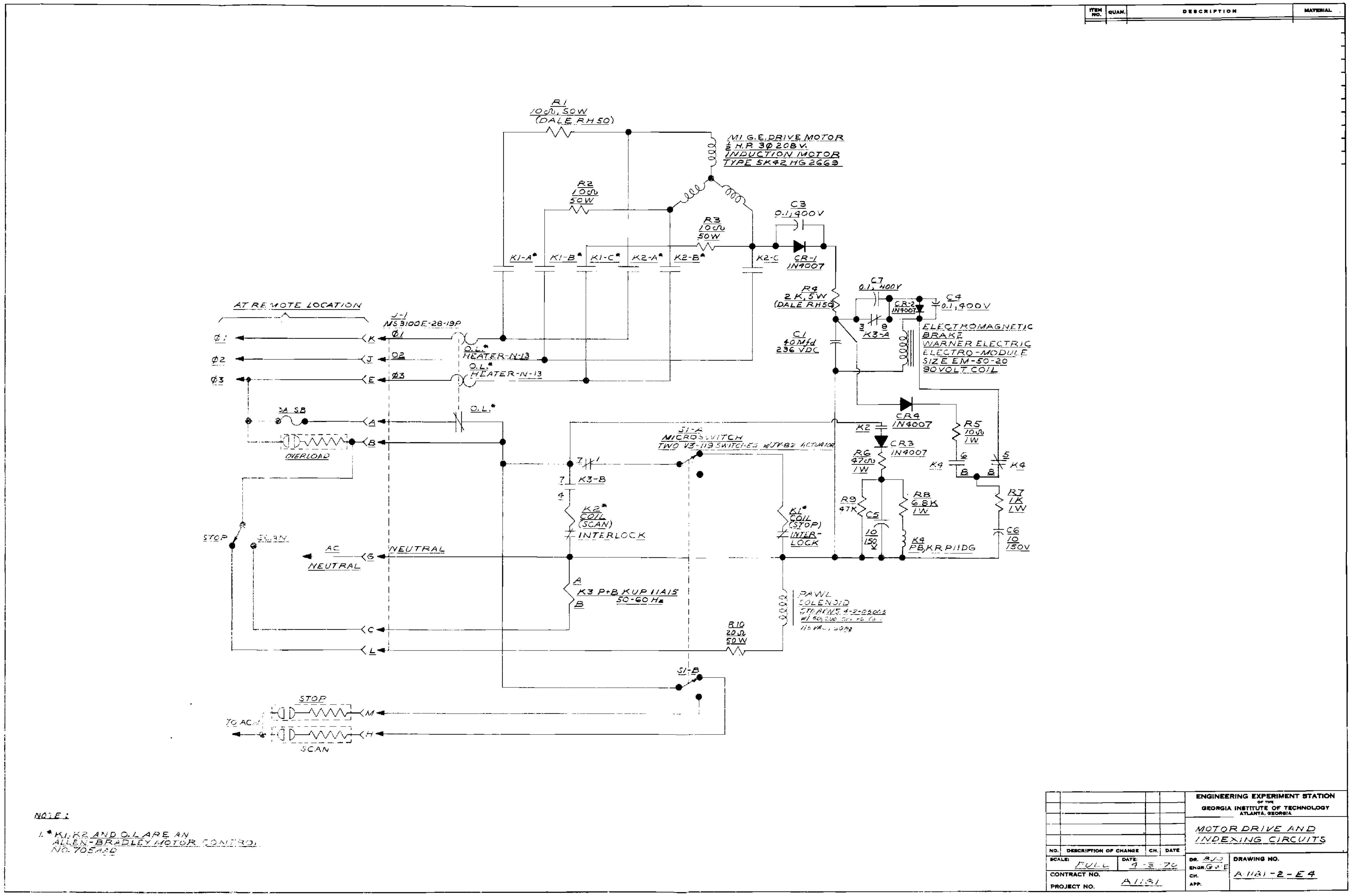

Figure 4. Motor drive and indexing circuit.

the feedhorn to the proper speed. The feedhorn will continue to scan until the control switch is moved to the "stop" position or until power is removed from the unit.

2. Operating Instructions

In order to operate this unit, external controls performing the same functions as those shown in Figure 4 must be provided. On initial turn-on, the phase sequence of the supplied power must be such as to produce motor rotation in the proper direction.

WARNING

DO NOT PLACE THE COMMAND SWITCH IN "STOP" UNTIL PROPER MOTOR ROTATION IS VERIFIED.

Proper motor rotation can be verified by first placing the control switch in the "scan" position and then connecting power. The motor should turn counter clockwise viewed from the pulley end; if the rotation needs to be reversed, two of the input phases should be interchanged.

Once proper rotation is verified, in order to stop and index the scanning mechanism, place the command switch in the "stop" position. Similarly, to start and run the feedhorn, place the switch in the "scan" position.

If the overload light lights, it indicates that the fuse is blown or the thermal overload has tripped. The thermal overload must be manually reset by pushing the button located on the cover plate of the control housing; see Figure 13, page 27.

3. Adjustments

The only adjustment which can be made is the adjustment of the trip position of the pawl-actuated microswitch S1. With the system de-energized, adjust the cam which actuates S1 so that S1 actuates when the pawl is 1/8-inch from its seated position.

B. Signal Circuits

1. Encoder Circuits

a. Principles of Operation. The encoder electronics consist of the power supplies and pulse circuitry needed to power the encoder and properly tailor its output signal. The package contains a -5.5 volt power supply to operate the lamp in the encoder, a +5.0 volt supply which powers the internal encoder electronics, a +12.0 volt supply which powers the pulse stretcher and amplifier, and the pulse stretcher and amplifier circuit. The schematic for these circuits is given in Figure 5.

The three power supplies are derived from two full-wave rectifier bridges filtered by 1,000 μfd electrolytic capacitors. These rectifiers yield 28.0 volt and 14.0 volt unregulated dc outputs. Each of the three power supplies is regulated by a Fairchild μA 723-C precision voltage regulator. The resulting outputs are regulated to better than 0.15 % from changes in line voltage and load. Since the regulators are essentially the same in each supply, only one will be described.

Figure 6 shows the equivalent circuit of the μA 723-C as it is implemented in the +5.0 volt supply. The reference voltage (V_{ref}) for the supply is obtained from a temperature-compensated 7.1 volt Zener diode buffered by a high-impedance amplifier. This V_{ref} is divided by a resistor divider network, R_a and R_b, to yield V' and compared with the output voltage (V_o) by a high-gain operational amplifier which biases the output transistor, T_1, so as to maintain the error voltage between V_o and V' at a minimum, regardless of changes in the supply voltage (V+) and the current supplied externally (I_o). Current limiting is achieved by connecting series resistor R_{cs} across the base-emitter junction of Transistor T_3. When the current I_o becomes large enough to drop 0.6 volts across R_{cs}, Transistor T_3 begins to conduct, reducing the drive voltage applied to Transistor T_1, thus reducing the output voltage. Transistor T_2 was added externally to increase the current capability of the regulator.

The power supply furnishing regulated -5.5 volts is very similar to the one furnishing 5.0 volts, except that to obtain a regulated negative output, it was necessary to tie the positive output of the μA 723-C to ground and use the negative regulated output as the -5.5 output. In this configuration, the 14 volt unregulated power supply that furnishes input for the μA 723-C is not tied directly to ground, but rather allowed to

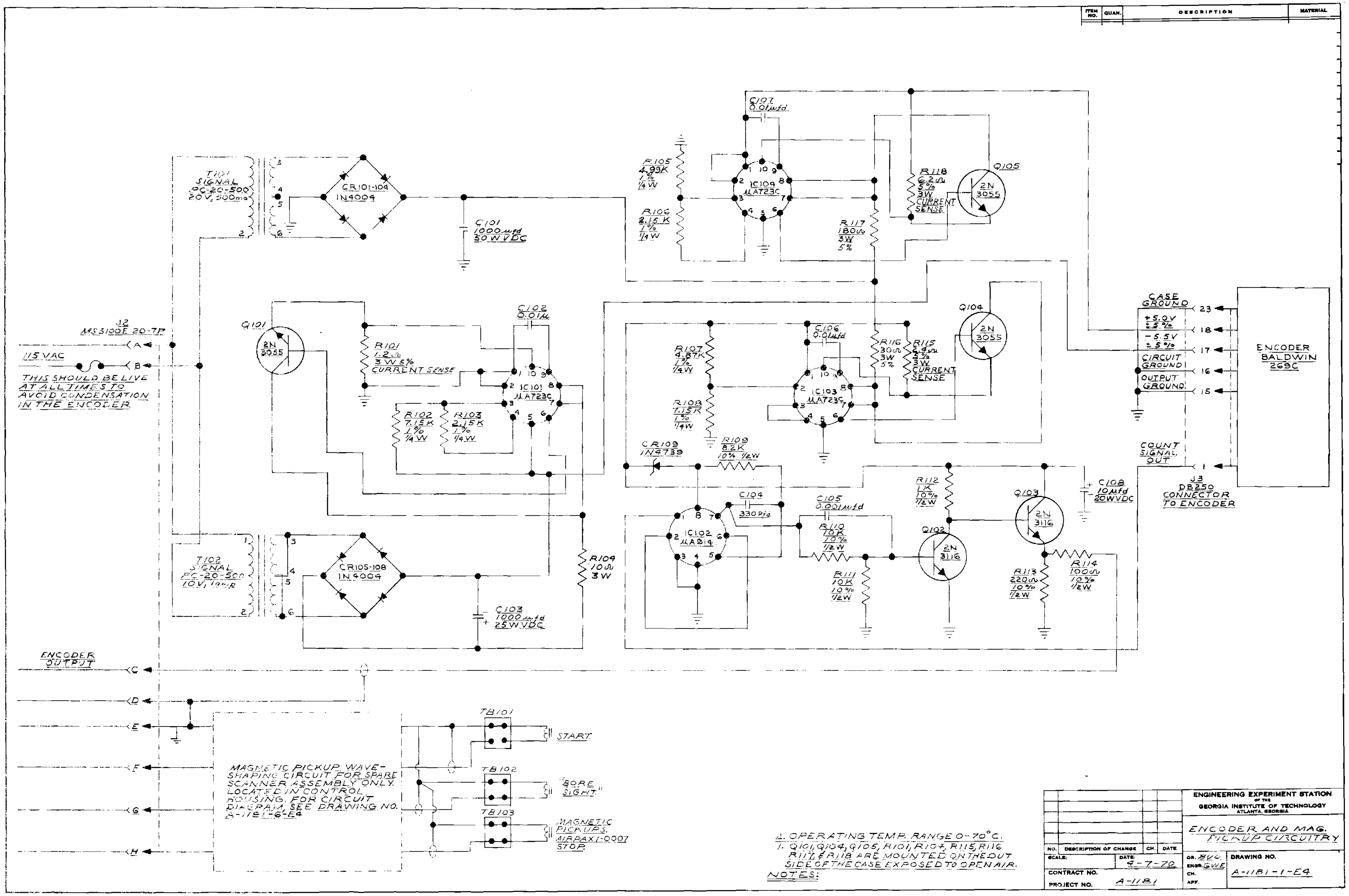

Figure 5. Encoder and magnetic-pickup circuitry.

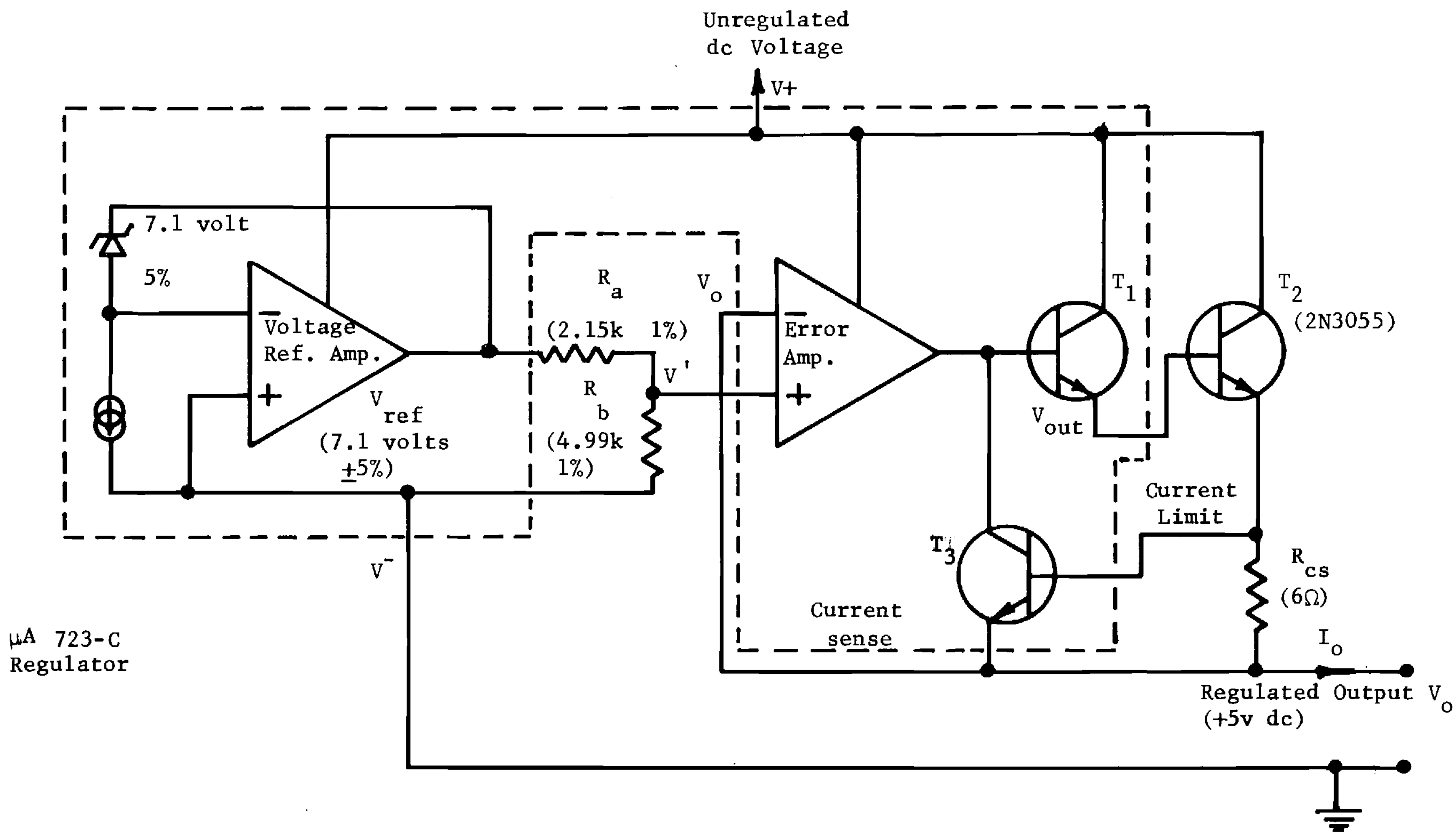

Figure 6. Block Diagram of the +5.0 Volt Regulator.

"float," as shown in Figure 7. NOTE THAT THE COMMON FOR THE NEGATIVE UNREGULATED SUPPLY SHOULD NOT BE SHORTED TO SYSTEM GROUND OR DAMAGE TO THE SUPPLY MAY RESULT.

The pulse-shaping circuitry included in the power-supply package consists of a 2-microsecond monostable multivibrator constructed from two RTL Nor Gates (triggered by pulses from the encoder), a pulse amplifier, and a buffer which yields a 10-volt, 250-KHz square-wave output when the scanner is running at 25 rev/sec. Figure 8 is a block diagram of the pulse-shaping circuitry.

The power supplies and associated circuitry are contained in a rectangular aluminum case with all power transistors and resistors exposed to the open air for heat-dissipation purposes. Care should be taken not to short the power transistor cases to the container, as damage to the power supplies can result.

b. Operating Instructions. It is only necessary to supply the 115 VAC to the input connector pins (shown in Figure 5) in order to operate these circuits.

2. Magnetic-Pickup Circuits

The magnetic-pickup pulse-shaping circuits produce a sharp rectangular output pulse for each incoming magnetic-pickup pulse. There are three separate, identical channels, one for each of the three magnetic pickups. The circuitry is shown on Figures 9 and 10.

Figure 11 shows a typical magnetic-pickup pulse and the resulting output pulse. The magnetic-pickup pulses on each channel are 0.040 seconds apart.

The operation of the "start" channel (see Figure 10) will be described below; the other channels work similarly. IC301 is used as a comparator. The non-inverting input is held at a negative threshold voltage V_T (see Figure 11). The incoming magnetic-pickup signal is applied to the inverting input. When the input becomes more negative than the

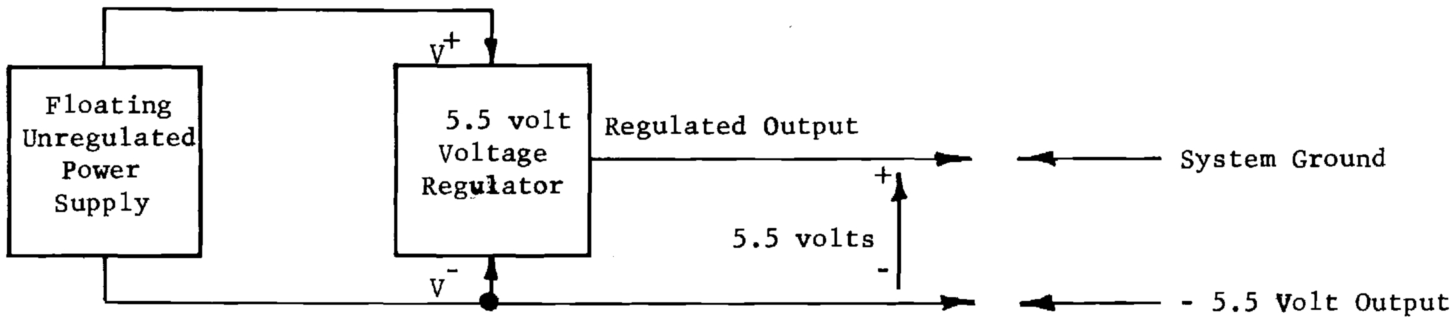

Figure 7. Block diagram of -5.5 volt power supply illustrating connection of the positive regulator to generate the negative regulated voltage.

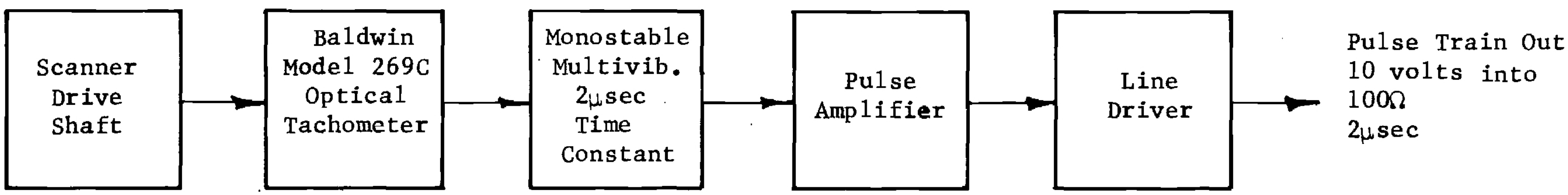

Figure 8. Block diagram of encoder pulse-shaping circuitry.

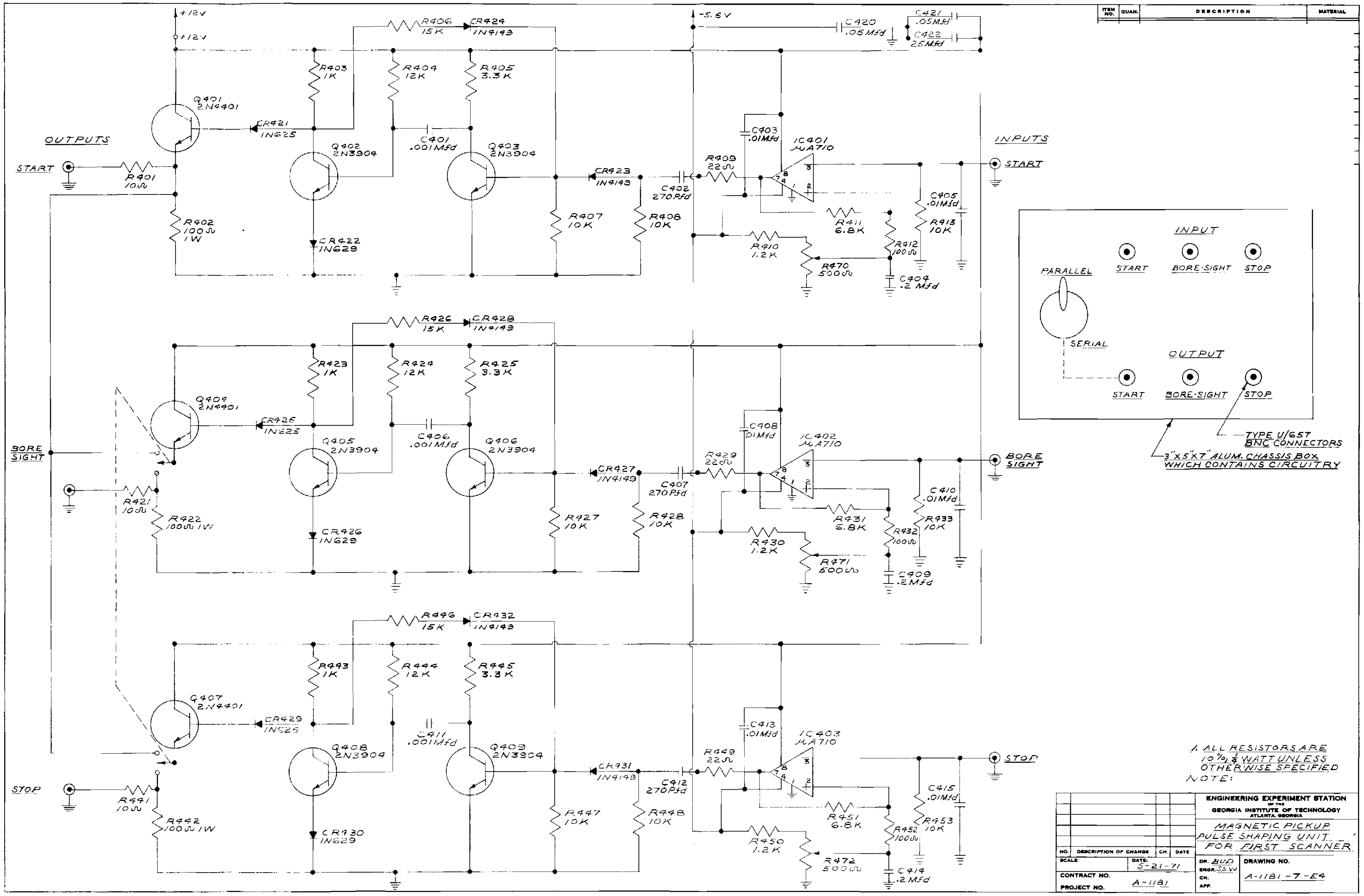

Figure 9. Magnetic-pickup pulse-shaping unit for first scanner.

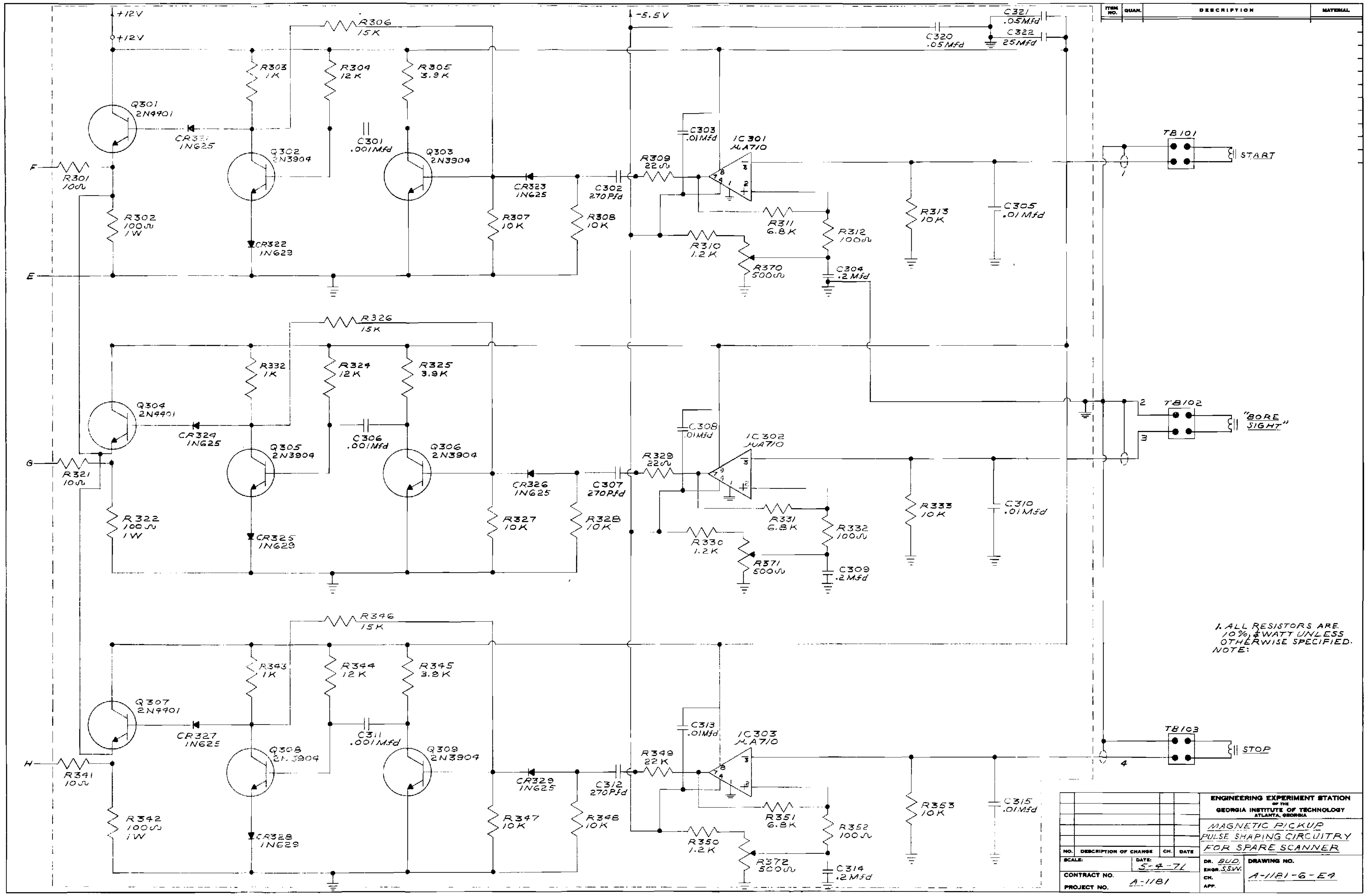

Figure 10. Magnetic-pickup pulse-shaping circuitry for spare scanner.

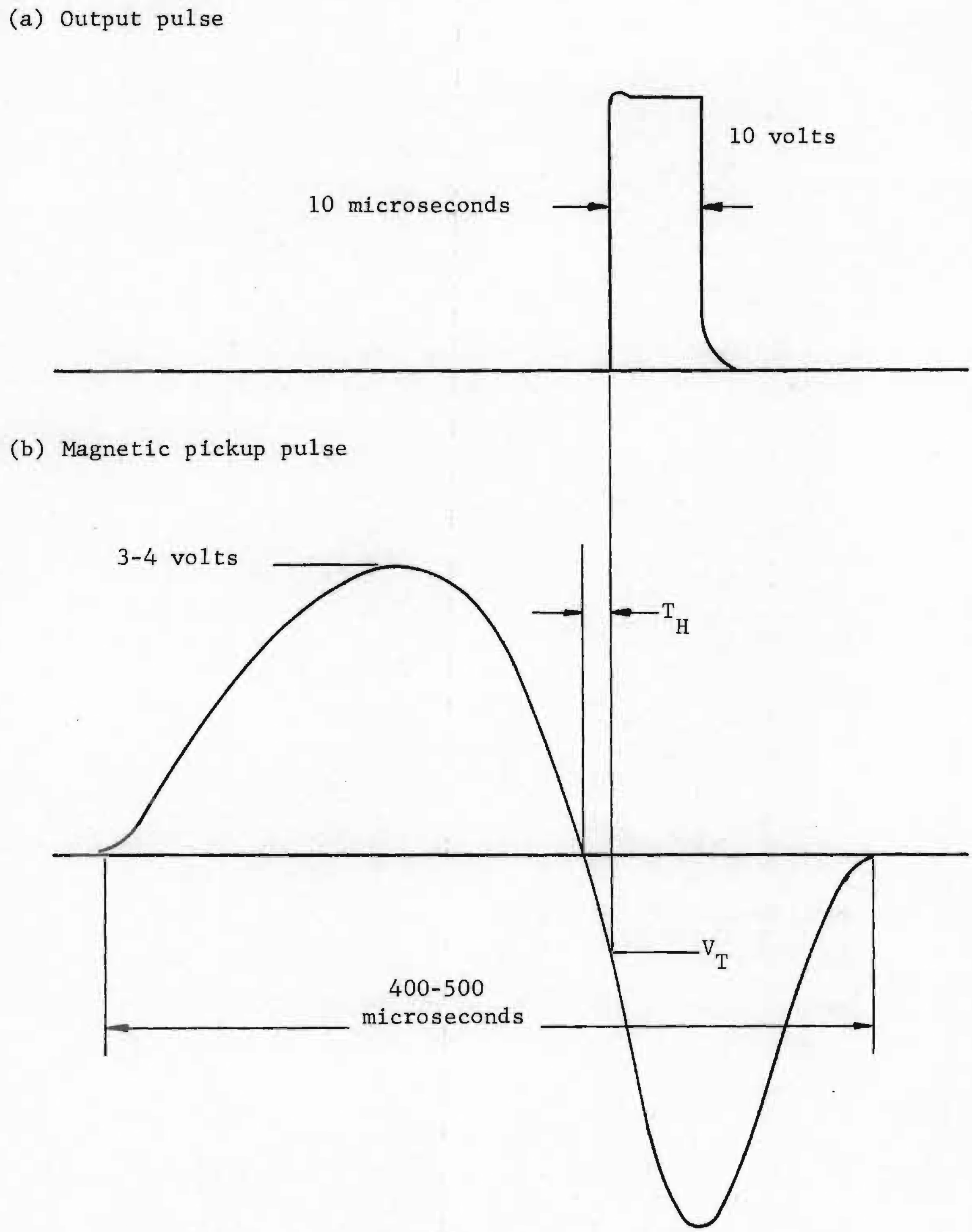

Figure 11. Typical shape for a magnetic-pickup pulse and resulting output pulse from pulse-shaping circuits.

threshold, the output of the operational amplifier rises to +5 volts. This voltage remains at +5 volts for approximately 200 microseconds, or until the pickup signal crosses V_T in a positive-going direction, and then drops back to its original value. Capacitor C302 and Resistor R308 differentiate this 200-microsecond pulse, resulting in a positive spike followed by a negative spike. Diode D323 clips the negative one, but the positive spike triggers the monostable circuit (consisting basically of Transistors Q302 and Q303 and Timing Capacitor C301) by turning Q303 "on." When the collector of Q303 drops to 0.2 volt, C301 causes Q302 to be turned "off." Q302 stays "off" until C301 charges up through R304. Thus, the monostable produces a 10-microsecond pulse at the collector of Q302, which drives the output transistor, Q301. The output stage is designed to produce a 10-microsecond, 10-volt pulse across a 50-ohm load at the output. The rise time of this pulse is approximately 0.2 microseconds.

The threshold V_T at which the comparator triggers is adjustable. It determines the hold-off time T_H, between the zero-crossing of the incoming signal and the rising edge of the output pulse, as shown in Figure 11(b). The threshold is adjusted by means of a trimpot on the circuit board (one trimpot for each channel). To make the adjustment, both the incoming pickup pulse and the output pulse should be displayed on a dual-trace oscilloscope on an expanded horizontal scale. The trimpot is turned with a screwdriver until the output pulse occurs at the desired point on the pickup pulse. For good stability, it is advisable to keep the threshold below -0.05 volts.

As stated earlier, the magnetic-pickup signals are processed differently in the two scanners. In the spare scanner, the circuitry is mounted inside the control housing, and uses the same power supplies (-5.5 volts and +12 volts) as the encoder circuitry. The signals available at the boom terminal are the rectangular output pulses of the shaping circuits, appearing serially on a single line. This is accomplished by ORing the output transistors through a common emitter resistor.

The circuitry for the first scanner unit is contained in a separate box with dimensions 3 x 5 x 7 inches. The three unshaped magnetic pickup pulses are available separately at the boom terminal. These are fed into three input BNC connectors on the box (see Figure 9); the rectangular output pulses are then available at the output BNC connectors. For operation of this box, external power supplies must be supplied via the three wires emerging from the end of the box. The color code is as follows:

Red	+ 12.0 volts (60 ma)
Violet	- 5.5 volts (20 ma)
Black	ground

The box also allows the option of ORing the outputs together so that all three pulses (corresponding to "start," "boresight," and "stop") appear at a single output BNC in a serial fashion. A toggle switch on the top of the box accomplishes this function. With the switch in the "parallel" position, each pulse appears at its usual BNC connector. With the switch in the "serial" position, all pulses appear in turn at the "start" BNC connector, while the other two BNC's are open circuits.

III. PREVENTIVE MAINTENANCE

A. Index Cam

Every 100 hours of operation, remove the motor housing and apply a thin coating of high-pressure grease[1] with a cotton swab to the steep face of the cam where the pawl impinges in stopping the cam. Do not allow an excess of grease to build up which might sling off and get on other parts of the mechanism.

B. Drive Belt

Whenever the index cam is greased as just described, examine the drive belt for wear. If any teeth are missing or if the edges are rough or worn, the belt should be replaced, following the procedure given in Section IV, Paragraph A-2.

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[1] - Extreme Pressure Lube No. 3, Chicago Manufacturing & Distribution Division, Evans Products Company, 1928 West 46th Street, Chicago, Illinois 60609.

IV. TROUBLE SHOOTING AND REPAIR

A. Mechanical

The only moving elements are in the index/drive mechanism of the scanner. The mechanical elements are conservatively rated and should give satisfactory service over extended periods of time. Except as mentioned in Section III, no lubrication is required unless new shaft bearings are installed. The following check list may be helpful in the event of unusual noise, vibration, or failure to operate.

1. Motor Does Not Operate

Make electrical check first to determine if correct voltage is being applied. If there are no electrical problems, then check to see if there is mechanical interference of the following nature.

a. Pawl locked in cam slot (see Figure 3). This may be due to a broken pawl return spring, in which case replace the spring. The pawl may also become locked in the cam slot if either cam or pawl is damaged or becomes excessively worn or rough through extensive wear. If this occurs, disassembly of the index/drive mechanism and repair or replacement of damaged or worn parts will be required. See Section VI for disassembly and reassembly procedure.

b. Microswitch cam loose on shaft. Reposition cam so that switches actuate when pawl is approximately 1/8 inch from bottom of cam slot. Put locking sealant on cam, set screws, and retighten.

2. Broken Or Worn Belt

Follow Section VI, Paragraphs 6, 7, 8, 23, 24, and 25. Slip the old belt over the end of the shaft and bearing, and withdraw through the opening in the index/drive housing window. Install the new belt in the reverse manner, and reassemble the other components in the reverse order from the disassembly procedure. Make sure the belt is tracking on both pulleys and then adjust the position of the motor/brake assembly for a moderately tight belt before locking the motor hold-down nuts. The belt has driving cleats and is wire-reinforced so excessive tightness is not required.

B. Electrical

The electrical portions of the lower-dish scanner have been designed for maximum reliability, and any failures occuring during normal use are likely to be caused by physical damage to the unit or connecting cables. The first step in troubleshooting should be a careful visual inspection to ensure there are no blown fuses, that the overload has not tripped, and that there is no physical damage to the components or interconnecting cables.

If these steps do not remedy the trouble, replacement of the scanner/boom assembly with the spare unit is suggested, and Georgia Tech should be contacted for specific troubleshooting and repair instructions.

Microswitches are made accessible by removal of the cover plate at the base of the motor housing. The bracket which holds the microswitches may be removed by taking out two screws. Replacement switches should be mounted on the bracket, reconnected and the bracket reinstalled. The microswitch cam adjustment should be checked and reset if necessary (see Section IV, Paragraph A-1-b).

V. REMOVAL AND INSTALLATION

A. Reflector

To remove the reflector, take out the capscrews, which are accessible from the rear of the intermediate support structure. It may be necessary to pry the reflector free of two tapered locating pins installed between the capscrews.

To reinstall the reflector, support it in place and fasten with the capscrews, drawing these up uniformly to prevent cocking. If the tapered pins are loose, drive them snugly into place prior to final tightening of the capscrews.

B. Boom and Scanner

The boom and scanner are mated together and should be removed as a unit and replaced as a unit, or replaced by the spare boom/scanner assembly as a unit. To change a boom/scanner assembly, the procedure is as follows:

1. De-energize electrical power to the lower dish.

2. Disconnect waveguide and electrical cables at the pedestal end of the boom. Place tape (or covers) over open waveguide ends.

3. Support the boom/scanner assembly by a sling and suitable lifting hoist.

4. Remove eight nuts from the bolts which hold the boom to the intermediate support structure.

5. Remove two ½-13 UNC bolts from inside the intermediate support structure and replace with longer ½-13 UNC jacking screws 3 inches long. Tighten the jacking screws against the guide pins in the boom, and lower the boom/scanner assembly until free of the system.

To reinstall, or to install a spare boom/scanner, the reverse procedure is followed, making sure that the jacking screws are first removed from the guide-pin bushings. The eight bolts which secure the boom should be drawn up uniformly, so as to avoid cocking the guide pins in the bushings. Tighten to 100 ft-lbs of torque.

VI. DISASSEMBLY AND ASSEMBLY

A. Scanner/Boom Disassembly

The scanner housing and boom are mated together and should not be interchanged with any other boom or scanner housing. The scanner housing should be separated from its matching boom before removing the organ-pipe scanner or the index/drive mechanism from the scanner housing. Separation of boom and scanner housing should proceed in the following manner.

1. Remove the three countersunk screws in the edge of the housing base.
2. Position the boom/scanner assembly on its side with the motor up.
3. Remove the cover plate located on the boom opposite the scanner.
4. Disconnect the Twistaguide section of waveguide from the bottom of the scanner or from the waveguide which runs inside the boom. Provision for quick disconnection is made at one end.
5. Remove the cable connection cover from the boom (Figure 1), where the control housing terminates adjacent to the boom. Disconnect the two control wire cables.
6. Remove the eight nuts from the studs which hold the scanner housing to the boom and separate the two parts of the scanner/boom assembly.

B. Scanner Disassembly

In addition to the figures referred to in the text following, it may be helpful to examine the exploded views of the index/drive components included in the Appendix (Figures A-1, A-2, A-3).

1. Position the scanner on its side with the motor side up.
2. Disconnect the 45^{o} H-plane bend from the bulkhead fitting mounted in the base of the scanner.
3. Remove the screws which attach the waveguide bulkhead fitting to the base of the scanner, and remove the bulkhead fitting. Note that studs go through the fitting and are fastened in a waveguide flange attached to a section of flexguide inside the scanner housing. See Figure 12. After removal of the bulkhead fitting, tuck the flexguide carefully back inside the scanner body so that when the scanner body is removed the flexguide will not catch on any projection. Do not bend the flexguide sharply.

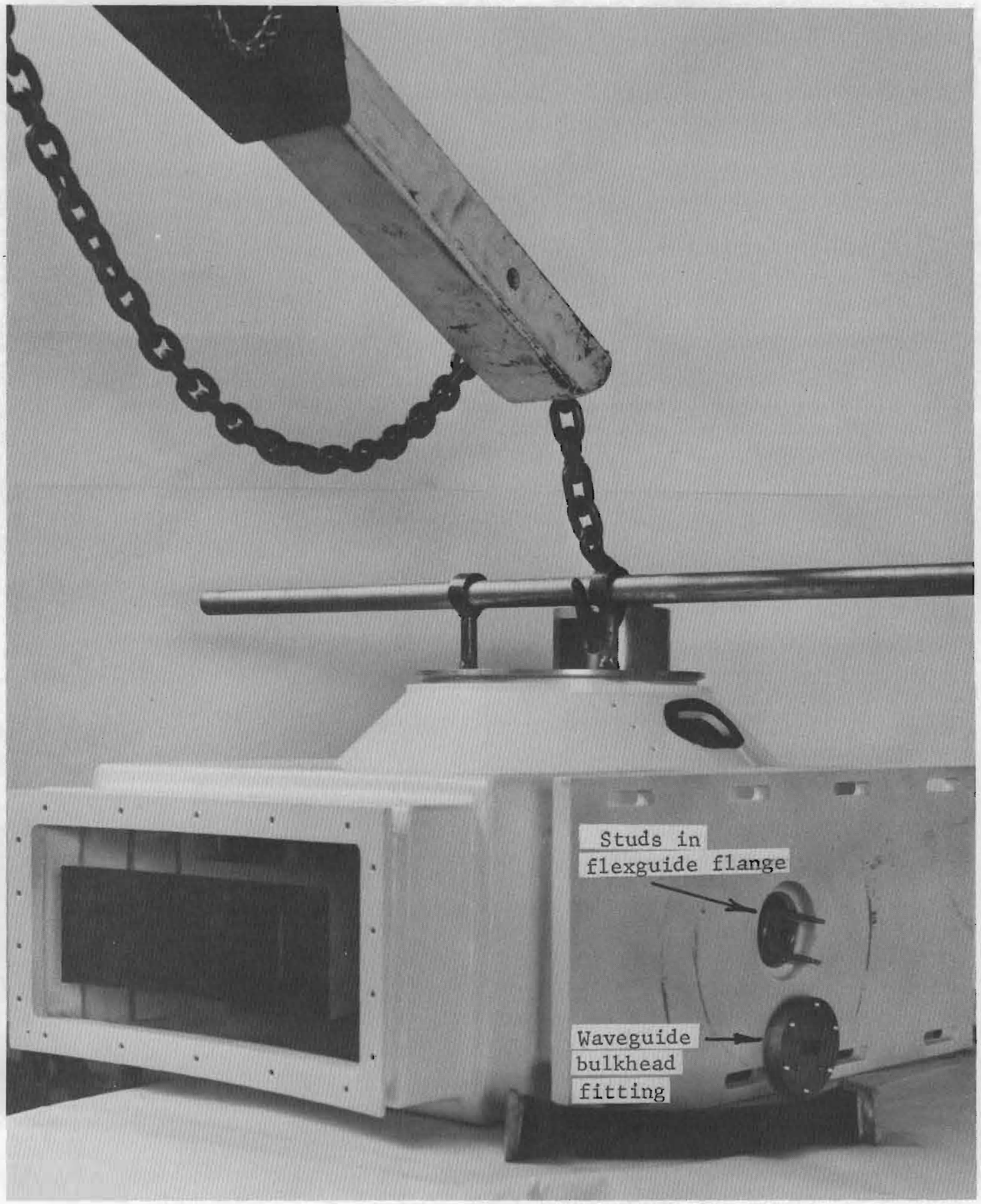

Figure 12. Base of scanner showing waveguide connections.

4. Loosen the clamp ring and remove the motor housing. The clamp is captive with the housing cover plate.

5. Disconnect the electrical leads from the motor and brake at the terminal strip on the motor frame.

6. Remove two nuts which hold the motor mounting plate to the housing cover and remove the motor and brake assembly, disengaging the belt from the driving pulley as the motor is removed.

7. Remove the radome retainer and the radome.

8. Remove all the screws which hold the housing cover plate to the scanner housing.

9. Insert ¼-20 UNC jacking screws into threaded holes between cover plate screws and tighten uniformly to break the cover loose.

10. Attach extension eyebolts (provided) to the two studs which hold the motor/brake assembly to the housing cover plate. Insert a crossbar through the eyebolts for lifting purposes. See Figure 13.

11. Using a shop hoist or other lifting device, lift the scanner and index/drive mechanism out of the housing. The scanner and index/drive mechanism must be very carefully eased out of the housing at an angle to avoid damage to the scanner flared horns. Shifting of the internal assembly back and forth in line with the direction in which the flared horns face will facilitate removal of the scanner from the housing without damage to any components.

12. Rest the scanner and index/drive mechanism on a table or workbench for further disassembly. From here on, tape or cover all entrances into microwave channels and guides as they are uncovered. Be very careful at all times to avoid damaging the waveguides and flared horns, which are easily bent.

13. Remove the section of flexguide from the rotary-joint input flange, Figure 14.

14. Remove the rotaty-joint flexible support by removing two screws which anchor the support to the flanged ring at the output end of the rotary joint. The support must be rotated 90° in either direction in order to remove it from the input flange of the rotary joint.

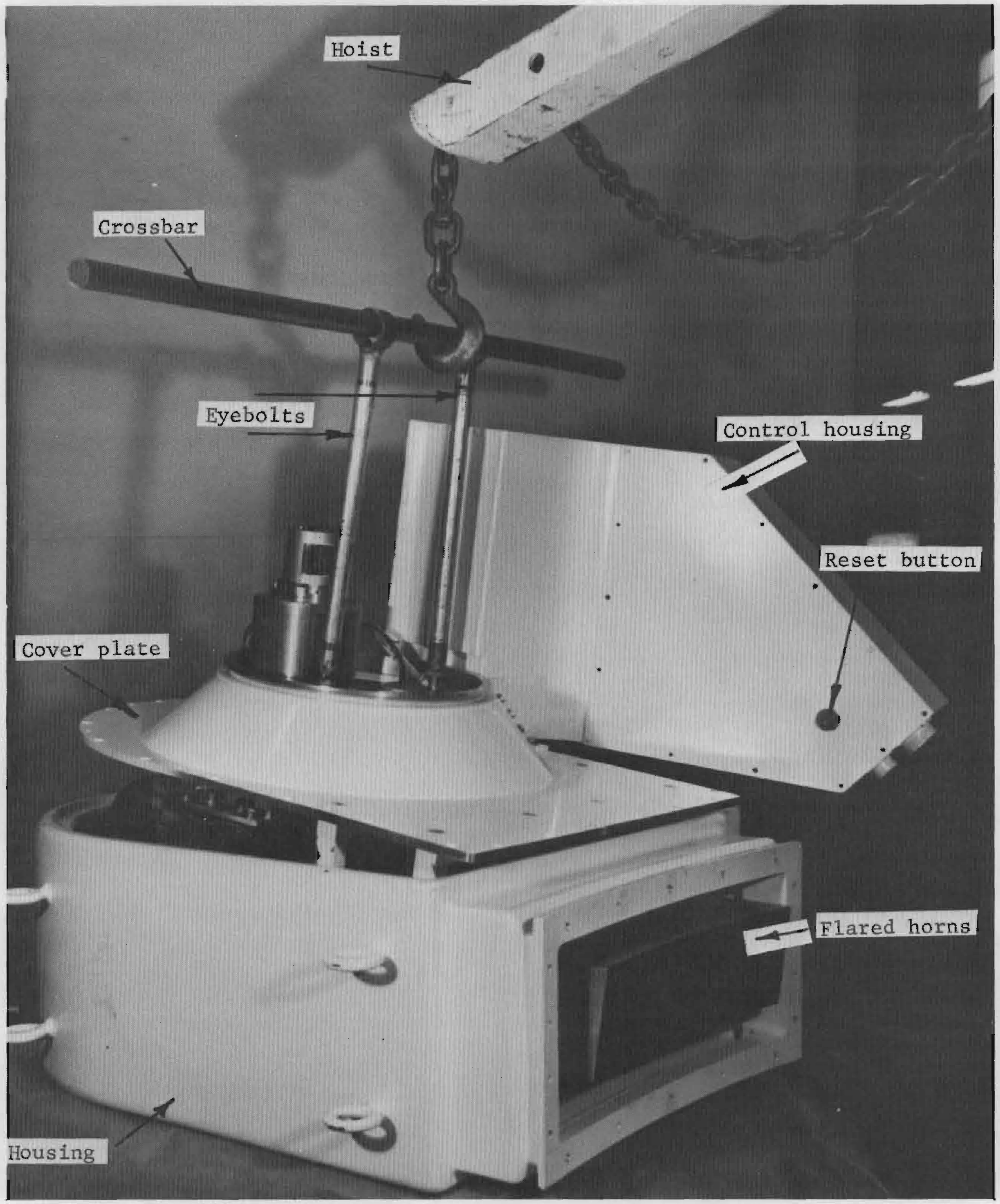

Figure 13. Arrangement for lifting organ-pipe scanner from scanner housing.

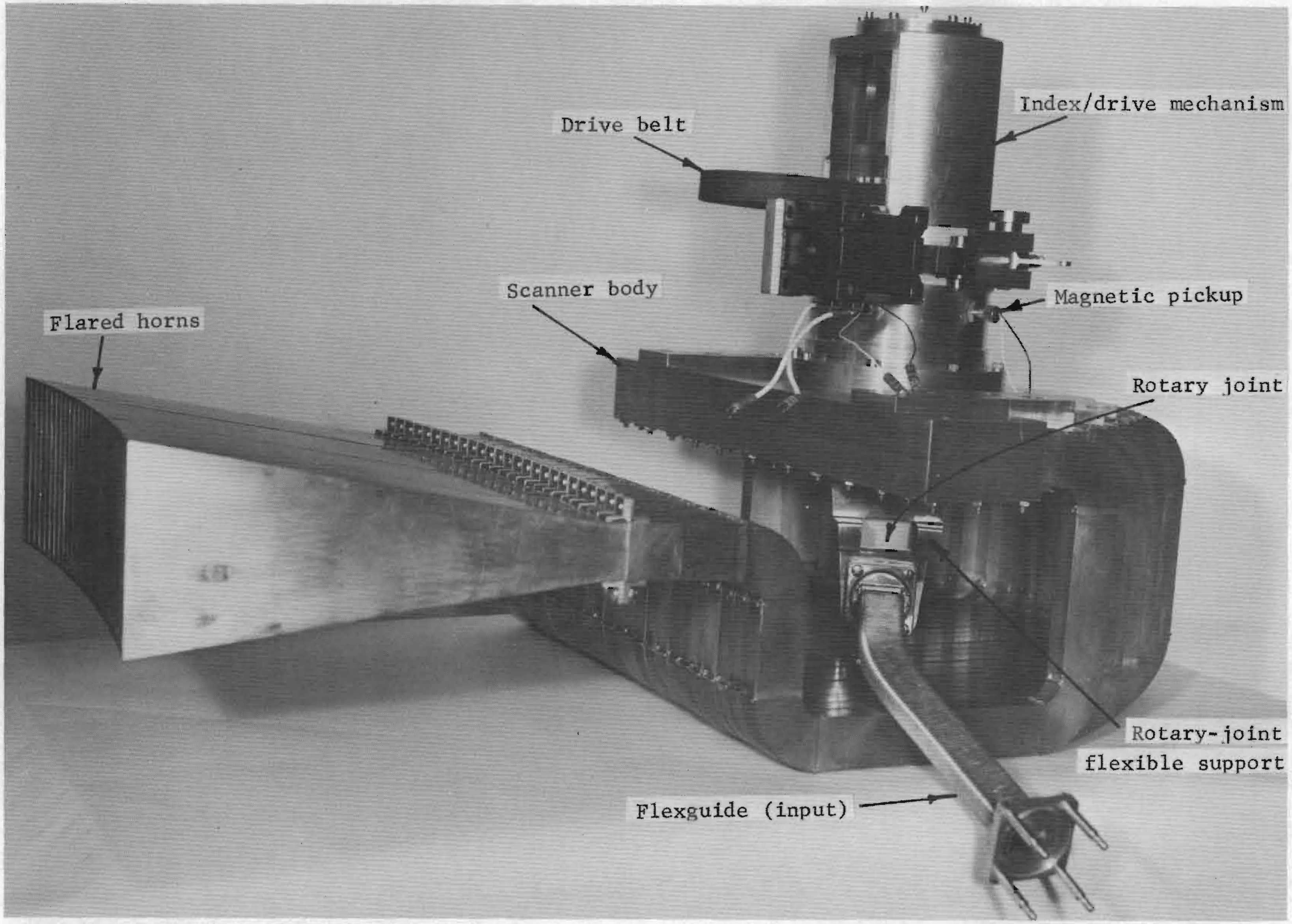

Figure 14. Organ-pipe scanner and index/drive mechanism.

15. Disconnect all electrical leads between the index/drive mechanism and the control housing.

16. Remove the bolts which attach the housing cover plate to the support brackets on the scanner body. Separate the housing cover plate from the scanner body. Note that dowel pins are installed in the scanner body for locating purposes at this junction.

17. Remove screws which hold the index/drive housing to the scanner body, and lift the index/drive mechanism out of the scanner body. Be careful not to injure the rotary joint or the channel separators in the scanner body.

18. Remove the nuts which hold the rotary joint to the feedhorn housing. Remove the rotary joint.

19. Take out the screws which hold the feedhorn retainer ring to the feedhorn housing. Remove the ring and the feedhorn. Treat the feedhorn with care; it is soft copper.

20. Remove the central screw which holds the index and drive components to the drive shaft.

21. Loosen the flexible coupling between the drive shaft and the encoder. Make sure the coupling is loose on the shaft.

22. Loosen the encoder clamp screws and carefully remove the encoder. If the coupling is tight on the shaft pry it off but do not pull. Pulling on the encoder may stretch the coupling.

23. Take out the flange screws which hold the outer-bearing housing in the index/drive housing. Insert jacking screws in the tapped holes in the flange and jack the outer-bearing housing out and from around the bearing on the drive shaft.

24. Withdraw the drive shaft and components from the index/drive housing, being careful not to damage the magnetic pickup. A modest force may be needed to push the shaft assembly out of the index/drive housing.

25. Remove all drive components from the drive shaft, taking note of the relative position of the components for ease in reassembly. A key is provided in the shaft which will align all components correctly on reassembly, provided that parts are not reversed end for end.

26. Remove the small bearing at the end of the shaft only if it is to be replaced. Use a bearing puller or arbor press if needed. When replacing the bearing, press on the inner race only or use the nuts to pull the bearing on the shaft. This bearing is sealed and has been prelubricated by the manufacturer; no further lubrication is required.

27. The rotary horn housing and bearing housing should be separated only if the bearings are to be replaced. To disassemble, support the bearing housing on the outer rim and press against the hub of the rotary horn housing using an arbor press. To remove the bearings from the bearing housing, remove the bearing retainer ring, reverse the housing in the arbor press and push against the bearing inner race.

When installing new bearings at the feedhorn end of the shaft, lubricate with G.E. silicone grease (Versilube G-322-L). Install the bearings back to back in matched pairs only, following the instructions packaged with the bearings. When the bearings are properly positioned on the shaft, there will be an axial preload gap between the inner races which will be closed when the shaft end-screw is tightened. Install the bearings first in the bearing housing, pressing only on the outer race. Install then on the hub of the rotary-horn housing, pressing only on the inner race.

28. To replace the index cam, it is necessary to separate the cam from the cam end plates. This may be done by pressing out the three spring pins which hold this assembly together. After installing a new cam, press the spring pins back in place. New spring pins will be needed only if the old ones seem to be worn or damaged. Install the spring pins so that the smooth side is exposed to the thrust of the polyurethane cushions in the cam when the shaft is arrested by the cam and pawl action. See Figure 3.

29. The index pawl will need replacing if damaged or scuffed or worn excessively. To remove the pawl, first remove the microswitch cam by loosening the two setscrews several turns and withdrawing from the shaft. Next loosen the two setscrews in the pawl several turns and press the shaft out of the pawl. If the nylon bushings for the pawl shaft are worn, press out the old ones and press in new ones. No lubricant is needed. Make sure the pawl shaft is free of burrs before reinstalling.

30. An elastic link is provided between the pawl and the solenoid.* This is a cartridge in which the resilient member is a polyurethane cylinder under compression when the solenoid is energized. When the pawl is seated in the slot of the index cam, the solenoid can close to within a range of 0.055 to 0.080 inches before beginning to compress the polyurethane cylinder in the cartridge. If this range should decrease to a minimum of 0.040 inch due to a loss in resilience of the polyurethane, the entire cartridge should be replaced.

31. Disassembly of the organ-pipe scanner body and the waveguides and flared horns is not recommended. The permanent joints in the waveguide components have been silver soldered, tested, and sealed to prevent rf leakage. The flanged joints, which are mechanically fastened, have been sealed against rf leakage with conducting paint (DuPont No. 4922), and the assembly has been given a high-power test for rf leakage. Separation of any of the joints will require resealing and testing for high-power performance. Arrangements should be made with Georgia Tech for maintenance on this portion of the scanner unit.

C. Reassembly of Scanner and Scanner/Boom Assembly

In general, reassembly of all components should follow in reverse the procedure of disassembly. The following suggestions and reminders should be noted.

1. Use new "O" rings in waveguide and mechanical joints if existing "O" rings are damaged or no longer resilient.

2. Replace any gaskets which are damaged or no longer resilient. Coat the gasket-metal interface with silicone grease (G.E. G-300 or equivalent) to prevent sticking and to repel moisture.

3. Use a locking sealant to lock all screw fasteners when reassembling the index/drive mechanism.

4. Check the clearance of the magnetic pickup slug clearance and reset if necessary. The setting should be 0.002 - 0.005 inch.

5. When reinstalling the scanner and index/drive mechanism in the housing, great care should be used to prevent damage to the soft

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*Photographs for Figures A-2 and A-3 were taken prior to a design modification which replaced the spring (Item 40) seen there with the cartridge now used.

copper flared horns. As shown in Figure 15, the horns should be guided into place as the assembly is lowered into the housing. Figure 13 shows a further stage in the assembly operation. Although not illustrated, guidance should be provided until the housing cover is seated in the recess in the housing.

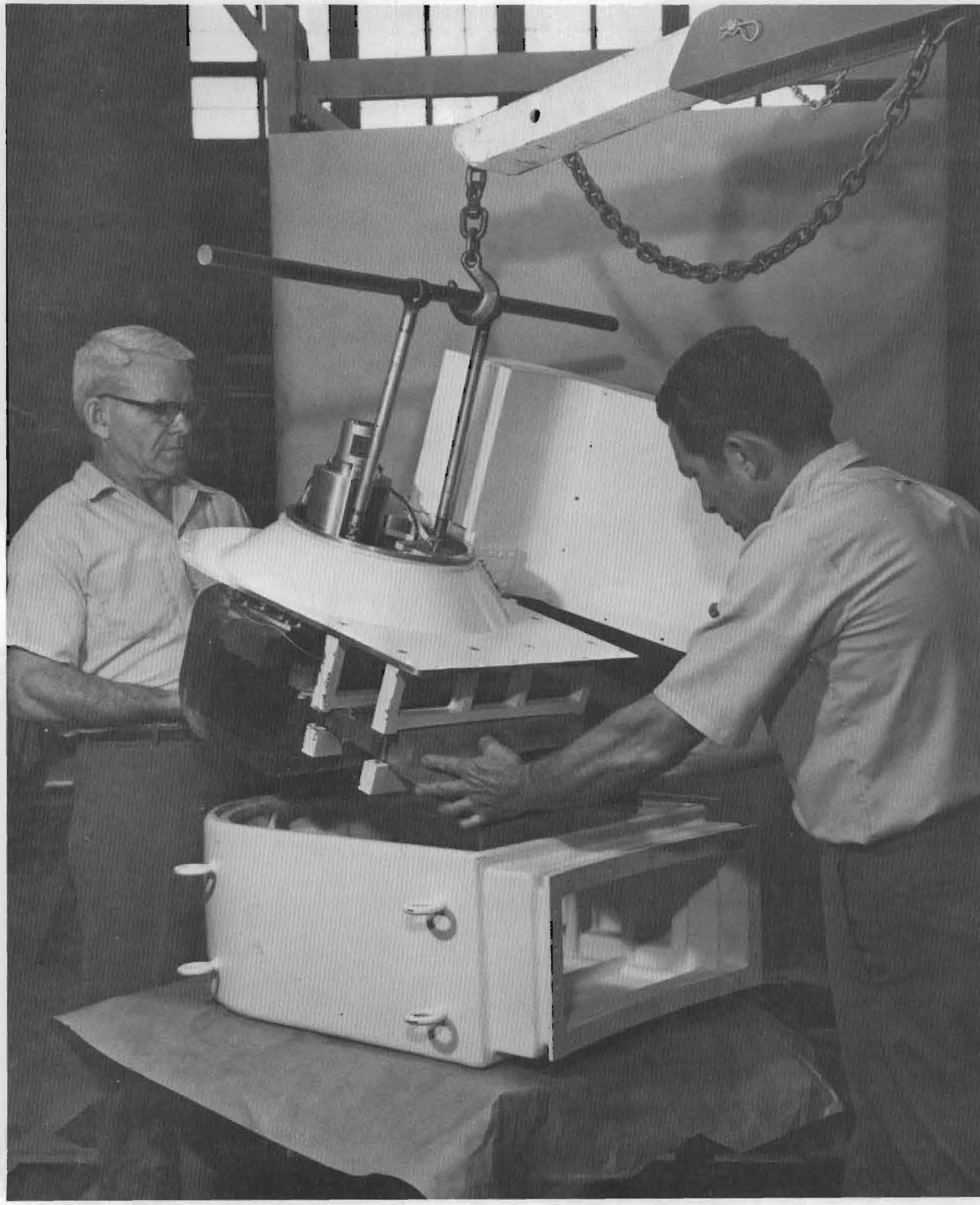

Figure 15. Guiding the organ-pipe scanner into or out of the scanner housing.

APPENDIX

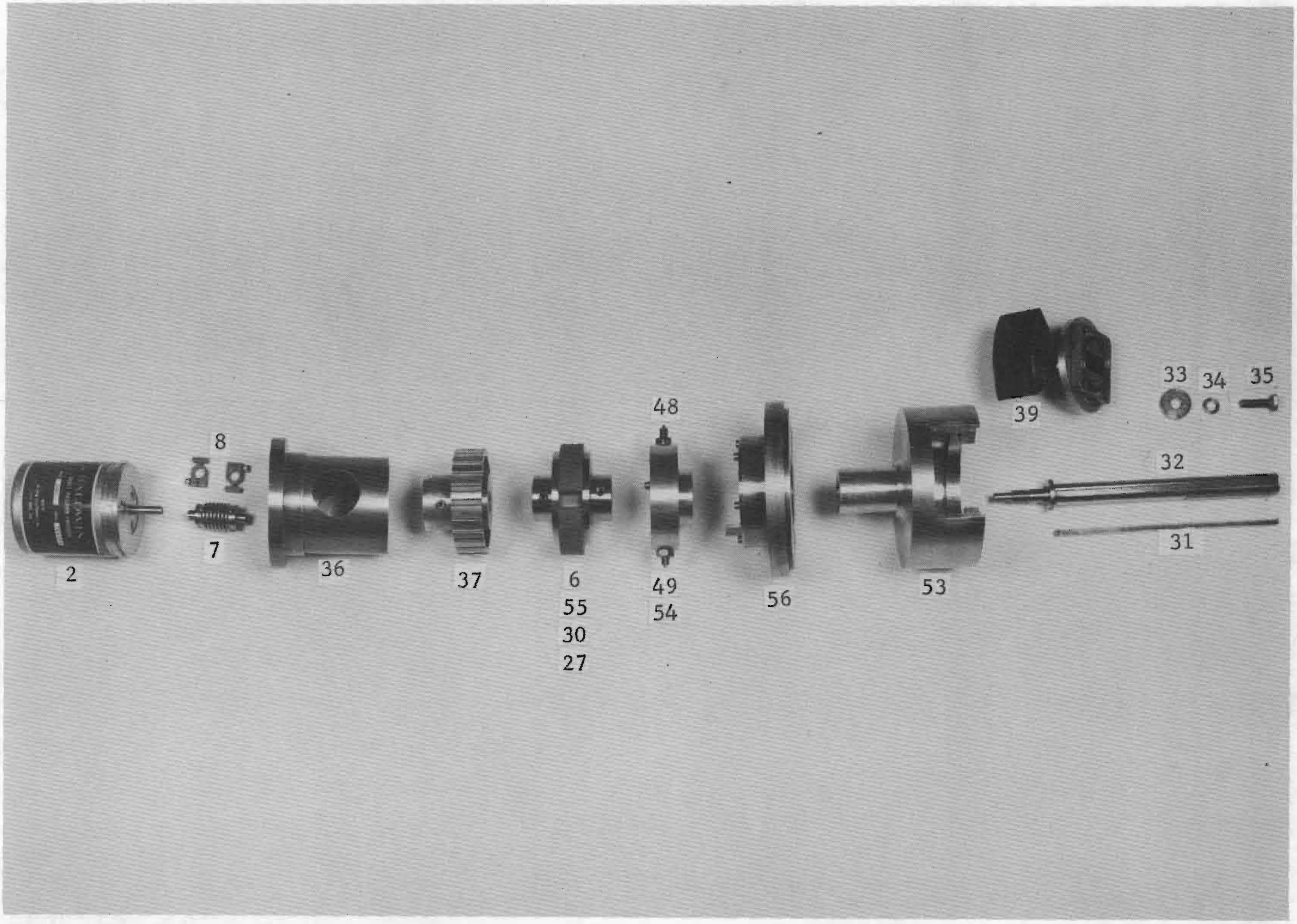

Figure A-1. Index/drive shaft components.

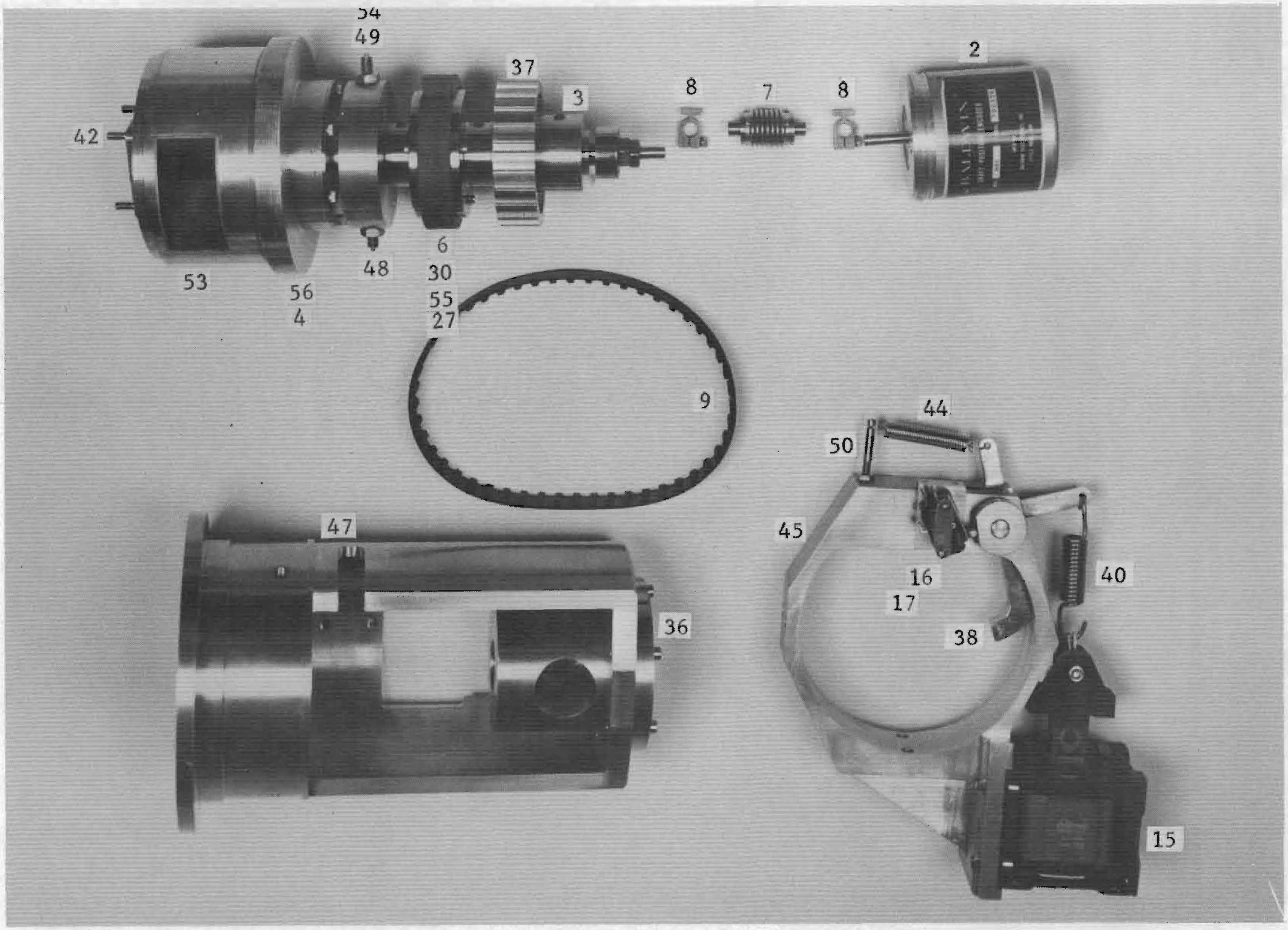

Figure A-2. Index/drive mechanism partially assembled.

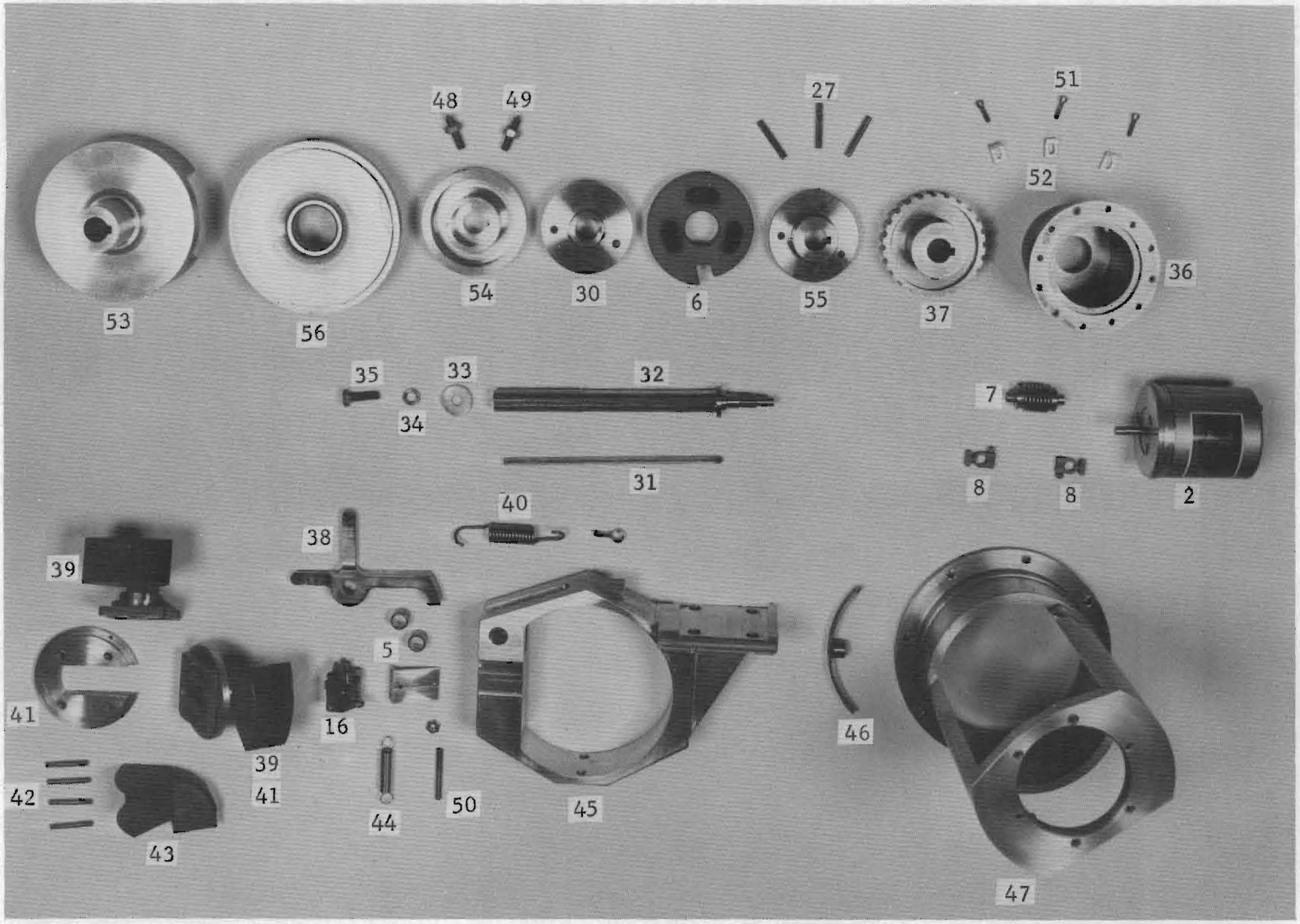

Figure A-3. Index/drive components.

LIST OF PARTS SHOWN ON FIGURES A-1, A-2, & A-3

Item No.	Description	Georgia Tech Drawing Number
2	Encoder	A-1181-124-M5, Item 7
3	Ball bearing	124-M5, Item 9
4	Ball bearing, matched pair	124-M5, Item 11
5	Nylon bushing	140-M4, Item 2
6	Index cam	126-M5, Item 8
7	Flexible coupling	124-M5, Item 12
8	Clamp, coupling	124-M5, Item 13
9	Drive belt	124-M5, Item 14
15	Solenoid	126-M5, Item 3
16	Microswitch	124-M5, Item 4
27	Spring pin	124-M5, Item 7
30	End plate, cam	126-M5, Item 5
31	Key	124-M5, Item 41
32	Shaft	124-M5, Item 27
33	Washer, shaft	124-M5, Item 42
34	Lockwasher, shaft	124-M5, Item 60
35	Screw, shaft	124-M5, Item 47
36	Holder, encoder	124-M5, Item 44
37	Pulley	124-M5, Item 28
38	Pawl	124-M5, Item 9
39	Feedhorn subassembly	144-M4 ---
40	Elastic link assembly	124-M5, Item 29
41	Spacer, feedhorn	144-M4, Item 4
42	Studs, feedhorn	152-M4, Item 3
43	Feedhorn	144-M4, Item 2
44	Spring, pawl return	126-M5, Item 13
45	Support, brake assembly	126-M5, Item 2
46	Bracket, magnetic pickup	127-M5, Item 8
47	Index/drive housing	124-M5, Item 43
48	Slug, brass	127-M5, Item 4

LIST OF PARTS SHOWN ON FIGURES A-1, A-2, & A-3
(Continued)

Item No.	Description	Georgia Tech Drawing No.
49	Slug, steel	A-1181-127-M5, Item 6
50	Spring post	126-M5, Item 11
51	Screw, encoder clamp	124-M5, Item 48
52	Clamp, encoder	124-M5, Item 40
53	Housing, feedhorn	144-M4, Item 1
54	Carrier, slug	127-M5, Item 11
55	End-plate, cam	126-M5, Item 6
56	Bearing holder	124-M5, Item 37

Note: Complete mechanical parts lists are shown on the assembly drawings. See LIST OF DRAWINGS for further information.

Item No.	Reference Symbol	Original Manufacturer's Name	Original Manufacturer's Parts Number	Item Name & Description	Quantity Per End Item*	Total Quantity Contract*	Estimated Unit Cost
1	Georgia Tech drawing no. A-1181-124-M5 Item No. 5	Microwave Development Laboratories, Needham, Mass.	MOD 112RL 136-Special (drawing No. C-01456-20-2689, REV A)	Rotary Joint	1	2	$700.00
2	Georgia Tech drawing no. A-1181-124-M5 Item No. 7	Baldwin Electronics, Inc. Little Rock, Arkansas	Original Design for 266A (drawing no. C-905-10085)	Optical Incremental Encoder	1	2	500.00
3	Georgia Tech drawing no. A-1181-124-M5 Item No. 9	The Barden Corporation Danbury, Connecticut	100FFTX1K5-G18	Ball Bearing	1	2	15.69
4	Georgia Tech drawing no. A-1181-124-M5 Item No. 11	The Barden Corporation Danbury, Connecticut	106HDL	Ball Bearing	1 Matched Pair	2 Matched Pair	88.80 Pair
5	Georgia Tech drawing no. A-1181-140-M4 Item No. 2	Thomson Industries, Inc. Manhasset, New York	6N8-D	Nylon Bushing	2	4	1.70
6	Georgia Tech drawing no. A-1181-151-M4 Item No. 3	Georgia Institute of Technology Atlanta, Georgia	None	Index Cam	1	2	80.00
7	Georgia Tech drawing no. A-1181-124-M5 Item No. 12	PIC Design Corporation 477 Atlantic Avenue E. Rockaway, N.Y. 11518	T1-10	Bellows Coupling	1	2	18.40
8	Georgia Tech drawing no. A-1181-124-M5 Item No. 13	Same as above	L1-9	Hub Clamp for Coupling	2	4	3.68
9	Georgia Tech drawing no. A-1181-124-M5 Item No. 14	Eaton Yale Town, Inc., Kenosha, Wisconsin 53140	187-L075	Positive Drive Belt	1	2	4.57
10	Georgia Tech drawing no. A-1181-127-M5 Item No. 2	Airpax Electronics, Cambridge, Maryland	1-0007	Magnetic Pickup	3	6	9.00
11	Georgia Tech drawing no. A-1181-124-M5 Item No. 2	General Electric Corp., Fort Wayne, Indiana	5K42HG2669	½hp. Motor	1	2	45.00
12	Georgia Tech drawing no. A-1181-2-E4, K-1	Allen Bradley Co., Milwaukee, Wisconsin	705AAD	Reversing Contactor Motor Control	1	2	84.00
13	Georgia Tech drawing no. A-1181-2-E4, O. L.	Allen Bradley Co., Milwaukee, Wisconsin	N-9	Heater	2	4	2.50
14	Georgia Tech drawing no. A-1181-124-M5 Item No. 3	Warner Electric Brake & Clutch Co., Beloit, Wisconsin	EM-50-20-M	Electromagnetic Brake, 90v coil	1	2	92.00

*Spare parts recommended for initial provisioning for 2000 hours operation.

Range Instrumentation Spare Parts List

Item No.	Reference Symbol	Original Manufacturer's Name	Original Manufacturer's Parts Number	Item Name & Description	Quantity Per End Item*	Total Quantity Contract	Estimated Unit Cost
15	Georgia Tech drawing no. A-1181-126-M5 Item No. 3	Stearns Electric Corp. Milwaukee, Wisconsin	4-2-05003	Solenoid, 50,2000 Series coil 115 vac, 60 Hz	1	2	21.00
16	Georgia Tech drawing no. A-1181-126-M5 Item No. 4	Microswitch Div, Honeywell Freeport, Illinois	V3-119	Microswitch	2	4	5.00
17	Georgia Tech drawing no. A-1181-2-E4, part of S-1	Microswitch Div, Honeywell Freeport, Illinois	JV-82	Actuator	1	2	2.50
18	Georgia Tech drawing no. A-1181-124-M5 Item No. 15	Airtron Div of Litton Industries, Morris Plains, New Jersey	93715	Waveguide O-Ring	6	12	.92
19	None	Chicago Mfg. & Distrib. Div. Evans Products Co. 1928 West 46th St.	#3	Extreme Pressure Lubricant	1 4oz. tube	2 4oz. tubes	2.00
20	None	General Electric Co. Silicone Prod. Dept. Waterford, N.Y.	G-300	Silicone Grease	1 2oz. tube	2 2oz. tubes	5.00
21	None	Same as above	Versilube G-322-L	Silicone Grease	1 2oz. tube	1 2oz. tube	5.00
22	Georgia Tech drawing no. A-1181-193-M4 Item No. 4	Waldes Kohinoor, Inc. 47-16 Austel Place, L. I. City, N. Y. 11101	N5100-25	Ring, retaining	6	12	.10
23	Georgia Tech drawing no. A-1181-193-M4 Item No. 8	Same as above	5133-15-W	E-Ring	6	12	.15
24	Georgia Tech drawing no. A-1181-193-M4 Item No. 12	Same as above	N 5000-50	Ring, retaining	6	12	.10
25	Georgia Tech drawing no. A-1181-124-M5 Item No. 61	Precision Rubber Products Corporation, Hartmann Dr. Lebanon, Tennessee	3/32(.103 ±.003) x 11 I.D. Nitrile (Buna-N)	O-Ring Special Size Cement from Stock material.	2	4	2.00
26	Georgia Tech drawing no. A-1181-124-M5 Item No. 63	Precision Rubber Products Corporation, Hartmann Dr. Lebanon, Tennessee	1/8(.139 ±.004) x 85½" long. Nitrile (Buna-N)	Same as above	2	4	4.00
27	Georgia Tech drawing no. A-1181-126-M5 Item No. 7	Elastic Stop Nut Division Amerace-Esna Corp. Union, N.J.	3/16 x 1, SST 18-8	Spring pin	6	12	.10
28	Georgia Tech drawing no. A-1181-124-M5 Item No. 6	Aeroquip Corp./Marman Div. 11214 Exposition Blvd. Los Angeles, Calif. 90064	4428-1206M	V-Band Coupling	0	0	50.00
29	Georgia Tech drawing no. A-1181-119-M5 Item No. 5	Delco-Remy Div. of General Motors Anderson, Ind. 46011	5-1956191	Nut Assembly	0	0	1.00

*Spare parts recommended for initial provisioning for 2000 hours operation.

Range Instrumentation Spare Parts List (continued)

LIST OF DRAWINGS

(Assembly drawings are capitalized)

Mechanical drawings - Size D

Vertical and horizontal rib details	A-1181-13-M4
Antenna back-up structure	37-M4
Large X double flared horn electroform mandrel, mandrel-feedhorn	103-M4
Flared horn machining detail, W/G clamps	108-M4
Feedhorn housing, retaining ring, slug carrier	130-M4
Retaining rings	131-M4
Flexible support, encoder clamp, spring post, shaft key, washer	132-M4
Scanner support, motor mount	137-M4
Drive-belt pulleys	138-M4
Brake assy support	140-M4
Shaft & bearing holder	141-M4
Pawl, cam, shaft, spring & anchor nut	143-M4
FEEDHORN SUBASSEMBLY	144-M4
Bulkhead fitting, flexible waveguide	146-M4
Index cam & cam end plate	151-M4
Modified choke flange, feedhorn spacer, feedhorn	152-M4
Magnetic pickup details	153-M4
Radome retainer	160-M4
Electronic support details, electronic mountings	162-M4
Scanner radome	164-M4
Scanner alignment jig	167-M4
Spacer	168-M4
Spacer	169-M4
Control housing brackets	170-M4
Hole pattern for rear access lid in boom	172-M4
Bulkhead fitting (access lid), terminal bracket (motor)	173-M4
Waveguide clamp	174-M4
Reset button assy, wrench, 45° H-plane head	179-M4
Flared horn machining detail	188-M4

LIST OF DRAWINGS (Continued)

(Assembly drawings are capitalized)

Mechanical drawings - Size D (Continued)

GENERAL ASSEMBLY - LOWER DISH	A-1181-189-M4
ELASTIC LINK ASSEMBLY	193-M4
Access cover	195-M4

Mechanical drawings - Size E

Offset paraboloidal reflector	A-1181-036-M5
26 channel large X scanner body, Sheet 1 & 2	107-M5
Waveguide channels	109-M5
SCANNER BODY & W/G ASSEMBLY	111-M5
Intermediate support structure	119-M5
Main support structure	122-M5
SCANNER ASSEMBLY	124-M5
MOTOR MOUNT ASSEMBLY	125-M5
INDEX/BRAKE ASSEMBLY	126-M5
MAGNETIC-PICKUP ASSEMBLY	127-M5
Index/drive housing	128-M5
Support details	133-M5
Scanner boom	135-M5
Housing cover	145-M5
Housing casting	147-M5
R.H. scanner housing	148-M5
L.H. scanner housing	149-M5
Motor housing support rings	154-M5
Motor housing	155-M5
Control housing	157-M5
View II control housing	158-M5
Boom side-rail	171-M5
Cable connection cover	180-M5

LIST OF DRAWINGS (Continued)

(Assembly drawings are capitalized)

Electrical drawings - Size D

Encoder & magnetic pickup circuitry	A-1181-1-E4
Motor drive & indexing circuit	2-E4
Power & control cable, signal cable	3-E4
Encoder schemetic diagram	5-E4
Magnetic-pickup pulse-shaping circuitry (for spare scanner)	6-E4
Magnetic-pickup pulse-shaping unit(for first scanner)	7-E4

LIST OF SPECIAL TOOLS FURNISHED

1.	Retainer-ring pliers, Waldes Truark Exterior field pliers No. 2200	1 Required
2.	Retainer-ring pliers, Waldes Truark Interior standard pliers No. 0100	1 Required
3.	Eyebolt - Special ½ x 15 inches for lifting scanner assembly from housing	2 Required
4.	Wrench - Special 7/16 inch box end for solenoid to elastic link nut (This is for scanner No. 1 only)	1 Required

ELECTRICAL PARTS LIST

Part No.*	Description	Manufacturer's Part No.	Manufacturer
R101	Resistor 1.2Ω 3W 5%	995-3A	Ohmite
R102	" 7.15kΩ ¼W 1%	CCA T-0	IRC
R103	" 2.15kΩ ¼W 1%	CCA T-0	IRC
R104	" 10Ω 3W 5%	995-3A	Ohmite
R105	" 4.99kΩ ¼W 1%	CCA T-0	IRC
R106	" 2.15kΩ ¼W 1%	CCA T-0	IRC
R107	" 4.87kΩ ¼W 1%	CCA T-0	IRC
R108	" 7.15kΩ ¼W 1%	CCA T-0	IRC
R109	" 8.2kΩ ½W 10%		Allen Bradley
R110	" 10kΩ ½W 10%		Allen Bradley
R111	" 10kΩ ½W 10%		Allen Bradley
R112	" 1kΩ ½W 10%		Allen Bradley
R113	" 220Ω ½W 10%		Allen Bradley
R114	" 100Ω ½W 10%		Allen Bradley
R115	" 2.4Ω 3W 5%	995-3A	Ohmite
R116	" 30Ω 3W 5%	995-3A	Ohmite
R117	" 180Ω 3W 5%	995-3A	Ohmite
R118	" 6.2Ω 3W 5%	995-3A	Ohmite
C101	Capacitor 1000μf 50wv	601D108G050JI4	Sprague
C102	" 0.01μf 100wvdc (Ceramic Disc)	TG-S10	Sprague
C103	Capacitor 1000μf 25wv	601D108G02SGI4	Sprague
C104	" 330pf 100wv	CD7FA331G03	Cornell-Dubilier
C105	" 0.001μf 1000wvdc	SHK-D10	Sprague
C106	" 0.01μf 100wvdc	TG-S10	Sprague
C107	" 0.01μf 100wvdc	TG-S10	Sprague
C108	" 10μf 20wvdc	CS13BE106K	Sprague

*Part Nos. on this page refer to Drawing A-1181-1-E4.

ELECTRICAL PARTS LIST (Continued)

Part No.*	Description	Manufacturer's Part No.	Manufacturer
Q101	Transistor 2N3055	2N3055	Motorola
Q102	" 2N3116	2N3116	Motorola
Q103	" 2N3116	2N3116	Motorola
Q104	" 2N3055	2N3055	Motorola
Q105	" 2N3055	2N3055	Motorola
IC101	Integrated Circuit µA723C	U5R7723312	Fairchild
IC102	" " µA914	UL991429	Fairchild
IC103	" " µA723C	U5R773312	Fairchild
IC104	" " µA723C	U5R773312	Fairchild
Encoder	Optical Tachometer	Model 269C	Baldwin Electronics
CR101	Diode 1N4004 400V piv	1N4004	Motorola
CR102	" " "	IN4004	Motorola
CR103	" " "	IN4004	Motorola
CR104	" " "	IN4004	Motorola
CR105	" " "	IN4004	Motorola
CR106	" " "	IN4004	Motorola
CR107	" " "	IN4004	Motorola
CR108	" " "	IN4004	Motorola
T101	Transformer 110/20V 0.5A	PC-20-500	Signal Transformer Company
T102	Transformer 110/20V 0.5A	PC-20-500	Signal Transformer Company
TB101	Term Block 5/40 Screw	2-140	Jones
TB102	" " " "	"	Jones
TB103	" " " "	"	Jones

*Part Nos. on this page refer to Drawing A-1181-1-E4.

ELECTRICAL PARTS LIST (Continued)

Part No.*	Description	Manufacturer's Part No.	Manufacturer
Mag.Pickups START	Magnetic Pickups	1-0007	Airpax Electronics
STOP	Magnetic Pickups	"	" "
BORE SIGHT	" "	"	" "
J2	Connector 8 pin	MS3102E-20-7P	ITT Cannon
J3	Connector 25 pin	DB-25S	ITT Cannon
	Clamp for DB-25S	DB 20962	ITT Cannon

*Part Nos. on this page refer to Drawing A-1181-1-E4.

ELECTRICAL PARTS LIST (Continued)

Part No.*	Description	Manufacturer's Part No.	Manufacturer
R1	Resistor 10Ω 50W	RH50	Dale
R2	" 10Ω 50W	RH50	Dale
R3	" 10Ω 50W	RH50	Dale
R4	" 2kΩ 50W	RH50	Dale
R5	" 10Ω 1W		Allen Bradley
R6	" 47Ω 1W		Allen Bradley
R7	" 1kΩ 1W		Allen Bradley
R8	" 6.8kΩ 1W		Allen Bradley
R9	" 47kΩ ½W		Allen Bradley
R10	" 20Ω 50W	RH50	Dale
C1	Capacitor 40μf 236VAC	KBL23P406Q	Cornell-Dubilier
C2	" 0.1μf 400V	X663F	TRW
C3	" 0.1μf 400V	X663F	TRW
C4	" 0.1μf 400V	X663F	TRW
C5	" 10μf 150V	121P10691R5S2	Sprague
C6	" 10μf 150V	121P10691R5S2	Sprague
C7	" 0.1μf 400V	X663F	TRW
CR-1	Diode 1N4007 1A 1000V	1N4007	Motorola
CR-2	" " " "	"	Motorola
CR-3	" " " "	"	Motorola
CR-4	" " " "	"	Motorola
K1, K2	AC Reversing Starter with O.L. heater	705-AAD Series K N13 (2 required)	Allen-Bradley Allen-Bradley
K3	Relay 115V 50-60Hz	KUP11A15	Potter & Brumfield
K4	Relay 110V DC	KRP11DG	Potter & Brumfield

*Part Nos. on this page refer to Drawing A-1181-2-E4.

ELECTRICAL PARTS LIST (Continued)

Part No.*	Description	Manufacturer's Part No.	Manufacturer
S1, S2	Switch Actuator	V3-119 Switch JV82	Microswitch Microswitch
	Electric Brake	EM-50-20 90V Coil	Warner Electric
	Pawl Solenoid	Model 4-2-05003 50, 200 Series Coil 115VAC, 60Hz	Stearns Electric
Motor	Electric Motor, General Electric, ½HP, 3phase 230/460 VAC 60Hz, 1725 rpm, Fan Cooled, 56C frame.	Type 5K & 2HG 2669	General Electric

*Part Nos. on this page refer to Drawing A-1181-2-E4.

ELECTRICAL PARTS LIST (Continued)

Part No.*	Description	Manufacturer's Part No.	Manufacturer
IC301	Operational Amplifier μA710	U5B7710393	Fairchild
IC302	" " "	"	"
IC303	" " "	"	"
R370	PC Board Trimpot - 500Ω	3007P	Bourns
R371	" " " "	"	"
R372	" " " "	"	"
Q301	Silicon NPN Transistor	2N4401	Motorola
Q304	" " "	"	"
Q307	" " "	"	"
Q302	" " "	2N3904	"
Q303	" " "	"	"
Q305	" " "	"	"
Q306	" " "	"	"
Q308	" " "	"	"
Q309	" " "	"	"
C320 C321	0.05 Mfd. disc ceramic capacitors	CK-503	Centralab
C322	25 Mfd. 25 volt electrolytic capacitor	NLW "Electronite"7013	CDE
C301 C306 C311	0.001 Mfd. - 100V Mylar tubular capacitor	WMF-1D1 " "	CDE " "
C302 C307 C312	270 Pfd. dipped silvered mica capacitor	CD7FC271G03 " "	CDE CDE CDE

*Part Nos. on this page refer to Drawing A-1181-6-E4 (spare scanner).

ELECTRICAL PARTS LIST (Continued)

Part No.*	Description	Manufacturer's Part No.	Manufacturer
C303	0.01 Mfd. 50 volt disc	CK-103	Centralab
C305	ceramic capacitor	"	"
C308		"	"
C310		"	"
C313		"	"
C315		"	"
C304	0.2 Mfd. 20 volt	CK-204	Centralab
C309	disc ceramic capacitor	"	"
C314		"	"
CR321	Silicon diode	IN625	Sylvania
CR323	" "	"	(or Hughes)
CR324	" "	"	"
CR326	" "	"	"
CR327	" "	"	"
CR329	" "	"	"
CR322	Silicon diode	1N629	Sylvania
CR325	" "	"	"
CR328	" "	"	"
R301	Resistor 10Ω ¼W 10%		IRC
R321	" " " "		"
R341	" " " "		"
R302	" 100Ω 1W 10%		"
R322	" " " "		"
R342	" " " "		"
R303	" 1kΩ ¼W 10%		"
R323	" " " "		"
R343	" " " "		"

*Part Nos. on this page refer to Drawing A-1181-6-E4 (spare scanner).

ELECTRICAL PARTS LIST (Continued)

Part No.*	Description	Manufacturer's Part No.	Manufacturer
R304,324 344	Resistor 12kΩ ¼W 10%		IRC
R305,325 345	" 3.9kΩ ¼W 10%		"
R306,326 346	" 15kΩ ¼W 10%		"
R307,327 347,308 328,348 313,333 353	" 10kΩ ¼W 10%		" " " " "
R309,329 349	" 22Ω ¼W 10%		"
R310,330 350	" 1.2Ω ¼W 10%		"
R311,331 351	" 6.8Ω ¼W 10%		"
R312,332 352	" 100Ω ¼W 10%		"

*Part Nos. on this page refer to Drawing A-1181-6-E4 (spare scanner).

ELECTRICAL PARTS LIST (Continued)

Part No.*	Description	Manufacturer's Part No.	Manufacturer
IC401	Operational Amplifier μA710	U5B7710393	Fairchild
IC402	" " "	"	"
IC403	" " "	"	"
R470	PC Board Trimpot 500Ω	3007P	Bourns
R471	" " " "	"	"
R472	" " " "	"	"
Q401	Silicon NPN Transistor	2N4401	Motorola
Q404	" " "	"	"
Q407	" " "	"	"
Q402	" " "	2N3904	"
Q403	" " "	"	"
Q405	" " "	"	"
Q406	" " "	"	"
Q408	" " "	"	"
Q409	" " "	"	"
C420 C421	0.05 mf disc ceramic capacitors	CK-503 "	Centralab "
C422	25 mf - 25 volt electrolytic capacitor	NLW "Electromite" 7013	CDE
C401 C406 C411	0.001μf 100 volt Mylar tubular capacitor	WMF-1D1 " "	CDE " "
C402 C407 C412	270 pf dipped silvered Mica capacitor	CD7FC271G03 " "	CDE " "

*Part Nos. on this page refer to Drawing A-1181-7-E4 (first scanner).

ELECTRICAL PARTS LIST (Continued)

Part No.*	Description	Manufacturer's Part No.	Manufacturer
C403	0.01µf 50volt disc	CK-103	Centralab
C405	ceramic capacitor	"	"
C408			
C410			
C413			
C415			
C404	0.2µf 20 volt	CK-204	Centralab
C409	disc ceramic capacitor	"	"
C414		"	"
CR421	Silicon diode	IN625	Sylvania (or
CR425		"	Hughes)
CR429		"	"
CR422		"	"
CR426		"	"
CR430		"	"
CR423	Silicon diode	IN4149	Sylvania
CR424		"	"
CR427		"	"
CR428		"	"
CR431		"	"
CR432		"	"
R401	Resistor 10Ω ¼W 10%		IRC
R421	" " " "		"
R441	" " " "		"
R402	" 100Ω 1W 10%		"
R422	" " " "		"
R442	" " " "		"
R403	" 1kΩ ¼W 10%		"
R423	" " " "		"
R443	" " " "		"

*Part Nos. on this page refer to Drawing A-1181-7-E4 (first scanner).

ELECTRICAL PARTS LIST (Continued)

Part No.*	Description	Manufacturer's Part No.	Manufacturer
R404,424 444	Resistor 12kΩ ¼W 10%		IRC "
R405,425 445	" 3.3kΩ ¼W 10%		" "
R406,426 446	" 15kΩ ¼W 10%		" "
R407,427 447,408 428,448 413,433 453	" 10kΩ ¼W 10%		" " " " "
R409,429 449	Resistor 22Ω ¼W 10%		" "
R410,430 450	" 1.2kΩ ¼W 10%		" "
R411,431 451	" 6.8kΩ ¼W 10%		" "
R412,432 452	" 100Ω ¼W 10%		" "
B401	Metal Chassis-box	CU-2108-A	Bud
B410-415	BNC chassis connectors	UG-657/U	Amphenol 31-102
B420	DPDT Toggle switch	20905FR	Arrow-Hart

*Part Nos. on this page refer to Drawing A-1181-7-E4 (first scanner).

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13. ABSTRACT

An offset paraboloidal scanning antenna has been designed, developed, and delivered for test purposes. The manual furnishes basic information needed for operation of the antenna and for routine maintenance. Included are electrical circuit diagrams, assembly and disassembly instructions, exploded views of critical components, electrical and mechanical parts lists, and a list of recommended spare parts for 2000 hours operation.