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THIRD INTERIM DEVELOPMENT REPORT  
FOR  
HIGH-POWER MULTIPLE ROTARY JOINT

FURTHER DISSEMINATION IS AUTHORIZED ONLY TO  
MILITARY AGENCIES.

THIS REPORT COVERS THE PERIOD 7 APRIL 1954 TO 7 JULY 1954

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SPERRY GYROSCOPE COMPANY  
DIVISION OF THE SPERRY CORPORATION  
GREAT NECK, NEW YORK

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ABSTRACT

This report describes the various phases into which the contemplated revised program will be divided for development of the Transvar<sup>TM</sup> rotary joint. It also describes the work performed during the third quarter of the program. This work, which was primarily concerned with further investigation on a step termination has substantially completed the subcomponent-development portion of the program.

## TABLE OF CONTENTS

<u>Paragraph</u>		<u>Page</u>
	Abstract	1
PART I		
SECTION A - PURPOSE		
1	Purpose of Program	1
2	Breakdown into Working Phases	2
SECTION B - GENERAL FACTUAL DATA		
3	References	4
SECTION C - DETAIL FACTUAL DATA		
4	Summary of Previous Interims	5
5	Step Transition	5
6	Project Performance and Schedule	6
SECTION D - CONCLUSIONS		
7	Conclusions	7
PART II		
PROGRAM FOR NEXT INTERVAL		
8	Program for Fourth Interim	8

## PART I

## SECTION A

## PURPOSE

## 1. PURPOSE OF PROGRAM

This program has as its purpose the design and construction of a multiple-channel, high-power, rotary joint of the Transvar type, operating in the frequency range of 5235 to 5325 mc. Primary objectives are: light weight, low VSWR, low insertion loss, and high power capacity.

The original contract specified delivery of a single operating model having three electrically independent channels. In tentative negotiations entered into during the first interim of the program, it was decided to reduce the number of channels from three to two, and to construct and deliver a breadboard model in addition to the final model.

As a result of the negotiations, the Bureau of Ships has prepared a contract amendment specifying a reduction in the number of channels from three to two, but still calling for the development and delivery of only one model. Authorization for performance of work under this amendment has not as yet been received. Hence it was possible to perform only a small amount of work during the third interim of the program.

## 2. BREAKDOWN INTO WORKING PHASES

The breakdown into breadboard-development and manufacturing phases as specified in previous reports will be modified, pending acceptance of the contract amendment, to include work only on a breadboard-model development.

Design objectives for this breadboard model will be as follows:

- a. Channels to carry high power.
- b. VSWR of each channel less than 1.15.
- c. Insertion loss of each channel less than 0.5 db.
- d. Crosstalk between channels less than -30 db.
- e. Waveguide terminals equivalent to 2" x 1" waveguide.
- f. Speed of rotation to be 90 rpm.
- g. No axial loads carried by joint.
- h. Maintenance, with negligible leakage, of a small positive pressure of dry air.

The breadboard development can be subdivided into the following phases:

- a. Study Phase.-This phase has already been completed. All available literature on the subject was studied to obtain a thorough background for development. Possible methods of development and construction were considered to determine which one was most feasible.

b. Development Phase.-This phase consists in applying the theory to the particular requirements of the joint, calculating critical dimensions, and making preliminary designs for important subcomponents. A part of this work has already been performed, as described in the introductory paragraph to the Detail Factual Data.

c. Design Phase.-The design details of the joint will be worked out during this phase, incorporating the results obtained in the development phase.

d. Manufacturing Phase.-In this phase the rotary joint will be constructed. A second portion of the manufacturing will allow for modification during the test phase to achieve the desired parameters.

e. Test Phase.-During this period the rotary joint will be tested, modified, and retested until the required results are obtained. This procedure will be necessary because of the empirical nature of some of the dimensions.

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SECTION B  
GENERAL FACTUAL DATA

3. REFERENCES

First and second Interim Development Report for High-Power Multiple Rotary Joint, furnished by Sperry Gyroscope Company to Bureau of Ships under Contract No. NObsr-63496.

SECTION C  
DETAIL FACTUAL DATA

4. SUMMARY OF PREVIOUS INTERIMS

The study and initial development work for the Transvar channels in the rotary joint was performed in the first two interims. The theory was reduced to a table which will permit rapid choice of waveguide channel dimensions when the number of required channels is officially determined. Investigation of measurement procedures was initiated for both low-power and high-power conditions. Required design of H-plane corners, taper transitions, and terminations was performed. Preliminary design work was also done as longitudinal chokes for the joint.

5. STEP TERMINATION

The quarter-wave-step polyiron termination which was developed for use in the isolated arms of the joint has been given further consideration from the mechanical standpoint. As a result, it is felt that polyiron is too fragile a material, both from a manufacturing and an operational standpoint. A study was then initiated into the use of powdered iron with a Teflon binder; this material has a loss greater than 40 db per inch. The resultant termination had

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not only good electrical characteristics, but also ruggedness and machinability. The termination VSWR was reduced to below 1.10 over the required frequency band.

6. PROJECT PERFORMANCE AND SCHEDULE

A project performance and schedule chart covering the five phases of the project will be provided with the interim reports when renegotiation and clarification of the present contract are concluded.

SECTION D  
CONCLUSIONS

7. CONCLUSIONS

The contemplated program for development of a breadboard-model two-or three-channel high-power multiple rotary joint will consist of study, development, design, manufacturing, and test phases. The work performed during the third interim completes the first phase and substantially completes the subcomponent-development portion of the second phase.

PART II  
PROGRAM FOR NEXT INTERVAL

8. PROGRAM FOR FOURTH INTERIM

It is planned, pending authorization, to complete the design and begin manufacture of the rotary joint. Further mechanical investigation into the problem of air seals as well as final high-power testing of the taper transition and H-plane corners will be made.

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