PROGRESS REPORT

PR 31570-510-1

For the Period of July 1, 1963 through July 31, 1963

DEVELOPMENT OF A HYDROGEN-OXYGEN SPACE POWER SUPPLY SYSTEM

NASA Contract NAS 3-2787

Prepared by W. D. Morath
W. D. Morath
Project Engineer

Approved by N. E. Morgan
N. E. Morgan
Program Manager

Released by W. R. Pierie
W. R. Pierie
Engineering Manager

Aerospace Division
VICKERS INCORPORATED DIVISION
of Sperry Rand Corporation
Torrance, California

INTRODUCTION

This report is issued to comply with the requirements of NASA Contract NAS 3-2787 and to report the work accomplished during the period July 1 through July 31, 1963. The objectives of this program are to conduct an engineering study, design, fabrication, and test work culminating in the design of an auxiliary electric power generation unit.

This Contract, NAS 3-2787, is a continuation of NASA Contract NAS 3-2550.

PROGRAM SCHEDULE

The program schedule is shown in Fig. 1.

FLIGHT TYPE POWER SYSTEM DESIGN

No work was scheduled during this reporting period on flight type power system design.

RELIABILITY AND QUALITY ASSURANCE

In compliance with NASA QA-2a, a Reliability and Quality Assurance Program Plan will be submitted on August 31, 1963.

PROTOTYPE COMPONENT DEVELOPMENT

All prototype hardware and test equipment has been inventoried in preparation for transfer from Contract NASA 3-2550 to Contract NASA 3-2787.

NASA CONTRACT NAS 3-2787

PROGRAM SCHEDULE AND PROGRESS CHART

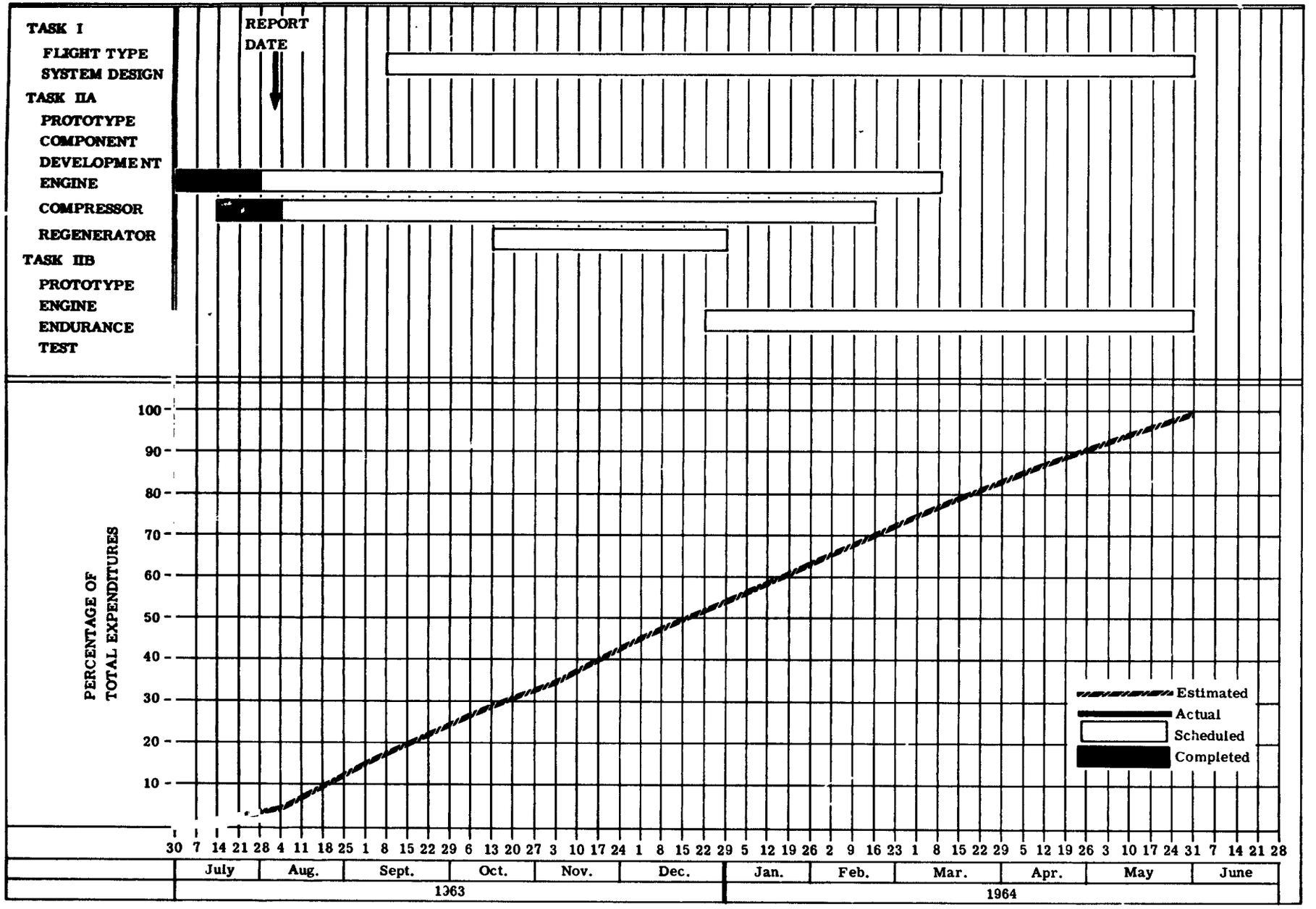

Fig. 1

PR-91570-511-1

Engine

Refurbishment of the existing engine hardware is in process.

Rework of the following parts has been accomplished during this period.

1. Two cylinders have been honed and inspected for roundness and taper. One cylinder has been drilled for thermocouples.

2. The compression and oil ring grooves of two pistons have been chrome plated and reground to eliminate ring groove taper.

3. Hydrogen valve guides have been sleeved and fitted with valves.

4. To eliminate adjustment problems caused by misalignment during installation, dowel holes were drilled in the mating surfaces of the oxygen body and the cylinder head for installation of locating pins.

5. An observation port has been machined in one oxygen injector body to provide a side view of the rocker arm and upper portion of the poppet valve.

6. The cylindrical, poppet contact surfaces of two oxygen injector rocker arms have been reground. New poppets will be machined for select fit with these reworked rocker arms.

The following redesign and fabrication is in process:

1. The oxygen injector has been redesigned to the configuration shown in Fig. 2. The old design is shown in Fig. 3 for comparison. The flex-pivot assembly has been eliminated by extending the quill shaft into a journal bearing of Haynes 25, which is pressed into the injector body. The journal shaft is of Rene' 41 flame plated with Linde LA-2 and the bearing insert is Haynes 25. The rocker arm was redesigned to clamp to the quill shaft extension. The new retainer spring provides for positive location and reduced pre-load. The seat and guide are of one piece to improve alignment. The poppet is barrel shaped on the guide surface to prevent binding, fluted to pass flow, and flame plated with Linde LC1B55 to reduce wear. The rocker arm, shaft, and relating parts have been released for manufacture. The valve and valve seat will be released for manufacturing during the week ending August 9, 1963. The seats will be fabricated as blanks so that different nozzle configurations may be machined into them as desired for test.

2. An improved hydrogen valve design has been devised and a layout drawing is being prepared.

3. A cylinder design study has been initiated to reduce heat loss of the exhaust gas, and to simplify fabrication.

The engine test stand is being refurbished and improved. Two new orifice inserts for use in the flow meters are being fabricated to increase propellant flow measurement accuracy in the low flow range. All pressure and ΔP gages are being recalibrated.

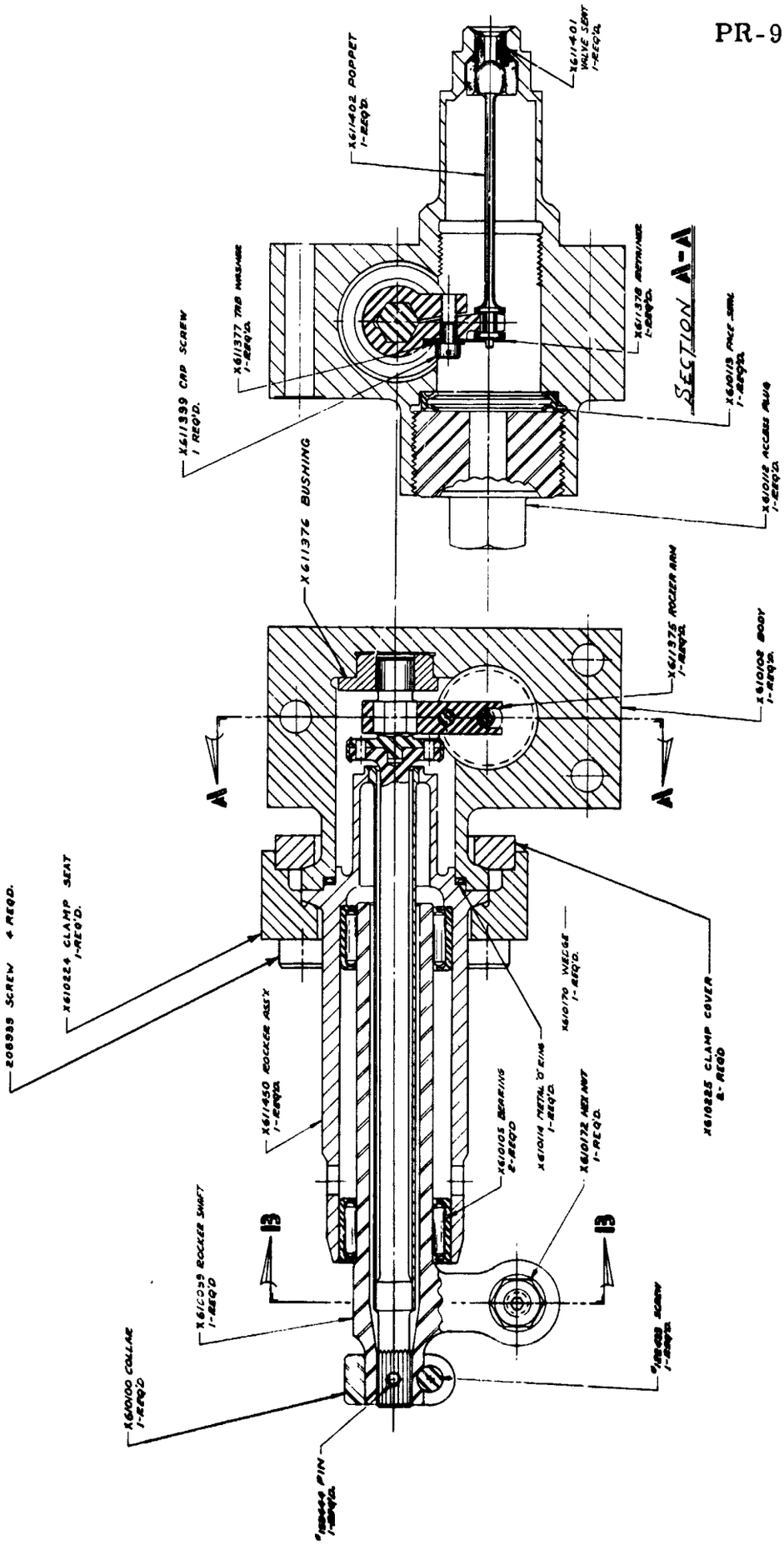

Fig. 2 - Redesigned Oxygen Injector

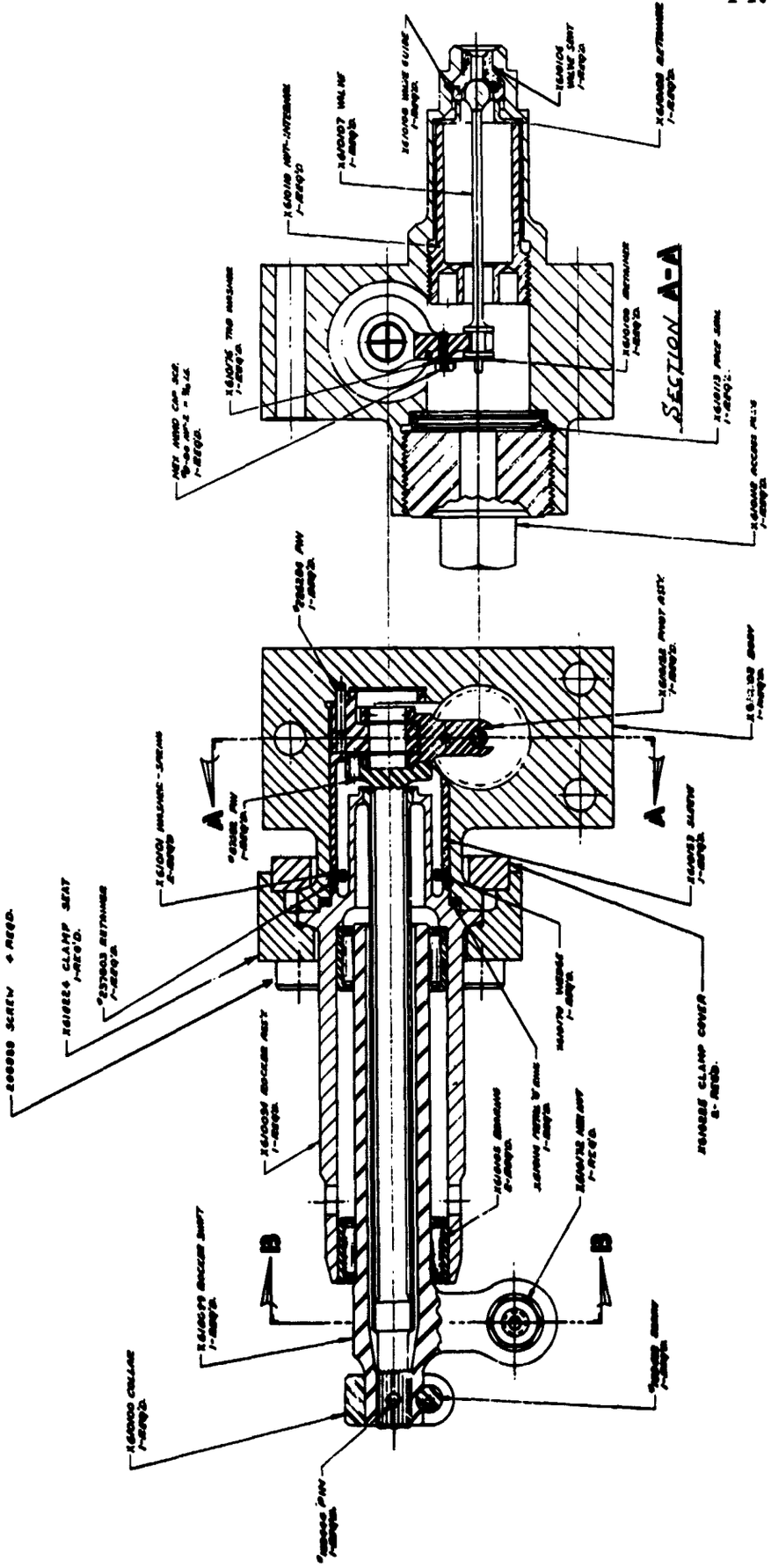

Fig. 3 - Original Design of Oxygen Injector

A Model KD850 Kinney vacuum pump was selected to reduce engine back pressure to one psi. The drawings for the concrete mounting pad are 90% complete.

Drawings for an electric hydrogen heater are complete.

Regenerator

No work scheduled this reporting period.

Compressor

The compressor drive mechanism has been redesigned, as shown in Fig. 4. The old drive linkage is shown in Fig. 5 for comparison. The new design eliminates all flexual members, has six less parts, eliminates one possible leakage path, provides for easier fabrication, assembly, and adjustment. The piston pin bushing will be of self lubricating teflon filled bronze. Alternate bearing materials are being studied. All parts have been detailed and are being checked. They will be released for fabrication during the week ending August 9, 1963. The first piston will be grooved for glass filled teflon "T"-type piston rings with metal expander rings supplied by Mace Corp.

The layout drawing of a new first stage cylinder head is shown in Fig. 6. This head eliminates the possibility of internal leakage from one valve to another.

A design study has been initiated in an effort to provide a better external drive linkage with less unbalanced vibrating mass.

PROTOTYPE ENGINE ENDURANCE TEST

No work scheduled for this reporting period.

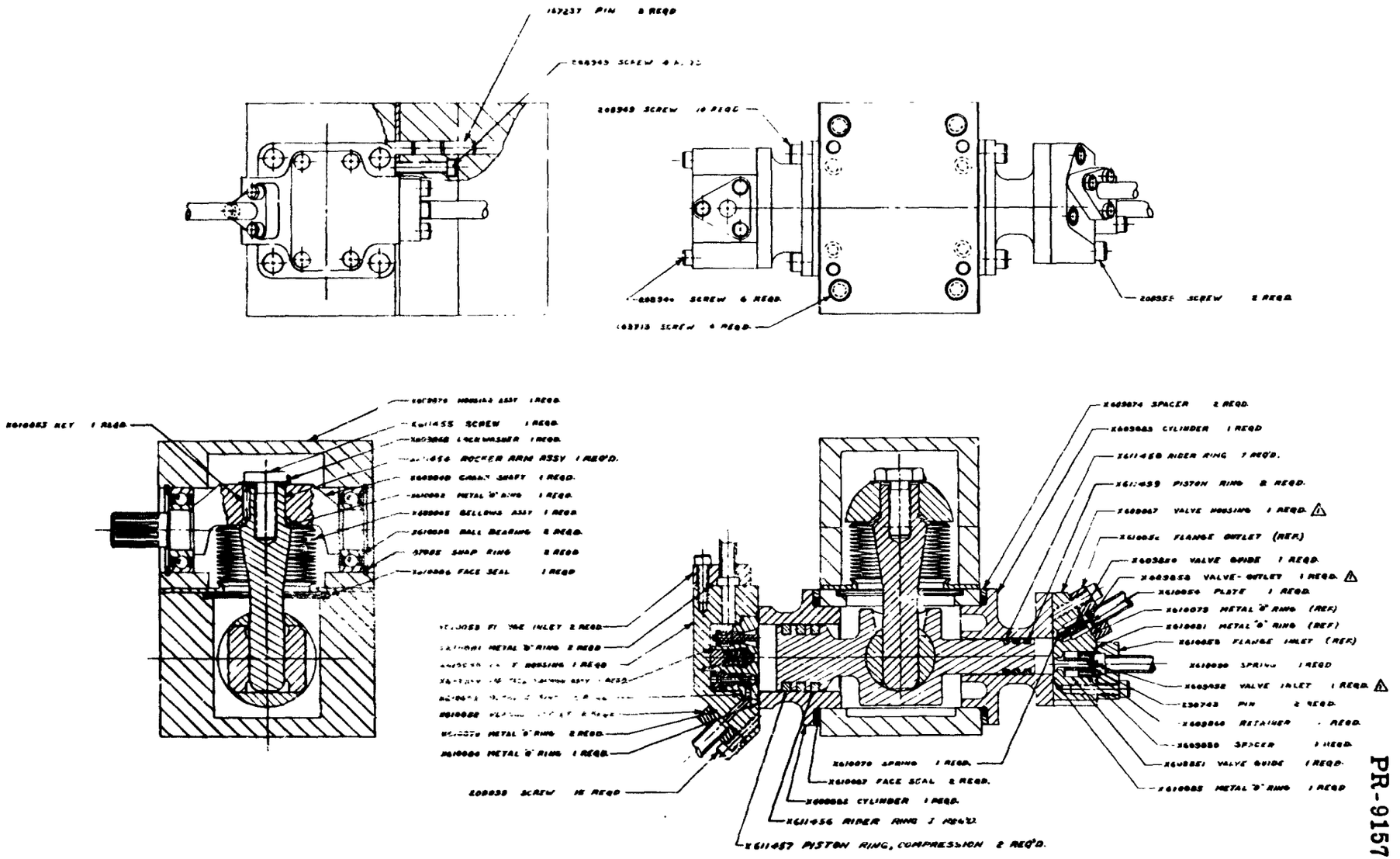

Fig. 4 - Redesigned Compressor Drive Linkage

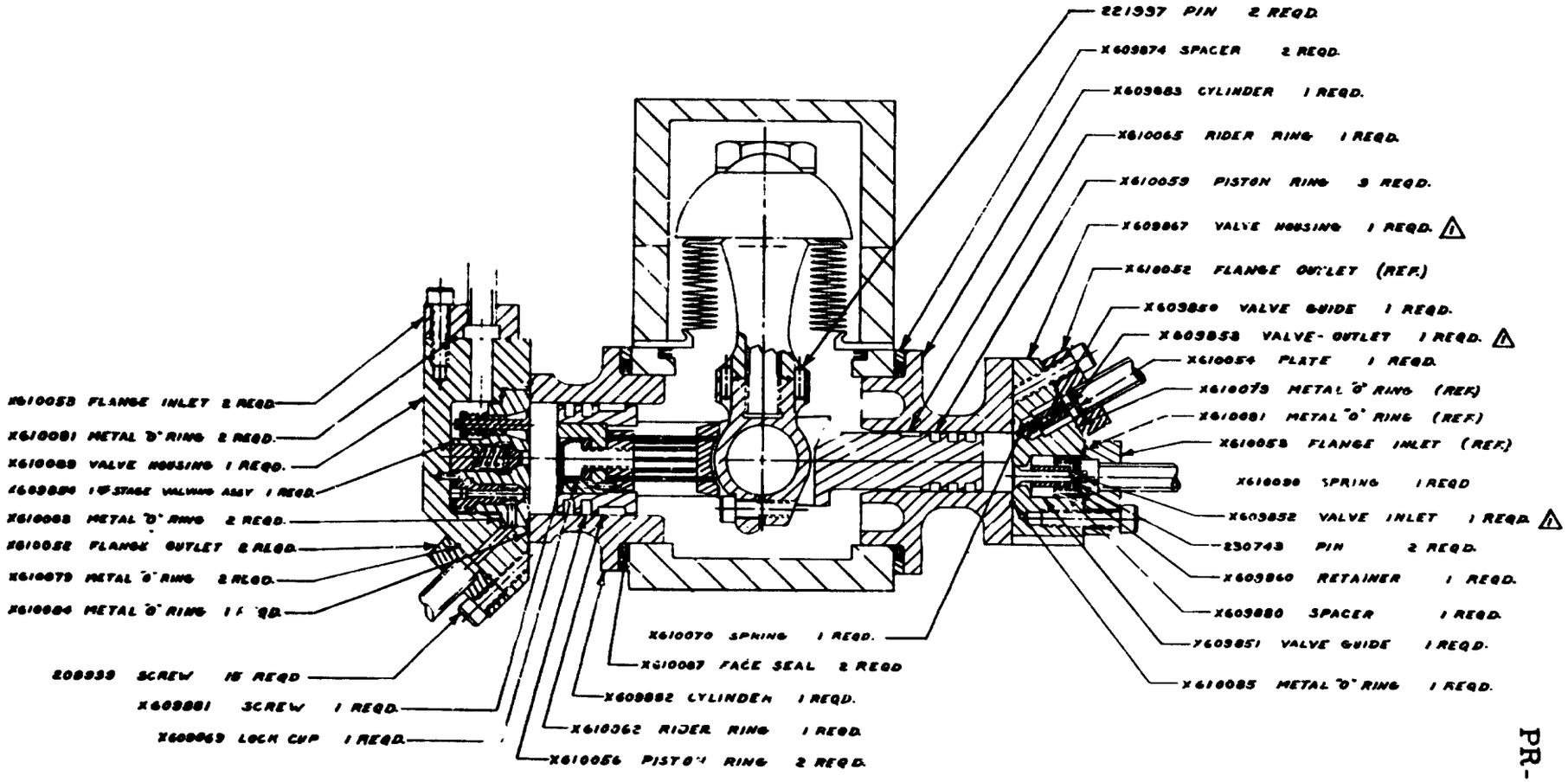

Fig. 5 - Original Compressor Drive Linkage Design

PR-91570-511-1

PR-91570-511-1

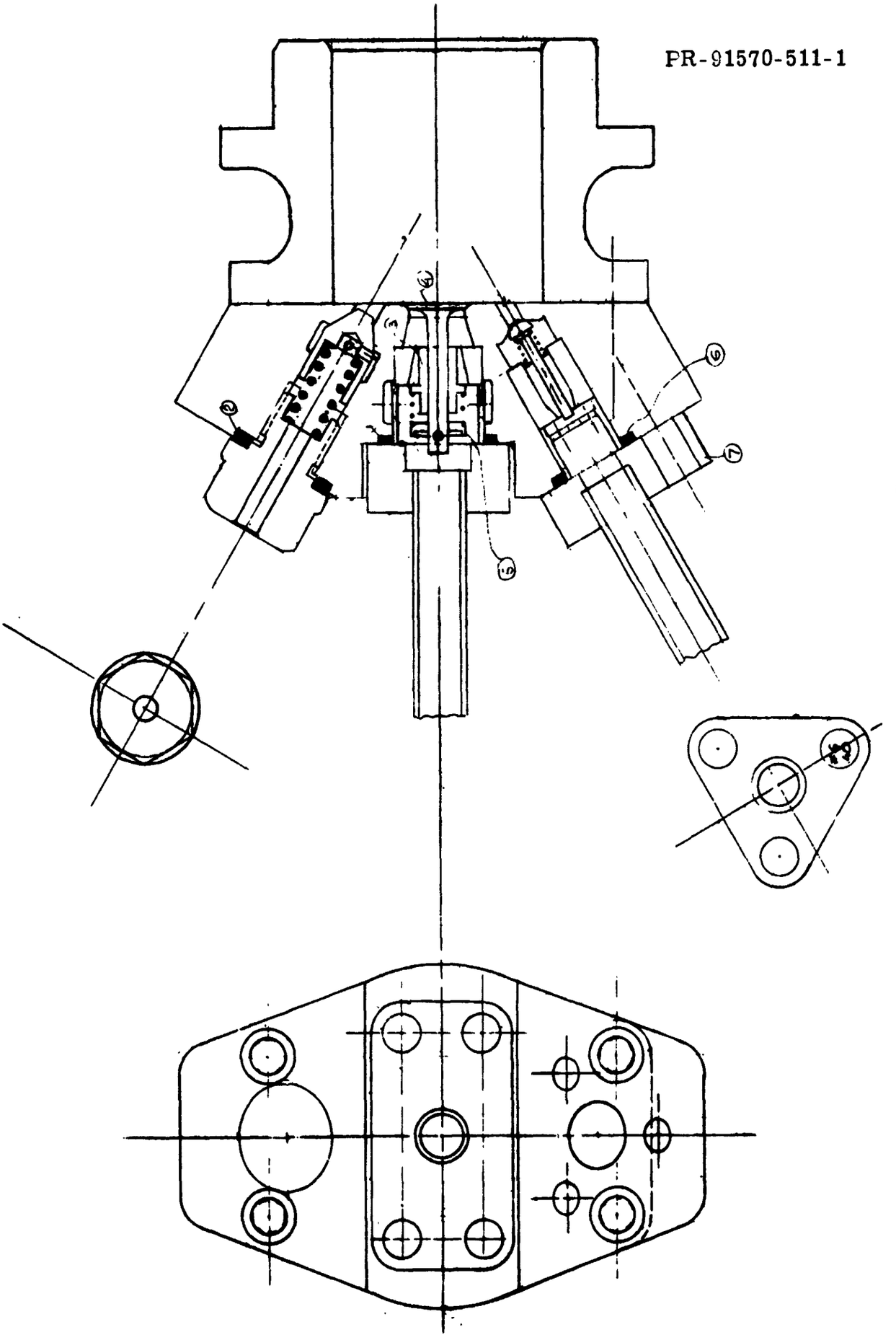

Fig. 6 - New First Stage Cylinder Head For Compressor