ENCLOSURE (B) 31

TO TEST THE LUBRICANTS UNDER-EXTREME PRESSURE

by

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ENCLOSURE (B)31

LIST OF TABLES AND ILLUSTRATIONS

ENCLOSURE (B)31

SUMMARY

Lubricating oils were tested in a special machine under conditions comparable to those existing in the main bearings of an aeroplane engine. The test results were not usable and it would be necessary that some parts of this machine be reconstructed, particularly those parts which apply pressure to the bearing test pieces, and also means would have to be provided for preventing the hydraulic oil from mixing with the test oil.

I. INTRODUCTION

A. History of Project

This machine was brought to the OFUNA laboratory two years ago from YOKOSUKA, and remodeled here in June of 1944 and placed in operating condition in November, 1944. In January, 1945, this machine was used to test Texaxo Airplane 120# oil and was broken at that time. Since that time, every effort to repair the machine failed.

B. Key Research Personnel Working on Project

Eng. Lieut. T. FUJIMOTO

II. DETAILED DESCRIPTION

A. Description of Test Apparatus

1. Application of the Load to the Test Pieces. The load is applied to the test pieces hydraulically, through a hole drilled in bearings such as shown in Figure 1(B)31.

2. The Measurement of the Torque. The torque of this machine is measured by magnetic striction using a coil, and tension wire which is attached just under the lower bearing.

The details of construction of the magnetic striction unit are not known and cannot be determined as the Electric Magnetic Company which constructed this apparatus was destroyed during the war.

Diameter of shaft is 1 cm., area of contact is 1 cm^2 (Figure 2(B)31)

B. Test Procedure

1. The Condition of Testing

Speed (maximum)..... 2800 RPM
Temp. of oil (Entry)..... 65 C
Pressure of supplying oil..... 5kg/cm^2
Ambient temperature.... room temperature

2. The Materials of the Test Pieces.

Shaft: Carbon Steel

Bearing: a. Carbon Steel.
b. Cu-Pb Alloy (Dendritic)
c. White Metal (Not used)
d. Bronze (Not used)

C. The Testing Method

1. The lubricating oil to be tested was circulated at the condition of no load.

2. The motor was driven slowly and gradually the speed was increased

3. The speed to be arrived at was 1000 RPM and the pressure was gradually applied, up to 100 kg/cm^2.

4. In this condition, the speed was maintained about 3 hrs to wear the bearing.

5. After this, the motor was driven at various desired speeds, and pressure applied slowly.

6. The pyrometer (thermocouple) used to measure the temperature of the bearing at the point of shaft contact was carefully observed and the test was stopped when a temperature of 85° C was reached.

7. This load (pressure) which produced a temperature of 85°C was called the film strength of the oil.

8. Upon disassembly of the machine the faces of shaft and bearing, were carefully inspected.

9. When the rubbing face was partially worn, the value of the unit loading was corrected accordingly by calculation.

D. Grinding of Test Pieces.

1. The shaft was ground by 0000 emery paper, and, after this, was finished, by Chrome Oxide Powder.

2. The bearing was not specially ground, but the test pieces were made very carefully.

E. Summary of Data

1. Conditions

Shaft..... Carbon Steel

Bearing .. Carbon Steel
Cu-Pb Alloy(pendritic)
Oil (tested) Texaco 120#
Maximum speed 2600 RPM

2. Data

a. Bearing: Carbon Steel. In these tests, the pressure on the test pieces was gradually increased, which caused the temperature of rubbing parts to increase gradually. As soon as the temperature reached as indicated by a pyrometer, 85°C, the test pieces generally welded to the shaft tightly.

At this time, the added (or applied) pressure calculated) was 500 kg/cm^2.

b. Bearing Cu-Pb Alloy. Next Cu-Pb alloy was used for the test pieces. At the beginning of the test, the temperature was

ENCLOSURE (B)31

gradually increased. However, the wear of the bearing was too fast to measure the film strength of the oil and the measurements were very difficult to obtain. Also the bearing surface wore badly.

Furthermore, since the upper half bearing was fixed, its wear made the centre of the shaft shift upward and become eccentric

III. CONCLUSIONS

This testing machine was designed by Mr. FUKUSHIMA (Engineer of the First Naval Technical Depot and Eng. Lieut. Comdr. IIMURE (the Third Naval Fuel Depot). It is far from being practical, or dependable, the main defects of this machine are as follows:

1. Oil Pressure System for Loading. The mechanism of applying the oil pressure for loading is not tight, so that the hydraulic oil leaks and mixed with test oil.

2. The Vibration of Shaft. At the beginning of this test, it operated very smoothly, but afterward, as the wear of the bearing progressed, the shaft began to vibrate. The reason was that the lower bearing, and the centre of the shaft became out of alignment and vibration began.

3. Oil Supply. This test pieces have the supply hole at the centre of the groove, so, in this machine, this supports the highest load. Efforts to drill a hole at the oblique side, as shown in Figure(B)31, were unsuccessful. It is not believed that this machine is of suitable design.

ENCLOSURE (B)31

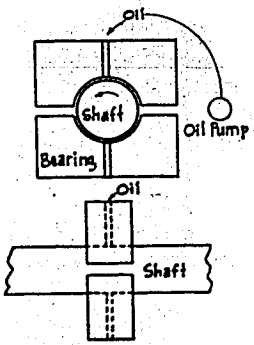

Figure 1(B)31
APPLICATION OF LOAD
TO TEST PIECE

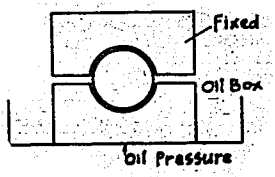

Figure 2(B)31
MEASUREMENT OF TORQUE

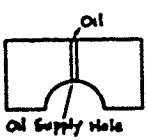

Figure 3(B)31
OIL SUPPLY
Vertical

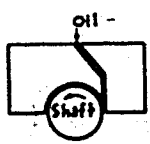

Figure 4(B)31
OIL SUPPLY
Oblique

ENCLOSURE (B)31

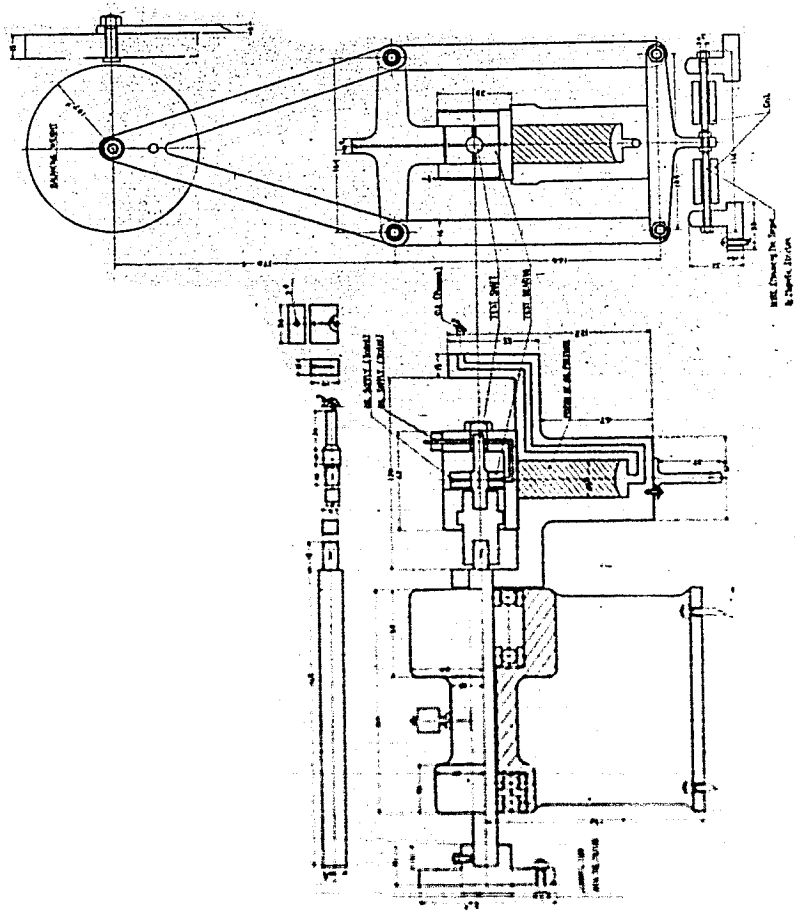

Figure 5(B)31
CROSS SECTION OF THE MAIN PARTS OF
EXTREME PRESSURE LUBRICANT TESTING MACHINE

ENCLOSURE (B)31

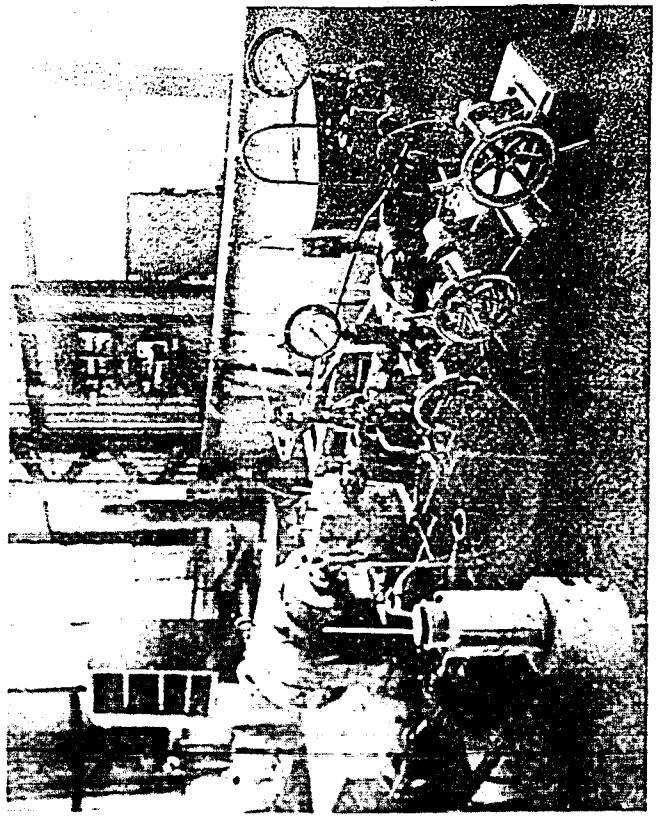

Figure 6(B)31
ALLEN'S EXTREME PRESSURE
LUBRICANT TESTING MACHINE