CONTINENTAL AIRCRAFT ENGINE CO.

DETROIT, MICHIGAN

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8 Sheets

CONTINENTAL O-1430 ENGINE

Stress Analysis of Crankcase, Gearcase, and Support Plate.

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STRESS ANALYSIS OF CRANKCASE, GEARCASE, AND SUPPORT PLATE.

References:- Continental O-1430-1 Engine Design Reports No. 61, "Load Analysis of Crankcase, Gearcase, and Support Plate", and No. 57, "Reduction Gear and Propeller Shaft Bearing Loads".

(1) The maximum instantaneous torque = Tm

$$Tm = \frac{12 \times 33000 \times 1000 \times 1.2}{2\pi \times 3000} = 25200 \text{ inch pounds}$$

2T = 50400 inch pounds

The tables below give the various stresses set up by the loads as reported in Design Report #61.

	Diaphragm Thickness Inches		Max Compressive Stress in Diaphragm Lbs/sq. in.
Nose Section	.437 to .250	(Fig 1)	2100
Reduction Gear Housing	.375 to .187	(Fig 2)	1980
Crankcase (Typical)	.375 to .187	(Fig 3)	2050

	Skin Thickness Inches	Max Shearing Stress In Skin Due to Torsion Lbs/sq in
Nose Section	.187	None
Reduction Gear Housing	.187	1240
Crankcase (Typical)	.187	785

(2) Shear stress due to gas force trying to pull cylinders from crankcase.

The area of the section around the cylinder flange is 5.03 sq. in. (Fig 4).

Load = 11160 lbs

Stress = 2220 lbs/sq. in.

This load may also be considered as tension in the horizontal plane and the crankcase has been so designed, by the location of suitable ribbing, to transfer this load directly in to the diaphragms where it becomes the reaction to the bearing loads. Considering this load as carried between the ribbing as shown in Fig 5, the stress becomes

$$\frac{11160}{2 \times 3\frac{1}{2}} = 1590 \text{ lbs/sq in.}$$

(3) Unit Stress due to inertia primary rocking couple within the crankcase.

Area of section thru center of crankcase ½ inch from the center diaphragm = 11.7 sq in.

Section Modulus (from layout, Fig 6) = 51.3 $in.^3$

Bending Moment (Primary) = 101000 inch lbs.

Unit Stress = $\frac{101000}{51.3}$ = 1970 lbs/sq in. tension and comp.

Bending Moment Secondary = $\frac{30000}{51.3}$ = 585 lbs/sq in. tension and compression.

It is possible for the primary and secondary forces to add up hence the maximum stress due to the sum of the above is

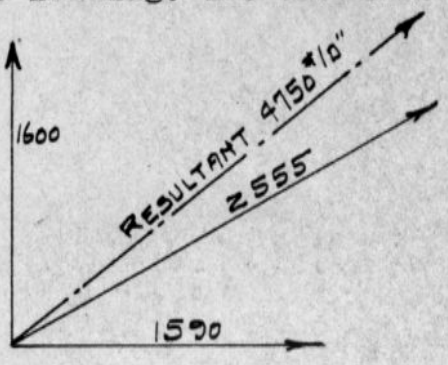
1970 + 585 = 2555 lbs/sq in.

(4) Bending Moment at center line of #1 cylinder due to rough landing (Acceleration = 4g) = 199,000 inch lbs.

Section Modulus (from layout, fig 7) = 124.03 $in.^3$

Unit Stress = $\frac{199,000}{124.03}$ = 1600 lbs/sq in. tension and comp.

It is possible, in a rough landing, to suddenly open the throttle thus giving the combination of the maximum inertia and gas loading on the crankcase at a time when it is subjected to extraneous loading. The combination of the forces would be



(5) The propeller thrust causes a tension in the nose section. The The maximum propeller thrust as shown in Design Report #57 is 3000 lbs. The Area of the smallest section of nose section is 4.60 square inches. (Fig 8)

Unit Stress = $\frac{3000}{4.6}$ = 650 lbs/sq in.

The bending, due to a rough landing, on the smallest section of the nose would be 8 x 350 or 2600 inch lbs. This may combine

with the propeller thrust giving a stress of

$$\frac{2600}{4.6} + 650 = 1210 \text{ lbs/sq in.}$$

As the propeller thrust is at a minimum during any maneuver that gives an appreciable gyroscopic couple, it is improbable that the combination of these two forces would exceed the maximum shown for the propeller thrust. (Max Gyroscopic Couple = 2580#)

The stresses shown above are well within the allowable limits of the material under consideration for use, Aluminum Company's Alloy #195, which has the following physical properties;

Tension:

Yield Strength.....	16,000 lbs/sq in.
Ultimate Strength.....	31,000 lbs/sq in.
Elongation.....	8% in two inches.

Compression;

Yield Strength.....	27,000 lbs/sq in.
Ultimate Strength.....	43,000 lbs/sq in.

Shear:

Shearing Strength.....	27,000 lbs/sq in.

Fatigue:

Endurance Limits.....	6,000 lbs/sq in.

Hardness:

Brinell.....	65.

Throughout the design of the gearcase and crankcase, it will be noted that every effort has been made to eliminate localization of stresses by the advantageous use of large fillets and careful disposition of metal in the various sections.

Considerable care has been exercised in the selection of the various sections discussed above and it is believed that they represent the maximum stressing in the crankcase and that, while the stresses in other locations will be lower, no value will exceed those herein mentioned.

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8-SHEETS
SHEET # 4

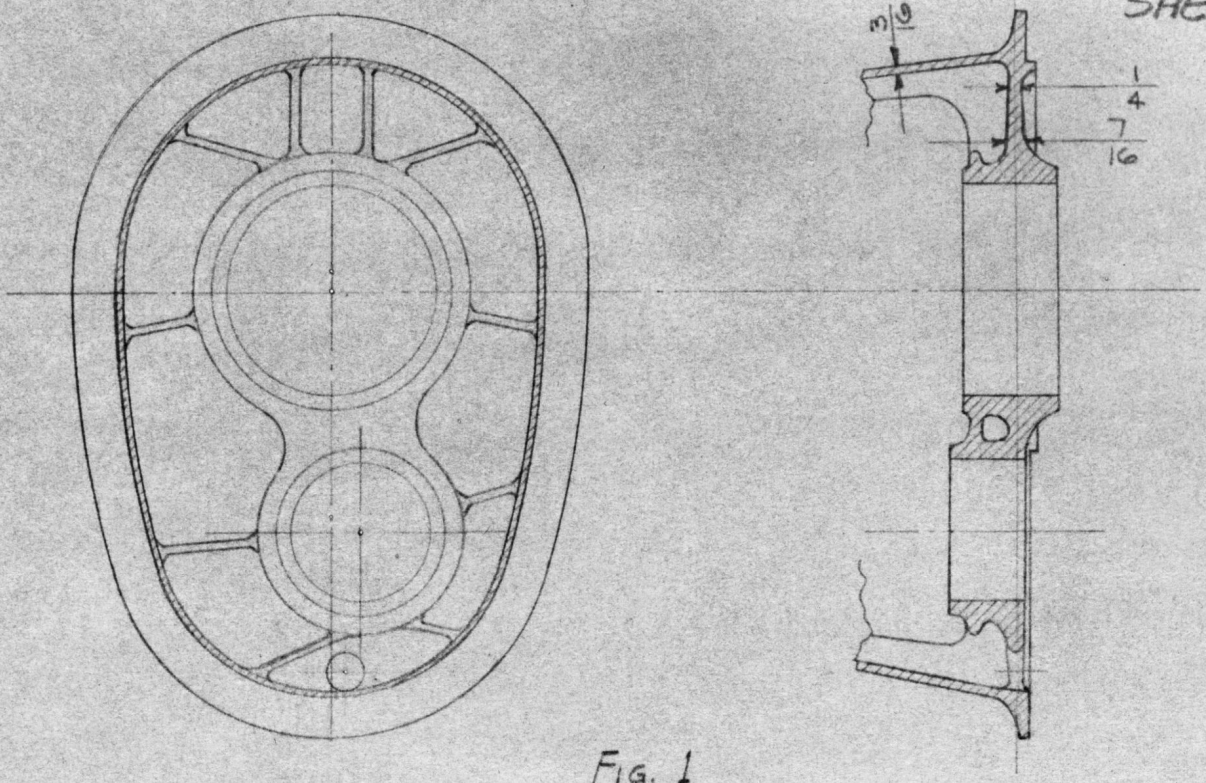

FIG. 1
NOSE SECTION
DIAPHRAGM

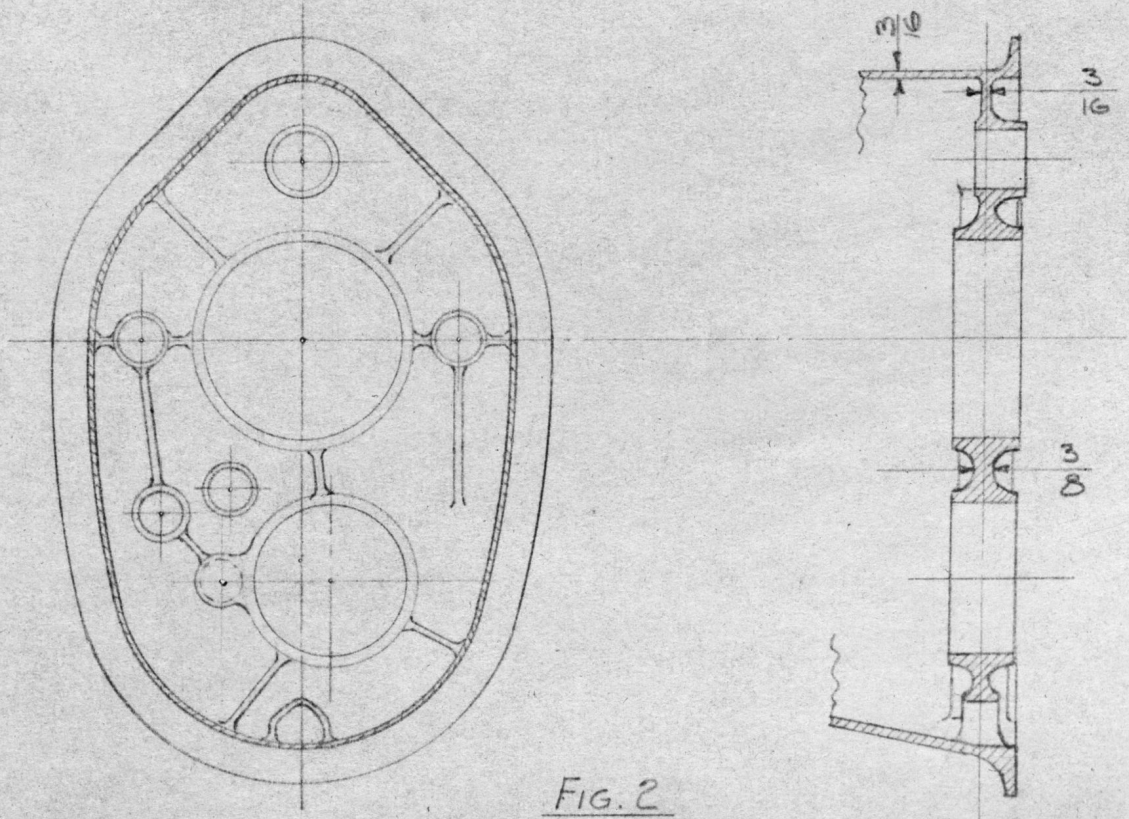

FIG. 2
REDUCTION GEAR
HOUSING DIAPHRAGM

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SHEET # 5

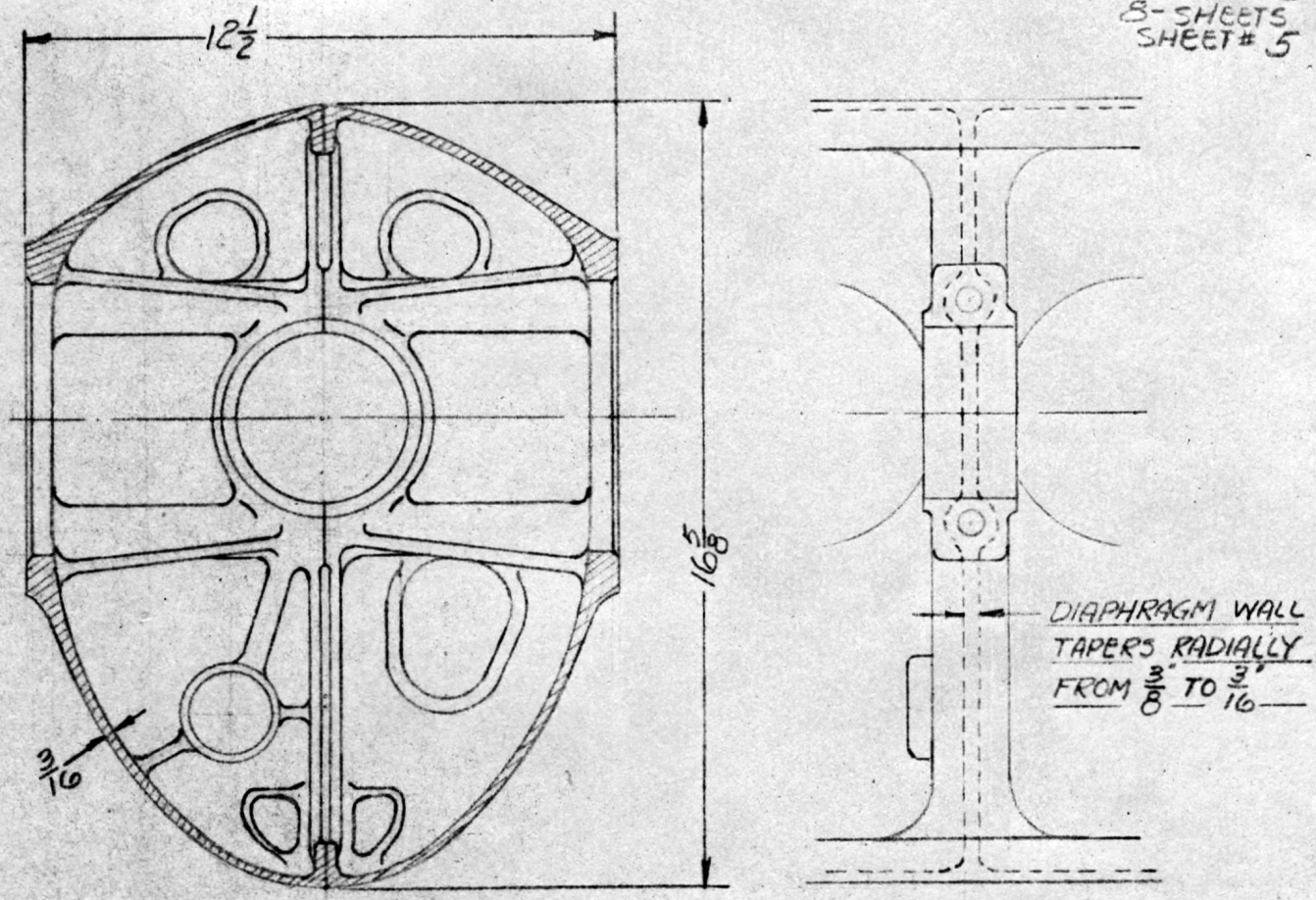


FIG 3
TYPICAL CRANKCASE SECTION

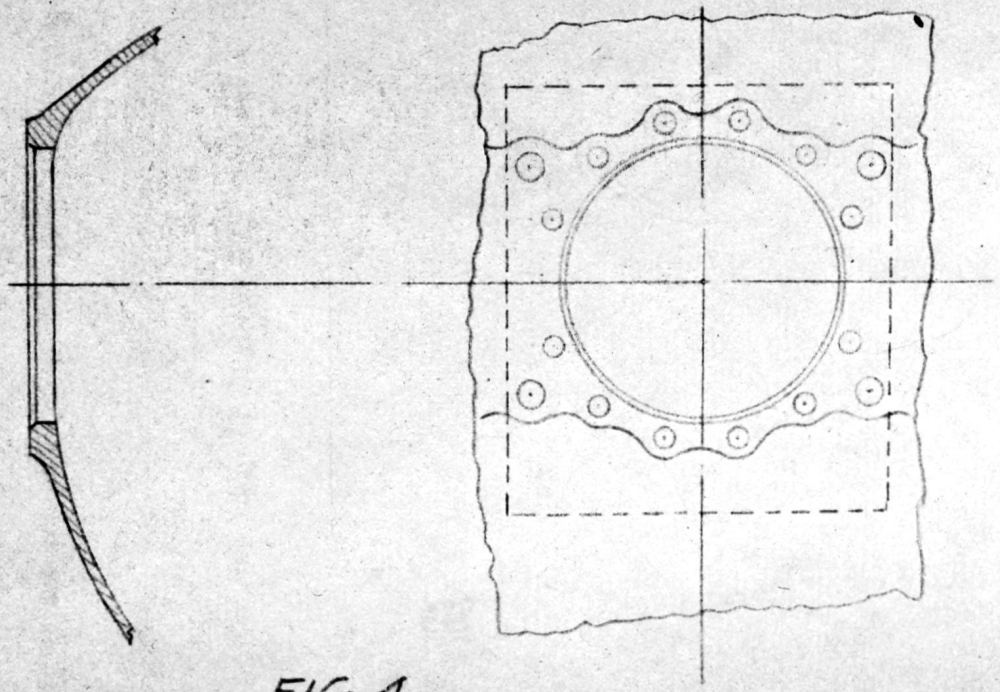
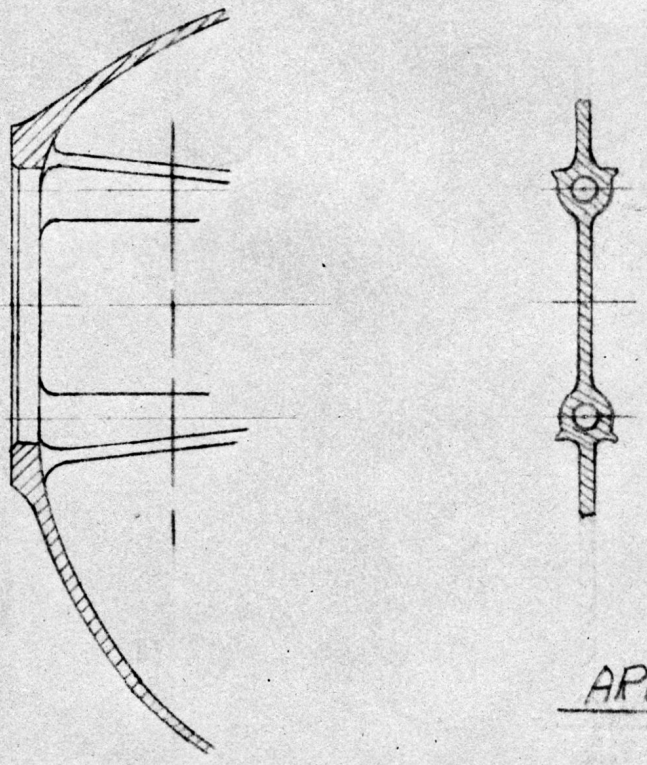


FIG 4
SECTION AROUND CYLINDER FLANGE
AREA CUT BY DOTTED LINES = 5.03"



AREA = 3.50"

FIG 5
SECTION THRU TYPICAL CRANKCASE DIAPHRAGM

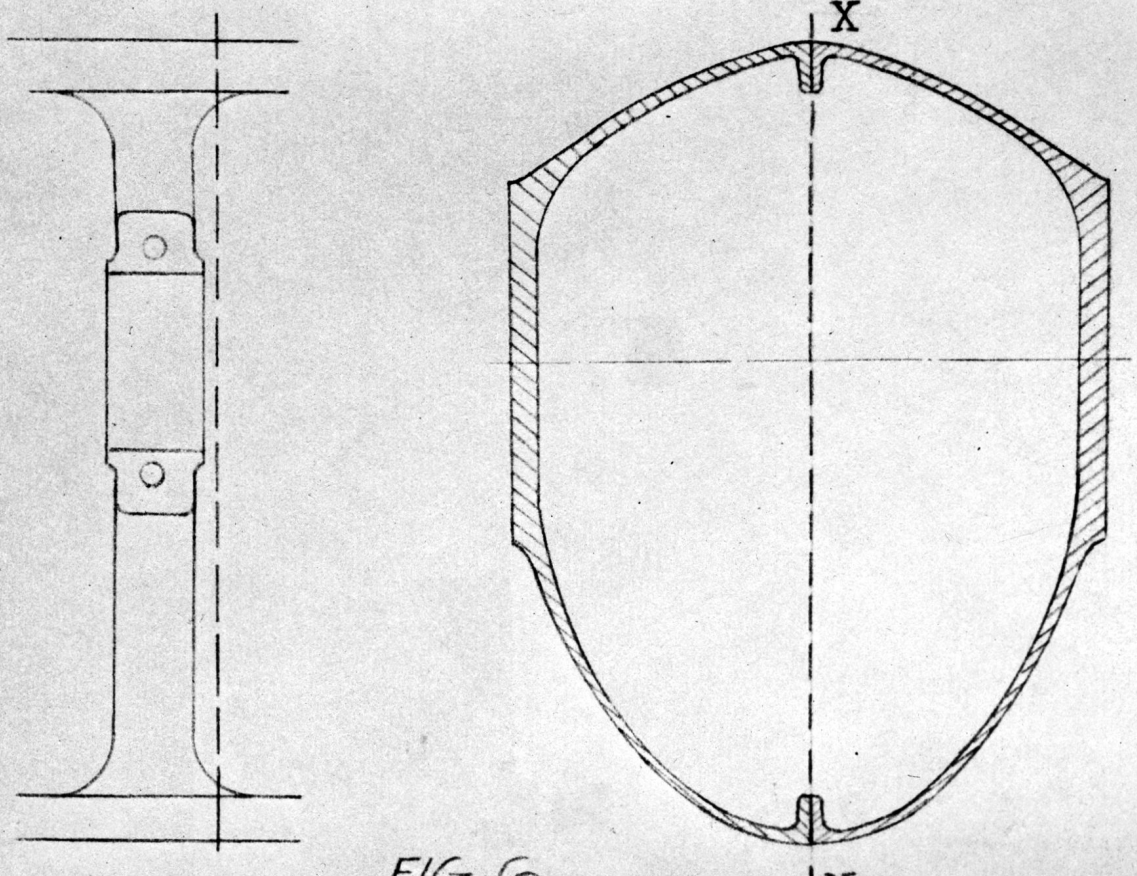


FIG. 6
SECTION THRU CRANKCASE $\frac{1}{2}$" FROM CENTER DIAPHRAGM
SECTION MODULUS = 51.3 IN^3

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SHEET #7

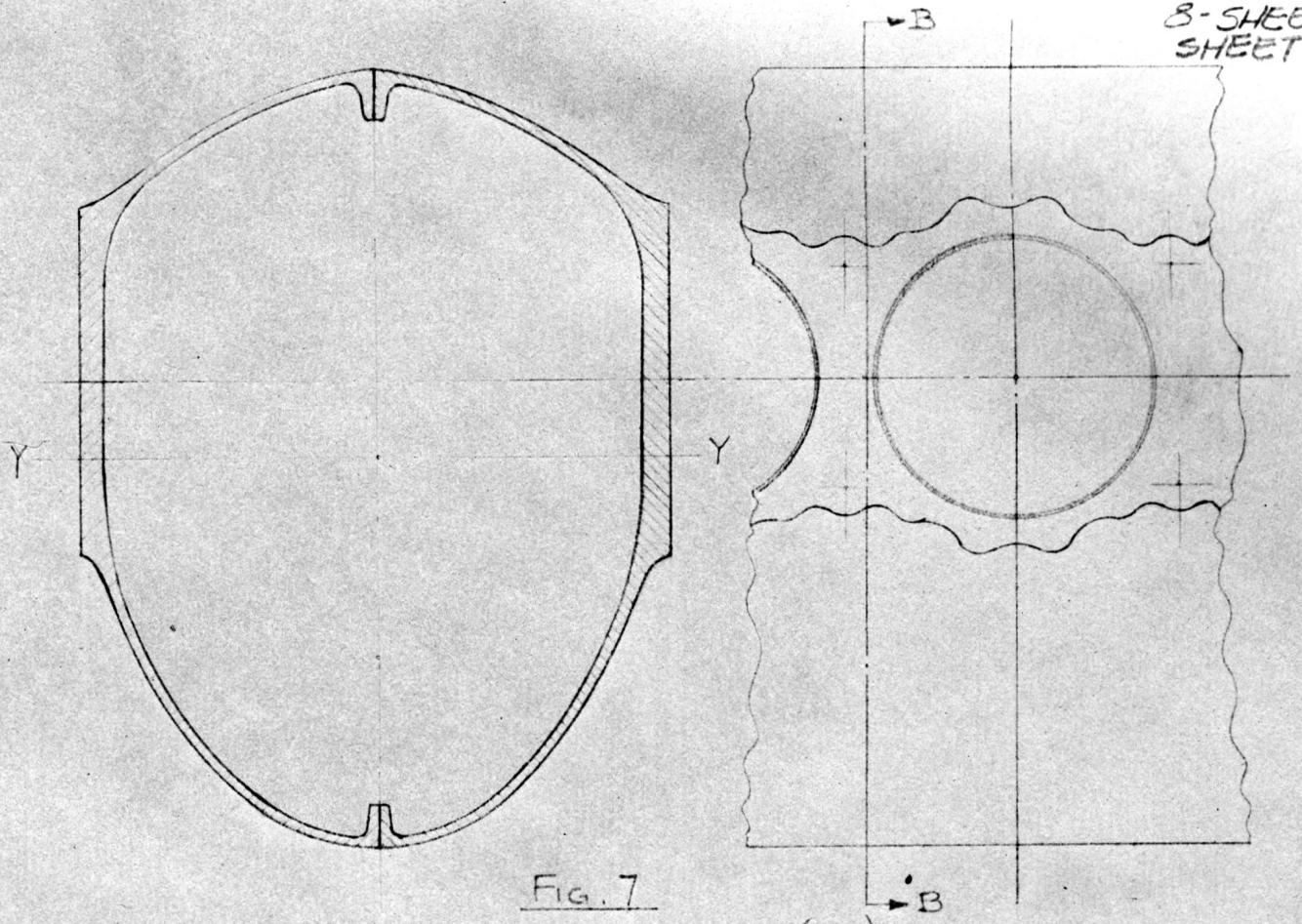

FIG. 7

SECTION THRU CRANKCASE (B-B).
ON ℄ NO. 1 CYLINDER.
SECTION MODULUS - 124.03 IN^3

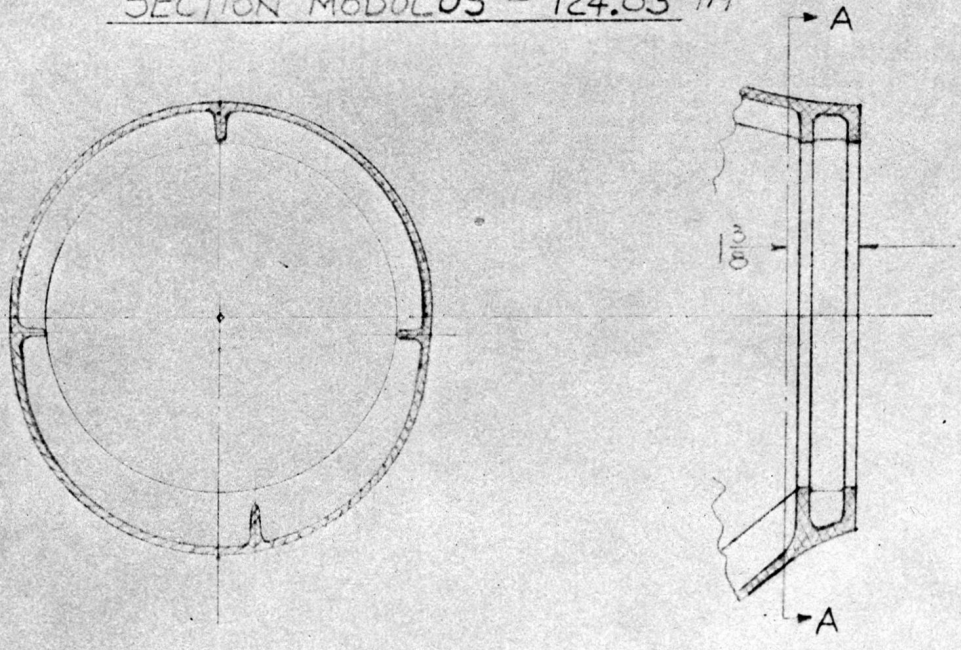

FIG. 8

SMALLEST NOSE SECTION
(A-A) TAKEN 1 3/8" FROM
FRONT FINISH AS SHOWN

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8-SHEETS
SHEET #8

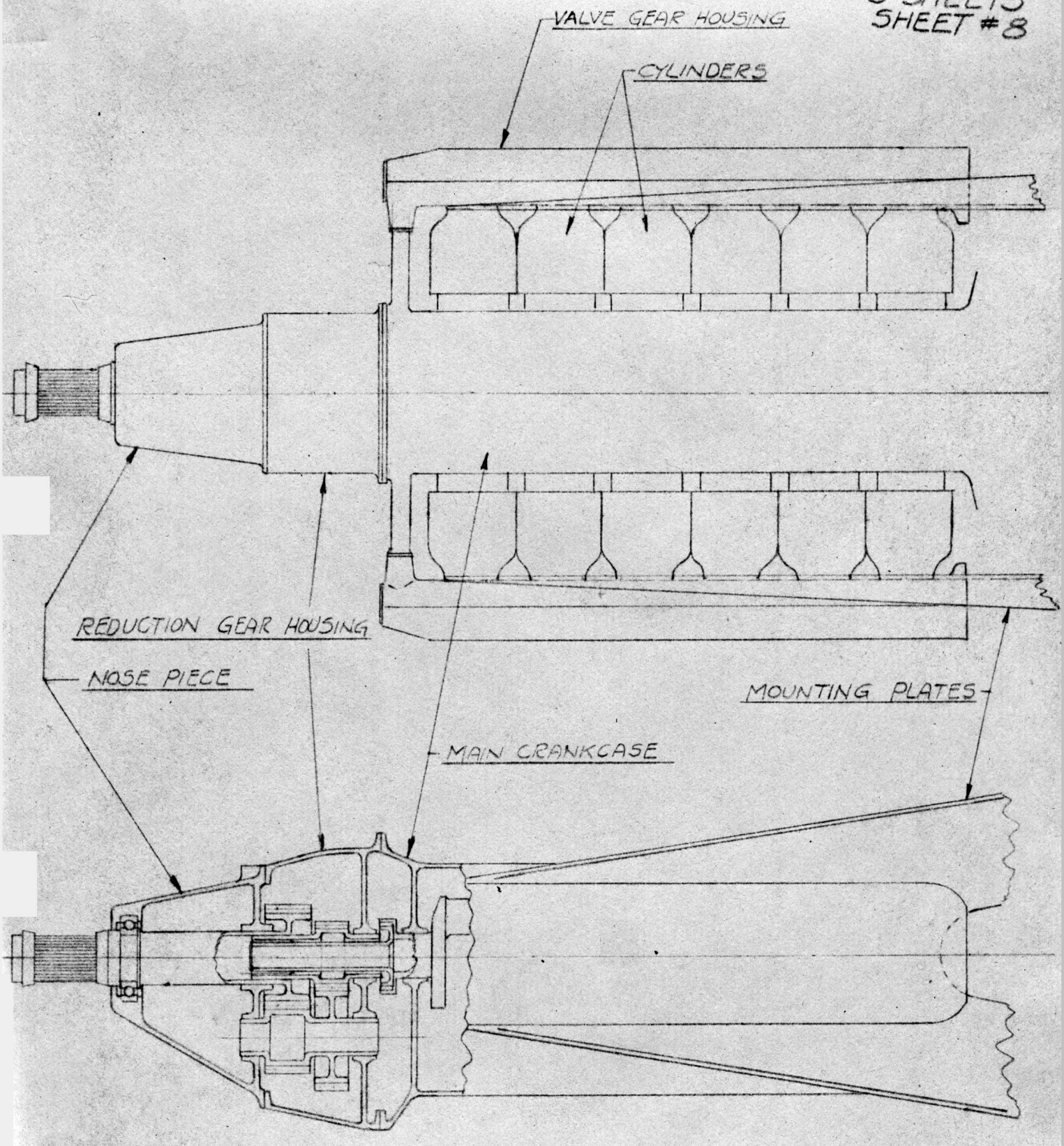

FIG. 9

ENGINE ASSEMBLY DIAGRAM