

for moderate revolution propellers, the maximum breadth of the developed blades is usually slightly greater (1"~3") than radial length from boss to tip in 3 bladed propellers, and about  $\frac{3}{4}$  length for 4 bladed one.

In the high revolution, the max. breadth of the developed area is about 1.3 to 1.4 times radial length of blade.

The diameter of Boss: ———

The diameter of the boss mainly depends on the diameter of the shaft, the thickness of metal in the boss at the centre varying

from .4" to 6" for propellers of 6' dia.  
 " 8" to 9" " 12' "

The root section of Blades: ———

As an approximation preparing to drawing the propeller the length of root section may be taken equal to the diameter of boss, being 2" to 3" less in large propeller of 12' dia. and 2" to 3" greater for smaller propellers particularly in the high revolution type.

The thickness of root section may then be obtained by using a constant of 150 for

$$\frac{n \cdot P \cdot R^2 \cdot N \cdot P}{P(D-d)}$$

where  $n$  = no. of blade for each propeller.

$b$  = breadth of root in inches

$h$  = thickness of root in inches

$N$  = revolutions per min.

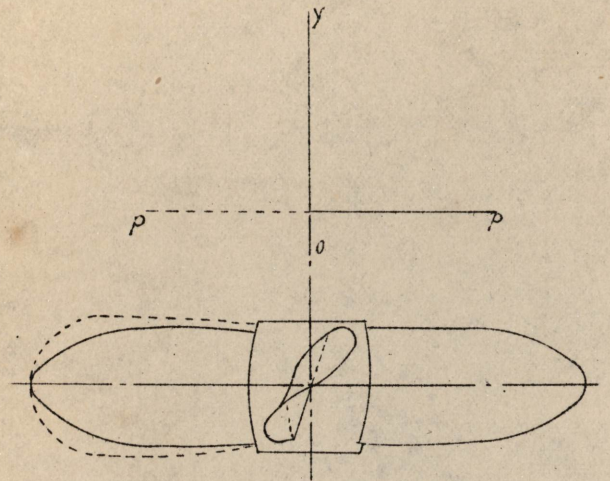
$P$  = Pitch in ft.

$P$  = S.H.P. per propeller.

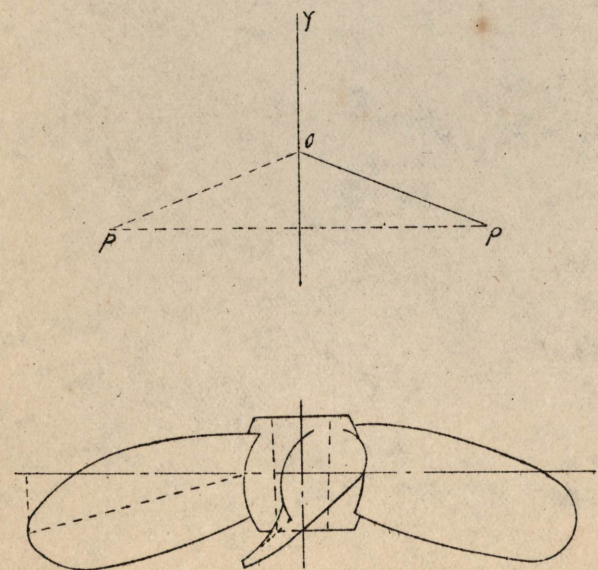
$D$  = dia. of propeller in feet

$d$  = dia of boss in feet.

第 6 圖



第 7 圖



The thickness of blade tips;—

The thickness of blade tip is about

$\frac{1}{4}$ " in blade of 6 ft diameter.

$\frac{1}{2}$ " " " " " "

The taper of the shaft in the cone;—

It should be 1 in 12.

The Keys:—

The keys are designed for a mean shearing stress of 20000 lbs/sq in on the mean dia of coned part of shaft. The propeller key or keys must transmit the whole of the twisting moment of the engine, and should be made as strong as the shaft.

The nut on secured end of shaft must be carefully guarded against slacking back, and the nuts and studs securing gland at forward end the cone if latter is separate from the propeller nut and all other attachments should be prevented from slacking back.

Example.

Design a propeller for a Bath ship.

Total S.H.P. = 4,8000

No. of shafts = 4.

(Power equally divided into each shaft)

Speed of ship = 23k.

R.P.M. = 290.

...  
 $\frac{10000}{\pi \times 2000} = 1.59$   
 $D = 1.59 \times 1000 = 1590$   
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...  
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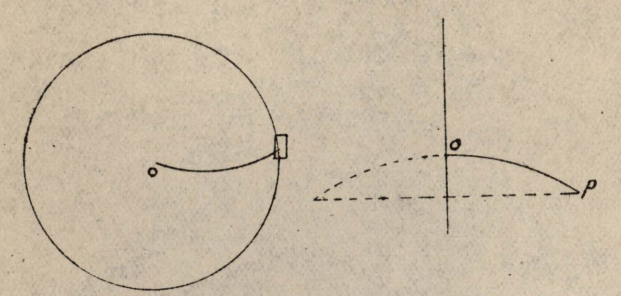
...  
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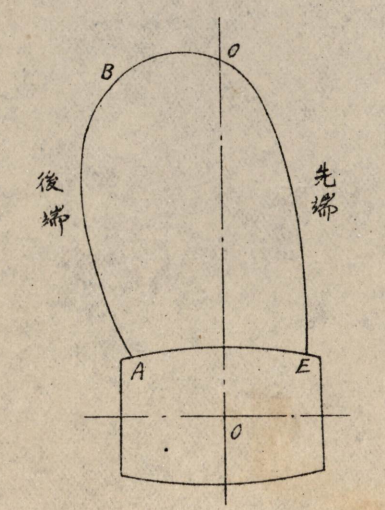
...  
 $\frac{10000}{\pi \times 2000} = 1.59$   
 $D = 1.59 \times 1000 = 1590$   
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...  
 $\frac{10000}{\pi \times 2000} = 1.59$   
 $D = 1.59 \times 1000 = 1590$   
 $D = 1.59 \times 1000 = 1590$

第 8 圖



第 9 圖



calculation: —

(1) Take peripheral speed = 10,000 ft/min.

(2) Diameter (D)

$$\pi D \times 290 = 10,000$$

$$D = \frac{10,000}{290 \times \pi} \approx 11'-0"$$

(3) Pitch (p) and Pitch ratio ( $\frac{P}{D}$ )

assuming pitch ratio = 0.94

$$P = D \times 0.94 = (11'-0") \times 0.94 = 10'-4"$$

(4) Apparent slip ( $\frac{v-v}{v} \times 100 = S\%$ )

$$v = 10.34 \times 290 \approx 3000$$

$$v = \frac{6080}{60} \times 23 = 2340$$

$$\therefore S = \frac{2000 - 2340}{2000} \times 100 = 22\%$$

(5) Effective Thrust

In recent practice usually assume propulsive eff. = 0.5

$$\text{Effective thrust} = \frac{\text{S.H.P.} \times 326 \times 0.5}{v} = \frac{12,000 \times 326 \times 0.5}{23} = 85,000 \text{ lbs.}$$

(6) Projected area ( $A_p$ )

assuming 13 lbs of thrust / sq ft

$$A_p = \frac{85,000}{13} = 6525 \text{ sq ft} = 45.5 \text{ sq ft}$$

(7) Projected area ( $A_p$ )

$$p.a. = \frac{A_p}{A} = \frac{\text{Projected area}}{\text{Peripheral area}}$$

$$0.202 = \frac{2.24}{p} = A$$

$$A = \sqrt{1 + 0.8 \times 0.94^2} \times 2.24 = 2.74$$

$$(2.74 = \frac{2.24}{p} = \frac{A_p}{A})$$

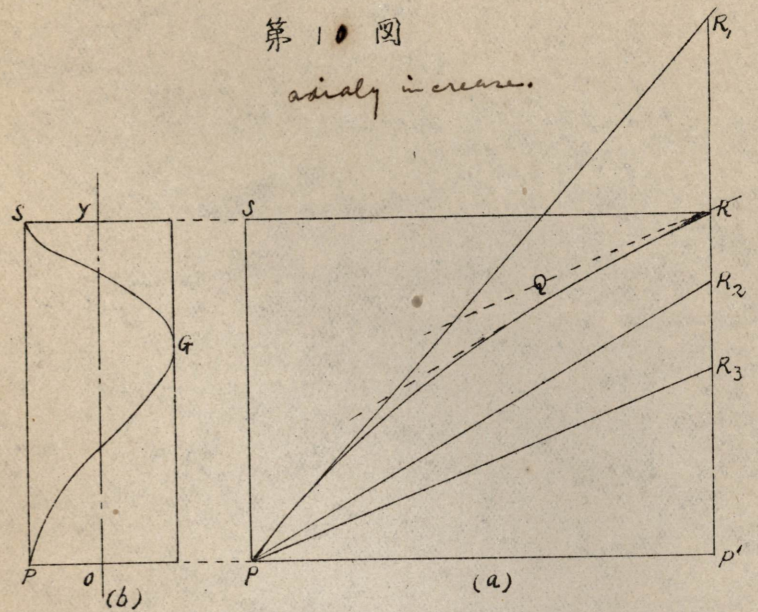
(8) Diameter of propeller  
 Diameter of propeller depends on the diameter of the shaft and in recent practice the turbine ship, the larger diameter of the propeller for T.R.D. = 0.52 x diameter of propeller = 0.52 x 11' = 5.72' = 5' 8.64"

(9) Thickness of the water in the propeller  
 at the center of the propeller in the water in the propeller

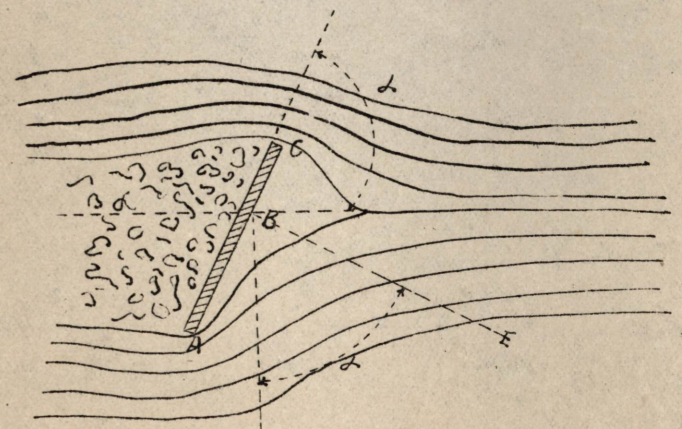
$$\frac{12,000 \times 326 \times 0.5}{23} = \frac{12,000 \times 326 \times 0.5}{23}$$

第 10 圖

axially increase.



第 11 圖



(7) Developed area ( $A_D$ )

$$\frac{\text{Projected area}}{\text{Developed area}} = \frac{A_p}{A_D} = 0.9$$

$$A_D = \frac{45.5}{0.9} = 50.5 \text{ sq'}$$

or

$$\frac{\text{Developed area}}{\text{Projected area}} = \sqrt{1 + 0.3p^2} \text{ (where } p = \text{pitch ratio)}$$

$$A_D = \sqrt{1 + 0.3 \times 0.9^2} \times 45.5 = 57.40'$$

$$\left( \text{that is } \frac{A_p}{A_D} = \frac{45.5}{57.4} = 0.88 \right)$$

(8) Diameter of Boss

Diameter of boss usually depends on the diameter of the shaft and in recent for the turbine ship, the largest diameter of boss = 0.22 x diameter of propeller for T.B.D. = 0.27 " " " B.S.

$$\therefore \text{Diameter of boss} = (11'-0") \times 0.27 = 3'-0" \text{ (in mean part)}$$

(9) Thickness of the metal in the boss at the centre.

For the thickness of the metal in the boss at the centre take 8"

(10) Root section

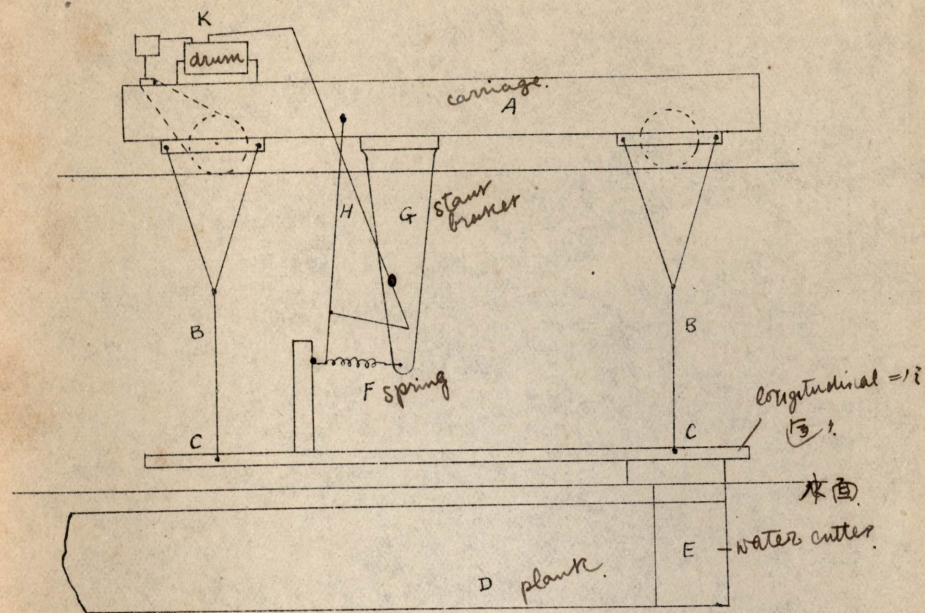
$$150 = \frac{n b h^2 p N}{7(D-d)}$$

$$= \frac{3 b h^2 \times 10 \frac{4}{12} \times 290}{12,000 \left(11 - 2 \frac{10}{12}\right)} = \frac{3 b h^2 \times \frac{124}{12} \times 290}{12,000 \times 8 \frac{2}{12}}$$

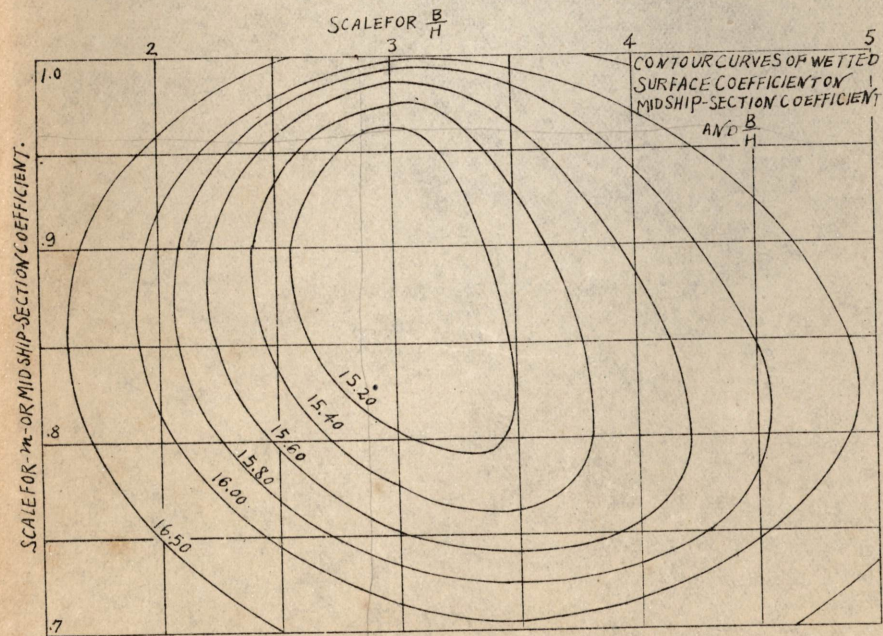
$$0.9 = \frac{A_p \times 0.9}{A_D} \Rightarrow A_D = \frac{A_p}{0.9}$$

*[Faint handwritten notes and calculations, including 'Pitch ratio', 'Diameter of propeller', 'Diameter of shaft', 'Diameter of boss', 'Developed area', 'Projected area', 'Pitch ratio', 'Diameter of propeller', 'Diameter of shaft', 'Diameter of boss', 'Developed area', 'Projected area', 'Pitch ratio']*

第 12 圖  
摩擦抵抗測定試驗裝置  
(W. Froude &)



第 13 圖



$$\therefore b \times h^2 = \frac{150 \times 100 \times 98}{31 \times 29} = 1640$$

$$b = 40'' \quad (\text{W. Provided})$$

$$h^2 = \frac{1640}{40} = 41 \quad \therefore h = 6.4 = 6\frac{1}{4}''$$

Principal dimensions.

Total S.H.P = 48,000      Dia. of propeller = 11'-0"  
 No. of shafts = 4      Pitch " = 10'-6"  
 Speed of ship = 23      Projected area = 45.50  
 R.P.M. = 290      Developed area = 57.40  
 Slip = 22%      Eff. thrust = 85,000 lbs.

(End)

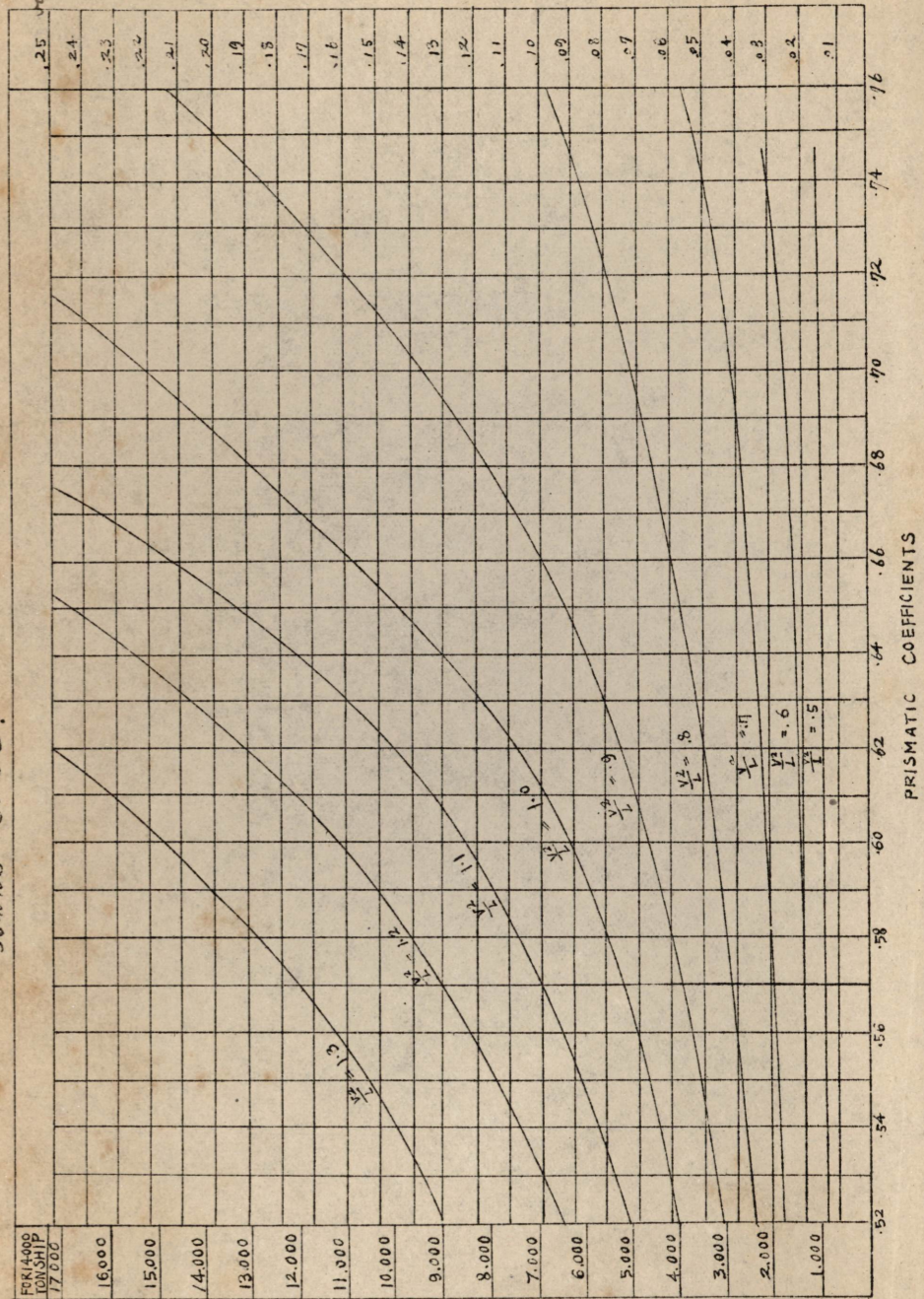
Exercise.

Design propeller for a battle ship.

Total S.H.P = 45,000  
 No. of shafts = 4  
 Speed of ship = 23  
 R.P.M = 300.

$$\begin{array}{r} 1250 \\ 4 \overline{) 45000} \\ \underline{8000} \\ 65000 \\ \underline{13000} \\ 52000 \\ \underline{13000} \\ 39000 \\ \underline{7800} \\ 31200 \\ \underline{31200} \\ 0 \end{array}$$

value of C.



第14圖  
Johns Curve.

*[Faint handwritten notes and calculations on the right page, including formulas like P = D x 0.14 x 110 x 10 x 0.14 = 10.0, and various other mathematical expressions.]*

Calculation; —

(1) Take peripheral speed = 10,000 ft/min.

(2) Diameter (D)

$$D = \frac{10,000}{300\pi} = 10'-7"$$

(3) Pitch (P) and pitch ratio ( $\frac{P}{D}$ )

Assuming pitch ratio = 0.94

$$P = D \times 0.94 = (10'-7") \times 0.94 = 10'-0"$$

(4) Apparent slip ( $\frac{v-V}{V} \times 100 = 8\%$ )

$$v = 10 \times 300 = 3000.$$

$$V = \frac{6080}{60} \times 23 = 2340$$

$$\therefore s = \frac{3000 - 2340}{3000} \times 100 = 22\%$$

(5) Effective thrust

In recent practice usually assume propulsive coeff. = 0.5

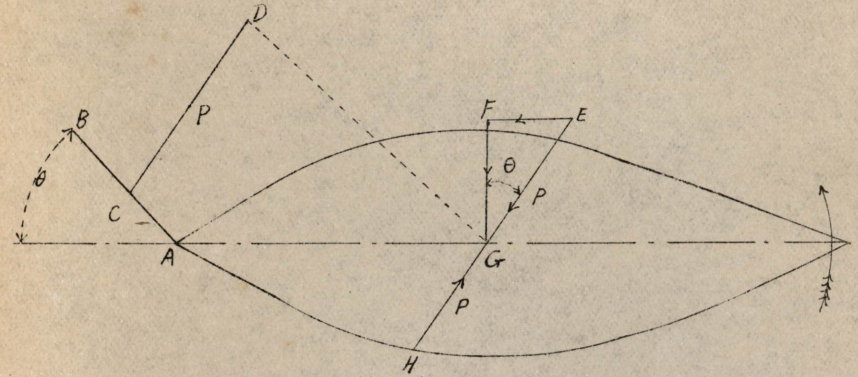
$$\begin{aligned} \text{Effective thrust} &= \frac{\text{S.H.P.} \times 326 \times 0.5}{V} = \frac{12,000 \times 326 \times 0.5}{2330} \\ &= 65,200 \text{ lbs.} \end{aligned}$$

(6) Projected area ( $A_p$ )

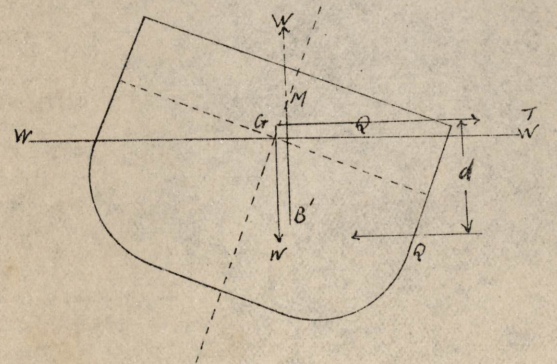
Assuming 13 lbs of thrust/sq ft

$$A_p = \frac{65200}{13} = 5020 \text{ sq ft} = 34.9 \text{ sq ft}$$

第 15 圖



第 16 圖



4. Developed area ( $A_D$ )

$$\frac{\text{Projected area}}{\text{Developed area}} = \frac{A_p}{A_D} = 0.9$$

$$A_D = \frac{34.9}{0.9} = 38.8 \text{ sq'}$$

or  $\frac{\text{Developed area}}{\text{Projected area}} = \sqrt{1+0.3p^2}$  (where  $p$  = pitch ratio)

$$A_D = \sqrt{1+0.3 \times 94^2} \times 34.9 = 39.4 \text{ sq'}$$

(that is  $\frac{34.9}{39.4} = 0.885$ )

(8) Diameter of Boss

$$\text{Diameter of boss} = (10' - 7'') \times 0.27 = 2' - 10''$$

(in mean part)

(9) Thickness of the metal in the boss at the center.

Take 8"

(10) Root section

$$150 = \frac{\pi b h^2 \lambda / p}{P(D-d)}$$

$$P = 11250$$

$$\lambda = 30^\circ$$

$$D = 10' - 7''$$

$$d = 2' - 10''$$

$$P = 10'$$

$$n = 3$$

$$150 = \frac{3 \pi h^2 \times 300 \times 10}{11250 \left( \frac{10' - 3}{4} \right)}$$

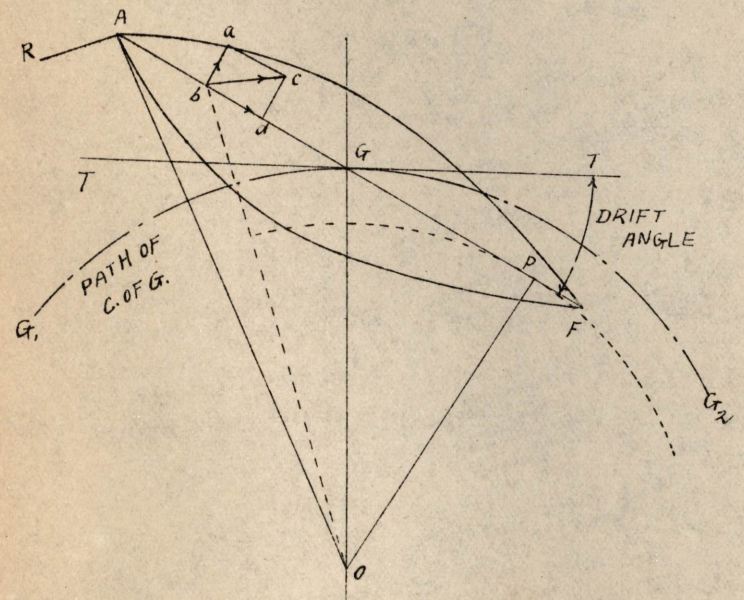
$$h^2 = \frac{150 \times 11250 \times 7 \frac{3}{4}}{3 \times 300 \times 10} = 140.625$$

$$1453.125$$

$$b = 40''$$

$$b = 40 \quad h^2 = \frac{1453}{40} = 35.82 \quad h = 5.98 \text{ in}$$

第 17 圖



$$\begin{array}{r} 387.5 \\ 37.5 \\ \hline 1937.5 \\ 2712.5 \\ 1162.5 \\ \hline 1453.12.5 \end{array}$$

$$\begin{array}{r} 50 \\ 75 \\ \hline 37.5 \end{array} \quad \begin{array}{r} 7.75 \\ 50 \\ \hline 387.50 \\ 37.5 \end{array}$$

4 1/2

$$\begin{array}{r} 37.5 \\ 37.5 \\ \hline 137.5 \\ 262.5 \\ 1162.5 \\ \hline 1406.25 \end{array}$$

$$\begin{array}{r} 358.2 \\ 40 \overline{) 1453} \\ \underline{120} \\ 233 \\ \underline{200} \\ 330 \\ \underline{300} \\ 30 \end{array}$$

150 x 11250 x 7.75

$$\begin{array}{r} 35.8 \quad 5.98 \\ 25 \overline{) 1000} \\ \underline{1000} \\ 980 \\ \underline{980} \\ 20 \\ 1188 \end{array}$$

$$\begin{array}{r} 127 \\ 34 \\ \hline 12937 \\ 129 \\ \hline 7 \end{array}$$

Developed area (A<sub>d</sub>)  

$$\frac{\text{Projected area}}{\text{Developed area}} = \frac{A_p}{A_d} = 0.9$$

$$A_d = \frac{34.9}{0.9} = 38.8'$$

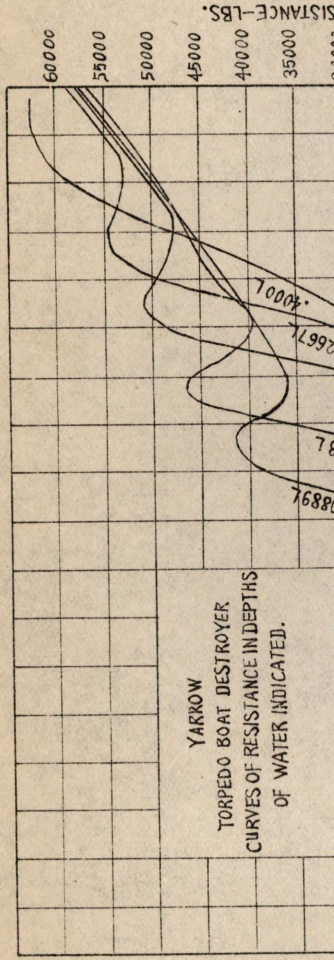
Developed area =  $\sqrt{1 + 0.1257} \times 34.9 = 39.40'$   
 (where  $\frac{34.9}{39.4} = 0.885$ )

(1) Diameter of Base  
 Diameter of base =  $(10^\circ - 7^\circ) \times 10.27 = 2.1$   
 (in mean part)

(2) Thickness of the metal in the base of the  
 cone  
 Take 1/8"

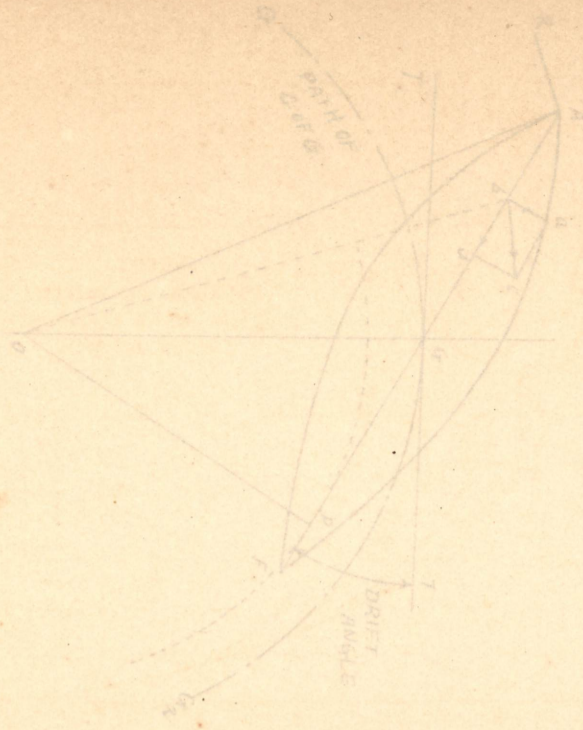
(3) Rear section

第 18 图

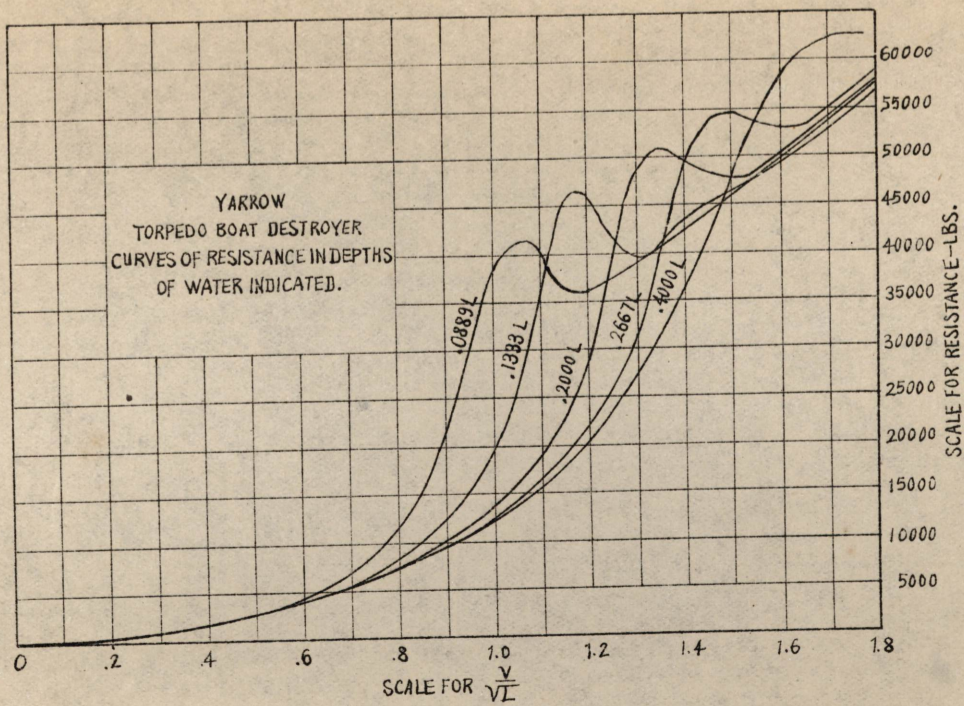


YARROW  
 TORPEDO BOAT DESTROYER  
 CURVES OF RESISTANCE IN DEPTHS  
 OF WATER INDICATED.

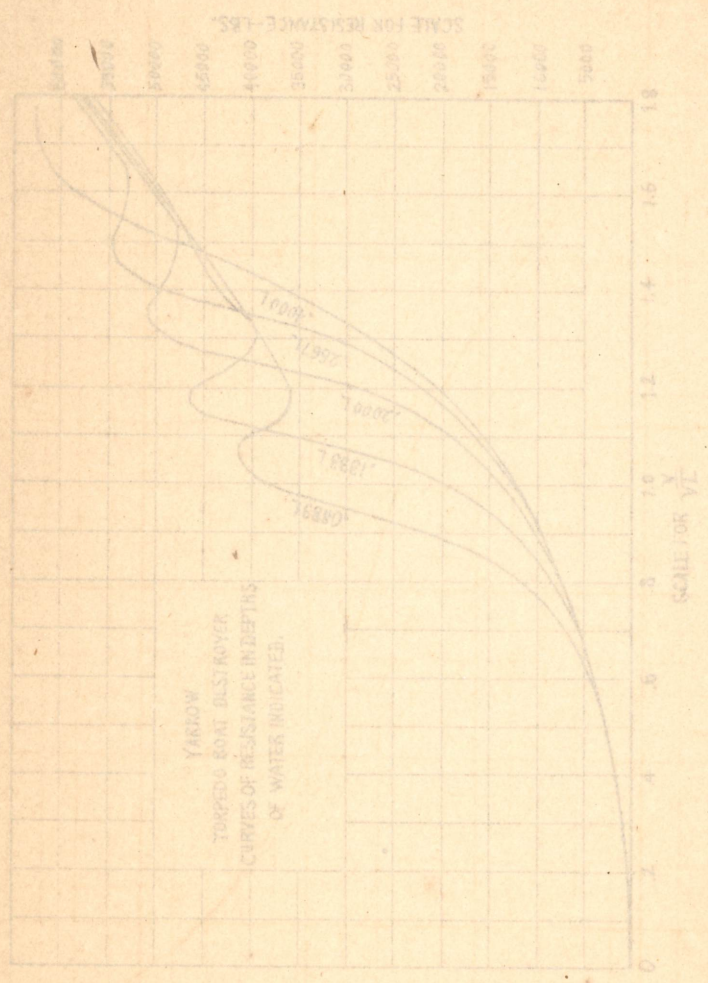




第 18 圖

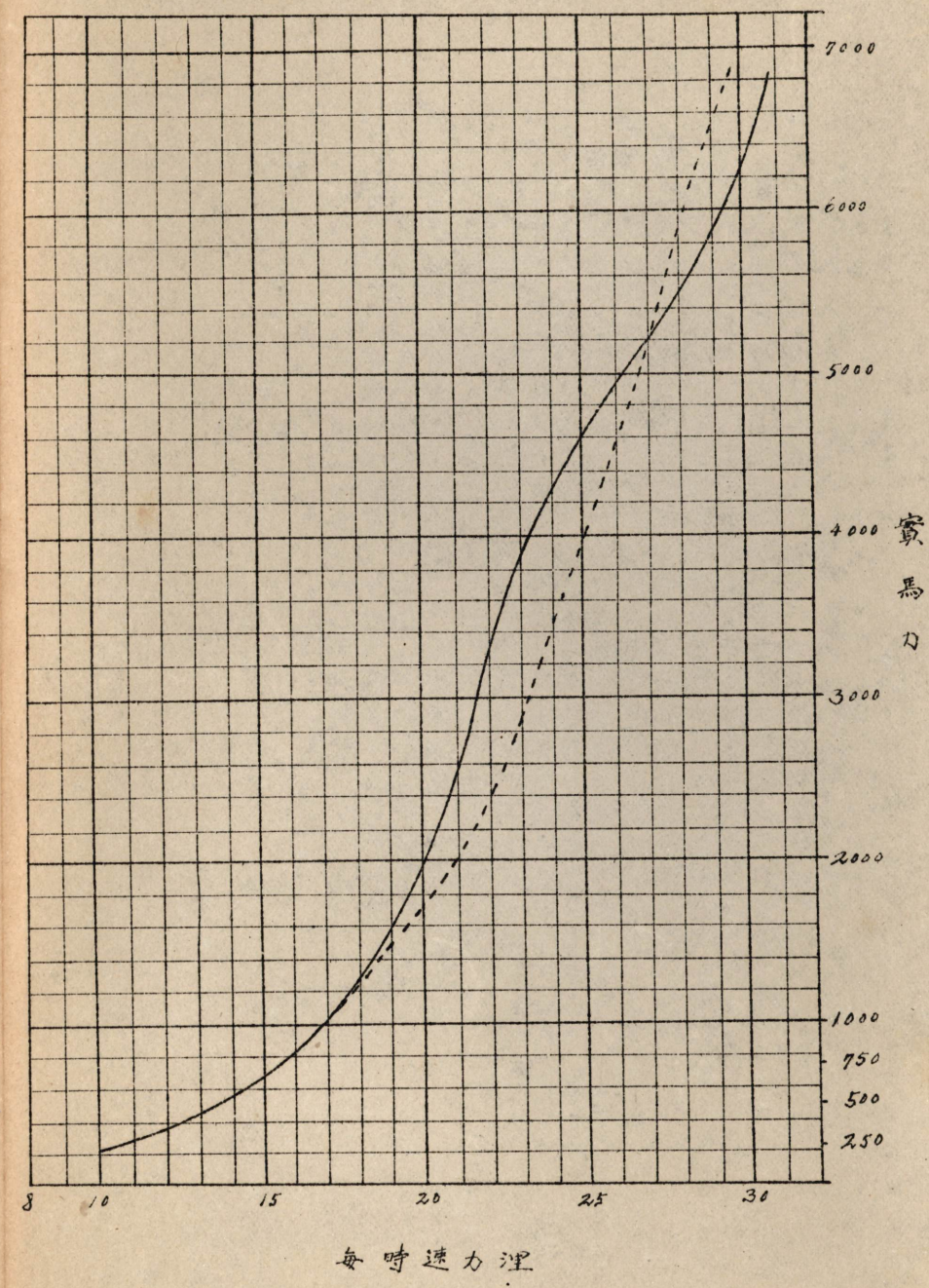


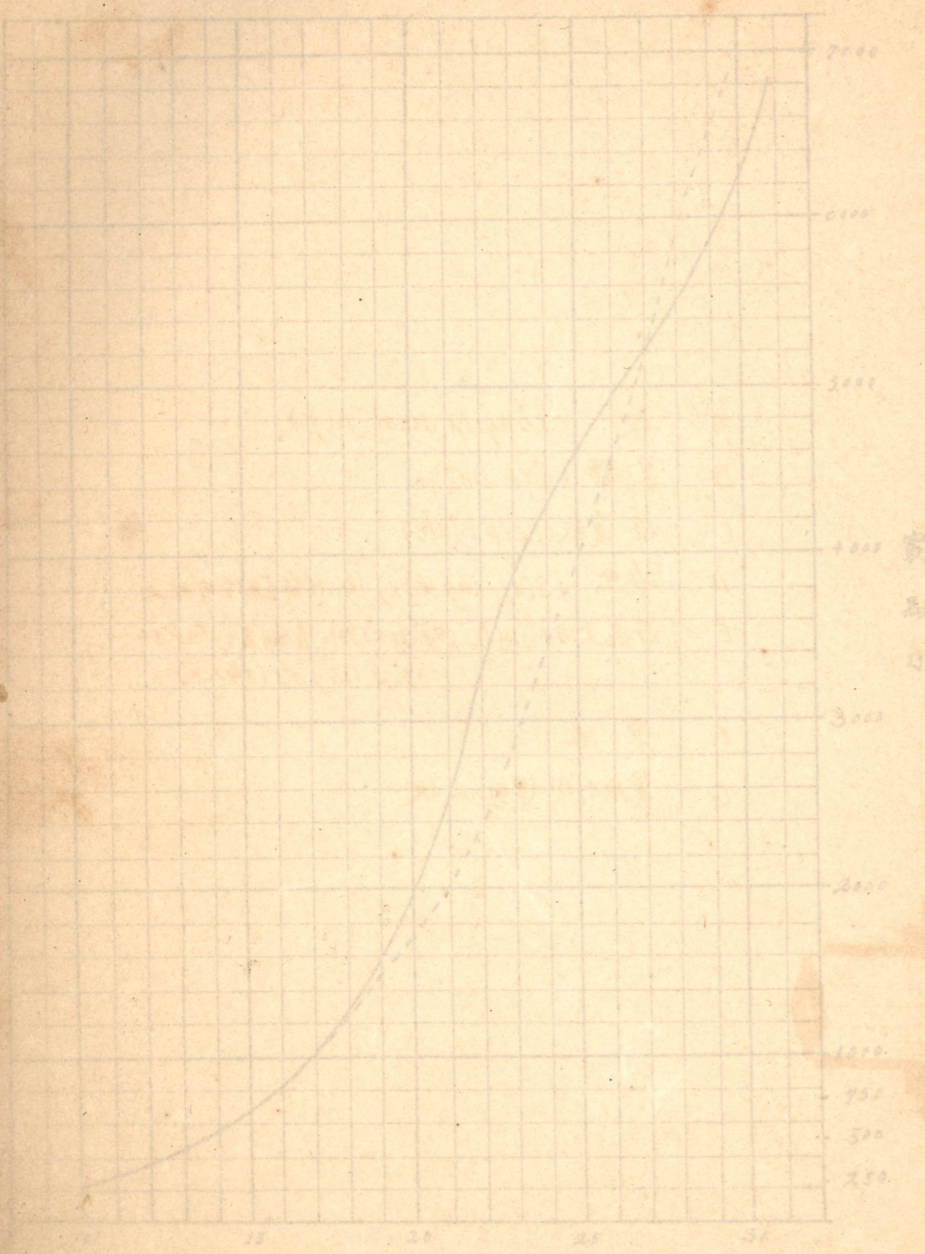
THE DEPTH OF WATER FOR EACH CURVE IN FIG. 18 IS INDICATED ON THE CURVE EXPRESSED AS A FRACTION OF THE LENGTH OF THE VESSEL.



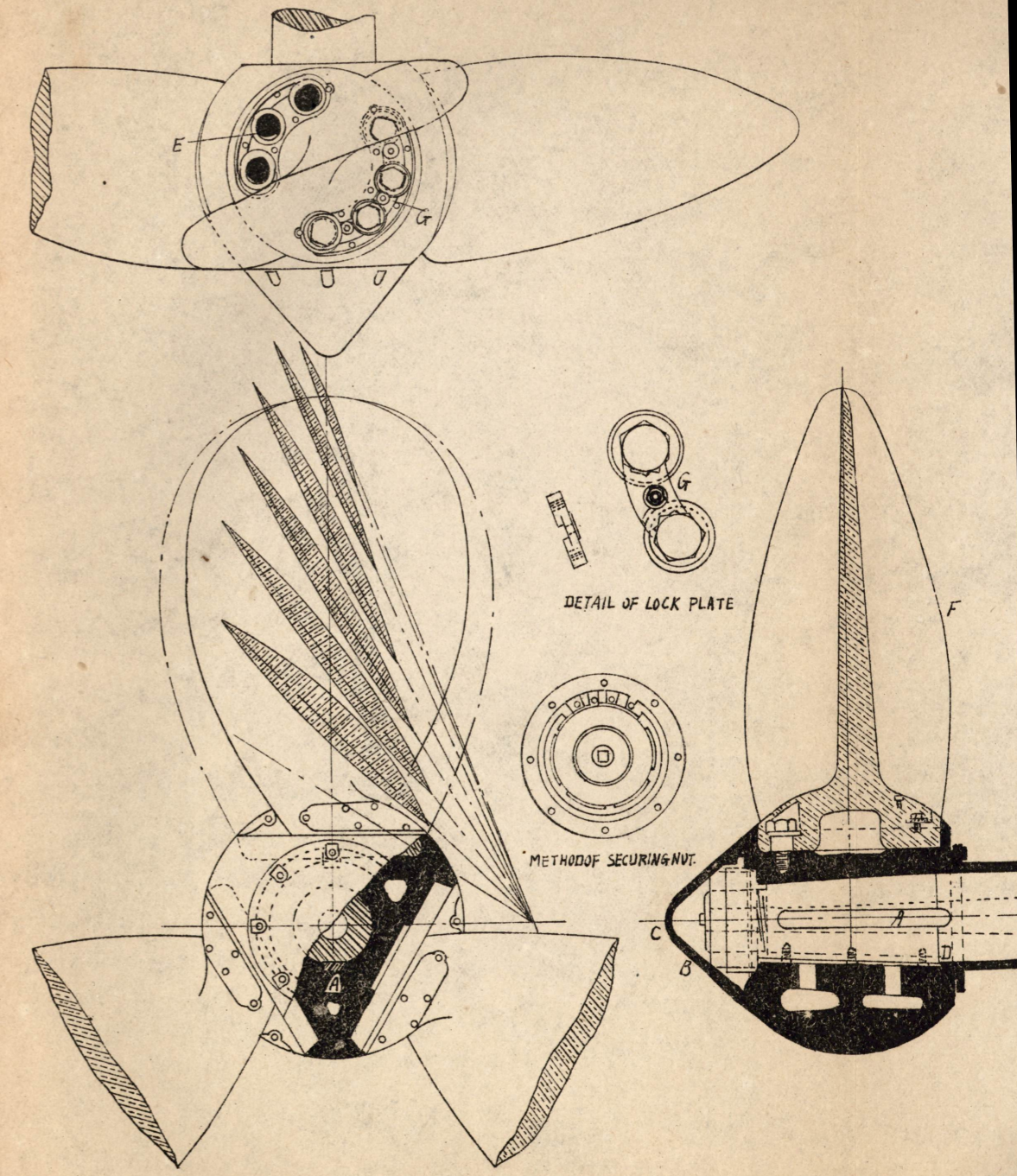
THE DEPTH OF WATER FOR EACH CURVE IN FIG. 18 IS INDICATED ON THE CURVE EXPRESSED AS A FRACTION OF THE LENGTH OF THE VESSEL.

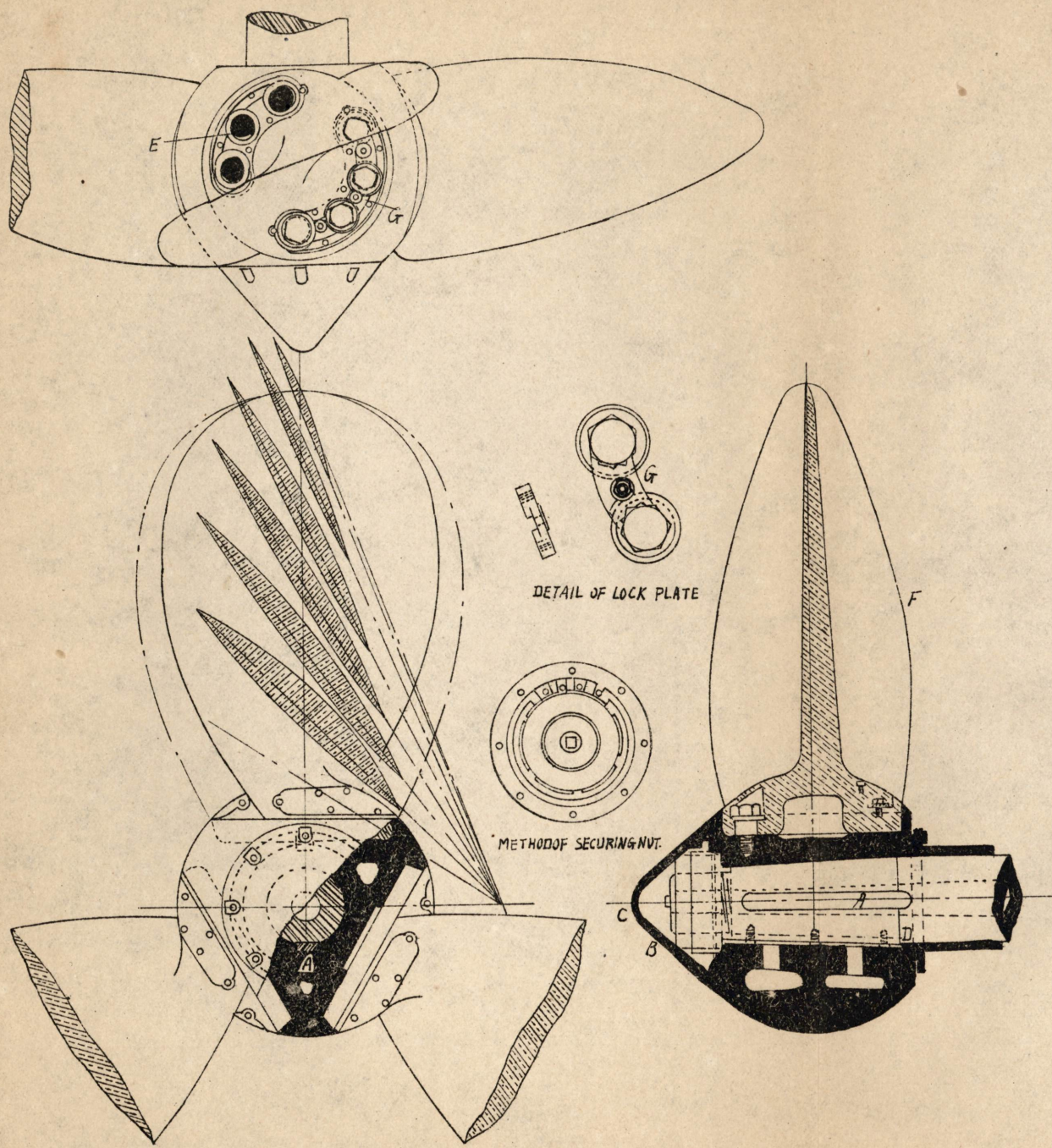
- A 橫 (longitudinal keel)
- B 蓋螺 (Cap nut)
- C 保蓋板 (keel plate)
- D 填墊 (Stiffing box) 海水管線作用防止
- E 許度使用構用孔 (螺釘、彈簧、鋼絲、銅絲、鋼索、鋼索、鋼索)
- F 翼、球
- G 翼板、斜板、鋼板



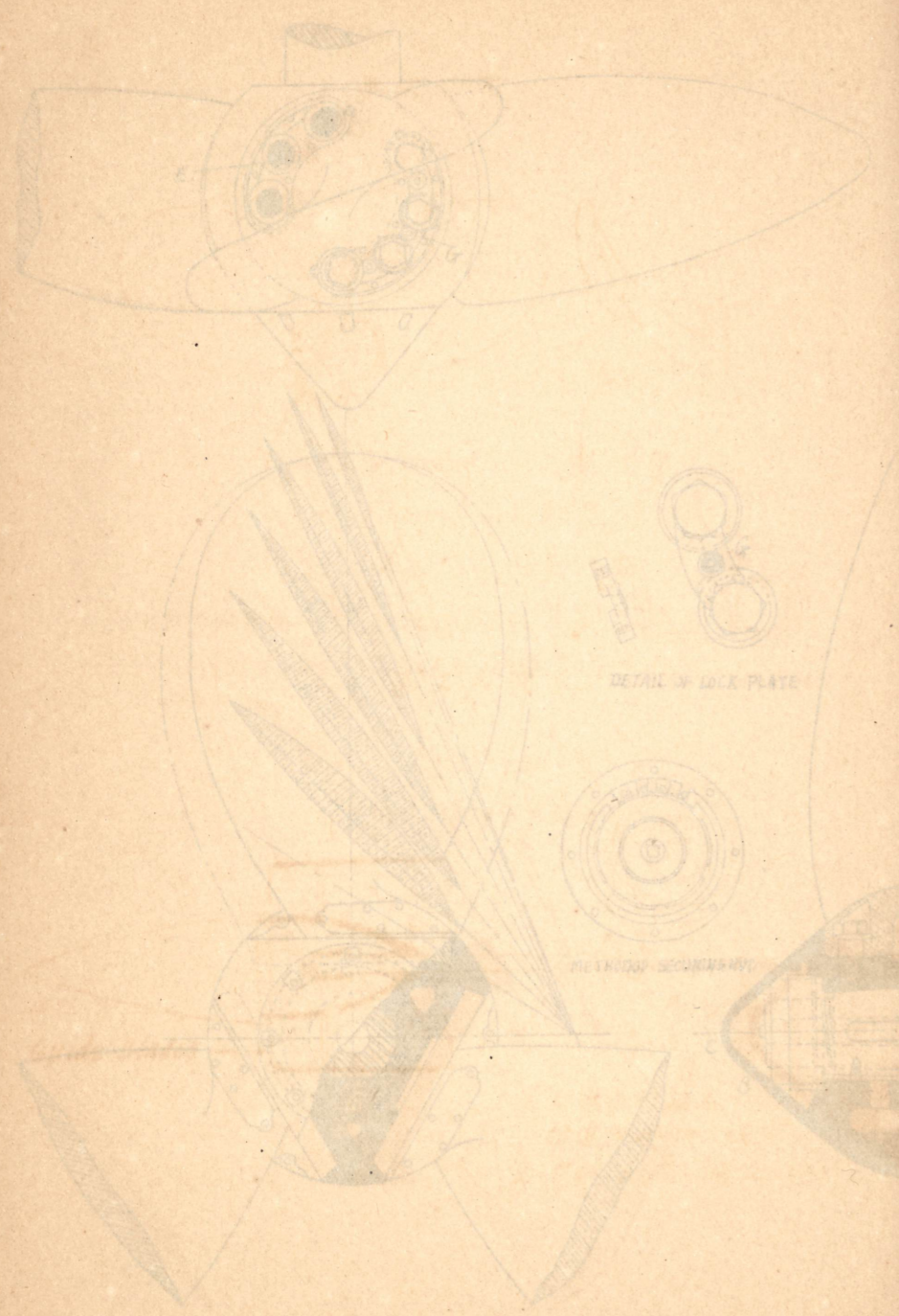


本图述力况

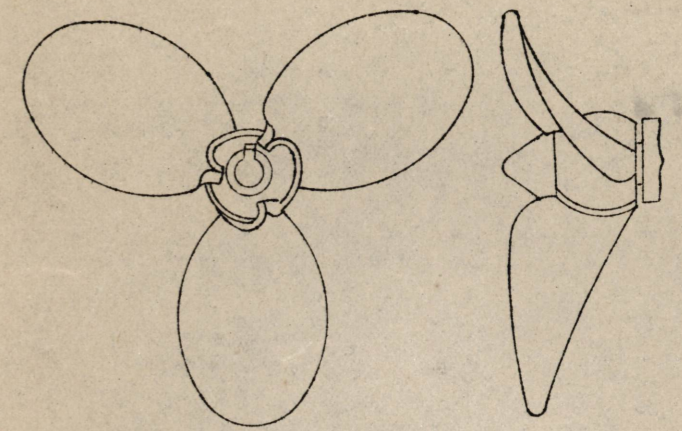




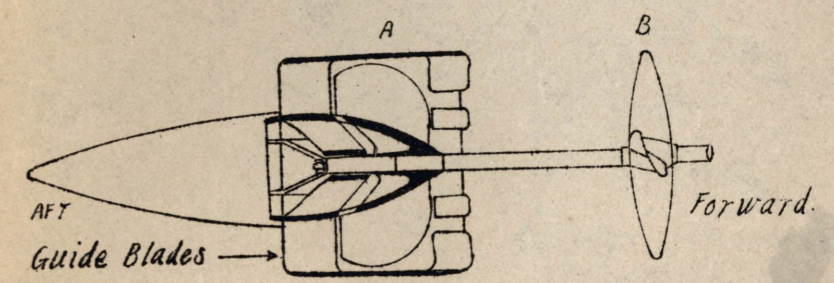
- A 楔 (Longitudinal key)
- B 蓋螺 (Cap nut)
- C 保護板 (Keep plate)
- D 填坐 (Stuffing box) 海水腐蝕作用防止
- E 節度更替用楯田孔 (螺釘の間、青銅若クハリグナム  
パイプ、ストロークヲ挿入ス)
- F 翼、縁
- G 翼取付用螺釘、止板



第 2 1 圖



第 2 2 圖

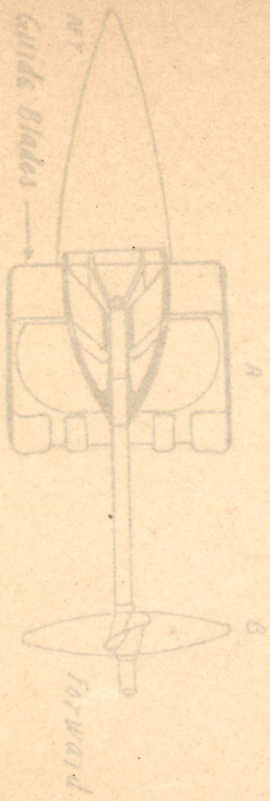


1. 后退用推進器、前進時、推進作用ヲサス様トセリ
2. ガイドレード、渦流ヲ防グ

第 21 圖

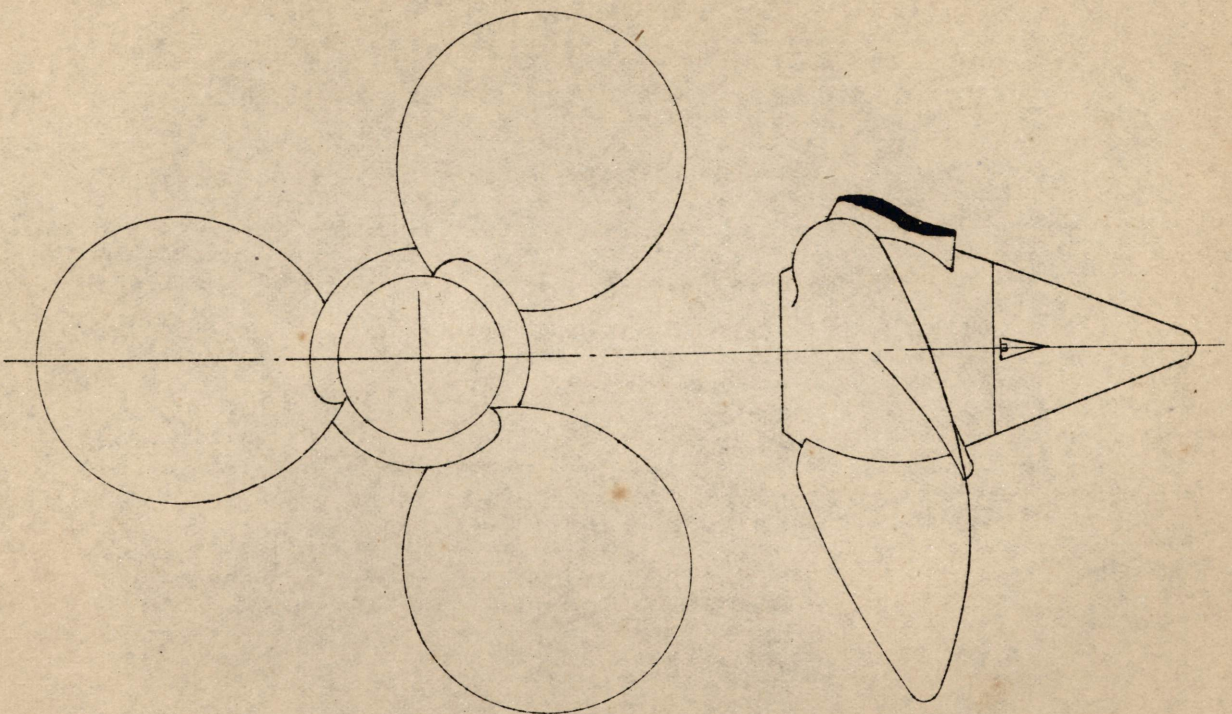


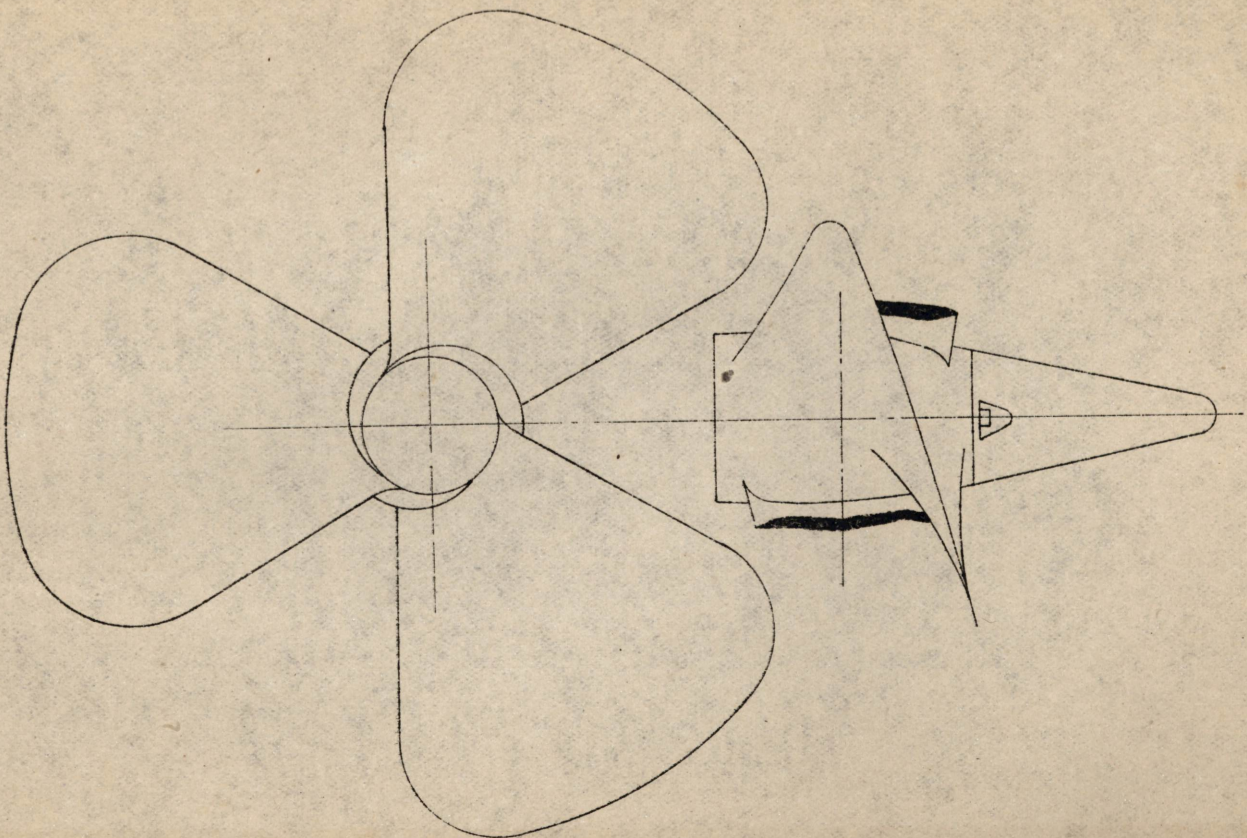
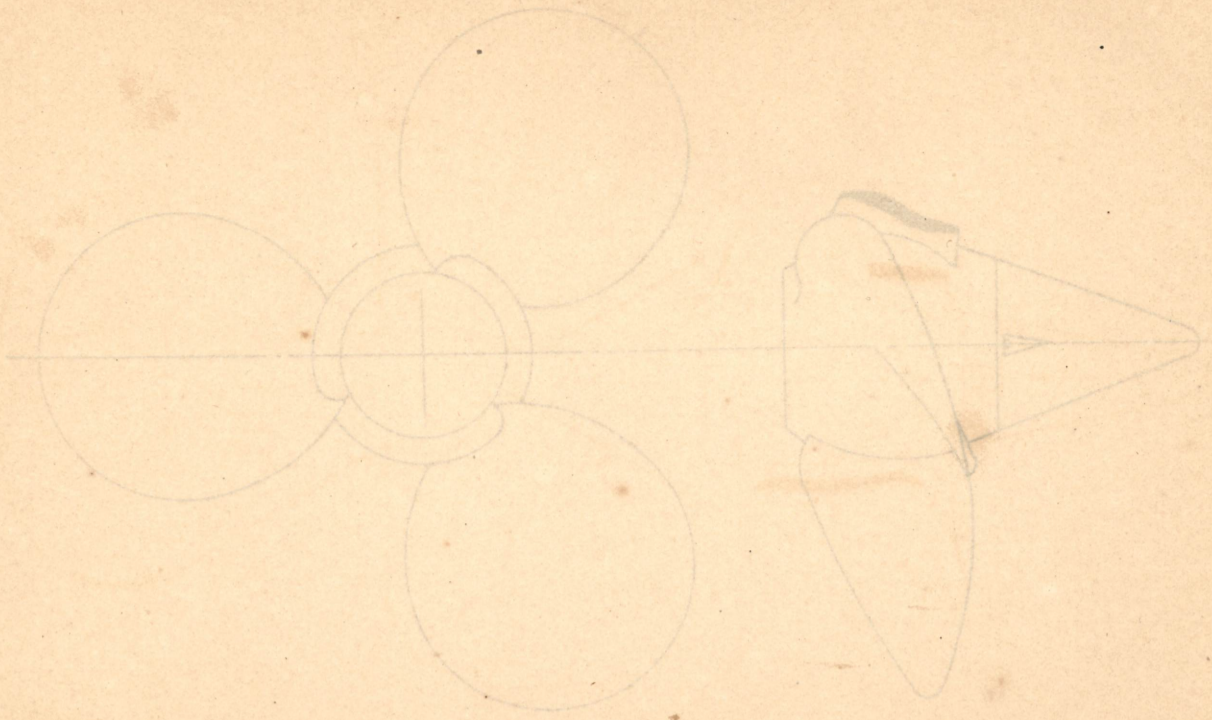
第 22 圖



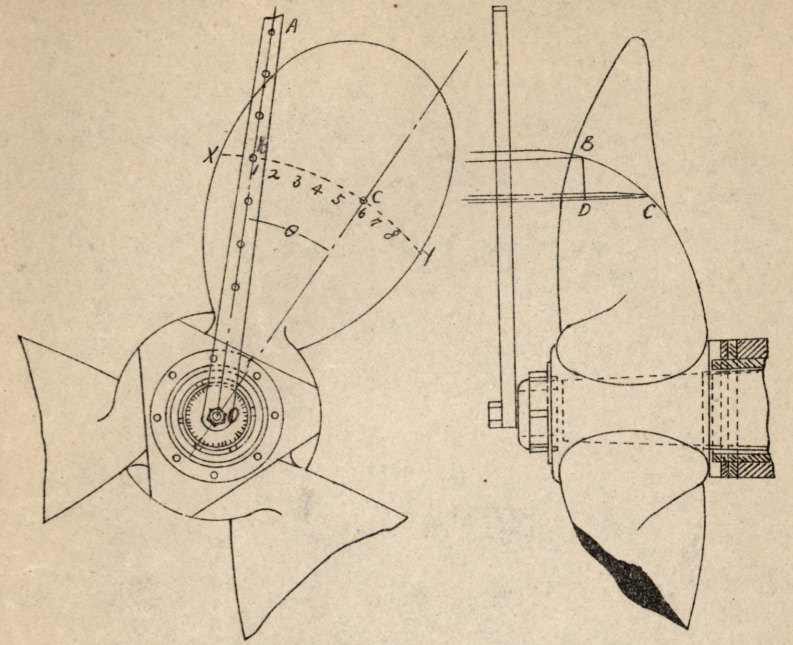
左邊用推進器，前進時  
推進物與+1+2線，+3+4  
2. 4. 5. 7. 9. 11. 13. 15. 17. 19.

第 23 圖



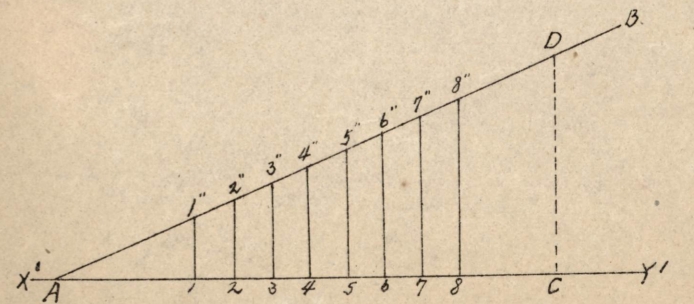


第 25 圖



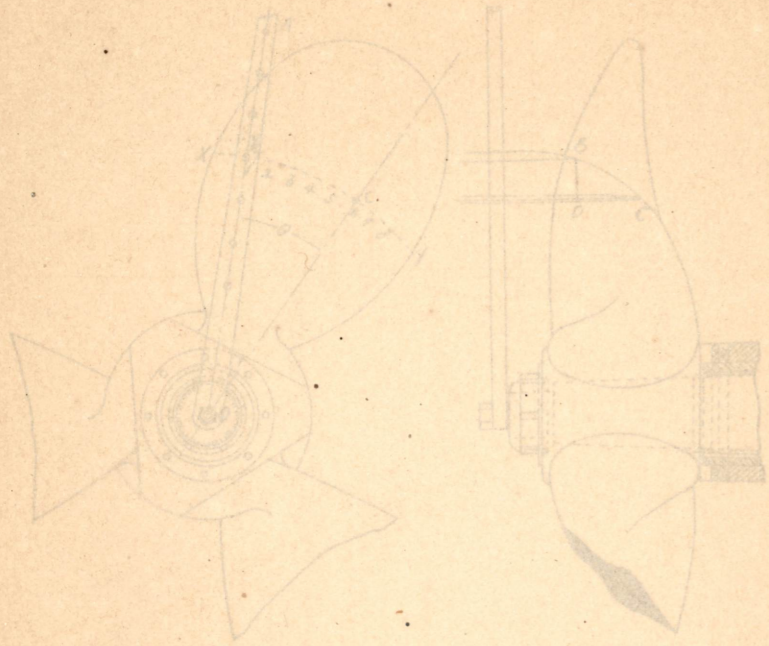
- Y 任意, 半径
- XY 棒 = 依リテ畫カタル弧
- BC 節 = 要スル間, ニ夾
- $\theta$  其, 角度

第 26 圖



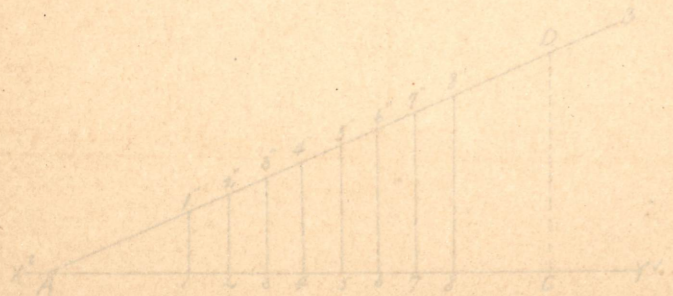


第 26 圖

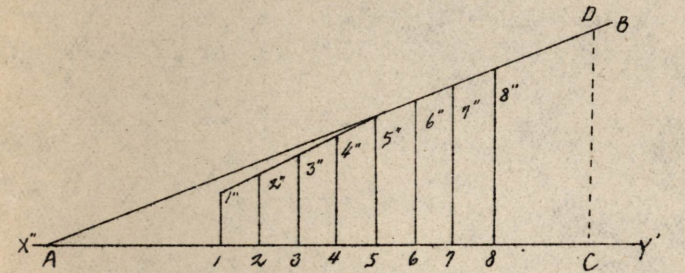
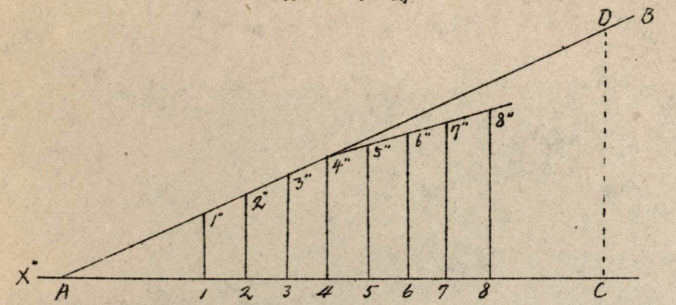


Y 法各半長  
 XY 法一板之量  
 BC 法一板之量  
 B 法一板之量

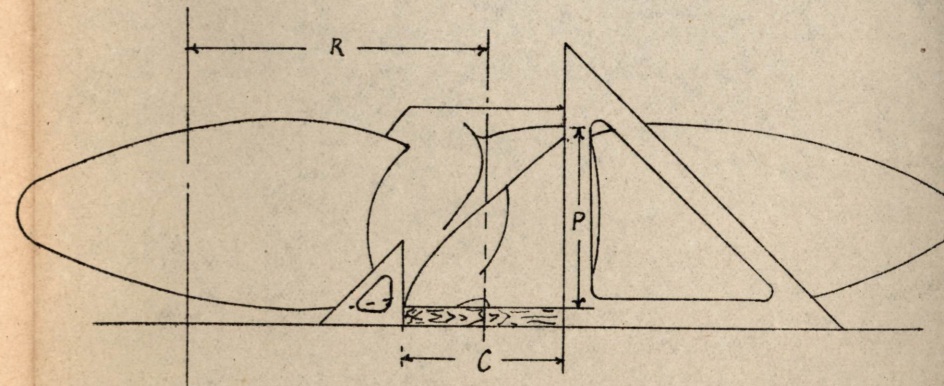
第 27 圖



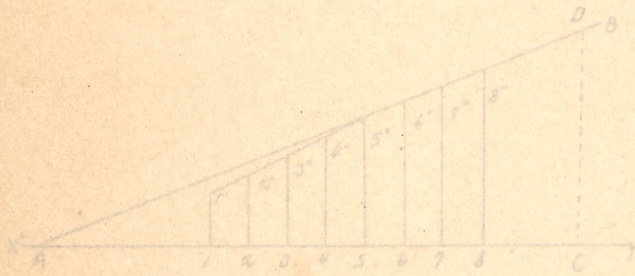
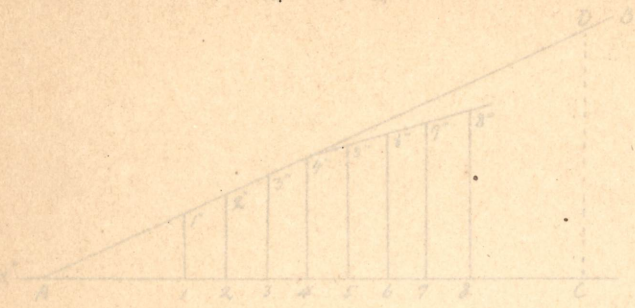
第 27 圖



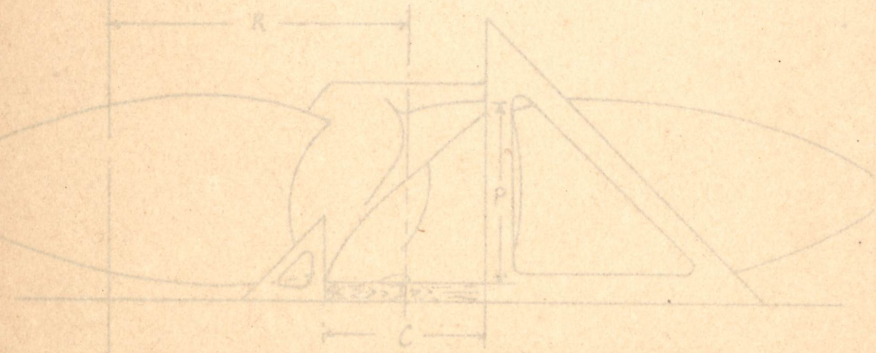
第 28 圖



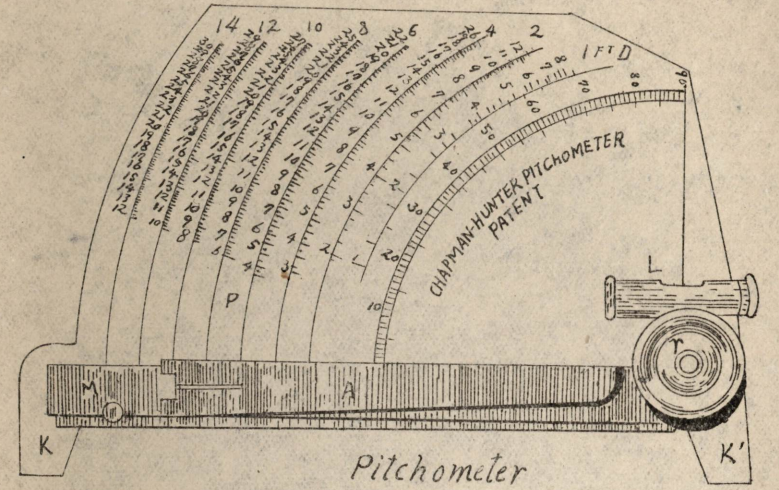
第27图



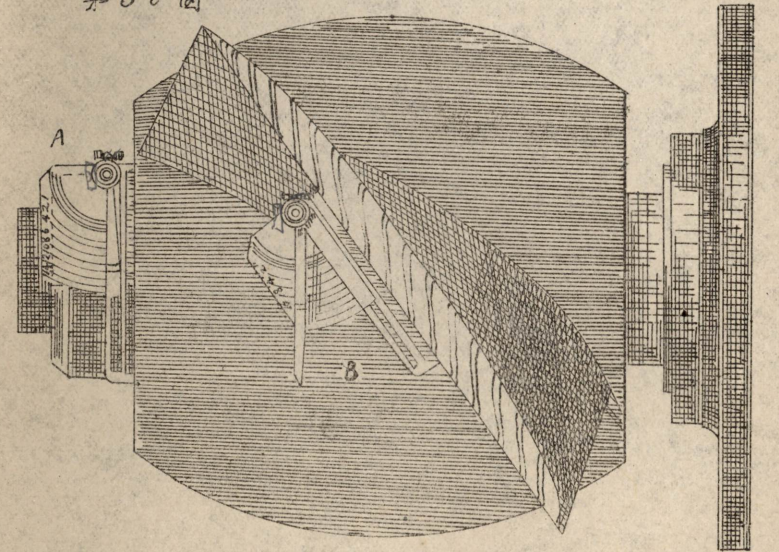
第28图



第29图

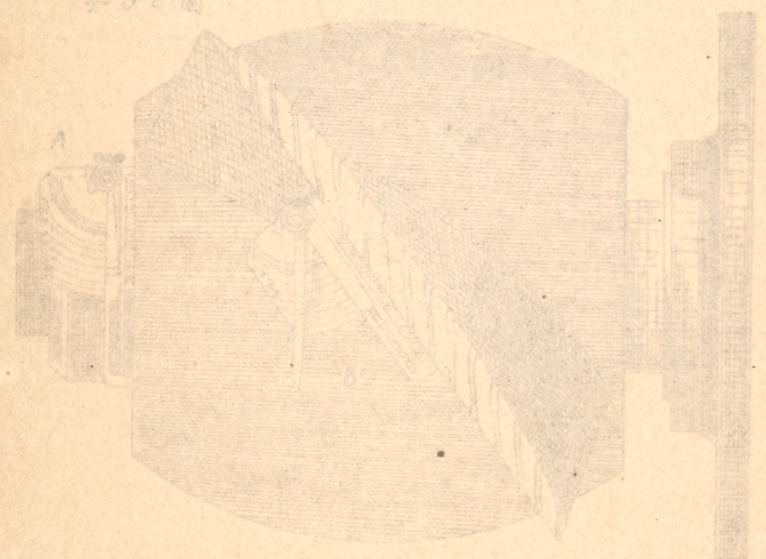
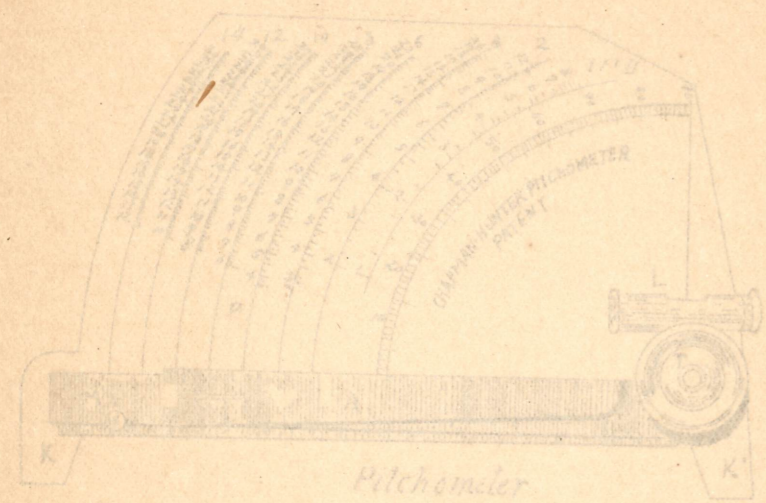


第30图

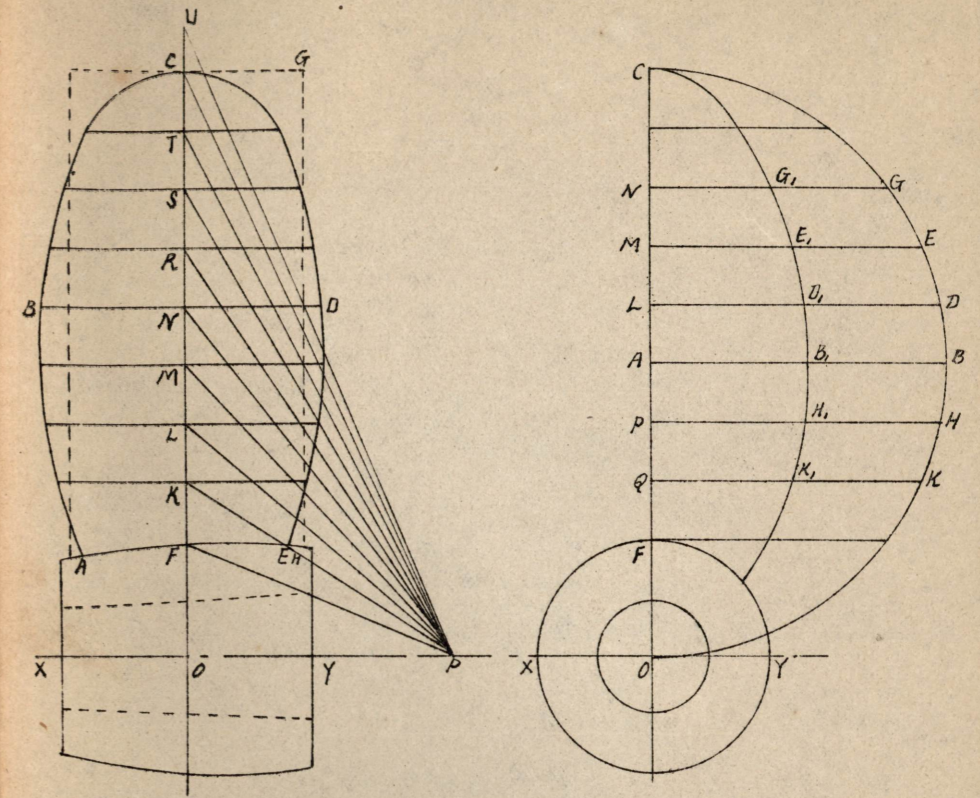


第30图

第 3 1 圖

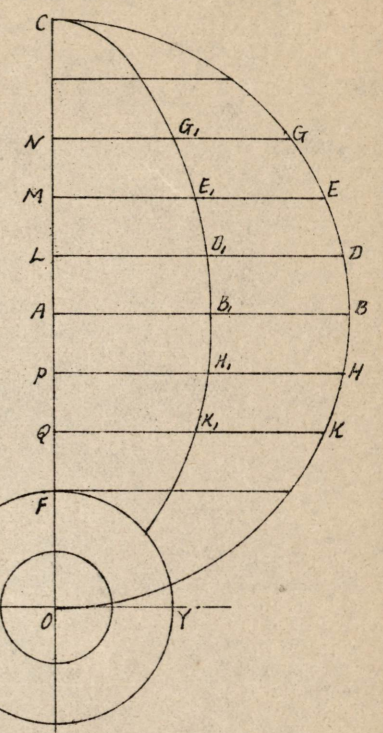


第 3 1 圖

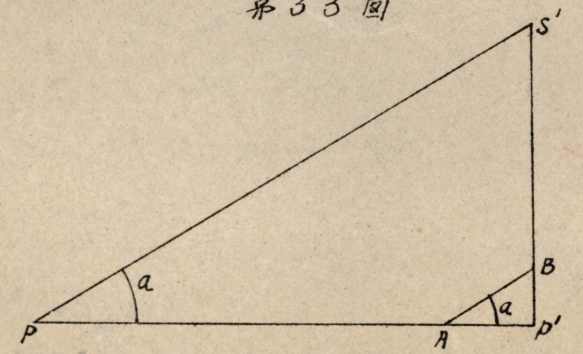


XY 軸，中心線  
 OC 軸 = 直角線 = 螺旋，半徑

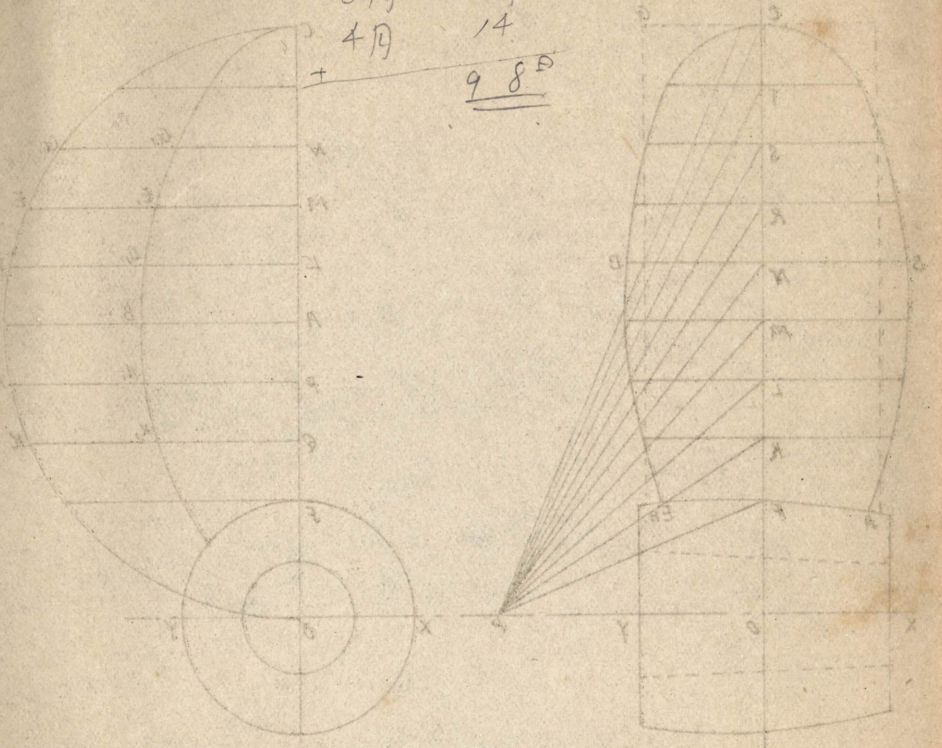
第 3 2 圖



第 3 3 圖



7月 23日  
 6月 30日  
 5月 31日  
 4月 14日  
98日



此圖之中心點 Y  
 此圖之中心點 X

圖 5 0 號

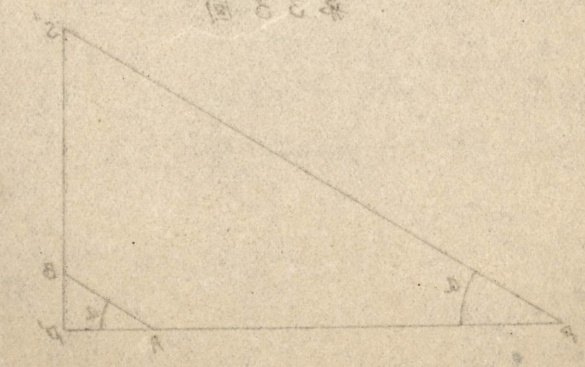


圖 2 0 號

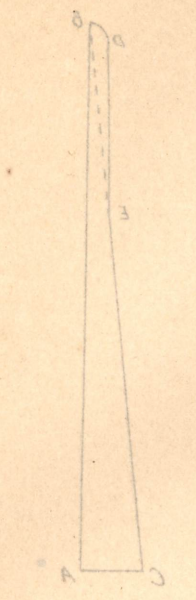


圖 6 0 號

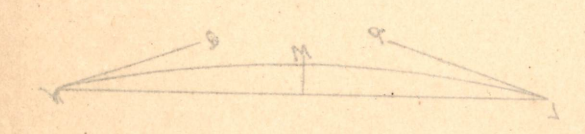


圖 7 0 號

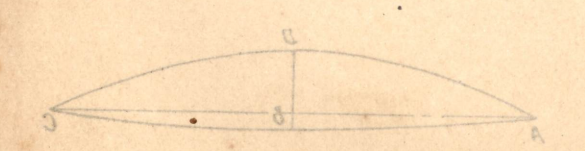
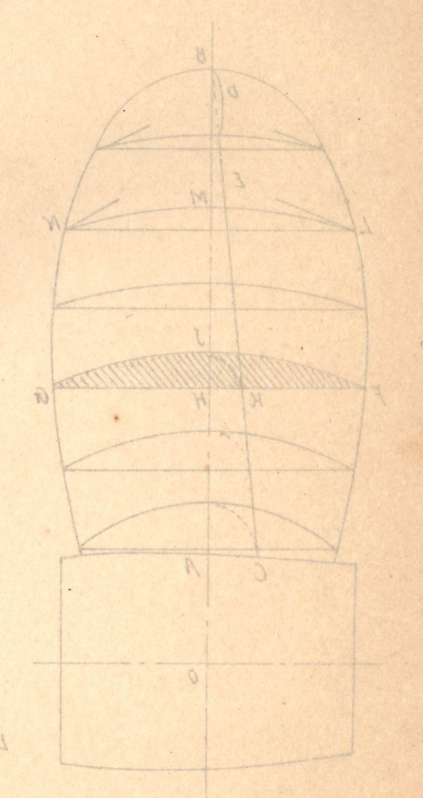
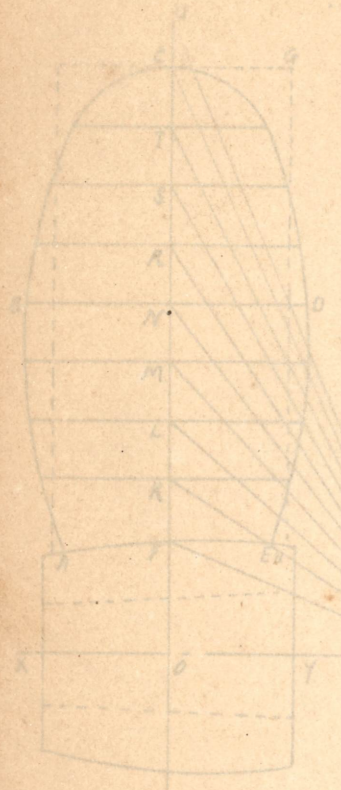


圖 4 0 號

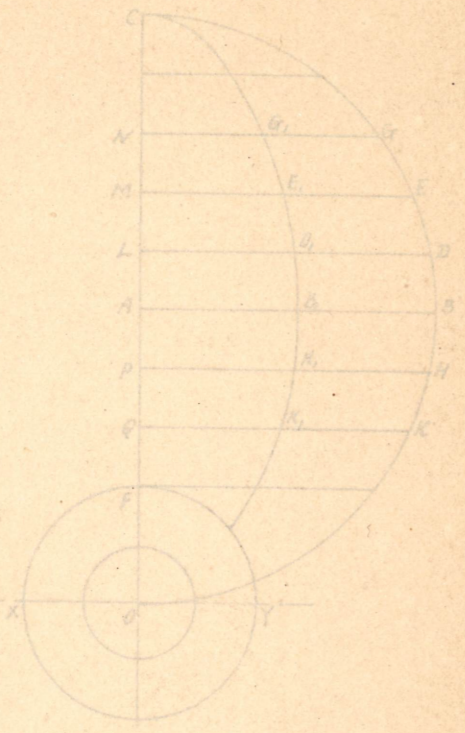


第 3 1 图

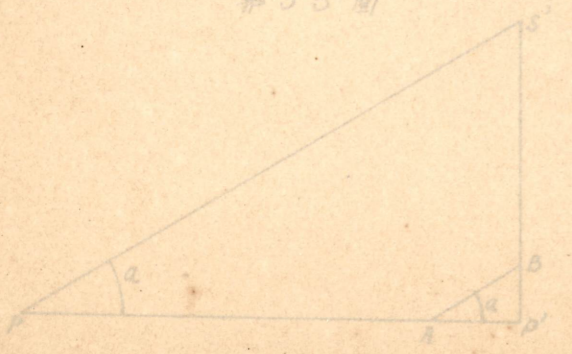


XY 轴 - 中心线  
 OC 轴 - 垂直线 - 以螺旋线为轴

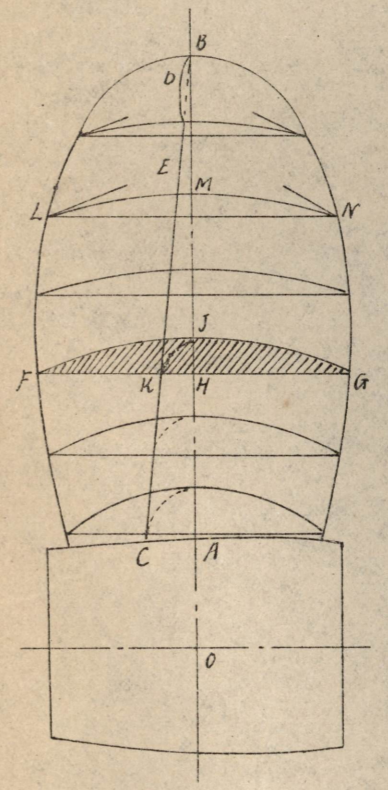
第 3 2 图



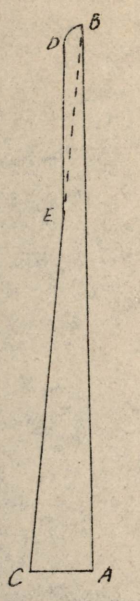
第 3 3 图



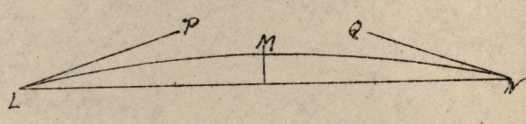
第 3 4 图



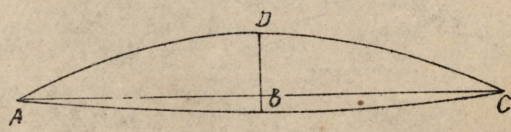
第 3 5 图



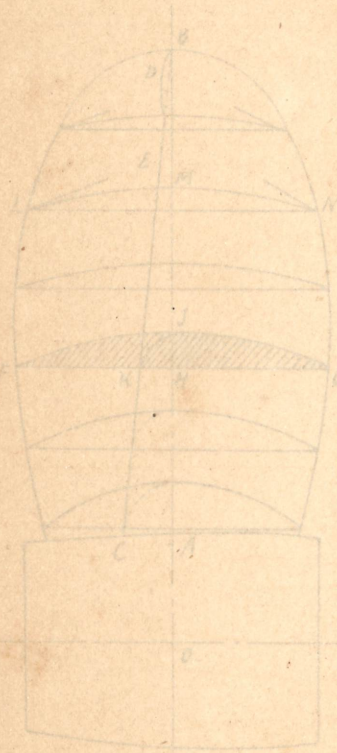
第 3 6 图



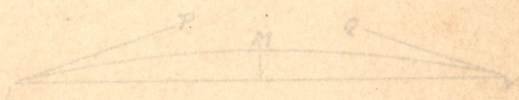
第 3 7 图



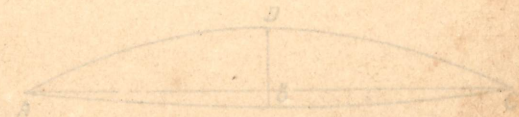
第 34 圖



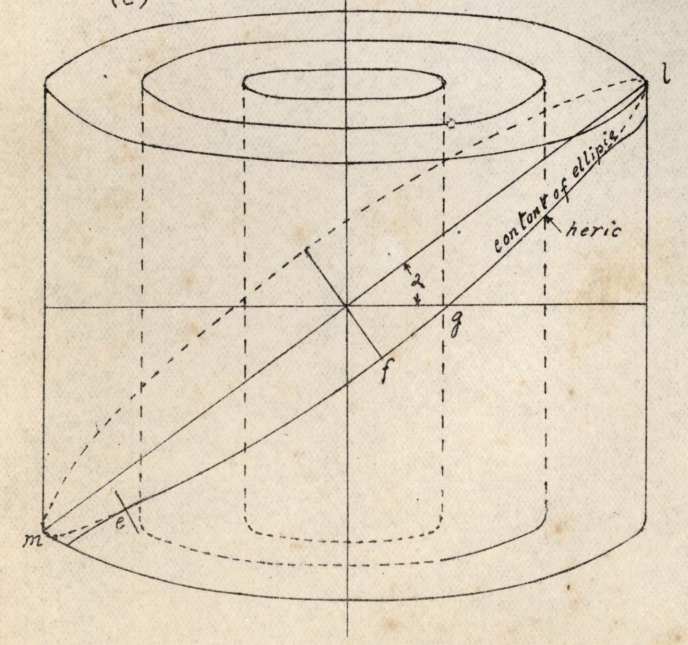
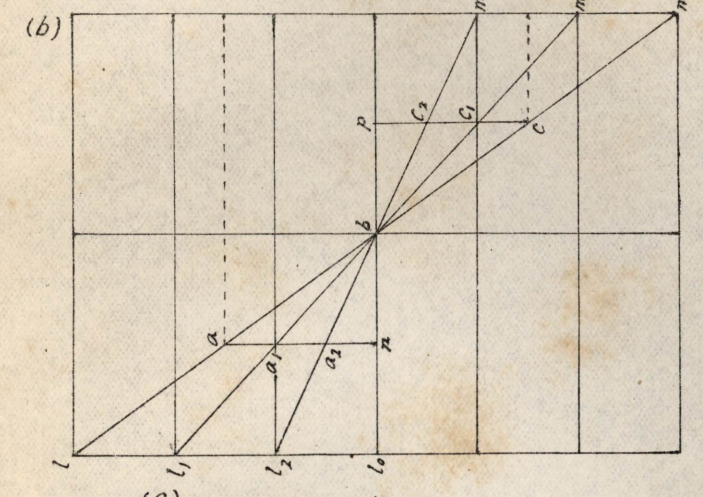
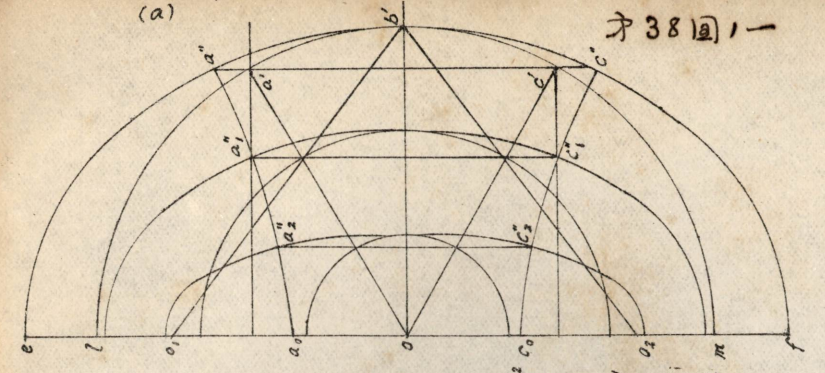
第 36 圖

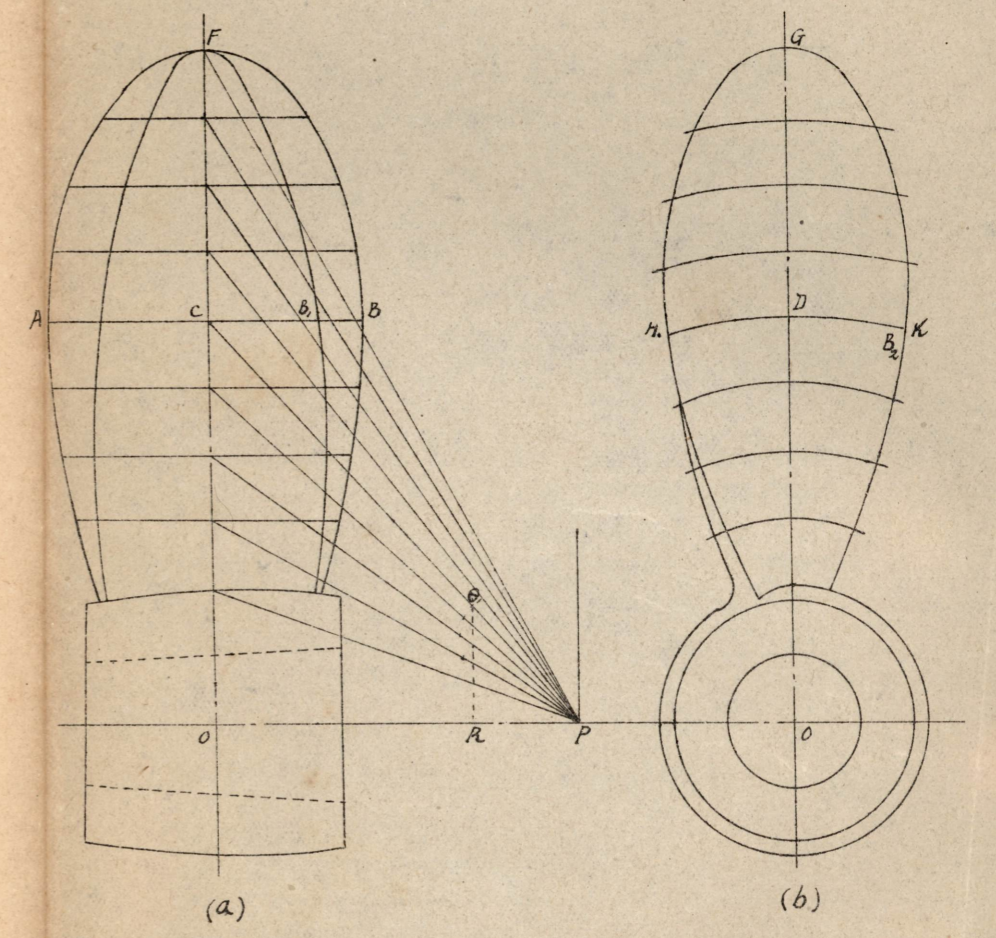
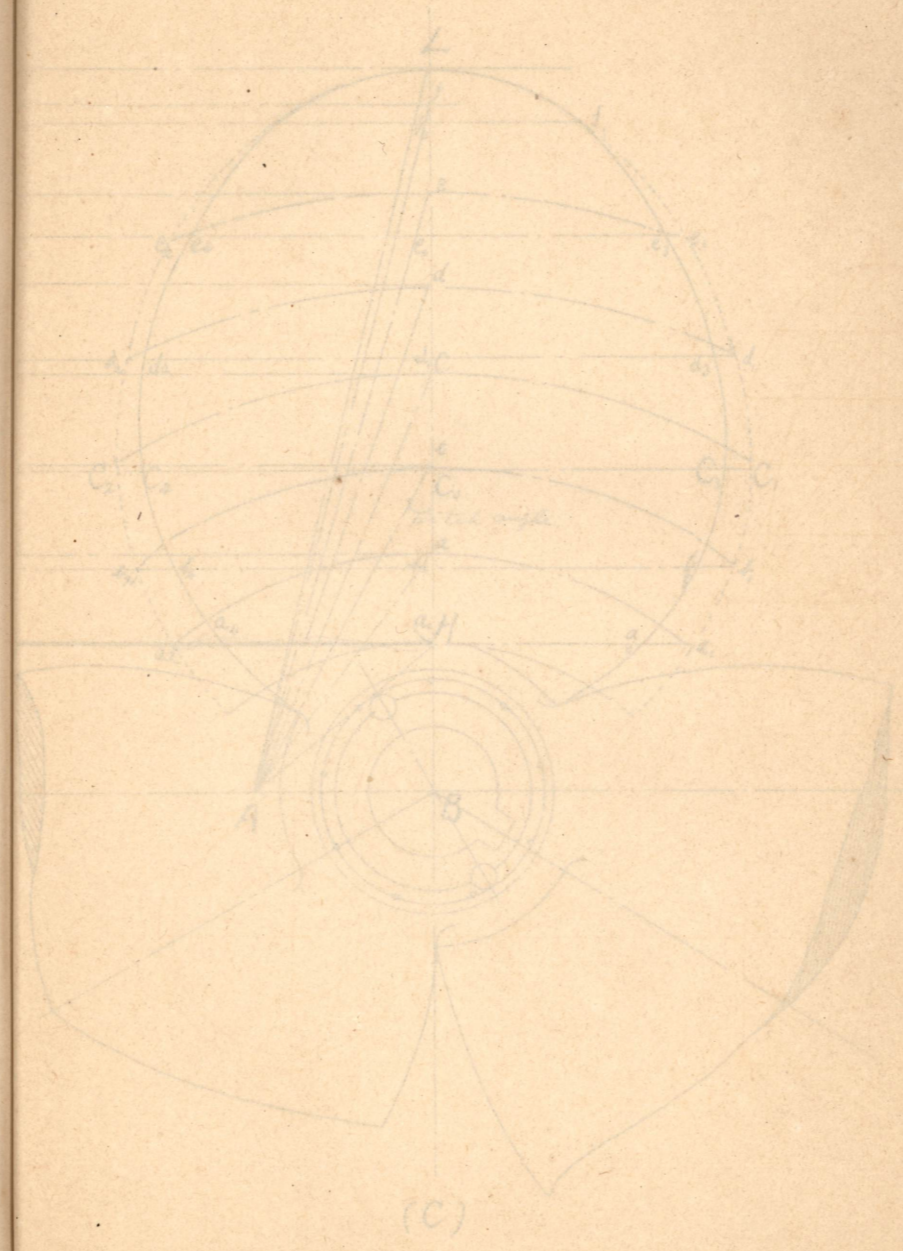
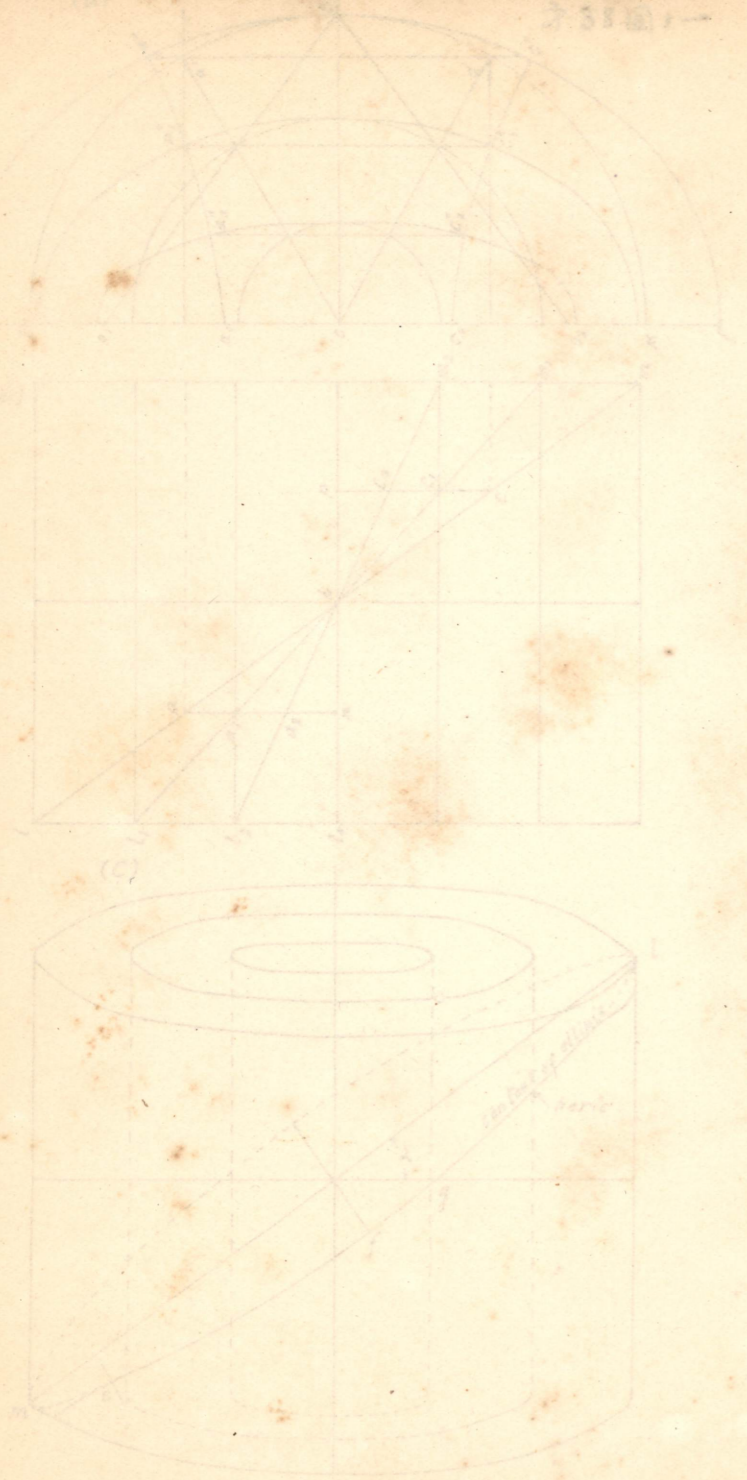


第 37 圖

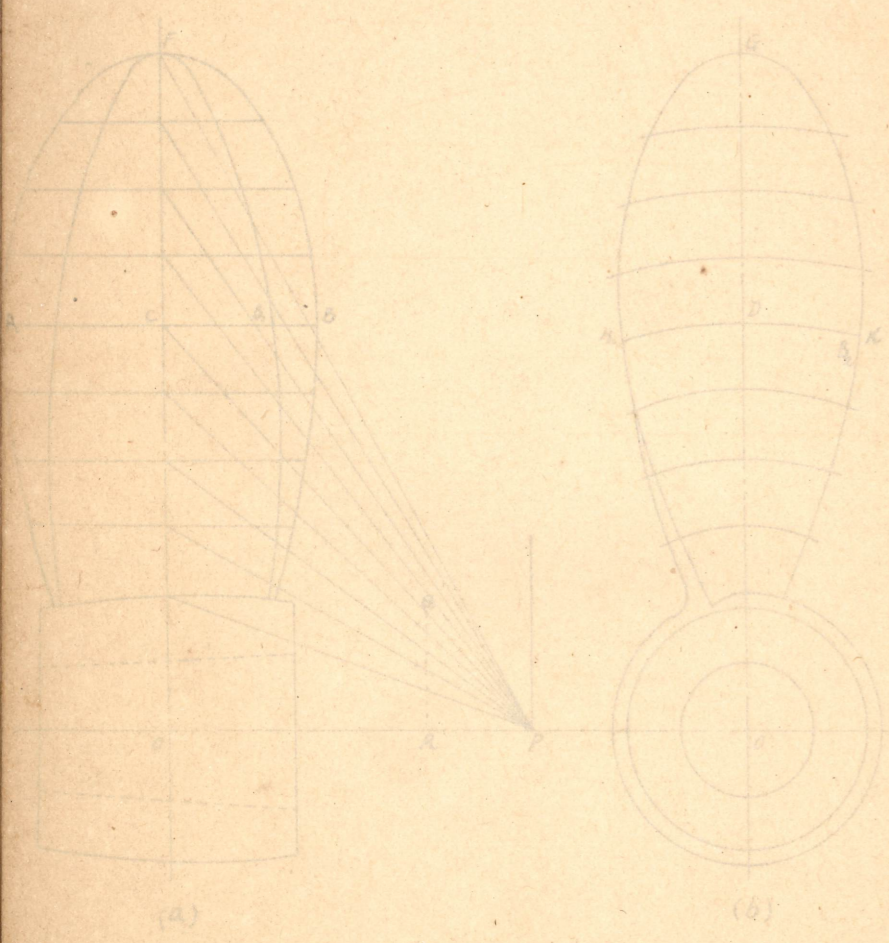


第 35 圖



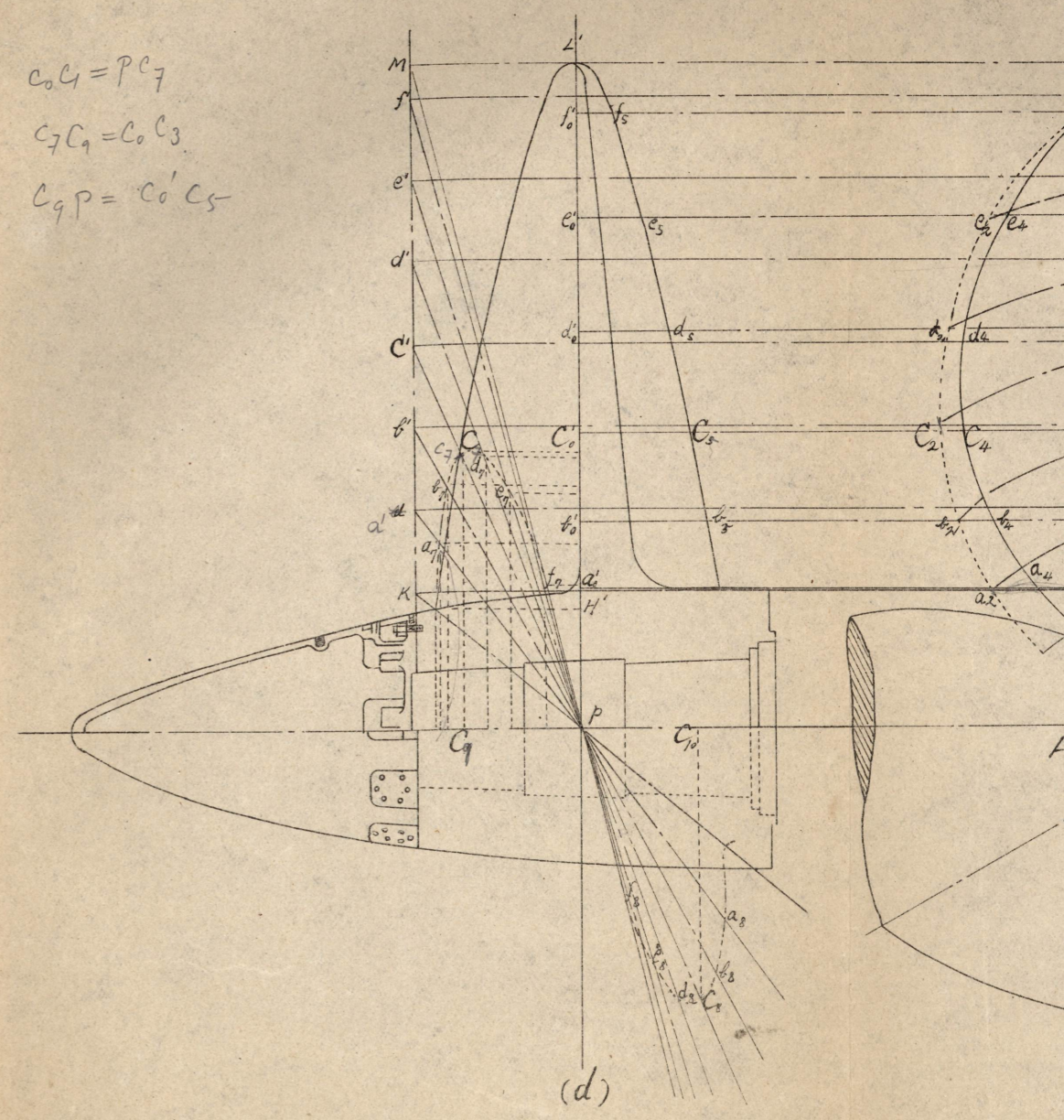


第 37 圖

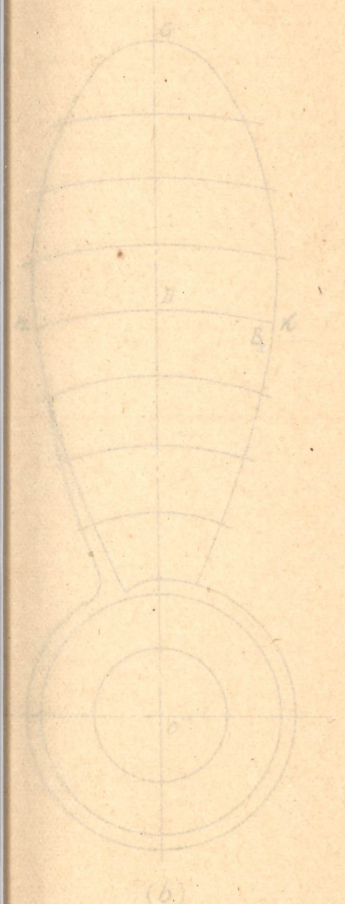


第 38 圖

$H'K = BA$   
 $C_0C_1 = P C_7$   
 $C_7C_9 = C_0C_3$   
 $C_9P = C_0'C_5$

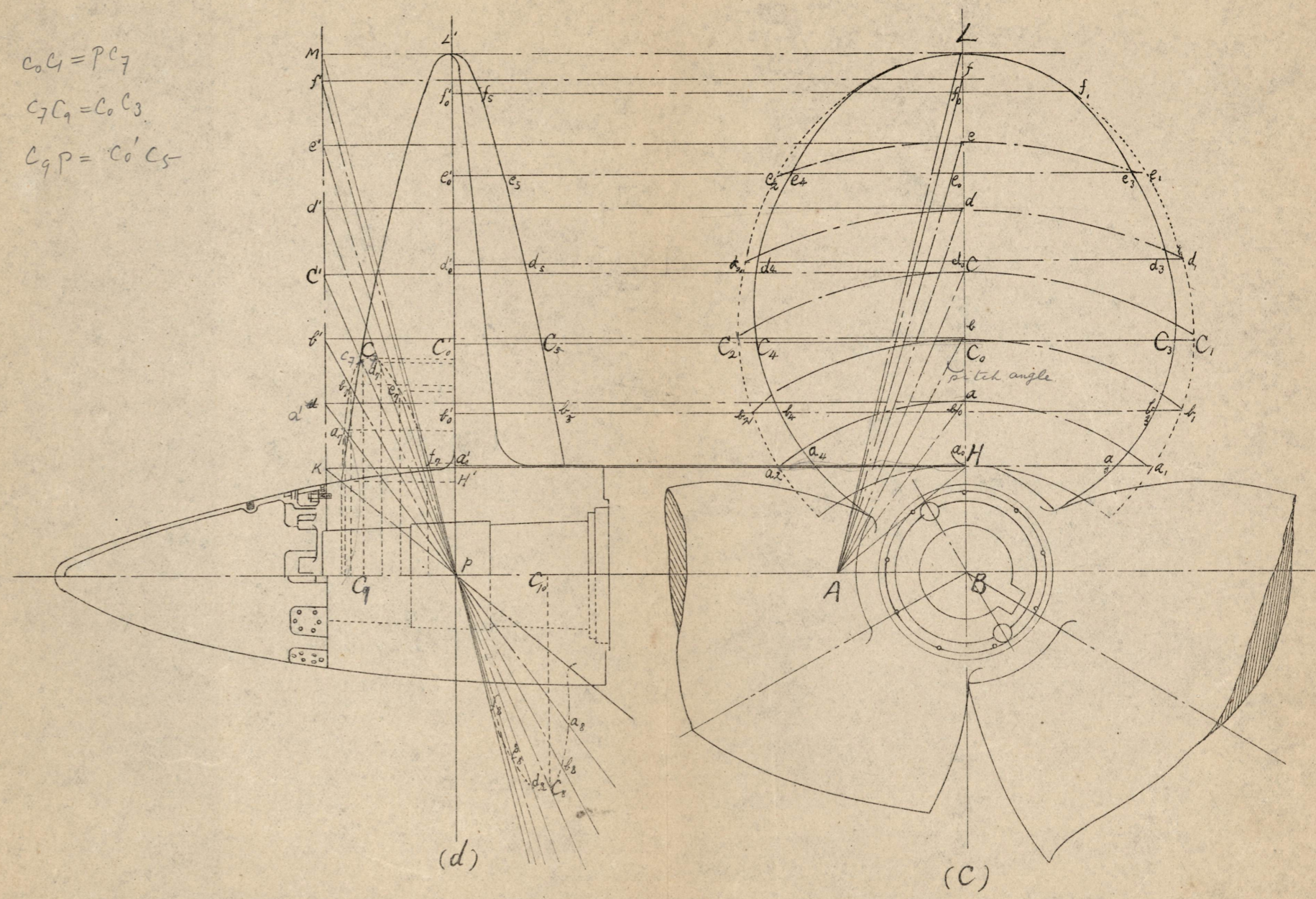


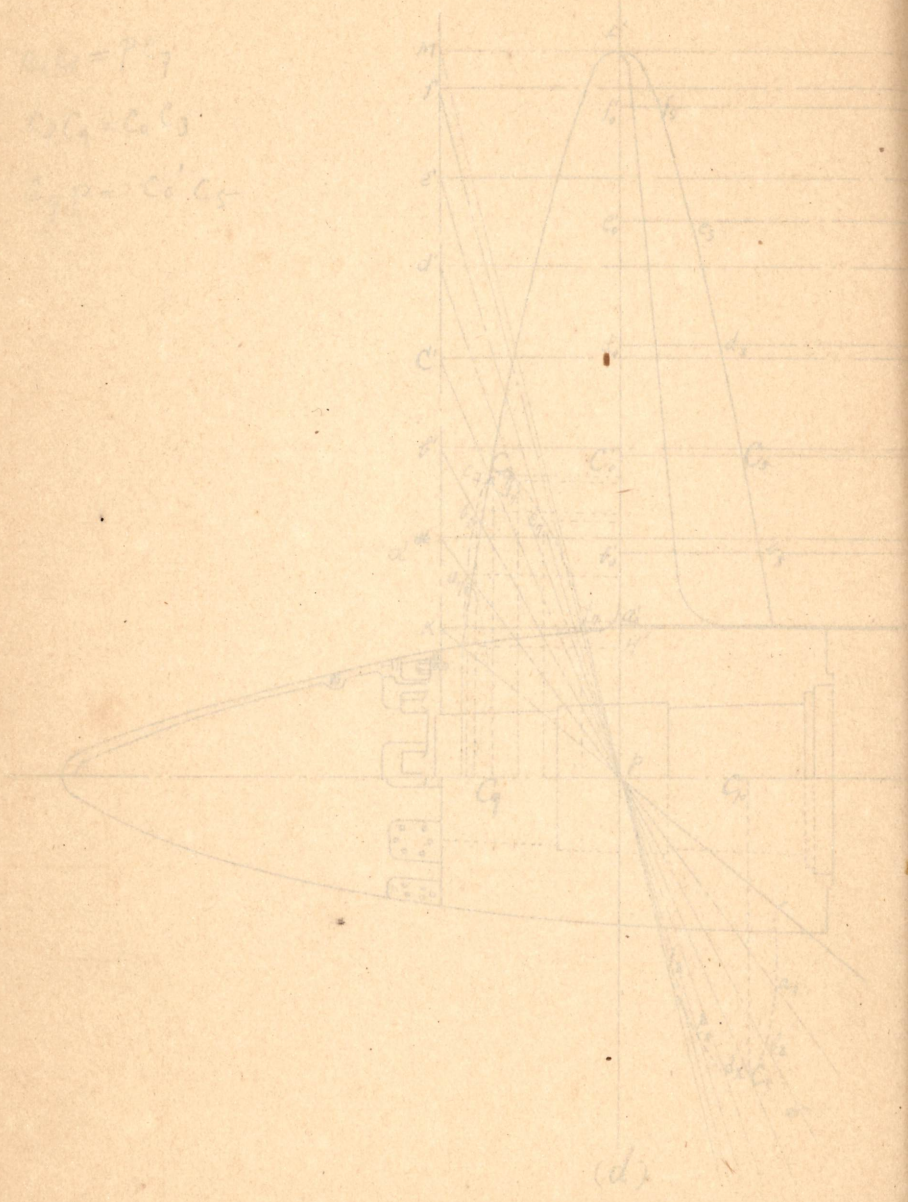




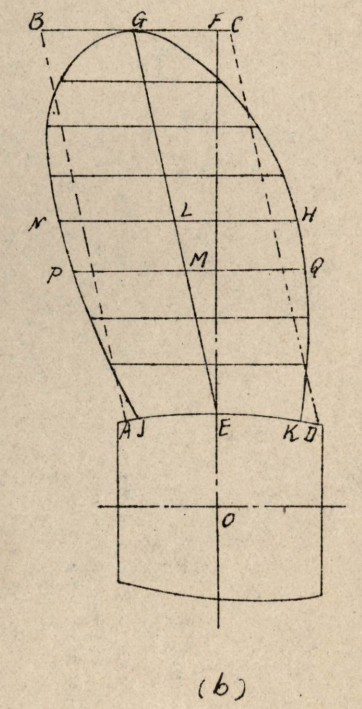
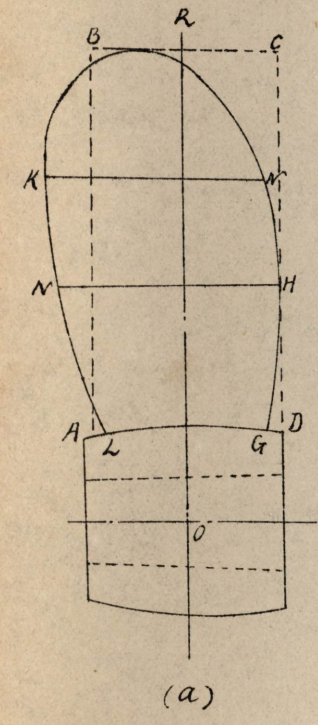
$H'K = BA$   
 $C_0C_1 = PC_7$   
 $C_7C_9 = C_0C_3$   
 $C_9P = C_0'C_5$

第 3 8 图

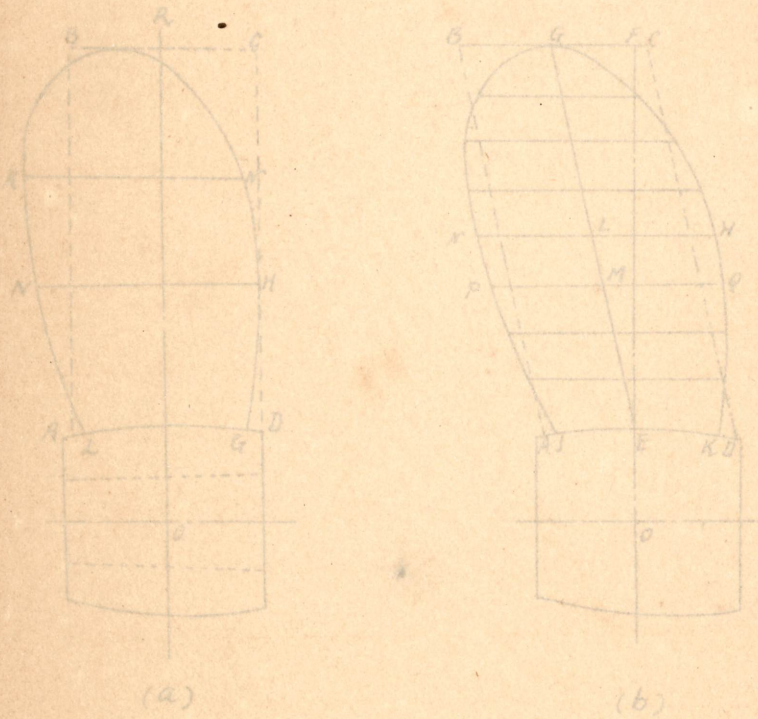




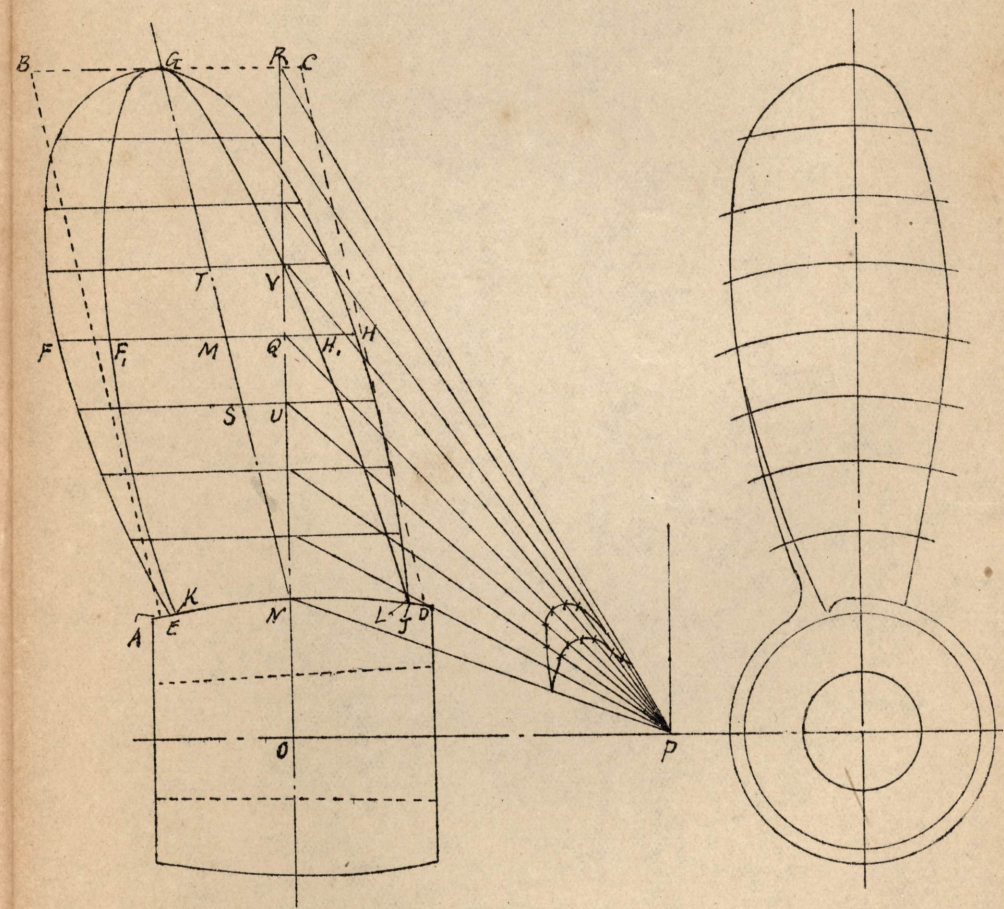
第 39 圖

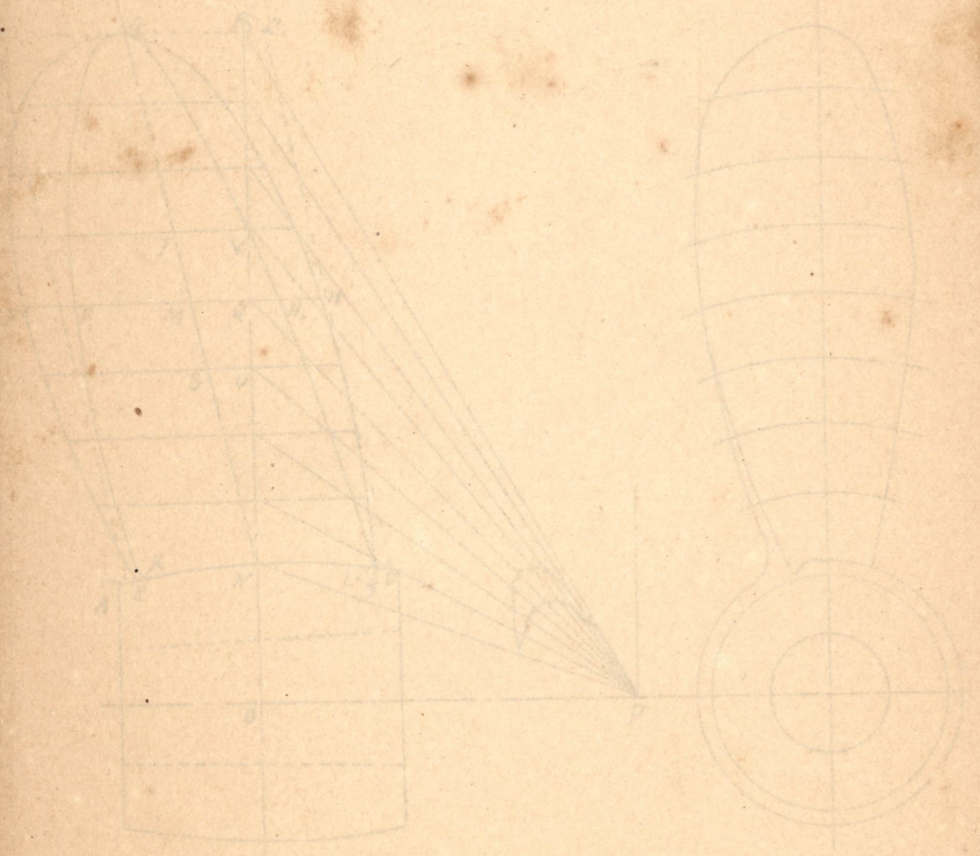


第 39 圖

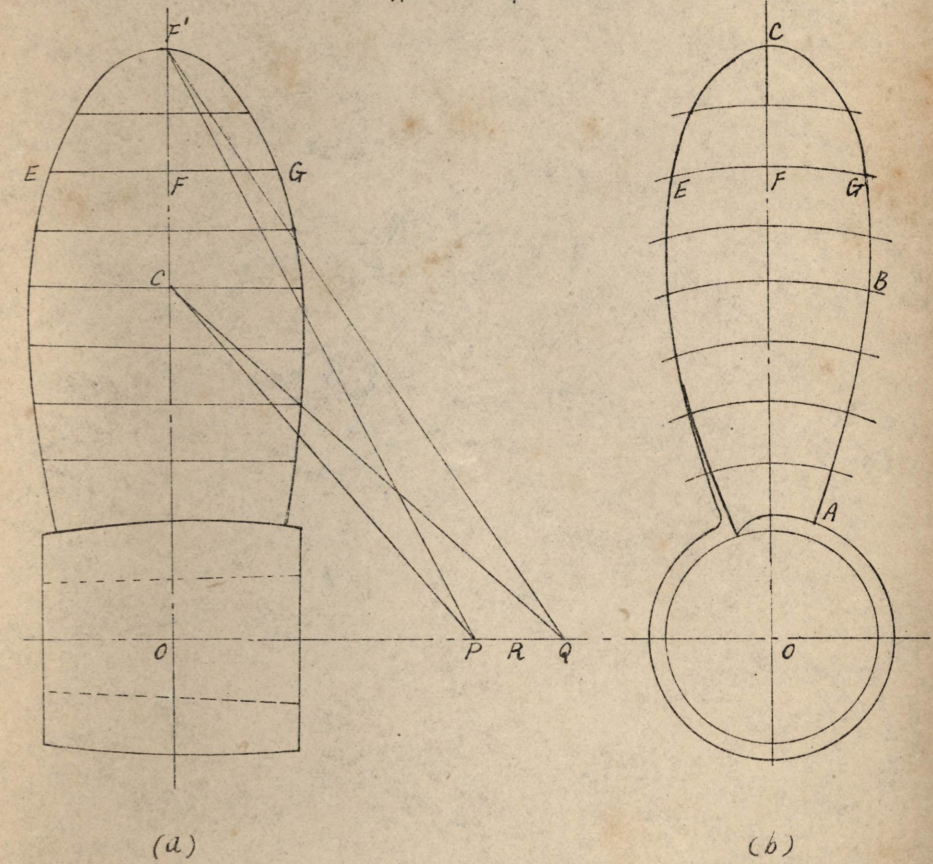


第 40 圖





第 4 1 圖



第廿九期

志羽

整理号	
寄贈者名	赤羽龍熊
寄贈年月日	1940.7.27
一番	2098