

BANCO INTERAMERICANO DE DESENVOLVIMENTO
- B I D -

EMPRÉSTIMOS: 162/OC - BR
1/SW - BR

**Projeto de Ampliação do Sistema de Água Potável
da Região Metropolitana da
Grande São Paulo.**

Relatório Final
VOLUME 2

D I V I S ã O

- I - DESENHO DE LOCALIZAÇÃO DA 1^a ETAPA DO SISTEMA CANTAREIRA
- II - DESENHOS DA ESTAÇÃO ELEVATÓRIA SANTA INÊS-ESI
- III - DESCRIÇÃO DOS TESTES DO MOTOR SÍNCRONO
- IV - DESCRIÇÃO DOS TESTES DA BOMBA
- V - DESENHOS DA ESTAÇÃO DE TRATAMENTO DE ÁGUA - GUARAÚ
- VI - FOTOGRAFIAS

OFFICIAL FILE COPY

DOC. INDEXED

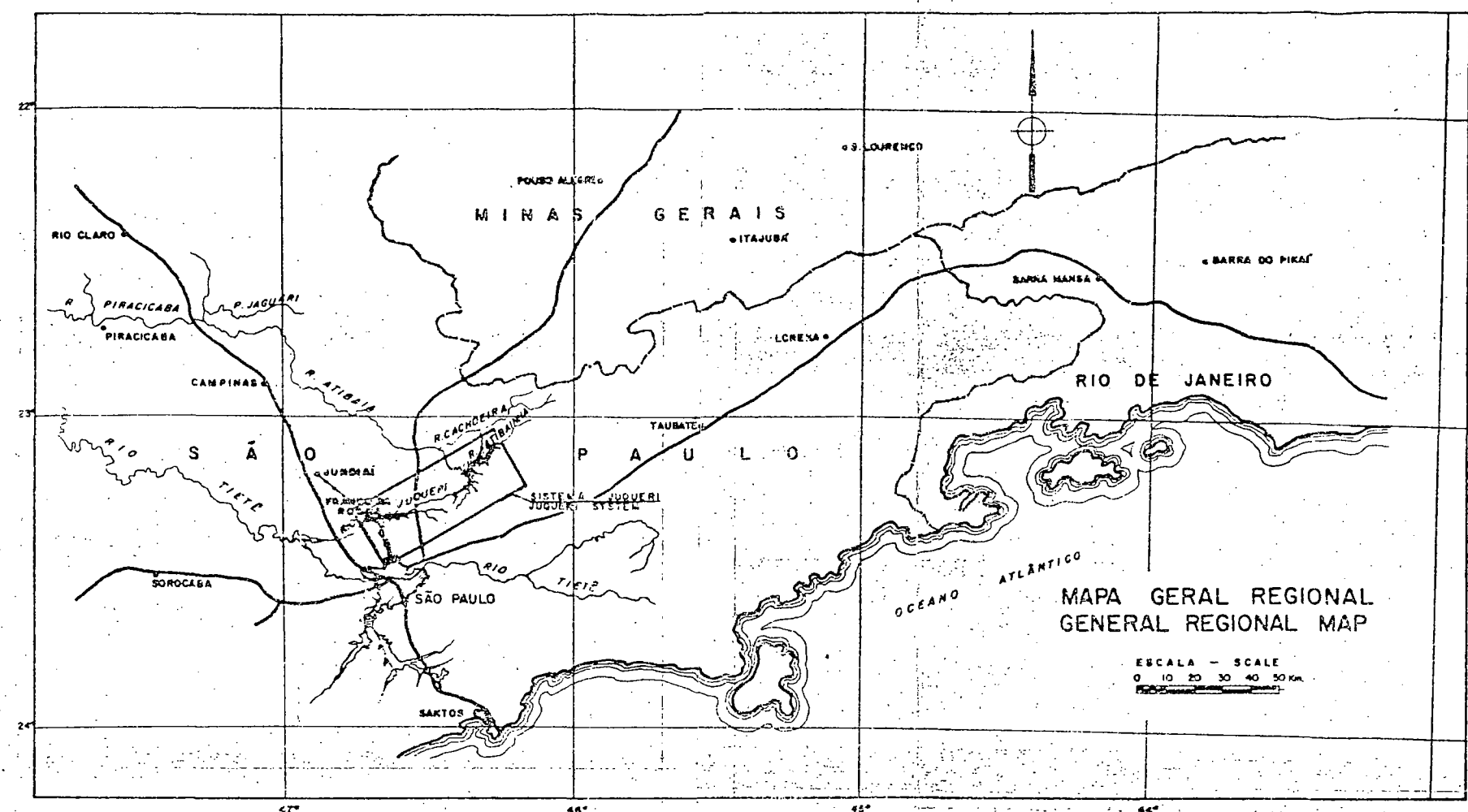
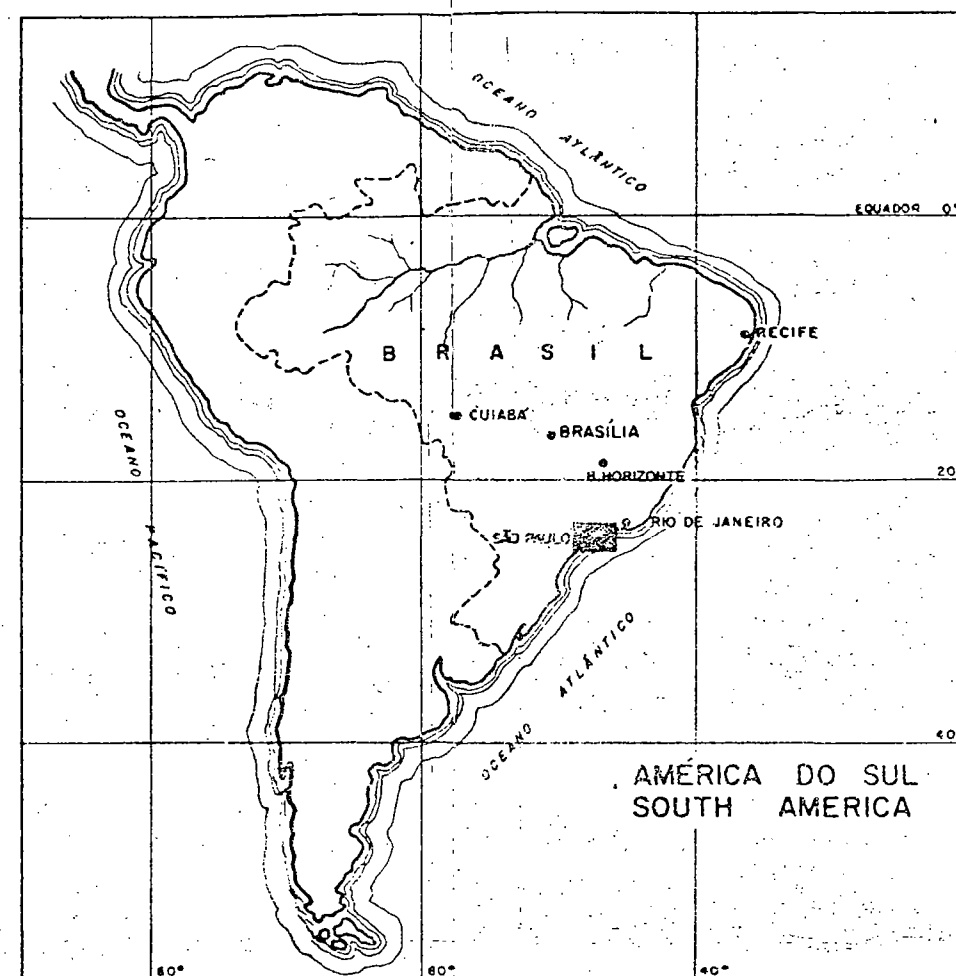
DIVISÃO I

I - DESENHO DE LOCALIZAÇÃO DA 1ª ETAPA DO

SISTEMA CANTAREIRA

Nº do Des.

- Planta de Localização 1ª etapa..... 100-00-01



SISTEMA JUQUERI
PARA ABASTECIMENTO DE ÁGUA DO GRANDE
SÃO PAULO

1-IGUETAPA
(VALIÃO KM 1/4)
BARRAGEM E TÚNEL DO ATISAINHA
BARRAGEM DO JUQUEI
ELEVADORIA SANTA INÊS
CANAL ADUTOR SUPERIOR
TÚNEL Nº 1
BARRAGEM DE ÁGUAS CLARAS
TÚNEL Nº 2 E OBRA DE REGULARIZAÇÃO
ESTACÃO DE TRATAMENTO DO QUARÁU

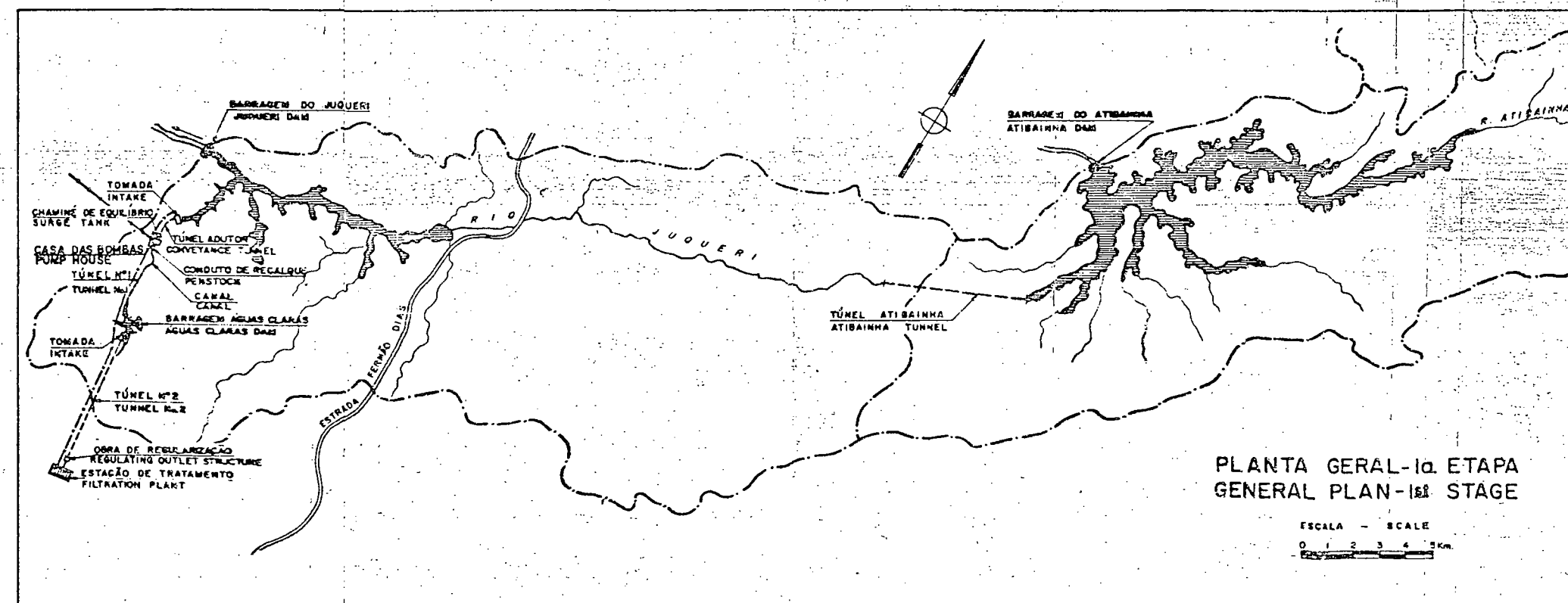
2 - 2a. ETAPA
(VAZÃO 55 m³/s)

BARRAGEM E TÚNEL DO CACHOEIRA
BARRAGEM E TÚNEL DO JAGUARI

JUQUERI SYSTEM
GREAT SAO PAULO WATER SUPPLY

1-12 STAGE
(FLOW 10 m³/s)
ATISAWA DAM AND TUNNEL
JUQUERI DAM
SANTA INES PUMPING PLANT
SUPERIOR CONVEYANCE CANAL
TUNNEL NO. 1
AGUAS CLARAS DAM
TUNNEL NO. 2 AND REGULATING OUTLET STRUCTURE
GUARAU WATER TREATMENT

2-20 STAGE
(FLOW 33 m³/s)
CACHOEIRA DAM AND TUNNEL
JAGUARI DAM AND TUNNEL



DISTÂNCIA PELAS ESTRADAS PRINCIPAIS
HIGHWAY DISTANCES


BARRAGEM DO JUQUERI-SÃO PAULO- 45 Km
SÃO PAULO - SANTOS - 72 Km

LEGENDA

LEGEND

-----	LIMITES ESTADUAIS	STATE BOUNDARIES
-----	LIMITE DA BACIA HIDROGRÁFICA	BOUNDARY OF DRAINAGE AREA
=====	RODOVIAS	HIGHWAYS
-----	LINHA DE 136 KV.	136 KV LINE
-----	LINHA DE 15,2 KV.	15,2 KV LINE

[illegible]

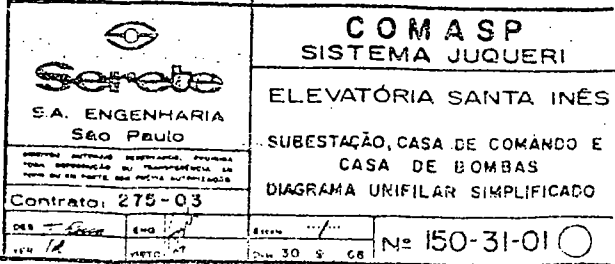
 <p>S.A. ENGENHARIA São Paulo</p>	<p>COMASP SISTEMA JUQUERI</p>
<p>PLANTA DE LOCALIZAÇÃO - 1ª ETAPA</p>	<p>CONTRATO 275 - 03</p>

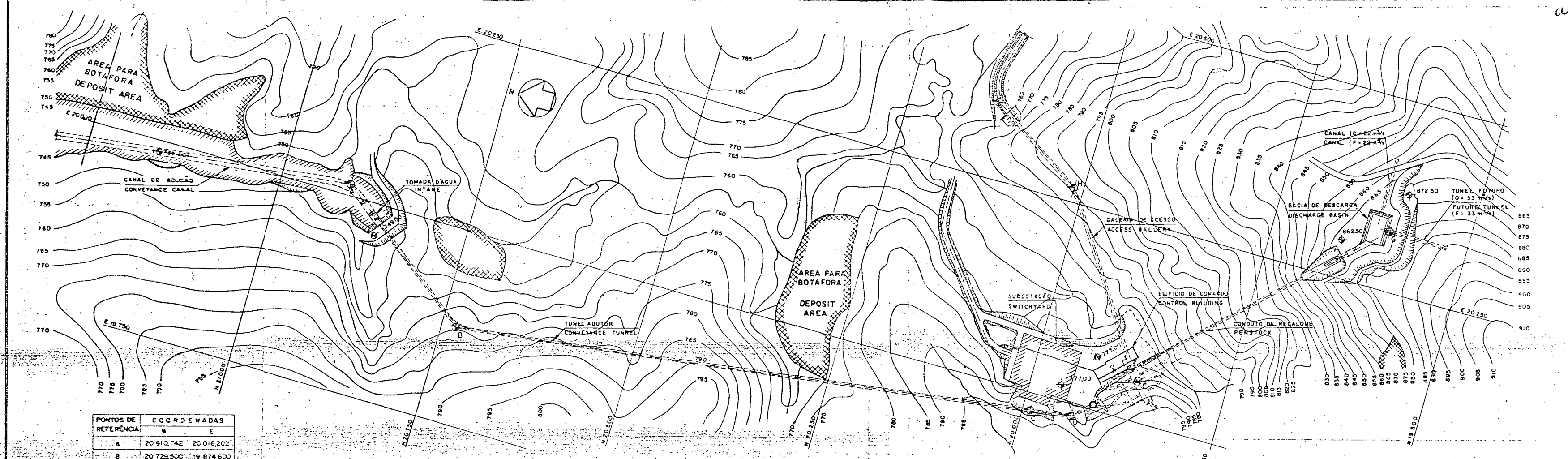
DIVISÃO II

II - DESENHOS DA ESTAÇÃO ELEVATÓRIA SANTA INÊS-ESI

Nº dos Des.

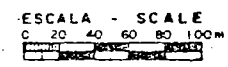
Instrumentação, Eletricidade e Força	150-30-01
Subestação, Casa de Comando e Casa de Bombas	150-31-01
Casa de Comando e Casa de Bombas (Esq. unifilar)	150-31-02
Planimetria e Esquema Geral	150-90-01
Edifício de Comando, Subestação e Bacia de Descarga	150-90-02
Casa de Bombas, Planta no Nível 722.4	153-90-01
Casa de Bombas, Planta no Nível 723.7	153-90-02
Casa de Bombas, Cortes Longitudinais	153-90-03
Casa de Bombas, Cortes Transversais	153-90-04
Casa de Bombas, Galeria de Acesso	153-90-05
Casa de Comando, Painéis de Comando e Proteção	156-38-01
Casa de Comando, Mesa de Comando	156-38-02
Casa de Comando, Disposição da Galeria de Entrada e Painéis Elétricos	156-40-01



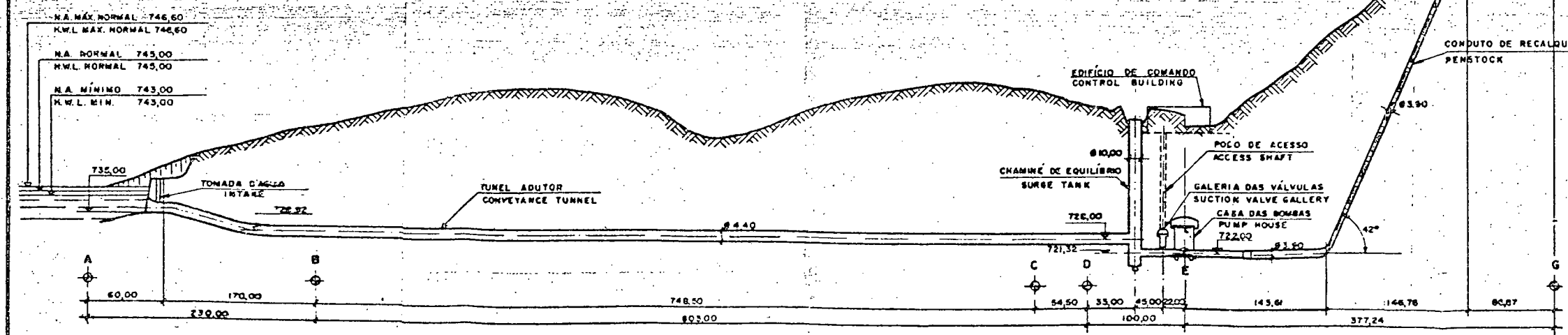


PONTOS DE REFERÊNCIA	COCORDENADAS	N	E
A	20 913,742	20 016,202	
B	20 729,500	19 874,600	
C	19 966,253	19 978,768	
D	19 934,323	19 986,323	
E	19 861,776	20 055,183	
F	19 873,650	20 067,701	
G	19 600,000	20 327,394	
H	20 042,420	20 269,613	
I	20 138,221	20 351,309	

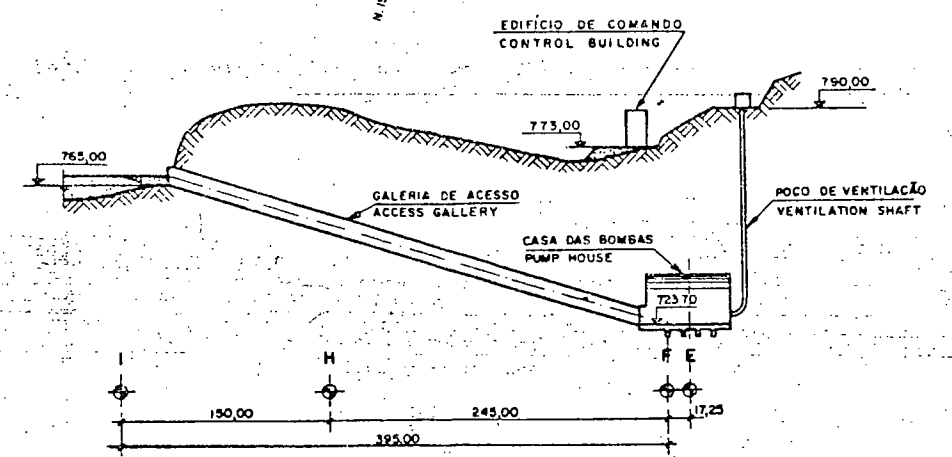
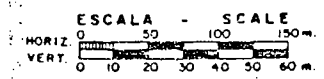
PLANIMETRIA GERAL
GENERAL PLAN
ESCALA 1:2000
SCALE 1:2000



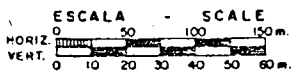
MA-Q=33 m/s 861,35
Q=22 m/s 861,05
Q=11 m/s 860,30
TWL-F=33 m/s 861,35
F=22 m/s 861,05
F=11 m/s 860,30



SEÇÃO LONGITUDINAL
LONGITUDINAL SECTION
ESCALA 1:2.500
SCALE 1:2.500



SEÇÃO TRANSVERSAL
CROSS SECTION
ESCALA 1:1.000
SCALE 1:1.000



ATUALIZAÇÃO GERAL	5/10/68 A
MODIFICAÇÕES	COORD. DATA REF.

UNIT: Meter

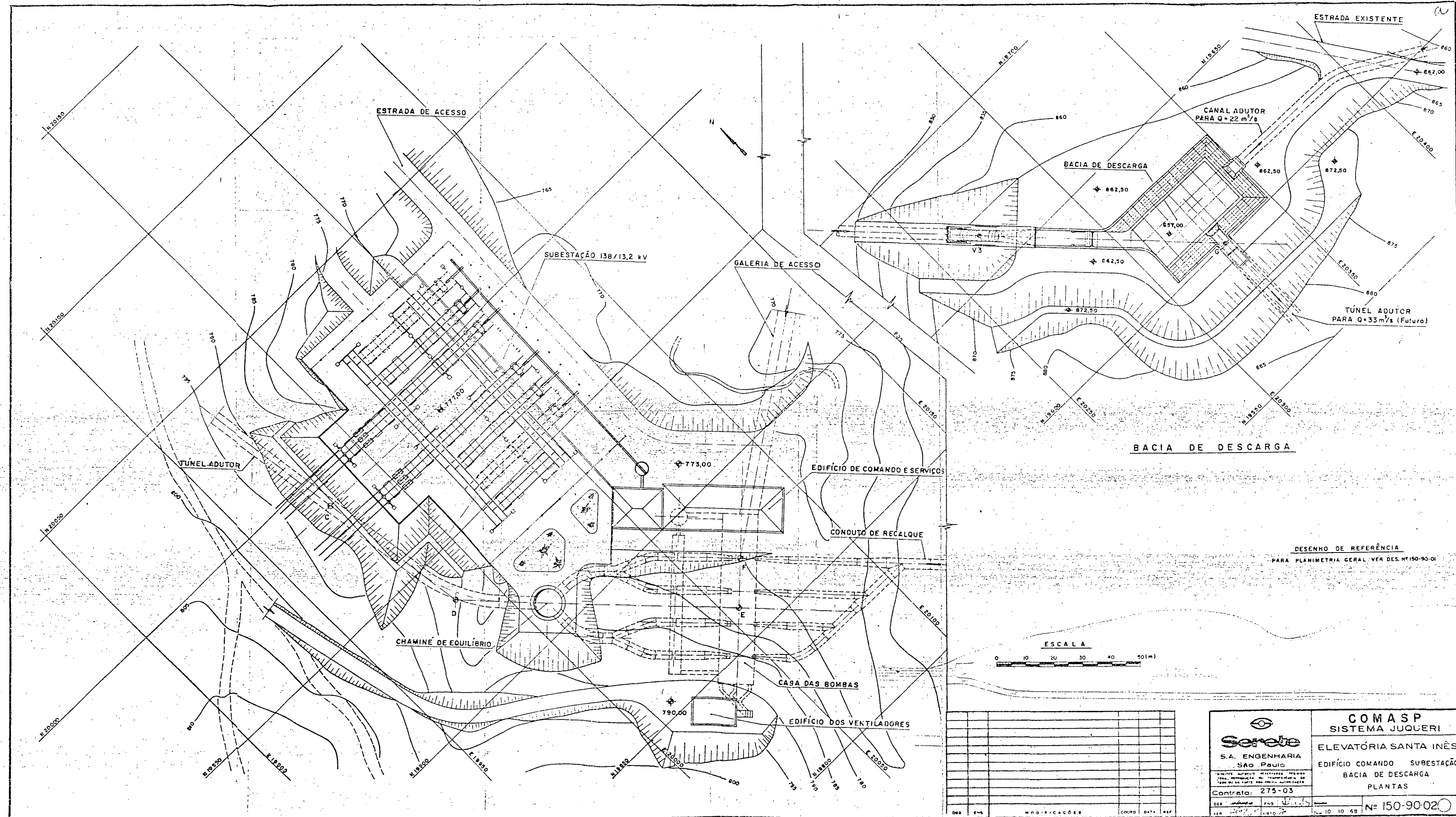
Serete
S.A. ENGENHARIA
São Paulo

Contrato: 275-03

SANTA INÊS PUMPING PLANT
GENERAL LAYOUT

COMASP
SISTEMA JUQUERI
ELEVATÓRIA SANTA INÊS
PLANIMETRIA
E
ESQUEMA GERAL.

Nº 150-90-01(A)



Architectural drawing of a door with dimensions:

- Overall width: 1924
- Overall height: 3800
- Side panel width (left): 457
- Side panel width (right): 457
- Door opening width: 610
- Door opening height: 1902

QUADRO DE EXCITAÇÃO
DO MOTOR (2x)

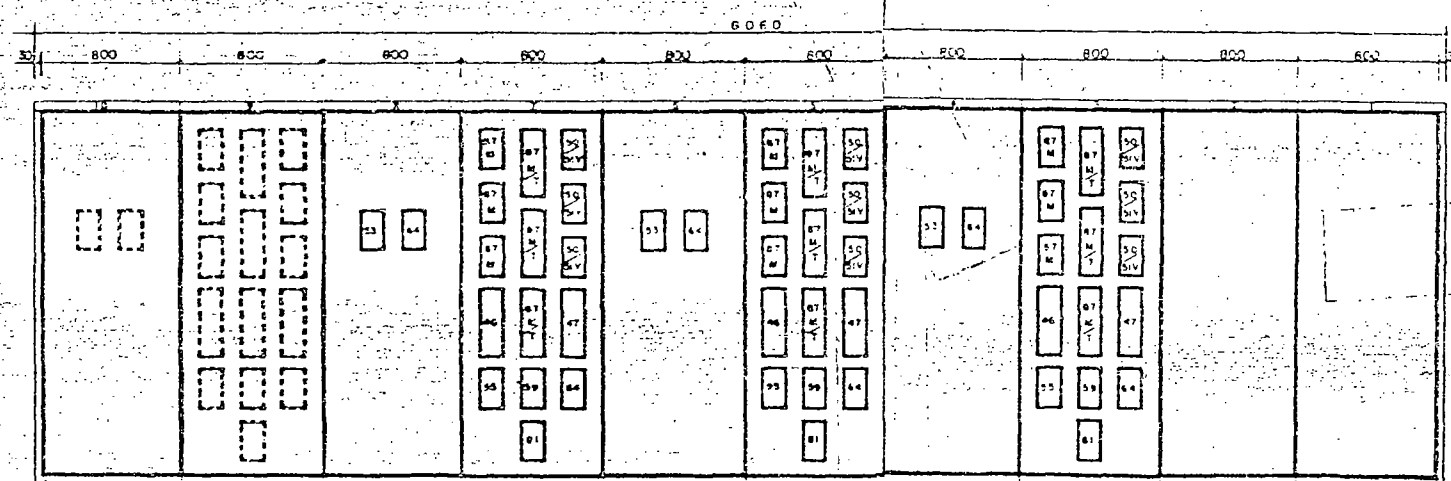


Diagrama de uma barra de distribuição elétrica com 8 seções. As seções são:


- ENTRADA
13,2 kV
- REATOR
- G G G
- TRANSFORMADORES DE MEDIÇÃO E RELES DO QUADRO DE PROTEÇÃO E CONTROLE
- TRANSFORM
- (Seção vazia)
- (Seção vazia)
- (Seção vazia)

Barra superior: 450V, 690V, 110V, 240V, 200V

Barra inferior: 100V, 180V, 500V, 110V, 200V, 220V, 200V

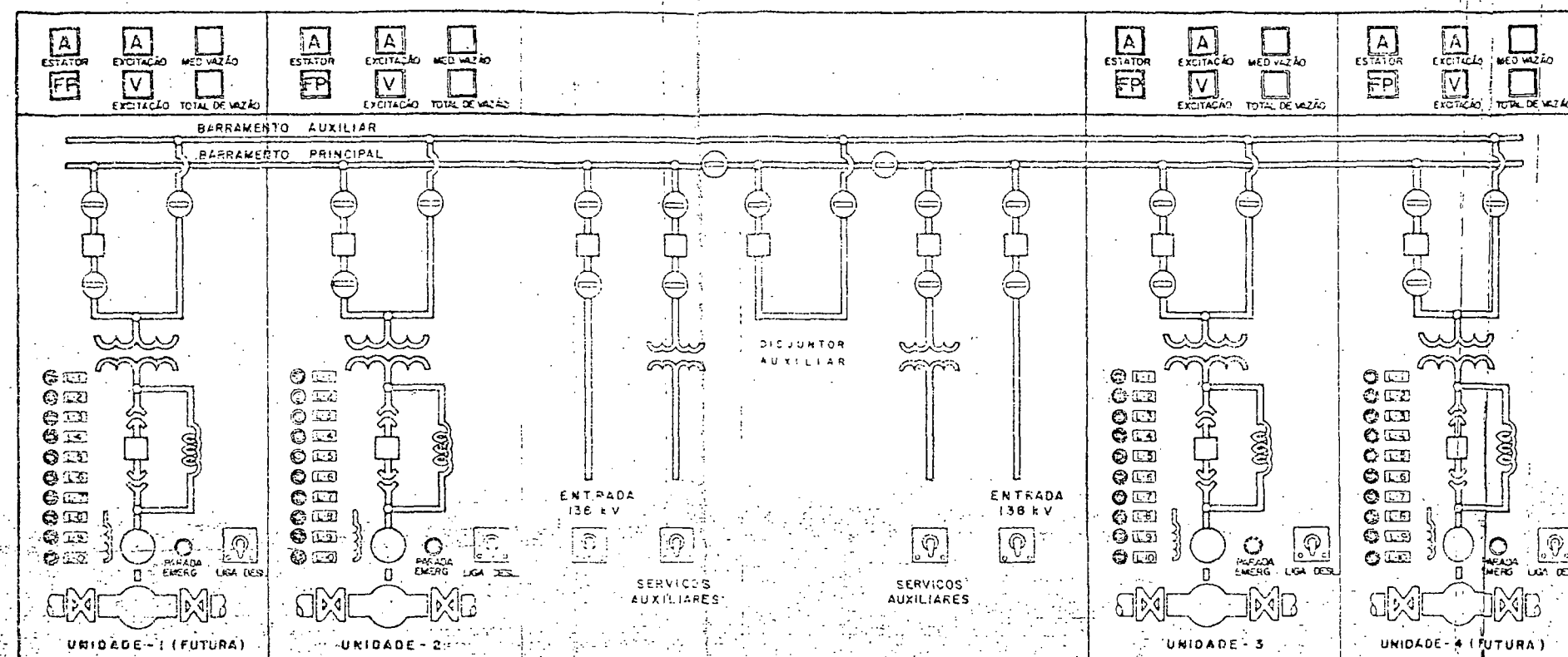
Símbolos: Relé (A, V), Fusíveis (círculos)

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








 <p>Serete S.A. ENGENHARIA São Paulo</p>	<p>COMASP SISTEMA JUQUERI</p>
<p>PROPOSTA ORÇAMENTARIA PRELIMINAR para a instalação de equipamentos de 1000 kg em 400, 400 e 400 kg</p>	<p>ELEVATÓRIA SANTA INÊS CASA DE COMANDO</p>
<p>Contrato: 275-03</p>	<p>PRATEIS DE ARRANQUE, COMANDO E PROTEÇÃO</p>
<p>DE: <i>Felipe</i> EPO: <i>Int</i></p>	<p>Quant: 1-20 Nº: 156-38-01</p>

T A M P O D A M E S A

E.SCALA 15

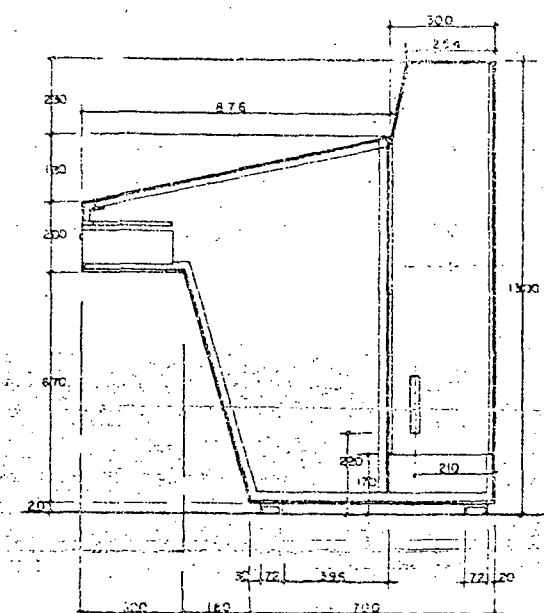


SIMBOLOGIA E LEGENDA

SÍMBOLO	MATERIAL TRANSLUCIDO CÔR	LÂMPADAS
 ELÉTRICO	VERMELHO	ENERGIZADO - ACESSO DESENERGIZADO - APAGADO
 DESMONTADOR	BRANCO	ABERTO - APAGADO FECHADO - ACESSO
 MOTOR	BRANCO	DESOLIGADO - APAGADO EM OPERAÇÃO - LÂMP. VERMELHA EX. VERDE - VERMELHO
 CAMPO	VERMELHO	CAMPO NÃO APLICADO - APAGADO CAMPO APLICADO - ACESSO
 VALVULA	AMARELO	FECHADA - APAGADA ABERTA - ACESSA
 ÁGUA	AZUL	SEM ÁGUA - APAGADA COM ÁGUA - ACESSA
 ÁGUA	AZUL	SEM ÁGUA - APAGADA COM ÁGUA - ACESSA
 PROIBIDO FUMAR	VERMELHO	NÃO INDISSOLUÇÃO DE POSIGAS
 LÂMP. PILOTO	VERDE	DESOLIGADO - APAGADA EM OPERAÇÃO - ACESSA

LEGENDA P/AS LÂMPADAS PILOTO

LÂMPADAS	DISCRIMINAÇÃO
L-1	RESFRIAMENTO DO AR DO MOTOR - LIGADO
L-2	RESFRIAMENTO DO ÓLEO - LIGADO
L-3	LUBRIFICAÇÃO DAS CAIXAS DE VED. DO EIXO-LIGADO
L-4	LUBRIFICAÇÃO DOS ANÉIS DE DESGASTE - LIGADA
L-5	BOMBA DE ÓLEO - LIGADA
L-6	VALVULA DA SUCCÃO FECHADA
L-7	VALVULA DE DESCARGA FECHADA
L-8	ROTOR DA BOMBA EM VAZIO
L-9	DISJUNTOR DE CURTO DO REATOR - FEERTO
L-10	MOTOR PRONTO PARA ARRANQUE




VISTA LATERAL

150

[illegible]

 <p>S.A. ENGENHARIA SÃO PAULO</p> <p><small>IMPORTA, PROJETOS, EXECUÇÃO, MONTAGEM, MANUTENÇÃO DE MÁQUINAS E EQUIPAMENTOS. 12 RUA DO COMÉRCIO, 100 - JARDIM PAULISTA - SÃO PAULO</small></p>	<p>COMASP SISTEMA JUQUERI</p>	
	<p>ELEVATÓRIA SANTA INÊS</p> <p>CASA DE COMANDO E BOMBAS</p> <p>MESA DE COMANDO</p>	
<p>Contrato: 275-03</p>		
<p>DE: <i>F. J. J. J.</i></p> <p>PAR: <i>J. J. J.</i></p>	<p>END: <i>100</i></p>	<p>EXEMPLO INDICADA</p> <p>0 - 78 10 00</p>
<p>Nº 156-38-02</p>		

 <p>Serele</p> <p>S.A. ENGENHARIA São Paulo</p>	<p>COMASP</p> <p>SISTEMA JUQUERI</p>
<p>NOTA: AUTORES RELEVANTES, INSCRIÇÃO TOMADA POR DEBATE E REGISTRO EM TOMADA DE FOLHA EM FOLHA AUTOMATIZADA</p>	<p>ELEVATORIA SANTA INES</p> <p>CASA DE COMANDO</p> <p>DISPOSIÇÃO DA GALERIA DE ENTRADA DA E PAINEIS ELETRICOS</p>
<p>Contrato: 275-03</p>	
<p>DES: <u>2</u></p>	<p>EM-INDICADA</p>
<p>Em: <u>22/07/77</u></p>	<p>Nº <u>156-40-01</u></p>

DIVISÃO III

III - DESCRIPTION OF SYNCHRONOUS MOTOR TESTS

(DESCRIÇÃO DOS TESTES DO MOTOR SÍNCRONO)

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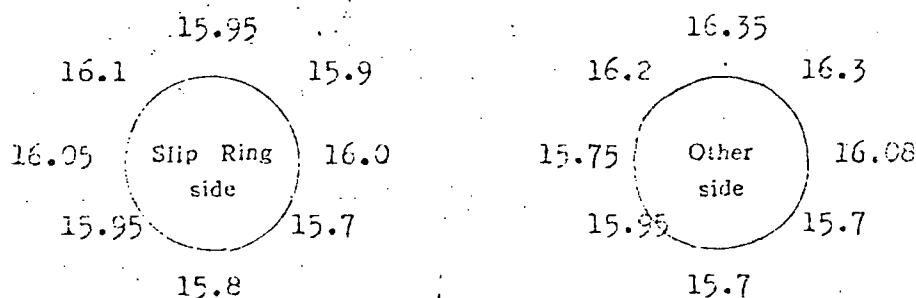
TEST REPORT

Measurement of Coil Resistance at 75 °C

Machine No. 850336

X
Stator Coil U to V= 0.0368 Ohms
V to W= 0.0367 Ohms
W to U= 0.0367 Ohms
Rotor Coil Ring to Ring 0.735 Ohms

Air Gap (mm)



Insulation Resistance; to Earth.

1000

Stator Coil (by 500 V Megger) 800 Megohms
Rotor Coil (by 500 V Megger) 40 Megohms
Space Heater (by 500 V Megger) 100 Megohms
Search Coil (by 500V Megger) 100 Megohms

High Voltage Test ; to Earth

	Hz	V	for	Result	Charging Current
Stator Coil	AC 60 Hz	29400	1 Minute	Good	U phase 1.47 A V " 1.40 A W " 1.49 A
Rotor Coil	AC 60 Hz	2500	1 Minute	Good	
Space Heater	AC 60 Hz	2000	1 minute	Good	
Search Coil	AC 60 Hz	1000	1 minute	Good	

Over-Current Test: 55 Over-Current for 1 minute Good.

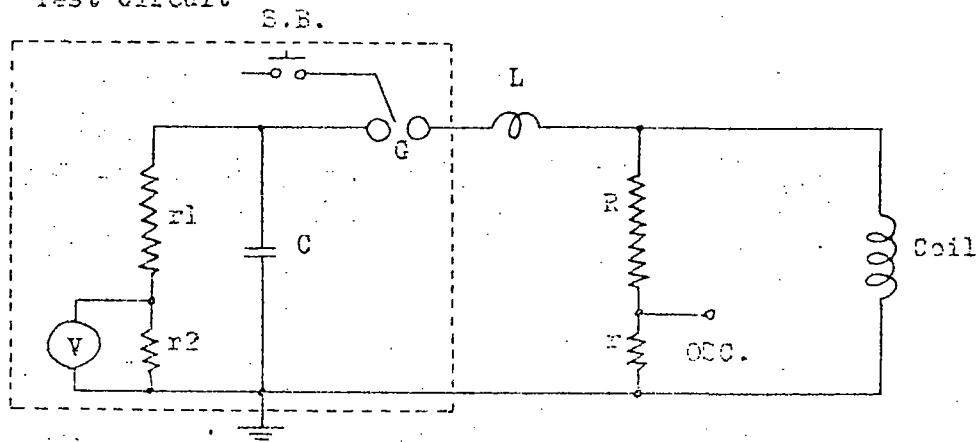
Over-Speed Test: 52 Over-Speed for 5 minute Good.

Date July-23-1970

Quality Control Section

Impulse Test result of the 20000HPSynchronous Motor Stator Coils (Unit 3)

1. Test Circuit



C : condenser

G : gap

L : inductance (for wave front adjustment)

R : resistance (for wave tail adjustment)

OSC : oscilloscope

S.B. : start button

 $r1, r2$: resistance (for potential divider)

V : volt meter

[] : 30KV Impulse generator (meter No. IBT-721)

Applied voltage : 5KV (crest value) per 1 coil.

Applied wave form : $3 \times 40 \mu S$

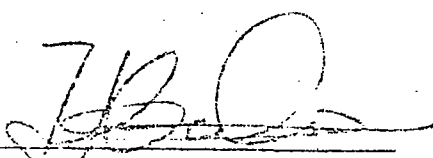
2. Test result

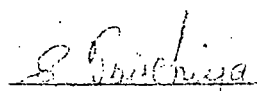
All 120 coils are good.

Test condition

coil temp. $31^{\circ}C$ room temp. $32^{\circ}C$

humidity 62%


 Manager of Q.C. section


 Surveyor to the E.V.

Test report of Performance test on 20000HP Synchronous
Motor for Companhia Metropolitana De Agua De Sao Paulo

Feb. 28, 1970

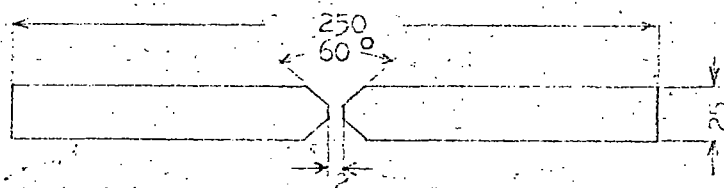
(A) Butt weld

a. Test piece

- (1) Operator Mr. T. Fujinaga
(2) Base Metal JIS G3101 SS41P
(3) Filler Metal JIS D5016 (AWS E7016)
(4) Nature of Electric Current ... AC

Dimension of Groove

Unit : mm



Arrangement of test piece

Base metal tensile Test piece	38
Tensile Test piece	38
Side bending Test piece	9
Side bending Test piece	9
Tensile Test piece	38
discard	
250	
190	

b. Test

(1) Radiographic inspection

Radiographic inspection was carried out prior to machining. Copies of Photo-Radiographs are attached to this report.

Result : No harmful indication are found.

(2) Tension test and bending test

Test pieces for Tension and bending test were prepared and tested in accordance with approved Specification by COMASP.

Result : Requirements of the specification were satis-

fied and test results are attached to this report.

These tests were witnessed by Mr. S. Tsuchiya of Bureau Veritas Surveyor.

(3) Macro-etch tests of welded joints

Macro-etch test were carried out on their sections of tensile test pieces before tensile test.

Macro-etch test pieces were inspected by presence of Mr. Tsuchiya of Bureau Veritas Surveyor.

Photograph of Macro-etch is attached to this report.

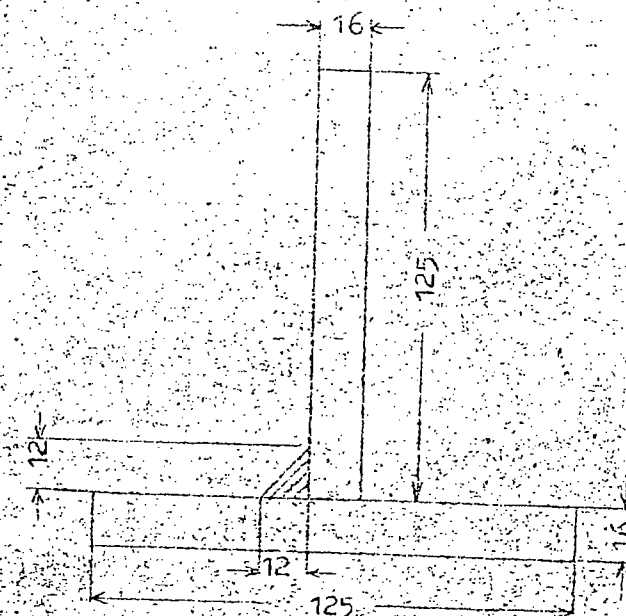
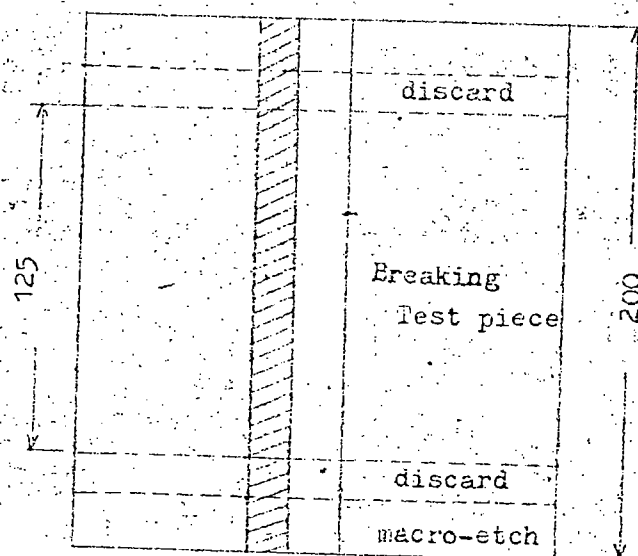
Result : Showing good penetration with no harmful defects.

(B) Fillet weld

a. Test piece

- (1) Operator Mr. R. Hashiguchi
- (2) Base metal JIS G 3101 SS41P
- (3) Filler metal JIS D 5016 (AWS E7016)
- (4) Nature of Electric Current AC

unit : mm



b. Test

(1) Breaking test

Breaking test piece was prepared and tested in accordance with approved specification by COMASP.

Result : Requirement of the specification was satisfied and test result are attached to this report.

This test was witnessed by Mr. S. Tsuchiya of Bureau Veritas Surveyor.

(2) Macro-etch test

Macro-etch test piece was witnessed by Mr. S. Tsuchiya of Bureau Veritas surveyor.

Photograph of macro-etched is attached to this report.

Result : Showing good penetration with no harmful defects.

Order No. _____

RESULT OF THE MATERIAL TESTINGSheet No. M-7026Date of Test Feb-26-1970Name of Articles Performance Test for Butt weldMaterial Grade JIS G 3101 SS41P

Require- ments	Quantity	Weight	Test Specimen			Tension Test					Bending Test		Impact Test	Hardness Test	Results
			Gauge Length mm	Dia in mm	Area in mm ²	Yielding Point in Kg/mm ²	Load in Ton	Tensile Strength in Kg/mm ²	Elongation in %	Reduction of Area in mm	Internal Dia in mm	Angle in degree	Brinell Hardness No.		
Test Marks				T x W					min.	min.	36	180°	min.		
A				24.9 x 25.0	623.0	25.7	26.7	42.9	50.0						Pass
B1				24.8 x 25.0	620.0	27.1	28.4	45.8							Pass
B2				24.7 x 25.0	617.0	27.2	28.4	46.0							Pass
C1				9.0 x 9.0						Bending Test	Good				Pass
C2				9.0 x 9.0							Good				Pass
Chemical Composition	Elements	C	Si	Mn	P	S							Heat treatment	Drawing No.	
	Require- ments in %	-	-	-	max. 0.050	max. 0.050									
	Charge No.	A	0.18	0.04	0.77	0.012	0.018								
Remarks	A : Tension test of Base metal														

Order No. _____

RESULT OF THE MATERIAL TESTING

Sheet No. M-7027

Date of Test : Feb-26-1970

Name of Articles. Performance Test for Fillet weld

Material Grade JIS G 3101 SS41P

Require- ments	Quantity	Weight	Test Specimen			Tension Test					Bending Test		Impact Test	Hardness Test	Results	
			Gauge Length mm	Dia in mm	Area in mm ²	Yielding Point in Kg/mm ²	Load in Ton	Tensile Strength in Kg/mm ²	Elongation in %	Reduction of Area in mm	Internal Dia in mm	Angle in degree	min.	Brinell Hardness No.		
Test Marks			50	TxW		min. 24		41-52	21	min.			min.			
A			"	16x25	400	26.7	19.1	47.6	40.0							Pass
Chemical Composition	Elements	C	Si	Mn	P	S										
	Require- ments in %	-	-	-	max.	max.										
	Charge No.				0.050	0.050										
	A	0.17	0.03	0.83	0.008	0.020										
Remarks		A : Tension test of Base metal														

Nagasaki Works

NAGASAKI STEEL WORKS MITSUBISHI STEEL MANUFACTURING CO., LTD

3-2, Mori-machi, Nagasaki, Japan

Purchaser Mitsubishi Electric Corporation

Order No. E2-1201-01

Ship

Engine No.

Works No.

RESULT OF THE MATERIAL TESTING

App No.

Sheet No. 23667

Date of Test Dec. 10, 1969

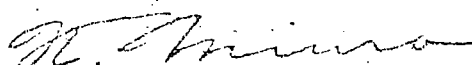
Works No. CN1 1805A

Name of Articles. Magnetic Pole Piece

Material Grade SCM2 (Special Requirement)

Require- ments	Quantity	Weight in kgs	Test Specimen			Tension Test					Bending Test		Impact Test	Hardness Test	Results
			Gauge Length in mm	Dia in mm	Area in mm ²	Yielding Point in Kg/mm ² min.	Load in Ton	Tensile Strength in Kg/mm ²	Elongation in % min.	Reduction of Area in % min.	Internal Radius in mm	Angle in degree	Charpy (kg-m/cm ²) (ft-lbs) min.	Brinell Hardness No.	
Test Marks			50	14	153.9	65		80	18	55			7	241-293	
2ZZD29	20	6106	"	"	"	83.2	15.00	97.4	18.5	56.8			7.3	293	Pass
Chemical Composition	Elements	C	Si	Mn	P.	S	Ni	Cr	Mo		Heat treatment		Drawing No.		
	Require-ments in %	0.28-0.33	0.15-0.35	0.60-0.85	max. 0.030	max. 0.030		0.90-1.20	0.15-0.35						
	Charge No.	49761	0.33	0.29	0.64	0.018	0.009	-	1.01	0.22	850°C Oil Cooling 580°C Furnace Cooling		0732782-1		
Remarks		(Contract No.) 13-5078													

We hereby certify that the material described herein has been made by the electric furnace process, and is that which has been tested to the satisfaction of the Surveyors in accordance with the requirements of the Specification.



Manager of Inspection Section Nagasaki Steel Works

Surveyor to the

Purchaser Nagasaki Works
 Order No. B2-1201-01
 Ship No.
 Engine No.
 Works No.

3-2. Mori-machi, Nagasaki, Japan RESULT OF THE MATERIAL TESTING

App. No.
 Sheet No. 25141
 Date of Test April 1, 1970
 Works No. CN10450A

Name of Articles. Bearing Cap (Load Side) Material Grade SC42 (Equivalent to ASTM A27-65)

Require- ments	Quantity	Weight in kgs	Test Specimen				Tension Test				Bending Test		Impact Test	Hardness Test	Results
			Gauge Length in mm	Dia in mm	Area in mm ²	Yielding Point in Kg/mm ² min.	Load in Ton	Tensile Strength in Kg/mm ² min.	Elongation in %	Reduction of Area in %	Internal Radius in mm	Angle in degree	Charpy (kg-m/cm ²) (ft-lbs ²) min.	Brinell Hardness No.	
Test Marks			50	14	153.9	21		42	24	35					
1E2D9L	1	650	"	"	"	26.6	7.30	47.4	35.0	57.7				123	Pass
Chemical Composition	Elements	C	Si	Mn	P	S	Ni	Cr	Mo	Heat treatment				Drawing No.	
	Require- ments in %				max.	max.									
	Charge No.				0.050	0.050				880-890°C				C165965-1	
	23751	0.19	0.45	0.72	0.018	0.015	-	-	-	Furnace Cooling					
Remarks	Contract No.														
	13-6819														

We hereby certify that the material described herein has been made by the electric furnace process, and is that which has been tested to the satisfaction of the Surveyors in accordance with the requirements of the JIS.

Manager of Inspection Section Nagasaki Steel Works Surveyor to the

MESSRS.

REPORT OF INSPECTION, TESTING

MITSUBISHI DENKI K.K.

NO. 231767


NAGASAKI SEISAKUSHO

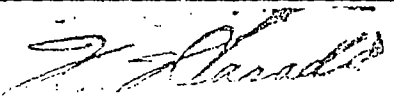
90-10% CUPRO-NICKEL TUBE

DATE: 70. 2. 20.

MFG. NO.		S I Z E				(mm)	NO.of PCS		WT. KGS		SPECIFICATION		
905596		Dia(or Thick)		Thick(or Width)		Length		208		292		JIS H3635 CN1FL-0	
Test piece	Tension Test			Hardness Test	Grain Size $\times 10^{-3}$ mm	Bending Expanding Flattening	Mercury Test	Hydrogen or Freedom from Embritt. Test	Shearing Force $L=100$ mm	Cleanliness $g/m^2 \times 10^{-3}$	Conductivity %	(Equivalent to ASTM B-111-68)	
	Tensile St.kg/cm ²	Elongation %	Yield St.kg/mm ²										
NO.	28 MIN	30 MIN				Test	Test		MIN	MAX	MIN		Dimensional Measurement OK
1	34.9	49.0				OK							Surface Finish OK
2													Eddy Current Test OK
3													Hydrostatic Test 30 kg/cm ² OK
4													Pneumatic Test kg/cm ²
5													
Chemical Analysis $\times 10^{-2}$												Remarks 4. Ex-100-100-1	
NI	FE	MN	FB	ZN	CU								
9.0 - 11.0	1.0 - 1.8	1.0 - MAX	0.05 - MAX	1.0 - MAX	RE								
9.5	1.3	0.6	TR	TR	RE								

Supervisor


 KOBE STEEL, LTD.
MOJI PLANT


Manager of Technical Section

Order No. 4 - E2 - 1201 - 01

RESULT OF THE MATERIAL TESTING

Sheet No.

Date of Test Apr. - 18 - 1970

Name of Articles.

Water Box

Material Grade JIS FC 25 (Equivalent to)
(ASTM A48-64)

Require- ments	Quantity	Weight	Test Specimen			Tension Test					Bending Test		Impact Test	Hardness Test	Results
			Gauge Length mm	Dia in mm	Area in mm ²	Yielding Point in Kg/mm ²	Load in Ton	Tensile Strength in Kg/mm ²	Elongation in %	Reduction of Area in mm	Internal Dia in mm	Angle in degree		Brinell Hardness No.	
Test Marks			20	20	314			min. 25	min.	min.			min.	max. 241	
F 2828			"	"	"		8650	27.6						197	Pass
Chemical Composition	Elements Require- ments in %	C	Si	Mn	P	S									
	Charge No.				max.	max.									
	F2828	3.28	1.86	0.81	0.011	0.021									
Remarks															

TABLE OF MATERIAL FOR SYNCHRONOUS MOTOR

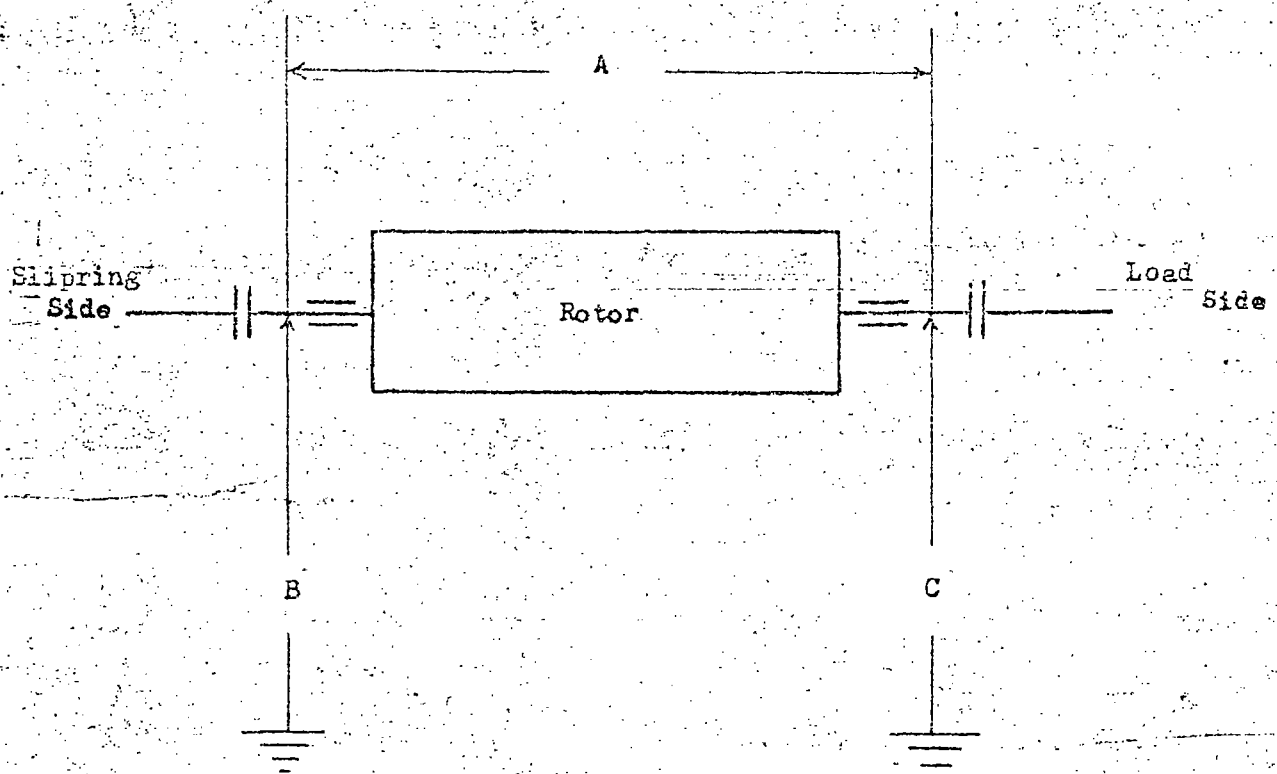
NAME OF ARTICLE	MATERIAL	SPEC NO. & MARK	TENSION TEST				CHEMICAL COMPOSITION	EQUIVALENT TO ASTM. SPEC. NUMBER
			Yield Point (Kg/mm ²)	Tensile Strength (Kg/mm ²)	Elongation (%)	Reduction of Area (%)		
Rotor Shaft	Carbon Steel Forging	JIS G 3201 SF 60	> 30	60 - 70	> 20	-	P < 0.035 S < 0.040	A 235 Class G.
Rotor Clamper	Chromium Molybdenum Steel	JIS G 4105 SUM 2	> 65	> 80	> 18	> 55	C : 0.28-0.33 Si:0.15-0.35 Mn: 0.60-0.85 P<0.030 S < 0.030 Cr : 0.90-1.20 Mo : 0.15 - 0.30	(AISI 4130)
Stator Frame	Roiled Steel	JIS G 3101 SS41	> 22	41 - 52	> 41	-	P < 0.050 S < 0.050	A283-67 Grade E
Stator Core	Silicon Steel Sheet	JIS C2551 S12F	Core loss (W/Kg) W 10/50 < 1.25 W 15/50 < 3.10		Flux density(gauss) B25 > 13900 B50 > 14900		-	A345-55 Class 58
Rotor Core	Roiled Steel	JIS G3101 SS55	> 41	> 55	> 16	-	C < 0.30 Mn < 1.60 P < 0.040 S < 0.040	A283-67 Grade D
Stator Coil	Copper Bar	JIS C3104 - 4	-	< 28	> 30	-	-	B272-66a
Rotor Coil	Copper Bar	JIS C3104 - 4	-	< 26	> 34	-	-	B272-66a

NAME OF ARTICLE	MATERIAL	SPEC. NO. & MARK	TENSION TEST				CHEMICAL COMPOSITION	EQUIVALENT TO ASTM SPEC. NUMBER
			Yield Point (Kg/mm ²)	Tensile Strength (Kg/mm ²)	Elongation (%)	Reduction of Area (%)		
Finger Plate	Brass Casting	JISH5101 YBc C ₃	-	> 25	> 20	-	Cu: 60.0 - 65.0 Pb: 0.5 - 3.0 Sn < 1.0 Al < 0.5 Fe < 0.8 Zn: Re	B-146-52 Alloy 6C
Bearing Pedestal	Carbon Steel Casting	JISC5101 SC42	> 21	> 42	> 24	> 35	P < 0.05 S < 0.05	A27-65
Bearing Shell	Carbon Steel Casting	JISC5101 SC42	> 21	> 42	> 24	> 35	P < 0.05 S < 0.05	A27-65
Cooler Tube	Seamless Copper Tube	JISH3632 CNTF1-0	-	> 28	> 30	-	Ni: 9.0 - 11.0 Mn < 1.0 PB < 0.05 Fe: 0.5 - 2.0 Zn < 1.0 Cu: Re	B111-68
Tube Plate	Naval Brass	JISH3203 NBsP1	-	> 35	> 20	-	Cu: 61.0 - 64.0 Sn: 0.7 - 1.5 Pb < 0.30 Fe < 0.30	B21-66a
Water Box	Grey Iron Casting	JISG5501 FC25	-	> 28-22 (according by thickness)	-	-	-	A48-64 Class 25

Shaft Voltage at 13200 V No-load

Machine No. 850337

Tested On Sep.-14-1970



A.C. (V)

A 0.09

B 0.83

C 0.73

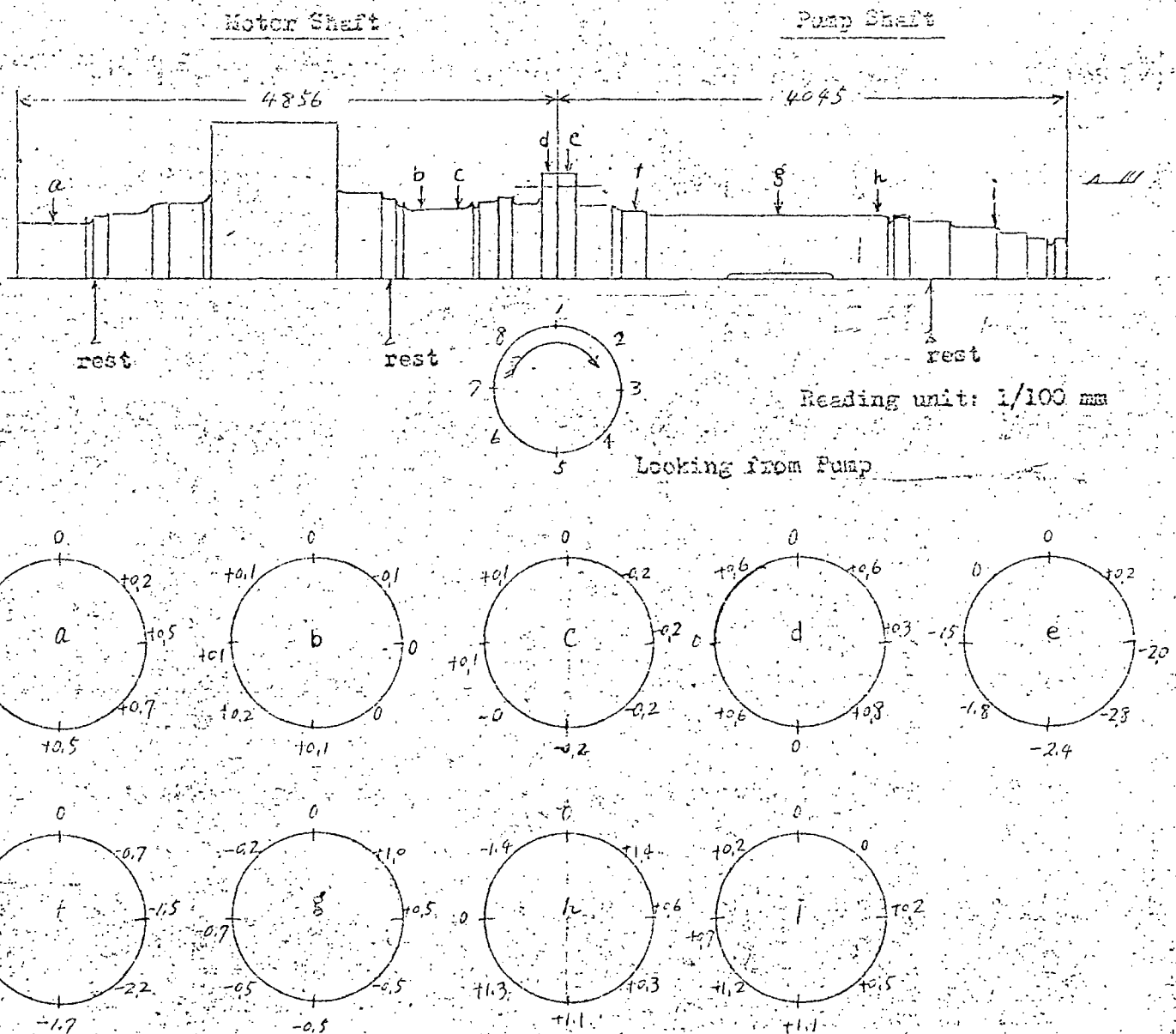
Date July-24-1970

Runout of Combined Motor and Pump Shafts (Unit 3)

The alignment of the combined motor and pump shafts was checked at the factory of MELCO, Nagasaki by rotating in a lathe.

The reading of an indicator is as follows.

This test was witnessed by Mr. E. Tsuchiya of Bureau Veritas Surveyor.



Manager of E.C. Section

Surveyor to the Bureau Veritas

PRESSURE TEST REPORT

Date : Sep-2-1970

Customer : Companhia Metropolitana De Água

De São Paulo-COMASP

Subject : Air cooler for 20000HP Synchronous Motor

W. Order No. : 4-E2-2361-01

No. of Set : 2 sets

Machine No. : 852810. 852811

1. Hydrostatic Test

Test Pressure 8.5 Kg/cm²

Test Time 1 Hr.

Test Result Good Good

Test Report

Subject: _____

Article: _____

Indoor Type
Metal-clad Switchgear

Customer: _____

COMPANHIA METROPOLITANA
DE AGODA DE SAO PAULO

Order No.: _____

Makers
Order No.: _____

C - 286 - 50

Machine No.: _____

913495; 409939; 406057-70

Date Tested: _____

July, 1970

Supervisor _____



Y. AVOH

Manager of

Field Engineering and
Control and Quality
Control Section



T. IKOMA

TEST RECORD OF SWITCH BOARD

Article: Switch board for Metal-clad Switchgear

Serial No. Refer to Remarks

Tested: M.D.K. works.

Date: July, 1970

Rule: NEMA, JIS

Room Temp. 30°C

Test results:

(1) Inspection and testing for back wiring and all apparatus.

(by wiring diagram No. AB58169-77) Satisfactory.

(2) Operation test:

Meters, relays, circuit breakers and other apparatus

are operated successfully by hand and electrically. Satisfactory.

(Test results of each apparatus are shown on other sheets)

(3) Insulation resistance (connecting 5 panels altogether)

(a) Between all L.T. electric circuits and ground. (by 500V. Megger) 5 MΩ

(b) Between all H.T. circuit and ground. (by 1,000V. Megger) 500 MΩ

(4) Dielectric test: (connecting 5 panels altogether)

Impress A.C. Voltage 60. cycles per sec. for one minute between

all electric circuit and ground. Satisfactory.

(a) L.T. circuit ground 1500 V.

(b) H.T. circuit ground 31000 V.

Remarks: List of Machine No.

1. Receiving Panel 406067
2. Short-Circuit Panel 406069
3. PTs & CTs Panel 406070
4. Transformer Panel 409939
5. Surge-Absorb Panel 413495

Messrs. COMPANHIA METROPOLITANA DE AGODA DE SAO PAULO

Nos. 5

Our Order No. C-285-50-801/806

Tester Matsushita

Checker

Y. Amoh

MITSUBISHI ELECTRIC CORPORATION KOBE JAPAN

TEST RECORD OF SWITCH BOARD

Article: Switch board for Metal-clad Switchgear

Serial No. Refer to Remarks

Tested: M.D.K. works.

Date: July, 1970

Rule: NEMA, JIS

Room Temp. 30°C

Test results:

(1) Inspection and testing for back wiring and all apparatus.
(by wiring diagram No. A358169-77) Satisfactory.

(2) Operation test:
Meters, relays, circuit breakers and other apparatus
are operated successfully by hand and electrically. Satisfactory.
(Test results of each apparatus are shown on other sheets)

(3) Insulation resistance
(a) Between all L.T. electric circuits and ground. (by 500V. Megger) 100 MΩ
(b) Between all H.T. circuit and ground. (by 1,000V. Megger) 200 MΩ

(4) Dielectric test:
Impress A.C. Voltage 60 cycles per sec. for one minute between
all electric circuit and ground. Satisfactory.

(a) L.T. circuit-ground 1500 V.

(b) H.T. circuit-ground 31000 V.

Remarks: List of Machine No.

1. Reactor Panel 406068

Messrs.	COMPANHIA METROPOLITANA DE AGODA DE SAO PAULO	Nos.	1
Our Order No.	C-286-50-801/806	Tester	Y. Matsushita
		Checker	Y. Amon

Vibration Measurement

(A) Machine No. Gen. 850337
Ex. -

(B) Test Condition

- | | |
|---|-----------------------------------|
| 1) Room Temp. 32.5 °C | 4) Bearing oil in-let Temp. 30 °C |
| 2) Rotor Temp. 39 °C | |
| 3) Bearing oil out-let Temp. (Slipping Side 38 °C
Load Side 43 °C) | |

(C) Test Result

R.P.M.	720			50 % Over Speed (1080)		
Measuring Part Vib.	Slipping Side	Load Side		Slipping Side	Load Side	
V	1.8	2.0		10	10	
H	4.2	2.4		23	19	
A	1.3	1.3		5	3.5	

Measured by Reutlinger Vib-Meter

unit $\times \frac{1}{1000}$ mm
(Half Amplitude)

V=Vertical Component

H=Horizontal Component

A=Axial Component

(D) Over Speed Test: 50 % Over Speed for 5 minute Good.

Residual Unbalance

Customer	<u>Comasp (Brazil)</u>
Order No.	<u>4-E2-2361-01</u>
Gut Put	<u>20000 HP</u>
Machine No.	<u>850337</u>

The final residual unbalance of the rotor is following

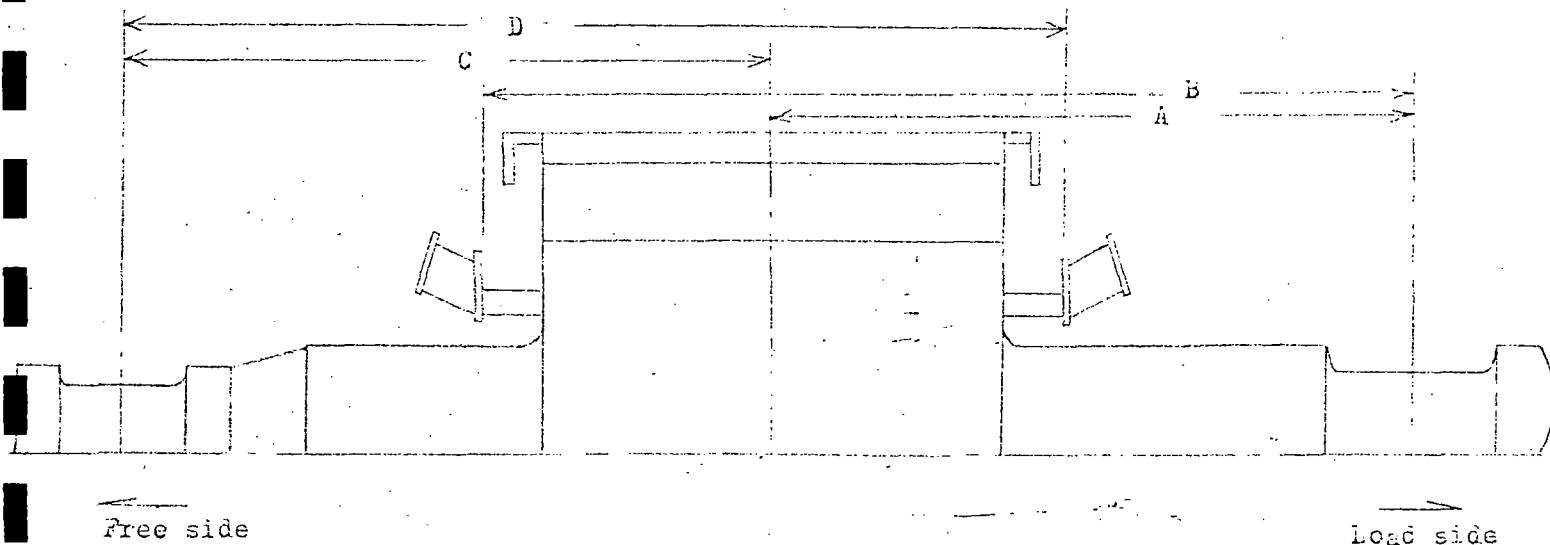


Fig.1

- A : distance between the center of the rotor and one of the load side journal
- B : distance between the center of the load side journal and the free side correction plane
- C : distance between the center of the rotor and one of the free side journal
- D : distance between the center of the rotor and the load side correction plane

RL : radius of the load side correction plane
 RF : radius of the free side correction plane
 W : rotor weight
 mL : the residual unbalance weight of the load side
 mF : the residual unbalance weight of the free side
 eL : the excentricity of the center of the gravity
 with the load side residual unbalance
 eF : the excentricity of the center of the gravity
 with the free side residual unbalance

Calculation of the residual unbalance

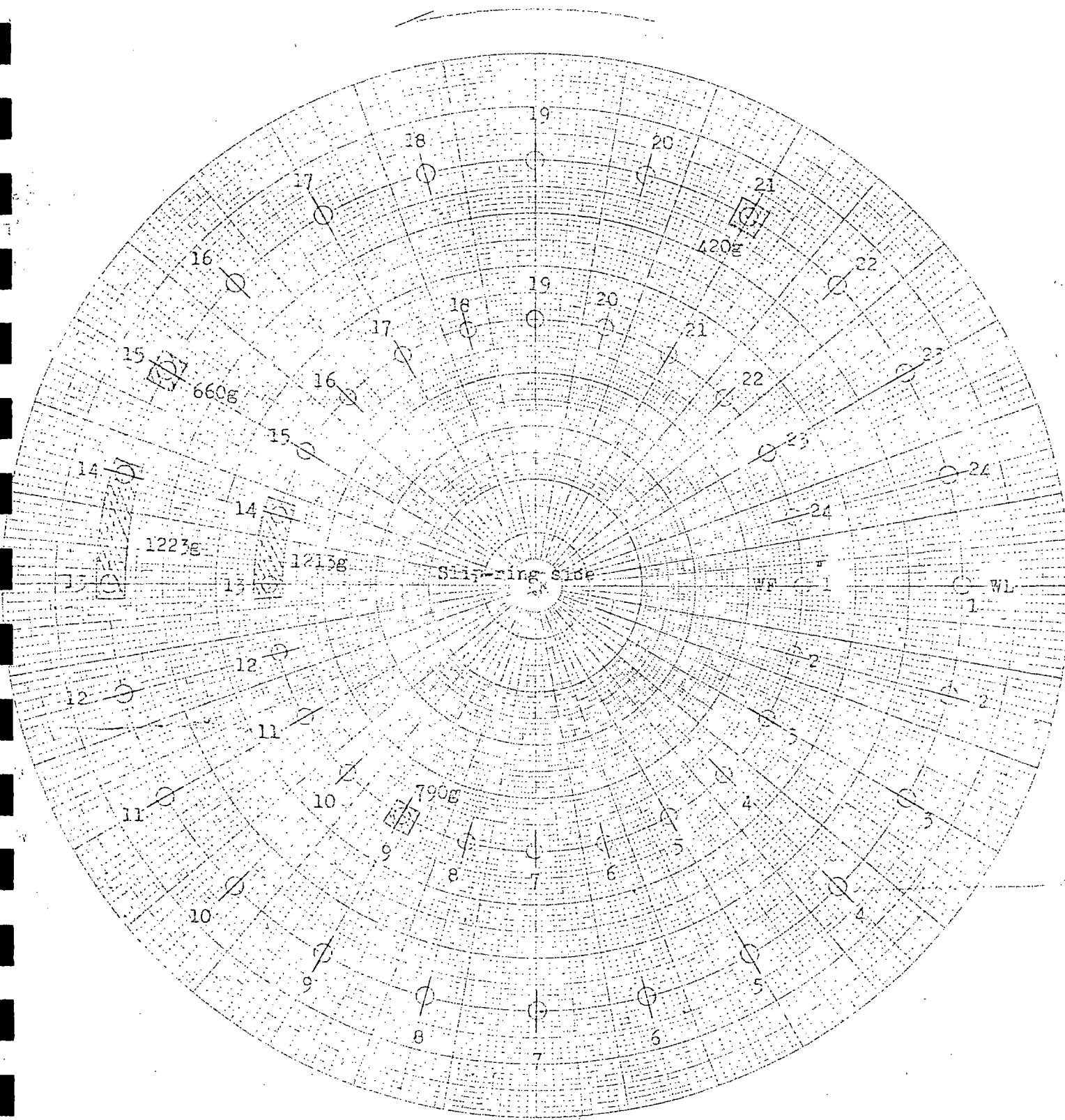
A = 1854 mm
 B = 2694.5 mm
 C = 2046 "
 D = 2886.5 "
 RL = 500 "
 RF = 500 "

W = 28500 Kg
 mL = 350g
 mF = 250g

$$\begin{aligned}
 eL &= \frac{mL \cdot RL \cdot D}{W \cdot C} \\
 &= 8.68 \mu
 \end{aligned}$$

$$\begin{aligned}
 eF &= \frac{mF \cdot RF \cdot B}{W \cdot A} \\
 &= 6.38 \mu
 \end{aligned}$$

Distribution Diagram of Balance Weight



Note :

- added balance weight
- WF Fan (Free side)
- WL Fan (Load side)

JES A4 (200^{mm} / 200^{mm} R461C

TRADE ★ MARK

CONSTRUCTION

20000 HP Synchronous Motor
~~=KVA =Farbne=Generator~~

Out put	20000	HP =KVA (14900 KW)
Power Factor	100	%
Frequency	60	c/s HZ
R.P.M.	720	r.p.m.
Voltage	13200	V
Ampere	665	A
Rating	Continuous	
Mach. No.	850337	
Rotation (Looking from Exciter Side)	Slipring Counter Clock Wise	
Insulation Class	" B "	

- KVA AC Exciter

Out. put	KVA (KW)
Power Factor	%
Frequency	c/s
Voltage	V
Ampere	A
R.P.M.	r.p.m.
No. of Pole	P
Rating	Continuous
Mach. No.	

W. O. No. 4-E2-2361-01

EFFICIENCY CALCULATION

HP SYNCHRONOUS MOTOR
20000 KVA-TURBO-GENERATOR

Power Factor 100 %

Machine No. 850337

Load	%	115	100	75	50	25
Out. Put	KW	17231	14968	11207	7435	3632
Line Voltage	V	13200	13200	13200	13200	13200
Line Current	A	765	665	499	333	166
Field Voltage	V	136	126	111	98	90
Field Current	A	182	169	148	131	120
Mechanical Loss	KW	64	64	64	64	64
Iron Loss	KW	93	93	93	93	93
Stator I ² R Loss	KW	64	49	27	12	3
Stray Load Loss	KW	38	29	17	9	3
Excitation Loss	KW	25	21	16	13	11
Total Loss	KW	284	256	217	191	174
In Put	KW	17515	15224	11424	7626	3806
Efficiency	%	98.38	98.32	98.10	97.50	95.43

Power Factor 80 %

Load	%	115	100	75	50	25
Out Put	KW	17165	14920	11169	7420	3637
Line Voltage	V	13200	13200	13200	13200	13200
Line Current	A	956	831	623	416	208
Field Voltage	V	210	191	161	133	109
Field Current	A	284	258	217	179	146
Mechanical Loss	KW	64	64	64	64	64
Iron Loss	KW	93	93	93	93	93
Stator I ² R Loss	KW	100	76	43	19	5
Stray Load Loss	KW	63	46	26	13	5
Excitation Loss	KW	60	49	35	24	16
Total Loss	KW	380	328	261	213	183
In Put	KW	17545	15248	11430	7633	3820
Efficiency	%	97.83	97.85	97.72	97.21	95.21

TEST REPORT

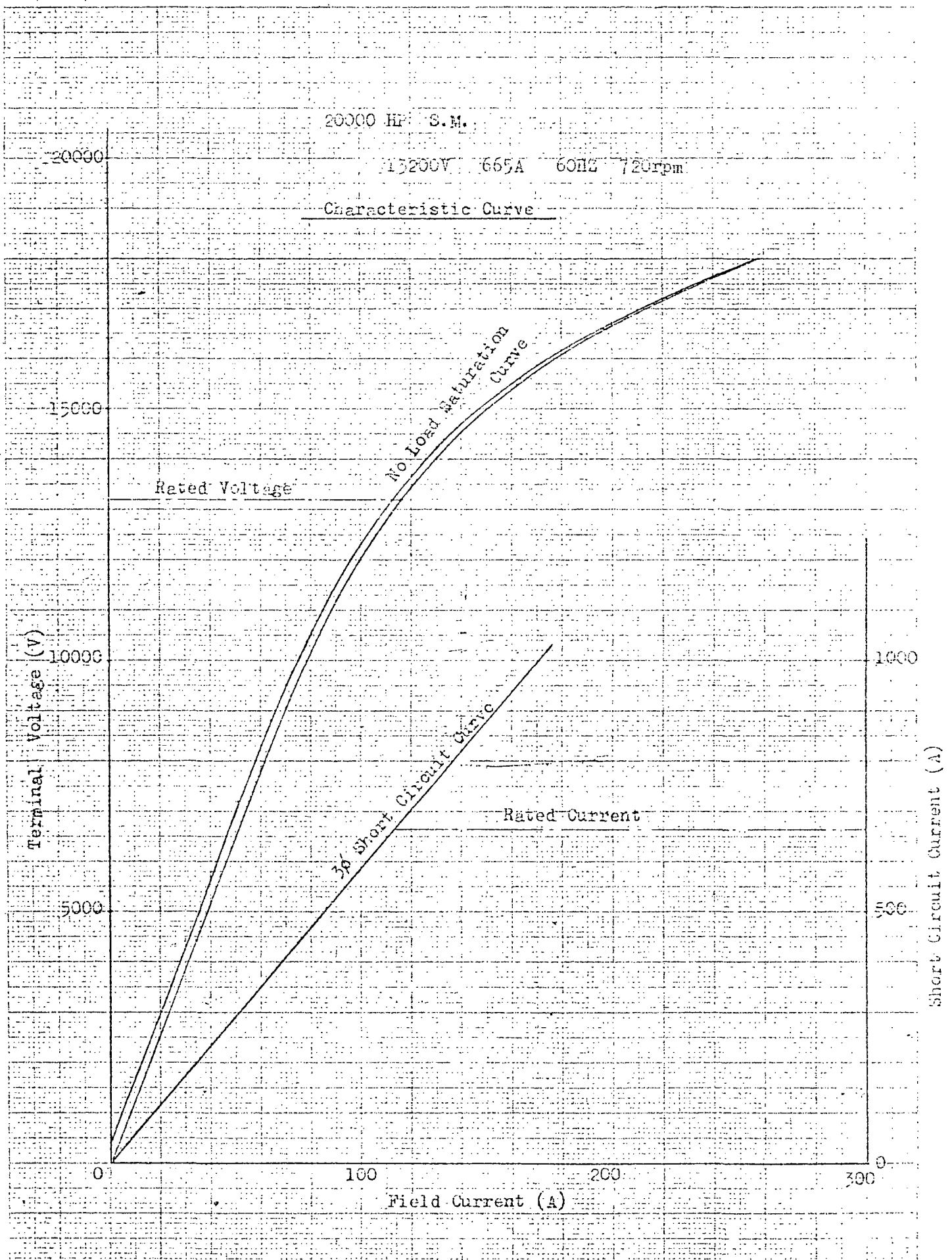
20000 HP
KVA Machine No. 850337

No - Load Saturation Test

Ascending				Descending			
Line Voltage	Field		R.R.M.	Line Voltage	Field		R.R.M.
	Volt	Amp.			Volt	Amp.	
2400	12.5	17.5	720	16800	137	203.5	720
4800	25	36	"	15600	111	164	"
7200	38	55.5	"	14400	89.5	133.5	"
9600	50.5	75	"	13200	77	113	"
10800	59	86	"	12000	65.5	96	"
12000	67	100	"	10800	55.5	82	"
13200	78	116.5	"	9600	46.5	70	"
14400	92	137	"	7200	34.2	50.5	"
15600	110.5	166	"	4800	22.2	32.5	"
16800	138	205	"	2400	10.2	14.5	"
18000	170	258	"				

Short Circuit Characteristic Test

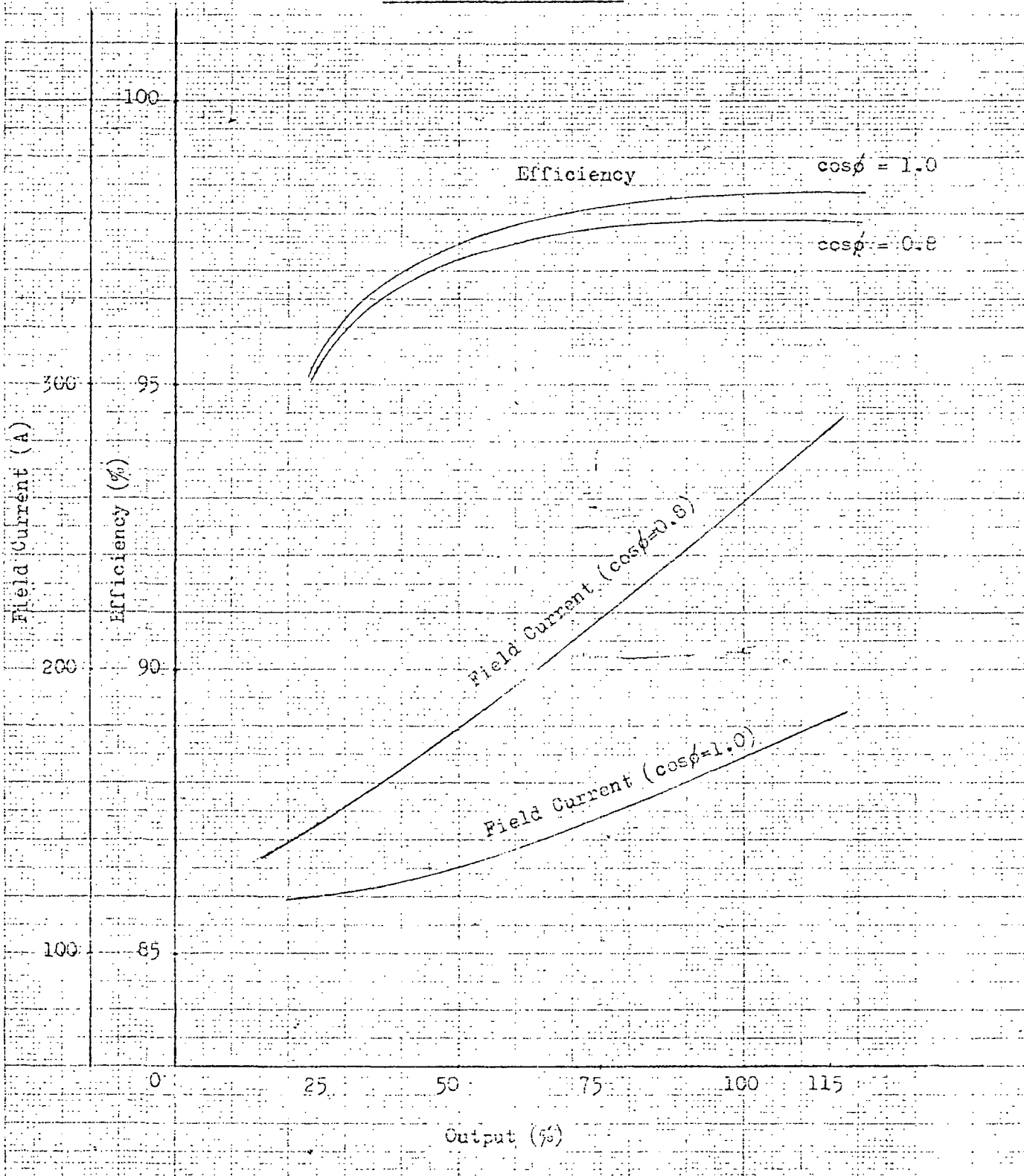
Line Amperes	Field		R.R.M.
	Volt	Amp.	
200	23.5	33.5	720
400	46	67.5	"
600	69	101	"
665	76	112.5	"
800	91.5	135.5	"
900	103	152.5	"
1000	114.5	170	"



20000HP S.E. (14900KW)

13200V 665A 1.0PF

Characteristic Curve



Order No. E2-2360-01

Ship No.

Engine

Works No.

RESULT OF THE MATERIAL TESTING

Sheet No. EM - 004

Date of Test March 12, 1970

Works No. CH1 1811A

Name of Articles. Generator Shaft

Material Grade SF60 (Equivalent to ASTM-A313)

Require- ments	Quantity	Weight in kgs	Test Specimen			Yielding Point in Kg/mm ² min.	Load in Ton	Tension Test			Bending Test		Impact Test		Hardness Test		Results	
			Gauge Length in mm	Dia in mm	Area in mm ²			Tensile Strength in Kg/mm ²	Elongation in %	Reduction of Area in %	Internal Radius in mm	Angle in degree	Charpy (kg-m/m ²) (ft-lbs) min.	Brinell Hardness No.				
Test Marks			50	14	153.9	30		60-70	mm L:20 T:15		22 44	180°						
2ZLD5G TL	1	24,400	"	"	"	33.1	9.45	61.4	29.0	46.9	Good	-		153	Pass			
BL			"	"	"	33.5	9.50	61.7	28.0	44.8	Good	-		167	Pass			
TT			"	"	"	33.8	9.60	62.3	26.0B	43.7	Good	-		167	Pass			
BT			"	"	"	33.8	9.55	62.0	27.0	43.7	Good	-		167	Pass			
Chemical Composition	Elements Require- ments in %	C	Si	Mn	P	S	Ni	Cr	Mo	Heat treatment		Drawing No.						
	Charge No.				max.	max.				870°C x 30Hr.		CE20075-2						
	60702	0.40	0.35	0.38	0.033	0.011	-	-	-	Air Cooling								
											610°C x 40Hr.		Furnace Cooling					
Remarks																		
K. Hirohashi Mitsubishi Electric Corporation																		

K. Hirohashi
Mitsubishi Electric Corporation

We hereby certify that the material described herein has been made by the electric furnace process, and is that which has been tested to the satisfaction of the Surveyors in accordance with the requirements of the JIS.

Manager of Inspection Section Nagasaki Steel Works

Surveyor to the Japanese Maritime

Purchaser: Nagasaki Works
 Mitsubishi Electric Corporation 3-2, Mori-machi, Nagasaki, Japan
 Order No. 12-1201-01
 Ship's No.
 Engine No.

App. No.
 Sheet No. 24054
 Date of Test Feb. 13, 1970
 Works No. CN1 1574

RESULT OF THE MATERIAL TESTING

Name of Articles. Rough Turned Rotor Shaft
 for 20,000 H.P. Synchronous Motor
 Material Grade SF60 (Equivalent to ASTM A235-Class A)

Requirements	Quantity	Weight in Kgs	Test Specimen			Tension Test					Bending Test		Impact Test	Hardness Test	Results
			Gauge Length in mm	Dia in mm	Area in mm ²	Yielding Point in Kg/mm ²	Load in Ton	Tensile Strength in Kg/mm ²	Elongation in %	Reduction of Area in %	Internal Radius in mm	Angle in degree	Charpy (kg-m/cm ²) (ft-lbs ²)	Brinell Hardness No.	
			50	14	153.9	min. 30		60-70	min. 1:20 15.15	min.	22 44	180°	min.		
Test Marks															
28DD1A TL	1	24,700	"	"	"	36.4	9.65	62.9	29.5	47.9	Good	-	170	Pass	
BL			"	"	"	36.7	9.60	62.3	30.0	50.1	Good	-	170	Pass	
TT			"	"	"	36.7	9.65	62.7	26.5	42.7	Good	-	170	Pass	
ET			"	"	"	36.4	9.45	61.4	28.0	46.9	Good	-	167	Pass	
Chemical Composition	Elements	C	Si	Mn	P	S	Ni	Cr	Mo	Heat treatment			Drawing No.		
	Requirements in %				max.	max.									
	Charge No.				0.035	0.040				870°C Air Cooling			CB20075-2		
	60106	0.35	0.30	0.40	0.013	0.021	-	-	-	580°C Furnace Cooling			Date of Last Stamp		
Remarks		CONTRACT NO. 13-4123													

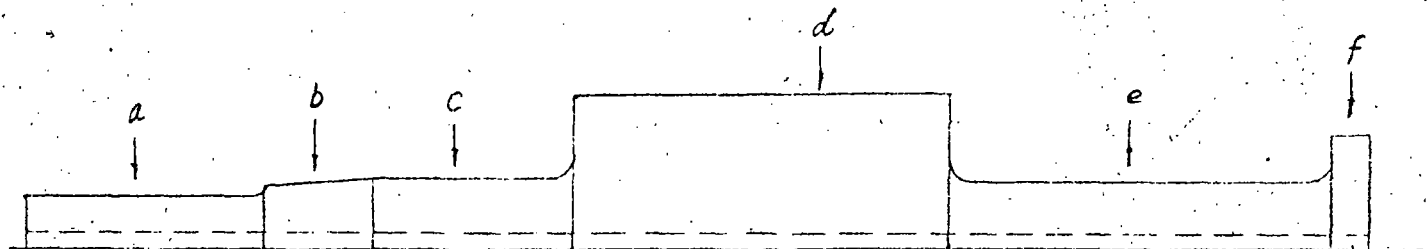
We hereby certify that the material described herein has been made by the electric furnace process, and is that which has been tested to the satisfaction of the Surveyors in accordance with the requirements of the JIS.

H. Minami
 Chief of Inspection Section Nagasaki Steel Works
E. G. ...
 Surveyor to the Bureau Veritas

Sheet No. 70-190

RESULT OF THE ULTRASONIC TEST

Purchaser	Name of Article	Drawing No.	Quantity	Works No.	Test Mark.	Heat No.	Grade.
Nagasaki Work's Mitsubishi Electric Corporation, Ltd.	Generator Shift	-	1	CN1 1574A	2ZDD1A	60106	SF60 Equivalent to ASTM A235 Class 7
Type of Apparatus.							
UR - 1							
Method of Testing.							
Straight beam.							
Angle beam.							
Frequency.							
2.25 M.C.							
Sensitivity.							
By MELCO Spec.							
I-I (5)							
Pulse Width.							
30 mm.							
Couplant.							
Machine Oil							
Surface Condition							
JIS 18s							
Equivalent to ASTM, E-114							
Process.	Class						
Final							
Photo No.							
Date of Test							
Feb. 12, 1970							
Comment	All surface was inspected by Ultrasonic testing and no flaw was found.						



Typical Echoes

	a	b	c	d	e	f
F/B	$\frac{0}{1.3}$	$\frac{0}{0}$	$\frac{0}{1.2}$	$\frac{0}{0.8-1P}$	$\frac{0}{1.1-12}$	$\frac{0}{1.2}$

Note : F / B F : Flaw Echo

B : Back Echo

F / B 0 → Flaw Echoes

1.3 → Back Echoes next to
Saturated (B2=30%)

Back Echoes Saturated (B1=100%)

Inspector of Bureau Veritas

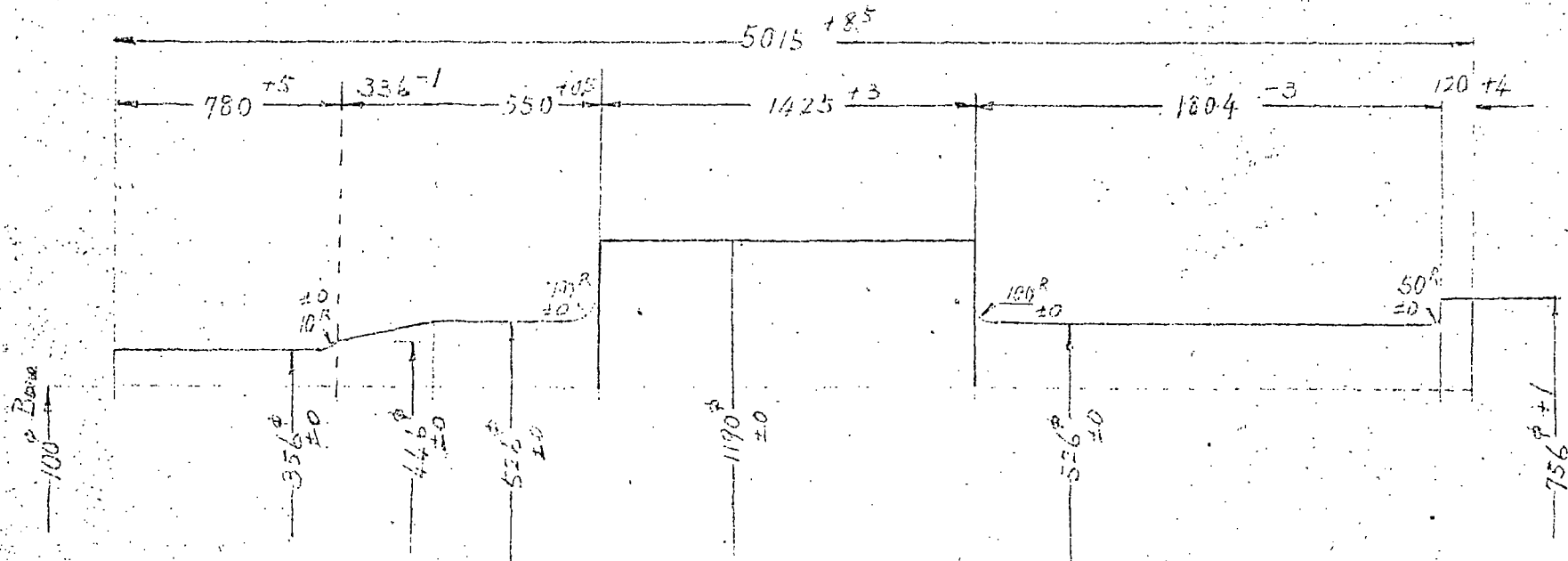
Chief of Inspection Section, Nagasaki Steel Works.

Sheet No.

RECORD OF INSPECTION

Date of Inspection: Feb 13, 1970

Purchaser Mitsubishi Nagasaki Electric Corporation	Builder	Ship No. or Engine No. E. NO. S. NO.	Name of Article Rough turned Rotor	Drawing No. CE20075	State of Machining R. T
Works No. CNI 1574	Test Mark 2ZDD1A	Heat No. 60106	Material Grade JIS G 3201 SP-60 (Equivalent to ASTM A225 Class G)	Wt. of Forg. kg	Wt. of Article kg
				Measuring Unit in M.M.	



Survey Stamp

S. Gendai
Inspector of Bureau Veritas

Chief of Inspection, Section Nagasaki Steel Works



ESTABLISHED
1885

INSPECTION CERTIFICATE

Date : December 24, 1969

Report No. : N- 5205

Specification ; JIS C 3104 (Equivalent to ASTM B272-66a)

Commodity ;

Item No.	Mfg. No.	Commodity	Quantity
		Tin - coated Annealed Copper Wire, 2.6 mm x 5.6 mm	1,154.5 kg

This is to certify that the above commodity has been duly inspected by us,
and it met and conformed to the contracted specification as follows.

The Fujikura Cable Works, Ltd.

for inspection
Chief of Inspection Section

Test Report ;

Lot Size : 15 Reels

Sample Size : 5 Reels

Properties	Spec. Value	Test Result			Remark
		Maximum Value	Minimum Value	Mean Value	
Thickness (mm)	2.6±0.07	2.650	2.620	2.633	
Width (mm)	5.6±0.10	5.620	5.590	5.606	
Tensile Strength (kg/mm ²)	max. 26.0	22.71	21.74	22.172	
Elongation in 250 mm (%)	min. 34.0	39.6	38.8	39.16	
Conductivity at 20 C (%)	min. 100.0	101.8	101.6	101.68	
Resistivity at 20 C ()					
Appearance		good			

No. 9841

Date: Dec. 17, 1969

Test Report for Copper Strip

2.3 x 45 (mm)

Specification No.

JIS C 3104-1

(Equivalent to ASTM B272-66a)

Process No.

4504B

Customer

Mitsubishi Electric
Corporation

Destination

Nagasaki

Contract Quantity

695 kgs

Tested Quantity

121.0 kgs (2 Coils)

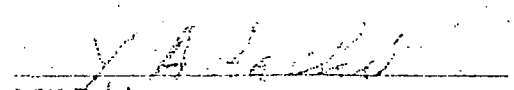
Previously Tested Quantity

Remaining Quantity

574.0 kgs

We hereby certify that the above mentioned
goods have been inspected as per attached sheets.

The Nikko Copper Works
of
the Furukawa Electric Co., Ltd


Chief Engineer of the
Technical Section

Test Data of Copper Strip

2.3 x 45

Test No.	Tensile Strength	Elongation	Bending	Electric.
	Kg/mm ²	%		Cond. (%)
Spec.	Max. 26	Min. 34	Edge-rise	Min. 100
1	22.4	45.2	Good	101.2
2	22.3	44.8	"	

Chemical Composition (%)

Cu

99.94

DIVISÃO IV

IV - DESCRIPTION OF PUMP TESTS

(DESCRIÇÃO DOS TESTES DA BOMBA)

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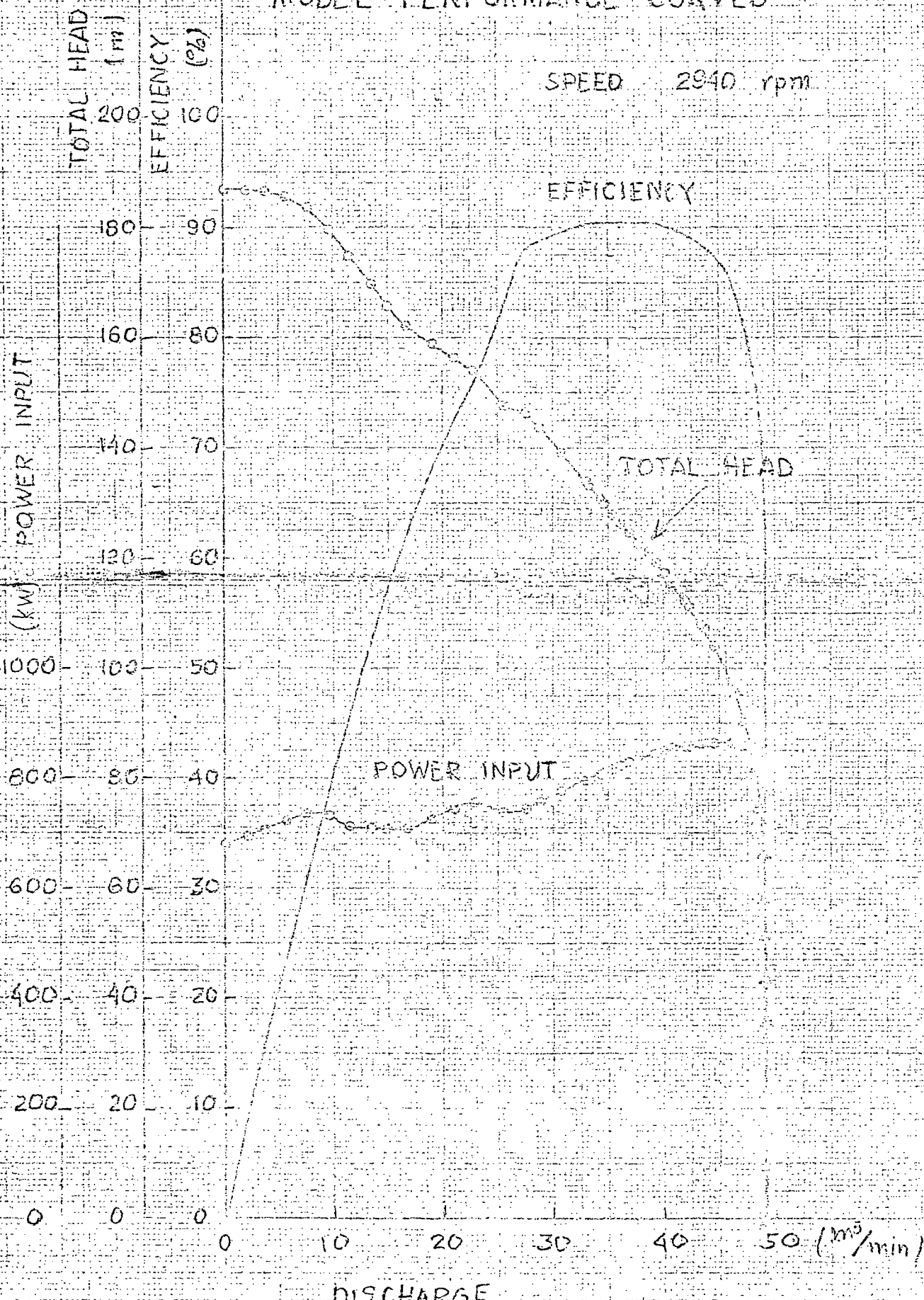
DESCRIÇÃO DOS MATERIAIS PARA AS BOMBAS HIDRÁULICAS

Peça	
Carcaça da bomba e anel difusor difusor	Aço fundido ASTM A 27 grau 60 - 30; Chapa de aço ASTM 283 grau B, para chapas de 51 mm ou menos de espessu ra e ASTM A 201, qualidade para for nalhas grau A, para chapas de espes sura acima de 51 mm.
Chapas de proteção	Chapa de aço ASTM A 283 grau B.
Bronze fundido	ASTM B 22, liga A.
Eixo	Aço forjado ASTM A 235, Classe E, re cozido antes da usinagem.
Metal antifricção para os mancais	ASTM B 23
Rotor	ASTM A 296 grau CA-15 ou ASTM B 148 liga 9 D.
Anéis de desgaste rotativos e luvas do eixo	Aço inoxidável ASTM A 296 grau CA, com dureza BHN mínima de 350.
Anéis de desgaste estacioná rios e rotor	Aço inoxidável ASTM A 296 grau CA, 15, faixa de dureza BHM de 250 a 300.
Parafusos, porcas e parafusos prisioneiros p/flanges s/pres são quando altamente solicita dos (sem contato com água)	ASTM A 320 grau L-43

Peça	Especificação do material
Parafusos, porcas e parafusos prisioneiros p/outros fins (sem contato com água)	ASTM A 307 (aço), latão ASTM B 21, Liga A
Parafusos, porcas e parafusos prisioneiros em <u>con</u> tato com a água	Aço inoxidável ASTM A 276, tipo 303.
Peças de ferro fundido	ASTM A 48, Classe 35
Materiais elétricos	Normas ABNT, NEMA, USAS e National <u>Electri</u> cal Code (USA).
Tubos de aço	USAS B 36 10, ASTM A 120 grau A.
Aço estrutural para monta <u>gem</u> com parafuso	ASTM A 7
Aço estrutural para solda <u>gem</u>	ASTM A 373
Tubo de latão	ASTM B 43
Válvulas de bronze	ASTM B 61 ou B 62
Tubos rígidos de cobre	ASTM B 42
Tubo flexíveis de cobre	ASTM B 88, tipo K
Eletrodutos rígidos	USAS C 80.1

MODEL PERFORMANCE CURVES

SPEED 2940 rpm



DISCHARGE

DATE: 10/10/10
 DRAWN: [Signature]
 CHECKED: [Signature]

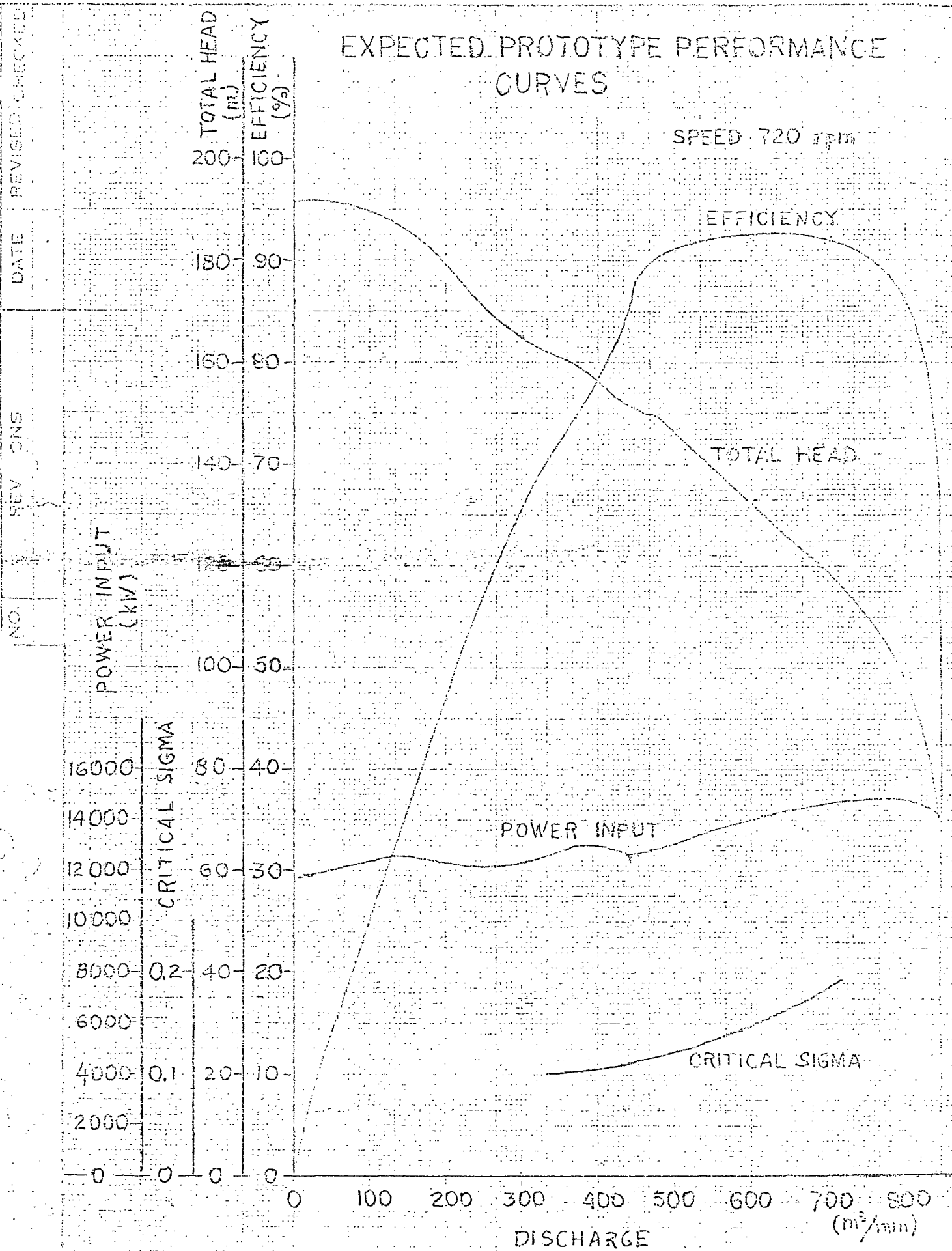
MODEL
 PERFORMANCE
 CURVES

REVISIONS
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S972497_1

EXPECTED PROTOTYPE PERFORMANCE CURVES

SPEED 720 rpm

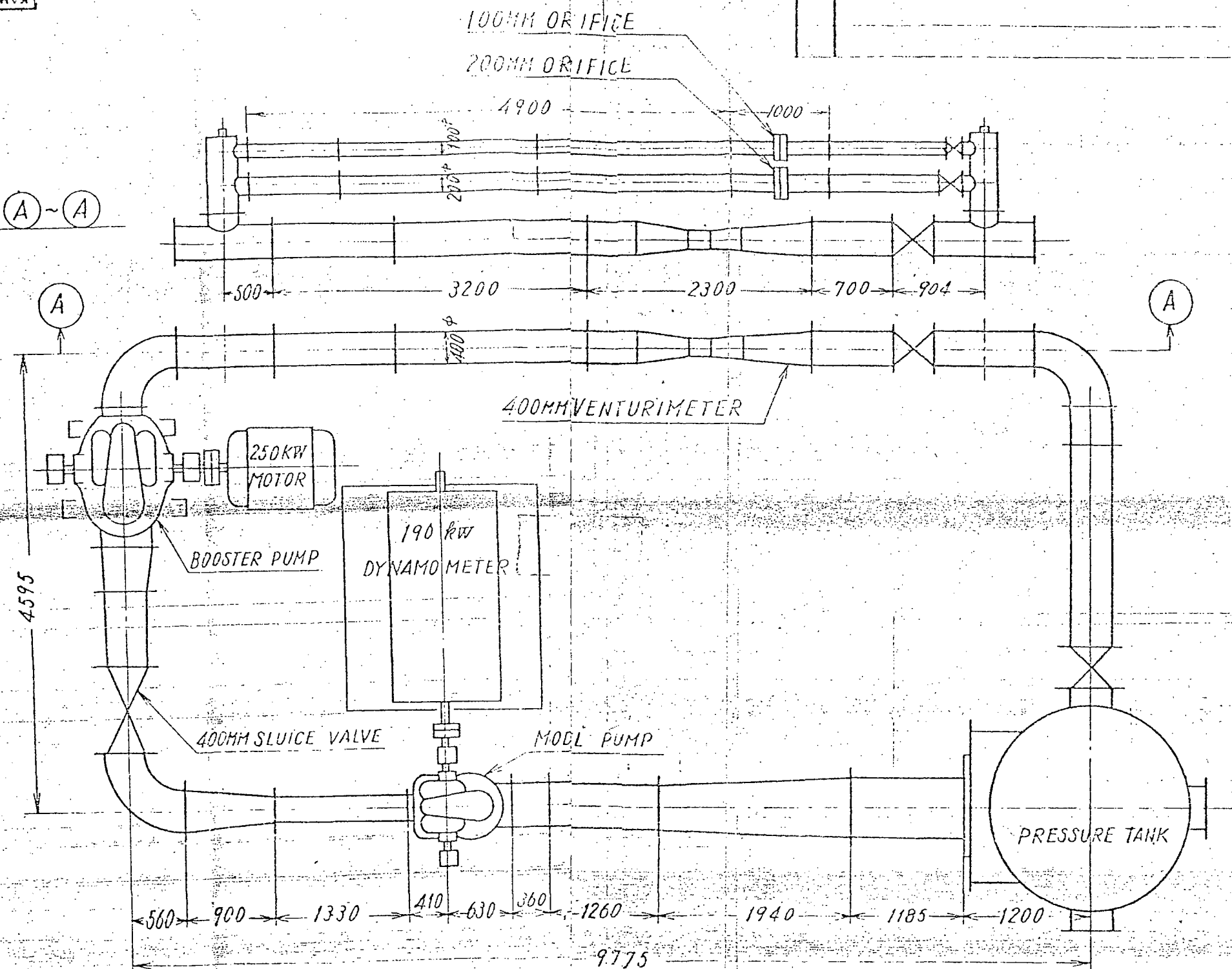


S979765-3

P351045
KAWAKAMI WORKS DWG. NO.

NO.	REVISIONS	DATE	REVISED	CHECKED

SECTION A~A



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DWN.	H. KAWAKAMI	24. FEB '70	THIRD	TITLE
CHKD.			ANG. PROJ.	ARRANGEMENT
APPD.	H. M. Gashiro		SCALE	OF
			50	MODEL TEST
Hitachi, Ltd. Tokyo Japan				KAWAKAMI WORKS DWG. NO. P351045

$$\left(= \frac{\text{AREA OF GLASS TUBE}}{\text{AREA OF MERCURY VESSEL}} \right)$$

NO. REV. DATE REVIS. CHECKED

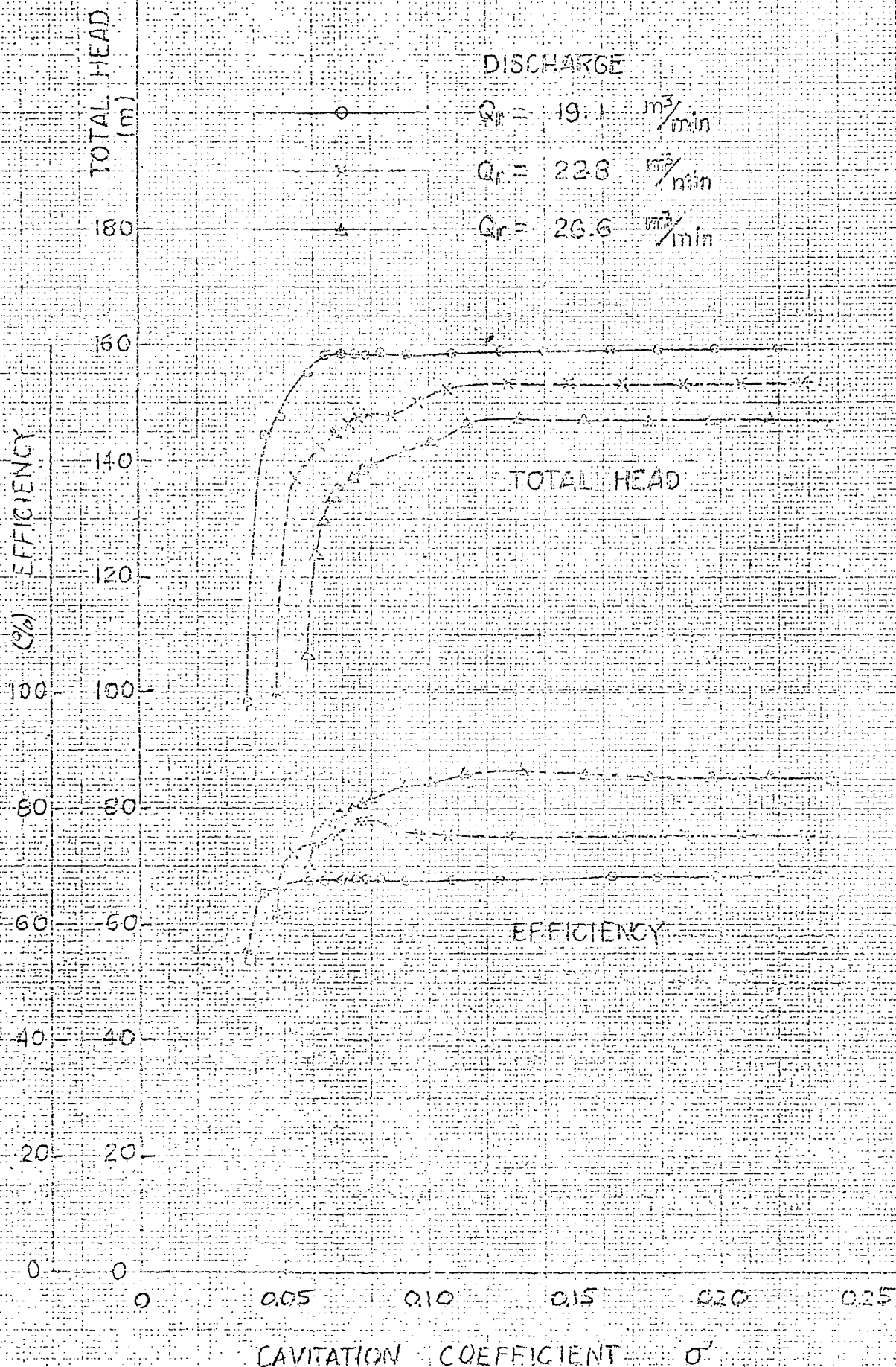
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MODEL CAVITATION
TEST CURVES

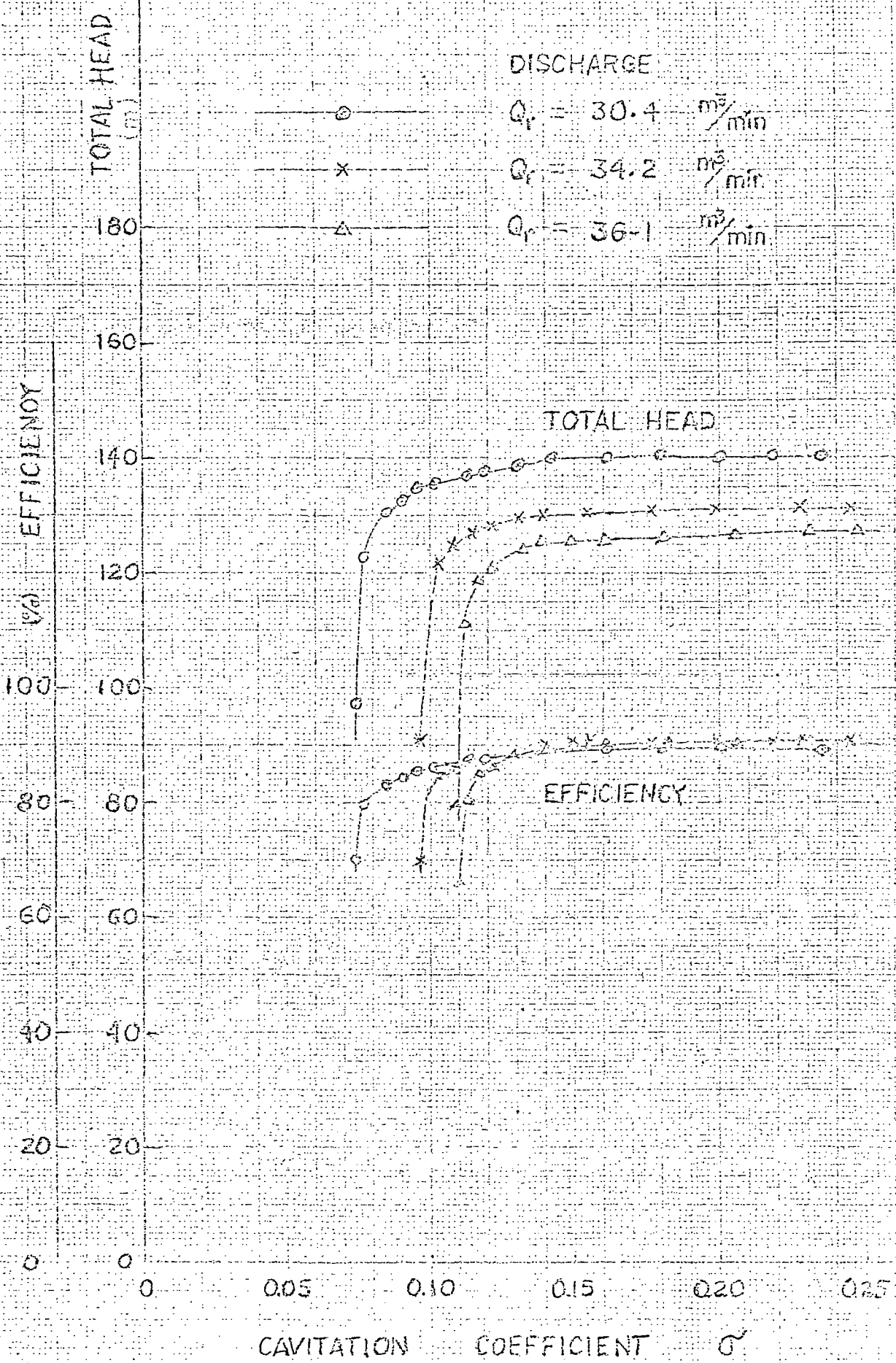
8972497

-2

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DATE
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MODEL CAVITATION
TEST CURVES

S 972497

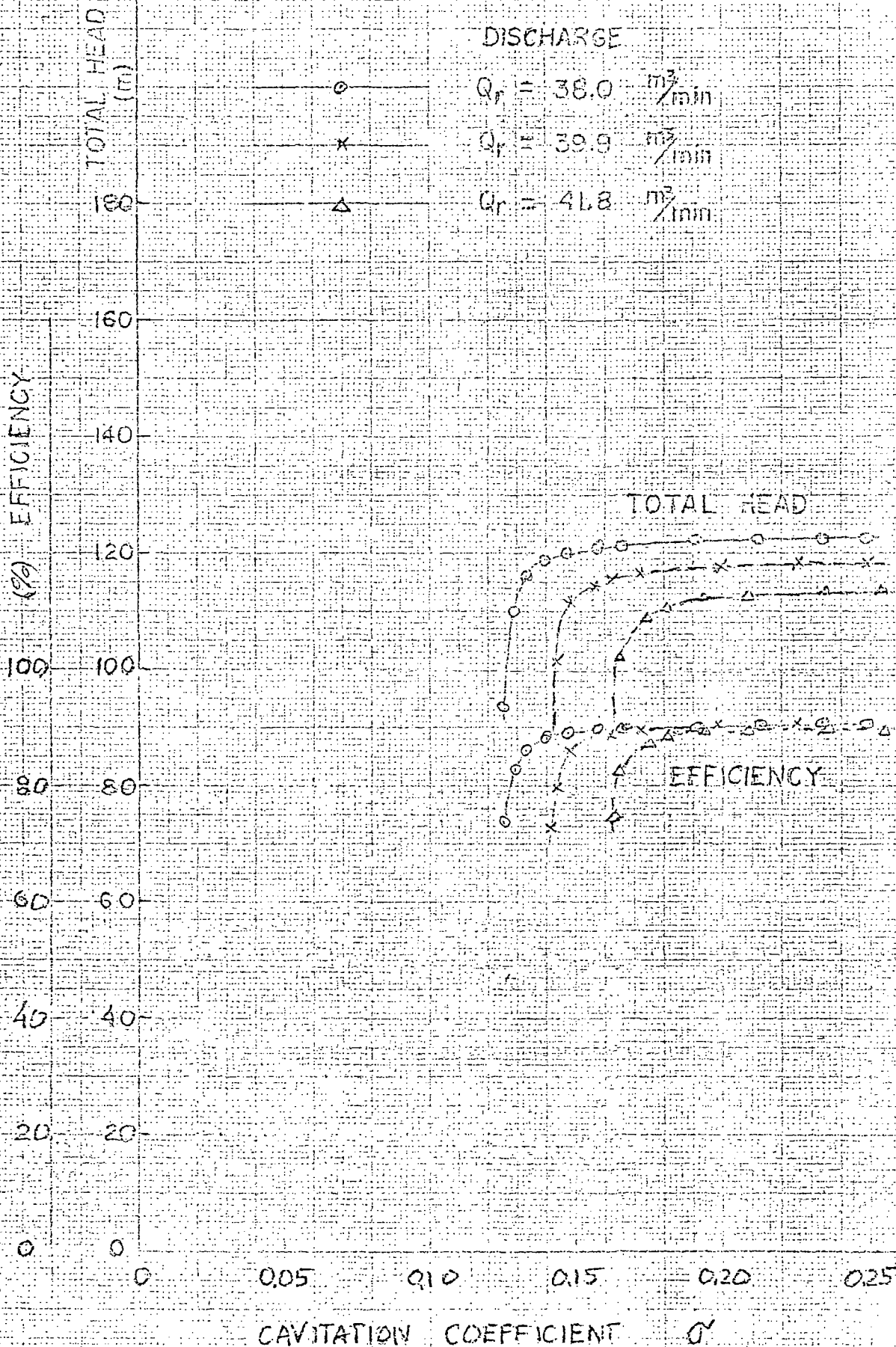
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MODEL CAVITATION
TEST CURVES

MODEL NO. 112

S 972497-4

Estimate of Prototype Performance

	MODEL				PROTOTYPE			
	$Q_m(\frac{m^3}{min})$	$H_m(m)$	$P_m(KW)$	$\eta_m(\%)$	$Q_p(\frac{m^3}{min})$	$H_p(m)$	$P_p(KW)$	$\eta_p(\%)$
1	0	187.01	679.82	0	0	191.74	11710	0
2	8.806	186.59	706.04	18.88	65.49	191.81	12162	16.77
3	7.592	183.76	784.76	30.98	130.63	188.41	12656	31.68
4	11.422	174.92	718.90	45.59	196.58	179.35	12297	46.69
5	14.920	165.74	708.11	56.88	259.71	169.93	12197	58.25
6	19.042	158.91	725.68	67.93	327.64	162.92	12500	69.57
7	22.768	154.20	756.63	75.59	391.75	158.10	13034	77.41
8	25.534	147.49	789.24	82.99	432.34	151.22	12733	84.99
9	27.487	146.27	744.21	83.00	472.94	149.97	12819	90.12
10	30.741	139.06	777.79	89.53	528.93	142.58	13397	91.69
11	32.253	133.03	792.09	90.32	572.20	136.43	13747	92.50
12	34.824	129.31	810.11	90.37	595.74	133.09	13954	92.55
13	36.908	124.85	830.09	90.42	635.04	126.01	14268	92.61
14	38.624	121.14	842.67	90.45	664.53	124.20	14315	92.63
15	40.137	117.32	849.72	90.25	690.42	120.30	14687	92.43
16	42.007	112.20	858.34	89.39	722.77	115.04	14794	91.54
17	43.430	107.69	860.88	88.52	747.26	110.41	14829	90.65
18	44.627	102.95	864.41	87.44	767.85	106.54	14839	89.55
19	46.233	97.38	862.28	84.98	795.43	99.84	14869	87.03
20	47.835	90.13	859.16	80.73	814.45	92.46	14799	82.73
21	48.310	81.83	850.76	75.59	831.22	83.93	14653	77.41
22	49.975	66.23	832.08	63.43	844.38	67.91	14359	64.99
23	49.150	51.26	807.14	50.75	845.67	52.56	12903	51.97
24	48.136	32.32	799.41	32.73	846.47	33.15	13613	33.57
25	49.217	-0.35	783.10	—	846.83	-0.36	13575	—

Model test data of Nos. 1-19 were obtained at the speed of 2,980 rpm. and test data of Nos. 20-25 at the speed of 1,700 rpm.

Example :

$$\eta_p = \frac{100}{1 + \left(\frac{100}{\eta_m} - 1 \right) \left(\frac{D_m}{D_p} \right)^{0.2}} = \frac{100}{1 + \left(\frac{100}{99.45} - 1 \right) \times \frac{1}{411.03}} = 99.98(\%)$$

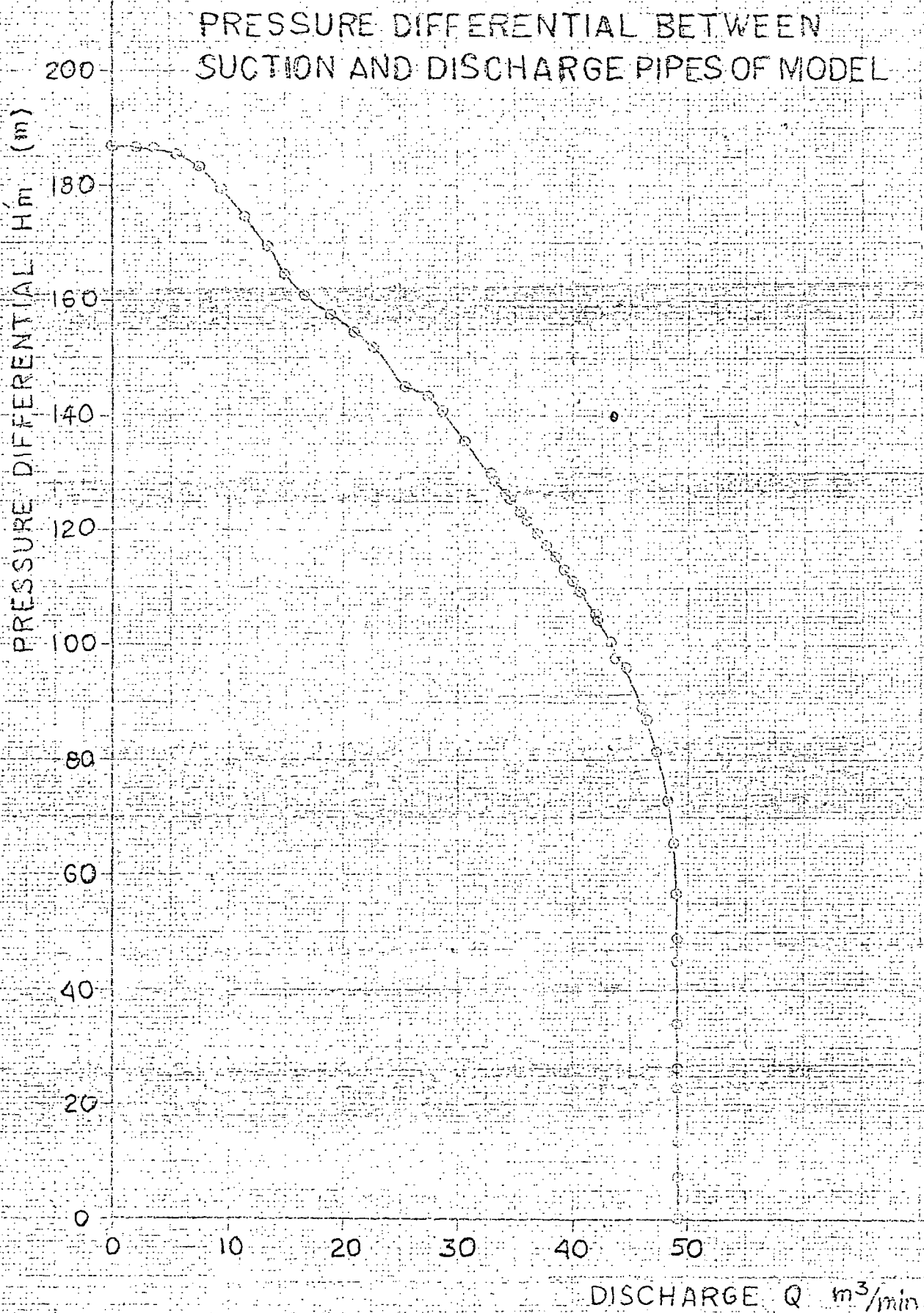
$$\frac{\eta_p}{\eta_m} = \frac{99.98}{99.45} = 1.0241 \quad \left(\frac{\eta_p}{\eta_m} \right)^{\frac{1}{2}} = 1.0120$$

$$Q_p = Q_m \left(\frac{\eta_p}{\eta_m} \right)^{\frac{1}{2}} \left(\frac{D_p}{D_m} \right)^2 \left(\frac{N_p}{N_m} \right) = Q_m \times 1.0120 \times 411^2 \times \frac{720}{2940} = 17.206 Q_m$$

$$H_p = H_m \left(\frac{\eta_p}{\eta_m} \right)^{\frac{1}{2}} \left(\frac{D_p}{D_m} \right)^2 \left(\frac{N_p}{N_m} \right)^3 = H_m \times 1.0120 \times 411^2 \times \left(\frac{720}{2940} \right)^3 = 1.0258 H_m$$

$$P_p = P_m \left(\frac{D_p}{D_m} \right)^3 \left(\frac{N_p}{N_m} \right)^3 = P_m \times 411^3 \times \left(\frac{720}{2940} \right)^3 = 17.225 P_m$$

8979765-2

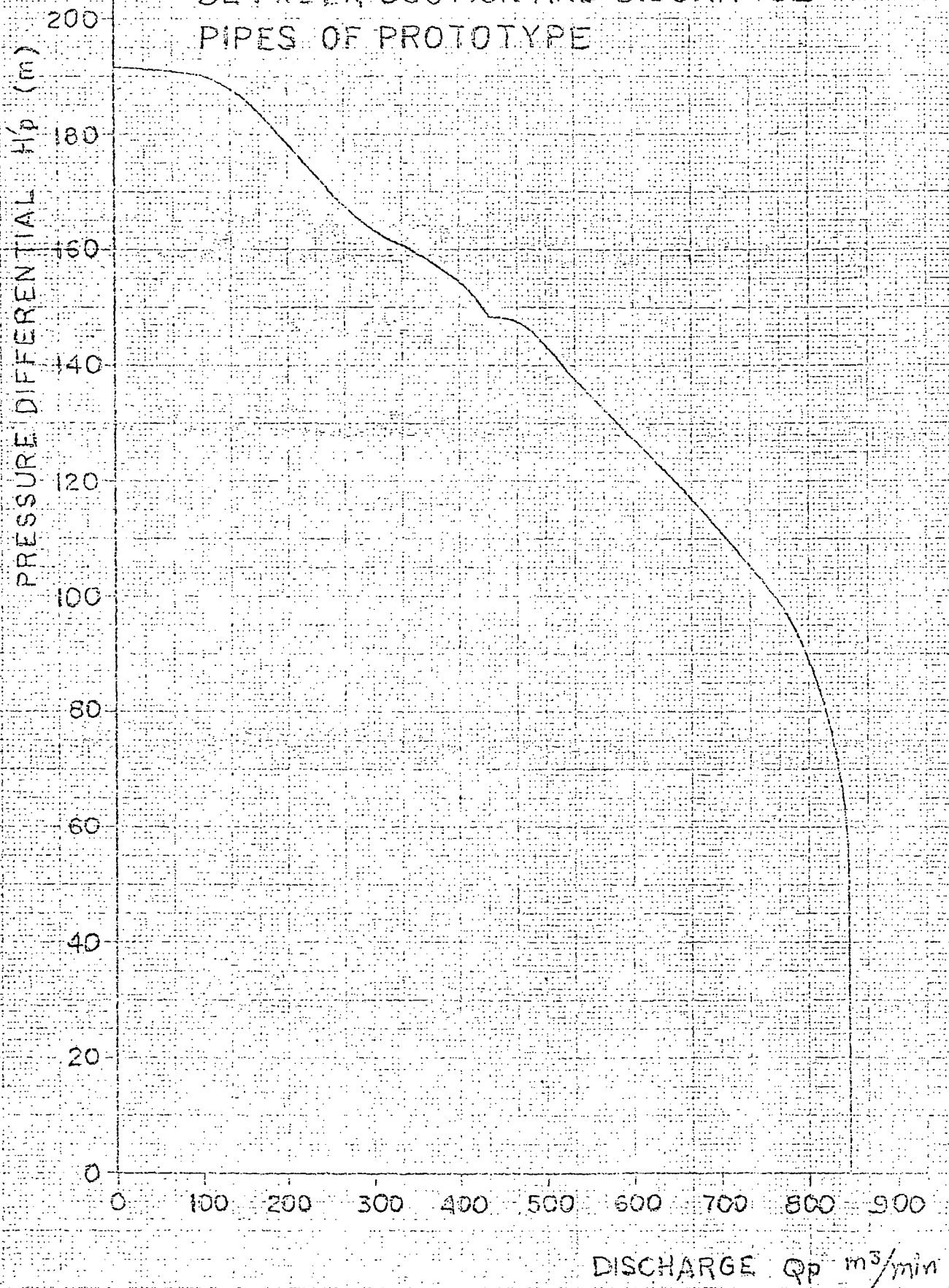


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S979765-1

ESTIMATED PRESSURE DIFFERENTIAL BETWEEN SUCTION AND DISCHARGE PIPES OF PROTOTYPE



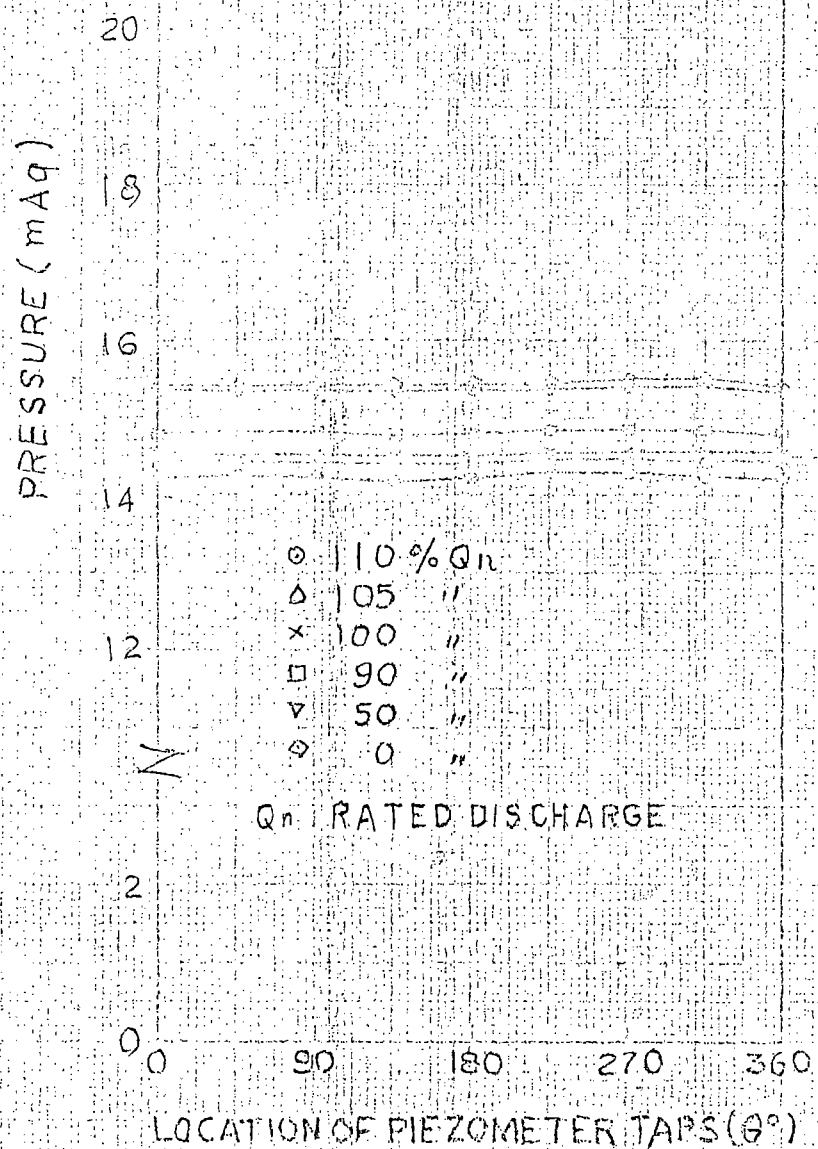
KTALAN, 25 MAR 70

U.S. NAVY

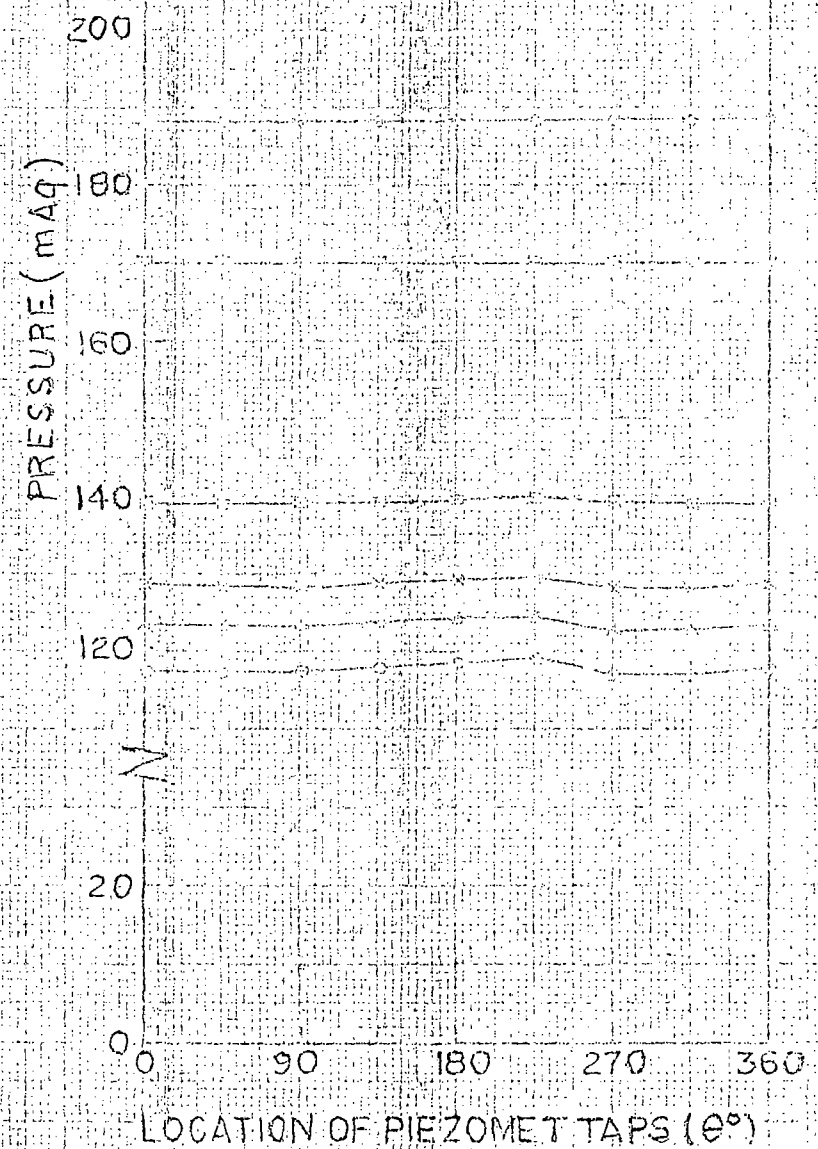
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U.S. NAVY

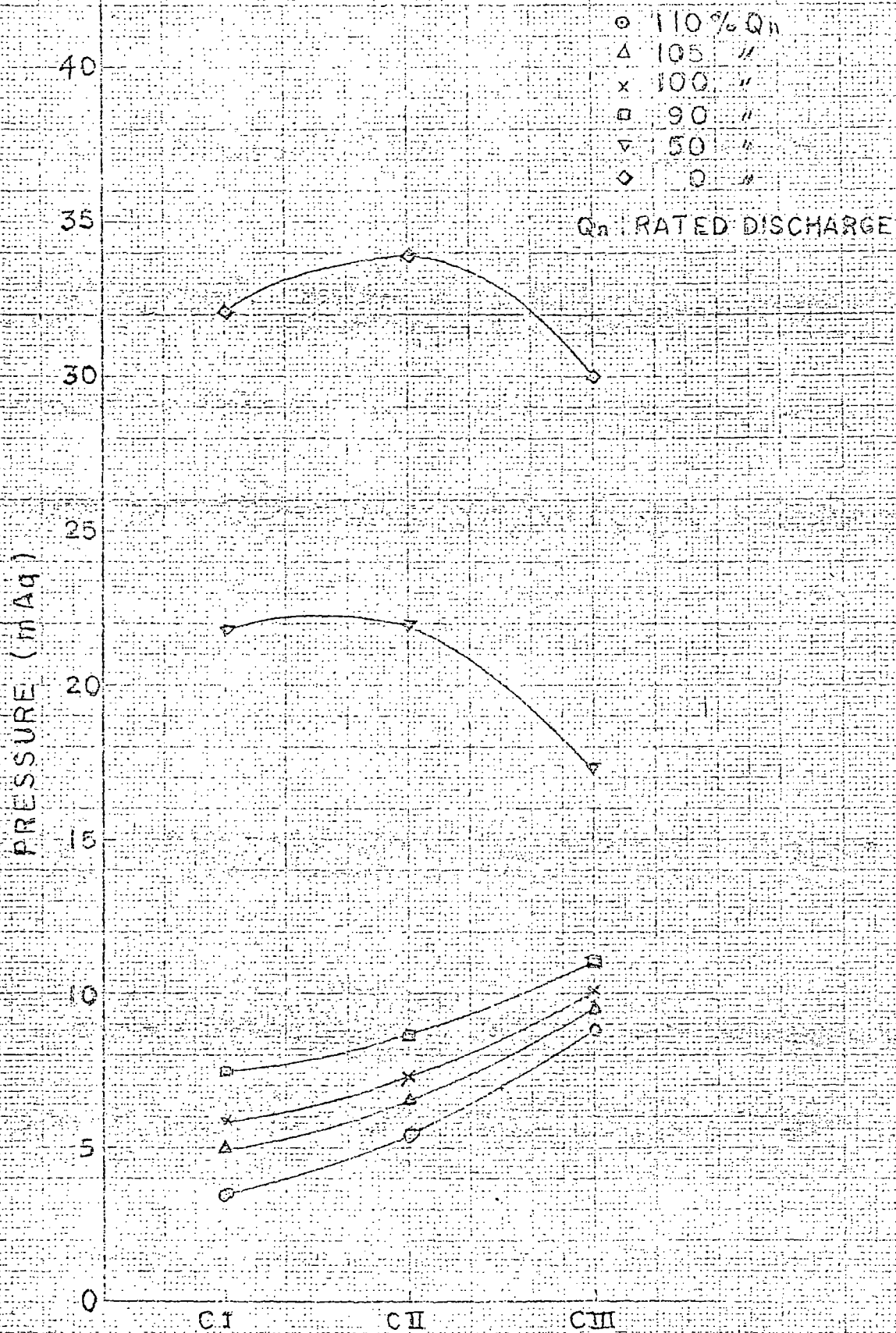
8979766-2



PRESSURE DISTRIBUTIONS IN SUCTION PIPE



PRESSURE DISTRIBUTIONS IN DISCHARGE PIPE



LOCATION OF PIEZOMETER TAPS

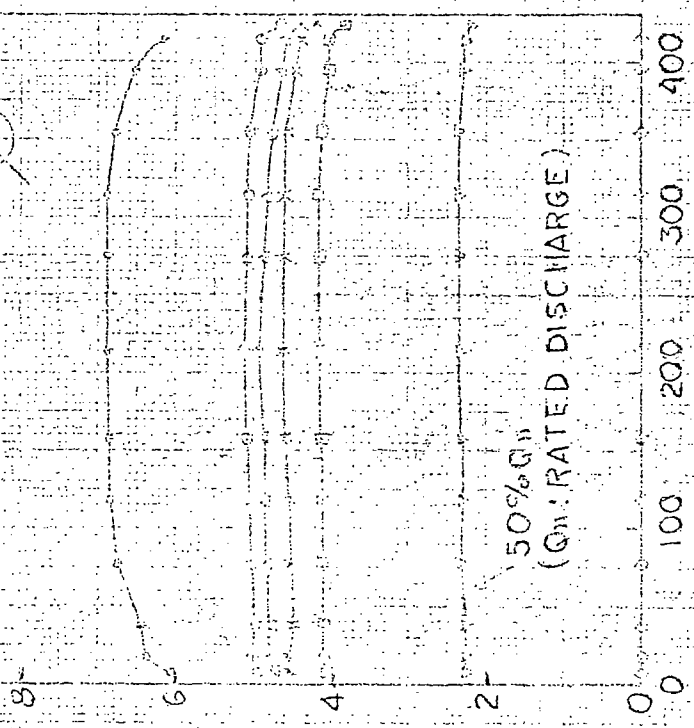
PRESSURE DISTRIBUTIONS AT IMPELER INLET

USE INVALUABLE 26 MAY 1960

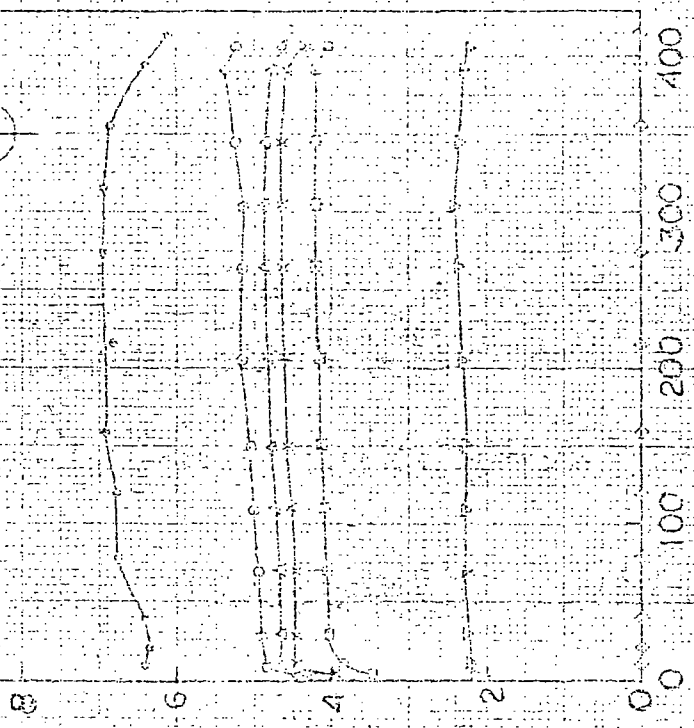
WILSON Ltd.

S979768-2

DIRECTION OF PITOT TUBE

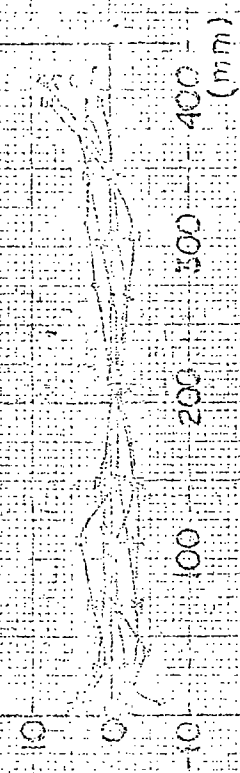
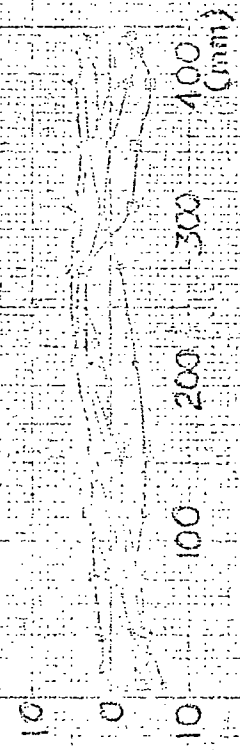


DIRECTION OF PITOT TUBE



DISTANCE FROM INNER WALL OF PIPE (mm)

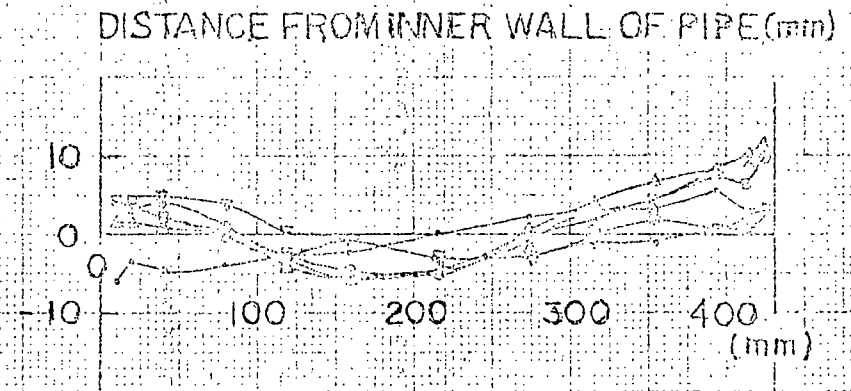
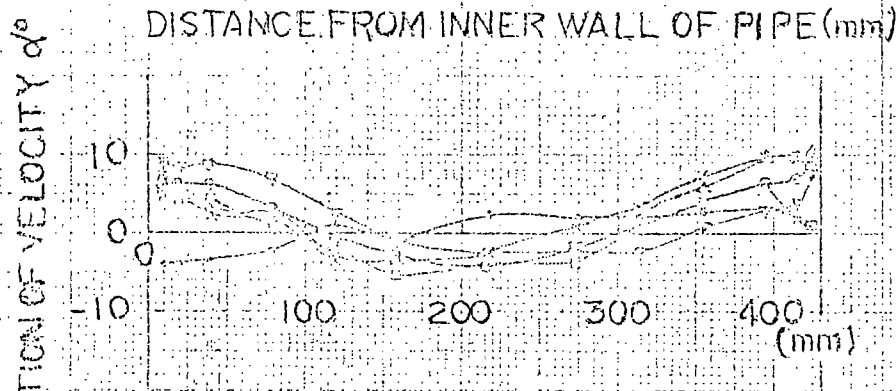
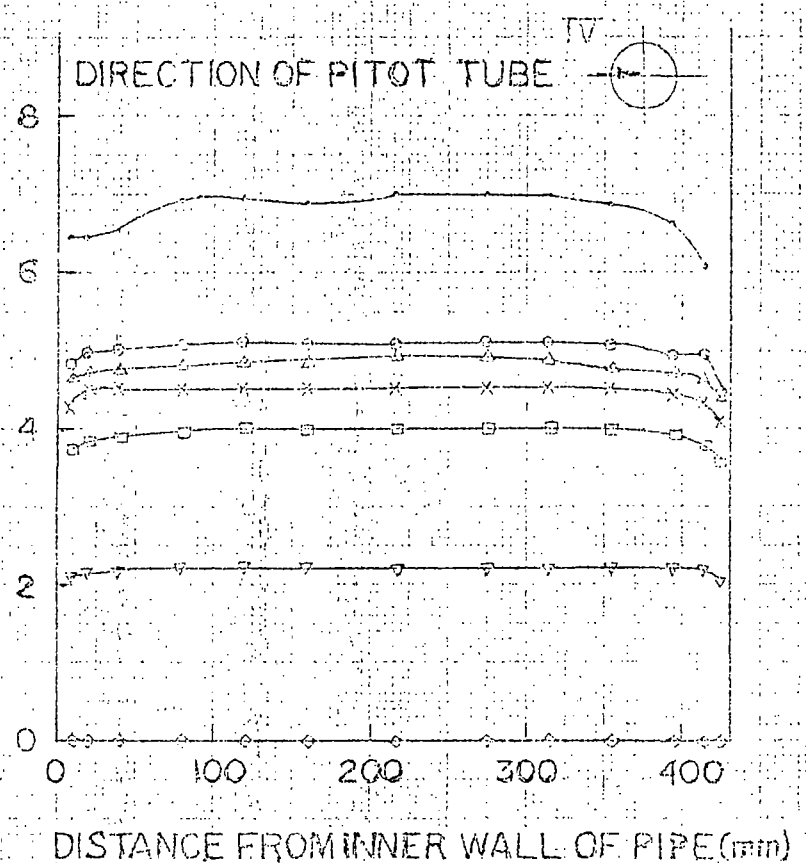
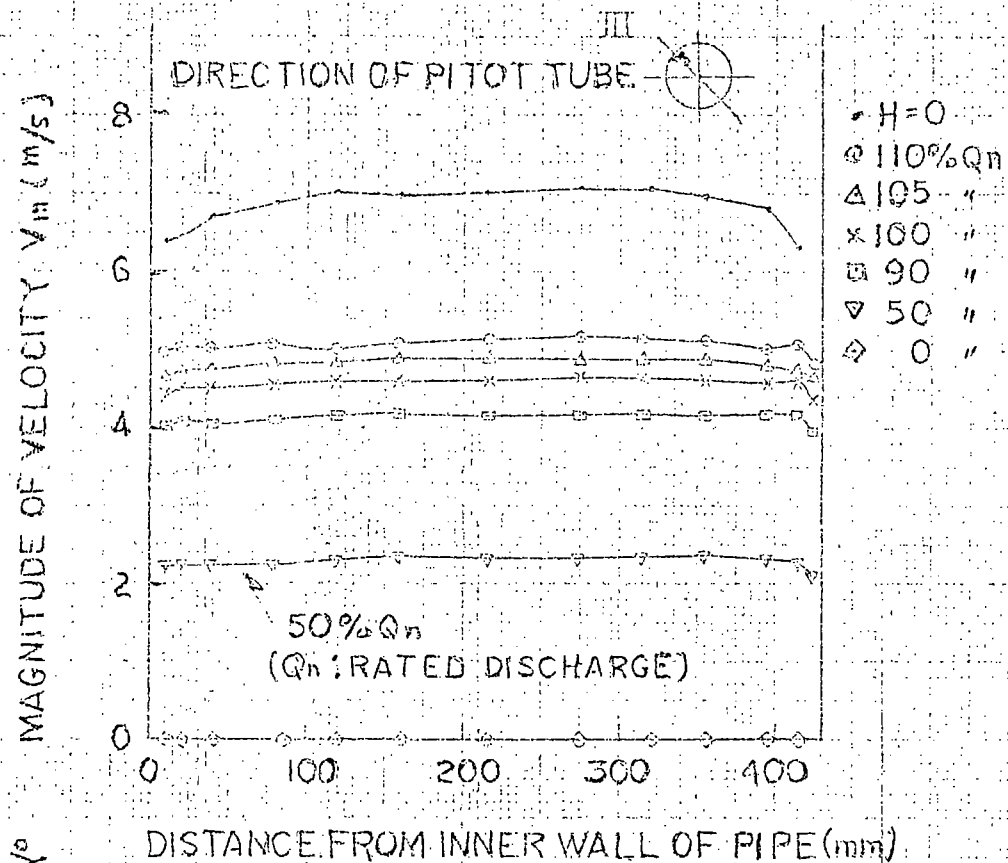
DISTANCE FROM INNER WALL OF PIPE (mm)



VELOCITY DISTRIBUTIONS IN SUCTION PIPE

MAGNITUDE OF VELOCITY V_m (m/s)

DIRECTION OF VELOCITY



VELOCITY DISTRIBUTIONS IN SUCTION PIPE

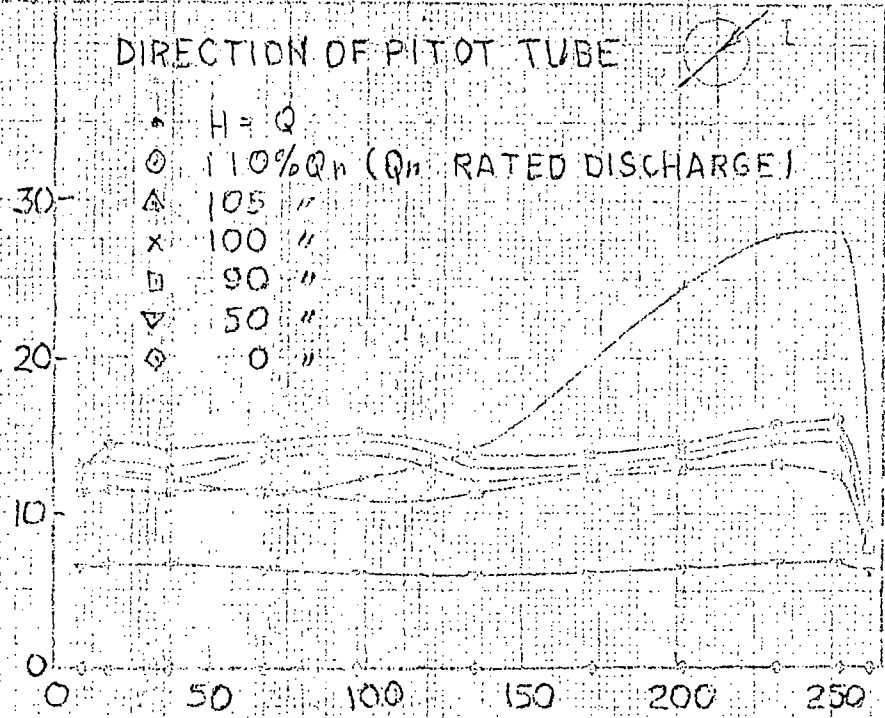
HAZARD 2/11/70

S979768 -4

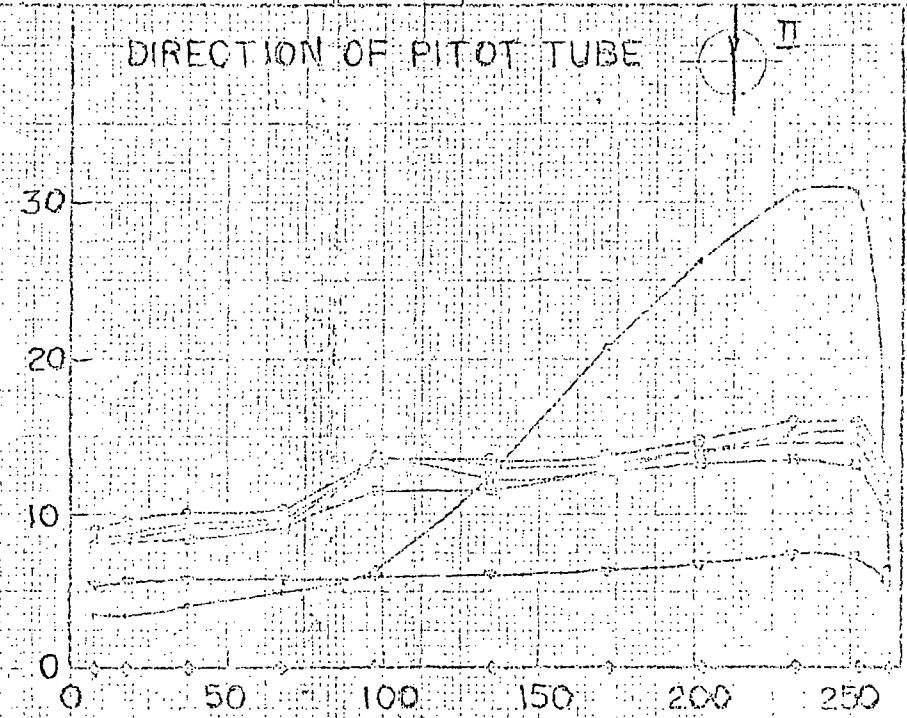
MAGNITUDE OF VELOCITY V_m (m/s)

DIRECTION OF PITOT TUBE I

- $H = Q$
- 110% Q_n (Q_n RATED DISCHARGE)
- △ 105 "
- x 100 "
- 90 "
- ▽ 50 "
- ◇ 0 "

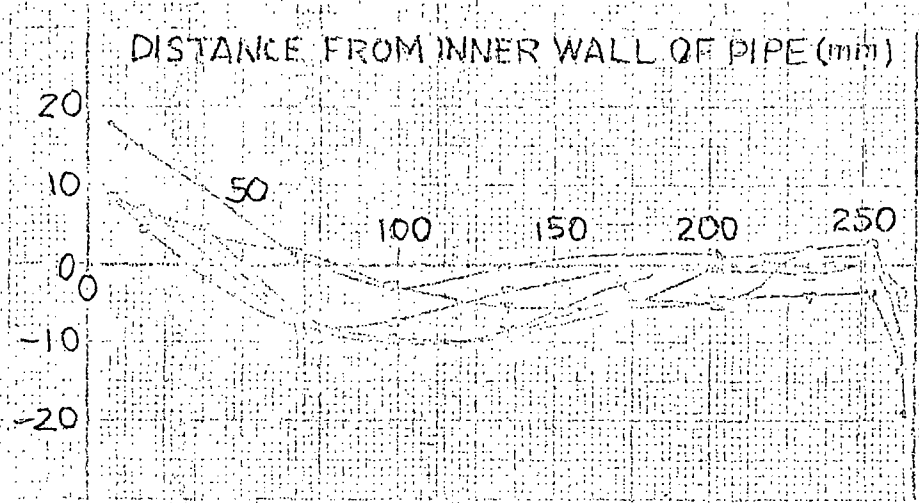


DIRECTION OF PITOT TUBE II

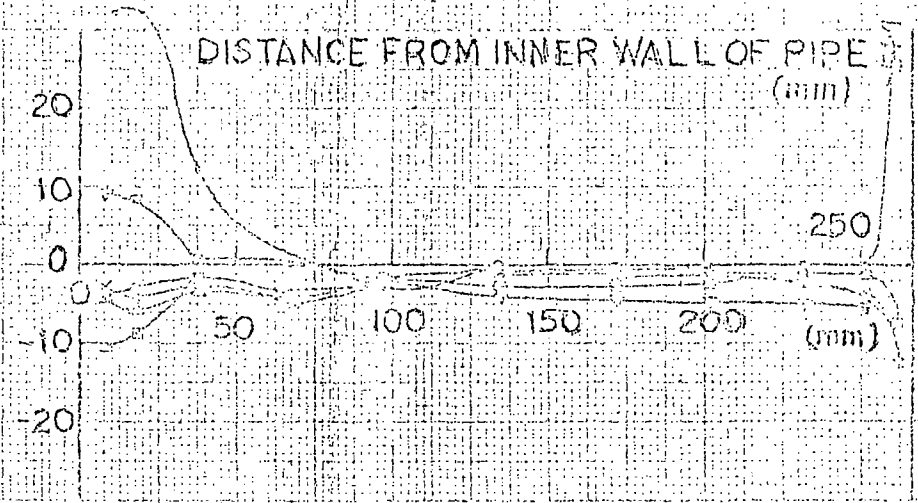


DIRECTION OF VELOCITY α°

DISTANCE FROM INNER WALL OF PIPE (mm)



DISTANCE FROM INNER WALL OF PIPE (mm)



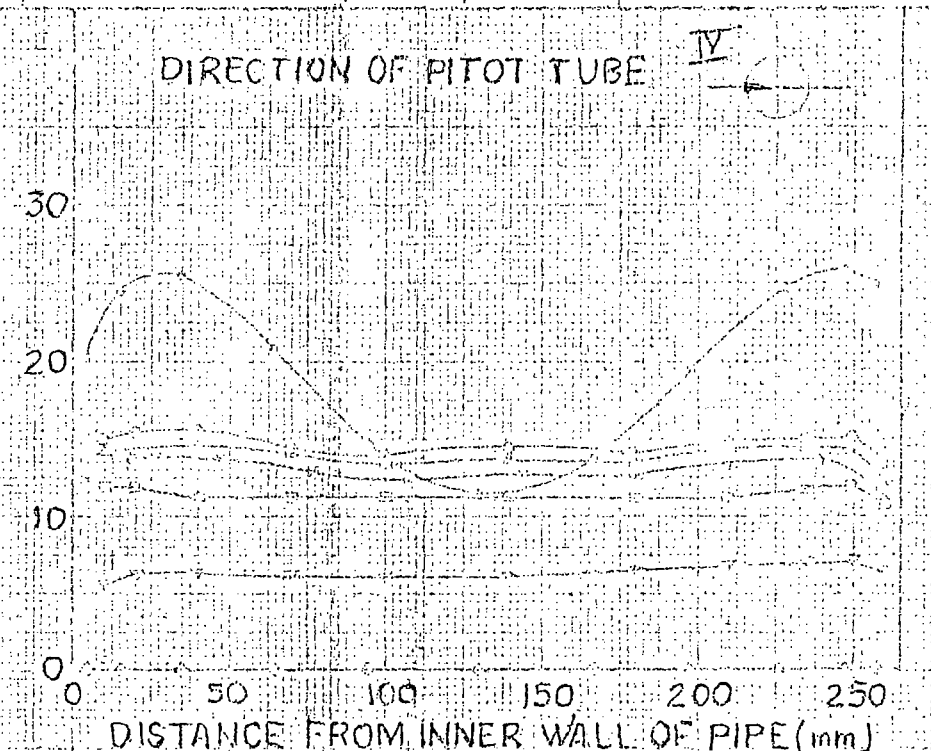
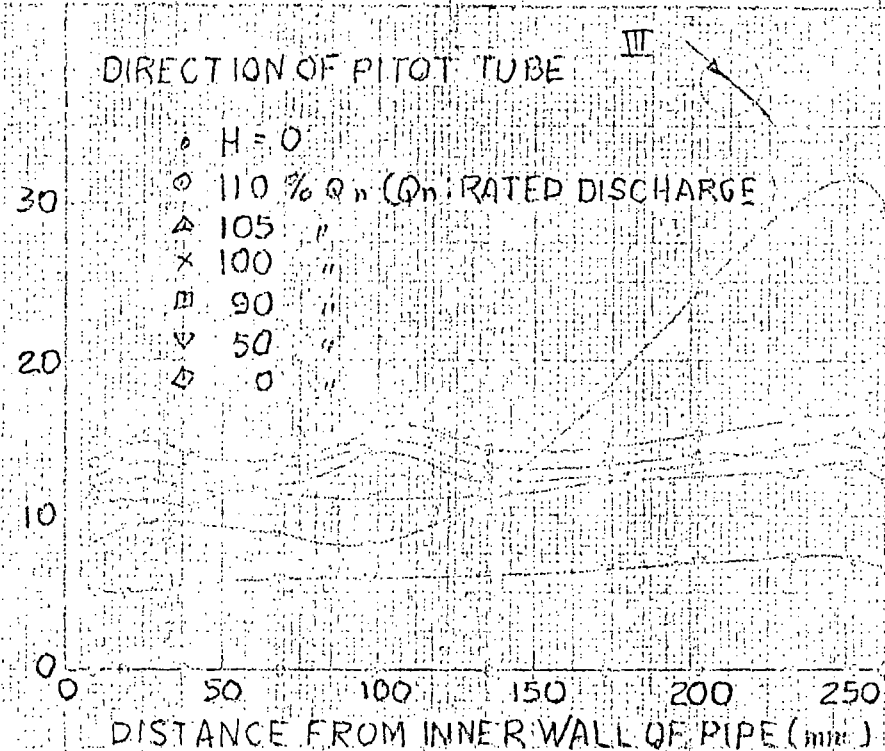
VELOCITY DISTRIBUTIONS IN DISCHARGE PIPE

S979768-5

NO.	REVISIONS	DATE	REVISED	CHECKED

MAGNITUDE OF VELOCITY V_m (m/s)

DIRECTION OF VELOCITY α°



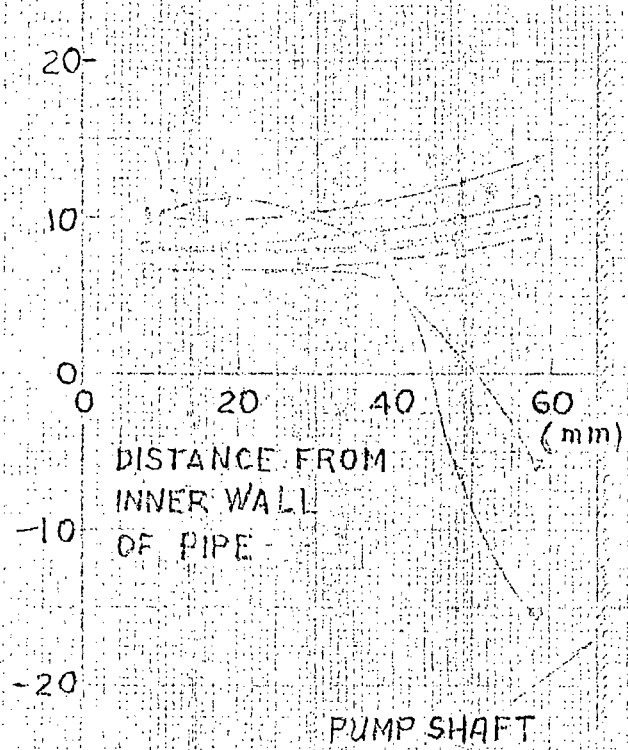
VELOCITY DISTRIBUTIONS IN DISCHARGE PIPE

S979768-6

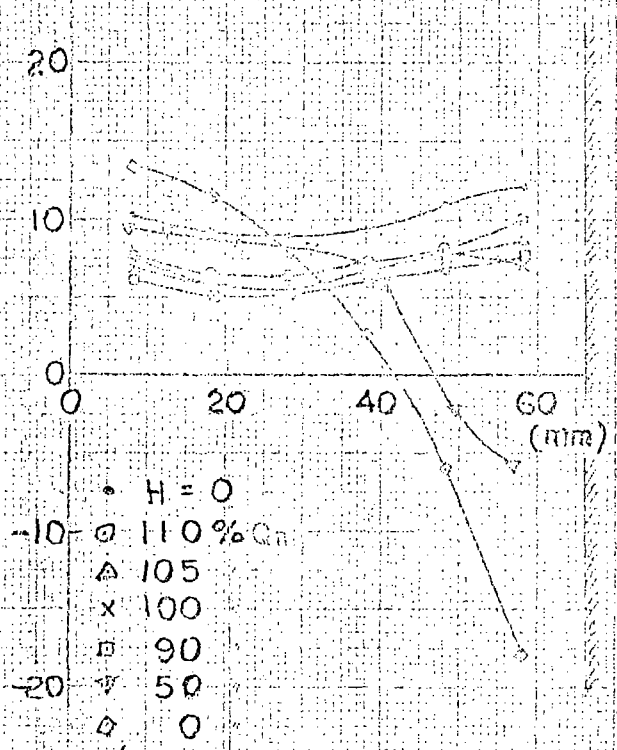
5979768-7

MAGNITUDE OF VELOCITY V_m (m/s)

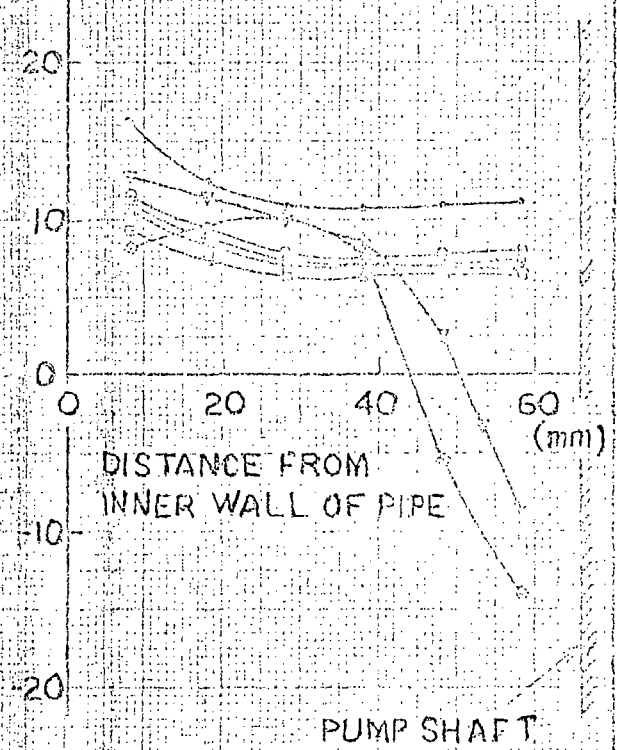
DIRECTION OF PITOT TUBE : CI



DIRECTION OF PITOT TUBE : CII



DIRECTION OF PITOT TUBE : CIII



DISTANCE FROM
INNER WALL
OF PIPE

DISTANCE FROM
INNER WALL OF PIPE

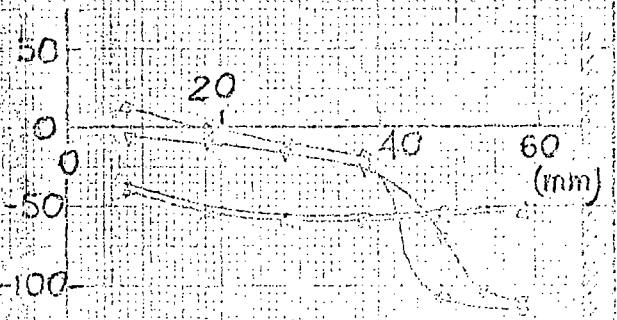
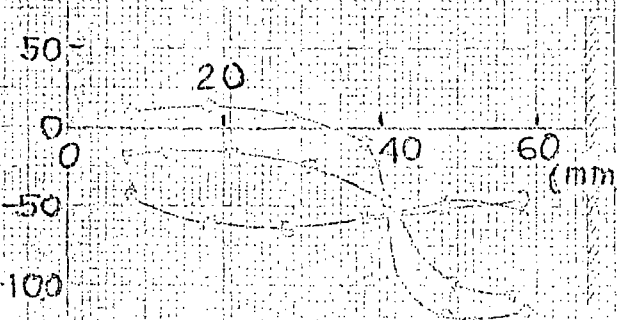
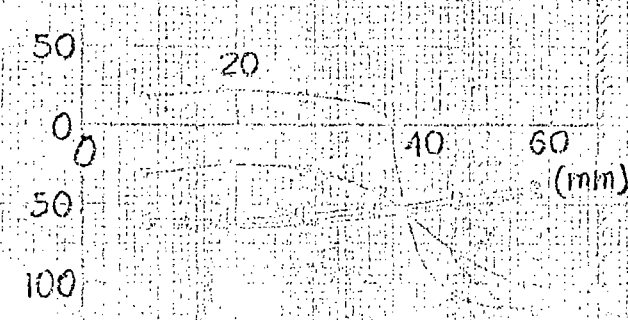
PUMP SHAFT

PUMP SHAFT

- $H = 0$
- $110\% Q_n$
- △ 105
- × 100
- 90
- ▽ 50
- ◇ 0

(Q_n : RATED DISCHARGE)

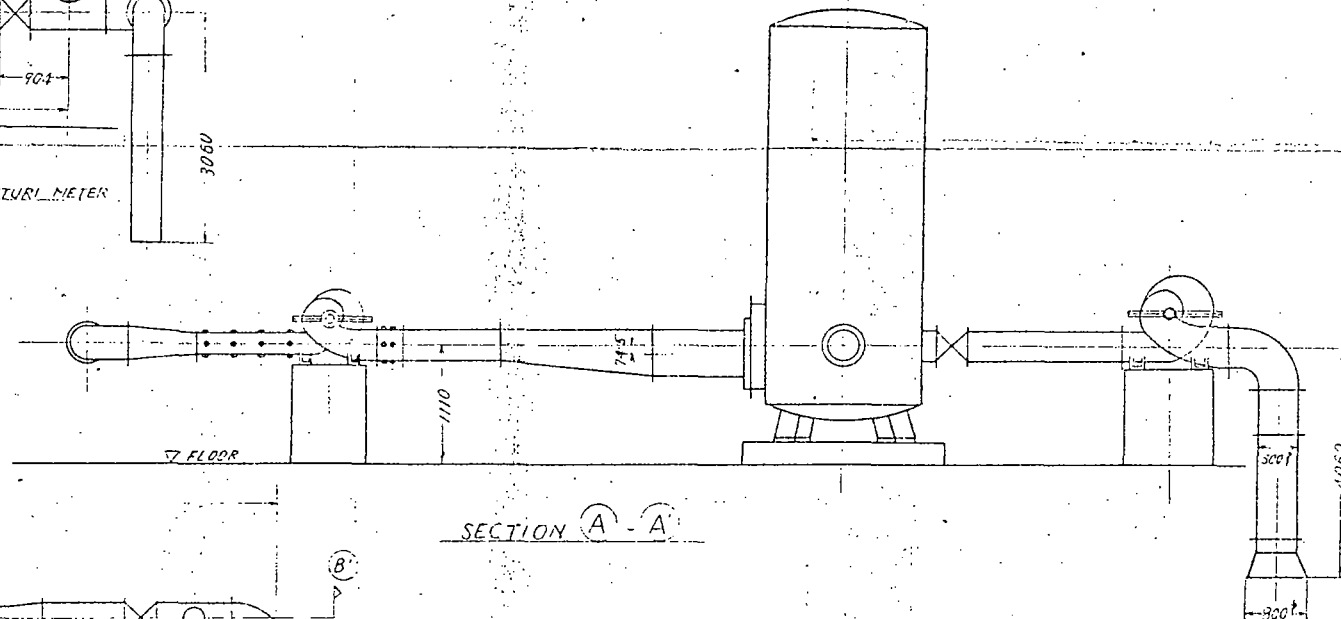
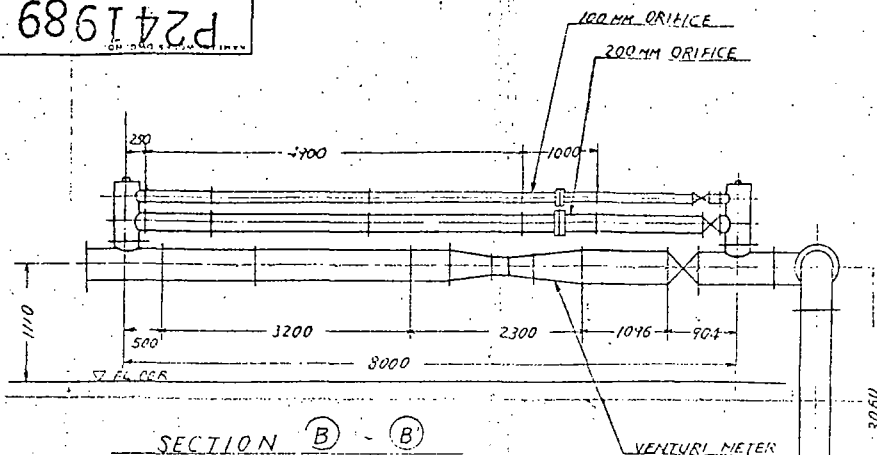
DIRECTION OF VELOCITY α°



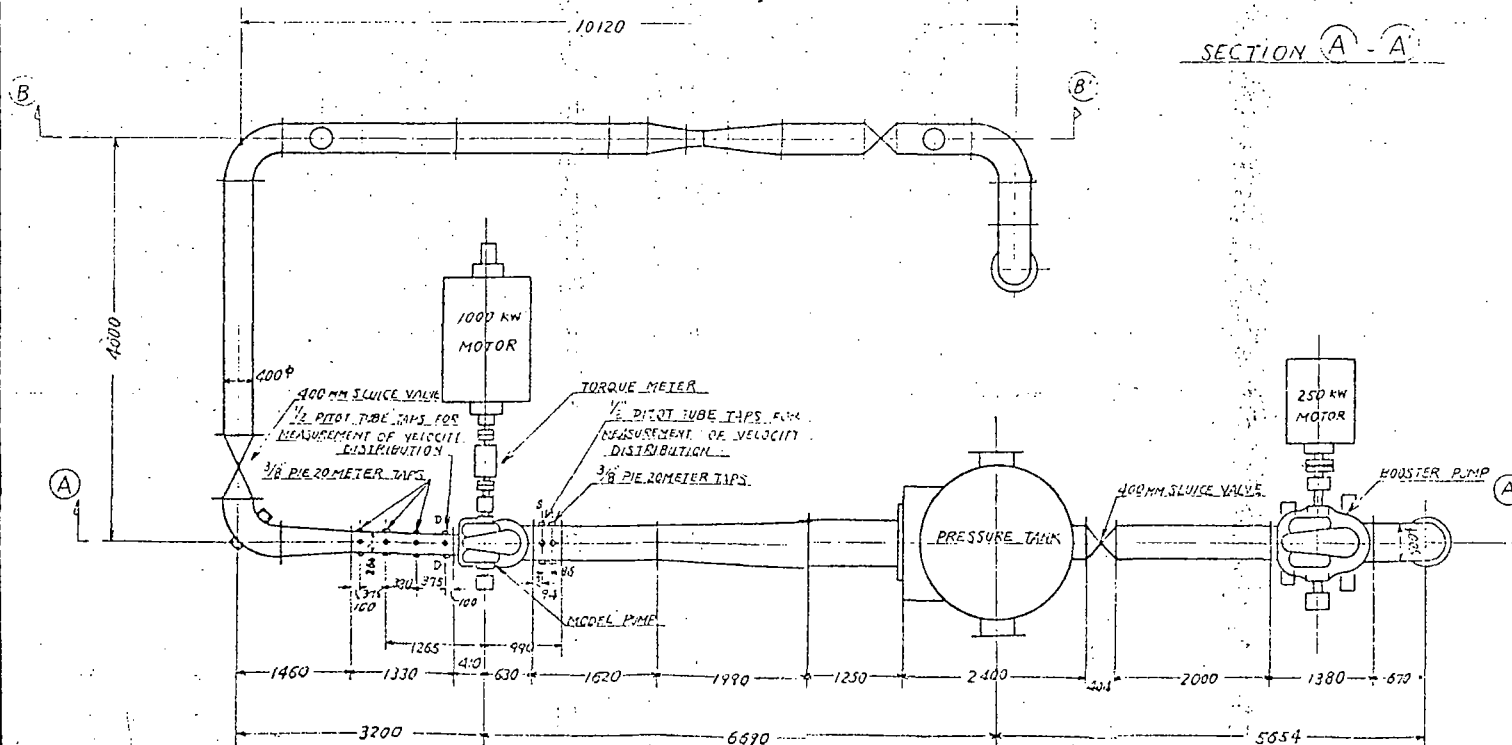
VELOCITY DISTRIBUTIONS AT IMPELLER INLET

P241989

NO.	REVISIONS	DATE	REVISED	CHECKED



-57-

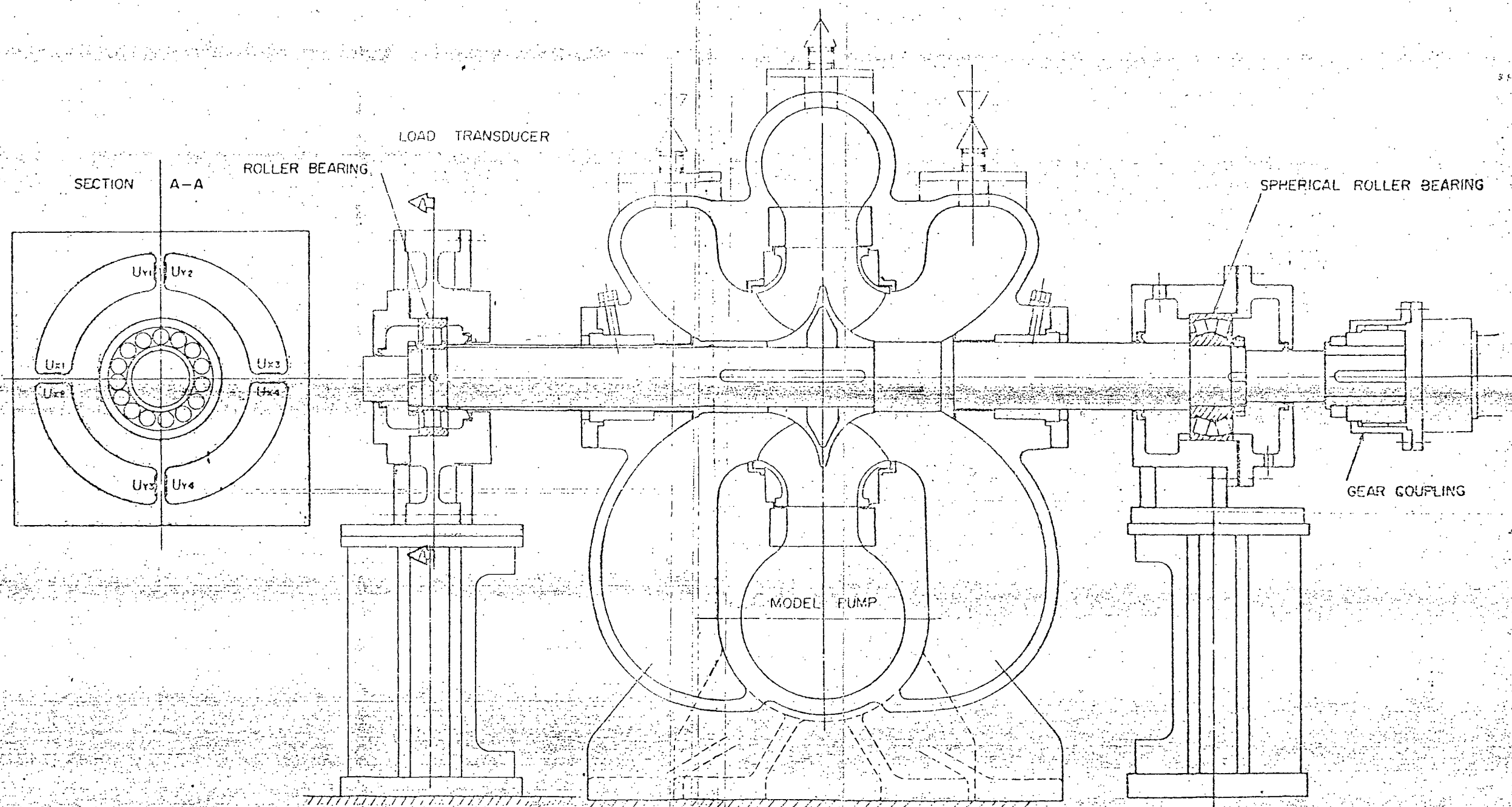


DRW. M. OHNO	30. MAR. 70	THIRD	TITLE
CHKD.		ANG. PROJ.	ARRANGEMENT
APPD. H. KUROKI		SCALE 1/50	OF
			MODEL TEST
			(USING NEW SUCTION PIPE)
			HITACHI WORKS ENG. NO.
			P241989
			-57-

Hitachi, Ltd.
Tokyo Japan

P350079

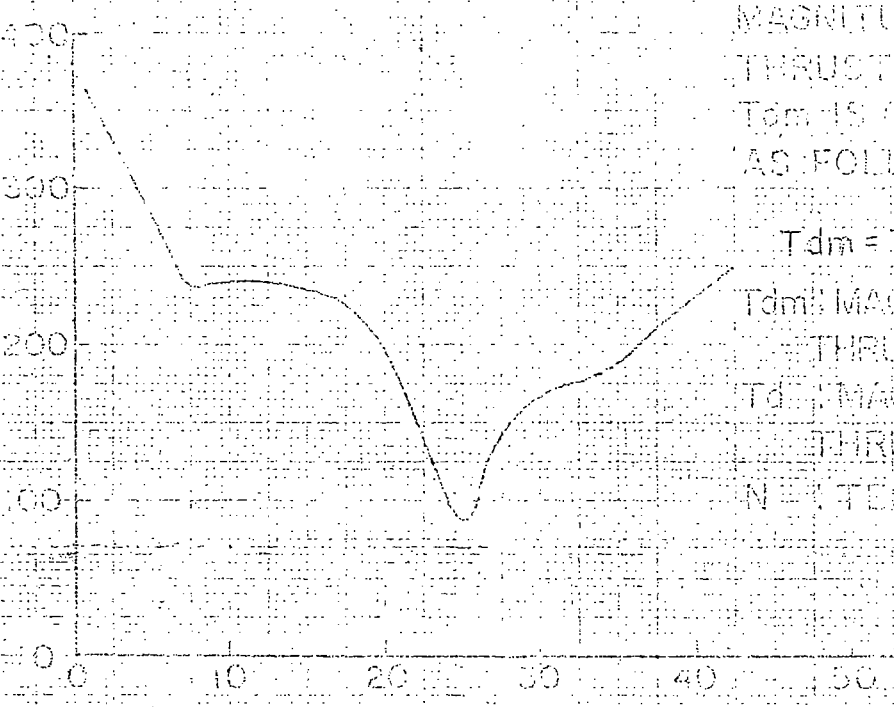
REVISED	DATE	BY	CHECKED



APPROVED FOR RELEASE		THIRD	APPARATUS FOR MEASURING RADIAL THRUST
DATE		AND, PROJ	
DRAWN BY			P350079
CHECKED BY			
HITACHI, Ltd.			

REVISED CALCULATED
DATE
REV. AND
NO.

MAGNITUDE OF RADIAL THRUST T_{dm} , kg



MAGNITUDE OF RADIAL THRUST AT 2940 rpm
 T_{dm} IS COMPUTED AS FOLLOWS

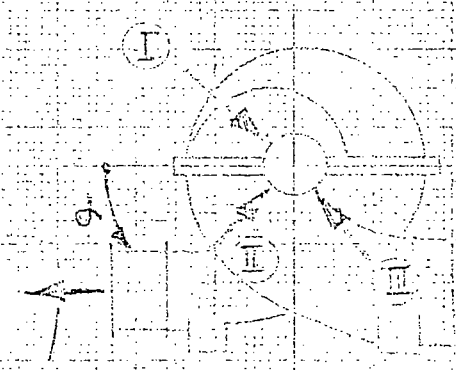
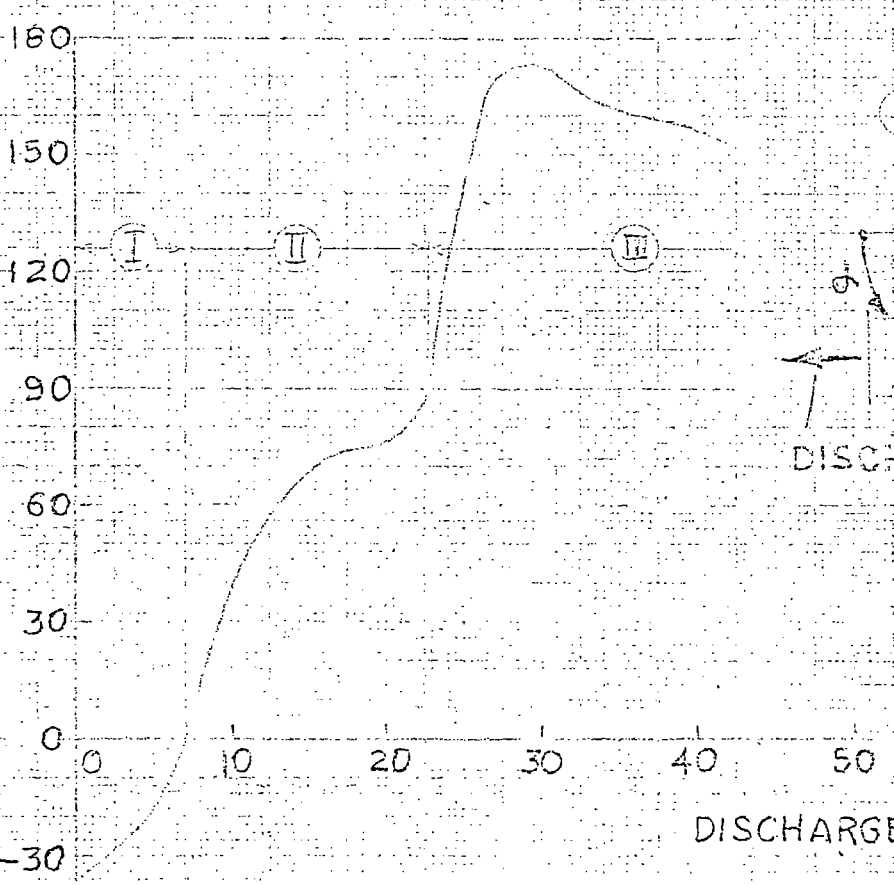
$$T_{dm} = T_d \times \left(\frac{2940}{N} \right)^2$$

T_{dm} : MAGNITUDE OF RADIAL THRUST AT 2940 rpm, kg
 T_d : MAGNITUDE OF RADIAL THRUST AT TEST SPEED, kg

N : TEST SPEED, rpm

DISCHARGE Q_m , m³/min

DIRECTION OF RADIAL THRUST α , deg



DISCHARGE

DISCHARGE Q_m , m³/min

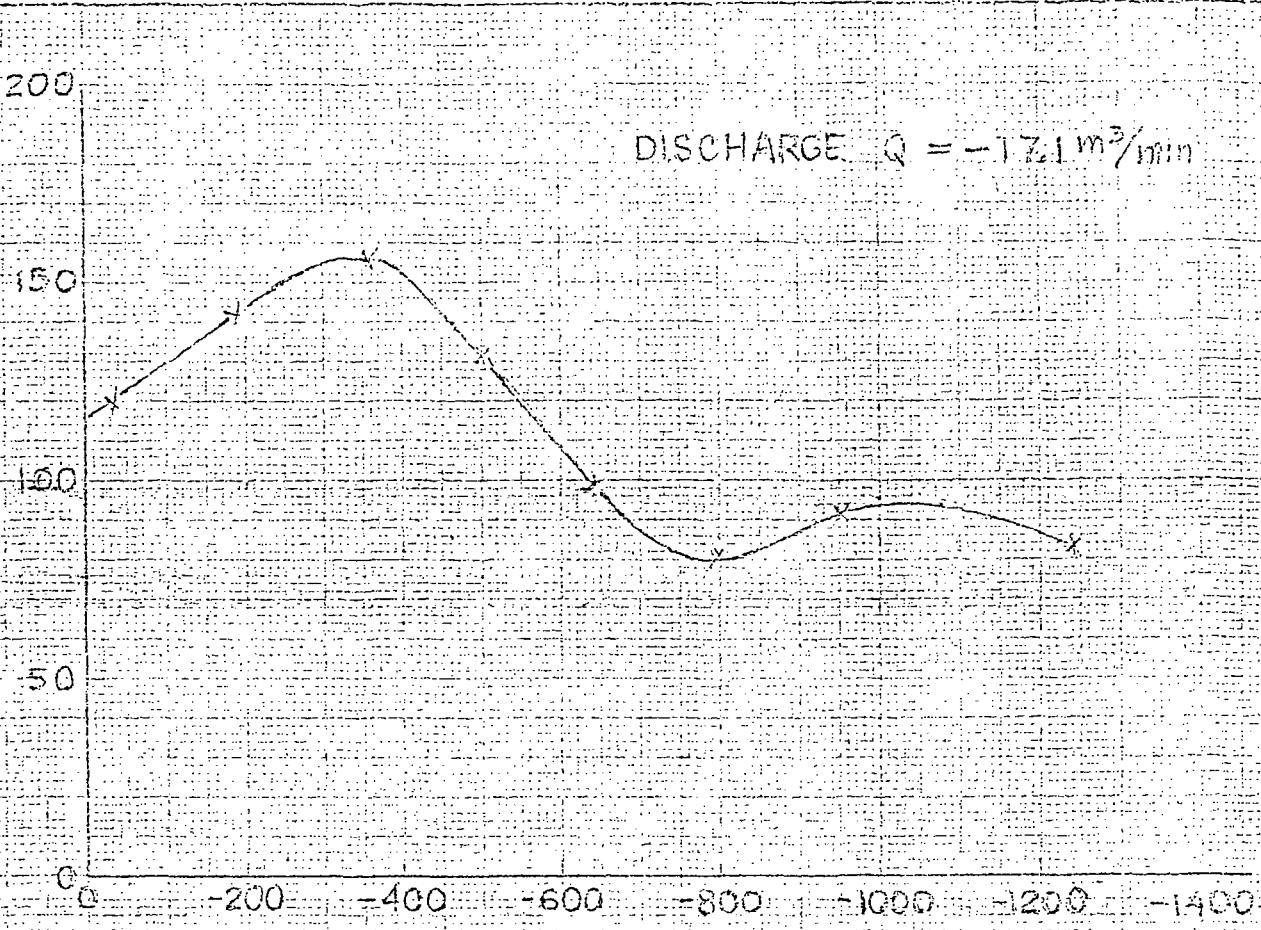
RELATION BETWEEN DISCHARGE AND RADIAL THRUST IN MODEL PUMP OPERATED IN THE PUMP RANGE

S 979770-1

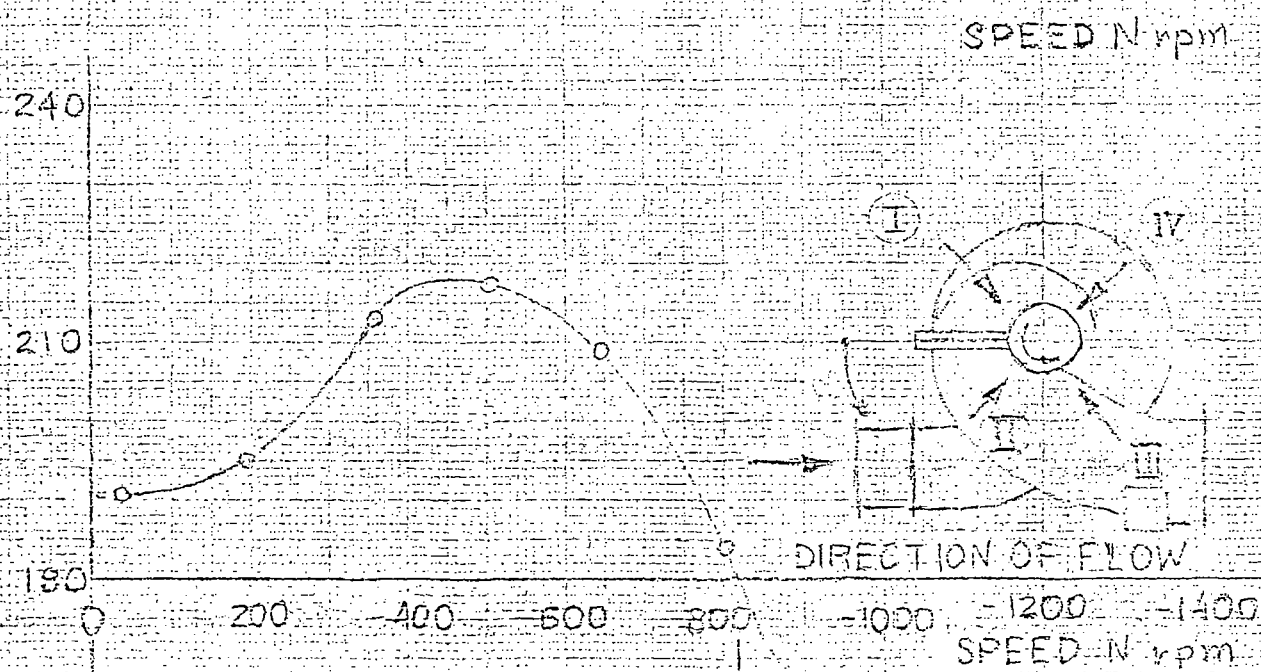
NO. REV. NS DATE REVISED CHECKED

MAGNITUDE OF RADIAL THRUST T_{dm} , kg

DISCHARGE $Q = -17.1 \text{ m}^3/\text{min}$



DIRECTION OF RADIAL THRUST α , deg

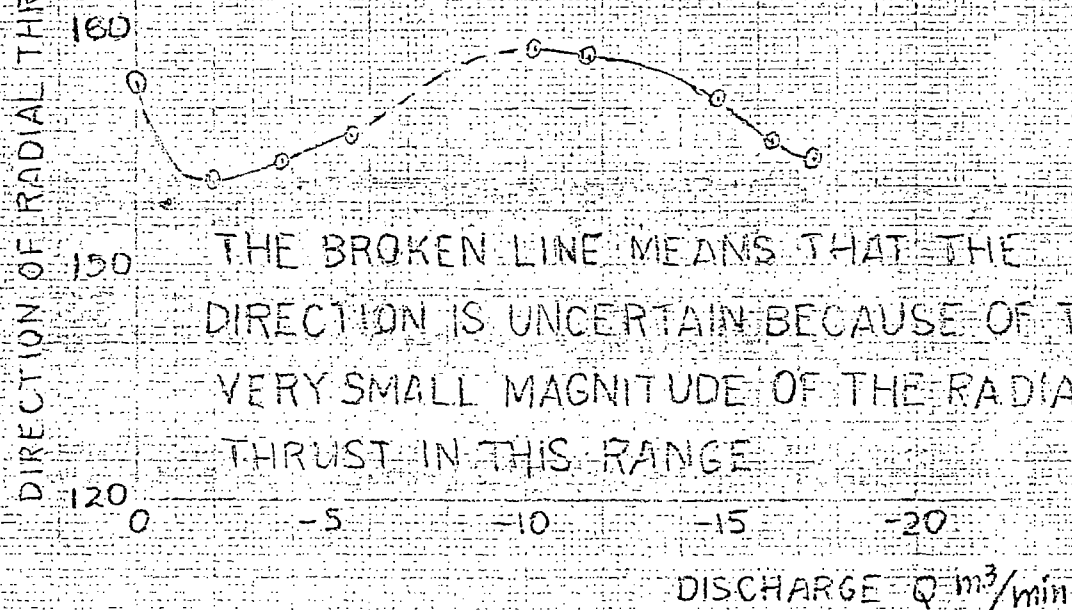
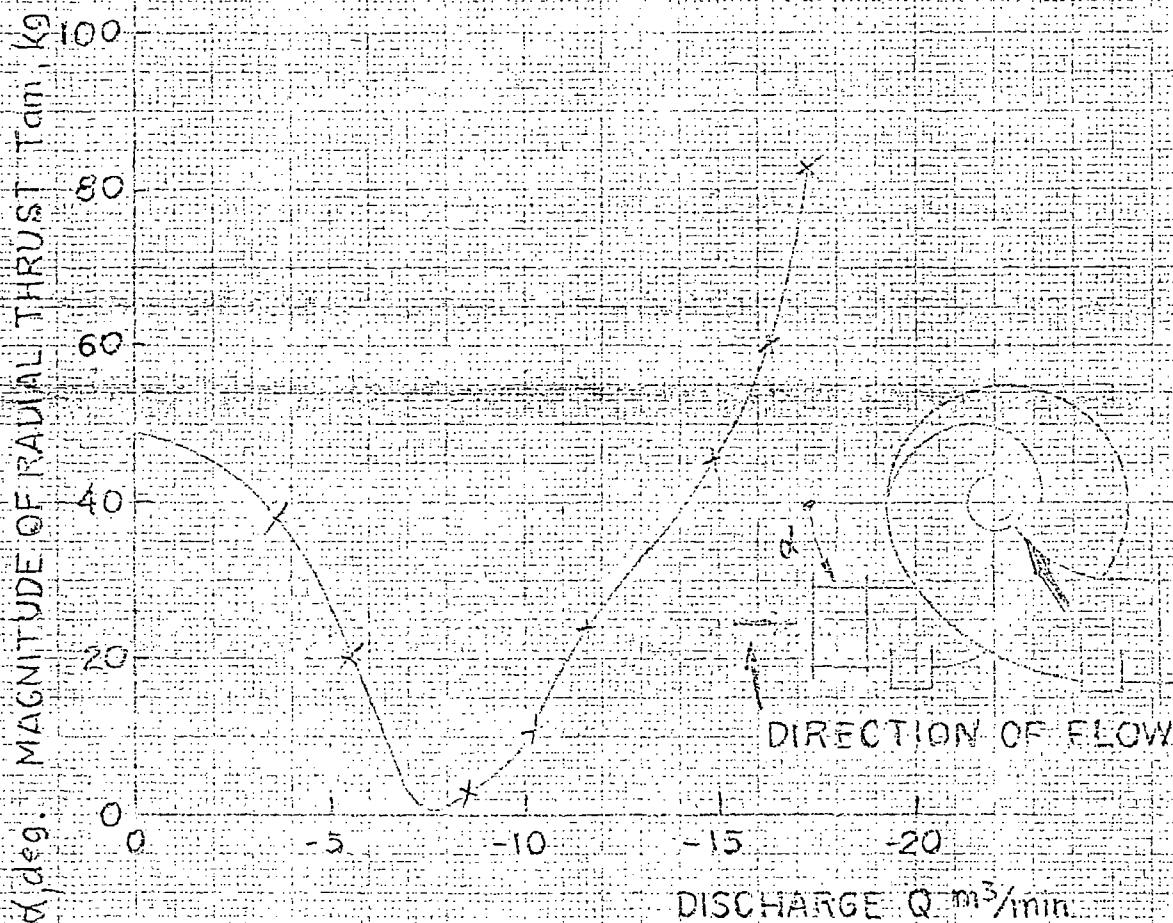


TEST RESULTS OF RADIAL THRUST
IN MODEL OPERATED IN TURBINE RANGE

Hitachi Ltd. s979770-2

INC.	REV.	NO.	DATE	REVISED	CHECKED

SPEED $N = -1250 \text{ rpm}$



THE BROKEN LINE MEANS THAT THE DIRECTION IS UNCERTAIN BECAUSE OF THE VERY SMALL MAGNITUDE OF THE RADIAL THRUST IN THIS RANGE

TEST RESULTS OF RADIAL THRUST
IN MODEL OPERATED IN TURBINE RANGE (2)

APP. K. V. K. 10.10.70
APP. S. S. S. 10.10.70
APP. M. M. M. 10.10.70

APP. S. S. S. 10.10.70

5979710-3

REVISIONS

DATE

REVISIONS

NO.

DIRECTION OF RADIAL THRUST α , deg

DIRECTION OF RADIAL THRUST α , deg

240

210

180

150

120

90

60

30

0

0.2

0.4

0.6

0.8

1.0

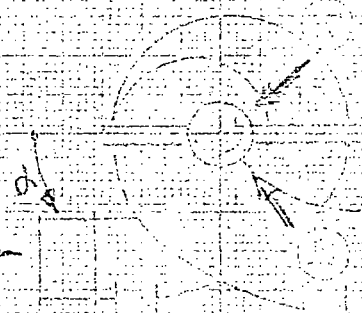
h : DIMENSIONLESS SPEED

q : DIMENSIONLESS DISCHARGE

IV

III

DIRECTION OF FLOW



DIRECTION OF RADIAL THRUST IN MODEL
OPERATED IN TURBINE RANGE

U.S. NAVY
NAVY RESEARCH AND DEVELOPMENT
WASHINGTON, D.C.

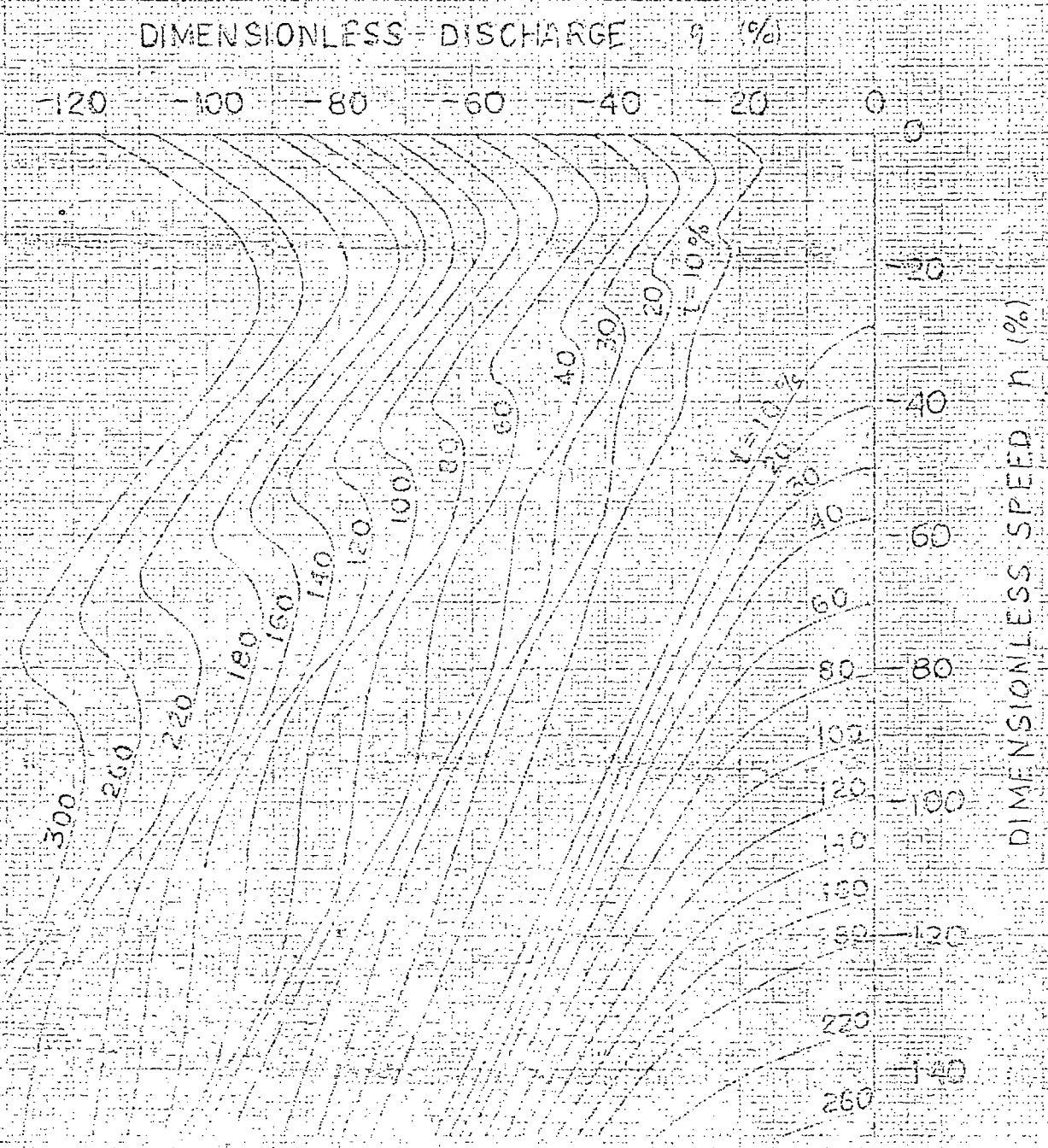
NAVY RESEARCH AND DEVELOPMENT
WASHINGTON, D.C.

5078770-4

DATE RECEIVED

REV. NO.

DIMENSIONLESS MAGNITUDE OF RADIAL THRUST

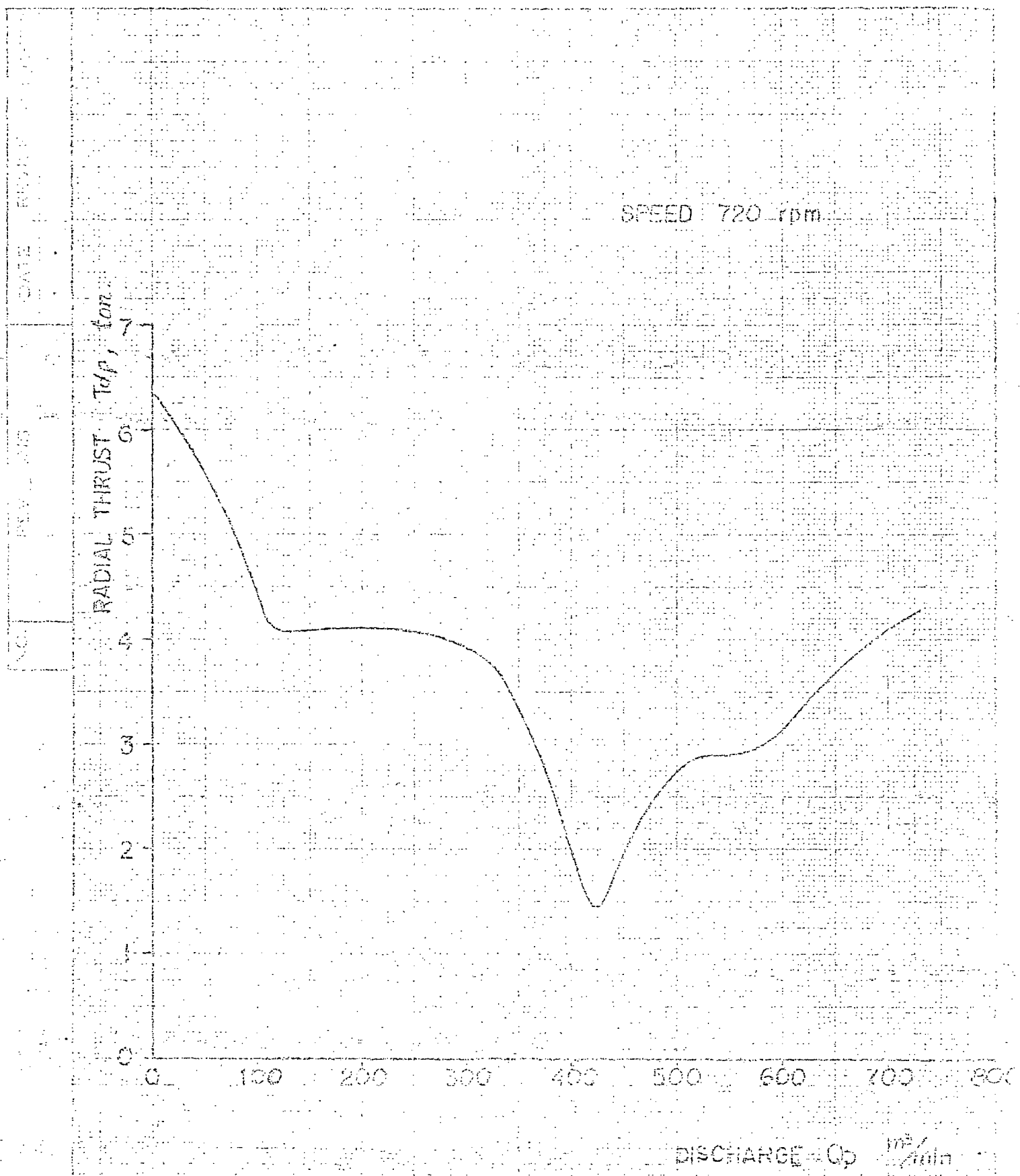


DIMENSIONLESS MAGNITUDE OF RADIAL THRUST
IN MODEL OPERATED IN TURBINE RANGE

1000 11/10 12 1967
CNS 11/10/11

11/10/11

S979770-5



ESTIMATED MAGNITUDE OF RADIAL THRUST IN PROTOTYPE
OPERATED IN PUMP RANGE

KARADA 12 DEC 67

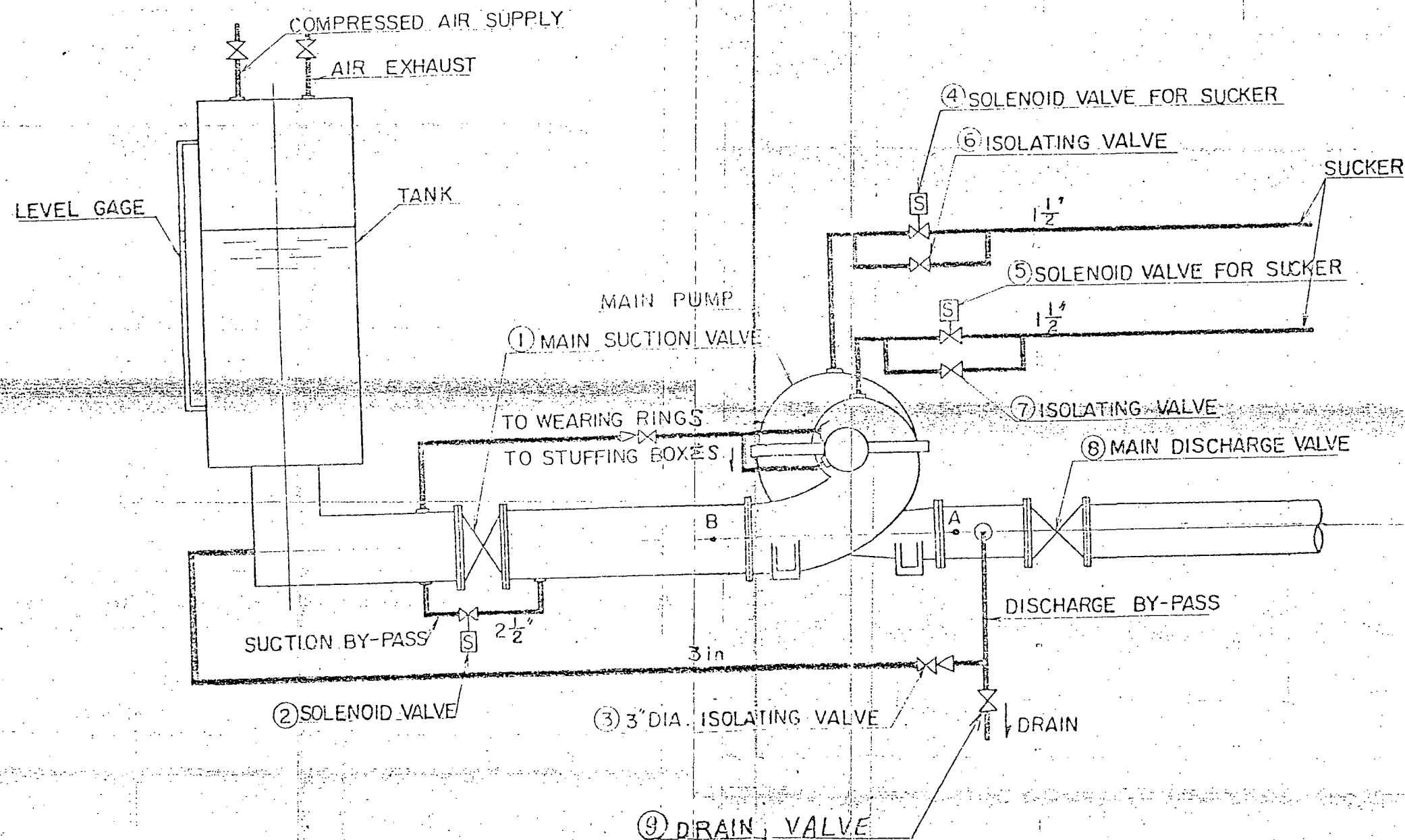
REMARKS

8979770-6

P350076

KAMCARI WORKS DWG. NO.

NO.	REVISIONS	DATE	REVISED	CHECKED



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DWN.	H. Takada	10. FEB. '70	THIRD
CHKD.			ANG. PROJ.
APPD.	K. Miyashiro		SCALE

PIPING SYSTEM DIAGRAM
FOR MODEL PUMP

Hitachi, Ltd.
Tokyo Japan

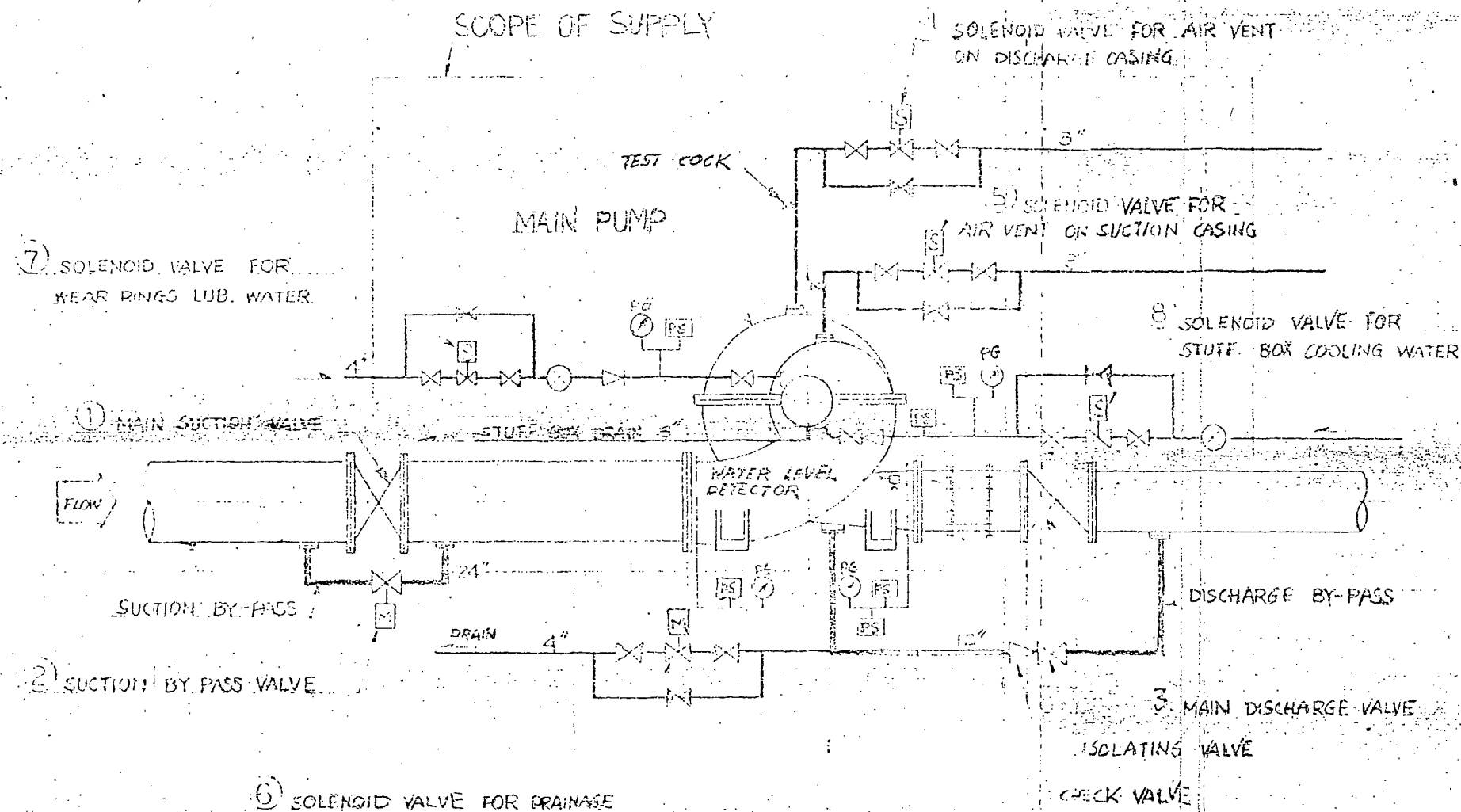
KAMCARI WORKS DWG. NO.

P350076

P351149

KAMEARI WORKS DWG. NO.

NO.	REVISIONS	DATE	REVISED	CHECKED
1	THIS DWG. IS PARTLY REPRODUCED FROM HITACHI DWG. NO. P350037. ACCORDING TO SEITEI DWG. NO. 156-26-25A.	APR. 17 '70	H. Kamekura	K



EXPLANATIONS

- RATOLARM TYPE FLOW SWITCH
- PRESSURE SWITCH
- STRAINER
- MOTOR OPERATED SLUICE VALVE
- SOLENOID VALVE
- ISOLATING VALVE (normally open)
- ISOLATING VALVE (normally close)
- CHECK VALVE
- PRESSURE GAUGE

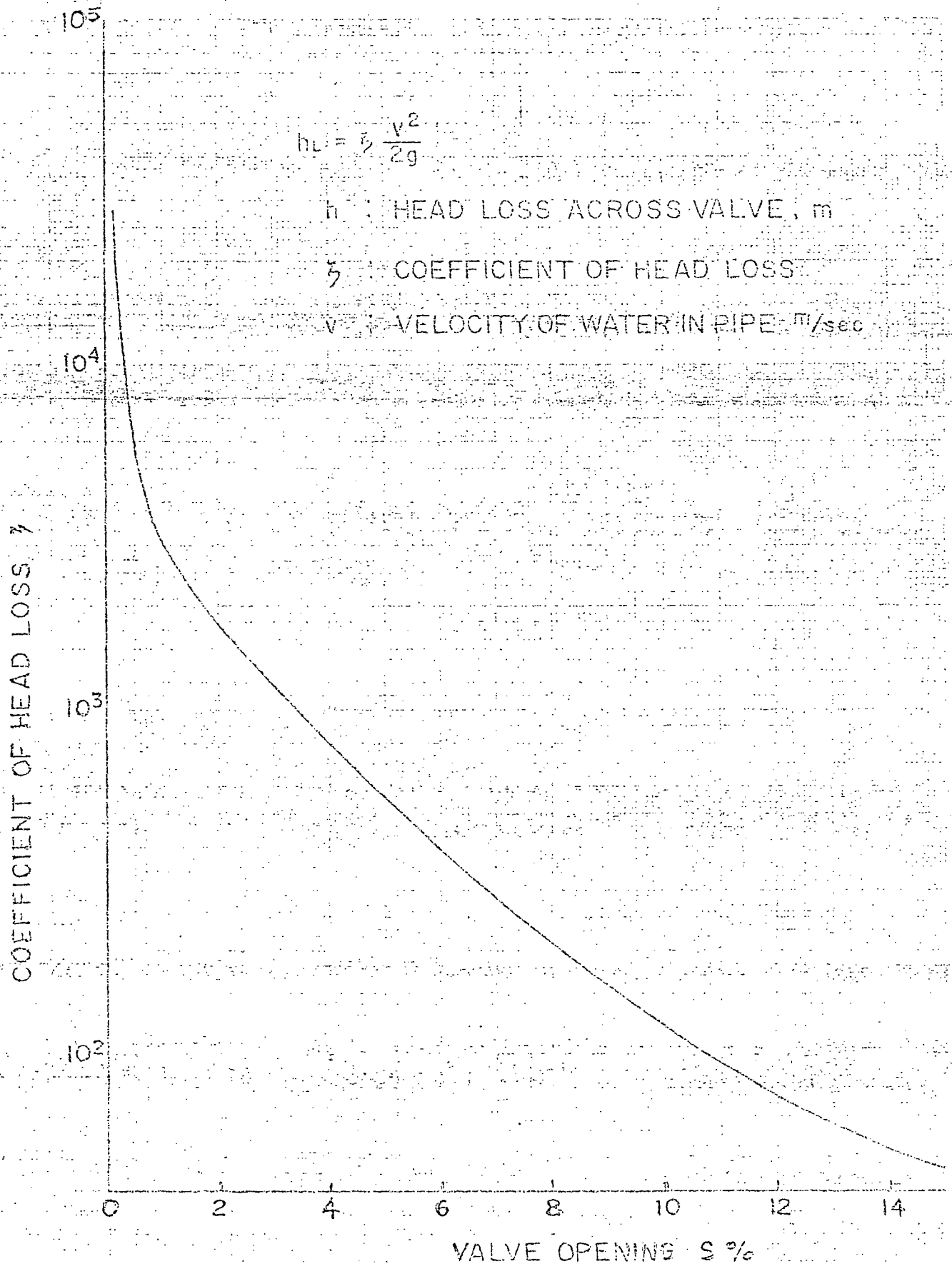
	Consumption (m ³ /hr)			Press. at pump inlet (kg)		
	min.	nom.	max.	min.	nom.	max.
FOR COOLING WATER OF STUFF BOX	2.5	3.5	5.5	2.0	4.0	5.0
FOR COOLING WATER OF OIL COOLER	8.0	17.0	20.0	1.0	4.0	5.0
FOR LUB. WATER OF WEAR RING.	72.0	220.0	295.0	1.0	4.0	5.0

REQUIREMENTS OF CLEAN WATER FOR EACH PUMP SET.

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OWN	H. Kamekura	APR. 16 '70	THIRD	TITLE
CHRD			ANG. PROJ.	PIPING SYSTEM DIAGRAM
APPD			SCALE	FOR
			N.T.S.	MAIN PUMP
				(PROTOTYPE)
				KAMEARI WORKS DWG. NO.
				P351149

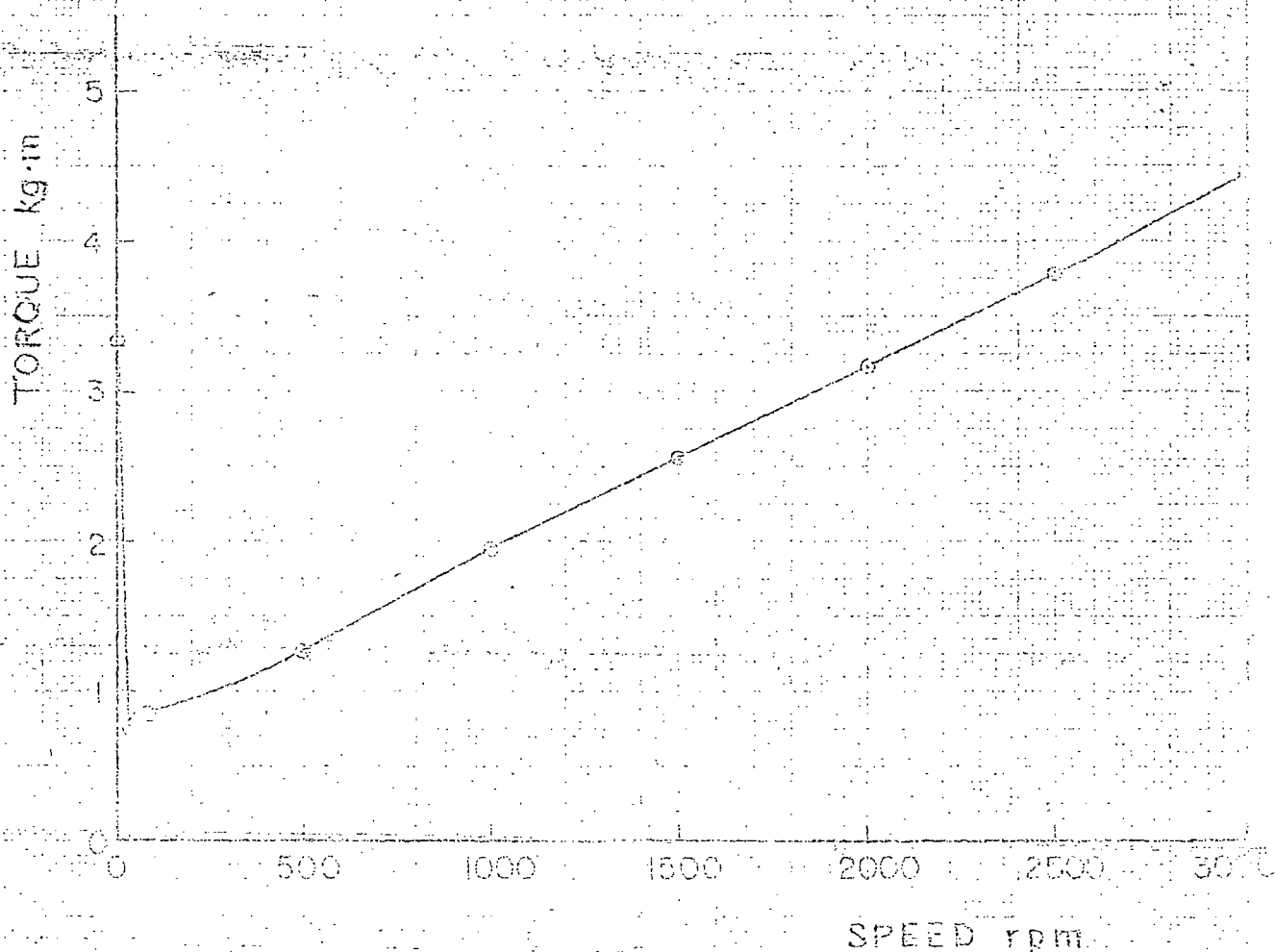
Hitachi, Ltd.
Tokyo Japan



COEFFICIENT OF HEAD LOSS
ACROSS SLUICE VALVE

DATE RECEIVED CHECKED

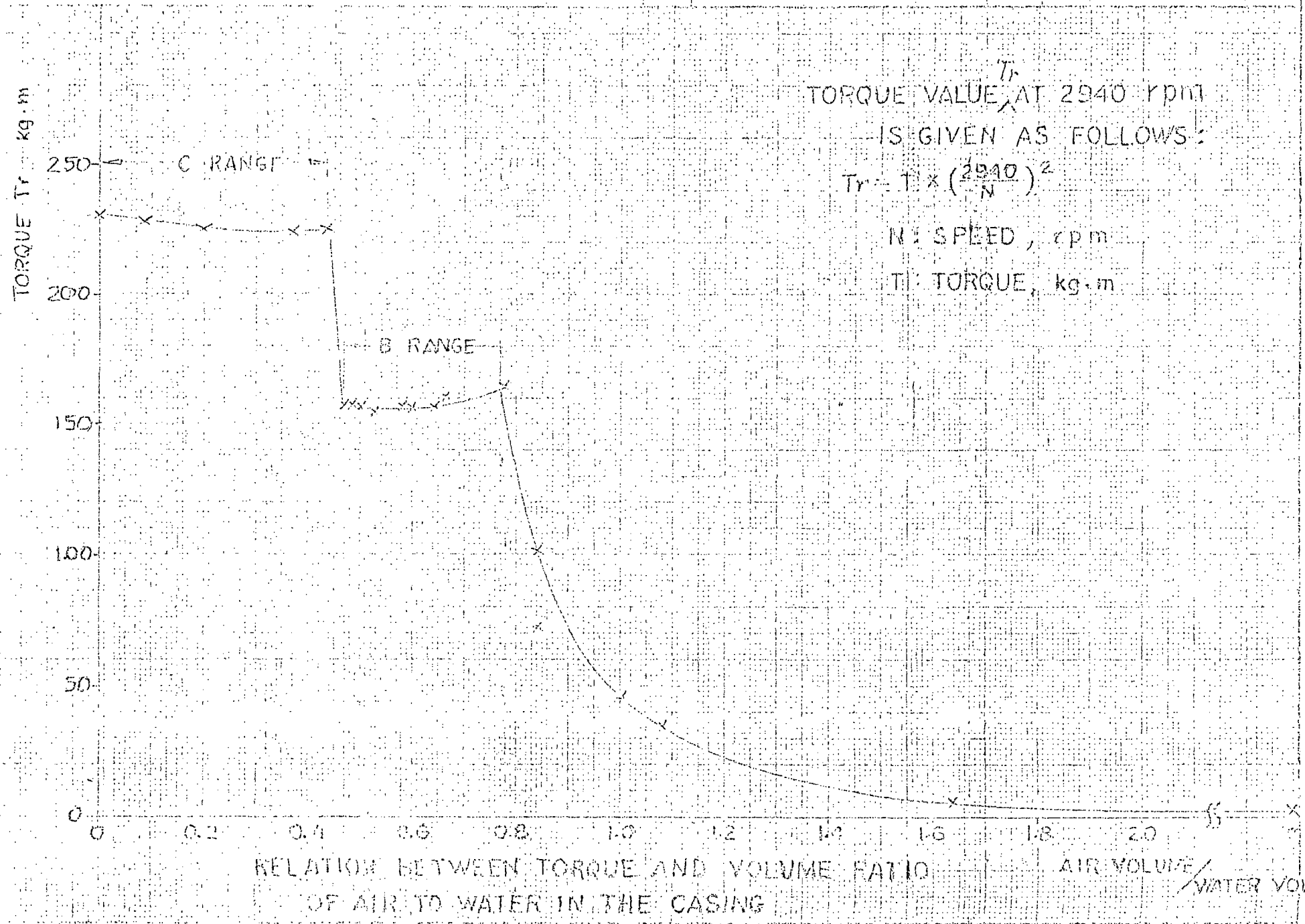
NO. REV. DES.



RELATION BETWEEN PUMP SPEED
AND TORQUE WITH PUMP CASING FILLED OF AIR

1. K. KADA 30.11.70
P. K. KADA

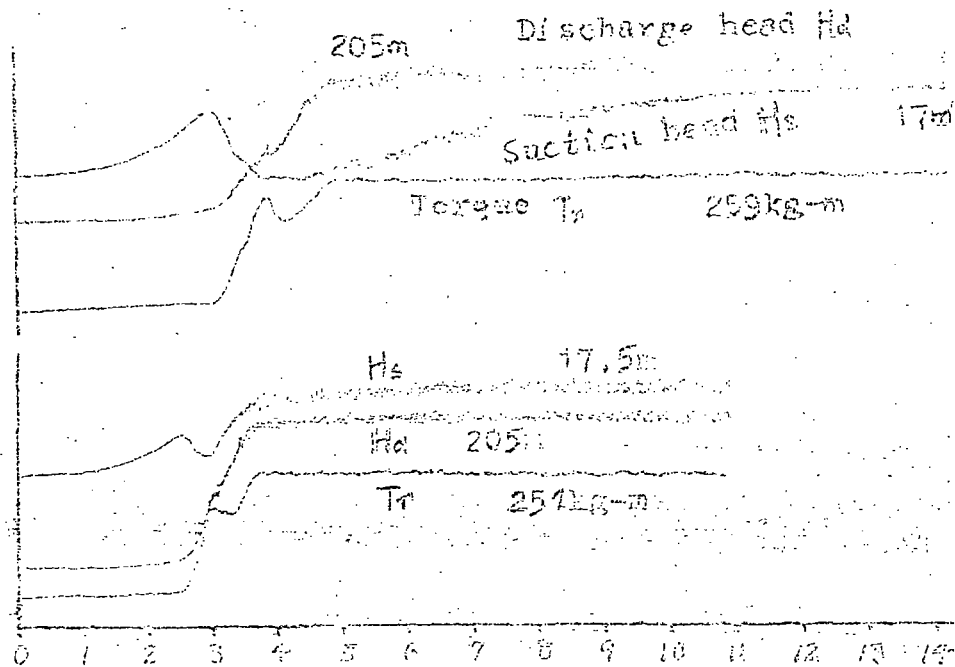
S979771-2



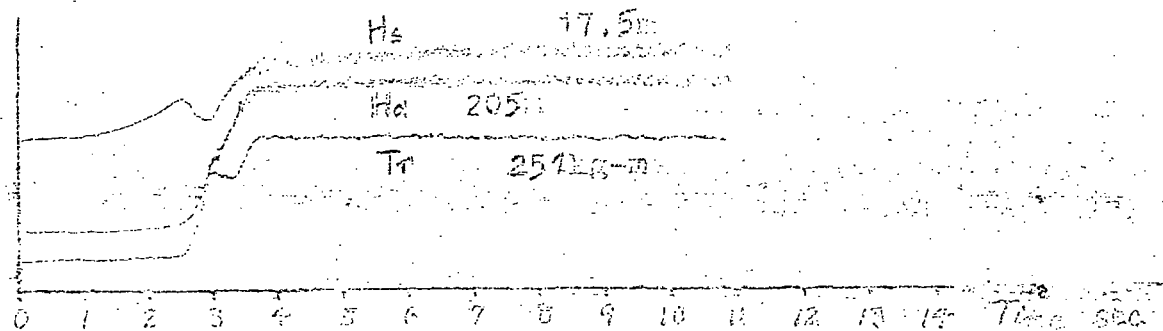
RELATION BETWEEN TORQUE AND VOLUME RATIO OF AIR TO WATER IN THE CASING

5979771-3

TEST NO. 1

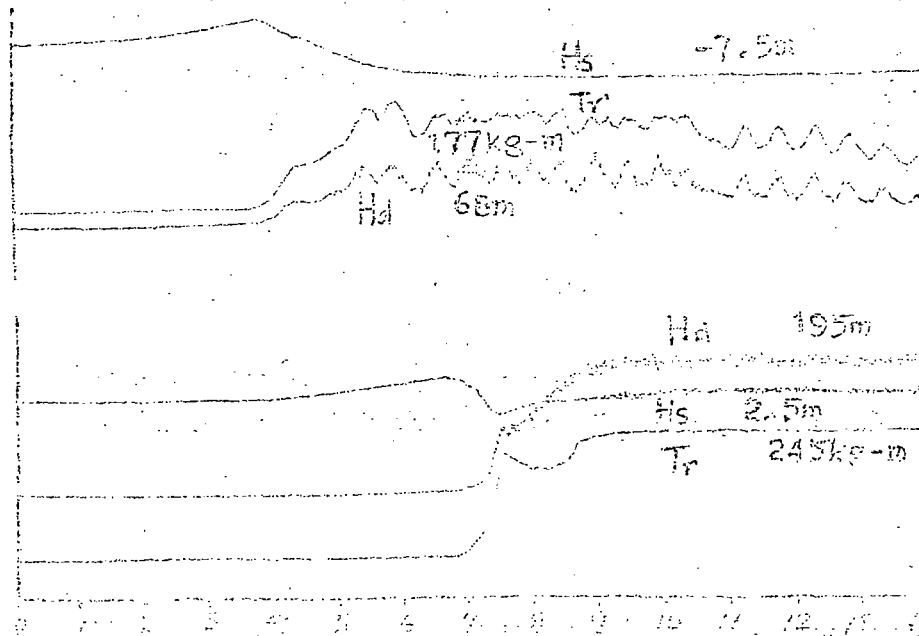


TEST NO. 2

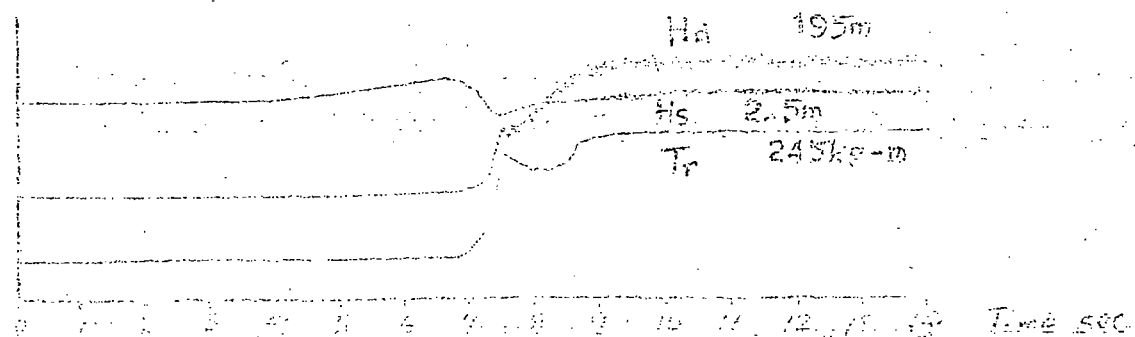


(a) Filling water through the main suction valve

TEST NO. 3

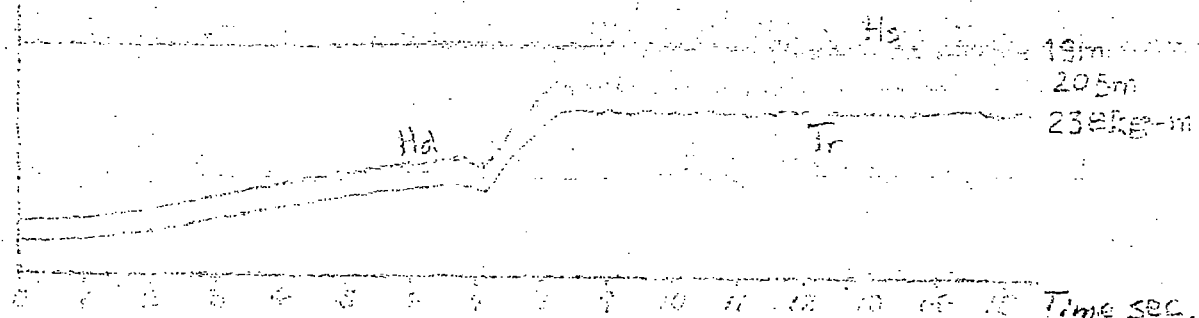


TEST NO. 4



(b) Filling water through the suction by-pass valve

TEST NO. 5



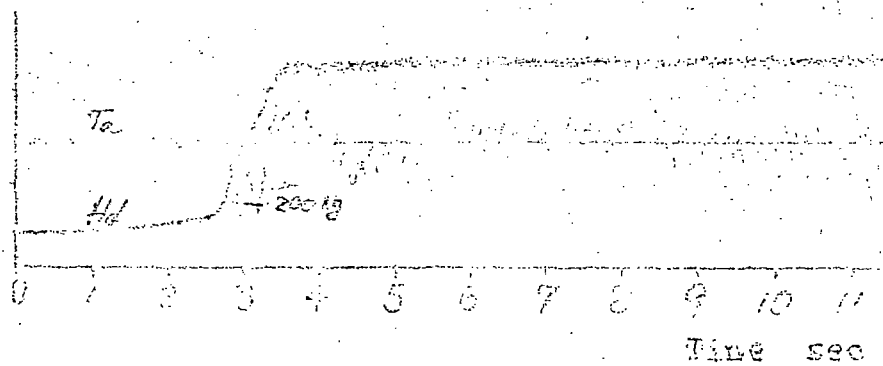
(c) Pump startup with the casing full of water

Transient change in torque, suction head and discharge head at pump startup

TEST NO. 1

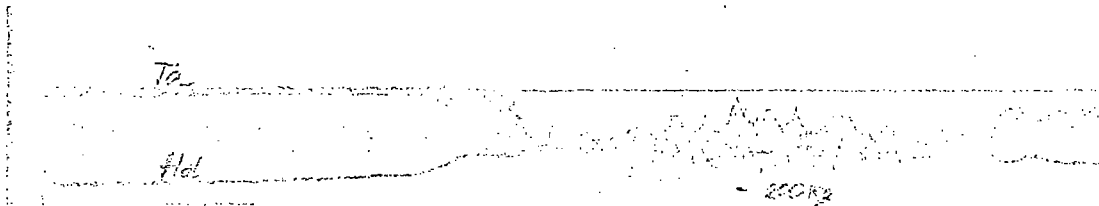
Axial Thrust T_a
Discharge head H_d - 200 ft

TEST NO. 2

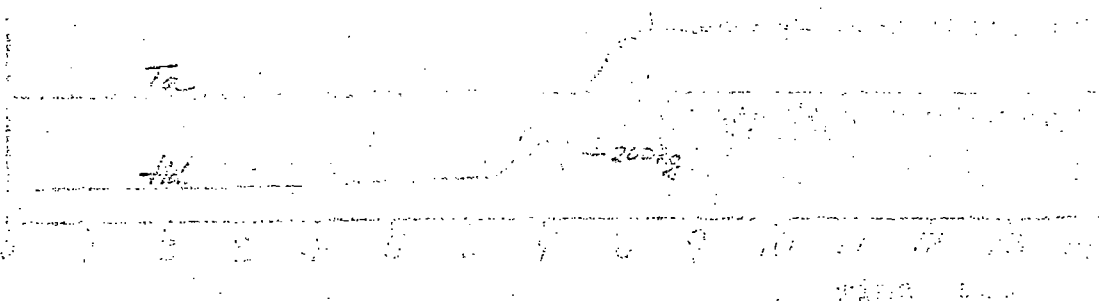


(a) Filling water through the main suction valve

TEST NO. 3



TEST NO. 4



(b) Filling water through the suction by-pass valve

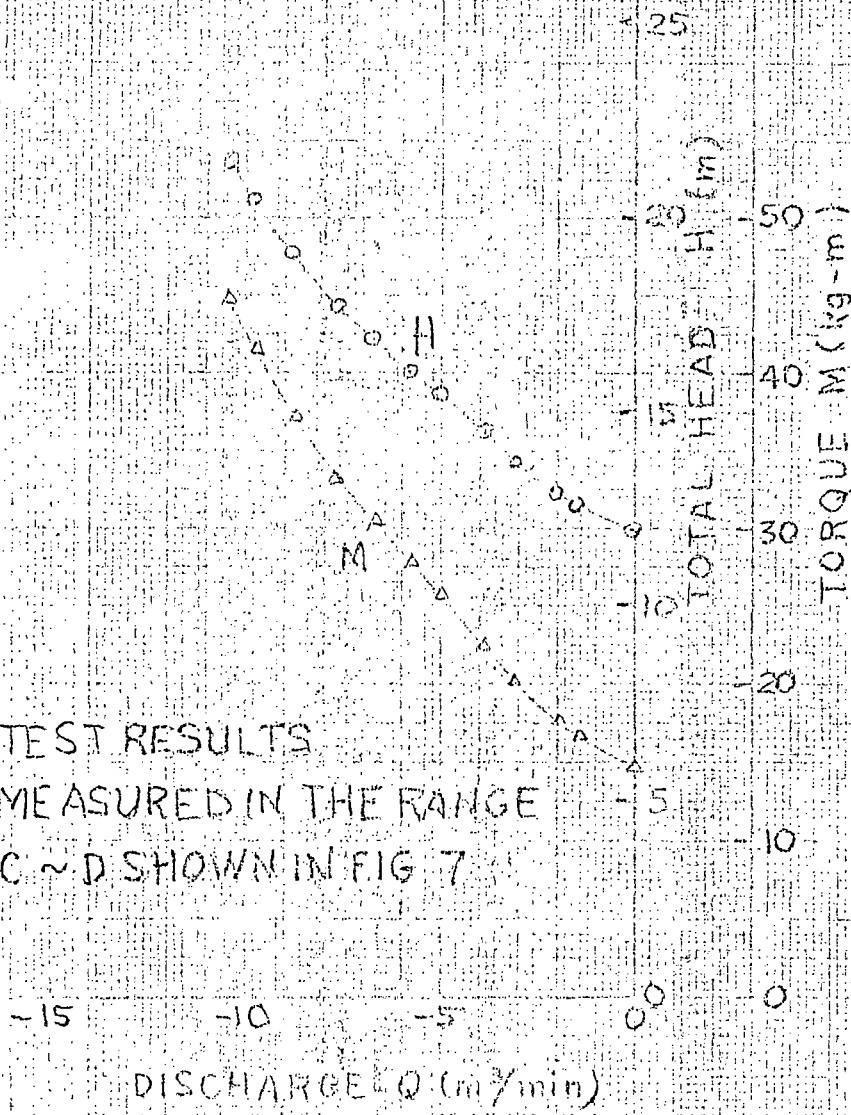
Transient change in axial thrust and discharge head
at pump startup

Start-up conditions (refer to Drawing P 350076)

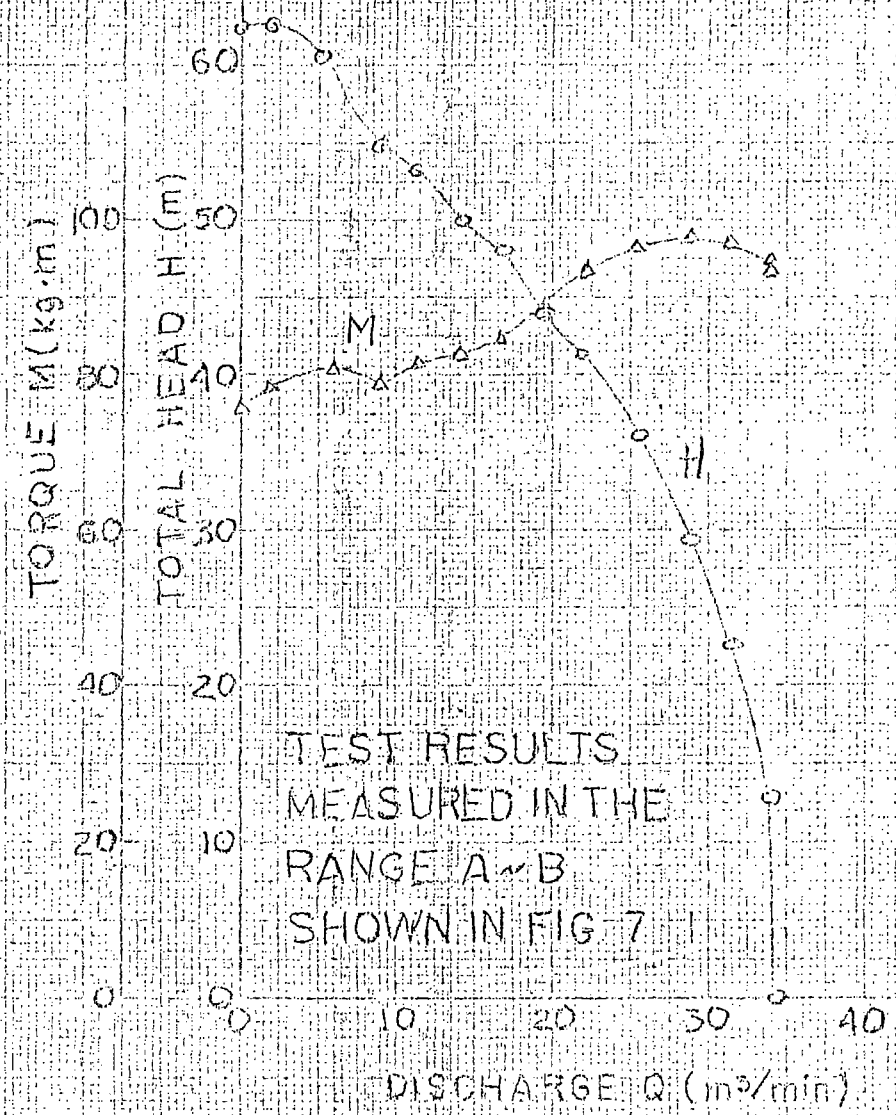
Test No.	Water to be filled	Discharge by-pass valve (3)	Air vent (7) (on suction casing)	Air Vent (6) (on discharge casing)
1	Through the main suction valve (1)	Open	Closed	Open
2	Through the main suction valve (1)	Closed	Closed	Open
3	Through the suction by-pass valve (2)	Open	Closed	Open
4	Through the suction by-pass valve (2)	Closed	Open	Open
5	Start -up with the casing full of water			

NO.	REVISIONS	DATE	REVISED	CHECKED

$N = 750 \text{ rpm}$



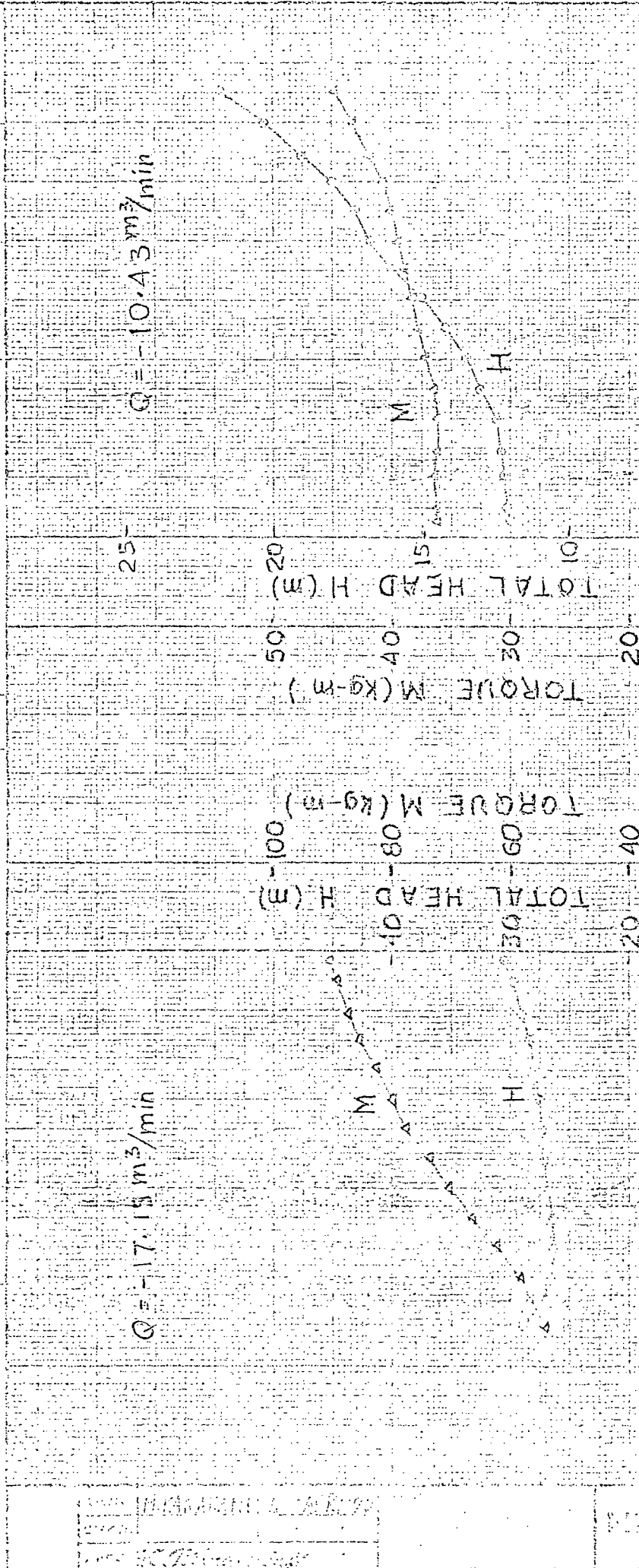
$N = 700 \text{ rpm}$



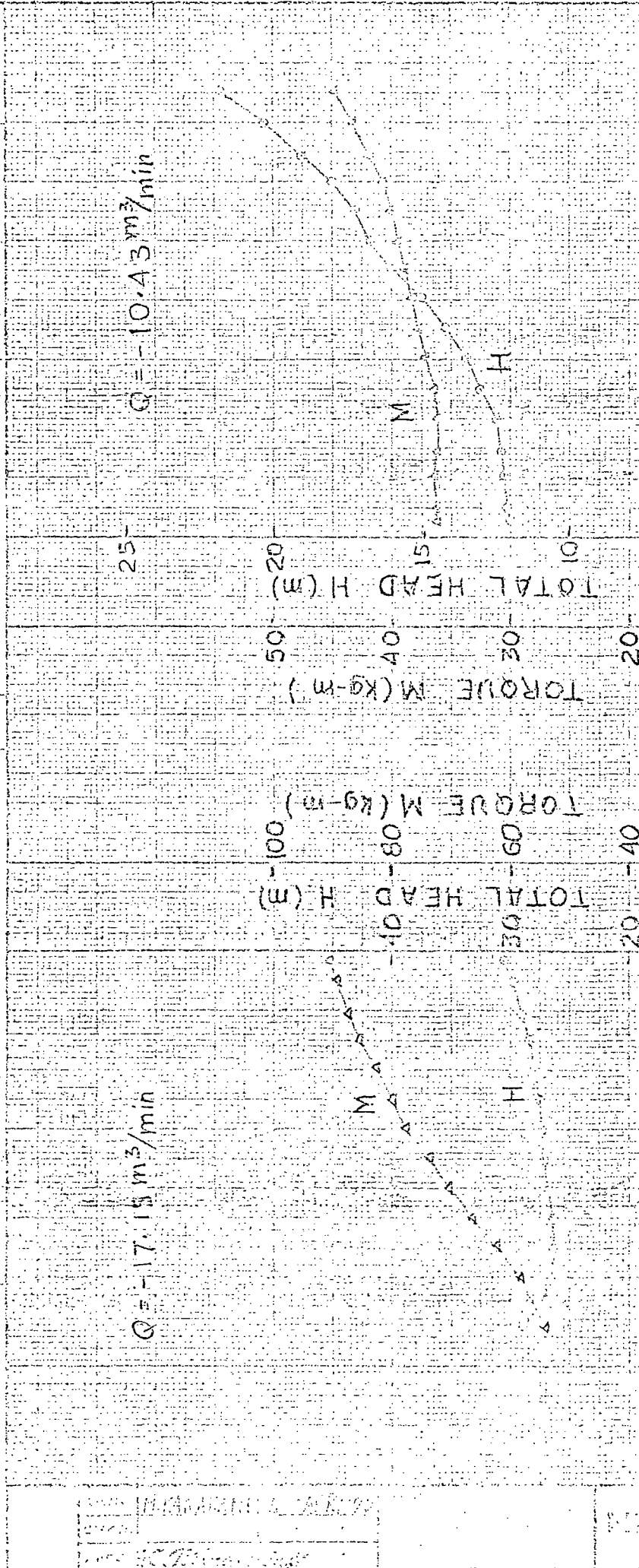
TEST RESULTS OF PUMP CHARACTERISTICS IN THREE QUADRANTS OF OPERATION (1)

S979769-1

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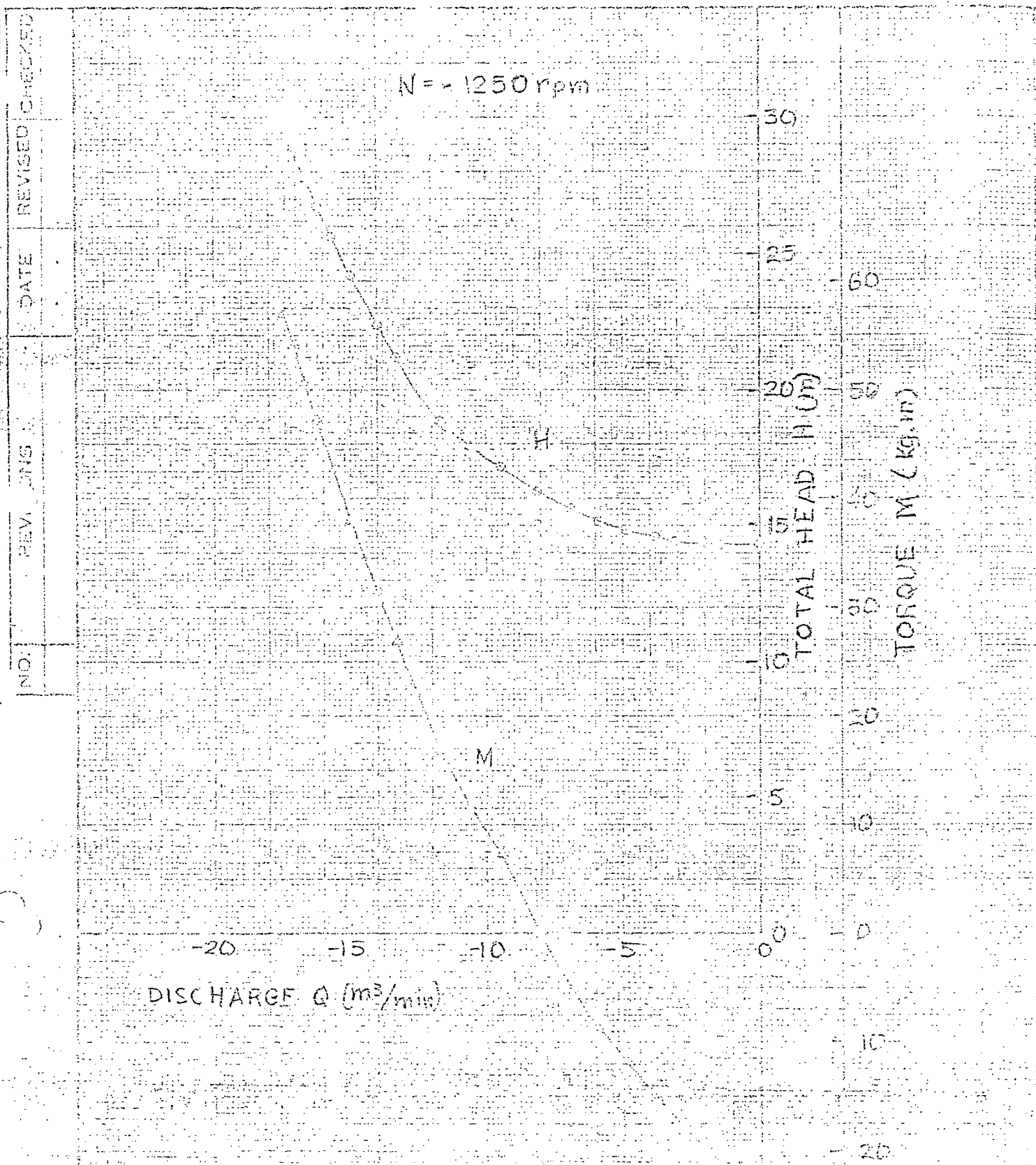


TEST RESULTS MEASURED
IN THE RANGE F ~ G
SHOWN IN FIG. 7-1



TEST RESULTS MEASURED
IN THE RANGE D ~ E
SHOWN IN FIG. 7-1

S979769-2



TEST RESULTS MEASURED
IN THE RANGE G ~ H SHOWN IN FIG. 71

TEST RESULTS OF PUMP CHARACTERISTICS
IN THREE QUADRANTS OF OPERATION (3)

5979709-3

DIVISÃO IV

IV - DESCRIPTION OF PUMP TESTS

(DESCRIÇÃO DOS TESTES DA BOMBA)

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DESCRIÇÃO DOS MATERIAIS PARA AS BOMBAS HIDRÁULICAS

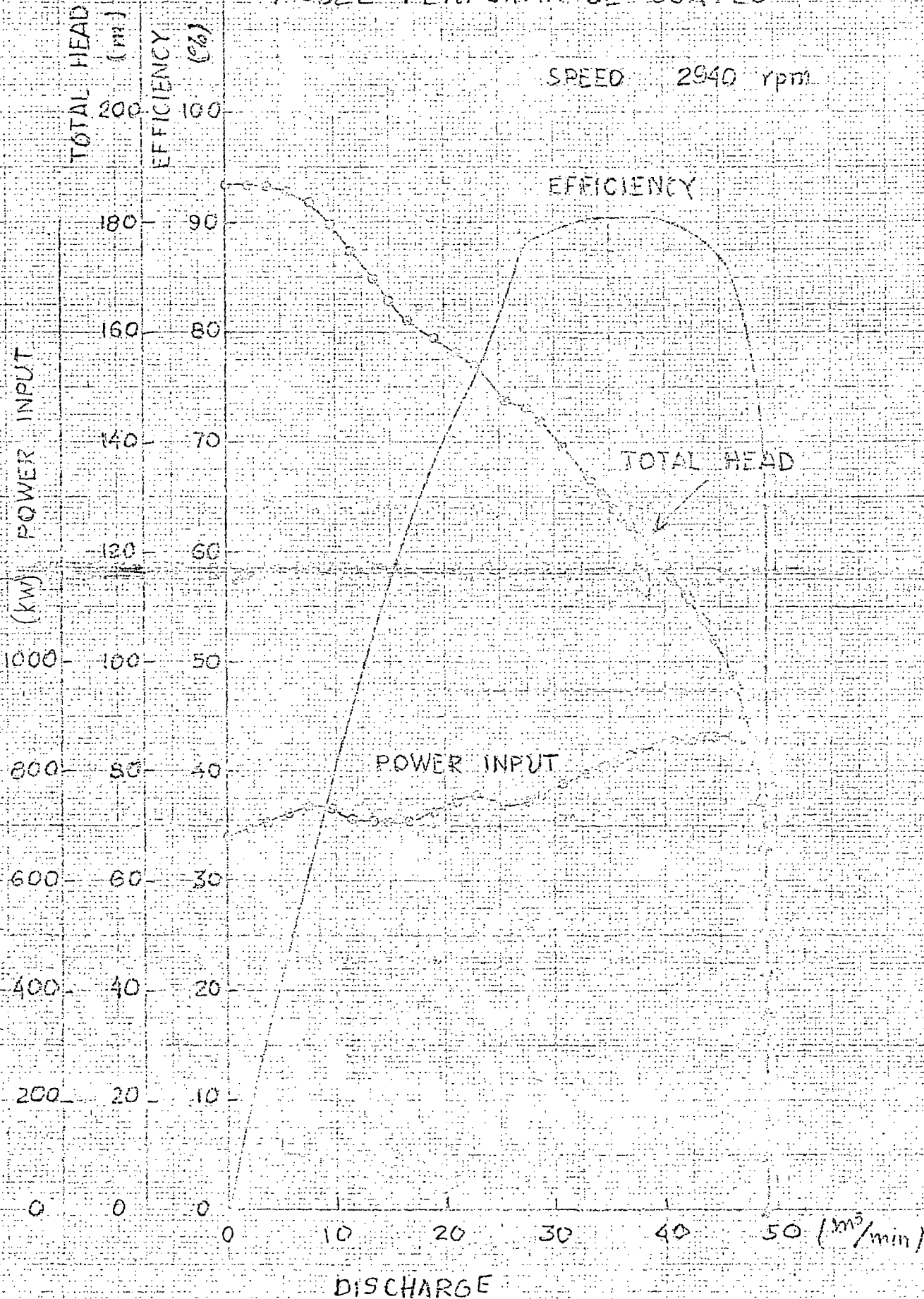
Peça	
Carcaça da bomba e anel difusor difusor	Aço fundido ASTM A 27 grau 60 - 30; Chapa de aço ASTM 283 grau B, para chapas de 51 mm ou menos de espessu ra e ASTM A 201, qualidade para for nalhas grau A, para chapas de espes sura acima de 51 mm.
Chapas de proteção	Chapa de aço ASTM A 283 grau B.
Bronze fundido	ASTM B 22, liga A.
Eixo	Aço forjado ASTM A 235, Classe E, re cozido antes da usinagem.
Metal antifricção para os mancais	ASTM B 23
Rotor	ASTM A 296 grau CA-15 ou ASTM B 148 liga 9 D.
Anéis de desgaste rotativos e luvas do eixo	Aço inoxidável ASTM A 296 grau CA, com dureza BHN mínima de 350.
Anéis de desgaste estacioná rios e rotor	Aço inoxidável ASTM A 296 grau CA, 15, faixa de dureza BHM de 250 a 300.
Parafusos, porcas e parafusos prisoneiros p/flanges s/pres são quando altamente solicita dos (sem contato com água)	ASTM A 320 grau L-43

Peça	Especificação do material
Parafusos, porcas e parafusos prisioneiros p/outros fins (sem contato com água)	ASTM A 307 (aço), latão ASTM B 21, Liga A
Parafusos, porcas e parafusos prisioneiros em <u>con</u> tato com a água	Aço inoxidável ASTM A 276, tipo 303.
Peças de ferro fundido	ASTM A 48, Classe 35
Materiais elétricos	Normas ABNT, NEMA, USAS e National <u>Electri</u> cal Code (USA).
Tubos de aço	USAS B 36 10, ASTM A 120 grau A.
Aço estrutural para monta <u>gem</u> com parafuso	ASTM A 7
Aço estrutural para solda <u>gem</u>	ASTM A 373
Tubo de latão	ASTM B 43
Válvulas de bronze	ASTM B 61 ou B 62
Tubos rígidos de cobre	ASTM B 42
Tubo flexíveis de cobre	ASTM B 88, tipo K
Eletrodutos rígidos	USAS C 80.1

REVISED /
 DATE
 REV. /
 DATE

MODEL PERFORMANCE CURVES

SPEED 2940 rpm



DISCHARGE

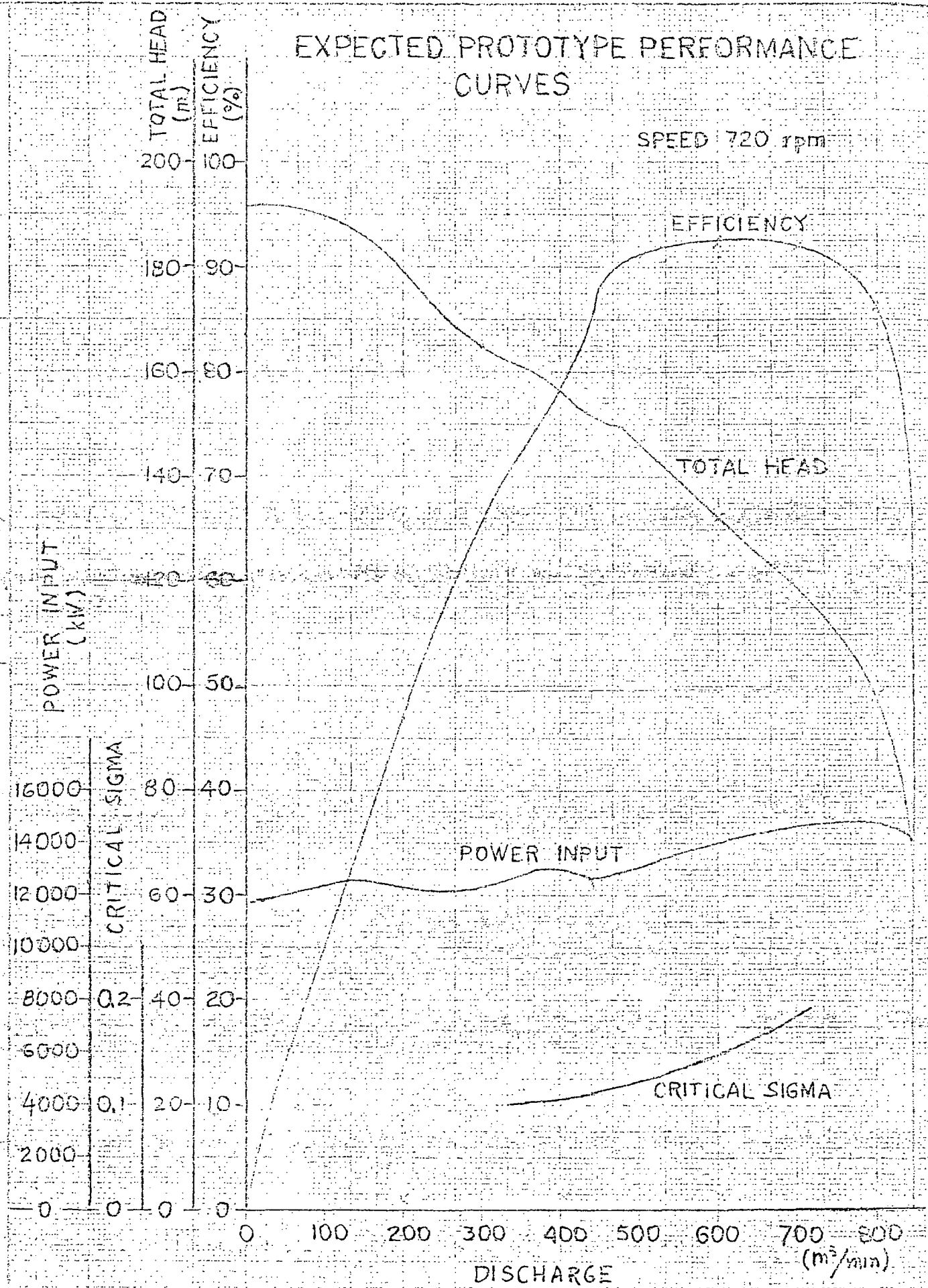
MODEL
PERFORMANCE
CURVES

S972497_1

DATE: _____ REVISED: _____
 NO. _____ REV. _____

EXPECTED PROTOTYPE PERFORMANCE CURVES

SPEED 720 rpm



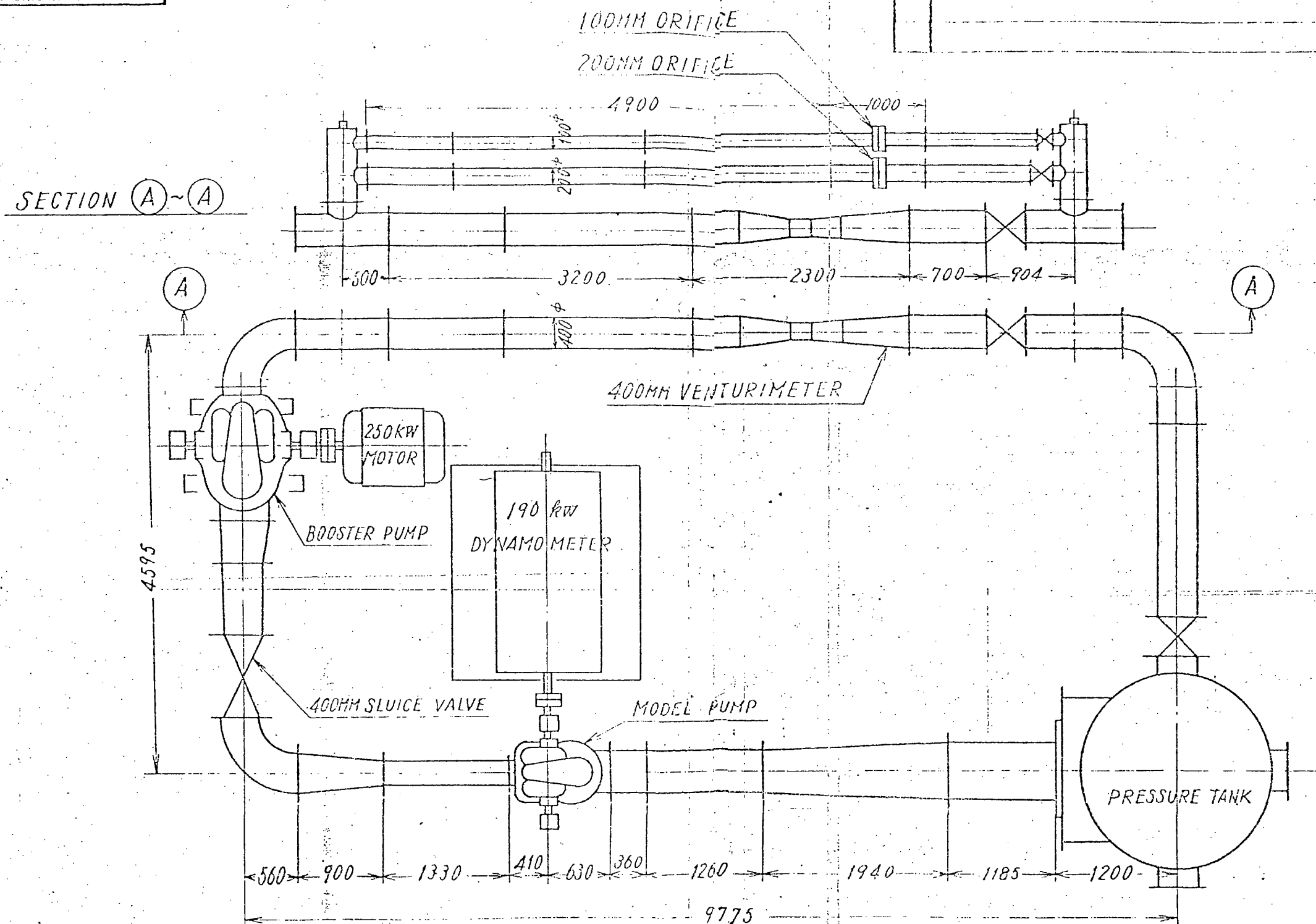
DESIGNED BY: _____
 CHECKED BY: _____
 DATE: _____

SCALE: _____
 UNIT: _____

S979765-3

P351045
KAMEARI WORKS DWG. NO.

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DWN.	H. KAWAKAMI	24 FEB '70	THIRD	TITLE
CHKD.			ANG. PROJ.	ARRANGEMENT
APP'D.	K. M. Gashiro		SCALE	OF
			1	MODEL TEST
			50	

Hitachi, Ltd.
Tokyo Japan

KAMEARI WORKS DWG. NO.
P351045

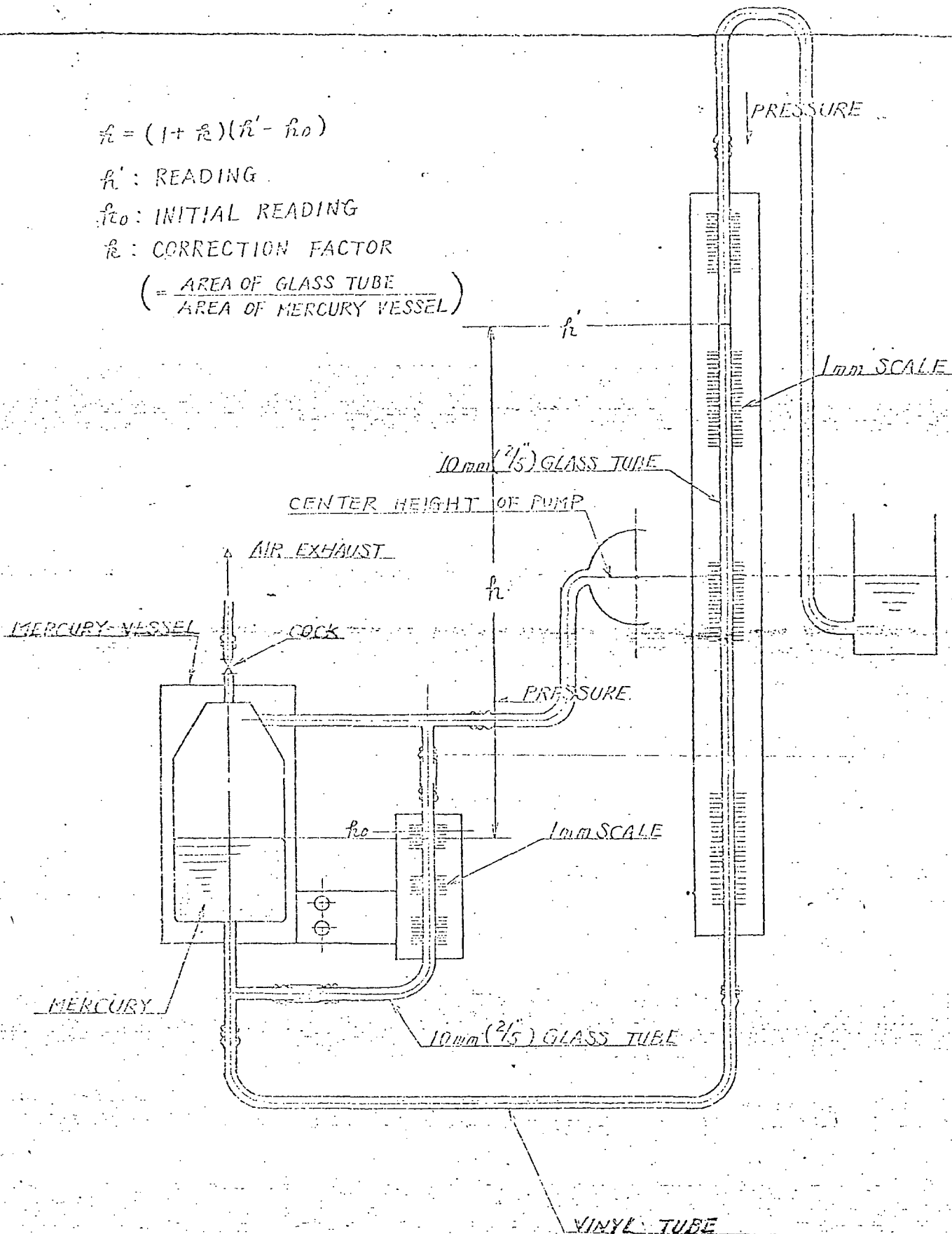
$$h = (1 + k)(h' - h_0)$$

h' : READING

h_0 : INITIAL READING

k : CORRECTION FACTOR

$$\left(= \frac{\text{AREA OF GLASS TUBE}}{\text{AREA OF MERCURY VESSEL}} \right)$$



OWN	DATE	FILE	U441490
CHKD			
APPR			

DATE REVISED: (RECORD)

REV. NO.

NO.

TOTAL HEAD (m)
160
140
120
100
80
60
40
20
0

EFFICIENCY (%)
100
80
60
40
20
0

DISCHARGE

$Q_r = 19.1 \text{ m}^3/\text{min}$

$Q_r = 22.8 \text{ m}^3/\text{min}$

$Q_r = 26.6 \text{ m}^3/\text{min}$

TOTAL HEAD

EFFICIENCY

CAVITATION COEFFICIENT σ

MODEL CAVITATION:
TEST CURVES

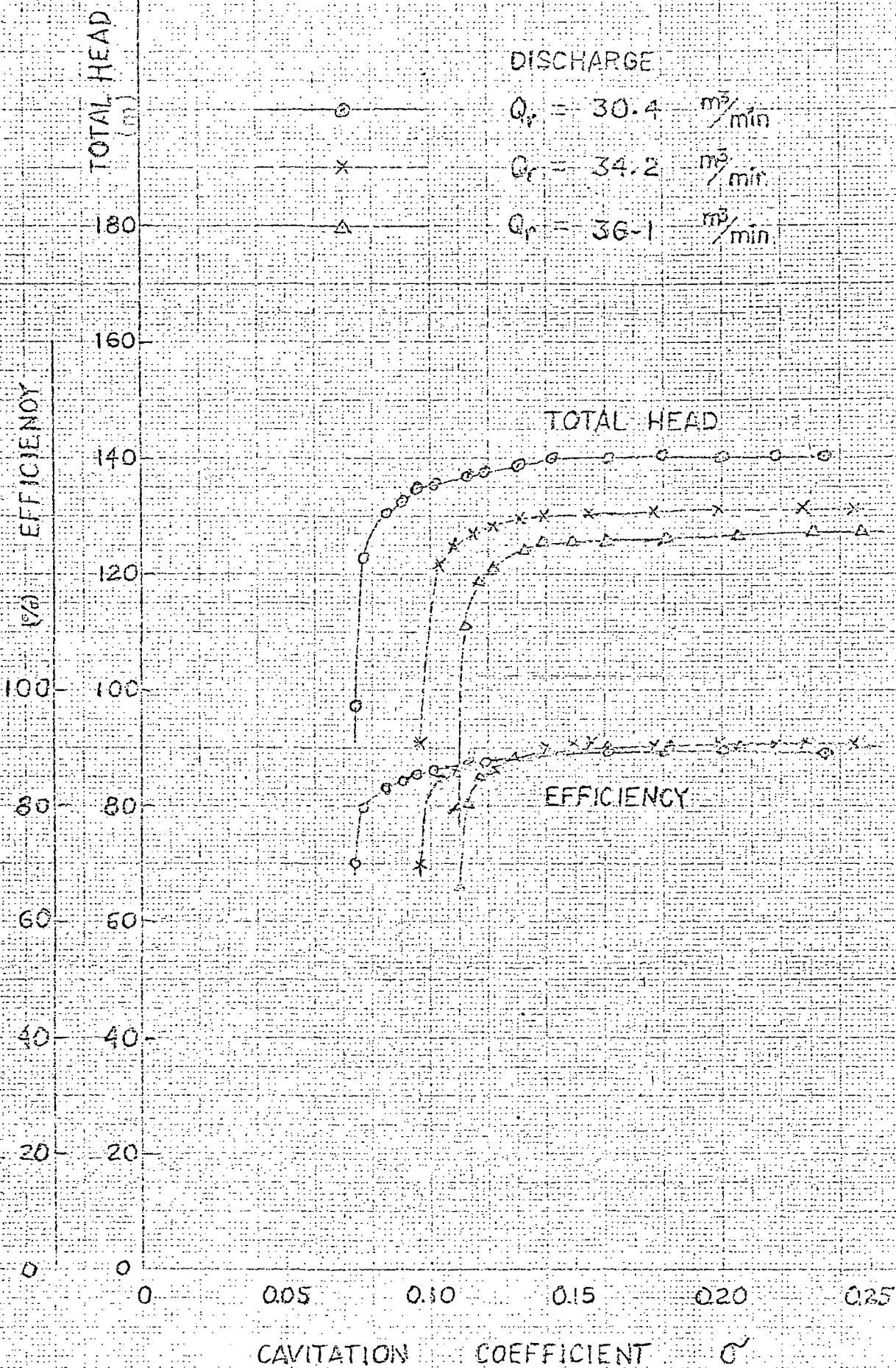
S 972497

-2

REVISOR CHECKED
DATE

REVISOR NO.

NO.



MODEL CAVITATION
TEST CURVES

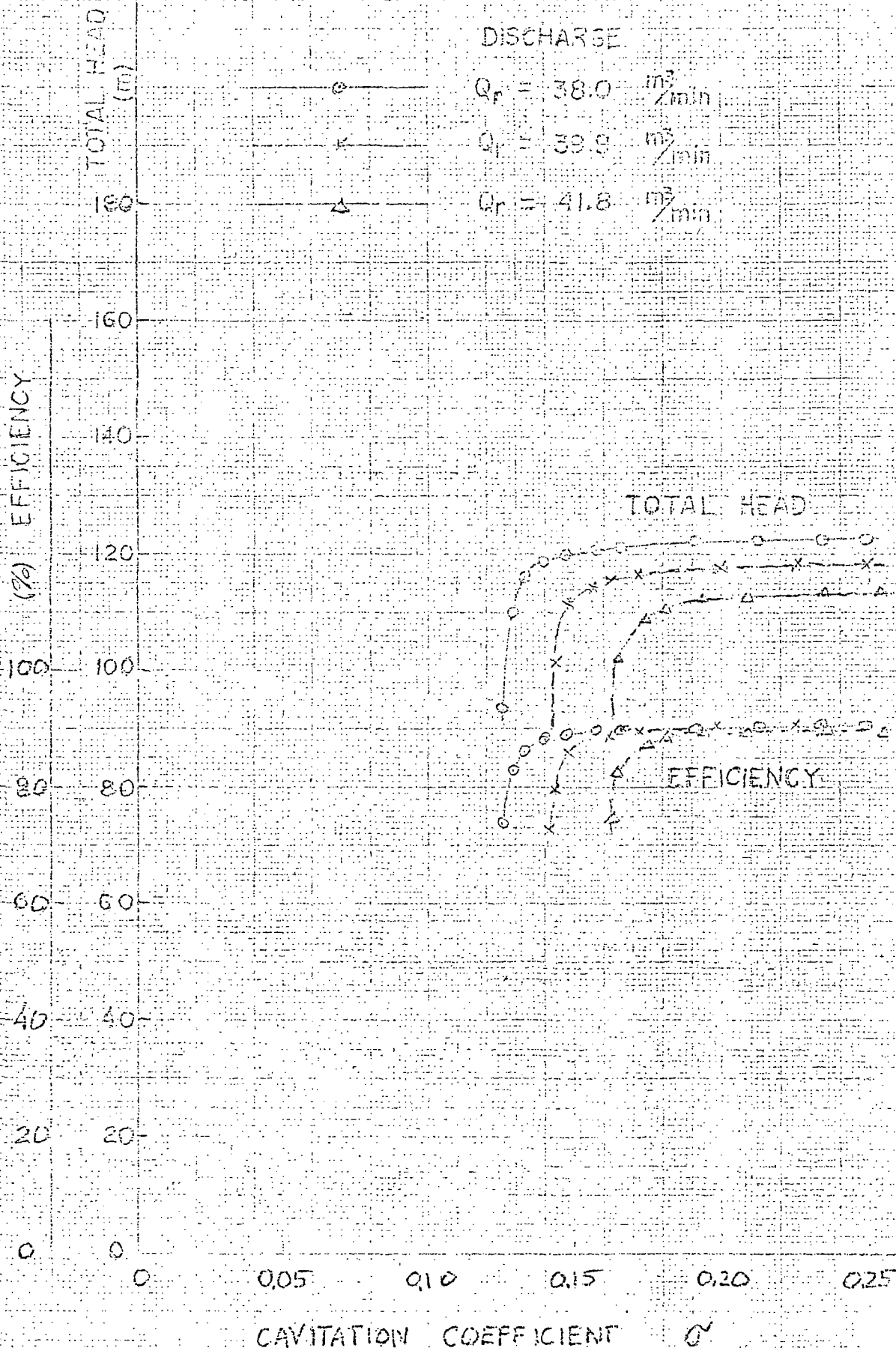
S972497

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DATE

REV. NO.

NO.



MODEL CAVITATION
TEST CURVES

TEST NO. (L.R.)

S972497-4

Estimate of Prototype Performance

	MODEL				PROTOTYPE			
	$Q_m (\frac{m^3}{min})$	$H_m (m)$	$P_m (kW)$	$\eta_m (\%)$	$Q_p (\frac{m^3}{min})$	$H_p (m)$	$P_p (kW)$	$\eta_p (\%)$
1	0	187.01	679.82	0	0	191.74	1171.0	0
2	8.806	186.59	706.04	16.28	65.46	191.81	1216.2	16.77
3	7.592	183.76	784.76	30.98	180.63	188.41	1265.6	31.08
4	114.22	174.92	718.00	45.59	196.58	178.85	1228.7	46.69
5	148.20	165.74	708.11	56.88	256.71	168.98	1219.7	58.25
6	19.042	158.91	725.68	67.93	327.64	162.92	1250.0	68.57
7	22.768	154.20	756.68	75.59	391.75	158.10	1303.4	77.41
8	25.534	147.49	789.24	82.99	482.84	151.22	1278.8	84.99
9	27.487	146.27	744.21	88.00	472.94	149.97	1281.9	90.12
10	30.741	139.06	777.79	89.53	528.98	142.58	1289.7	91.69
11	33.253	133.06	798.09	90.82	572.20	136.43	1374.7	92.50
12	34.624	129.81	810.11	90.87	585.74	133.09	1365.4	92.55
13	36.908	124.85	830.09	90.42	635.04	128.01	1429.8	92.81
14	38.924	121.14	842.67	90.45	664.56	124.20	1431.5	92.68
15	40.127	117.33	849.72	90.25	690.43	120.80	1468.7	92.43
16	42.007	112.20	858.34	89.89	722.77	115.04	1479.4	91.54
17	43.420	107.69	860.88	88.52	747.26	110.41	1482.9	90.05
18	44.637	102.95	864.41	87.44	767.85	106.54	1483.9	89.55
19	46.283	97.33	868.28	84.96	793.48	99.84	1486.9	87.09
20	47.835	90.18	859.16	80.73	814.45	92.46	1479.9	82.78
21	46.610	81.83	850.70	75.59	881.22	83.93	1465.3	77.41
22	49.075	66.22	832.03	68.43	844.88	67.91	1435.0	64.99
23	49.150	51.26	807.14	50.75	845.67	52.53	1290.8	51.97
24	49.166	32.33	790.41	22.73	846.47	33.15	1261.6	33.57
25	49.217	7.035	783.10	—	846.86	7.036	135.25	—

Model test data of Nos. 1-19 were obtained at the speed of 2,980 rpm and test data of Nos. 20-25 at the speed of 1,700 rpm.

Example :

$$\eta_p = \frac{100}{1 + \left(\frac{100}{\eta_m} - 1 \right) \left(\frac{D_p}{D_m} \right)^{0.2}} = \frac{100}{1 + \left(\frac{100}{90.45} - 1 \right) \times \frac{1}{4.11^{0.2}}} = 92.08(\%)$$

$$\frac{\eta_p}{\eta_m} = \frac{92.08}{90.45} = 1.0241 \quad \left(\frac{\eta_p}{\eta_m} \right)^{\frac{1}{2}} = 1.0120$$

$$Q_p = Q_m \left(\frac{\eta_p}{\eta_m} \right)^{\frac{1}{2}} \left(\frac{D_p}{D_m} \right)^2 \left(\frac{N_p}{N_m} \right) = Q_m \times 1.0120 \times 4.11^2 \times \frac{720}{2940}$$

$$= 17.206 Q_m$$

$$H_p = H_m \left(\frac{\eta_p}{\eta_m} \right)^{\frac{1}{2}} \left(\frac{D_p}{D_m} \right)^2 \left(\frac{N_p}{N_m} \right)^3 = H_m \times 1.0120 \times 4.11^2 \times \left(\frac{720}{2940} \right)^3$$

$$= 1.0258 H_m$$

$$P_p = P_m \left(\frac{D_p}{D_m} \right)^5 \left(\frac{N_p}{N_m} \right)^2 = P_m \times 4.11^5 \times \left(\frac{720}{2940} \right)^2 = 17.225 P_m$$

PRESSURE DIFFERENTIAL BETWEEN SUCTION AND DISCHARGE PIPES OF MODEL

PRESSURE DIFFERENTIAL H_m (m)

200

180

160

140

120

100

80

60

40

20

0

0

10

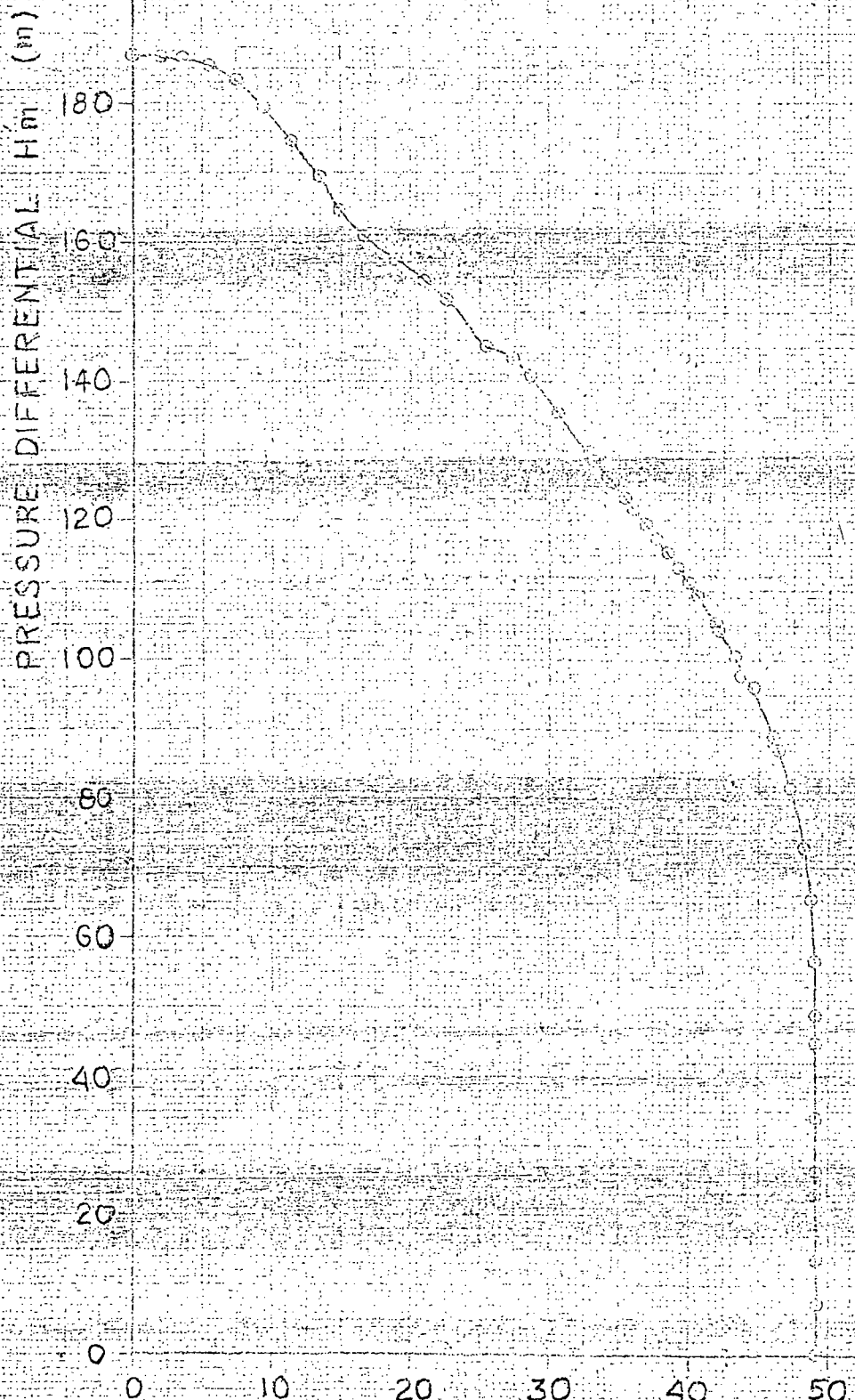
20

30

40

50

DISCHARGE Q m^3/min



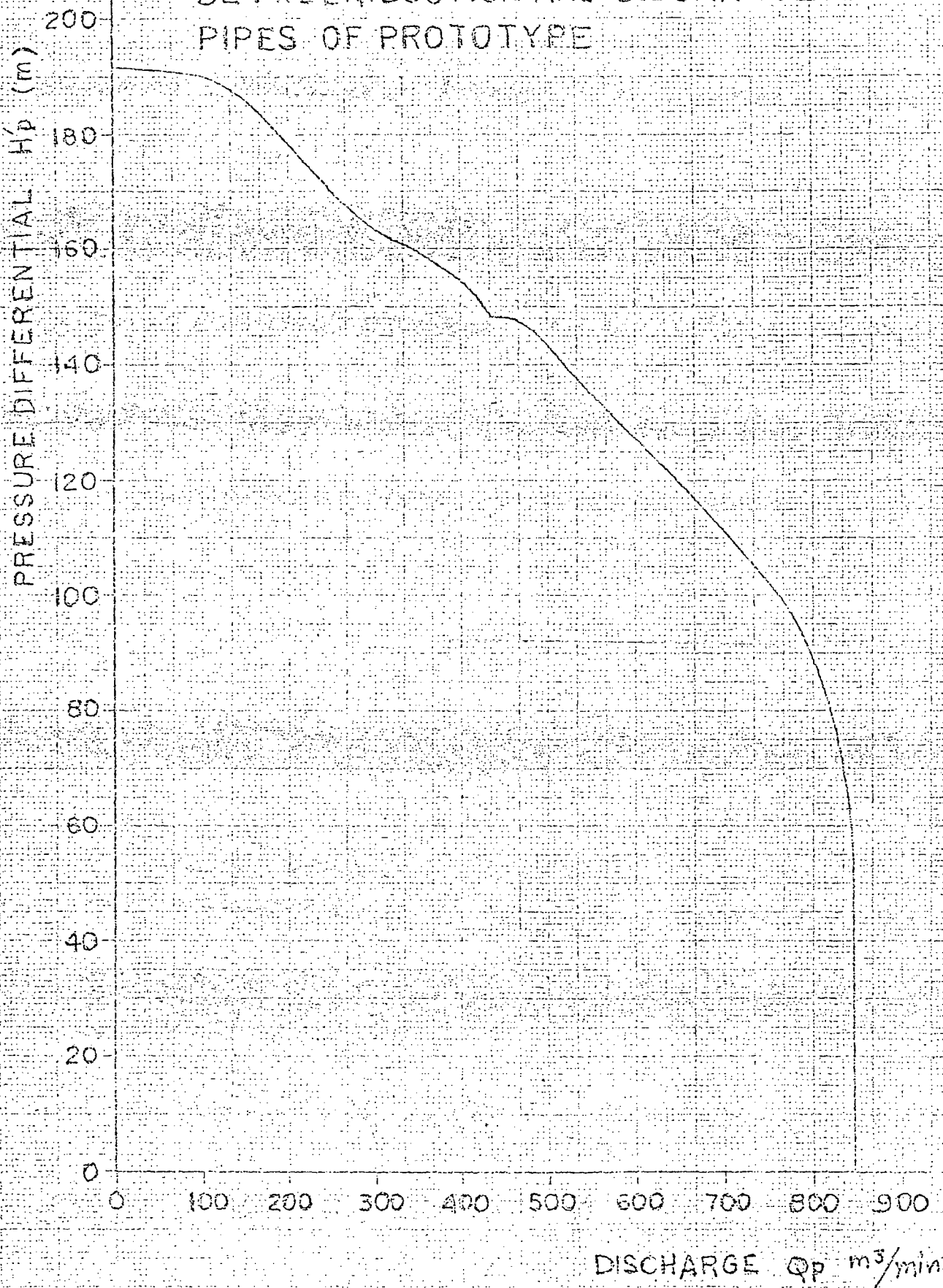
TAKADA ET AL. 74

DAIWA

Naohi. LAC.

S979765-1

ESTIMATED PRESSURE DIFFERENTIAL BETWEEN SUCTION AND DISCHARGE PIPES OF PROTOTYPE



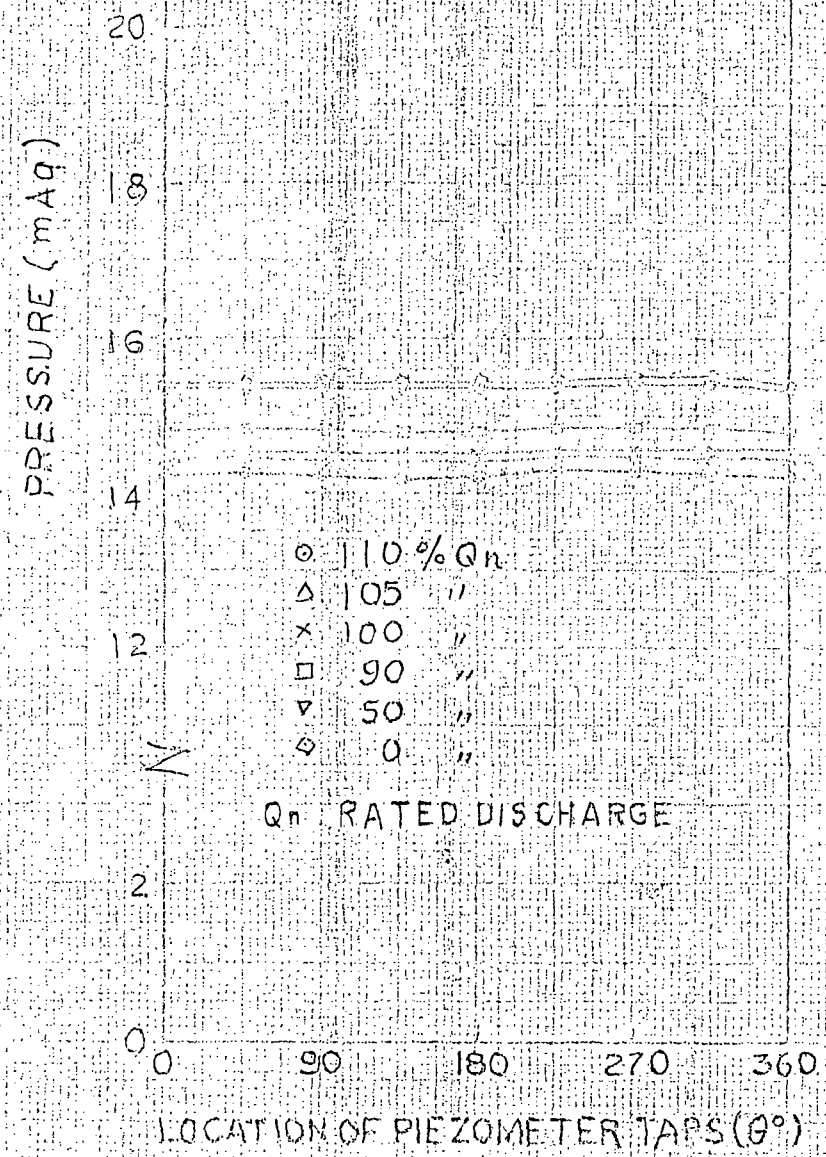
STANDARD 35 100.70

STANDARD 35 100.70

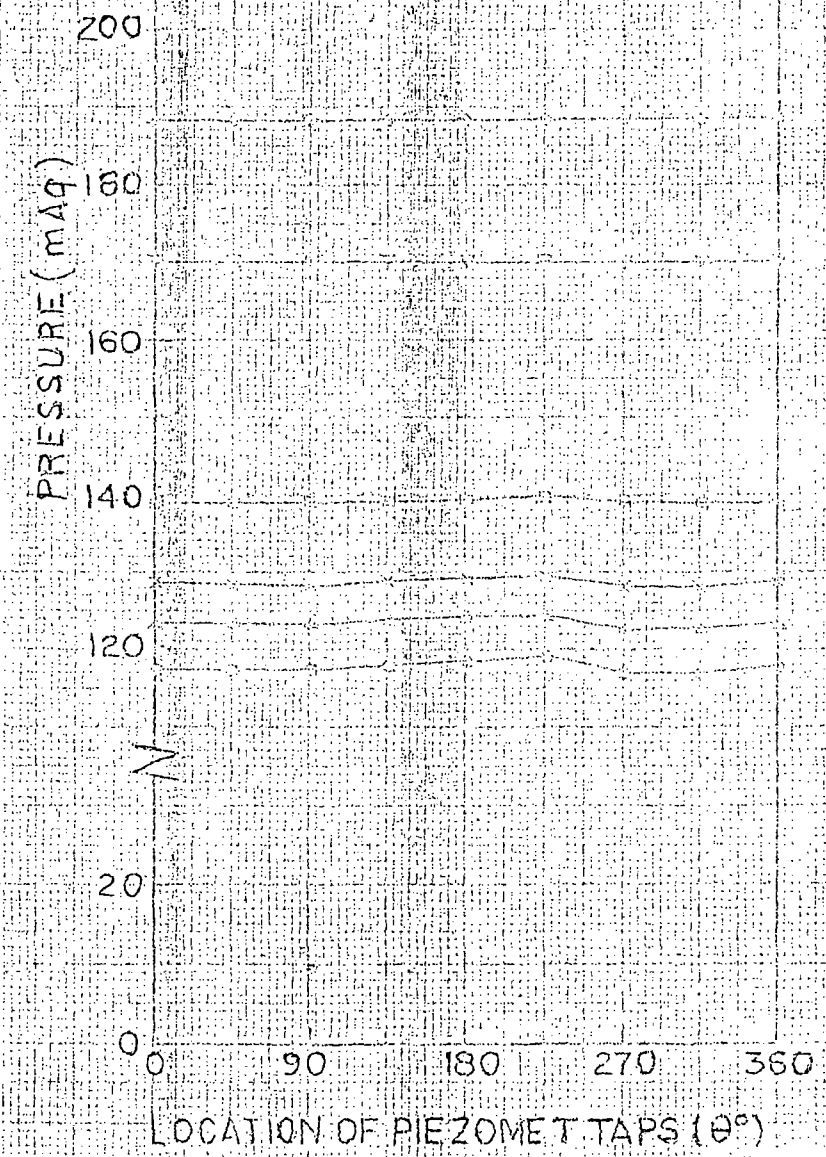
STANDARD 35 100.70

STANDARD 35 100.70

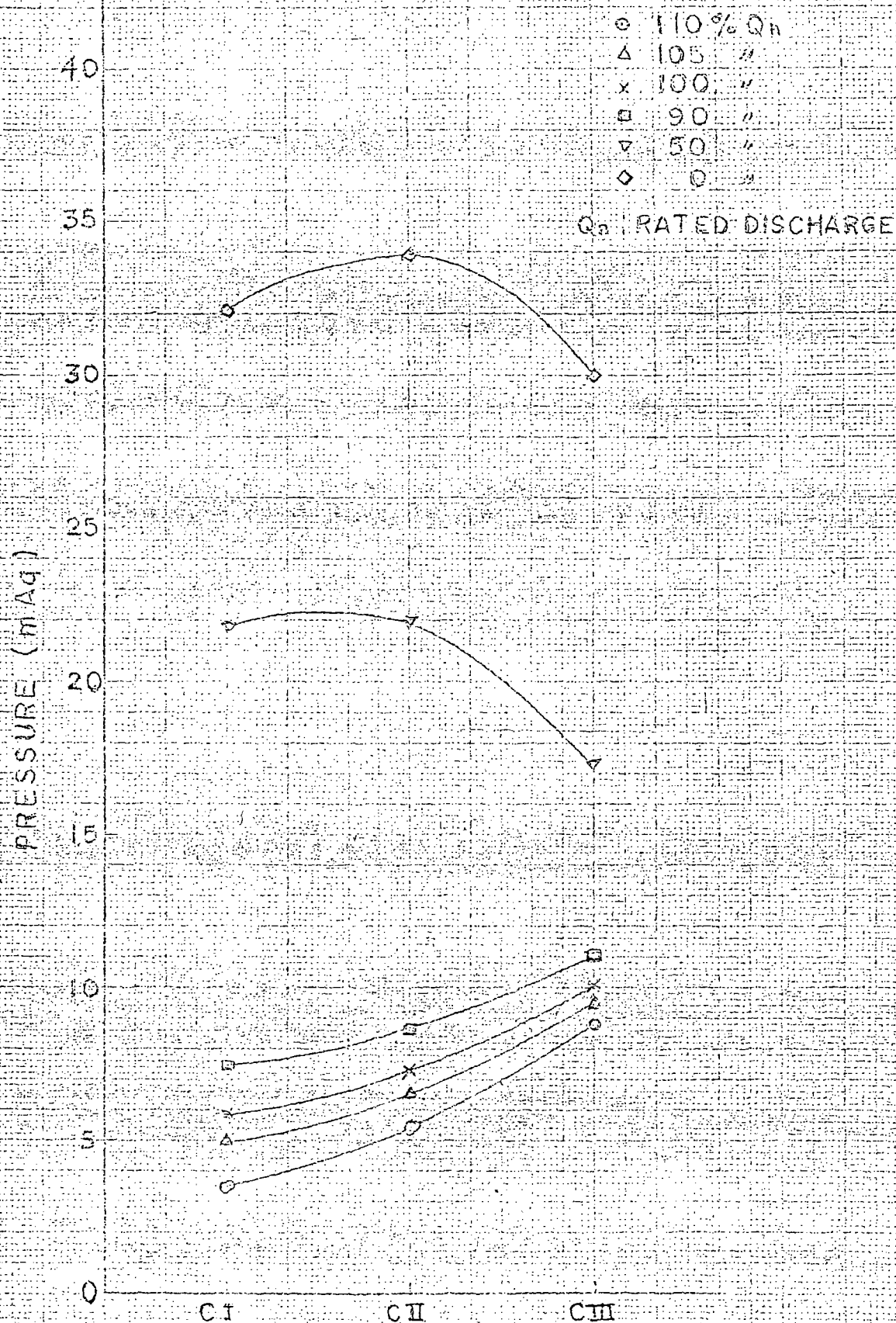
8979766-2



PRESSURE DISTRIBUTIONS IN SUCTION PIPE



PRESSURE DISTRIBUTIONS IN DISCHARGE PIPE



LOCATION OF PIEZOMETER TAPS

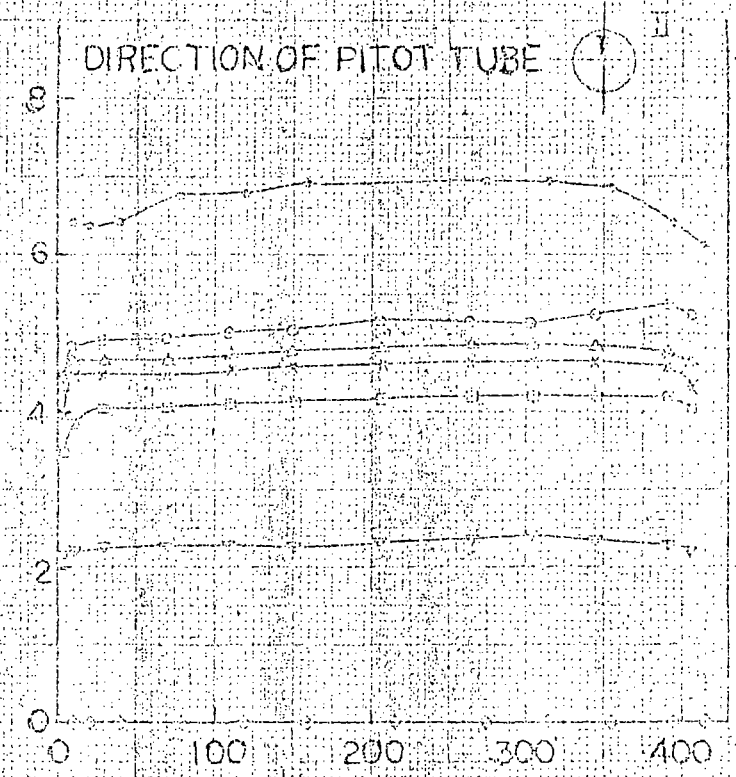
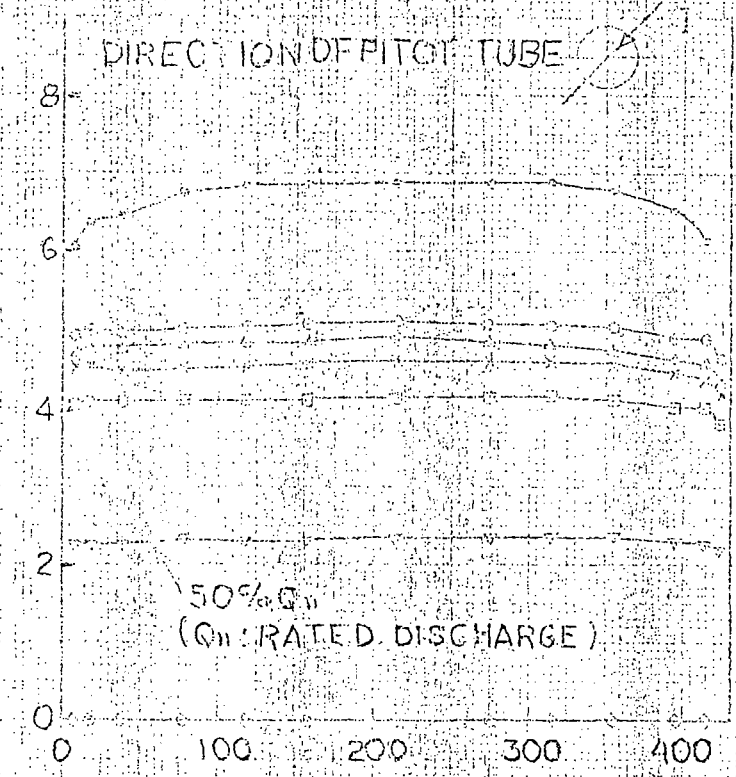
PRESSURE DISTRIBUTIONS AT IMPEELER INLET

100% RATED DISCHARGE, 26 JUL 70

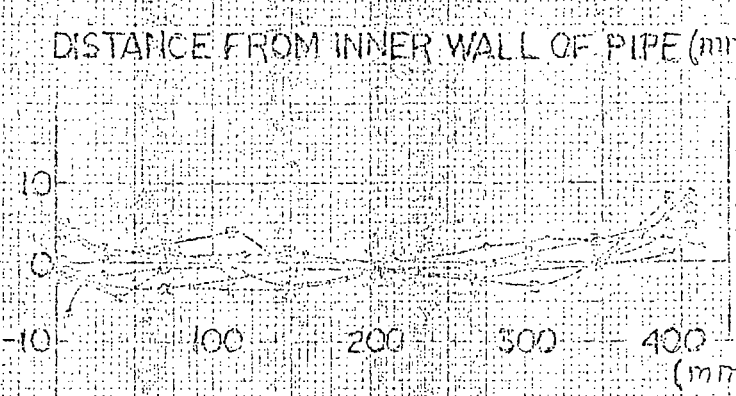
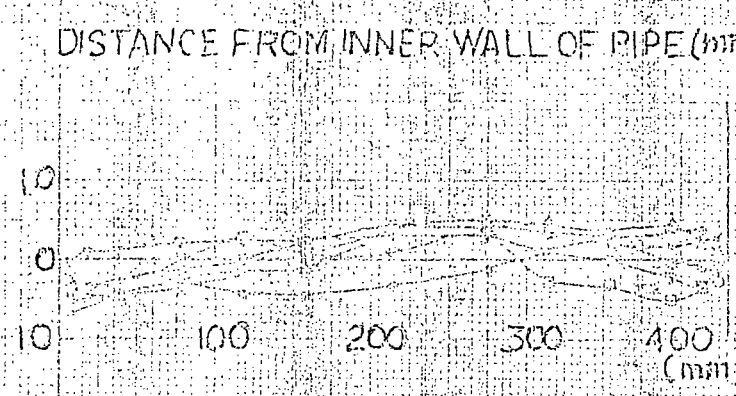
Mitsubishi Ltd.

S979768-2

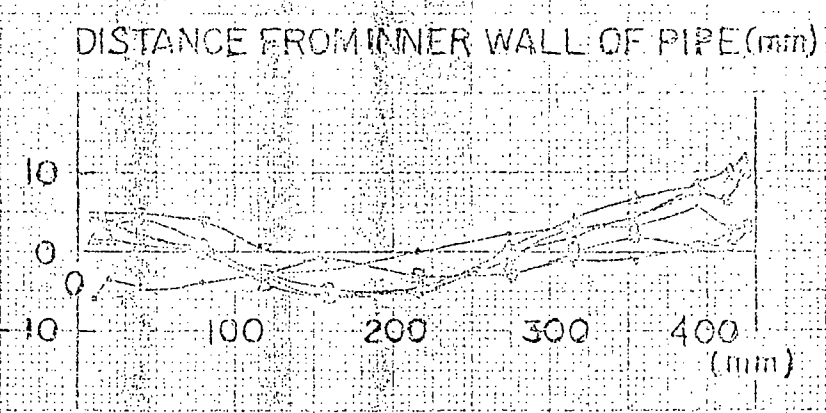
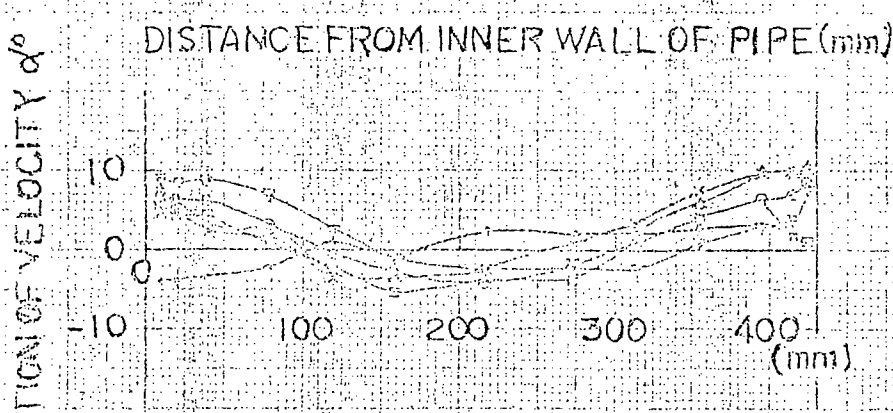
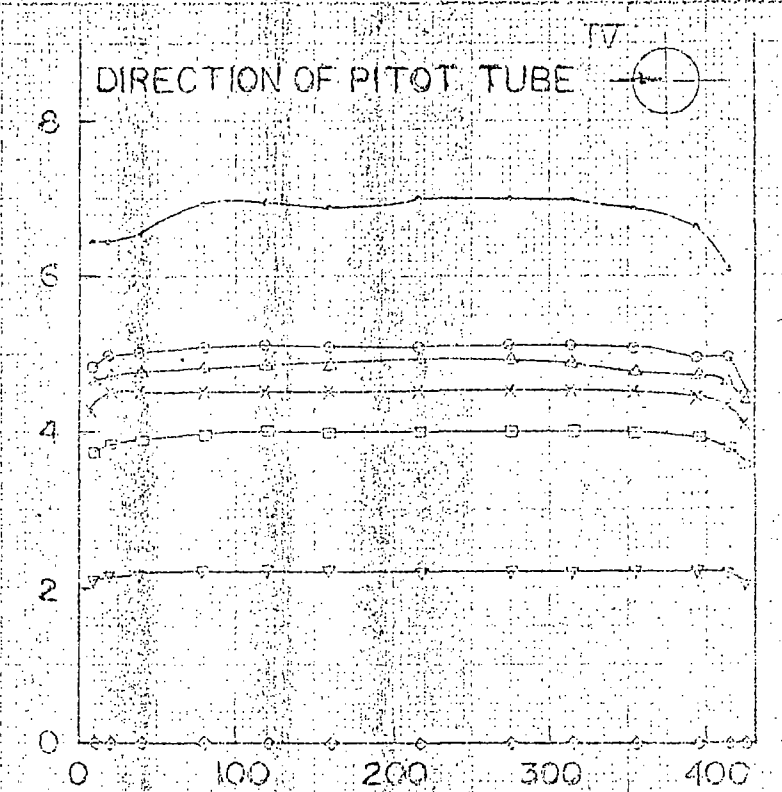
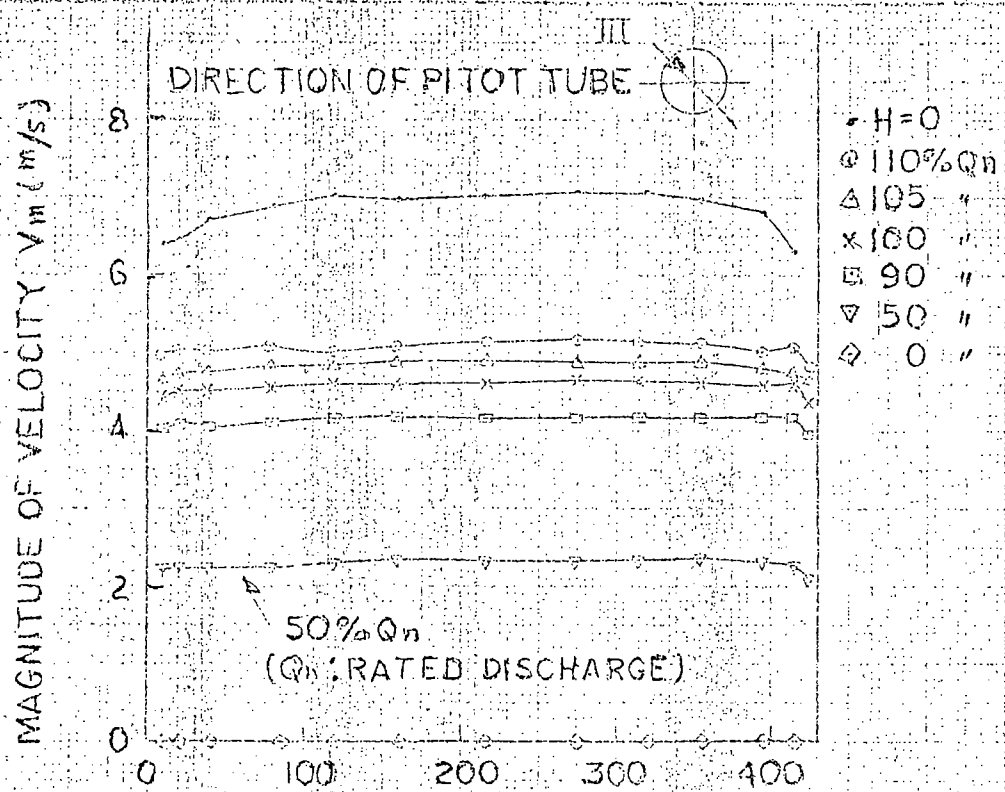
MAGNITUDE OF VELOCITY V_m (m/s)



DIRECTION OF VELOCITY α°



VELOCITY DISTRIBUTIONS IN SUCTION PIPE



VELOCITY DISTRIBUTIONS IN SUCTION PIPE

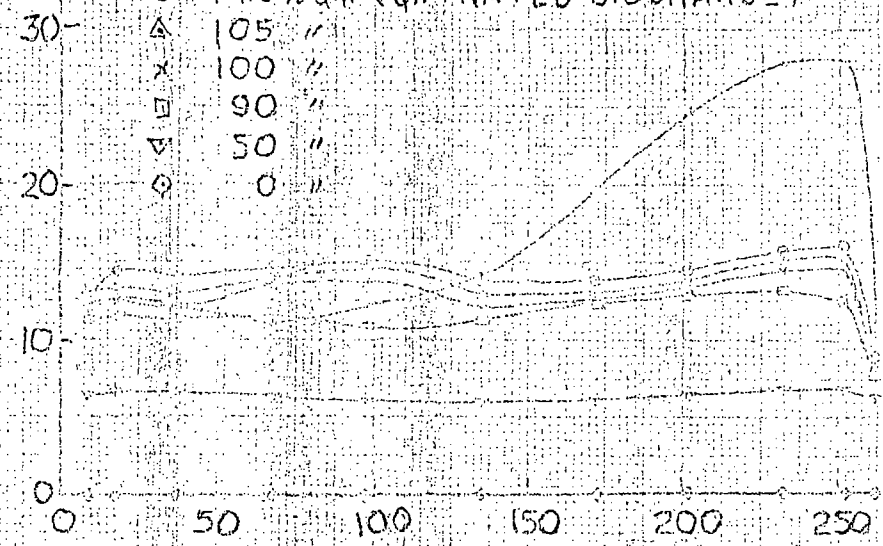
Handwritten notes on the left margin.

S979768-4

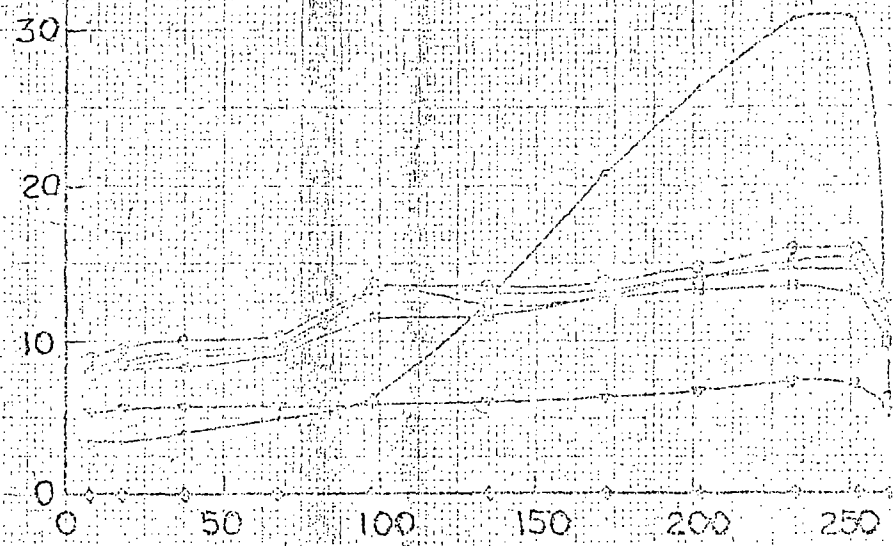
MAGNITUDE OF VELOCITY V_m (m/s)

DIRECTION OF PITOT TUBE I

- $H = 0$
- 110% Q_n (Q_n RATED DISCHARGE)
- △ 105 "
- × 100 "
- 90 "
- ◇ 50 "
- ◇ 0 "

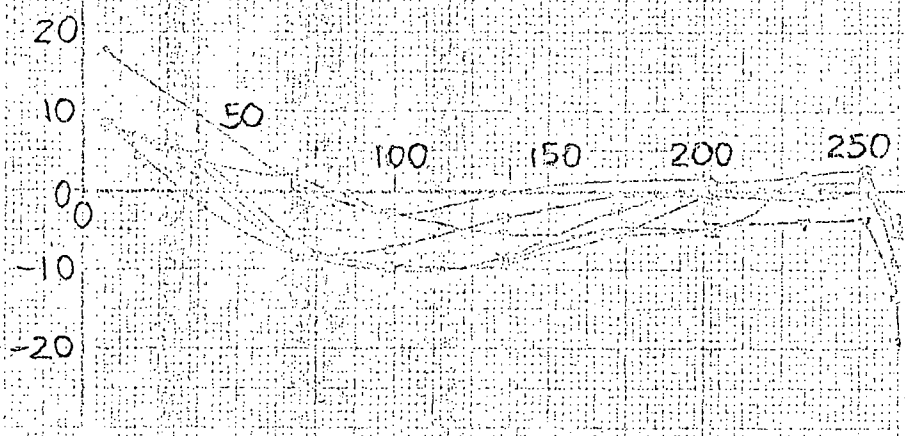


DIRECTION OF PITOT TUBE II

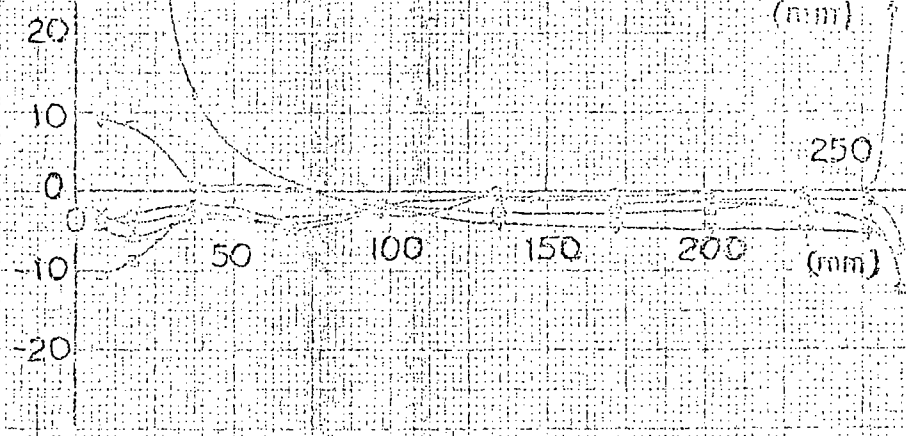


DIRECTION OF VELOCITY α°

DISTANCE FROM INNER WALL OF PIPE (mm)



DISTANCE FROM INNER WALL OF PIPE (mm)



VELOCITY DISTRIBUTIONS IN DISCHARGE PIPE

S979768-5

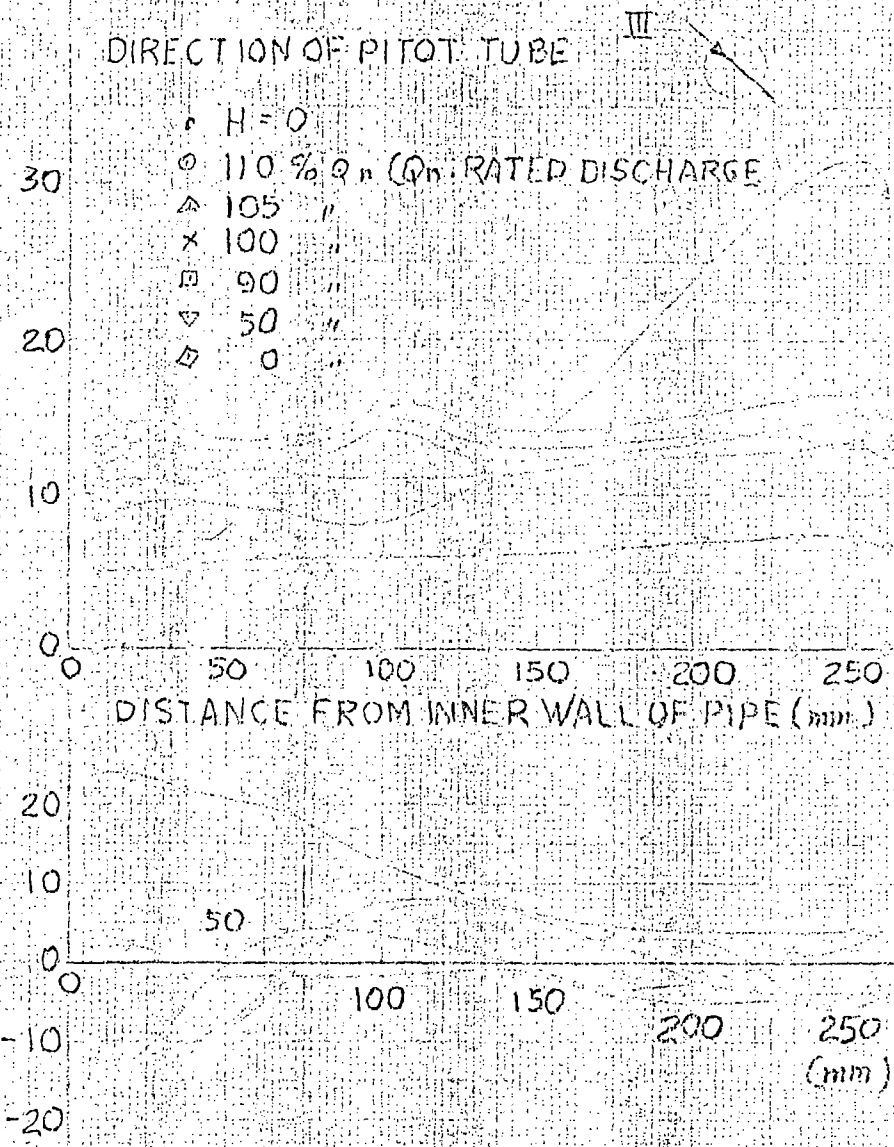
S979768-6

HYDRO-METAL

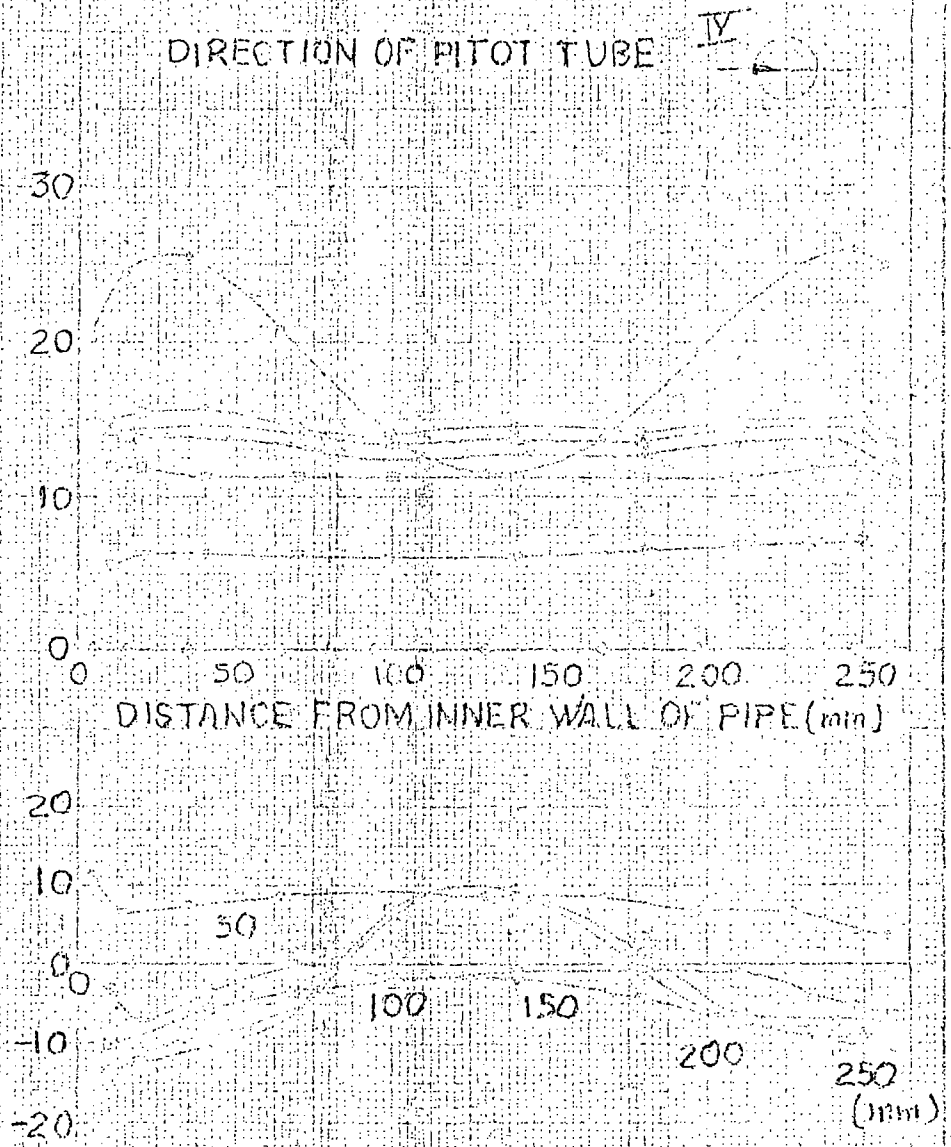
WATER

DIRECTION OF VELOCITY α°

MAGNITUDE OF VELOCITY $V_m (m/s)$



NO.	REV.	UNS.	DATE	REVISED	CHECKED
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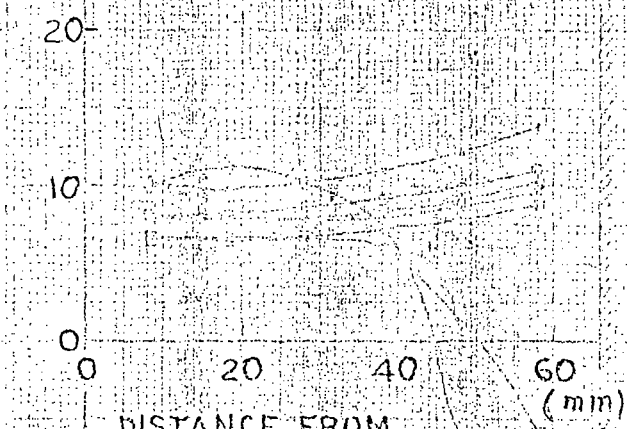
VELOCITY DISTRIBUTIONS IN DISCHARGE PIPE

DIRECTION OF PITOT TUBE : CI

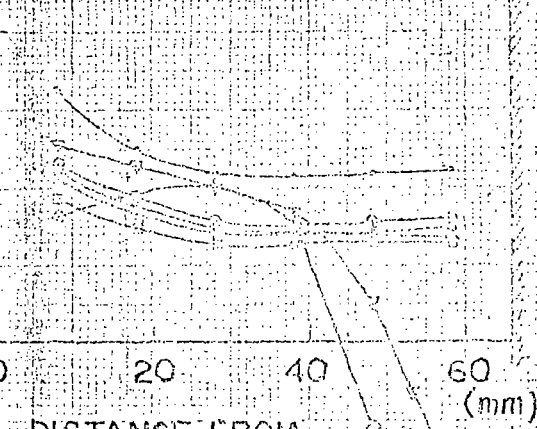
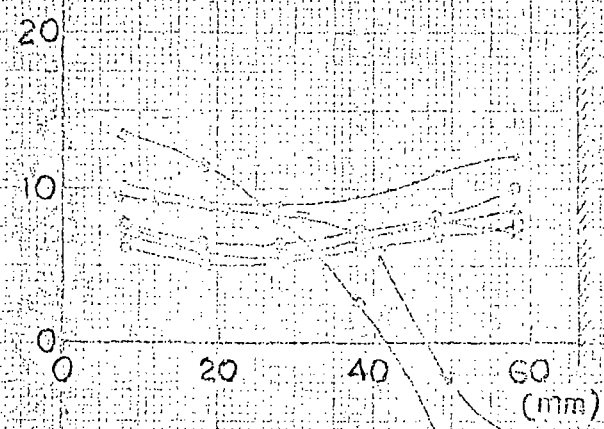
DIRECTION OF PITOT TUBE : CII

DIRECTION OF PITOT TUBE : CIII

MAGNITUDE OF VELOCITY V_m (m/s)



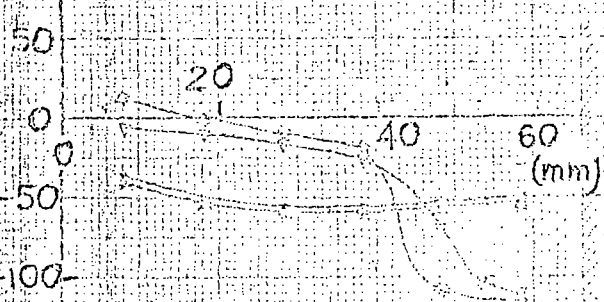
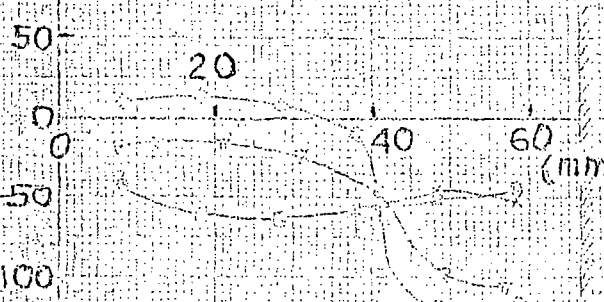
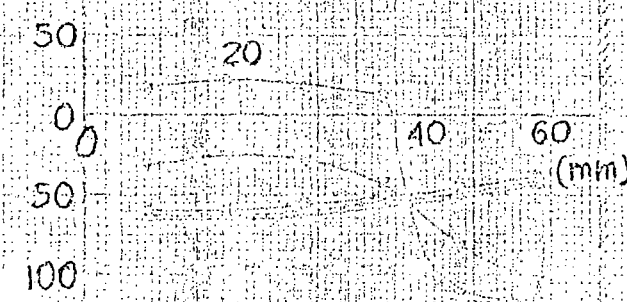
DISTANCE FROM INNER WALL OF PIPE



DISTANCE FROM INNER WALL OF PIPE

- $H = 0$
 - 110% Q_n
 - △ 105
 - × 100
 - 90
 - ▽ 50
 - ◇ 0
- (Q_n : RATED DISCHARGE)

DIRECTION OF VELOCITY α°



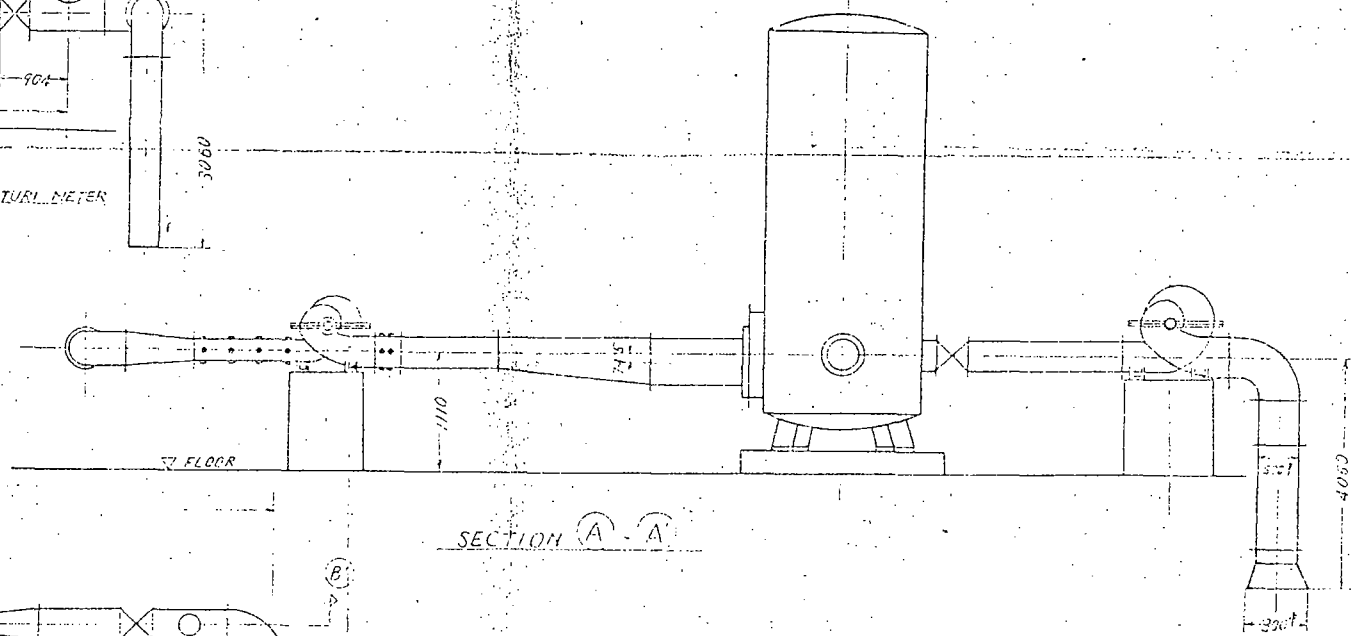
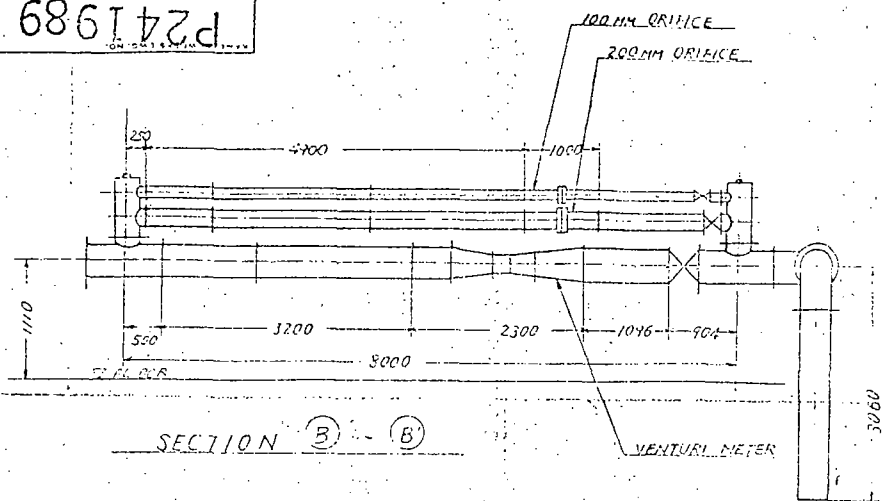
PUMP SHAFT

VELOCITY DISTRIBUTIONS AT IMPELLER INLET

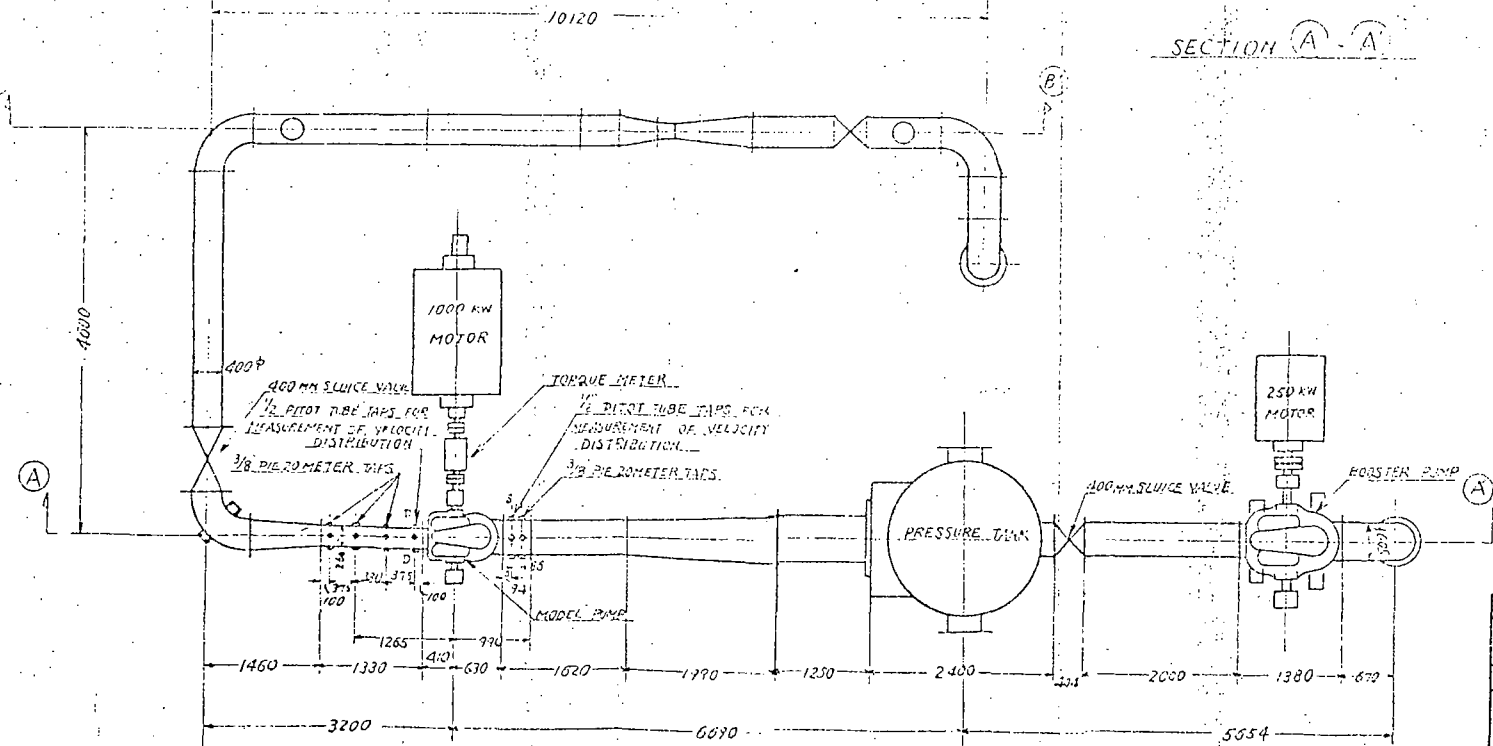
SS79768-7

P241989

NO.	REVISIONS	DATE	REVISED	CHECKED



-57-



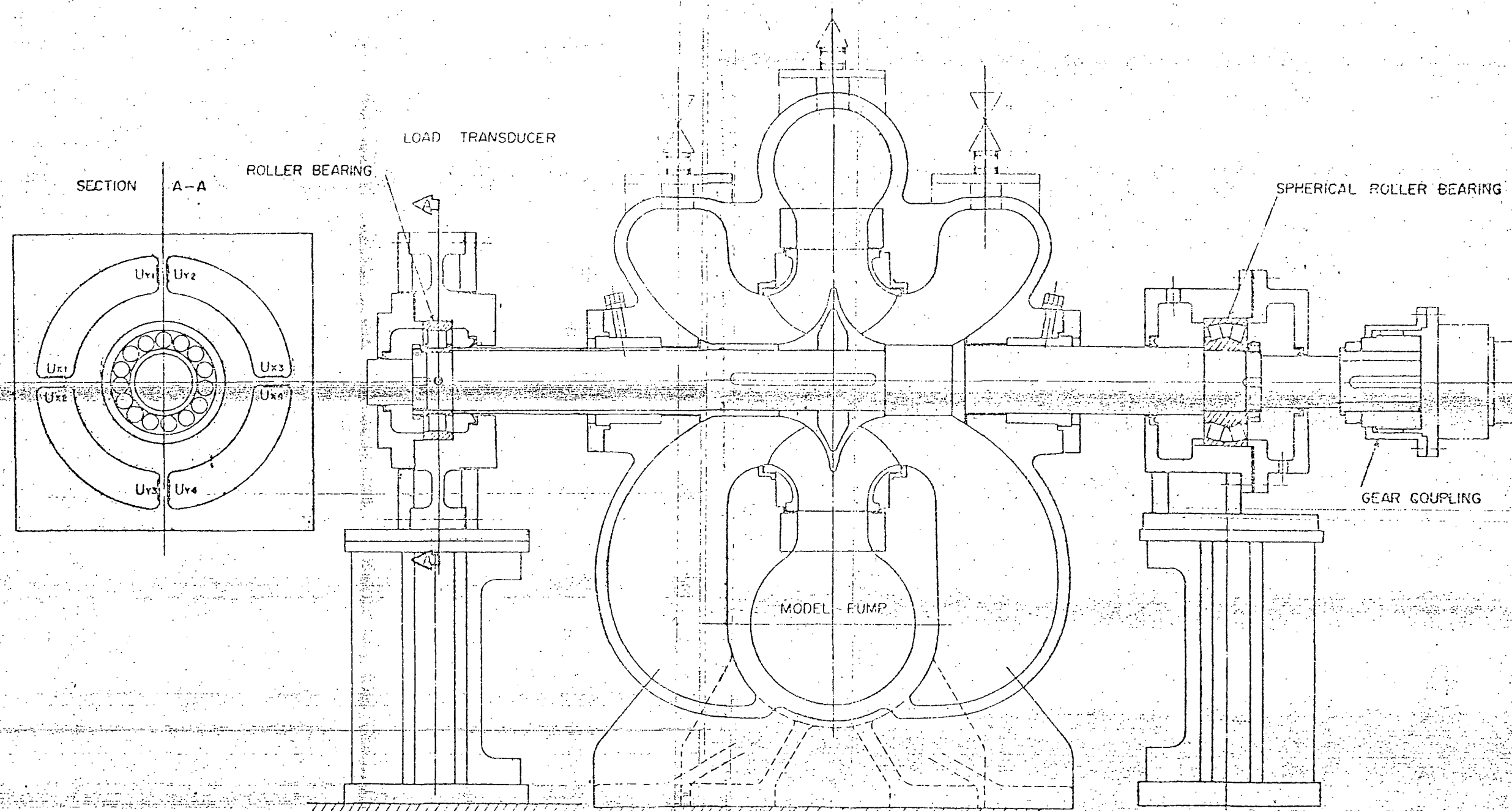
OWN	M. CHINO	20-MAR-70	THIRD	ARRANGEMENT OF MODEL TEST (USING NEW SUCTION PIPE)
CHKD			ANG. PROJ.	
APPD	M. KAWA		SCALE 1/80	

Hitachi, Ltd.
Tokyo Japan

P241989 -57-

P350079

NO.	REVISIONS	DATE	REVIEWED	CHECKED

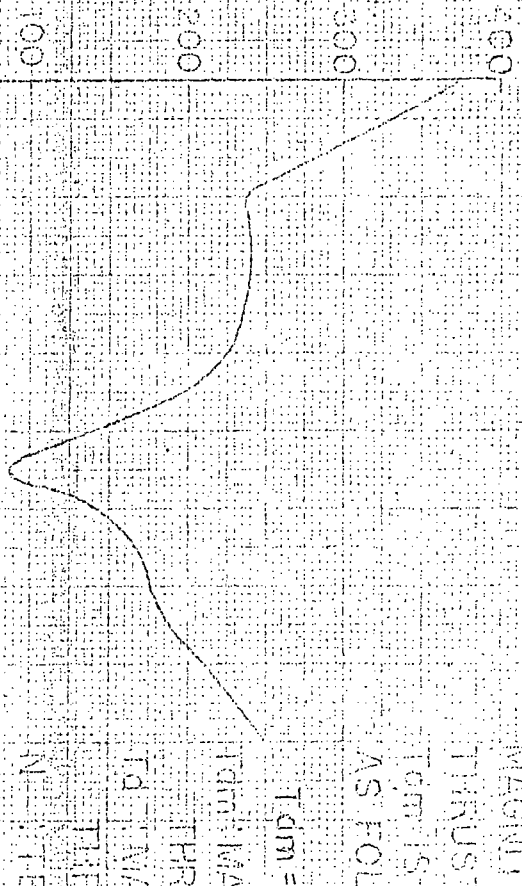


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APPROVED	THIRD	APPARATUS FOR MEASURING RADIAL THRUST
DATE	NO.	
HITACHI LTD.		P350079

NO.	REV.	DATE	REVISED	CHECKED

MAGNITUDE OF RADIAL THRUST T_{dm} , kg



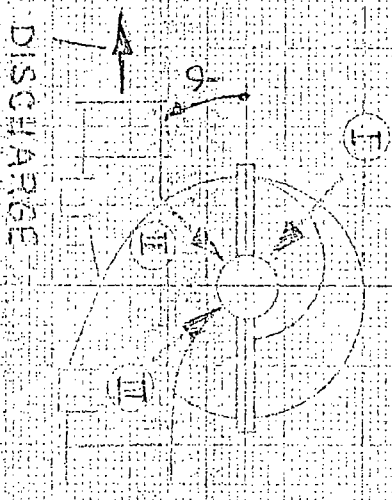
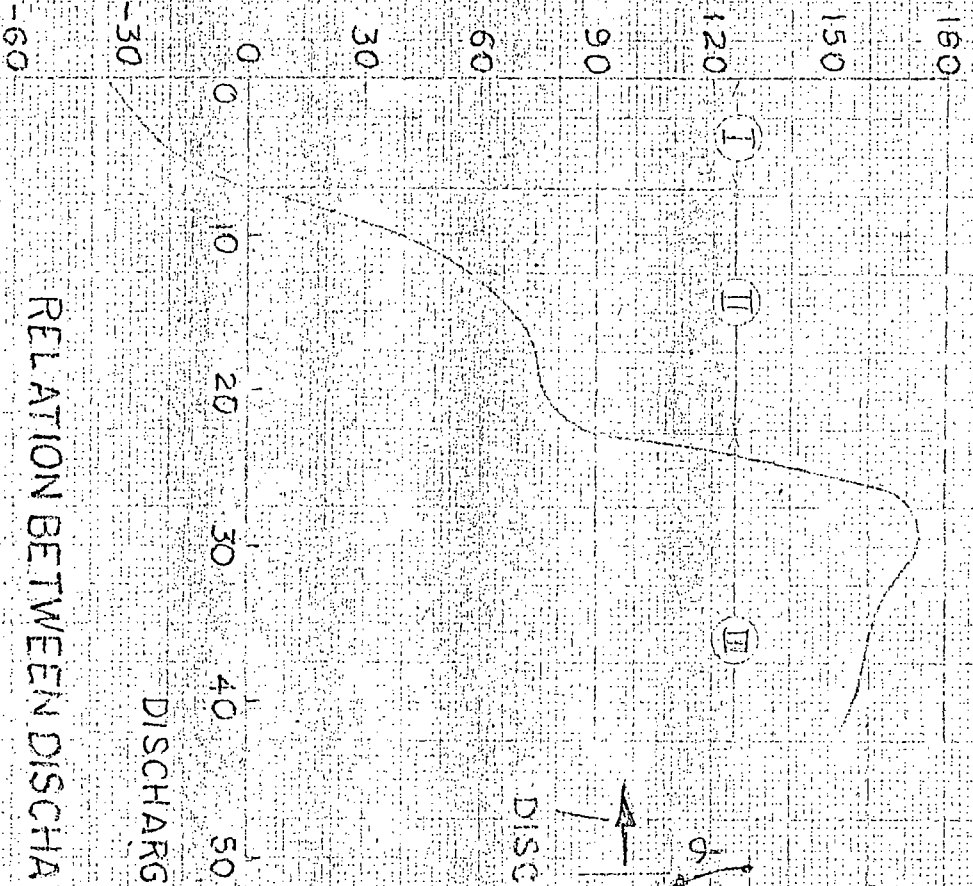
MAGNITUDE OF RADIAL THRUST AT 2940 rpm T_{dm} IS COMPUTED AS FOLLOWS

$$T_{dm} = T_d \times \left(\frac{2940}{N} \right)^2$$

T_{dm} MAGNITUDE OF RADIAL THRUST AT 2940 rpm, kg
 T_d MAGNITUDE OF RADIAL THRUST AT TEST SPEED, kg
 N TEST SPEED, rpm

DISCHARGE Q_m m³/min

DIRECTION OF RADIAL THRUST α , deg



DISCHARGE Q_m m³/min

RELATION BETWEEN DISCHARGE AND RADIAL THRUST IN MODEL PUMP OPERATED IN THE PUMP RANGE

Rev. 1/1/11 5:00 PM

1/1/11 11:11 AM

S 979770-1

NO. REVISING DATE REVISED CHECKED

MAGNITUDE OF RADIAL THRUST Y_{dm} , kg

200
150
100
50
0

-200 -400 -600 -800 -1000 -1200 -1400

DISCHARGE $Q = -1.721 \text{ m}^3/\text{min}$

SPEED N , rpm

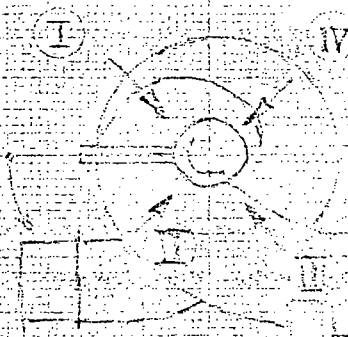
DIRECTION OF RADIAL THRUST α , deg

240
210
180
150

200 400 600 800 1000 1200 1400

SPEED N , rpm

DIRECTION OF FLOW

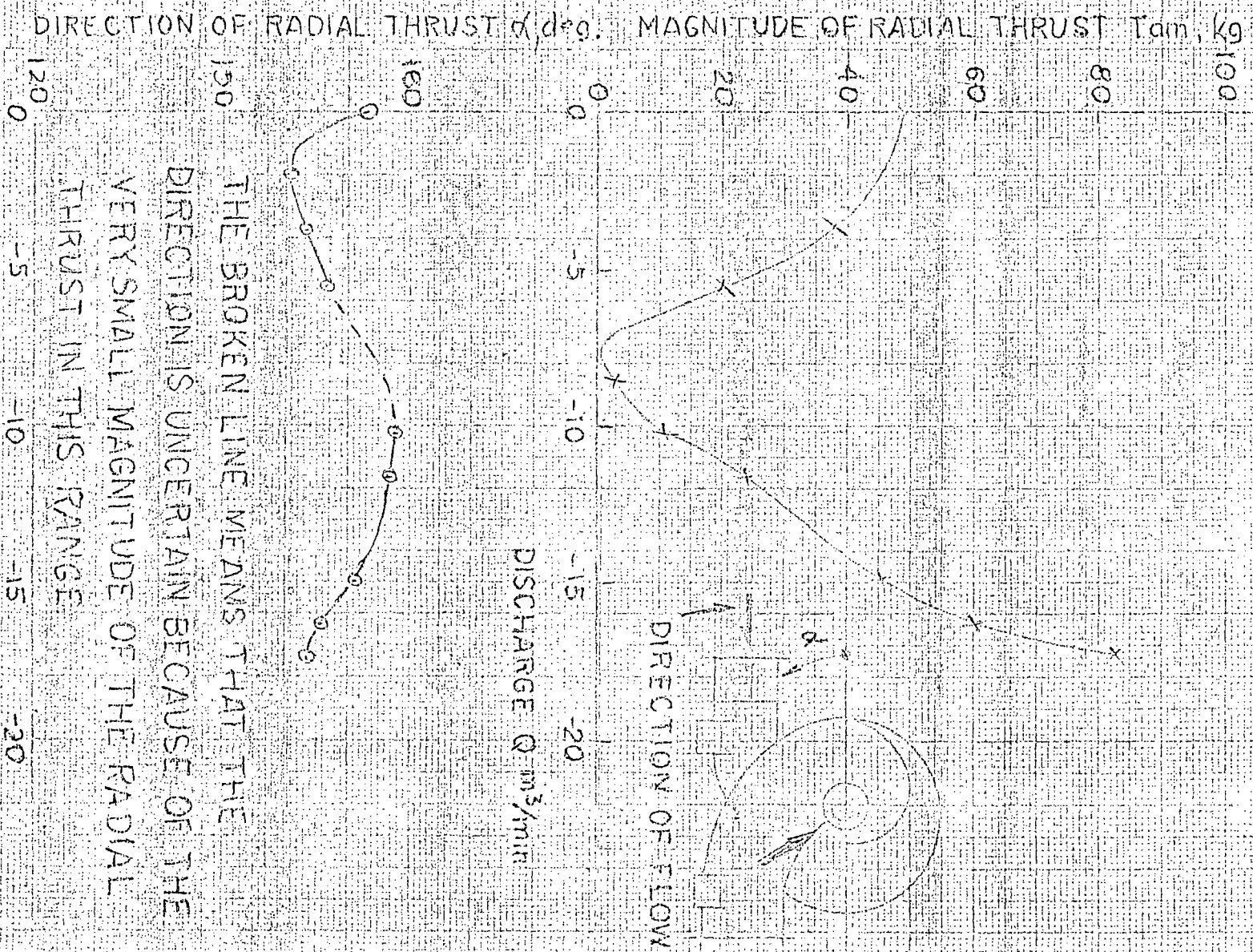


TEST RESULTS OF RADIAL THRUST
IN MODEL OPERATED IN TURBINE RANGE

Hitachi Ltd. 5979770-2

NO.	REV.	NS	DATE	REVISED	CHECKED

SPEED $N = -1250 \text{ rpm}$



THE BROKEN LINE MEANS THAT THE DIRECTION IS UNCERTAIN BECAUSE OF THE VERY SMALL MAGNITUDE OF THE RADIAL THRUST IN THIS RANGE

TEST RESULTS OF RADIAL THRUST
IN MODEL OPERATED IN TURBINE RANGE (2)

DISCHARGE $Q, \text{m}^3/\text{min}$

DATE REVISION CHECKED

NO. OF SIGNS

DIRECTION OF RADIAL THRUST α , deg

240
210
180
150
120

0.2 0.4 0.6 0.8 1.0

n : DIMENSIONLESS SPEED
 q : DIMENSIONLESS DISCHARGE

IV

III

DIRECTION OF FLOW

180

150

120

0.2 0.4 0.6 0.8 1.0

$\frac{q}{n}$

DIRECTION OF RADIAL THRUST IN MODEL
OPERATED IN TURBINE RANGE

KITAKAWA PLANT, JR.
TOKYO, JAPAN

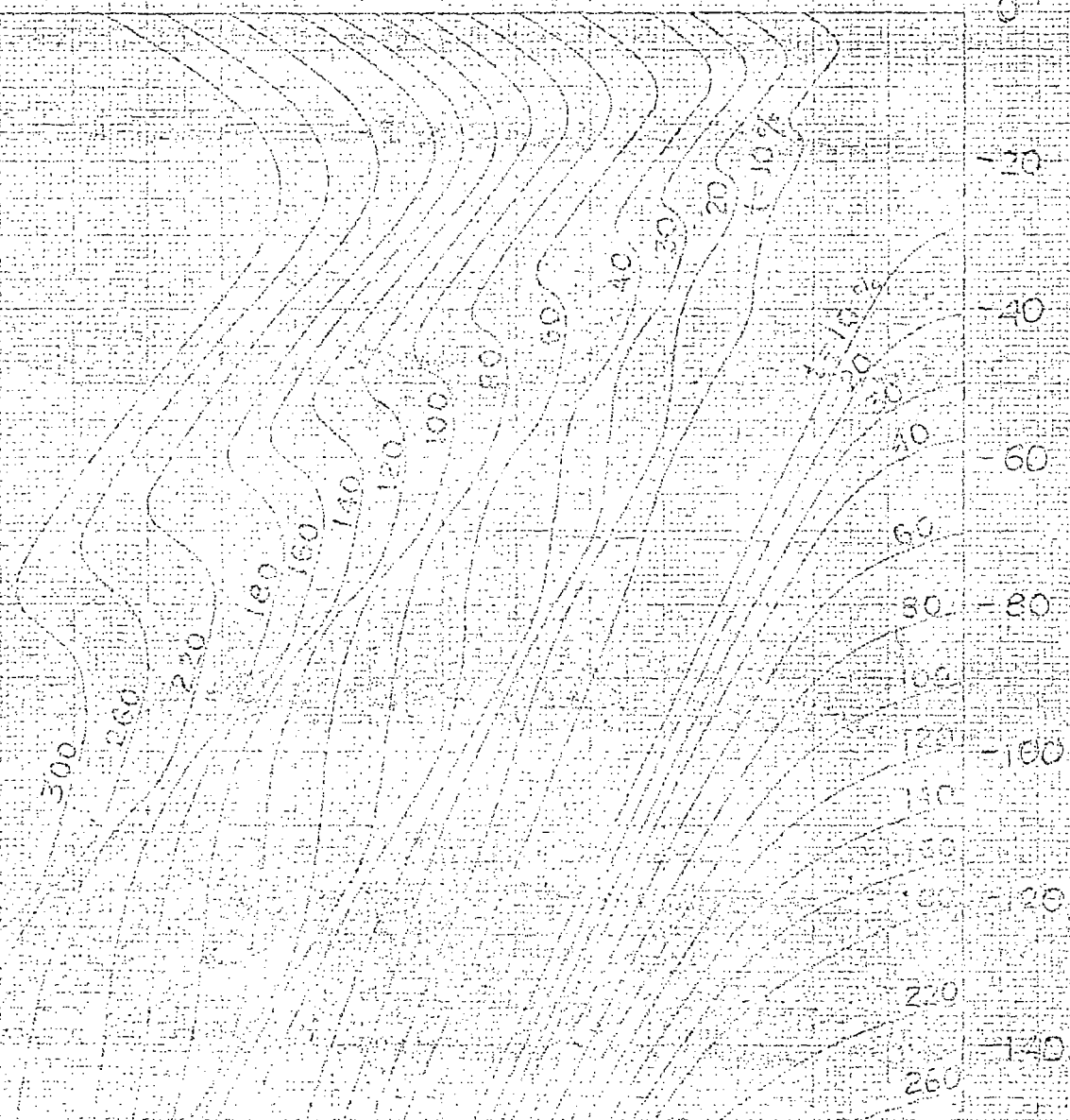
MODEL NO. 100

3970770-4

DIMENSIONLESS MAGNITUDE OF RADIAL THRUST

DIMENSIONLESS DISCHARGE q (%)

-120 -100 -80 -60 -40 -20 0



DIMENSIONLESS SPEED n (%)

DIMENSIONLESS MAGNITUDE OF RADIAL THRUST

IN MODEL OPERATED IN TURBINE RANGE

DATE 11/12/70 BY J. P. W. 1000
 INFORMATION

RECEIVED 11/12/70
 1000

S979770-5

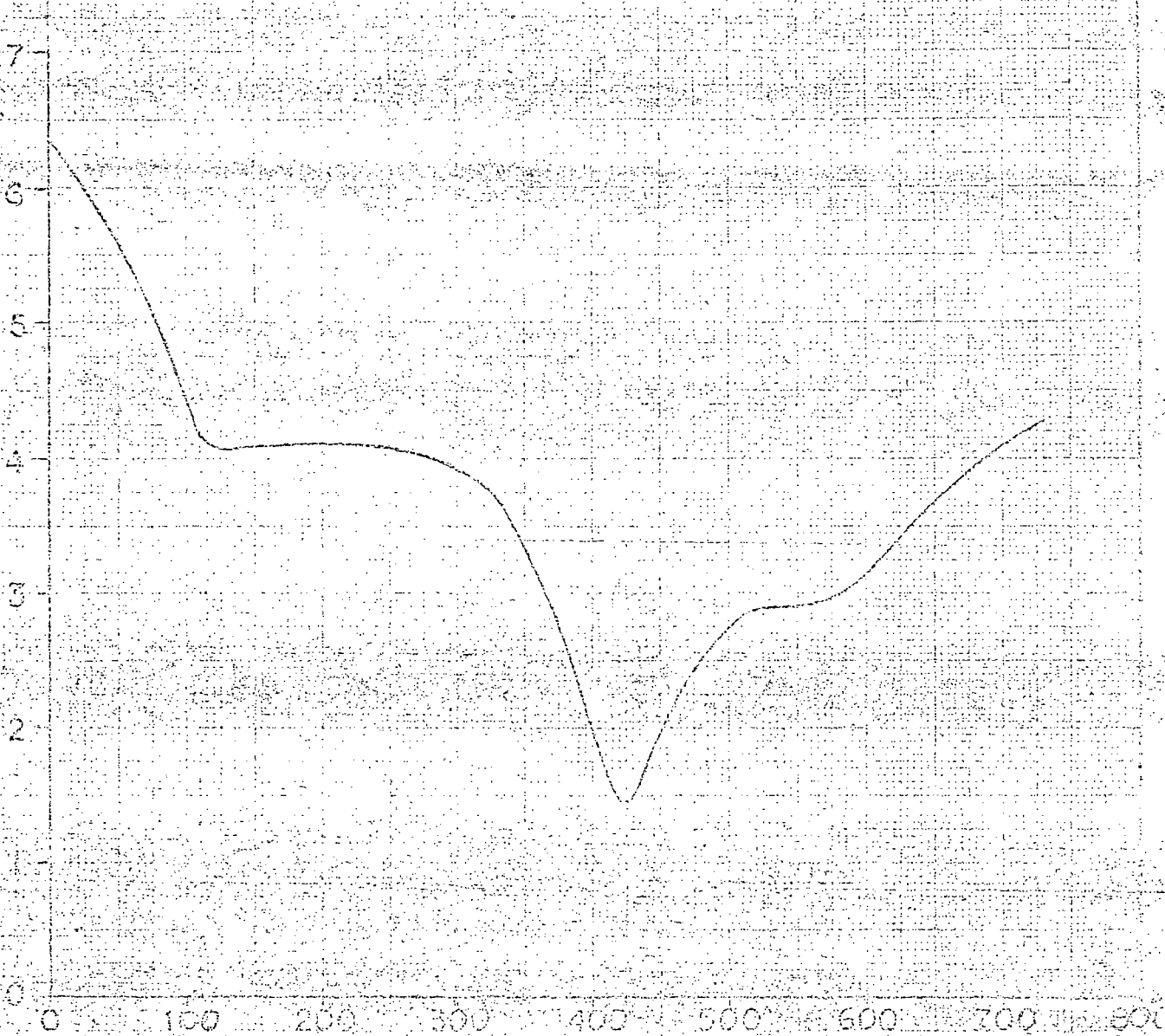
DATE _____ REVISED _____ CHECKED _____

REV. NO. _____

NO. _____

SPEED 720 rpm

RADIAL THRUST T_{dp} , ton



DISCHARGE Q_p , m³/min

ESTIMATED MAGNITUDE OF RADIAL THRUST IN PROTOTYPE
OPERATED IN PUMP RANGE

DR. K. TAKADA 10 DEC. 67

DR. H. KAWABE

DR. T. KAWABE

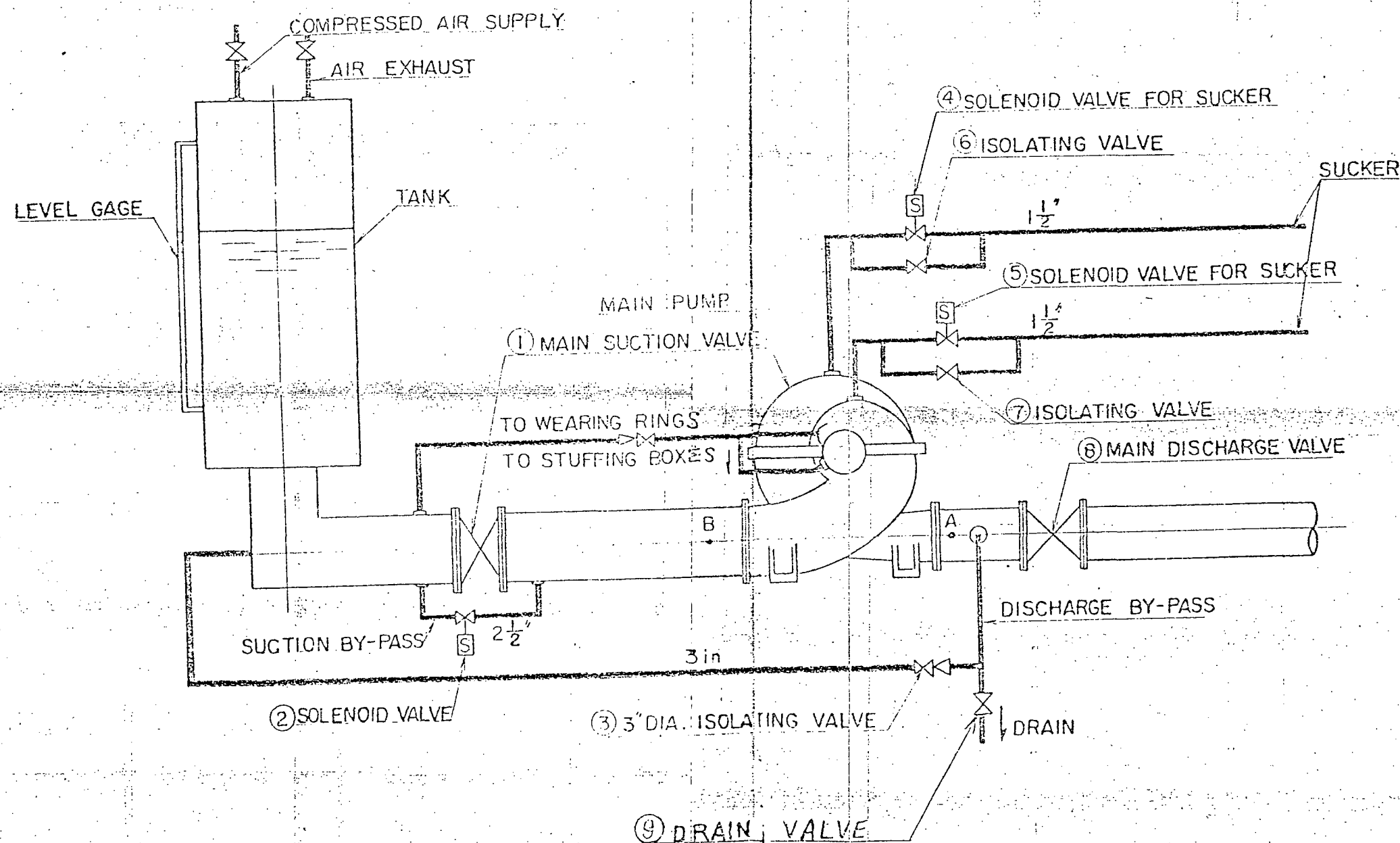
DR. T. KAWABE

S979770-6

P350076

KAMEARI WORKS DWG. NO.

NO.	REVISIONS	DATE	REVISED	CHECKED



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DWN.	H. Takata	10. FEB. '70	THIRD	TITLE
CHKD.			ANG. PROJ.	
APPD.	K. Miyashiro		SCALE	

Hitachi, Ltd.
Tokyo Japan

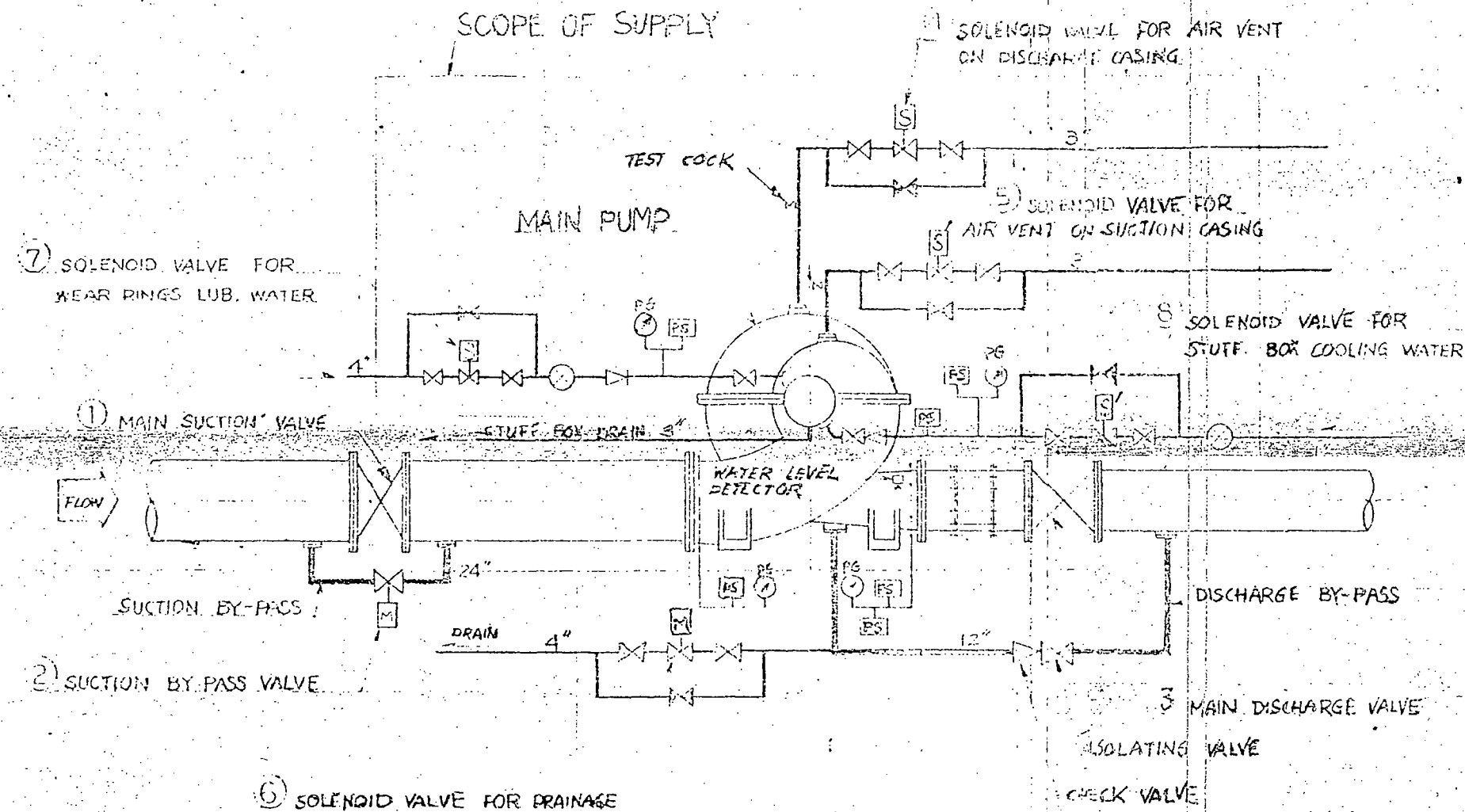
KAMEARI WORKS DWG. NO.

P350076

P351149

KAMEARI WORKS DWG. NO.

NO.	REVISIONS	DATE	REVISED	CHECKED
Δ	THIS DWG. IS PARTLY REVISED FROM HITACHI DWG. NO. P3500377.			
	ACCORDING TO SEBEITE DWG. NO. 156-26-05A.	APR. 17 '90	N. Kawabara	K



EXPLANATIONS

- RATOLARM TYPE FLOW SWITCH
- PRESSURE SWITCH
- STRAINER
- MOTOR OPERATED SLUICE VALVE
- SOLENOID VALVE
- ISOLATING VALVE (normally open)
- ISOLATING VALVE (normally close)
- CHECK VALVE
- PRESSURE GAUGE

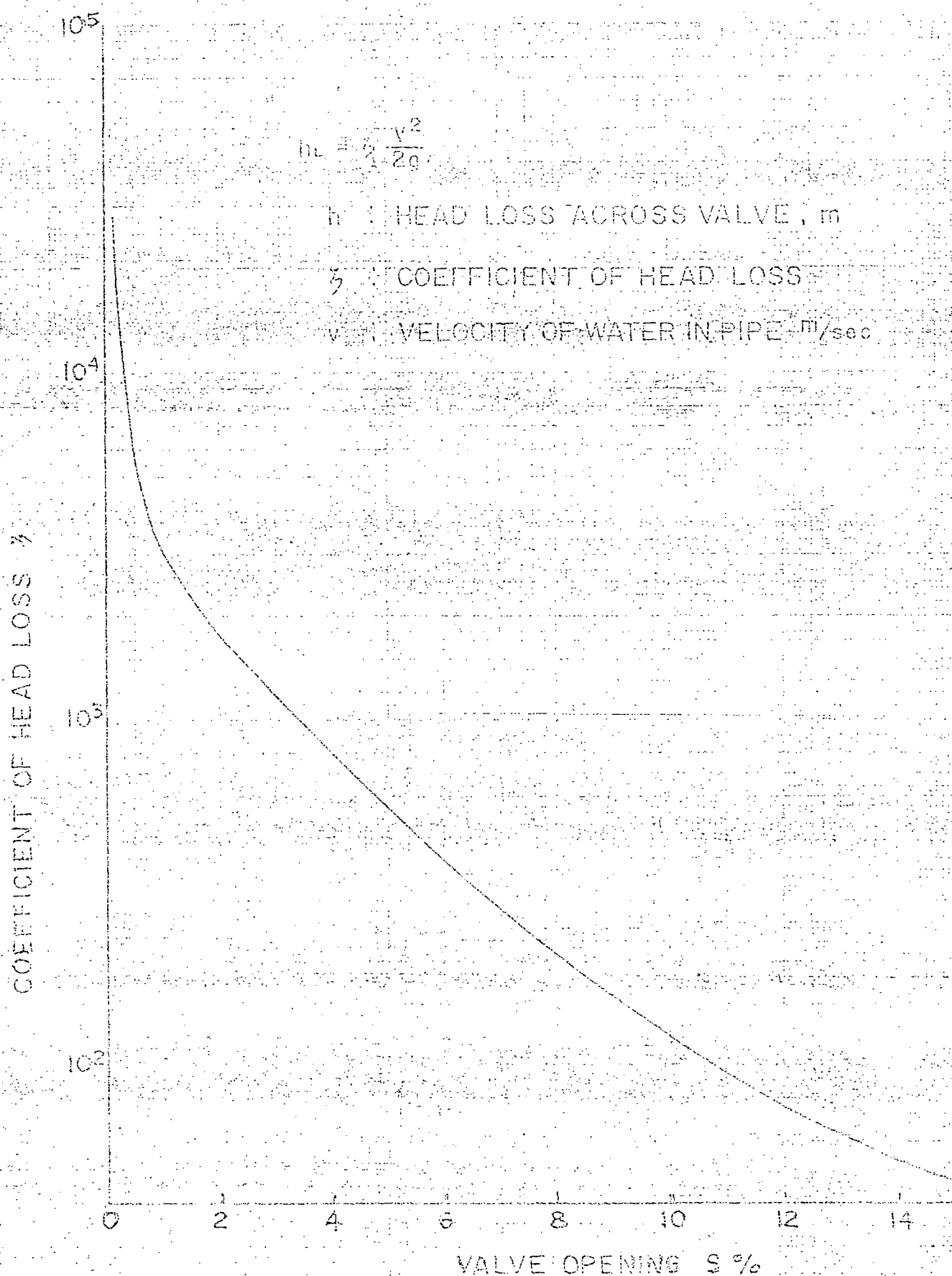
	Consumption (m ³ /hr)			Press. at pump inlet (kg/cm ²)		
	min.	nor.	max.	min.	nor.	max.
FOR COOLING WATER OF STUFF BOX	2.5	3.5	5.5	2.0	4.0	5.0
FOR COOLING WATER OF OIL COOLER	8.0	17.0	20.0	1.0	4.0	5.0
FOR LUB. WATER OF WEAR RING	72.0	220.0	295.0	1.0	4.0	5.0

REQUIREMENTS OF CLEAN WATER FOR EACH PUMP SET

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OWN	N. Kawabara	APR. 16 '90	THIRD	TITLE
CHKD	I. Kawabara		ANG. PROJ.	PIPING SYSTEM DIAGRAM
APPD			SCALE	FOR
			N.T.S.	MAIN PUMP
				(PROTOTYPE)
				KAMEARI WORKS DWG. NO.
				P351149





COEFFICIENT OF HEAD LOSS
ACROSS SLUICE VALVE

NO. DATE REVISED CHECKED

NO. DATE REVISED



RELATION BETWEEN PUMP SPEED
AND TORQUE WITH PUMP CASING FILLED OF AIR

TESTED BY K. TAKADA 30 MAR 70
CHECKED BY K. KAWAMOTO

9979771-2

T_r
TORQUE VALUE AT 2940 RPM
IS GIVEN AS FOLLOWS:

$$T_r = T \times \left(\frac{2940}{N} \right)^2$$

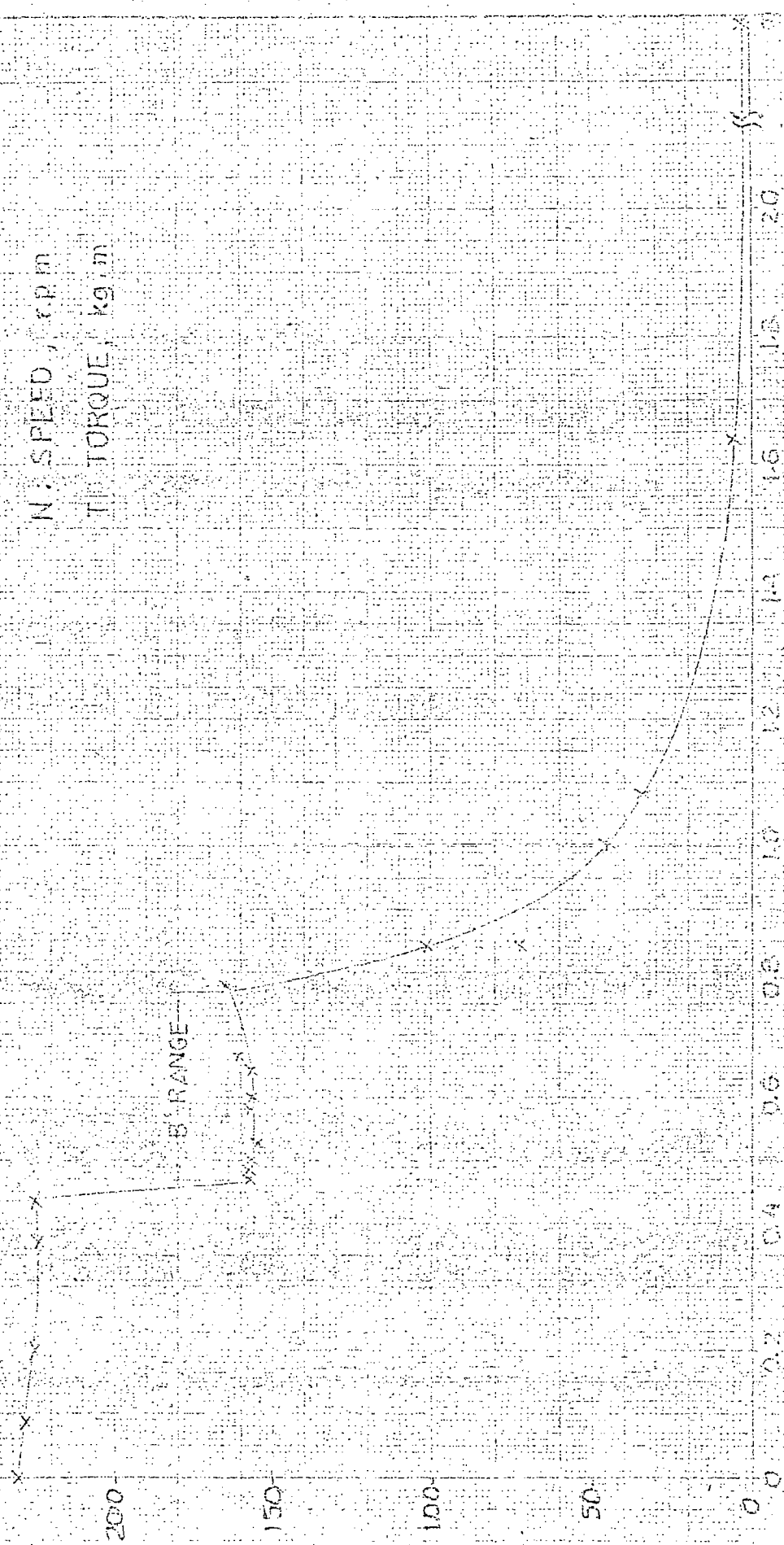
N: SPEED, rpm

T: TORQUE, kg.m

TORQUE T_r kg.m

C RANGE

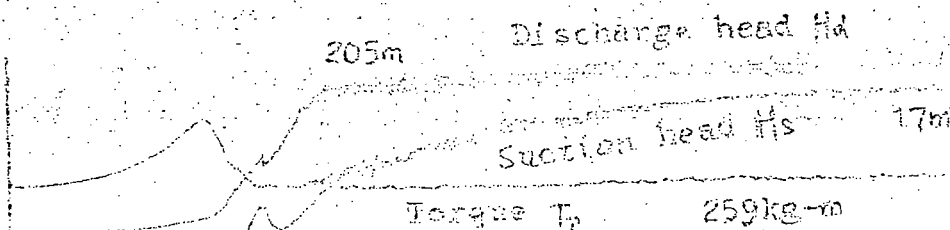
B RANGE



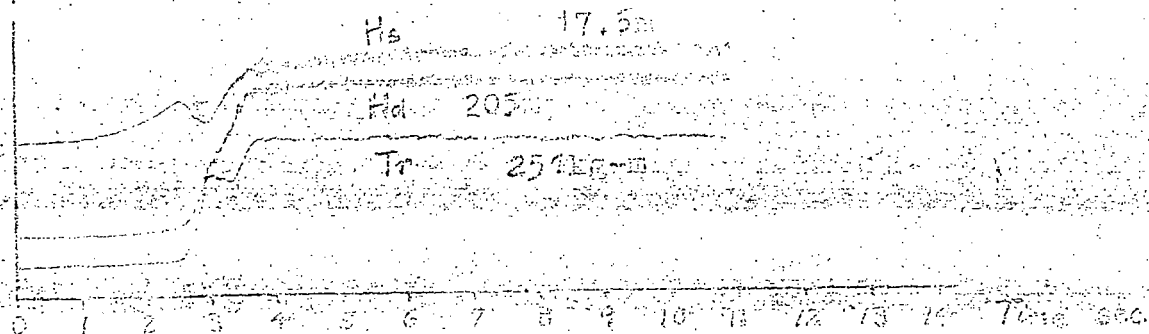
RELATION BETWEEN TORQUE AND VOLUME RATIO
OF AIR TO WATER IN THE CASING

8979771-3

TEST NO. 1

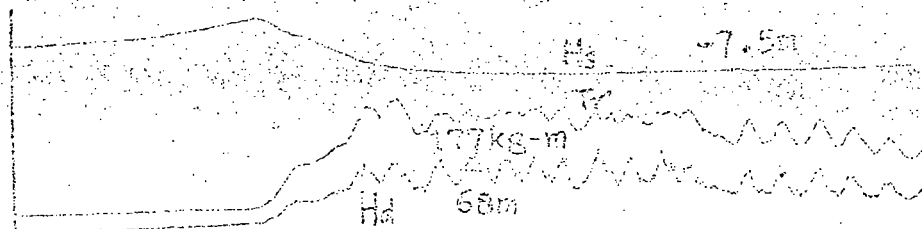


TEST NO. 2



(a) Filling water through the main suction valve

TEST NO. 3

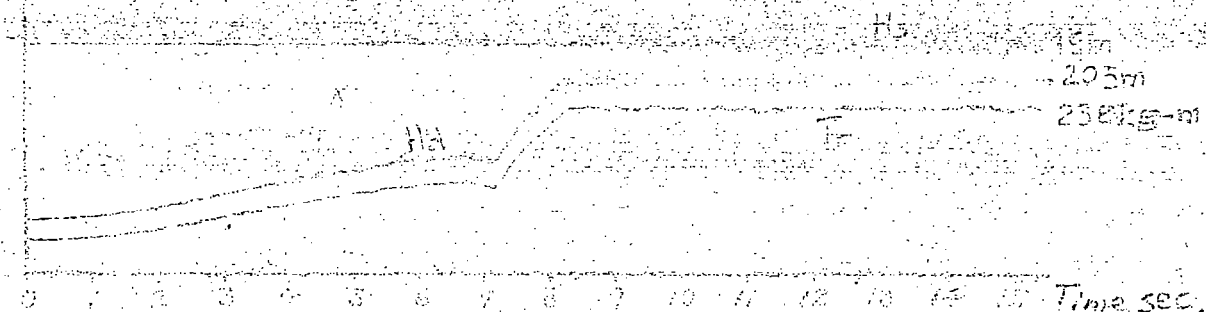


TEST NO. 4



(b) Filling water through the suction by-pass valve

TEST NO. 5



(c) Pump startup with the casing full of water

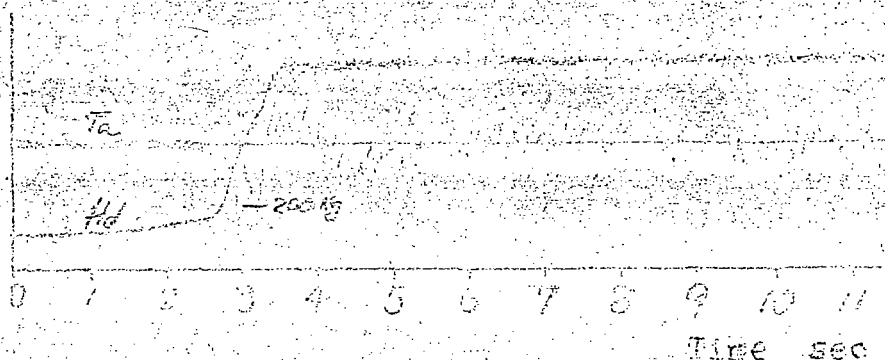
Transient change in torque, suction head and discharge head at pump startup

TEST NO. 1

Axial thrust T_a

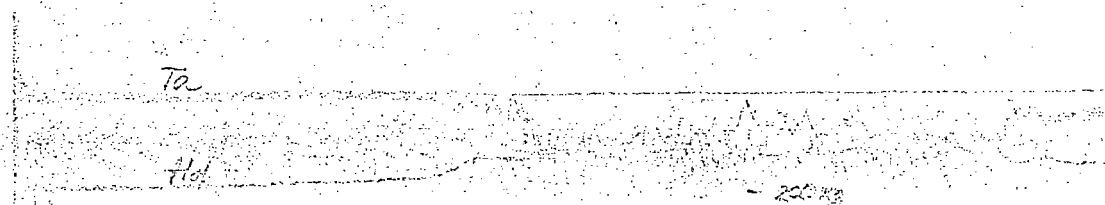
Discharge head H_d - 200 kg

TEST NO. 2

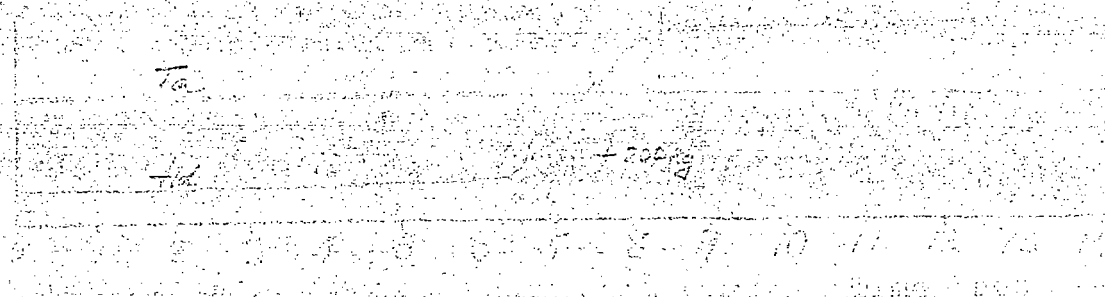


(a) Filling water through the main suction valve

TEST NO. 3



TEST NO. 4



(b) Filling water through the suction by-pass valve

Transient change in axial thrust and discharge head
at pump startup

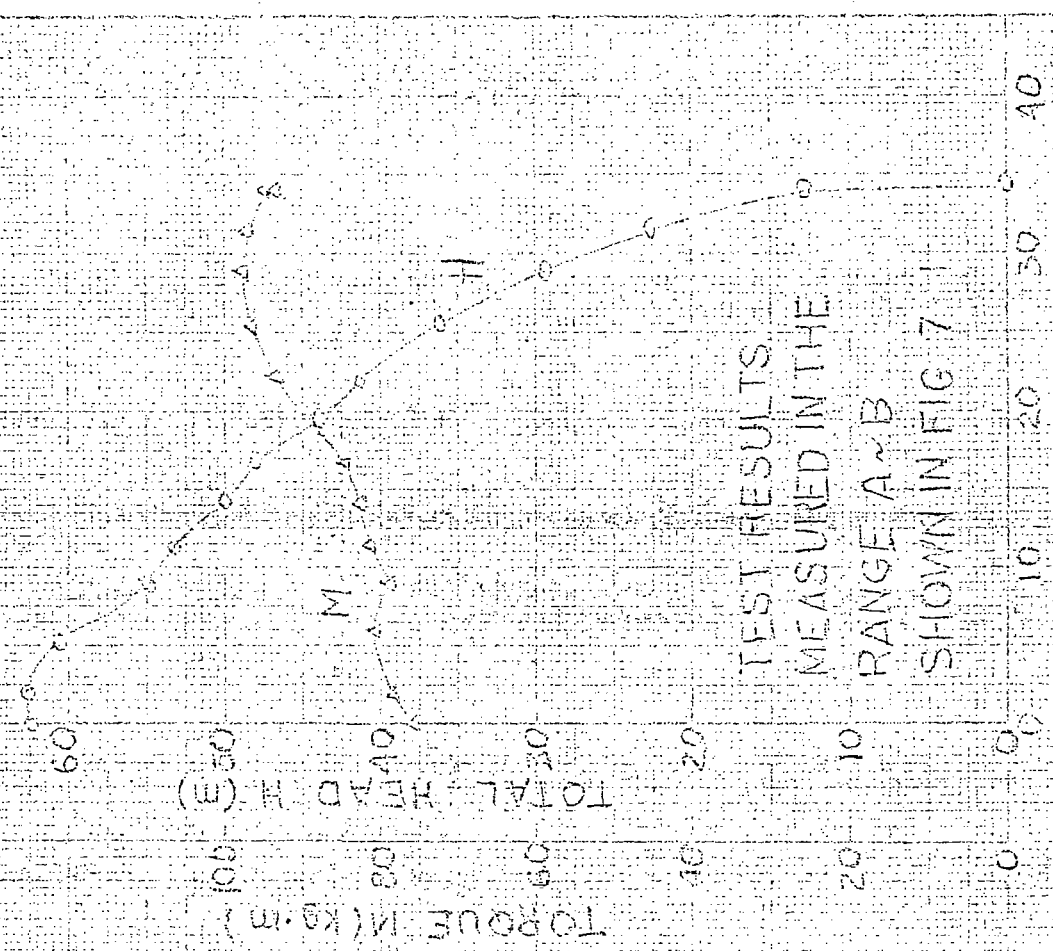
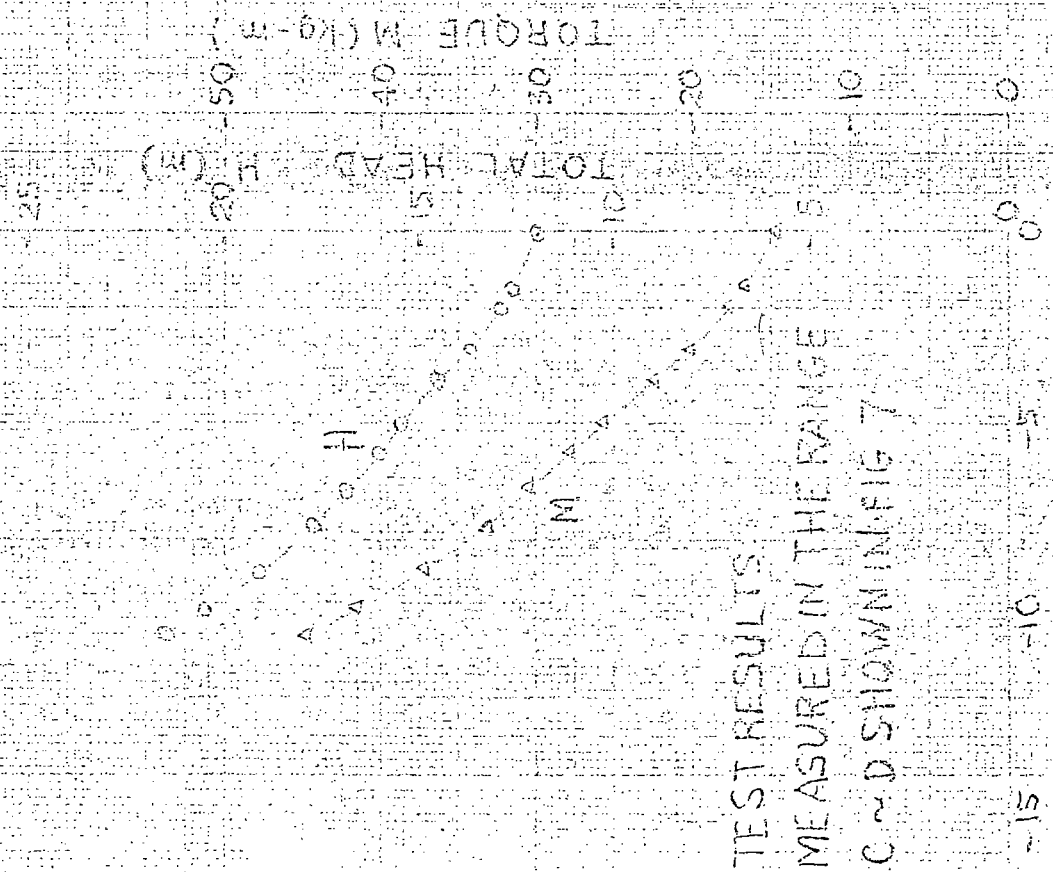
Start-up conditions (refer to Drawing P 350076)

Test No.	Water to be filled	Discharge by-pass valve (3)	Air vent (7) (on suction casing)	Air Vent (6) (on discharge casing)
1	Through the main suction valve (1)	Open	Closed	Open
2	Through the main suction valve (1)	Closed	Closed	Open
3	Through the suction by-pass valve (2)	Open	Closed	Open
4	Through the suction by-pass valve (2)	Closed	Open	Open
5	Start -up with the casing full of water			

NO.	REV.	DATE	REVISOR	CHECKED

N = 750 rpm

N = 700 rpm



DISCHARGE Q (m³/min)

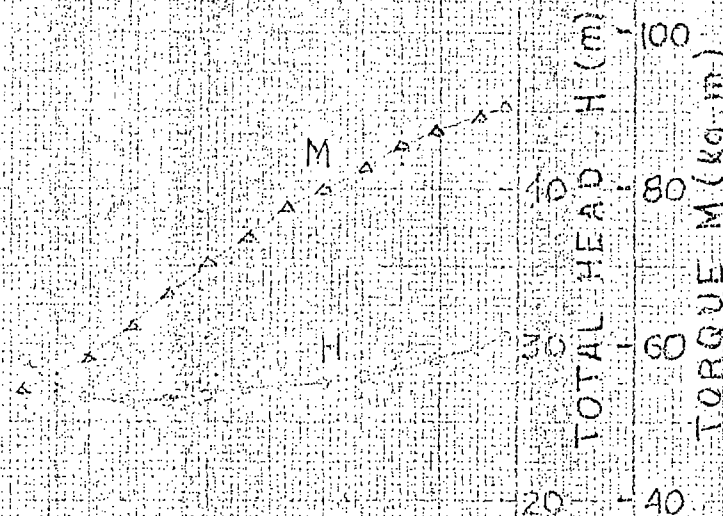
DISCHARGE Q (m³/min)

TEST RESULTS OF PUMP CHARACTERISTICS IN THREE QUADRANTS OF OPERATION (I)

5979769-1

NO.	REVISIONS	DATE	REVISED	CHECKED

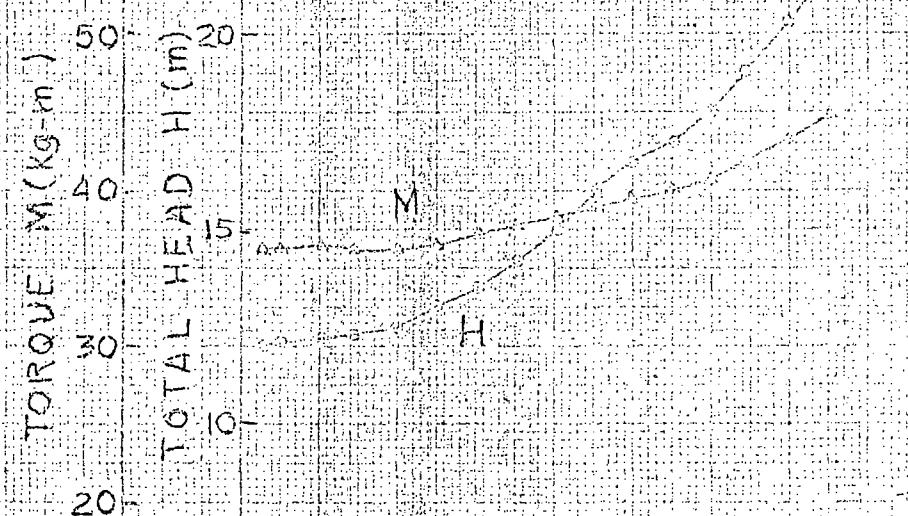
$Q = -17.15 \text{ m}^3/\text{min}$



TEST RESULTS MEASURED
IN THE RANGE F ~ G
SHOWN IN FIG. 7-1

SPEED N (rpm)

$Q = -10.43 \text{ m}^3/\text{min}$



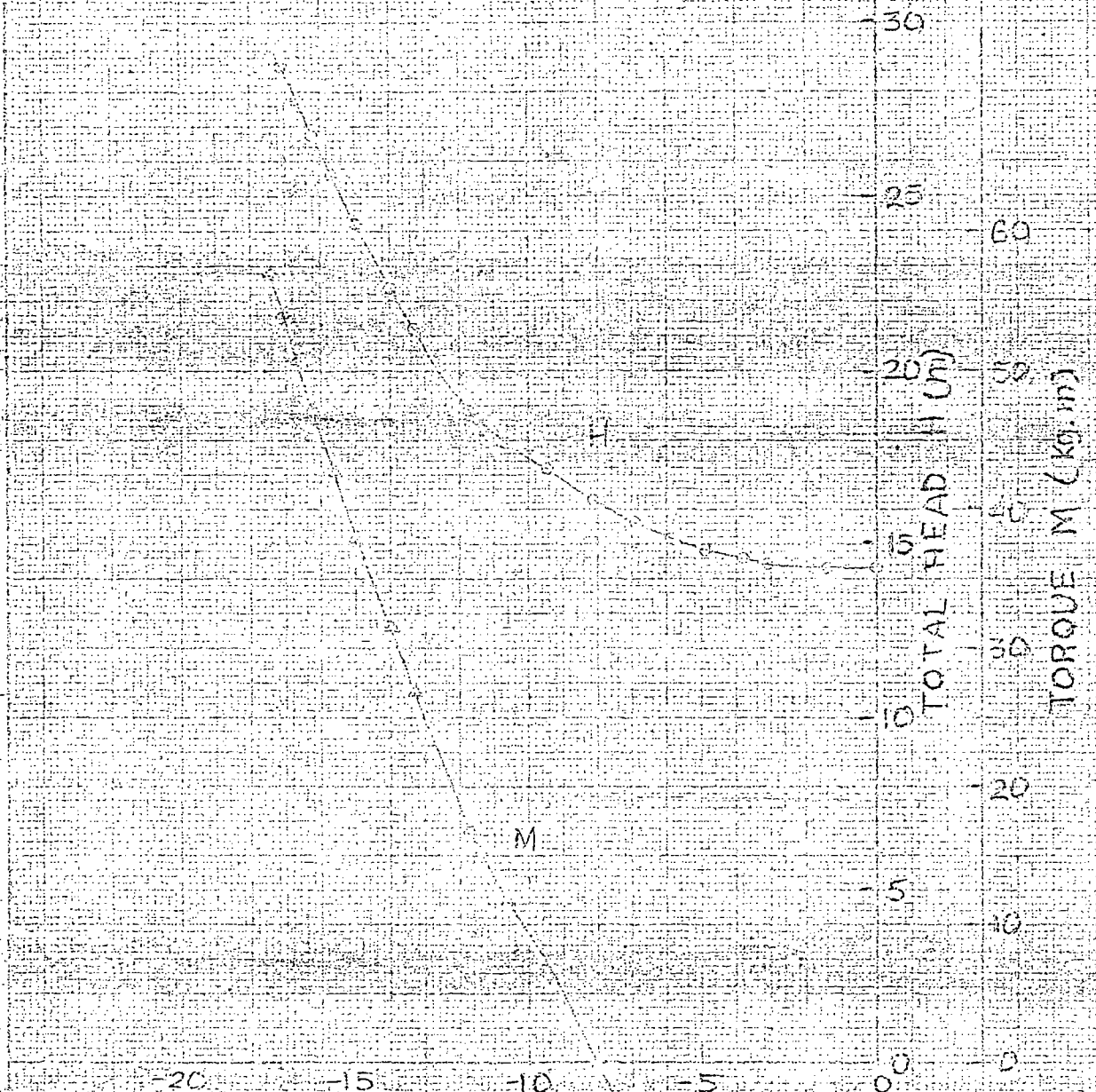
TEST RESULTS MEASURED
IN THE RANGE D ~ E
SHOWN IN FIG. 7-1

SPEED N (rpm)

TEST RESULTS OF PUMP CHARACTERISTICS IN THREE QUADRANTS OF OPERATION (2)

NO. REV. DATE REVISED CHECKED

$N = -1250 \text{ rpm}$



DISCHARGE Q (m^3/min)

TOTAL HEAD H (m)

TORQUE M (kg.m)

TEST RESULTS MEASURED

IN THE RANGE G~H SHOWN IN FIG 71

TEST RESULTS OF PUMP CHARACTERISTICS
IN THREE QUADRANTS OF OPERATION (3)

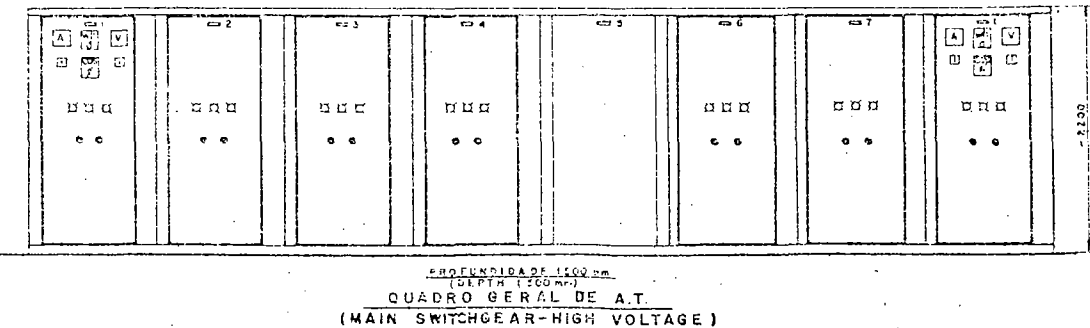
DATE: 11/11/1961
BY: [Signature]
CHECKED: [Signature]

PROJECT: 1251
SUBJECT: [Blank]

S979709-3

DIVISÃO V

Quadro Geral de Alta Tensão, Vista Frontal e Diagrama Unifilar.....	1
Diagramas Unifilares das Subestações nºs 1 e 2 e dos Painéis IP, EP, 2MA, 2MB, e 5EM.....	2
Diagramas Unifilares das Subestações 3 e dos Painéis 3MA, 3MB e Removedores de Lodo.....	3
Diagramas Unifilares dos Painéis IEP, IEM, IM e 3EM.....	4
Vista Frontal das Subestações I e II e dos Painéis "2MA", "2MB", "IP", "EP" e "5EM".....	5
Vista Frontal da Subestação nº 3 Painéis 3MA, MB e Painel de removedores de lodo.....	6
Vista Frontal dos Painéis IEP, IEM, 3EM e IM.....	7
Diagramas de Comando.....	8-9
Diagramas de Comando do Sistema de Cal.....	10
Diagramas de Comando.....	11-12
Painéis de Controle.....	13
Equipamento mecânico Solos de Cal.....	1a
Equipamento mecânico Reservatórios de Sulfato.....	2a
Equipamento mecânico Reservatórios Polieletrólíticos e Misturadores Químicos.....	3a



SIMBOLOGIA (SYMBOLS)

TRANSFORMADOR
(TRANSFORMER)

TRANSFORMADOR DE POTENCIAL
(POTENTIAL TRANSFORMER)

TRANSFORMADOR DE CORRENTE
(CURRENT TRANSFORMER)

DISJUNTOR DE FORÇA TIPO EXTRAÍVEL, CLASSE 15kV
(15KV CLASS, POWER CIRCUIT BREAKER, DRAW-OUT TYPE)

DISJUNTOR TRIPOLAR DE BAIXA TENSÃO, TIPO CAIXA MOLDADA, COM
ABRIGO DE INTERVENÇÃO VISÍVEL, M.A. NÃO AUTOMÁTICO
(LOW VOLTAGE MOLDED CASE CIRCUIT BREAKER, 3 POLE, WITH TRIP

CHAVE SECCIONADORA DE 3 POSIÇÕES (1-DESL-2)-CLASSE 15kV
(15KV CLASS, INTERRUPTER SWITCH, 3 POSITION LINE1-OFF-LINE2)

CHAVE SECCIONADORA - CLASSE 15kV
(15KV CLASS, INTERRUPTER SWITCH)

CHAVE SECCIONADORA FUSÍVEL - CLASSE 15kV
(15 KV CLASS, FUSED INTERRUPTER SWITCH)

FUSÍVEL
(FUSE)

CHAVE MAGNÉTICA, 3 POLOS, PARTIDA DIRETA, TAMANHO 1 DA NEMA NO
MAGNETIC STARTER 3 POLE, FULL VOLTAGE, NEMA SIZE 1 SHOWN

IGUAL ACIMA, PORÉM PARA TENSÃO REDUZIDA, TIPO AUTO-TRANSFOR-
MADORA, TAMANHO 1 DA NEMA
(SAME AS ABOVE EXCEPT REDUCED VOLTAGE, AUTO-TRANSFORMER

AMPÉRIMETRO
(AMPERMETER)

VOLTIMETRO
(VOLTMETER)

WATT HORAS - DEMANDA
(WATT HOURS - DEMAND)

INDICADOR COS φ
(COS φ INDICATOR)

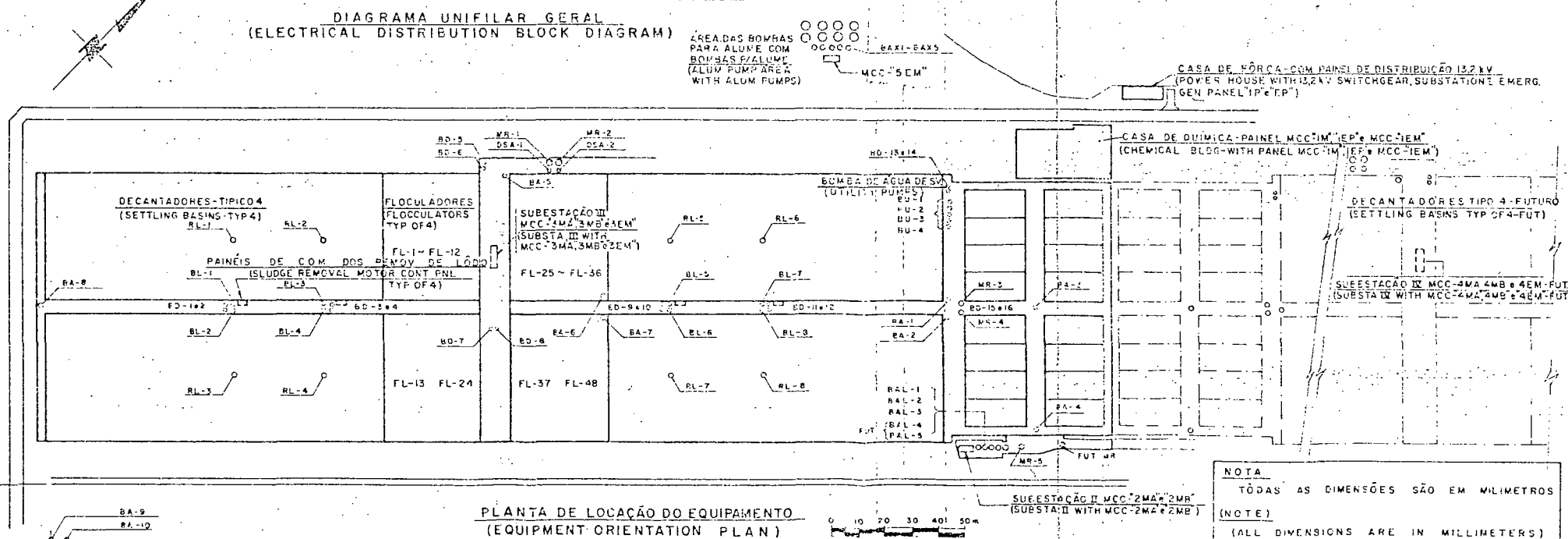
CHAVE DE TRANSFERÊNCIA
(TRANSFER SWITCH)








MOTOR - Nº INDICA HP
(MOTOR - NUMBER INDICATES HP)

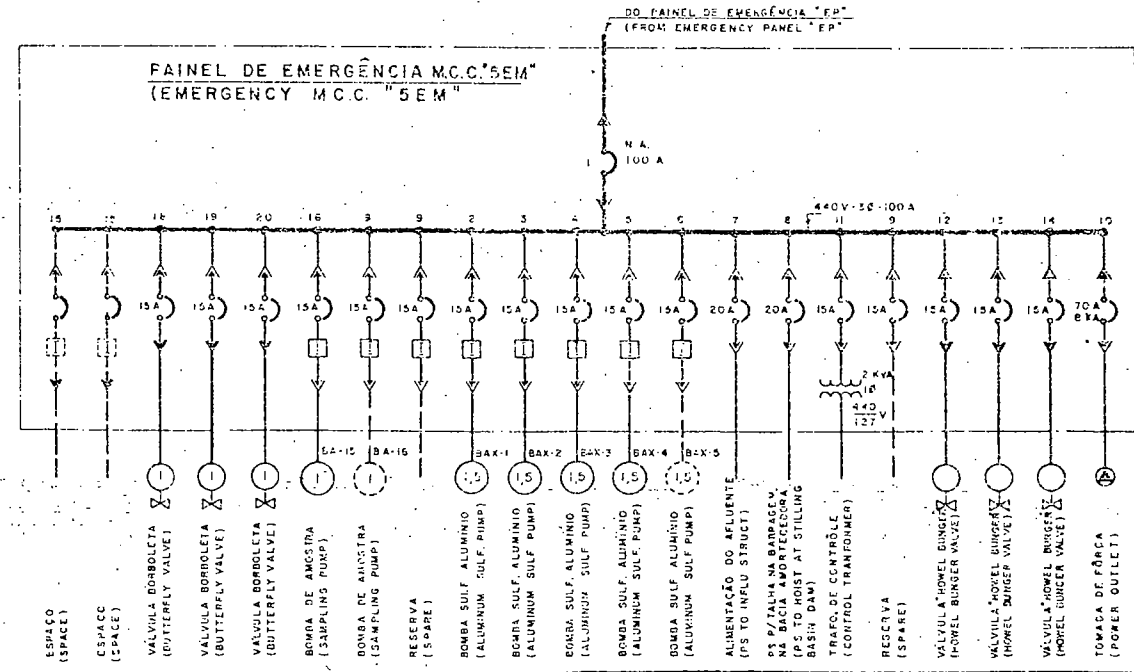
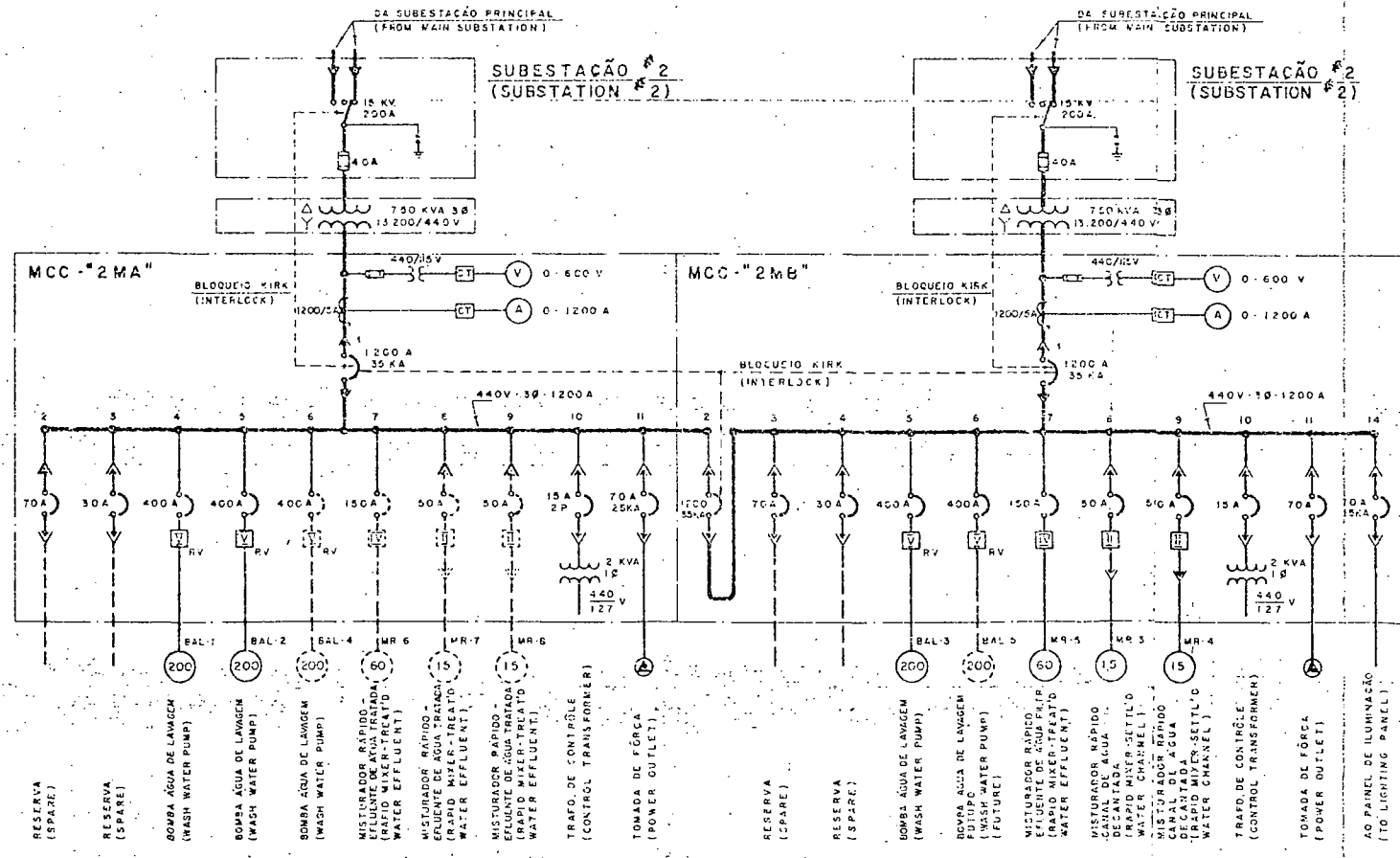
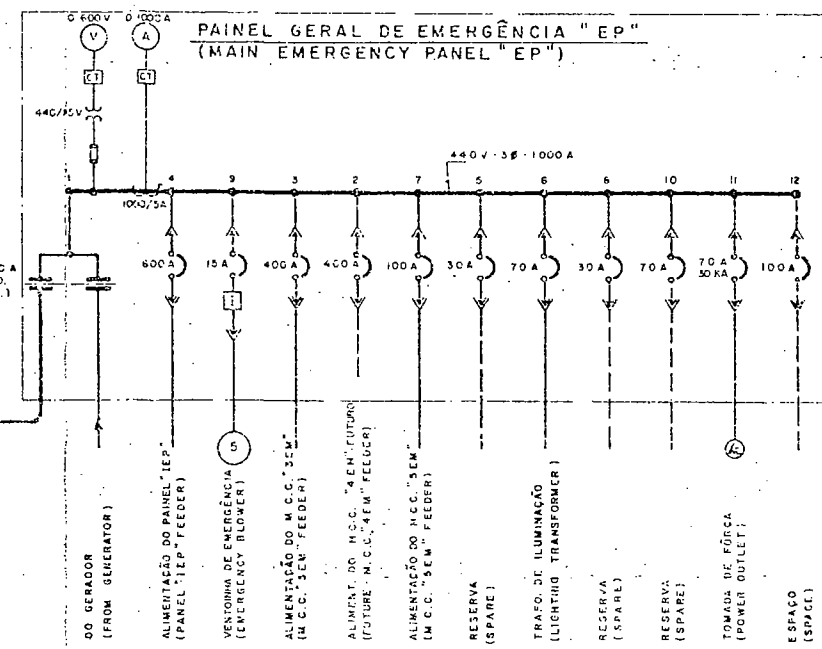
GERADOR
(GENERATOR)

PARA-RAIOS
(LIGHTNING ARRESTER)

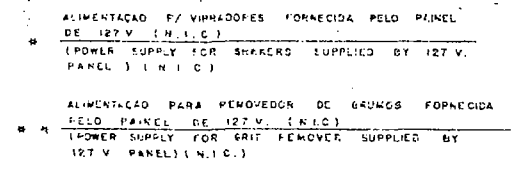
TCMADA DE FORÇA
(POWER OUTLET)

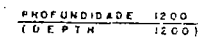


N.º	DATA	REVISÃO	POR	APROV.	DATA	DESENHO DE REFERÊNCIA	NÚMERO	APROVAÇÕES					CIA. METROPOLITANA DE ÁGUA DE SÃO PAULO	 COMASP	ESCALA 1" = 1' (NO SCALE)
								JAMES M. MONTGOMERY CONSULTING ENGINEERS, INC.	DATA		DATA	COMASP	DATA		ESTAÇÃO DE TRATAMENTO DE ÁGUA-GUARAÚ (WATER TREATMENT PLANT-GUARAÚ)
								DES. 	DES.		7-7-70	DES.		QUADRO GERAL DE ALTA TENSÃO; VISTA FRONTAL E DIAGRAMA UNIFILAR	N.º
									PROJ.			PROJ.			
									VER.		10-7-70	VER.			
									VISTO		10-6-70	VISTO			
									APROV.			APROV.		(MAIN SWITCHGEAR EQUIPMENT ORIENTATION PLAN AND SINGLE LINE DIAGRAM)	
									N.º INTERNO	S - XII - 01		APROV.			



N.º	DATA	REVISÃO	POR	APROV.	DATA	DESENHO DE REFERÊNCIA	NÚMERO	APPROVAÇÕES						CIA. METROPOLITANA DE ÁGUA DE SÃO PAULO	ESCALA SEM ESCALA (NO SCALE)
						JAMES M. MONTGOMERY CONSULTING ENGINEERS, INC.		DATA	<i>Gereia</i>	DATA	COMASP	DATA	ESTÇÃO DE TRATAMENTO DE ÁGUA GUARÁU (WATER TREATMENT PLANT GUARÁU) DIAGRAMAS UNIFICARES DAS SUBESTAÇÕES "I E #2" E DOS PAINÉIS "IP-EP-2MA-2MB E 5EM" (SINGLE LINE DIAGRAM - SUBSTATIONS "I AND #2" AND PANELS "IP EP-2MA-2MB AND 5EM")	R. FL	
								DES. <i>gereia</i>	07.07.70	DES.				N.º	
								PROJ.		PROJ.					
								VER. <i>gereia</i>	10.11.70	VER.					
								VISTO		VISTO					
								APROV. <i>[Signature]</i>		APROV.					
								N.º INTERNO 5-EE-02		APROV.					



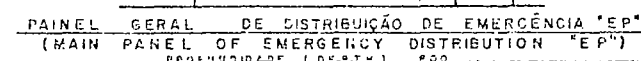
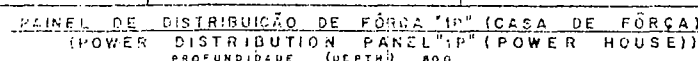
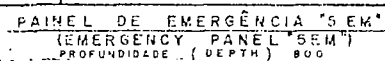


TRANSF 750 KVA
13200 / 440 V- 3 Ø

TRANSF. 750 KVA
13200/440V--3Ø


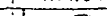
PROFUNDIDADE 1200
(01 PTH 1200)

SUBESTAÇÃO	II	E	M.C.C. "2 MA" - "2 MB"
(SUBSTATION	II	AND	M.C.C. "2 MA" - "2 MB"




SUBESTAÇÃO I E PAINEL "1P"
(SUBSTATION I AND PANEL "1P")

[illegible]

JAMES M. MONTGOMERY CONSULTING ENGINEERS, INC.		DATA	APROVAÇÕES
		DES. <i>J. J. J.</i>	
		PROJ.	
		VER.	
		VISTO	
		APROV.	
		N.º INTERNO 5 - XII	

DATA	COMASP	DATA
7-7-70	DES.	
	PROJ.	
10-7-70	VER.	
10/10/70	VISTO	
	APROV.	
	ΔPROV.	

CIA. METROPOLITANA
 ESTAÇÃO DE
 (WATER,
 VISTA FROM
 E DOS PAÍ-
 SE
 (FRONT VIEW
 AND OF THE

NOTA:		TODAS AS DIMENSÕES SÃO EM MILÍMETROS	
(NOTE):		(ALL DIMENSIONS ARE IN MILLIMETERS)	
FOLHA Nº 5		SHEET NO. 5	
DA ÁGUA DE SÃO PAULO MENTO DE ÁGUA-GUARAÚ MENT PLANT-GUARAÚ AS SUBESTAÇÕES I e II, MA, 2MB, 1P, EP e 5EM		ESCALA 5/ ESCALA (NO SCALE) R. FL. N.  COMASP	
E. SUBSTATIONS I AND II, 2MA, 2MB, 1P, EP AND 5EM			

NOTA:
TODAS AS DIMENSÕES SÃO EM MILIMETROS

(NOTE):
(ALL DIMENSIONS ARE IN MILLIMETERS)

FÔLHA Nº 5	SHEET NO. 5
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CIA. METROPOLITANA DE ÁGUA DE SÃO PAULO

SHEET NO. 5

ESTACÃO DE TRATAMENTO DE ÁGUA-GUARÁ
(WATER TREATMENT PLANT-GUARÁ)

VISTA FRONTAL DAS SUBESTAÇÕES I e II,
E DOS PAINÉIS 2MA, 2MB, 1P, EP e 5EM

FRONT VIEW OF THE SUBSTATIONS, I AND II,
AND OF THE PANELS 2MA, 2MB, 1P, EP AND 5EM



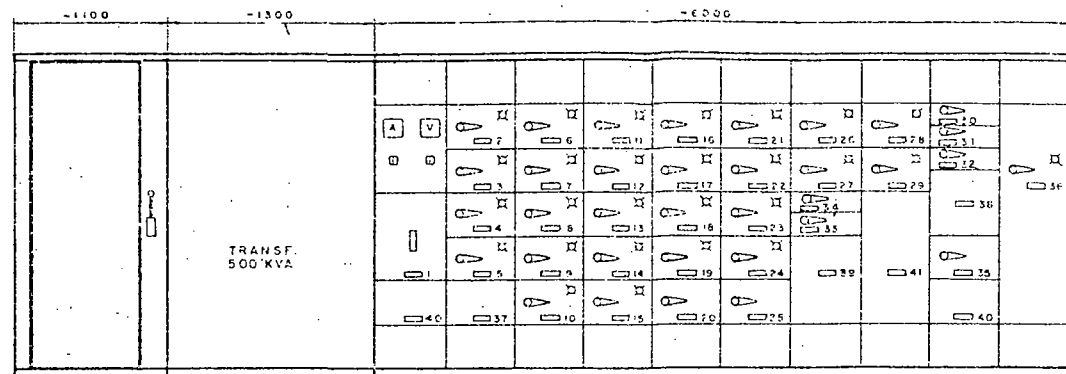
ESCALA
S/ESCALA

(NO SCALE)	
B	E

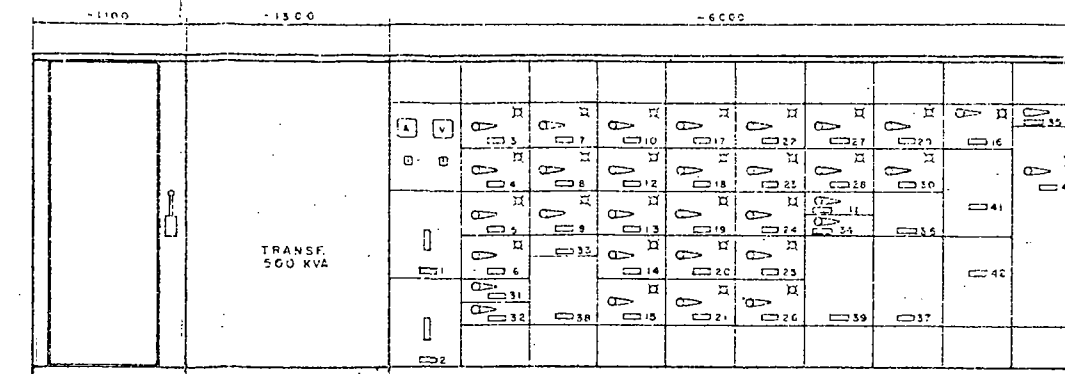
R.	PL.
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№.	
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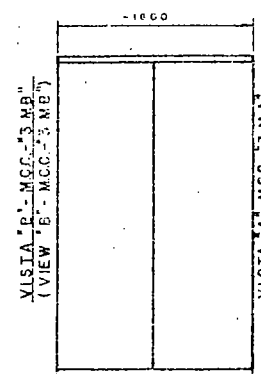
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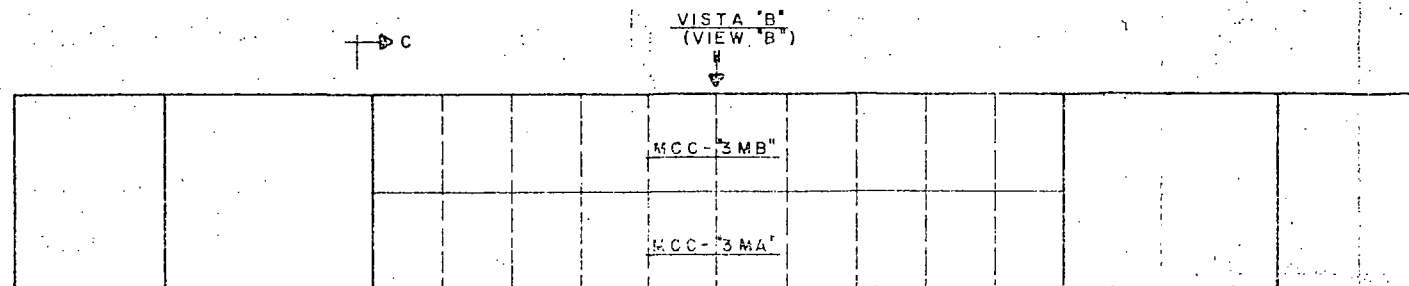
VISTA FRONTAL "A" MCC-3MA
(FRONT VIEW "A" MCC-3MA)



VISTA FRONTAL "B" MCC-3MB
(FRONT VIEW "B" MCC-3MB)

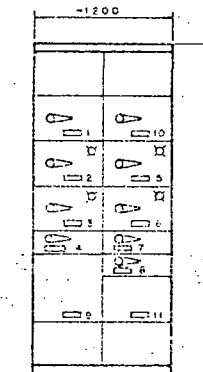


CORTE "C-C" (SECTION "C-C")

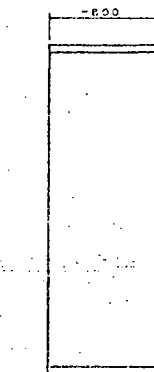


PLANTA - (PLAN)

SUBESTAÇÃO III C.C.M. - 3MA - 3MB
(SUBSTATION III AND MCC-3MA - 3MB)



VISTA FRONTAL
(FRONT VIEW)



VISTA LATERAL
(SIDE VIEW)

PAINÉIS DE CONTROLE DOS MOTORES DOS REMOVEDORES DE LODO (4)
(SLUDGE REMOVAL MOTORS CONTROL PANEL) (4)

PLAQUETAS DE IDENTIFICAÇÃO PARA O C.C.M. - 3MA
(M.C.C. - 3MA NAMEPLATE SCHEDULE)

1	DISJUNTOR GERAL (MAIN CIRCUIT BREAKER)	22	FLOCULADOR DE ALTA ENERGIA FL-18 (FLOCCULATOR - HIGH ENERGY FL-18)
2	FLOCULADOR DE ALTA ENERGIA FL-1 (FLOCCULATOR - HIGH ENERGY FL-1)	23	FLOCULADOR DE ALTA ENERGIA FL-19 (FLOCCULATOR - HIGH ENERGY FL-19)
3	FLOCULADOR DE ALTA ENERGIA FL-2 (FLOCCULATOR - HIGH ENERGY FL-2)	24	FLOCULADOR DE ALTA ENERGIA FL-20 (FLOCCULATOR - HIGH ENERGY FL-20)
4	FLOCULADOR DE ALTA ENERGIA FL-3 (FLOCCULATOR - HIGH ENERGY FL-3)	25	RESERVA (SPARE)
5	FLOCULADOR DE ALTA ENERGIA FL-4 (FLOCCULATOR - HIGH ENERGY FL-4)	26	FLOCULADOR DE BAIXA ENERGIA FL-21 (FLOCCULATOR - LOW ENERGY FL-21)
6	FLOCULADOR DE ALTA ENERGIA FL-5 (FLOCCULATOR - HIGH ENERGY FL-5)	27	FLOCULADOR DE BAIXA ENERGIA FL-22 (FLOCCULATOR - LOW ENERGY FL-22)
7	FLOCULADOR DE ALTA ENERGIA FL-6 (FLOCCULATOR - HIGH ENERGY FL-6)	28	FLOCULADOR DE BAIXA ENERGIA FL-23 (FLOCCULATOR - LOW ENERGY FL-23)
8	FLOCULADOR DE ALTA ENERGIA FL-7 (FLOCCULATOR - HIGH ENERGY FL-7)	29	FLOCULADOR DE BAIXA ENERGIA FL-24 (FLOCCULATOR - LOW ENERGY FL-24)
9	FLOCULADOR DE ALTA ENERGIA FL-8 (FLOCCULATOR - HIGH ENERGY FL-8)	30	REMOVEDORES DE LODO - PAINEL - 1 (SLUDGE REMOVAL PANEL - 1)
10	RESERVA (SPARE)	31	REMOVEDORES DE LODO - PAINEL - 3 (SLUDGE REMOVAL PANEL - 3)
11	FLOCULADOR DE BAIXA ENERGIA FL-9 (FLOCCULATOR - LOW ENERGY FL-9)	32	DISJUNTOR GERAL DO TRANSF. DE CONTROLE (CIRCUIT BREAKER - CONTROL TRANSF.)
12	FLOCULADOR DE BAIXA ENERGIA FL-10 (FLOCCULATOR - LOW ENERGY FL-10)	33	DISJUNTOR GERAL - ILUMINAÇÃO (CIRCUIT BREAKER - LIGHTING)
13	FLOCULADOR DE BAIXA ENERGIA FL-11 (FLOCCULATOR - LOW ENERGY FL-11)	34	TONADA DE FORÇA (POWER OUTLET)
14	FLOCULADOR DE BAIXA ENERGIA FL-12 (FLOCCULATOR - LOW ENERGY FL-12)	35	RESERVA (SPARE)
15	RESERVA (SPARE)	36	MISTURADOR RÁPIDO - MR-2 (RAPID MIXER - MR-2)
16	FLOCULADOR DE ALTA ENERGIA FL-13 (FLOCCULATOR - HIGH ENERGY FL-13)	37	ESPACO (SPACE)
17	FLOCULADOR DE ALTA ENERGIA FL-14 (FLOCCULATOR - HIGH ENERGY FL-14)	38	TRANSFORMADOR DE CONTROLE (CONTROL TRANSF.)
18	FLOCULADOR DE ALTA ENERGIA FL-15 (FLOCCULATOR - HIGH ENERGY FL-15)	39	TRANSFORMADOR DE LUZ (LIGHT TRANSF.)
19	FLOCULADOR DE ALTA ENERGIA FL-16 (FLOCCULATOR - HIGH ENERGY FL-16)	40	ESPACO (SPACE)
20	RESERVA (SPARE)	41	PAINEL DE RELÉS (RELAY PANEL)
21	FLOCULADOR DE ALTA ENERGIA FL-17 (FLOCCULATOR - HIGH ENERGY FL-17)	42	RESERVA (SPARE)

PLAQUETAS DE IDENTIFICAÇÃO PARA O C.C.M. - 3MB
(M.C.C. - 3MB NAMEPLATE SCHEDULE)

1	DISJUNTOR GERAL (MAIN CIRCUIT BREAKER)	22	FLOCULADOR DE ALTA ENERGIA FL-41 (FLOCCULATOR - HIGH ENERGY FL-41)
2	DISJUNTOR DE INTERLIGAÇÃO (TIE BREAKER)	23	FLOCULADOR DE ALTA ENERGIA FL-42 (FLOCCULATOR - HIGH ENERGY FL-42)
3	FLOCULADOR DE ALTA ENERGIA FL-25 (FLOCCULATOR - HIGH ENERGY FL-25)	24	FLOCULADOR DE ALTA ENERGIA FL-43 (FLOCCULATOR - HIGH ENERGY FL-43)
4	FLOCULADOR DE ALTA ENERGIA FL-26 (FLOCCULATOR - HIGH ENERGY FL-26)	25	FLOCULADOR DE ALTA ENERGIA FL-44 (FLOCCULATOR - HIGH ENERGY FL-44)
5	FLOCULADOR DE ALTA ENERGIA FL-27 (FLOCCULATOR - HIGH ENERGY FL-27)	26	RESERVA (SPARE)
6	FLOCULADOR DE ALTA ENERGIA FL-28 (FLOCCULATOR - HIGH ENERGY FL-28)	27	FLOCULADOR DE BAIXA ENERGIA FL-45 (FLOCCULATOR - LOW ENERGY FL-45)
7	FLOCULADOR DE ALTA ENERGIA FL-29 (FLOCCULATOR - HIGH ENERGY FL-29)	28	FLOCULADOR DE BAIXA ENERGIA FL-46 (FLOCCULATOR - LOW ENERGY FL-46)
8	FLOCULADOR DE ALTA ENERGIA FL-30 (FLOCCULATOR - HIGH ENERGY FL-30)	29	FLOCULADOR DE BAIXA ENERGIA FL-47 (FLOCCULATOR - LOW ENERGY FL-47)
9	FLOCULADOR DE ALTA ENERGIA FL-31 (FLOCCULATOR - HIGH ENERGY FL-31)	30	FLOCULADOR DE BAIXA ENERGIA FL-48 (FLOCCULATOR - LOW ENERGY FL-48)
10	FLOCULADOR DE ALTA ENERGIA FL-32 (FLOCCULATOR - HIGH ENERGY FL-32)	31	REMOVEDORES DE LODO PAINEL - 2 (SLUDGE REMOVAL PANEL - 2)
11	RESERVA (SPARE)	32	REMOVEDORES DE LODO PAINEL - 4 (SLUDGE REMOVAL PANEL - 4)
12	FLOCULADOR DE BAIXA ENERGIA FL-33 (FLOCCULATOR - LOW ENERGY FL-33)	33	DISJUNTOR GERAL DO TRANSFORMADOR DE CONTROLE (CIRCUIT BREAKER - CONTROL TRANSF.)
13	FLOCULADOR DE BAIXA ENERGIA FL-34 (FLOCCULATOR - LOW ENERGY FL-34)	34	DISJUNTOR GERAL - ILUMINAÇÃO (CIRCUIT BREAKER - LIGHTING)
14	FLOCULADOR DE BAIXA ENERGIA FL-35 (FLOCCULATOR - LOW ENERGY FL-35)	35	TONADA DE FORÇA (POWER OUTLET)
15	FLOCULADOR DE BAIXA ENERGIA FL-36 (FLOCCULATOR - LOW ENERGY FL-36)	36	ESPACO (SPACE)
16	RESERVA (SPARE)	37	PAINEL DE RELÉS (RELAY PANEL)
17	FLOCULADOR DE ALTA ENERGIA FL-37 (FLOCCULATOR - HIGH ENERGY FL-37)	38	TRANSFORMADOR DE CONTROLE (CONTROL TRANSF.)
18	FLOCULADOR DE ALTA ENERGIA FL-38 (FLOCCULATOR - HIGH ENERGY FL-38)	39	TRANSFORMADOR DE LUZ (LIGHT TRANSF.)
19	FLOCULADOR DE ALTA ENERGIA FL-39 (FLOCCULATOR - HIGH ENERGY FL-39)	40	VENTILADOR PARA AGUA BRUTA (BLOWER FOR RAW WATER)
20	FLOCULADOR DE ALTA ENERGIA FL-40 (FLOCCULATOR - HIGH ENERGY FL-40)	41	VENTILADOR PARA GALERIA (BLOWER FOR GALLERY)
21	RESERVA (SPARE)	42	VENTILADOR PARA GALERIA (BLOWER FOR GALLERY)

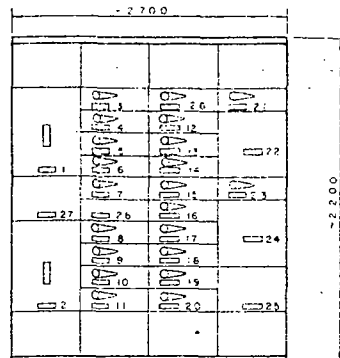
PLAQUETAS DE IDENTIFICAÇÃO PARA OS PAINÉIS DOS REMOVEDORES DE LODO
(SLUDGE REMOVAL PANELS NAMEPLATE SCHEDULE)

1	DISJUNTOR GERAL (CIRCUIT BREAKER)
2	BOMBAS DE LODO BL-2, BL-4, BL-6, BL-8 (SLUDGE PUMPS BL-2, BL-4, BL-6, BL-8)
3	BOMBAS DE LODO BL-1, BL-3, BL-5, BL-7 (SLUDGE PUMPS BL-1, BL-3, BL-5, BL-7)
4	DISJUNTOR GERAL DO TRANSFORMADOR DE CONTROLE (CIRCUIT BREAKER - CONTROL TRANSF.)
5	RASPADORES DE LODO RL-1, RL-2, RL-3, RL-4 (SLUDGE SCRAPER RL-1, RL-2, RL-3, RL-4)
6	RASPADORES DE LODO RL-5, RL-6, RL-7, RL-8 (SLUDGE SCRAPER RL-5, RL-6, RL-7, RL-8)
7	PROTEÇÃO CATÓDICA (FUTURO) (FUTURE CATH. PROTECTION)
8	TONADA DE FORÇA (POWER OUTLET)
9	TRANSFORMADOR DE CONTROLE (CONTROL TRANSF.)
10	DISJUNTOR GERAL - ILUMINAÇÃO (PAINÉIS 3 E 4) (CIRCUIT BREAKER - LIGHTING) (PAINÉIS 3 AND 4)
11	ESPACO (SPACE)

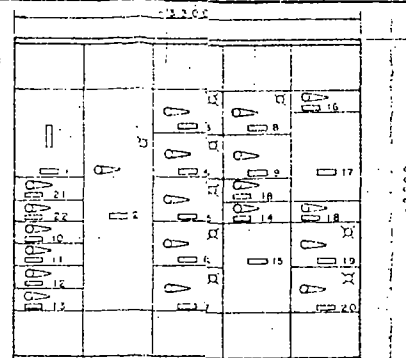
NOTA
TODAS AS DIMENSÕES SÃO EM MILÍMETROS
(NOTE)
(ALL DIMENSIONS ARE IN MILLIMETERS)

FOLHA Nº 6 SHEET NO. 6

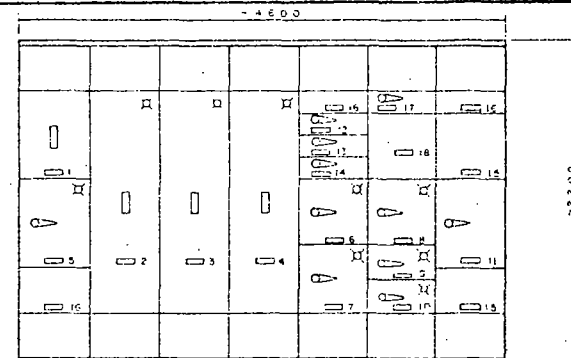
N.º		DATA	REVISÃO	POR	APROV.	DATA	DESENHO DE REFERÊNCIA	NÚMERO	APROVAÇÕES		DATA	COMASP	DATA	CIA. METROPOLITANA DE ÁGUA DE SÃO PAULO	ESTAD. DE TRATAMENTO DE ÁGUA-GUARAU (WATER TREATMENT PLANT-GUARAU)	ESCALA (NO SCALE)
									JAMES M. MONTGOMERY CONSULTING ENGINEERS, INC.						VISTA FRONTAL DA SUBESTAÇÃO III, PAINÉIS 3MA, 3MB E PAINÉIS DOS REMOVEDORES DE LODO (FRONT VIEW OF THE SUBSTATION III PAINÉIS 3MA, 3MB AND SLUDGE REMOVAL PANEL)	
									DES. 8-1-70		DES. 7-1-70					
									PROJ. 8-1-70		PROJ. 7-1-70					
									VISTO 10-1-70		VISTO 10-1-70					
									APROV. 10-1-70		APROV. 10-1-70					
									N.º INTERNO 8-11-06		APROV.					



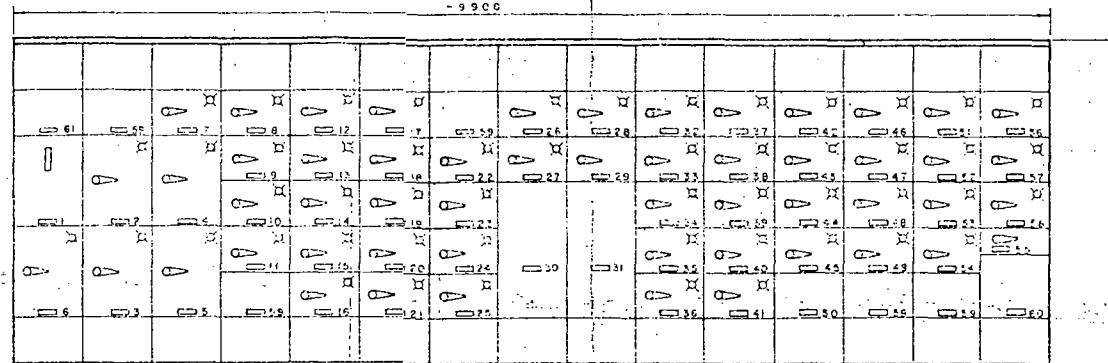
PAINEL DE DISTRIBUIÇÃO DE FORÇA EMERG. "IEP"
(EMERGENCY POWER DISTRIBUTION PANEL "IEP"
PROFUNDIDADE (DEPTH) - 600



PAINEL DE EMERGENCIA "3EM"
(EMERGENCY PANEL "3EM"
PROFUNDIDADE (DEPTH) - 600



PAINEL DE DISTRIBUIÇÃO DE FORÇA M.C.C. - "1M"
POWER DISTRIBUTION M.C.C. - "1M"
PROFUNDIDADE (DEPTH) - 600



PAINEL DE EMERGENCIA "1EM" - PROFUNDIDADE 800
(EMERGENCY - M.C.C. "1EM") - (DEPTH) 800

PLAQUETAS DE IDENTIFICAÇÃO DO PAINEL DE EMERGENCIA
(EMERGENCY MCC NAMEPLATE SCHEDULE)

"1EM"					
1	DISJUNTOR GERAL (MAIN CIRCUIT BREAKER)	26	EXTINTOR DE CAL EX-1 (LINE SLAKER EX-1)	51	BOMBA DE POLIELECTROLITO BP-1 (POLYELECTROLYTE PUMP BP-1)
2	BOMBA DE AGUA P/SERVICOS GERAIS BU-3 (UTILITY WATER PUMP BU-3)	27	EXTINTOR DE CAL EX-2 (LINE SLAKER EX-2)	52	BOMBA DE POLIELECTROLITO BP-2 (POLYELECTROLYTE PUMP BP-2)
3	BOMBA DE AGUA P/SERVICOS GERAIS BU-4 (UTILITY WATER PUMP BU-4)	28	EXTINTOR DE CAL EX-3 (LINE SLAKER EX-3)	53	BOMBA DE POLIELECTROLITO BP-3 (POLYELECTROLYTE PUMP BP-3)
4	COMPRESSOR DE AR C-1 (AIR COMPRESSOR C-1)	29	RESERVA (SPARE)	54	BOMBA DE POLIELECTROLITO BP-4(FUTURO) (POLYELECTROLYTE PUMP BP-4(FUTURE))
5	COMPRESSOR DE AR C-2 (AIR COMPRESSOR C-2)	30	PAINEL P/ RELES (RELAY PANEL)	55	DISJUNTOR GERAL DO TRANSF. DE CONTROLE (CONTROL TRANSFORMER CIRCUIT BREAKER)
6	COMPRESSOR DE AR C-3(FUTURO) (AIR COMPRESSOR C-3(FUTURE))	31	ESPAÇO P/ RELES DE CONTROLE (SPACE FOR CONTROL RELAYS)	56	MISTURADOR DE POLIELECTROLITO MTC-1 (POLYELECTROLYTE MIXER MTC-1)
7	RESERVA (SPARE)	32	BOMBA DE AMOSTRA BA-1,DECANTADOR (SAMPLING PUMP BA-1,SETTL'G BASIN)	57	MISTURADOR DE POLIELECTROLITO MTC-2 (POLYELECTROLYTE MIXER MTC-2)
8	COLETOR DE PO CP-1-SILO DE ARMAZ (DUST COLLECTOR CP-1-STORAGE BIN)	33	BOMBA DE AMOSTRA BA-2,DECANTADOR (SAMPLING PUMP BA-2,SETTL'G BASIN)	58	MISTURADOR DE POLIELECTROLITO MTC-3 (POLYELECTROLYTE MIXER MTC-3)
9	COLETOR DE PO CP-2-SILO DE ARMAZ (DUST COLLECTOR CP-2-STORAGE BIN)	34	BOMBA DE AMOSTRA BA-3, FILTRO DE FILTRO (SAMPLING PUMP BA-3, FILTER INFLUENT)	59	ESPAÇO (SPACE)
10	COLETOR DE PO CP-3-SILO DE ARMAZ (DUST COLLECTOR CP-3-STORAGE BIN)	35	BOMBA DE AMOSTRA BA-4, FLUENTE DO FILTRO (SAMPLING PUMP BA-4, FILTER EFFLUENT)	60	TRANSFORMADOR DE CONTROLE (CONTROL TRANSF.)
11	COLETOR DE PO CP-4-SILO DE RECEB (DUST COLLECTOR CP-4-RECVG BIN)	36	BOMBA DE AMOSTRA BA-11(FUTURO) (SAMPLING PUMP BA-11(FUTURE))	61	ESPAÇO (SPACE)
12	SECADOR ROTATIVO DR-1-SISTEMA DE CAL (ROTARY DRY FEEDER DR-1-LINE SYSTEM)	37	BOMBA DE AMOSTRA BA-12(FUTURO) (SAMPLING PUMP BA-12(FUTURE))		
13	SECADOR ROTATIVO DR-2-SISTEMA DE CAL (ROTARY DRY FEEDER DR-2-LINE SYSTEM)	38	BOMBA DE AMOSTRA BA-13(FUTURO) (SAMPLING PUMP BA-13(FUTURE))		
14	SECADOR ROTATIVO DR-3-SISTEMA DE CAL (ROTARY DRY FEEDER DR-3-LINE SYSTEM)	39	BOMBA DE AMOSTRA BA-14(FUTURO) (SAMPLING PUMP BA-14(FUTURE))		
15	SECADOR ROTATIVO DR-4-SISTEMA DE CAL (ROTARY DRY FEEDER DR-4-LINE SYSTEM)	40	MISTURADOR DE PROD. QUIMICOS SUPLEM. MTC-4 (SPARE CHEMICAL MIXER MTC-4)		
16	TRANS. DE FERRUGEM SC-1-SISTEMA DE CAL (SCREW CONVR. SC-1-LINE SYSTEM)	41	MISTURADOR DE PROD. QUIMICOS SUPLEM. MTC-5 (SPARE CHEMICAL MIXER MTC-5)		
17	VALVULA ROTATIVA DE DESLIG. VRC-1 (ROTARY CUT-OFF VALVE VRC-1)	42	MISTURADOR DE PROD. QUIMICOS SUPLEM. MTC-6 (SPARE CHEMICAL MIXER MTC-6)		
18	VALVULA ROTATIVA DE DESLIG. VRC-2 (ROTARY CUT-OFF VALVE VRC-2)	43	MISTURADOR DE PROD. QUIMICOS SUPLEM. MTC-7 (SPARE CHEMICAL MIXER MTC-7)		
19	VALVULA ROTATIVA DE DESLIG. VRC-3 (ROTARY CUT-OFF VALVE VRC-3)	44	MISTURADOR DE PROD. QUIMICOS SUPLEM. MTC-8 (SPARE CHEMICAL MIXER MTC-8)		
20	BOMBA DE ALIM. DE CAL BC-1 (LINE FEED PUMP BC-1)	45	MISTURADOR DE PROD. QUIMICOS SUPLEM. MTC-9 (SPARE CHEMICAL MIXER MTC-9)		
21	BOMBA DE ALIM. DE CAL BC-2 (LINE FEED PUMP BC-2)	46	BOMBA DE PRODUTOS QUIMICOS SUPLEM. BPO-1 (SPARE CHEMICAL PUMP BPO-1)		
22	BOMBA DE ALIM. DE CAL BC-3 (LINE FEED PUMP BC-3)	47	BOMBA DE PRODUTOS QUIMICOS SUPLEM. BPO-2 (SPARE CHEMICAL PUMP BPO-2)		
23	BOMBA DE ALIM. DE CAL BC-4 (LINE FEED PUMP BC-4)	48	BOMBA DE PRODUTOS QUIMICOS SUPLEM. BPO-3 (SPARE CHEMICAL PUMP BPO-3)		
24	BOMBA DE ALIM. DE CAL BC-5 (LINE FEED PUMP BC-5)	49	BOMBA DE PROD. QUIMICOS SUPLEM. BPO-4(FUTURO) (SPARE CHEMICAL PUMP BPO-4(FUTURE))		
25	BOMBA DE ALIM. DE CAL BC-6 (LINE FEED PUMP BC-6)	50	ESPAÇO (SPACE)		

PLAQ. DE IDENT. DO PAINEL DISTR. FORÇA EMERG.
(EMERG. POWER DISTR. PANEL NAMEPLATE SCHEDULE)

"IEP"	
1	DISJUNTOR GERAL (MAIN CIRCUIT BREAKER)
2	CENTRO DE CONTROLE DOS MOTORES "1EM" (MOTOR CONTROL CENTER "1EM")
3	BOMBAS DE DREN. (RESERVA) (SUMP PUMPS (SPARE))
4	BOMBAS DE DREN. BD-17 + BD-18 (SUMP PUMPS BD-17 + BD-18)
5	BOMBAS DE DREN. BD-13 + BD-14 (SUMP PUMPS BD-13 + BD-14)
6	BOMBAS DE DREN. BD-15 + BD-16 (SUMP PUMPS BD-15 + BD-16)
7	DOSADOR DE FLUORETO C/ MISTURADOR DO-4 (FLOUORIDE FEEDER WITH MIXER DO-4)
8	DOSADOR DE CAL DG-1 (LINE FEEDER DG-1)
9	DOSADOR DE CAL DG-2 (LINE FEEDER DG-2)
10	DOSADOR DE CAL DG-3 (LINE FEEDER DG-3)
11	EVAPORADOR DE CLORO EV-1 (CHLORINE EVAPORATOR EV-1)
12	EVAPORADOR DE CLORO EV-2 (CHLORINE EVAPORATOR EV-2)
13	EVAPORADOR DE CLORO EV-3 (CHLORINE EVAPORATOR EV-3)
14	EVAPORADOR DE CLORO EV-4 (CHLORINE EVAPORATOR EV-4)
15	EVAPORADOR DE CLORO EV-5 (FUTURO) (CHLORINE EVAPORATOR EV-5 (FUTURE))
16	EVAPORADOR DE CLORO EV-6 (FUTURO) (CHLORINE EVAPORATOR EV-6 (FUTURE))
17	EVAPORADOR DE CLORO EV-7 (FUTURO) (CHLORINE EVAPORATOR EV-7 (FUTURE))
18	ELEVADOR (ELEVATOR)
19	TOMADA DE FORÇA (POWER OUTLET)
20	RESERVA (SPARE)
21-23	DISJUNTORES P/ PAINÉIS DE EMERGENCIA (BREAKER TO EMERGENCY DIST. PANEL)
24	TRANSFORMADOR P/ PAINEL DE EMERGENCIA "1EM" (EMERGENCY TRANSF. FOR PANEL "1EM")
25	TRANSFORMADOR P/ INSTRUMENTAÇÃO (INSTRUMENTATION TRANSF.)
26	TRANSFORMADOR DE CONTROLE (CONTROL TRANSF.)
27-28	RESERVA E ESPAÇO (SPARE AND SPACE)
29	LUZ DE EMERGENCIA (EMERGENCY LIGHT)

PLAQ. DE IDENT. DO PAINEL DE EMERG.
(EMERGENCY MCC NAMEPLATE SCHEDULE)

"3EM"	
1	DISJUNTOR GERAL (MAIN CIRCUIT BREAKER)
2	MISTURADOR RÁPIDO MA-1 (RAPID MIXER MA-1)
3	BOMBA DE AMOSTRA BA-5 (SAMPLING PUMP BA-5)
4	BOMBA DE AMOSTRA BA-6 (SAMPLING PUMP BA-6)
5	BOMBA DE AMOSTRA BA-7 (SAMPLING PUMP BA-7)
6	BOMBA DE AMOSTRA BA-8 (SAMPLING PUMP BA-8)
7	BOMBA DE AMOSTRA BA-9 (SAMPLING PUMP BA-9)
8	BOMBA DE AMOSTRA BA-10 (SAMPLING PUMP BA-10)
9	RESERVA (SPARE)
10	BOMBAS DE DREN. DUPLAS BU-1-2-3-4 (DUPLEX SUMP PUMP BU-1-2-3-4)
11	BOMBAS DE DREN. DUPLAS BU-5-6-7-8 (DUPLEX SUMP PUMP BU-5-6-7-8)
12	BOMBAS DE DREN. DUPLAS BU-9-10 (DUPLEX SUMP PUMP BU-9-10)
13	BOMBAS DE DREN. DUPLAS BU-11-12 (DUPLEX SUMP PUMP BU-11-12)
14	LUZ DE EMERGENCIA (EMERGENCY LIGHT)
15	TRANSFORMADOR DE LUZ DE EMERGENCIA (EMERGENCY LIGHT TRANSF.)
16	DISJ. PARA TRAF. CONTR. ALIM. ALUME (CONTROL & ALIM. FEED'S TRASF. BREAKER)
17	TRANSF. DE CONTROLE E ALIM. DE ALUME (TRANSF. FOR CONTROL AND ALIM. FEEDERS)
18	RESERVA (SPARE)
19	ALIMENTADOR DE ALUME Nº1 (ALUM. FEEDER NO.1)
20	ALIMENTADOR DE ALUME Nº2 (ALUM. FEEDER NO.2)
21	RESERVA (SPARE)
22	TOMADA DE FORÇA (POWER OUTLET)
23	ESPAÇO (SPACE)

PLAQ. DE IDENT. DO MCC. - "1M"
(M.C.C. 1M NAMEPLATE SCHEDULE)

"1M"	
1	DISJUNTOR GERAL (MAIN CIRCUIT BREAKER)
2	BOMBA DE AGUA PARA SERVICOS GERAIS BU-1 (UTILITY WATER PUMP BU-1)
3	BOMBA DE AGUA PARA SERVICOS GERAIS BU-2 (UTILITY WATER PUMP BU-2)
4	BOMBA DE AGUA P/ SERVICOS GERAIS BU-3 (FUT.) (UTILITY WATER PUMP BU-3 (FUTURE))
5	VENTOINHA IS-1 (BLOWER IS-1)
6	VENTILADOR (FUTURO) (VENTILATOR (FUTURE))
7	VENTILADOR (FUTURO) (VENTILATOR (FUTURE))
8	VENTILADOR (FUTURO) (VENTILATOR (FUTURE))
9	VENTILADOR (FUTURO) (VENTILATOR (FUTURE))
10	VENTILADOR (FUTURO) (VENTILATOR (FUTURE))
11	DISJUNTOR PARA TRANSF. DE LUZ (CIRCUIT BREAKER TO LIGHT TRANSF.)
12	RESERVA (SPARE)
13	RESERVA (SPARE)
14	TOMADA DE FORÇA (POWER OUTLET)
15	ESPAÇO (SPACE)
16	ESPAÇO (SPACE)
17	DISJUNTOR PARA TRANSF. DE CONTROLE (CIRCUIT BREAKER CONTROL TRANSF.)
18	TRANSFORMADOR DE CONTROLE (CONTROL TRANSF.)

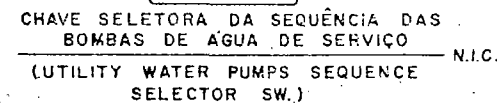
NOTA:	
TODAS AS DIMENSÕES SÃO EM MILÍMETROS	
(NOTE):	
(ALL DIMENSIONS ARE IN MILLIMETERS)	

FOLHA Nº 7	SHEET Nº 7
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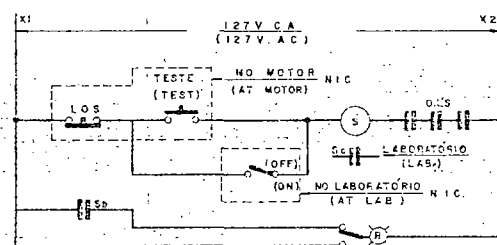
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(NOTE:
[ALL DIMENSIONS ARE IN MILLIMETERS])

FOLHA Nº 7 SHEET NO. 7

N.º DATA		REVISÃO		POR APROV. DATA		DESENHO DE REFERENCIA		NÚMERO		APROVAÇÕES		CIA. METROPOLITANA DE AGUA DE SÃO PAULO		ESTACÃO DE TRATAMENTO DE AGUA-GUARAU (WATER TREATMENT PLANT-GUARAU)		ESCALA (NO SCALE)	
										DES. <i>[Signature]</i> PROJ. <i>[Signature]</i> VER. <i>[Signature]</i> VISTO <i>[Signature]</i> APROV. <i>[Signature]</i> N.º INTERNO 5-XII-07		DES. <i>[Signature]</i> PROJ. <i>[Signature]</i> VER. <i>[Signature]</i> VISTO <i>[Signature]</i> APROV. <i>[Signature]</i>		VISTA FRONTAL DOS PAINÉIS "IEP", "1EM", "3EM" e "1M" (FRONT VIEW OF THE PANELS "IEP", "1EM", "3EM" & "1M")		COMASP 	

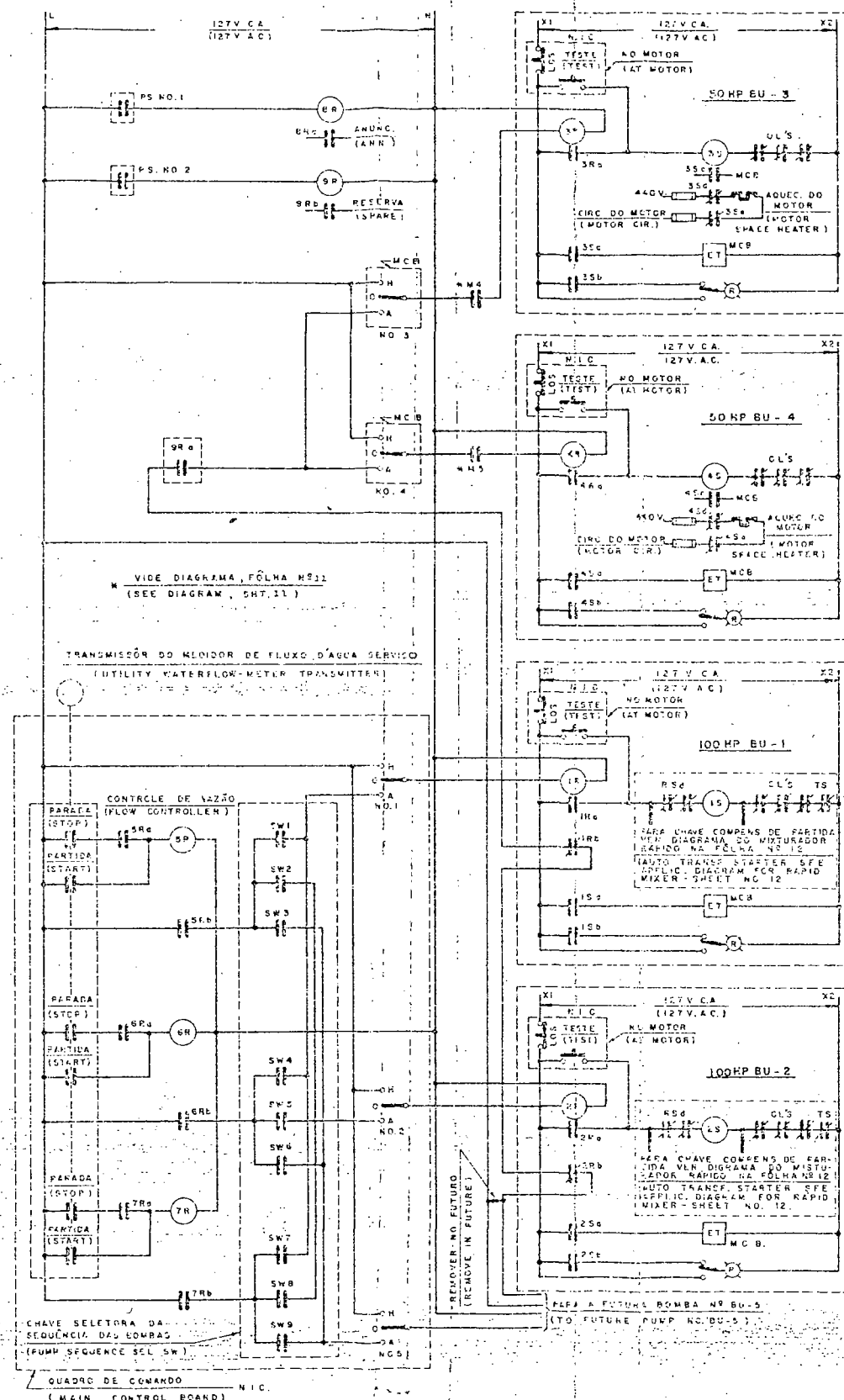


OPERAÇÃO DAS CHAVES (SWITCH DEVELOPMENT)							
FUNÇÃO (FUNCTION)	(SW NO)	POSIÇÃO DO SELETOR (SELECTOR POSITION)					
		3-2-5	4-5-3	5-3-4	3-5-4	4-3-5	5-4-3
1ª BOMBA (FIRST PUMP)	1	X					
	2		X				
	3			X			
	4				X		
2ª BOMBA (SECOND PUMP)	5					X	
	6						X
	7						
	8						
3ª BOMBA (THIRD PUMP)	9						
	0						



BOMBAS DE AMOSTRAGEM N.ºS.
BA-1, BA-2, BA-3, BA-4, BA-5, BA-6, BA-7, BA-8, BA-9, BA-10

(SAMPLING PUMPS NOS.
BA-1, BA-2, BA-3, BA-4, BA-5, BA-6, BA-7, BA-8, BA-9, BA-10)



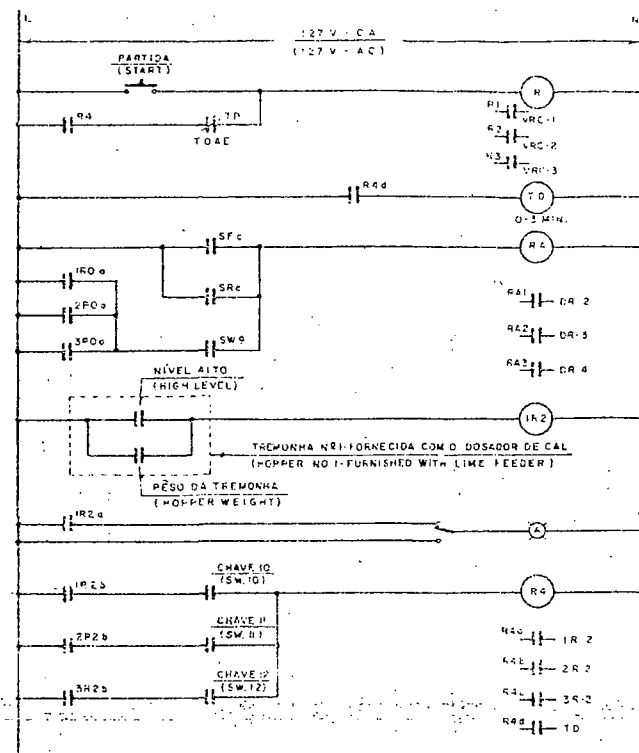
SIMBOLOGIA
(SYMBOLS.)

- | | |
|--------|--|
| | CONTATOR MAGNÉTICO IDENTIFICADO PELO NÚMERO
(STARTER COIL IDENTIFIED BY THE NUMBER) |
| | RELÊ DE TEMPO
(TIME DELAY RELAY COIL) |
| | RELÊ MAGNÉTICO - SEM RETENÇÃO
(MAGNETICALLY HELD ELECT. RELAY) |
| | MOTOR
(MOTOR) |
| | LÂMPADA PILOTO VERMELHA
(INDICATING LIGHT RED) |
| | LÂMPADA PILOTO VERDE
(INDICATING LIGHT GREEN) |
| | VÁLVULA SOLENOIDE
(SOLENOID VALVE) |
| | CONTATOR DE HORAS
(RUNNING TIME METER) |
| | CONTATO "C" NORMALMENTE ABERTO DO CONTATOR MAGNÉTICO "1S"
(NORMALLY OPEN CONTACT "C" ON MAGNETIC STARTER "1S") |
| | CONTATO "S" NORMALMENTE FECHADO DO RELÊ "2R"
(NORMALLY CLOSED CONTACT "S" ON RELAY "2R") |
| | RELÊ TÉRMICO
(OVERLOAD RELAY) |
| | CHAVE SELETOIRA DE TRÊS POSIÇÕES
(3 POSITION SELECTOR SWITCH) |
| TCAE | CONTATO DE RELÊ DE TEMPO FECHA APÓS UM TEMPO PRE-FIXADO DE ENERGIIZAÇÃO
(CONTACT TO CLOSE AFTER ENERGIZATION OF TIMER OR TIME DELAY RELAY) |
| MCB | QUADRO PRINCIPAL DE COMANDO - INSTRUMENTAÇÃO (N.I.C.)
(MAIN CONTROL BOARD - INSTRUMENTATION) |
| FCB | QUADRO DE COMANDO DOS FILTROS - INSTRUMENTAÇÃO (N.I.C.)
(FILTER CONTROL BOARD - INSTRUMENTATION) |
| IC | CONTATO INSTANTÂNEO
(INSTANT. CONTACT) |
| LOS | BOTÃO DE BLOQUEIO
(LOCK OUT (STOP)) |
| XI-X2 | TERMINAIS DO TRANSFORMADOR DE CONTROLE FORNECIDO COM A CHAVE DE PARTIDA
(TERMINALS AT STARTER CONTROL TRANSFORMER FURNISHED WITH STARTER) |
| N.I.C. | NÃO INCLUIDO NO CONTRATO - FORNECIDO POR OUTROS
(NOT IN CONTRACT - FURNISHED BY OTHERS) |
| | CONTATO "S" NO RELÊ 4S, PARA SER USADO NO CIRCUITO DE CONTROLE DO EQUIPAMENTO 1S-1
(CONTACT "S" ON RELAY 4S, TO BE USED IN CONTROL CIRCUIT OF EQUIPMENT 1S-1) |
| | PRESSOSTATO
(PRESSURE SWITCH) |

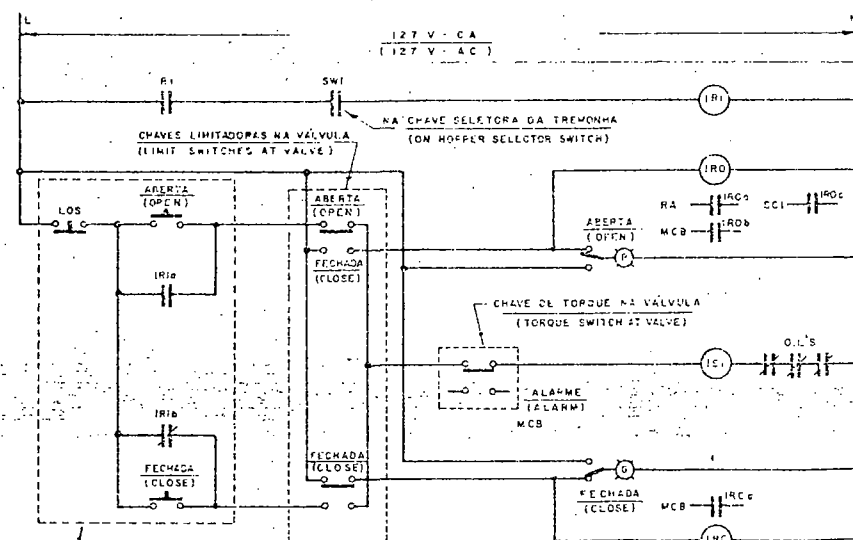
NOTAS (NOTES)

- 1) VER FOLHA Nº 12 PARA DISPOSIÇÃO DOS RELES, CHAVES, LÂMPADAS, ETC. LOCALIZADAS NO RAÍSEL DE CONTROLE DA ALIMENTAÇÃO DE CAL E NO RAÍSEL DA ESTAÇÃO DE TRANSCÊNCIA DE CAL
- 2) REFER TO SHEET NO 13 FOR RELAYS, LIGHTS, SWITCHES, ETC. LOCATED IN RELAY PANELS, LINE FEEDING CONTROL PANEL AND LINE TRANSFER STATION
- 3) OS RELES, LÂMPADAS, INTERRUPTORES E FOTOÍRRAS SEM REFERÊNCIA, OU NÃO, LOCALIZADOS NA FOLHA Nº 13 DEVEM SER MONTADOS NO COMPARTIMENTO DA CHAVE DE PARTIDA CORRESPONDENTE
- 4) RELAYS, LIGHTS, SWITCHES AND PUSH BUTTONS WITHOUT REFERENCE AND NOT SHOWN ON SHEET NO 13 SHALL BE MOUNTED IN THE CORRESPONDING STARTER COMPARTMENT

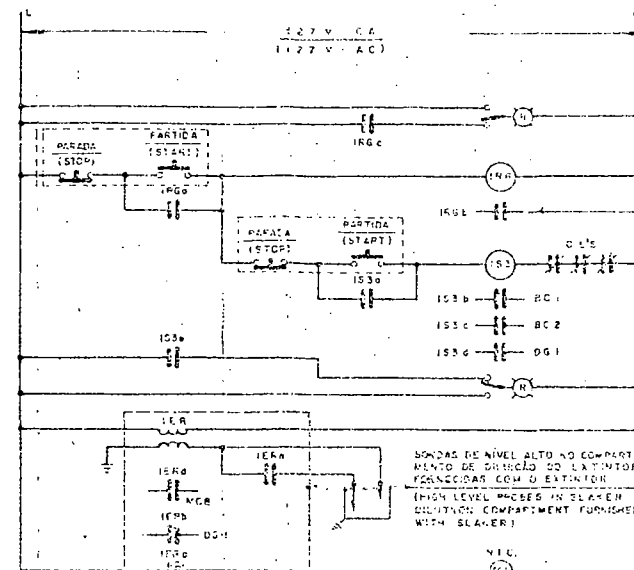
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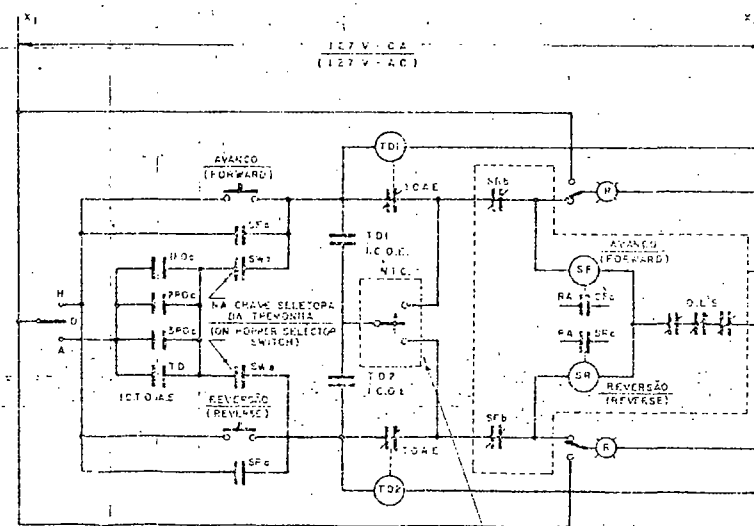
TREMONHAS - SISTEMA DE ABASTECIMENTO
(HOPPERS - FILLING SYSTEM)



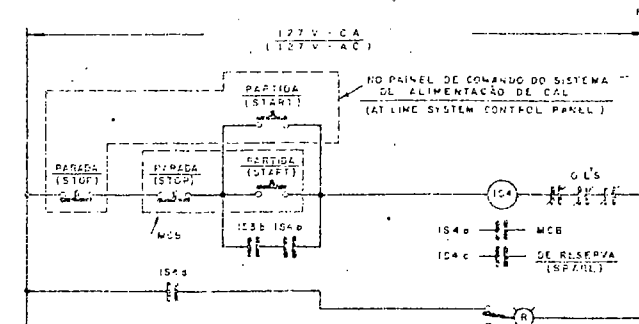
VÁLVULAS ROTATIVAS DE FECHAMENTO NOS VRC-1, VRC-2 E VRC-3
(ROTARY CUTOFF VALVES NOS. VRC-1, VRC-2 AND VRC-3)



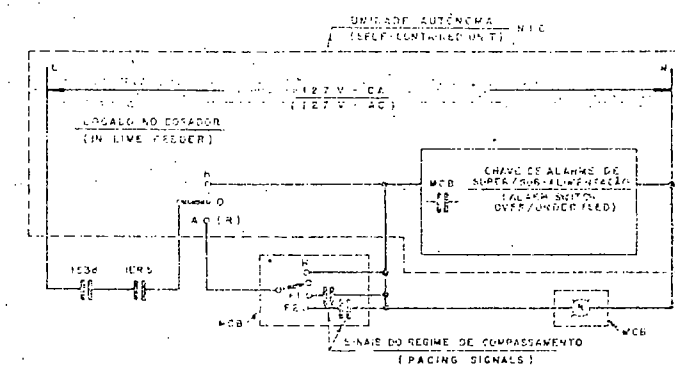
EXTINTORES NOS EX-1, EX-2 E EX-3
(SLAKERS NOS. EX-1, EX-2 AND EX-3)



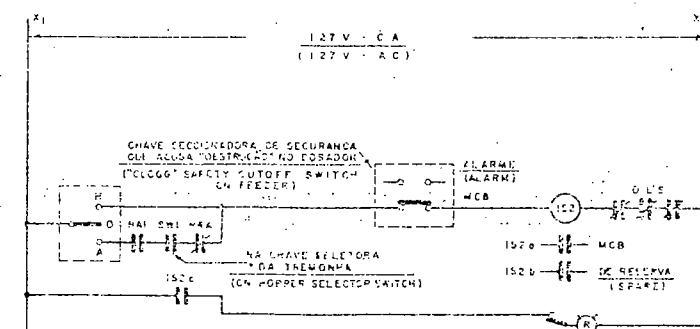
TRANSPORTADOR TIPO PARAFUSO Nº SC-1
(SCREW CONVEYOR NO. SC-1)



POMBAS DE ALIMENTAÇÃO NOS BC-1, BC-2, BC-3, BC-4, BC-5 E BC-6
(FEED PUMPS NOS. BC-1, BC-2, BC-3, BC-4, BC-5 AND BC-6)



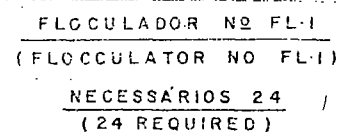
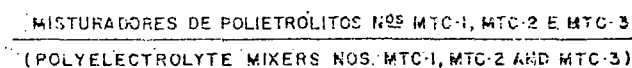
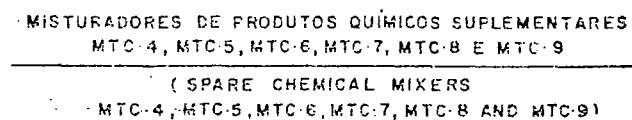
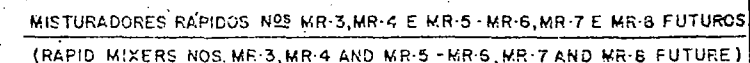
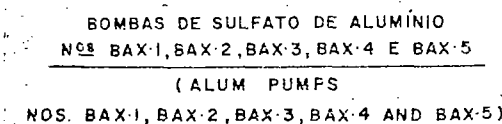
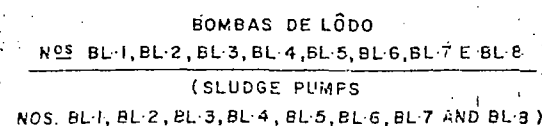
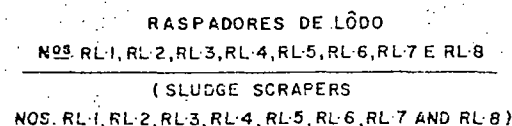
DOSADORES NOS DG-1, DG-2 E DG-3
(FEEDERS NOS. DG-1, DG-2 AND DG-3)



DOSADORES A SECO, TIPO ROTATIVOS NOS DR-2, DR-3 E DR-4
(ROTARY DRY FEEDERS NOS. DR-2, DR-3 AND DR-4)

N.º		DATA	REVISÃO	POR	APROV.	DATA	DESENHO DE REFERÊNCIA	NÚMERO	APROVAÇÕES				FOLHA Nº 10		SHEET NO. 10	
									JAMES M. MONTGOMERY CONSULTING ENGINEERS, INC.		DATA	COMASP	CIA. METROPOLITANA DE ÁGUA DE SÃO PAULO		ESTÁÇÃO DE TRATAMENTO DE ÁGUA-GUARAU (WATER TREATMENT PLANT-GUARAU)	
									DES.		DES.	COMASP	DIAGRAMAS DE COMANDO DO SISTEMA DE CAL (LIME SYSTEM CONTROL DIAGRAMS)		ESCALA SEM ESCALA (NO SCALE)	
									PROJ.		PROJ.	COMASP				
									VER.		VER.	COMASP				
									VISTO		VISTO	COMASP				
									APROV.		APROV.	COMASP				
									REVISÃO		REVISÃO	COMASP				

[illegible]



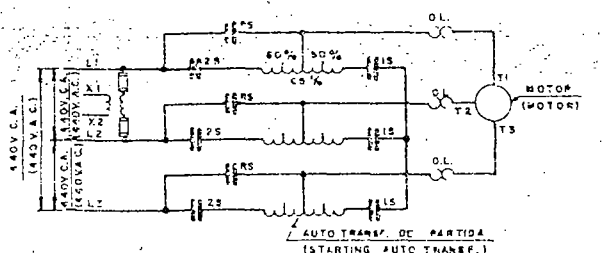
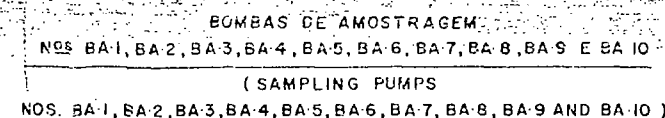
SEQUÊNCIA DE PARTIDA
(START-UP TIME SEQUENCE)

M. C. C. 3 M A

М. С. С. 3 М В

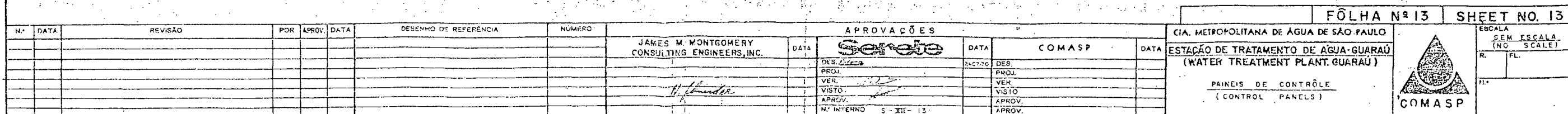
IDENTICO AO 3MA EXCETO O CONTATO "M-3" QUE E PARA VENTILADORES V-1 E V-2
(SAME AS M.C.C. 3MA EXCEPT "M-3" CONTACT IS FOR BLOWERS V-1 AND V-2)

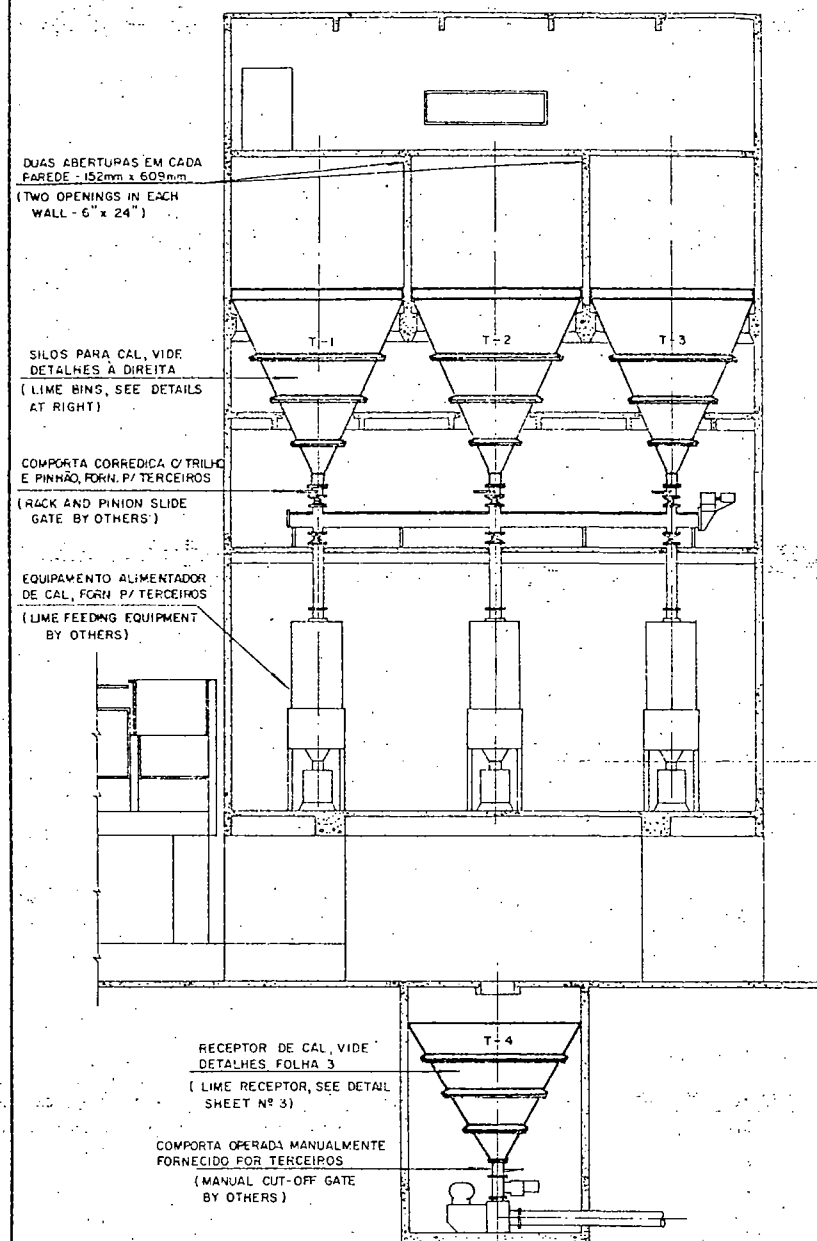
DIAGRAMA PARA OS VENTILADORES V-1 E V-2, IGUAL AO DOS FLOCULADORES
(DIAGRAM FOR BLOWERS V-1 AND V-2 SAME AS FOR FLOCCULATORS)



MISTURADOR RAPIDO Nº MR-1 E VENTILADOR Nº V-3
(RAPID MIXER NO. MR-1 AND BLOWER NO. V-3)

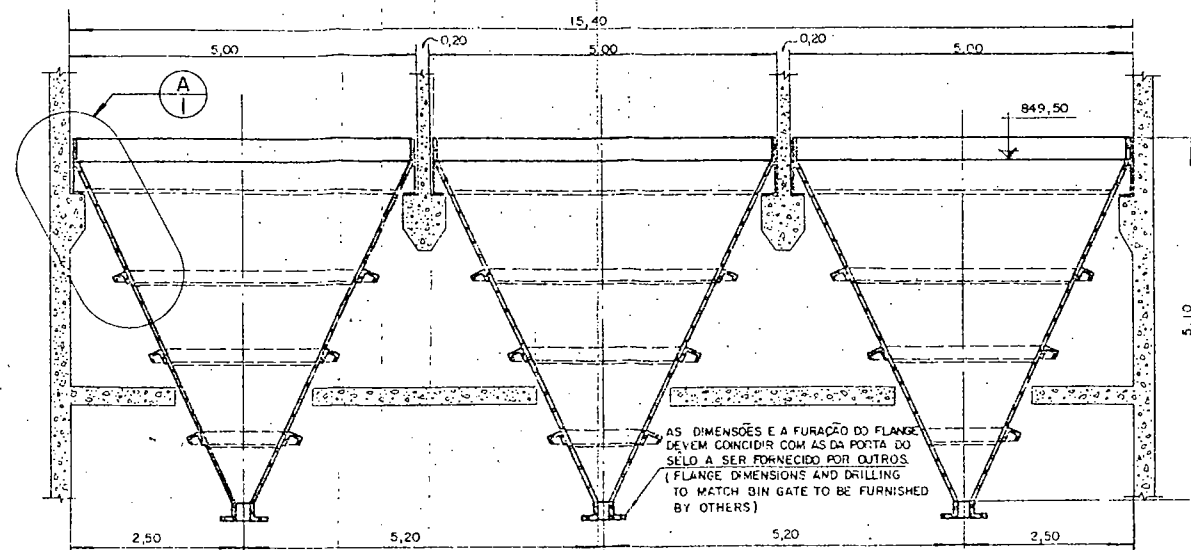
N°	DATA	REVISÃO	POR	APROV.	DATA	DESENHO DE REFERÊNCIA	NÚMERO	APROVAÇÕES
						PARA LEGENDA E NOTAS GERAIS VER FOLHA Nº8, PARA DISPOSIÇÃO DAS COMPONENTES, VER FOLHA Nº10.	JAMES M. MONTGOMERY CONSULTING ENGINEERS, INC. DES <i>H.J. Hunter</i>	<div style="float:right;">CIA. METROPOLITANA DE ÁGUA DE SÃO PAULO</div> <div style="clear:both;"></div> ESTÁGIO DE TRATAMENTO DE ÁGUA-GUARAU (WATER TREATMENT PLANT GUARAU) DIAGRAMAS DE COMANDO (CONTROL DIAGRAMS)
								DATA: <i>Sereno</i> DES.: _____ PROJ.: _____ VER.: _____ VISTO.: _____ APROV.: _____ N° INTERNO C - XII - 12





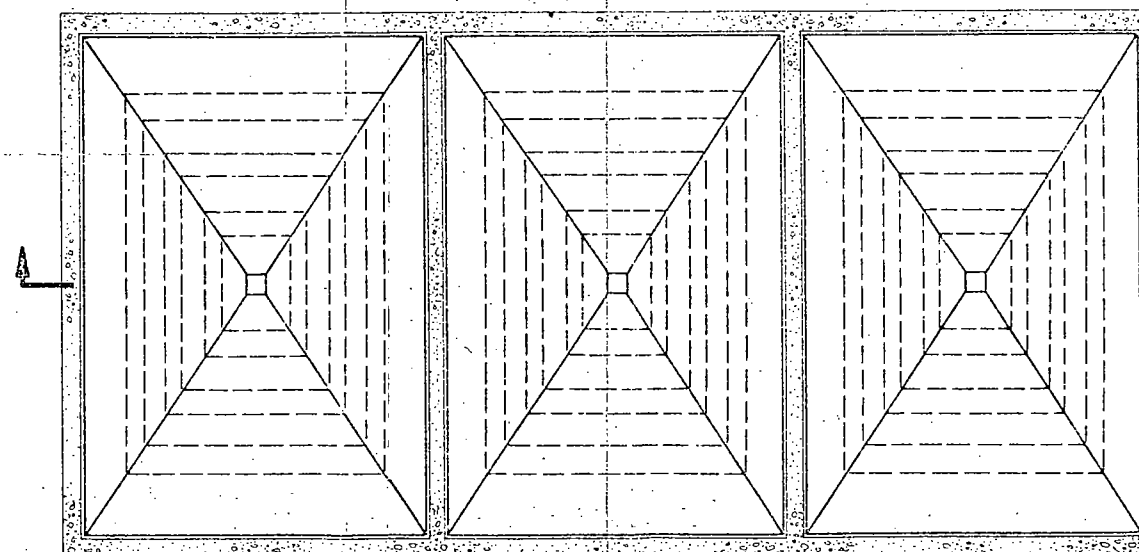
CORTE ATRAVÉS DA CASA DE QUÍMICA
(SECTION THRU CHEMICAL BUILDING)

SEM ESCALA (NO SCALE)



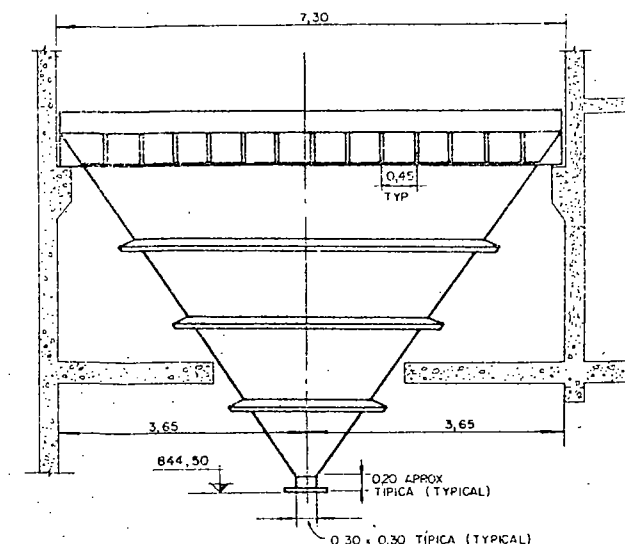
CORTE (SECTION)

SEM ESCALA (NO SCALE)



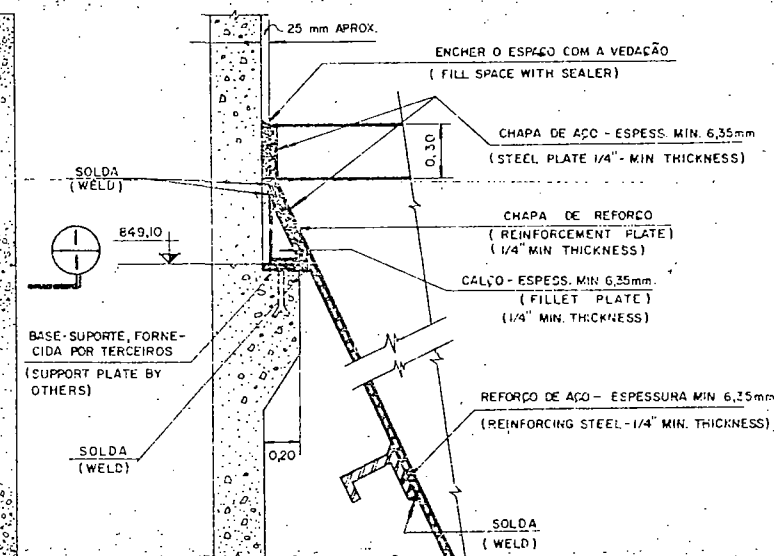
PLANTA (PLAN)

SEM ESCALA (NO SCALE)



CORTE (SECTION)

SEM ESCALA (NO SCALE)



DETALHE (DETAIL)

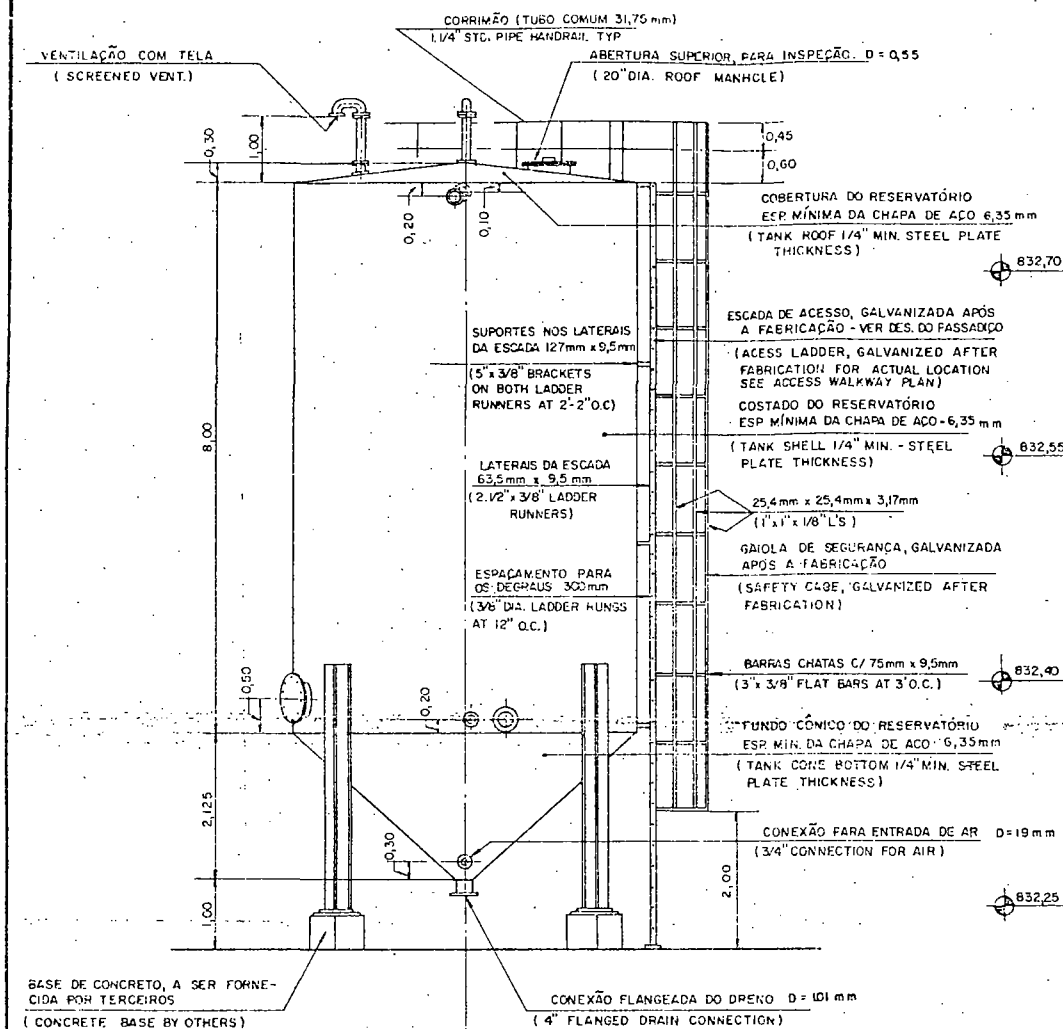
SEM ESCALA (NO SCALE)

NOTA:
TODAS AS DIMENSÕES ESTÃO EM METROS, EXCETO QUANDO INDICADO DE OUTRA FORMA.

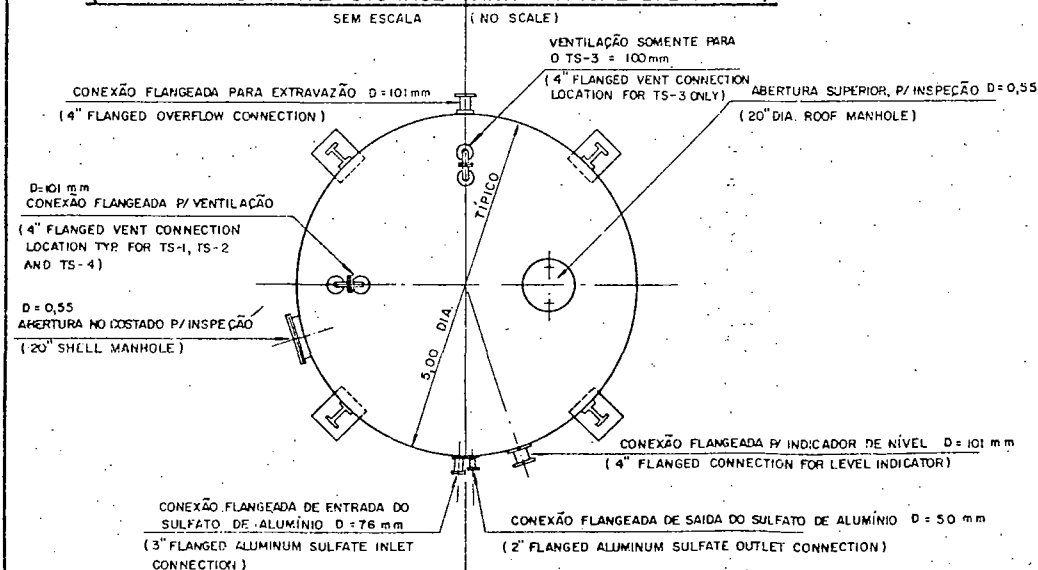
(NOTE:
(UNLESS OTHERWISE NOTED ALL DIMENSIONS ARE IN METERS))

FOLHA Nº 1 a (SHEET Nº 1)

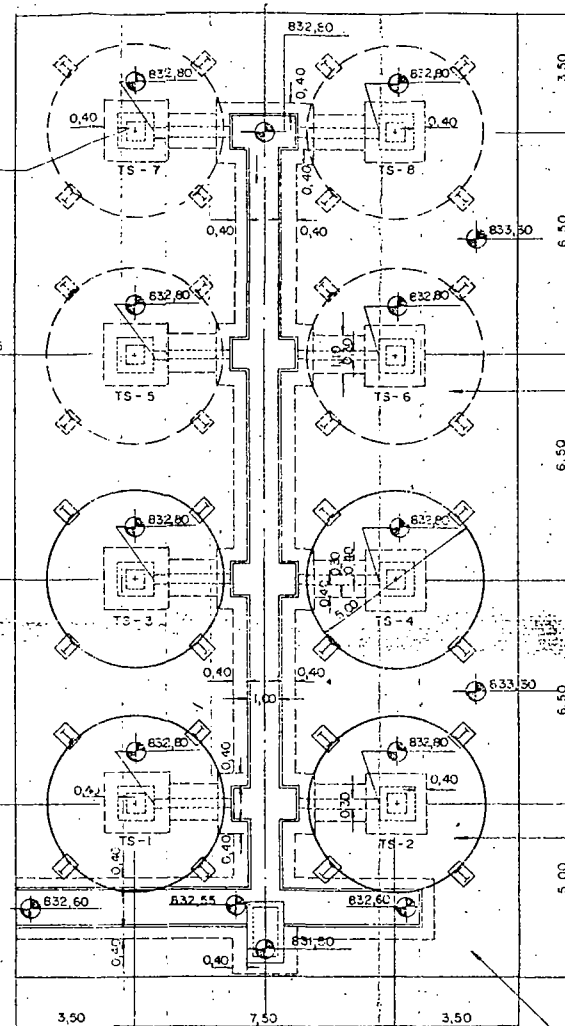
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								JAMES M. MONTGOMERY CONSULTING ENGINEERS, INC.	DATA: 12/4/70	DES. S. V. 001	DES. 27-1-70	ESTÁÇÃO DE TRATAMENTO DE ÁGUA-GUARÁU (WATER TREATMENT PLANT - GUARÁU)	R. FL.
												EQUIPAMENTO MECÂNICO GRUPO X (MECHANICAL EQUIPMENT GROUP X)	N.º
												(LIME STORAGE BINS)	COMASP



RESERVATÓRIOS P/ARMAZENAMENTO DE SULFATO DE ALUMÍNIO - PERFIL TÍPICO
(ALUMINUM SULFATE STORAGE TANK - TYPICAL ELEVATION)



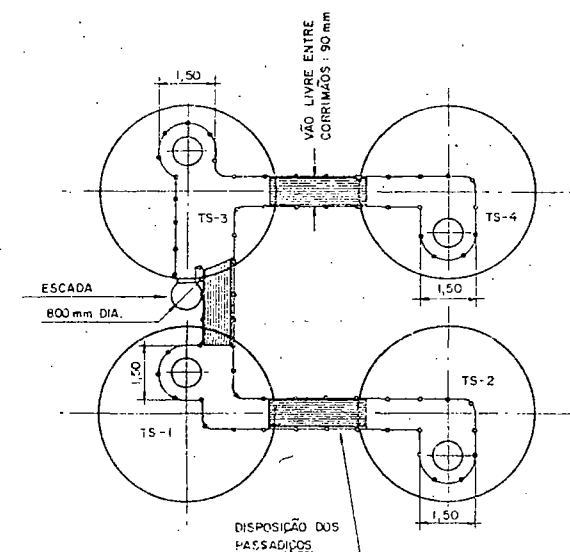
RESERVATÓRIOS P/ARMAZENAMENTO DE SULFATO DE ALUMÍNIO - PLANTA TÍPICA
(ALUMINUM SULFATE STORAGE TANK - TYPICAL PLAN)



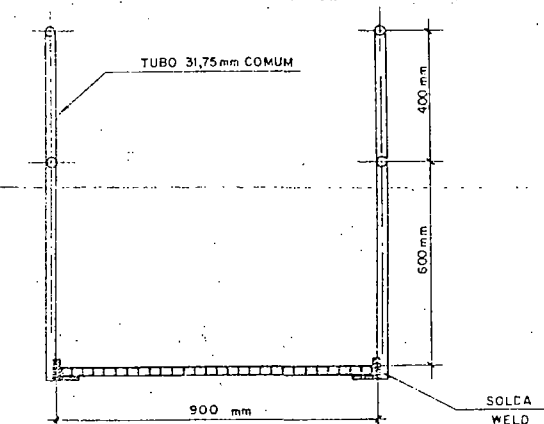
DISPOSIÇÃO DOS RESERVATÓRIOS P/ARMAZENAMENTO DE SULFATO DE ALUMÍNIO
(ALUMINUM SULFATE STORAGE TANK ARRANGEMENT)

SEM ESCALA (NO SCALE)

NOTA: RESERVATÓRIOS PARA ARMAZENAMENTO DE SULFATO DE ALUMÍNIO - TS-1, TS-2, TS-3 E TS-4.
(NOTE: ALUMINUM SULFATE STORAGE TANK TS-1, TS-2, TS-3 AND TS-4)



DETALHE DA LIGAÇÃO ENTRE OS TANQUES E PASSADICO
CONNECTION DETAIL BETWEEN TANK AND WALKWAY

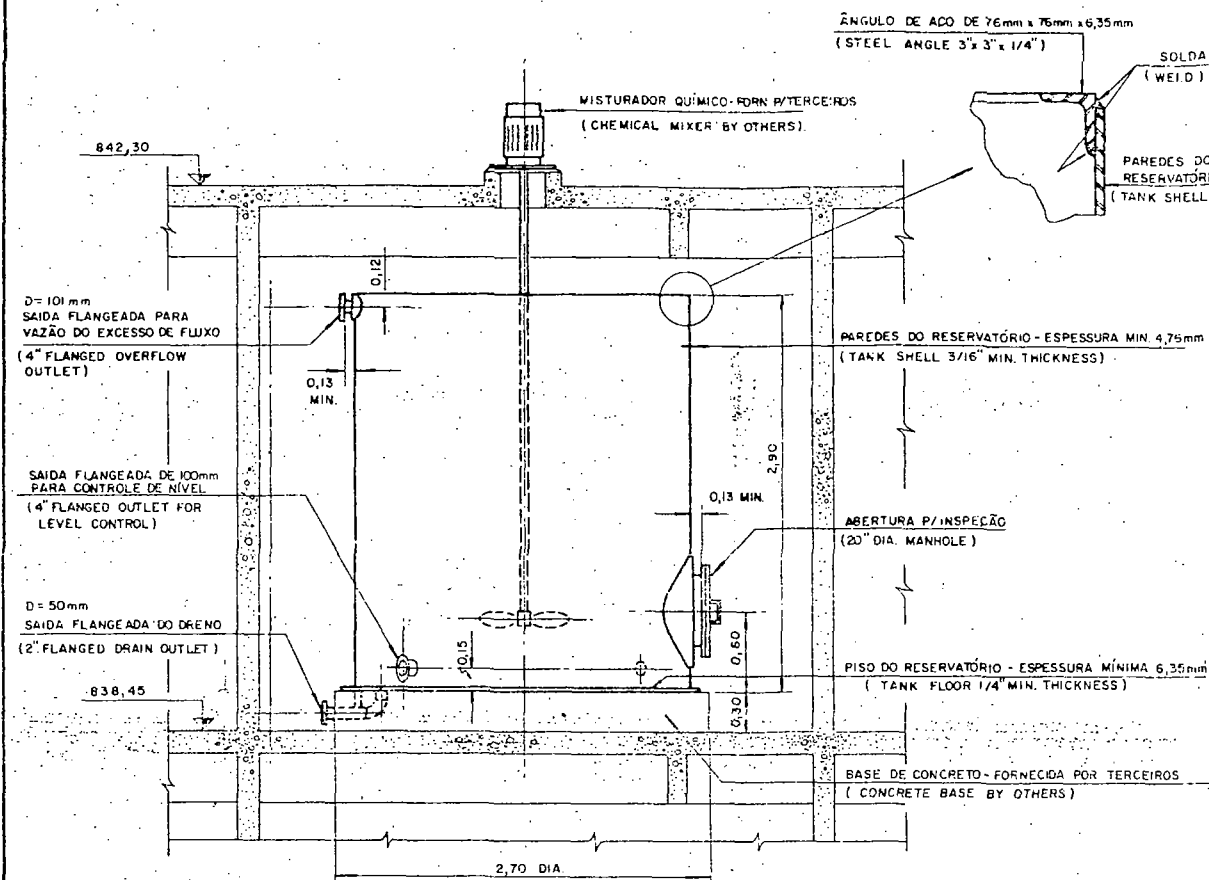


DETALHE TÍPICO DOS PASSADICOS ENTRE TANQUES
DETAIL TYPICAL WALKWAY BETWEEN TANKS

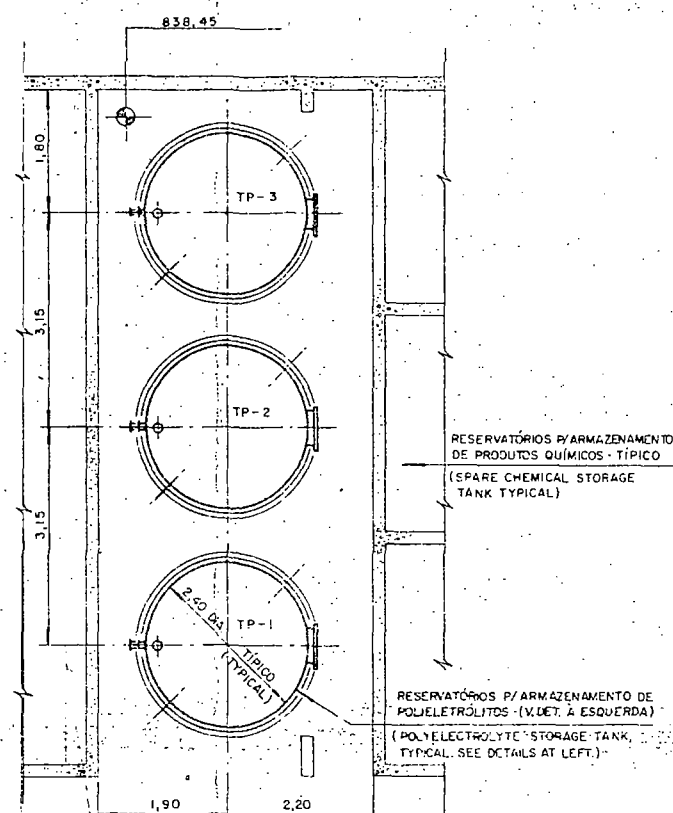
NOTA: TODAS AS DIMENSÕES ESTÃO EM METROS, EXCETO QUANDO INDICADO DE OUTRA FORMA.
(NOTE: UNLESS OTHERWISE NOTED ALL DIMENSIONS ARE IN METERS)

FOLHA Nº 2 a (SHEET Nº 2)

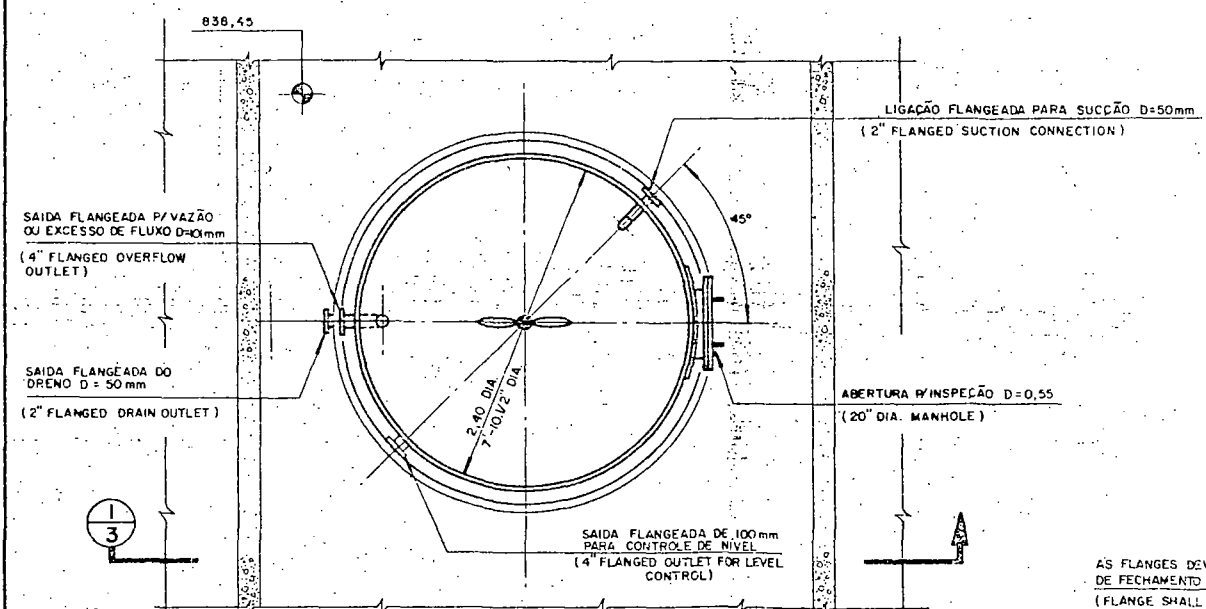
Nº	DATA	REVISÃO	POR	APROV.	DATA	DESENHO DE REFERÊNCIA	NÚMERO	APROVAÇÃO	DATA	COMASP	DATA	CIA. METROPOLITANA DE ÁGUA DE SÃO PAULO	ESCALA INDICADAS (NOTED)
								JAMES M. MONTGOMERY CONSULTING ENGINEERS, INC.	21/1/16	DES. <i>Elmora</i>	26-1-70	ESTÁÇÃO DE TRATAMENTO DE ÁGUA-GUARÁU (WATER TREATMENT PLANT - GUARÁU)	R. FL.
								DES. <i>Elmora</i>		PROJ.		EQUIPAMENTO MECÂNICO - GRUPO II (MECHANICAL EQUIPMENT GROUP II)	Nº
								VER.		VER.		RESERVATÓRIOS P/ARMAZENAMENTO DE SULFATO DE ALUMÍNIO (ALUMINUM SULFATE STORAGE TANK)	
								VISTO		VISTO			
								APROV.		APROV.			
								Nº INTERNO S-VI-002		APROV.			



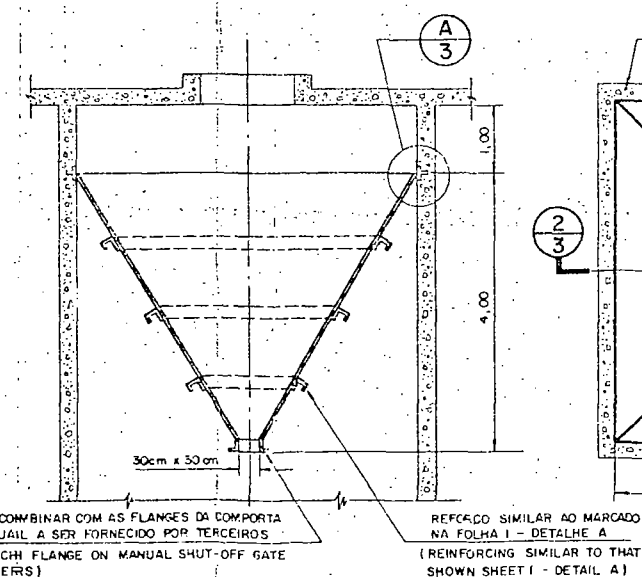
CORTE (SECTION) 1/3
SEM ESCALA (NO SCALE)



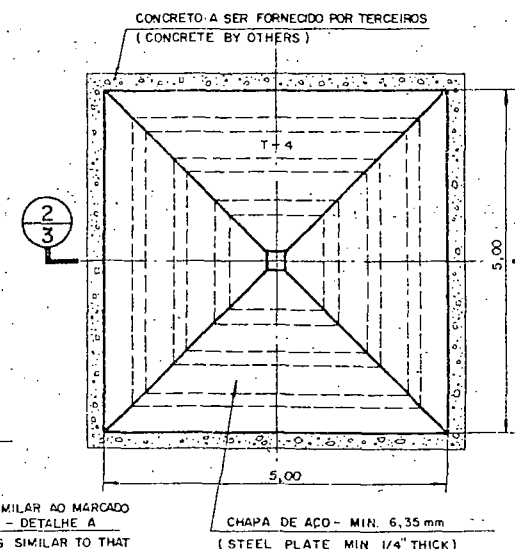
PLANTAS DOS RESERVATÓRIOS DE POLIELETRÓLITO
(PLAN OF POLYELECTROLYTE TANKS)
SEM ESCALA (NO SCALE)



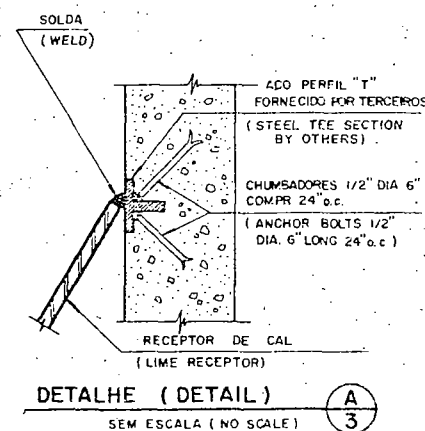
RESERVATÓRIO DE POLIELETRÓLITO-PLANTA TÍPICA (POLYELECTROLYTE TANK-TYPICAL PLAN)
SEM ESCALA (NO SCALE)



CORTE (SECTION) 2/3
RECEPTOR DE CAL (LIME RECEPTOR)
SEM ESCALA (NO SCALE)



PLANTA (PLAN)



DETALHE (DETAIL) A/3
SEM ESCALA (NO SCALE)

NOTA:
TODAS AS DIMENSÕES ESTÃO EM METROS, EXCETO QUANDO INDICADO DE OUTRA FORMA.
(NOTE:)
(UNLESS OTHERWISE NOTED ALL DIMENSIONS ARE IN METERS.)

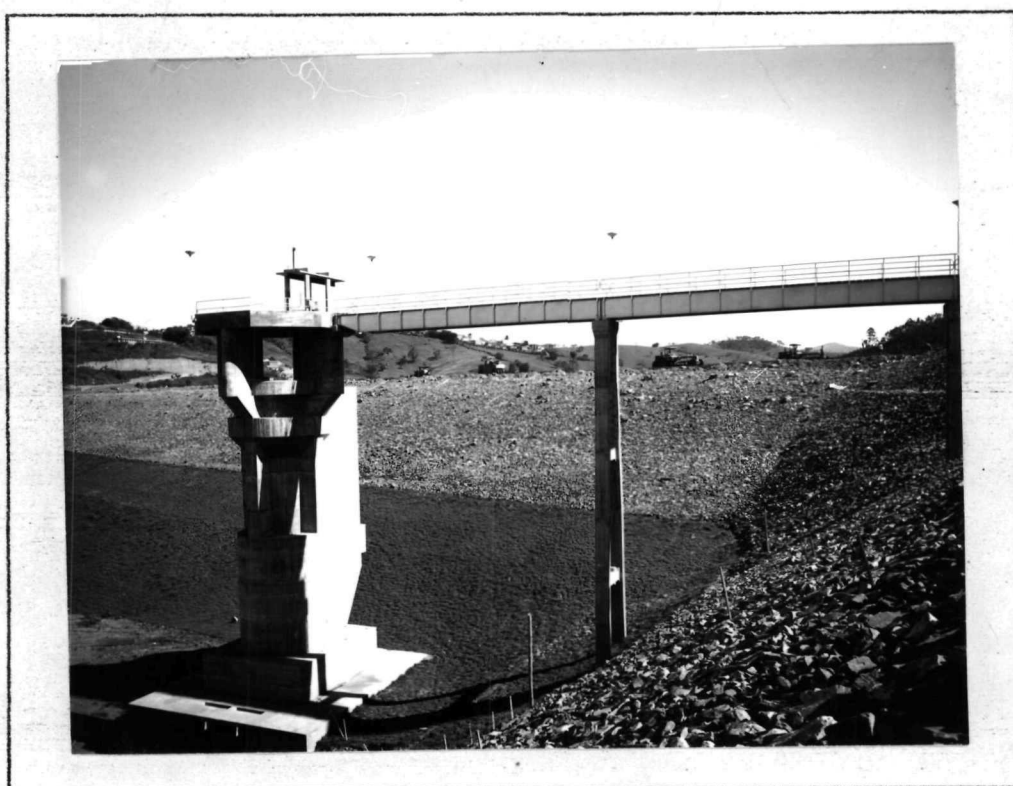
FOLHA Nº 3a (SHEET Nº 3)

N.º	DATA	REVISÃO	POR	APROV.	DATA	DESENHO DE REFERÊNCIA	NÚMERO	APROVAÇÕES	COMASP	DATA	CIA. METROPOLITANA DE ÁGUA DE SÃO PAULO	ESCALA INDICADAS (NOTED)
								JAMES M. MONTGOMERY CONSULTING ENGINEERS, INC.			ESTAÇÃO DE TRATAMENTO DE ÁGUA-GUARÁ (WATER TREATMENT PLANT - GUARÁ)	R. FL.
								DES. 23-1-70			EQUIPAMENTO MECÂNICO GRUPO I (MECHANICAL EQUIPMENT GROUP I)	N.º
								PROJ.			RESERVATÓRIOS POLIELETRÓLITO E MISTURADORES QUÍMICOS (POLYELECTROLYTE STORAGE TANKS AND CHEMICAL MIXERS)	
								VER.				
								VISTO				
								APROV.				
								N.º INTERNO S-X-003				

DIVISÃO VI

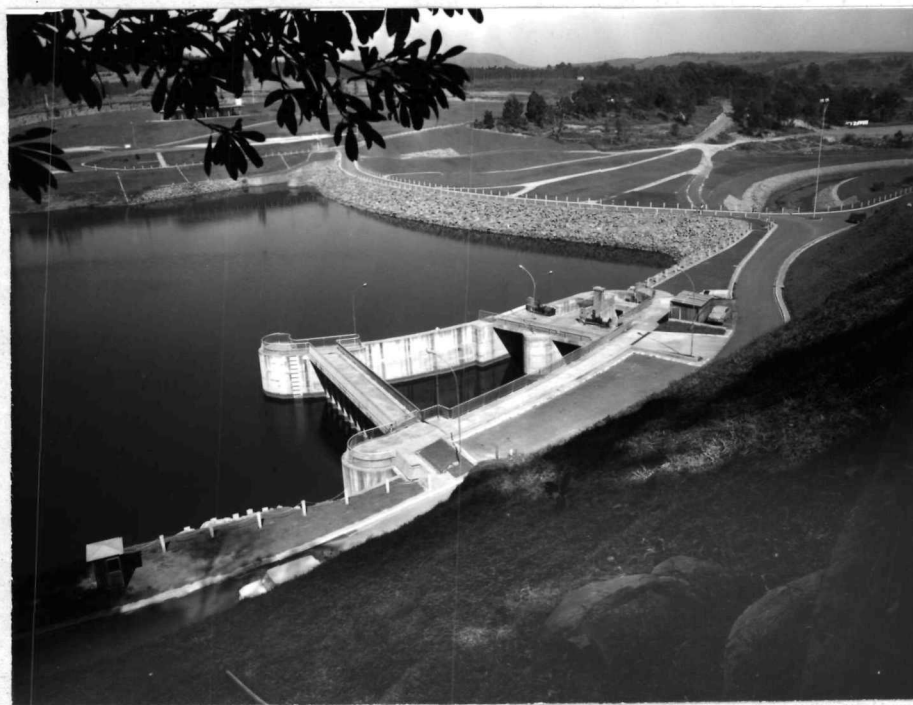
VI - FOTOGRAFIAS

BARRAGEM DO ATIBAINHA

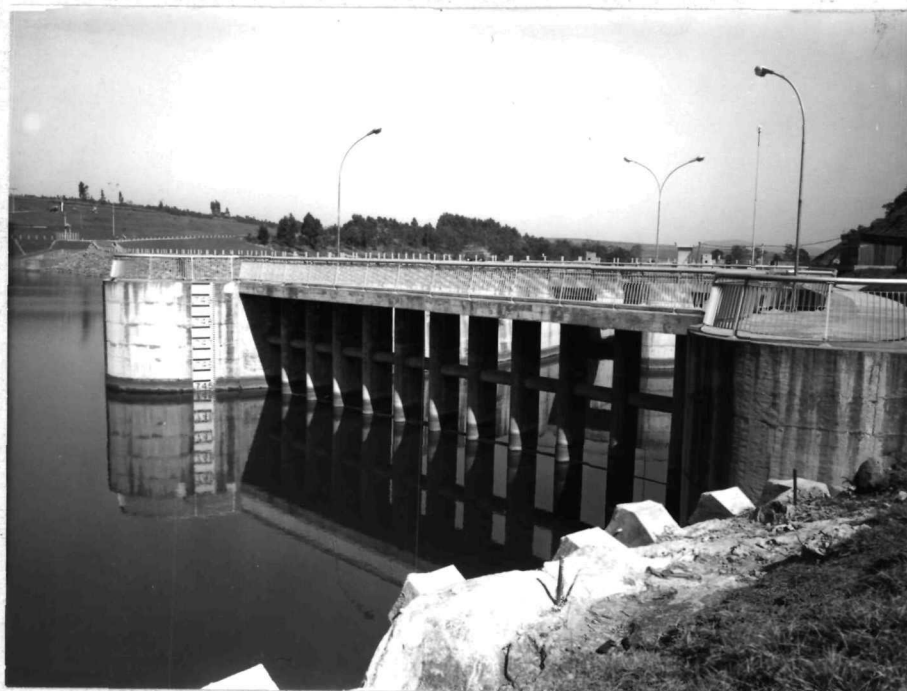


Vista do Vertedouro Tulipa e da Face de Montante
da Barragem de Terra

BARRAGEM ENGº PAIVA CASTRO (EX-JUQUERÍ)

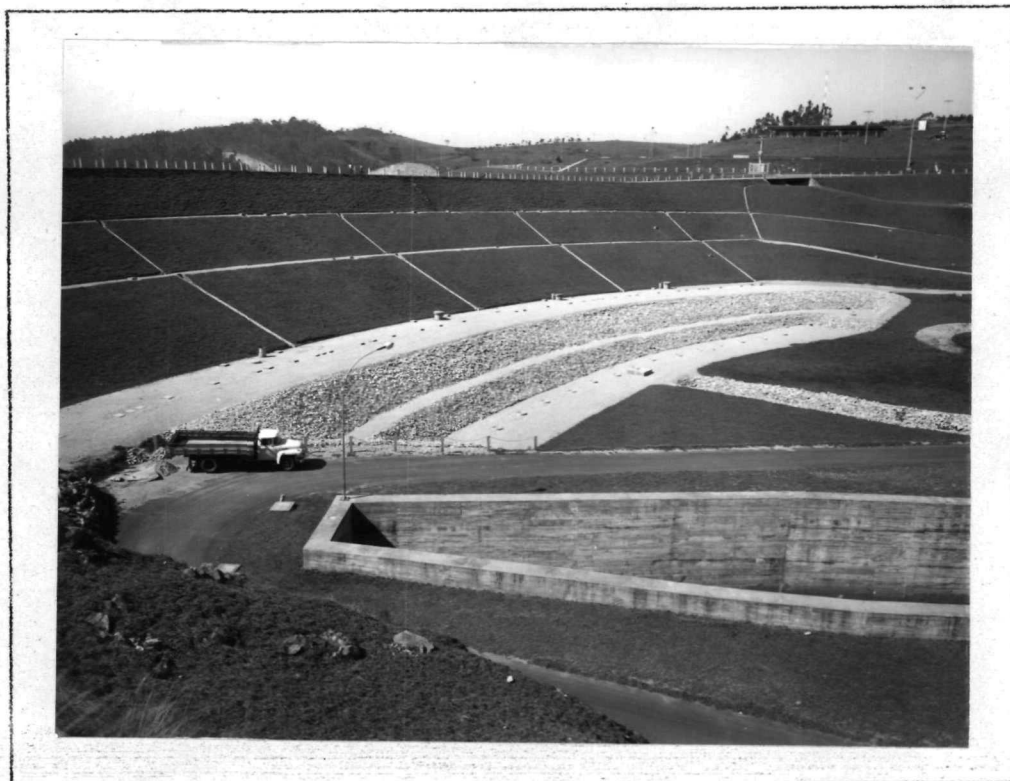


Vista Geral - Montante



Descarregador Principal

BARRAGEM ENGº PAIVA CASTRO (EX-JUQUERÍ)

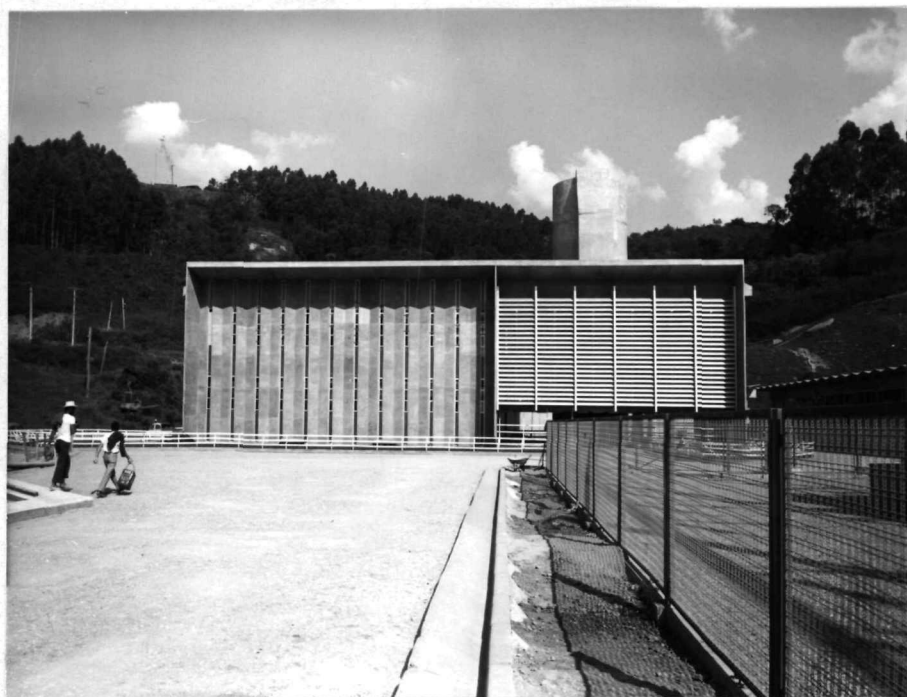


Vista Geral - Jusante

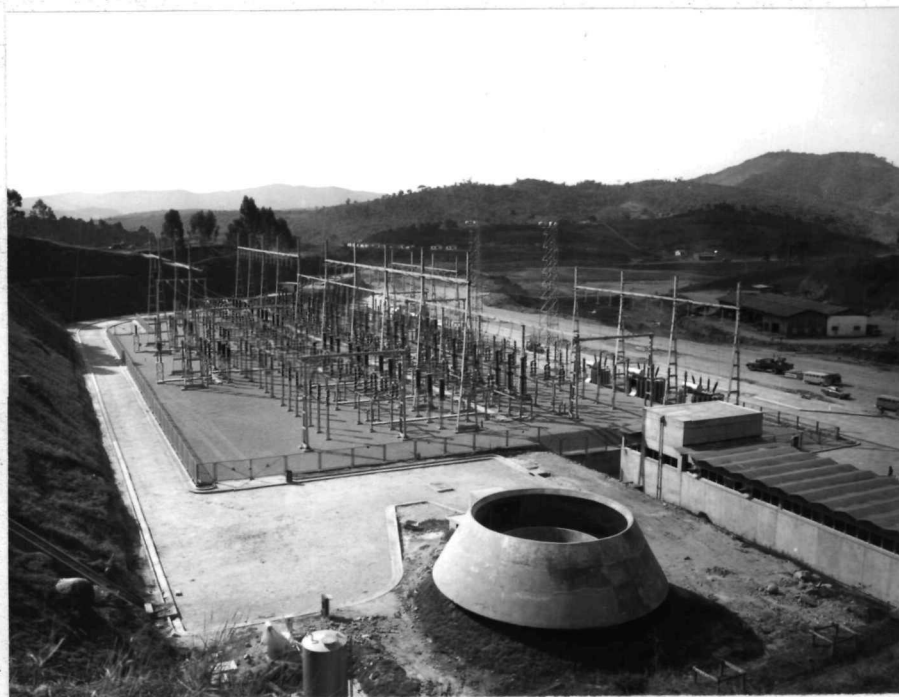


Reservatório Engº Paiva Castro

ESTAÇÃO ELEVATÓRIA DE SANTA INÊS - ESI



Edifício de Comando e Serviços



Sub-Estação

ESTAÇÃO ELEVATÓRIA DE SANTA INÊS - ESI



Chaminé de Equilíbrio



Painéis de Comando e Mesa de Controle

ESTAÇÃO ELEVATÓRIA DE SANTA INÊS - ESI

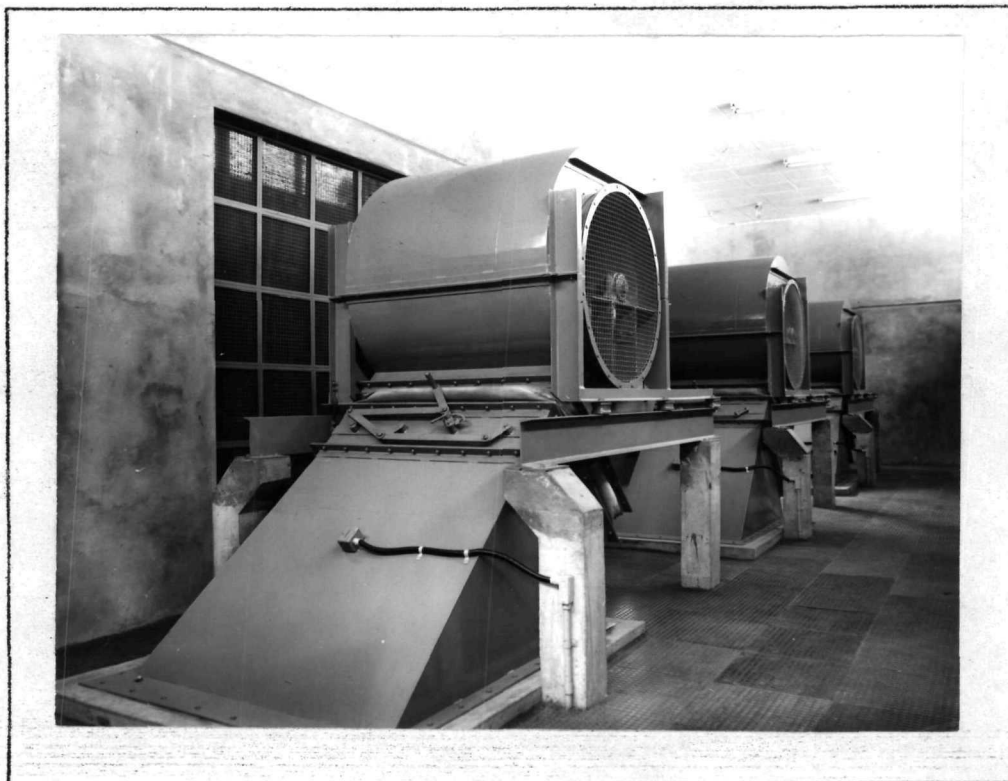


Painel de Comando de Serviços Auxiliares

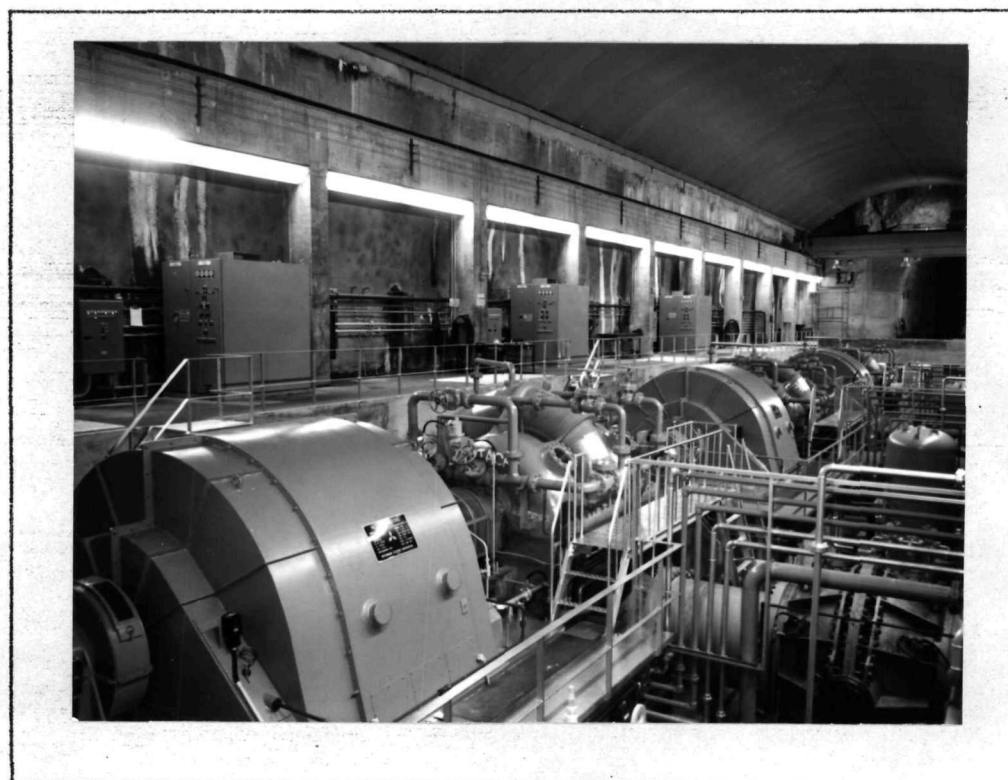


Painéis de Comando de Válvulas e Excitação dos
Motores

ESTAÇÃO ELEVATÓRIA DE SANTA INÊS - ESI



Ventiladores

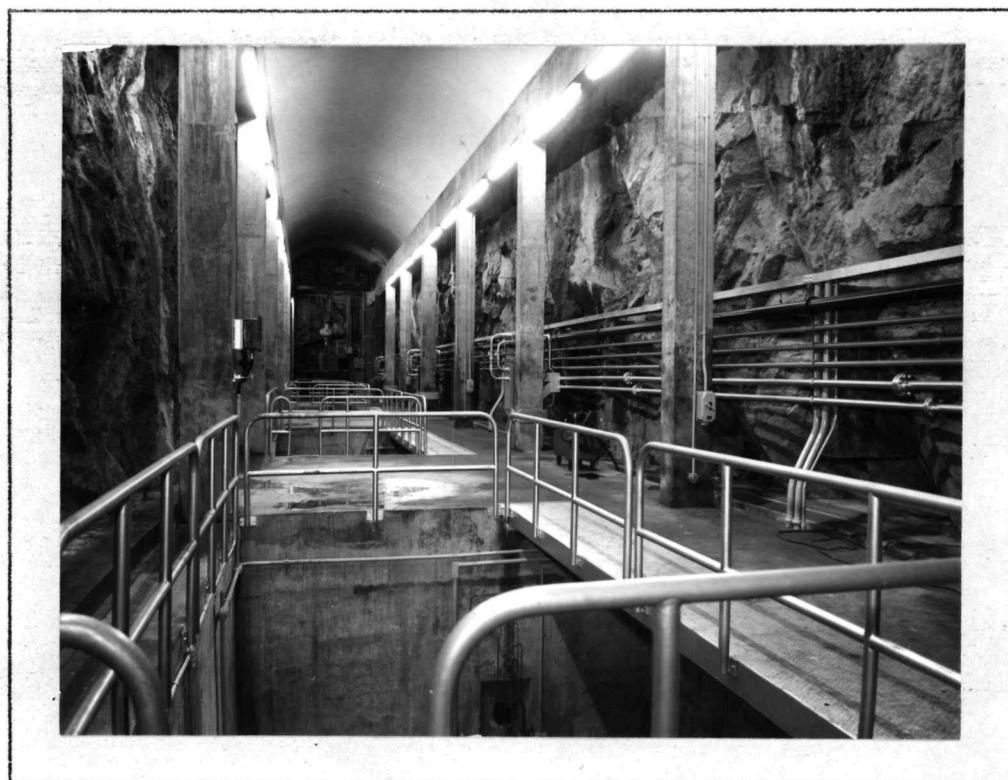


Casa de Bombas

ESTAÇÃO ELEVATÓRIA SANTA INÊS - ESI

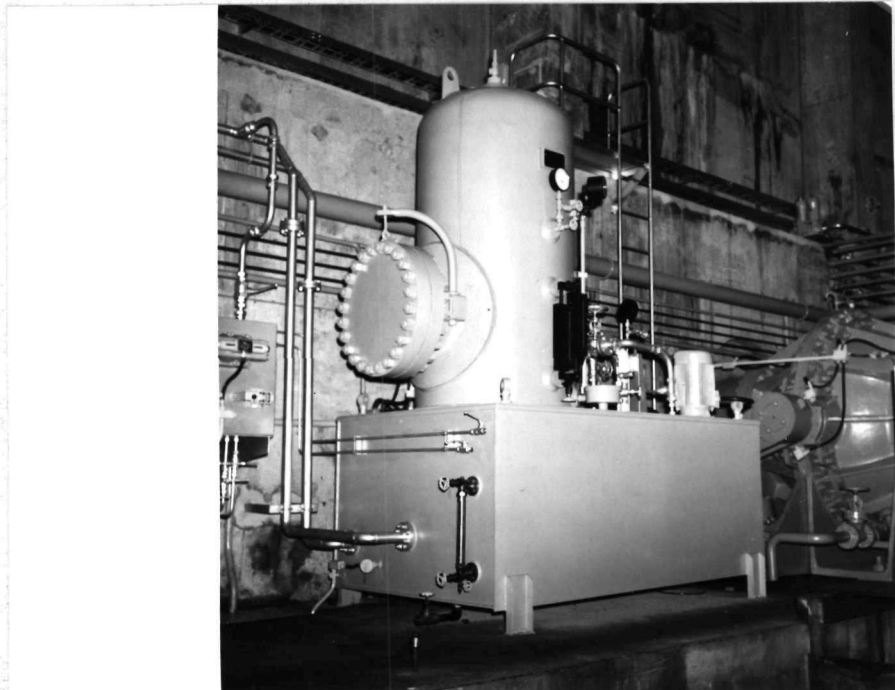


Válvula de Recalque

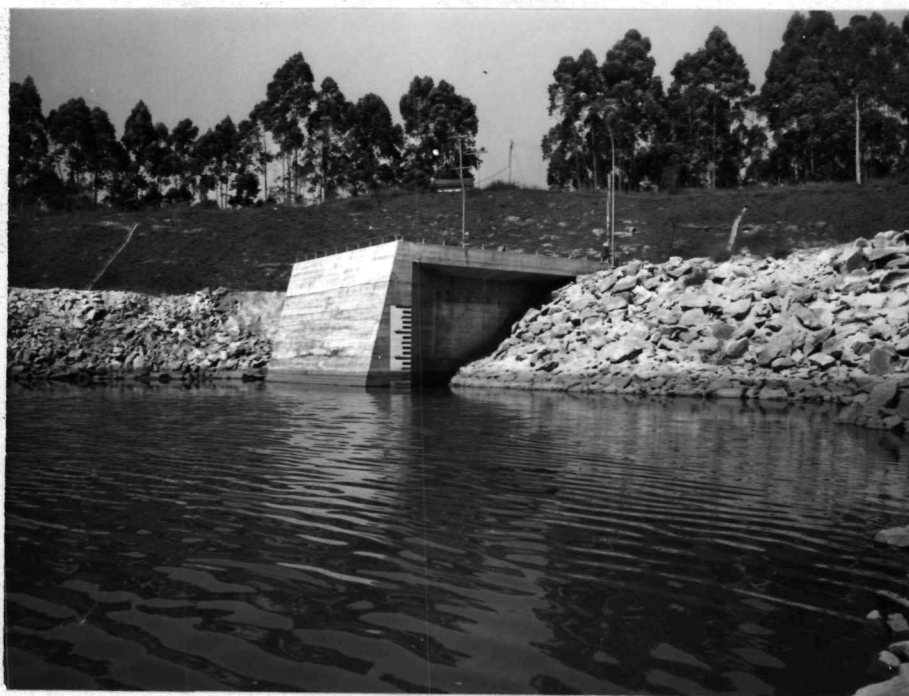


Galeria de Válvulas

ESTAÇÃO ELEVATÓRIA SANTA INÊS - ESI

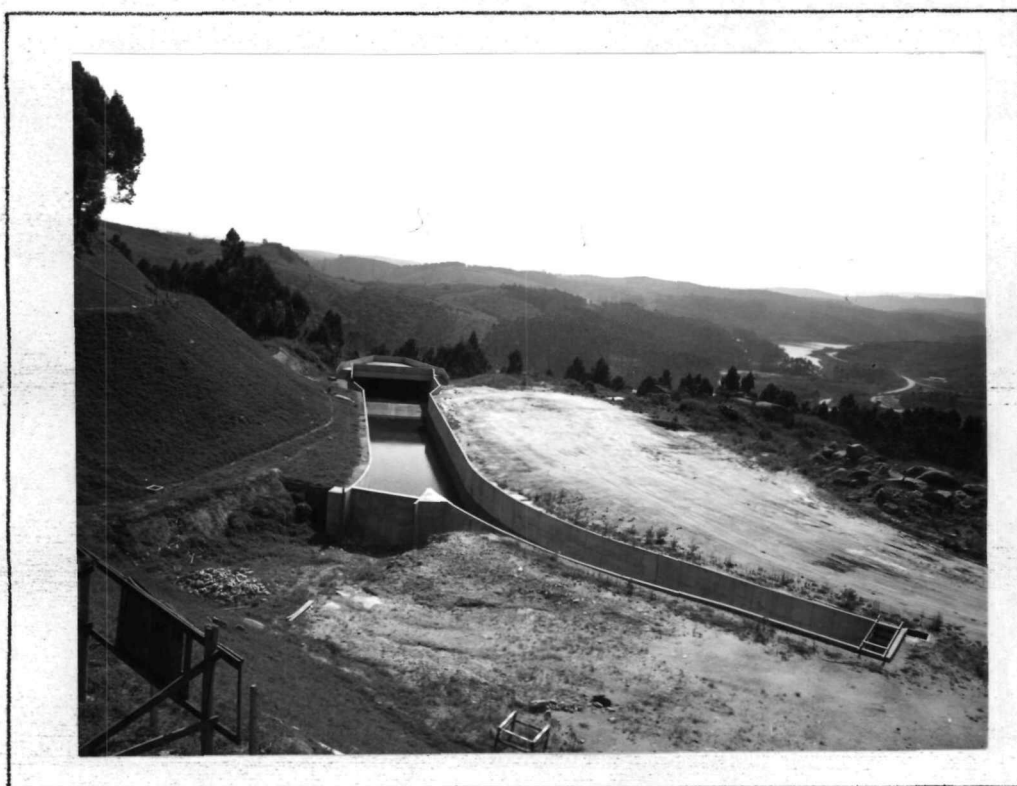


Equipamento Óleo Pneumático



Tomada D'água do Túnel Adutor

ESTAÇÃO ELEVATÓRIA SANTA INÊS - ESI



Canal de Ligação entre Duto de Recalque e
Canal Coberto

ESTAÇÃO DE TRATAMENTO DE ÁGUA DO GUARAÚ-ETA

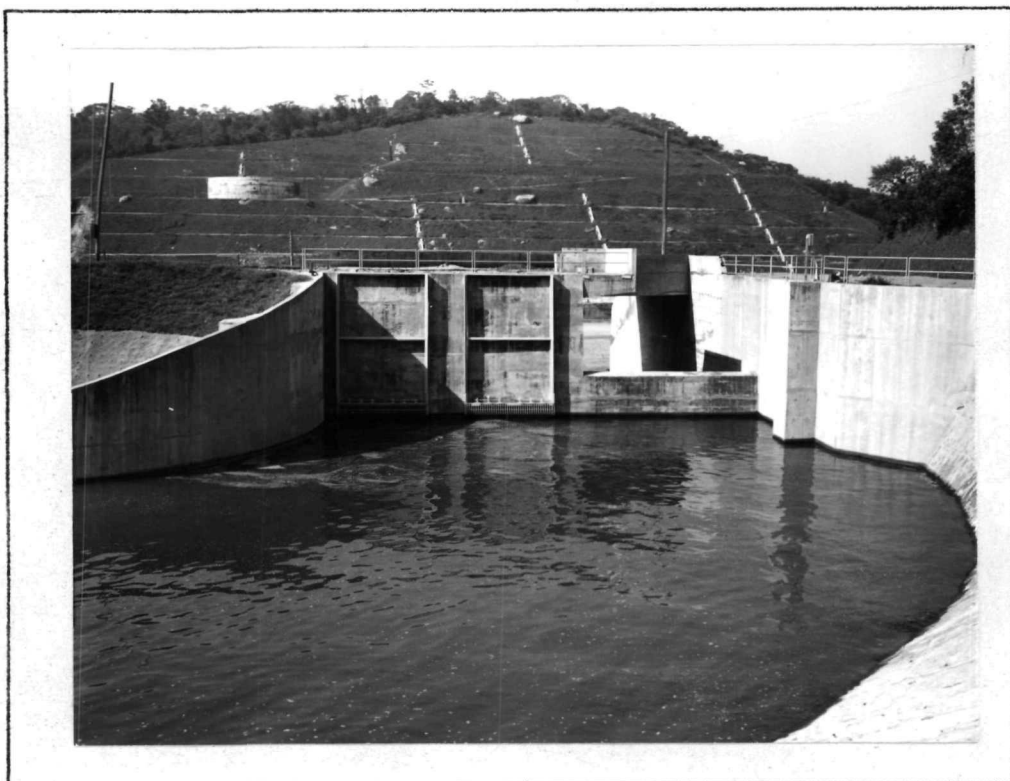


Vista Geral



Casa de Química

ESTAÇÃO DE TRATAMENTO DE ÁGUA DO GUARAÚ-ETA

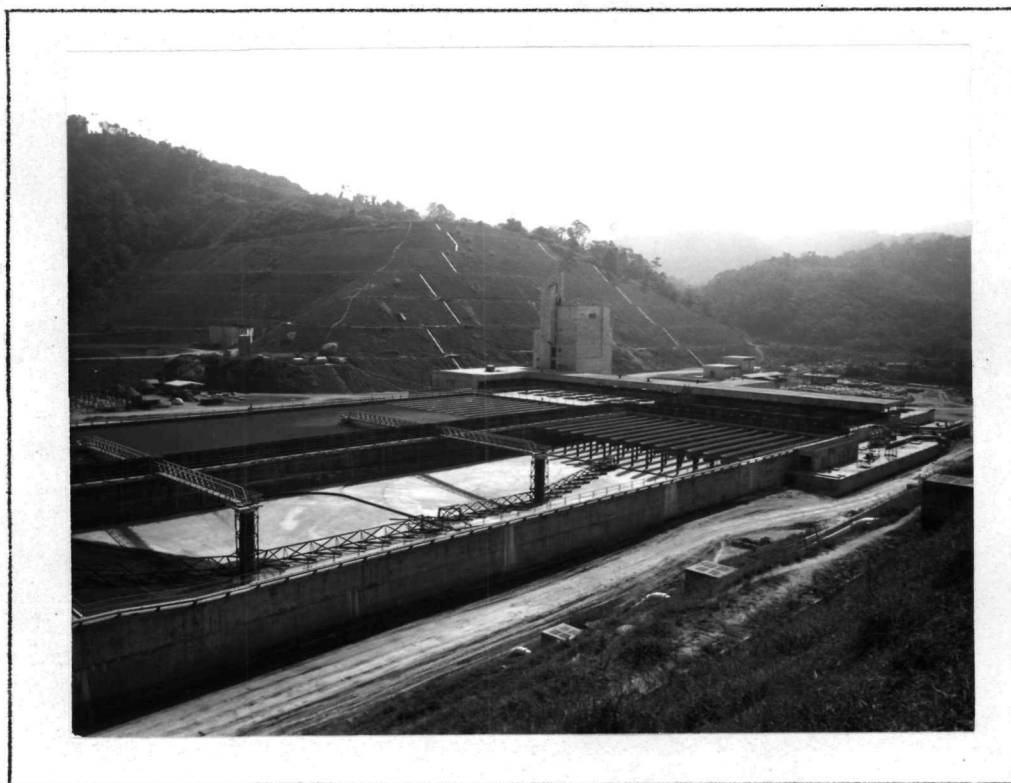


Tomada D'Água Bruta

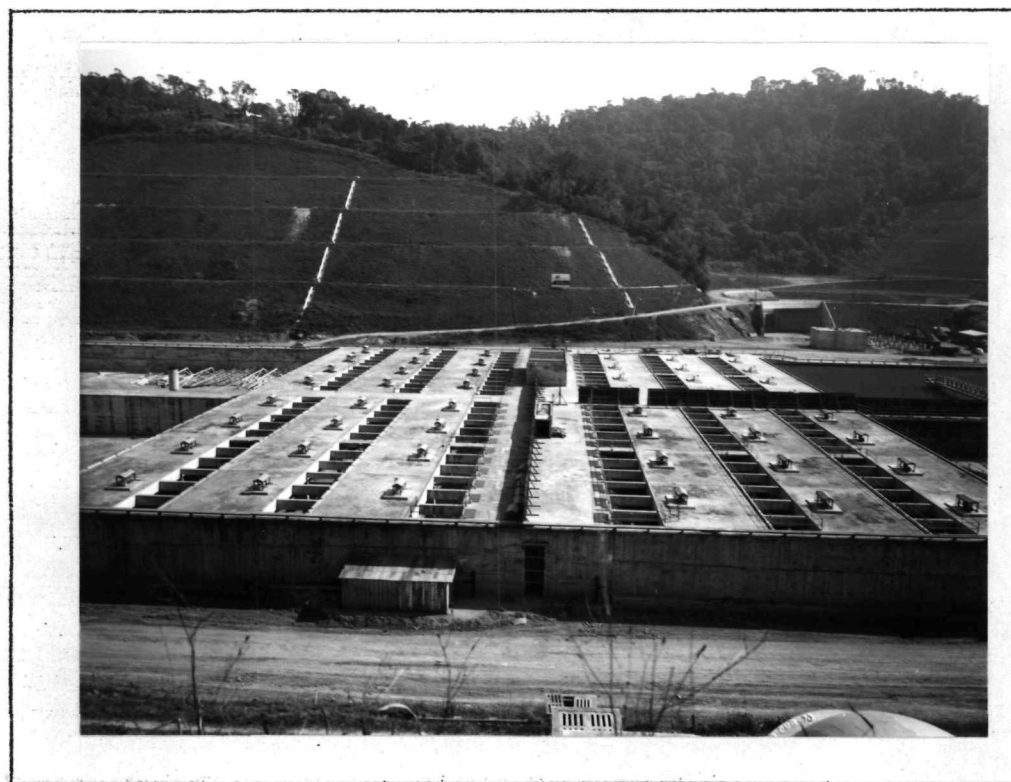


Decantadores 1 e 2

ESTAÇÃO DE TRATAMENTO DE ÁGUA DO GUARAÚ-ETA

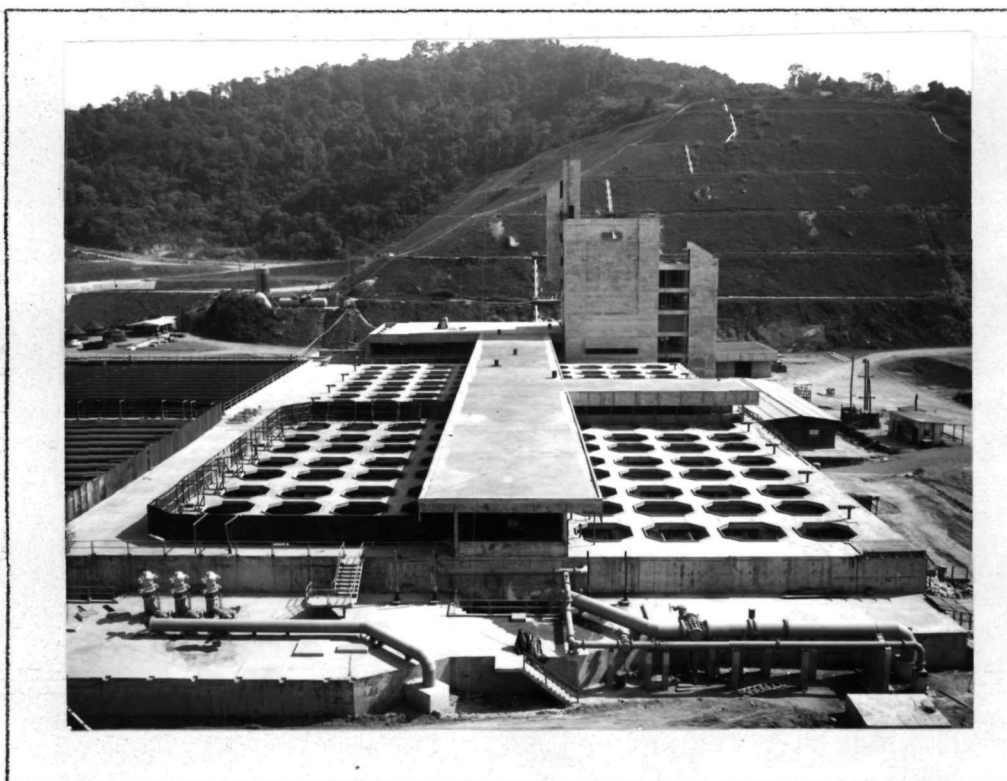


Decantadores 3 e 4

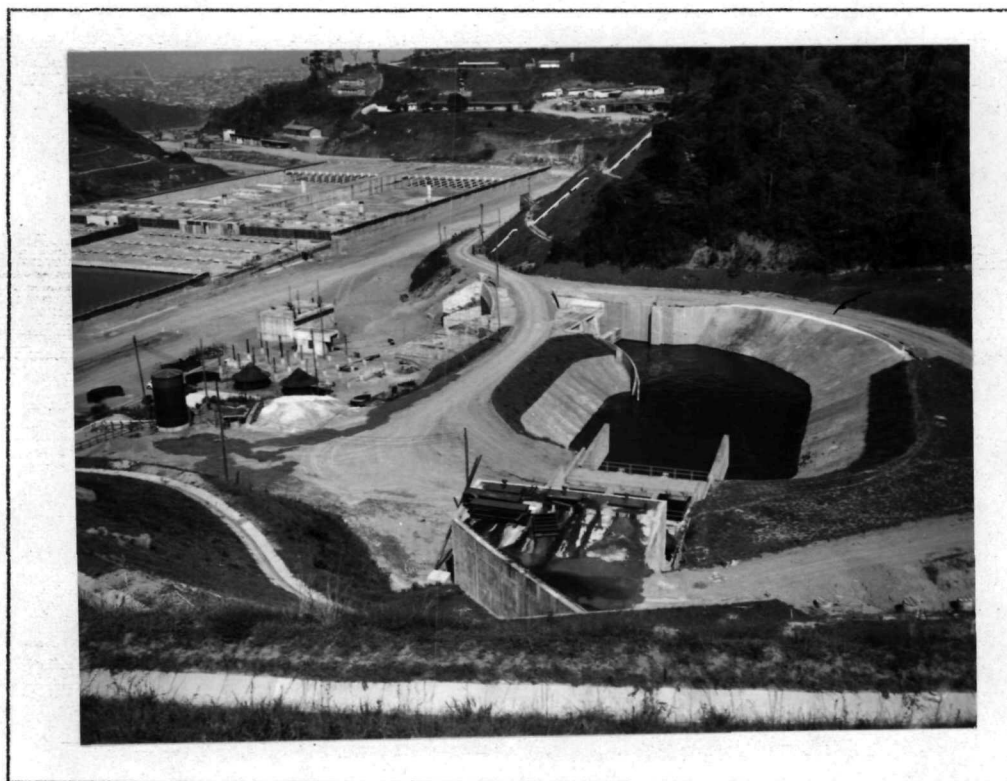


Floculadores

ESTAÇÃO DE TRATAMENTO DE ÁGUA DO GUARAU-ETA



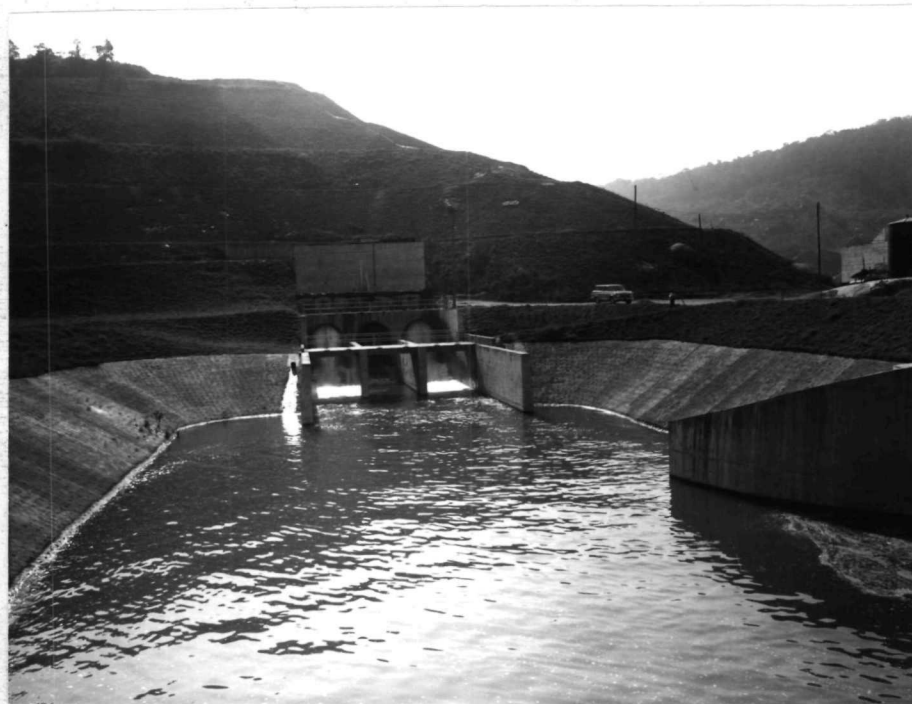
Filtros



Bacia de Tranquilização

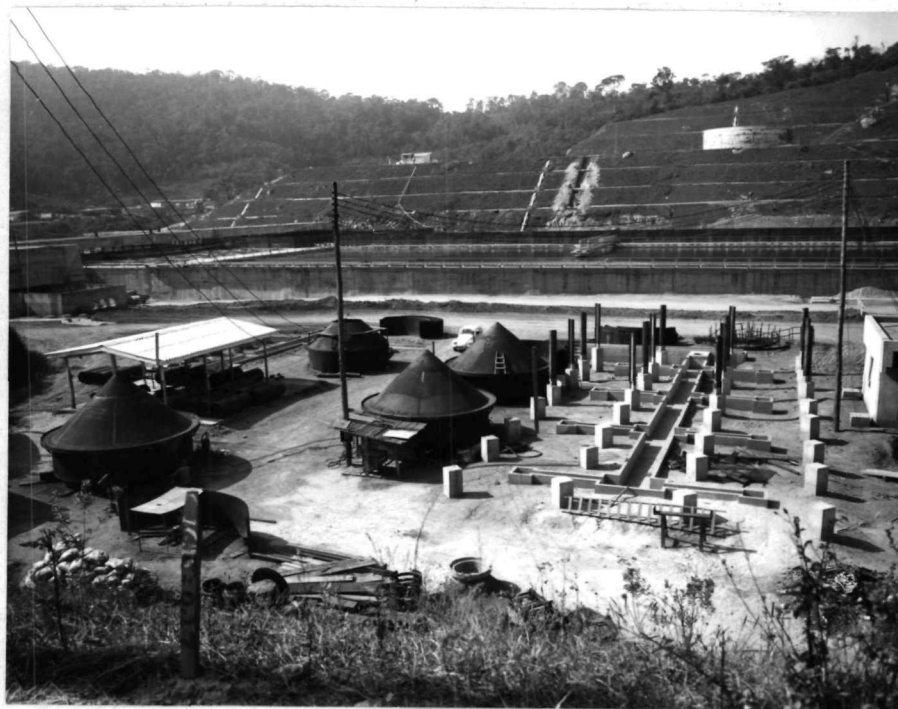


Saída para o SAM

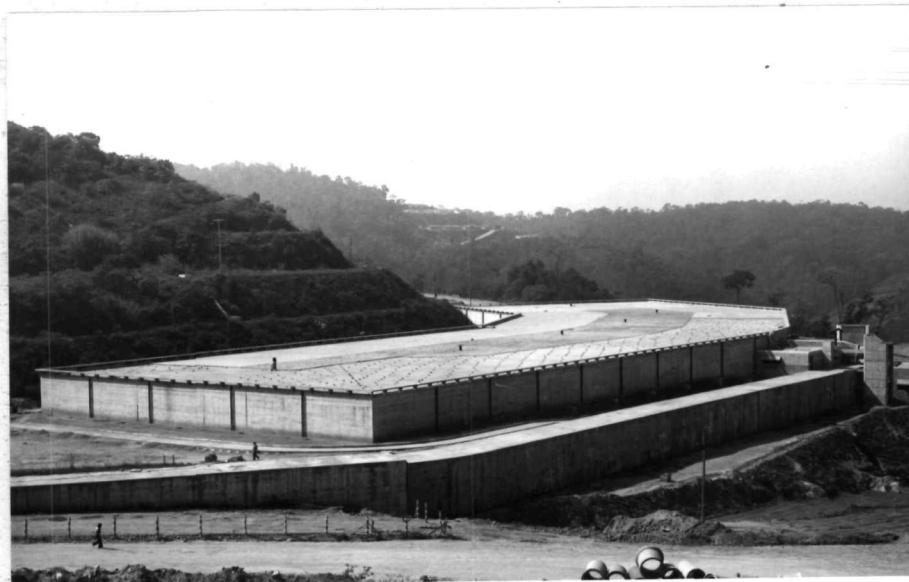


Saída do Túnel nº 2

ESTAÇÃO DE TRATAMENTO DE ÁGUA DO GUARAÚ-ETA



Armazenagem de Sulfato de Alumínio e Cloro



Reservatório de Água Tratada (R-1)

SISTEMA ADUTOR METROPOLITANO (SAM)



Soldagem de Tubos



Assentamento de Tubos

VOLUME 2

ORIGINAL: SUBGERÊNCIA DE OPERAÇÕES, REGIÃO III*

CC.: BID/DIVISÃO DE OPERAÇÕES '(Sr.M.Valderrama)*

BID/PRA (Sr. J.A. Lynn)*

→ BID/PRA (Sr. U.Olivero)*

BID/AUDITOR GERAL*

BID/ARQUIVO CENTRAL

BID/REPRESENTAÇÃO (Sr. E.C.Lima)*

ELECTRO-WATT LTD

ELETROPROJETOS S.A./RIO

ELETROPROJETOS S.A./SP*

(*) Com fotografias