4.3 Soaking pits

4.3.1 Soaking pits

(1) Present problems

The existing soaking pits have a serious problem of combustion control. Improper temperature control raises the pit temperature extremely high (about 1,400°C) and causes most of the ingots to be washed. The pit pressure control dampers of particularly Nos. 1 to 6 soaking pits are improperly arranged and incapable of correct operation, resulting in an extremely high pit pressure and spouting of flame from the soaking pit top. With no cinder holes provided, cinder must be manually removed once per two months. This operation calls for frequent pit cooling and heating. These unfavorable operating conditions result in shortening the life of the soaking pits.

The downtime results of the soaking pits are shown in Table 4-1. Most of the downtime is accounted for by refractories replacement.

Table 4-1. Downtime ratio of soaking pits

1978	Sep.	Oct.	Nov.
Downtime ratio (%)	30.8	28.6	46.3
Number of days out of operation (day)	74	71	111

Notes: 100% = 30 or 31 days x 8 soaking pits

The temperature of combustion air is 250 to 300°C due to recuperator leakage and malfunction. This compares with the design temperature of 500°C.

(2) Description of rehabilitation

The soaking pits shall be modified as described below, with their dimensions and main specifications remaining unchanged.

a) The burners shall be renewed.

b) As for Nos. 1 to 6 soaking pits, a damper shall be installed after the recuperator to control the pressure of two soaking pits each, and the flues shall be modified accordingly.

Control of more than one soaking pit by one damper is practiced at Nippon Steel's works (Muroran, Kamaishi, Sakai and Hirohata). This control method accompanies fluctuations in the soaking-pit pressure, but these pressure fluctuations are not violent enough to interfere with the operation of soaking pits. There also is little or no likelihood that opening of the pit cover introduces cold air and discharges hot exhaust gases.

It may be more desirable to individually control the pressure of each soaking pit. After various studies described in Item 4.3.1.(5), however, the method of controlling two soaking pits by one damper has been adopted in this rehabilitation plan in consideration

of the existing flue layout, space available for recuperator installation, damper arrangement, and necessary investment.

These modification plans are shown in Drawing Nos. RP-0003 to RP-0007. The flues of Nos. 7 and 8 soaking pits remain unchanged.

c) Recuperators of the stack type shall be installed for Nos. 1 to 6 soaking pits, and exhaust gases will be removed by natural draft. The existing finned-tube recuperators for Nos. 7 and 8 soaking pits shall be replaced.

d) Entire instrumentation shall be renewed.

Instrumentation of the soaking pits is described in Item 4.3.1.(4) and an instrumentation list is shown in Table 4-3.

e) Pit covers shall be renewed with brick hangers changed.

f) Refractories shall be replaced.

g) Steel structure plates and air piping shall be partially modified.

h) Cinder shall be removed by soaking pit crane, using the devices shown in Drawing No. RP-0002.

The soaking pit bottom control shall be undertaken carefully.

The rehabilitation plans for the soaking pits are shown in Tables 4-2.

(3) Main specifications

Type	Top one-way fired recuperative soaking pit
Quantity	2 pits/battery x 4
Size	2,700 mm (W) x 5,100 mm (L) x 3,600 mm (D)
Charging capacity	45 tons max.
Fuel	Mixed gas (Blast furnace gas + fuel oil)

Table 4-2. Rehabilitation plan for soaking pits

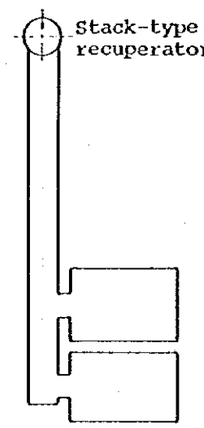
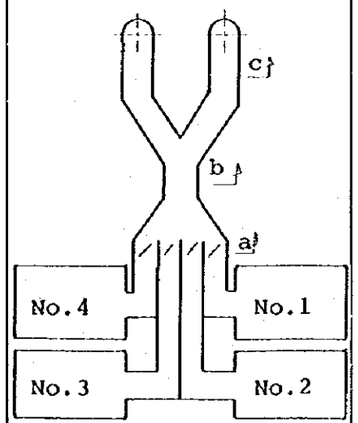
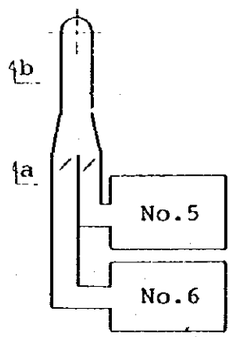
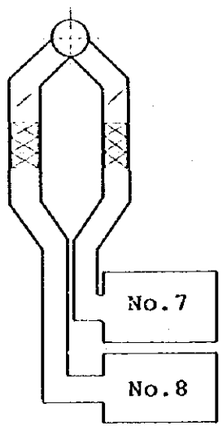
		Rehabilitation plan (Common to Nos. 1 to 8 soaking pits)	Present specifications		
			Nos. 1 to 4 soaking pits	Nos. 5 and 6 soaking pits	Nos. 7 and 8 soaking pits
1. Pit	(1) Pit dimensions	Modification of steel structure and replacement of refractories with pit dimesnions unchanged	2,700 W x 5,100L x 3,600 D	Same as left	Same as left
	(2) Charging capacity		45 tons max.	Same as left	Same as left
2. Burner	(1) Fuel	Replacement of all burners with present specifications unchanged	BFG + fuel oil	Same as left	Same as left
	(2) Quantity	Total 8 sets	4 sets/4 pits	2 sets/2 pits	2 sets/2 pits
	(3) Capacity (per set)	3.5 x 10^6 kcal/hr			3.5 x 10^6 kcal/hr
3. Combustion air fan	(1) Quantity	(Existing fans will be reused)	2 sets/4 pits		3 sets/2 pits
	(2) Capacity		7,000 m^3/hr x 500 mmAq		5,000 m^3/hr x 490 mmAq
4. BFG fan	(1) Quantity	(Existing fans will be reused)	1 set/4 pits	1 set/2 pits	1 set/2 pits
	(2) Capacity		5,000 m^3/hr x 200 mmAq		
5. Flue	(1) Layout	Modification;  Flue layout of Nos. 7 and 8 soaking pits will remain unchanged			

Table 4-2. (Continued)

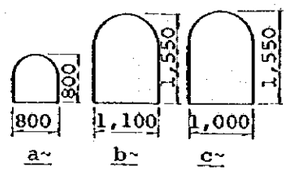
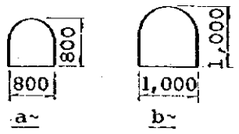
	(2) Cross-section dimensions	Modification; Flue cross-sections of Nos. 1 to 6 soaking pits shall be "b" in right figures, respectively			Cross-section dimensions not known
6. Recuperator	(1) Type	Renewal; Radiation type (Stack type for Nos. 1 to 6 pits) Replacement: Finned-tube type for Nos. 7 and 8 pits	Convection type (Flue tube type)	Same as left	Convection type (Finned-tube type)
	(2) Quantity	3 sets for Nos. 1 to 6 soaking pits, and 2 sets for Nos. 7 and 8 soaking pits	2 sets/4 pits	1 set/2 pits	2 sets/2 pits
	(3) Exhaust gas temperature (at recuperator inlet)	1,100°C (1,150°C max.)	Details not known	Details not known	1,100°C
	(4) Preheated air temperature (at recuperator outlet)	500°C	ditto	ditto	500°C
	(5) Exhaust gas volume	6,400 m^3/hr	ditto	ditto	4,250 m^3/hr
	(6) Air volume	4,300 m^3/hr	ditto	ditto	2,850 m^3/hr
	(7) Location	Installed in stack for Nos. 1 to 6 soaking pits Installed in flue for Nos. 7 and 8 soaking pits *Exhaust gas and air pressure losses will be held within present values	Installed in flue (Vertical type)	Installed in flue (Vertical type)	Installed in flue (Horizontal type) *Drawings show that gas recuperator is installed just after air recuperator, but details are unknown
7. Flue damper (for pit pressure control	(1) Type	Renewal; Rotary type	Rotary type	Rotary type	Rotary type
	(2) Quantity	3 sets for Nos. 1 to 6 soaking pits, and	4 sets/4 pits	2 sets/2 pits	2 sets/2 pits

Table 4-2. (Continued)

		2 sets for Nos. 7 and 8 soaking pits			
	(3) Location	After recuperator	In flue of each pit at the end of each gathering flue	In flue of each pit at the end of each gathering flue	In flue of each pit after recuperator
	(4) Water cooling	Not provided	Provided	Provided	Not provided
8. Exhaust system	(1) System	Renwal; natural exhaust system for Nos. 1 to 6 soaking pits. (Stack with recuperator) 1 set/2 pits	Forced exhaust by fan	Forced exhaust by fan	Natural exhaust
	(2) Forced exhaust capacity	—	17,000 m^3/hr x 80 mmAq 1 set/4 pits	Details not known 1 set/2 pits	— —
9. Piping		Extension of combustion air piping (500 ϕ)			
10. Fuel oil and compressed air heater		Renewal			
11. Instrumentation		Renewal; Refer to Table 4-3			

(4) Instrumentation

a) Basic considerations

(i) The soaking-pit instrumentation system shall consist of electronic analog instruments which permit each soaking pit to be monitored and controlled in the soaking-pit instrument room.

(ii) In case of electric power failure, the soaking-pit instrumentation system shall be made capable of performing one cycle of operation (e.g., closing of a shutoff valve or opening of a pit pressure control damper) by both the residual pressure in the air receiver of the instrumentation pneumatic power supply and the residual pressure in the oil tank of the instrumentation hydraulic power supply, provided that the residual pressure in the air receiver of the instrumentation pneumatic power supply shall cover the closing of fuel shutoff valves alone.

b) Functional description

(i) Pit temperature control

Each soaking pit shall be provided with two temperature-sensing points so that its temperature can be measured accurately for proper operation.

A switch shall be provided to permit selection between these two temperature-sensing points.

Maximum heat input control devices shall also be provided.

(ii) Fuel oil flow control

Positive displacement flowmeters shall be installed to measure the flow rate of fuel oil.

(iii) BFG (blast-furnace gas) flow control

The fuel oil/BFG ratio is controlled.

(iv) Atomizing compressed air flow control

The fuel oil/air ratio is controlled.

(v) Combustion air flow control

The volume of combustion air for the soaking pit greatly varies between the heating period and the soaking period. For this reason, the split ranging system shall be adopted which uses master and slave valves.

(vi) Pit pressure control

The pressure of two soaking pits shall be controlled in one loop by the damper installed after the recuperator.

(vii) Exhaust gas temperature control

Exhaust gas temperature shall be controlled by introducing diluting cold air before the recuperator.

(viii) Preheated combustion air temperature control

Preheated combustion air temperature shall be

controlled by releasing combustion air at the recuperator outlet.

(ix) Fuel oil temperature control

Fuel oil temperature shall be controlled by switching on and off an electric heater.

(x) Atomizing compressed air temperature control

Atomizing compressed air temperature shall be controlled by switching on and off an electric heater.

(xi) Combustion air pressure control (for prevention of blower surging)

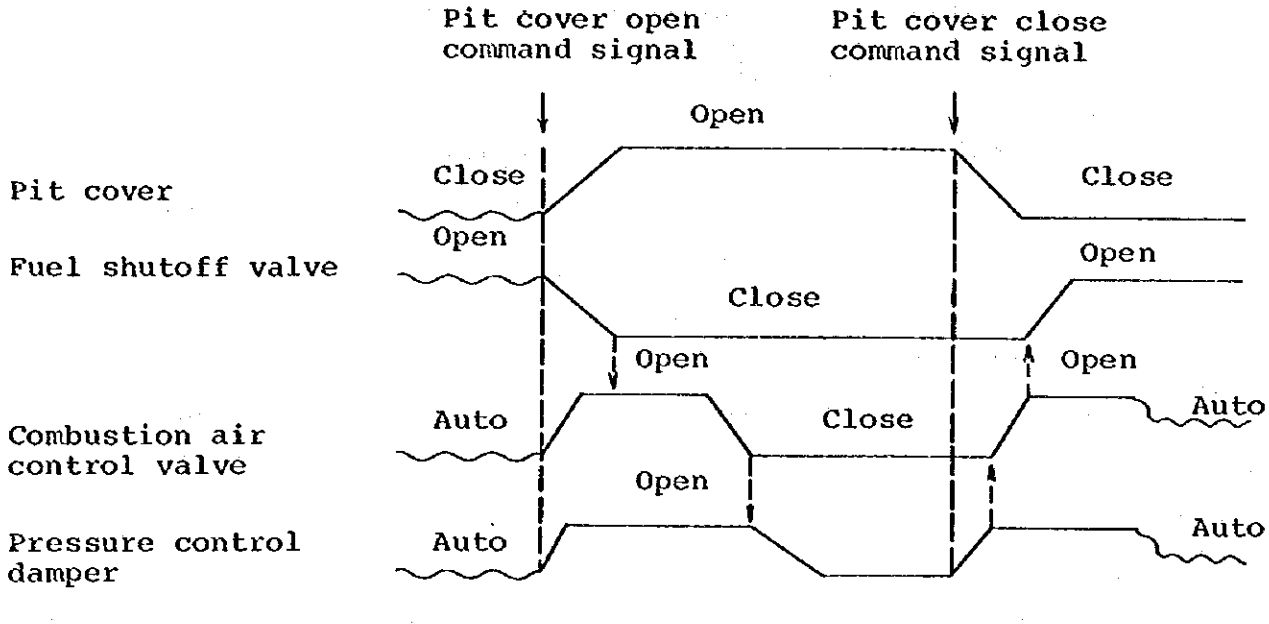
Blower surging shall be prevented by sensing common blower header pressure and controlling the amount of air released through release pipe.

(xii) BFG pressure control (for prevention of blower surging)

Blower suring shall be prevented by sensing common blower header pressure and controlling the volume of gas at the blower inlet.

(xiii) Sequence control

Pit cover opening and closing, and emergency shutoff shall be basically performed as shown in the following schedule:



c) Electric power supply for instrumentation

An exclusive electric power supply system shall be provided for instrumentation.

d) Pneumatic power supply for instrumentation

An exclusive pneumatic power supply system shall be provided for instrumentation and shall deliver boosted and dehumidified air.

e) Hydraulic power supply for instrumentation

An exclusive hydraulic power supply system shall be for instrumentation. One hydraulic power supply shall provide hydraulic drive for two or three soakiing pits.

Table 4-3. Instrumentation list

No.	Item	Function	Quantity
1	Pit temperature control	TRCA	8
2	Fuel oil flow control	FRCQ	8
3	BFG flow control	FRCQ	8
4	Atomizing compressed air/ fuel oil flow ratio control	FIC (ratio)	8
5	Combusion air/(fuel oil + BFG) flow ratio control	FIC (ratio)	8
6	Pit pressure control	PIC	5
7	Exhaust gas temperature control (for recuperator protection)	TICA	5
8	Combustion air temperature control (for recuperator protection)	TICA	5
9	Fuel oil temperature control	TIC	4
10	Atomizing compressed air temperature control	TIC	4
11	Combustion air pressure control (for prevention of blower surging)	PIC	5
12	BFG pressure control (for prevention of blower surging)	PIC	3
13	Sequence control		1
14	Temperature recorder	TRCA	8
15	Instrument panel		2
16	Electric power supply for instrumentation		1

Notes: TRCA: Temperature recording controller with alarm
FRCQ: Flow recording controller with integrator
FIC: Flow indicating controller
PIC: Pressure indicating controller
TICA: Temperature indicating controller with alarm
TIC: Temperature indicating controller

(5) Study of soaking-pit recuperator and damper arrangement Table 4-4 gives the results of study on the soaking-pit recuperator and damper arrangement (plans A to D).

a) Plan A is inferior to plan B because of pit pressure fluctuations, but better than plan B in terms of required modification and investment.
This plan is also practiced at Nippon Steel's works without any operational problems.

b) Plan B is the best suited for rehabilitation, but has little feasibility because of limited recuperator installation space, extensive flue modification, tight schedule, and large investment required.

c) Plan C is insufficient to eliminate recuperator and damper troubles.

d) Plan D can be executed in the shortest schedule with the lowest investment, but provides little improvement, if any, and has such operational problems as decreasing the combustion air temperature.

As a result, plan A has been adopted.

Table 4-4. Study of soaking-pit recuperator and damper arrangement

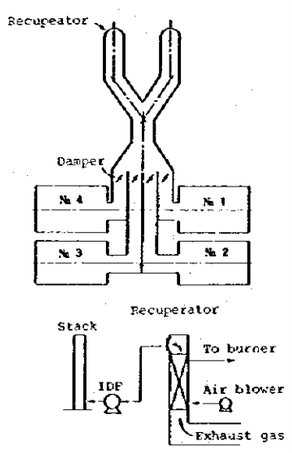
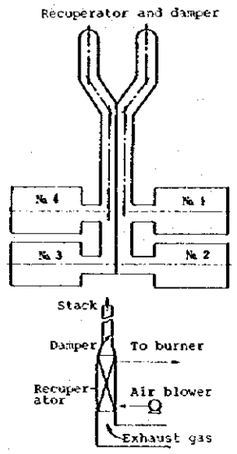
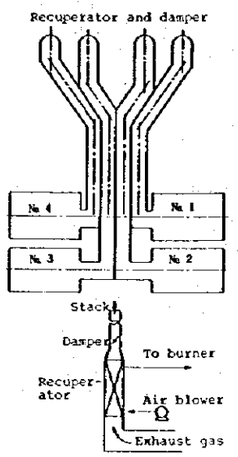
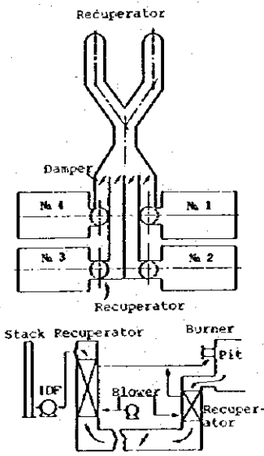
	Present condition	Rehabilitation plan			
		Plan A (adopted)	Plan B	Plan C	Plan D
1. Layout					(1) Same as present layout (2) Injection of diluting air into flue ahead of damper to lower exhaust gas temperature (for damper protection) (3) Renewal of recuperator (to same specifications as present ones)
		(1) Renwal of recuper-ator (2) Removal of IDF and atack (3) Installation of damper after recu-perator	(1) Renewal of recuper-ator (2) Removal of IDF and atack (3) Installation of damper after recu-perator	(1) Installation of additional recu-perator in down-take (2) Renewal of exist-ing recuperator	

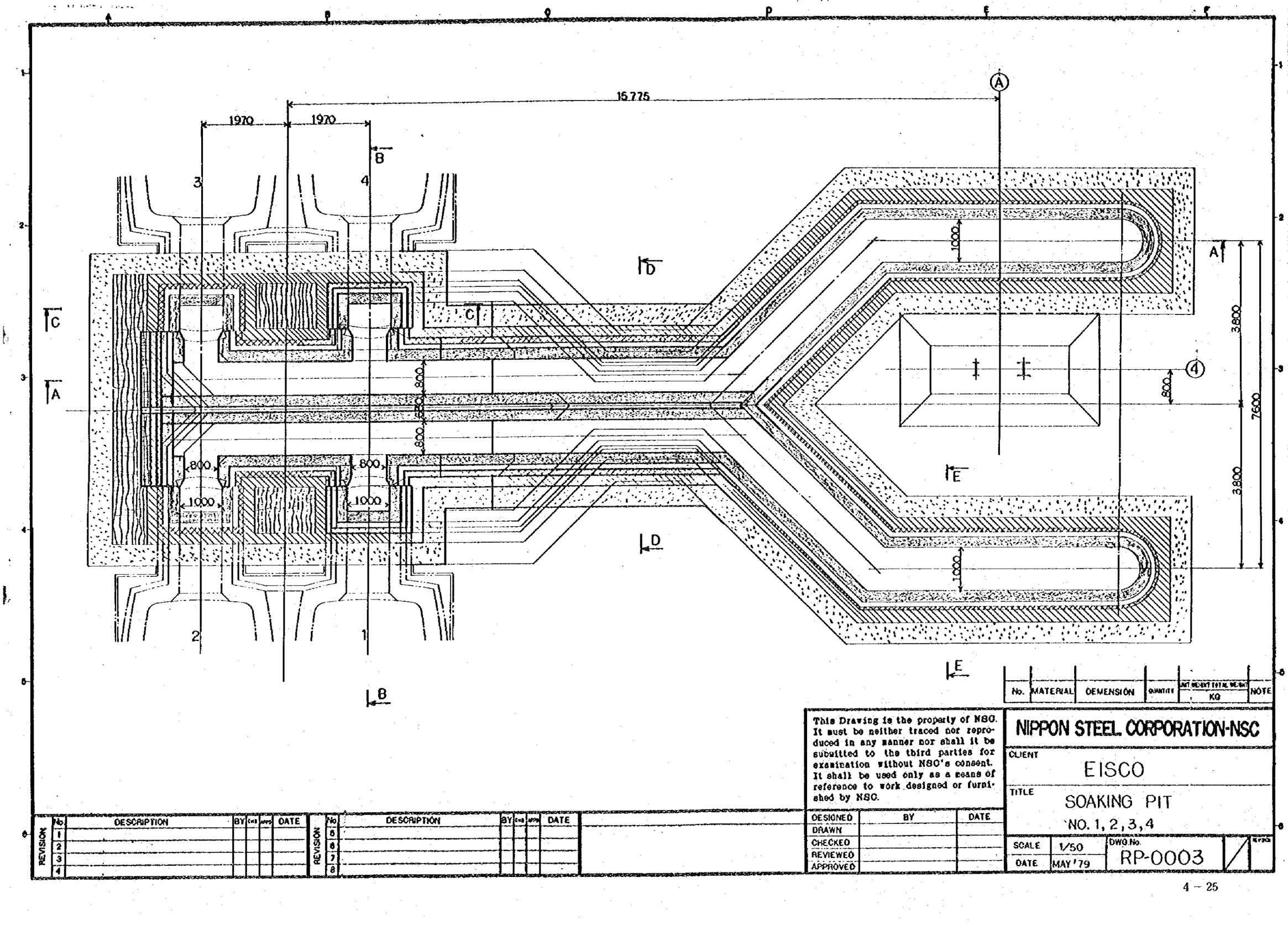
Table 4-4. (Continued)

2. Recuperator (1) Type (2) Quantity	Convection type (finned tube type) 2 sets/4 pits	Radiation type (stack type 2 sets/4 pits	Radiation type (stack type) 4 sets/' pits	Radiation + radiation type (4 sets + 2 sets)/4 pits	Convection type (flue tube type) 2 sets/4 pits
7. Damper (1) Type (2) Quantity	Rotary type (water cooled) 4 sets/4 pits	Rotary type (not water cooled) 2 sets/4 pits	Rotary type (not water cooled) 4 sets/4 pits	Rotary type (water cooled)	Rotary type (water cooled or not)
4. Pit pressure control system	Pressure control of each pit	Pressure control of gathering flue common to two pits	Pressure control of each pit	Pressure control of each pit	Pressure control of each pit
5. Problem	(1) Severe recuperator and damper damage	(1) Pit pressure fluctuations due to pressure control of gathering flue (But these pressure fluctuations does not interfere with the operation.)	(1) Extensive flue modification work required (2) Is it possible to secure space for installation of additional recuperator?	(1) Grave risk of additional recuperator being damaged by after burning, etc. (2) There is no space in Nos. 5 and 6 pits to install additional recuperator. (3) Installation of additional recuperator lowers exhaust gas temperature in damper area by about 100°C, but water cooled dampers are still required. (4) Is it possible to install additional recuperator?	(1) Exhaust gas temperature must be lowered to operate damper without water cooling. This reduces recuperator waste heat recovery and thermal efficiency. (2) Recuperator troubles such as dust clogging cannot be eliminated.

Table 4-4. (Concluded)

6. Evaluation rating*					
i) Investment					
o Flue work (including brick)		2	3	1	1
o Recuperator		2	3	3	1
ii) Work period		2	3	1	1
iii) Operation		2	1	3	3
iv) Overall evaluation		1	2	3	4

1 = Excellent; 2 = Good; 3 = Fair; 4 = Poor.



No.	MATERIAL	DEMENSION	QUANTITY	UNIT WEIGHT TOTAL WEIGHT KG	NOTE

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NIPPON STEEL CORPORATION-NSC

CLIENT: EISCO

TITLE: SOAKING PIT NO. 1, 2, 3, 4

	BY	DATE
DESIGNED		
DRAWN		
CHECKED		
REVIEWED		
APPROVED		

SCALE 1/50 DATE MAY '79 DWG.No. RP-0003 REVISION

REVISION No.	DESCRIPTION	BY	CHD	APPD	DATE
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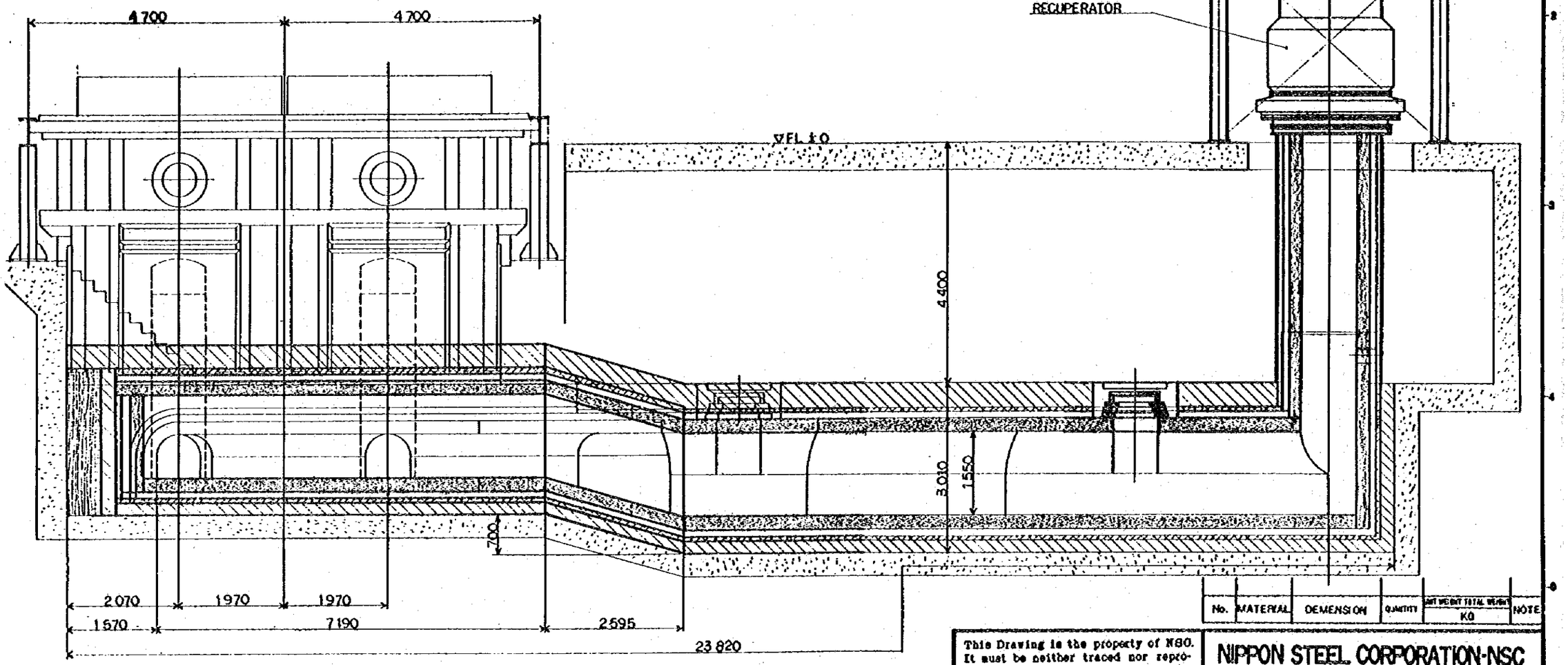
SECTION A - A



No.	MATERIAL	DEMENSION	QUANTITY	UNIT WEIGHT TOTAL WEIGHT KG	NOTE

NIPPON STEEL CORPORATION-NSC

CLIENT: EISCO

TITLE: SOAKING PIT NO.1, 2, 3, 4

DESIGNED	BY	DATE	
DRAWN			
CHECKED			
REVIEWED			
APPROVED			

SCALE 1/50 | DWG.No. RP-0004 | REVISION

DATE MAY '79

REVISION	No.	DESCRIPTION	BY	CHD	APPD	DATE
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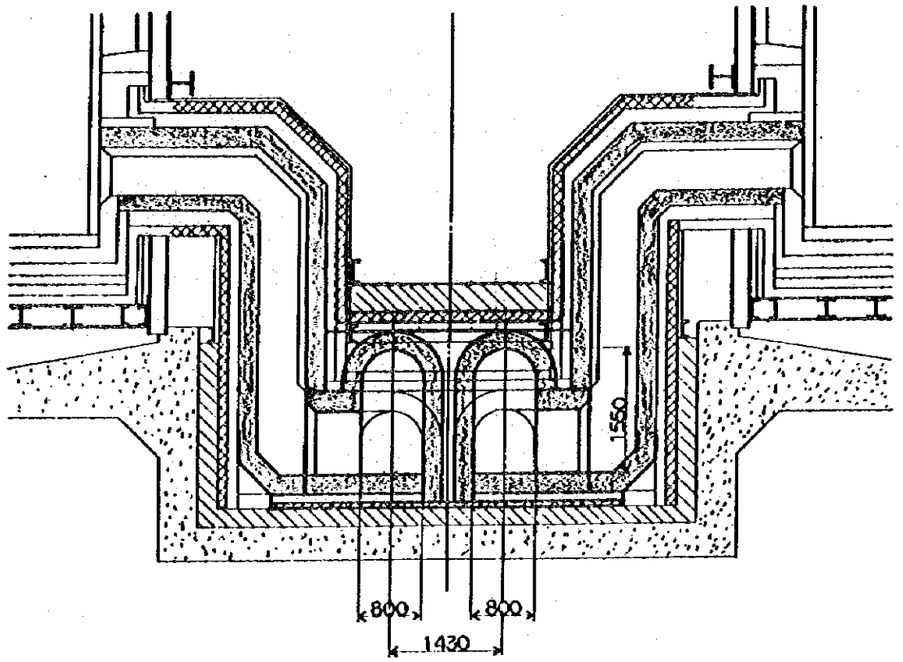
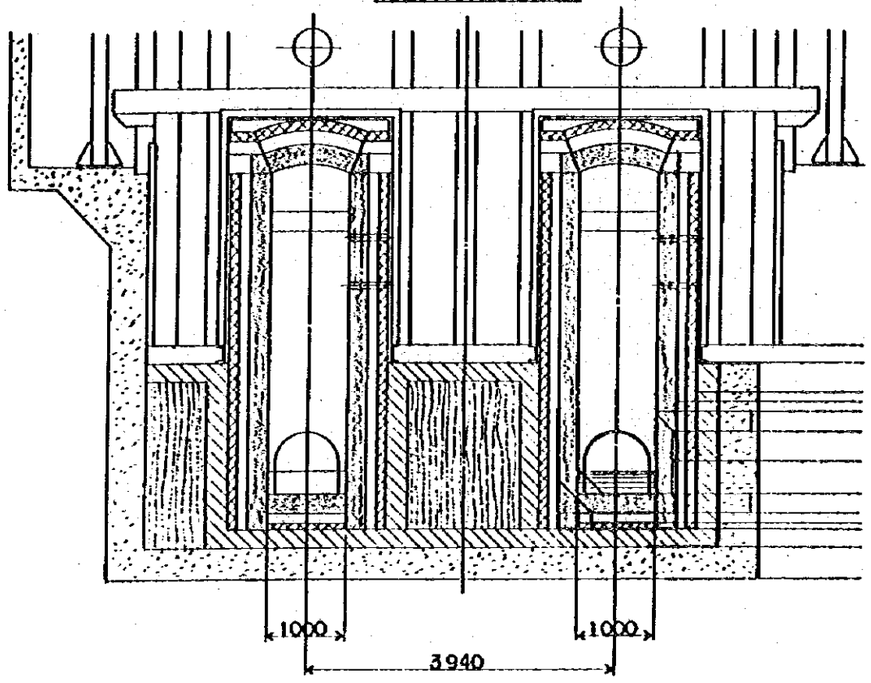
SECTION B-B



SECTION C-C



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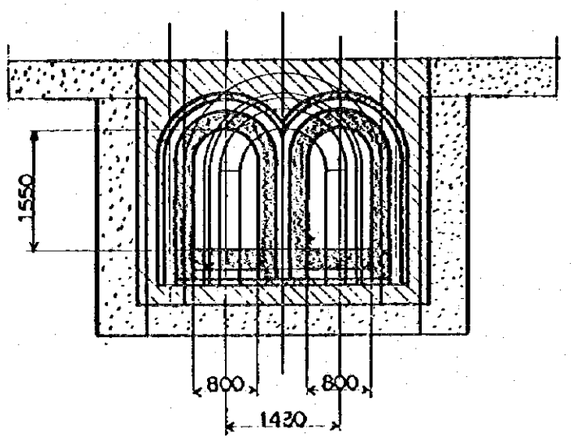
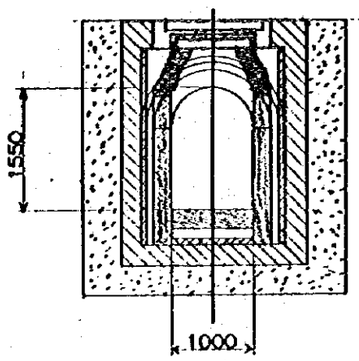


SECTION E-E



No.	MATERIAL	DEMENSION	QUANTITY	UNIT WEIGHT TOTAL WEIGHT KG	NOTE

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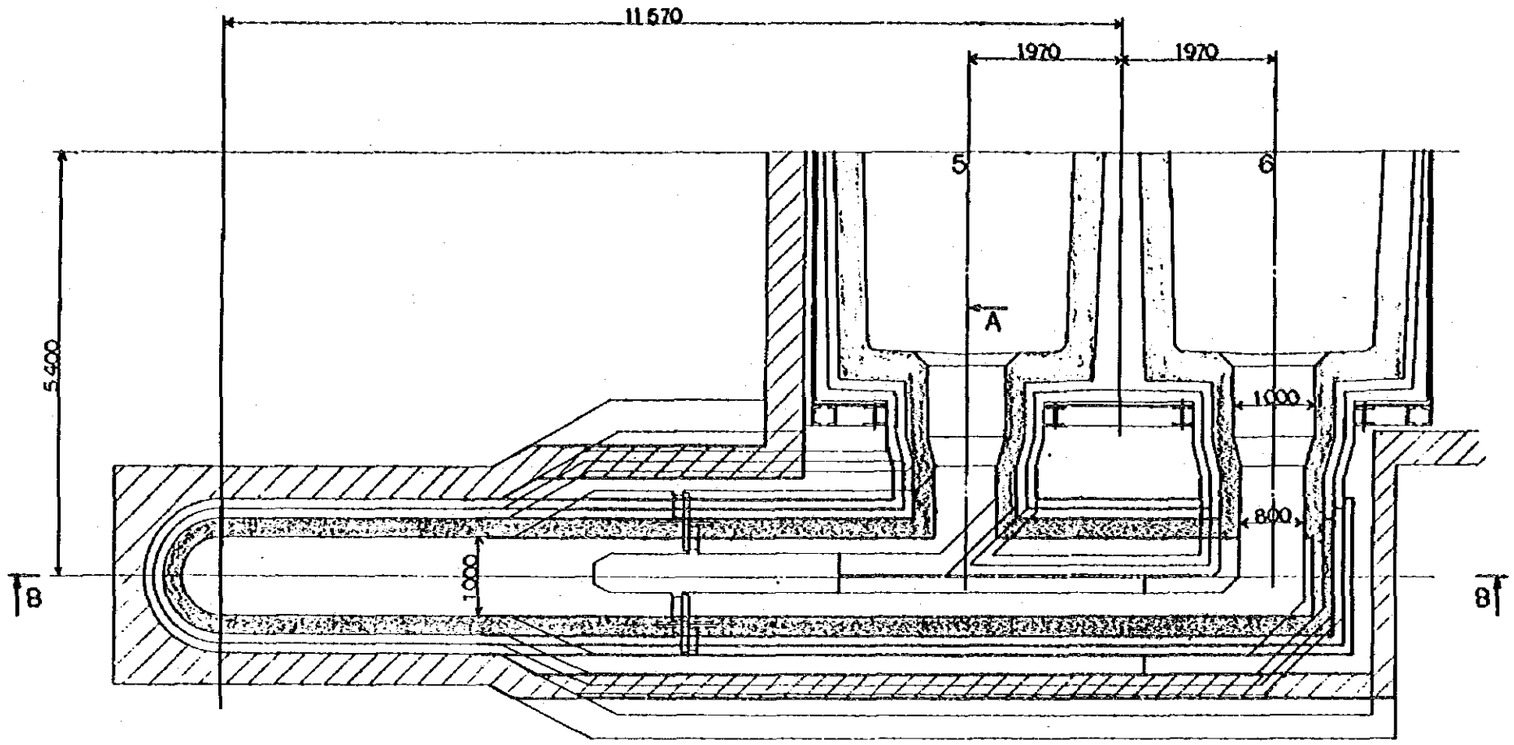
APPROVED		

NIPPON STEEL CORPORATION-NSC

CLIENT: EISCO

TITLE: SOAKING PIT NO. 1, 2, 3, 4

SCALE	1/50	DWG.No.	RP-0005
DATE	MAY '79		



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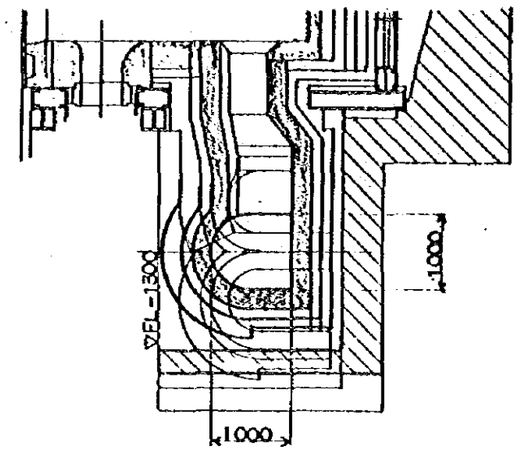

SECTION A-A

No.	MATERIAL	DEMENSION	QUANTITY	UNIT WEIGHT TOTAL WEIGHT KG	NOTE

NIPPON STEEL CORPORATION-NSC

CLIENT: EISCO

TITLE: SOAKING PIT NO. 5, 6

SCALE	1/50	DWG.No.	RP-0006
DATE	MAY '79		

	DESIGNED	BY	DATE
	DRAWN		
	CHECKED		
	REVIEWED		
	APPROVED		

REVISION	No.	DESCRIPTION	BY	CHD	APPD	DATE
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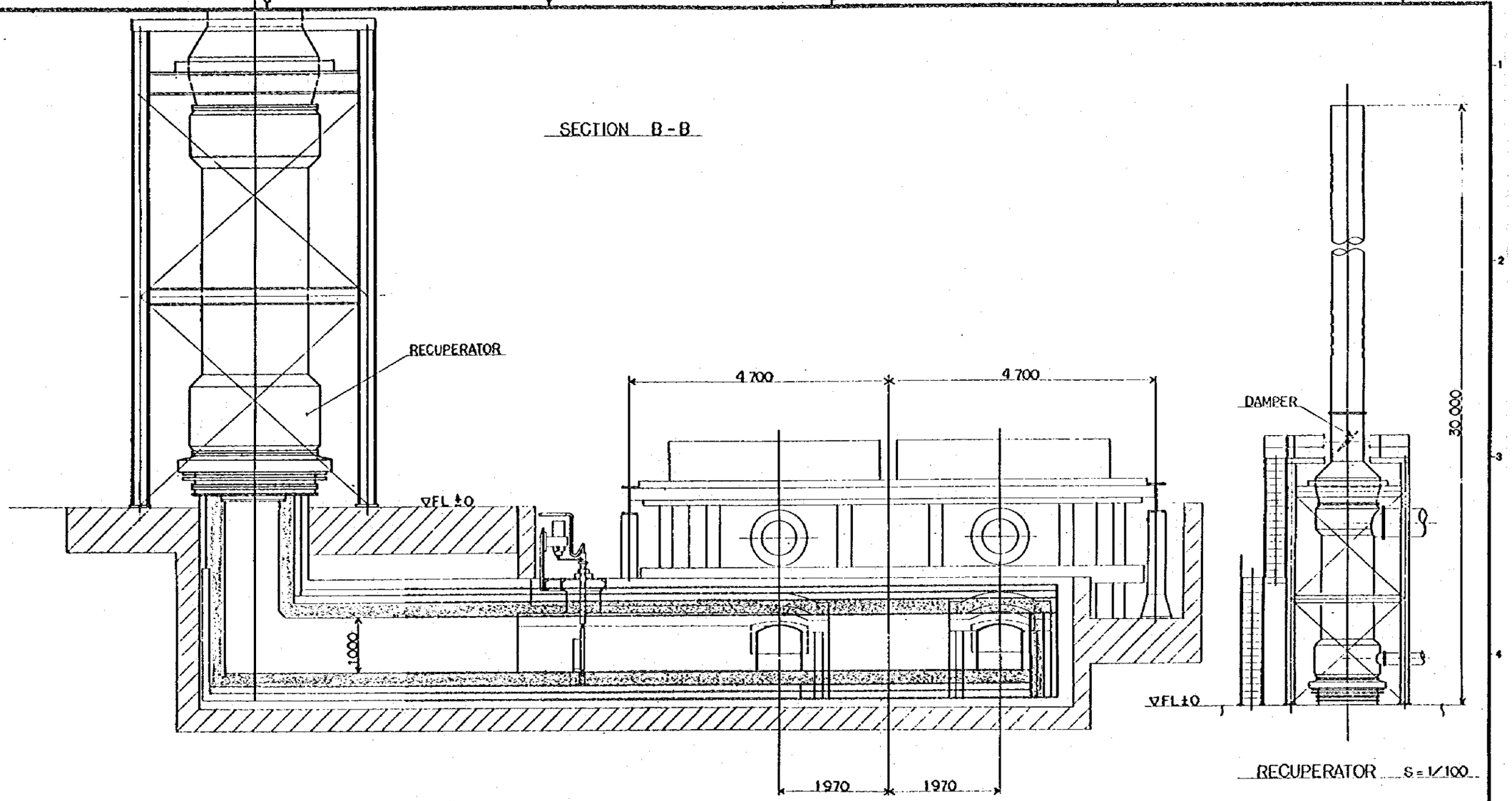
SECTION B-B



RECUPERATOR S=1/100

No.	MATERIAL	DEMENSION	QUANTITY	UNIT WEIGHT / TOTAL WEIGHT KG	NOTE

NIPPON STEEL CORPORATION-NSC

CLIENT: EISCO

TITLE: SOAKING PIT NO. 5, 6

SCALE	1/50	DWG.No.	RP-0007
DATE	MAY '79		

	BY	DATE
DESIGNED		
DRAWN		
CHECKED		
REVIEWED		
APPROVED		

REVISION No.	DESCRIPTION	BY	CHD	APPD	DATE
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4.3.2 Soaking pit refractories

(1) Present problems

The soaking pits and their covers refactories are made of firebrick. The pit covers are partially repaired at intervals of one to three months and totally repaired every five months. The soaking pits are partially repaired at intervals of one to two months and completely repaired every eight months. Possible causes for these short lives of the soaking pits and their covers are as described below.

a) Operating conditions

Combustion control is not performed successfully. Generally, the cold-ingot ratio is about 5% at ordinary integrated steelworks but a very high 40 to 50% at EISCO. And ingots are charged tilted against the pit walls, seriously damaging the pit walls.

b) Maintenance of pit cover frameworks

The pit cover frameworks are deformed greatly. The seal plates are severely damaged. Most of them are in unsatisfactory condition and heated red hot.

c) Quality and shape of refractories

Corner and ridge chips are found on most of brick. This is probably because brick corners are physically weak and brick are improperly packaged and handled. In particular, deformed brick in the pit covers

does not have sufficient strength because they are hand-moulded brick.

d) Brick laying

Most of brick joints have virtually no mortar filled, and allowance for expansion is provided little.

(2) Description of rehabilitation

a) Operating conditions

Firstly, ingots must be charged upright into the soaking pit. To this end, it is very important to fill the bottom of the soaking pit with bottom-making material and to effect careful bottom control. The dual purposes of the bottom-making material are to protect the bottom of the soaking pit and to erect ingots upright in the soaking pit. Ingots must be also shaped better through efforts at improvement in ingotmaking operation.

Secondly, care must be exercised to prevent ingots and crane tongs from striking against the pit walls when the soaking pit crane is operated. Crane operators should be instructed to observe this precaution strictly.

Thirdly, efforts should be made to avoid rapid heating and cooling of the soaking pits.

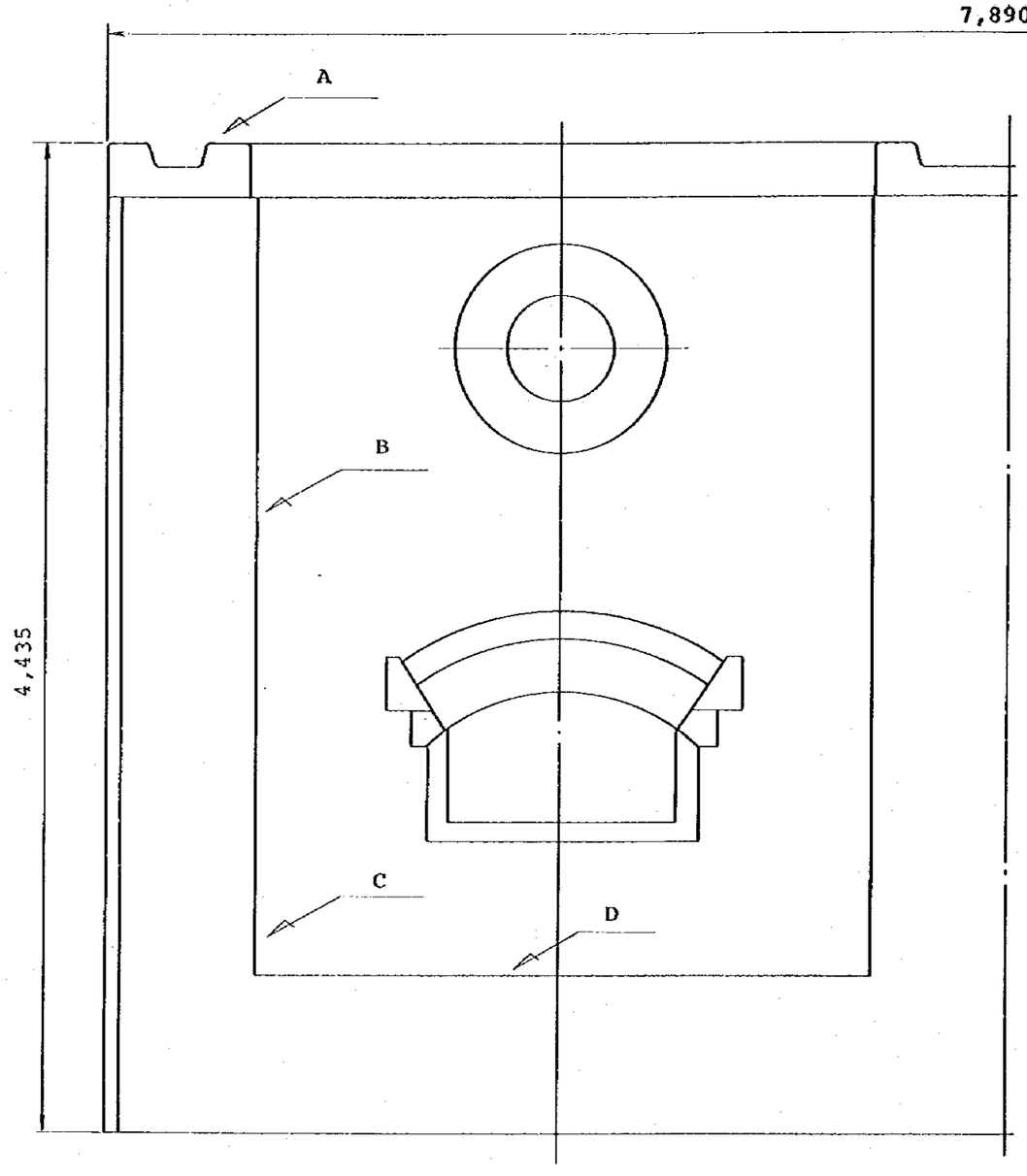
If these protective measures are properly taken, the life of the soaking pits will be substantially prolonged.

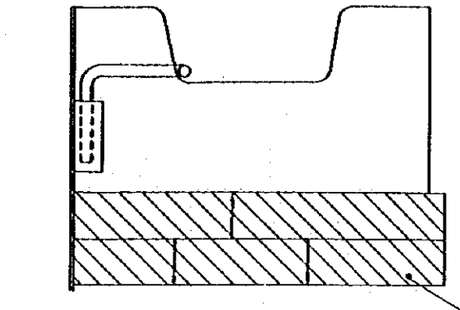
b) Soaking pits

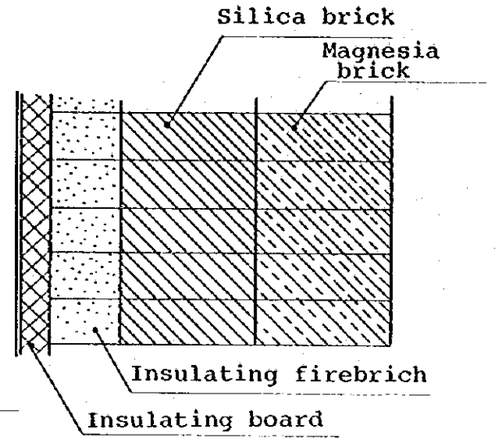
The soaking pits refractories shall be made of fire-brick.

General side walls shall be made of silica brick which have excellent resistance to spalling and creep. However, the lower parts of the side walls and the bottom shall be made of basic brick to prevent erosion by scale. At the back of the side walls and the bottom shall be provided insulating firebrick and board. The walls shall be provided with tension brick to prevent them from protrusion. Curve tile brick in the topmost parts of the walls, except the partition wall, shall also be made of tension brick. These measures can prevent the flow of seal sand into the space between the shell and brick.

The pit walls should be made of plastic refractories if longer lining life is desired in the future. Plastic refractories, however, call for skill in laying and cause greater trouble than firebrick when imporperly laid. Even when plastic refractories are used in the pit walls, it is desirable to make the partion wall with firebrick.
General types of refractories used in the soaking pits are shown in Fig. 4-3.







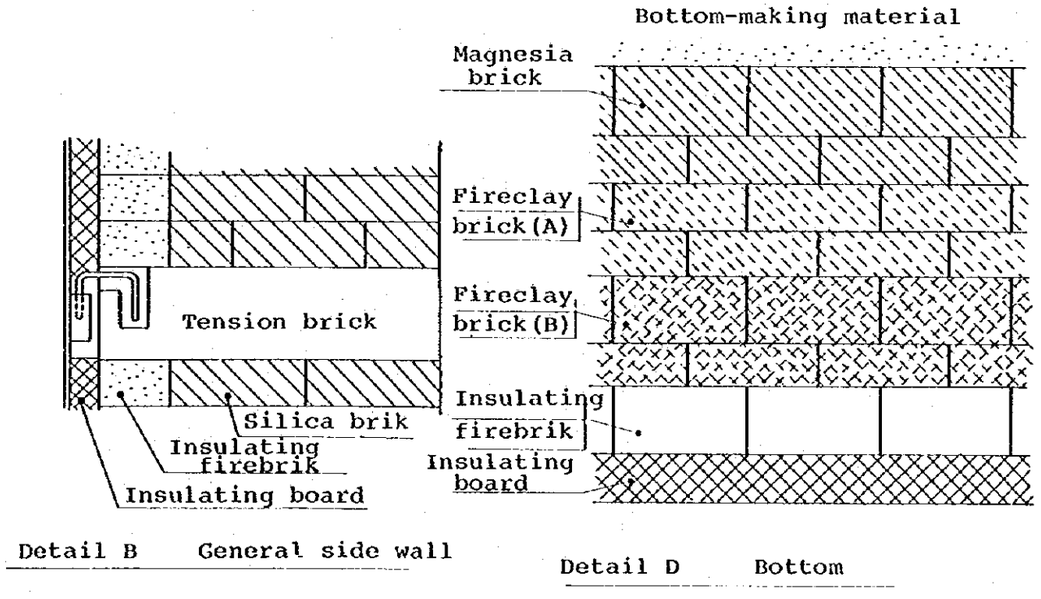


Fig.4-3. Shcematic diagram of soaking pit lining

c) Soaking pit covers

The soaking pit covers shall be made of plastic or castable refractories to improve spalling resistance and to prevent gas escape by monolithic structure.

Plastics are more durable than castables but require a high degree of skill in laying. They also are liable to deterioration when stored for a long period of time. Thus, use of castable refractories should be preferred at present.

The cover lining is schematically illustrated in Fig. 4-4 and Drawing No. RP-0008.

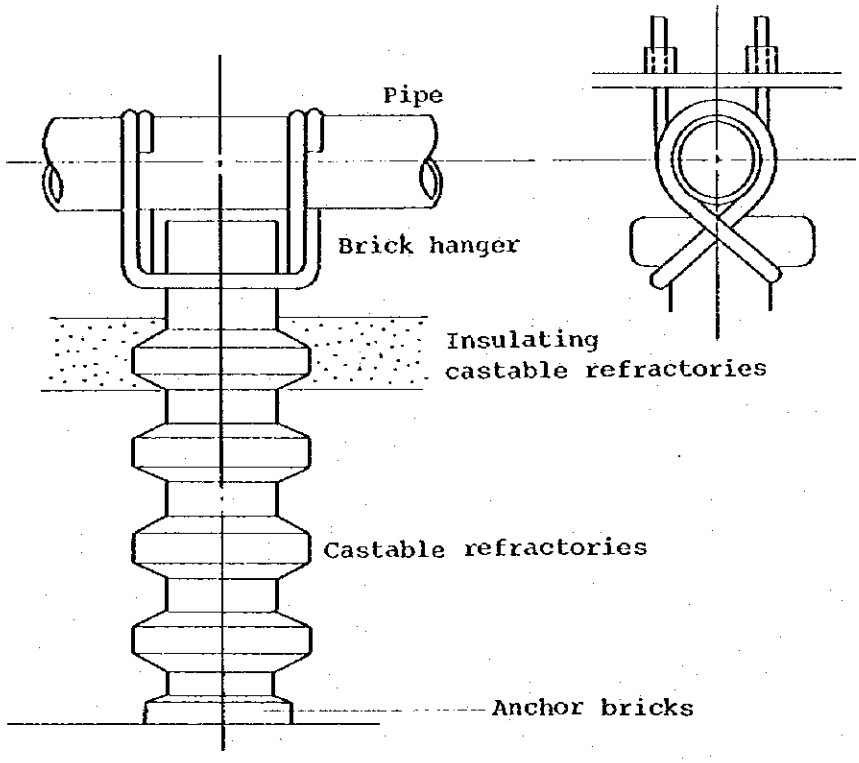
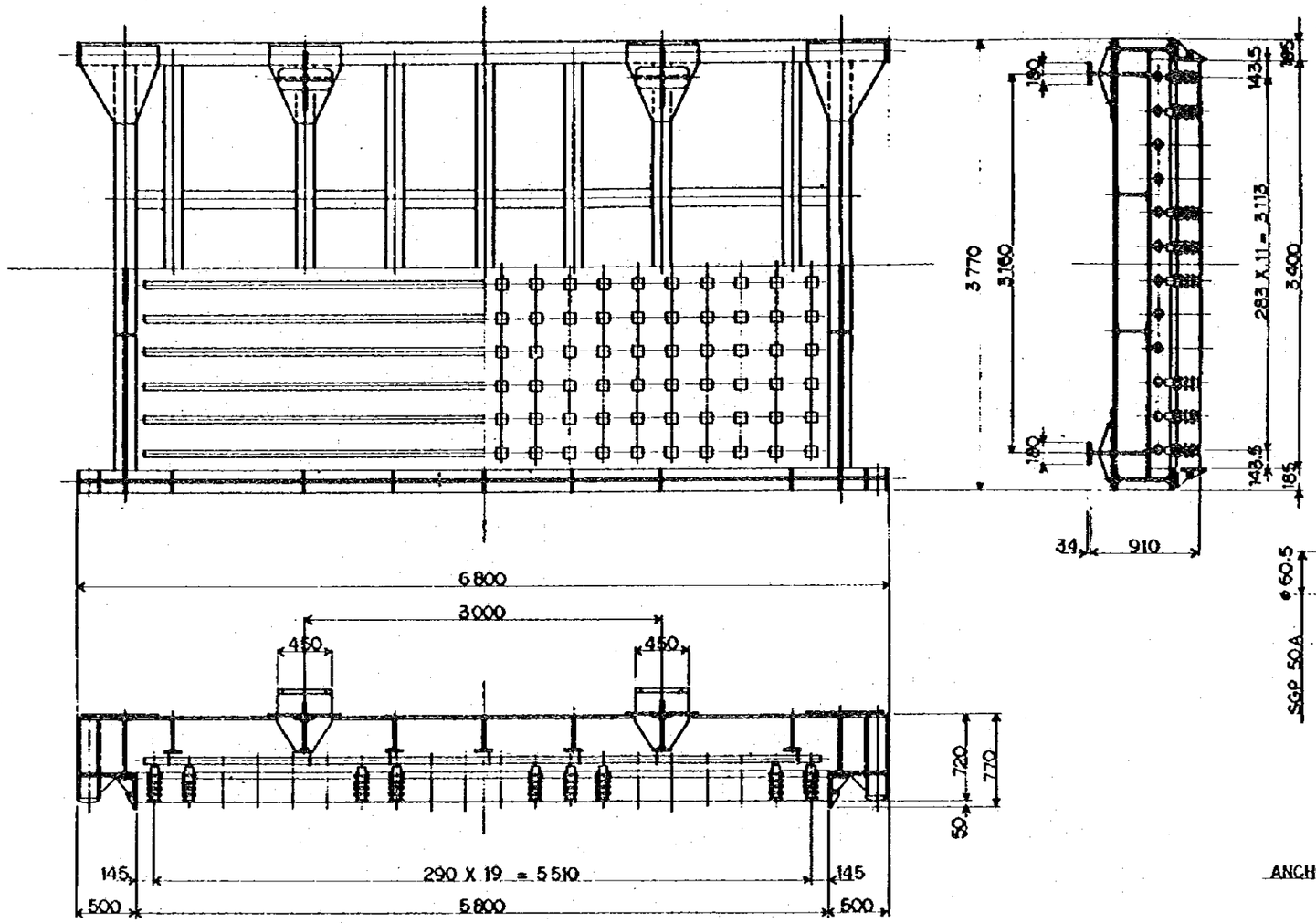


Fig.4-4. Schematic diagram of hangle bricks



No.	MATERIAL	DIMENSION	QUANTITY	UNIT WEIGHT / TOTAL WEIGHT KG	NOTE

REVISION No.	DESCRIPTION	BY	CHKD	APPD	DATE
1					
2					
3					
4					

REVISION No.	DESCRIPTION	BY	CHKD	APPD	DATE
6					
7					
8					

DESIGNED		
DRAWN		
CHECKED		
REVIEWED		
APPROVED		

NIPPON STEEL CORPORATION-NSC

CLIENT: EISCO

TITLE: SOAKING PITCOVER

SCALE	1/30, 5	DWG No.	RP--0008
DATE	MAY '79		

4.3.3 Cover cranes

(1) Present problems

The existing two cover cranes must be entirely renewed because of severe damage and wear of the drive units related to travelling and hoisting. Plant shutdown caused by cover crane failures accounts for an average of 19 hr per month (between September and November, 1978). Most of these crane failures are electrical failures, mainly collector problems and wiring and motor burnouts.

(2) Description of rehabilitation

The two cover cranes shall be both renewed in accordance with the existing rail span.

(3) Main specifications

Type	Electric motor driven type
Quantity	2 units (one for Nos. 1 to 4 soaking pits and the other for Nos. 5 to 8 soaking pits)
Crane span	9,400 mm
Lift	180 mm
Travelling speed	24.0 m/min
Cover weight	21 tons/cover
Main power source	380 V, 50 Hz

Operation of the cover cranes shall be manually controlled from the instrument room of the soaking pits.

4.4 Blooming mill and auxiliaries

4.4.1 Present problems

Failures of the blooming mill, including the manipulator, working roller tables and breast rollers, are most frequent and responsible for an average of 50.3 hr per month of plant shutdown (between September and November, 1978).

Electrical equipment accounts for more than the half of these failures. There also are many mechanical drive unit failures, such as unbalanced wear of speed reducer gears and wear of bearings. The gear box covers are not bolted, resulting in incomplete closure.

4.4.2 Description of rehabilitation

(1) Manipulator

The manipulator shall be renewed with the existing manipulator guide length and tilting finger positions unchanged. Since the existing wire rope drive system for the tilting fingers fails frequently, it shall be renewed by a drive system of the worm reducing type.

The existing AC drive motors shall be replaced by DC motors to improve controllability and to reduce motor burnouts.

(2) Breast rollers

The breast rollers shall be basically the same as the present specifications but shall be independently driven to allow for the ease of maintenance.

(3) Mill screwdown speed reducers

The existing mill screwdown speed reducers shall be renewed because of their obsolescence and wear-out. The AC screwdown drive motors shall be replaced by DC motors to enhance stopping accuracy.

4.4.3 Main specifications

(1) Manipulator

Type	Electric motor driven type
Side guide length	4,800 mm (exluding end guide)
Finger	Worm reducing type with 4 fingers
Side guide opening	2,300 mm max.
Side guide moving speed	0.8 m/sec
Finger tilting stroke	600 mm

(2) Breast rollers

Barrel length	2,100 mm
Roll diameter	590 ϕ/490 ϕ mm
Journal diameter	180 ϕ mm

4.5 Roller tables

4.5.1 Present problems

Most of the existing roller tables are obsolete, and many rollers are incapable of rotation.

Plant shutdown due to roller table troubles averages 22.3 hr per month (between September and November, 1978).

4.5.2 Description of rehabilitation

(1) Ingot receiving table

The ingot receiving table shall be renewed with the roller diameter and roller barrel length unchanged.

The foundation shall be constructed to accommodate an ingot scale and three roller tables for future installation (ingot receiving table, ingot scale table and ingot waiting roller table). In this step, the ingot receiving table and ingot waiting table shall be installed. The ingot receiving table shall have to be moved when the ingot scale table is installed.

Equipment shall also be provided to receive scale falling from the roller tables.

(2) Front extension table

The front extension table shall be renewed with the roller specifications unchanged.

This table has the same function as the working roller tables of transferring slabs and blooms which elongate greatly during rolling.

Because of the resultant need for synchronization with the working tables, DC motor shall be installed. Taking account of maintenance, the table rollers shall be independently connected to corresponding DC motors through a coupling.

(3) Ingot approach table

The ingot approach table shall be renewed with the roller specifications unchanged.

This table shall also use rollers connected to DC motors for the same reason as described in (2) above.

(4) Front and back working tables

The front and back working tables shall be renewed with the roller specifications unchanged.

Because of the need for synchronization with the mill rolls, these working tables shall be driven by DC motors.

This system is generally used in Japan and seems satisfactory enough when ingot size and economy are considered.

(5) Back extension table

The back extension table shall be renewed with the specifications unchanged. Rollers connected to DC motors shall be used for the same reason as described in (2) above.

(6) Shear roller tables A and B

These tables shall be renewed with the roller dimentions unchanged. Four entry rollers of the these 21 rollers shall be rollers connected to DC motors for the same reason as described in (2) above.

(7) Runout tables A and B

These tables shall be replaced with motor rollers to the same specifications as the present ones.

(8) Other

The existing roller table aprons shall be reused.

Those of the existing rollers which can be reused shall be held as spare rollers.

The relationship between roller table layout and slab and bloom length is shown in Fig. 4-5.

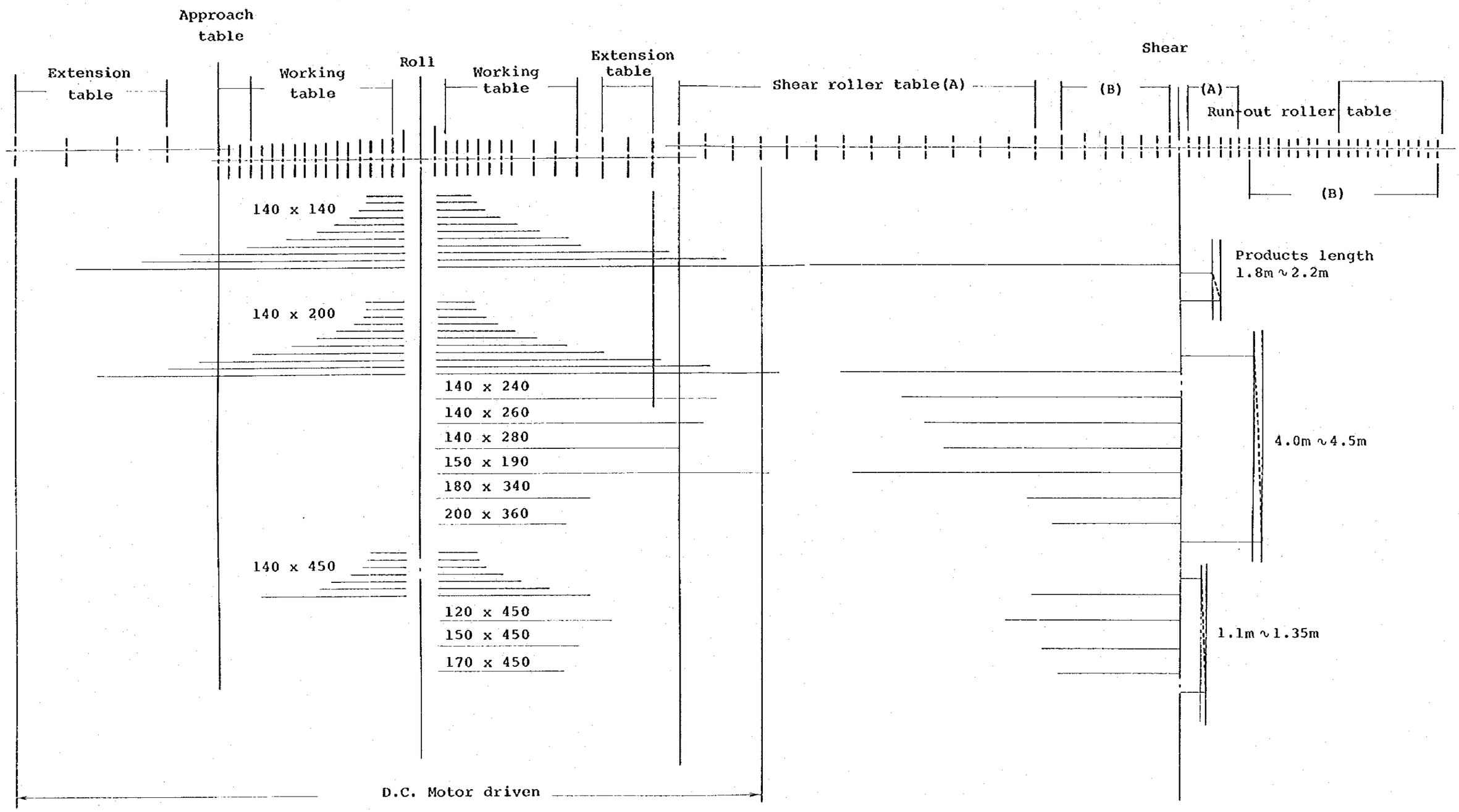


Fig.4-5. Roller table layout and production length

4.5.3 Main specifications

Main specifications of the table rollers are given in Table 4-5.

Table 4-5. Table rollers of blooming mill

No.	Name of table roller	Table dimension					Speed (m/sec)	Drive	Remarks
		Roller dia. (ϕ mm)	Roller length (mm)	Roller pitch (mm)	No. of rollers	Table * length (mm)			
1	Ingot receiving table	400	800	650	5	2,600	1.0	Common	L.S.H. (line shaft drive)
2	(Ingot scale table)	400	800	650	5	2,600	1.0	Common	L.S.H. (line shaft drive, if necessary)
3	Ingot waiting table	400	800	650	5	2,600	1.0	Common	L.S.H.
4	Extension table (mill front)	380	1,000	2,800	4	8,400	2.8-5.6	Individual	Roller connected to DC motor with coupling
5	Ingot approach table	350	2,300	600	4	1,800	2.8-5.6	Individual	
6	Working table (mill front)	350	2,300	600	13	7,200	2.8-5.6	Common	L.S.H.
7	Breast roller	590/490	2,100	900	1	-	2.8-5.6	Individual	
8	Breast roller	590/490	2,100	900	1	-	2.8-5.6	Individual	
9	Working table (mill back)	350	2,300	600 x 6 1,200 x 3	10	7,200	2.8-5.6	Common	L.S.H.
10	Extension table (mill back)	350	2,300	1,400 x 2	3	2,800	2.8-5.6	Individual	Roller connected to DC motor with coupling
11	Shear table (A)	380	1,000	1,500	4 10	19,500	2.8-5.6 2.2	Individual Individual	Ditto Ditto
12	Shear table (B)	380	1,000	1,200 x 2 1,000 x 2 900 x 1 625 x 1	7	5,925	2.2	Individual	Ditto
13	Runout table (A)	380	1,000	550	6	2,750	2.2	Individual	Motor roller
14	Runout table (B)	380	1,000	550	20	10,450	2.2	Individual	Motor roller

* : Length of roller table as measured between centers of first and last rollers.

4.6 Electric equipment

4.6.1 Use of DC screwdown motors

(1) Present problems

The screwdown system is obsolete with motor and secondary-resistor burnouts and coupling breakage taking place. Now driven by AC motors, it is poor in stopping accuracy. Overload by AC motors causes motor burnouts frequently.

(2) Description of rehabilitation

DC motors shall be used. Controls and wiring shall be completely renewed to reduce screwdown failures and to improve stopping accuracy.

(3) Main specifications

Motor	DC 52 kW/104 kW, 550/1,650 rpm
DC power source	SCR (thyristor)
Motor cooling	Open pipe ventilation
Brake	DC electromagnetic brake

4.6.2 Use of DC manipulator motors

(1) Present problems

Driven by AC motors, the manipulator has poor controllability and causes motor burnouts.

(2) Description of rehabilitation

DC motors shall be used to drive the manipulator and fingers, and controls and wiring shall be renewed to reduce manipulator failures.

(3) Main specifications

Motor	Manipulator: DC 22 kW/44 kW, 650/1,950 rpm
	Finger: DC 15 kW/30 kW, 260/520 rpm
DC power source	SCR (thyristor)
Brake	DC electromagnetic brake
Motor cooling	Open pipe ventilation

4.6.3 Front and back working roller tables

(1) Present problems

Driven by AC motors, the front and back working roller tables cannot have their speed matched with the mill speed. Overload by AC motors causes motor burnouts. Some rollers are incapable of rotation.

(2) Description of rehabilitation

DC table drive motors shall be used to match the table speed with the rolling speed, and controls and wiring shall be renewed.

This will eliminate motor overload and reduce motor burnouts.

(3) Main specifications of motors

Front working roller table	37 kW/74 kW, 575/1,725 rpm, 2 motors
Back working roller table	37 kW/74 kW, 575/1,725 rpm, 2 motors
Appraoch table	11 kW/22 kW, 800/2,000 rpm, 4 motors
Front extension table	11 kW/22 kW, 800/2,000 rpm, 4 motors
Back extension table	11 kW/22 kW, 800/2,000 rpm, 3 motors
Shear roller table	11 kW/22 kW, 800/2,000 rpm, 4 motors
DC power source	SCR (thyristor)
Motor cooling	Open pipe ventilation

4.6.4 Independent drive of breast rollers by DC motors

(1) Present problems

The breast rollers are now mechanically coupled to the front and back working roller tables, resulting in maintenance difficulty.

(2) Description of rehabilitation

The breast rollers shall be independently driven by DC motors.

(3) Main specifications

Brest roller motor	3.7 kW/7.4 kW, 1,025/2,050 rpm
DC power source	SCR (thyristor)
Motor cooling	Open pipe ventilation

Notes: The following measures shall be taken with respect to Items 4.6.1 through 4.6.4:

1) Forced-cooling fans for motors shall be installed in the mill motor room.

2) The motors shall be provided with protective circuits (current-limiting circuits, etc.) to prevent their burout by overload.

3) SCRs (thyristors) and controls shall be provided with failure detectors for ease of maintenance and shall be installed for ease of parts replacement.

4.6.5 Roller table motors

(1) Present problems

The present roller table motors are obsolete with motor and secondary-resistor burnouts frequently taking place.

(2) Description of rehabilitation

The motors, controls and wiring shall be completely renewed to reduce failures.

(3) Main specifications

Motor	AC 30 kW, 6 P, 2 units AC 7.5 kW, 4 P/10 P, 30 units AC 11 kW, 6 P/10 P, 13 units

4.6.6 Other

A large amount of dust enters the mill pulpit because of poor sealing. Room temperature is so high that equipment failrues frequently occur due to deterioration and insulation drop. Therefore, the mill pulpit shall be lined and made airtight.

An air-conditioning system shall be installed also to maintain constant temperature in the pulpit.

4.6.7 Cooling equipment for motor room and units installed in motor room

(1) Present problems

a) Poor sealing of the motor room raises room temperature and permits the entrance of dust, leading to the failure of controls for the Ilgner motor-generator set and mill drive motor.

b) Cooling capacity for the entire motor room is insufficient.

c) Undercooling of the Ilgner motor-generator set and mill drive motor causes insulation trouble and other failures.

i) Coolers for the Ilgner motor-generator set and mill drive motor are deteriorated and short on capacity.

ii) The commutator sides of the DC generators and mill drive motor are open, adding to the lack of cooling effect.
(Temperature inside the DC generators and mill drive motor is over 60°C)

(2) Description of rehabilitation

a) The motor room shall be made airtight.

b) A ventilating and cooling system of increased capacity shall be installed for the motor room.

i) The present forced-draft fan room shall be enlarged.

ii) Pressure inside the motor room shall be made higher than the surrounding area to prevent the entrance of dust.

c) The cooling system for the Ilgner motor-generator set (drive motor and DC generators) and mill drive motor shall be completely changed from the existing unit-cooling system to a down-draft system.

d) The sides of the DC generators and mill drive motor opposite to the commutator shall be enclosed with new end covers.

e) A sealed compartment shall be provided in the motor room to house the SCRs (thyristors) and controls for DC motors and shall be cooled by an air conditioner.

f) Forced-cooling fans for DC motors shall be installed in the motor room, and air ducts shall be installed running from the motor room to the individual DC motors.

4.6.8 Lubricating system for bearings of Ilgner motor-generator set

(1) Present problems

In case of power failure, the lubricating oil pump is driven by a battery-operated DC motor. This DC motor and its control have frequent troubles.

(2) Description of rehabilitation

a) The battery and DC motor shall be removed.

b) An elevated oil tank shall be installed to supply lubrication to the Ilgner motor-generator set for the time (about 1 hr) during which the Ilgner motor-generator set completely stops in case of power failure. A switching device shall be provided for the purpose.

c) The lubricating system shall be completely renewed.

4.6.9 Exciters for DC generators and mill drive motor

(1) Present problems

The exciter (Amplidyne) for the DC generators and the exciter (Metadyne) for the mill drive motor are obsolete and subject to frequent failures. Spare parts are also difficult to obtain.

(2) Description of rehabilitation

a) SCRs (thyristors) shall be used in place of the Amplidyne, Metadyne and base exciters.

b) The existing controls and wiring shall be completely renewed.

c) A sealed compartment shall be provided in the motor room to house the thyristors and controls and shall be cooled by an air conditioner.

d) The existing exciters shall be removed.

Notes: The thyristor exciters will apply higher voltage (harmonic surge voltage) to the field of the DC generators and mill drive motor, leading to the possibility of breakdown of field coil insulation. Therefore, the following measures seem necessary:

i) Strengthened field coil insulation of DC generators and mill drive motor

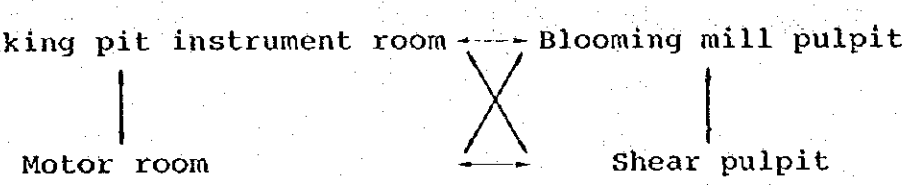
ii) Overhaul of DC generators and mill drive motor

It seems necessary to ask AEG, the manufacturer of the DC generators and mill drive motor, to study the need for the above-mentioned measures.

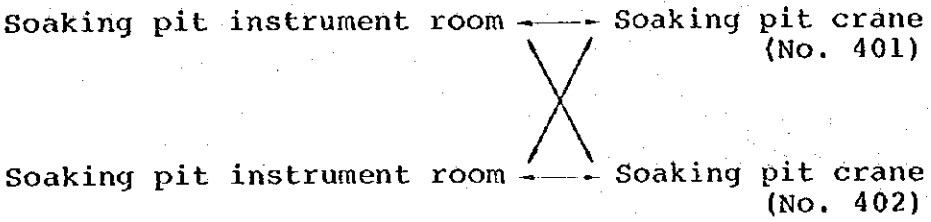
4.6.10 Communication equipment

The following systems shall be installed to ensure rapid and reliable communications concerning operations and failures with related departments and thus to minimize equipment downtime.

(1) Interphone system



(2) Radio communication system for crane operation



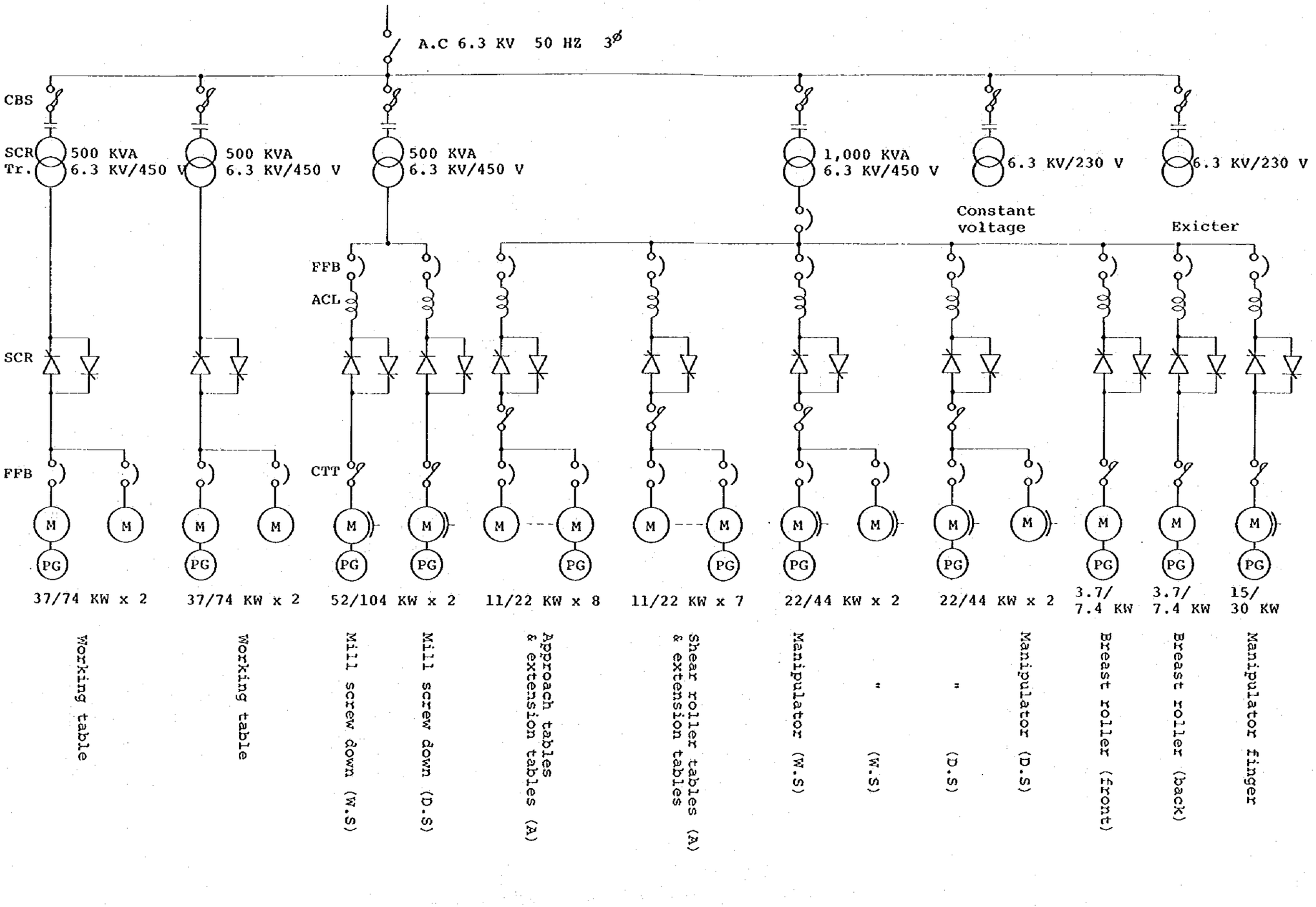


Fig. 4-6. DC motor skeleton diagram

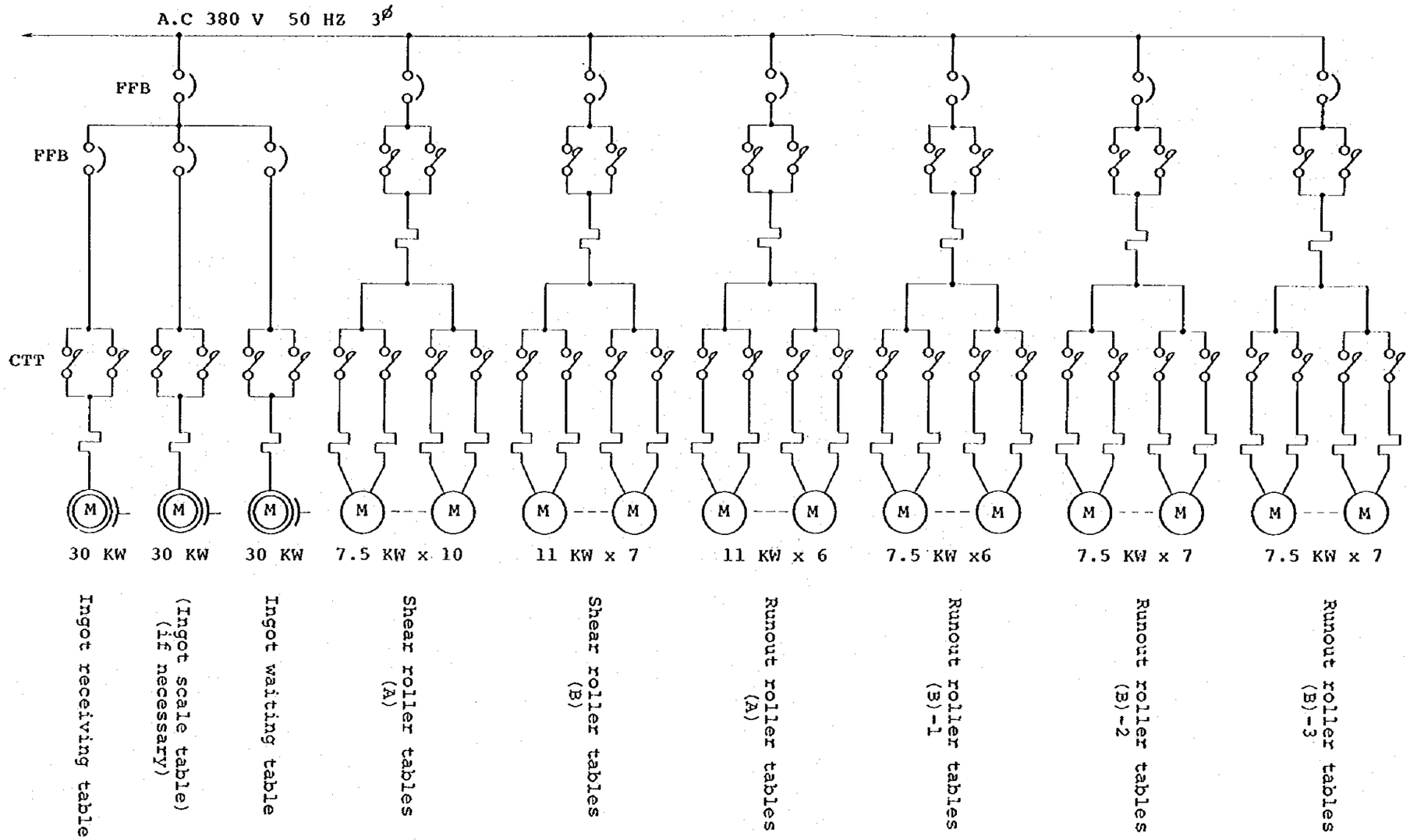


Fig. 4-7. A.C Table motor skeleton diagram

4.7 Auxiliaries

4.7.1 Centralized grease equipment

(1) Three centralized grease systems shall be installed to supply grease to individual table roller necks.

a) System for ingot receiving table, (ingot scale table), waiting table, extension table (mill front), approach table, and working table (mill front)

b) System for working table (mill back), extension table (mill back), and shear tables A and B

c) System for runout tables A and B

(2) Main specifications

Type	Electric motor driven loop type
Tank capacity	35 liters x 2, 20 liters x 1
Pump delivery	192 cc/min x 2, 60 cc/min x 1
Rated pressure	210 kg/cm^2

4.8 Ingot scale table (if necessary)

(1) If necessary for production control, the type of ingot scale described below may be installed.

Fig. 4-8. shows an ordinary ingot scale of the lifting type. This type of ingot scale may be driven electrically or hydraulically.

Since the mast guide of the EISCO soaking pit cranes is only 3,500 mm high above the ground, this type of ingot scale has the possibility of striking against the ingot and soaking pit cranes.

Instead, an ingot scale of the direct table receiving type is recommended which weighs both the ingot and table at the same time. This type of ingot scale needs the equipment to dispose of scale falling from ingot surfaces. In general, ingot scales require detailed routine maintenance and are very difficult to maintain.

The ingot scale table shall be located in the ingot receiving table under this rehabilitation plan. When installing the ingot scale, the ingot receiving table will have to be moved 2,600 mm to receive an ingot from the soaking pit crane. he ingot scale table of the direct receiving type is schematically illustrated in Drawing No. RP-0009.

A ingot weight display and recorder will be installed in the soaking pit instrument room, and ingot weighing will be made possible both manually and automatically.

(2) Main specifications

Type	Direct table receiving type
Maximum capacity	5 tons
Minimum graduation	10 kg
Accuracy	1/1,000

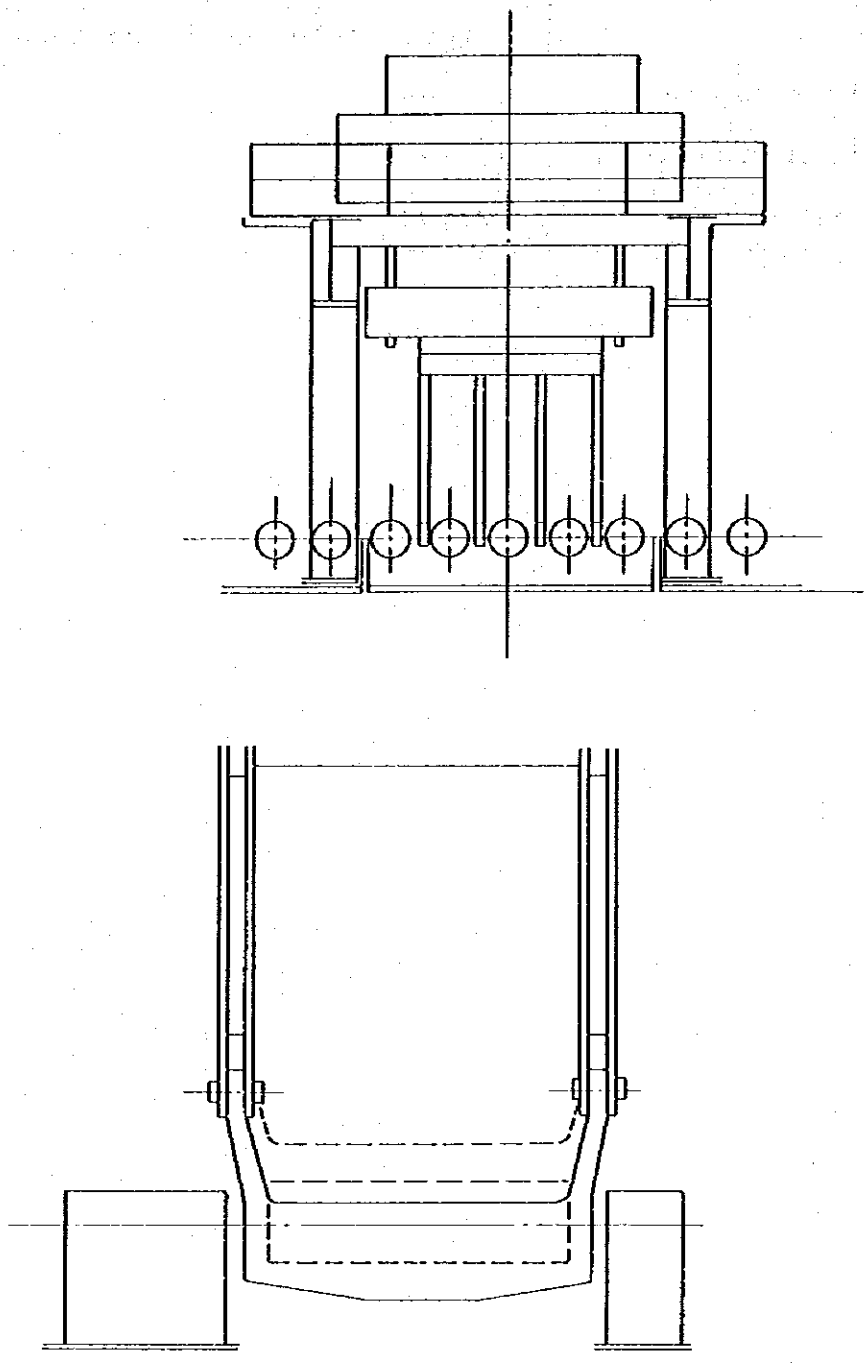
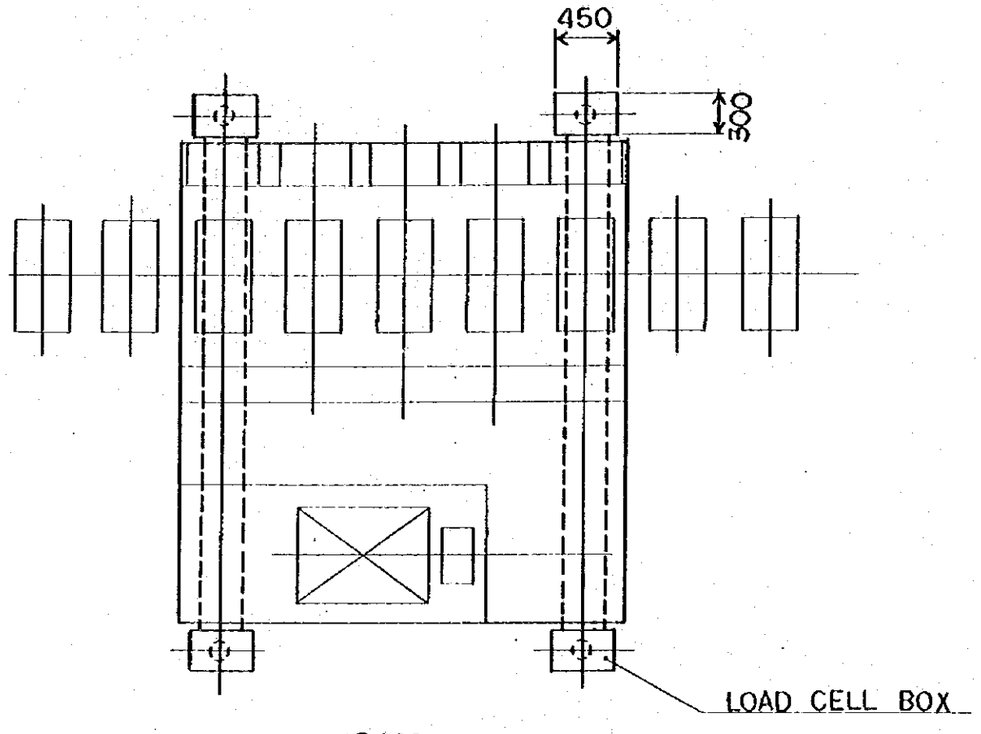
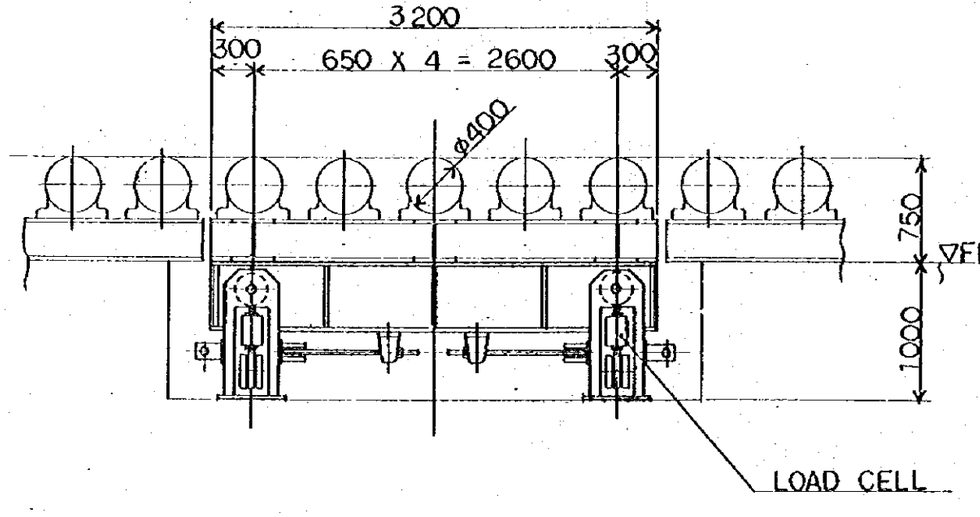
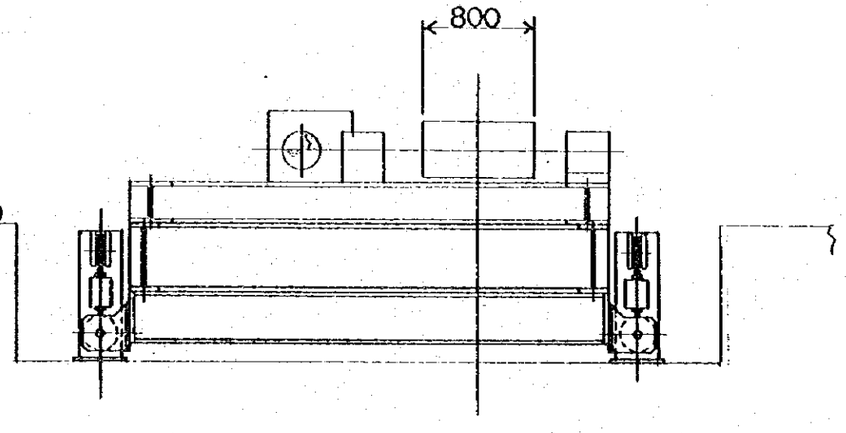


Fig. 4-8. Ingot scale (lifting type)







No	MATERIAL	DIMENSION	NOTE

This Drawing is the property of NSC. It must be neither traced nor reproduced in any manner nor shall it be submitted to the third parties for examination without NSC's consent. It shall be used only as a means of reference to work designed or furnished by NSC.

NIPPON STEEL CORPORATION·NSC

CLIENT: EISCO

TITLE: BLOOMING MILL
INGOT SCALE (OPTION)

SCALE: 1/40 DWG No: RP-0009

DATE: MAY'79

REVISION No	DESCRIPTION	BY	CHD	APP'D	DATE
1					
2					
3					
4					
5					
6					
7					
8					

	BY	DATE
DESIGNED		
DRAWN		
CHECKED		
REVIEWED		
APPROVED		

4.9 Civil and building works

Data required for studying the existing foundations and buildings, such as meteorological conditions, soil conditions, design calculation sheets, and design codes and regulations, have not been made available to us. Therefore, study is made here under the following conditions.

4.9.1 Soaking bay building

Since their degree of deterioration with age is not known, it is assumed that the existing crane runway girders may be all replaced. It is also assumed that the building foundation will not be modified because its strength and other particulars are not known.

Since increased soaking pit crane weight must be considered, more detailed study for the soaking pit building and foundation should be made by EISCO.

4.9.2 Foundations for manipulator and roller tables

Since the fatigue of foundations for the manipulator, working roller tables and other tables is now known, no additional piles will not be driven. The bearing power of ground is assumed to be satisfactory engough.

More detailed study should be made by EISCO.

4.9.3 Soaking pit flues

Since foundation data are not available, detailed study cannot be made. The area where flues of Nos. 1 to 4 soaking pits converge shall be modified. Deterioration of the existing foundations is not taken into account.

More detailed study should be made by EISCO.

4.9.4 Motor room

Thyristor and control compartments shall be provided in the existing motor room.

More detailed study should be made by EISCO.

5. SPECIFICATIONS OF MAIN EQUIPMENT

5. Specifications of main equipment

Notes: Asterisks in the following tables denote specifications of modified or new equipment.

5.1 Soaking pits

Item	Name of equipment	Quantity	Specifications
(1)	*Soaking pit	8	Top one-way fired recuperative soaking pit. Size : 2,700 mm (W) x 5,100 mm (L) x 3,600 mm (D) Fuel : Mixed gas (blast furnace gas + fuel oil) Charging capacity : 45 t/pit (max.)
(2)	*Recuperator	3 (#1 ∿#6) 2 (#7, 8)	Stack-type metallic recuperator. Temperature of preheated air at outlet : 500°C Convection type (Finned-tube type) Temperature of preheated air at outlet : 500°C
(3)	*Cover crane	2	Capacity: 21 t Crane span : 9,400 mm Lift : 180 mm Traveling speed: 24.0 m/min
(4)	*Soaking pit crane	2	Type : Overhead type Capacity : 5 ton Crane span : 21 m Lift : 6,500 mm (FL+3,500 mm, FL-3,000 mm) Speed: Lifting 20 m/min Traversing 50 m/min Traveling 120 m/min Revolving 5 r.p.m Tons control 4 times/min

5.2 Blooming mill

Item	Name of equipment	Quantity	Specifications
(1)	Blooming mill	1	Type : 2-high reversing, preset control Roll dimensions : 900 mm dia (max) x 2,200 mm (L) Lift : 500 mm Speed : 0 - 65 - 95 - 120 r.p.m
(2)	*Manipulator	1	Type : Electric motor-driven, rack and pinion reducing type Length of side guide: 4,800 mm Finger : Four for front drive side only Traversing speed of side guide: 0.8 m/sec Tilting stroke : 600 mm
(3)	Slab shear	1	Type : Electric motor-driven, start stop/down-and-up-cut type Shear width : 950 mm Shearing force : 700 t Shearing cycle : 8 sec/cut
(4)	Crop pusher	1	Traveling speed : 0.85 m/sec Pushing force : 20 t

5.3 Table rollers

No.	Name of table roller	Dimensions (mm)	No. of rollers	Length (mm)	Speed (m/s)
1	*Ingot receiving table	(dia) 400ø x 800 (L)	5	2,600	1.0
2	*(Ingot scale table)	ditto	5	2,600	1.0
3	*Ingot waiting table	ditto	5	2,600	1.0
4	*Extension table	380ø x 1,000	4	8,400	VV
5	*Mill approach table	350ø x 2,300	4	1,800	VV
6	*Working roller table	350ø x 2,300	13	7,200	VV
7	*Breast roller table	590ø/490øx2,100	1		VV
8	*Breast roller table	590ø/490øx2,100	1		VV
9	*Working roller table	350ø x 2,300	10	7,200	VV
10	*Extension table	350ø x 2,300	3	2,800	VV
11	*Shear roller table (A)	380ø x 1,000	4	19,500	VV
		380ø x 1,000	10		2.2
12	*Shear roller table (B)	380ø x 1,000	7	5,925	2.2
13	*Runout roller table (A)	380ø x 1,000	6	2,750	2.2
14	*Runout roller table (B)	380ø x 1,000	20	10,450	2.2

5.4 Ingot scale (if necessary)

No.	Name of equipment	Quantity	Specifications
(1)	*Ingot scale	1	Type : Direct table receiving type Capacity : 5 t Minimum graduation : 10 kg

6. REHABILITATION COST

6. Rehabilitation cost

6.1 Estimate conditions

6.1.1 The scope of estimate is based on the rehabilitation plan described in Item 4, excluding Item 4.10.

6.1.2 Equipment is estimated on a CIF basis.

6.1.3 Erection cost covers equipment removal and installation, and it estimated from past experience on a Japanese basis. The cost of civil and building works is calculated from the conditions given in Item 4.9. The cost for construction materials is estimated on F.O.B. basis, since those materials are thought to be available in Egypt.

6.1.4 Spare parts for one year of operation are estimated for modified equipment.

6.1.5 The cost is estimated on a Japanese basis on May, 1979 and price escalation is not considered.

Rate of exchange between U.S. dollars and Japanese Yen is as follows;

U.S.$1.00 = 219.75 Yen (20 May, 1979)

6.1.6 The following items are not included in this estimate:

(1) Utilities for erection and hot-run, such as electricity, water, fuel, flushing or lubricating oil, compressed air, steam, etc.

(2) Inspection by third parties

6.2 Approximate estimate of equipment purchasing cost and erection cost

The estimated cost of this rehabilitation plan its shown in Table 6-1, and the approximate cost of the rehabilitation plan including the ingot scale and ingot scale table is given in Table 6-2.

6.3 Approximate total rehabilitation cost

	Rehabilitation plan		Rehabilitation plan including ingot scale and ingot scale table	
	Million Yen	Thousand U.S.$	Million Yen	Thousand U.S.$
Equipment purchasing cost	2,181	9,925	2,223	10,116
Erection cost	751	3,418	761	3,463
Engineering fee	290	1,320	300	1,365
Startup technical assistance fee	37	168	37	168
Total	3,259	14,831	3,321	15,112

Table 6-1. The estimated cost of rehabilitation plan

No.	Equipment	CIF cost		Erection cost		Total		Remarks
		Million Yen	Thousand U.S.$	Million Yen	Thousand U.S.$	Million Yen	Thousand U.S.$	
1	Soaking pits	966	4,396	238	1,083	1,204	5,479	Soaking pit crane: 2 units Cover crane : 2 units Cinder removal bucket: 2 units Steel framework : 1 set Refractory : 1 set Stack : 3 units Recuperator : 5 sets
2	Blooming mill	510	2,321	56	255	566	2,576	Front table : 2 units Separating equipment: 1 set Scale removal equipment: 1 set Extension table: 7 rollers Approach table : 4 rollers Working table : 23 rollers Shear table : 21 rollers Runout table : 26 rollers Breast roller : 2 rollers Manipulator : 1 set Mill screwdown system: 1 set Centralized grease system: 1 set
3	Electrical equipment	464	2,111	127	578	591	2,689	
4	Instrumentation	241	1,097	80	364	321	1,461	Soaking pit instrumentation : 1 set
5	Civil and building works			250	1,138	250	1,138	
	Total	2,181	9,925	751	3,418	2,932	13,343	

Table 6-2. The estimated cost of rehabilitation plan (including the ingot scale and ingot scale table)

No.	Equipment	CIF cost		Erection cost		Total		Remarks
		Million Yen	Thousand U.S.$	Million Yen	Thousand U.S.$	Million Yen	Thousand U.S.$	
1	Soaking pits	966	4,396	238	1,083	1,204	5,479	Soaking pit crane: 2 units Cover crane : 2 units Cinder removal bucket: 2 units Steel framework : 1 set Refractory : 1 set Recuperator : 5 sets Stack : 3 units
2	Blooming mill	528	2,403	61	277	589	2,680	Front table : 3 units Separating equipment: 1 set Scale removal equipment: 1 set Extension table: 7 rollers Approach table : 4 rollers Working table : 23 rollers Shear table : 21 rollers Runout table : 26 rollers Breast roller : 2 rollers Manipulator : 1 set Mill screwdown system: 1 set Centralized grease system: 1 set
3	Electrical equipment	466	2,120	127	578	593	2,698	
4	Instrumentation	263	1,197	85	387	348	1,584	Soaking pit instrumentation : 1 set Ingot scale : 1 unit
5	Civil and building works			250	1,138	250	1,138	
	Total	2,223	10,116	761	3,463	2,984	13,579	

7. CONCEPTUAL CONSTRUCTION SCHEDULE

7. Conceptual construction schedule

Table 7-1 shows the conceptual construction schedule for the rehabilitation plan of the blooming mill.

This schedule is planned on a standard basis in Japan.

7.1 Nos. 1 to 8 soaking pits may be rehabilitated in two groups of four pits each, with Nos. 1 to 4 soaking pits rehabilitated first.

7.2 The runway girders are scheduled to be replaced partially in advance of blooming mill shutdown, to the extent that it does not disturb soaking pit operation.

7.3 This construction schedule is just conceptual.
On implementation of this rehabilitation plan, EISCO shall make more detailed construction schedule considering the following points;

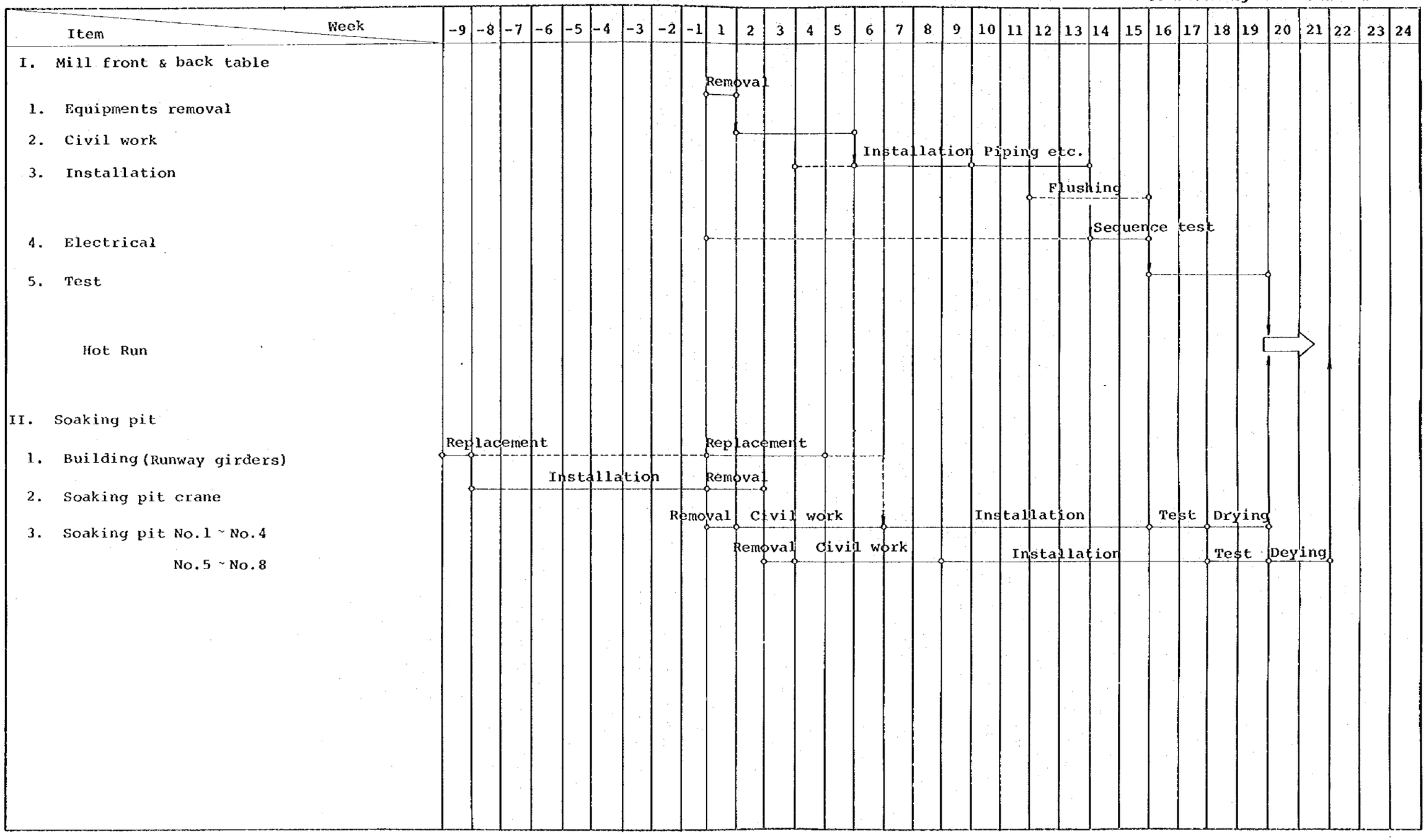
(1) Production plan during construction

(2) Foundation for renewed equipment

(3) Construction method

Table 7-1. Conceptual construction schedule

Note: - denotes the period prior to blooming mill shutdown



8. NECESSITY OF INVESTMENT

8. Necessity of investment

If the blooming mill of EISCO is left as it is, its monthly production will go below 8,000 t/month after three years, as shown in Fig. 1-1. This production volume will amount to only about a half of 16,100 t/month of ingots which must be rolled, and will eventually lead to the shutdown of the blast furnaces, let alone the steelmaking plant. This rehabilitation plan represents the investment to restore the production of the present blooming mill to the original level.

This investment is essential to keep production level of the blooming mill to meet the required production of ingots from steelmaking plants.

The estimated annual increase in the production of heavy sections is (16,100 t/m - 12,000 t/m) x 0.8 x 0.82 x 12 ≈ 32,000 t/y.

At present, this increase of production is very effective for solving shortage of steel material in Egypt, moreover, for reducing quantity of imported steel material.

9. DRAWING LIST

9. Drawing list

RP-0001: Blooming mill rehabilitation plan

RP-0002: Soaking pit bucket & rake

RP-0003: Soaking pit Nos. 1, 2, 3, 4 (a plane figure)

RP-0004: Soaking pit Nos. 1, 2, 3, 4 (a side view)

RP-0005: Soaking pit Nos. 1, 2, 3, 4 (Sections)

RP-0006: Soaking pit Nos. 5. 6 (a plane figure)

RP-0007: Soaking pit Nos. 5, 6 (a side view)

RP-0008: Soaking pit cover

RP-0009: Blooming mill ingot scale