3-4 Foundry for Light Alloys, Pistons and Piston Rings

3-4-1 Outline of Processes

(1) Working equipment and its layout

Table AI-3-4-1 and Fig.AI-3-4-1 shows the working equipment and its layout.

(2) Organization and personnel

Table AI-3-4-2 shows the organization and personnel.

3-4-2 Analysis of Production Processes

(1) Outline table of the process analysis

This is shown in Figs.AI-3-4-3 and AI-3-4-4.

(2) Flow chart and process chains

This is shown in Fig.AI-3-4-5

(3) Problems and improvement of operational procedures and process chains for main finished products and parts

1) There are trial-and-error operations in adjusting the right mold to the left when arranging the molding tools for piston casting. Changing of the molds is time consuming and loss of materials is great. Conversion to adjustable molds should be considered.

2) Gate cutting on piston

As the ingate residue is large cutting has to be continuous and this shortens the life of the cutting device. It is necessary to re-examine the cutting method for the piston gate.

3) The finishing allowance is 2.5 - 3 mm and this shortens the service life of the cutting device. Improvement of the mold precision should be considered.

4) The quantity of piston dead head is too great. As the finishing allowance is too large great stress is placed on the processing blade. Materials and energy loss is great. Re-consideration of the metal mold is needed.

5) As the insert for the cut ingate is wire gauze it is easily snagged. Conversion from the wire gauze to an iron plate should be considered.

(4) Problems and improvement of operational procedures and division of labor

Because of the electric situation night working is done but there are work areas where lighting is insufficient. Particularly the lighting for the piston ingate cutting area is poor. The safety cover for the band saw is not completely secured. Increasing lighting equipment and safety measures should be considered.

The throwing away of sand after use in shell molding is a waste of raw materials. Methods for its retrieval should be considered.

(5) Problems and improvements of layout and material handling

Nothing of note.

(6) Problems and improvement of equipment

Molten metal for the piston ring casting is carried by manpower with a ladle to supply to the casting mold.

There is danger of scalding. In order to ensure the safety of operations it is necessary to consider use of an automatic supply system in the future.

3-4-3 Products Quality

(1) Occurrence of rejects due to changing of the casting sand

Rejects due to blowholes occurring at the time of casting sand changing are frequent. These become evident during the various machining processes. Not only this shop but all the shops receiving products from here are affected. It is necessary to investigate the

causal relations of casting sand changing and reject occurrence and the economic repercussions of this.

(2) Lack of awareness with regard to occurrence of rejects

When the reject rate is within a 10% margin the causes are not seriously followed up. Further, it is considered sufficient if rejects are melted down and re used. The policy of investigating the origins of rejects must be established and strengthened in the future.

Table AI-3-4-1 EQUIPMENT LIST
- PISTON & PINTON RING FOUNDRY -

Piston Foundry

No.	Description		Q'ty
1	Reverberating Furnace	300kg	1
2	Holding Furnace	200kg	4
3	Permanent Molding Machine		4
4	High-speed Hydraulic Press	20t	1
5	Trimming Press		1
6	Ladle Crane	1t	1

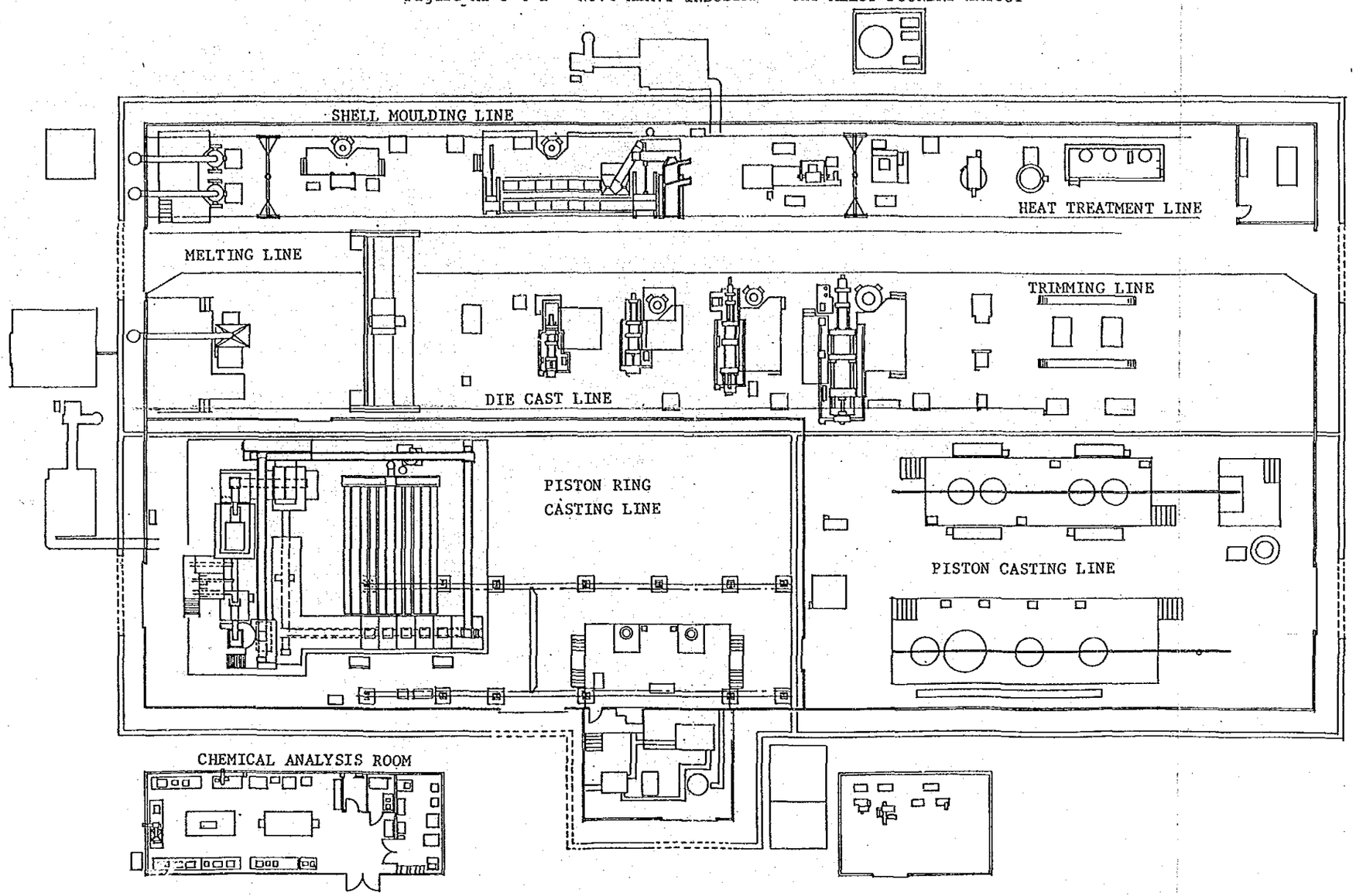
Piston Heat Treatment System

1	Solidification Treatment Furnace	1
2	Artificial Ageing Furnace	2
3	Quenching Tank	1
4	Mono Rail Hoist	1

Piston Ring Foundry

1	High Frequency Induction Furnace	1
2	Semi-automatic Molding Machine	1
3	Moulding Flask	1
4	Hopper	1
5	Traverser	1
6	Sand Testing Equipment	1
7	Tumbler	1
8	Semi-automatic Internal Grinder	1
9	Internal Grinder	1
10	External Grinder	1

Figure AI-3-4-1 NO.4 HEAVY INDUSTRY LIGHT ALLOY FOUNDRY LAYOUT



Equipment Installed by Additional Loan

1. B600 & X2000 Light Alloy Foundry (Item Nos. IV-3-1 to IV-3-4 & IV-4)
2. Piston Ring Foundry for B600 & X2000 and other 4 types vehicles and for 8 products of other projects (Item Nos. VIII-2-1, VIII-2-6 & VIII-2-10-(1))
3. Piston Foundry for B600 & X2000 and other 4 types vehicles and for 8 products of other projects (Item Nos. VII-1, 2 & VIII-6-2, 4)

PISTON RING CASTING EQUIPMENT

HIGH-FREQUENCY FURNACE
SAND TREATMENT UNIT
MOLDING MACHINE
MATERIAL TESTING MACHINES
METAL ANALYSER
RAW MATERIAL TESTER

PISTON CASTING EQUIPMENT

300 kg REVERBERATORY FURNACE
HOLDING FURNACE
PERMANENT CASTING MACHINE
TRIMMING PRESS
T6 TREATMENT UNIT

Figure AI-3-4-2 LIGHT ALLOY FOUNDRY SHOP STAFFING

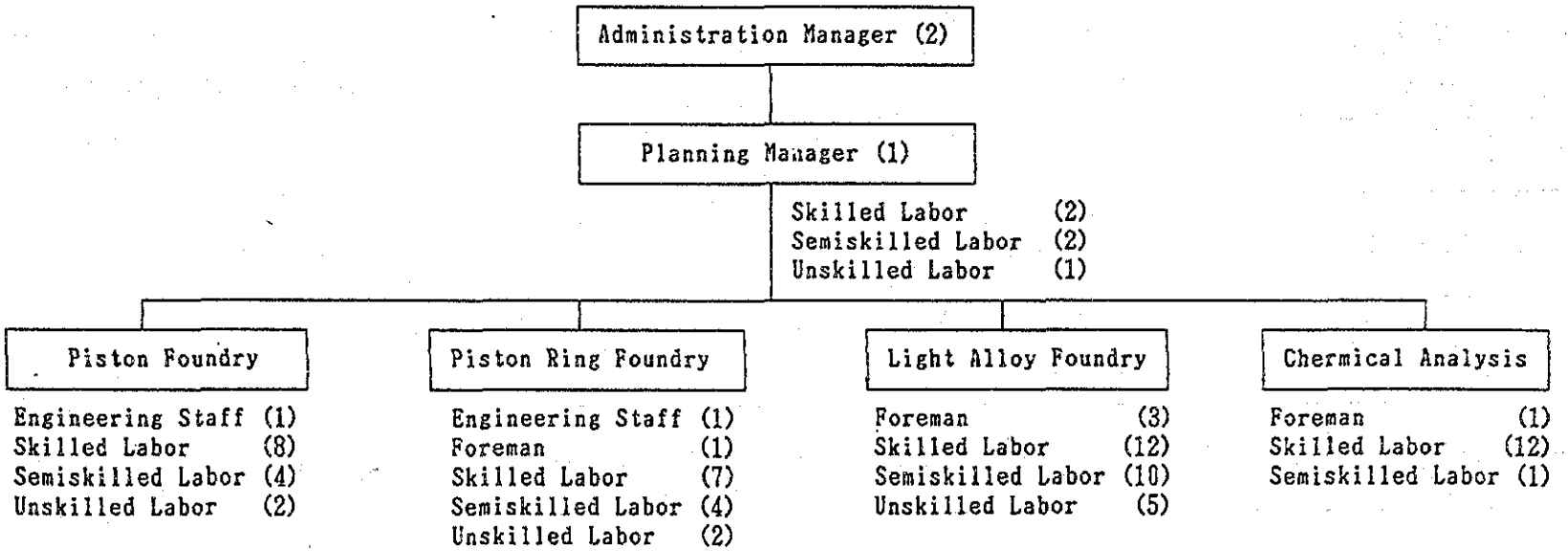


Figure AI-3-4-3 PRODUCTION PROCESS FLOW OF LIGHT ALLOY PARTS

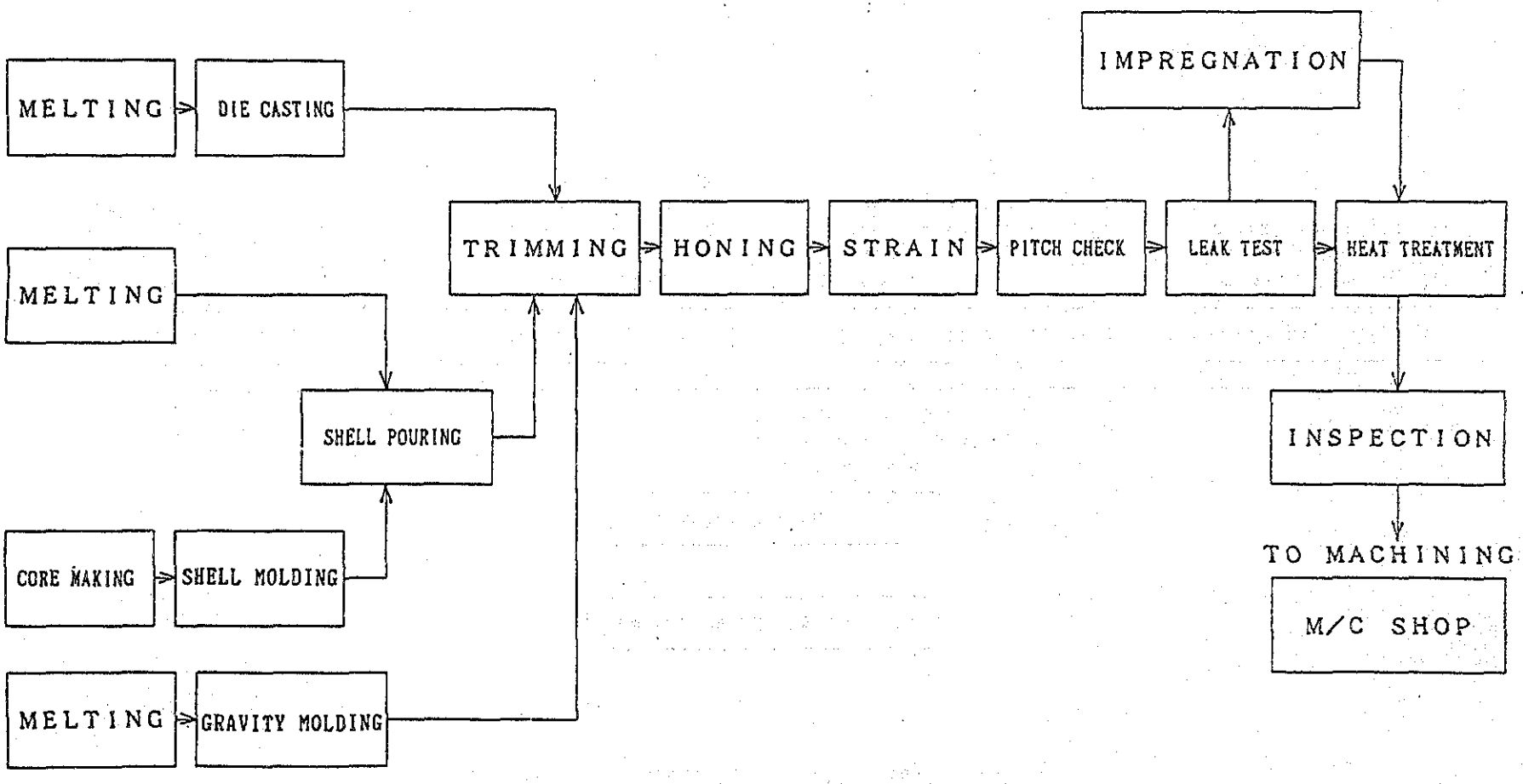


Figure AI-3-4-4 PRODUCTION PROCESS FLOW OF PISTON RING

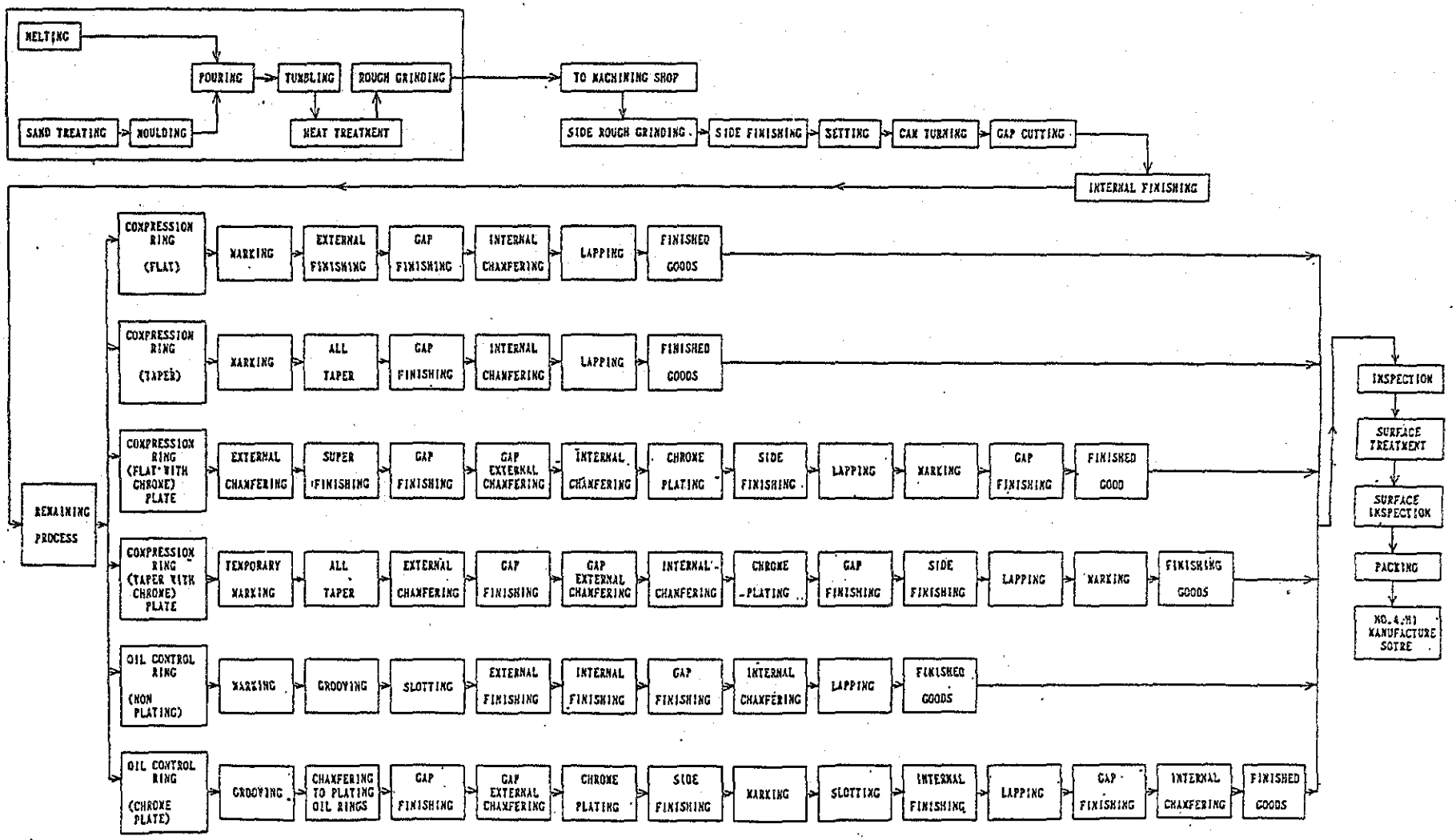
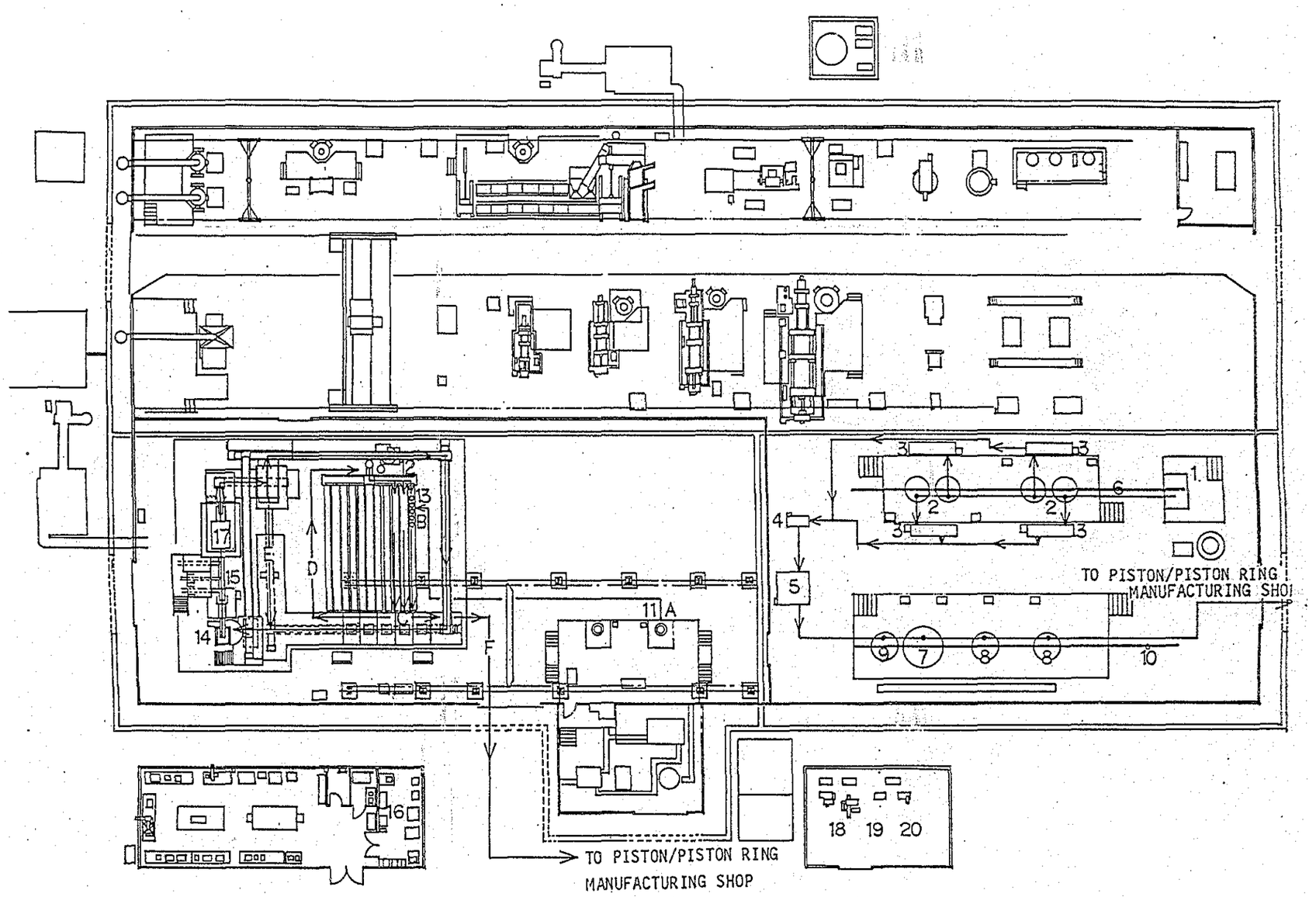


Figure AI-3-4-5 NO.4 HEAVY INDUSTRY LIGHT ALLOY FOUNDRY FLOW DIAGRAM



No.	Description		Q'ty
1	Reverberating Furnace	300 Kg	1
2	Holding Furnace	200 kg	4
3	Permanent Moulding Machine	2	4
4	High-speed Hydraulic Press	20t	1
5	Trimming Press		1
6	Ladle Crane	1t	1
7	Solidification Treatment Furnace		1
8	Artificial Ageing Furnace		2
9	Quenching Tank		1
10	Mono Rail Hoist		1
11	High Frequency Induction Furnace		1
12	Semi-automatic Moulding Mahchine		1
13	Molding Flask		1
14	Hopper		1
15	Traverser		1
16	Sand Testing Equipment		1
17	Tumbler		1
18	Semi-automatic Internal Grinder		1
19	Internal Grinder		1
20	External Grinder		1

Piston Ring Foundry

A	Melting
B	Pouring
C	Mould Breakdown
D	Return way of Frame
E	Return way of large grained sand
F	Piston Ring

3-5 Machine Shop for the Piston and Piston Ring

3-5-1 Outline of Processes

(1) Working equipment and its layout

The working equipment and its layout is shown in Fig.AI-3-5-1

Table AI-3-5-1 shows the machine processing equipment for the piston

Table AI-3-5-2 shows the machine processing equipment for the piston ring.

(2) Organization and personnel

Total personnel numbers 94. The Fig.AI-3-5-2 shows the organization and personnel formation.

(3) Supply performance of the raw materials and parts

Table AI-3-5-3 indicates the raw materials and parts together with their supply performance.

(4) Production estimates and performance

Table AI-3-5-4 shows the production estimates and performance. Table AI-3-5-5 indicates the production capacity for the processing of the large piston. Table AI-3-5-6 indicates the analysis of processes for the small piston.

3-5-2 Analysis of Production Processing

(1) Outline analysis of processes

Analysis of processing of the large piston is shown in Fig.AI-3-5-3, and analysis of processing of the large piston is shown in Fig.AI-3-5-4.

The flow chart for the piston and piston ring is as shown in Fig.AI-3-5-5.

(2) Problems and improvement of the operational procedures and process chains of the main finished products and parts

1) The layout of equipment for the machine processing line of the B-600 piston is poor. The equipment is not laid out according to the order of processes. This hinders the flow of products and increases the number of intermediate parts. Walking distances of the operators are long and this decreases production output. The arrangement of equipment should be changed to fit the order of processes.

2) The oil holes of the large piston are not appropriate. The six table boring machines require one operator each for operations. This leads to differences in processing time and performance. Flow is interrupted by stations which have a large number of intermediate parts or products on hand. The installation of a new special oil hole processing machine should be considered.

3) There are too many working lots. Some processes have exclusive carts others involve carrying by hand by one or two items. This leads to an increase of parts in process and hinders the flow. Possible improvements are as follows:

- change to a send as you make policy

- installation of chute, and abolition of the placing of parts on the floor after stopping of the chute of the necessary parts in process (this is done to adjust the time differences of the various processes).

4) As the cutting tools for changing are not at hand the operators must stop equipment if broken or when grinding to fetch replacements. This results in decrease of production output. Operators should ensure that an appropriate quantity of replacements should be at the side of the equipment.

5) Since cutting oil is not used during processing of the oil holes the life of cutting tools is short and damage frequent. This can be expected to lead to an increased expense for cutting tools and a reduced productivity. A collection tank should be provided so that cutting oil can be obtained.

6) The placing of the piston ring processing machine is poor. Overcrowding and bottlenecks occur and this results in increase of parts in process and wasteful operations. The layout of equipment should be considered.

7) As the piston rings are supplied individually their arrangement is time consuming. The use of a chute for the transportation of the piston rings should be considered.

8) The chips from the piston processing are all thrown away. As this is wasteful of resources those which are dry should be separated from those wet and re use should be considered.

(3) Problems and improvement of equipment layout and material handling

The process layout mixes the flow of the inspection and production processes in the piston and piston ring shop and involves wasteful transportation. A change of layout should be considered.

(4) Problems and improvement of working equipment

Rapid falls in the air pressure of the shop occur. As the special machine for piston hole opening will not function at pressures of 3 kg/cm_2 operations cease. The rapid falls in air pressure also cause damage to the cutting tools. An air checking apparatus is needed. Supply capacity with the requirements at present and with an air blow cleaner installed should both be considered.

The use of the piston ring duplex head grindstone is limited and there are no spares in stock. The maintenance of consumable cutting tools is insufficient and should be considered.

3-5-3 The Occurrence of Rejects

(1) The reject rate for the piston and piston ring are high. There are 5,506 processes per month for the piston. Of these 4,705 are superior and 801 are rejects giving a reject rate of 14.5%.

There are 18,217 piston rings processed per month, and of these 15,272 are superior and 2,945 are rejects. The reject rate is 16%. This results in waste of materials and expenses due to re-processing. It

is necessary to investigate the causes of the rejects and undertake their prevention.

(2) Problems and improvement of product quality standards and inspection methods

1) As there are no standards for checking lines there is a danger of repeated occurrence of rejects. Standards must be set and implemented and training take place.

2) Checking devices on the processing lines of the piston ring were not in evidence. It is necessary to provide these.

3) Raw data is collected but this is not analyzed. The use of inspection data is insufficient. Methods of quality control and analysis of data must be carried out and proceeded with actively.

4) No documents for standards of the piston ring processing were seen. Standard manuals must be placed at the side of equipment and operations take place in accordance with these.

Table A1-3-5-1 EQUIPMENT LIST - PISTON MACHINING -

Category	Code	Description	Q'ty	Damage	Deterioration	Remarks
	HSAL	Single Purpose Machine-Skirt End and Skirt Inside	2	None	None	
Single	HSAL	Single Purpose Machine-Outside	2	None	None	
Purpose	HSAL	Single Purpose Machine-Pin Hole	2	None	None	
Machines	HSAL	Single Purpose Machine-Ring Grooves	2	None	None	
	HSAL	Single Purpose Machine-Circlip Grooves	2	None	None	
	HSAL	Single Purpose Machine-Crown Head	4	None	None	
Drilling	BD	Bench Drilling Machine	6	None	None	
Machines	DPU	Oil Hole Automatic Drilling Machine	1	None	None	
Special	FBM	Pin Hole Fine Boring Machine	2	None	None	
Purpose	SHFB	Cam-Copying Machine	2	None	None	
Machines	MC-2	Slit Cutting Machine	1	None	None	
	LPF	Pin Hole Lapping Machine	1	None	None	
Others	WCB	Washing Tank	1	None	None	
		Total	28			

Table AI-3-5-2 EQUIPMENT LIST - PISTON RING MACHINING -

Category	Code	Description	Q'ty	Damage	Deterioration	Remarks
	4L	Cam Turning Lathe	2		Not Confirmed	
	4L	Turning Lathe (Internal Rough)	1		Not Confirmed	
	4L	Turning Lathe (Finishing)	2		Not Confirmed	
Lathes	4L	Turning Lathe (Taper)	1		Not Confirmed	
	4L	Turning Lathe (Super Finish)	1		Not Confirmed	
	4L	Turning Lathe (External Rough)	3		Not Confirmed	
	4L	Turning Lathe (Finishing)	1		Not Confirmed	
	4L	Turning Lathe (External Groove)	2		Not Confirmed	
	DDG	Double Disk Grinder	1		Not Confirmed	
Grinders	DDG	Double Disk Grinder	1		Not Confirmed	
	RSG	Rotary Surface Grinder	1		Not Confirmed	
	RM	Gap Cutting Machine	2		Not Confirmed	
Milling	RM	Milling Machine for Oil Slot	2		Not Confirmed	
M/C's	RM	Gap Cut off Machine for Angle	1		Not Confirmed	
		Ring Receiver for Grinder	1		Not Confirmed	
		Presetting Machine	1		Not Confirmed	
		Setting Machine for Cam Lathe	2		Not Confirmed	
		Automatic Gap Finishing Machine	1		Not Confirmed	
		External Lapping Machine	4		Not Confirmed	
		Marking Machine	1		Not Confirmed	
Special		Automatic Printing Machine	1		Not Confirmed	
Purpose		Grinder for Gap Adjustment	1		Not Confirmed	
Machines		Counting Scale	1		Not Confirmed	
		Automatic Machine for Keystone	1		Not Confirmed	
		Drilling Machine for Notch	1		Not Confirmed	
	pr	Automatic Hole Punching Press	2		Not Confirmed	
		Inside Chamfering Machine	2		Not Confirmed	
	HP	Hand Press	11		Not Confirmed	
		Degreasing Tank	1		Not Confirmed	
		Drying Oven	1		Not Confirmed	
		Total	53			

Table AI-3-5-3 RM AND CP PROCURED

	1987									1988	Total	Remarks
	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.		
Piston	5,060	5,060	5,060	5,060	5,060	5,060	5,060	5,060	5,060	5,060	50,600	Total of Large and Small Sizes.
Piston Ring	27,500	27,500	27,500	27,500	27,500	27,500	27,500	27,500	27,500	27,500	275,000	

Table AI-3-5-4 SCHEDULED AND ACTUAL PRODUCTION

		1987									1988	Total
		Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	
Piston	Scheduled	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	46,000
	Actual	806	1,500	2,175	5,000	5,000	5,000	4,000	2,776	3,511	5,000	34,762
Piston Ring	Scheduled	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	250,000
	Actual	12,987	15,227	21,117	31,517	20,117	6,582	24,127	24,099	24,405	19,327	199,505

Table AI-3-5-5 PRODUCTION CAPACITY - LARGE SIZED PISTON MACHINING (LINE B) -

Equipment	HSAL-1	HSAL-3	HSAL-2	BD	HSAL-4	FBM	SHFB	HSAL-5	HSAL-6
Line Capacity, pcs/min (Machine Time + Human Time)	1.67	1.73	1.61	1.65	1.38	1.41	1.16	0.97	0.81
Production, pcs/day	229	221	237	231	277	273	328	394	472
Production, pcs/month	5,038	4,862	5,225	5,082	6,094	6,006	7,216	8,668	10,388
Production, pcs/year	60,456	58,344	62,700	60,984	73,128	72,072	86,592	104,016	124,656
Production, vehicle/year	15,114	14,586	15,675	15,246	18,282	18,018	21,648	26,004	31,164

Notes: Capable of 14,586 vehicles/year production.

On the Current Layout Bases Used:
Working Time = 7.5 hour/day
Working Day = 22 Day/Month
Operation Rate = 85%

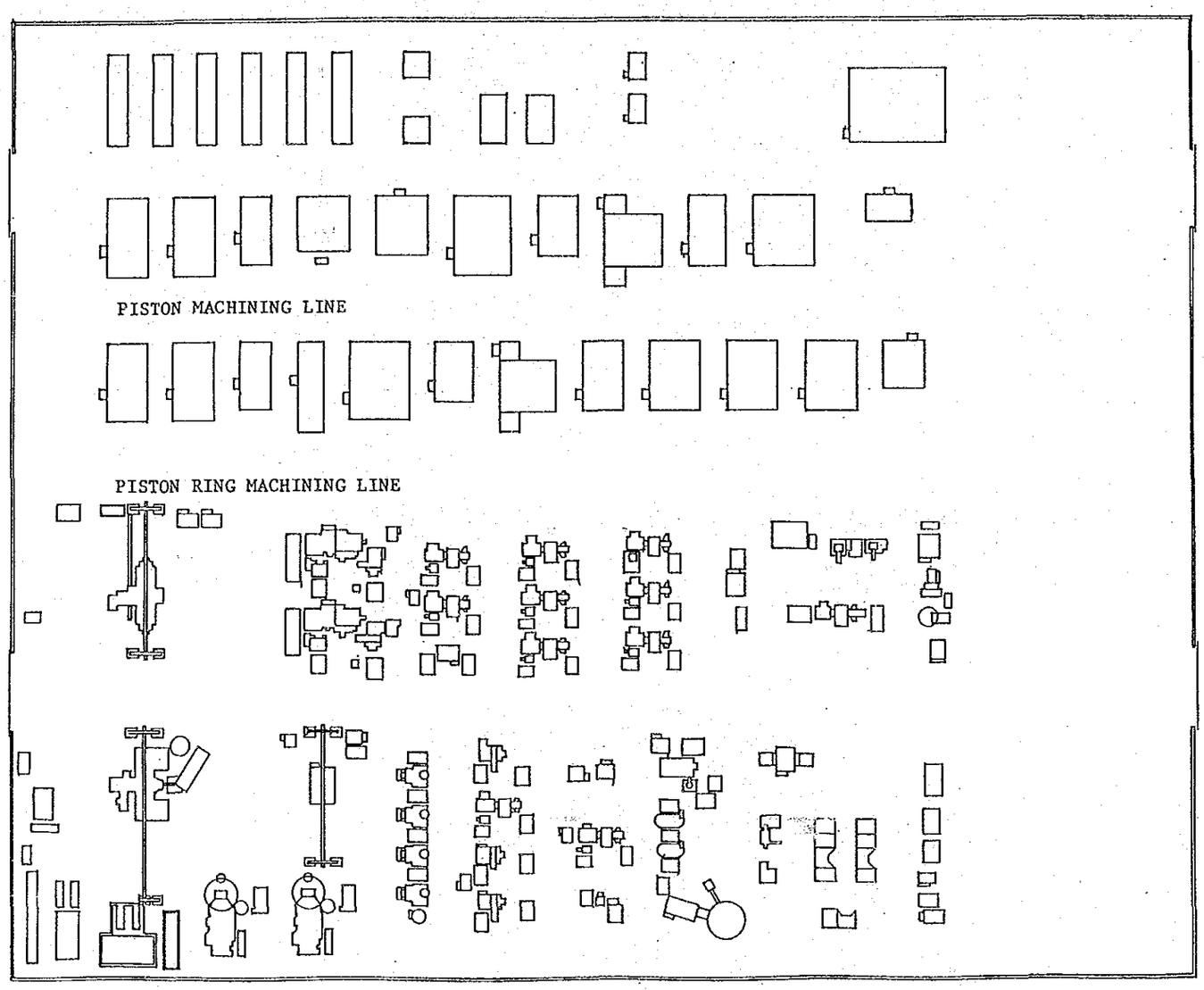
Table AI-3-5-6 PRODUCTION CAPACITY - SMALL SIZED PISTON MACHINING (LINE A) -

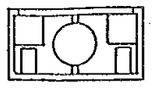
Equipment	1 HSAL	2 HSAL	3 HSAL	4 MC-2	5 DPU	6 FBM	7 MSAL	8 SHFB	9 MSAL
Line Capacity, pcs/min (Machine Time+Human Time)	1.00	1.14	0.96	0.99	0.83	0.84	0.69	0.60	0.48
Production, pcs/day	360	346	375	363	433	428	521	600	750
Production, pcs/month	7,920	7,612	8,250	7,986	9,526	9,416	11,462	13,200	16,500
Production, pcs/year	95,040	91,344	99,000	95,760	114,312	112,992	137,544	158,400	198,000
Production, vehicle/year	23,760	22,836	24,750	23,940	28,578	28,248	34,386	39,600	49,500

Notes: Capable of 22,836 vehicles/year production.

On the Current Layout Bases Used:
Working Time = 7.5 hour/day
Working Day = 22 Day/Month
Operation Rate = 85%

Figure AI-3-5-1 NO.4 HEAVY INDUSTRY PISTON AND PISTON RING MANUFACTURING SHOP LAYOUT



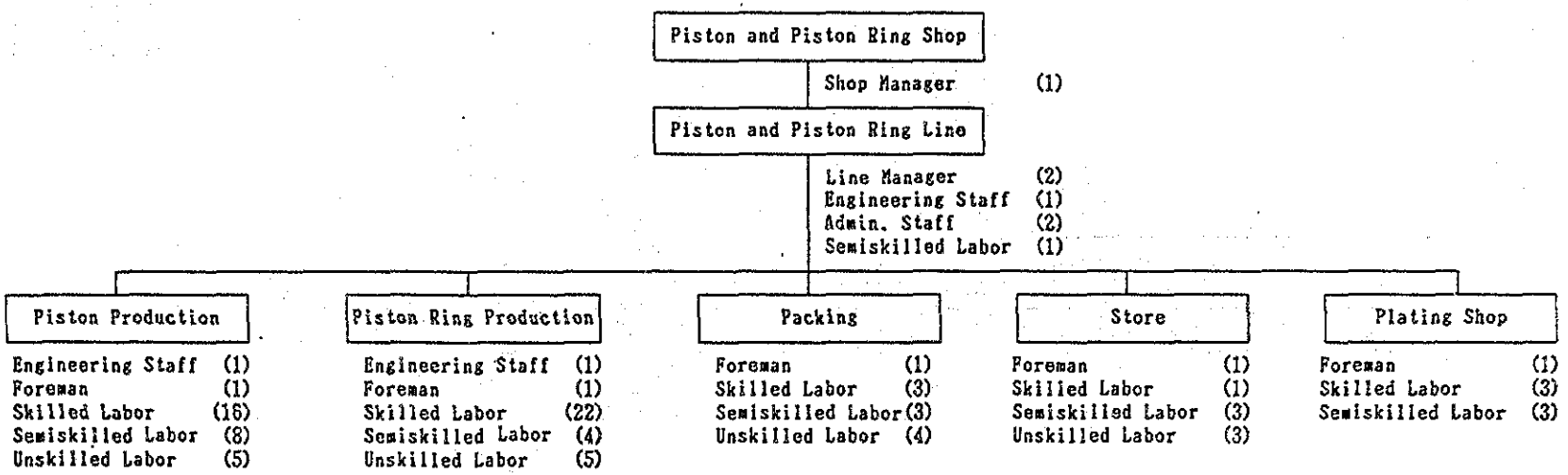


Equipment Installed by Additional Loan

1. Piston Ring Machining Equipment for B600 & X2000 and other 4 types vehicles and for 8 Products of other projects
   (Item Nos. VIII-2-2,5 & 8 & VIII-2-10(2) & VIII-2-11)

2. Piston Machining Equipment for B600 & X2000 and other 4 types vehicles and for 8 Products of other projects
   (Item Nos. VII-3 & VIII-6-1, 3, 4, & 5)

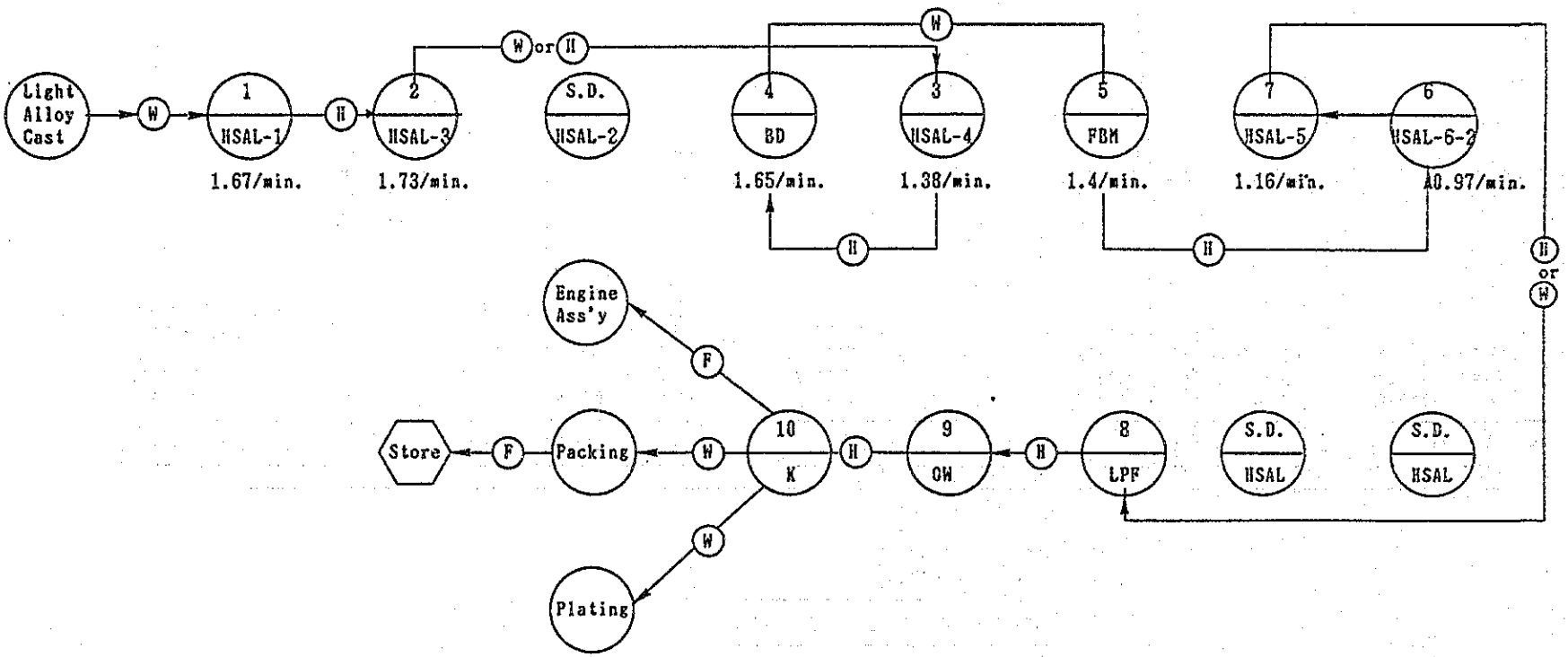
Table A1-3-5-2 PISTON, PISTON RING SHOP



Shop Manager	1
Line Manager	2
Engineering Staff	3
Admin. Staff	2
Foreman	5
Skilled Labor	45
Semiskilled Labor	22
Unskilled Labor	17

Total 97

Figure AI-3-5-3 LARGE SIZED PISTON PRODUCTION PROCESS FLOW (B Line)



Legends:
- F Fork Lift
- H Hoist
- S.D. Shut Down
- W Wagon

Figre AI-3-5-4 SMALL SIZED PISTON PRODUCTION PROCESS FLOW (A Line)

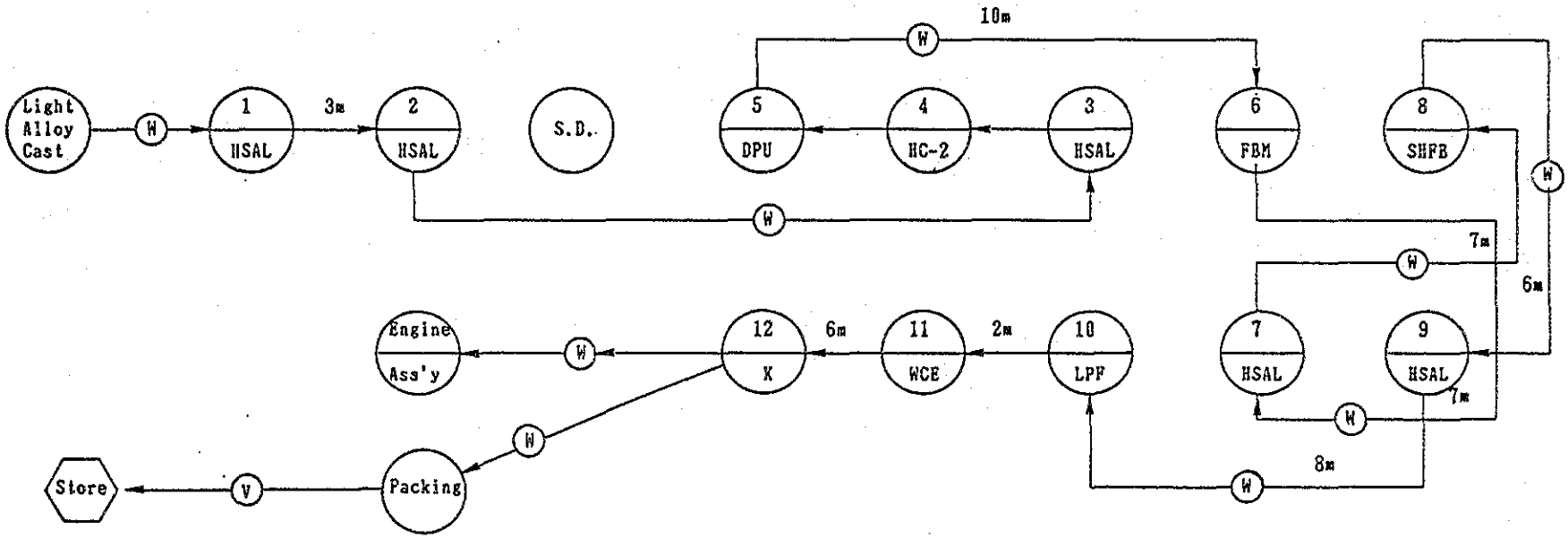
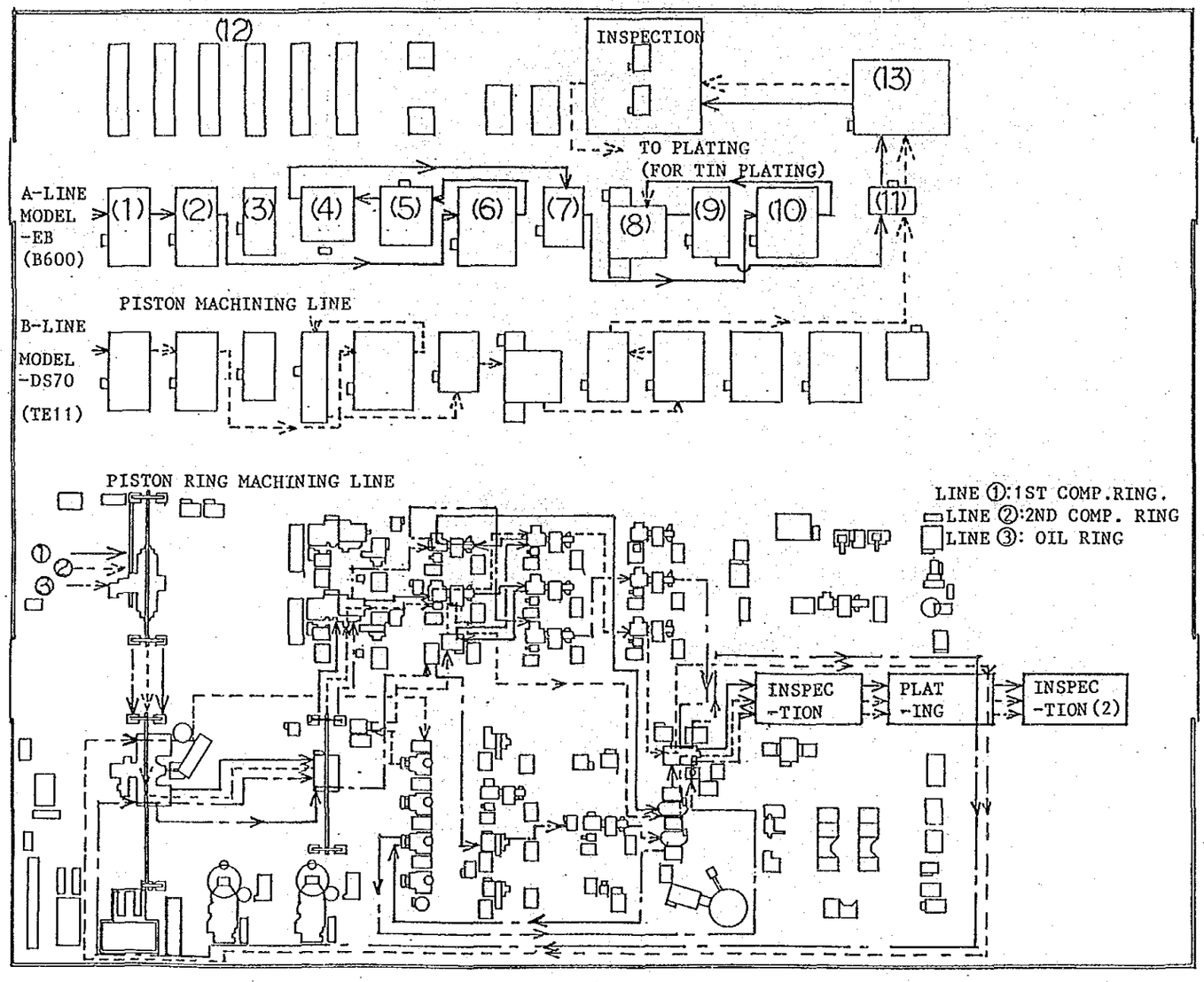


Figure AI-3-5-5 NO.4 HEAVY INDUSTRY PISTON AND PISTON RING MANUFACTURING SHOP FLOW DIAGRAM



(1) Alignment for skirt edge machining
(2) Outside rough machining and center boring
(3) Idle
(4) Oil hole drilling
(5) Slit grooving
(6) Ring grooving
(7) Pin hole drilling
(8) Outside machinery (recessing)
(9) Circlip machining
(10) Head finishing
(12) Shelf
(13) Cleaning

Equipment Installed by Additional Loan

1. Piston Ring Machining Equipment for B600 & X2000 and other 4 types vehicles and for 8 products of other projects.
(Item Nos. VIII-2-2 , 5, 7 & 8, VIII-2-10(2) & VIII-2-11)

2. Piston Machining Equipment for B600 & X2000 and other 4 types vehicles and for 8 products of other projects
(Item Nos. VII-3 & VIII-6-1, 3, 4 & 5)

3-6 Machine Shop

3-6-1 Outline of Processes

(1) Working equipment and its layout

Fig.AI-3-6-1 shows the working equipment and its layout. Table AI-3-6-(1)(2) gives a list of the equipment in stock of the machine shop.

(2) Organization and personnel

Shown in Fig.AI-3-6-2.

(3) Raw materials and parts and their supply performance

The supply performance for raw materials and parts is shown in Table AI-3-6-2.

(4) Production performance and capacity

1) Production performance

Production performance is shown in Table AI-3-6-3.

2) Production capacity

The obligation rate for the above production performance is between 19.8% and 76.8%.

As is shown by Tables AI-3-6-4 and AI-3-6-5 if the equipment burden rate is to be leveled out, the highest burden rate is 65.3%. So that one supposes equipment operating rate 85% that is 1.3 times the production of 1987 should be possible.

3-6-2 Analysis of Production Processing

(1) Outline analysis of processing

Shown in Tables AI-3-6-3 and AI-3-6-4.

(2) Flow chart

The flow chart is as shown in Figs.AI-3-6-5 (1) to (3).

(3) Problems and improvements of operating procedures and process chains

1) Screw drilling processing at present involves the connected processes of tapped drilling, tap holding, reamed hole processing and the cutting tools employed in each phase must be changed. This hinders productive efficiency.

The use of a cutting tool with a multiple spindle attachment which would reduce the changing operations should be considered.

2) There is only one hoist on the line for the setting and taking off of products, which therefore is done by hand. This causes back strain and lowers efficiency. Increase of hoisting tools or installation of a roller with lifter should be considered.

3) As the line is not in series processes are at a distance and carts are used for loading and carrying. It is difficult to have a sense of progressive processing. Conveyance is time consuming and operational efficiency hindered. It is necessary to reconsider layout and strengthen line production system.

4) As finished parts are left with chips hanging for a long time these are knocked off from the holes using a bar. This is time consuming. Use of an air hose to knock off chips, etc. should be considered.

5) Jigs with guide bush attachment are used for drilling. This causes shaking of the arm which makes aligning difficult. Further the guide bush touches the end of the drill. This causes break damage and wear to both the drill and the guide bush. The jig should be made into a dividing index jig by fixing the arm.

6) As the fixing position for the product is low drilling operations are done squatting and this causes back strain. It is necessary to raise the fixing bench.

7) The center hole processing for the X-2000 crankshaft is done with a drilling M/C according to a marking-off. As the front and rear sides

are not balanced roughnesses remain. A regular centering machine should be used. Since the precision of the present centering machine can not be guaranteed because of superannuation replacement is necessary.

8) As the chips are all thrown away it is necessary to examine ways to collection and classify these for re use.

(4) Problems and improvements of operational methods and division of labor

1) The bolts, nuts and pins are processed using a turret lathe. This requires a large number of cutting tools and a large variety of sockets. So the making of one bolt requires more than five minutes and is inefficient. It is necessary to improve the cold header and aim for mass production results through intensive production.

2) As the number of processing lots is large this results in a large number of products in process and waiting, and lowers the efficiency and increases transportation steps. Line production system for the main parts should be considered.

3) Screw operations for the X-2000 locker cover cap are divided so that brazing is for the car frame and screw cutting for the machinery. Conveyance wastes much time. It is necessary that brazing operations take place in the welding area of the machine shop.

4) The blanking operation of the transfer idle gear is done in the No.1 HI after annealing operations in the No.4 HI heat treatment shop have finished. Gear cutting takes place in No.4 HI after this. Waste of time in transportation is great. So it is necessary to perform blanking operations in the No.4 HI.

(5) Problems and improvements of equipment layout and material handling

1) The grinding area is located at the far end of the shop and so the transportation from heat treatment using a fork-lift is bothersome. Further the assembly areas for the engine and transmission are distant. Conveyance involves wasted time. Also damage is done during carriage. This results in increase of products in process. If it is necessary to move grinding near to the processes which require this.

If grinding machines are centralized this should be close to the assembly areas and where transportation is easy.

2) Operation loads are concentrated on the No.5 radial boring machine. So there are a large number of cylinder blocks and crank shaft parts in progress near to the two No.5 radial boring machines. This speeds up equipment deterioration and is a cause of equipment breakdowns. The rapid introduction of a multi- purpose machine should be considered.

3) There is too much distance between crank shaft processes The approx. distance is 60 m and time loss due to transportation great. The positioning of the main equipment on the crank shaft processing line should be re examined and distanced equipment moved to create a line.

4) There are not enough carts. This leads to hand carriage over long distances in some cases. Also transportation wastes time and reduction of productivity results. Increase of the number of carts should be considered.

5) As there are no placement racks for placing finished products these are placed on the floor temporarily. This results in soiling, scratching, and flawing of products and is tiring for the operators. The installation of racks should be considered.

6) The completed individual parts are carried into the store and then sent from their to the assembly shop and this makes the lack of carts worse. Further the store management is complicated. A direct supply route to the assembly shop should be considered.

7) There is no direct pathway from the machine shop or engine and transmission assembly shop to the vehicles or car frame shops. Conveyance involves a considerable detour. The creation of a direct route to save transportation time is necessary.

8) As the ring gear drive pinion for the B-600 and X-2000 fall apart when these are sent in pieces form the No.1 HI. Further flaws from banging occur. Since they are likely to cause poor fit that result in noise special boxes for placing the set should be made for their transportation.

(6) Problems and improvements of working equipment

1) 27% of the equipment in shop is out of order. Great confusion in the line arrangements results, and special machinery is over burdened. This leads to chain breakdowns. So it is necessary to quickly set up a maintenance system to assure the repair or replacement of deteriorated equipment.

2) It is difficult to obtain spare parts such as electrical repair parts, bearings and seals, so repairs of broken equipment cannot be carried out and parts of the turret lathe, thread rolling machine, boring machine, milling cutter, etc. are taken and used for ad hoc repairs. Substitute machinery for machines which have parts that cannot be produced domestically or which manufacturers no longer produce should be considered.

3) The maintenance of jigs is poor and so time is wasted in getting them out. It is necessary to decide on a storage area, indicate jig names clearly, and introduce carts for exclusive use with the jigs. Jig racks should also be installed.

4) In order to get the temperature of the heating furnace of the sheet ring of the cylinder head to 100 degrees centigrade requires two hours. Waiting time is long and efficiency poor. introduction of a high performance furnace should be considered. Using a solar system to preheat the water should also be considered.

5) As there are no standards for the fitting of jigs the fitting position alters with each changing. There are no standard keys or pins. So the extracting is time consuming. In order to assure that fitting to the same place is achieved meet marks and standard keys and standard bosses must be observed.

6) As washing capacity is insufficient the cylinder blocks, cylinder heads, transmission cases, and crank case still have chips attached after washing. Blocking of the oil holes by chips causes seizures when the engine is running. The introduction additional washing devices and air blowers should be considered.

7) As the gear cutting machine is an old model processing takes time. If this breaks down obtaining spare parts will be difficult and this may

cause future bottlenecks. Introduction of a more efficient machine should be considered.

8) 5 or 6 damaged parts of the formed cutters were thrown behind the machine but there were no thread rolling dies spare parts. Further two broken parts were found left on the rack at the side of the machine. As the particular cutting blades, shaped blades, thread rolling screws, shaping cutters, gear cutters, diamond dressers, and grindstones are difficult to obtain it is necessary to manage them strictly.

9) As the checks of equipment precision and jig precision are inadequate they are at present judged by reference to product precision. So it requires time before the actual state of reject occurrence can be grasped and early measures cannot be taken. Preventative maintenance is needed.

10) There are about 10 spring balancers kept on the shelves. These are not used, it is necessary to make these usable.

(7) Problems and improvements of the reception of raw materials and parts

The delay of forging products is one problem for the reception of parts. Delay in these forged parts results in delay of the parts of the following process, and this delay in turn results in hindrances to the progress management.

Delayed blank materials and dispatched finished goods are shown in Table AI-3-6-6.

1) When the output of completed products (including the 10% reject rate) exceeds the scheduled output the surplus output is stored inside the shop for the following dispatch. The accumulation of the surplus output is one cause of the increase of parts in process. This is linked perhaps to the low awareness of quality control. An examination of the occurrence of rejects and measures for their quick reduction are needed.

2) There is no check system of parts delivered. A system for assuring product quality is needed.

3) There are delays in the reception and issuance of parts. However, as causes of these are not investigated the introduction of a system of production management is needed.

3-6-3 Analysis of Product Quality

(1) The occurrence of rejects

1) A reject rate within 10% is treated as acceptable and there is very little quality control training implemented. So it is necessary to introduce quality control.

2) The number of rejects increases the further along the process chain one proceeds. In order to avoid reject occurrence products are processed which are outside of the allowable specifications leaving more work for the later processing. Training so that processing is done according to the specifications for each process must be carried out.

3) The right and left balance of the X-2000 crank shaft is not maintained during center hole buffing and so the hole is off center. Processing residue leads to rejects. Repair or replacement of the centering machine should be considered.

4) There is no special area for rejects. Superior products are marked with a blue paint and rejects with a red but no products marked red were to be seen. Further as there is no special area it is possible that inferior goods will be mixed with superior if the paint rubs off. So it is necessary to set aside an area for rejects.

(2) Relation with preceding and following processes

1) There are a large number of cast and forged parts i.e. the large end of the connecting rod, the outside diameter of the gear parts of B-600 and X-2000, or the outside circumference of the X-2000 cylinder block. When delivered the parts with a large finishing allowance are selected and machined. These operations put a burden on machine processing and lead to early wear of cutting tools. The repair of molds is needed.

2) When loose shape cast and forged products are delivered these are classified and on rare occasions sent back. As these are machine

processed for cutting intermittently this causes damage to cutting tools. The repair of molds is needed.

3) Forged products with blowholes or with impurities cannot be discovered with external observation alone. When these are discovered during processing the material is disposed of as unusable. The loss due to processing is large. So it is necessary to prevent the entry of foreign bodies through management of raw materials.

(3) Problems and improvements of quality standards and inspection methods

The following problems can be indicated:

1. The operational standards are not clear. Standards are not clearly indicated at the operational areas

2. The manual indications for the arrangement of operations are all stored with the person in charge of the line but these are not indicated at individual sections where operations take place.

3. The system of self checking is not regulated. There are plate gauges at processing points. There is no ruling as the check period or check records.

4. On the spot inspection by the inspectors is only done on request of the line. However, 5 continuous inspections are implemented at the line's request during changing of arrangements.

5. Due to lack of all checking instruments at present checks are performed by attaching standard blocks to the products and centering and measurements are taken with

6. There are devices to compare the positioning of bulb sheets, but it seems that these have not been used.

7. Regular checking of inspection instruments does not take place.

8. There is a shortage of inspection records and analysis reports.

The above are all defects of the inspection system. These should be promptly remedied and the inspection system organized.

3-6-4 Production Equipment and Maintenance

There is a general maintenance system for No.4 HI. This however is well below the level actually required by the individual shops. For example simple breakdowns such as detached springs on the radial drilling machine of the machine shop are left unrepaired and so the machine is stopped. The broken machines cause confusion to processing arrangements and over burden specialist equipment, thus creating a vicious circle. Repair parts are used and produced by the line equipment. This hinders the actual production of the line. So it is necessary to set up a system in No.4 HI whereby a maintenance shop is installed and with maintenance personnel being stationed at the level of the individual shops.

Table AI-3-6-1(1) EQUIPMENT LIST - LV MACHINE SHOP

Category	Code	Description	Qt'y (A)	Qt'y Out of Service (B)	Qt'y Deteriorated in (B) (C)	Qt'y Deteriorated in Operation (D)	Remarks
Turning Machines	4L	4' Lathe	10	6	6		
	6L	6' Lathe	17	4	3		Parts Used for Other Machines
	8L	8' Lathe	5				
	1TL	No.1 Turret Lathe	16	2	2	6	2 Nos. Being Repaired in No.5 HI
	3TL	No.3 Turret Lathe	42	14	12	2	
	4TL	No.4 Turret Lathe	11	3	2		
	5TL	No.5 Turret Lathe	2				
	4COL	4' Profiling Lathe	2	1	1		Parts Used for Other Machines
	7COL	7' Profiling Lathe	6	1			
Milling Machines	2PM	No.2 Plain Milling Machine	14	3	3	1	
	2VM	No.2 Vertical Milling Machine	6				
	4VM	No.4 Vertical Milling Machine	1				
	DSM	Dual Head Milling Machine	1				
	SLM	Spline Milling Machine	3				
Drilling Machines	BD	Bench Drilling Machine	9				
	3UD	No.3 Upright Drilling Machine	10	2	1		Parts Used for Other Machines
	4UD	No.4 Upright Drilling Machine	6	2	1		
	ACD	Centering Machine	1	1	1		
	3MD	No.3 Multi-Spindle Drilling MC	6	3	3		
	3RD	No.3 Radial Drilling Machine	1	1			
	5RD	No.5 Radial Drilling Machine	8	1			
	HTP	Tapping Machine	6	3	3		Parts Used for Other Machines
Grinders	30G	Cylindrical Grinder	3	2	2		
	50G	Cylindrical Grinder	7	1			
	3IG	Internal Grinder	3				
	2HSG	Face Grinding Machine	3				
	FCG	Centerless Grinding Machine	2				
	HNF	Honing Machine	2				
	CMG	Cam Grinder	1				
	SCG	Centerless Grinding Machine	1	1	1		

Table AI-3-6-1(2) EQUIPMENT LIST - LV MACHINE SHOP

Category	Code	Description	Qt'y (A)	Qt'y Out of Service (B)	Qt'y Deteriorated in (B) (C)	Qt'y Deteriorated in Operation (D)	Remarks
Gear Cutting and Finishing Machines	HGS	Gear Hobbing Machine	3				
	4GS	Gear Shaping Machine	3	1	1	1	
	VMGS	Gear Tooth Chamfering Machine	2			1	
	RMGS	Gear Tooth Chamfering Machine	1				
	SGS	Gear Shaving Machine	2	1			
	TGS	Gear Tester	1				
Others	2TZ	Roll Forming Machine	2				
	DBZ	Balancing Machine	3			1	
	2THZ	Roll Forming Machine	3	1	1		Parts Used for Other Machines
	THZ	Roll Forming Machine	1				
	VBT	Broaching Machine	1				Power is Insufficient.
	OL	Oil Groove Cutter	1			1	
	4HC	Sawing Machine	3	1	1		
	JHE	Heating Furnace	1				
	HB	Horizontal Drilling Machine	1				
	SDA	Gear Tooth Chamfering Machine	1				
	OPH	Hydraulic Press	3				
	MGK	Magnetic Flaw Detector	1				
	TG	Cutting Tool Grinding Machine	15	1	1		Vacuum Bulb is Missing.
	OW	Washing Tank	3				
	GW	Gas Welder	2	2			
	C	Engine Tester	2			1	
Simple Purpose Machines	MHFB	Fine Drill	7				
	SPU	Combined Unit	1	1			Lube Oil Pump Failure
	HBPU	Horizontal Drilling Unit	6	2	2		Drilling Oil Trouble
	VBPU	Upright Drilling Unit	1				
		Total	275	61	47	14	

Table AI-3-6-2 PROCUREMENT RECORD OF CP (ENGINE COMPLETE)

Model		1987									1988	Total	Remarks
		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan		
B600	for Vehicle	33	55	55	66	66	55	55	55	55	55	550	
	for Repair Parts	110	110	-	-	110	110	110	-	-	55	605	
X2000	for Vehicle	55	66	88	66	66	77	77	77	67	67	705	
	for Repair Parts	55	55	165	165	55	55	55	165	110	88	968	

Table A1-3-6-3 SCHEDULED AND ACTUAL PRODUCTION (ENGINE COMPLETE)

		1987									1988	Total
		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	
B600	Scheduled	130	150	50	60	160	150	50	50	50	100	950
	Actual	12	64	37	92	62	111	101	76	108	89	752
X2000	Scheduled	101	112	233	213	113	123	123	122	163	148	1,451
	Actual	34	41	39	48	74	53	30	26	37	31	413

Table AI-3-6-4 MACHINES WITH HIGHER LOAD

No.	Code	Descriprion	Load, %	Remarks
1	4L	4' Lathe	76.8	50% Loaded when Shared by 6' Lathe
2	HGS	Gear Hobbing Machine	72.4	65% Loaded when Shared by 4GS
3	SGS	Gear Shaving Machine	65.3	
4	3UD	No.3 Upright Drilling Machine	65.2	52% Loaded when Shared by 4UD
5	5TL	No.5 Turret Lathe	58.2	
6	2VM	No.2 Vertical Milling Machine	57.9	
7	4GS	Gear Shaping Machine	57.9	
8	SLM	Spline Milling Machine	57.6	
9	2PM	No.2 Plain Milling Machine	52.4	
10	5RD	No.5 Radial Drilling Machine	50.5	

Note: Loads on No.1, 2 and 4 are possibly shared by 6L, 4GS and 4UD, respectively.

Table AI-3-6-5 OPERATING RATE OF EQUIPMENT FOR B600 AND X2000 ENGINE AND TRANSMISSION

Equipment	Qt'y in Operation (Unit)	Total Time of Loading (hr.)	Oprating Rate (%)
No.1 Turret Lathe	7	4,373	37.9
No.3 Turret Lathe	36	25,380	42.7
No.4 Turret Lathe	10	8,017	48.5
No.5 Turret Lathe	2	1,921	58.2
4' Lathe	5	6,338	76.8
6' Lathe	13	8,611	40.1
8' Lathe	3	1,798	36.3
No.2 Plain Milling Machine	12	10,378	52.4
No.2 Upright Milling Machine	6	5,734	57.9
No.4 Upright Milling Machine	1	690	41.8
Bench Drilling Machine	8	2,620	19.8
No.3 Upright Drilling Machine	8	8,602	65.2
No.4 Upright Drilling Machine	5	2,597	31.4
No.3 Multi-Spindle Drilling M/C	4	2,468	37.4
Radial Drilling Machine	8	6,674	50.5
7' Profiling Lathe	2	1,660	50.3
Spline Milling Machine	2	1,802	57.6
Gear Hobbing Machine	1	1,195	72.4
Gear Shaping Machine	2	1,190	57.9
Gear Tooth Chamfering Machine	1	429	26.0
Upright Tooth Chamfering M/C	1	631	38.2
Gear Shaving Machine	1	1,078	65.3
Face Grinding Machine	2	1,450	43.9

Note: Basis of Calculation

Working Time 7.5 H/D
Working Day 22 Ds/M
Actual Production for 10 Months, Apr.,1987 - Jan.,1988

Production

B600
Engine and Transmission Complete for Vehicle = 400 Units
Engine Complete for Spare Parts = 352 Units
X2000
Engine and Transmission Complete for Vehicle = 187 Units
Engine Complete for Spare Parts = 226 Units

Table AI-3-6-6 CP IN DELAY OF SUPPLY, THE WORST FIVE, AS OF FEB. 16, 1988

(Unit: pcs)

Vehicle	Component Parts	Qt'y in Delay	Origin of Dispatch
Materials Supplies in Delay			
B600	Connecting Rod	440	No.3 HI
	Universal Joint	660	No.3 HI
	Clamp	880	No.3 HI
	Arm Shaft Upper	440	No.3 HI
	Main Drive Gear	220	No.3 HI
X2000	Connecting	880	No.3 HI
	Sliding Joint, Inter	440	No.3 HI
	Yoke	440	No.3 HI
	Nuckle Spindle, Front	440	No.3 HI
	Universal Joint Yoke	880	No.3 HI
Component Parts Supplies in Delay to Ass'y Shop			
B600	Connecting Rod	100	No.3 HI
	Reverse Gear	70	No.4 HI Machine Shop
	Cylinder Head	40	No.4 HI Machine Shop
	Valve Guide	120	No.4 HI Machine Shop
	Crank Case	60	No.4 HI Machine Shop
X2000	Cylinder Block	99	No.4 HI Machine Shop
	Tappet Follower	139	No.1 HI
	Counter Shaft	139	No.1 HI
	Idle Gear Transfer	98	No.4 HI Machine Shop
	Rocker Arm Cover Ass'y	139	No.4 HI Body Ass'y Shop

Figure AI-3-6-1 NO.4 HEAVY INDUSTRY LAYOUT OF MACHINE SHOP

s: Out of Service
d: Deteriorated
u: Unable to Repair

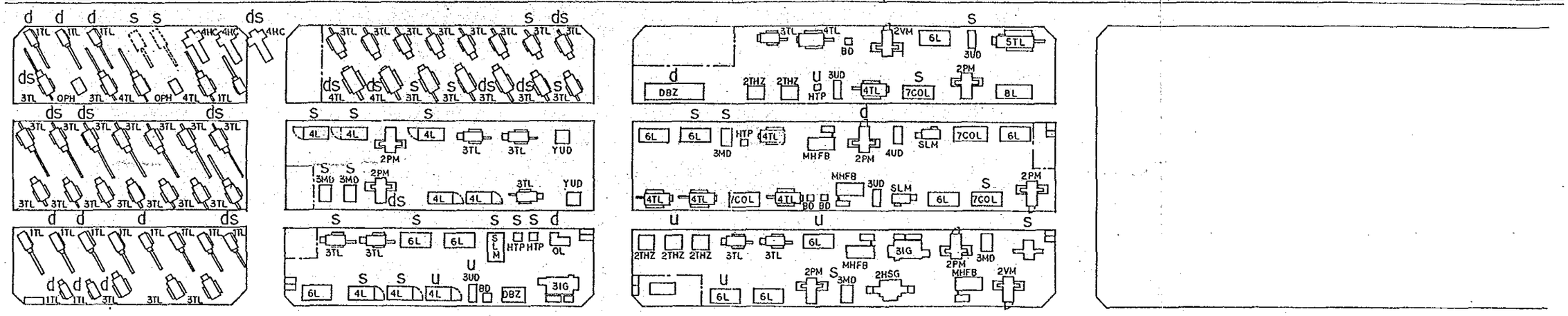


Figure AI-3-6-2 MACHINE SHOP STAFFING

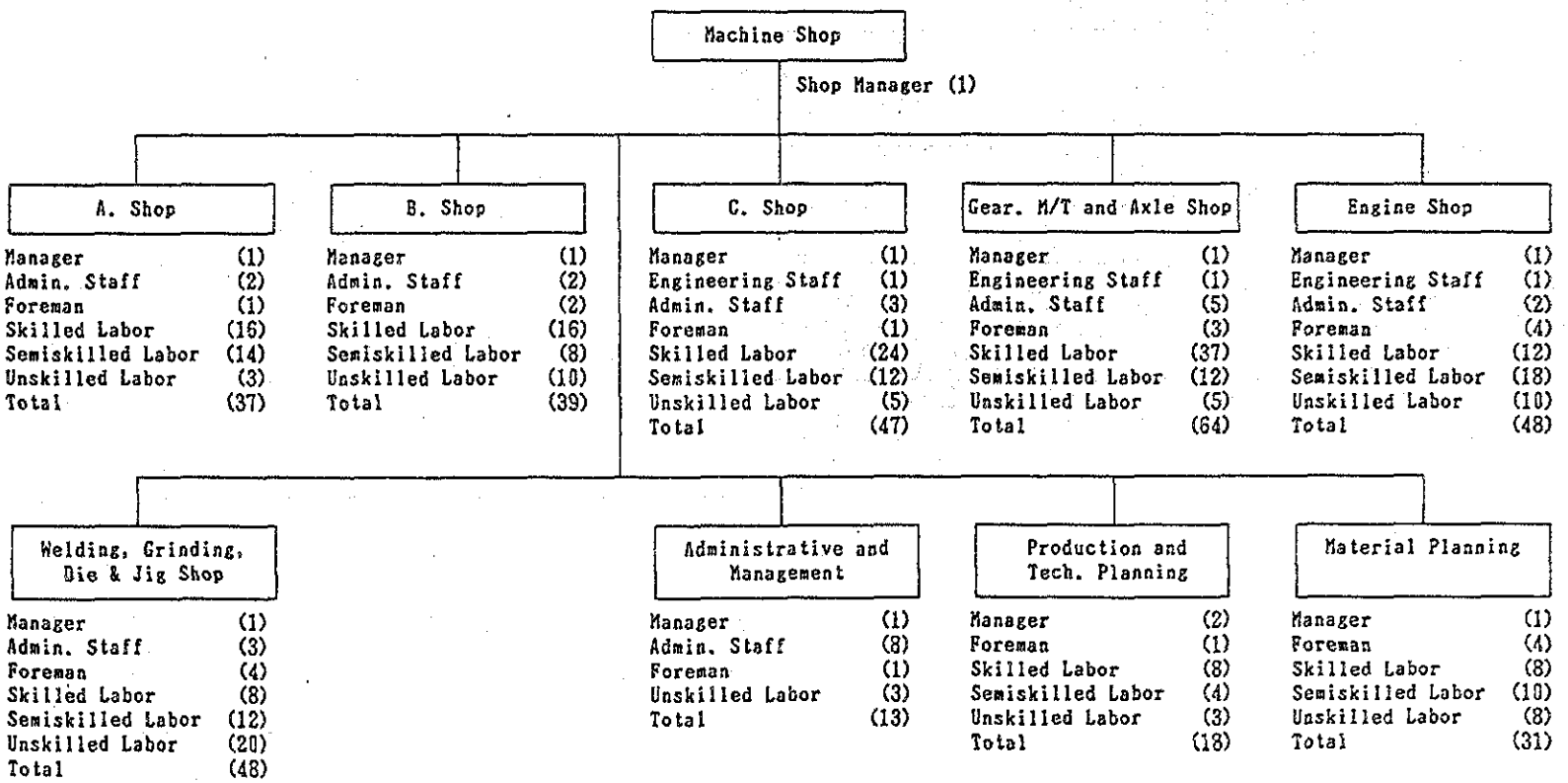


Figure A1-3-6-3 OPERATION PROCESS CHART, CRANKSHAFT

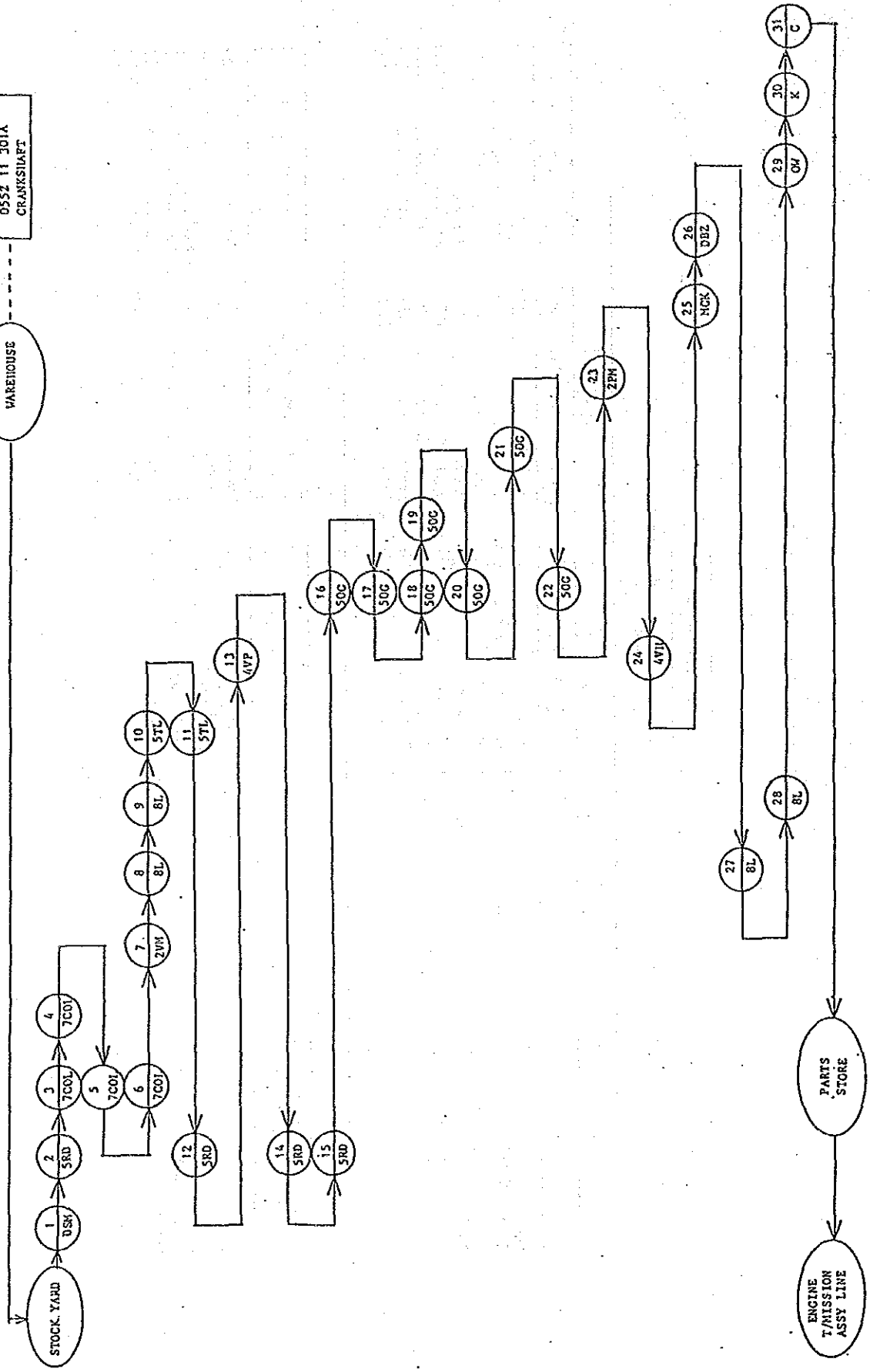


Figure AI-3-6-4 OPERATION PROCESS CHART, CYLINDER BLOCK

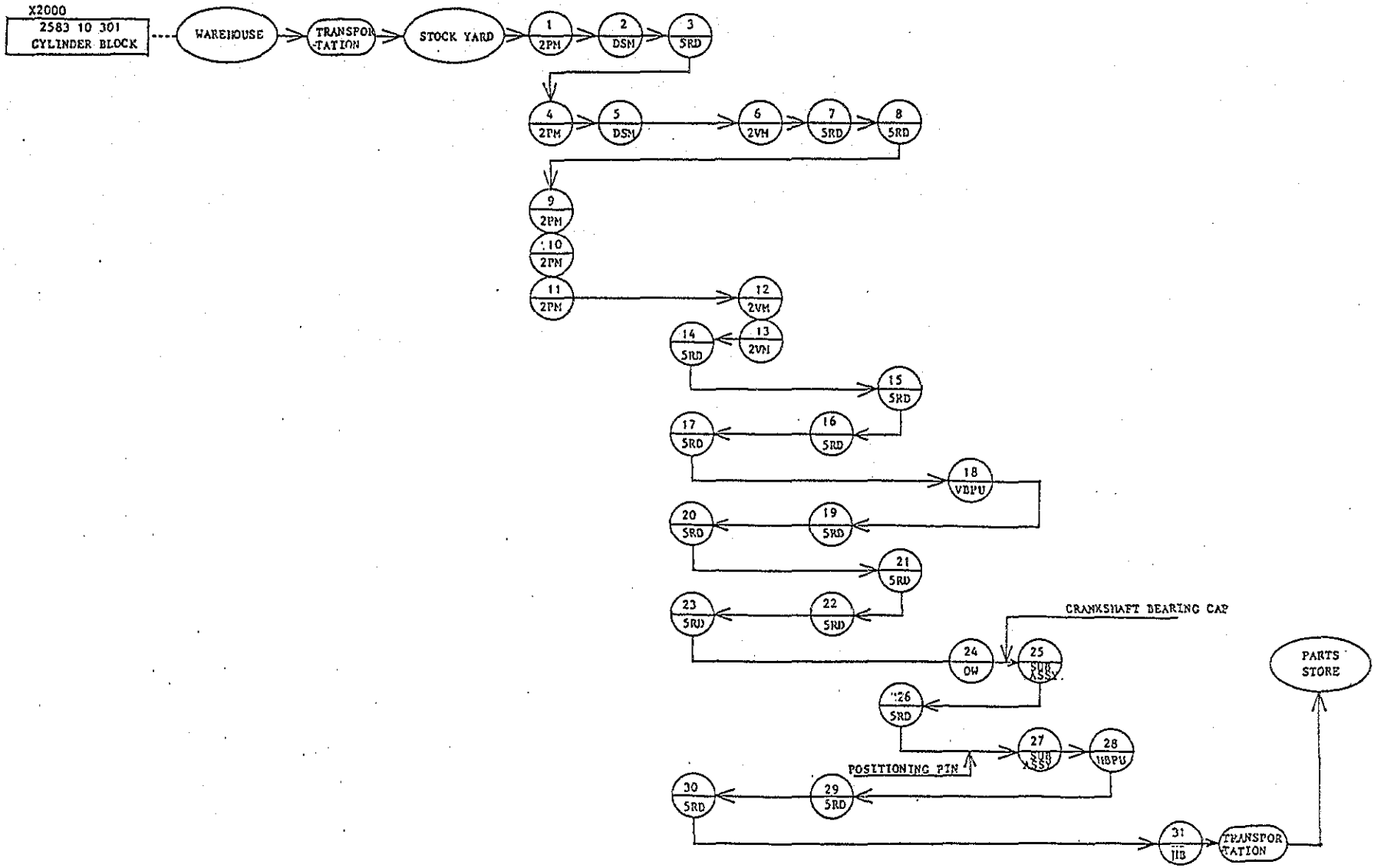
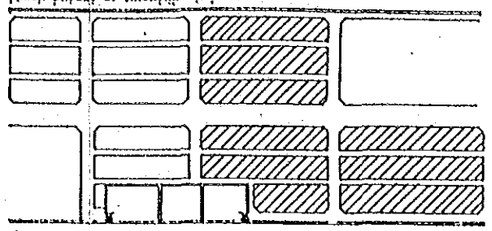


Figure AI-3-6-5 (1) WORK FLOW OF MACHINE SHOP

FLOW OF CRANK SHAFT P.NO. 0552 11 301A

BLOCK LAYOUT OF MACHINE SHOP



— ENLARGED VIEW OF SHADED AREA —

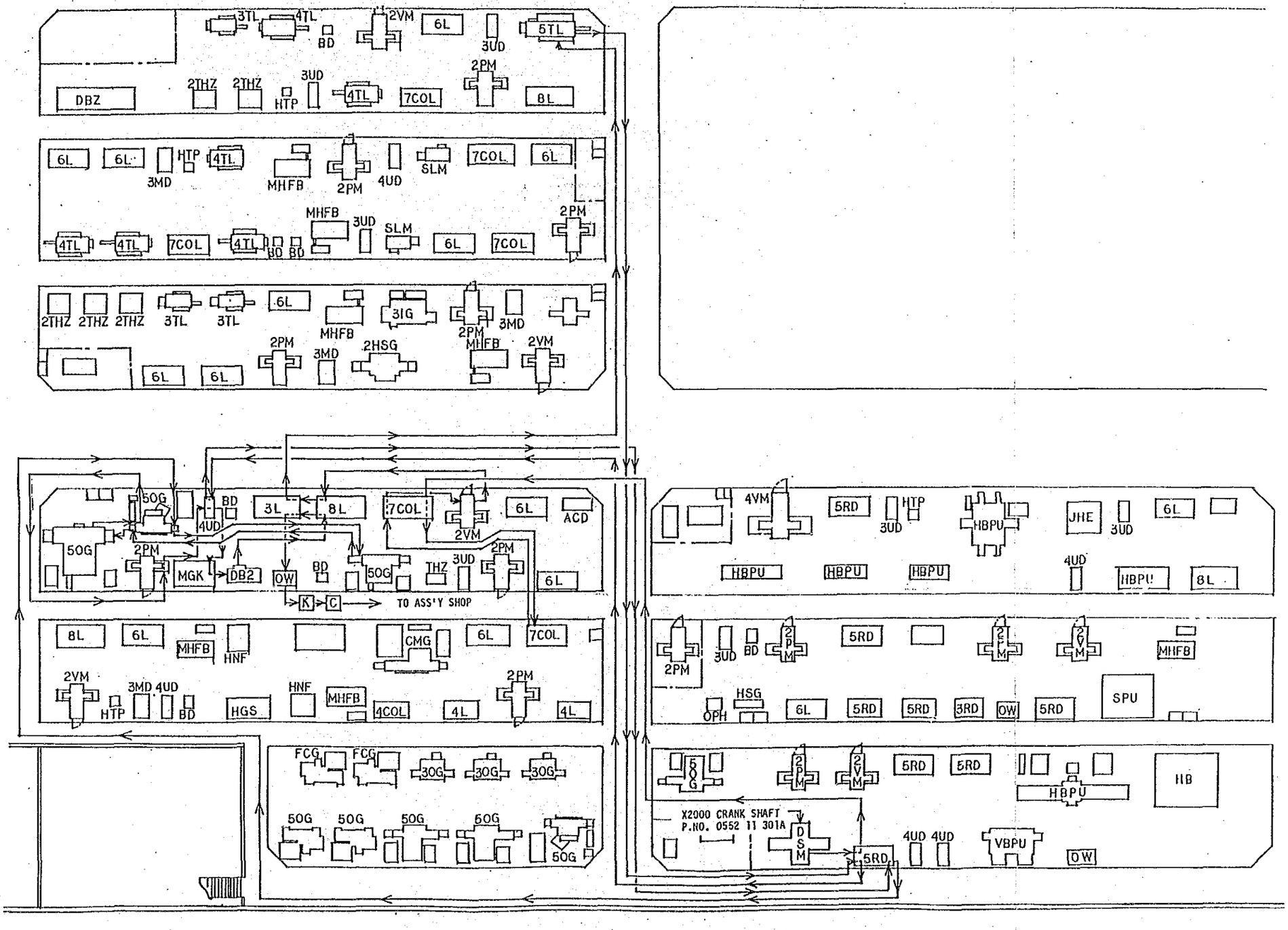
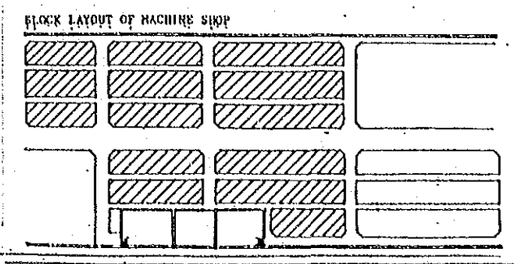


Figure AI-3-6-5 (2) WORK FLOW OF MACHINE SHOP

FLOW OF TIMING GEAR	P.NO. 0114 11 316
FLOW OF CYLINDER HEAD BOLT	P.NO. 2783 11 311
FLOW OF AXLE SHAFT	P.NO. 0111 26 115
FLOW OF MAIN DRIVE GEAR	P.NO. 2783 17 201



- ENLARGED VIEW OF SHADED AREA -

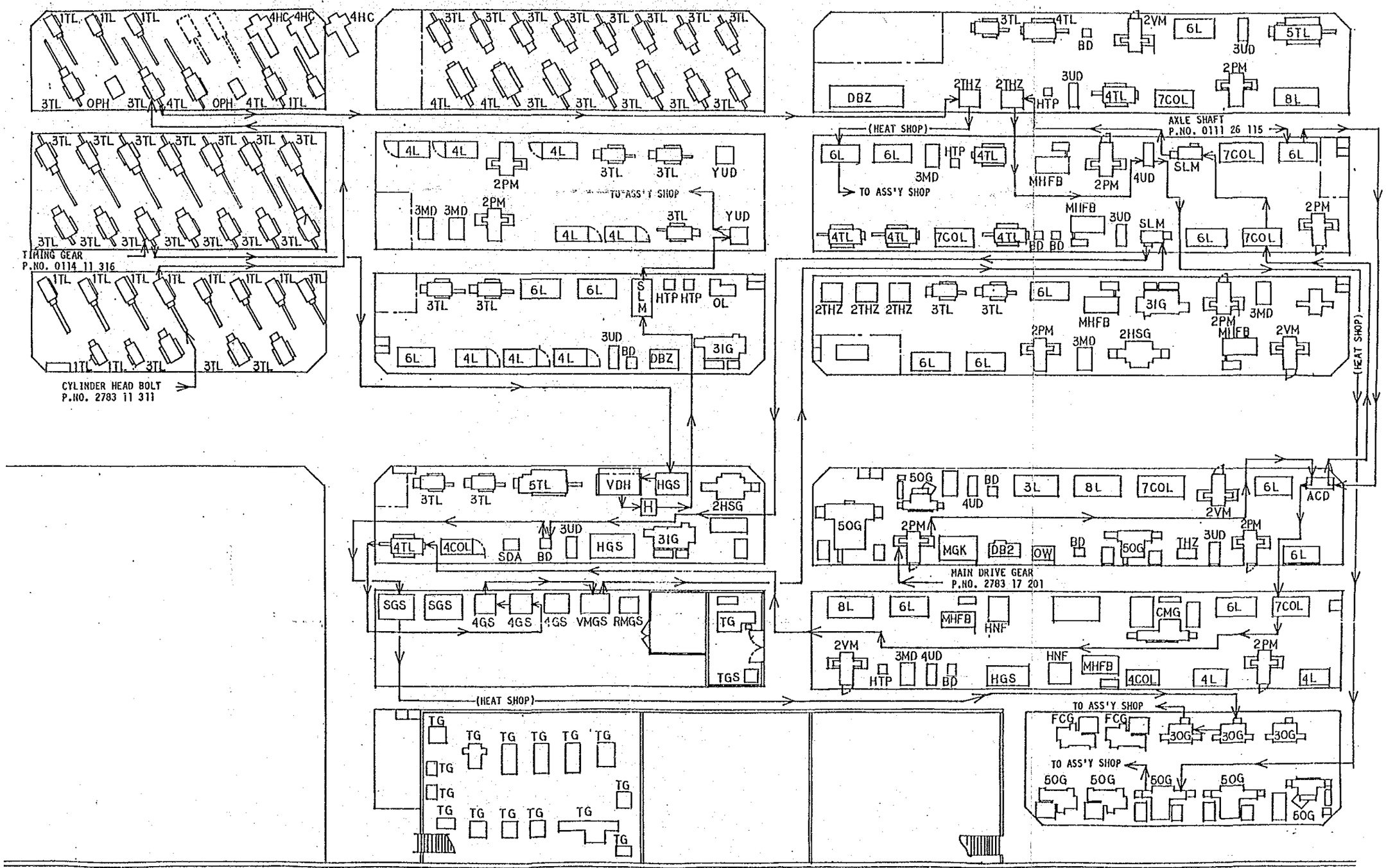
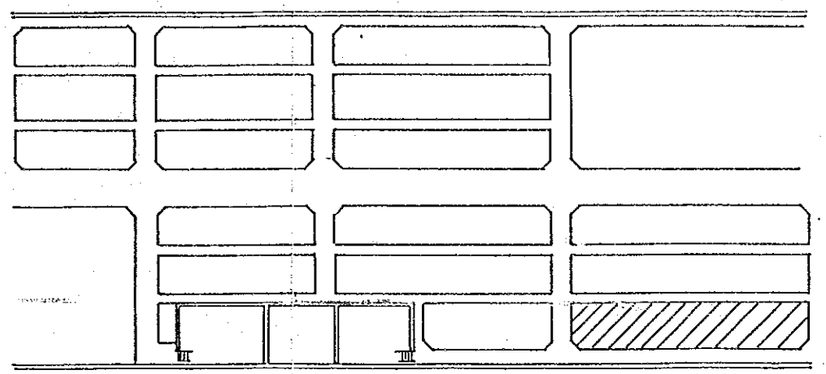


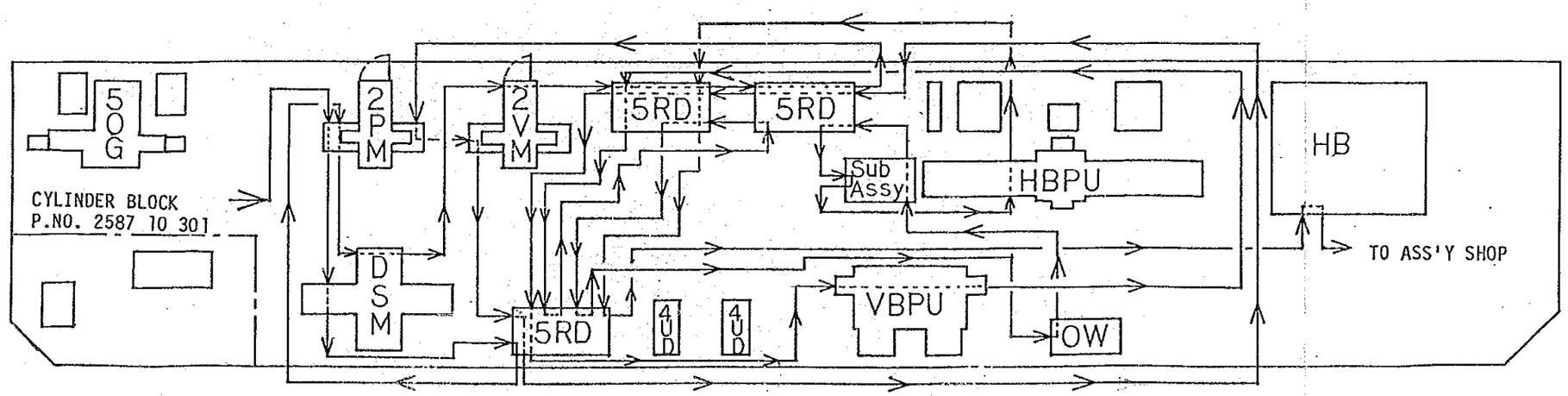
Figure AI-3-6-5 (3) WORK FLOW OF MACHINE SHOP

FLOW OF CYLINDER BLOCK P.NO. 2587 10 301

BLOCK LAYOUT OF MACHINE SHOP



- ENLARGED VIEW OF SHADED AREA -



3-7 Heat Treatment Shop

3-7-1 Outline of Processes

(1) Working equipment and its layout

Fig.AI-3-7-1 shows the equipment and its layout.
Tables AI-3-7-1 (1) to (3) show the equipment.

(2) Organization and personnel

Fig.AI-3-7-2 shows the organization and personnel

3-7-2 Analysis of Processing

(1) Outline analysis of processing

Tables AI-3-7-2 (1) and (2) together with Fig.AI-3-7-3 outline the process analysis for the main parts

The following processes can be done in this shop:

1. gas carburizing
2. bright quenching
3. bright tempering
4. water quenching
5. press quenching
6. refining
7. selective tempering
8. annealing
9. liquid carburizing
10. lubricating

(2) Problems and improvement of operational procedures and process chains

Nothing of note

(3) Problems and improvements of operational methods and division of labor

Nothing of note.

(4) Problems and improvements of the layout and material handling of equipment

1) As carts are scarce transportation of products between processes is done by hand. This results in wasted time. It is necessary to consider the introduction of a product bench with an attached roller and of flat palettes and pallet trucks.

2) As the number of product benches is limited piling on the floor occurs. Time is wasted through moving piles. Increase of the carts should be considered.

(5) Problems and improvements of working equipment

The following problems with working equipment can be indicated (Refer to Fig.AI-3-7-4)

1) The dust collector duct of the salt furnace is deteriorated resulting in poor collecting performance. This will affect the human operators if left unresolved and it is necessary to repair or replace this promptly.

2) Because of the under capacity of the shot blast there is not enough capacity to handle the large items. Operations are spread over a number of times. It is necessary to increase the shot blast equipment.

3) As the cyanic drainage is out of order salt bath carburizing treatment cannot be done and operations are done with gas carburizing instead. But the load for gas carburizing has increased. Repair is required promptly.

4) Salt does not dissolve at specified temperatures so a low temperature tempering furnace is used instead. The load for this is very heavy, and tempering is time consuming. It is necessary to increase the temperature of the salt bath regularly in order to prevent interior clumping.

5) Management of cyanic is poor, and open cyanic cans are left lying about. This is a fatally toxic substance. Provision of a store room should be considered.

6) Diesel oil is used as fuel. But the supply of the diesel oil used for both the boiler and the salt bath is difficult. Change of the heat source should be considered.

7) As the high speed cutting machine is out of order hardness testing is not possible by cutting. This must be promptly repaired.

Table A1-3-7-1 (1) EQUIPMENT LIST OF HEAT TREATMENT SHOP

No.	Description		Qt'y	Specification	Cost	Remarks
Production Facility						
1	Equipment for Gas Carburizing Hardening and Tempering	1) Workbench	1 Set			
		2) Degreasing Wash Tank (with Oil Separator & Water Pan)	1 Set			
		3) Electrically Heated Granulate Gas Carburizing Furnace	1 Set			
		4) Oil Bath for Quenching (with Exhaust Equipment)	1 Set			
		5) Electric Pit Furnace	1 Set			
		6) Continuous Heating Furnace	1 Set			
		7) Water Cooling Basin	1 Set			
		8) Blacking Equipment	1 Set			
		9) Electric Hoist (with Spare Parts)	1 Set	0.5 Ton		
		10) Monorail	1 Set			
		11) Electric Hoist (with Spare Parts)	1 Set	1 Ton		
		12) Gantry Crane	1 Set			
2	Equipment for Press Quenching	1) Chamber Furnace	1 Set			
		2) Oil Pan (with Dolly)	1 Set			
		3) Quenching Press (for Low Gear and Clutch Hub)	1 Set			
3	Equipment for Shot Blast	1) Shot Blasting Machine (with Dust Collector and Duct)	1 Set			
4	Equipment for Liquid Carburinzing Hardening and Tempering	1) Workbench	1 Set			
		2) Degreasing Wash Tank (with Oil Separator & Water Pan)	1 Set			
		3) Salt Bath Furnace for Carburizing (with Preheating Furnace & Blower)	1 Set			
		4) Quenching Oil Bath	1 Set			
		5) Salt Bath Furnace for Heating	1 Set			
		6) Salt Bath Furnace for Tempering, High Temperature (with Cooling Fan)	1 Set			
		7) Salt Bath Furnace for Tempering, Low Temperature	1 Set			
		8) Cooling Water Tank	1 Set			
		9) Anti-Rust Liquid Tank (with Dolly)	1 Set			
		10) Exhaust Equipment	1 Set			
		11) Electric Hoist (with Spare Parts)	1 Set	0.5 Ton		
		12) Gantry Crane	1 Set			
5	Equipment for Partial Tempering	1) Lead Bath Furnace (with Exhaust Device)	1 Set			
		2) Workbench (for Lead Bath Furnace)	1 Set			
		3) Cooling Water Tank	1 Set			
6	Equipment for Lubrite Treating	1) Lubrite Treating Instrument (with Recovery Tank)	1 Set			

Table AI-3-7-1 (2) EQUIPMENT LIST OF HEAT TREATMENT SHOP

No.	Description		Qt'y	Specification	Cost	Remarks
7	Equipment for High Frequency Induction Hardening Apparatus	1) High Frequency Induction Hardening Apparatus (with Spare Parts)	1 Set	80kW-200KHz		
		2) Ditto (with Spare Parts)	1 Set	150kW-10KHz		
		3) Shrinkage Fit Press for Ring Gear	1 Set			
		4) Oil Mist Collector (with Dolly)				
		5) Anti-Rust Liquid Tank (with Dolly)	1 Set			
		6) Oil Tank for Quenching (with Dolly)				
8	Equipment for Straightening	1) Center Hole Grinding Machine	1 Set			
		2) Hydraulic Straightening Press	1 Set	15 Ton		
		3) Surface Plate	1 Pc			
		4) Measuring Instruments (Gauge Block, Micrometer, V-Block, Dial Gauge, Vernier Caliper and Others)		1 Lot		
9	Equipment for Inspection	1) Magnetic Flaw Detector	1 Set			
		2) Rockwell Hardness Tester	2 Sets			
		3) Rockwell Superficial Hardness Tester	1 Set			
		4) Vickers Hardness Tester	1 Set			
		5) Brinell Hardness Tester	1 Set			
		6) Endless Grinding Machine (with Spare Belts)	1 Set			
		7) Double Head Grinding Machine (with 5 Grindstones and 100 Brushes)	1 Set			
		8) High Speed Cutting Off Machine, Large-sized (with Grindstones and Vice)	1 Set			
		9) High Speed Cutting Off Machine, Small-sized (with Vice, Grindstones and Cutting Oil)	1 Set			
		10) Polisher (with Disk, Paper, Cloth and Dryer, and Others)	1 Set			

Table A1-3-7-1 (3) EQUIPMENT LIST OF HEAT TREATMENT SHOP

No.	Description	Q't'y	Specification	Cost	Remarks
9 Equipment for Inspection (Cont'd)	11) Water Distilling Instrument (with Electric Stove, Balance and Others)	1 Set			
	12) Metallurgical Microscope	1 Set			
	13) Printing Instruments (with Built-up Type Dark Room, Sink, Printing Paper, Enlarger)	1 Set			
	14) Potentiometer	1 Set			
	15) Analysis Instrument	2 Sets			
	16) Hardness Testing Instrument	1 Set			
	17) Master Gauge for Clutch Hub	1 Set			
	18) Densimeter	2 Sets			
	19) Hand Tools & Measuring Tools		1 Lot		
	20) Jig for Press Quenching		1 Lot		
Ancillary Equipment	1) Boiler & Water softener	1 Set			
	2) Waste Water Treatment Device & Piping Material		1 Lot		
	3) Heavy Oil Tank	1 Set			
	4) Roller Conveyor	25 Sets			
	5) Jigs Shelf	5 Sets			
	6) Tool Cabinet	3 Sets			
	7) Hanger	1 Set			
	8) Portable Pump	1 Set			
	9) Hand Lift	1 Unit			
	10) Fire Extinguisher	2 Sets	ABC 10B Type		
	11) Foundation Materials for Machinery		1 Lot		

Table AI-3-7-2(1) MAJOR PROCESSES OF HEAT TREATMENT

Major Part	Process	Equipment	Remarks
Transmission Gear Transfer Gear Spider Side Gear	1 Degrease Washing	Washing Tank	
	2 Carburizing Hardening	Electrically Heated Granulate Gas Carburizing Furnace and Oil Tank	
	3 Degrease Washing	Washing Tank	
	4 Tempering	Electric Pit Furnace	
	5 Shot Blast	Shot Blasting Machine	
	6 Lubrite	Lubrite Treating Instrument	Transfer Gear and Spider Only
Ring Gear Low Gear	1 Degrease Washing	Washing Tank	
	2 Carburizing	Electrically Heated Granulate Gas Carburizing Furnace	
	3 Heating	Chamber Furnace	
	4 Heating	Press Quenching M/C	
	5 Degreas Washing	Washing Tank	
	6 Tempering	Electric Pit Furnace	
	7 Shot Blast	Shot Blasting Machine	
Drive Pinion Ball Stud Steering Pinion	1 Degrease Washing	Washing Tank	
	2 Carburizing Hardening	Electrically Heated Granulate Gas Carburizing Furnace and Oil Tank	
	3 Degrease Washing	Washing Tank	
	4 Tempering	Electric Pit Furnace	
	5 Partially Tempering	Lead Bath Furnace	
	6 High Frequency Induction Hardening	80kW High Frequency Induction Hardening Apparatus	
	7 Shot Blast	Shot Blasting Machine	
	8 Center Grinding	Center Grinding Machine	Drive Pinion and Steering Pinion Only
	9 Hydraulic Straightening	Hydraulic Straightener (Hammer)	
Washers and Small-sized Parts	1 Degrease Washing	Washing Tank	
	2 Preheating	Preheating Furnace	
	3 Carburizing	Liquid Carburizing Furnace	
	4 Heating	Salt Bath	
	5 Heating	Oil Tank	
	6 Degreas Washing	Washing Tank	
	7 Tempering	Salt Bath (Low Temperature)	
	8 Washing	Washing Tank	
	9 Anti-Rust Treatment	Tank for Anti-Rust Liquid	

Table AI-3-7-2(2) MAJOR PROCESSES OF HEAT TREATMENT

Major Part	Process	Equipment	Remarks
Bolts (Socket)	1 Degrease Washing	Washing Tank	
	2 Heating	Salt Bath	
	3 Heating	Oil Tank (Water Tank)	Water Cooling Only for Socket
	4 Degreas Washing	Washing Tank	
	5 Tempering	Salt Bath (High Temperature)	
	6 Cooling Washer	Washing Tank	
	7 Hydraulic Straightening	Hammer	For Parts with Length more than 100 mm
	8 Anti-Rust	Tank for Anti-Rust Liquid	
Socket, Shift Fork, Shift Fork Rod	1 Heating	80kW High Frequency Induction Hardning Apparatus	
	2 Hydraulic Straightening	Hammer	Shift Fork Rod Only
Joint Yoke, Shaft	1 Heating	150kW High Frequency Induction Hardening Apparatus	
	2 Tempering	Electric Pit Furnace	
	3 Hydraulic Straightening	Hydraulic Straightener	
Spring	1 Tempering	Salt Bath	

Figure AI-3-7-1 LAYOUT OF HEAT TREATMENT SHOP

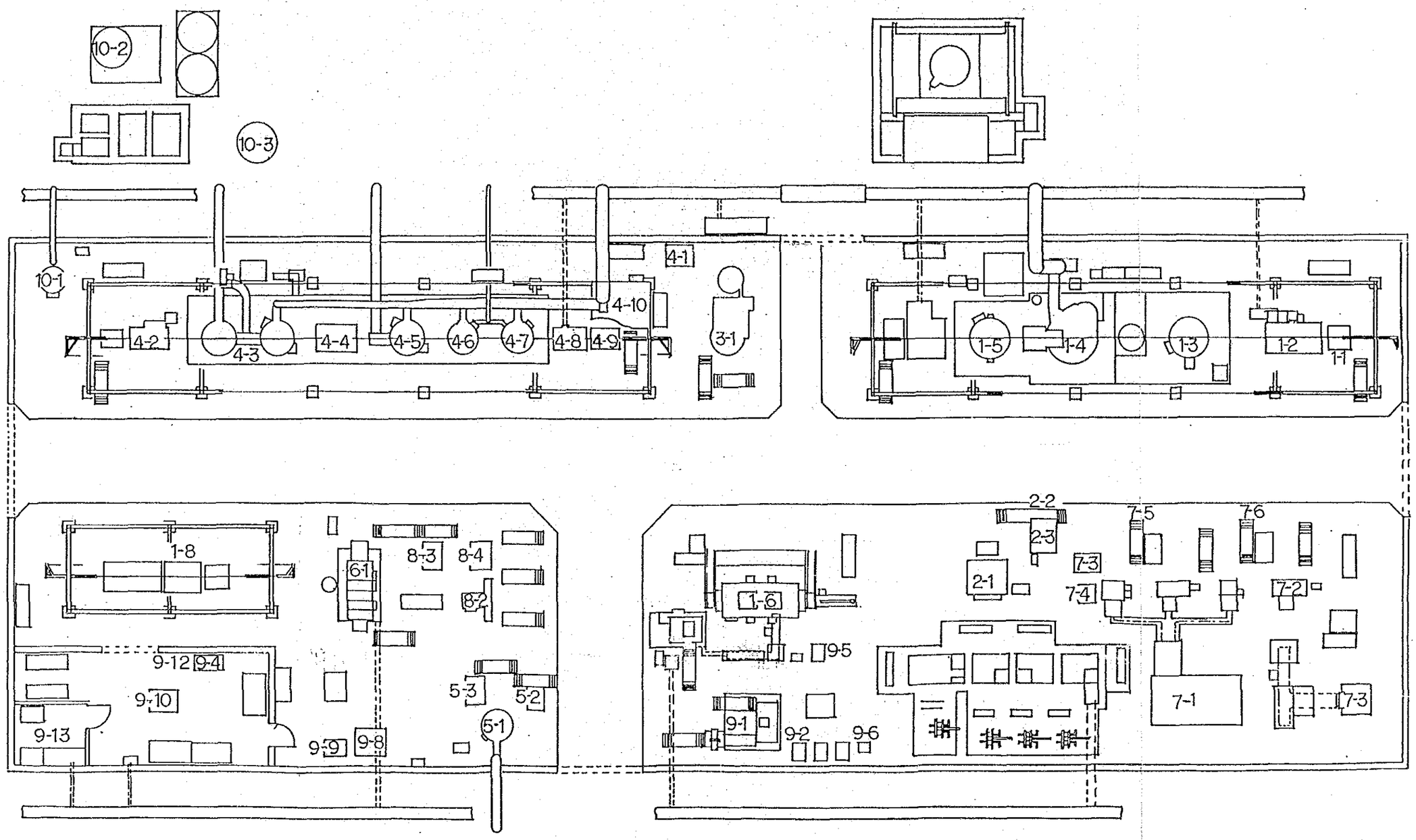


Figure AI-3-7-2 ORGANIZATION CHART OF HEAT TREATMENT SHOP

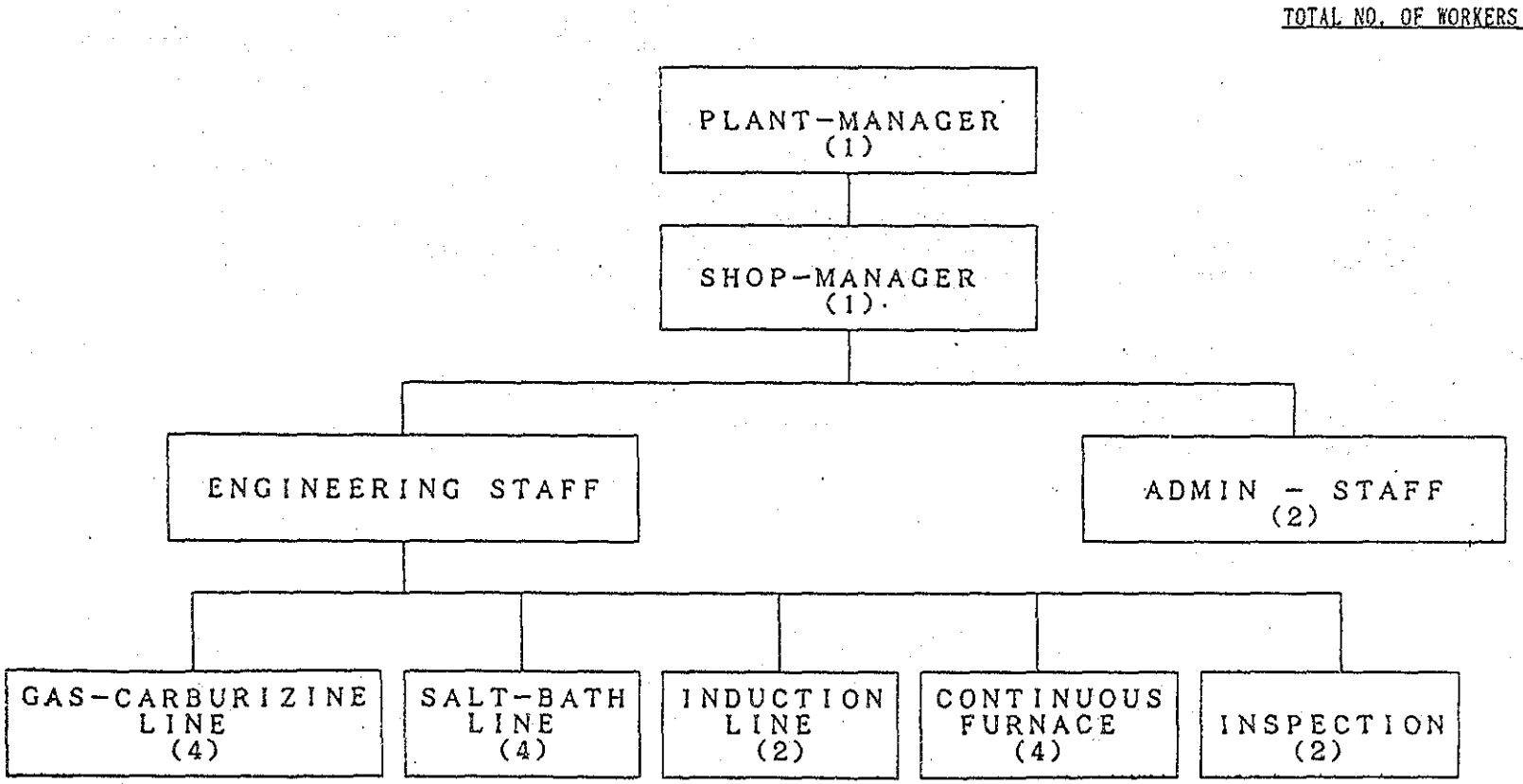


Figure AI-3-7-3 OUTLINE OF GEAR WORKING FLOW

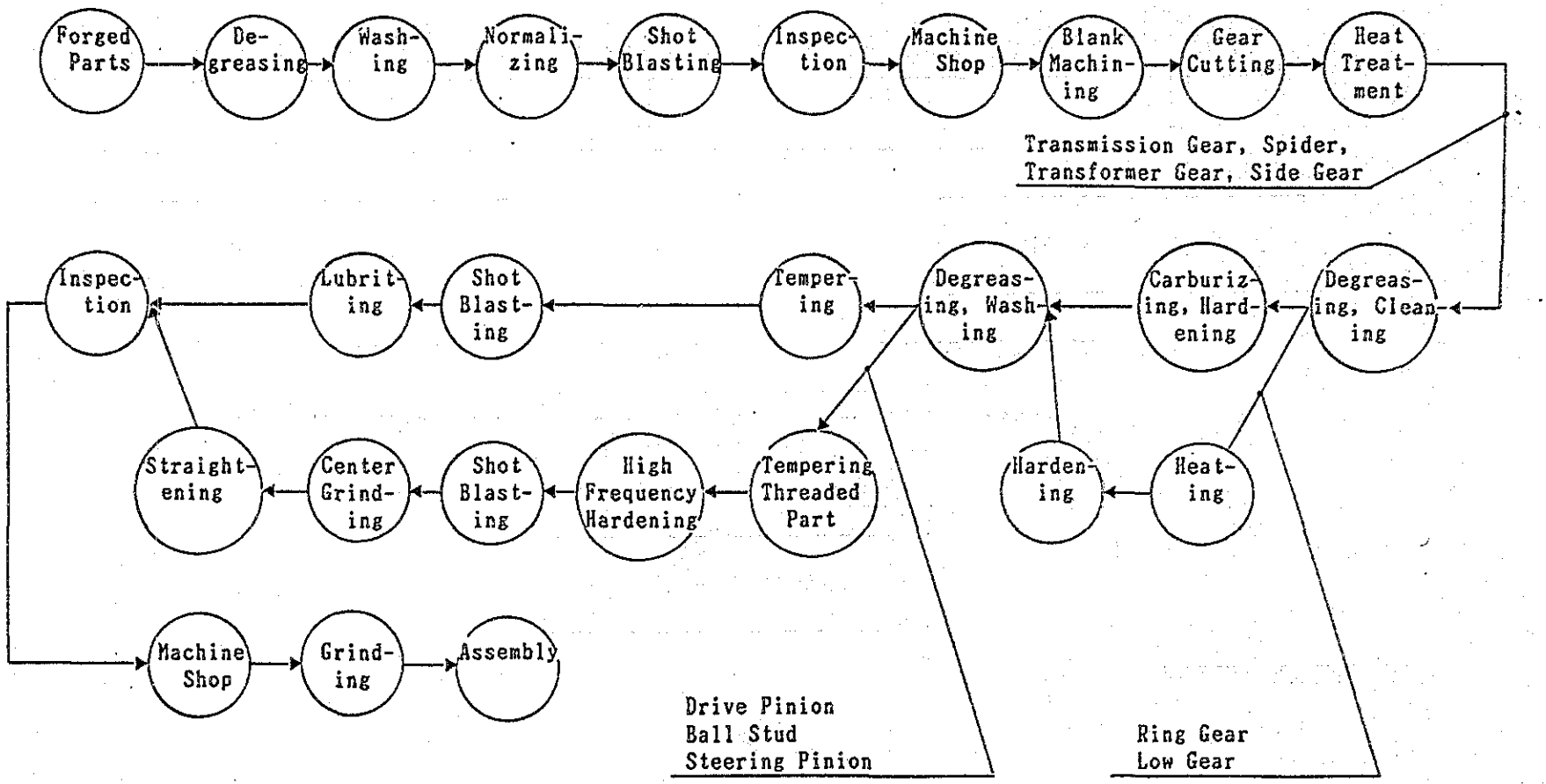
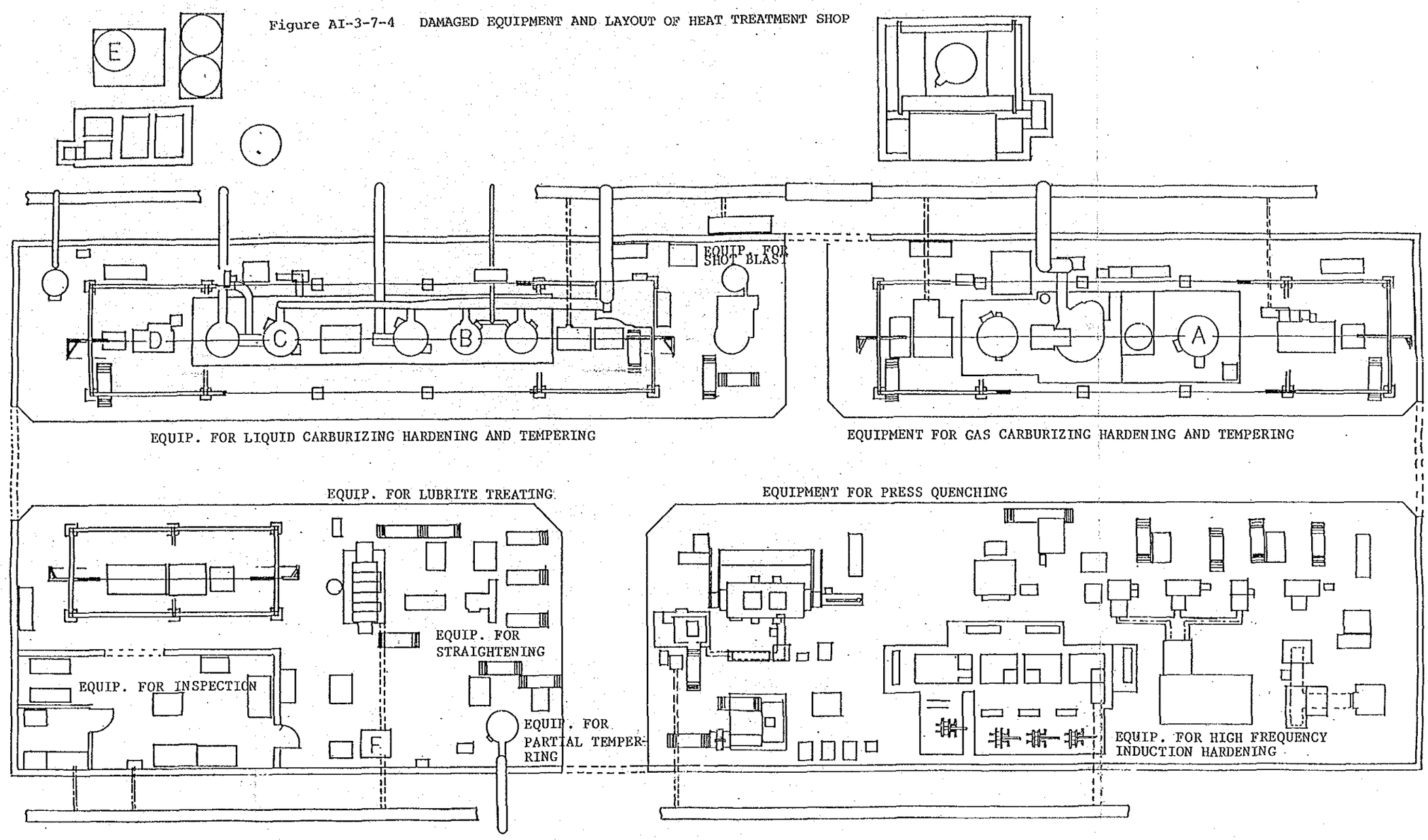


Figure AI-3-7-4 DAMAGED EQUIPMENT AND LAYOUT OF HEAT TREATMENT SHOP



Code	Equipment	Condition Failure	Remarks
A	Electrically Heated Granulate Gas Carburizing Furnace		Fan cover is damaged.
B	Salt Bath Furnace for Tempering	X	Temp. of GS430 can not be controlled.
C	Salt Bath Furnace for Carburizing	X	Cyanic Waste Water Treatment Divice is damaged.
D	Degrease Washing Tank	X	Tank is deteriorated by rust.
E	Cyanic Waste Water Treatment Device	X	Pump & Piping are damaged.
F	High speed Cutting M/C	X	Heavy Vibrations are generated from main axle.

Equipment Installed by Additional Loan

- Heat Treatment Equipment for 4th stage of parts localization of B600 & X2000 (Item No. III-3-2-2 9)

Chapter 4

HEAVY VEHICLES MANUFACTURING FACILITY

Chapter 4 HEAVY VEHICLES MANUFACTURING FACILITY

4-1-1 No.1 HI Heavy Vehicles Production Equipment

(1) Equipment and its layout

The equipment and its layout for each of the shops for Heavy Vehicle Production Equipment is indicated in the following documents:

Heavy vehicle assembly shop	Fig.AI-4-1-1
Htaukkyant shop	Fig.AI-4-1-2
Press shop No.2	Fig.AI-4-1-3
Transmission and heat treatment shop	Fig.AI-4-1-4
Bolt and nut shop	Fig.AI-4-1-5
Leaf spring shop	Fig.AI-4-1-6
Rear body shop	Fig.AI-4-1-7

(2) Organization and personnel

Organization and personnel are as shown in Table AI-4-1-1.

(3) Supply Performance of Raw Materials and Parts

The supply performances are shown in Table AI-4-1-2.

(4) Production performance and equipment capacity

Production performance and equipment capacity are shown in Table AI-4-1-3.

4-1-2 Heavy Vehicles Assembly Shop

In this shop, an assembly shop for 6.5 ton and 3.5 ton trucks, the assembling operations for the top parts, cab and frame of dumping trucks, wreckers, and tankers take place.

In regard of layout it is necessary to consider this together with and evaluation of the secondary extension plan for the Htaukkyant plant and other related shops.

(1) Problems of line balancing

The drilling operations for the side frame are done with the two radial drilling machines and jigs placed at the both sides of the line. Production figures for frame drilling are less by one unit than the production figures for the chassis final assembly line. If a breakdown occurs it is difficult to devise a substitution.

To improve the frame assembly line the following require consideration:

1. move the cross member work area to the east side of the paint booth

2. move the radial drilling machine, column drilling machine, arc welder and other processing equipment.

3. installation of another radial drilling machine for side frame drilling and one more set of drilling equipment.

Two riveting guns share a generator for frame assembling operations and as a result when both are in operation at the same time generating power is sometimes insufficient. It is necessary to have one generator for each gun.

(2) Quality control measures

1) Installation of vehicle inspection devices

Heavy vehicles, such as the trucks and buses, are not inspected with the tester devices when they come off the line, but are immediately dispatched. The testing devices for vehicle inspection were placed during the initial installation of the present line in the present service shop. However, placed on the shop floor these devices are now unusable due to damage caused by rain flooding of the sunken shop floor.

In order to ensure the safety and quality of the vehicles it is necessary to consider the installation of inspection testing devices at the point where vehicles come off the final assembly line of the

heavy vehicles assembly shop.

As domestic production of transmission proceeds the installation of a speedometer tester needs consideration.

2) Improvement and enlargement of the component parts area and integration of service shops

At present, engine repair equipment such as the engine dynamo-meter, etc. is installed in the Heavy Vehicle Assembly Shop. It is necessary to consider the transfer of this engine repair equipment to the service shop or the north-east of the service shop of the fuel tank and muffler area in order to enlarge the component parts area, storage and unpacking of packing cases, and assure the improvement of product quality.

(3) Enlargement of the work area for changeover to domestic production of metal sheet parts
In order to assist the domestic production of sheet metal small parts it is necessary to consider creation of a work space in the service shop.

(4) Equipment needing replacement

There is equipment requiring replacement in this shop which were not mentioned in the HIC list.

4-1-3 Htaukkyant Bus Shop

(1) The upper part assembly line for dump truck, wrecker, etc. is located here and since space is necessary for installing vehicle inspection equipment and for retouching of vehicles coming off the inspection line it should be moved to the Htaukkyant Bus shop in order to allow for this installation.

(2) Installation of vehicle inspection equipment in addition to machine and equipment for bus production needs consideration.

4-1-4 Press Shop No.2

(1) Quality control

Trimming operations taking place after the Press operations are at present by hand. However, trimming by hand tends to result in loose parts and numerous problems such as poor fitting of the cab door develop. The following points need to be considered when mechanizing to improve product quality:

1. Production of trimming patterns
2. Installation of an automatic trimming machine

(2) Overcoming bottlenecks

A ratio comparison of the time required for die changing of the large size press in the No.2 press shop and operating time (stamping time) at present is as follows:

Operating time	30%
Die changing time	70%

In order to shorten the time required for the die changing of the large press it is necessary to consider the mechanization of die changing.

4-1-5 Machine and Heat Treatment Shop

(1) New installation of re-grinding machine for shaving cutter

Normally after production of every 1,000-3,000 products the toothed blade of the shaving cutter is measured and re-sharpened. The present shop has 2 cutter machines. As the production output per machine is 3,500 it is necessary to sharpen the blades.

Introduction of shaving cutter re-grinding machines should be considered for purposes of re-sharpening.

(2) New equipment for replacement and overcoming bottlenecks

Processing of the main shaft, counter shaft, drive pinion shaft with present equipment requires respectively 25, 70 and 15 minutes.

Production of 4 of each the the shaft types in one day requires 440 minutes. Programming time is 180 minutes. Therefore the total of production and programming time is 620 minutes per day, so that operating time involves overtime. Introduction of a Gear Shaping machine to improve productive efficiency and shorten working time should be considered. Equipment requiring replacement because of deterioration is listed in Annex 3.

(3) Equipment for fuel conversion

To meet shortage of fuel resources consideration of changing fuel for the heat treatment shop is required.

4-1-6 Bolt and Nut Shop

(1) Equipment needed for overcoming bottlenecks

1) Thread rolling machine

This is used for production of bolt screws of each type besides those for vehicles. The machine has the highest operating rate in this shop. In the event of a breakdown there is no substitution available. It is therefore necessary to consider adding another thread rolling machine unit to current facilities.

2) Plating equipment and waste treatment

This is an electric zinc plating machine with a maximum handling capacity of 250kg per day and an actual performing capacity of some 150kg per day. Due to expansion of facilities for each of the different nut and bolt type equipments output exceeds 300kg per day. Therefore the increase of the plating equipment's capacity is necessary.

(2) Equipment increases

1) Wood screw producing machine

There are ten of this machine in the present shop. These facilities are all badly aged and 6 are beyond repair. The machinery, of the cutting type, has only one tenth of the productivity of modern rolling type equipment. In order to enable the production of tapping screws and wood screws of each type and dimension the elimination of the ten present machines and the introduction of 3 new rolling type models should be considered.

2) Long size bolts

Present equipment cannot produce long bolts of M12 - M20 x 95 - 180mm length. However, this is necessary to the expansion of productive capacity of M6 - M10 x 55 - 95mm length bolts. Introduction of one large and one small size bolt homer each should be considered.

4-1-7 Leaf Spring Shop

(1) Expansion of equipment to overcome bottlenecks

As the leaf spring shop involves much hot working and heat treatment handling of the machinery is rough and deterioration of equipment takes place easily. Pieces of equipment are requiring consideration as to replacement or expansion to overcome bottlenecks.

(2) Expansion of the U-Bolt manufacturing equipment

The equipment installed in the Leaf Spring Shop is judged to be appropriate because U-bolt is manufactured by forming with heating like leaf spring.

(3) Heat source conversion equipment

It is necessary to consider the conversion of the heat source of furnace facilities in the Spring Shop to meet the future changes of fuel resources.

4-1-8 Rear Body Shop

There is equipment requiring either replacement or repair.

4-1-9 Others

(1) Maintenance of blanks

Thin plates for press use, blanks (rough materials) for spring use, and wires and rods for bolt and nut use are all left outside in their packing crates. Because of seeping of rain during the monsoon and temperature differences between day and night in the dry season (some 20 degree c) condensation inside the crates develops. The rough materials develop rust and this results in an impoverishment of quality. Storage measures for the packing crates are urgently required.

It is necessary to supply according to planning packing crates of the component parts and raw materials from unloading from ship, unpacking, use and up to production. However, as the raw materials are shipped to Burma at a rate of one or two times yearly the provision of a large number of packing crates is difficult to assure. Materials are stored outside because deterioration of quality is difficult to observe and judge by eye in the case of thin iron plates, materials for springs, and wire rod material for bolts and nuts. As a result, quality of products was far below the expected levels. The following counter-measures are recommended to improve the present condition of storing the blanks:

Countermeasure 1:

Storage of thin plates for press

Reception of packing cases for press use thin plates should be considered for the storage area of Press Shop No.2 to make the movement of the storage area for the press patterns.

Countermeasure 2:

Storage of blanks for bolt and nut use and for spring use

The introduction of a crane (3 tons) for storage and for use in realizing the material handling plan for the spring shop should be considered.

Further, an overhead crane could be installed on the runway of steel frame materials of this raw materials area. Roofing and side wall construction should employ local products.

Table AI-4-1-1 STRENGTH SITUATION OF PRODUCTION DEPARTMENT NO.3

Name of Plant/Shop	Manager & Engineers	Foreman	Skilled Labor	Semi-Skilled Labor	Un-Skilled Labor	Total
Department Office	2	3	3	40	31	79
Heavy Vehicle Manufacturing Plant	4	9	60	70	18	161
Heavy Vehicle Components Manufacturing Plant	2	8	23	107	9	149
Press Shop No.1 & 2	4	5	26	45	24	104
Bolt & Nut Manufacturing Shop	2		9	24	2	37
Spring Manufacturing Shop	1		7	16	9	33
Bus Manufacturing Plant (Htauk Kyant)	3	5	25	36	11	80
Rear Body Manufacturing Shop	1	4	25	25	7	62
Heavy Vehicle Repair Shop	1		9	10		20
Light Vehicle Repair Shop	2	4	16	32	9	63
Service Station No.1	2	2	12	26	5	47
Service Station No.2	2	2	9	10	7	30
	26	42	224	441	132	865

Table AI-4-1-2 PROCUREMENT RECORD OF RM AND CP

(Unit: Set Vehicle)

Vehicle	Year:	1984		1985		1986		Total	
Truck	TE 6.5 Ton	566	774	450	630	450	630	1,466	2,034
	WA	50		50		-		100	
	KM 3.5 Ton	158		130		180		468	
Bus	BM 25 Pass.	100	104	100	118	50	72	250	294
	BX 33 Pass.	4		185		22		44	
Total		878		748		702		2,328	

Table A1-4-1-3 PRODUCTION AND PRODUCTION CAPACITY

Production

Year	Model	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Total
	TE	50	72	56	7	46	44	43	58	80	44	32	86	618
	WA	-	-	-	-	-	-	-	-	-	-	-	-	-
	KM	-	-	-	-	-	-	-	5	-	22	55	6	88
1984	BM	3	11	11	-	-	-	1	-	1	13	14	15	69
	BX	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	53	83	67	7	46	44	44	63	81	79	101	107	775
	TE	32	44	76	97	25	98	103	86	85	17	45	74	782
	WA	-	-	-	-	-	-	-	-	1	45	-	-	46
	KM	2	-	-	-	76	2	2	-	-	34	48	4	168
1985	BM	4	8	2	-	-	6	20	13	-	6	5	5	69
	BX	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	38	52	78	97	101	106	125	99	86	102	98	83	1,065
	TE	34	77	79	80	42	66	18	75	10	10	1	69	561
	WA	-	-	-	2	-	-	50	-	-	-	-	-	52
	KM	41	4	-	-	-	-	-	-	50	90	40	-	225
1986	BM	2	3	1	10	10	8	-	5	10	15	9	3	76
	BX	-	-	-	-	-	1	3	4	-	-	-	4	12
	Total	77	84	80	92	52	75	71	84	70	115	50	76	926

Model		Established Capacity
TE	Potential	4 Vehicles/8hr x 20ds = 80 Vehicles/month
	Original	4 Vehicles/8hr x 25ds = 100 Vehicles/month
BM	Potential	1 Vehicle /8hr x 20ds = 20 Vehicles/month
	Original	1 Vehicle /8hr x 25ds = 25 Vehicles/month

Notes: Production Capacity

1. TE and BM represent other models.
2. The present capacity was established in 1982 due to change of working days (Saturday was set as off day).

Figure AI-4-1-1 LAYOUT OF HEAVY VEHICLE ASSEMBLY SHOP

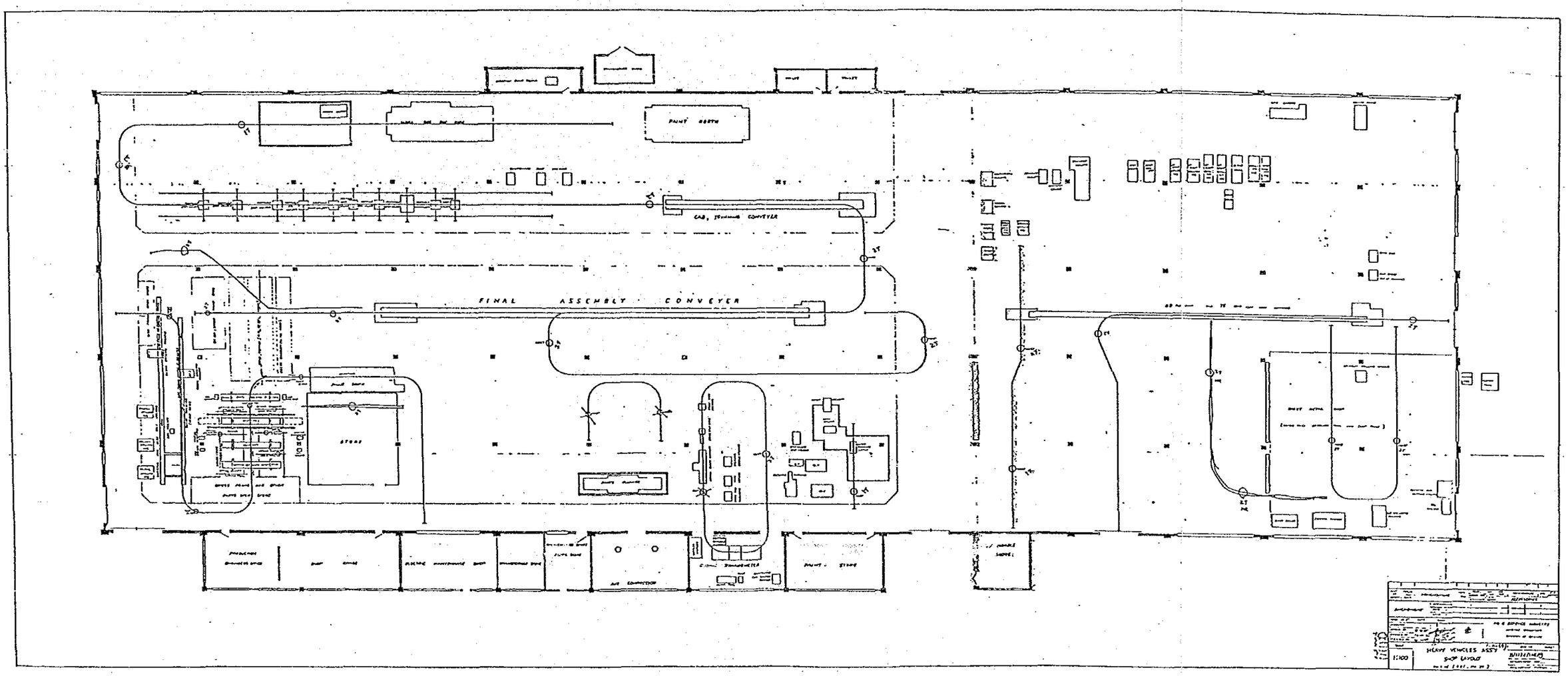
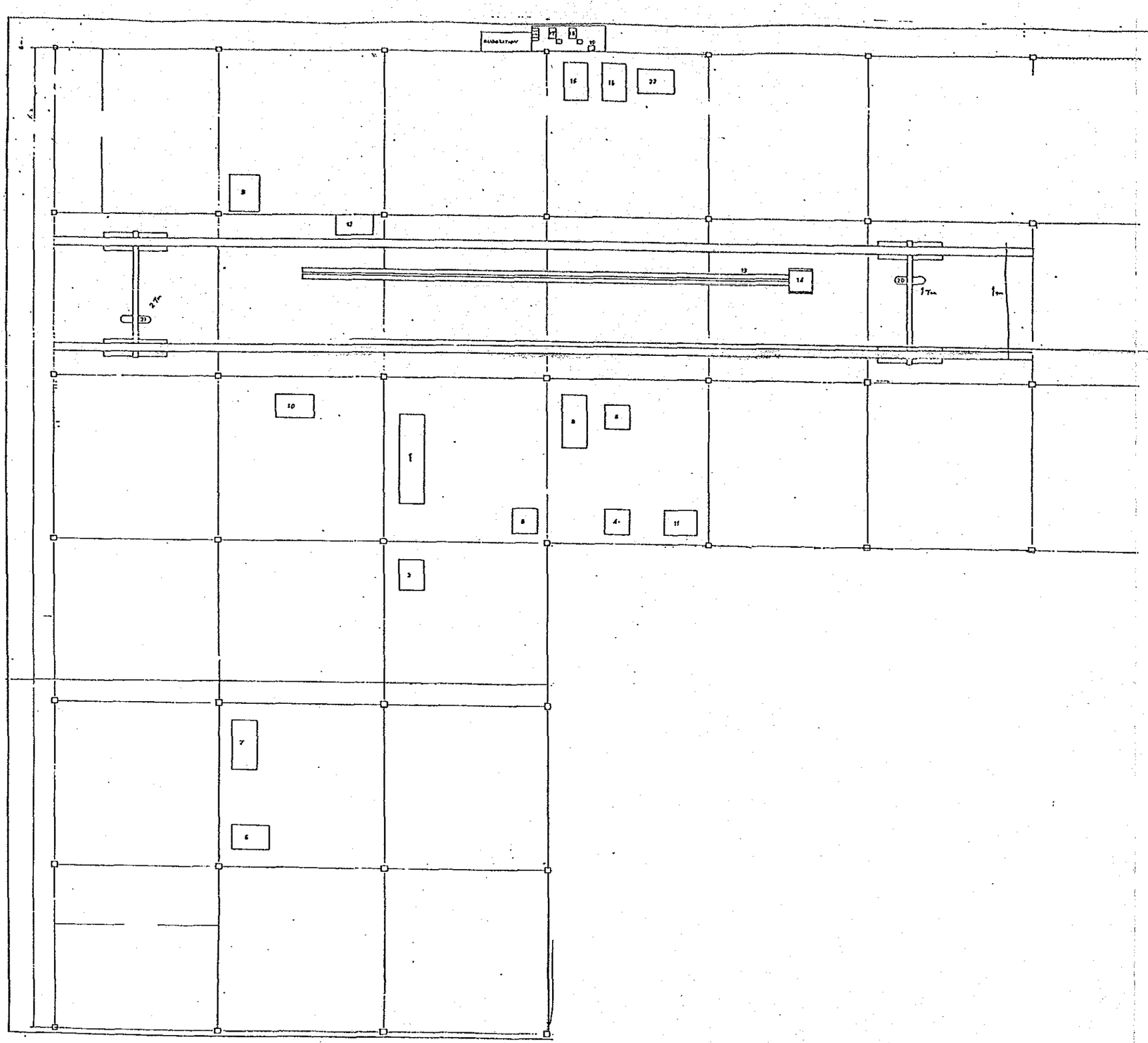


Figure AI-4-1-2 · LAYOUT OF HTAUKKYANT BUS SHOP



SR. NO.	NOMENCLATURE
22	AIR COMPRESSOR
21	OVER HEAD CRANE
20	OVER HEAD CRANE
19	WATER PUMP
18	AIR COMPRESSOR
17	AIR COMPRESSOR
16	PORTABLE AIR COMPRESSOR
15	PORTABLE AIR COMPRESSOR
14	CONVEYOR MOTOR
13	PUSHER CONVEYOR
12	BRAKE FLUID BLEEDER
11	PORTABLE WELDING TRANSFORMER
10	HYDRAULIC GENERATOR
9	TIRE INFLATION EQUP:
8	ELECT: BENCH GRINDER
7	WOOD BAND SAWING M/C
6	HIGH SPEED CIRCULARSAW BENCH M/C
5	ELECTRIC BENCH DRILL
4	STATION SPOT WELDER
3	WORD SHEAR M/C
2	BAND SAWING M/C
1	SHEARING M/C

Figure AI-4-1-3 LAYOUT OF PRESS SHOP NO.2

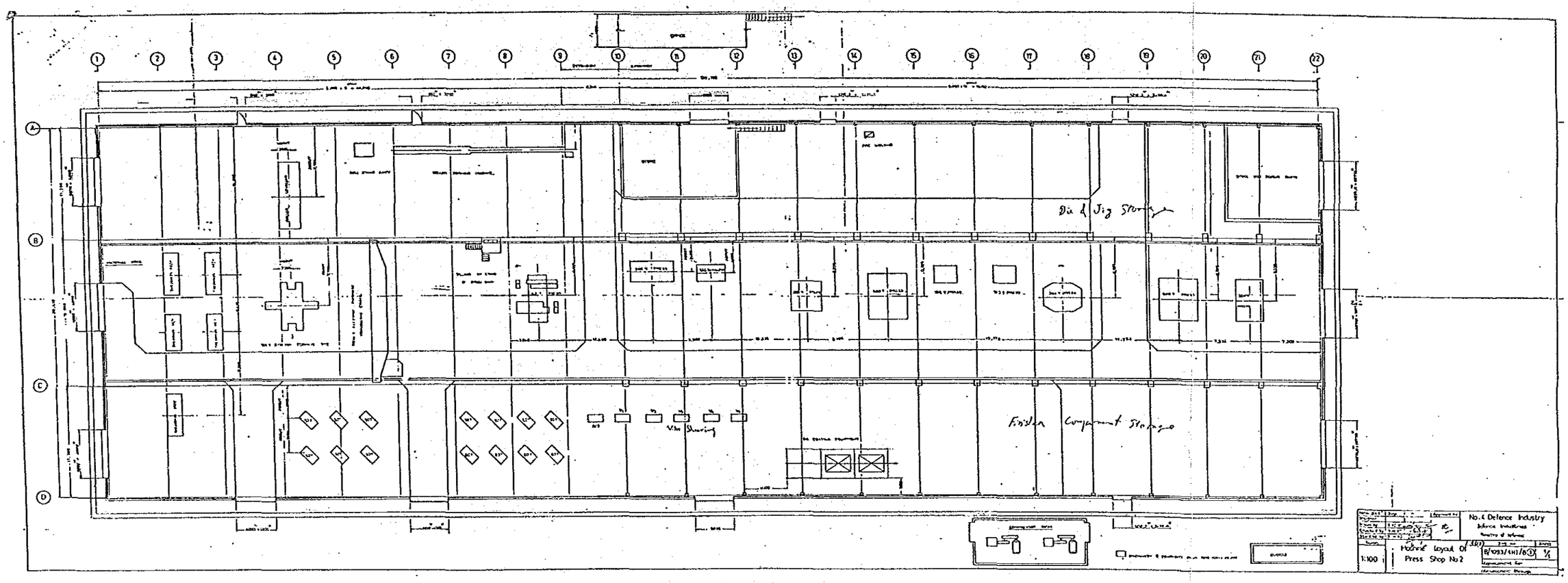


Figure AI-4-1-4 LAYOUT OF TRANSMISSION AND HEAT TREATMENT SHOP

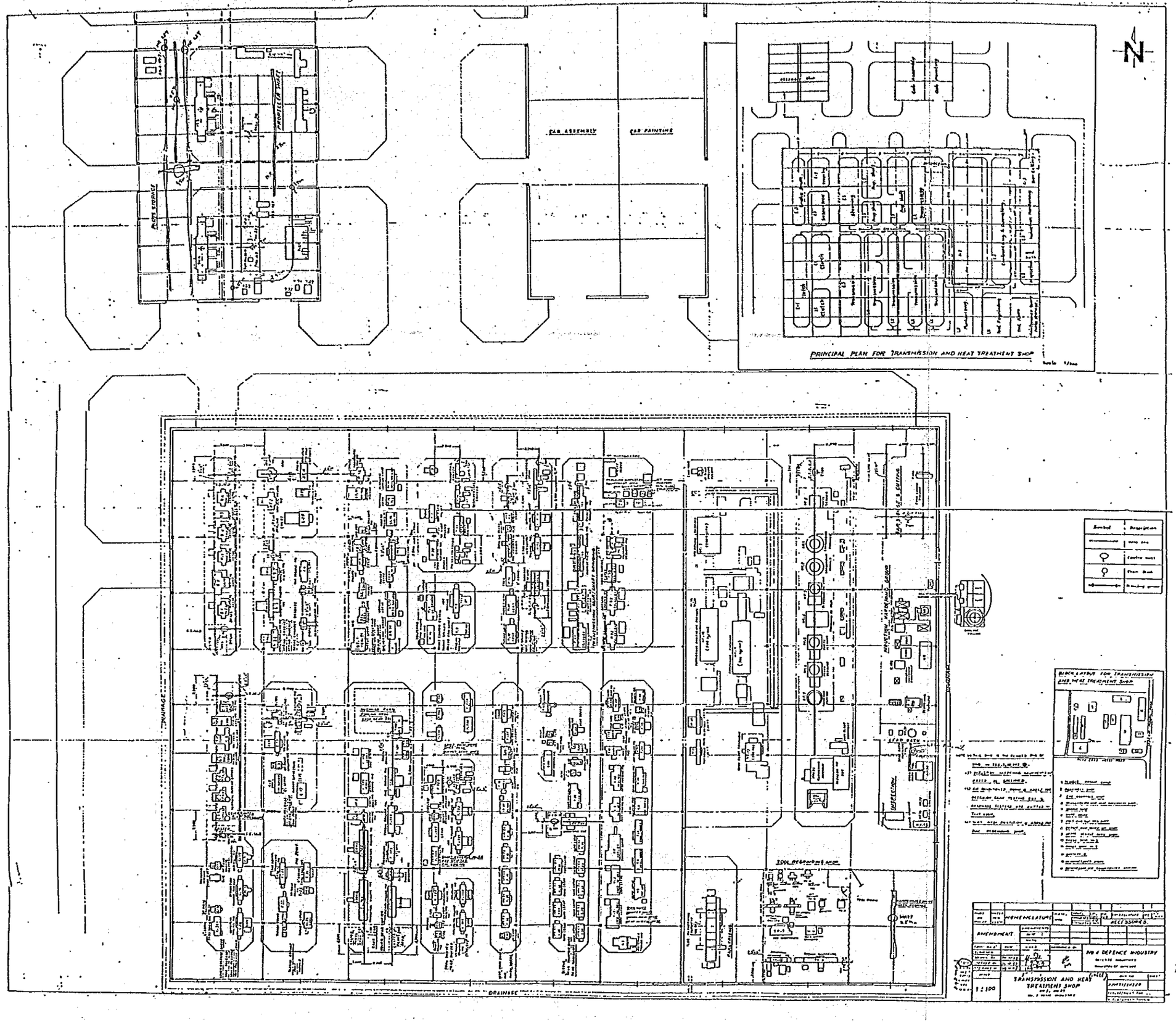
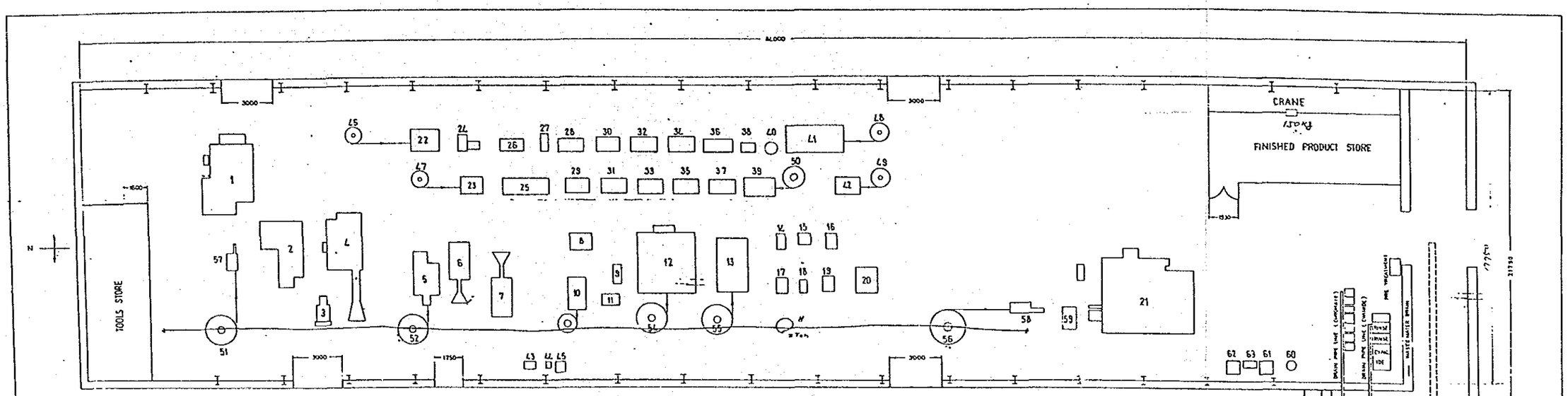


Figure AI-4-1-5 LAYOUT OF BOLT & NUT MANUFACTURING SHOP



BOLT SECTION

SR NO	MACHINE NAME	MODEL NO	ITEM NO
1	HEADER	BH.5	I.I.E.1
2	TRIMMER	BH. 6	I.I.E.2
3	POINTER	BH. 7	I.I E.3
4	THREAD ROLLING	BH. 8	I.I.E.4
5	HEADER	H.30	I.1
6	TRIMMING	R.30	I.2
7	THREA ROLLING	TR.20	I.3
8	"	TR.15	I.I.E.9
9	"	TR.12	I.8
10	HEADER	H.15	I.6
11	SLOTTING	S.15	I.7

NUT SECTION

SR NO	MACHINE NAME	MODEL NO	ITEM NO.
12	NUT FORMER	NF.30	I.4
13	"	NF.20	I. 9
14	TAPPING M/C	"	II.5.7/2
15	"	[illegible]	II.5. 3/4
16	"	BM. 12	II.I.E.8
17	"	"	II.5.1/2
18	CHAMFERING		II.5. 3/4
19	TAPPING M/C	BM.2950	2.6.3(C)2
20	"	BM.8051	2.6.2(C)2
21	NUT FORMER	NF. 560	B.1

NAIL WIRE SECTION

SR NO	MACHINE NAME	MODEL NO	ITEM NO
22	NAIL MAKING M/C	NM.60218	"
23	"	NM 60.316	"
24	TUMBLING BARREL	-	-
25	MULTI PURPOSE LATHE	551125	-
26	SINGLE PURPOSE LATHE	69250	-
27	UP.RIGHT DRILLING	WDD.540	I.I.E.8

WOOD SCREW SECTION

SR NO	MACHINE NAME	MODEL NO	ITEM NO.
28	WOOD SCREW MAKING M/C	W.778	3rd M5.3.3
29	"	W.777	3rd M5.3.1
30	"	W.780	3rd M5.3.2
31	"	W.779	3rd M5.3.2
32	"	W. 783	3rd M5.3.3
33	"	W. 781	3rd M5.3.2
34	"	W. 784	3rd M5.3.4
35	"	W. 782	3rd M5.3.3
36	"	W. 786	3rd M5.3.5
37	"	W. 785	3rd M5.3.4

RIVET SECTION

SR NO	MACHINE NAME	MODEL NO	ITEM NO.
38	TUMBLING BARREL	-	3rd M5.1.1
39	HEADING M/C	H.300	3rd M5.1.1
40	CENTRIFUGAL SEPARATOR	-	3rd M5.1.1
41	HEADING M/C	H.301	3rd M5.1.2
42	"	H.299	3rd M5.1.1

SR NO	MACHINE NAME	MODEL NO	ITEM NO
43	GRINDING M/C		I
44	"		
45	"		
SERIAL NO.	NOMENCLATURE		
45,47,48,49,50,51	BARE STOCK REEL		
52 53, 54, 55, 56	"		
57, 58	WIRE STRAIGHTNER		
59 "	HEATER		
60	DRYER		
61, 62	TRANSFORMER		
63	SWITCH BOARD		

Note: This is updated version of dwg. no. B/2007/IHI/C.

PART OR COMPT	PIECES PER ASSY	NOMENCLATURE	MATERIAL	MODEL NO. / ITEM NO. / STD	NOMENCLATURE	STD	I.D. CODE
					ACCESSORIES		

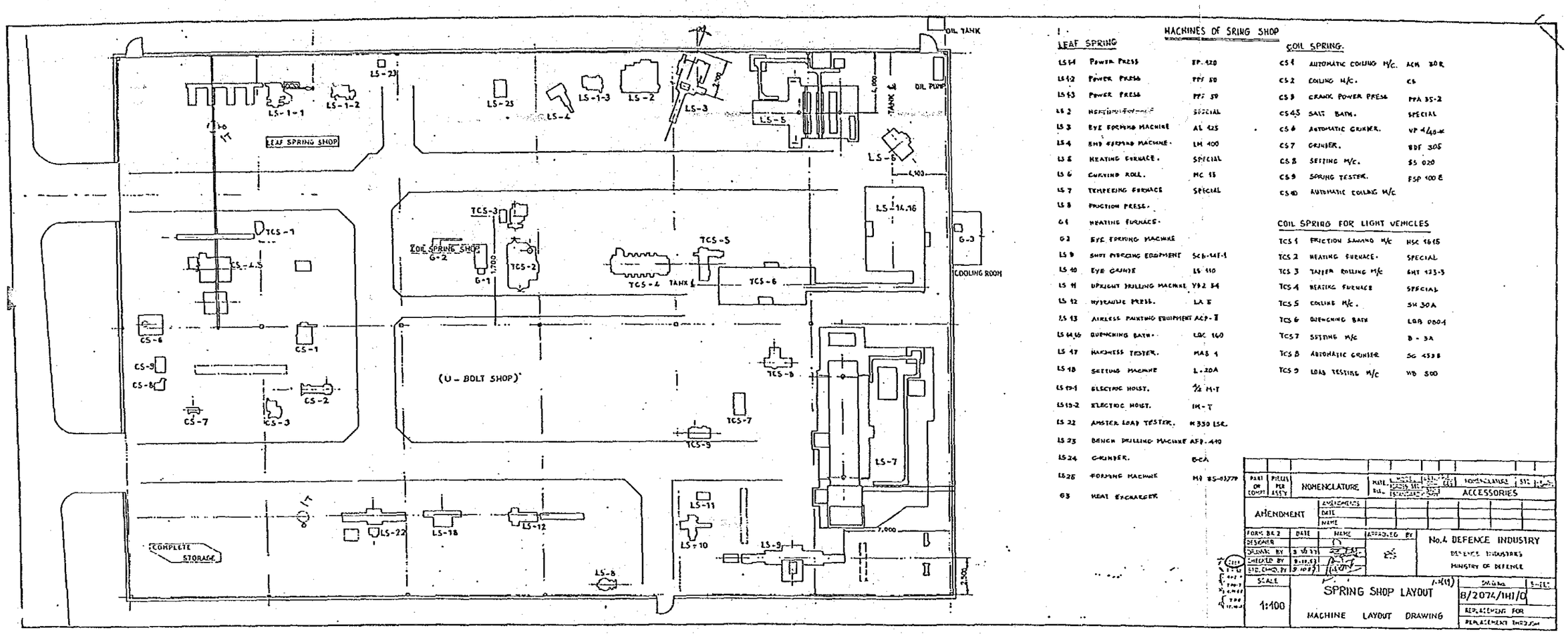
AMENDMENT	AMENDMENTS	DATE	NAME

FORM 882	DATE	NAME	APPROVED BY
DESIGNER			
DRAWN BY	3.10.87		
CHECKED BY			
STD CHKD BY	3.10.87		

NO.4 DEFENCE INDUSTRY
DEFENCE INDUSTRIES
MINISTRY OF DEFENCE

SCALE	MACHINE LAYOUT 1.2(3) FOR BOLT & NUT MANUFACTURING SHOP (IHI)	ENG. NO.	SHEET
1:100		B/2007/IHI/D	
		REPLACEMENT FOR	
		REPLACEMENT THROUGH	

Figure AI-4-1-6 LAYOUT OF SPRING SHOP



MACHINES OF SRING SHOP

LEAF SPRING

LS 1-1	Power Press	EP. 420
LS 1-2	Power Press	PPF 80
LS 1-3	Power Press	PPF 39
LS 2	Heating Furnace.	Special
LS 3	Eye forming Machine	AL 425
LS 4	End forming Machine.	LH 400
LS 5	Heating Furnace.	Special
LS 6	Curving Roll.	MC 15
LS 7	Tempering Furnace	Special
LS 8	Friction Press.	
G 1	Heating Furnace.	
G 2	Eye forming Machine	
LS 9	Shot Peening Equipment	SCB-14F-1
LS 10	Eye Grinder	LS 110
LS 11	Upright Drilling Machine	VB2 34
LS 12	Hydraulic Press.	LA 5
LS 13	Airless Painting Equipment	ACP-I
LS 14,16	Quenching Bath.	LQC 160
LS 17	Hardness Tester.	MAS 1
LS 18	Setting Machine	L-20A
LS 19-1	Electric Hoist.	½ M-T
LS 19-2	Electric Hoist.	1M-T
LS 22	Master Load Tester.	M 330 LSC.
LS 23	Bench Drilling Machine	AFB-440
LS 24	Grinder.	B-CA
LS 25	Forming Machine	MB BS-01779
G3	Heat Exchanger	

COIL SPRING

CS 1	Automatic Coiling M/c.	ACM 30R
CS 2	Coiling M/c.	C6
CS 3	Crank Power Press	PPA 35-2
CS 4,5	Salt Bath.	Special
CS 6	Automatic Grinder.	VP 440-K
CS 7	Grinder.	BDF 305
CS 8	Setting M/c.	SS 020
CS 9	Spring Tester.	FSP 100 E
CS 10	Automatic Coiling M/c	

COIL SPRING FOR LIGHT VEHICLES

TCS 1	Friction Shaving M/c	HSC 1615
TCS 2	Heating Furnace.	Special
TCS 3	Taper Coiling M/c	GHT 123-3
TCS 4	Heating Furnace	Special
TCS 5	Coiling M/c.	SH 30A
TCS 6	Quenching Bath	LQB 0804
TCS 7	Setting M/c	B-3A
TCS 8	Automatic Grinder	SG 4538
TCS 9	Load Testing M/c	MB 500

PART OR COMPT	PIECES PER ASSY	NOMENCLATURE	MATL	NOMENCLATURE
			Bal.	ACCESSORIES

AMENDMENT — AMENDMENTS / DATE / NAME

	DATE	NAME	APPROVED BY
DESIGNED			
DRAWN BY	3 10 93		
CHECKED BY	9.10.93		
STD. CHKD. BY	9.10.93		

No.4 DEFENCE INDUSTRY
DEFENCE INDUSTRIES
MINISTRY OF DEFENCE

SCALE 1:100

SPRING SHOP LAYOUT
MACHINE LAYOUT DRAWING

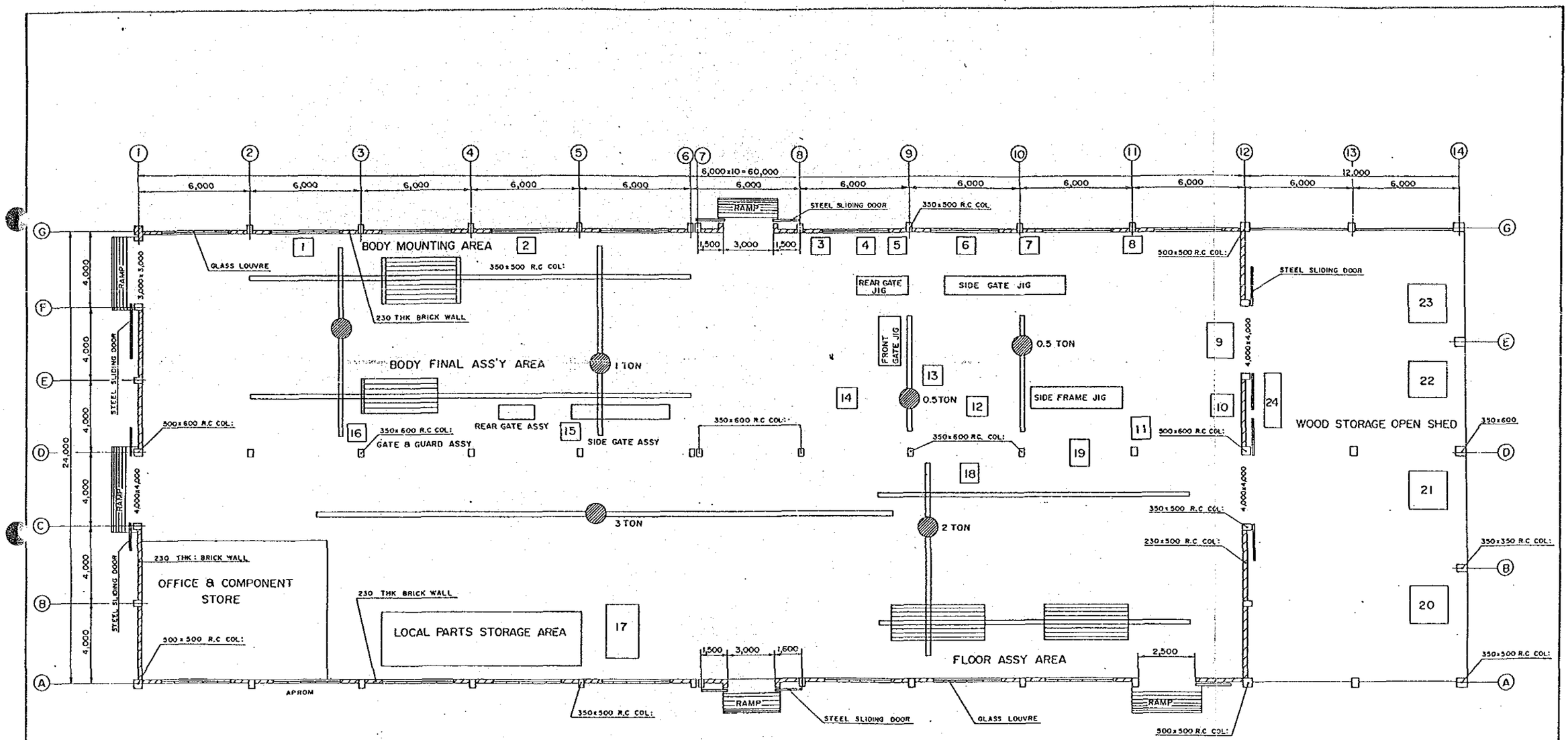
A1-4-1(1)

SW.No. 8/2074/1H1/0

REPLACEMENT FOR

REPLACEMENT THROUGH

Figure AI-4-1-7 LAYOUT OF REAR BODY SHOP



No.	DESCRIPTION	MODEL	No.	DESCRIPTION	MODEL
1	ELETRIC ARC WELDER	YK 305 SL	13	ELETRIC ARC WELDER	
2	"		14	"	
3	"		15	"	
4	"		16	"	
5	BENCH DRILLING	BA-330-2	17	MULTIPLE DRILLING M/C	MDM 2
6	ELETRIC ARC WELDER		18	CROSS CUTTER	
7	"		19	CROOVER	MIA
8	BENCH DRILLING	YUD-700	20	3 SIDE PLANER	PT-18C
9	RIVET HEATER		21	"	PT-18C
10	ELETRIC ARC WELDER		22	"	PT-18B
11	BENCH DRILLING	YUD-540	23	CROSS CUTTER	CB-30
12	BAND SAW	CHA-300	24	THICKNESSIG PLANER	EH-12

SCALE	DRAWING No.
	DESCRIPTION LAYOUT of REAR BODY SHOP IN BURMA
DATE	SIGNATURE