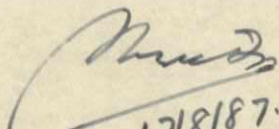


INDUSTRIAL TRAINING

WORK TERM-I

REPORT FOR
W. T.—1. (INDUSTRIAL ENGG.)
THAPAR INSTITUTE OF
ENGINEERING & TECH.
(DEEMED UNIVERSITY) PATIALA.

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17.12.87


17/8/87.
Head,
Placement & Coordination Deptt.
Thapar Institute of Engineering & Technology,
PATIALA-147001.

1987

RAJIV JASUJA

Thapar Institute of Engineering & Technology

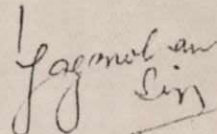
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CERTIFICATE OF SUPERVISOR

This is to certify that Mr. Rajiv Jasuja,
has worked on the subject "GRINDER DESIGNING"
& MAINTENANCE JOBS", at PARTAP STEEL ROLLING
MILL (1935), Ltd. CHHEHARTA.

The work has been carried out by the candidate
himself, under our supervision and guidance
and the data included in this report are
genuine.



(ER. JAGMOHAN SINGH)

(W.M.)

PARTAP STEEL ROLLING MILL
(1935), Ltd.

CHHEHARTA.

PLACE : CHHEHARTA.

DATE : July, 1987.

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A C K N O W L E D G E M E N T .

It is my proud and rare privilege to place on record my deep sense of gratitude and express my indebtedness to my Supervisor , Er. JAGMOHAN SINGH: W. M., P.S.R.M. (1935) Ltd. CHHEHARTA. for his keen interest, encouragement, able supervision and invaluable expert guidance throughout the training.

I owe a special debt of gratitude to Mr. Ajmer Singh, G.M. (Projects) without whose willing and whole hearted co-operation and help, it would have been difficult to accomplish this job.

My thanks are also due to Mr. Amrit Pal (Scrap Supervisor) for his ever ready help at all times during this study.

I am highly grateful to Mr. HARDHIAL SINGH foreman, Work shop, Mr. GURJEET SINGH, Shaper-man, Workshop, Mr. B.D. SHARMA, Hobbing Operator,

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Workshop, for their timely Co-operation and help rendered during this study.

I sincerely wish to acknowledge my gratitude towards my respected parents for their constant help and inspiration.

I am also thankful to my colleagues Mr. Ashim Kumar, Training Engineer, Mr. RAMAN DEEP SINGH SODHI, Training Engineer for the co-operation and help they offered to me during this study.

Finally, I take this opportunity to thank Mr. Bakshish Singh , Steno for the excellent typing of this Manuscript.

July , 1987.

(RAJIV JASUJA)

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Scrap
Specification
Adopted
In
P.S.R.M.(1935)Ltd.
Chheharta.

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SCRAP SPECIFICATION.

Mill heavy or Selected heavy Scrap

Fresh end Cuttings of Rolling Mills, Angles, Rounds and Flats end Cutting, Rivets, heavy forgings, heavy motor parts, free wheels, thick pipe cuttings, Nuts Bolts, Plate cutting $\frac{1}{16}$ " to $\frac{1}{4}$ ", Forging's flash.

Heavy Kabari.

Pipe Cuttings (NOT more than 2" length), Heavy cycle parts, Cycle handle, Pressed Jaricans, Kadhai, Kabza cuttings, Wagon sheet cuttings of 2'x2' size, Chabi cuttings.

(Note up to 10% lengthy material acceptable subjected to cutting charges.)

Medium Kabari.

Light cycle parts, Drum Cuttings and Punchings, wire and Patti bundles, Wire mesh, wire rope (Not more than 3" length. Wheels, Chain, Light automobile parts.

Light Kabari.

Big Sheet Cuttings, Tin Tapper, Boxes, Containers, Kanastar, Packing Patti, Karahi, Small pieces of tin.

H.S. turning and Boring.

Turning boring coils as well as crushed free from dust, slag (5% C.I boring permissible.)

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**FURNACE
SECTION**

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SECTION-1.

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MODEL II DIRECT ARC MELTING FURNACE

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SECTION-I

MAINTENANCE INSTRUCTIONS

FURNANCE

FURNANCE TYPE MODEL-II DIRECT ARC MELTING FURNANCE
SERIAL NO 502014
INSTALLED AT AFRITSAR

TECHNICAL DATA

SHELL DIAMETER	<u>2252 mm</u>
SHELL HEIGHT	<u>2566 mm</u>
HEIGHT OF SYLL LEVEL	<u>1245 mm</u>
TRANSFORMER RATING	<u>5000 KVA (CONTINUOUS)</u> <u>6000 KVA (DURING BELT-</u> <u>DOWN)</u>
ELECTRODE DIAMETER	<u>305 mm (12")</u>
CHARGING	TOP
ANGLE OF FORWARD TILT	<u>45°</u>
ANGLE OF BACKWARD TILT	<u>15°</u>
ELECTRODE CONTROL	AMPLIDYNE
TILTING	HYDROLIC
ROOF LIFTING AND SLEWING	HYDROLIC
ELECTRODE CLAMP OPERATION	PNUMATIC
HIGH VOLTAGE SUPPLY	3 PHASE 11 KV 50 C/S 250 MVA. A.C.
CONTROL SUPPLY	3 PHASE 415 ± 5% 50 C/S 4 wire A.C.
TRANSFORMER SECONDARY VOLTAGE	95V-250V (10 steps)

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NO. OF TAPS ON TAP BOARD	10
NO. OF TAPS ON TAP CHANGER	4
TYPE OF TAP CHANGER	OFF LOAD
COOLING WATER FOR FURNACE (AT 25°C)	260 Lit/min (80G.P.M.)
COOLING WATER PRESSURE	1.4Kg/Cm ² (20Lbs/In ²)
COOLING WATER FOR TRANSFORMER (AT 35°C)	320Lit/min (70G.P.M.)
COOLING WATER PRESSURE	0.4Kg/Cm ² (5Lbs/In ²)

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SECTION_2

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SECTION-2

BRIEF DESCRIPTION OF EQUIPMENT

2.1

INTRODUCTION

The furnace comprises a cylindrical refractory lined shell with dished bottom and domed roof. The shell is mounted on a chasis which also carries a back frame with the roof suspension beams electrode masts, winch units for electrode arms etc.

The chasis with the furnace shell and the back frame is carried on two toothed rockers for back frame ensures that the torque and stresses set up by roof or electrode movements are transmitted directly to the chasis and have no effect on the furnace shell

The furnace is provided by specially constructed transformer. The electrode movement is controlled electrically by a set of sensitive amplidyne. Tilting and roof lifting are done hydroillically while the electrode clamps and the slage are operated pneumaticly.

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2.2

FURNACE SHELL

The furnace shell is cylindrical with a dished bottom. It is rigidly contained in a crasis which is also extended to one side to carry a back frame.

The platform structure, with shell and back frame tilts on two rockers mounted under the platform adjacent to the shell the rockers have teeth to ensure alignment and they engage with corresponding teeth on the pedestal tracks.

2.3

PEDESTAL TRACKS

A pair of pedestal tracks mounted on the furnace foundation, engage with the teeth in the rockers on the furnace platform to carry the entire weight of furnace structure.

2.4

BACK FRAME

Back frame moves on a track on the crasis with the electrode masts the roof suspension beams, the roof raising mechanism.

2.5

DOOR GEAR

Door Gear is pneumatically and/or manually operated and counter - balanced with suitable weights, so that it may be adjusted to suit the weight of the door and brick work.

The door slides in a vertical guides behind which is situated on water cooled door arch. The door is arranged for easy sealing

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and an effective seal is made between the door and the arch by the vertical guides

2.6

ROOF LIFTING

Two roof rings are supplied so that one is in operation on the furnace, the other may be bricked ready for use. They are of water cooled type and supported by four links attached to the roof lift beams.

A platform is provided over the roof brick work to enable the operators to carry out any adjustments necessary to the electrode clamps and fit new electrodes as required.

2.7

ROOF SUSPENSION BEAMS

This assembly together with the roof is swung off the furnace for charging.

2.8

ROOF LIFT

The furnace roof is suspended at four points and is lifted by two hydraulic cylinders mounted on the back of the structure.

2.9

ROOF SWING

One vertical pivot pin is provided and secured to the chassis the back structure carrying the roof lifting mech. rotates about this pivot pin supported on rollers which move on a track concentric with its pivot pin. Rotation of the back structure and

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consequently swinging of the roof is carried out by the double cylinder.

2.10 ELECTRODE ARMS

These are the tubular steel section and carry the water cooled Copper bustubes to the electrode clamps the electrode masts mounted on the back structure.

The bustubes and the electrode arms are suitably installed.

2.11 ELECTRODE CLAMPS

The electrode clamps are made of non-magnetic heat resisting steel water cooled Copper inserts are included in the clamps for carrying the current to the electrodes. The clamps are operated by pneumatic cylinders and operating lever.

2.12 H.T. SWITCHGEAR

The H.T. Switchgear for the incoming supply and control of the furnace transformer consists of a vertically isolating oil ckt. breaker mounted on the withdrawable truck. The gear is specially constructed to withstand frequent operation, both for breaking of Magnetising current of the transformer as well as, clearing the faults and short ckt. conditions during melting operation.

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The O.C.B. can be operated by manual or solenoid closing mech.

2.13

TRANSFORMER

The transformer is of the close type and constructed with specially reinforced windings to withstand heavy current fluctuations in furnace operation. A large No of voltage tappings are provided for connection to the tap changer to regulate furnace power input, arc length etc. during melting operation.

The transformer is of OFW (Oil forced water cooled) type.

2.14

REACTOR

The transformer is provided with a series reactor included in the same tank. The reactor has tappings brought to the tap changer, via , a link board on the top of the transformer tank. The selection of the reactor tappings corresponding to the voltage tappings are to be made for the stability of the arc and minimising the line fluctuation, depending on the quality of the charge material and the fault level of the supply system for overall electrical efficiency minimum amount of reactance should be chosen.

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2.15

ELECTRODE CONTROL

The electrodes are regulated by a motor Amplidyne set comprising three amplidynes mounted on a common bed plate with a driving motor.

The amplidynes are arranged to balance the arc voltage against the arc current through suitable rectifiers and resistances etc. so that if the arc current increases or the arc voltage decreases to a point of unbalance electrodes will be raised & converse, by means of motorised winch motors (winch unit) pulleys and wire ropes. The D.C. motors of the winch units are specially designed to have low moment of inertia for quick response.

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SEQUENCE
OF
OPERATION

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SECTION-3

SEQUENCE OF OPERATION

CHARGING

3.1

CHARGING

1. Level the furnace and rest it on the rear bumpers and front bumpers up.
2. Rise the electrode arm in the top position, raise the roof, slew the back structure, thus leaving the furnace top exposed without obstruction.
3. Bring the charging bucket to the centre over the shell, and lower carefully into the shell, avoiding the side walls of the furnace.
4. Check that no heavy scrap is in contact with the slag door and arch cooler.
5. See the top surface of the charge material is fairly level and will not cause any obstruction in slewing back the roof and lowering the same in position.

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Melting

3.2

MELTING

1. Check the cooling water ckts for free and adequate flow of clean water.
2. Switch on the main distribution board and MF. Ckt breaker closing rectifier .
3. Check that all auxiliary isolators are closed including the auxiliary isolator inside the amplidyne control cabinet.
4. Make sure that tripping battery is fully charged.
5. Select a low voltage tapping and start the transformer oil pumps.
6. Set the current adjusting rheostats to give the required loading.
7. Start the amplidyne generator set .
8. Rise the electrodes by means of either the individual control switches and /or the master control switch on the furnace control panel.
9. Turn the MF-OCB. remote control switch clockwise to close the breaker. The individual phase control switches of the electrodes and
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the Manu-Auto selector switch and also the master control switch should be in 'AUTO' position.

10. Operate the furnace on a low voltage for sufficient time for the electrodes to bore holes into the charge.

11. When these holes have formed, change over to a higher voltage tap.

12. As the charge melts, lower the voltage gradually to shorten the arch length so that the same does not strike the side wall refractories.

13. During refining cycle, the energy input is very small and normally that required to compensate for heat losses. This would also depend on metallurgical requirement.

14. After refining the furnace, tilt for slagging and pouring as in next point.

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TILTING

3-3

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Slagging

3.3.1

BACK TILTING (SLAGGING)

1. To slag , it is necessary to move the front bumper out by operating air control valve mounted on the Tilt control desk, when the 'Green' indicating lamp will go out and the 'red' indicated lamp will glow
2. START the hydraulic pump the 'start' push button on the TILT CONTROL DESK.
3. TILT the FURNACE forward a few degree by the JOYSTICK SWITCH on the desk and move the rear bumper out by their Air Control valve, when, 'RED' indicating Lamp will glow.
4. TILT back the furnace as required for slagging.
5. After slagging operation, tilt the furnace forward a few degrees beyond the level position. Bring the rear bumper in vertical position when the red lamp will go off and 'GREEN' LAMP will glow.

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6. TILT the furnace backward until it rests on the 'REAR BUMPER'
7. Switch off the hydraulic pump .
8. Operate the 'Front Bumper' to bring it into vertical position when its 'RED' Lamp will be off and 'GREEN' Lamp will glow.

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Pouring

3.3.2

POURING

1. Check that the electrodes are raised and clear off the molten metal level.
2. Ensure that the MF OCB is off.
3. See that the roof is properly resting on the furnace shell and the locking pin is in position.
4. Move the front bumper out.
5. Start the hydrolic pump.
6. Tilt the furnace gradually by operating the tilting cylinder through the JOYSTICK SWITCH, upto 45° max.
7. After pouring of the metal bring the furnace back into level position to rest on the 'Rear Bumper' and also bring the 'Front Bumper' in vertical level.
8. Switch off the hydrolic pump motor.

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SECTION-4

Refractories

REFRACTORIES

POINTS TO BE CONSIDERED.

1. To prevent oxidation of the furnace shell for this layer of 'C' Paste at the bottom of the furnace shell is required.
2. For better heat insulation a layer of heat insulation is provided between shell and the refractory.
3. It is essential to allow for certain circumferential expansion of the side wall and roof refractories as recommended by the refractory suppliers .
4. There should be a parting course of some neutral type of refractories as Chrome brick between acid and basic refractory materials .
5. To ascertain the arc voltage and response of Auto Electrode control unit, it is necessary to effectively earth the bottom of the ramming mass through the furnace shell.

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SECTION-5

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LIST OF RECOMMENDED SPARES FOR

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SECTION-5

LIST OF RECOMMENDED SPARES.

FOR
MODEL II DIRECT ARC MELTING FURNACE.

ITEM NO.	DESCRIPTION	Qty. per FURNACE
1.	WATER COOLED slag door and Flange	1 Set
2.	ELECTRODE gland and Seal ring	3 Nos.
3.	buffer Spring	3 Nos.
4.	Crosshead roller without bearing	12 Nos.
5.	roller Bearing for Crosshead roller	48 Nos.
6.	Spares for Door Opening Cylanders, Comprising :-	1 Set.
	2- Rubber Cup Seal	
	1- Rod seal	
	1- Wiper seal	
	1- 'O' Ring	
7.	Spares for Bumper Cylander Comprising :-	2 Sets.
	2- Cap Seals	
	1- Rod seal	
	1- wiper Seal	
	1- 'O' ring	
8.	Spares for slewing cylander, comprising :-	1 Set
	2- Leather Cup seal.	
	1- Rod Seal.	
	1- wiper Seal.	
	1- 'O' Ring.	

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9.	Spares for Hydraulic Flat Cylinder Comprising :- Chevron Rings	2 Sets (1set of 5 nos)
10.	ELECTROD CLAMP Assembly Comprising:- Clamp holders, clamp band and lever for electrode arm.	5 Sets.
11.	n.c. Copper Clamp insert.	5 Sets.
12.	Bustube insulation.	5 Sets.
13.	Spares for Electrode Operating Cylinder comprising:- Piston ring, gland packing and inner & outer spring.	6 Sets.
14.	Spares of hydrolic roof lifting Cylinder comprising :- 2- Leather Cap seal 1- Rod seal 1- Wiper seal 1- 'O' Ring	2 Sets.
15.	Slag Door Water Jacket	1 No.
16.	Roof Ring	1 No.
17.	1/2" BSP Air Control Valve	4 Nos.
18.	Heavy Duty Joystick Switch	2 Nos.
19.	Tube Insulator for crosshead	5 Nos.
20.	Winch Spur Gear and Pinion	3 Sets
21.A.	Steel wire Rope	52 Metres.
21.B.(i)	Fibre Band Assembly	5 Nos.

Contd....3

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|--|-------------|
| (ii) Steel wire rope | 150 metres. |
| 22. Winch drum | 3 Nos. |
| 23. L.F. Cable | 200 metres. |
| 24. Current Transformer 15000/5 | 3 Nos. |
| 25. Recommended Spares for hydraulic equipment | |
| (i) Spares for check valve | |
| (a) 3 Off - 'O' ring. | |
| (b) 3 Off - Spring. | |
| (c) 2 Off - Valve. | |
| (d) 2 Off - Seat. | |
| (ii) Spares with check valve with jet: | |
| (a) 2 Off - 'O' ring. | |
| (b) 2 Off - Spring. | |
| (c) 2 Off - Valve. | |
| (d) 1 Off - Valve. | |
| (e) 3 Off - Seat. | |
| (f) 1 Off - Plug. | |
| (iii) Spares of Pilot Operated check valve. | |
| (a) 1 Off - Gasket Kit. | |
| (b) 2 Off - Spring. | |
| (c) 1 Off - Poppet. | |
| (d) 1 Off - Sleeve. | |
| (iv) Spares for blowing pressure relief Valve. | |
| (a) 1 Off - Piston. | |
| (b) 1 Off - Seat. | |

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- (c) 1 Off - Gasket Kit.
- (d) 1 Off - Spring.
- (e) 1 Off - Spring.
- (v) Spares for main pressure Relief Valve
 - (a) 1 Off - Piston.
 - (b) 1 Off - Seat.
 - (c) 1 Off - Spring.
 - (d) 1 Off - Spring.
 - (e) 1 Off - Spring.
 - (f) 1 Off - 'O' ring.
 - (g) 1 Off - 'O' ring.
 - (h) 1 Off - 'O' ring.
- (vi) Spares for double solenoid Direction Valves
 - (a) 1 Off - Gasket Kit.
 - (b) 2 Off - Spring.
 - (c) 2 Off - Push rod.
 - (d) 2 Off - Coil.
 - (e) 2 Off - Cover.
 - (f) 2 Off - Spring.
- (vii) Spares for single solenoid Directional Valve:-
 - (a) 1 Off - Gasket Kit.
 - (b) 2 Off - Spring.
 - (c) 2 Off - Coil.
- (viii) Spares for pump:-
 - (a) 1 Off - Ring '25'.
 - (b) 1 Off - Vane kit.

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- (c) 2 Off - 'O' Ring.
- (d) 1 Off - Oil Seal.
- (e) 1 Off - Bearing.
- (f) 1 Off - Bearing.
- (g) 1 Off - rotor.
- (ix) 1 Off - Strainer 20G.

26. Spares of OCB Crompton 11 KV.

- (i) 6 Off - OCB through insulator with current carrying parts.
- (ii) 3 Sets - Set of three spout insulators & flange assembly without current carrying parts.
- (iii) 6 Off - main moving contacts.
- (iv) 24 Off - Spring for fixed contact.
- (v) 24 Off - Main fixed contacts.
- (vi) 6 Off - Arcing fixed contact.
- (vii) 1 Off - Shunt Trip Coil for 50V.D.C.
- (viii) 1 Off - Solenoid Coil for 110V.D.C. for non-latching type-mechanism.
- (ix) 2 Off - O.C.B. accelerating spring.

27. Spares for TRANSFORMER.

- (i) 1 Off - Oil Temp. Indicator.
- (ii) 1 Off - winding temp. indicator.
- (iii) 1 Off - pressure gauge (Oil or water)
- (iv) 1 Off - pressure gauge Valve.
- (v) 1 Off - Thermometer.

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- (vi) 1 Off - Buchholz Relay.
 - (vii) 1 Off - Silica Gel Breather.
 - (viii) 1 Off - Spark gap assembly.
28. (a) Spares for Amplidyne.
- (i) 1 Off - Amplidyne Generator.
for Model II.
- (b) Spares for Amplidyne Control panel.
- (i) 1 Off - Rectifier type #61.
 - (ii) 1 Off - Rectifier type #62.
 - (iii) 1 Off - Rectifier type #4.
 - (iv) 1 Off - Rectifier type W11.
 - (v) 1 Off - Stabilising Condenser.
C.2
 - (vi) 1 Off - Transformer TR2.
 - (vii) 1 Off - Phase Control SWITCH.
 - (viii) 1 Off - Hand Auto Switch.
 - (ix) 1 Off - Master Control Switch.
 - (x) 1 Off - Striking Relay.

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PREREQUIREMENTS

FOR

CONCAST

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1 Tundish Preheating
Station

2 Tundish Car

3 Mould And Associated
M/c Parts

4 Cooling Chamber

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5 Withdrawal Unit

6 Discharge Roller
Table

7 Hydraulic System

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1. TUNDISH PREHEATING STATION (OIL-FIRED)

Function

The heating station serves to preheat the tundish up to the temperature required for Casting. Motor driven blower supplies the burners with the necessary Combustion air. The oil is pumped by a rotor driven pump.

Thermostatic controlled heater is available.

CONTROL

- Blower

- 1. Non-reversible contractor control.
 - 1 illuminated push button "on" (Green)
 - 1 illuminated push button "off" (Red).
- at the (NAB) Main Control Box.

- Pump

- 1 Non-reversible contactor control.
 - 1 illuminated push button "on" (green)
 - 1 illuminated push button "off" (Red).
- at the (NAB) Main Control Box.

INTERLOCK.

If blower is tripped, pump has to be stopped.

ALARM

The rotors are protected by thermomagnetic overload relay. If one of the relays trip, alarm

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"preheating station blower" is announced at the measuring board MAB at General Section.

2. TUNDISH CAR

Function

The purpose of the car is to transport the tundish from the preheating station to the exact casting position above the Moulds.

CONTROL

- 1 Reversible contactor control
- 1 Push button "forward" (black)
- 1 Push button "return" (black)

In a small control box ABT locally mounted on a column.

INTERLOCK

None

ALARM

The motor is protected by a thermomagnetic overload relay. If it trips, alarm "tundish car" is announced at the measuring board MAB at General section.

3. MOULD AND ASSOCIATED MACHINE PARTS

3.1 Mould Oscillation

Function:

The Mould is provided for shaping the strand therein.

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The oscillation Movement is used to prevent the strand from sticking at the walls of the Mould.

The oscillation frequency may be selected in two steps by electrical pole-changing of the A-C Motor at 75 and 100 cycles/minutes.

CONTROL

- 2 Non-reversible contactor controls
(2 Motor speeds by pole-changing)
- 1 Selector Switch "Slow/feet" (Without "O" position)
at measuring board at strand section.
- 1 Illuminated pushbutton "ON" (Green)
- 1 Illuminated push button "OFF" (Red)
at Measuring board at strand section.

INTERLOCK

The oscillation drive has to start automatically, if the Mode selector Switch for the unit is set in position "Casting" and the casting speed potentiometer is Moved out of the Zero position after "ready to cast" signal has been announced. The drive is stopped automatically by resetting the potentiometer at Zero position.

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The drive can be started and stopped manually if the position 'casting floor' is selected at the mode selector switch for the withdrawal unit.

ALARM

Both (speed) windings of the motor are protected by the thermomagnetic overload relays.

The alarm contacts of the 2 relays are connected in parallel to our alarm annunciation "oscillation" at measuring board at strand section.

3.2 MOULD COOLING WATER

Function

The molten steel poured into the moulds is shaped therein into a billet. To extract the heat, the mould tubes are cooled with water in a closed circuit.

CONTROL

No electrical control, only manually operated control valves and mechanical flow rate indicators with flow switches to provide a contact at minimum flow (N.O. Contact).

INTERLOCK

The flow of the cooling water circuit of each

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mould is monitored by a minimum contact. If minimum flow is available, one of the conditions for "ready to cast" is fulfilled.

ALARM

If the mode selector switch at the measuring board is set into position "casting" and water flow drops below minimum, alarm "Mould cooling fall" is initiated at measuring board at strand section.

A special horn has to be mounted.

3.3. ALUMINIUM WIRE FEEDER

Function

Aluminium is to be fed into the mould during the casting in order to "Kill" the steel. The speed of the feeding should be proportionate to the withdrawal speed and the base speed should have all external references which could be set before it is synchronised with the withdrawal speed.

CONTROL

- 1 Non-reversible DC thyristor control
- 1 illuminated push button "ON" (Green)
- 1 illuminated push button "OFF" (Red)
- 1 Base speed setting potentiometer at the measuring board at General section.

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INTERLOCK

Speed signal from the withdrawal drive.

ALARM

None

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4. COOLING CHAMBER

4.1 Steam exhaust

The hot strand leaving the mould is cooled in the chamber by water sprayed directly into the surface. A part of the water is evaporised. Generating big quantities of steam. This steam is sucked off by an axial ventilator and conducted out of the casting bay.

CONTROL

2 Non reversible contactor controls

1 Time relay (0-60 sec) for high inertia load start

INTERLOCK

None

ALARM

The motor is protected by thermo-magnetic overload relay. If this relay trips, alarm "steam exhaust" is announced at the measuring board at General section.

4.2 SPRAY WATER

Function

The strand leaving the mould has still a liquid core, so it is cooled till complete solidification by water directly sprayed onto the surface.

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A pressure switch provides an alarm contact in case of a fall below a preset level.

CONTROL

1 Contactor controls for value, with one solenoid

INTERLOCK

The spray water has to be inserted or stopped if
(a) the selector switch of withdrawal unit at strand section is set into position "casting".

(b) the "Ready to Cast" - signal has been announced.

(c) the casting speed potentiometer at MOP is turned out or into zero-position.

For testing purposes valve can be controlled by the push buttons "ON" - "OFF". If the mode selector switch is set into position "Casting floor".

ALARM

At the minimum water pressure a relay trips and alarm "spray water is announced at the measuring board at strand section".

4.5 ROLLER APRON WINCH

Function

The winch is used to lift and lower the Roller aprons. The drum is driven by a geared motor and is held by a brake.

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CONTROL

- 1 Push button "UP" (black)
- 1 Push button "down" (Red) at ABCH

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5. WITHDRAWAL UNIT

5.1 Main drive

Function

Through the withdrawal and straightening unit, the dummy bar is driven up to the mould, and after the cast is started, the dummy bar with attached strand is withdrawn.

The three basic rolls of the unit are driven by a DC Motor with attached holding brake.

A tachogenerator is provided for feedback.

CONTROL

- 1 Mode selector switch

Positions

Casting-0-casting floor - MCD (from left to right)

- 1 casting speed recorder(0 - 6 m/min)
- 1 Pilot light "Ready to cast"(white)at strand section of MAB
- 1 Potentiometer with an attached unit switch for setting the casting speed
- 1 Pilot light "Ready to cast" (white)
- 1 Push button "Up" (Orange)
- 2 Push button "down"(yellow)

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AT MCP

- 1 Pilot light "Ready to cast" (white)
- 1 Push button "fast forward" (white)
- 1 Push button "fast Return" (black)
- 1 Casting speed indicator (6 - 0- 6 m/min)

AT MCD

- 1 ammeter at DC panel

INTERLOCK

- Speed control by potentiometer is possible only if the "Ready to Cast" conditions are fulfilled and the selector switch at MAB is set into position casting.
- In position "casting floor" the withdrawal unit can be controlled by the push buttons up/down" at MCP.
- The push buttons at MCD are activated only if the selector switch is set into position "MCD" (Main Control Desk)
- If the selector switch is turned into position "0" the control voltage of the corresponding strand is switched off at MAB

ALARM

Same

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5.2 HYDRAULIC CONTROL

- Withdrawal unit

Function

Both upper rolls of the withdrawal unit can be pressed and adjusted separately by hydraulic cylinders. The individual pumps and solenoid valves/strand are mounted at common tank. A filter pump serves to clean the oil in the tank.

CONTROL

- 1 Non reversible contactor control
- 2 thermal overload relay
- 1 illuminated push button "ON"(Green)
- 1 illuminated push button "OFF"(Red)
- (For each pump motor)
- 5 Contactor control for 5 solenoid valves
- 2 push buttons "UP" (yellow)
- 2 push buttons "Down" (Orange)
- 1 illuminated push button "Low pressure"(Green)
- 1 illuminated push button "high Pressure"(Green)

These push buttons have to be installed at control desk at strand section MCD.

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INTERLOCK

- Motors can be stopped by push buttons only, if the mode selector switch at MAB is turned into position "MCD".
- This interlock prevents undesired stopping of pumps during casting or when the dummy bar is inserted.
- The solenoid for upward movement can be activated only if the selector switch at MAB is set into position MCD. Key operated push buttons prevents undesired lifting of the swings during castings or when the dummy bar is inserted.

LAMP

None

5.3 HYDRAULLIC CONTROL - Dummy bar storage

Function

The dummy bar storage has the purpose to store the dummy bar during casting and to place it at the roller table during preparation of cast. It is moved by hydraulic cylinders.

CONTROL

- 2 Contactor controls for magnetic valve (2 solenoids/valve)

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1 push button 'IN' (Yellow)

1 illuminated push button "Out" (Orange)

INTERLOCKING

None

ALARM

None

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6. DISCHARGE ROLLER TABLE

6.1 Roller Motor

Function:

- Roller table consists of a certain number of rollers driven by a group via reduction gear boxes and chains.
- the straightened and cut billets are transported by the roller table to the pusher to be discharged on to the cooling beds.
- The other purpose in the reverse direction is to transport the dummy bar from the receiver to the withdrawal unit.

CONTROL

Same.

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7. HYDRAULLIC SYSTEM - Pusher

Function

During 'auto' operation the pusher is controlled by the "starting" - signal of the insulated contact plate and limit switches.

The movement of the pusher will be stopped and reversed by a limit switch at the end position of the cylinder. At the initial position - second limit switch deenergises the solenoid and the pusher stops. In "man" - operation the pusher moves forward or backward as long as the corresponding push button is pressed.

CONTROL

- Solenoid valve
- 2 cont. controls (a 4/3 way valve)
- 2 cont. controls for 2 limit switches
- 1 push button "forward" (white)
- 1 Push button "Return" (orange)
- 2 indicating lights (amber)

HYDRAULLIC PUMP MOTOR

- 1 oil level controller for alarm annunciation

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CONCAST
SECTION

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DESIGN

CHARACTER-
ISTICS

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DESIGN CHARACTERISTICS.

NO OF R/C	
NO OF STANDS	- 2 ¹
DESIGN LIMITS	min -100 mm sq. max 150 mm sq 120x100 mm sq .
r/c equipped to cast	- 100mmsq and 120mm sq.
casting radius	- 6mm
Billet lengths	- min 2.0m max 5.5m
Type of Inile	- Stopper Inile or slide gate.
Capacity of Inile	- 12.5/14 tons max.
Type of cutting device	- gas torches.
method of discharge	- on horizontal rollers table on to cooling beds

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STEEL QUALITY AND STEEL TEMPERATURE

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1.1

(1)
Steel quality

In principle only fully killed steel can be continuously cast, killed either with Si or Al or both.

The casting practice will be modified when the deoxidation is carried out primarily with Al.

Kimmed or semikilled steel can not be continuously cast into billets. In the case where it becomes obvious that the steel is not completely killed i.e. becomes obviously that the steel is not completely killed i.e. activity in the ladle, early ladle analysis showing declining Si, Mn and C levels or steel instability in the mould (Boiling or inexplicable large level changes), the cast should be immediately terminated. Proceeding under these conditions may result in sub standard billet quality, breakouts or both.

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1.2

STEEL TEMPERATURE

Steel temperature plays a very important roll in the continuous casting process due to the influence it has on the safety of the operation (and thereby the production) and the final billet quality.

Due to the large variation in the transport time ladle size, steel grades, sections and number of stands, the desisive steel temp. is usually taken as that in the tundish.

Tundish length and design also have an influence on the steel temperature. In the case where the distance from the steel in pouring point to the furthestmost nozzle is relatively large (e.g. 6 stand tundish), a temp difference between the hottest and coldest areas & upto 100° may be present. This temp. difference should be established during preceeding tundish trials or within the first few casts after for the following reasons.

- To determine a reliable measuring position which allows the accurate estimation of steel temp. at the extreme hot and cold points of the tundish.
- To know, in the accidental case of a very hot heat, when the maximum safe temperature in the hottest part of the tundish is being approached (in order to take corrective action)
- To know, in the case of a cold heat, when the minimum temperature is being approached at an extreme nozzle position. The temperature in the tundish can be in the range of.

steel liquid temperature plus 15-55°C depending on the conditions prevailing. The concost representative in charge of the commissioning will establish the actual working temperature to be applied;

however some generalisations can be made.

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Generalisations

- For very low C steels and small nozzle diameters (upto 15 mm dia) freezing can occur abruptly as the temperature approaches.
- From the view point of product quality and operational reliability, it is better to cast at the minimum practical steel temperature in the tundish commensurate with emptying the ladle.
- casting extremely hot increases the danger of breakouts.

1.2.1. Temperature measurements

For and during each cast, the steel temperature should be measured at following places and times :

- in the furnace (prior to tapping)
- in the ladle (prior to rinsing)
- in the ladle (after rinsing)
- in the tundish every 15 minute where the first two measurements should be taken after the tundish is full and at plus 5 mm

1.2.2. Required steel temperatures:

It depends upon the local condition.

1. tapping time
2. transport time

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3. Capacity
4. Preheat
5. Tundish size etc.

STEEL TEMPERATURE LOSSES

Case I

55 ton stoppered ladle, electric furnace,
three stand tundish(15 mm dia nozzle)

(0.18 - 0.28 % c)

- | | <u>Avg. loss</u> |
|--|-------------------|
| - Furnace tap temperature : 1650/1660 ^o C | 30 ^o C |
| - Steel temperature in ladle : 1620/1600 ^o C | 80 ^o C |
| - Steel temperature in tundish: 1540/1560 ^o C | No |

Case II

45 ton stoppered ladle, electric furnace, three
strand tundish (14.5 dia nozzle) 0.07 - 0.18% c

- | | <u>Avg. loss</u> |
|--|------------------------------------|
| - Furnace tap temperature: 1660/1670 ^o C | 30 ^o C |
| - Steel temperature in ladle: 1630/1640 ^o C | 75 ^o C |
| - Steel temperature in tundish: 1550/1575 ^o C | 0.10% C |
| | 1540/1565 ^o C - 0.10% C |

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Case III

100 ton stoppered ladle tundish (16 mm dia nozzle)
(0.10 - 0.20% C) SM furnace, 6 strand high tundish
preheat

- | | <u>Avg. loss</u> |
|--|------------------|
| - Furnace tap temperature : 1660°C | - 45°C |
| - Ladle before rinsing : 1610/1620°C | - 20°C |
| - Ladle after rinsing : 1600/1590°C | - 45°C |
| - Steel temperature in tundish : 1540/1560°C | |

1.2.3. Temperature measuring instrument:

Normally two separate temperature stations are used i.e. one at the furnace(s) and other located on the caster itself.

1.2.4. Delayed start of cast

Ladle holding times at the CCM in excess of 15 min should be avoided for the reasons -

- where stoppers are used, the rods may be chemically and erosively attacked
- steel layering particularly cold layering near the ladle bottom, may develop lumps rinsing is continued (for reasons of cast, material etc.)

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1.2.3

TEMP. MEASURING EQUIPMENT

Normally, two separate temp. stations are used i.e. One at the furnace('s) another located on the caster itself. In order to avoid confusion, the instruments must be in good condition and calibration in the commissioning stages, all instruments must be calibrated prior to each other.

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1.2.4

DELAYED START OF CAST

In general, ladle holding times at the CCM in excess of 15 mins should be avoided for the following reasons:-

- Where stoppers are used, the rods may be chemically and corrosively attacked
- Steel layering, particularly cold layering near the ladle bottom, may develop unless rinsing is continued (which for reasons of cost, materials and danger may be impractical). Difficulties with stoppers, sliding valves and frozen tundish nozzles will occur.

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STEEL SUPPLY FOR THE TUNDISH

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START
OF
CAST

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2.1

START OF CAST

2.1.1 TUNDISH POSITIONING FOLLOWED BY LADLE POSITIONING

This procedure is adopted when unpreheated tundishes (which are special working face liners) are used or when last minute nozzle preparation (which needs access to the nozzles from the tundish Lid light) is necessary. Additionally, this procedure is also needed in case where the ladle alignment (e.g. crane supported Ladle) depends on relative tundish position. After practice (and where the layout is very simple i.e. no complication with sliding valves, pouring tubes, etc.) it will be found that the Ladle positioning and the tundish positioning can be performed almost simultaneously so that once the tundish is positioned the ladleman is ready to start pouring .

It is always advisable, in the early stages to check that the ladle nozzle is aligned centrally over the tundish in pouring port in the tundish cover.

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2.1.2

LADLE POSITIONING FOLLOWED BY TUNDISH POSITIONING

This procedure is usually adopted in cases where tundish preheat loss is a decisive factor e.g. extended tundish transport, heat conductive tundish covers, time consuming tundish preposition at the casting position (alignment, stoppers, sliding valves, costing tubes etc.) also, time consuming ladle operations, demand this procedure e.g. ladle positioning on cars or turrets combined with hydrolic connections for ladle valves, air cooling connections etc. when this procedure is adopted, the tundish nozzles are usually presealed before tundish preheating or just prior to driving the tundish into casting position.

After the casting leader has checked that all necessary preparation work has been done ("ready to cast" status available, protection device in position etc.) he gives the command to open the ladle nozzle. The tundish should be filled as fast as possible. Insulation power should be added to the tundish as soon as it is ideal to start pouring into the moulds when the tundish is Ca. 3/4 full.

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2.2

CASTING WITH STOPPER EQUIPPED LADLE

Steel level in tundish should be kept as constant as possible, e.g. working level \pm 40mm when stopper equipped ladle are used, this can be achieved by fully opening the stopper when the tundish level is Ca.40mm below working level & closing the stopper when the tundish level is Ca.40mm above working level. Throttling the ladle stream in order to maintain the tundish level at a constant height is not recommendable since this ladle to heavy stopper head and ladle nozzle wear and additionally, due to a "fanning" stream caused by a partly closed ladle nozzle the temp.loss between ladle and tundish will be higher than those with a solid, tight stream

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2.3

CASTING A LADLE EQUIPPED WITH SLIDING VALVE NOZZLE

When using a sliding valve, the position of the valve can be chosen so that an equilibrium between steel quality following flowing out of the ladle and being cast into the moulds, can be achieved e.g. the valve remains at a constant setting and is only altered in order to compensate for the decreasing throughout due to the reduction for the ferrostatic pressure in the ladle.

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2.4

SEQUENCE CASTING

Sequence casting i.e. costing more than one ladle through the tundish, increases the yield and the m/c utilisation. However, the following conditions need to be fulfilled.

a) Only similar steel quality should be used in sequence.

b) The ladle charging time, i.e. the time between emptying one ladle and opening the stopper or valve of the next ladle must be such that the tundish level never drops below 100 mm (depth) Depending on tundish volume and section being cast, the available time for changeover is in the range 2-6 mins.

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2.5. EMERGENCY CONDITIONS

Some of the irregularities which can occur are listed below alongwith the steps taken to remedy them.

2.5.1. The ladle Nozzle cannot be opened

The nozzle can be oxygen lanced within reason to remove steel. Skulling - care should be taken to avoid damage to nozzle.

2.5.2. Ladle nozzle cannot be sufficiently closed

The machine design incorporates tundish overflow spouts, slag boxes and vessels prepared for accepting "dumped" steel. In the case where a stopper or valve system cannot control the flow into the tundish to the point where steel begins to overflow into the system, the decision has to be made to remove the ladle from the machine excessive overflow is also dangerous.

2.5.3. Ladle Nozzle becomes narrow due to skull build up

In this case, the ladle nozzle can be opened again by oxygen lancing. The level in the tundish should not fall below 100 mm during this operation.

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2.5.4. Sliding valve breakouts

If careless preparations or sub-standard materials are used then sliding valve creates problems.

2.6. END OF CAST

Particularly in the case of sliding valve mechanism the ladle nozzle should be closed as soon as slag appears. In General the ladle slag should not be poured into tundish.

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STEEL
SUPPLY
TO
THE
MOULD

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3. STEEL SUPPLY TO THE MOULD

3.1. Casting speed

It is influenced by factors below:

- a) The casting speed should be such that the solidified strand sheet leaving the mould is strong enough to withstand the ferrostatic pressure.

For this caster, speed ranges are below:

<u>Section</u>	<u>Casting speed range</u>
100	2.8 - 3.0
120	2.2 - 2.4
150	1.6 - 1.8

- (b) The billet must be completely solidified prior to cutting. Based on M/C Design, the various distances measured (along the strand path) from the mould level to the significant points are as follows:

<u>Tangent Roll</u>	9.4 m	First point, where billet receives mechanical stress
<u>Last pinch roll</u>	10.9 m	2nd point where the billet receives mechanical stress
<u>Last pinch roll</u>	2m 12.9m	At this point, the billet should be fully solidified under normal casting conds.
1 m in front of sheer or torch cutting unit	14.4 m	At this point, the solidification must be complete under all conditions for safety.

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3.3 Casting speed and through puts

<u>Section</u>	<u>Casting speed</u>	<u>Through puts</u>
-	Range (m/min)	Range(kg/min)
100	2.8 - 3.0	213 - 228
120	2.2 - 2.4	241 - 263
150	1.6 - 1.8	274 - 308

Specific weight = 7.6 g/cubic.cm.

3.4. Casting

The essential duties of mould operator during a fast are below:

Adjusting of casting speed

Speed should be so adjusted that the steel quality corresponds to the tundish nozzle flow rate. The steel level in the mould will then remain and should be as constant as possible. If speed is not adjusted or late starts may result in overflows and breakouts.

Slag fishing

Slag floating on the steel level should be removed with a wire rod.

Check of mould lubrication

The repressed oil flow rate should be adjusted to such an amount that the steel does not stick to the mould wall during upward movement of mould.

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There should be no excessive oil floating on the steel level. Flow rate should remain constant for a certain billet section.

Observation of steel stream into the mould

It may be noted that small steel stalactites build up on the tundish nozzle exit due to damaged nozzle such stalactites should be pushed off with a piece of ϕ rod or burned away by careful oxygen lancing. Skull must be removed by small crow bar.

3.5. End of cast

The throughput will decrease with the decreasing stream level, in the tundish at the end of the cast. As long as the slag runs out of the nozzle or the casting stream becomes unstable due to too low steel temperature or too low casting speed, the steel supply to the mould has to be stopped by swinging in emergency launder. Casting speed should be reset to the normal value. If any reason causes the strand to be run very slowly or stopped for a period, the secondary cooling should be regulated to prevent the strand from being overcooled.

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MOULD DESIGN

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MOULD

4. DESIGN

The mould consists of two parts:

- i) Mould tube made of copper;
- ii) Water jacket

The mould tube is fixed to the key plates and mounted in the water jacket so that it can be freely expand downwards. Water seals are fitted at both ends. An oiler plate is mounted at top plate, attached to the bottom of water jacket are rolls adjustable by excentres.

For each section size, it is recommended to have assembled water jackets and copper tubes ready as spares in order to reduce mould changing time.

4.1. Mould tubes

The mould tubes are made of phosphorus deoxidised electrolytic copper with a hardness of 70 - 90 kg/sq. mm. They are tapered and chromium plated.

When mounting the mould tube, care should be taken that its position is exactly central in the water jacket in order to ensure a uniform cooling water in all the four sides.

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4.2. Foot rolls

When using tapered and chromium plated mould tubes, the foot rolls prevent the lower part of the mould tubes from wearing out excessively and allow on the other hand, an easy dummy bar insertion. These rolls must be adjusted accurately to the mould bottom dimension and must be strictly parallel to the mould side walls. The casting radii template should be used for chocking this point.

When iron tapered and slightly tapered moulds are used the foot rollers fulfill the function of centrally locating the billet into the mould cavity in order to provide uniform primary cooling.

4.3. Mould lubrication

The repressed oil is fed to the various oiler plate outlets by means of an oil pump through separate feed lines. Distribution of oil should be equal in inside surfaces of tube. Oil supply is proportional to pump speed. Oil supply must be checked during casting. Oil consumption depends upon -

- a) Surface of the mould tube walls
- b) strand section

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c) Cast steel quality

d) Casting speed

An oil supply of Ca. 0.6 cubic.cm/min/cm circumference of cast section is usually required.

4.4. Mould cooling

Optimum mould cooling is achieved with a water velocity between 5 and 7 m/sec., in the water gap found by mould tube and water jacket. Water qualities for the section are below:

<u>Section</u>	<u>Optimum flow range</u>
100	720 - 1010 l/min
120	880 - 1250 l/min
150	1080 - 1520 l/min

Hardness of the mould cooling water should not exceed 2° dH (German hardness). If hardness is more, deposits (CaCO_3) will result on the mould wall, leading to the overheating of the tube. Tube will also deform.

Preferably, zero hardness is used. Variation of the mould cooling water has small effect on the billet quality problems.



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4.5. Maintenance and cleaning:

Good maintenance and care of the mould during operation will result in higher mould life. Breakouts and overflows shortens a mould tube life and physical damage.

After every cast, the mould tubes must be cleaned of the residues from burned oil and carefully inspected.

4.6. Mechanical damage

Longitudinal scratches in the lower part of the mould tube cause no harm. Longitudinal scratches in the upper part should not be wider and deeper than 0.5 mm and the surrounding area has to be ground and polished carefully to remove any sharp films. Heavy scratches in the horizontal direction, especially in the upper part may lead to breakouts.

4.7. Wear at mould exit

If the chromium plating in the lower part of the mould is worn, the taper may soon be lost. Billets cast with moulds having only a small or one sided taper are inclined to show Rhombic deformation due to uneven cooling. Rhombic distortion can also lead to breakouts, usually well below the mould exit.

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In this case the mould tube has to be exchanged.

4.8. General remarks

With the mould tube lives being achieved today, the tube costs/ton of steel are quite low. It is, therefore, advisable to replace suspicious tubes than to risk further breakouts or defective billets.

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MOULD
OSCILLATION

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5. MOULD OSCILLATION

5.1. Design

The mould is mounted on the mould table and oscillated by an eccentric drive e on a curve corresponding to the casting radius.

5.2. Stroke and frequency

The stroke length is 0 - 24 mm. The frequency can be chosen between 75 and 100 strokes/min. Because of the eccentric drive, the mould oscillating speed changes during the up and down movement according to sinusoidal function.

The frequency should be adjusted in such a way as to achieve a mean mould speed of about 30 - 40% higher than average casting speed.

5.3. Deviation

The oscillation movement of the curved and parallel mould, tube sides should be checked after every major repair period with a dial gauge. The maximum horizontal deviation (tolerable) measured on a new mould tube should not exceed 0.2 mm at the casting stroke length. These tests are done dynamically to a solid independent structure (e.g. tundish car).

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STRAND() GUIDE

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6. STRAND GUIDE

6.1. Design

Strand guide is provided between mould and pinch roll unit. The spray tubes of the secondary cooling are attached to this guide. The guide consists of a water cooled frame with fixed positioned rolls and dummy bar guides on the outer radius side.

6.2. Adjustment of strand guide:

Normally, the roll opening in the strand guide are adjusted to width, 5 mm to 10 mm wider than the cast section. After every replacement, the strand guide must be aligned with the mould. This is done with the help of a special radius template which is lowered down the mould cavity. The curved sides are aligned in such a way that the rolls on the outer radius match the machine radius.

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DUMMY

BAR

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7. DUMMY BAR

7.1. Design

Dummy bar provides the connection between mould and pinch roll unit at the beginning of the cast and its head is closing the mould bottom. The dummy bar is flexible in radial direction and link type design.

7.2. Insertion of dummy bar

The dummy bar is introduced approximately 100 mm into the mould tube reversing the withdrawal unit. The sealing is achieved by tamping a length of asbestos cord firmly into the gap between the dummy bar head and the copper tube faces. This sealing must be covered with nail nips. Then wire rods (6-12 mm dia) should be placed around the starting anchor accelerating the solidification of the liquid steel at the beginning of the cast.

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**ROLLING
SECTION**

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ROLLING SECTION

I

(a) THE ROLLING PROCESS

After manufacture, steel is cast continuously into lengths of smaller section which are subsequently parted into shorter lengths. For the majority of applications the cast material has neither the shape nor the metallurgical prop. required for the ultimate product. Consequently, steel is mechanically worked to the required shape in the course of which the structure is refined with accompanying improvements in properties.

Hot working may take the form of rolling, forging or extrusion. Forging was the earliest method to be used but rolling has proved to be a high speed process capable of handling large tonnages to relatively close tolerances. Nevertheless forging and extrusion can impart properties not found in rolled products so that these methods have their applications.

Steel rolling consists of passing the material usually termed the stock, between two rolls driven at the same peripheral speed in opposite directions

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and so speed that the distance between them is somewhat less than the thickness of section entering them.

In these circumstances the rolls grip the material and deliver it reduced in thickness, increased in length & probably somewhat increased in width.

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ROLLING
PLANT
AND
CLASSIFICATION

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II

CLASSIFICATION

Rolling Mills can be classified with respect to number and the arrangement of rolls. The simplest and most common type of Rolling Mills is two-high mill rolls of equal size are rotated in opposite directions. Another type is Three-High mill consisting of an upper and lower driven roll and a middle roll which rotates by friction or each may be separately driven. The third type is the Four-High mill. In this small diameter rolls, roll the product to very close tolerances. They need lesser power. For small diameter rolls have less strength and rigidity than large rolls, they must be supported by a large diameter back up rolls. There is another type called Cluster Mill .

In the factory we use a combination of Two-High and Three-High mills in rolling.

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III

ROLLING MILL PLANT

Each set of rolls is called a stand. The stands as illustrated in fig. is having a housing, U-shaped frame-work cast in iron or steel.

It has a separate top casting and are termed open top housing. Another type is O-shaped housing. In this factory we have U-shaped housings.

The housing is bolted to a bed plate embedded in concrete and housings are separated by tie bars (or a common top casting).

The space enclosed by the frame work is called window in which the roll chocks are located. The chocks house bearings which support and locate the mill rolls. The rolls are driven by spindles. The rolls housed have their axis horizontal.

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MILL _

_ LAYOUT,

_ DRIVES
AND

_ BEARING

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MILL LAYOUT

There are three mills in this factory. The fourth is under construction (1987).

The three mills are :-

- | | |
|--------------|---|
| 1. Six stand | 14" Mill |
| 2. Six stand | 12" Mill |
| 3. Another | 14" Mill called coil mill
in which there are in all
four sets of stands 4, 2,
4 & 2 in number arranged
in series. |

All the mill stands are positioned in a line side by side and coupled together by spindles to a common drive. Such a layout is called open train.

In the coil mill the layout is cross country mill arrangement. The stands are usually arranged side by side in two or more parallel lines & are spaced so that stock leaves one stand before entering the next.

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IV

MILL DRIVES

All modern Rolling Mills including this factory are driven by alternating current motors. They use a flywheel and are restricted to a fixed speed. Flywheel is needed to curb the fluctuations of energy when peak loading occurs during rolling of the stock.

The drive to the rolls is transmitted from the flywheel through the gear reduction unit and then through the pinions by spindles. To accommodate roll gap adjustment the spindles are fitted with couplings which allow a limited amount of spindle angularity, universal couplings are used in mills which are based on hook design basis. Here the coupling connects the driven & the driver shaft by means of a sleeve which has splines at its inner periphery i.e. it is a sleeve or muff coupling.

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V

MILL BEARINGS

Rolling mill Bearings are required to withstand extremely severe operating conditions including heavy shock loads, varying speeds and extreme temperature variations, and they are often vulnerable to the ingress of scale dirt and water. Mill Bearings used in this plant are plain metal bearings.

The bearing has to withstand both the radial roll separating force and the roll and thrust. This bearing is formed by running the white metal etc. into recesses of cast checks, which are then machined to profile & drilled for grease grooves. The recesses hold drilled for grease grooves. The recesses hold metal for radial & thrust loads.

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THE
ROLL
AND
ROLL
ADJUSTMENT

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VI

THE ROLLS

The terms describing the parts of a roll are indicated. For most duties rolls require strength, resistance to wear and resistance to heat and roll materials divide into the categories i.e. iron or steel. Steel rolls are much stronger and tougher than iron rolls, but wear more quickly due to their low hardness. As the rolls wear through use, the shape and surface finish of the product is affected and ultimately the rolls have to be withdrawn from service to be returned to a smaller diameter.

The surface hardness is a measure of wear resistance and with many types of roll the hardness decreases as the rolls are turned down.

MATERIAL FOR TYPES OF ROLLS

1. Cast Steel Rolls
2. Chilled C.I. Rolls.

A chilled roll is so-called because the barrel is cast against metal surfaces which cause rapid solidification providing a hard brittle surface of white iron called the 'chill'.

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ROLL ADJUSTMENT

In both horizontal & vertical mills adjustments are necessary to give variations in the roll gap & for axial alignment of the rolls. The roll gap adjustment is usually referred to as screwdown and it is conveniently achieved in simple Two-High mill by keeping the bottom rolls fixed and adjusting the top rolls by taut and bolt arrangement.

In Three-High mills the middle roll is usually fixed while the top & bottom rolls are adjustable.

Axial or lateral adjustment of chocks is necessary to locate the roll and to align the two halves of a groove. The simplest method utilizes clamps or fingers on the housings to retain the chocks within windows.

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ACCESSORIES

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VII

ACCESSORIES

MANIPULATORS

In primary & many intermediate reversing mills manipulators are required to handle the heavy stock between passes. In this plant manual labour performs the function of manipulators.

GUIDES

Guides as the name implies assist stock in entering and leaving the rolls. They are termed entry or delivery guides according to their location and are customarily secured to rest guide or clamp bar, running in parallel with rolls and mounted across the housing.

REPEATERS

Looping trains have previously been transferred to in which the front end of the stock is caught as it emerges from one stand and looped through approximately 180° into the adjacent stand. Originally this function was performed manually but as stock sizes & speeds have increased the automatic repeaters have been developed.

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COOLING BED AND COILERS

The collection of hot stock from a rolling mill presents problems in most types of mill but the nature of the problems vary a great deal from mill to mill. In heavy mills the problem is largely one of cooling large tonnages of stock, whereas with high speed re-rolling mills the problems are centred around the arresting of fast moving stock and collecting in such a manner that the metallurgical and physical properties of fast moving stock are not adversely affected. Consequently heavier products are delivered in st. lengths to cooling beds where the stock can be supported for cooling, but for lighter products, where the rolled out length is great coilers are used direct from the mill to avoid the necessity for shearing into shorter lengths for handling.

The coilers used for narrow and some medium width strip mills are vertical spindles coilers. A horizontal spindle coiler synchronised to mill speed receives the front end via a series of guides and coiling then takes place continuously with the mill while the remaining stock is being rolled. Contd.....3

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In one design end of strip is guided to a fully expanded mandrel and the guide rolls remain in place for a significant proportion of the cooling line. When full length is coiled the coiler slows down, the mandrel collapses & coil is pushed off.

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ROLL PASS AND SEQUENCES

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VIII

ROLL PASS

An annular slot turned in the body of a rolling mill roll is called the roll groove. A combination of the grooves in two mating rolls is termed the roll pass. The design of the roll passes is based on the knowledge of the theory of plastic deformation of metal. Sizing of each rolled shape should be in keeping with the principles of the given metal rolling method and with the design features of the given rolling mill. The proper pass design provides for steady conditions of processing and ensures high quality of the rolled products as well as the most favourable technical and economical characteristics of the production.

By the Roll Pass design or sizing of the rolled products is meant the distribution of deformation among the metal passings in rolling and also the design of the shapes and calculation of dimensions of the roll passes, as well as the design of rolled workpiece sections.

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The following types of roll passes are prevalent:-

- (1) Cogging down passes (used for initial cogging and reducing the cross-sectional area of ingot or billets).
- (2) Preleader or roughing passes (used to reduce the cross-sectional areas of the rolled section and impart it the first shape).
- (3) Leader passes (these are next to the last passes which impart the final shape & size to the rolled sections).
- (4) Finishing passes (used to produce the final shape).

PASS SEQUENCES

The continuous billet mill commences with box passes and changes to diamond square sequences although there are examples of such mills using a diamond square sequence throughout. Three-High and (Two-High) reversing mills employ box passes formed by open square sequences.

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GENERAL
DISCUSSION
ABOUT
MACHINING

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SHAPING GEOMETRICAL AND REAL SURFACES

Real surfaces, obtained on a solid body by any method of working the material (casting, pressworking, machining, metallizing, etc.), have one feature in common, consisting in the fact that any real surface is only a certain approximation of the corresponding geometrical (imaginary or "ideal") surface. Therefore the processing operation of producing a real surface already incorporates the process of shaping the corresponding geometrical surface or, in other words, incorporates the process of geometrically shaping the real surface.

A geometrical surface is usually defined as the trace obtained in the motion of one geometrical generating line, called the generatrix, along another geometrical generating line, called the directrix. The trace is understood to be the shaped surface conceived as a continuum of consecutive geometrical positions of the generating line.

Consequently, to shape any geometrical surface, two geometrical generating lines and their relative motion are required (Fig.1a through F).

Real surfaces can be shaped on metal or other material with the aid of auxiliary bodies having auxiliary real surfaces, lines and points which shall be conditionally referred to, from here on, as auxiliary material elements in contrast to the imaginary elements, nonexisting in reality, which are to be called,

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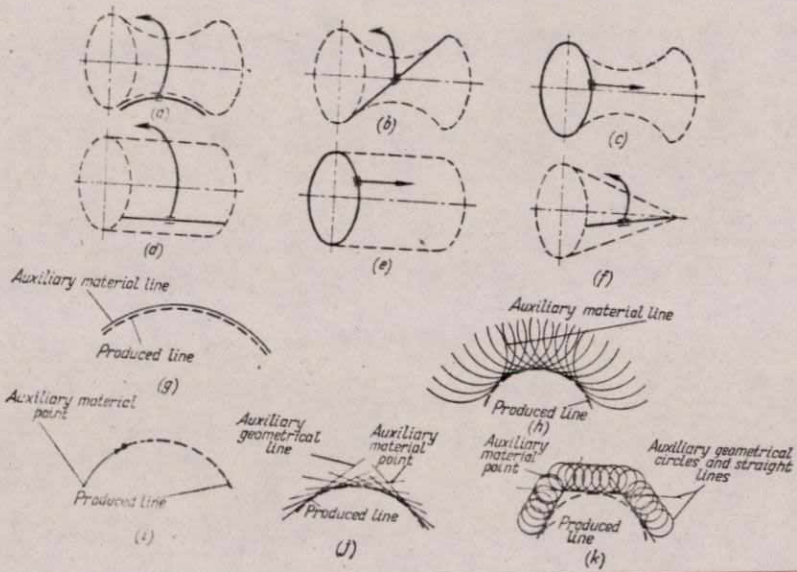


Fig. 1. Methods of producing geometrical surfaces

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also conditionally, geometrical elements. The geometrical generating lines and, consequently, the required surfaces are produced in the motion of these real auxiliary elements.

The relative motions of the geometrical lines in producing surfaces are called formative motions.

Therefore, the shaping of a surface primarily involves the production of the geometrical generating lines, as a result of whose relative formative motions the surface is produced.

There are four methods of producing geometrical lines with an entirely definite number of formative motions.

The forming method (Fig.1g) is one in which the configuration and extent, or length, of the auxiliary material line coincide with the configuration and extent of the line being produced. The latter is obtained as a copy or "mirror reflection" of the material line. The geometrical line is produced without any formative

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motions; all that is required is a positioning motion to move the auxiliary element to the initial position.

The generating method (with one formative motion-rolling) is one in which the line (Fig.1h) is obtained as the envelope of the consecutive positions occupied by the auxiliary element (in the form of a line) as it rolls along the line being produced.

The tracing method (also with a single formative motion) is one in which the auxiliary element in the form of a material point (Fig.1i) produces the line being formed as the trace it leaves in its motion (the material point is understood, of course, to be a short length of the cutting edge on the tool).

The tangent method (with two or more formative motions) is one in which the line being formed is tangent to a series of supplementary auxiliary lines,

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1-2. SHAPING GEOMETRICAL AND REAL SURFACES


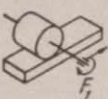


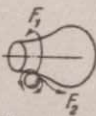


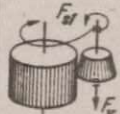
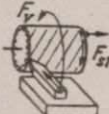
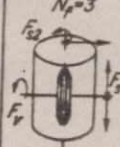

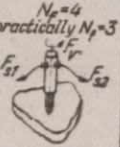
Methods of producing the geometrical directrix		forming	generating	tracing	tangent
		$N_f=0$	$N_f=1$	$N_f=1$	$N_f=2$
Methods of producing the geometrical generatrix	forming	 (a)	 (b)	 (c)	 (d)
	generating		 (f)	 (g)	 (h)
	tracing		 (j)	 (k)	
	tangent		 (n)	 (o)	 (p)

Fig. 2. Possible methods of shaping surfaces

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produced by the material point either by the tracing method (Fig.1j) or the tangent method (Fig.1k).

To produce a specified surface, it is necessary to have a geometrical generatrix and directrix of a corresponding configuration which can be formed by any one of the four methods outlined above. It follows that the methods of shaping surfaces are composed of the methods used to produce the geometrical generating lines of the surface being shaped. Since many combinations of line formation methods are possible, the method of shaping a surface depends, not only on the configuration of the auxiliary element (cutting tool) and the method of producing each separate generating line, but also upon the combination of methods used for geometrical formation of the generating lines.

Figure 2 illustrates the geometrical methods of shaping various surfaces depending on the combination of methods used in the formation of the geometrical generatrix and directrix. In embossing or forming sheet metal (Fig. 2a), both geometrical generating

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lines are produced by the forming method and therefore no formative motions are needed. One motion for setting the material auxiliary surface into its final position is sufficient.

In rolling surfaces (Fig.2b), in particular in burnishing bed ways with a roll, the generatrix is produced by the forming method (formation of the line along the roll length) while the directrix is obtained by the generating method and therefore one formative motion is required. Here F_1 is the rolling motion of the burnishing roll.

In cutting thread with a form tool (Fig.2c), the configuration of the generatrix is a copy of the former cutting edge of the tool, while the helical directrix is obtained as the trace in a single formative motion F_v .

When thread is milled with a single-thread cutter (Fig.2d), the generatrix is produced by the forming method and the directrix by the tangent

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method, the latter requiring two formative motions: rotation F_v : rotation and helical motion F_{s1} .

The geometrical generatrix is produced in the four preceding cases by the forming method which requires no formative motions, while the directrix is produced by the forming, generating, tracing or tangent method. Therefore the number of formative motions required to produce the surface is determined only by the method of producing the directrix.

The generatrix and directrix of the surface being shaped are produced in the remaining examples (Fig, 2f through p) by one or several formative motions and therefore the number of formative motions required to produce a surface will be the sum of the numbers of formative motions required to produce each of the two geometrical generating lines of the surface to be machined. The remaining illustrations of Fig. 2 show the following machining methods and the corresponding methods of

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geometrically shaping the surfaces.

In Fig. 2f, a ball is burnishing a contoured surface of revolution by the double rolling method with two formative motions: F_1 being the rolling of the ball around the circumference and F_2 being the rolling of the ball along the curvilinear contour (profile) of the surface of revolution.

Figure 2g illustrates the generation of the side surfaces of the teeth on a spur gear by means of a gear-shaper cutter, employing a combination of the generating and tracing methods with two formative motions: F_v (generating motion made up of co-ordinated rotation of the gear blank and cutter) and F_{fi} (rectilinear motion , or feed, of the cutter).

In Fig.2h a spur gear is being ground with a helically profiled (worm type) grinding wheel by a combination of the generating and tangent methods.

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Three formative motions are required: one motion is generation for shaping the tooth profile, and two motions- grinding wheel rotation and its longitudinal motion along the teeth- are required to shape the tooth form along its length. Since it is necessary to rotate the wheel to obtain the generating motion of the standard rack, this rotation is used to shape the tooth form along its length. Consequently, two of the three formative motions coincide and the gear is ground with two motions F_v and F_{s1} .

In Fig. 2f a rotary gear-shaping cutter cuts a spur gear by the tracing and generating method with two formative motions.

The relief surfaces on the helical teeth of a plain milling cutter (Fig.2k) are relieved by a pointed tool by the double tracing method with two formative motions: F_v along an Archimedean spiral and F_{s1} along a helix.

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In Fig. 2n a disk-type grinding wheel is generation grinding a spur gear with three formative motions, F_v , F_{s1} and F_{s2} , by a combination of the tangent and generating methods.

A curvilinear surface is ground in Fig.20 with a disk-type wheel by the tangent and tracing method with three formative motions.

The milling of a curvilinear three-dimensional surface with end milling in a tracer-controlled duplicating machine (Fig.2p) is done by the double tangent method. Each of the curvilinear generating lines is produced by two motions: F_v , and F_{s1} or F_{s2} . To realize this method, four formative motions are required but, since the cutting motion F_v participates in the production of both lines, actually only three different motions are necessary.

Three combinations of line formation methods

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TABLE 2

Correlation Between the Processing Method and the Method of Geometrically Shaping a Surface

20

Processing method	Formative tool	Type of auxiliary element	Method of obtaining geometrical generating lines		Number of formative motions
			generatrix	directrix	
Casting	Foundry moulds	Surface	Forming	Forming	0
Die forging	Dies	Surface	Forming	Forming	0
Blanking	Dies	Line	Forming	Tracing	1
Knurling and rolling	Knurls or rolls	Line	Forming	Generating	1
Ball burnishing	Ball	Surface	Generating	Generating	2
Metal cutting (machining)	Cutting edge	Line or point	Tangent	Generating, or tangent	tracing 1 to 3
Grinding	Grinding wheel	Line or point	Tangent	Generating, or tangent	tracing 2 or 3
Honing	Abrasive sticks	Point	Tracing	Tracing	2
Abrasive vapour blasting	Abrasive slurry	Surface	Forming	Tracing	1
Buffing	Buffing wheel	Point	Tangent	Tangent	3
Lapping	Lap	Point	Tracing	Tracing	2
Superfinishing	Abrasive stones	Point	Tangent	Tangent or tracing	3
Ball hole-burnishing	Ball	Line	Forming	Tracing	1
Electrical-discharge machining	Electrode	Line	Forming	Tracing	1
Plastics moulding	Moulds	Surface	Forming	Forming	0
Metallizing	Workpiece	Surface	Forming	Forming	0
Chromium and nickel electroplating to size	Workpiece	Surface	Forming	Forming	0
Ultrasonic machining	Sonic contour	Line	Forming	Tracing	1
Wire-drawing	Drawing die	Line	Forming	Tracing	1

SHAPING SURFACES

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(Fig.2e, i and m), generating and forming, tracing and forming, and tangent and forming, are purely theoretical cases that are unrealizable in practice.

The shaping of surfaces by the tracing and tangent method (Fig.2l) has found no application as yet in its " true form".

In the general case, the number of formative motions is determined by the equation

$$N_f = N_g + N_d - \frac{1}{2} N_c \quad (1)$$

where N_g = number of formative motions required to produce the generatrix of the geometrical surface.

N_d = number of formative motions required to produce the geometrical directrix

N_c = number of coinciding formative motions.

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PROJECT

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INTRODUCTION

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1.

INTRODUCTION -

Grinder is a device which is used to remove unwanted or extra material from job or work piece.

This is done by applying suitable pressure between the work piece and the high speed revolving wheel . The extra material is chucked off by friction developed by the applied pressure .

Grinders are also used to produce certain amount of surface-finish to the surface to be grinded.

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1.4

KINDS OF GRINDERS -

There are diff. kinds of grinders which are employed for diff. operations .

They can be classified according to work done by them and the condition of working .
thus -

Thereclassification can be done as-

- Hanging Grinders .
- Fixed Grinder .
- Vertical Grinder .
- Horizontal Grinders .
- Unidirectional grinders .

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GRINDER DESIGN

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Surface Grinding

SURFACE GRINDING

1. Horizontal Spindle Surface Grinding .
2. Vertical Spindle Surface Grinding.

for portable grinders wheel used are of
three Bond types, namely,

1. Resinoid
2. Rubber
3. Vitrified.

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grinding & abrasive

GRINDING AND OTHER ABRASIVE PROCESSES.

1. Processes & equipment discussed under this heading use abrasive grains for shaping workpieces by means of M/cing or related methods. Abrasive grains are hard crystals either found in nature or manufactured. The most commonly used materials are

ALUMINIUM OXIDE

SILICON CARBIDE &

DIAMOND

Other materials such as garnet , Zirconia , Glass & even Walnut shell are used for some applications.

Abrasive products are used in three basic forms by Industry.

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- 2 -

- a. BONDED to form a solid shaped tool such as disks (The basic shape of grinding wheel)
Cylinders, rings, Cups , Segments or sticks to name a few
- b. COATED on backings made of paper or cloth, in the form of sheets strips & Belts.
- c. LOOSE held in some liquid & solid carrier, (for lapping , Polishing, tumbling). or propelled by centrifugal force, air or water pressure against the work piece (blast cleaning)

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2.

The applications for abrasive processes are multiple & varied. They include:

a. CLEANING, of surface, also the coarse removal of excess of material such as rough off-hand grinding in foundries to remove gates and risers.

b. SHAPING, such as in form grinding & tool sharpening.

c. SIZING, a general objective, but of primary importance in precision grinding surface.

d. SURFACE FINISH IMPROVEMENT, either primarily as in lapping, honing & polishing or as a secondary objective in other types of abrasive processes

e. SEPARATING, as in cut off & slicing operation.

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3.

MAIN FIELD

The main field of application of abrasive process is in metal working , because of the capacity of abrasive grains to penetrate into even the hardest materials and alloys. however, the great hardness of the abrasive grains makes the process also preferred for working other hard materials, such as stones, glass & certain types of plastics.

Abrasive processes are also chosen for working relatively soft materials such as wood, rubber etc. , for such reasons as high stock removal rates, long-lasting cutting ability, good form control, a fine finish of the worked surface.

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OLD

METHOD

ADVANTAGE

AND

DISADVANTAGE

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2

METHOD UNDER USE !

Grinder which are used are of hanging kind in which the job is fixed and the grinder is in the manual control .

Job is kept horizontally and the grinder is then moved along the unwanted material .

Grinder can (of this kind) grind only along the axis of the job because the axis of the wheel revolving is almost vertical .

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2.1

DISADVANTAGES .

- UNEQUAL REMOVAL OF MATERIAL .
- ↓ NO REQUIRED SURFACE -FINISH .
- ↓ COSTLY METHOD .
- DANGEROUS FOR WORKER.

2.2

ADVANTAGES .

- COMPACT UNIT .
- FAST PRODUCTION .
- EASY TO HANDLE .
- NO STRIGHTNING IS NEEDED.

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GRINDING WHEELS

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GRINDING WHEELS

ABRASIVE MATERIAL

In early times, only natural abrasives were available from about the beginning of this century, however, manufactured abrasives, primarily silicon carbide & aluminium oxide, have replaced the natural materials, even natural diamonds have been almost completely supplanted by synthetics. Superior and controllable properties, and dependable uniformity characterised the manufactured abrasives.

Both silicon carbide & aluminium oxide abrasive are very hard and brittle, this brittleness called friability is controllable for different applications friable abrasive break easily, thus forming sharp edges. This decreases the force needed to penetrate into the work material and the heat generated during cutting. Friable abrasives

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- 2 -

are most commonly used for precision & finish grinding. Tough abrasives resist fracture and last longer. They are used for rough grinding, snagging, and off-hand grinding.

As a general rule, although subject to variation -

1. Aluminium Oxide abrasive are used for grinding plain and alloyed steel in a soft or hardened conditions.

2. Silicon Carbide abrasives are selected for cast iron, non-ferrous metals and non-metallic materials .

The sizes of abrasive grains are defined in accordance with commercial standard C.S.271-65. Bored on U.S. standard sieves, the grain sizes are designated by numbers which approximate the number

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- 3 -

of grains per linear inch. Grinding wheels are usually made with a single size of grain, although grinding wheel manufacturers some times deliberately mix two or more grain sizes for functional reasons. The term GRIT size is also used for designate grain size.

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GRINDING MATERIALS

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GRINDING MATERIALS

1. Aluminium Oxide.
2. Silicon Carbide
3. Diamond.
4. Garnet.
5. Zirconia.
6. Glass.
7. Walnut Shell.

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FABRICATION

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MATERIALS
EMPLOYED

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MATERIALS EMPLOYED

1. Mild Steel (M.S.).
2. Cast Iron (C.I.).
3. Die Iron.

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MAIN COMPONENTS

- 1.1 Electric Motor.
- 1.2 Grinding wheel.
- 1.3 Mechanical Arrangement.

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1.3

MECHANICAL COMPONENTS

- a) Lower Base Plate.
- b) Upper Base Plate.
- c) Bearing.
- d) Guides.
- e) Die Case.
- f) Dies.
- g) horizontal drive nut (Square Type).
 * Bolt
- h) handle.
- i) roller Supports.

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1.3.a) LOWER BASE PLATE

Dimensions - 2500 X 300 X 21.

Material - M. S.

Original Size - 2550 X 350 X 25.4

Final Size - 2500 X 300 X 21

Tools Used - Single point insert bit tool.

M/C Used - Planer.

Processes Performed - planing.

Bore Dia - 40.

Depth of Bore - 21

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1.3.b) UPPER BASE FLATE

Dimensions	- 2500 x 300 x 21
Material	- M. S.
Original Size	- 2550 x 350 x 25.4
Final Size	- 2500 x 300 x 21
Tools Used	- Single point insert lat tool
M/C Used	- planer.
Processes performed	- planing.
Bore Dia	- 40. ϕ
Depth of Bore	- 50 ϕ x 18 Depth

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d)

GUIDE

No. of Units -	4
Material used -	Al 100
Processes employed	1. Gas Cutting 2. Shaping 3. Slotting 4. Filing 5. Welding
<u>Machines Used</u>	1. Gas Cutter 2. Shaper 3. Files 4. Welding Unit (Arc Welding)

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Dimensions

Length	-	300 mm
Breadth	-	70 mm
Height	-	25 mm

Procedure

1. Four pieces of angle of length 300 mm is taken and are welded with the two plates (on each piece) of dimensions (70 X 25) mm on its sides .
2. Top of the each angle is made ni perfectly smooth by snapper used.
3. A slot of 10 mm width and 200 mm length is made with the cutting tool on snapper 11/0 on the finished side of each piece of angle
4. These pieces are then welded with the upper plate as indicated on the drawing.

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Procedure

1. Two squares of thickness 25 mm & sides 150 mm are cut from a plate with the help of gas cutter.
2. Both are welded just for easy handling, are then shaped to the final shape.
3. Bore making is done by holding the pieces on the lathe and the bore is made of the die size.
4. In the centre of the width on each of the four sides, internal threading is done with the help of die set for suitable studs.

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e) Die Case **Die Case**

No. of cases - 2
Materials used - n.s.
Processes employed -
1. Gas cutting
2. Shapping
3. Bore lapping
4. Drilling
5. Threading

Dimensions

Length - 150 mm
Breadth - 150 mm
Thickness - 23 mm
Bore dia - 120 mm

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f) DIES Dies

No. of Dies-

2

MATERIAL -

Die steel

Processes employed -

1 Marking

2. Drilling

3. Fieling.

DIE SHAPE -

Crosssection of
Lockring.

Dimensions -

As recommended
by WHEELS INDIA LTD.
for Lockring + 3 mm.
On each side (Clearance)

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g) HORIZONTAL DRIVE NUT & BOLT

No. of Bolts -	1
MATERIAL -	M.S.
Processes employed -	1. Turning 2. Facing 3. Threading (Square Threads) 4. Step making (Stepping)
<u>DIMENSIONS</u> -	As given in Diagram.

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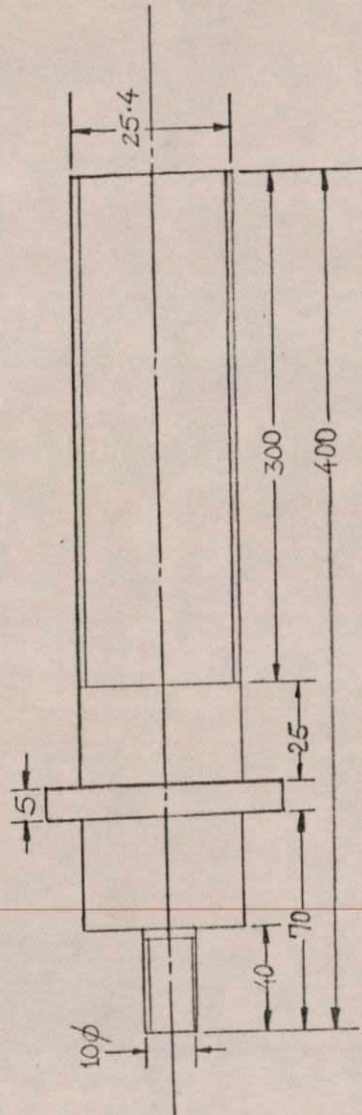
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Note : Not to the scale all dim. in mm.

Horizontal Drive Bolt

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ROLLER SUPPORTS -

Roller Supports

No. of Rollers - 2

MATERIAL -

M.S.

(Covered with Rubber)

DIMENSIONS -

According to the
piece to be grinded.

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ADVANTAGE OF NEW MODEL -

1. Cheaper & less No. of grinding wheels are needed.
2. Longer life of wheel.
3. Lesser power Consumption.
4. One motor can drive two units.

DISADVANTAGE

1. Complex Model.
2. Lesser production in Camprison .

Inspite of these disadvantages this model can work more efficiently if the skilled worker is allowed to operate it.

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DRAWINGS

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GENERAL

ASSEMBLY

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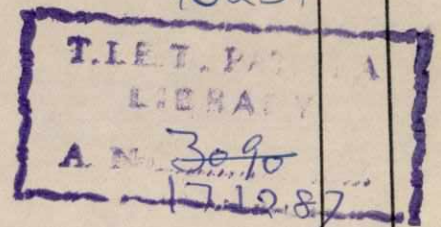
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DETAILED UNITS



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