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Medal Limited

SOM/84/008 4.5.1988
SOM/84/002

FINAL REPORT

Rehabilitation of Equipment and Upgrading of Efficiency of the Foundry and Mechanical Workshop in Mogadishu, SOMALIA

UNIDO Contract No. 84/8

Project No. RP/SOM/84/002 , DP/SOM/84/003

Activity Code: 31.8

Prepared by: MEDAL Ltd. Istanbul, Turkey

Istanbul, 4.5.1988

This report comprises of final versions of three draft final reports and one mission report prepared earlier.

FINAL REPORT.I

Consultancy Services for the Rehabilitation of Equipment and Upgrading of the Efficiency of the Foundry and Mechanical Workshop

in

MOGADISCIO, SOMALIA

UNIDO Contract No. 84/8SM
Project No. RP/SOM/84/002
Activity Code RP/01/31.8

Prepared by: MEDAL, Consultancy and Research for Metallurgical Industries Ltd. Istanbul, Turkey.

Mogadiscio, 16-July- 1985.

This report comprises this title page, one (1) synopsis page, twenty two (22) pages of text and six (6) appendixes (1 through 6).

SYNOPSIS.

Field work in FMW for the duration of four months were carried out by Medal team consists of two experts, in connection with the project entitled ' Rehabilitation of Equipment and Upgrading of the Efficiercy of the Foundry and Mechanical Workshop '

Great number of damaged equipment showed an urgent machine repair demand and had the priority. By using local possibilities, some of the mostly needed equipment have been repaired, some new manufacturing technologies were introduced such as tripod lifting, oxy- LPG cutting and production of some items revised such as tanks. Training course about electrical maintenance and on the job training on electrical and mechanical maintenance have been completed and some others such as welding technology and Oxygen- LPG cutting process continue.

FMW mainly suffers from production losses created by electric power cuts and lack of spare parts and skilled personnel. The spare parts problem seemed not to be considered as an important point at the begining however was enlarged day by day. At the moment, even the preparation of specification for the spare parts requires a long time consuming work because of lack of documentation of any sort. While the labour capacity comperatively is sufficient for production, it is very poor for repair and maintenance. This problem should be solved by employing technical school graduates with skills in repair and maintenance. Also power cuts should be eliminated with a generator as it is done all over the country. A private workshop should be considered for subcontracting electrical repair of pump motors.

TABLE OF CONTENTS.

INTRODUCTION

Under UNIDO project No. RP/SOM/84/002, Activity Code RP/01/31.8 a contract ' for the provision of services relating to the Rehabilitation of Equipment and Upgrading of the Efficiency of the Foundry and Mechanical Workshop in Mogadiscio in the Democratic Republic of Somalia has been concluded between

UNIDO
United Nations Industrial
Devolopment Organization
Vienna, Austria

and

MEDAL
Consultancy and Research
for Metallurgical Industries Ltd.
Istanbul, Turkey

Within the scope of the contract, field works in Somalia were carried out by

Mr. Levent Gencoglu Electrical Engineer. (Team Leader)
Mr. Ihsan Ayanoglu General Foreman

from January 8th to May 8th 1985.

The aim of the project is to provide the necessary expertise and day to day shop level technical assistance to the Somali counterparts in order to put into operation the idle and under utilized equipment, and achieve self dependence in the latter's exploitation and maintenance, by relevant upgrading of the local skill.

This report has been prepared in order to state activities, accomplishments, bottlenecks, findings and recommendations. On the begining of the report, FMW is described generally and a work plan for the extended period is given at the end. The report is requested by UNIDO in the contract on paragraph 2.10.a

Thanks are expressed to all counterparts and the management of the Foundry and Mechanical Workshop for their kind support and cooperation on this mission.

1.00 GENERAL DESCRIPTION OF FOUNDRY AND MECHANICAL WORKSHOP WHEN MEDAL EXPERTS ARRIVED.

1.10 Departments

FMW consists of foundry section with a pattern making shop, steel structure section, mechanical workshop section and administration building with a laboratory.

1.11 Foundry

A 5 ton overhead crane which was damaged and needed urgently repair, serves the main aisle of the whole building. Around 70 % of the equipment were out of order or partly working order. The equipment in operation was in bad condition and needed cleaning. Pattern shop was comperatively in a well kept condition. Although some of the machinery needed repair.

List of Foundry Equipment and their Conditions.

Name	Manufacturer	Origin	Condition
Copper Melting Furnace	M.A.F	Italy	out of order
Overhead Crane	Kuli	W. Germany	out of order
Sand mixer	Gostol	Yugoslavia	out of order
Vibrator	Gostol	Yugoslavia	in order
Hammer	Mario Densatti	Italy	out of order
Aluminium Melting Furnace	not identifiable		out of order
Double Wheel Grinder I	Silex	France	out of order
Sand Blast	Hunziker	Switzerland	out of order
Double Wheel Grinder II	Gostol	Yugoslavia	out of order
Core Sand Mixer	Gostol	Yugoslavia	out of order
Band Saw	Fabrica Masina	Yugoslavia	out of order

List of Foundry Equipment and their Conditions (continued).

Name	Manufacturer	Origin	Condition.
Drying Oven	CER	Yugoslavia	Out of order
Large Cupola	Gostol	Yugoslavia	in order need repair
Small Cupola	M.A.F	Italy	in order need repair
Moulding Machine I	British Moulding Machine Co.	England	in order
Moulding Machine II	British Moulding Machine Co.	England	in order

List of Pattern Shop Equipment and their Conditions.

Name	Manufacturer	Origin	Condition.
Combination Machine for Wood Working	SCM	Yugoslavia	in order partly damaged need ~~need~~ repair
Band Saw	EJCA	Sweden	in order
Blade Welding Machine	Ideal	W. Germany	out of order
Dust Control Machine	DCE	England	partly in order
Band Saw	Contoura	Italy	in order
Circular Disk	Wadkin Bursgreen	England	out of order
Flat & Circular Sanding Machine	not identifiable	not identifiable	out of order
Disk Sander I	Kontovoci	Italy	out of ~~in~~ order
Disk Sander II	EJCA	Sweden	in order
Drill Machine	Arbaga Maskiner	Sweden	in order
Saw Blade Sharpener	Vollmer Werke		in order

List of Pattern Shop Equipment and their Conditions (continued)

Name	Manufacturer	Origin	Condition
Spindel Sander	Sternbergs	Sweeden	in order
Lathe Machine I	Centauro	Italy	in order
Lathe Machine II	EJCA	Sweeden	out of order
Bench Grinder	Black & Deck	Italy	in order

1.1.2 Steel Structure Section.

The overhead crane also serves this section. About 60 % of the equipment were totally or partly unoperable and the rest needed maintenance and cleaning. Welding cables were damaged and out of safety. The tidiness and upkeep of the place was not sufficient. Luna Migatronic welding machine is damaged and lack of any manuel and spare parts.

List of Steel Structure Equipment and their Conditions.

Name	Manufacturer	Origin	Condition.
Milling Machine	Prvomajska	Yugoslavia	in order
Jaka	Edwards Truefold	England	in order
Guillotine Shears I	Jelsin Grad	Yugoslavia	out of order
Bending Machine I	Jelsin Grad	Yugoslavia	out of order
Guillotine Shears II	Goteneds	Sweeden	in order some parts need revision.
Profile Shears I	Construzioni Mechanische Ames	Italy	out of order

List of Steel Structure Equipment and their Conditions (continued)

Name	Manufacturer	Origin	Condition.
Pipe Bending Machine	Wax		in order
Circular Saw	Thomas	Italy	in order
Radial Drilling Machine	Livnica	Yugoslavia	in order, need repair
Bending Machine II		USSR	out of order
Profile Shears II		USSR	out of order
Welding Machine	Luna Migatronic	Sweden	out of order
Welding Machine	not identifiable	Italy	in order
Welding (4 off) Machine	Luna LDA 275	Italy	in order
Welding Machine	ICEB	Italy	heavily damaged
Welding Machine	Sipe	Italy	heavily damaged
Welding Machine	Sipe	Italy	out of order
Welding Machine	Europa	Italy	out of order

1.1.3 Mechanical Workshop.

The mechanical workshop consists of a machine shop and a pump repair section which establishment is still continuing under the technical assistance of a subcontractor. The equipment in the workshop were comperatively in good operational state. Electric installation of the machinery were in better condition than other sections.

List of Mechanical Workshop Equipment and their Conditions.

Name	Manufacturer	Origin	Condition.
Lathe Machine	Storebro	Sweeden	in order
Lathe Machine		USSR	in order
Lathe Machine		USSR	in order
Lathe Machine	Prvomojska	Yugoslavia	in order
Lathe Machine	Voghera	Italy	in order
Lathe Machine	Prvomojska	Yugoslavia	in order
Lathe Machine	Voghera	Italy	in order
Electric annealing furnace	Naber	Germany	out of order
Shaper	NOLL		in order
Shaper	Majevica	Yugoslavia	in order
Metal hack saw	Continental		in order
Bending and ram press	WIKSTROM	Sweden	in order
Columenn Drilling		USSR	out of order
Milling Machine	ZEUS di Bonfiglio	Italy	in order
Milling Machine	ZEUS di Bonfiglio	Italy	in order
Metal band saw	POBEDA	Yugoslavia	out of order
Threading Machine		USSR	out of order

Newly Installed Equipment in Pump Repair Section.

Column crane 1000 kp/3m

Column crane 1000 kp/3m

Sand Blast Chamber

Testing Stand (Swivelling Column crane 1000 kp/2.5m, testing bansin, testing equipment, electric control and display, testing motors and measuring section)

Welding transformer

Double belt grinding machine

Newly Installed Equipment in Pump Repair Section (continued).

Gas welding and cutting equipment
Swage Block
Straightening Plate
Forge fire
Anvil
Double wheel grinding machine
Air compressor $64m^3/h$ free air delivery
Pallets for reception of pumps
Electric hand tools (Drilling machine, percussion drilling machine, percussion chisel drilling machine, angle hand grinder, flexible shaft machine)
Column type drilling machine
Extractor fan

1.1.4 Administration Building.

The building accomodates a gathering room which serves for training and meetings of the personnel, laboratory, a number of stores and office rooms and a canteen. An office room contains a drawing table in an un usable condition and lack of any drawing material. Also another room is used for sanitary facilities.
Laboratory is designed mainly to serve the Foundry. The equipment and their conditions are given below:

List of laboratory Equipment and their Conditions.

Name	Manufacturer	Origin	Condition.
Laboratory Mixer PLK	George Fischer Ltd.	Switzerland	in order
Sand Rammer PRA	George Fischer Ltd.	Switzerland	in order
Moisture teller	Harry W. Deiter Co.	U.S.A	in order
Sifting Machine	Harry W. Deiter Co.	U.S.A	in order

List of Laboratory Equipment and their Conditions (continued).

Name	Manufacturer	Origin	Condition.
Core Drying Oven PKK	George Fischer Ltd.	Switzerland	in order
Digital Analytical Balances	Sartorius	Germany	in order
Universal Timer	Dimco- Gray Co.	U.S.A	in order
Permeameter	Georges Fischer Ltd.	Switzerland	in order
Universal sand Strength Machine	Harry W. Deiter Co.	U.S.A	out of order
Hot plate	Garhardt	Germany	in order
Hot plate	Garhardt	Germany	in order
Outoclay	Harry W. Dieter Co.	U.S.A	in order, needs spare parts.
Carbon and Sulphur determination Machine	Strohlein	Germany	out of order
Electrophotometer	Fisher	U.S.A	in order
Digital Analytical Balance	Sartorius	Germany	in order
Digital Analytical Balance	Sartorius	Germany	in order
Distilating Machine	F.M	Germany	in order, needs spare parts.

1.2.0 Energies and Media.

1.2.1 Electric Energy.

Incoming electric energy of 160 KVA 15 KV 50 H2 (3 wire) from the public power line is stepped down to 380/220 V in an own transformer station where is under the responsibility of National Electric and Energy Agency.

In the field of electric energy is distributed by 6 switchboards. The switchboards distribute the energy to the machinery by 25 A thermaly protected switches. Each switchboard contains 14 switches.

1.2.2 Water.

Water is supplied through a well, via a water tower to the administration building, the foundry, the mechanical workshop and outside taps.

1.2.3 Compressed Air.

A compressor station supplies 6 At compressed air to the foundry. Compressed air for mechanical workshop is supplied by a mobile compressor.

2.00 ACTIVITIES OF MEDAL TEAM.

2.1.0 Rehabilitation of Equipment.

Repair sequence of damaged equipment has been made according to importance of use. So urgently needed machinery had the priority.

List of Repaired Equipment.

Name of Equipment.	Location.
Overhead Crane	(Foundry and Steel Structure Section)
Bending Machine I	(Steel Structure Section)
Profile Shears I	(Steel Structure Section "outdoor")
Profile Shears II	(Steel Structure Section "indoor")
Sand Mixer	(Foundry)
Guillotine Shears II	(Steel Structure Section)
Drill Machine	(Steel Structure Section)
Disk Sander I	(Pattern Shop)
Circular Saw	(Pattern Shop)

2.1.1 Overhead Crane.

Works carried out: Electrical connections rewired, push button unit replaced, bolts tightened, gears lubricated, for electric wiring diagram (Ref. App. 1 Drw. 1).

Working Period: Three weeks.

2.1.2 Bending Machine I.

Works carried out: Damaged electric motor has been sent to repair-shop, repaired and mounted, damaged contactor and thermic relay changed, gear assembly lubricated, all machine cleaned with naphtha.

Working Period: One week.

2.1.3 Profile Shears I.

Works carried out: Gear assembly repaired, worn part of shaft filled and turned in the lathe for finishing, all electric system revised, new power cable installed, all machine cleaned with naphtha.

Working Period: Two weeks.

2.1.4 Profile Shears II.

Works carried out: A new bushing has been made for bearing, worn surface of shaft filled, lubrication pump repaired, a new complete electric system installed, electric motor repaired, blades changed, all machine cleaned with naphtha.

Working Period: Three weeks.

2.1.5 Sand Mixer.

Works carried out: The rollers and electric limit switches have been repaired, a new steel robe fitted.

Working Period: One week.

2.1.6 Guillotine Shears II.

Works carried out: Plastic air hose replaced with galvanized pipe in order to prevent air leakages, a new power cable installed underground, whole machine lubricated and cleaned with naphtha.

Working Period: One week.

2.1.7 Drill Machine.

Works carried out: Water pump repaired and necessary accessories fitted, a new start- stop switch replaced with broken original one, machine cleaned with naphtha.

Working Period: Four days.

2.1.8 Disk Sander I.

Works carried out: Damaged gear assembly repaired, necessary areas cleaned and lubricated.

Working Period: Two days.

2.1.9 Circular Saw.

Works carried out: Broken cast- iron part on the shaft has been repaired.

Working Period: One day

2.2.0 Equipment Which Repair Still Continue.

2.2.1 Guillotine Shears I.

Works carried out: Electric damage on demagnet system repaired, gear assembly dismantled in order to disassemble shaft for repair. At the moment repair is stopped because of lack of oxygen for anneal and a hydrolic jack. When these materials are available, repair will continue.

2.2.2 Luna Migatronic Welding Machine.

The machine has been used for different purposes before it was installed properly and some of the parts are missing. In order to put into operation again, the parts and technical manual are needed. Necessary contacts will be made with the manufacturer soon.

2.3.0 Upgrading of the Efficiency.

In order to upgrade the efficiency, the activities given below have been carried out.

2.3.1 Training Courses.

- In plant training course on basic electric knowledge and maintenance of electric equipment has been completed. Training course notes were prepared according to technical knowledge of technicians and the subjects have been selected specifically in order to fill up technical lacks of knowledge (App.No. 3). Also "Safety and First aid for Electric Shock" section was added to the training notes. The notes are suggested to be translated into Somali and given to the counterparts.

- In plant training course about Oxy- LPG cutting progress is started but not completed because of oxygen run out, will be continued when oxygen is available.

- In plant training course about metal working techniques and welding technologies is started and still continues.

2.3.2 Oxygen-LPG Cutting Process.

- In order to reduce the cost, material waste and increase production rate; oxy- LPG cutting unit has been proposed by Medal instead of using arc welding. (App. No. 4).

  Necessary equipment was only available in April because of some difficulties on local purchase. Detail of training course is given on paragraph 2.3.1

2.3.3 New Productions.

Portable Tripot Lifting Apparatus.

In order to handle lifting difficulties where overhead crane is not available, an easy to use portable lifting apparatus has been made. (App. No.1 Drw. 3).

Roll Type Positioner.

The apparatus is used on tank production to join the bended sheet metals to each other by turning them on the rollers. Necessary drawings prepared and production is started.

2.3.4 Technical Revisions on Production.

Steel Structure Section: Modifications are made and the drawings prepared for modified items together with technological instructions. (App. No.1 Drw. 2, App. No. 2).

2.3.5 Other Activities.

a- Private shops in Mogadiscio have been surveyed in order to identify local purchase possibilities and assist the counterparts in the purchase of the material and spare parts required for production and repair of the equipment.

b- In order to prevent welding machine cables from possible damages, an underground electric installation has been designed and for this purpose, cable pits were opened and cleaned, floor concrete broken. When the ordered materials are available, the installation will be completed. Also the cables which show open wires could only be repaired with insulation tape because of the lack of new cable and connector.

2.3.5 <u>Other Activities (continued)</u>.

c- In order to identify possible electric repairshops for subcontracting purposes of rewinding work required for pumps, the workshops in Mogadiscio have been surveyed and a report prepared on the request of Mr.H.J. Fritz Senior Industrial Devolopment Officer, Engineering Industries Section, Division of Industrial Operations, UNIDO. (App. No. 5).

d- During the general inspection of transformer station which is under the responsibility of National Electric and Energy Agency, main transformer has been found with run out of oil because of leakage. The agency has been warned and necessary instructions given to the counterparts for regular checkings.

e- During the repair of the equipment described on paragraph 2.1.0 necessary day to day practical advices such as instructions for operation and maintenance given to the counterparts.

3.00 FINDINGS AND ANALYSES.

As a result of investigations, below facts were discovered and analized

3.1.0 Great Number of Damaged Equipment, Lack of Spare Parts and Documentations.

Especially in Steel Structure and Foundry Sections, the number of equipment was very high. Most of the equipment needed spare parts and tools for repair and operation. Prior to commissioning and during the initial operation of the equipment, it seemed spares and documentations for repair and maintenance were not considered as an important point. Now without documentation, preparation of specifications of these spare parts and tools becomes nearly impossible. Even the manufacturers of some machinery are not identifiable. Medal team has tried to fill up this gap, by repairing existing damaged parts instead of replacing them and using the poor local purchase possibities as much as possible.

3.2.0 Local Purchase Possibilities.

Another point which effects the working rate is some difficulties on local purchase. First, to find any spare parts either for electrical or mechanical repair is hardly possible in local purchase. Second, even if parts are available in local market, limitations and long procedures prevent their purchase.

3.3.0 Electric Power.

Electric power cuts occur very often and this stops almost whole activities in FMW.

Existing electric transformer capacity of 160 KVA would not be enough for any future extension .

3.4.0 Counterparts.

The number of counterparts were not sufficient. These were two electricians (one has hardly any experience and technical knowledge), one mechanic and seven other workers at the Steel Structure Section involved in production. There is not any mechanical or electrical engineers involved in maintenance. For the first three weeks after the arrival of the team, most of the above mentioned counterparts were on leave.

During the four months field work, the activities which details are given in the body section have been carried out by using local possibilities as much as possible. Accomplishments, bottlenecks and recommendations conserning this period of the field work are stated below.

4.00 Accomplishments.

A- Mostly needed equipment have been repaired and day to day practical technical advice for maintenance and operation of the machinery have been given to the counterparts. There are still some damaged equipment in lack of spare parts.

B- Training course on electric maintenance has been completed and some others are started, still continuing.

C- Production of some items were revised and necessary drawings have been prepared.

D- Some auxilary apparatus have been produced in order to eliminate some manufacturing difficulties.

5.00 Bottlenecks.

A- Most of the equipment need spare parts and tools for repair and maintenance.

B- Local purchase possibilities are very poor. This effects the working rate.

C- Electric power cuts occur very often.

D- The number of counterparts are very poor for maintenance.

6.00 Recommendations.

A- Labour capacity for maintenance should be enlarged by employing technical school graduates. Also maintenance department should be established and one engineer for electrical and another one for mechanical maintenance have to be incharge of the department.

B- In order to solve electric power cut problems, a generator set should be installed for FMW. If it is not available, at least a 20 KVA generator has to be considered for large cupola furnace in order to eliminate problems caused by power cuts during the melting process.

Recommendation (continued).

Also 160 KVA rated power of existing transformer will not be sufficient for any future extension after the operation of Pump Repair Section, during the test of higher powered pumps.

C- A sound storage system has to be established to FNW after the purchasing of the spare parts.

D- A private workshop should be considered for subcontracting electrical repair of pump motors after the operation of Pump Repair Section.

7.00 WORK PLAN FOR THE DURATION OF EXTENDED FOUR MONTHS.

Medal team is planning to carry out the activities given below for the duration of the future four months.

- Rehabilitation of Equipment
- Preparing of specifications of spare parts required for the repair and maintenance of the equipment.
- Assisting in installing the new electric equipment and making necessary wire and cable connections required for Pump Repair Section.
- Completing the training course about metal working techniques and welding technologies.
- Training counterparts on operation procedures of newly acquired repair and maintenance tools.
- Production of role type positioner required for sheet metal welding in tank production.

LIST OF APPENDIXES.

1- Drawings.

Drawing No. 1: Renewed Wiring Diagram for Overhead Crane.

Drawing No. 2: Modified Manufacturing Drawings of Tanks.

Drawing No. 3: Drawing of Tripot Lifting Apparatus.

2- Manufacturing Instructions for Tanks.

3- Training Course Notes About Basic Electric Knowledge and Maintenance of Electric Machinery.

4- Training Course Notes About Oxygen- LPG Cutting Process.

5- Survey Notes About Existing Private Electric Motor Rewinding and Repairshops in Mogadiscio.

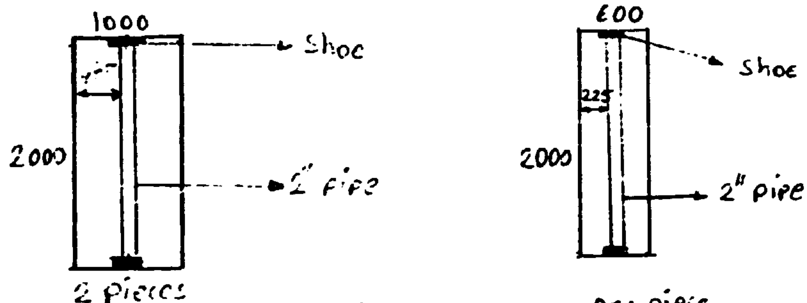
6- List of Persons Met.

MANUFACTURING INSTRUCTIONS.

$20m^3$ Tank.

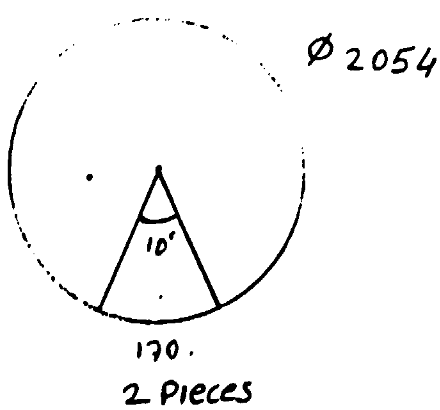
It is prepared from 2000 X 1000 X 5mm sheet steel plate which is the available material at FMW and local market.

1- Prepare the plates as shown above.
2- On bending machine bend them to a circle and spotweld ends on the bending machine.
3- Weld ends completely on the floor in order to have 7 rolls all together.
4- Place bottom and upper shoes inside two longer rolls and one short roll as given below and weld one 2" support pipe for each roll (altogether 3 rolls).



5- Put rolls in right order for welding.
Note: Joints on each roll must not be alined to each other.
6- First spotweld the rollers to each other then put the whole piece on "roll type positioner" and start welding inside by turning the piece on rollers. When half of the roll is welded from inside, start welding from outside.

7- Cut a circle of 2054mm diameter.



Manufacturing Instructions $20m^3$ Tank (continued).

8- Cut a slice out as shown above 10° or 170mm on periphery.

9- Connect both ends and weld on both sides.

10- Prep re another dom as described above.

11- Weld the doms on two sides of the roll first spotweld on 8 points opposite to each other then continue with welding.

12- Mark circle of the top hole by compass and cut.

13- Prepare top hole neck.

14- Prepare covers for the top hole neck and weld them on top, fit and drill holes.

15- As final step, prepare the stands of the tank in accordance with the measurements shown in the drawing and mount the tank on them and weld.

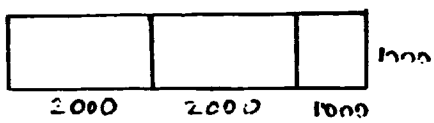
16- According to the measurements shown in the picture, weld lifting eyes on the tank.

MANUFACTURING INSTRUCTIONS.

$10m^3$ Tank.

It is prepared from 2000 X 1000 X 5mm sheet steel plate which is the available material at FKW and local market.

1- Weld two and half plates as shown below.



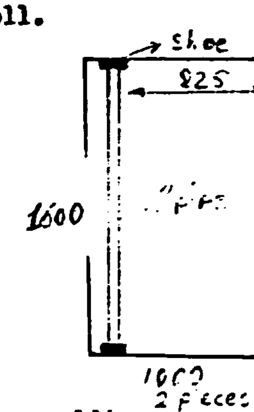
5 Pieces

2- On bending machine bend it to a circle and spotweld ends on the bending machine.

3- Weld ends completely on the floor.

4- Prepare 5 rolls as described above.

5- Place bottom and upper shoes inside two rolls as given below and weld one 2" support pipe for each roll.



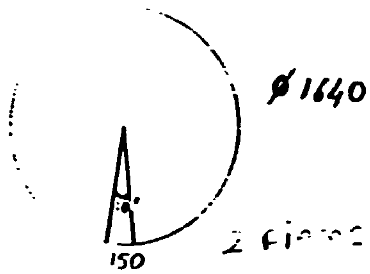
6- Put rolls in right order for welding.

Note: Joints on each roll must not be alined to each other.

7- First spotweld the rollers to each other then put the whole piece on "roll type positioner" and start welding inside by turning the piece on rollers. When half of the roll is welded from inside, start welding from outside.

Manufacturing Instructions $10m^3$ Tank. (continued).

8- Cut a circle of 1640mm diameter



9- Cut a slice out as shown above 10^o or 150mm on periphery.

10- Connect both ends and weld on both sides.

11- Prepare another dom as described above.

12- Weld doms prepared earlier on two sides of the roll first spotweld on 8 points opposite to each other, then contimue with welding.

13- Mark circle of the top hole by compass and cut.

14- Prepare top hole neck.

15- Prepare covers for the top hole neck and weld them on top, fit and drill holes.

16- As a final step, prepare the stands of the tank in accordance with measurements shown in the drawing and mount the tank on them and weld.

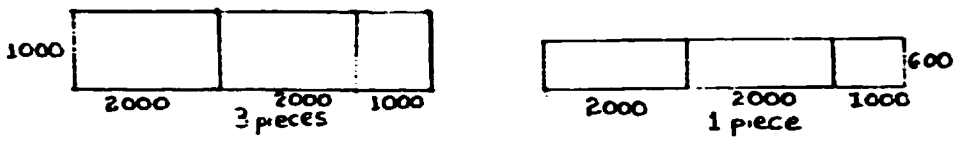
17- According to the measurements shown in the picture, weld lifting eyes on the tank.

MANUFACTURING INSTRUCTIONS.

$8m^3$ Tank.

It is prepared from 2000 X 1000 X 5mm sheet steel plate which is the available material at FMY and local market.

1- Prepare the plates shown below

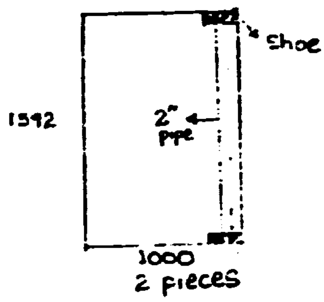


2- On bending machine bend them to a circle and spotweld ends on the bending machine.

3- Weld ends completely on the floor.

4- Prepare 4 rolls as described above.

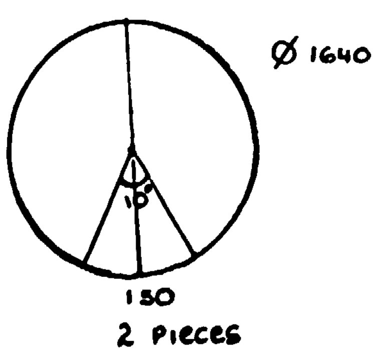
5- Place bottom and upper shoes inside two longer rolls as given below and weld one 2" support pipe for each roll.



6- Put rolls in right order for welding.
Note: Joints on each roll must not be alined to each other.

7- First spotweld the rollers to each other then put the whole piece on "roll type positioner" and start welding inside by turning the piece on rollers. When half of the roll is welded from inside, start welding from outside.

8- Cut a circle of 1640mm diameter.



Manufacturing Instructions $8m^3$ Tank (continued).

9- Cut a slice out as shown above 10° or 150mm on periphery.

10- Connect both ends and weld on both sides.

11- Prepare another dom as described above.

12- Weld doms prepared earlier on two sides of the roll first spotweld on 8 points opposite to each other, then continue with welding.

13- Mark circle of the top hole by compass and cut.

14- Prepare top hole neck.

15- Prepare covers for the top hole neck and weld them on top, fit and drill holes.

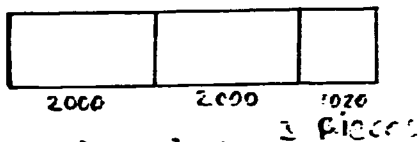
16- As a final step, prepare the stands of the tank in accordance with the measurements shown in the drawing and mount the tank on them and weld.

17- According to the measurements shown in the picture, weld lifting eyes on the tank.

MANUFACTURING INSTRUCTIONS.

$6m^3$ Tank.

It is prepared from 2000 X 1000 X 5mm sheet steel plate which is the available material at PKW and local market.

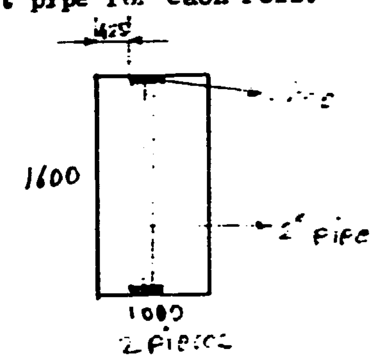


1- Prepare 3 plates as shown above.

2- On bending machine bend them to a circle and spotweld ends on the bending machine.

3- Weld ends completely on the floor in order to have 3 rolls.

4- Place bottom and upper shoes inside two of the rolls as given below and weld one 2" support pipe for each roll.

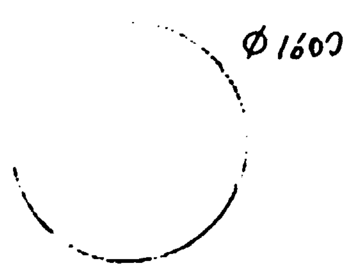


5- Put rolls in right order for welding.

Note: Joints on each roll must not be alined to each other.

6- First spotweld the rollers to each other, then put the whole piece on "roll type positioner" and start welding inside by turning the piece on rollers. When half of the roll is welded from inside, start welding from outside.

7- Cut a circle of 1600mm diameter.



Two pieces

Manufacturing Instructions $6m^3$ Tank (continued).

8- Weld both circles on two sides of the roll produced earlier. First spot-weld on 8 points opposite to each other then continue with welding.

9- Mark circle of the top hole by compass and cut.

10- Prepare top hole neck.

11- Prepare covers for the top hole neck and weld them on top, fit and drill holes.

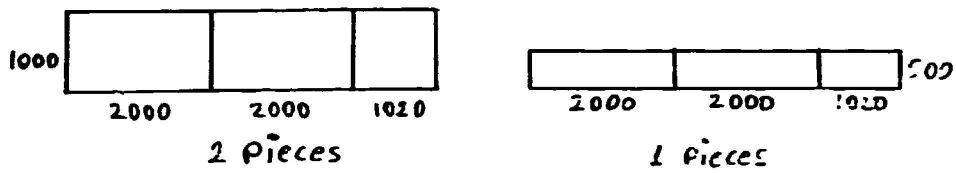
12- As a final step prepare the stands of the tank in accordance with measurements shown in the drawing and mount the tank on them and weld.

13- According to the measurements shown in the picture, weld lifting eyes on the tank.

MANUFACTURING INSTRUCTIONS.

$5m^3$ Tank.

It is prepared from 2000 X 1000 X 5mm sheet steel plate which is the available material at FMW and local market.

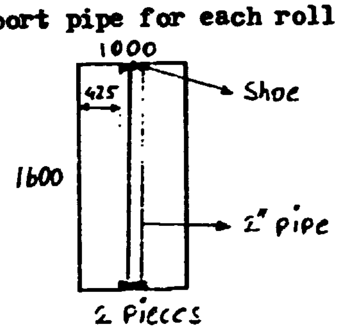


1- Prepare the plates shown above.

2- On bending machine, bend them to a circle and spotweld ends on the bending machine.

3- Weld ends completely on the floor in order to have 3 rolls.

4- Place bottom and upper shoes inside two longer rolls as given below and weld one 2" support pipe for each roll.

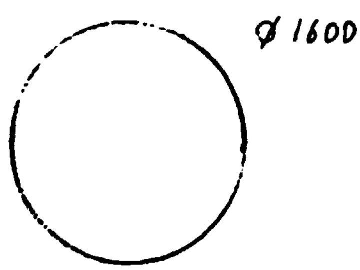


5- Put rolls in right order for welding.

Note: Joints on each roll must not be alined to each other.

6- First spotweld the rollers to each other then put the whole piece on "roll type positioner" and start welding inside by turning the piece on rollers. When half of the roll is welded from inside, start welding from outside.

7- Cut two circles of 1600mm diameter.



2 pieces

Manufacturing Instructions $5m^3$ Tank (continued).

8- Weld both circles on two sides of the roll produced earlier. First spot-weld on 8 points opposite to each other then continue with welding.

9- Mark circle of the top hole by compass and cut.

10- Prepare top hole neck.

11- Prepare covers for the top hole neck and weld them on top, fit and drill holes.

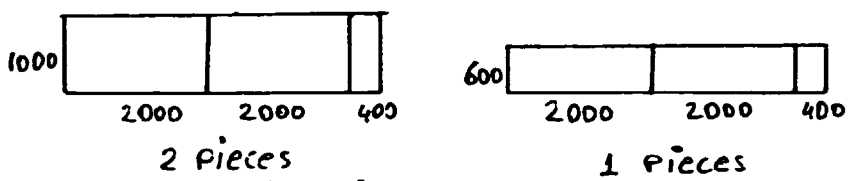
12- As a final step prepare the stands of the tank in accordance with measurements shown in the drawing and mount the tank on them and weld.

13- According to the measurements shown in the picture, weld lifting eyes on the tank.

MANUFACTURING INSTRUCTIONS.

$4m^3$ Tank.

It is prepared from 2000 X 1000 X 5mm sheet steel plate which is the available material at FMW and local market.

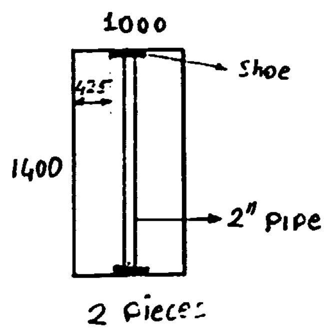


1- Prepare the plates shown above.

2- On bending machine, bend them to a circle and spotweld ends on the bending machine.

3- Weld ends completely on the floor in order to have 3 rolls.

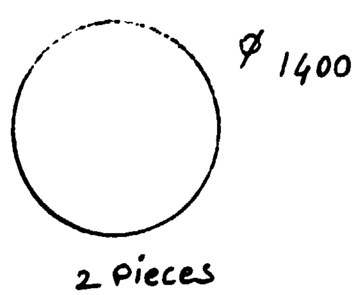
4- Place bottom and upper shoes inside two longer rolls as given below and weld one 2" support pipe for each roll.



5- Put rolls in right order for welding.
Note: Joints on each roll must not be alined to each other.

6- First spotweld the rollers to each other then put the whole piece on "roll type positioner" and start welding inside by turning the piece on rollers. When half of the roll is welded from inside, start welding from outside.

7- Cut two circles of 1400mm diameter.



Manufacturing Instructions $4m^3$ Tank (continued).

8- Weld both circles on two sides of the roll produced earlier. First spot-weld on 8 points opposite to each other, then continue for welding.

9- Mark circle of the top hole by compass and cut.

10- Prepare top hole neck.

11- Prepare covers for the top hole neck and weld them on top, fit and drill holes.

12- As a final step, prepare the stands of the tank in accordance with measurements shown in the drawing and mount the tank on them and weld.

13- According to the measurements shown in the picture, weld lifting eyes on the tank.

MANUFACTURING INSTRUCTIONS.

$2m^3$ Tank.

Prepared from 2000 X 1000 X 5mm sheet steel plate which is the available material at PMW and local market.

1- Prepare the plates shown above.

2- On bending machine, bend them to a circle and spotweld ends, on the bending machine.

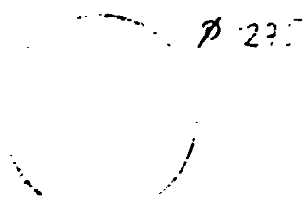
3- Weld ends completely on the floor in order to have two rolls.

4- Put two rolls opposite to each other.

Note: Joints on each roll must not be alined to each other.

5- First spotweld the rolls to each other then put the whole piece on "roll type positioner" and start welding inside by turning the piece on rollers. When half of the roll is welded from inside, start welding from outside at the same time.

6- Cut two circles of 1275mm diameter from sheet metal.



2 pieces

7- Weld both circles on one side of the rolls produced earlier. First spotweld on 8 points opposite to each other, then continue with welding.

8- Mark circle of the top hole by compass and cut.

9- Prepare top hole neck

10- Prepare covers for the top hole neck and weld them on top, fit and drill holes.

Manufacturing Instructions $2m^3$ Tank (continued).

11- As a final step, prepare the stands of the tank in accordance with the measurements shown in the drawing and mount the tank on them and weld.

12- According to the measurements shown in the picture, weld lifting eyes on the tank.

BASIC ELECTRIC KNOWLEDGE AND MAINTENANCE OF ELECTRIC EQUIPMENT

1. Basic Electric Knowledge.

1.a. The SI Units.

The units of the quantities most commonly used in Electrical Engineering (volts, amperes, watts, ohms etc) are those of the metric system. They are embodied in International system of units.

The SI electrical units are based on mksa (meter- kilogram- second- ampere) system. They have been adopted by the standardisation bodies of the world, including the International Electrical Commission (IEC), the American National Standards Institute (ANSI), and the standard board of the Institute of Electrical and Electronics Engineers (IEEE).

Ampere have been defined as follows:
Ampere: The constant current, if maintained in two straight parallel conductors of infinite length, of negligible circular cross section, and placed 1 meter apart in vacuum, would produce between these conductors a force equal to 2×10^{-7} newton per meter of length.

1.b. Derived SI Units.

Most of the quantities and units used in electrical engineering, fall in the category of SI derived units, that is, units can be completely defined in terms of the base and supplementary quantities. Below table, lists some of the principal electrical quantities in the SI system.

SI Derived Units Used in Electrical Engineering.

Quantity.	SI Unit Name	Symbol.
Frequency	Hertz	Hz
Force	Newton	N
Energy	Joule	J
Power	Watt	W
Quantity of electricity, electric charge.	Coulomb	C
Potential Difference	Volt	V
Capacitence	Farad	F
Electric Resistance	ohm	Ω
Inductance	Henry	H

The definitions of these quantities are:

Herts: The unit of frequency, 1 cycle per second.
Newton: The force that will impart an acceleration of 1 meter per second to a mass of 1 kilogram.
Joule: The work done by a force of 1 newton acting through a distance of 1 meter.
Watt: The power required to do work at the rate of 1 joule per second.
Coulomb: The quantity of electric charge that passes any cross section of a conductor in one second when the the current is maintained constant at 1 ampere.
Volt: The potential difference between two points of a conducting wire carrying a constant current 1 ampere, when the power dissipated between these points is 1 watt.

Farad: The capacitance of a capacitor in which a charge of coulomb produces 1 volt potential difference between its terminals.

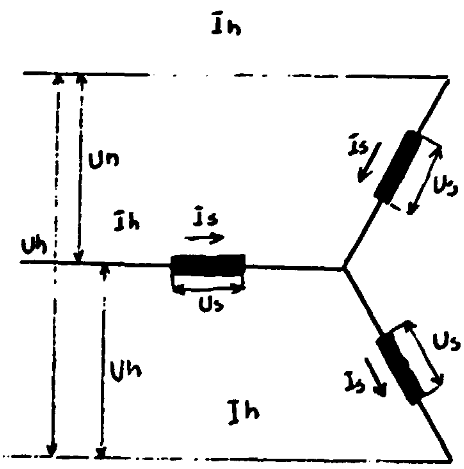
Ohm: The resistance of a conductor such that a constant current of 1 ampere in it produces a voltage of 1 volt between its ends.

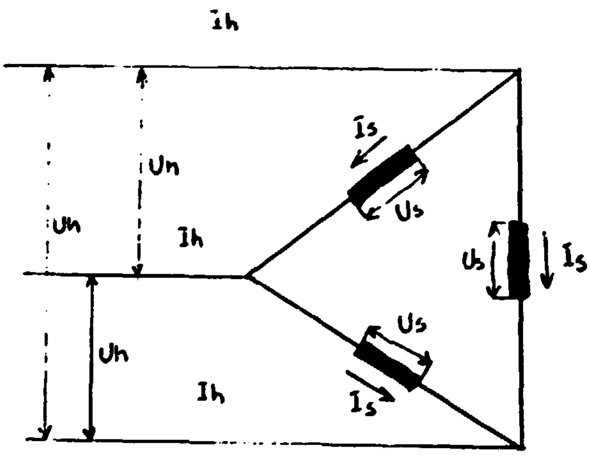
Henry: The inductance for which induced voltage in volts is numerically equal to the rate of change of current in amperes per second.

1.c. Three phase Systems.

Three phase Y and Δ connections: In a balanced 3 phase system, the star connection is also called the Y connection. The relations of the currents and the voltages are:

Star	Delta.
$Ih = Is$	$Ih = \sqrt{3}\, Is$
$Uh = \sqrt{3}\, Us$	$Uh = Us$

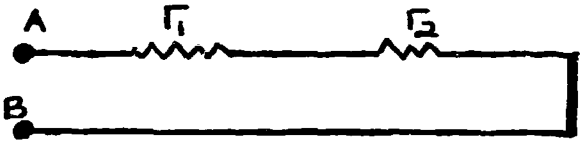




1.d. Resistances in Series.

When two or more resistances are connected in series, the equivalent resistance of the combination is equal to the sum of the resistances of the individual - resistors; that is -

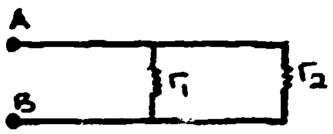
$$req = r_1 + r_2 + \dots$$



1.e. Resistors in parallel:

When two or more resistances are connected in series, the equivalent resistance of the combination is determined from the relation.

$$\frac{1}{req} = \frac{1}{r1} + \frac{1}{r2} \Longrightarrow req = \frac{r1r2}{r1+r2}$$



1.f. Active and Reactive Power and Power factor (Cosp)

In alternating current circuit, the power is equal to the product of the effective values of U and I multiplied by the cosine of the phase angle between them that is:

$$P = Ueff.\ Ieff.\ Cos\varphi = Watts.$$

The reactive power or VAr is

$$Q = Ueff.\ Ieff.\ Sin\varphi = VAr.$$

The volt amperes is

$$S = P + Q = Ueff.\ Ieff = VA.$$

1.g. **Basic Electric Formulas.**

$$\underset{U}{(V)} = \underset{I}{(A)} \cdot \underset{R}{(\Omega)} \qquad I = \frac{U}{R} \qquad R = \frac{U}{I}$$

Single Phase: $\underset{P}{(W)} = \underset{U}{(V)} \cdot \underset{I}{(A)} \qquad I = \frac{P}{U} \qquad U = \frac{P}{I}$

Three Phase: $\underset{P}{(W)} = \sqrt{3}\,\underset{U}{(V)}.\underset{I}{(A)}.\ \mathrm{Cos}\,\varphi \qquad I = \frac{P}{\sqrt{3}U.\mathrm{Cos}\,\varphi} \qquad U = \frac{P}{\sqrt{3}\,I.\ \mathrm{Cos}\,\varphi}$

2. MAINTENANCE OF ELECTRIC MACHINERY

2.a. Storage:

Machines not for immediate use should be stored in a dry atmosphere not subject to extremes of heat or cold. The storage place should be entirely free from vibration and the machines should be protected from dust, dirt, oil, etc.

During storage the machines should be inspected fairly frequently and the shafts rotated at least once everyweek to counteract any tendecy of the grease to harden, and to prevent brinelling of the bearings. In the event of the grease having deteriorated, or in any case after two years of storage, the grease should be thoughly cleaned out and replaced with the correct grade grease.

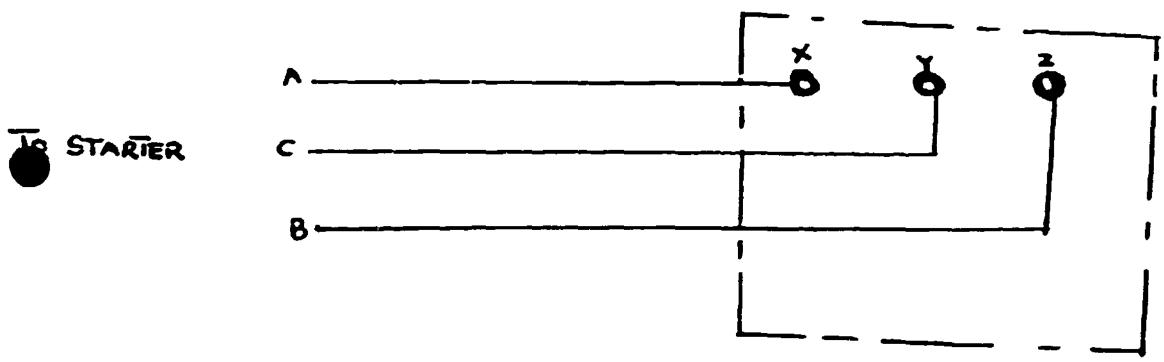
Before installation it is recomended that the insulation resistance of the windings be checked since during storage the machine may have become damp, particularly if it has not been possible to store the machine under suitable conditions. The insulation resistance may be measured with a 500 V megger.

Insulation resistance varies greatly with humidity and therefore it is recomended that if it becomes damp the machine be thoroughly dried out before being commissioned.

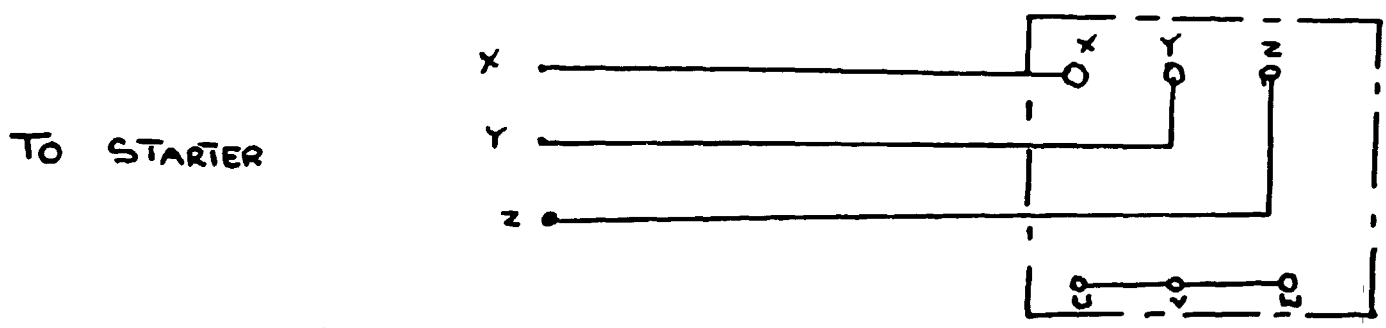
2.b. Electric Connections.

A selection of a.c. motor connection diagrams are given below.

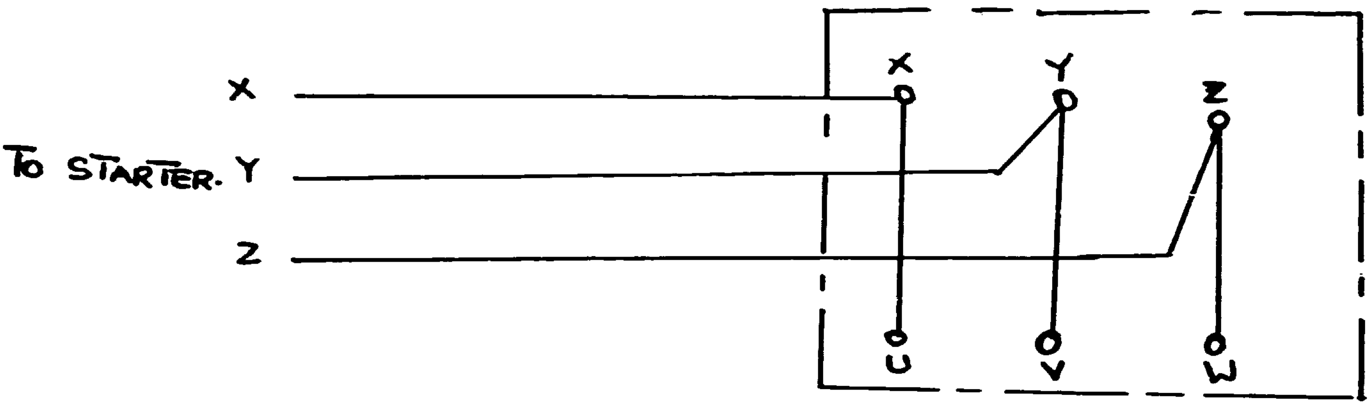
DIRECT ON LINE OR AUTO - TRANSFORMER STARTING.



1) - 3 Terminals, Star or Delta Connected Stator Winding.

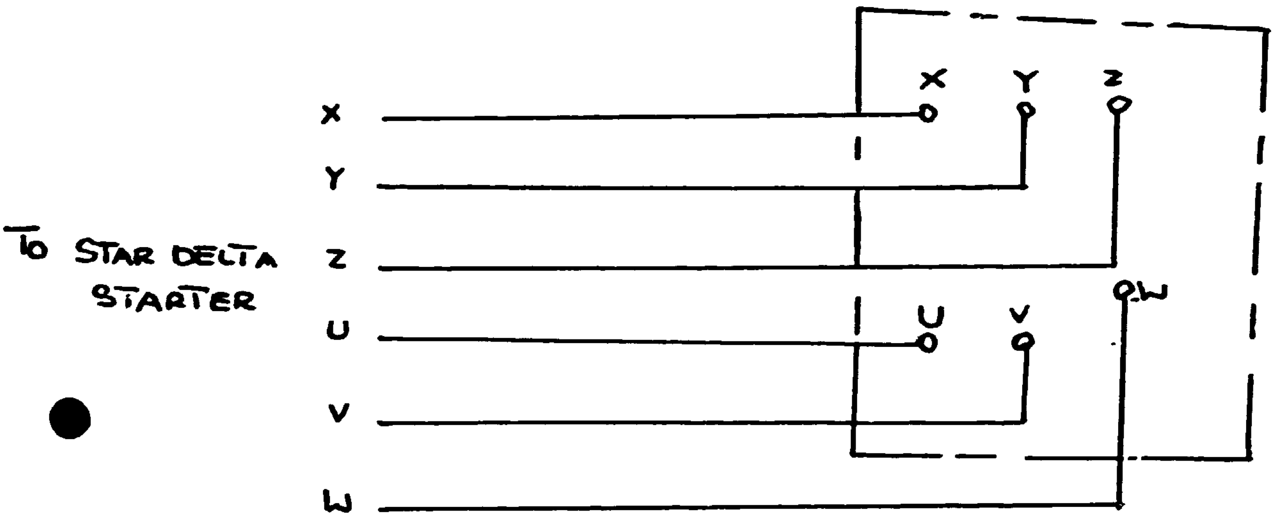


2) 6 Terminals, star connected stator windings.



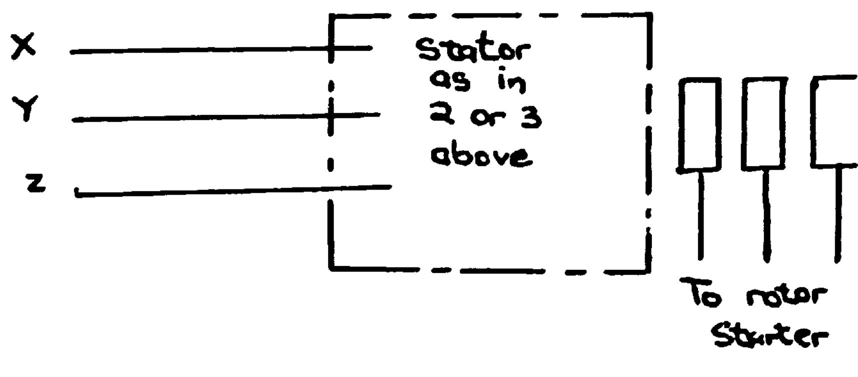
3) 6 Terminals , Delta Connected Stator Winding.

<u>Star - Delta Starting.</u>



4) 6 Terminals, Start in Star - Run in Delta.

<u>Slipring Motors.</u>



5) Rotor Resistance Start.

2.c. Maintenance:

Efficient operation of any machine depends upon correct installation and regular maintenance.

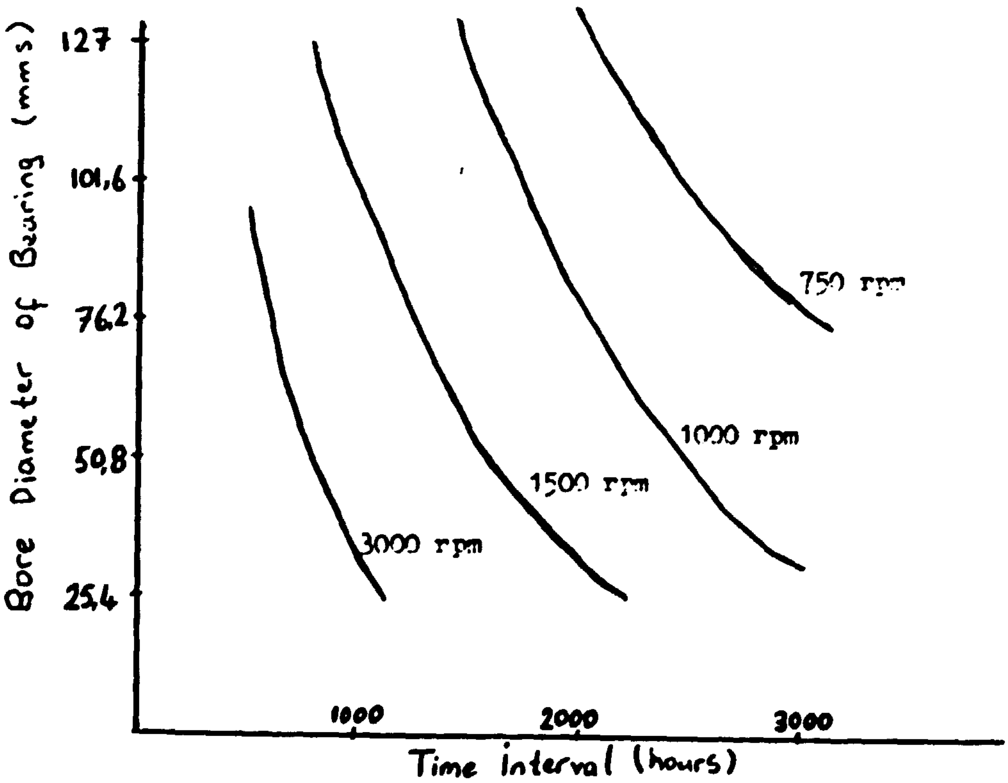
During the first few months of service a new machine should receive some attention. Foulty installation is more likey to cause trouble during this initial period in which all working parts are settling down to their working surfaces and temperatures. Careful attention to the following may help to prevent serious trouble devoloping later.

- Ensure that all external cables are adequately cleated and secure . that there is no evidence of chafing.
- Check that all therminals are clean and tight.
- Ensure that the windings and bearings are not overheating and the motor runs smoothly and quietly.
- Check security of the fixing bolts and/or slide rails, pulleys, couplings etc.
- Compare the actual load current with the full load current given on the name plate.
- Keep the machine as free as possible from oil, dirt, dust and particularly moisture.
- Do not allow tools, oil cans, piece of rag etc to lie around or on the machine frame and see that cooling fans are not blocked.

2.d. Bearings:

Lubrication: Ball and roller bearings require some attention as they are correctly charged with grease when the motor leaves the works to last at least twelve months under normal service conditions witout relubrication.

The below chart gives recommended future lubrication intervals and is based on correctly fitted bearings, not overloaded and running under good clean conditions.



<u>Cleaning Bearings</u>: It is recommended that old grease be flushed out of the bearing and bearing housing at intervals of approximately two years. For this purpose use mixture of petrol and light machine oil mixed in the ratio 8 : 1 respectively remembering that petrol is flammable and the usual care with regard to naked lights must be observed.

<u>Fitting New Bearings</u>:

In the case of replacements, the bearings to be fitted should be of the same size as the one removed. The bearing clearances must also be the same.

The protective grease or compound in which new bearings are packed should be removed before fitting the bearing, and this may be achieved by immersing the complete of part bearing in a hot oil bath until the protective grease has been washed off.

Three quaters fill the inner cap with grease and place it on the shaft ; after oiling the shaft slightly, push the bearing on to the shaft seat and drive home against its shoulder. This can be done by using a tube having an inside diameter slightly greater than the shaft diameter and having end faces square with a bore.

Use a bearing drawer in order to remove the bearing from the shaft.

<u>Working life of Ball and Roler Bearings</u>.

-	-Safely working life on max rpm (hours)
750 rpm	20000
1000 rpm	16000
1500 rpm	11000
3000 rpm	6000

2e) Contactors and Thermic Overload Relays.

Contactors are widely used on control and protecting circuits of motors. It is also possible to make some control functions with their auxilary contacts. Beside this by using a few contactor, star delta starting and revolution changes are possible.
Thermic overload relays are used for the protection of motor circuits. (see 3b).

Maintenance of Contactors:

Laminated maginets of contactors should be kept clean by wiping with a clean cloth. Under no circumstances should a file be used. The majority of contacts are made from copper and are electroplated, this is mainly to give some degree of corrosion resistance. Some contacts have silver alloy faces. Contacts should be kept free from oil and dirt by wiping with a clean cloth, moistened with safety cleaning solvent. If the contact surface is very rough, a fine sand paper should be used to clean the surface.

2f) Maintenance of Transformers.

The following maintenance procedures is recommended for transformers:

Every Month.

1. Check the transformer oil level
2. Check the slica gel breather
3. Inspect the buchols relay for trapped gas
4. Inspect the external connections for signs of heat discolouration.

First Three Months.

1. Check condition of the cooling oil. There after annually.

Every Twelve Months.

1. Check condition of the cooling oil
2. Check reading of the oil gauge against a dipstick reading.
3. Test the buchholz relay
4. Measure and record the insulation resistance values of the winding insulation
5. Clean and examine insulators for damage
6. Clean and check the spark gap
7. Check the coil clamps for tightness
8. Test all valves, plugs etc. for freedom of operation.

2g. Fault Finding.

Procedure: Fault finding should always be systematic, commencing with the most likely faults first, such as blown fuse or tripped overload.

Next a visual inspection should be made to ascertain that no obvious disconnections or broken components are visible. Check whether the fault has occured in the main or the control circuit of a drive.

If the fault still persists, then a detailed electrical check of the circuit must be made using a suitable meter. It should be possible to quickly establish at which point the fault has occured and appropriate action may be taken.

Further Action.

Always ascertain the reason for the fault. For instance a blown control fuse indicates a fault in a control circuit and obviously this must be corrected before replacing the fuse.

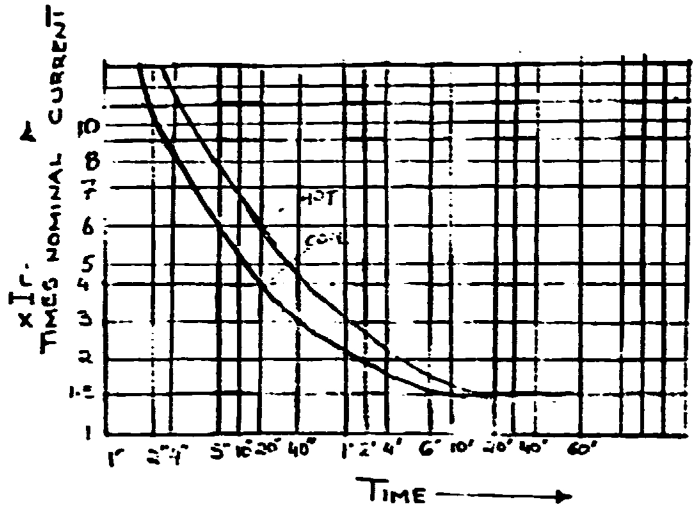
3. Some Useful Charts and Tables.

3a. According to motor nominal current, thermic overload relay, fuse and power cable square selection table for 3 phase motors.

MOTOR NOMINAL POWER KW	HP	COS φ	EFFICIENCY %	220V. NOMINAL CURRENT	220V. FUSE DIRECT	220V. FUSE λ-Δ	380V. NOMINAL CURRENT	380V. FUSE DIRECT	380V. FUSE λ-Δ	500V. NOMINAL CURRENT	500V. FUSE DIRECT	500V. FUSE λ-Δ	380V. THERMIC RELAY	380V. λ-Δ SWITCH	380V. NYY CABLE
0.25	0.34	0.7	62	1.4	4	2	0.8	2	2	0.6	2	2	[illegible]		4x2.5
0.37	0.5	0.72	64	2.1	4	2	1.2	4	2	0.9	2	2	[illegible]		4x2.5
0.55	0.75	[illegible]	69	2.7	4	4	1.6	4	2	1.2	4	4	[illegible]		4x2.5
0.75	1	0.8	74	3.4	6	4	2	4	4	1.5	4	4	[illegible]		4x2.5
1.1	1.5	[illegible]	77	4.4	6	6	2.6	4	4	2	4	4	[illegible]		4x2.5
1.5	2	[illegible]	78	6	16	10	3.5	6	4	2.6	4	4	[illegible]		4x2.5
2.2	3	[illegible]	81	8.7	20	16	5	10	6	3.7	10	6	4-6		4x2.5
3	4	[illegible]	81	11.5	20	16	6.6	16	10	5	10	10	[illegible]	2-5	4x2.5
4	5.5	[illegible]	82	14.7	25	20	8.5	20	16	6.4	16	10	[illegible]	5-8	4x2.5
5.5	7.5	[illegible]	83	19.8	35	25	11.5	25	20	8.5	20	16	8-12	5-8	4x2.5
7.5	10	0.86	85	26.6	50	35	15.5	35	25	11.5	25	20	11-16	7-10	4x2.5
11	15	0.8	87	39	63	50	22.5	35	35	17	35	25	12-20	10-11	4x4
15	20	0.86	87	50	80	63	30	50	35	22.5	35	35	[illegible]	16-25	4x4
18.5	25	[illegible]	88	62	100	80	36	63	50	27	50	35	[illegible]	16-25	4x6
22	30	[illegible]	89	72	100	80	43	63	50	32	63	50	[illegible]	25-40	4x10
30	40	[illegible]	90	98	125	100	57	80	63	43	63	50	[illegible]	25-40	4x10
37	50	[illegible]	90	120	200	160	72	100	80	54	80	63	[illegible]	40-80	4x16
45	60	[illegible]	91	143	225	200	85	125	100	64	100	80	[illegible]	50-80	3x25+16
55	75	[illegible]	91	180	250	225	104	160	125	78	125	100	[illegible]	60-80	3x35+16
75	100	[illegible]	91	246	350	250	142	200	160	106	160	125	[illegible]	50-80	3x50+25
90	125	[illegible]	92				169	225	200	127	200	160	[illegible]	80-100	3x70+35
110	150	[illegible]	92				204	250	225	154	225	200	[illegible]	100-140	3x95+50
125	180	[illegible]	92				243	300	250	182	250	225	[illegible]	100-140	[illegible]

The thermic overload relays should be set to the 1.2 times of motor nominal current . On λ-Δ starting the thermic relay should be installed on the winding line not the main line and set to the 0.57 times of motor nominal current.

3b. Tripping times of thermic overload relays according to the nominal current



4. Safety:

Before starting any work on electric installations major rules given below must be remembered.

1. Never take anything for granted
2. Know where you are every minute
3. Know where you are going before you make a move
4. Plan every job before you start it
5. Do not change your plan while the job is underway.

4a) Safe Clothing and Hand Tools.

Unsafe personnel clothes and small hand-held equipment cause significant injuries. Many learn through experience or by accident and follow all rules of personal safety.

Following rules listed below will eliminate the potential of injury and also serve to emphasize to maintenance electrician safety objectives.

- All metallic objects should be prohibited from being carried on the person. These include such items as wristwatches, rings, belt buckles, metal pens, rules, flash lights, key or watch chams etc.
- Basic clothing whether intended for use in warm or cold climates, should be tightfitting without loose sleeves, cuffs etc, to contact or catch upon equipment while working or climbing.
- Shoes should be of insulating type, rubber- soled or worn with rubber boots. It is higly recommended that shoes be of safety-toe-type.
- Miscellenous small hand tolls such as pliers, cutters, nut drivers, and test leads should be insulated.
- Portable powered hand tools should be of 3 wires grounded design.
- Aluminum ladders are usually prohibited for all electrical maintenance and installation work. They can be wed with a reasonable degree of safety in low- and medium voltage areas if they are equipped with a dialectric barrier.

Safety Procedures:

Procedures covering basic safety requirements should be reduced to writing and distributed to personnel.

- Operating of Switches and Disconnects:

  1. Closing: Manuel switches and disconnects should always be closed by a single unhesitating motion with one hand if possible. Do not reverse action under any circumstances.

  2. Opening: Always reduce load wherever possible before opening circuit. Do not attempt to interrupt full load or short circuit currents unless switch, disconnect or braker is rated for such duty.

- Grounding Procedure: All fixed and portable test equipment shall be effectively grounded prior to being energized. All ground connections should be checked at least annually.

- Fuse Pulling and Replacements: Fuse pulling should be done only with use of approved type nonconducting fuse pullers and with circuit deenergized. Replacement fuses should be of the same rating and style unless it is determined by careful - examination that the size and style being installed are proper for the circuit.

- Prohibition of Work on Live Circuits Over 110 V: Work shall not be perfomed on live circuits unless absolutely necessary. "Live" work shall not be permitted on circuits of more than 110 V except on instrument circuits and then only by qualified personnel

- Requirements for Test of Circuit to Determine Power Has been Shut Off:

  Before working on any circuit, a check should be made with an approved type of voltage tester (voltmeter, circuit tester etc) to determine definetely that the circuit is deenergized.

- Secondary Circuits of Current Transformers: The secondary circuit of current transformer must be kept closed. Opening of this circuit will result will result in high induced voltages which can injure personnel or damage windings.

- Floor Protection: Main switching, control and test areas which involve voltage of over 220 V should be equipped with rubber matting.

ELECTRICAL SHOCK
ARTIFICIAL RESPIRATION AND FIRST AID.

DO NOT TOUCH THE VICTIM WITH BARE HANDS until the circuit is broken.

SWITCH OFF. If this is not possible, use any handy dry insulating material such as a rubber based mackintosh or an overcoat will suffice, and pull the victim clear of the conductor.

ARTIFICIAL RESPIRATION - MANUAL

1. Lay the patient on his back with arms to the sides. If on a slope the stomach should be slightly lower than the chest.
2. Inspect the mouth and throat to ensure that these are clear of obstruction.
3. Kneel on one side of the patient level with the head, place one hand under the neck and the other on top of the head (Fig.1).
4. Lift the neck and tilt the head back as far as possible.
5. Move the hand from under the neck and place it on the chin, the thumb between the chin and mouth, with the index finger along the line of the jaw, and with the remaining fingers curled (Fig. 2).

Fig. 1

Fig. 2

6. Using the thumb of the hand on the chin to keep the lips sealed, open your mouth wide and make a seal round the patient's nose and blow deeply and evenly (FIG.3)
7. After blowing, check the rise of the chest, (Fig.4)

Fig. 3

Fig. 4

8. If the chest does not rise, the nose may be blocked. In this event the patient's mouth should be opened using the hand on the chin; open your mouth wide and making a seal round his mouth blow into his mouth. Turn the head to observe the chest rise. This may be used as an alternative to blowing into the nose even when the nose is not blocked, but in this case the nose must be sealed either with the cheek or by moving the hand from the top of the head and pinching the nostrils. The head must be kept at full backwards tilt.

9. Start with ten quick deep breaths and then continue at the rate of twelve to fifteen breaths per minute. This should be continued until the patient revives or a doctor certifies death.

10. In case of facial injuries it may be necessary to do a manual method of artificial respiration .

11. It is ESSENTIAL to commence artificial respiration without delay.

12. Send for medical assistance as soon as possible.

FIRST AID - BURNS.

If as a result of electric shock the patient is suffering from burns, the following instructions should be carried out without hindrance to artificial respiration.

a) Do not attempt to remove clothing adhering to the burn.

b) If other help is available, or as soon as artificial respiration is no longer required, cover the wound with a DRY dressing.

c) Oil or grease in any form should NOT be applied.

Levent Gencoglu

Team Leader

MEDAL.

Oxygen - LPG Cutting Process.

Oxygen - LPG cutting is a manual process in which the metal to be cut is melted away by heat generated from burning LPG by pure oxygen.

LPG compared to acetylene is safe, easy to handle and have no problem of carbide storage.

The simplest gas cutting system consists of compressed- gas cylinders, gas regulators, hoses and a cutting torch. Oxygen and LPG are stored in separate cylinders. The gas regulator attached to each cylinder (LPG or Oxygen) controls the flow of gas from the cylinder to the flexible rubber hose that delivers the gas to a gland attached to the appropriate inlet on the cutting torch.

Cutting torch consists of two parts. First part contains two valves one for oxygen inlet and the other for LPG inlet. These valves control heating and cutting processes. First, the pressure, velocity, and flow can be adjusted and second, the ratio of oxygen to LPG can be varied.

Second part of the cutting torch contains only one valve for adjustment of oxygen flow which is necessary during the cutting. This equipment can be mounted on a hand truck or it can be a stationary installation.

Using Procedure of the System.

Before starting the process, a suitable cutting tip should be selected according to the thickness of the material and fixed to its place on the torch.
The sequence for setting up the cutting outfit is given below.

1. Make sure vented gases are safely dispersed. Wipe out cylinder valve outlet with a clean lint- free cloth.
2. Attach the oxygen regulator to the oxygen cylinder.
3. Attach the LPG regulator to the LPG cylinder.
4. Connect the cutting hose to the regulators and the cutting torch.
5. Individually purge the oxygen line while the oxygen line is closed. Vent gases safely.
6. Set the oxygen and LPG regulators to the recommended working pressure with appropriate torch valve open.
7. Open the LPG inlet valve and light the cutting torch.
8. Open the oxygen inlet valve and adjust the flame, using both inlet valves.

After the adjustment of the flame, the material to be cut is partly heated up to melting temperature. Then the second oxygen valve is turned on slowly in order to start cutting. If cutting is not possible this means pre- heating is not sufficient. So the second oxygen valve is closed down and the material is heated again. This procedure is continued until the material is ready for oxygen oxidation (Cutting).

In order to make a straight and easy cut, an apparatus with wheels can be connected to torch. Four cicular cuts, a pair of compasses can also be connected.

Different tips should be used for different thicknesses. Below table gives tip numbers according to thickness of material.

Between 1mm and 10mm	Tip No. 25
" 10mm and 30mm	" No. 50
" 30mm and 50mm	" No. 100
" 50mm and 100mm	" No. 250

Cutting process should be done minimum 3 meters away from where the pressure cylinders are. After the cutting process each regulator has to be closed down and the pressure gages should be checked that the pressure in the hoses is zero

Ihsan Ayanoglu
MEDAL.

Foundry & Mechanical Workshop,
Mogadishu - Somalia.

24-April- 1985.

Appendix 5.

A Survey on Existing Private Electric Motor Rewinding and Repairshops in Mogadiscio, Somalia.

In order to identify possible electrical repairshops for subcontacting purposes of repair rewinding work required for pumps and to identify eventual needs for technical assistance to improve their capabilities, electrical repairshops in Mogadiscio have been surveyed.

Two shops have been found able to undertake the subcontracting services after some technical assistance. The rest of the shops are not suitable due to lack of know- how and raw materials, not being interested in the subject and financial problems.

The selected two workshops and their capabilities and needs are given below.

Workshop 1

Manager: Mr. Maxammed Cumar Axmed

Shop Name: Dukaanka Q. Farsamada Korontada iyo Saabidda Kotoorada.

Year of Establishment: 1981

Know - How: Enough for electrical repair of pump motors

Man Power: Seven technicians are working with a number of young fellows who wish to learn the job without getting any money.

Financial Capacity: Lack of raw materials and some essential tools such as electric testers, effects rate and quality of the work.

Existing Equipment: A very simple motor testing panel without any ammeter and voltmeter, one clamp ammeter with voltage and resistance range, one simple winding machine.

Assistance Required: Expert on electrical motor winding with experience on small shop management procedures, one ton stationary electric crain, foot operated fork lift(hydrolic), drying oven, motor testing panel, winding machine, 500 V Megger for insulation resistance measurement, multitester (avometer)

Working Capacity: 25 - 30 medium size electric motors in one month with external labour force when necessary.

Working Area: Around 45 square meters.

Power Supply: Sufficient for possible extention.

Workshop 2

Manager: Mr. Dahir Mohammed Hassan

Shop Name: Dahir Tundo Elettromeccanica

Year of Establishment: First established in 1949 by an Italian fellow called Mr. Tundo. After his death, Mr. Dahir Mohammed Hassan got in charge of the business in 1978.

Know - How: Enough for electrical repair of pump motors.

Man Power: Nine technicians are working with a number of young fellows who wish to learn the job without getting any money.

Financial Capacity: Owner claims that his finances are sufficient for importing all required raw materials and essential tools.

Existing Equipment: One simple winding machine, one drying oven for small size motors, one megger for insulating resistance measurement, one multitester (avometer)

Assistance Required: Expert on electrical motor winding with experience on small shop management procedures, one ton stationary electric crain, foot operated hydrolic forkpoint, drying oven, motor testing panel, winding machine, 500 V megger for insulation resistance measurements, multitester (avometer)

Working Capacity: 25 - 30 medium size electric motors in one month.

Working Area: Around 25 square meter; planning to move to a larger shop around 200 square meter in the near future.

Power Supply: Sufficient for possible extention.

REMARKS

As the capabilities and needs described above, it seems the two repairshops mentioned above can undertake the subcontracting services of repair and rewinding, after the technical assistance of UNIDO.

The repairshop called Dahir Tundo Elèttromeccanica seemed more capable for the purpose because of being able to handle quite higher working capacity at the moment, making a better work planning, having less problem of raw material supply. Also work place is found comparatively in order.

On the other hand, limited working space may create some problems for an extention. So moving to a larger work place is essential.

Levent Gencoglu

L. Gencoglu

Team Leader,

Medal

List of Persons Met.

Appendix 6.

Mr. K.B. Raif, Acting Resident Representative, UNDP, Mogadiscio.

Mr. S.P. Brown, Deputy Resident Representative, UNDP, Mogadiscio.

Mr. A. Khalifa, Assistant Resident Representative, UNDP, Mogadiscio.

Mr. M.Z. Khan, Assistant Resident Representative, UNDP, Mogadiscio.

Mr. Mohamed Ali Dahir, General Manager, FMW, Mogadiscio.

Mr. Nihat.G. Kinikoglu, Project Manager, CTA, FMW, UNIDO.

Mr. Abdullahi Hussein Ismael, Deputy General Manager, FMW, Mogadiscio.

Mr. Suleiman Abdullahi Giama, Works Engineer, FMW, Mogadiscio.

Mr. Mohamed Mohamud Hersi, Engineer incharge of FMW, Mogadiscio.

Mr. I. Velev, Substantive Officer, UNIDO, Vienna.

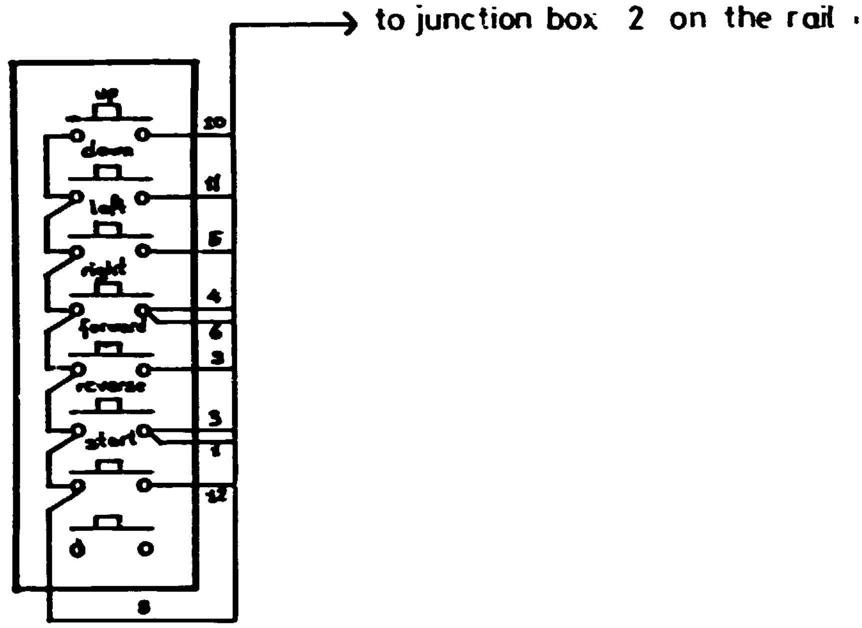
Mr. H.J. Fritz, Senior Industrial Devolopment Officer, UNIDO, Vienna.

Mr. R. Tompkins, Contracts Officer, UNIDO, Vienna.

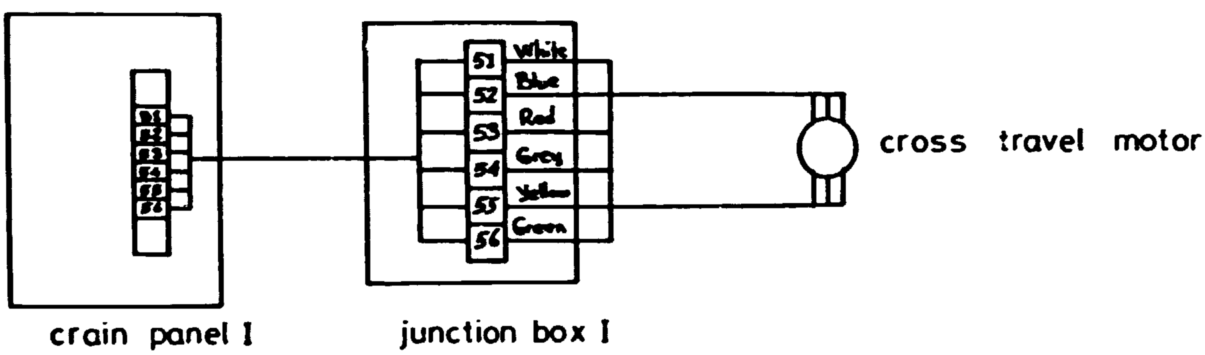
Mr. K.O. Bender, Field Technical Adviser, Fritz Werner Expert Gmbh, FRG.

RENEWED WIRING DIAGRAMS FOR OVERHEAD CRAIN

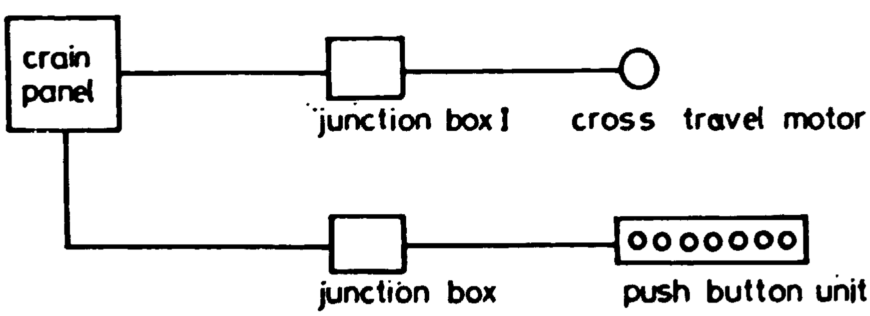
renewed wiring diagrams of push button unit



renewed wiring diagrams of cross travel motor

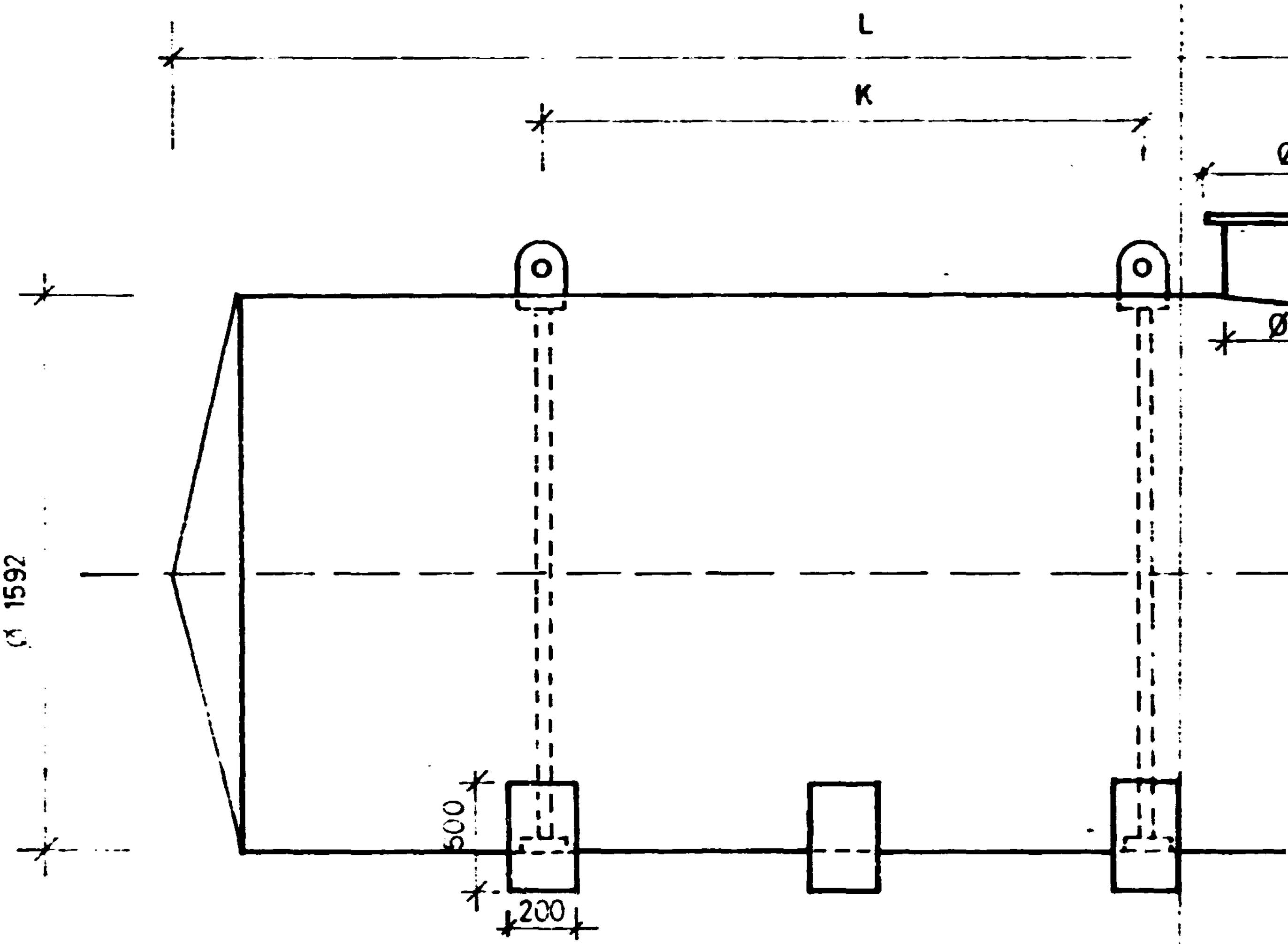


general connection diagram



FMW

8m



side view

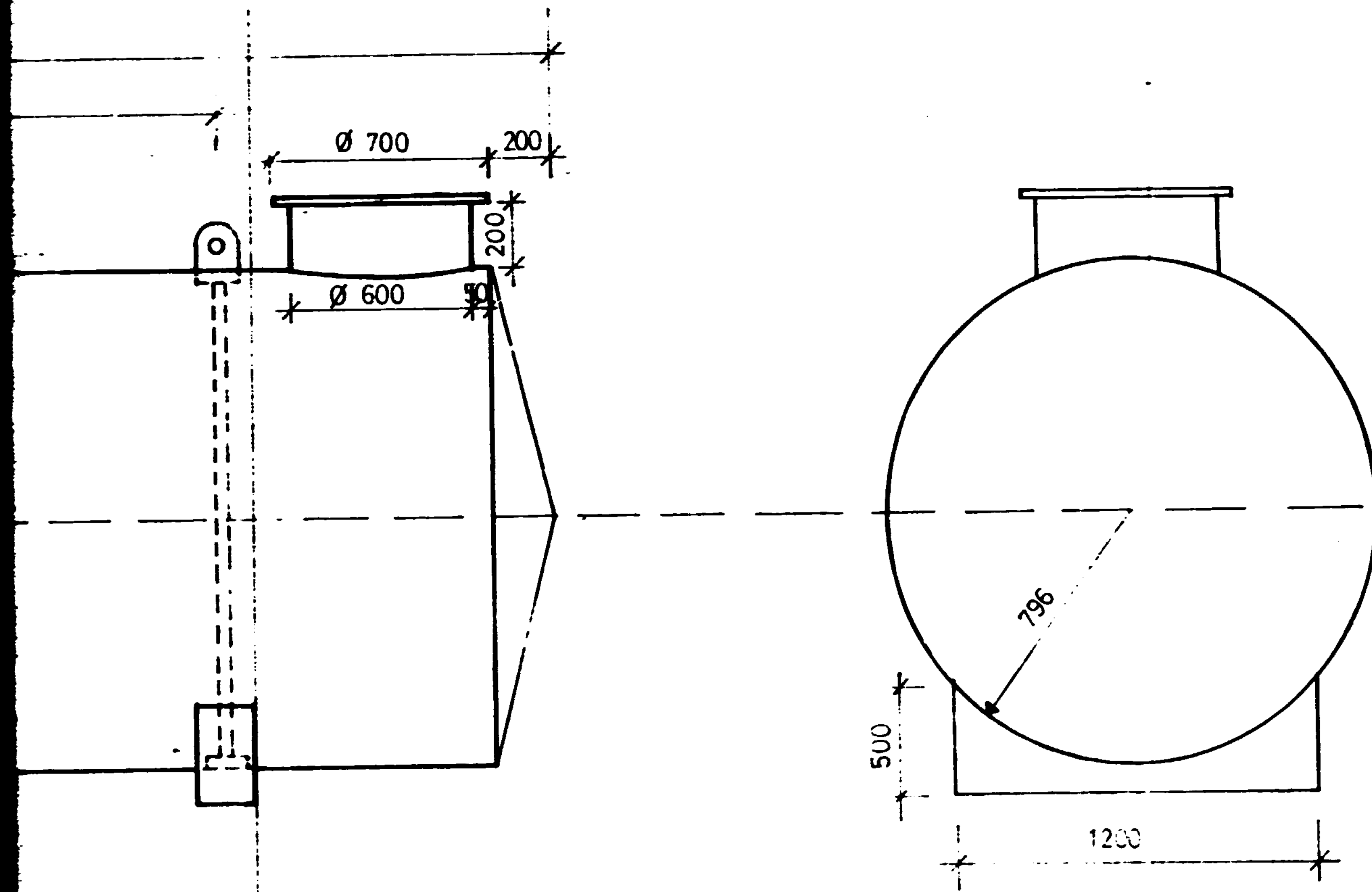
SECTION 1

8

10

SECTION 2

$8m^3$–$10m^3$ TANKS

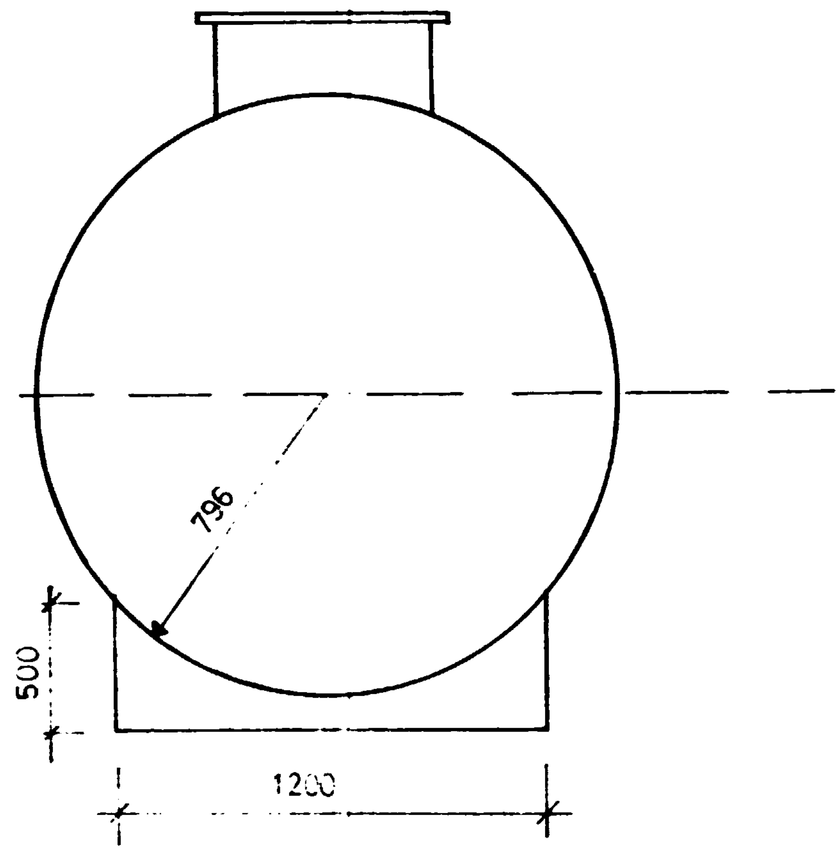


front view

w

	L	K
$8m^3$	4000	1800
$10m^3$	5400	2800

TANKS

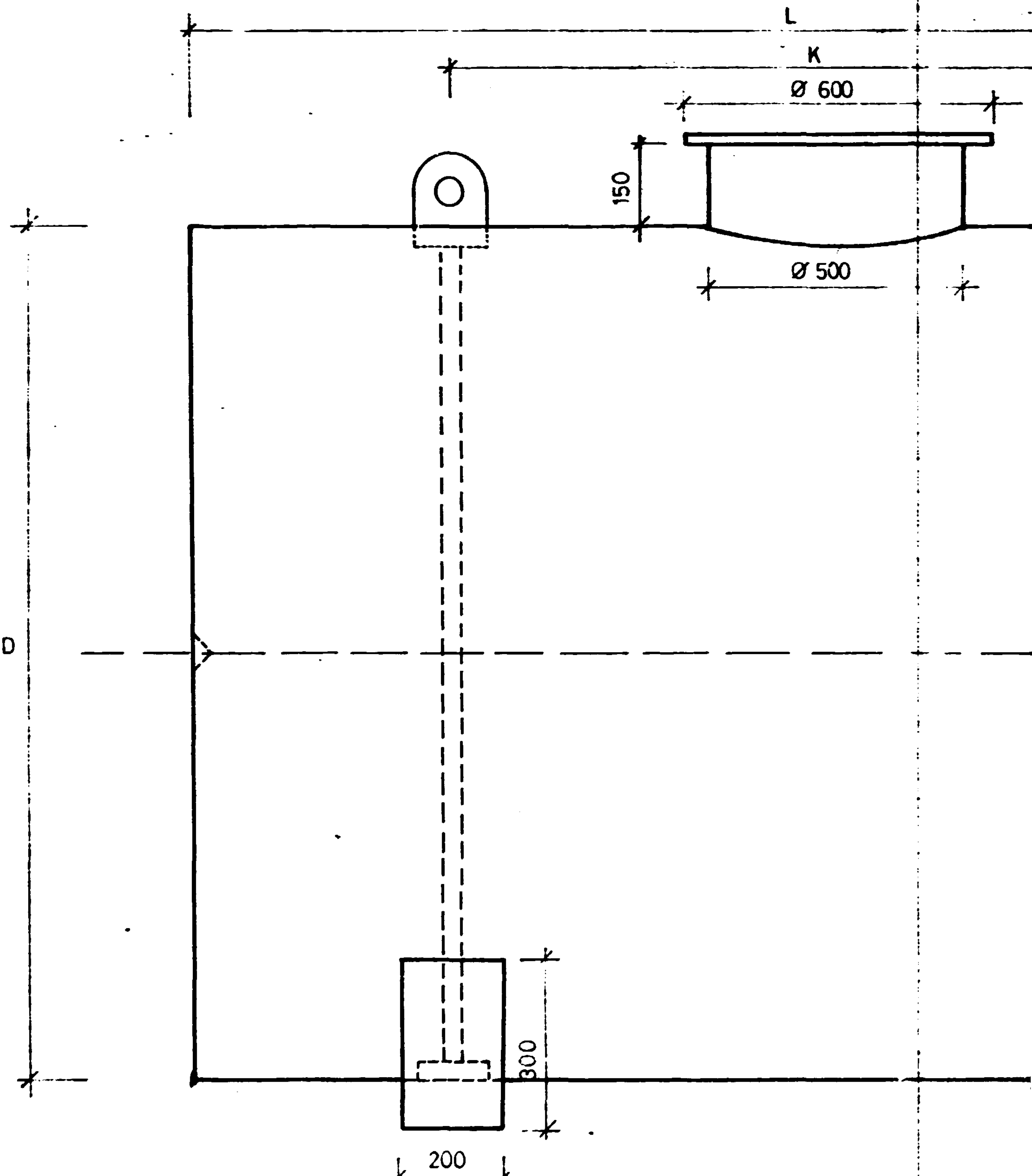


front view

SCALE 1/20

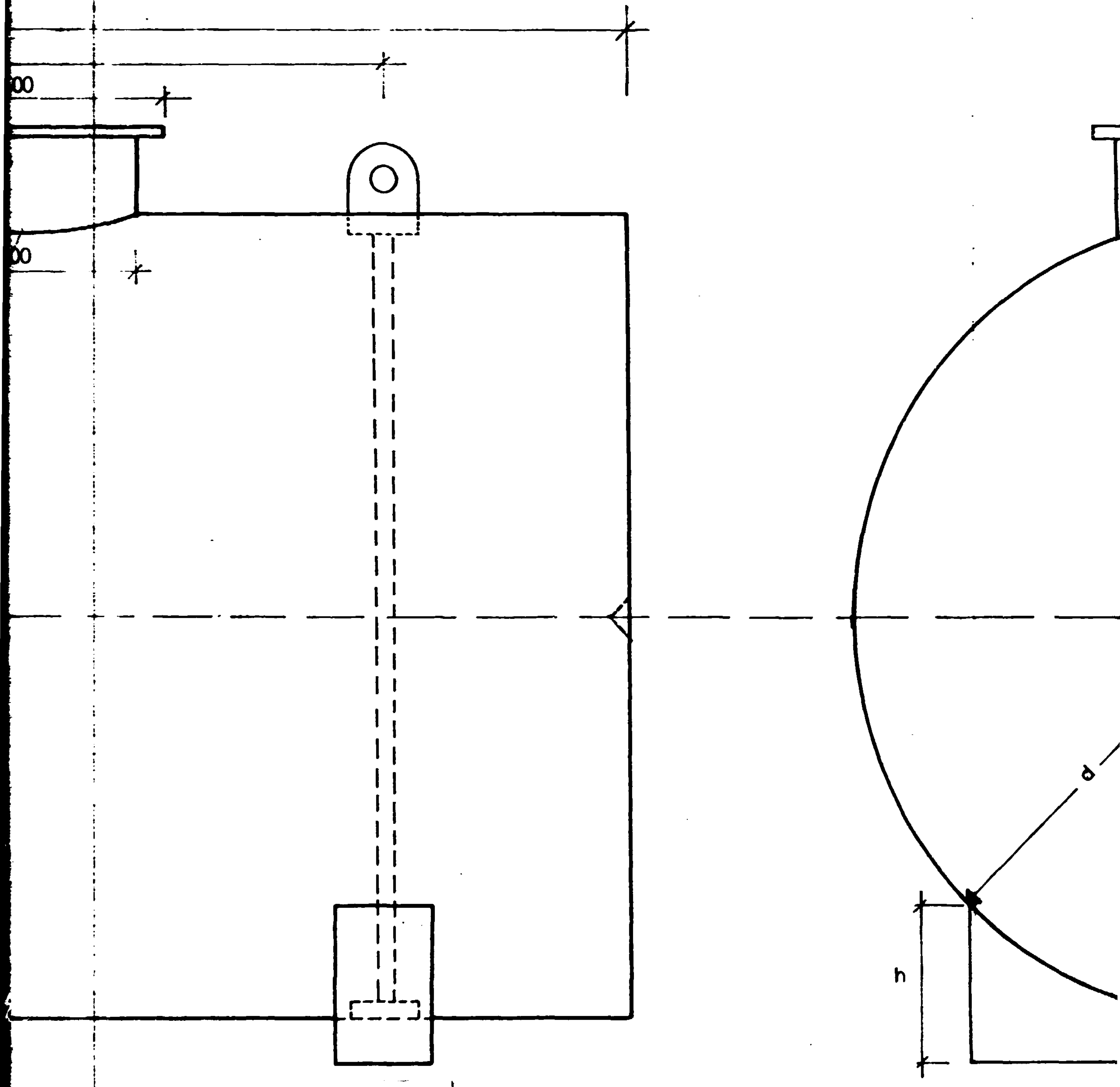
FMW

SECTION 1



side view

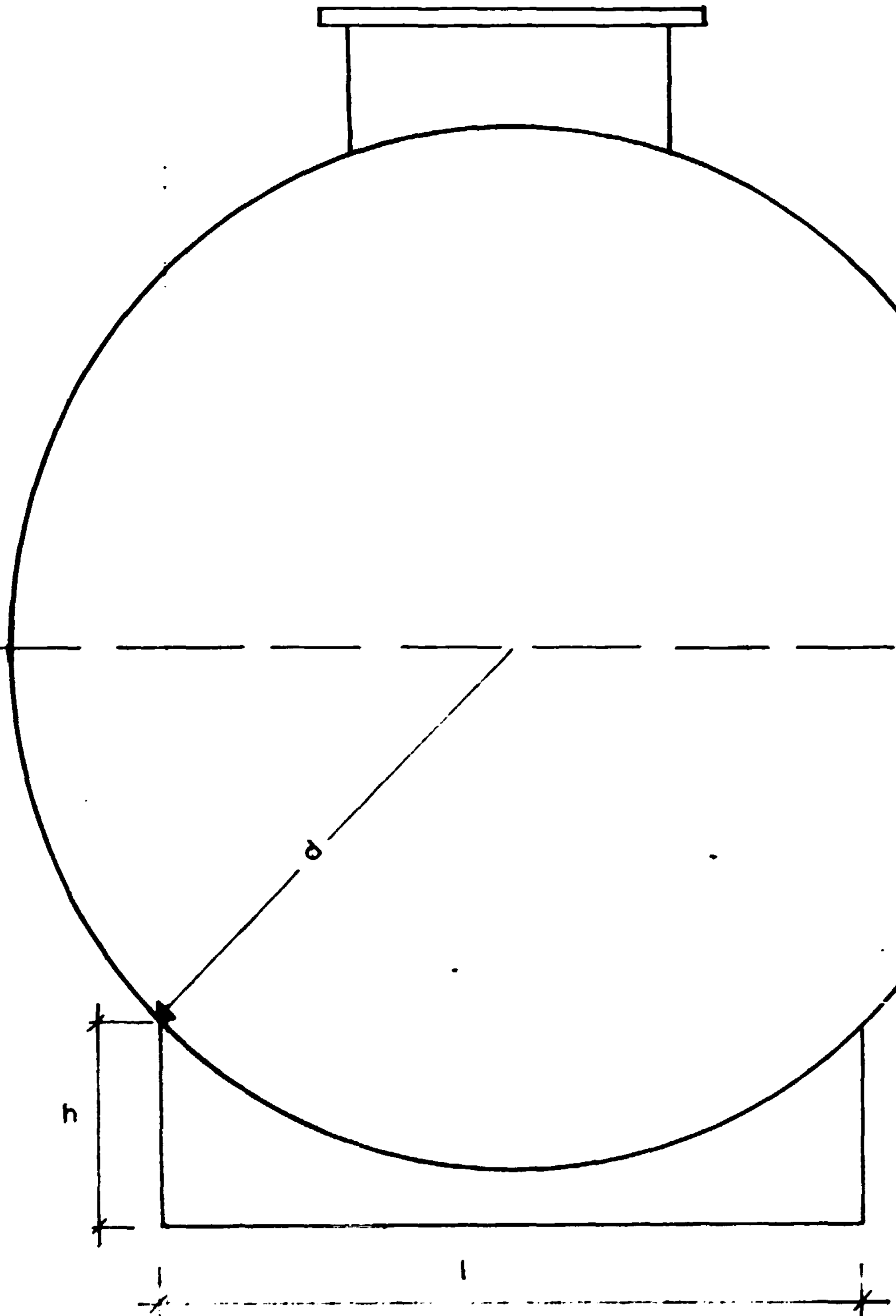
$4m^3$ – $5m^3$ – $6m^3$ TANKS



SECTION .2

W

	L	K	D	l	h	d
$4m^3$	2600	1600	1400	1000	300	700
$5m^3$	2500	1500	1600	1100	300	800
$6m^3$	3000	2000	1600	1150	300	800



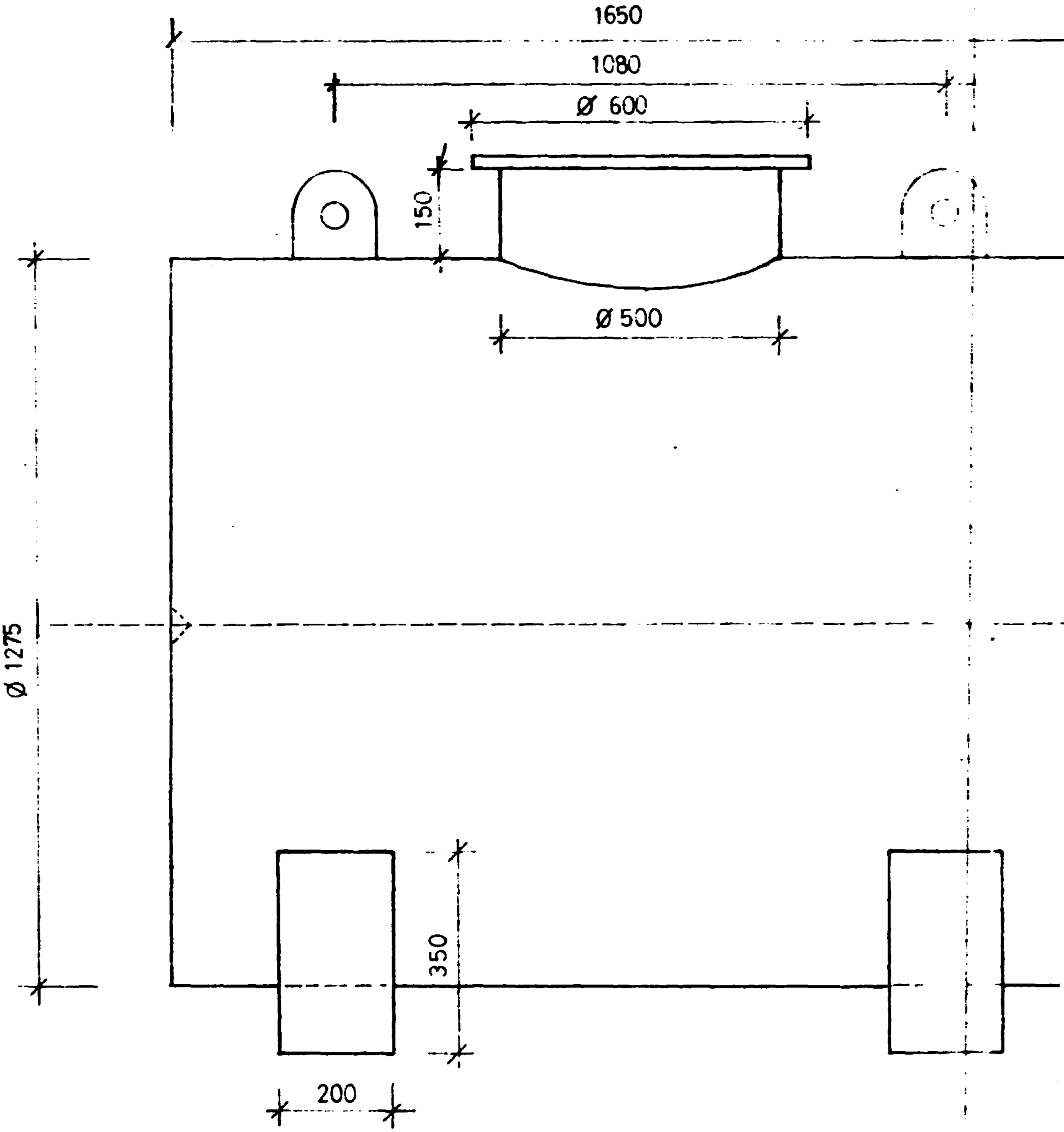
l	h	d
1000	300	700
1100	300	800
1150	300	800

front view

SECTION 3

SCALE 1/10

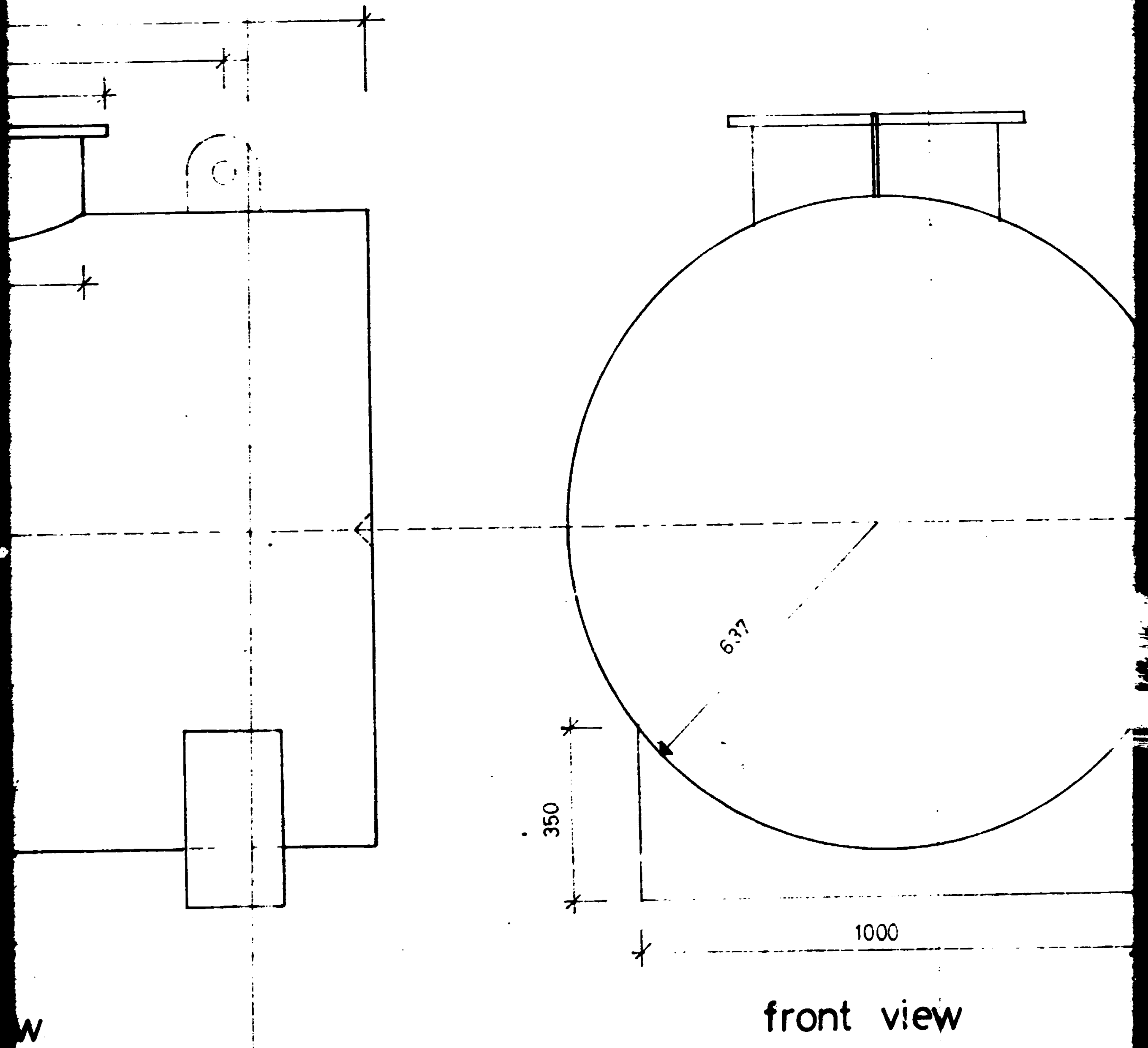
FMW



side view

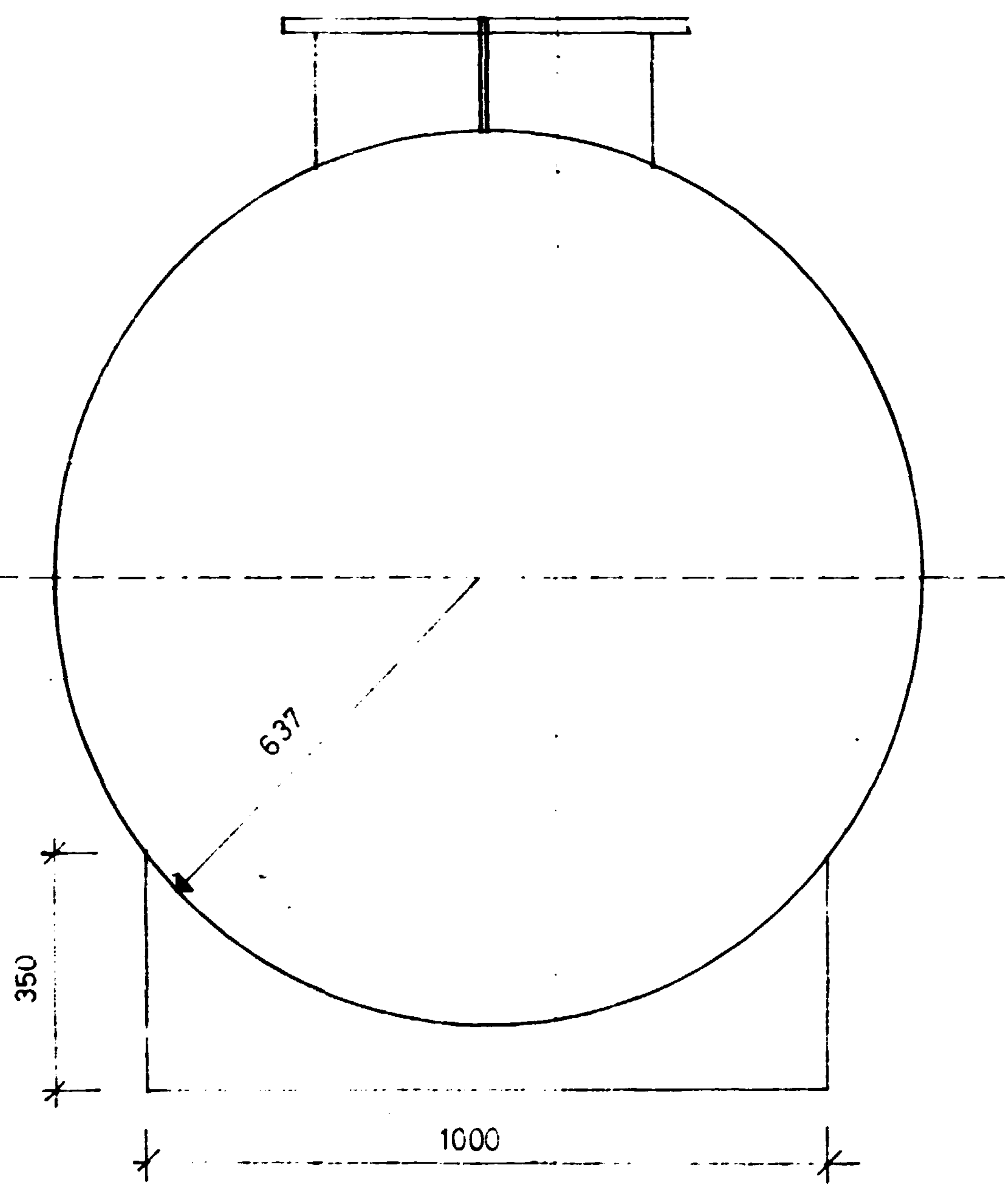
SECTION 1

2m^3 TANK



SECTION 2

$2 m^3$ TANK



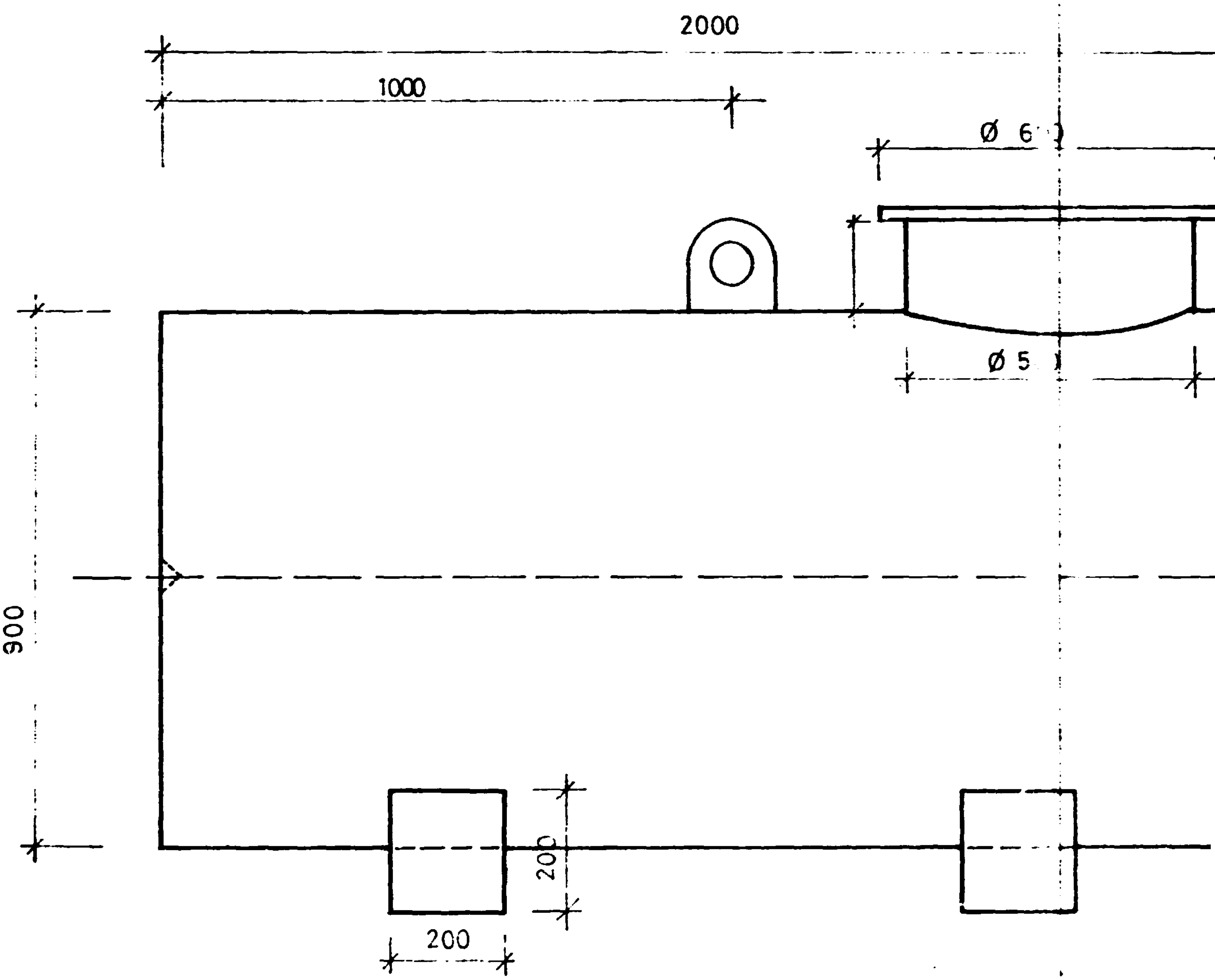
front view

SECTION 3

SCALE 1/10

FMW

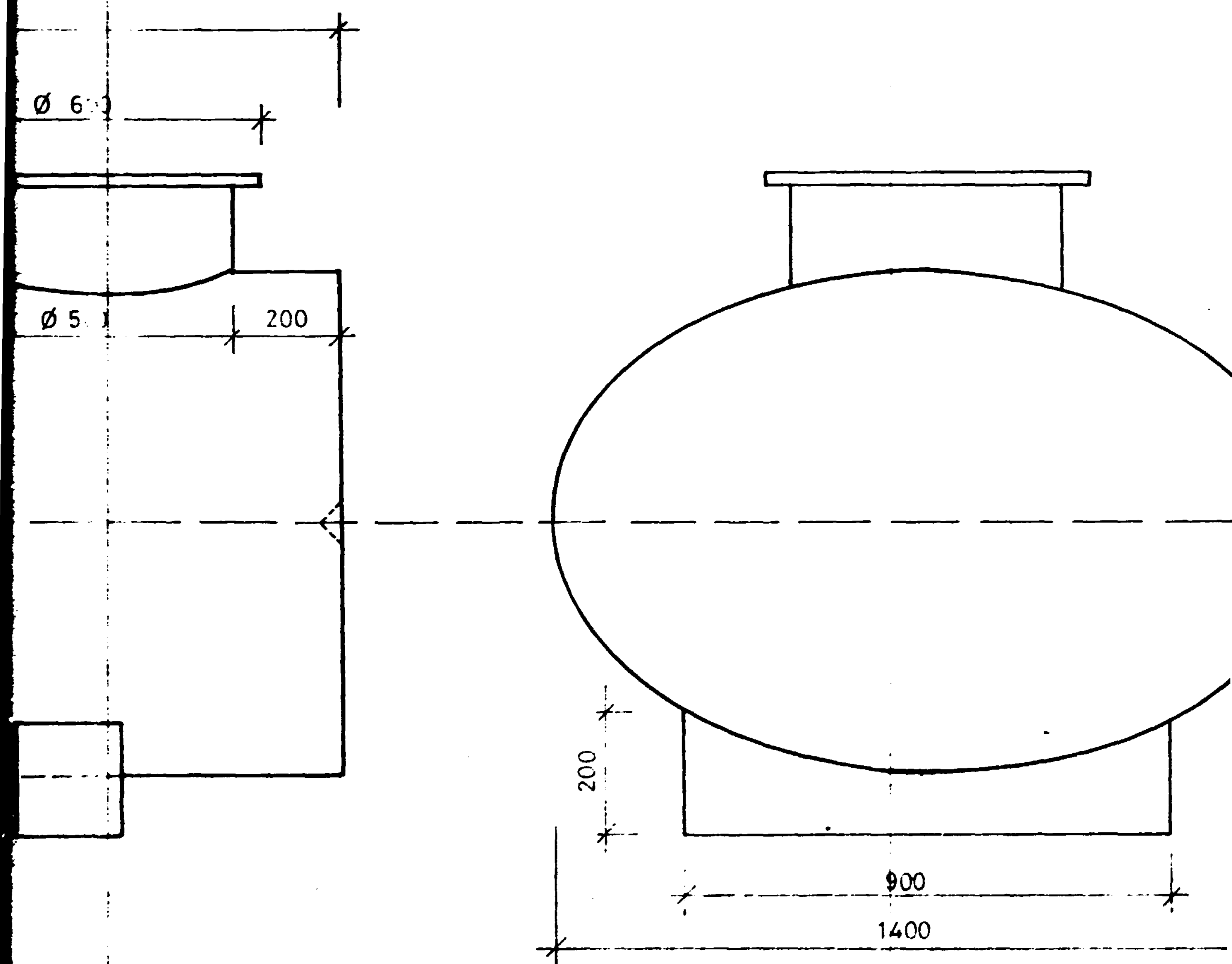
2 m³ ELLIPSE TAN



side view

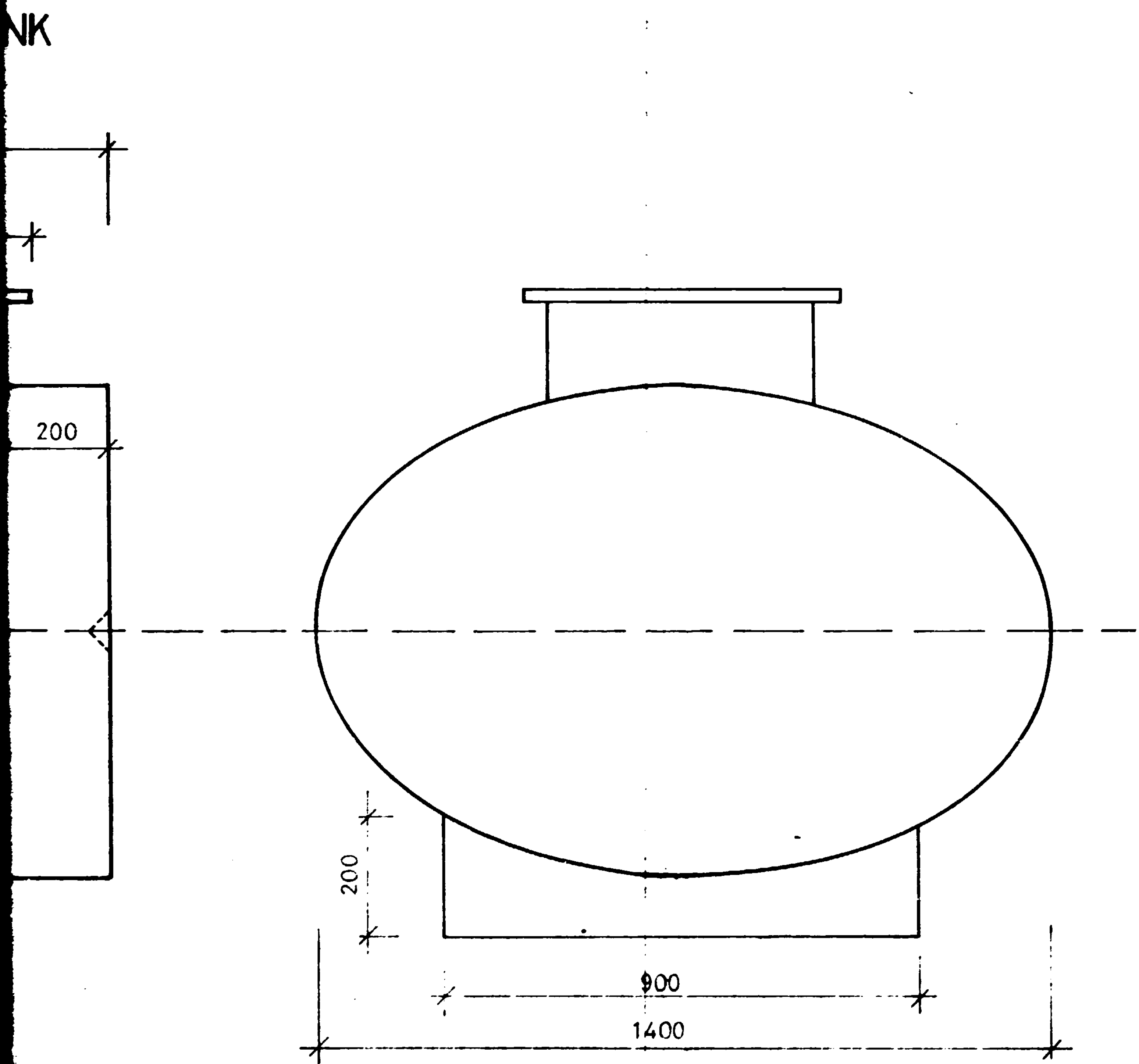
SECTION 1

LLIPSE TANK



front view

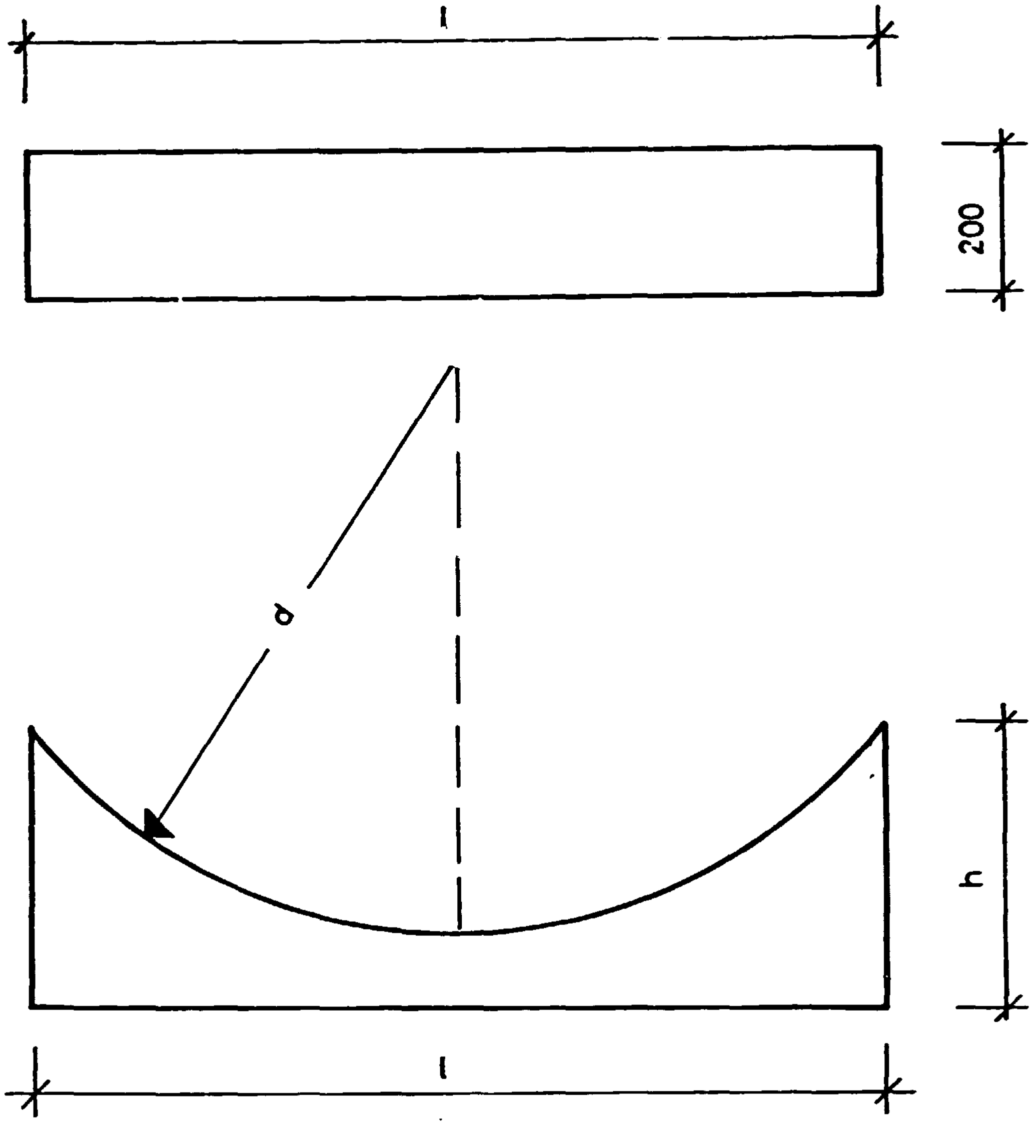
SECTION 2



front view

SECTION 3

FMW

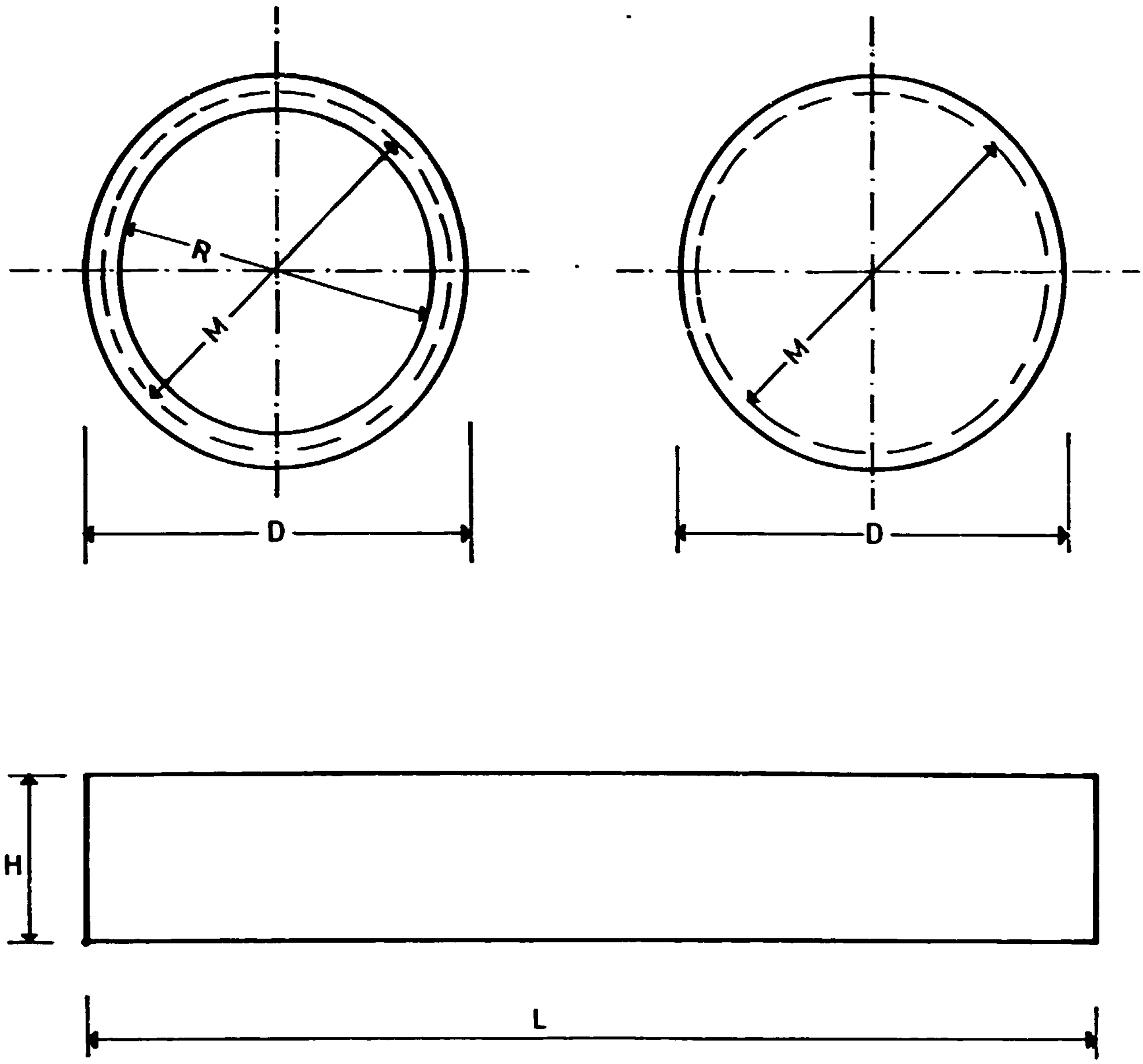


STANDS

	l	h	d	t
$2m^3$	1000	350	637,5	4
$4m^3$	1000	300	700	5
$5m^3$	1100	300	800	5
$6m^3$	1100	300	800	5
$8\text{-}10m^3$	1200	500	796	5
$20m^3$	1600	500	1000	6

SCALE 1/10

FMW

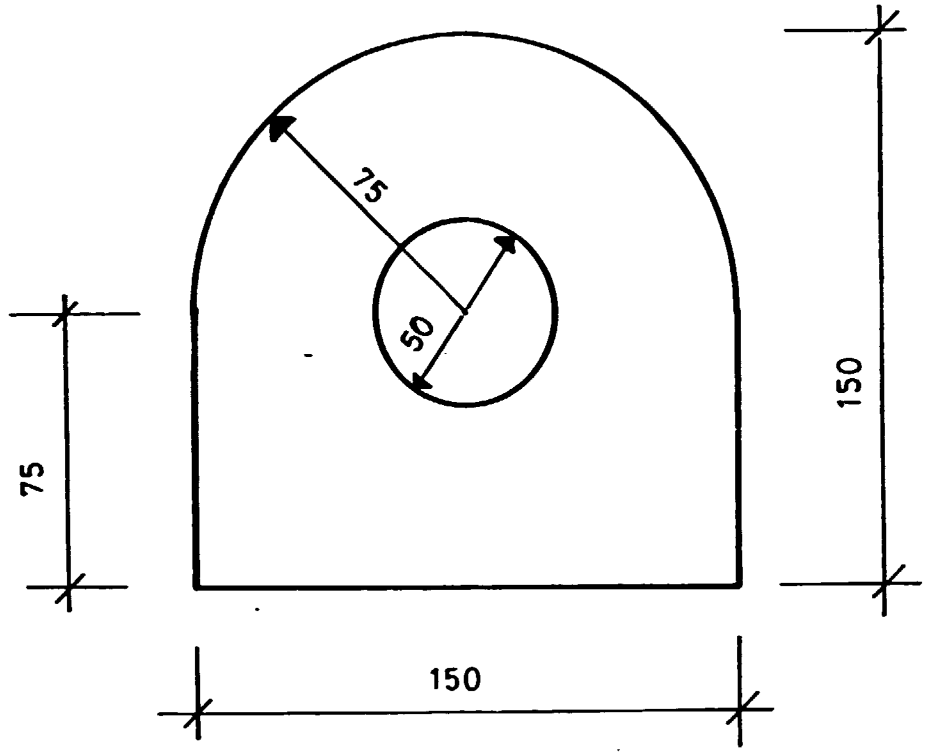


NECK

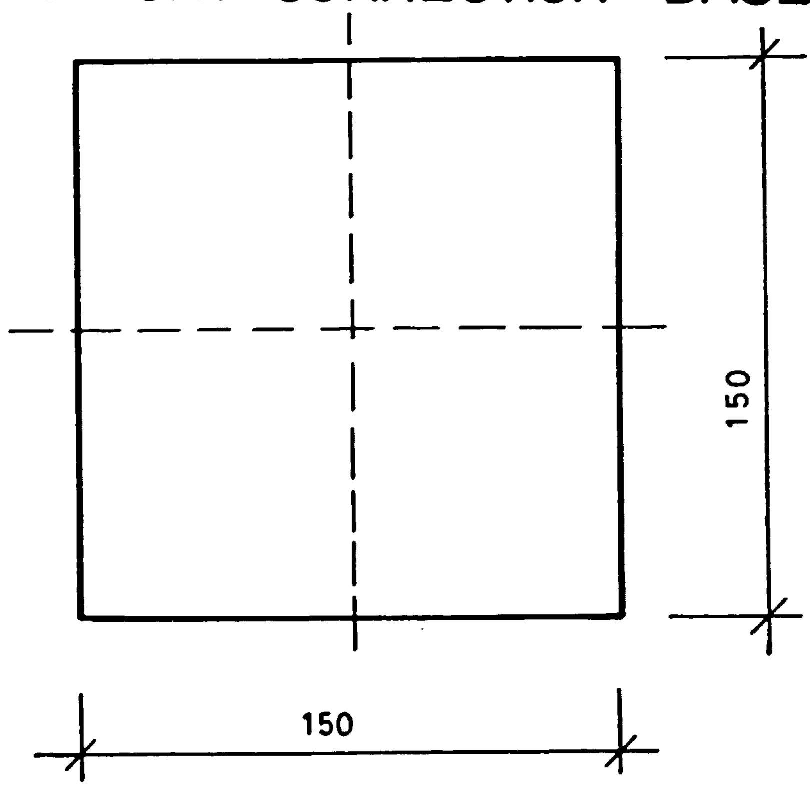
	D	R	hole number	hole diameter	thickness	L	H	M
$2m^3$	600	500	12	15	5	1570	250	550
$4\text{-}5\text{-}6m^3$	600	500	12	15	5	1570	250	550
$8m^3$	700	600	16	20	5	1880	300	650
$10m^3$	700	600	16	20	5	1880	300	650
$20m^3$	700	600	16	20	5	1880	300	650

FMW

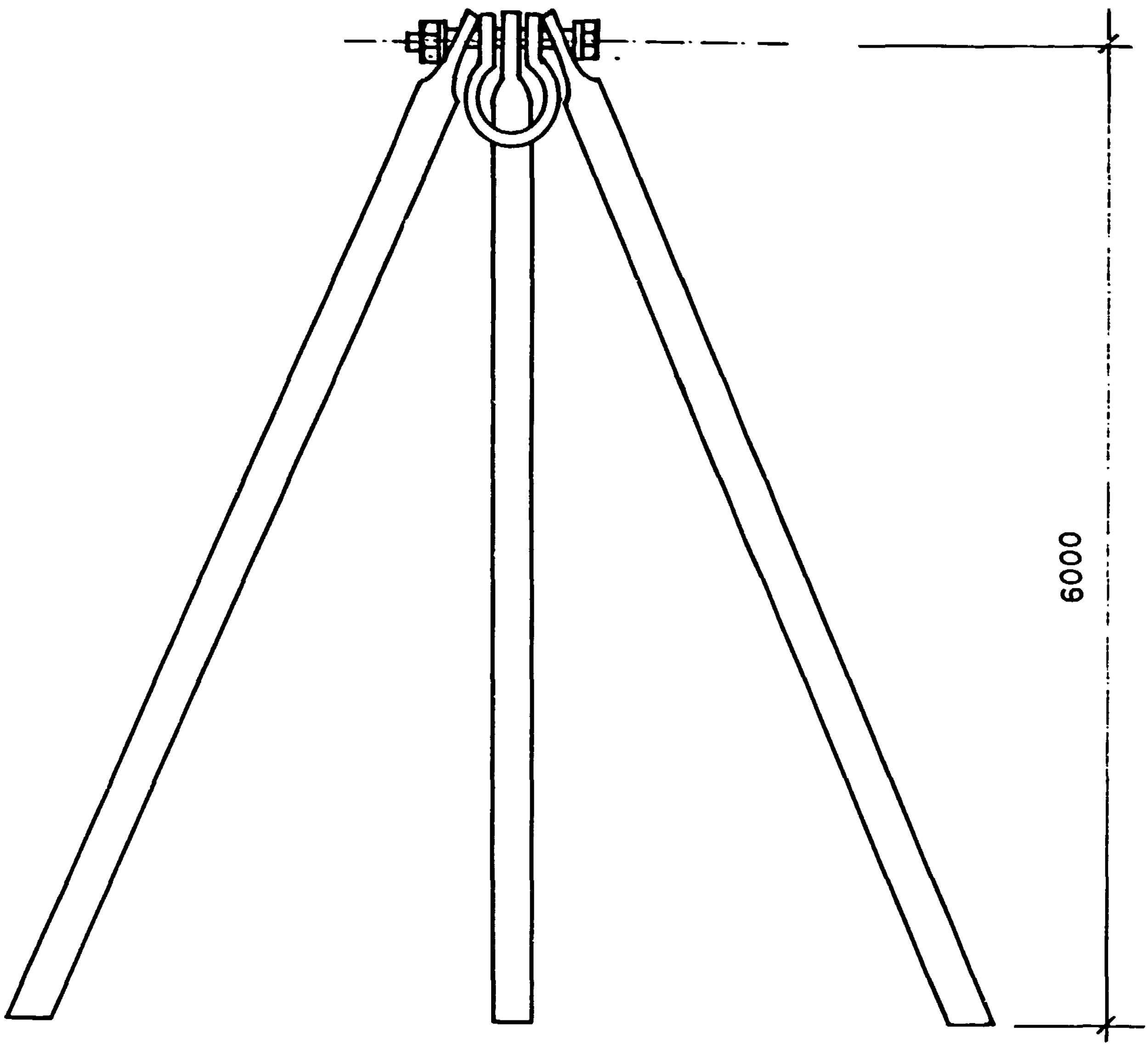
LIFTING EYE



SUPPORT CONNECTION BASE



SCALE 1/2



10 TONS TRIPOT LIFTING

FINAL REPORT II

Consultancy Services for the Rehabilitation of Equipment and Upgrading of the Efficiency of the Foundry and Mechanical Workshop

in

MOGADISCIO, SOMALIA

UNIDO Contract No. 84/8SM
Project No. RP/SOM/84/002
Activity Code RP/01/31.8

Prepared by: MEDAL, Consultancy and Research for Metallurgical Industries Ltd. Istanbul, Turkey.

Istanbul, 27-September-1985

This report comprises this title page, one (1) synopsis page, twelve (13) pages of text and four (4) appendixes (1 though 4)

SYNOPSIS

Field work in FMW for the duration of extended four months which was confirmed by UNIDO in telex 38330 sent to Project Manager, were carried out by Medal team consists of two experts, in connection with the project entitled 'Rehabilitation of Equipment and Upgrading of the Efficiency of the Foundry and Mechanical Workshop!

In order to reduce the number of equipment out of operation, machine repair and maintenance had the priority in the extended period of mission. All the equipment which could be repaired with locally available material and local production were repaired. The remaining machines which are only about 20%, need spare parts from original suppliers.

Installation of the electric equipment were completed during the assembling of the equipment required for test base in Pump Repair Section. New Manufacturing technologies were introduced such as using of roll type positioner, on tank production, new designs were introduced on production such as 40, 150, 300 m^3 tanks and LPG tupe production, preparation of spare parts and in plant training course on welding technology have been completed.

During this extended four months, electric power cuts have not occured as much as it had formely. Lack of spare parts has still been the first problem to be solved for FMW. At the moment new engineers and technical school graduates are being employed. This will eliminate the difficulties created by poor labour capacity.

A generator could solve electric power cut problems which are probably going to occur again in the future.

TABLE OF CONTENTS

INTRODUCTION

Under UNIDO project No. RP/Som/84/002, Activity Code RP/01/31.8 a contract for the provision of services relating to the Rehabilitation of Equipment and Upgrading of the Efficiency of the Foundry and Mechanical Workshop in Mogadiscio in the Democratic Republic of Somalia has been concluded between.

UNIDO

United Nations Industrial
Devolopment Organization
Vienna, Austria

and

MEDAL

Consultancy and Research
for Metallurgical Industries Ltd.
Istanbul, Turkey.

Within the scope of the contract, field works for the extended four months in Somalia were carried out by

Mr. Levent Gençoğlu, Electrical Engineer, (Team Leader)
Mr. İhsan Ayanoğlu, General Foreman.

from May 8^{th} to September 8^{th} 1985.

The extention of the contract is confirmed by UNIDO and Medal in telexes one SM63075 date 16 Aug.85 sent to Medal by UNIDO and the other one 1025 date 26.9.85 sent to UNIDO by Medal.

The aim of the project is to provide the necessary expertise and day to day shop level technical assistance to the Somali counterparts in order to put into operation the idle and under utilized equipment and achieve self dependence in the latter's exploitation and maintenance by relevant upgrading of the local skills.

This report has been prepared in order to state activities, accomplishments, bottlenecks, findings, recommendations, concerning the extended period of the field work.

The reports is requested by UNIDO in the contract on paragraph 2.10.a.

Thanks are expressed to Mr. Nihat G. Kınıkoğlu, project Manager CTA. UNIDO; Mr. Mohamed A. Dahir, General Manager, FMW; all counterparts and the management of the Foundry and Mechanical Wokshop for their kind support and cooperation on this mission.

1.00 ACTIVITIES OF MEDAL TEAM

1.1.0 Rehabilitation of Equipment

List of Repaired Equipment

Name of Equipment	Location
Band Saw	Foundry
Copper Melting Furnace	Foundry
Double Disk Grinder I	Foundry
Double Disk Grinder II	Foundry
Sand Blast	Foundry
Core Sand Mixer	Foundry
Large Cupola	Foundry
Saw Blade Welder	Pattern Shop
2 Tons Gear Chain Pulley	Steel Structure Section
Sipe Welding Machine I	Steel Structure Section
Overhead Crane	Foundry & Steel Structure Section.

1.1.1 Band Saw

Works carried out: Broken main switch replaced, mechanical parts lubricated, all machine cleaned with naphta. A saw blade is fixed.

Working Period: 5 days.

1.1.2 Copper Melting Furnace

Gear box disassembled and all parts cleaned. Main shaft straightened in hand press.

Working Period: One Week.

1.1.3 Double Disk Grinder I

Broken main switch replaced, cable installation is completely renewed, machine cleaned with naphta.

1.1.4 Double Disk Grinder II

Broken main start switch replaced, main supply cable renewed, machine cleaned with naphta. This machine contains two electric motors. At the moment, only one is in operation and the other is damaged.

1.1.5 Sand Blast

A new main contactor is fixed (The original one was broken), machine cleaned with naphta, a main supply cable installed.

- This machine was not in operation for years because of the damage in its electrical system. At the moment it is in quite good condition.

1.1.6 Core Sand Mixer

Starting system has been changed because the original contactor was not available. A three phase start switch installed, machine cleaned with naphta, damaged main supply cable renewed. Machine is in lack of one blade which is added to the spare part list.

- Above four machines were in lack of electric supply. A main electric supply cable is installed underground for this purpose from the nearest distribution box to a connection box then from the connection box, one supply cable for each machine has been installed. Main supply cable is protected with a thermally protected switch. Working Period for above mentioned machines: 2 weeks.

1.1.7 Large Cupola

During the operation, the large cupola was damaged due to metal leak.

Working Period: 3 days

1.1.8 Saw Blade Welder

Rusted electrodes have been cleaned, necessary adjustments were made, whole machine was cleaned.

1.1.9 2 Tons Gear Chain Pulley

Broken mechanical parts were made in workshop and assembled in their places. All parts have been cleaned and lubricated.

1.1.10 Sipe Welding Machine I

Broken start switch replaced, electrode cables connected.

1.1.11 Overhead Crane

Main energy supply cable installation has been renewed. 20 meter cable was installed on the wall inside plastic pipes, main switch cleaned.

1.2.0 Upgrading of the Efficiency

1.2.1 New Productions

Manufacturing of Roll Type Positioner

The production of parts which was started earlier is completed and assembled. The apparatus is in use at the moment. It is used on tank production to join the bended sheet metals to each other by turning them on the rollers. Necessary instructions for operation of the apparatus have been given to the counterparts during the production of tanks.

LPG Tupe Production

Two LPG Tupes have been produced by using existing possibilities in FMW. One has been tested under 5 atmosphere pressure. The other one is in lack of valve at the moment.

- This work was requested by FMW management.

150 m^3 and 40 m^3 Tank Production

For both tanks, necessary drawings and required material list for production are prepared and (App. 2 Figs. 1,7) sheet plates have been bended, necessary instructions were given to the counterparts.

Production still continues (App. 3)

- Also technical drawings are prepared for the production of 300 m^3 tank (App. 2 Fig. 7).
- 20 m^3 tank drawing which was prepared before has been revised. (App. 2 Fig. 5).

1.2.2 Training Course

In plant training on metal working techniques and welding technologies is completed.

1.2.3 Preparation of Specifications of Spare Parts and Expandibles

The FMW suffers from lack of spare parts for repair and maintenance. In order to solve this problem, preparation of the specifications of spare parts was essential. Especially for electric parts, each machine has been examined one by one because the existing documents hardly included the electric parts while a great number of catalogues were missed. (App. 1).

Working Period: 5 weeks.

1.3.0 Other Activities

1.3.1 Installing the New Electric Equipment and Making Necessary Wire and Cable Connections Required for Pump Repair Section

Main cables were installed in a cable duck made underground between the nearest distribution box to Test Base Control Panel. Necessary wires were connected between Test Base Control Panel and a connection box where the pump motors get energy.

Energy supply cables also installed for two electric motors, the overhead crane and one panel on the Test Base.

1.3.2 Underground Electric Installation for Welding Machines

For this purpose, main cable duck were opened and cleaned, floor concrete was broken in advance. Necessary cables have been installed underground inside galvanized pipes and plugs were fixed on certain areas where welding machines are normally in operation. These plugs could also be used for single phase supply.

For the welding machines which work outside Steel Structure Section, existing lighting supply cable has been used because the lighting system in Foundry & Steel Structure Section is completely damaged and not needed at the moment.

If it is requested to use lighting system in the future, same line can be used for this purpose with a simple connection change.

- In order to use electrical hand tools properly, a single phase cable has been installed on the wall in the Foundry.
- Electric distribution boxes in FMW have been cleaned.
- Damaged welding machine cables have been repaired.
- Necessary Operation instructions about the tools which were purchased recently, have been given to counterparts during daily operations of repair and production.
- A material list required in steel Structure Section for the period of one year has been prepared and presented to FMW management. (App. 4).
- Guillotine Shears I Could not be repaired because oxygen for anneal was not available.
- Necessary contact has been made with the manufacturer of Luna Migatronic welding machine for operation instructions and spare part list. The documents received on last day of Medal's field work. List of spare parts for repair has been given to project manager.

2.00 FINDINGS AND ANALYSES

As a result of investigations, below facts were discovered and analized:

2.1.0 Great Number of Damaged Equipment, Lack of Spare Parts and Documentations.

Especially in Steel Structure and Foundry Sections, the number of damaged equipment was very high. This number has ben tried to be reduced by using FMW possibilities as much as possible and the percentage of equipment not in operation became around 20%. On the other hand, it should be considered that the equipment which is in operation at the moment, still need spare parts for maintenance and possible damages which might occur in the future.

Necessary contacts had been made with the manufacturer of Luna Migatronic welding machine and the document about operation instructions and spare part list have been received on the last day of field work. By using these documents and ordering the spare parts, the machine can be repaired in the future.

2.2.0 Local Purchase Possibilities.

Difficulties in local purchase effected the working rate. To find any spare parts either for electrical or mechanical repair is hardly possible in local market.
On this extended period of time, FMW was comperatively much better on purchasing the materials required for repair and maintenance.

2.3.0 Electric Power.

Electric power cuts did not occur very often in this period but probably will be a problem to be difficult to face in the future. Existing electric transformer capacity of 160 KVA would not be enough for any future extension.

2.4.0 Counterparts.

At the moment the number of counterparts are being enlarged by employing 7 engineers and 30 technical school graduates. One engineer will be responsible for maintenance with 2 new technicians for electrical and 2 new technicians for mechanical maintenance.

Other sections will also have enough labour capacity. On the other hand it should be considered that the adaption of these engineers and technicians to work will take some time because of their inexperience on practice.

During the extended four months of field work, the activities which details are given in the body section have been carried out by using local possibilities as much as possible. Accomplishments, bottlenecks and recommendations concerning this period of field work are stated below:

3.00 Accomplishments.

A- Most of the damaged equipment have been repaired and day to day practical technical advice for maintenance, operation of the machinery and production for Steel Structure Section have been given to the counterparts. A small number of machines which are not in operation at the moment could not be repaired because of lack of spare parts needed to be purchased from original suppliers.

B- Training course on welding technology has been completed.

C- Necessary drawings for the designs of 40 , 150 , 300 m^3 tanks have been prepared and the production of 40 and 150 m^3 tanks were started under the inspection of Medal team and necessary instructions and advices have been given to the counterparts.

D- One roll type positioner as an auxilary apparatus for tank production and two LPG tupes (one lacking valve) have been produced.

E- Necessary wire and cable connections and electric installations required for pump repair section have been completed.

F- Specifications of spare parts and expandibles required for repair and maintenance of equipment have been prepared.

G- Necessary day to day advice was given to the counterparts on operation procedures of newly acquired repair and maintenance tools.

4.00 Bottlenecks.

A- Most of the equipment need spare parts for repair and maintenance.

B- Local purchase possibilities are very poor, they effected the working rate.

C- Electric power cuts may create some problems any time.

5.00 Recommendations.

A- New engineers and technicians need practical training before any responsibility is given to them.

B- In order to solve electric power cut problems, a generator set should be installed for FMW. If it is not available, at least a 20 KVA generator has to be considered for large cupola furnace in order to eliminate problems caused by power cuts during the melting process.

On the other hand, 160 KVA rated power of existing transformer will not be sufficient for any future extension.

C- A sound storage system has to be established to FMW especially after the purchasing of the spare parts.

LIST OF APPENDIXES

LIST OF SPARE PARTS AND EXPANDIBLES.

STEEL STRUCTURE SECTION.

Milling Machine.

Prvomajka
Zagrep Yugoslavia   Type: UG - 1   No: 04475515

Part No.	Part Name	Manufacturer	Spacifications	No. Off
1	Contractor	Iskra, Yugoslavia	Type: K 1/8 It = 16A, Un = 500V 380V ——— 4 KW 1NO, 1 NC contact Coil: 220V	10
2	Themic relay	Iskra, Yugoslavia	Type: RB 2/1 0.5 - 1A	1
3	Diode Module	Iskra, Yugoslavia	Type: B 48 N 3B1	2
4	Diode Module		Type: PZ24 - 2/69 U = 24V, I = 1 - 2A	6
5	Transformer	Lyubljana Crnuce Yugoslavia	Type: PV4 - 480 3 Primer: 380V 1.16 A, 50HZ Seconder: 110 - 18 - 31V, 1.8/6.4 0.4 KVA	1
6	Limit Switch	Iskra, Kranj Yugoslavia	Type: Mjh 6 220V - 10A 380V - 6A	1

(Continued on next page)

Part No.	Part Name	Manufacturer	Specifications	No. Off
7	Three phase on - off switch	Rade Kancar Yugoslavia	3 ph. 600V, 40A 26 - 40	1
8	Blade Holder		Shaft dia. : 17mm.	4
9	Vee belt		700 x 18mm	2
10	Vee belt		1320 x 13mm	4

RADIAL DRILLING MACHINE

LIVNICA ZELJEZA I TEMPERA KIKINDA Yugoslavia

Type: RB-40 Factory No: 29/1461 10 - 40mm

Part No.	Part Name	Manufacturer	Specifications	No. Off
1	Diode Module	Iskra, Yugoslavia	B48N 3C1	2
2	Relay		220V, 50 Hz 3 NO, 3 NC Contact	1
3	Start Stop push button		6 A, 500V	2
4	Contactor	Rade Koncar	Type: CN 10 380V, 4.7 KW AC3 Ith = 23A Coil : 220V	3
5	Thermic Relay	Iskra, Yugoslavia	Type: RB 2/1 2 - 4A	1
6	Thermic Relay	Iskra, Yugoslavia	Type: RB 2/1 4 - 8A	1
7	Thermic Relay	Iskra, Yugoslavia	Type: RB 2/1 0.5 - 1A	1
8	Fuse patron		2, 6, 10, 16, 25A (500V)	9 each
9	Fuse head		25A, 500V	15
10	Fuse Contact Insert		2, 6, 10, 16, 25A (500V)	3 each

GUILLOTINE SHEARS I

AB Goteneds MEK, VERKSTAD GOTENE - SWEEDEN

Machine Type: L - 620, Machine No: 11596, Manu. Year: 1981

Lubrication: Shell valvata oil J460 or similar

Part No.	Part Name	Manufacturer	Specifications	No. Off
1	Foot operated switch	Cutler - Hammer Svenska AB Helsing borg	600V 15A -20c - +40c No: 1025 IH41C	1
2	Contaktblock	Cutler - Hammer	10316 H39	2
3	Konktforarflader	"	69 - 2230	2
4	Lockable emergency stop switch	Telemecanique	ZB2 RA91 XB2M 5A 380V	2
5	Limit switch (roll type)	Siemens	3SE3 100 - IE 10A 500V 500V heavy duty, same polarity	3
6	Indication Lamp	Rafi	1. 60 502, 250V, 2W	4
7	Diode		6I 7746	5
8	Transformer		240V/24V 50 Hz 0.25 KVA	1
9	Printed Circuit	Alingsas Elkamponeter AB	Type 810205 Ser: 11210	2
10	Contactor	Siemens	3TB44	2
11	Thermic relay	Siemens	3UA42 00 - 7AK 16 - 25 A aux. cont. : 6A	2
12	Diode Module		8107 AC KBPC 25 - 20	2

Part No.	Part Name	Manufacturer	Specifications	No Off
13	Three phase on - off switch	Kraus & Naimer	Type: K25 C029 10	2
14	Single phase on - off switch	Kraus & Naimer	Type: C 10 A 200 12A 600V AC	2
15	Single phase on - off switch	Kraus & Naimer	C10 A176	2
16	Single phase on - off switch	Kraus & Naimer	C10 A222	2

MECHANICAL PARTS.

Part No.	Part Name	Manufacturer	Specifications	No. Off
1	Lower Blade	AB Goteneds	OG - 6 - 21	1
2	Spring	AB Goteneds	OLA - 5 - 7	2
3	Lower Blade	AB Goteneds	OG - 6 - 1	1
4	Bearing	AB Goteneds	3 - 1823 - 3	2
5	Sealing	Gaco	DPSM 659010	1
6	Sealing	AB Goteneds	74.5 X 3	1
7	Sealing	AB Goteneds	44.6 X 2.4	1
8	Valve	ROSS	D2273 A. 4011	1
9	V Belt	AB Goteneds	B - 55	3
10	Sealing	AB Goteneds	49.5 X 3	1
11	Sealing	AB Goteneds	104.5 X 3	1
12	Sealing Ring	Gaco	DPSM. 659010	1
13	Sealing	Gaco	114.5 X 3	1
14	Air inlet Adapter	Ortlinghaus	0 - 086 - 006 -01 - 002R ½"	1
15	Pneumatic Clutch	Ortlinghaus	0 - 400- 129- 40- 030 hal ø 45 H7	1
16	Ball Bearing	SKF	6310	3
17	Ball Bearing	SKF	7311 B	2

(Continued on next page)

Part No.	Part Name	Manufacturer	Specifications	No. Off
18	Cap	Specma	UC - HB - 1163 - 40	1
19	Oil tupe	AB Goteneds	3 - 1956	1
20	Bushing	AB Goteneds	1 - 1460- 11 J- 95 X 120	1
21	Bushing	AB Goteneds	ø 60m6 / 50F7 X 45 JM-1	2
22	Bushing	AB Goteneds	3 - 1819 - 2	2
23	Lubricating Oil	Shell	Shell Volvata Oil J 460 or Similar	20 Litre

Guillotine Shears II

Machine MNFG and Steel Foundry

Jelsingrad

Banja Luka Yugoslavia

Part No.	Part Name	Manufacturer	Specifications	No. Off
1	Contactor	Rade Kancar	CN 16 , 380V - 7.5 KW AC3 Ithz = 30 A	2
2	Contactor	Rade Kancar	CN10 380V - 4.7 KW AC3 Ithz = 23 A	2
3	Thermic Relay	Iskra	RB 2/1 1 - 2 A	1
4	Thermic Relay	Iskra	RB 2/1 12 - 24 A	1
5	V Belt	Iskra	JUS. GE 2050 17 X 11 X 1700	3
6	Fuse Link	Iskra	63, A	6

Bending Machine

"JELSINGRAD" Machine Factory and Steel Foundry

BANJA LUKA Yugoslavia

Part No.	Part Name	Manufacturer	Specifications	No. Off
1	Contactor	Iskra	K16, 380V - 7.5 KW	1
2	V Belt	Iskra	1800 X 13 mm.	4

Profile Shears

OMES CESOIA UNIVERSALE Tipo: CEU - 13 Italy

1	Complete blade set	1

Luna LDA Welding Transformer

Type: LDA 275

Norsvemas AB Savelundsgaten 15C, 44100 Alingsas - Sweeden

Complete Catalogue in English

Part No.	Part Name	Manufacturer	Specifications	No. Off
1	Diode Assembly		Radditel 25 73 DB 250F 60% SILARC 251 Part No: 27 5ZF23D1	1
2	Rectifier Diode (Single)	Siemens	E 1220 S20 (wire connected side is anode)	180
3	Rectifier Diode (Single)	Siemens	E 1120S20 (wire connected side is cathode)	180
4	3 Phase on- off switch		40A 500V	5
5	Control Lamp		340. T . 120°C Part No: 460225	20
6	Motor Starting Condenser		Part No: 418763	5
7	Cable Socket		Part No: 403614	10
8	Current Adjusting Handle		Part No: 2105HF 14D2	5
9	Fjader for Skala		Part No: S17 - 401	5
10	Regler Spindel		Part No: 37 - 202	5
11	Regler Chunt		Part No: 36 - 206	5
12	Skydd for Likriktarbrygga		Part No: 36424	6

LUNA MIGATRONIC WELDING MACHINE.

Norsvemas AB P.O. BOX 450, Savelundsgaten 15 E

S - 44129 Alingsas - Sweeden

Machine Type: 270

Machine No: 81410135

* Complete catalogue for wiring diagram instructions for operation and maintenance in English including spare parts list.

Part No.	Part Name	Manufacturer	Specifications	No. Off
1	Diode Module	Siemens	Dioden Saule Ausf. C67117 - A5312 - A545 OF Type: SSi 24 E 11/12 -DB 125/165 - 200	1
2	3 ph. Selector Switch		K2910, 1 - 12 Step AC1 — 16A, 600V	1
3	3 ph. On - Off Switch		16A - 550V	2
4	Condenser		B32231 3.3M 250 5	3
5	Transformer	Metric Nortra Denmark	380 - 220 - 0V Nr: 13093 16160032	1
6	Contactor	Danfoss Denmark	CH16 380V - 7.5 KW 1 No. INC Contact	1
7	Selanoid Valve	Sirai RIOLTELLO		1
8	Protector		T-2060ILI9 - 810 LI29- 22 POT	
9	Welding Wire	Luna		5 Coil

FOUNDRY SECTION

SAND MIXER "MAMUT - M3"

GOSTOL Goriske Strojne Tovarne in Livarne
Nova Gorica Yugoslavia

Part No.	Part Name	Manufacturer	Specifications	No. Off
1	Fuse Patron		63A, 10A	30 each
2	3 ph. On - Off Switch	Rade Kancar	3 X 380V, 32 KW Type: 2063 (G560)	2
3	Contactor	Iskra	380V, 32 KW 63A, 500V aux cont: 6A Type: K63 (VK5)	2
4	Thermic Relay	Iskra	500V 24 - 45A 1 No. 1NC Contacts aux cont: 4A Type: RB4	2
5	Contactor	Iskra	380V, 4KW 16A, 500V 1 No. 1NC Contacts Coil: 220V Type: K 1/8	2
6	Push Button		6A 380V Type: 6782. 008	10
7	Limit Switch	Iskra Kranj	KT g- 1 500V 10A (Stick Type)	6

MAGNETIC VIBRATOR

Gostol

Goriske Strojne Tovarne in Livarne nova Gorica Yugoslavia.

Part No.	Part Name	Manufacturer	Specifications	No. Off
1	Contactor	Iskra	380V, 4 KW Type: K 1/8	2
2	Contactor	Iskra	380V, 7.5 KW Type: K 2/8	1
3	Thermic Relay	Iskra	2 - 4 A Type; RB21 1No. 1NC Contacts	3
4	3 ph. On- Off Switch	Rade Kancar Zagrep Yugoslavia	16 A	2
5	Diode		BY 306	6
6	Fuse Link		10A, 4A	18 each

OVERHEAD CRANE

KULI West Germany

Complete Manual for Maintenance, Spare Parts Including Wiring Diagram .

Part No.	Part Name	Manufacturer	Specifications	No. Off
1	Contactor		CN 1 DB 291 634/e AC3 Ith = 25A 380 Vac. 11 KW	2
2	Contactor		CNJ BB 313 693/D 380V 3 KW	10

CHAMBER DRIER

CER Cacak

Fabrika Termotehnickih Uredaja I Montaza OO UR & Invest Oprema

Machine Type: Sn - 200 Yugoslavia

Part No.	Part Name	Manufacturer	Specifications	No. Off
1	Contactor	Iskra	K 1/8 380V 4 KW	3
2	Contactor	Iskra	K 2/8 380V 7.5 KW	2
3	Contactor	Iskra	K- 10- 41/220i 10A, 500V (SK 5 - 6)	2
4	Bimetalic Relay	Iskra	0.5 - 1A Type RB 2/1	3
5	Bimetalic Relay	Iskra	2 - 4A Type RB 2/1	2
6	Temperature Indicator	ATM	Nicl- Ni DIN ⟨-20 ... 20 - 1200°C Scale 1200°C 48.09 MV Broj: IT	1
7	Otomat	Honeywell	R 4297B 101 220V 50 Hz ⟨10 S 3A	1
8	Limit Switch	Iskra Kranj	Type: MS oh 6/63 (with stick) Broj: SL 2	5
9	Limit Switch	Iskra Kranj	Type: KT 9 - 1 500V - 10A	5

(Continued on Next Page)

Part No.	Part Name	Manufacturer	Specifications	No. Off
10	Temperature Regulator	Jumo	0 - 300°C L = 300mm Type: STE - 0 Broj: RT2	2
11	Pyrometer	ATM	Kat: br L = 500mm 42. 21. 431 NiCr - Ni, Broj: DC	1
12	Burr Switch	R. Koncar	25A, 500V 2G25 - 10-2/2	5
13	Burr Switch	R. Koncar	16A, 500V, 2G16-15-3/2	5
14	Bimetalic Relay	Iskra	1 - 2A Type: RB - 2/1	2
15	Spindle Limit - Lock		Broj: SLT	1
16	Fuse Patron	Kontakt	10A, 500V D11 - 10	18
17	Fuse Patron	Kontakt	6A, 500V D11 - 6	24
18	Gouging Resistance		20	2

SAND BLAST

W. Hunzinker AG,

CH- 5054 Kirchleerau Switzerland

Modell: ST 700 Fabr. Nr: 118' 374

Part No.	Part Name	Manufacturer	Specifications	No. Off
1	Contactor	Sprochert Schuh	Type: CA1 - 10 Ie = 25A 500V Size: 0+	2
2	Electromagnet Valve 3/8"	Danfess Best Nr: 778	Type: EVB D10 220V 50 Hz 5W C=90 F= 164 At: 10 LBS: 142, mm 10	1
3	Bush Button	BACO	Type: AC01	4
4	Schutz	Sprochert Schuh	Best. Nr: 779 (Type: CT 1 - 10) (0.55 - 0.9A)	2
5	Start-Stop Switch	BACO	Type: CC10	1
6	Manometer	0 - 10 Atu	Best Nr: 776	1

DOUBLE DISK GRINDER MACHINE

GOSTOL: Goriske Strojne Tovarne in Livarne Nova Gorica

Yugoslavia

Part No.	Part Name	Manufacturer	Specifications	No. Off
1	Contactor	Iskra	4 KW 380V Type: K 1/8	2
2	Thermic Relay	Iskra	RB 2/1 4 - 8 A	2

(Continued on Next Page)

Part No.	Part Name	Manufacturer	Specifications	No. Off
3	Push Button		6A 380V Type: 6782.008	4
4	V Belt	Sava	17 X 11 X 1750	
5	Fuse Link		20A.	18
6	Grinding Wheel	SWATY	450 X 52 X 150 V= 45 M/Sec C 16 R6 B	6 each

CORE AND SAND MIXER (MJ-50)

GOSTOL

Goriske Strojne Tovarne in Livarne Nova Gorica Yugoslavia.

Part No.	Part Name	Manufacturer	Specifications	No. Of
1	Grease for Bearings		LIS 1 - 3	20 Kg
2	Contactor	Iskra	4 KW K 1/8 (VK- 2)	1
3	Bimetalic Relay		5 - 10A.	
4	V Belt	Astra	17 X 11 X 1100	2
5	Blade		576-01-05	5

BAND SAW (AS- 800)

ARSENIJE SPACIC ZAJECAR Yugoslavia

Part No.	Part Name	Manufacturer	Specifications	No. Of
1	Ball Bearing		6207	2
2	Ball Bearing		6208	1
3	Ball Bearing		6210	1

(Continued on Next Page)

Part No.	Part Name	Manufacturer	Specifications	No. Off
4	V Belt		13 X 8 X 1750	4

DOUBLE DISK GRINDER.

Manufacturer: OUTILLAGE ELECTRIQUE SILEY
170, Rue Sadi - Carnot - 93 - Bagnolet France

Machine Type: 454 R mm
Sous le No: 9630 62 D 554, D maxi: 302 , D mini: 200.
Vit maxi: 2070 T/M

Part No.	Part Name	Manufacturer	Specifications	No. Off
1	Grinding Stone			6

CUPOLA (ø 600)

GOSTOL: Goriske Strojne Tovarne in Livarne Nova Gorica Yugoslavia

Part No.	Part Name	Manufacturer	Specifications	No. Off
1	Contactor	Iskra	Type: K25 25A 500V Coil: 380V Aux. Cont: 6A, 380V, 2 NO, 2NC Contacts	3
2	Thermic	Iskra	6 - 12A	1
3	Time Relay	Crailset	Type: 88221 4VA 220V 50 Hz Contacts 230V 5A 1 No, 1 NC contacts	1
Mechanical Parts				
4	Wire net for centrifugal blower			1 m^2
5	V Belt	UNIROYAL MANULI	Type: A59 13 X 1502 Li 1535 LP	4

PATTERN SHOP

ESSLINGER Farben

D 7301 Deizisau - Esslingen

Germany

1. Pattern paint (red) 50 litres.
2. Pattern paint (black) 5 litres.
3. Disolvent (thinner) 50 litres.
4. Pattern fillets 15 Kg.
5. Varnish mops (soft hair) diam. 6, 10, 15, 20 mm. 3 pcs each.

Friedrish Zimmerman Maschinenbau

7306 Denkendorf Postf. 1109

Germany

1. Vee- belt for Milling machine F Z 1 — 6 pcs.
2. Disc cutters ∅ 30, 35, 40, 45, 50 mm — 2 pcs each.
3. Disc cutters ∅ 60, 70, 100 mm — 1 pc. each.
4. Disc cutters HHS r.10, 12 mm — 2 pcs each.
5. Cutter simplex 5° conical
   r.3, 5, 8, 10, 15 mm — 1 pc. each
6. Cutter Duplex 5° conical
   ∅ 6, 10, 15 mm — 2 pcs. each.

EJCA Verkstads

Wahlstram & Co.

Varnamo

Sweeden

1. Vee- belt for lathe type TMV - 10
   from motor to variator 3 pcs.
   From variator to spindle 2 pcs.

2. Vee- belt for band saw diam. 400 1 pc.

Vollmer Werke
Maschinenfabrik Gmbh
7950 Biberach / Riss
Post fach 820
Germany

1. Machine Band saw files 12 pcs.
Order No. 226 3400 - 16

<u>Wood for the Pattern Shop</u>

5 m^3 Pine wood (fine graned)
thickness 50 mm.
width 200 mm.

Vacum cleaner (Industrial type)
To be used in workshops as well as offices.

Combination woodworking machine jointer and thicknesser.
Capacity in width 400 - 600 mm.

Note.

The one in the Pattern shop is in poor state and the capacity is only 300 mm.

LUNA AB
44101 Alingsas 1
Sweden

1. Shrink age ruler in mm. (wood)
   0.5m 0.75% 1% 1.5% 2 pcs each.
   1 m 0.75% 1% 1.5% 1 pc. each.

2. Paring gouges
   6 X ø 6, 12 X ø15, 25 X 40ø 2 pcs each.

3. Curved gouges
   15, 25mm in width 2 pcs each.

4. Wood turning chisels
   6, 12, 25 mm 3 pcs each.

5. Wood turning gouges
   10, 20 mm 2 pcs each.

6. Corrugated steel fasteners
   20 mm 1000 pcs.

7. Drillbits for metal (ordinary)
   diam. 2 3 4 5 mm 10 pcs each.

8. Trysquares
   150 mm. 4 pcs.
   250 mm. 2 pcs.

9. Divider (caliper) adjustable setting
   175 mm 4 pcs

10. Pincers 175 mm 4 pcs

11. Cross pen hammer AB5 4 pcs.

12. Band saw blade for wood
    Width 12 mm, thickness 0.6 mm
    teeth per inch 4

PATTERN SHOP. (Electrical Parts)

COMBINATION MACHINE FOR WOOD WORKING (mini. 30)

SCM Linvincilile Yugoslavia.

Part No.	Part Name	Manufacturer	Specifications	No. Off
1	Complete 3 phase start-stop switch unit.	Bremas Complesso A Schema	3 74 C 620	1
2	3 phase start-stop switch	Bremas	A 1603 16A, 550V 380V, 6.3 KW Modella 16A	1
3	Start -stop switch	Bremas	A1609 16A, 550V 380V, 6.3 KW Modella: 16A	1

BAND SAW

EJCA Verkstads Ab
Wahlstram & Co. Varnamo / Sveden.

Part No.	Part Name	Manufacturer	Specifications	No. Off
1	Contactor	Danfess, Denmark	Type: C10 Max. 10A / 600VAC Aux. Cont: 6A/600VAC 1 NC, 1 No contacts 380V 4 KW Coil 220V, 50 Hz	1
2	Thermic relay	Danfess, Denmark	Type: T16 500VAC 2A 1.2 - 1.9A	1

(Continued on Next Page)

Part No.	Part Name	Manufacturer	Specifications	No.Off
3	Start-stop button	Kraus & Naimer W. Germany	B9 20A $2.5mm^2$ A, 176 10A 380V	4
4	Three phase Start-stop switch	Kraus & Naimer W. Germany	C10 A202	2

DCE DUST CONTROL EQUIPMENT LIMITED

Thurmaston Leicester England
Type No: UMA 74 G1
Serial No: 146, 830
1HP, 415V 3 Phase 50 Hz

Part No.	Part Name	Manufacturer	Specifications	No.Off
1	Complete Pulimatic FE Controller		Serial No: FE 12 100, 100 0.75 KW 50 Hz 380V/440V	1

BAND SAW

ST Centauro, Fonderia and Officine/Limidi di
Soliera (Modena) Italy

Type of Machine: 800 ST Serial No: 1185

1	Star- Delta Starting Switch	Ergo	20A-500V	2

CIRCULAR SAW

Wadkin Bursgreen Service and Tools Bursgreen (Durham) Ltd.
Fence Houses, Co. Durham.
Sales
Wadkin Ltd.
Leicester, England.
Machine No: 10AGS 791207

Part No.	Part Name	Manufacturer	Specifications	No. Off
1	Sprindle housing		B- 1026M/101	1
2	M10 X 25 Long hexagon head bolt			3
3	Riving knife pivot bracket		B- 1026/114	1
4	M8 - 120 Long socket head cap screw			2
5	Starter Switch		MEM 446ADC	1
6	Fenner Vee Ropes		2230	5
7	8" Disk Saw			3

MECHANICAL WORKSHOP

Via S. Francesco
D'ASSISI, 33 Italy

LATHE MACHINE

BMP Voghera Yugoslavia

Part No.	Part Name	Manufacturer	Specifications	No. Off
1	Contactor		380V 4 KW Coil: 220V 1No, 1NC. Cont.	1
2	Contactor		380V. 25A Coil: 220V	1
3	Thermic relay		10 - 18A	1
4	Lamp	Izumi Denk. Co. OSAKA JAPAN	P.V.28V 50-60Hz 30V	5

LATHE MACHINE

BMP Voghera Yugoslavia

Part No.	Part Name	Manufacturer	Specifications	No. Off
1	Contactor	Siemens	3- TA20 10-0A Ith = 20A Nema Size 00 Ip = AC4 1NO Contact SEV. Ith = 16A 380V 4KW AC3 Coil: 24V	2
2	Thermic relay	Siemens	3UA 40 00 - 0AP 0,6- 1A Aux. Cont: 6A 0,6 - 1A	2
3	Contactor	Siemens	3TA21 10- 0 A Nema Size: 0 380V 7.5 KW 2NO Contacts	2
4	Thermic relay	Siemens	3UA 41 0T OT 11 - 16A Aux. Cont. 6A	2

(Continued on Next Page)

Part No.	Part Name	Manufacturer	Specifications	No. Off
5	Ammeter		0 - 37, 5A Scale SC 6 HE60GE	1
6	Fuse	Siemens	Original Diazed 6A, 500V Trag No: 5SA 234	18
7	Fuse	Siemens	25A 500V No: 6SA 284	18

LATHE MACHINE

Russian

Part No.	Part Name	Manufacturer	Specifications	No. Off
1	Transformer		4200 VA 220/24V 50 Hz	1
2	Contactor		380V, 7.5 KW	1
3	Thermic		380V 10 - 18 A	1
4	Thermic		380V 0.5 - 1 A	2
5	Contactor		380V 16A	1
6	Time relay		0 - 240 Second	1

LATHE MACHINE

U.S.S.R

Part No.	Part Name	Manufacturer	Specifications	No.Off
1	Transformer		160VA 380/110. 24V	1
2	Contactor		16A 110V Coil	2
3	Thermic		0.10- 0.32A	1
4	Contactor		40A Coil 110V	1
5	Thermic		20- 25A	1
6	Thermally protected 3 phase switch		6A 380V 50 Hz	1
7	Thermally protected 3 phase switch		25A 380V 50Hz	1
8	0- 240 Seconds Time Relay			1
9	380V 4A Limit Switch (with stick)			2
10	380V 6A 220V 4A. Limit Switch (with roller)			2
11	Ammeter 0- 20A Scale			1

MILLING TOOL GRINDING MACHINE

YUGOSLAVIA

Part No.	Part Name	Manufacturer	Specifications	No. Off
1	Contactor	TEOMR. CEMA	10A 600V AC 380V 4.5 KW	2
2	Thermic relay	Iskra	RB 2/1 2-4A	2
3	Thermic relay	Iskra	RB 2/1 0.25- 0.5A	2
4	Thermic relay	Iskra	RB 2/1 0.5 - 1A	2
5	Fuse Patron		10, 6A	9 each
6	Transformer		250VA 380/220/110/24/6A 50 Hz	11

BAND SAW MACHINE

Pobeda

Industrija Masina - Novi SAD Jugoslavija

TIP MASINE: MA - 200
FABRICKIBROJ: 5331 - 14
TEZINA ukp: 740
GODINA PROIZVODNJE: 1975
ATEST BROJ: A1.06.04- 10

Document about maintenance and operation instructions, including spare part list and electric wiring diagram.

Part No.	Part Name	Manufacturer	Specifications	No. Off
1	Contactor	Iskra Kranj.	VKOO / 4-8 6A. 500V	1
2	Contactor	Iskra Kranj.	VKOO / 64	3
3	Thermic relay	Iskra	RB 2/1 2 - 4A	2
4	Thermic relay	Iskra	RB 2/1 0.25 - 0.5A	1
5	Thermic relay	Iskra	RB 2/1 1-2A	1
6	Start Stop Switch	Cema Italy	Type: 100SDN1	2
7	Push button	Cema Italy	DHPLD 1G	2
8	Push button	Cema Italy	100 PRIG	2
9	Diode Module	Iskra	B40C5000 / 3300	2
10	Relay		24V 50Hz 3NO, 3NC Contacts	2
11	Condenser	Iskra	10µF / V 63V - KCU - 1011	5
12	Glass tube fuse		1.5A and 6.3A 250V	12 ea
13	Fuse Patron		2, 6, 10A 500V	8 each

MILLING MACHINE I

Zeus di Bonfiglio & C.

Via Piave 2 Castano Primo (Milano)

1-Lubricating Oil. Testa Arm/30-V Avanzamenti Arm/65-5

Address: BOL Raffineria OLII LUBRIFICANTI - MILANO: 20ef

MILLING MACHINE II

Zeus di Bonfiglio & C.

Via Piave 2 Castano Primo (Milano)

Part No.	Part Name	Manufacturer	Specifications	No. Off
1	Transformer	MG Elettromeccanica	Monophase 75VA 50/60Hz 220, 270, 380V/24, 28, 30V	1
2	Contactor	BBC	SLA 12 - I B 151 Ith2 = 20A Coil: 24V, 50Hz	2
3	Fuse		4, 25A 500V fuse	1
4	Diode Module (4 diode)		28V. no more data	2

ELECTRIC ANNEALING FURNACE

Naber Industrieofenbau
2804 Lilienthal / Bremen W. Germany
Med. N41 380V 3~
Nr. 56913 50Hz 18.2A
Max 1150°C 12 KW.

Complete spare part list and drawings of electronic control unit.

Part No.	Part Name	Manufacturer	Specifications	No. Off
1	Printed Circuit	Naber Industrieofenbau	E 3 with 3 spare condenser. Temperature Processor TPI Modell: N41 Schaltplan 30321	1
2	Condenser		0.05 F X +50 Ω 250 Vac	2
3	Limit Switch	BERNSTEIN SCHALTSYSTEME	6 C UJ R 1N 10A 500V	1

BENDING AND RAM PRESS

BR WIKSTROMS MEK VERKSTAD AB
93100 SKELLEFTEA - SWEDEN
Type: BMP20 TILLV NR: 277/568
Hydro Oil: BP HLP 46
Kungl. Arbetarskyddsstyrelsens
Typgod Kannande Nr
KAS - 222. 31 - 5303/76 - KATEGORI - 1
Electric Panel Manufacturer
Elkapsling Ab
P.O.Box 18 8402 Ange/SWEDEN

(Continued on Next Page)

Part No.	Part Name	Manufacturer	Specifications	No.Off
1	Hydro. Oil	BP	BP HLP 46	25 Lt.
2	Pressure gauge	WIKA	0-250 bar scale 0- 25 mpa scale	1
3	Relay	PILZ GMBH H& Co.	Type: PIH- 2NKS 220Vac / 1a Coil 220V ac 5 VA / 40-60Hz Aux. Cont: 250V ac 4A/1100VA/ Si4A trage No: 474062	1
4	Relay	Releco	Type: 34.3.02 24V 50Hz 100 Ω	1
5	Contactor	ASEA	DEG. 20 SK 432 3213 Ith: 16A 500V	1
6	Thermic relay	ASEA	6- 11A	1
7	Condeser	Rita	630V dc - 250Vac -40 — +85°C 0.5 F 220 RC - Unit PMR 2026	3
8	3 phase On - off switch	KRAUS & NAIMER	C 26 A 202	1
9	3 phase On - off switch	KRAUS & NAIMER	C18 A221	1
10	Indication lamp	ASEA	5W Type:OSM2	3
11	Push button	ASEA	Type: OKM 500V 10A	2

(Continued on Next Page)

Part No.	Part Name	Manufacturer	Specifications	No.Off
12	Selenoid	SHHWELM TOWLFA Hyduulics	Type: W42MC21A1POT	1
13	Valve	HAWE	Type: DG2H	1

LATHE MACHINE

Luna Machine No: 17366
STOREBRO
MOD GK-195
NO: 17366
380V 50Hz

Part No.	Part Name	Manufacturer	Specifications	No.Off
1	Contactor	Siemens	11 E 3TB42	2
2	Relay	Siemens	22E 3TH80	1
3	3 phase Start-stop switch (selector type)	KRAUS & NAIMER Austria	16A	1
4	3 phase thermally protected switch	Siemens	1.6- 2.5A 3VE1010 - 2H 16A	1
5	Thermic Relay	Siemens	6.5 - 9.5A 1 NO, 1NC Contact	1
6	Thermic Relay	Siemens	8- 12A 1 NO, 1NC Contacts	1

(Continued on Next Page)

Part No.	Part Name	Manufacturer	Specifications	No.Off
7	3 phase switch	KRAUS & NAIMER	B17 A441 10HP 600V 3 phase	1
8	Limit Switch	ELECTRO	E2B . 111 380V	1 6 eac

DOUBLE DISK GRINDER

Reme
D mt Nr: 053040
Type: DS 30/400

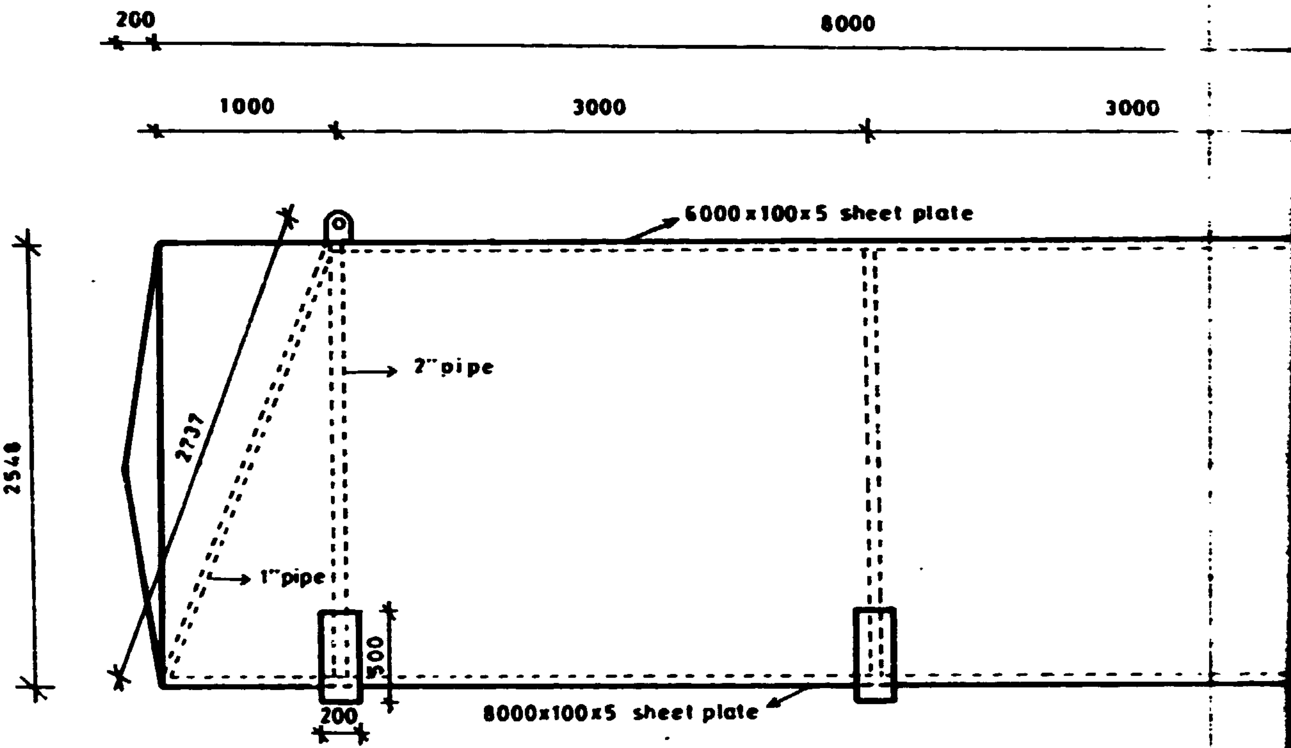
Part No.	Part Name	Manufacturer	Specifications	No.Of
1	Thermally Protected Switch	KLOCKNER - Moeller	PKZ 0 - 6 6A 500V ac 4 - 6A	2

FMW.

Fig.1

APP. 2

40 m³ TAN

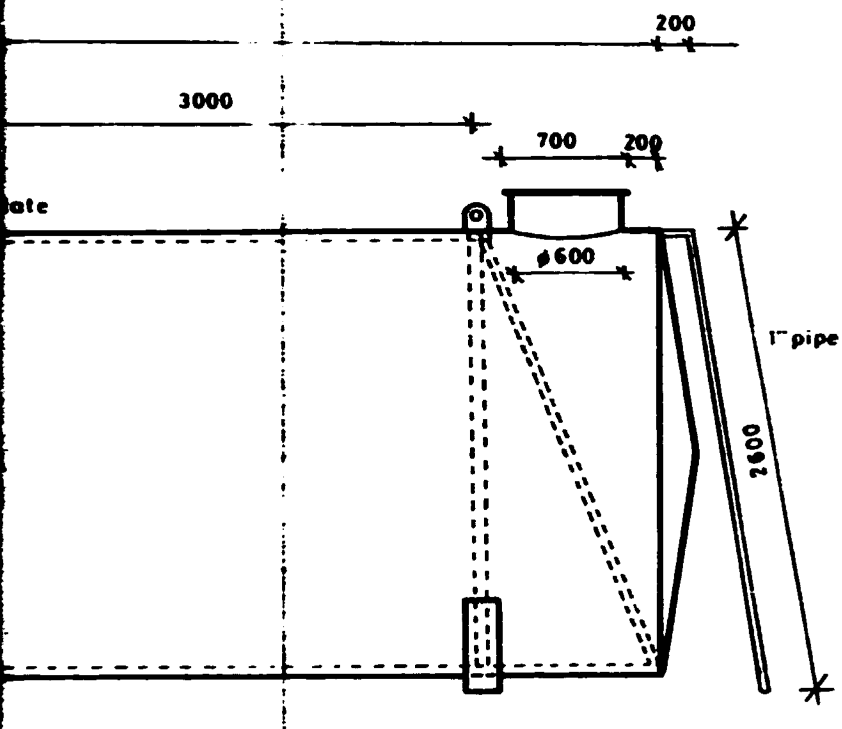


Side View

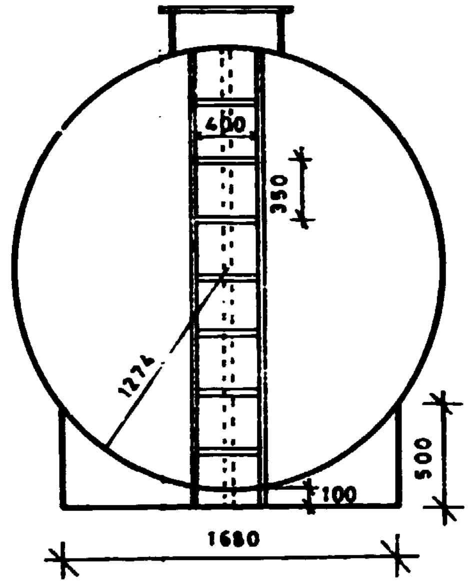
Floor Concrete must be able to stand 15 kg

SECTION 1

$40\,m^3$ TANK



ew

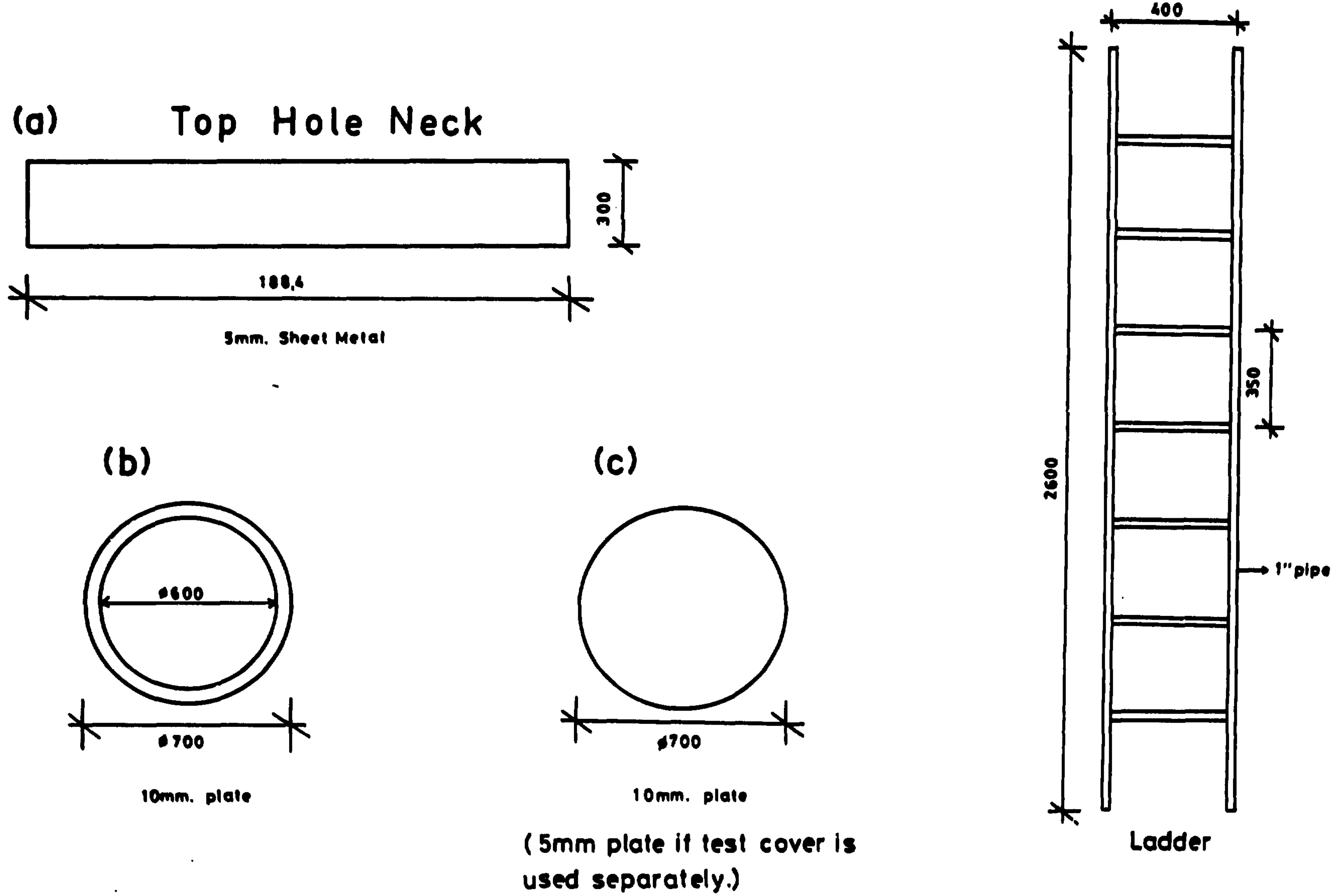


Front View

to stand $15\,kg/cm^2$

SECTION 2

Fig. 2



(a)
Top Hole Neck
300
188,4
5mm. Sheet Metal
(b)
ø600
ø700
10mm. plate
(c)
ø700
10mm. plate
(5mm plate if test cover is used separately.)
400
2600
350
1"pipe
Ladder

Fig. 3

STANDS

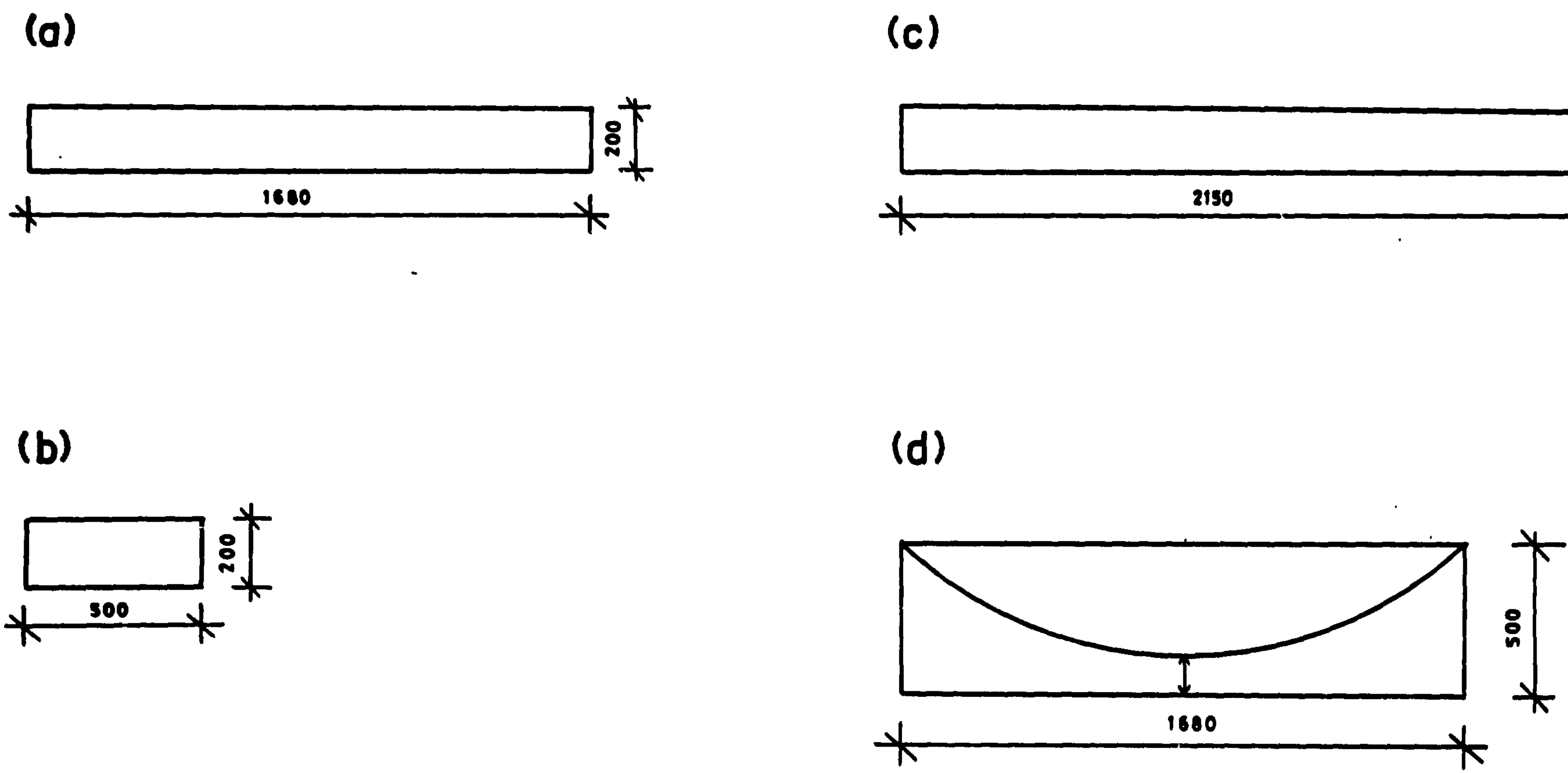


Fig.4

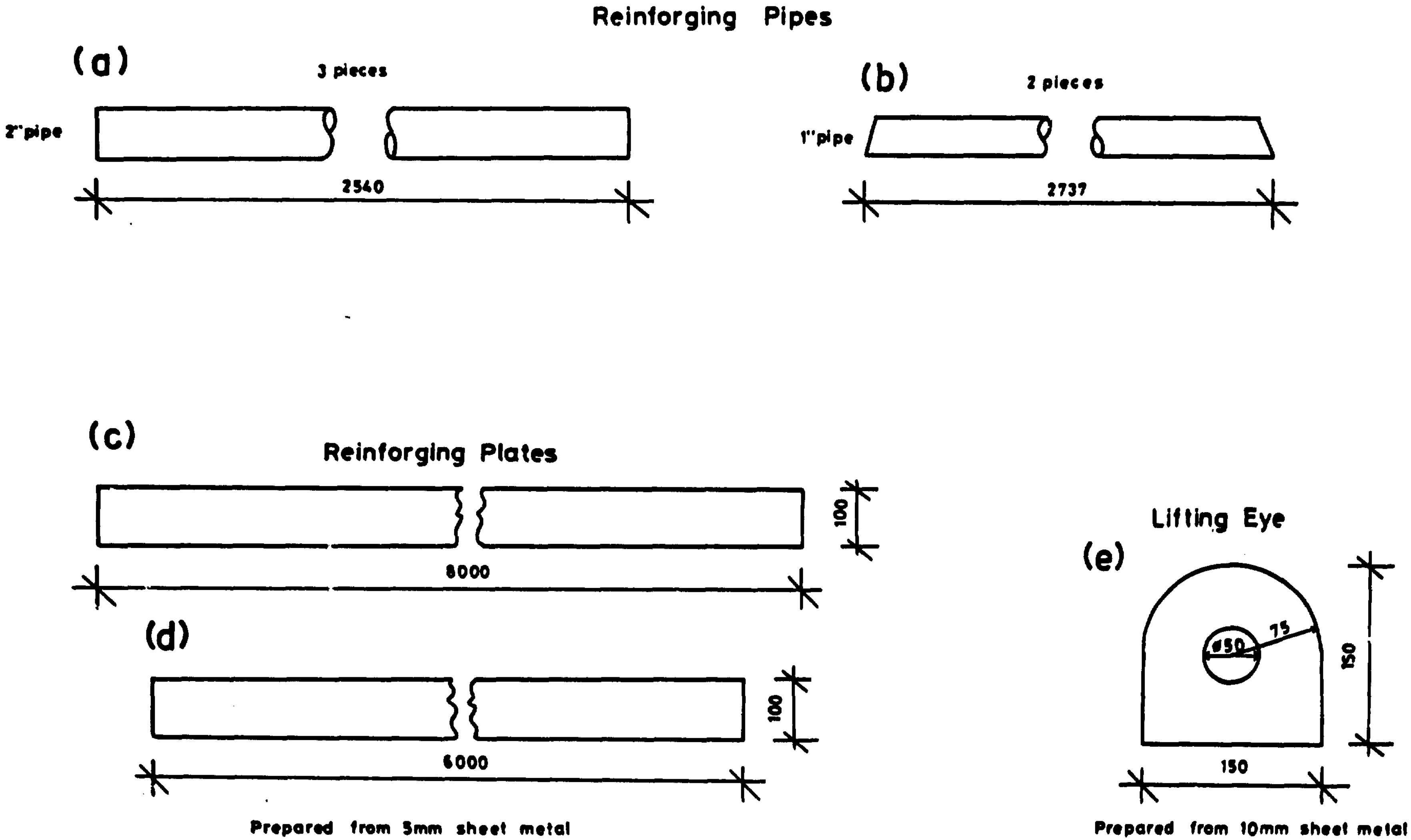
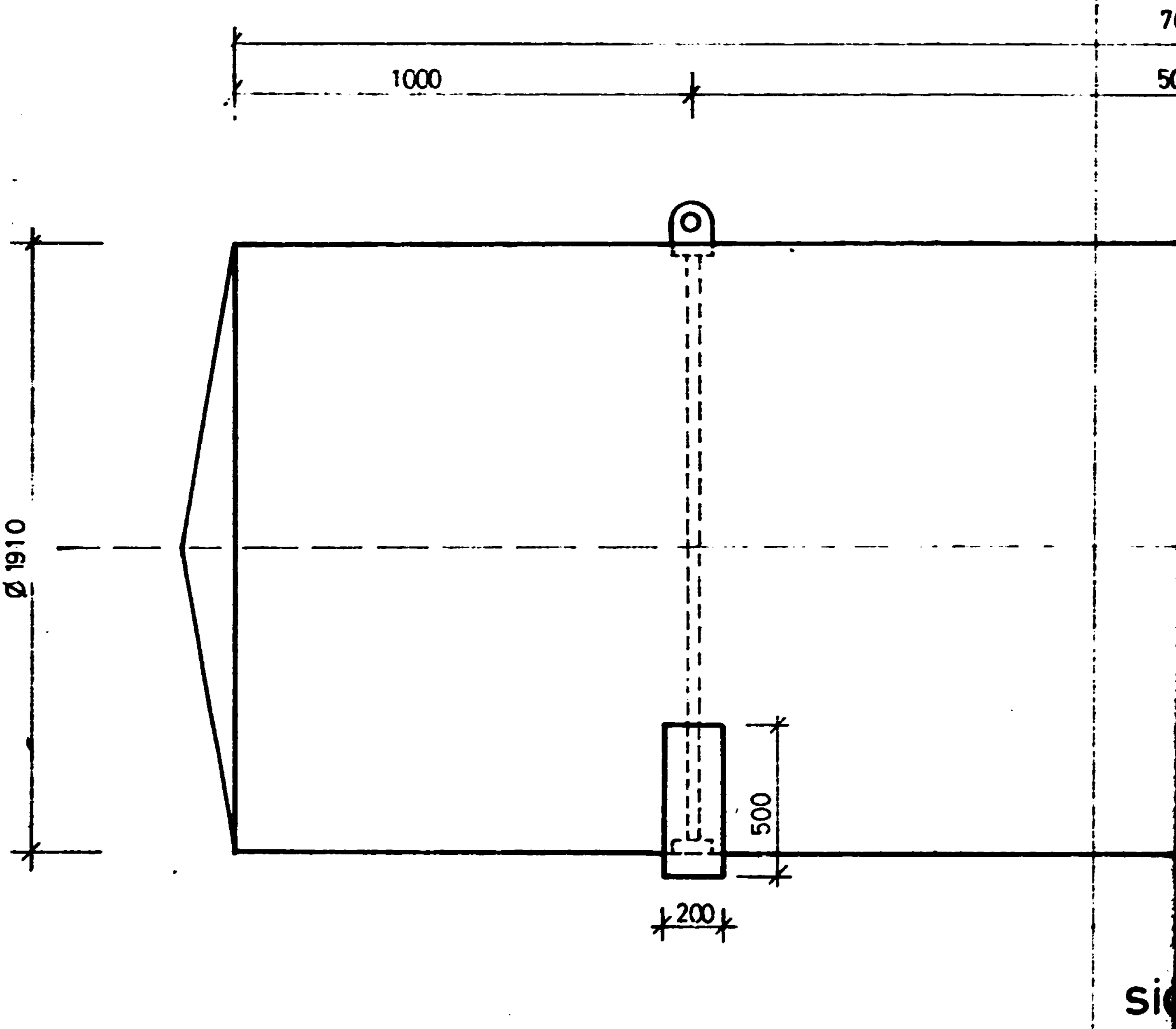
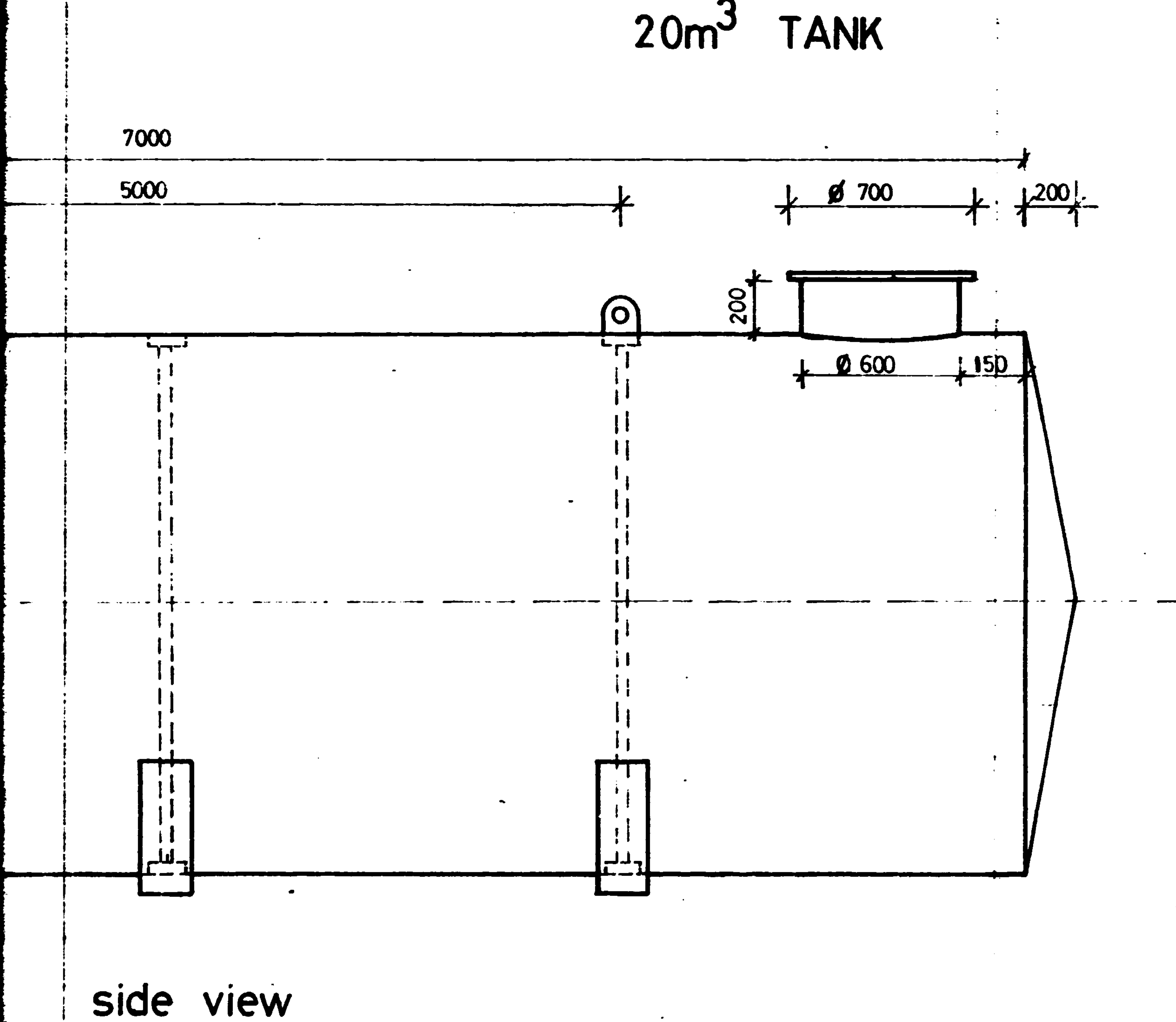

Reinforging Pipes
(a)
3 pieces
2"pipe
2540
(b)
2 pieces
1"pipe
2737
(c)
Reinforging Plates
100
8000
(d)
100
6000
Prepared from 5mm sheet metal
Lifting Eye
(e)
ø50
75
150
150
Prepared from 10mm sheet metal

Fig.5

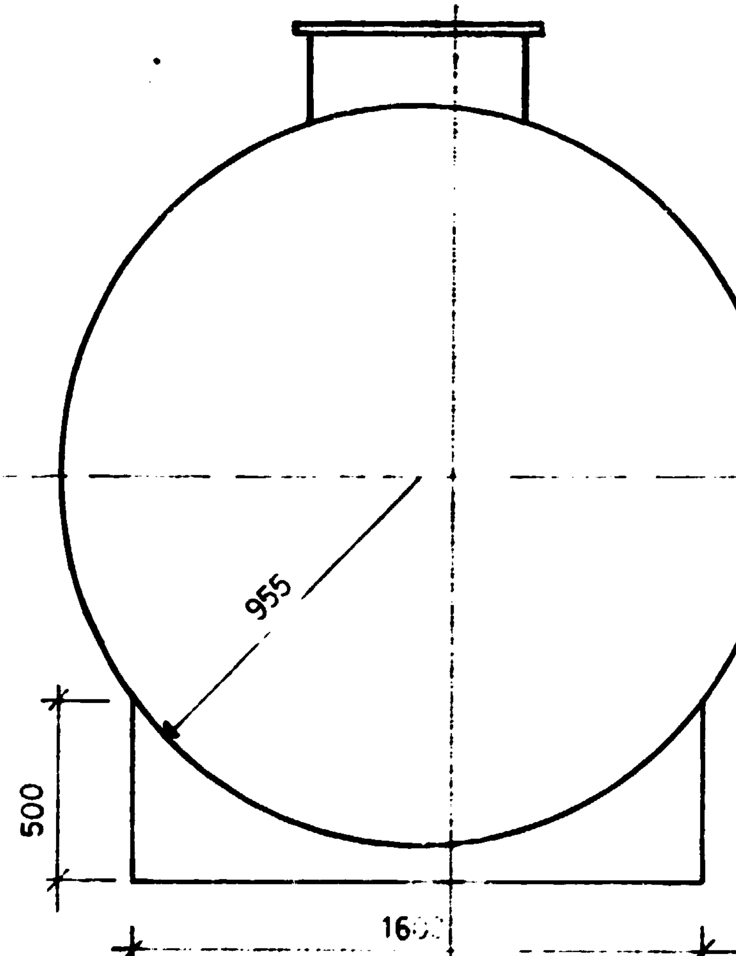
FOUNDRY and MECHANICAL WORKSHOP MOGADISCIO, SOMALIA



SECTION 1



SECTION 2



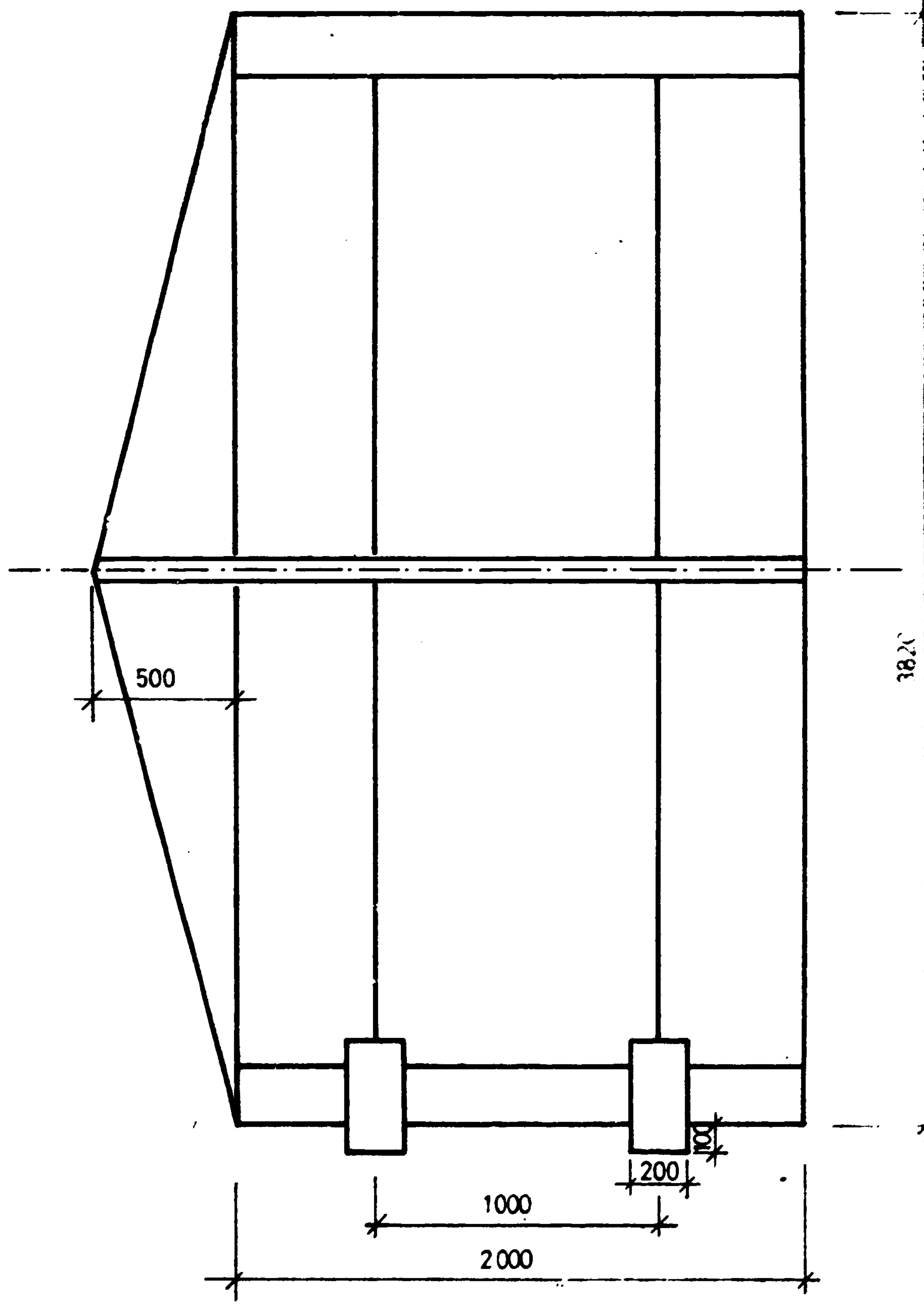
front view

scale 1/20
the measuments are in milimeter
sheet metal thickness is 5 mm
concrete stands are suggested

Fig.6

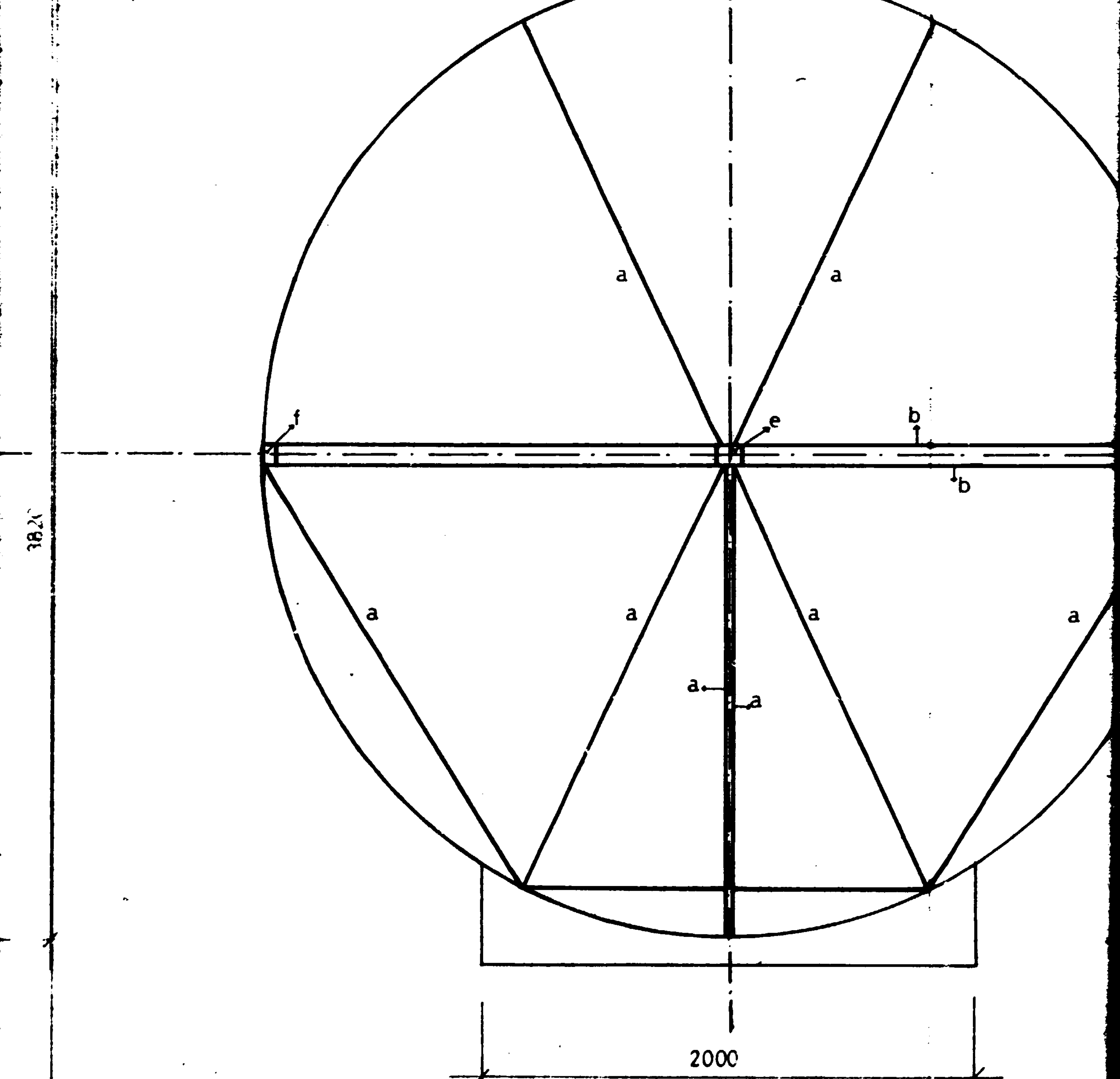
SECTION 1

150 TONS HORI

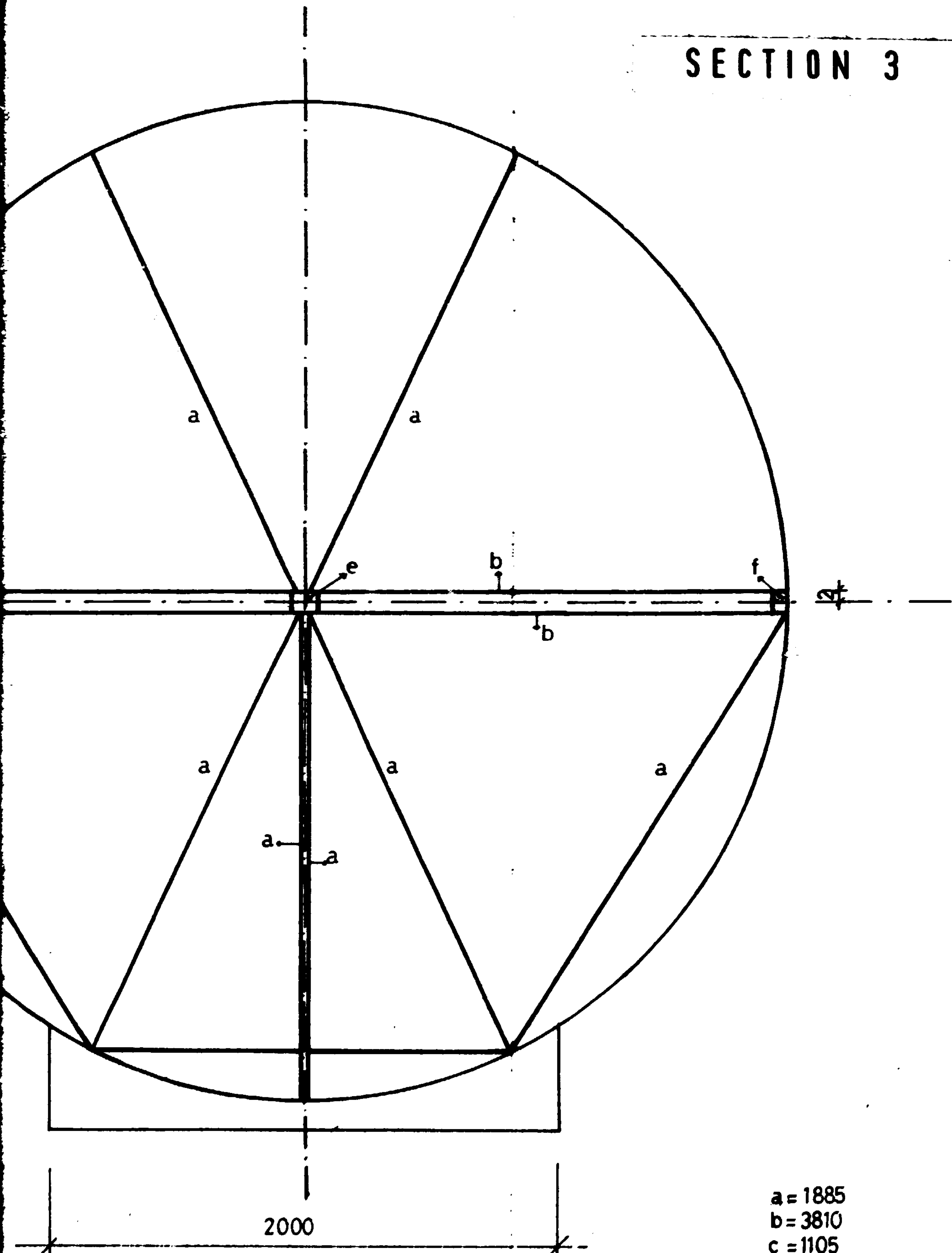


S HORIZONTAL TANK

SECTION .2



SECTION 3

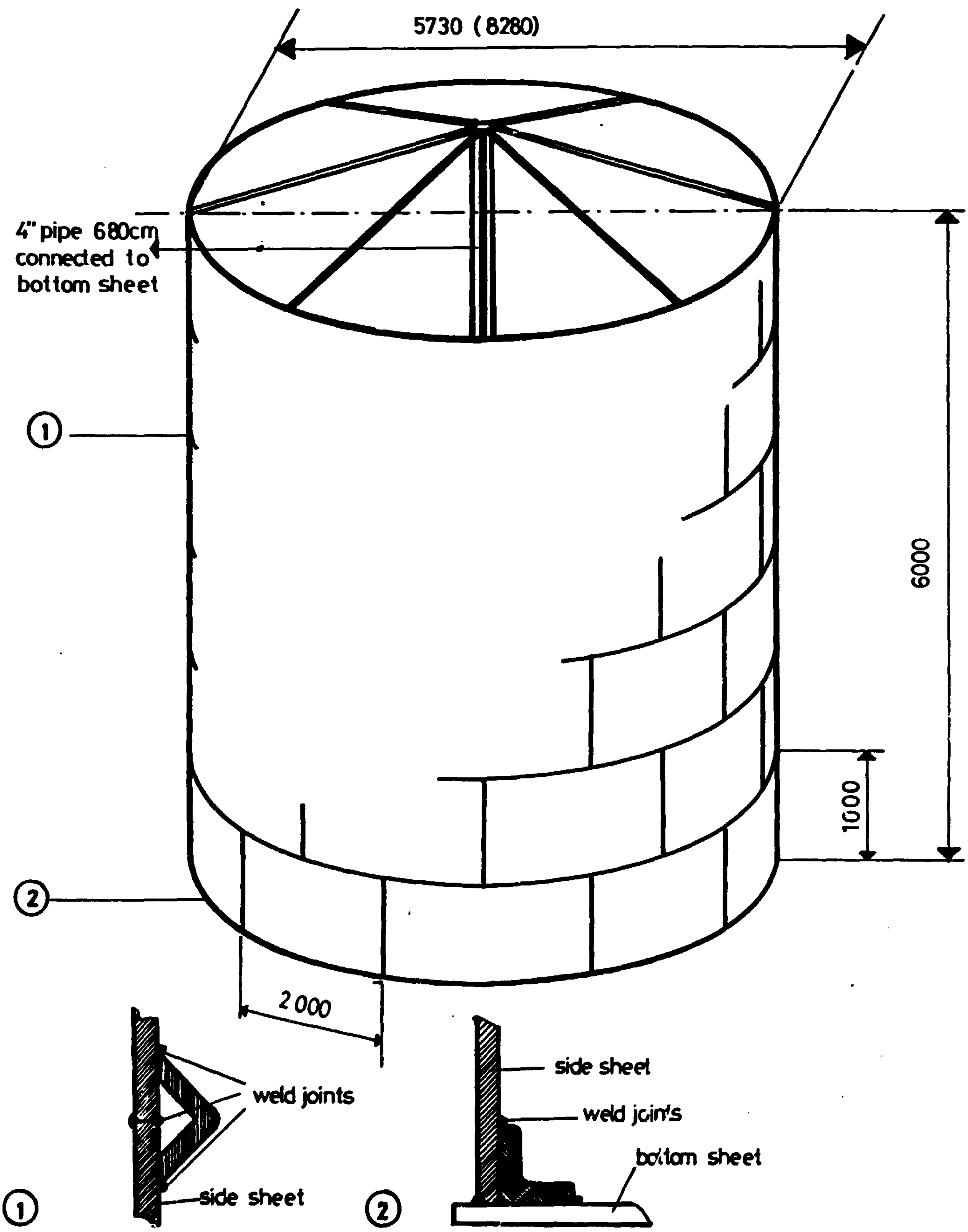


a = 1885
b = 3810
c = 1105
d = 2000
e = 100
f = 50
g = 500

SCALE 1/20

Fig.7

VERTICAL TANK ($150 m^3$)

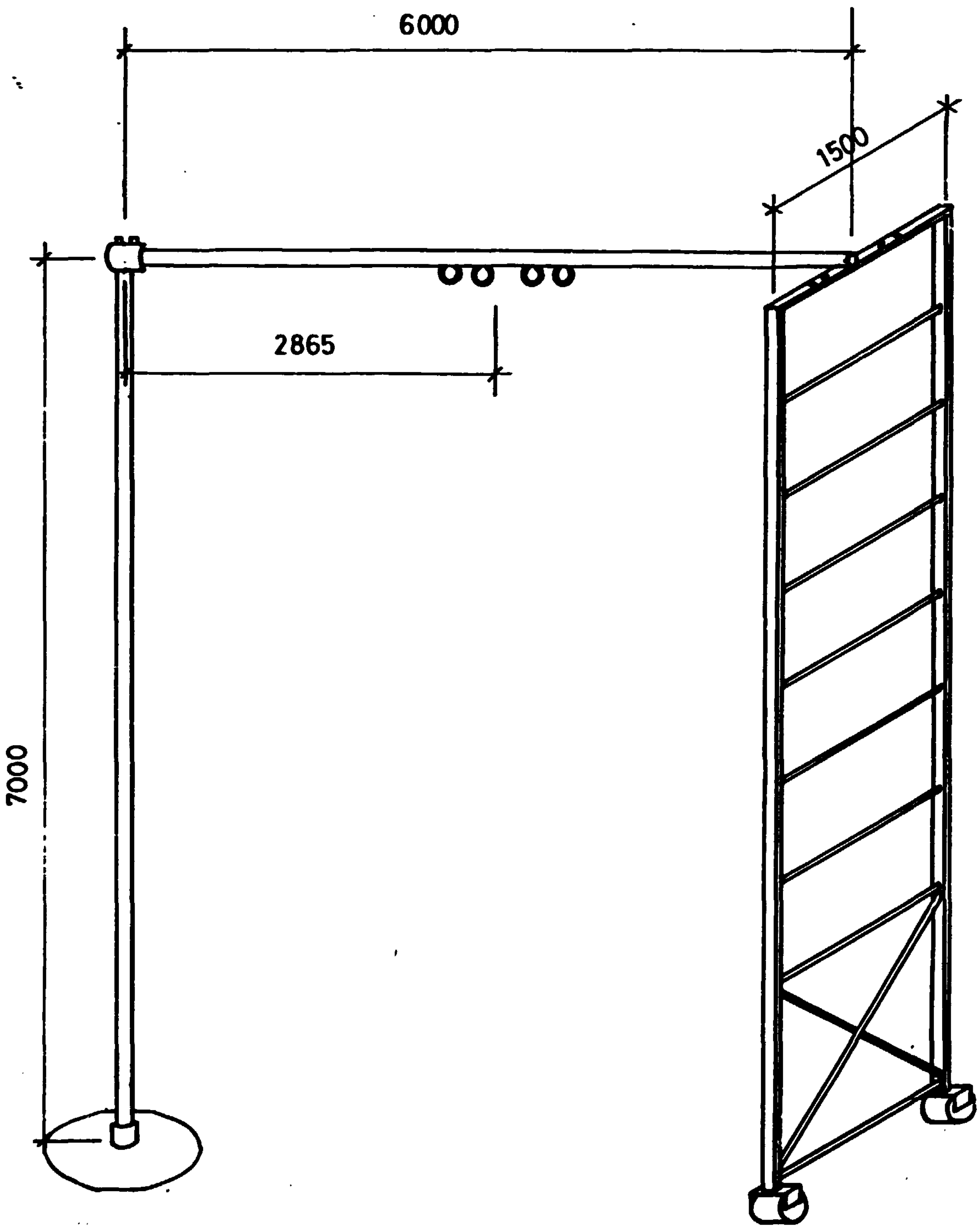


figures in brackets show dimensions of $300 m^3$ tons tank

FMW

Fig.8

ROTARY OVERHEAD CRAIN

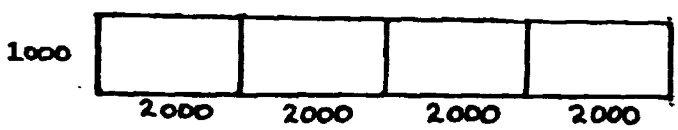


MANUFACTURING INSTRUCTIONS

40 m^3 Tank.

It is prepared from 2000 x 1000 x 5 mm sheet metal which is the available material at FMW and local market.

1- Prepare the plates shown below:

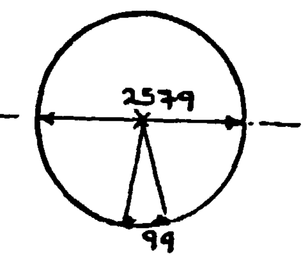


8 pieces

2- On bending machine, bend them to a circle and spotweld ends on the bending machine.

3- Weld ends completely on the floor in order to have 8 rolls.
4- First spotweld the rolls to each other on a straight floor then put the whole pieces on "roll type positioners" [three positioners are required for 40 tons tanks] and start welding inside. When half of the roll is welded from inside, welding from outside can be started and complete welding of the whole piece. [Never weld outside without welding inside first].

5- Cut a circle of 2579 mm diameter as shown below:



6- Cut a slice out as shown above 99 mm on the periphery.

7- Connect both ends and weld on both sides. Hammer it on the ground from inside to outside hitting on knife edge guide hammer.

8- Prepare another dam as described above.

9- Prepare two sheet plates on 8.000 x 100 x 5 mm and 6000 x 100 x 5 mm dimensions. Weld the longer one on the floor of the cylinder and the shorter one on ceiling of the cylinder. [Figs.1 and 4].

10- Prepare the support pipes as shown on drawing 4 and weld them on the sheet metal pieces welded on the floor and the ceiling of the cylinder formerly [Fig.1]

11- Weld the dams on two side of the cylinder. First spotweld on 16 points opposite to each other then continue with welding inside first, then outside.

12- Mark circle of the top hole by compass and cut.

13- In order to prepare top hole neck [Fig.2], prepare neck cylinder as shown on Fig. 2a then prepare the flanch [2b] and the cover [2c]. Spotweld the flanch and the cover to each other. Drill 14 mm 24 holes on both pieces, tighten all bolts and then weld the flanch on the neck.

14- In order to prepare the stands [Fig.3], first prepare the pieces shown on the drawing then weld them together.

15- Mount the tank on them according to Fig. 1

16- Prepare the lifting eyes as shown on Fig.4

17- Weld them on the tank according to the measurements shown on Fig.1

18- Prepare the lader as shown on Fig.2

19- First weld two pipes on the top side of the tank [Fig.1] and then weld the lader on them.

MATERIAL LIST FOR 150 M^3 TANK.

2000 x 1000 x 5 mm Sheet metal: 100 pieces.

4" Pipe [6800 mm length] : 1 piece.

Angle iron 40 x 40 x 4 mm [6000 mm length] : 35 pieces.

Electrode	: 20.000 pieces.
Bolt ∅ 25, : 300	: 18
Nut for ∅ 25 bolt	: 18
Washer	: 36

MATERIAL LIST FOR 40 M^3 TANK.

2000 x 1000 x 5 mm Sheet metal	: 41 pieces
3" Pipe [6000 mm length]	: 2 pieces
Electrode	: 3000 pieces

Required Materials in Steel Structure Section for the Period of One Year in Order to Produce 12 Trailers, 4 Windmills, 12 20m^3 tanks, 12 10m^3, tanks, 24 2.2m^3 tanks, 36 Waist boxes.

Material	Description	Quantity	App. Weight.
Sheet Metal	150cm x 600cm x 6mm	75 Pieces	32.500 Kg.
Sheet Metal	150cm x 600cm x 5mm	60 Pieces	21.600 Kg.
Sheet Metal	120cm x 240cm x 4mm	130 Pieces	12.000 Kg.
Sheet Metal	120cm x 240cm x 3mm	325 Pieces	22.500 Kg.
Sheet Metal	100cm x 200cm x 5mm	15 Pieces	80 Kg.
Galvanised Sheet Metal	100cm x 200cm x 1mm	10 Pieces	160 Kg.
Angle Iron	80mm x 80mm x 8mm	200 Meters	1000 Kg.
Angle Iron	40mm x 40mm x 4mm	500 Meters	1100 Kg.
U Iron	40mm x 40mm x 40mm x 3mm	100 Meters	100 Kg.
U Iron	60mm x 60mm x 2mm	180 Meters	200 Kg.
U Iron	40mm x 40mm x 2mm	180 Meters	170 Kg.
U Iron	70mm x 70mm x 3mm	50 Meters	70 Kg.
Pipe	ø : 120mm	12 Meters	55 Kg.
Pipe	ø : 76mm	100 Meters	100 Kg.
Bar (St 55 or 60 surface hardened)	ø : 70mm	10 Meters	30 Kg.
Bolt and Nuts	5/8"	1600 Pieces each	
Washer	5/8"	3200 Pieces	3000 Kg.
Electrodes	Length 350mm ø : 3.25mm	40.000 Pieces	
Electrodes	Length 350mm ø : 2.5 mm	17.000 Pieces	
		Total	94.640 Kg.

FINAL REPORT III

Consultancy services for the Rehabilitation of Equipment and Upgrading of the Efficiency of the Foundry and Mechanical Workshop

in

MOGADISCIO, SOMALIA

UNIDO Contract No. 84/8

Project No. RP/SOM/84/002

Activity Code RP/OI/3I.8

Prepared by: MEDAL, Consultancy and Research for Metallurgical Industries Ltd. Istanbul, Turkey.

Istanbul, 22-August-1987

This report comprises this title page, one(I) synopsis page, fifteen (I5) pages of text and six (6) appendixes (I though 6)

SYNOPSIS

Field work in FMW for the duration of sixteen months were carried out by one NEDAL expert, in connection with the project entitled " Rehabilitation of Equipment and Upgrading of the Efficiency of the Foundry and Mechanical Workshop "..

FMW, operating as a jobbing foundry and machine shop was in need of new products to fill its idle capacity and to earn enough cash for its survival. A market survey previously prepared by FMW management and CTA, based on this survey various products were designed, copied or developed for manufacturing. New technogies also introduced such as use of rotary crane on vertical tank construction. In addition, a continous technical drawing course prepared to upgrade technical drawing reading skill of the technicians and to enable them manufacturing according to the designs prepared.

FMW suffers from high rate of personnel turnover and as a consequence unskilled labor, lack of spare parts and tools, frequent power cuts and time consuming formalities for local purchase. Towards the end of the mission period new materials, tools have been ordered and a new power generator installed to solve some of above cited problems.

TABLE OF CONTENTS

INTRODUCTION

Under UNIDO project No. RP/SOM/84/002, Activity code RP/OI/3I.8 a contract for the provision of services relating to the Rehabilitation of Equipment and Upgrading of the Efficiency of the Foundry and Mechanical Workshop in Mogadiscio in the Democratic Republic of Somalia has been concluded between

UNIDO

United Nations Industrial
Devolopment Organization
Vienna, Austria

and

MEDAL

Consultancy and Research
for Metallurgical Industries Ltd.
Istanbul, Turkey.

Within the scope of the contract, field works for the extended thirteen months plus two and one month with further extension in Somalia were carried out by

Mr. Ersin Bastug, Mechanical Engineer.

from Apr I9th I986 to Aug I9th I987.

The general aim of the project is to provide the necessary expertise and day to day shop level technical assistance to the Somali counterparts in order to put into operation the idle and under utilized equipment and achieve self dependence in the latter's exploitation and maintenance by relevant upgrading of the local skills. The specific task of the mission is installation and commissioning of the furnaces.

This report has been prepared in order to state activities, accomplishments, bottlenecks, findings, recommendations, concerning the extended period of the field work.

This report is requested by UNIDO in the contract on paragraph 2.IO.a.

Thanks are expressed to Mr. Mohamed A. Dahir, General Manager, FMW; Dr. Nihat Yinikoglu, Project Manager CTA, UNIDO; all counterparts and the management of the Foundry and Mechanical Workshop for their kind support and cooperation on the mission.

I.00 ACTIVITIES OF MEDAL TEAM

I.I.0 New Product Designs

List of Designed New Products

Name of Product	Function of Product
Sugar mill hand operated	Extracting the juice from sugar cane
Motor driven sugar mill	Extracting the juice from sugar cane
Citrus fruit presses	Extracting the juice from grapefruit, lemon and orange
Maize sheller	Taking apart the seeds from maize
Cast hand pump	Pumping of water up to IO meters depth
Steel construction hand pumps	Pumping of water up to IOO meters depth
Solar heater	Heating water by solar energy
SADCOM (Somalian Animal Driven Combi)	Agricultural field work
Wind mill and gear box	Water pumping and operating agricultural implements.

I.I.I Sugar Mill Hand Operated

A hand operated sugar mill has been designed by using local market and manufacturing possibilities. The aim was to encourage the small farmers in Somalia, to supply FMI with marketable goods and to upgrade the efficiency and quality of FMI products. Necessary modifications were applied after the testing of prototype.

Development period: 5 weeks

I.I.2 Motor Driven Sugar Mill

A motor driven sugar mill has been designed for larger capacity processes. Again considering local market and manufacturing possibilities to supply marketable products for FMI and to upgrade the efficiency and quality of FMI products as a consequence.

Development period: 8 weeks

I.I.3 Citrus Fruit Presses

One for orange size circuit fruits other for grapefruit which is widely consumed as juice in Somalia have been designed and manufactured.

Development period: 3 weeks

I.I.4 Maize Shellers

Two hand operated maize shellers have been manufactured for farmers. One copied from a Chinese for single corn other for two corns and two handles locally designed.

Development period: 7 weeks

I.I.5 Cast Hand Pump

A cast hand pump was already manufactured. Its technical drawings were prepared for the file.

Period: 2 weeks

I.I.6 Steel Construction Hand Pumps

Steel construction hand pumps were also manufactured previously. Technical drawings were prepared for two different types.

Period: 2 weeks.

I.I.7 Solar Heater

A flat-plate solar collector to be built with simple locally available materials such as ordinary galvanized water pipes has been designed. However not manufactured yet.

Development period: 4 weeks

I.I.8 SADCOM (Somalian Animal Driven Combi)

A donkey driven combi including two planters, one plough, one weeder, one ferrow on a single main frame has been designed, manufactured, developed and tested. Same frame also has a barrow attachment which could be used for transport to and from field.

Studying period: I5 weeks

I.I.9 Wind Mill and Gear Box

Two kinds of wind mill have been designed, one with horizantal axis machine with I8 fan- type blades. Transmission system converts the rotary action of the rotor into reciprocating action for the pump. Another one also is horizontal axis machine with I8 fan-type blades but with a gear box which chances the axis of rotary action from horizontal to vertical, on the floor level rotary action of the wind mill with a second gear box with two outlets is used as a power source for equipments such as shellers, grinders. Same gear box also provides reciprocal action for pumps.

Development period: I7 weeks

I.2.0 Upgrading of the Efficiency

I.2.I Training Course

A technical drawing course for technicians and workers has been given between Jan 87 and Aug 87.

I.2.2 Rotary Crane

The technology of the large size vertical tank building with rotary crane has been developed . The rotary crane with an adjustable height from 6 meters to IO meters has been designed. The production of its parts was completed and assembled. It will be used on large size tank production to weld the ben. ded sheet metals to each other. It put the sheets to their required place in tank body with a greater accuracy. Necessary instructions for operations of the apparatus have been given to the counterparts during the production.

I.2.3 Discharrow

Necessary modifications has been made on a previously manufactured discharrow to make it agreeable for Somalia conditions. By keeping the specifications and functions some of its parts have been chanced to use the materials which is available in local market.

I.2.4 Other Activities

A luggage rack has been designed for a four wheel driver truck.

The list of the presence cutters which are used to produce the gears has been prepared. It was found out some of them were missing. Lacking cutters have been ordered to fill the gap.

Technological information about the helix gears and production instructions has been given to the counterparts. Some calculations have been made for costumers from private industrial sector.

It was showed how to find the development of the conical bended sheet. Some developments have been prepared for products.

The drawing of the loading platform has been prepared for a tractor.

The drawing of some demaged machine parts have been prepared to re-produce them in FMW.

Technical information about the power transmission on the machine driving system has been given to the counterparts.

2.00 FINDINGS AND ANALYSES

As a result of investigations, below facts were discovered and analized.

2.I.0 Poor Quaility of Products

The quality of products were manufactured at FMW was very poor. Most of the products were not able to do its function efficiently. Materials and manufacturing methods of products were not sufficient. On the other hand Somalia imports the most industrial items from abroad. To find a market for products againts the imported ones and products of private manufacturers, FMW products must have a good quality and must be chaper. MEDAL team has tried to upgrade the efficiency and quality of products for upgrading the efficiency of FMW by designing new products which are made from available material in local market and supplying technological information about the production of them.

2.2.0 Technological Knowledge

Due to high rate of personnel turnover FMW lacks from skilled labor. FMW must find a way either by pension fund or by higher salaries to keep its labor force for longer periods. Medal team has tried to give technological information such as technical drawing course, production instructions during the field work.

2.3.0 Varieties of Products

Previously member of products offered to market by FMW was only few and very low in quality. Although as it will be seen from following chapters, new products were designed quality still not at the required level. Probably until more stable labor force obtained quality defficiency will be one of the problems. Number of products developed during this mission is sufficient for FMW's development and cash flow if quality is obtained.

2.4.0 Local Market Possibilities

To supply the materials from local market was restricted by formalities. The variety of the materials were limited. The properties of materials were not suitable for all designing and development purposes. Mostly limited amount of materials was available for a limited time. Continuous supply of materials was not possible.

2.5.0 Power Cut

Electric power cuts occured quite often in I986 and I987 sometimes continiously for months. As a result of regular production stopped at FMW only with two small generators production of some of the items carried out from time to time. After the arrival of large generator, which was ordered previously by the project, production of items detailed in the report were realized.

2.6.0 Counterparts

There were 9 engineers in FMW. 2 engineers in foundry section, I engineer in steel structure, 3 engineers in workshop, 2 engineers in planing and I engineer in maintenance. Medal team appreciate their kind assistance to realize project work.

During the sixteen months field work, the activities which details are given in the body section have been carried out by using local possibilities as much as possible.

Accomplishments, bottlenecks and recommendations conserning this period of the field work are stated below:

3.00 <u>Accomplishments</u>

A- Some new agricultural implements have been designed.

B- Necessary drawings for the designs have been prepared and the production of most items were started under the inspection of MEDAL team and necessary instructions and advices have been given to the counterparts.

C- Training course on technical drawing has been given.

D- Some apparatus have been designed in order to eliminate the manufacturing difficulties.

4.00 <u>Bottlenecks</u>

A- Most of the machines and tools are not suitable for precise work. They need adjustment or spare parts and repairing.

B- The material supplying is hardly possible from local market and quality of materials are not suitable which effectes the production quality and rate.

C- Technological knowledge and working discipline of the workers are very poor.

D- Frequent power cuts or lack of currency for purchase of diesel oil.

5.00 Recommendations

A- The maintenance and repairing of machines should be continued. The complete checking, adjustment and repairing for machines should be done periodically.

B- Necessary materials and spare parts should be supplied continously from local market as much as possible or should be imported in enough quantity for production of items and maintaining machinery.

C- Training course on technical drawing should be continued and more training courses on workshop practise should be started.

D- A file system should be realized for technical drawings and production instructions.

E- A quality control section with authority has to be established to eliminate the production faults before reaching to the customers.

LIST OF APPENDIXES

I- Reports

2- Figures

DRAWINGS

Complete set of drawings as described in attached part lists are with FMW.
Only part lists and assembled drawing of each item are presented in the report.
Pictures of the implements except windpump, taken at Mogadishu International Exibitation participated by FMW. Windpump picture is taken at FMW assembly yard.

Report No. I- ENERGY REQUIREMENT OF SOMALIA

As it knowm, the energy is greater problem for people all around the world especially for developing countries. Energy sources are different such as oil products, solar, wind, hydro, animal, human, fossil products (coal, lignite...). The cost of the energy is a big problem. Somalia is a developing country whose energy problems are largely not yet solved. The energy sources in using are very poor for Somalia. The energy which is used already dominated almost totaly by imported petroleum derivates, the country economy depent on imported petroleum. Somalia has two rivers which are not sufficient to get hydrolic energy even not enough to supply water for irregation, people and livestocks. Only during the rainy season rivers have sufficient amount of water. In the northern of country there are some coal mines without the accurate knowledge of quantity and quality. Some goverment and private agencies have worked on them but it seems not suitable to use largely. On the other hand, the draught animal power acts an important role in daily life of people. It is largely used for transportaion and agricultural purposes. The draught animal power can be used parallel with mechanisation which makes it more efficiently and adaptable for different purposes. But because of low technological knowledge and finance problems in addition the lack of spare parts, trained technic personel and responsible maintenance the using of animal power is limited. Somalia is placed on the horn of Africa and owing its locations in the Indian monsonic area (between I2° N and 2° S), enjoys an intense and quite regular resource of solar and wind energy. During the whole year, the sun rays can be obtained as excellent all over the country. Solar energy can act an important role in energy problem. But again , seperatly, the use of solar energy is very poor in Somalia. The people have not ability to buy or produce, built, operate and maintenance of solar devices. Somalia has been identified as potential regions of good wind power availability. The studies of the wind resource in Somalia shown an excellent wind resource. But the using of the wind energy is not satisfactory yet. Some applications have been realesed by different agencies different times but they were limited and not able to spread the use of wind energy largely in daily life of people. Also maintenance, spare parts, knowledge problems are already prevent a large use of wind energy.

As it noted, Somalia uses imported petroleum derivates in addition to begin totaly depent on imported petroleum, the country also finds it impossible to finance their imports. To help the solution of energy problem can be realized very simple if it is approached with a pragmatic view. In this case, the energy sources, which are rich as natural but not in use, can be put into the efficient use. The draught animal power, human power, solar and wind energy can act important roles in the country economy. When they are supported with simple devices, they can obtain more advances for the country economy and they can upgrade the living standards df people.

Charcoal is one of the most important energy source in Somalia. It is used widely from simple charcoal stoves which is nearly in every house in towns to cupola operation. Country's already limited woodland is destroyed by charcoal production which is one of the most important causes of spread of desert.

MEDAL team has tried to support the country's economy and people by designing implements which use the energy sources pointed above such as windpumps, animal driven agricultural implements.

Report No. 2- SUGAR MILL HAND OPERATED-MOTOR DRIVEN SUGAR MILL

Sugar is highly nourishing food which is widely used in daily life. Sugar is obtained from different plants such as sugar beet and sugar cane. Sugar cane, which is grown widely in Somalia, have a main body which includes the sugar juice. Sugar canes have different diameters and lengths. They may have a size 20-50 mm in diameter and 2000 mm in length. A sugar cane contains an amount of juice equal to 10-20% of its own weight. Sugar are produced from the juice. For this purpose, juice extracted from the cane is boiled then crystallization is applied by seeding. For extraction, different methods are used such as boiling, pressing etc. Commonly used one and most effectif method for small farmers is pressing. In this method sugar juice comes out under the pressure. This method can easily applied using available instruments in farms or villages. Probably two simple stone were used in earlier times. Under the light of industrial developments special machines are designed.

The production of sugar cane and extraction of its juice in Somalia has not reached yet satisfactory levels. The under the utilization of the sugar production in rural areas constitute a serious loss for national economy. Sugar has a very important place in the economic life. Sugar cane is economically viable product which if produced in great quantities and utilized efficiently will provide considerable benefits for the country's economy. The current sugar cane production in rural areas is not efficient as it has to be, just because, first there are deficiencies in its utilization, secondly opportunities for marketing. The sugar produced outside of the site of production is not economic and this fact is a direct consequence of the low rate of production. Therefore efficient utilization of the existing sugar cane production will have direct positive effect on the quantity of processed sugar obtained thus rendering economically viable its marketing outside of the site of production.

The solution of this problem might turn out to be very simple if it is approached with a pragmatic view. The sugar cane juice extractor device of which technical characteristics are displayed in this report, is a very handy and " simple to use " machine designed especially for those peasants who cultivate the sugar cane on a small scale as it happens to be in most of the villages in Somalia where its production is made. The function of this hand operated sugar mill does not require any other extra energy than that of man power of it may simply function with the current available energy and this machine extracts the juice of sugar cane by pressing which is a much more efficient way than all other methods. Therefore the utilization of this method by itself means greater quantity of sugar production with the same level of sugar cane production compared with the production of sugar by different methods. As it is explained above the direct consequence of the utilization of this method is increase in the production of sugar which will stimulate in it's turn the production of sugar cane itself because marketing of the surplus production would have become economically viable and this means importing less sugar from abroad therefore saving foreing currency will help to alleviate the burden on the national economy caused by considerable amounts of foreing trade deficit.

The sugar mill has been designed under the light of the points explained above. Foundry and Mechanical Workshop was a suitable unit to realize it. The machine has been designed depend on the production capability of FMW and material available in local market.

Structure of machine: The machine has a frame which contains different parts. The frame consists of two supporting plates and four standing bars. Supporting plates are placed at the both ends of it which in the shape of a quadratic prism. The cases for ball bearings which carry the shafts are placed on the plates. The machine includes three shafts which carry the pressing rollers made of cast iron. Each roller has a gear at the one end of its shaft. Machine has two handles which are connected to the same shaft to turn a gear which in turn put into motion other gears and rollers. One of the pressing rollers is operated under the spring tension and moves up and down for 3-4 mm to adjust according the thickness of the canes.

Frame consists of supporting plates and standing bars. Standing bar of 20mm diameter has a tapped blind hole on both ends. Supporting plate,is 350 mm by 225 mm by 5 mm in dimensions, has one hole for standing bar on each corner. One of the corners cut to give a suitable adjustment for roller movement. The standing bars placed between two plates, they are fixed by bolts of IO mm diameter.

There are bearing cases which carry the ball bearings of shafts inside machine. The cases are placed into the holes on the plates. Cases have been designed for easy production and mounting. Ball bearings choosen in suitable size and specifications with plastic cover at one side to keep away juice effect.

Shafts carry the rollers. There are three shafts and rollers fixed together by using the pins and keys. Rollers are fixed to the shafts with circular steel covers. Circular covers in turn fix the rollers with pins and keys to shafts. One of the rollers can move during sugar cane processing to adjust itself to the thickness of the canes by means of a spring tension. It can move 3-4 mm up and down to enable canes easy enterence between rollers. Movable roller has larger diameter and longer length closing other in both ends. In such design juice can flow between the rollers but it can not pass over to the sides to other parts of machine such as spring, standing rollers, bearings etc. Juice flow down and is stored in a chancable container.

Machine is operated by handles which are turned by two persons standing on both sides of machine. The handles are fixed to the shaft which turn the smallest roller which placed at the top. Small roller at the top works as a splicer cutting sugar canes longittudinally into stripes for easy pressing. Movement is transported to others by gears with a ratio of I/2. During the operation each person in turn supply the canes to the machine. Each time I or 2 canes are pressed among the rollers.

Capacity of machine vary by depending on the size of canes and operating velocity. When the handles turn with a speed of I2 rpm, canes have a velocity of I80 metres per hour. If two canes are feeded together, machine has a cane processing capacity of I70-I80 canes per hour, as a result sugar cane juice of 60 kg per hour can be obtained from the machine.

Motor driven sugar mill is also in great demand for sugar processing in Somalia. It has a larger sugar cane processing capacity. It may be used by villages and large farms to process sugar canes of large fields

Structure of machine: Machine is mounted on a stand. There are two supporting plates which are fixed on a base plate by bolts. Plates carry the shafts which in turn carry the rollers. Sugar canes are pressed passing them through the rollers. Machine is driven by an 5.5 kw electric motor. The speed of electric motor is reduced by reductor gears. Machine has three shafts. They are placed as one of them at the top of the others. The electric motor turn the top shaft which turns other gears which fixed at the end of the shafts. The shafts have brass bearings placed in the supporting plates. The brass bearings can be moved by adjusting the bolts which are placed on the edges of the supporting plates. The adjustment of the brass bearings chance the distance between the rollers to enable canes in different size to be feeded to the machine easily and to make up wearing. Base plate, supporting plates, rollers and gears are made of cast iron, shafts are made of steel and stand is made of U channels. The structure of machine is similar to hand operated but it has higher processing capacity of sugar canes. Each time 2-4 canes could be pressed among the rollers. The shafts have a speed of 24 revulation per minute which means a velocity of 600 metres per hour for canes. If 600 canes could be processed each hour 210 kg per hour juice can could be obtained from the machine.

The processing of sugar cane includes the operation: pressing, boiling and seeding and centrifugal refining. The pressing is carried out by hand operated or motor driven sugar mill. Boiling process is a simple operation. Juice coming from extractor is boiled in hopper pans by using the pressed sugar cane stalks as fuel. The catalyst sugar seeds are added to the juice to grow sugar crystals while the boiling. After the boiling, the refining process takes place. The substance coming from boiler is put into the centrifugal machine and machine is turned. Because of the centrifugal force, the substance inclines to go away from the centre of machine spreading on to the filter screen, water is sprayed in the centre which later water passes through the filter washing sugar and leaves the machine at the bottom. Inside the machine only the sugar crystals remain and their colour turns to yellowish white or white depending amount of water used for washing. The sugar crystals are taken out from the machine and are dryed under sun spread on a piece of cloth. After the drying, the sugar is ready to use.

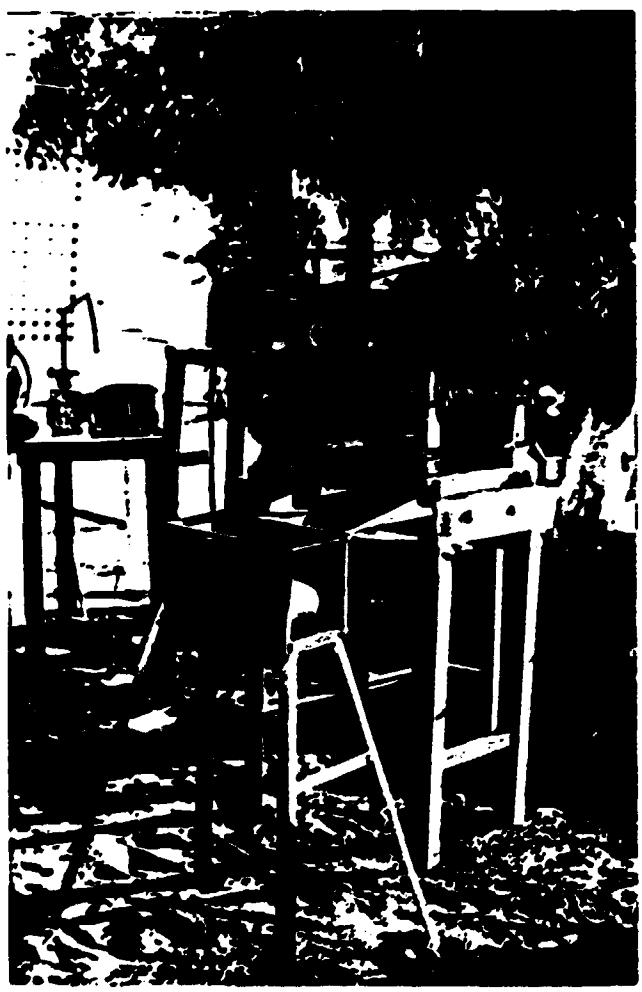
As a pre-study before designing a farm which is 35 km away from Mogadiscio was visited several times, where an old sugar cane juice extractor, juice boiling section and centrifugal machine were placed together. Machines are operated by a diesel engine and power is translated by belts and gears. The extracting and centrifuging operations were studied and the problems were discussed by the operators. The system was very complicated. There were so many belts and gears which are not necessary when they are designed properly.
Also a sugar factory 500 km away from Mogadiscio was visited. There a motor driven sugar mill is used to test the juice capacity of sugar canes in the laboratory. The machine was operated and necessary information was obtained from operators.

Sugar Mill Hand Operated

With three drums (one of them splicer)
Double handle for 2 persons.
Approximate capacity : 180 kg cane/hr or 60 kg juice/hr which equals to 6-24 kg of sugar/hour.
Weight without frame : 20 kg.
Weight with frame : 40 kg.

Sugar Mill Motor Driven

With three drums (one acts as splicer)
Motor power : 5.5 kw (3 HP)
Approximate capacity : 600 kg cane/hr or 210 kg juice/hr which equals to 18-72 kg of sugar per hour.
Weight without frame : 800 kg.
Weight with frame : 1100 kg.



No	Qan.	Description	Drawing No	Scale	Material
39	2	Shaft-nut	1.01.39	1:1	Ø35x7 mm round steel
38	2	Ball bearing	1.01.38	1:1	6006-RS - SKF
37	8	Bolt	1.01.37	1:1	ØM10x25 mm
36	1	Pin	1.01.36	1:1	Ø6x35 mm round steel
35	7	Pin	1.01.35	1:1	Ø6x25 mm round steel
34	4	Washer	1.01.34	1:1	Ø21x2 mm round steel
33	4	Ball bearing	1.01.33	1:1	6004-RS - SKF
32	2	Spring	1.01.32	1:1	Ø2,4x692 mm steel wire
31	2	Spring bolt	1.01.31	1:1	Ø21x82 mm round steel
30	6	Nut	1.01.30	1:1	ØM12
29	1	Handle end part	1.01.29	1:1	Ø34x35 mm round steel
28	1	Handle end part	1.01.28	1:1	Ø34x25 mm round steel
27	2	Handle bar	1.01.27	1:1	Ø14x145 mm round steel
26	2	Handle	1.01.26	1:1	255x Ø10 mm round steel
25	1	Drum key	1.01.25	1:1	17x12x6 mm steel
24	1	Shaft-nut	1.01.24	1:1	Ø52x10,5 mm steel
23	1	Shaft-nut	1.01.23	1:1	Ø42x13 mm steel
22	1	Shaft-nut	1.01.22	1:1	Ø42x11,5 mm steel
21	1	Drum key	1.01.21	2:1	17x12x6 mm steel
20	2	Drum key	1.01.20	2:1	15x10x6 mm steel
19	3	Gear key	1.01.19	2:1	8x8x5 mm steel
18	2	Drum key	1.01.18	2:1	15x10x6 mm steel
17	1	Gear	1.01.17	1:1	Ø84x8 mm plate
16	2	Gear	1.01.16	1:2,5	Ø162x8 mm plate
15	2	Drum cover	1.01.15	1:1	Ø58x10 mm plate
14	1	Shaft	1.01.14	1:1	Ø50x337 mm round steel
13	1	Shaft	1.01.13	1:1	Ø40x249 mm round steel
12	1	Shaft	1.01.12	1:1	Ø40x256 mm round steel
11	2	Spring guide	1.01.11	1:1	70x20x20 mm steel
10	2	Spring-nut	1.01.10	1:1	55x20x20 mm steel
9	2	Moving bearing case	1.01.09	1:1	70x65,5x19 mm steel
8	2	Bearing case	1.01.08	1:1	Ø70x19 mm plate
7	2	Bearing case	1.01.07	1:1	Ø55x18 mm plate
6	4	Drum cover	1.01.06	1:1	Ø135x10 mm plate
5	1	Drum	1.01.05	1:1	Ø77x144 mm cast iron
4	1	Drum	1.01.04	1:2,5	Ø155x144 mm cast iron
3	1	Drum	1.01.03	1:2,5	Ø170x165 mm cast iron
2	2	Supporting plate	1.01.02	1:2,5	350x225x5 mm plate
1	4	Supporting bar	1.01.01	1:1	Ø20x190 mm round bar

Date

Ersin BASTUĞ

Hand Operated Sugar Mill

Foundry & Mechanical Workshop

UNIDO

No: 1.01

No	Qan.	Description	Drawing No	Scale	Material
26		Gib head key	1.02.24		
25		Screw	1.02.24		M16
24	6	Pin	1.02.24	1:1	Ø16x50mm steel
23	1	Distance piece	1.02.23	1:2,5	318x108x25mm cast iron
22	1	Base frame	1.02.22	1:5	5756mm 120x55x7mm angle
21	6	Cover	1.02.21	1:2,5	Ø200x15mm steel
20	1	Base	1.02.20	1:5	710x476x50mm cast iron
19	2	Bearing case	1.02.19	1:2,5	300x175x70mm cast iron
18	2	Bearing case	1.02.18	1:2,5	350x210x70mm cast iron
17	1	Shaft	1.02.17	1:2,5	Ø50x475mm steel
16	1	Shaft	1.02.16	1:2,5	Ø60x540mm steel
15	1	V pulley	1.02.15	1:1	Ø100x60mm cast iron
14	1	V pulley	1.02.14	1:2,5	Ø400x44mm cast iron
13	1	Gear	1.02.13	1:1	Ø96x75mm cast iron
12	1	Gear	1.02.12	1:2,5	Ø408x70mm cast iron
11	1	Gear	1.02.11	1:1	Ø102x100mm cast iron
10	1	Gear	1.02.10	1:2,5	Ø445x95mm cast iron
9	3	Gear	1.02.09	1:2,5	Ø250x50mm cast iron
8	1	Shaft	1.02.08	1:2,5	Ø80x650mm steel
7	2	Shaft	1.02.07	1:2,5	Ø80x475mm steel
6	2	Roll	1.02.06	1:2,5	Ø260x330mm cast iron
5	1	Roll	1.02.05	1:2,5	Ø250x330mm cast iron
4	1	Bearing	1.02.04	1:1	80x80x70mm brass
3	2	Bearing	1.02.03	1:1	80x80x70mm brass
2	2	Support cover	1.02.02	1:1	160x80x60mm cast iron
1	2	Support	1.02.01	1:2,5	600x360x60mm cast iron

Date

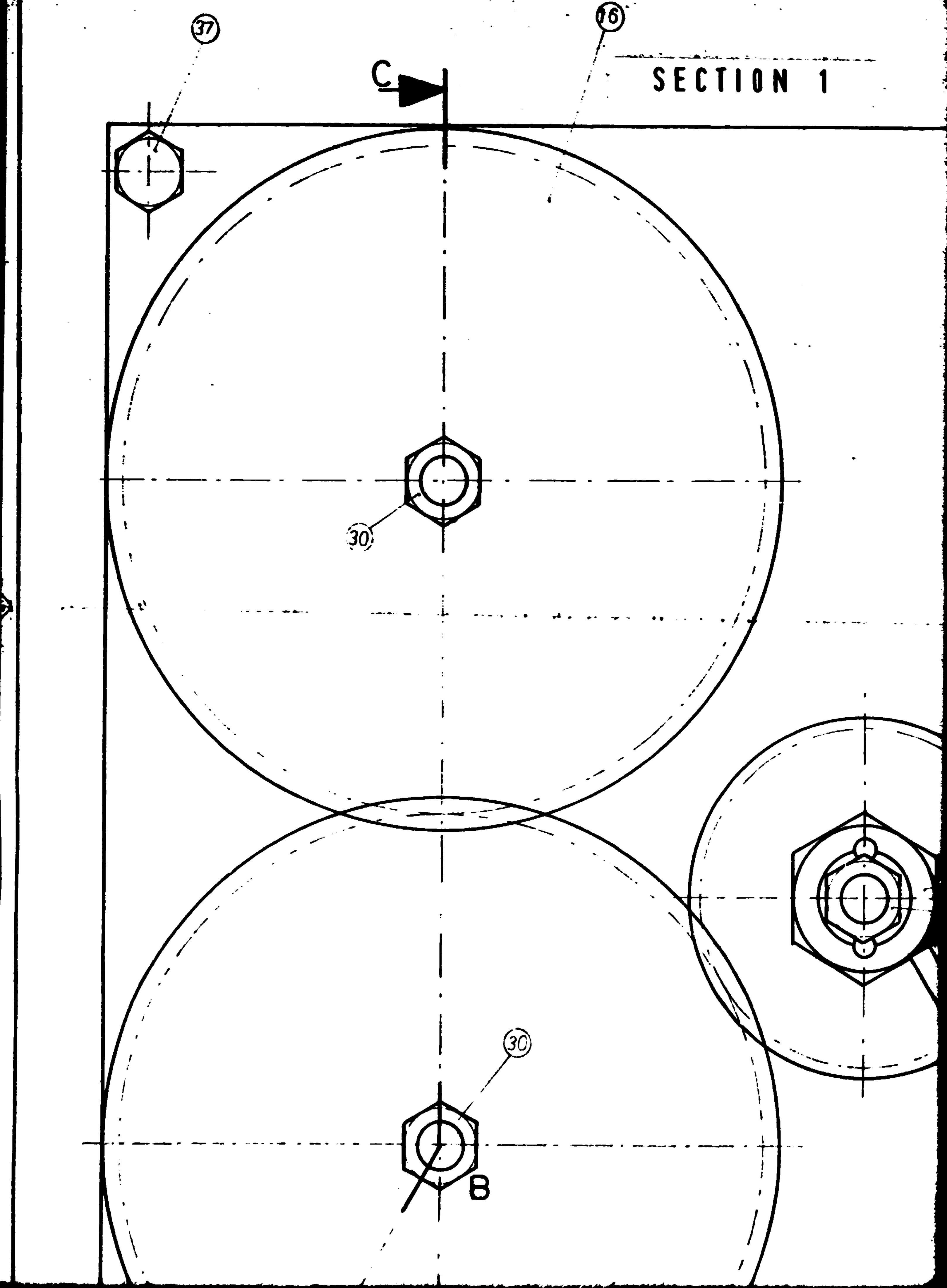
Ersin BASTUG

Motor Driven Sugar Mill

Foundry & Mechanical Workshop

UNIDO

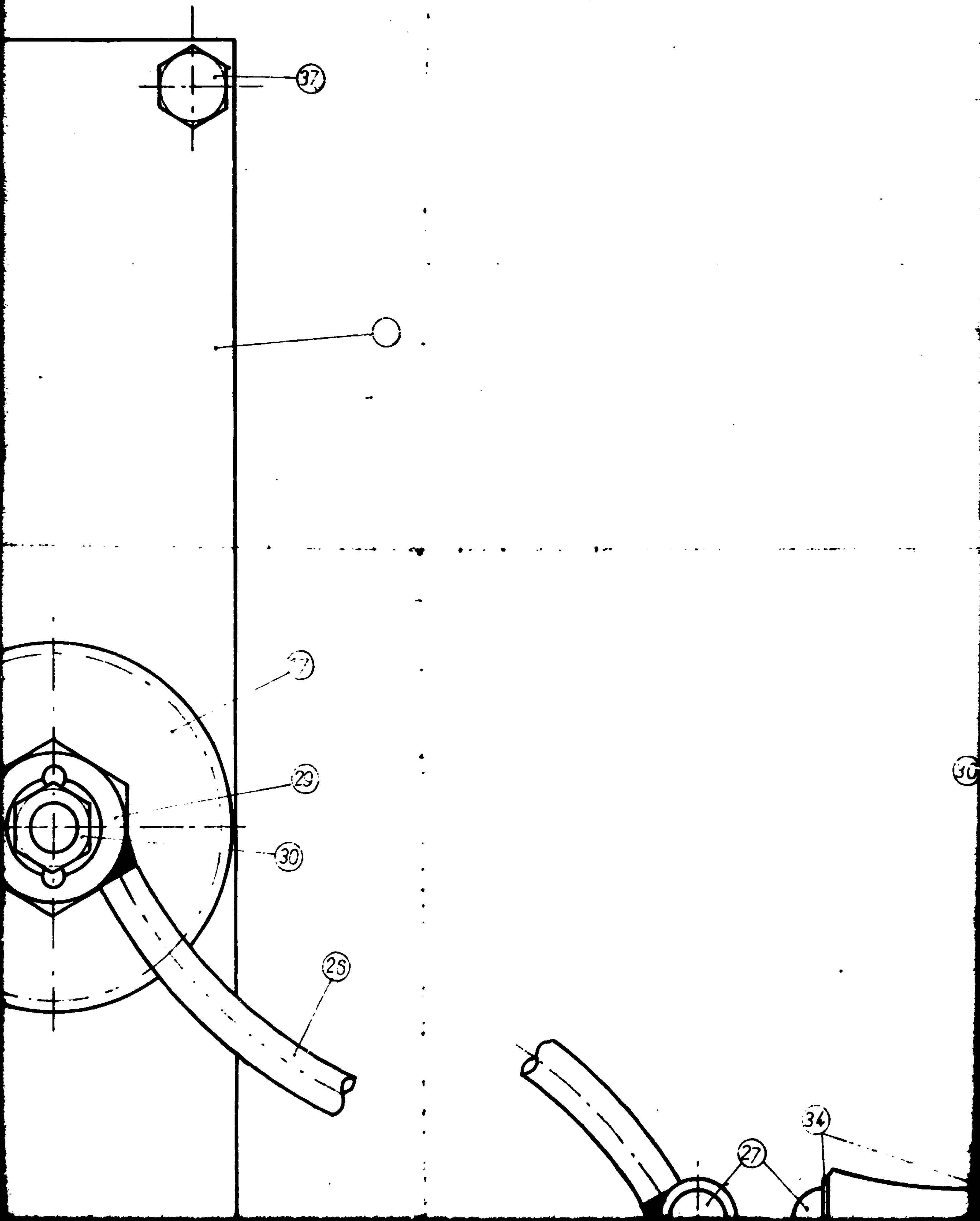
No: 1.02



Foundry/Mechanical Workshop
Mogadiscio-Somalia

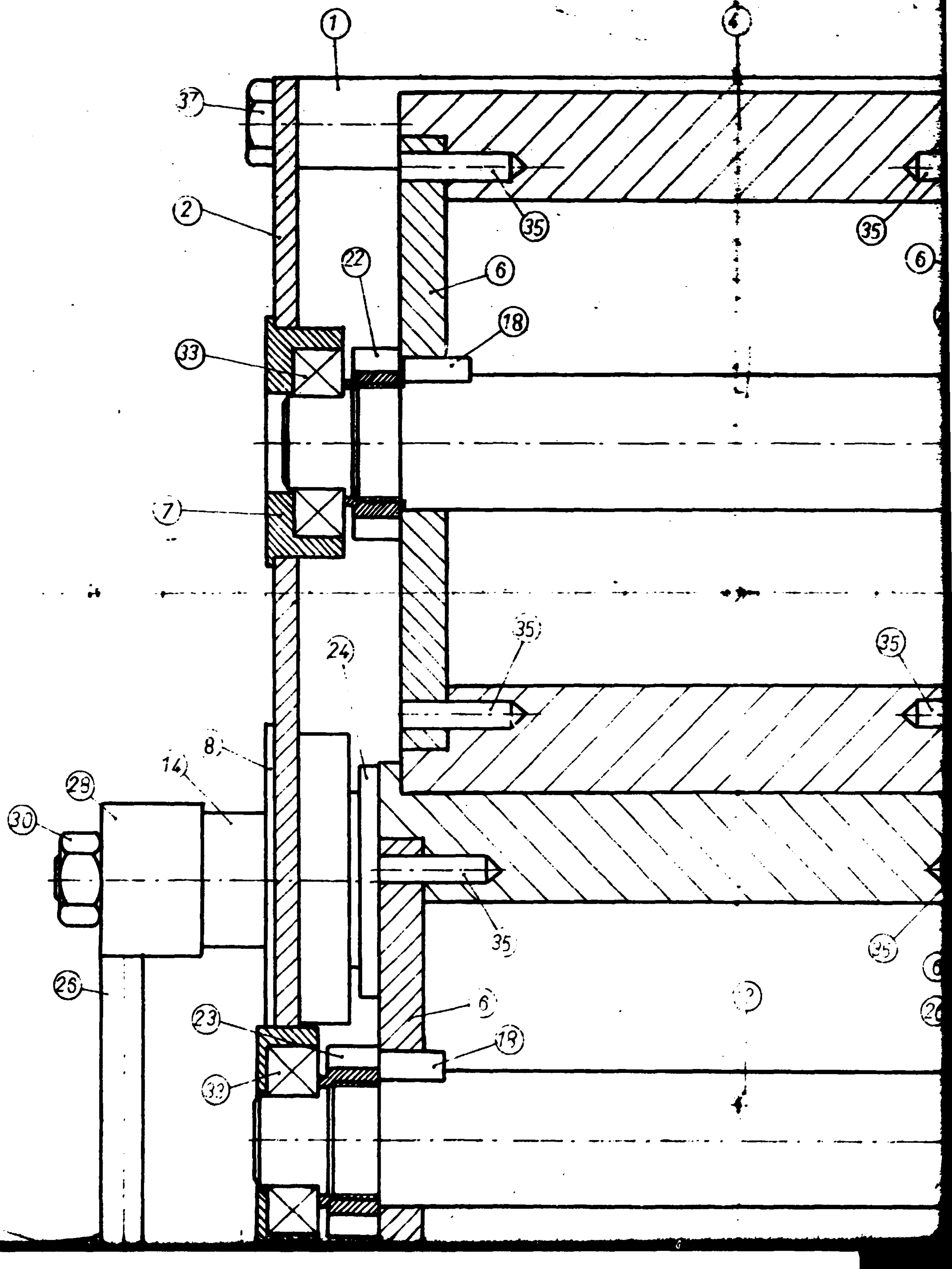
Appendix I.

SECTION 2



SECTION 3

section A_C



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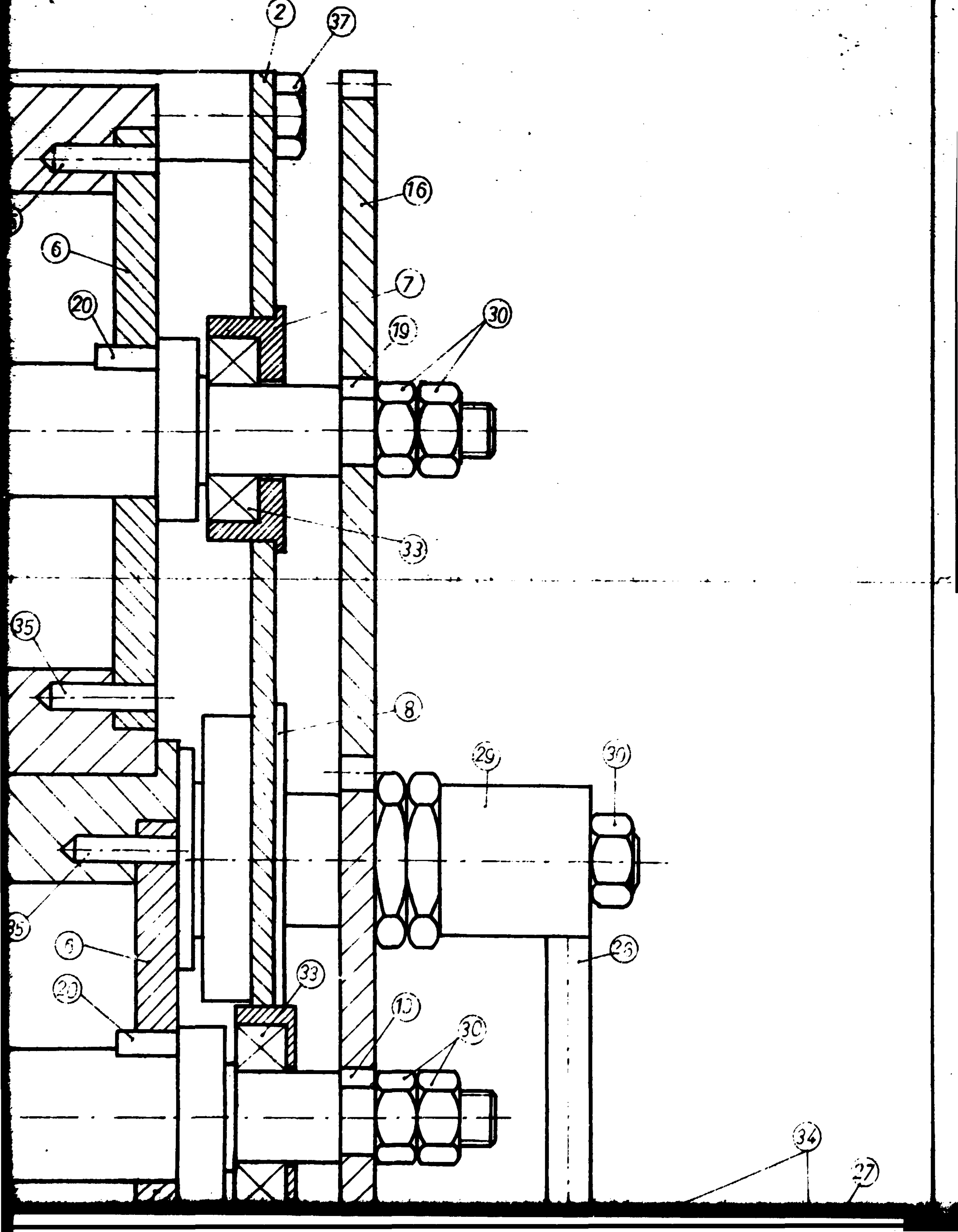

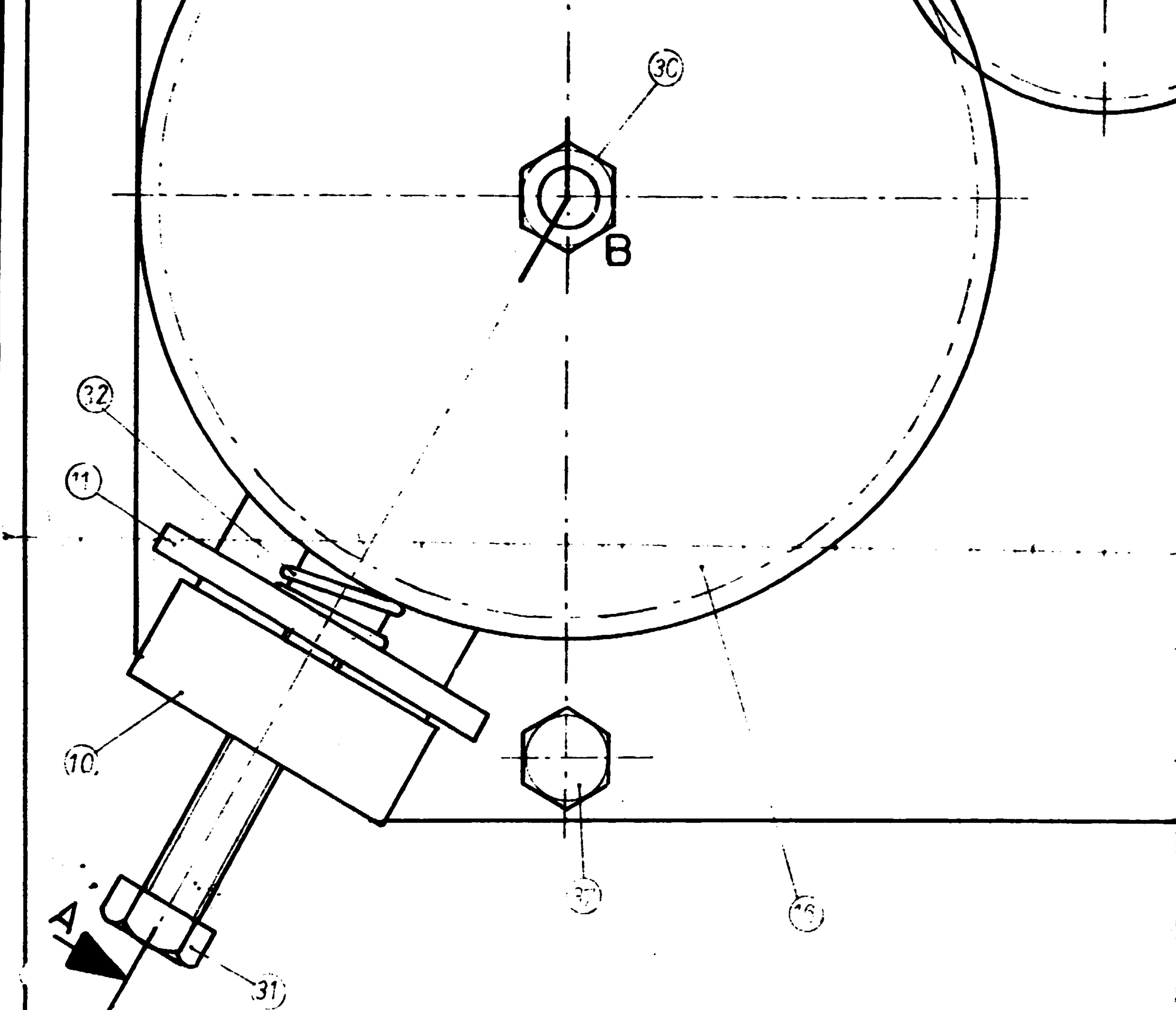

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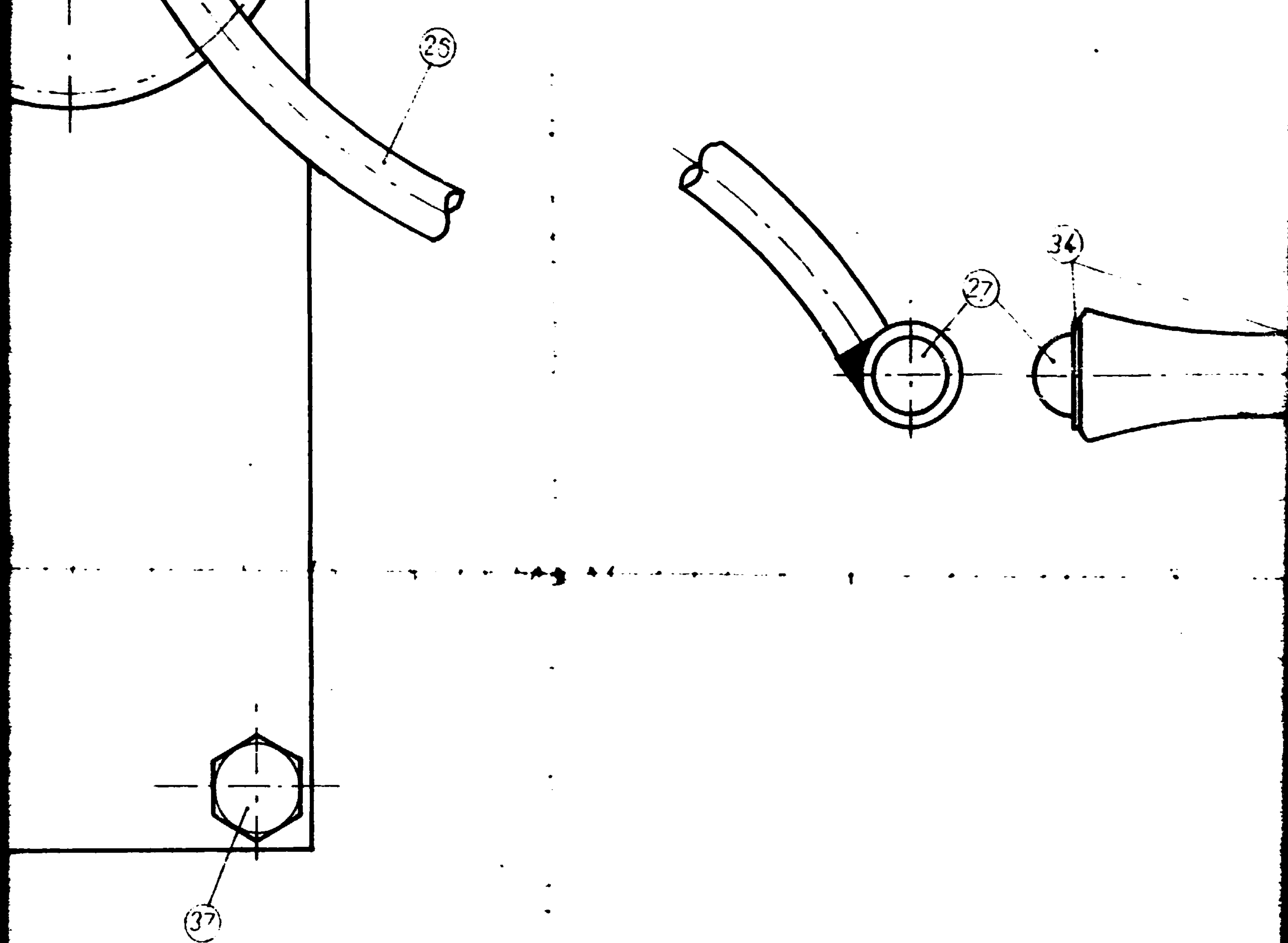

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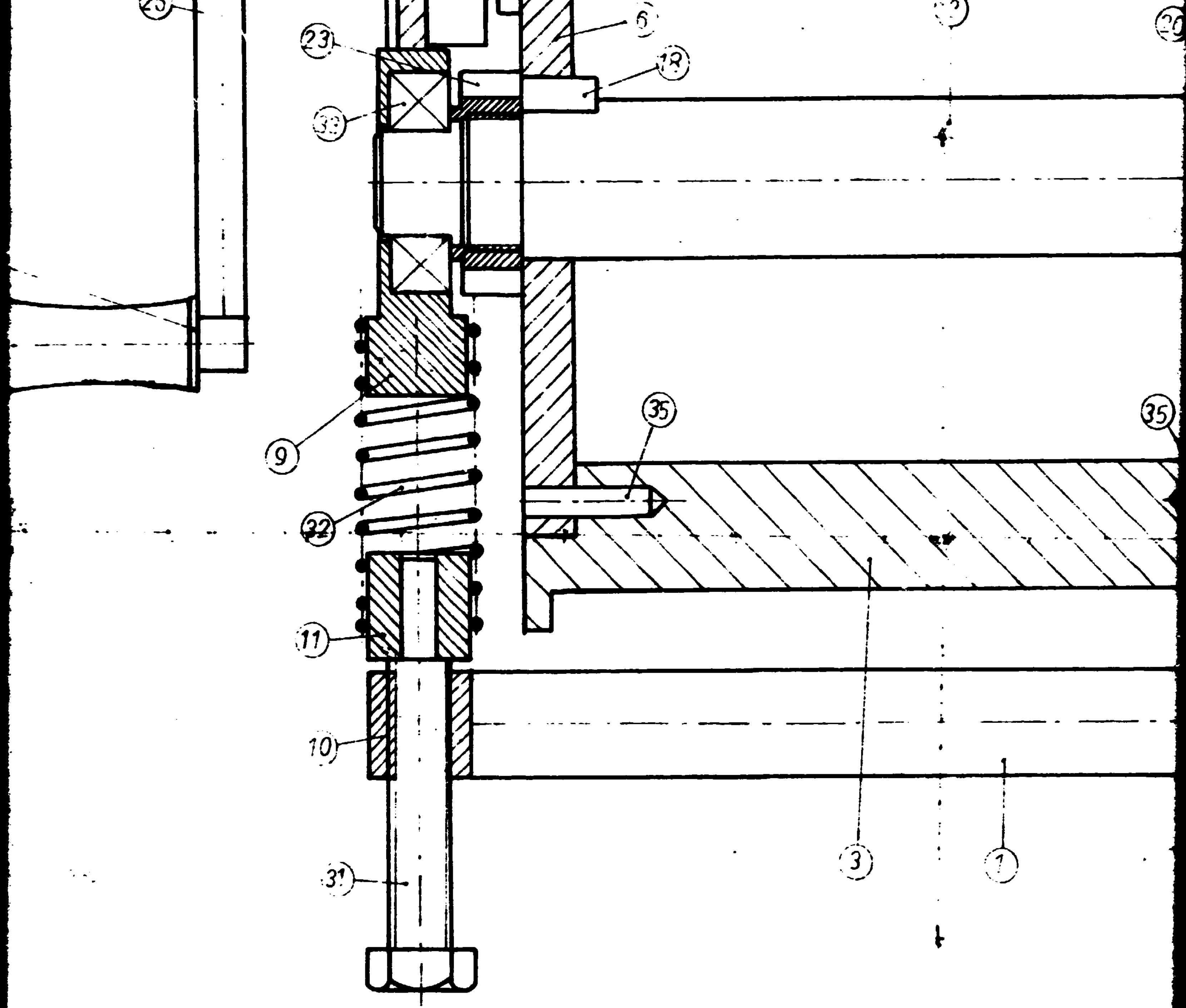

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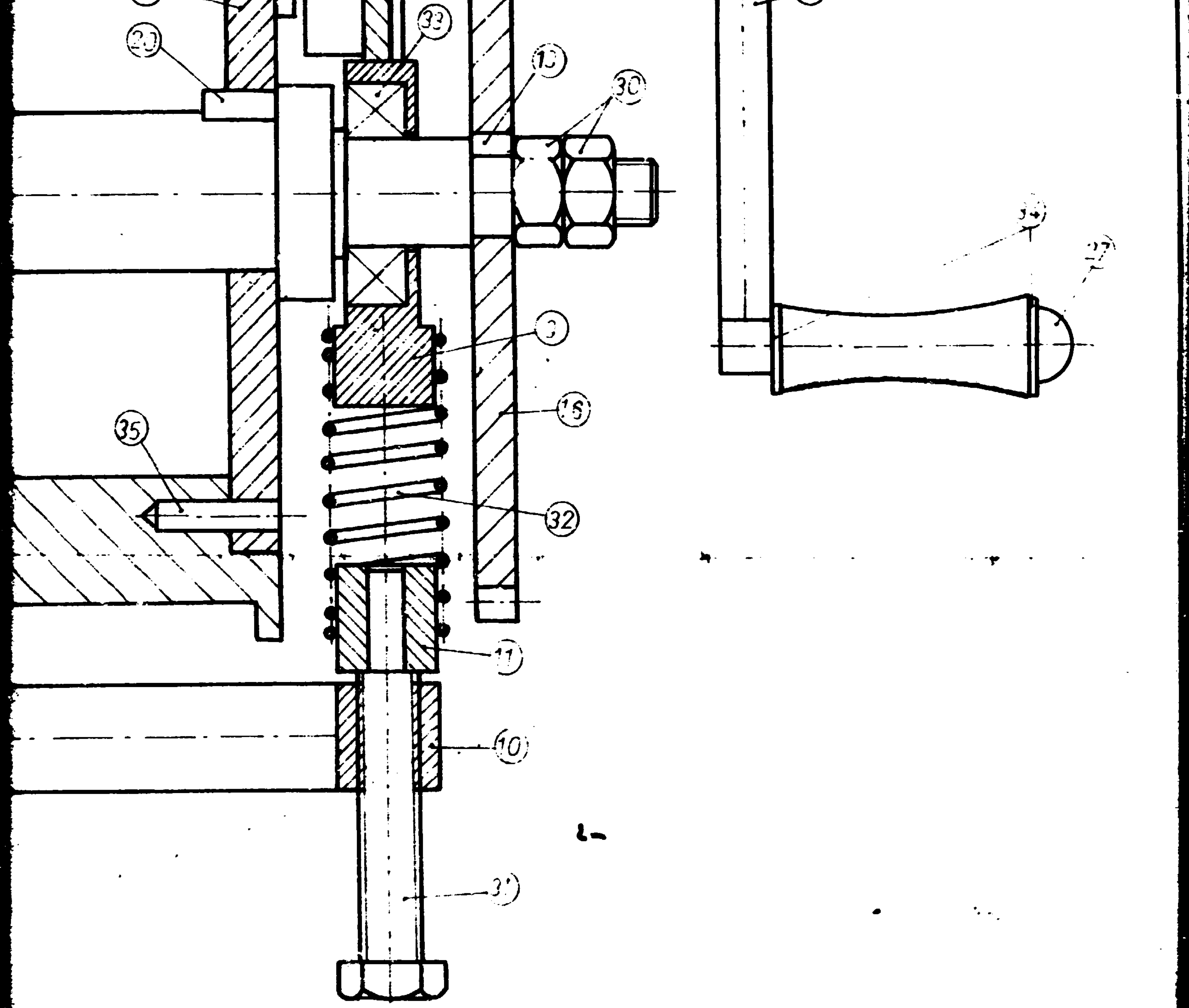

SECTION 8

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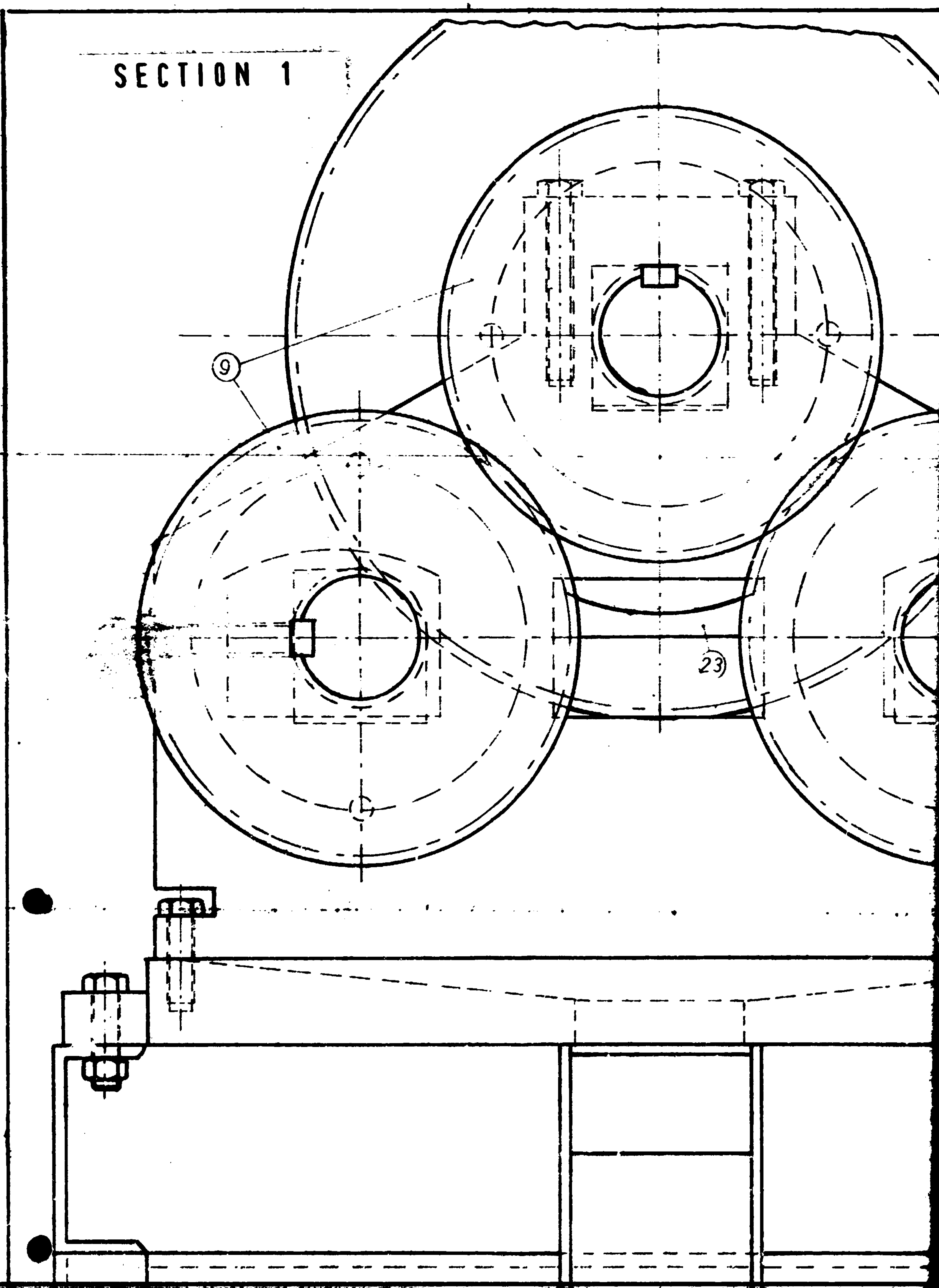
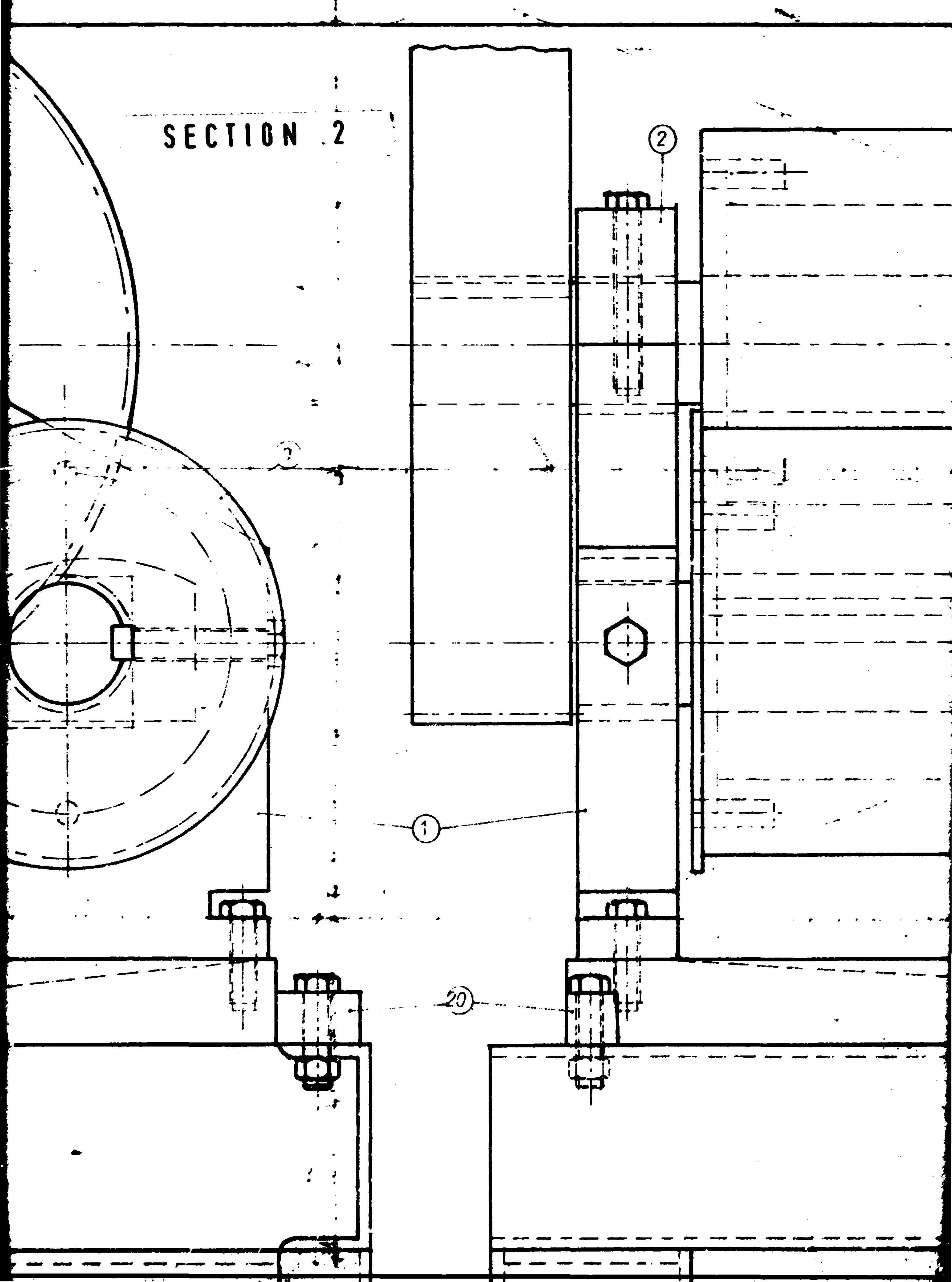
SECTION 1

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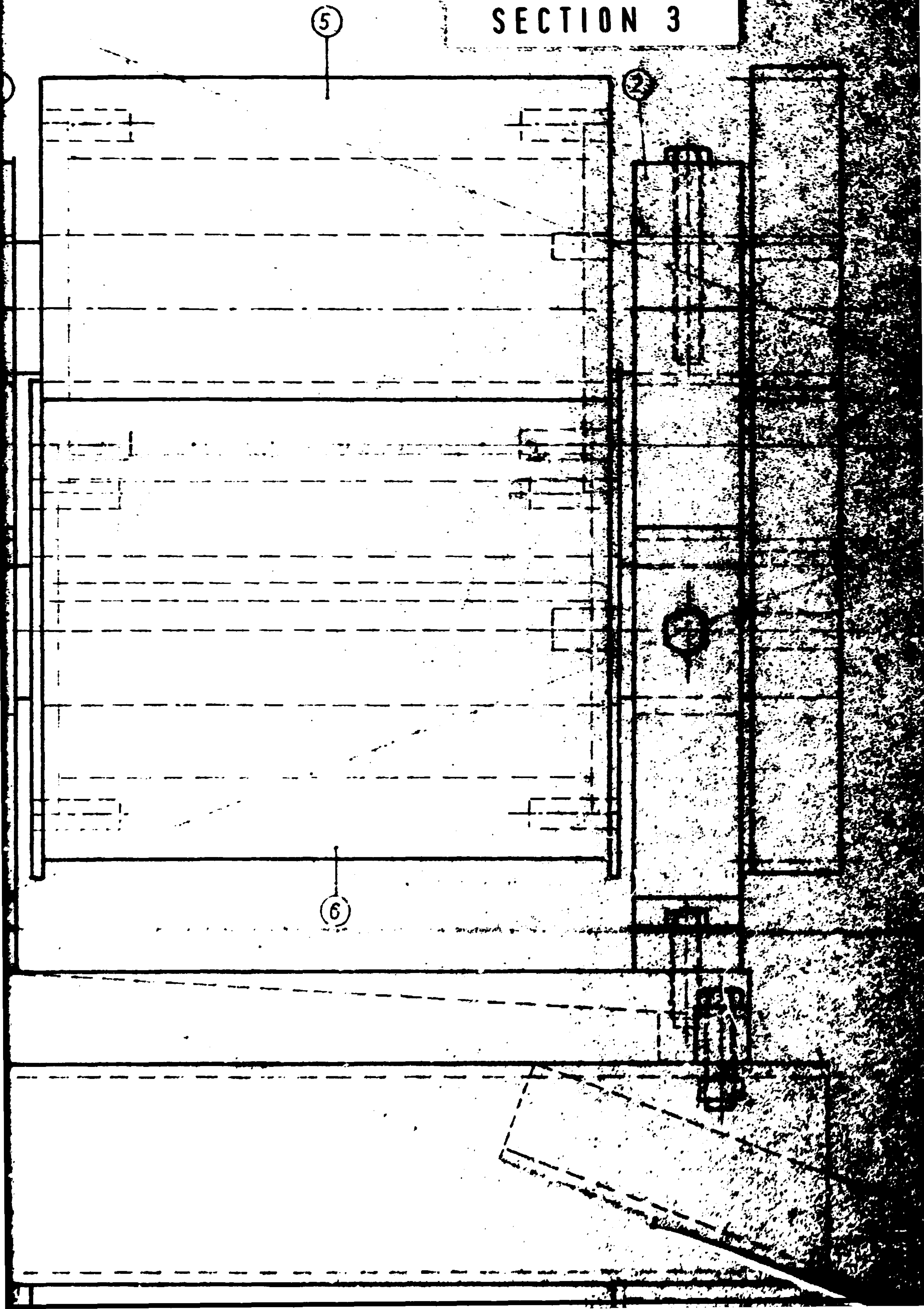
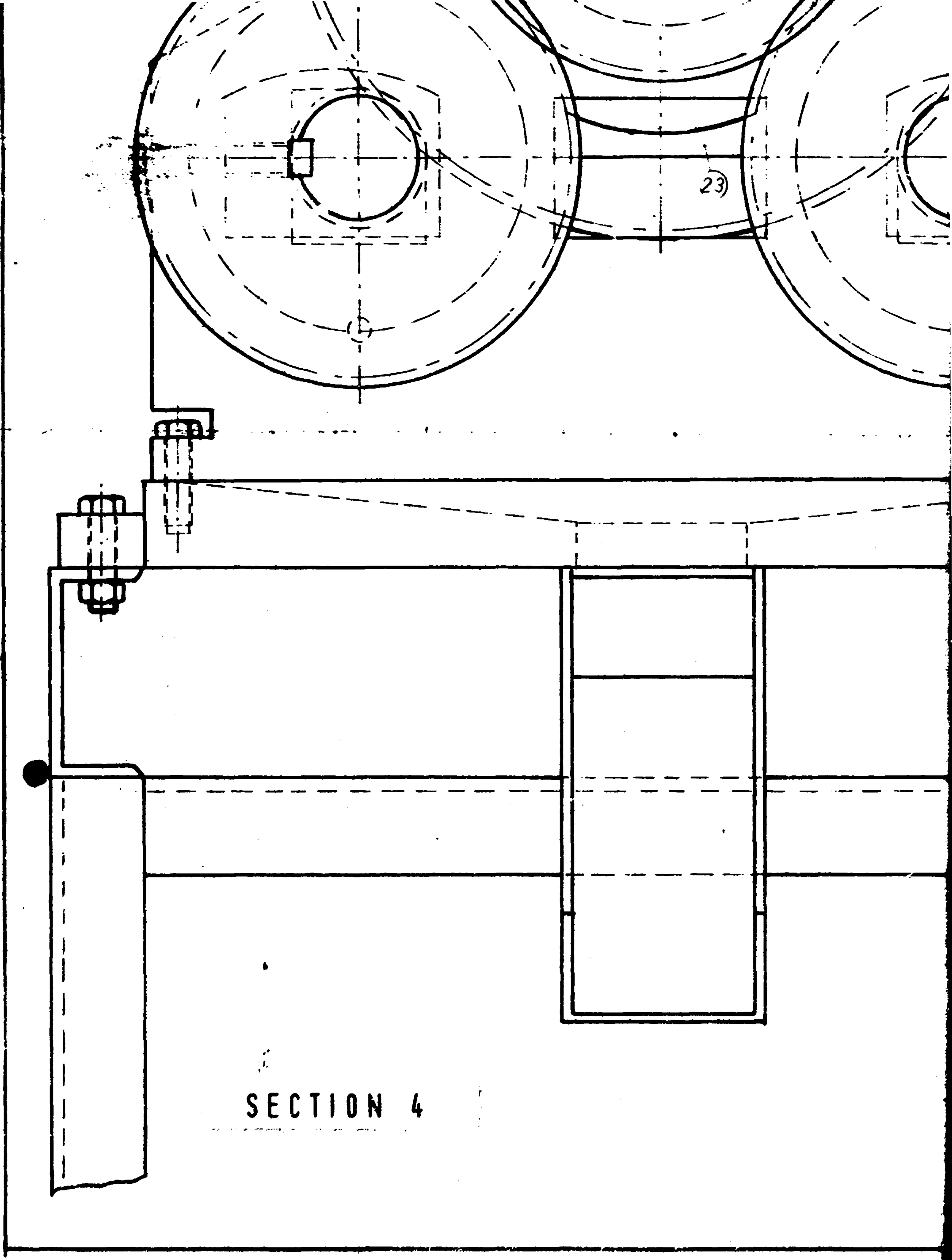
SECTION 3





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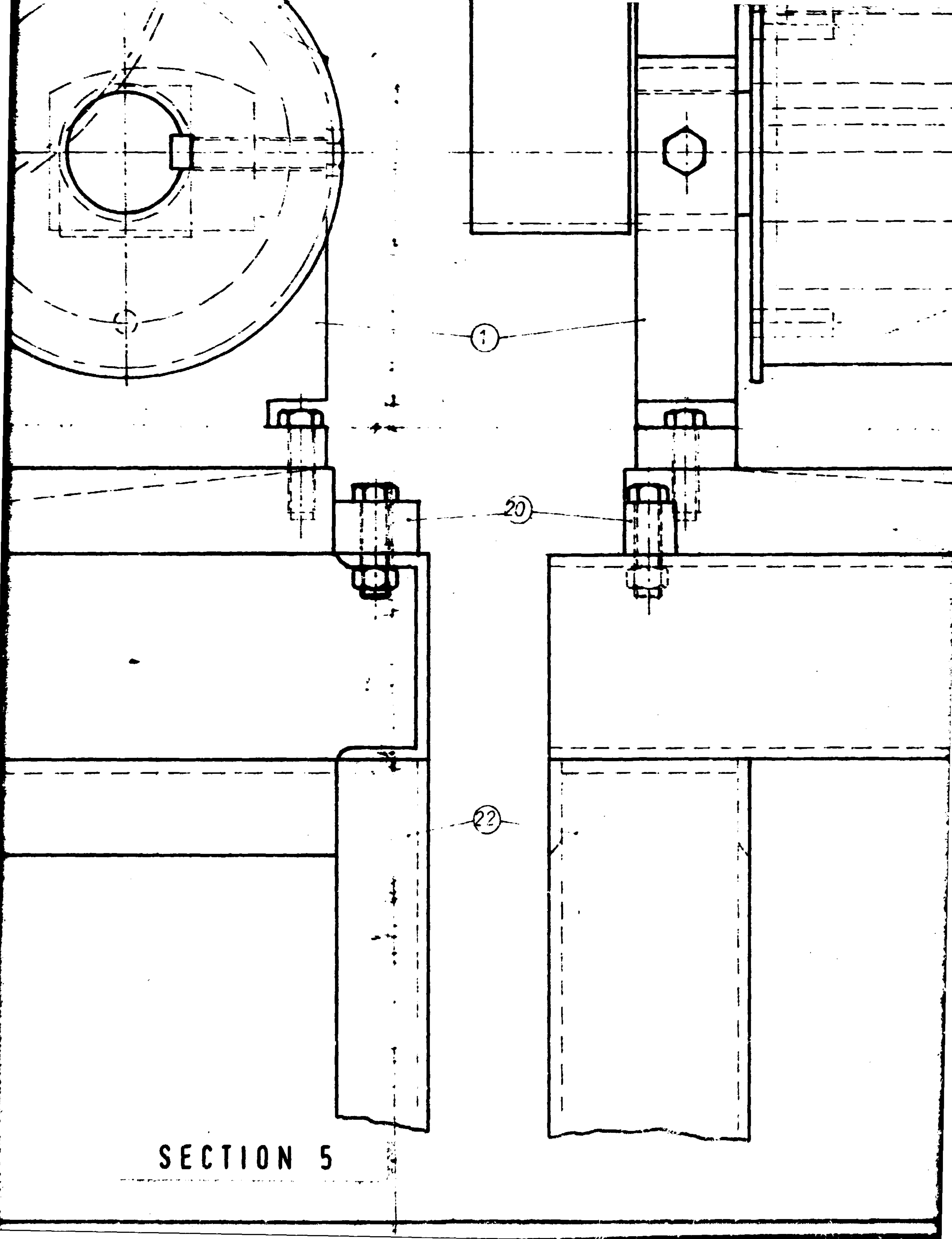

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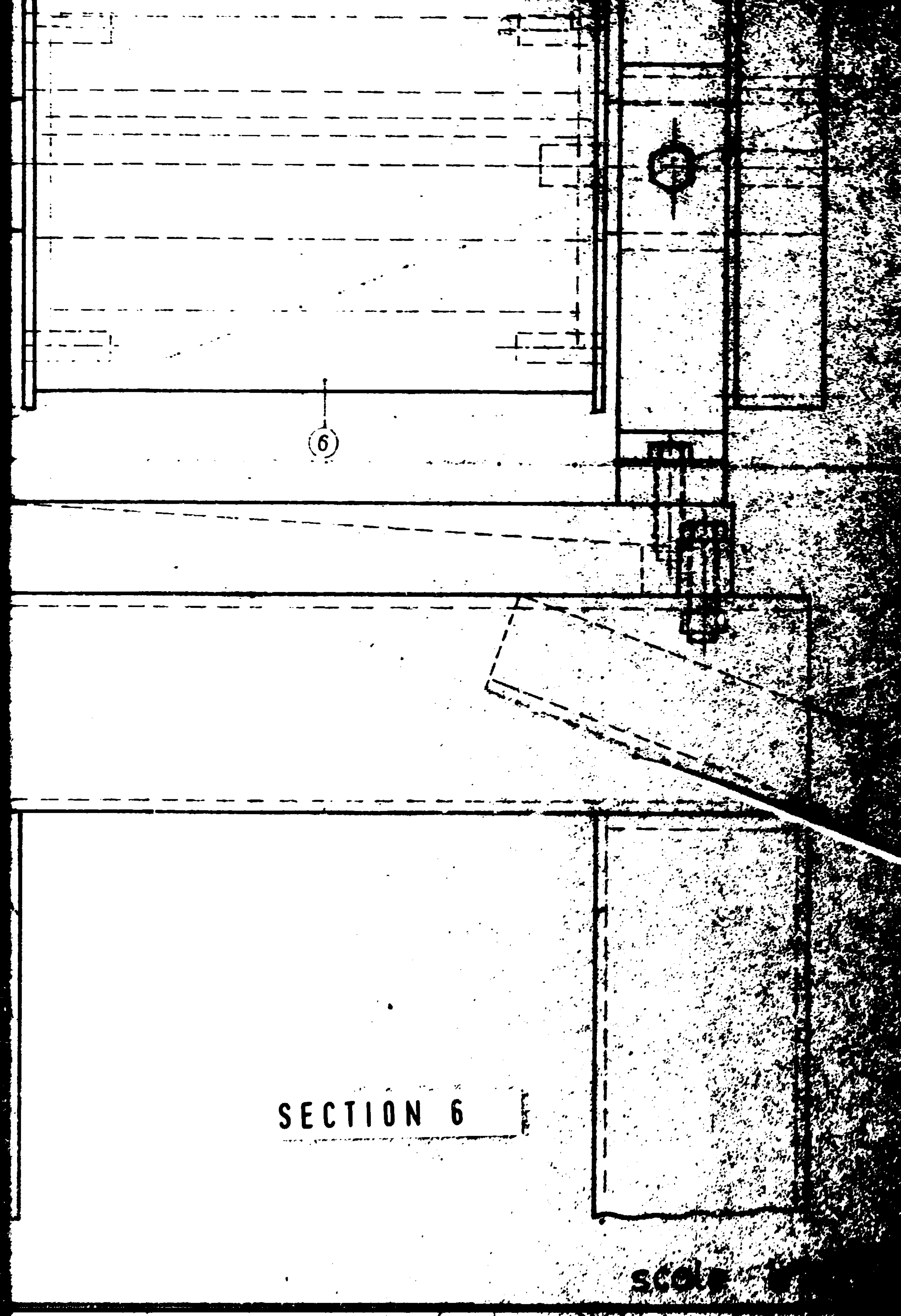

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SECTION 6
scale

Foundry/Mechanical Workshop
Mogadiscio-Somalia

Appendix I.

Report No. 3- CITRUS FRUIT PRESSES

Grapefruit and lemon are important products of Somalia. People consume them mostly as juice. Superimutto which is water mixed grapefruit juice is most widely consumed soft drink all over the country.

Two simple hand operated fruit presses have been developed, one smaller size for orange, the other large size for grapefruit.

Presses have a pipe column inserted in a cast iron base. At the top of the pipe a gear system connected to a handle presses aluminium cap to the top of the grapefruit which is sliced into two. Juice flows through perforated aluminium base support into a cup placed at the bottom.

Approximate capacity is 30 fruits per minute.

Citrus Fruit Presses

Small for orange and lemon
Large for grapefruit
Pressing speed approximately 30 fruits/min.
Weight small size : 3 kg
Weight large size : 5 kg

16	1	Grub screw	1.07.16 s	2:1	ø M8 x 14 mm
15	1	Spring	1.07.15 s	1:1	
14	1	Slotted screw	1.07.14 s	1:1	ø M6 x 50 mm
13	1	Top part	1.07.13 s	1:1	Aluminium
12	1	Handle arm	1.07.12 s	1:1	ø18 x 98 mm steel
11	1	Handle	1.07.11 s	1:1	Wooden
10	1	Handle head	1.07.10 s	1:1	Aluminium
9	1	Lower part	1.07.09 s	1:1	Aluminium
8	1	Middle part	1.07.08 s	1:1	Aluminium
7	1	Pendant	1.07.07 s	1:1	Aluminium
6	1	Pinion	1.07.06 s	1:1	ø 25 x 101 mm steel
5	1	Rack	1.07.05 s	1:1	ø 17 x 152,5 mm steel
4	1	Head-neck	1.07.04 s	1:1	Cast iron
3	1	Ring	1.07.03 s	1:1	Cast iron
2	1	Column	1.07.02 s	1:1	ø28 x 350 mm steel
1	1	Base	1.07.01 s	1:1	Cast iron
No	Qan.	Description	Drawing No	Scale	Material

Date

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Citrus Fruit Press - Small Size

Foundry & Mechanical Workshop

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No: 1.07.

No	Qan.	Description	Drawing No	Scale	Material
16	1	Grub screw	1.07.16 b	2:1	ØM 8 x 14 mm
15	1	Spring	1.07.15 b	1:1	
14	1	Slotted screw	1.07.14 b	1:1	ØM 6 x 50 mm
13	1	Top part	1.07.13 b	1:1	Aluminium
12	1	Handle arm	1.07.12 b	1:1	Ø18 x 98 mm steel
11	1	Handle	1.07.11 b	1:1	Wooden
10	1	Handle head	1.07.10 b	1:1	Aluminium
9	1	Lower part	1.07.09 b	1:1	Aluminium
8	1	Middle part	1.07.08 b	1:1	Aluminium
7	1	Pendant	1.07.07 b	1:1	Aluminium
6	1	Pinion	1.07.06 b	1:1	Ø25 x 101 mm steel
5	1	Rack	1.07.05 b	1:1	Ø17 x 207,5 mm steel
4	1	Head-neck	1.07.04 b	1:1	Cast iron
3	1	Ring	1.07.03 b	1:1	Cast iron
2	1	Column	1.07.02 b	1:1	Ø28 x 410 mm steel
1	1	Base	1.07.01 b	1:1	Cast iron

Date

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Citrus Fruit Press - Big Size

Foundry & Mechanical Workshop

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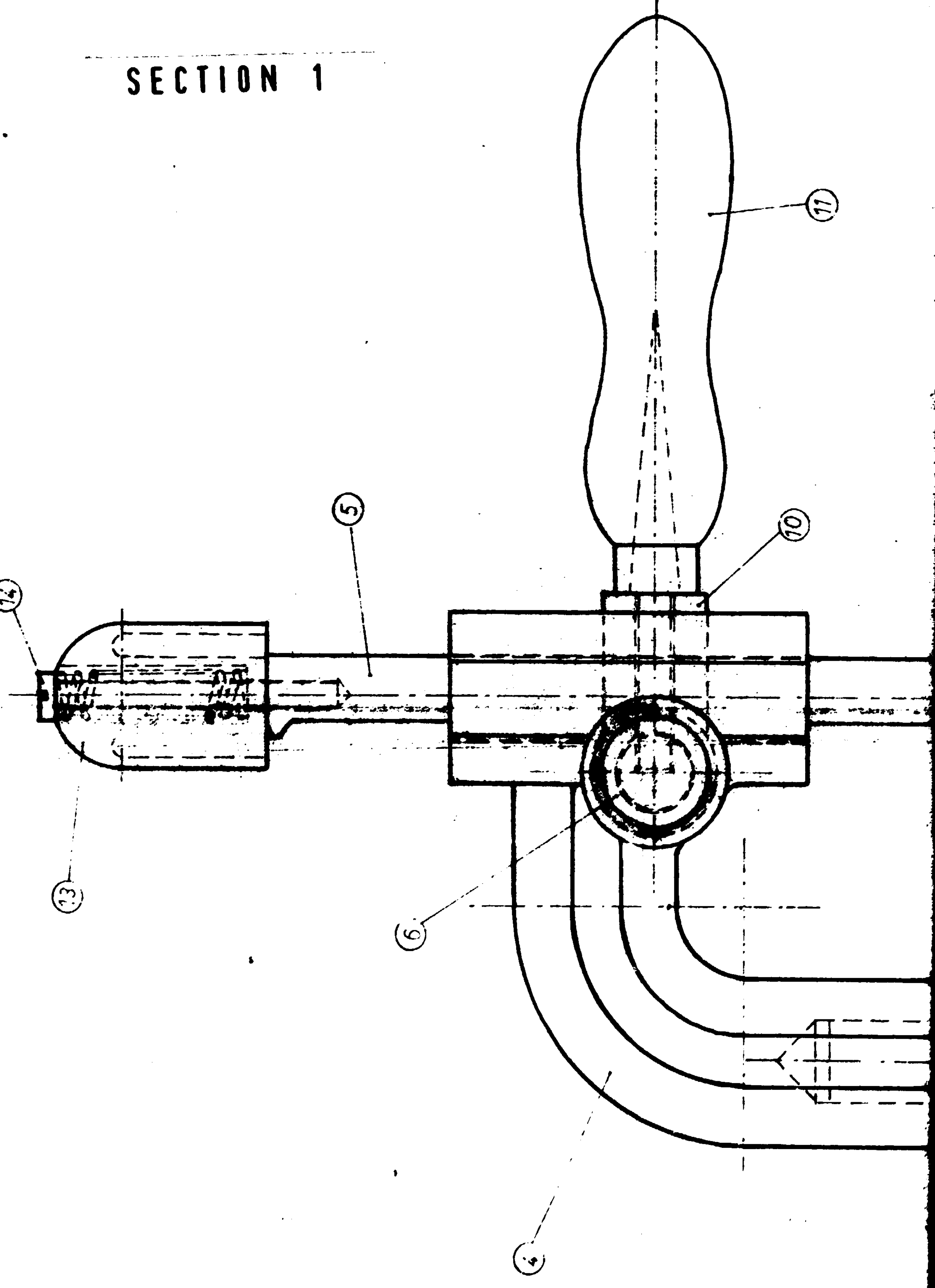
Page 2

No: 1.07.

SECTION 1



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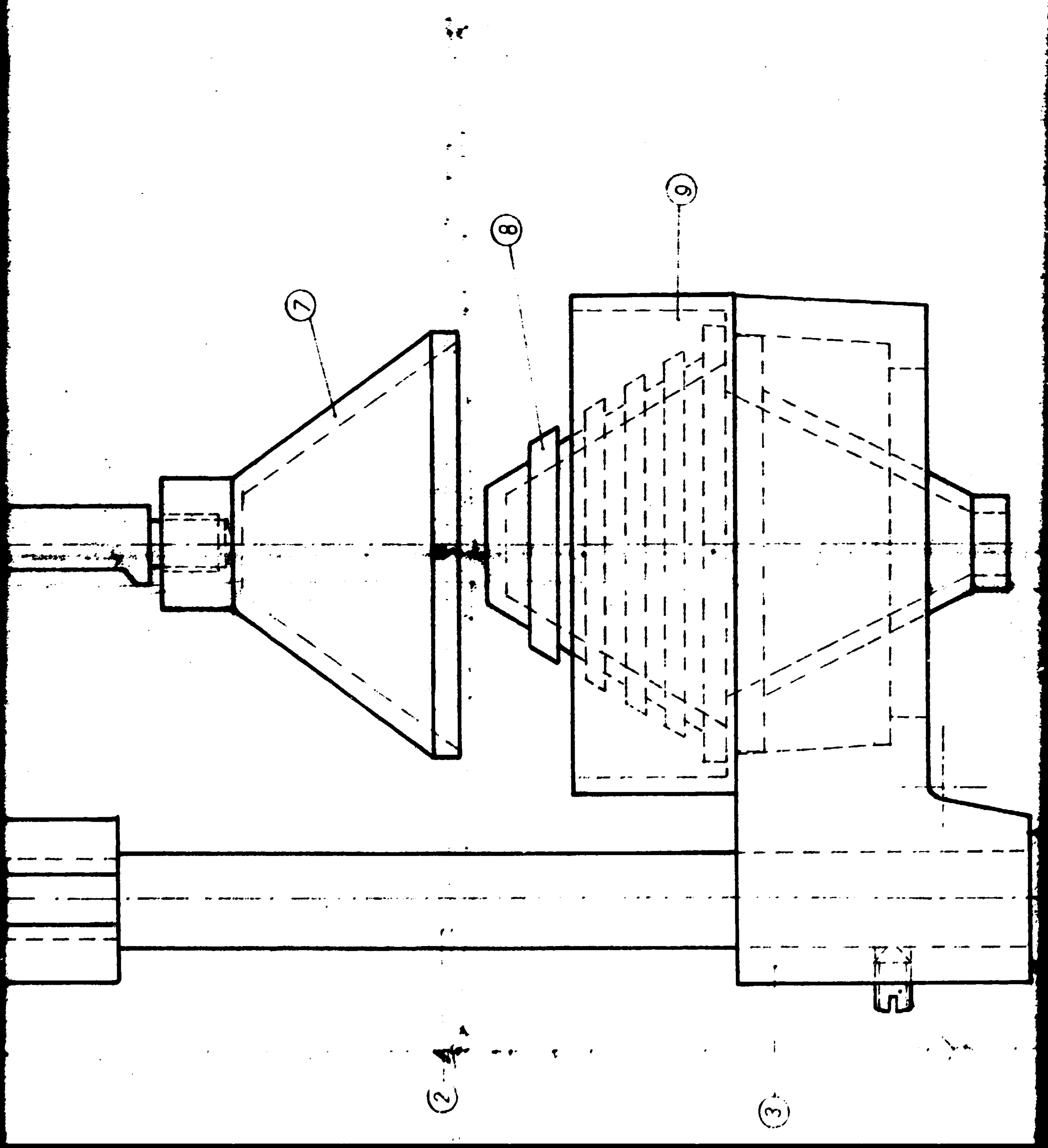

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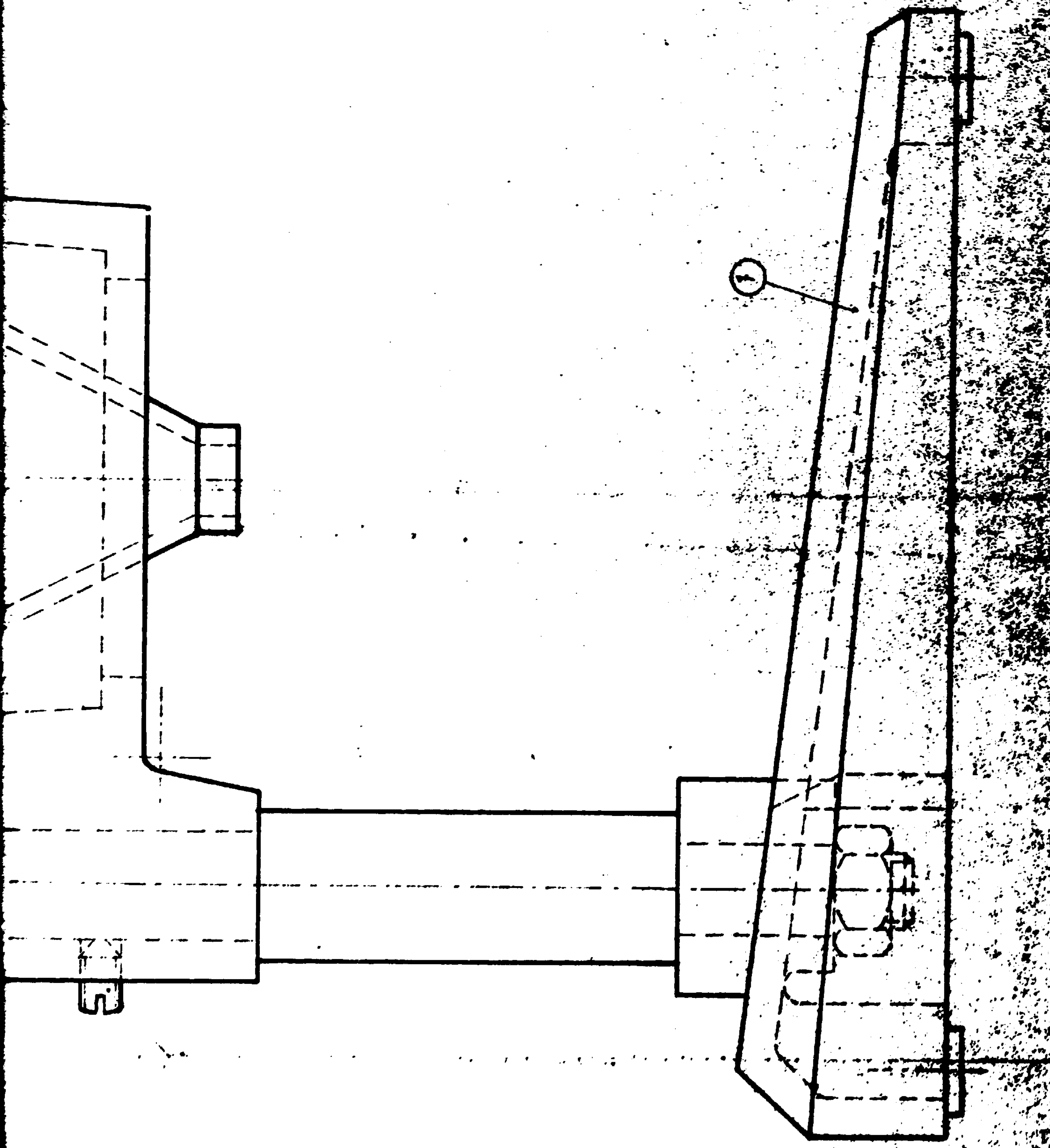

Report No. 4- MAIZE SHELLER

The production of maize in Somalia has an important place in the country's economy. Maize is produced by relatively small commercial sector employing controlled irrigation and traditional farms. By far the largest segment of the population engaged in agriculture lives outside the monetary economy, producing primarily for its own consumption and marketing any excess beyond family needs. After the production of maize, farmers have to process it to chance its condition for storage. For this purpose they require agricultural implements. The main processes are the taking out the kernels from maize cob and the grinding the kernels into the maize flour. In rural areas, small farmers need hand operated shellers and grinders to process the maize.

A China model cast iron for single kernel copied , another one for two kernels and double handles for two people designed at FMW. Both are simple for manufacture and easy to maintain.

Structure of two kernels machine: It has a shaft on which sheller plate is placed. Shaft is located between two side plates on which carry bearing parts. Bearing parts consist of brass bushes in which shaft turns. Side plates are joined by steel rods on each corner of the plates. The shaft is turned by handles. The device includes the feeders which bring the maize to shelling on correct position and press it to the teeth of the sheller plate for shelling. The feeder has a spring which applies pressure to the maize in the feeders which adjust the position of maize cobs and turn them during the forward motion to process all kernels around the maize cob. The capacity of the sheller is 25 kg maize kernels per hour.

No	Qan.	Description	Drawing No	Scale	Material
31	1	Disc	1.06.D1	1:1	ø355x40mm cast iron
30	1	Washer	1.06.W1	1:1	ø35x3mm steel
29	2	Tooth	1.06.T3	1:1	37x8x5mm steel
28	2	Tooth	1.06.T2	1:1	43x8x5mm steel
27	2	Tooth	1.06.T1	1:1	50x8x5mm steel
26	2	Spring	1.06.S2	1:1	
25	1	Shaft	1.06.S1	1:1	ø30x248mm steel
24	4	Support	1.06.R1	1:1	ø15x193mm steel
23	8	Pin	1.06.P4	1:1	ø14x32mm steel
22	1	End cover	1.06.P3	1:2,5	360x203x5mm Steel
21	1	Side cover	1.06.P2	1:2,5	360x360x5mm steel
20	1	Side cover	1.06.P1	1:2,5	360x360x5mm steel
19	1	Nut	1.06.N1	1:1	(øM22x1,5)x10mm
18	1	Woodruff key	1.06.K1	1:1	16x6,5x5mm -steel
17	2	Holder	1.06.H1	1:1	ø2"x200mm pipe
16	4	Fork part	1.06.F2c	2:1	ø10x15mm steel
15	4	Fork part	1.06.F2b	2:1	20x20x5mm steel
14	8	Fork part	1.06.F2a	2:1	20x20x5mm steel
13	4	Bolt	1.06.F1	1:1	øM8x25mm
12	2	Centering	1.06.C4	1:1	ø25x17mm steel
11	2	Centering	1.06.C3	1:1	ø25x17mm steel
10	1	Bush case	1.06.C2	1:1	ø32x24mm steel
9	1	Bush case	1.06.C1	1:1	ø38x18mm steel
8	2	Bolt	1.06.B3	1:1	øM10x46mm
7	1	Bush	1.06.B2	1:1	ø33x15mm brass
6	1	Bush	1.06.B1	1:1	ø22x20mm brass
5	2	Arm	1.06.A5	1:1	120x10x5mm steel
4	4	Arm	1.06.A4	1:1	37,5x20x5mm steel
3	4	Arm	1.06.A3	1:1	36x20x5mm steel
2	2	Arm	1.06.A2	2:1	93x20x10mm steel
1	2	Arm	1.06.A1	2:1	95x20x10mm steel

	Date
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Maize Sheller

Foundry & Mechanical Workshop

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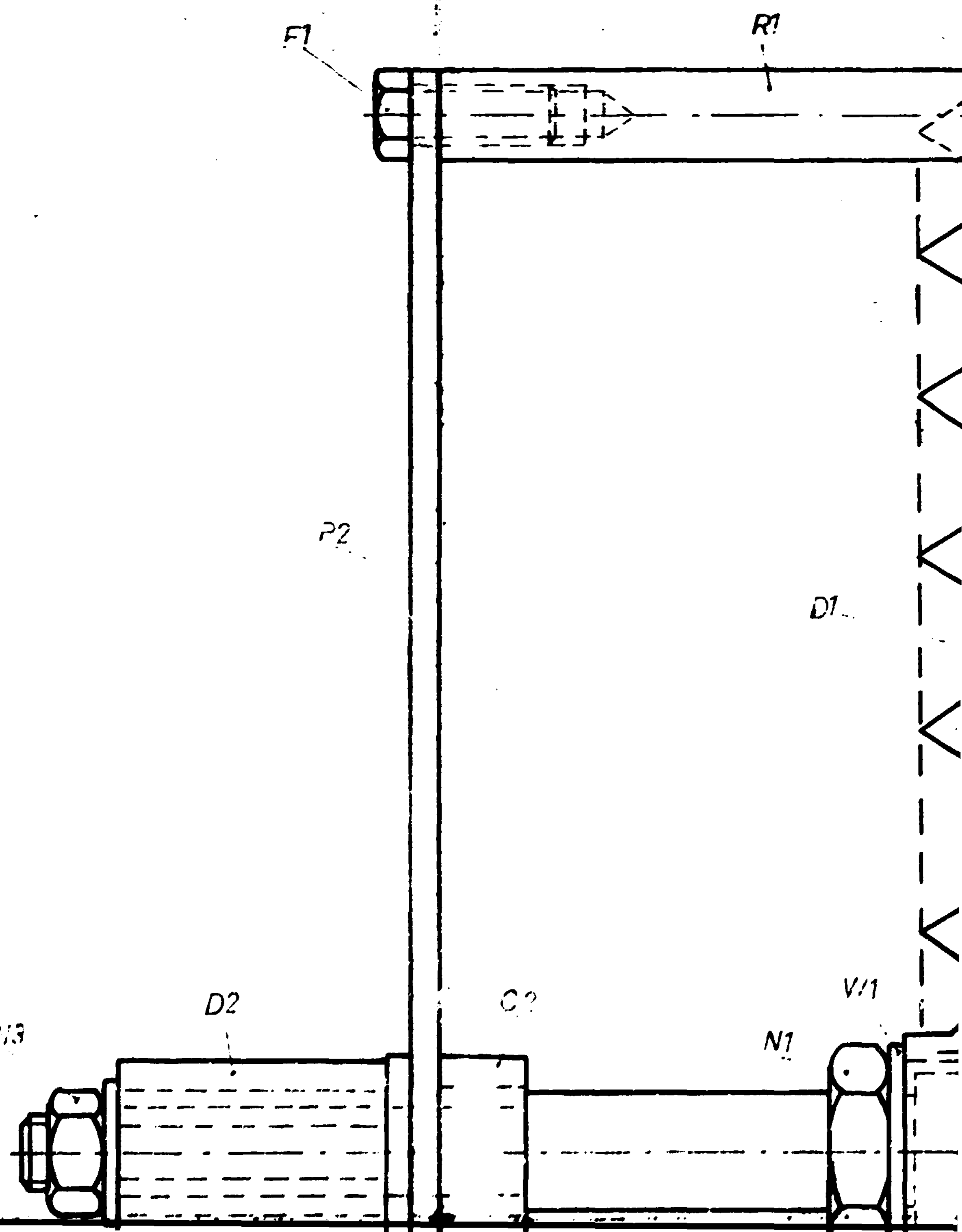
No: 1.06.

SECTION 1



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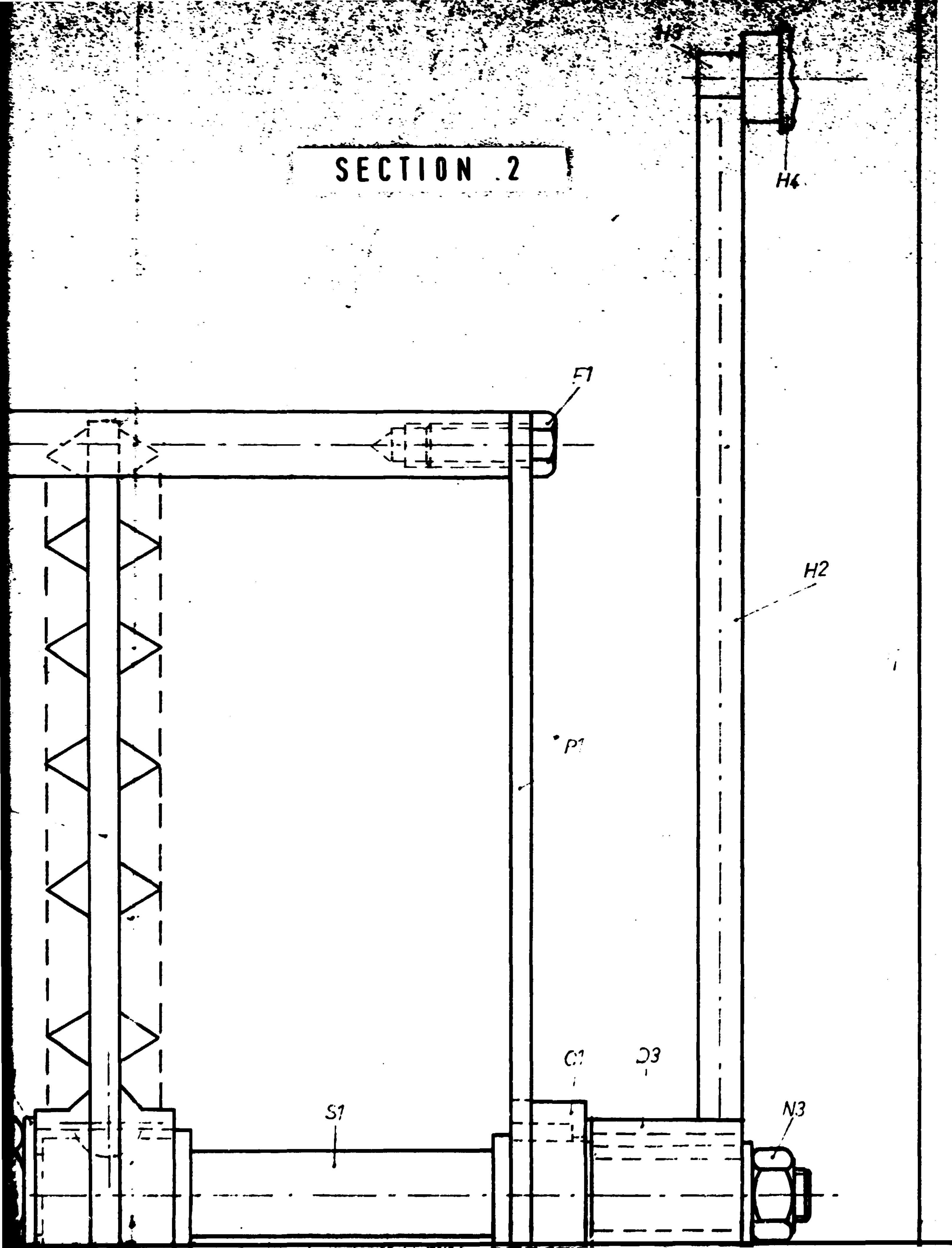
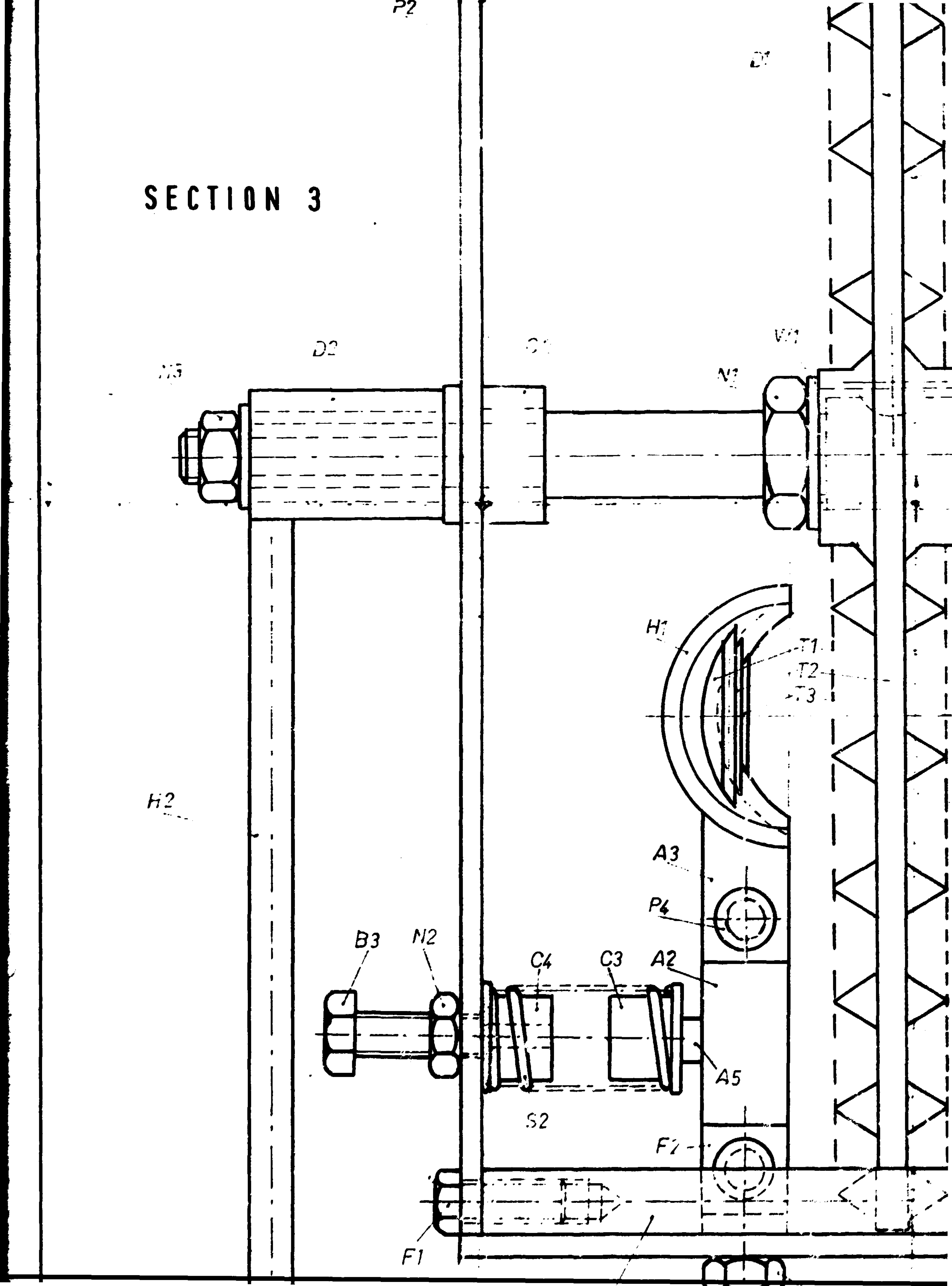


SECTION 3



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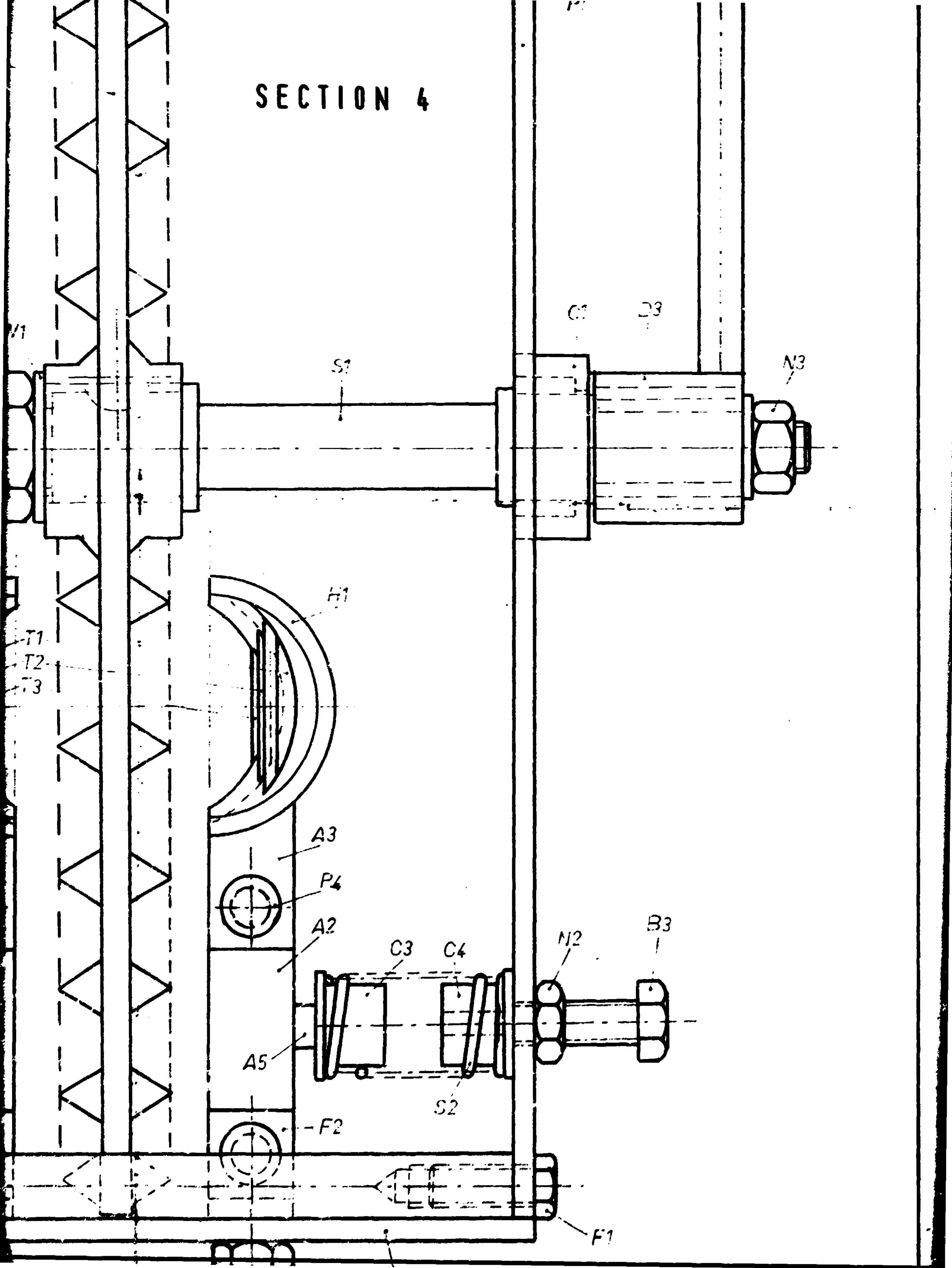

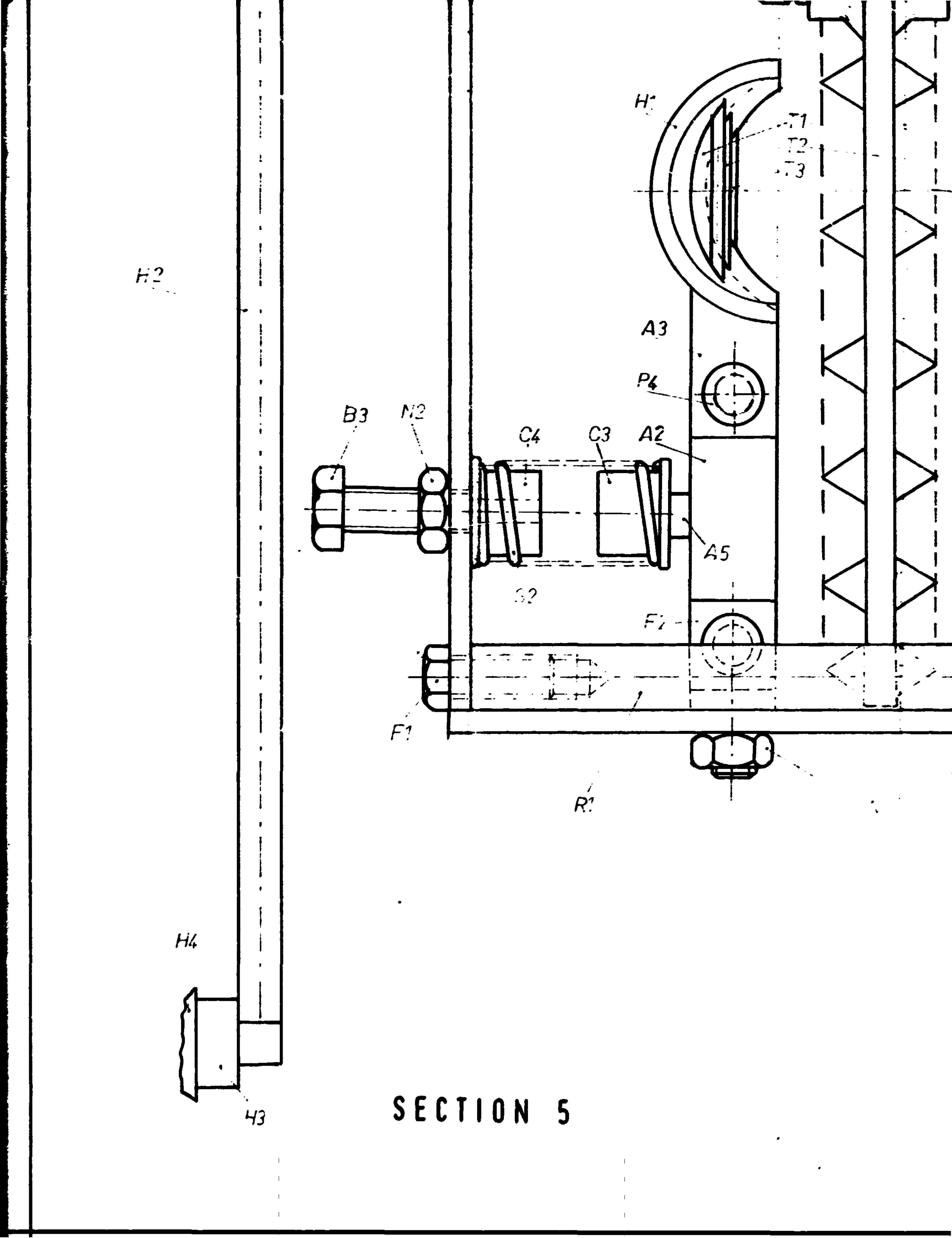

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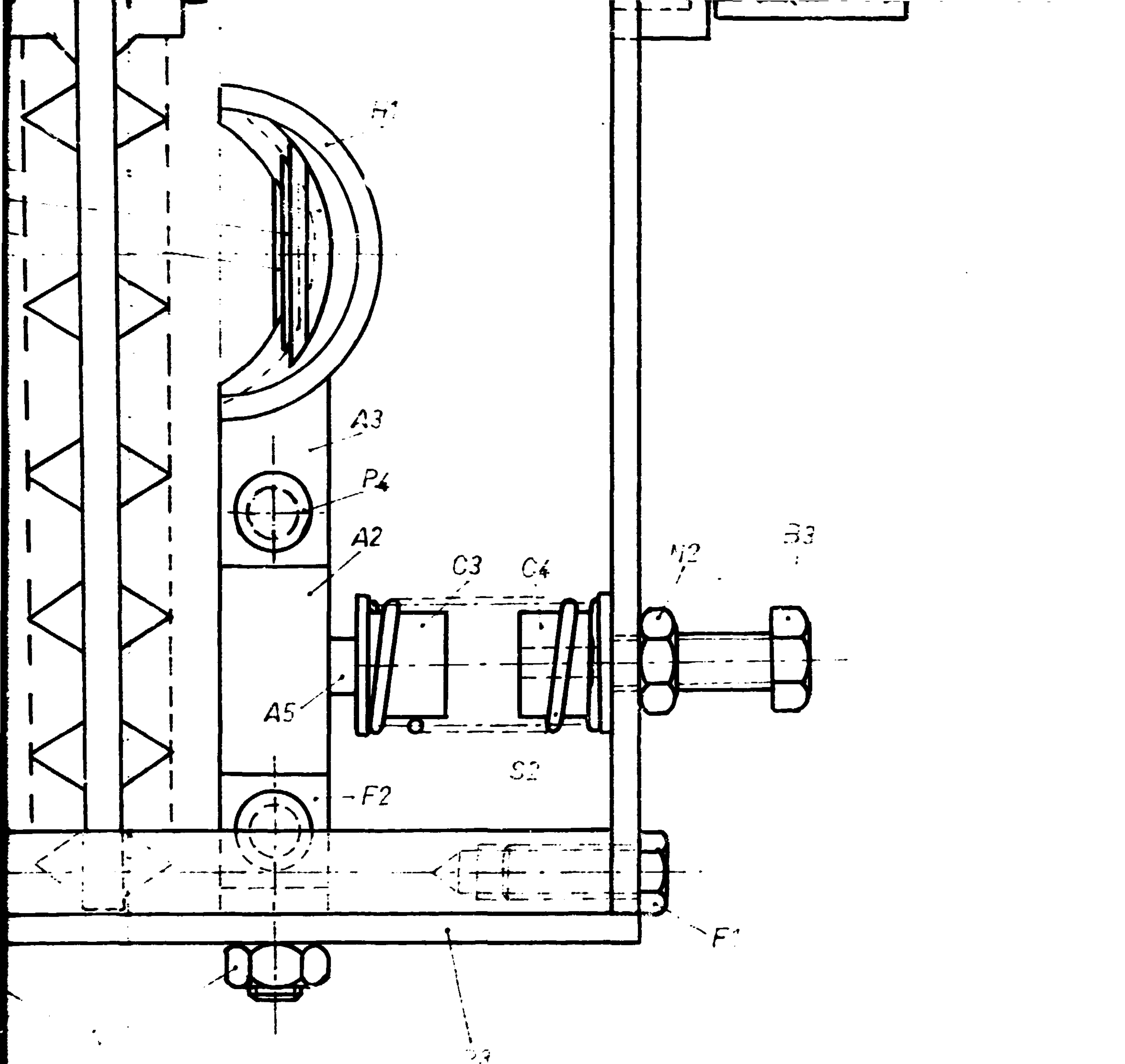

SECTION 6

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Report No. 5- CAST HAND PUMPS

Water is scare and not accessible by most of the people in Somalia. Water is need for drinking, home use and live-stocks. People living around two rivers (Shabelle and Jubba), both of which flow in the southern part of the country are lucky by being close to water source most of the year. Wells are often deep and not sufficient for people and live-stocks. A pratical solution of water problem for rural areas is use of hand pumps. Hand pumps are cheap and suitable in size to supply adequate water in most of the remote rural areas in Somalia.

METAL team has been prepared the technical drawings of hand pumps for file

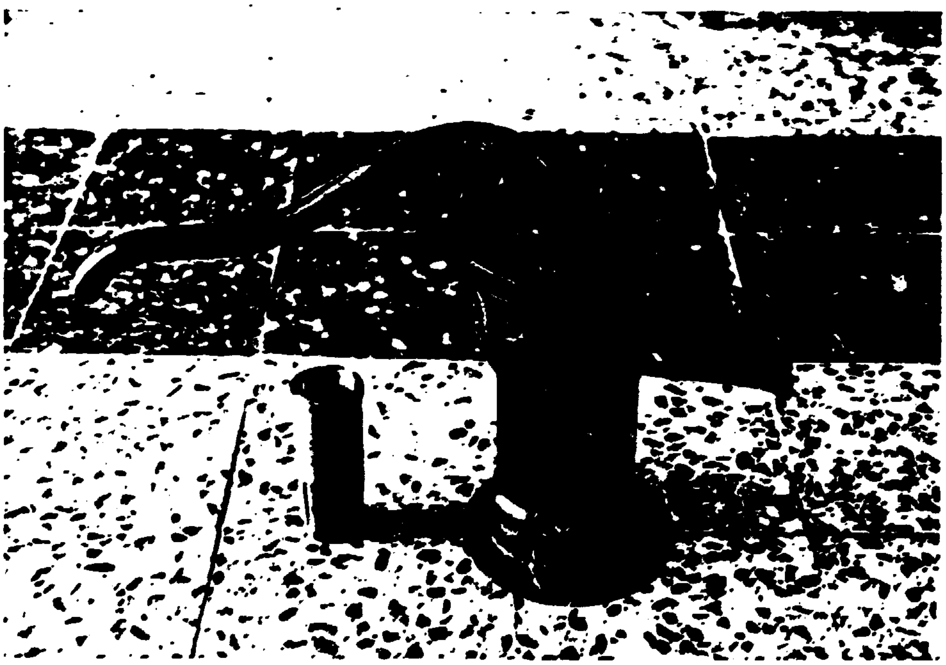
Structure of the pump: Pump body is made of cast iron which is more resistable to corrosion than steel. Body has a suitable shape for its function. Water is risen by sucking action. There is a hole through which plunger works up and down. Plunger is made of brass or aluminium sleeve and brass valves. There is no bearing except a simple bolt at top..Handle is also made of cast iron. It is placed at the top of the main body and connected to the plunger with a steel rod. The main body is joined to the base with bolts. The stroke of the pump is 70 mm. Plunger diameter is 95 mm. Pump is designed to be used on shallow wells with a depth of IO metres or less. The capacity of pump is I500 litres of water per hour. The plunger system in the pump body is placed above the ground therefore it is easy to reach for maintenance and for changing leather.

Cast Hand Pump

Maximum depth : I0 m
Plunger diameter : 95 mm
Stroke : 70 mm
Stroke/min : 40 - 50
Output/stroke : 0.50 lt
Water/hr : I200 - I500 lt

Water is risen by sucking action (vacuum). The plunger system is in the pump body above the ground therefore its easy to reach for maintenance and change of leather.

The body is cast iron more resistable to corrosion than steel.



No	Qan.	Description	Drawing No	Scale	Material
6	1	Bolt			
5	1	Plunger rod	1.10-05	1:2,5	Steel
4	1	Handle	1.10-04	1:5	Cast iron
3	1	Base	1.10-03	1:2,5	Cast iron
2	1	Cover	1.10-02	1:2,5	Cast iron
1	1	Body	1.10-01	1:2,5	Cast iron

	Date
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Cast Hand Pump

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No: 1.10

Foundry/Mechanical Workshop **Appendix I**
Mogadiscio-Somalia

Report No. 6- STEEL CONSTRUCTION HAND PUMPS

MEDAL team has been prepared the technical drawings of steel construction hand pumps for file.

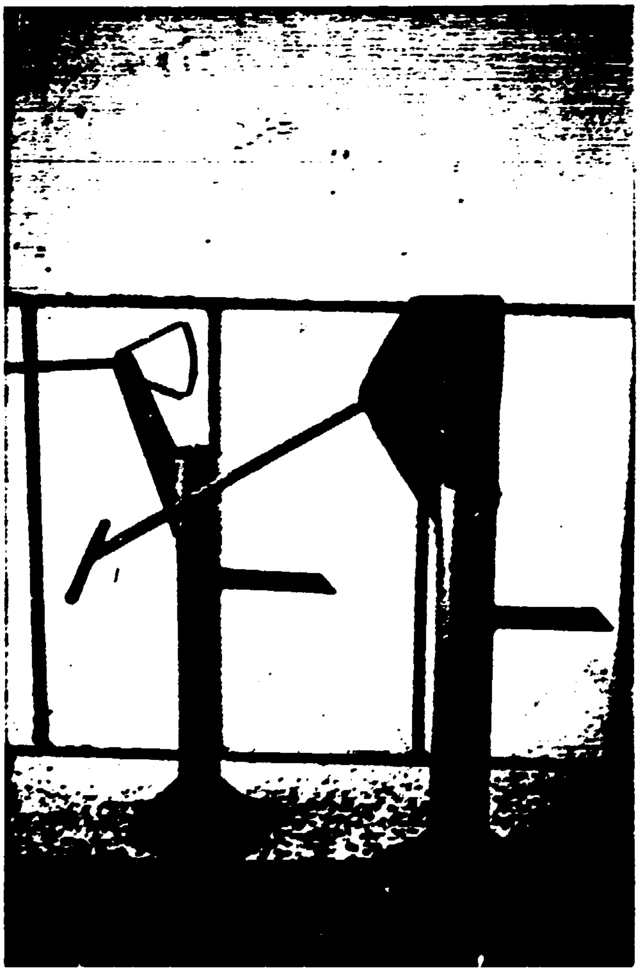
Structure of pump: Two types of budies are available; deep well type and deep and shallow well type with sand protection. The main body is made from steel pipe of 3 inches in diameter. Output pipe is placed on the middle of the body, it is made from steel pipe of I$\frac{I}{4}$ inches in diameter. Body has a base flange and supports are made from sheet metal of 5 mm in thickness. At the top of the body handle supports are fixed. All parts are joined by welding. Handle can be single or double by depending on costumers requires, it is made from pipe of $\frac{I}{2}$ inches in diameter. Handle is placed on the supports with a simple shaft. It is connected to the plunger with a steel rod or pipe. Plungers are made of brass or cast iron. Plunger can be multi-stages. Between the 0-25 metres: single plunger is used, for every 25 metres another plunger piston leather is added. Plunger has a diameter of 55 mm or 90 mm. Stroke of the pump is I00 mm. The capacity of pumps change between the 500 litres and I500 litres depending on plunger diameter which is turn depends on depth of the well.

Steel Construction Hand Pumps

Maximum depth	100 m	30 m
Plunger diameter	55 mm	90 mm
Stroke	100 mm	100 mm
Stroke/min.	30-40	30-40
Water/stroke	0.23 lt	0.63 lt
Water/hr	400-550 lt	1150-1500 lt
Plunger stages	0-25 m single	0-25 m single
	25-50 m double	25-50 m double
	50-75 m triple	
	75-100 m quadruple	

Plungers are brass or cast iron, cylinders brass or aluminium. Two types of bodies are available ; deep well and deep and shallow well types with sand protection. Both with double or single handle.

Weight of the body : 15-16 kg.



No	Qan.	Description	Drawing No	Scale	Material
18	1	Wire			ø 5mm steel wire
17	2	Nut			ø M12
16	1	Washer	1-09a-16	1:1	ø 24x3 mm steel
15	1	Bolt	1-09a-15	1:1	ø M12x70mm
14	1	Handle rounded	1-09a-14	1:2	325mm-25x12,5x4mm U cha
13	1	Bush	1-09a-13	1:1	ø 22x32mm brass
12	1	Bush case	1-09a-12	1:1	ø 30x30mm steel
11	1	Arm end	1-09a-11	1:1	ø 21x2 mm steel
10	1	Handle arm	1-09a-10	1:1	ø 1/2" x 600 mm pipe
9	1	Muff flange	1-09a-09	1:1	ø 79x5 mm steel
8	1	Muff	1-09a-08	1:1	ø R2" x 60mm
7	1	Dust cover	1-09a-07	5:1	ø 17x15mm steel
6	1	Top cover	1-09a-06	1:1	ø 83x5 mm steel
5	2	Handle support	1-09a-05	1:2	373x46x5 mm steel
4	1	Exit pipe	1-09a-04	1:2,5	ø 1 1/4" x 260mm pipe
3	4	Support	1-09a-03	1:1	105x100x5mm steel
2	1	Bottom flange	1-09a-02	1:2,5	ø 300x5mm steel
1	1	Body	1-09a-01	1:5	ø 3" x 785mm pipe

Date

Type - a

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Steel Structure Hand Pump

Foundry & Mechanical Workshop

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No	Qan.	Description	Drawing No	Scale	Material
21	1	Handle arm	1-096-18	1:1	ø 1/2" x 396 mm pipe
20	1	Wire			ø 5 mm
19	2	Limiting rod	1-096-17	1:1	ø 8 x 32 mm steel
18	2	Nut			ø M12
17	1	Washer	1-096-16	1:1	ø 24 x 3 mm steel
16	1	Bolt	1-096-15	1:1	ø M12 x 70 mm
15	1	Handle rounded	1-096-14	1:2	325 mm - 25 x 12,5 x 4 mm U chal.
14	1	Bush	1-096-13	1:1	ø 22 x 32 mm brass
13	1	Bush case	1-096-12	1:1	ø 30 x 30 mm steel
12	2	Arm end	1-096-11	1:1	ø 21 x 2 mm steel
11	1	Handle arm	1-096-10	1:1	ø 1/2" x 600 mm pipe
10	1	Muff flange	1-096-09	1:1	ø 79 x 5 mm steel
9	1	Muff	1-096-08	1:1	ø R 2" x 60 mm
8	1	Cover	1-096-07b	1:2	573 x 40 x 0,5 mm sheet
7	1	Cover	1-096-07a	1:1	260 x 40 x 0,5 mm sheet
6	2	Top cover	1-096-06	1:1	79 x 23,5 x 5 mm steel
5	2	Handle support	1-096-05	1:2	350 x 185 x 5 mm steel
4	1	Exit pipe	1-096-04	1:2,5	ø 1 1/4" x 260 mm pipe
3	4	Support	1-096-03	1:1	105 x 100 x 5 mm steel
2	1	Bottom flange	1-096-02	1:2,5	ø 300 x 5 mm steel
1	1	Body	1-096-01	1:5	ø 3" x 75 mm pipe

Date

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Type - b

Steel Structure Hand Pump

Foundry & Mechanical Workshop

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Page 2

No: 1.09

No	Qan.	Description	Drawing No	Scale	Material
24	1	Handle arm	1-09c-21	1:1	ø 1/2" x 396mm pipe
23	2	Limiting rod	1-09c-20	1:1	ø 8x32 mm steel
22	1	Pipe			ø 1/4"
21	1	Fork	1-09c-19	1:1	545x25x3mm steel + 24x25x5mm steel
20	1	Pin	1-09c-18	1:1	ø12x30mm steel
19	1	Case	1-09c-17	1:1	ø25x24mm steel
18	2	Nut		1:	øM12
17	1	Washer	1-09c-16	1:1	ø24x3mm Sheet
16	1	Bolt	1-09c-15	1:1	øM12x70mm
15	1	Handle arm	1-09c-14	1:1	ø 1/2" x 92,5mm pipe
14	1	Bush	1-09c-13	1:1	ø22x32mm brass
13	1	Bush case	1-09c-12	1:1	ø30x30mm steel
12	2	Arm end	1-09c-11	1:1	ø21x2 mm steel
11	1	Handle arm	1-09c-10	1:1	ø1/2"x600mm pipe
10	1	Muff flange	1-09c-09	1:1	ø79x5mm steel
9	1	Muff	1-09c-08	1:1	øR 2" x60mm
8	1	Cover	1-09c-07b	1:2	573x40x0,5mm sheet
7	1	Cover	1-09c-07a	1:1	240x40x0,5mm sheet
6	2	Top cover	1-09c-06	1:1	79x23,5x5mm steel
5	2	Handle support	1-09c-05	1:2	350x185x5mm steel
4	1	Exit pipe	1-09c-04	1:2,5	ø1 1/4" x260mm pipe
3	4	Support	1-09c-03	1:1	105x100x5mm steel
2	1	Bottom flange	1-09c-02	1:2,5	ø300x5mm steel
1	1	Body	1-09c-01	1:5	ø3"x795mm pipe

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Steel Structure Hand Pump

Foundry & Mechanical Workshop

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SECTION 1

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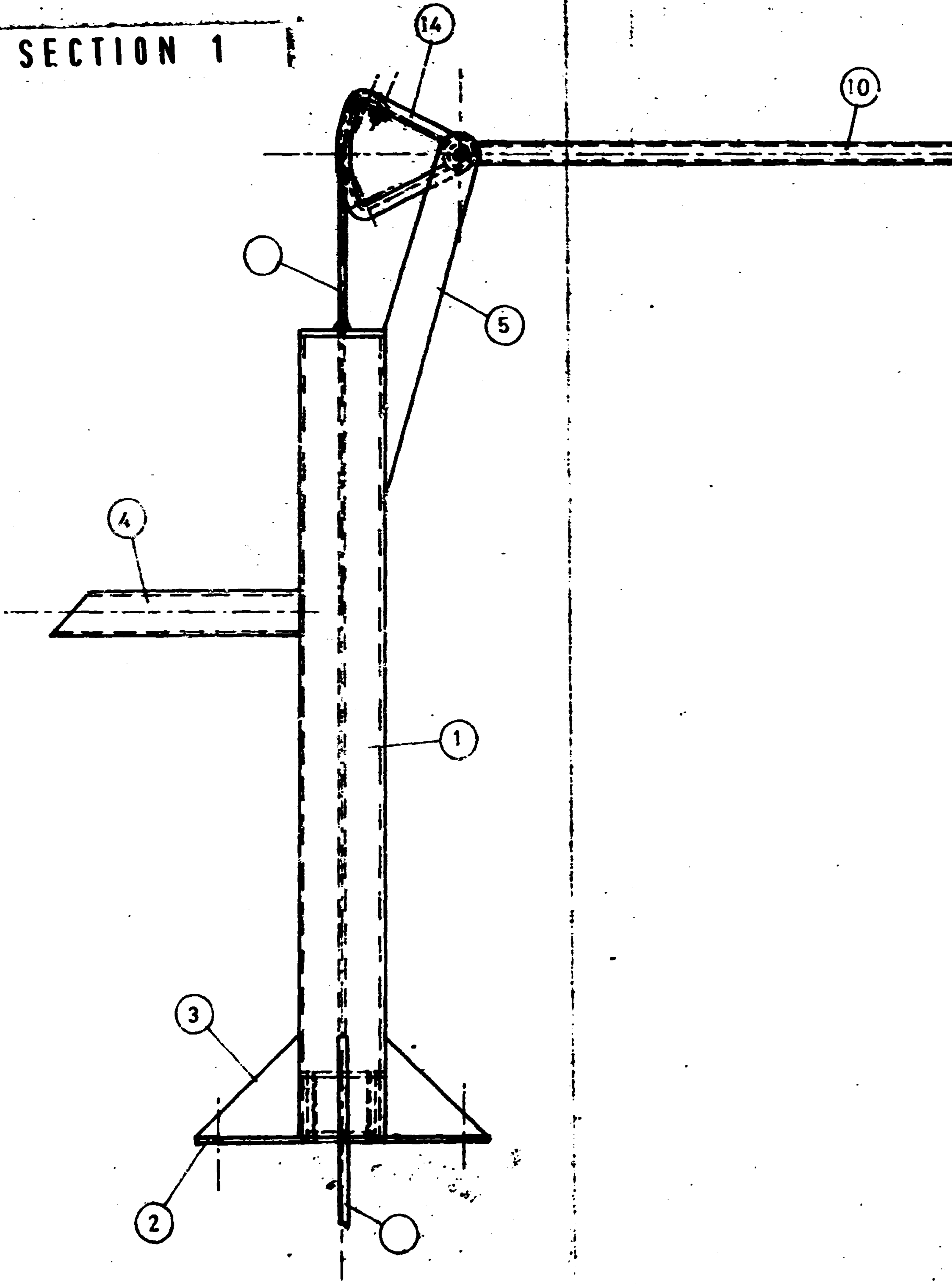

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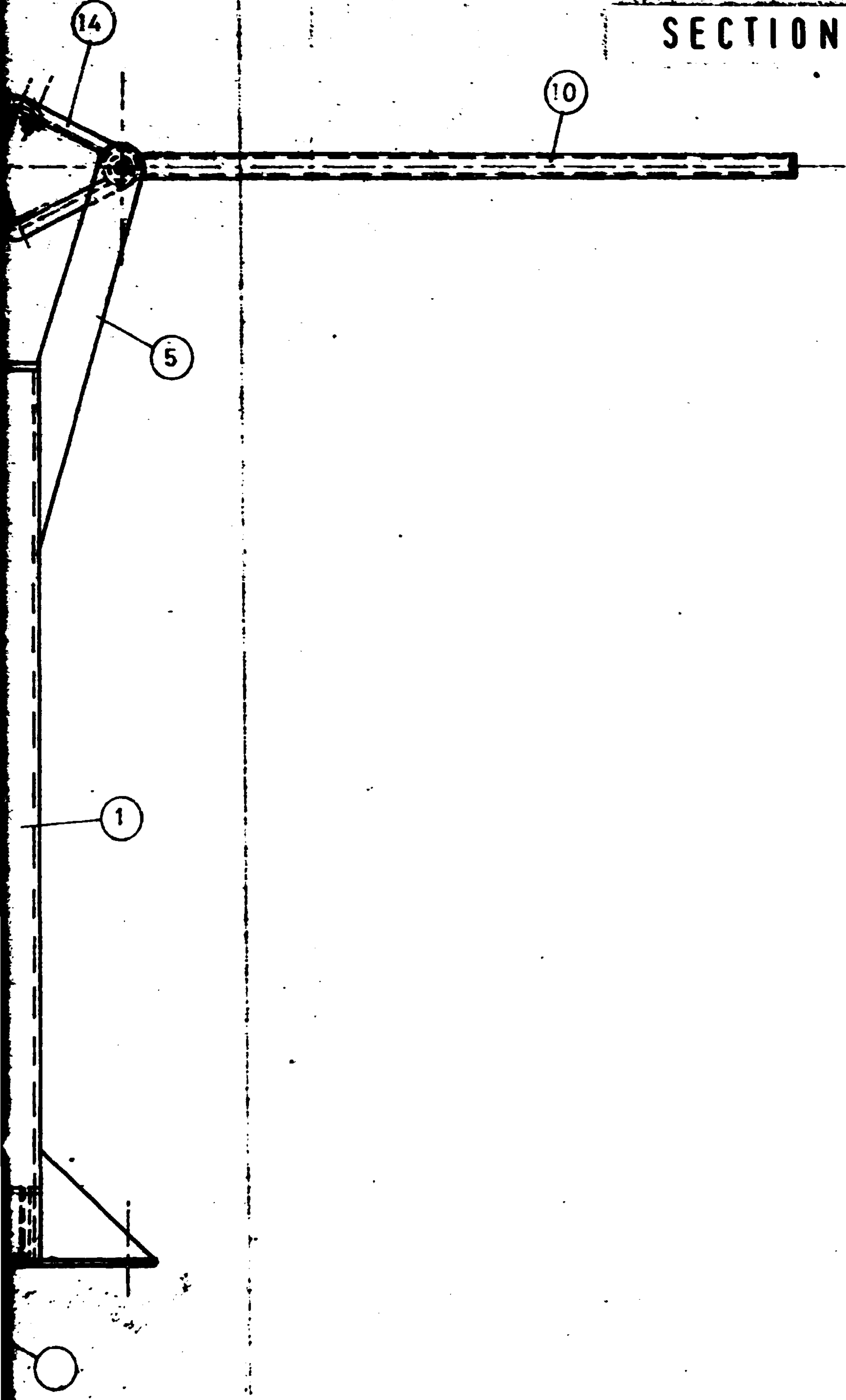
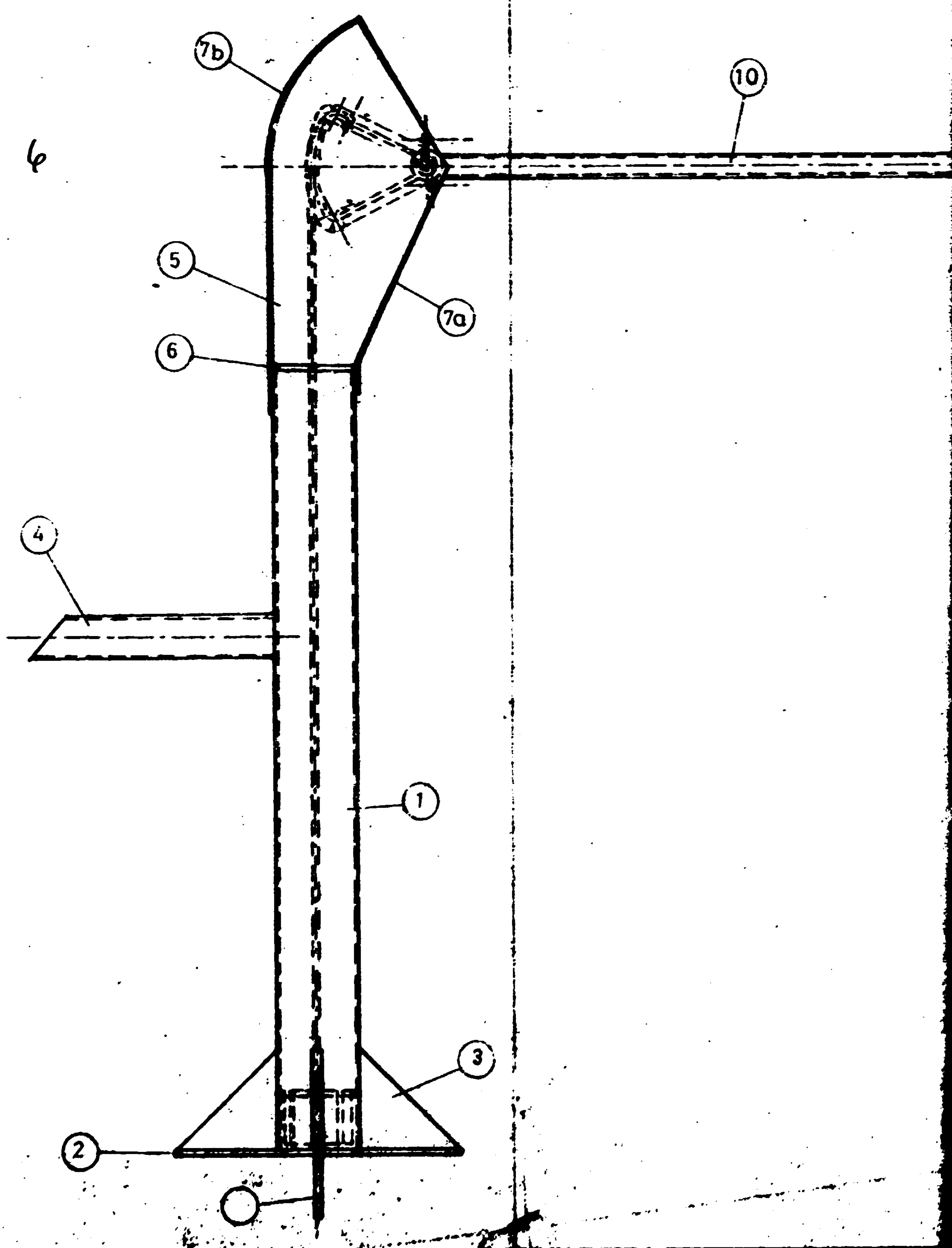


SCALE 1/5

SECTION 1

6



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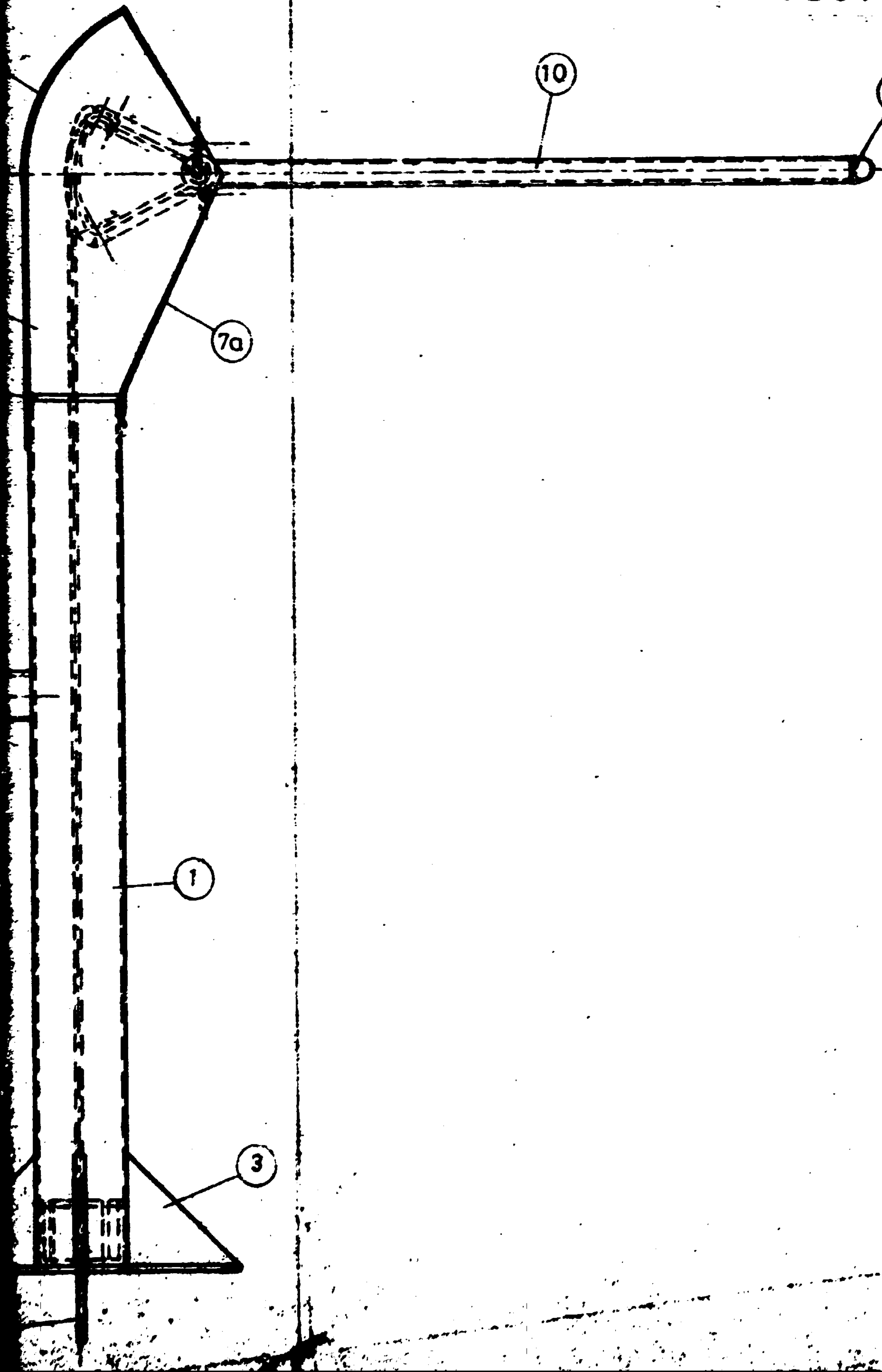
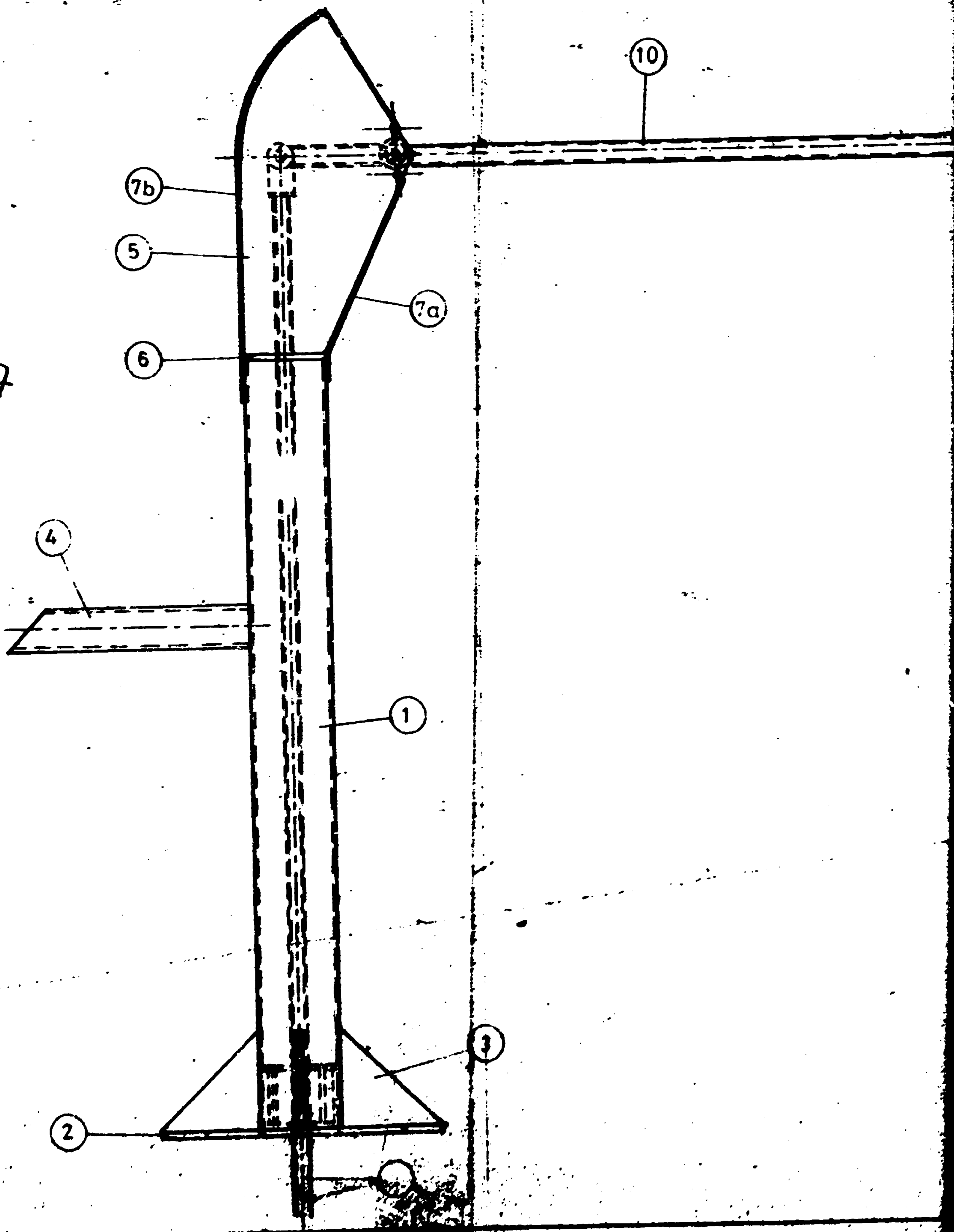


SECTION 1

7



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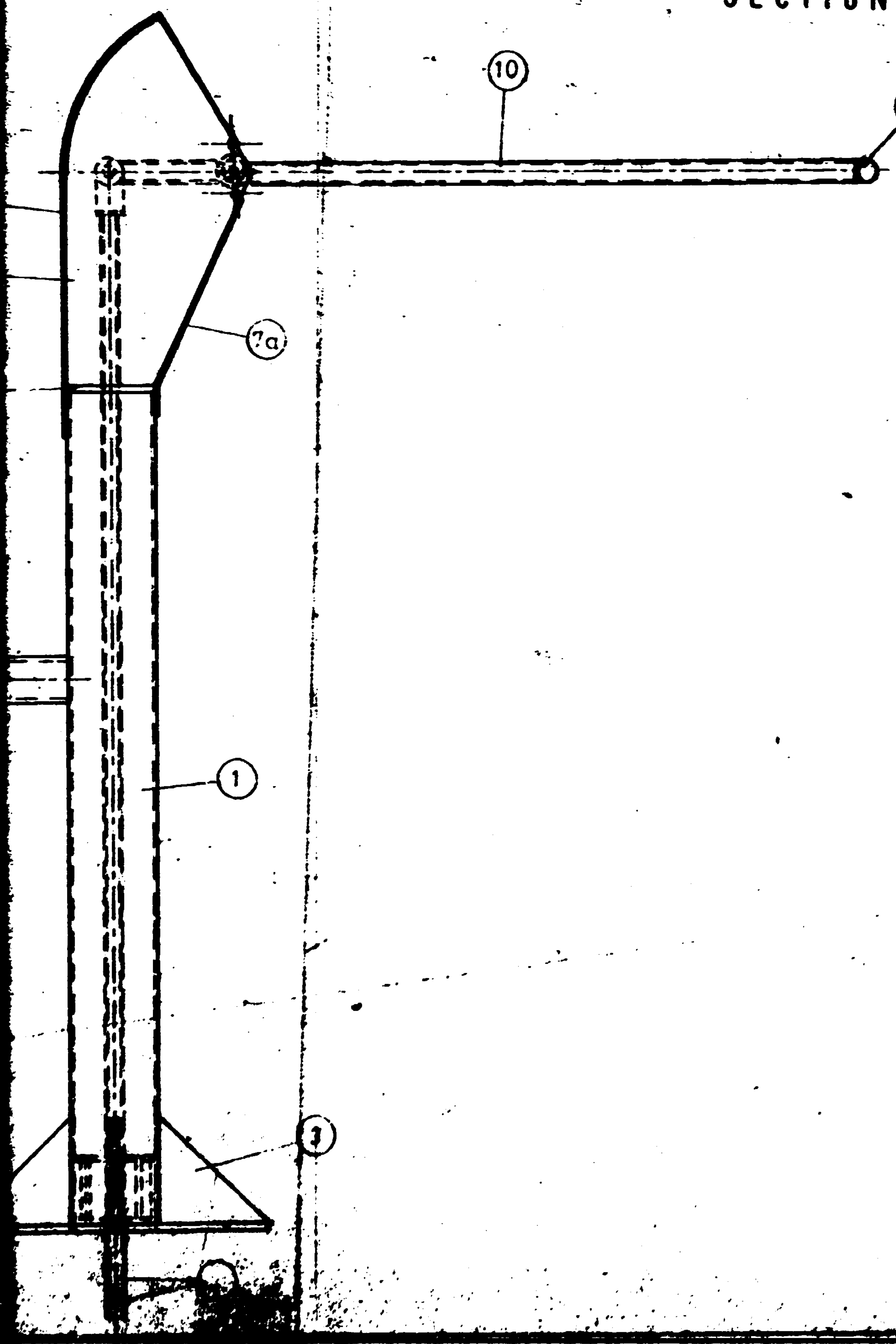

Report No. 7- SOLAR HEATER

Solar energy is an important energy source in Somalia. Where sun shines through out the year, the most common ways to use solar energy are drying under sun and heating of water by solar collectors. To help the energy problem of the country, MEDAL team has designed a solar collector by using the local materials as much as possible instead of imported systems and components.

The design comprise a separate collector (absorber) that is connected to a hot water storage tank via a piping system. The storage tank being a separate unit can easily be insulated and store the hot water over night. In a thermosiphon system the tank's base is positioned above the top of the collector and water from the tank is circulated through the collector and back to the tank by means of the natural effect of circulation caused by hot water in the collector. Cold water, fed to the bottom inlet of the collector from the base of the tank, heats up, as it does so, becomes lighter thus rising through the collector and back to the tank. It is admitted to the tank through an inlet in the upper section of the tank and when returned heated to the tank, forms a hot water layer on the lower cold water which has yet to pass through the collector. Once water in the tank has been heated by natural thermosiphon circulation through the collector, it can be drawn off for use. For efficient circulation the tank's base should be at least 30 cm above the collector's top but a height seperation of 60 cm is often preferable to avoid reverse flow from the tank to the collector which can occur during cold nights when the collector is not functioning. In stuatinos where the storage tank can not be sitted above the collectors, it is necessary to employ a water pump to force water through the collector. Experience has also shown that, where the water is calcareous, oxygenous, dirty or chemically contaminated, clogging of the collector and corrosion might be problem. In such cases piping of wider dimensions, and more than I5 mm in diameter and heat exchanger may be necessary.

The collector has been designed as a I.2 m^2 flat-plate solar collector. The collector has two main distrubution pipes and absorption pipes. Absorption pipes are $\frac{I}{2}$ inches in diameter are connected to two distrubution pipes positioned on two ends of them.

The water enters from one end then pass through the absorption pipes and leaves the collector to the tank. Absorption pipes are placed into a box made from the sheet matel of I.5 mm. The top of the box, there are two glass covers. A wooden frame is to place the glass covers. There is a suitable distance between the glass covers to obtain absorption efficiently. The absorption pipes are fixed with absorber surfaces to increase the absorbing area of the collector. To prevent the escaping of heat from the bottom, sides and distrubution pipes isolator is used at the distrubution pipes, bottom and edges of the tank. Capacity of the collector is the heated water of 250 litres per hour as a avarage of whole day.

No	Qan.	Description	Drawing No	Scale	Material
13	1	Distance	1.11.13	1:5	870x30x1,5 mm sheet
12	2	Frame part	1.11.12	1:5	870x15x10 mm wood
11	4	Frame part	1.11.11	1:5	70x15x10 mm wood
10	1	Frame part	1.11.10	1:5	870x40x30 mm wood
9	2	Glass	1.11.09	1:10	1665x870x5 + 870x825x5 mm glass
8	2	Fixing plate	1.11.08	1:10	1200x50x1,5 mm sheet
7	2	Fixing plate	1.11.07	1:10	1490x45x1,5 mm sheet
6	9	Absorber plate	1.11.06	1:10	1490x80x1,5 mm sheet
5	2	Supplying pipe	1.11.05	1:1	⌀ 1" x 240 mm pipe
4	10	Absorber pipe	1.11.04	1:1	⌀ 1/2" x 1520 mm pipe
3	2	Collector pipe	1.11.03	1:1	⌀ 1 1/2" x 840 mm pipe
2	1	Cover	1.11.02	1:10	5120x60x1,5 mm sheet
1	1	Main box	1.11.01	1:10	2000x1200x1,5 mm sheet

	Date
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Solar Heater

Foundry & Mechanical Workshop

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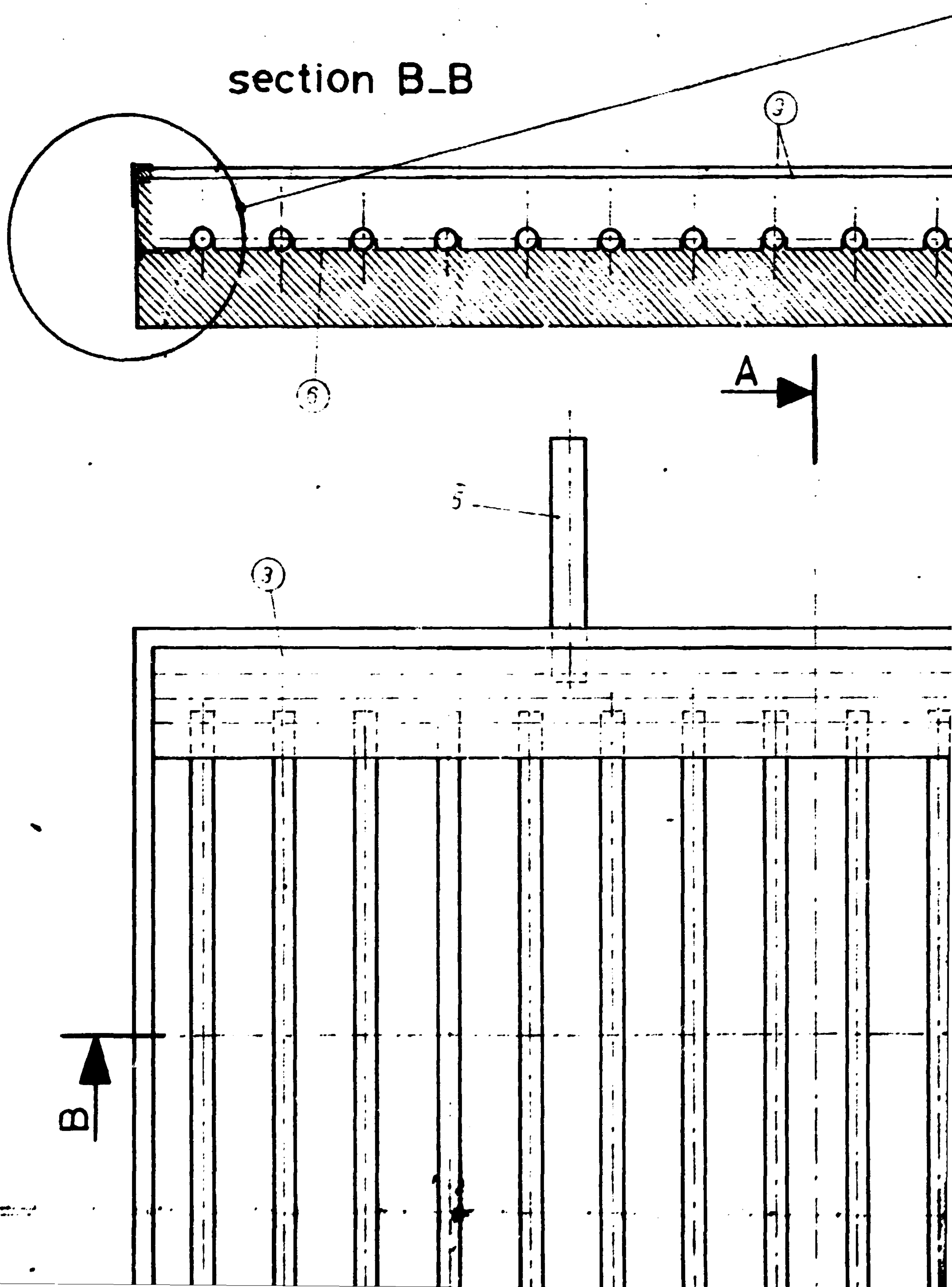
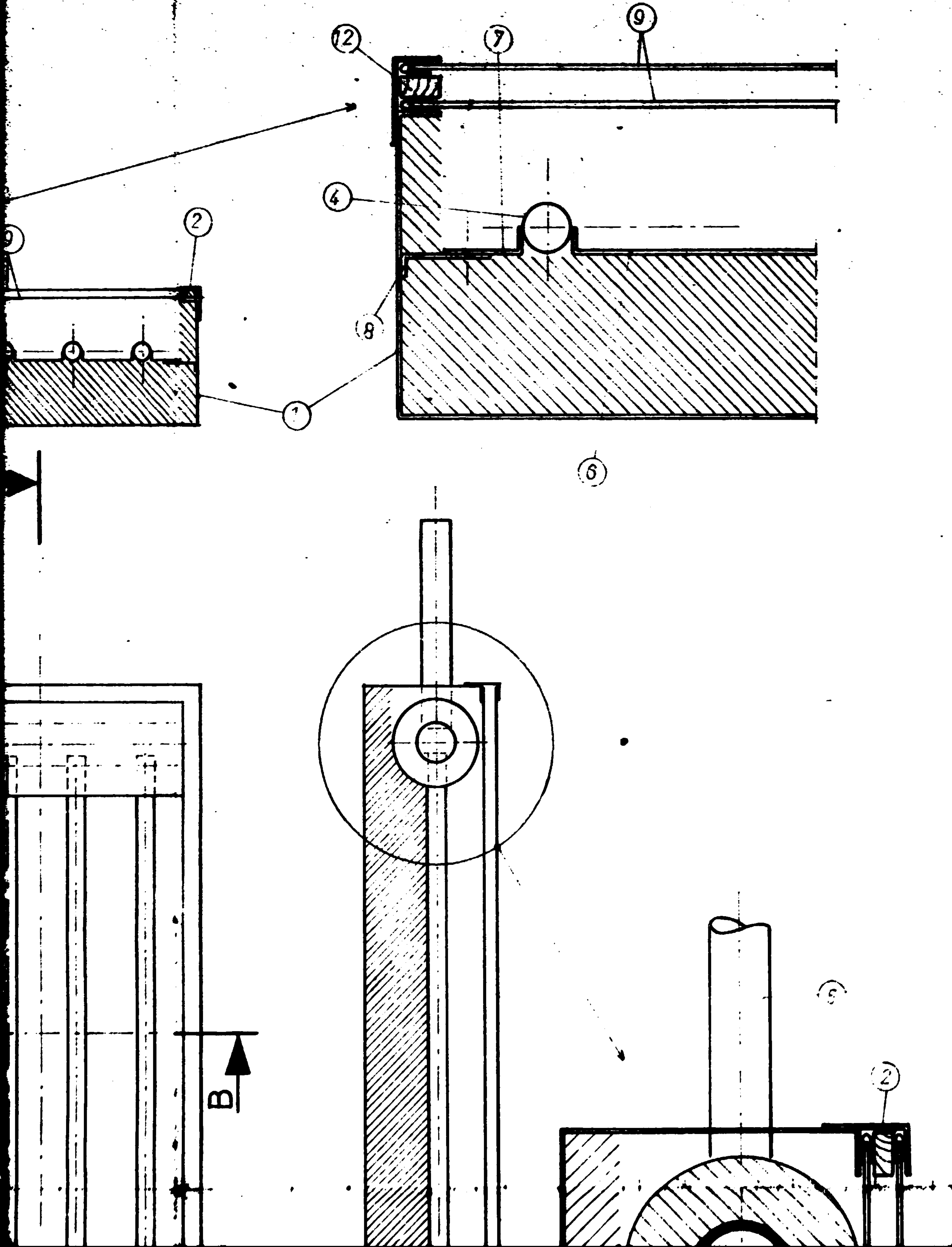
No: 1.11

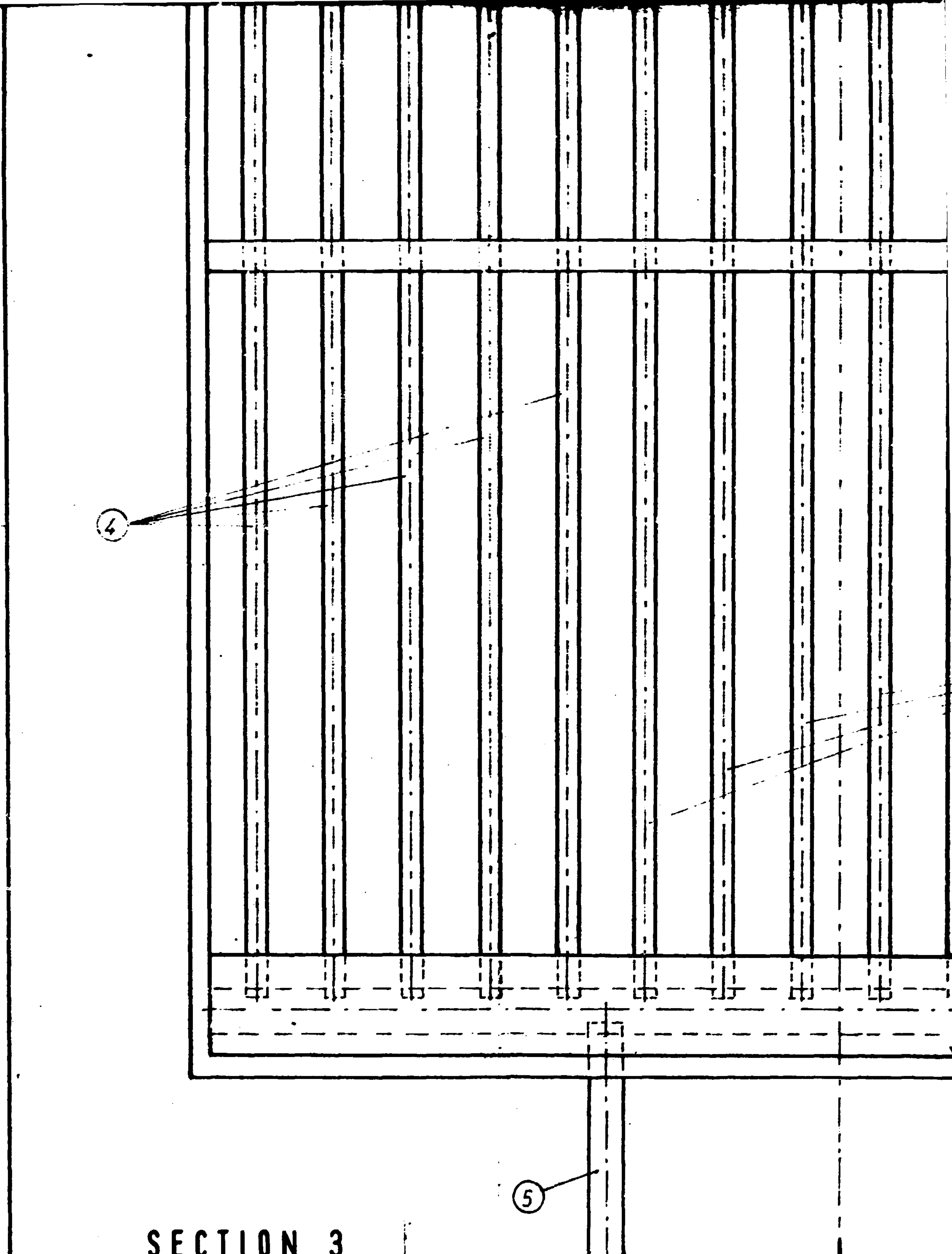
SECTION 1

section B_B



SECTION 2





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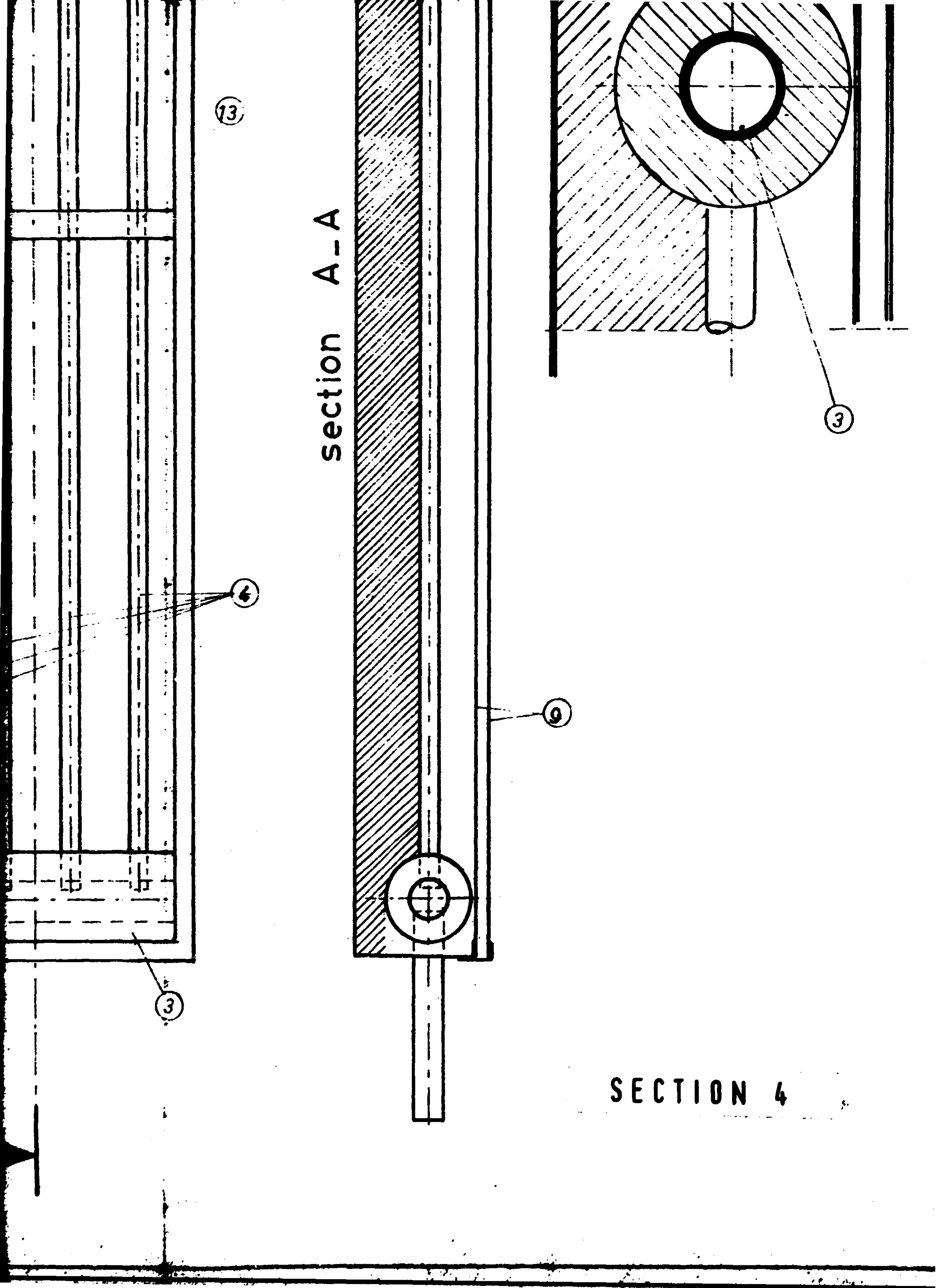


SECTION 4

Foundry/Mechanical Workshop Mogadiscio-Somalia

Appendix I.

Report No. 8- SADCOM (SOMALIAN ANIMAL DRIVEN COMBI)

Animals have been used to either replace or supplement the need for human energy expended in the production of food and in transportation. As the main instrument of production of the small farmers, 85-90 % of Africa depend on the manual and draught power, the benefits of mechanisation go to barely IO %. The modernisation of draught animal power would amount to strengthening the instrument that would enable the man to make a decent living, which he has been unable to do so far, as he has not been able to join the development stream fully in the last two decades. Draught animal power can play it's potential role only if conscious attemps are made to upgrade it. Upgrading the draught animal power systems do not necessarily mean that more animals have to be brought into position. The emphasis should be to get more output from the same system by better implements and cards, only a well-equipped infrastructure can upgrade draught animal power. It can be used parallel with mechanisation and give economical means for modernisation. The bulk of power needs would still have to come from human and animals. In Somalia, human energy would still be as high as 80 % in most areas. To the extend possible part of this labour should be passed on to draught animal power.

MEDAL team has tried to design a multi-purpose implement for small farmers using draught animal power. It can be used for a variety of purposes to help the upgrading the draught animal power. It has been designed to allow efficient and speedy work with minimum workmanship with a simple design, so that it can be manufactured locally, light in weight for easy transportation, ready for immediate use without loss of time for preparatory adjustments and made of locally available materials. Also the maintenance is easy and that spare parts would always be available from local manufacturer. There is economy in it however, loans have to be provide probably as credit for people to purchase or lease.

Structure of device: The device consists of a main frame on which implements are fixed. Main frame is made from U channel 40 mm by 20 mm by 5 mm in dimensions. It consists of two parts which are welded together as T shape. One of them is on driving axis and short one makes a right angle with it. In some areas two U channels come face to face and make a square shape. Handles are made from pipe of $\frac{I}{2}$ inches. They are two on both side and supported with a flange. On driving axis where extra U channels welded to make it stronger fixing holes are drilled. Holes are used to insert the handles of inplements to main frame. For pulling action a metal plate is welded on the front end of the frame.

The device has two kinds of wheels for front and back. There are two back and one front wheel. Wheels are made from steel stripe have a diameter of 300 mm. The wheels are supported by using the steel rods to act as spokes. Front wheel has a different function. When the driver wants to chance the direction of the movement, the front wheel can be turned easily because of that design. Both back and front wheels have a support made of $\frac{I}{2}$ inches pipes placed into another pipe of $\frac{3}{I}$ inches in diameter to reinforce the support.

Planting operation is probably the most important operation performed by SADTOK. Factors in planting are timing, seedbed, depth of planting, plant population, plant spacing and row width. Attemps must be made to time the planting at the on set of the rains Maize, being a large seed, can tolerate a moderately rough seedbed A rough seedbed is also more erosion resistant than a fine seedbed and is less likely to waterlog. Maize can emerge from depths of planting of between 2-3 inches. The drier the conditions the deepe should be the planting. This depth makes emergence more likely when there is a dry period after the first rains and at the same time gives greater protection for the seed from birds and rodents. The plant population at harvest is less than that at planting for the following reasons: Level of germination of seed, loss of seed caused by planting to deep or to shallow also birds and rodents, pests and diseases, excessive or inadequate rainfall, plant nutrient deficiences or excesses. In the theory the area available for growth of each plant should be equal. The row width now used is 0.75 metres. The planter designed includes two planters, one on each side. Each one has two buckets, one for seed and the other one for fertilizer. Planters are fixed to main frame by simple butterfly bolts. The function of main frame is to carry the planters and to chance the distance between two planters when the farmer require to use different plant spacing. Frame is also made from 40 mm U channel and pipe of $\frac{I}{2}$ inches and pipe of $\frac{3}{4}$ inches in some areas. It has extension arms are fixed on both sides of the main frame. The body of planters consist of a circular plate on which both fixed and moving fingers are placed. The fixed fingers are welded strongly to prevent the bending, if they bend even slightly on any impact toward the moving finger, bending eventuall reduce the space for the seed to fall so blockage occures. The length of the moving fingers are made slightly less than the fixed fingers to prevent premature opening on contact with ground. On both side, hexagonal plates act as case and cover for fingers in which seeds fall down, first from hopper to the seed wheel then to the ground. Seed wheel is placed between the hexagonal frame and seed hopper. Seeds are filled into hopper, from hopper they pass on the seed wheel on which seed grooves drilled. A small pieces of sponge rubber is added in the base of hopper to prevent seed from being jammed between the wheel and the hopper. To carry all this components, a piece of $\frac{3}{4}$ inches is used as a shafth, also transference of movement is provided by a pin between the middle part and seed wheel. The latter consists of two hoppers however, one of them is used to supply the fertilizer. The matrials are selected to make production less expensive, available in local market and manufacturing is easy.

Ploughing is an important operation in field work. To prepare the field for sowing ploughing is required. Plough consists of a share malboard, land side, frog and leg. The operation surface of it consists of share and malboard. The principal job of the operating surface is that of cutting off frow slice from land and inversing it a side. Inversion of the furrow slice follows its displacement on the operating surface. Furrow slice shifting over the surface develops pressure on it. These pressures are strongest near to the share point and at the malboard breast, with the result that the operating surface is usually made by two or three pieces, share, malboard or malboard breast in order that the share and malboard breast can be changed with new ones. The function performed by the share is that of cutting off the furrow slices under it from the furrow bottom then the furrow slices is raised along the operating surface. The malboard is that part of the plough just back of the share. It receives the furrow slices from the share and turns it. The principal job of the malboard is that of cruching and inversi the furrow slices cut off from the land by the cutting edge of the share and shin of the malboard. On the left side of the frog is a land side. It is a long flat metal piece that absorbs the side forces created when the furrow is turned. Frog is at the center and all the other parts are fastened to it. The principal job of the leg is that of connecting the frog to the main frame. The share w designed as enough strong to abrasive action during plowing. Both the share and malboard are made from the sheet of 3 mm in thickness. Land side was set horizantally also it is made from the sheet of 3 mm in thickness. Frog consists of two parts welded together. The leg was designed by using the Uchannel of 40 mm by 20 mm by 5 mm in dimensions. To fix the plough to the main frame another U channel part welded horizantally on the vertical leg and welded fixing pipes are placed into the holes in the main frame. The materials for the parts were choosen to be strong enough to bear work force of operation loads and to be light enough for donkey's pulling action.

The main object of the cultivation is to destroy weeds. The weeder consists of spring-type cultivator tines. Cultivator tines are made from sheet material. They have a supporting handle which made from the pipe. They are fixed on the main frame by supporting handles. The handles are placed into the holes in the main frame. They can be fixed on different heights. There are three hoes. The hoes have a suitable shape to weed the wild plants. The material is the sheet of three millimetres was choosem to be strong enough to work under operation loads. The edges of them are sharpened to cut the wild plants.

Cultivating is an important operation in landwork. A simple furrow is used to prepare the land for crops by breaking up the soil around them destroying weeds. Furrow is made from a sheet metal of 2 mm in thickness. It shaped by bending. Its handle is made from the pipe to attach it on the main frame. The shape of the furrow is suitable for cultivating and it is strong to work efficiently.

When farmers are going to field and coming back, they have to carry their tools and personal goods. A simple barrow helps to the farmers to carry their tools. Barrow is placed on the main frame of the combi. Barrow is made from the sheet of 0.5 mm in thickness. It is produced easily because of its simple design.

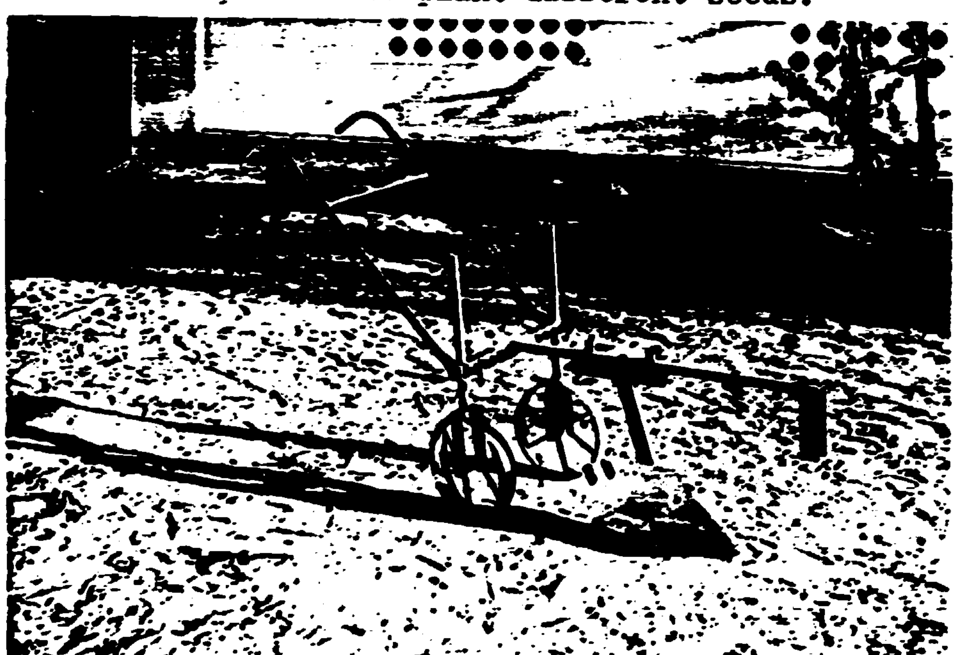
SADCOM

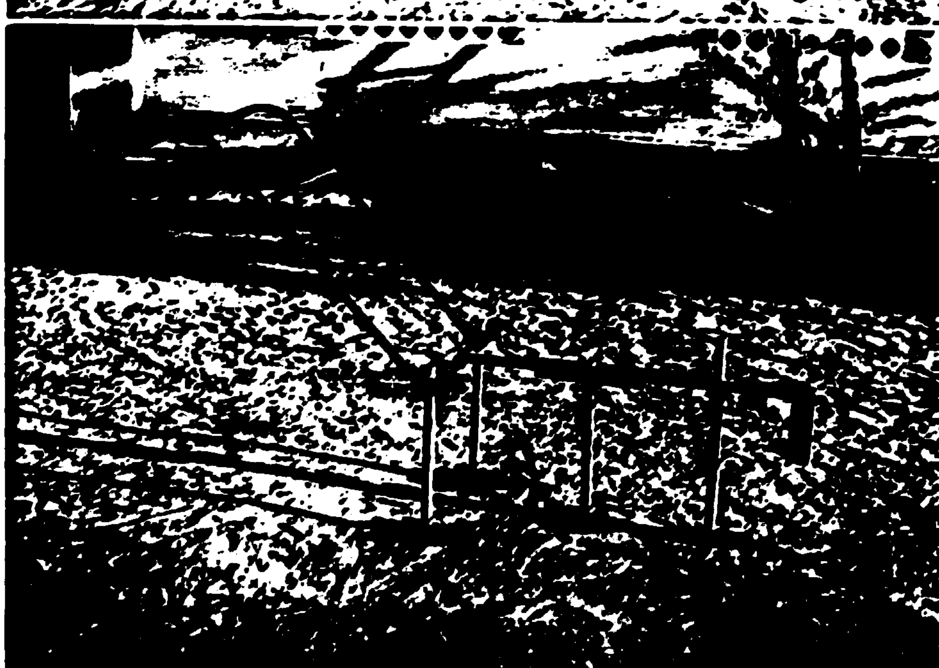
Somalian Animal Driven Combi

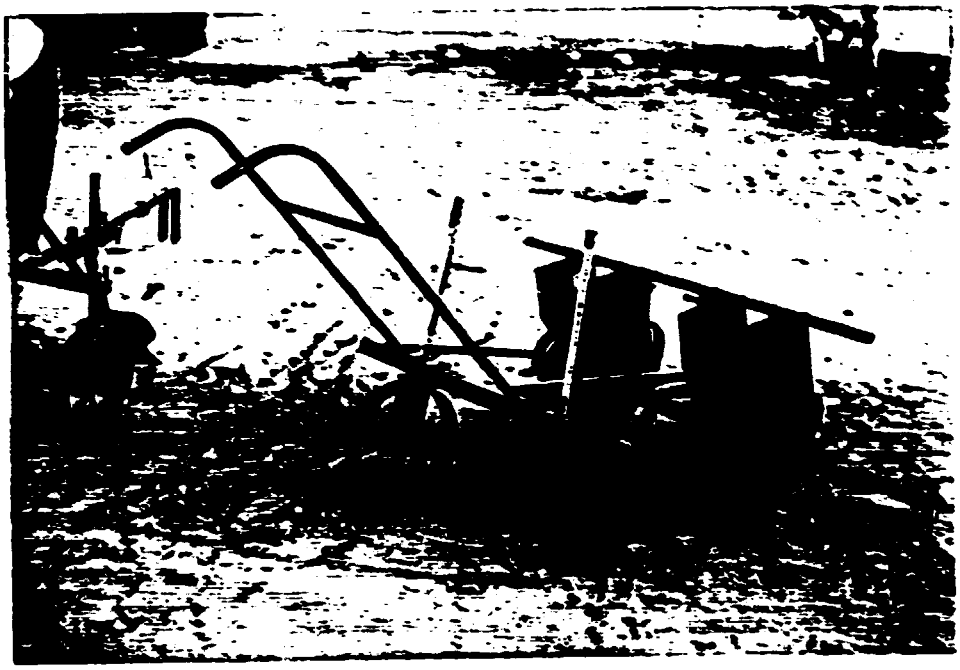
A single frame with plough, weeder, two planters, ferrow, barrow attachements. The frame could also be used as an animal driven wheel barrow.

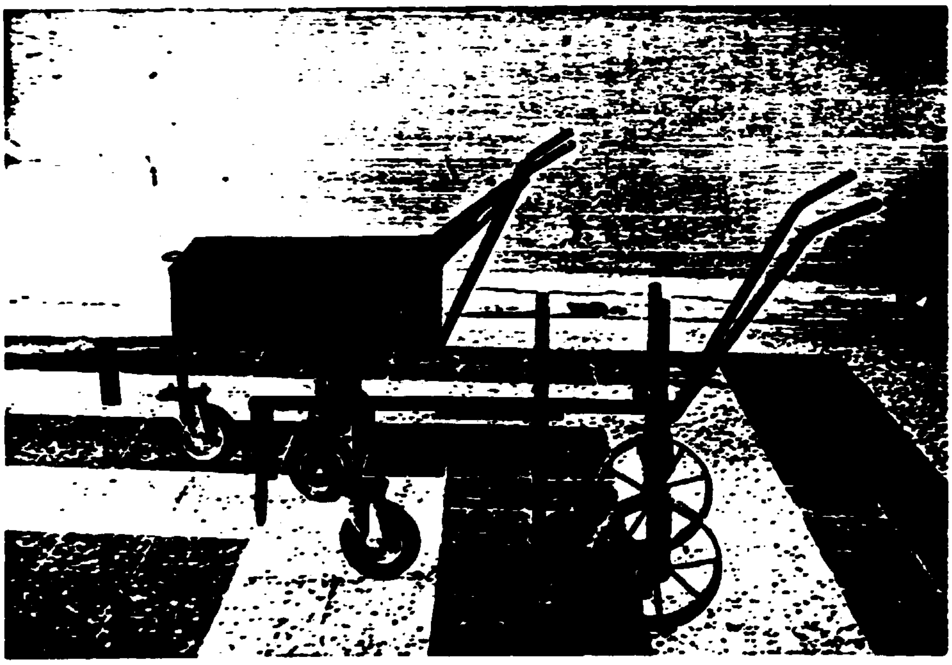
Frame weight : 9 kg. Weight of two planters : 40 kg. Weight of ferrow : 8 kg. Weight of plough : IO kg. Weight of three shoes weeder : 5 kg.

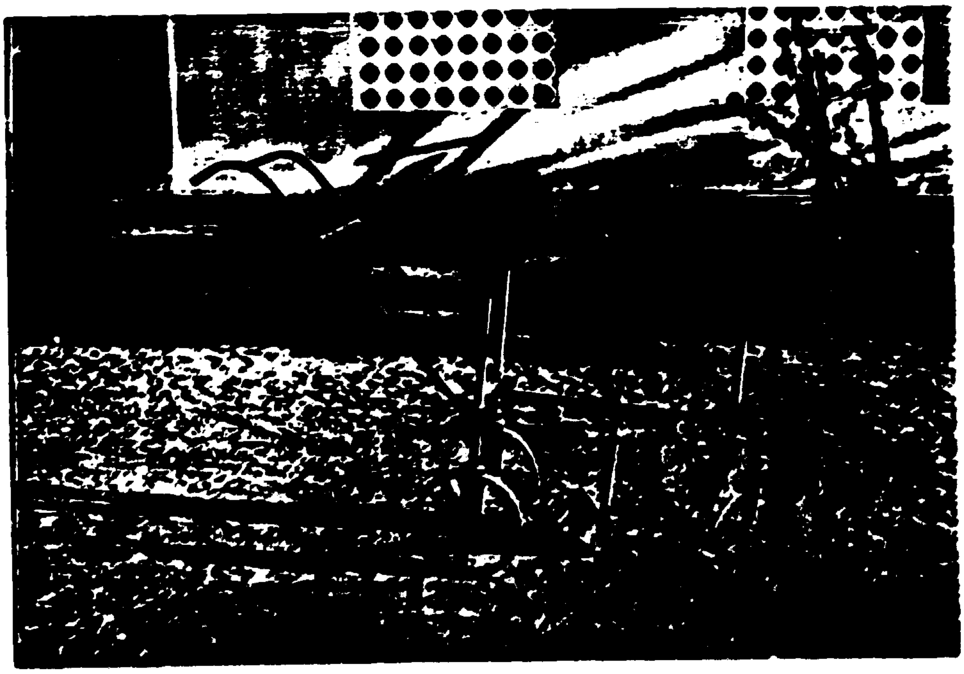
SADCOM is designed primarily for donkey traction.
Penetration of plough, weeder and ferrow could be adjusted by the adjustable height of pulling string and shoes. Various disks are available for the planter to plant different seeds.











48	4	Side cover	1.04.50	1:1	160x70x3 mm sheet
47	4	Curved cover	1.04.49	1:1	788x160x2 mm sheet
46	4	inside cover	1.04.48	1:1	340x135x2 mm sheet
45	2	Plant rool	1.04.47	1:1	ø70x80mm cast iron
44	2	Dung rool	1.04.46	1:1	ø70x80mm cast iron
43	2	Shaft pin	1.04.451	1:2,5	ø8x182 mm steel
42	2	Central plate shaft	1.04.45	1:2,5	182 mm - 1" pipe
41	3	Wheel band	1.04.43	1:1	2828x60x5 mm steel
40	2	Central plate	1.04.44	1:2,5	2x(ø180x5 mm steel)
39	3	Wheel outside pipe	1.04.42	1:1	204 mm - 3/4" pipe
38	3	Wheel inside pipe	1.04.41	1:1	210mm - 1/2" pipe
37	3	Wheel bolt	1.04.40	1:1	ø M16
36	4	Back wh. side support	1.04.39	1:1	720x40x5 mm steel
35	2	Back wheel top part	1.04.38	1:1	160x70x5 mm steel
34	2	Back wheel handle	1.04.37	1:1	970mm - 3/4" pipe
33	2	Front wh. side support	1.04.36	1:1	436x40x5 mm steel
32	1	Bearing bolt washer	1.04.35	1:1	ø26x5mm steel
31	1	Bearing cover	1.04.34	1:1	15mm - 1" pipe
30	1	Front wh. bearing bolt	1.04.33	1:1	ø19x102 mm steel
29	1	Front wheel bearing	1.04.32	1:1	ø27 x58mm brass
28	1	Front wheel top part	1.04.31	1:1	80x42x5mm - 100x80x3mm sheet
27	1	Front wheel handle	1.04.30	1:1	300mm - 3/4" pipe
26	8	Ring	1.04.29	1:1	40mm - 1" pipe
25	2	Hanging guide	1.04.28	1:1	80mm - 1" pipe
24	1	Hanging shaft	1.04.27	1:1	1350mm - 3/4" pipe
23	4	Baluster nut	1.04.23	1:1	øM12
22	2	Baluster	1.04.22	1:5	1270 x20x3 mm stripe
21	2	Joint part arm	1.04.21	1:5	310 mm - 3/4" pipe
20	2	Joint end bolt	1.04.20	1:5	øM12
19	2	Bottom-joint part	1.04.19	1:5	600mm - 40x20x5mm channel
18	2	Top-joint part	1.04.18	1:5	600mm - 40x20x5mm channel
17	2	Fixing pipe	1.04.17	1:5	560mm - 3/4" pipe
16	1	Fixing part	1.04.16	1:5	350mm - 40x20x5 mm channel
15	2	Jointing pipe	1.04.15	1:5	140mm - 3/4" pipe
14	2	Strong hold	1.04.14	1:5	450mm - 40x20x5 mm channel
13	2	Shaft end bolt	1.04.13	1:5	øM12
12	1	Shaft inside pipe	1.04.12	1:5	1150mm - 1/2" pipe
11	1	Shaft outside pipe	1.04.11	1:5	1150mm 3/4" pipe
10	1	Handle middle part	1.04.10	1:5	460mm - 1/2" pipe
9	2	Handle side part	1.04.09	1:5	2200 mm - 1/2" pipe
8	1	Front bottom body pr.	1.04.08	1:5	50mm - 40x20x5mm U chnl.
7	1	Back bottom body pr.	1.04.07	1:5	300mm - 40x20x5mm U chnl.
6	28	Bolt	1.04.06	1:5	øM12 x 20mm
5	28	Bolt handle	1.04.05	1:5	ø3x30mm steel
4	30	Nut	1.04.04	1:5	øM12
3	2	Tractional part	1.04.03	1:5	380x40x5mm steel
2	1	Buttock body	1.04.02	1:5	1100mm - 40x20x5mm U chnl
1	1	Main body	1.04.01	1:5	960mm - 40x20x5mm U chnl
No	Qan.	Description	Drawing No	Scale	Material

	Date	
Ersin BASTUĞ		
SADCOM		
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No	Qan.	Description	Drawing No	Scale	Material
10	3	Pin	type - d	1:1	3 x (ø8x50 mm) steel
9	6	Pin	type - c	1:1	6 x (ø8x47 mm) steel
8	7	Pin	type - b	1:1	7 x (ø8x11 mm) steel
7	4	Pin	type - a	1:1	4 x (ø8x7 mm) steel
6	1	Central piece	f4	1:1	ø74x50 mm steel
5	2	Side piece	f3	1:1	2 x (50x20x5 mm) steel
4	2	Side piece	f2	1:1	2 x (50x20x20 mm) steel
3	1	Central piece	f1	1:1	ø26x25 mm steel
2	1	Base plate	P2	1:2	375x165x5 mm steel
1	1	Base plate	P1	1:1	155x140x5 mm steel

	Date
Ersin BASTUĞ	

SADCOM - Fixer parts

Foundry & Mechanical Workshop

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Page 3

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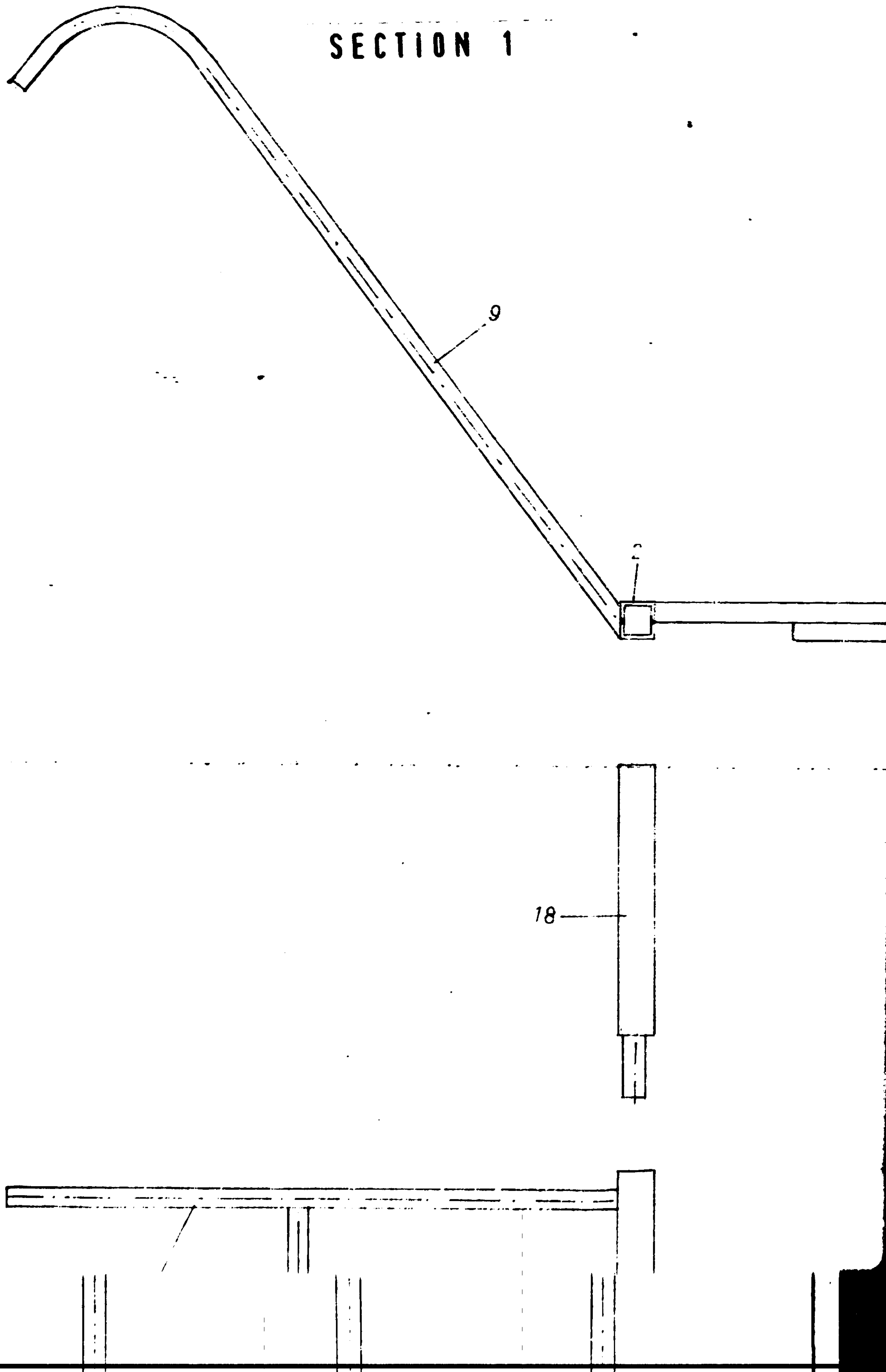
SECTION 1



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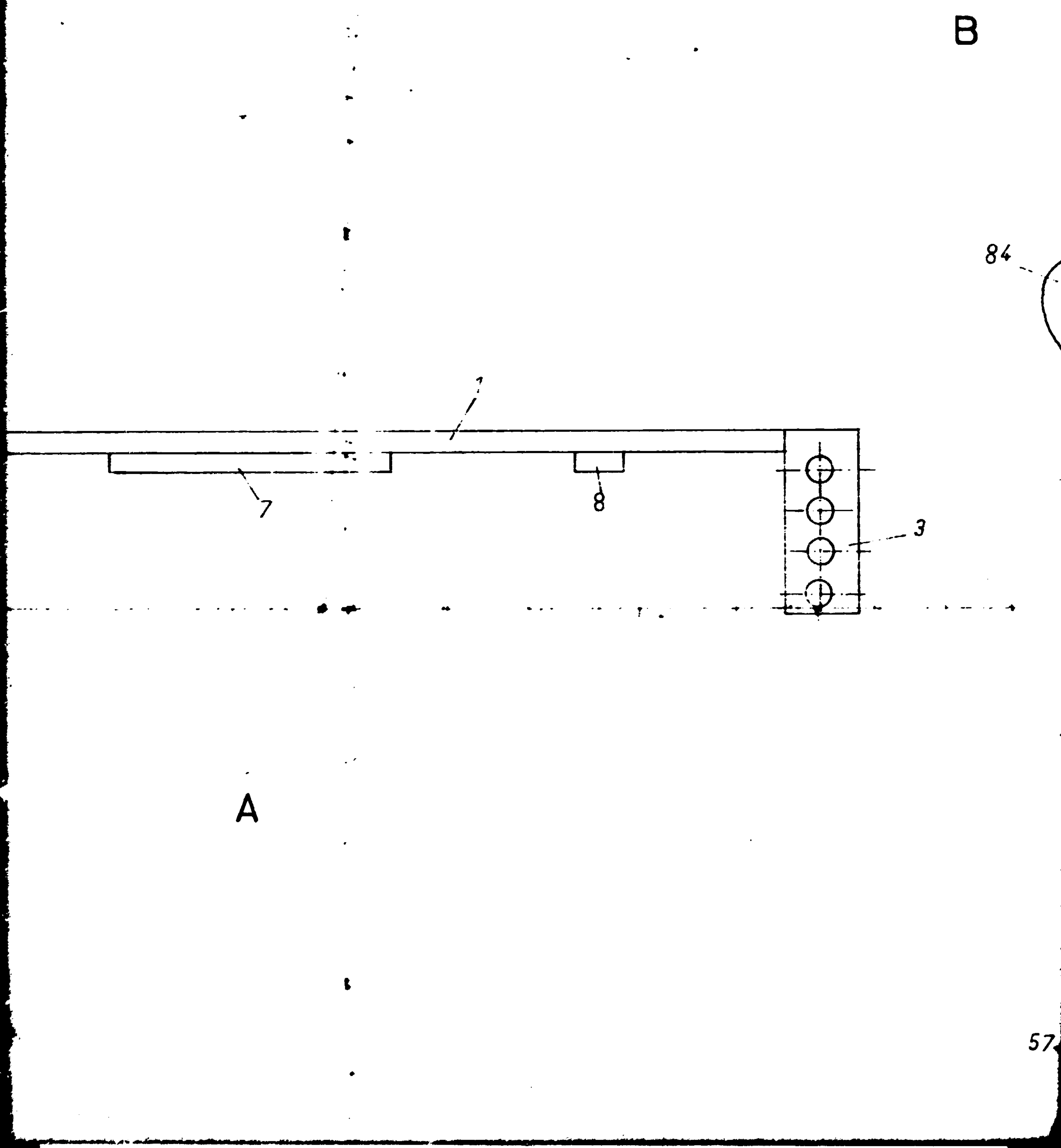


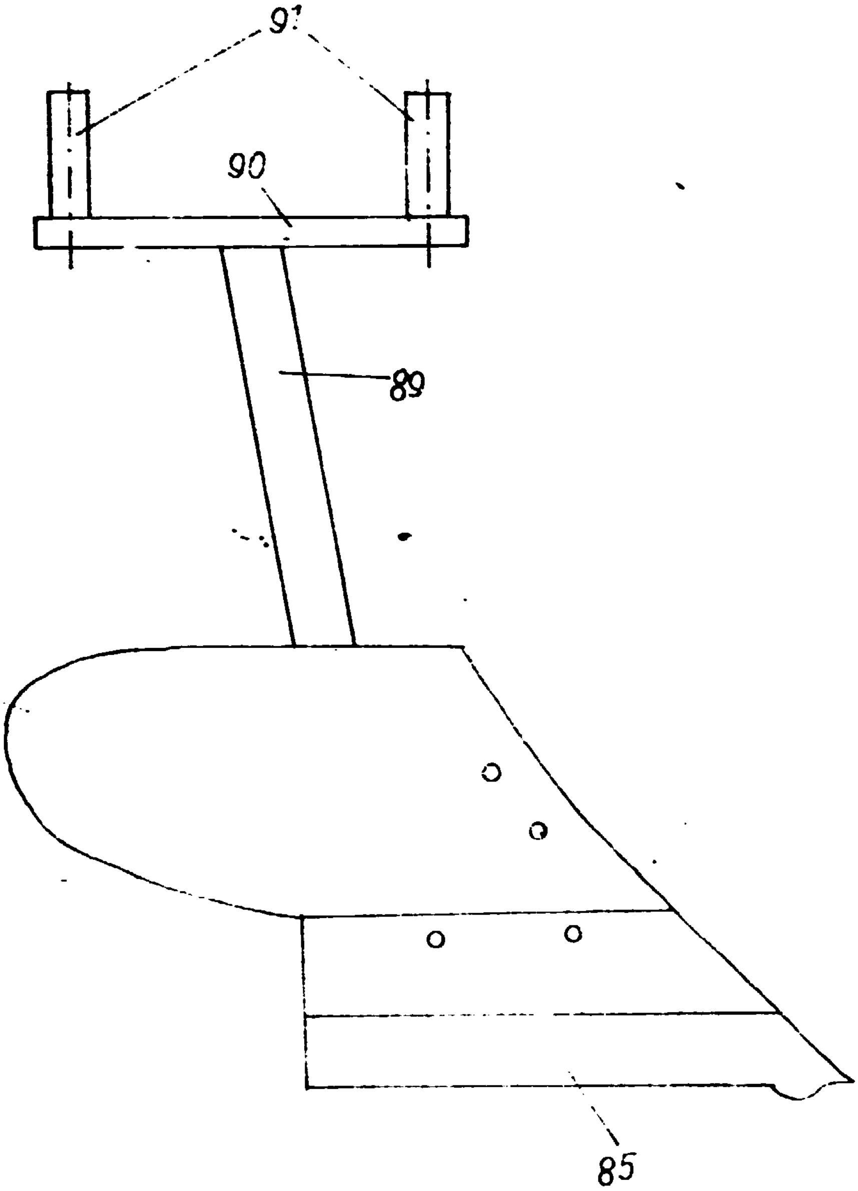
Foundry/Mechanical Workshop
Mogadiscio-Somalia

Appendix I.

Report No. 9- WIND MILL AND GEAR BOX

SECTION 3

B



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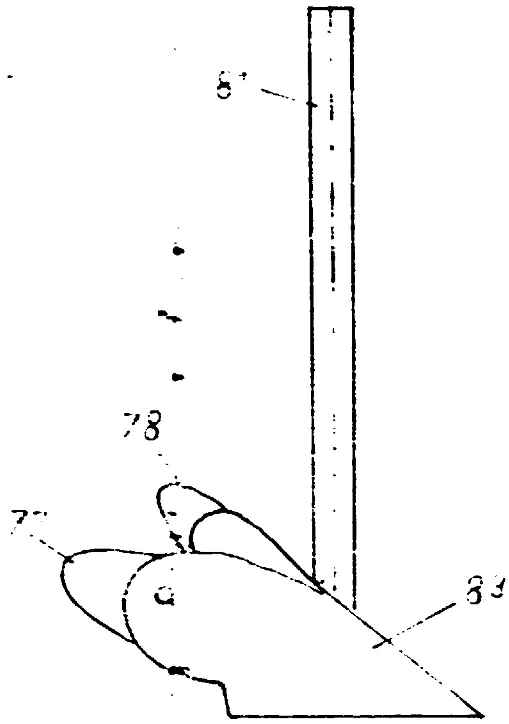

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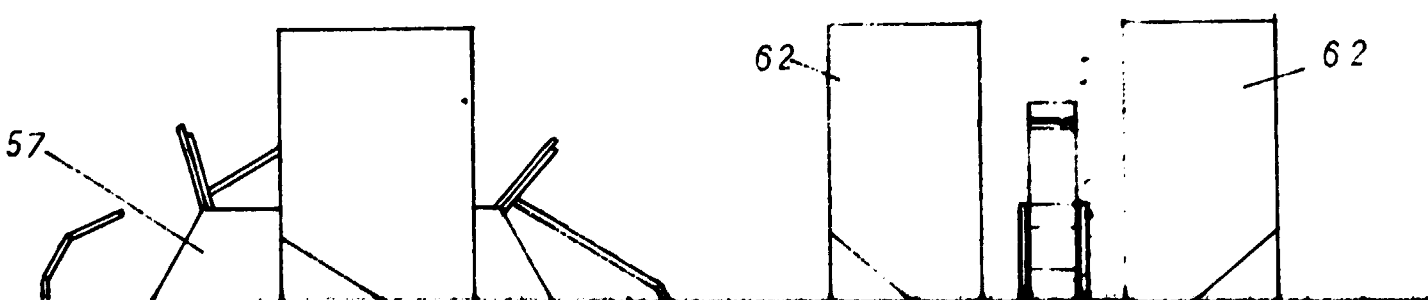
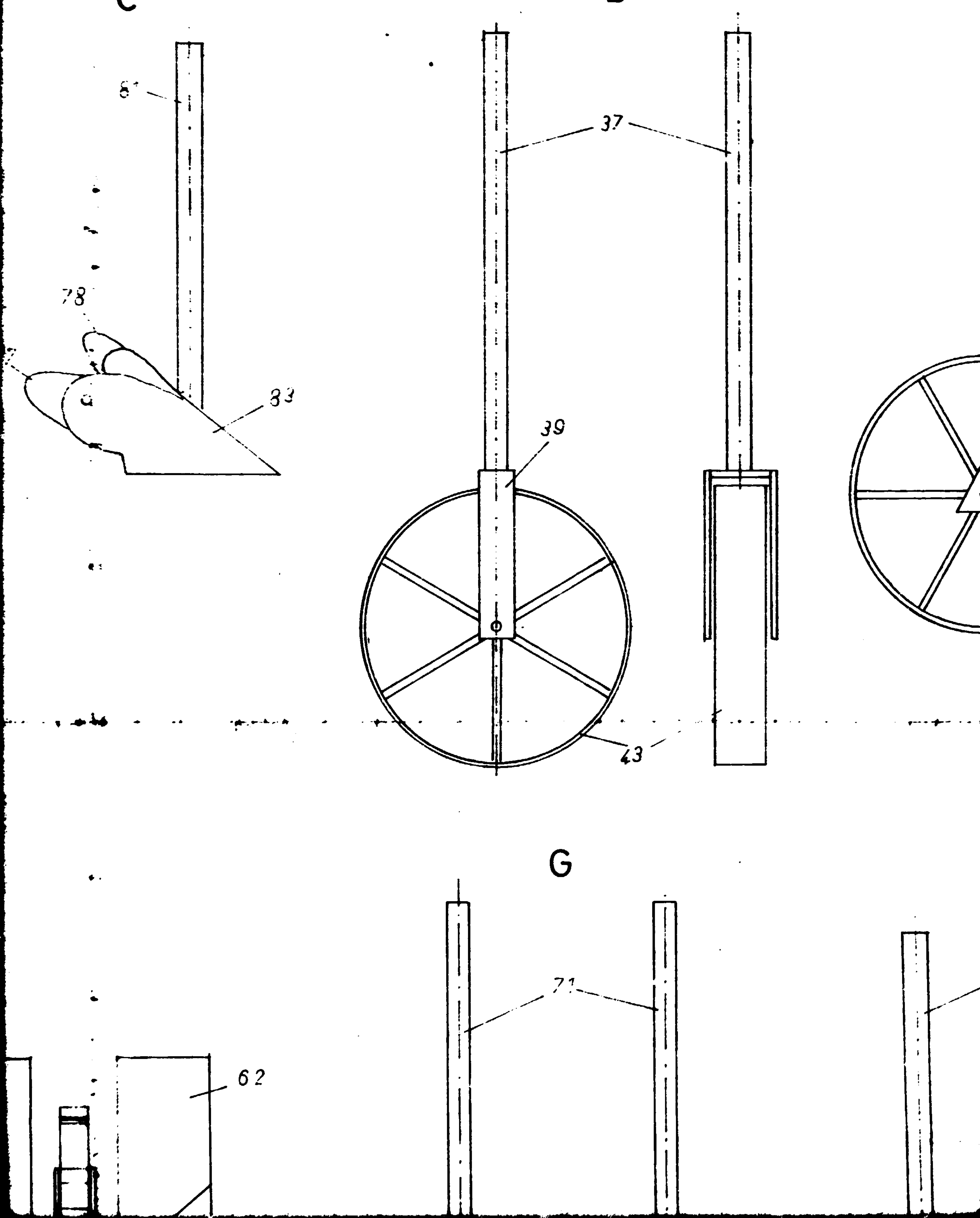


agricultural devices which is operated by wind energy will be very

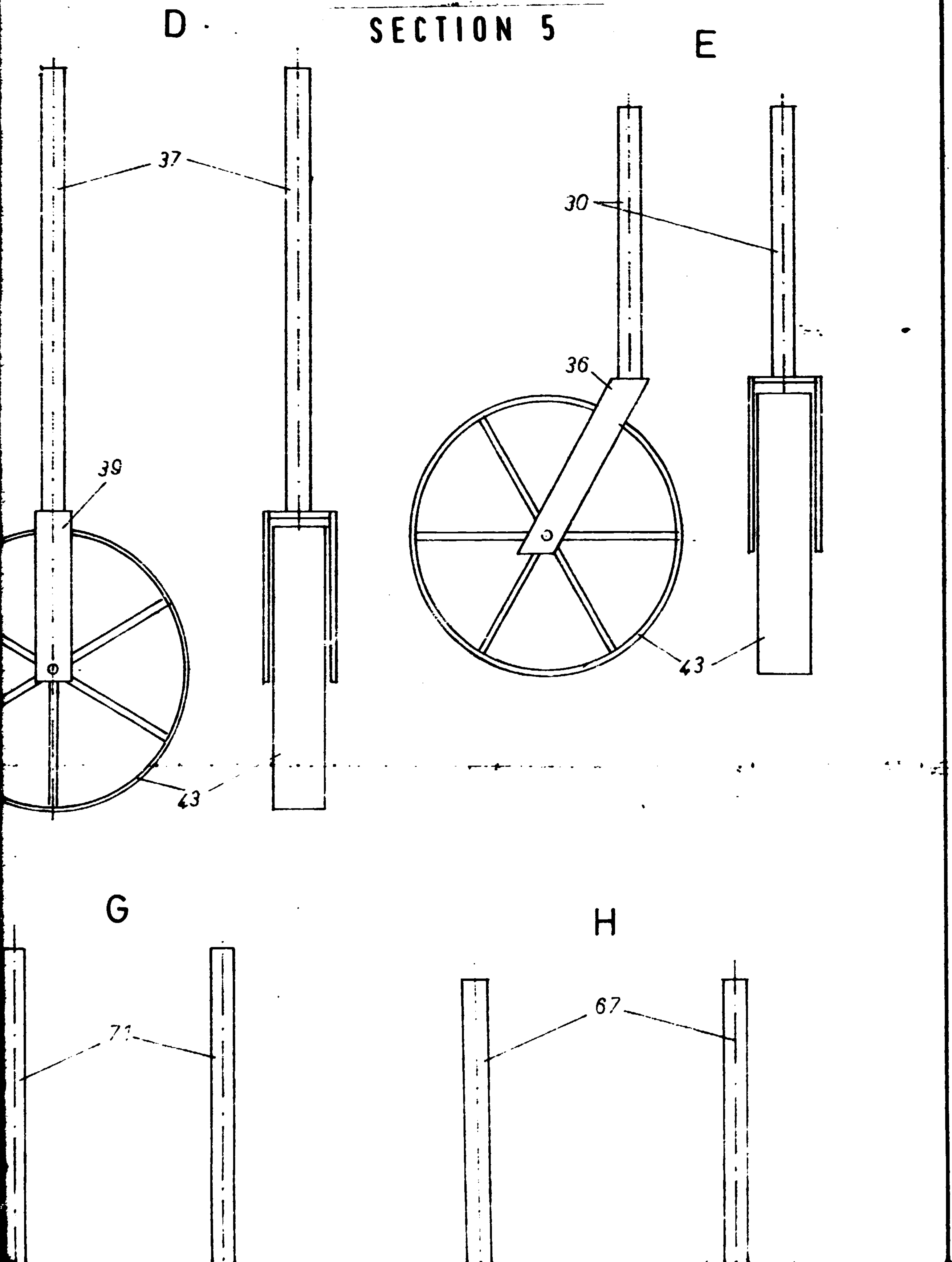
SECTION 4



of thc rotor irto rcciprocating action for the pump direct at the

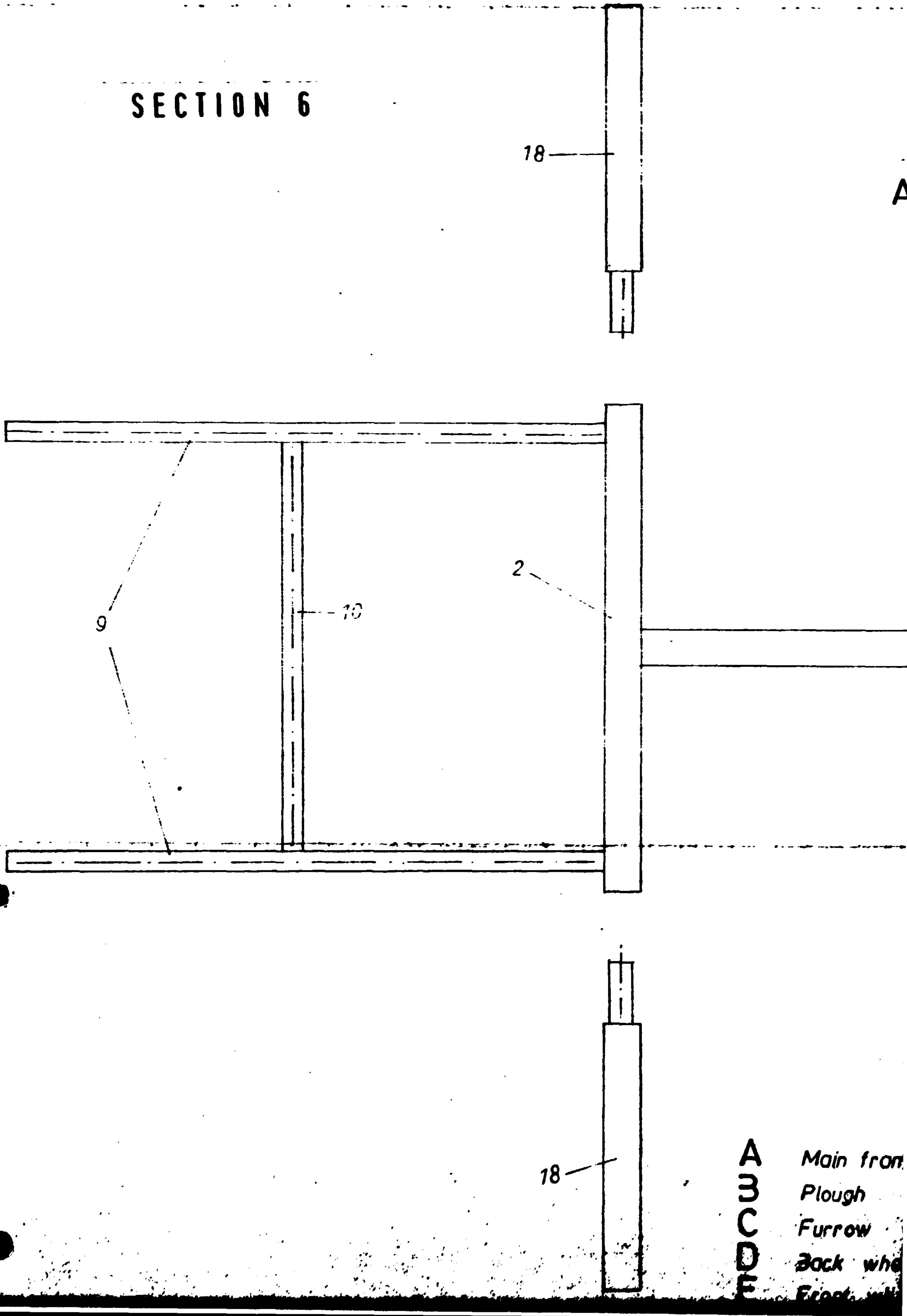
top of the tower. Second design includes a gearing mechanism which

SECTION 5



Gear shafts turn in the ball bearings which is placed into the housing. Housings are welded on the box walls. The shaft of the

SECTION 6



A Main fram

B Plough

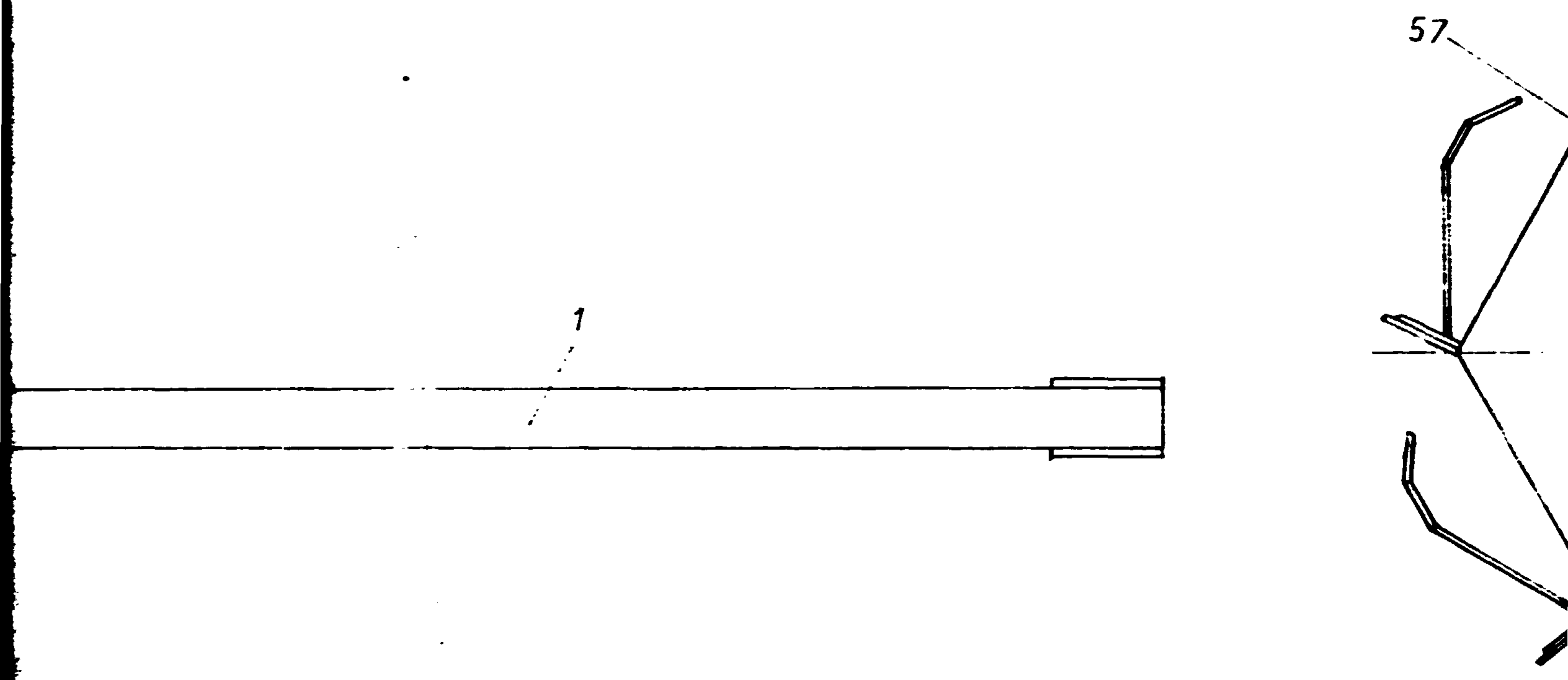
C Furrow

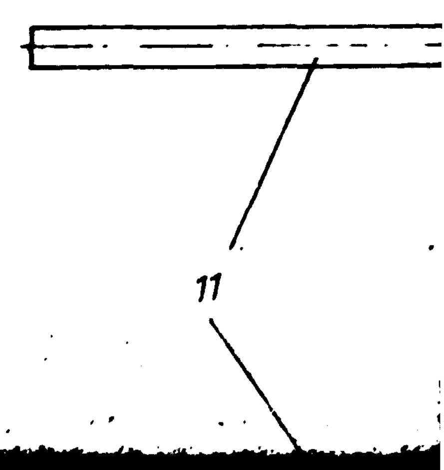
D Back whe

E Front wh

A

SECTION 7

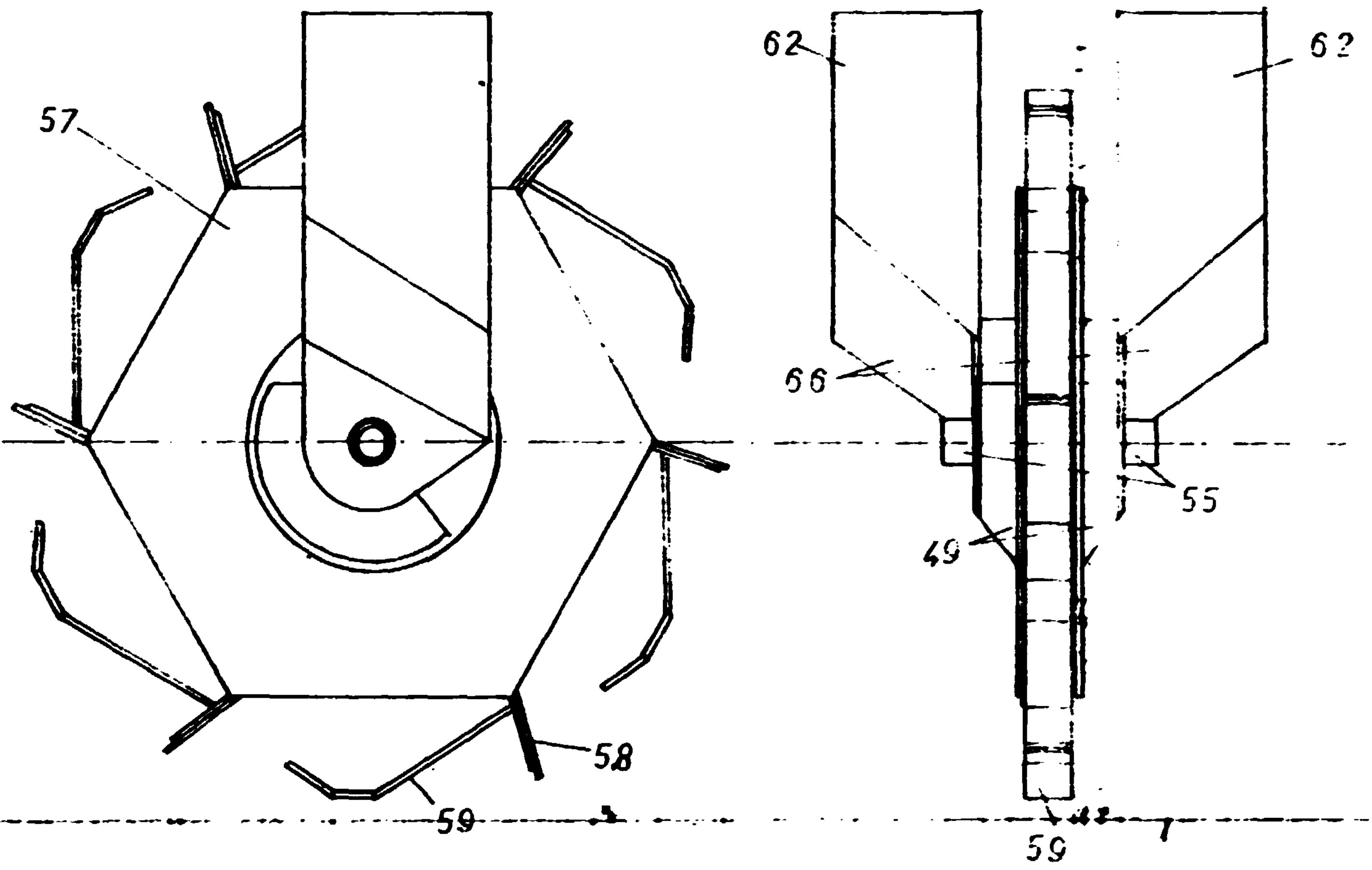




Main frame
Plough
Furrow
Back wheel
Front wheel

SECTION 8

F



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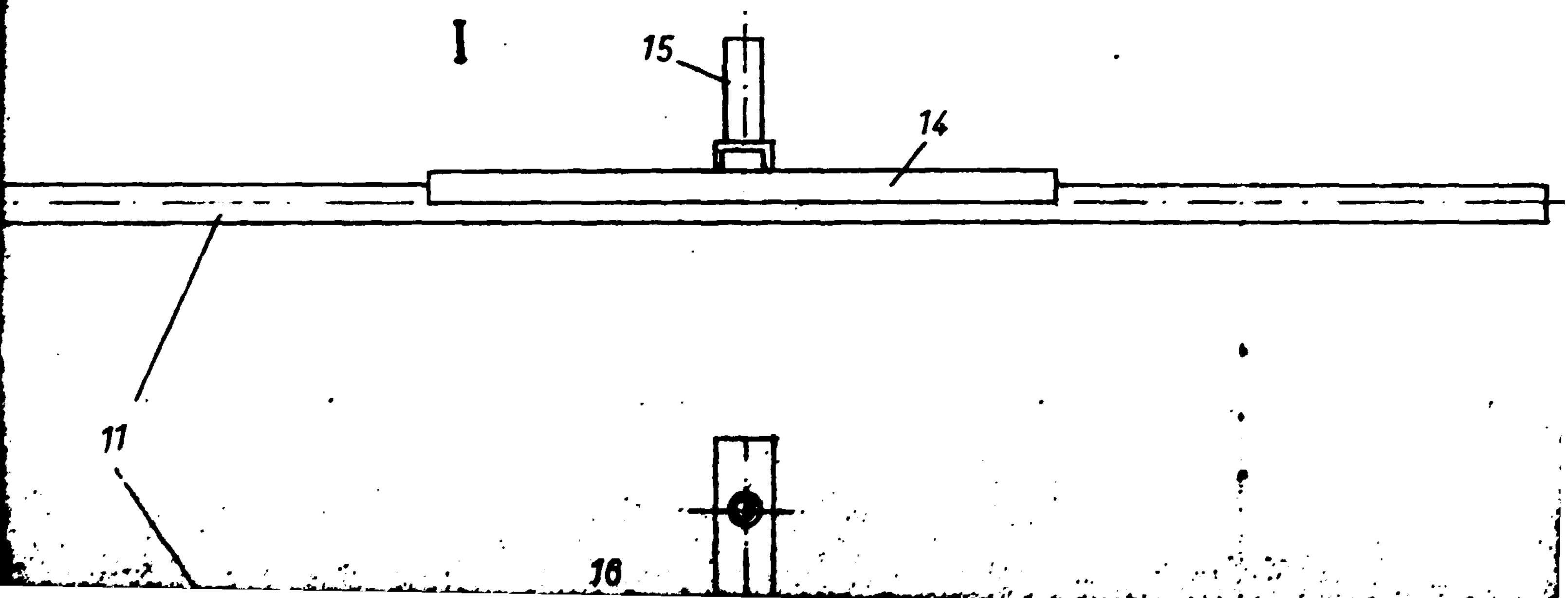

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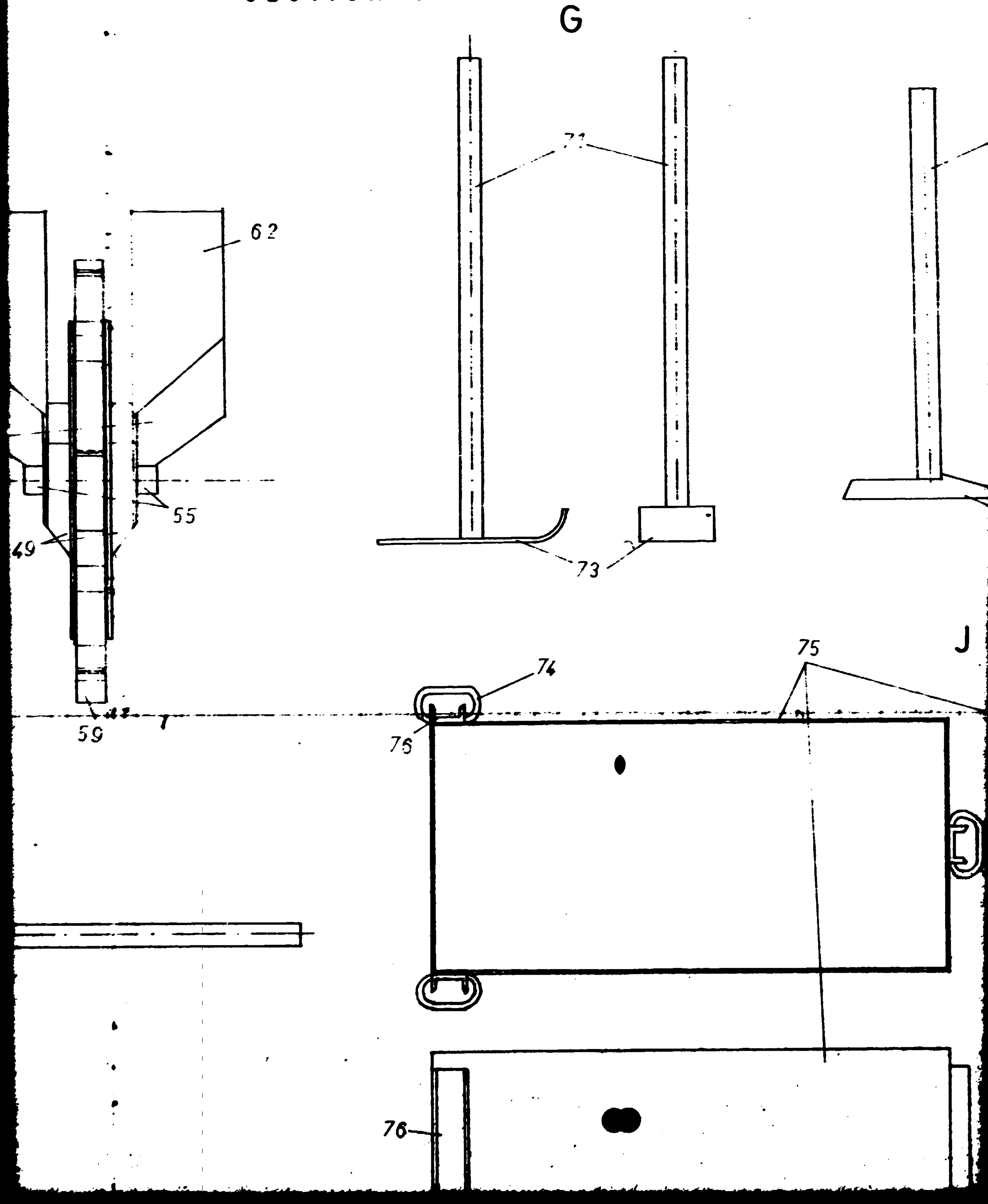

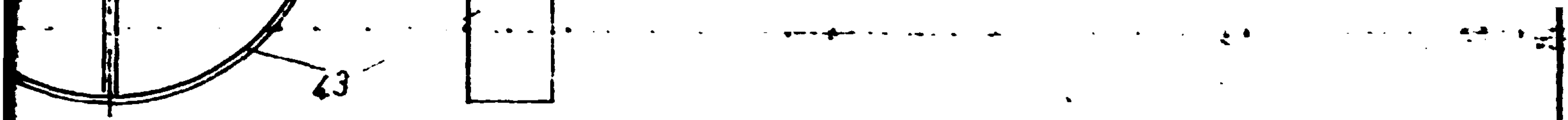

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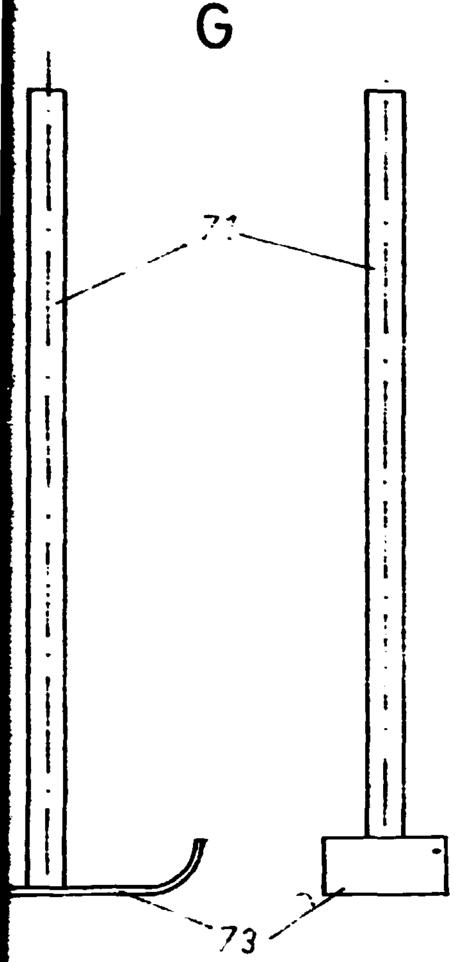
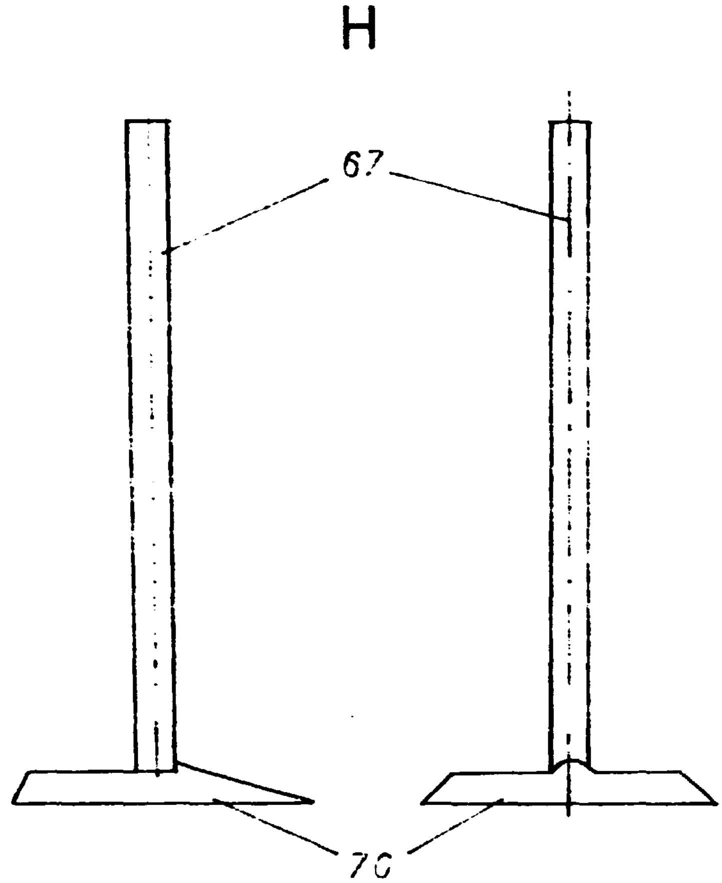
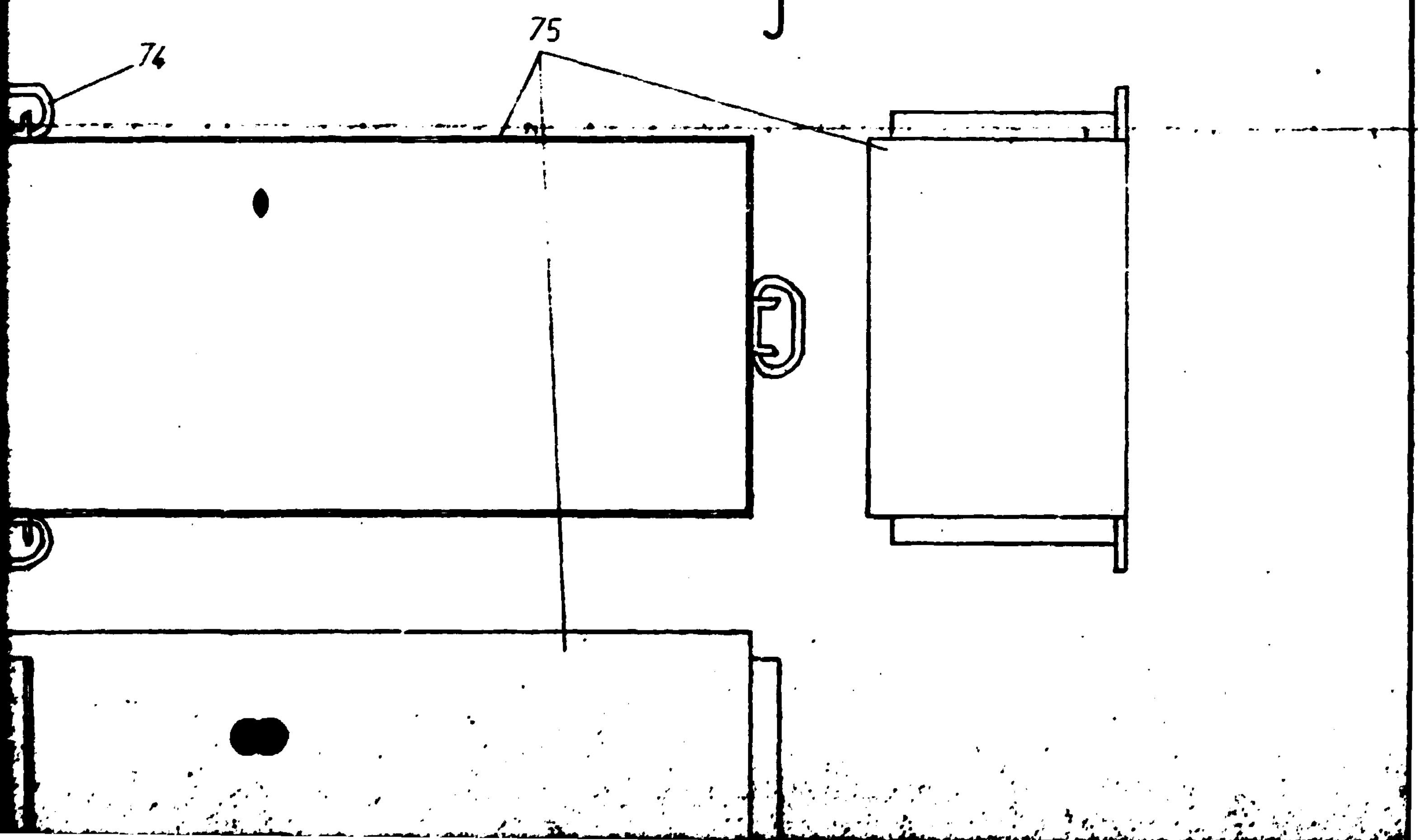
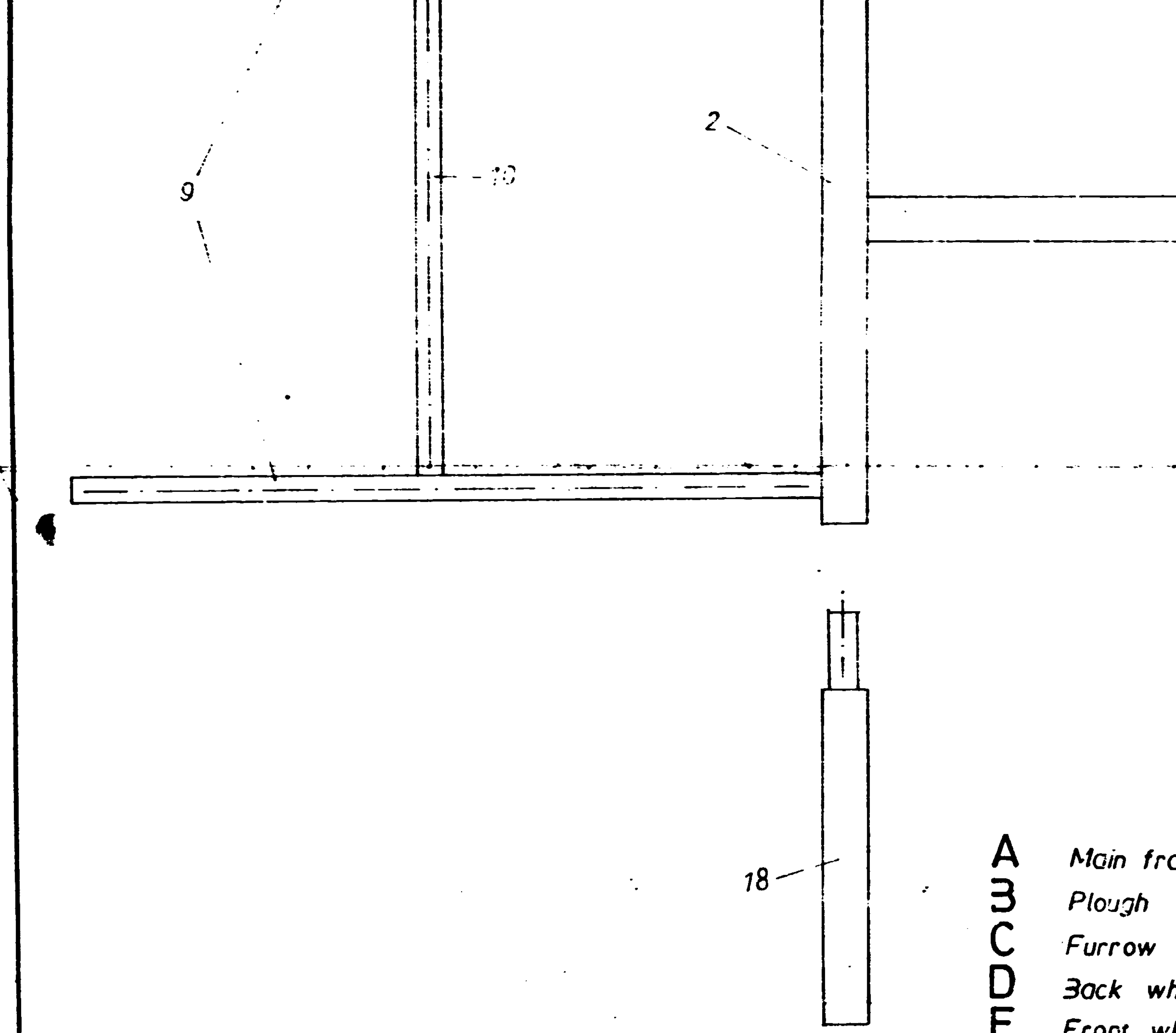


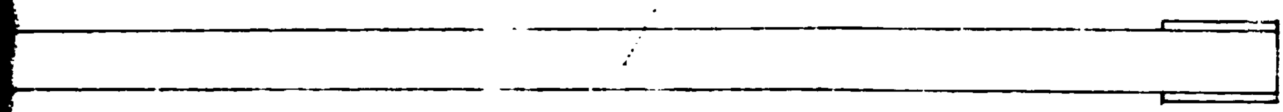


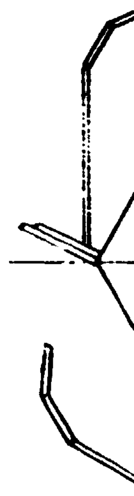


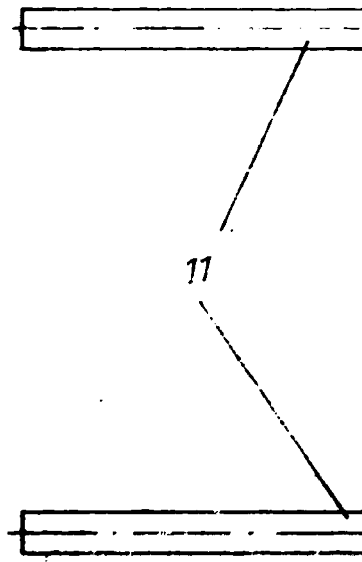


A Main fra
B Plough
C Furrow
D Back wh
E Front wh
F Planter
G Scating
H Weeder
I Jointing
J Barrow

SECTION 11

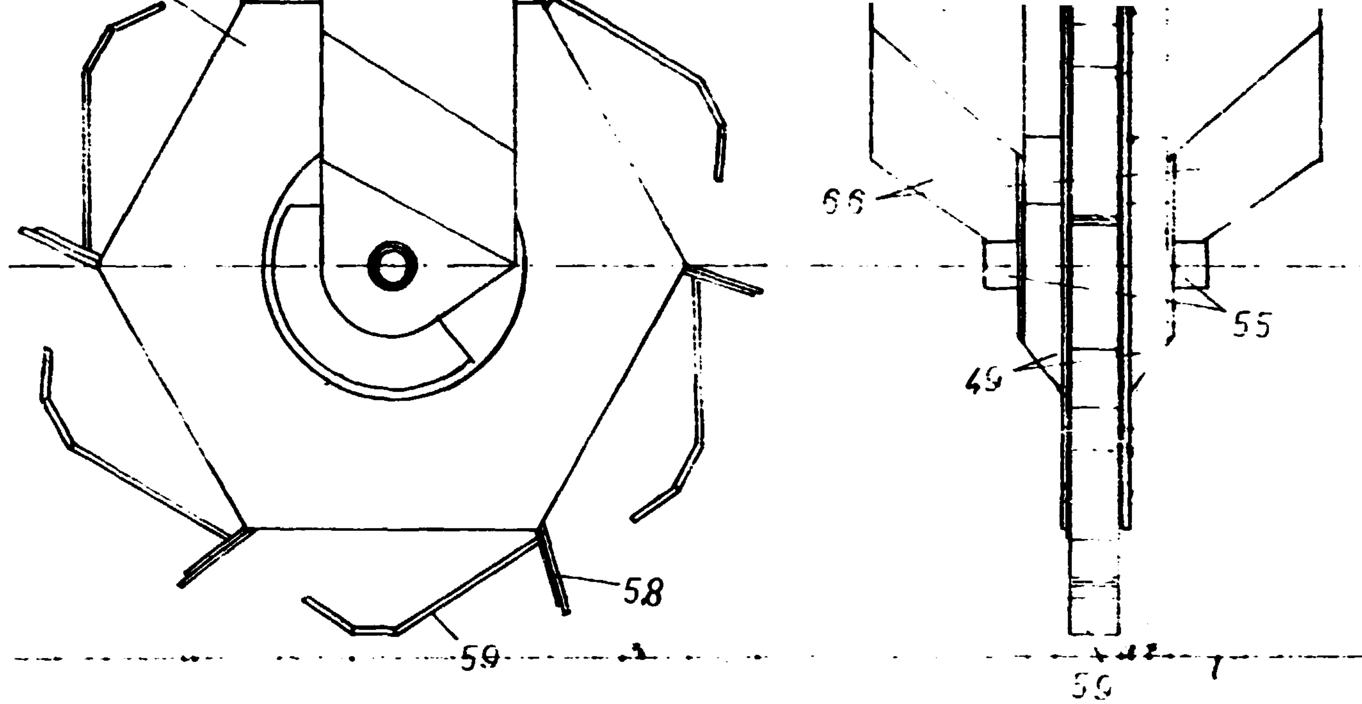






A Main frame
B Plough
C Furrow
D Back wheel
E Front wheel
F Planter
G Scating guide
H Weeder
I Jointing
J Barrow

SECTION 12



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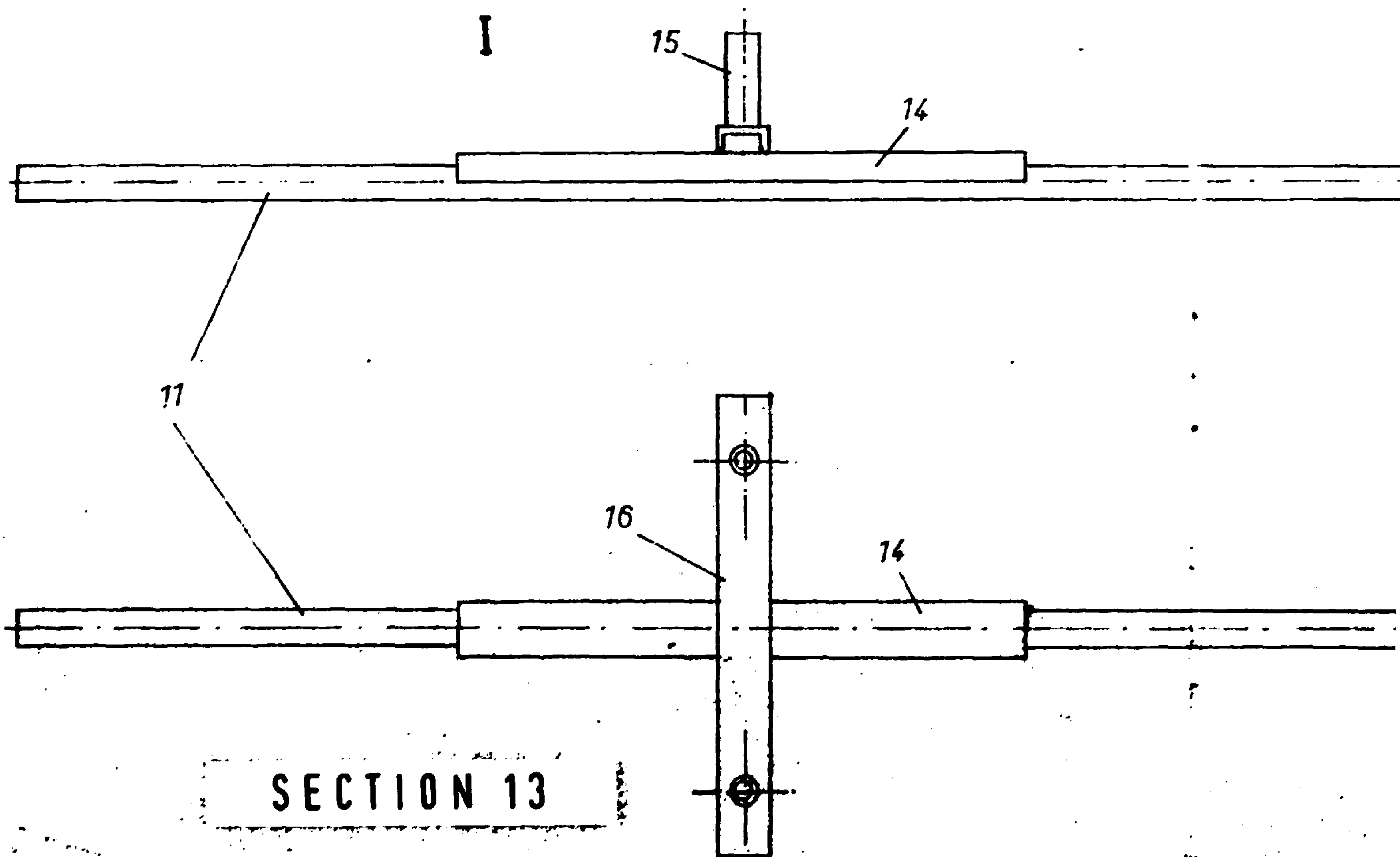

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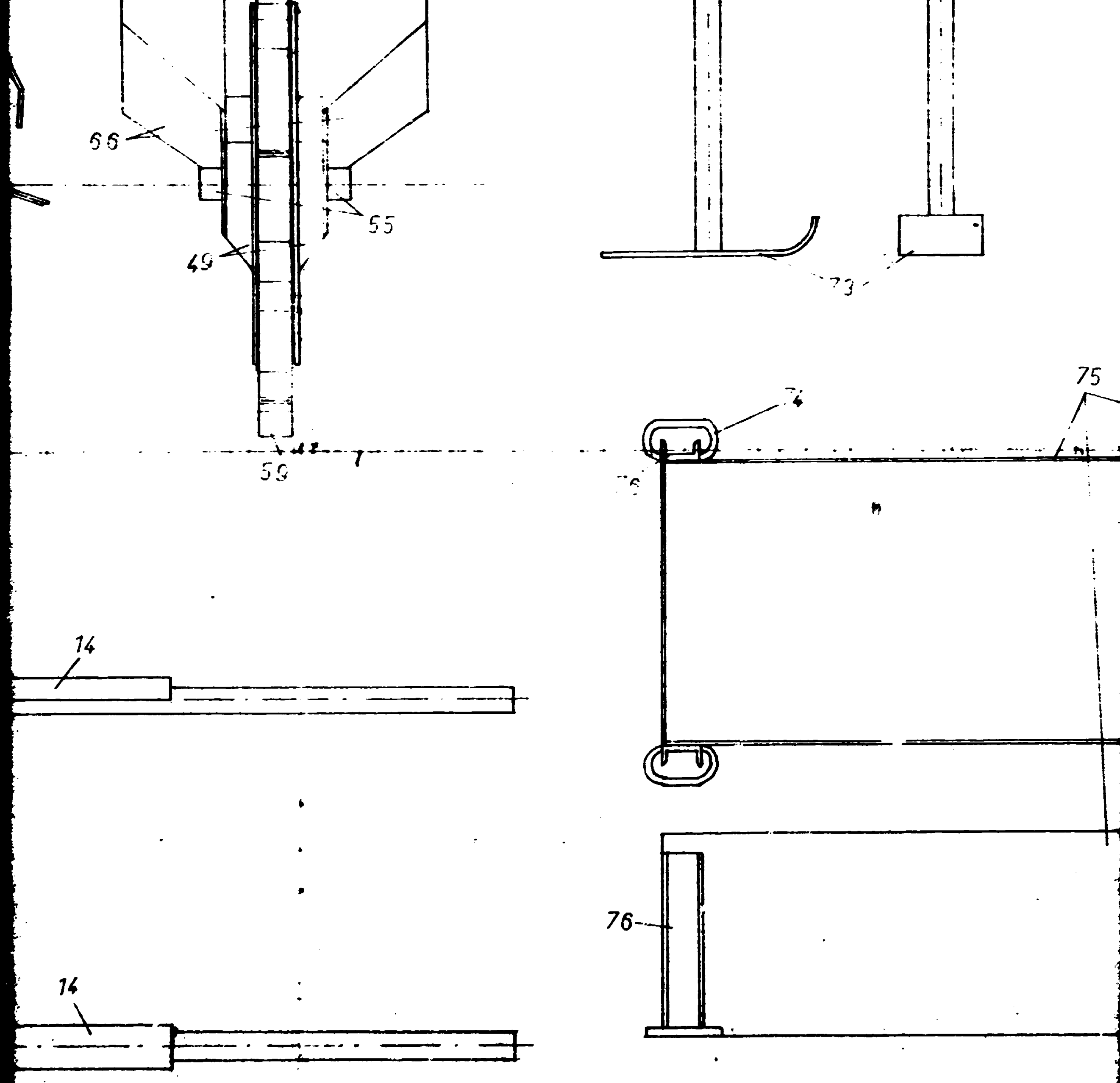

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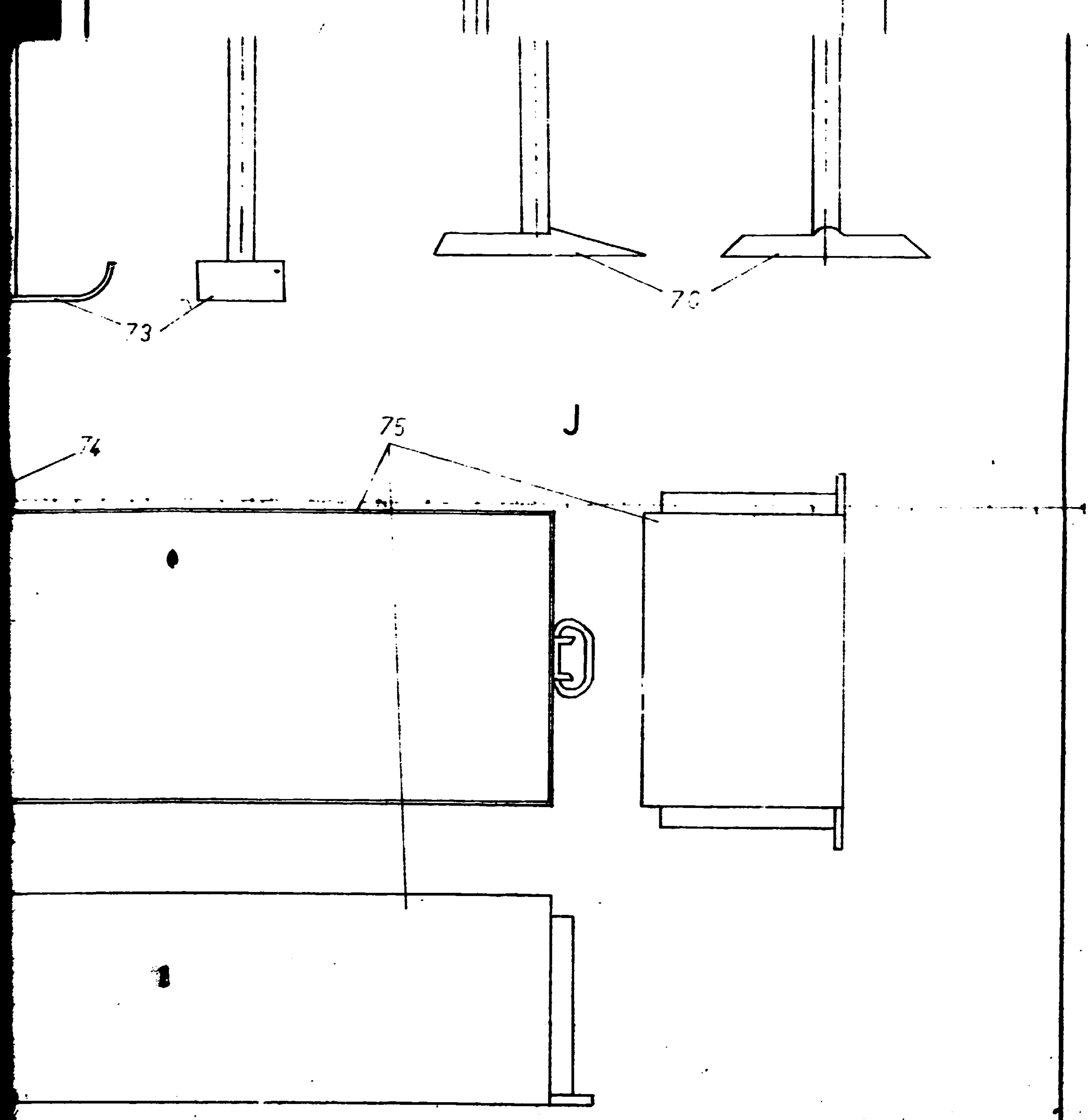


SECTION 15

Scale 1/5

Mogadiscio-Somalia

Report No. 9- WIND MILL AND GEAR BOX

Wind is a clean, replenishable source of energy. With a windpump it could provide energy for pumping water for household, irrigation and livestock. With windmill it could perform agricultural tasks such as corn grinding, sugar cane crushing, threshing, wood cutting and other special applications. People in Somalia (less than 5 millions, three quarters of which are not sedentary) and livestock (more than 50 millions of heads) have a vital demand of water that can be very limitedly satisfied by two rivers (Shabelle and Jubba) both of which flow in the southern part of the Somalia. Since the wells are often deep and relatively few (less than 2000) with regards to the amount of livestock and to the extension of the country and since deep waters are often too salty for watering, a large amount of the water need is satisfied by means of rain reservoirs, either many natural and quasi natural ponds or few large artificial basins. Since the national economy is essentially based on the zootechnic activity, it is clear that the water supply is the main requirement in Somalia. On the other hand, the country is lucky in subject of wind energy. Wind energy is suitable in almost all parts of the country. Excellent conditions prevail in places along the cost and the northern interior of the country. The country's big potential on wind energy is not used efficiently yet Points which speak in favcurof energy are not only the good potential conditions which indicate that this energy source would be an attractive option in economic terms in many places. Seen in the medium and longterm, however, the importance of wind energy as a source of energy in Somalia could extend for beyond the pumping of water, driving agricultural devices and generation of electricity. In case where the water is used for livestock it can be assumed that one pump connected to a wind mill supply an avarage of 100 cattle or camels or 1000 goats or sheep. The people will get cheap drinking water and using of the deep water instead of surface water from pools specific infectious diseases transmitted by contaminated drinking water will correspondingly frequently less occur. The use of wind energy to pump the water for small scale irrigation have economic advantages over diesel or petrol operated pumps. In rural area, farmers can use wind energy to process their products to chance them in a suitable condition to store, use or sell. The agricultural devices which is operated by wind energy will be very efficient and separetly used. Many works, which is done by using the human power already, will be done by using the wind energy with more efficiently and higher capacity.

MEDAL team has tried to help the solution of energy and water problems by designing two kinds of wind mill. Locally manufactured wind mills gain a number of advantages:

- Import substitution and hence saving of foreign currency.
- Shorter supply lines from manufacturer to costumer, resulting in more locally adopted systems, reduced transport costs, elimination of import formalities, fewer " middle-man " and improved spare parts and after-sales services.
- Enchantment of developing country capability.
- Job creation within the local economy.
- Provision of more reliable power source than with diesel in remote areas.
- Wider use of pumped water, leading to improved agricultural outputs.

Locally produced windpumps will have longer life, higher reliability and lower maintenance costs than many previously imported windmills, which will create number of difficulties such as; needing forcing currency, delivery time can be long and shipping costs high, not getting own wind expertise and this results in lack of information and knowledge and finally difficulties to get service and spare parts. Designed windmills have been adopted to local conditions. The wind mills use eighteen blades rotating on a horizantal axis to capture wind energy and transfer that energy to pumping mechanism. They are multi-bladed, fan type rotor windmills. The emphasis on design for Somalia focused on making system cheaper lighter, simpler and easier to maintain than the more complex wind mill systems. To adapt the components to local conditions, the number of the components in the system were reduced as much as possible. They require servicing only a annual basis usually only for a change of lubricant. Their design causes no loss of operating efficiency and in many cases actually improves performance. In their constructions, local materials were used as much as possible. Their design suits local conditions prevailing in the Somalia.

Structure of wind mills: Two designs were prepared. First one includes a crank drive mechanism which converts the rotating action of the rotor into reciprocating action for the pump direct at the top of the tower. Second design includes a gearing mechanism which changes the rotating axis from horizantal to vertical to operate agricultural devices. Both are multiblade types. They have I8 blades on their wheels. The blades are connected to the hub of wheel by using connection arms made of angle iron. Blade rings hold the blades firmly and give them a suitable position on a correct angle with wind direction. Wheel is connected on the rotor by a shaft which is made of high tensile steel and is positioned by ball bearings. Bearing case of the rotor is fixed to the transmission box which is placed on the top of the tower. The box is made of sheet metal. Inside the box one end of the rotor is connected to the crank section. Crank mechanism consists of connection parts and shafts,pins in different length and they are connected together by pins. Rotating action of the rotor is converted into reciprocating action by the crank mechanism. The movement of the fourth part is reciprocating action and the piston pipe is joined on it. The box including crank mechanism also has the tail vane is fixed on it. The tail vane adjust the position of wheel depending on the wind direction. It is connected to the box with springs to move the box when the wind direction changed. The tower is made of angles with supporting box. Tower is built on a concrete block into which the tower legs are inserted. There is a ladder to climb to the top of the tower for adjustment, maintenance and initial assembling. Second design of the wind mill has the same structure except the crank mechanism. It is also has same specifications but it gives a rotating action on vertical axis. Box at the tower only change the axis of the rotating action from horizantal to vertical by gears. The gears are bevel gears and are placed into the transmission box of wind mill. The rotor of the wheel turns the horizantal shaft on which the bevel gear is fixed. This gear works with another bevel gear in cooperation. There is $\frac{I}{2}$ ratio between the gears. The gears are designed to work under the wind load.

The gear bOx placed on floor level to supply power to implements and to convert rotating action to reciprocal for pumping consists of three bevel gears. They are positioned as one of them at the top and it's axis is vertical. The other two gears work with top gear as match on both side and their axises are horizantal. The gears are located in a box which is made from sheet material of 5 mm in thickness. The box is supported with bars on corners.

Gear shafts turn in the ball bearings which is placed into the housing. Housings are welded on the box walls. The shaft of the top is fixed to the vertical shaft of the wind mill and is drived by wind mill. The shaft of the side gears are horizantal and the ends of the shafts are suitable to fix agricultural implements such as juice extractor, maize sheller and maize grinder on them. The gear box could also be used to operate sugar mill to process sugar cane. Gear box also has a crank mechanism which is fixed to the bevel gears in the box for pumping the water. The implements which are fixed on the box help the farmers on their everyday work The system can be used by small farmers with low cost, easy setting, operation and maintenance or by village people in turn.

As a pre-study, the wind mills which builded previously were visited. It was found out that all wind mills were out of order. They have been examined carefully to find the problems. One of the problems was the fatigue of the connection rod between wind mill and piston of pump. Under frequently repeated stresses metal will fracture at a much lower point than it's ultimate strength. For this reason the factors in choosing the material for connection rod must be accurately calculated. To solve the problem the rods must be chanced with stronger ones. Another problem was the leather impairment. After some time the leathers worn-out because of the quality in most of the case. The solution of this problem was chemical treatment before operation. Chemical treatment applied before uping give leather excellent service capability.

CAPACITY AND POWER OF WIND MILL:

- P : Power (watt)
- d : Air density (kg/m^3)
- V : Uninterrupted wind velocity (m/s)
- A : Rotor area (m^2)
- D : Rotor diameter (m)
- Cp: Power coefficient
- pi: Symbol of the ratio of the circumference of a circle to its diameter (ie 3.I4I59)

$$A : (pi) \times (D)^2 \times \left(\frac{I}{4}\right) \ldots (m^2)$$

$$P : \left(\frac{I}{2}\right) \times (d) \times (V)^3 \times (A) \times (Cp) \ldots (watt)$$

- d : I.3 (kg/m^3)
- D : 5 (m)
- Cp: 0.4

$$A : (3.I4I59) \times (5)^2 \times \left(\frac{I}{4}\right)$$

$$A : 20\ (m^2)$$

- V : between I and I0 (m/s)

V	I	2	3	4	5	6	7	8	9	I0
P	52	4I6	I404	3328	650	II232	I7836	26624	37908	5200

- N : Rotor turn (rpm)
- TSR : Ratio of the speed at which the blade tip is travelling to the freestream windspeed
- k : Constant
- r : Radius of rotor (m)

$$r : \frac{D}{2} \ldots (m)$$

N :((TSR)X(V)X(60)X(k))/((2)X(pi)X(r))

- TSR : I
- k : I.47

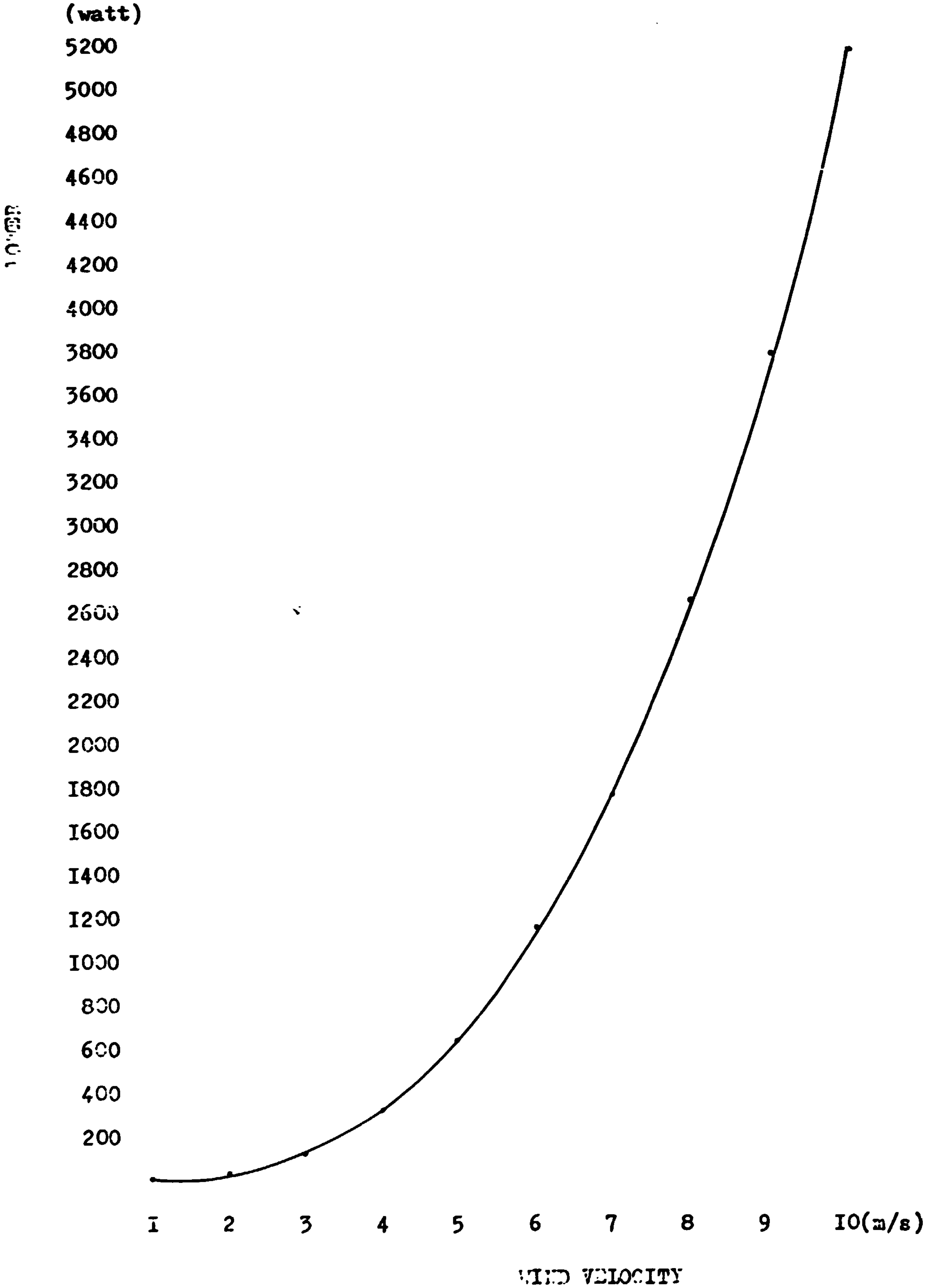
$$r : \frac{5}{2} : 2.5 \text{ (m)}$$

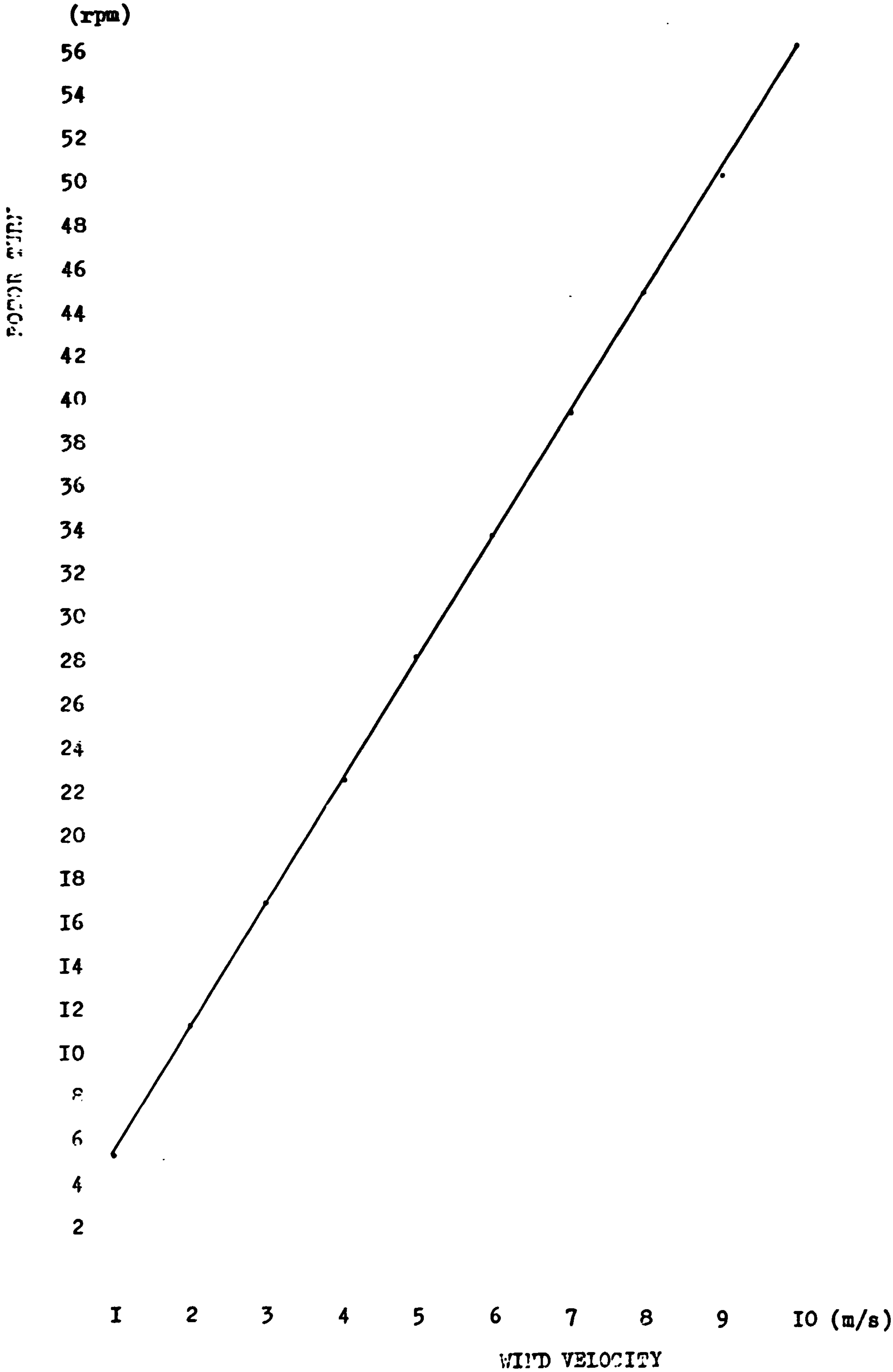
- V : between I and IO (m/s)

V	I	2	3	4	5	6	7	8	9	IO
N	5.6I	II.23	I6.84	22.46	28.07	33.69	39.30	44.92	50.53	56.I5

and

P	5.2	41.6	I40.4	332.8	650	II23.2	I783.6	2662.4	3790.8	5200
N	5.6I	II.23	I6.84	22.46	28.07	33.69	39.30	44.92	50.53	56.I5


(watt)
5200
5000
4800
4600
4400
4200
4000
3800
3600
3400
3200
3000
2800
2600
2400
2200
2000
I800
I600
I400
I200
I000
800
600
400
200
I
2
3
4
5
6
7
8
9
I0(m/s)


(rpm)
ROTOR SPIN
56
54
52
50
48
46
44
42
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
1
2
3
4
5
6
7
8
9
10 (m/s)
WIND VELOCITY

Windmill

Rotor height :	I8.5 m (centre of axis)
Rotor diameter :	5 m
Power at IO m/s :	5200 watt
Number of blade :	I8
Starting wind speed :	2 m/s
Breaking wind speed :	IO m/s
Pump piston diameter :	80 mm
Stroke length :	I40 mm
Output/stroke :	0.90 lt
Output/hr :	I500 lt

Plungers up to 25 m single stage
25 - 50 m double stage
50 - 75 m triple stage
75 - IOO m quadruple stage

No	Qan.	Description	Drawing No	Scale	Material
47	1	Bush	1.08.M47	1:1	ø58x40mm brass
46	1	Plate	1.08.M46	1:1	175x100x16mm steel
45	1	Boss	1.08.M45	1:1	ø90x14mm steel
44	1	Connection shaft	1.08.M44	1:1	ø45x130mm steel
43	1	Crank connection	1.08.M43	1:1	255x80x40mm steel
42	1	Housing shaft	1.08.M42	1:1	ø45x171mm steel
41	1	Housing	1.08.M41	1:1	ø90x115mm round steel
40	1	Bracket neck	1.08.M40	1:1	ø90mm x70mm pipe
39	2	Bracket	1.08.M39	1:1	130x130x10mm steel
38	2	Side part	1.08.M38	1:2,5	ø85x35mm steel
37	1	Side part	1.08.M37	1:2,5	370mm-100x50x6mm U chan
36	2	Side part	1.08.M36	1:1	260mm-30x30x3mm angl
35	1	Side part.	1.08.M35	1:1	140x55x6mm steel
34	2	Side part	1.08.M34	1:2,5	50x50x10mm steel
33	1	Side part	1.08.M33	1:2,5	215x80x10mm steel
32	1	Side part	1.08.M32	1:2,5	200x110x5mm steel
31	1	Side part	1.08.M31	1:2,5	120x120x5mm steel
30	1	Side part	1.08.M30	1:2,5	135x40x10mm steel
29	1	Side part	1.08.M29	1:2,5	190x40x10mm steel
28	1	Box inside	1.08.M28	1:1	155x55x5mm steel
27	1	Box inside	1.08.M27	1:1	155x135x5mm steel
26	1	Box inside	1.08.M26	1:2,5	305x170x5mm steel
25	1	Box bottom	1.08.M25	1:2,5	305x305x5mm steel
24	2	Box side	1.08.M24	1:2,5	320x305x5mm steel
23	1	Box back	1.08.M23	1:2,5	325x310x5mm steel
22	1	Box top	1.08.M22	1:2,5	305x305x5mm steel
21	1	Pin			ø12x45mm steel
20	1	Ball bearing			6212 - SKF
19	1	Ball bearing			6016 - SKF
18	1	Bearing base	1.08.M18	1:1	ø225x35mm steel
17	1	Bearing	1.08.M17	1:2,5	ø155x280mm steel
16	1	Sealing			Rubber
15	1	Bearing cover	1.08.M15	1:1	ø155x8mm steel
14	6	Support	1.08.M14	1:1	210x40x10mm steel
13	6	Support	1.08.M13	1:1	125x125x10mm steel
12	1	Hub wheel	1.08.M12	1:2,5	ø350x15mm steel
11	1	Hub wheel	1.08.M11	1:2,5	ø250x15mm steel
10	1	Hub rod	1.08.M10	1:1	ø88x776mm steel
9	6	Arm end	1.08.M09	1:1	50x50x10mm steel
8	6	Arm support	1.08 M08	1:1	147,5x50x10mm steel
7	6	Connection arm	1.08.M07	1:2,5	1830mm-50x50x5mm angl
6	6	Connection arm	1.08.M06	1:2,5	1960mm-50x50x5mm ang
5	6	Circular guy	1.08.M05	1:10	2250x40x10mm steel
4	6	Circular guy	1.08.M04	1:5	40x1120x10mm steel
3	18	Blade fixing	1.08.M03	1:1	2mm sheet
2	18	Blade fixing	1.08.M02	1:2,5	2mm sheet
1	18	Blade	1.08.M01	1:10	1mm sheet

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Wind Mill

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No	Qan.	Description	Drawing No	Scale	Material
94	1	Tail spring	1.08.M94	1:1	ø10x2075 mm steel
93	1	Tail spring	1.08.M93	1:1	ø10x24710mm steel
92	1	Tail member	1.08.M92	1:10	1770x383x2mm sheet
91	1	Tail member	1.08.M91	1:10	1600x500x2mm sheet
90	1	Tail member	1.08.M90	1:10	1380x500x2 mm sheet
89	1	Tail member	1.08.M89	1:10	1160x500x2 mm sheet
88	1	Tail member	1.08.M88	1:1	1205x20x3 mm steel
87	1	Tail member	1.08.M87	1:1	1455x20x3 mm steel
86	1	Tail member	1.08.M86	1:1	1770x20x3 mm steel
85	2	Tail member	1.08.M85	1:1	552,5mm-30x30x3mm angle
84	2	Tail member	1.08.M84	1:1	545mm-30x30x3 mm angle
83	2	Tail member.	1.08.M83	1:1	695mm-30x30x3mm angle
82	1	Tail member	1.08.M82	1:1	940mm-30x30x3mm angle
81	2	Tail member	1.08.M81	1:1	1928mm-30x30x3mm angle
80	1	Frame member	1.08.M80	1:10	3870x50x10 mm steel
79	1	Frame member	1.08.M79	1:10	3870mm-50x50x5mm angle
78	1	Frame member	1.08.M78	1:1	880mm-20x20x4mm angle
77	1	Frame member	1.08.M77	1:1	815mm-20x20x4mm angle
76	2	Frame member	1.08.M76	1:1	1060mm-20x20x4mm angle
75	1	Frame member	1.08.M75	1:1	260mm-45x45x5mm angle
74	1	Frame member	1.08.M74	1:1	225mm-45x45x5 mm angle
73	1	Frame member	1.08.M73	1:1	315mm-45x45x5mm angle
72	1	Frame member	1.08.M72	1:1	345mm-45x45x5mm angle
71	1	Frame member	1.08.M71	1:1	380mm-45x45x5mm angle
70	2	Tail Connection	1.08.M70	1:1	50x45x10mm steel
69	1	Tail connection	1.08.M69	1:1	750mm x 40x40x5 mm angle
68	1	Frame part	1.08.M68	1:1	40x40x5mm x460mm angle
67	1	Tail shaft	1.08.M67	1:1	ø35x465 mm steel
66	2	Pulley	1.08.M66	1:1	ø100x32 mm steel
65	1	Pulley arm	1.08.M65	1:1	175x50x10 mm steel
64	1	Pipe end	1.08.M64	1:1	106x40x5 mm steel
63	1	Guide pipe	1.08.M63	1:2,5	ø4" x1090 mm pipe
62	1	Support	1.08.M62	1:1	130x108x10 mm steel
61	1	Support	1.08.M61	1:1	130x108x10mm steel
60	1	Support	1.08.M60	1:2,5	ø180x142 mm steel
59	1	Support	1.08.M59	1:2,5	ø180x142 mm steel
58	1	Plate	1.08.M58	1:2,5	500x240x15mm steel
57	1	Bracket plate	1.08.M57	1:2,5	250x240x15 mm steel
56	2	Bracket support	1.08.M56	1:1	55x45x10mm steel
55	2	Bracket support	1.08.M55	1:1	115x45x10 mm steel
54	2	Bracket support	1.08.M54	1:1	73x45x10mm steel
53	1	Bracket pipe	1.08.M53	1:1	ø4" x45mm pipe
52	1	Crank connection	1.08.M52	1:1	165x80x40 mm steel
51	1	Connection shaft	1.08.M51	1:1	ø45x71mm steel
50	1	Crank connection	1.08.M50	1:1	345x100x16mm steel
49	1	Bearing housing	1.08.M49	1:1	ø90x24 mm steel

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Windmill

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143	1	Strut	1.08.T09c	1:5	2077mm - 40x40x4mm angle
142	1	Strut	1.08.T09b	1:5	2077mm - 40x40x4mm angle
141	1	Strut	1.08.T09a	1:5	2077mm - 40x40x4mm angle
140	8	Side support	1.08.T08	1:5	4128mm - 30x30x4mm angle
139	1	Strut	1.08.T07d	1:5	2437mm - 45x45x5mm angle
138	1	Strut	1.08.T07c	1:5	2437mm - 45x45x5 mm angle
137	1	Strut	1.08.T07b	1:5	2437mm - 45x45x 5mm angle
136	1	Strut	1.08.T07a	1:5	2437mm - 45x45x5 mm angle
135	1	Strut	1.08.T06d	1:5	2807mm - 45x45x5mm angle
134	1	Strut	1.08.T06c	1:5	2807mm - 45x45x5mm angle
133	1	Strut	1.08.T06b	1:5	2807mm - 45x45x5mm angle
132	1	Strut	1.08.T06a	1:5	2807mm - 45x45x5mm angle
131	8	Side support.	1.08.T.05	1:5	4515mm - 30x30x4mm angle
130	4	Tower leg	1.08.T04	1:10	4080mm - 60x60x6mm angle
129	4	Tower leg	1.08.T03	1:10	4160mm - 70x70x7mm angle
128	4	Tower leg	1.08.T02	1:10	4160mm - 70x70x7mm angle
127	4	Tower leg	1.08.T01	1:10	450 x 70x70x7mm angle
126	3	Pumping pipe	1.08.M126		ø 1/4" x 6500 mm pipe
125	5	Case pipe	1.08.M125	1:1	ø60x 3300 mm aluminium pipe
124	1	Rod-connection	1.08.M124	1:2,5	ø70x55 mm steel
123	1	Rod-connection	1.08.M123	1:2,5	164x30x5mm steel
122	1	Rod-connection	1.08.M122	1:1	555 x 40x10mm + ø13x50mm st
121	1	Rod-connection	1.08.M121	1:1	335x40x5 mm steel
120	1	Rod-connection	1.08.M120	1:1	335x40x5mm steel
119	1	Rod-connection	1.08.M119	1:1	ø38 x 85 mm steel
118	1	Rod-connection	1.08.M118	1:1	55x42x40mm steel
117	1	Rod-connection	1.08.M117	1:1	42x40x15mm steel
116	2	Rod-connection	1.08.M116	1:1	50x42x10 mm steel
115	1	Rod-connection	1.08.M115	1:1	225x41x3 mm sheet
114	1	Rod-connection	1.08.M114	1:1	300x 42x3 mm sheet
113	1	Rod-connection	1.08.M113	1:1	300x42x3 mm sheet
112	1	Fixing	1.08.M112	1:1	200x40x 5 mm steel
111	1	Wooden connection	1.08.M111	1:1	680x32x 32 mm wood
110	1	Rod	1.08.M110	1:1	ø 16 x 2895 mm steel
109	1	Guide - break	1.08.M109	1:1	ø120 x13 mm steel
108	1	Guide - break	1.08.M108	1:2,5	202x142 x34 mm cast iron
107	1	Guide - break	1.08.M107	1:2,5	ø16x1540 mm steel
106	1	Guide screw	1.08.M106	1:1	ø12 x70mm steel
105	1	Guide part	1.08.M105	1:1	95x40x8 mm steel
104	1	Guide body	1.08.M104	1:1	810x40x9mm steel
103	1	Spring connection	1.08.M103	1:1	160x40x5mm steel
102	1	Spring connection	1.08.M102	1:1	50x45x10mm steel
101	2	Spring connection	1.08.M101	1:1	50x50x10mm steel
100	1	Spring connection	1.08.M100	1:1	160x50x10 mm steel
99	2	Spring connection	1.08.M99	1:1	50x10x10 mm steel
98	1	Spring connection	1.08.M98	1:1	ø16x204 mm steel-chain link
97	1	Chain end	1.08.M97	1:1	ø12x775 mm steel
No	Qan.	Description	Drawing No	Scale	Material

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Windmill

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[illegible]	[illegible]	[illegible]	1.08.T39	1:1	ø12x310mm steel
190	1	Stair support	1.08.T38	1:5	110mm-30x30x4mm angle
189	1	Stair support	1.08.T37	1:5	110mm-30x30x4mm angle
188	7	Stair support	1.08.T36	1:5	160mm-30x30x4mm angle
187	7	Stair support	1.08.T35	1:5	160mm-30x30x4mm angle
186	2	Stair case	1.08.T34	1:10	1500mm-30x3mm stripe
185	2	Stair case	1.08.T33	1:2,5	6000mm-30x3mm stripe
184	2	Staircase	1.08.T32	1:2,5	6000mm-30x3mm stripe
183	1	Firming	1.08.T31	1:5	2845mm-50x50x5mm angle
182	1	Firming	1.08.T30	1:5	2475mm-50x50x5mm angle
181	1	Firming	1.08.T29	1:5	2121mm-45x45x5mm angle
180	1	Firming	1.08.T28	1:5	1751mm-40x40x4mm angle
179	1	Firming	1.08.T27	1:5	1430mm-40x40x4mm angle
178	1	Firming	1.08.T26	1:5	1113mm-40x40x4mm angle
177	1	Firming	1.08.T25 e	1:1	ø17x22mm steel
176	1	Firming	1.08.T25 d	1:1	ø6x30mm steel
175	1	Firming	1.08.T25 c	1:1	50mm-25x25x4mm angle
174	1	Firming	1.08.T25 b	1:1	77mm-25x25x4mm angle
173	1	Firming	1.08.T25 a	1:5	870mm-40x40x4mm angle
172	1	Crown block	1.08.T24	1:1	248x248x125mm cast iron
171	4	Fixing	1.08.T23	1:1	255mm-40x40x4mm angle
170	1	Crown block	1.08.T22	1:2,5	358x358x105mm cast iron
169	4	Fixing	1.08.T21	1:2,5	407mm-40x40x4mm angle
168	1	Crown block	1.08.T20	1:2,5	
167	1	Platform support	1.08.T19 c	1:5	1300mm-40x40x4mm angle
166	1	Platform support	1.08.T19 a	1:5	1300mm-40x40x4mm angle
165	2	Strut	1.08.T18	1:2,5	597mm-40x40x4mm angle
164	4	Fixing	1.08.T17	1:1	335mm-30x30x4mm angle
163	1	Strut	1.08.T16 d	1:5	820mm-35x35x4mm angle
162	1	Strut	1.08.T16 c	1:5	820mm-35x35x4mm angle
161	1	Strut	1.08.T16 b	1:5	820mm-35x35x4mm angle
160	1	Strut	1.08.T16 a	1:5	820mm-35x35x4mm angle
159	8	Side support bar	1.08.T15	1:1	ø12x2790mm steel
158	1	Strut	1.08.T14 d	1:5	1070mm-35x35x4mm angle
157	1	Strut	1.08.T14 c	1:5	1070mm-35x35x4mm angle
156	1	Strut	1.08.T14 b	1:5	1070mm-35x35x4mm angle
155	1	Strut	1.08.T14 a	1:5	1070mm-35x35x4mm angle
154	4	Fixing	1.08.T13	1:1	500mm-30x30x4mm angle
153	1	Strut	1.08.T12 d	1:5	1385mm-40x40x4mm steel
152	1	Strut	1.08.T12 c	1:5	1385mm-40x40x4mm steel
151	1	Strut	1.08.T12 b	1:5	1385mm-40x40x4mm steel
150	1	Strut	1.08.T12 a	1:5	1385mm-40x40x4mm steel
149	8	Side support bar	1.08.T11	1:1	ø12x3645mm steel
148	1	Strut	1.08.T10 d	1:5	1707mm-40x40x4mm angle
147	1	Strut	1.08.T10 c	1:5	1707mm-40x40x4mm angle
146	1	Strut	1.08.T10 b	1:5	1707mm-40x40x4mm angle
145	1	Strut	1.08.T10 a	1:5	1707mm-40x40x4mm angle
No	Qan.	Description	Drawing No	Scale	Material

	Date
Ersin BASTUĞ	

Wind Mill

Foundry & Mechanical Workshop		Page 4
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No	Qan.	Description	Drawing No	Scale	Material
217	2	Break part	1.08.T61	1:1	15x15x50mm steel
216	1	Break rope			ø15mm x 15000mm rope
215	1	Handle arm	1.08.T60	1:1	ø20x135mm steel
214	1	Break handle	1.08.T59	1:1	165x35x5mm steel
213	1	Break part	1.08.T58	1:1	390mm - 60x60x6mm angle
212	1	Break part	1.08.T57	1:1	390x48x8,5mm steel
211	1	Break part	1.08.T56	1:1	390x48x8,5mm steel
210	2	Break part	1.08.T55	1:1	ø10x225mm steel rod
209	2	Break part	1.08.T54	1:1	ø10x320mm steel
208	2	Break part	1.08.T53	1:1	170x35x8,5mm steel
207	2	Break part	1.08.T52	1:1	193x35x8,5mm steel
206	1	Break bush	1.08.T51	1:1	ø25x7mm brass
205	1	Break bush	1.08.T50	1:1	ø30x7mm brass
204	1	Break part	1.08.T49	1:1	57x50x10mm steel
203	1	Break part	1.08.T48	1:1	57x50x10mm steel
202	1	Break part	1.08.T47	1:1	680x50x7mm steel
201	1	Break bolt	1.08.T46	1:1	ø26x720mm steel
200	2	Break part	1.08.T45	1:1	ø25x35mm steel
199	1	Break nut	1.08.T44	1:1	ø50x50mm steel
198	1	Break part	1.08.T43	1:1	ø10x1855mm steel
197	4	Peg	1.08.T42	1:1	ø24x800mm steel
196	8	Leg fixing	1.08.T41c	1:1	100x100x5mm steel
195	4	Leg fixing	1.08.T41b	1:1	110x70x10mm steel
194	4	Leg fixing	1.08.T41a	1:2,5	300mm - 80x80x8mm angle
193	16	Side support fixing	1.08.T41	1:1	425x30x5mm steel

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Wind Mill

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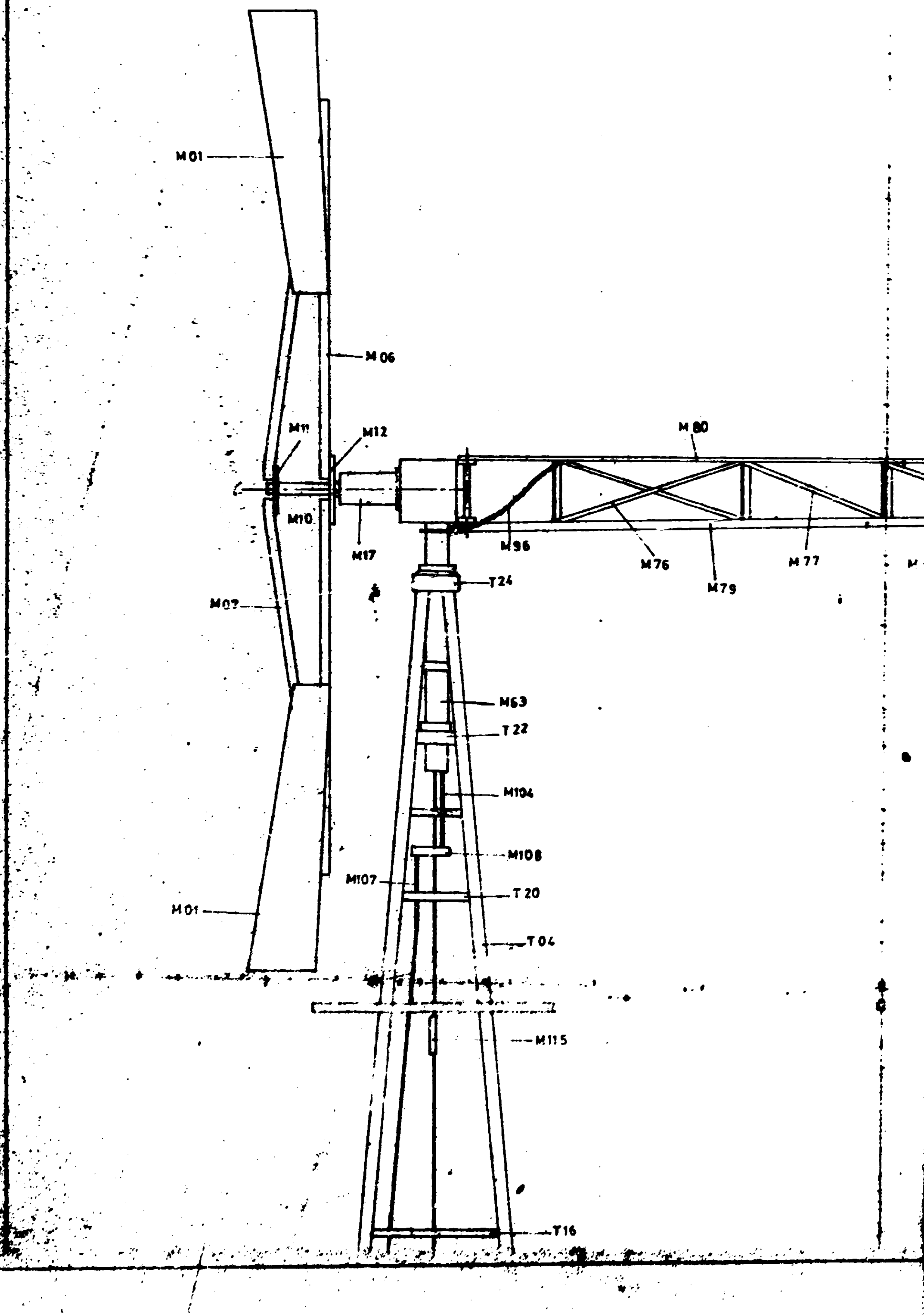
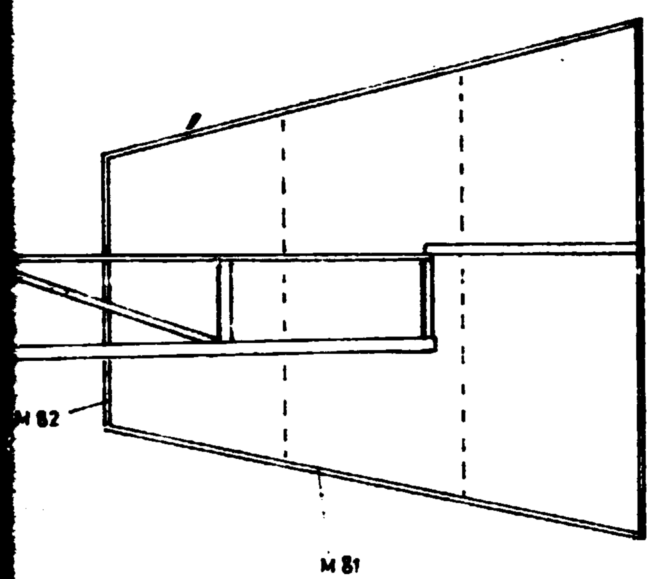
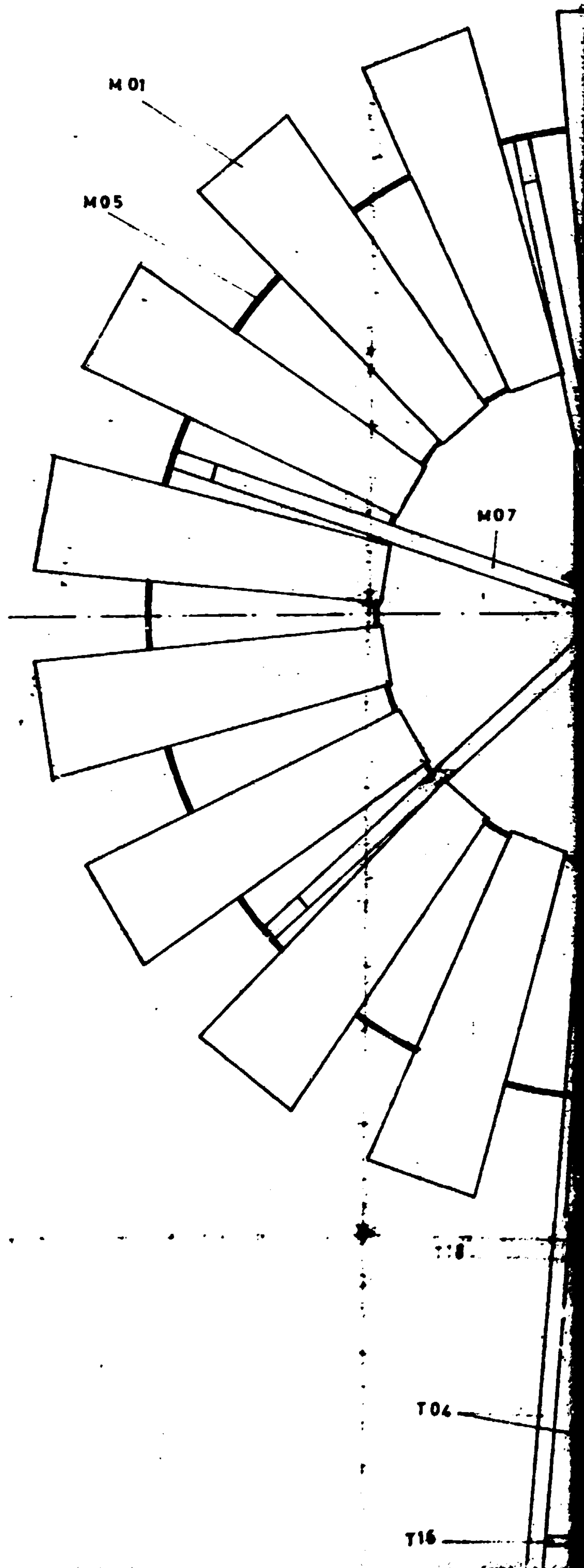
No: 1.08



M 01
M 06
M11
M12
M 80
M10
M17
M36
M76
M79
M 77
T24
M07
M63
T 22
M104
M108
M107
T 20
M 01
T 04
M115
T16

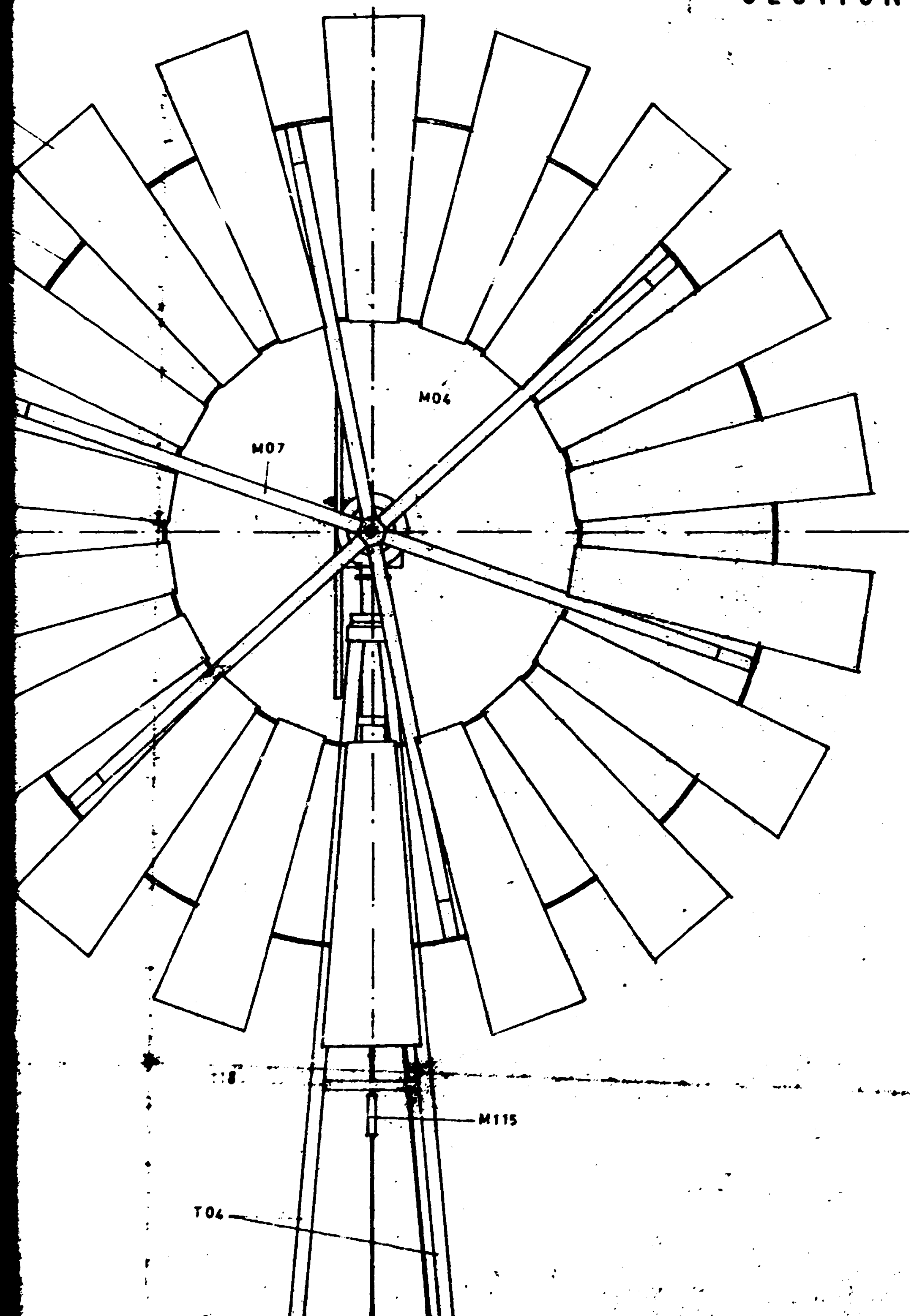




SECTION 2

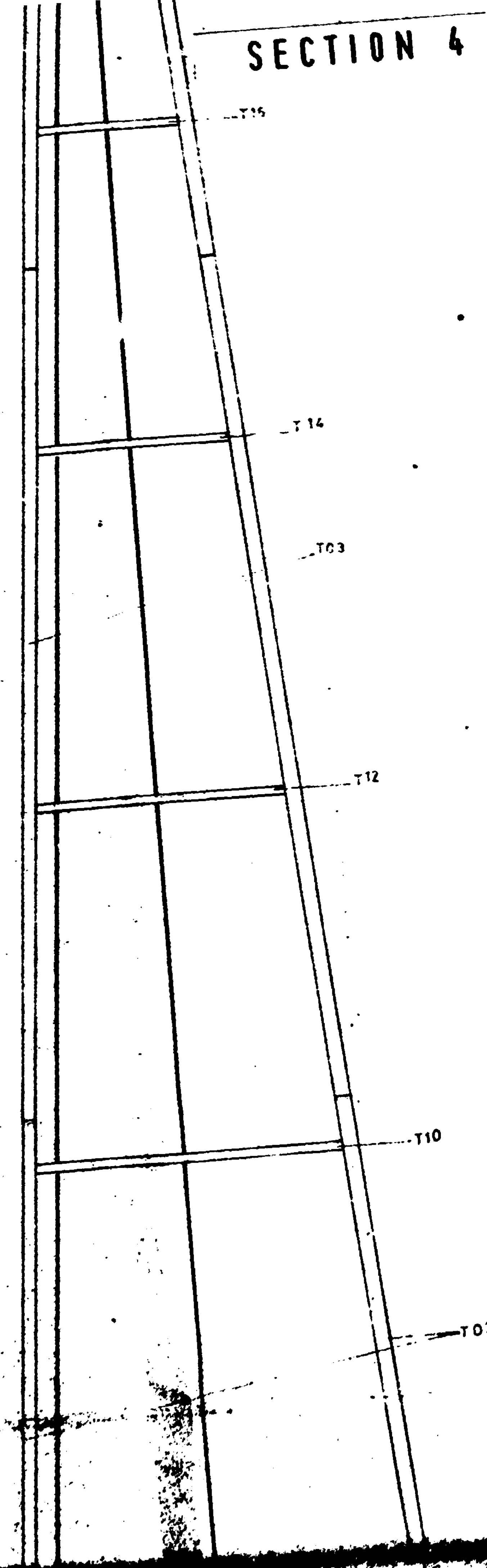
SECTION 2

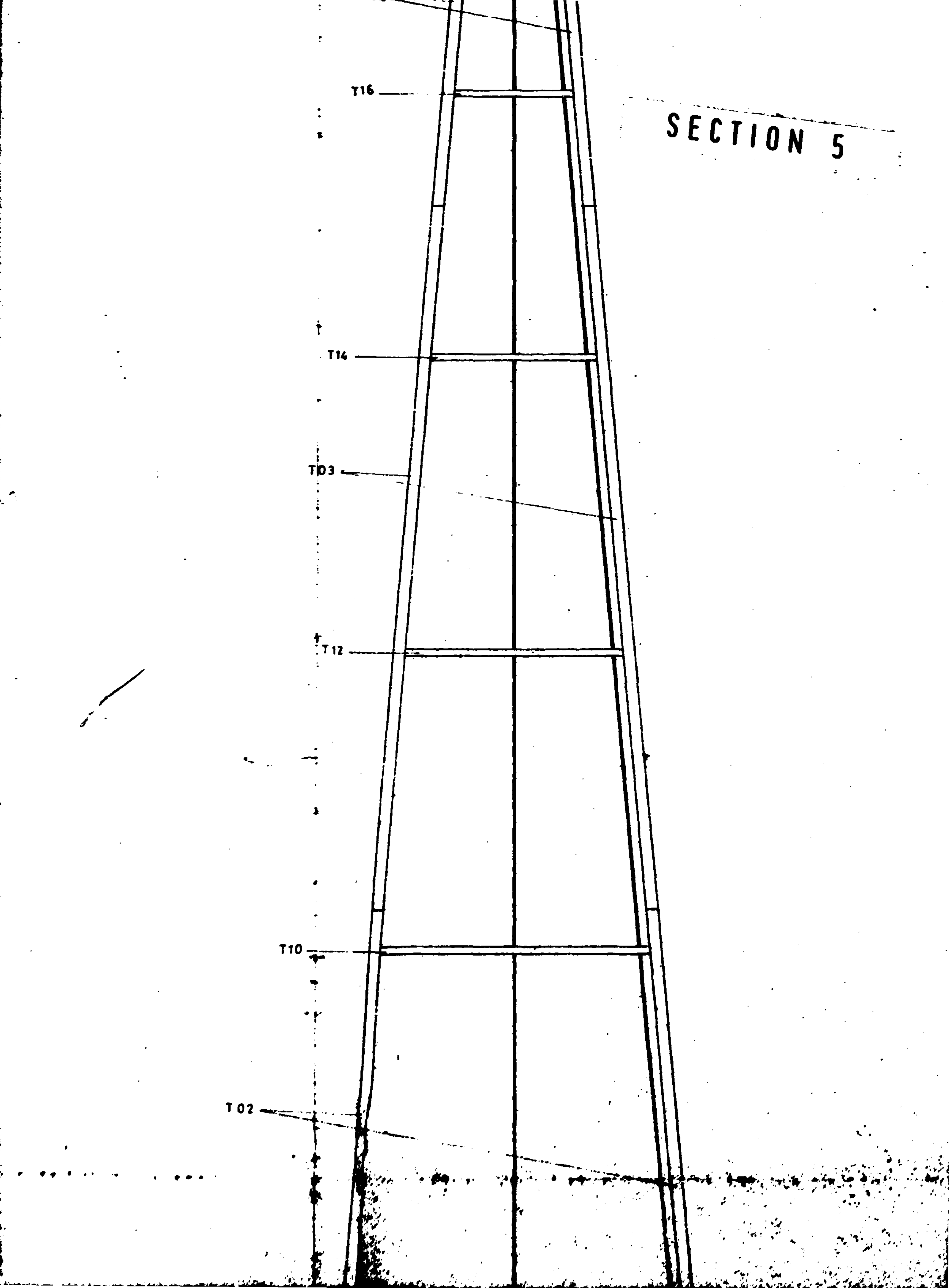
SECTION 3



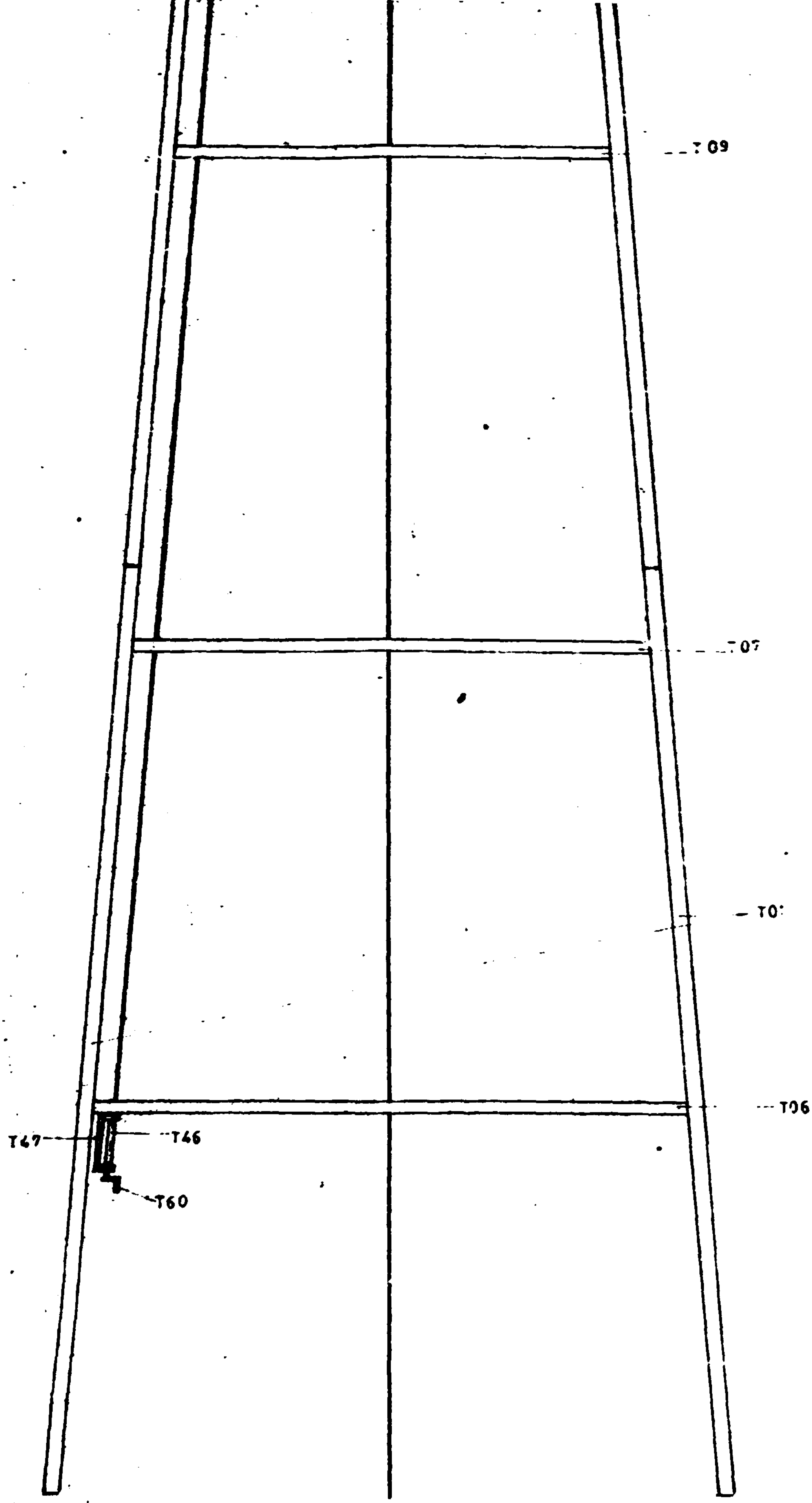
SECTION 3

SECTION 4




SECTION 5
T16
T14
T03
T12
T10
T02

10



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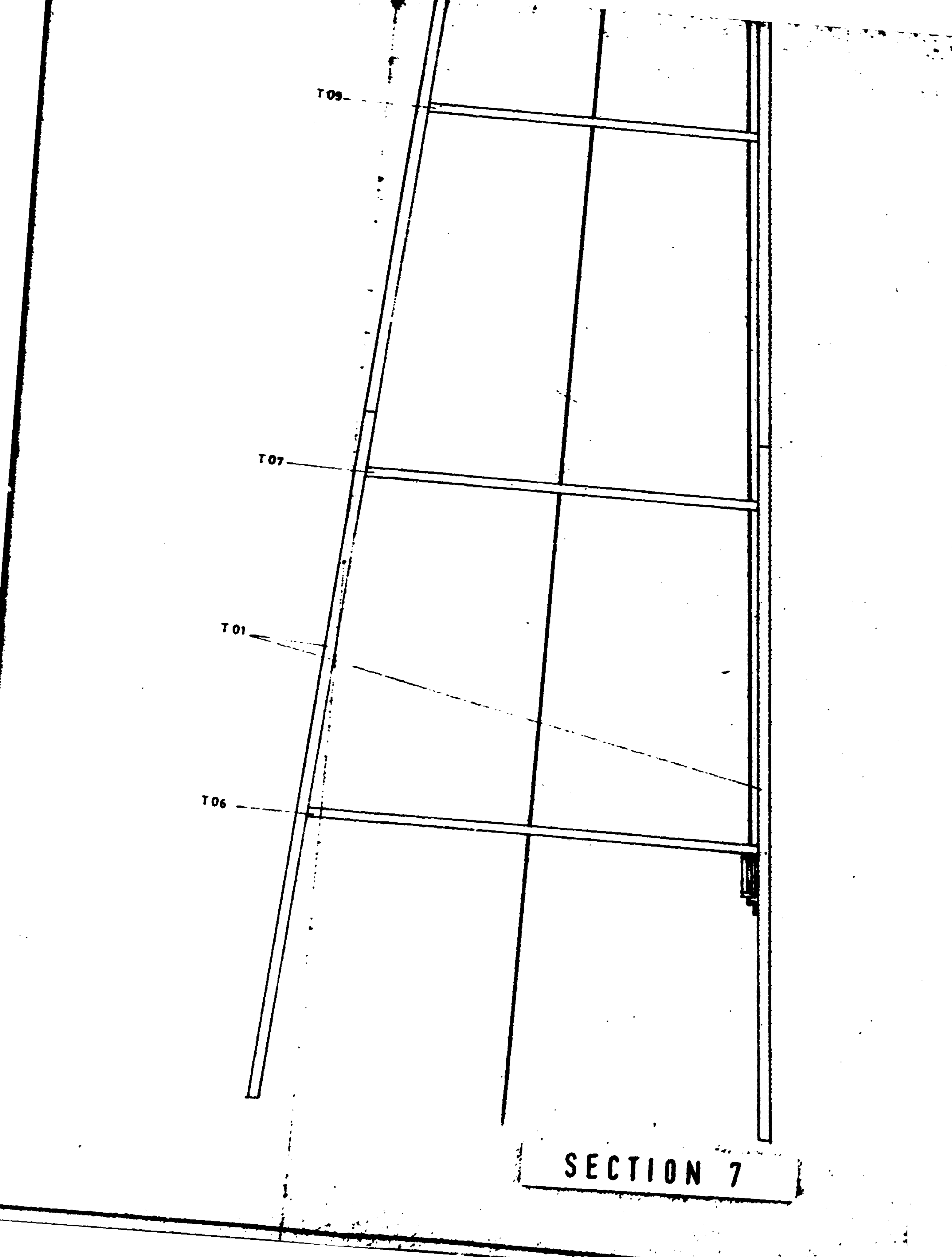

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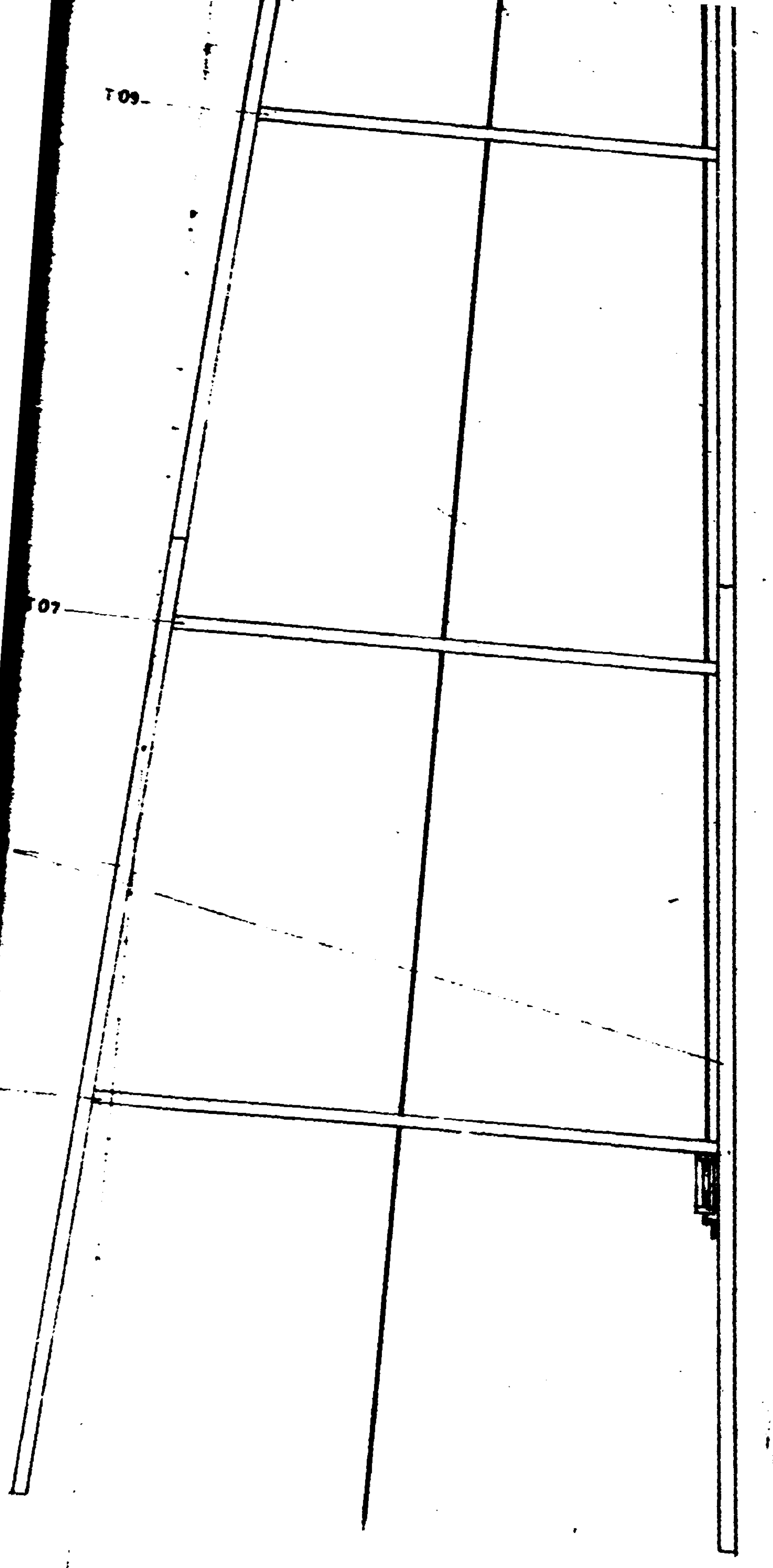

SECTION 8

scale 1/25

No	Qan.	Description	Drawing No	Scale	Material
17	1	Core box	1.08.C802 b	1:1	Wood
16	1	Core box	1.08.C802 a	1:1	Wood
15	3	Body	1.08.S07	1:1	Pipe
14	6	Floater	1.08.S06	1:1	Brass
13	3	Bottom flange	1.08.S05	1:1	Brass
12	3	Plunger leather flange	1.08.S04	1:1	Brass
11	3	Plunger body flange	1.08.S03	1:1	Brass
10	6	Plunger body	1.08.S02	1:1	Brass
9	3	Top flange	1.08.S01	1:1	Brass
8	4	Body	1.08.L08	1:1	Pipe
7	8	Floater	1.08.L07	1:1	Brass
6	8	Floater nut	1.08.L06	1:1	Brass
5	4	Bottom flange	1.08.L05	1:1	Brass
4	6	Plunger leather flange	1.08.L04	1:1	Brass
3	4	Plunger body flange	1.08.L03	1:1	Brass
2	8	Plunger body	1.08.L02	1:1	Brass
1	4	Top flange	1.08.L01	1:1	Brass

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L - Large size parts
S - Small size parts

Wind Mill - Plungers

Foundry & Mechanical Workshop

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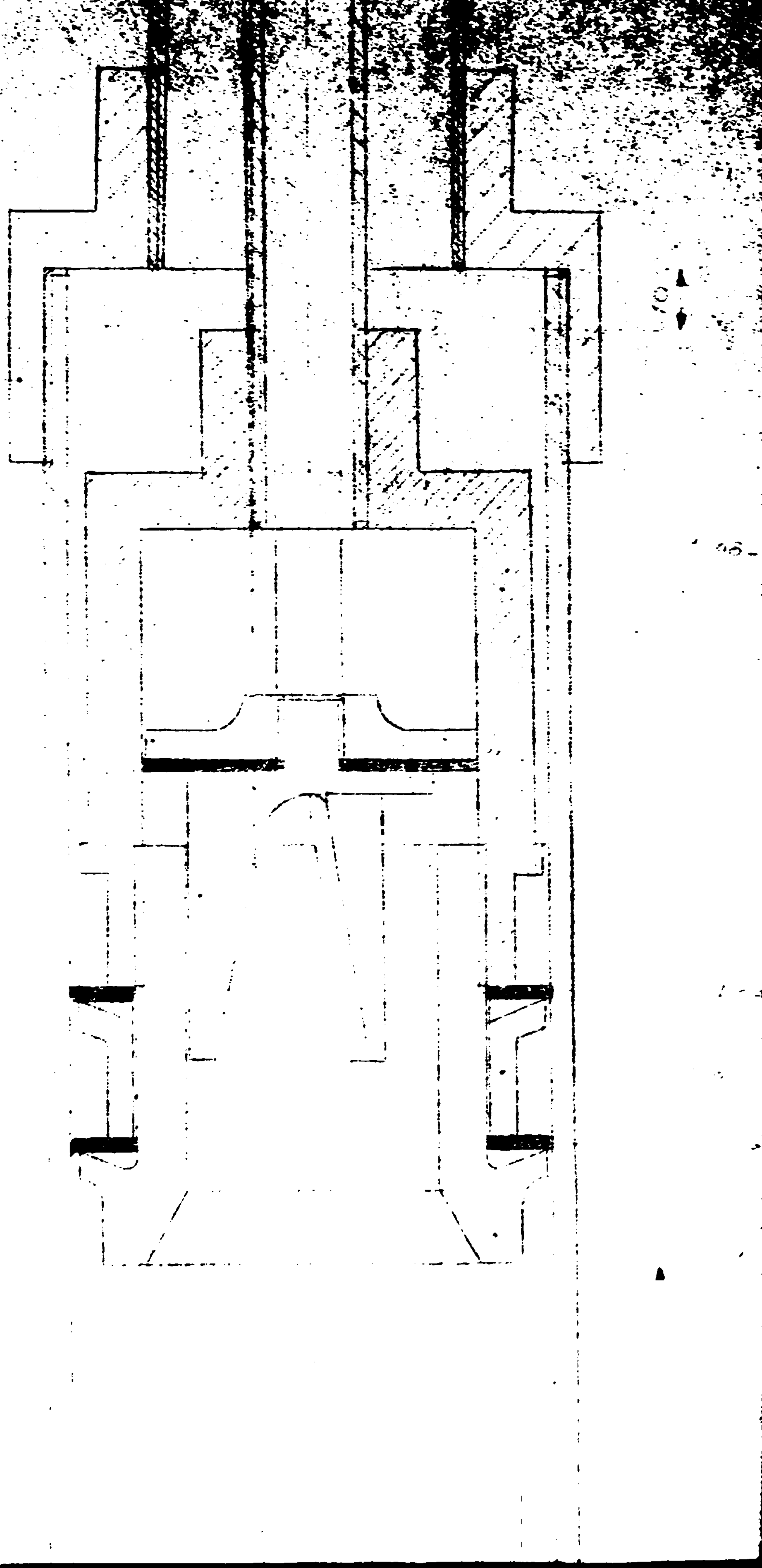
No: 1.08



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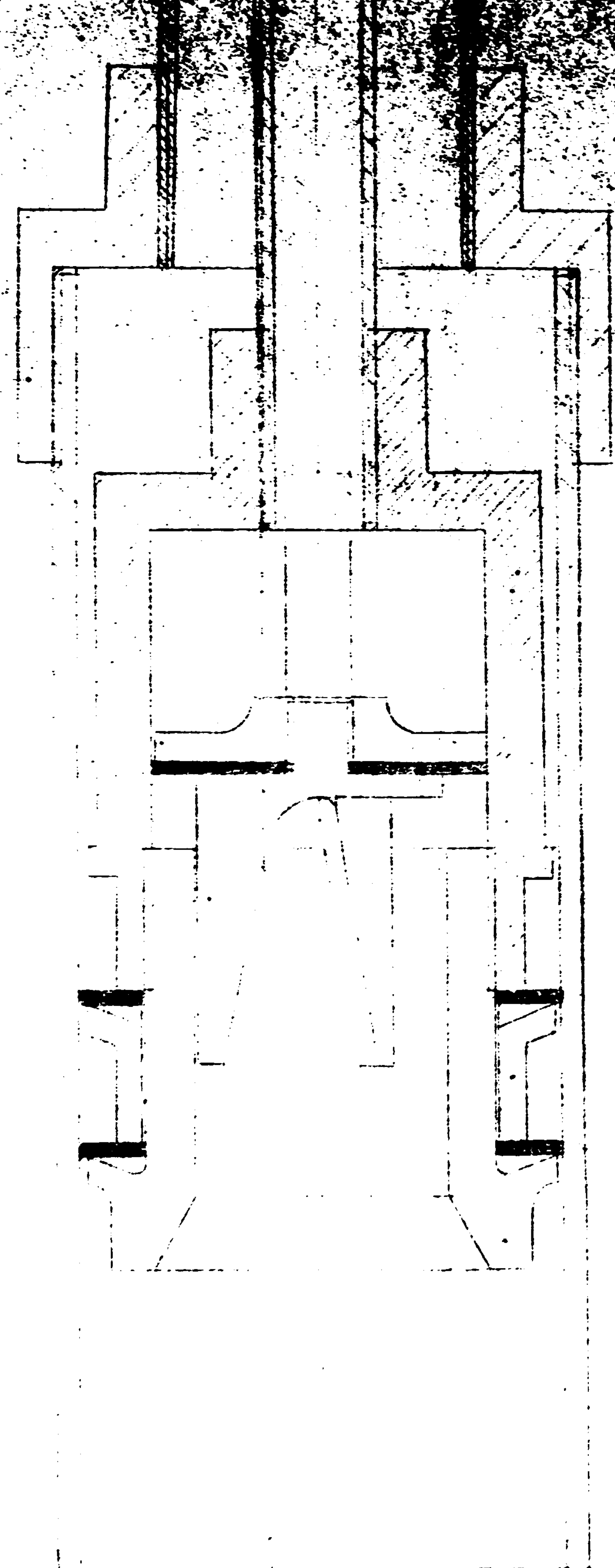
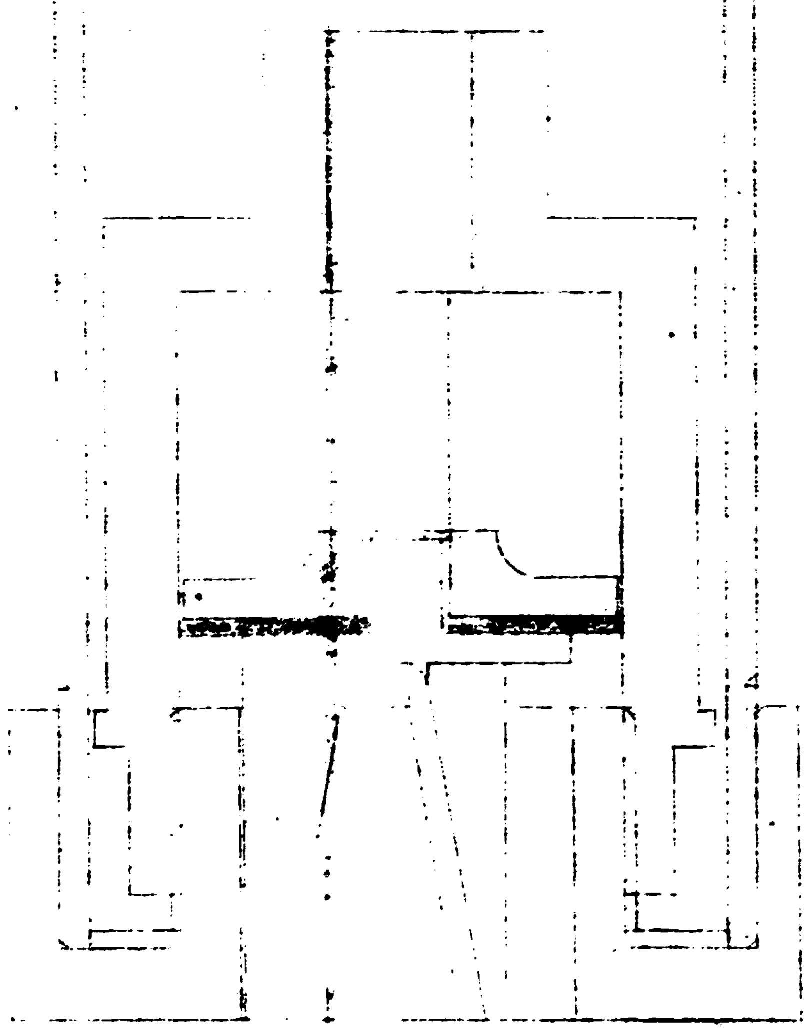
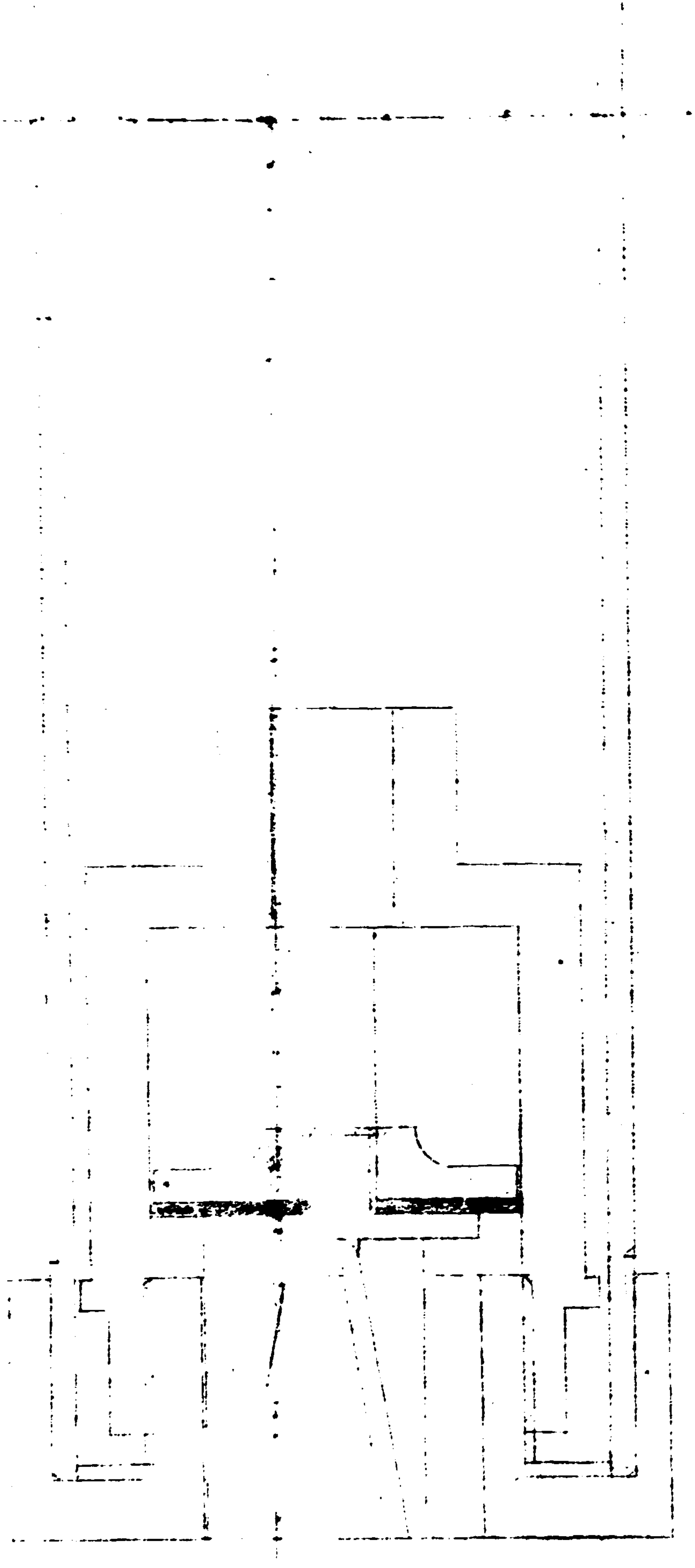


SECTION 2

SECTION 3





SECTION 4

48	2		1.12.35	1:5	1003 x 50 x 5 mm Stripe
47	2		1.12.32	1:10	2x (2500mm - 50x50x5mm angle)
46	2		1.12.31	1:10	1170mm - 50x50x5mm angle

No	Qan.	Description	Drawing No	Scale	Material
28	4	Washer	1.05.W2		ø31x3mm steel
27	1	Washer	1.05.W1		ø45x4mm steel
26	1	Shaft	1.05.S4	1:1	ø22x138mm stee
25	2	Shaft	1.05.S3	1:1	ø22x65mm stee
24	2	Shaft	1.05.S2	1:1	ø30x192mm ste
23	1	Shaft	1.05.S1	1:1	ø34x267mm ste
22	2	Bottom rod	1.05.R1	1:1	ø20x390mm ste
21	2	Side cover plate	1.05.P2	1:1	180x172x5mm st
20	1	Top cover plate	1.05.P1	1:2,5	440x172x5 mm s
19	4	Nut	1.05.N5		øM8
18	4	Nut	1.05.N4		øM10
17	4	Nut	1.05.N3		øM18
16	2	Nut	1.05.N2		øM16
15	1	Nut	1.05.N1		øM20
14	1	Key	1.05.K2	1:1	27x8x5mm ste
13	2	Key	1.05.K1	1:1	ø6x33 mm stee
12	1	Bevel gear	1.05.G2	1:1	ø166x27mm ste
11	1	Bevel gear	1.05.G1	1:1	ø166x27mm ste
10	4	Bolt	1.05.F2		øM10x26mm
9	4	Bolt	1.05.F1		øM8x22 mm
8	4	Bearing case	1.05.C3	1:1	ø50x20mm stee
7	2	Bearing case	1.05.C2	1:1	ø55x113 mm st
6	1	Bearing case	1.05.C1	1:1	ø65x80mm st
5	4	Ball bearing	1.05.B4	1:1	62203-2RS -
4	2	Ball bearing	1.05.B3	1:1	6204-RS - SK
3	3	Ball bearing	1.05.B2	1:1	6005-RS - S
2	1	Ball bearing	1.05.B1	1:1	6006-RS - SK
1	2	Arm	1.05.A1	1:1	270x40x5mm ste

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Gear Box

Foundry & Mechanical Workshop

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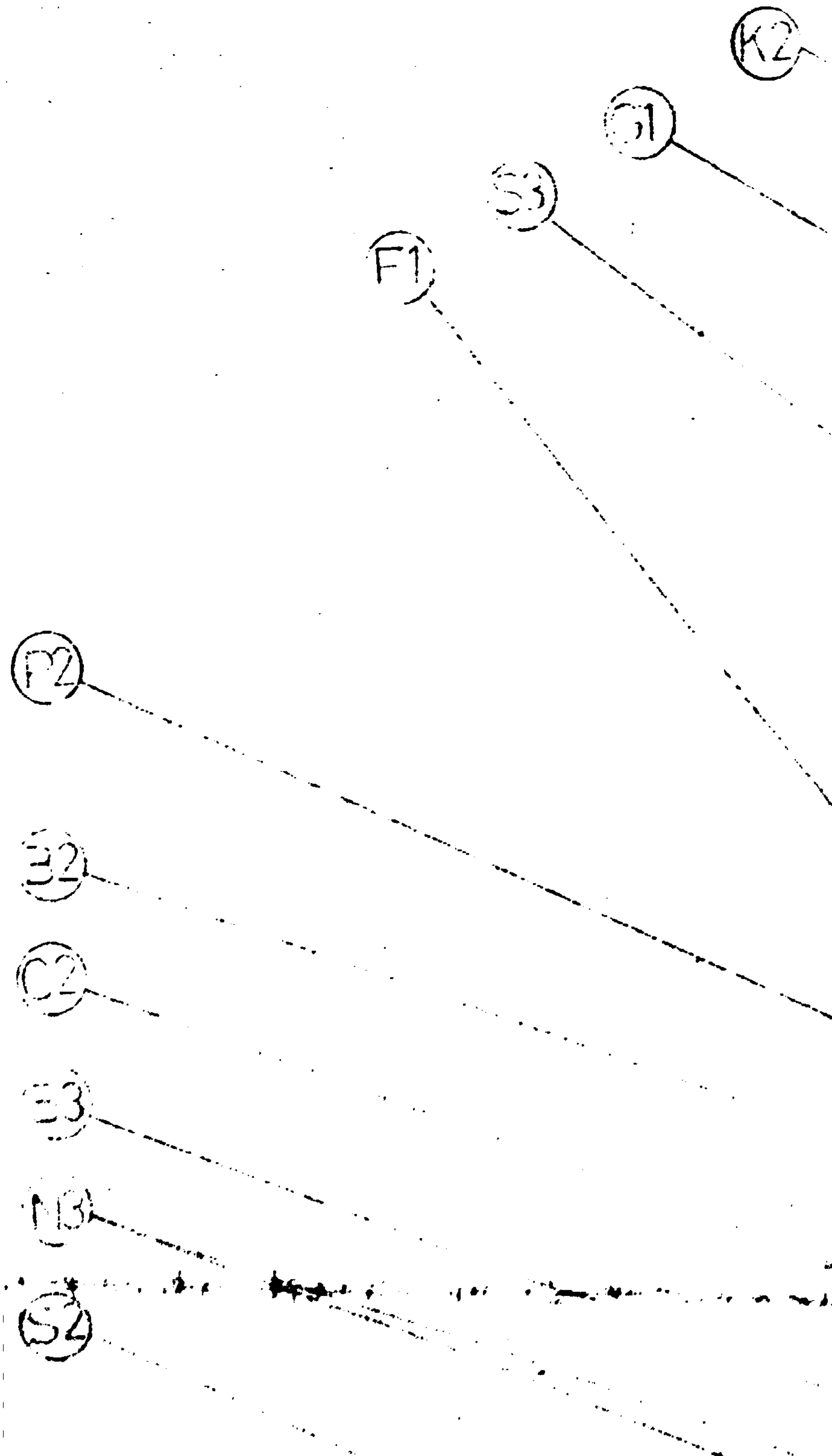
No: 1.05.

ECTION 1



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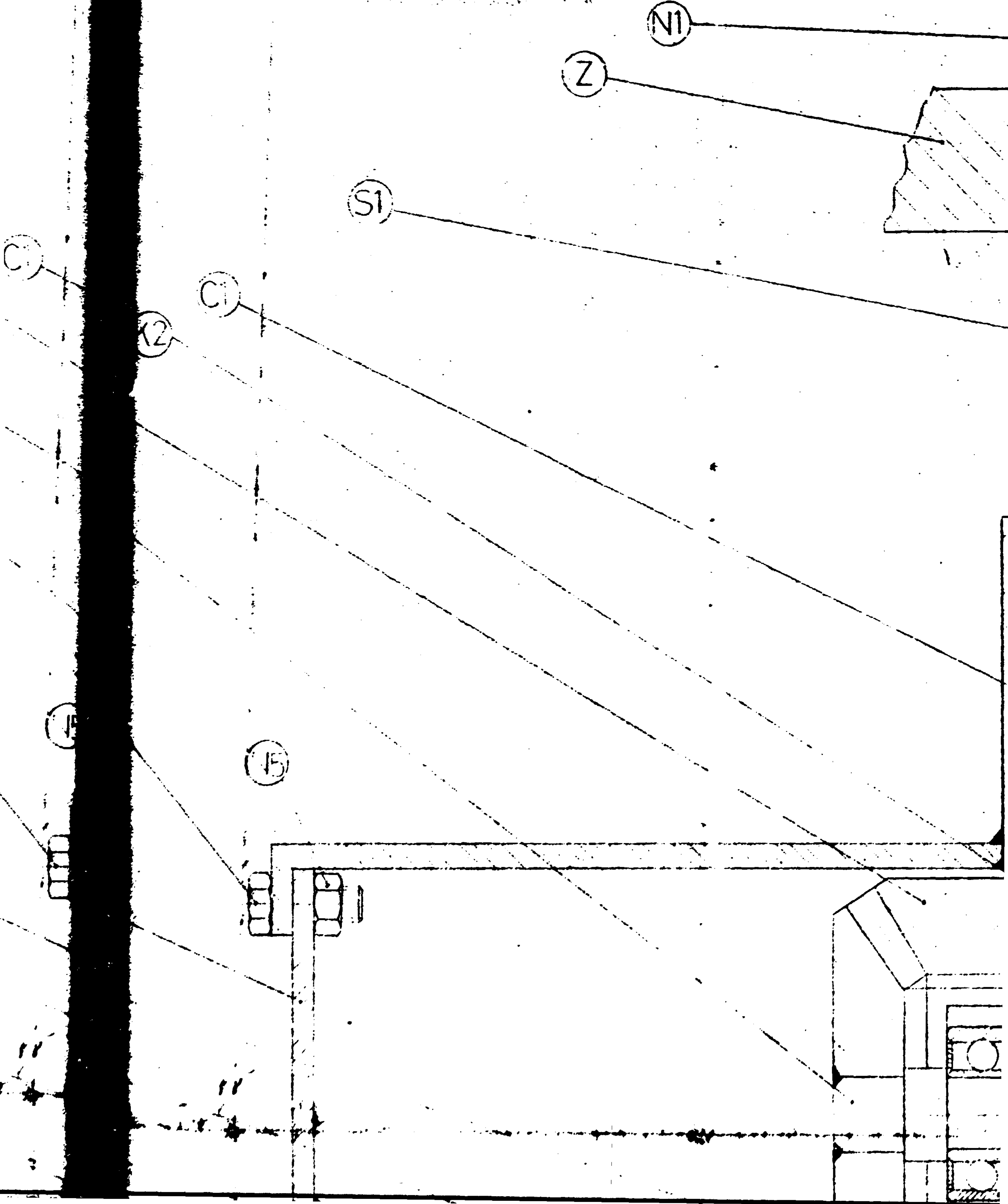

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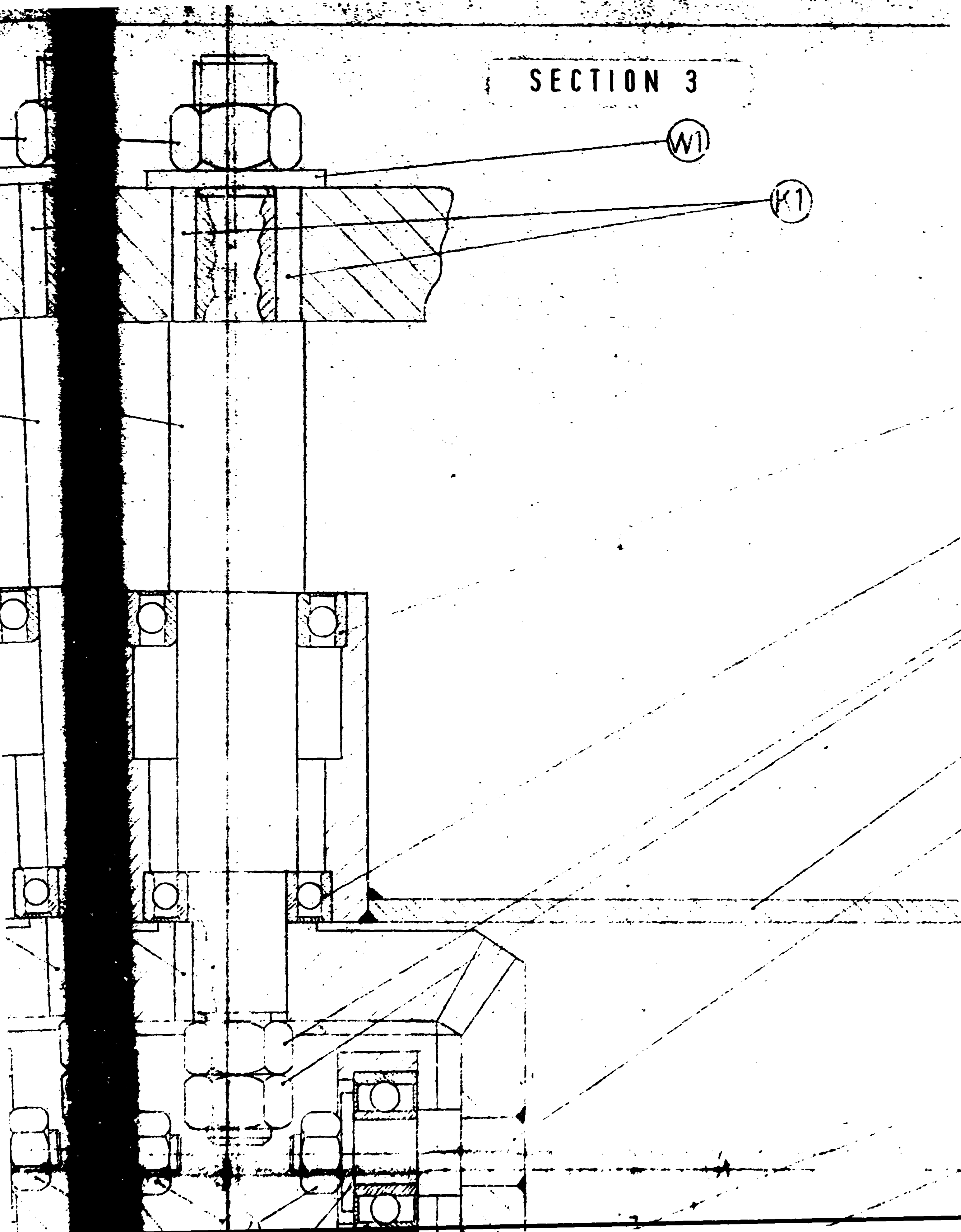
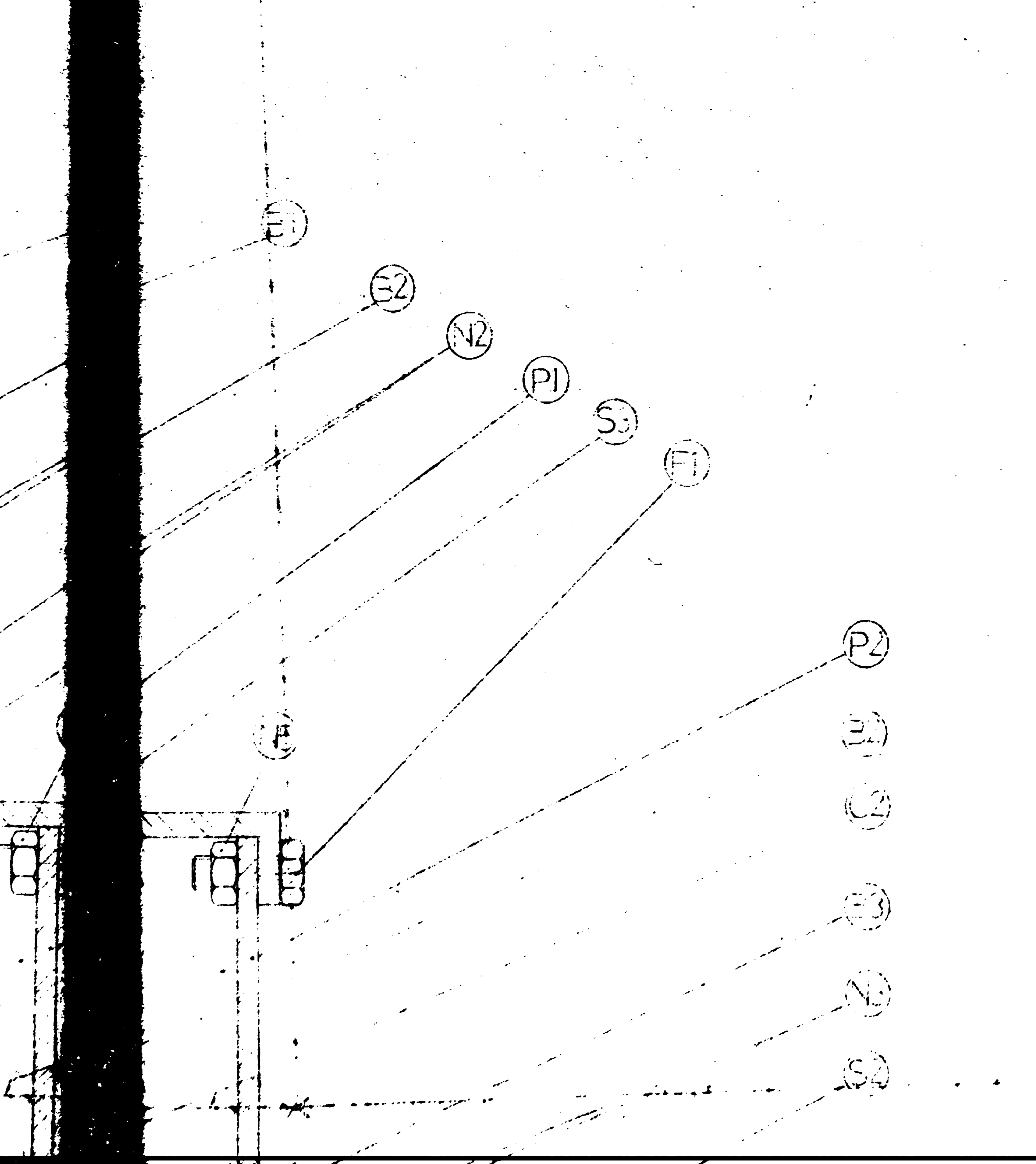
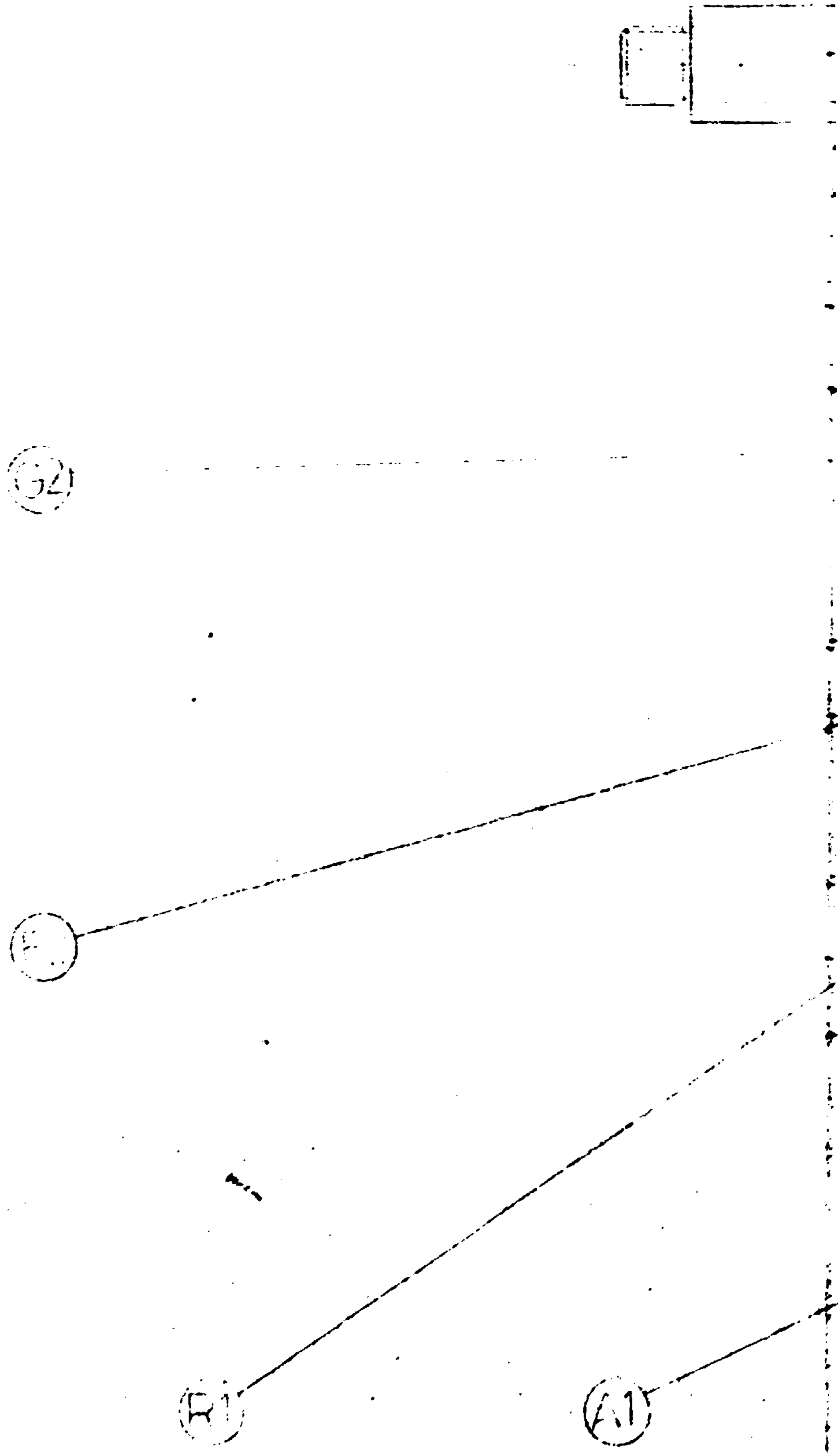
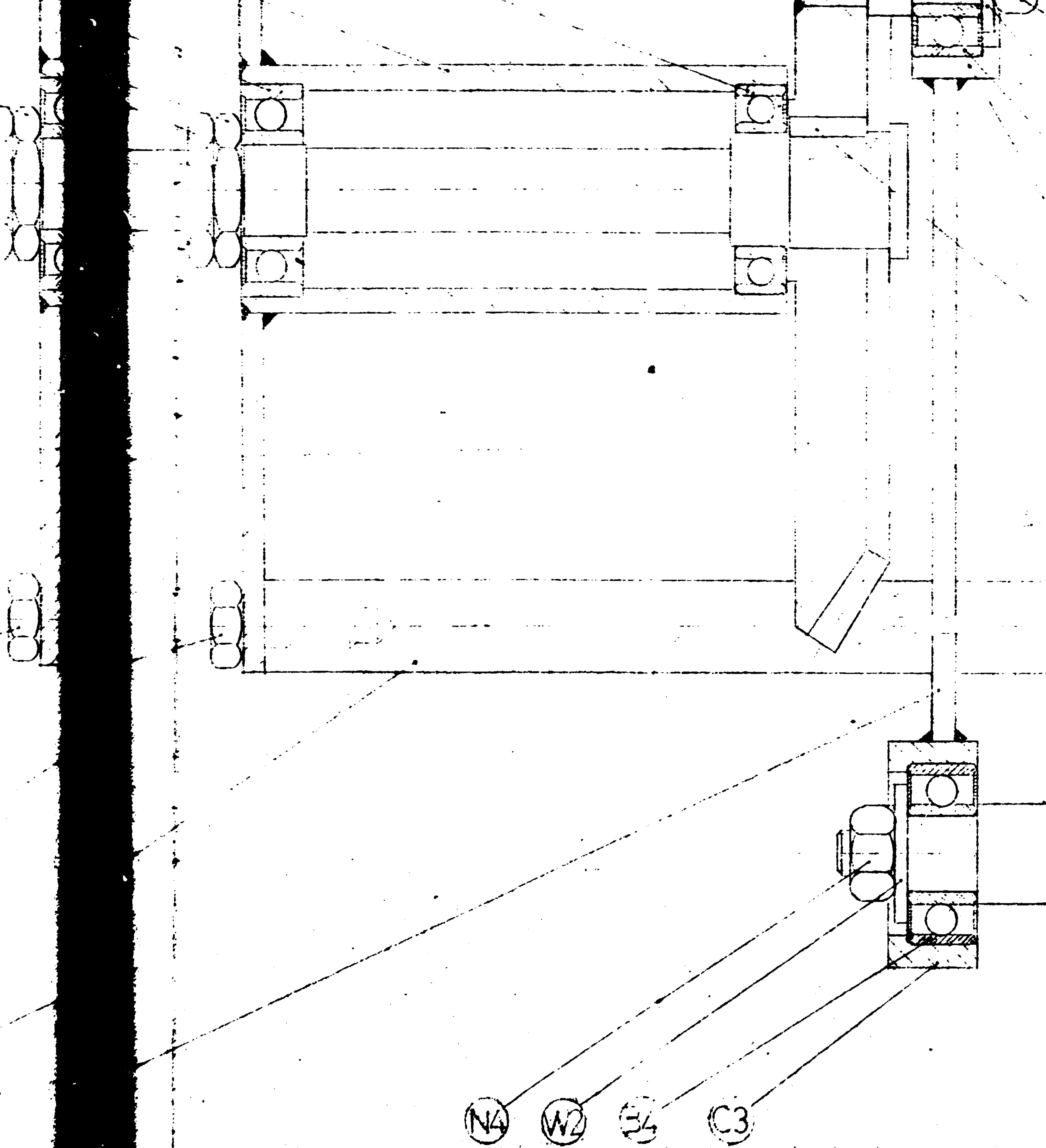


SECTION 4

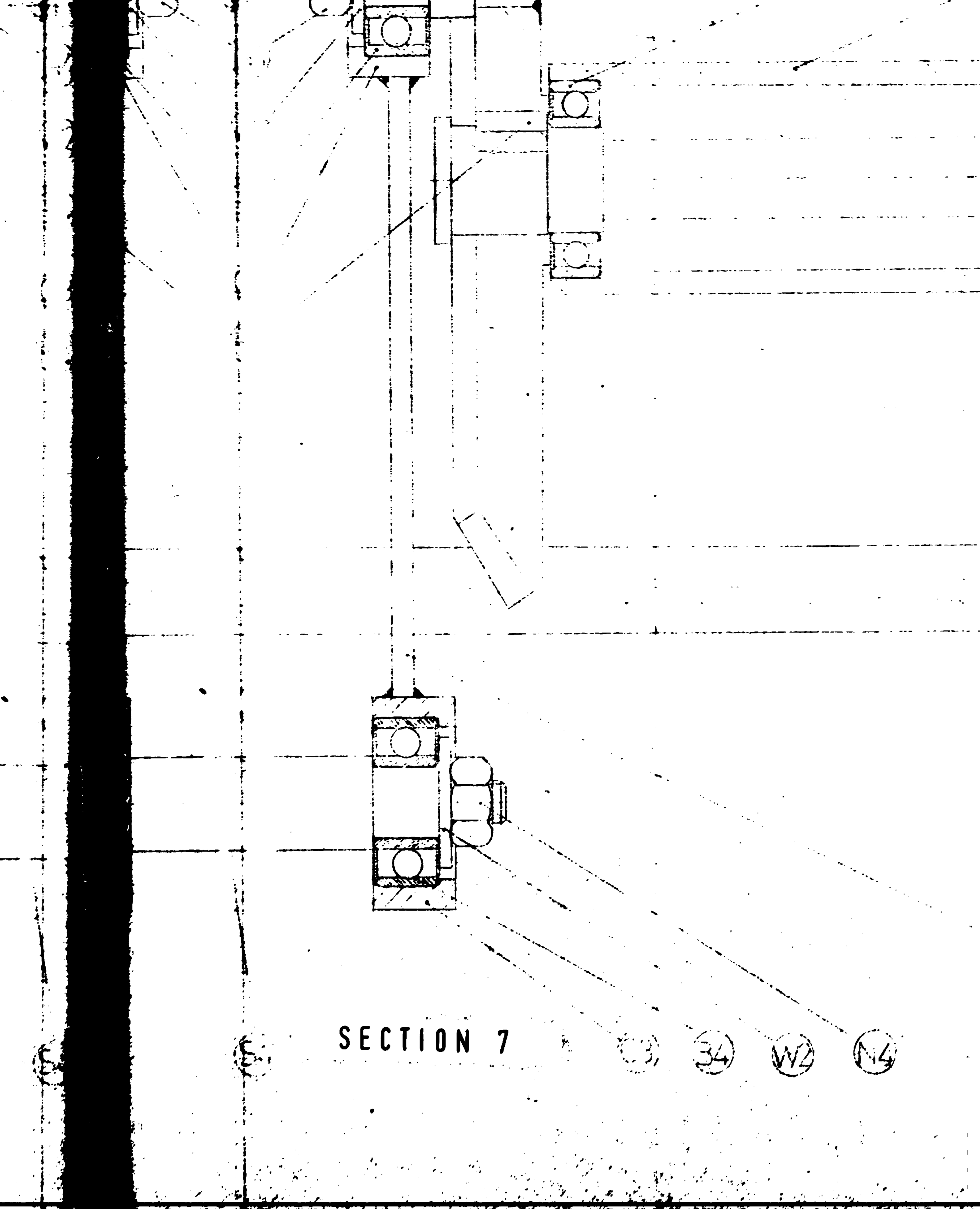


SECTION 5

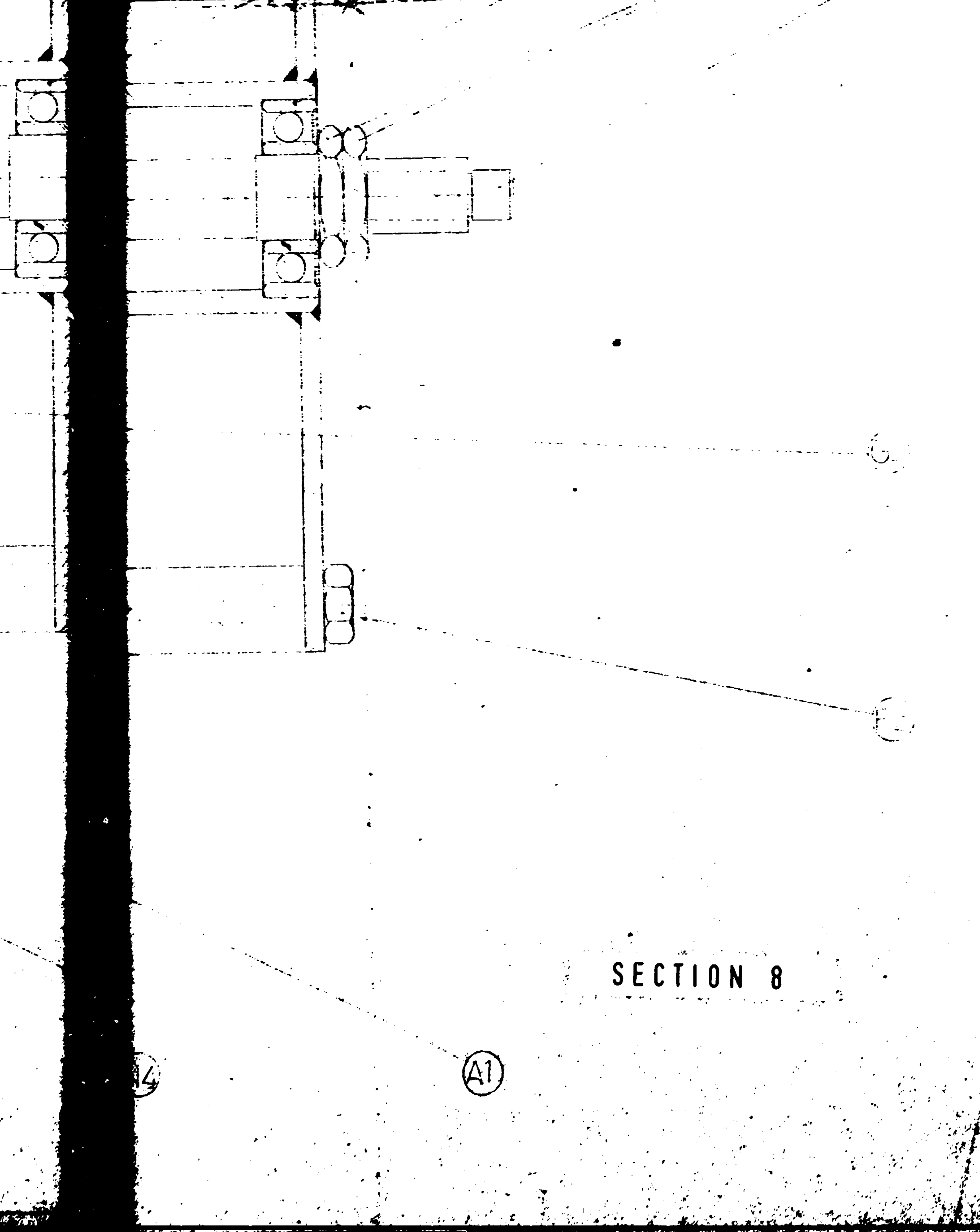




SECTION 6



SECTION 7



SECTION 8

Mogadiscio-Somalia

Report No. IO- ROTARY CRANE

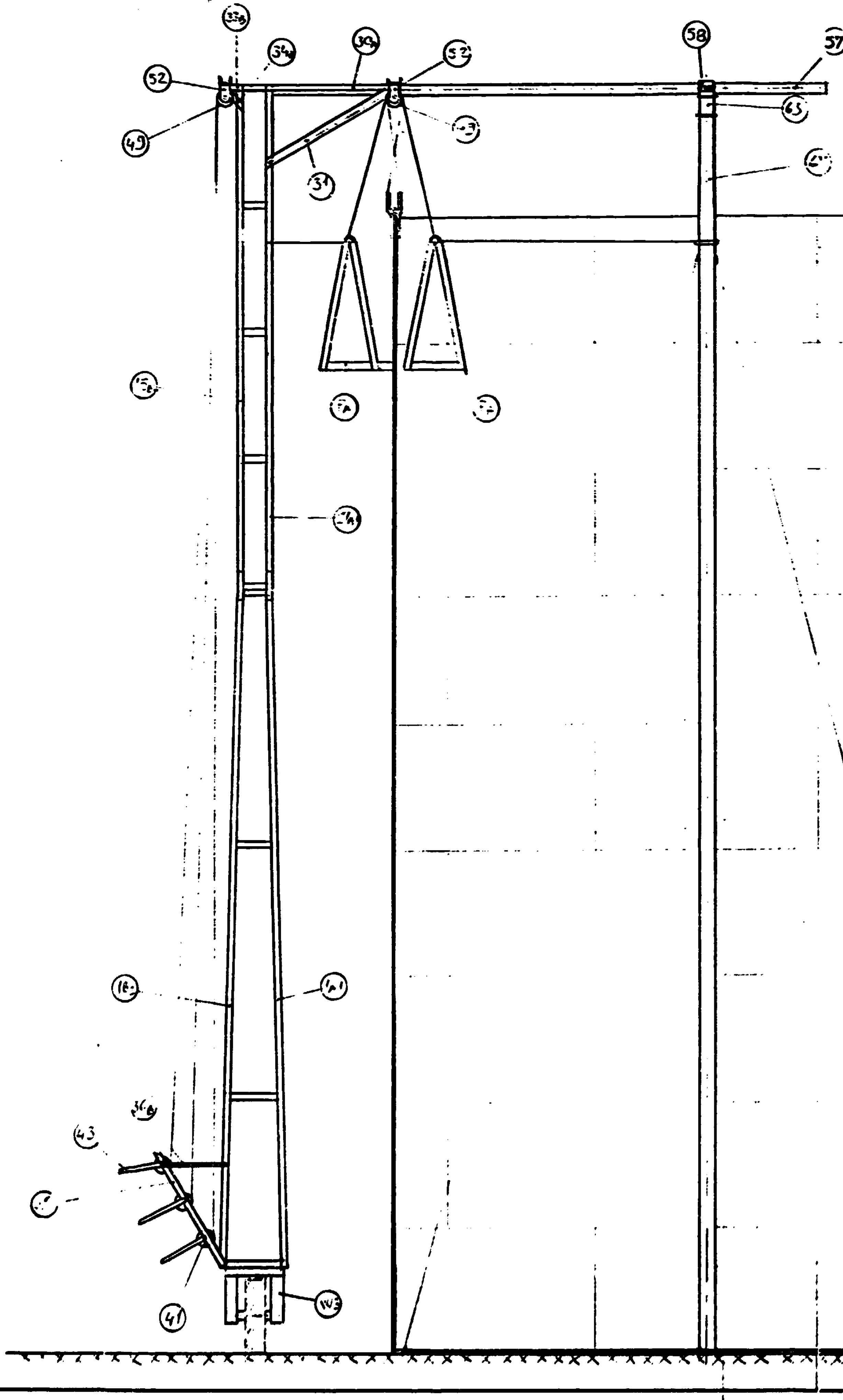
Production of the water and fuel tanks have an important pla FMW. Different sizes of tanks are produced by FMW ranging fr 20 m^3 to 500 m^3. FMW is one of the bigest builder over the and it is the single manufacturer of vertical tanks. The tan which less than I50 m^3 are produced by following the manufac instructions were prepared by MEDAL team previously. But the duction of the tanks over I50 m^3 had a lot of difficulties. building of those tanks was very troublesome and expensive possible only if a suitable crane was available. To build a a scaffold was being prepared by FMW and for each new tank taking time to prepare a scaffold and additional cost was hi take apart the scaffold and to transport it for different ta different locations was making the cost even higher.

Medal team has tried to find out a solution to build the tan easily, rapidly and cheaper. For this purpose a rotary cran been designed. By using this portable crane the building of can be realized quickly and cheaper. The use of the crane w vide an important advantage to FMW againts to other builders

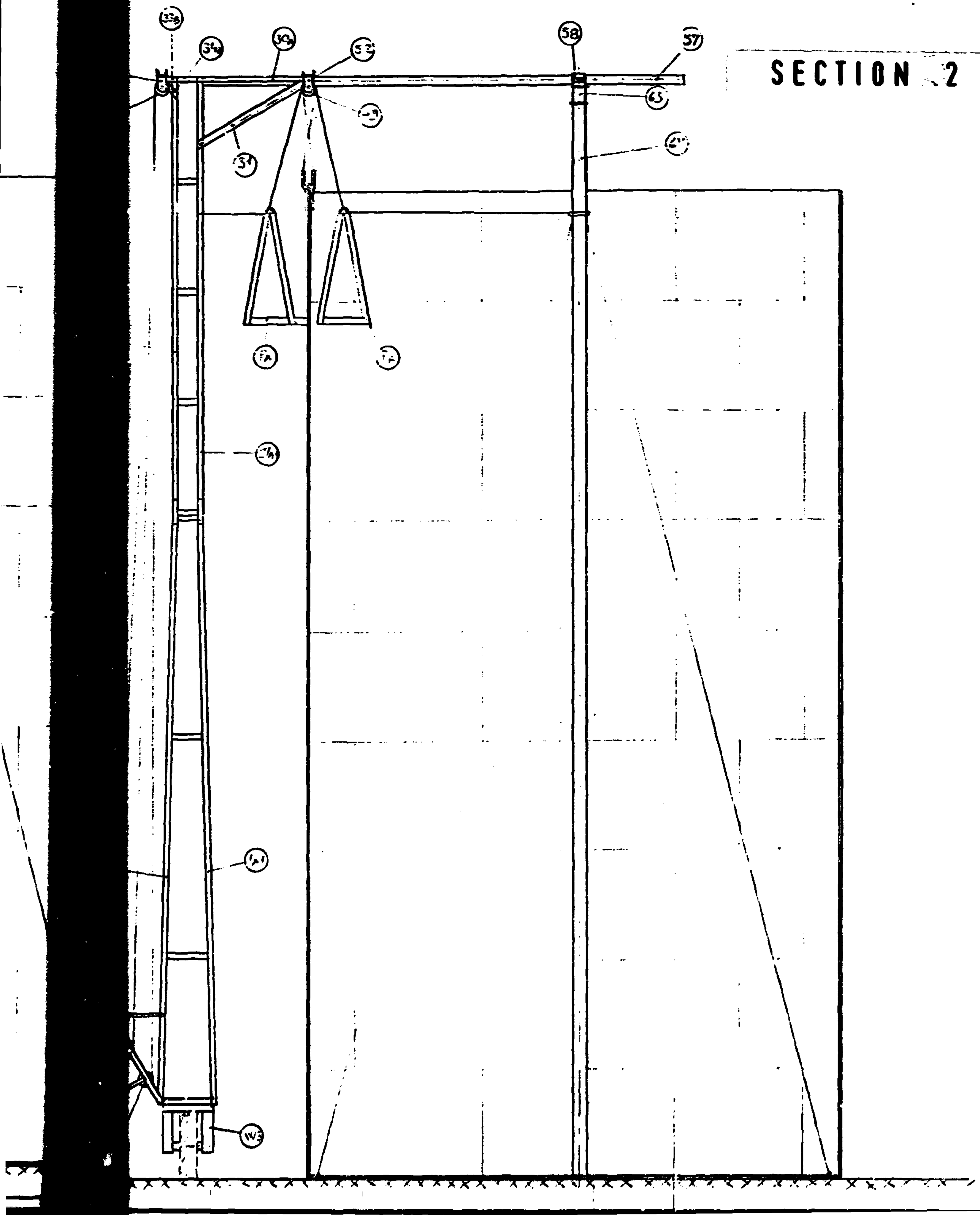
Structure of the rotary crane: It is made of mostly from an iron. It is connected to the central pole of the tank by a tion pipe and could be turned all around the tank during co tion. Pulleys are fixed on the top of the crane, from these platforms on which workers work are carried together with sh material. There are two platforms. One of them is placed in tank and other one is placed outside the tank. Between the forms is the side wall of the tank. Also between the outsid form and tank surface the sheet which will be welded on the wall is pulled up from the ground again with two pulleys at Because of the position of hanging pulleys, the sheet mater lifted up it comes on exact position where it will be welde does not require further adjustment by technicians. Platfor sheet are lifted up by ropes, connected to driving drums. T are operated by two persons. The crane is portable, it move wheels. The old car rims were used in design of the wheels. body include two main parts. Base part is made by welding t irons, it has a height of 6 meters. The crane can be used i

height to build the several tanks which have a height of up
meters. The second part include the angle irons fixed on the
part with bolts. Over 6 meters, the crane can be extented in
ferent heights with I meter increments by adding the extendin
parts. As a result of that the crane can be builted up 6,7,8
I0 meters in height. This gives a large interval to the buil
produce the tanks in different heights. Also the diameter of
[illegible] connection pipe between th
[illegible] of the tanks. Although initially the crane
[illegible] several tanks, the [illegible] special. T
[illegible] transport [illegible], only the [illegible] rigid other
[illegible] the tank is built. Also the [illegible]
[illegible] it is [illegible] with crane [illegible]
[illegible] material. [illegible] will [illegible]
[illegible]

SECTION 1



SECTION 2



48	2		1.12.35	1:5	1003 x 50x5 mm st
47	2		1.12.32	1:10	2x(2500mm-50x50x5mm
46	2		1.12.31	1:10	1170mm-50x50x5mm
45	1		1.12.30B	1:10	1370mm-50x50x5mm
44	1		1.12.30A	1:10	1370mm-50x50x5mm
43	2		1.12.29B	1:1	300mm-50x50x5 mm
42	2		1.12.29A	1:1	300mm-50x50x5 mm
41	2		1.12.28	1:10	1190mm-50x50x5m
40	1		1.12.27B2	1:10	1050mm-50x50x5mm
39	1		1.12.27B1	1:10	1050mm-50x50x5mm
38	1		1.12.27A2	1:10	1050mm-50x50x5mm
37	1		1.12.27A1	1:10	1050mm-50x50x5m
36	16		1.12.26	1:1	Ø10x250 mm stee
35	2		1.12.25	1:10	1140x30x3 mm st
34	2		1.12.24	1:10	1230x30x3 mm st
33	2		1.12.23	1:10	1330x30x3 mm stri
32	2		1.12.22	1:10	1435x30x3 mm st
31	1		1.12.21B	1:5	1050mm-30x30x3m
30	1		1.12.21A	1:5	1050mm-30x30x3mm
29	1		1.12.20B	1:5	910mm-30x30x3mm
28	1		1.12.20A	1:5	910mm-30x30x3mm
27	6		1.12.19	1:1	280mm-30x30x3mm
26	1		1.12.18B	1:5	770mm-30x30x3 m
25	1		1.12.18A	1:5	770mm-30x30x3 mm
24	4		1.12.17	1:1	280mm-50x50x5mm
23	1		1.12.16B	1:2,5	630mm-50x50x5mm
22	1		1.12.16A	1:2,5	630mm-50x50x5mm
21	3		1.12.15B2	1:2,5	1039,5mm-50x50x5mm
20	3		1.12.15B1	1:2,5	1039,5mm-50x50x5mm
19	3		1.12.15A2	1:2,5	1039,5mm-50x50x5 mm
18	3		1.12.15A1	1:2,5	1039,5mm-50x50x5mm
17	22		1.12.14	1:1	Ø10x270 mm stee
16	2		1.12.13	1:10	2300x30x3 mm st
15	2		1.12.12	1:10	2500x30x3 mm str
14	2		1.12.11	1:10	2300x30x3 mm st
13	2		1.12.10	1:2,5	333,5mm-50x50x5m
12	2		1.12.09	1:10	1902,5mm-50x50x5mm
11	2		1.12.08	1:2,5	320mm-30x30x3 mm
10	2		1.12.07	1:5	1790mm-30x30x3mm
9	2		1.12.06	1:2,5	300mm-30x30x3 mm
8	2		1.12.05	1:5	1490mm-30x30x3mm
7	2		1.12.04	1:2,5	280mm-50x50x5 mm
6	1		1.12.03B	1:5	1190mm-50x50x5m
5	1		1.12.03A	1:5	1190mm-50x50x5m
4	1		1.12.01B2	1:10	5370mm-50x50x5mm
3	1		1.12.01B1	1:10	5370mm-50x50x5mm
2	1		1.12.01A2	1:10	5370mm-50x50x5
1	1		1.12.01A1	1:10	5370mm-50x50x5mm
No	Qan.	Description	Drawing No	Scale	Material

Date

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Rotary Crane

Foundry & Mechanical Workshop

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Pag

No: 1.12

No	Qan.	Description	Drawing No	Scale	Material
96	1		1.12.W6	1:1	ø80x5mm + ø20x50mm angle
95	1		1.12.W5	1:2,5	320mm-50x50x5mm angle
94	1		1.12.W4	1:2,5	300mm-50x50x5mm angle
93	2		1.12.W3	1:2,5	360mm-50x50x5mm angle
92	1		1.12.W2	1:1	ø130x5mm + ø65x90mm steel
91	1		1.12.W1	1:1	ø36x250mm steel
90	2		1.12.PB5	1:1	ø15x135mm steel
89	4		1.12.PB3	1:2,5	1030mm-50x50x5mm angle
88	2		1.12.PB2	1:2,5	500mm-50x50x5mm angle
87	2		1.12.PB1	1:5	1200mm-50x50x5mm angle
86	2		1.12.PA5	1:1	ø15x135mm steel
85	2		1.12.PA4	1:2,5	400mm-50x50x5mm angle
84	4		1.12.PA3	1:2,5	1030mm-50x50x5mm angle
83	2		1.12.PA2	1:5	500mm-50x50x5mm angle
82	2		1.12.PA1	1:10	2500mm-50x50x5mm angle
81	1		1.12.67	1:10	ø4" x10800mm pipe
80	2	Nut	1.12.66		øM10
79	2	Bolt	1.12.65		øM10
78	4	Pliers arm	1.12.64		
77	1		1.12.63	1:1	ø4" x200mm pipe
76	4	Nut	1.12.62		øM14
75	4	Bolt	1.12.61		øM14 x15mm bolt
74	1		1.12.60	1:10	ø3" x1750mm pipe
73	1		1.12.59	1:1	ø120x15mm steel
72	2		1.12.58	1:1	220x100x5mm stripe
71	1		1.12.57	1:20	ø2 1/2" x6200mm pipe
70	1		1.12.56	1:1	250x50x5mm stripe
69	28		1.12.55		øM14
68	14		1.12.54	1:1	ø22x45mm steel
67	14		1.12.53	1:1	65x44x5mm steel
66	28		1.12.52	1:1	100x65x5mm steel
65	14	Nut	1.12.51		øM16
64	14		1.12.50	1:1	ø35x67mm steel
63	14		1.12.49	1:1	ø110x32mm cast iron
62	6	Washer	1.12.48		øM14
61	12	Washer	1.12.47		øM10
60		Nut	1.12.46		øM14
59	6	Nut	1.12.45		øM10
58	12	Pin	1.12.44	1:1	ø6x25mm steel
57	6		1.12.43	1:1	210x45x10mm steel
56	6		1.12.42	1:1	ø40x25mm steel
55	6		1.12.41	1:1	ø140x5mm steel
54	2		1.12.40	1:1	ø79x261,5mm steel
53	2		1.12.39	1:1	ø79x261,5mm steel
52	2		1.12.38	1:1	ø79x261,5mm steel
51	3		1.12.37	1:10	1900mm - 3" pipe
50	1		1.12.36B	1:2,5	509mm-50x50x5mm angle
49	1		1.12.36A	1:2,5	509mm 50x50x5mm angle

	Date
Ersin BASTUG	

Rotary Crane

Foundry & Mechanical Workshop

UNIDO

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No	Qan.	Description	Drawing No	Scale	Material
102	2	Ball bearing	1.12.W12		6006-2RS - SKF
101	4	Bolt	1.12.W11		ø M16x30 mm
100	6	Washer	1.12.W10		ø M16
99	6	Nut	1.12.W9		ø M16
98	1	Washer	1.12.W8		ø M20
97	2	Nut	1.12.W7		ø M20

	Date
Ersin BASTUĞ	

Rotary Crane

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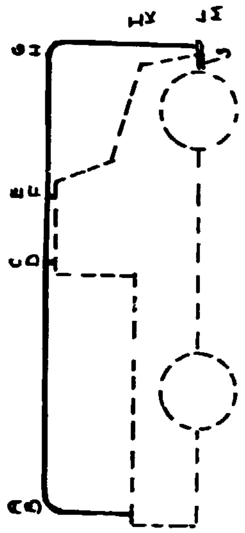
Appendix I.

Report No. II- DISCHARROW

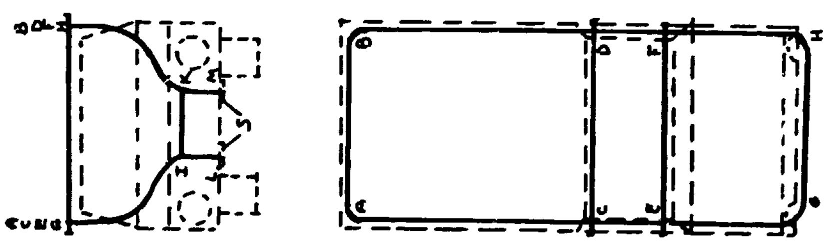
As required by FMW some modifications have been made on a previously designed discharrow to use available materials in its production. The specifications of discharrow has been kept as orginal, only some parts were changed to adapt it to materials available from local market.
The main frame was originally made of hollow square sections. This material was not available at the local market. The pipes were used instead of hollow square sections. Connection parts on the main frame was changed depending on the shape of the pipe. The thickness of connection and supporting parts were increased because material used in new design had lower tensile strength, because of the lack of the required materials at the local market. The thickness of the discs were increased for the same reason.
The complete production of the discharrow requires better material and some specific machines and tools. In addition to suitable materials presses and square drifts are necessary to produce it at FMW. More study and preparation are necessary.

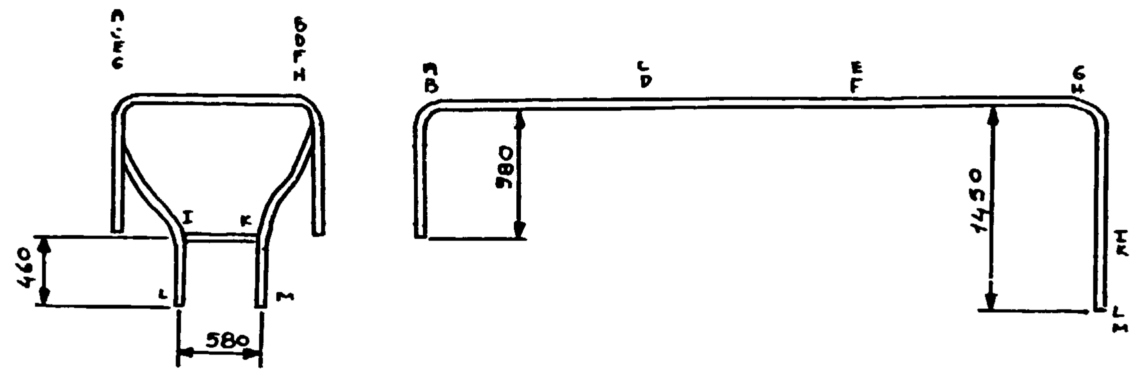
Figure I. LUGGAGE RACK

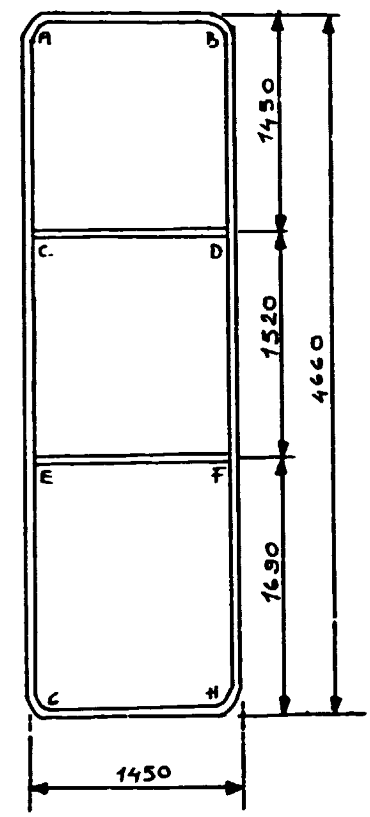
During the field work, a luggage rack frame was designed and produce under the inspection of Kedal team due to a costumer requirement.



Mounting scheme of luggage rack on truck.







Material : $\frac{3}{4}$ inches pipe

Fixing bar:

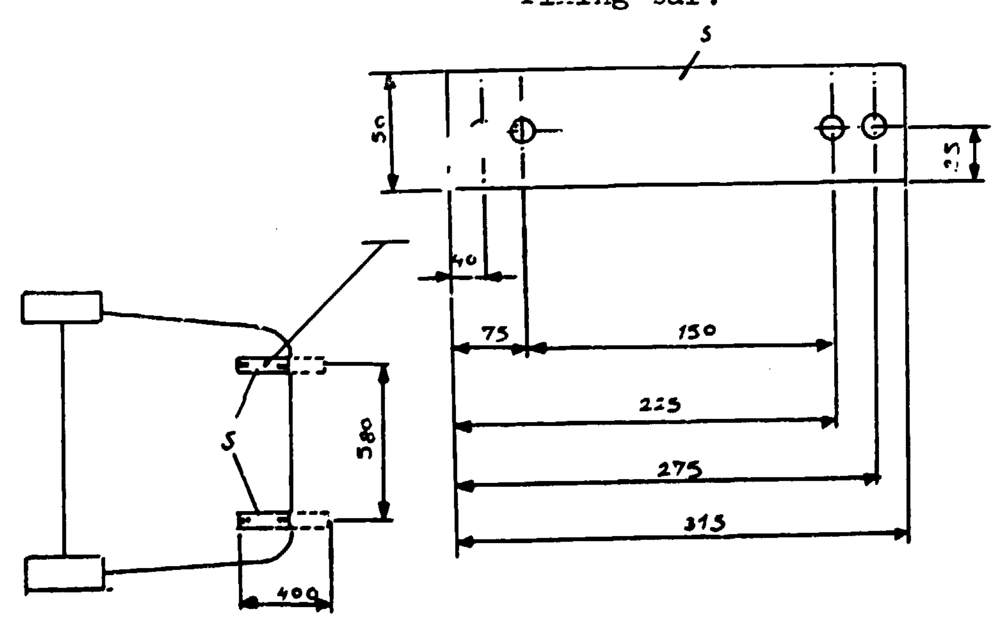


Figure 2. LOADING PLATFORM

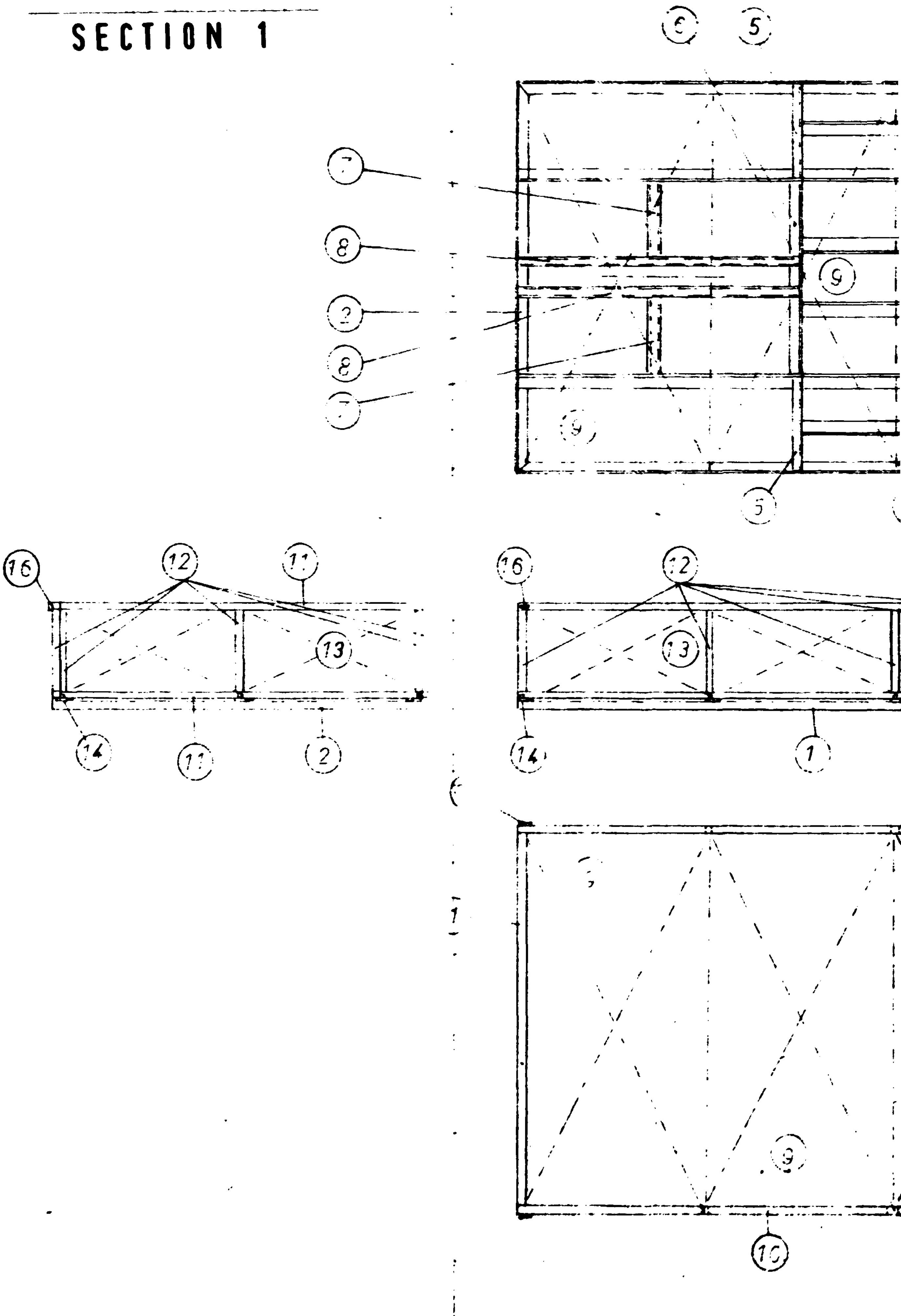
During the field work, a loading platform was designed and produced under the inspection of Medal team due to a costumer requirements. Platform is designed for a tractor truck to carry goods.

Material List:

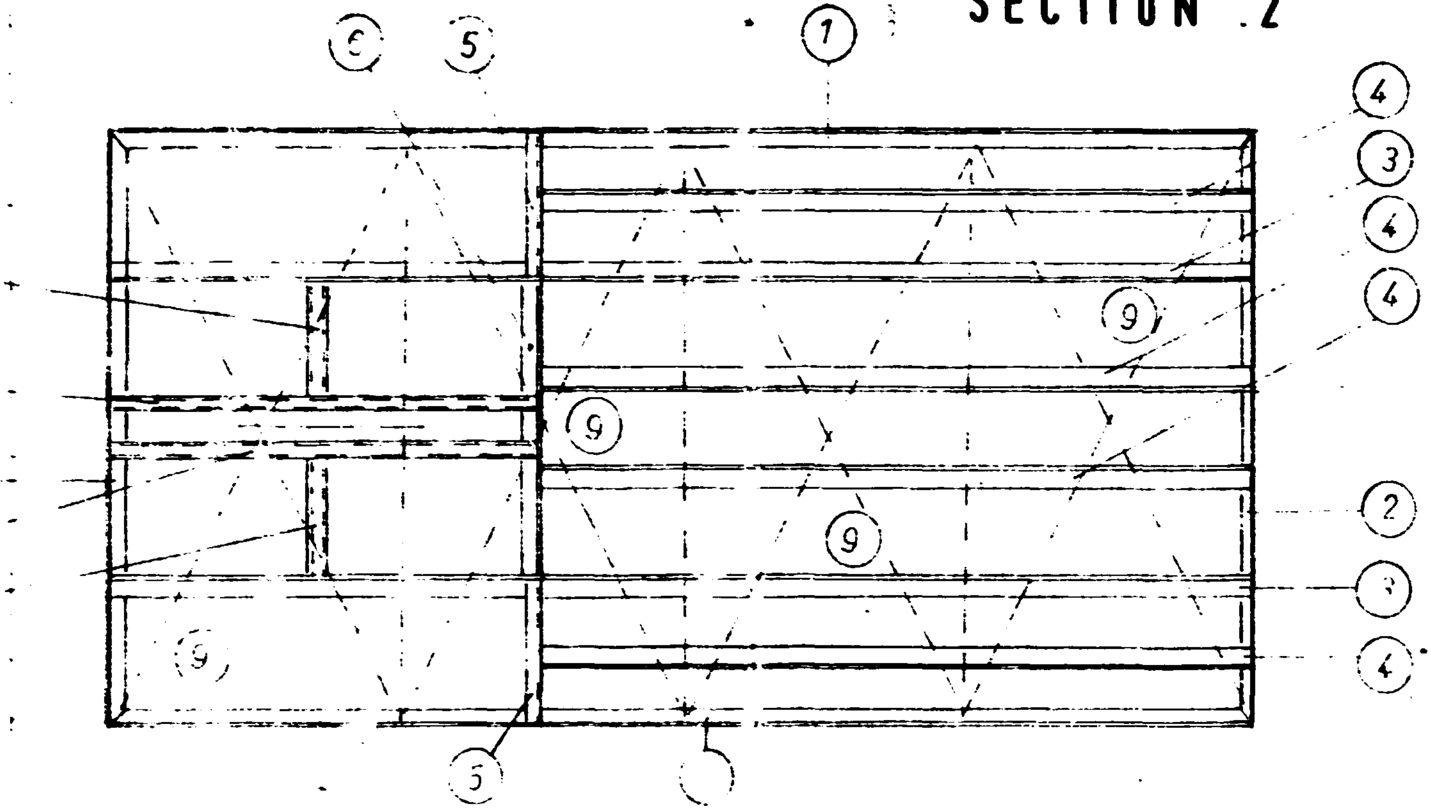
Order No.	Number	Length/a/b	Width	Scale	Material
I	2	4000		I:I	50x50x5 mm angle
2	2	2000		I:I	50x50x5 mm angle
3	2	3990			70x70x5 mm angle
4	4	2495			60x90x6 mm or 70x70x5 mm angle
5	2	490		I:I	50x50x5 mm angle
6	I	I000			70x70x5 mm angle
7	2	395	I35	I:2.5	2mm sheet
8	2	I490	I92	I:I	2 mm sheet
9	4	2000	I000		2 mm sheet
I0	4	4000	I000	I:I	2 mm sheet
II	4	I930	I00	I:I	2 mm sheet
I2	I6	430	I00	I:I	2 mm sheet
I3	6	2000	500		2 mm sheet
I4-I	I2	55	45	I:I	3 mm sheet
I4-2	I2	58		I:I	Ø I/2 inches pipe
I4-3	I2			I:I	Ø 2Ix2 mm sheet
I4-4	I2	28		I:I	Ø I/2 inches pipe
I4-5	I2			I:I	Ø 2Ix2 mm sheet
I4-6	I2	85		I:I	Ø I5 mm round steel
I5-I	4	55	45	I:I	3 mm sheet
I5-2	4	58		I:I	Ø I/2 inches pipe
I5-3	4			I:I	Ø 2Ix2 mm sheet

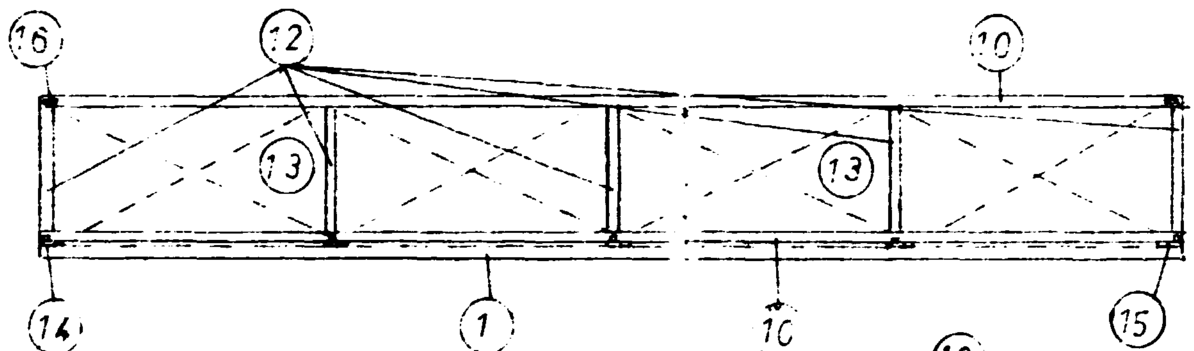
Order No.	Number	Length/a/b	Width	Scale	Material
I5-4	4	28		I:I	Ø I/2 inches pipe
I5-5	4			I:I	Ø 2Ix2 mm sheet
I5-6	4	85		I:I	Ø I5 mm round steel
I6-I	4	I50		I:I	Ø 8 mm round steel
I6-2	4	20		I:I	Ø 8 mm round steel
I6-3	4			I:I	Ø I2x3 mm sheet
I6-4	4	I65	30	I:I	3 mm sheet
I6-5	8	35	20	I:I	3 mm sheet
I6-6	4	25		I:I	Ø 5 mm round steel

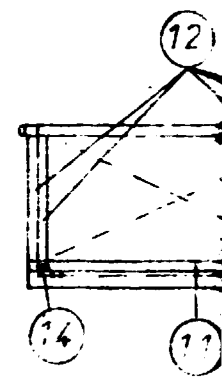
SECTION 1

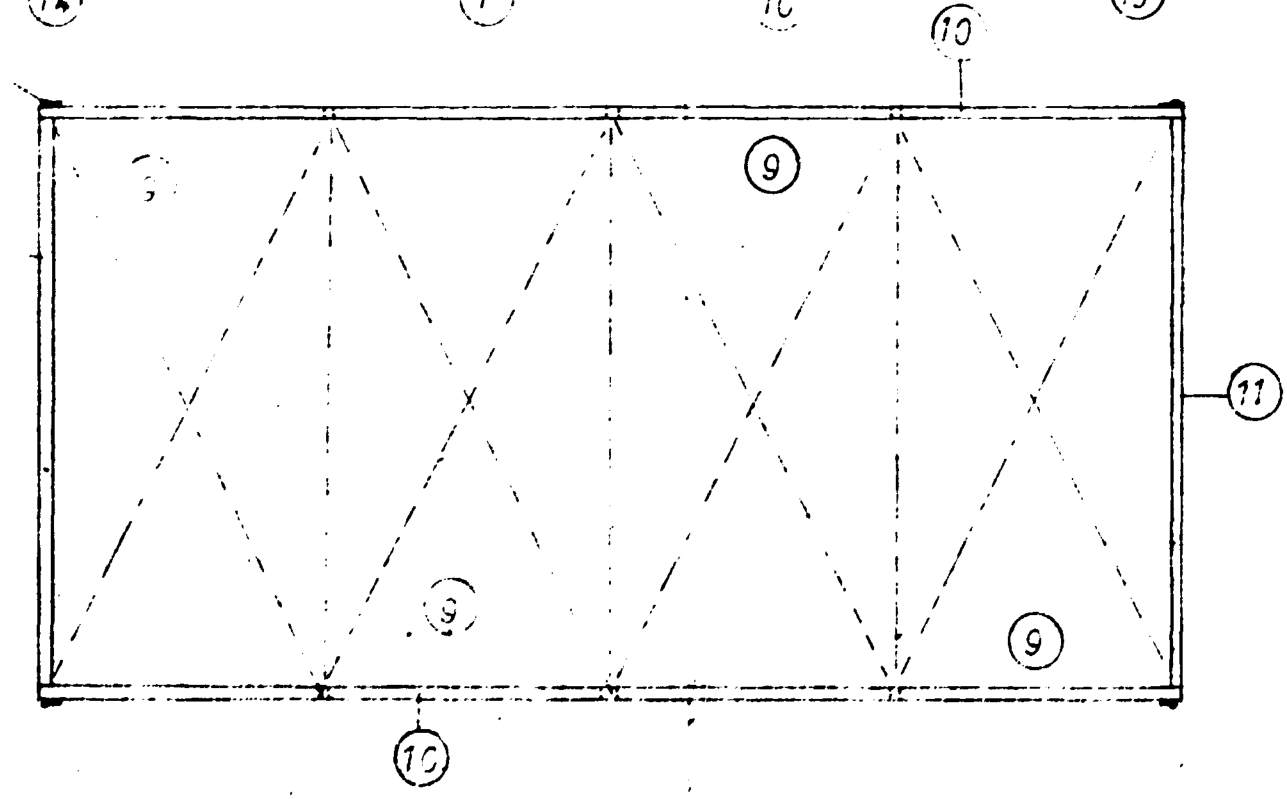


SECTION .2

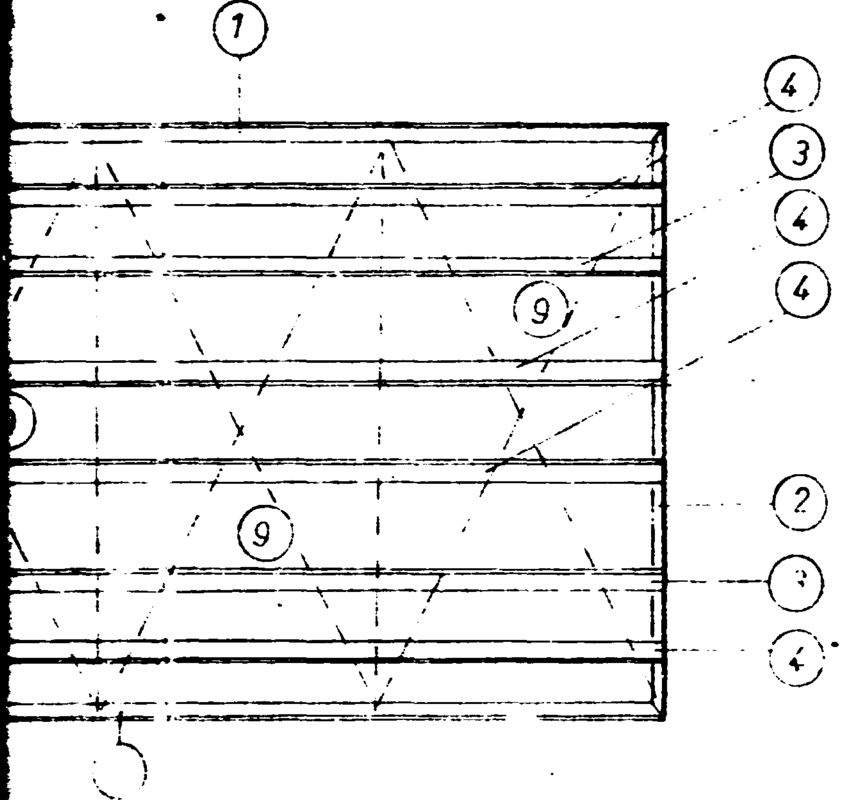


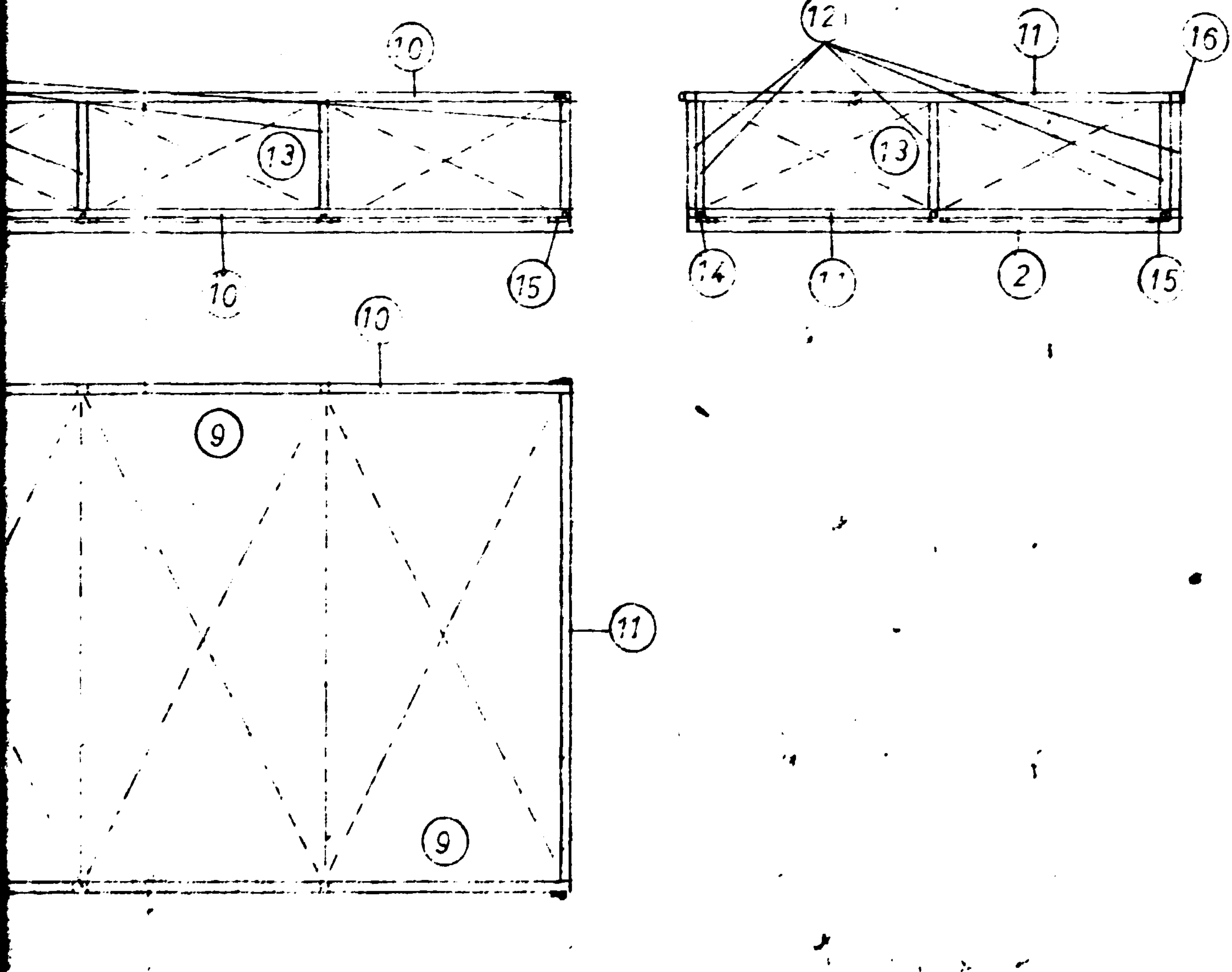






SECTION 3





scale 1/25

Foundry/Mechanical Workshop
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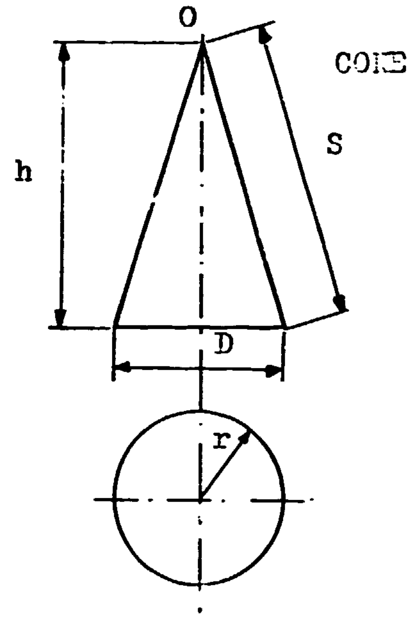
Appendix 2.

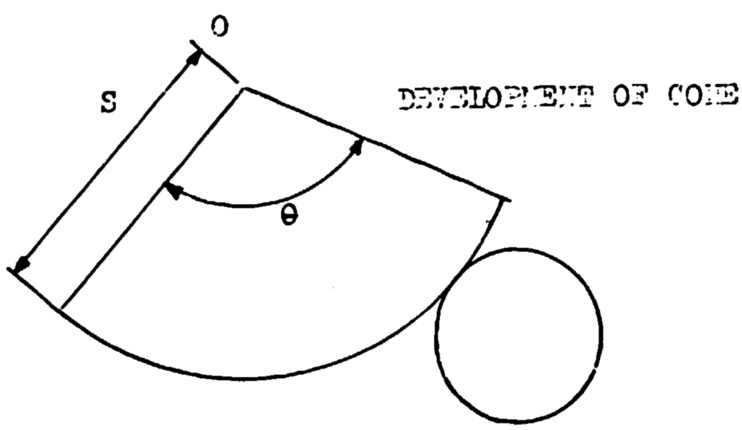
Figure 3. CONICAL BENDED SHEET

During the field work, it was find out that there were mistakes in the conical bended work pieces. To upgrade the metal work it was shown to the counterparts how to find the development of conically bended sheets.

Symbols:

- O : Vertex of cone and centre of development.
- S : Edge of cone.(mm)
- D : Diameter of base circle..(mm)
- r : Radius of base circle ......(mm)
- h : Height of cone ....(mm)
- θ : Angle of development



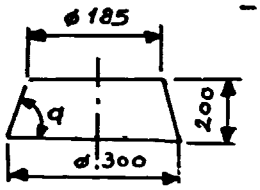


$$\theta : \frac{D \cdot 180}{S}$$

$$S : \sqrt{\left(\frac{D}{2}\right)^2 + h^2}$$

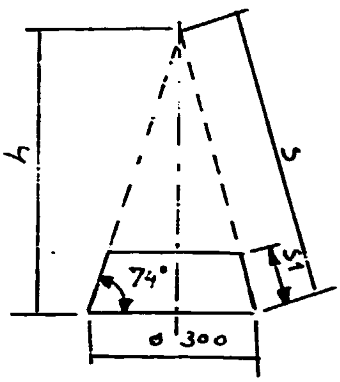
Examples:

- a -



required bended sheet

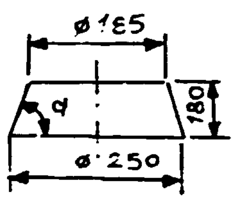
$$a : \text{arc tg} \frac{200}{\left(\frac{300 - 185}{2}\right)} : 74 \text{ degrees}$$



$$S : \frac{150}{\text{Cos } 74} : 547.3 \text{ mm}$$

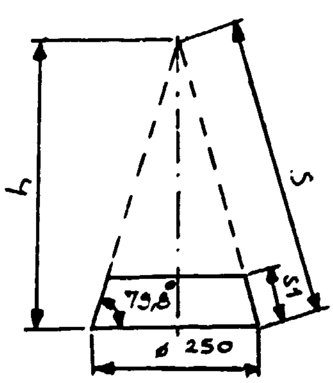
$$\theta : \frac{300 \times 180}{547.3} : 98.67 \text{ degrees}$$

- b -



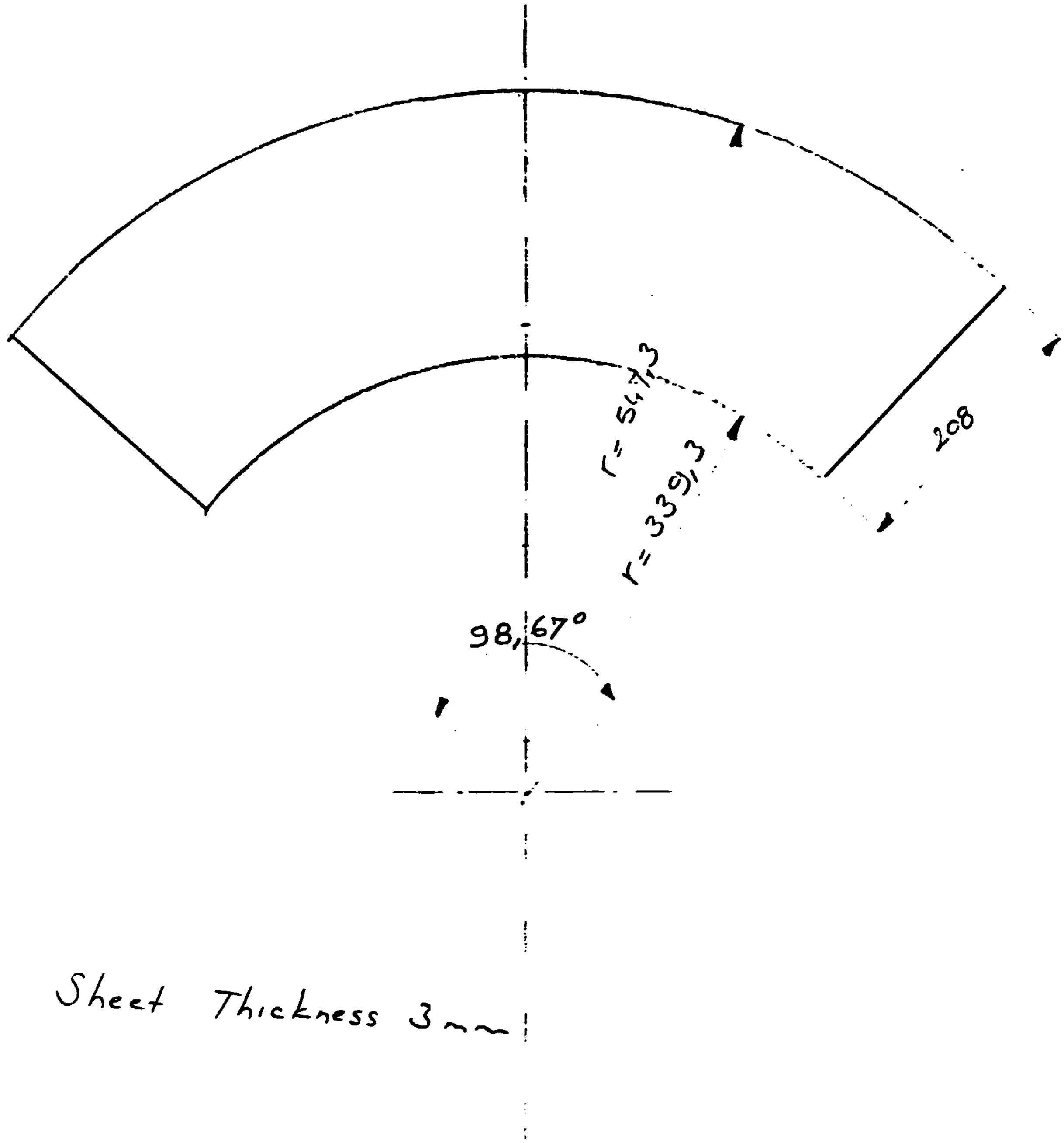
required bended sheet

$$a : \text{arc tg} \frac{180}{\left(\frac{250 - 185}{2}\right)} : 79.8 \text{ degrees}$$



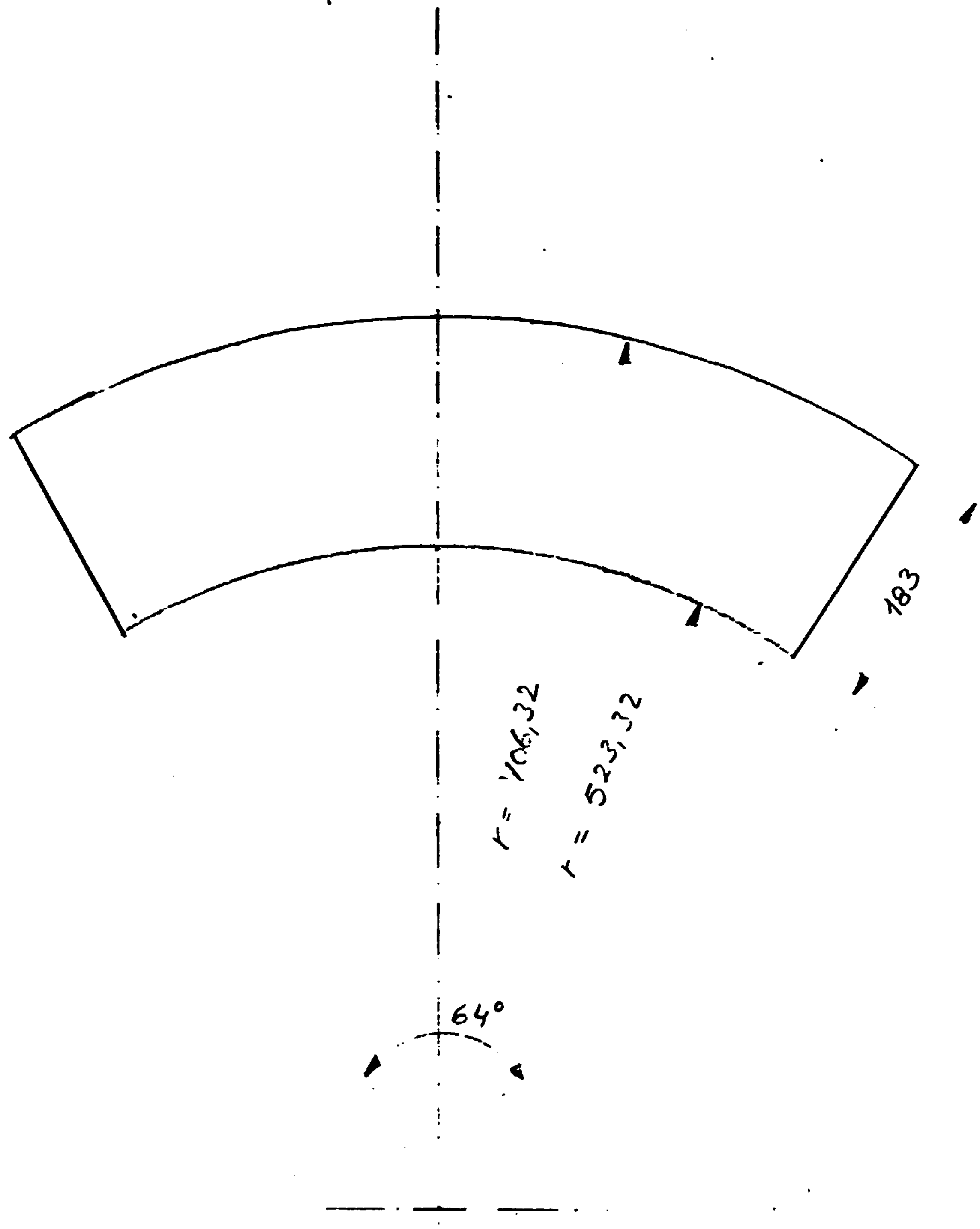
$$S : \frac{125}{\text{Cos } 79.8} : 706.52 \text{ mm}$$

$$\theta : \frac{250 \times 180}{706.52} : 64 \text{ degrees}$$



Sheet Thickness 3 mm

Design Expert : Ersin Bastuğ
FMW - 20-7-1986



Sheet Thickness 3 mm

Design Expert: Ersin Baştuğ
FMW - 20-7-1986

Foundry/Mechanical Workshop Appendix 3.
Mogadiscio-Somalia

TRAINING COURSE NOTES ABOUT TECHNICAL DRAWING

During the field work, it was found out that the technological knowledge of the workers was very poor. Even some of them can not read any written information or instroduction. They can not measure a distance or calculate correctly. This effected their performance and consequently they could not produce the workpieces in required quality.

To produce the workpiece in correct dimensions and quality in an appropriate working time with minimum wasted materials training the workers on the subjects of technical operations and drawing was necessary. However for continuity of working staff it is necessary to keep trained personal as long as possible within the institution.

Technical drawing course was started at the begining of 1987. It was intended to start earlier but for several reasons class room and necessary things was not ready on time. At the begining of the course, an examination was taken and depending of the result of it, workers were divided into two classes. First class with a lower level of knowledge. Second class with better level of understanding and background. The method of the training course on technical drawing is to explain and show the rules of technical drawing and their applications, to give an ability of understanding a workpiece from a drawing and to draw it from original object and to use the technical drawing on work to produce a workpiece correctly and accurately and if time permits to teach the standarts. For each student drawing paper, ruler, compass, rubber and other necessary equipments were purchased by GTZ. After several introductory lessons in each class every time a new workpiece was studied and students prepared drawing for it. Information about the object was given before starting each drawing. The students were being checked during the drawing of the objects and completed drawings were checked and mistakes were corrected one by one. Students are graded for each drawing and at the end of each class their grade showed their performance which became a basis for insentive payment to the technicians.

TECHNICAL DRAWING NOTES

Unit I. Technical Drawing
Drawing Equipments
Drawing Lines
Some Basic Drawing Rules

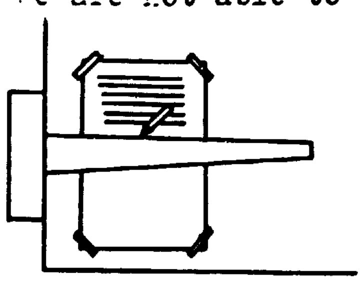
Technical Drawing:

Technical drawing is used to explain a workpiece which will be produced. Technical drawing helps to make a simple information about workpiece. It makes the communication between the certain stages of production team rapidly and safely. It is used to explain all machining steps, material properties and dimensions easily and accurately. Technical drawing is pepared by depending on some rules. Over the world, technical drawing is drawn with same rules. To understand a technical drawing does not require to know any extra foreign languages. Technical drawing is like a language which if you know the rules of it you can communicate with a another technical person. It is important to learn the rules correctly and study on them decidedly for better applications.

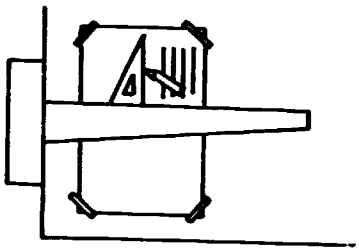
Drawing Equipments:

Different instruments are used for certain purposes in technical drawing.The main instruments are tee-square, set squares, rulers, compass and pencil. Accuracy in drawing depends on using a hard, sharpened pencil, 2H or 3H, sharpened to a long point. One must keep his pencil sharpened. Hold your pencil at a right angle to the paper and twice pass on the lines.

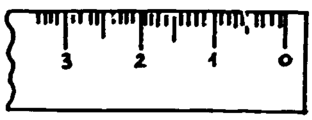
Tee-square is an instrument which is used to draw straight horizontal lines and helps to use of other rulers. It has two wooden or plastic arms. One of them is long and has a straight edge for drawing. Other one is short and is fixed to the end of the long arm at a right angle. To use the tee-square, put it on table as straight edge on forward direction. During drawing, press short arm to left side of table and hold it firmly to prevent moving. To draw different horizantal lines move it by sliding up and down, take edge of table as a guide. Unfortunately we are not able to provide trainess with tee-squares.

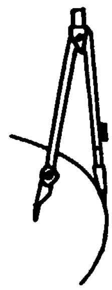


Set square is an instrument which is used to draw vertical and angular straight lines. It has a triangular shape. Almost, two kinds of set square are used in technical dnawing. One of them has angles of 90,60 and 30 degrees. Other one has angles of 90 and 45 degrees. Set square is always used with tee-square. To use the set square, put it on table and place to straight edge of the tee-square. Start with pressure tee-square to edge of table then move hand to hold both tee-square and set square firm. When you drawn first line, move tee-square down below to give a clear view of line.



Rulers are used for measuring and marking out. They have many kinds. Always mark the overall size first. With practice unequal sizes can be measured without moving the ruler.
Compass is used to draw the circles. It is placed on the centre of the circle and is set to the radius of the circle.





Drawing Lines:

I- Faint: It is used for constraction and projection lines. It is faint enough to be left in when the drawing is finished.
2- Medium black: It is used for dimension lines.
3- Heavy black: It is used for out lines. These must still be drawn with a sharp, hard pencil, to give a crisp, clear line.

Faint

Medium black

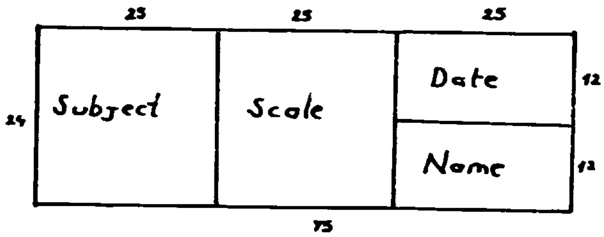
Heavy black

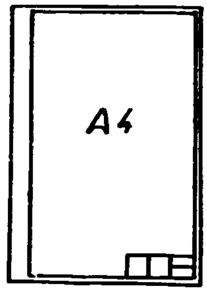
Some Basic Drawing Rules:

When measuring it is better to make a short faint line rather than a dot. The short faint line will disapear into the final line but a heavy dot usually shows.

To give some information about the drawing, a name panel is used. The papers which are used in technical drawing have standart dimensions. All the exercises in this study will fit on A4 paper. A4 paper is 297 mm in length and 210 mm in width.

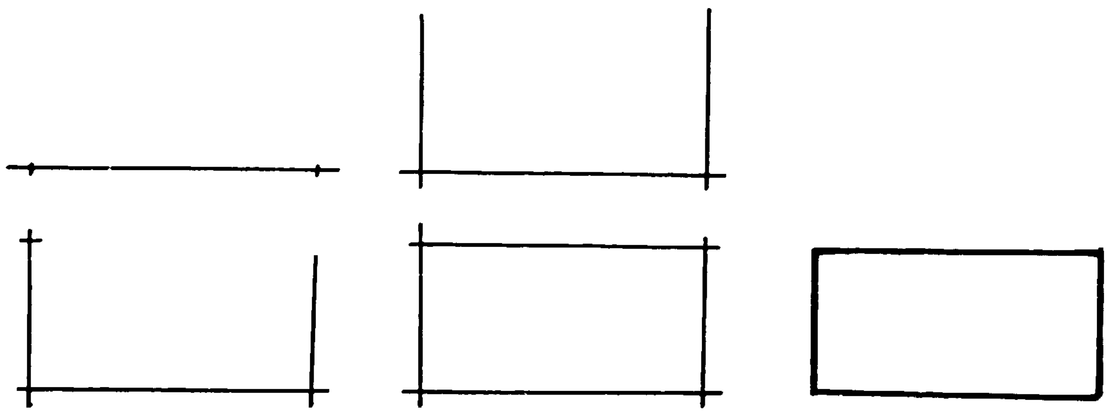
For most small exercises the 75 mm name panel will be sufficient. If extra information is available the panel can be added.





Stages in marking out a rectangle:

I- Place and fix your paper on table
2- Set tee-square on paper
3- Draw faint line and measure 100 mm on line
4- Set set-square on straight edge of tee-square
5- Move set- square up to marks and draw faint vertical lines
6- Measure and mark 50 mm up left hand line
7- Move up tee-square
8- Draw faint horizantal line on mark
9- Re-sharpen your pencil
10- Line in exactly required rectangle



Unit 2. Scale Drawing
Dividing a Line into Equal Parts
Angles

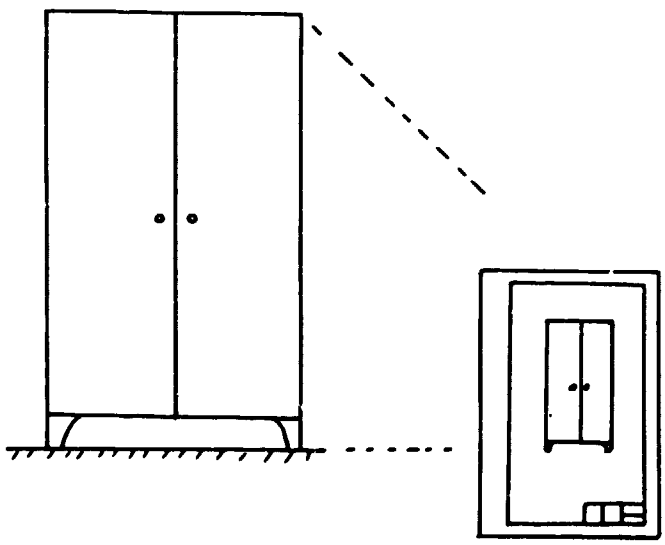
Scale Drawing:

Not many objects can be drawn full size on paper. Look around and try to pick out things which will fit on the paper. Example a table is too big and a key is small to fit on the paper. Therefore when we draw objects we use a scale to make its size is suitable to fit on paper. Example a car would have to reduced. This is a drawing to a smaller size. On the other hand where greater accuracy and detail is required, an object needs to be drawn out to a larger size. We use three kinds of scale:

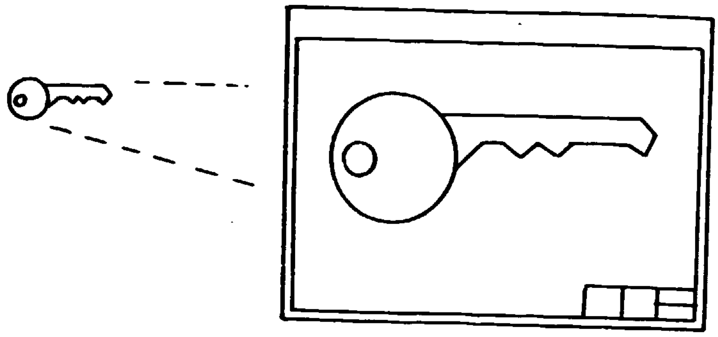
I- Full size scale
2- Smaller scales
3- Larger scales

When we use full size scale, the objects would have not to reduced or to be drawn out to a larger size. They can be fitted on paper as saving marking out the full length because their dimensions are suitable to fit on paper as same. Full size can be written on a drawing as I:I.

When we want to draw a big object on paper we use a smaller scale. When we use the smaller scale we draw the lines shorter than original with a proportion but we save the angles as same. Also all dimensions are reduced with same scale in the drawing and the scale must be written on the drawing to give information about reducing. Smaller scales are I:2, I:2.5, I:5, I:IO, I:20, I:50 and I:IOO. In practise I:2 and I:5 are the most frequently used scales.



Some objects are small to see all details clearly. When we draw this objects in full size we can not give information clearly and our drawing will be un-defined. When we use the larger scale, we draw the lines longer than original with a proportion but we save the angles as same. Also all dimensions are largered with same scale in the drawing and scale must be written on the drawing to give information about largering. Larger scales are 2:I, 5:I, IO:I, 20:I, 50:I and ICO:I.



Dividing a Line into Equal Parts:

I- Draw faint line, using your ruler

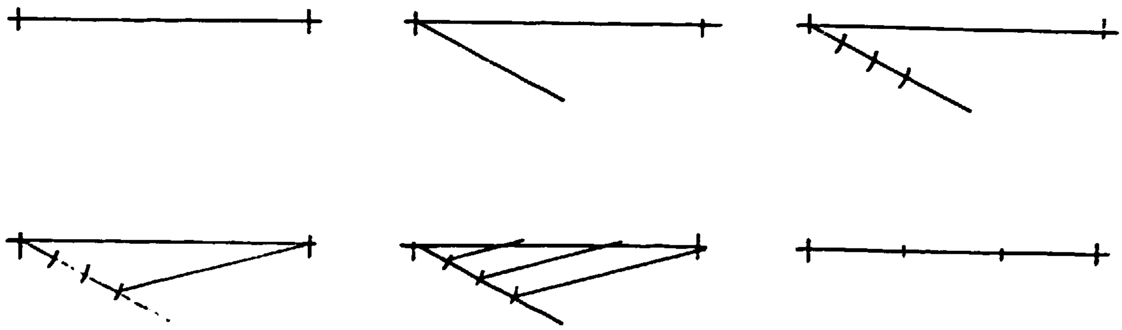
2- Using set-square, draw another line as pivoted with first one

3- Using compass, mark parts required. The length of line is not exceeded when number of required parts is marked

4- Using ruler and set-square, join last mark with end of line

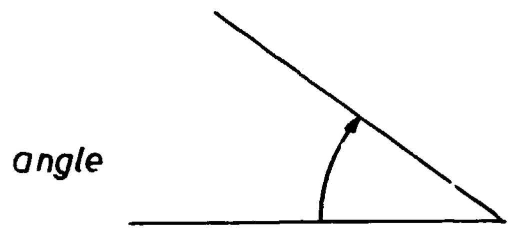
5- Move set-square and draw parallel lines

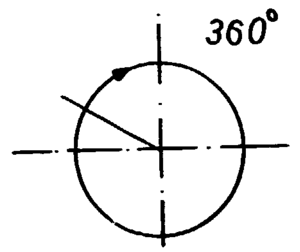
6- Original line will then be divided into required number of equal parts.

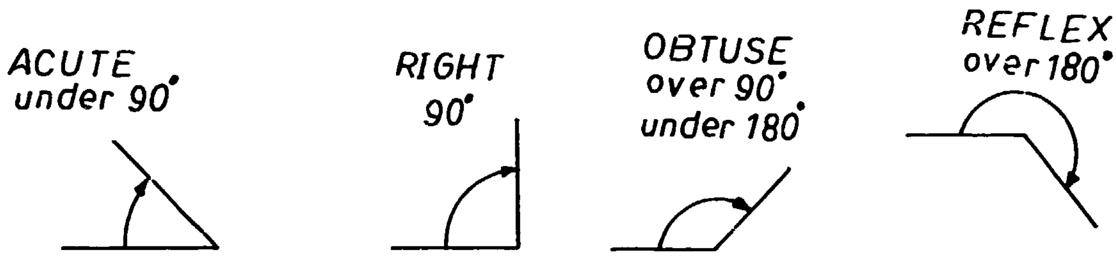


Angles:

If two lines are pivoted as one line opens they form an angle. If the rotation is continued the line will cover a full circle. The unit for measuring an angle is a degree, which is I/360th. part of the whole circle. It can be said, there are 360 degrees at a circle. Name of the angles: If angle less than 90 degrees, it is called ACUTE. Example: 30, 60, 45, 5, 89, I, 15 degrees etc. 90 degrees is called RIGHT angle. If angle over 90 degrees and under 180 degrees, it is called OBTUSE. Example 9I, I00, I79, I50 degrees etc. If angle over I80 degrees, it is called REFLEX. Example I85, I8I, 240, 300 degrees etc. The angles are always measured as clockwise.







How to bisect a line:

I- Draw faint line

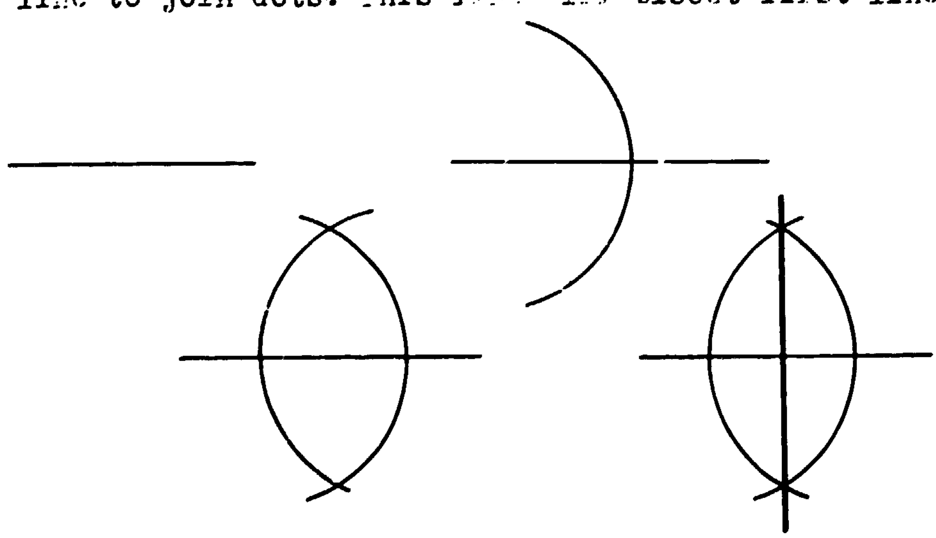
2- Set compass any opening and place needle on the line

3- Draw two marks as above and under line

4- Place needle on another point on line

5- Draw new two marks as above and under line but they will cross other marks and there will be two dots in the centre of crosses

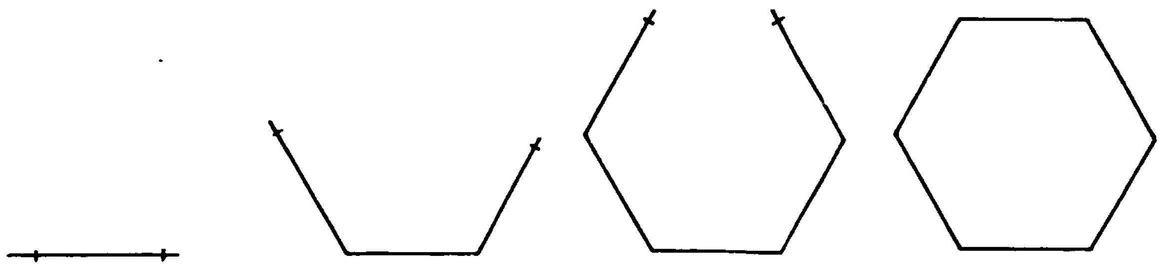
6- Draw line to join dots. This line will bisect first line



Unit 3. Hexagon
Octagon
Pentagon
Sketching

Drawing of Hexagon:

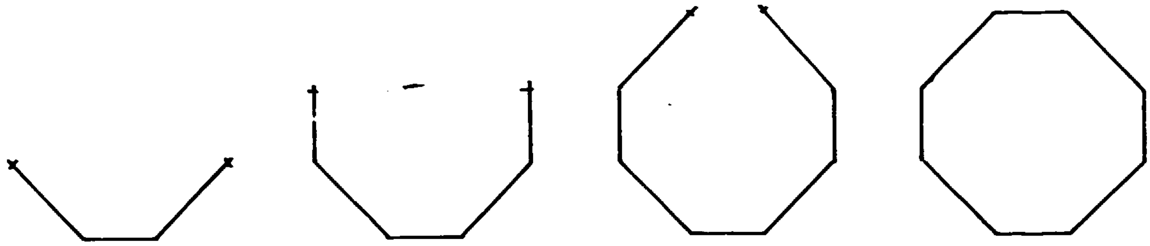
I- Place ruler on paper
2- Draw faint line
3- Set compass to length of side
4- Mark out length of side on line by using compass
5- Place set-square of 60 degrees to straight edge of ruler
6- Draw faint lines from marks
7- By using compass, mark out length of side on lines
8- Place set-square as turned opposite direction
9- Draw faint lines from marks
I0- By using compass, mark out length of side on lines
II- By using ruler draw faint line to join marks
I2- Finally line in. Construction should be faint enough to leave in. Erasing lines spoil drawing.



Drawing of Octagon:

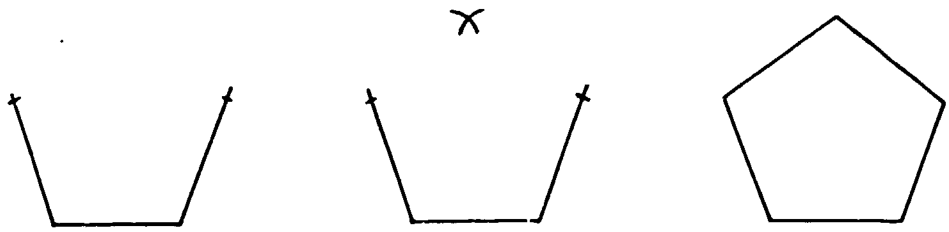
I- Place ruler on paper
2- Draw faint line
3- Mark out length of side on line, by using compass
4- Place set-square of 45 degrees to straight edge of ruler
5- Draw faint lines from marks
6- By using compass, mark out length of side on lines
7- Draw vertical faint lines from marks, by using set-square and ruler
8- By using compass, mark out length of side on lines
9- By using set-square of 45 degrees, draw faint lines from marks

IO- By using compass, mark out length of side on lines
II- By using ruler , draw faint line to join marks
I2- Finally line in. Faint horisantal and vertical lines help to check accuracy of your marking out.



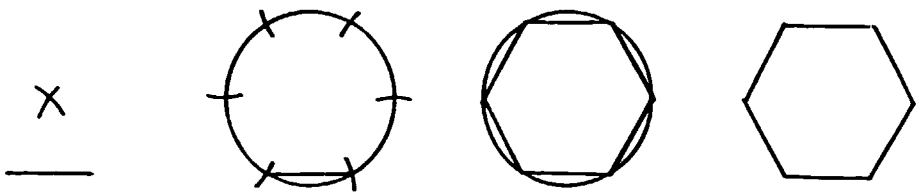
Drawing of Pentagon:

I- Place ruler on paper
2- Draw faint line
3- Set compass to length of side
4- Mark out length of side on line, by using compass
5- By using protractor, mark out angle of 72 degrees on both marks
6- By using a ruler, draw faint lines as on angle of 72 degrees from marks
7- By using compass, mark out length of side on lines
8- Mark apex by striking length of side with compass
9- Draw lines to join apex with marks on lines as on angle of 72 degrees from first line
IO- Finally line in



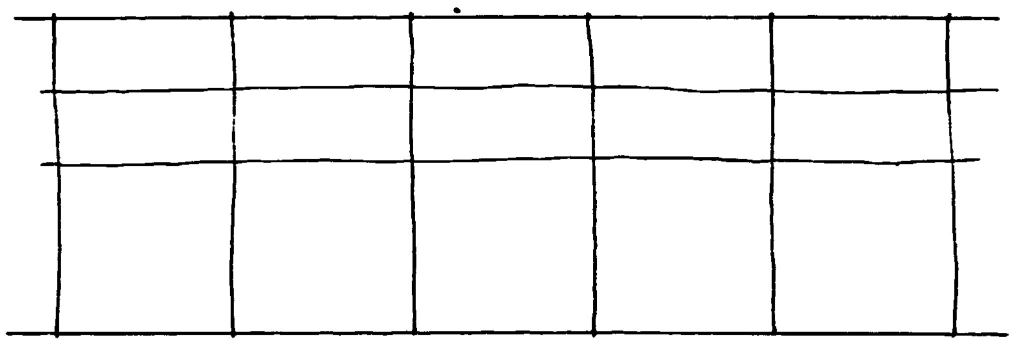
Drawing of Hexagon in a Circle:

I- Draw horisantal faint line on length of side
2- Find centre of circle. Radius is length of side
3- Draw in circle
4- Mark around with radius
5- Draw lines to join marks
6- Finally line in

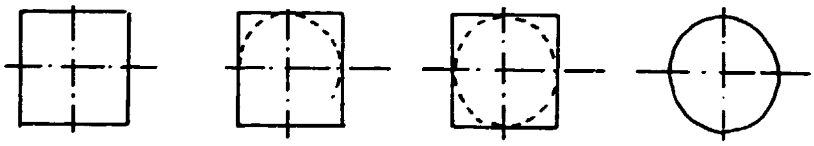


Sketching:

HB or H pencil is used for sketching. Because of the pivot of arm and wrist it is difficult to draw a long straight line. When you want to draw a straight line it is better to sketch in short lengths using the edge of the paper as a guide. A long continuous line tends to wander. Sketch faintly at first, then firmly, in short accurate strokes. Layout about half a sheet with marks 25 mm apart at the top and bottom of the sketch. Join the marks keeping as straight as possible. Cross lines can then be drawn the same way.



The circle or part of a circle is eaiser to draw if split into quarters. Sketch in lightly before lining in.



Many objects are symmetrical that is they are the same shape each side of a centre line.

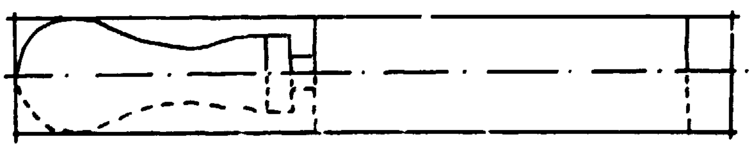
Stages in sketching a chisel:

I- Observe the length in relation to the width

2- Mark out a box with a centre line

3- Mark off the other proportions. Lightly sketch in the curves

4- Line in with short accurate strokes

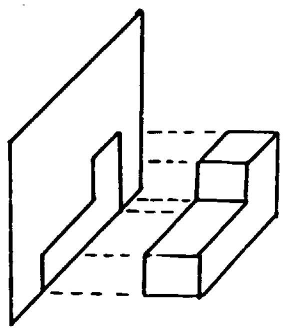


Unit 4. Orthographic Projection
Drawing Board Work

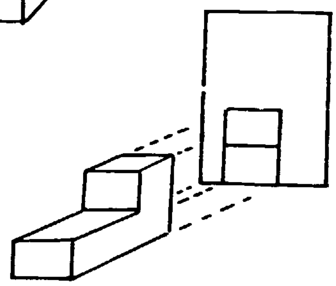
Orthographic Projection:

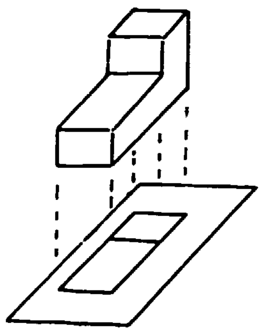
In technical drawing to explain details and to understand the properties of workpieces orthographic projection is used. Orthographic projection shows all details of a workpiece. Orthographic projection is drawn depending on some simple rules.

Example; Take this very simple solid, stand a piece of paper behind and look at it from the front. Imagine the shape projected on the paper. We call the paper a plane.

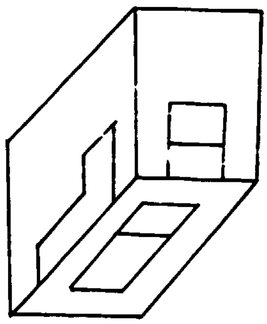


Stand another piece of paper behind and lokk at it from the other side. That view show what the side of solid looks like.

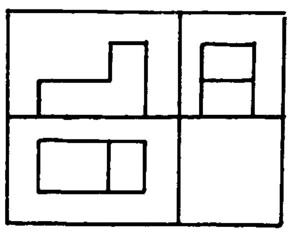


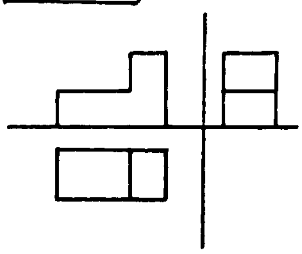


Stand another piece of paper and look at it from the top. That view show what the top of the the solid looks like. All these views show what each different side of the solid looks like. Seperate they do not convey much but together.



Even when the solid is taken away, the shape can be visualised. To carry these pieces of paper stuck out at right angles would be very in convenient, so we flatten them out like this.

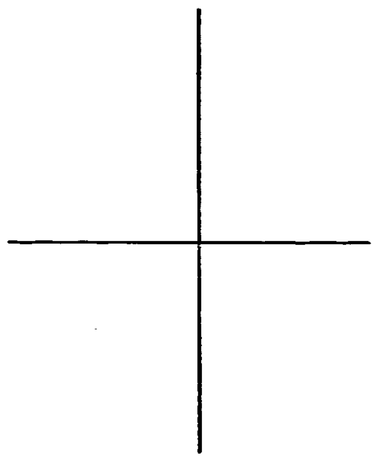


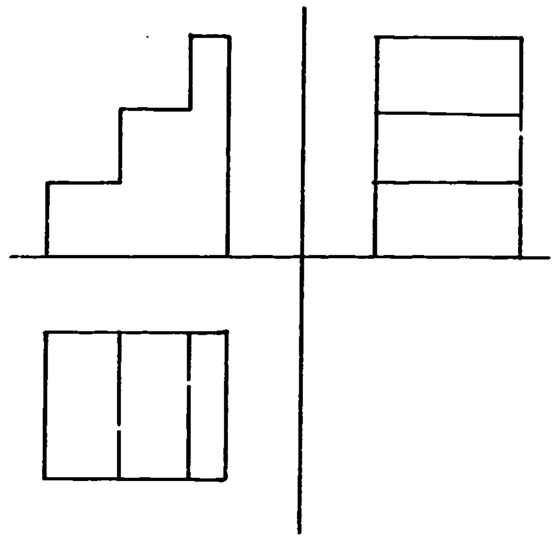


Then to simplify even more, we remove the planes and only leave the lines where they intersect.

Drawing Board Work:

Use A4 paper. Start with the lines where the planes intersect. Draw everything faintly and line in the outline of the object finally, remember the plan must always be under the front elevation and is always the same width. Allow a space between the intersection line and the front elevation. Allow a space and draw the end elevation.





Unit 5. Hidden Edges

How To Draw Circular Parts

Hidden Edges:

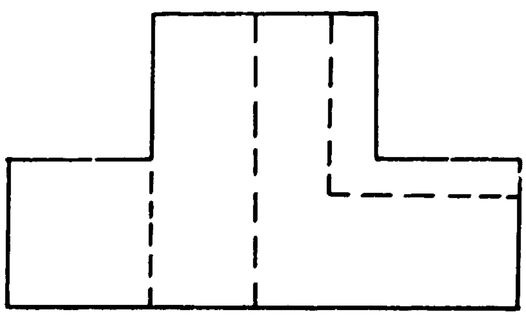
Hidden lines are drawn with dashes and spaces about equal in length. The strength of hidden lines is medium black, between faint lines and outlines.

Some rules:

I- Start and finish a hidden line with a dash

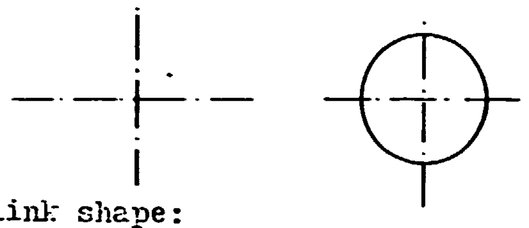
2- When the line turn to another direction, make corners of hidden lines

3- Some times we have exception to the rule. Where a hidden line joins into a full line in the same direction, finish with a space .



How To Draw Circular Parts:

When we want to draw a circle we use a compass or a circle template. But always we need a centre to draw a circle. In thechnical drawing a centre is shown with centre lines cross in the middle point of a circle. Centre lines are used to make the centre of the circle positive. The streght of these lines is medium black.

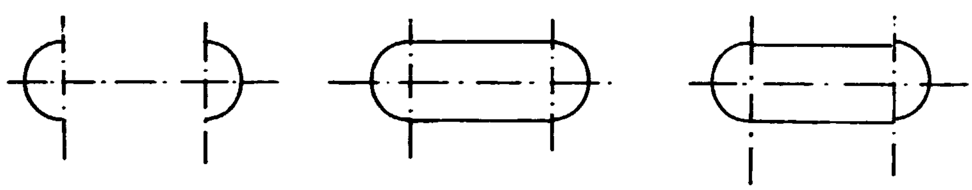


How to draw link shape:

I- Always mark tha part of the circle first

2- Then join the lines to the circle

3- Putting in the circle last usually causes a mismatch on the joinin



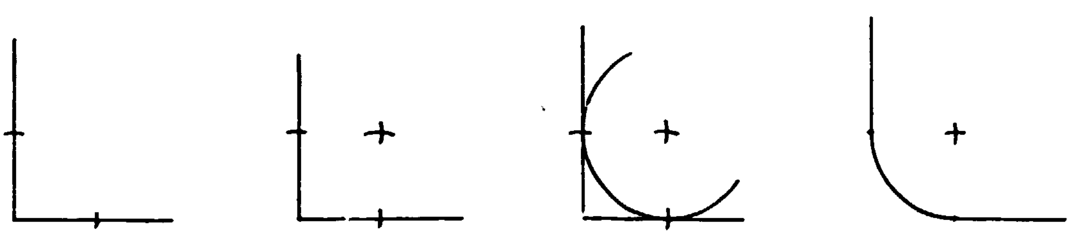
Stages in marking a radius in a corner:

I- Set a compass to the radius and mark from the corner

2- Mark out the centre, place the compass on the marks and mark out a dot as crossing marks from corners

3- Line in the radius, place the compass on the centre and draw the radius

4- Join the lines to the circle

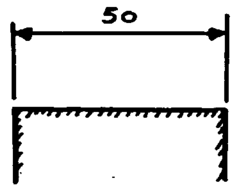


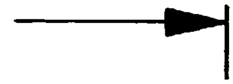
Unit 6. Dimensioning

Dimension lines show the size and tha place of the parts at the drawing. Those are drawn continious and limited with arrowheads on both ends. The strength of these lines is medium black.

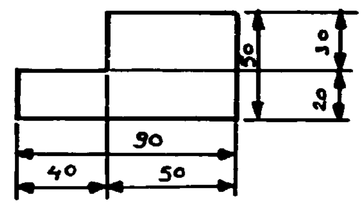
Arrowheads : They are placed on both ends of dimension lines and all arrowheads in a drawing are same size.

The method of dimensioning: Keep the dimension lines IO mm apart to give adequate space for the figures. Avoid haphazard dimensioning

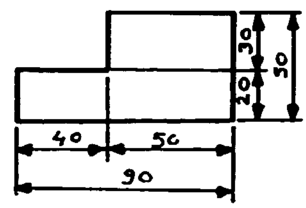




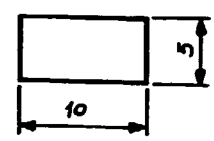
This kind of dimensioning gives a bad condition. Dimensions are not suitable to read easily and drawing is not clear.



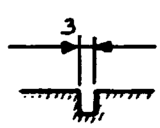
The overall dimensions is placed outside the smaller dimensions. Drawing must be clear.

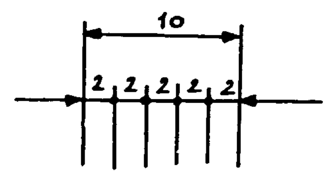


Dimensions are placed above the dimension lines.
Figures must be readable from the bottom or right.

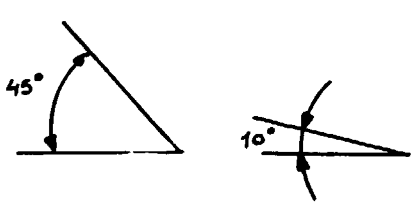


Dimensioning a narrow space: No room for arrow heads, place arrowheads outside.

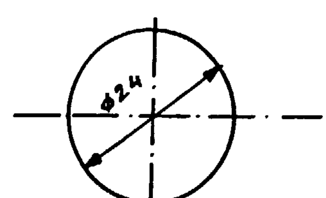




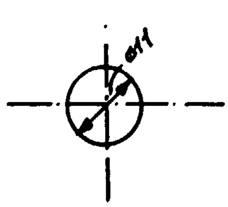
Dimensioning an angle:



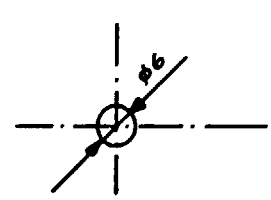
Dimensioning circles: Place the dimension line inside of circle



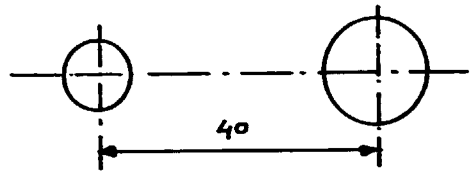
Medium circles: No place for number, write it outside.



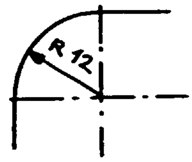
Small circles: Place the dimension line outside of the circle



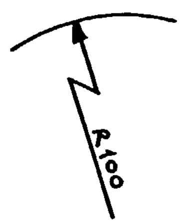
Distance between centre lines are important dimensions to show.



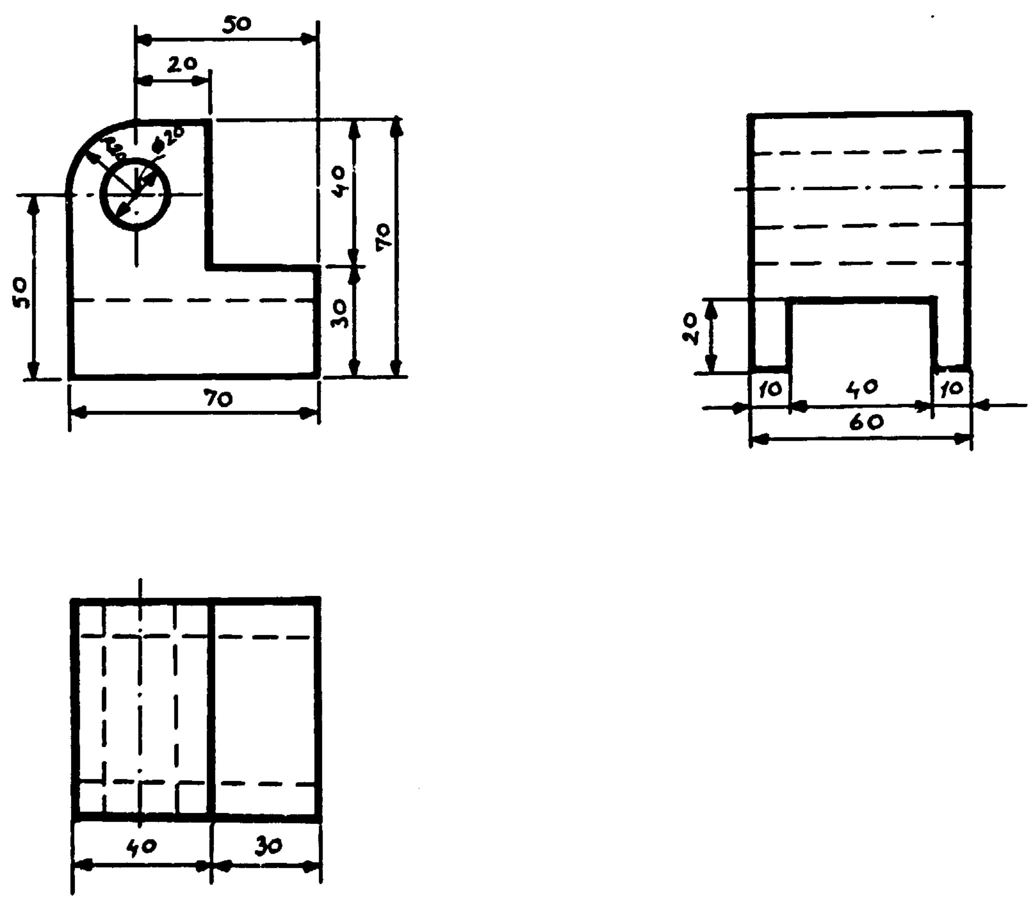
To show a radius, write R before the numbers.



If the centre of the circle is off the paper,

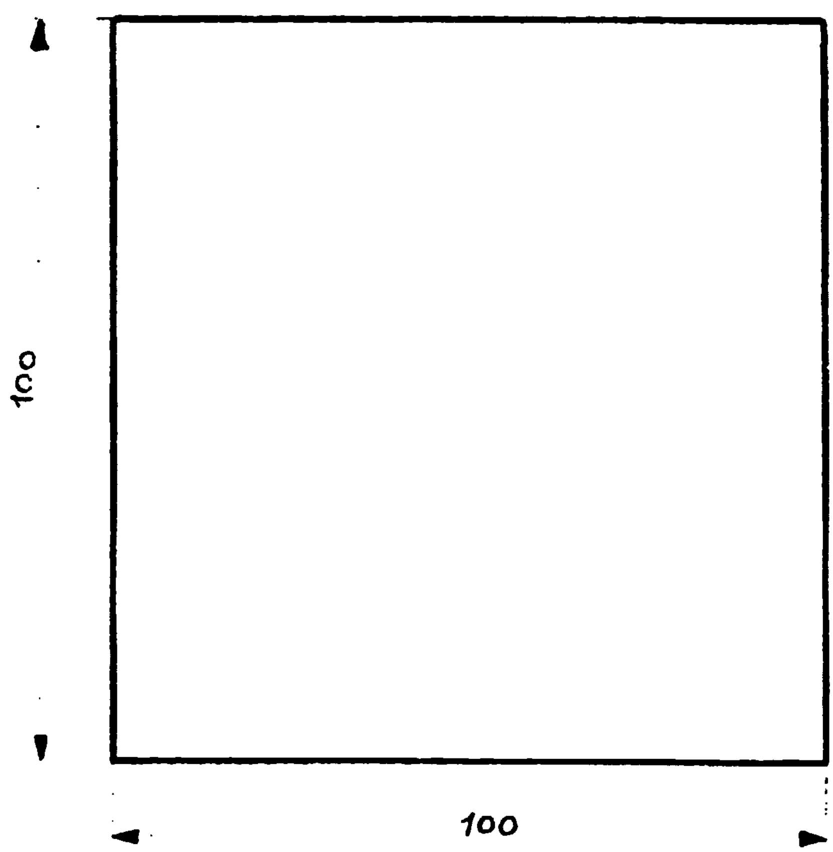


It is not neces ary to dimension every view. It is understood that a size given in one view is the same in which view it is projected . Aim to produce bianced dimensioning.

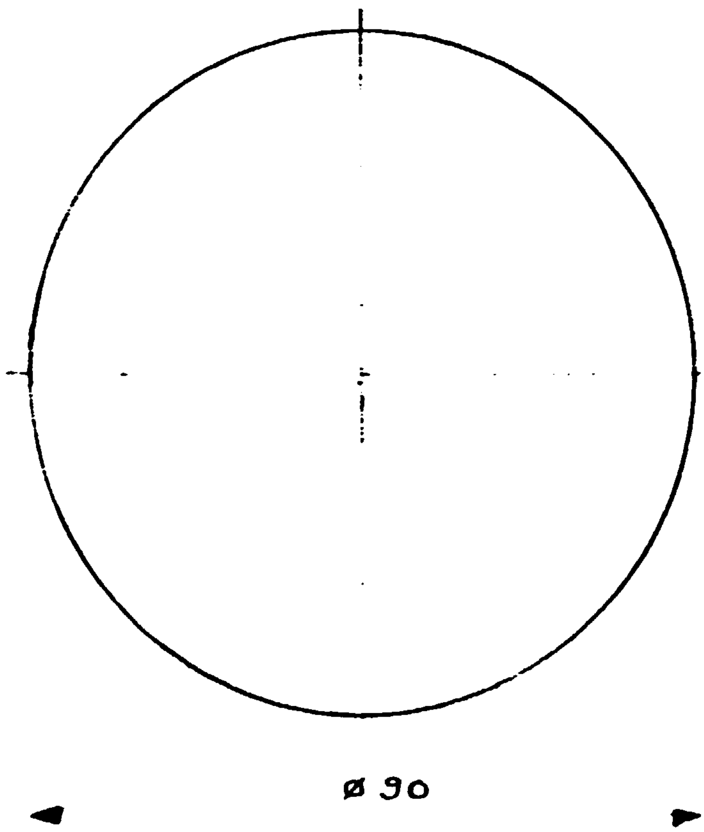


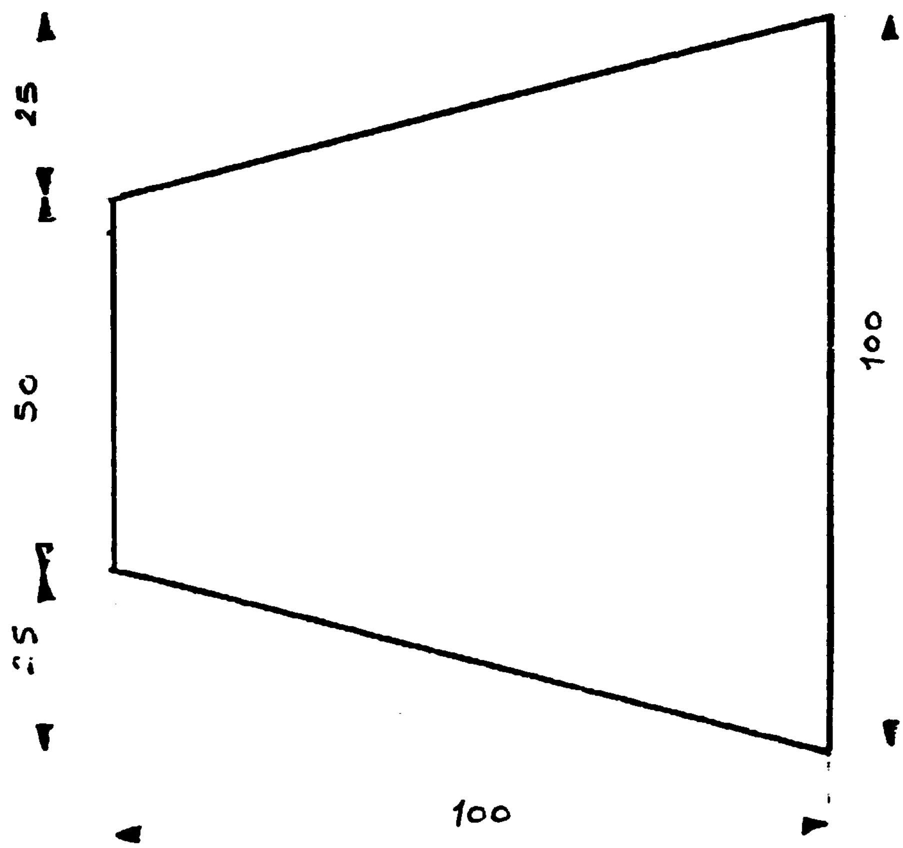
Following above described instroductory classes I6 workpieces one by one drawn on papers and blackboard.

Square



Circle

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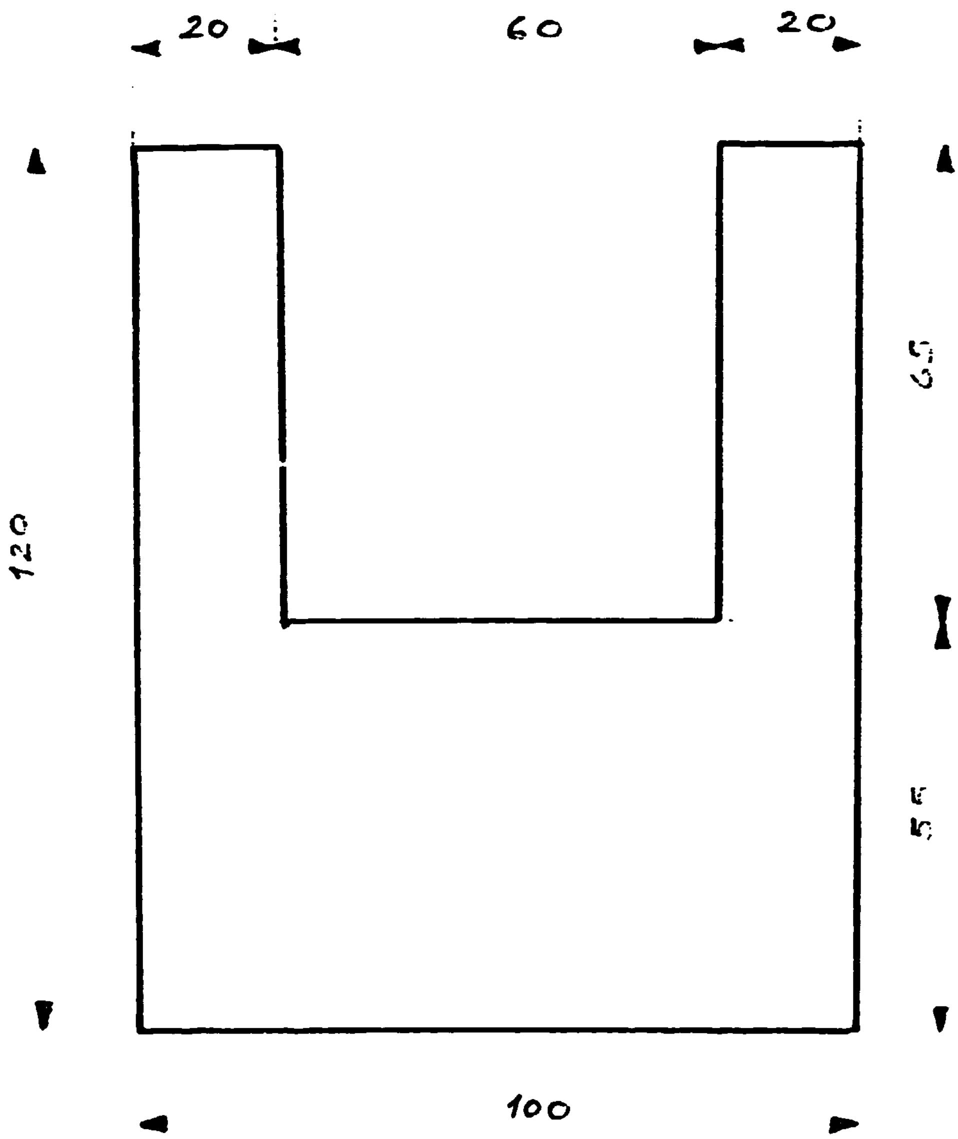
25
100
100



20
60
20
120
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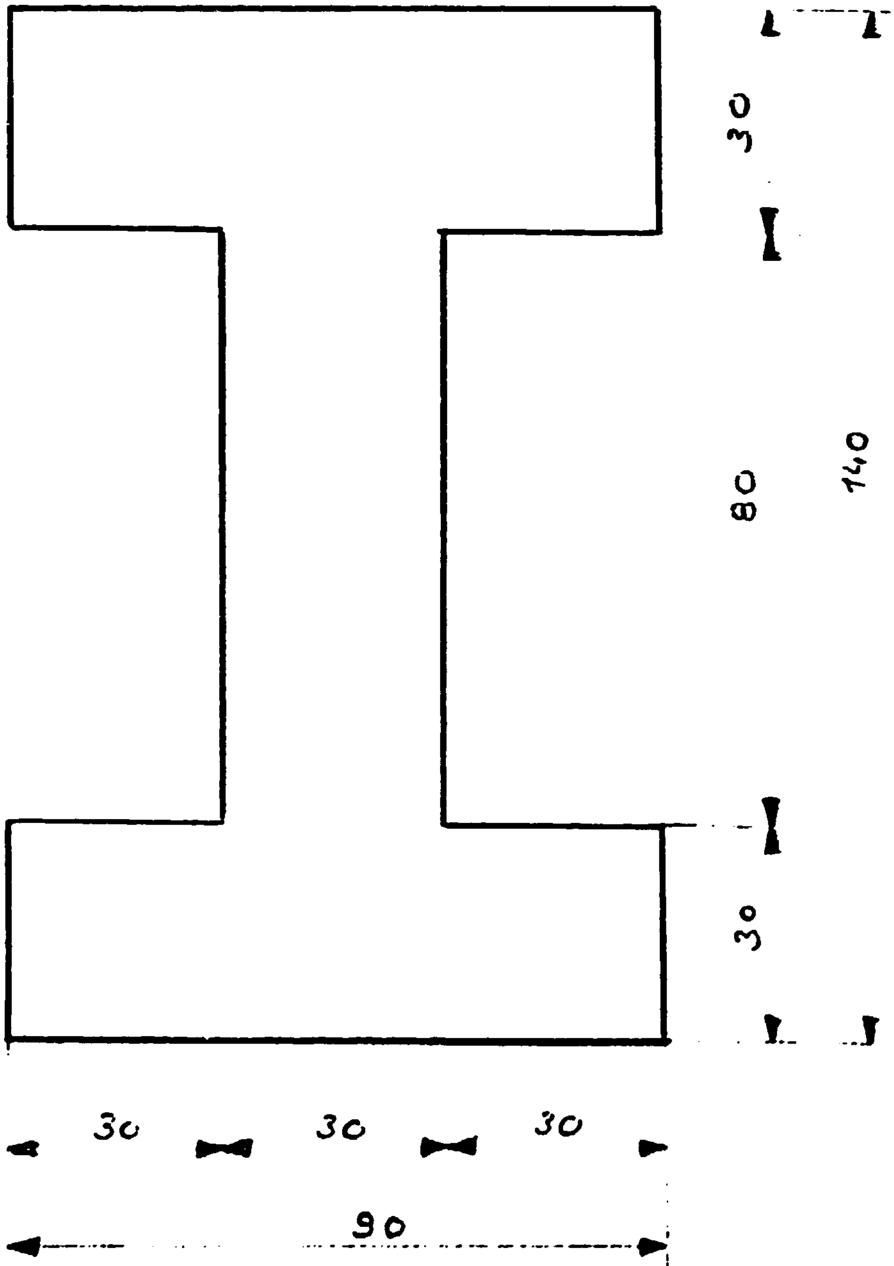
100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30
30
30
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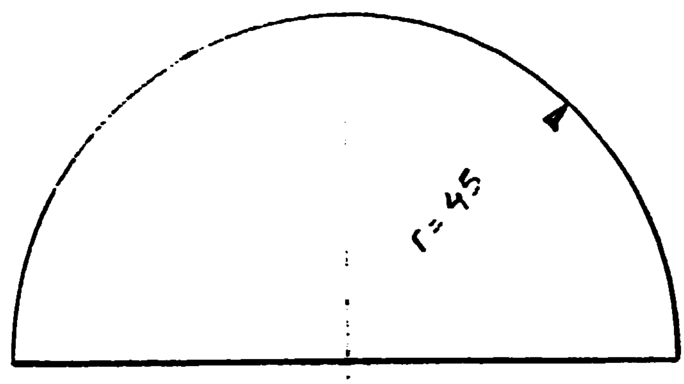
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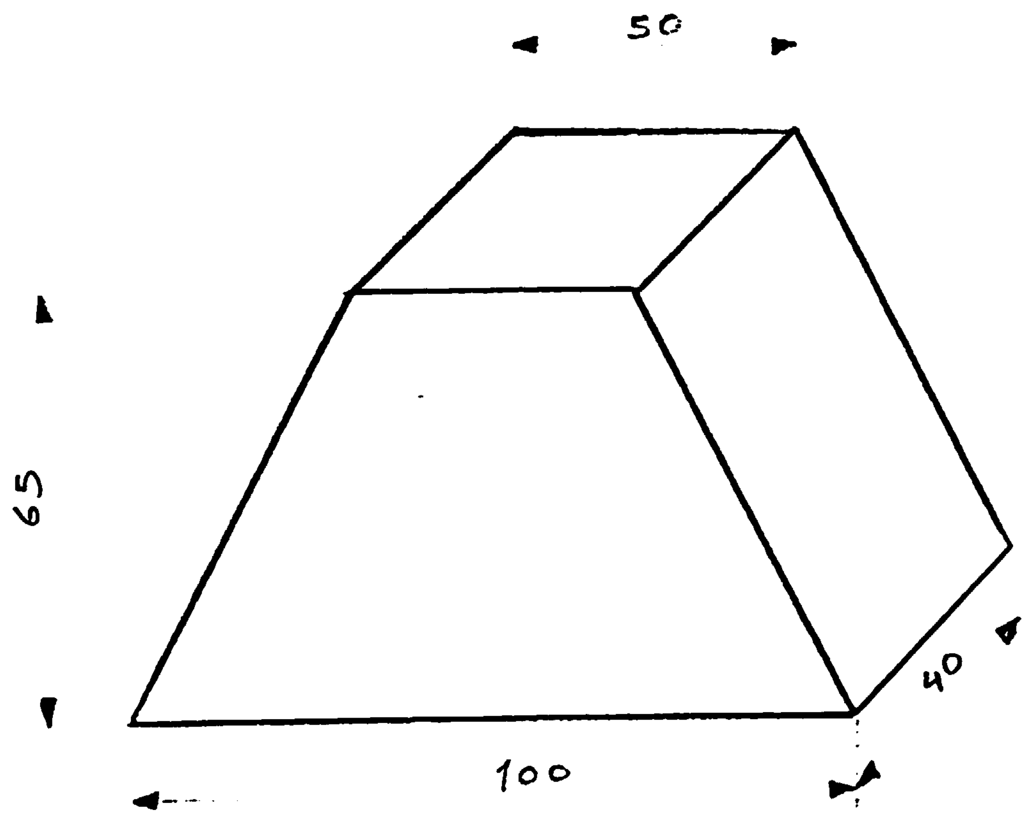
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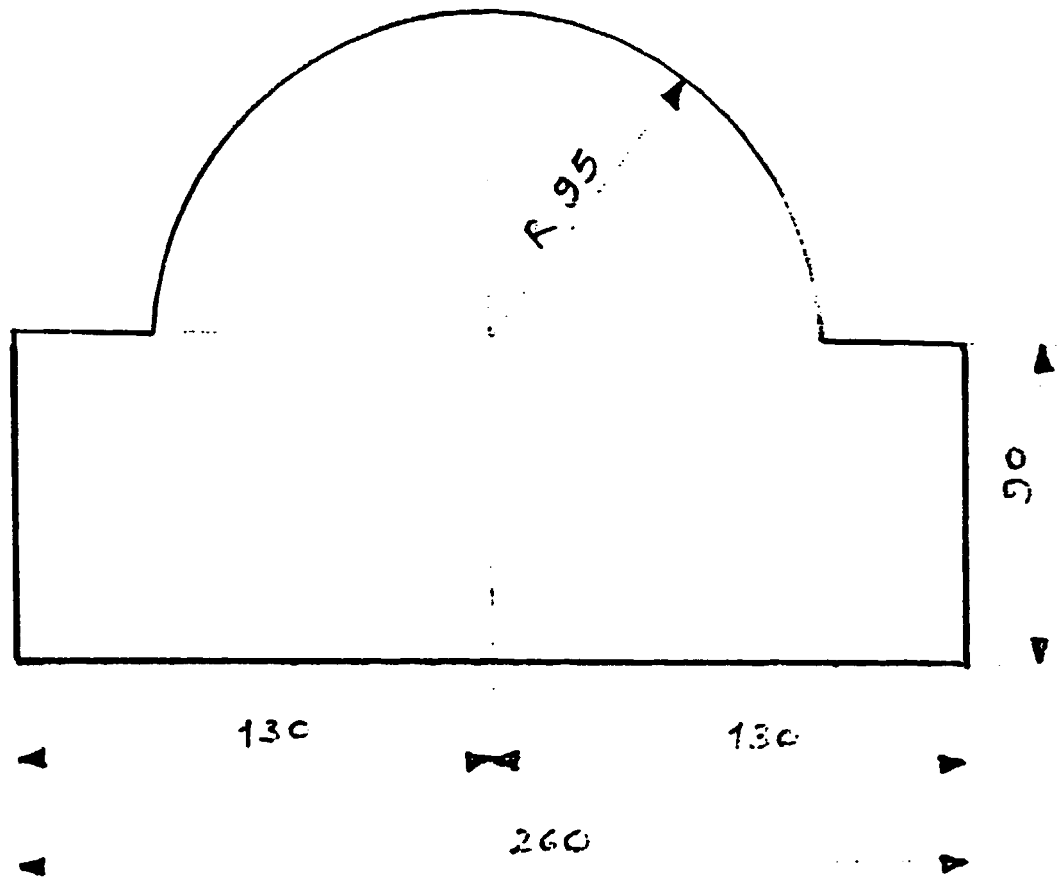
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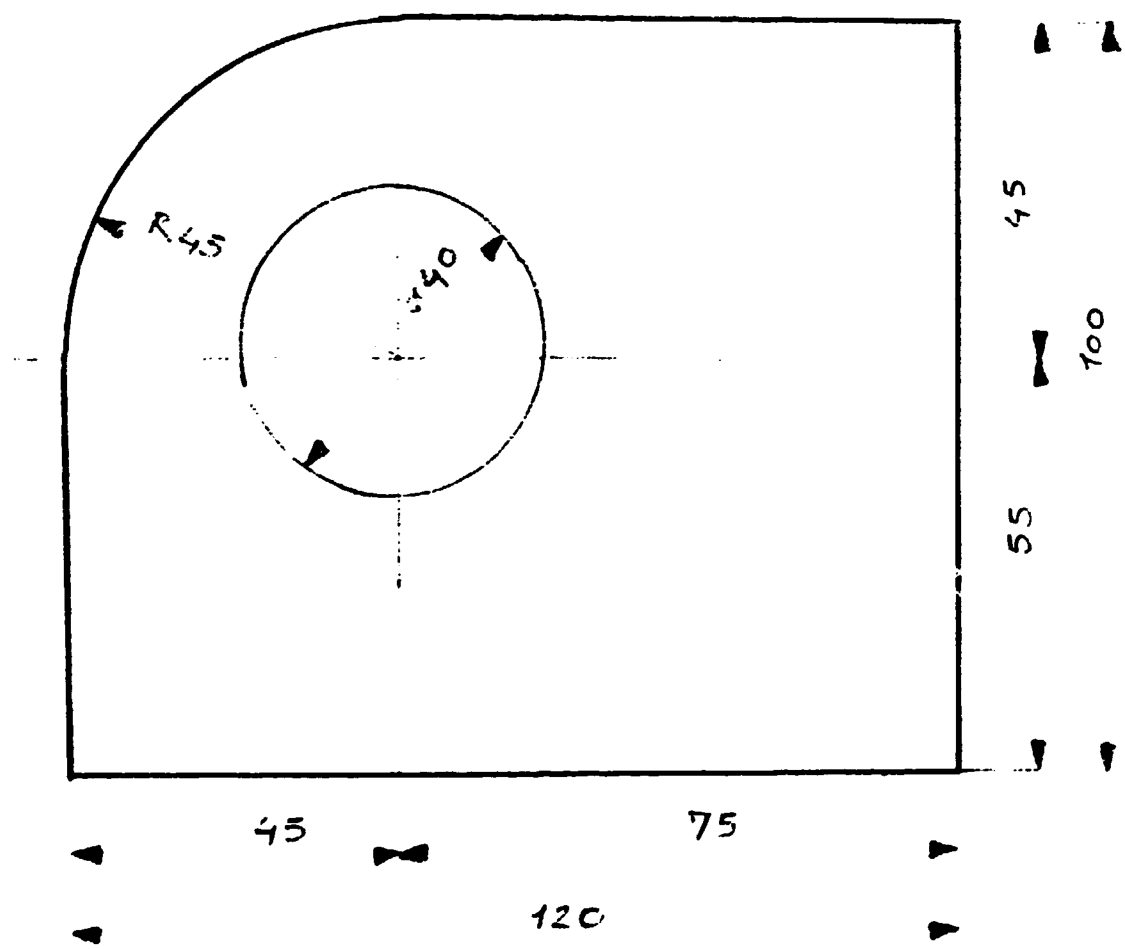
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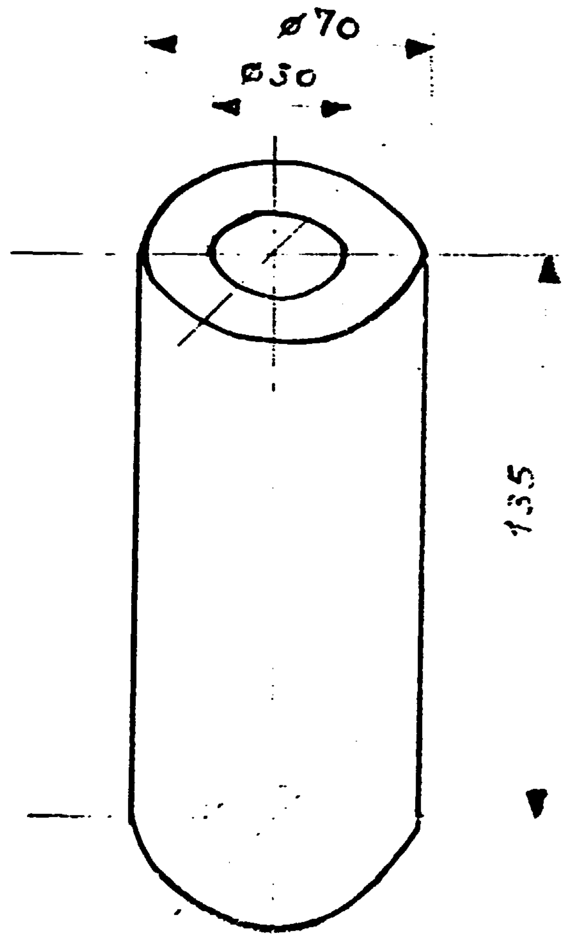
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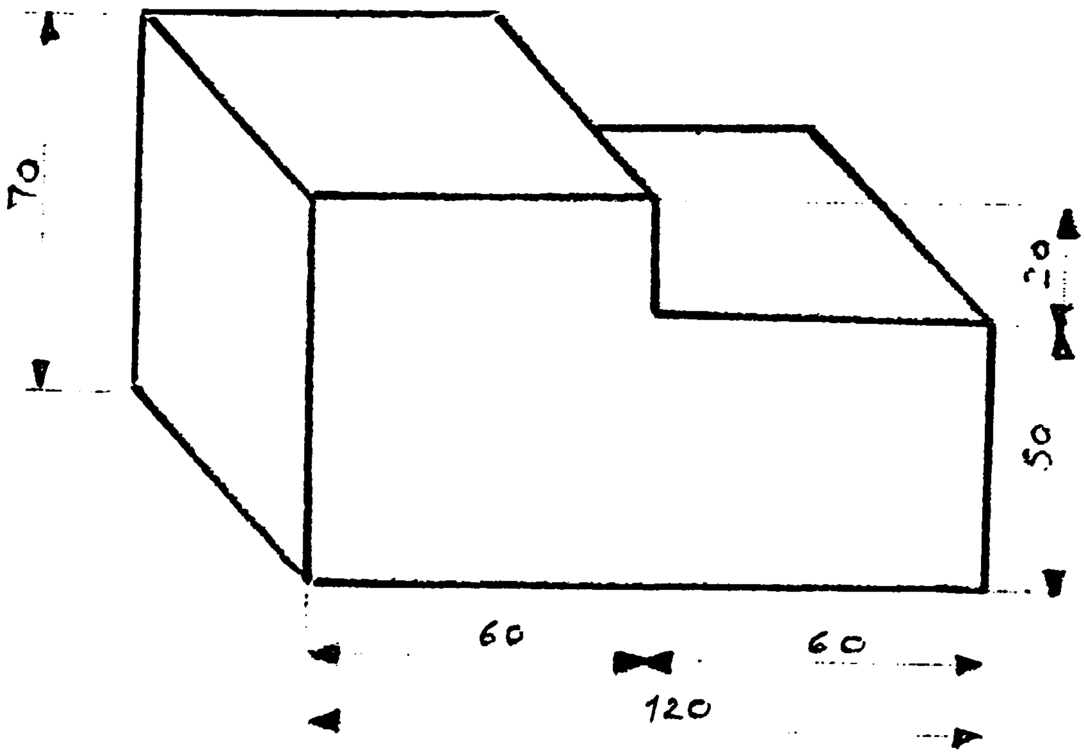
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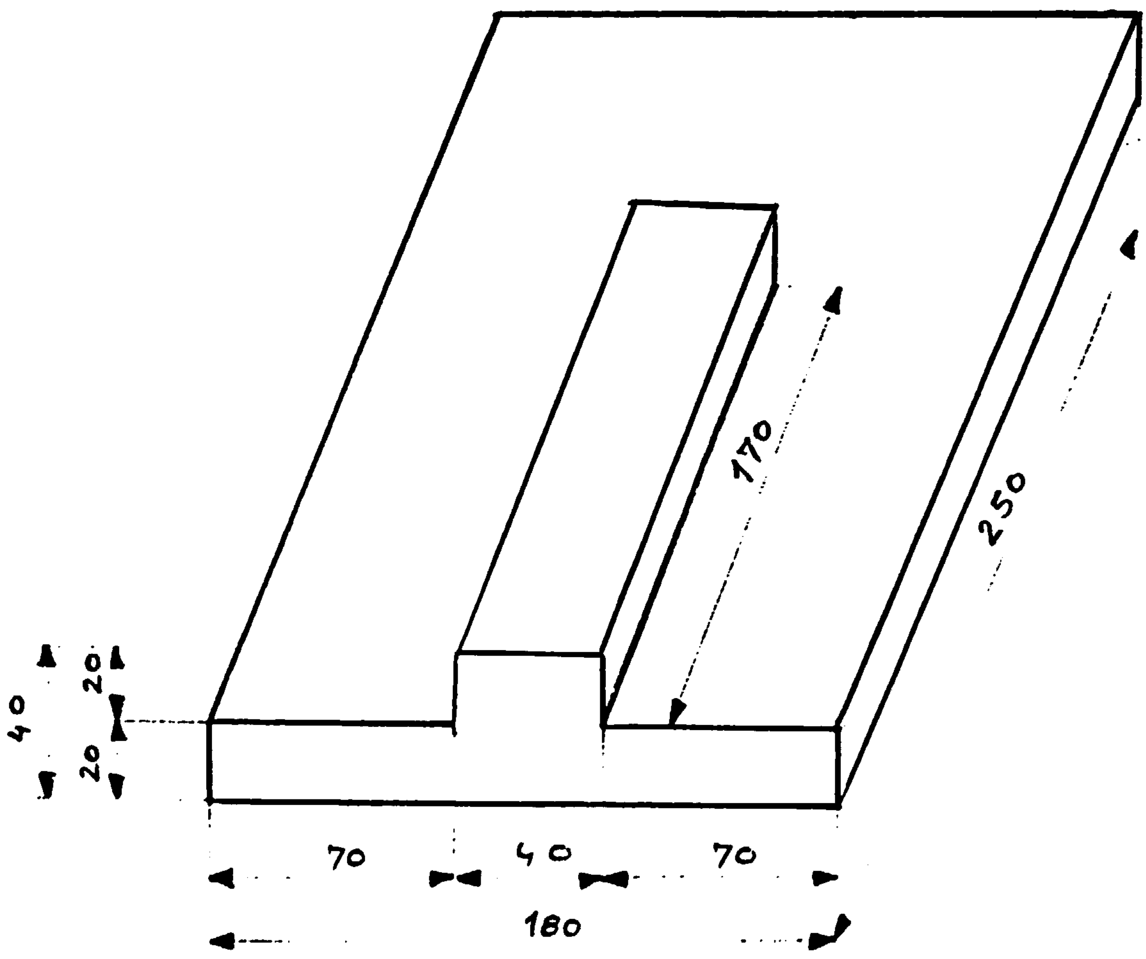

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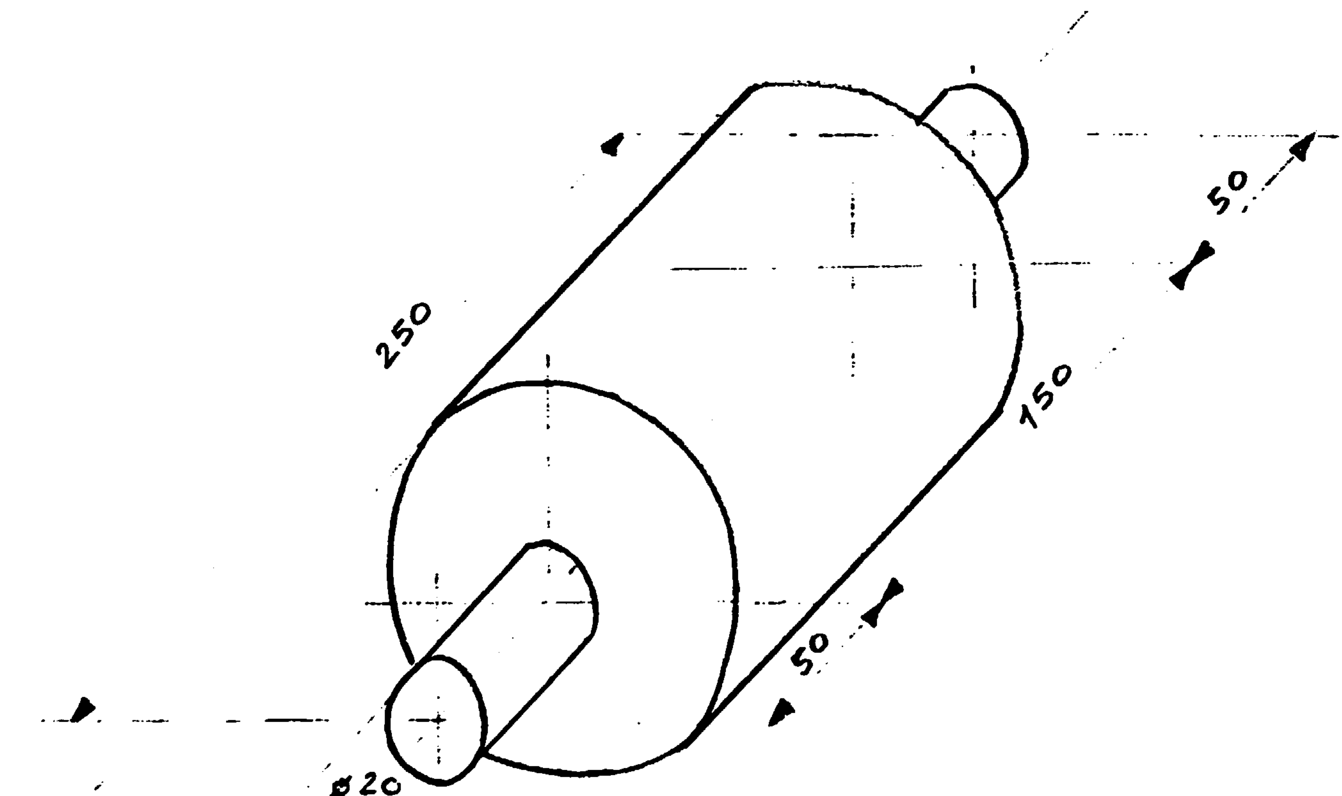

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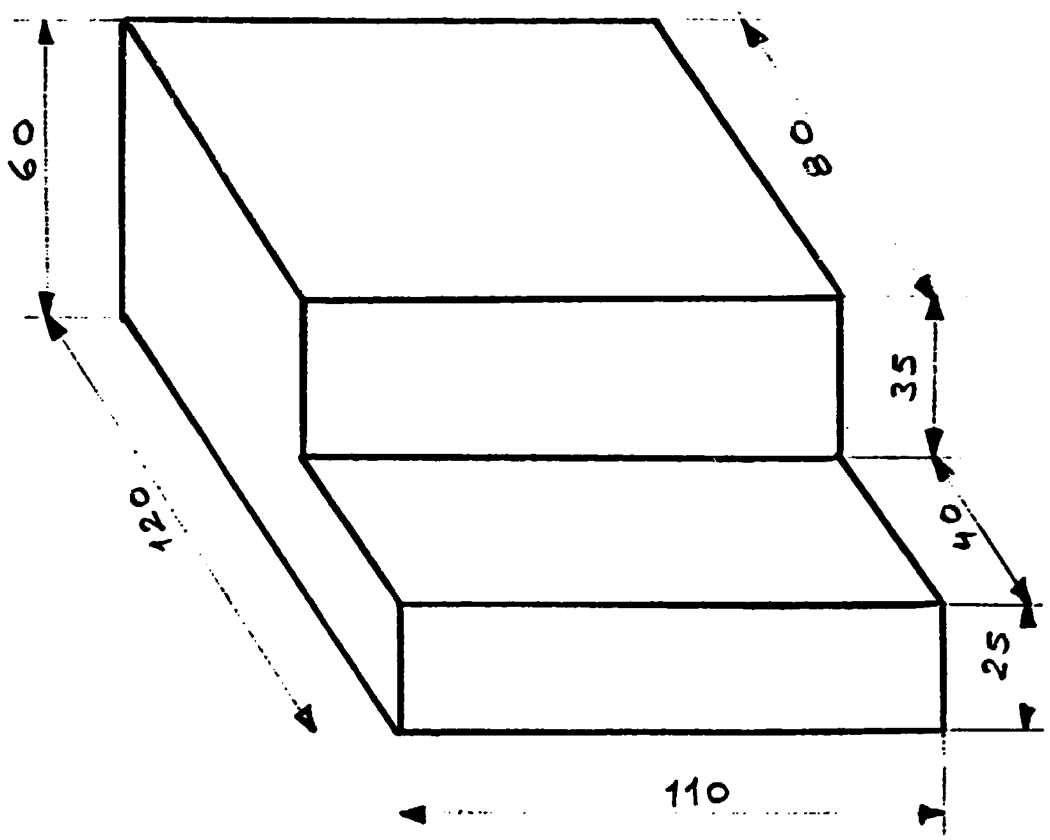
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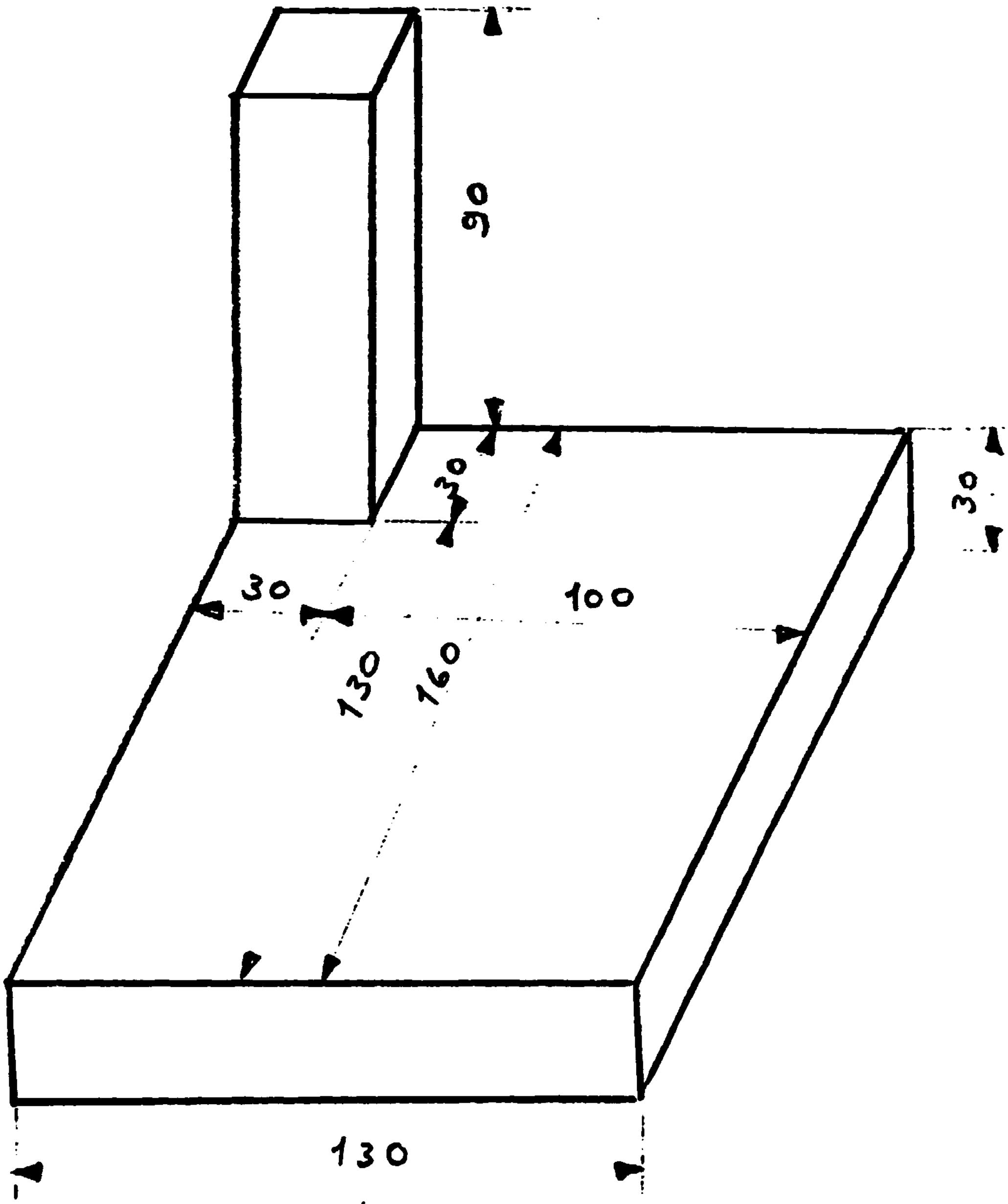
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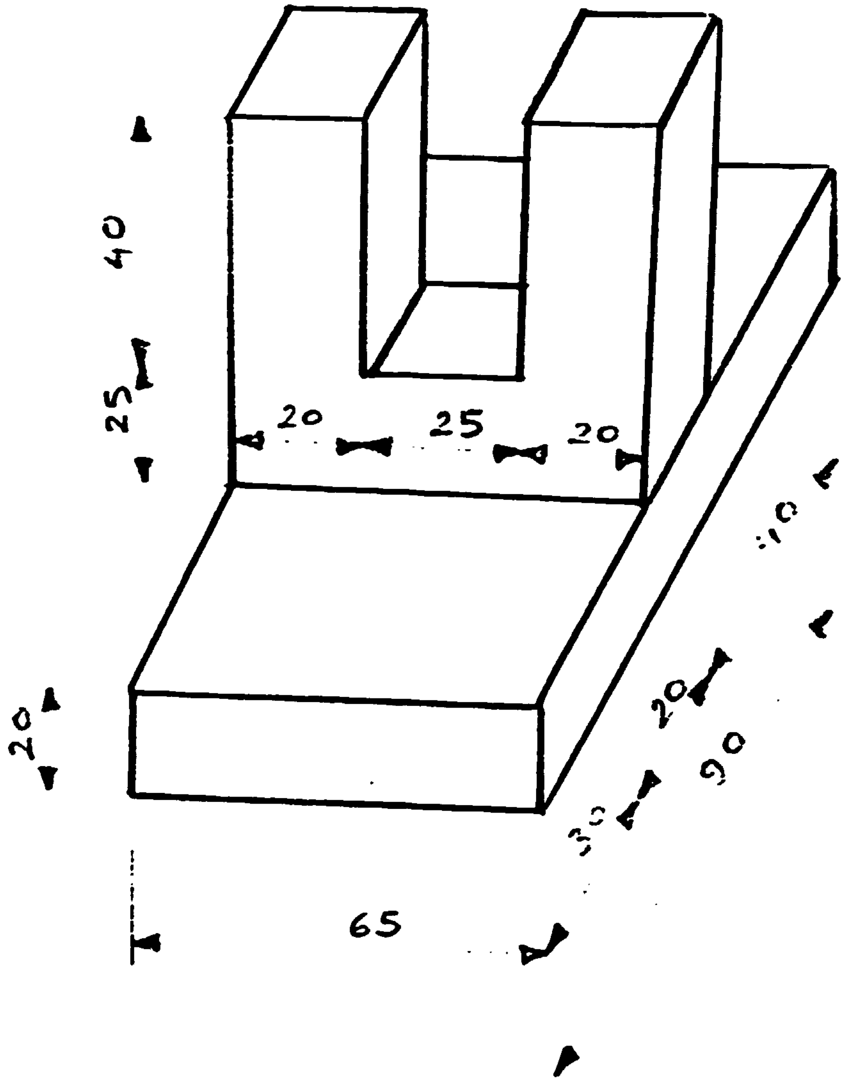
40
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20
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90
65

GEAR MAKING

In order to produce gears necessary for designed implements and for customer requirements machine shop operators trained on gear making. However before machine shop in-plant training, available and missing cutters in the stores of [illegible] were determined.

THE LIST OF THE PRESENCE CUTTERS FOR GEAR MANUFACTURING

The cutters which are present at store in FMW are marked on list with " x". Each cross shows one cutter.

Module	Using area Theeth numbers	Step Number	Store	Module	Using area Theeth numbers	Step Number	Store
I	I2 - I3	I	x	I.75	I2 - I3	I	x
I	I4 - I6	2	x	I.75	I4 - I6	2	xx
I	I7 - 20	3	xx	I.75	I7 - 20	3	x
I	2I - 25	4	xx	I.75	2I - 25	4	xx
I	26 - 34	5	x	I.75	26 - 34	5	
I	35 - 54	6		I.75	35 - 54	6	
I	55 - I34	7	x	I.75	55 - I34	7	x
I	I35 -	8	x	I.75	I35 -	8	x
I.25	I2 - I3	I		2	I2 - I3	I	x
I.25	I4 - I6	2	x	2	I4 - I6	2	x
I.25	I7 - 20	3		2	I7 - 20	3	
I.25	2I - 25	4	x	2	2I - 25	4	x
I.25	26 - 34	5		2	26 - 34	5	x
I.25	35 - 54	6		2	35 - 54	6	
I.25	55 - I34	7	xx	2	55 - I34	7	x
I.25	I35 -	8		2	I35 -	8	x
I.5	I2 - I3	I		2.25	I2 - I3	I	
I.5	I4 - I6	2	x	2.25	I4 - I6	2	x
I.5	I7 - 20	3		2.25	I7 - 20	3	
I.5	2I - 25	4		2.25	2I - 25	4	x
I.5	26 - 34	5		2.25	26 - 34	5	
I.5	35 - 54	6	x	2.25	35 - 54	6	
I.5	55 - I34	7	x	2.25	55 - I34	7	x
I.5	I35 -	8	x	2.25	I35 -	8	

Module	Using area Teeth numbers	Step Number	Store	Module	Using area Teeth numbers	Step Number	Store
2.5	I2 - I3	I	x	3.5	I2 - I3	I	
2.5	I4 - I6	2	x	3.5	I4 - I6	2	x
2.5	I7 - 20	3		3.5	I7 - 20	3	
2.5	2I - 25	4	x	3.5	2I - 25	4	x
2.5	26 - 34	5		3.5	26 - 34	5	
2.5	35 - 54	6		3.5	35 - 54	6	
2.5	55 - I34	7	x	3.5	55 - I34	7	x
2.5	I35 -	8		3.5	I35 -	8	
2.75	I2 - I3	I		3.75	I2 - I3	I	
2.75	I4 - I6	2	x	3.75	I4 - I6	2	x
2.75	I7 - 20	3		3.75	I7 - 20	3	
2.75	2I - 25	4	x	3.75	2I - 25	4	x
2.75	26 - 34	5		3.75	26 - 34	5	
2.75	35 - 54	6		3.75	35 - 54	6	
2.75	55 - I34	7	x	3.75	55 - I34	7	x
2.75	I35 -	8		3.75	I35 -	8	
3	I2 - I3	I		4	I2 - I3	I	
3	I4 - I6	2	x	4	I4 - I6	2	x
3	I7 - 20	3		4	I7 - 20	3	
3	2I - 25	4	x	4	2I - 25	4	x
3	26 - 34	5		4	26 - 34	5	
3	35 - 54	6		4	35 - 54	6	x
3	55 - I34	7	x	4	55 - I34	7	x
3	I35 -	8		4	I35 -	8	
3.25	I2 - I3	I		4.25	I2 - I3	I	
3.25	I4 - I6	2	x	4.25	I4 - I6	2	x
3.25	I7 - 20	3		4.25	I7 - 20	3	
3.25	2I - 25	4	x	4.25	2I - 25	4	x
3.25	26 - 34	5		4.25	26 - 34	5	
3.25	35 - 54	6		4.25	35 - 54	6	
3.25	55 - I34	7	x	4.25	55 - I34	7	x
3.25	I35 -	8		4.25	I35 -	8	

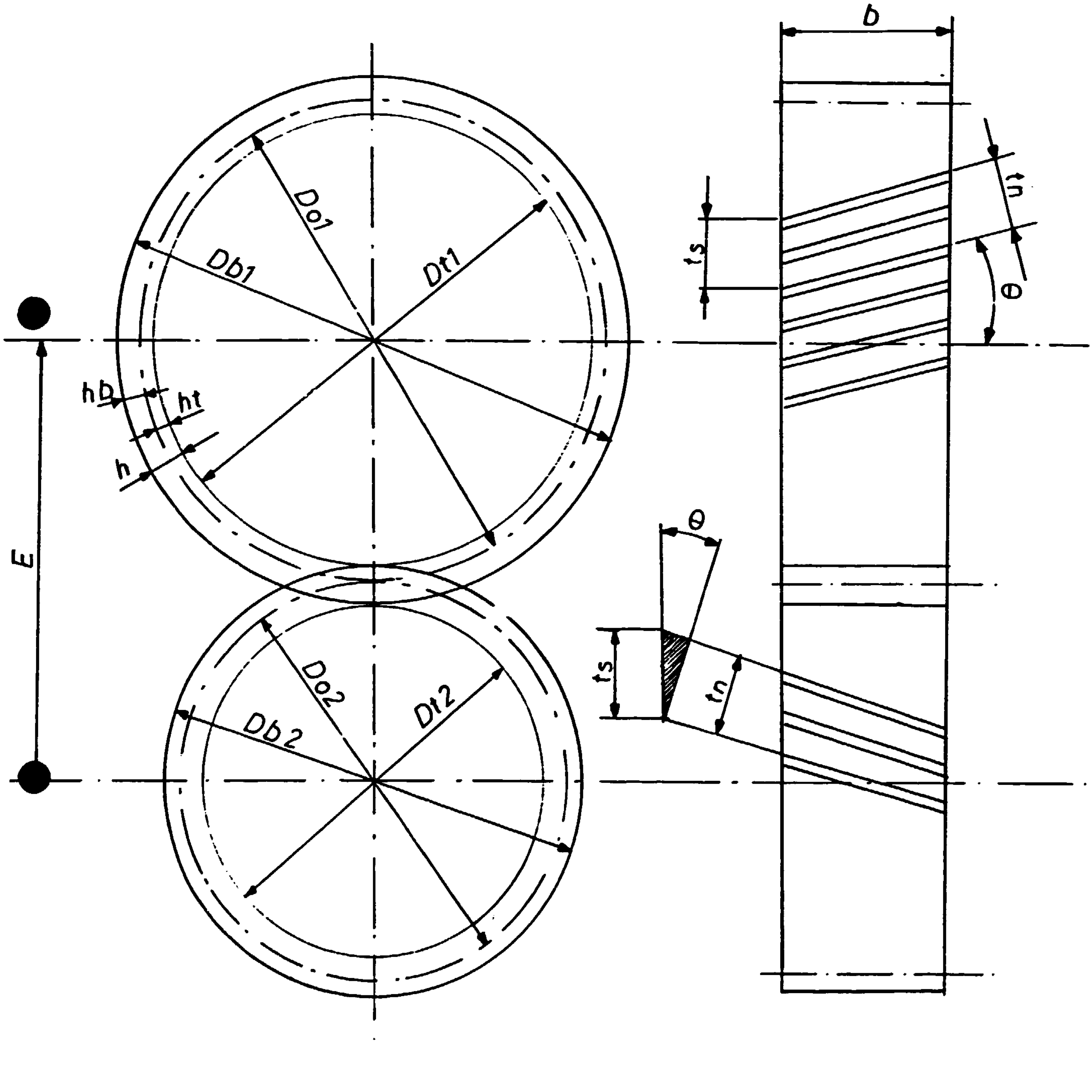
Module	Using area teeth numbers	Step Number	Store	Module	Using area teeth numbers	Step Number	Store
4.5	I2 - I3	I		5.5	I2 - I3	I	
4.5	I4 - I6	2	x	5.5	I4 - I6	2	
4.5	I7 - 20	3		5.5	I7 - 20	3	
4.5	2I - 25	4	x	5.5	2I - 25	4	x
4.5	26 - 34	5		5.5	26 - 34	5	
4.5	35 - 54	6		5.5	35 - 54	6	x
4.5	55 - I34	7	x	5.5	55 - I34	7	
4.5	I35 -	8		5.5	I35 -	8	
4.75	I2 - I3	I		5.75	I2 - I3	I	
4.75	I4 - I6	2	x	5.75	I4 - I6	2	
4.75	I7 - 20	3		5.75	I7 - 20	3	
4.75	2I - 25	4	x	5.75	2I - 25	4	
4.75	26 - 34	5		5.75	26 - 34	5	
4.75	35 - 54	6		5.75	35 - 54	6	
4.75	55 - I34	7	x	5.75	55 - I34	7	
4.75	I35 -	8		5.75	I35 -	8	
5	I2 - I3	I		6	I2 - I3	I	x
5	I4 - I6	2		6	I4 - I6	2	x
5	I7 - 20	3		6	I7 - 20	3	
5	2I - 25	4		6	2I - 25	4	x
5	26 - 34	5		6	26 - 34	5	
5	35 - 54	6		6	35 - 54	6	
5	55 - I34	7		6	55 - I34	7	x
5	I35 -	8		6	I35 -	8	
5.25	I2 - I3	I		6.25	I2 - I3	I	
5.25	I4 - I6	2		6.25	I4 - I6	2	
5.25	I7 - 20	3		6.25	I7 - 20	3	
5.25	2I - 25	4		6.25	2I - 25	4	
5.25	26 - 34	5		6.25	26 - 34	5	
5.25	35 - 54	6		6.25	35 - 54	6	
5.25	55 - I34	7		6.25	55 - I34	7	
5.25	I35 -	8		6.25	I35 -	8	

Module	Using area Teeth numbers	Step Number	Store
6.5	I2 - I3	I	
6.5	I4 - I6	2	
6.5	I7 - 20	3	
6.5	2I - 25	4	
6.5	26 - 34	5	x
6.5	35 - 54	6	
6.5	55 - I34	7	
6.5	I35 -	8	
6.75	I2 - I3	I	
6.75	I4 - I6	2	
6.75	I7 - 20	3	
6.75	2I - 25	4	
6.75	26 - 34	5	
6.75	35 - 54	6	
6.75	55 - I34	7	
6.75	I35 -	8	
7	I2 - I3	I	
7	I4 - I6	2	
7	I7 - 20	3	x
7	2I - 25	4	
7	26 - 34	5	x
7	35 - 54	6	x
7	55 - I34	7	
7	I35 -	8	

TECHNOLOGICAL INFORMATION ABOUT HELIX GEAR

HELIX GEAR:

Symbol	Name	Formula
Θ	Helix angle	$\mathrm{Cos}\ \Theta : \frac{mn}{ms} : \frac{tn}{ts}$
d	Angle between centres	$d : \Theta I + \Theta 2$
mn	Normal module	$mn : \frac{tn}{pi} : ms \times \mathrm{Cos}\ \Theta$
ms	Circular module	$ms : \frac{ts}{pi} : \frac{mn}{\mathrm{Cos}\ \Theta} : \frac{Do}{z}$
tn	Normal pitch	$tn : mn \times pi : ts \times \mathrm{Cos}\ \Theta$
ts	Circular pitch	$ts : \frac{tn}{\mathrm{Cos}\ \Theta} : \frac{mn \times pi}{\mathrm{Cos}\ \Theta} : ms \times pi$
Do	Diameter of pitch circle	$Do : ms \times z : \frac{mn \times z}{\mathrm{Cos}\ \Theta} : \frac{tn \times z}{pi \times \mathrm{Cos}\ \Theta}$
Db	Diameter of addendum circle	$Db : Do + (2 \times mn) : mn \times (\frac{z}{\mathrm{Cos}\ \Theta} + 2)$
Dt	Diameter of dedendum circle	$Dt : Do - (2.332 \times mn)$
z	Number of teeth	$z : \frac{Do}{ms} : \frac{Do \times pi}{ts} : \frac{Do \times \mathrm{Cos}\ \Theta}{mn}$
H	Helix pitch	$H : Do \times pi \times \mathrm{Cotg}\ \Theta : \frac{Do \times pi}{\mathrm{tag}\ \Theta} : \frac{mn \times pi \times z}{\mathrm{Sin}\ \Theta}$
b	Gear width	$b : 3 \times tn : IO \times mn : bn \times \mathrm{Cos}\ \Theta$
bn	Tooth length	$bn : \frac{b}{\mathrm{Cos}\ \Theta}$
h	Tooth height	$h : 2.I66 \times mn$
hb	Addendum	$hb : mn : \frac{tn}{pi}$
ht	Dedendum	$ht : I.I66 \times mn : h - hb$
E	Centre distance	$E : \frac{DoI + Do2}{2}$


b
tn
ts
θ
Do1
Db1
Dt1
hb
ht
h
E
θ
ts
tn
Do2
Dt2
Db2

Subject: Helix gear calculation for Macaroni Factory in Mogadiscio

θ : 20 degrees

z : 80

Dt : 82.8 mm

b : I3 mm

Dt : Do -(2.332 X mn)

Dt : $\frac{mn \times z}{\cos\theta}$ - (2.332 X mn)

mn : $\frac{Dt}{\left(\frac{z}{\cos\theta} - 2.332\right)}$: $\frac{82.8}{\left(\frac{80}{\cos 20} - 2.332\right)}$: I mm

ms : $\frac{mn}{\cos\theta}$: $\frac{I}{\cos 20}$: I.064 mm

tn : mn X pi : I X 3.I4I59 : 3.I4 mm

ts : $\frac{mn \times pi}{\cos\theta}$: $\frac{I \times 3.I4I59}{\cos 20}$: 3.34 mm

Do : $\frac{mn \times z}{\cos\theta}$: $\frac{I \times 80}{\cos 20}$: 85.I3 mm

Db : Do - (2 X mn) . 85.I3 - (2 X I) : 87.I3 mm

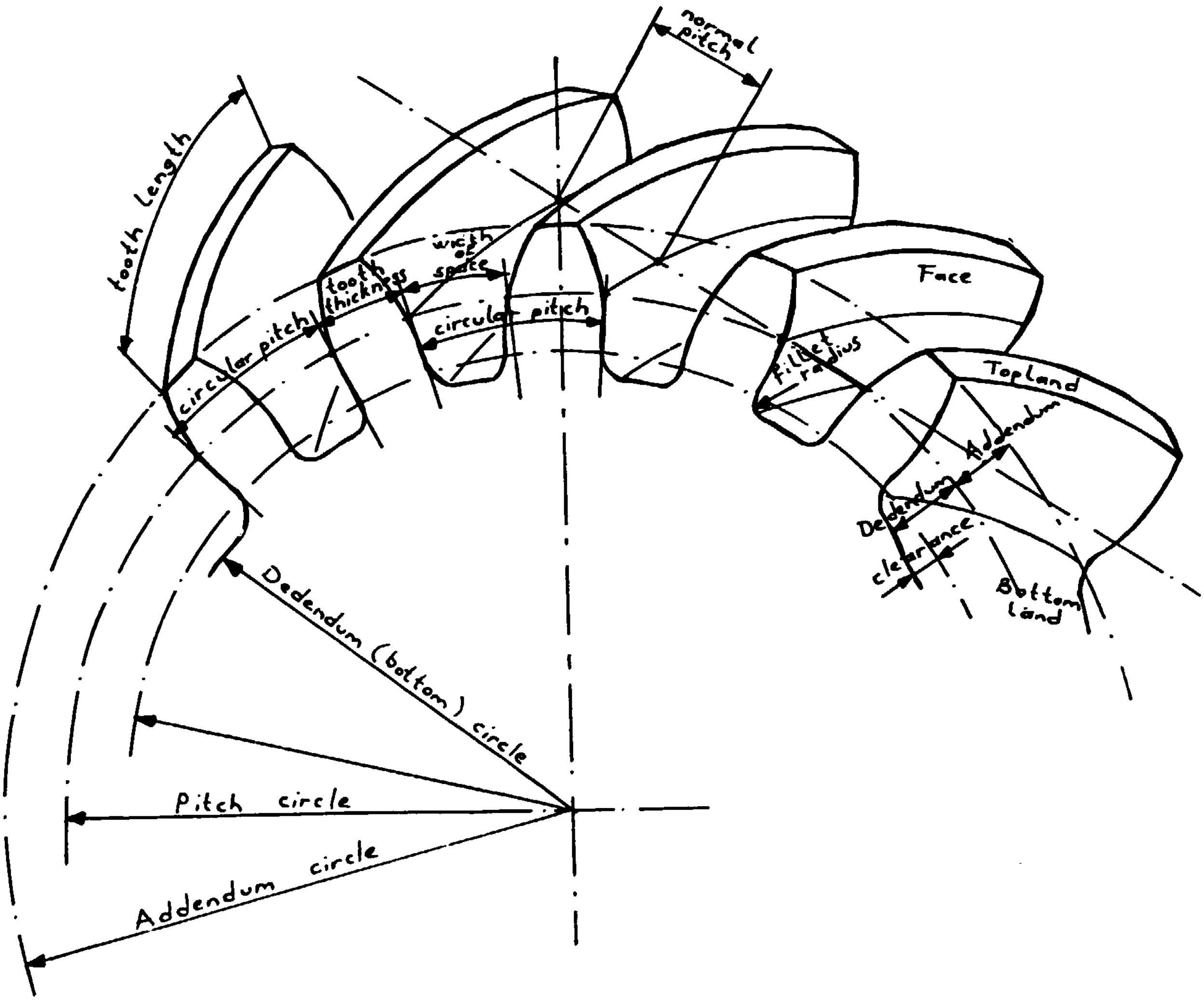
E : $\frac{mn \times pi \times z}{\sin\theta}$: $\frac{I \times 3.I4I59 \times 80}{\sin 20}$: 734.8 mm

bn : $\frac{b}{\cos\theta}$: $\frac{I3}{\cos 20}$: I3.83 mm

h : 2.I66 X mn : 2.I66 X I : 2.I66 mm

hb : mn : I mm

ht : I.I66 X mn : I.I66 X I : I.I66 mm



tooth length
normal pitch
width of space
tooth thickness
circular pitch
circular pitch
Face
fillet radius
Topland
Addendum
Dedendum
clearance
Bottom land
Dedendum (bottom) circle
Pitch circle
Addendum circle

TECHNICAL INFORMATION ABOUT POWER TRANSMISSION

Expressions:

- M : Rotary movement (kgcm)
- P : Power (kw or HP)
- N : Turn (rpm)
- F : Force (kg)
- v : Linear speed (m/s)
- D : Diameter (cm)
- pi: Symbol of the ratio of the circumference of a circle to its diameter (ie 3.I4I59)
- w : Rotary speed (I/s)
- r : Radius (cm)

Mathematical Symbols:

- Rotary movement : $\frac{\text{Power}}{\text{Turn}}$

$M : 97400 \frac{P}{N}$ -Power as kw

$M : 71620 \frac{P}{N}$ -Power as HP

- Power : Force X Linear speed

$P : F \times v$

- Force : $\frac{\text{Rotary movement}}{\text{Radius}}$

$F : \frac{M}{r}$

- Linear speed : $\frac{\text{pi} \times \text{Diameter} \times \text{Turn}}{60}$

$v : \frac{3.14159 \times D \times N}{60}$

- Linear speed : Rotary speed X Radius

$v : w \times r$

- Rotary speed : $\frac{Pi \times Turn}{30}$

$w : \frac{3.14159 \times N}{30}$

Power Transmission Calculations for Bandsaw Machine:

Machine is operated by an electric motor. There is a pulley is connected to the motor shaft. The movement is transported to another pulley by belt. The shaft which carries the second pulley has a drive wheel for blade.

Electric motor specifications:

P : 4 (kw)

N : 2870 (rpm)

Transmission system specifications:

Diameter of pulleys and drive wheels.

DI : II0 (cm)

D2 : 470 (cm)

D3 : 80 (cm)

" It is required the linear speed of bandsaw blade is 20 metres per minute."

Present situation:

<u>Pulley I.</u>

$M : 97400 \frac{4}{2870} : 136$ (kgcm)

NI : 2870 (rpm)

<u>Between Pulley I. and Pulley 2.</u>

NI X DI : N2 X D2

$$N2 : \frac{NI \times DI}{D2}$$

$$N2 : \frac{2870 \times II0}{470} : 672 \text{ (rpm)}$$

Drive Wheel

$$v : \frac{pi \times D3 \times N2}{60}$$

$$v : \frac{3.I4I59 \times 0.8 \times 672}{60} : 28.I5 \text{ (m/s)}$$

$$v : 28.I5 \times 60 : I689 \text{ (m/min.)}$$

$$F : \frac{2 \times M}{D3}$$

$$F : \frac{2 \times I36}{80} : 3.4 \text{ (kg)}$$

" It is required:

$$v : 20 \text{ (m/min.)}$$

Application:

New electric motor specifications:

P : 2 (kw)

N : I400 (rpm)

Also it is fixed, a reductor between the electric motor and pulley to reduce the turn. The ratio of the reducing is I:35

New turn: NI: 40 (rpm)

Pulley I.

$$M : 97400 \frac{2}{I400} : I39 \text{ (kgcm)}$$

NI: 40 (rpm)

Between Pulley I. and Pulley 2.

$$N2 : \frac{40 \times II0}{470} : 9.36 \text{ (rpm)}$$

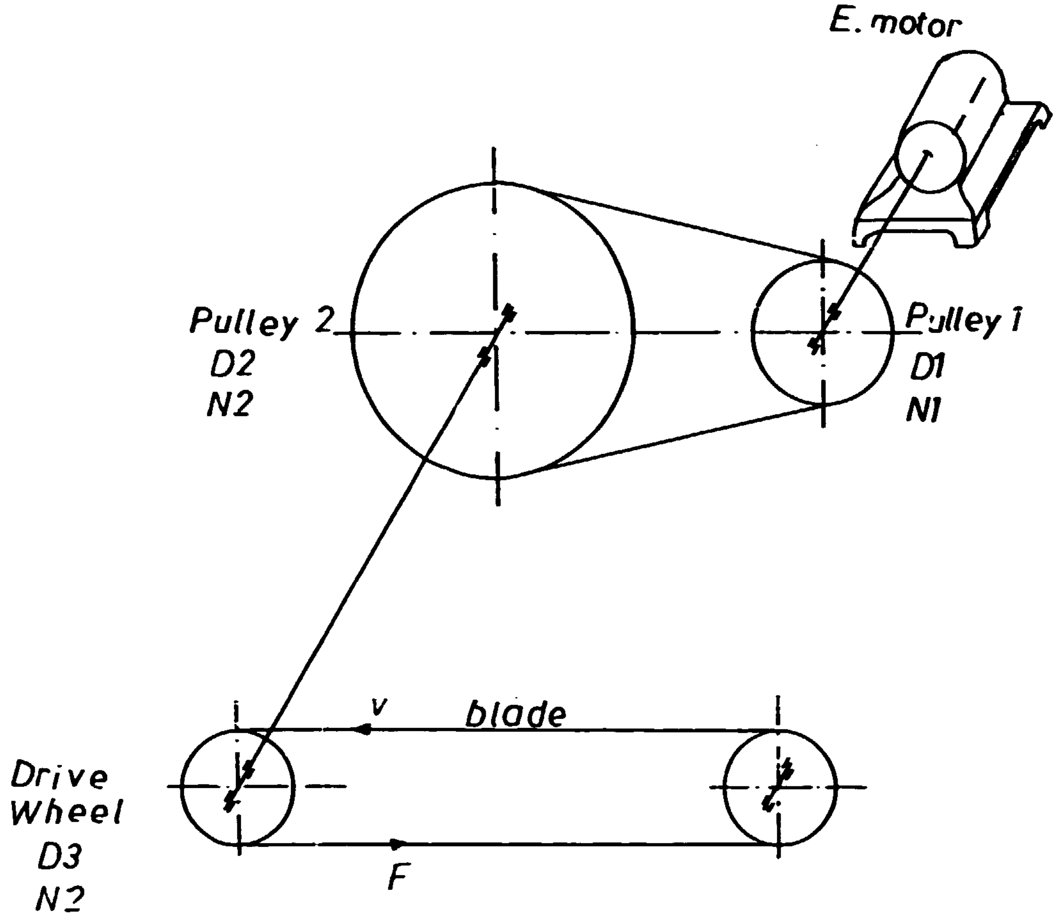
Drive Wheel

$$v : \frac{3.14159 \times 0.8 \times 9.36}{60} : 0.39 \ (m/s)$$

$$v : 0.39 \times 60 : 23.4 \ (m/min.)$$

$$F : \frac{2 \times 139}{80} : 3.475 \ (kg)$$

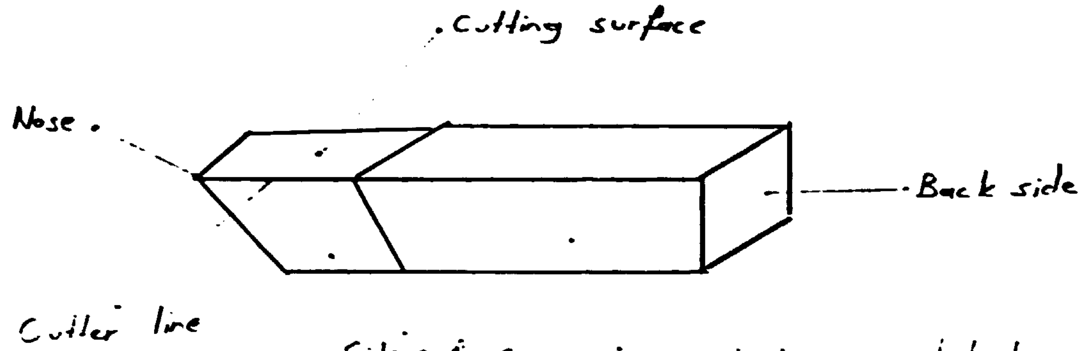
Linear speed v: 23.4 (m/min.) is approximately equal to required linear speed. It can be used for this purpose.



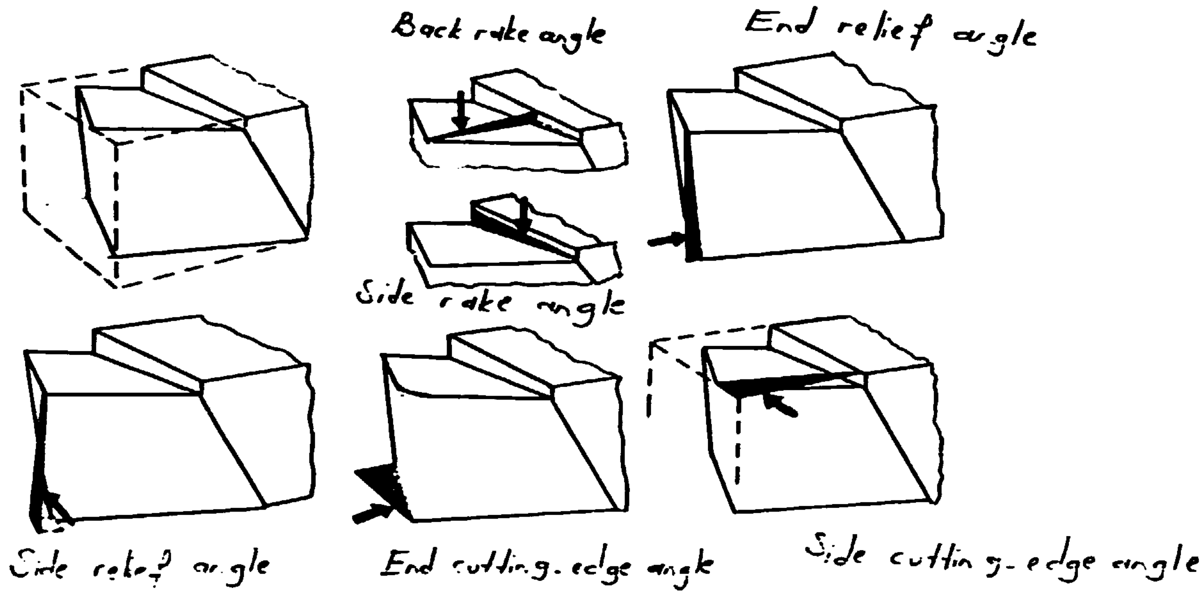
Bandsaw Machine Power Transmission System

TECHNOLOGICAL INFORMATION ABOUT CUTTER ANGLES, DIE CASTING SET, DRAWING OF CASTING PIECE, DRAWING OF DRILLING MACHINE BOLT.

During the field work, several times technological informations about different subjects were given to the counterparts, also some drawings were made for production line. Technological information about cutter angles, die casting set, drawing of casting piece and drawing of drilling machine bolt were put in this report to give some examples of this kind of services.



Cutting tool cou and body



Back rake angle is the angle between the cutting face of the tool and holder, measured parallel to the side of the holder.

Side rake angle is the angle between the cutting face of the tool and holder, measured perpendicular to the side of the holder

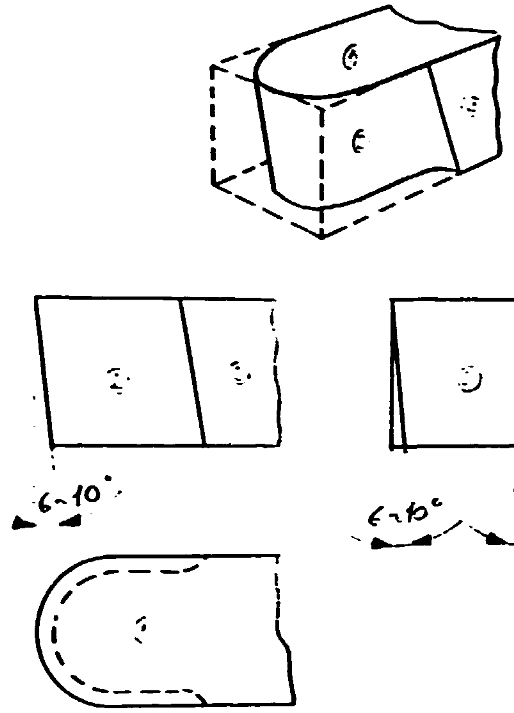
End relief angle is the angle between the end face of the tool and a line drawn from the cutting edge perpendicular to the base of the holder

Side relief angle is the angle between the side flank immediately below the side cutting edge and a line drawn through the side cutting edge perpendicular to the base of the tool holder

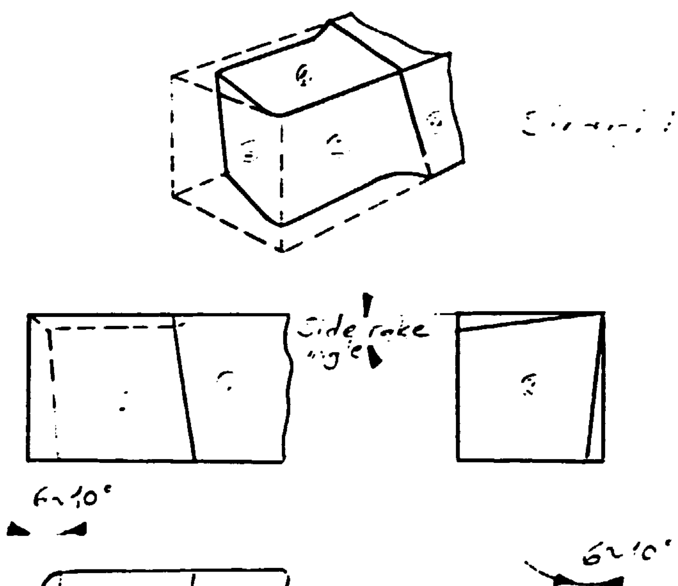
End cutting-edge angle is the angle between the end cutting edge of the tool and a line perpendicular to the side of the shank

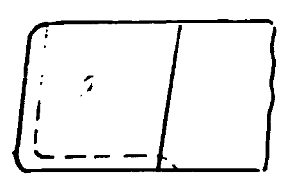
Side cutting angle is the angle between the side cutting edge and the projected side of the holder

Nose radius is the radius on the tool between the end and the side cutting edges

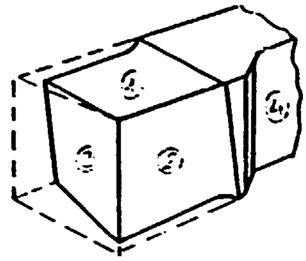


Round nose

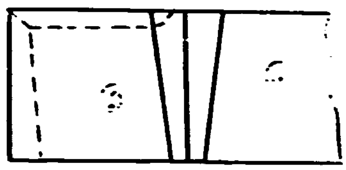


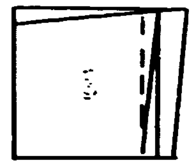


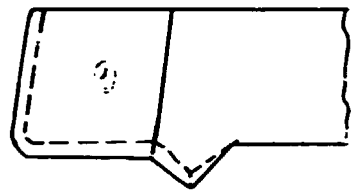
Mild steel	[illegible]
Cast steel	[illegible]
Grey cast iron	[illegible]
Brass	[illegible]
Aluminium	25°

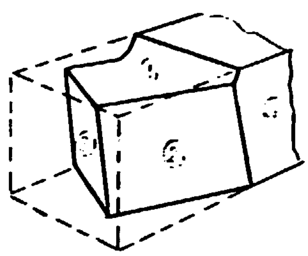


Offset



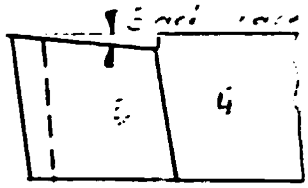


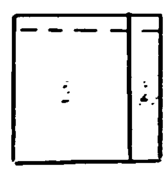


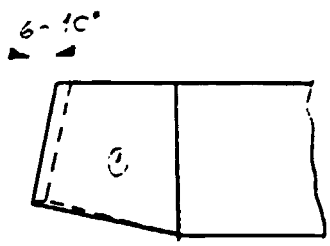


Lead angle

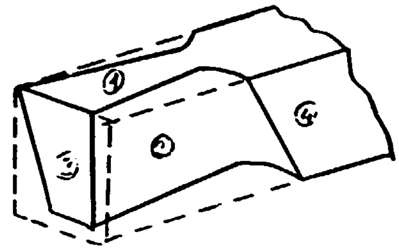
End rake angle

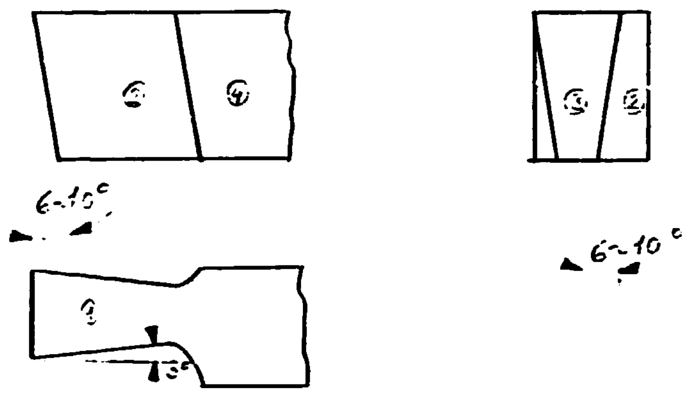


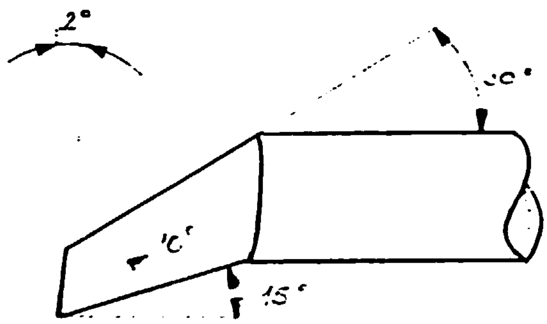




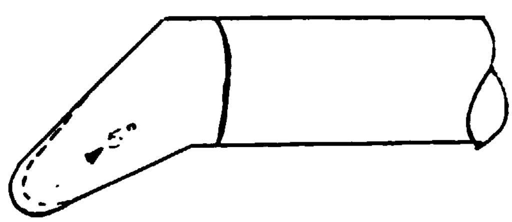
	[illegible] rake angle
Mild steel	15~20°
Cast steel	5~10°
Grey cast iron	-
Brass	-2~-5°
Aluminium	25~30°



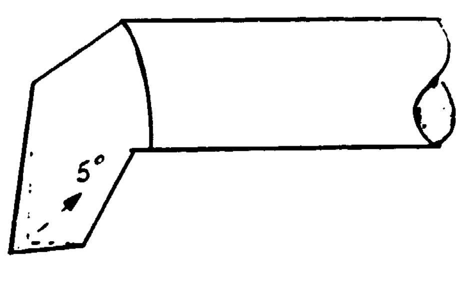




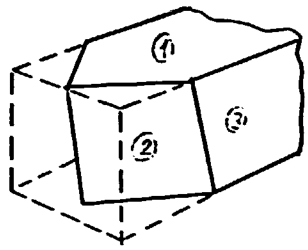
Light turning and facing



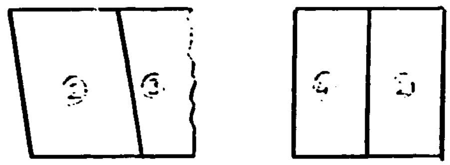
Round nose roughing

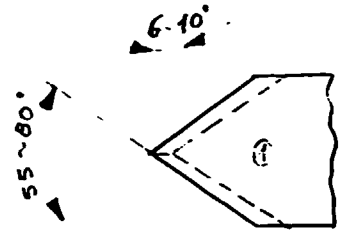


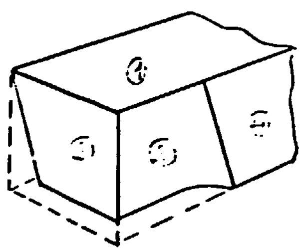
Square nosed roughing



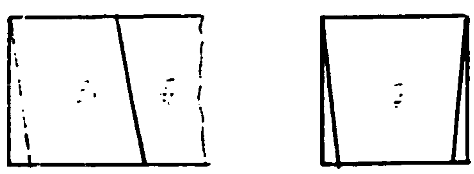
Threading

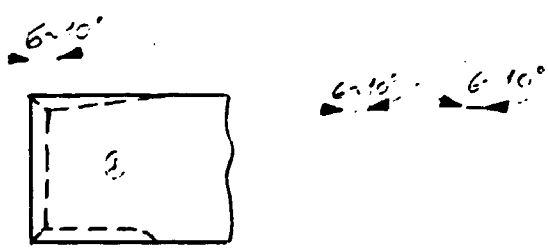




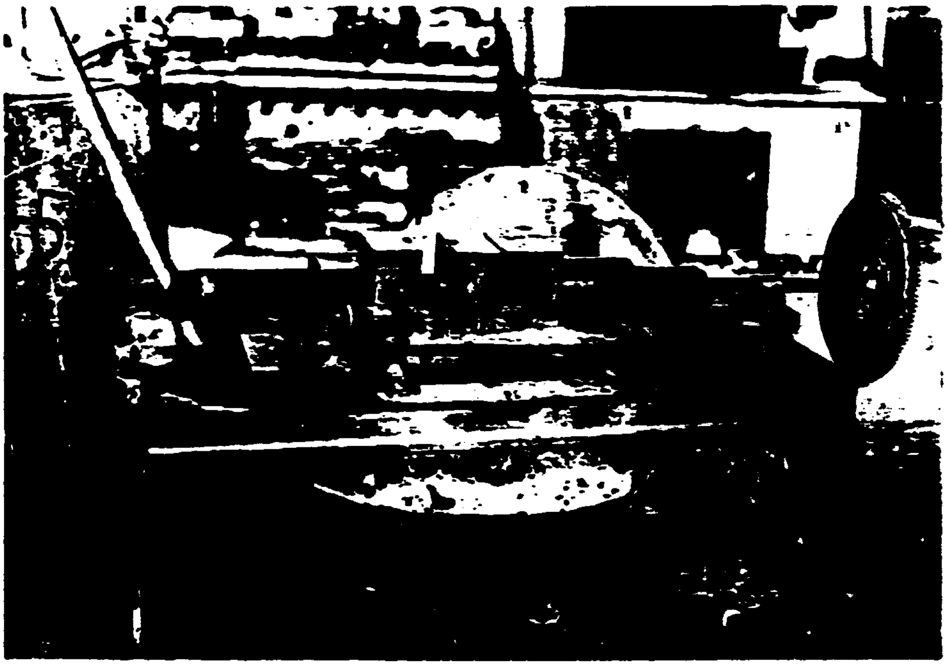


End cutting





Die casting die set



Die casting products

No	Qan.	Description	Drawing No	Scale	Material
6	1	Cover's die part	1.13.06	1:1	140x140x105mm steel
5	1	Cover's die part	1.13.05	1:1	140x140x105mm steel
4	1	Die guide	1.13.04	1:1	140x140x90mm steel
3	1	Die body	1.13.03	1:1	Ø85x340mm steel
2	1	Distance part	1.13.02	1:1	140x140x70mm steel
1	1	Die head	1.13.01	1:1	140x140x80mm steel

Ersin BASTUĞ	Date

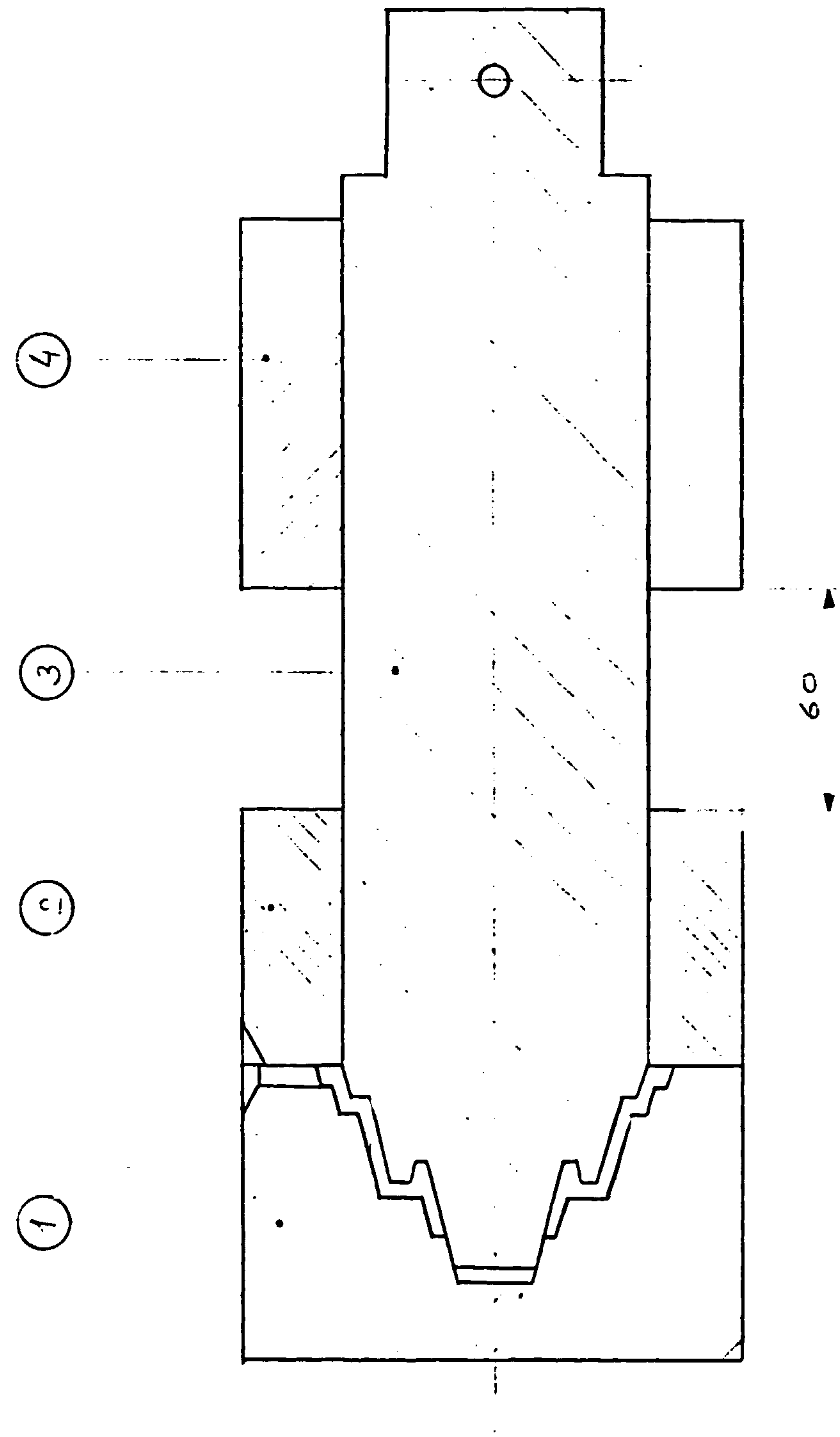
Die Casting

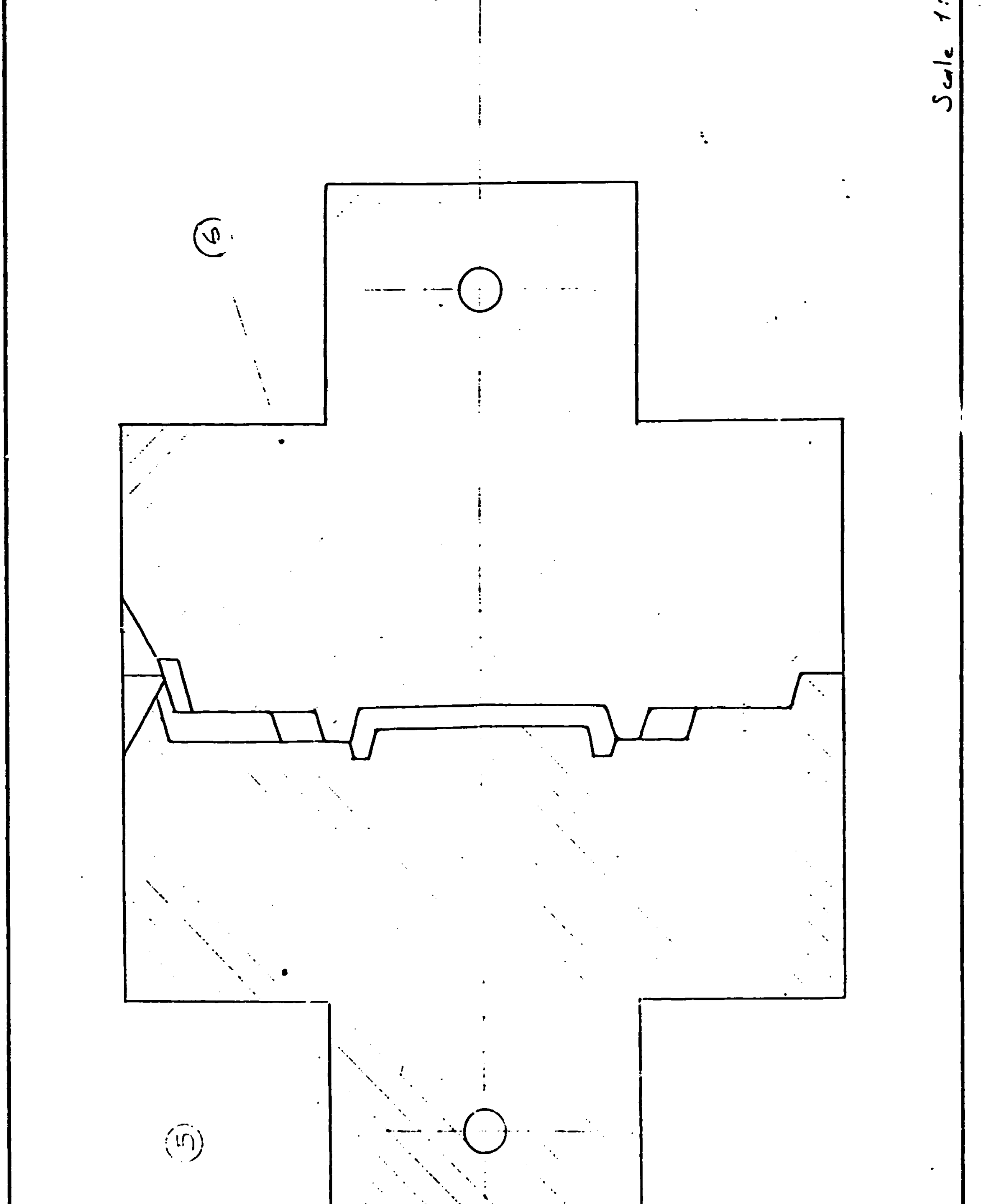
Foundry & Mechanical Workshop

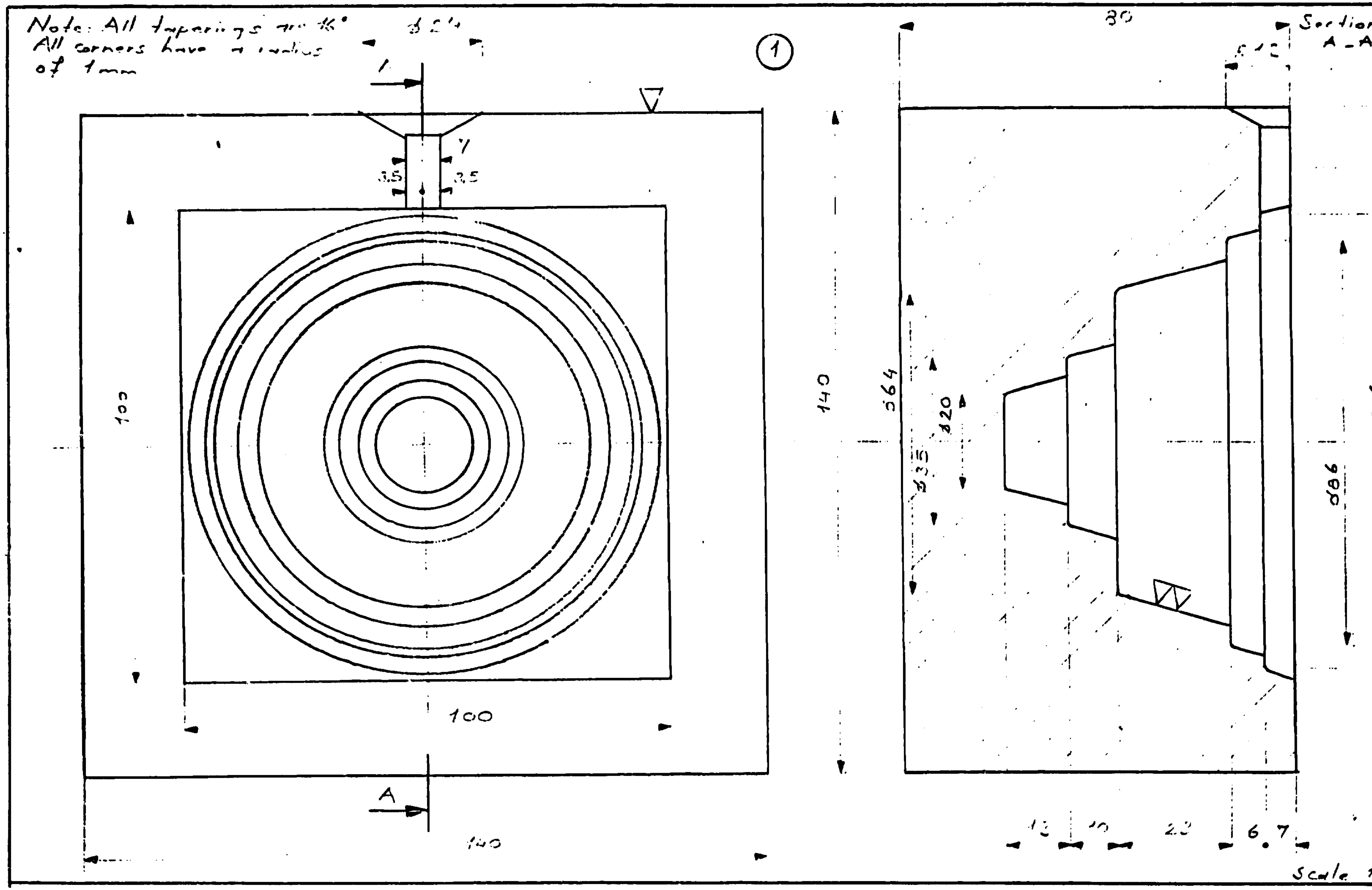
UNIDO

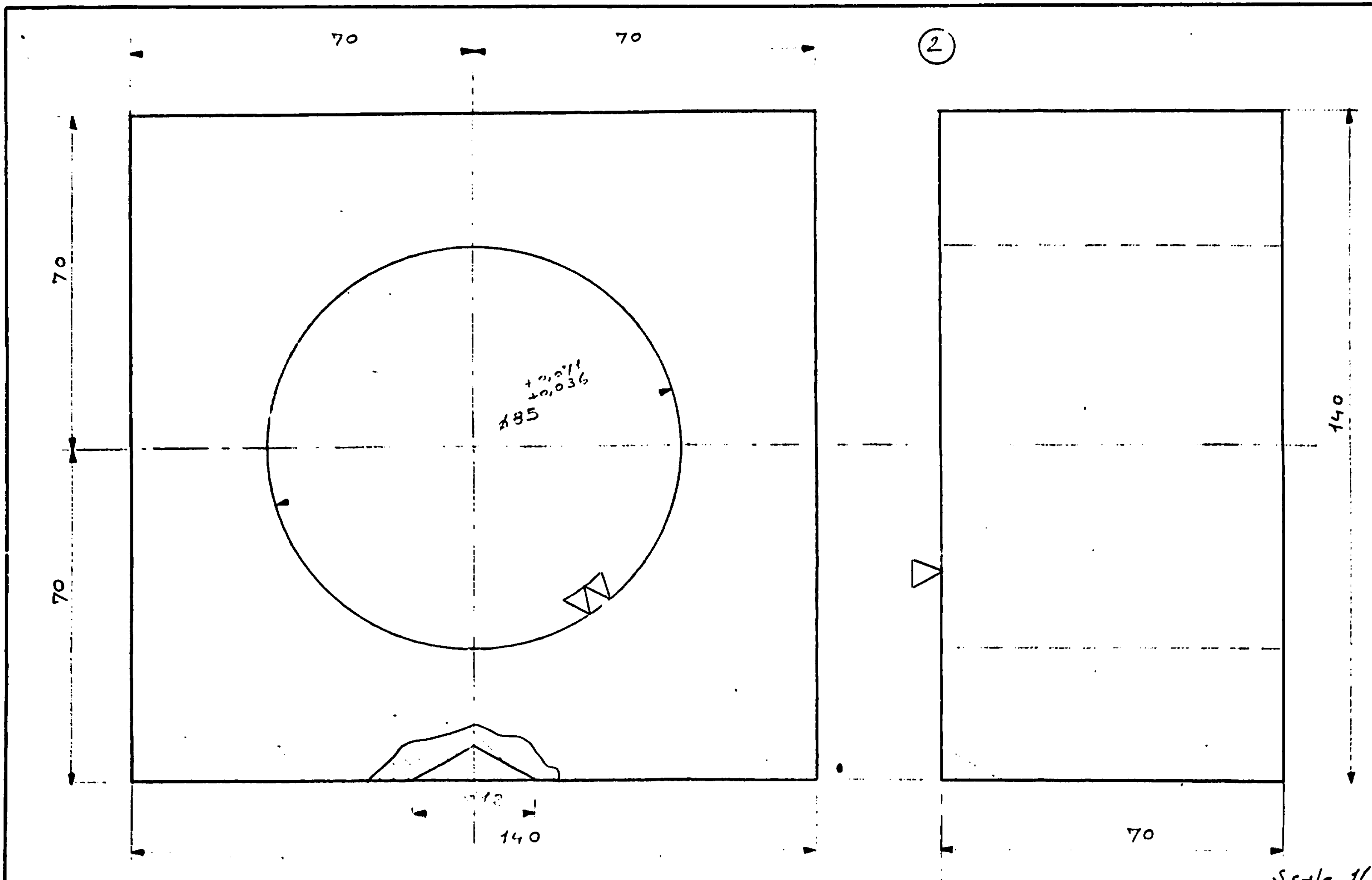
No: 1.13

Scale 1:2



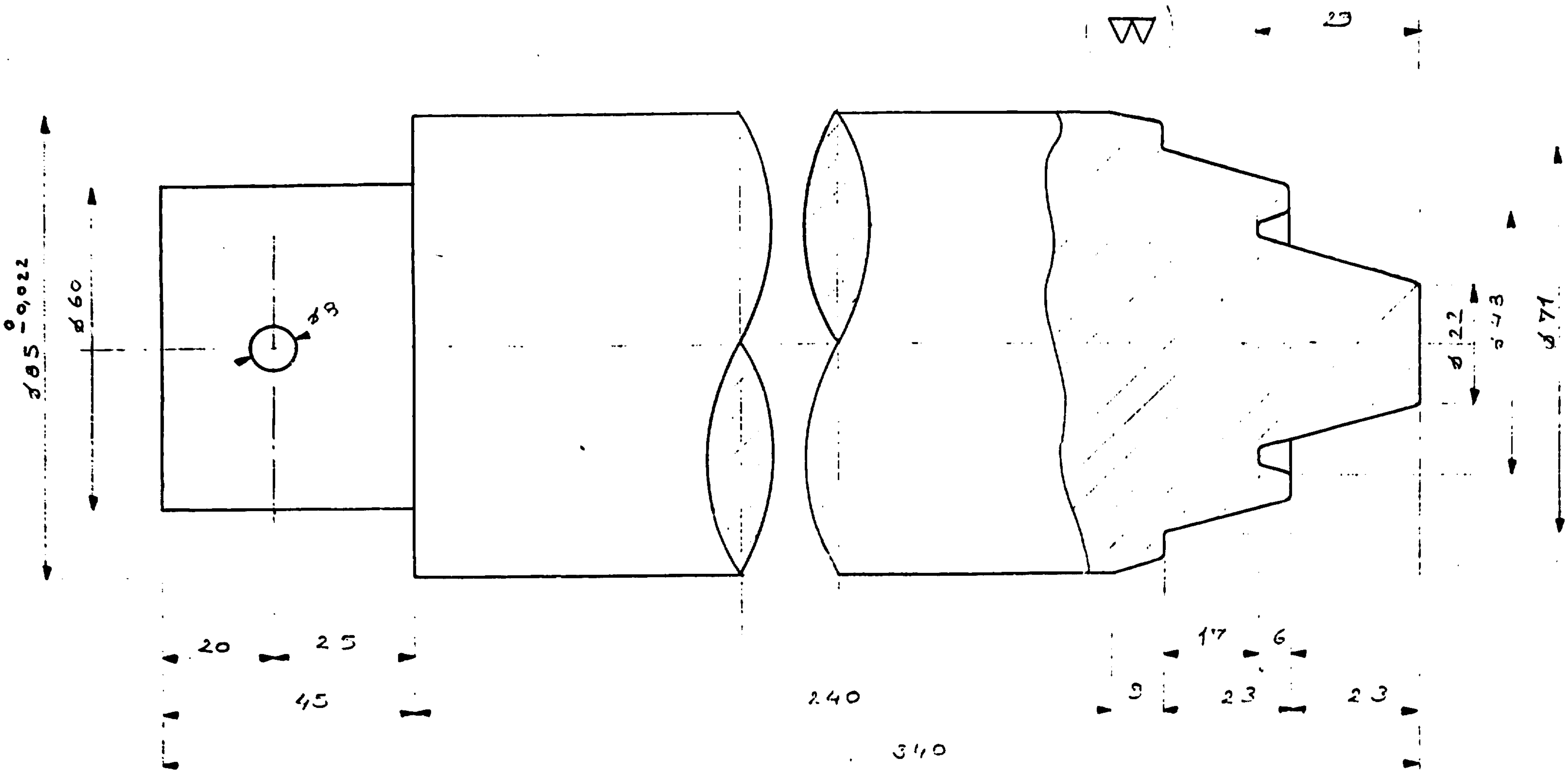

6
5
Scale 1:


Note: All taperings are 15°
All corners have a radius
of 1mm
1
Section
A-A
A
100
140
30
ø64
ø35
ø20
ø86
3.5
6.7
Scale 1

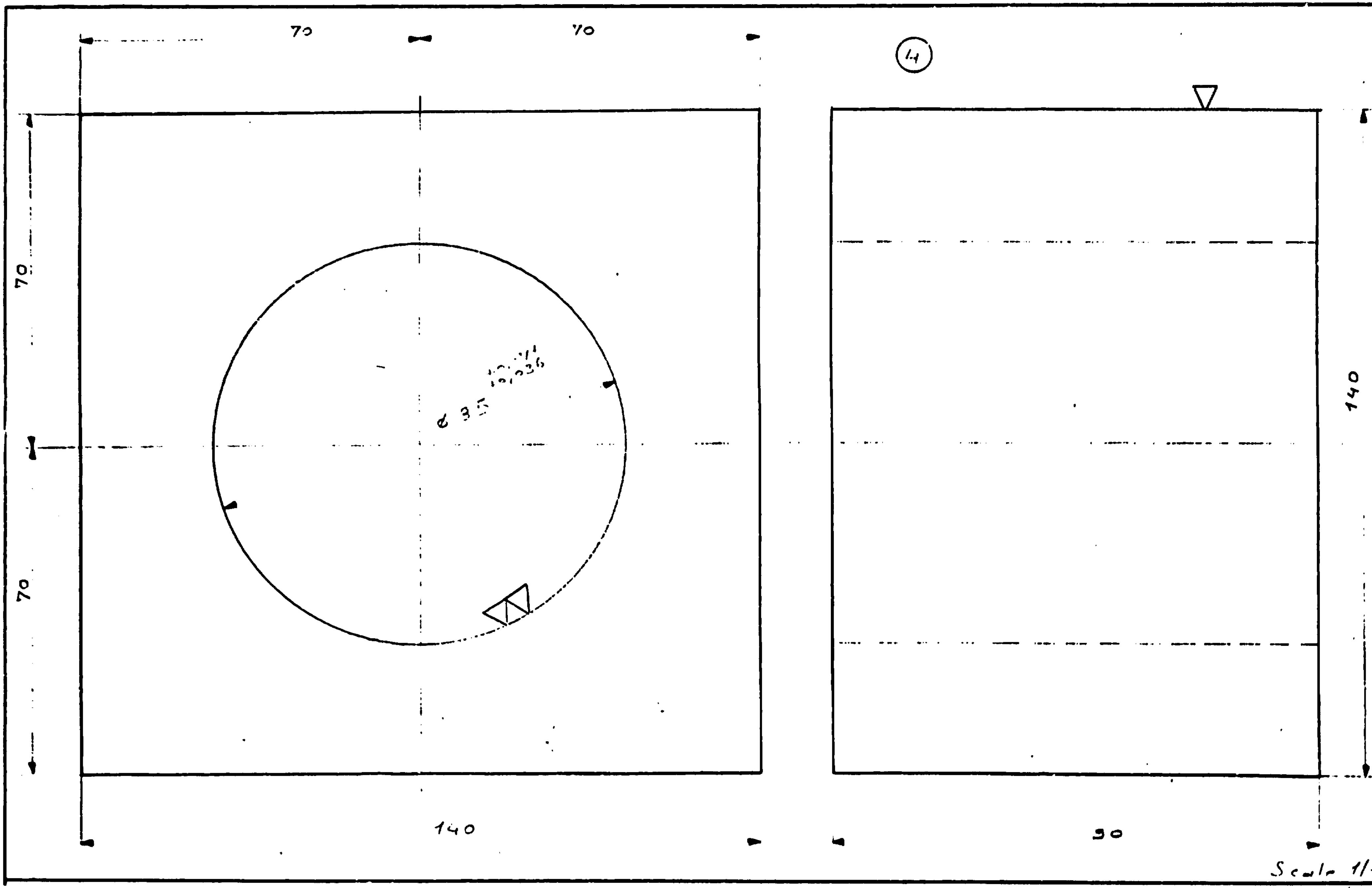


Scale 1/1

Note: All tapering are 16°
All corners have a radius of 1 mm



Scale 1/1



70
70
4
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70
ø 35
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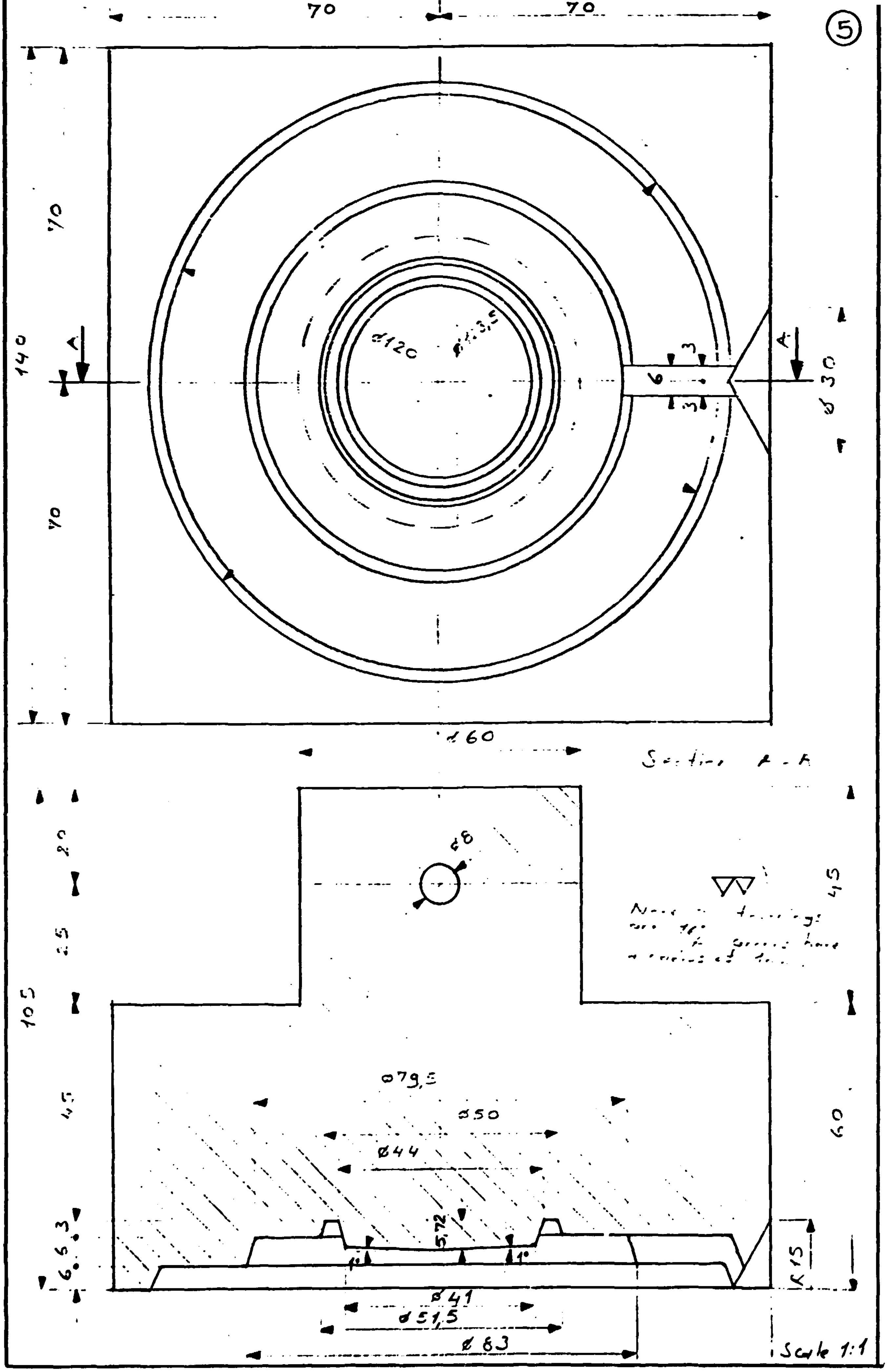
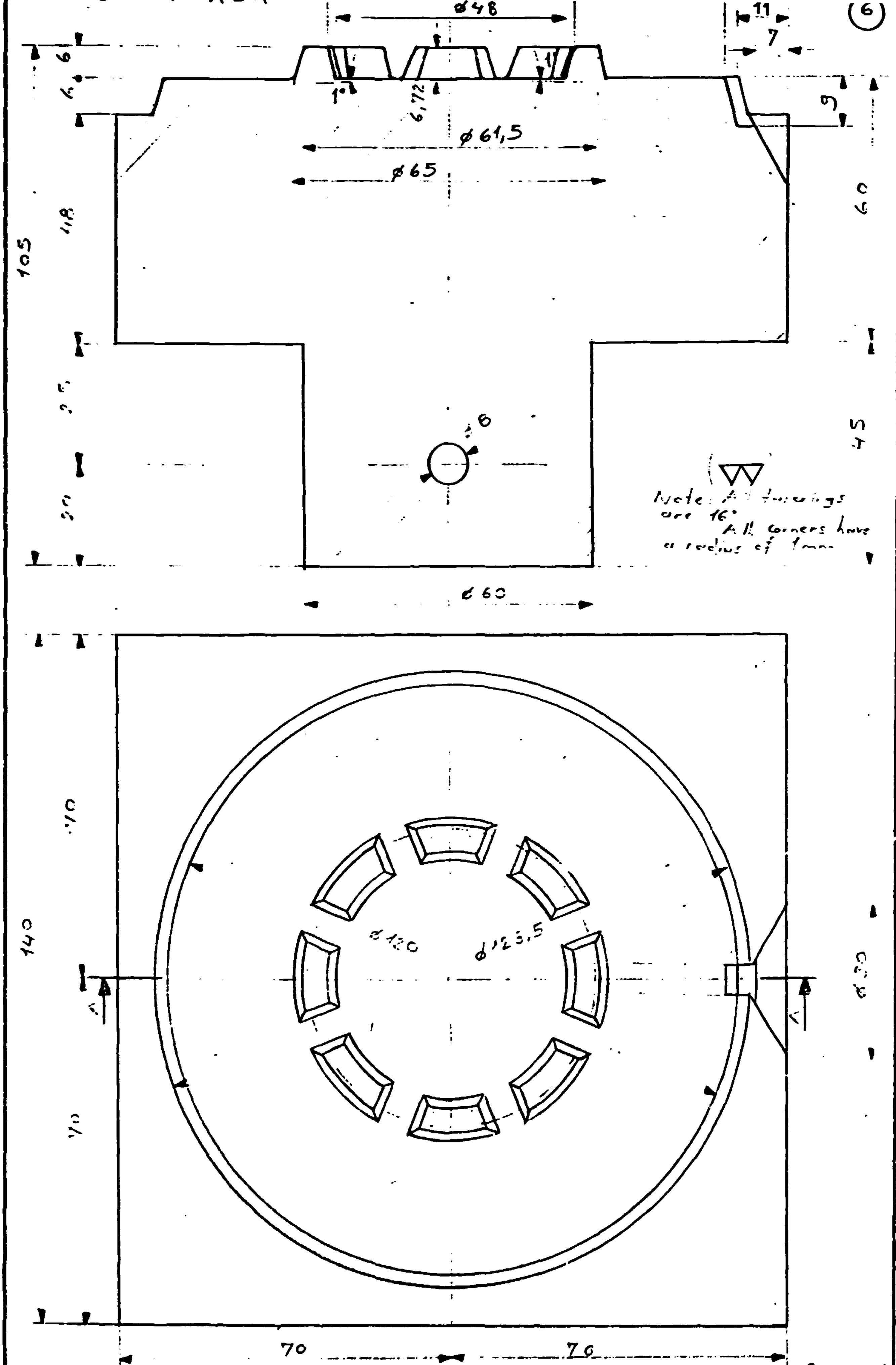
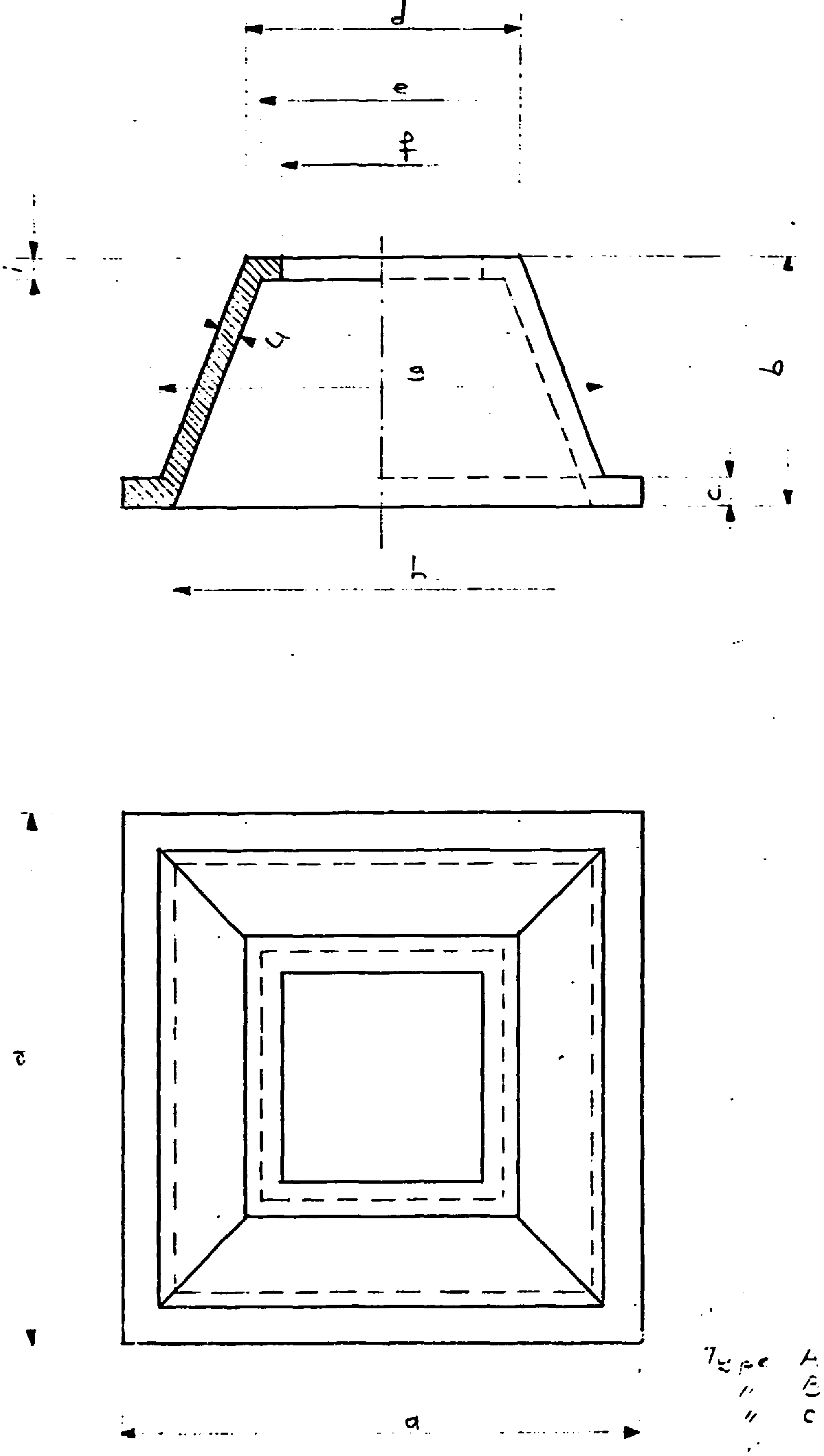
50
Scale 1/1



5
70
70
140
70
70
A
A
ø120
ø30
6
3
3
160
Section A-A
ø8
45
105
60
ø79,5
ø50
ø44
5,72
ø41
ø51,5
ø83
R15
Scale 1:1

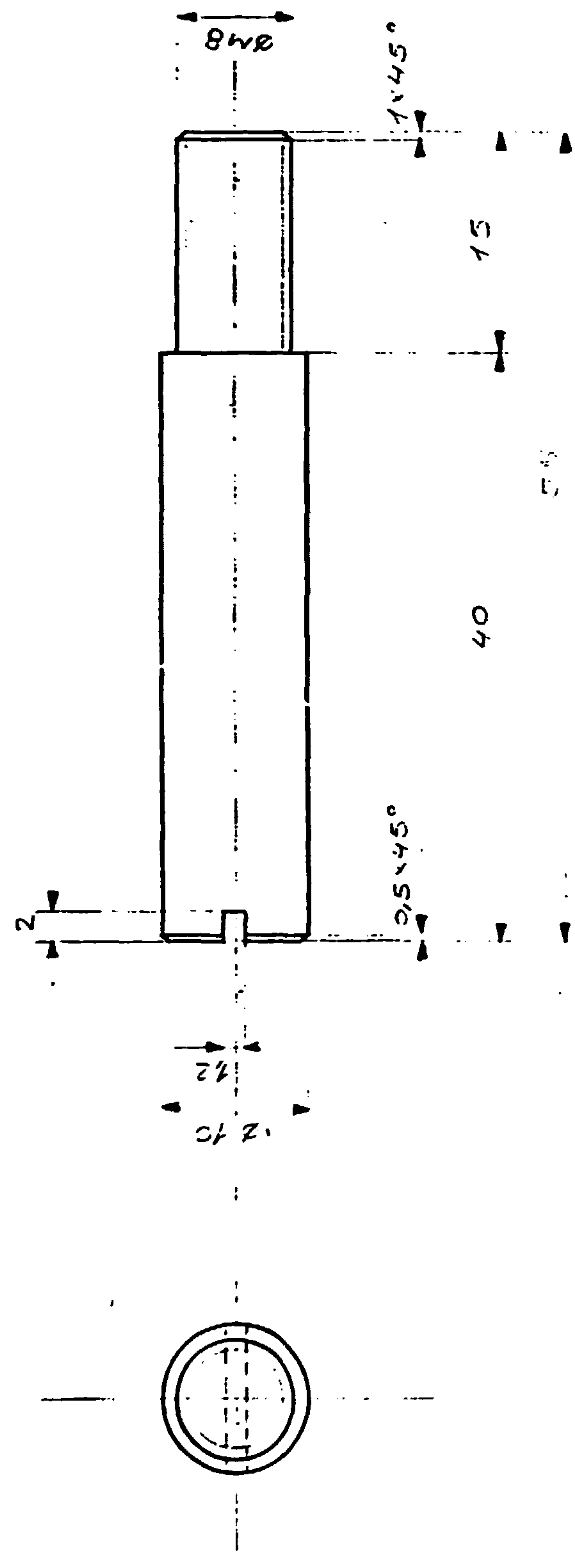


(6)
ø48
11
7
6
1°
6,72
ø61,5
ø65
105
ø6
Note: All turnings are 16°
All corners have a radius of 1mm
ø60
ø120
ø123,5
140
70
70
140
Scale 1:1



Dimensions / Type	a	b	c	d	e	f	g	h	i	J
A	180	85	10	95	85	70	155	145	7,5	7,5
B	220	95	12,5	130	120	100	190	185	10	7,5
C	260	105	15	165	155	130	225	220	12,5	7,5

Scale 2:1



REPORT OF MISSION

Installation and Commissioning of the Furnaces

in

MOGADISCIO, SOMALIA

UNIDO Contract NO. 84/8

Project NO. RP/SOM/84/002

Activity Code RP/OI/3I.8

Prepared by: [illegible], Consultancy and Research for Metallurgical Industries Ltd. Istanbul, Turkey.

Istanbul, [illegible] August I987

This report comprises this title page, eleven (II) pages of text and six (6) appendixes (I through 6).

TABLE OF CONTENTS

INTRODUCTION

Under UNIDO project No. RP/SOM/84/002, Activity Code RP/OI/3I.8 a contract for the provision of services relating to the Rehabilitation of Equipment and Upgrading of the Efficiency of the Foundry and Mechanical Workshop in Mogadiscio in the Democratic Republic of Somalia has been concluded between

UNIDO

United Nations Industrial
Devolopment Organization
Vienna, Austria

and

MEDAL

Consultancy and Research
for Metallurgical Industries Ltd.
Istanbul, Turkey.

Within the scope of the contract, field works for the extended three months in Somalia were carried out by

Mr. Aydın Can, Electrical Engineer,
Mr. Ihsan Ayanoğlu, General Foreman.

from May I6th to August I6 th I987.

The aim of the project is to provide the necessary expertise and day to day shop level technical assistance to the Somali counterparts in order to put into operation the idle and under utilized equipment and achieve self dependence in the latter's exploitation and maintenance by relevant upgrading of the local skills. Assistance in design and manufacturing of new products was the specific aim of this mission.

This report has been prepared in order to state activities, accomplishments, bottlenecks, findings, recommendations concerning the this period of the field work.

The report is requested by UNIDO in the contract on paragraph 2.IO.a.

Thanks are expressed to Mr. Mohamed A. Dahir, General Manager, FMW; and Dr. Nihat G. Kinikoglu, Project Manager CTA, UNIDO; all counterparts and the management of the Foundry and Mechanical Workshop for their kind support and cooperation for this mission.

I.00 ACTIVITIES OF MEDAL TEAM

I.I.0 Installation and operating of the furnaces

Installation of the furnaces has been completed. Furnaces were operated and handed over to FMW.

Furnaces:

- Rotary Cast Iron Melting Furnace
- Electric Furnace for Melting and Holding Aluminium Alloys
- Crucible Furnace for Melting Copper Base Alloys
- Muffle Furnace for Heating Forging Ingots

I.I.I Rotary Furnace

MEDAL team adjusted the level of the concrete base which was made by FMW previously but was not in level. Wheel frames were fastened by steel anchorages. The body of the furnace was put in its place by using the holders on the body, positioning was made precisely. Recuperator car and recuperator were placed according the project. Fuel line and air line were completed and instruments were installed and adjusted. Panel frame was set and cable connections were made. Chimney for exhausting the gases out of the recuperator was prepared and placed on the top of the recuperator. Rotating action of the body was checked and last adjustments were made. Preheating operation was completed according to the instructions. Two casting were made with rotary furnace on 16th June 1987. First time, 1000 kg of metal was melted and casted with cold furnace. Secondly 1200 kg of cold metal was charged and melted in hot furnace. Required temperature was reached in shorter time than specified time period, a detailed melting procedure was prepared and several times discussed with engineers in-charge. Rotary furnace was handed over to FMW on 17th June 1987.

I.I.2 Electric Furnace

Furnace body was fixed with anchorages on its mounting base and the level of it was checked. Electric panel was set and cable connections were made. Furnace was checked and preheating operation was completed according to the instructions. Several aluminium casting were made with furnace and furnace was handed over to FMW on I4 th June I987.

I.I.3 Crucible Furnace

Furnace body was fixed with anchorages on its mounting base and the level of it was checked. Fan was fixed and air hose installed between the fan and burner. Fuel line was completed. Control panel was set and cable connections were made. Preheating operation was completed according to the instructions. Several brass castings were made and furnace was handed over to FMW on I4 th June I987.

I.I.4 Muffle Furnace

Furnace body was fixed on its mounting base and level of the furnace was adjusted. Fan was fixed fuel line and air hose between the fan and the burner were set. Control panel and cable connections were completed. Preheating operation was completed according to the instructions. The furnace was used to heat a steel block of I2 kg and it was handed over to FMW on I5th June I987.

I.2.0 Installation and Operating of the Expendable Thermocouple Temperature Measurement System

System consists of a wall mounted panel, an immersion thermocouple and compensation cable. Panel cabinet was installed to a suitable wall which obtains to measurement of the temperature at both rotary and cupola furnaces. The parts of immersion thermocouple were fixed together and compensation cable was connected between the panel and the immersion thermocouple. Electrical connections were completed and adjustment of the panel was made. It was shown to the counterparts how to use the thermocouple and how to measure with system. System was used for several measurements at the rotary, cupola and crucible furnaces. Initially the location of the thermocouple was too close to the furnaces, output effected by heat, later by changing the position of the panel to colder area problem solved.

I.3.0 Digilab Temperature Measurement System

During the presence of MEDAL team, digilab temperatur measurement system parts did not arrived completly to FMW. Main machine did not come until MEDAL team departured, only some spare cables and repairing parts came. National project counterpart made all necessary applications to both forwarding agent and UNDP office but a positiveresult could not be obtaine before the departure of the team.

I.4.0 Rehabilitation of Equipment

Repair sequence of demaged equipment has been made according to importance of use. Urgently needed machinery had been given priority.

List of Repaired Equipment

Name of Equipment	Location
Shaper (large)	Mechanical Workshop
Shaper (small)	Mechanical Workshop
Air Compressor	Mechanical Workshop
Grinding machine	Mechanical Workshop
Main Electrical Control Panel	Foundry
Radial Saw	Patern Shop
Pump Repair Section	Mechanical Workshop

I.4.I Shaper (large)

Machine was out of order. It was disassembled and checked. It has been found out that the tapped hole was damaged at the point which operating handle and eccentric rod was connected. Hole was filled up by welding and drilled again and the parts were connected together. Oil was put into the machine, electrical connections controlled.

I.4.2 Shaper (small)

Machine was out of order because of stroke adjustment part of reciprocating arm was broken, also gear box needed adjustment and some bolts and nuts were missing. Broken parts were manufactured again. Gear box was adjusted, necessary bolts and nuts were put into the machine. Oil was put into the machine. Electrical checking was made and broken main contactor was changed.

I.4.3 Air Compressor

Main switch box was destroyed, so changed. Cables reconnected. Neuter wire was broken, causing electrical shocks during operation. Neuter wire was reconnected.

I.4.4 Grinding Machine

Coolant pump motor was broken, so changed and the cable of pump and fan were connected to the main machine. The lamp was reconnected. Termics of electrical control system readjusted and wires fixed. Universal switch was broken, it was taken off and changed.

I.4.5 Main Electrical Control Panel

Main electrical control panel of foundry section was exploded. It was repaired and connections were made.

I.4.6 Radial Saw

Machine switch was not functioning. Necessary repairing was made.

I.4.7 Pump Repair Section

Electrical connections were made for pump testing unit. Pump motors, champers and magnetic valves were changed. Because of faulty voltmeters, they were disconnected and changed.

I.5.0 Oxy-acetylene Unit

Oxy-acetylene parts were put together. The four cylinders which came from Turkey were prepared for operation. In plant training carried out to show how to use oxy-acetylene unit to FKM technicians and workers. Unit was used for repairing overhead crane and to open the tapping hole of the rotary and cupola furnaces during the casting.

I.6.0 Overhead Crane

Overhead crane rails were in a bad condition. Concrete which holds the rails was demaged at several points, connections bars were broken or free to move. Rails were not straight. The level of rail way was not correct. It was decided to take out the rails and adjust the concrete then to put U channels under the rails before the rails were placed. For this reason rails have been cut out, concrete base was prepared and U channels were placed under rails in couple of meters. For lifting channels a simple lifting system was prepared. Because of FKM did not have a suitable lifting system or crane, a platform was made on the concrete for working on the crane. After furnaces and temperature measuring systems were ready MEDAL team was contioned to work on the repair of the crane. However, because of the limited time repairing rails could not finished until the departure of MEDAL team.

I .7.0 Training Courses

Counterparts were trained on operation of furnaces, their maintenance and use of oxy-acetylene system, also by taking part in the maintenance activities counterparts consequently trained on maintenance.

2.00 FINDING AND ANALYSES

As a result of investigations, below facts were discovered and analized.

2.I.0 Damaged Equipments

It was found out that there are still a lot of machines which need to be repaired or adjusted. FMW mechanical maintenance group is not able to repair every kind of damage, they have not enough knowledge on their subjects. We strongly recommend UNIDO to provide training to maintenance engineer who is one of the best and technicians. Especially for rotary furnace experienced persons are required for operating and maintenance. UNIDO should provide opportunity for furnace operators to work abroad for sometime.

2.2.0 Overhead Crane

Overhead crane is in a bad condition and it is one of the most usefull equipment at the foundry. To complete the repairing of overhead crane a team of three experts with experience on the subject and donated with necessary equipments is required at least for two months.

During the three months of field work, the activities which detailed in the body section have been carried out by using local possibilities as much as possible. Accomplishments, bottlenecks and recommendations conserning this period of the field work are stated below.

3.00 ACCOMPLISHMENTS

A- Installation of furnaces have been made. Furnaces were operated and handed over to FM.

B- Immersion thermocouple temperature measurement system has been installed, operated and handed over to FM.

C- Repairing of some machines were made and necessary technological instructions were given to the counterparts.

D- Overhead crane repairing has been started.

E- Necessary training about furnaces has been given to the counterparts.

F- Oxy-acetylene unit has been put into using in production line.

4.00 BOTTLENECKS

A- Repairs on overhead crane need to be completed.

B- Some machines need repairing.

C- Technological knowledge of counterparts are very poor on mechanical maintenance and some operations.

5.00 RECOMMENDATIONS

A- Maintenance persons should be trained on maintenance subjects.

B- Experied persons should be employed for mechanical maintenance and for operating furnaces and machines.

LIST OF APPENDIXES

I N S T R U C T I O N S F O R I N S T A L L A T I O N

- Crucible Furnace for Melting Copper Base Alloys
- Muffle Furnace
- Electric Furnace for Melting and Holding Aluminium Alloys
- Rotary Cast Iron Melting Furnace

CRUCIBLE FURNACE FOR MELTING COPPER BASE ALLOYS

a- Fix the furnace on its mounting base by means of steel anchorages; be sure it is level.

b- Fix the fan to the ground as shown in the Installation Chart.

c- Install the air hose between the fan and the burner.

d- Erect the fuel circuit according to the diagram and connect it to the elastic fuel hose.

f- Fasten the control panel on a convenient column or on a wall; install the cable connection between the fuel pump and the fan according to the Circuit Diagram.

g- Make the cable connection of the control panel.

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MUFFLE FURNACE

a- Fix the furnace on its mounting base by means of steel anchorages; be sure it is level.

b- Fix the fan to the ground as shown in the Installation Chart.

c- Install the air hose between the fan and the burner.

d- Erect the fuel circuit according to the diagram and connect it to the elastic fuel hose.

e- Fasten the control panel on its frame on the body; install the cable connection between the fuel pump and the fan according to the Circuit Diagram.

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ELECTRIC FURNACE FOR MELTING AND HOLDING ALUMINIUM ALLOYS

a- Fix the furnace on its mounting base by means of steel anchorages; be sure it is level.

b- Connect the electric panel to its stand on the body of the furnace in such a manner that the panel faces the furnace.

c- Make the cable connections between the panel resistance fasteners and the panel thermocouple in conformity with the Electric Wiring Diagram.

(For thermocouple connection use the special cable you will find in the set)

d- Connect the transmission line of the panel.

ROTARY CAST IRON MELTING FURNACE

a- Fasten, by steel anchorages, the wheel frames of the rotating furnace to the concrete base in full concordance with the dimensions shown in the project.

It is important that the frames are parallel to each other and that they are placed on the same axis and further on the same level.

b- Fasten the recuperator elbow rays to its base as to be on the same axis with the wheel frames and according to the spacing dimensions set forth in the project.

c- Place the rotary furnace in its place by using the holders on the body; control the positioning precision on the recuperator and the burner side.

d- Place the recuperator car on the ray and draw the car towards the furnace by leaving enough working space in between.

e- Pull the recuperator frame in its place in a manner to centre the vertical axis of the recuperator elbow and fix its legs on the base by means of roll bolts.

f- Place the recuperator on the frame by paying attention to the channel inlets and outlets and fasten it to the frame by the screws which are specially made for this purpose.

g- Install the air channels by propping them up temporarily; control positioning precision and accordingly fasten the fan and the supporting pole on the base.

h- Erect the fuel circuit of the fan according to its diagram.

j- Set the panel frame on a convenient place so that the discharge chute of the furnace can be easily seen and the normal course of the work is not hindered. Then install the cable connection in order to provide the energy inlet to the panel and to provide the circuit flow between the the panel and the engines, according to the electric Circuit Diagram .

k- Erect a fume box and a chimney for exhausting the gasses out of the recuperator.

INSTRUCTIONS FOR USE

- Crucible Furnace for Melting Copper Base Alloys
- Muffle Furnace
- Electric Furnace for Melting and Holding Aluminium Alloys
- Rotary Cast Iron Melting Furnace

CRUCIBLE FURNACE FOR MELTING COPPER BASE ALLOYS

- The Crucible Melting Furnace has a capacity for melting 100 kg. of copper alloys in a period of approximately 2 hours at cold charging.

- The Furnace is equipped with a fan (2 HP), a burner PLB-2 with a maximum fuel capacity of 19 kg/h and a mechanically propelled tipping unit.

SWITCHIG-ON

- Start up the fan and the fuel pump by pressing the buttons (Figs 1 and 2) on the control panel, respectively..

- Light the burner and adjust the fuel and air until the required flame is obtained.

SWITCHING-OFF

- The furnace is switched off by pressing the buttons of the fuel pump and the fan, respectively.

-The fuel inlet valve on the burner is turned off fully.

PREHEATING

At the preheating operation the furnace is heated upto approximately 300^{0}C and thereafter the temperature is increased by 100^{0}C at intervals of 6 hours until 800^{0}C is reached. At 800^{0}C the furnace is turned off and allowed for cooling. The normal operation is commenced after it gets completely cool.

CHARGING

The Crucible Melting Furnace is opened by tilting the top cover backwards and charging is effected in conformity with the casting technique of each type of metal alloys to be melted.

DISCHARGING

Dumping is mechanically propelled. When the wheel is turned counterclockwise, the furnace will turn around its axis and

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tilt towards the Discharge Chute. The level of tilting is adjusted according to the amount of the metal to be charged.

MAINTENANCE

- Clean the Burner after each Switching on/Switching off process.

- Test the Fan Bearings once in every six month period.

MUFFLE FURNACE

- Dimensions : 30 X 40 X 60
- Operates by liquid fuel
- Has a capacity to muffle 12 kg. of steel upto 1000^{0}C in 20 minutes, at cold charging.
- Is equipped with a Thermocouple Gauge which indicates the internal temperature.

SWITCHING-ON

- In order to start operating the Muffle Furnace first start the fan by pressing the Start Button (Fig. 1) on the control panel and then press the Button(Fig. 2) on the control panel to operate the fuel pump.

- The air and fuel inlet valves on the burner are turned on and the burner is lighted.

- The burner is regulated to give the desired flame.

SWITCHING-OFF

- The fuel valve is closed.

- The fuel pump and the fan are turned-off by pressing the respective buttons on the control panel.

PREHEATING

At the preheating operation the furnace is heated upto 300^{0}C and thereafter the temperature is increased by 100^{0}C at intervals of 6 hours until 800^{0}C is reached. At 800^{0}C the furnace is turned off and allowed for cooling. The normal operation may be commenced after this process is completed.

MAINTENANCE

- Clean the burner after each Switching on/Switching off process.

- Test the fan bearings once in every six months period.

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CHARGING, DISCHARGING

Entry to the Muffle Zone is provided by openning the articulated cover in front of the furnace. The metal pieces to be muffled are placed carefully in this zone. The cover is closed .

The same process applies in Discharging.

ELECTRIC FURNACE FOR MELTING AND HOLDING ALUMINIUM ALLOYS

- The capacity of the furnace is 50 kg.
- The furnace is equipped with an electronic thermostat of DP 96 RP type. Power: 3 X 5 = 15 KW/380V ; 50 Hz.
  Max. Heat Available : 800^{0}C.
  Resistanve Wire : KANTHAL A-1 Ø 2,5 mm.
  Crucible : Silica Type No. 120

SWITCHING-ON

- Fill the crucible with the charge.
- Turn on the switch which is placed on the panel (Fig. 1)
- Adjust the electronic thermostat on the panel to the proper temperature (max. 800^{0}C). Refer to the Thermostat Catalogue for this process.
- At the properly adjusted temperature the metal contained in the crucible will melt and be maintained at the desired temperature. $\pm$ 5^{0}

SWITCHING-OFF

- Turn off the Switch (Fig. 1) on the Control Panel in order to stop the operation of the furnace.

MAINTENANCE

There is no component part installed on the furnace which requires special maintenance.

PREHEATING

The initial starting temperature will be adjusted to 300^{0}C and thereafter it will be increased by 100^{0}C at intervals of 6 hours until 800^{0}C is reached. At 800^{0}C the furnace will be allowed for rest until it gets completely cool.

CHARGING

- The cover on the Furnace is tilted backwards so that the Crucible will get available for use.

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- The metal to be melted is poured into the crucible in accordance with its respective casting technique.

DISCHARGING

Molten metal within the crucible is emptied with metal buckets or crucibles.

ROTARY CAST IRON MELTING FURNACE

The Rotary Cast Iron Melting Furnace has a capacity to melt 1000 kgs. of iron in a period of approximately 3 hours at cold charging.

The furnace is equipped with a recuperator which heats the air upto 500^{0}C, a fan with 7,5 HP, and a burner with a capacity of 184 kg./h.

The body rotating mechanism consists of a Reduction Gear of 1,5 HP; 30 d/d and a Chain Sprocket. The body rotates 1 per minute. It operates upto (max) 3^{0}E viscosity diesel fuel or fuel oil.

SWITCHING-ON

- Start operating the fan by pressing the button (Fig. 1) on the control panel.

- Adjust the burner to medium settings.

- Turn on the fuel pump. (Fig. 2)

- Light the burner.

- By proper damper adjustment, an orange flame is obtained (It is also necessary that fuel intake adjustment be made according to the desired operation capacity of the furnace).

- The desired rotating adjustment of the furnace is provided by pressing the respective buttons (Figs. 3,7,4) on the Control Panel.

SWITCHING-OFF

The furnace is switched off by pressing the stop buttons of the fuel pump and the fan and of the reducer if the engine is in operation, respectively (Figs. 7, 5, 6).

PREHEATING

As it is known, the sudden exposure of fire bricks to high

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temperatures is disapproved. For this reason during preheating the temperature is increased upto 300^{0}C and thereafter it is increased by 100^{0}C at intervals of 6 hours until 800^{0}C is reached. At 800^{0}C the furnace is turned off and allowed for rest until it gets completely cool. The furnace may be put into normal operation only after this process is completed.

MAINTENANCE

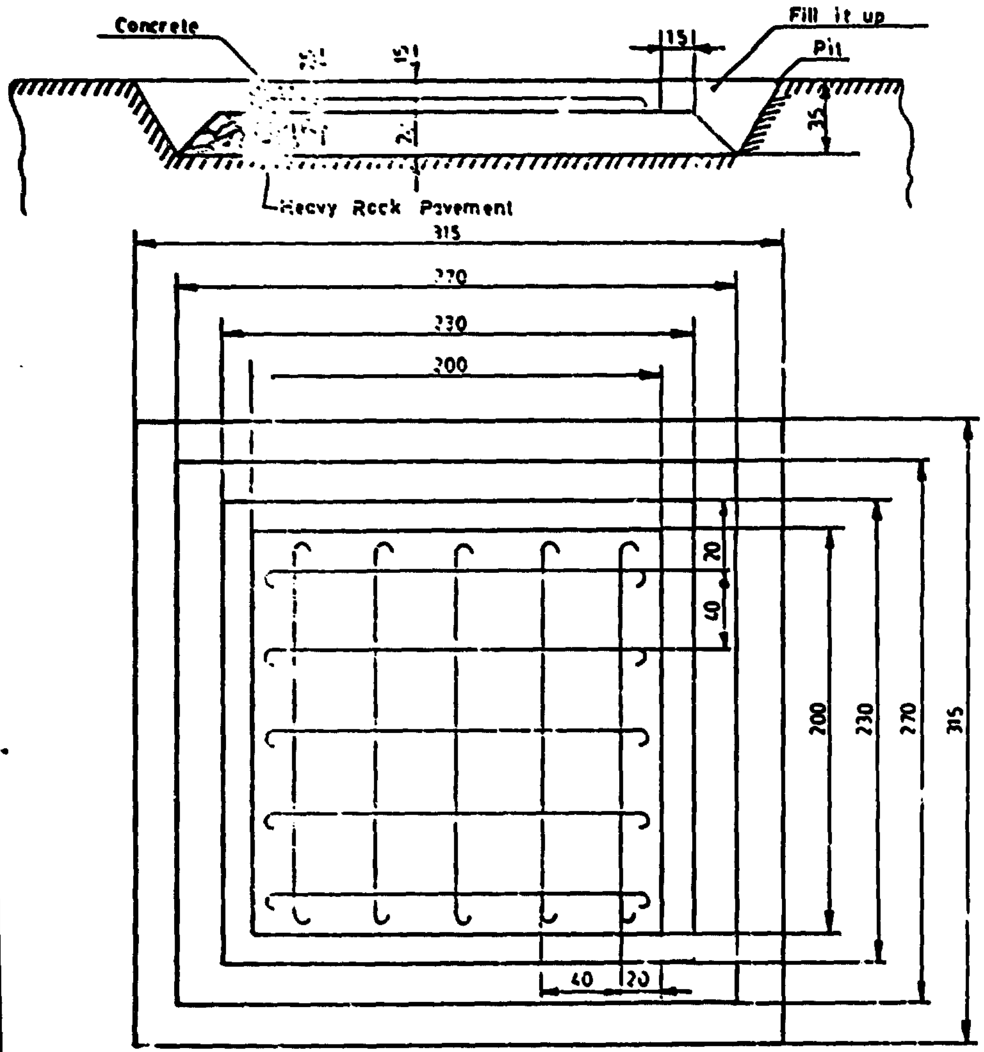
- Clean the burner following each switching on/switching off process.
- Test the lubricants of rollers, gear pump and bearings once in every six months period.
- Change the oil of the Reduction Gear at the close of the first six months period initially, and thereafter once in a year.

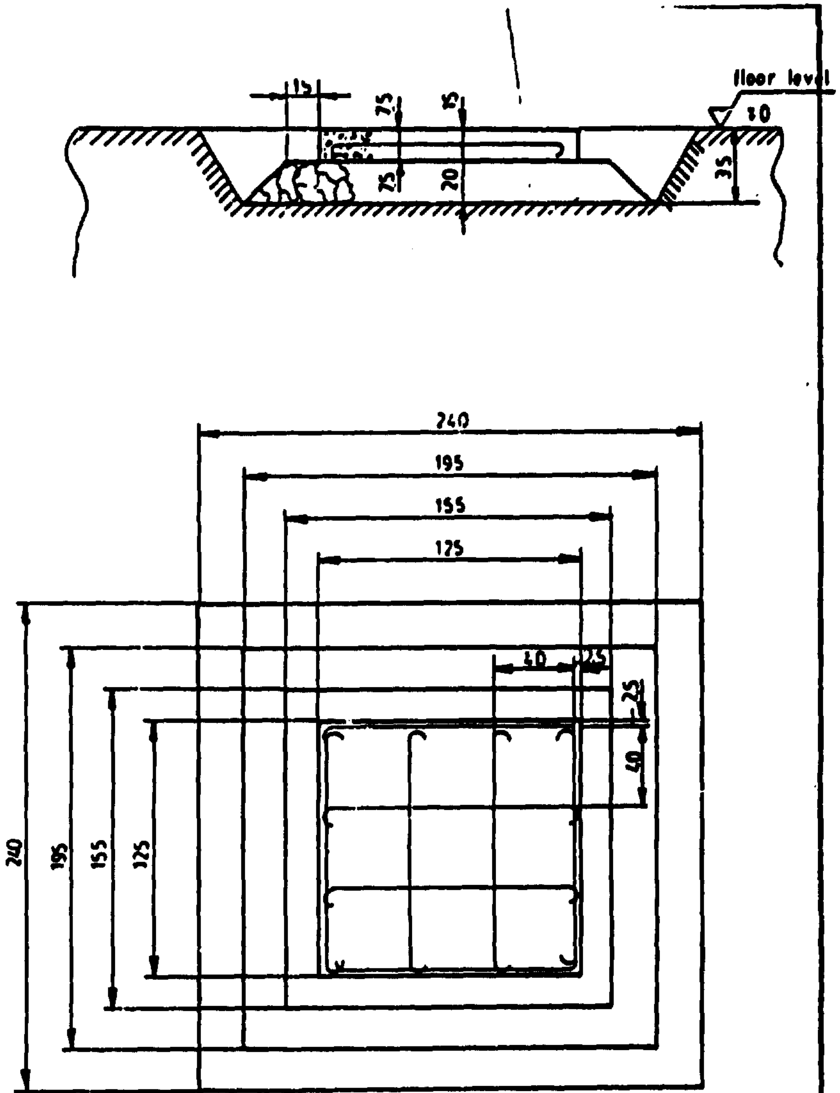
CHARGING

Recuperator Elbow is pulled away from the furnace. The cover on the recuperator side is opened and the metal to be melted is charged into the furnace.

DISCHARGING

Discharge Chute located on the body of the furnace is drawn a little bit above the horizontal position and the plug at its end is opened. Then by the use of the proper directioning button (Fig.) the chute is drawn downwards and the molten metal is poured into the crucible.

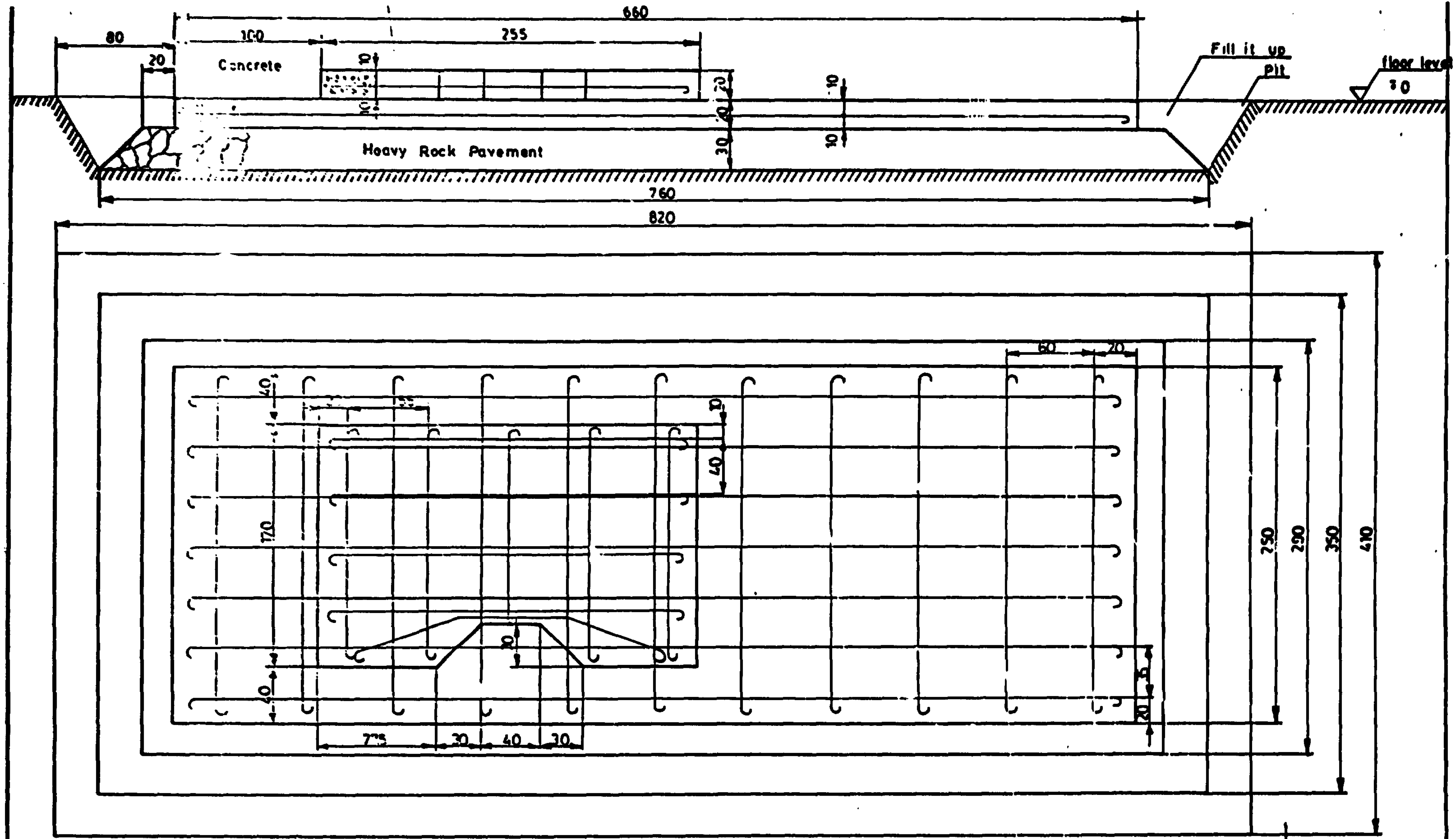




— CRUCIBLE FURNACE AND MUFFLE FURNACE

ELECTRIC FURNACE

— Measurements are in cm
— Reinforcing bars are 10 mm in diameter
— Dosage for $1 m^3$ concrete
— $0.7 m^3$ agregate + $0.5 m^3$ sand + 350 kg cement (7 bags)



Switch board will be installed at this point to the wall

- 1000 kg ROTARY FURNACE FOUNDATION PLAN
- Measurements are in cm
- Reinforcing bars are 12 mm in diameter.
- Dosage for $1 m^3$ concrete
- $0.7 m^3$ agregate + $0.5 m^3$ sand + 350 kg cement (7 bags)

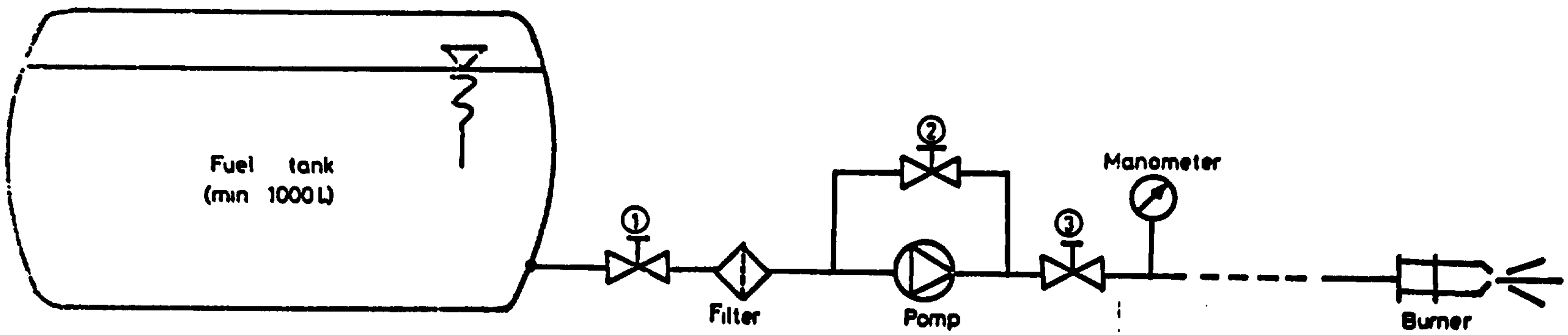
LIGHT DIESEL OIL FUEL LINE DIAGRAMME FOR FURNACES :

VALVE POSITIONS :

1 Fully closed out of operation fully open in operation

2 Adjust flowrate of fuel depending on pressure gage

3 Always full open. Closed during maintenance



- Pipes : 1/2"
- Valves : 1/2" Schieber type
- Pomp : 6 Atm 200 l/h Gear type
- Filter : 1/2" Bucket type
- Manometer : 0-10 Atm

POWER REQUIREMENTS

EQUIPMENT	POWER (KW - 380 V.)	CABLE SECTION MINIMUM (mm)
Rotary Cast Iron Melting Furnace	2,2 7.5	4 x 2.5 4 x 4
Crucible Furnace (Copper)	3	4 x 2.5
Muffle Furnace	2.2	4 x 2,5
Electric Furnace (Aluminium)	18	4 x 6

EXPENDABLE THERMOCOUPLE
TEMPERATURE MEASUREMENT SYSTEM
INSTALLATION AND OPERATING INSTRUCTIONS

The temperature measurement system consists of a wall mounted panel to indicate temperature of molten metal and show status of measurement; a dipping rod unto which the expendable thermocouples are inserted and compensation cable to connect the rod with the measurement panel.

The equipment operates on a mains supply of 220 Volts, 50 Hz. The terminals at the bottom of the cabinet are marked with appropriate labels to indicate where the mains supply will be connected. As the system is isolated, polarity is of no importance. A cable gland is supplied to be utilized into whichever premarked holes is suitable for entering the power supply cable. A cable with plug is also included in case a receptacle is available nearby.

Installation of the panel cabinet onto a wall or a suitable column is possible with the four holes at the rear which needs to be market first and then screwed vertical in place with whichever means regularly practiced at site.

The dipping rod is delivered in two pieces for trans ort. It is to be made into a straight one piece with the connecting unions. The rod is equipped with a handle on one end, a rubber receptacle on the other for connection of the expendable thermocouple. The receptacle is of replaceable type and has to be replaced with a new one in case of excessive wear or molten metal attact.

The compensating cable is for connection of the dipping rod with the instrument panel. Like the mains supply, its connection point is marked on the terminals inside the panel. Please note the polarity. At the rear of the rubber receptacle it is the terminal which is thicker which sould be recognized as the positive (+) terminal. This positive is connected with the red lead of the compensating cable and hence with the terminal market (+) in the cabinet. The other lead which is white in colour is the negative polarity of the emf generated by the thermocouple. To be certain of the correct polarity another check will be to find continuity with the positive lead with the inner copper ring in the receptacle and the negative lead with the outer copper ring in the receptacle.

It is advisable to turn on the instrument minimum 10 minutes prior to taking a measurement.

With the power on (on-off button on the right hand bottom of the instrument door), insert a thermocouple to the dipping rod. The green status lamp will be on to indicate that a thermocouple has been inserted and that this thermocouple is in good order. i.e. not open circuited. When the tip of the thermocouple is now dipped into a molten metal the figures (originally in the order of 200 °C) will start to increase, the yellow lamp will come on to indicate

Cfulahaab Munday Moxxi

that the measurement is in progress, at the end of which will the horn blow, the red lamp will come on and the last figure of display will be locked. The horn will go off after an instant. The rod must be taken out off the molten metal at the first hear of the horn sound. The figure now continuously displayed is the temperature of the molten metal at the time of measurement and will remain for your reference until a new thermocouple is inserted [illegible] hold release button on the left bottom of the panel cover is pressed. The system is now ready for a second temperature measurement. Please note that insertion of a new thermocouple will cause both red and green lamps to come on and system ready (green only) will be on only after the release button is pressed.

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FMW: Mogadiscio-Somalia

Appendix 6.

ADDITIONAL INSTRUCTIONS FOR THE ROTARY FURNACE

16-Aug-87

1- Record on a log book every action performed throught the casting.

2- Check system completely.

3- Prepare necessary tools (glasses, gloves, oxygen pipe, hammer etc).

4- Close taping hole.

5- Charge material.

6- Open diesel vanes on supplying line.

7- Prepare fire torch.

8- Switch on fan.

9- Open diesel and air vanes on regulator and light the burner.

10- Adjust flame (diesel vane and air vane) so that flame is in the rotary and not touching the recuperator.

11- Check air temperature every 15 minutes and record.

12- When approximately half of the metal is molten (approx. 200°C air temperature) start turning furnace approx. 30° angle to continuosly one side.

13- Turn rotary when temperature is raised to approx. 250°C (whenever metal is completely molten).

14- Re-adjust flame whenever rising of temperature stops (open diesel vane more).

15- Stop turning when temperature of air rises to approximately 400°C, check temperature of molten metal (1400°C-1450°C).

16- Open taping hole and keep it open throught the casting.

17- Pour molten material and swing furnace to both sides upto certain degrees while metal is not poured out from rotary furnace.

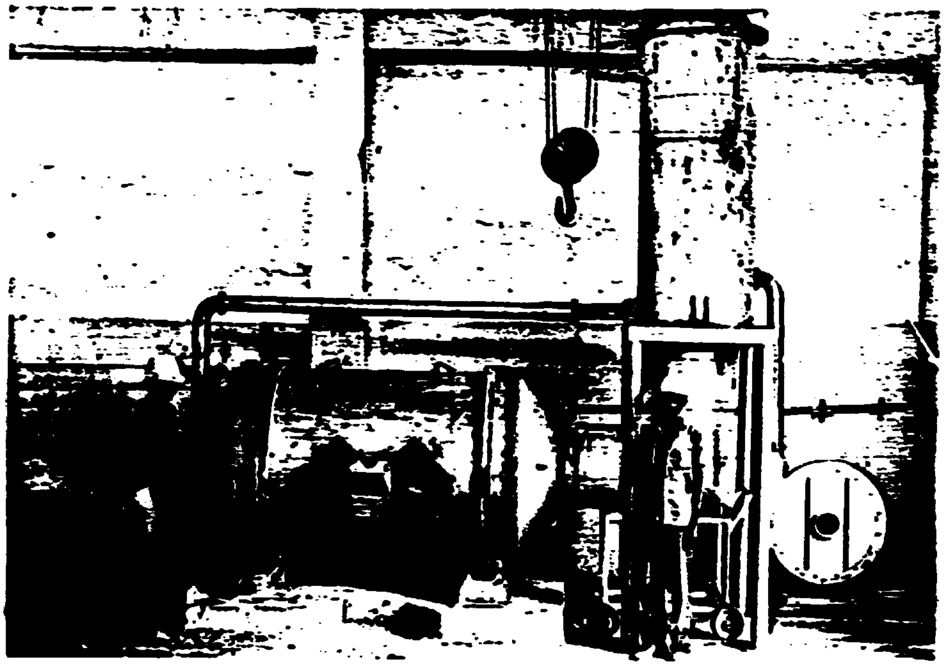
18- Empty all material and slug at the end of casting.

19- Close all vanes, switch off fan.

20- Clean furnace.

MOHAMMED ABDINASSER ADEN,
FMW, ENGINEER.

Rotary Cast Iron Melting Furnace



Electric Furnace for Melting and Holding Aluminium