AMERICAN CONSULTING ENGINEERS COUNCIL'S

HEAVY MOVABLE STRUCTURES
MOVABLE BRIDGES AFFILIATE

3RD BIENNIAL SYMPOSIUM

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SESSION
WORKSHOP NOTES

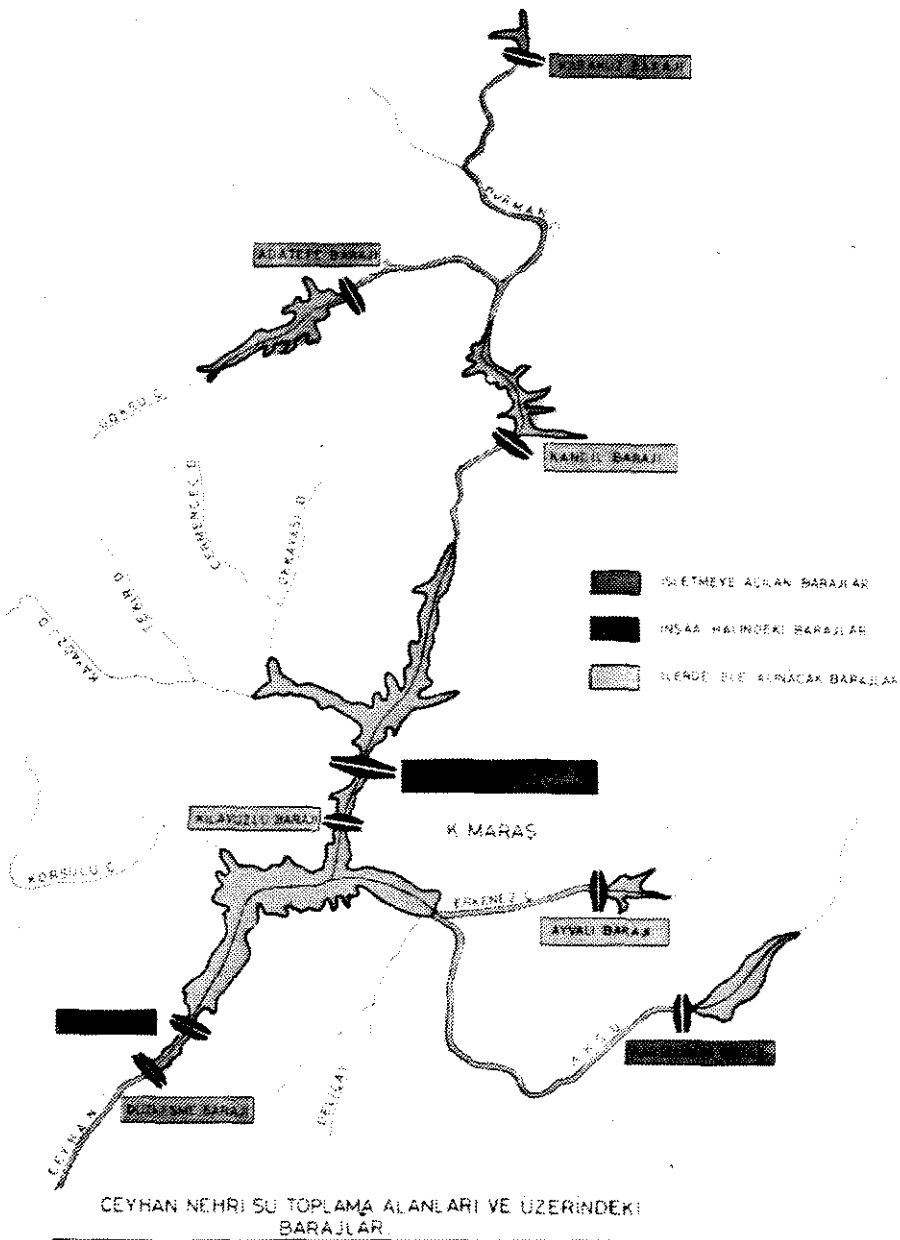
Session (4-6)
"Menzelet Dam - Turkey ",Ernst Herz,
Mannesmann Rexroth, Lohr, Germany

Menzlet Dam – Turkey

Ernst Herz

Customer:	DSI, Ankara
Consulting Co.:	SU-Yap, Ankara
Contractor:	Yet Yapi, Adana
Steel Construction Co.:	Tarmans Tarim, Karaman-Maras

From 1985 to 1990 the Menzelet Dam with an incorporated power plant was built in East Turkey, at the river Ceyhan. The power plant makes use of the energy potential of the Ceyhan river with its tributaries. The drawing shows the systems already in operation, those under construction, and those scheduled.



CEYHAN NEHRİ SU TOPLAMA ALANLARI VE ÜZERİNDEKİ BARAJLAR

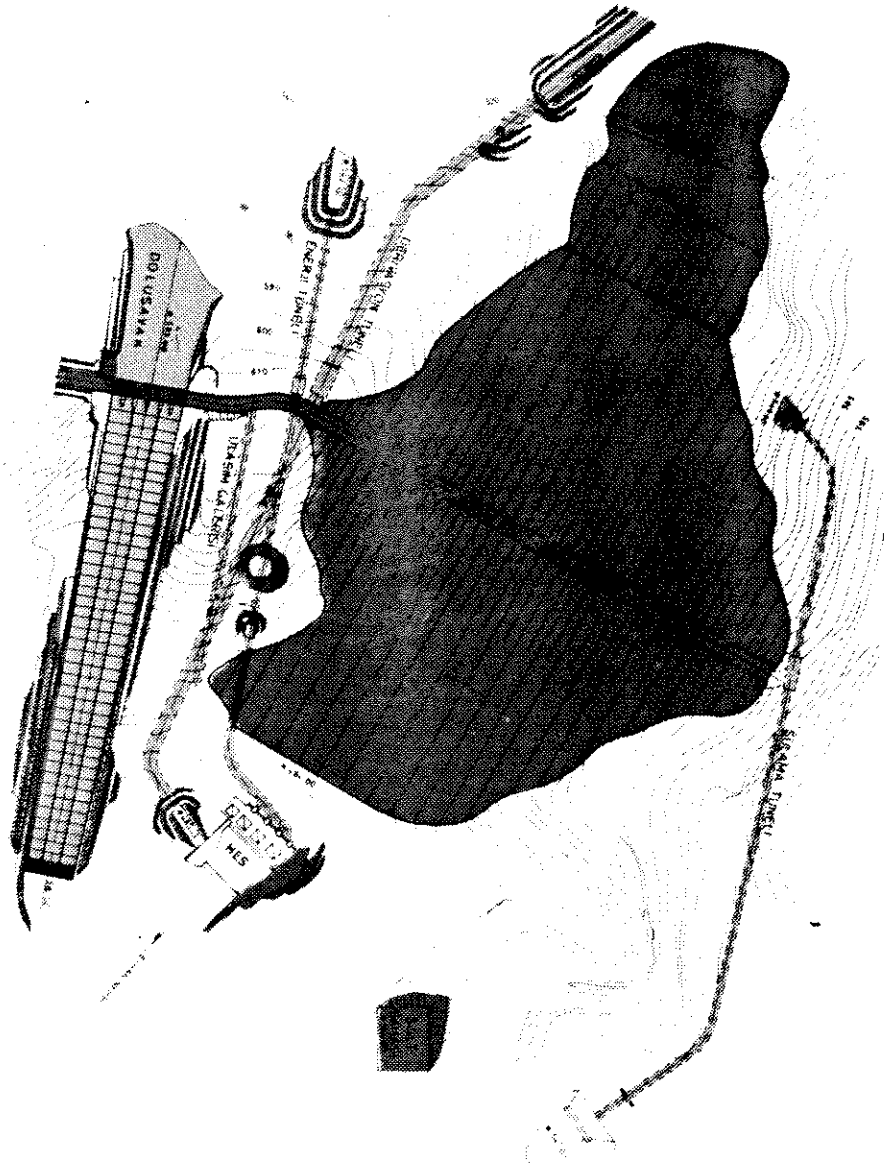
1. Description of the Dam

The dam is designed as a rock-fill dam with the following technical data:

– length of the dam crest	425 m
– width of the dam crest	12 m
– max. dam height from bottom up	150.5 m
– top edge of dam drest	+ 614.5 m
– max. permissible water level in reservoir	+ 611.60 m
– min. permissible water level inreservoir	+ 560.20 m

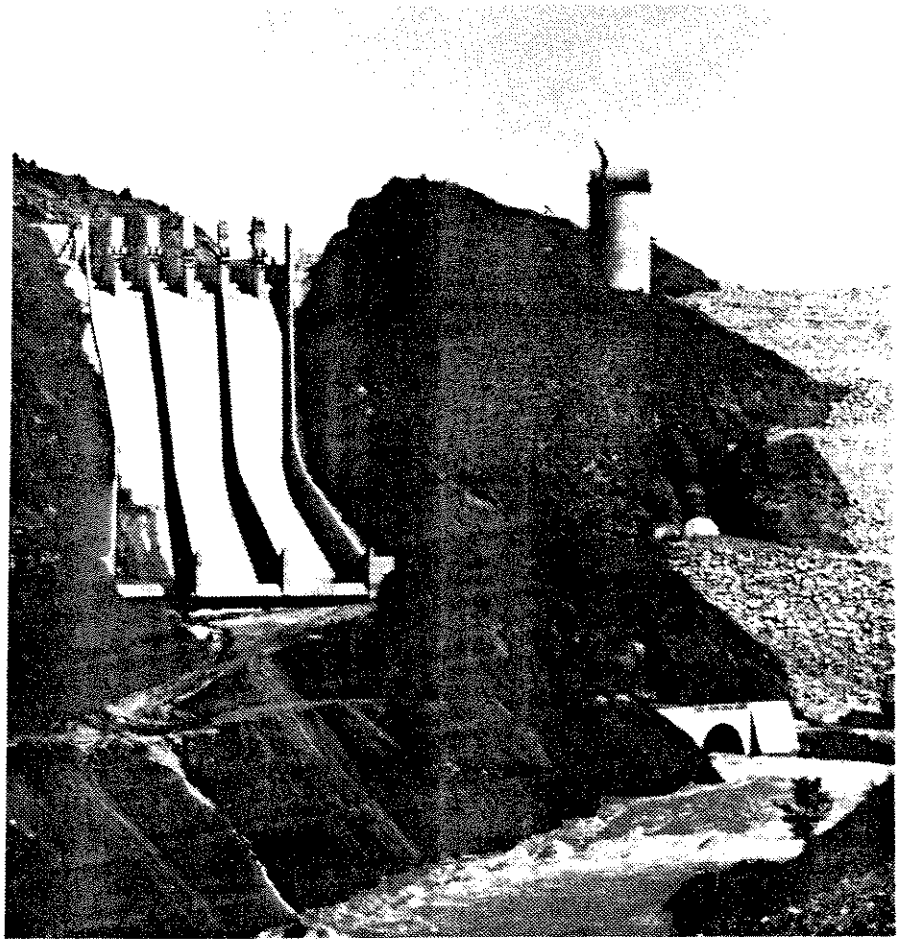
In accordance with the outline the total project consists of the following:

- front dam
- main dam
- flood level drain
- re-direction duct / bottom drain
- feed water duct
- pressure substations for high tension
- irrigation duct



2. Flood Drain

The flood drain located at the right-hand side of the dam is equipped with 6 segmental flood gates with an inside dia. of 7.5 and height of 12.25 m. The flood gates are designed as cable drives with mechanical winches.



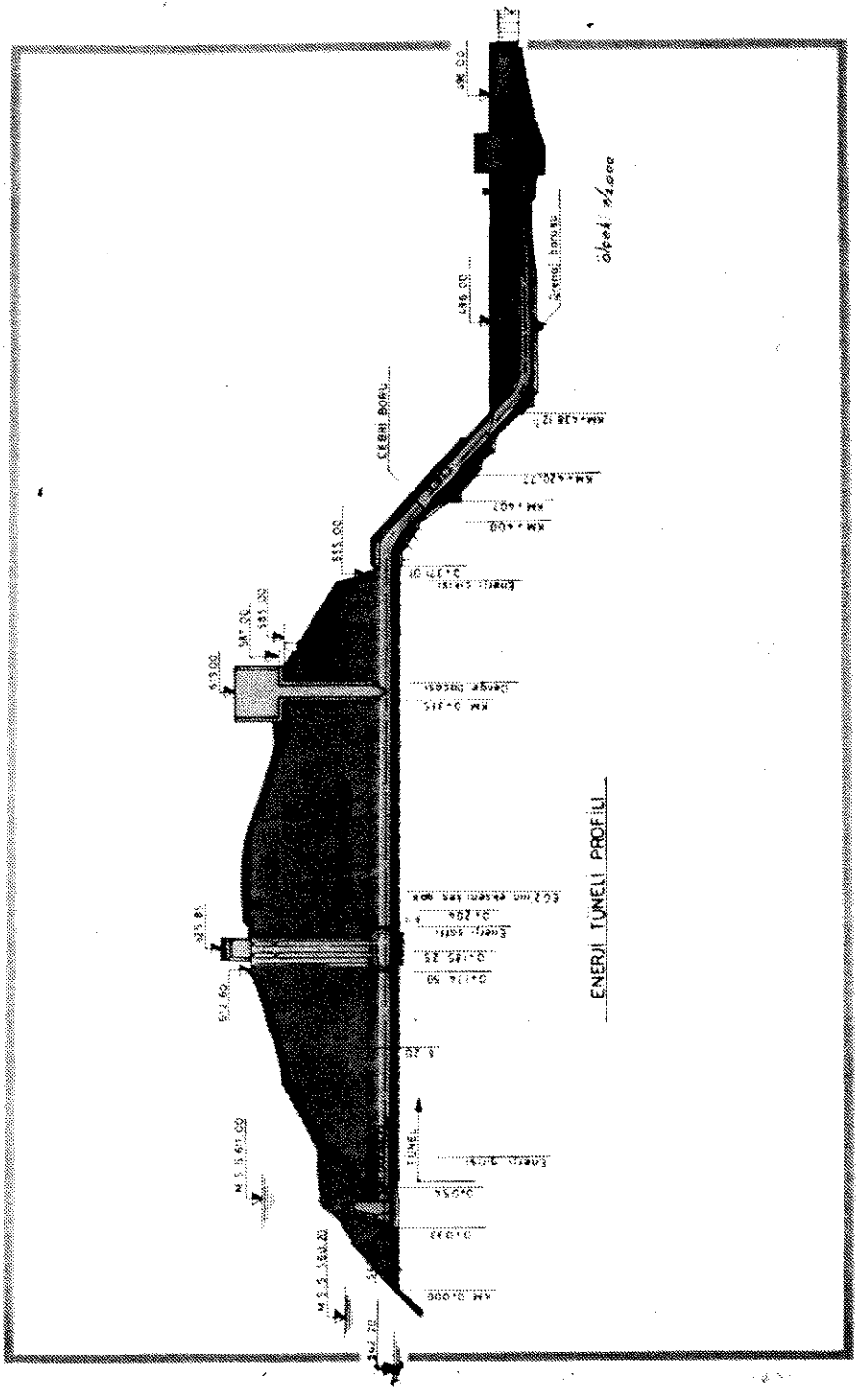
3. Feed Water Duct

The feed water duct is shown in the cross section. The bottom of the inlet is at height notation 543.20. A duct with a dia. of 6.20 connects to that.

In the first third of the feed water duct, approx. 130 after the inlet, we find the structure for the closing off installations. They include a rectangular shaft for the inlet sluice and another one for the dam beam seal. The power house is located above these shafts.

After another 130 m of duct, before the beginning of the pressure pipe line we find the surge tank for energy conversation with quick shutoff of the turbines. The surge tank is connected with the actual pressure compensation tank with a dia. of 14 m and a height of 37 m via a vertical, armor-plated pressure shaft with a dia. of 6.2 m and a height of 39 m.

Immediately in front of the power house the pressure pipe line turns into a distributor pipe line which takes the feed water to the individual turbines.



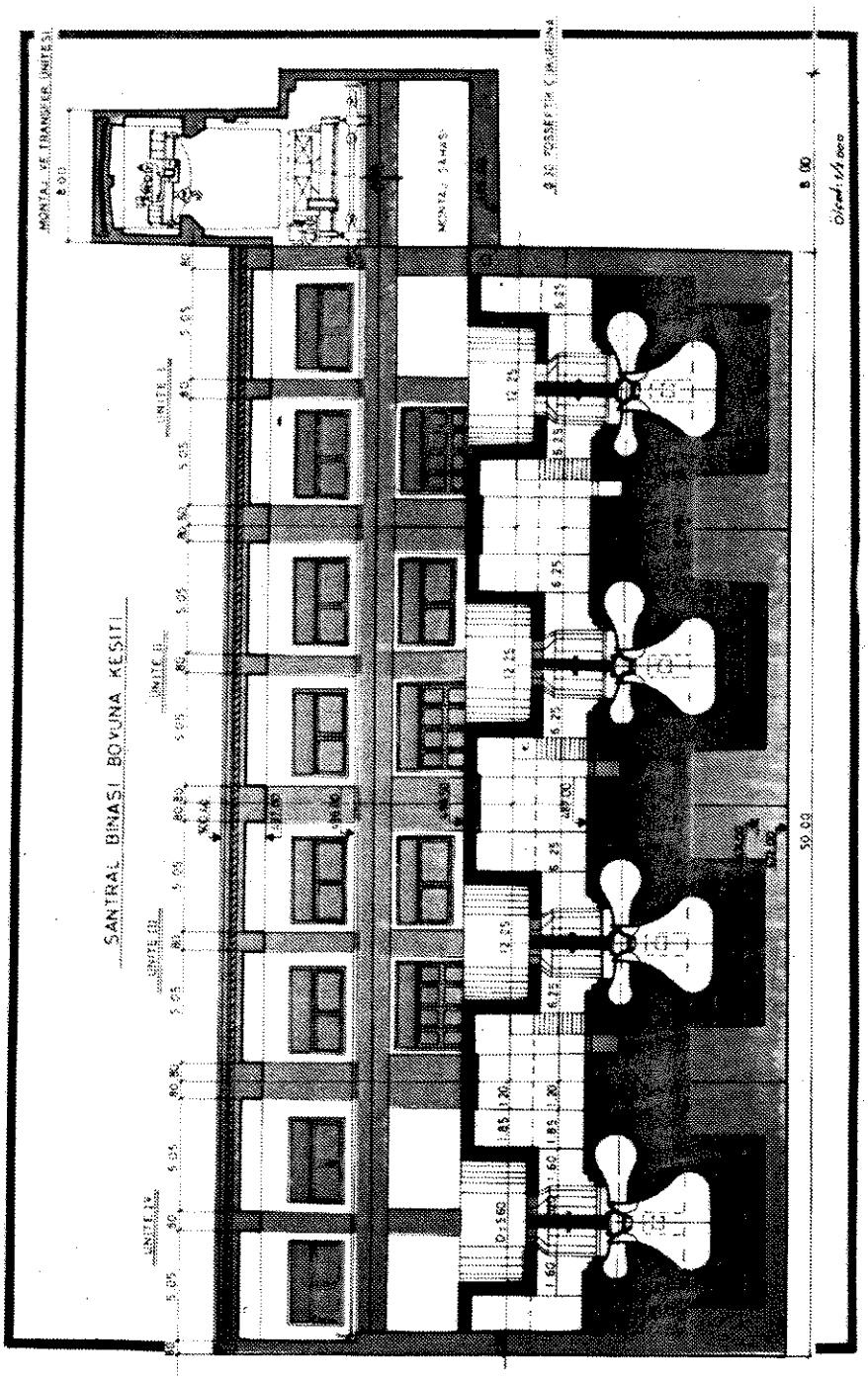
4. Power House

As shown in the cross section below, the power house is equipped with 4 sets of machinery which are connected with the unions of the distributor pipelines.

A throttle with an inside diameter of 2.0 m is located directly in front of each turbine.

The machines have the following data:

type of machinery	**Francis**
performance	41 MW
max. height of drop	126.48 m
normal height of drop	104 m
min. height of drop	75.1 m
absorption volume of the turbines	32.7 m3/sec.
generator power	33 kVA
generator voltage	13.8 kVA
turbine speed	333.3 rpm
total degree of efficiency	0.9



5. Inlet Sluices

Inlet sluices of this size were first planned by the Turkish consulting firm SU-YAPI alone. To determine the occurring static and dynamic loads an expertise was obtained from Prof. Dr. Naudascher, Technical University Karlsruhe together with Prof. Dr. Schmausser, Aalen.

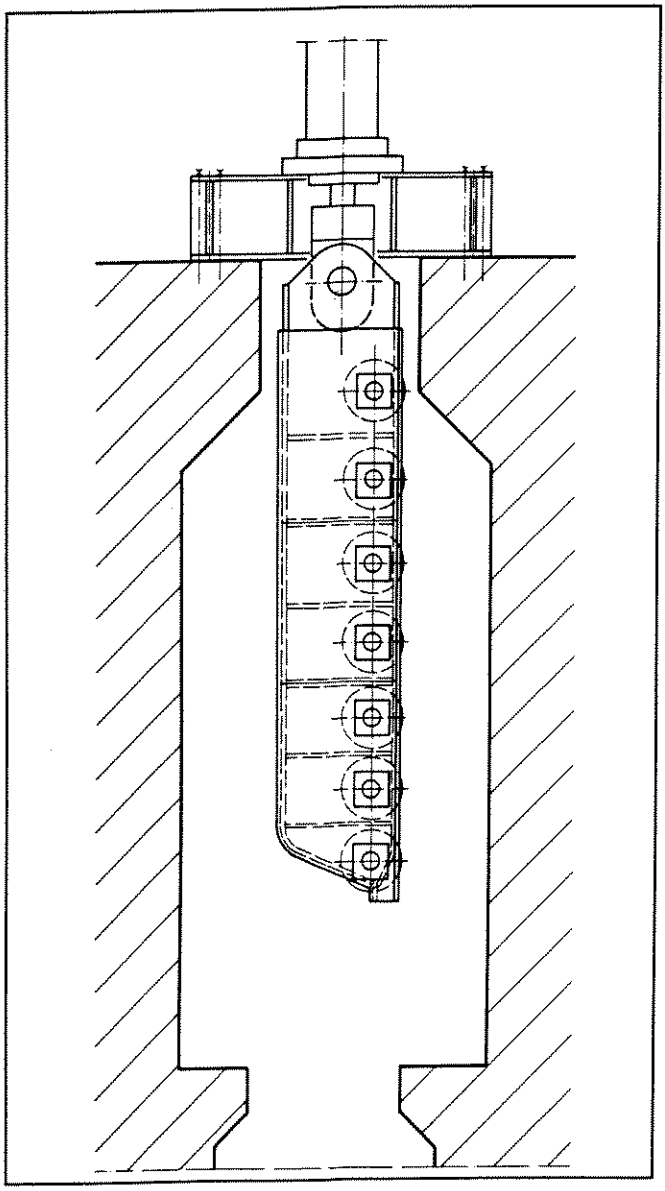
Technical Data of the Sluice:

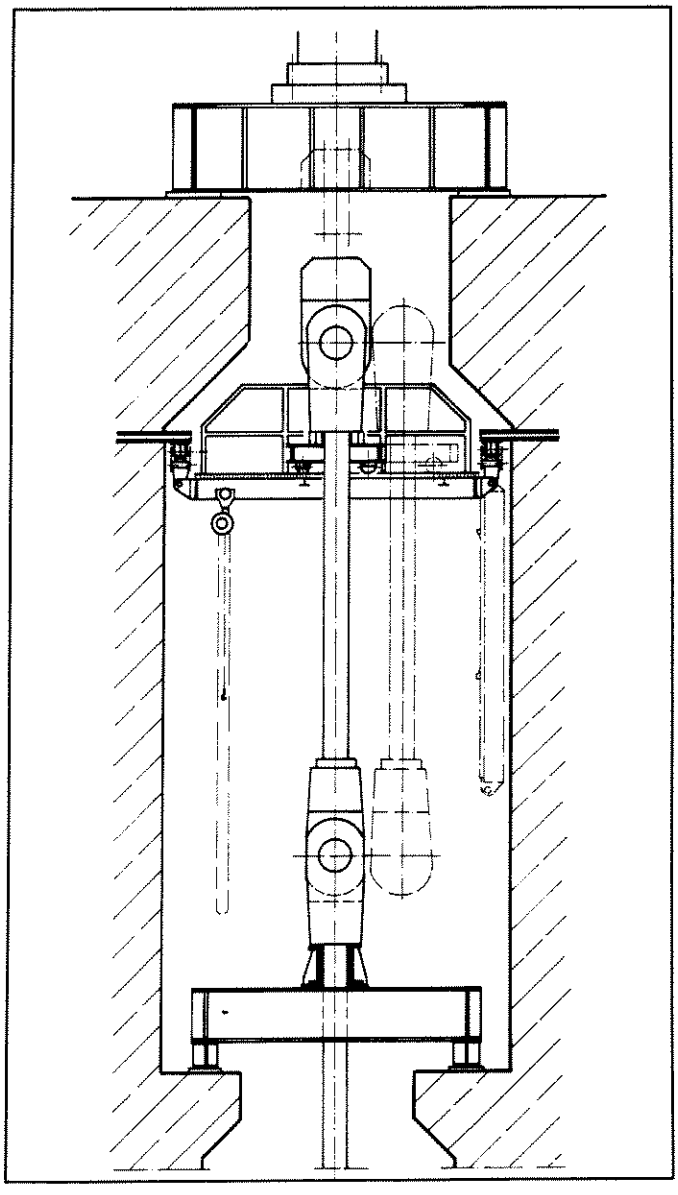
vertical clearance	6.2 m
breadth clearance	6.2 m
water pressure at bottom of sluice	68.5 m
flow Q	130 m/sec.
max. water pressure	26 250 kN
max. lowering power with quick shut-off	5700 kN
max. lifting power with opening position filling of duct	5600 kN
lifting power for opening of sluice	1800 kN

speeds:

normal lowering	vS = 1.0 m/min
rapid lowering	vS2 = 3.0 m/min
lifting in filling position	vH1 = 0.15 m/min
lifting to open sluice	vH2 = 0.96 m/min

As shown in the drawing, the sluice gate is designed as a rolling vertical lift gate with a baffle plate above the water level and 7 rollers (D - 700 mm) each per each side. The seals are located below water level.





Due to shipping and assembly requirements the body comes in three parts; the individual parts of the sluice gate are screwed together.

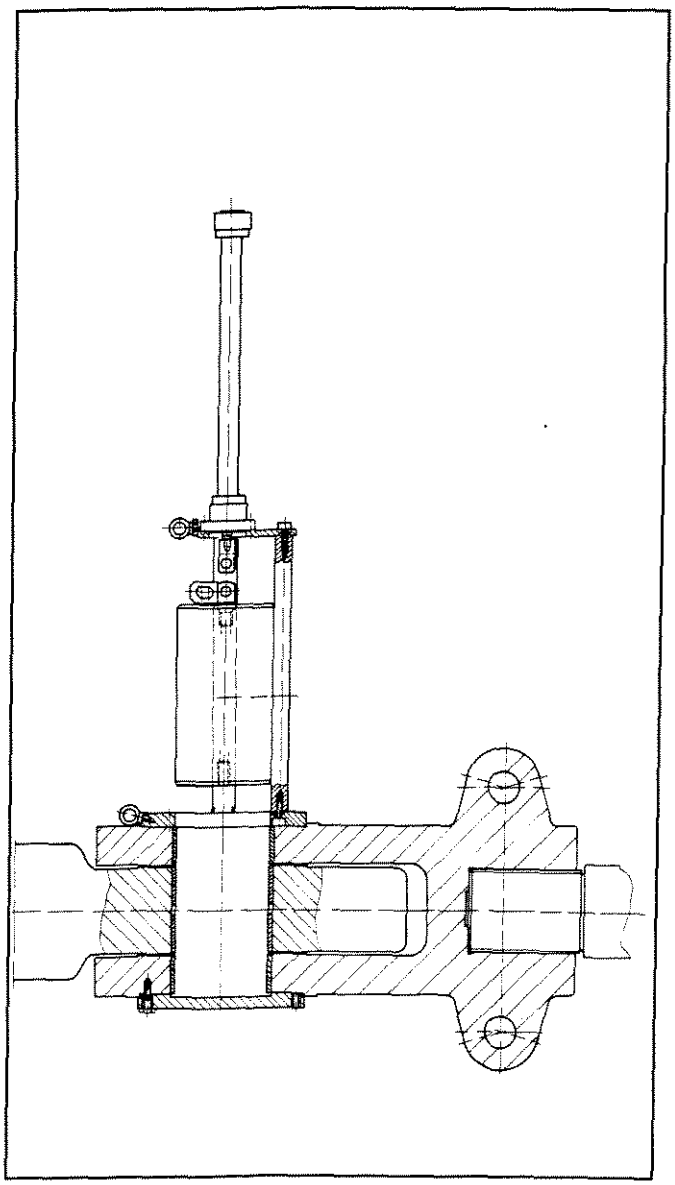
They were filled with a total of approx. 45 tons of scrap concrete for weight. For this purpose the sluice gate was provided with a back wall below water level at approx. 3/5 of the width.

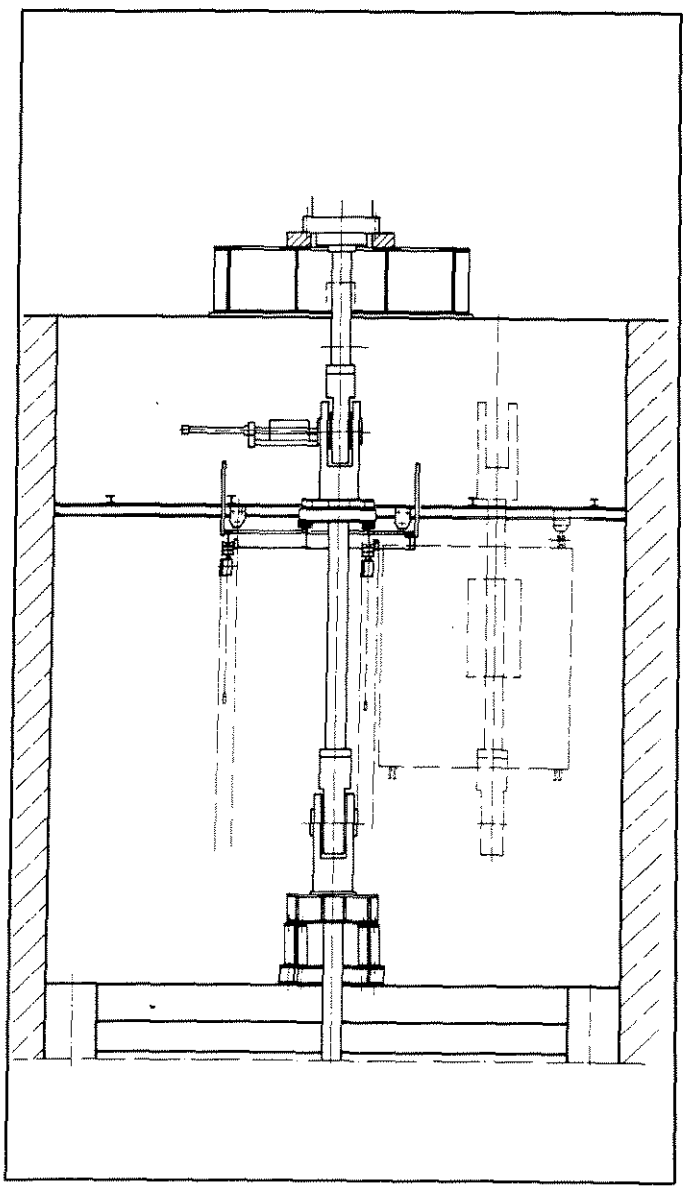
As mentioned before, the sluice gate is located in a vertical shaft. The platform of the power house located above is at height notation 614.50. The power house is equipped with a crane with a lifting power of 300 kN, 10 m lifting height above ground level.

This power house contains the lifting cylinder on a steel construction frame. A lifting rod structure consisting of 11 parts and with a total length of 57.68 m was built between the sluice gate and the hydraulic cylinder.

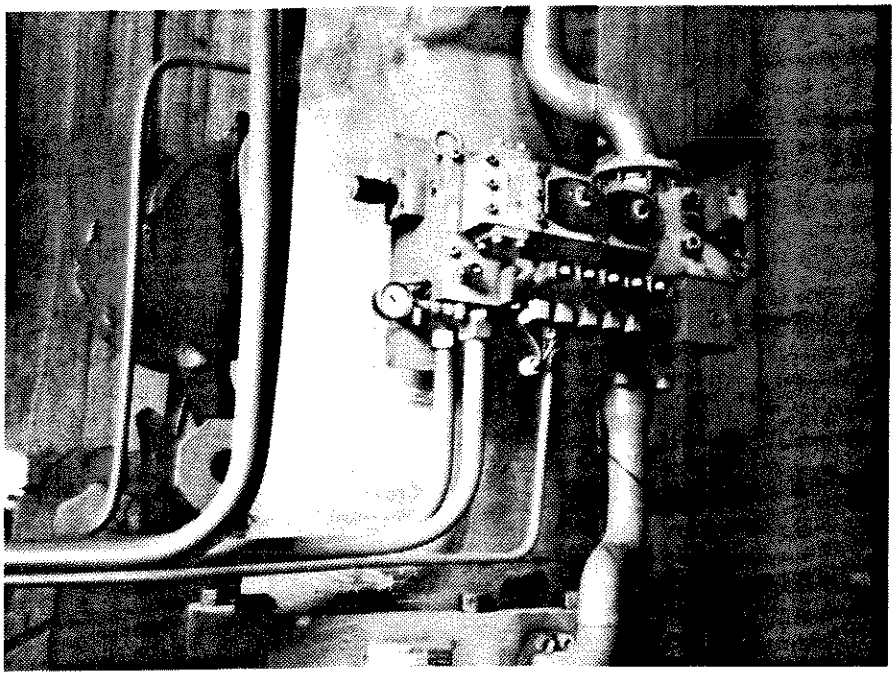
The lifting rod structure can be installed and/or removed section by section to pull up the sluice gate into the revision chamber at height notation 605.60. Because of the heavy individual weights of the rod structure parts (approx. 5.5 tons each) Mannesmann Rexroth designed a special installation for assembling and disassembling the rod structure. It basically consisted of a folding, mobile working platform as shown in the sketches. This working platform carried the supports for catching the rod structure sections and the working platform for assembling and disassembling the connection bolts. Due to their weight even these bolts could no longer be handled manually, therefore, a hydraulically operated assembly equipment as shown was developed for the assembly and disassembly of the bolts. A disassembled part of the rod structure can be moved over to the side by means of the assembly platform allowing the power house crane to reach past the cylinder frame and to pull the piece of the rod structure onto the power house and put it down in there.

During the rod structure disassembly a beam construction supports the weight of the sluice gate and the rod structure (total weight approx. 190 tons).





6. Hydraulically Driven Inlet Sluice Gate



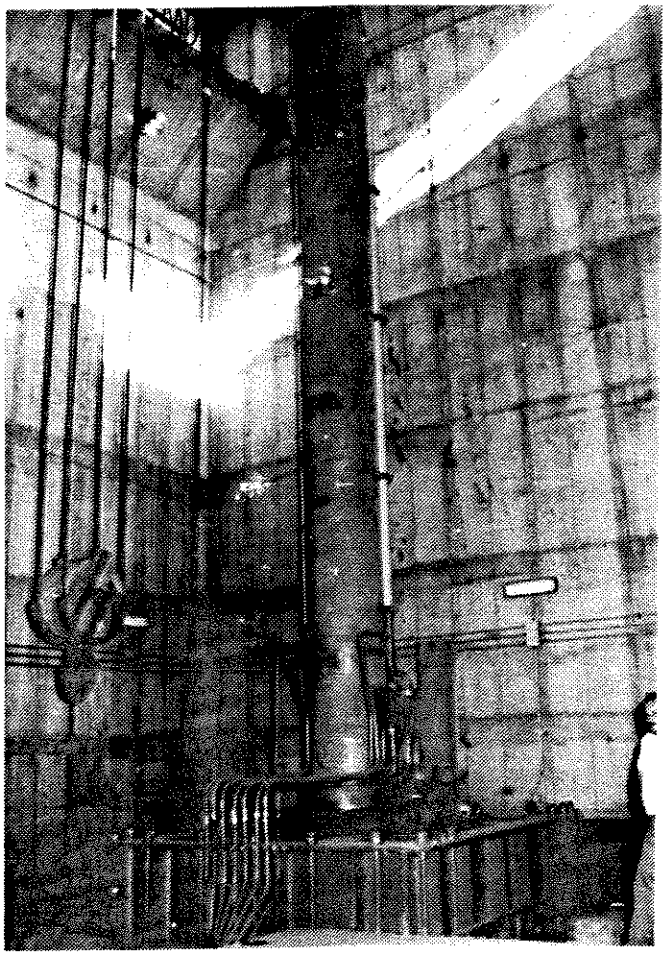
The sluice gate is operated with a hydraulic cylinder with the following dimensions: 660/250 x 6650 stroke.

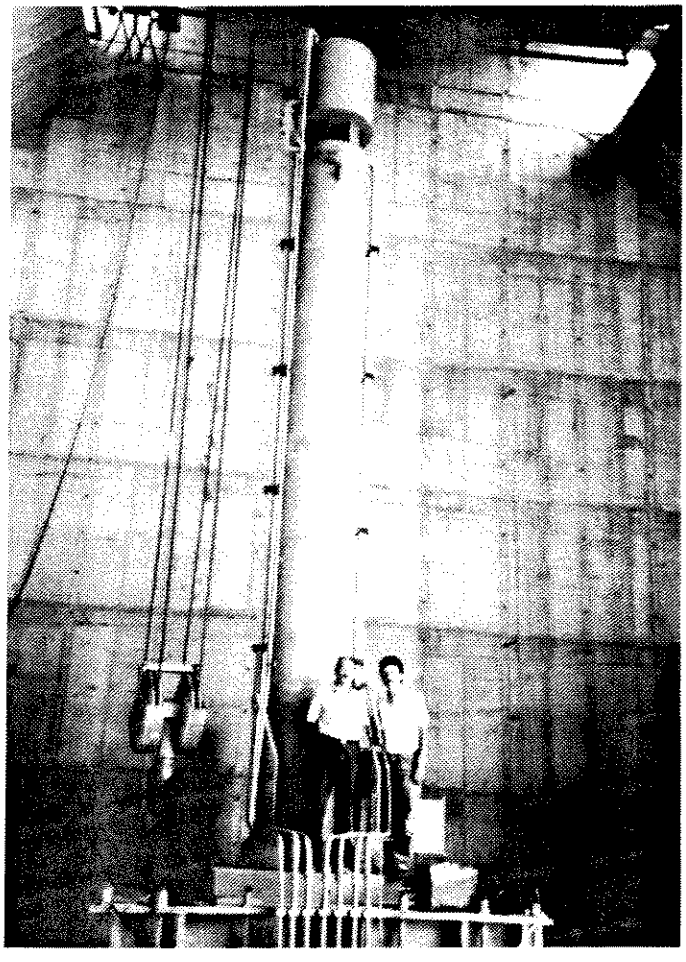
The cylinder is mounted onto the before mentioned working platform by means of a top flange. The maximum working pressure in the cylinder is 195 bar.

The rapid lowering process is done without running pumps. To achieve an uninterrupted filling of the cylinder a top-mounted tank is mounted to the top of the cylinder from which the differential volume = piston rod volume is drawn in.

A manifold is mounted to the cylinder carrying all required controls for normal lowering, rapid lowering, and lifting; as well as shut-off valves for leakage-free shut-off process. For safety reasons the control for the lowering process was designed redundantly.

To disassemble the rod structure the cylinder has to be extended without any load attached. To achieved controlled motion, the cylinder is pressurized with 8 - 10 bar on the piston side during the lowering process without the sluice gate attached.



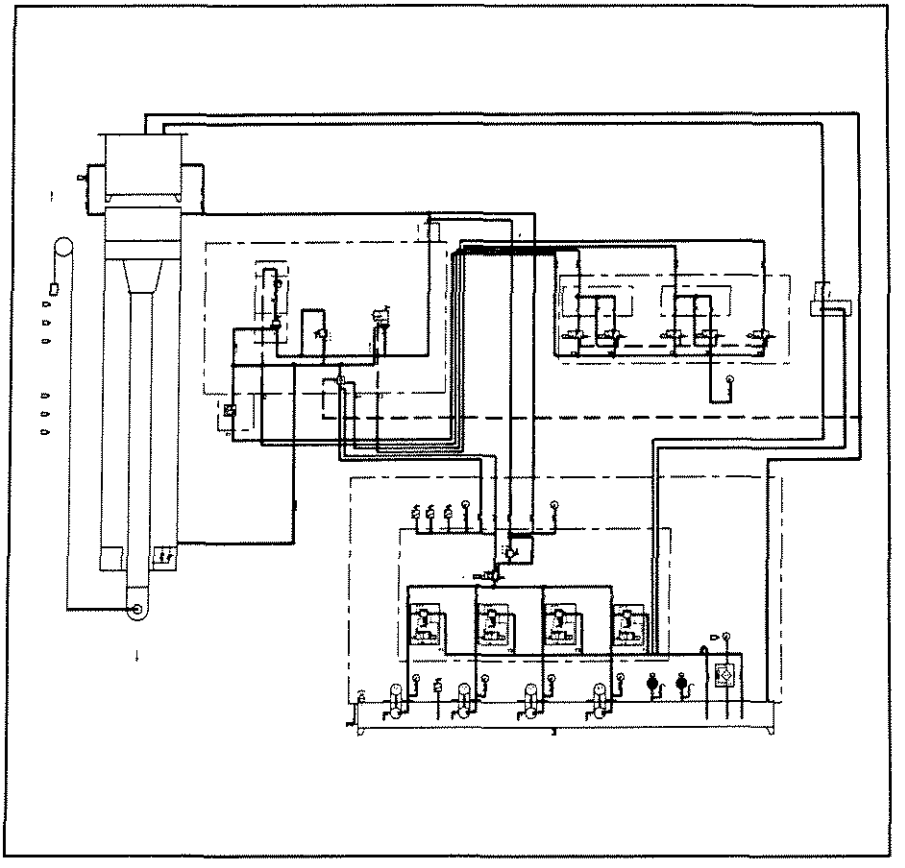


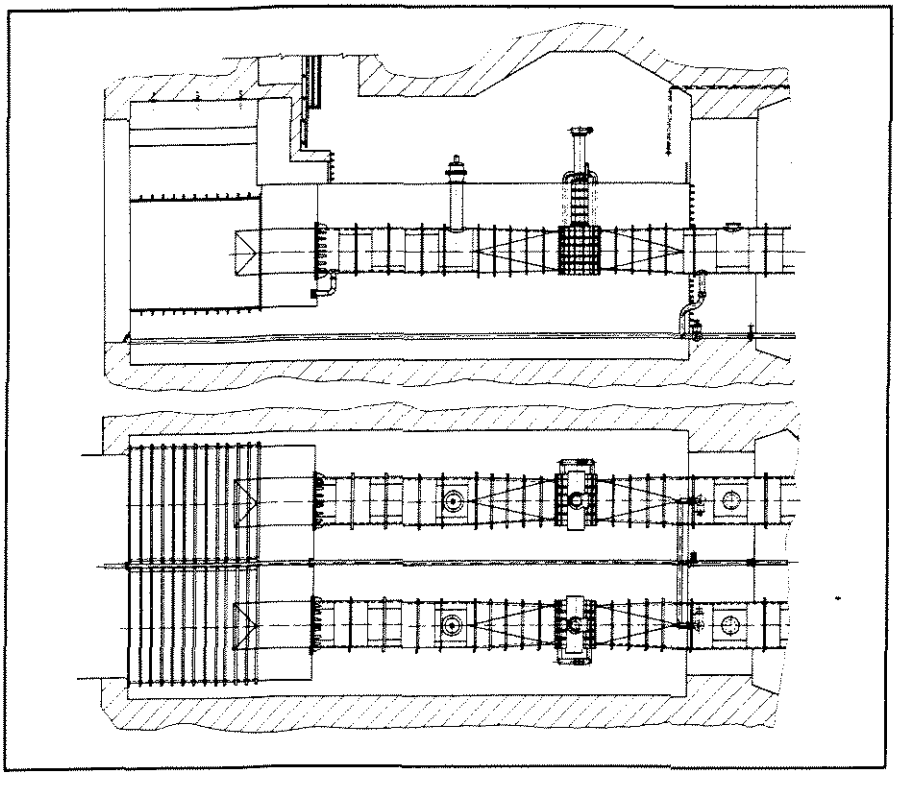
The hydraulic power unit is a compact design and it basically includes the oil reservoir with a nominal volume of 4000 dm3 with the following components mounted:

- 2 high pressure pump sets
  Q = 22 dm3/min
  p = 220 bar
  N = 11 kW
- to open the sluice gate to fill the duct
- 2 medium pressure pump sets
  Q = 141 dm3/min
  p = 75 bar
  N = 22 kW

to open the sluice gate. Each pump set has a pressure relief valve with solenoid-actuated unloading to facilitate a starting of the electric motors without load.

All important functions are monitored via pressure switches. Included with the power unit are generously dimensioned return line filters, oil level indicators, blue gel filters to serve as dehumidifiers, level indicators, shut-off valve, and all other installations required to achieve a user-friendly long-term operation of the system.





7. Redirection Duct - Ground Drain

During the construction of the dam the redirection duct was used to redirect the river. The duct diameter is 10 m, the duct length is 702 m, the tunnel is dimensioned for a water volume to be removed of 1050 m3 per second. Two ground drains were installed into the redirection tunnel after completion of the basic construction work.

Each ground drain consists of a sliding sluice, dimensions 1.1 x 1.8 m, and a poppet spool valve with a dia. of 2000 switched in sequence.

The sliding sluice is a state-of-the-art design with a closed sluice housing and the cylinder mounted on top of the pressure cover.

Normally, the sluice gate is opened only with the water pressures balanced, i.e. with a closed poppet spool valve. The closing process takes place against full flow. However, the hydraulic system is designed in such a way that opening against the water pressure is possible, also.

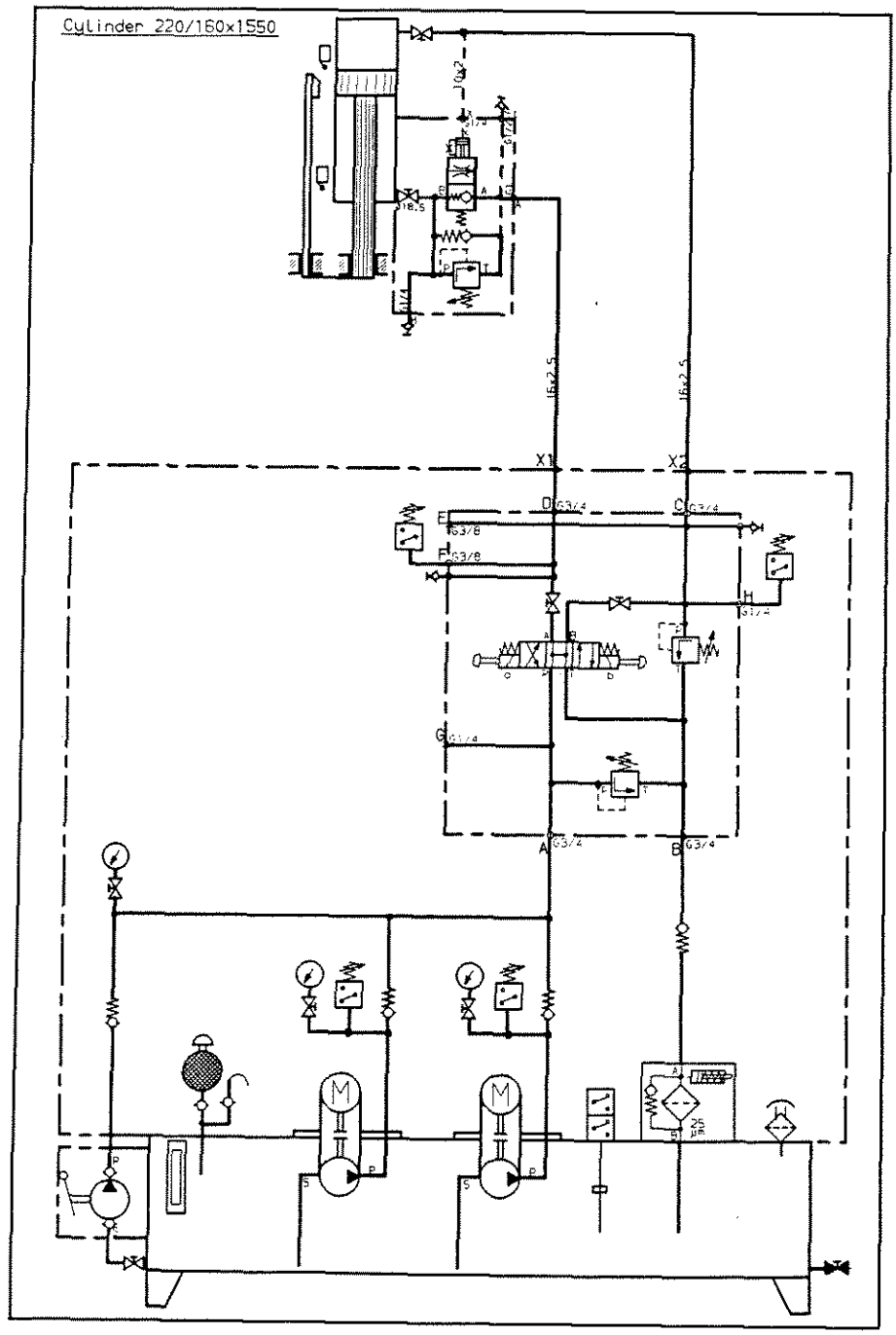
8. Hydraulically Driven Slide Sluices

compressive force	1300 kN
traction	200 kN
lifting speed	0.4 m/min
lowering speed	0.21 m/min
cylinder dimensions	320/220 x 2000
piston diameter	320 mm
piston rod	220 mm
stroke	2000 mm

Directly flanged onto the cylinder is a manifold with the controls required for *controlling the lowering speed* and for a leakage oil-free shut-off process, including pressure stabilization. In addition, the *cylinder has a manually operated lock to* secure the sluice gate in its highest position. This lock is used only during maintenance work and it is monitored by a limit switch.
Parallel with the cylinder is a limit switch system which includes the *following limit* switches:

– sluice gate open
– sluice gate closed
– leakage oil control
– leakage oil control defective - ALARM

The hydraulic power unit for two sluice gates is a state-of-the-art design with 2 pump sets, 2 complete manifold for the *lifting and lowering processes, all neces*sary monitor instruments to monitor the pipe lines for broken pipes, oil level monitors, and maximum pressure *monitors for* both lines.



9. Irrigation Duct

The irrigation duct is designed with a dia. of 3.5 m, with a total length of 774 m. The *water volume is 25 m/sec.* The equipment to regulate the water volume is similar to the above described ground drain, how*ever, with smaller diameters; in this case* the size of the sluice gate is only 1.5 x 1.5.

10. General Information

Mannesmann Rexroth supplied the complete hydraulic systems for this project, including the pertinent elect. controls. The complete assembly and start-up took place in cooperation with the Turkish subsidiary

Also, the complete engineering for the rod structure with assembly installations for the inlet sluice gate was worked out. Part of this supplied by Hidropar.

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