Paper No. 171

INDIGENOUS DEVELOPMENTS TO EXPLOIT HYDEL POTENTIAL IN PAKISTAN

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SYNOPSIS

Nature has blessed this country with lot of water resources in the northern area and the water flows into the rivers in plains out of which a biggest net work of canals has been made for irrigation purposes by making barrages. The natural gradient of land is much steeper than optimised gradient required for canals and in order to match with the land gradient for irrigation purposes, the canals have been given falls varying from 2-10 ft, and some time more than this, after every 1000 to 2000 ft. Different means have been adopted to dissipate extra kinetic energy imparted in the water at different sites. Utilization of this potential has certain limitations i.e. no storage capacity and no fluctuating load. For this purpose some developmental work has been done by the National Institute of Power which does not involve the conventional set up of expensive civil work as shown in different slides.

1. INTRODUCTION

Pakistan has lot of natural water resources available for power generation with high head and high discharge in the northern area of the order of about 30,000 MW and low head high discharge in the plains to the tune of few thousand Mega Watts. The exploitation of low head and high discharge requires lot of money as demonstrated by three power station on canal falls like Chichoki, Shadiwall and Nandipur and in the northern area, the conventional construction of hydel stations to exploit such hydro-electric potential in the country requires lot of money and it is only due to lack of resources and indigenous developments no real break-through has been achieved in the past.

Regarding the aggrigated power of low head high discharge on canal falls it is about few thousand MW and 900 MW has been identified by WAPDA around barrages. This Institute requires collaboration from WAPDA in order to extend the unit capacity from 50 KW to 5000 KW or so while utilizing its indigenous development. Indigenous technology developed by this Institute does not involve the breaking of the existing banks for the existing barrages as shown on slides and furthermore, the problems faced by this institute for small stations shall be reduced if the energy is fed into the Electrical system of WAPDA.

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* D.G. National Institute of Power, Govt. of Pakistan

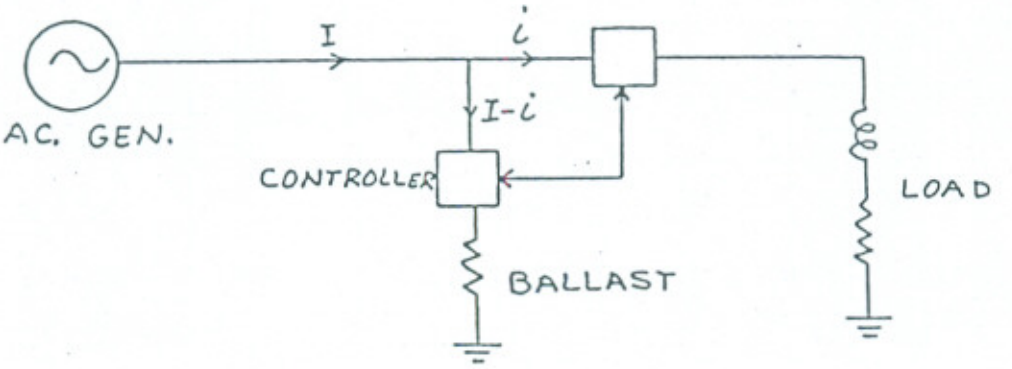
2. POWER POTENTIAL

Regarding the assessment of the power potential available in Pakistan, Irrigation and Power Department & WAPDA are aware of but it is the technological break-through which is needed to exploit them which can meet our demands today and tomorrow. In fact the potential is in abundance but the will for accomplishment is needed.

In order to show you the extent of blessings by nature, the Rasul Hydel Electric Station is given as an example which came into existance due to Irrigation Engineering (because the bed of the Upper Jehlum Canal was made according to the set of principles of engineering) and the natural flow of the river. At a later stage, three more hydel stations with a total capacity of 40 MW under Colombo Plan were added. The availability of such potential is not new but it is the indigenous development which is lacking in the country to harness such resources.

3. FREQUENCY CONTROL THROUGH BALLASTS

Overseas Companies and Intermediate Technology Development Group based in UK have developed electronic controller which is being commercially used for low head high discharge unit for the purpose of maintaining a fixed frequency as shown in the diagram, but unfortunately the alternator's supply becomes rich in harmonics and no more useful for the induction machinery.



Showing the use of ballast to divert the surplus current.

4. EDDY CURRENT BRAKING

This Institute has developed eddy current braking which has its limitations for controlling frequency for capacities up to 100 KW. This system exerts a fixed load on the alternator shaft by sharing the mechanical power depending upon the electrical load on the alternator as shown in figure 2.

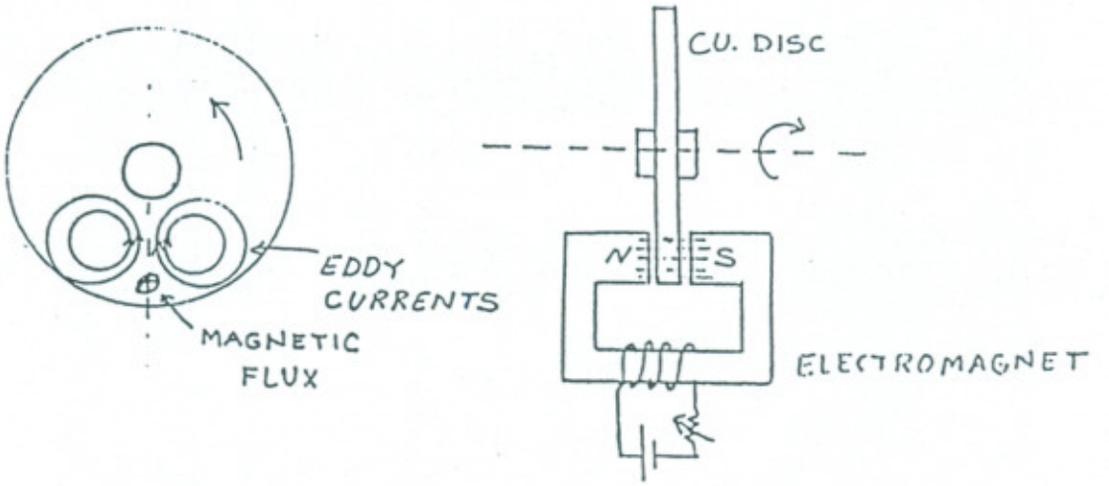


Fig.2 Showing the principles of eddy current braking.

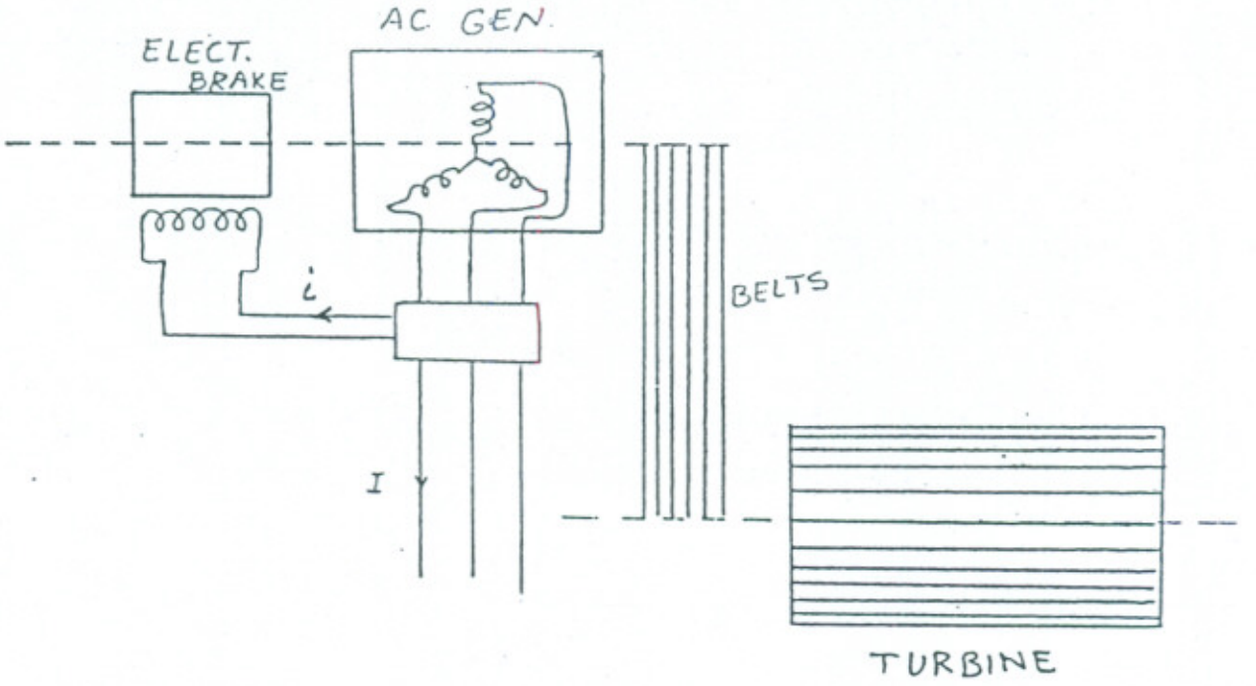


Fig. 3. Overall arrangements for the application of eddy current braking.

5. PITCH CONTROL OF BLADES

In both the above frequency control methods mentioned above wastes power in the form of heat and electro-mechanical forces, for which dissipation is a problem and it puts the limitations on the capacity of the machine. For bigger units, the turbine should generate the required power and by-pass the extra water so that the irrigation requirements be met without disturbance.

Considering the quality of the skill available in common workshops, mechanical arrangement has been adopted through gears which is much more economical as compared to the hydraulic system. For a four blade turbine unit the gear has been developed as shown in the figure and the unit is in operation at D.G. Khan site.

The locking of blades has been achieved through worm & worm wheels of a very large ration of 2000. The driving motor a 60 Watt, 12 Volt, DC Series Motor fixed inside the hub. The motor is controlled with electronic circuitory incorporating a frequency counter to operate the motor in one direction or the other. Different slides shall show the different views. In fact this principle is already in use of Foker Aircraft.

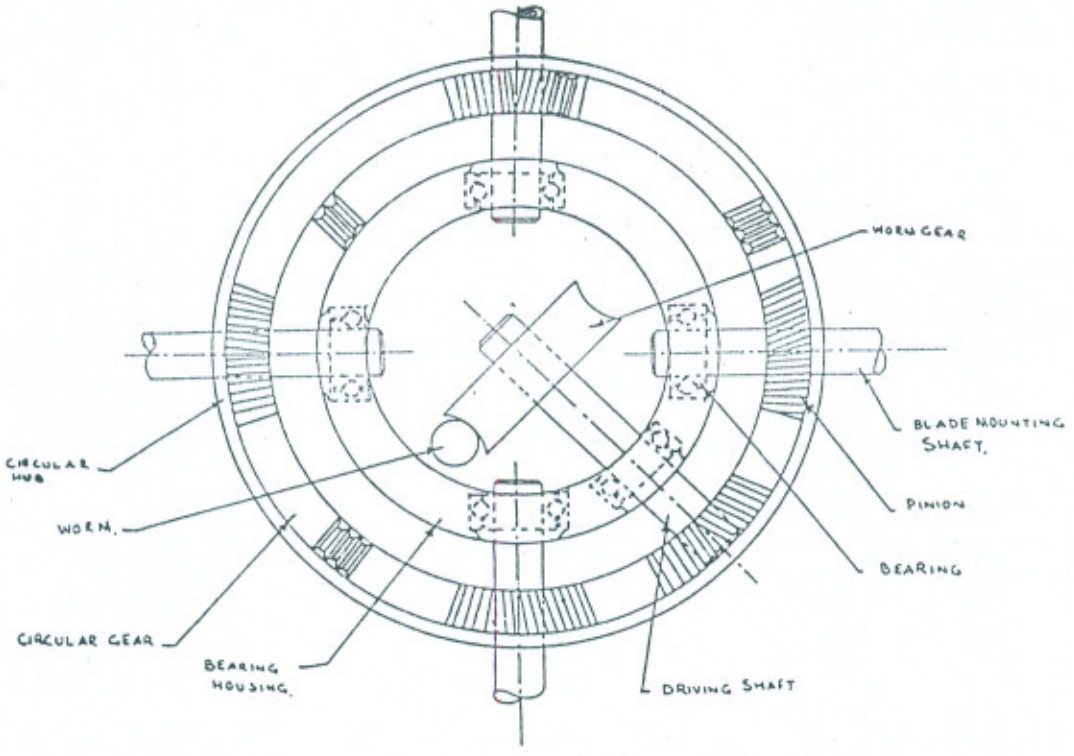


Fig. 4. Gear arrangements for blade angle control.

6. CONCLUSIONS

a 50 KW hydel staion on the man-made canals has been made operational at a cost about Rs.8,000/- per KW by avoiding the expensive civil works normally required for conventional construction. It shall help the developing countries to accelerate their programmes for electric power generation due to low capital outlay.

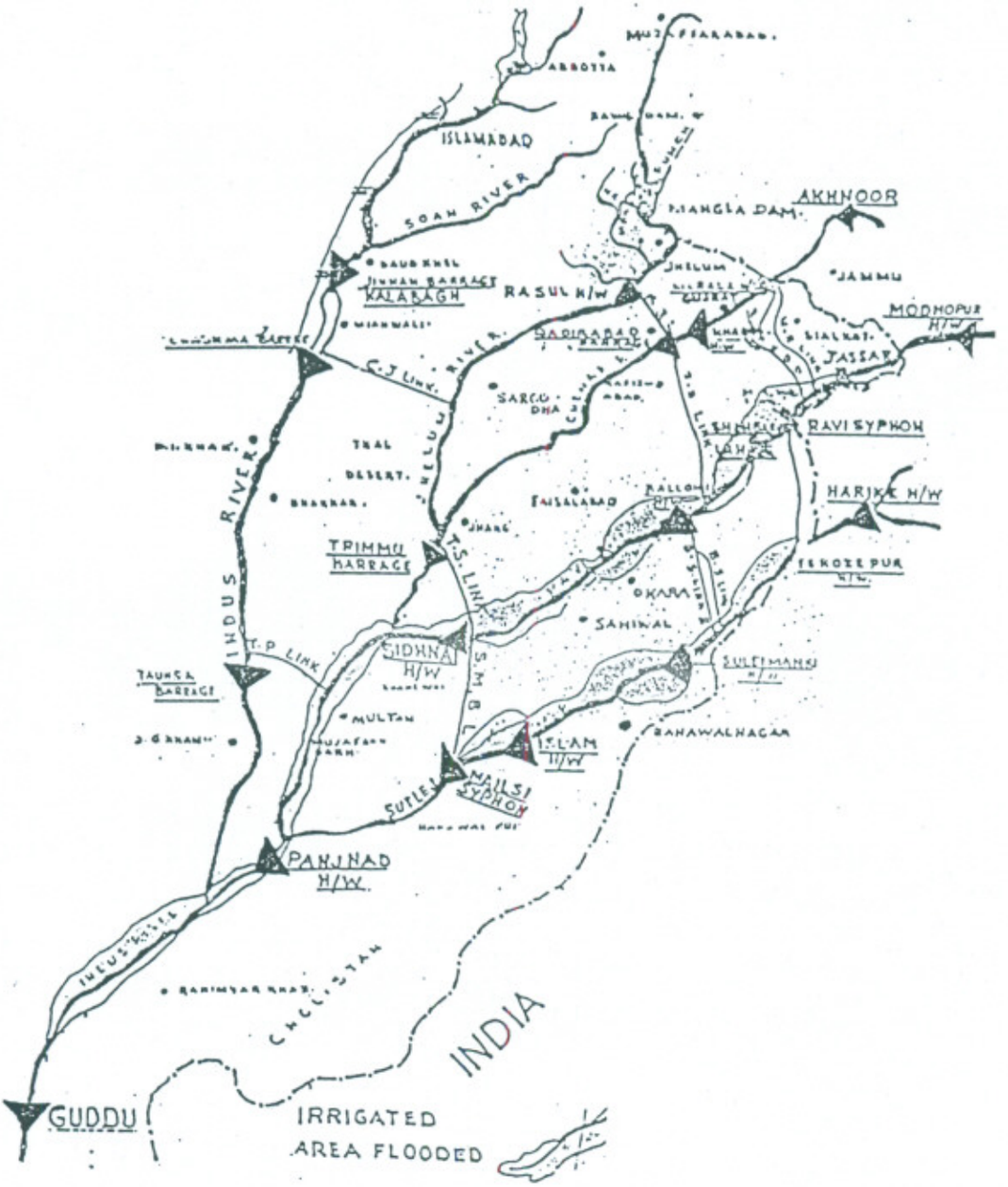

ISLAMABAD
SOAN RIVER
MANGLA DAM
AKHNOOR
JAMMU
MODHOPUR H/W
JASSAR
RAVI SYPHON
HARIKE H/W
FEROZEPUR H/W
RASUL H/W
KALABAGH
JINNAH BARRAGE
MIANWALI
SARGODHA
JHELUM
CHENAB
J.C. LINK
T.P. LINK
T.S. LINK
S.M.B. LINK
INDUS RIVER
THAL DESERT
BHAKKAR
FAISALABAD
JHANG
TRIMMU BARRAGE
SIDHNAI H/W
TAUNSA BARRAGE
D.G. KHAN
MULTAN
OKARA
SAHIWAL
SULEIMANKI
BAHAWALNAGAR
ISLAM H/W
SUTLEJ
MAILSI SYPHON
PANJNAD H/W
INDUS BASIN
RAHIMYAR KHAN
CHOLISTAN
INDIA
GUDDU
IRRIGATED AREA FLOODED

FIG. 1

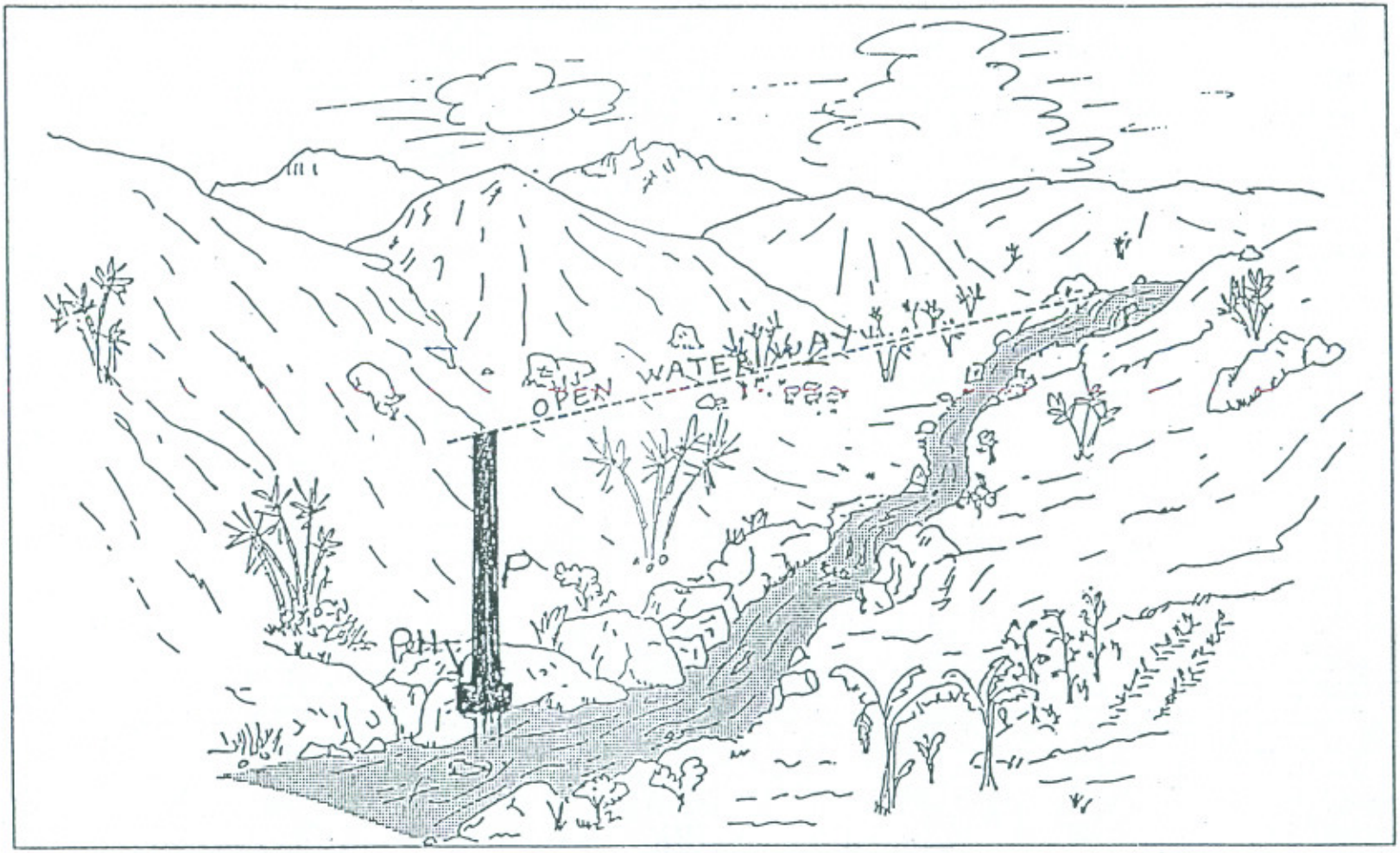


FIG. 2 COUNTRY SIDE POWER HOUSE

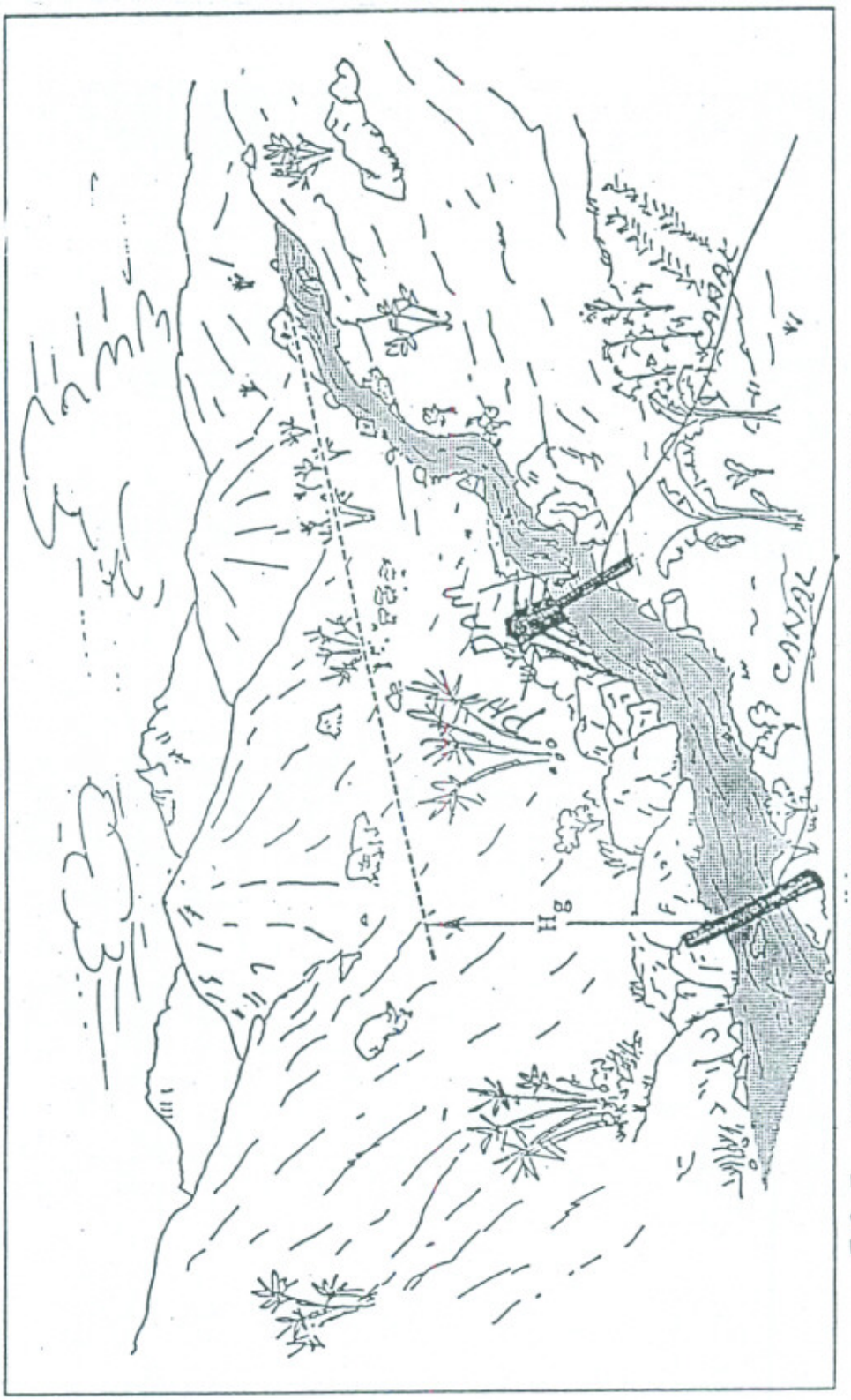


FIG. 3 POWER & IRRIGATION ORIENTED DAMS IN PAKISTAN

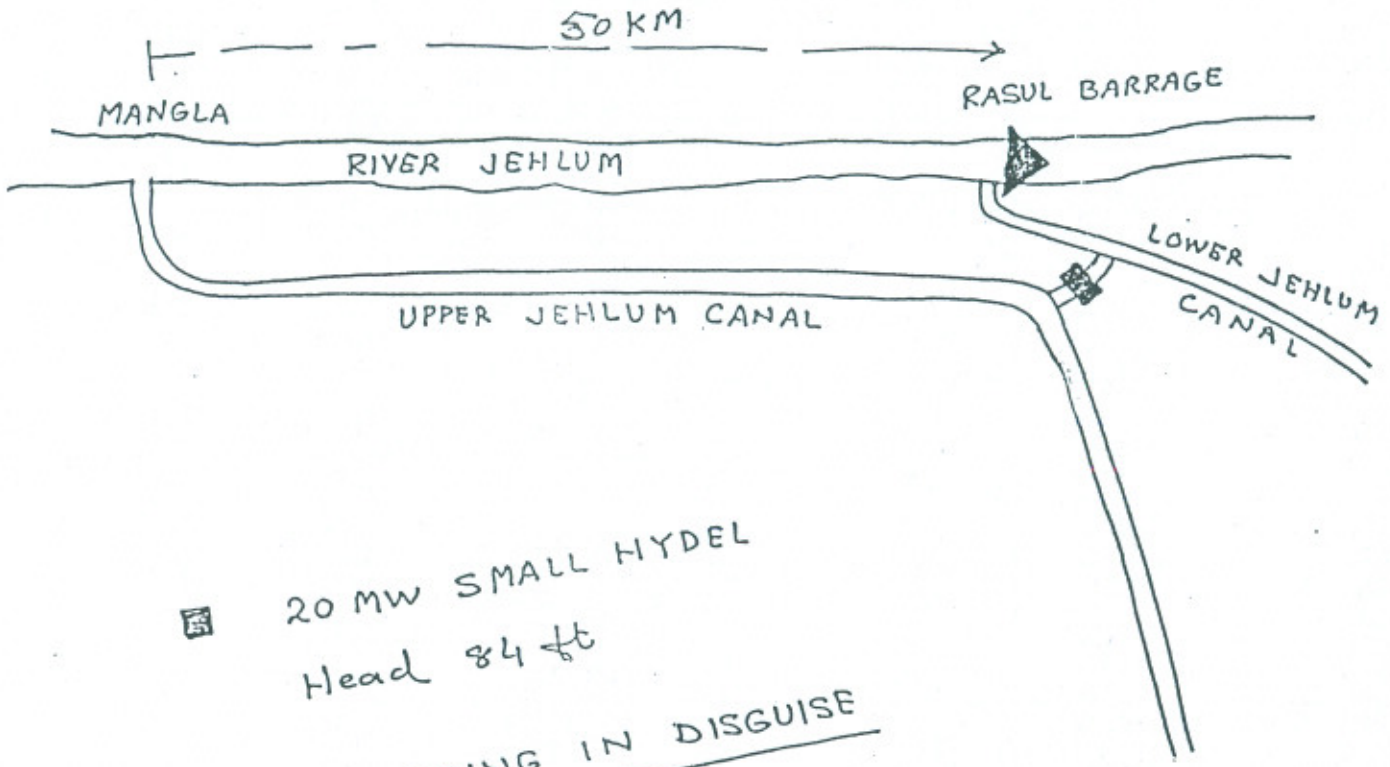


FIG. 3(a) A BLESSING IN DISGUISE

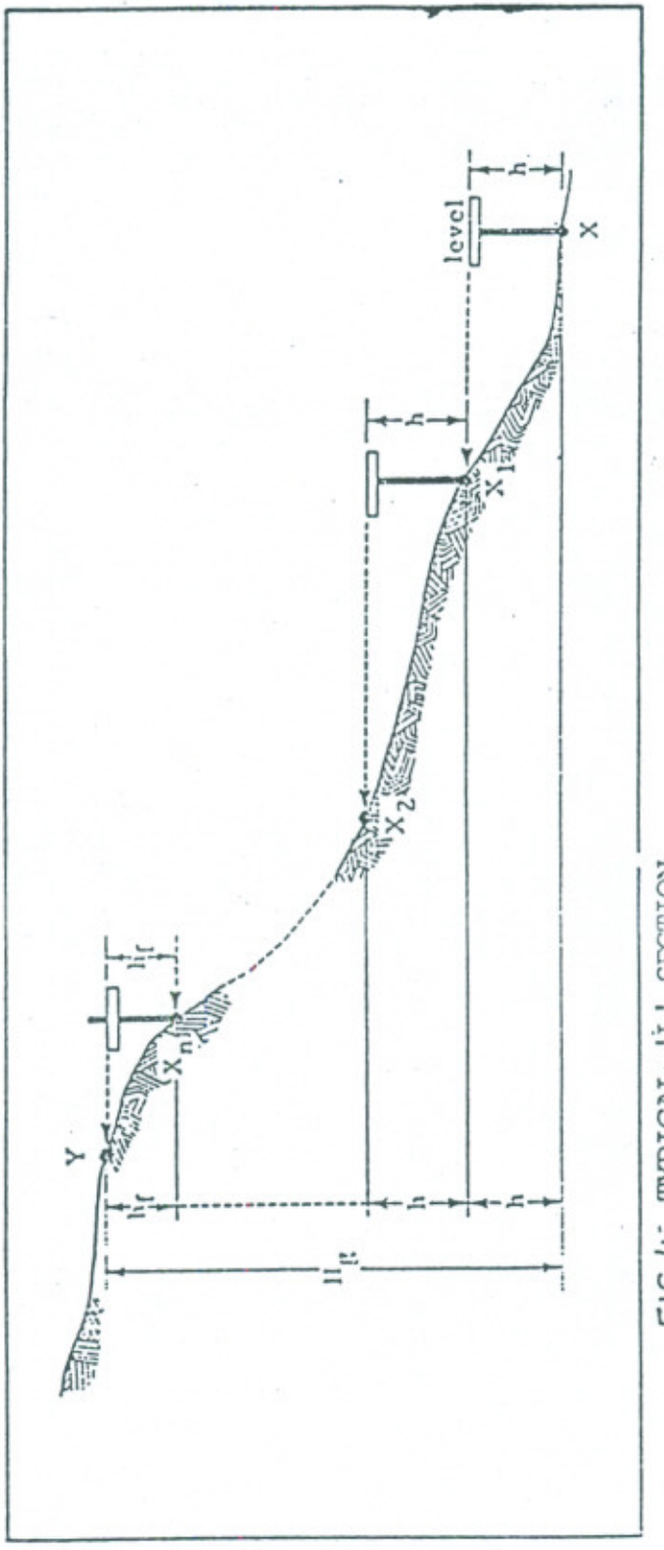


FIG. 4 TYPICAL 'L' SECTION

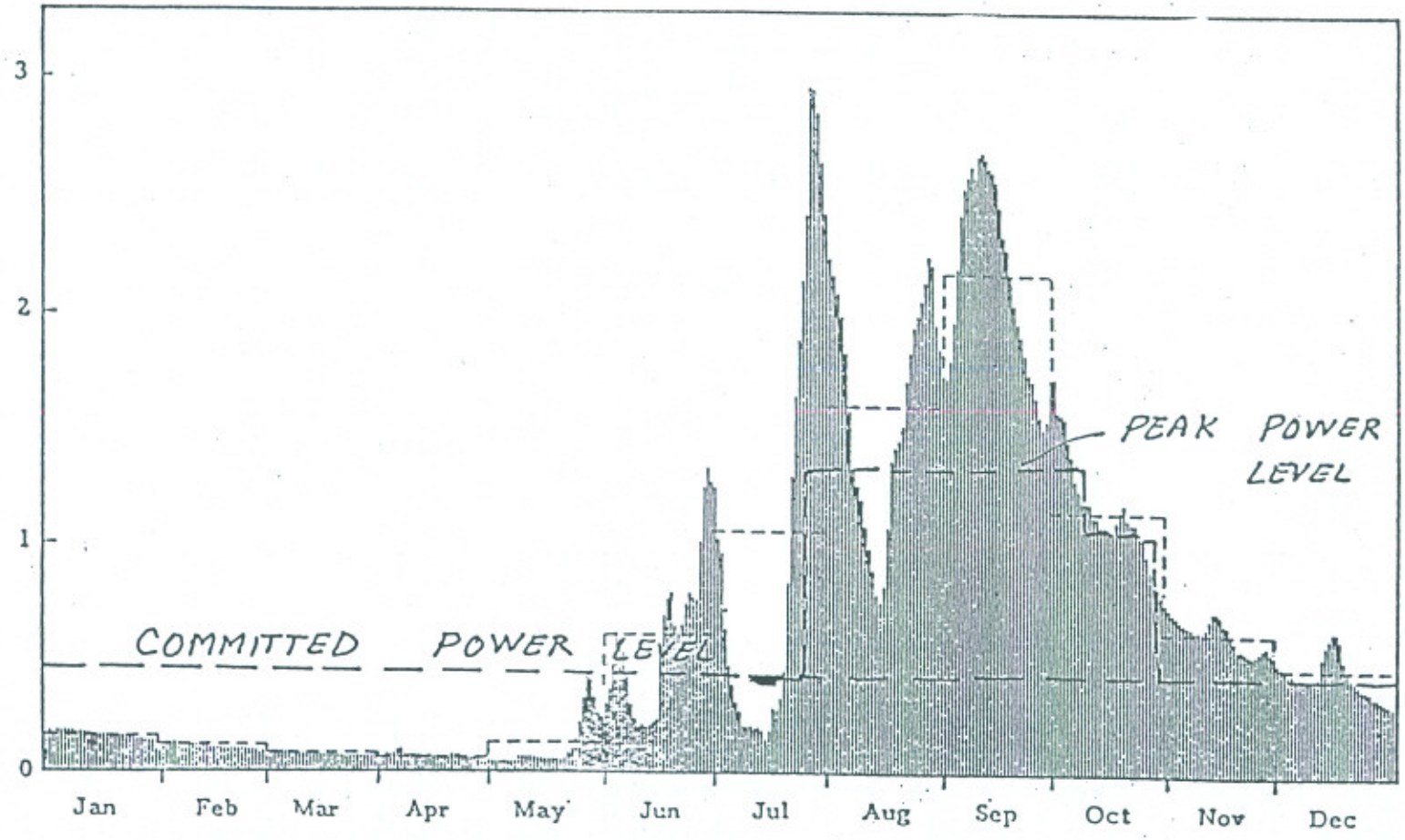


FIG. 5 FIRM POWER & FLOOD WATER POWER FOR A NORMAL DAM

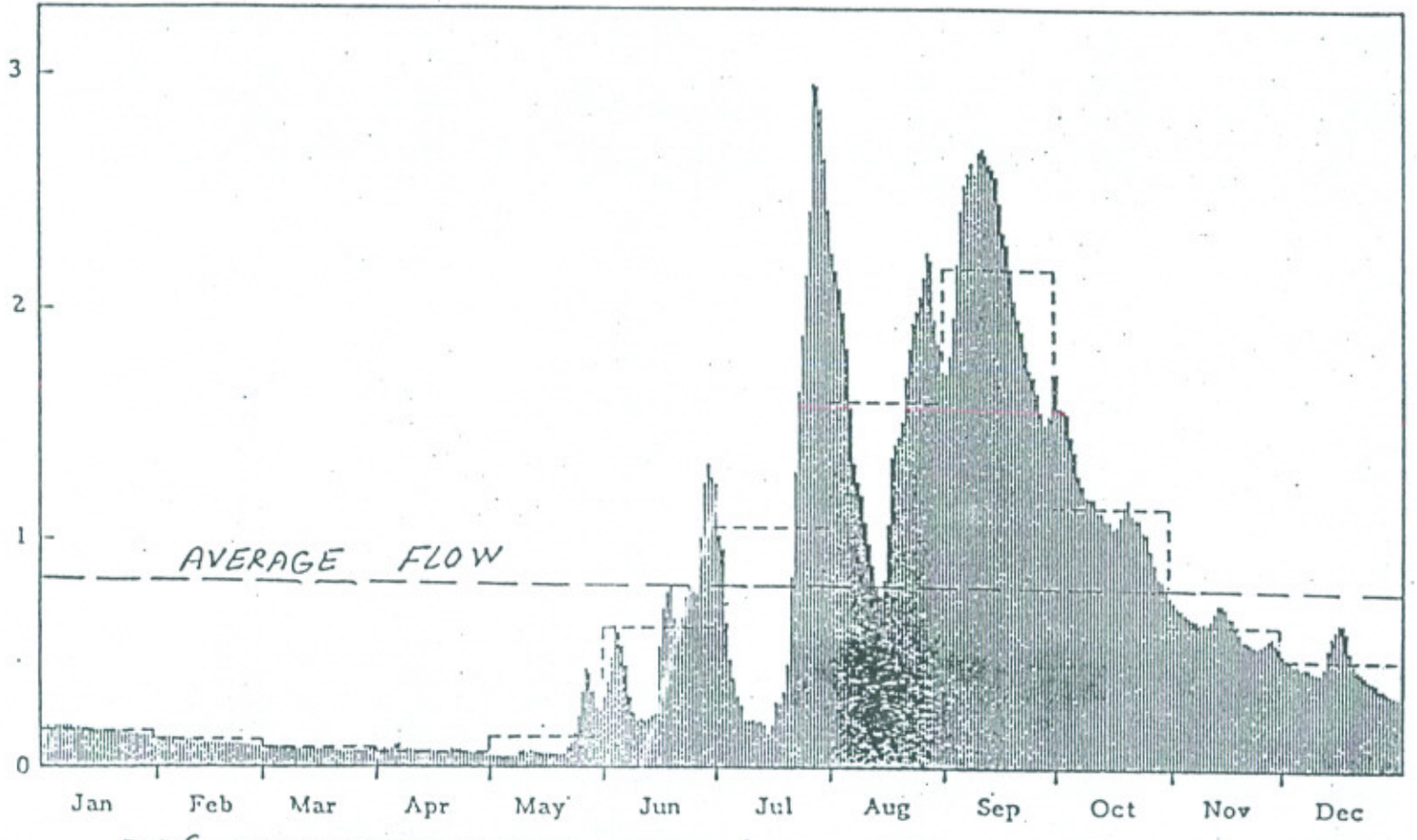


FIG.6 AVERAGE MONTHLY FLOW & CONTROLLED AVERAGE FLOW FOR 100% UTILIZATION

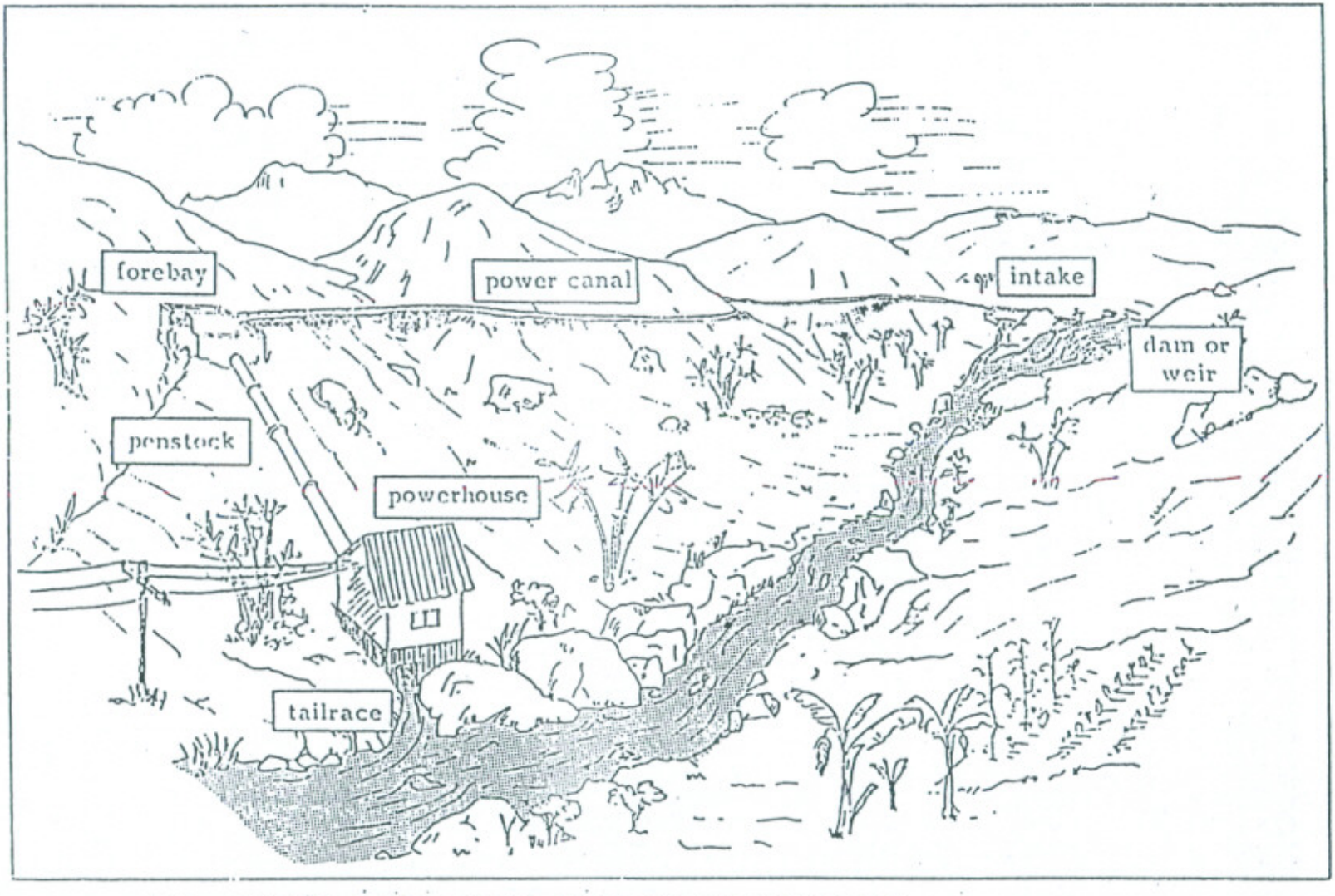


FIG 7 TYPICAL CONVENTIONAL HYDRO ELECTRIC STATION