There is a slight possibility of an electrification of the Panama railroad over the relocated lines, the electrification depending entirely upon the nature of the traffic conditions that result after completion of the canal. The circuits from the station to the load centres, in general, will be in duplicate, insuring as far as possible an absolutely continuous service. The station will be connected by means of a high voltage transmission line to the present steam generating station at Miraflores, which station will be held in reserve to tide over either shut-down or low-water periods of the Gatun station.

The hydroelectric station is to be situated adjacent to the north wall of Gatun Spillway. The building will be constructed of concrete and steel, and will be of a design suitable for a permanent power house in a tropical country. The dimensions of the building are such as to permit the present installation of the three 2,000-kilowatt units, and provision is made for a future extension of three additional similar units. The building will be rectangular in shape, and will contain one main operating floor, with a turbine pit and two galleries for electrical equipment. The station equipment will include a 30-ton crane to be used during erection and whenever repairs are to be made. The building, with the machinery and electrical equipment, is laid out upon the unit principle. Each unit consists of an individual headgate, penstock, governor, generator, exciter, oil-switch, and control panel. The position of the main features of the development relative to the Spillway channel are shown in Figure 1.

Water is to be taken from Gatun Lake, the elevation of which will vary with the seasons from 79 to 87 feet above sea-level through a forebay which is constructed as an integral part of the curved portion of the north Spillway approach wall. The curved portion of the Spillway wall contains five large apertures into the forebay and will serve as a fender wall to prevent floating debris from accumulating at the headgates.

From the forebay, the water will be carried to the turbines through three steel plate penstocks, each having an average length of 350 feet. The penstocks are to be constructed of ⅜-inch plates riveted together, and are to be 10 feet 6 inches in diameter inside. The exterior of the penstock is to be surrounded by a thick concrete coating to serve both as a protection against corrosion, and as a means of strengthening the penstock against superimposed earth pressures. The concrete will have a minimum thickness of 12 inches and will be anchored to the steel by means of Z-bars, which are riveted to the plates. The position of the station building relative to the headgates requires that each penstock makes a right angle bend to enter the station. The alignment of penstocks is such that the steel and masonry will be entirely covered by the fill of Gatun Dam. Near the lower end of the penstocks, at the building wall, there will be installed a testing link, the purpose of which is to measure, by the velocity method, the quantity of water flowing in the tube.

The entrances to the penstocks will be closed by cast iron headgates, and bar iron trash racks, the latter being provided for the purpose of preventing sunken débris from entering the penstocks and either clogging or breaking the turbine runner. The headgates will be raised and lowered by individual motors, which will be geared to rising stems attached to the gate casting. Control of each motor from the station switchboard will be effected by means of reversing contactors with interlocks, a limit switch, and a float switch, all operating automatically. The driving machinery and the motors will be housed in a small concrete gate house, erected upon the forebay wall directly over the gate recesses and trash racks. The gate house will be constructed for the present requirements of three headgates, and provision is made for a future addition of three more units.

The turbogenerator units are to be of the vertical type; the entire weight of the rotating element being suspended from an overhung thrust bearing, which is supported from the top shield of the generator. The water turbine proper will be of the spiral casting, one runner, Francis type, and is to be set in heavy masonry foundation. The water will enter the turbine through a tapering joint from the penstock and discharge into an increasing, elbow draft tube, made of ¼-inch steel plates and will be imbedded in the concrete foundation. A section of the station, showing the arrangement of penstock, turbine, and draft tube, is illustrated in Figure 2. The turbine is rated at 2,250 kilowatts at a speed of 250 r.p.m. and will consume approximately 500 second feet of water at full load.

Superimposed upon the turbine casting is to be the generator, a distance ring, six feet in height, separating the two. The generator is to be rated at 2,000 kilowatts, and will deliver 3-phase 25 cycle current at 2,200 volts potential. The turbine, generator, and auxiliary equipment are to be of the best mechanical and electrical construction obtainable. The governor is to be mounted upon one side of the distance ring and is to be geared solidly to the main shaft.

The path of the electrical energy from the generator to the outgoing feeders is shown diagramatically by the heavy line in Figure 2. The leads emerge from the lower part of the generator and pass through a manhole at the base of the turbine into a duct line, which carries the cables to manholes in the cable vault; thence the leads are taken up the building wall in tile ducts to the generator reactances. The reactances are to give protection to the generators in event of severe and protracted short-circuit outside the machines and consist of air insulated coils mounted upon concrete cores; a reactance coil is inserted in each of the three phases of each generator.

Adjacent to the reactances is a concrete cabinet which contains small series and shunt transformers for energizing the instruments and protective devices on the main control switchboard. The generator leads next enter a concrete compartment which houses a pair of oil switches. The two switches permit a selection of connections to either of the duplicate buses, which are situated on the first gallery floor, directly underneath the generator oil switches. The buses are to distribute the energy among the several circuits, each of which is equipped with oil switches. The distributing circuit passes from the circuit switch to an instrument transformer compartment, which is quite similar to the generator instrument transformer compartment. From the instrument transformers, the circuit cables drop into the vertical duct shelves in the cable vault below; thence make an exit from the station through manholes at either end of the building into duct lines at the crest and toe of Gatun Dam. As far as practicable, the entire electrical equipment is in duplicate, and is designed with continuity of service, operating accessibility, and protection of human life as the prime considerations.

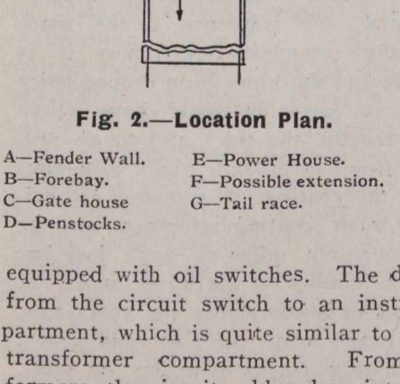

Fig. 2.—Location Plan.

A—Fender Wall.
B—Forebay.
C—Gate house
D—Penstocks.
E—Power House.
F—Possible extension.
G—Tail race.