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Rated Flow 300 cfs Ad.

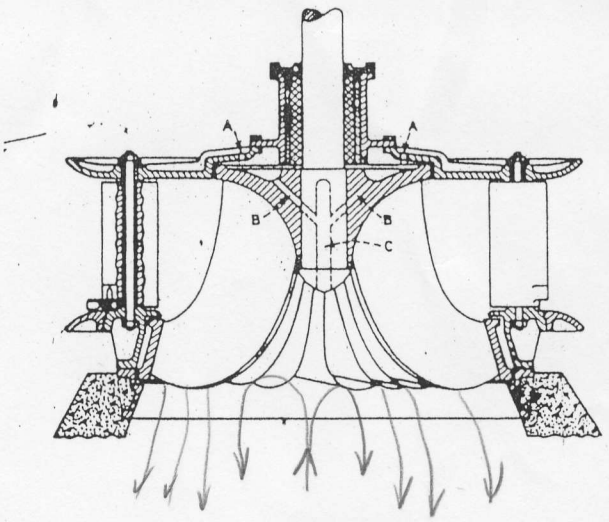
We operate a hydroelectric plant in parallel with our steam plant, but during about two-thirds of each year we experience a water shortage for the hydro plant. This plant has one 800 hp Francis wheel direct-connected to a 625 kva 0.80-pf ac generator, which connects with the local utility company at our switchboard. The turbine operates under a 27 ft. head on water supplied through a 1300 ft. penstock. A float-actuated selsyn motor at the dam actuates the turbine gates so as to utilize the flow of the river continuously during dry periods.

To start the wheel and bring it up to synchronizing speed required 75 cfs of water. Having read at one time something about increasing the power of a waterwheel by admitting air to it during part-gate operation, I decided to see what could be done with our wheel. The problem was to apply the air where it would do the most good. Looking at a blueprint of the wheel I found that the shaft was drilled from the lower end up to near the top of the hub as at 'C' in the figure.

In my way of reasoning to a solution of the problem I decided that the best place to admit the air would be into the center of the draft tube. Doing this at low flows would tend to keep the water to outer periphery of the wheel where it would have the greatest turning effect and therefore develop the most power. So working on this theory we bored and tapped two 1 ½" holes in the turbine cover plate as at 'A'. We also drilled two 1 ½" diagonal holes 'B' through the runner hub and shaft to connect with the center hole. A pipe with a valve was threaded into the holes in the cover plate to control airflow to the turbine.

After some experimenting we found only one of the air connections was required, so removed the other and plugged the hole in the cover plate. We have found on our unit that admission of air begins to increase the power of the turbine at 35% gate opening with the greatest increase occurring at 17.5% gate opening. This is the opening required to bring the wheel up to synchronizing speed without air. But with air admission to the draft tube the unit will generate 80 kw. Without air the unit requires 75 cfs to bring it up to speed but with air 25 cfs is sufficient.

There was only one day last summer when the flow was down to 25 cfs at which point we were unable to operate the wheel. Most of the time we were operating at about 10% gate opening and carrying about 50 kw load. Without the air we would have been unable to generate any power a good part of the time in the summer months. This gives an idea what can be done by admitting air to a hydro turbine operated at small gate openings.



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