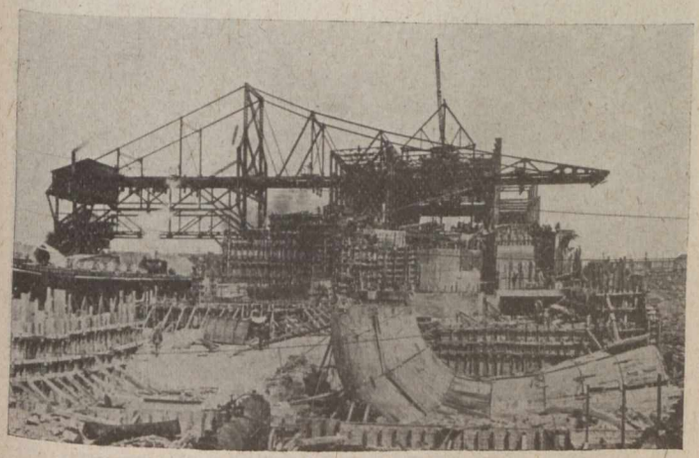
any chance of settlement of crushers or bins; any settlement will throw the shafting out of alignment and cause endless trouble. Strength of the supporting members of bins must be carefully worked out and liberal bracing provided. Foundation drawing are always furnished with the crushers, but the designer must see that ample clearances are provided for removing the eccentric at the bottom. It is most important that the elevator be of liberal length and at least two buckets on the tangent should be allowed below the end of chute discharging from crusher, and the same number on top discharging into the screen chute.

If the elevator is too short, stone will spill between the belt and pulleys and soon wear out the belt. Some bins are designed with flat bottoms, but those with a 45-deg. slope are better, as they save labor. Flat chutes are a source of annoyance and expense and 45 degs. is about the minimum on which stone will slide. If measuring boxes are used for proportioning the aggregate, they should be telescoping to allow the mixture to be varied, and the bottom should close automatically.

For crushing hard rock or rock containing silica, manganese steel heads are usually specified. Good heavy belts should be provided to drive the crushers. If they are too light they will stretch and slip and cause the crusher to stall on heavy loads. The mixers should preferably be



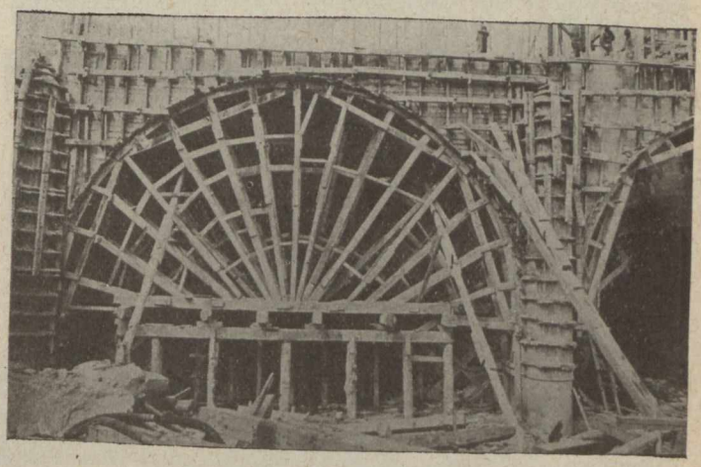
DRAFT TUBE FORM IN PLACE, CEDARS RAPIDS MFG. & POWER CO.

motor driven, direct connected. Sand making by swing hammer mills or rolls is usually expensive and troublesome, and should be considered only as a last resort. Care should be used in aligning the bucket elevator, for if the belt does not run true it will cause endless difficulties.

Space does not permit further discussion of the construction plant at Cedars. It was very complete, however, and consisted of 34 locomotives, hundreds of dump cars, 7 large steam shovels, locomotive cranes, derricks, shops, etc. The cost was in the neighborhood of $700,000.

Unusual forms are generally laid out by the engineer, especially those which are curved. When the scroll case and draft tubes are formed in concrete, the turbine manufacturer furnishes outline drawings and sections, from which the ribs are designed. These are drawn out full size on a laying out floor for the use of the carpenters, similar to laying out the ribs of a ship. The ribs are then set in position, using a top and bottom keel to get the correct curve, and the lagging applied. The ribs are usually spaced closely enough to allow the lagging to be made of ⅞-in. spruce cut in narrow strips. On extremely sharp bends these strips are steamed so that they will bend easily. After the forms are lagged, they are cut in pieces of a size convenient to handle (extra ribs are provided for this) and taken down and moved to the powerhouse site. Forms of this character are sometimes made collapsible so that they can be used several times. The general rule, however, is to make a set of forms for each unit, as it is seldom that a plant is large enough to allow the use of forms more than once. The reason for this is that the forms must stay for a considerable period to allow the concrete to set, and on a small or medium size development time cannot be spared for this delay.

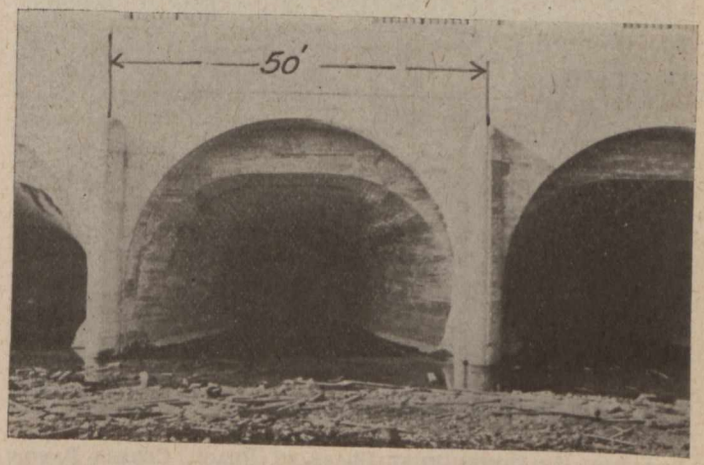
The usual shape of draft tube has a flat surface on the bottom large enough to support the form. After the excavation is completed, a pad of concrete is poured with the top to correspond to the elevation of the bottom of the tube. Rods with eyes or hooks formed in the end are embedded in the concrete to serve as anchors and to which the form is wired to prevent its floating when the concrete is



DRAFT TUBES BEING CONCRETED, CEDARS RAPIDS MFG. & POWER CO.

brought up around it. The form is then set on the pad and wired fast. The upper portion is braced with wooden struts and guyed with cables in the correct position. Added weight is sometimes given to the form by piling loose rock inside. After each lift of concrete is poured the position of the form is checked by means of the transit, both lengthwise and longitudinally. It probably will have shifted slightly, but by means of jacks and steel rope it can be easily brought back to the correct position. Especial care should be taken as the concrete approaches the top that the last lift will have the form on the centre lines.

The speed ring anchor bolts are set in place by means of a templet which is bored for the exact spacing of bolts



DRAFT TUBE COMPLETED, CEDARS RAPIDS MFG. & POWER CO.

and supported on the top of the draft tube form. They will extend for a considerable distance below the top of the tube and are liable to be overlooked. It is a good plan to have the anchor bolts laid out in plain sight of everyone, so that foremen as well as engineers will have them in mind.

It is desirable to have the progress records in such form that the information may be quickly grasped by inspection, and for this purpose curves or diagrams are used. A graphic log may be plotted on profile cloth to show daily maximum and minimum temperatures, rainfall, number of