ABSTRACT

A hydraulic turbine installation and method of assembling a turbine headcover composed of two half sections in the turbine pit. The opening into the pit at the top thereof is smaller than the diameter of the headcover. Furthermore, the turbine thrust bearing flange located in the pit below the opening defines an inside diameter which is also less than the diameter of the headcover. However, diametrically opposed slots are provided in the thrust bearing flange having a span therebetween which is greater than the diameter of the headcover. This arrangement permits lowering the headcover half section with its diameter dimension disposed vertically through the top opening into the pit and then rotating the half section into the thrust bearing slots so that the diameter dimension is disposed horizontally. From this position, means are provided to rotate and lower each turbine half section onto its pit mounting.

3 Claims, 10 Drawing Figures
HYDRAULIC TURBINE INSTALLATION AND
METHOD OF ASSEMBLING THE TURBINE
HEADCOVER THEREIN

This invention pertains to hydraulic turbine genera-
tors in general, and more particularly, to a structure
and method for installing a turbine headcover into the
in a pit in which the turbine runner is located. This pit is
usually defined by a concrete superstructure generally
indicated. In the normal arrangement of a vertical
hydro-turbine generator or a reversible pump turbine,
the turbine runner is located at the bottom portion of
the pit and the generator is located above the pit.

An annular flange is provided at the opening in the
pit. This annular flange defines an inside diameter
which is considerably smaller than the diameter of
the pit. The generator stator (not shown) is, in most
instances, supported by this annular flange. Spaced
downwardly from and on the inside of the pit are a
plurality of annular flanges which provide a support
for the turbine-generator thrust bearing (not shown).

It should be noted that the inside diameter defined by
the thrust bearing flanges is also smaller than the diameter
of the pit and as herein shown may be still smaller
than the diameter of the generator stator mounting
flange.

The ends of the thrust bearing flanges define
therebetween openings or slots at the plan view which are diametrically
opposed from another. The span between opposite
openings and is, in this instance, equal to the di-
ameter of the pit. Two wicket gates and are
herein schematically shown to indicate the mounting
location of the turbine headcover.

The turbine headcover is composed of two half
sections and 18. Each half section is provided with a di-
ameter dimension and a radius dimension which
is equal to the diameter and radius of the assembled
headcover.

The method of assembly of the headcover is depicted
in the figures shown in the drawings. Referring to
figs. 1, it will be seen that each half section is provided
with a number of strategically located lifting points
which will be described as an explanation of
the method of assembly is disclosed. Two conventional
hoists or cranes of sufficient capacity are required
above the pit. Furthermore, an additional hoist is re-
quired from below the pit as is shown in figs. 5
through 7. The headcover half section 17 is connected
to the hoists which for purposes of description may be
referred to as the main hoist connected to cable 22 and
the auxiliary hoist controlling the cable 23. The main
cable 22 is connected to the lifting point 24 which is
substantially at the center of the diameter dimension 19
of the headcover half section. The auxiliary cable 23 is
connected to the lifting point 26 which is at one end of
the half section diameter dimension 19. With this sup-
port, the half section can be pivoted so that the diam-
ter dimension 19 is substantially vertically disposed
and the radius dimension 21 is substantially horizontally
disposed. In this position, the half section can be lower-
ed through the opening 9 defined by the flange 8 and
also the opening defined by the thrust bearing flanges
11. This position is shown in fig. 1

The headcover half section 17 is located in alignment
with the diametrically opposed slots 12 and 13 between
the ends of the thrust bearing flanges. As shown in
fig. 2, the half section 17 is rotated about the main lift-
ing point 24 by lowering the auxiliary cable 23 until the
half section 17 attains the position shown in fig. 3. In
this position, the diameter dimension 19 is in the hori-
zontal position and the radius dimension 21 is vertically
disposed. When in the position shown in fig. 3, sta-
tionary cables 26 and 27 are connected to the half sec-
tion 17 to support it while the main and auxiliary hoist connections are rearranged. Referring to FIG. 4, which is an end view of FIG. 3, the main cable 22 is now connected to a lifting point 28 on the surface 29 of the headcover at a point in alignment with substantially the midpoint of the diameter dimension 19 of the half section. The auxiliary cable 23 is connected to the lifting point 24.

Referring now to FIG. 5, a secondary hoist cable 31 is connected through a lifting point 32 provided in the superstructure 7 of the hydro installation and to a connecting point 33 on the headcover half section 17. Referring to FIG. 6, the secondary hoist is operated to swing or laterally move the half section 17 toward the lifting point 32. Simultaneous with this movement, the auxiliary hoist 23 is lowered to permit the half section to pivot about the connecting point 28 of the main cable toward the horizontal position shown in FIG. 7. When in the position shown in FIG. 7, all three hoists are lowered equally to permit the half section to be lowered onto the wicket gates 14 and onto the blocks 33 as shown in FIG. 8.

Once in the position shown in FIG. 8, the three hoists are disconnected from the half section 17 and the other half section 18 is lowered into place in the same manner as shown in FIG. 8. Once half section 18 is moved into alignment with section 17, they are rigidly connected together. The main hoist is then attached to the assembled headcover as shown in FIG. 10 and the assembled headcover is lowered into its permanent position above the turbine runner (not shown).

From the above description, it can be seen that a novel combination of structural configuration of the turbine headcover half sections and the turbine pit permit the headcover to be assembled in half sections, while, at the same time, permitting the generator stator support flange and the turbine thrust bearing support flange to define diameters smaller than the diameter of the pit. Furthermore, because of the slots 12 and 13 between the ends of the thrust bearing support flanges 11, the half sections 17 and 18 can be rotated in the manner shown in FIG. 2 with only a minimum amount of head room between the mounting position of the headcover and the top of the pit. This is particularly desirable in vertical hydro-turbine installations since each additional foot of excavation, which can be saved, results in a saving of hundreds of thousands of dollars in the cost of the installation.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A hydraulic turbine generator installation comprising in combination:
   a vertically disposed turbine pit having a first inside diameter,
   an annular flange about the top of said pit defining an opening having a second inside diameter less than said first diameter,
   a substantially annular headcover composed of two half sections having an assembled outside diameter only slightly less than said first diameter but greater than said second diameter, each half section having an equal radius less than said second diameter,
   and a plurality of arcuate spaced flanges connected to the inside of said pit spaced downwardly from said annular flange defining an inside diameter less than the assembled outside diameter of said headcover, said flanges being arranged to define therebetween diametrically opposed openings having a span therebetween greater than the diameter of said assembled headcover, the width of said openings being greater than the thickness of said half sections whereby said half sections can be supported with their diameter dimensions disposed vertically and lowered through said opening of said second diameter into alignment with said openings and then rotated through said openings so that the diameter dimension of said half sections is disposed horizontally.

2. The hydraulic turbine installation set forth in claim 1 wherein the diametrically opposed openings between said thrust collar supporting flanges are in alignment with the joint between the two half sections when they are in the assembled headcover position.

3. The method of mounting a hydraulic turbine headcover composed of two half sections into the turbine pit in a horizontal position wherein a flange provided about the pit opening has an inside diameter less than the assembled diameter of said headcover and greater than the radius thereof, each half section having diameter and radius dimensions equal to the diameter and radius of the assembled headcover, said method comprising the steps of:
   a. lowering a half section partially through said pit opening with the radius dimension thereof disposed substantially horizontally and the diameter dimension disposed substantially vertically;
   b. rotating said half section through diametrically opposed openings provided in the turbine thrust bearing support flange so that said radius dimension is disposed vertically and said diameter dimension is disposed horizontally;
   c. simultaneously lowering, rotating and laterally moving said half section so that said radius and diameter dimensions are both horizontally disposed and said half section is located above its pit mounting location;
   d. lowering said half section onto its pit mounting;
   e. installing the other half section by repeating steps (a) through (d); and
   f. connecting said half sections together to form a unitary headcover.

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