by a high accuracy of realizing the governor functions. In this case the value of the transfer function from the servomotor of the gate apparatus to the main slide valve of the runner and the magnitude of the overlaps on the main slide valve do not affect the accuracy of the governor system, and therefore the values of the indicated function and overlap of the main slide valve are selected so as to provide minimum oil leakage and a sufficient safety factor of the control loop of the runner blades.

Furthermore, the structure of the governor system used permits solving a number of additional problems. For instance on the No. 3 unit of the Upper Tuloma hydrostation the vibrations of the runner-blade servomotor were reduced considerably by installing between the adder Σ_2 and magnetic amplifier MA (Fig. 1) an adjustable dead-band device and by selecting the appropriate value of the integration time constant. The integrator in combination with the dead-band device create in the transient state insensitivity of the runner-blade servomotor to oscillations of the guide apparatus, the frequency of which is higher and the amplitude is lower than the preassigned value. Comparative tests conducted at the Upper Tuloma hydrostation showed that the servomotor of the runner of the No. 3 unit does not respond to oscillations of the servomotor of the guide apparatus whose period is 3-4 times greater than on the other units, where a dead zone is not set. At the same time, a plot of the governor relationship during forward and reverse running of the regulating gear showed that the zone of static inaccuracy after installing the electric governor was practically reduced to zero, whereas before modernization this zone was 0.6°, which amounts to about 2% of the inaccuracy of the governor system (Fig. 4).

Another problem which is additionally being solved by the governor system under consideration is the possibility of accomplishing forced automatic setting of the runner slide valve in the middle position by means of the electronic governor. Such a measure may be necessary on a number of units in connection with the considerable resetting forces on the runner servomotor and increased oil leakages. On the units of the Kapchagai and Kakhovka hydrostations the oil leaks are so great in connection with the incomplete return of the main slide valve of the runner to the middle position that it will not be possible to provide a normal regime of the oil pumps in the case of automatic regulation of the unit. At these hydrostations the slide valve of the runner is set in the middle position by hand. To automate the process of forced setting of the runner slide valve in the middle position it is necessary to install additionally in the electronic governor system a sensor of the position of the main slide valve (SPV) (see Fig. 1), the output signal of which is sent through the normally open contacts (R) to the adder Σ_1, after the process of regulating the blades is completed. The moment of completion of the process of regulating the runner blades can be determined, for example, by means of a comparator, to the input of which is sent the signal of the prescribed and actual runner-blade angles.

Conclusion. The preceding method of controlling the runner blades of a Kaplan turbine has a number of advantages compared to the hydromechanical method and it should be introduced both at hydrostations being put into operation for the first time and when modernizing operating hydrostations by replacing the mechanical drive system of the runner blades by an electrical system.

ERRATA

In Gidrotekhnicheskoe Stroitel'stvo, No. 12,1980, on p. 1248, line 5 from the bottom should read "...2000 kN," p. 1249, line 4 of the text from top should read "...5000 kN," on p. 1256, line 10 from the bottom should read "...70 MN."