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Course: Master of Mathematics (MMath)

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United States Coast and Geodetic Survey  
Tide- predicting Machine No. 2.

The United States Tide Predicting Machine No. 2 was designed and built in Office of the Coast and Geodetic Survey by R. A. Harris and E. G. Fischer, was completed in 1910 and was first used in 1912. The machine was the successor of William Ferrel Tide-Predicting Machine hence the "No. 2". The machine operates on the same principles as Lord Kelvin's Tide Predicting Machine. One part of the machine sums the heights of 37 tidal constituents, in order to calculate the height of the tide at any given time. The other side summed their derivatives. By calculating the times at which the sum of the derivatives went through zero the machine could identify the stationary points of the tide height function. These stationary points included high tides and low tides. Thus the machine could predict not only the time of high and low tides but also the height of each tide.

The machine uses a system of gearing whereby shafts representing the tidal constituents are made to rotate with angular speeds proportional to the actual speeds of the constituents. The harmonic motion of the tide is simulated by a system of cranks and sliding frames. A chain connecting the shafts sum the heights of the tidal constituents while a second chain sums their derivatives. The output of the machine came in two forms; firstly the height of the tide at given times and the time of high and low waters is indicated by the arrangement of dials and pointers, secondly a graphic representation of the tide is generated by the machine. The machine weighs over 1,000 Kg the heavy cast iron base of the machine serves to increase the stability and hence the accuracy of the machine.

The machine was used to generate the official US tide tables until 1966 when it was replaced by digital electronic computers. Accurate tide tables were and remain indispensable to the fishing and shipping industries of the United States.

[1] National Oceanic and Atmospheric Administration( US Department of Commerce) Tide Predicting Machines 2004

<http://www.co-ops.nos.noaa.gov/predmach.html>

[2] Paul SCHUREMAN, *Manual of Harmonic Analysis and Prediction of Tides*, U.S. Department of Commerce, Coast and Geodetic Survey, Special Publication No. 98, U.S. Government Printing Office, Washington, 1958 (reprinted May 1988).

[3]<http://www.ams.org/new-in-math/cover/tidesIII3.html>

JAVA simulation of Kelvin's Tide Predicting Machine  
American Mathematical Society 2004

*The United States Tide Predicting Machine No. 2 is currently on display in the lobby of the National Oceanic and Atmospheric Administration in Silver Spring, MD.*