CHAPTER 21

A PULSATING WATER TUNNEL

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Purpose of Apparatus.

Since the basic mechanism of sand transportation in wave motion is so far unknown, there is a great need for observations of such transportation in large waves, especially, because of the possible difference of transportation in prototype wave motion from that in small model waves.

By means of the apparatus described in the present paper the water and sediment motion near the bed can be reproduced or a prototype scale with the only modification that velocities at all points are in phase.

Principle of the Pulsating Water Tunnel.

The apparatus forms a U-channel consisting of two vertica risers (height 11 ft.) and a horizontal tunnel (length 51 ft.). The central part of the tunnel is a lucite test section, (Figs. 1 and 2)

By means of pneumatic machinery the water is made to perform oscillations in the U-channel with periods and amplitudes corresponding to the wave motion just above the bed of the sea. The water tunnel has a natural frequency (9 sec. period) close tc those of the larger motions to be produced, thus reducing the energy consumption to a minimum.

Bed material may be placed on the bottom of the test section, which has a width of 16 in. and a height of 12 in.

Range of Apparatus.

The apparatus can be applied to wave periods from 3 sec. upwards, and storm waves can be studied at full scale from 4 tc 10 sec. periods. Maximum horizontal amplitude in the test sectic is 23 ft. Thus, for instance, the motion of a storm wave of 10 period and a height of 20 ft. in deep water can be followed from deep water until a depth of 40 ft.

Problems that can be studied.

The pulsating water tunnel furnishes a means for the stud of numerous littoral drift problems, of which so far little or nothing is known, such as the maximum depth to which sediment transportation will occur, the mechanism of transportation and tl shape of the bottom (plane or rippled) at various depths for varic prototype materials. The amount of suspension may be measured

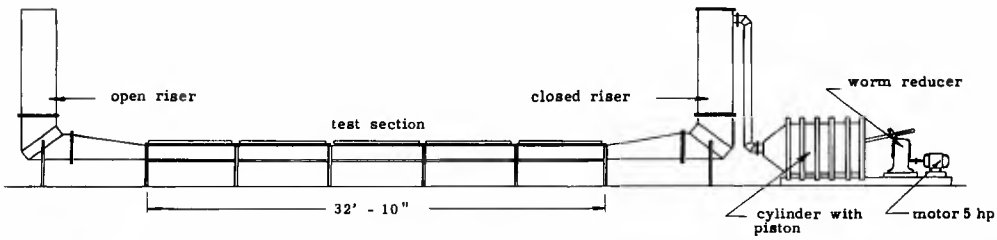

Fig. 1. U- Channel and drive system.

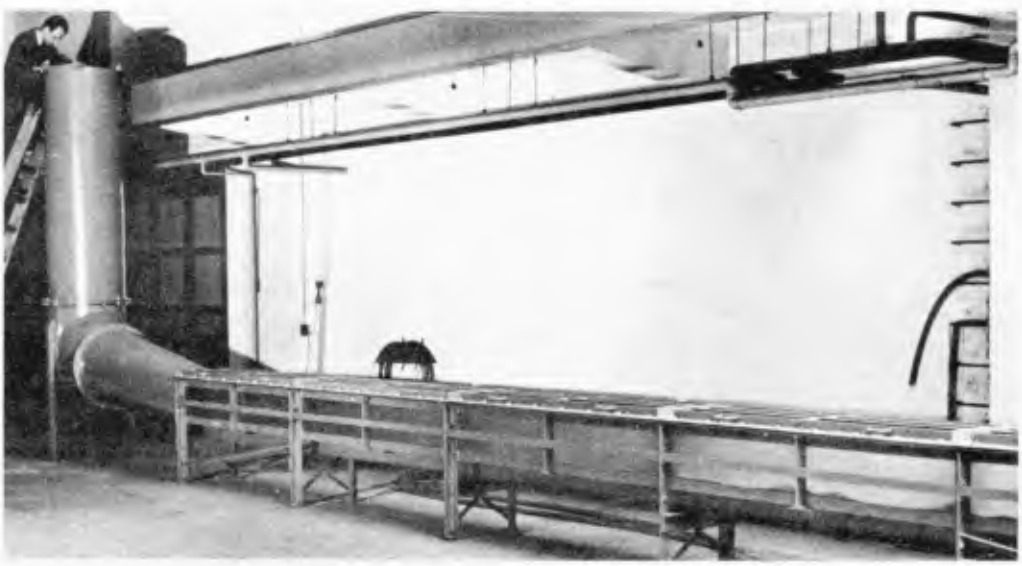

Fig. 2. View of the test section and the open riser.

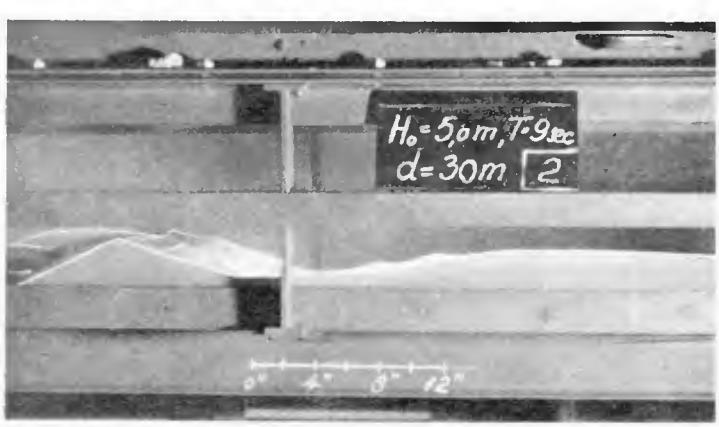

Fig. 3. Giant ripples formed 80 minutes after start of test.

and the character of the flow above the bed may be studied.

The fact that the apparatus does not reproduce the phas variation of the wave motion along the bed is probably of mino significance only because the amplitudes at the bottom are alw small in comparison with the wave lengths.

Preliminary Results.

The apparatus has been in operation only for a few mon It has, however, been observed that under most prototype sto conditions the bed is covered by ripples of wave lengths from few inches in deep water (more than 130 ft.) to several feet ir shallow water. At very large velocities the ripples are wiped

Due to the ripples, suspended load occurs to much larg depths than usually anticipated.

The choice of a relatively low and wide cross section o the tunnel was based on the assumption that the ripples would wiped out at much smaller orbital velocities than now observec The giant ripple systems call for a much larger ratio of depth width of the cross section than applied in the present apparatu

It seems that the study of the prototype transportation pattern can be very helpful in selecting the proper material fo model investigation. Although the factors determining ripple lengths in model and in prototype are different, the ripple len in models being a function mainly of the grain size, it seems the eddy patterns are quite similar. The model material shoul therefore reproduce the prototype ripples approximately true t scale.