

INTERNATIONAL CURTIS MARINE TURBINE COMPANY,  
149 BROADWAY, NEW YORK, U. S. A.

CABLE ADDRESS "CURTURBINE, NEW YORK."

February 27, 1905.

Mr. E. W. Rice, Jr.,  
Schenectady, New York.

Dear Mr. Rice:

I duly received yours of February 21st inclosing Dr. Steinmetz' preliminary report setting forth his views relating to steam turbines. I think his suggestions as to the desirability of laboratory tests on the characteristics of dry and superheated steam are very good and his other suggestions of using static apparatus in various ways are also wise, I think.

I do not think Dr. Steinmetz has however touched upon the most important features which are likely to conduce towards steam economy. These are the theoretical benefits to be had by splitting the operations up into more stages.

At our last turbine conference February 3, I expressed the opinion that better results (judging both from theory and from practical results heretofore obtained) can be had by multiplying the number of stages and working with comparatively low bucket velocities. but Dr. Steinmetz did not agree with this, and does not seem to have appreciated the benefits that theoretically must result from a multiplication of the velocity developing and velocity extracting steps. I feel quite sure that Dr. Steinmetz could not have given any thought to this aspect of the matter. Otherwise he would have seen it.

The work done by the steam on the buckets is as the square of

RECEIVED,  
OFFICE OF JNO V.P.  
MAILED 2-1905  
3/3  
Answered  
Copy to  
E. W. Rice



its velocity in any stage, whereas the friction and eddy current losses which take place in the nozzles and in the buckets are as the cube of the virtual velocity. Hence by splitting up the steps or in other words, working with a lower steam velocity, the energy losses become reduced more rapidly than is the work done by the steam. Suppose for example, we have a 4 stage machine in which the virtual velocity of the steam in each stage is 2000 ft a second and we compare this with an 8 stage machine having a virtual velocity in each stage of 1410 ft. a second, or in other words in which the velocities in the two cases are as 2 to  $\sqrt{2}$ . The work done by each stage in the 8 stage machine will be half that done by each of the stages in the 4 stage machine. The energy loss due to friction and eddy currents in each stage of the 4 stage machine will correspond to the cube of 2 or 8, whereas in the 8 stage machine it will correspond to the cube of 1.41 which is 2.82. As there are twice as many stages in the 8 stage machine the total energy loss will be this latter quantity multiplied by 2 which is 5.64 as compared with a loss of 8 in the case of the 4 stage machine.

There can be no doubt, looking at the matter from a purely theoretical standpoint that all losses would be diminished by reducing the temperature and pressure range involved in each stage, just as it is in a multiple expansion engine.

A somewhat similar comparison could be made in respect to the rotation losses which, other things being equal, vary as the cube of the peripheral speed so that it is very desirable to keep down the revolutions of the diameter from theoretical as well as from



practical considerations.

Very truly yours,

CGC/ED

*Chas. G. Curtis*