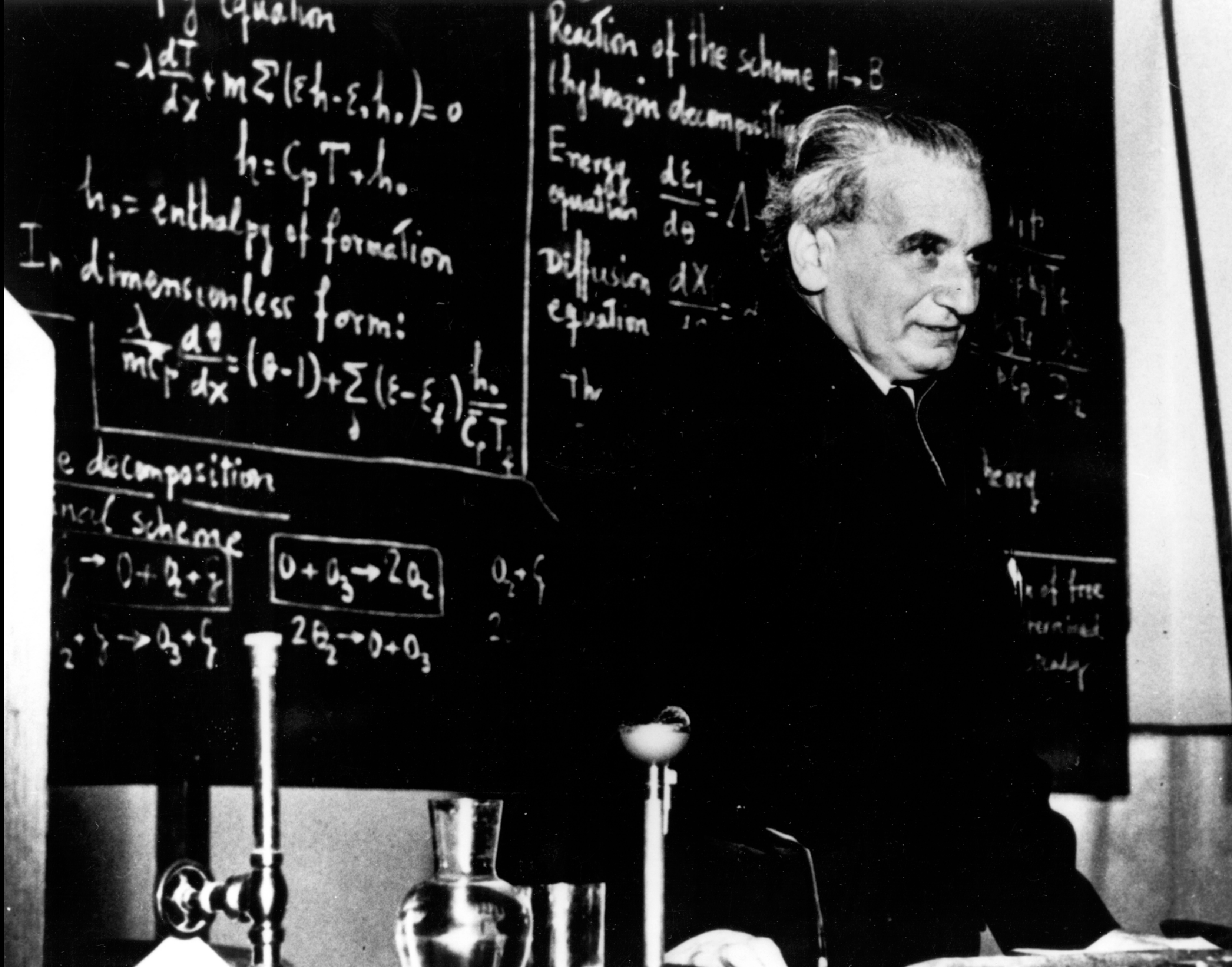
Bringing Aerodynamics—and Aeronautical Engineering—to the American University

Deborah G. Douglas, MIT Museum

3 March 2015 • The NACA Centenary • National Air and Space Museum

Courtesy MIT Museum, photographer Michael Cardinali

Courtesy MIT Museum



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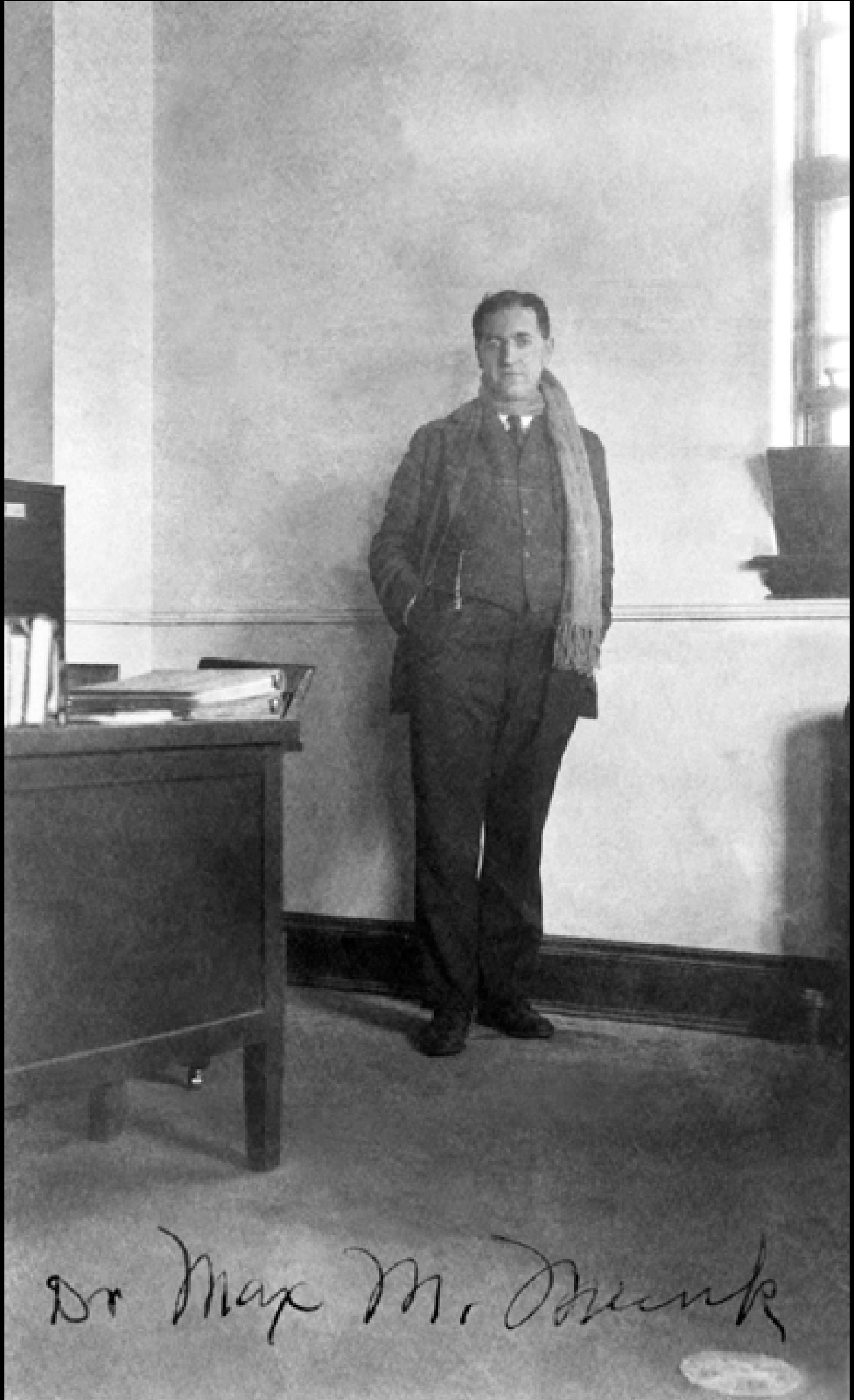

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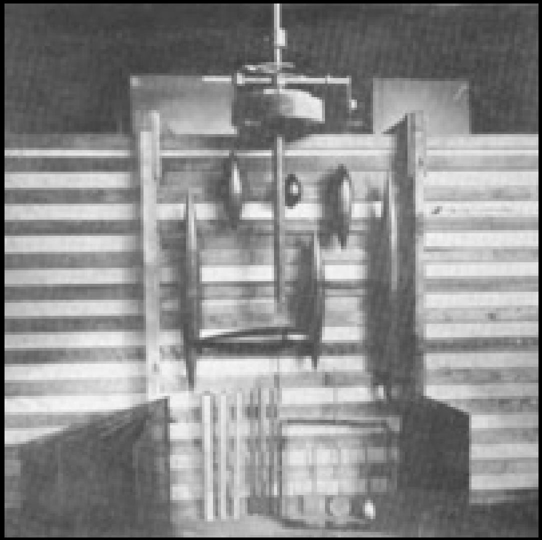

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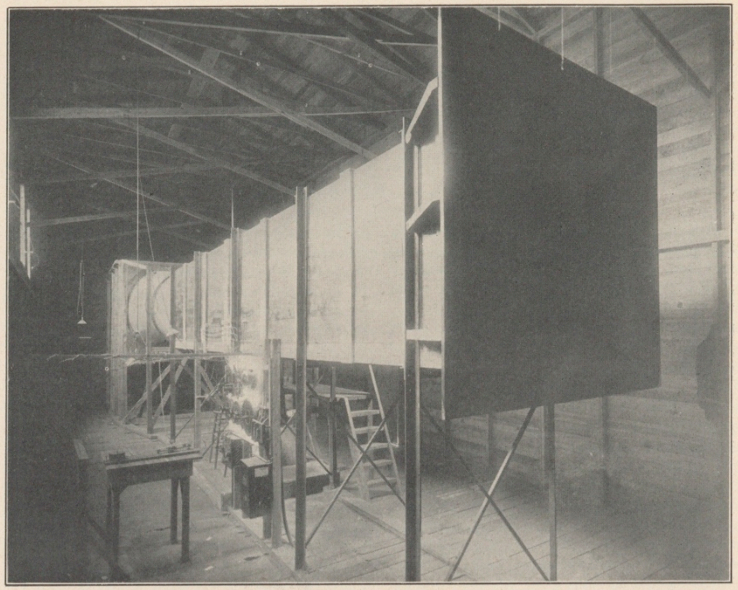


Suction end of wind tunnel

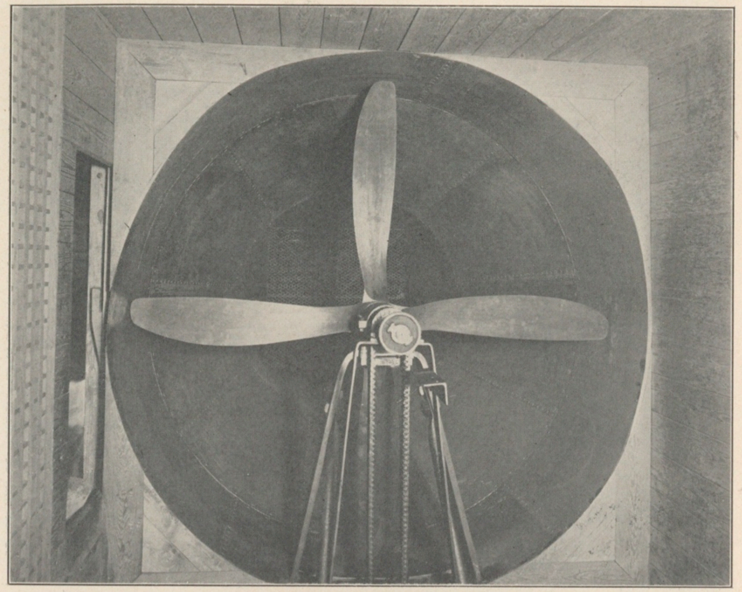
along the three axes in space, as well as rotations about any of them. In general, the effect of the air on a solid object moving through it requires the measurement of three forces and three couples corresponding to the three axes of space.

Towing experiments become mechanically difficult to arrange, and in view of the high speeds required in aëronautics a long building like a rope walk is necessary. Such tests have been made at the Kiel Navy Yard in Germany and at the University of Paris. At the latter institution a dynamometer car running along a track carries objects under test mounted on a weighing mechanism. The tests are conducted in the open air and are subject to error due to gusty winds.

If it be accepted that aërodynamic forces depend on the relative motion of air and object under test, it is immaterial whether the object be towed in still air at a given velocity, or held stationary in a uniform current of air of the same velocity. The use of an artificial wind is the "wind tunnel" method, which has come into general use abroad. The doctrine of relative motion is fundamental in mechanics, and discrepancies between results of tests made by the two methods may be ascribed to the probability of errors due to the influence of the car and wind gusts in the towing method, and to irregularity in the flow of air in the wind tunnel method.

The validity of wind tunnel tests depends upon the uniformity of flow of the air. The production of a current of air that shall be constant in velocity, both in time and space, is a difficult problem.

When it was decided to build a wind tunnel at the Massachusetts Institute



Propeller for wind tunnel

of Technology for use by students in aëronautical engineering, a study was made of the most successful wind tunnels abroad. The conclusion was reached that the staff of the National Physical Laboratory, Teddington, England, had developed a wind tunnel of convenient form and of a high degree of uniformity of flow. This tunnel was the result of a methodical series of experiments with wind tunnels of various forms, in which the following conclusions were reached:

1. Models should be placed in the suction stream leading to a fan where turbulence is least.

2. A four-bladed aëroplane propeller of low pitch gives a more steady flow than the ordinary propeller fan used in ventilation work, and a much steadier flow than any blower of centrifugal type.

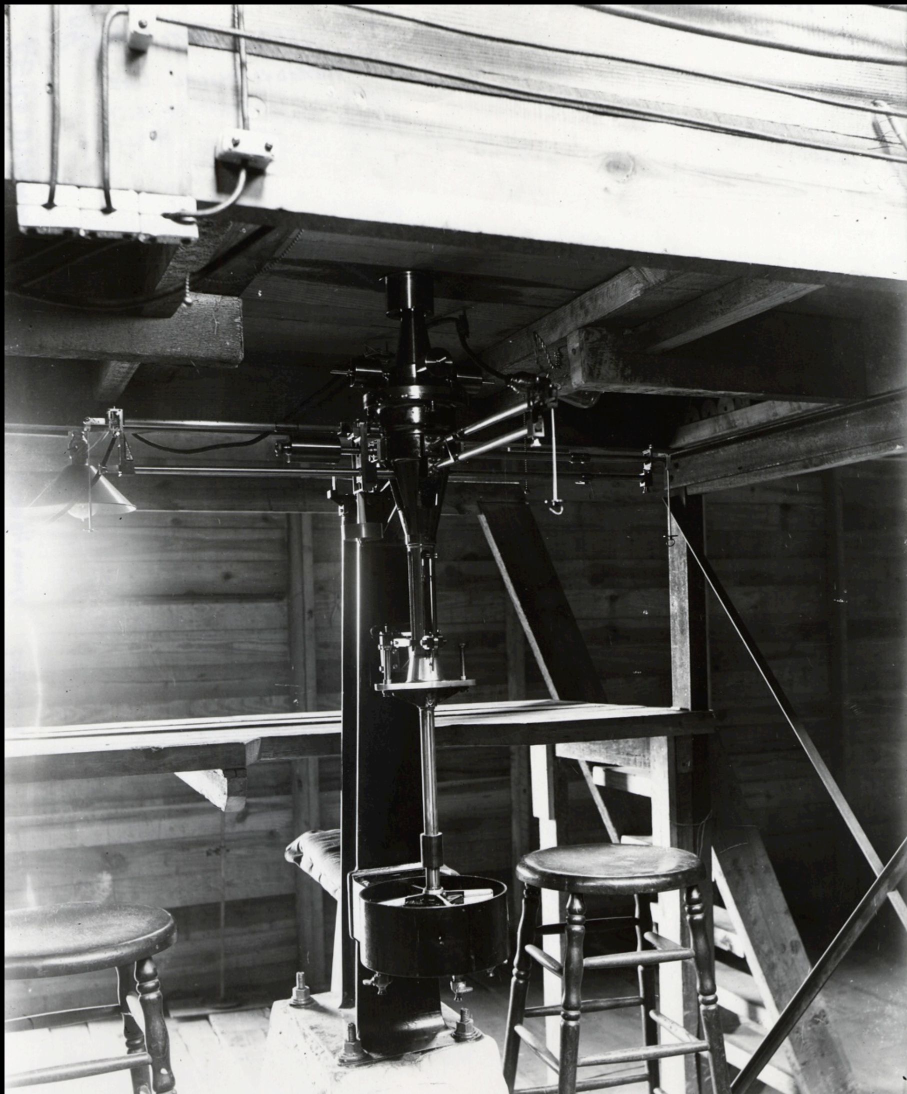
3. The wind tunnel should be completely housed to avoid the effect of outside wind gusts.

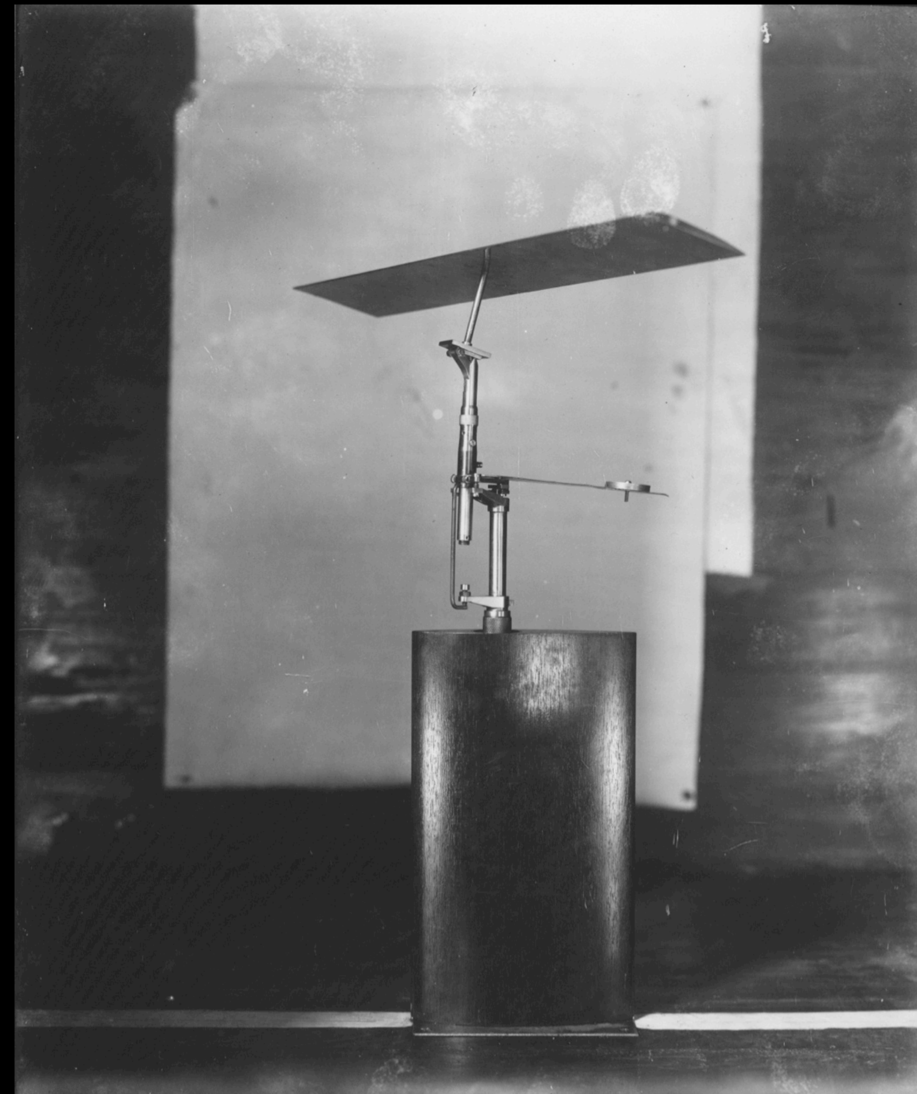
4. Air from the propeller should be discharged into a perforated box of great volume, to damp out turbulence, and to return the air at low velocity to the room.

5. The room through which air returns from the perforated box to the suction nozzle should be at least twenty times the sectional area of the tunnel.

The wind tunnel of the Massachusetts Institute of Technology was built in accordance with the English plans with the exception of several changes of an engineering nature introduced with a view to a more economical use of power. An increase of the maximum wind speed from 34 to 40 miles per hour was thus obtained.

Upon completion of the tunnel an investigation was made of the steadiness





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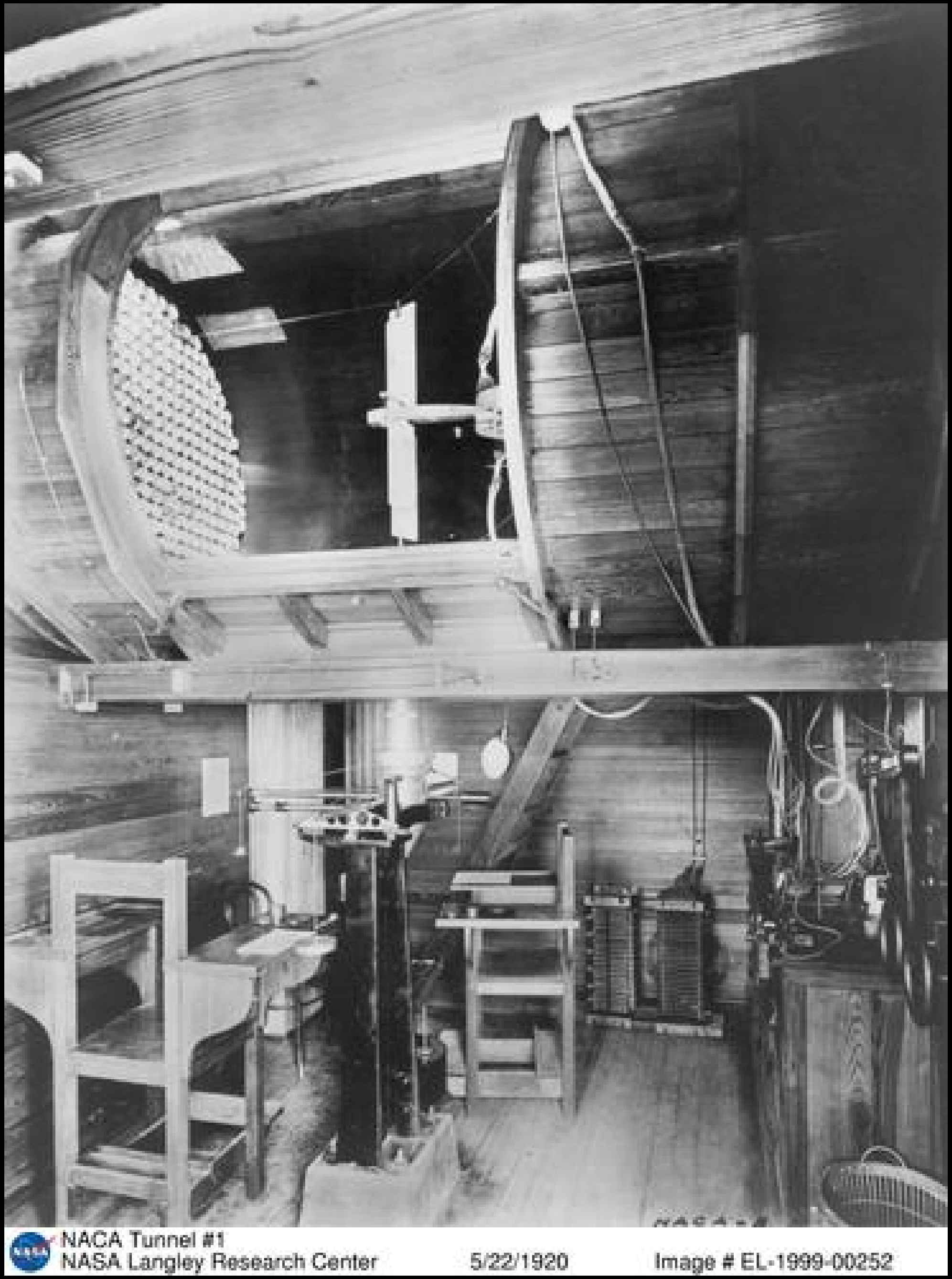

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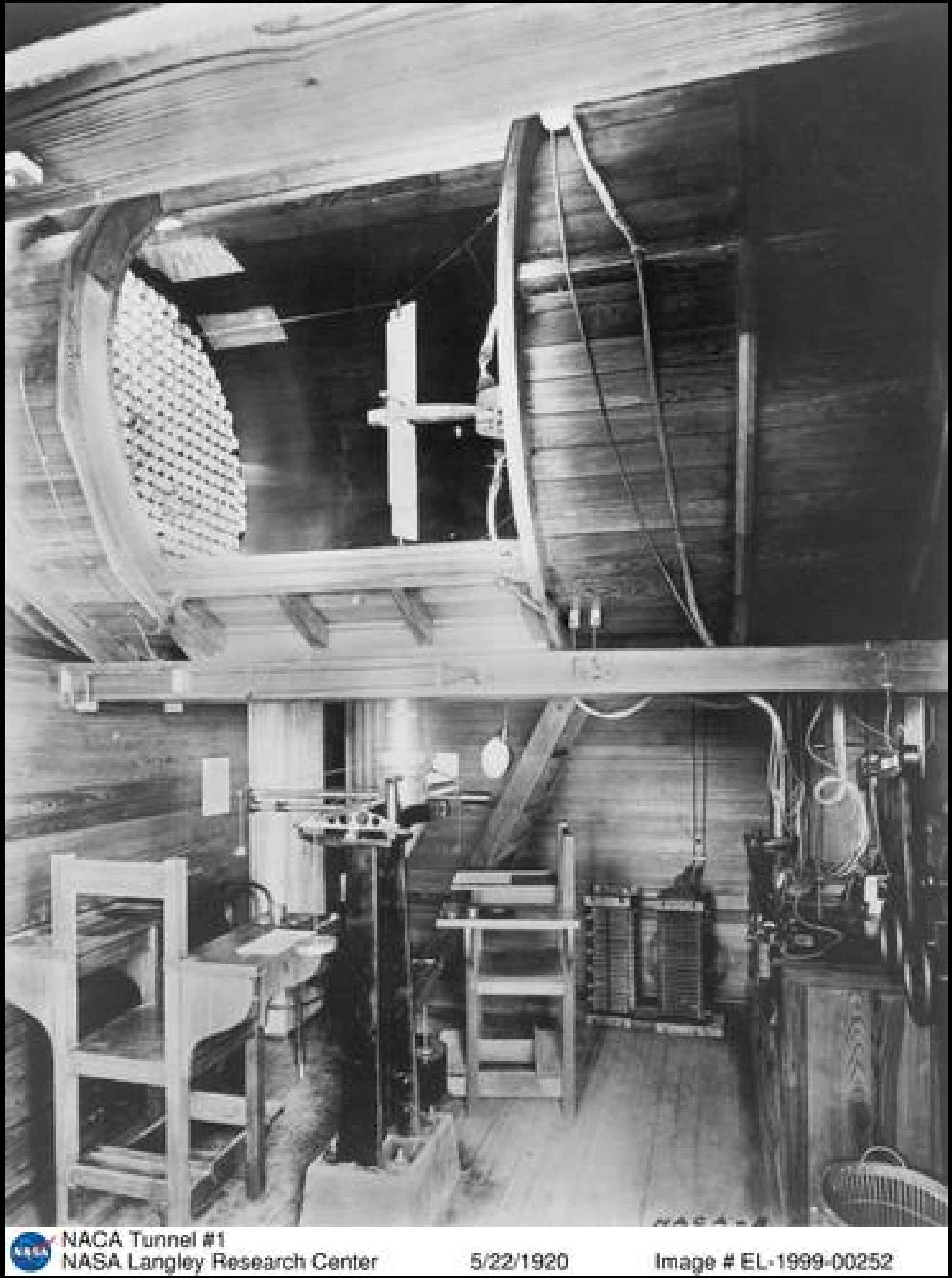

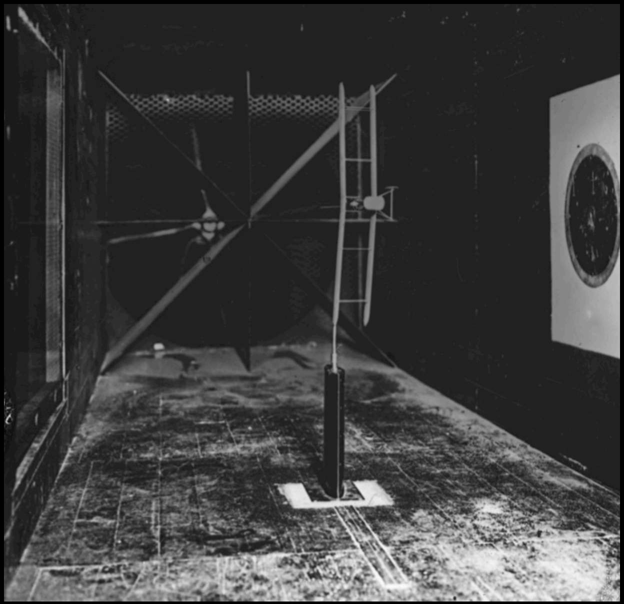

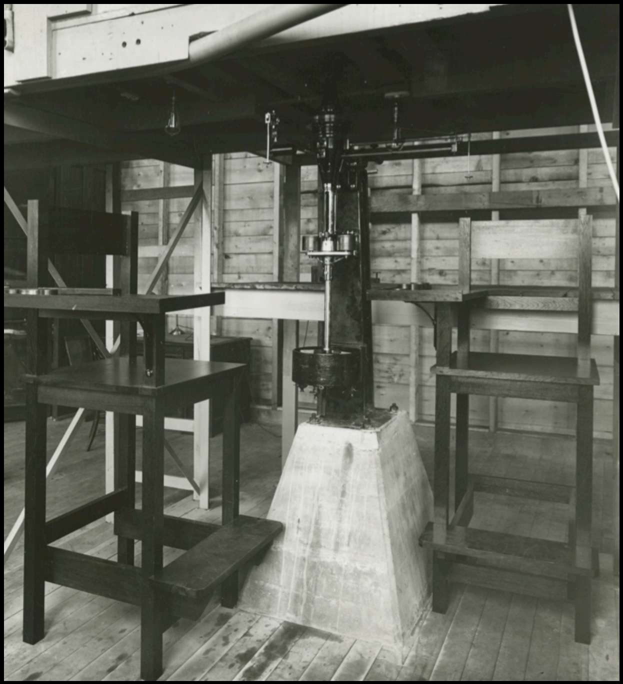

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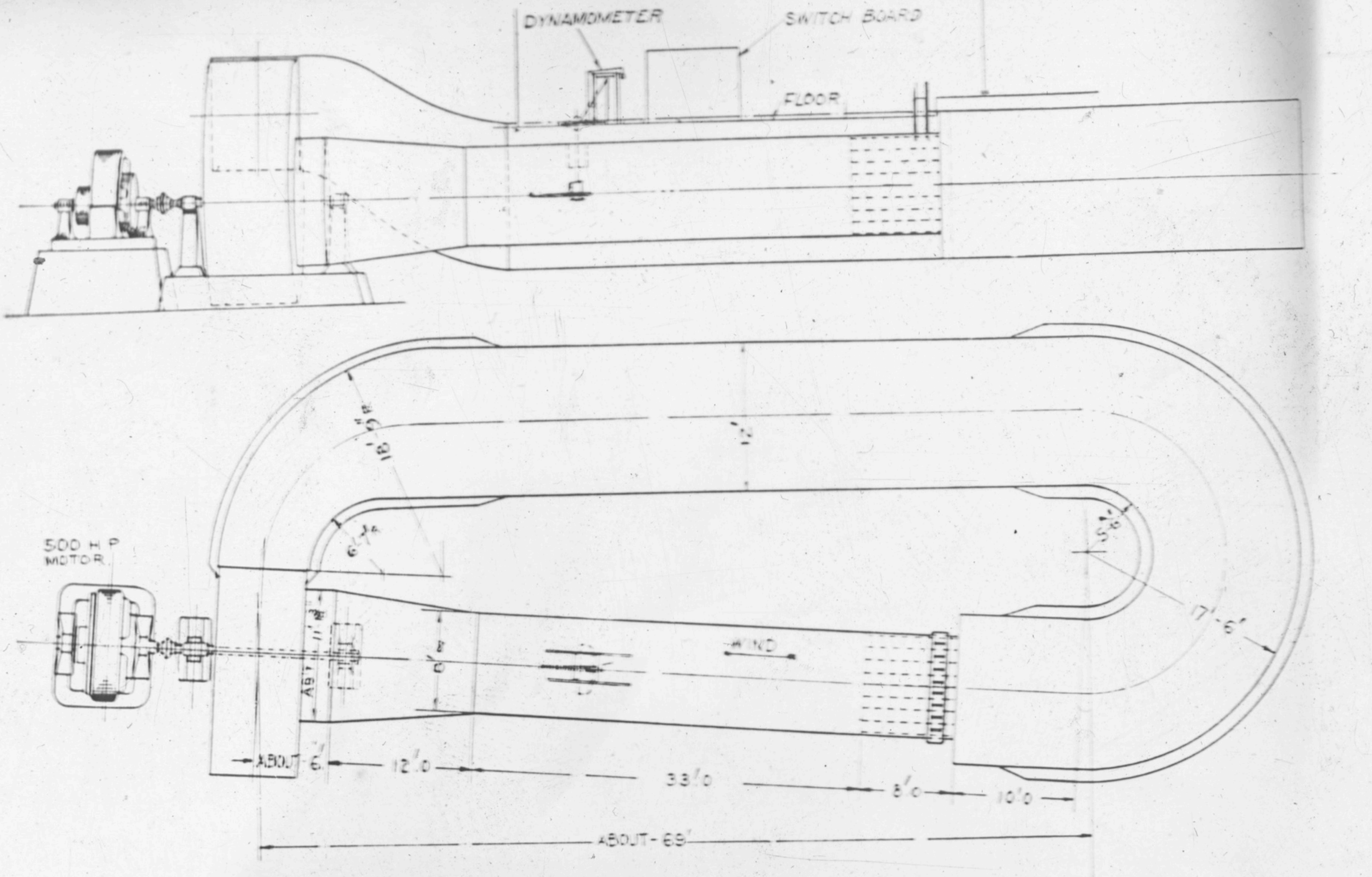

FIG. 6. ELEVATION AND PLAN OF THE WIND TUNNEL OF THE UNITED STATES NAVY DEPARTMENT

been devoted to the resistance of airship hulls, etc., for which work a special suspension method of mooring wires, bell cranks and weights, has been adopted with great success. A differential pressure gage, sensitive to pressure changes of one-...nth of an atmosphere is used in the determination of

stream from the blower has a direct relation to the velocity of the wind in the experimental chamber, against which it has been calibrated for all speeds. The pitot tubes used have been themselves checked with the standard tubes of the National Physical Laboratory of England and the Aerodynamical La...

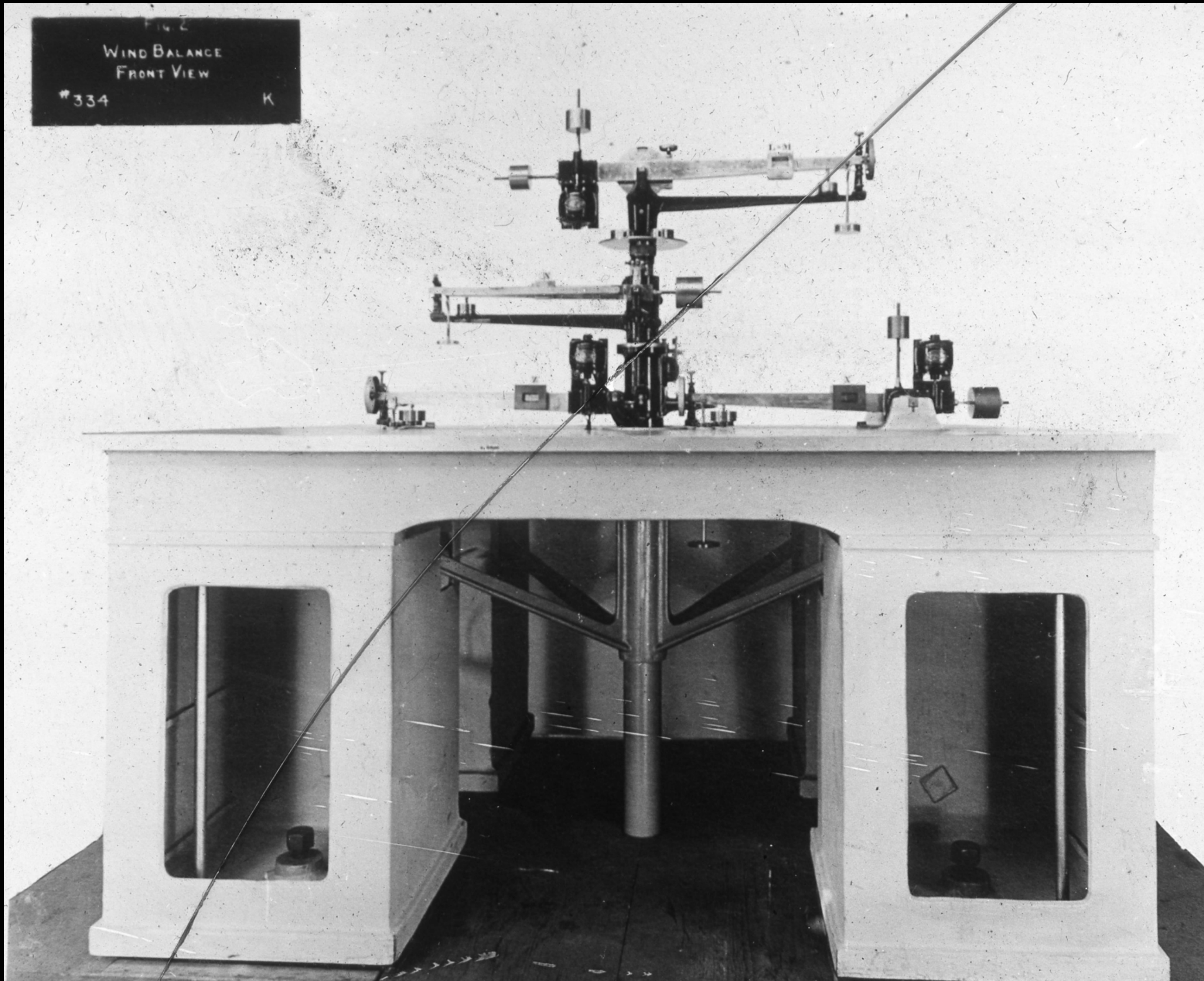
Fig. 2
Wind Balance
Front View
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UPPER FLOOR, EDISON'S MENLO PARK LABORATORY, DEARBORN, MICH.

Courtesy Library of Congress

Courtesy Library of Congress



Courtesy MIT Museum