TESTS OF ROTATING CYLINDERS*

By ELLIOTT G. REID

FOLLOWING on the publication in FLIGHT of November 27 and December 4 of the articles dealing with the Flettner " Rotor," we have received from Mr. G. W. Lewis, Director of Aeronautical Research in the United States, a copy of " American National Advisory Committee for Aeronautics Technical Note No. 209," which deals with tests on rotating cylinders. Extracts of this report are published below, lack of space preventing us from giving the report in full. The only omissions, however, are Figs. 2 and 3, which show the installation of the apparatus used for the tests, and Tables III and IV, giving data of cross-cylinder, and Tables V, VI and VII, giving data of compound strut. For all practical purposes the required data can be read off with sufficient accuracy from the graphs, Figs. 7-14 inclusive. We have, however, reproduced Figs. 15, 16 and 17, which show the flow around the smooth cylinder at an air speed of 5 m. per second and at rotational speeds of 600 r.p.m., 1,200 r.p.m. and 2,400 r.p.m.

Mr. Lewis, in his covering letter, states that further tests are being made in the direct application of the rotating-cylinder principle to actual aeroplane design.—ED.

Introduction

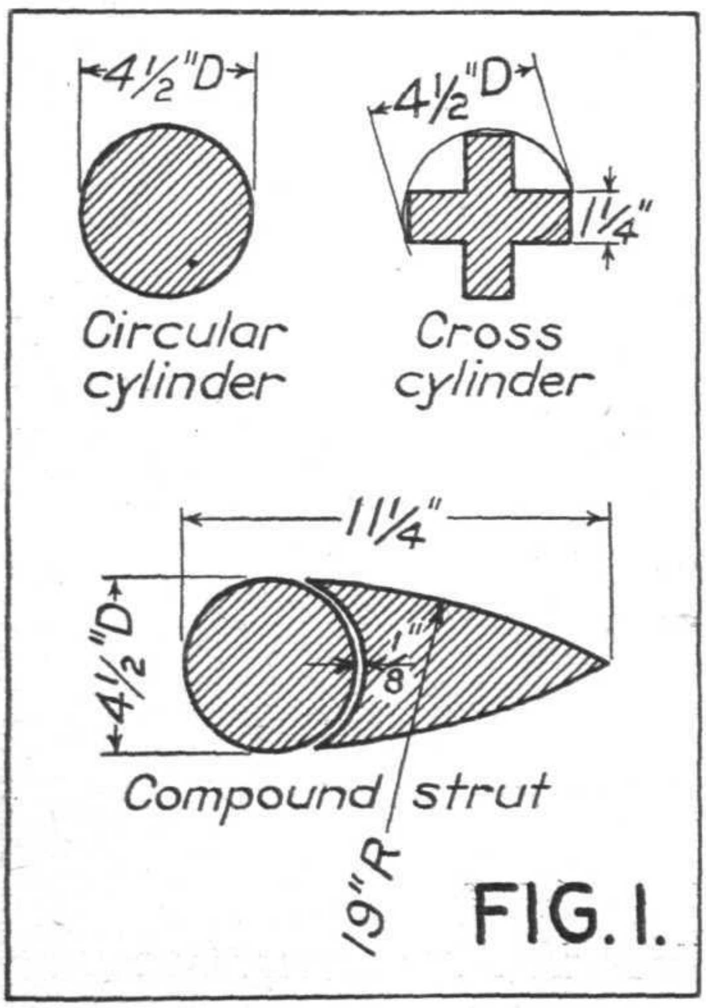
A COMBINATION of translation and circulation is the basic concept of the theory of airfoils proposed by Kutta, as well as those of Joukowski, von Mises, Lanchester and Prandtl (Reference 1). The tests described below constitute an attempt to measure the forces arising from controlled combination of these two types of flow.

The observed data consist of drag and cross-wind forces, air speed, revolutions per minute of the cylinder and electrical input to the motor driving the cylinder. Individual observations were made by bringing air speed and revolutions per minute to the desired values and measuring the other quantities simultaneously.

The programme of test was as follows :—The circular cylinder was tested at an airspeed of 15 m./s. (49·2 ft./sec.), and increasing rotative speeds until the power limit of the drive motor was reached. The air speed was then reduced to 10 m./s. (32·8 ft./sec.) and the process repeated. It became necessary to go to 7 (23) and, finally, 5 m./s. (16·4 ft./sec.) in order to reach a maximum " lift/drag " ratio.

The performance of the cross cylinder, at 15 m./s. (49·2 ft./sec.), was very erratic. A marked hysteresis loop made its appearance in the vector diagram of resultant air force, and, when excessive vibration was encountered at 3,000 r.p.m. and 10 m./s. (32·8 ft./sec.) air speed, the work on this model was discontinued.

* Technical Note No. 209 of American National Advisory Committee for Aeronautics.



TESTS OF ROTATING CYLINDERS : Fig. 1 : Dimensions of cylinders and compound strut used in the experiments.

TABLE I.—*Circular Cylinder.*

R.P.M.	D / kg	CWF / kg	C_D	C_{CW}	V / (m/s)	γ
25	1·136	—·010	·925	—·008	15	·010
500	1·136	+·010	·925	—·008	15	·200
900	1·026	—·020	·835	—·016	15	·360
1,020	·942	—·022	·766	—·018	15	·408
1,115	·852	—·007	·693	—·006	15	·460
1,240	·777	+·003	·632	+·002	15	·496
1,300	·754	·018	·614	·014	15	·520
1,300	·747	·043	·608	·035	15	·520
1,400	·740	·150	·602	·122	15	·560
1,500	·744	·283	·605	·230	15	·600
1,500	·740	·305	·602	·248	15	·600
1,600	·744	·400	·605	·326	15	·640
1,600	·744	·453	·605	·369	15	·640
1,700	·759	·608	·618	·495	15	·680
1,700	·751	·625	·611	·508	15	·680
1,700	·750	·598	·610	·487	15	·680
1,780	·751	·660	·611	·537	15	·712
1,800	·754	·673	·614	·548	15	·720
1,900	·757	·798	·616	·650	15	·760
1,900	·751	·815	·611	·663	15	·760
1,900	·757	·758	·616	·617	15	·760
2,000	·759	·873	·618	·710	15	·800
2,080	·765	·868	·622	·706	15	·832
2,100	·764	·997	·622	·811	15	·840
2,200	·764	1·073	·622	·873	15	·880
2,220	·787	1·158	·640	·942	15	·888
2,300	·772	1·188	·628	·967	15	·920
2,420	·754	1·278	·614	1·040	15	·968
2,500	·742	1·338	·604	1·089	15	1·000
2,600	·729	1·468	·593	1·194	15	1·040
2,620	·724	1·303	·589	1·060	15	1·048
2,700	·710	1·578	·578	1·284	15	1·080
1,300	·353	+·308	·646	·563	10	·780
1,500	·351	·418	·642	·764	10	·900
1,700	·338	·636	·618	1·163	10	1·020
1,900	·331	·758	·605	1·386	10	1·140
2,100	·322	·978	·589	1·789	10	1·260
2,300	·324	1·083	·593	1·980	10	1·380
2,500	·332	1·293	·607	2·362	10	1·500
2,700	·334	1·403	·611	2·564	10	1·620
2,900	·346	1·443	·633	2·639	10	1·740
1,800	·085	·605	·622	4·43	5	2·16
2,100	·105	·820	·769	6·00	5	2·51
2,400	·130	·995	·952	7·28	5	2·87
2,700	·151	1·110	1·105	8·13	5	3·23
3,000	·168	1·170	1·230	8·57	5	3·59
3,300	·188	1·250	1·376	9·15	5	3·95
3,600	·196	1·295	1·434	9·48	5	4·32
1,800	·167	·660	·624	2·46	7	1·54
2,100	·173	·860	·646	3·21	7	1·79
2,400	·181	1·140	·676	4·26	7	2·05
2,700	·197	1·365	·736	5·10	7	2·30
3,000	·222	1·700	·829	6·35	7	2·56
3,300	·256	1·945	·956	7·26	7	2·82
3,600	·287	2·210	1·070	8·25	7	3·07

$S = 0{\cdot}1741\ m^2$; $q = 1{\cdot}535\ kg./m^2$ (5 m/s.), $3{\cdot}01\ kg/m^2$ (7 m/s.), $6{\cdot}15\ kg./m^2$ (10 m/s.) and $13{\cdot}81\ kg./m^2$ (15 m/s.).