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EXPERIMENTS ON THE DRAUGHT PRODUCED IN DIFFERENT PARTS OF A LOCOMOTIVE BOILER WHEN RUNNING.

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The experiments here described were tried some time ago under the writer's direction, in order to illustrate the varying conditions under which a locomotive boiler is called upon to work during different portions of a journey. They were made on a four-wheel coupled bogie express passenger engine on the Lancashire and Yorkshire Railway, taking a passenger train from Victoria Station, Manchester, to Chapel Street Station, Southport, and back, a distance of 35 miles each way, with an intermediate stoppage about midway at Wigan. The train was made up of engine, tender, and ten coaches, as shown in Fig. 1, Plate 38; the total length over the buffers was 386 feet, and the total weight about 200 tons. The engine had cylinders 18 inches diameter and 26 inches stroke; coupled wheels 7 ft. 3 ins. diameter; heating surface, tubes 1108·75 square feet, fire-box 107·68, total 1216·43 square feet; fire-grate area $18\frac{3}{4}$ square feet. The total weight of the engine in working order was 44·8 tons, of which the driving wheels carried 16·5 tons, the trailing wheels 14·5, and the bogie 13·8 tons. The tender, having a tank of 1,800 gallons capacity, weighed with water and coal 26·1 tons. The total weight of engine and tender was therefore 70·9 tons. In both the outward and the return journey the rails were dry and the wind moderate.

Vacuum pipes were fixed in the chimney and smoke-box in the four positions A, B, C, D, shown in Figs. 2 and 3, Plate 38. From these pipes india-rubber tubing was led to four water-gauges filled with coloured water and placed on a board on the platform in a convenient position for the observer to read them readily. A fifth pipe was put through one of the bottom tubes into the fire-box, and

(continued on page 202.)

*Outward Journey, 35 miles,
from Victoria Station, Manchester, to Chapel Street Station, Southport.*

Average Speed 48·4 miles per hour.

Distance from Manchester.	Gradient.	Speed.	Boiler Pressure per square inch above atm.	Vacuum, column of water.			Pressure in Ashpan.
		Miles per hour.		Chimney.	Smoke- box.	Brick Arch.	Column of water.
Miles.		Miles.	Lbs.	Inches.	Inches.	Inches.	Inch.
1·84	Rising	35	153	13·9	4	2	0·25
3·00	Rising	38	155	18	4·9	2·4	0·25
4·00	Rising	36	155	18	4·9	2·4	0·25
4·70	Rising	40	155	18	4·9	2·4	0·25
5·90	Falling	50	157	18	4·9	2·4	0·25
7·50	Rising	50	160	18	4·9	2·4	0·25
8·90	Falling	52	145	15	4	2	0·50
10·85	Falling	57	140	15	4	2	0·75
11·85	Rising	50	140	15	4	2	0·75
12·90	Level	52	152	15	4	2	0·75
14·59	Rising	52	145	9	4	1	0·75
16·70	Rising	48	140	7	3	1	0·50
18·85	Falling	42	155	9	4	1	0·25
19·70	Rising	42	153	9	4	1	0·25
21·50	Rising	50	160	15	5	2	0·50
22·45	Falling	54	155	15	5	2	0·50
23·70	Falling	55	155	7	4	1	0·75
25·75	Level	56	158	7	4	1	0·75
27·40	Rising	52	160	10	5	2	0·75
29·40	Rising	54	155	10	5	2	0·75
30·48	Level	54	155	10	4	1	0·75
32·60	Level	55	150	15	4	1	0·75

*Return Journey, 35 miles,
from Chapel Street Station, Southport, to Victoria Station, Manchester.*

Average Speed 40 miles per hour.

Distance from Manchester.	Gradient.	Speed.	Boiler Pressure per square inch above atm.	Vacuum, column of water.			Pressure in Ashpan.
		Miles per hour.		Chimney.	Smoke- box.	Brick Arch.	Column of Water.
Miles.		Miles.	Lbs.	Inches.	Inches.	Inches.	Inch.
34·30	Falling	10	150	—	—	—	—
33·90	Falling	32	155	12	6	3	0·25
33·00	Level	40	155	12	6	3	0·25
31·00	Falling	46	154	15	7	3	0·50
30·20	Rising	47	150	15	7	3	0·50
28·40	Rising	48	152	15	7	3	0·50
26·20	Rising	52	152	12	5	2	0·50
24·30	Rising	46	154	12	5	2	0·50
23·20	Rising	47	152	15	6	2·5	0·50
21·60	Falling	47	155	12	5	2	0·50
19·90	Falling	48	158	12	5	2	0·50
17·90	Rising	19	155	—	—	—	—
16·90	Level	35	155	17	5	2·2	0·25
16·00	Rising	35	150	17	5	2·2	0·25
15·20	Rising	35	155	18	6	3	0·25
14·00	Rising	40	158	15	5	2	0·50
13·00	Level	46	155	11	5	2	0·75
11·70	Falling	50	152	11	5	2	0·75
10·00	Rising	52	150	13	6	3	0·75
9·00	Rising	46	158	13	6	3	0·75
8·00	Falling	44	152	12	5	2·5	0·75
6·60	Rising	46	152	8	3	1	0·75
5·20	Falling	47	143	11	5·5	2·5	0·50

(continued from page 199.)

turned up so as to stand above the brick arch at E, Fig. 4. Two other pipes were placed at F and G, for measuring the pressure of air at the front and back of the ashpan. The three pipes E, F, G, were also led to water-gauges on the platform with the four others. The orifice of the pipe A was in the centre of the chimney and half way up. The orifice of B was level with the top row of tubes, and half way between the blast-pipe and the tube-plate. The orifice of C was level with the bottom row of tubes, and vertically under B. The orifice of D was level with the middle row of tubes, and half way between the blast-pipe and the smoke-box door. At all these three points in the smoke-box the vacuum was found to be the same. The area of opening of the damper in front of the ashpan was 320 square inches.

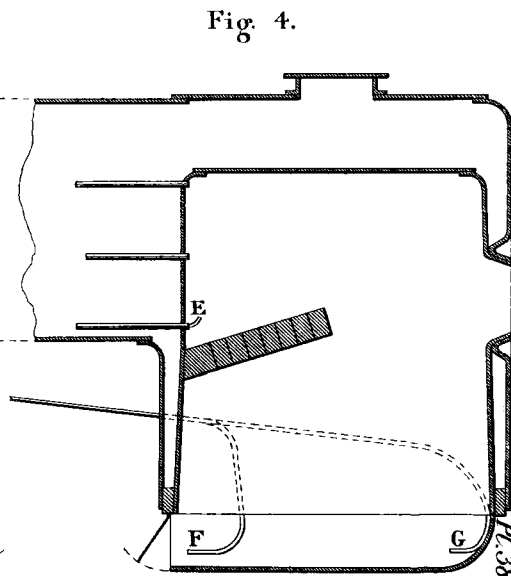
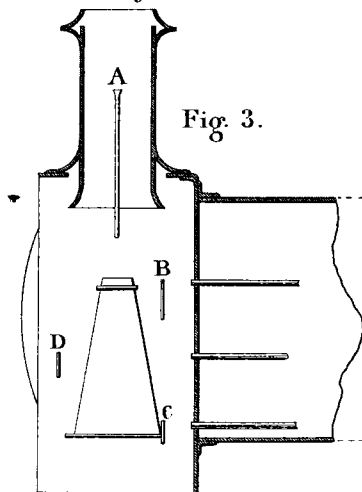
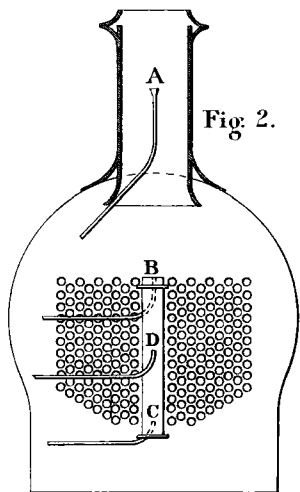
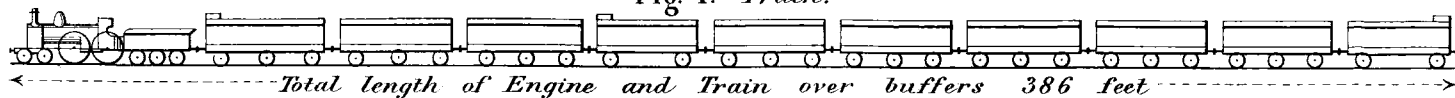
The results of the observations are recorded in the accompanying tables, pages 200-1; and are also plotted as a diagram in Plates 39 and 40, in which is added a profile of the line, showing the nature of the gradients. It will be seen that the vacuum produced in the chimney varied from 7 to 18 inches of water column; in the smoke-box from 3 to 7 inches; and over the brick arch in the fire-box from 1 to 3 inches. In the ashpan the pressure varied from $\frac{1}{4}$ to $\frac{3}{4}$ inch column of water. The boiler pressure varied from 140 to 160 lbs. per square inch above atmosphere. On the outward journey the greatest speed was 60 miles per hour, and the average was 48.4 miles, including the midway stoppage at Wigan. On the return journey the greatest speed was 55 miles per hour, and the average 40 miles, including the stoppage. The speeds were taken by a Boyer speed recorder.

These experiments the writer thinks illustrate fairly the conditions under which locomotive boilers work upon railways, and show that these conditions are if anything more severe than those to which the boilers are subjected in torpedo boats, where so much trouble has been experienced through leaky tubes. As locomotive boilers under these conditions are seldom troubled with leaky tubes, this fact seems to indicate that, if induced draught were used instead of forced draught in torpedo boats, some of the troubles met with in the latter might be got rid of.

LOCOMOTIVE BOILER DRAUGHT.

Plate 38.

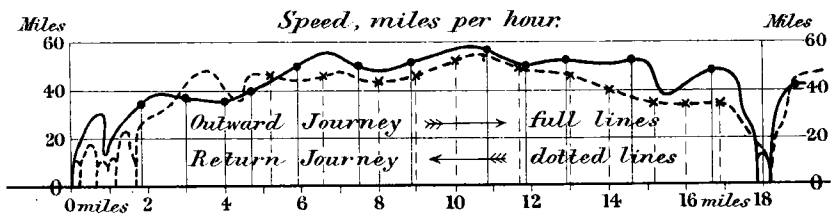
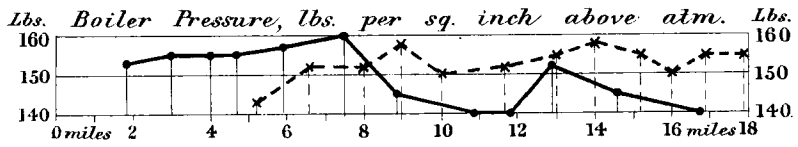
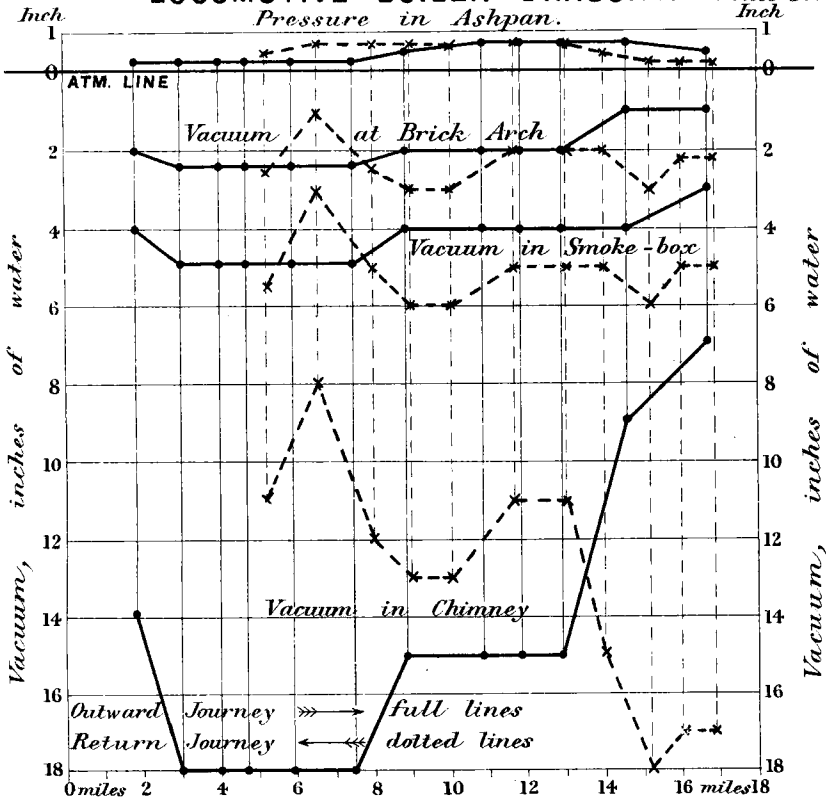
Fig. 1. Train.



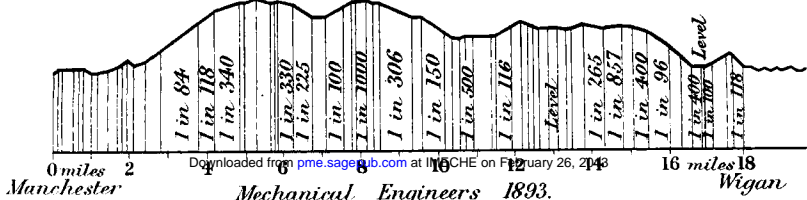
Scale $\frac{1}{80}^{th}$

LOCOMOTIVE BOILER DRAUGHT. Plate 39.

Pressure in Ashpan.



Profile of Line between Manchester and Wigan.



LOCOMOTIVE BOILER DRAUGHT. Plate 10.

