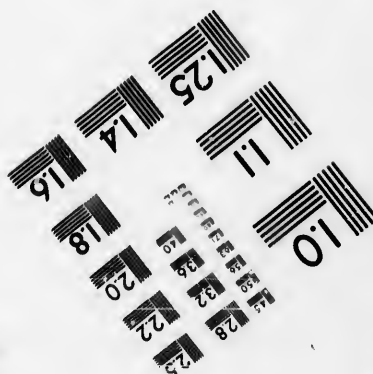
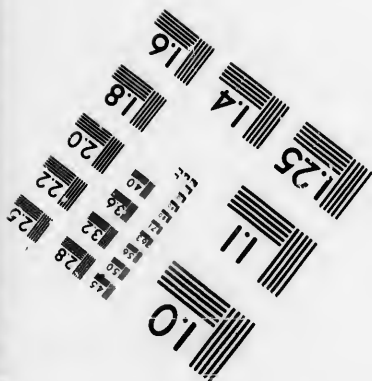
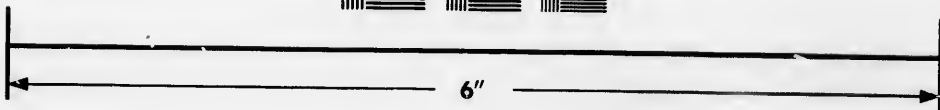
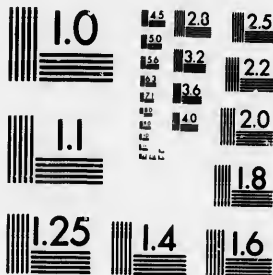


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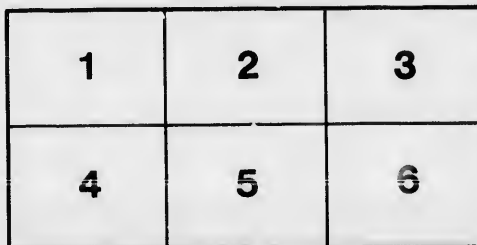
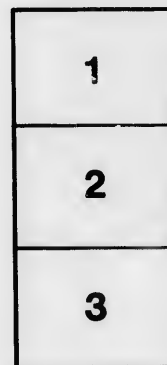
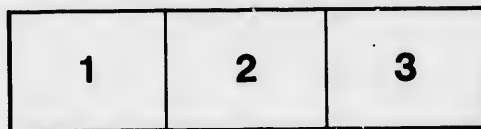
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EFFECT OF VARYING THE WEIGHT OF REGENERATOR IN A HOT-AIR ENGINE.

BY G. W. BISSELL, AMES, IOWA.

(Junior Member of the Society.)

WHEN the writer was connected with Cornell University, as instructor in experimental engineering, he noticed that experiments with a Rider Compression Pumping Engine gave data showing a lowering of temperature of the jacket-water in its course through the engine, instead of an elevation of temperature, as he expected. Many experiments, conducted carefully and with special pains in the calibration of thermometers, and in their use by interchange of position, confirmed the phenomenon.

The experiments which are herein described, and of which the data are given, were made to find out what effect, if any, varying the amount of metal in the regenerator would have upon the phenomenon referred to.

The Rider Compression Hot Air Pumping Engine is too well known to require description. The fuel used consisted of wood used for starting the fires and hard coal. The amount used in each run was determined as in the standard method of steam-boiler trials. All of the water pumped passed through the jacket of the displacing cylinder, except a small stream which was carried through the jacket of the working cylinder. Both streams of water were united beyond the pump and delivered to

* Presented at the Montreal meeting, June, 1894, of the American Society of Mechanical Engineers, and forming part of Volume XV. of the *Transactions*.

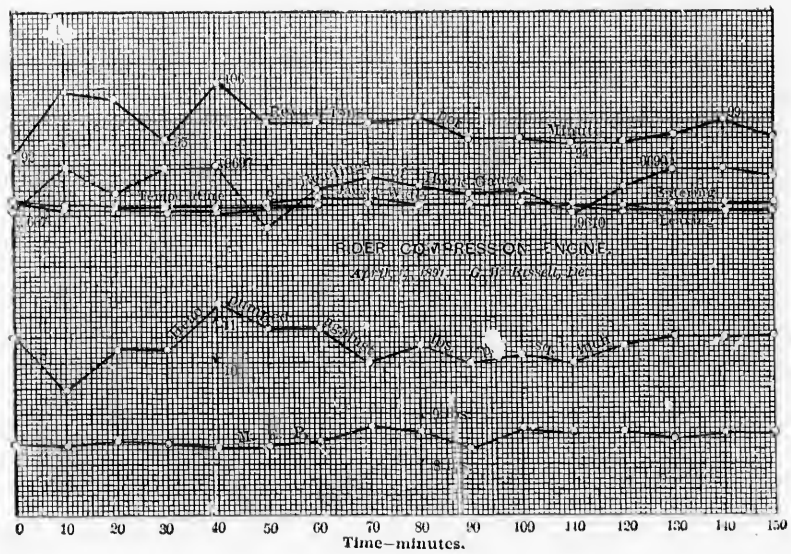
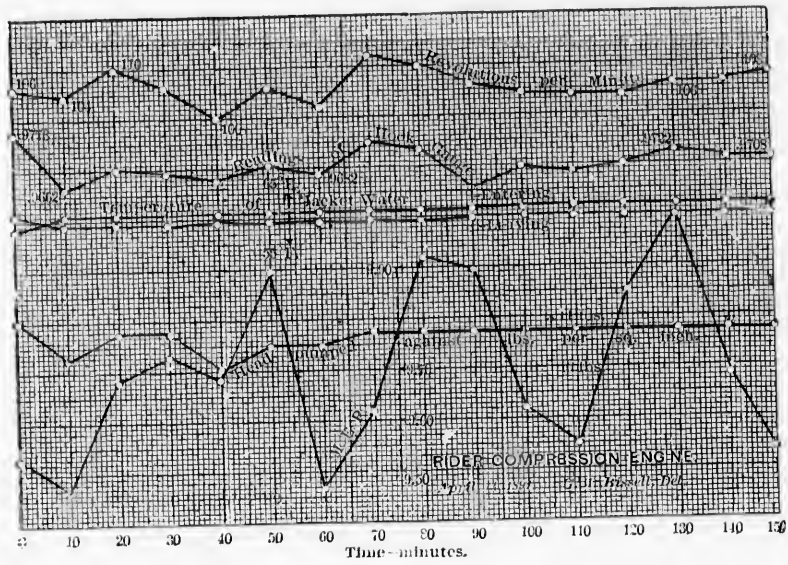
the weir, which measured the water pumped. The head against which the pump worked was made by throttling the discharge, and was measured by a pressure-gauge in the usual way. The indicator was attached to the regenerator chamber, and its drum received motion from the working cylinder. The speed was obtained by hand counting. The thermometers used for determining the temperatures of the jacket-water were eighteen inches long, graduated to 1/5° Fahr., and carefully compared, besides being frequently interchanged during each test.

The data and results are appended. Graphical logs and a graphical record of the final results are also given. The observations were taken by Messrs. Clarke and Heilman, then senior students in the laboratory, the latter being now instructor in the laboratory. The writer gave close supervision to the experiments here reported, and frequently verified the readings of the temperatures of the jacket water.

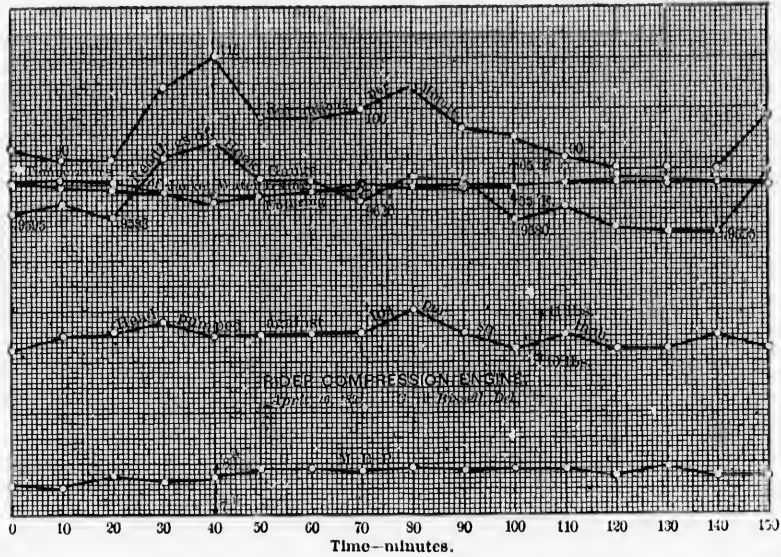
TEST NO. 1.

All of regenerator in ; weight of same, 20.75 lbs. Date, April 14, 1891, Duration, 2 hours 30 minutes. Zero of weir, 0.7833 feet. Weight of wood, 6.2 lbs. Weight of coal, 4.63 lbs.

No.	Time.	Weir Reading.	Head, lbs.	M. E. P.	TEMPERATURES.				Revs. per Minute.
					Room.	Water at Weir.	Jacket.		
							Entering.	Leaving.	
1	3.20	0.9773	11.00	9.53	77	86.8	58.2	61.2	106
2	3.30	0.9662	10.25	9.47	..	87.5	60.9	59.0	104
3	3.40	0.9703	10.75	9.68	..	88.0	60.9	58.9	110
4	3.50	0.9691	10.75	9.73	..	88.4	60.7	58.9	106
5	4.00	0.9675	10.00	9.68	76	89.3	60.9	59.5	100
6	4.10	0.9704	10.50	9.89	..	89.9	61.1	59.2	106
7	4.20	0.9682	10.50	9.47	..	90.1	61.1	59.5	102
8	4.30	0.9748	10.75	9.62	..	89.6	61.3	59.3	112
9	4.40	0.9733	10.55	9.92	77	89.8	61.2	59.2	110
10	4.50	0.9653	10.75	9.89	..	89.9	61.4	59.8	106
11	5.00	0.9695	10.75	9.62	..	90.4	61.5	59.8	104
12	5.10	0.9687	10.75	9.53	77	90.5	61.7	59.9	104
13	5.20	0.9700	9.85	9.85	..	90.8	61.9	59.9	104
14	5.30	0.9722	10.75	10.00	..	91.0	61.9	60.0	106
15	5.40	0.9712	10.75	9.68	77	91.0	61.9	59.9	106
16	5.50	0.9708	10.75	9.53	..	91.0	61.9	59.9	108
Mean ..	.....	0.9703	10.66	9.69	.....	89.62	61.16	59.62	105.9



4 EFFECT OF VARYING THE WEIGHT OF REGENERATORS.



TEST NO. 2.

Two-thirds of generator in; weight of same, 13.5 lbs. Date, April 15, 1891. Duration, 2 hours, 30 minutes. Zero of weir, 0.7853 feet. Weight of wood, 8.75 lbs. Weight of coal, 6.5 lbs.

No.	Time.	Weir Reading.	Head, lbs.	M. E. P.	TEMPERATURES.				Revs. per Minute.
					Room.	Water at Weir.	Jacket.		
							Entering.	Leaving.	
1	3.00	0.9609	10.50	8.39	83	78.4	62.9	62.9	92
2	3.10	0.9600	9.50	8.34	..	79.9	62.2	61.5	104
3	3.20	0.9642	10.25	8.49	..	81.6	61.8	61.2	103
4	3.30	0.9690	10.25	8.39	..	82.5	61.8	60.9	95
5	3.40	0.9697	11.25	8.32	79	83.9	61.7	60.7	106
6	3.50	0.9573	10.75	8.33	..	85.0	61.8	61.4	98
7	4.00	0.9648	10.75	8.39	..	86.1	62.2	63.2	98
8	4.10	0.9673	10.00	8.62	78	87.3	62.3	62.9	98
9	4.20	0.9659	10.35	8.62	..	84.6	62.2	62.2	99
10	4.30	0.9638	10.00	8.22	..	84.5	62.2	62.3	96
11	4.40	0.9645	10.15	8.70	78	85.7	62.5	62.3	96
12	4.50	0.9610	10.00	8.57	..	86.8	62.6	62.4	94
13	5.00	0.9660	10.35	8.62	..	88.0	62.9	62.0	94
14	5.10	0.9690	10.50	8.47	..	88.6	62.9	61.6	96
15	5.20	0.9689	10.50	8.62	78	89.2	62.9	61.7	99
16	5.30	0.9678	10.55	8.62	..	89.4	62.9	61.7	96
Mean ..	.....	0.9655	10.35	8.49	79	85.0	62.3	61.9	97.7

TEST NO. 3.

One-third of regenerator in ; weight of same, 6.75 lbs. Date, April 16, 1891. Duration, 2 hours 30 minutes. Zero of weir, 0.7853 feet. Weight of wood, 8.0 lbs. Weight of coal, 6.0 lbs.

No.	Time.	Weir Reading.	Head, lbs.	M. E. P.	TEMPERATURES.				Revs. per Minute.
					Room.	Water at Weir.	Jacket.		
							Entering.	Leaving.	
1	2.20	0.9595	10.35	7.56	78	93.0	65.5	65.3	92
2	2.30	0.9610	10.50	7.48	..	93.6	64.8	66.2	90
3	2.40	0.9583	10.55	7.78	..	94.5	64.5	65.7	90
4	2.50	0.9700	10.75	7.65	..	95.9	63.3	63.5	104
5	3.00	0.9734	10.50	7.72	78	96.4	63.0	61.6	110
6	3.10	0.9660	10.55	7.87	..	92.1	63.0	63.3	93
7	3.20	0.9658	10.55	7.87	..	92.4	63.7	63.8	98
8	3.30	0.9620	10.60	7.80	..	93.5	63.9	64.9	100
9	3.40	0.9667	11.00	7.87	78	94.0	64.5	64.3	104
10	3.50	0.9653	10.55	7.80	..	93.7	64.6	64.9	96
11	4.00	0.9580	10.25	7.87	..	94.4	64.5	64.5	94
12	4.10	0.9603	10.50	7.87	76	95.5	65.3	68.5	90
13	4.20	0.9565	10.25	7.72	..	90.9	65.8	65.4	88
14	4.30	0.9555	10.25	7.87	..	90.3	67.7	65.3	88
15	4.40	0.9555	10.50	7.65	75	90.4	65.2	66.5	88
16	4.50	0.9693	10.25	7.68	..	89.6	64.7	65.0	98
Mcan ..	.....	0.9626	10.49	7.75	77	93.1	64.5	64.9	95.5

RESULTS.

Diameter of working piston, 6.75 inches ; diameter of pump plunger, 1.5 inches ; length of stroke of working piston, 0.732 feet ; length of stroke of pump plunger, 0.713 feet.

Test No.	1	2	3
Date.....	4-14-1891	4-15-1891	4-16-1891
Duration	2½ hours	2½ hours	2½ hours
Weight of regenerator, lbs.....	20.75	13.50	6.75
Head pumped against, feet.....	24.51	23.80	24.12
Weir reading.....	0.9703	0.9655	0.9626
Weir zero	0.7853	0.7833	0.7853
Head over weir, feet.....	0.1850	0.1862	0.1773
Water delivered, cubic feet per second	0.0215	0.0202	0.0193
Temperature of water at weir, Fahr.....	89.62	85.00	98.1
Effective horse-power	0.0590	0.0542	0.0528
M. E. P.	9.69	8.49	7.75
Revolutions per minute.....	105.9	97.7	95.45
Indicated horse-power.....	0.880	0.711	0.632
Mechanical efficiency, per cent.	6.79	7.62	8.20
Coal consumed per hour, lbs.....	2.84	4.00	3.68
Coal per I.H.P., per hour.....	3.22	5.62	5.82
Initial temperature of jacket-water.....	61.16	62.30	64.5
Final temperature of jacket-water.....	59.62	61.9	64.9
Rise in temperature of jacket-water.....	-1.54	-0.4	+0.4

REMARKS.—The rise in temperature of the water from the pump to the weir was occasioned partly by the jacket-water from the working cylinder which was admitted to the discharge pipe after the final temperature of the main stream had been measured, and partly by the arrangement of the discharge pipe, which was carried through the upper part of the room in the vicinity of steam pipes for a considerable distance before reaching the weir tank.

Inspection of the above data and results reveals the following :

Reducing the weight of the regenerator reduces the cooling effect of the engine upon the jacket-water, and finally results in actually raising its temperature,

6 EFFECT OF VARYING THE WEIGHT OF REGENERATOR.

And also increases the mechanical efficiency;

But at the expense of the duty and of the total efficiency as shown by the items under the heads respectively of "Water delivered, cubic feet per second," and "Coal per I. H. P. per hour."

