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FUEL RESEARCH INSTITUTE

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TECHNICAL MEMORANDUM

NO. 17 OF 1969.

FURTHER TESTS ON STOKERMATIC SPACEHEATERS.

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FUEL RESEARCH INSTITUTE OF SOUTH AFRICA.

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FURTHER TESTS ON STOKERMATIC SPACE HEATERS.

1. SCOPE OF TESTS.

In earlier tests, described in Technical Memorandum No. 24 of 1968, "Performance of Stokermatic Space Heaters", three models were investigated, viz.

the Little Giant, No. GT 4411, rated output 40,000 B.Th.U/h.
No. DT 6807, rated output 80,000 B.Th.U/h.
Super Giant, STA 6794, rated output 100,000 B.Th.U/h.

In these tests, only the smallest model achieved the rated output, that of the other two models was only approximately half the stated figure.

A further examination of these models revealed that the coal feed rate did not permit a very much greater output than was achieved during the experiments.

In the larger model, the feed rate could, however, be increased appreciably by altering the pulleys of the belt drive; in the case of model 6807, the motor, fan and speed reduction mechanism driving the feed screw from an integral unit. Altering the speed of the feed screw is thus virtually impossible. The output could only be increased by cutting out the thermostats so that non-stop operation was obtained.

The units were re-tested at full load, while some additional trials at reduced load were also performed.

In the case of the Super Giant, the following test runs were made:

a)...../

- a) Continuous operation at a feed rate of 5.9 kg/h (13 lb/h).
- b) Continuous operation at a feed rate of 3.85 kg/h (8.5 lb/h).
- c) With the feed rate at 5.9 kg/h, the unit was operated on an "on-off" cycle, the "on" phase lasting 10 minutes, followed by an "off" period of the same duration, where the feed screw and the fan supplying the combustion air were switched off.
- d) With the same feed rate, and on a similar cycle, where the air supply was, however, maintained.

The 6807 unit was tested as follows:

- a) Continuously.
- b) On the "on-off" cycle as in (c) above.
- c) Controlled by the thermostat.

The Little Giant was tested:

- a) Continuously.
- b) Controlled by the thermostat.

The experimental results are presented in Tables No. 1 to 3.

The fuel used in these experiments was a Witbank bituminous coal, having a calorific value of 6740 kcal/kg.

The temperature and velocity of the air issuing from the louvres of the apparatus were measured. Table No. 4 gives the average results; temporal variations are not appreciable.

For further particulars of these units and on the test procedure, reference is made to Technical Memorandum No. 24 of 1968, mentioned above.

2. DISCUSSION OF TEST RESULTS.

Smoke, Efficiency:

The units operated smokelessly under all conditions. The efficiencies attained are mediocre, but in all cases the best efficiency was obtained at the maximum output.

Temperature...../

Temperature Distribution:

Neither the velocity nor the temperature of the air issuing from the various louvres of each unit are uniform, though the differences are not so large that conditions must be considered to be unacceptable.

Installing some scoops or baffles in the interior of the unit could increase the uniformity.

Effectiveness of Control:

The controls installed on the unit permit adjustment of the output over the range from banking to maximum output. The degree of linearity of the controls was not investigated.

Fuel Charging and De-ashing Facilities:

Charging of the fuel is convenient but the tightness of the hoppers could be improved: coal dust penetrates into the motor compartment which, especially in the belt-driven model, may cause trouble.

De-ashing of the Little Giant gives no trouble and the occasional clinker is easily broken up by the apparatus provided for this purpose.

In the larger units, de-ashing is less convenient. These units were presumably designed to produce ash in a clinkered or sintered form. With the Witbank coal used, the ash usually remains sandy and tends to spill outside the receptacles provided.

The tightness of ash-pit and fire doors could be improved.

Durability of Screw Feed:

Two of these units were tested continuously over a period exceeding 3 months during which period no breakdowns of the coal feed nor of the mechanism occurred.

Effectiveness of Heat Exchanger:

The stack temperatures of the units are rather high, which indicates that the efficiency of the heat exchanger is

not...../

not very good. Improvements would, however, entail a far reaching re-design.

Further Comments:

The self-tapping screws used on the door hinges tend to loosen. The fan casings are not rigidly fixed and occasionally touch the rotor.

The enamel on the ash-pit door discolours due to overheating.

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PRETORIA.

15th April, 1969.

TABLE NO. 1.
PERFORMANCE OF STOKERMATIC LITTLE GIANT
NO. G.T. 4411

Test No.		413	414
Stack Temp. Diff.	°C	419	272
CO ₂ content	%	7.7	4.5
CO content	%	0.03	0.05
Carbon Loss	%	6.2	6.6
Total Losses	%	41.9	45.5
Efficiency	%	58.1	54.5
Firing Rate (nominal)	kg/h	2.2	1.2
Output	kcal/h	9030	4670

Test No. 413: at maximum capacity.

414: controlled by thermostat.

TABLE NO. 2.
PERFORMANCE OF STOKERMATIC UNIT NO. 6807.

Test No.		410	411	412
Stack Temp. Diff.	°C	420	287	162
CO ₂ content	%	6.8	4.2	3.2
CO content	%	0.03	0.1	0.15
Carbon Loss	%	8.2	9.9	24.3
Total Losses	%	46.2	52.4	50.4
Efficiency	%	53.8	47.6	49.6
Firing Rate (nominal)	kg/h	4	2	1
Output	kcal/h	14500	6420	3060

Test No. 410: at maximum capacity.

411: on/off cycle, timed.

412: controlled by thermostat.

TABLE NO. 3.

PERFORMANCE OF STOKERMATIC SUPER GIANT
NO. STA 6794

Test No.		406	407	408	409
Stack Temp. Diff.	°C	584	482	412	386
CO ₂ content	%	13.6	7.1	6.7	5.4
CO content	%	0.03	0.03	0.06	0.03
Carbon Loss	%	10.3	4.9	8.8	4.6
Total Losses	%	41.4	51.2	51.2	53.5
Efficiency	%	58.6	48.8	48.8	46.5
Firing Rate (nominal)	kg/h	5.9	3.85	2.95	2.95
Output	kcal/h	21090	12100	8910	8830

Test No. 406: Maximum rate.

407: Reduced rate, continuous.

408: Maximum rate, intermittent (timed on/off cycle)

409: Maximum rate, intermittent, fan on.

TABLE NO. 4...../

TABLE NO. 4.
AIR TEMPERATURE AND VELOCITY DISTRIBUTION

Unit		Position															
		A	B	C1	C2	C3	D1	D2	D3	E1	E2	E3	F1	F2	F3	G	
GT 4411	Temperature °C	76	93	74	76	70	86	81	76								
	Air speed ft/min.	471	390	462	380	266	445	324	326								
DT 6807	Temperature °C	A 45	B 63	C 72	D1 47	D2 51	D3 50	E1 64	E2 67	E3 91	F1 58	F2 58	F3 69				
	Air speed ft/min.	620	438	840	782	503	523	695	554	527	637	588	530				
STA 6794	Temperature °C	72	69	82	84	68	74	86	110	107	68	69	114	67			
	Air speed ft/min.	815	781	550	561	401	534	223	329	273	379	382	418	325			

NOTE: For location of positions see Figure 1 of Technical Memorandum No. 24 of 1968.
C1, C2, C3 indicate highest, middle and lower position in louvre C, etc.
Temperatures recorded are those obtained at full load.