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TEGNIESE / TECHNICAL MEMORANDUM NO. 24 OF 1968.

PERFORMANCE OF STOKERMATIC SPACE HEATERS.

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1. Scope of Test.

Three types of Stokermatic Space Heaters were tested under conditions similar to those likely to be experienced in practice where this type of equipment is frequently used by unskilled operators. It was thus not attempted to attain the highest possible efficiency by reducing the excess air to a minimum or to practice great care in the removal of the ash. Nevertheless, the efficiency attained under these conditions was of the order of 50%.

2. Description of Equipment.

The units are small underfeed stokers, equipped with a constant speed fractional horse power motor, direct coupled to the gear box driving the feed screw and to the fan providing the combustion air. No adjustment of the coal feed rate beyond "on" and "off" is thus possible. The air quantity is adjusted by a damper which is set according to the air requirements of the fuel.

A heat exchanger is installed over the retort and combustion chamber; a separate fan circulates the air in the room to be heated over the exchanger.

The output of the heater is controlled thermostatically. Details differed slightly in the various models tested. In general, the coal feed rate and the circulating fan are controlled by a built-in thermostat/on "on-off" control/which also prevents overheating of the heat exchanger. An additional room thermostat may, however, also be used.

During ...../

During banking, the coalfeed is periodically switched on for a few minutes by a "hold-fire" control which may either be operated on a time basis or by a thermostat.

The models tested were as follows:

A small model, nr. GT 4411 with cabinet dimensions 38 in (H) x 28 in (W) x 17 in (D)
A model DT 6807, 38 x 34 x 23
A model STA 6794, 38 x 38 x 23.

In the first two models, the stoker fan forms an integral part of the driving motor, in the third, the fan is driven by a Vee-belt.

3. Test Procedure.

In these tests it was not attempted to attain the highest possible efficiency but rather to run the units in a manner corresponding to their use by an inexperienced operator. A considerable quantity of excess air was admitted in order to ensure troublefree and smokeless operation.

The usual data, necessary for the calculation of the stack losses were collected. At the end of the test, the contents of the combustion chamber were drawn and quenched in order to determine the quantity of combustible matter left. This is necessary in these short tests for the calculation of the quantity of carbon actually burnt, and of the flue gas volume. The carbon-in ash loss, obtained from these data is, however, rather higher than would be obtained in practice.

In addition, the uniformity of the air distribution (in respect of quantity and temperature) was checked.

The test results are presented in tables no. 1 and 2 and figure 1.

4. Test results.

It will be noted that the CO_2 content of the flue gas was low, and the stack loss consequently rather high. This was, however, done deliberately and smokeless operation was obtained under all conditions (excepting the first 10 minutes after first

kindling ...../

kindling the fire). This also ensured that an easily handled sandy ash, containing little clinker, was obtained.

The carbon in ash losses are high, but it is likely that similar losses would frequently be experienced in practice if the ashes are carelessly removed.

The appearance of the fire was good in all cases, no black centre or uneven burning was observed.

Neither the temperature distribution of the outgoing air, nor the quantities issuing from the various louvres, were entirely uniform; the differences are not likely to cause discomfort in practice. Conditions could be improved by placing a few simple scoops or baffles inside the cabinet.

In one case, the output was calculated from the air quantity and its temperature rise and this figure agreed closely that determined by the indirect method.

The banking performance of the small unit was, in earlier tests, found to be very good as the fire could be held almost indefinitely at a negligable heat output. The larger units were not, so far, tested extensively in this respect.

4. Remarks on Construction.

For use under South African conditions, use of a heavier gauge steel for the bunker and the enclosures appears to be advisable. Otherwise, the duration of the experiments was too short to indicate the existence of serious shortcomings, with one exception:

The feed screw of the A15 unit was, on arrival found to be jammed by a piece of shale, causing the feed screw to break. Provisions of a shearing pin or similar device in an accessible position would be desirable.

Two of the units are now subjected to a long-term practical test.

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CHIEF RESEARCH OFFICER.

PRETORIA.
7th June, 1968.
/HW

TABLE NO. 1.

PERFORMANCE DATA OF THREE STOKERMATIC SPACE HEATERS.

Model		GT 4411	DT 6807	STA 6794	Particulars of Coal Fired
Firing Rate	kg/h	2.5	3	4	Cal.Val. 6870 kcal/kg
Stack Temp.	^{o}C	419	392	445	C 70.6% D.A.F.
Ambient Temp.	^{o}C	20	24	31	H 3.85% D.A.F.
Ashes Discarded	kg	2.38	3.26	1.26	Ash 13.7%
Percentage Carbon	%	21.7	55.9	63.5	Moisture 2.3%
CO_2 in flue gas	%	6.8	7.5	6.0	Vol.Mat. 26.9%
Efficiency	%	57.5	56.8	50.6	Type: Witbank Bituminous
Output	kcal/h	9,900	11,600	14,000)2	Size: Peas
	BThU/h	39,500	40,600	55,500	
Stack Loss)1	%	37.7	29.0	42.7	
Carbon in Ash, Loss	%	4.8	14.2	6.7	
Duration of Test	hours	5	5	3	

Notes. 1. Losses due to unburnt gases in flue gas are negligable.

2. Output for Model STA 6794, calculated from air quantity and temperature rise : 14,300 kcal/h.

TABLE NO. 2.

AIR AND TEMPERATURE DISTRIBUTION.

Type	Louvre	Dimensions in.	Flow Air Feet/min	Air Temp. °C
A 15 GT 4411	A	$5\frac{1}{8}$ x $5\frac{1}{8}$	449	78
	B	$5\frac{1}{8}$ x $5\frac{1}{8}$	396	84
	C	$5\frac{1}{8}$ x $13\frac{3}{4}$	325	86
	D	$5\frac{1}{8}$ x $13\frac{3}{4}$	280	74
DT 6807	A	$5\frac{1}{8}$ x $5\frac{1}{8}$		44
	B	$5\frac{1}{8}$ x $5\frac{1}{8}$		61
	C	$5\frac{1}{8}$ x $5\frac{1}{8}$		60
	D	$5\frac{1}{8}$ x $13\frac{3}{4}$		48
	E	$5\frac{1}{8}$ x $13\frac{3}{4}$		60
	F	$5\frac{1}{8}$ x $13\frac{3}{4}$		58
STA 6794	A	$5\frac{1}{8}$ x $5\frac{1}{8}$	728	67
	B	$5\frac{1}{8}$ x $5\frac{1}{8}$	840	58
	C	$5\frac{1}{8}$ x $5\frac{1}{8}$	670	58
	D	$5\frac{1}{8}$ x $13\frac{3}{4}$	540	58
	E	$5\frac{1}{8}$ x $13\frac{3}{4}$	410	71
	F	$5\frac{1}{8}$ x $13\frac{3}{4}$	500	63
	G	$4\frac{1}{2}$ x $5\frac{1}{8}$	130	45
Total Air Flow (at intake) 18.7 m^3/min (660 ft^3/min) at 31°C.				

See figure No. 1 for location of louvres.

FIG. I.

LOCATION OF LOUVRES.