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WU 18114

FUEL RESEARCH INSTITUTE OF SOUTH AFRICA.

TECHNICAL MEMORANDUM NO. 1 OF 1964.

PRELIMINARY REPORT ON THE PERFORMANCE OF ZAVICHACK
WATER HEATING APPARATUS.

By:

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The output was determined by pumping water from a 1,000 gallon tank at a fixed rate through the boiler, and recording the temperature rise. Since the temperature of the water was generally rather lower than would occur in practice, the rate of heat transfer during the test was somewhat higher and the radiation loss rather smaller than under practical conditions. The boiler, as tested, was however not lagged, applying some insulation would more than compensate for these deviations.

Usually, the duration of the test was four hours, following a preliminary period during which the fuel bed attained a stable condition. Fuel was added at 20 minute intervals and the fuel bed lightly poked on these occasions.

These were performed at constant draught (2, 4, 6 and 8 mm water column), and two series of tests were performed.

In the first series, all joints and seams through which air could infiltrate were sealed, and secondary air was admitted through a 3" diameter opening in the ash box door.

In the second series, the stove was tested as received and secondary air entered at the base of the boiler through the joint between the boiler and the ash box.

Smoke evolution was visually observed by directing a spotlight at the chimney top. Since smokeless operation was nearly always realised, it would have been futile to instal a smoke density meter.

3. TEST RESULTS:

When testing the stove as received, smoke evolution ceased 15 to 20 minutes after lighting up and a clear start could be maintained thereafter. The CO₂ of the flue gas was, however, rather low (of the order of 10%), indicating that rather too much air entered the combustion space, therefore, the boiler was also tested with a reduced supply of secondary air.

Table 1 .../

Table 1 shows the most important test result.

Since the operation in test No. 6A was far from smokeless, this test was not run for the full 4 hours and the efficiency figure is therefore not reliable.

In tests 7 and 10 the quantity of combustibile matter in the ashes was unduly high, as indicated by the other tests, this figure need not exceed 6 to 8%, and could be even less in practice, where the fire can be left undisturbed for a longer period.

The difference between firing efficiency and overall efficiency indicates the magnitude of the heat losses from the boiler shell. By applying lagging, the efficiency could be increased

Tests 9A to 11, indicated that increasing the draught has not very much effect on the combustion rate. Though more air is drawn in, most of this apparently by-passes the combustion zone and dilutes the flue gas.

If, however, the stove is well sealed, not enough secondary air is introduced at low loads and the fire smokes.

The admission of secondary air in the correct amount and at the right place would improve matters.

4. CONCLUSION:

The apparatus was found to be able to burn bituminous coal smokelessly and efficiently in its present state and it is expected that by introducing modifications, the operation could be improved still further.

(SIGNED) G.A.W. van DOORNUM.

CHIEF OF DIVISION.

PRETORIA
5/2/64

TABLE 1.

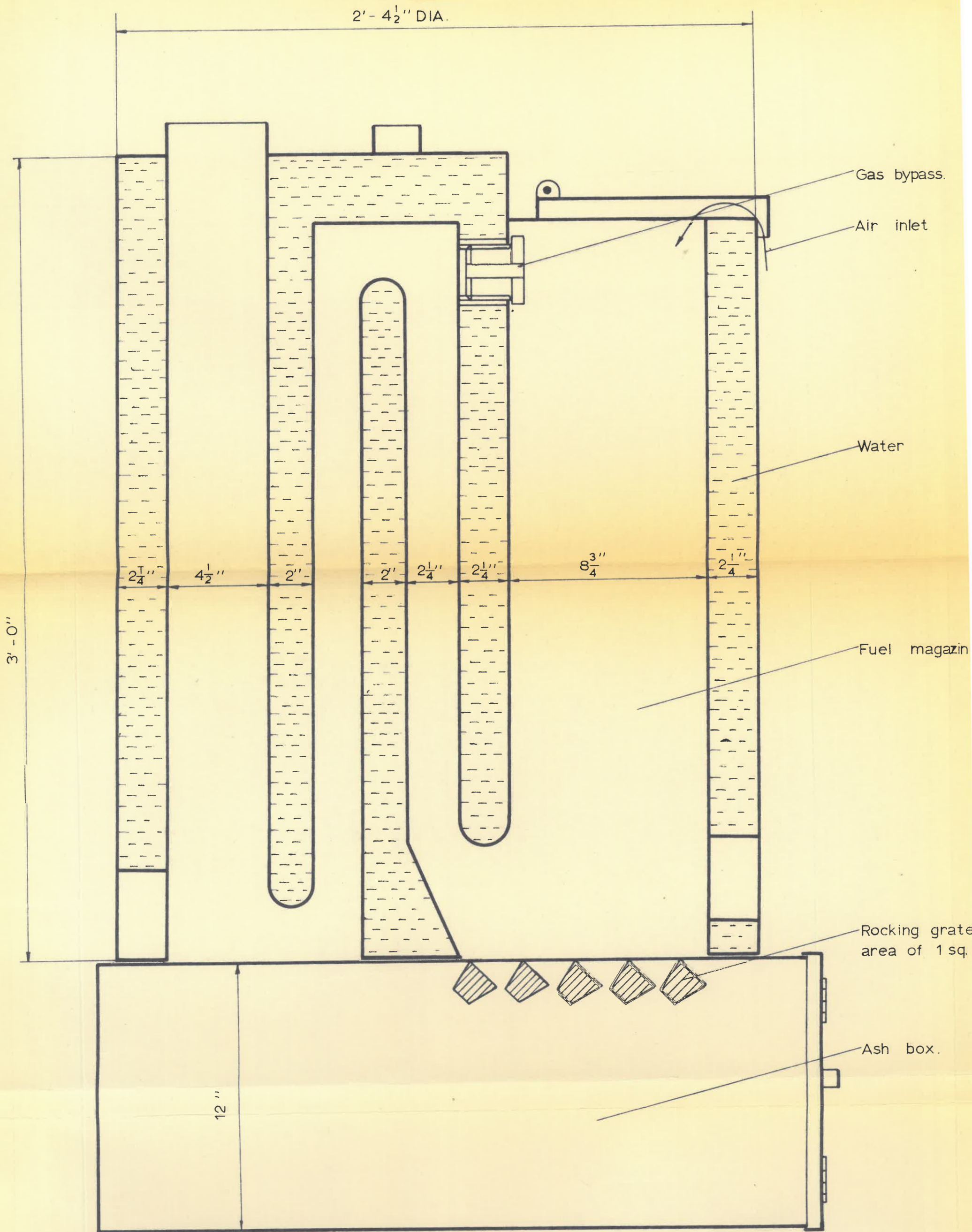
STOVE: ZAVICHACK BOILER. TABULATION OF TEST RESULTS FOR VARIOUS CONDITIONS.

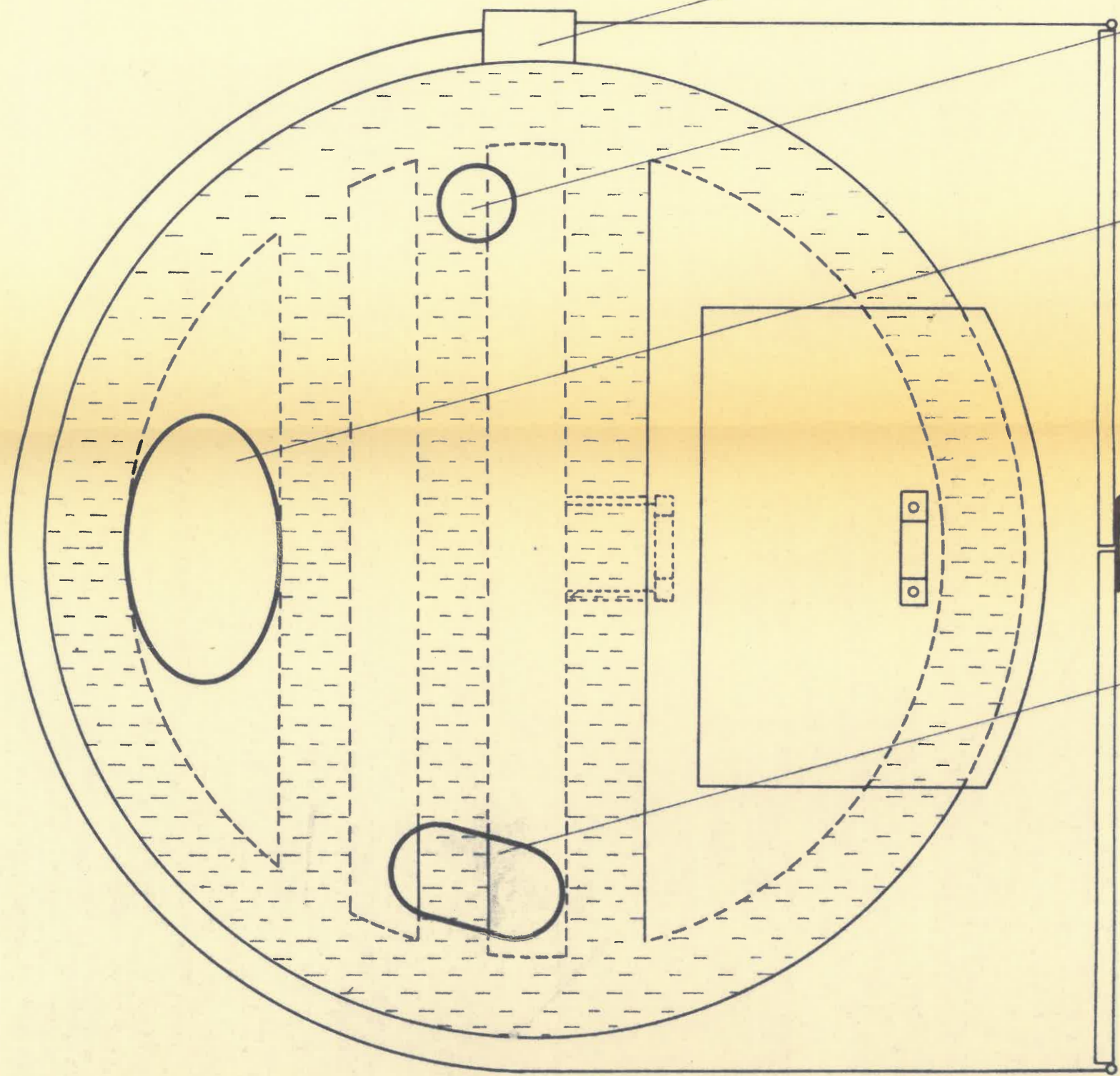
Test No	Draught mm/wg	Stack Temp. °C	Room Temp. °C	% CO ₂	% CO	Fuel Consumption Kg/hr.	Water Flow Rate Kg/hr	Temp. Rise °C	Rate of Temp. Rise °C/hr	Latent and Sensible Heat Loss: %	Loss Due to Unburnt Gasses: %	Loss Due to Carbon losses %	100 all Calcu- lated losses %	Efficiency %	Output Kcal/hr	Re- marks
6A	2mm (Sealed)	300	22.3	13.7	2.1	7	2271.18	10.5	5	11.79	7.85	5.66	74.7	53.76	24572.39	A
6B	4mm (Sealed)	350	27.6	13.27	0.16	6.613	2267.4	12.87	4.5	15.63	0.69	7.37	76.31	69.1	29834.06	C
7	6mm (Sealed)	429	27.0	10.1	0.4	8.666	2252.25	14.21	5	23.16	2.06	12.37	62.4	57.84	32729.5	B,D
9A	2mm	307	26.3	10.8	0.3	6.103	2292.0	9.4	3.1	16.42	1.58	6.4	75.6	65.35	26039.8	E
9B	4mm	373	30.0	10.6	0.3	6.933	2171.25	13.7	4.5	20.47	1.61	6.4	71.52	67.15	30398.625	E
10	6mm	394	24.0	9.8	0.2	8.26	2285.0	14	6	21.75	1.05	14.48	62.72	60.9	32860	B,E
11	8mm	390	24.0	9.44	0.26	8.35	2278.75	15	7	23.68	1.52	9.02	65.78	64.55	35196	E

Cal.Val. of fuel (lower value): 6529 Kcal/kg

- A. Test discontinued after 1½ hours as smoke evolution was excessive. The efficiency figure is not reliable as the duration of the test was too short.
- B. In these tests, the quantity of unburnt material in the ashes was unduly high.
- C. Operation was not entirely smokeless.
- D. Some smoke evolution occurred after refuelling.
- E. No smoke was produced during the test period.

Zavichack Stove.





Water inlet.

Hot water out

Stack

Inspection hole

crack stop