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THE USE OF LEADED FUEL IN GASOLINE BURNERS

PURPOSE

To investigate the service life of various commercially available gasoline burning appliances operated on gasoline containing TEL, and the health hazards resulting from the lead.

SUMMARY

Gasoline containing 3.0 cc. of TEL/gal. may be used satisfactorily with regard to service life in gasoline burning appliances incorporating either a filter-type vaporizer as on the Kempkook, Model 2522, manufactured by the American Gas Machine Co., or the vaporizer tube-burner head combination as used in the G.I. Pocket Stove, Model 530. manufactured by the Coleman Company. The service life of appliances having a vaporizer tube located directly within the flame, and without an arrangement for removing lead dust from the fuel vapor, is relatively short when using leaded fuel, resulting in unsatisfactory operation of the unit.

Operation of a stove or heater equipped with a vaporizer-filter tube appears safe from a toxicological viewpoint, even with little ventilation. Where lead is present in the exhaust fumes, care should be taken to provide adequate ventilation.

INTRODUCTION

Among users of gasoline-burning heaters and cooking stoves, the difficulty of obtaining unleaded gasoline has caused concern since many such appliances do not operate satisfactorily on fuel containing TEL. Many owners of such appliances have attempted using "Ethyl" gasoline and other motor gasolines containing TEL, with resultant poor operation as reflected by the many complaints from the users which have been brought to our attention.

Some manufacturers of such equipment have accepted the problem of gasoline supply and they have overcome the operating difficulties of their units through changes in design. However, it appears that little or no thought has been given to the possible

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toxicological conditions present when leaded fuel is used.

This project was undertaken to study the operation of several common such appliances, purchasable by the average individual, for operating characteristics and possible design improvements, and to determine roughly the health hazards involved.

EXPERIMENTAL

Equipment

Selection was made to include the more commonly used gasoline burning appliances. Among the units tested were four types of open flame appliances and one automobile heater which has an enclosed combustion chamber. A description by name and model number, with photograph references is as follows:

1. Speedikook, Model No. 6206, manufactured by American Gas Machine Company, Albert Lea, Minnesota. Fig. 1.
2. Kempkook Model No. 2522, manufactured by American Gas Machine Company, Albert Lea, Minnesota. Fig. 2.
3. Coiltrol Fire Pot, Model No. 44A, manufactured by Clayton and Lambert, Louisville, Kentucky. Fig. 3.
4. G.I. Pocket Stove. Model 530, manufactured by the Coleman Company Inc. Fig. 4.
5. South Wind Car Heater, Model No. 781, manufactured by the Stewart Werner Corp. Fig. 5.

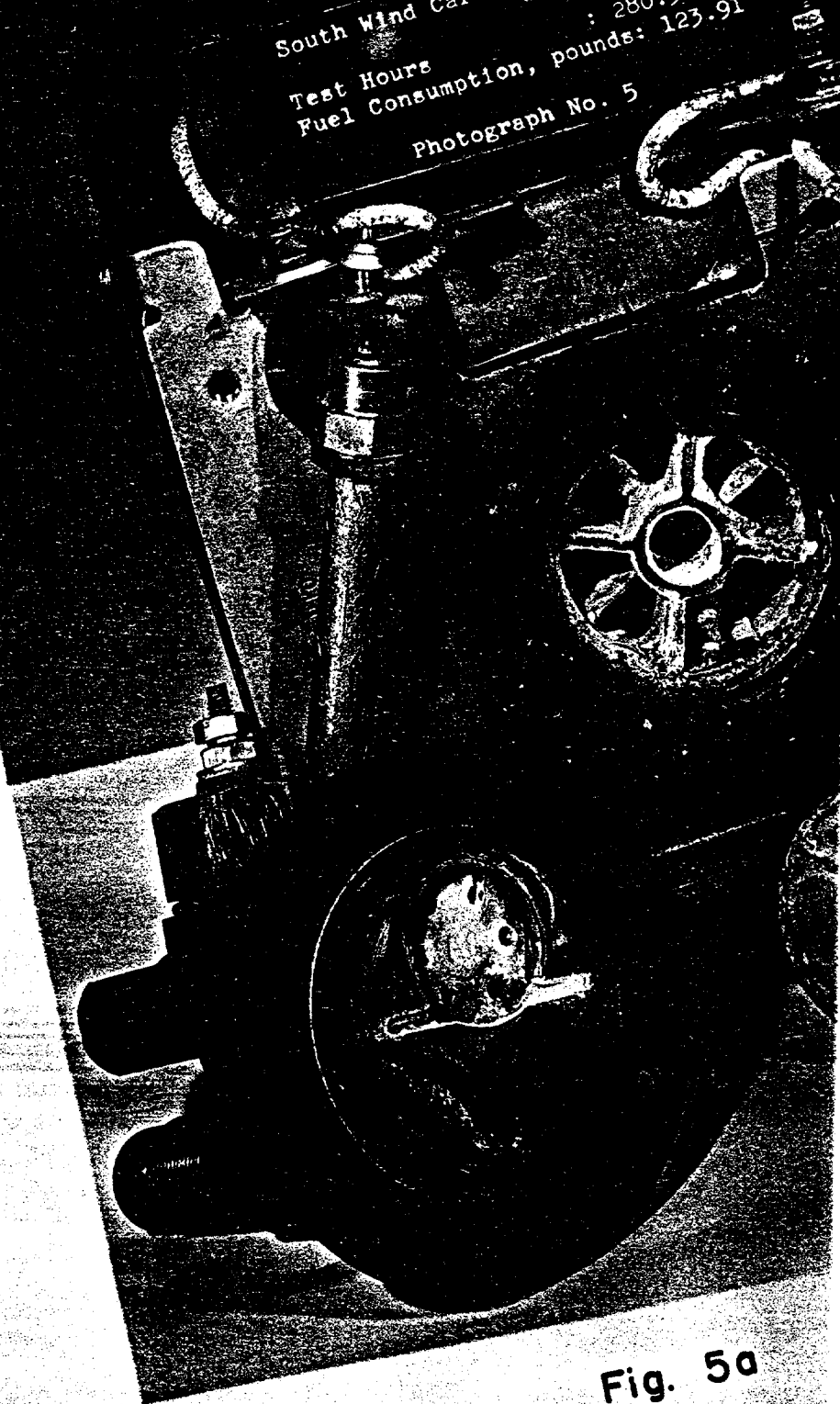
Procedure

The schedule of operation of the various units was one hour of operation followed by a shut down period sufficient to allow the units to cool to room temperature, then repeating the cycle. This type of operation gave an average operating time of approximately 26 hours per week, which allowed sufficient time for corrosion to take place on surfaces covered by deposits.

The rate of fuel consumption of the open flame appliances was regulated to obtain moderate boiling of water in vessels with loose-fitting covers. The two American Gas Machine Co. stoves and the Clayton and Lambert Coiltrol firepot were used to heat sauce pans of three quart capacity. The two Coleman G.I. Pocket Stoves were used to heat the covered utility cup which is a part of the case.



South Wind Car Heater, Model No. 781
Test Hours : 280.3
Fuel Consumption, pounds: 123.91
Photograph No. 5



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Fig. 5a

Care was taken not to disturb deposit formation or to make mechanical adjustments to any unit after it was placed on test. The fuel supplied to all units was the same. Blank runs were made using the same base gasoline containing no TEL to serve as a basis of comparison with tests in which the fuel contained 3.0 cc. of TEL/gal. as 62-Mix "Ethyl" fluid.

An attempt was made to determine, qualitatively, the health hazard involved in burning leaded fuel by sampling the air in a room in which a stove was operating, and also having analyses made for lead content of the water heated in the covered vessels during the tests.

Results

The results on the service life of the various units are presented in Table I.

The results show that a reasonably long life of trouble-free operation can be had from all of the units tested provided that lead-free gasoline is used as the fuel. When lead is present in the fuel some of the units have a very short operating life or considerable maintenance is required, while others appear only mildly affected by the presence of lead. The units in which gasoline is mainly vaporized (TEL is thermally decomposed) after the fuel leaves the tip of the jet, and the products of combustion are permitted to escape to the atmosphere, as in the South Wind Car Heater and the G.I. Pocket Stove. operation from a mechanical viewpoint is wholly satisfactory for long periods even on fuel containing as much as 3 cc. of TEL/gal. These tests show that Stewart Warner's claim of a 300-hr. life for their unit appears justified.

Incorporated in the Kampkook stove is a steel wool-filled tube which is a small version of the E-23 generator tube originally developed by these Laboratories for use on the U.S. Army Field Range, Model of 1937 (LTD 43-27). That tube is set over a flame and the fuel as it passes through it is heated to a temperature high enough to effect vaporization of the fuel and decomposition of the TEL present. The lead particles are deposited in the filter and the vapors passing out are lead-free.

The Coiltrol Fire Pot can not be used satisfactorily on leaded gasoline in its present state. The vaporizer tube at present consists of a length of 1/8-in. pipe containing a small wound cable. The pipe is wound in a coil of 3 turns with an inside diameter of 1-1/4 in. Fuel passes downward through the pipe and the flame rises from a jet set below and passes up through the center of the coil. Temperatures in the coil are well above that required to decompose TEL, with the result that when lead is present in the fuel the lead dust deposits on the inner surfaces of the tube and on the cable,

TABLE I - Service Life of Various Gasoline Burner Appliances

<u>Unit</u>	<u>Time of test, hr.</u>	<u>TEL cc./gal.</u>	<u>Fuel consumed,</u>		<u>Cause of failure and</u>
			<u>lb.</u>	<u>lb./hr.</u>	
Speedikook	78(1)	0	14.7	0.19	
Speedikook	22	3.0	4.49	.20	Flame illuminiscent too low to permit boiling of water.
Kampkook	77.5(1)	0	24.9	.32	
Kampkook	53.5	3.0	20.7	.39	Flame illuminiscent too low at end of test boiling of water.
Coiltrol	156.5(1)	0	87.9	.56	
Coiltrol	16	3.0	8.0	.5	Fuel rate dropped so flame failure occurred test hours.
Coiltrol	14	3.0	12.64	.90	Flame size could not be maintained because of frequent flame out when operating at 1 lb. rate. First flame at 1.7 test hours.
South Wind Car Heater	75(1)	0	36.64	0.46	
South Wind Car Heater	280(1)	3.0	123.91	.44	Moderate deposit in combustion chamber.
G.I. Pocket Stove	205(1)	0	44.32	.22	
G.I. Pocket Stove	165.4	3.0	31.47	.19	Failure caused by deposit on fuel tip and dislodging of base of burner head.

(1) Test terminated because of no indication of failure

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causing plugging of the tube.

Contamination

Analysis of the water heated in the covered vessels indicated less than one mg. of lead per 500 ml. of water after several hours of operation. An air sample taken at a height of 2.5 ft. above 3 units operating simultaneously in an open room with a total fuel consumption rate of 0.912 lb./hr. (containing 3 cc. of TEL/gal.), contained 5 micrograms of lead per cubic foot. That amount would appear to be low enough for safety. However, in a small closed space such as a tent or small room, continued exposure to the fumes from even a G.I. Pocket Stove might be harmful if leaded fuel were used.

The Speedikook camp stove operating on leaded fuel was placed in a room of 5200 cu. ft. volume, made of concrete block and having no ventilation other than that furnished by infiltration around doors and windows. The lead content of the air after burning 0.212 pounds of fuel in 1.75 hours increased from 0 to 1.0 microgram per cu. ft.

In general, it appears practical and safe to operate units such as the South Wind Car Heater and airplane cabin heaters on leaded gasoline for space heating where the fumes can be vented to the outdoors. For confined areas with only slight ventilation, the filter tube type such as the E-23 generator and that used on the Kampkook stove appear to be the only ones at present which are safe to operate on fuel containing TEL, without fear of toxicological effects.

Food cooked over a burner using leaded fuel, and where the lead appears in the exhaust fumes, should be kept well covered to prevent contamination with lead.

References: Lab. Notebook 1388

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