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COLEMAN INVERTED LANTERNS

by

Selden D. Cole
Heating and Air Conditioning Section
Building Technology Division

for

Office of the Quartermaster General
Department of the Army

NBS

U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

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I. INTRODUCTION

In compliance with a request originating at a conference on July 21, of representatives of the Office of the Quartermaster General, the Coleman Company, and the National Bureau of Standards, additional tests were made of a new inverted lantern submitted by the Coleman Company and of one of the previous specimens after overhauling it to determine the operating characteristics at normal ambient and at an ambient temperature of 135° F. The pressure-regulating valves in these lanterns were tested under dynamic conditions with air flowing through the fuel-metering orifices. This report supplements the preliminary report forwarded to the Office of the Quartermaster General under date of July 14, 1953.

II. TEST EQUIPMENT AND PROCEDURE

Temperatures, pressures, and luminosity were measured with the same equipment described in the preliminary report, except that the gasoline temperature in the tank was measured with a thermocouple in an immersion well attached to the gasoline filler cap.

Two lanterns were used in this series of tests. One lantern was a new specimen submitted by the manufacturer's representative while the other lantern was one previously used but overhauled by the manufacturer's representative. In this latter specimen, the ceramic mantle holder was replaced with a new one having slightly larger and more uniformly cast holes, the generator was replaced with a previously used one which had been blown out with compressed air, and an orifice-cleaning needle from another generator was substituted for the original needle.

The lanterns were tested with a full tank of gasoline at the initial starting for each operation and a pressure of 30 psig was applied to the tank with the air pump, after lighting.

III. TEST RESULTS

The new lantern, when operated in a room where the ambient temperature increased gradually from [illegible] to 93.5° F over a four-hour period, burned with a tank pressure varying between 34 psig maximum and [illegible] psig minimum and with fuel temperatures in the tank varying between 155° and 179° F following the

changes in tank pressure. The luminosity ranged from 100 to 155 candlepower when the orifice was cleaned once an hour. The value of 155 candlepower was recorded one hour after starting the lantern, after which the luminosity became fairly steady at 100 to 115 candlepower.

The same lantern, when placed on a table in a room thermostatically controlled at a temperature between 128° and 132° F and started under these conditions, had a maximum fuel temperature in the tank, within one hour, of 197° F. After the first hour, the tank pressure varied between 28 and 39 psig and the luminosity between 50 and 80 candlepower. At one time the tank pressure dropped to 22 psig with a drop in tank temperature and luminosity but increased immediately after cleaning the orifice with the orifice-cleaning needle.

The rebuilt lantern containing the pressure-regulating valve used in the earlier tests was allowed to burn in an ambient temperature of approximately 90° F for two hours. After this time, it was placed in the hot room with the new lantern for the next three hours at 128° to 132° F ambient temperature. The tank pressure increased from 16 to 36 psig and the candlepower from 80 to 130 in the next 25 minutes. During the succeeding hour, the pressure had again reached 16 psig with a corresponding drop in candlepower to 35. For the remainder of the test, the pressure did not exceed 18 psig and the candlepower did not exceed 40. Orifice cleaning failed to permanently increase the candlepower.

The pressure-regulating valve was removed from the new lantern and placed in the old lantern. At an ambient temperature of 135° F, the tank pressure leveled off at 31.5 psig and the luminosity was steady at 90 candlepower. A second old pressure-regulating valve that had not been used before in any test run at this Bureau was placed in the new lantern. With this regulating valve, the pressure varied between 25 and 35 psig at an ambient temperature of 135° F. The candlepower varied from 40 to 70, momentarily increasing when the orifice was cleaned with the orifice cleaner. These two lanterns were then placed in closed compartments not much larger than the lanterns but with access for combustion air. In 15 minutes, the pressure in the gasoline tank of the new lantern with the old valve was 43 psig, whereas the pressure in the old lantern with the new valve was 60 psig and still increasing. At this time, both lanterns were removed from the test compartments and the pressure gradually started to go down. Thermocouple measurements indicated that the temperature in the compartments was about 160° F at the end of the 15-minute period.

Measurements were made of the three pressure-regulating valves to determine the diameter of the fuel-metering orifice and the diameter of the ball that slides into it when the tank pressure increases. The new valve and the valve not previously used had the same measurements of 0.040-in. ball diameter and 0.0415-in. orifice diameter whereas the valve used in previous tests had a ball and orifice diameter so nearly the same that they formed almost a gas-tight closure when the tank pressures increased.

Measurements were also made of the travel of the stem of the three pressure-regulating valves when different pressures were applied to the bellows element in a manner simulating tank pressure during normal operation. The results of these tests are summarized in table 1.

Table 1. DYNAMIC PRESSURE TESTS OF PRESSURE-REGULATING VALVES IN COLEMAN LANTERNS

Pressure applied to bellows element	Travel of valve stem, thousandths inch				
	Old valve No. 1		Old valve No. 2	New valve	
	Pressure Increasing	Pressure Decreasing	Pressure Increasing	Pressure Increasing	Pressure Decreasing
lb/in.^{2}					
0	0	0	0	0	---
5	2	2	1 1/2	1/2	---
10	3	4	2	1	2
15	6	7	2 1/2	1 1/2	2
20	8	10	3	2	2 1/2
25	11	12	4 1/2	---	2 1/2
30	13	14	5 1/2	2	14
35	16	17	17	2 1/2	17
40	18	20	18	3	21
50	23	25	24	27	
60	29			32	

The valve stems in the new valve and the old valve not previously used (No. 2) showed only slight movement until a critical ascending pressure of 35 to 45 psig was reached at which pressure the valve stems moved toward a closed position with a snap action. On descending pressure, this snap action took place near 30 psig on the new valve. Old valve No. 1 under the same test conditions showed a steady movement of the valve stem on both ascending and descending pressures from 0 to 60 psig.

The snap action in two of the valves was attributed to sticking of some part of the mechanism because both the spring and the bellows in these valves would normally produce a modulated movement of the valve stems with changes in pressure. Stickiness in the operation of the pressure-regulating valves would cause variations in the operating pressure of a lantern under otherwise similar conditions.

The lower end of the spherical balls on the end of the valve stems of the three valves projected from 0.0355 to 0.038 inch through the fuel-metering orifices. Since the spherical ends were about 0.040 inch in diameter, a valve-stem travel of 0.015 to 0.018 inch would cause the maximum restriction of the fuel-metering orifice.

It is believed that the observed variations in the valve-stem travel with pressure and the differences in clearance between the spherical balls and the orifices caused the variations in operating pressure observed when the three valves were used in the two lanterns during these tests. In particular the small clearance between ball and orifice for old valve No. 1 and the earlier closure of the fuel-metering orifice with rise in pressure probably accounted for the lower operating pressure and lower luminosity observed when this valve was used.

No tests were made at low ambient temperature during this series.

IV. DISCUSSION AND CONCLUSIONS

This series of tests of one new and one old specimen of the Coleman inverted lantern indicated the following conclusions:

1. The pressure-regulating devices limited the tank pressures satisfactorily in ambient temperatures from 50° to 135° F.

2. The lanterns should not be used where the heat cannot readily be dissipated. In confined spaces, the hot gases from the lantern can heat the fuel tank excessively and produce pressures that the relief device cannot compensate for. The pressures developed in the tank when the lanterns were operated in a small compartment during this series of tests indicated that excessive self-heating of the lanterns caused the high pressures observed during the earlier series of tests when the lanterns were operated in the same compartments.

3. The pressure regulating valve is one of the more important components of the lantern that determines whether or not its operation will be satisfactory. Therefore, every effort should be made to attain good quality control on this device with respect to clearance between spherical portion of valve stem and orifice, regulating pressure of the valve, freedom of motion of bellows and spring, and projection of valve stem through the fuel-metering orifice. A difference of 0.0015 inch between the diameters of the spherical tip and the fuel-metering orifice appeared to provide good operation during the tests made here.

4. Regular and frequent use of the orifice cleaner will be necessary to maintain a good luminosity with the inverted lantern.

3. The pressure regulating valve on one of the [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] time during the trials with them.

4. Cleaning and inspection of the [illegible] will be necessary to maintain a good [illegible] service.