F.R.Note No. 345
Research Programme
Objective

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH AND FIRE OFFICES' COMMITTEE
JOINT FIRE RESEARCH ORGANIZATION

THE POSSIBLE FIRE HAZARD OF AN ELECTRICALLY HEATED DISINFECTANT DISPERSING UNIT

by

E. H. Coleman and G. H. J. Elkins

Summary

An apparatus for dispersing disinfectant in hospital rooms has been examined, and tests have been made to assess the fire hazard associated with its use.

F.1040/18/28
February 1958

Fire Research Station,
Boreham Wood,
HERTS.

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Introduction

At the request of the Engineering Division, Ministry of Health an apparatus for dispersing a disinfectant, "Listerair", in unattended rooms in hospitals, has been examined and tests made to assess the fire hazard associated with its use.

The apparatus operates by heating the fluid in a metal tank provided with a small vent. The pressure generated as the fluid boils disperses the vapours produced. A thermostatic switch switches off the apparatus when the temperature rises after the charge has been dispersed.

After a small fire had been reported, two of these apparati, one slightly modified, and a small quantity of "Listerair" fluid were sent to Joint Fire Research Organization for investigation.

The Apparatus

The Apparatus (Fig. 1) consists of a rectangular welded metal tank, made of 1/16 in. thick sheet steel, external dimensions 16 x 8 x 15 cm and capacity 1585 mls (56 fl.oz.). This is fitted with a screw-on filling cap 1 in. in diameter with a 1/16 in. diameter venting hole. The tank is heated by a mica sandwich electric heater held against its base by a metal plate $\frac{3}{8}$ in. thick, leaving the edges of the heater exposed to the atmosphere. This heater is rated at 1000 watts, but only reaches this rating when connected to a 250 volt supply, which is the maximum voltage recommended by the makers. The operation of the heater is controlled by a thermostatic switch, which can switch the hot plate off, but not on unless operated manually. A warning light shows when the hot plate is live. The internal connections of the apparatus are exposed to the atmosphere and the whole apparatus is enclosed in a sheet metal case, fitted with an aluminium top and with an expanded metal screen over the base. It is supported on insulated feet giving a ground clearance of 1 inch.

The modified apparatus has a time switch on the mains lead instead of the thermostatic cut-out and the filling cap has been raised so that it protrudes above the aluminium top. The space between the top and the filler has been packed to prevent spillage entering the body of the apparatus. Two holes had been drilled in the filler cap.

Method of operation

A measure, capacity 373 mls (13.2 fl.oz.) is provided with the apparatus and the quantity of "Listerair" recommended for use varies with room size up to a maximum of three measures, 1125 mls, (39.5 fl.oz.). (The makers recommend 1 measure for each 1000 cu.ft for intense fumigation and 1 measure for each 2000 ft for general fumigation). This is poured into the tank and the screw cap, fitted with a metal sealing ring, is screwed on tightly. The thread on the cap of the model submitted for test was defective, and the cap could not be screwed down tightly. The apparatus is then switched on and left, usually unattended, to be switched off later at the mains. With the modified apparatus the time switch is set to switch off after a period varying with the amount of fluid used.

Experimental

"Listerair" fluid is stated to contain 87 per cent of phenol. Its flash and fire points were determined using the Cleveland Open Cup method and these results together with data of phenol are given in Table 1.

Table 1

Flammability Data of "Listerair" and Phenol

Material	Flash point Open Cup °F	°C	Fire Point Open Cup °F	°C	Lower Flammable Limit per cent by volume	Auto Ignition Temperature °F	°C
Listerair fluid	230	110	240	116	-	-	-
Phenol	185	85	-	-	1.1	1319	716

A small charge 195 mls (7 fl.oz.) of "Listerair" fluid was placed in the unmodified unit and it was switched on. Phenol vapour was evolved when the hot plate temperature reached approximately 200°C. After evolution of vapour had ceased, the temperature of the hot plate rose to approximately 230°C when the thermostatic switch operated. When the apparatus was inspected after the test, condensed phenol vapour was observed under the lid and on the insides of the cowl. It is possible that the vapour had penetrated because of the ill-fitting cap.

The filling cap of this unit was made tight and then fitted with a short tube connected to a mercury manometer, 1125 ml of distilled water (equivalent to the maximum charge of fluid) was placed in the apparatus, and it was switched on. After 12 minutes the pressure in the tank had risen to 1 lb/sq.in and it increased to 4 lb/sq.in. after 25 minutes; 40 minutes after switching on, the hot plate temperature was steady at 200°C and the temperature of the air space near the thermostatic switch was steady at 105°C. The pressure remained steady until 1 hour had elapsed when it rose slightly above 4 lb/sq.in. just before the charge was exhausted at 1 hr. 5 minutes. The hot plate and air space temperatures then rose quickly, and at 1 hr. 12 minutes, when the hot plate temperatures was 270°C and the air space was 200°C, the thermostatic switch operated.

No pressure experiments were carried out with the modified apparatus as its larger venting area would give rise to much lower pressures. The modified apparatus was charged with 100 mls of "Listerair" fluid and switched on. When evolution of vapour ceased, the hot plate temperature was approximately 220°C. A residue of some 50 mls of a dark brown liquor was left in the tank on cooling.

Discussion

One measure of "Listerair" fluid when vapourised will produce approximately 2.8 cu.ft of phenol vapour with a lower flammable limit of 1.1 per cent by volume in air. This 2.8 cu. ft vapour if dispersed in 1000 cu. ft air, as recommended by the makers, is thus insufficient to render the atmosphere flammable.

The test showed that phenol vapour could penetrate inside the cowl of the unmodified apparatus of the type involved in the fire. There is thus a possibility of the vapour concentration in this region being above the lower flammable limit, and also it would be possible for condensed vapour to come into contact with the hot plate or switch. None of the electrical fittings is of a flameproof type and therefore there is a possibility of ignition of vapour by a spark from the thermostatic switch or ignition of liquid or vapour by contact with the element of the heater. The internal temperature of the heating element was not measured, but since the thick metal sole plate reached a temperature of nearly 300°C., the internal temperature of the heater could have been as high as the spontaneous ignition temperature of phenol, 716°C (a dull red heat).

The modifications should have decreased the risk of fire since there is less likelihood of spillage and vapour penetrating inside the cowl, and the replacement of the thermostatic switch by a time switch, remote from the apparatus, will reduce the possibility of ignition by a spark. The two vents instead of one provides a safety factor should one become blocked.

Acknowledgment

Mr. M. Harris assisted with the experimental work.

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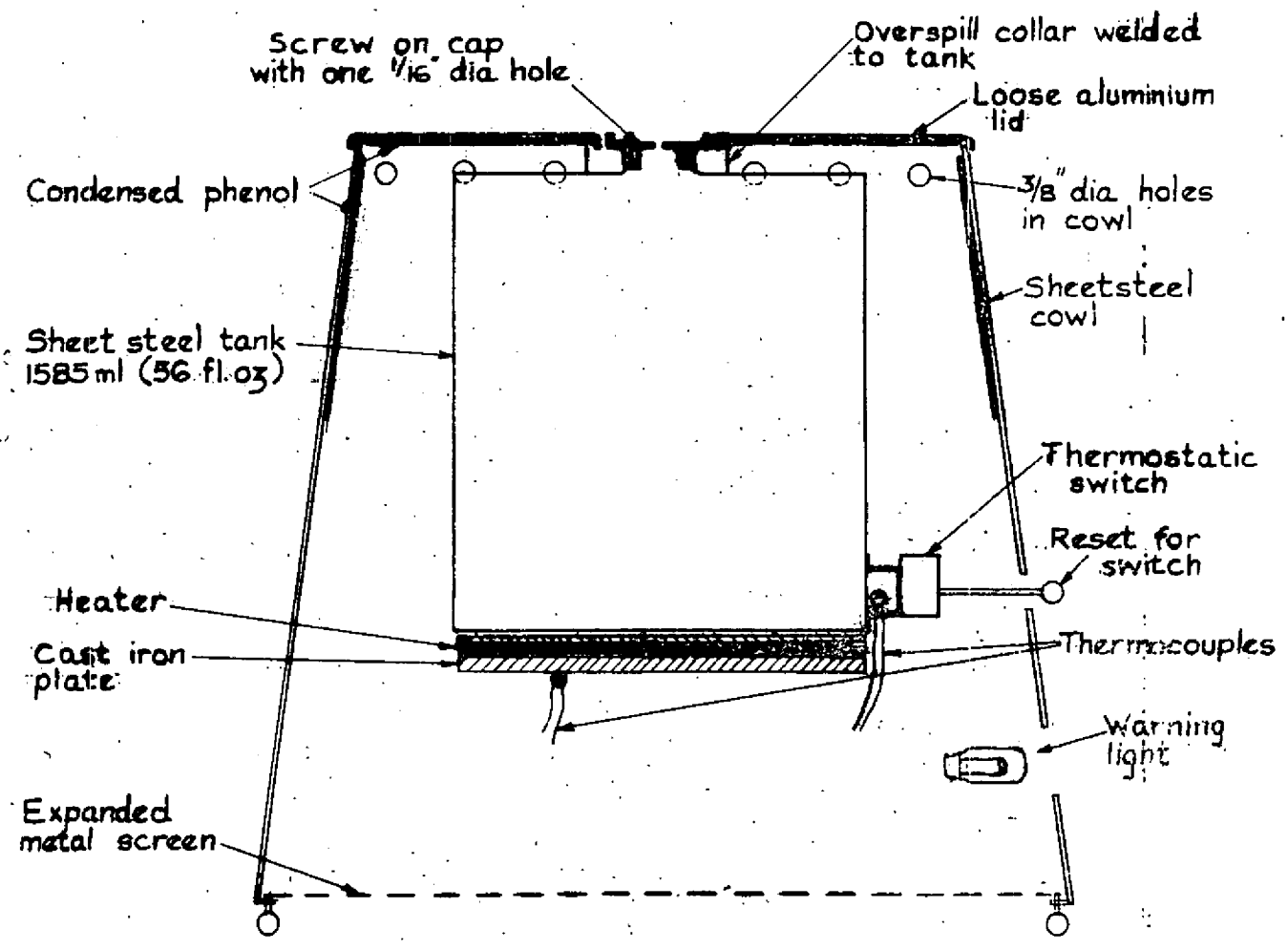
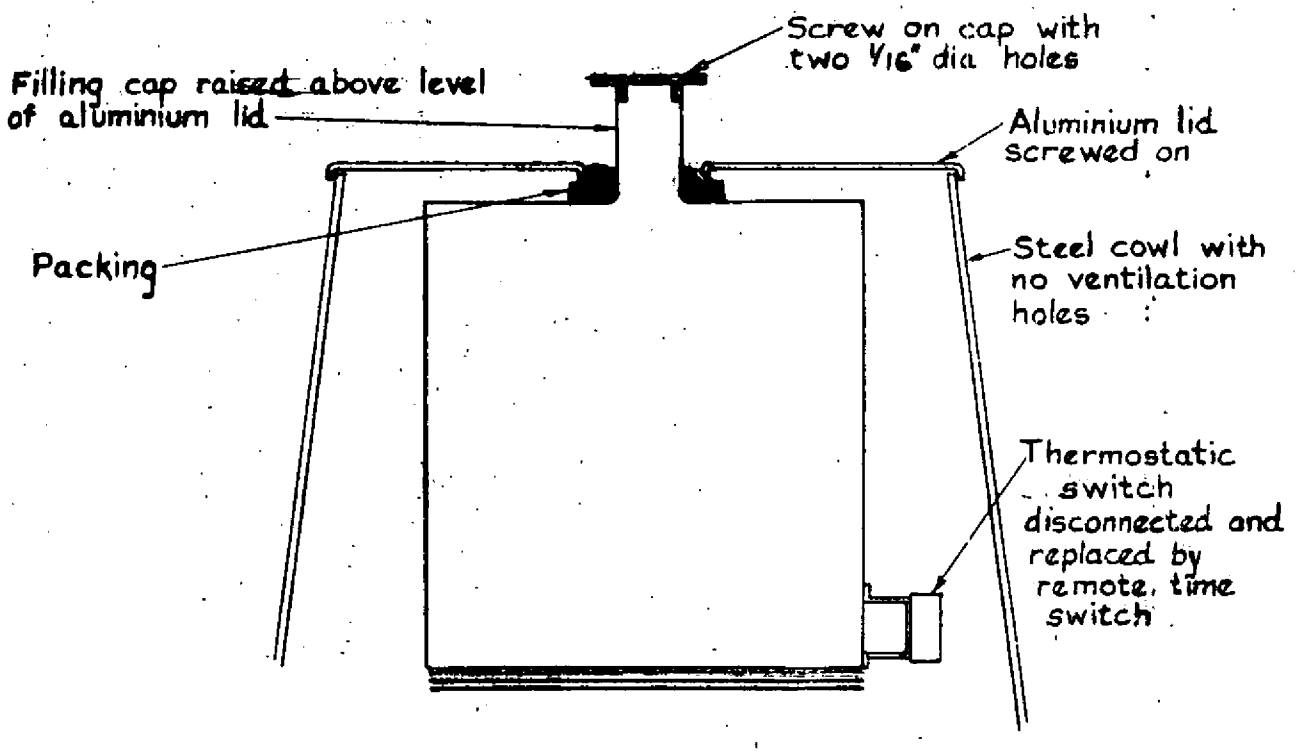


UNMODIFIED UNIT



MODIFIED AFTER FIRE

FIG.1. DIAGRAMMATIC SKETCH OF "LISTERAIR" DISINFECTING UNIT