Serious Explosion During Cleaning of a Copper Kettle

To the Editor: A serious and potentially lethal explosion occurred during the cleaning of a copper kettle regularly used for halothane. Thymol (used as a preservative in halothane) has a low vapor pressure, and hence accumulates within copper kettles. Periodic cleaning is needed to assure continued, effective vaporization of halothane. Diethyl ether is one solvent for thymol which is readily available to anesthetists. For several years we have rinsed kettles periodically with diethyl ether, drained the excess through the petcock, and blown off the residual ether by running oxygen through the kettle. A laboratory technician, well versed in machine maintenance, suffered mild first- and second-degree burns when a copper kettle exploded during cleaning.

The accompanying photograph gives some indication of the force of the explosion. The heavy copper lid of the kettle was stripped from its threads, blown five feet, eight inches to the ceiling, into the plaster to a depth of one inch. The copper frame of the sight glass was torn from the three steel screws holding it in place, blown five feet across the room, and partially through a door consisting of ½ inch plywood sheathed on both sides with 20 gauge sheet metal. One of the flowmeter tubes was completely shattered; strangely enough, it was a low-flow oxygen flowmeter tube not associated with vaporization through the kettle. Shattered glass was retained effectively by the plexiglass shield held in front of the flowmeter tubes by four screws. Although cracked at all four corners, the shield protected those in front of the flowmeters from flying glass. Only good fortune protected the technician from the flying metal.

An explosion in a device used for non-explosive anesthesia is an embarrassing occurrence which should be prevented from happening again. The ingredients for all explosions are: (1) an ignition source, (2) an oxidant, and (3) a fuel. We have not been able to identify the ignition source, but the sources of oxidant and fuel are self-evident.

During the cleaning process, the effluent from the gas machine was led by a conductive rubber tube through the sheet-metal-clad door to a closet with a large, open, louvered window where explosive agents are stored. However, when the building is heated the natural convection of air is from the outside through the closet, under the door, into the building, rather than the intended pathway out through the louvers. Inspection of the damage done to the anesthesia machine has shown that the explosive process originated distal to the kettle. We presume that somehow the ether vapor was ignited and that the explosive process travelled back through the delivery tube into the kettle flowmeters. The technician was wearing conductive shoes and standing on a conductive floor, so that a static spark from his motion was unlikely. Other people passing by in the hall or smoking in an adjacent room were possible sources of ignition.

Fig. 1. Copper kettle after explosion.
The oxidant was unavoidable if the porous bronze disc was to be cleaned thoroughly. It is contrary to good practice to use any gas other than oxygen in the oxygen circuits of an anesthesia machine, and some gas must be used to empty the cleaning fluid from the space below the sintered disc. Thus, this contribution to the explosion cannot be avoided.

A way of avoiding repetition of this incident is to use a nonexplosive cleaning agent. Carbon tetrachloride and trilene are cheap, effective solvents but must be removed metic-

uloously before the kettle is used because of danger of hepatotoxicity. An alternative, which we will employ in the future, is to clean the machine in the operating room, where effective ventilation dilutes the vapor, and traditional precautions to avoid sparks and flames are enforced.

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Drugs

ANALEPTICS To be potentially useful, analeptics must be capable of producing the desired response in most, if not all, patients selected without producing undue side effects. In the past, analeptics have been advocated as a) arousal agents; b) semi-arousal agents (restoring severely depressed patients to a safe state of only moderate depression); and c) respiratory stimulants. In none of these three categories do the analeptics satisfy the criteria of reliability and safety. It would seem that there is little, if any, place for analeptics in clinical medicine. (Mark, L. C.: Analeptics: Changing Concepts, Declining Status, Amer. J. Med. Sci. 254: 298 (Sept.) 1967.)

HALOTHANE AND THE LIVER Whether halothane can evoke liver damage has not yet been settled. In particular, the question of how halothane affects a diseased or predamaged liver has not been answered. To explore this problem, the allyl alcohol test, which allows quantitative evaluation of liver damage, was utilized. In studies of rats it was found that halothane definitely can evoke hepatotoxicity, but only in the predamaged liver. It was not necessary to expose such a liver more than once to halothane to cause parenchymatous lesions and jaundice. Halothane increased the degree of allyl alcohol damage by 100 per cent. Methoxyflurane also increased allyl alcohol damage to the liver significantly. Ether anesthesia, however, had no effect on normal or predamaged liver. (Eger, W., and Nasr-Esfahani, H.: Halothane Damage of the Rat Liver as Compared to Methoxyflurane and Ether Narcosis, Klin. Wschr. 43: 889 (Sept.) 1967.)