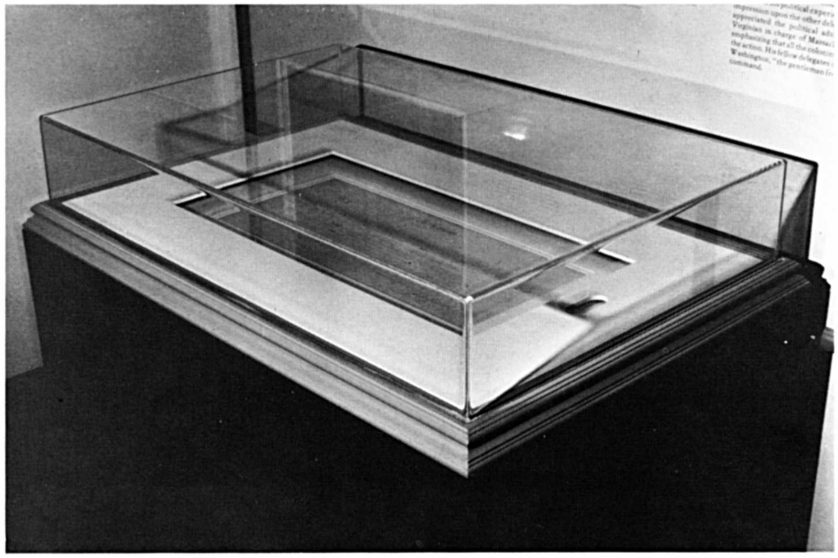
A COOLED DISPLAY CASE

Tim Padfield

Abstract

A cool display case was made for a vellum document, George Washington's commission. A close fitting airtight container was used. This maintained a nearly constant relative humidity on cooling, but care was needed to minimise temperature gradients. Thermoelectric coolers were used. The showcase performed satisfactorily for one year with no change in its internal moisture content.

This is a digital facsimile of the article first published as: Tim Padfield, 'A cooled display case', Museum *146 (1985) 102-103.*



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NATIONAL MUSEUM OF AMERICAN HISTORY, Washington, D.C. George Washington's Commission on display.

A cooled display case

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The display case illustrated in Figure 50 was made for a vellum document, George Washington's Commission as Commander in Chief of the Continental Army, so that it could be shown in a temporary exhibition at the National Museum of American History in Washington, D.C. The document is kept cooler than the exhibition room so that it remains in the condition it enjoyed in its permanent home at the Library of Congress.

This cool, stable climate was achieved by enclosing the document in a closely fitting airtight case which had a thermoelectric cooler. The bottom and sides were made of aluminium, the top was hardened glass. Figure 51 shows the construction.[1]

The relative humidity in such a case need not be actively controlled. The absorbent vellum and its card mat stabilize their own moisture content in the simplest possible way — there is nowhere for the water to go and there is no source of water that they can absorb. The reason for this is that the enclosure is small so the volume of air within it holds a negligible amount of moisture in comparison with the vellum document and its mat. The walls of the container are of materials which are impermeable to water. Constancy of moisture content in the vellum depends on two other factors — there must be hardly any variation in temperature within the enclosure and there must be no leakage of air into the enclosure. A sufficiently uniform temperature was attained by insulating the base and sides of the case and by enclosing it in a larger case so that the glass cover of the airtight inner container was shielded from draughts.

Airtightness was obtained by using orthodox vacuum technology. The glass pressed against an 'O' ring which lay in a groove in the metal sides of the box. The glass was held in place by spring-steel clips.

Only about 25 watts of cooling power was needed to hold the case at 16 °C in an ambient temperature of about 21 °C. Two thermoelectric coolers were pressed up against the aluminium base of the case. Thermoelectric coolers are solid-state devices with no moving parts. A cooling effect is produced by passing an electric current through the junction between two semiconductors. This is called the Peltier effect. Heat is generated elsewhere in the circuit and this must be

1. Further technical details about this care are given in the preprints of the seventh triennial meeting of the ICOM Committee for Conservation held in Copenhagen, September, 1984, pp. 17.38-42.

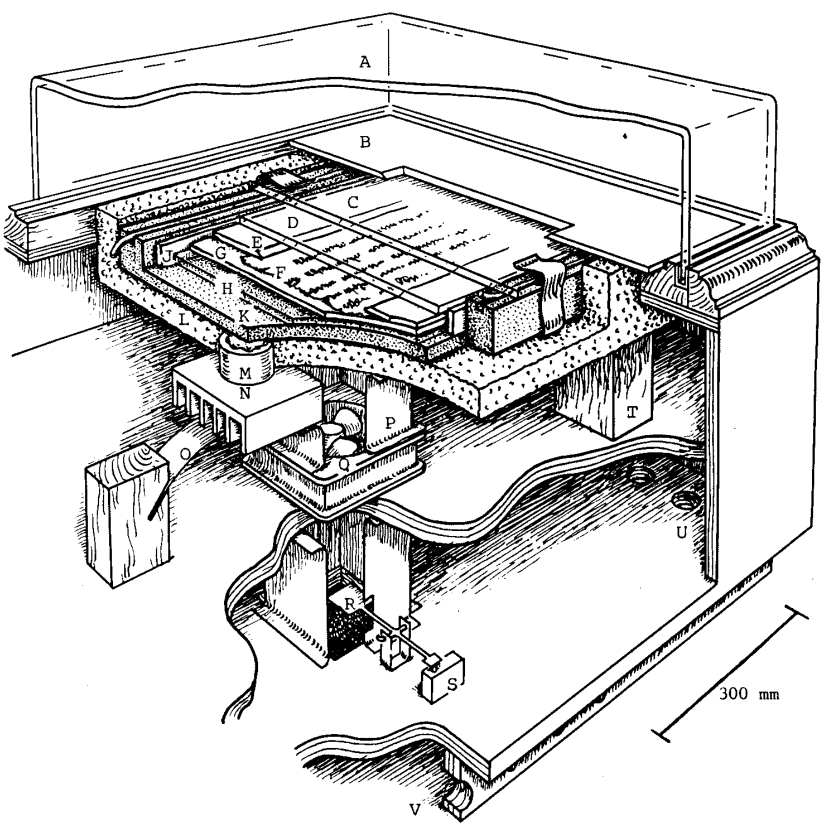
dissipated, in our case by a stream of air from a fan. These devices are not very efficient but for small cooling loads they compare favourably with mechanical cooling units and are very reliable. Even the fan can in some applications be replaced by convective cooling.

The technology used for this display case was entirely orthodox and, in principle, can be used to cool museum objects of other shapes and sizes. Thermoelectric devices, unlike other refrigeration systems, do not mind being turned upside down so they can also be used to keep objects cool during transport.

There is a risk of condensation whenever a container is cooled and so it is very important to ensure uniformity of temperature within the enclosure. Stirring the air with a fan will do this, but it is a pity to complicate the system and it is risky to introduce electro-mechanical devices so close to the object; it is better to use convective stirring. Our show-case displayed a flat document, so the temperature gradient through the short vertical distance was negligible. If we were asked to do a similar job for a tall object we would move the cooler to the top of the enclosure to ensure convective circulation of air.

Leak detection is important. Any steady drift in relative humidity (RH) within the case indicates a leak. A cobalt-salt RH-indicating strip will therefore also serve as a leak detector. The salt is capable of changing colour as the RH changes, a property which enables the RH to be indicated.

This cooling system with its need for an airtight insulated container also ensures protection for the document against air pollution, handling, fire and flood. On the other hand there is a danger of damage from pollutants released by materials within the enclosure which are very effectively trapped. It is important that only inert materials are used or displayed within an airtight case. The case illustrated contained only aluminium, glass acrylic sheet and archival paper besides the inked vellum of the document.



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Cut-away diagram of the display case. The document (F) is enclosed by mat (E) and backboard (G). All this is sandwiched between Plexiglas sheets (D) and (H) and bound together with adhesive tape round the edges. This sealed assembly lies in the aluminium tray (K) and is covered by armoured glass (C). A viton 'O' ring lies in a groove round the edge of the tray. The glass is pressed down onto the 'O' ring by spring-steel clips. The tray is insulated by cork (L). All of this is supported within the show-case by four wooden blocks (T) so that it can be lifted out easily once the Plexiglas case top (A) has been removed. A frame (B) conceals the cork insulation and steel clips. The thermoelectric coolers (M) and the heat dissipating fins (N) are pressed up against the aluminium tray by a spring (O). The duct (P) directs cooling air from the fan (Q) over the fins and eventually out through the holes (U) in the base of the case. Air comes into the case through holes (V) and is drawn up past the hinged plate (R), which operates switch (S) when it is pressed up by the flow of air.