Columbia University
in the City of New York

LAMONT GEOLOGICAL OBSERVATORY
PALISADES, NEW YORK

Technical Report CU-11-61-AT(30-1)1808Geol.

A large-volume water sampler

By Robert Gerard and Maurice Ewing

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Abstract-A variety of large-volume samplers have been employed in the collection of sub-surface radioisotope samples by different institutions. This report describes a 220 liter sampler which has been used successfully by workers of the Lamont Geological Observatory in the collection of more than 300 sub-surface water samples. The water sampler is fitted with a single door which can be sealed securely with an "O" ring seal. A reversing thermometer pair and a bourdon recorder are provided to indicate the depth of closing. The sampler can be made for use with an hydrographic wire or a larger diameter trawl wire. An inert plastic lining may be applied to the sampler for the collection of samples which are affected by metal contact.

INTRODUCTION

RADIOISOTOPE MEASUREMENT of sea water has become an important new tool in oceanographic research. A recent paper, BROECKER, GERARD, EWING, HEEZEN (1960), describes the application of radiocarbon analysis to problems of mixing and residence time of ocean water masses. Most sea water isotope samples must be collected in volumes of about 200 liters minimum. The collection of large-volume samples for radiocarbon or other radioisotope analysis from deep water masses

places strenuous requirements upon the facilities of a research vessel as no standard sampler is commonly available. During the International Geophysical Year, each oceanographic institution engaged in a radiocarbon program had its own version of a large-volume sampler for collecting sub-surface water samples. As part of the research in the forthcoming International Indian Ocean Expedition several institutions are again scheduled to make large-volume water sample collections.

The present note has been prepared in the belief that some measure of standardization of technique and equipment is desirable among the groups engaged in this research. The large-volume water sampling apparatus used over the past eight years by workers of Lamont Geological Observatory has undergone considerable evolution, as described by EWING and GERARD (1956). The present water sampler used aboard the R/V VEMA has approximately 220 liters capacity. It has been successfully used in the collection of more than 300 samples.

DESCRIPTION

The body of the sampler is a galvanized steel tank commercially sold as a water storage tank by suppliers of home plumbing equipment. One tank presently in use has been sand-blasted and coated inside

with an epoxy resin lining for collecting isotope samples where contamination from metal contact is undesirable. The tank has an outside diameter of 18.25 inches, and a wall thickness of .125 inch. The top of the tank is cut off evenly at a height of 51 inches leaving an open topped container of approximately 400 liters capacity. A sheet metal partition is bolted across the inside diameter of the tank extending to 10 inches from the bottom. A rim cut from .75 inch steel plate is bolted in the open end of the tank. This rim with an inside diameter of 13 inches is lined with a brass strip which serves as a seating surface for a round plastic door.

The door is made of Melamine Plastic (a rigid material having canvas filler) 1.5 inches thick and fitted with a rubber "O" ring around its perimeter which seats against the brass-faced rim. The plastic door is centered above the round opening and is hinged on an axis at the same plane as the "O" ring (Fig. 1). The door operates in the manner of a round flue damper. When it is open or vertical, it divides the tank opening in half and aids in the circulation of water through the sampler. When the door is closed it seals off the contents of the tank from any outside contact.

The water sampler is provided with a reinforced plastic (epoxy resin on fiberglass) hood or scoop which

overhangs one side of the tank and is closely fitted around the plastic door when it is in the vertical or open position. When the sampler is lowered in the ocean this hood acts to conduct the water past one side of the door and into the tank. The partition inside the sampler further directs the flow to the bottom of the tank and thence up and out the opposite side of the opening (Fig. 2). Dye experiments have shown that less than 0.1 per cent of an original water volume remains in the sampler after it is lowered 100 meters. Fig. 3 shows the round door in the open and closed positions.

The closing of the door is effected by a "messenger" in the form of a five pound weight which is dropped down the wire from the surface. The water sampler has been made in two styles. One is designed for lowering on the end a typical hydrographic wire. This model has a bail and shackle fitting above the central axis of the tank. The photographs of Fig. 3 show this arrangement. The other type (suggested in Fig. 2) is designed for use with a larger diameter trawl wire and has fittings along one side for fixing it to the wire. When used with a hydrographic wire the sampler is provided with lead ballast cast into its bottom to aid in lowering. The type of sampler with the side fittings has a 1500 pound coring device fixed to the wire rope below the sampler as a weight.

CONTROLS

Both types of samplers are provided with means for determining the depth of closing. Inside each sampler, fixed to the center partition is a reversing frame which rotates 180 degrees when the door is closed (Fig. 4). This frame holds a protected and an unprotected deep-sea reversing thermometer which indicate the temperature and depth of the *in situ* sample.

Outside the sampler in contact with the door is a simple bourdon gauge which traces its deflection with pressure on a smoked glass slide. It also makes an identifying mark at the depth where the door closes. This bourdon gauge recorder is illustrated in Fig. 5.

When the sampler closes, a sliding spring-loaded pin locks the door in the closed position while being brought to the surface.

When the sample is brought up samples are immediately obtained for salinity and dissolved oxygen determination as a further check on water mass identification.

OPERATION

Aboard the R/V VEMA the large-volume water sampler has been used to collect samples for tritium, radiocarbon, Ra^{226}, Sr^{90}, and Cs^{137}.

In operation, the water sampler is fixed to the trawl wire outboard of the ship, lowered to the esti-

mated depth and tripped by messenger after an interval sufficient for the thermometers to come to thermal equilibrium. The sampler is then hauled up and secured outboard at rail level, the door opened, and salinity and oxygen samples obtained. The sampler is then pumped out to a processing tank through the use of a submersible pump which is lowered to the bottom of the sampler. This type of pump is used to avoid possible aeration of the sample.

ACKNOWLEDGMENTS

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Legend to Accompany Figures

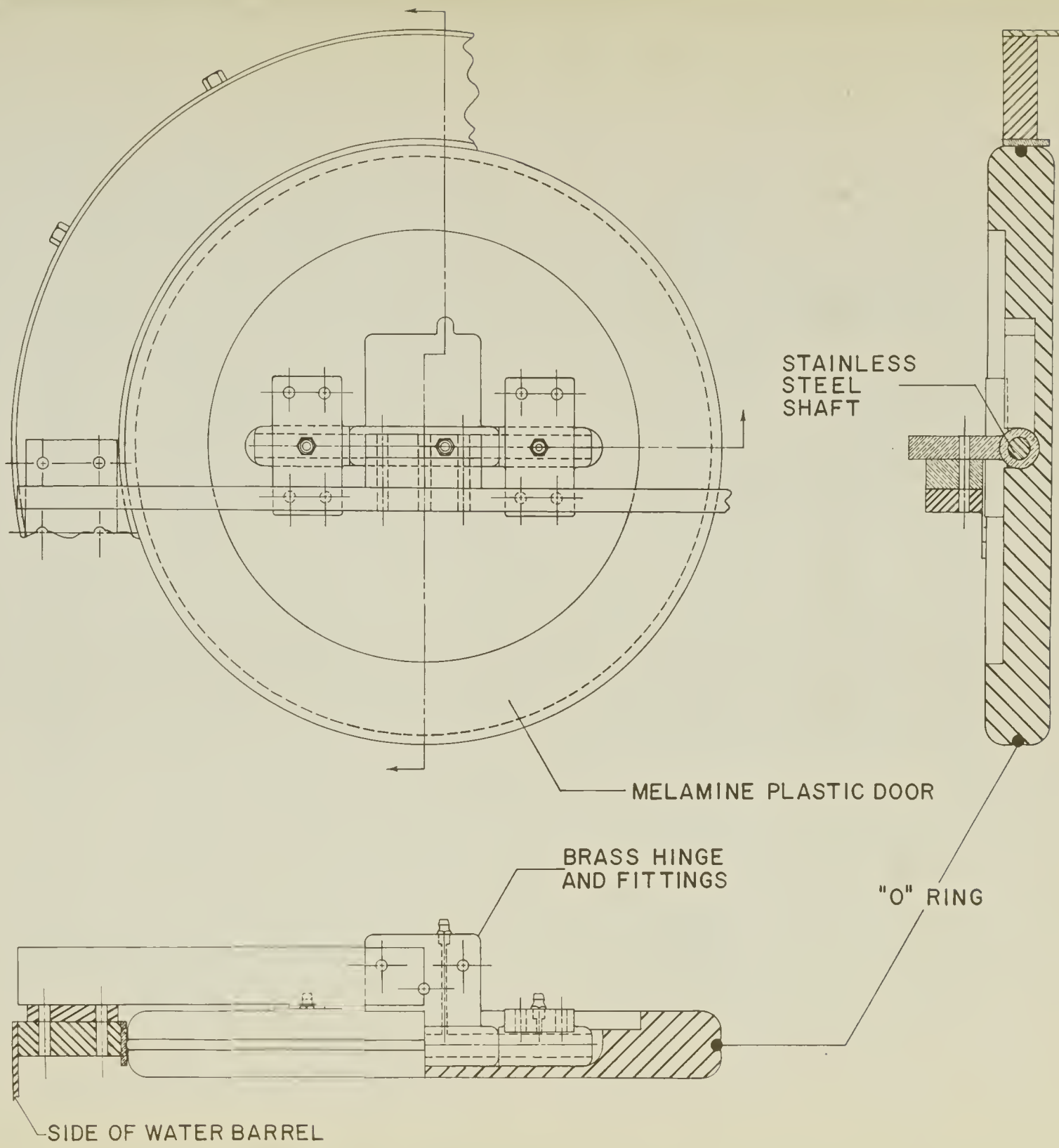
Fig. 1 Detail of large-volume water sampler door.

Fig. 2 Schematic crossection diagram of large-volume water sampler. Drawing on the left shows the sampler door open and the direction of circulation. Drawing on the right shows the door in the closed position.

Fig. 3 Photographs of large-volume water sampler. Left photo shows door closed, right photo shows door open. Also shown are the bail for fixing to hydrographic wire and the messenger-activated release mechanism.

Fig. 4 View of large-volume water sampler from above. Inside the sampler the reversing thermometer holder can be seen. The fiberglass hood covers the other half of the sampler opening.

Fig. 5 Depth-of-closing recorder showing the schematic arrangement. When the door closes the slide holder translates downward so that the stylus makes a vertical mark across the smoked slide, interrupting the curve traced by the Bourdon tube due to pressure. The solid line shows the stylus trace to the mid depth of a hypothetical lowering. The dashed line indicates its future progress to the point of closing and its return to the surface.



DETAIL OF LARGE-VOLUME WATER SAMPLER DOOR

0 7 SCALE IN INCHES

FIGURE 1

FIGURE 3

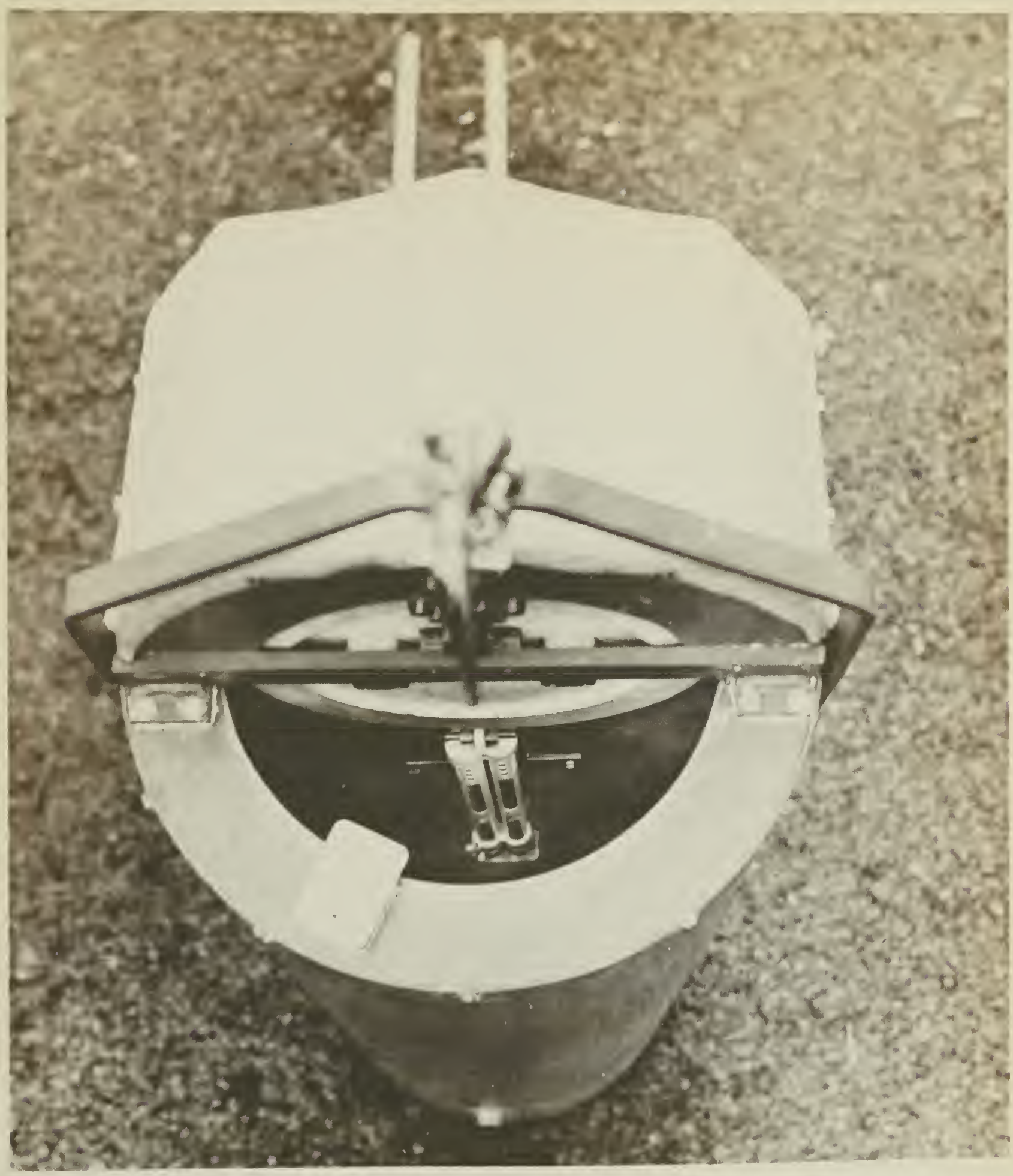


Fig. 4. View of large-volume water sampler from above. Inside the sampler the reversing thermometer holder can be seen. The Tuberculosis bacteria cover the other half of the sampler opening.

FIGURE 4

BOURDON TUBE DEPTH-OF-CLOSING RECORDER

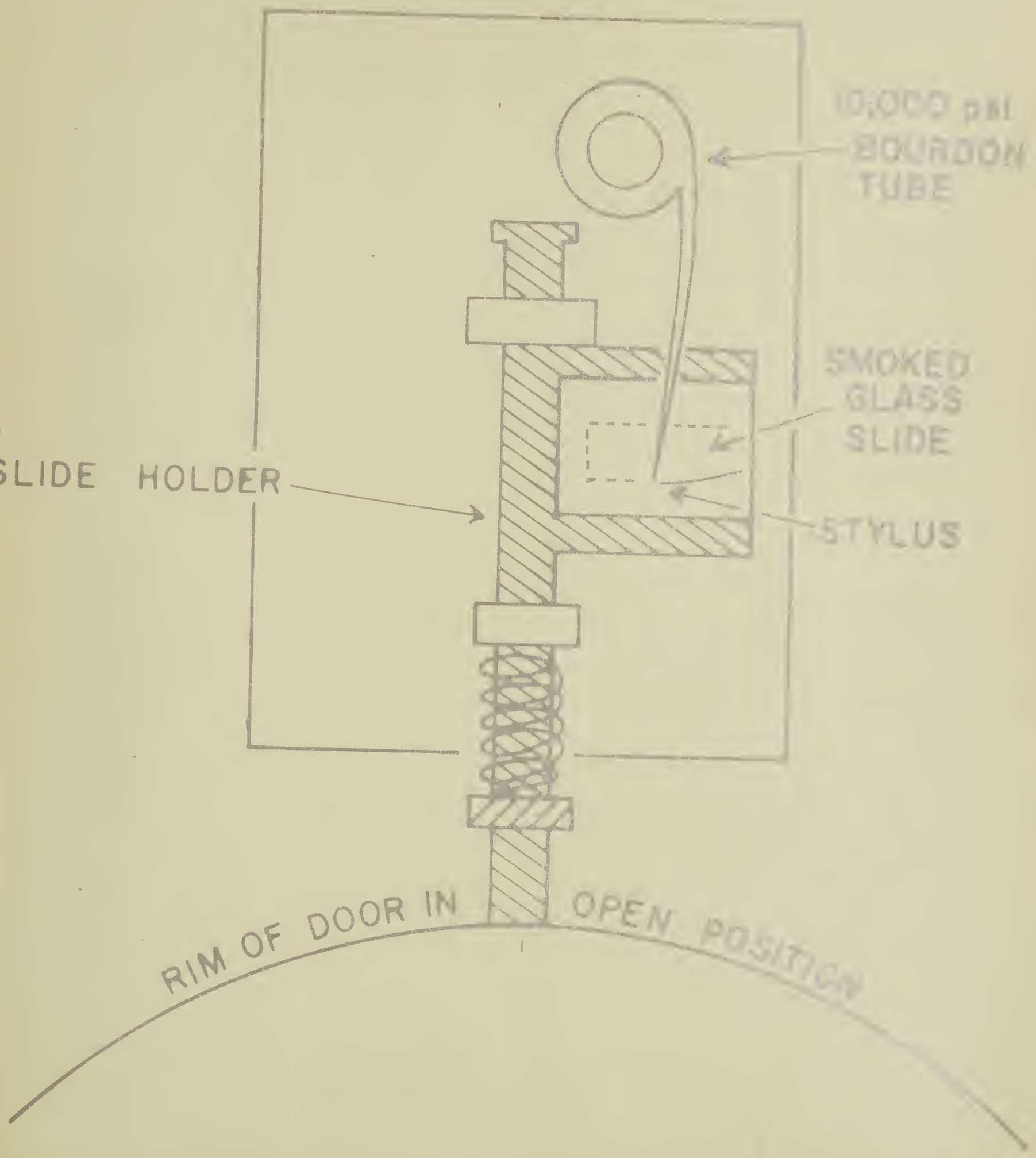


FIGURE 5