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# A Small Winery Freezing Unit for Disgorging Bottle-Fermented Champagne

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## Summary and Conclusion

A small frozen food display case was purchased for about $325 and was modified for use in freezing the sediment in champagne bottles for disgorging. The unit performed extremely well and permitted disgorging at a rate of 20 bottles an hour by one individual who performed all operations in freezing, disgorging, refilling, corking and attaching the wire hood to the bottles. Cost of operation was negligible.

The only negative aspect of the operation was the slow evaporation of alcohol from the water/alcohol solution. Small quantities of alcohol had to be added after extended use to maintain the solution at 35% alcohol (by volume) to prevent freezing of the solution. This was not found to be a serious problem.

We conclude from our experience with this unit that it is very suitable for disgorging champagne in small wineries.

# A Small Winery Freezing Unit for Disgorging Bottle-Fermented Champagne

Champagne produced by the aditional method (in-bottle rmentation or "methode ampenois") is made by starting ith the appropriate wine, adding precise amount of sugar and a ampagne strain of yeast (and casionally other materials), ttling, capping (usually with a own cap) and storing in a rizontal position to undergo rmentation. Carbon dioxide gas produced during the fermentaon process, but is not allowed to cape; therefore, considerable ressure is developed in the bottles. fter sufficient time has passed to low complete fermentation and e development of the champagne buquet, the champagne must ndergo a clarification process in hich the dead yeast cells and diment are removed. This is complished by placing the ttles upside down (either vertical slightly inclined from vertical) racks, periodically rotating them d dropping them back into the cks (riddling) to dislodge the diment from the sides of the ttle and cause the sediment to be posited by gravity on the cap. his step is followed by a disgorgg process which is accomplished y freezing the deposited material the neck of the still-inverted ottle, turning the bottle upright to n angle of about 45°, quickly moving the crown cap and allowg the internal bottle pressure to low out the plug of frozen sedient. The bottle is then refilled ith sufficient syrup, champagne tc. to replace the amount lost in e disgorging process. It is then orked and the wire hood is atched to hold the cork in place gainst internal pressure (2).

Large producers of champagne use high capacity equipment which is too large and too expensive for small producers. Small wineries sometimes resort to relatively crude, slow methods (such as placing the bottles in various ice/salt solutions) and processing a few bottles at a time. Mississippi wineries and other relatively low volume producers need small-scale equipment designed especially for their unique requirements. This publication presents information on a small, efficient and economical device designed and developed for freezing the necks of champagne bottles before disgorging. The design is for a unit that satisfies the present needs of the Enology Laboratory at Mississippi State University; however, it also will satisfy the requirements of many small wineries and can be scaled up or down to provide larger or smaller capacities as needed by the individual winery. The factors of primary importance in this design involved the need to satisfy the following requirements:[1] the unit should be relatively inexpensive, of sufficient capacity for use in a small winery, simple to operate, economical to use, readily available, portable and conventional so that service and repairs can be made by available technicians.

**Fig. 1. Freezing unit with top open and bottle rack installed.**

[1]*Appreciation is acknowledged to Dr. B. J. Stojanovic, enologist and head, A. B. McKay Food and Enology aboratory, for his suggestions regarding requirements for small-scale production and processing of ampagne.*

Fig. 2. Freezing unit with insulated cover closed.

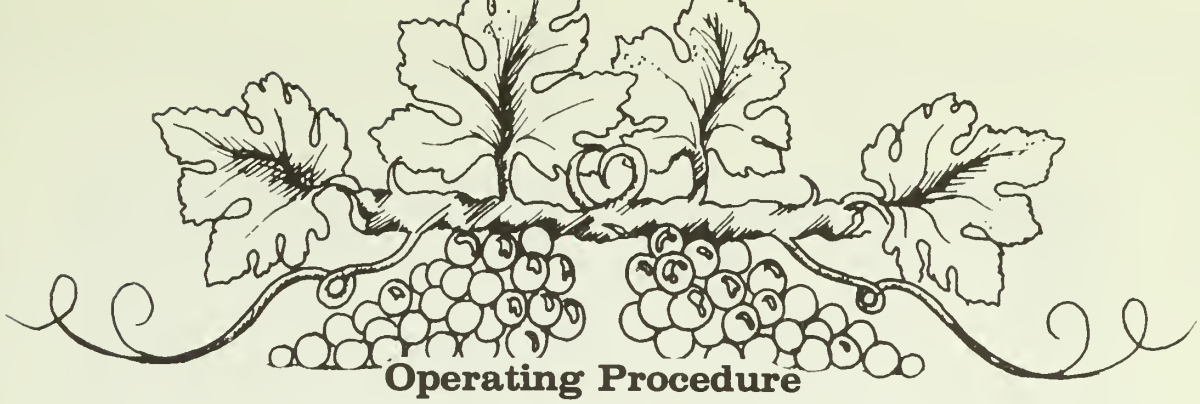
## System Components

The basic unit (Figures 1 and 2) is a small open chest type frozen food display case (Artic Star,® Model PL-3, manufactured by the Artic Star Mfg. Co., 3540 West Pioneer Pkw., Arlington, TX 76013) which was modified by the addition of a bottle rack (Figures 1 and 3) and an insulated cover (Figures 1, 2 and 4) and by sealing the freezer compartment to hold a cooling solution. The unit has a 1/5 horsepower refrigeration system that operates on 115 volt, 60 Hz alternating current and has variable temperature control. It has a freezing compartment about 27 inches (68 cm) long by 15 1/4 inches (39 cm) wide by 11 inches (28 cm) deep with overall dimensions of 34 inches (86 cm) long by 22 inches (56 cm) wide by 28 inches (71 cm) high.

The box originally was designed for holding and displaying solid materials and had open seams, rivets, etc., and it was necessary to seal all potential leaks so that it would retain the cooling solution. The leaks were sealed with clear Dow Corning® silicone rubber sealer.

The rack shown in Figures 1 and 3 was fabricated from 0.040-inch (1 mm) stainless steel sheet pop-riveted to an aluminum angle framework. It was designed to hold fifteen 750 ml champagne bottles in an inverted position. It would be more desirable to use stainless steel throughout; however, the aluminum frame was used in th case because it was immediatel available. The rack also could b made of wood, plastic, wire or othe materials, depending upon the availability and the skills of th fabricator.

The plywood cover (Figures 1, 2 and 4), which was insulated wit Celotex® Thermo-Bord (a polyisocyanurate), was added t improve the efficiency of the oper tion by reducing the cooling loss from the unit. The cover was kept in place during precooling of th freezing solution as well as durin the disgorging process and remo ed only to remove bottles or insert bottles into the rack.



## Operating Procedure

The general steps in the procedure used in these experiments were the following:

1. The inverted bottles of champagne were chilled for 24 to 48 hours at about 25°F (-4°C).
2. The freezer unit containing the bottle rack and freezing solution was precooled overnight in preparation for use the following day.
3. The chilled bottles of champagne were placed in the rack and left long enough for the sediment to freeze in the necks.
4. The first bottle with the frozen plug of sediment was removed from the rack for disgorging after about ten minutes and was replaced at the same time by another bottle of chilled champagne from the cold stablilization chamber.
5. This process was continued until all 15 bottles in the rack had been disgorged. The neck of the first replacement bottle was frozen by this time, and the process of removal and replacement of bottles was continued.

The following discussion presents the procedural steps in greater detail.

The champagne was first cooled to about 25°F (-4°C) to reduce the internal pressure and reduce losses during disgorging. This precooling was done in the Laboratory cold stabilization chambers but also could be accomplished in a household or industrial freezer or refrigerator with appropriate temperature controls. Some producers precool the champagne only to around 45°F (7.2°C) (1); however, the colder the champagne (within limits) the lower the pressure and the more easily the sediment is frozen.

The freezer unit was filled with the cooling solution to a depth that would reach about one inch (2.5 cm) up on the neck of the inverted bottles suspended in the rack. The actual depth of the solution used in this case was about 2.75 inches (7 cm).

Various anti-freeze solutions were tested to determine their suitability for this application. The solution that appeared to function most effectively was a mixture of 65% water and 35% ethyl alcohol of about 70 proof. The alcohol slowly evaporated and had to be replenished occasionally. The solution was checked periodically with a Proof and Tralle's hydrometer to determine when more alcohol should be added.

The empty rack was placed in the unit before precooling because frost build-up on the interior of the unit sometimes prevented insertion of the rack after precooling.

Precooling overnight was required to reduce the temperature of the freezing solution to 5°F (-15°C) with the small capacity refrigeration unit. This unit was selected for its ability to maintain the proper temperature during the freezing/disgorging operation. The low initial cost and low cost of operation justify the use of the small-capacity unit rather than a large-capacity refrigeration unit with quick-freezing capability but higher initial and operating costs.

Chilled bottles of champagne were transferred from the cold chamber to the rack in the cooling unit with a minimum of agitation. It is recommended that bottles be handled gently and deposited carefully in the rack during this transfer process. The freezing solution contained slushy ice during the disgorging operation, but this is a normal condition and will create no problems. However, it is not recommended that bottles be left in the unit (with the freezer in operation) overnight, as the solution may freeze solid, trapping the bottles in the ice.

About ten minutes were required to freeze the sediment in the necks of the first 15 precooled bottles placed in the rack. A new bottle of chilled champagne was inserted in the place of each bottle removed for disgorging. The neck of the first replacement bottle was frozen by the time the first 15 bottles were removed. The temperature of the freezing solution and the time of cooling were selected to allow withdrawal of bottles and continuous insertion of new bottles ready for disgorging. This timing permitted continuous disgorging for any desired length of time.

The output rate was about twenty 750 ml bottles per hour with only one individual performing all operations of freezing, disgorging and refilling, corking and attaching the wire hood.

Cost of operating the unit was about two cents per hour (based on 4.5 cents per kilowatthour for electrical power).

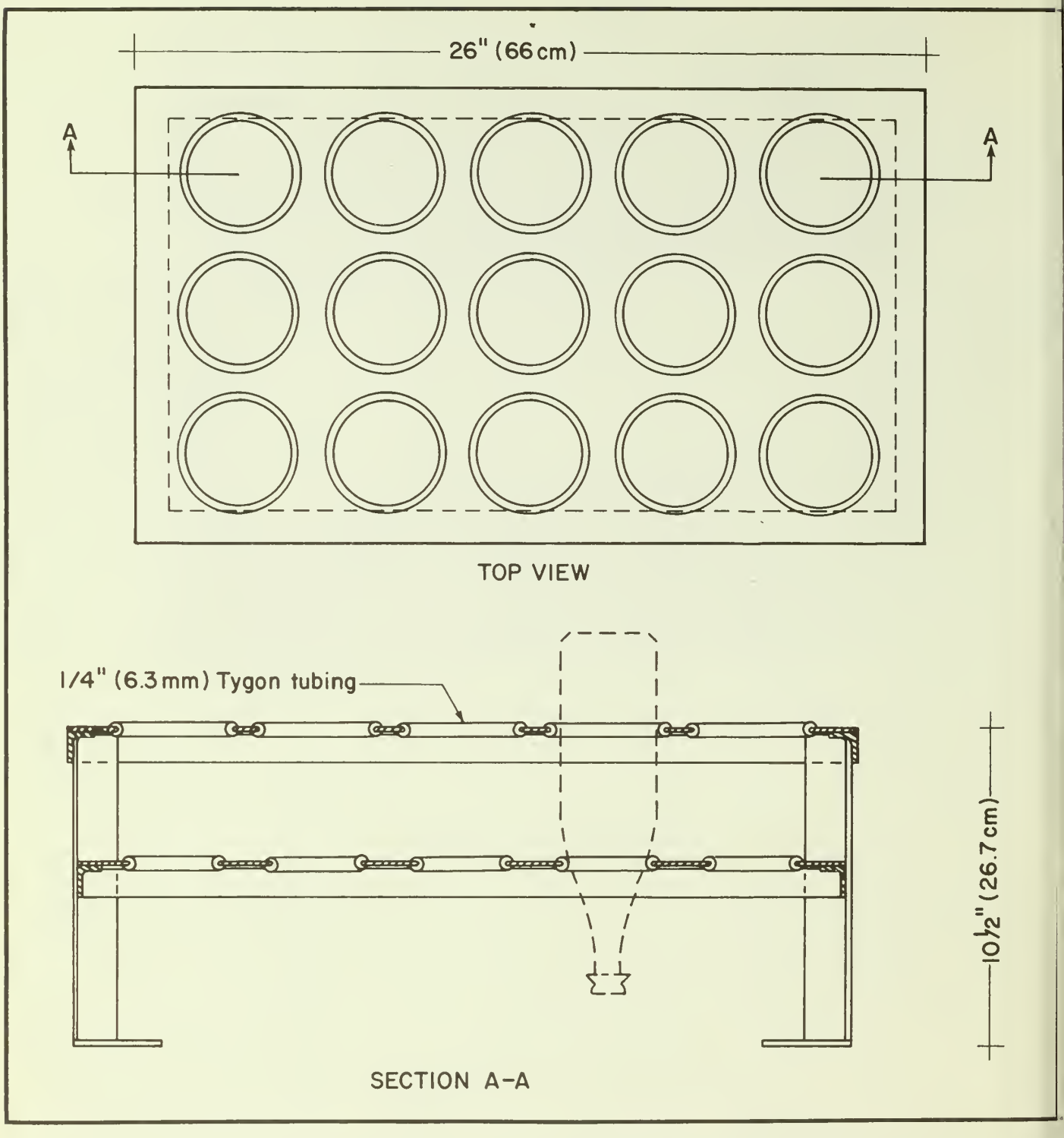
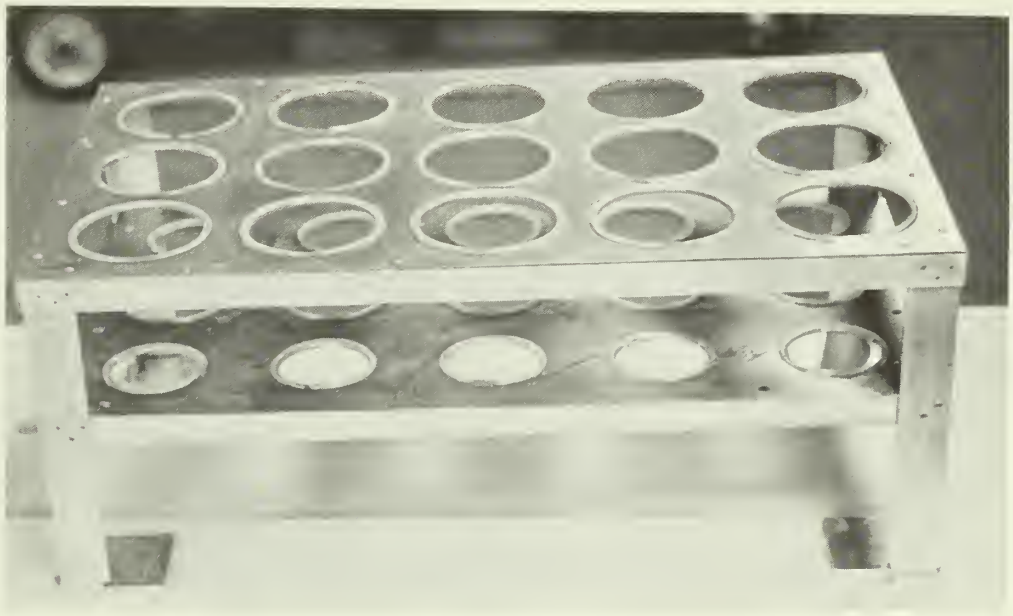
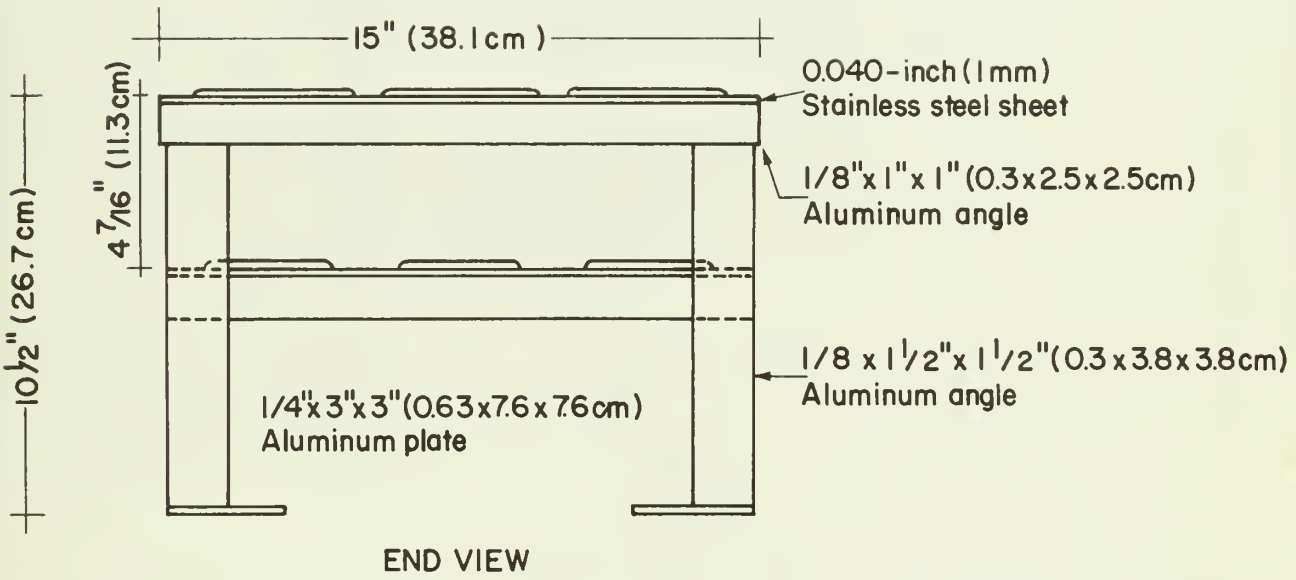



FIGURE 3. CONSTRUCTION DRAWINGS AN

NOTE: Holes in top plate bored 3 7/8" (9.8 cm) and lined with Tygon tubing.
Holes in bottom plate bored 2 3/4" (7 cm) and lined with Tygon tubing.






PHOTOGRAPH OF BOTTLE RACK

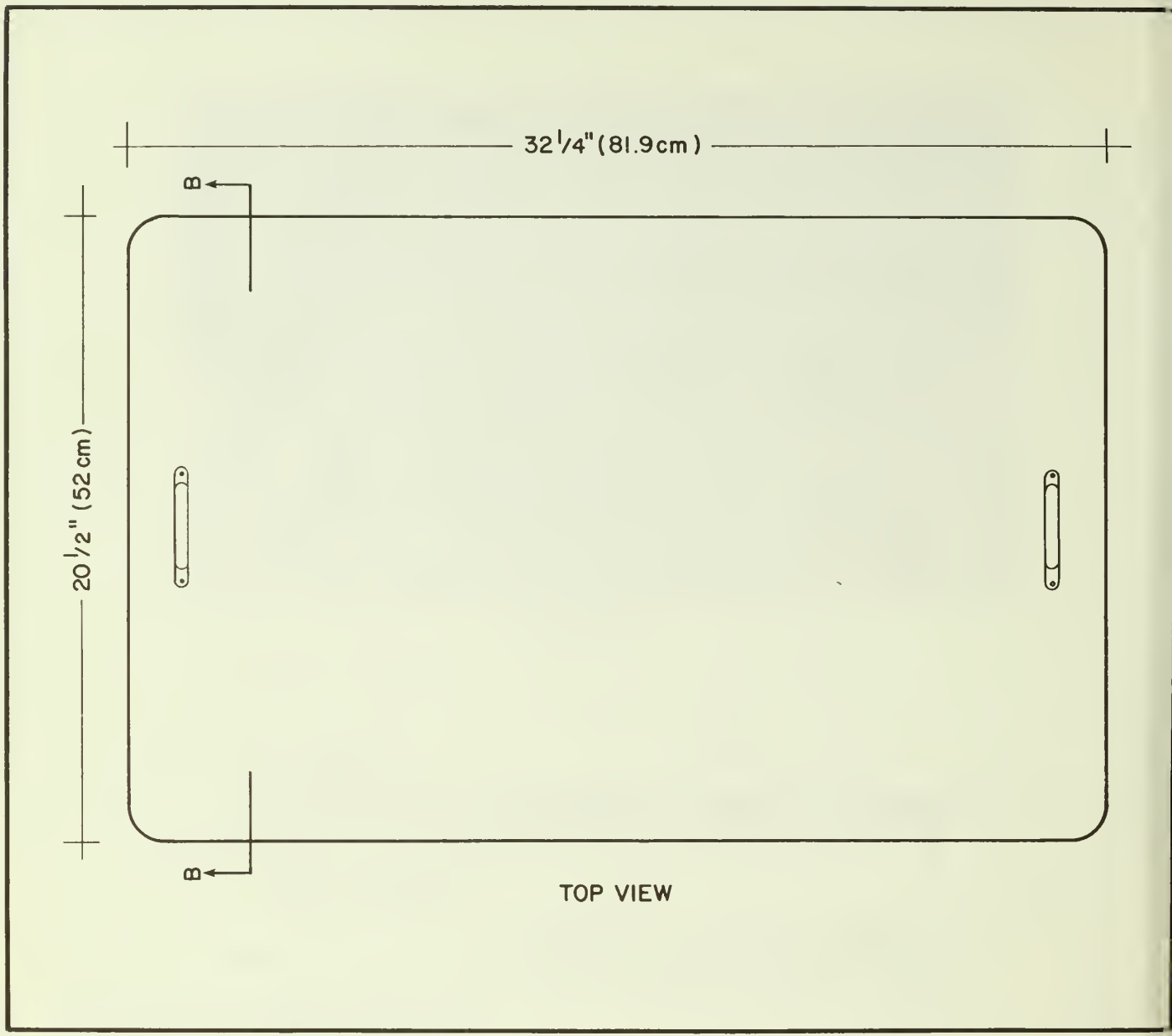
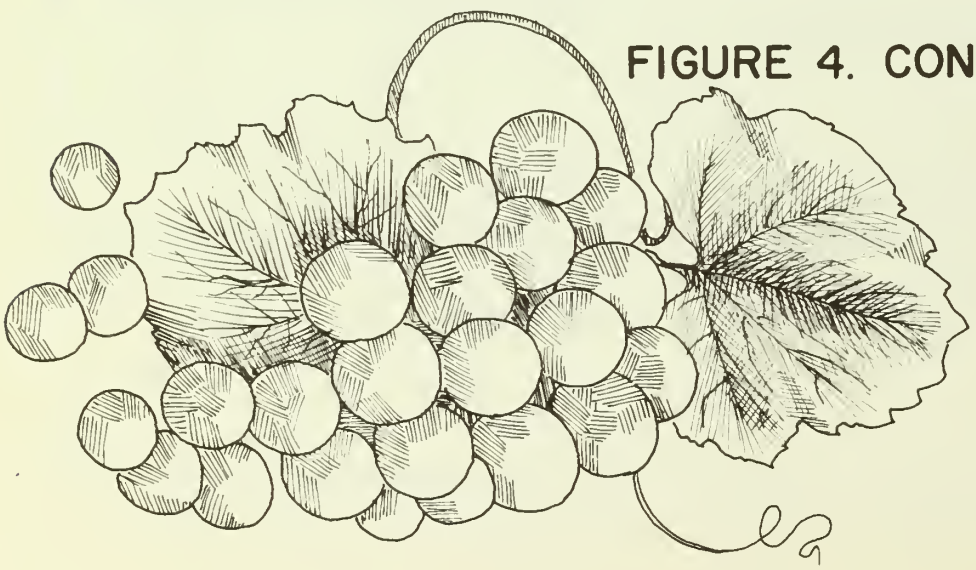
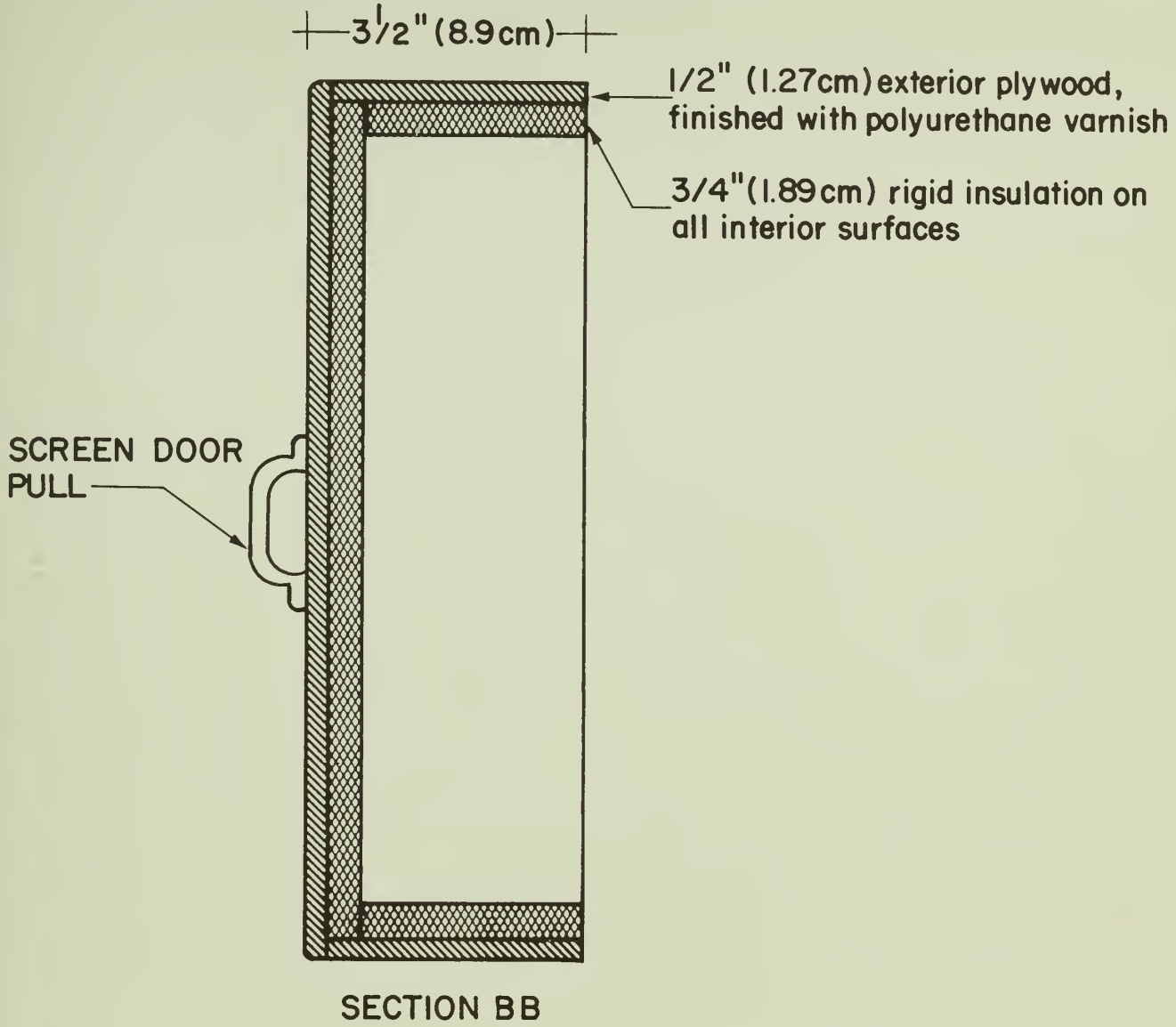



FIGURE 4. CONSTRUCTION DRAWIN



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