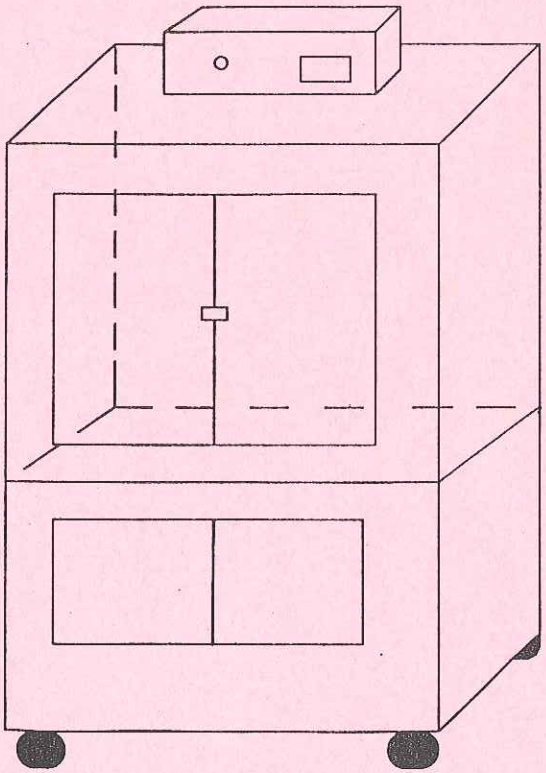
GRANDPA FRED'S BABY TENDER

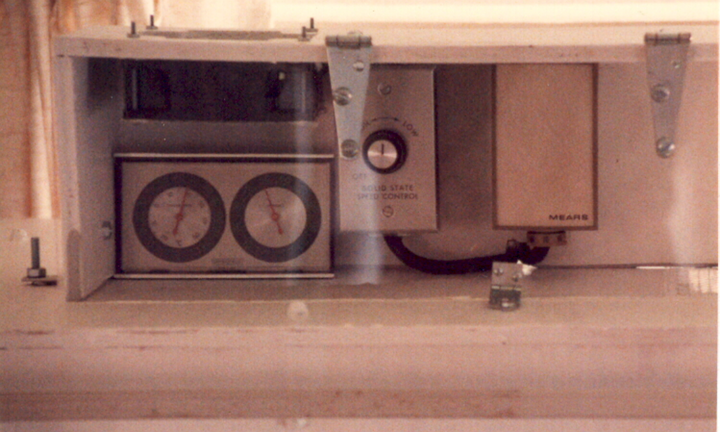
or

Why and How We Built our Aircribs

by

Stephen Ledoux and Carl Cheney

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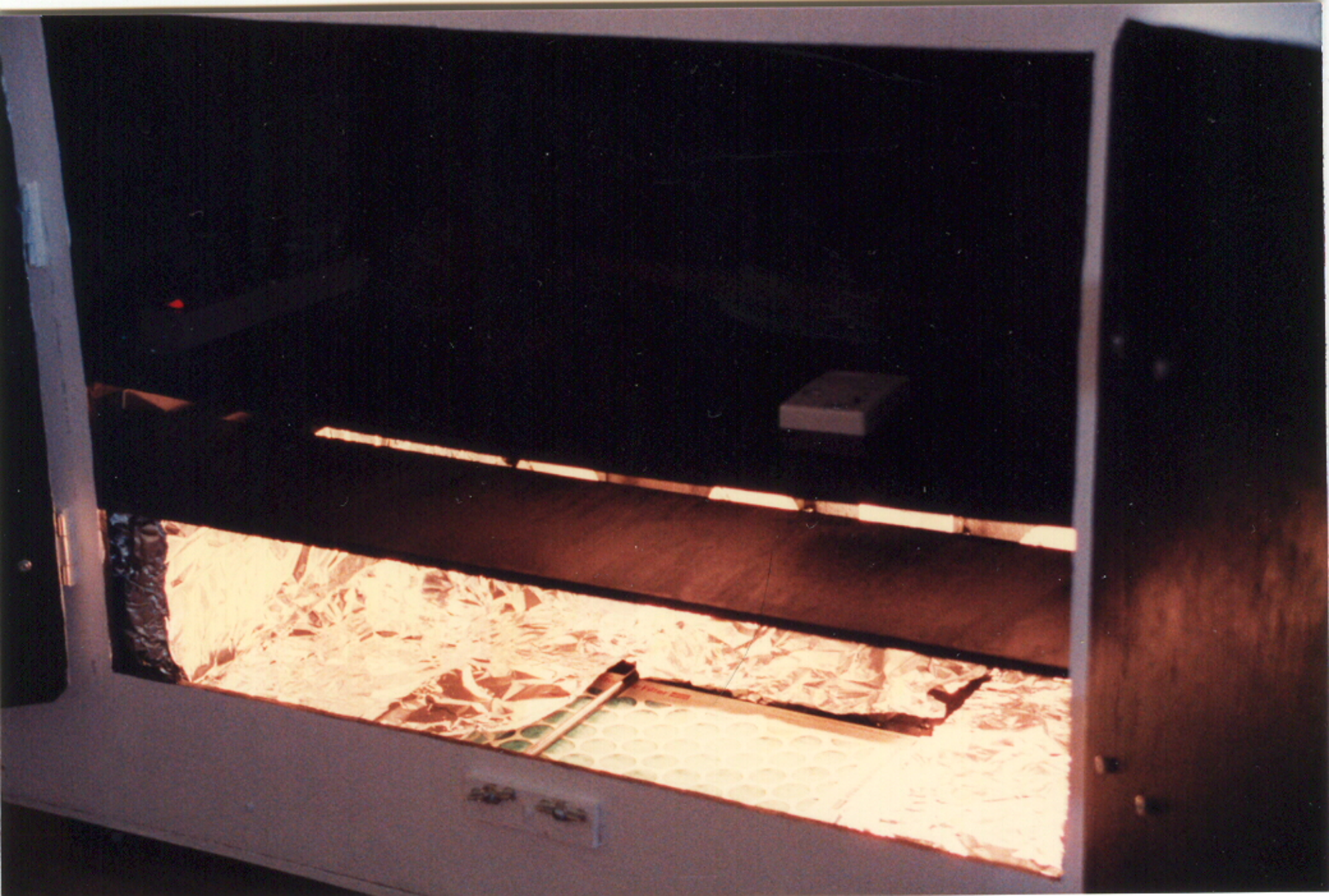

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by

Stephen Ledoux
State University of New York
Canton

and

Carl Cheney
Utah State University
Logan

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Printed in the United States of America.

This report was originally prepared for presentation at the Twelfth Annual Convention of the Association for Behavior Analysis, Milwaukee, WI, 22-25 May 1986.

Published by: A B C

Advanced Behavior Change Services (ABCS)

Publisher's Note

WARNING!

This book is designed to provide information regarding the subject matter covered, with the understanding that the authors and publisher are not providing psychological, medical, or other professional services. Raising children is sometimes very difficult; if expert assistance is desired or required, contact a competent professional such as a Behaviorologist or Behavior Analyst.

Foreword

The First Baby Tender

B. F. Skinner

I designed what we called the baby tender as a laborsaving device. We wanted to have a second child, but my wife said she rather hated the chores of the first year or two. I suggested that we simplify the care of a baby. All that was needed during the early months was a clean, comfortable, warm, and safe place for the baby, and that was the point of the baby tender. I started to build it about the time we started the baby, and in spite of war-time shortages finished it just before our daughter Deborah was born.

As soon as she came home from the hospital, we put her in the baby tender. We discovered immediately that the labor we saved was far less important than the advantages for her. She slept on a tightly stretched canvas covered with a sheet (later replaced with a single plastic cloth that felt rather like linen). There were no nightclothes, sheets, or blankets, and she wore only a diaper. There was no danger that she would smother, as there occasionally is in a standard crib. She breathed clean air, which we humidified and maintained at just the right temperature. She was free of colds for many years, and I am inclined to think that it was due primarily to the warm humid air she breathed as a child. In the winter in a northern climate a house is about 30 degrees below body temperature, and the air the baby breathes is chilled further by evaporation from moist surfaces in the air passages. It is possible that the superficial layers of the bronchi and lungs grow as much as 40 degrees below body temperature, and that could make a great difference. The species originated in the tropics, where warm, moist air was standard, and there may not have been enough time for further evolutionary changes.

The space was quiet, and Deborah was free to move about and take comfortable positions at any time of day or night. She soon began to exercise much more vigorously than would have been possible in a standard crib, and she grew very strong. Our pediatrician commented on her unusual strength. Her skin stayed dry, and she never had any diaper rash. She never objected to being put into the baby tender and almost never cried.

Her rapid physical development was matched by behavioral gains. She was free to explore all parts of the space and there was a large window through which she could watch life around her. At one point she seemed to pass through a phase in which she used her feer prehensilely, Another couple who made and used a baby tender sent us a photograph of their baby holding its bottle in its feet while it drank. I made toys which Deborah used very early. By pulling a ring that hung from the ceiling, she produced a whistle. By twisting a T-bar that hung from the ceiling, she made small banners spin. Later, by pulling a ring she operated a music box, tone by tone.

She was not socially isolated. She was taken out for feeding and play, of course, and we could allow the neighborhood children to talk and gesture to her through the window without passing on their viruses. The labor we saved not only made it easy for us to treat her affectionately but encouraged us to spend more time with her. She spent a lot of time outside the baby tender, especially as she grew older. Eventually she slept in it only at night and for naps.

During her second and third years, when we could predict her bowel movements, she slept without clothing. Urine passed through the plastic cloth (which could be quickly washed and dried) into a tray to be thrown out the next morning. She learned to postpone urination, in part, I think, because of the consequences. Urination in a diaper is immediately followed by a pleasurable warmth; it is only after several minutes that a damp diaper grows cold and uncomfortable. Without a diaper urination immediately moistens the skin and chills it. Deborah began to go for long periods of time without urinating, and by the time she first slept in a bed she had learned to keep herself dry and never wet her bed. All the supposed psychological problems connected with toilet training were avoided.

I have seen many young people who spent part of their first years in similar spaces, and most of them were rather tall and strong. It would be extraordinary if those first years of rapid growth could have made that kind of difference, but it is certainly something worth exploring further.

The response to my article in The Ladies Home Journal, written when Deborah was nine-months-old, drew hundreds of letters asking where a "baby tender" could be purchased or how one could be made. I sent out hundreds of crude instructions. There were only a very few critical letters. I have never found anyone who, upon seeing a baby in an Aircrib, did not immediately think it was a wonderful idea. But misunderstandings began to spring up and were widely circulated. The Journal had given my article the title "Baby In A Box" and some of the misunderstanding came from a confusion with the equipment used in operant research. Misunderstandings are still common. Here is a sample from an article published by a reputable psychologist: "In the late '40s, Professor Skinner invented the 'Air-Crib,' a Skinner box for babies. It was a large, soundproof, germproof, air-conditioned box for giving children mechanical care for the first two years of life." Every statement in the passage is wrong. I designed and built the box in 1944. It is not an experimental apparatus. It is not soundproof; Deborah was shielded from loud noises, but we could hear her at all times. It is not germ-proof, although it was a kind of shield against sudden large doses of infection. "Air-conditioned" suggests cooling, but the air is only warmed. It is no more mechanical than a standard crib, and there was nothing mechanical about the care we gave our child. Deborah may have spent a bit more time in the Aircrib than she would have spent in a standard crib, because she was freer and more comfortable there, but in her second year she merely slept in it, at night and for naps. (Perhaps I should add that rumors that she committed suicide or

became psychotic are equally wrong. Now 43, she is a happily married, talented artist and writer.)

It is possible to build a better world for a baby and the baby tender was a step in that direction.

B. F. Skinner
January, 1987*

*The Skinners' first daughter, Julie, is also happily married, is engaging in a successful career as a Behaviorologist, and has used an Aircrib with all of her own children.

SL & CC

Table of Contents

Dedications

To my son, Miles Lincoln, who could not spend as much time in the Aircrib as he might have wanted.

Stephen Ledoux

To Scott, Taya, Carter, Mary, and their mothers, all willing and happy participants in the improvement of child rearing concepts and technology.

Carl Cheney

To the future children of this world (or??).

C.C. and S.L.

Acknowledgements

Some of the materials and inspiration for this report came from a course in which the following students participated: Craig Loftin, Karen Coor, Greg Morey, Brian Lech, and Sharon Lauer.

We also wish to thank Jack Alvord, Elliott and Marilyn Bonem, Bob Crow, Robert Epstein, Brian and Linda Lech, John Mabry, Jack Michael, Richard and Elki Powers, John Nixon, and Nelly Maude Case.

Finally, we wish to express our appreciation and thanks to Burrhus Frederic Skinner (Grandpa Fred) for writing "The First Baby Tender" as the Foreword for this book.

S.L. and C.C.

Introduction

In October, 1945, the Ladies Home Journal contained an article entitled "Baby in a Box" by Prof. B.F. Skinner. (Dr. Skinner is currently Emeritus Professor at Harvard University; the article is reprinted in Appendix J.) This article introduced to the world the "baby tender," a self contained "room" for very young children. The baby tender is an enclosed temperature, humidity, sound, and airflow controlled crib to be used by children from birth to about two years of age. It is one of very few dramatic innovations in terms of child rearing ideas to appear this century. Beds for babies have changed only slightly since the time of the cradle. The technology of child rearing has improved very little when considering such items as conventional cribs, strollers, playpens, high chairs, walkers, and potty chairs (although Appendix L presents improvements in the technology of toilet training). Construction materials have improved and subtle changes make these items safer and a bit more convenient but overall the philosophy and practices of child rearing with respect to these items have remained as they were in the 1920's or earlier (but see Appendix K). The concept and technology of the baby tender, however, proved very successful. Since the early 1950's perhaps thousands of babies (including five of ours) and their families have enjoyed the benefits of the baby tender, or, as it is now called, the Aircrib.

Despite the many advantages provided by the Aircrib, its adoption has been relatively limited. Typically only couples associated in one way or another with the academic discipline known as behavior analysis have heard of, or used, an Aircrib. Aircribs were commercially manufactured in the late 1950's and early 1960's but have not been commercially available since. While a few secondhand Aircribs, both homebuilt and commercial models, may be found, there have not been nearly enough Aircribs available for all the couples who want them. So even though construction plans have not been available, most people who wanted an Aircrib have had to build their own. Being among those who built their own, we have assembled this description of how we built four Aircribs so that others can know that it is certainly possible for them to build their own also and thereby provide their children and families with all the Aircrib's advantages.

Our report describes one proven and cost effective way, including some possible variations, that we have found for constructing an Aircrib at home. Considering the enormous advantages of the Aircrib over a traditional crib, the initial apparent high cost, we believe, was very well spent. Some elementary skills, such as using hand tools, were required. But we found, with ourselves and students at least, that modest mechanical or building talents were quite adequate.

We started building and using Aircribs in the early 1960's and have used a variety of designs with different children. Lately we have adapted a design that Dr. Skinner had made and modeled but had not actually constructed. This design is based on Dr. Skinner's experience with the original and subsequent Aircribs. He has encouraged us, as he does everyone, to build and use Aircribs and to modify the construction in any way deemed safe and useful.

Since many features of an Aircrib can be considered as matters of taste, special concern, or even expediency, different designs for these features should not compromise the basic concept of a safe, comfortable, and advantageous infant environment.

Dr. Skinner invented the Aircrib for his second child when he and his wife desired to reduce the labor, expense, and worry associated with the first two years of child rearing as experienced with their first child. The Aircrib did provide reductions in labor, expense, and worry. These were advantages for the parents. But it also did much more. In practice, the Aircrib provided numerous advantages for the child. In fact, the advantages for the child were greater than the advantages for the parents.

The Aircrib's advantages begin to appear at first glance. The baby cannot get caught between crib bars for there are none. Nor can the baby fall out for it is completely enclosed. The enclosure includes padded walls, Plexiglas doors and windows, a moisture free mattress, and a sound attenuating ceiling. There is no necessity for bedding, for the Aircrib contains a thermostatically controlled heat source. Indeed, this feature alone adds at least four more immediate advantages: no expensive blankets that require washing, the baby cannot get uncovered and cold, and the baby is not restricted or in danger of suffocation. These are not minor advantages and in fact, by themselves, constitute great improvements over traditional arrangements. This self-contained heating system insures the proper temperature at all times without drafts or variation. By adjusting the temperature to fit the individual baby's needs, fussing can be reduced and sleeping improved. Babies cry when they are uncomfortable and being cold is a noxious event that can easily be avoided. Even a wet diaper need not cause a cold bottom because the baby lies on a porous single sheet mattress that allows warm air circluation.

We have tried a large variety of mattress materials, some better than others, but all with the same criteria. The criteria are that the material must provide a safe, dry, comfortable bed that 1) allows the baby to breathe freely when face down, 2) passes liquid easily, and 3) is durable and cleanable. Most of our mattresses have consisted of a single layer of material on a frame such that it can be easily removed as a unit and washed in the shower. A very young baby can be bathed in the Aircrib as the water can simply run off into a drip pan. Bathing supplies, diapers, baby wipes, bottles, etc., can be stored right on the mattress before the baby is very active so that everything coming into contact with the baby is warm. When the baby becomes more active, these items can be stored in the base of the Aircrib where they will still be kept warm.

A fan draws outside air through a filter at the bottom, over a warmed surface and set of baffles, gently past the baby, and out an opening at the top. Since hot air rises, the airflow continues, albeit at a reduced rate, even if the fan stops. Indeed, except in hot weather, when the heating system is off and a higher airflow may be desirable, the fan is generally kept at a low setting so as not to draw air too quickly.

Previous Aircribs we have used have included a variety of safety features. Some had an alarm (a dry-cell powered buzzer) that would go off if the temperature went too high or too low, or if the power went off, or if the fan stopped. The Aircrib described in

this report has a commercial "power off" alarm located in another room (to avoid frightening the baby should the buzzer sound).

Since the baby is not covered by blankets and usually not even swaddled in sleepers, it is wholly visible from outside the Aircrib. Therefore, the baby can be "shown off" to casual visitors without the trauma of waking it and hauling it out and letting people breathe on it and excessively handle it. Furthermore, as it grows, the baby cannot throw its bottle or toys out of the Aircrib and find itself wanting. Also siblings or pets cannot deposit unwanted items in the Aircrib, or enter it.

Due to its self contained nature, the Aircrib serves as the child's own "room" and can be located anywhere in the house. This allows a family to live in a smaller apartment, or an older sibling to share a bedroom with the baby. Our children treated the Aircrib as their own room and would often ask to get in it seemingly for privacy, comfort, or relaxation. In general it seems that our babies spent about as much time, or even less time, in the Aircrib than they would have spent in a conventional crib. Since it appears that we were less busy with infant housekeeping (laundry, cleaning, checking at night, etc.), we had more time to take the baby out and play. This was wonderful both for us and for the child.

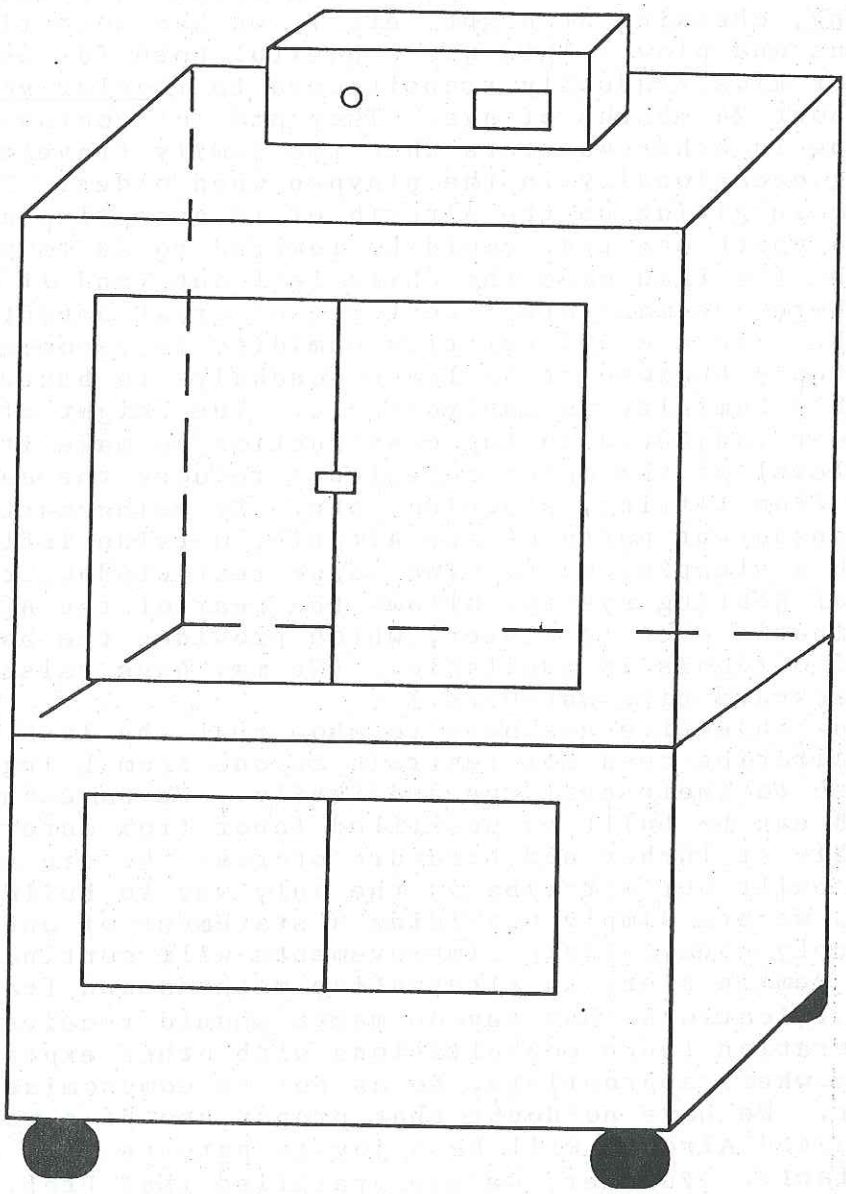
Our kids gradually transitioned to regular youth beds when they were about 24 months of age. They had, of course, had experience sleeping in other quarters when the family traveled and even began napping occasionally in the playpen when older. There was never a problem in giving up the Aircrib or in accepting another bed. We chose a youth bed that could be lowered so as to place the mattress near the floor in case the child fell out (and it does happen).

There are many other features of great advantage with an Aircrib. Since a 50% relative humidity is recommended, both for comfort and because it is least conducive to bacteria growth, the Aircrib's humidity is controllable. The height of the mattress from the floor (adjusted during construction to make it close to the waist level of the major caregiver) reduces the caregiver's muscle stress from lifting, stooping, etc. By using curtains or blinds on the transparent parts of the Aircrib, outside influences need not disturb a sleeping baby. The large rear window, together with the internal heating system, allows the rear of the Aircrib to face a room window, even in winter, which provides the baby with whatever view of outdoors is available. (We may have raised a generation of avid backyard bird watchers.)

Our objective has been to show that the lack of commercially built Aircribs need not restrain anyone from bringing the Aircrib's benefits to their children and family. We have shown that an Aircrib can be built by unskilled labor from materials readily available at lumber and hardware stores. We are not saying that the way we built our Aircribs is the only way to build an Aircrib. Rather, we are simply providing a statement of one way it has been adequately done. Design improvements will continue to be discovered and we remain alert to alternative methods and features. However, any modifications that anyone makes should receive careful consideration (even consultations with other experienced users), and testing where appropriate, so as not to compromise safety or comfort. We have no doubt that proper use of a well designed and constructed Aircrib will be a joy to parents (and even grandparents) and infants. Further, we are gratified that Prof. Skinner is

delighted finally to be able to refer people with inquiries about Aircribs to a report such as this one rather than simply to searches for literature and used Aircribs.

Briefly, the Aircrib constructed for this report is a two part (top and bottom) box. The top has a Plexiglas door on the front and Plexiglas windows on the ends and back. The bottom contains a series of light bulbs that are thermostatically controlled to provide heat. An air intake in the floor is covered by a filter and the air is drawn through the Aircrib by a fan mounted on the roof. The Aircrib mattress of porous material lies above a drip pan which in turn sits above a set of air and light baffles. Parts of the walls inside the baby's chamber are padded. The entire structure is of one-half inch thick plywood pieces bolted together. Reasons for these and other features are described in the report itself. Responses to some commonly asked questions will be found in Appendix G.



Materials We Used

Wood

4 4'x8' sheets of ½" plywood (Exterior, with Exterior glue, both sides smooth, no warp)
3 8' long: 2x2s (pine was fine)
2 8' long: 2" Mull Casing/Double rounded edge stop
1 22" long: ½" dowel

Additional wood (mattress related; see Step 5)

For: porous Aircrib mattress design:
3 8' long: 2½" Mull Casing/Double rounded edge stop

OR

For: design using conventional-crib mattress:
See Appendix D.

Additional wood (door related; see note before Step 90)

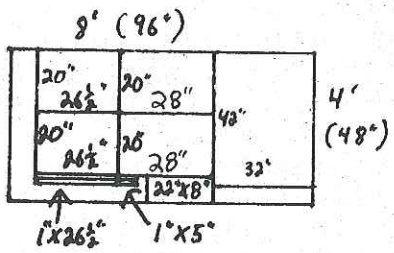
For: swinging doors:
No additional wood.

OR

For: sliding door:
See Appendix C.

Plexiglas-type material* (¼" thick)

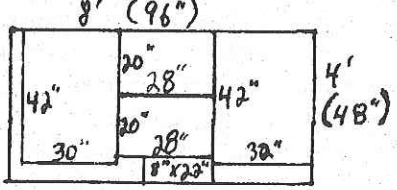
1 4'x8' sheet, cut as shown, when we used swinging doors:
1 30"x42" piece
2 20"x28" pieces
1 8"x22" piece
2 20"x26½" pieces
2 1"x26" pieces
2 1"x5" pieces



OR

1 4'x8' sheet, cut as shown, when we used a sliding door:
1 30"x42" piece
2 20"x28" pieces
1 8"x22" piece
1 30 x42 piece

NOTE: These sizes apply to Model B only; see Appendix C.



*"Plexiglas" is a product brand name. Other companies make similar material under other names. We used both Plexiglas and other brands.

Paint

2 qts. (Tru-Test No. 626) white oil-base latex enamel undercoater
1 qt. (Tru-Test No. LE-1) white gloss, water clean-up, latex enamel
1 qt. (Tru-Test No. LE-2) black gloss, water clean-up, latex enamel
3 2" brushes

Mechanical hardware*

(All bolts are round-head "stove" bolts, ¼x20, unless otherwise specified; all nuts, bolt caps, washers, and lock washers are also for ¼x20 bolts, unless otherwise specified.)

NOTE: At first we were using packaged products but the packages contained unnecessary items that had to be discarded. So we switched to unpackaged products. Screws were not used. (Also, some stores gave discounts for buying in quantity and/or for buying mainly from them.)

4 ½" bolts
146 3/4" bolts
26 1" bolts
2 1¼" bolts
8 2" bolts
18 3" bolts
4 3" flat-head bolts:
4 2" flat-head bolts:

5 eyebolts with 1½" shanks
1 eyebolt with 3½", or more, fully threaded shank
30 washers
4 lock washers
160 nuts
70 bolt caps
20 1¼" flat-head nails
32 2"x5/8" "corner irons" (elbow braces)
16 1½"x5/8" "corner irons" (elbow braces)
4 2"x½" mending plates
2 3" strap hinges
4 4" T-hinges
4 1 3/4" turn buttons
1 1 3/4" hasp with staple
4 2 3/4" (3 hole) flat-lying chest handles (e.g., by Stanley)
1 spring-covered cupboard hook
2 ordinary (no brake) castor wheels with bolt plates
2 castor wheels with brakes (and bolt plates)
1 14"x25" dust filter (e.g., Owens/Corning fiberglass)
1 6½"x6½" piece of ¼" mesh screen
1 14"x14" piece of ¼" mesh screen
1 2'x6' roll of closed-cell foam padding ("Unilite" or "Ensolite")

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*Some items are pictured in the Parts Figure at the end of these lists.

Additional hardware (mattress related; see Step 5)

For: porous Aircrib mattress design:

- 24 1½" bolts
- 4 eyebolts with 1½" shanks
- 28 nuts
- 56 washers
- 1 piece of mattress material: 2 yards of 42" wide Lamcron II Multifilament Polyester, 8xx mesh, from Lambert Co., Boston, MA
- 1 40' roll of 2¼" wide weatherproof plastic lawn furniture repair webbing

OR

For: design using conventional crib mattress:
See Appendix D.

Additional hardware (door related; see note before Step 90)

For: swinging doors:

- 12 ½" bolts
- 14 1" bolts
- 4 1½" bolts
- 4 washers
- 30 nuts
- 4 bolt caps
- 4 1 3/4" turn buttons
- 1 1½"x48" piano hinge

OR

For: sliding door:
See Appendix C.

Electrical Hardware

- 2 4"x2" service boxes
- 3 3½"x3½" service boxes
- 1 4"x4" service box with cover plate
- 10 cord clamps
- 6 2-wire wire nuts
- 4 3-wire wire nuts
- 1 25' length of 14/3 electric cord
- 2 grounded (3 prong) plugs
- 1 6 outlet socket bus with power switch and circuit breaker
- 3 ceramic light fixtures with chains
- 2 "Y" screw-in light bulb sockets
- 1 15w light bulb
- 4 60w light bulbs
- 1 Oak Ridge brand impedance-protected "High Tech Fan System" with 2 screens, 10' or more of power cord, plus bolts and nuts to mount it to ½" thick plywood
- 1 Emerson solid state fan speed control switch (Model No. SW81)
- 1 Thermostat (Mears brand M-21SP electric heat, single line break, with heat anticipator and 50°-90° range [F])

Additional Items

Thermometer/hydrometer instrument (Springfield Model No. 1803)
Ultrasonic humidifier with humidistat (Sunbeam Model No. 661)
Crib bumpers
Curtain/blinds
Mobiles
One-way intercom (Network brand "Baby-sitter" Model No. RB-10)
Battery operated electronic solid state power-off alarm (Cable Electric Model No. 48630)

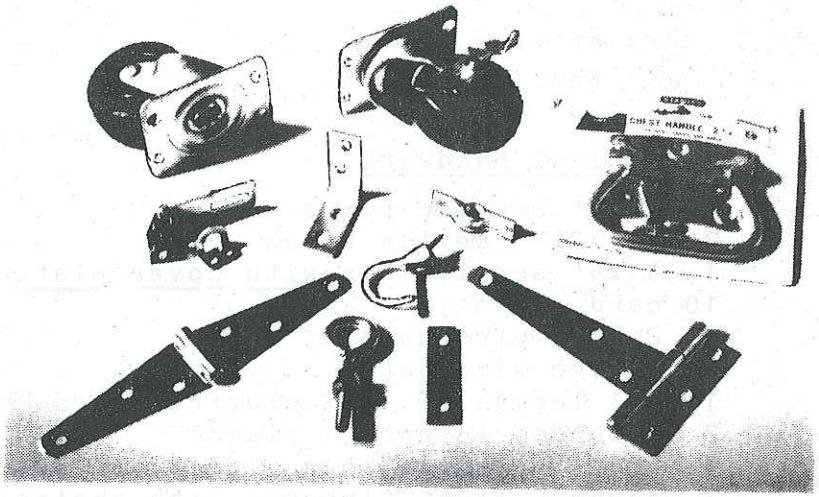
Household items (some were not used with every alternative)

Aluminum foil (heavy duty)
Duct tape
Wood glue (Elmer's)
Paint drop cloths
Paint thinner

Top: plain castor, castor with brakes.

Middle: hasp with staple, corner iron, spring covered cupboard hook, turn button, handle.

Bottom: strap hinge, eye bolt, mending plate, T hinge.



Parts Figure

Tools We Used

(Some were not used with every alternative.)

pencil (for marking measurements and bolt holes)
chalk (for marking what each piece was, after cutting it)
4' T square (for large measurements)
tape measure / ruler / L square (for smaller measurements)
jig saw
circular saw (although extra effort on the jig saw may have sufficed)
hand saw
hammer
drill
¼" drill bit
½" drill bit
other drill bits as needed
screwdriver
pliers
staple gun and staples
wire cutter/stripper
screen cutters
ice pick

Construction Steps

To avoid construction problems and delays, we gathered together all materials and tools before we began. Also, we always wrote on each piece what it was as soon as it was cut. To reduce confusion in the report, we have numbered the figures according to the step in which they first appear, rather than consecutively. Further, while each figure is to scale within itself wherever possible, the figures were not drawn to the same scale.

Depending on the number of people involved and how much time is devoted each day, construction can take from three days to months. This Aircrib took about two weeks. Furthermore, two models are being described in this report: Model A, which works best when both parents are six feet tall or taller, and Model B, which works best when neither parent is that tall. Model B is 8" shorter because its lower half is 8" shorter. Model A has 20" in which to place a humidifier while Model B has only 12" of space for a humidifier. Since the humidifier we used in Model A (a Sunbeam Ultrasonic No. 661) was only 11" tall, it fit Model B as well. This report also describes two alternative door styles, swinging doors or a sliding door (see the note before Step 90). Two alternative mattress styles are also described, the usual porous Aircrib mattress or a conventional crib mattress (see Step 5).

Finally, a series of appendices contains other alternatives that we considered, other possibilities that we never got around to considering, and other useful and interesting readings as well.

Initial wood cuts

Step 1: From the first of the four 4' x 8' plywood sheets, we cut two boards with the dimensions 48" x 27" (see Figure 1a). These pieces became the bottom of the lower half (the Aircrib base) and the top of the upper half (the Aircrib roof). See Figure 1b.

Step 2: From the 42" x 48" piece left over from Step 1, we cut a board 36" x 26 1/8" (see Figure 2). The "1/8 inch" is necessary because "½ inch" plywood is not ½" thick but only about 7/16" thick. This piece was to be one of a set of four. (The other three come from the next step.) We set aside the left-over piece, after marking it "From Step 2", for use in making the drip pan support plank later. (But see Step 5 about alternatives.)

Step 3: From the second of the 4' x 8' plywood sheets, we cut three more boards also 36" x 26 1/8" (see Figure 3a). These three boards plus the one cut in Step 2 became the sides of the Aircrib's upper and lower halves (see Figure 3b). We set aside the left-over piece after marking it "From Step 3". For Model B: we cut 8" off two of these boards, making them 28" x 26 1/8". These smaller boards became the lower half's sides.

Step 4: From each of the two remaining 4' x 8' plywood sheets, we cut two boards (for a total of 4) each 48" x 36" (see Figure 4a). These four boards became the fronts and rears of the Aircrib's upper and lower halves (see Figure 4b). We set aside the left-over pieces, after marking them "From Step 4", for use in making the necessary baffles, later. For Model B: we cut 8" off two of these boards, making them 28" x 48". These smaller boards became the lower half's front and rear.

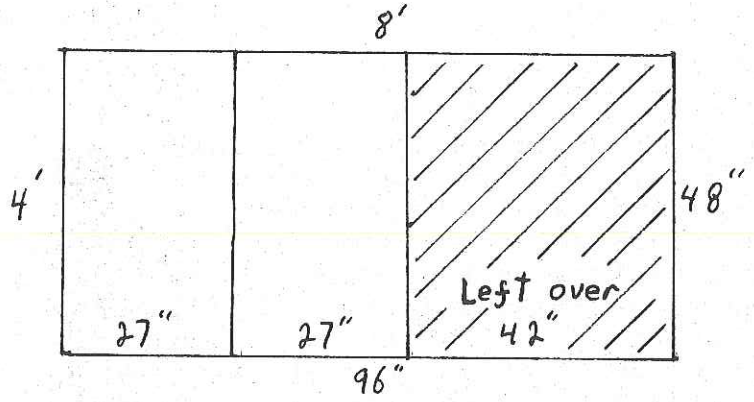


Fig. 1a

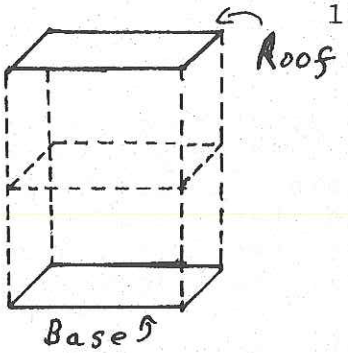


Fig. 1b

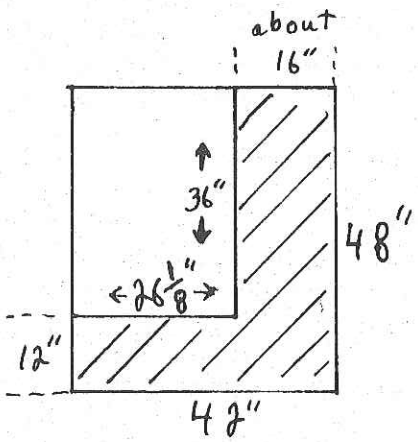


Fig. 2

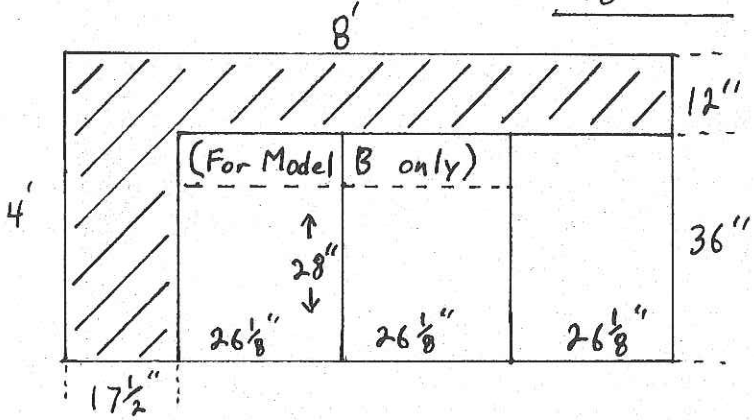


Fig 3a

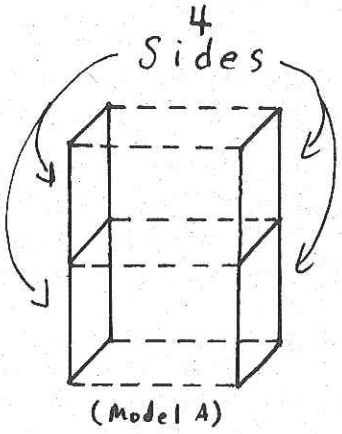


Fig. 3b

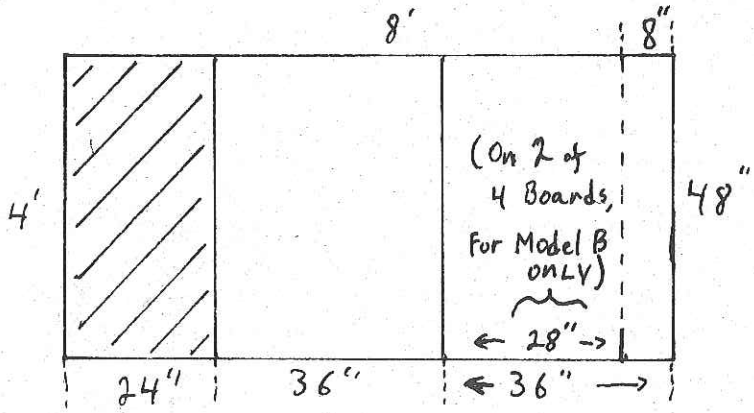


Fig 4a

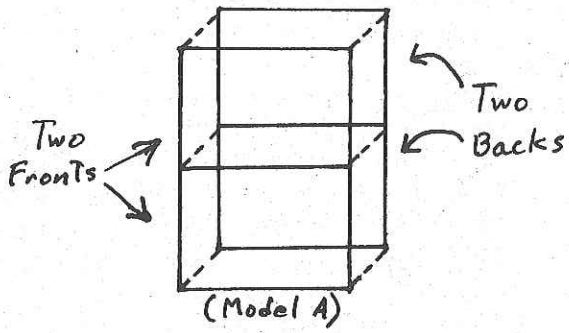


Fig 4b

Step 5: At this point we realized we would have to make some decisions about alternative methods, features, and materials. Choosing certain of these alternatives would definately have necessitated changes in the materials we used and/or the construction steps. We have listed some alternatives that we faced in Appendix A. (Also, see Appendices B, E, and F, as well as C, on a sliding door.)

However, one alternative we did follow got its own appendix, as all the steps below report the construction of early Aircribs according to the design that followed the porous Aircrib mattress concept. In a later Aircrib we made some design changes to allow the use of a conventional-crib mattress. All these design changes are contained in Appendix D. For the later Aircrib, we followed the steps below but, 1) ignored all step references to the "drip pan plank" and the "mattress frame pieces," and 2) followed Appendix D before doing the "finishing touches" steps that were appropriate.

Window and door "frame" cuts

Step 6: From each of two 36" x 48" boards that were cut in Step 4, we cut out a rectangle 26" x 38" (i.e., about 5" from all edges). (See Figure 6a.) One of the resulting "frames" became the upper half's front, where the Plexiglas (or similar material) doors would be attached. The other became the upper half's rear, containing a Plexiglas window. (Regarding the cut-out rectangles, see Step 7.) We drilled small holes for a jig saw just outside the four corner marks of our measurement before cutting out the rectangle (see Figure 6b). After we cut out the rectangles we "squared" the corners of the resulting frames.

Step 7: We marked, as "Left over from Step 7", the rectangle cut out to make the rear window frame, and set it aside. We cut the other rectangle (left after making the upper half's front door frame) into halves, as shown in Figure 7, for use as the doors for the front of the lower half (see next step). For Model B: We cut 8" off the doors, making them each 18" x 19". We kept checking how they fit the door frame and made adjustments accordingly.

Step 8: We took one of the two boards that we had cut in Step 4 for the lower half's front and rear, and made it the front by cutting out the center so that a lower front door frame was left. For Model A, the original piece measured 36" x 48". For Model B, the original piece measured 28" x 48". In each case, the frame was 5" thick on each side (see Figure 8) but this time our drill holes for the jig saw went inside the corner marks. As usual the corners had to be squared after the rectangle was removed. The rectangle was marked "left over from Step 8".

Step 9: From each of two of the 36" x 26 1/8" boards that were cut in Steps 2 and 3, we cut out a rectangle 16" x 24", with 5" from the top (26 1/8" long) edge, and 5" from each side (36" long) edge, but with 7" from the edge that would be used at the bottom (also 26 1/8" long), opposite the top edge (which would meet the roof). The jig saw holes were again on the outside of the corner marks. The resulting "frames" became the upper half's sides, which would contain Plexiglas windows. (See Figure 9.) We set aside the left over cut-out rectangles, marking them "from Step 9".

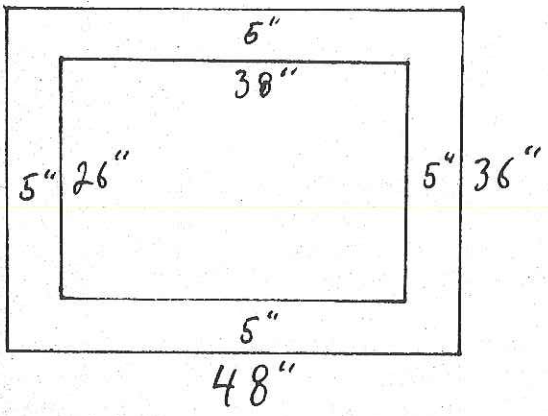


Fig. 6a

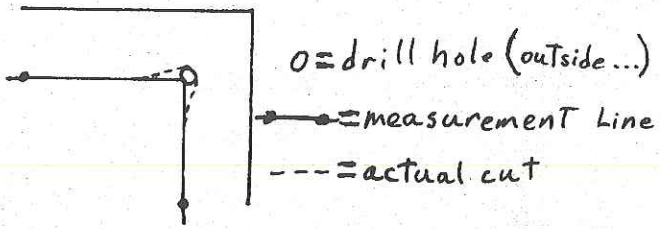


Fig. 6b

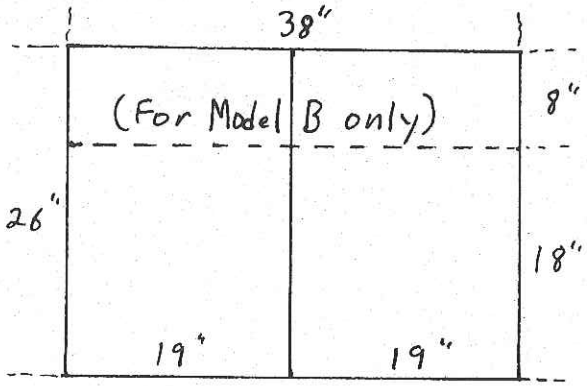
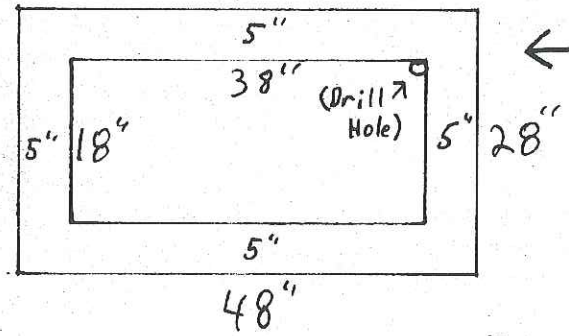


Fig. 7



← Model B measurements. (See Fig. 6a for Model A's measurements.)

Fig. 8

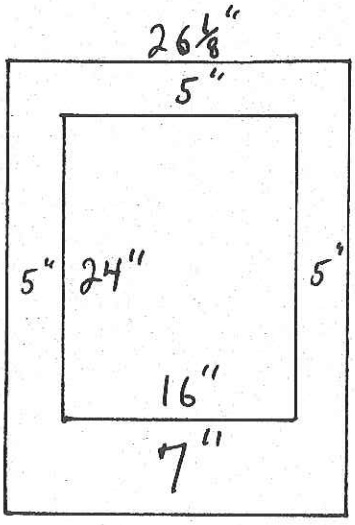


Fig. 9 →

Top edge (to meet roof)

Bottom edge

Accessory hole cuts

Step 10: In the roof piece, cut in Step 1, we cut a square hole, 5"x5", for the air outlet for the fan box (the "fan box hole"). Its front edge was 6" from the roof's front edge, and its side edges were each 21½" from the roof's side edges. (See Figure 10.)

Step 11: In the base piece, cut in Step 1, we cut a square opening, 12"x12" for the filter hole. Its front edge was 6" from the base's front edge and its side edges were 18" from the base's side edges. (See Figure 11.)

Step 12: In the lower half's rear wall (cut in Step 4 and mentioned in Step 8), in the upper left corner as viewed from the inside front, we cut a small opening for "cord access" (a hole for the fan's electric cord, and some other wires, to pass through from the fan box on the roof to locations such as the electric outlet bus, in the lower half). This hole measured about 1½" x 1½". Its channel was 2" long, from the rear wall's left edge, and its top edge was 4" from the rear wall's top edge. (See Figure 12.)

Step 13: We gathered the parts of the upper half (roof, front frame, rear frame, and side frames) into one place, and the parts of the lower half (base, front frame, rear wall, side walls, and front doors) into another place.

Basic upper half assembly

Step 14: NOTES:

In this and all remaining sections we used ¼ x 20 round-head "stove" bolts of the length specified, unless otherwise stated. Also unless otherwise stated, all bolts in the upper half (which holds the baby) were placed with their heads inside the Aircrib and were fastened with bolt caps on the outside; all lower half bolts were placed with their heads on the outside and fastened with nuts on the inside.

When installing the elbow braces ("corner irons"), as described here, and under "Basic lower half assembly", we got a close fit by slightly (i.e., less than 1/16") offsetting, away from the edge, each brace when it was first placed for marking and drilling its first bolt hole. (See Figure 14.)

Braces were used, rather than "screws and glue", to enable easy dissassembly either for storage between babies (ours or perhaps those of relatives or friends) or for shipping or moving or selling. Braces also make it easy to assure that the Aircrib can be located anywhere, as it can be taken apart to fit through narrow doorways if it won't fit when assembled, or taken in sections up or down stairways.

Later, where our Aircrib developed gaps at joined pieces (for instance, from warped wood), we placed extra braces, usually 1½" braces, either internally or externally, as required. Thus we avoided using screws which can damage the wood, especially during disassembly and reassembly.

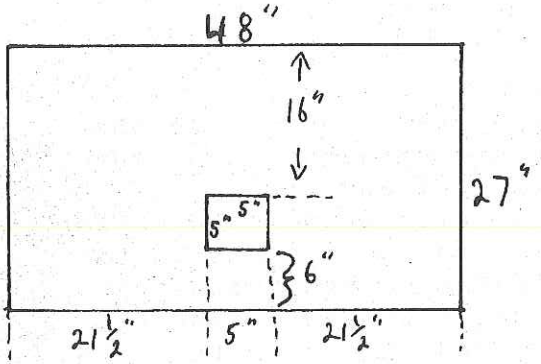


Fig. 10

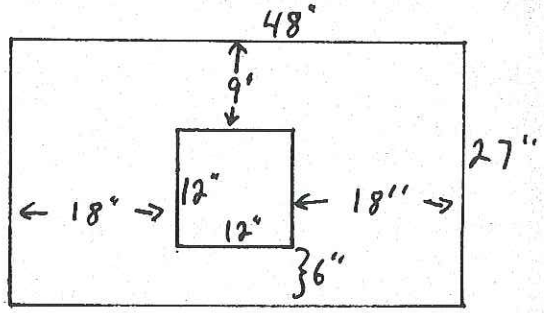


Fig. 11

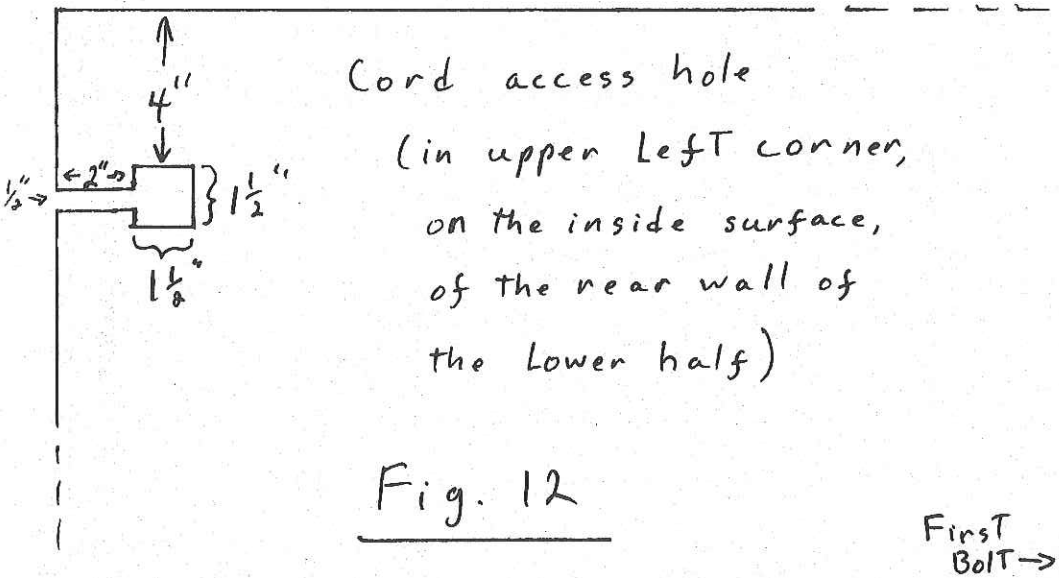


Fig. 12

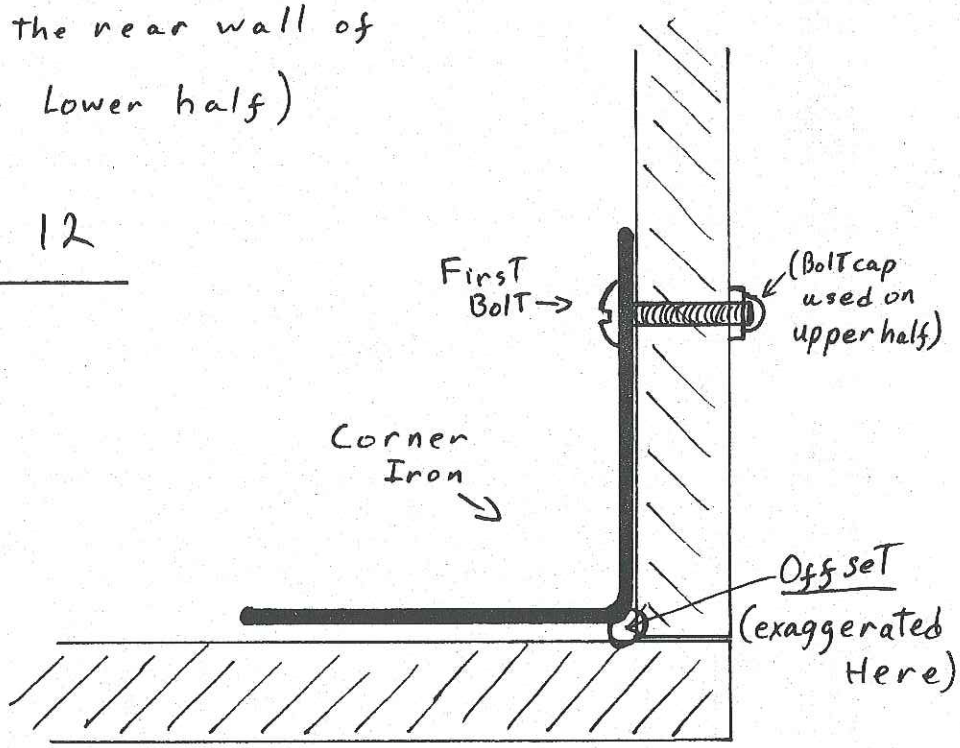


Fig. 14

Step 15: Placing the roof on the workbench (or floor), with the surface that is to be inside, facing up, and with the front edge, with the "fan box hole" (Step 10) near it, placed towards us, we temporarily arranged the front, rear, and side frames' edges for the best fit to the roof and each other. For some edges it was necessary to trim a little. Then we lightly marked which edges were to be joined, keeping the most "nicely" finished side of each piece on the inside of the Aircrib, and the 7" width of the side frame away from the roof.

Step 16: Placing the front frame on the workbench, outside facing down, we set two braces (2" braces for all "upper and lower half assembly" steps) on the edge of the front frame that was to meet the roof (slightly offset away from the edge, as described in the note above). Each brace was 12" from the frame edge's center (see Figure 16a). We marked the locations on the wood of the bolt holes that were at the end of the braces and drilled (with a $\frac{1}{4}$" bit) the bolt holes and bolted the braces to the front frame, using 3/4" long bolts and bolt caps. (The braces were always on the inside. This eliminated the problems that the brace's bend would cause if the brace was placed on the outside.) For a tight fit, the bolt caps were allowed to sink a little into the wood without rotating. (See Figure 16b for the relative positions of the braces, bolts, and caps.) If a bolt cap reached its limit before it got tight, we added a washer between the cap and the wood.

Step 17: Placing the front-frame-edge braces onto the matching roof edge, we marked and drilled the bolt-hole locations, and bolted the front frame to the roof, again, and as usual, using 3/4" bolts.

Step 18: Placing a side frame with its outside facing down on the workbench, we set two braces on the edge that was to meet the roof (slightly offset ...), each 6" from the frame-edge's center, and marked the bolt holes. Then we set two more braces (slightly offset ...) on each of the side frame's side edges that would form corners with the front and rear pieces. Each member of each pair of these was 9" from the center of their edge. We marked and drilled these bolt holes, as well as those marked on the edge that would meet the roof, and bolted the 6 braces into place.

Step 19: With the other side frame, we repeated Step 18.

Step 20: Taking each side frame in turn, we placed it on the matching roof edge and marked and drilled the bolt-hole locations for both the roof and the front frame, and bolted the sides to the roof and the front frame.

Step 21: Placing the rear frame on the workbench, outside facing down, we set two braces, again each 12" (see Figure 16) from the center of the frame's edge, on the edge that was to meet the roof (and again, slightly offset ...). Then we marked and drilled the bolt-hole locations and bolted the braces to the rear frame.

Step 22: Positioning the rear frame onto the matching roof edge, allowing for the best fit and contact with the side frame braces, we marked the bolt-hole locations on the roof edge, as well as on the side edges of the rear frame where the already mounted side-frame braces met the rear frame. We drilled all these bolt-hole locations and bolted the rear frame to the roof and side frames.

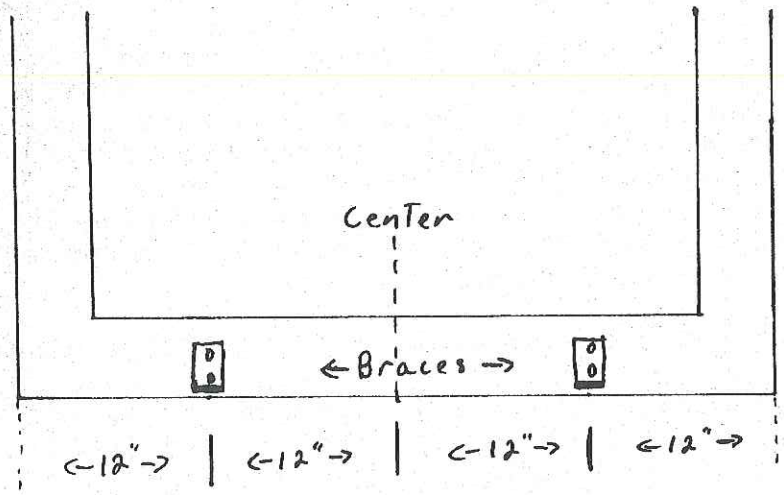


Fig. 16a

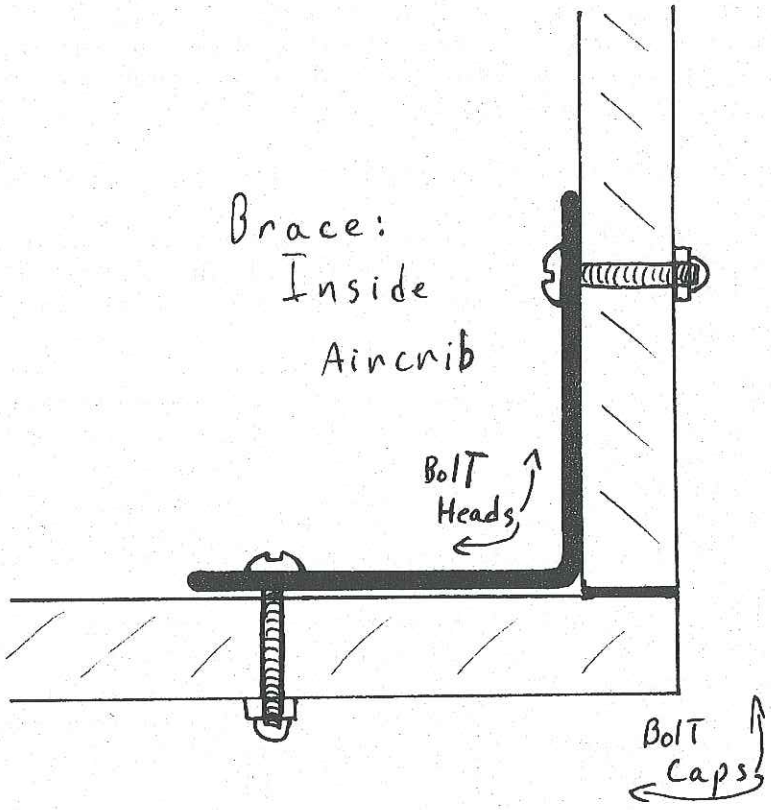


Fig. 16b

Basic lower half assembly

Step 23: Placing the base of the lower half on the workbench, with the inside facing up, and the front edge with the "filter hole" (Step 11) near it placed towards us, we temporarily arranged the rear and side walls' and front frame's edges for the best fit to the base and each other, trimming a little where necessary. Then we lightly marked which edges were to be joined, keeping the rear wall's cord access hole (Step 12) in the upper left corner inside, as viewed through the front frame.

Step 24: Placing the front frame on the workbench, outside facing down, we set two braces, each 12" from the frame edge's center (slightly offset ...) on the edge that was to meet the base. We marked and drilled the bolt-hole locations and bolted the braces onto the front frame, with the bolt heads on the outside and nuts on the inside against the brace.

Step 25: Placing the front-frame-edge braces on the matching base edge, we marked and drilled the bolt-hole locations, and bolted the front frame to the base.

Step 26: Placing a side wall with its outside facing down on the workbench, we set two braces on the edge that was to meet the base (slightly offset ...) each 6" from that edge's center, and marked bolt holes. Then we set two more braces on each of the side wall's side edges (slightly offset ...) that formed corners with the front and rear. Each member of each pair of these was 9"*** from the center of their edge. We marked and drilled these bolt holes as well as those marked on the edge that met the base, and bolted the six braces into place.

Step 27: With the other side wall, we repeated Step 26.

Step 28: Taking each side wall in turn, we placed it on the matching base edge, and marked and drilled the bolt holes for both the base and the front frame, and bolted the sides to the base and to the front frame.

Step 29: Placing the rear wall on the workbench, outside facing down, we set two braces, again each 12" from the center of the wall's edge, on the edge that was to meet the base (This time we did NOT offset the braces, because the rear wall must be removed and replaced later and offset braces make this especially difficult.) Then we marked and drilled the bolt holes and bolted the braces to the rear wall.

Step 30: Positioning the rear wall onto the matching base edge, allowing for the best fit and contact with the side wall braces, we marked the bolt holes on the base edge, as well as on the side edges of the rear wall where the already mounted side wall braces met the rear wall. We drilled all these bolt holes and bolted the rear wall to the base and side walls.

*** For Model B, the braces were 7" from the center of the edge.

Accessory wood cuts

Step 31: From one of the pieces left over from Step 4, we cut a piece 20" x 47" to be used as the center baffle in the lower half (see Figure 31).

Step 32: From the other piece left over from Step 4, we cut two pieces, each 10" x 47" to be used as the side baffles in the lower half. (From one piece, we cut two squared notches as shown in Figure 32. These notches go against the left rear corner, and near the rear center, to allow for wiring.)

Step 33: From the piece left over from Step 2, we cut a board 43 3/4" long and about 15" to 17" wide, for use as the drip pan plank in the lower half (see Figure 33).

Step 34: Note: The next three steps refer to cutting pieces for the fan box. Our fan was 4 5/8" wide, and had 4 1/8" separating the centers of the holes for the mounting screws.

Step 35: From the piece left over from Step 7, we cut one piece 7" x 22" (for the top of the fan box) and two pieces each 7" x 7" (for the sides of the fan box) and one piece 7" x 21" (for the back of the fan box). Note, in Figure 35, that we avoided the damaged corners of the "Step 7 left over piece," if there were any.

Step 36: From one of the two side pieces of the fan box, we removed an octagonal shaped piece, for the fan hole, by drilling all outer edge corners (as indicated) and cutting out the piece, rounding the inside corners, after marking its shape according to the measurements in Figure 36. (Later, holes got drilled in the corners to accept the fan mounting bolts.)

Step 37: In the center of one of the long edges of the fan-box back piece, we cut a notch as shown in Figure 37 (as a hole for the wiring to leave the box).

Step 38: After marking what each one was, and keeping them together, we set the fan box pieces aside.

Step 39: For the next two steps (all lower half pieces), we used the following table:

The three lengths of 2x2 (actually 1½" x 1½"), each 8' long were cut in the following manner, according to Steps 40 and 41:

one 8' length: 26", 26", 26"
One 8' length: 26", 23", 23"
one 8' length: 47", 47"

Step 40: We cut four baffle supports (two center baffle supports and two side baffle supports) each 26" long.

Step 41: We cut two mattress supports for the sides each 23" long, and two mattress supports for the front and rear, each 47" long.

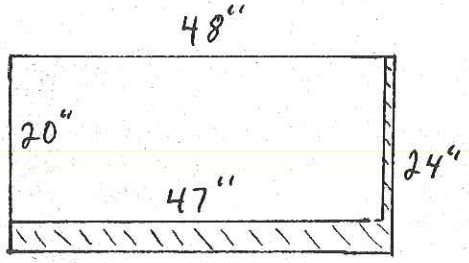


Fig. 31

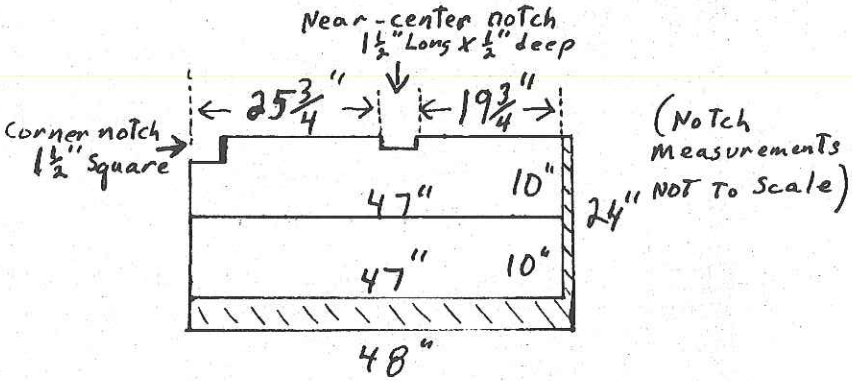


Fig. 32

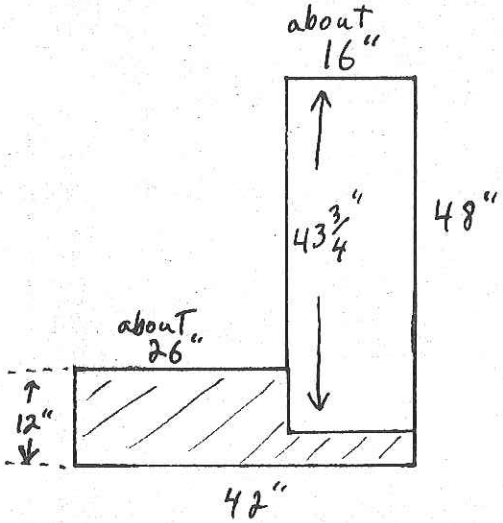


Fig. 33

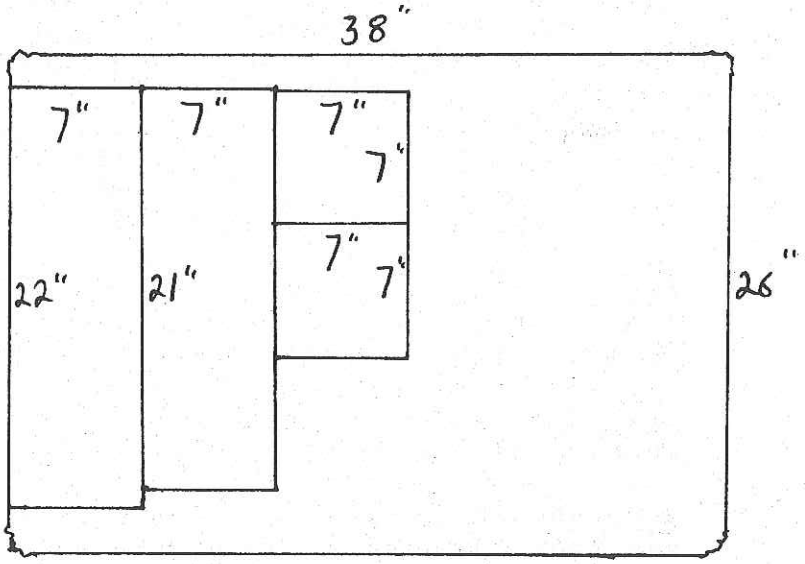


Fig. 35

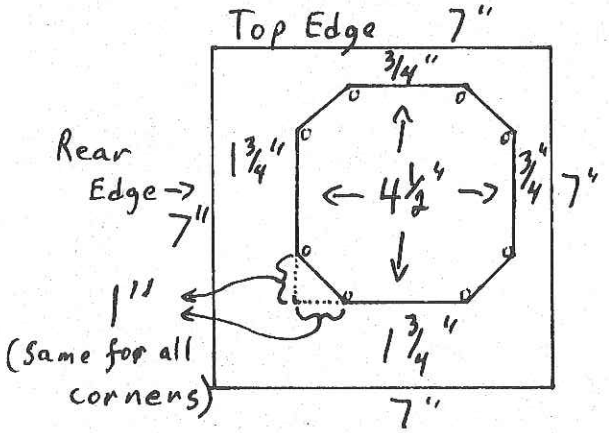


Fig. 36

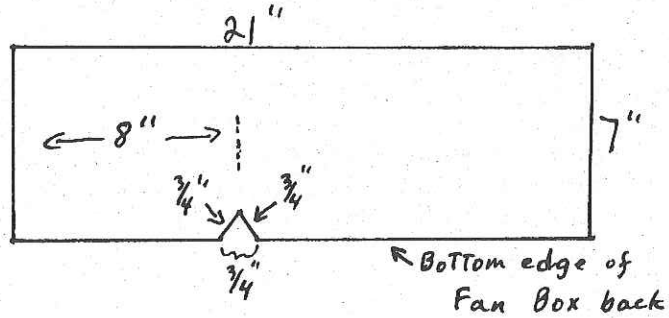


Fig. 37

Step 42: For the next step (all lower half pieces) we used the following table:

The two lengths of 2" Mull Casing (actually 2" x 3/8", with both edges rounded, and in some locales called "DRES" for double rounded edge stop), each 8' long, were cut in the following manner, according to Step 43:

One 8' length: 48 3/4", 27"
One 8' length: 48 3/4", 27"

Step 43: We cut two pieces each 48 3/4" long and two pieces 27" long. The two short pieces became the join strips on the outside of the lower half's sides, and the two longer pieces became the join strips on the outside of the lower half's front and rear.

Step 44: We put the fan box pieces with the upper half, and gathered all the remaining lower half pieces together (front doors, center baffle, side baffles, drip pan plank, baffle supports, mattress supports, and join strips) in preparation for painting and installation.

Step 45: For the next two steps (for the "mattress frame pieces", see Step 5) we used the following table:

The three lengths of 2½" Mull Casing (actually 2½ x ½", with both edges rounded, and in some locales called "Chair Rail" or "DRES" for double rounded edge stop), each 8' long, were cut in the following manner, according to Steps 46 and 47:

One 8' length: 41", 25", 20"
One 8' length: 41", 25", 20"
One 8' length: 46", 46"

Step 46: We cut two pieces each 41" long, and two pieces each 25" long. These four pieces became the upper section of the mattress frame. (Their lengths are underlined in the above table.)

Step 47: We cut two pieces each 20" long, and two pieces each 46" long. These four pieces became the lower section of the mattress frame.

Step 48: We gathered all the mattress frame pieces together, and set them apart from the upper and lower half pieces.

Step 49: Lastly, from the piece left over from Step 8, we cut two 2" wide and 38" long strips for the lower half's top and bottom door frame molds. We placed these pieces with the other lower half pieces, calling them "molding strips".

Initial accessory installation

Step 50: Using 1¼" flat-head nails, we attached the side pieces of the fan box to the back piece as in Figures 50a and 50b, making sure that the notched edge of the back piece was in an orientation consistent with the left side piece (with the fan hole). Then we attached the top piece over the back and sides as in Figure 50c, and set the fan box aside.

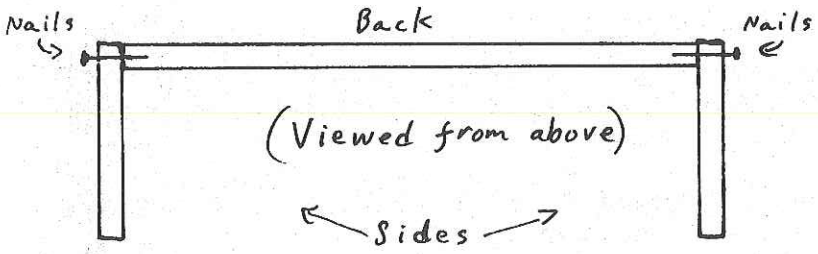


Fig. 50a

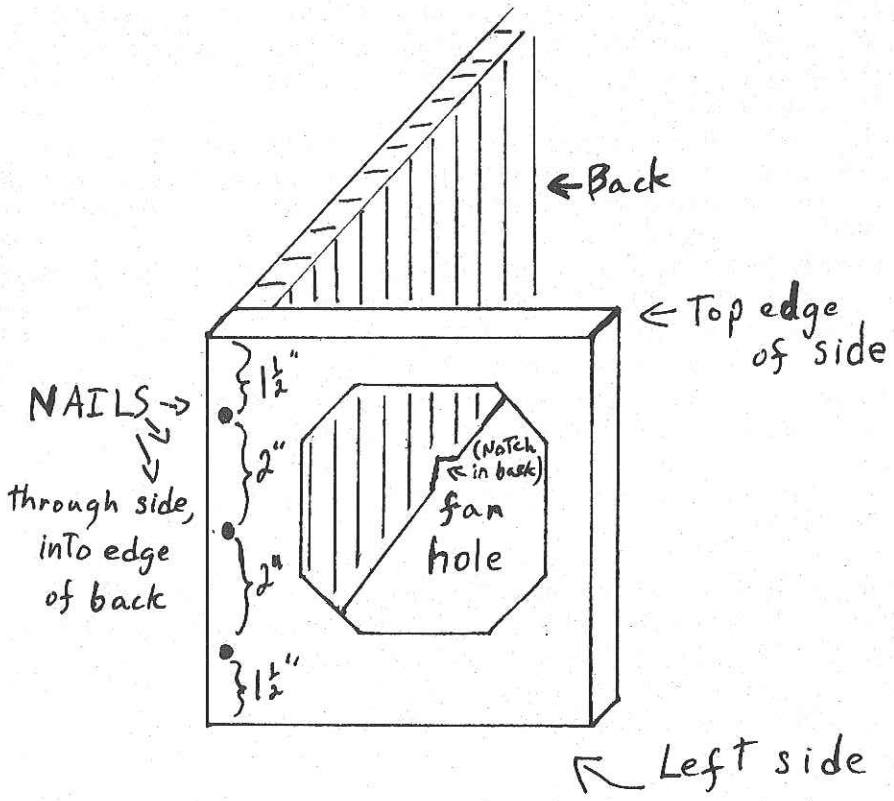
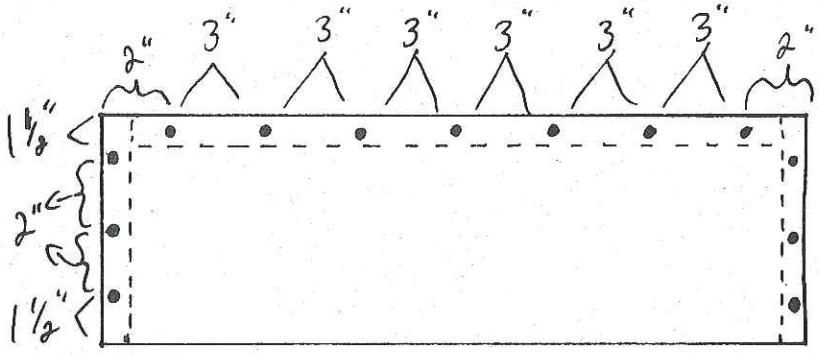


Fig. 50b



View of Top from above, showing Locations of nails through top into edges of sides and back.

Fig. 50c

Step 51: We placed the upper half upside down on a flat surface. Using a 4' long straight edge, we inspected the edges of the upper half that were to meet the lower half when they were joined, checking for evenness, and trimmed the edges as necessary.

Step 52: We repeated for the lower half (right side up) the steps accomplished with the upper half in Step 51.

Step 53: To prepare the 2"x2" mattress supports and the 2" DRES join strips for installation, we proceeded as follows:
A: On each of the four mattress support pieces, and the four join strips, we marked the center line.
B: We applied C, D, and E below to the front edge (lower half) mattress support and join strip (using, for the front edge support and strip only, flat-head bolts instead of the round-head bolts used everywhere else).
C: On the workbench, we placed the join strip (with its rounded edged surface facing down), beneath the mattress support, with their center lines coinciding, and one of their long sides flush together (see Figure 53a).
D: Holding them firmly in this position, we drilled two bolt holes (through both pieces). The holes were 12" from the center line, one on either side of it. ALSO, they were located 1" below the edges that were flush together (see Figures 53a and 53b).
E: We temporarily bolted them together with 3" long bolts, with the nuts placed against the mattress support.

Step 54: We repeated C through E of Step 53 for the rear mattress support and join strip.

Step 55: We repeated C through E of Step 53 for one side's mattress support and join strip, with the exception that the bolt holes went only 6" (NOT 12") from the center line.

Step 56: We repeated Step 55 for the other side's mattress support and join strip.

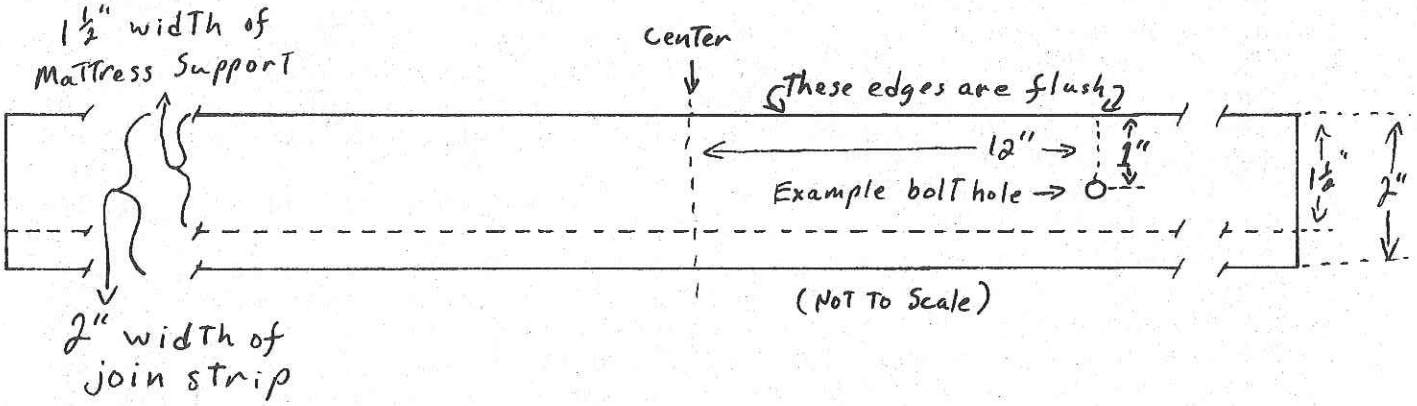


Fig. 53a

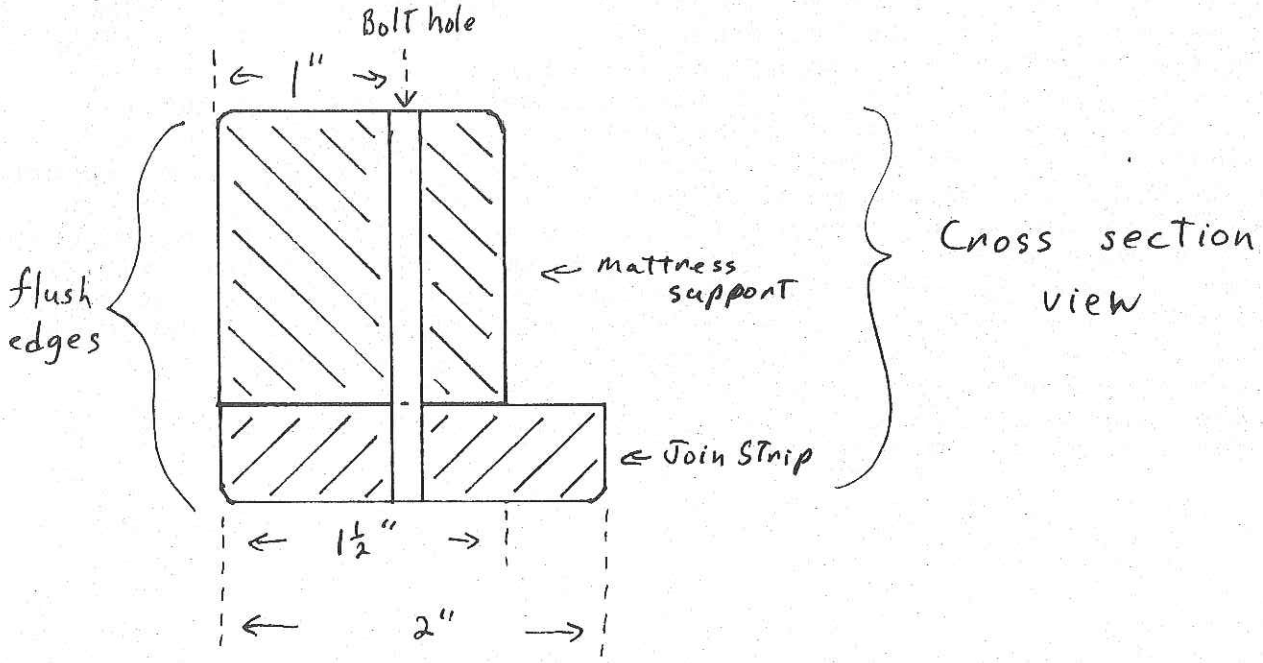


Fig. 53b

Step 57: To install the mattress supports and join strips to the lower half, we proceeded as follows:
A: We marked the centers of the lower half's front, rear, and side edges (see Figure 57a). On the outside of each of these edges, we marked a line 1½" below the top of the edge.
B: We applied C, D, E, F, and G, below, to the front edge and its join strip and mattress support. (For the front edge, we used the strip and support that we put together earlier with flat-head bolts.* See Step 53B.)
C: We removed the bolts from the mattress support and join strip.
D: We placed the join strip against the outside of the lower half's edge so that the strip's bottom edge (the one that was NOT flush with the support) rested on the line drawn in Step 57(A). We made sure that the strip's rounded corner surface faced us, not the lower half's edge. The strip's center, and the center of the edge, were lined up. For the front and rear strips, the strip extended beyond the lower half's edge, on each end, by about 3/8". For the side strips, the strips' ends were flush with the lower half's side edges. ALSO, the strip was always placed so that ½ inch of it was above, and 1½ inches of it was below, the lower half's edge (see Figure 57b).
E: We marked the bolt-hole locations on the lower half's edge, through the join strip bolt holes, and drilled the edge's bolt holes.
F: Using the same bolts we removed (with the nut again placed inside, against the mattress support), we bolted the join strip and mattress support to the lower half's edge, with the edge between them (see Figure 57c, a cross-section view).
G: Then we added, from the inside, one more 3" bolt and nut to each end of the mattress support. "From the inside" because we needed to be sure that the location for these bolts put them through the join strip, and the plywood edge, and the mattress support, without ending up in a position that would interfere with positioning the side mattress supports. Therefore, we located the bolt holes 1 3/4" in from the ends of the mattress support and ½" up from the bottom surface of the mattress support (See Figure 57d). For the front edge, we again used flat-head bolts.* For the rear edge, we used the round head bolts as usual.
H: We repeated C through G above, for the rear edge and its mattress support and join strip.

*These flat-head bolts have their heads outside the Aircrib. Where it was necessary (to avoid damaging the area where the head met the wood) we drilled out wider but shallow indentations in the holes for the heads to rest in.

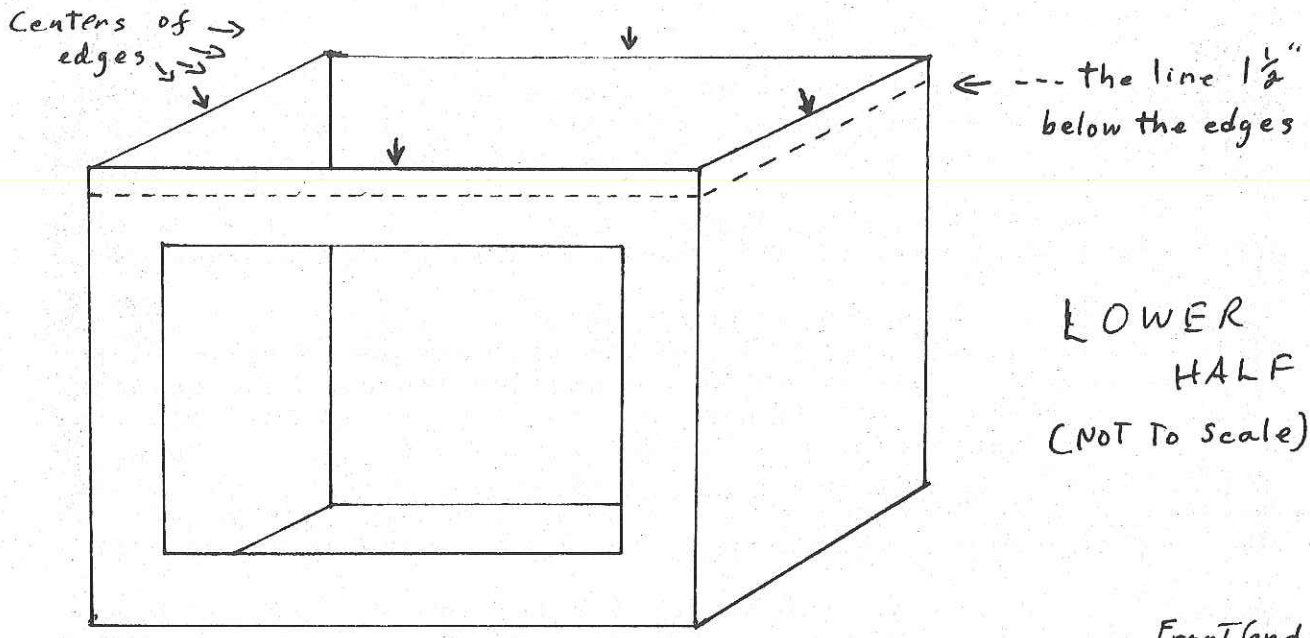


Fig. 57a

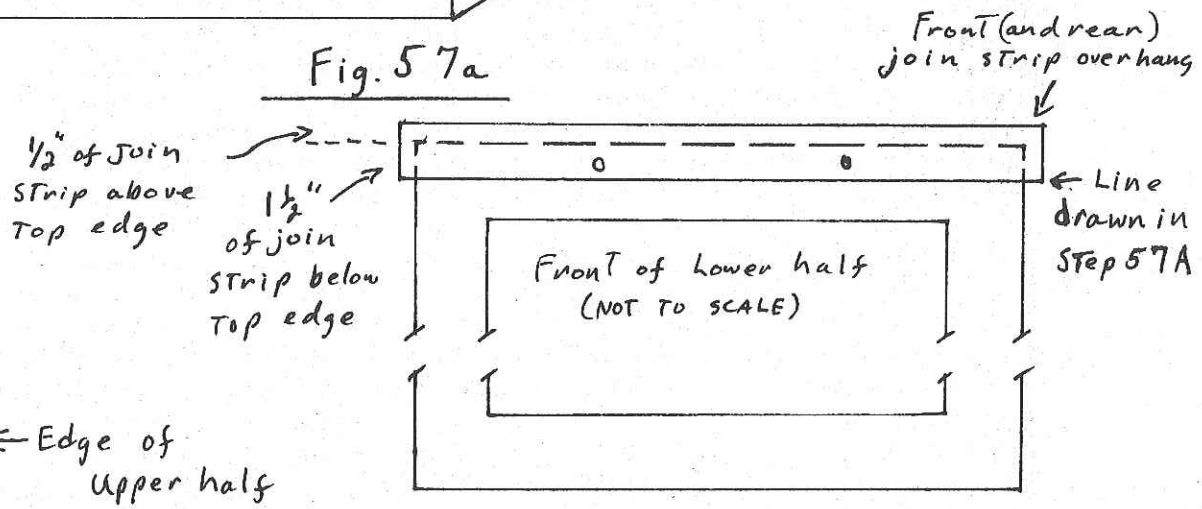


Fig. 57b

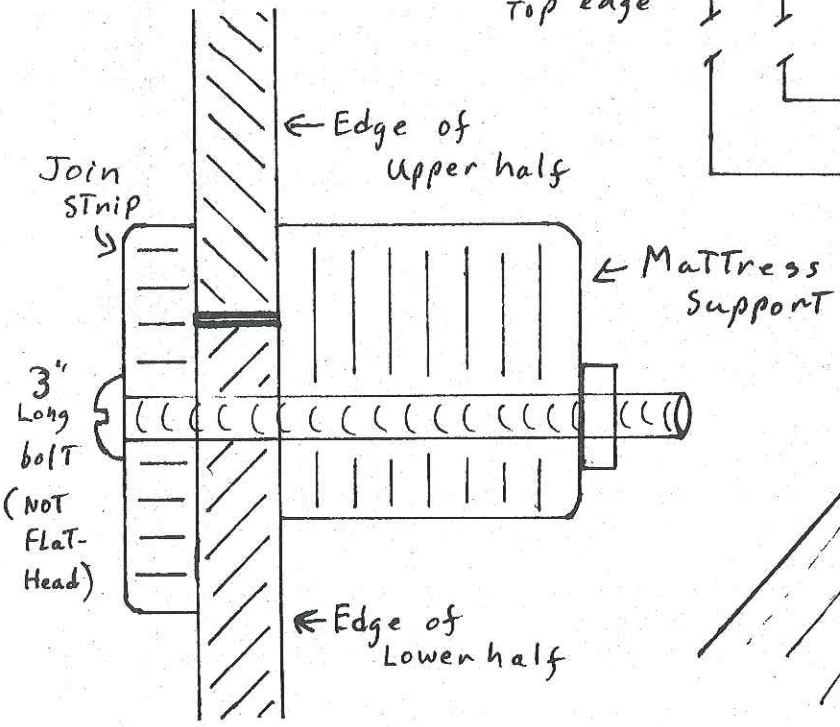


Fig. 57c

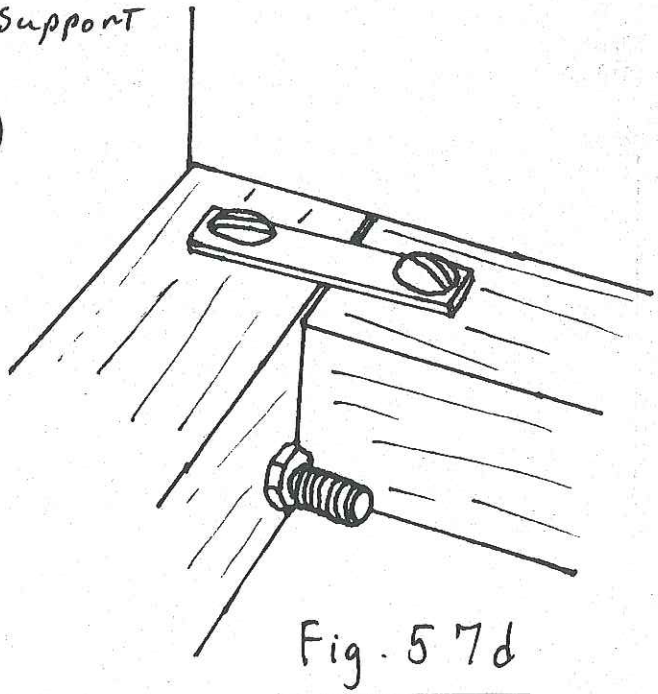


Fig. 57d

Step 58: We repeated C through F (not G) of Step 57 for one side edge and its mattress support and join strip, being sure that the side join strip was flush, on its end, with the front's join strip.

Step 59: We repeated C through F (not G) of Step 57 for the other side edge and its mattress support and join strip, being sure...

Step 60: We added a 2" x ½" "mending plate" (also shown in Figure 57d) across the intersections of the mattress supports in each corner. For each plate, we marked and drilled one end, bolting it down to the mattress support with a 2" bolt and nut (with the bolt head on top against the plate) before continuing. Then, while pushing and holding the intersection together tightly, we marked the plate's other bolt hole. Then we drilled this hole and bolted down the other end of the plate with a 2" bolt and nut.

Step 61: We joined the two halves together by placing the upper half's edges into the groove made between the raised portions of the join strips and the mattress supports. (We first loosened all join-strip/mattress support bolts and then settled the upper half down, before retightening the bolts.) We then checked for vertical wobble between the two halves from uneven edges (see Figure 61a). When necessary, to reduce the wobble while being careful to retain as level a fit as possible, we had to remove the upper half, trim its edges, and rejoin the halves. We also checked for proper horizontal fit of the upper half's edges into the groove (see Figure 61b) and, when necessary, and possible, used the extra length on the 3" bolts to adjust for the best fit we could get. (Wherever all measurements had been correctly executed, and the boards were not warped, the two halves joined together smoothly.) Then we separated the halves before going to the next step by loosening all the join strip/mattress support bolts and lifting off the upper half.

Step 62: To install the drip pan plank, we removed the nuts from the two join strip/mattress support bolts on the left side and on the right side. After placing a 1½" elbow brace on each bolt (see Figures 62a and 62b) we replaced the nuts.

Step 63: We placed the drip pan plank atop the four braces and, from underneath, through the holes at the ends of the braces (of course), we marked the bolt holes on the drip pan plank. Then we removed the drip pan plank and drilled the bolt holes.

Step 64: To be sure it fit, we replaced the drip pan plank and bolted it to the braces with 3/4" long bolts, with the heads on top against the plank and the nuts underneath against the braces (see Figure 62b, above).

Step 65: Once again, we removed the drip pan plank (for the painting steps to come), leaving the nuts and bolts connected to the braces.

Vertical fit

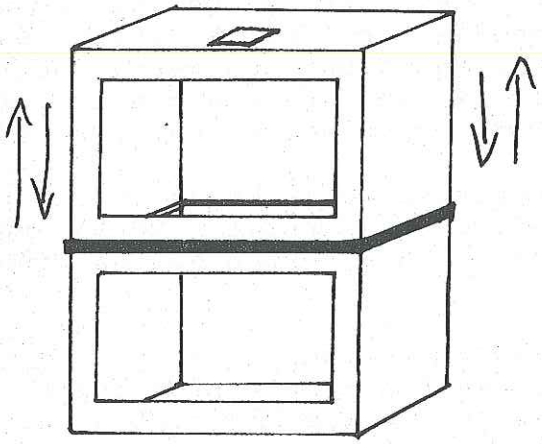


Fig. 61a

(NOT To Scale)

Horizontal fit

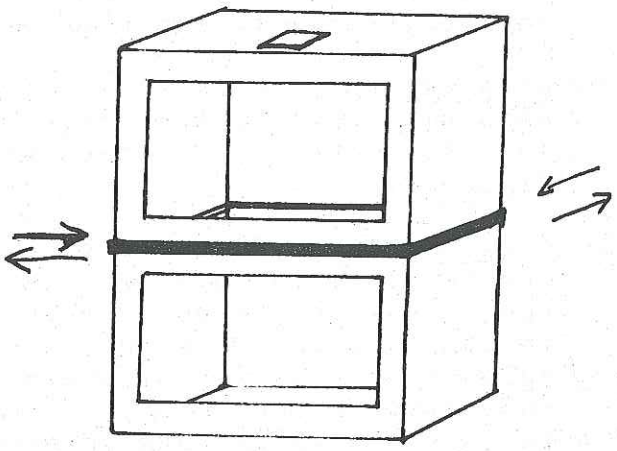
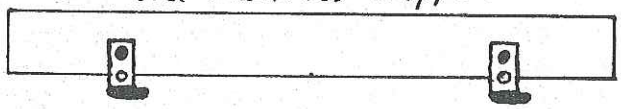


Fig. 61b

side Mattress Support



(NOT To Scale)

Fig. 62a

Cross Section View

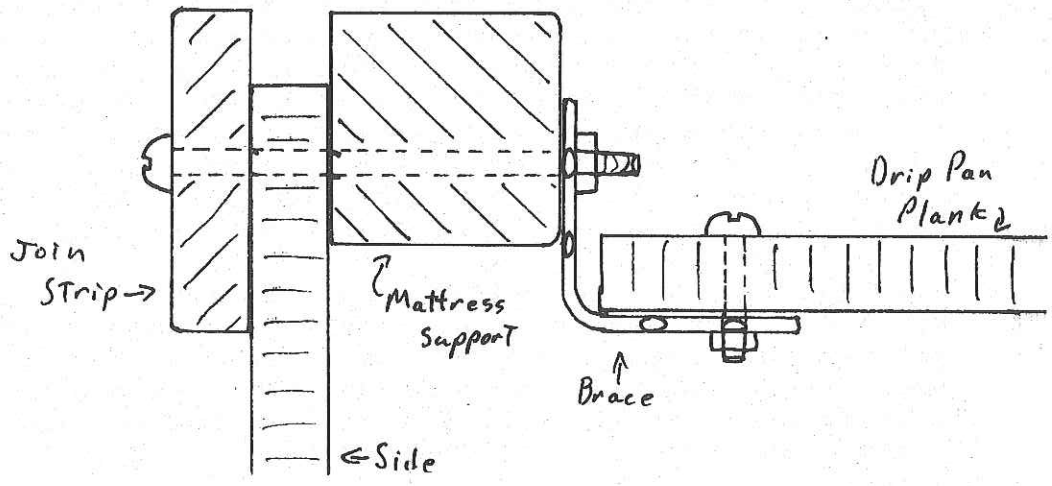


Fig. 62b

Step 66: Note: the side baffles are called "side" baffles because the center area between them, as they rest against the front and rear, is open and covered by the "center" baffle (which leaves open spaces between its edges and the front and rear) located above them (see Figure 66). All baffles are connected to the side walls by their baffle supports, as described below.

Step 67: For the side baffle supports, we marked a line across each side wall of the lower half, on the inside. The lines were 10" above the base. Also, we marked the center of the line. See Figure 67.

Step 68: Then we took each of two baffle supports in turn and treated them as follows: We marked the center line and placed two 1½" braces, each 6" from the center line and offset as described in Step 14, onto the support on an edge that assured that the support's rough-cut side would go against the side wall, as indicated in Figure 68. (Commonly, 2x2's are made by sawing 2x4's in halves without then smoothing the 2x2's newly sawed sides.) We marked and drilled the bolt holes closest to the braces' bend(!) and bolted the braces to the support using 3" long bolts and nuts, with the bolt head against the brace (temporarily) rather than against the wood.

Step 69: We took each of the "Step 68" supports in turn and did as follows: we turned the support over so that the braces pointed down and placed the support against the side wall so that the support's top edge rested on the line drawn across the side wall in Step 67, with the center of the support's edge coinciding with the center of the line on the wall (see Figure 69). Keeping the support in this position, we marked and drilled the bolt holes, on the wall, near the ends of the braces. For the left wall side baffle support ONLY (as viewed through the front frame) we cut off 1" of the end that was to go near the rear wall (for electric cord access) before continuing. Then we bolted the support to the side wall using 3/4" long bolts, with nuts on the inside against the brace.

Step 70: We placed both side baffles across the supports, one up against the rear wall, the other against the front frame (see Figure 66). For each side baffle in turn, we marked bolt holes where the baffle rested on the 3" long bolts that were holding the braces to the supports. We removed the baffle and drilled its bolt holes and reinserted the baffle to check its fit by placing it on the supports with each extra length of bolt, coming up through the support, resting in the baffle's bolt holes.

Step 71: Then we removed the side baffles, for the painting steps. We also removed the baffle supports, taking out the 3" bolts and setting them aside. We left the braces bolted to the side walls. (When we reinstalled the baffles later, each baffle bolt was inverted so that its head was against the baffle and its nut was against the brace. This applied to the center baffle as well, below.)

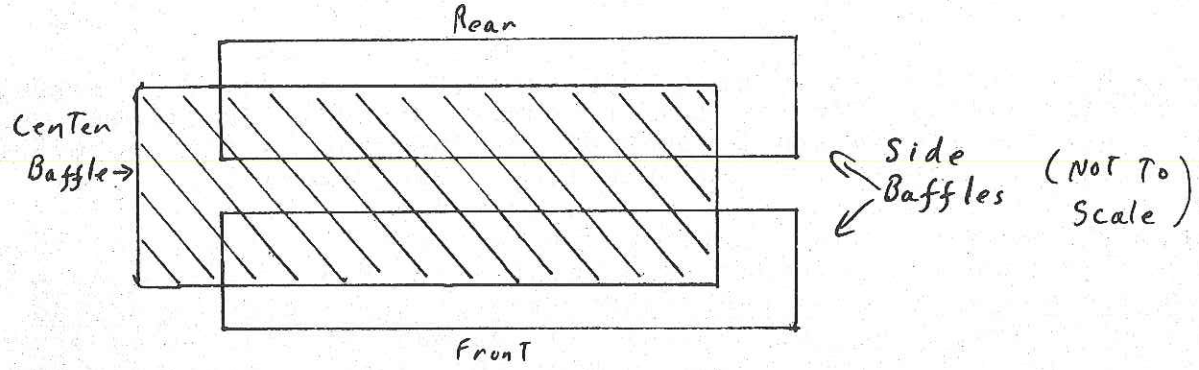


Fig. 66

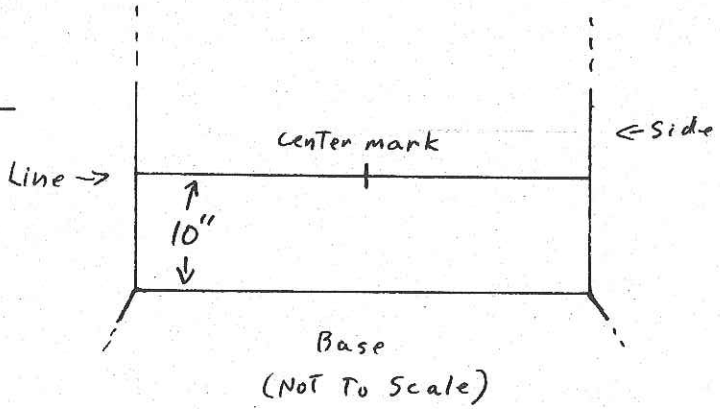


Fig. 67

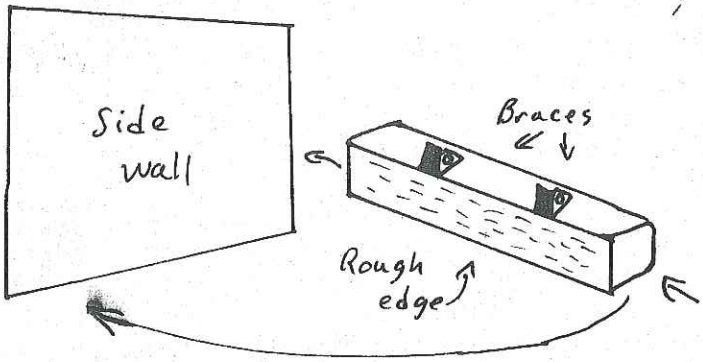


Fig. 68

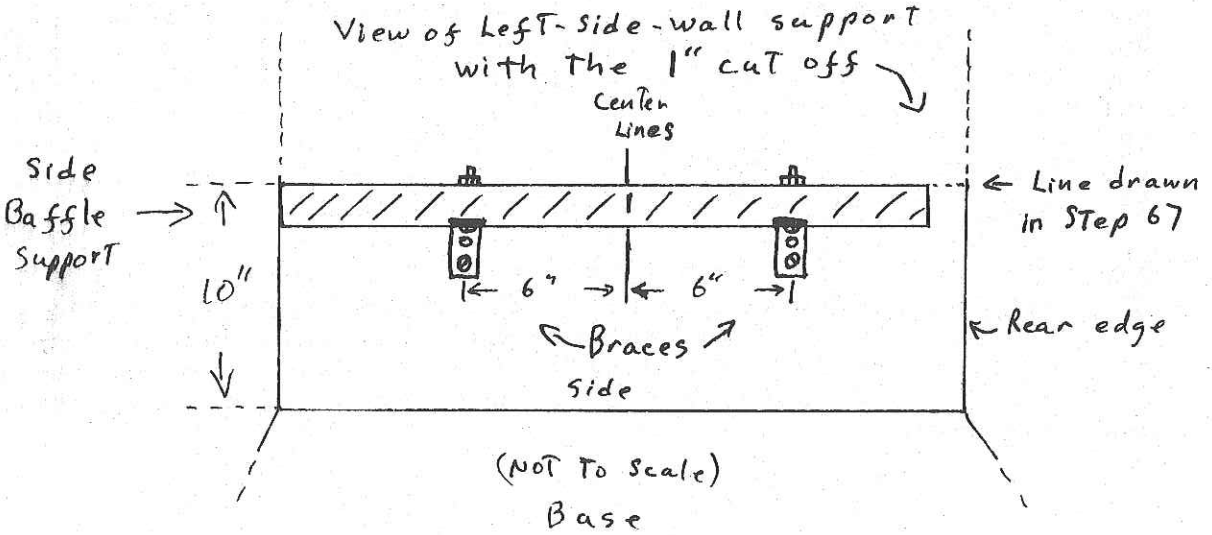


Fig. 69

Step 72: For the center baffle supports, we marked a line across each side wall of the lower half, on the inside. The lines were 4" above the line drawn in Step 67 for the side baffle supports. We also marked the center of the line. See Figure 72.

Step 73: With the two remaining baffle supports, using the lines drawn in Step 72, we repeated Steps 68 and 69 EXCEPT 1) that a third brace was put on the center line of the support and also bolted to the side wall, and 2) that we substituted "lines drawn in Step 72" for "lines drawn in Step 69", and 3) we ignored the reference to the "left wall side-baffle support". (See Figure 73.)

Step 74: We took the center baffle and marked the centerline of its two short edges. Then we placed the baffle across the center baffle supports with the baffle's centerline marks resting on the supports' center bolts. We marked the bolt holes where the baffle contacted the bolts (three bolts per side). Then we removed the baffle and drilled its bolt holes and reinserted the baffle to check its fit by placing it on the supports with the extra lengths of bolt, coming through the support, resting in the baffle's bolt holes.

Step 75: Then we removed the center baffle, for the painting steps. We also removed the baffle supports, taking out the 3" bolts and setting them aside. We left the braces bolted to the side walls. (The bolts were inverted later, as described in Step 71.)

Step 76: We installed the simple filter-holding bar (dowel), on the base, inside the lower half, in the following manner. At each of the locations on the base indicated in Figure 76, we drilled holes for the eye bolts (with a $1\frac{1}{2}$" shank, and with eyes large enough for the 22" long, $\frac{1}{2}$" dowel to pass through). Using one nut on each side of the base, we passed the eye bolts through these holes and adjusted the shanks such that the dowel, when passed through the eyes, remained about $\frac{1}{2}$" above the base. To hold the filter (14" x 25" is a common size filter; see the materials list) in place, we put half of the filter over the hole, and passed the dowel through the eye bolts that were on the side of the hole which corresponded to the filter's centerline. First, we put one end of the dowel through the rear eye, pushing the dowel toward the rear, then we reversed direction and put the other end through the front eye, pushing toward the front and letting the end of the dowel rest against the front. (Only one half of the filter's area is used over the hole at one time; when necessary, the first half is replaced by the second half, doubling the use of each filter.) We removed the filter for the painting steps.

Step 77: After turning the lower half face down on its front, we installed the two castor/wheels with brakes onto the front corners of the base, and the two ordinary castor/wheels onto the rear corners of the base, according to the location measurements given in Figure 77. We used 3/4" bolts with nuts against the castor's mounting plate.

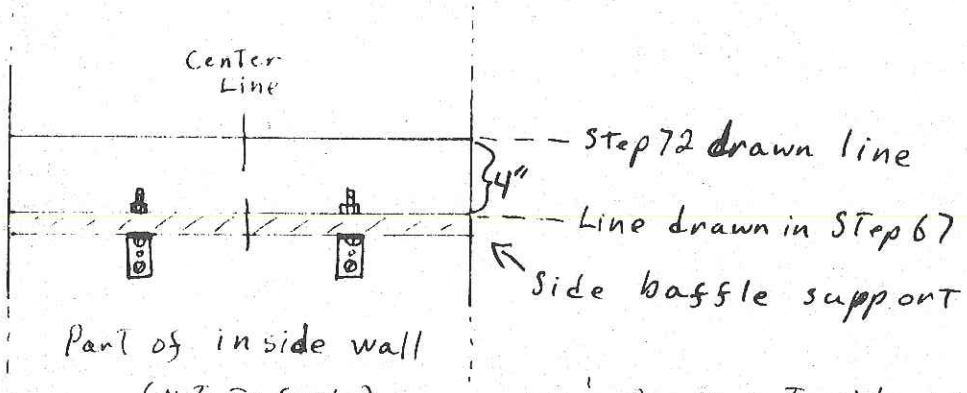


Fig. 72

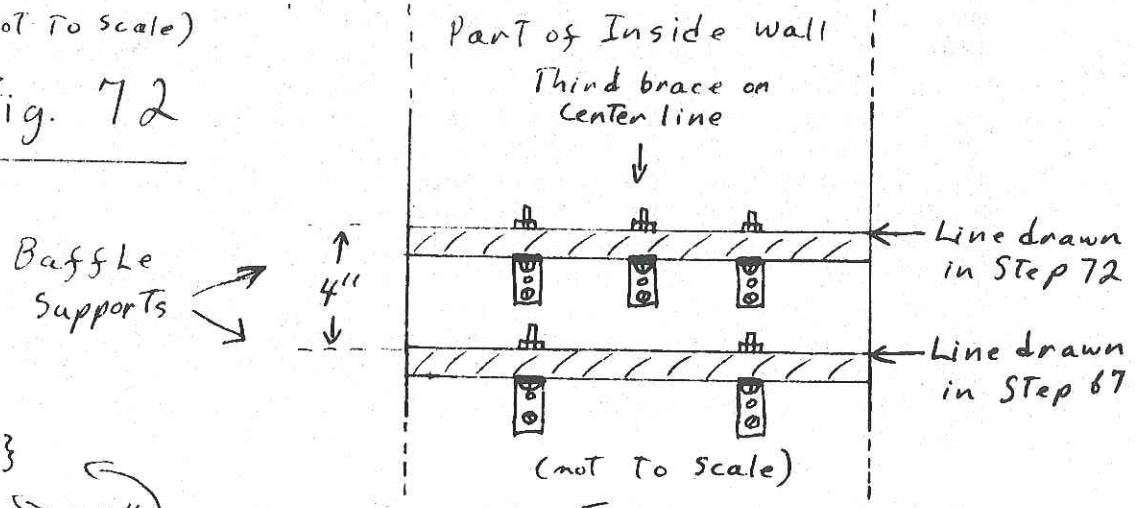


Fig. 73

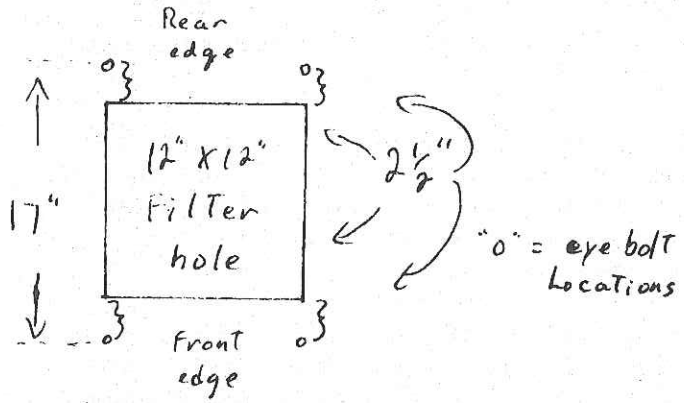
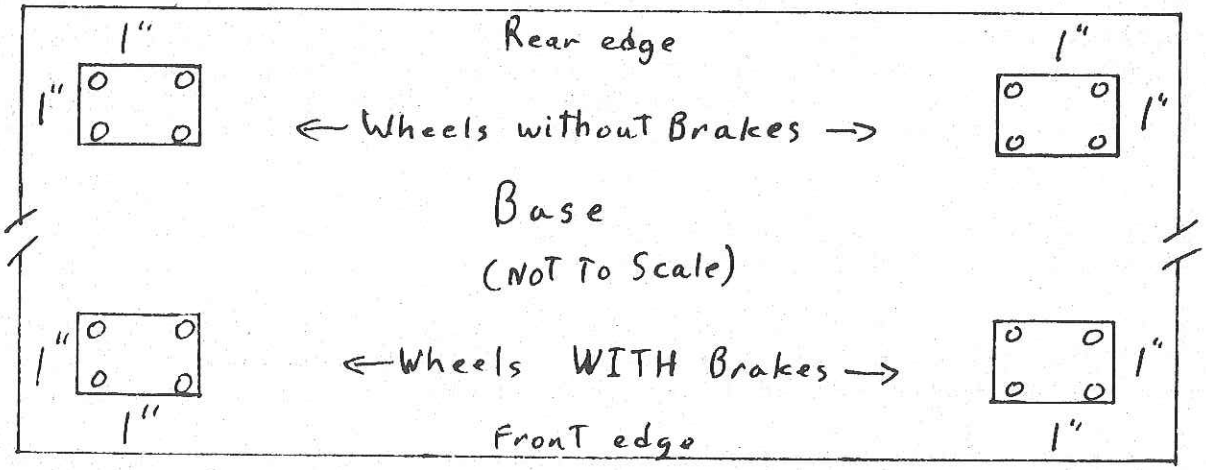


Fig. 76



Castor bolt-plate Locations

Fig. 77

Painting

NOTE: We used odorless, non-toxic, washable, (water clean-up) glossy paint (after the odorless, non-toxic, white oil-base latex enamel undercoater).

Step 78: Undercoating:
A: We placed the upper half with its roof on the floor and, starting with the inside and outside of the edges which will join with the lower half (as these need to dry first), we undercoated all the rest of the upper half, inside and out.
B: Placing the lower half with its rear wall on the floor, we undercoated the bottom of the base.
C: Setting the lower half back onto its castors, we undercoated all the rest of it, inside and out.
D: Keeping each piece separate, we undercoated the fan box, inside and out, and all sides of each of the other pieces: the lower half's front doors, the molding strips, the drip pan plank, the center and side baffles, the filter-holding dowel, the mattress frame pieces, etc.
E: Placing the upper half right side up, we undercoated the roof top.

Step 79: (We always let parts dry before handling them again.) Placing the lower half with its rear wall on the floor once again, and using white paint, we painted the bottom of the base. Then we put the lower half back on its castors and painted all the rest of the outside (ONLY), again, white.

Step 80: Placing the upper half with its roof on the floor, and starting with the inside and outside of the edges which will join with the lower half (as these need to dry first), and using white paint, we painted all the rest of the upper half, inside and out.

Step 81: Keeping each piece separate, and using white paint, we painted the fan box (inside and out), and the outside and edges of the lower half's front doors, and all surfaces of all the mattress frame pieces. (Before painting the lower half's front doors, we placed them in the door frame different ways until we were sure of the best fit, and marked them.) Still using white paint, we painted all sides of all remaining pieces not listed in Steps 82, 83, or 84.

Step 82: Placing the upper half right side up and using white paint, we painted the roof top.

Step 83: With the lower half still on its castors, and now switching to black paint, we painted all of the lower half's inside, including the inside edges of the front door frame.

Step 84: Keeping each piece separate, and using black paint, we painted the inside surface of the lower half's front doors, and all surfaces of the molding strips, the drip pan plank, the three baffles, the four baffle supports, and the filter-holding dowel.

Remaining upper half accessories

NOTE: For all steps in this section, we used the usual ¼x20 bolts of the length designated, with bolt caps (unless otherwise specified), putting the bolt heads inside the Aircrib. Also, we did not remove all of the paper covering the Plexiglas pieces, so as to keep them from getting scratched.

Step 85: We covered the 5" x 5" vent hole on the outside of the Aircrib with a 6½" x 6½" square piece of ¼" mesh screen and fastened the screen into place with a staple gun and staples (which were not long enough to go all the way through the plywood).

Step 86: Turing the upper half over carefully so that its rear window space faced up, we removed a 3" square of paper from both sides of the Plexiglas at the places indicated in Figure 86. Viewing through the 3" squares on each edge, we evenly covered the rear window space with the rear Plexiglas window (30" x 42") whose edges extended about 2" beyond the edges of the space. We marked "OUTSIDE" on the outside surface of the pane, and "ROOF" along the roof edge. On the Plexiglas, 1" in from the edge all around, we marked bolt holes which lined up with the elbow brace bolt caps already on the window frame, extrapolating the two locations on the bottom of the window, from those on the top (or measuring for them: they were 12" from the bottom's center). We added an extra bolt location in the center of the top and bottom.

Step 87: We removed the Plexiglas and drilled the bolt holes. We stopped after each hole and removed a 1" square of the paper covering from around the hole on the drilling side (i.e., the outside). This also gave the drill a chance to cool between holes. We drilled slowly and at low speed so as to avoid overheating the plastic. (If it overheats it can crack and/or it can stop the drill.) After all the holes were done, we removed a 3" strip of paper from all of the edges, including the bolt holes, of the other side (i.e., the "inside").

Step 88: We repositioned the windows and drilled ONE hole at a time in the frame, through the pane's bolt holes, dropping a 1" long bolt through each hole as it was done to keep the window in position. When all the holes were drilled, we removed the bolts and the pane and cleared away the sawdust from both sides of the frame and the pane. Again, we repositioned the Plexiglas and bolted it to the frame with the 1" long bolts, and bolt caps, with a washer between the Plexiglas and each bolt cap (and with the bolt caps on the outside).

Step 89: For each side window in turn: we turned the upper half over so that the side window faced up. Then we repeated the applicable parts of Step 86 for the side window EXCEPT: 1) the bottom bolt hole locations were 6" from the center, not 12", 2) we did not add extra locations on the top and bottom centers, and 3) the side window panes each measured 20" x 28". Then, we repeated Steps 87 and 88 for the side windows. (See Figure 89.)

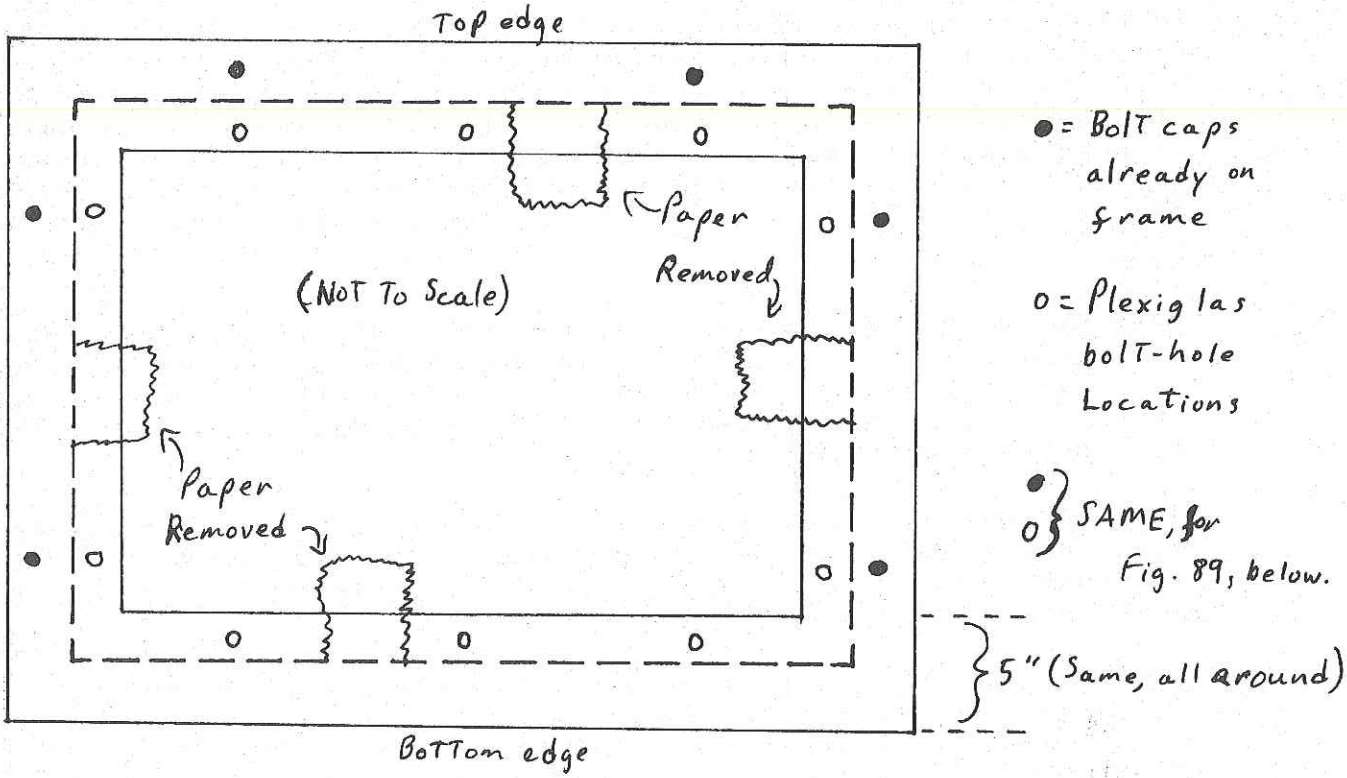

Top edge
Paper Removed
(NOT To Scale)
Paper Removed
Bottom edge
● = Bolt caps already on frame
o = Plexiglas bolt-hole Locations
SAME, for Fig. 89, below.
5" (Same, all around)

Fig. 86

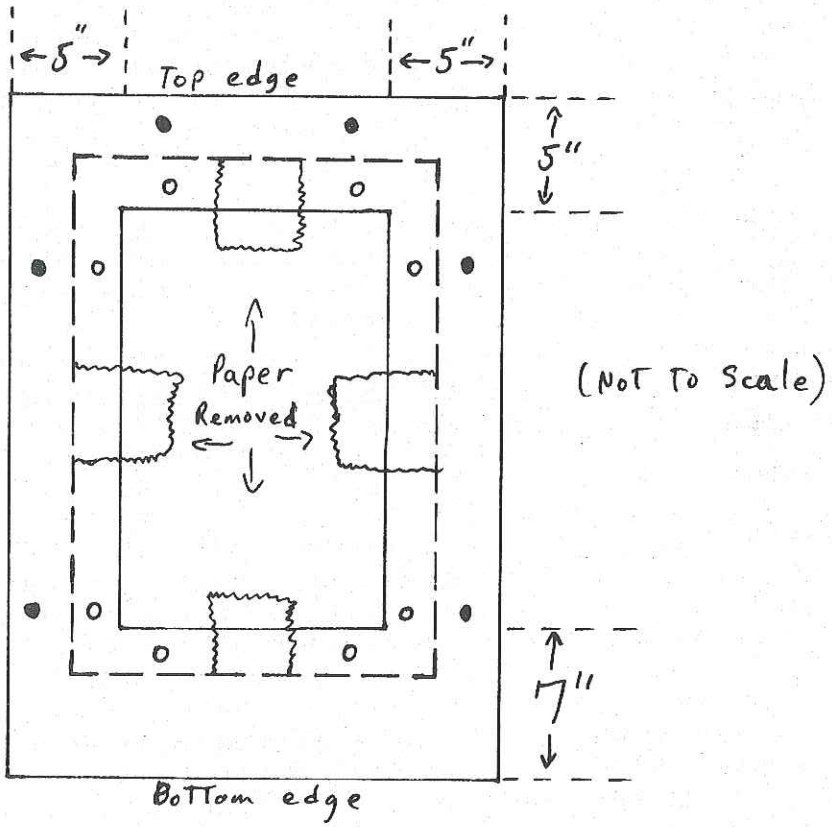

←5"→
Top edge
←5"→
5"
Paper Removed
(NOT To Scale)
7"
Bottom edge

Fig. 89

Steps for upper half's doors

NOTE: Another alternative got its own appendix: While Steps 90-99 below describe our installation of swinging doors on one of our Aircribs, the steps in Appendix C describe our installation of a sliding door on another of our Aircribs. We found the sliding door to be cheaper, easier to install, and, more important, safer. When we used a sliding door, we skipped these steps and continued with Step 100, doing Appendix C just before the "Finishing Touches" steps.

Step 90: With a hacksaw, we cut the 1½" x 48" piano hinge into two equal 24" lengths. To reduce the chance of either hinge pin falling out, we kept the original top end as the top end of one of the two hinges, but considered the original bottom as the top end of the other hinge.

Step 91: On both hinges, using a ¼" drill bit, we expanded the hinge holes that were to be used with ¼" bolts. We followed the alternating pattern in Figure 91, which shows the hinges as they were used on the Aircrib.

Step 92: Placing the upper half so that the rear window rests on the floor, we marked the center lines of the top and bottom edges of the door frame (the center-to-edge distances was 19"). We checked which edges of the Plexiglas doors (each 20" x 26½") fit best together, marked them, then we proceded. We set the doors in place so that their touching edges met tightly along the frame's center line. We marked one surface of each door "outside", and marked which edge was near the roof. Then we checked one door at a time. With all measurements and cuts being reasonably accurate, the doors overlapped the top and bottom by about ¼" and the sides by about 1" (see Figure 92). A greater side overlap was ignored. (A lesser side overlap would have required adjustments in the steps below.) We removed some paper to view the overlap.

Step 93: We removed the doors to the workbench one at a time, being careful not to move the other door until we had replaced the first one. For each hinge in turn, following the orientation in Figure 91, we placed the hinge flat atop its edge of Plexiglas, with the hinge pin a) set facing up, and b) half over the Plexiglas (see Figure 93). We put the top and bottom of each hinge 1¼" from the top and bottom of the Plexiglas, marked bolt holes on the Plexiglas through the six enlarged hinge holes, and drilled these bolt holes, recalling the drilling techniques mentioned in Step 87. Then we placed the doors back onto the upper half as described in Step 92 and marked, onto the door frame edges, the locations of the Plexiglas bolt holes, so that we would know where to drill the ½" wide but shallow (counter-sunk) depressions for the door hinges' bolt heads to rest in when the doors are closed.

Step 94: We checked the size of the heads on our bolts, moved the doors, and drilled out these depressions to fit the heads. Then we removed a 2" wide strip of paper from both sides of the doors along the hinge edges and bolted the hinges to the Plexiglas doors, using ½" long bolts, and nuts instead of caps so that the doors could swing open as far as possible. (The nuts were put on the outside.)

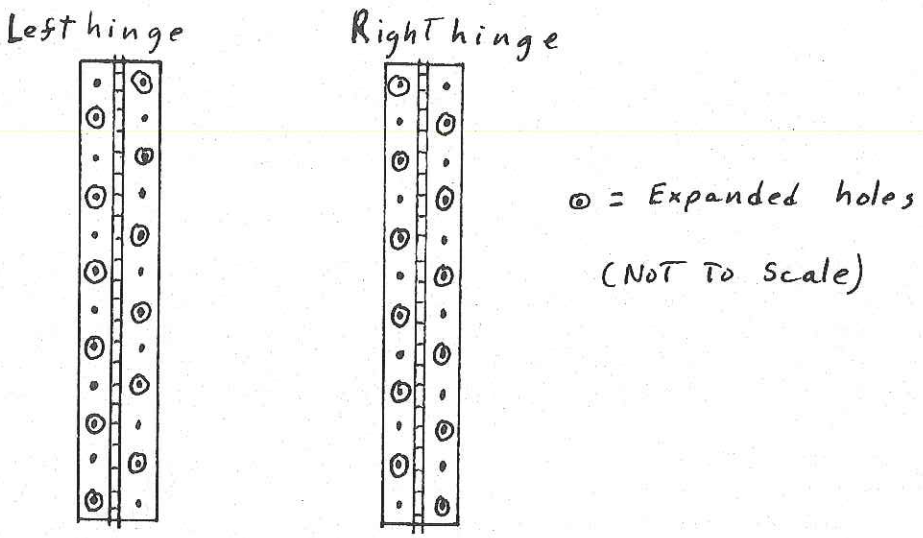


Fig. 91

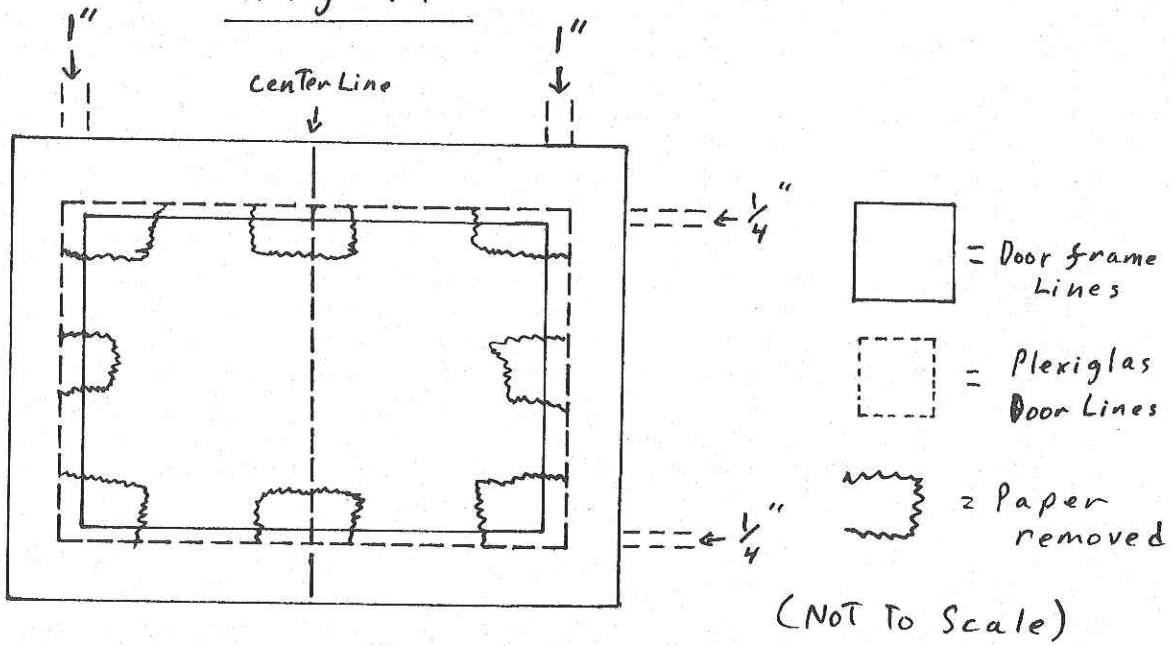


Fig. 92

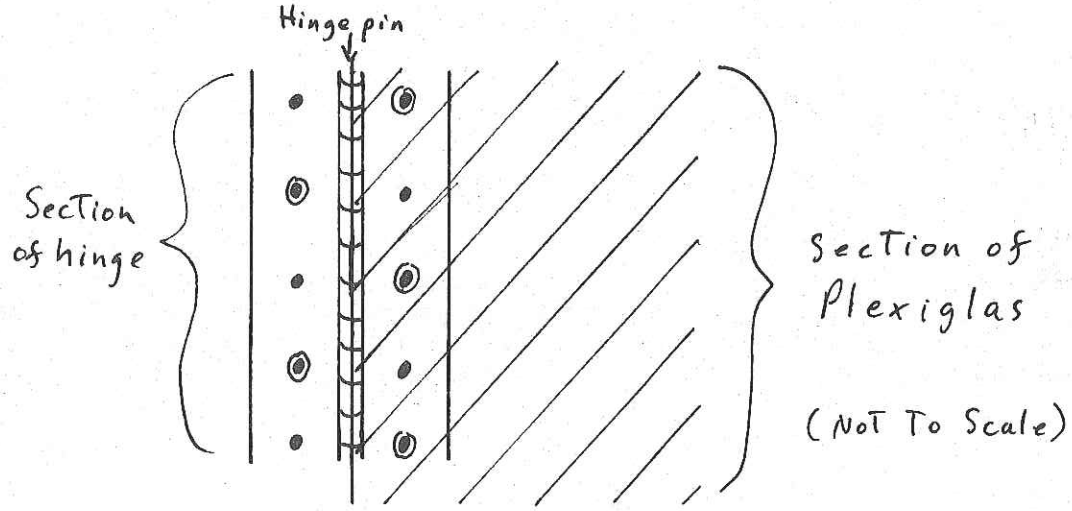


Fig. 93

Step 95: For attaching the Plexiglas doors, we used the two 1" wide strips of Plexiglas, each 26" long, as "build-up" strips to go under that part of the hinges which was to get attached to the door frame.

Step 96: We placed the doors into their positions. For each door hinge in turn, we placed the build-up strip in position under the hinge and marked its bolt holes through the enlarged hinge holes. Then we removed the strip and drilled the holes. Then we removed the paper from the strip and replaced the strip in position.

Step 97: With both doors in position and with each hinge's build-up strip in place, we put 1" long bolts temporarily through the hinge holes into the build-up strip holes to help keep the strips in the desired position during drilling. Then for each hinge hole, one at a time, we removed the 1" long bolt, drilled the frame's bolt hole through the hinge and build-up strip, and reinserted the 1" long bolt to temporarily hold the parts in place.

Step 98: Before proceeding, we drilled a bolt-hole in the center of each of the two 1" wide x 5" long Plexiglas build-up strips. We also drilled a hole 1" from each end of each strip for the 1 3/4" turn buttons. (See Figure 98a.) With the doors still temporarily held in place as described in Step 97, we set one of these build-up strips at the top of the doors, and the other at the bottom of the doors (see Figure 98b), with the center bolt-hole centered on the line where the doors met and with a hair's width between the strips and the doors. We then prepared to bolt each strip in turn to the door frame by drilling all these holes through the frame, through the strip (one hole at a time, center hole first), and putting a 1" bolt temporarily through the strip and the frame (center hole only) to hold the strip in place.

Step 99: We bolted the doors into final position by doing the following with each door in turn:
A: We removed the temporary bolts from the hinge/build-up strip/frame and took the paper off both sides of the build-up strip, noting which side contacts the frame.
B: After cleaning away all sawdust from all surfaces, we replaced the strip and put the hinge back over it and replaced the temporary bolt at each end of the strip.
C: Then, holding the door open, we put the 1" bolts into the other holes from inside the Aircrib and fastened them with nuts against the hinge.
D: We then did the same for the bolts at the ends of the strips and closed the door.
Finally, we removed the bolt from the center of the turn-button build-up strip and put it back through from inside the Aircrib, fastening it with a nut against the strip. Then we attached 1 3/4" turn buttons to the ends of each strip, with bolts placed from the inside of the Aircrib, and fastened as shown in Figure 99.

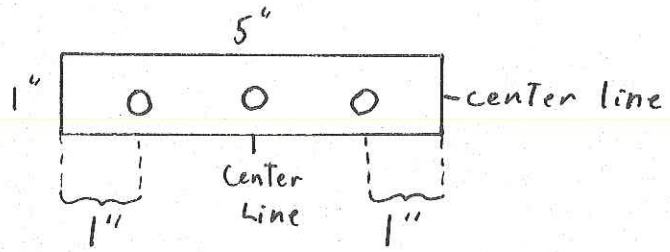


Fig. 98a

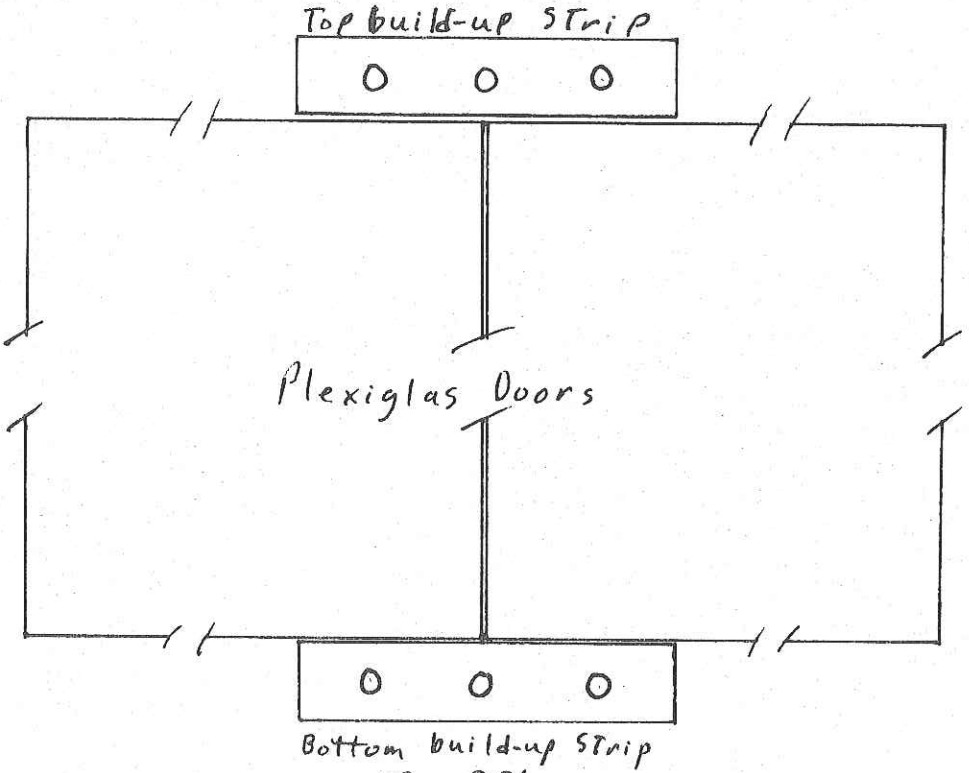


Fig. 98b

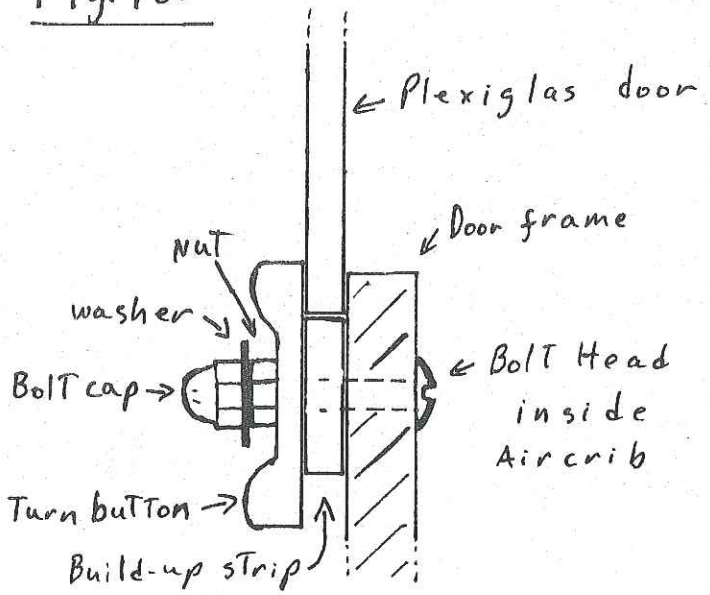


Fig. 99

Upper half accessories, continued

Step 100: For each side in turn, we placed the upper half with a side on the floor, and placed two 2 3/4" handles on the side that was up. The handles were placed one on each side of the lower part of the Plexiglas window (see Figure 100). We marked and drilled the bolt-hole locations and bolted the handles to the plywood with 3/4" long bolts with caps on the outside. Note: the brand of handles that we used, that fit the space between the join strip and the window pane edge, had only three bolt holes and these required a little enlarging to fit $\frac{1}{4}$ x 20 bolts.

Step 101: Finally, we stood the upper half upright and attached a spring closed cupboard hook, as a cord hook, as shown in Figure 101, to the right edge of the outside of the rear window frame, 2" below the top of the roof.

Fan box electrical accessories

Step 102: We began mounting the fan by placing it over the fan hole and marking the locations for its bolt holes. The fan for one Aircrib came with screens. The fan for another did not, so we made them with $\frac{1}{4}$" mesh screen. With screens on both sides of the fan, we mounted the fan with bolts of the size and length to do the job. We placed the fan inside the fan box so that the cord connection would end up in the lower rear corner of the fan box. (One screen was mounted on the outside of the fan box wall.)

Step 103: Having obtained an "Impedance Protected" fan (and made sure that our fan had at least 10 feet of cord), we decided to control the air flow by controlling the fan speed. So we installed a "ceiling fan" control in the following manner:
A: We placed a standard 4"X2" service box oriented vertically, on the inside rear wall of the fan box, with its vertical centerline $5\frac{1}{2}$" from the left wall of the fan box. Then, using the predrilled holes in the box, we marked and drilled two bolt holes in the rear wall of the fan box and bolted the service box to the rear wall with two 3/4" bolts, with nuts inside the service box.
B: We attached 2 cord clamps as shown in Figure 103a.
C: We cut the fan's cord 12" from the fan and, passing the cut ends through the cord clamps, we wired the ends as shown in Figure 103b, to the fan control which we then mounted on the face of the service box. Later, the fan's plug left the fan box through the notch to go down the back and through the cord access hole, in the rear of the lower half, to plug into the socket bus.

Step 104: We repeated Step 103A for the thermostat's service box, except that the box's vertical centerline was located $10\frac{1}{2}$" from the left wall of the fan box. Then we attached a single cord clamp. (See Figure 103a.)

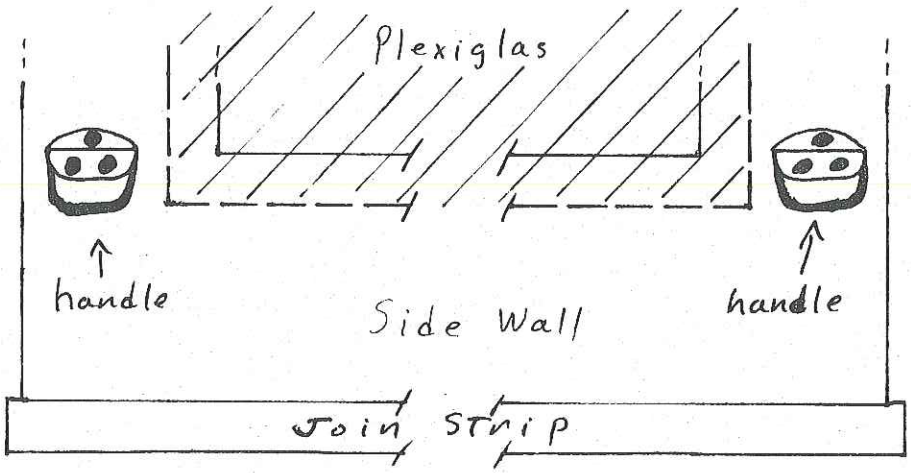


Fig. 100

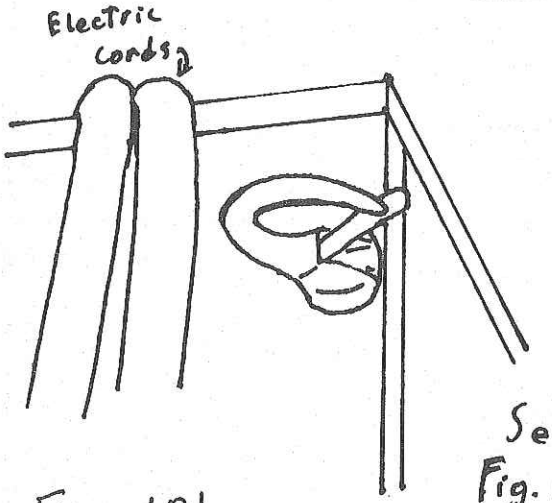


Fig. 101

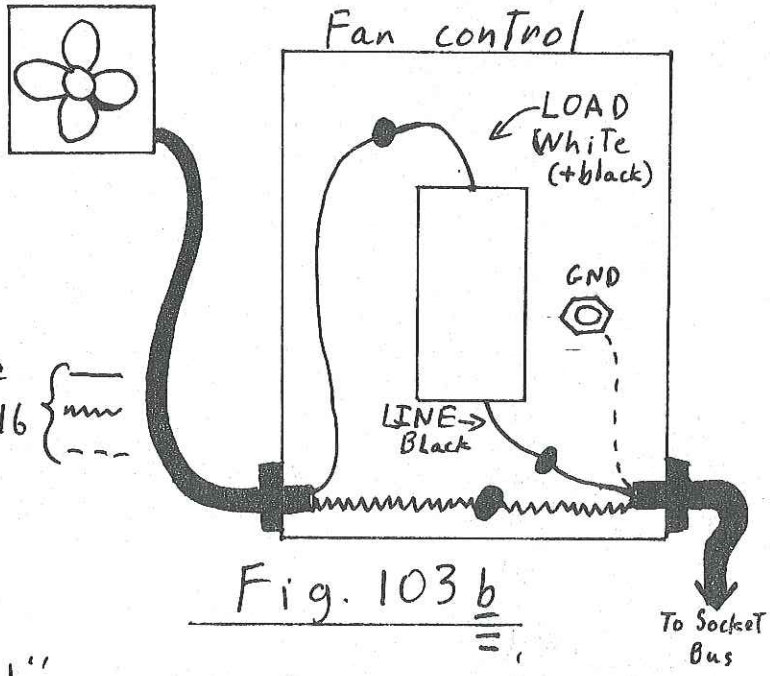
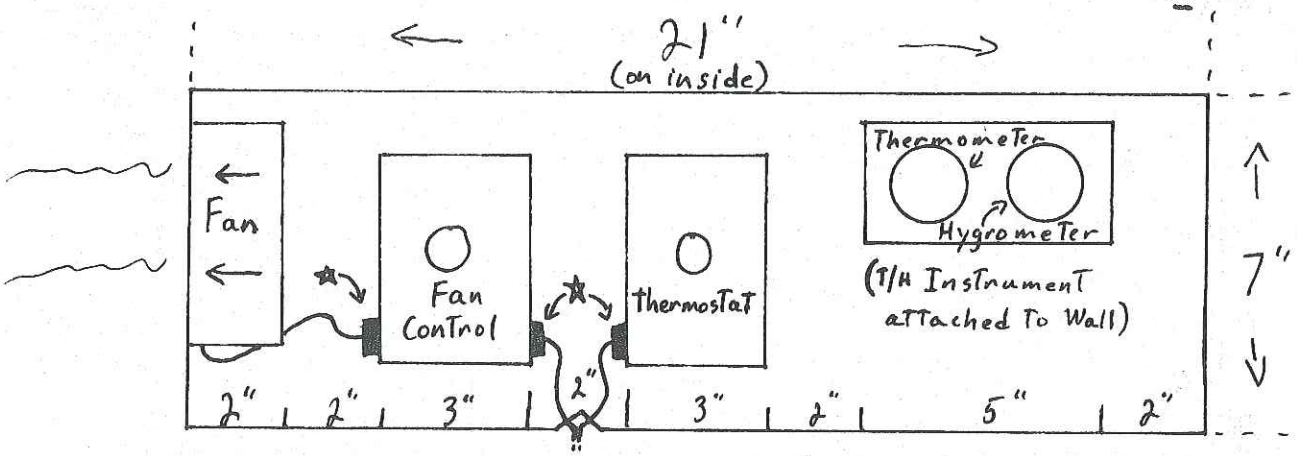


Fig. 103b



☆ = (Tightened) Cord Clamps

Fig. 103a

Step 105: Taking one end of 12 feet of 14/3 electric cord, we wired the single-line break (40°-90°F range) thermostat as shown in Figure 105, mounting the thermostat on the face of the service box. The thermostat cord would later exit the fan box through the notch and travel into the lower half, through the cord access hole, to be attached to the main junction box. This would hard-wire the lower half's rear wall and the fan box together (so when moving the two halves, the fan box always gets removed from the upper half and kept with the lower half).

Step 106: Offsetting them a full ¼" away from the edge, we placed one 1½" elbow brace on the outside in the center of the bottom edge of each of the fan box's side walls. For the brace on the side with the fan, we marked and drilled the hole closer to the brace's bend. For the other brace we marked and drilled the hole near the brace's end. Then we bolted the braces to the fan box with 3/4" bolts, with the nuts inside the box.

Step 107: Running the two cords through the notch, we placed the fan box atop the roof of the upper half, so that we could see 3/4" between the box's right side wall and the side edge of the air vent and so that we could see 3/4" between the box's rear wall and the rear edge of the air vent. We then marked and drilled the bolt holes at the ends of the braces to mount the fan box on the roof. For the right side, we used a ¼x20 eye bolt with 1½" of thread (more would have been OK) as shown in Figure 107b. For the left side we used an eye bolt with 3" (min.) of thread (more would have been OK) as shown in Figure 107a. The extra length of bolt on the left side was included because it would be in the way so that no one could put things in front of the fan and thereby block the air flow. Eye bolts were used because we could later hang mobiles from them if we choose to. (Finally, we clamped the cords from the fan box into the cord hook.)

Step 108: We attached the 8"x22" Plexiglas fan box door in the following manner:
A: We placed the door in position, taped it there, and set up two 3" strap hinges, each 7½" from its end of the door.
B: On the door, we marked the two holes nearer the end of each hinge and, after removing the door and drilling the holes, we removed all the paper from the door and bolted the hinges to it using ½" bolts with the heads against the hinges and the nuts against the door.
C: We then attached a 1 3/4" hasp to the center of the edge of the door that stands above the roof of the fan box. (We had to use smaller nuts and bolts that fit the hasp.) We then attached the hasp's staple to the top of the fan box where it would help hold the door in place tightly. (See Figure 108.)
D: We replaced the door into position and marked on the roof of the upper half the two holes nearer the end of each hinge and drilled the holes and bolted the hinge to the roof using 3/4" bolts with the heads inside the Aircrib and nuts against the hinges.

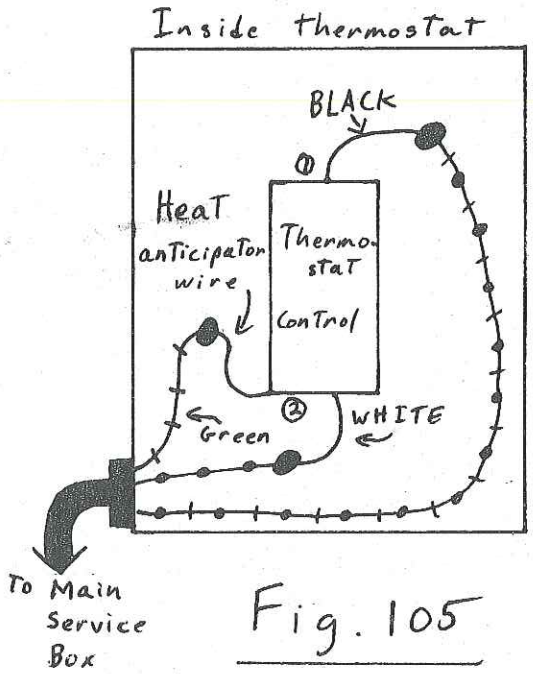


Fig. 105

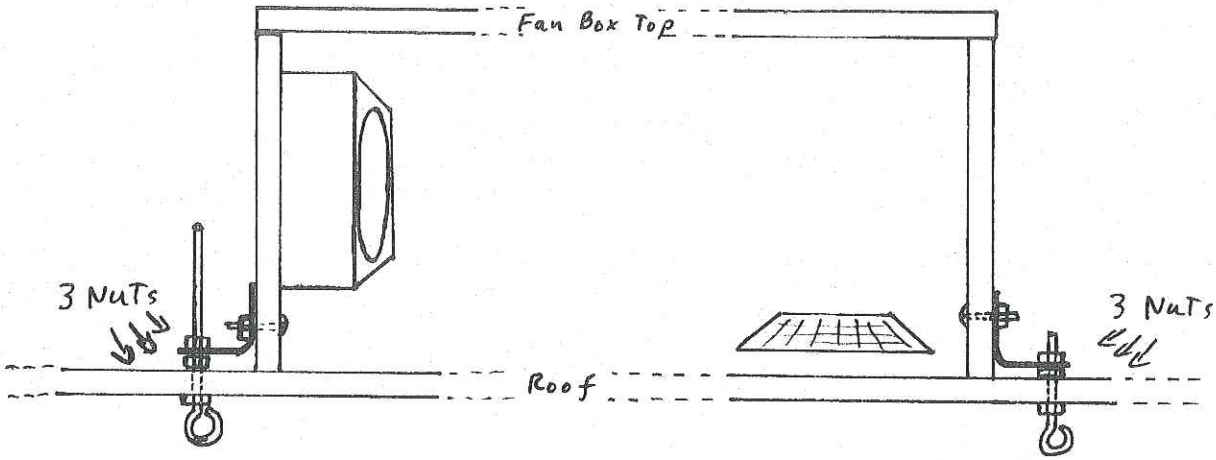


Fig. 107a

Fig 107b

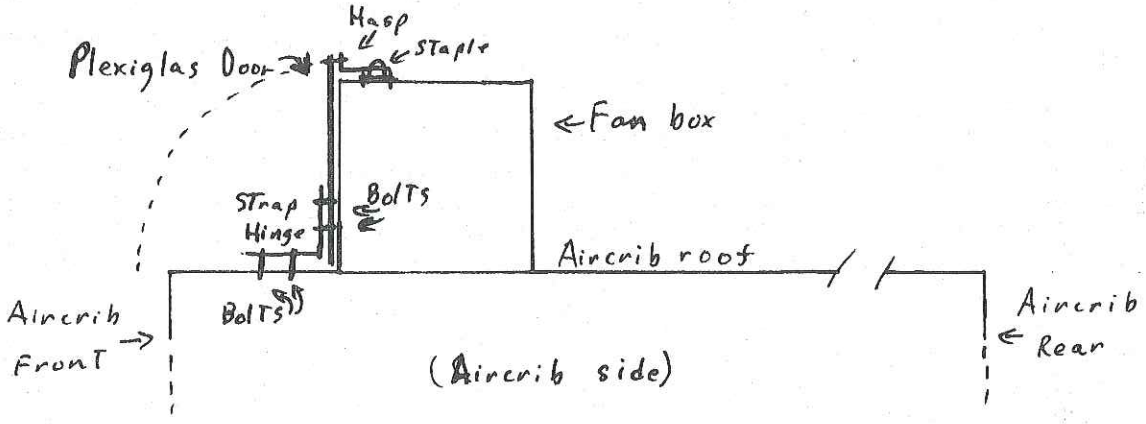


Fig. 108

Remaining electrical accessories

Step 109: To make these steps easier, we removed the lower half's rear wall by removing the eight bolts that held it in place (two at each side, two at the base, and one at each mending plate).

Step 110: We drew a horizontal line across the inside of the rear wall 5" above the bottom edge, and, at each of the locations specified next we drew an 8" long vertical line that was bisected by the horizontal line. The locations were all measured from the left side edge; they were, respectively, 10½", 20½", 27½", and 34½" from the left edge. (See Figure 110.)

Step 111: After checking the sockets and 3½" x 3½" service boxes for correct orientation to keep the light chains hanging straight down, and marking this orientation on the boxes, we mounted the boxes, centered at the 10½", 20½", and 34½" positions, by marking bolt holes on the wall through two of each box's predrilled mounting holes and bolting the boxes to the wall with 3/4" bolts with the nuts inside the boxes. (One nut in each box was left loose, to be tightened later after wrapping the exposed ground wire to the bolt beneath the nut.) We also installed the necessary cord clamp on each box; see Figure 111 for the locations of these lamps.

Step 112: We bolted the 4" x 4" main service box, at the 27½" location, in the same way as the other boxes, except that we offset the box towards the top of the wall to line up the cord clamp locations as also shown in Figure 111. Then we installed this box's cord clamps. We called this the "central box".

Step 113: The box at the 10½" position holds one light, and we called it the "single light box" or "SLB". The boxes at the 20½" and 34½" positions each holds two lights, via "Y" sockets. These we called "double light boxes" and one was designated "A" and the other "B"; hence "DLB-A" and "DLB-B" (see Figure 111).

Step 114: We drew some of our supply of 14/3 three-wire cord through the clamp into the SLB. (We always drew in extra slack wire during these steps, and never cut the cord until it was necessary to do so to go on.) Always following standard electrician's procedures and code, we wired the SLB cord to one of the light sockets. We then withdrew all but 1" of the insulated slack cord back out of the box, clamped down the cord, attached the ground wire by fastening it under one of the nuts on one of the box's mounting bolts, and mounted the socket to the box, covering all wiring. Then, we measured 3½ feet of cord from the clamp, cut the cord, and attached one of the three-prong plugs to the end of the cut cord to plug in the light, later.

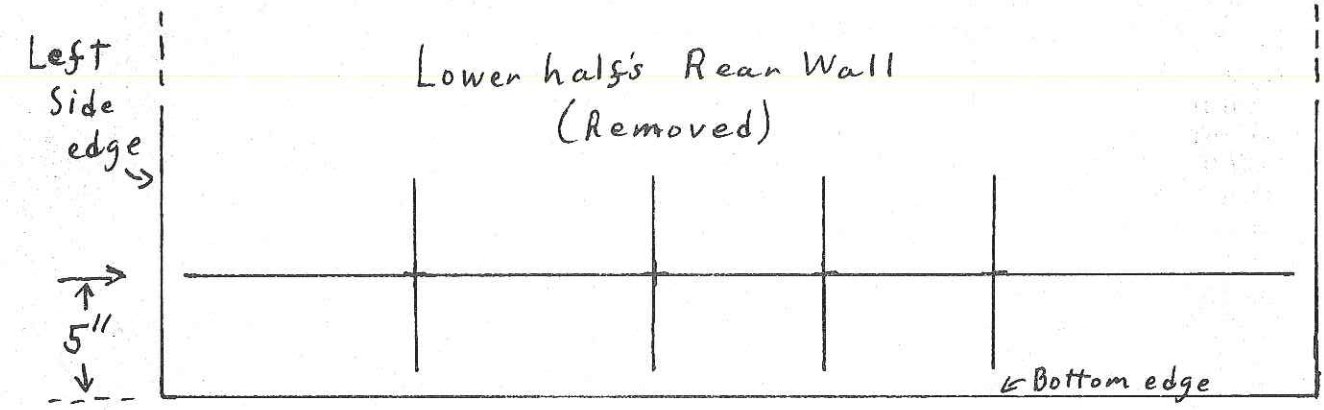


Fig. 110

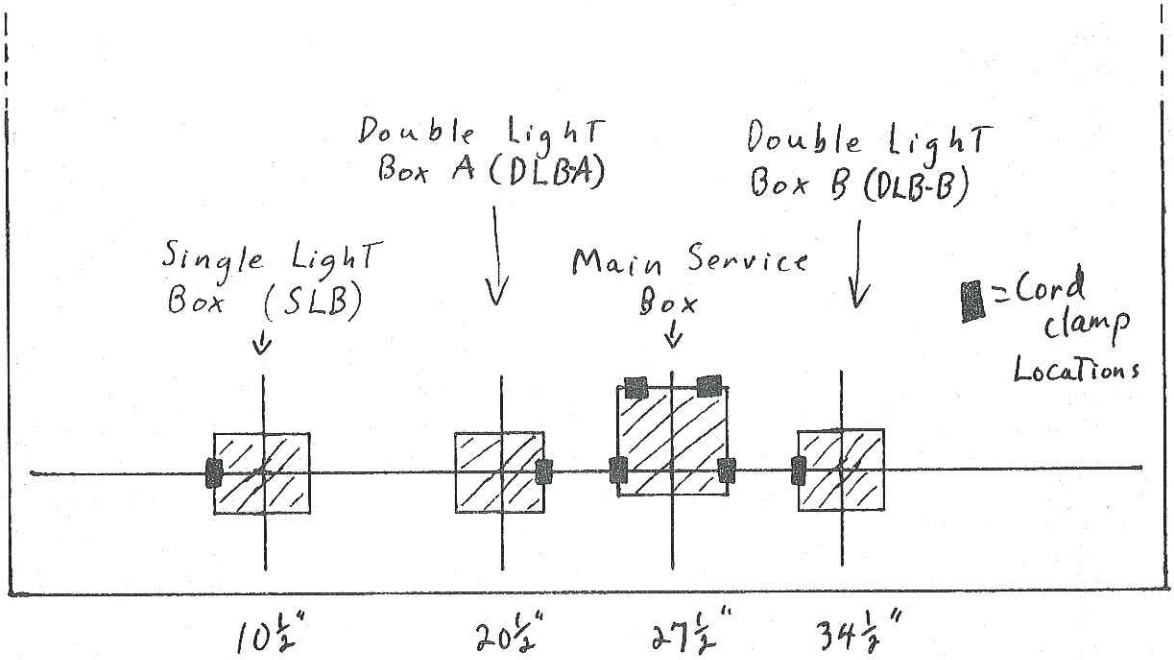


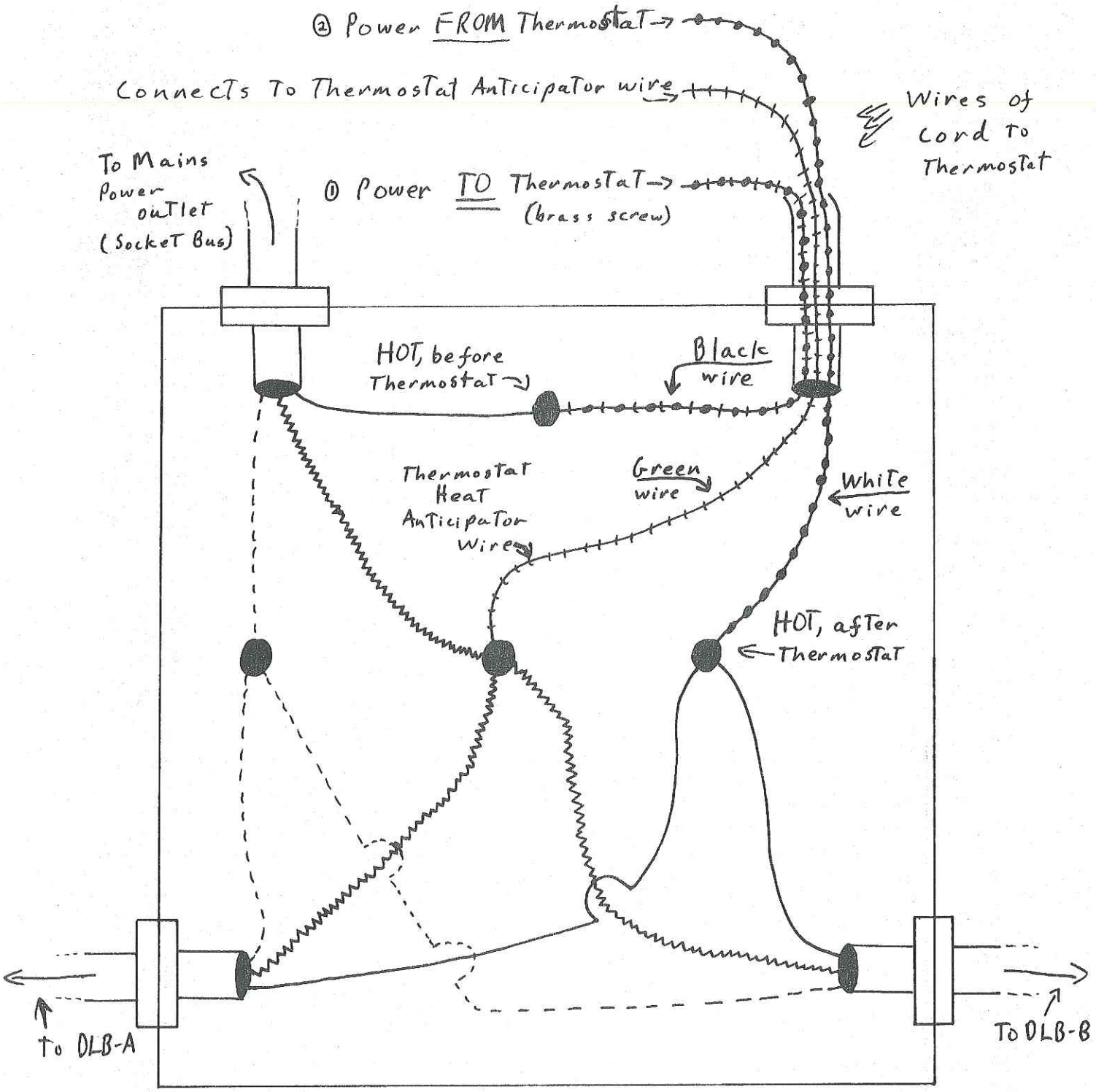
Fig. 111

Step 115: Similarly, for each of the double-light boxes (DLB-A and DLB-B) in turn, we drew some cord through the clamp into the box and wired the cord to a light socket. Then we withdrew the slack cord back out of the box leaving 1" of fully insulated cord on the box side of the clamp (as in Step 114) and clamped down the cord, attached the ground wire, and mounted the socket to the box. Then we measured 10" of cord from the clamp and cut the cord.

Step 116: We wired the central box as follows:
A: We inserted the cord from DLB-A through the left side clamp into the central box and inserted the cord from DLB-B through the right side clamp into the central box, and tightened the clamps on the central box.
B: We cut a length of cord five feet long, inserted 6" of one end into the central box through the top left clamp and tightened the clamp, and then we attached a three-prong plug to the other end. This cord would later plug into the socket bus for power.
C: We then took the 12' of cord connected to the thermostat, passed it through the cord access hole from the "outside" side of the rear wall, and inserted 6" of it into the central box through the top right clamp, and tightened the clamp.
D: We connected the wires in the central box, as shown in Figure 116, after removing the insulation from all but 1" of each cord.
E: Then we attached the central box's cover plate into position, covering all wiring.

Step 117: We placed the socket bus (after drilling mounting holes in its base tabs) on the upper surface of the center baffle, along the left wall about 2" from the left wall. We marked and drilled bolt holes and bolted the bus to the baffle with 3/4" long bolts and nuts, with the nuts on the underside of the baffle. The bus's cord was drawn out the cord access hole. Outside the Aircrib, it would be attached to a grounded (three-wire) extension cord in order to reach the grounded (three-hole) wall outlet that we planned to use to supply power to the Aircrib.

Step 118: We added a 15 watt light bulb to the single-light socket and two 60 watt bulbs each, with a "Y" adaptor, to the double bulb sockets. (We could always go to the 40 watt or 75 watt if necessary.) Before proceeding, we plugged in the SLB's cord to a wall socket and tested it. We also plugged in the main service box and tested the double lights and thermostat. We had to recall that these lights will go on and off as the thermostat is changed, only if their socket chains have not been pulled, breaking the circuit, and thereby turning the lights off. The lights go on if the thermostat is turned up and off when it's turned down. (Also, we had to remember 1) that the 15 watt bulb is always on, and 2) that the socket bus had its own power switch that had to be on.)



—— Black Wires (Main, Hot, power, Line,...)

wwww White Wires (return, Lead, Neutral, ...)

---- Green Wires (Ground)

①
②
} See Fig. 105.

Fig. 116

Remaining lower half accessories

Step 119: Laying the lower half's front doors flat, white (out) side up, we placed two 4" T hinges at roughly the "thirds" points (see Figure 119) on the outside edge of each door, adjusting the lower hinges so that NO bolts would catch on the front edge of the baffle when the hinges were bolted down. The hinge pins rested beyond the edges of the doors. Using only the two holes on each hinge strip that were farthest away from the pin, we marked and drilled the bolt holes and bolted the hinges to the doors with 3/4" bolts and nuts with the heads on the outside against the hinge.

Step 120: We placed the lower half so that the rear wall space rested on the floor, and drilled a hole 3/4" above the center of the upper edge of the door frame and another one 3/4" below the center of lower door-frame edge (see Figure 120a). We also drilled a hole half way from each end of each of the upper and lower door-frame molding strips, but only 3/4" from one edge and $1\frac{1}{4}$" from the other (see Figure 120b). We held the upper strip so that its center hole and the upper door-frame edge's hole coincided while $\frac{1}{2}$" of the strip was visible along the inside of the door frame, and bolted them together with a $1\frac{1}{4}$" long bolt with the nut inside against the strip. Then we did the same with the lower strip and the lower-door frame edge.

Step 121: We placed a turn button on the right side of the bolt holding the upper molding strip. The turn button's center was $1\frac{1}{2}$" from the bolt, and otherwise placed to assure that $\frac{1}{4}$" (no less) of either of the turn button's "wings" would extend beyond the edge of the door frame. We marked and drilled this hole (holding one end of the molding in place because the drill would need to go through the molding strip as well as the frame) and bolted the turn button to the frame/strip using a 2" flat-head bolt with a washer, a lock washer, and two nuts (in that order) on the inside against the strip (these were needed, with the two nuts tighter against each other than against the washers and the strip, to assure that the turn button would neither come loose nor be too tight to turn). We repeated this step for a turn button on the left side of the bolt holding the upper molding strip.

Step 122: We repeated Step 121 for the turn buttons that go on either side of the bolt holding the lower molding strip in place.

Step 123: For each of the lower half's doors in turn, we set the door in place, resting it on the molding strips, and marked each hinge's three bolt holes on the door frame. Then we drilled the holes and bolted the doors to the frame using 3/4" bolts with nuts on the inside.

Step 124: Before proceeding, we cleared out any residual sawdust inside the lower half and returned the lower half to its upright position. We attached a 1 3/4" hasp across the middle of the lower half's doors (and used a small padlock as necessary to keep small children out of the lower half).

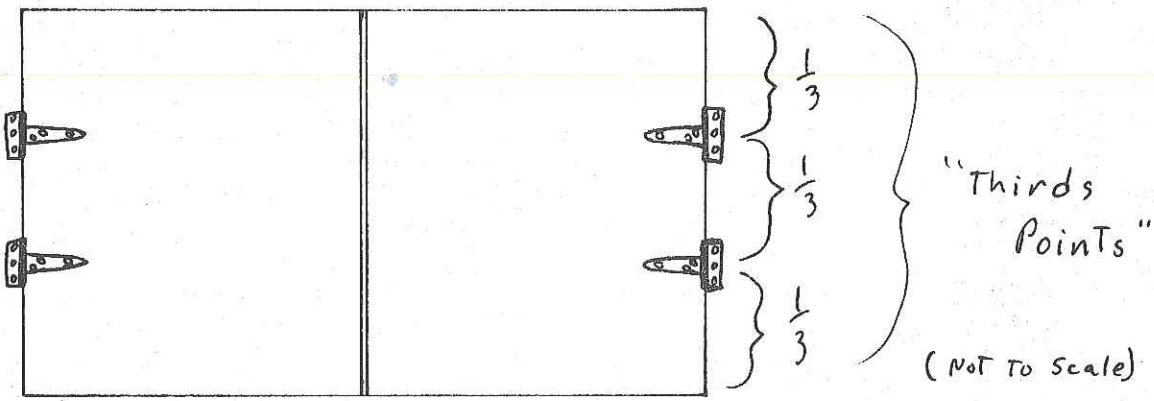


Fig. 119

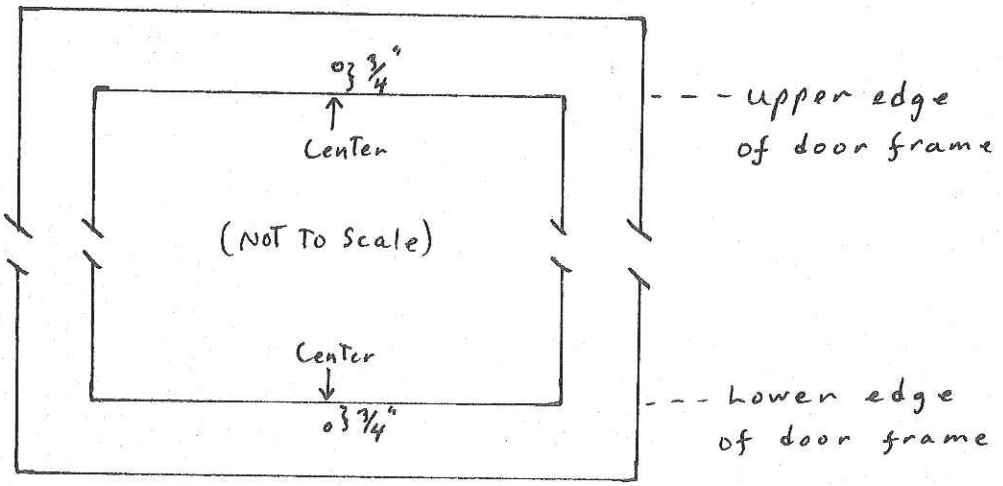


Fig. 120a

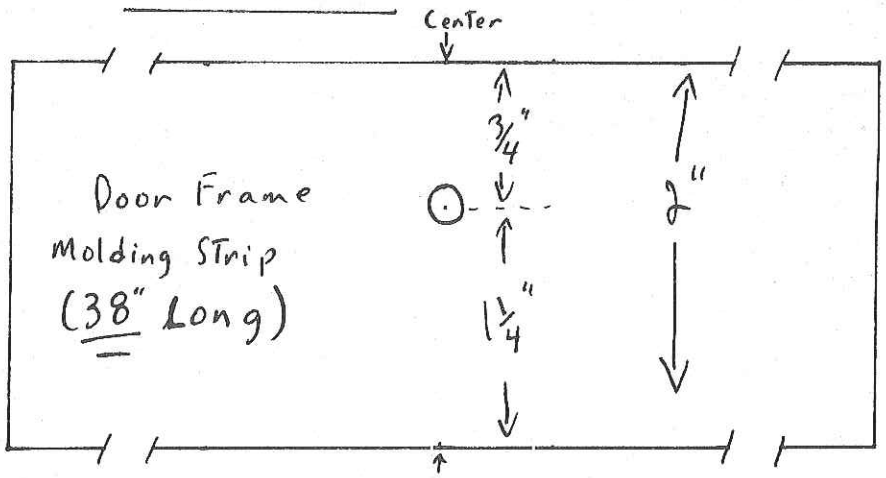


Fig. 120b

Step 125: We covered the 12" x 12" filter hole, on the inside of the lower half, with a 14" x 14" square piece of ¼" mesh screen and fastened the screen into place with a staple gun and staples (which were not long enough to go all the way through the plywood). Then we installed the filter in the manner already described in Step 76. We also lined the bottom around the filter, and up the sides (to the level of the baffles) with heavy aluminum foil to reduce heat lost through these areas.

Step 126: We inverted (from the position shown in Figure 73 and discussed in Step 71) the baffle support bolts, and reinstalled, through the rear wall space, the baffle supports, the center baffle, and the two side baffles, so that the heads of the 3" baffle-support bolts were against the baffles (see Figure 126).

Step 127: We reinstalled the drip pan plank, but attached it to the underside of its four elbow braces. Then we wrapped it, top and bottom, with heavy aluminum foil. (Model B: attach to top side.)

Step 128: Being careful 1) that the SLB's power cord would come up through the notch in the left corner of the baffle, and 2) that the main power cord and the thermostat cord would both come up (from the main service box) through the notch near the center of the baffle, we reattached the rear wall with its eight bolts (listed in Step 109). Then, after running the fan cord through the cord access hole, we plugged the fan into the socket bus. We also plugged the SLB's cord and the main power cord (from the main service box) into the socket bus. Then we ran the socket bus's cord out through the cord access hole and attached it to its extension cord which was ready to be plugged into a power outlet. Finally, we lifted the upper half and rejoined it with the lower half, tightening all the join-strip bolts.* (Later, when moving the Aircrib from the workshop to the bedroom, we had to separate the two halves and move one at a time. To do this, we detached the fan box from the upper half and set it on the drip pan plank in the lower half, while we did the moving. This was necessary because the Thermostat's cord, from the fan box, is hard wired to the main service box in the lower half.)

Using a conventional-crib mattress

NOTE: The next section describes the steps we took when using the design that followed the porous Aircrib mattress concept. Appendix D describles the steps (wood cuts, assembly, painting, installation, etc.) we took when we made design changes to allow us to use a conventional-crib mattress. See Appendix D.

*See the Air Flow Diagram, Figure 128.

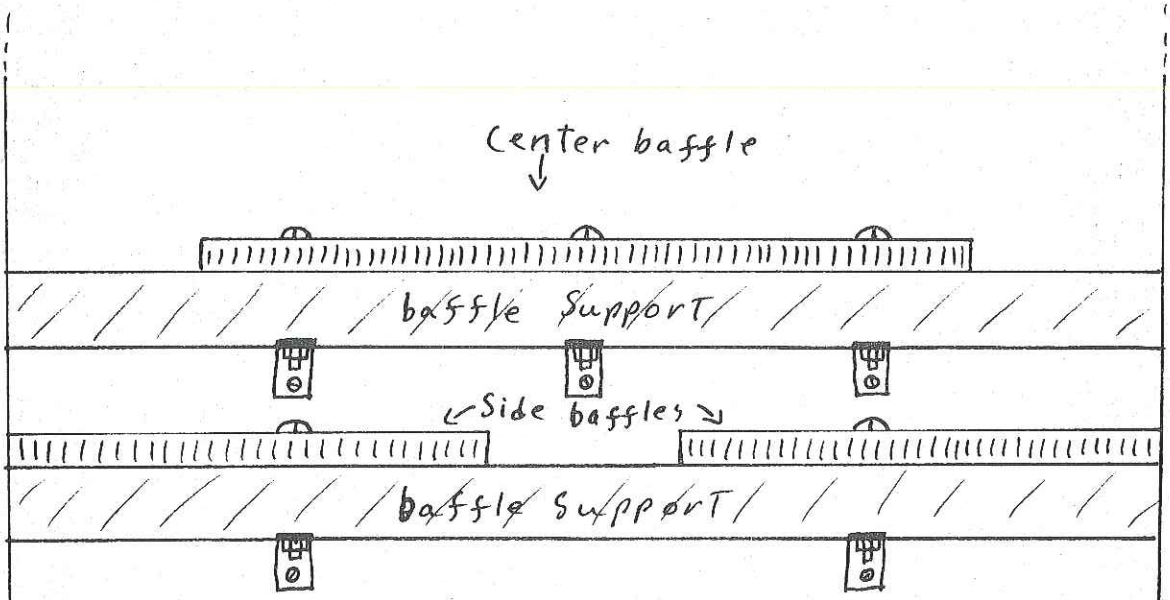
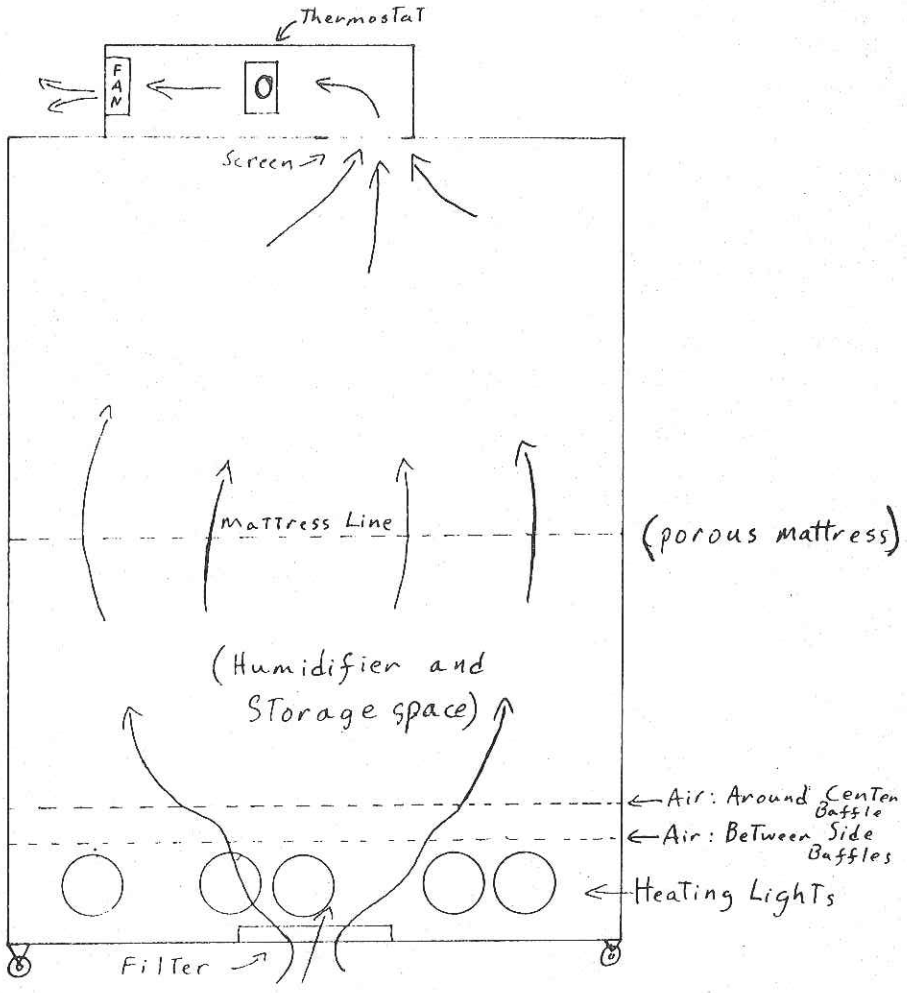


Fig. 126



Airflow Diagram, Figure 128.

Frame and mattress assembly (for the porous Aircrib mattress)

Step 129: On one of the two 25" long upper mattress frame pieces we marked bolt hole locations as follows: At each end we located a bolt hole 1½" from both the end and one of the edges (this edge would be on the outside of the frame). We located four more bolts 3½" from the end bolts and 5" from each other, always 1½" from the outside edge. We drilled these holes and placed this piece atop the other 25" long piece and marked the second piece's bolt hole locations through the holes in the first piece. Then we drilled these holes also.

Step 130: On one of the two 41" long upper frame pieces, we marked bolt hole locations as follows: At each end, we located a bolt hole 3" from the end and 1½" from one of the edges (this edge would be on the outside of the frame). We located six more bolts 5" from the end bolts and from each other, always 1½" from the outside edge. We drilled these holes and placed this piece atop the other 41" long piece and marked the second piece's bolt hole locations through the holes in the first piece. Then we drilled these holes also.

Step 131: We set out the 20" long and 46" long lower frame pieces as shown in Figure 131a. We placed the upper frame pieces atop the lower frame pieces, only these were arranged as shown in Figure 131b. We marked the lower frame pieces' bolt hole locations through the upper frame pieces' bolt holes and drilled the lower frames' bolt holes

Step 132: On a very flat surface, we set out the lower frame (Figure 131a), with the rounded edges facing up, and spread the mattress material over it, extending 8" beyond each outside edge. We stapled the material to one of the 46" long pieces (putting staples between each bolt hole, parallel to the direction of the frame piece). Then we placed some weights on the stapled piece and, while stretching the material tautly, stapled it to the other 46" piece (one staple between each bolt hole, as usual). Next, we stapled the material to a 20" long piece and, weighting it down, stretched the material taut and stapled it to the other 20" long piece. We then added a second set of staples along the edge away from the bolt holes all around the frame, and tapped all staples with a hammer to assure that they were fully and firmly seated in the wood. (The staples were not long enough to go through the wood.)

Step 133: After making bolt holes in the material by separating the weave with an ice pick over each of the frame's bolt holes, we spread two lines of Elmer's glue on each piece of the lower cloth covered frame (one line near the outside edge, and one line near the inside edge). Then we placed the upper frame pieces (again, with the rounded edges facing up) onto the lower frame and placed 1½" bolts in all bolt holes except the corner holes. We then carefully turned the whole frame over, pushing all the bolts completely through as we did so, and put nuts on the bolts at each end of each side of the frame (8 nuts altogether).

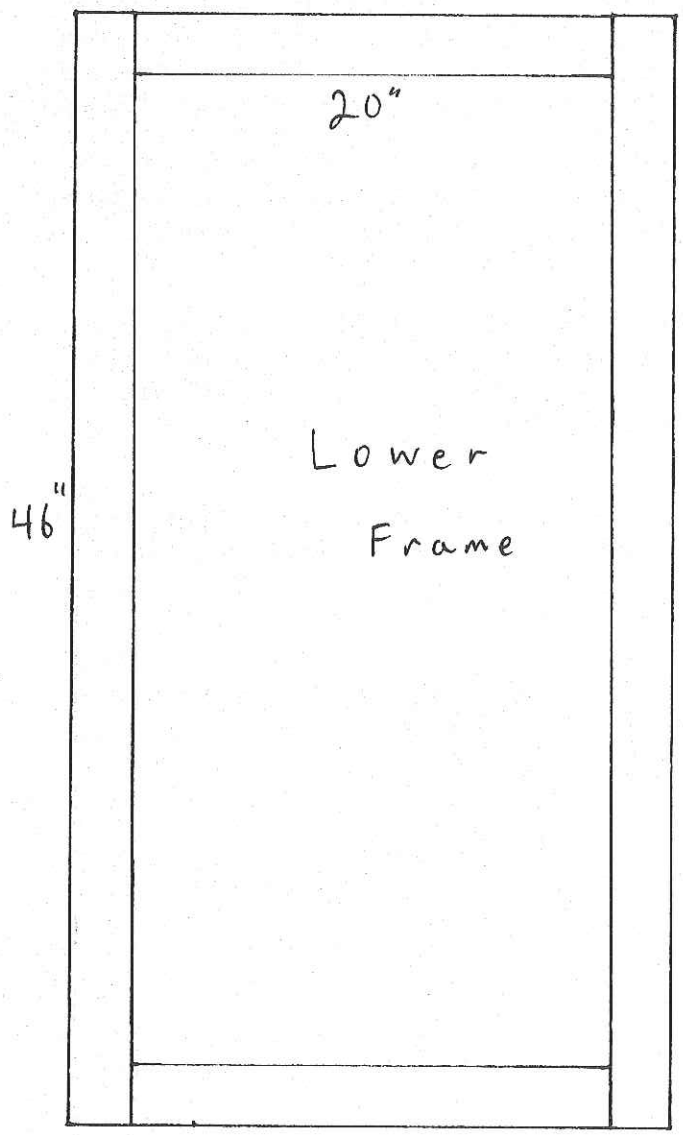


Fig. 131a

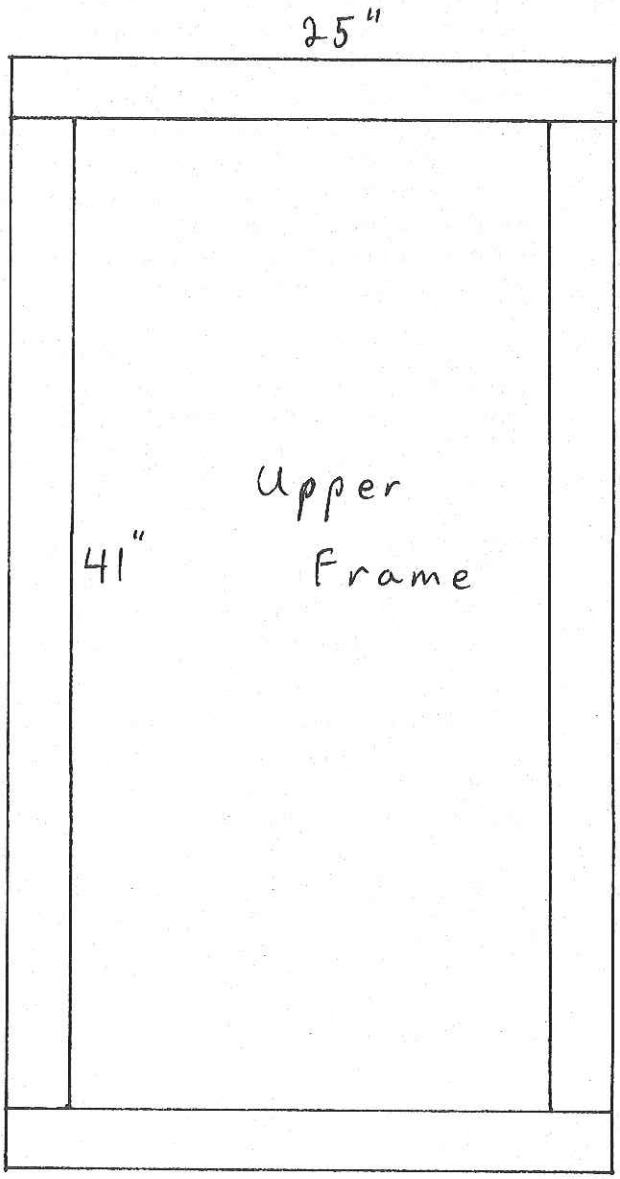


Fig. 131 b

Step 134: We double folded (see Figure 134) the material over the back of the frame, doing the long frame parts first, and making bolt holes in the material and putting the material on the bolts with each fold. As the double fold was completed for each bolt on each part of the frame, we first placed a washer and then we tightened a nut on each bolt that did not receive a nut in Step 133. (The nuts were not made very tight because they would have to be removed soon for attaching the safety set.) Finally, for each bolt that did receive a nut in Step 133, we removed the material and the nut, replaced the material, added a washer, and retightened the nut. Then we trimmed off the excess material that extended beyond the frame and added one row of staples on the inside edge of the bottom of the frame, with the staples between each bolt, and another row of staples on the outside edge of the bottom of the frame.

Step 135: In each corner, we put a 1½" eye bolt, that already had a washer on it, through the bolt hole and material from the top of the frame and added another washer and then a very tight nut on the bottom of the frame. (Later, we used the eye bolts as tie downs for the crib bumpers.)

Step 136: While we worked straight from the roll of safety net (lounge-chair repair) material, we used four 52" long strips and eight 31" long strips to construct the safety net. (This component has not been proved necessary.)

Step 137: Working one bolt at a time, we removed the nut and attached the safety net material in the manner shown in Figure 137, replacing the nut tightly after adding another washer. We left no slack in the safety net!

Step 138: We installed the four long strips first, then, as we installed the eight short strips, we interwove all the strips (see Figure 138).

Cross Section (not to scale)

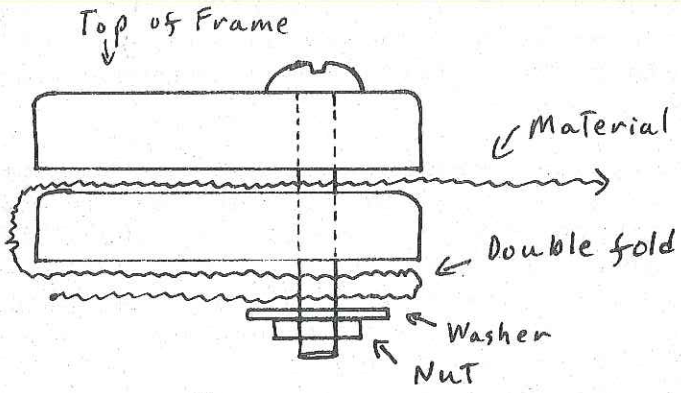


Fig. 134

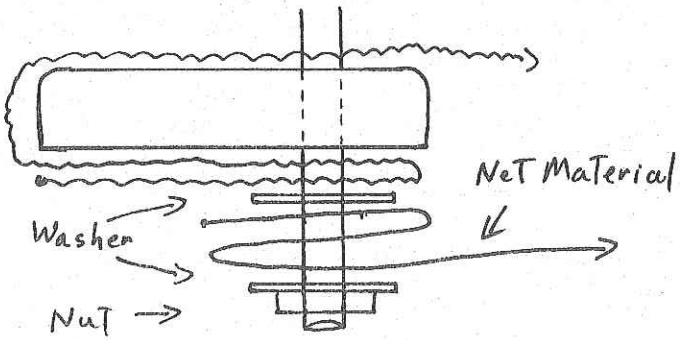


Fig. 137

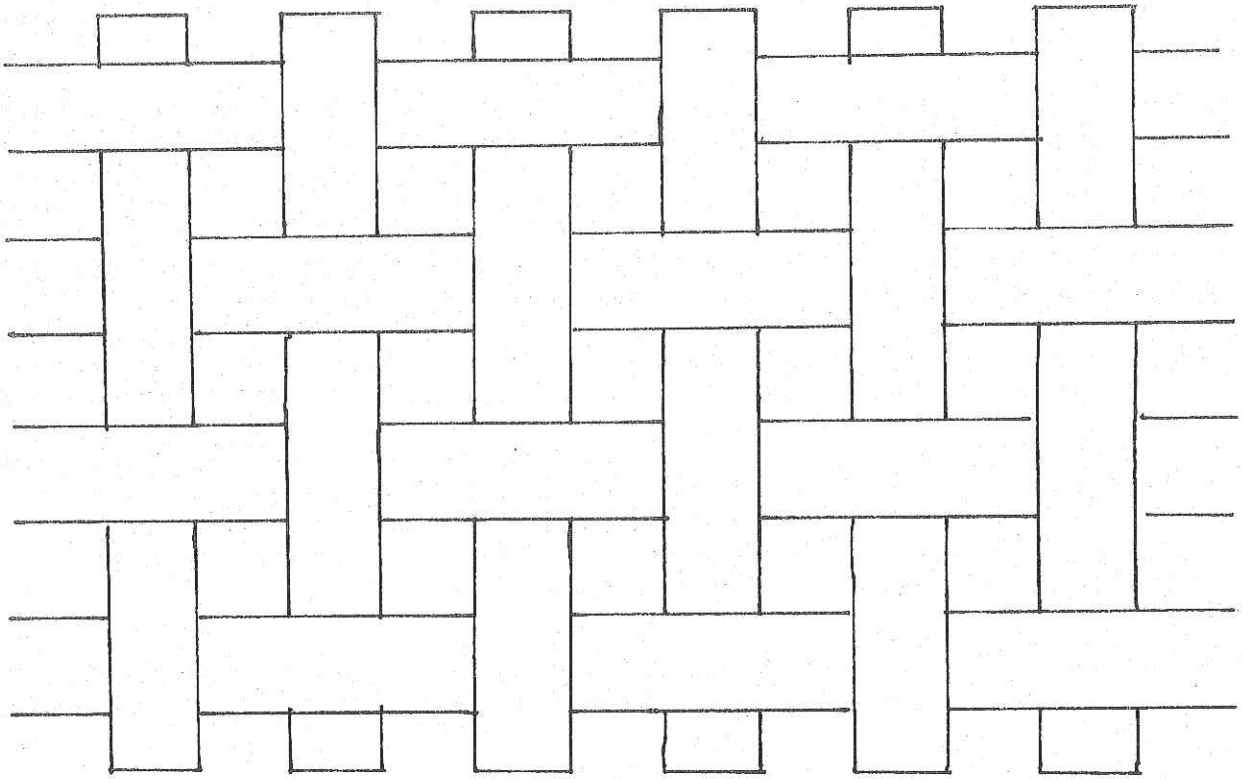


Fig. 138

Finishing touches*

Step 139: After one more thorough cleaning of the entire Aircrib, and after letting the paint dry from the touching up we did wherever it was necessary, we laid a double layer of paper towels on the top of the drip pan plank, and inserted the mattress through the top half's front door.

Step 140: Using closed-cell foam padding (often used by campers as pads under their sleeping bags) which neither absorbs moisture nor is affected by temperature changes, we stapled the padding to the ceiling of the upper half (but not over the air vent) and around the top edge of all the walls. The pad extended ½" below the level of the top of the door frame as a safety measure to reduce injury in baby's head gets bumped (see Figure 140). We also extended the padding half way down from the ceiling in the corners, although this would not really be necessary were we to have put crib bumpers in the corners as well as around the sides, which we did next. We used tubular crib bumpers that were over 4" in diameter, for we feel that they are safer than the flat types for Aircribs using a porous Aircrib mattress.

Step 141: We taped over the cord access hole and the cord notch on the fan box to make the air flow through the Aircrib in the desired manner. We also removed all the protective paper from both sides of all Plexiglas pieces.

Step 142: Using the eye bolts on the Aircrib's ceiling, we hung mobiles. We also hung curtains on the windows (outside) and put a retracting roll-up shade over the door. Plus we put a combination thermometer/hygrometer (humidity meter) in the fan box (as shown in Figure 103a).

Step 143: We plugged the transmitter portion of a one-way intercom into the socket bus and left the transmitter atop the center baffle. We plugged in the receiver portion in another part of the house, where we wanted to be able to hear the baby when we were out of sight of the Aircrib. Also, in another part of the house (so as to avoid the baby being startled by it) we plugged in a battery operated "power-off" alarm so we would be told instantly if the power went off in the middle of the night and could do whatever was necessary. Since the Aircrib is heated by the electric lights, the baby might get cold with the power off. This type of alarm is to be recommended for use with conventional cribs as well. (Even with the power off, adequate air circulation would continue; however temperature, and indeed, humidity as well, would be our concerns if the power went off.) For our Aircrib with the conventional-crib mattress, we placed the intercom transmitter in a more appropriate location. (Also, see Appendix G.)

*When we used a conventional-crib mattress and/or a sliding door, we completed Appendices C and/or D before doing these Finishing Touches steps.

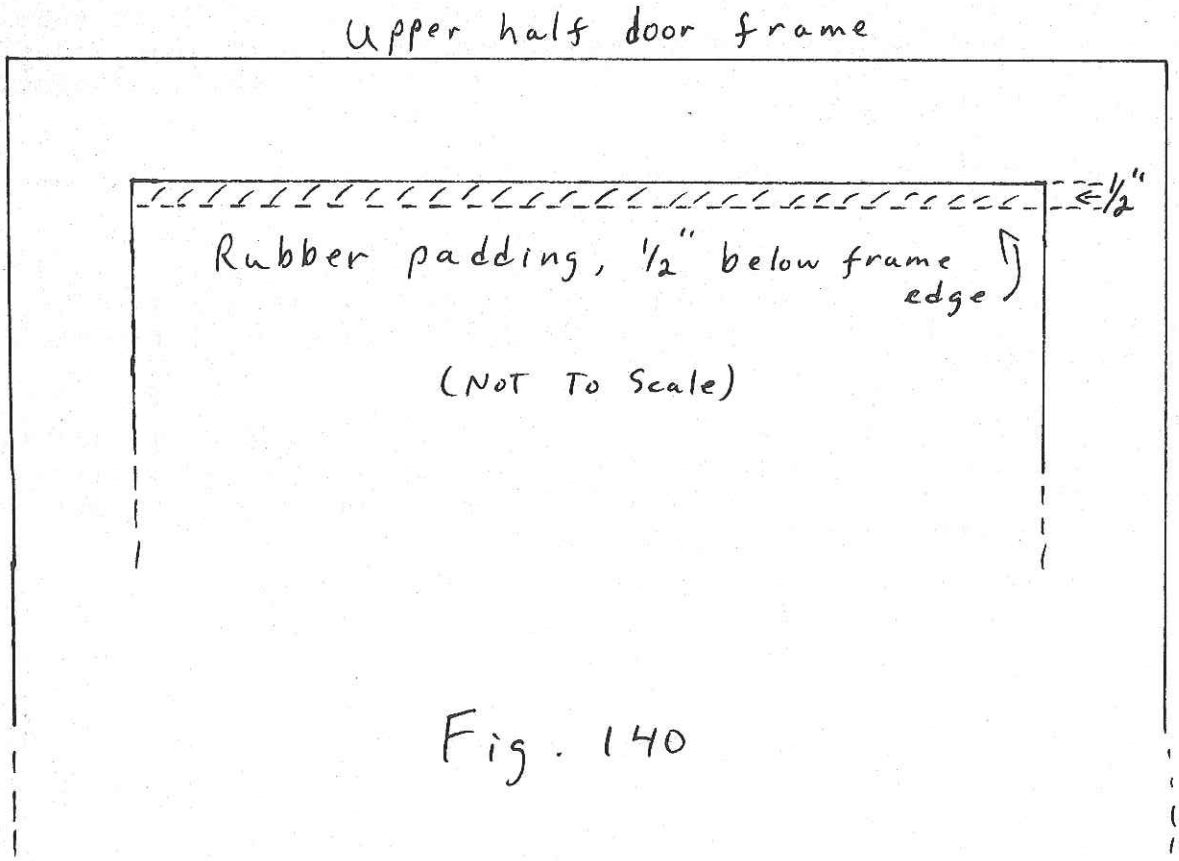

Upper half door frame
1/2"
Rubber padding, 1/2" below frame edge
(NOT To Scale)

Fig. 140

Step 144: Through the lower half's front door we placed a one gallon capacity ultrasonic humidifier, with an automatic humidity control, atop the center baffle, and plugged it into the socket bus. Placing a spare thermometer inside the upper half, we could test for the settings of both the thermostat and the humidity control which would give us the desired combination of 50% humidity at the temperature our baby needed. (In our tests, we also placed a thermometer in the light chamber of the lower half and found that it never got more than a degree or two hotter than the temperature in the upper half, although we only tested to about 85°.)

Step 145: We enjoyed our babies, both inside and outside the Aircrib.

NOTE: We ran sound tests and found that even with all the hard Plexiglas, sound levels inside the Aircrib would not be considered as posing any threat to a baby's hearing, even when they were crying. (See Appendix I.)

Note: It was not uncommon to have a few nuts and bolts left over when we were done building an Aircrib, since our parts lists evolved, as our designs improved, rather than reflecting perfect counts of the parts actually used.

References

Skinner, B.F. (1972) Baby in a Box. In B.F. Skinner, Cumulative Record, Third Edition. NY: Appleton-Century-Crofts, pp. 567-573.

Skinner, B.F. (1979) My Experience with the Baby-Tender. Psychology Today, March, pp. 29-40.

Further Reading

TIME Magazine. A Skinnerian Innovation: Baby in a Box. September 20, 1971, p. 51.

The Washington Post. Ways to Improve the World are on Psychologist's Mind. (By Sally Squires.) Reprinted from the Albany Times Union, Wednesday 1 January 1986, pp. C-1,C-4.

Appendix A

Alternatives We Considered

-Having a professional do the major wood-cutting for us.

-Leaving out the rear or side windows to save expense (Plexiglas is not cheap) even though windows are preferred, especially the rear window which can go up against some room window for viewing the outside world.

-Using a fan that was not "impedance protected" and so could not be used with a fan-speed control. For this would have required changing the fan box's door so that an extra piece of wood or Plexiglas could be slid back and forth over the ceiling vent to control the airflow.

-Using screws for the lower half's door hinges (cheaper than nuts and bolts).

Appendix B

Minor Items We Never Got Around to Doing

-Use white tape to seal the fan box to the roof, and to seal other air leaks as well, such as the cord access hole.

-Attach strips of wood to the inside of the side edges of the lower half's doors for a better seal against light and air leaks.

-Put a strip of Plexiglas along the edge of the lower half's right side door which meets the edge of the left side door to reduce air leakage yet permit light through to show when the heating lights have cycled on. (Such a strip also reduces the number of needed turn buttons to as few as one -- in the upper corner of the left side door.)

-Add tape around the edges of any Plexiglas swinging doors to make them more visible when they are open.

-Assembling a spare mattress (when not using a conventional-crib mattress) so that one could be used while the other was being cleaned.

-Change other ceiling bolts to eyebolts to hang more mobiles, etc.

-Use one of the blank spaces on the fan box's rear wall as the location for a separate humidistat to operate the humidifier (especially had we gotten a humidifier which, due to being too large, had to be located outside the Aircrib, blowing its moist air in through some specially cut hole).

-Put quarter-round on the windows, especially the sills, and half-round on the upper half's door sill.

Appendix C

Sliding Door Steps

The following steps describe our installation of a sliding door on one of our later Aircribs, instead of the swinging doors on an earlier Aircrib (and described in Steps 90-99). The steps and measurements given here pertained to a sliding door on a Model B. (In the case described in these steps, the Aircrib had also been adapted for a conventional crib mattress as described in Appendix D.) The following additional parts were necessary for a sliding door:

-Wood:
- 2 - 8' long: 2x2s
- 2 - 8' long: 1x3s (strapping: actual size 2¼ x 3/4)
- 2 - 8' long: 2" DRES
- 4 - 8' long: 2½" DRES

-Hardware (except parts already on the Aircrib that got removed and reused):
- 2 - 1¼" bolts (All bolts are ¼ x 20.)
- 12 - 3" bolts
- 2 - 3½" bolts
- 4 - 1¼" flathead bolts
- 8 - 2" flathead bolts
- 2 - eyebolts with 4" long shanks
- 1 - 2½" deep, ¼ x 20, U-bolt with plate
- 36 - washers
- 4 - lock washers
- 10 - nuts
- 18 - bolt caps
- 1 - 2" corner iron
- 1 - 5" long (total length) double-ended spring clip

-other:
- 1 - 2" x 42" strip of closed-cell foam padding
- 1 - 30" x 42" piece of Plexiglas

Step C1: We cut the wood as we went along, and describe the lengths in these steps as "about x" long, because sometimes the actual size needed was a little longer than the size we expected would be needed. The sizes we expected would be needed are indicated on the following table of cuts for each type of wood.

Two 8' lengths of 2x2: -33" 33" 27½"
-27½" 38"

Two 8' lengths of 1x3 strap (actual size 2¼" x 3/4"):
-33" 33"
-37⅛" 37½"

Two 8' lengths of 2" DRES: Same cuts as 1x3 strap

Four 8' lengths of 2½" DRES:
-45" 45"
-45" 40"
-37½" 27½"
-28" 28" 27½"

Step C2: We assembled the wood to form guides for the Plexiglas vertically-sliding door by naming the pieces and orienting them as indicated in Figure C2 which shows a crossection view of the right side guide (consisting of A+ and B+ sections; visually reorient the figure for left side and bottom guides, with the shared edge of the B+ pieces always on the outside.) The names in Figure C2 refer to the following wood types: "Big A" is 1x3 strap; "Small A" is 2" DRES; "Small B" is 2½" DRES, and "Big B" is 2x2. Big A and Small A together are called A+, and Big B and Small B together are called B+. The approximate placement of the bolts through the guide parts is also indicated in the figure as is the position of the Plexiglas (for the right side).

Step C3: We took the Big Bs for the upper half's sides, which were 33" long, and rested their ends on the join strip. We marked and drilled bolt holes using the locations of the original bolts holding the elbow braces to the front frame. We then took each Small B for the upper half's sides (each 28" long) and placed it in turn with one edge flat (shared) with the edge of the Big B that was away from the door. Then, with the Small B's ends each 2½" from the Big B's ends, we drilled the Small B's bolt holes through the Big B's bolt holes. We bolted the resulting B+s to the sides using 3" bolts (to replace the 3/4" bolts that had been used for the elbow braces) with heads inside against the braces and with two washers and a bolt cap on the outside. Figure C3 shows the locations of these and many other parts, including the bolts. Also, see Figure C9.

Step C4: Similarly, we took the Big and Small As (also 33" long) for the upper half's sides, held them as A+s, and rested them against the join strip with their common edge also shared with the edge of the door frame. We drilled bolt holes, adjacent to the B+ bolts, through these A+s and the frame, and bolted them to the frame with 2" flathead bolts (heads on the outside and 2 washers plus a bolt cap on the inside).

Step C5: We took another Big A and Small A, each about 37¼" long, and placed them with their shared edge along the join strip, between the side A+s. After drilling holes adjacent to the more central join strip bolts, we bolted this A+ to the frame the same way as the side A+s (Step C4).

Step C6: We then placed a Small B piece so that it rested, with its finished side against the frame, on top of the A+ installed in Step C5. We located the bolt holes adjacent to the A+'s bolts and attached it to the frame with 1¼" bolts, with heads on the inside and nuts on the outside.

Step C7: For the top edge of the door frame, we began with another Big A and Small A (each about 37½" long). These made an A+ but we placed the shared edge away from the door frame's edge, putting the Big A's unshared edge along the door frame, with the whole A+ placed between the side A+s. After drilling holes adjacent to the frame's upper elbow brace bolts, we bolted this A+ to the front frame in the same way as the side A+s (Step C4).

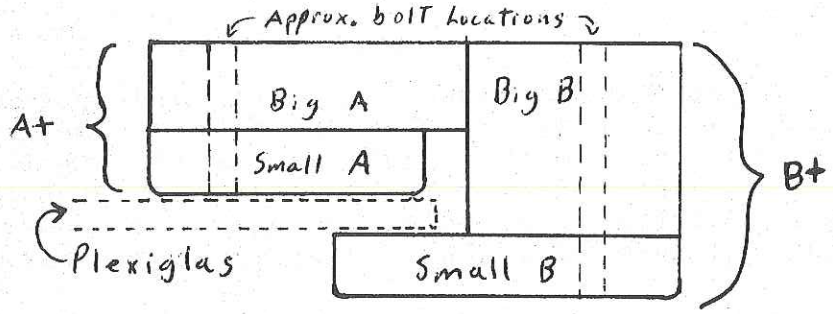
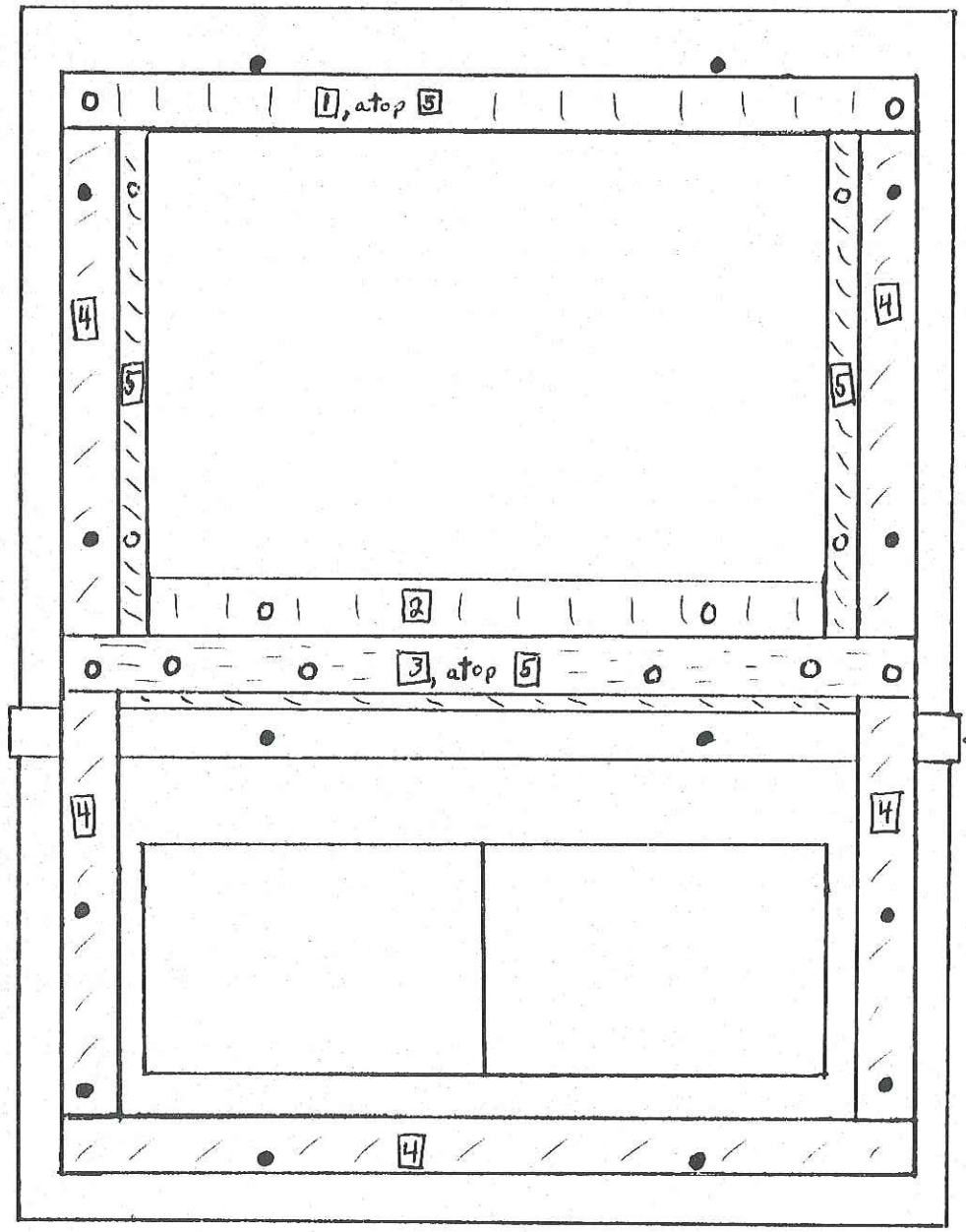


Fig. C2



||| 1: Small B, and behind it is an A+

||| 2: Small B

= 3: Crossbeam, and behind it is an A+

// 4: B+s

= 5: A+'s (partial view)

Visible Bolt Locations:

● Already present

o New

Fig. C3

Step C8: Then we took a Small B piece (about 45" long) and rested it on the Small B parts of the side B+s at the top of the frame. We drilled a hole at each end through this Small B, and the Big B pieces behind it (the other part of each side's B+), and the frame, and bolted this Small B across the top of the frame using 3" bolts with heads and two washers on the inside and bolt caps plus 2 washers on the outside.

Step C9: We completed the lower half's side B+s by treating the Big Bs and Small Bs seperately. We took the Big Bs (each 27¼" long) and removed, from one end of each of them, a piece about 2" wide and 3/8" deep so that this end could be placed over the join strip (see figure C9). Then, holding each Big B in place in turn, and, using the locations of the original elbow brace bolts, we marked and drilled bolt holes in the Big B and temporarily held them in place with 3" bolts. Then we took the Small Bs (each also 27½" long) and, placing them so that their top edge would touch the bottom edge of the Small Bs of the upper half's B+s, we marked and drilled their bolt holes also. (Their bottom edges were, of course, also offset about 2½" above the bottom edges of their Big B pieces.) Finally, we bolted each B+ to the lower half using the 3" bolts with heads on the outside.

Step C10: Using the elbow brace bolt locations on the bottom of the lower half, we attached a B+ across the bottom, consisting of a Big B (about 42" long) and a Small B (about 45" long). The Small B's ends extended beyond the Big B's ends so that the Small B's ends could cover the exposed ends of the Big Bs of the side B+s. This bottom B+ was attached also with 3" bolts with their heads on the outside.

Step C11: We made a central crossbeam by centering one Small B piece (about 40" long) on another Small B piece (about 45" long) so that the longer piece's ends extended about 2½" beyond the shorter piece's ends. Holding them together, we marked and drilled bolt holes along the center line 2" and 12" from each end of the shorter piece. We bolted them together, forming the cross beam, using four 1¼" long flathead bolts and bolt caps with the heads against the shorter piece. (See figure C11.)

Step C12: To attached the crossbeam we first drilled bolt holes (for mounting the crossbeam) 1" from each end of the longer piece of the crossbeam, on its centerline. We then placed the crossbeam in a position where its upper edge was ¼" above the seams formed where the Small B parts of the upper and lower halves' B+s meet. Finally, using the crossbeam's mounting holes as a guide, we drilled through the other parts, including the frame, and mounted the crossbeam using 3½" bolts with heads on the outside (inside, with porous mattress).

Step C13: On the inside of the lower half's bottom B+, we placed a 2" wide by about 42" long strip of closed-cell foam padding, as a cushioned resting place for the Plexiglas door when it is in the lower position. (The padding strip was placed so that it arched upwards between its front and back, lengthwise.)

Step C14: In the center of the top edge of the Plexiglas door, 1½" down from the edge, we drilled the two holes necessary to attach a "U" bolt. Then we slipped the door into place down through the top of the door frame and attached the U bolt as indicated in Figure C14. We also attached a 5" long double-ended spring clip to the U bolt as the handle by which not only to lower and raise the door but also to hold the door in its raised, and so closed, position.

Step C15: We held the door in its closed position by clipping the other end of the double-ended spring clip to a pair of eyebolts that were attached to the top of the Aircrib in the following manner. In the center of the top and front of the upper half, we attached a 2" corner iron to the roof and the front frame, using all four holes. For the two roof holes, we used two of the 3/4" bolts that had been removed earlier, with the bolt caps on the outside. For the two front frame holes, we used two eyebolts, with 4" long shanks, held on the outside with a washer and nut against the frame, and held on the inside with a lock washer and bolt cap against the brace. We bent the top eyebolt down until it touched the bottom eyebolt so that the spring clip could go around both together. (After painting, we tightly stuffed a 42" long by 1½" wide strip of foam pad - left over from earlier steps - into the full length of the gap where the door is inserted at the top of the door frame.)

Step C16: We painted all exposed sides of the new wood with undercoat and white paint (after completing Appendix D, if using a conventional crib mattress) after removing the door; we reinstalled the door when the paint was dry

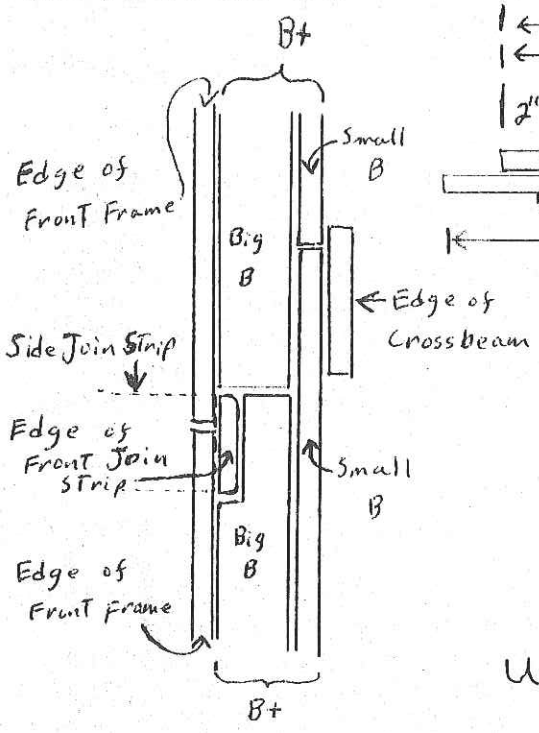


Fig. C9

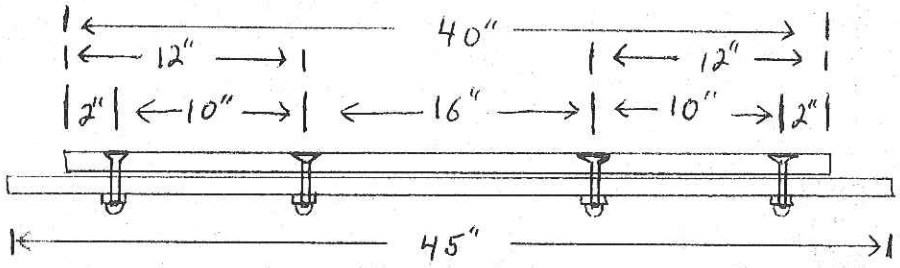


Fig. C11

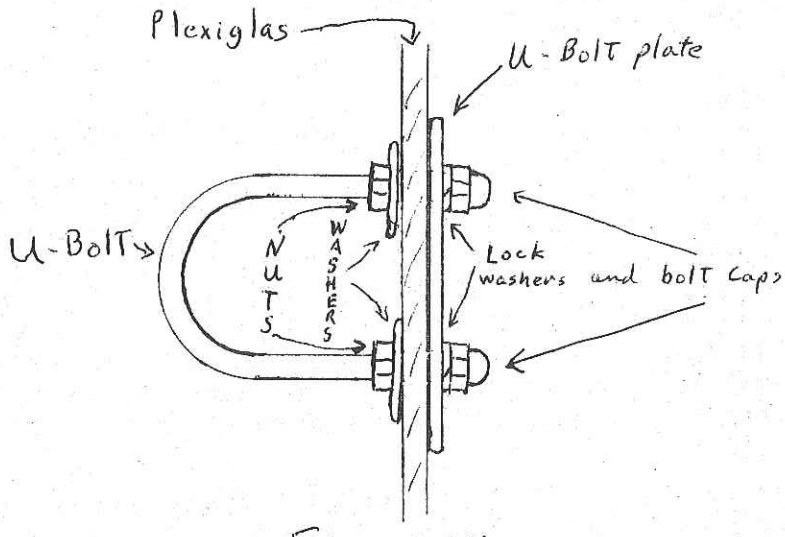


Fig. C14

Using a Conventional Crib Mattress

While use of a conventional crib mattress brings changes to the list of Aircrib advantages (adds some, drops others), it is an option we have exercised. The following steps are the steps we took to adapt the Aircrib to the use of a conventional crib mattress. (The Aircrib we adapted was a Model B that also used the sliding door alternative.) The following additional parts were necessary to complete this adaptation:

-Wood: 1 - 44" long: 2x2

-Hardware (except parts already on the Aircrib that got removed and used):

16 - 3/4" bolts (see note, below)
4 - 1" bolts
4 - 2" bolts
4 - 1¼" flathead bolts
4 - washers
28 - nuts
6 - bolt caps
100- 1¼" flathead nails
12 - 1½" corner irons
4 - 2" mending plates
4 - 21" x 3½" pieces of ¼" mesh screen

-Other: 1 - set of flat-style crib bumpers
1 - conventional crib mattress ("portacrib" mattress, 32" long by 24½"-25" wide by 3" deep)

Note: some 3/4" bolts were available from those bolts discarded during the completion of Appendix C.

Step D1: We cut the Drip Pan Plank (DPP) as described in Steps 33, 62, 63, 64, 65, 78D, and 84, with the installation step being Step 127. We waited until all pieces from this appendix (and Appendix C) were ready to paint and then painted the DPP at that time also, along with all the touch up painting called for in the first step of the Finishing Touches section, Step 139. Then, leaving all hardware in place, we set the DPP itself aside for later use if we ever decided to switch to using the original porous Aircrib mattress design.

Step D2: To make the base for the conventional crib mattress (CCM), we retrieved the "left over from (LOF) Step 3" piece of plywood and cut the two required pieces from it. One piece measured 17 1/4", or so, X 47", cut from the short but wide end, and the other measured 8 3/4", or so, X 47", cut from the long but narrow end (see Figure D2). The "or so" refers to the fact that we needed to adjust the 8 3/4" wide piece to be more or less than 8 3/4" according to how wide the 17 1/4" wide piece actually was, so that the total width of the two pieces, set back to back (on their straightest edges) was 25 3/4" to 26". We marked the new left over pieces as "leftover from D2" because we would need them later in Step D8.

Step D3: We placed the CCM base pieces atop the matress supports and marked the outside corners of each piece so that we could cut out the corners so that the pieces would rest clear of the mending plates/bolts (see Figure D3).

Step D4: We took the 1 1/2" elbow braces that were originally put in place for the DPP (see Step 62) and inverted them and moved them to the hole nearest the braces' bend, while also inverting the DPP's bolts and leaving them tightened in place (see Figure D4a). Putting the two base pieces in place, we marked the location of the bolt holes on the bottoms of the pieces through the braces' holes that were still free, again, nearest the braces bend, and drilled these holes and checked the fit by dropping 1 1/4" long flat head bolts through the base pieces into the brace holes (see Figure D4b). The mounting nuts would later go underneath the base pieces, against the brace, but would not be overtightened since the base pieces do not rest directly on the braces. Between the brace and the base piece would also be a washer and an extra nut that was tightened to pull each bolt's flat head into the wood to make a flat surface.

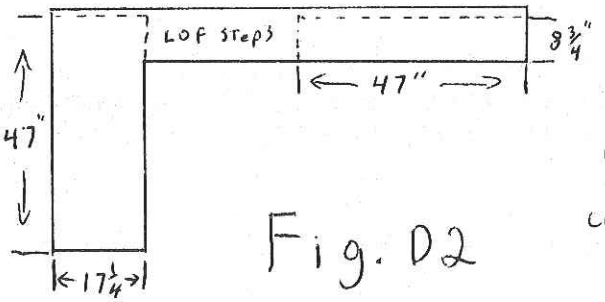


Fig. D2

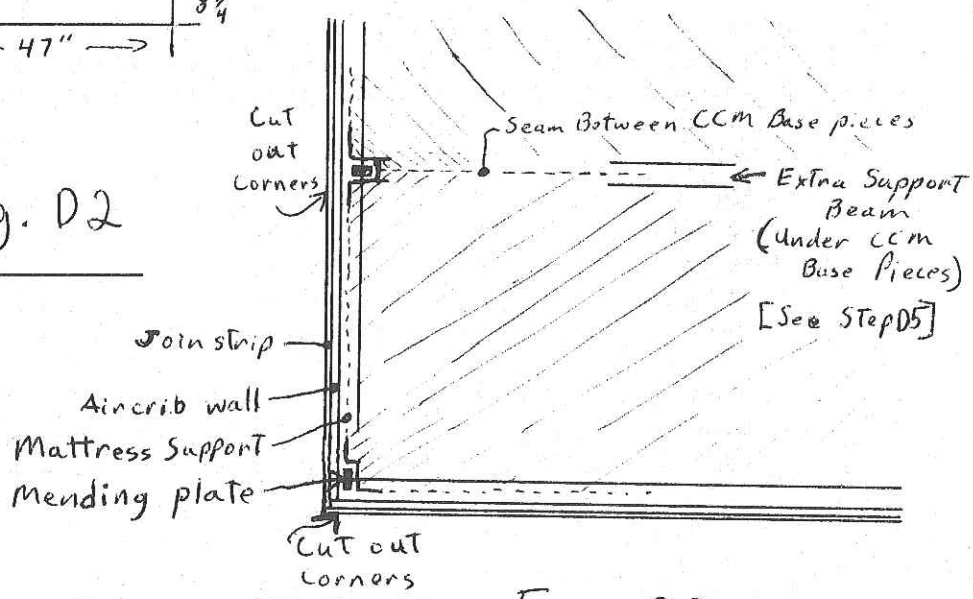


Fig. D3

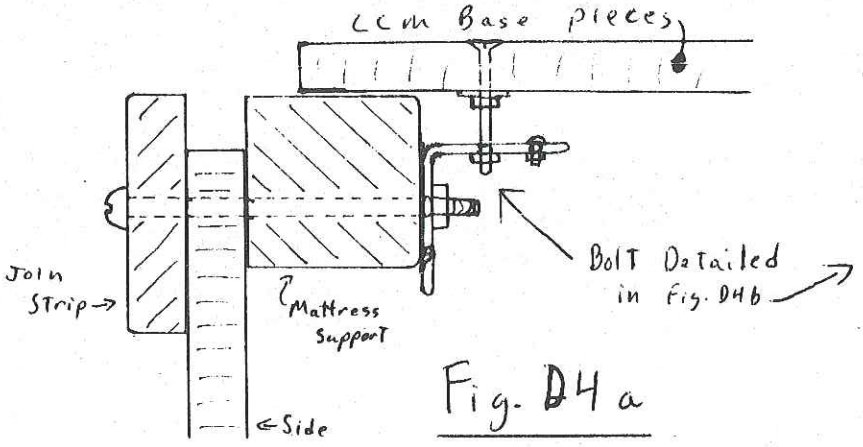


Fig. D4a

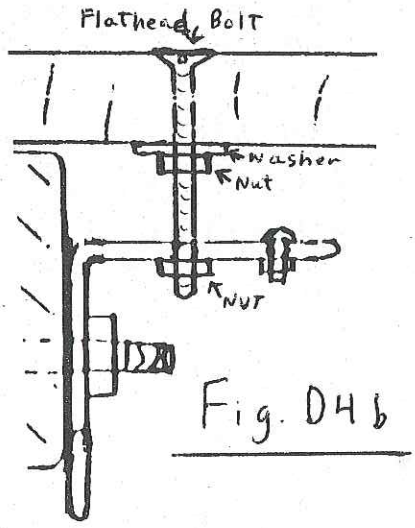


Fig. D4b

Step D5: Marking a line on the mattress supports where the seam between the two base pieces is located, we added an extra support beam by centering a 44" long 2 X 2 under the seam between the two mattress supports. We placed a 2" mending plate evenly over each end of the extra support beam where it meets a mattress support and marked and drilled bolt holes, through the mattress support and extra base support beam, for the mending plate bolts. Adding an additional mending plate underneath each mattress support/extra support beam junction, we bolted them altogether using 2" long bolts, with nuts against the lower mending plate (see Figure D5). We also marked and cut the seam corners of the base pieces so that they would clear the mending plates holding the extra support beam. (See Figure D3.)

Step D6: We then removed the base pieces and the extra support beam for later painting, leaving all hardware in place.

Step D7: We cut six airflow holes, and squared their corners, on each of the Aircrib's sides, after marking their locations and drilling starting holes inside the measurements' corners, as in Figure D7.

Step D8: We cut the following pieces from the following "left over from (LOF) Step X" sources:
- From the "LOF Step 31" piece, we cut two 3" X 22" pieces.
- From the "LOF Step 32" piece, we cut two 3" X 22" pieces.
- From the "LOF Step 33" piece, we cut two 3" X 22" pieces plus one 3" X 9 1/2" piece.
- From the "LOF Step 49" piece, we cut one 10 1/2" X 22 piece.
- From the large "LOF Step D2" piece, we cut one 10 1/2" X 22" piece and three 3" X 9 1/2" pieces, and three 3" X 2 1/2 " pieces.
- From the small "LOF Step D2" piece, we cut two 3" X 22" pieces plus one 3" X 2 1/2" piece.

The eight 3" X 22" pieces were for the tops and bottoms of the two air flow boxes and the bottoms and backs of the two air deflector "boxes" (there were no tops for the air deflector boxes; see Figure D11b). The four 3" X 9 1/2" pieces were for the sides of the two air flow boxes. The four 3" X 2 1/2" pieces were for the sides of the two air deflector boxes. And the two 10 1/2" X 22" pieces were for the backs of the two air flow boxes.

Step D9: Reviewing the nailing procedures for assembling the fan box pieces (Step 50), we assembled the two air deflector boxes, using 1 1/4" nails, according to the patterns in Figure D9a and D9b, and using the following of the cut pieces: four of the 3" X 22" pieces (one for each box's bottom and one for each box's back) and the four 3" X 2 1/2" pieces, (two for each box's sides.)

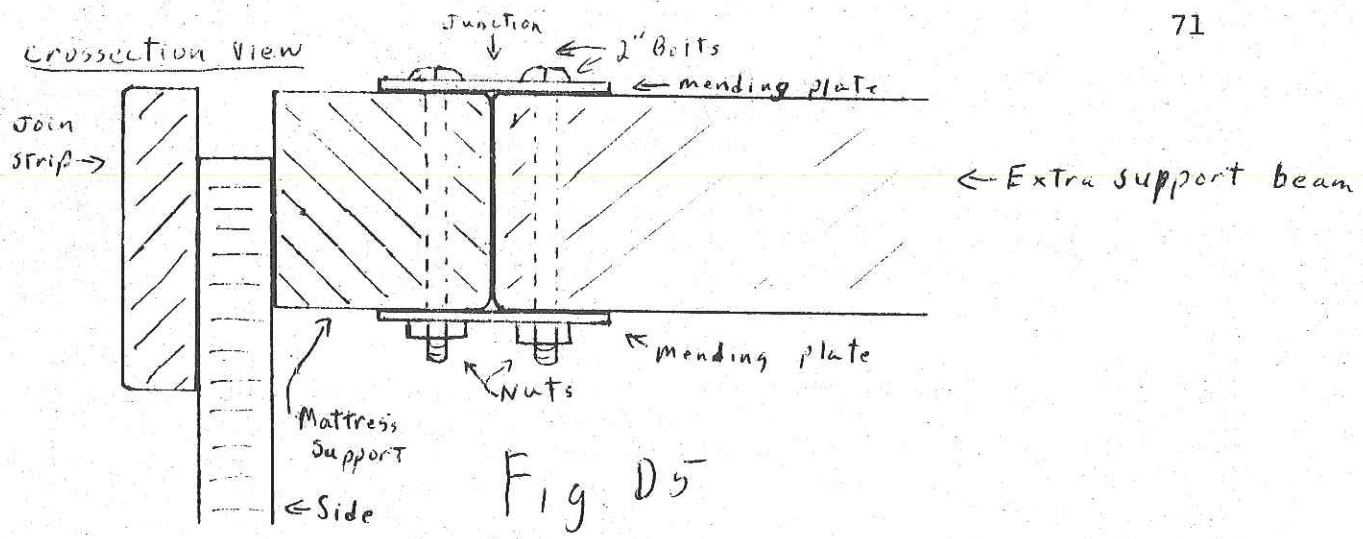
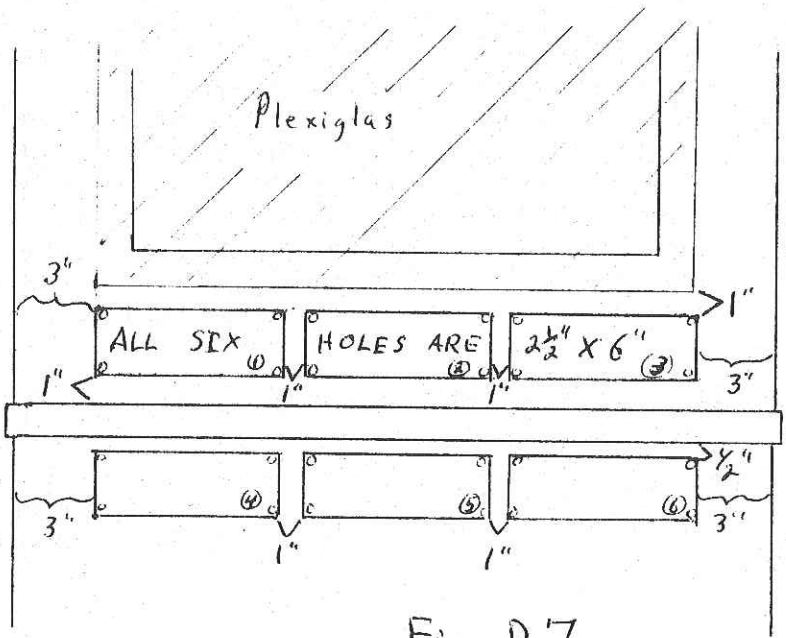


Fig D5



NOT To Scale

Fig. D7

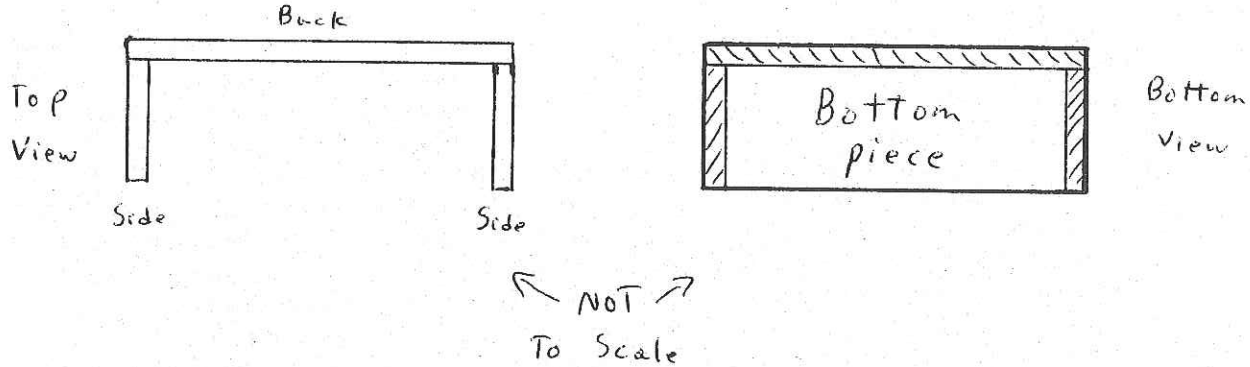


Fig. D9a

Fig. D9b

Step D10: Again, employing the fan box assembly nailing procedures, we assembled the air flow boxes, with 1 1/4" nails, according to the patterns in Figure D10, using the remaining pieces as follows: four 3" X 22" pieces (one for each box's bottom and top), four 3" X 9 1/2" pieces (two for each box's sides) and two 10 1/2" X 22" pieces (one for each box's back). First the top and bottom were nailed to the sides, then the back was nailed onto all four of the other pieces.

Step D11: We placed each air flow box in position, as indicated in Figures D11a and D11b, and marked on each one's sides where indentations would have to be cut out to accomodate the join strip. We cut out the indentations and began mounting each box to the Aircrib using four 1 1/2" elbow braces (corner irons) in the positions indicated in Figure D11a, by marking and drilling the bolt holes at the ends of the braces where the braces contact the Aircrib sides as well as the boxes themselves. We first tightened the braces to the boxes using 3/4" bolts with the bolt heads against the braces. Then we tightened the braces to the Aircrib, using 3/4" bolts (again with bolt heads against the braces) for the braces that attached to the lower half, and using 1" bolts (with the heads inside the Aircrib, and first passing through an additional brace inside the Aircrib) with bolt caps against the braces (outside the Aircrib) for the braces that attached to the upper half. (The extra braces inside the Aircrib will hold the air deflector boxes in place.)

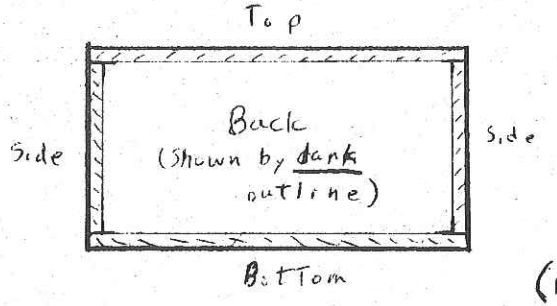
Step D12: We mounted the air deflector boxes inside the Aircrib by placing them between the extra braces mounted with the 1" bolts in the previous step, and marking and drilling the bolt holes on the box's sides near the ends of the braces and attaching the braces to the boxes with 3/4" bolts with the heads against the braces (see Figure D11b).

Step D13: Leaving all hardware on the boxes, we removed them for the painting steps.

Step D14: (Painting Steps) After completing Appendix C (if using a sliding upper half door), and removing all sawdust, etc., we put undercoat paint on all appropriate surfaces of the following pieces: air hole edges, air flow boxes, air deflector boxes, CCM base pieces and extra support, (all Appendix C pieces), and all Aircrib areas needing touchup painting. Then we put white paint on: the outside and edges of the air flow and air deflector boxes, the top and edges of the CCM base pieces, the air hole edges, (all appropriate Appendix C pieces), and all Aircrib areas needing white paint touch up. Then we put black paint on: the inside of the air deflector and air flow boxes, the bottom of the CCM base pieces, the CCM base extra support, and all Aircrib areas needing black paint touchup.

Step D15: We stapled each of the four 21" X 3 1/2" pieces of 1/4" mesh screen over one of the four sets of air holes (three 2 1/2" X 6" holes per set).

Step D16: We then remounted the CCM base extra support, the CCM base pieces, and the air flow and air deflector boxes. Finally we inserted the flat crib bumper and the mattress. In each corner of the bumper a 1½"-2" diameter hole was cut (and the edges resewn) at the level of the mattress top to enhance air circulation. See Figure D16. (Bolt caps covered exposed bolts in the front corners.)



Note How Sides Join Top and bottom.
(Not To Scale.)

Fig. D10

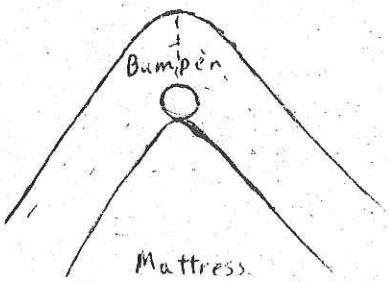
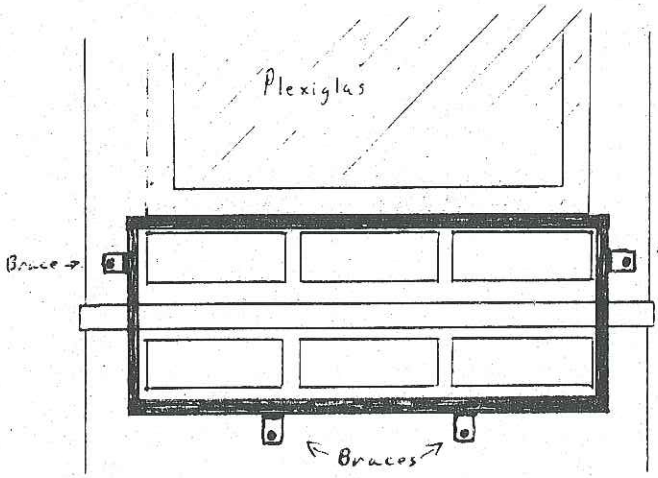


Fig. D16



(Top, Bottom, and Sides are shown, But not back.)

Fig. D11a

NOT To Scale

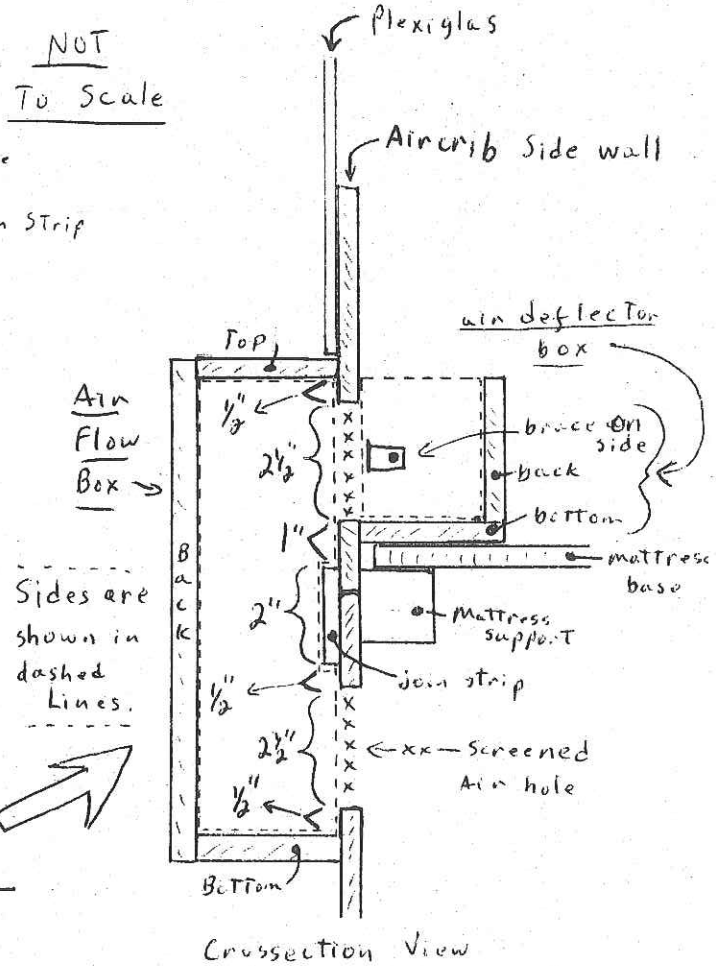


Fig. D11b

Appendix E

Reinforcing Devices, and Parental Data Collection

We have instrumented an Aircrib such that 35mm slides shown by a Carosel projector were used to consequate movements or vocalizations. The images were projected through an end window onto a white cloth suspended from the ceiling. We also mounted an instant-on TV against a window and turned it on and off following baby activity suitably transduced. We have not used a joy-stick device, however there is no reason such instrumentation could not be adapted. Any activity the baby can accomplish which can be transduced is fair game for recording and/or using to activate other devices or stimuli, and/or using as reinforcing consequences, etc. Developmental data is easy to collect and in fact use of the Aircrib seems to facilitate parents recording more data such as daily weight, body length, activity patterns, feeding and elimination times (which are important for future toilet training), vocal activity, use of feet to hold bottles, rolling over, etc.

Appendix F

Adaptations for the Infant At-Risk

The Aircrib provides a platform for a variety of monitoring devices and associated alarms that can help with the care of an at-risk infant or simply for data collection. For example, a TV camera suitably positioned can provide a full body view of the baby 24 hours a day and in any room in the house to which you can carry a monitor. An auditory monitor, wireless or attached, can provide sounds to a listener over a relatively great distance in and around the home. Movement transducers can easily be applied to the mattress to record activity and as input to a reinforcing or stimulating device. Sound activated relays can be used since the fan noise is constant and outside disturbances are minimized. Since there are no blankets the Aircrib can be used much as an incubator is used, in that attachments can be made directly to the baby without the constraint of also having to keep the baby warm with coverings. Sophisticated filters can easily be used so as to minimize the presence of allergens. Special lighting can be arranged in the Aircrib if required, as can modified humidity. Vibrators can be attached to the mattress to provide tactile stimulation, and gas and urine collection is possible. The list could go on and on.

Appendix G

Questions and Answers

The following are examples of questions we have been asked, or which have occurred to us, and some brief responses.

1) Q. "Didn't Skinner's daughter turn out funny?"
   R. Debbie is a successful artist currently living in London, England. Although she has a fine sense of humor and can be amusing at times we wouldn't call her "funny".

2) Q. "Won't the baby suffocate in there?"
   R. The baby can't possibly suffocate since there is both active and passive air flow. Furthermore, since there are no blankets the baby can't get wrapped up and smother.

3) Q. "Do you ever take the baby out?"
   R. Of course, dummy; the Aircrib is used like a regular bed or crib for the baby to rest and sleep in. In practice, because the Aircrib helps parents have more time and energy, babies spend less time in the Aircrib than in a conventional crib.

4) Q. "What about a power failure?"
   R. There is no immediate danger because nothing wrong can happen. If the crib isn't opened it will retain its warmth for awhile. In our Aircribs a power failure causes a "power-off alarm" to sound in another room of the house (so the alarm does not disturb the baby) alerting us so that we can take action in time, if any action becomes necessary. No big deal.

5) Q. "How much does it cost?"
   R. How many options do you want to include? How many tools do you already own? How much material do you have on hand? All these items come into consideration. My (CDC) first Aircrib was built by graduate students in Dr. Israel Goldiomond's laboratory at Arizona State University and cost very little. However, a reasonable figure for current (1986) conditions is about $300-$400. You must also consider resale value of at least on-half the original cost and, of course, the savings accrued by not buying blankets or washing them, or having to maintain the house thermostat higher, etc. And then there are the benefits of the Aircrib over the conventional crib to be considered. Can a dollar value be put on these? We doubt it, especially since even a good, furniture-quality conventional crib usually costs nearly as much as an Aircrib but lacks the advantages.

6) Q. "What do you do when the baby cries?"
R. Look through the window and try to figure out why. If necessary we opened the door and checked the baby. Considering that the baby might be cold, we ran a temperature check. Having started with about 84° (F), we adjust up or down from there to what seemed to best satisfy the baby. Each baby is a little different and each Aircrib is a bit different so you have to experiment a bit as you go along. As the baby gets older the temperature can usually be reduced. A warm baby doesn't fuss. We tried to anticipate the baby's needs and attend to it before crying started. If the baby did cry we attended to it as quickly as possible so as not to reinforce prolonged crying. When we first brought the baby home from the hospital we had a small intercom in the crib next to the baby and the other unit next to our bed. At night we could listen to the baby breathing and the fan humming and know everything was alright.

7) Q. "Why did you go to all that trouble?"
R. Because we wanted something better for our children and for ourselves. The advantages for everyone were well beyond the trouble and cost. Besides it was a labor of love and we enjoyed doing it and talking about it to everyone.

8) Q. "How can I be convinced it is the best thing to do?"
R. Talk to people who have reared kids in an Aircrib or to the kids themselves. To our knowledge no one has had a bad experience with an Aircrib; quite the contrary, every user seems to be an enthusiastic advocate.

9) Q. "Where can I find a used one or how can I acquire an Aircrib?"
R. We are organizing a users group and hopefully we will post a newsletter from time to time. At present you can only find one by "word of mouth" or build your own.

Appendix H

Aircrib Research and User's Group

HELP! Your help is needed. Have you used an Aircrib? Are you currently using one? Will you be using one soon? Do you know anyone* who has used or is using one? Please help us. Send us the information requested in the forms below. Use the forms or copies of the forms or a separate sheet of paper. (All information will be treated confidentially and when reported, identities will remain anonomous.)

We wish to maintain a list of people who have used an Aircirb or who are presently using one. Such a list could serve multiple functions. It could help interested parents obtain a secondhand Aircrib by helping users find buyers for their used ones (as we are willing to serve as a referral service for secondhand Aircribs). It could also help us gather historical, demographic, scientific, and anecdotal information on Aircrib design, use, problems, solutions, success, etc. Such information would be important to anyone doing Aircrib research and could be available to them. Indeed, such a list could help all Aircrib users, past, present, and future, to help each other.

If sufficient interest was evident, we would develop and circulate an Aircrib newsletter to those whose names and addresses are on the list. So please complete the appropriate forms and send them to the address shown. Basically, we seek such information as the type and source and age of your Aircrib, how many children you have used it with, what you intend to do with your Aircrib, and other information and anecdotes as well as names and addresses.

Send your information to: Dr. Carl Cheney (Retired)
Department of Psychology
Utah State University
Logan, UT 84322
U.S.A.

OR to: Dr. Stephen Ledoux (Retired)
Behaviorology / ABCS
State University of New York at Canton
Canton, NY 13617
U.S.A. ledoux@canton.edu

For further information write to either of these two addresses.

*Feel free to give them a copy of the appropriate form.

79-82
(2 copies)

Basic form

NAME: _____ DATE: _____

ADDRESS: _____ PHONE: ( ) -

_____

_____

city state zip

I KNOW OF OTHERS WHO ◯ HAVE USED AN AIRCRIB, ◯ ARE USING AN AIRCRIB, ◯ DESIRE MORE INFORMATION ON AIRCRIBS.
THOSE WHO DO NOT MIND MY SENDING YOU THEIR NAMES AND ADDRESSES ARE:

NAME: _____ NAME: _____

ADDRESS: _____ ADDRESS: _____

_____ _____

_____ _____

city state zip city state zip

◯ I have a copy of GRANDPA FRED'S BABY TENDER OR WHY AND HOW WE BUILT OUR AIRCRIBS

SEND THIS FORM TO: DR. CARL CHENEY
DEPT. OF PSYCHOLOGY
UTAH STATE UNIVERSITY
LOGAN, UT 84322
U.S.A.

OR TO: DR. STEPHEN LEDOUX
BEHAVIOROLOGY / ABCS
SUNY-CANTON
CANTON, NY 13617
U.S.A.

FOR FURTHER INFORMATION WRITE TO EITHER OF THESE TWO ADDRESSES.

YOUR COMMENTS:

83-86
(2 copies)

Advanced form

NAME: _____ DATE: _____

ADDRESS: _____ PHONE: ( ) -

_____

_____

city state zip

(1) ◯ I used an Aircrib for (2) ◯ one child (Name: _____)

(3) ◯ more than one child

(Names: _____)

(4) ◯ I am now using an Aircrib for my ____ (1st, 2nd, etc.) born child.

(Name: _____)

(5) ◯ I plan to use an Aircrib in the future (possible dates: _____)

(6) ◯ I built my own Aircrib(s). (In "comments" section below, please give the date, features, construction, photo, information source.)

(7) ◯ I obtained a secondhand Aircrib. (Please give name and address of previous owner, date, features, construction, photo.)

(8) ◯ I intend to build my own Aircrib. (Date? Features? Construction? Information source?)

(9) ◯ I would like to obtain a secondhand Aircrib.

(10) ◯ I have a used Aircrib for sale. (Send photos, price desired, and brief description of features and construction.)

(11) ◯ I intend to keep my Aircrib. (For grandchildren? For ??)

(12) ◯ I sold my Aircrib. (Name and address of buyer?)

(13) ◯ My Aircrib is/was no longer usable (and (14) ◯ has been disposed of).

I KNOW OF OTHERS WHO (15) ◯ HAVE USED AN AIRCRIB, (16) ◯ ARE USING AN AIRCRIB, (17) ◯ DESIRE MORE INFORMATION ON AIRCRIBS.

THOSE WHO DO NOT MIND MY SENDING YOU THEIR NAMES AND ADDRESSES ARE:

NAME: _____ NAME: _____

ADDRESS: _____ ADDRESS: _____

_____ _____

_____ _____

city state zip city state zip

My knowledge of Aircribs comes mostly from: _____

_____

_____.

If you have used or are using an Aircrib, please use the space below to give your comments on any or all of the following points. Thank you

Aircrib advantages? Adjustments to other beds (trips, visits, transition)? Aircrib used more/same/less than conventional crib? Why? Protection from/frequency of/ severity of colds and other contagious diseases? Exercise? Foot use? Your time spent with the baby: More? Less? Why? Good times? Poor times? Why? (I.e., pleasant interaction?)

Please continue with descriptions of any anecdotal information, stories, incidents, and/or recollections (etc.) that you have about you and your child/children (a) when you were using an Aircrib, and (b) later, when the child/children had gotten older. (Feel free to use additional sheets as desired.)

(18) ◯ I have a copy of GRANDPA FRED'S BABY TENDER OR WHY AND HOW WE BUILT OUR AIRCRIBS

SEND THIS FORM TO: DR. CARL CHENEY Retired
DEPT. OF PSYCHOLOGY
UTAH STATE UNIVERSITY
LOGAN, UT 84322
U.S.A.

OR TO: DR. STEPHEN LEDOUX Retired
BEHAVIOROLOGY / ABCS
SUNY-CANTON
CANTON, NY 13617 ledoux@canton.edu
U.S.A.

FOR FURTHER INFORMATION WRITE TO EITHER OF THESE TWO ADDRESSES.

Appendix I

Adequacy of Methods to Control Sound Levels in Aircribs

(Summary)

Stephen Ledoux, Paul Filion, Richard Schmeling

The survival of a cultural depends in part on the adequacy of the culture's child rearing practices (Ledoux, 1985; Skinner, 1971). Behavior analysts have argued that the success of child rearing practices can be enhanced when the science of behavior is applied to changing those practices (Malott & Whaley, 1983). One of the many areas where the application of the science of behavior has made progress is the development of controlled environments for children, especially the controlled environment called the baby tender, or Aircrib (Skinner, 1945). Since persons desiring to use an Aircrib today are often limited to building their own, various designs have become available as do-it-yourself builders have reported their designs in the literature (Bilbrey & Bilbrey, 1974; Ledoux & Cheney, 1985).

Most Aircrib designs call for Plexiglas (or similar material) in the construction of the baby's chamber because it is strong and somewhat flexible and so it is unlikely to break and become dangerous as is the case with ordinary glass. For the tensile strength of ¼" thick Plexiglas is 1000 lbs./sq. in. (Bilbrey & Bilbrey, 1974). However, because of its hardness, and therefore its potential for sound reflection, the use of Plexiglas has caused concern among designers and parents. An Aircrib in which the sound levels are unsafe would be unacceptable.

In the present study, the decibel (dB) levels inside the Aircrib reported by Ledoux and Cheney (1985) were measured under various conditions that could affect and/or control sound levels. The purpose of the measurements was 1) to determine whether the sound level under any of the tested conditions was unsafe, and 2) to determine the effectiveness of some of the tested conditions (those involving simple additional construction steps) in reducing sound levels. Assuming that the dB levels proved safe, if the construction steps found to reduce dB levels are added to an Aircrib design, then that Aircrib would be even safer. Hence, using these added steps could ease designer and parental concerns thereby improving the likelihood of expanding the use of the Aircrib.

Method

Apparatus

A "Quest Model 155 Impulse Precision Sound Level Meter" was used in this study. Its microphone was suspended inside the Aircrib, at about the position of a baby's ear, by an eight foot extension cord so that the meter itself could be read outside the Aircrib.

The Aircrib's fan was a well used, impedance protected Muffin fan which had previously cooled the inside of electronic components for many years.

The Aircrib's crib bumpers were five inch diameter, cloth covered, tubular sacks of foam pieces.

The foam padding, which covered the Aircrib's ceiling and the upper half of the non-Plexiglas parts of the baby's chamber, was of closed cell construction. It was originally sold for use by hikers as a pad to go under their sleeping bags. The foam pad's trade names include "Unilite" and "Ensolite".

Procedure

The "dBA" weighting scale was used in all measurements. (All measurements were made by interobserver agreement among the three authors. If a reading was not seen the same by all three, it was repeated (once was always enough) until it was seen the same. This was necessary with less than 10% of the readings. Thus agreement was not derived through any manner of calculations.) The "A" weighting in decibels is a convention scale often used by individuals and organizations concerned with occupational and industrial hearing conservation. It is the accepted scale used by the Occupational Safety and Health Association of America (OSHA) and is the most common measure used by diagnostic and hearing conservation professionals.

Under each of a variety of conditions, dB readings were taken when there was quiet in the Aircrib (quiet time) and when there was crying in the Aircrib (crying time). The crying was provided by a tape recording of a baby's crying for 15 seconds which was played back by a tape recorder, inside the Aircrib, at a sound level which generated about the same dB level as when the cry was first made during its recording.

The other conditions concerned the levels to which the fan speed was adjusted, whether the crib bumpers were in place in the Aircrib or not, and whether the foam padding was installed in the Aircrib or not. The lowest fan speed setting used was not the lowest setting possible since it was presumed that in actual practice the fan would not be operated so low when a baby was present in the Aircrib, for reasons concerning air circulation. No readings were taken with the fan off during crying times for the same reason. (Readings were taken with the fan off during quiet time for reasons of comparison.)

It must be stressed that the fan used in this study was old and considerably louder than newer fans. When measured, a new fan was so quiet that its sound was not detectable by the meter whose threshold was approximately 27 dB. (A new fan in an Aircrib should by itself reduce sound levels from those reported below. As a new fan gets older and/or louder, the data below suggest that it should not cause any dangerous sound level by itself.)

Results and Discussion

With the foam padding in place, using the crib bumpers reduced the ambient sound level 2-4dB, during both quiet and crying times, at the high and medium fan speeds (the speeds most likely to be in actual use), but left the sound level at the low fan speed unaffected. Without the foam padding in place, using the crib bumpers reduced the levels 1-3dB at all tested fan speeds during both quiet and crying times. (See Table 1.)

Whether bumpers were in place or not, using the foam padding showed little consistent attenuating effect on sound levels at all fan speeds during quiet time. However, with the exception of "low fan speed with bumpers in place during crying time" when there was no change in sound level, the presence of the foam padding did reduce the levels 2-3dB at all fan speeds during crying time. (See Table 1.)

The Aircrib itself was found to attenuate external noises, such as a TV set, by 5-10dB. So loud sounds outside the Aircrib were still audible but at reduced levels.

OSHA has put forth guidelines for maximum exposure to variable intensity noise in the workplace and in other living situations. Generally speaking, noise at or above 80 dBA is thought to pose a possible hearing danger over long periods of time. That is to say, according to OSHA, an average noise intensity of 80 dBA over a period of eight hours constitutes 100% of the allowable exposure to that noise. The highest readings recorded in this study were those in which the crying condition was present. The highest readings under the crying condition were recorded at peak-level, the loudest point of the cry. Since it is highly unlikely that a baby would cry continuously for a period of eight hours with an average intensity of 80 dBA, a baby in an Aircrib would not even approach the time-weighted threshold for possible hearing loss.

The combination of crib bumpers and foam padding described and tested here appear to be more than adequate to control the sound level in an Aircrib of the design tested. Hence, designers and parents need not worry as much that the sound reflectance of Plexiglas will cause dangerous sound levels inside their Aircrib. The data here suggest clearly that the Plexiglas is not a problem.

Table 1

Without foam padding in place	Quiet time dB	Crying time dB
Fan on high:		
No bumpers	61	80
With bumpers	58	78
Fan on medium:		
No bumpers	59	81
With bumpers	58	79
Fan near low:		
No bumpers	59	80
With bumpers	58	78
Fan off:		
No bumpers	<30	XX
With bumpers	<30	XX
With foam padding in place	**Quiet time dB**	**Crying time dB**
Fan on high:		
No bumpers	61	78
With bumpers	58	76
Fan on medium:		
No bumpers	62	78
With bumpers	58	76
Fan near low:		
No bumpers	57	78
With bumpers	57	78
Fan off:		
No bumpers	<30	XX
With bumpers	<30	XX

References

Bilbrey, J. and Bilbrey, S. (1974) Aircrib: an apparatus for environmentally controlled child rearing. Behavioral Engineering, 1, 3, 11-13.

Ledoux, S. (1985) Complementing parents: a review of The Critieal Years by Dorris Durrell. (See Appendix K.)

Ledoux, S. and Cheney, C. (1986) Some non-commercial Aircrib models. Report given at the 12th Annual Convention of the Association for Behavior Analysis.

Malott, R. and Whaley, D. (1983) Psychology. Holmes Beach, FL: Learning Pubs.

Skinner, B.F. (1945) Baby in a Box. (See Appendix J.)

Skinner, B.F. (1971) Beyond Freedom and Dignity. NY: Alfred A. Knopf.

Appendices J & K
(from Convention handout)
are available from Their original Sources ☺

91 - 96

Appendix J

Baby in a Box
by Prof. B.F. Skinner

(Originally appeared in Ladies Home Journal, October, 1945.)

[Also in Skinner, B.F. (1972). Cumulative Record - 3rd Edition (pp 567-573). NY: Appleton-Century-Crofts.]

●●●

97 - 104

Appendix K

Complementing Parent: A Review of
The Critical Years by Doris Durrell*

Stephen Ledoux, Ph.D.

●●●

*Durrell, D.E. (1984). The Critical Years: A Guide for Dedicated Parents. (207 pages.)

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(This review originally appeared in extensively abridged form in The Behavior Analyst, 1986, Vol. 9, No. 2. It appeared in slightly expanded form in Behavior Analysis and Social Action, 1987, Vol. 6, No. 1.)

Note: Today, Glenn Latham's books are preferred! JK
(See www.behaviorology.org)

Appendix L

The Technology of Toilet Training
Carl Cheney

This paper is a description of some principles and equipment employed in toilet training children which have been used on a limited scale and with great success. The principles are those derived from operant and respondent conditioning research. Emphasis is upon response contingent consequences. The equipment consists of lights mounted in a unit separate from the training chair. The unit has a face painted on it and the lights operate contingent upon "sitting" and upon urinating. Advantages suggested include being able to start training at an early age, instant and continuous response contingent feedback, mechanical definition of the responses, and child operated.

The establishment of conventional toilet behavior in children is often a lengthy and traumatic process. In nearly all cases, parents will voice some uneasy concern about this training period. Often, the situation is fraught with confusion, embarrassment, aversiveness, and in many cases, pain. Children require various lengths of time to become "toilet trained" and graduate with considerable topographic and attitudinal individuality about the entire affair.

There have been many analyses of and recommendations for the process of toilet training children. The following is a method which stems from and adheres to the principles of operant and respondent conditioning. It has been employed with at least six children and the generality of the principles has been substantiated with many species in many situations. There is little doubt that these principles hold for this kind of behavior; the only problem lies in the environmental implementation.

A basic assumption of operant conditioning is that behavior is a function of its consequences. This is to say that the frequency of a response will increase if followed by reinforcement and decrease if punished. Operant behavior is often discussed in terms of chains of responses. The probability of each link in the chain can be manipulated depending on its individual consequences. If the entire response chain has a low probability of occurrence, at or near zero, a shaping procedure is employed. In this case, reinforcement is made contingent upon responses that successively approximate the complete chain of desired behavior. The criterion for reinforcement is gradually shifted so that only closer approximations are reinforced and eventually the terminal performance is present at some strength.

Stimulus control in operant conditioning refers to the fact that conditions present in the environment set the occasion for certain responses. In other words, in the presence of some specific stimulus, responses of a certain topography may have above zero probability of reinforcement. For example, the presence of a WALK sign on the street corner sets the occasion whereupon crossing is reinforced, whereas DON'T WALK sets the occasion wherein crossing has a high probability of being punished. In this instance, we say the signs exert stimulus control.

The analysis of the toilet training situation begins with a description of the behavioral chain that terminates in successful performance, i.e., accurate and timely eliminative behavior. The essential elements (links) of this chain are identified, working backward from elimination, and each element is then to be provided with some reinforcer. The terminal behavior is not difficult to identify or to mechanically define. Sitting on the chair, the second link, is also simple to mechanically define. Antecedent links beyond these two, however, call for some subtle discriminations on the parent's part. (Whoever is the engineer on this project shall be called the parent.)

In order for the parent to apply response contingent consequences in this situation, he or she must be experienced in detecting the child-produced stimuli that precede and accompany evacuation. The parent's behavior, therefore, must first come under stimulus control. This experience is generally obtained during the child's toddling months. However, the parent should also observe the older child during evacuation in order to "learn" the behavioral signs. The parent should maintain some record of eliminative behavior in terms of time and type prior to serious toilet-behavior shaping. A written log may be maintained, if necessary.

During the period of recording the baseline level, other conditioning processes can also be placed in effect. For example, the training chair should become a comfortable part of the child's environment. It can be placed anywhere in the house and used by the child for many things. (We often "baited" the chair with a desirable toy, or an "M&M" candy, so as to increase the frequency of the child going near the chair and simply to pair the two.)

The bathroom should also take on reinforcing properties. Since the use of the toilet in the bathroom is the desired eventual terminal response, the bathroom should have no deliberate pairing with any aversive situation. On the other hand, however, play and "loving" by the parent can often occur in the bathroom. In addition to at least not making the bathroom aversive, this procedure decreases the probability of the eliminative process itself taking on generalized aversive properties.

When the baseline level of elimination is relatively clear and the training chair is a pleasant piece of furniture, i.e., the child goes near and sits on it occasionally, conditioning can begin in earnest.

Two features of toilet training that are the most obvious and often the most difficult to obtain are, sitting on the chair and eliminating. Traditionally, sitting on the chair is directed by the parent and maintained by the parent's playing, reading, or talking with the child. This often leads to gradually more and more cajoling by the parent for the child to "go". As time lags, the parent (and child) become bored and uneasy, the verbalizations are no longer sufficient to maintain the child's sitting and the trial may terminate with both individuals unhappy. Also, the child might detain elimination simply because the parent's attention (reading, talking and playing) is reinforcing. It may be the case that this is the only time the parent attends to any great extent to the child.

As a means of circumventing some of these difficulties, we have made some slight but critical modifications in a standard training chair that result in the ability to apply response contingent reinforcement automatically. A second unit, which is approximately the same size as the training chair, has been added (see figure 1). This was done so as to be able to deliver response contingent consequences as effectively as possible. The second unit is a box that houses a 12v dry cell, a stepping switch, relay, visible lights, and appropriate wiring. A crucial feature seems to be the arrangement of the lights and the clownface (or any other design) painted on the front.

By adding this simple extrinsic mechanism for delivering response contingent stimuli, we have had no problem obtaining or maintaining sitting on the chair for "great" lengths of time, up to 40 minutes in one instance. The parent at first briefly sits with the child and provides verbal "encouragement" for sitting, "straining," and "going pottie." But this is only delivered intermittently and is quickly faded altogether. The major reinforcer for sitting comes from the closure of a switch mounted on the chair leg and the subsequent flashing of lights on the clown-faced unit placed in front of the chair. This flashing occurs around the outside of the face as a result of the stepping switch-flasher unit and continues for as long as the chair leg switch is closed. The reinforcement for eliminating is instantly provided in our chair by urine making contact across two small steel bolts set in the bottom of the pot and wired by means of NuWay snaps to the clown-face unit. This contact closure lights up the smile and face of the clown. The contacts are set in the deepest part of the pot at a point most likely to be hit first by urine. Setting the contacts a critical distance apart will often cause the lights to blink ON and OFF a few times before staying ON. This is apparently of some added interest to the child. It is the case with small children that having a bowel movement is nearly always accompanied by urination. Urination alone is no problem. In instances of equipment malfunction where the lights did not operate when the chair was sat upon, the child would seek out the parent and communicate this problem. That the lights are reinforcing in themselves is also attested to by the fact that many older neighborhood children frequently request the use of the "electric chair".

In addition to the application of reinforcement for appropriate use of the training chair or toilet, contingent aversive consequences are applied for elimination other than on the chair. Response contingent punishment is often delivered as a result of the act itself, i.e., the physical discomfort, but in addition, mild punishment in the form of signs of displeasure can be given by the parent. In the early stages of training, these "accidents" sometimes occur and are usually the result of the parent not programming (suggesting) the use of the chair at appropriate intervals. We have had rapid success with starting children at 17 months of age. Other than being wet upon arising, training has effectively been accomplished in a matter of 2 or 3 weeks with no trauma on the part of the parent or child.

Subsequent environmental engineering and reinforcement is necessary for the development and maintenance of continued toilet use. We have had the chair always freely available and not isolated from the family (many times in front of the T.V. set). Use of the dry cell is both safe and eliminates a restrictive wall cord. The child's clothes are always such that they can be easily lowered and raised by the child. Transitioning onto the bathroom toilet completely has simply been a matter of time and traveling convenience and not at all difficult. One need simply continue to provide reinforcement for better and closer approximations.

The major techniques we have employed in summary are: Using a log of most probable evacuation times; pairing the process and equipment with positive reinforcement; delivering instant response contingent consequences (punishment for not using the toilet included) and an extrinsic automatic stimulus source.

It is worth noting that ours is by no means the first apparatus to manage such contingencies. B.F. Skinner reports a similar device constructed for his second daughter, Deborah (the Aircrib baby):

> When Debbie was old enough to be put on the toilet, I found a mechanical solution to a related problem. When a parent stands by until a child urinates before taking it back to crib or playpen, the child may postpone urination because contact with the parent is thus prolonged. If, instead, the child is left alone on the toilet, it may be left much longer than necessary and taken up with a red ring around its bottom. I attached to the toilet seat a music box that began to play as soon as a few drops of moisture struck a strip of paper under the seat. (The tune was "The Blue Danube.") We planned to leave Debbie on the toilet until we heard the music and then come and take her off, but the music proved to be reinforcing; in other words, she quickly learned to urinate at once "to make the music box play."

(B.F. Skinner. The Shaping of a Behaviorist. New York: Alfred A. Knopf, 1979.)

Toilet training for the individuals involved in this paper has been a brief and pleasant process.*

*For the best discussion of toilet training procedures, see the book Toilet Training in Less Than a Day by N.H. Azrin and R.M. Foxx (Pocket Books, New York, 1976).

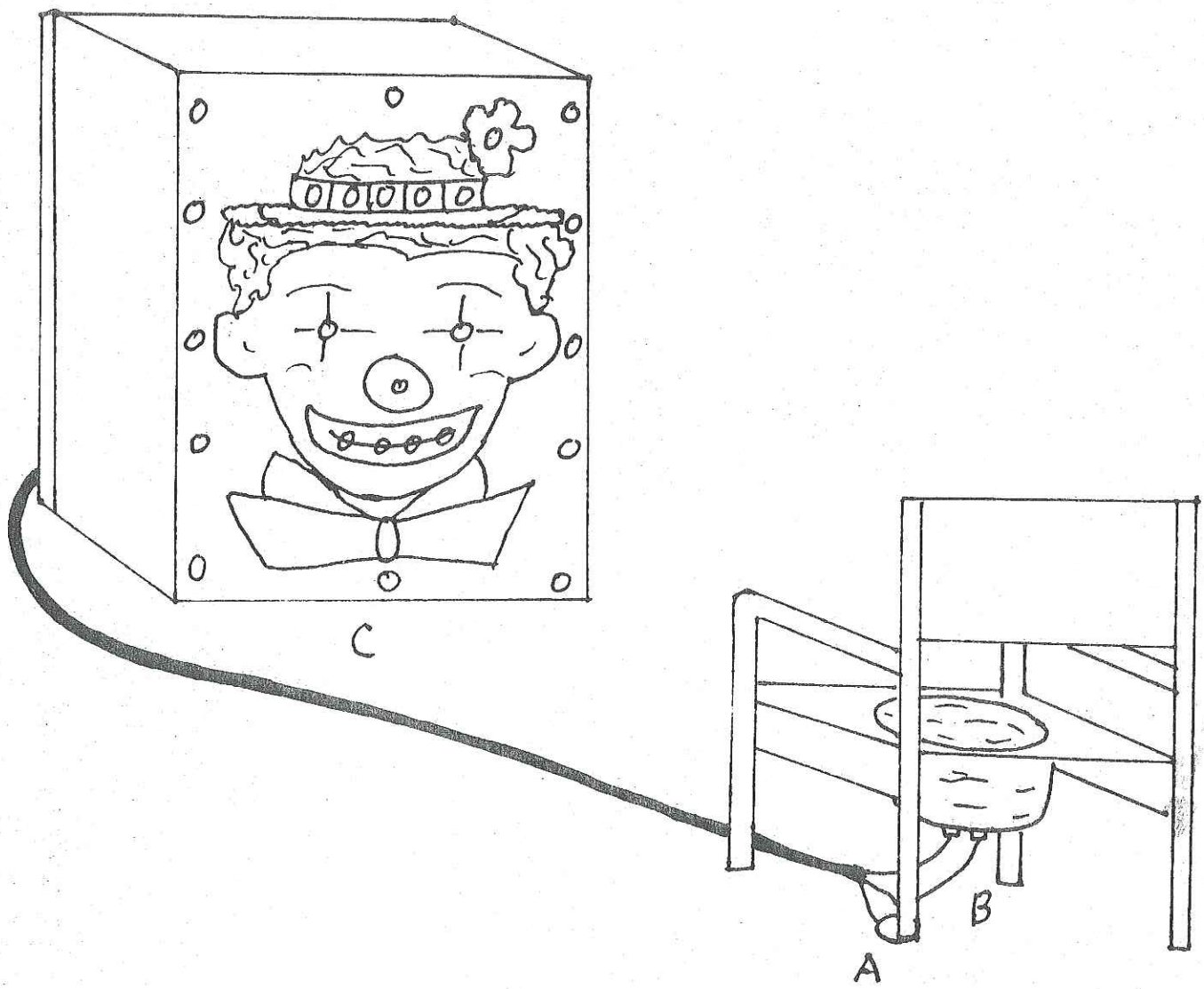

Figure 1. Schematic of the major components. Leg switch at A; contacts at B; and light unit at C.