THE DESIGN
OF A MULTIPURPOSE CHAIR
FOR CHILDREN

Thesis by

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ABSTRACT

A combination high chair, youth chair and low chair has been designed and developed for a mass market.

A market survey was conducted to determine the controlling market factors for design considerations. It indicated that the children's furniture business is highly competitive with many firms manufacturing high grade products. Competitive products were studied to evaluate their design features. Parents' desires were brought out by a consumer survey. A physiological study established the relationships of the seat, backrest and footrest.

The final design has been directed toward the large potential market desiring a multipurpose seat for children. It has three distinct uses, (1) high chair, (2) youth chair, (3) low chair. It consists of an aluminum tubing frame, a large plastic tray for food serving and play area, and a plastic fabric seat that is easy to clean and comfortable to sit in.

The color scheme of gray and yellow or red is very appealing. It is a chair that mothers will find hard to resist.

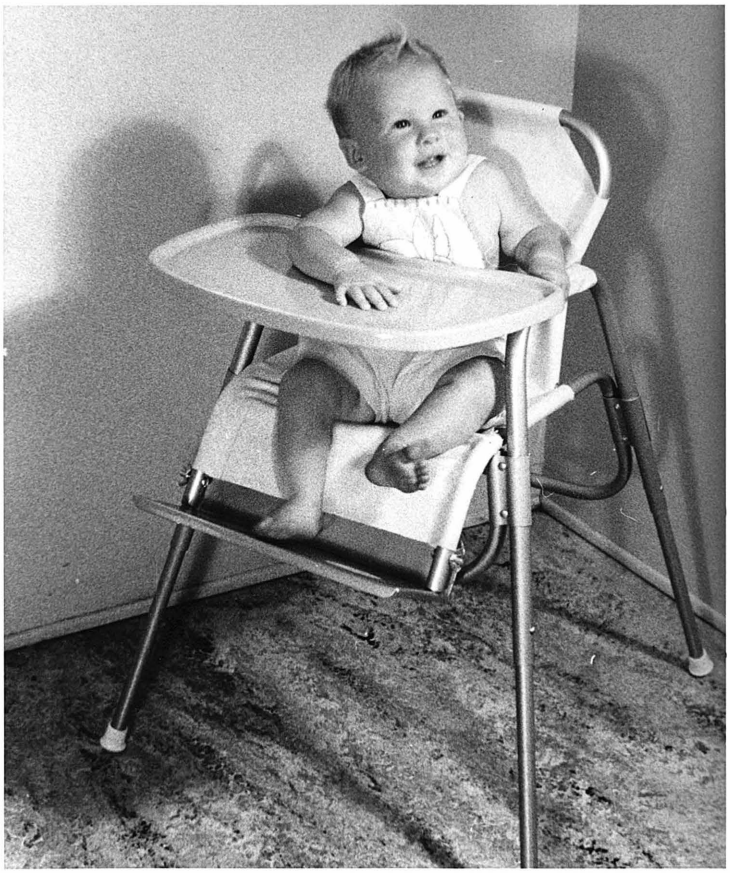

Fig. 1 Design Solution

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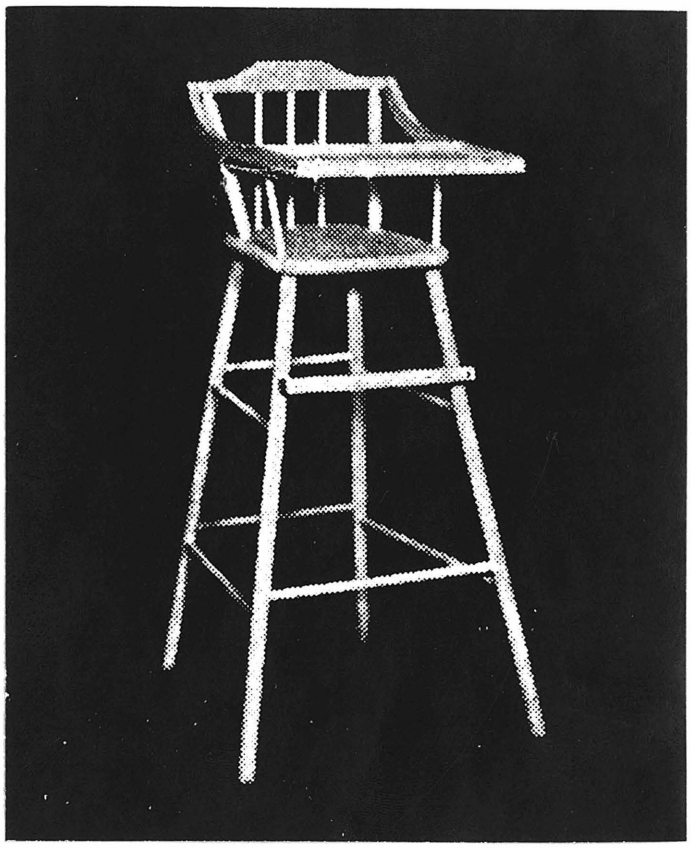

Fig. 2 Early High Chair (Grandfather's Day)

INTRODUCTION

Children's high chairs today are very similar to the high chairs of generations ago. There have been many patents issued to cover tray catches and other minor differences in chairs, but essentially they are the same as in grandfather's day. The mere fact that the general design has lasted for so many years is some evidence that difficulty is encountered trying to improve it.

There is one variation that uses a low table with a seat suspended from the center. This is relatively new, but has not been universally accepted as the ultimate in design and utility.

The defects of present day designs fall into the following categories: (1) instability, (2) too heavy, (3) not easily carried about, (4) cannot be converted to a youth chair or low seat, (5) not easily cleaned.

This thesis is an investigation into these problems to find an acceptable design to meet the requirements.

MARKET SURVEY

Approach

"Markets are people with money to spend and the desire to spend it."(1)* To place a product in the market place where people will see it and buy it requires many preliminary investigations - the first of which is market analysis. Even before a product is designed it is necessary to discover not only where the buyers are, but how much money they have to spend, what kind of people they are, and other miscellaneous data about ages, sexes, living conditions and cultural habits. There are many questions to be answered about the consumer. What is his standard of living? What are his habits and desires? What effect has climate? When these things have been analyzed a product can be more intelligently designed and engineered in size, shape, style, material, color, and weight to appeal to the greatest number of people living in the market area.

Purchasing Power

The present United States Market consists of 144 million people with an annual income of $200 billion.(2) It is the richest market the world has ever seen. During the war and since, people have spent freely for a limited supply of goods, but now the picture

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*Numbers in parentheses indicate listing in Reference Section, page 51.

MARKET SURVEY

is changing. The seller's market is a thing of the past. People expect and require more selling today than they did yesterday. They are sensitive to price again and the product must be priced right.

Population - Migration and Increase

The depression of the 1930's and World War II caused a great migration all over the United States, but the South Central States lost the greatest proportion. The influx to the West Coast increased its purchasing power by one-third. For the country as a whole, the population has increased 13,359,000 since 1939.(3) This increase represents a sizable bulge in the population rise, but even more significant is the greater increase in number of families. Families have increased faster than the population.(4)(5) This is the result of the wartime marriage boom.

The women included in the wartime migration were young. They came from rural areas to urban. Consequently farm areas lost population and cities gained.(6) These women exert 98 percent(7) of the buying influence for children's specialties and also control the areas of expenditure for the rest of the family income.(8) For this reason it is necessary to investigate women's desires for the design of children's furniture.

MARKET SURVEY

Birth Rate

The birth rate of the United States has increased rapidly in the last several years.(9) The average monthly birth rate now is about twice the average for 1939.(10) The latest estimates point out that the 1947 baby crop is the largest in United States history - probably as high as 3,910,000 births.(11) In April of 1947 there were more children under five years old in our population than in 1940. This gives the children's specialties manufacturers a fertile field now and for several years to come. Estimates indicate this situation might lead to another boom about 1970.(12)(13)

Marriages and Families

The great increase in the marriage rate during and following the war supports the figures of a higher birth rate in the years ahead. Recent surveys have shown that there are proportionately more married people in the population than ever before. The higher birth rate has been called temporary, but it is too early to tell whether it will continue.(14) The present annual rate of marriages is about 2,000,000. This is nearly 50 percent greater than the average of the late '30's, but it is not expected to continue.(15) By 1950 it is estimated that the number of new families will be more than one-third of the total number of all families.(16) When this proportion of consumers is new to the market it presents a golden sales opportunity.

MARKET SURVEY

Decentralization and Distribution

The wartime trend to urban living is diminishing. Except for the wartime period, the last 30 years have seen a decentralization of population. As more and more people get out of the city there will be more and more department stores needed in new communities. This is going to add a new importance to shipping space and weight.(17) Furniture is distributed nationally from manufacturer to representative to retailer. Any saving in weight or size in the product means savings in freight charges and storage space for everyone connected with its distribution.

Conclusions

1. Price the product to sell.

2. Women exert 98 percent of the buying influence on children's specialties.

3. The birth rate is at an all-time high giving the largest market in history.

4. One-third of the number of families are in the market for the first time.

5. The trend is toward suburban living which puts emphasis on shipping weight and storage space.

PRODUCT STUDY

A number of the most popular high chairs were studied to ascertain their design features, functions, and appearance. Appendix A lists a representative cross section of these products and their outstanding points. They are priced from a low of about $10 to a high of about $40. The higher priced chairs feature upholstered seats, plastic trays, convertibility to table and chair, and accessories which range from desirable to useless.

Many manufacturers have provided upholstered seats to give a more sumptuous appearance and a softer seat for the child. In doing this the chair has been made more difficult to clean. Spilled food gets into crevices and corners and is impossible to remove. The plastic tray has been introduced because of its shining appearance and smooth surface that is easy to clean with no cracks or pores for food to collect in. Convertibility to table and chair has been included in the design of some high chairs to give an added feature - a selling point. Consumer opinion varies as to the desirability of this feature. The bottoms of the chair legs do not offer a very clean surface for a child to chew on when they are turned up after having been on the floor. Some mothers also feel that it is more bother than it is worth to convert to the table and chair combination, then back to the chair again when the child is to be fed.

PRODUCT STUDY

Another complaint registered against high chairs is lack of adequate adjustment of the footrest to the growing child. Most footrests are adjustable in an arc with the center of rotation just below the seat. With this type of footrest the small child has support for the backs of his legs and heels only. His feet are not braced on the rest. A better footrest adjusts the distance below the seat edge.

Still another shortcoming of some chairs is the overhead tray. This is the type that swings up over the child's head while he is in the chair. The difficulty is that the child's head is in the path of the tray. The sliding tray is more functional and is liked better by most mothers.

Most of the present day high chairs have a slanting backrest, but no slope to the seat. The more comfortable adult dining chairs have a slight slope to both. This supports the body in a natural position and gives greater comfort. A sloping seat and backrest is not only more comfortable for the child but also tends to keep his back in contact with the backrest and keeps him in the chair.

Conclusions

1. Stability is paramount.

2. Make it easy to clean.

3. Comfort should be built in by giving the seat and backrest a slight slope.

PRODUCT STUDY

4. The footrest should be capable of being adjusted in such a way that it decreases the distance between the seat edge and footrest when it is in position for the small child.

5. The tray should be the sliding type. It should operate easily and be capable of being removed and taken to the sink for washing.

6. The quality of materials and workmanship should be good.(18) The price should be commensurate with the quality.

Fig. 3

PRESENT DAY HIGH CHAIRS

CONSUMER SURVEY

Another prerequisite for designing a high chair is to go to the consumer to find out some of his desires in such a product. He is the buyer and the user - his thoughts should be analyzed to arrive at a design that includes as many of his needs as possible. It is always necessary for the designer to evaluate the consumer's wishes to eliminate any impossible features that are the result of uninformed reasoning. Therefore, this survey of potential consumers is to determine their desires on possible features of a high chair. Do they dislike any features of high chairs they have used in the past? Do they think that a feeding chair should be convertible to other useful seats for a child? What about tray size? Is the average tray large enough to suit most mothers? Then there is the question of seat height. How many mothers like low seats, how many like high seats? Finally it would be wise to get some idea of their thoughts on materials, color, and price. These items give the chance for a wide selection and divergence, but give a clue to the trend in thinking.

The preferred approach for the answers to these questions is by consumer questionnaire. Questions were carefully worked out to get answers from the consumers on their views of the problem. The questionnaire was distributed to 44 people with one or more children in or near the high chair age. A special effort was made to distribute them among different income groups as well as

CONSUMER SURVEY

different occupations and interests. They were sent to friends and acquaintances in the following States: Maine, Massachusetts, New York, New Jersey, Michigan, Virginia, Texas, and California. It is realized that the number of questionnaires is limited, but it is believed that the results are useful in showing trends and feelings of the average consumer.

The answers to the questionnaire give results that range from high correlation to scattered, but all answers help in determining the trend of the consumer's thinking. These are the questions and results:

1. (a) Have you used a high chair for feeding your child?

Yes	83%
No	17%
	100%

(b) If not, what have you used?

Babee-tenda	13%
Car seat	2%
Low chair on wheels	2%
	17%

2. Have you used a car seat for your child?

Yes	88%
No	12%
	100%

3. (a) Would you like to be able to convert a child's eat-chair to a youth chair?

Yes	77%
No	11%
No opinion	12%
	100%

CONSUMER SURVEY

It is significant that more than half the people who used a Babee-tenda reported that they would like to be able to convert to a youth chair. This is an important point since they are unable to do this with their present equipment.

3. (b) Would you like to be able to use the seat for a car seat?

Yes	53%
No	38%
No opinion	9%
	100%

4. Have you taken your child to a restaurant?

Yes	85%
No	15%
No opinion	0%
	100%

5. (a) Do you take your child's feeding chair with you to feed your child away from home?

Yes	12%
No	85%
No opinion	3%
	100%

(b) If not, would you take a lightweight folding eating chair?

Yes	74%
No	14%
No opinion	12%
	100%

CONSUMER SURVEY

6. Should the tray of a child's eating chair be large enough for a play area?

Yes	46%
No	52%
Undecided	2%
	100%

7. What is your opinion of the size of high chair trays?

Too large	0%
Too small	59%
Just right	39%
No opinion	2%
	100%

8. Do you like the high chair tray high enough to go over the dining table?

Yes	58%
No	40%
Undecided	2%
	100%

9. Do you prefer to feed your child in his high chair at the same time as the family meal?

Yes	32%
No	61%
Undecided	7%
	100%

10. Do you like to sit down to feed your child?

Yes	96%
No	2%
No opinion	2%
	100%

CONSUMER SURVEY

11. What room do you consider best in which to feed your child?

Kitchen	87%
Nursery	2%
Dining room	9%
Other	2%
	100%

12. Do you think that a child's eating chair with a seat about the same height as a dinette chair is -

Too high	7%
Too low	68%
About right	23%
No opinion	2%
	100%

13. What colors do you like for a child's eating chair?

Green	4%
Baby blue	4%
Red	5%
Gray	2%
Baby pink	2%
Medium blue	13%
Yellow	8%
White	19%
Natural	34%
Other	9%
	100%

These results are indecisive. There are many colors checked and probably the range would be greater if there were more colors listed on the questionnaire.

14. Check your preference of material for a child's eating chair.

Wood	59%
Aluminum tubing	39%
No opinion	2%
	100%

CONSUMER SURVEY

The choice of material is not decisive. Wood received the most votes, but this is understandable since wood has been used universally for years and aliminum has not. However, an encouraging number recognized the possibilities of aluminum tubing which shows that consumers are receptive to new materials.

15. What do you consider a fair price for a child's eating chair that is convertible to a car seat and restaurant chair?

Under $5	3%
$5 to $9	7%
$10 to $14	20%
$15 to $19	34%
$20 to $24	16%
Over $25	11%
No opinion	9%
	100%

Suggested prices cover a wide area. The median is in the $15 to $19 range. Any price within this range can be considered to be a fair price.

Conclusions

1. The feeding chair should be designed to include the possibility of using it as a youth chair and as a car seat.

2. A folding, portable chair is desirable.

3. Pleasing, harmonious colors should be used.

4. Use aluminum tubing for the frame.

PHYSIOLOGICAL AND PSYCHOLOGICAL REQUIREMENTS

One of the first requirements for a comfortable and scientifically correct chair for seating children is a search into physical measurements of young children.

The measurements of the average youngster between the ages of two and three are used because the seat must be large enough to seat him. Any younger child would have smaller dimensions. The average child at this age has hips about 7 1/4 inches wide, a chest slightly narrower, and shoulders about 9 3/4 inches wide.(19) The distances from his shoulders to hips is 12 3/4 inches, hips to knees 6 3/8 inches, and knees to feet 6 3/8 inches.(20)(21)

The proportionate length of the upper extremities does not alter materially as the child grows older. The legs do not grow more rapidly until fourteen or fifteen years of age.(22)

> Dr. Milton J. E. Senn says, "The construction of the chair should be such that the child has plenty of room between the tray and his ribs to give him some freedom of motion. The footrest should be wide enough to support the whole foot and adjustable to the right height to permit the feet to rest firmly on it without the seat cutting in underneath the knees. It is uncomfortable and exhausting to sit with feet dangling and may cause even a hungry baby to refuse food in order to escape from this painful position."(23)

A talk with Dr. Harvel B. Clarke, orthopedic specialist of Pasadena, California, disclosed that a chair with particular emphasis on posture is not necessary for young children. Their bones are still developing and as long as a seat does not cut the legs and is the right depth from front to back, it will be satisfactory. He

said to make it comfortable but not to worry about posture of children of high chair age. Posture is not a problem until the child is in the sixth year.

From the outset a search was made to evaluate color schemes in the light of pleasing surroundings for the child. A communication from Dr. Arnold Gesell of the Clinic of Child Development, Yale University, sums up the situation very well. He says, "Color embellishments will probably have more atmospheric significance for the adult than for the child."

Conclusions

1. The chair should be large enough to give freedom of motion.

2. The footrest should be fully adjustable to allow the child's feet to be supported at all times.

3. Emphasis on posture is not necessary.

4. Colors have more significance for the adult than for the child.

DESIGN CONSIDERATIONS

Approach

The approach to the final design was made by visualizing an ideal design. Such a design is a chair of greater utility than present chairs on the market. It is a chair that has more than one use, and these uses are dictated by the desires of the consumer. His primary use for this chair is as a high chair. Next in importance is its convertibility to a youth chair. This is to seat the three or four year old child at the correct height at the dining table. Following these uses is the desire to use the chair as a car seat and as a low seat either for feeding the child or as a play chair for him to use as his own. In each of these applications it is paramount that the chair have great stability and sturdiness. Aside from these features, the consumer, manufacturer and retailer are all interested in having it fold to a smaller dimension. The consumer's interest centers in taking it along on visits away from home. The manufacturer and retailer are interested because it is packaged in a smaller carton and stored in a smaller space. Mothers have cautioned, however, that if folding causes the chair to lose any of its stability or sturdiness, it loses all of its sales appeal.

Preliminary Considerations

Several methods of folding chairs are shown in Figs. 4, 5,

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6, 7, and 8. Fig. 4 offers a framework that is very easy to fold to a flat position. The primary disadvantage, however, is its association with a collapsible chair. This is looked on by the consumer as very undesirable. It does not give a feeling of sturdiness and looks temporary. Also there is difficulty in using cross-bracing to get rigidity.

Fig. 5 also folds easily to a flat position, but it also looks like a collapsible chair. The seat has a large overhang that decreases the stability, and the long slanting side members interfere with the space for resting the arms.

Fig. 6 has the same temporary, collapsing appearance. The weight of the occupant places a large bending moment on the rear legs. This tends to bend them and becomes worse as the weight and vigor of the growing child increases.

Fig. 7 is better from a mechanical standpoint, but the seat overhang borderson the maximum and it looks unstable.

Fig. 8 offers an A-frame construction that is very strong. This frame differs from the previous designs inasmuch as it folds from side to side and looks stable. The seat is anchored securely and has very little overhang. It has the features that are desired. It is the basis of the final design.

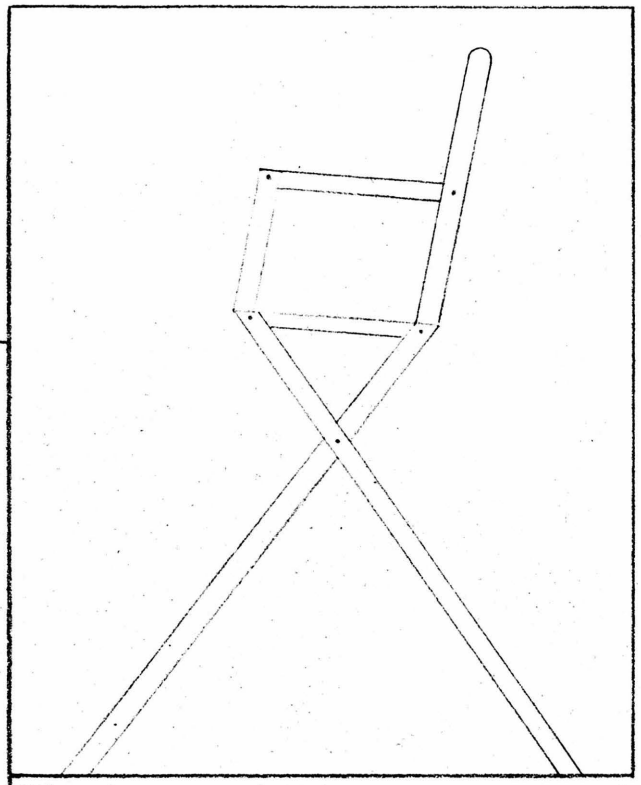

Fig. 4

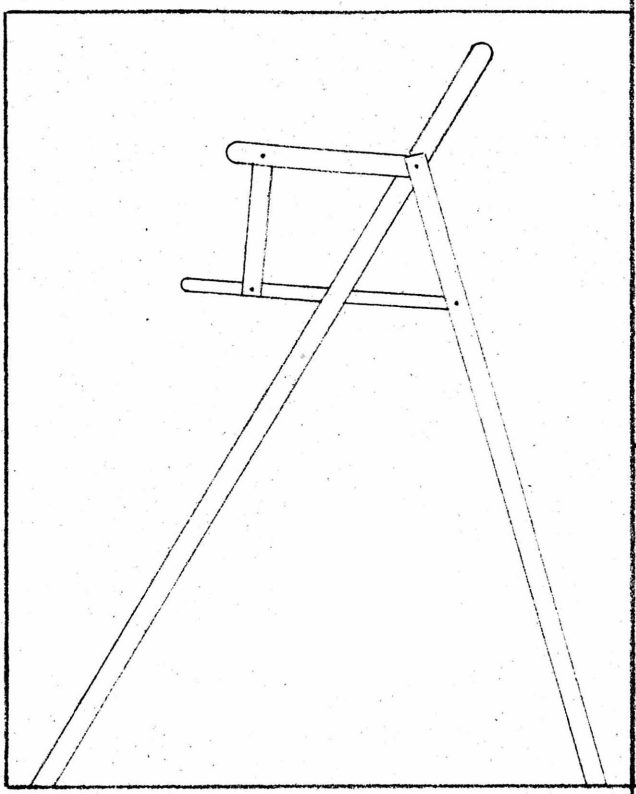

Fig. 5

Fig. 4 Folding Chair No. 1

Fig. 5 Folding Chair No. 2

Fig. 6 Folding Chair No. 3

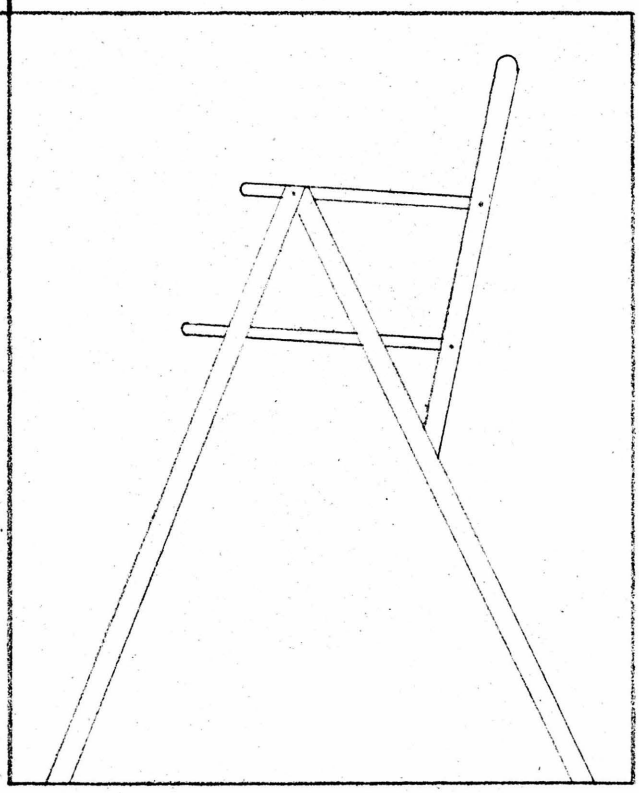

Fig. 6

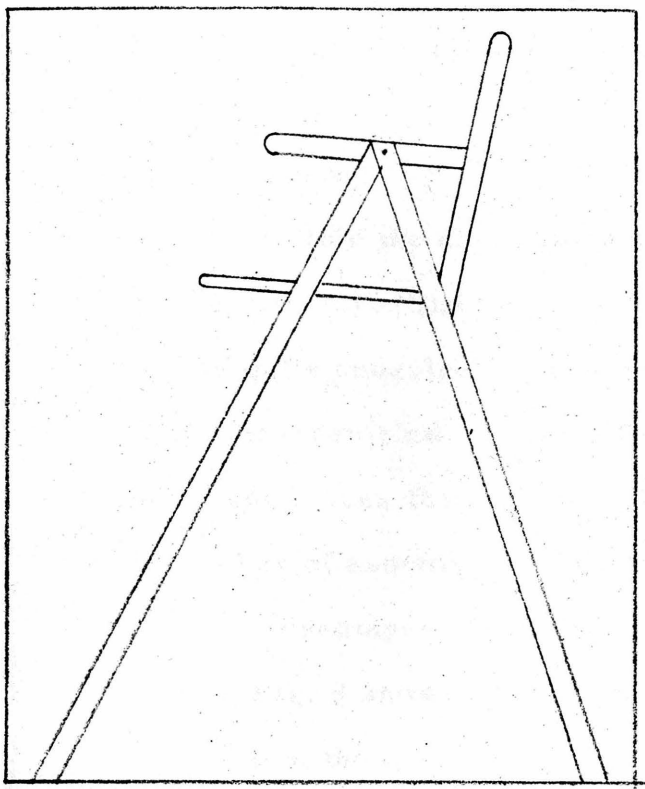

Fig. 7

Fig. 7 Folding Chair No. 4

Fig. 8 Folding Chair No. 5

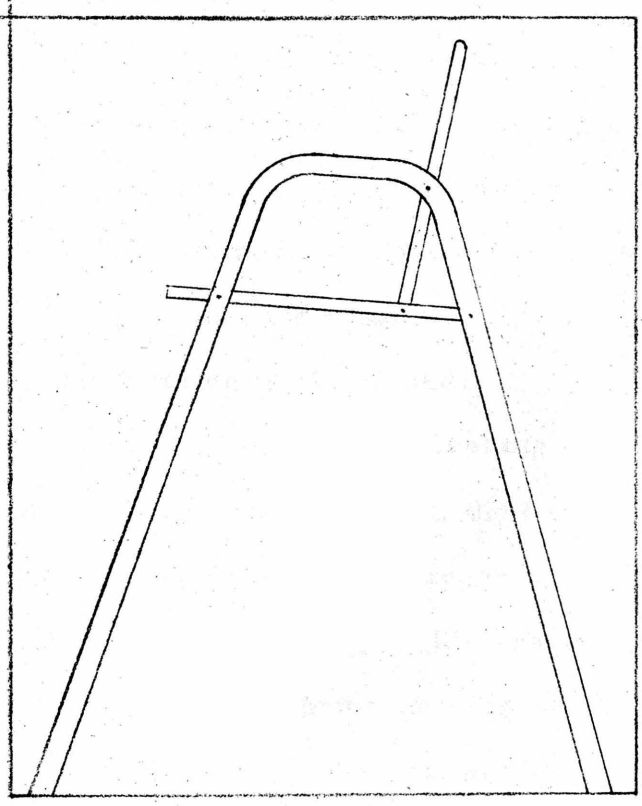

Fig. 8

DESIGN CONSIDERATIONS

Folding Frame

To fold the chair completely it is necessary to devise some lateral bracing. One method is the use of removable bracing, but this is quite undesirable because it means the chair has to be partially disassembled. This method produces a portable chair that has many pieces that are cumbersome to carry to say nothing of the bother of assembly and disassembly. These disadvantages defeat the advantages of folding.

Fig. 9 shows a solution that uses cross-bracing with the upper ends of the braces pin-connected and the bottoms sliding. The bottom ends are raised into position to set up the chair and are clamped in place. A model was made to test this bracing. The cross members introduced a foreign element to the design that detracted from the appearance. Also several operations were required to fold it. Most important of all is that the chair was not rigid enough. For these reasons this bracing is abandoned.

Fig. 10 shows an adaptation of stepladder type of bracing. This coupled with a removable piece of tubing at the top of the back was designed to operate as a pair to give rigidity. The upper brace slips out of place, then the lower brace folds upwards. This brace has the advantage of not being able to be folded when a child is in the seat. The handle of the brace comes up under the seat and in its folded position is three or four inches about the seat level. It

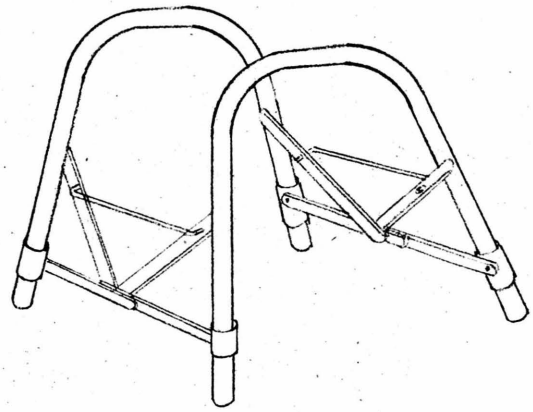

Fig. 9

Cross-Bracing

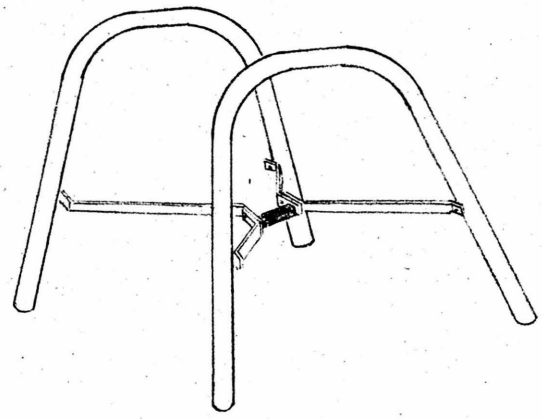

Fig. 10

Stepladder Bracing

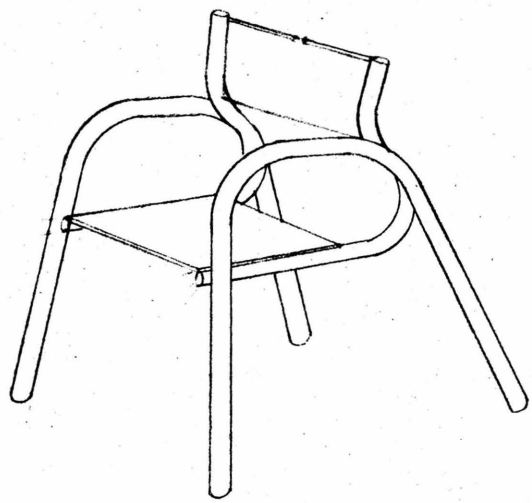

Fig. 11

Rigid Seat and Backrest

is very simple, but a model proved it to be lacking in rigidity and the design was abandoned.

Fig. 11 uses a different system. It has no bracing as such. Here a solid seat and backrest are used as structural members. They are hinged on one side and held in place with thumb screws on the other. A model proved that this offers more rigidity than the others, but more bracing is needed below the seat. However, to give a good appearance and to give more comfort, the seat and back would have to be curved or padded. Either method would unduly increase the expense of the unit. This expense plus the need of more bracing below the seat, rule it out as being too costly and impractical.

At this point a re-study was made into the advantages of a folding unit. So much difficulty is encountered in producing a good rigid structure that folds easily with a minimum of work and expense that it was necessary to re-examine the merits of a folding unit. All of the research material presented previously was studied. Also mothers were questioned again to make a final decision. This study has disclosed that stability and rigidity are absolutely essential in a high chair. Ability to be folded is definitely secondary. The number of times that a chair would need to be folded is relatively infrequent. It would be an advantage to fold it into a small carton for shipping. It also would be handy to have it fold to carry on visits

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away from home, but these visits probably average less than once a month. With these facts in hand, it is decided that a folding chair is not essential. However, tubing has the unique ability of being able to be telescoped and in this case serves an excellent purpose. It reduces the leg length by one-half for shipping and transporting the chair, but what is more important it increases its utility. The chair can be used with the legs adjusted to the short position as a car seat, low chair or play chair for the child. The telescoping legs will be used, but beyond that the design proceeds on a rigid type chair.

FINAL DESIGN

The final design is directed toward the great majority of consumers who expressed a desire for a multipurpose chair. This chair is shown in Figs. 12, 13 and 14 to illustrate its three distinct uses as a high chair, youth chair and low seat.

This chair is designed to have stability - a point that is uppermost in the mind of any mother when shopping for a high chair. The legs are spread far apart and the seat lowered more than most existing chairs on the market today. The widespread legs give a good stance that makes the chair difficult to tip. Reducing the height of the seat produces two advantages. It lowers the center of gravity and brings the seat to the right level to seat the three to five year old child at the correct height for eating from the dining table.

The legs have an adjustable joint to allow the chair to be made into a low seat (Fig. 17). This joint is positive in action and operates against spring pressure. The two spring loaded buttons are pressed in with the thumb and forefinger, then the outside tubing slides over the smaller tubing. When the buttons of the locking device coincide with the holes in the outer tubing the buttons snap out and give positive locking of the legs. The spring has enough tension to prevent tiny hands from operating it, but works easily for grownups. When the chair is in the low position it can be used as a low chair for feeding the child, or with tray

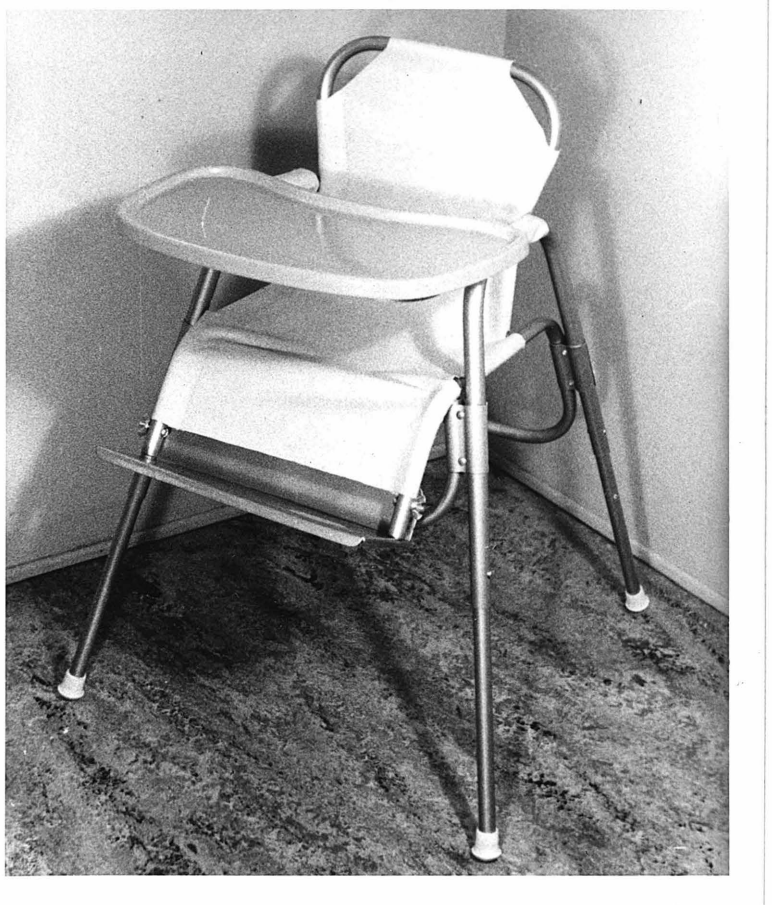

Fig. 12 High Chair (Final Design)

Fig. 13 Youth Chair (Final Design)

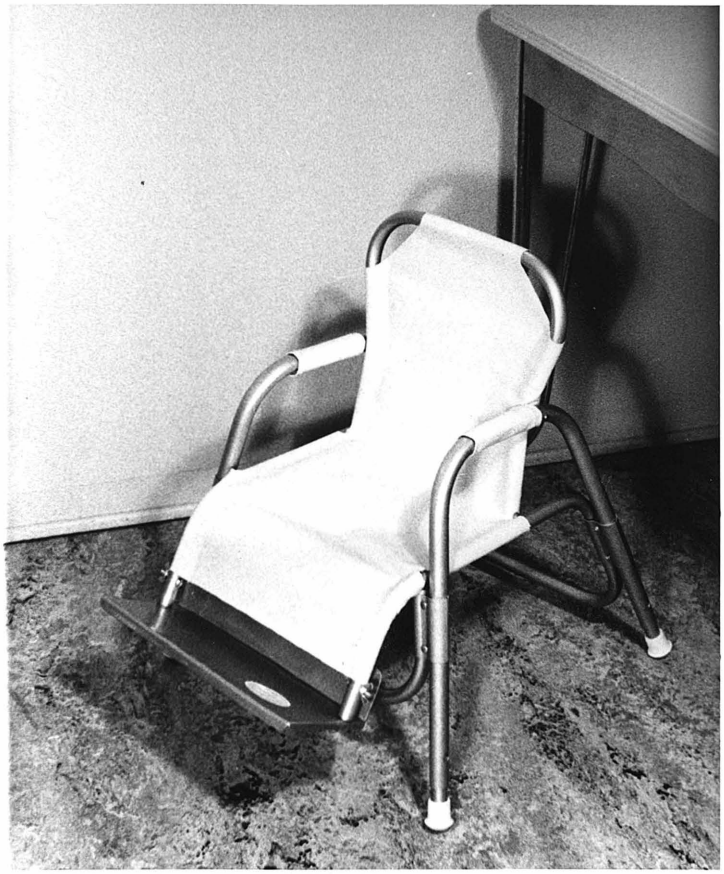

Fig. 14 Low Chair (Final Design)

FINAL DESIGN

removed, as a low chair. Originally it was planned to use the chair for a car seat too, but as the design progressed it was found that it was too large and cumbersome to make a good car seat, so this use has been discarded. It is felt that the chair performs the uses stated above in excellent fashion. To add other uses that cannot be accomplished equally as well jeopardizes the design and begins to place it in the category of a gadget.

Many mothers have complained in the past about hard-to-clean high chairs. For this reason plastic coated fabric has been chosen for the seat. This material offers a smooth waterproof fabric that is comfortable to sit on and is inert to alkalies and acids in soaps, foods, body secretions, etc. The fabric has been designed to slip on the tubing and is in one piece from the top of the backrest to the front of the seat which gives an unbroken surface for easy cleaning. There are no corners or crevices for crumbs and spilled food to collect in. The fabric has also been designed to cover the tubing at all areas where a child's bare skin might come in contact with it. The armrests have been covered for this reason by a piece of fabric that doubles as reinforcement for the seat.

Comfort has not been overlooked. In this design both the seat and backrest have a slight slope. By experimentation the correct slopes and included angle between seat and backrest have

been determined and incorporated in the chair. This produces a seat of greater comfort and helps keep the child in the chair.

A further aid to the comfort of the child is the fully adjustable footrest. Present day chairs have a footrest that adjusts in an arc centered just below the front edge of the seat. This means the small child is unable to rest the soles of his feet on the footrest. He is only able to dangle his legs with the backs of his feet and legs resting on a board. The chair presented here has a footrest that adjusts up and down on an incline to allow for both short and long legs. No matter how short the child's legs he is still able to rest his feet comfortably.

The tray is an important part of any high chair. Not only should it be of adequate size for food serving and play area for the child, but it must also be durable and easy to keep clean. For these reasons a plastic tray has been specified. Such a tray offers a fine smooth surface that can be washed easily. The complaint about food beaten into the grain of wooden trays is made a thing of the past. Also this tray is easily adjusted to take care of both small and large children. The tray is easily removed by releasing two spring-loaded catches. This means that the tray can be taken to the sink and washed in hot water. Every mother knows the advantages of this.

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The frame of the chair is aluminum tubing that offers a light, easily portable, easy-to-clean material. It is light but strong. No longer is it back-breaking work to move the chair to feed the child near the window or on the porch, or just to move the chair to clean the floor around it. Lightness is important in another way. The manufacturer and everyone in the distribution channel save money on shipping charges and storage.

The simplicity of this design and the manner in which it is assembled allows the use of pleasing color combinations. The exposed aluminum frame has a soft sparkle with depth of color produced by a sprayed on phenolic finish. The fabric for the seat is supplied in two colors - yellow or red. Either of these colors harmonizes with the frame and the light gray tray. These colors are chosen for their gayety and will fit in with most kitchen color combinations.

Throughout the design of this high chair, quality of materials has been uppermost in consideration. At the same time it is necessary to consider price. Both consumers and buyers in stores have agreed that something around $15 is a fair price. Quality does not necessarily mean high priced materials. It means the right material in the right place. This objective has been foremost in the design presented here. Materials have been chosen for their quality, yet for their ability to stay within the

FINAL DESIGN

price range. It is felt that the design described here has wonderful possibilities and offers many selling points at a price far below comparable products. So much appeal at a fair price cannot be turned down by the consumer.

DETAILS OF MANUFACTURE AND STRENGTH ANALYSIS

Frame

The frame (Fig. 18) is 61S-T6 aluminum tubing[24] and is made up of seven major parts - two side members with telescoping legs, a one piece seat support and rear leg brace, a one piece backrest frame, a horizontal brace below the seat at the front, an adjustable footrest, and a tray support. All tubing is bent on standard tube bending machinery. Rivet holes are drilled after bending. The finish is called Zapon. It is a phenolic lacquer and is sprayed on after the tubing is bent and drilled.

Side Members

The upper tubing of the side frame members is 7/8'' O.D. with .058'' wall. The telescoping lower section is 3/4'' O.D. with .035'' wall. The mechanism to lock the legs when in either of their two positions - extended or telescoped - is shown in Fig. 19, Appendix B. It has two spring loaded buttons mounted in a cylindrical wood housing that is pressed into the end of the 3/4'' tubing.

Calculations for Lock Mechanism Spring

Design for a working force of 5 lbs. on two 5/16 in. diameter buttons.

Assume a spring diameter of 1/4 in.

Use 180,000 lbs./sq. in. music wire.

DETAILS OF MANUFACTURE AND STRENGTH ANALYSIS

Allowable deflection of spring is .305 in.

Solving for stress/lb. of load -

$$s = \frac{180{,}000}{5} = 36{,}000 \text{ lbs./sq.in/lb. of load}$$

From chart[25] - wire dia. = .027 in., use standard size of .026 in.

From chart[25] - inches deflection/active coil/lb. of load = .017 in.

Solving for inches deflection/active coil/5 lb. load -

$$d = .017 \times 5 = .085 \text{ inc.}$$

Solving for number of active coils -

$$\text{coils} = \frac{.305}{.085} = 3.59 \text{ active coils}$$

Add one inactive coil to each end for a total of 5.59 coils

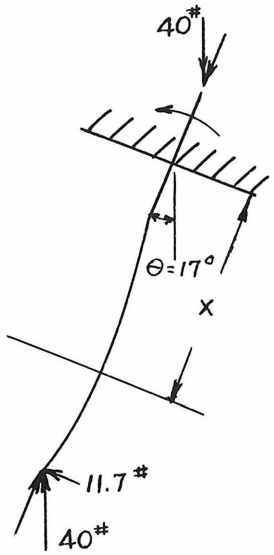
Solving for solid length -

$$\text{solid length} = 5.59 \times .026 = .1454 \text{ inc.}$$

Calculations for the Deflection of the Legs

The top of the leg is held tight in a clamp that produces a beam with the top end built in and the other end hinged as shown in the following diagram. The leg length is 18 inches and the 40 lb. load is the weight of an average five year old child. This load is considered to be acting all on one leg to give the worst

possible loading. The fixed end has a couple applied that is resisted by a lateral force at the hinged end.



Solving for location of maximum deflection of legs -

Deflection curve equation(26)

$$\frac{dy}{dx} = \frac{Mo}{S} = \left(\frac{p \cos px}{\sin pL} - \frac{1}{L} \right)$$

$\frac{dy}{dx}$ = slope of leg

Mo = moment about fixed end = 211 inch lbs.

x = distance from fixed end to point of maximum deflection in inches.

L = length of column = 18 in.

S = axial load = 38.2 lbs.

Maximum deflection occurs where $\frac{dy}{dx} = O$

DETAILS OF MANUFACTURE AND STRENGTH ANALYSIS

$$\frac{dy}{dx} = 0 = \frac{Mo}{S}\left(\frac{p \cos px}{\sin pL} - \frac{1}{L}\right)$$

$$p = \sqrt{\frac{S}{ET}} = \sqrt{\frac{11.7}{10{,}000{,}000 \times .00505}} = .0276$$

$$\frac{dy}{dx} = 0 = \frac{211}{38.2}\left(\frac{.0276 \cos .0276\ x}{\sin .0276\ (18)} - \frac{1}{18}\right)$$

$$\frac{.0276 \cos .0276x}{.47716} = \frac{1}{18}$$

$\cos .0276x = .961$

$.0276x = .279$ radians

$x = 10.1$ inches from fixed end

Solving for maximum deflection[26]

$$y = \frac{Mo}{S}\left(\frac{\sin px}{\sin pL} - \frac{x}{L}\right)$$

$$y = \frac{211}{38.2}\left(\frac{\sin .0276\ (10.1)}{\sin .0276\ (18)} - \frac{10.1}{18}\right)$$

$$y = 5.52\left(\frac{.27564}{.47716} - .561\right)$$

$y = .0939$ inches

The maximum deflection due to the combined compressive and bending loads is .0939 inch at a point 10.1 in. below the clamp on the legs. This deflection is so small as to be negligible.

DETAILS OF MANUFACTURE AND STRENGTH ANALYSIS

Solving for bending stress at top of legs -

$$S = \frac{M}{Z}$$

S = bending stress in lbs./sq. inch

M = bending moment = 11.7 x 18 = 211 inch lbs.

Z = section modulus = .0134 inch^3

$$S = \frac{211}{.0134} = 15{,}700 \text{ lbs./sq. inch}$$

This stress is well below the yield strength of 40,000 lbs./sq. inch[27] for the material and is therefore quite satisfactory.

Seat Frame

The seat frame is one piece of tubing and does double duty because it also serves as lateral brace for the rear legs. It is 3/4'' O.D. with .058'' wall. The front ends are bent down to receive the telescoping ends of the footrest.

Backrest Frame

The backrest frame is bent from one piece of tubing. It is 3/4'' O.D. with .035'' wall.

Front Leg Brace

The front leg brace is bent from 3/4'' O.D. tubing with .058'' wall. A 5/8'' aluminum plug is set flush in each end of the tube after bending and is staked in place. The exposed end

DETAILS OF MANUFACTURE AND STRENGTH ANALYSIS

of the plug is drilled and tapped to receive an 8-32 machine screw that fastens the front of the seat frame. This plug and fastening is shown in Fig. 17, next page, and in Fig. 20, Appendix B.

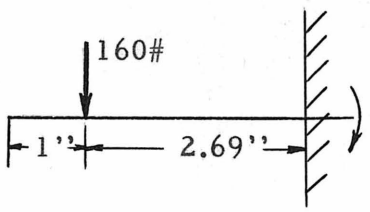
Footrest

The footrest is fabricated from 5/8'' O.D. tubing with .035'' wall and .092'' aluminum sheet. The sheet is bent and riveted to the tubing as shown in Fig. 21, Appendix B. The finish is applied after fabrication.

Calculations for Deflection of Footrest Due to Cantilever Action

Assume a concentrated load of 160 lbs., 1 inch from the free end.

Thickness of metal is .092 in.



Solving for location of neutral axis

$$c = \sum \frac{a'y}{a}$$

c = distance from neutral axis to extreme fiber in inches

a = area of parts of cross section in sq. in.

a'y = moments of areas about x-x axis.

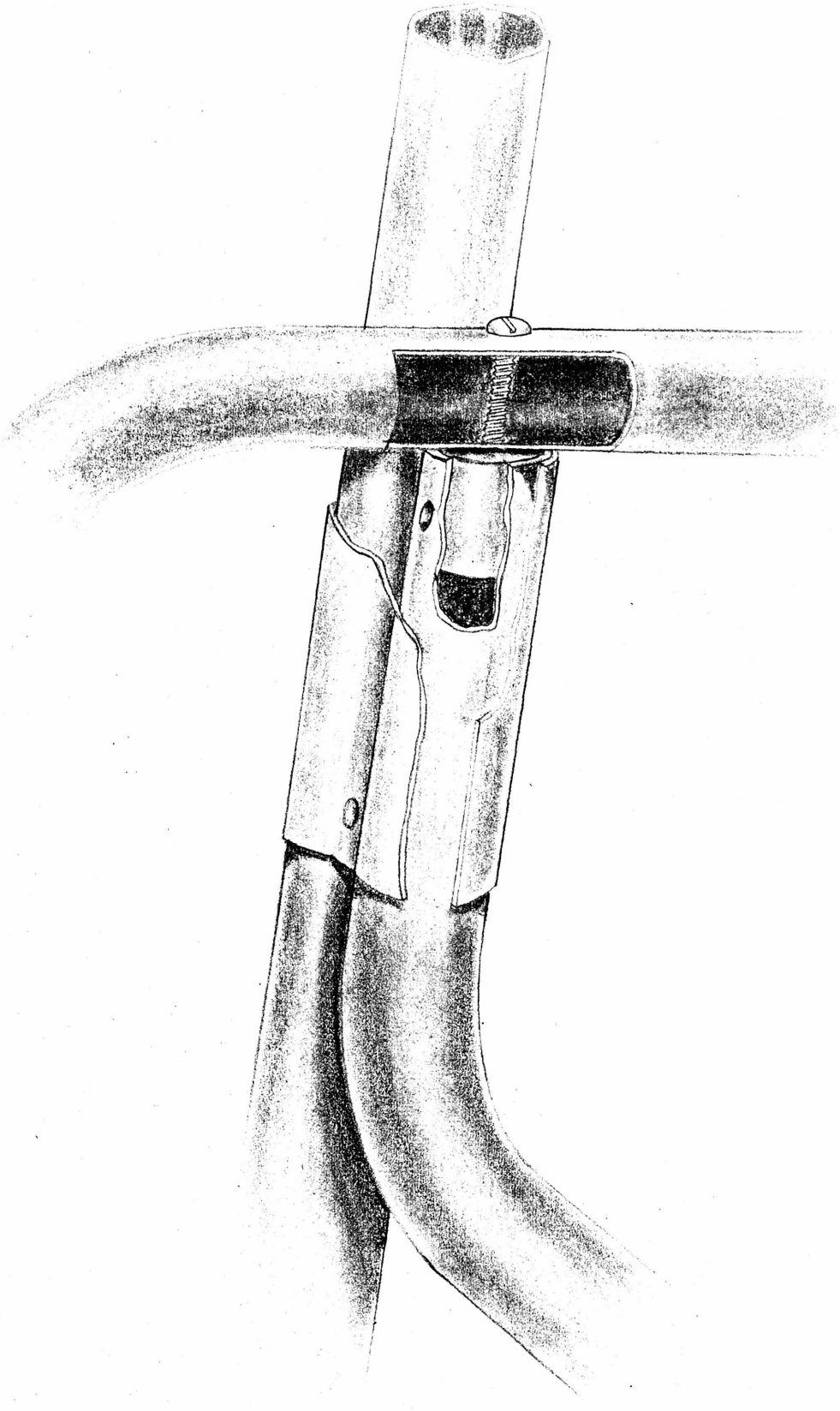
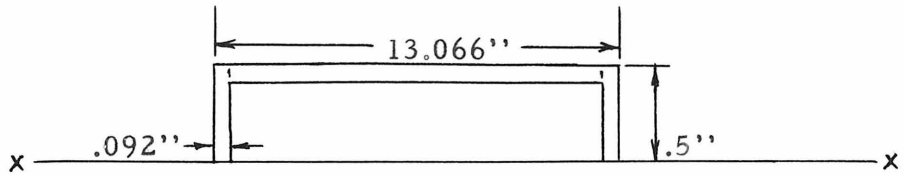


Fig. 15

Cutaway View of Seat and Front Leg Brace Fastening

DETAILS OF MANUFACTURE AND STRENGTH ANALYSIS



$$c = \frac{13.066 \times .092 \times .454 + 2 \times .5 \times .092 \times .25}{13.066 \times .092 + 2 \times .5 \times .092}$$

c = .439 in. above x-x axis.

Solving for moment of inertia of the section[28]

$$I = \frac{ht}{12}\left[t^2 + 12\left(b - c - \frac{t}{2}\right)^2\right] + \frac{db}{6}\left[b^2 + 3(2c - b)^2\right]$$

$$I = \frac{13.066 \times .092}{12}\left[(.092)^2 + 12\left(.500 - .439 - \frac{.092}{2}\right)^2\right]$$

$$+ \frac{.092 \times .500}{6}\left[(.500)^2 + 3(2 \times .439 - .500)^2\right]$$

$$I = .1\left[.00946 + 12(.015)^2\right] + .00767\left[.25 + 3(.378)^2\right]$$

$$I = .1\left[.00846 + .0027\right] + .00767\left[.25 + .428\right]$$

$I = .00632$ inches^4

Solving for deflection due to cantilever action [28]

$$D = \frac{Wl^3}{3EI}$$

D = deflection in inches

W = load = 160 lbs.

DETAILS OF MANUFACTURE AND STRENGTH ANALYSIS

l = length of beam = 3.69 inches

E = modulus of elasticity

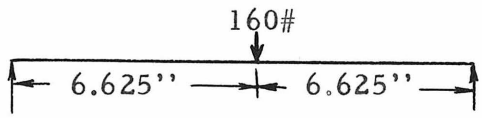
I = moment of inertia = .00632 inches^4

$$D = \frac{160 \times (3.69)^3}{3 \times 10{,}000{,}000 \times .00632} = .0424 \text{ inches}$$

Calculations for Deflection of Footrest as an End Supported Beam

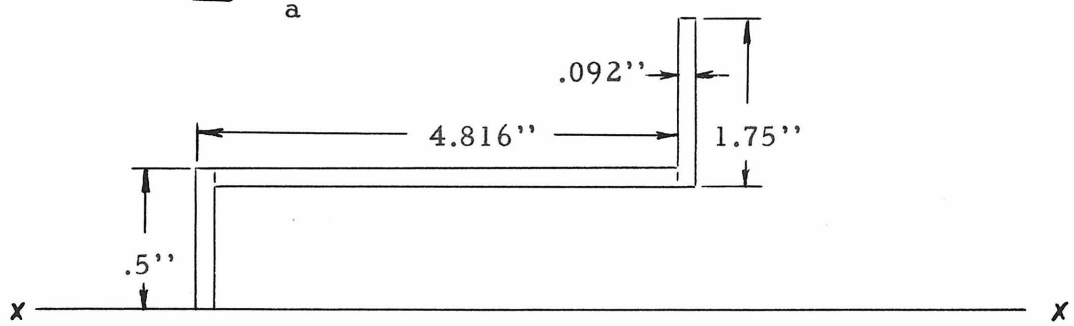
Assume concentrated load of 160 lbs. at center.

Thickness of metal = .092 in.



Solving for location of neutral axis

$$c = \sum \frac{a' y}{a}$$



$$c = \frac{.5 \times .092 \times .25 + 4.816 \times .092 \times .454 + 1.75 \times .092 \times 1.283}{.5 \times .092 + 4.816 \times .092 + 1.75 \times .092}$$

c = .646 in. above x - x axis

DETAILS OF MANUFACTURE AND STRENGTH ANALYSIS

Solving for moment of inertia of section

$$I = \sum a\,y$$

$$I = .046 \times .396 + .443 \times .192 + .161 \times .637$$

$$I = .2059 \text{ inches}^4$$

Solving for deflection due to beam supported at the ends

$$D = \frac{W\,(l)^3}{48\ E\ I}$$

$$D = \frac{160 \times (13.25)^3}{48 \times 10{,}000{,}000 \times .2059} = .00377 \text{ inches}$$

The total deflection of the footrest at the front center edge is the sum of the two deflections calculated here.

$D_1 + D_2$ = total deflection

Total deflection = .0424 + .00377

= .0462 inches

This amount of deflection is so small as to be negligible.

Calculations for Maximum Stress in Footrest

Solving for bending stress due to cantilever action

$$S = \frac{Mc}{I}$$

S = stress in lbs./sq. in.

M = moment about support in inch lbs.

DETAILS OF MANUFACTURE AND STRENGTH ANALYSIS

c = distance from neutral axis to extreme fiber

= .439''

I = moment of inertia = .00632 inches^4

$$S = \frac{160 \times 2.69 \times .439}{.00632} = 29{,}900 \text{ lbs./sq. in.}$$

Solving for bending stress due to support beam action

$$S = \frac{Mc}{I}$$

$$S = \frac{160 \times 13.25 \times .646}{2 \times 2 \times .2059} = 1660 \text{ lbs./sq. in.}$$

The total bending stress in the footrest is the sum of the stresses set up by the cantilever and supported beam action.

Total stress = $S_1 + S_2$ = 29,900 + 1660

= 31,560 lbs./ sq. in.

This stress is well below the allowable yield strength of 40,000 lbs. for the material.

Tray Support

The tray is supported on a 3/4'' x 3/16'' strap that is bent in a U-shape and the free ends are bolted to the armrests with 8-32 machine screws and nuts. (Fig. 22, Appendix B). The strap has four drilled holes on each side to engage the tray locking pins and allow ample adjustment of the tray.

DETAILS OF MANUFACTURE AND STRENGTH ANALYSIS

Tray

The tray (Fig. 23, Appendix B) is injection molded cellulose acetate (Tenite I). It has a thickness of 1/8" and the inserts for the catches are molded with the piece.

Fabric Seat

The fabric for the seat and backrest is "Wynsote", a poly-vinyl chloride supported fabric. It has a 1.85 drill backing with an 8 ounce coating. The fabric is in two pieces. One piece forms the backrest and seat, the other covers the armrests and goes under the seat for reinforcement. The fabric is cut on a fabric cutter that cuts out a quantity at once, then the edges are sewn to slip over the tubing. The thread is 4 cord, number 16 cotton with glazed finish in color to match the fabric. Also sewn to the seat fabric at the sides is a fabric strap with snap fastener. This acts as a safety strap and keeps the child in the seat.

Leg Tips

The bottoms of the legs have rubber tips to keep the chair from sliding and to protect the floor from being marked.

Assembly

All rivets and machine screws are steel with a cadmium plate. The rivets are 3/16" diameter with brazier heads, and the machine screws are 8-32.

DETAILS OF MANUFACTURE AND STRENGTH ANALYSIS

The side frames are assembled with the telescoping sections and rubber tips. The two side frames are then assembled to the front leg brace with the special clamps. The smaller piece of fabric is slipped on over the rear legs and brought up into place on the armrests. Next the other piece of fabric is slipped on the backrest and seat frames and the two frames are riveted together. Then this sub-assembly is set down between the side frames. The backrest is riveted to the armrests. The rear of the seat frame is fastened to the rear legs with the special clamps. The front of the seat frame is fastened to the front leg brace with two machine screws. In the meantime the footrest tubing and bent sheet has been riveted. This sub-assembly is now fastened to the seat frame with two machine screws and wing nuts.

Calculations for Strength of Riveted Joints[29]

Failure by shear

Ultimate shearing load per rivet = $f_s \times A_s \times N$

f_s = ultimate shear strength of shank of rivet in lbs./sq. in.

A_s = cross section area of shank of rivet in sq. in.

N = number of shear planes

Rivets are 3/16'' diameter steel

Ultimate shearing load per rivet = $45{,}000 \times 3.14 \ (.0937)^2 \times 1 = 1240$ lbs./sq. in.

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Bearing Failure

Ultimate bearing load per rivet = $f_b \times A_b$

f_b = ultimate bearing strength of the metal in the shank of the rivet or of the metal against which the rivet is bearing, whichever is smaller (lbs./sq. in.)

A_b = area in bearing in sq. in.

Rivets are 3/16'' diameter steel with 3/8'' diameter head

Ultimate bearing load per rivet = 45,000 x .0829

= 3730 lbs./sq. in.

The shear load and bearing load are both well below the yield strength of 61S-T6 aluminum tubing (40,000 lbs./sq. in.) and can be considered to be very satisfactory.

CONCLUSION

The design reflects the wishes of those consumers that want a chair for children that is an excellent high chair and converts to a youth chair and low chair. The design offers more value and sales appeal at the retail price of $17.50 than any chair on the market. The unit is to be distributed until the initial production volume is sold. A simultaneous consumer sampling accompanies the selling during this period. The production schedule is arranged to allow changes that consumer sampling uncover. These suggested changes will be studied and if they are considered essential to meet the needs of the consumer, they will be incorporated.

Analysis of the nationwide market, tool and die life, subcontracting rates and production techniques indicates that a preliminary run of 1000 units can be retailed at $17.50.

The distribution follows the usual channel - from manufacturer to distributor to retail outlet to consumer. This policy assures smooth handling and full market coverage.

A greater amount of success for the design can be attained if a coined name is attached to the product. Any trade name should be easily remembered, simple and self-pronouncing. A name such as Seat-a-Babe has excellent possibilities.

A clean, easily read tag or folder is attached to every chair. It describes the many possible uses for the unit with well

CONCLUSION

illustrated pages showing its uses and operation.

The design developed here offers a maximum of usefulness, efficiency, safety, sanitation, and appearance. It includes the chair frame with telescoping legs, fully adjustable footrest, seat of plastic coated fabric, and sturdy plastic tray for food serving and play area. Each unit will also have a safety strap to keep the young child in the seat.

Aesthetically the design is simple, graceful, and cleancut. It has balance and sturdiness. The large easily removed tray helps safeguard the young child in the seat. The harmonious and sanitary color scheme of red or yellow and gray gives an air of quality and richness. It is different than any high chair on the market. Increased sales appeal are brought about by the following high performance features:

1. New sanitary aluminum frame.
2. Gleaming easy-to-clean fabric seat.
3. Durable plastic tray.
4. Converts to a youth chair when high chair is outgrown.
5. Excellent stability for safety.
6. Light weight, easy to carry.
7. New telescoping legs.
8. Can be used as a low chair.
9. Easy to remove tray.

CONCLUSION

10. New type adjustable footrest.
11. Rubber tips on legs.
12. Fully adjustable tray.
13. Safety strap.
14. Retail price only $17.50.

REFERENCES

1. Anonymous, Modern Plastics, Markets - Present and Future, (May 1947), Vol. 24, No. 9, Pg. 94.

2. Anonymous, Fortune, The Market: 1948, (Nov. 1947), Vol. 36, No. 5, Pg. 77.

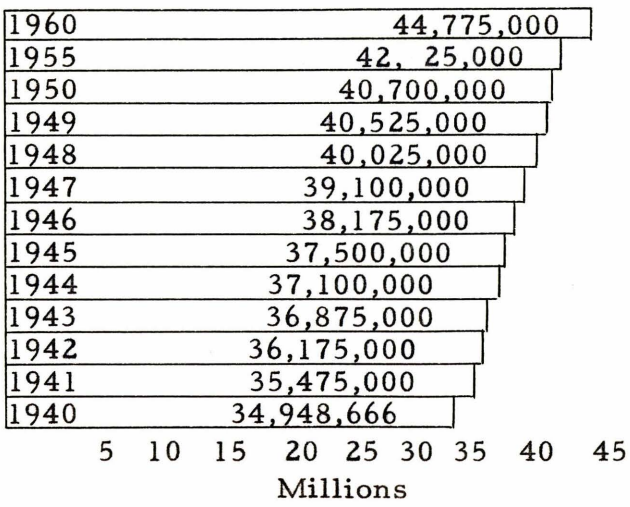
"The United States market is best described as a splendid and provocative sight. It consists of 144 million people whose total income will probably come close to $200 billion in 1948."

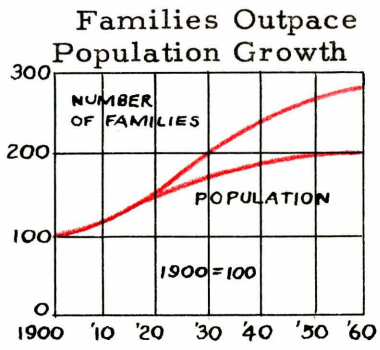
3. Anonymous, United States News, More Millions of Americans, (Oct. 24, 1947), Vol. XXIII, No. 17, Pg. 117.

"Since 1939, about 13,359,999 additional people have crowded into the U. S. That is more people than live in all Canada. It is equal to one-fourth the people living in England. The U. S. already has a population as large as it was expected to be two years from now."

4. Anonymous, Modern Plastics, Markets - Present and Future, (May 1947), Vol. 24, No. 9, Pg. 94.

ESTIMATED NUMBER OF FAMILIES IN THE U.S.
JULY 1, 1940 to JULY 1, 1960





REFERENCES

5. Anonymous, Fortune, The Market: 1948, (Nov. 1947), Vol. 36, No. 5, Pg. 77.

"While the population has been increasing 9 percent since 1940, the number of families has grown by 12 percent."

6. Anonymous, Modern Plastics, Markets - Present and Future, (May 1947), Vol. 24, No. 9, Pg. 94.

"There was a wartime migration of women, mostly young, from rural areas to cities of over 100,000 population. Farm areas lost 11.3 percent of their female population; large cities gained 13.1 percent in female residents, and smaller cities, 9.5 percent."

7. Anonymous, Printers Ink, The Influence of Women on Buying, (Oct. 17, 1947), Vol. 221, No. 3, Pg. 84.

"The percentage of total sales finally influenced by women; not necessarily purchases by women.
Children's and infants' specialties. . . . .98%"

8. Beck, Benton D., Advertising and Selling, How Women of 18 - 30 Look at Merchandise, (Sept. 1946), Vol. 39, No. 9, Pg. 49.

"The typical woman in her twenties is 24 years of age - a housewife and a mother. Her husband is around 28 years of age - they have at least one child. She and her husband are urbanites and enjoy an average family income, as of 1945, of $4290. This woman directed the expenditure of $2515 of the family income and this amount for purposes of day-to-day consumption only. She spent $776 of it for food at home, another $176 was spent for food away from home. She disbursed $415 of it for clothing - $88 for home furnishings - and another $72 of it for recreation. She is also an active partner in designating areas of use for the balance of the family income."

REFERENCES

9. Anonymous, Fortune, The Market: 1948, (Nov. 1947), Vol. 36, No. 5, Pg. 77.

"The birth rate which reached 21.5 per thousand of population in 1944, as compared to an average of 17.3 in the decade 1931-40, has now surpassed the wartime record and moved up to 26.2."

10. Anonymous, United States News, Trend in U. S. Birth Rate - An End to the Boom?, (May 23, 1947), Vol. XXII, No. 21, Pg. 24.

"The number of newborn babies jumped sharply in July 1946, and reached a peak in December when 343,000 births were reported by the Census Bureau. That number was almost twice the monthly average in 1939. If continued it would mean an annual rate of 29.5 births for each 1000 persons in the population - an alltime record birth rate for the country."

11. Anonymous, Los Angeles Times, U. S. Birth Rate Sets New All-Time Record, (Feb. 25, 1948), Vol. LXVII, Pg. 1.

"The birth rate reached a new all-time high last year and the death rate was near the record low in 1946, Federal Security Administrator Oscar R. Ewing reported today.

"Estimates by the National Office of Vital Statistics showed 3,720,000 registered births, an increase of 431,000 over the previous year and 785,000 over the war-time peak in 1943.

"When unregistered births are included, the total is expected to reach 3,910,000 compared with 3,470,000 in 1946.

"The birth rate was estimated at 25.9 per 1000 population including the armed forces overseas. This is 11 per-cent over 1946 and the highest on record."

REFERENCES

12. Anonymous, Fortune, The Market: 1948, (Nov. 1947), Vol. 36, No. 5, Pg. 77.

". . . . .; by April the under-five-year-old population of the U. S. had already increased 36 percent from 1940. This means a predictable wave of special demand for years ahead, including another boom in the diaper service business along about 1970."

13. Anonymous, Modern Industry, There's Gold in Them Thar Kids, (Jan. 15, 1948), Vol. 15, No. 1, Pg. 46.

"Estimating the nations under three market at 8 million, Johnson and Johnson are optimistic over the needs of the nation's toddlers. Johnson and Johnson claims the American baby is a $300 million market for products every year."

14. Anonymous, United States News, Trend in U. S. Birth Rate - An End to the Boom?, (May 23, 1947), Vol. XXII, No. 21, Pg. 24.

"It is too early to determine whether a higher birth rate is a temporary phenomenon or is here to stay, but there is some evidence that American families may be growing larger, thus modifying a 100-year trend toward smaller families."

15. Phelp, Katherine, Printers' Ink, The Demand for Household Goods, (March 14, 1947), Vol. 218, No. 11, Pg. 50, from the Research Dept., Curtis Publishing Co.

"The present annual rate of 2,000,000 marriages is nearly 50 percent greater than the average of the late '30's. Though this extreme rate is not expected to continue, a greater than normal number is expected for at least the next three years."

REFERENCES

16. Phelp, Katherine, Printers' Ink, The Demand for Household Goods, (March 14, 1947), Vol. 218, No. 11, Pg. 50, from the Research Dept., Curtis Publishing Co.

"According to recent releases by the Census Bureau, between July 1940 and July 1950, nearly 15,000,000 new families will have been formed. (During this same period almost 9,000,000 homes will have been broken up by death or divorce, leaving a net growth for the decade of 6,000,000 families).

"The total number of families in 1950 estimated by the Census Bureau will be 41,000,000. The 15,000,000 of all families new to the market place represents a tremendous sales and advertising responsibility."

17. Anonymous, Modern Plastics, Markets - Present and Future, (May 1947), Vol. 24, No. 9, Pg. 94.

"The past 30 year period has been one of increased decentralization. Urban population grew slightly during the war, but the general trend is already reversing. Increased suburbia will mean the location of more and more department stores branches outside of urban centers, an increase in number of units in chains. It will add a new importance to shipping weight of products."

18. Anonymous, Consumer Research Bulletin, High Chairs, (Nov. 1946), Vol. 18, No. 5, Pg. 5.

19. Wellman, Beth L., A Handbook of Child Psychology, (1931), Pg. 268, Clark University Press.

20. Griffith, J. P. Crozer, M.D., Ph.D., and Mitchell, A. Graeme, M.D., Textbook of Pediatrics, (1941), Pg. 13, 3rd edition, W. B. Saunders Co.

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Length of Infants

Birth	20	inches
3 months	23.5	"
6 months	26.7	"
1 year	28	"
2 years	32	"
3 years	35.5	"
4 years	38	"
5 years	41.5	"

Relation of Length of Trunk to Total Length of Infants

Shoulder to hips	3/8 of total
Hips to knees	3/16 of total
Knees to feet	3/16 of total

21. Clarke, Carl D., Illustration: Its Technique and Application to the Sciences, (1939), Pg. 115, John D. Lucas Co., Baltimore, Maryland.

22. Griffith, J. P. Crozer, M.D., Ph. D., and Mitchell, A. Graeme, M.D., Textbook of Pediatrics, (1941), Pg. 13, 3rd Edition, W. B. Saunders Co.

"The proportionate length of the upper extremities does not alter materially as the child grows older. The legs do not grow more rapidly until 14 or 15 years of age."

23. Senn, Milton J. E., M.D., and Newill, Phyllis Krafft, All about Feeding Children, (1944), First edition, Pg. 74, Doubleday Doran and Co.

REFERENCES

24. Anonymous, Alcoa Aluminum and Its Alloys, (1947), Page 43, Aluminum Company of America, Pittsburg, Penn.

25. Anonymous, Basic Design Charts to Determine Safe Load and Rate of Deflection for Helical Extension or Compression Springs, (1944), Pg. 19, Wallace Barnes Co., Div. of Associated Spring Corp., Bristol, Conn.

26. Timoshenko, S., Strength of Materials, (1941), Pg. 28, Part II, Lancaster Press Inc., Lancaster, Pennsylvania.

27. Anonymous, Alcoa Aluminum and its Alloys, (1947), Pg. 93, Table 16, Aluminum Company of America, Pittsburgh, Pennsylvania.

28. Anonymous, New Departure Handbook, (1945), Vol. II, Pg. 152, New Departure, Division of General Motors, Bristol, Connecticut.

29. Anonymous, Riveting Aluminum and its Alloys, (1941), Pg. 5, Aluminum Company of America, Pittsburgh, Pennsylvania.

APPENDIX A

A list of representative high chairs on the market and their outstanding features.

Sears Roebuck

High chair. $9.75
Not upholstered
Made from softwood
Non-adjustable footrest
Sliding tray
Natural finish with decals

Sheboygan Chair Co.

High chair #3550 . . . . . $13.50 in 1946 (No model available in stores visited, price probably about 25% higher now.)
Sliding wooden tray
Upholstered
Wood construction
Footrest adjusts in an arc
Natural finish
Weight $18\frac{1}{2}$ lbs.
Stability rated below average by Consumers Research bulletin

Baby Line

High chair #6200 . . . . . .$13.95
Not upholstered
Folds to make table and chair
Sliding wooden tray
Wood construction
Natural finish with decals

APPENDIX A

Edison Wood Products Inc.

High chair and table set #28. . . . . $15.95 in 1946 (No model available in stores visited, price probably about 25% higher now.)
Not upholstered
Chair sets on table, can be taken apart to make table and chair combination
Sliding plastic tray
Wood construction
Natural finish or white
Weight about 30 lbs.
Stability rated excellent by Consumers Research Bulletin

Storkline

High chair #136. . . . . .$17.95
Not upholstered
Sliding wooden tray
Wood construction
Natural finish

Thayer Inc.

High chair #823. . . . . .$18.54
Not upholstered
Sliding wooden tray
Wood construction
Footrest adjusts in an arc
Natural finish with decals
Weight about 22 lbs.
No safety strap

Huber Engineering Co.

Travl-chair. . . . . .$19.95 plus $8.25 for accessories
Not upholstered
Convertible to youth chair, car seat, rocking chair, low seat
Portable, disassembles to a package 21'' x 18'' x 5''
All aluminum construction. Plastic tray (sliding)
Red and cream enameled finish
Weight 10 lbs, 14 oz.
Stability claimed to be excellent

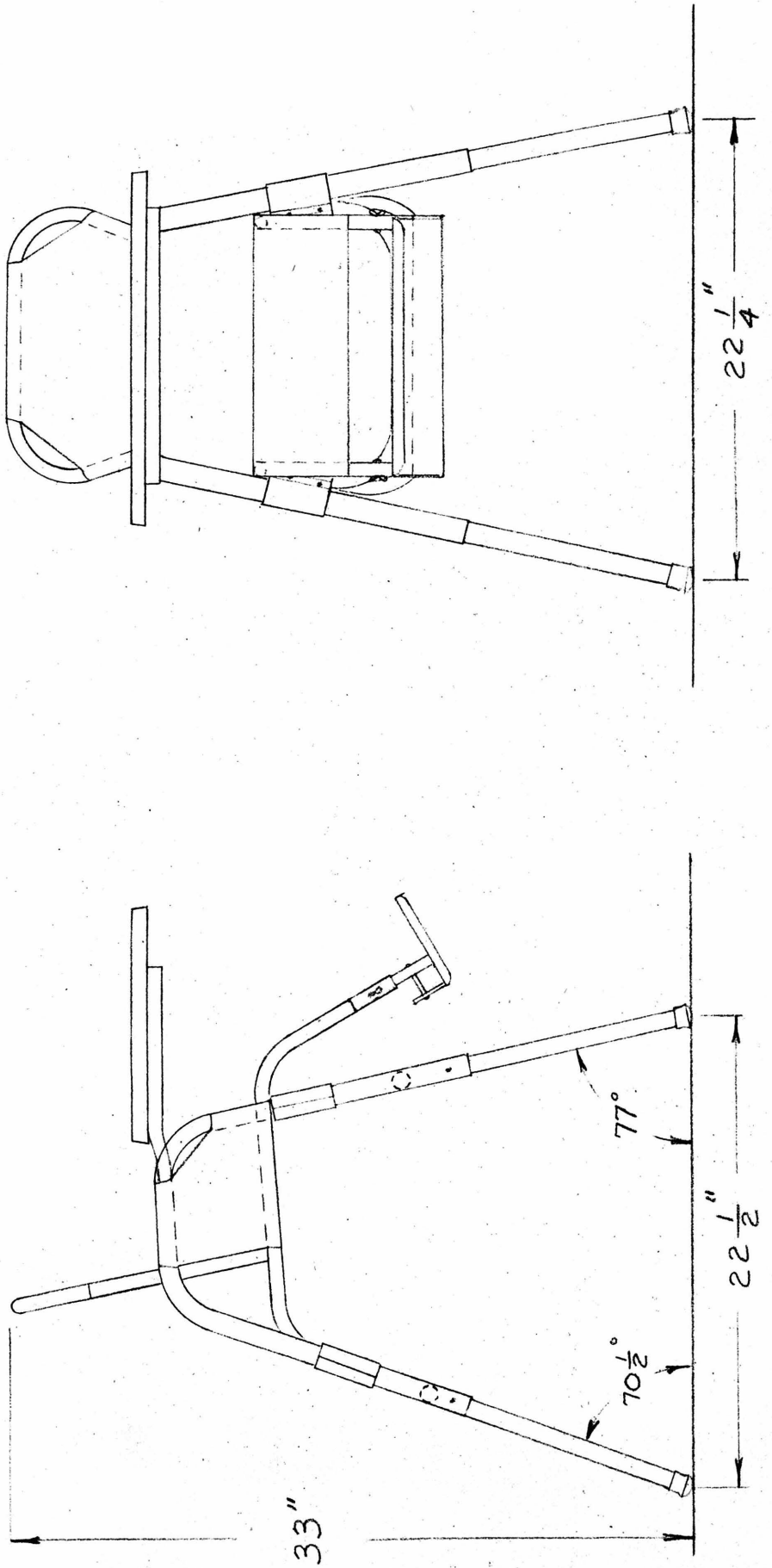
APPENDIX A

Babee-Tenda Corp.

Safety Chair #120. . . . . $25.18 plus $12.64 for accessories. Accessories include small folding chair, canopy, apron and harness.
22'' high table with chair suspended from center
Converts to play table and chair if small folding chair is purchased as an accessory
Padded seat swings to and fro in table
Stability rated highest of all types tested by Consumers Research Bulletin
Masonite and wood construction
Portable, folding
Natural finish

Thayer Inc.

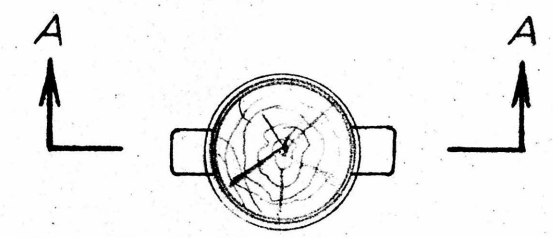
High chair #4867. . . . . $38.46
Upholstered in candy stripe pattern fabric
Combination overhead and sliding tray
Wood construction
Plastic tray
Footrest adjusts in an arc
Converts to table and chair
Weight about 28 lbs.
Polished aluminum tray bracket
Finished in natural, mapletone, white,pink, or blue enamel



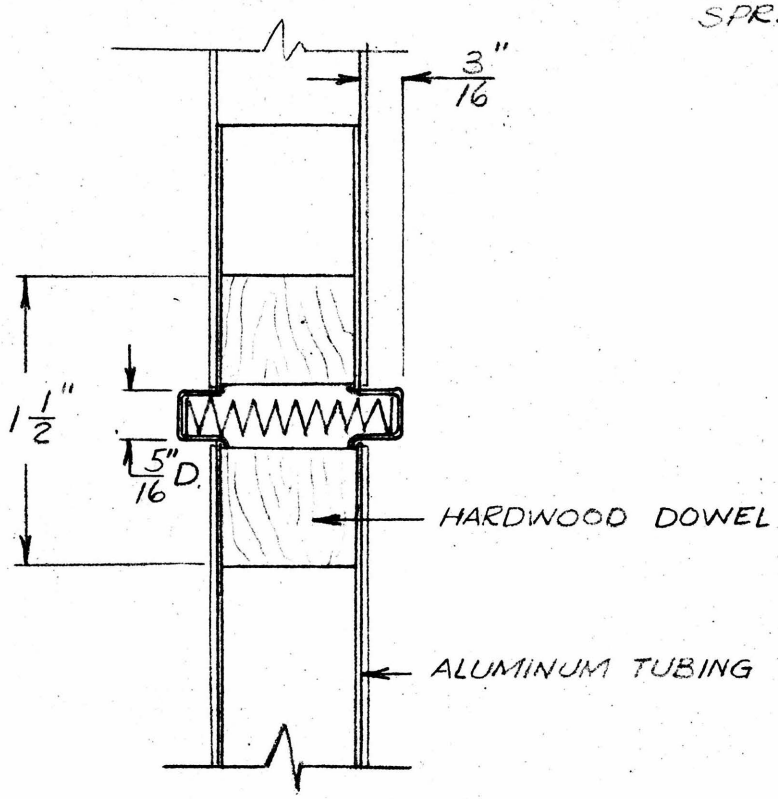
ASSEMBLY DRAWING

FIG. 16

CRAIG PAUL 5/11/48



MATERIALS –
TUBING – $\frac{3}{4}$", 61S-T, .035" WALL ALUMINUM
BUTTONS – DRAWN BRASS
SPRING – $\frac{1}{4}$" × $1\frac{1}{16}$", STEEL

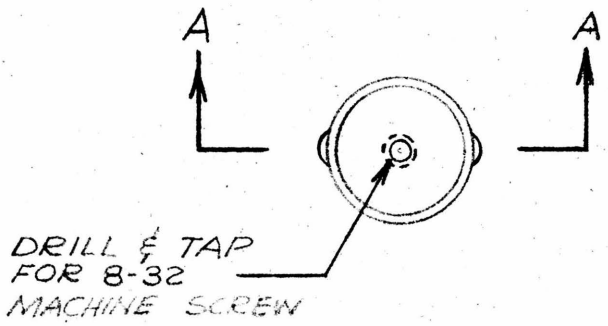


A-A

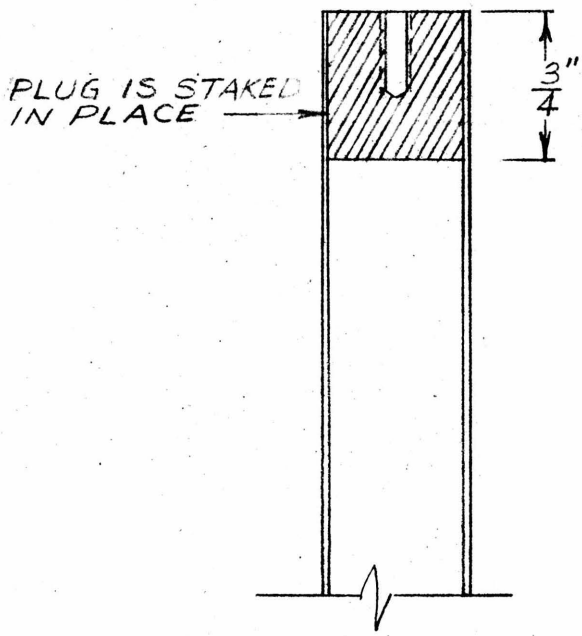
LEG LOCKING MECHANISM

FIG. 17

CRAIG PAUL 4/19/48



TUBING – $\frac{3}{4}$", 61S-T, .058" WALL ALUMINUM
PLUG – $\frac{5}{8}$" ALUMINUM ROD

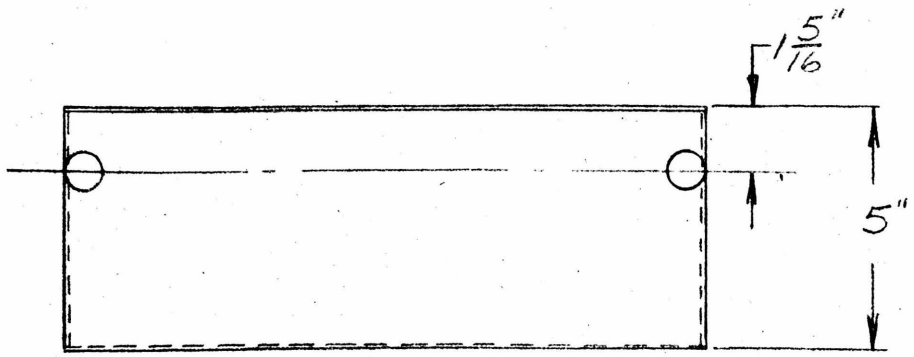


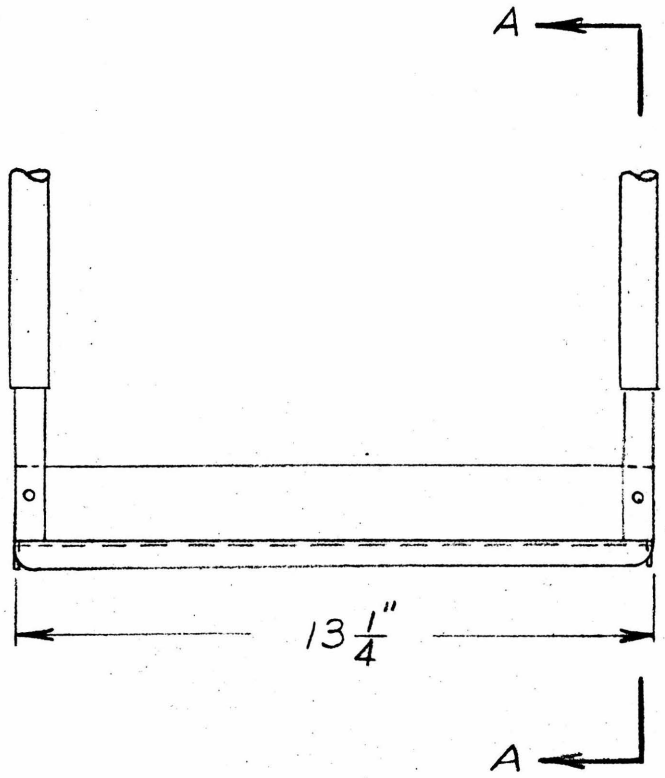
A-A

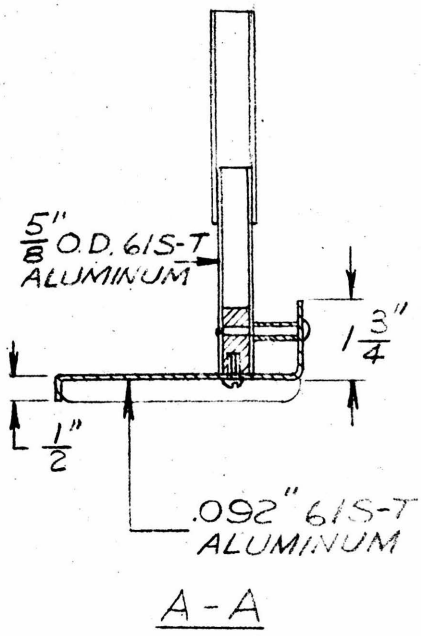
FRONT LEG BRACE PLUG

FIG. 18

CRAIG PAUL 4/19/48





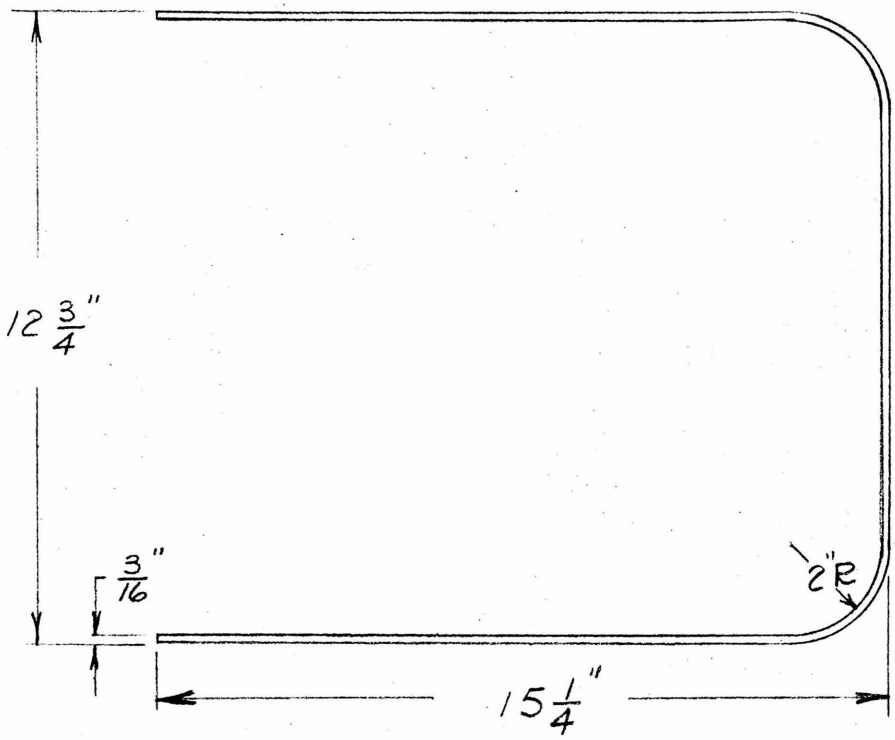


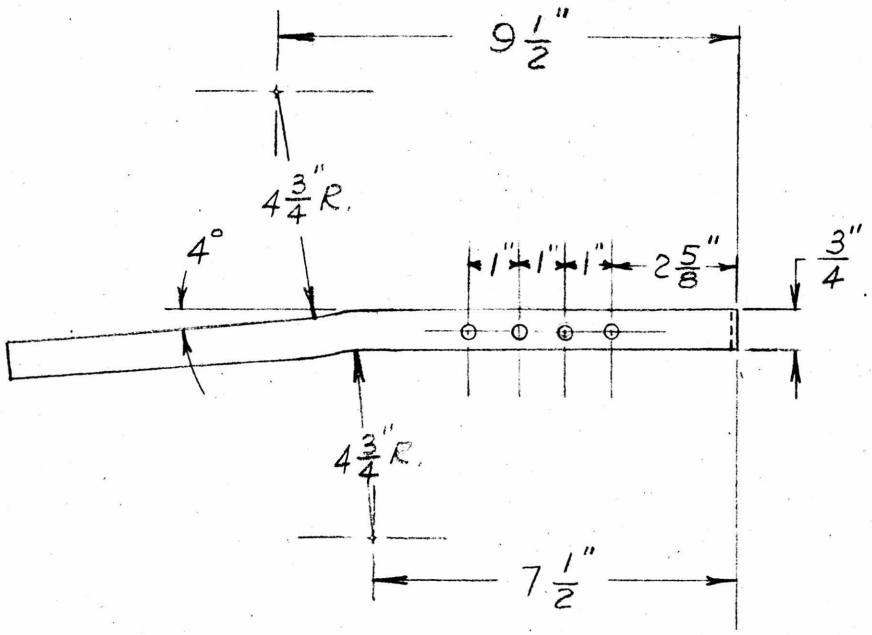
A-A

FOOTREST

FIG. 19

CRAIG PAUL 4/19/48



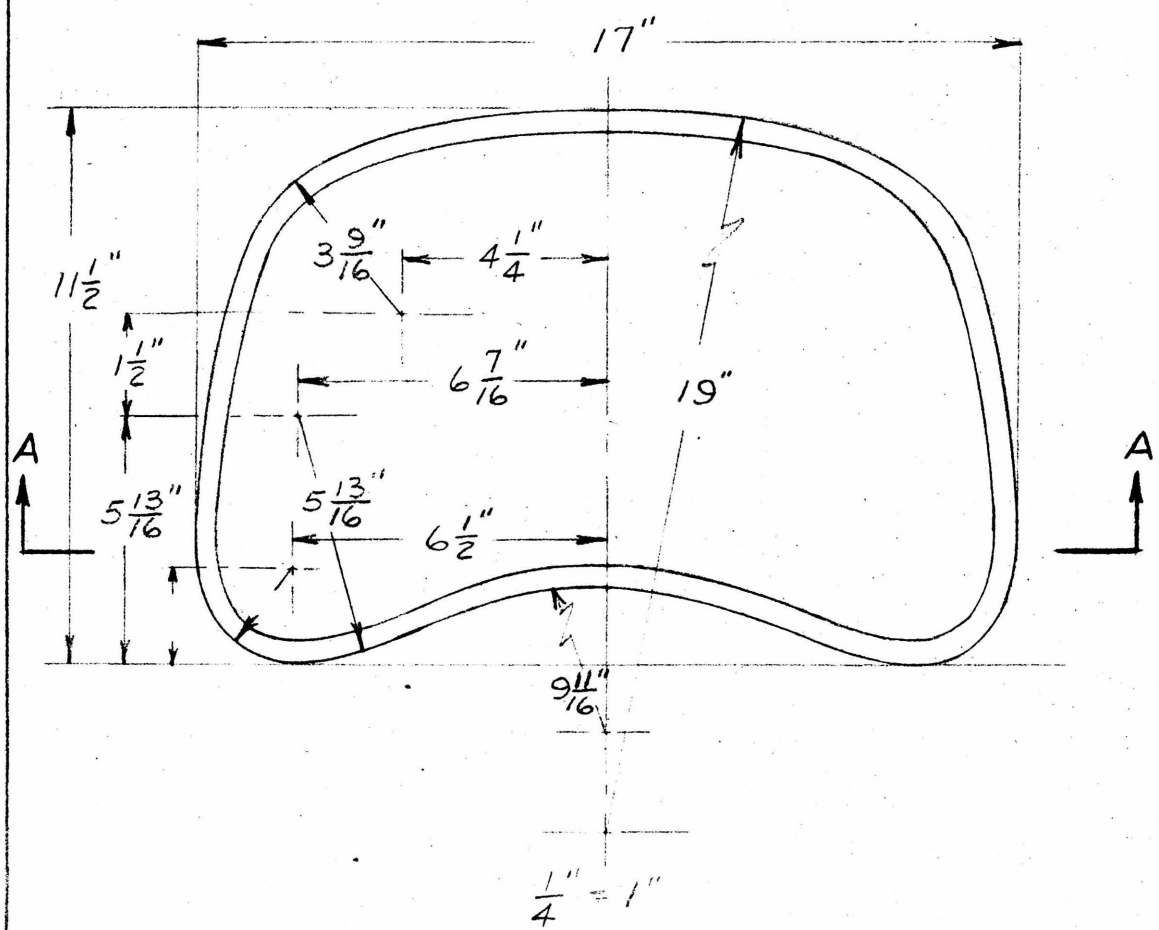


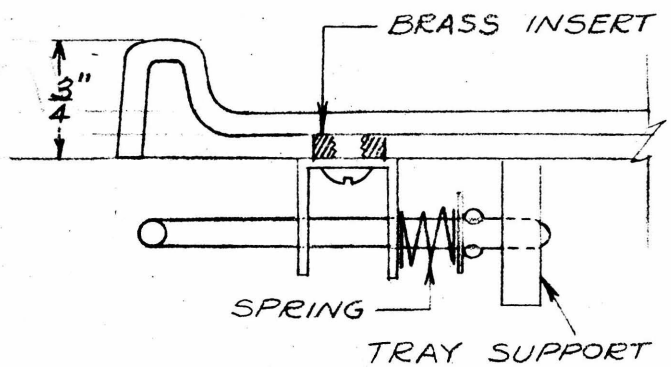
TRAY SUPPORT

FIG. 20

CRAIG PAUL 5/17/48

A-A



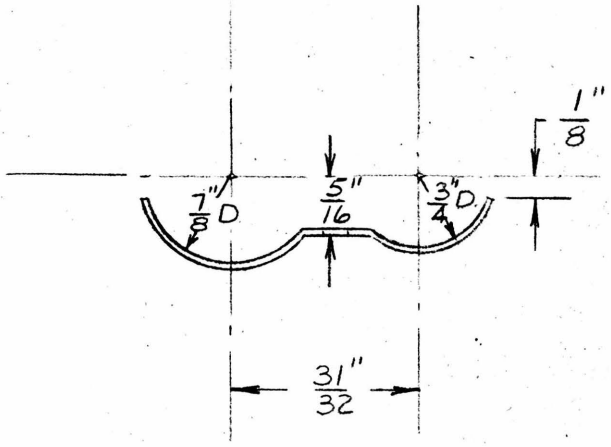


DETAIL B
FULL SIZE

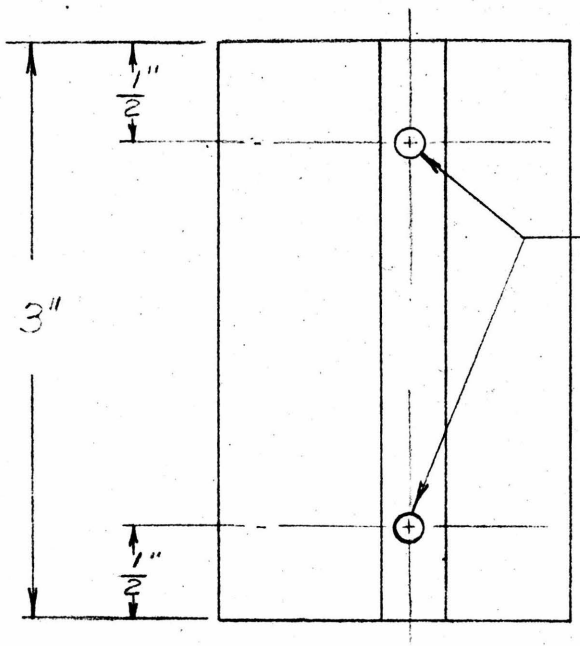
TRAY

FIG. 21

CRAIG PAUL 5/11/48



MATERIAL - .051", 61S-T ALUMINUM.



7"/32 DIA. - 2 HOLES

RIVETED CLAMP

FIG. 22

CRAIG PAUL 4/19/48