

TOYS FOR PRE-SCHOOL CHILDREN-PRAM-CUM-STROLLER

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Toys for pre-school children -

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Toys for Pre-school Children - Pram-cum-Stroller

Diploma project

Submitted in partial fulfilment of the
requirements for the postgraduate diploma in
industrial design

by

H.V. Bhasin

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Approval sheet

Diploma project entitled

Toys for Pre-school Children - Pram-cum-Stroller

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postgraduate diploma in industrial design

Guide

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Shri M. Chattopadhyay

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1.0 PROBLEM STATEMENT

Toys for Pre-school Children

2.0 INTRODUCTION

Children's early years are vitally important and in these years they need maximum comforts, attention, and plenty of things and people to play with. Some experts even go as far as to insist that a child's essential characteristics are irrevocably formed by the time he is five.

Young parents of today are well aware of these needs. In every growing family, from whichever income group, one could always find some form of equipment for the comfort of the young children and along with that some play things too. The type of equipment or toys may differ from one income group to another. Choice is often limited by the family resources and space in or around home.

The economic condition of an average family in India, as it is today, limits the parents to buy what they consider as the most essential for them and for their children. So buying of toys is most affected as most parents tend to give more importance to the physical comfort that they or their children can get rather than to buy toys for their children, more so as children lose interest in a toy very soon. Most often the attempt is to improvise or make toys at home.

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Happily it is possible to do so to quite some extent, because the need of a young child for play things is rather elementary and simple. In early years of child's life, child can play with almost anything that produces sound, has some attractive colours, form and textures or the child could just play for hours in sand, clay or water. The toys dealing with the social training are also easy to improvise as child lives in a make believe world.

Home-made cotton dolls, paper masks or paper crowns, etc. are not uncommon. The only kind of toys that are probably a bit difficult to improvise, are the one's which help to develop the child's motor ability, as these toys are relatively big, complex and mechanical toys. These very toys are also difficult to buy because of their higher prices. Secondly, these toys have a small useful life for once the child develops his general physical capabilities these toys become useless. At this age children start going to schools, have many friends and prefer playing physically active games. It is for these reasons that parents feel the pinch, buying these toys. Some times they would rather spend the money on other essential items required for the family.

Type	Development	Commercial toy	Improvisation
Perception conception	Awareness of various simple sounds, voices, words, forms, colour, textures etc. and conceiving a relationship between action and reaction in simple cases.	Mini piano singing birds talking dolls box and a hammer jumping monkey, and other similar toys in different forms, colours, textures etc.	Almost anything at home that can be pushed around, kicked and what can produce sound.
Social	Awareness of Mine - Mummy, Papa, dolls Me - Demanding attention and possessive.	Various types of dolls	Cotton or other home made doll dresses.
	Ours) Home Yours) T.V. Theirs) Market, fruit seller	Mini models and sets	Cardboard boxes, chairs, fruit trays etc.
	We, you, they - share, turns by turn (delayed rewards)	Simple games of marbles, cards etc.	In child's imagination they turn into Houses, Toys sets, Market shop, etc.
	a. Big muscle movements - crawl stand walk run, and other coordinated movements of arms and legs like climbing, pushing, kicking.	a. <u>Direct</u> Walkers, Rockers, Tricycle, Baby scooter <u>Indirect</u> Plays giving initiative to run around like Hiding house Hobby horse, etc.	Various games like "where am I", "climb and jump"
Motor ability	b. Five muscle movements - picking up, carrying, pouring, sketching, writing etc.	b. Building blocks, trolleys tea sets drawing books colours and brushes etc.	Giving a helping hand to mother scribbling on scrap paper, etc.

3.0 PROBLEM DEFINITION

Problem needs redefining because of the socio-economic conditions of an average Indian family where the buyer can afford only what he considers as an essential for his growing family.

The problem could be defined as, 'design of some equipment required for a growing family so as to make it multi-functional and thereby accommodating some play value for children, with specific emphasis on developing their motor abilities'.

4.0 INFORMATION

It is essential first to establish a list of items, or equipment that are commonly used in a growing family along with a list of various types of toys available in the market which help in the development of motor abilities of the child.



4.1 Play equipment - motor type

This category of toys include the equipment used mainly for big muscle movement of children, like walking, moving arms or legs, etc. Among these the most common one's are

- . Rocking horse or rocker
- . Tricycle
- . Baby scooter
- . Bicycle

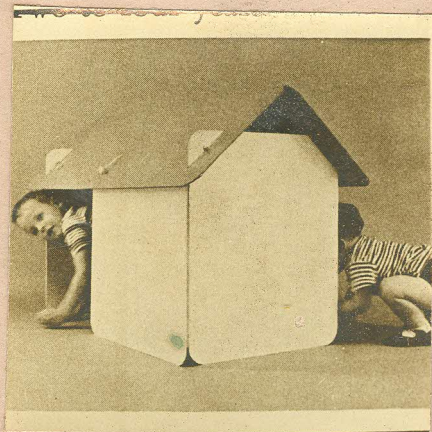
Bicycles are used by bigger children, when they have acquired greater control on their motor abilities and are allowed to go out without any supervision.





Next in line are baby scooter and tricycle. Here too, children are allowed to play with these under partial supervision, in parks or on side streets. Rocker is the only equipment which gives enough exercise in a small area within the four walls of a room.

There is another category of toys which encourage body movements indirectly by adding some play element in the toy. Hiding house, hobby horse and pulling trolley for children are some such toys. However, in their absence children are often seen to improvise such games with common household things. They would play hide and see behind the cot, under a bed or by just standing behind a curtain. They could take a bamboo stick or a walking stick and play a hobby horse. Often various other kinds of such improvised toys are seen with children. One common sight on side streets is children running along the road, rolling a tyre or some metal ring.



4.2 Common equipment in a growing family.

The equipment in study is restricted to the type which has strong structural qualities, as it is required to stand the man handling of a child. Such type of equipment could be categorised as below.

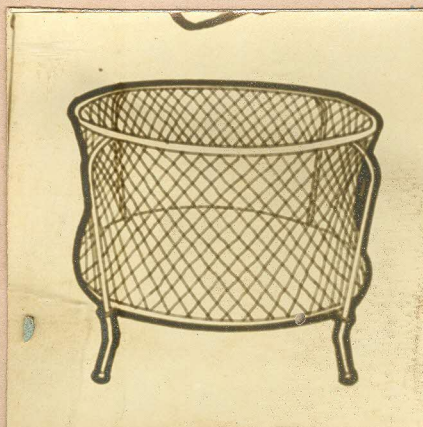
- . Children's furniture
- . Common household furniture
- . Storage units
- . Transportation units

4.2.1 Children's furniture

This includes

- . High-low type chairs
- . Playpens
- . Cradles
- . Baby cots

Such type of equipment are still not common in an average Indian family.



4.2.2 Common household furniture

Furniture usually increases as the family grows. The items this includes are common, chairs, tables, beds, cots, etc.,

4.2.3 Storage units

Along with the usual storage units, additional storage units are required for children. These may be to store toys, books, napkins and other such small items that may be required by or for children.

4.2.4 Transportation units

These may include

- Serving trolleys
- Luggage carriers
- Garden wheel barrow
- Prams, Push chairs, Strollers, etc.
- Baby walker

Here, only the units that are required for children are common in India in a limited way. whereas other items are almost absent.



5.0 ANALYSIS

Children's furniture

Various kinds of furniture are available in the market though the buyers here are few. In India the economic level of an average family is such that they cannot afford the furniture items which are exclusively for the children, in some families, though, we do find some kind of cradles or cots. The use of high chairs for children is also, only in some upper class families. The only kind of chairs if at all in use, for children, are the push chairs which, however, could not be placed in this category.



Function of children's furniture is to provide some sitting or resting place for children.

High chairs are generally used for dinner so that the child could come at the level of the dinner table and learn table manners.

Low chairs are chairs made for children so as to fit in the children's world. They are small in size and light in weight so that child can drag and play with them.

Play pens and cots allow a limited protected area within which a child can play unattended.

They are useful when the mother has to go out or has to be busy in places where children cannot be taken.

Common household furniture

It includes all kind of furniture that one could think of. Various designs are available in the market and many times the furniture may be made-to-order type. Functions of this kind of furniture are varied but in general they provide a place to sit, sleep or keep things on, like beds, chairs, high and low tables, etc. Rocking chairs are also available in the market. They form good play things for children except that, being made for grown ups, they are rather too big for children. Swings are quite common in Gujarati families and are a good play thing for children too. Turn chairs or stools, etc. are also very useful play equipment for children for they allow some kind of movements. Children also make good use of beds for play, if kept close to windows, for they would climb the window bars and jump on to the beds.



Storage units

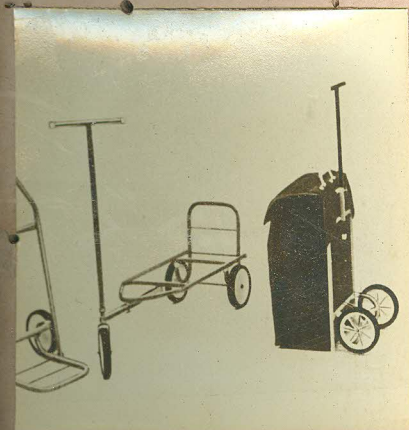
Most storage units are heavy equipment required for permanent use. Such storage units obviously cannot be used for any play things for they are void of any movement. The only kind of use that they can have for play is probably of climbing on or hiding behind type.



Some storage units have rather temporary use for storage like storage of toys where the toys would be taken out almost every day, or the low tables kept in the sitting room for keeping some light reading material, magazines etc. Such storage units may have some potential for creative use for play things.

Transportation units

Various such units are in use for domestic purposes. The units like market trolley and luggage carrier are quite common abroad though such items have not come to Indian market because of their high cost. They are very useful domestic equipment and would have definitely been accepted in Indian market if they could be less expensive. Similar is the case of domestic all purpose trolley. Luggage carriers could especially be very useful if the family goes out for small holiday trips. Need of a market trolley is similarly felt when one has to bring a lot of material home.



A second class of transportation equipment at home is of the type which is used for or by children alone. Such items are various kinds of prams, strollers or carry-cots etc. There are also some baby walkers which help a child to learn to walk.

5.1 Socio-economic analysis

Home

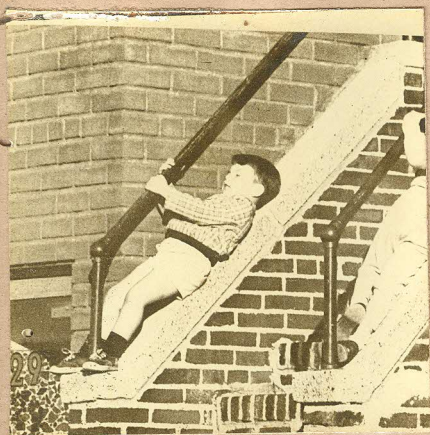
Concept of joint family is losing its meaning fast in India as more and more people are getting educated for each person wants to go and live at places where he can best earn his livings. With the result, families are become smaller. An average family may today constitute of parents with two or three children in urban areas. The whole family may be living in one or two roomed flats or houses with or without facilities for separate kitchens, baths, etc. In these situations there is usually no possibility of separate room for children. Children play in one corner of the house which may at the most be separated by a cot or curtain, etc. Storage too is a problem and most things are stored in corners or in the almirahs, trunks and boxes stacked one over the other or just things pushed under the beds.



Children

In an average family hardly any play things are bought for children. Expense on such things is kept to minimum. Tendency is to improvise or make such things at home, as far as possible. Children learn to play with the things around them such as cycle tyres,





common household utensils, pillows and cotton filled dolls. Occasionally some toys are bought but these are generally the inexpensive type and have a rather short life.

Most children have to stay at home in their earlier years, under the supervision of their mother. They share the mother's bed at night and have the full bed to themselves in the day time. They sit and play on the floor with all kind of things spread around them. Younger children may sit in the pram kept close to, where his mother is working, and may play with some small toys.

Occasionally, there might be a rocker, tricycle or a baby scooter in some families. But tricycle or baby scooter could be played with only in some open areas where children are allowed to go and are often used only by slightly older children. Younger children have, however, to stay at home and play with whatever they can play within a room.

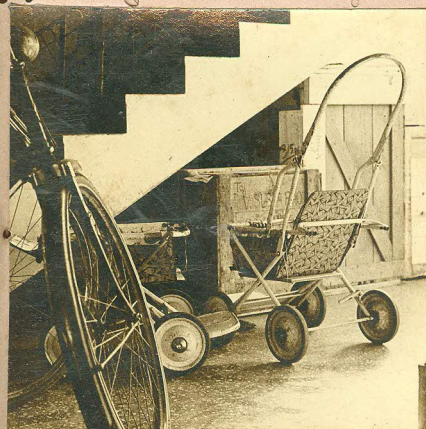
Parents' as buyers

Most of the equipment that is bought for home, in a growing family, usually centres around children. Parents are very much concerned about their children and spend quite a lot of their time and money for children.

They would buy the best possible equipment they can for their children. Often, they can ill afford it. The reasons for buying in such cases are also related to status symbol.

It is important, therefore, to look for an equipment that is or fast becoming a status symbol in an average Indian family and develop or design this product in such a way that, without losing its original identity, it can be used for many more purposes. This would increase the utility of a product that is going to come home sooner or later.

One of the most important and useful equipment in this category, for children, is a pram or a stroller. They are popular in both big cities and smaller towns. However, its use is limited to carrying a young child along when one goes out shopping or just for a stroll. Once the child grows big it lies around useless till a new arrival or else remains stored in some corner of the house. Pram, therefore, has good design potential.



5.2 PRAMS: a comparative analysis

Detailed analysis is restricted to prams. Various designs of prams are popular the world over. In general they satisfy one or more of the functions given below, viz. .

- . Carriage
- . Sleeper
- . Stroller

Naturally, the three-in-one type of prams are more expensive. Such prams are very popular in Western countries and U.S.A. These prams may cost anywhere around four times as much as, a sleeper-cum-stroller, the type most popular in India. The later type are much less bulky and cost around Rs.150/- to Rs.200/- in India.

The third type is the one which serves only as a stroller. One such model popular in Russia has only two wheels compared to the usual four wheeled prams and is extremely light and easy to manage.

A comparative analysis of the three types of prams viz.

- | | |
|-------------------------------|------|
| . American convertible type | 3IN1 |
| . Indian stroller-cum-sleeper | SS |
| . Russian stroller | RS |

would indicate the advantages of one over another.

5.2.1 Use

3IN1 Carriage-cum-stroller-cum-sleeper

SS Stroller-cum-sleeper

RS Stroller

The sleeping position in SS pram cannot be used for the babies who have not yet developed their cervical region of the spine, since the seat does not present a flat surface. This type has only one stroller position.

RS type of pram too has only one stroller position.

5.2.2 Frame

3IN1 Chrome plated tubular steel frame
folding flat for storage.

SS Painted tubular steel frame
folds flat for storage.

RS Chrome plated tubular steel frame
no folding.

Chrome plated frame obviously is less vulnerable to rust than the painted one.

The surface finish obtained in plating is superior to that of painted one. Paint gets gradually removed with slightest damages.

Flat folding frame is advantageous for storage as well as for carrying provided of course weight of the pram is not too much. The 3IN1 type, though folds flat, is rather heavy and so cumbersome to carry.

5.2.3 Suspension

3IN1 Helical spring suspension

SS No suspension system

RS No suspension system

The suspension system in 3IN1 pram plays a major role. One cannot afford to do away with a good suspension system since this enables comfortable and smooth ride for the baby and avoids jerks.

5.2.4 Wheels

3IN1 Four wheels, spoked and chrome plated solid rubber tyres,
chrome plated hub caps,
front swivel wheels for easy steering are provided optional.

SS Four wheels, spoked and painted solid rubber tyres,
chrome plated hub caps,
no swivel wheels.

RS Two wheels, spoked and chrome plated solid rubber tyres,
chrome plated hub caps,
no swivel wheels.

The RS type of pram has only two wheels which makes the steering very easy. At the same time because of it having only two wheels, its weight is much less compared to the other two types.

5.2.5 Fenders or mudguards

3IN1 Chrome plated steel fenders

SS No fenders

RS No fenders

Fenders fixed to the pram, if at all, should not have any sharp corners, as they only help in tearing clothes.

5.2.6 Footrest

3IN1 Adjustable wire footrest

SS Non-adjustable flat footrest

RS Non-adjustable flat footrest

The adjustable wire footrest of chrome plated material in the 3IN1 pram has its own merits and demerits. If, mud sticking to the soles of the shoes of the baby, it won't accumulate on to the wire footrest. The flat painted footrest in the other two, has the disadvantage of paint coming off due to constant rubbing of the shoes.

The danger of the baby's feet or their fingers getting caught into the space in between the wire footrest could be avoided if the wires are close enough.

5.2.7 Brakes

3IN1 Four wheel safety brake

SS A brake provided on one of the back wheels only.

RS No brakes

Brakes are essential as they enable parking of the pram on slopes and inclines.

For brakes to be really effected, they should be on all the four wheels.

However, no special brakes are needed for the RS type of pram where the frontal footrest itself rests on the ground and stops the movement.

5.2.8 Seat

3IN1 Body of the green channel quilted fabric on outside laminated to 1/4".
Waterproof and washable.

Three positions of reclining back.

Lift out carriage body.

SS Body of cotton fabric.

Moderate padding.

Non-washable.

Single position of backrest.

RS Moderate padding.

Washable.

Single position of backrest.

To make the body washable and childproof, vinyl covers are desirable. But they don't provide ventilation or absorb perspiration.

Three positions of reclining back give greater freedom of adjustability.

Liftout carriage body in 3IN1 type could be lifted up and carried in a car or used as a cradle in the house.

5.2.9 Sun visor

3IN1 Sun visor optional

SS No sun visor

RS No sun visor

Babies of tender age need such facilities for protection of their eyes and other vital organs.

5.2.10 Basket

3IN1 Attachable wire basket

SS No basket or pocket

RS No basket or pocket

Some storage space is needed for keeping baby's spare clothes, feeding bottle etc. A shopping basket is a useful addition.

5.2.11 Extra seat

3IN1 Attachable hitch hiker seat for second child.

SS No additional seat

RS No additional seat

Attachable seat in case of 3IN1 type is easy to remove if not needed, but a provision for an extra seat is not very necessary.

5.2.12 Weight

3IN1 Weight around 30 lbs.

SS Weight around 16 lbs.

RS Weight around 11 lbs.

5.3 Functional analysis - Indian pram

5.3.1 Wheels

- . The wheels provide rotation to the pram.
- . Whole weight on the axles is taken up by the wheels.
- . The brake operates on one of the wheels.

5.3.2 Axles

- . The axles position the wheels
- . The wheels rotate free on the axles
- . The weight on the crossed members is taken up by the two axles.

5.3.3 Crossed members

- . Crossed members take the weight of the baby
- . The wheel base of the pram is fixed by the length of these crossed members.

5.3.4 Arm rest member

- . It is fixed to the crossed members
The saddle is mounted on this arm rest member.

5.3.5 Seat

- . Seat enables the child to sit or sleep.
- . The seat being suspended, absorbs shocks to certain extent.
- . A safety strap fixed on to the seat takes care that the child does not slip out of the seat.

5.3.6 Handle

- . It helps in shifting the point of application of force to a comfortable height.

5.3.7 Seat back adjuster

- . This enables the adjustment of the seat back in two positions, sitting or sleeping.

5.3.8 Foot rest adjuster

- . It adjusts the footrest in sitting and sleeping positions.

5.3.9 Foot rest

- . It enables the baby to rest his feet.

5.3.10 Locking rings & members

- . These hold the handle and the pram in their positions and prevents it from folding while in use.

5.3.11 Brakes

- . The brakes restrict the wheel movement when required, thereby restrict pram from rolling.

5.4 Structural analysis - Indian pram

The dimensions of the pram are given below.

Body 37" x 18" x 12"

Handle 37" high, foldable

When folded the pram folds flat, however, the wheels are projecting out, with the result even in the folded state it is not very compact and so difficult to carry around.

In general, pram is preferred to be carried on wheels rather than in folded position.

Even when not in use the pram remains unfolded in the house unless of course the child has grown over the pram age.

5.4.1 Stability

Pram is structurally strong and reasonably stable. It can take moderately strong shocks without toppling. But it has no suspension system and injury can be caused to the child, in such a case without the pram having to topple over.

Jerks are a big problem in this pram because of absence of any suspension system. They are only moderately absorbed by the seat which is suspended on the arm rest. It is really difficult to carry the pram up or down the staircase with the child sitting on the pram. This becomes more of a problem if the distance between the wheels does not match with the size of steps.

5.4.2 Material

The basic structure of the pram is built of standard steel tubes, rods and strips. Main elements used for the main body are steel tubes and strips whereas the locking members and rings are made of steel rods. The sizes of the three are given below.

Steel tubes	1/2" outer diameter
Steel strips	1/2" width, 1/4" - 1/8" thick
Steel rods	1/4" diameter

The advantage of using steel is its high strength and reasonably low cost, though the cost of steel has gone up considerably in recent times.

Steel structure has the disadvantage that it becomes too heavy and has poor weather resistance as it rusts unless some protective layer is provided. In the Indian pram most of the steel parts are painted. Only handle and hub caps are chrome plated. Paint peels off rather too easily and once peeled, surface is prone to get rusted. Rust not only weakens the members but is also very harmful if goes inside child's body. Therefore, such a material should be avoided.

Aluminium is a good material in this respect. It is light in weight, has reasonable strength and does not require painting or any protective

coating. It has good finish and its cost is comparable to steel for the same volume.

Seat of the pram is made of a cushioned pad backed by plywood board. It has good strength but nails and screws used for fixing the seat can create problem if not fixed properly.

Hard rubber tyres are used on the wheels.

They have good wear resistance.

5.4.3 Manufacturing processes

The main processes involved in manufacturing various elements are bending and forging.

There are many parts which require more than one operations for its manufacture. Production could be quickened if these parts or the number of operations involved for their manufacture could be reduced.

Seat is hand made, which is a slow process but as only one seat is required per pram, their production rates can be matched.

Wheels and tyres used are generally standard.

5.4.4 Assembly

Some elements of the pram have high degree of complexity in assembling. One element may be connected to six or seven different elements.

This makes assembly work difficult and a greater accuracy is needed in various processes.

The main fabrication methods involved are riveting, screwing or tag welding.

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Seat is suspended on to the arm rest by stitching the cloth around it. Fixing of the padding to the seat requires nailing and care is needed to see that the nail heads do not project out and may become the cause of some injury.

5.5 Ergonomical analysis

5.5.1 Child's growth

First few months of the child's life are very critical. Child at this age is very tender and sensitive. Any sharp changes in the temperature or weather can affect his health considerably. For this reason, generally parents don't like to take the child out for first two, three months, and keep the child at home well-protected in a shaded but airy area. Even when the parents start taking the child out in the pram, child is usually well covered and taken in lying position. So, for the first few months the pram should have the seat in such a way that the child can be taken out in lying position. Slowly his cervical region develops and he begins to sit. During this period the inclination of the seat can be changed from near horizontal to almost vertical position. Even when child can sit, the feet need to be kept, as if in the lying position for a month or two. It is only after that, that he starts sitting with his feet resting on the foot rest. At this stage, however, it is necessary to keep him strapped or some how provide a way to keep him from slipping off the seat.

5.5.2 Sitting posture

- It is very essential that changes in the sitting posture be allowed in a seat, for it is difficult to maintain the same sitting posture for long.
- Height of the seat from the foot rest should be such that the smallest child's feet can reach the foot rest without any pressure being exerted on the thighs.
- Seat depth is governed by the distance of the back from the inside of the knee of the smallest child. The important point to see is that there is no undue pressure on the thigh muscles and back is fully supported. Seat depth for smaller children is often
- adjusted by keeping a cushion behind their back.
- Seat width should be wide enough to accommodate the biggest child, but not too loose for the smallest. Smaller children, however, require a lying position rather than sitting and in that position they should have enough space to turn around, so the problem does not remain so critical.
- The seat should have at least an inclination of about 5° to the horizontal, so that the child does not slip off the seat. A strap may be provided to hold the child in place.

- . Back rest should be flat and moderately padded. It should support the entire back of the child as his back is not yet fully developed.
- . Various inclinations of the back rest are desirable to accommodate individual child and also to allow a gradual change from sleeping to sitting postures, as the child grows.

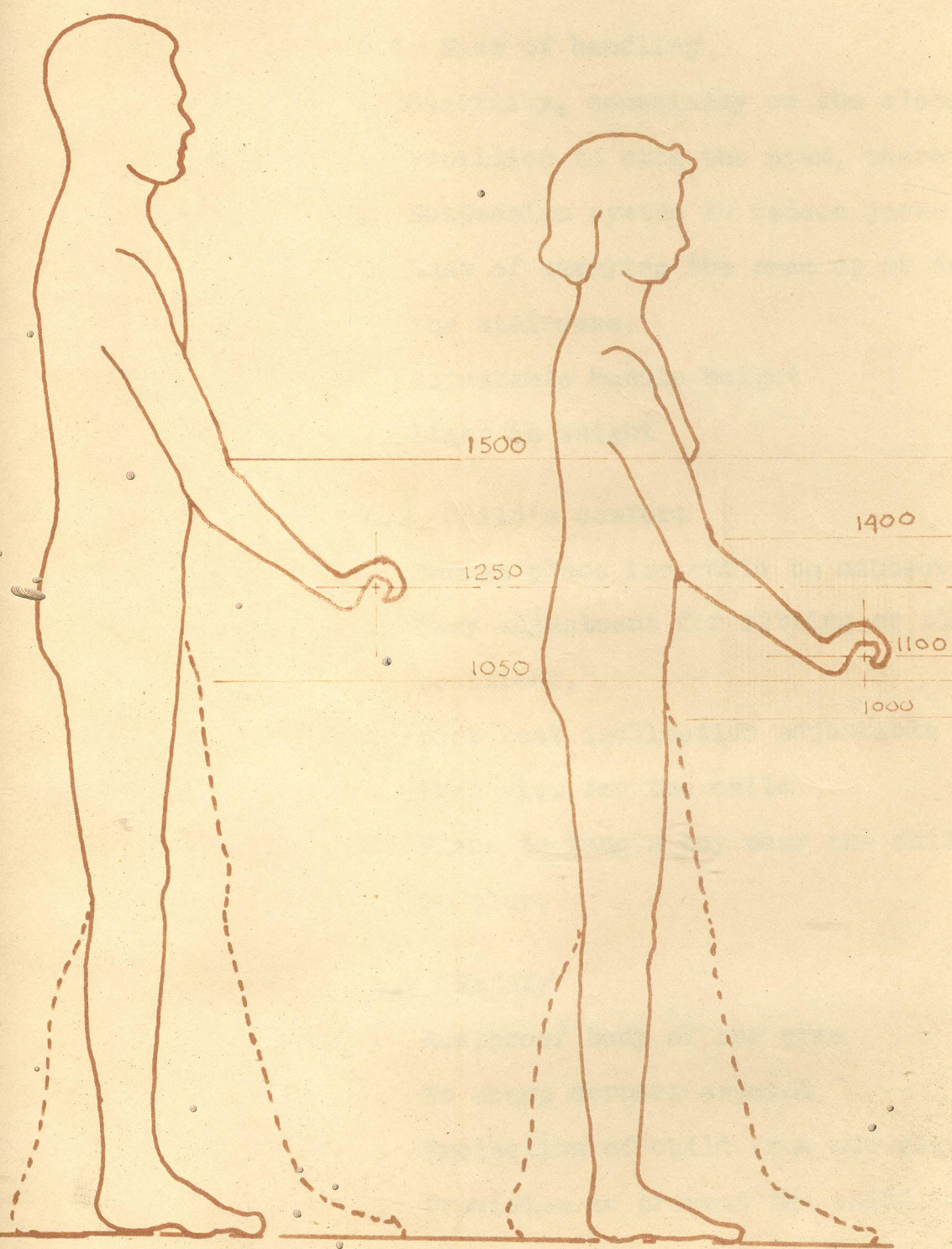
5.5.3 Glare

Any kind of glare is harmful for children as their eyes are extremely sensitive and sight not fully developed. Glare in general causes discomfort and may even cause a vision disability, so a sun visor in a pram is very important.

5.5.4 Jerks and shocks

Any kind of jerk or shock causes inconvenience to the body and jerks over an extended period cause general fatigue and tiredness. For children, they being tender special care should be taken to see that they do not get too many jerks while being carried in a pram. So, some kind of a suspension system is very essential in a pram. In the present pram there is no suspension system to absorb jerks except that the seat is suspended on the arm rest and absorbs shocks to some extent.

ANTHROPOMETRIC DATA
HANDLE HEIGHT (FOR PRAM)



All Dimensions in mm

6.0 HYPOTHESIS

It can be concluded from the analysis that the pram must satisfy the following requirements.

6.1 Ease of handling

- . Stability, especially on the slopes
- . Provision to stop the pram, where desired
- . Suspension system to reduce jerks
- . Ease of carrying the pram up or down the staircase.
- . Adjustable handle height
- . Light in weight

6.2 Child's comfort

- . Enough place for child to manoeuvre
- . Easy adjustment for sitting or sleeping positions.
- . Back rest inclination adjustable
- . Free view for the child
- . Place to hang a toy near the child for him to play.

6.3 Safety

- . Rustproof body of the pram
- . No sharp corners exposed
- . Protection of child from sun glare
- . Provision to prevent the child, slipping off the pram.
- . The pram must be able to withstand an overactive child.

6.4 Storage facilities

- . Storage space for keeping baby's accessories.
- . Storage space for marketing
- . Minimise, storage problem for pram

6.5 Other uses

- . Provision for some play value for the child to develop his motor abilities.
- . Some other domestic uses, when not used as a pram.

6.6 Low cost

- . Cost, comparable with the present Indian pram.

7.0 DESIGN DECISION & SOLUTION.

It is observed that people have a tendency to buy things that have some close identity to the products already popular in use, for example rockers, tricycles, baby scooters etc. for children. It was, therefore, decided that the pram under design should function also as one of these conventional toys. Since the design is to be for pre-school children, the toys of this category would be rocker and tricycle.

7.1 Alternative solutions

Pram could function as a toy only when, either the child has grown over the age of pram and the pram is used as a toy with moderate alterations, or could be converted to a toy whenever desired by some quick and simple adjustment.

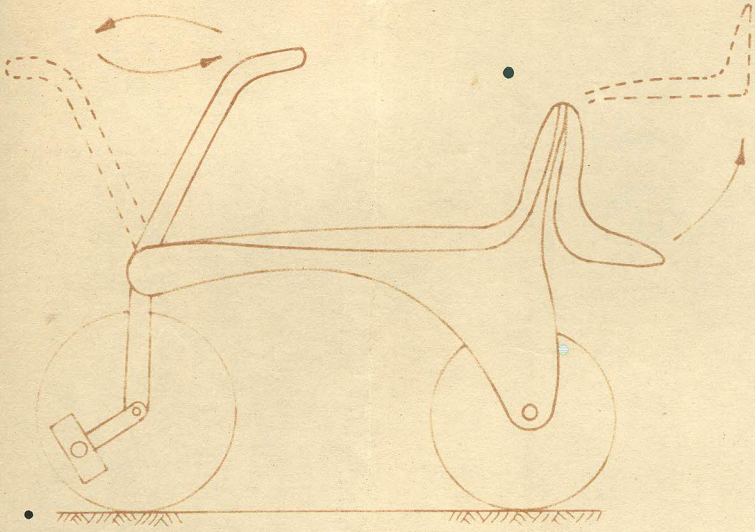
7.1.1 Pram-cum-tricycle

Pram requires moderate alterations for it to be used as a tricycle, so the change over from pram to tricycle and vis-a-vis cannot be done very frequently.

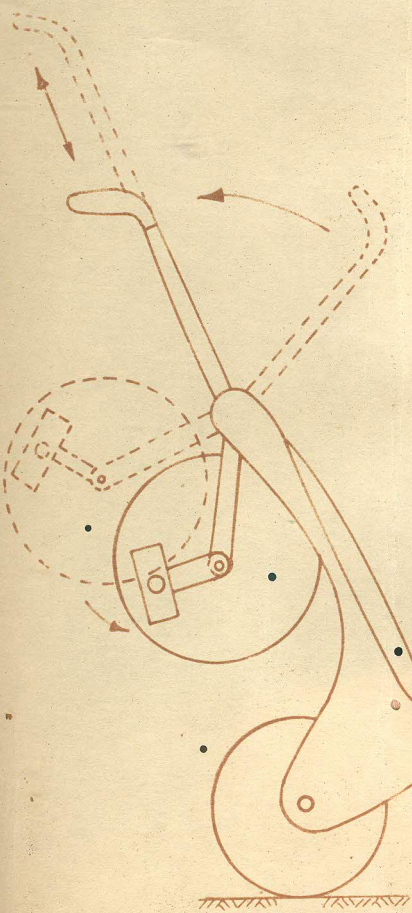
The third wheel of the tricycle could be folded behind the seat when it has to be used as a pram, but the pedals projecting out of the front wheel still remain a problem.

ALTERNATIVE SOLUTIONS : TRICYCLE-CUM-STROLLER

TRICYCLE



STROLLER
THIRD WHEEL FOLDED

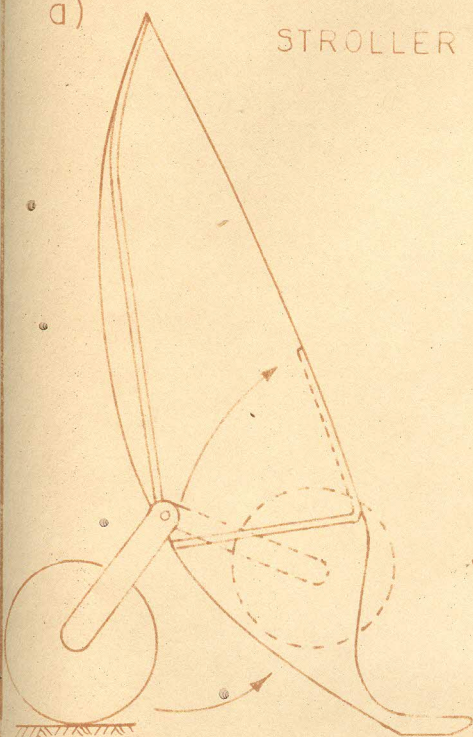


STROLLER
THIRD WHEEL REMOVED

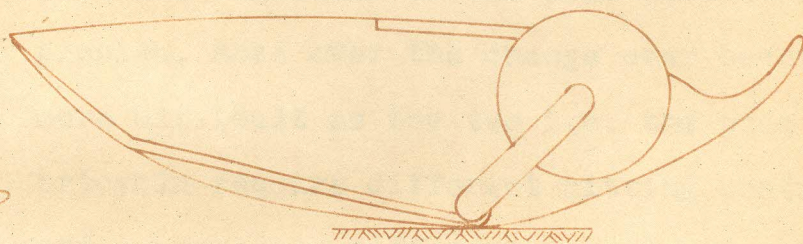


ALTERNATIVE SOLUTIONS : ROCKER-CUM-STROLLER

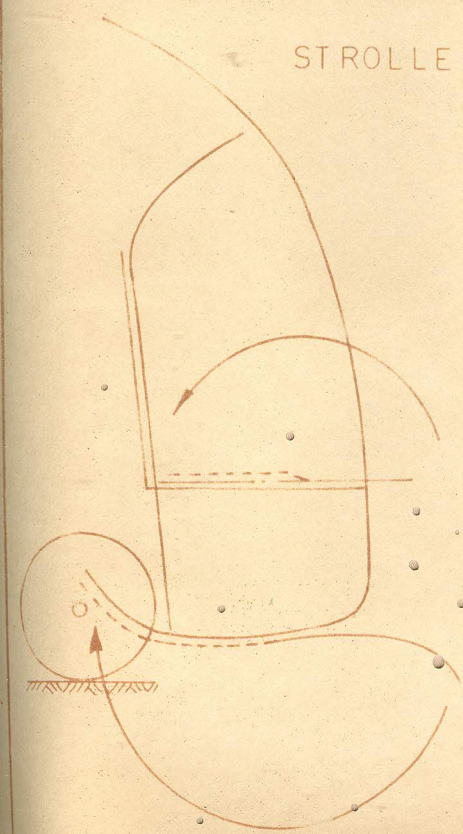
a) STROLLER



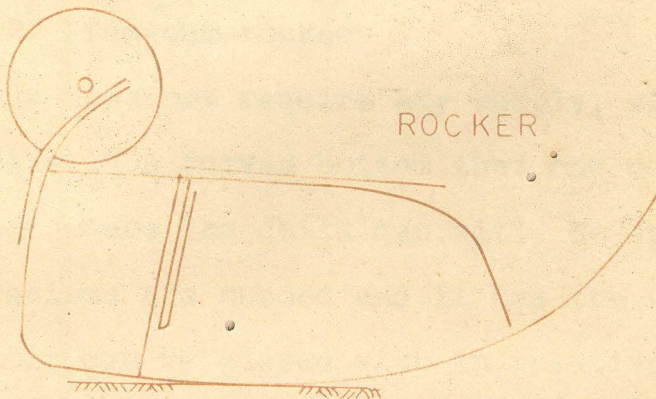
ROCKER



b) STROLLER



ROCKER



As an alternative this wheel could be removed when used as a pram and could be attached when to be used as a tricycle. In such a case, a change over from pram to tricycle or vis-a-vis becomes more complicated and the wheel has a chance of getting lost. In that case the use of the pram as a tricycle will not be possible unless a spare wheel is bought.

In case all the three wheels are used for pram the stability of the pram becomes a problem, more over the change over becomes more difficult as the two i.e. the pram and tricycle require different sitting postures and accommodate different age groups. Since the change over is difficult, one would not like a frequent change and once the pram has been converted to a tricycle it is likely to remain for reasonably long time. This creates a problem when a next child is born, for then either it will be used as a pram or only a tricycle.

7.1.2 Pram-cum-rocker

Rocker does not require any wheels, all it require is a curved bottom that can rock and a seat where the child can sit. No special mechanisms are needed and it has the advantage that it can be played with in relatively small area.

With slight structural changes in the conventional Indian pram, it should be possible to have a curved base for it to act as a rocker. In such a case a change over would be quick needing only some small adjustments. This, then has the advantage that it can be used as a pram for the younger child and whenever needed, as a rocker for the older.

7.2 Solution

Salient features of the design.

7.2.1 Ease of handling

Pram has only two wheels, but has front legs which make the base broader and gives stability to the pram, at the same time make the brakes needless. It has light structure made of aluminium tubes. Because of only two wheels and light weight manoeuvrability is easy. It also does not have any problem taking up or bringing it down the staircase as against a four-wheeled pram and with the provision of a suspension system the jerks are reduced. Handle height can be adjusted from person to person as per their convenience, simply by changing the inclination slightly. Handle has a rubber sleeve on it for better grip.

7.2.2 Child's comfort

The design satisfies all the requirements for child's comfort, as per the hypothesis except for a very young child, who needs a flat surface for sleeping. In the designed pram, the back can be adjusted at any inclination desired with the limitation that any of the two surfaces i.e. back and base of the seat do not slope downwards in carrying or resting position of the pram. This ensures that the child will not slip out of the pram, but brings in the limitation that the sleeping surface cannot be made completely flat. So the use had to be optimised to gain other advantages at the cost of a little inconvenience to very young child, if taken out in a pram. However, this limitation exists in the conventional Indian pram and this design has an edge over the old one in the sense that it provides complete adjustability of the back as against only two positions in the conventional pram. Both, seat and back are well padded for child's comfort.

Child has enough place to manoeuvre. The seat length is increased when it is used for sleeping position by unfolding the seat and can be made smaller for sitting position. Toys can be hanged to the frontal structure which goes over the seat but leaves enough free view for the child.

7.2.3 Safety

Use of steel is reduced to that in wheels, suspension system and for rivetting alone, for they require high strength. For rest of the body aluminium tubes and rods are used which are rustproof. Almost entire structure is made of tubes which have no open ends and no sharp corners except for seat and suspension system and even there the corners are either rounded off or padded to reduce the chances of any accidents or at least reduce the degree of injury due to it.

Pram is reasonably stable and capable of withstanding an overactive child. For safety, the child is kept strapped to the seat when in a sitting position.

A sun visor can be attached at any inclination desired so as to protect the child from heat and glare. It would be an accessory to pram.

7.2.4 Storage facilities

Storage space for keeping baby's accessories is provided behind the back, where a pocket is provided for the storage.

Storage space for marketing is provided below the seat as a basket. It can easily accommodate an average family's daily marketing. The basket can be easily taken off the pram to facilitate, taking things out of the basket.

The basket can act as storage space for keeping vegetables etc. when it is out of the pram and the pram is lying at home.

The problem of storage of pram comes when its use is over as a pram, for after that, a conventional pram remains useless. However, this problem is solved by not letting the pram remain useless, as long as it lasts. It can be used for storage, in that case the space occupied by it is utilised rather than wasted.

7.2.5 Other uses

If the seat is folded and fixed along with the back, the pram can be used as a trolley for carrying moderately heavy objects which people may come across in domestic use, the limitation being the size of the pram.

It can also be used as a luggage carrier and especially for parents who would like to go on some short trips with their children.

Even if it does not carry full luggage, it at least helps in easing the luggage problem.

Once the parents have reached their destiny the luggage would be removed seat unfolded and the trolley has again become a pram.

This would enable the parents to carry the pram along with them, where instead of the pram being carried would carry some luggage.

It can be carried, easily, in a taxi.

Its structure enables reasonably big attache case or bag to be held within it. Its frontal curved surface enables to be used as a rocker. The back of the seat acts as a seat in this case and so, is also well padded.

One only needs to fold the frontal legs of the pram and keep the pram down on its front and it becomes a stroller.

Because of its light weight, its two wheels and the type of structure designed in a way that it can be put down and moved around in various positions, easily. It leaves enough potential of motor-play for children to explore.

7.2.6 Cost

The cost is comparable to the prams available in the market, in fact it is a little less expensive. This has been achieved by reducing the number of parts, manufacturing operations, processes and the complexity in assembly.

The main body is made of aluminium tubes and rods, the cost of which are comparable to that of steel and in fact aluminium tube are less expensive than those of steel for the same dimensions.

The main manufacturing process involved is that of bending aluminium tubes.

Assembly operations mainly involve drilling

and rivetting, which are both relatively inexpensive.

Welding is completely avoided, which is a difficult and expensive process if clean finish is required.

Because of the main structure being of aluminium no painting is required on it. This saves on the painting cost.

