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DEVELOPMENT OF FURNITURE AND JOINERY INDUSTRY AND CREATION OF A CENTRE*

DP/YUG/73/006

YUGOSLAVIA

Technical report: Assistance in furniture design

Prepared for the Government of Yugoslavia by the
United Nations Industrial Development Organization,
executing agency for the United Nations Development Programme

000557

Based on the work of Torsten Laakso, expert in furniture design

United Nations Industrial Development Organization
Vienna

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Explanatory notes

The following abbreviations are used in this report:

BiH	Republic of Bosnia and Herzegovina
IRC	Istraživačko Razvojni Centar. This is the research and development RO of SIPAD
K-D	Knock down
OOUR	Osnovna Organizacija Udruženog Rada. (Basic Organization of associated labour). This is a self-managed unit of an enterprise.
RO	Radna Organizacija. (Working organization). This is an association of OOURs based, in SIPAD, on geographical proximity.

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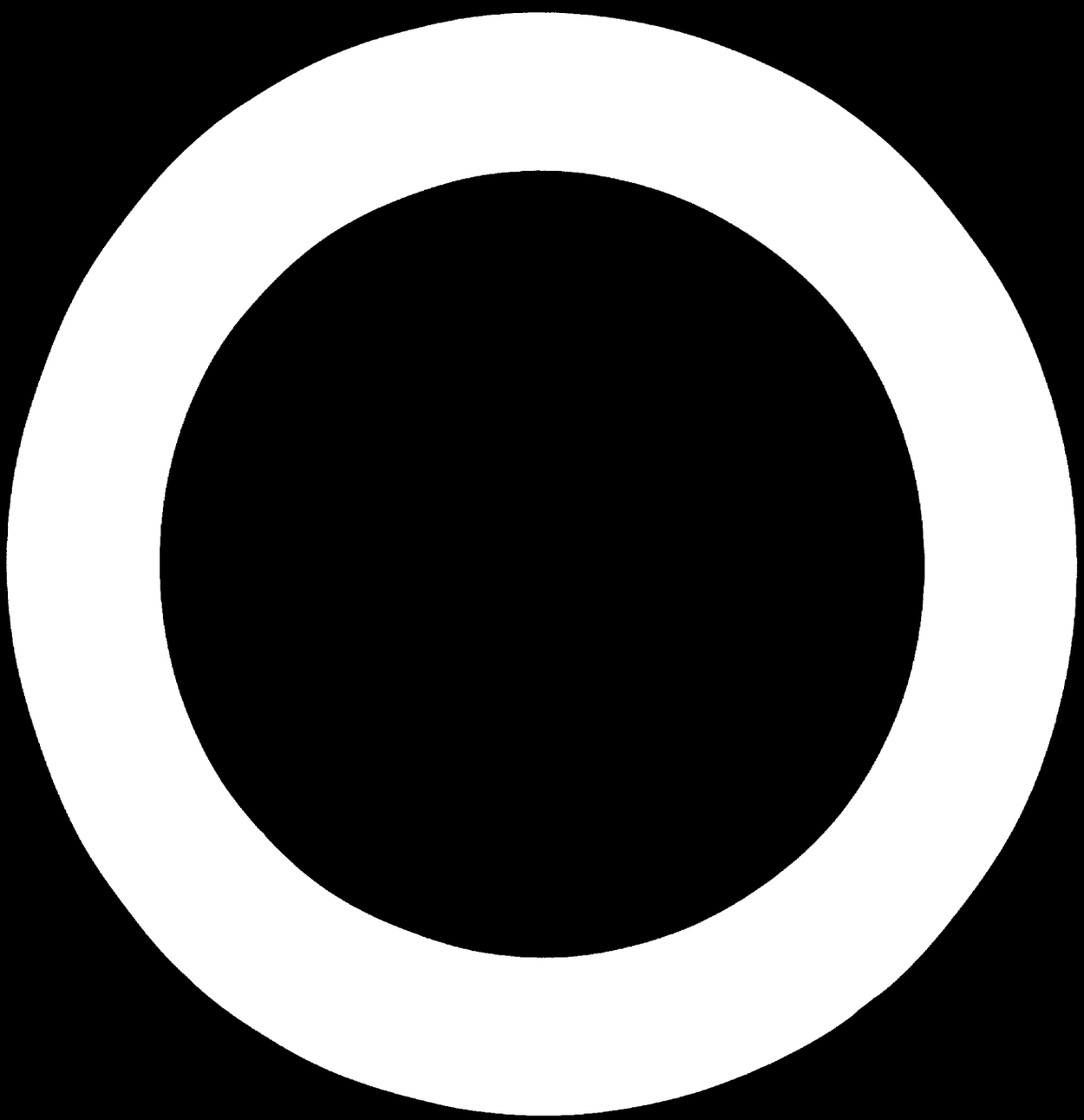
ABSTRACT

As a part of the on going project "Development of the furniture and joinery industry and creation of a centre" (DP/YUG/73/006) an expert in the design of upholstered furniture was sent to Yugoslavia to advise and assist the designers of the SIPAD Design Center, Sarajevo. The mission lasted from 6 February to 30 March 1979.

The expert visited three factories and made specific suggestions on the design problems encountered there. In the Design Centre he advised on the designs to be produced by 13 existing factories which are being modernized and by another 6 factories which are at the planning stage. He also gave lectures on design of upholstered furniture.
A seminar on product development was held on 30 March 1979 Sarajevo for the factory management, the export and domestic sales staff and the staff of the Design Centre.



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FINDINGS

ŠIPAD is currently building 13 new factories and rebuilding 6, for production of solid-wood furniture aimed at export.

The design department is designing several hundred new products for these factories, and is consequently working under a very great pressure.

Most of these designs are at the "idea" stage, and time is running short for the prototyping and redesign work.

RECOMMENDATIONS

The product development for the "13 + 6" program could be speeded up and safeguarded by appointing a top level team consisting of an industrial engineer, a marketing expert and a designer to help chosing and refining the designs after prototypes are made but before production starts.

I. THE "13 + 6" (NEW FACTORIES) PROGRAMME

FINDINGS

With the implementation of the "13+6" programme ŠIPAD is vastly increasing its capacity for production of solid-wood furniture. The factories are at various stages of construction, the first are to start production in the autumn of 1979.

These factories are big (ca.200 people) and well equipped and need big volumes of production to be profitable.

The training of the workforce is also in progress, but even so it is to be expected that a certain "running-in" time is needed before a really export - quality product can be turned out. As the domestic market is already almost saturated an overflowing of sub-quality products from the new factories might cause problems also for the existing ones.

The ŠIPAD design department is contracted to work several hundred new designs for the 13+6 factories.

As time is short this places a great strain on the department resources and partly prevents it from giving its normal service to the existing factories.

The new designs are currently at the "idea" stage with 1/1 drawings being worked out.

Many of the designs appear to be excellent, but a final appraisal, particularly from a market point of view, can be made only when prototypes have been made.

A very substantial part of the work still remains to be done. The building of prototypes has to be supervised,

especially upholstery can be designed as the three dimensional form of the cushions is seen. The production engineering will force changes and redesigns, colour and material schemes are still missing etc.

RECOMMENDATIONS

The workforce training and material utilization programme currently being built up for "VARDA" Višegrad should be given top priority.

It should be implemented at each new factory as they start up, and repeated until an export quality production is reached.

To allow the design department some time to work for existing factories and to speed up and upgrade the process of adapting the "13+6" designs for production and markets a task force could be formed.

It should consist of at least a top level production engineer, a marketing man with the knowledge of the specific markets aimed at, and a designer capable of cooperating with the other two.

This high level team could be brought in at suitable times, to the various plants, for one or two weeks at a time, to boost the product development of export furniture.

II. DESIGN DEPARTMENT

FINDINGS

The Design Department of ŠIPAD is part of OOUR Design and Architecture that belongs to the R.O. IRC Research and Development).

It consists of 15 architects, 10 technicians, and 3 draughtsmen.

Of the 7 experienced workers 2 also have administrative functions, which take some time away from actual design work.

Currently ŠIPAD is trying to find a suitable scheme of financing this OOUR.

Charging the factories by the piece gives incentive for great numbers of design but no responsibility for quality, whilst a straight royalty is problematic in connection with redesign and colour or material choosing services, and certainly gives no incentive to train, or even cooperate with, factory designers.

RECOMMENDATIONS

The choice of colours or textiles for furniture can have as much impact on sales as new design.

This is a service of the design centre that the factories should utilize better. It is quick and easy to apply and results are sometimes spectacular.

A better cooperation should be established between the buying sector and the design department.

The designers must have access to all material samples, and should be consulted when buying textiles etc. ŠIPAD is a big enough customer even to demand its own colour or to reserve the right to specific designs.

If the designers and technologists participate in the buying of fittings and certain raw materials a standardization occurs that helps reduce stocks and prices and could eventually lead to a ŠIPAD production of certain items with a high enough turnover.

It is usual in big design offices that a certain specialization occurs within the office, in the case of ŠIPAD the following arrangement would seem to be efficient:

For factory visits an architect and a technician should be paired up. This would give the designer more opportunity to concentrate on visual appearance, colours and materials, whilst the technician would help solve production problems as a kind of production-designer.

This way, even the fairly inexperienced designers could be sent out and make use of their specific talent without being hindered by too little knowledge of technology.

This approach would also help design work. In big offices it is usual that a drawing goes back and forth between a designer and a production designer until both are satisfied with the result.

One or more designers could specialize in visualizing designs. A good true-to-perspective picture is the best and quickest way to evaluate design, and saves a lot of full scale drawing work.

The planning and supervising of fair-stands should be given, in rotation, to each designer and technician pair, even the inexperienced. The quickest way to understanding of quality and workmanship is to be able to make comparisons with other products during a longer period of time, as when erecting a stand at a furniture fair.

After initial investments have been made by ŠIPAD, the Design Centre could work within the suggested 1% royalty. This is a low figure, but on the other hand there is virtually a monopoly situation. When a royalty basis cannot be applied the Centre would have to charge the factories separately for its service.

III. THE USE OF VENEERS IN "ŠIPAD" FACTORIES

It is a serious disadvantage that veneers of all the local timbers cannot be obtained. Different species of wood in the same product lowers the price class in export, high quality retailers will not accept such usage.

A worthwile experiment would be to make the "colonial" chair with a back-armrest assembly built up or finger jointed of pine instead of the (technologically fully justified) beech bent-wood. At least in Scandinavia and the United States a better price might be obtained. Since veneer and solid wood of the same species are not available the factories resort to one of the following practices:

- Veneering of edges with 0,8 mm veneer. This is not acceptable in export. Edges and corners are sharp and chip easily or even rip off during handling.

- Veneering with exotic veneer and edgestripping with beech. The edge strip is different in

colour and grain. If very skilfully stained, a fair result can be obtained but again it could be sold only in a low price class.

Suggested solutions:

1. Import only a few species of veneer and only when the solid wood is also available.

2. Use only domestic wood and make own veneers to fit it (especially pine!). This leads to a limited choice of woods but a better product, within this limitation and no dependence on imported materials.

3. Use "ultrapas" or similar instead of veneer. It is good in some cases but attention has to be paid to the choice of colours and patterns. Give this problem to the design department.

4. Combine beech or other solid wood with exotic veneer in such a way to make it into a decoration. A possible way of doing this is suggested in the design of an occasional table and line of office furniture submitted to "NERETVA" Konjic.

IV. FACTORY "VARDA" VIŠEGRAD

Regarding "modern" or Scandinavian-derived designs that the factory produces, some problems in the use of pine as raw material are apparent.

In Scandinavia the pinus silvestris is used that has a straight grain, can be obtained free of knots in big dimensions and it is fairly uniform in colour when new. These characteristics have led to design where simple form is utilised to show off the faultless material.

The pinus nigra used in BiH is different. There are far more knots, the grain is livelier, the wood is harder and heavier. These different properties must lead to slightly different approach to production - design.

Even if it is technically acceptable to glue a solid wood tabletop together from 50-80 mm slats, it seems that 35 - 40 mm would be much better from a design and market - acceptance point of view. A top with wide slats of different colours and a few big "dead" knots is not acceptable while many small knots and narrower slats give the appearance of a "pattern" and is acceptable. As compensation the top of pinus nigra could be thinner as the material is heavier and has something of a "hardwood" feel. (See figures I and II.)

Generally pinus nigra should be glued from slats when used in wide dimensions.

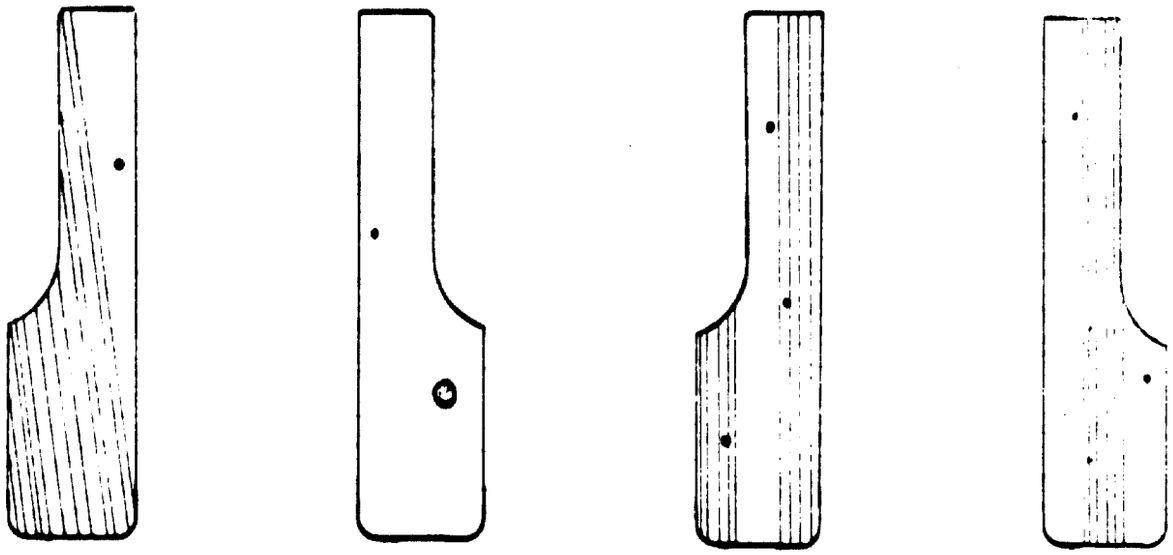
Also all possible care should be taken to avoid big knots or discoloration in one "strategic" part of an otherwise fine piece of furniture. This is clearly unacceptable in the export market. The parts must be sorted for grain, colour and knots and assembled correspondingly. (See figures I and II.)

This slows down assembly for a time, but soon becomes routine.

VARDA has a well - designed group of pine furniture of "show-wood", 1-,2-, and 3-seaters and table, but some details should still be looked into:

The bottom spring - frame of the 3-seater is too low in dimensions (figure III). The assembly screws should be countersunk, and the "no-tolerance" inserting of the veneered top of the table could more realistically be made as shown in figure IV.

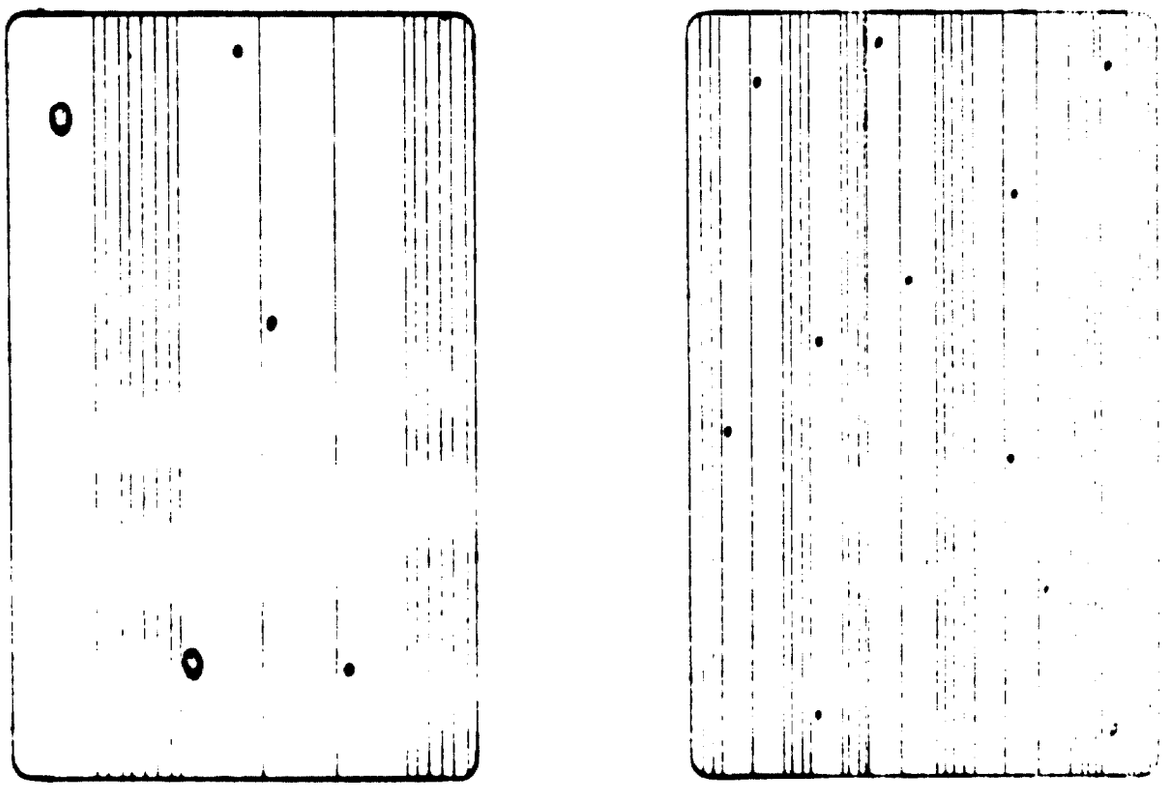
Figure I. Arms of a chair



NOT ACCEPTABLE

ACCEPTABLE

Figure II. Table top



NOT ACCEPTABLE

ACCEPTABLE

Figure III. Bottom spring frame of 3-seater

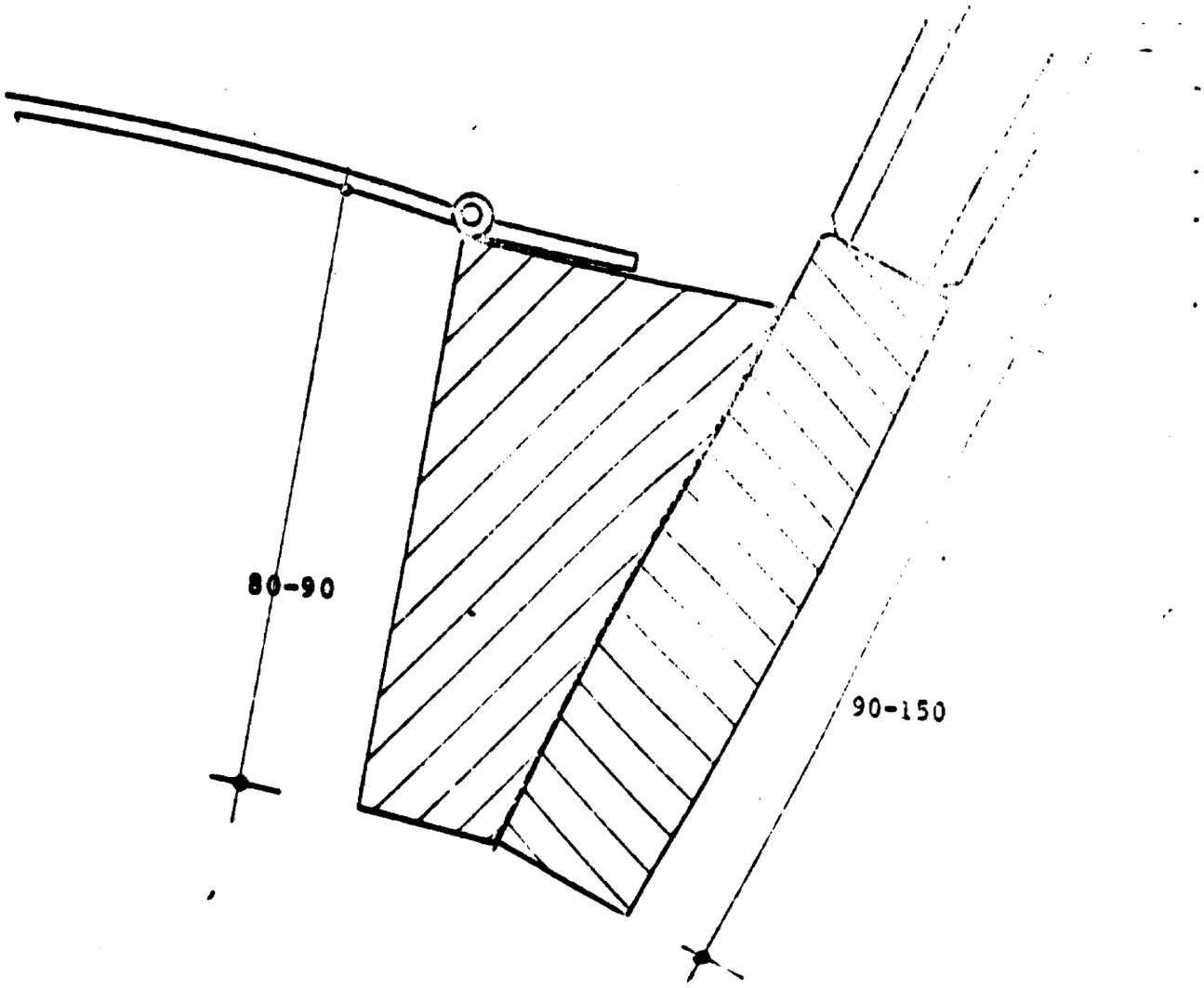
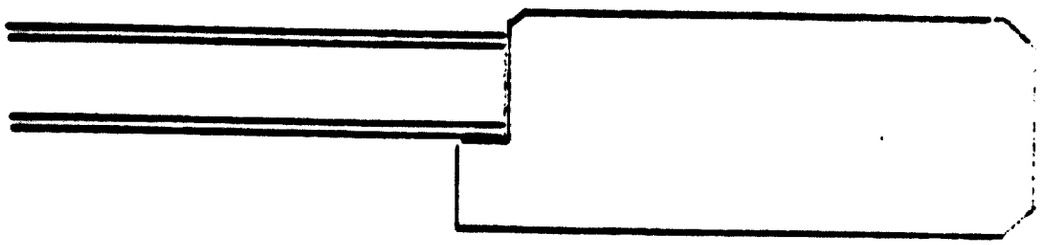


Figure IV. "No-tolerance" inserting for table top



V. FACTORY "NERETVA", KONJIC

There is in Konjic a tradition of wood carving of national fame in Yugoslavia. The factory is trying to incorporate this traditional craft into the industrially produced furniture.

From a cultural and design point of view this is a commendable approach but no easy task to perform.

As a wood carving is a work of art it has to be of high artistic value to be acceptable. The idiom or style as such is not the obstacle, but the quality of the work.

Such artistic work requires a lot of time and is therefore expensive. It must be used rather as a piece of jewellery a "medallion" at the exactly right spot.

The furniture itself must be rather severe in appearance not to compete with the carving, and very straightforward to produce, otherwise the price will become prohibitive. Anyway the price class will be such that no execution errors are allowed. The best approach seen at the factory was a technique which could be called "parquetry" where small carved "boards" were fitted into a frame, this has two advantages: the basic furniture can be varied by use of different inserts and the carving itself could be comissioned out to become a "cottage-industry" of the surrounding country side.

Apart from this design-problem some production problems were evident.

When a wide board of solid wood is used for a top or front, the wood tends to warp because one side is sprayed with laquer and one side not.

The solution is to give also the inside a coat of laquer and to use a "dove-tail" instead of dowels as a joint.

Generally the use of solid wood tops has become fashionable but the technology involved is already forgotten.

A broad piece of solid wood must be allowed to work across the grain or it will break up the construction when it takes up moisture.

Some typical constructions are shown in figure V.

This factory has access to some species of timber that could be utilized better: ash and elm. These are relatively precious woods and should be treated accordingly. Especially ash, natural colour is the big fashion in Europe right now.

1. The same principles apply as already stated in the comment on "VARDA" Višegrad but in these timbers no knots or discolorations of visible parts are allowed at all.

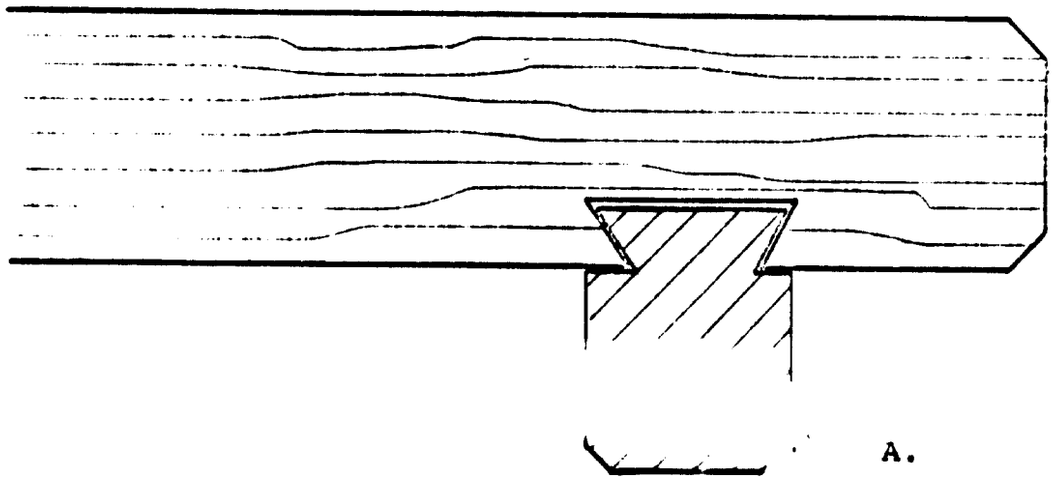
2. Different species of wood must not be mixed in the same product, nor should a different veneer be used. It is better from an acceptance point of view to use "ulcrapas" in suitable "uni" colours or even imitation marble if need be.

3. The wood must be finished in natural colour (only stained when colour-defective) with a half-matt laquer to a "silky" sheen.

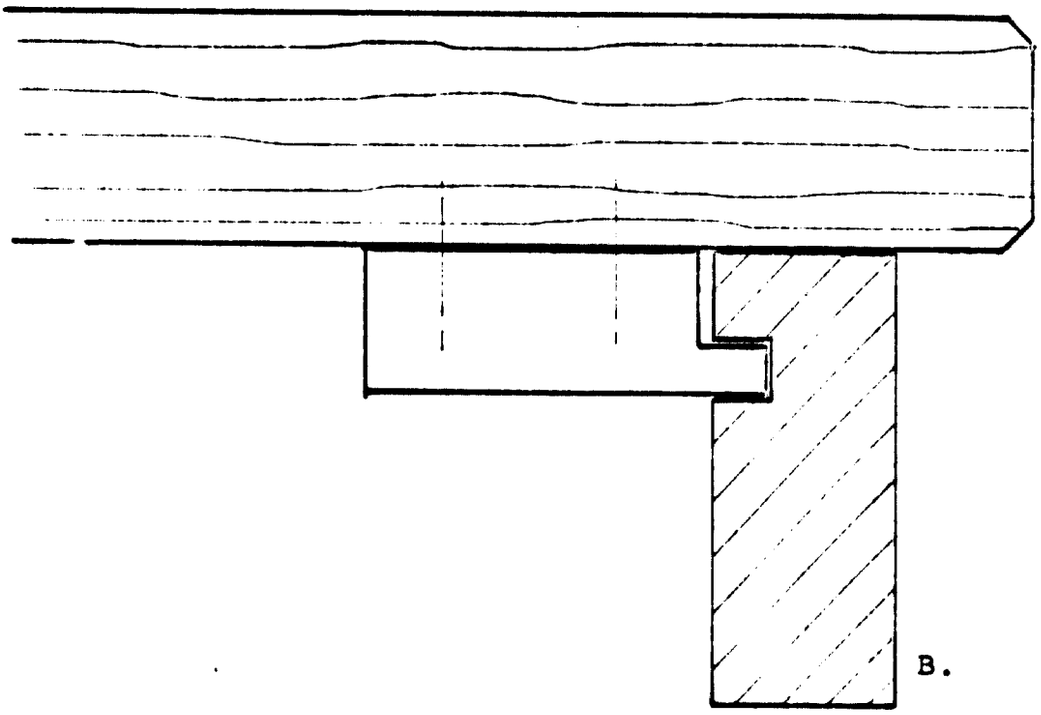
4. The design can be very simple, all technical problems avoided, as the timber itself has a high decorative value.

Occasional tables would be the best start for export, since they have a big demand, are bought separately, are easily made K.D., and only one size is required..A beautiful package should be designed by the graphics designer of the design center.

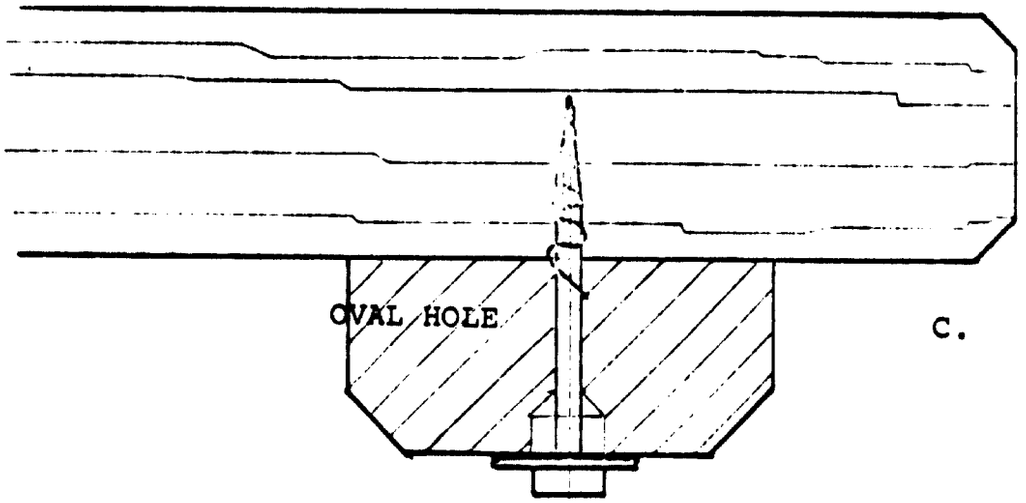
Figure V. Typical constructions for jointing solid wood table tops to rails



A.



B.



C.

VI. TABLE AND CHAIR FACTORY "KONJUH", ŽIVINICE

It was found that the quality and workmanship was quite good but the design of the products partly very old and partly too production oriented.

These problems had been correctly diagnosed by the factory staff. Outlines of redesigns and new designs were laid down and agreed upon. It was also agreed that since other factories might benefit from example of factory-designer cooperation, the consultant would work together with Mr. Praskać on the design and redesign programme.

At a later visit to Konjuh, the expert handed over sketches and full scale drawings of relevant construction details.
The redesign was done by introducing the least possible change to the products in attempting to remove the problems encountered.

The concept of the new design was that would be made K-D for export, and sawn rather than turned to even the workload of production lines.

The new line consists of constructions for a chair,armchair, dinner and occasional tables and a trolley.

Two alternative forms were shown, but the possibility exists to work out some more later, when the construction has been tried out and prototypes exist that give a better possibility of working out detailed machining and finishing solutions.

In discussing the utilization of timber for the back leg of the chair, it appeared that Konjuh too could benefit from the "blocking-over" technique that is going to be introduced at "Varda".

Annex I

ŠIPAD PRODUCT DEVELOPMENT POLICY

Product development costs time as well as money.

Like any other activity it needs production facilities and skilled labour force.

The effort can be divided into three roughly equal parts.

- At the factories there should be prototyping facilities and some skilled workers available.
  Also the relevant executives must be expected to give enough of their time and attention.
  This could be expected to cost around 1% of the factory turnover.
- The design department could also work with the discussed 1% royalty budget, but not without fairly big initial investment as many of the designers are still very young and many snags exist in the cooperation with the factories.
- The setting up of the furniture testing and research laboratory should be speeded up with all the available means.
  There is an appreciable latent need for testing of new models to prevent expensive complaints, and for experimental prototypework involving e.g. laminated parts, that Šipad factories have little experience in, so far.
  Ordinary prototyping should not be taken away from the factories, as this would lower incentive and alienate the products from the people who produce them.

If furniture research was budgeted at 1% the total would be 3% which is what Scandinavian factories usually pay designers in royalties.

As it is obvious that the only way to raise export profits is to develop clearly distinguishable well designed Šipad furniture, the highest Šipad executives should come out in favour of product development work. It is only another management detail but has to be taken care of.

Annex II

A PRACTICAL GUIDE TO PRODUCT DEVELOPMENT OF SIPAD FURNITURE

A. Design

"The question of design is so fundamental to the furniture industry that it would be difficult to exaggerate its importance. Yet much of the industry throughout the world still lacks any understanding of the place and function of design in relation to its products. In many cases, design, where it is given any attention is thought of exclusively in visual terms, as something to be added to, or subtracted from the final appearance of the product in order to distinguish it".

Above is a quotation from a lecture by Desmond P. Cody, expert in industrial engineering, which indicates that not only designers think that design is important. Design however does not start with the designer, nor can he do it alone.

One should really distinguish between design and product development, of which the designer's task is only a part.

It is often demanded that the designer must have total knowledge of production technology.

Depending on his basic training, which differs in different countries, he has some technical knowledge, but if he depends only on that, it is more a limitation than an asset.

The highest available knowledge must be brought to bear and the most recent and pertinent knowledge of local skills and raw-materials at each individual factory.

It is far more important that the designer is a good designer than a good technician. The same applies to market knowledge. Unexperienced designer has some,but the sales executive obviously has much more and recent knowledge.

Before any design work is undertaken, the designer must be thoroughly briefed. He cannot work without facts, and it is a bad investment not to give him all available facts.

The following check-list has been made to facilitate the co-operation between the factories and the designer and to help ensure that all pertinent facts are taken into the account.

	Action to be taken	Starting date	Completion date	Responsibility	Note
1.	Nominate a team			Management	
2.	Make a time schedule			Team	
3.	Review present situation			Team	Checklist 1 & 2
4.	Make a product strategy			Management & Team	
5.	Review the product range			Team	
6.	Decide what to design			Management	
7.	Make a design brief			Team	Checklist 3
8.	Visualize ideas			Designer	
9.	Discuss proposals			Team	
10.	Make main drawings			Designer	
11.	Make prototypes			Prod.manager & Designer	
12.	Study prototypes			Team	
13.	Redesign			Designer	
14.	Decide on O-series			Management & Team	
15.	Test			Prod. manager	
16.	Prepare sales material			Sales manager & Designer	
17.	Test market acceptance			Sales manager	
18.	Redesign if necessary			Designer	
19.	Decide on production			Management	
20.	Start publicity drive			Sales & Desig.	
21.	Follow up			Team	

1. Product development is a high level team work where all the best knowledge of markets, technology and economy should be available. The ideal working-group should consist of 3 people: production manager, (or specific product development manager if there is one), sales manager and designer.

The factory manager representing knowledge of economic resources should step in when decisions are being made.

The designer could be either of the factory or of the OOUR Design & Architecture. Šipad designers could specialize to work either with specific factories or with specific problems i.e. upholstered furniture, corpus furniture etc.

The composition of the group not only contributes the best knowledge in each field but also as the work goes on each person will benefit from the others know-how and get a much more profound knowledge of what can be done and why. For instance the salesman would pick up a lot of sales arguments already while developing the product.

2. Product development does not start with design nor are they synonymous.

The group must expect to meet frequently to execute its work.

A timetable has to be made, taking into account the factory's possibilities to produce prototypes and also granting the designer a reasonable time to do his work.

A normal duration would be 1 - 2 years, so the work has to be started well in advance of expeccted end of the life cycle of the present products.

In fact this work should be started again from the begining as soon as one cycle is completed.

3. The foundation of product development (PD) work is the present situation and how it is expected to develop. The strong and the weak points of the factories should be mapped out in details.

What can reasonably be bettered, what bottleneck shoud be avoided?

Can some existing resources be further developed to create a unique skill?

The biggest money may be in upholstered suites but also the biggest competition. Is there not a weakly covered area in the market that this factory could specialize for: institutions, hotels, schools, old peoples homes, student-homes?

4. A product policy should be laid down in such a way that everybody involved in the work can understand and identify with it, For instance: "Our aim is to produce knock-down tables of local wood of a good design and quality in the low to medium price range".

This product policy has to be adhered to, for a length of time, say 5 years, to allow for technical adjustment and to get known by the factory staff, the retail stage and finally the buying public. Of course it has to be adjusted from time to time but the general direction should remain the same.

A Šipad factory should check on the general policy of Šipad to be able to obtain e.g. the right raw materials and so that Šipad factories do not cover the same areas while leaving other areas completely uncovered.

5. Every product of the factory should be reviewed from every point of view.

Is it making a profit or not?

Is its turnover big or small?

Is it easy to produce, what are the snags, what are the favorable properties?

Is somebody producing the same thing cheaper? Why? Is it really identical or just looking alike but better suited for production?

Is there sales resistance ? Why ?

Is the size right, the colours etc.?

If a thorough analysis is not done, some mistakes in present products may be repeated.

6. A wide or a narrow product range? The product analysis will show where the best product is situated from a production and market point of view.

This would lead to narrowing down of the product range, which is good, up to a point. If there is an otherwise good suite that

requires complementation, this has to be made even if the separate product is not favourable; or should it not be bought from another factory that can produce it better?

It seems that most Šipad factories could get a technologically more favourable production if there was more cooperation between the factories.

The first important decision is:

- What to drop,
- what to retain.
- what to redesign,
- What new designs are needed.

7. The new designs and the scope of redesign has to be agreed upon and described in such a way that the designer gets all pertinent information without being bound hands and foot.

- Define as well as possible for instance "redesign of chair No 15; the seating angle is now under 90°; but now easy to produce because of straight back legs. Can it be made K-D ? New colours and textiles, market trends towards lightness".
- Relevant production technical background: "flat pieces, mouldered form before assembly, minimum inside radius 3cm. plywood seat and back can be curved one way".

- Relevant market requirements: "highish back, fairly large, upholstered seat & back, high "status" value, fairly high price allowed".

A time schedule should be made but the designer must be given enough time to do his job properly.

8. The designer's work at this stage should be "visualization"; that is, the ideas shown in the form of"pictures" rather than technical drawings.

Details of particular interest can be shown in 1/1 scale otherwise it is sufficient to use a fairly large perspective drawing (front & back) that is easily read, and an "exploded" drawing when the construction is complicated.

It is important to make many proposals. Even if everyone is not so good in every respect, quite new combination may crop up at the following discussions with the PD-group. Also variations of the separate themes should be made as numerous as possible.

It is dangerous to start detailed construction too early because it restricts imagination and causes resistance to changes.

9. The proposals should be discussed in a positive manner. Creativity is very easy to kill.

Even if a proposal is not accepted it may contain details or ideas that can be used in other products.

Rather than making specific requests for changes, the problems involved in producing each part should be explaned, which might cause a new solution to be found.

The specific demands of the tentative sales outlets must be discussed: for example, "who assembles the K-D products: the customer or the retailer".

lo. When the group has reached a decision the designer makes the "main drawings" 1/1, with all relevant specifications.

It is good to write a fairly elaborate description, the solution may not be as evident to the factory as it is to the one making the drawing. A perspective - drawing should always be submitted.

On the other hand, it is more important that the designer is a good designer than a production technician. He (she) should concentrate on the solutions affecting the design, while purely technical details should be supplied by the factory.

11. When the PD-group is satisfied with the drawing, a decision should be made about prototypes.

At this stage the time-schedule should be checked to conform with the factories' facilities to produce prototypes and other factors that may have appeared during the work.

12. The prototypes again should be analysed from every point of view, as a total and in each separate part. Is it functional, is it good, is it necessary etc.

The prototype should be remade or changed as many times as is necessary for the group to be convinced that the product is good.

Technical testing is usually pointless because joints are handmade and not exact and many parts may be "mock-ups" rather then the real thing.

13. It is still not too late to back out or make a fresh start.

14. Now is the time to be critical. The factory is committing itself. O-series production (i.e. the production of small batches of 10-15 pieces used for the running-in of tools and jigs, for checking the production time etc.) is a big investment and all relevant decision-making bodies should be consulted.

How big an O-series should be depends on various factors and varies from case to case. It should be big enough to be useful but not so big as to hurt if anything goes wrong.

15. Laboratory testing should be carried out always when facilities are available and the least doubt exists about any new technique or material used.

A test certificate is becoming an even greater sales argument. Testing is cheaper than substituting new furniture of a hotel or a school.

16. The designer knows how to show his design to its best advantage. He should always be involved when making catalogues, photographs, or planning exhibitions.

To the buying public the function, let alone the assembly of a piece of furniture is not self evident. Every pain should be taken in avoiding unnecessary complaints by supplying enough information on the product: its properties, its use and its care.

17. Market testing is mostly conducted by participation in fairs and exhibitions. Šipad has so many sales outlets that that some suitable ones could always be chosen for test sales of O-series products to make absolutely sure that the market acceptance is good.

18. Public reaction should be channeled back to the factory for possible last revision.

19. When all the previous steps have been taken commitment to a full scale production can be made with the conviction that everything has been made to ensure success.

2o. The launching of a new product should be coupled to a publicity drive through all available media: radio, newspapers, periodicals, TV. The message should be: "We have done a big job, We have a great product, we are proud to show it to anyone."

Again the designer is in a position to supply reproducable drawings and other suitable visual-commercial material.

21. The process never ends, public reaction, complaints, etc. must reach the factory.

Are there similar products on the market, are they better or cheaper, why?

B. Requirements of good furniture

It must fit the user.	Have the right measurements to fit the human body Give the user a correct posture. Not cause pressures in wrong places. Also fit special requirements of e.g. old people and children.
Must have utility.	Allow alternative positions, uses. Have a clear function, good assembly instructions.
Must be easy to handle.	Light to move if movable, KD-for removals if heavy, with possibility to clean under or behind.
Be strong	Good construction, hard wearing surfaces, high quality textiles, no sharp edges to wear or chip if wood. Not deform.
Be servicable	Easy to clean, worn parts to be exchangable.
Be safe	Not fall over or on user, not cause tripping, not crush fingers or allow user to become stuck, no sharp corners at the height of small children etc.
Be economic	Be worth the price, not necessarily cheap if high quality and long use is expected.
Fit its place	Fit the climate, relieve heat or moisture, fit the space in size and form.
Fit society	Fit the social and cultural surroundings, suit estethic need in form and colour give an impression of quality. Have the right feeling of "status" for its social and economic surroundings.

Fit technology	**Be favourable to produce** **Fit the** raw materials available locally and utilize **them to their best advantage.** **Fit the skills and the knowledge of the** work force **available and give them a possibility to** utilize **their specific skills to the best advantage.**

C. Design brief

Define product

-type of furniture

-type of use

-expected market area

-price class

-quality

-size

-preferred construction

Define materials

-type of wood

-preferred dimensions

-textiles

-plastics

-paints

-stains

-bleach etc.

Define way of forming

-sawn

-turned

-flatline

Special techniques available

-laminating

-bending

-pressing

-veneering etc.

Special restrictions

-width of edge-strip

-inner radiuses

-machining of assemblies

Non-material characteristics

-status value

-style

-feeling

Influence of outlets

-customer assembly

-"do it yourself" type of sale

-"over the counter" (folding)

-SIPAD overseas assembly

-Reatailers assembly

Intended markets

-export

-domestic

-institutions

-contract

Define work

-how many designs

-what variations

-what time limit

Check timetable

-research

-visualization

-discussions

-main drawings

-prototyping

Factory situations/some points

1. Rough outline

   -type of production

   -volumes required

   -degree of mechanization

2. Utilization

   -is the workload suitably divided

   -what kind of product would balance the load

3. Raw materials

   -wood locally available

   -quality

   -main characteristics

Annex III

SYNOPSIS OF LECTURES ON CONSTRUCTION AND DESIGN OF UPHOLSTERED FURNITURE GIVEN BY THE EXPERT AT SIPAD DESIGN CENTER, SARAJEVO, IN MARCH 1979

Construction — is traditionally wood but many materials can be used. The most important are mentioned together with main characteristics and advantages + disadvantages.

Wood — Conifers are mostly used. Best is a light, not too hard wood. Rough joinery methods can be used.

+ Easy to approximate strength of construction
  Strong if correctly made
  Easy fastening by tacking, nailing or screwing.
  Suits different requirements as to volume.
- Not free forming. Needs panels, burns.

Metal — Round or square steel tubes or profiles most used
Easy to construct & suited for mass production

+ Incombustible; can be made springy
- Heavy, fastening must be foreseen . No tacking unless wood inserts.
  No volume, much padding must be used.

Plastic foams — Fast and efficient manufacture, thinnest construction = 20-50 mm depending on foam.

+ Free form. No panels
- Must be reinforced with fibers, difficult to calculate construction, inserts for all fastening and tacking, combustible.

Padding — Although their chemical formation can very considerably the foams used for padding are of two main types.

1. "Polyether" foam is made in large loaves (2 x 2 m) of indefinite length and cut to suitable sizes. The density used for seats is 35 kg/m^3 and for backrests

20-25 kg/m3. If padding is thin and the use hard as e.g. for working chairs the density should be at least 50 kg/m3.

To "standardize" and use the same density in seat and back is an expensive mistake.

35-40 kg foam is too hard to give a nice rounded form needed for the cover and so it is necessary to use a softer layer on top. Arm rests "bottom" easily and may need a first strip of very hard "composite" of torn offcuts under a softer layer that gives form.

Figure 2.

The thickness of foam used in seats may vary from 2 cm upward depending on the results aimed at, but a reasonable comfort in an easy chair is reached by 7-8 cm foam in the seat and 5-6 cm in the back if construction is otherwise right.

Foam that is not dense enough can be made harder to carry more weight, but will collapse after use and should not be employed.

2. Polyurethane "cold foam" is made in a mold to any shape. Care must be taken however to stay within the limits of what cloth can be reasonably made to cover.

"Cold foam" is heavier and more expensive but has a "springier" feel and can be fireproof. The price is partly offset by speedier manufacture of complicated shapes.

Springs

Padding alone gives a sitting person enough comfort but the act of sitting down may be a "jarring" experience, and the habit of customers to test comfortability by jumping up and down requires the use of springs.
Many types are used, but the principle of function is one of those listed:

1. Spiral springs are usually manufactured under licence to some patented process and as such are good, but the designer should pay attention to:
   - that the bottom under the springs is strong enough.
   - that a suitable layer of stiff material is used on top of the springs to divide the weight and stop individual springs from being felt.
   - that enough foam is used on top to give a soft feel.
   - that the steel edge of the assembly is insulated enough by cotton and cloth not to chafe through.
   - that the minimum construction height should be about 15 cm.

2. No-sag springs come in rolls and are cut to suitable lengths and fastened to a frame with clips. The hardness of the assembly can be varied by using more or less arch, by the thickness of the spring and by adding crosswise connections between the separate springs: rubber bands or clips.
   Care should be taken:
   - that the springs are not made so highly arched and unconnected that they twist and fall to the side.
   - that fastening clips are suitably insulated against the spring to prevent "squeaking"
   - that a suitable cover is used on top of the springs. The neatest are two layers of cotton cloth sewn together with 2 cm of foam between, but a plain polypropylene cloth can be used if it is stiff enough and fastened proprely. (Fig. 4)

- the frame must be strong since this spring both pulls and pushes. The minimum dimension of a 3-seater frame is 100 x 40 mm (pine) with 2 crossbraces (Fig. 3)

No-sag springing is virtually everlasting if done right and has the added advantage of a convex form that helps stretch the cloth over the cushions.

3. "Siso-spring" A spiral spring in a plastic cover is made into a loop and fastened by fitting into a circular groove machined into the (beech) frame. (fig. 5) Design features:
   - neat, needs no cover;
     concave, hanging form tends to wrinkle cover on cushions.

4. Rubber webbing comes in many forms. The easiest to use is one that can be stretched by hand and tacked to the frame. NOTE: Bands should be tacked to the outside, or best, over the outside and under the frame (Fig. 6). Design features:
   - webbing does not have to be spaced evenly, but can be concentrated in the area of pressure
   - has to be covered like no-sag
   - concave form
   - 2- and 3-seaters need braces placed between cushions as webbing must be two-way; a way to overcome this is to place the webbing angled crosswise.

(Fig. 7).

Covers were earlier tacked on from front to back and the back nailed by visible tacks or sewn on by hand, but this is now too expensive.

Now, covers for furniture are confectioned like clothes for people.
The form of upholstered furniture must be in principle tapering upwards so that the cover can be slipped on and tacked under. If this is not possible parts should be covered separately and then assembled.

DESIGN NOTE: Upholstered furniture should be designed from outwards in, starting with the form of the cover and the placing of the seams.

- Cloth should always be given a convex shape.
  A concave shape will not be able to "feed" cloth as padding compesses but will stretch and become permanently wrinkled (Fig 9 A-D)
- When concave forms are wanted glue should not be used but tacking with a strip of cardboard and turning over as shown in Fig 8. A similar trick can be used to hide tacks as shown in Fig.4.

The normally used seams are shown in Fig 10.
Seams must be chosen with regard to the material. The basic seam is not much used as it tends to stretch open and the cloth under the seam is not controlled and may turn this way or that (Fig. 10A)

The "covered" seam (B) is much stronger and maybe the best overall. It is reasonably easy to learn to sew and is very strong. It is not suited however for very thick velvet type cloth as the surface opens in an unorganized manner.

The "leather" seam (C) requires more skill (2-needle machine) and is not very strong but

strip of cloth is added under.

In all seams care must be taken to choose the colour of thread which matches the cloth. This can be learned only by trial and error.

The "keder" seam (D) is least sensitive as the thread is covered from view. Placing of a distinct seam below the corner properly will create an image of roundness (E).

Cushions have to have a convex form, the softer the rounder.

- the simpliest techinque is sawing corners round by bent saw. The center is still flat however and the bare foam will catch the cloth and prevent "feeding" (Fig.11A).
- adding softer foam and glueing around the edges (B)
- adding fibrefill to the top of the foamblock gives a positive form and also "lubricates" the surface so that the cloth can move into the depression (C).
- the softest cushion is made by wrapping one or several layers of fiberfall around the core of foam (D).
  Fiberfill should be high quality dacron/polyester. Acrylic will go flat with use in a seat.
- offcuts can be shredded and used inside of a foam "pillowcase" (E). This is cheap, but this cushion deforms easily and filling to the size is difficult.

To obtain a varied appearance without changing production superficial decor can be used.

- buttoning helps to "organize" the wrinkling of a cushion.
  Care must be taken that the string is strong enough not to be twisted off.
  Also, the top of the padding must be soft enough or else the buttons will "bob" on the surface in an ugly manner. (Fig. 12A)
- buttoning can be combined with decorative seams (D)
- a "pull-in" effect can be obtained by cutting a slot in the foam and fastening a piece of cotton cloth, sewn to the cover, to the underside of the cushion (C)
- dividing the form mostly also requires dividing of the foam. The cover is sewn as separate "pockets" separate layers. (E)
- tightly spaced tufting is made by special machine (G)
- different materials can be combined to give better properties and decor (F).
- "quilting" the top cloth with a layer of soft foam or fiberfill to a cotton undercloth (13)
  Gives a great variety of patterns, but the forms obtained are rather shallow (13 A B C)
  If a deep form is wanted then the cloth must be cut accordingly 14 x 14 B
- wrinkles will appear when cloth is bent to a form it cannot follow. This can be used as a decoration if done in an organized way.

Generally the soft "casual" wrinkled look is quite difficult to obtain, as upholsterers tend to pull the cloth tight and the soft padding required will compress too much.

It is important to realize the possibilities of changing the appearance of upholstered furniture by introducing changes that affect the production as little as possible.

As an example of this kind of thinking Fig. 16 shows the placing of the seam on a cushion and the way the appearance changes.

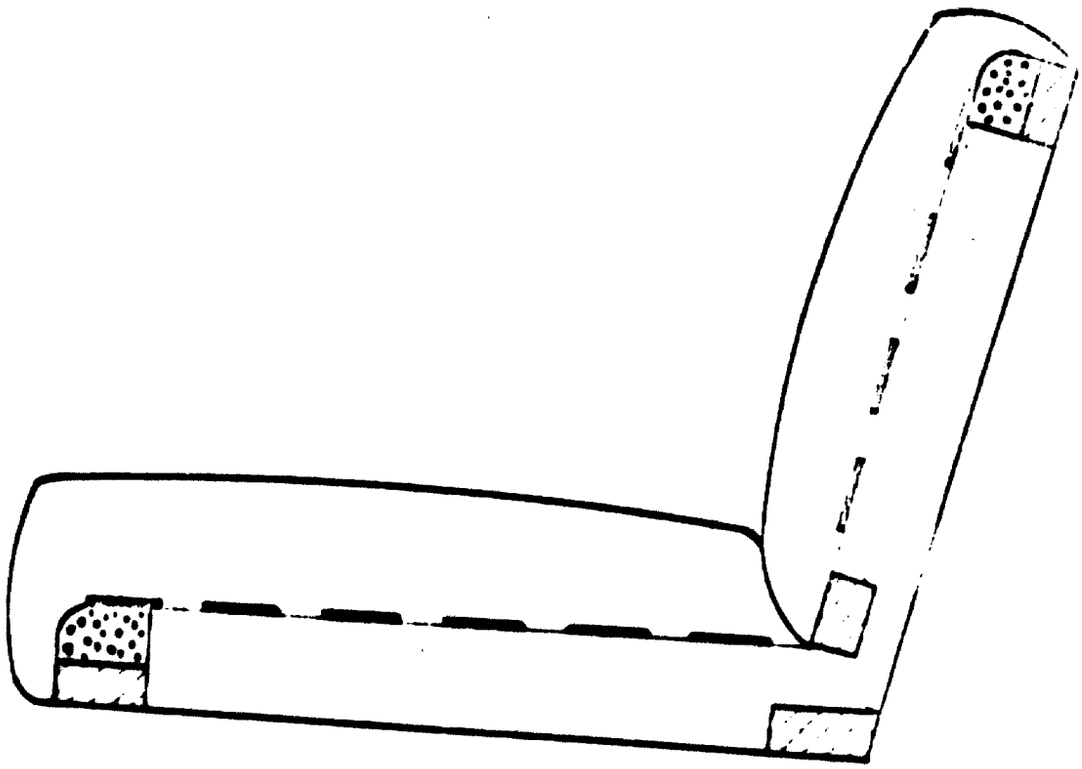


Figure 1

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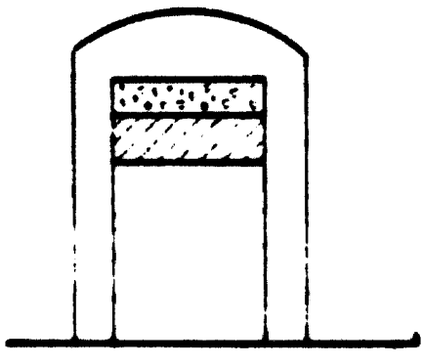
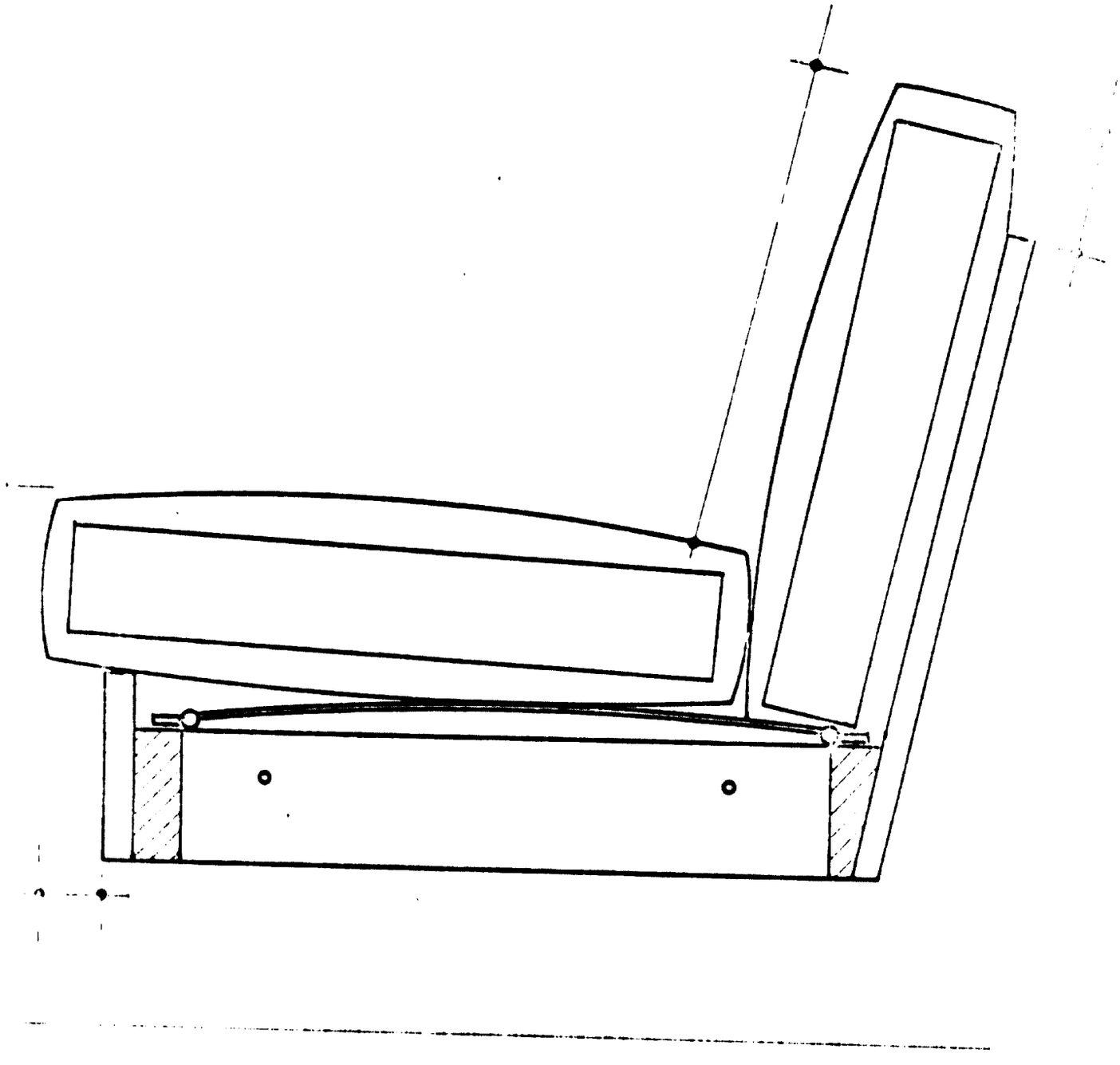


Figure 2



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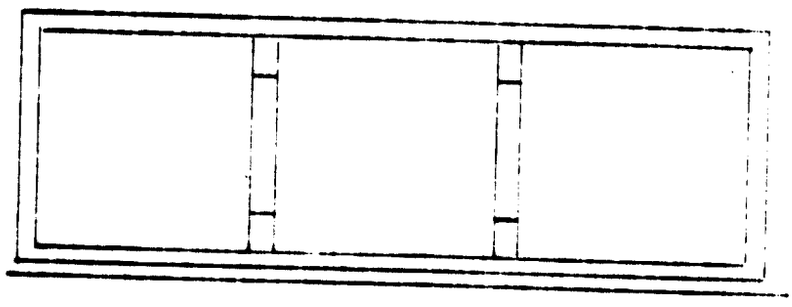

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Figure 3

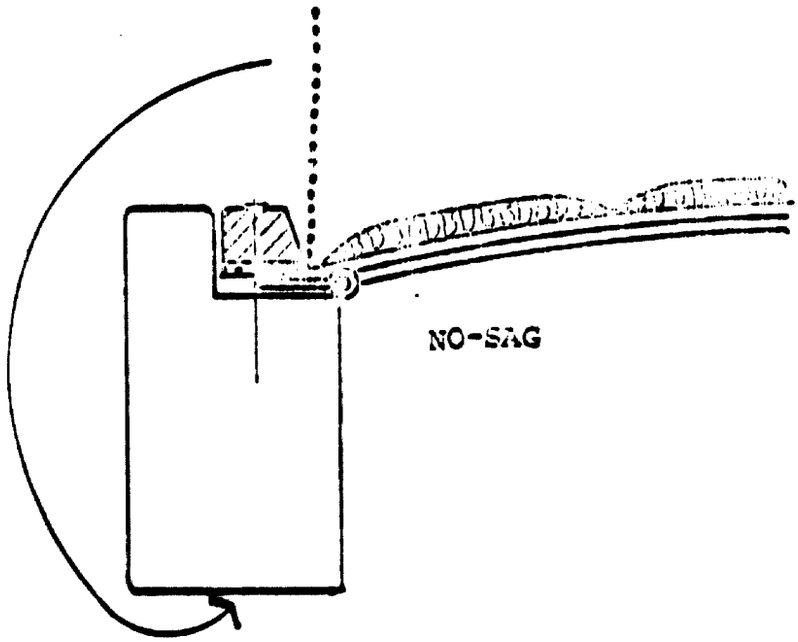


Figure 4

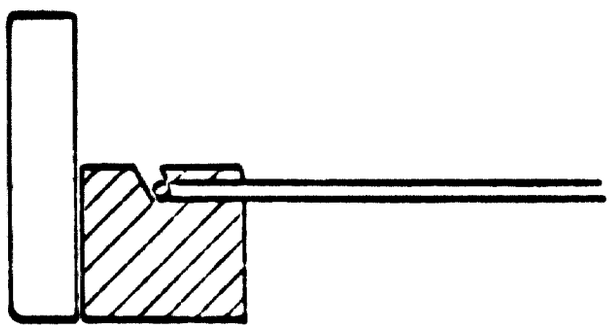


Figure 5

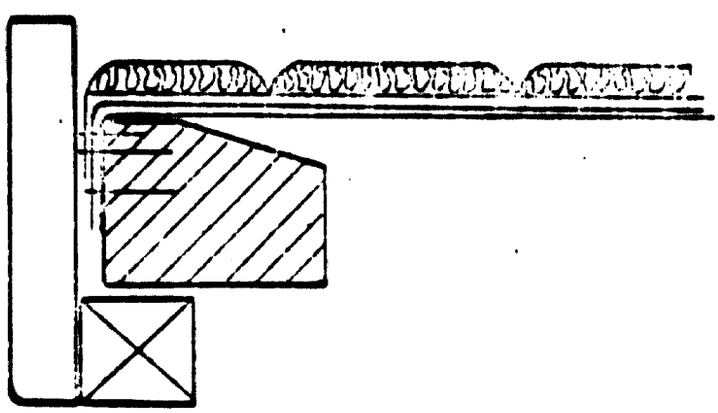


Figure 6

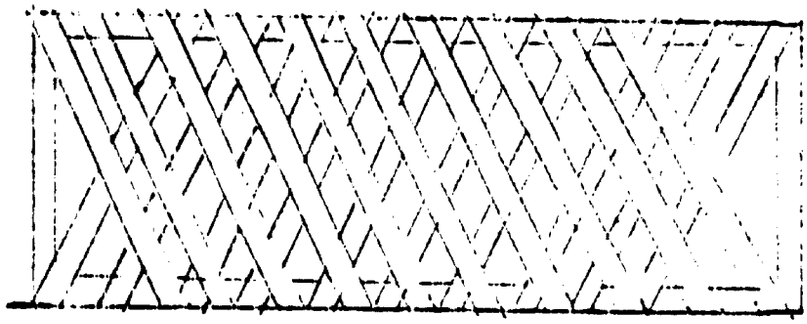


Figure 7

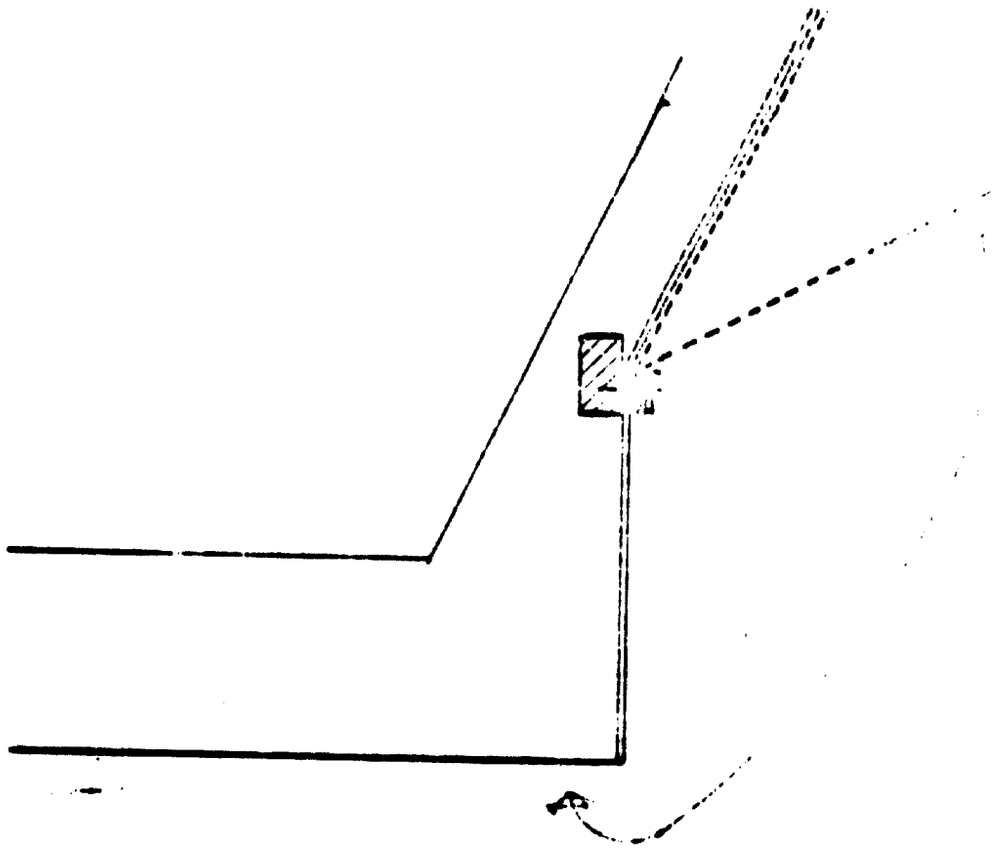
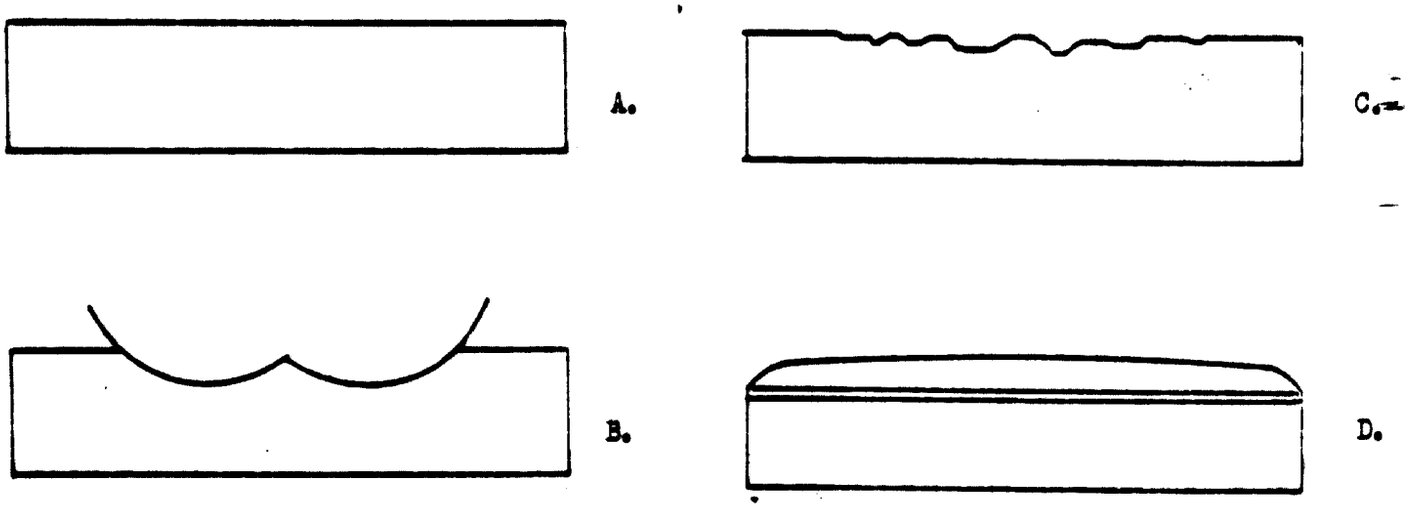


Figure 8



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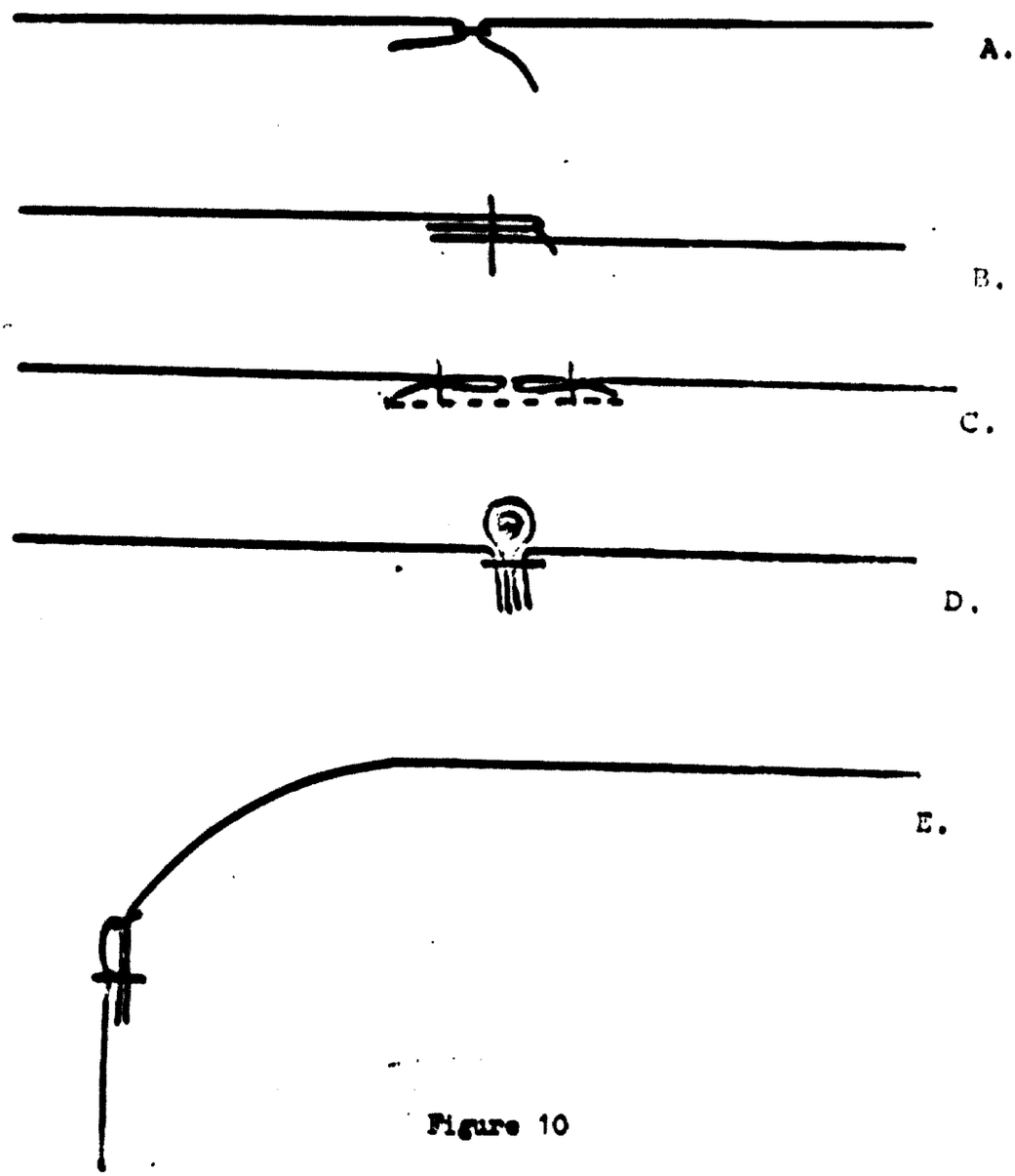


Figure 10

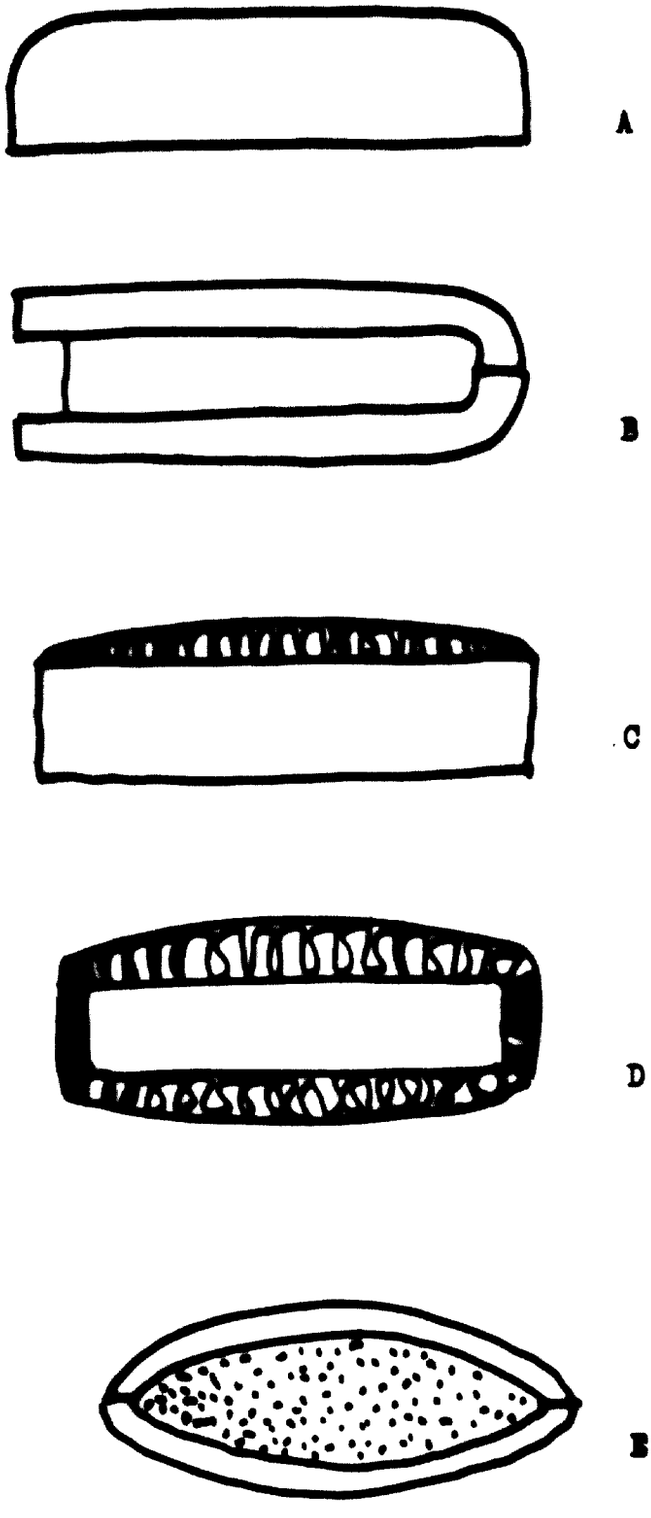


Figure 11

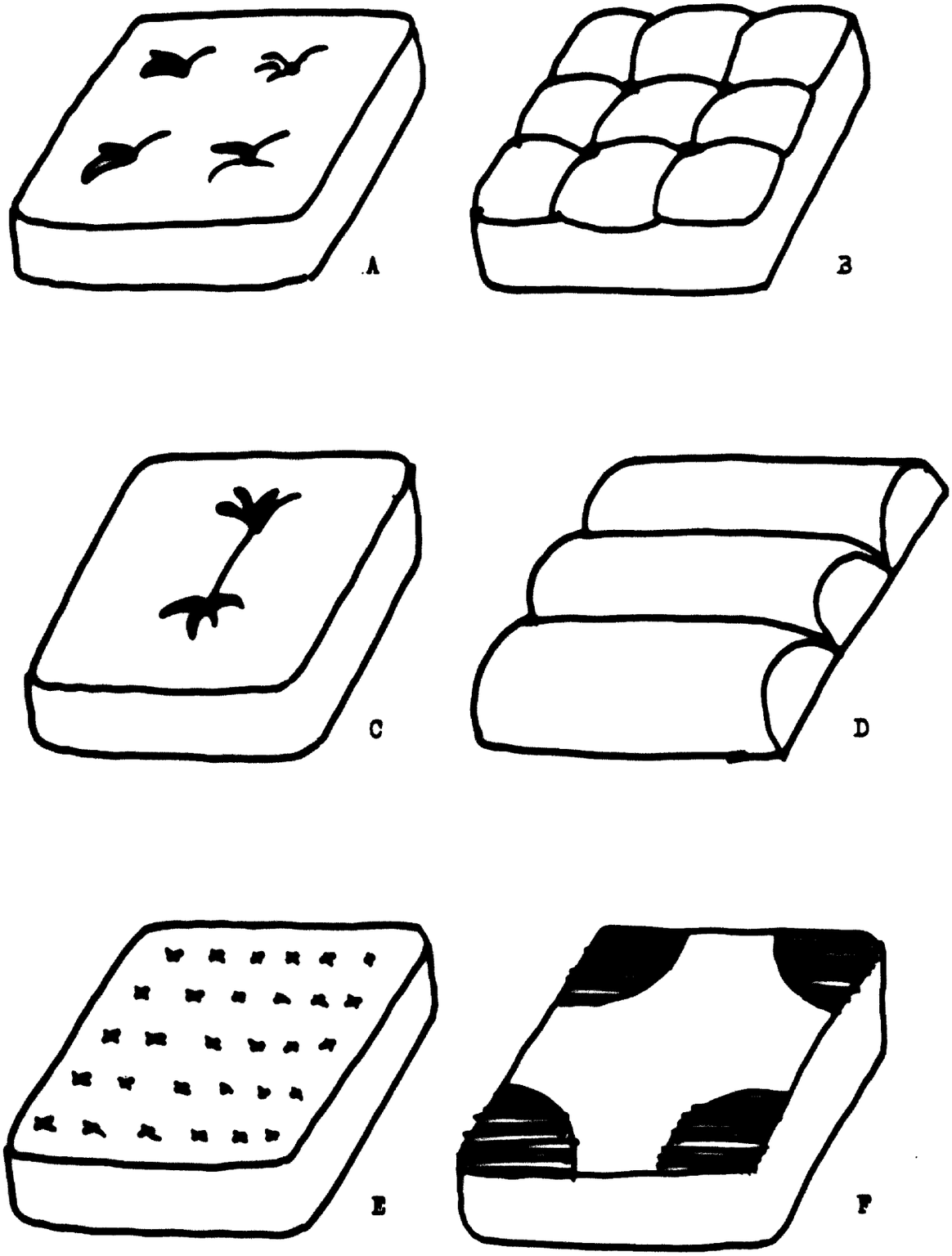


Figure 12

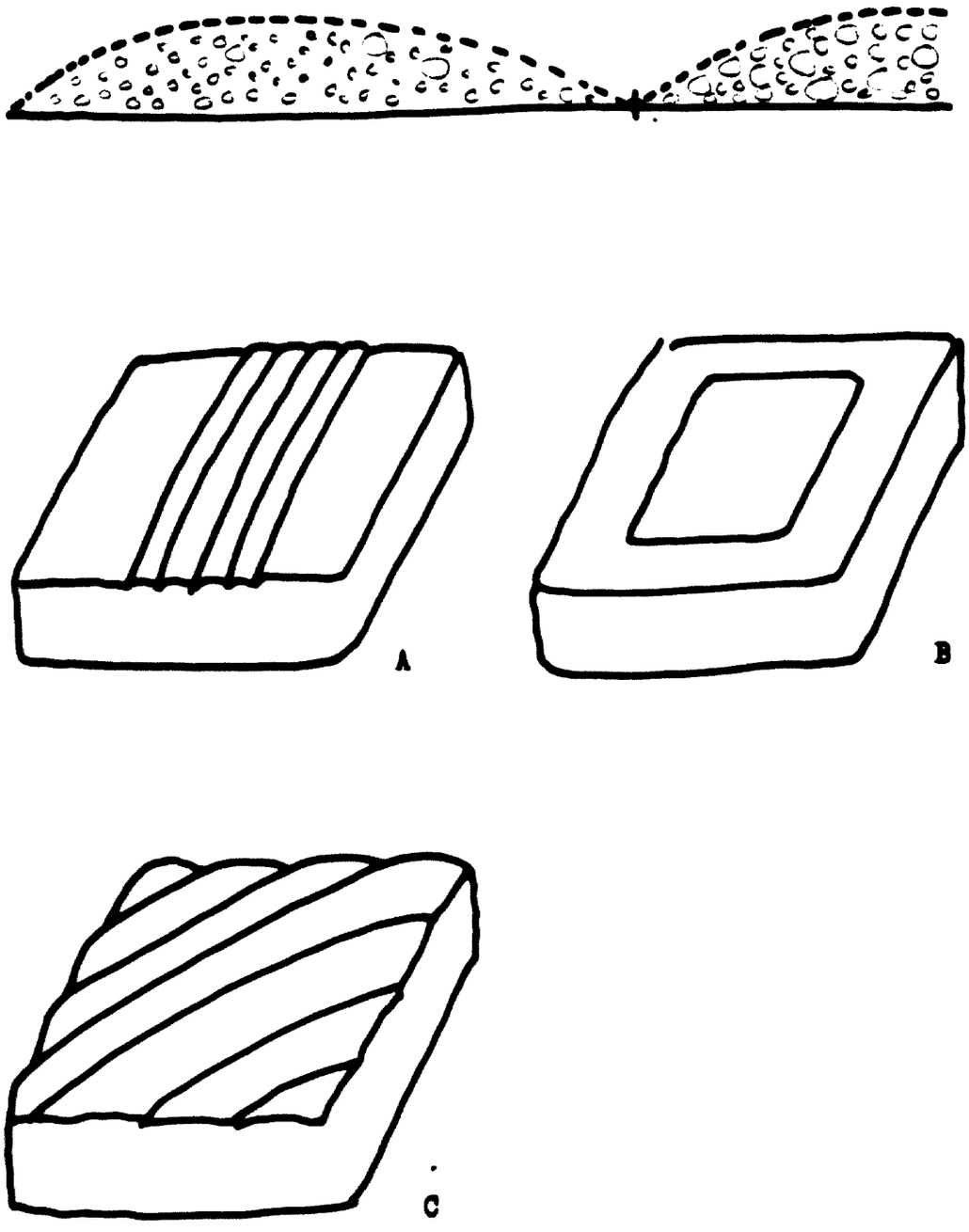


Figure 13

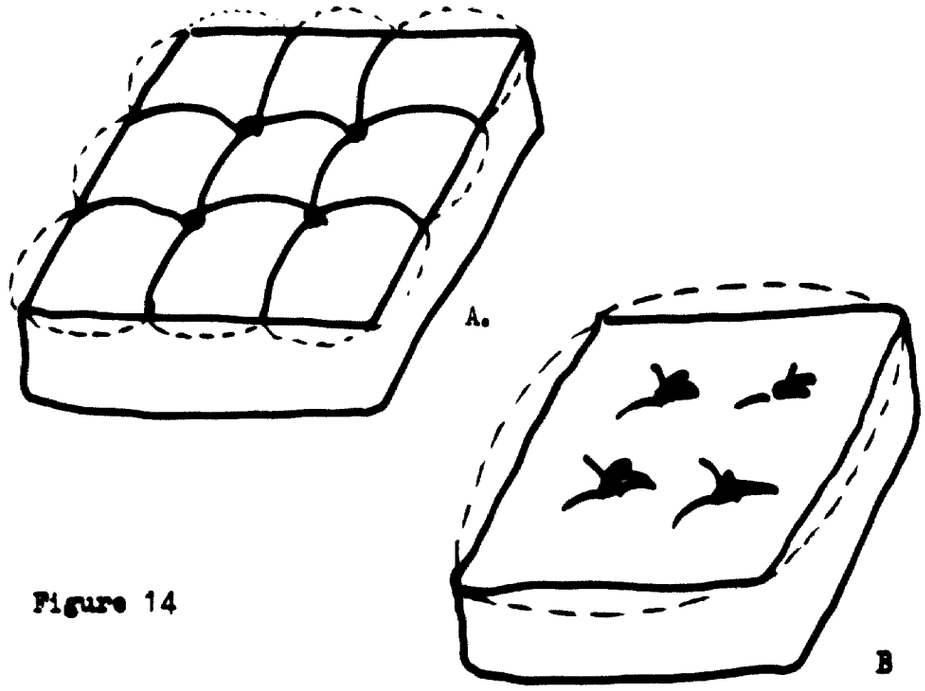


Figure 14

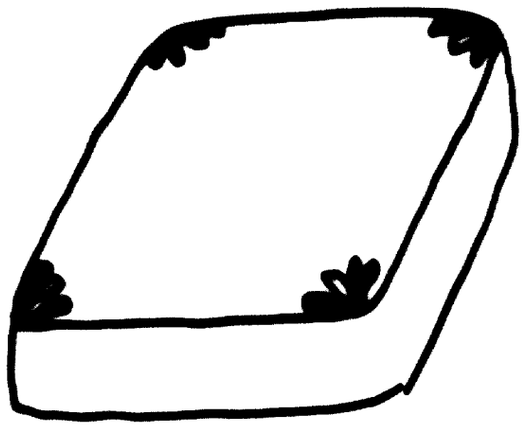
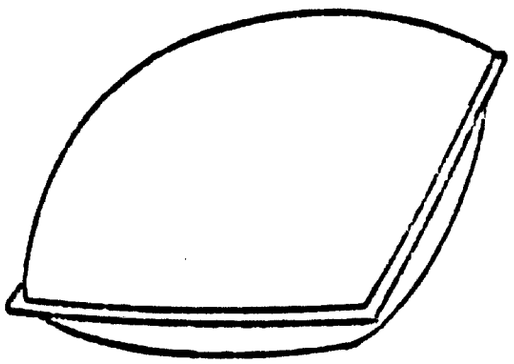
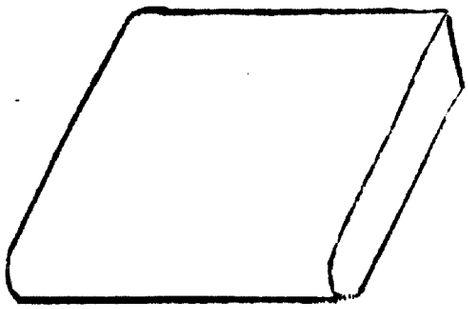


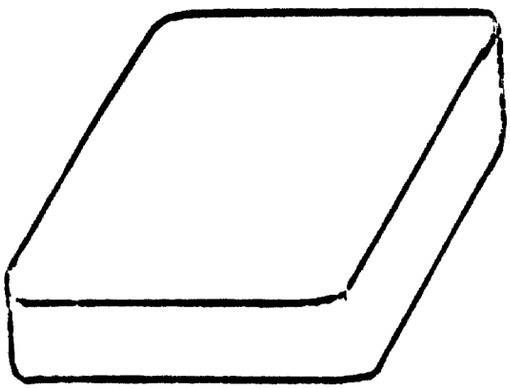
Figure 15



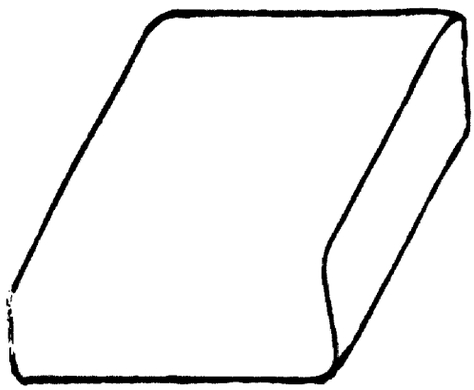
"PILLOW"



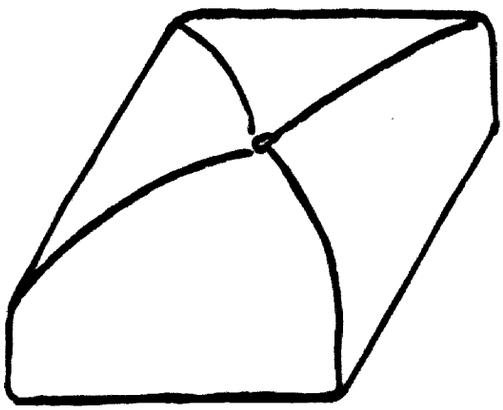
TUNNEL + ENDS



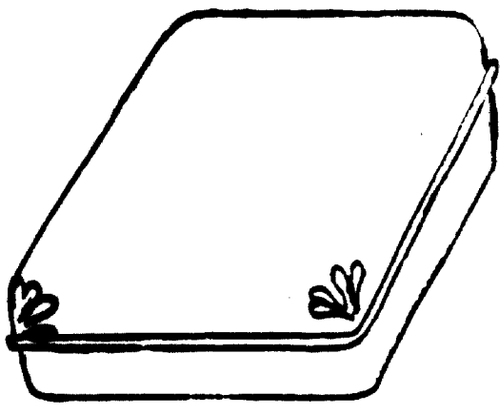
TOP-BOTTOM-COLLAR



TENNIS-BALL



ENVELOPE



SEMI-PILLOW

Figure 16. Placing of seams on cushions

We regret that some of the pages in the microfiche copy of this report may not be up to the proper legibility standards, even though the best possible copy was used for preparing the master fiche

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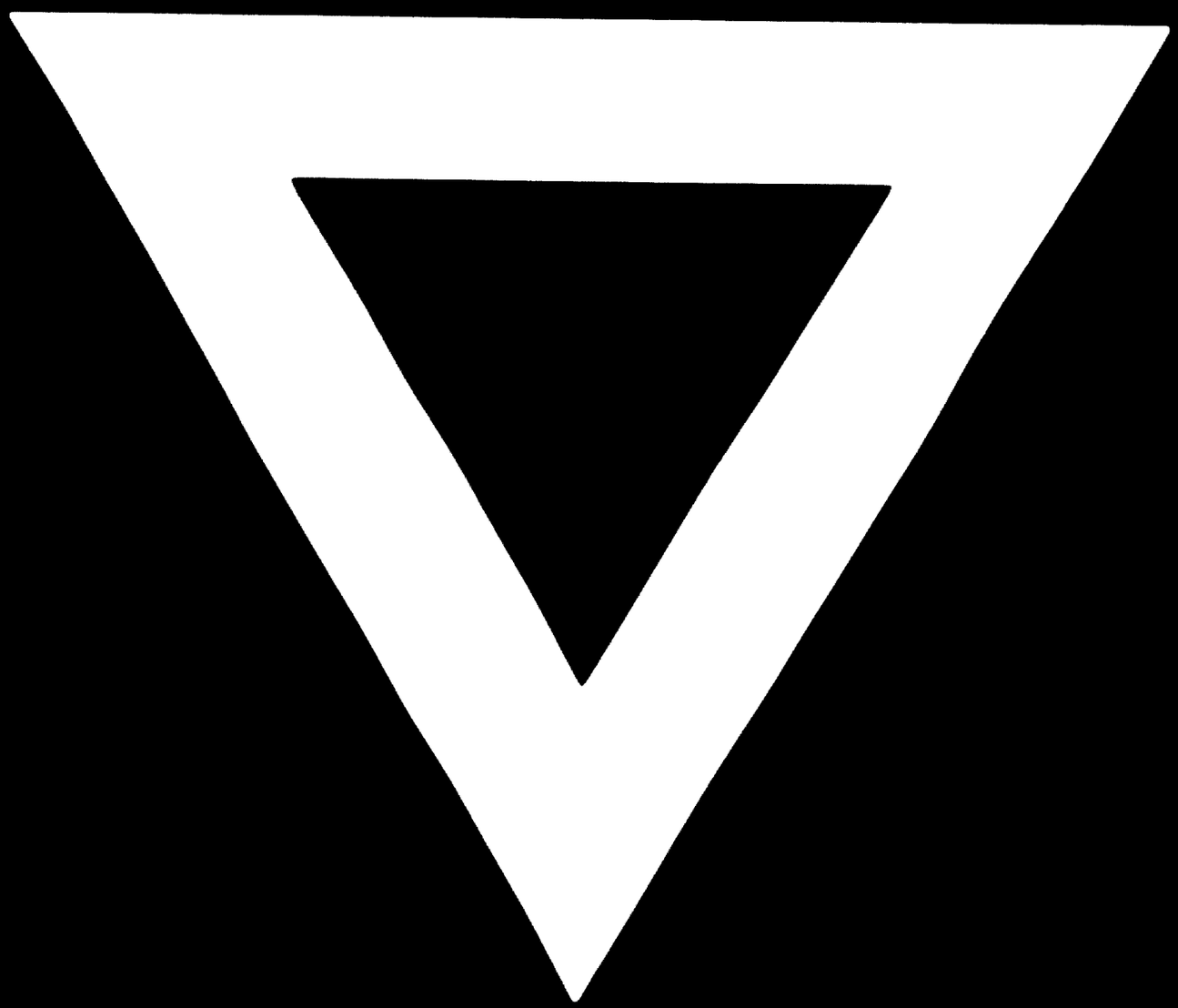

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