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ENGLISH

PROPOSAL FOR LOCAL MANUFACTURE OF ADOBE CORRUGATED STEEL GRAIN BINS

by

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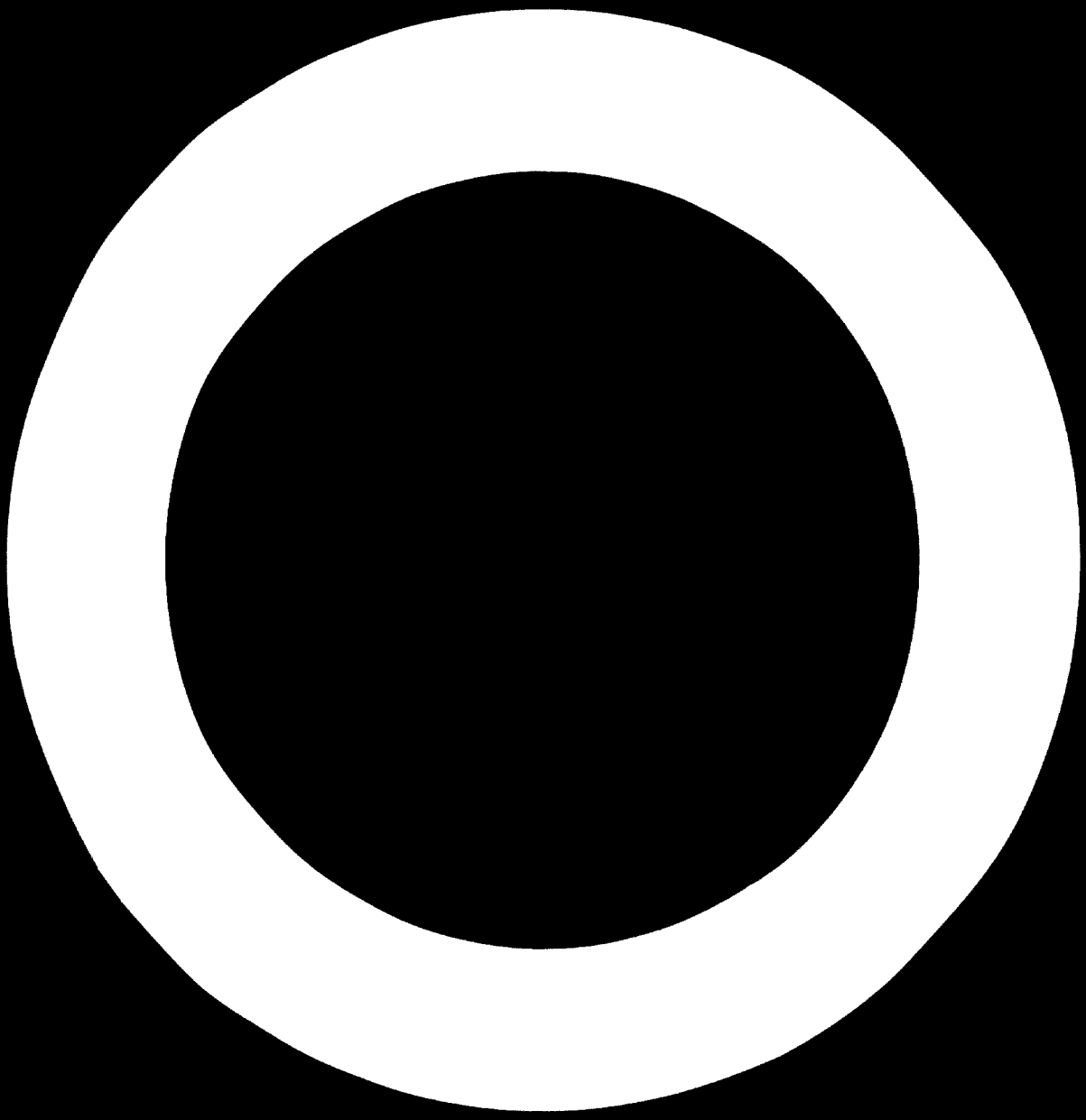
id.73-5144

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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1. Introduction (General)

Bridging the gap between the manufacture of simple agricultural tools in a black smith shop and the establishment of commercially viable plants in developing countris is a traditional stumbling block to both Governments and international development organizations. This study is an attempt to hypothesize the activities and resources required to set up a minimum size manufacturing plant capable of clearly demonstrating all the necessary techniques required to bridge this development gap.

The manufacture of modern steel grain storage bins (silos) is the object of this monograph. It represents a very good choice to illustrate, transfer of technology vis-à-vis single product manufacturing. The history of industrial development is replete with examples of attempting to transfer manufacturing technology by introducing modern machines and methods and then attempting identify enough varied products and markets to maintain machine utilization and train operators. From this nucleus it was assumed that somehow an entire industrial sector would suddenly result. Usually a monopoly situation has resulted with the establishment market oriented manufacturing blocked from establishment.

Grain bins are an excellent initial manufacturing venture both from the demand and supply side. A sizeable import is already extant in many developing countries, and the delivered retail prices are approximately 2½ times those prevalent in certain of the developed countries. Grain storage is currently one of the biggest problems in the developing world (See Famine Amidst Plenty-Time, Magazine April 30, 1973).

Dr. Boerma, Director General of FAO, estimates that new storage facilities for 150,000.000 metric tons of grain need to be established within the developing countrise to prevent wide spread starvation due to the depleted world grain supply and is proposing a unified attack on the problem on a world wide basis.

The estimated annual savings in grain attainable with modern storage equipment in contrast to use of traditional storage systems are well known. At current world market prices the average savings amount to approximately $ 5.00 per ton per annum.*) At this rate of savings, the capital return period is approximately three to five years for investment in corrugated steel bins equipped with aeration systems. This makes local manufacture an attractive investment proposition, especially if stored grain can be used as collateral.

The manufacturing technology is not highly sophisticated, yet illustrates the importance of all aspects of industrial management. In addition, the means of deficit financing and investment recovery are thoroughly understood by international banking agencies. It should also be added that grain bins illustrate the advantages of prefabrication manufacturing versus on the site construction and therefore will have an important impact towards establishing a sheet metal industry.

The objectives are to limit the project to the manufacture of one specific product, which is a completely self supporting entirety. The product should be chosen according to the following criteria: It should be supported by an adequate small market. It should represent a viable, self liquidating investment project without recourse to subsidies. It should be as small as possible but admit a clearly superior level of technology. It should clearly demonstrate all facets of industrial technology, including purchasing, inventory control, engineering, development, service, market development, and new manufacturing techniques in one complete package. In total it should represent a manufacturing prototype which can easily be copied and evaluated relative to extension into an entire manufacturing sector. This would lead to the establishment of a multiplicity of nuclear, single, product oriented manufacturing enterprises along with clearcut knowledge of the minimum foreign expertise to be imported.

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*) Calculated on the basis of $ 120 per metric ton average grain price. (At this writing, the international market price for rice is $ 440 per ton for milled rice!)

The initial programme and the extensive efforts fit well into the general programme of UNIDO. The enclosed Draft Report-Proposal for Local Manufacture of Modern Steel Storage Equipment is an attempt to illustrate a typical example. It is believed that this approach could facilitate direct, semi-public investments through long term borrowings from sources such as World Bank, and various international lending agencies without recourse to foreign equity and other vested interest forms of capital formation. This would allow more flexibility, more rapid and rational development and support foreign exchange policies.

As is often done in developed countries, the exercise consists of:

1. market survey of competitive products
2. establishment of desired specifications for market penetration and target level
3. testing competitive product performance
4. rational breakdown into suitable components
5. decisions on which raw materials, parts and services to purchase or include in the manufacturing plant
6. decisions on new equipment, finances, etc. to include.
7. redesign of parts in line with available resources.

Certain highly developed countries have consistently applied this technique to introduce new product manufacturing technology with great success. The popular alternative of technical co-operation and licensing agreements have not been very successful thus far as applied to agricultural machinery. The primary reasons are lack of expertise vis-à-vis the problems of development and the setting of short range economic goals on the part of the licensor. UNIDO is flexible and competent vis-à-vis both difficulties and in addition less biased and more altruistic in project identification, test and analysis of competitive products, design of manufacturing facilities and implementation of local manufacture.

II. Proposal

The proposal is to establish a prototype, small single complete product manufacturing plant which would:

1. Be commercially viable;
2. Provide manpower development;

3. Serve as a prototype for other single product manufacturing activity and product development;
4. Serve as a prototype for market development, both national and regional;
5. Serve as a prototype for UNIDO activities in development and in technology transfer.

III. Assumptions of the Report:

1. that public sector support is available in the form of tax vacations during the start-up;
2. ability to obtain adequate foreign exchange, and long term bank loans at 10% interest per annum;
3. a private sector capital structure is assumed and standard accounting procedures used to illustrate it;
4. protection against imports during start-up and for a reasonable period thereafter; and reduced import taxes on components not available locally, etc.;
5. that a retail installed price of $ 15 per metric ton of capacity (MT) will prevail;
6. that an ex-factory "whole-sale" price of $ 9 per MT will prevail and that the burden of the market development expenses will be upon the retailer;
7. that an adequate manufacturing site can be obtained, complete with adequate electricity, water and other services for $ 10,000; the cost of building is based on the cost of an imported light weight steel structure with local erection supervised by UNIDO experts;
8. specifications and durability of product line will be equivalent to or exceed commercially available models;
9. that general purpose machine tools will be used with an emphasis on modern associated fixtures and special tooling;
10. that machine tools and parts can be imported and installed for 130% of the world market price for similar tools and parts;
11. that a significant portion of the special tools, gages, dies and fixtures will be made in the plant tool room as a pre-manufacturing exercise;
12. that the factory will operate 2,000 hours per annum and a standard hour (for productivity calculations) equals 45 minutes;

13. that direct labour costs average $ 0.30 per hour and indirect (skilled) labour costs average $ 0.50 per hour;
14. that high salaried foreign personnel will be subsidised during start-up to the extent of the $ 0.50 per hour rate;
15. productivity of labour is assumed to be 75 %, that of semi- illed labour in developed western countries;
16. that new product development, new manufacturing methods and repair will be carried out in the plant tool room/experimental shop.

IV. The Manufacturing Plant - Production of Grain Storage Bins Suitable for most Developing Countries

Forword:

There are approximately 30 different manufacturers of this line of equipment world wide. It has been well received by the developing countries, especially in the rice producing areas. It is produced in most of the developed countries in small quantities for domestic use. It is also being produced in several developing countries. In some cases under license and in other cases, developed locally. The equipment is relatively easy to manufacture.

The plant herein discussed has a one shift capacity of approximately 200,000 MT of storage capacity per year. This size market exists in at least 10 of the developing countries.

The raw materials required are universally available and the labour content and the associated skills developed quite high. Dependent on the country, from 15 % to 25 % of content will need to be imported initially, based on the $ 15 per MT installed price.

This exercise is a logical first step towards the rational development of an agricultural structure manufacturing industry and thence on to various similar equipment. The initial investment is modest, the time required to reach production relatively short and the economic rate of return on capital very high. These attributes make it attractive as a prototype manufacturing exercise directed towards a single product. Storage of grain is often a Government sponsored function in the developing countries with Government owning and managing most of the equipment.

Certain countries have had treaties [illegible] technology [illegible] ultimately [illegible] countries' standpoint this avoids the many delays, biases and interference inherent in many licensing and technical co-operation contract negotiations. It also enables continuing use of subsidiary Government and UNIDO resources.

Plant and Production Requirements

Introduction

This plant proposal represents an "economic minimum" composite, based on UNIDO's experience in three developing countries. The plan in outline form follows:

1. The Government selects a suitable locally accepted product line.
2. With UNIDO's requested assistance hires a contractor to break down the product line into components and propose modifications to suit feasible local manufacturing practices.
3. With UNIDO's requested assistance makes decisions whether to build, buy locally or import on each part.
4. UNIDO upon request, plans the tools and methods and the physical plant to produce this "economic minimum".
5. The Government provides the land and physical plant.
6. UNIDO assists, upon request, in providing experts and technicians through the start up phase.
7. UNIDO assists, upon request, on a continuing basis in extension efforts for other product lines.
8. UNIDO assists, upon request, in plant expansion marketing development and product diversification activities.
9. UNIDO assists, upon request, in efforts to develop local sources for ancillary automotive* components.
10. The general aspects of the project are to be non-proprietary to assist UNIDO in extending the scheme to other countries.

* *includes agricultural as sub-set

Product Specification

The specifications for most steel grain bins are remarkably similar. Complete details of a typical model are included here for reference. Optional associated equipment for drying and handling are also shown. The following exercise is confined to manufacture of complete storage bins, although it is obvious that prefabricated structures could easily be added to the product line.

Design specifications (Standard Bins)

For initial production only two sizes of bin will be considered. They will be a 5 meter diameter by 5 meter eave hight and a 10 meter diameter by 5 meter eave. These have capacities respectively of 2,400 bushels (60 metric tons) and 10,000 bu (265 metric tons). The roof pitch is 3:4:5. A study of catalogues and offerings from bin manufacturers is indicative of the various sizes that can easily made from the same equipment without re-tooling. These two sizes were selected as representative of trends in modern grain storage and drying systems. Their trends apply for both on the farm and light industrial applications. Complete auxiliary equipment for drying and handling can be initially imported and later locally manufactured.

The steel specified is galvanised sheet of 50,000 Psi minimum yield strength. The thickness is modified accordingly. This represents the most modern practice. Machinery for manufacturing channel-lock drying floors will be initially introduced. This will provide an immediate side-line of manufacturing a complete line prefabricated steel buildings. (See Appendix). Side sheets will be designed so that whole numbers of sheets will produce whole number, metric diameters. The proportions (spacing and depth) will correspond to modern trends and produce whole number metric eave heights. This will simplify rapid introduction of special sizes at a later date. Wider, deeper corrugations will be used for easier forming (this is the most recent trend).

Design modifications will be minimal, and only as required, to suit manufacturing constraints. Capacities and durability will be equivalent or exceed those of commercially available models. As large a percentage of parts as possible will be redesigned for local fabrication from raw material

and the use of low production fabrication methods. The manufacture will include as much of the bin as possible in the manufacturing schedule. Initially critical parts such as high strength sheet steel and fasteners will be imported to maintain performance and durability. As required, machinery may be added and greater content manufactured locally.

Plant specifications and capital budget:	Cost:
1. 950 sq meters floor space (Central factory only, satellite factory/warehouse/erector not included)	
2. estimated cost with electrical/mechanical equipment (assumes modern light, steel building)	$ 40,000
3. output of 100 MT per hour	
4. value of land	$ 10,000
Total (land and building)	$ 50,000

[illegible]

1. Corrugation Machine
2. Long leaf bending machine
3. Deep throat drill presses
4. Floor panel drawing machine
5. Rolling die slitter for sheet

[illegible]

1. Fork lift truck
2. Combination Machine shop
3. Small shears
4. Bending machine
5. Radial saw
6. Office furniture and equipment
7. Perishable tools and repair parts supplies

[illegible]

VII. Capital Structure Assumptions

The following general assumptions are made:

1. The steel supplier will be willing to extend XX days credit on terms of 1/4 % per month;
2. The Government will either be an investor or a lender for the project;
3. That tax and tarif concessions are obtainable for at least 5 years;
4. That all profits can be plowed back into expansion for a period of 5 years. A natural expansion pattern could be local development and manufacture of prefabricated steel buildings;
5. That a surplus of manpower is used for training purposes and that excess capacity will be used for job contracting if practical. Obviously certain machines are not heavily loaded and manpower might be shuttled between machines.

VIII. Trial Manufacturing Cost Statement, Assumptions

Assumed production rate equals 100 MT storage capacity per hour. Assuming a one shift operation of 2,000 hours per annum, the production is 200,000 MT/annum.

Assumed retail price per unit is $ 15 per MT. The ex-factory price is assumed to be $ 9 per MT.

IX. Trial Profit and Loss Statement for the Year Ended 31 December 1975

Net Sales:	$ 1,800.000	
less returned goods	$ 50.000	$ 1,750.000
Cost of Goods sold:		
finished goods inventory, 1 Jan.1976	$ 190.000	
cost of goods manufactured	$ 1,150.000	
total cost of goods available for sale	$ 1,340.000	
less finished goods inventory 31 December 1974	$ 150.000	
cost of materials sold		$ 1,190.000
Gross Margin:		$ 560.000
Selling and Administrative Expenses:		
Selling Expenses:		
sales salaries and commissions	$ 57.500	
advertising expenses	$ 17.500	
total selling expenses	$ 75.000	
Administrative Expenses:		
Salaries and fees	$ 42.500	
miscellaneous administrative	$ 7.500	
total administrative costs	$ 50.000	
total selling and administrative expenses		$ 125.000
net operating profit		$ 430.000
non operating profit		$ 20.000
net profit before taxes		$ 450.000
estimated income tax		nil
net profit after tax		$ 450.000

X. Trial Manufacturing Cost Statement for 1975

Work-in-process inventory, 1 January 1976		$ 50.000
raw materials		
inventory, 1 January 1976	$ 230.000	
purchases	$ 820.000	
freight in	$ 20.000	
cost of materials available for use	$1,070.000	
less inventory, 31 December 1974	$ 250.000	
cost of materials used	$ 820.000	
direct labour	$ 78.000	
Manufacturing Overhead:		
indirect labour	$ 50.000	
factory heat, light and power	$ 40.000	
factory supplies used	$ 58.000	
depreciation of plant and equipment	$ 89.000	
insurance and taxes	$ 25.000	
total manufacturing overhead	$ 262.000	
total manufacturing costs		$ 1,150.000
total work-in-process during period		$ 1,200.000
less work-in-process inventory, 31 December 1974		$ 100.000
cost of goods manufactured		$ 1,105.000

XI. Trial Balance Sheet, 31 December 1975 - Assets

Current assets:		
cash and securities		$ 125.000
accounts receivable	$ 250.000	
less allowance for doubtful accounts	$ 12.500	$ 237.500
Inventories:		
finished goods	$ 150.000	
work-in-process	$ 100.000	
raw materials	$ 350.000	
supplies	$ 50.000	
	$ 650.000	$ 650.000
prepaid expenses		$ 25.000
total current assets		$ 1,037.500
Fixed assets:		
land	$ 25.000	
buildings (2.100 m^2)	$ 100.000	
less depreciation	$ 12.500	$ 112.500
machinery and equipment	$ 140.000	
less depreciation	$ 14.000	$ 126.000
total fixed assets		$ 238.500
total assets		$ 1,276.000

XII. Liabilities and Equity, 31 December 1975

Current liabilities:		
accounts payable	$ 125.000	
notes payable	$ 125.000	
Accrued liabilities:		
wages and salaries payable	$ 15.000	
interest payable	$ 5.000	$ 20.000
allowance for taxes (state and local)	$ 12.500	$ 12.500
total current liabilities		$ 282.500
Fixed liabilities:		
mortgage bonds 7%	$ 293.500	$ 293.500
Equity:		
capital stock	$ 250.000	
surplus	$ 450.000	
total equity		$ 993.500
total liabilities and equity		$ 1,276.000

XIII. Trial Ratio Analysis

Ratio Name		Trial	Average
1. current ration = 1,037.500/782.500	=	3.7:1	2.3
2. acid test or quick ratio = 375.000/282.500	=	1.33	1.1
3. average collection period = 100/(1.800/365)	=	50 days	40 days
4. asset earning power = 430/1.276	=	34%	18%
5. return on owners equity = 450/993	=	45%	16%
6. inventory turnover = $\frac{1.190}{650}$	=	1.8	-
7. net profit on sales 450/1.800	=	25%	-
8. investment turnover 1800/1.276	=	1.4	
9. ROI = 450/1.276	=	35%	
10. receivable total assets = $\frac{250}{1276}$	=	20%	25%
11. inventories total assets = $\frac{650}{1276}$	=	51%	24%
12. fixed assets total assets = $\frac{2385}{1276}$	=	19%	30%
13. leverage $\frac{1276}{250}$	=	5	-
14. proprietary ratio 250/1276	=	0.2	-

XIV. PARTS BREAKDOWN AND STANDARD COST ANALYSIS

The complete part list for the proposed bin is included here to establish the approximate number and complexity of parts to be purchased, manufactured or assembled.

Using the sketches of the major parts as models, rough estimates have been made of the design modifications required, the raw material costs, the tools required, the manpower and the manufacturing costs. Approximately 75% of the content and operations are included. This will serve as an outline for the contractor to follow in specialising the project for the specific country. In this area there is room to exercise considerable ingenuity in adapting manufacturing to meet local constraints.

Only the major components which are made from galvanised steel are accounted for in the process analysis and cost analysis. The remaining minor parts, for example doors and hatches, are assumed to evolve with some design assistance out of locally available raw materials, for example hot rolled steel, concrete wood etc. at a final cost equivalent to that in the U.S.

The manufacturing for sake of simplicity is treated as being under one roof with open air storage. In practice much of the manufacture would be done in small, satellite factory/erector/dealer establishments. They would serve as warehouses and fabricate doors etc. Presumably the cost would be the same as under one roof because of lowered overhead costs and transport costs.

XV. CAUTION

The extent of validity of the assumptions used in preparing this report varies widely throughout the developing countries. This report illustrated most of the important factors affecting the design and profitable operation of a small manufacturing plant.

The report should provide guidelines enabling a contractor to make a comprehensive plan for establishing such a plant quickly and accurately by comparing local prices, productivity, etc. It should also enable Government officials or local lending agencies using standard accounting procedures and adjusting for local variations to establish preliminary project feasibility and priority. The cost estimating procedures used in estimating part standard costs and machine requirements are very crude and use many rules of thumb. For this reason, and in order to reinforce the manpower development aspects of the exercise more than ample machinery and manpower is assumed.

For the purpose of identifying all manufacturing operations required use was made of specification sheets and parts lists of a popular brand storage bin. This is for reference only and should not be construed as a recommendation to copy or otherwise use this or any propriatary information as a strict basis for design or other unethical usage. Most of the technical aspects of design and manufacture are well known to the industry. Use of a composite technology based on the best features of various brands will result in a superior product.

Nonetheless, this information is important from the standpoint of clearly acquainting prospective investors, contractors and project managers as to the scope of preliminary planning required prior to successful implementation of such manufacturing project.

Should serious interest in pre-project activity develop in a specific country, a UNIDO staff mission of 10 days could provide the additional detail and adjustment necessary for implementing phase 1.

XVI. Conclusions and Follow-up Action recommended:

Included for study and guidance is a pro-forma request for UNIDO assistance. The source of funds for the assistance should be discussed first with the UNDP Resident Representatives' office and second with the UNIDO Field Adviser. If an examination of the report indicates a clear interest in establishing a factory, a request for implementation of Phase I can be sent to UNIDO via the Resident Representative. If the examination indicates need for clarification prior to initiation of Phase I, a request for a UNIDO staff advisory mission to come to the country is recommended. In either case the advice and assistance of the UNDP office is essential.

UNIDO has already compiled much pertinent information on many developing countries. This information and knowledge is available on request to tailor this proposal to the varied needs of individual countries. We hope that this proposal will serve as a prototype for the establishing plants of different sizes and for different product lines. We envision that this extension can be accomplished on a regional basis and hope that the co-operatic countries will not make the information generated proprietary either within, or ex country.

A draft project data sheet is enclosed, for your information and reference, for project implementation Phase I.

APPENDIX I

Contents Working papers and industrial information to be evaluated and elaborated for inclusion in the final working prospectus.

It includes:

1. Typical bin illustrative material.
2. Data on construction of foundations and erection tools and procedures.
3. Sketches and photos showing typical special machines and methodology in use in the United States and suggested low capital machines and labor intensive methodologies which might be substituted.
4. Approximate prices of bins and auxiliary equipment.
5. Typical auxiliary equipment and systems for storage and drying.
6. Illustrations of an experimental drying bin with complete integrated facilities for 1) filling, 2) circulating, 3) drying, 4) storage, 5) unloading.
7. Illustrations of a simple locally fabricated machine for simultaneously 1) corrugating, 2) embossing for drill, 3) curving side sheets.
8. Authors notes:

The information included represents the results of a brief earlier investigation of bin technology in 1971. Since the search was not comprehensive and the technologies available are changing, a new more thorough evaluation needs to be conducted.

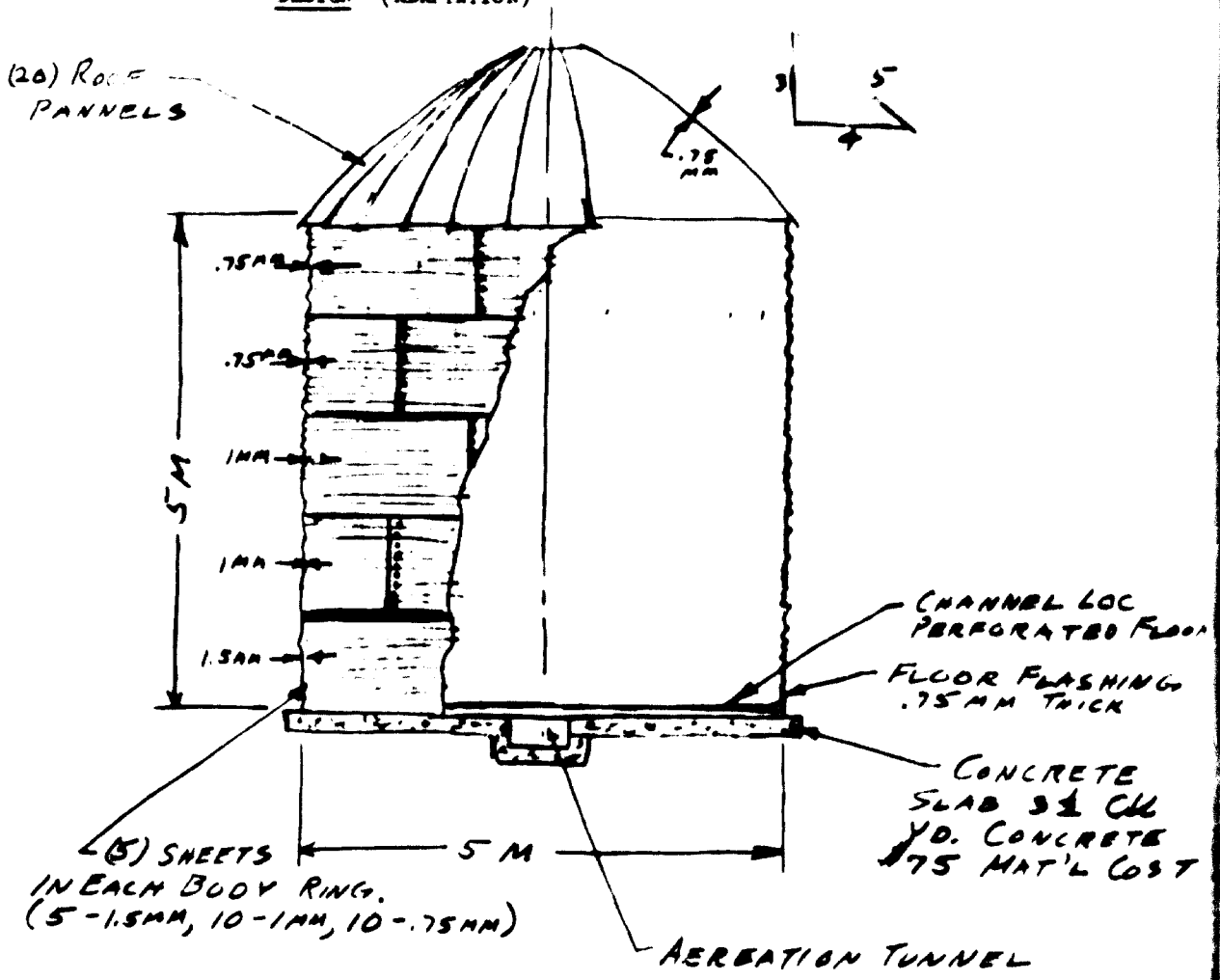
The existing markets vary widely, requiring from approximately 50,000 to 500,000 metric tons per annum of manufacturing capacity to serve them. In some cases the markets may be grouped. The manufacturing sector may be public owned, privately owned or two stage, public private (recommended).

In order to allow design flexibility it will be necessary to provide designs for special low cost low volume machines which can be locally assembled. It is proposed that a prospectus represent the two extremes. Although some of the bin parts could be conveniently manufactured from imported precorrugated cut sheets, it is proposed that all fabrication should start with coiled sheet stock. This will result in savings in stock inventory, shipping costs import "friction", etc. and better support on expanded sheet metal industry.

The prospectus is not at this time acourate or complete. It has been prepared as a guideline and format for the production of an action oriented prospectus by a consultant. This document must include a complete plant design both technical and financial aspects in generalised format and must be accurate for at least one developing country. It should be comprehensive and in format to allow international banking institutions to evaluate and modify it on the spot into a viable investment project.

Terms of reference for the consultant are included and draft pilot plant design for knapsack sprayers as a guide to the extent of documentation to be produced.

DESIGN (ADAPTATION)



LIST OF DEVIATIONS FROM USUAL US DESIGN.

1. STEEL 50,000 MIN YIELD (ST'D 33,000 SAME COST PER LB 30% LIGHTER THICKNESS USED)
2. CONVERSION TO METRIC SYSTEM. (PITCH OF CORRUGATIONS, BOLT SPACINGS, DIAMETRAL INCREMENTS, ETC.
3. DOME ROOF DESIGN, Z CROSS SECTION WITH WOOD SPACERS  BOLT HOLES ARE MARKED AND DRILLED IN AN ARC TO PROVIDE DOME UPON ASSEMBLY.

PARTS LIST - 60 TON (5x5) BIN

Part No.	Description	No. Req'd	Wt.Ea.	Total Wt.	Raw Mat'l
100	Base Body Sheet	5	95 lbs	476 lbs	$ 57.00
101	Middle Body Sheet	10	63 lbs	630 lbs	$ 75.00
102	Top Body Sheet	10	47,5 lbs	475 lbs	$ 57.00
103	Roof Rafter	20	22 lbs	440 lbs	$ 52.00
104	Floor "Plank"	100 lineal meters		565 lbs	$ 67.00
105	Rafter Spacer (Wood)	20	2 lbs	40 lbs	$ 2.50
106	Flashing (Floor)	20	4,3 lbs	85 lbs	$ 12.00
107	5/16" or 8 mm Bin Bolts w/Nuts and Washers	1800		36 lbs	$ 54.00

Imported Materials Total $ 374 per 60 Ton Bin or $ 6.20 per Ton. It is estimated that this would to $ 4.00 for a 10 M Dia x 5 M 265 Ton Bin.

MANUFACTURING COST BREAK DOWN AND COMPARISON US Vs LOCAL ESTIMATE

US 10' dia x 16 high [illegible] dia x [illegible] high

part name	U.S. BIN No. or quant.	Wt. or Vol.	Material cost	Labour Hrs.	Ex-fact price	User cost	PROPOSED No. or quant.	Wt. or Vol.	Material cost	Labour Hrs.	Ex-fact price	User cost	
1. 10' dia x 4" concrete	[illegible]	2.5Yd^3	$ [illegible]	24 MH	-	$ [illegible]							foundation
1a. [illegible] dia x 100mm concrete								2m^3	$ [illegible] total	48	-	$ [illegible] total	$ [illegible]/ton
2. body ring sheets (4') reg. [illegible] x 4 length 16 GA	[illegible]	[illegible]	$ [illegible]		$	$ [illegible]							
2a. body ring sheets [illegible] reg. x [illegible] mm							[illegible]	[illegible]	$ 44		$ [illegible]	$	$ [illegible]
3. body ring sheets 18 GA	16 [illegible]	[illegible]	$ [illegible]		$ [illegible]	$ [illegible]							
3a. body ring sheets [illegible] mm							5	[illegible]	$ [illegible]		$ [illegible]	$ [illegible]	$
4. body ring sheets 20 GA	16	[illegible] lbs.	$ [illegible]		$ [illegible]	$ [illegible]							
4a. body ring sheets 75mm								[illegible]	$ [illegible]		$ [illegible]	$ [illegible]	$ [illegible]
5. roof pannels	[illegible]	[illegible] lbs.	$ [illegible]		$ 44	$ [illegible]							
5a. roof pannels							[illegible]	[illegible]	$ [illegible]		$ 44	$ [illegible]	$ [illegible]
6. double door		[illegible] lbs.	$ [illegible]		$ [illegible]	$ [illegible]		[illegible]	[illegible]		$ [illegible]	$ [illegible]	$ [illegible]
7. centre ring assy	[illegible]	35 lbs.	$ [illegible]		$ 24	$ [illegible]		[illegible]	$		$ 24	$ [illegible]	$
8. collar flanning	[illegible]	[illegible] lbs.	$ 2		$ [illegible]	$ 20		[illegible]	$ [illegible]		$ [illegible]	$ 20	$
9. bin bolts and seals	[illegible]	[illegible] lbs.	$ [illegible]		$ [illegible]	$ [illegible]	[illegible]	[illegible]	$ [illegible]		$ [illegible]	$ [illegible]	$ [illegible]
10. base angles and anchors	1 set	[illegible] lbs.	$ 4		$ [illegible]	$ [illegible]	set	[illegible]	$ [illegible]		$ [illegible]	$ [illegible]	$ [illegible]
11. complete [illegible] total	[illegible]	[illegible] lbs.	$ [illegible]		[illegible]	$ [illegible]	[illegible]	[illegible]	$ [illegible]			$ [illegible]	$ [illegible]
12. complete bin check		[illegible] lbs.	400		$ [illegible]	$ [illegible]		[illegible]			[illegible]	[illegible]	[illegible] ton, $ [illegible]
13. perforated drying floor	[illegible]	[illegible] lbs.	$ [illegible]		$ [illegible]	$ [illegible]	20m^2	450 [illegible]	$ [illegible]		$ [illegible]	$ [illegible]	anodized lum. [illegible]
14. sub floor ducts and later (see App. [illegible])	32 [illegible] 16 GA	140 lbs.	$ 16		$ [illegible]	$ [illegible]	[illegible] mm	[illegible]	$		$ [illegible]	$	
15. flanning	50'	[illegible] lbs.	$ [illegible]		$ [illegible]	$ [illegible] $ [illegible] total	[illegible]	[illegible]	$ [illegible] $ [illegible] total		$ [illegible] $ [illegible] total	$ [illegible]	add [illegible] floor $ [illegible] ton
16. errection on site exclusive of concrete				24MH	$[illegible]/ton installed complete	$[illegible] $[illegible]				[illegible]		$ [illegible]	suggested [illegible] price $ 240 [illegible] ton, $[illegible]

The above table is a price and weight breakdown comparison of [illegible] tons U.S. bin Vs locally manufactured [illegible] tons bin, including estimates of errection, foundation, etc. Local prices are based on [illegible] [illegible] figures. U.S. bin prices are compiled from data of Keller Farm Supply - Anna Illinois. The ton unit used is one ton of rough rice storage capacity.

TABLE [illegible]

TYPICAL MISCELLANEOUS LOCAL CONSTRUCTION COSTS, LABOR, AND MATERIALS

SOUTH EAST ASIA, MARCH, [illegible]

Group A

Item of Work In Place	Unit or Quantity	Cost Price Labor and Material US$
Excavation	Cubic Meter	.59
Backfill	Cubic Meter	[illegible].30
Concrete, Structural	Cubic Meter	106.
Concrete, Regular	Cubic Meter	94.
Concrete, Plain	Cubic Meter	29.90
Brick Masonry, Regular	Cubic Meter	26.60
Brick Masonry, Plain	Cubic Meter	[illegible]
Stone Masonry	Cubic Meter	26.
Mortar, Regular	Square Meter	[illegible]
Mortar, Plain	Square Meter	.84
Cement Tile, Plain	Square Meter	1.90
Cement Tile, Colored	Square Meter	[illegible].20
Terrazo Tile	Square Meter	4.25
Porcelain Tile	Square Meter	10.80
Wood Truss for Roof	Square Meter	124.
Asbestos Cement Roof	Square Meter	3.50
Galvanized Iron Roof, Corrugated	Square Meter	2.40
Galvanized Iron Roof, Plain	Square Meter	5.40
Roof Tile, Flemish	Square Meter	2.35
Roof Tile, Frog	Square Meter	3.00
Roof Tile, Wood Plate	Square Meter	5.90
Ceiling, Asbestos	Square Meter	3.
Ceiling, Acoustical	Square Meter	5.70
Teakwood Framework	Cubic Meter	290.
Doors, Wood Panel	Square Meter	11.70
Doors, Glass	Square Meter	9.20
Lavatory	Set	92.
Sink	Set	67.50
Wood Painting	Square Meter	1.29
Wall Liming	Square Meter	0.13
Paving, 1st Class	Square Meter	7.60
Paving, 2nd Class	Square Meter	5.90
Paving, 3rd Class	Square Meter	3.95

Group B

Building Materials Only Not Erected	Unit or Quantity	Cost Price Material Only US$
Cement (Local)	Kilogram	[illegible]
Gravel	Cubic Meter	[illegible]
Sand, Clean	Cubic Meter	[illegible]
Sand, For Fill	Cubic Meter	[illegible]
Reinforcing Steel (Import)	Kilogram	[illegible]
Structural Steel (Import)	Kilogram	[illegible]
Brick	1,000	[illegible]
Bamboo (Average)	100	[illegible]
Teakwood - 1st Class	Cubic Meter	[illegible]
Teakwood - 2nd Class	Cubic Meter	[illegible]
Teakwood - Regular	Cubic Meter	[illegible]
Lumber - 1st Class	Cubic Meter	[illegible]
Lumber - 2nd Class	Cubic Meter	[illegible]
Lumber - Concrete Forms	Cubic Meter	[illegible]
Asphalt	Kilogram	[illegible]
Steel Paint	Kilogram	.66
Wood Paint	Kilogram	.86
Red Lead Paint	Kilogram	.66
Terrazo Tile	Square Meter	[illegible].01
Porcelain Tile	Square Meter	5.70
Split Stone	Cubic Meter	[illegible]

Group [illegible]

Labor	Rate Per Day (Basic Rate)[1] US$
Common Labor	[illegible]
Semi-Skilled Labor	[illegible]
Skilled Labor	[illegible]
Painter	[illegible]
Carpenter	[illegible]
Stone Mason	[illegible]
Brick Mason	[illegible]
Steel Erector	[illegible]
Iron Worker	[illegible]
Welder	[illegible]
Electrician	[illegible]
Cement Finisher	[illegible]
Machinery Erector	[illegible]
Truck Driver (Average)	[illegible]
Night Watchman	[illegible]
Supervisor (for 10 Workers)	[illegible]

Note: Applicable to Groups A-B-C: All prices shown are in US$. Prices are applicable in [illegible]
For price index in other areas, add 10 to 15 percent.

[1] Add to cost of labor: 35 percent for fringe benefits including insurance, vacation, sick leave, medical, transportation, rice allowance, etc.

Source:

ALL PRICES LESS 40%
50 Bu PADDY RICE = 1 METRIC TON
40 Bu MAIZE = 1 " "

** 30 FT. DIAMETER BINS

Eave Height	Total Height	Storage & Drying Capacity Bushels	Bin Only W/2 Ring Base: Catalog Number	Weight Pounds	Price		Weight	Entrance Collar Size ●	Price
8	[illegible]	[illegible]	AA 30 3	[illegible]	[illegible]				
10 8	19 8	[illegible]	AA 30 4	[illegible]	1810.00				
13 4	22 4	[illegible]	AA 30 5	[illegible]	[illegible]	Chan lok perf floor	[illegible]		[illegible]
16	25	[illegible]	AA 30 6	[illegible]	[illegible]	B/O steel floor support	2182		577.00
18 8	27 8	[illegible]	AA 30 7	[illegible]	[illegible]	Plenum ring 14 ga ▲	[illegible]	[illegible]	[illegible]
						Plenum ring 14 ga	618	[illegible]	[illegible]

For inside and/or outside wall ladders see Bin ladder price section. All 30' Diameter Bins come standard with Center Cap and 2 roof hatches.

The bottom ring can be punched for floor flashing installation at List Price $1.75 per sheet. Bottom sheet can be cut for Entrance Collar $20.00 net.

** Includes 1[illegible] roof trusses, [illegible] piece panel roof sections

*** 33 FT. DIAMETER BINS

Eave Height	Total Height	Storage & Drying Capacity Bushels	Bin Only W/2 Ring Base: Catalog Number	Weight Pounds	Price		Weight	Entrance Collar Size ●	Price
8	17 10	[illegible]	AA 33 3	[illegible]	[illegible]				
10 8	20 6	[illegible]	AA 33 4	[illegible]	[illegible]	Chan lok perf floor	2474		[illegible]
13 4	[illegible]	[illegible]	AA 33 5	[illegible]	[illegible]	B/O steel floor support	[illegible]		[illegible]
16	25 10	[illegible]	AA 33 6	[illegible]	[illegible]				
18 8	28 6	15,200	AA 33 7	[illegible]	[illegible]	Plenum ring 12 ga ▲	1022	[illegible]	[illegible]

For inside and/or outside wall ladders see Bin ladder price section.
All 33' Diameter Bins come standard with Center Cap and 2 roof hatches.

The bottom ring can be punched for floor flashing installation at List Price $1.75 per sheet. Bottom sheet can be cut for Entrance Collar $20.00 net.

*** Includes 15 roof trusses, [illegible] piece panel roof sections

36 FT. DIAMETER BINS

Eave Height	Total Height	Storage & Drying Capacity Bushels	Bin Only W/2 Ring Base: Catalog Number	Weight Pounds	Price		Weight	Entrance Collar Size ●	Price
8	19	[illegible]	AA 36 3	[illegible]	[illegible]				
10 8	21 8	[illegible]	AA 36 4	[illegible]	[illegible]	Chan lok perf floor	[illegible]		[illegible]
13 4	24 4	[illegible]	AA 36 5	[illegible]	[illegible]	B/O steel floor support	[illegible]		[illegible]
16	27	[illegible]	AA 36 6	[illegible]	[illegible]	Plenum ring 12 ga ▲	[illegible]	[illegible]	[illegible]
18 8	29 8	[illegible]	AA 36 7	[illegible]	[illegible]				

For inside and/or outside wall ladders see Bin ladder price section.
All 36' Diameter Bins come standard with Center Cap and 2 roof hatches.

The bottom ring can be punched for floor flashing installations at List Price $1.75 per sheet. Bottom sheet can be cut for Entrance Collar $20.00 net.

*** Includes 15 roof trusses, [illegible] piece panel roof sections. ▲ Plenum or drying ring adds [illegible] of height to your bin. Super Bin Sheets punched for B/O stiffners $2.00 per Bin Sheet. ● Entrance collar included in Plenum ring price. When ordering: Please specify style of door (Dutch or slat). All doors come standard with auger slide.

SPECIAL LIGHT GAUGE BINS

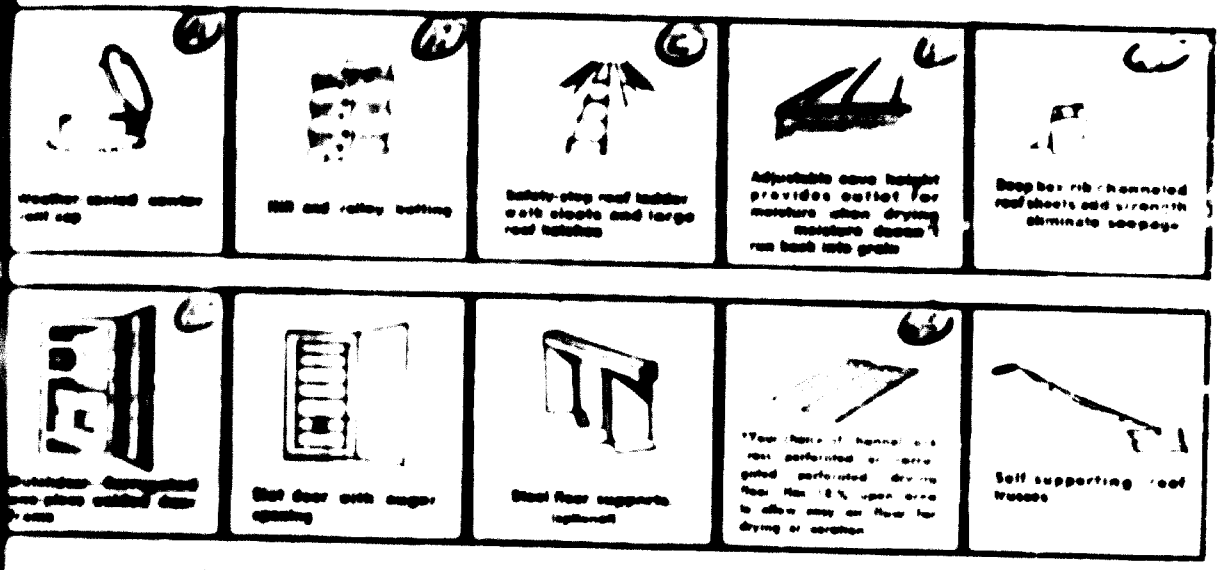
DIAMETER	CATALOG NO	SIDEWALL GAUGES	CAP. BUSHELS	LIST PRICE
21'	SP 21 6 2	16 16 16 20 20 20	5100	[illegible]
24'	SP 24-6 2	16 16 16 16 20 20	[illegible]	[illegible]
27'	SP 27 6 2	14 16 16 18 20 20	[illegible]	[illegible]
30'	SP 30 6 2	14 16 16 16 20 20	[illegible]	[illegible]
33'	SP 33-6 2	14 16 16 16 20 20	[illegible]	[illegible]
36'	SP 36 6 2	14 16 16 16 20 20	[illegible]	[illegible]

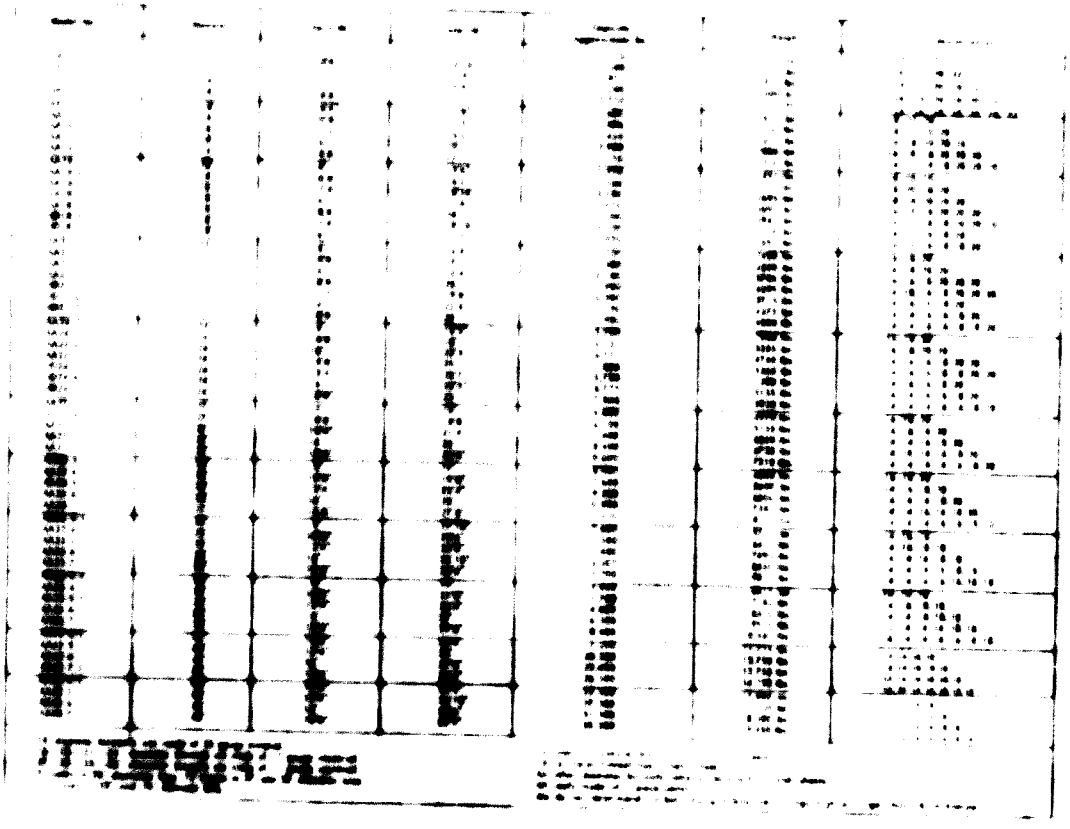
All special light gauge bins are priced with no base angles, small door in the 2nd ring and 1 roof hatch.

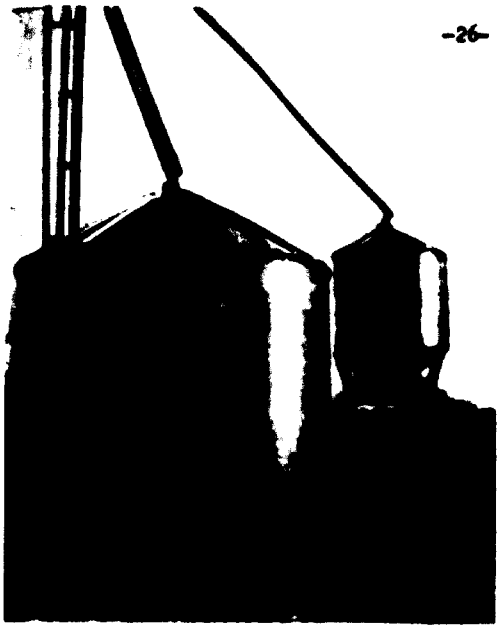
All prices are subject to change without notice. F.O.B. [redacted] 1971

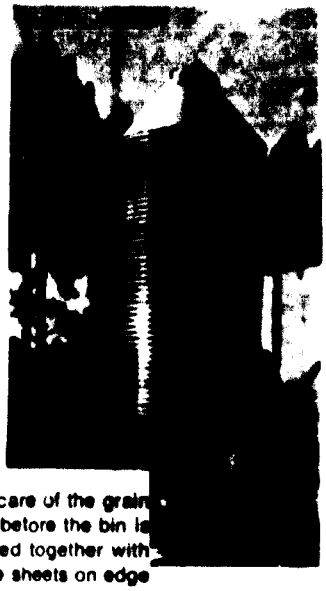
APP I

FIG. 2

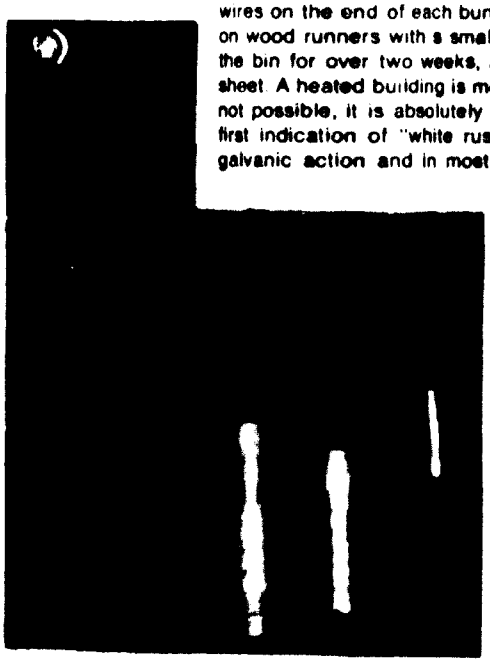

Adjustable eave height provides outlet for moisture when drying moisture doesn't run back into grain
Deep box rib channeled roof sheets add strength eliminate seepage
Safety-step roof ladder with cleats and large roof hooklets
Self supporting roof trusses







CAUTION: All Galvanized Steel is subject to "white rust". Proper care of the grain bin body sheets and roof is very important to prevent "white rust" before the bin is erected. All sheets for each body ring of the bin will come bundled together with wires on the end of each bundle. Loosen these wires and stand the sheets on edge on wood runners with a small air space between adjacent sheets. If you are storing the bin for over two weeks, a small amount of light oil should be applied to each sheet. A heated building is most desirable for storing the disassembled bin; if this is not possible, it is absolutely necessary to store this material in a dry place. At the first indication of "white rust", wiping the material with kerosene will arrest the galvanic action and in most cases restore the appearance of the material.



1. CHECK THE SHIPMENT

When you come to the factory to pick up your bin, stay with the truck as it is being loaded and make sure all parts for the bin are being loaded.

When you are erecting the bin yourself and are receiving the bin via commercial carrier or a bin distributor, first check all parts and packages against the packing list and bill of lading. DO NOT accept delivery of your bins without noting any missing parts or shipping damage on the delivery slip **plus** notify the delivering carrier in writing and request an inspection.

When you are satisfied that you have all parts in good condition, lay parts out for convenient access and read this manual completely before proceeding with erection.

2. CHOOSING BIN SITE

The site selected should be level with firm soil and provided with good drainage to prevent water accumulation around or under the bin. If some fill is required, it should be watered and tamped thoroughly to prevent uneven settling from the weight of the bin, slab and contents. When determining the location for the bin, several other factors should be considered:

a. Easy access for loading and unloading

b. Proximity of electricity and gas for operation of fans, heaters, augers, etc.

c. Room for future additional bins.

Commercial Bin

Consult "Erection Commercial (tall) Bin" which is found in the back of this manual.

3. TOOLS REQUIRED

a. 2—1/2" box or open end wrenches
b. 2—3/4" box or open end wrenches
c. 2—long drift punches
d. 1—speed or impact wrench, if available
e. 1—screwdriver
f. 1—center bin jack or 2' x 4" cross arm on pole to support center ring while assembling roof.
g. Bin jacks—one jack per vertical seam is sufficient for up to 9 ring bins. Commercial (tall) bins require extra heavy jacks.

4. PREPARING THE FOUNDATION

a. Determine the exact center of the site and drive a stake using a piece of pipe or a 2 x 4 at that spot. The top of the stake should be the same height as the desired level of the concrete pad which should be at least 4" above ground level.

b. Prepare a scribing compass using a straight length of 2 x 4 or 2 x 6. Nail a short pointed stake to one end of the 2 x 4 to mark the circumference of the concrete pad on the ground. Drive a nail into the other end of the compass to act as a pivot point on the center stake. The distance from this nail to the marking point on the end of the compass should equal the bin diameter plus 6". For example, this distance is 12'-6" for a 24' diameter bin.

c. Make your scribed line.

d. Dig inside the scribed circle sufficiently to accommodate the cross section of concrete for the circumferential footing and bin pad as shown in Tables 1 or 2 and Figs. 1 or 2. After the earth excavation, it is well to spread a thin layer of sand to level the ground to the approximate elevation desired for the bottom of the concrete pad.

e. Install a sturdy concrete pouring form around the circumference of the pad to be formed. You should use your scribing compass (b) again to locate the forms and with a carpenter's level placed on the compass you will be able to set the top of the forms to match the top of your center stake in order to insure a level floor at the desired elevation. Reusable Baughman steel pouring forms are very handy or 8" wide strips of plywood may be staked in the ground. Another method of forming the foundation is to use 1 x 8 boards set into a square with the corners blocked off to form an octagon.

f. Place a sheet of 4 mil polyethylene film or "visqueen" over the earth or leveling sand to provide a moisture barrier.

g. Place the reinforcing rods as indicated in Fig. 1 or 2. Maintain in place as the concrete is poured.

h. Pour the concrete. A satisfactory concrete mix is one part cement, two parts sand, and three parts gravel or the standard mix supplied from concrete ready-mix plants. A 5 or 6 bag mix of ready mix concrete can be purchased commercially.

i. Use your scribing compass as a screed board to level the concrete pad. Do not allow more than 1/8" difference in level over the length of a body sheet. Level surface is essential to simple erection and proper installation of a raised steel floor for drying. Failure to have a level concrete pad for the bin will automatically void the warranty.

j. Place anchor bolts in wet concrete as specified in Table 3 and Fig. 3. Anchor bolts are not furnished, but can be purchased from most any local hardware supplier. Bolts can also be drilled in after the concrete is formed. Our chord layout in Table 1 is for putting anchor bolts either inside the bin or outside the bin.

Fig. 1 CONCRETE PAD for BINS TO 9 RINGS

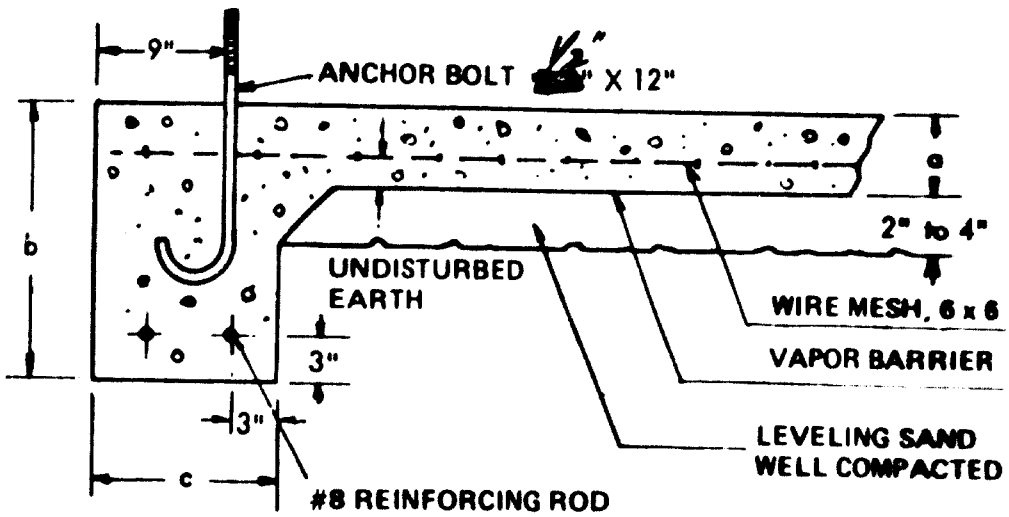


Table 1 PAD DIMENSIONS , MATERIALS , TO 9 RINGS

Bin Dia.	Concrete Slab Dia.	Min. Slab Thickness a	Footing Depth b	Footing Width c	Concrete Cu. Yds.	Wire Mesh + Vapor Barrier, (f	#8 Reinf Rod Lin. Ft.
14'	15'	4"	8"	8"	2.5	165	
15'	16'	4"	8"	8"	3.0	185	
16'	17'	4"	8"	8"	3.5	215	
18'	19'	4"	12"	8"	4.5	270	115
21'	22'	4"	12"	8"	6.0	365	135
24'	25'	5"	18"	12"	10.0	475	160
27'	28'	5"	18"	12"	13.0	600	175
30'	31'	5"	18"	12"	15.0	735	195
33'	34'	6"	18"	12"	20.0	890	215
36'	37'	6"	18"	12"	25.0	1055	230
42'	43'	6"	18"	16"	33.0	1430	270
48'	49'	6"	18"	16"	40.0	1880	310

Fig. 2 CONCRETE PAD for BINS, 12 TO 18 RINGS

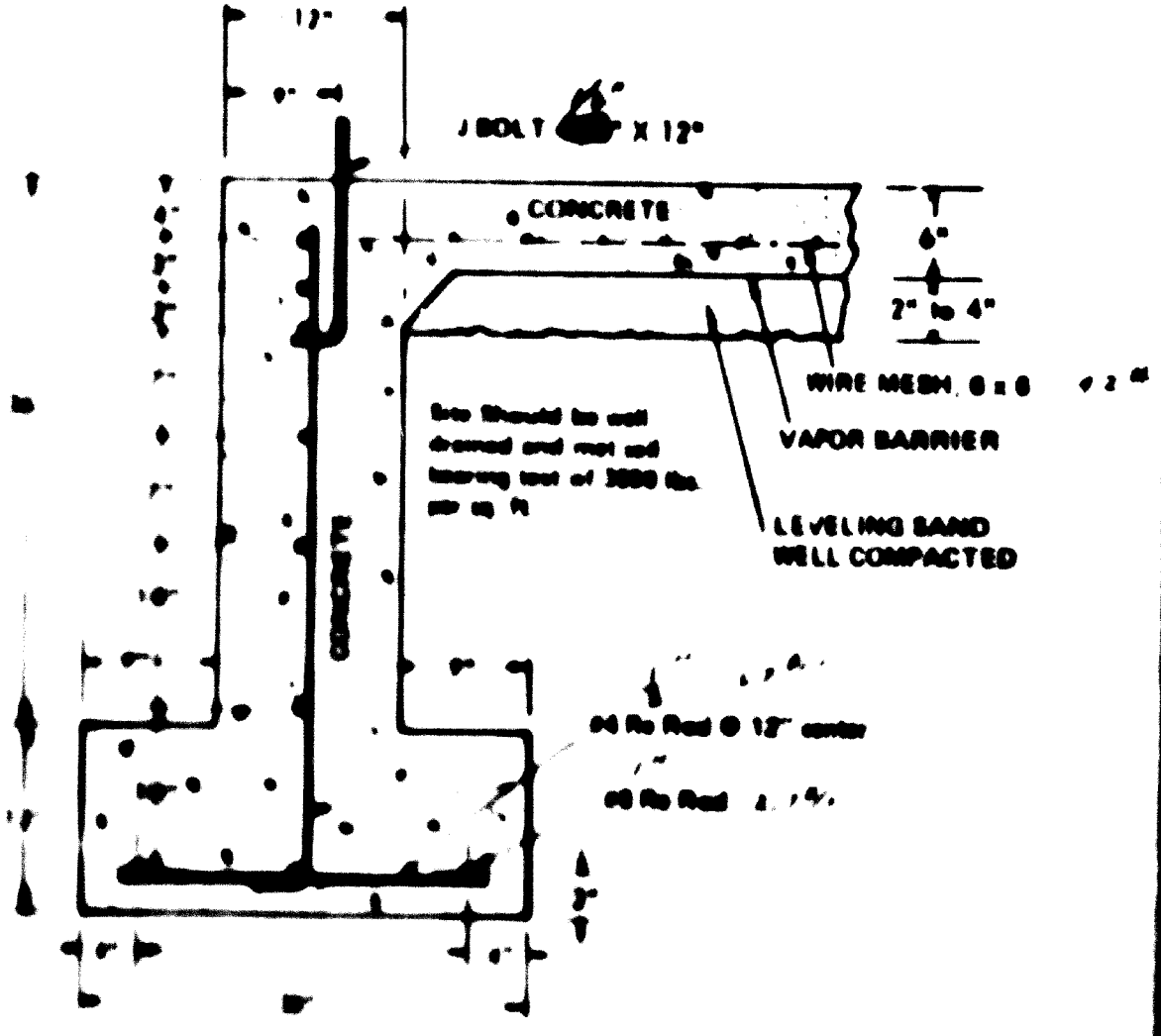
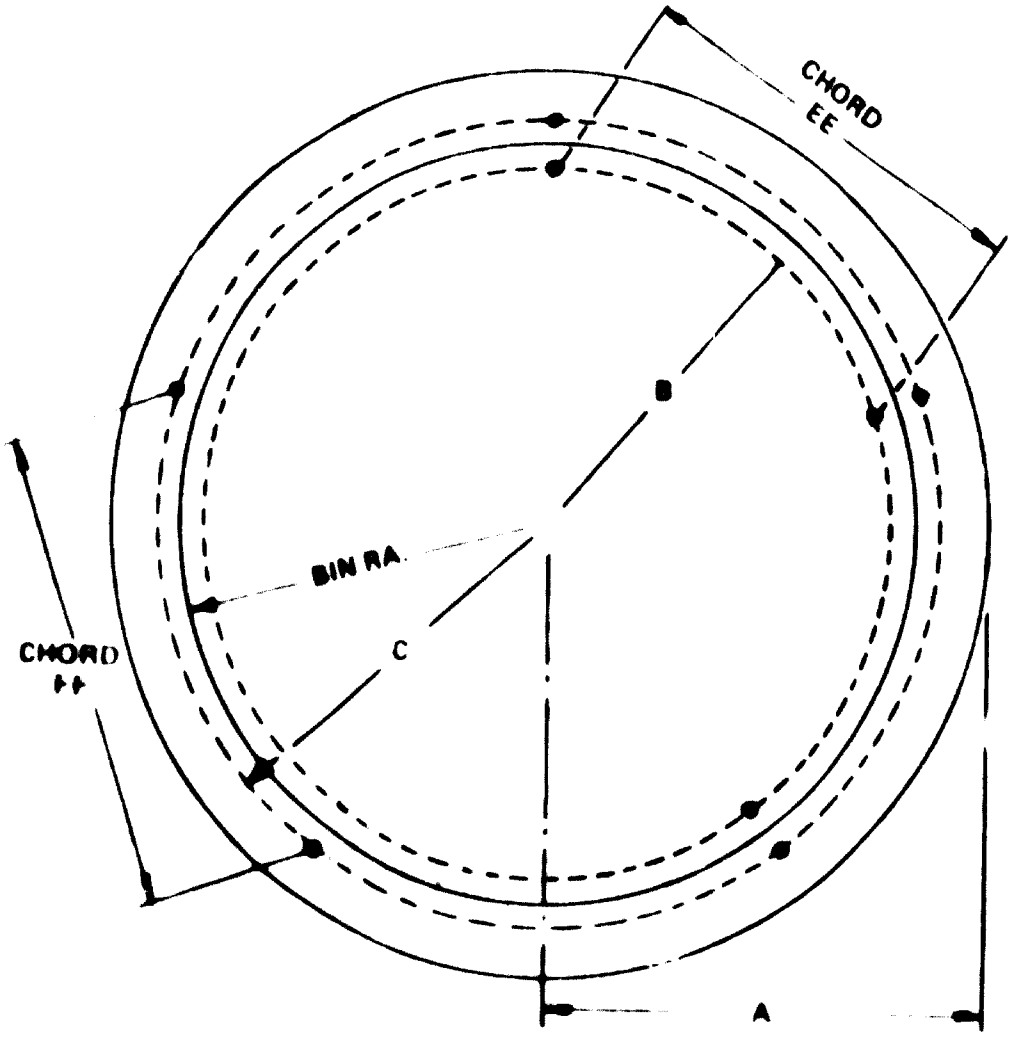


Table 2 MATERIALS 12 TO 18 RINGS

For Concrete Pad dimensions and square footage of 6 x 6 Wire Mesh and Vapor Barrier same as shown on Sheet 1 for applicable bin diameter.

ANCHOR BOLT SETTING PLAN: Fig. 3



ANCHOR BOLT SETTING: ANCHORS OUTSIDE BIN
ANCHOR BOLT SETTING: ANCHORS INSIDE BIN

BIN RAD	SLAB RA	RADIUS B	RADIUS C	9 RINGS OR LESS			12 18 ROWS		
				NO BOLTS	CORD EE	CORD FF	NO BOLTS	CORD EE	CORD FF
14	7' 0	6' 9	7' 1	6	7' 11	8' 4	15	7' 10	2' 11 3/8
15	8' 0	7' 3	7' 7	6	8' 6	8' 11	15	3' 0	3' 1 13/16
16	8' 6	7' 8	8' 1	6	7' 8	8' 1	18	2' 8¾	2' 9 11/16
18	9' 6	8' 9	9' 1	6	8' 6	9' 1	18	3' 0¾	3' 1 7/8
21	11' 0	10' 3	10' 7	7	8' 10¾	9' 2¾	21	3' 0¾	3' 1 7/8
24	12' 0	11' 9	12' 1	8	8' 0	8' 3	24	3' 1	3' 1 7/8
27	14' 0	13' 2	13' 7	8	8' 1	9' 3¾	27	3' 1	3' 1 13/16
30	15' 6	14' 8	15' 1	10	8' 1¾	9' 3 7/8	30	3' 1	3' 1 13/16
33	17' 0	16' 3	16' 7	11	8' 2	9' 4 1/8	33	3' 1	3' 1 13/16
36	18' 6	17' 8	18' 1	12	8' 2¾	9' 4 5/16	36	3' 1	3' 1 13/16
42	21' 6	20' 8	21' 1	14	8' 3¾	9' 4 5/8	42	3' 1¾	3' 1 13/16
48	24' 6	23' 8	24' 1	16	8' 3¾	9' 4¾	48	3' 1¾	3' 1 13/16

5. ERECTING THE BIN

Pre-assembly Notes

(1) Before starting to bolt body sheets together, consult Tables 4 or 5 for the proper gauge for each ring and study Fig. 4 for bins up to 9 rings, or Fig. 1 of the stiffener column drawing for bins 12 rings and higher.

(2) Body sheets are sent out color coded on the edge, and also usually have a mill marking on the sheet, to denote the gauge of material. Color marking is as follows:

12 gauge Green
14 gauge Yellow
16 gauge Red
18 gauge Blue
20 gauge Black
22 gauge Copper

(3) Bolts, nuts, washers and small brackets pertaining to various components of the bin are shipped in separate cartons. These hardware cartons are marked:

Body Pack
Roof Pack
Door Pack
Ladder Pack
Foundation Ring Pack
Entrance Collar Pack
Floor Pack (for flashing)

(4) It is suggested that these packs be kept separate and not mixed. Table 6 is a handy reference indicating proper bin size.

(5) Bolts should be installed with the bolt head and neoprene washer on the outside of the bin, such as on body sheets and roof panels.

(6) We recommend using flat washers under each nut. This is particularly important where slotted holes are encountered.

(7) **Do not over tighten the bolts.** If an impact wrench is used, 15 lbs torque is sufficient. Over tightening can partially fracture the bolt which may not be apparent at the time, but can result in the bolt head shearing off at some later date.

Table 4 RING GAUGES—STORAGE AND DRYING BINS

* The bottom ring is always the No. 1 Ring.

Model No	Dia	Ring Gauges						
		#1	#2	#3	#4	#5	#6	#7
AA 15-3	15"	20	20	22				
AA 15-4	15"	18	20	20	22			
AA 15-5	15"	18	18	20	20	22		
AA 15-6	15"	16	18	18	20	20	22	
AA 15-7	15"	16	16	18	18	20	20	22
AA 18-3	18"	18	20	20				
AA 18-4	18"	18	20	20	20			
AA 18-5	18"	18	18	20	20	20		
AA 18-6	18"	16	18	18	20	20	20	
AA 18-7	18"	14	16	18	18	20	20	20
HD 18-5	18"	14	16	16	18	20		
HD 18-6	18"	14	18	16	18	18	20	
AA 21-3	21"	16	18	20				
AA 21-4	21"	16	18	20	20			
AA 21-6	21"	16	16	20	20	20		
AA 21-7	21"	14	16	18	18	20	20	20
HD 21-5	21"	14	18	16	18	20		
HD 21-6	21"	14	14	16	16	18	20	
HD 21-7	21"	14	14	16	16	18	18	20
AA 24-3	24"	16	18	20				
AA 24-4	24"	16	18	20	20			
AA 24-6	24"	14	16	18	18	20	20	
AA 24-7	24"	14	16	16	18	18	20	20
HD 24-5	24"	14	16	16	18	20		
HD 24-6	24"	14	14	16	16	18	20	
HD 24-7	14	14	14	16	15	18	20	
AA 27-3	27"	16	18	20				

Model No.	Dia.	Ring Gauges						
		#1	#2	#3	#4	#5	#6	#7
AA 27-4	27"	14	16	18	20			
AA 27-5	27"	14	14	16	18	20		
AA 27-6	27"	14	14	16	16	18	20	
AA 27-7	27"	14	14	14	16	16	18	20
AA 30-3	30"	16	18	20				
AA 30-4	30"	14	16	18	20			
AA 30-5	30"	14	14	16	18	20		
AA 30-6	30"	14	14	16	16	18	20	
AA 30-7	30"	14	14	14	16	16	18	20
AA 33-3	33"	14	16	18				
AA 33-4	33"	14	16	18	18			
AA 33-5	33"	14	14	16	18	18		
AA 33-6	33"	14	14	14	16	18	18	
AA 33-7	33"	14	14	14	16	16	18	18
AA 36-3	36"	14	16	18				
AA 36-4	36"	14	16	18	18			
AA 36-5	36"	14	14	16	18	18		
AA 36-6	36"	14	14	14	16	18	18	
AA 36-7	36"	14	14	14	16	16	18	18
AA 42-4	42"	12	14	16	18			
AA 42-5	42"	12	14	16	18	18		
AA 42-6	42"	12	14	16	16	18	18	
AA 42-7	42"	12	14	14	15	18	18	18
AA 48-4	48"	11	12	14	18			
AA 48-5	48"	11	12	14	16	18		
AA 48-6	48	11	12	14	16	18	18	
AA 48-7	48"	11	12	14	16	16	18	18

Fig. 4 BODY SHEET LAYOUT, BINS, 9 RINGS OR LESS

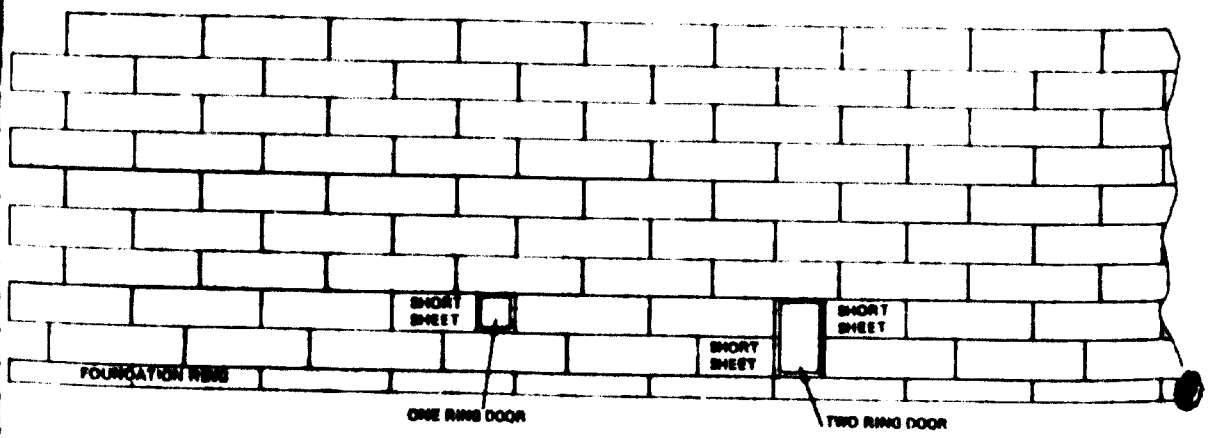


Table 5 RING GAUGES—COMMERCIAL BINS

★ The bottom ring is always the No. 1 Ring.

Model No.	Dia.	Ring Gauges																	
		#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11	#12	#13	#14	#15	#16	#17	#18
EA 18-9	18'	14	14	16	16	18	18	20	20	20									
EA 18-12	18'	14	14	16	16	16	16	18	18	18	20	20	20						
EA 18-15	18'	14	14	14	16	16	16	16	18	18	18	18	20	20	20	20			
EA 18-18	18'	14	14	14	14	16	16	16	16	16	18	18	18	18	18	20	20	20	20
EA 21-9	21'	14	14	16	16	18	18	20	20	20									
EA 21-12	21'	14	14	14	16	16	16	16	18	18	20	20	20						
EA 21-15	21'	14	14	14	16	16	16	16	18	18	18	18	20	20	20	20			
EA 21-18	21'	14	14	14	14	14	16	16	16	16	16	18	18	18	18	20	20	20	20
EA 24-9	24'	12	14	14	16	16	18	18	20	20									
EA 24-12	24'	12	14	14	14	16	16	16	18	18	18	20	20						
EA 24-15	24'	12	14	14	14	14	16	16	16	16	18	18	18	20	20	20			
EA 24-18	24'	12	12	14	14	14	14	14	16	16	16	16	18	18	18	18	20	20	20
EA 27-9	27'	12	14	14	14	16	16	18	18	20									
EA 27-12	27'	12	14	14	14	16	16	16	16	18	18	20	20						
EA 27-15	27'	12	14	14	14	14	16	16	16	16	18	18	18	18	20	20			
EA 27-18	27'	12	12	14	14	14	14	14	16	16	16	16	16	18	18	18	18	20	20
EA 30-9	30'	12	14	14	14	14	16	16	18	20									
EA 30-12	30'	12	14	14	14	14	16	16	16	16	18	18	20						
EA 30-15	30'	12	14	14	14	14	14	16	16	16	16	18	18	18	18	20			
EA 30-13	30'	12	12	14	14	14	14	14	14	16	16	16	16	16	18	18	18	18	20
EA 33-9	33'	12	14	14	14	14	16	16	18	16									
EA 33-12	33'	12	14	14	14	14	16	16	16	16	18	18	16						
EA 33-15	33'	12	14	14	14	14	14	16	16	16	16	16	18	18	18	18			
EA 33-18	33'	12	12	14	14	14	14	14	14	16	16	16	16	16	16	18	18	18	18
EA 36-9	36'	12	14	14	14	14	16	16	18	18									
EA 36-12	36'	12	14	14	14	14	16	16	16	16	18	18	18						
EA 36-15	36'	12	12	14	14	14	14	14	16	16	16	16	16	18	18	18			
EA 36-18	36'	12	12	12	14	14	14	14	14	14	16	16	16	16	16	16	18	18	18
EA 42-9	42'	11	12	12	14	14	16	16	18	16									
EA 42-12	42'	11	12	12	14	14	14	16	16	16	18	18	18						
EA 42-15	42'	11	12	12	14	14	14	14	14	16	16	16	16	18	18	18			
EA 42-18	42'	11	12	12	12	12	14	14	14	14	14	14	16	16	16	16	18	18	18
EA 48-9	48'	11	12	12	14	14	16	16	18	18									
EA 48-12	48'	11	12	12	14	14	14	14	16	16	16	16	18						
EA 48-15	48'	11	12	12	12	12	14	14	14	14	16	16	16	16	18	18			
EA 48-18	48'	11	11	11	12	12	12	12	12	12	14	14	14	14	16	16	16	18	18

TABLE 6 BOLT PLACEMENT

Use 5/16" x 3/4"	1. In vertical and horizontal seams of all body sheets in bins less than 9 rings and in 16, 18, and 20 gauge sheets of bins 9 rings and over. 2. For fastening base angles to bin wall. 3. For fastening ladder brackets. 4. In vertical seams of 14 gauge foundation ring sheets.
Use 5/16" x 1"	1 Where 5/16" x 3/4" bolts are too short to facilitate drawing parts together. 2. In roof panels. 3. In doors. 4. In entrance collars with 14 gauge rings. 5. For fastening stiffeners to bin walls.
Use 5/16" x 1 1/4"	1. On lower end of trusses. 2. In horizontal seam of 14 gauge foundation ring sheet.
Use 3/8" x 3/4"	1. In vertical and horizontal seams of all 11, 12 & 14 gauge body sheets in bins 9 rings and over. 2. In vertical seams of 12 gauge foundation ring sheets.
Use 3/8" x 1 1/4"	In horizontal seam of 12 gauge foundation ring sheets.

b. Start with the top body ring

(1) The customary procedure for assembling the bin is first to bolt together directly upon the prepared foundation those body sheets which are furnished to form the top ring of the bin, then to mount the roof complete on this top ring, and finally, to lift the assembled portion of the bin with jacks spaced around the circumference so that body sheets may be bolted to the bottom edges of completed rings until the planned bin height is obtained.

(2) The body sheets for the top ring must be turned on edge so that the side containing the second horizontal row of bolt holes, about 9" from the edge of the sheet, is uppermost. These holes are used in fastening the roof hold down brackets.

(3) In bolting the body sheets together follow a consistent pattern such as always overlapping the vertical edge of the left sheet over the right. All vertical seams between adjoining body sheets require strip caulking on the underneath lap. This caulking is placed outside of and next to the bolt holes (Fig. 5). There is adequate strip caulking in the hardware carton to caulk the vertical seams only. If you caulk the horizontal seams you will have to buy additional caulking.

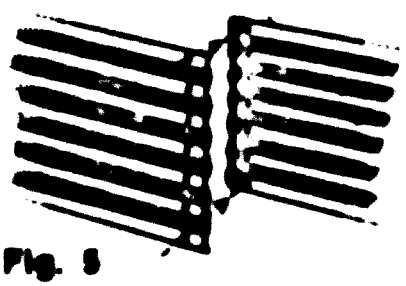


Fig. 5

c. Assembling the Roof

(1) Before starting on the roof, be sure you have received for the particular diameter bin the correct number of roof panels and the proper size center ring with the same number of holes as panels. Consult Table 7.

Table 7 ROOF PANEL SCHEDULE

Bin Dia.	Center Ring Dia.	Number Panels	Number Trusses
15'	24"	20	0
18'	24"	24	0
21'	36"	28	0
24'	36"	24	8
27'	36"	27	9
30'	36"	30	10

Notes:
a. For 14', 16', 33' and 36' diameter bins, see special instruction in Appendix "A"
b. For 42' and 48' Roofs, separate instructions accompany each bin shipped.

CENTER RING ASSEMBLY FOR 15'-18' DIAMETER BINS.

(B) Unbolt the center ring from the roof cap on 15' and 18' diameter bins. or unbolt the inner ring and brackets from the outer ring when erecting 21' diameter or larger bins. Follow Fig. 6 in attaching upper roof brackets to the center ring of 15' and 18' diameter bins. Fig. 6a shows the attachment of upper roof brackets to the outer center ring on bins 21' diameter and larger. Note that the distance from the center of the bottom hole to the bottom of the ring in Fig. 6a is 5/8". Do not turn this ring upside down.

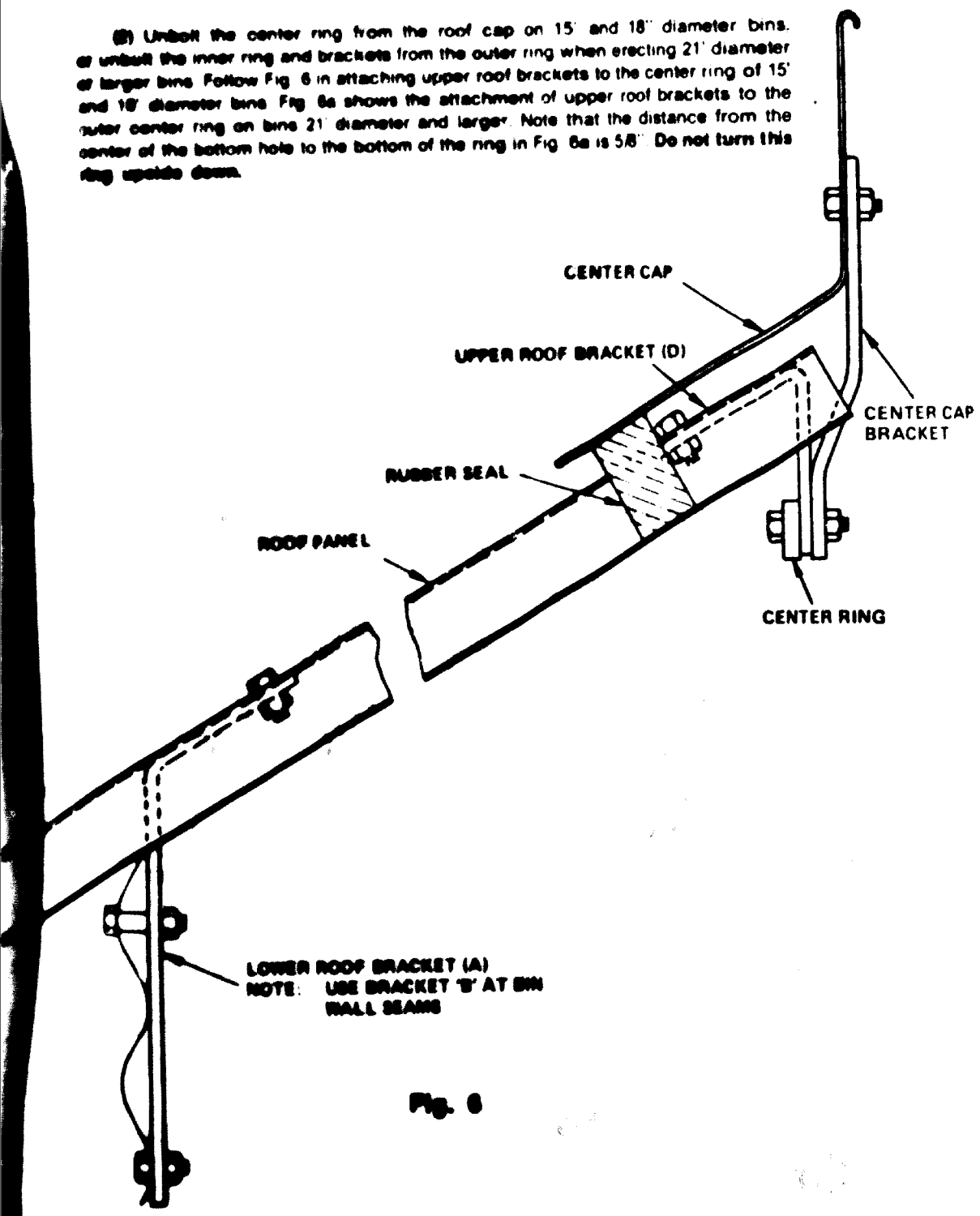


Fig. 6

CENTER RING ASSEMBLY FOR 21'-35' DIAMETER BINS.

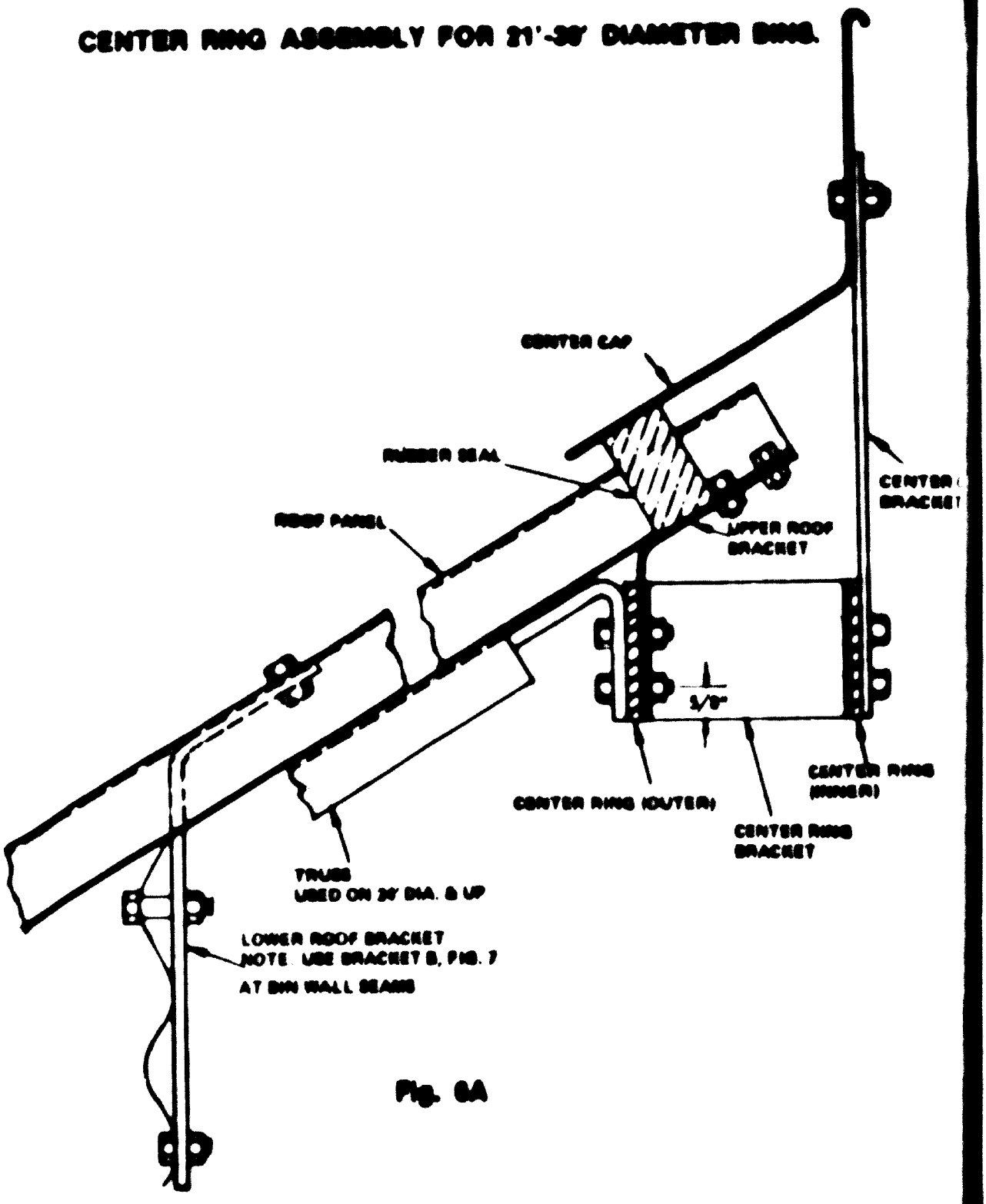
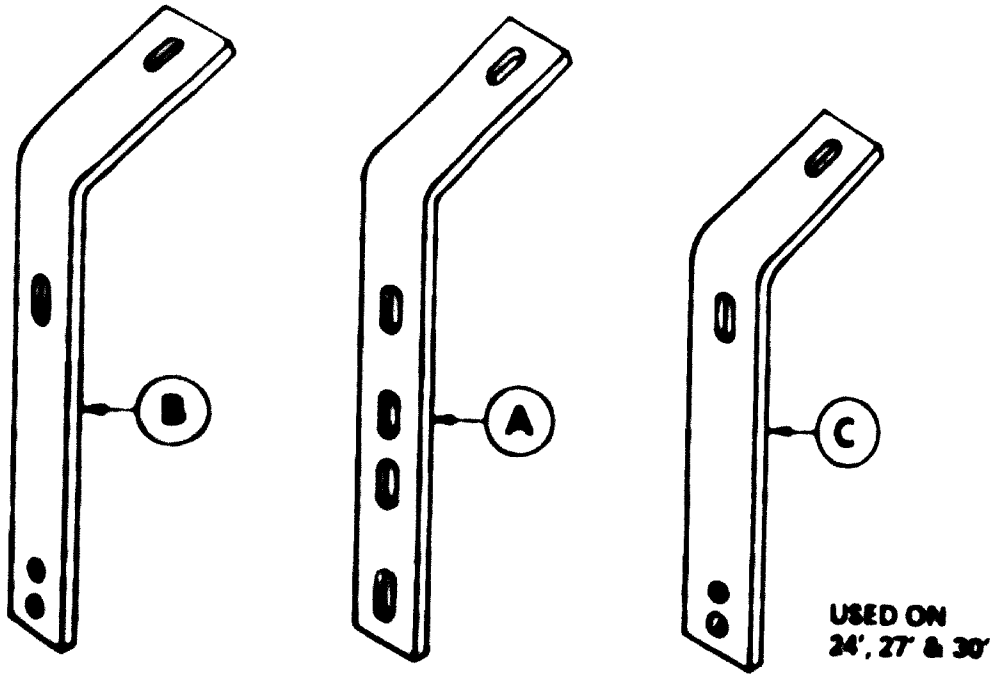


Fig. 6A

(3) Fig. 7 shows three types of lower roof brackets that are used in bolting the roof panels to the top body ring. These brackets should be bolted to the panels as they are mounted in the roof, but they should not be bolted to the bin wall sheets until all the roof panels are in place. On bins of 15', 18' and 21' diameters, "A" brackets are bolted to the bottom hole of every fourth rib of the roof and the lower end of these brackets will at the proper time be bolted at each vertical seam where the bin wall sheets are joined. "B" brackets are bolted at all the intervening ribs. For bins 24' diameter and larger, since a rafter is bolted at each vertical seam and since roof panels are centered over the rafters, no lower roof bracket is bolted at the vertical bin wall seams. For these larger bins, the roof panels are bolted to the top body ring with "B" brackets at the panel ribs and with "C" brackets midway between the ribs.

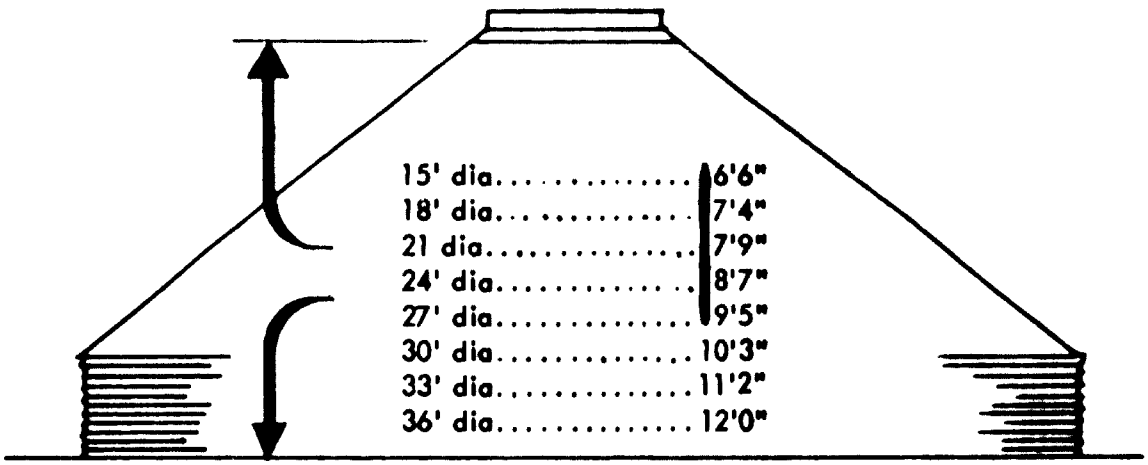
(4) Note that the hold down brackets are provided with slotted upper holes and double sets of lower holes which permit attaching the roof panels so that they may either be pulled down flush on the top body ring or supported with an air space approximately 1/2" between the roof and the top body ring.



ROOF BRACKETS

Fig. 7

(5) Place a center bin jack or a 2" x 4" pole with cross arm to support the center ring over the center of the bin pad. The ring should be supported high enough to allow the roof panels to lie at a 30 degree pitch when bolted to the center ring and the upper edge of the top body ring. Taking into account the 33" width of the top body ring and the pitch of the roof, this means that in starting the roof assembly, the center ring should be supported at the following heights above the bin pad:



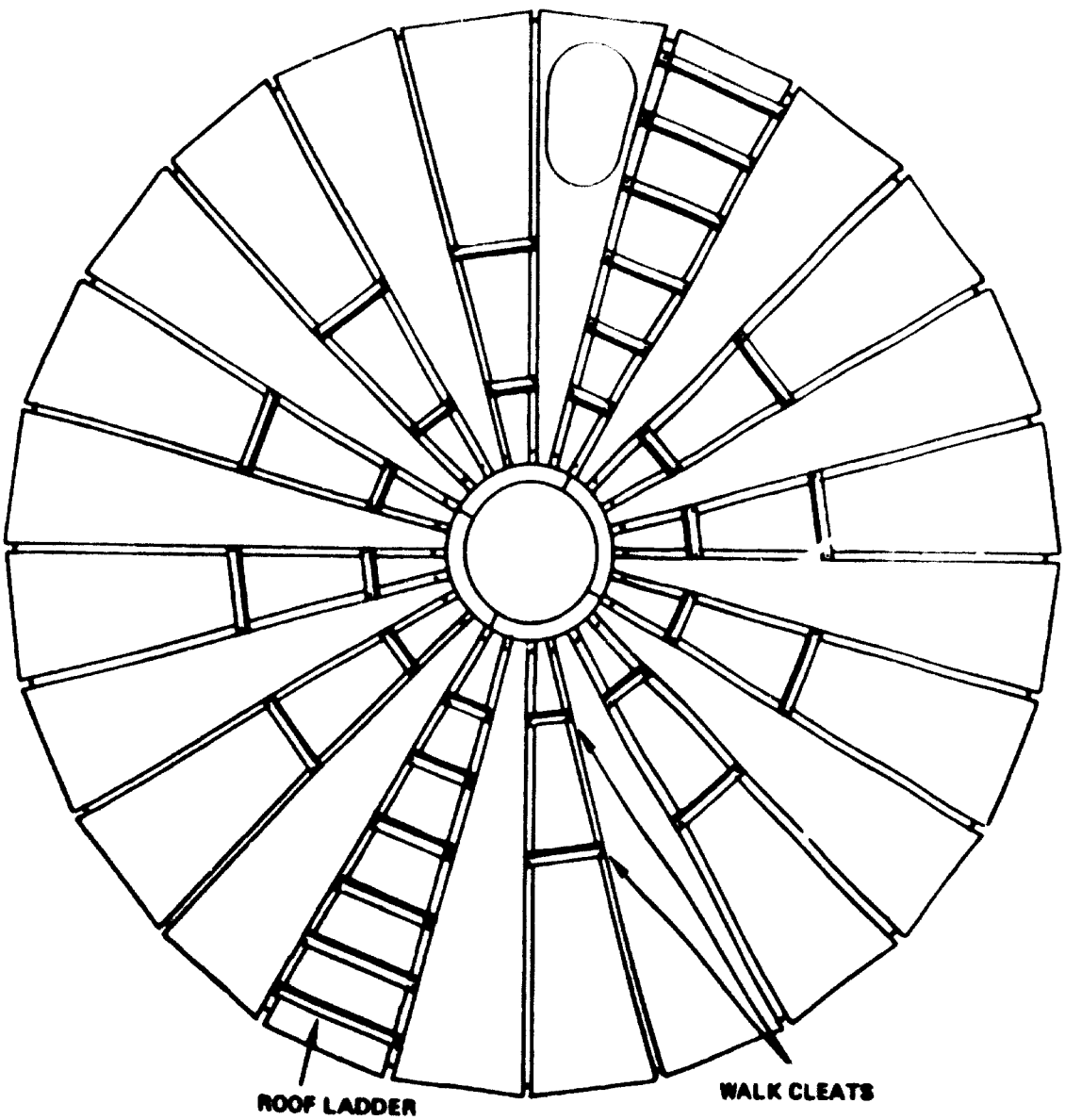
(6) On bins 21' diameter and less which do not have roof trusses, the next step is to mount four roof panels, equally spaced around the bin, bolting the nose of each panel to the upper roof brackets as discussed in par c(2), above. Working counter-clockwise, bolt additional panels to the center ring until the roof is complete. Left channel, or rib, of each panel is placed over the right channel of the previous panel. Special care should be taken in positioning roof panels with hatch openings in relation to roof and bin wall ladders.

(7) Bolt the ribs of the roof panels together loosely, except at the second and fourth holes from the nose which are left open until the walk cleats are attached. In bolting the ribs together at the bottom hole, attach the lower roof brackets on the underside of the panels as discussed in par c(3), above.

(8) Because of stacking during bundling and shipping, it may appear that the panels are too wide to fit consecutively over the center ring angle lugs. There might appear to be a gain as you work. If this happens, simply squeeze the narrow end of the panel. To facilitate fitting the roof panels together and to line up the lower roof brackets with the pre-punched holes in the top body ring, it may be helpful to raise or lower slightly the height of the center ring on the support.

(9) Fig. 8 shows the arrangement of roof ladders and the upper and lower rings of walk cleats. Roof ladder angles are bolted at each hole along the length of the ribs on panels immediately to the left of hatch sheet. On bins with trusses, the ladders should be put on panels over trusses.

(10) After all roof panels, ladders and walk cleats are in place, bolt lower roof brackets to the top body ring and tighten all bolts in the roof panels



Roof ladders will not be evenly spaced. Move each ladder angle to the roof bolting it fits.

Fig. 8

(11) On bins, 24' diameter and larger, trusses are furnished to give additional strength to the roof. These trusses must be bolted in place before mounting the roof panels. Fig. 9 shows the arrangement of trusses for a 24' diameter roof. For larger diameters, the arrangement is similar, keeping in mind that there is a truss to be bolted at each vertical seam of the top body ring. Fig. 6A shows the bolting of trusses to the center ring at every third space around this ring.

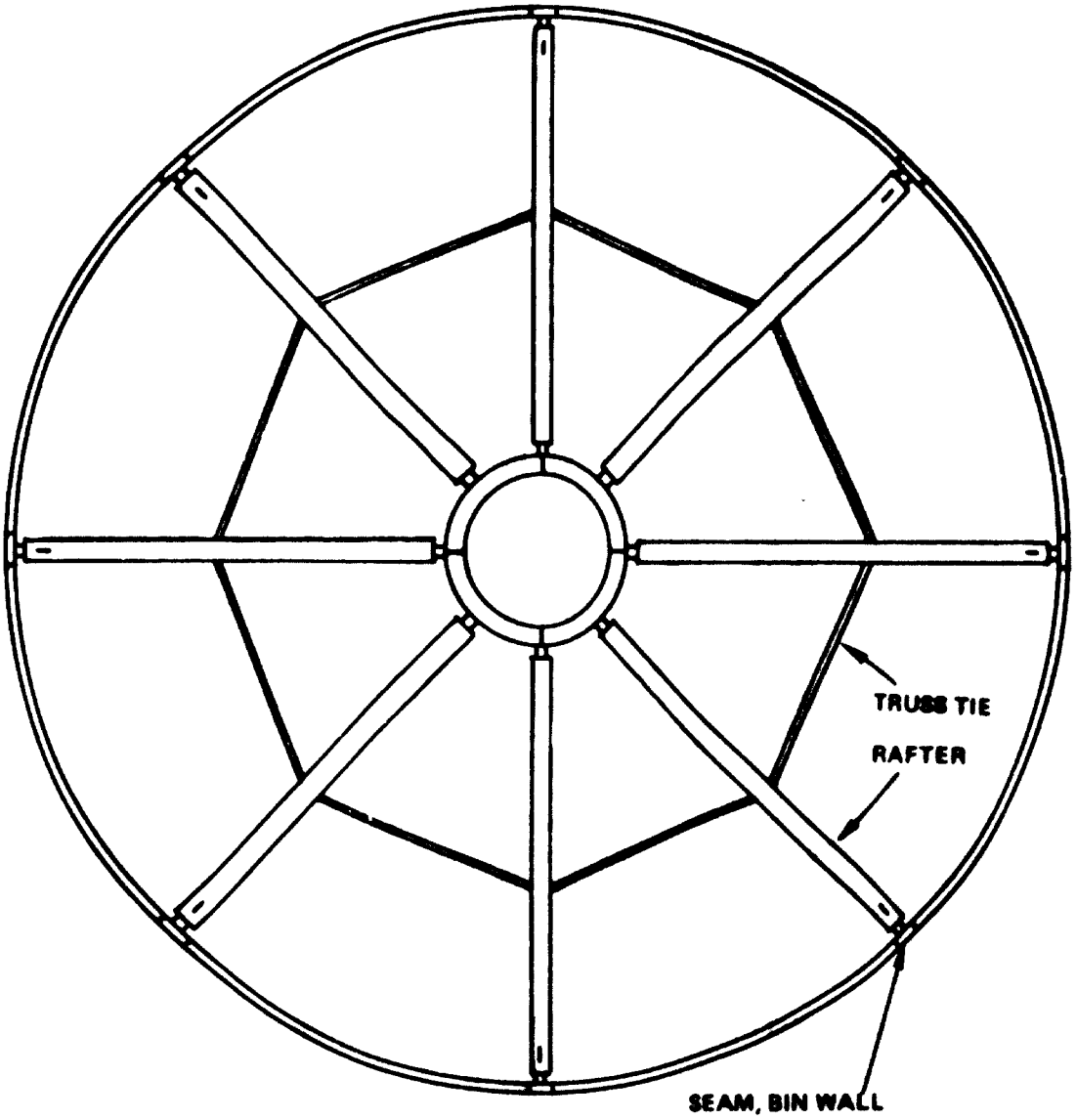
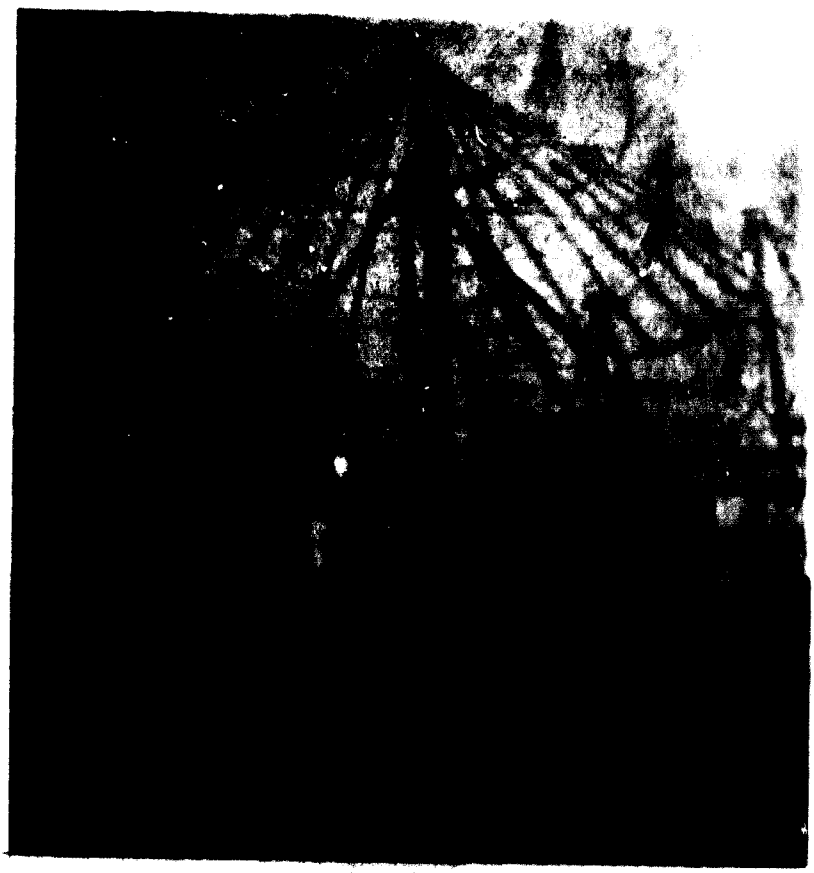


Fig. 9

(12) After trusses and roof panels are in place the trusses are joined together with truss ties as indicated in Fig. 9. These ties may be bolted at either of the two adjacent slots near the third point in the truss angle, whichever will best fit in keeping the trusses in a straight alignment.

(13) After the truss system has been completely installed, the roof panels are mounted and bolted down in essentially the same steps as described in par c (6) thru (10) except that with rafters present, it is best to start by centering one roof panel over a truss and proceeding counterclockwise around the bin to attach the other panels. Every third panel should be centered over a truss.

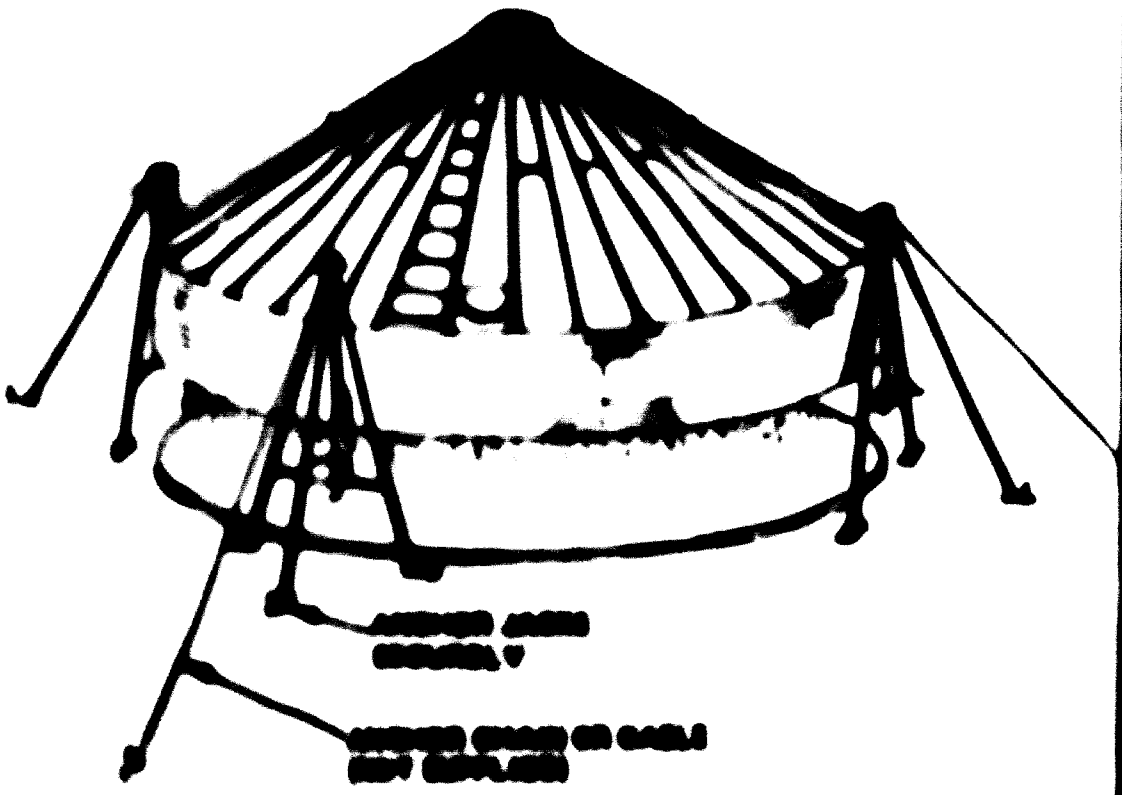
(14) The final step to complete the roof assembly is to mount the center cap in place. For 15' and 18' diameter bins refer to Fig. 6. Four center cap brackets for the 15' diameter and three brackets for the 18' diameter are used to bolt the center cap to the center ring. For 21' and larger diameter bins, refer to Fig. 6a, and use three brackets. Before tightening down the center cap, insert the notched rubber sealing strips under the skirt of the cap to fill the voids between ribs of the roof panels.



[illegible]

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]



[illegible]

Fig. [illegible]

(2) Raise to one ring clearance again and repeat process. When necessary lower bin to get [illegible] attach the bin jack brackets to the lowest ring in place thus far. Continue [illegible] for door opening.

(3) **Door Installation** The door frame must be installed before attaching lower rings or foundation ring (see Fig. 4 for location of short bin wall sheets to accommodate door opening). **Do not tighten bolts in rings adjacent to door until door frame is securely in place.** Open the door hardware pack and remove the items. Set the door frame in the opening of bin with corrugated bolting edge on the inside. Use double strands of weather sealer to caulk all seams around the door frame.

(4) **Base Angles** Base angles (2" X 2" X 4") are furnished to be bolted to the lower edge of the bottom ring. After this is done and the bin is completely assembled raise the bin high enough to coat the bottom of the base angle ring with sealing mastic. Then lower the bin down on the pad and add additional mastic if required around the bottom of the bin to insure a good seal between bin and pad.

(5) **Anchor Lugs** After the bin has been erected anchor lugs should be bolted to the J bolts previously set in the concrete as shown in Fig. 3 and Table 3. These lugs are bolted to the inside of the bin wall with two bolts which go in holes which must be field drilled at approximately the second corrugation from the bottom as indicated in Fig. 11.

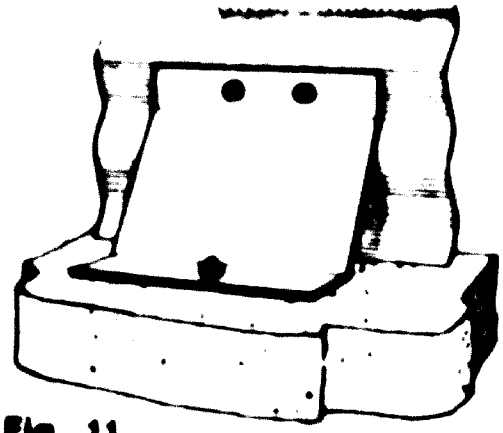


Fig. 11

(6) **Ladders** The outside ladder is located on the side of the bin directly under the roof ladder. Inside ladders are located under the lower roof hatches. Brackets are attached to the side of the bin at the horizontal seams, and the ladders are bolted to the brackets. Ladder brackets should be caulked around the bin mounting holes.

(7) **Foundation Ring and Entrance Collar** If a raised perforated floor is to be installed and fans and heaters are to be attached to provide a drying bin, the bin wall sheets of the bottom ring may be ordered with special punching to accommodate the floor flashing and with a cut-out for the entrance collar. The most widely used provision for a drying bin, however, is to use a 21" wide foundation ring at the bottom of the bin. This ring is installed by lifting the bin to a height of about 2' after you have completed the door installation. Select the best location for the entrance collar, and install entrance frame. Fasten the short sheet to one side of the frame. Then install the complete ring. When you have gone completely around the bin, fasten the standard length corrugated sheet to the other side of the frame (Fig. 12). Make certain the bottom of the foundation ring has the base angle ring attached to it. Using 5/16" X 1 1/2" bolts on the top row of the foundation ring, you may later place the perforated floor flashing and double nut to these bolts.

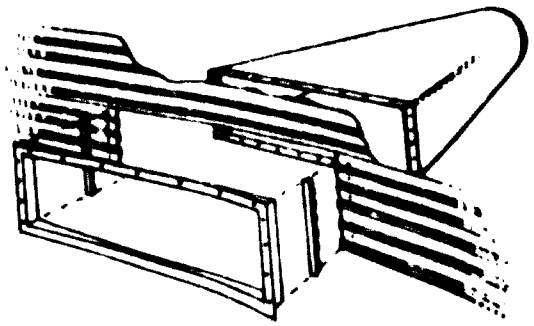


Fig. 12

(8) Transitions

a. Transition ducts for 22" and 24" drums on Baughman 3,5 or 7 H.P. fans and heaters which connect with 44" entrance collar are delivered knocked down in three parts plus a hardware pack. To assemble this transition slip the body halves together at the seams and bolt. Caulk the seam between the collar ring and transition body and bolt the transition to the collar through holes which must be field punched or drilled in the transition body to match holes in the collar.

b. The Baughman TR 24" — 18" transition is similar to the above transition in assembly but is designed with an 18" angle ring for a collar to fit the Baughman 2 H.P. aeration fan.

c. A larger transition to connect the Baughman 10 H.P. fans and heaters with 26" drums to the 62" entrance collar comes from the factory fully assembled.

(9) Twin Bin Connector. If it is desired to connect a single fan and heater unit to two bins, Baughman makes a "Y" valve connector which is designed to join two bins set apart exactly 53 1/4" wall to wall as shown in fig. 13. A 24" transition connects this "Y" valve with a Baughman 3, 5 or 7 H.P. fan and heater.

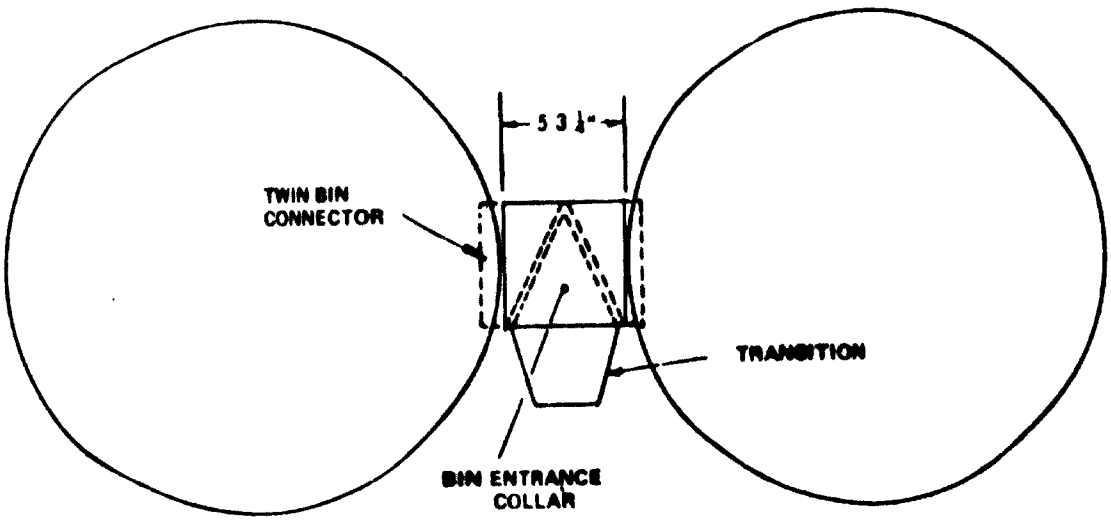


Fig. 13

6. ERECTING COMMERCIAL (TALL) BINS

a For bins 12 rings and higher, the height and weight of the structures require special attention to foundation design, strengthening of bin sidewalls and special heavy duty erection jacks

b Carefully choose a site that is well drained We advise taking soil bearing tests to assure a soil bearing of 3000 lbs per square foot For loose soils such as sandy-clay, organic or organic silt and soft clay, a competent engineer should be obtained. Consider local frost conditions and any code requirements Any backfill should be 15000 lbs floor load When leveling slab, keep in mind that the edge of slab where bin wall sets must be held to within 1 8" square level High spots will cause excessive loads on bin walls Use concrete equivalent to 2500 lbs Fig 2 gives a typical cross-section of a concrete pad for a bin of 12 rings and over, but it would be well to have an engineer verify its adequacy against conditions at the site

c. Note that Table 3 requires three times as many anchor lugs for tall bins as for bins 9 rings or less

d It is best to engage experienced erection contractors for tall bins Such contractors should have the heavy jacks required to handle the weight of these bins

e Stiffeners

(1) Z-Bar Stiffeners are provided for strengthening the sidewalls of tall bins The accompanying drawing entitled Arrangement and Assembly Stiffener Columns" gives the details of stiffener installation Study this drawing carefully.

(2) Note that stiffener columns are made up of Z Bars bolted end to end Each stiffener covers the width of three bin wall sheets and their lengths are such that they are designed to be joined together at a point on the sidewall the width of one corrugation above the horizontal seam where adjacent body rings are bolted together Thus, bottom stiffeners are slightly longer (99 1/4") and upper stiffeners are slightly shorter (93") than intermediate stiffeners (95 3/4").

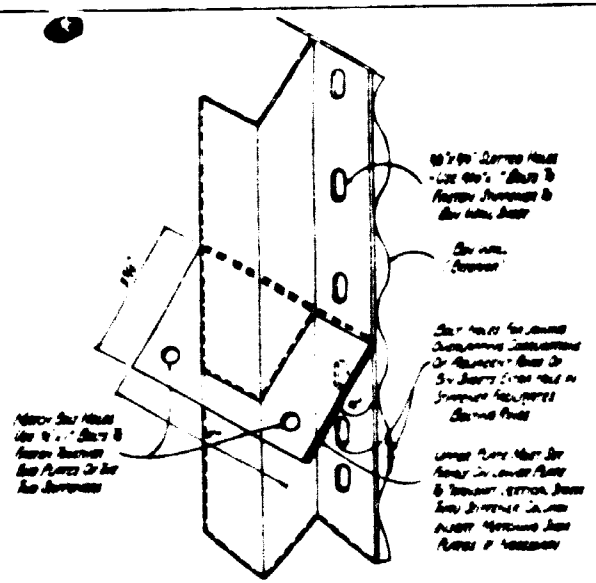
(3) Bin wall sheets come punched with rows of holes so that stiffener columns will be spaced around the inner circumference of the bin wall at intervals of three stiffener columns per bin wall sheet.

(4) Stiffeners are bolted to the bin wall sheets at the time the body rings are mounted starting first with the upper stiffeners Slotted holes in the stiffeners and a supply of shim plates are provided to facilitate bolting stiffeners firmly together end to end. The large end plate on each bottom stiffener should be anchored with two 1/2" bolts imbedded in the concrete foundation.

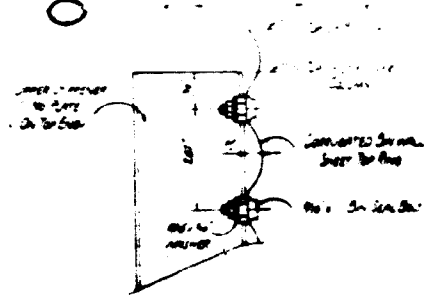
(5) On 12 ring bins up to 36' diameter, use stiffeners on the bottom 6 rings — one upper and one bottom stiffener per column. For all bins over 12 rings and for 12 ring bins of 42' and 48' diameters use stiffeners to the full eave height.

f. Bins 12 rings and higher are provided with a special small door factory assembled in a bin wall sheet which goes in the third body ring above the foundation. Our regular doors, 1 ring or 2 ring, are not designed to withstand the heavy pressures experienced in the lower body rings of tall bins.

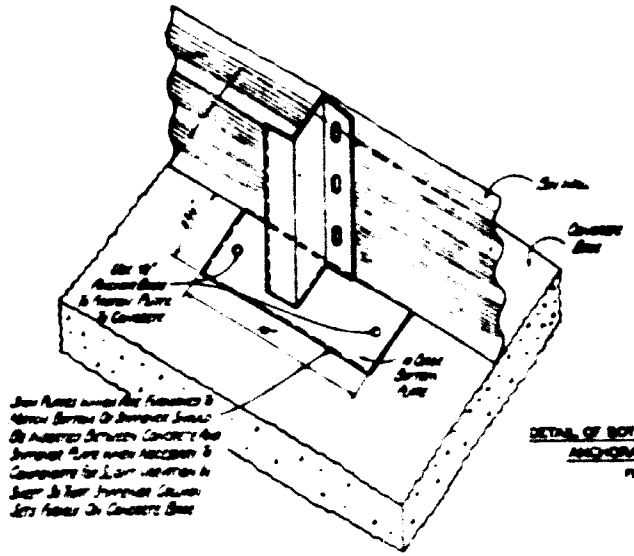
g. The stiffeners discussed in this manual are not to be confused with stiffeners to be installed on the outside of drying bins containing certain makes of stirring devices. Such stiffeners are the subject of special orders, different hole punching and separate instructions for the particular type of installation being planned.



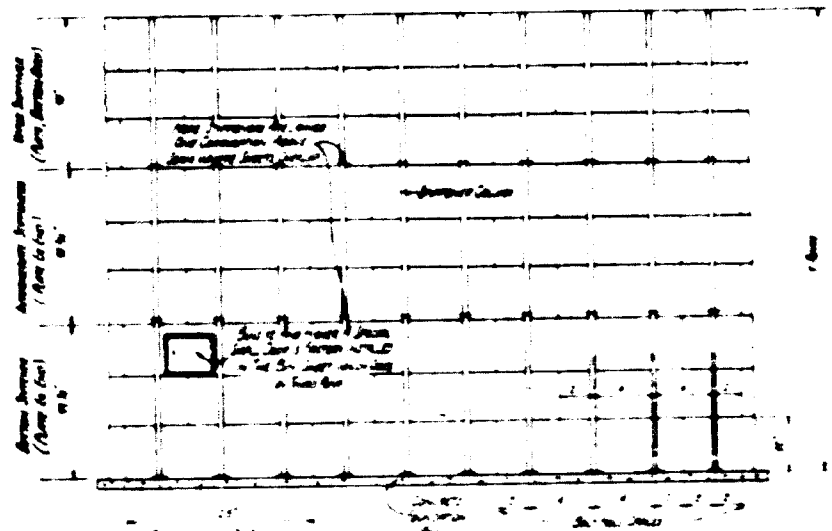
DETAIL OF STIFFENER CONNECTIONS
FIG. 4



DETAIL OF BOLTING STIFFENER
TO TOP RING OF BIN
FIG. 3



DETAIL OF BOTTOM STIFFENER
ANCHORAGE TO BASE
FIG. 2



ARRANGEMENT OF STIFFENERS
TYPICAL SECTION OF BIN WALL
FIG.

APPENDIX A
Special Instructions for Assembling 14', 16', 33' and 36' Diameter Roofs

1. 14' and 16' Diameter Roofs

a. 14' and 16' diameter roofs are each composed of 26 panels. No trusses are used in these roofs and, unless special ordered, they come without hatch sheets. Fig. 14 illustrates how the hold-down straps and center lugs are attached. On 14' and 16' bins, there will be only two hold-down straps per foot sheet. The center strap is not used. Holes in the top body ring for bolting the hold-down straps must be field drilled or punched with the drift punch.

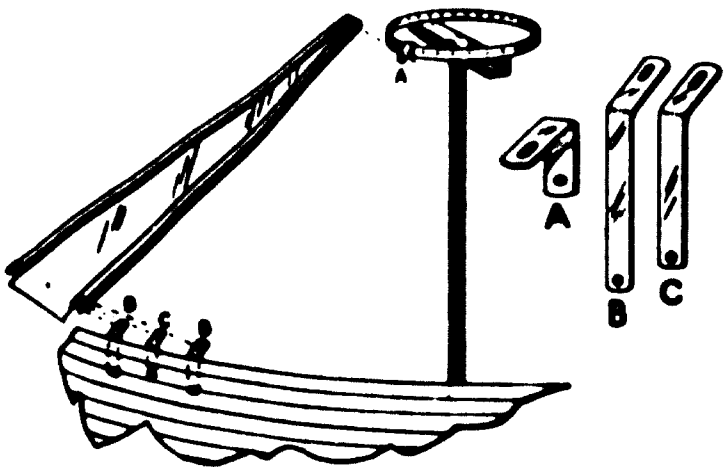


Fig. 14

2. 33' and 36' Diameter Roofs

a. The 33' and 36' diameter bins each have 30 roof panels and 15 roof trusses spaced under alternate roof panels. Roof trusses are bolted level with the top edge of the top body ring at equal intervals around this ring which measure 82" for the 33' roof and 89-1/3" for the 36' roof. All holes in the top body ring for bolting trusses and roof hold-downs must be field drilled or punched.

b. For the bolting of roof trusses to the center ring, refer to Fig. 6A. On the 33' bin roof, the trusses are joined together with one ring of truss ties as shown in Fig. 9. The 36' bin roof has two rings of truss ties spaced at approximate third points along the length of the trusses.

c. For bolting roof panels to the top body ring, refer to use of hold-down brackets "B" and "C" as shown in Fig. 14.

Bryloo Floor Installation

OBTAIN PROPER FLOOR OR STEEL FLOOR SUPPORT DRAWINGS FROM BAUGHMAN OSTER BEFORE INSTALLING

Check Figure I to see how the steel floor supports should be positioned for proper support. If you should choose to use concrete blocks for this job (Figure II) a 2" x 6" board should be laid across the blocks for adequate support. Table A shows the size and number of blocks and lengths of 2" x 6" to be used. On links, bundles, and color coding for each channel look cross perforated floor, consult Table B

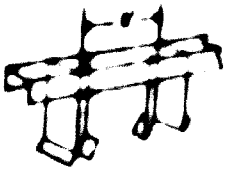


Fig. I

PERFORATED FLOOR DETAIL

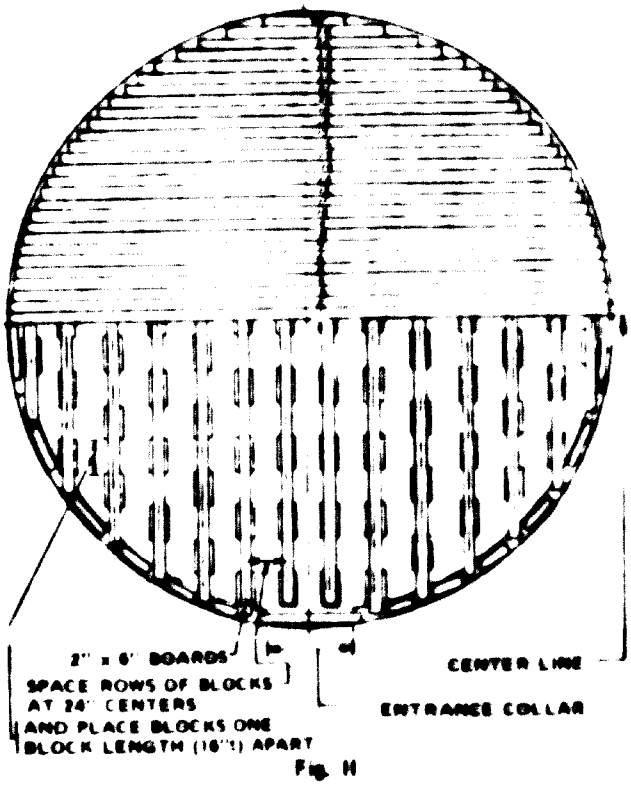


Fig. II

NOTE See quantity of Blocks and 2 x 6 required in Table B

TABLE A

No. of blocks and linear ft. of perforated 2 x 6

Bin Diameter	8" x 16"	8" x 16"	Ft. of 2" x 6
18'	76	76	147
21'	100	100	200
24'	128	128	200'
27'	164	164	300'
30'	100	100	300
33'	205	205	672
36'	256	256	902

NOTE 16' height obtained by stacking 8" x 16" blocks or 8" x 16" block. Care should be taken to see that the bin is round before the floor is installed

If concrete blocks and wood are used on other floors with roofing nails. If steel floor support parts are used, go exactly by the lay out which should be furnished with each set of floor support parts being shipped. If you do not have this lay out, do not start installation until you have received it.

DO NOT REMOVE NUTS IN THE FOUNDATION RING EXCEPT AROUND TRANSITION COLLAR AND BOTTOM OF DOOR FRAME

Fig. III

BEFORE FILLING THE BIN BE SURE THAT ALL BRACE TIE BARS ARE IN PLACE AND THAT ALL TIE BAR BOLTS ARE SECURELY FASTENED

FLOOR FLASHING

Consult Table B for the number of pieces of perforated flashing needed for each diameter bin.

The openings that remain around the outer edge of the floor next to the bin wall can be covered with the floor flashing. These sections match the bin wall bolts at the top edge of the foundation ring.

Using another nut and washer, secure flashing sections in place over the ends of the bolts. Now secure the flashing to the floor with sheet metal screws. (Figure III)

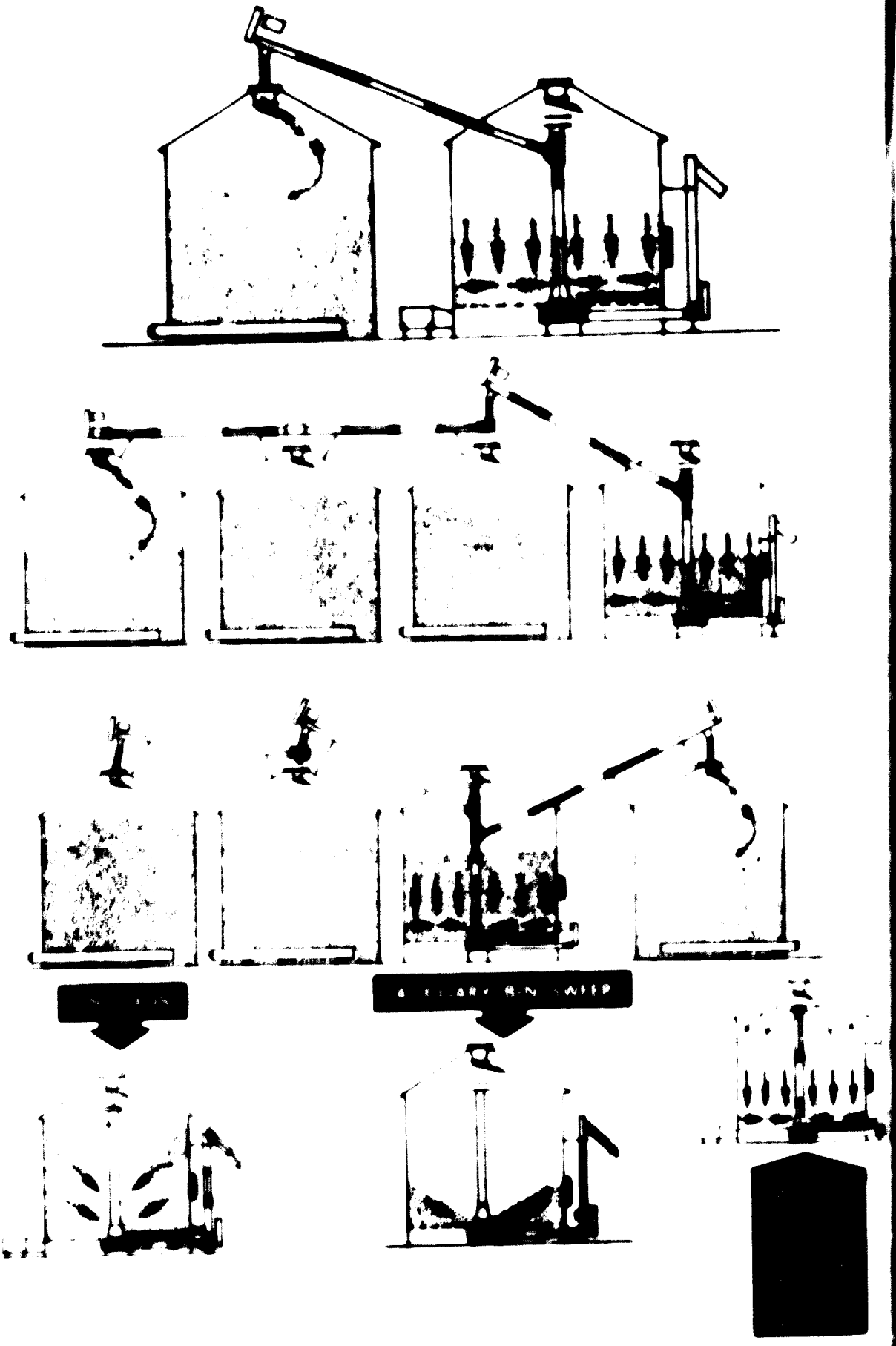
CHANNEL LOCK CROSS
PERFORATED FLOOR INFORMATION

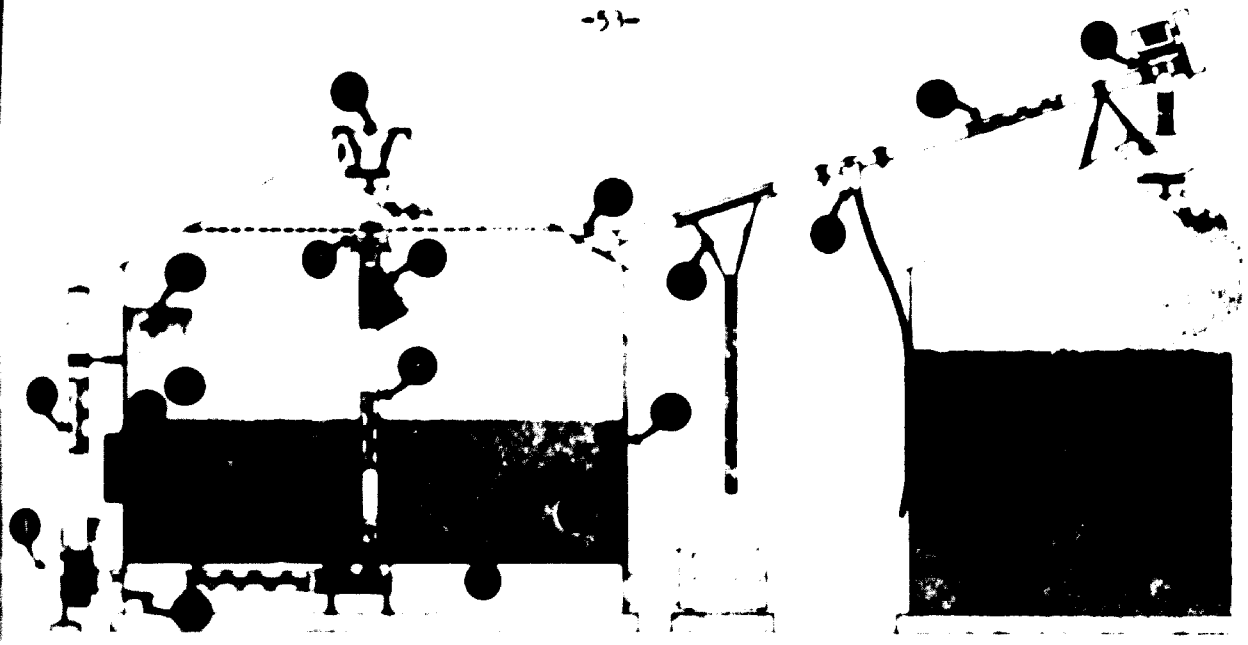
FLOOR PANEL	DIAMETER OF FLOOR									
Color Coding	White	Green	Gray	Copper	Blue	Black	Red	Yellow	Pink	Orange
0	14'	15'	16'	18'	21'	24'	27'	30'	33'	36'
1	13'8"	14'6"	15'9"	17'6"	20'2"	23'6"	26'6"	29'6"	32'9"	35'3"
2	13'6"	14'6"	15'7"	17'6"	20'2"	21'6"	26'4"	29'6"	32'3"	35'3"
3	13'2"	14'2"		17'2"	19'10"	23'2"	26'2"	29'5"	32'7"	35'3"
4	12'8"	13'10"	15'4"	16'10"	19'10"	23'0"	26'0"	29'2"	32'5"	35'3"
5	12'0"	13'5"	15'0"	16'8"	19'6"	[illegible]	25'9"	29'0"	32'2"	35'3"
6	11'4"	12'10"	14'7"	16'0"	19'2"	[illegible]	25'6"	28'8"	31'11"	34'10"
7	10'8"	12'2"	[illegible]	[illegible]	[illegible]	[illegible]	25'2"	28'4"	31'8"	34'10"
8	9'6"	11'4"	13'5"	15'0"	18'2"	21'6"	24'8"	28'0"	31'4"	34'6"
9	8'3"	10'3"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30'11"	34'2"
10	6'4"	9'1"	11'8"	13'4"	16'8"	20'6"	23'9"	27'2"	30'6"	33'8"
11	3'0"	7'3"	10'6"	12'2"	16'0"	19'8"	23'2"	26'9"	30'0"	33'2"
12		4'10"	9'1"	10'10"	15'2"	17'2"	22'6"	26'0"	29'6"	32'8"
13			7'2"	9'4"	14'2"	16'0"	21'8"	25'4"	28'11"	32'2"
14			4'3"	7'4"	12'10"	19'0"	20'11"	24'8"	28'3"	31'8"
15				4'0"	11'3"	18'0"	20'0"	23'10"	27'6"	31'0"
16					9'3"	14'6"	19'2"	23'0"	26'8"	30'4"
17					6'8"	11'2"	13'6"	22'0"	25'10"	29'8"
18						11'4"	11'4"	20'8"	25'0"	28'10"
19						8'11"	6'0"	19'8"	24'2"	28'0"
20						4'10"	17'10"	18'3"	23'0"	27'0"
21							16'8"	16'9"	21'8"	26'0"
22							15'4"	14'10"	20'4"	24'8"
23							9'4"	12'9"	18'8"	23'6"
24								10'0"	17'0"	22'0"
25								5'9"	15'0"	20'6"
26									12'10"	18'8"
27									9'6"	16'10"
Number of Bundles	3	4	5	5	6	6	8	12	13	14'6" 7'4" 15
Pieces of Flash	12	13	14	15	17	20	22	24	27	30

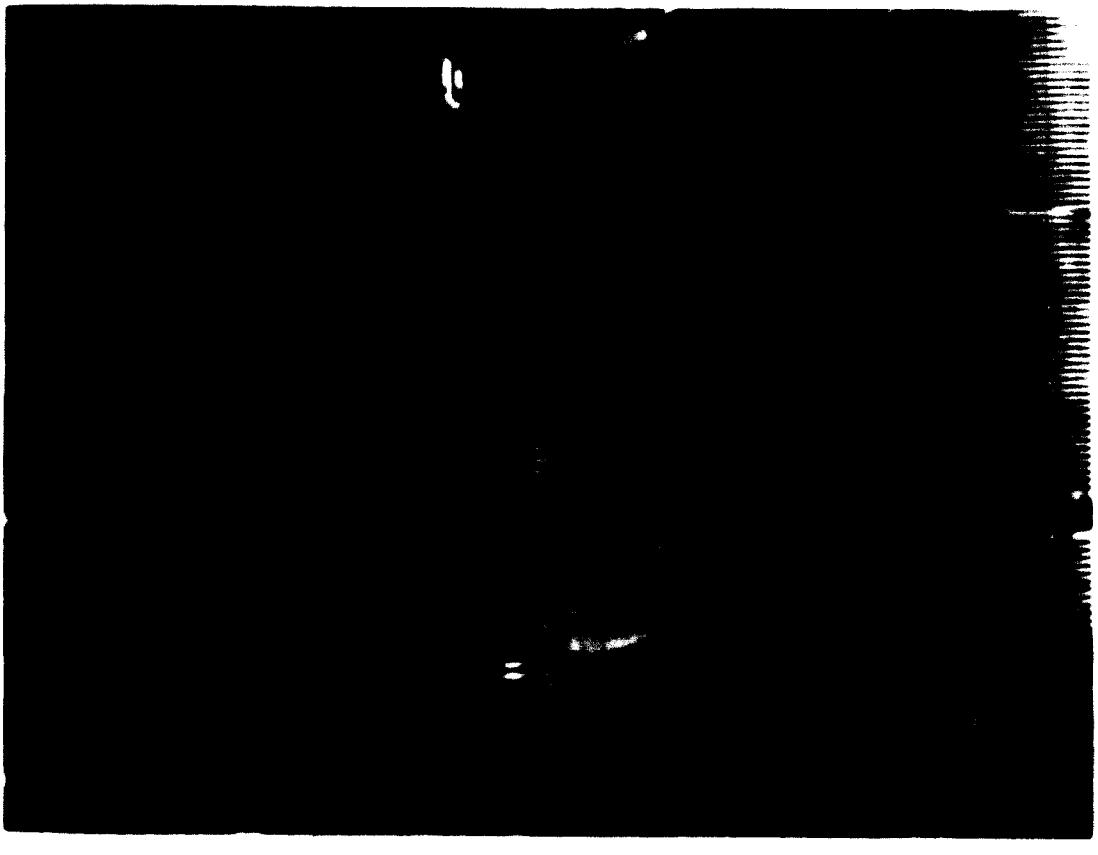
Every block in each diameter column represents one bundle. The first block in each column is the No. 1 bundle.

Note: Center of 14' diameter bin bisects No. 1 panel, therefore three panels this length are required. All others are furnished in pairs. One panel each length on each side of center line of bins.

AUTOMATIC CONTINUOUS FLOW

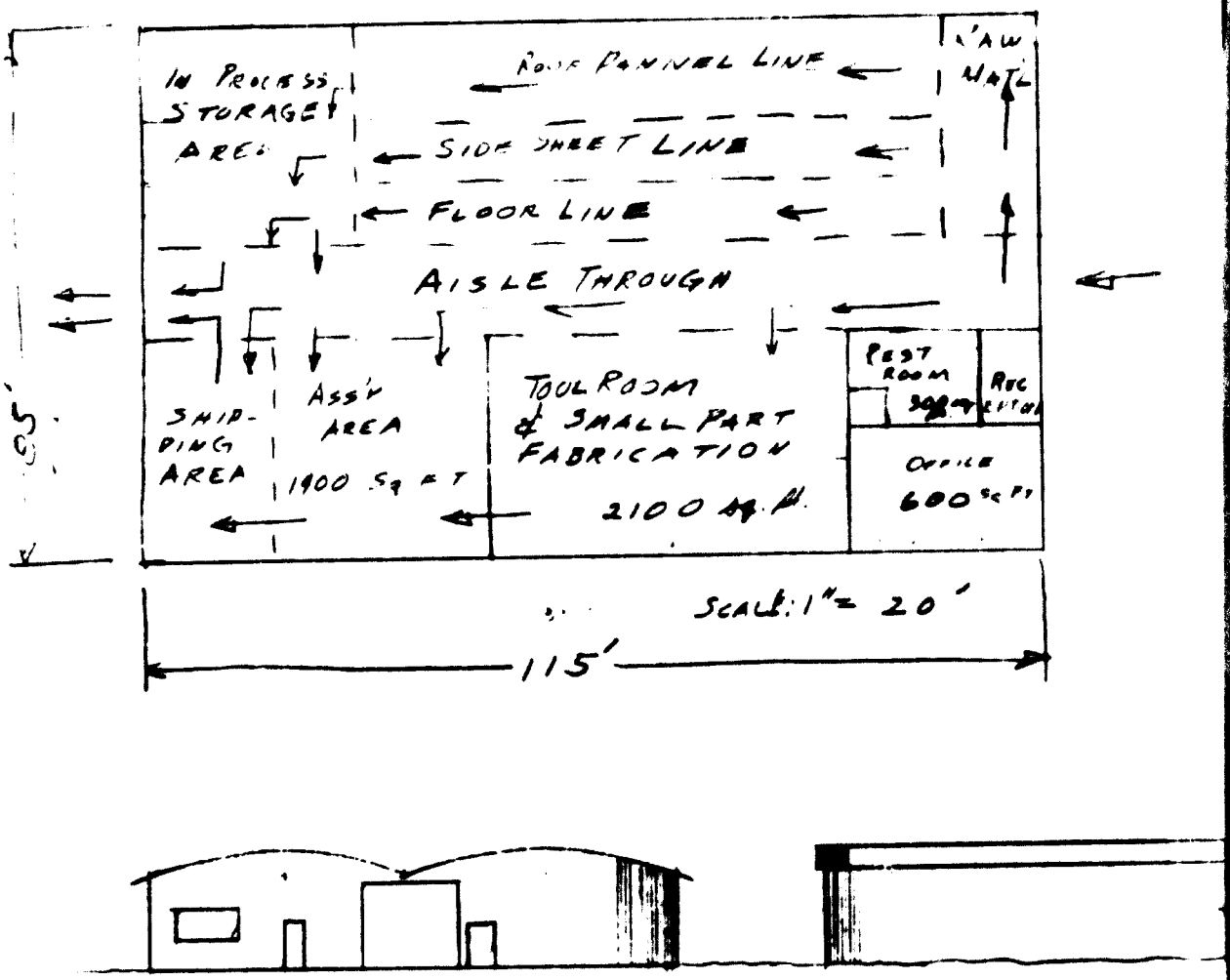






The above is a fully integrated dryer, storage bin with integrated filling, emptying or transfer of grain to adjacent bin. Capacity in rice is 2 tons per hour 22% moisture to 14%. Storage capacity is 19 tons of paddy. Complete unit is available for manufacture under license.

Factory Building - fig. 15



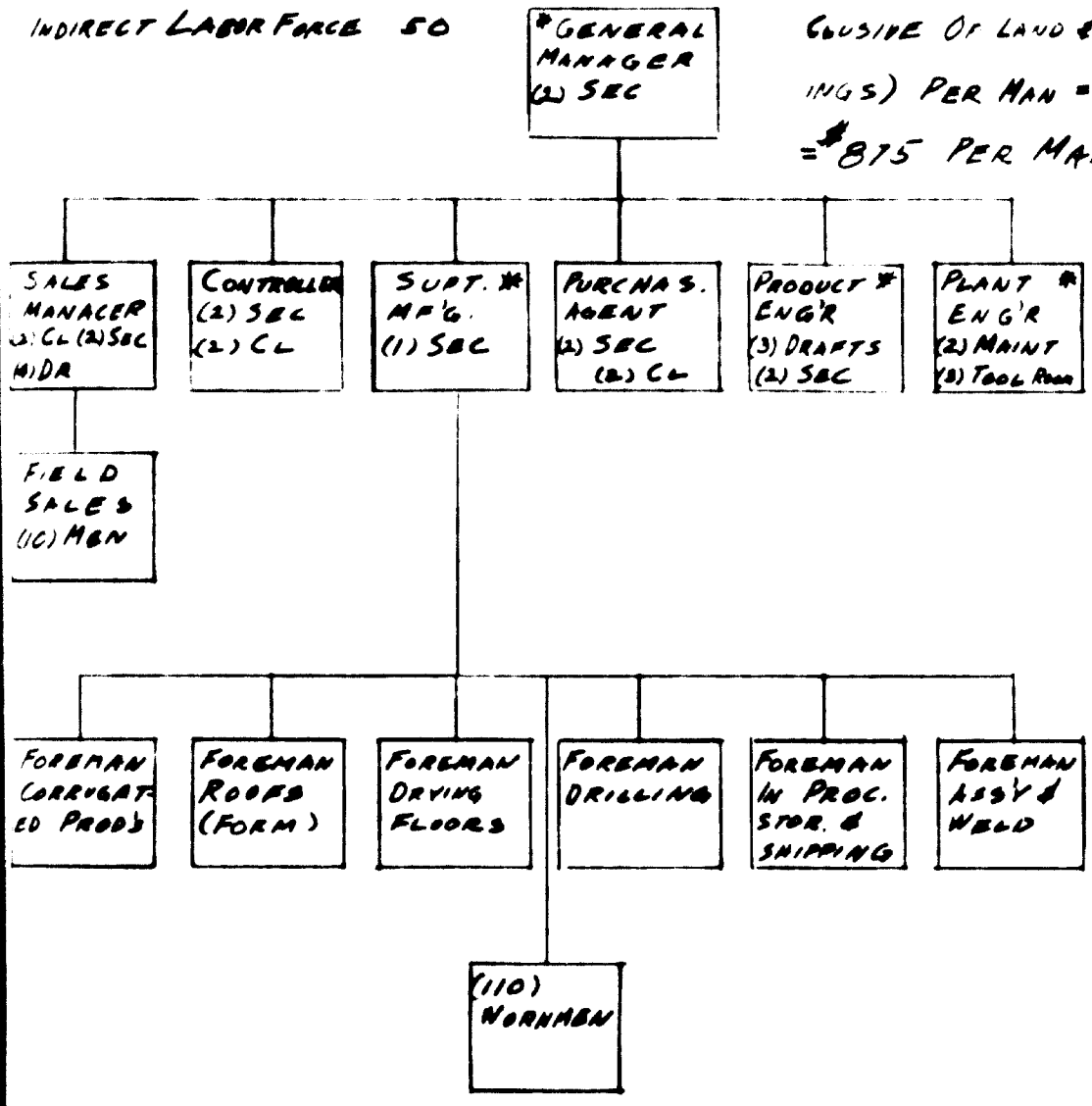
The entire structure shown (wall and roof) is constructed from bin floor pannels (unperforated). Estimated wholesale cost, locally manufactured is $20/ft.^2$ (surface) x 20,000 $ft.^2$ = US$ 4,000. This gives some idea of potential savings in building costs using this material and structure. For cost purpose we are figuring US$ 3.00 per square foot complete with mechanical and electrical equipment, exclusive of land , or US$ 29,400.

TABLE OF ORGANIZATION

DIRECT LABOR FORCE 110

INDIRECT LABOR FORCE 50

FIXED CAPITAL (EXCLUSIVE OF LAND & BUILDINGS) PER MAN = $\frac{\$140,000}{160}$ = $875 PER MAN



* FOREIGN PERSONS

CL = CLERK
DR = DRIVER
SEC = SECRETARY
ASS'Y = ASSEMBLY
ENG'R = ENGINEER

AVERAGE DIRECT LABOUR COST IS ASSUMED TO BE $.35/HR. & AVERAGE INDIRECT LABOR TO BE $.50/HR. FOREIGN WAGES ARE ASSUMED SUBSIDIZED TO THAT LEVEL FOR THREE YEARS

NOTES ON PAGES 54-55

THE $29,400 FIGURE FOR THE BUILDING REPRESENTS A POTENTIAL FOR LOCAL MANUFACTURE. THE ASSUMED FIGURE USED IN THE TRIAL ACCOUNTING WAS $100,000.

THE TABLE OF ORGANIZATION IS PACKED FOR TRAINING PURPOSES AND TO MAINTAIN HIGH LEVELS OF LABOUR INTENSIVITY. IT WILL BE NECESSARY TO MODIFY STANDARD MACHINES AND METHODS TO ACCOMMODATE TO THIS. SOME SUGGESTIONS ALONG THESE LINES FOLLOW. A LARGER MARKET WOULD ALLOW TWO SHIFT OPERATION AND INCREASE THE INTENSIVITY, WITHOUT NEED OF NEW TRAINEES.

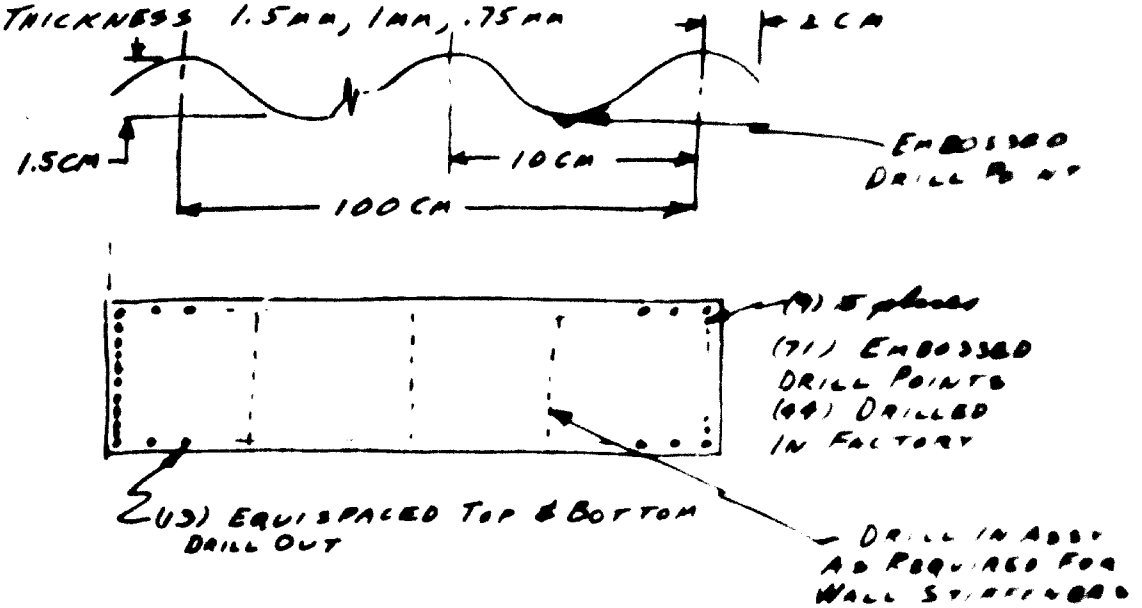
IT IS SUGGESTED THAT CONSIDERATION BE GIVEN TO MOVING ALL DRILLING, ASSEMBLY AND WELD TO SATTELITE WORKSHOPS SCATTERED THROUGHOUT THE MARKET AREA. THESE COULD ASSIST IN WAREHOUSING, SALES AND ERRECTION AS WELL AS APPROXIMATELY 3/8 OF THE TOTAL LABOUR INPUT.

PARTS 100, 101, 102

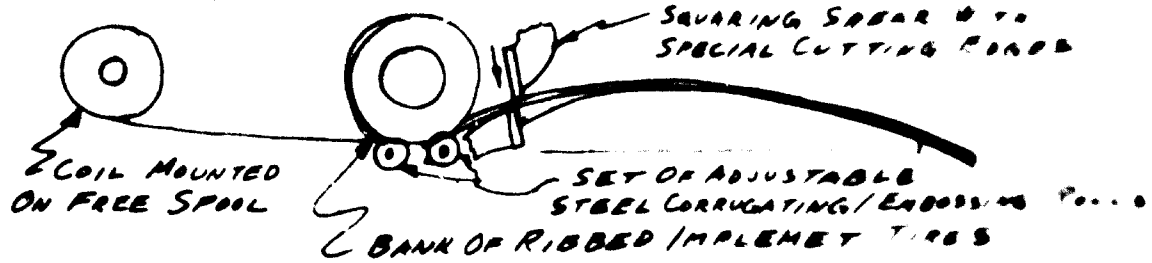
1. BLANK SIZE 318 CM X 115 CM

2. THICKNESS 1.5MM, 1MM, .75MM

3.



4. SUGGESTED SPECIAL TOOLS



5. CAPACITY & MAN POWER: 100 TONS PER HR. → 1.67 TONS PER MIN. → 180 METERS PER HOUR → 180 M/HR OR .18 KMH. EXCLUDED IS A PHOTO OF AN EXPERIMENTAL MACHINE & ITS OUTPUT REQUIRES (2) OPERATORS AND (2) SHEET STACKERS AND (1) BALER/STOCK CHASER. ESTIMATED LOCAL DEVELOPMENT AND PROCUREMENT COSTS $15,000.

6. SPECIAL DEEP THROAT BRACKET MOUNTED DRILL (SEE FIGURE 4.2) ESTIMATED LOCAL PROCUREMENT $200 E. EFFECTIVE RATE REQ'D IS 42 SHEETS PER 45 MIN. NO OR ACTUAL INSTANTANEOUS RATE OF 56 SHEETS PER HOUR. MANPOWER REQ'D (1) OPERATOR - (2) HANDLERS (1) STOCK CHASER/TOOL SHARPENER. 9 MIN. PER SHEET (9) PER HOUR. (9) DRILLS ARE REQUIRED.

7. TOTAL MANPOWER = 41

Figure 4.2

Figure 4.2 shows a bracket mounted electric drill fitted with a special long throated base. This allows the nesting of premarked, formed sheets and drilling simultaneously the required holes. The special bases can be readily manufactured. The major limitation of stacking is the weight and handling characteristics of the parts. This machine is designed primarily for the satellite plants. It has definite advantages of low initial cost and portability.

Electric Drill

The [illegible] (Fig. 12) is intended for drilling holes, [illegible] up to [illegible] mm in machining metal parts. The drill is mounted on a special support 2 and is suitable for drilling holes and removing sheared-off studs and bolts from the [illegible] at a distance of up to 10 [illegible] from the [illegible]. The [illegible] electric drill can be used for [illegible] for grinding, polishing, [illegible] the appropriate working tool being secured to the drill spindle.

As shown in Fig. 13 the electric drill consists of casing [illegible] with a sealed [illegible] stator reduction unit casing 1, interme-

FIG 4.2

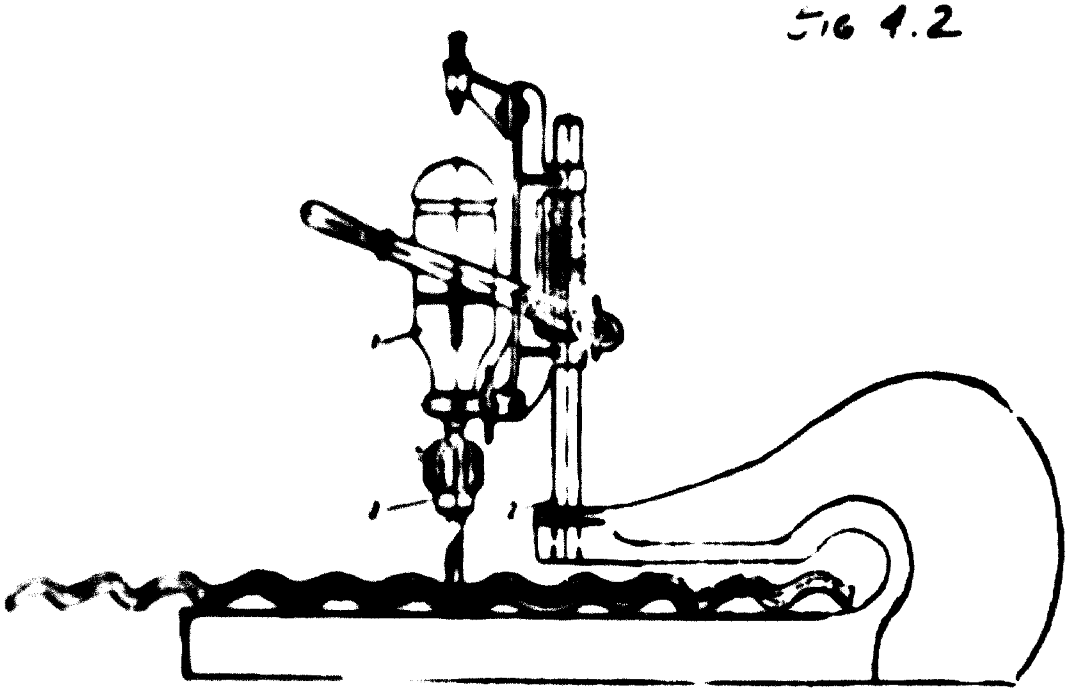
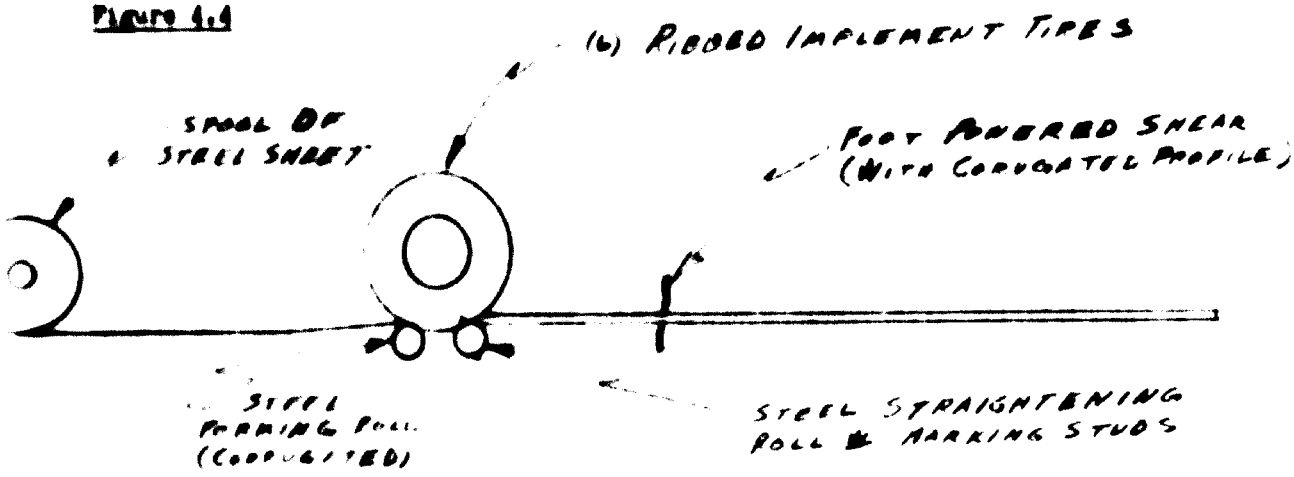
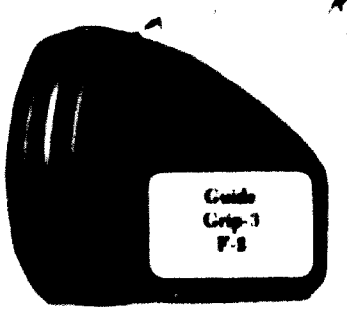


Fig. 12 Bracket-Mounted Electric Drill: 1—electric drill, 2—support, 3—chuck with drill.

Figure 4.4



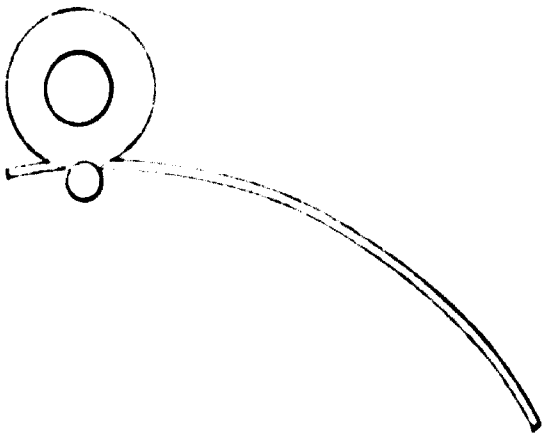


The machine shown above is a rather crude machine developed by the author which is capable of continuous corrugation of galvinised sheet (coil). Conical studs added to the straightening roll accurately mark the proper hole locations. Cut-off is controlled by a travel-dial and microswitch. This machine could be fabricated locally.

Alternately, a conventional, continuous roll forming machine with conical studs added could be imported. This is the approach assumed in the body of the report.

Figure 4.5

(See figure 4.4). If the straightening roll is removed the two roll system becomes an effective roll curving machine with the corrugated sheet curving around the steel roll. The degree of curvature is roughly proportional to the pressure between rolls. The machine could either be electric motor driven or placed in a vertical position and driven by hand by means of a long, overhead crank. This would render the machine portable and allow sheets to be curved at the site.

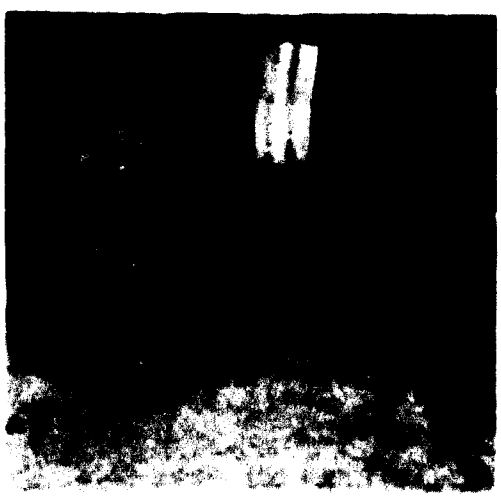


Overhead/Pro 1-a- ic Cut-O S ur I d. FC ---Warr

Overhead Vi[illegible] Entry End Long. Roll Form Corrugating Lin[illegible] Republic Steel Corp.

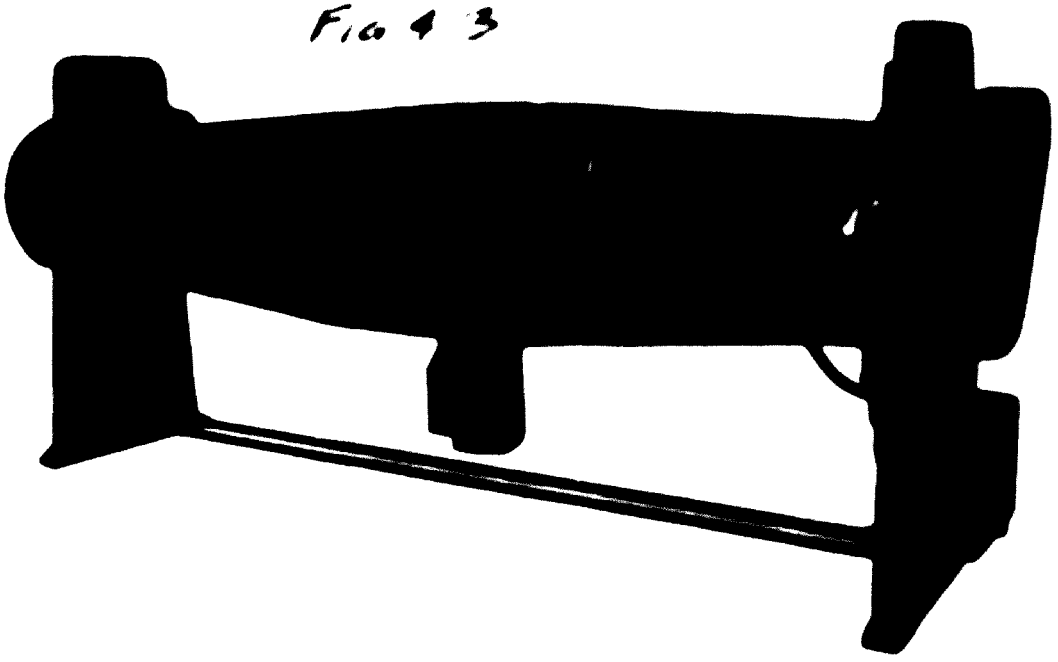
CORRUGATION

Shown (Fig.10) is estimated $ 300,000 corrugating machine suitable for a steel mill. Small capacity machines have been built for a bin manufacturer for approximately $ 30,000. The cost of the simplified machine line demonstrated experimentally by the author is estimated at under $ 10,000. It has the advantage of also embossing hole locations and producing controlled sheet curvature. (Fig.11).



ABKANTMASCHINE KR-9-2 E

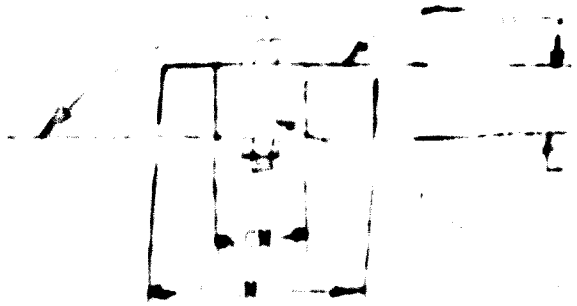
Fig 4 3



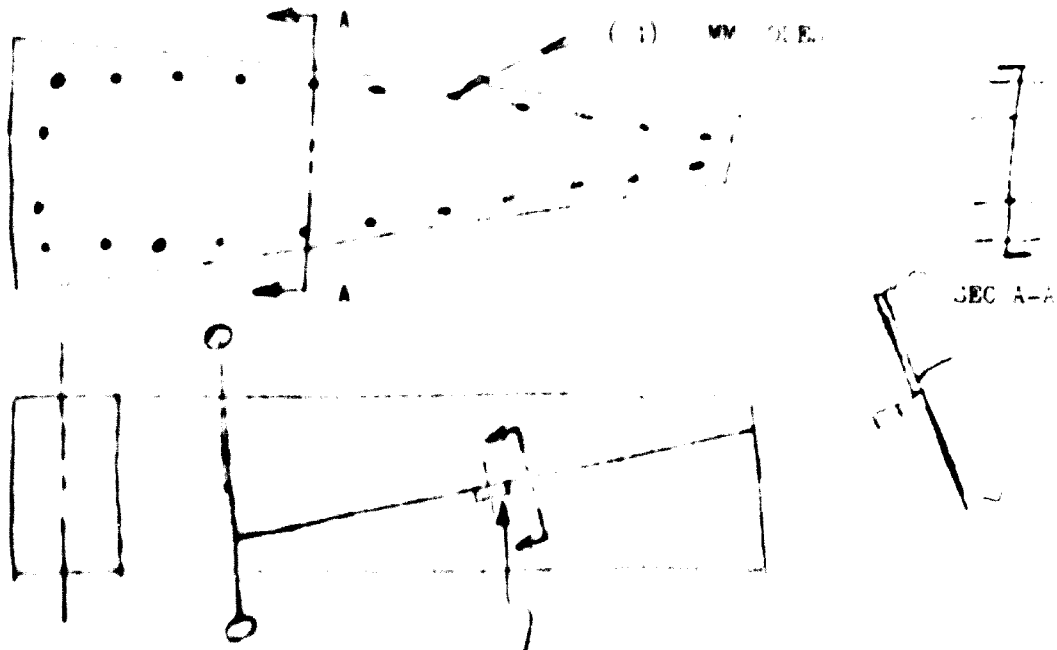
[illegible]

PARTS TO [illegible]

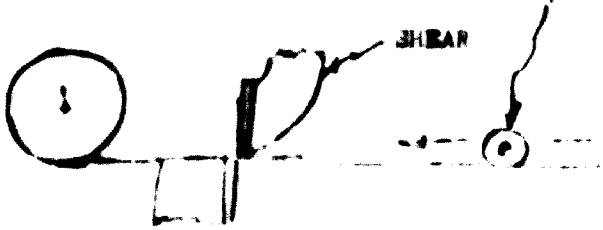
[illegible] STEEL ROOF PANELS

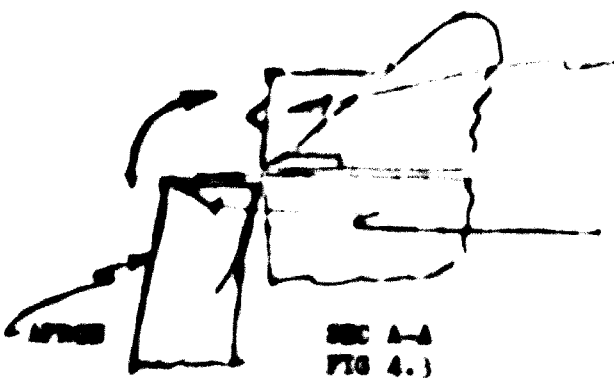


[illegible] PERFORATED METAL SPACER



ROLLING DIAGONAL SIDED SLITTER REQUIRES ( ) OPERATORS AND (4) HANDLERS. OUTPUT [illegible] PARTS IN 45 MIN. INSTANTANEOUS RATE [illegible] PER HOUR 2 MEN





EMBOSSING PUNCH FOR DRILL POINTS.

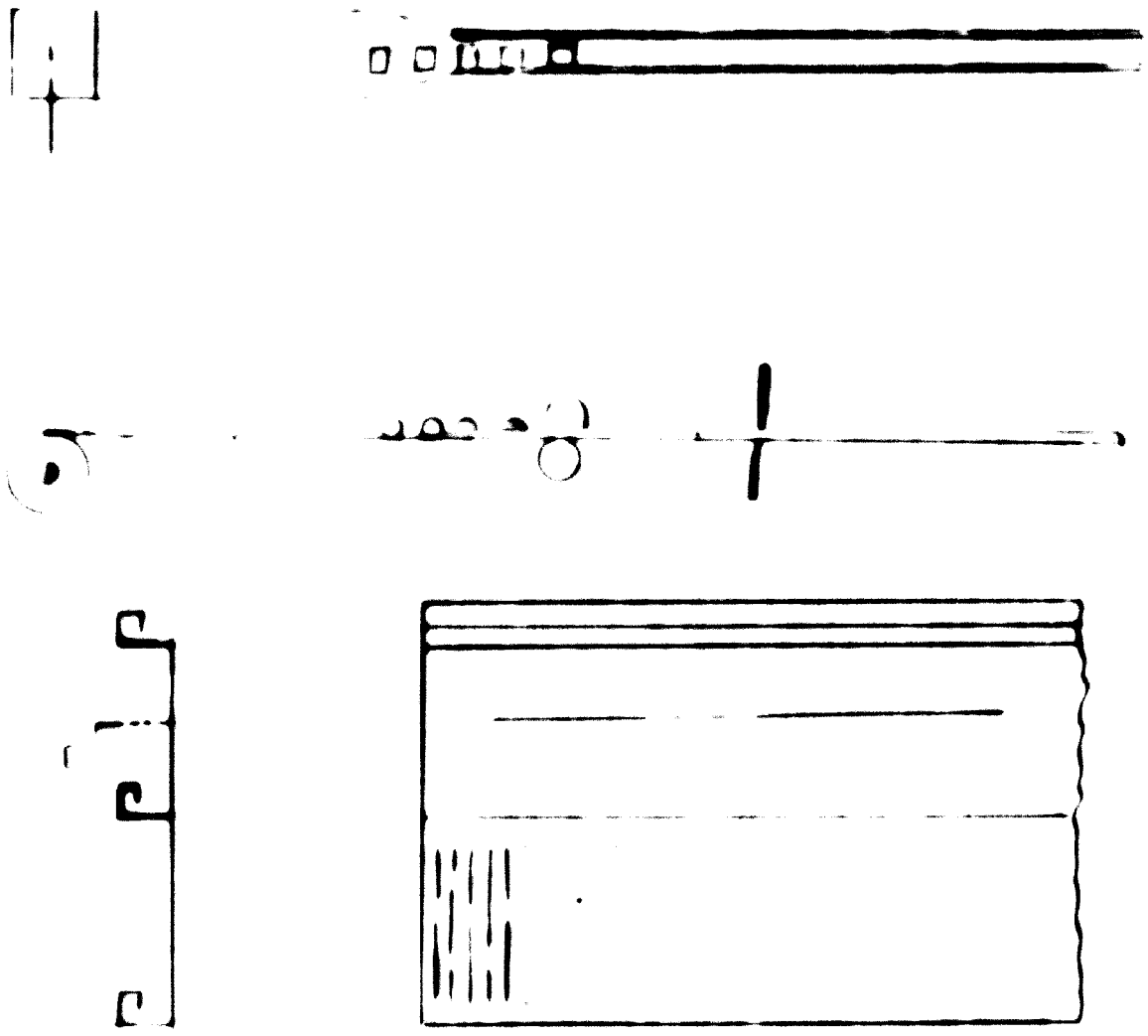
REQUIRES ( ) OPERATORS AND ( ) HANDLERS [illegible] BENDS PER HOUR INSTANTANEOUS RATE MATING DIE SET ON AN ARC TO PERMIT BOWED ROOF. 5 MEN

MACHINE COST - $10,000

SEC A-A FIG 4.)

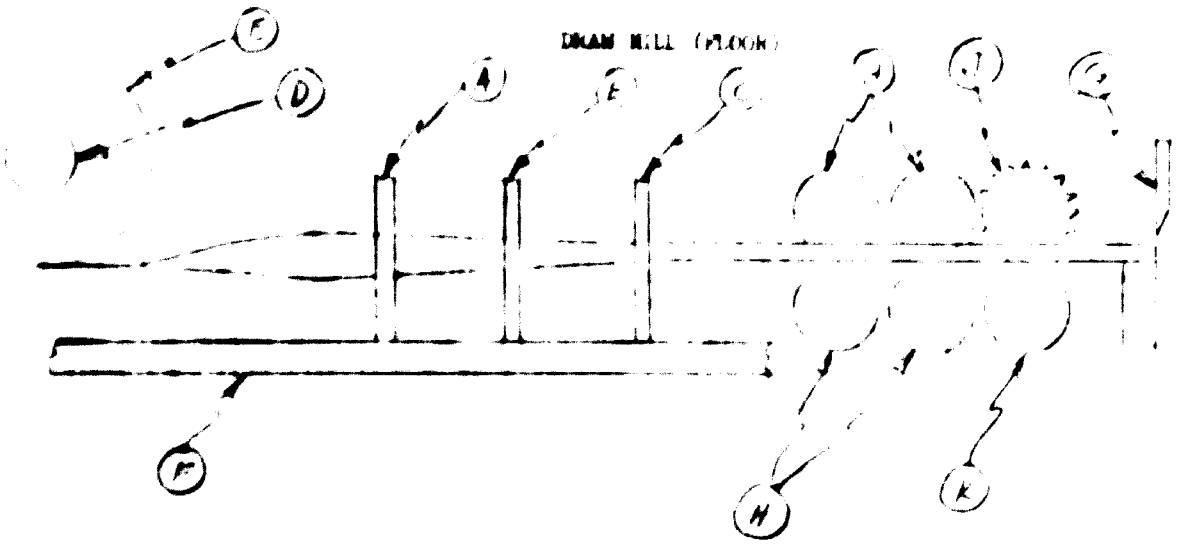
INSTANTANEOUS DRILL RATE OF 36 PER HOUR
10 PARTS PER HOUR ——(4) DRILLS [illegible] GUIDES.
TWO SLACK USED ON PART 105 12 MEN

Fig 9.6



TYPICAL FLOOR PANNEL FOR AERATED FLOOR:

This type of pannel floor is made from 18 and 20 GA galvanized steel. The slotted air holes are embossed to provide lateral strength. If the holes are longitudinal, the floor is much weaker. Perforating rolls can be spread to emboss only without perforating. Pannels (unperforated) on edge can be substituted for 2 x 8 joists and are usually cheaper than wood joists. Pannels can be placed on a palisade to form a perimeter for a factory building. They can also be used for an arched roof. It is proposed that corners can be made by breaking on line to form a corner pannel as shown. Machinery costs approximately $5,000 and runs about 200 ft./min or about 120 ft²/min. capacity.

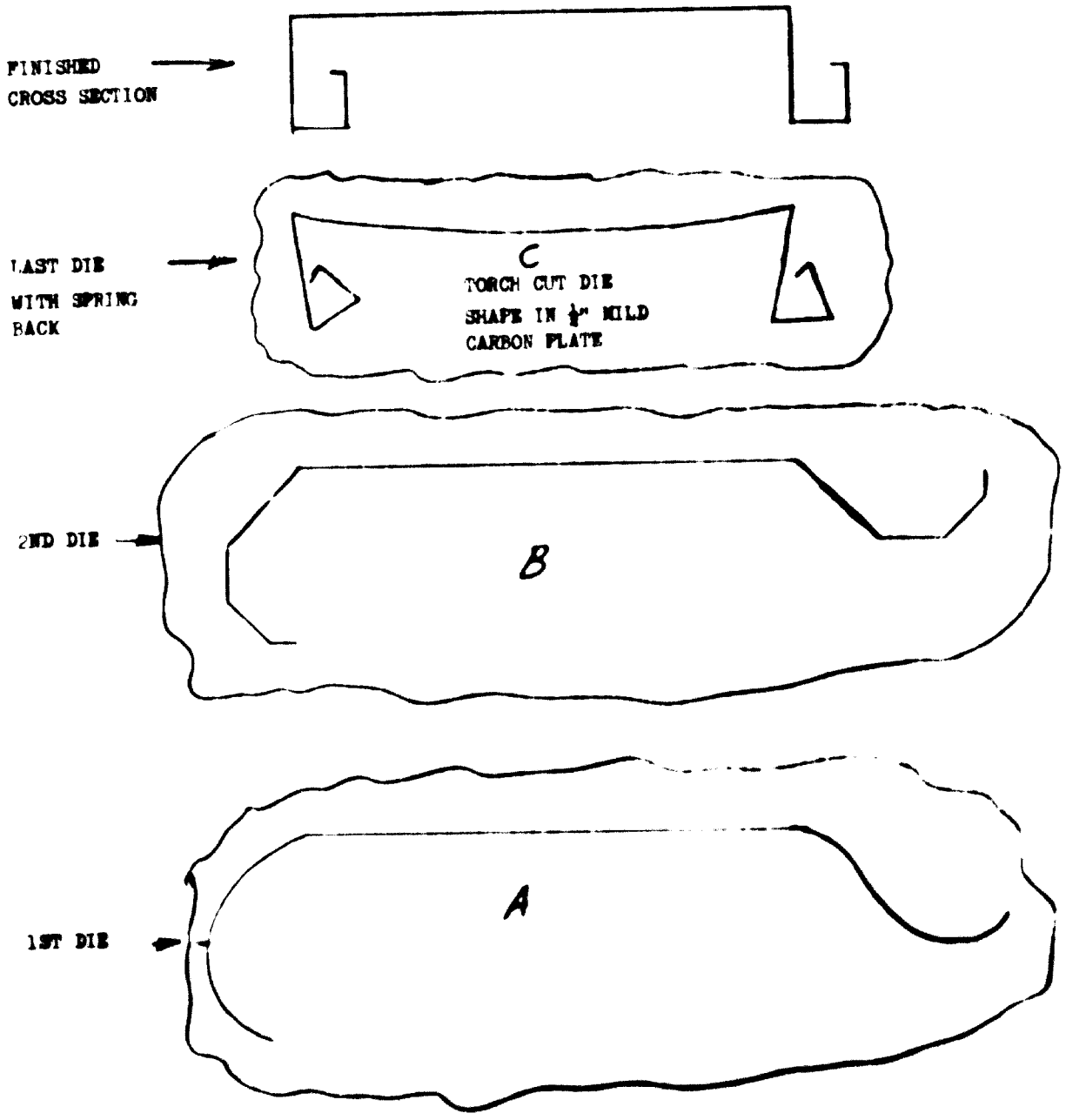


A. 1ST DRAW DIE PLATE
B. 2ND DRAW DIE PLATE
C. FINAL DRAW DIE PLATE
D. SPOOL
E. ROLLED GALVANIZED SHEET (1 MM THICK)
F. FRAME - DRAW MILL
G. CUT-OFF SHEAR
H. TRACTION ROLLS
I. PERFORATING ROLL (MALE)
J. PERFORATING ROLL (FEMALE)

COMMERCIAL DOOR PANNEL MILLS USE A SERIES OF ROLLERS INSTEAD OF DRAW PLATES AND COST APPROXIMATELY $20,000 WITH CUT-OFF SHEAR. ESTIMATED LOCAL COSTS TO FABRICATE AND DEVELOP THE DRAW MILL ARE $10,000.

FLOOR PANEL DRAW PLATES (PROGRESSIVE)

THE DRAW PLATES ARE MADE BY TORCH CUTTING
½" CARBON STEEL PLATE AND HAND FILLING.



WORK FOR 90° BEND IN .04" STEEL OF 50,000 PSI YIELD PER INCH (LINEAL)

1. $50{,}000 = \frac{MI}{C} = \frac{M}{Z} \rightarrow M = 50{,}000\ \frac{1}{6}(.04)^2 = .0016(8333)$

   $M = 13.4\ \# - in.$

2. WORK $= \frac{\pi}{2}(13.4) = 21$ IN - #. FOR 6 90° BENDS IN CROSS SECTION

   126 IN - # / IN TRAVEL.

3. WITH GOOD LUBRICATION THE EFFICIENCY SHOULD BE 75% ⟶ 1800 IN - # / IN ⟶

   150 FT - LB/IN ⟶ 1800 FT-LB/FT. ASSUME V = 50 FPM ⟶ 90,000 FT # / MIN ⟶

   2.7 HORSE POWER.

   $HP = \frac{TN}{63{,}000}$, $N = 25 \rightarrow T = \frac{63{,}000(2.7)}{25} = 6800\ \# - in$

   $R = 3.8" \rightarrow W_T = 1780$ LBS TENSION TO DRAW.

4. ALLOWABLE SURFACE COMPRESSIVE PRESSURE

   = 100,000 PSI. FOR SINGLE SET OF ROLLS SEPARATING LOAD =

   8900 LBS W = 5"

   $\rightarrow$ 1780 LBS/IN; $Sc = .591\sqrt{\frac{1780\ E}{7.6}} = .591(5.5)10^3\sqrt{235}$

   $\rightarrow Sc = 15.3(.591)(5.5)10^3 = 50{,}000$ PSI ⟶ POSSIBLE

   IN DAMAGE. USE TWO SETS OF TRACTION ROLLS

Included for reference are some low cost tools which could be used effectively in low volume manufacturing lines. These could be adapted by a local machine shop into serviceable substitutes for more expensive shears and presses.

12-inch Radial-arm Saw

- Motor develops 4 HP
- Cuts wood up to 4 in. thick

$369.95

This muscular saw can handle your biggest projects—build furniture, remodel a room, build a room. Motor develops 4 HP—rated at 5 HP. Up-front controls—no reaching across the table to make adjustments. Solidly constructed with cast iron arm and column support. The ⅝-in. shaft with standard ⅝-24 thread end takes molding heads, sanding discs or a drill attachment. Elevating crank raises, lowers blade.

Make miter cuts—arm swings left or right, locks for any angle cut. Fixed stops at center, 45°. Miter scale. Make rip cuts—blade swivels left or right with stops at center and 90°. Scale on arm measures rip width (26½-in. maximum). Make bevel cuts—blade tilts and locks to make any angle cut. Stops at vertical, 45°, horizontal. Bevel angle scale.

Carriage rolls smoothly on sealed ball bearings. Warp-resistant table (30x24 in.). Capacitor-start motor with overload protector—guards against burnouts. Automatic blade brake stops spinning blade in seconds. Blade guard with anti-kickback and spreader device and retractable lower shield. Push-pull switch with key. Includes 12-in. Kromedge® chisel-tooth blade. 230-240-v., 60-Hz. AC. UL listed. Guaranteed 1 yr. (p. 685).

9 W 2051N—Shipping weight 242 pounds $369.95

9-inch Radial-Arm Saw

- Motor develops 1½ HP
- Cuts wood up to 2½ in. thick

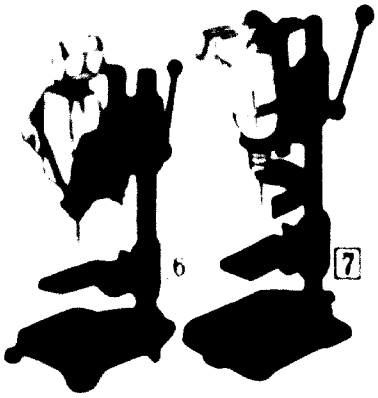
$164.00

This 9-in. saw can perform the same jobs that any 12-in. can—on a smaller scale. Motor develops a maximum 1½ HP—rated at 1 HP. Solidly constructed with cast-aluminum arm and column support. You can add molding head, sanding disc or drill attachment to standard ⅝-24 thread end of ⅝-in. shaft. Crank raises, lowers blade. Warp-resistant 30x24¼-in. table.

Make miter cuts—arm swings left or right, locks for any angle cut. Fixed stops at center, 45°. Miter scale. Make rip cuts—blade swivels left or right with stops at center and 90°. Maximum rip width, 25½ in. Make bevel cuts—blade tilts and locks to make any angle cut. Stops at vertical, 45°, and horizontal. Bevel scale.

Carriage rolls smoothly on sealed ball bearings. Capacitor-start motor with overload protector . . . guards against burnouts. Manual blade brake. Blade guard with anti-kickback-spreader device. Push-pull switch with locking key. 9-in. Kromedge® chisel-tooth blade. 110-120-v., 60-Hz. AC. UL listed. Guaranteed 1 yr., p.685.

9 W 2834N—Shipping weight 100 pounds $164.00



Drill Stands with tilt tables

6 **Drill Stand** for ¼ inch drills. Fits ⅛, ¼, ⅜ inch D grip or pistol grip handles. Adjustable rack and pinion depth control 0 to 4 inches deep. 6 inch throat. With 7½ x 7½ inch cast aluminum base. Tilt table for angle drilling. With 20 inch steel column.

9 W 29887C Wt. 18 lbs. **$29.88**

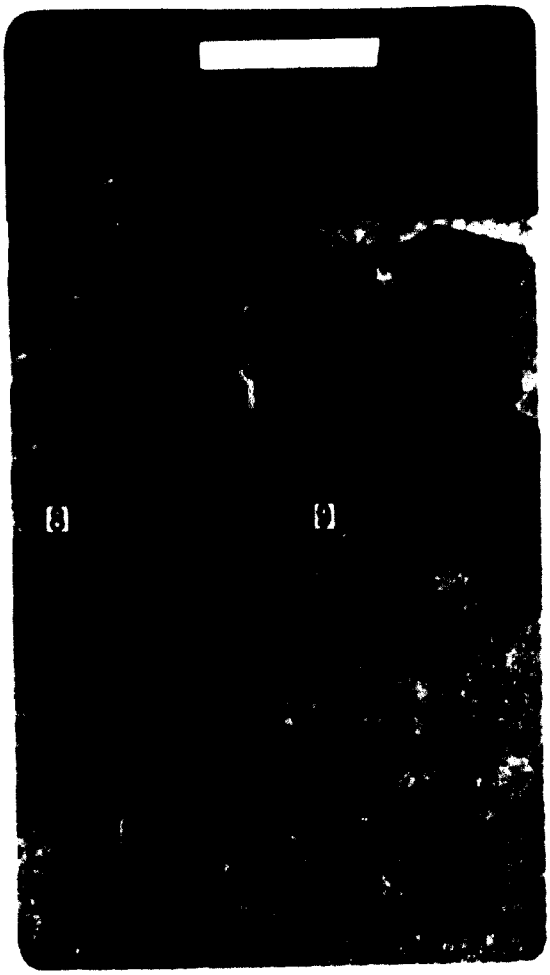
7 **2-position Drill Stand** for ¼ and ⅜-inch drills. Mounting bracket fits all Sears ¼ inch and ⅜ inch electric drills (except 9W1138) fits most other makes, too. Use vertically or horizontally.

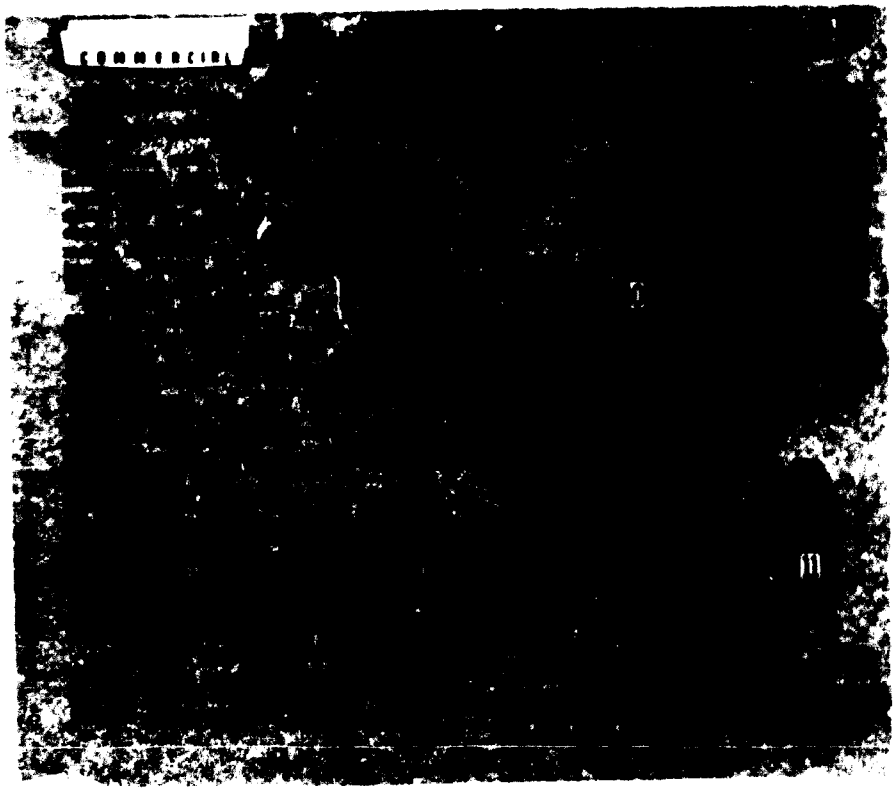
Tilt table for angle drilling. Locking depth gauge with 0 to 2½ inch depth range. With 4½-inch throat depth, 1 inch diameter tubular column 18 inches high. Cast alum. base 6x6 inches.

9 W 29886—Wt. 9 lbs. 2 oz. **$16.66**

Like 7 above except without tilt table or guard.

9W2988—Shpg. wt. 8 lbs. 2 oz. **$13.88**





THE DRILL SHOP

[illegible]-inch Reversible Drills

Single speed develops ½ HP **$56.99**

Single speed develops ⅜ HP **$48.99**

Variable speed develops ⅜ HP **$39.49**

Single speed ⅓ HP **$26.99**

COMMERCIAL Double insulated* sectional aluminum housing with non-glare satin finish. Develops ½ HP. No-load speed 575 rpm. With 100% ball and roller bearings. Precision helical gears for long life. Double reduction gearing for torque. Top handle for 2-hand use. 4 position adjustable side handle. Both removable. Double pole switch. Trigger lock. With 1/2x20 threaded spindle ... externally removable brushes ... toggle-type reversing switch. High impact polymer handles ... Includes 8 foot neoprene 2-wire cord. See 1 year Guarantee and Important Note on facing page. [illegible] Shpg. wt. [illegible] ... $56.99

Double insulated* sectional polished aluminum housing. Removable 2 position rear handle. Trigger lock. Safety switch. High impact polymer handles. No-load speed [illegible] rpm. Ball and sleeve bearings ... externally removable brushes ... helical gears. With [illegible] threaded spindle. [illegible] Double reduction gearing ... 1 year Guarantee and Important Note on facing page. [illegible] Wt. [illegible] ... $48.99

[illegible] variable speed trigger ... High impact polymer motor housing ... aluminum gear housing ... removable rear handle ... 1 year Guarantee ... Important Note on facing page. [illegible] Shpg. wt. [illegible] ... $39.49

[illegible] reversible ... Double reduction gears ... Removable ... Ball ... bearings ... page. Shpg. wt. [illegible] ... $26.99

NOTE: Double insulated tools plug into any standard [illegible] outlet without grounding adapter

Variable-speed Drills

[1] Without bit $49.50

[2] Without bit $39.50

[3] Without bit $29.50

[4] Without bit $19.85

[5] Without bit $9.85

[illegible] the 3 [illegible] double insulated* Reversible [illegible] just flip reversing lever to release stuck drill bits instantly. Change variable speed ... increase pressure on trigger ... speed and torque. Spindle lock for easy chuck removal. See 1 year Guarantee and Important Note on facing page.

1 Motor develops ⅜ HP. No-load speed 0 to 1000 rpm. Three pre-set speed settings. Selector permits quick change from one setting to another. With 100% ball bearings. High impact polymer rear housing. Removable side handle can be mounted on either side ... Neoprene 2-wire 8 foot cord. [illegible] Shipping weight [illegible] lbs. ... $49.50

2 Motor develops ⅜ HP. No-load speed 0 to 1100 rpm. Three pre-set speed settings with safe release for each speed ... Ball roller and permanently lubricated sleeve bearings. High impact polymer motor housing ... aluminum gear housing. Spindle Lock. With ... wire cord. [illegible] Shipping weight 4 lbs. 2 oz. ... $39.50

3 Motor develops ⅜ HP. Variable no-load speed 0 to 1000 rpm. Polymer motor housing, aluminum gear housing. With ball thrust and permanently lubricated sleeve bearings. Two-wire 8 foot cord. [illegible] Shipping weight 4 lbs. 1 oz. ... $29.50

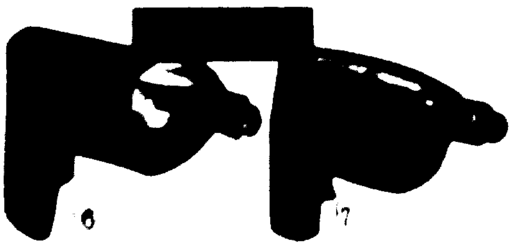
Motor develops ¼ HP. (Not shown.) Not reversible. Variable no-load speed 0 to 1200 rpm. Otherwise like (3) above. With 8 foot 2 wire cord. [illegible] Shipping weight 4 lbs. 1 oz. ... $24.75

Single-speed Drills

4 Motor develops ¼ HP. Double insulated.* With ball thrust and sleeve bearings. No-load speed of 1200 rpm. Polymer motor housing and aluminum gear housing. Spindle lock for fast chuck removal. With 2 wire 6 foot cord. [illegible] Shpg. wt. 4 lbs. 1 oz. ... $19.85

5 Motor develops ⅛ HP. Permanently lubricated sleeve bearings. Double reduction gears for steady power. No-load speed of 1100 rpm. High impact handle. Aluminum motor housing. Requires grounding. Includes 6-foot, 3-wire cord. [illegible] Shpg. wt. 3 lbs. 15 oz. ... $9.85

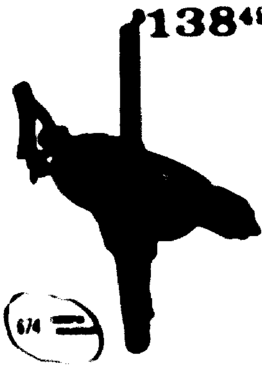
See IMPORTANT NOTE and one-year guarantee on facing page



6 [illegible] double insulated.* Motor develops ⅜ HP. With ball thrust and sleeve bearings ... single reduction helical gears. No-load speed of 1000 rpm ... housing with aluminum gear housing ... See 1 year Guarantee and Important Note on facing page. [illegible] Shipping weight [illegible] ... [illegible]

7 Motor develops ¼ HP ... sleeve bearings ... single reduction gears. No-load speed of 1000 rpm ... made of high-impact ... aluminum housing. Requires grounding. 6 foot 3-wire cord. See 1 year Guarantee and Important Note on facing page. [illegible] Shipping weight [illegible] ... [illegible]

Without bit **$138.49**



[illegible] reversible. Motor develops over [illegible] HP. With 100% ball and needle bearings. Single speed. Triple reduction gears for extra torque ... Top rear handle removable. Rigid sectional aluminum housing. No-load speed 600 rpm ... inches long. With [illegible] wire cord adapter ... See 1 year Guarantee and Important Note on facing page. Shpg. wt. 23 lbs. [illegible] ... $138.49

R.K.Berky/rk
19 June 1973
ID/B/80/Add.1
Component 1.02.09
PAD B/73-180

UNITED NATIONS DEVELOPMENT ORGANIZATION
UNIDO

Terms of Reference

Service (Job) Title: Preparation of a Comprehensive General Proposal for Local Manufacture of Modern Grain Storage Equipment and Gathering of Supporting Data.

General Background Information

To prevent wide spread starvation it is imperative that buffer storage facilities for grain be set up in most of the developing countries. (See Famine 'midst Plenty - Time Magazine, April 30, 1973) An estimated requirement of one metric ton for each 20 people is estimated as required. The estimated annual savings in grain value attainable through use of modern storage systems vis-à-vis traditional storage systems is $ 5.00 per metric ton.

The installed cost of storage in developing countries is $ 25 - $ 30 per metric ton of capacity, for either imported equipment or traditional equipment. The installed cost of modern corrugated steel bins in the United States runs from $ 10 - $ 15 per metric ton of capacity. The cost of shipping coiled sheet steel to almost any of the developing countries in quantity, adds less than 20% to its cost. Preliminary studies by UNIDO show that with slight changes in design and manufacturing techniques, modern grain bins could be locally manufactured with the following desirable results.

1) A local installed price of under $ 15 per metric ton of capacity.
2) A savings of grain value exceeding the foreign exchange expenditure in one year.
3) An upgrading of local manpower and technology resources.

Local manufacture of grain storage systems has been initiated in several developing countries. (Wimberly Report [illegible]) Transfer of inappropriate technology has resulted in higher installed prices than necessary. It is believed that the appropriate manufacturing techniques are not sophisticated and can be easily mastered in most developing countries.

Project Objectives

1. To produce for dissemination to developing countries in generalized form complete documentation and guidelines for local manufacture of modern corrugated steel bins.

2. To study and adapt existing technology in order to meet plant design objectives as follow:
   a) Ex-factory cost of $ 9.00 per ton;
   b) Capital investment of $ 1,500 per worker or less;
   c) Minimal size output (one shift output 200,000 tons per annum approximately);
   d) Rational use of galvanized steel sheet integrated with locally available materials - wood - concrete etc.

3. The documentation should be logically presented in flexible format so that it can be easily modified to reflect the specific needs of any developing country. It should be useful as a pre-investment document and understandable to a non-technical potential investor.

4. The documentation should include:
   a) Table of organisation including list of foreign personnel and duration of assignment;
   b) Sketches and tool design;
   c) Machine and equipment specifications;
   d) Product adaptation (design for local conditions of manufacture);
   e) Production cost estimates;
   f) Plant layout;
   g) Financial prospectus including trial balance sheet, profit/loss statement manufacturing cost statement in conventional format;
   h) List of potential international investment sources;
   i) List of potential international manufacturing technology sources;
   j) List potential developing countries.

A copy of a similar documentation is appended to be used as a guide for format and content and is considered to be part of the terms of reference.

It is intended that the general documentation will be upgraded in the field and the project implemented in selected countries.

A major constraint is to provide maximum flexibility relative to:

1) output
2) intensity of manpower
3) divisability or module form
4) level of sophistication
5) investment sources.

Scope of Contracting Services

Phase I

1. Compile a list of small grain bin manufacturers with inclusion of approximate size, output, and financial structure (per Dun and Bradstreet data).

2. Study one or more factories in depth and take photographs or make sketches of the major processes involved.

3. Determine approximate sales prices, both retail and ex-factory.

4. Determine average erection costs and man-hours of labor required.

5. Compile a normal list of tools used for bin erection.

6. Conduct a survey of the willingness of manufacturers to participate in specific projects through the following: joint venture, technical co-operation and licencing, investment and compile a list for follow-up by UNIDO.

7. Compile current information on low cost high strength steel sheet for bin usage. (For example Armco Cainex or equivalent, particularly prices and extent of usage by the industry)

Phase II

8. Using the above data attempt a complete pilot manufacturing plant proposal for implantation in a developing country, which meets the basic objectives of the background section.

9. Submit the raw data from phase I investigation to UNIDO along with the draft manufacturing proposal.

10. Upon receipt of UNIDO's comments prepare and submit the final draft in English in three copies.

11. Upon approval from UNIDO proceed with translation and publication in English, French and Spanish (copies each). Offset printing or Xerox with clear illustrations will be acceptable.

Time Schedule

1. UNIDO will return comments on the draft manufacturing proposal and raw data within two weeks of receipt.

2. UNIDO will return comments and/or approval of the final draft within one week of receipt of copies.

3. Approval of the final draft must be completed by January 1, 1975.

4. Receipt of English copies by

5. Receipt of French and Spanish copies by _____.

Language

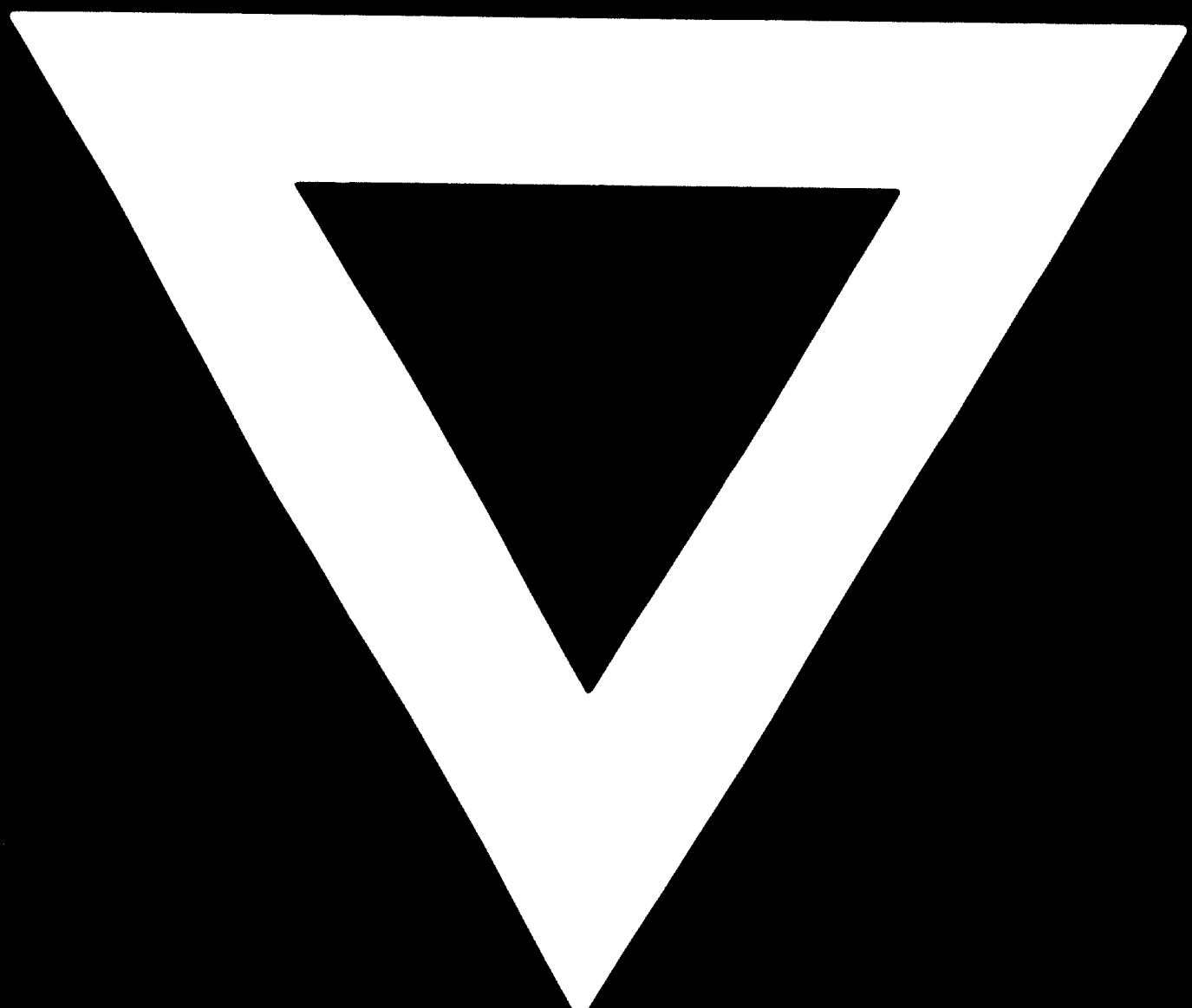
Primary working papers and reports and documents in English.

Reports

Two brief timely progress reports plus the preliminary and final documents are required.

Administrative

The contractor is responsible for all services, travel, or sub-contractural expenses.



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