SHIP PRODUCTION COMMITTEE
FACILITIES AND ENVIRONMENTAL EFFECTS
SURFACE PREPARATION AND COATINGS
DESIGN/PRODUCTION INTEGRATION
HUMAN RESOURCE INNOVATION
MARINE INDUSTRY STANDARDS
WELDING
INDUSTRIAL ENGINEERING
EDUCATION AND TRAINING

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U.S. DEPARTMENT OF THE NAVY
CARDEROCK DIVISION,
NAVAL SURFACE WARFARE CENTER

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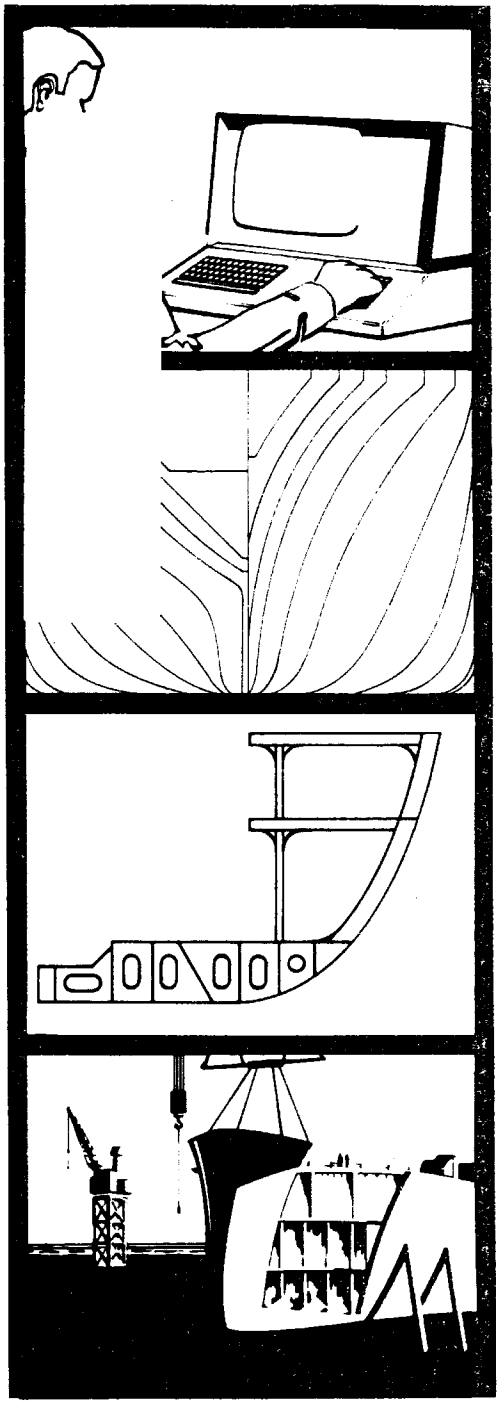


R ESEARCH
AND
E NGINEERING
FOR
A UTOMATION
AND
P RODUCTIVITY
IN
S HIPBUILDING

Proceedings of the
REAPS Technical Symposium
June 21-22, 1977
New Orleans, Louisiana

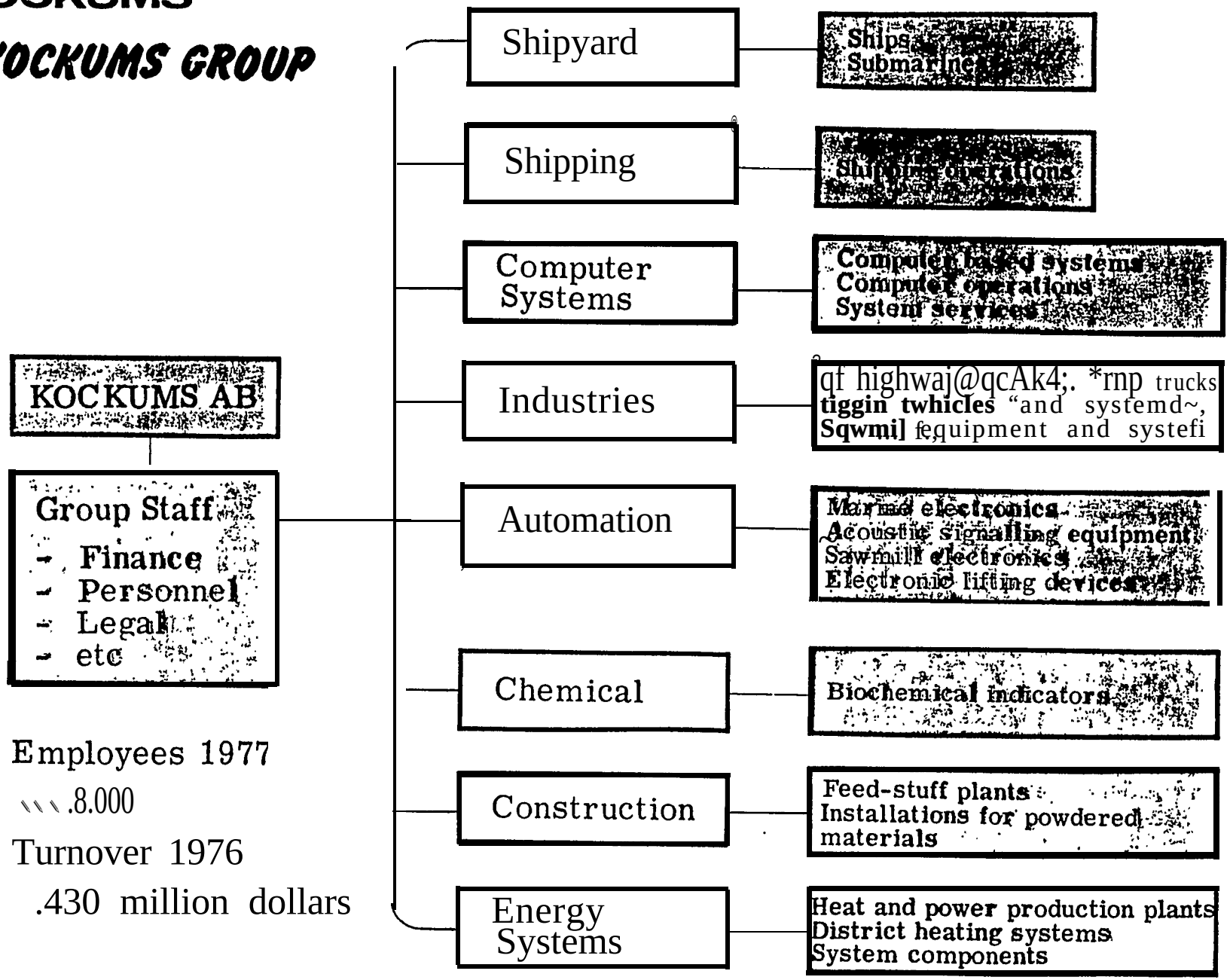
RECENT DEVELOPMENTS IN COMPUTER BASED SYSTEMS AT KOCKUMS

Kai Holmgren
Kockums Computer Systems AB
Malmo, Sweden

As the Director of Kockums Computer Systems, Mr. Holmgren is responsible for all its activity (development of systems, marketing, computer production, etc.). He has been with Kockums in various positions since 1961. Before that time, he was in charge of technical systems development at the Swedish Aeroengine Company.

KOCKUMS

THE KOCKUMS GROUP



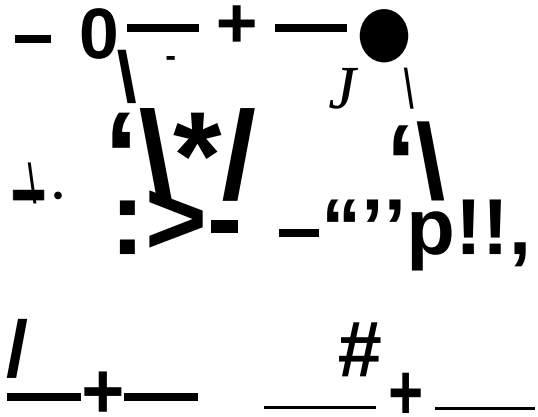
Employees 1977

\\\ .8.000

Turnover 1976

.430 million dollars

Information System

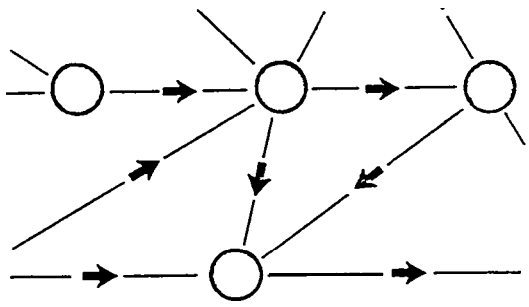


- Stations (Departments, persons, machines etc)

  producing
  consuming
  handling information

- Transportation ways
- Information media (documents, files, data bases etc)

Computer- based Information System

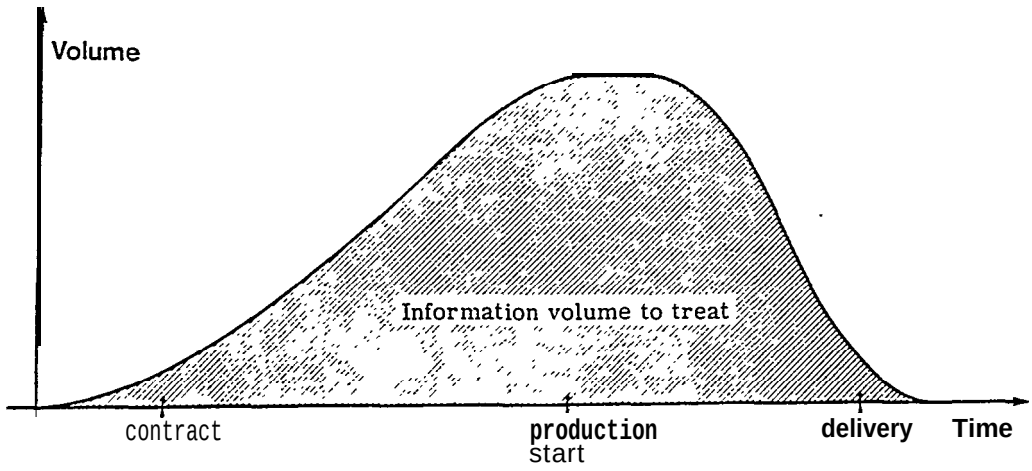


- Network covering the main activities of a company
- A major part of the activities are covered by computer applications
- The individual computer applications are designed so that they can "talk" to each other

Characteristics of Shipbuilding

- Tailor-made product
- Short series
- All activities concentrated around one complicated and expensive product
- Different types of design activities (Hull, out-fitting machinery)
- . Different types of production
- . Heavy product requiring extensive areas, transportations and lifting
- Much work done out-doors
- . Steel is costwise almost 50 % of the total material

Information Structure



- Large volumes of design and work preparation information (short series)
- Material information and standardization very vital.
- .The overall planning and follow-up is very essential (a ship represents a big and complicated project)

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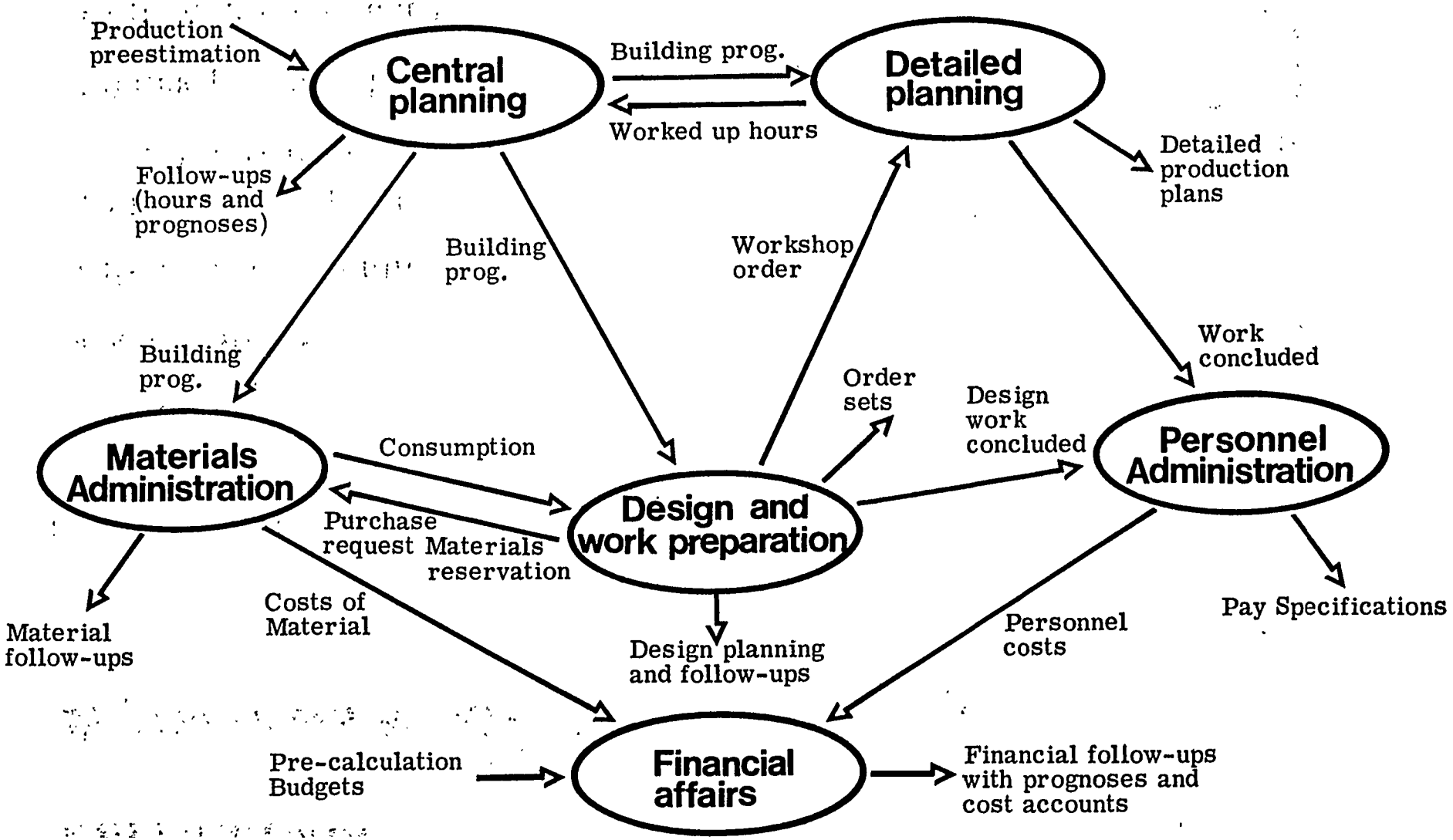
Survey SYSTEM



KOCKUMS

Display screen terminal

Inquiry / Dialogue

- Material status
- Work status
- Resource planning
- Plate and profile administration
- Work preparation
- Financial accounting
- . . . . . .

KOCKUMS

The planning function

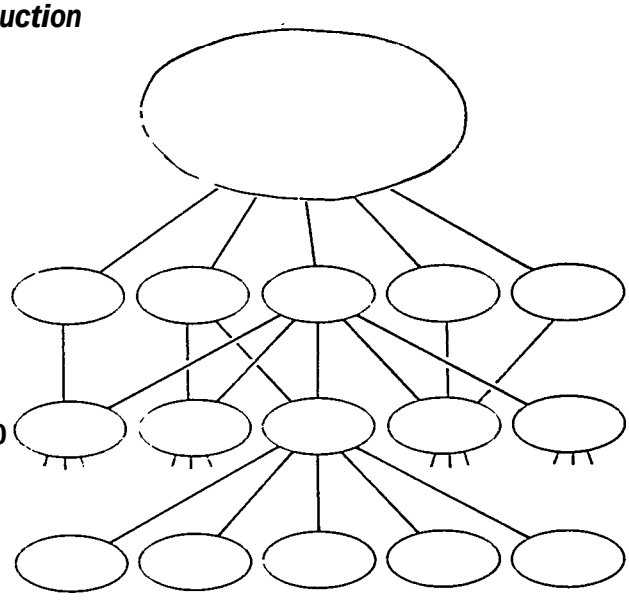
Central planning 

Detailed planning – design			
Drawing offices			
Hull P	*Electrical* F	*Outfitting* W	*Machinery* F

Detailed planning – Production		
Workshops		
Hull 4!+% components	*Hull w 10utfitting ~ assembly*	*Machinery~*

KOCKUMS

Planning levels for production



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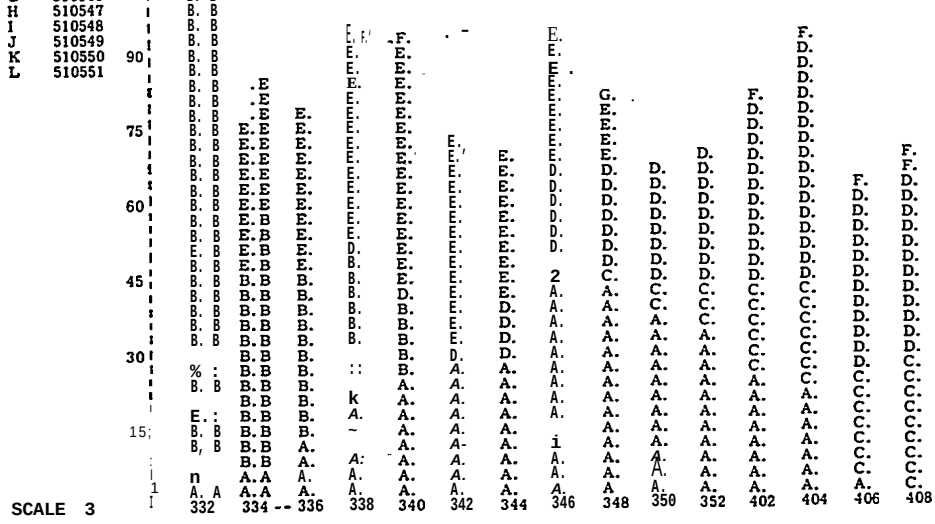
KOCKUMS MEKANISKA VERKSTADS AB
OH303A
WORK CENTRE: 729 -736

WORK LOAD DIAGRAM 1 PAGE 2-1
730827 WORKLOAD SCHEME

Work load diagram



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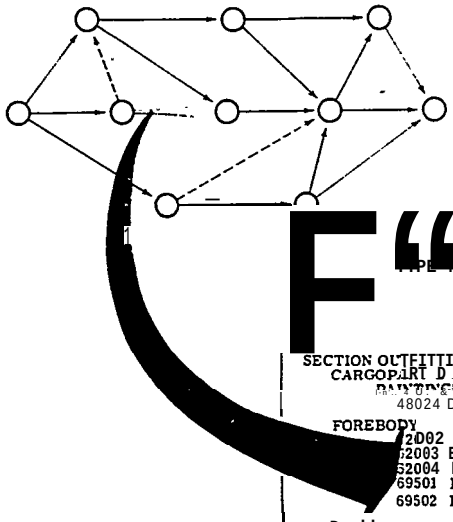
Conversion of a network into a building programme



PRODUCT

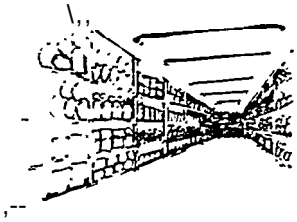
s o 510-549
PAGE: 25

TYPE NO 2CSELAY FLOAT OUTDOCK DESIGNVERRY

	DELIVERY WEEK DRAW-INGS	MA-TERIALS
SECTION OUTFITTIMi		
CARGOPART D SECTIOX		
PAINTING ZONE 1		
48024 D796BB READY-hL4DE FOR SEC OLTF	---	515
FOREBODY		
72002 FOREBODY OLTF. IN HULL DEPT	446	504
72003 El 391 SEC OUT	501	509
72004 B 991 READY-h2ADE FOR SEC OUTF	---	513
69501 PIPETOWER	446	504
69502 PIPETOWER READY-MADE	---	506
Deckhouses		
71302 H702 SEC OUTF	503	511
71304 H702 READY-MADE FOR SEC OuTFF	---	513
71503 H703SB SEC OUTF	502	510
71504 H'i03SB READY-MADE FOR SEC OUTF	---	510

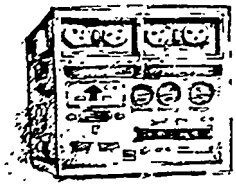
KOCKUMS

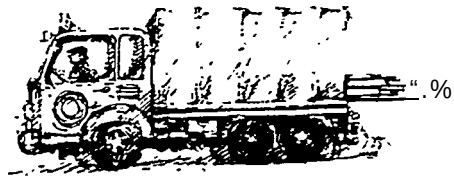
50,000 kinds of materials



10,000 (stock materials)

Ordered by the computer

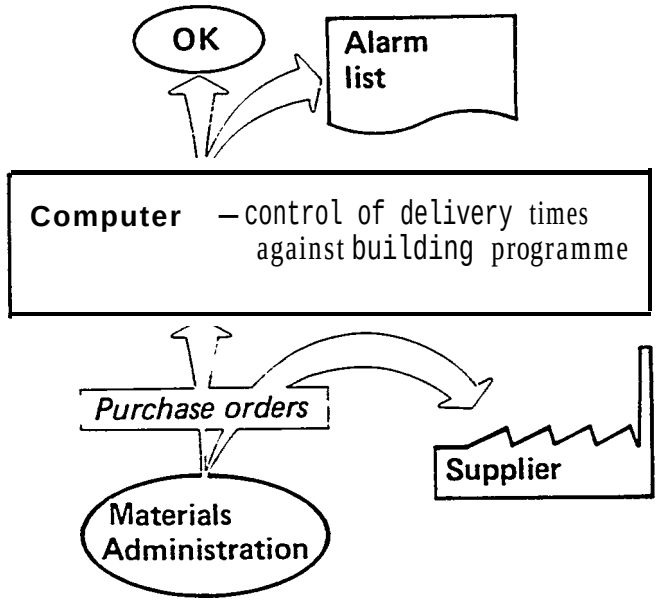




40,000 (direct materials)

Ordered by the designer

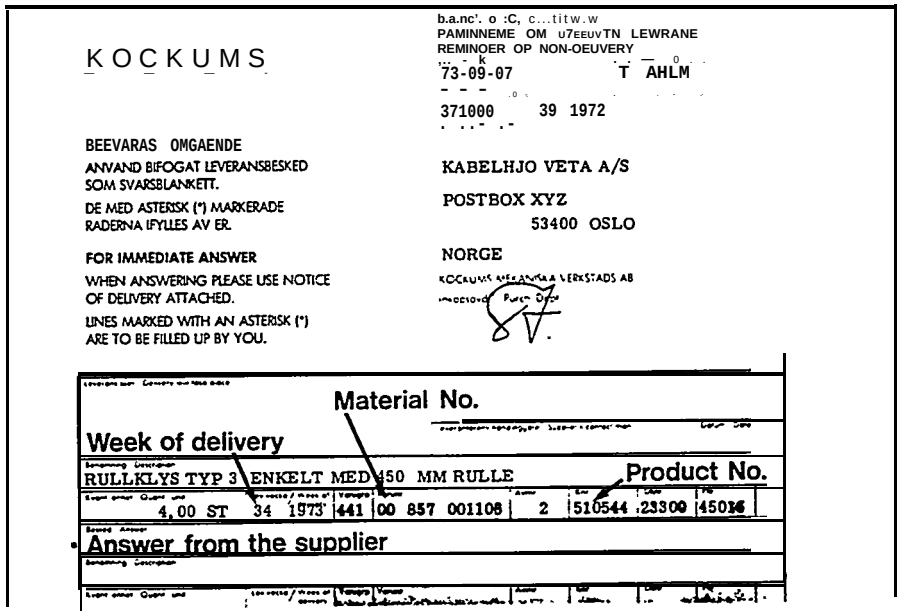
KOCKUMS



Purchase requests

KOCKUMS

Reminder of non-delivery



KOCKUMS

b.a.nc'. o :C, c...titw.w
PAMINNEME OM u7EEUVTN LEWRANE
REMINOER OP NON-OEUVERY
73-09-07 T AHLM
371000 39 1972

BEEVARAS OMGAENDE
ANVAND BIFOGAT LEVERANSBESKED
SOM SVARSBLANKETT.
DE MED ASTERISK (*) MARKERADE
RADERNA IFYLLES AV ER.

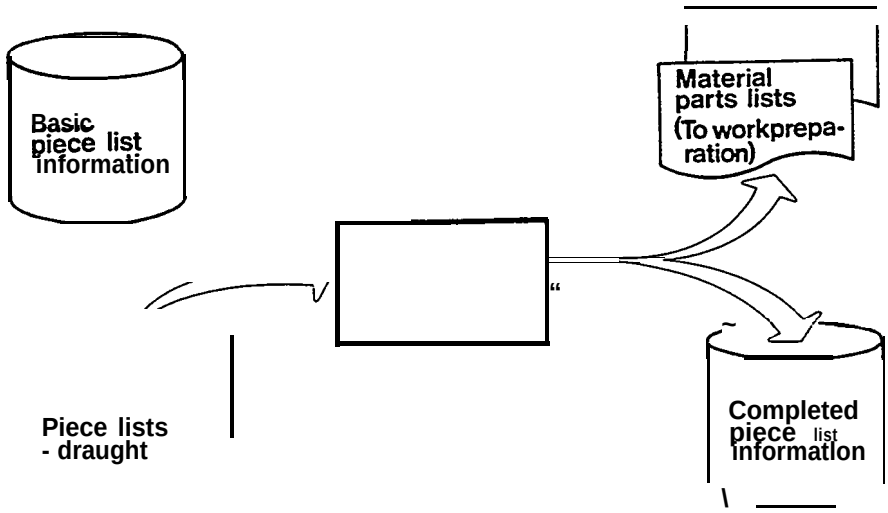
FOR IMMEDIATE ANSWER
WHEN ANSWERING PLEASE USE NOTICE
OF DELIVERY ATTACHED.
LINES MARKED WITH AN ASTERISK (*)
ARE TO BE FILLED UP BY YOU.

KABELHJO VETA A/S
POSTBOX XYZ
53400 OSLO
NORGE

Material No.
Week of delivery
RULLKLYS TYP 3 ENKELT MED 450 MM RULLE
Product No.
4,00 ST 34 1973 441 00 857 001108 2 510544 23300 45016
Answer from the supplier

KOCKUMS

Data bank for piece list information



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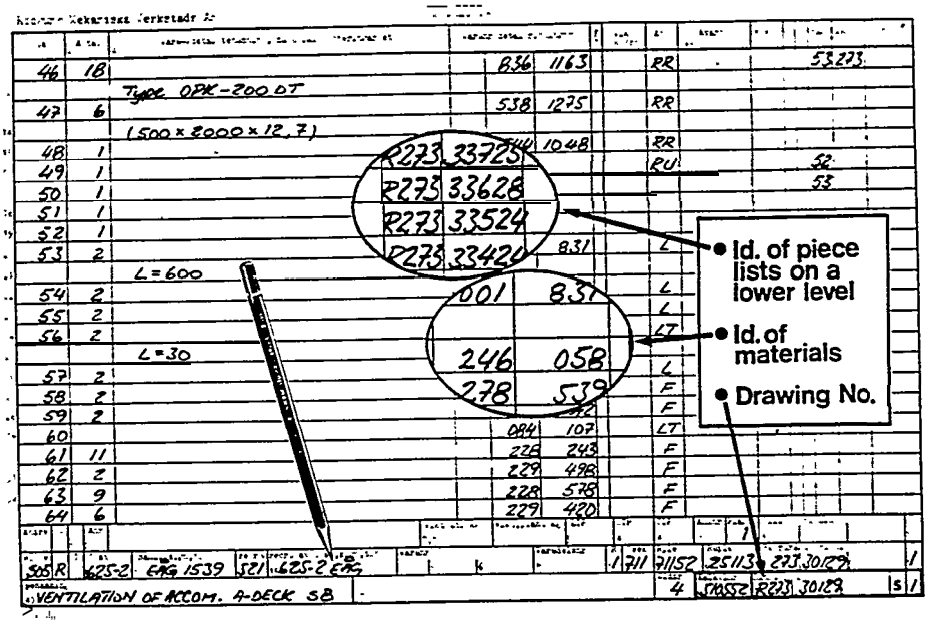
Piece list — draught



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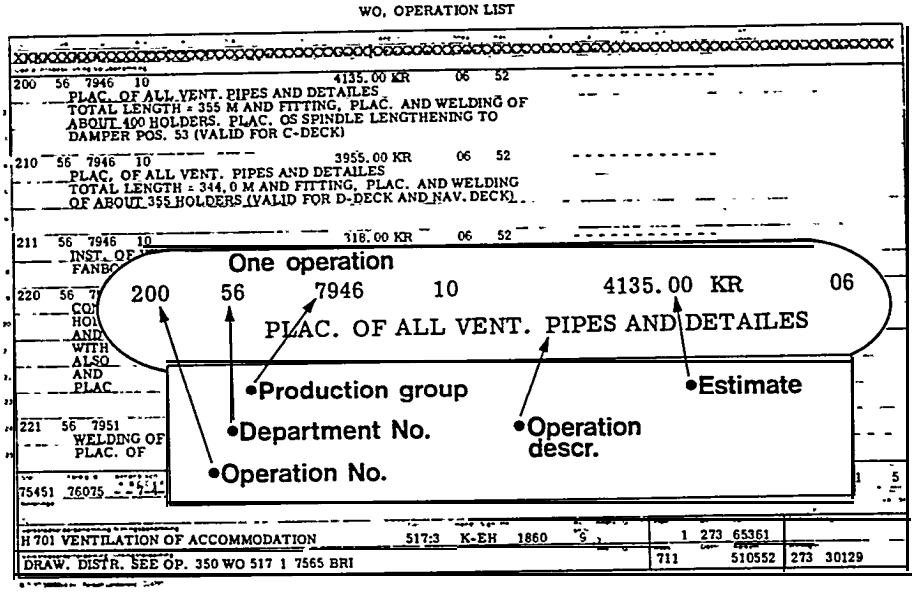
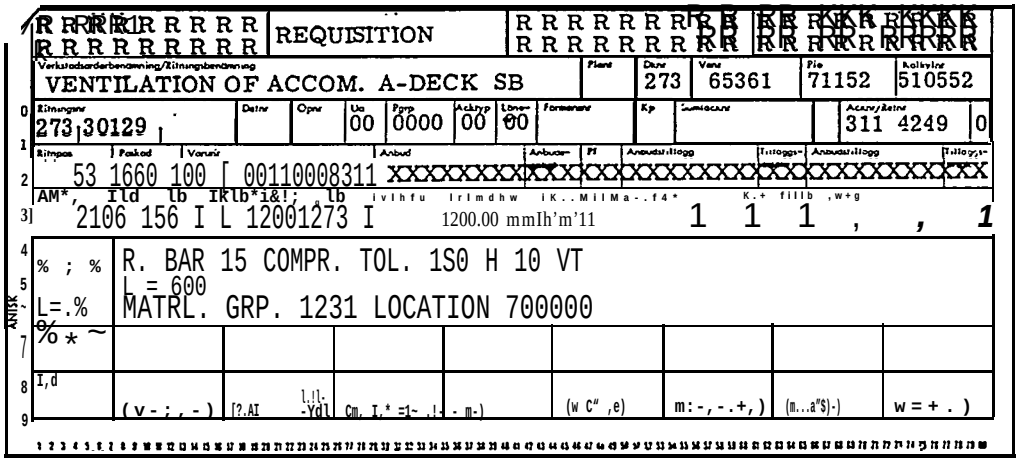
Operation list



KOCKUMS

Order-set–material requisition

- Product No.
- Planning unit
- Reference No. with check digit
- Material No.
- Planned quantity
- Required quantity (filled in manually)



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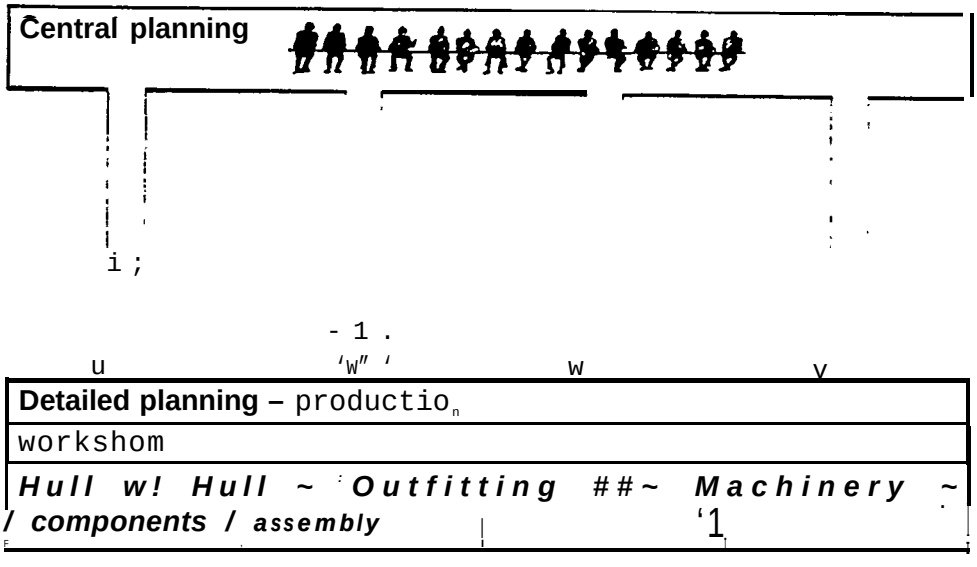
The planning function



KOCKUMS

Detailed plan for Workshops

KOCKUMS MEKANISKA VERKSTADS AB
OUTFITTING
QD1128

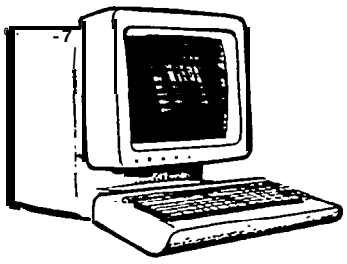
PRODUCTION PROGRAMME
① DEPT 734 ORDERDISTRIBUTION AREA 911
73-03-23

PRODUCT NUMBER	WORK SHOP ORDER	PLAN UNIT	JOB ②	PROD GROUP	PLAN HOUR ③	CA-PACITY	START	FIN-ISHED ④	STATUS	WORK ORDE DESIGNATIO
510539	59674	45015	10- 20	7046	16.7	0.8	73061	73085	8P	ou'rD3CNt.
510540	56848	32603	10- 20	7946	11.2	0.8	73081	73084	P	G 402 PLAC
510540	57093	32603	10- 20	7946	10.9	0.8	73 08]	73084	P	~ \;2&Yh;R
510540	44327	24513	40	7946	3.0	1.0	73082	73095		
510539	57179	71398	50- 70	7046	16.1	0.2	73082	73105	P	H-702 OUt
		REMAINING HOURS WEEK 7308 289							ACCUMULATED	1408
510539	55410	62703	140- 150	7946	16.0	1.1	73091	73094	-----	8903 DIDTI
510539	56960	38603	30- 70	7046						

- Identification of department and order distribution area ①
- Identification of a job ②
- Planned man-hours ③
- Starting and completion time ④

KOCKUMS

Production situation for a work order ?



Planned, processed and remaining man hours

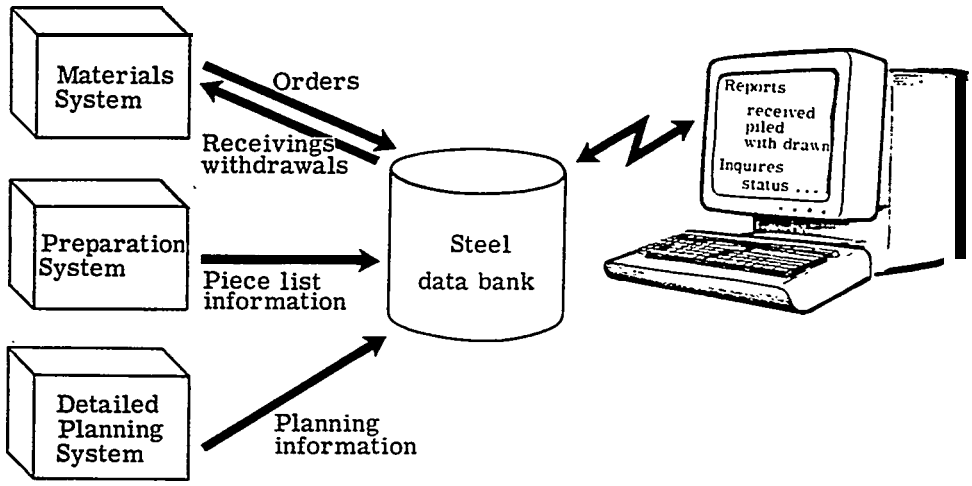
Planned start-end

Actual start-end

Current status of operations

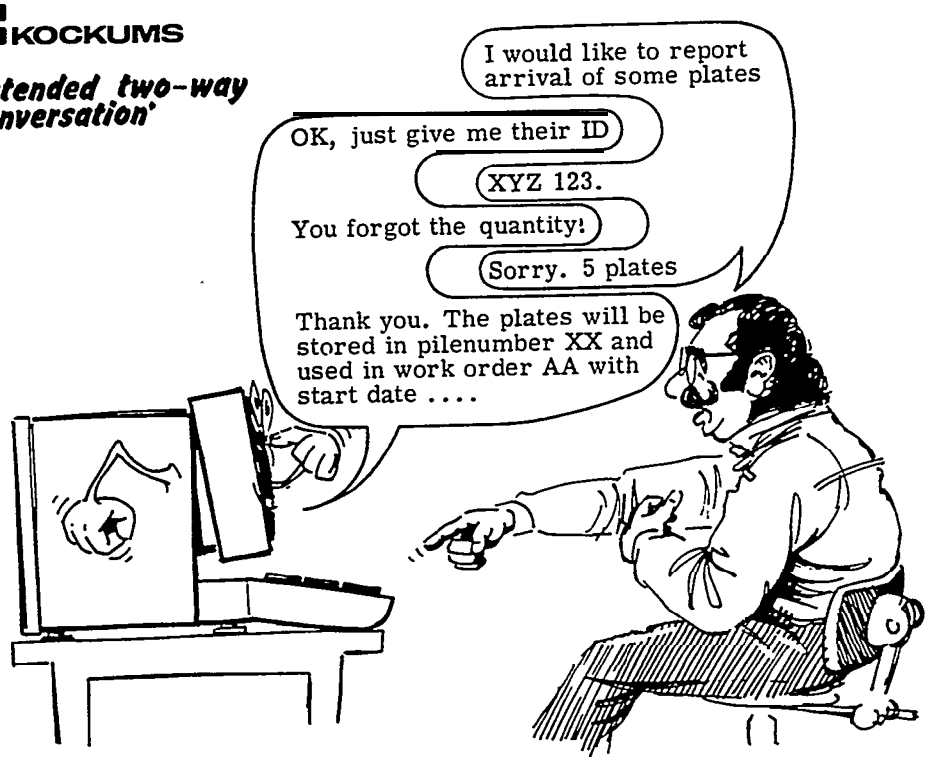
KOCKUMS

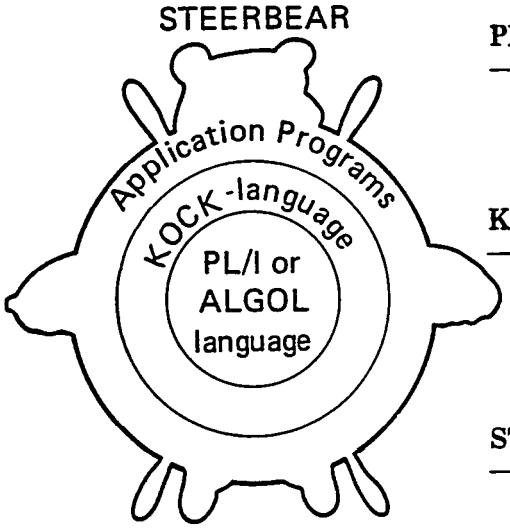
Steel administration system



KOCKUMS

Extended two-way 'conversation'





PL/I or ALGOL
— a general programming language

KOCK
— a programming language with geometry and data bank facilities

STEERBEAR
— an integrated system for shipbuilding application

C 302

Main features
of KOCK language

1 All PL/I or ALGOL available

2 Data base formats for

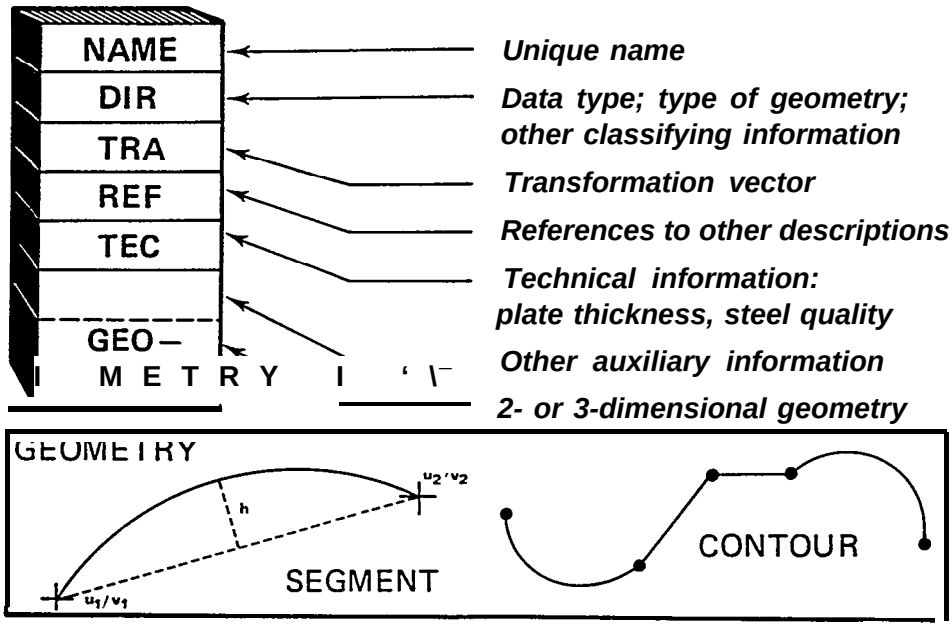
- Geometry
- Tables
- Arbitrary information

3 Extensive subroutine system for

- Data base operations
- Geometry and table handling

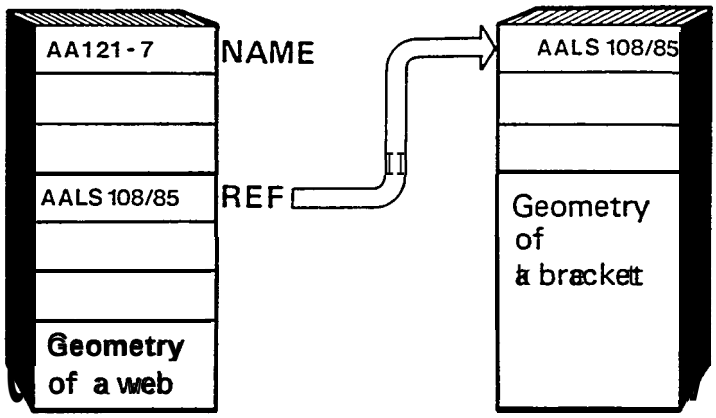
C 303

KOCK description in the data bank

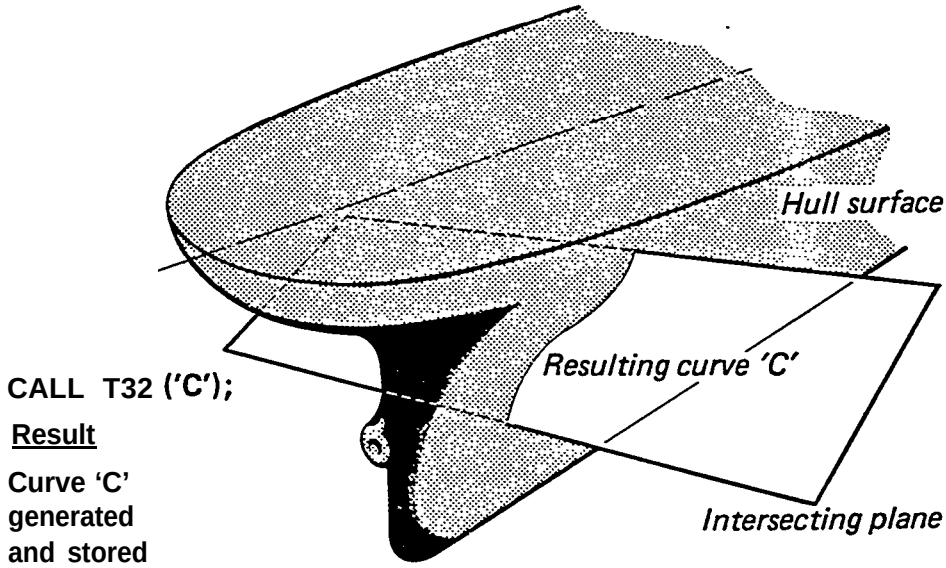


c 305

Reference between **KOCK** *descriptions in the data bank*



Cut surface with plane



CALL T32 ('C');

Result

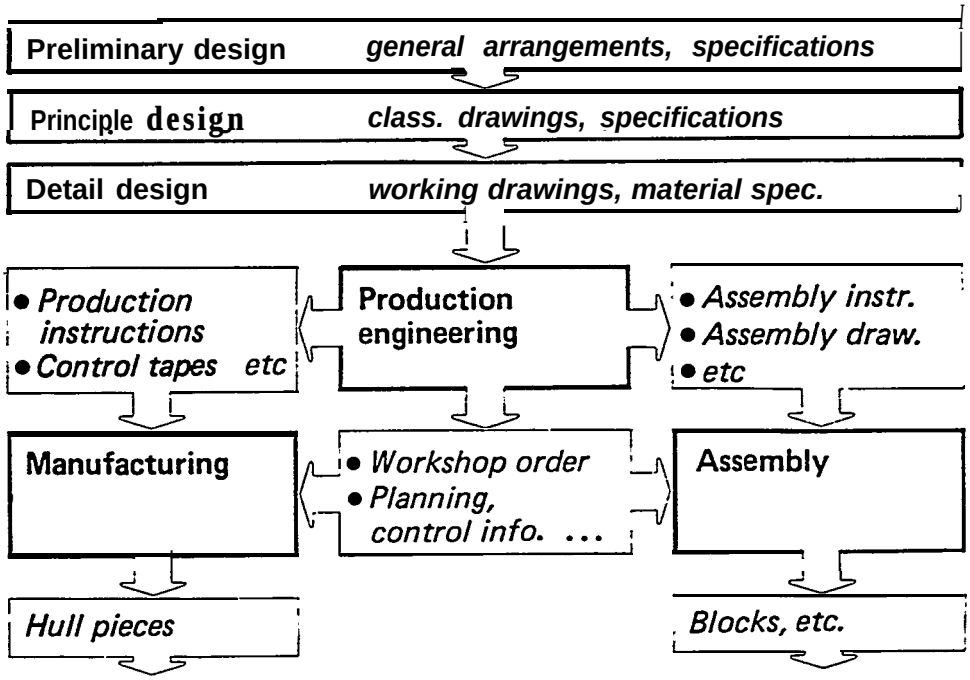
Curve 'C' generated and stored

c 501

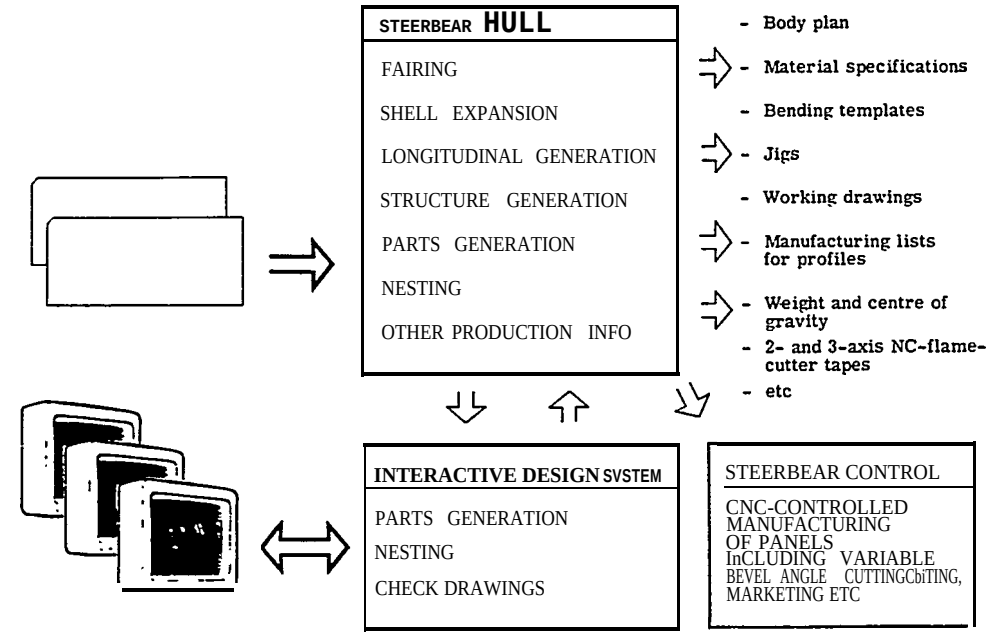
Some typical application subroutines

Hydromechanical calculations	• T61 — Moment of surface • T64 — Simpson integral • ...
Nesting	• PA3 — A nest • PM18 — Along to corner • PD1 — Draw text • ...
Generation of hull pieces (micro design standards)	• T200 — Generate outer contour • T232 — Set cutouts • T300 — Tripping bracket • ...

Principle flow – design and production

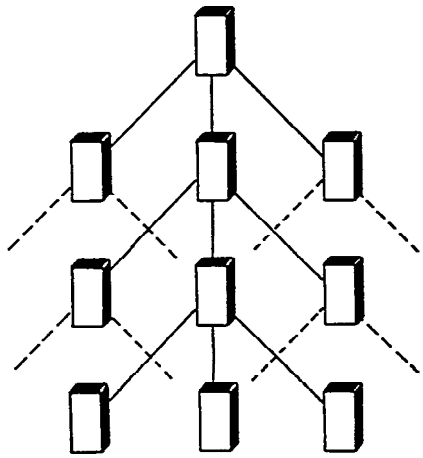


KOCKUMS



C 304

Hierarchy in data bank



	Example
Hull reference	**AA HULL 546**
Building blocks	**AA 121**
Panels	**AA 121–7**
Hull pieces	**AA 121–7–S250P**

C 506

Hull structure generation

Generation of panels

. Brackets
- Scallops, cutouts, holes
- Stiffeners, flanges
- ...

... can be done by

- KOCK programming

or

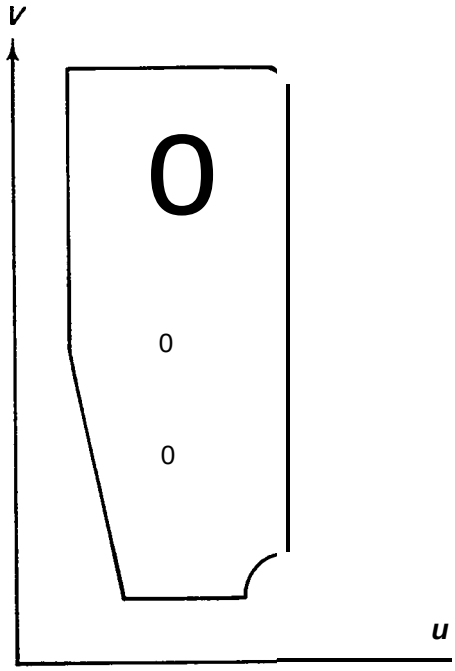
- Structure programming

... based on

- Micro design standards
- Special set of application subroutines
- Structure data bank

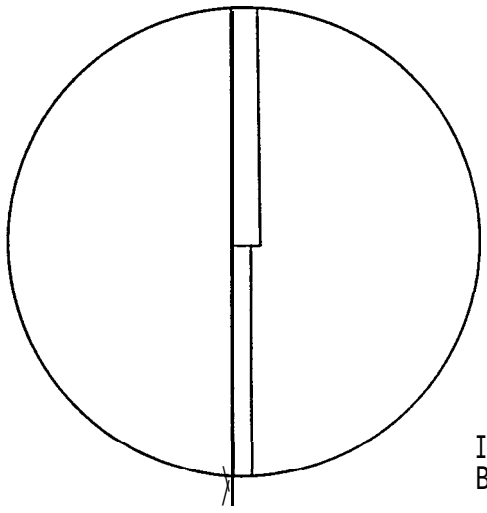
Simple KOCK program

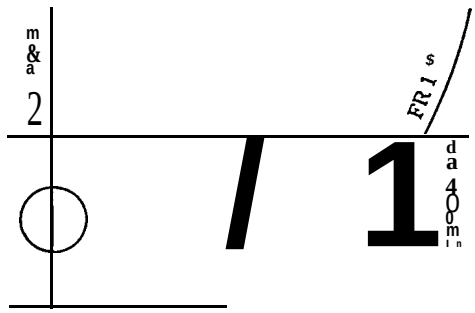
```
...
INITIATE KOCK (2000);
TREAT (≪TESTEIT≫);
POINT (200,100);
SEGMENT (0,425,100);
CIRCLE (-75,90,90);
SEGMENT (0,500,1050);
CIRCLE (50,90,90);
LINE WITH ANGLE (180,350);
LINE WITH ANGLE (270,500);
SEGMENT (0,200,100);
FOR V = 450,850,900 DO
IF V≺900 THEN
ADD CIRCULAR CONTOUR (300,V,50)
ELSE
ADD CIRCULAR CONTOUR (300,V,75);
NREA = 1;
REA (1) = 14.5;
PUT RECORD (≪DIM≫,2,-1);
KOCK DUMP (≪TESTEIT≫);
DRAW DESCRIPTION (≪TESTE
TERMINATE KOCK;
...
```



KOCKUMS

Panel boundaries





INPUT:
BOUNDARY, FR148/V=5200/'AG162-3'

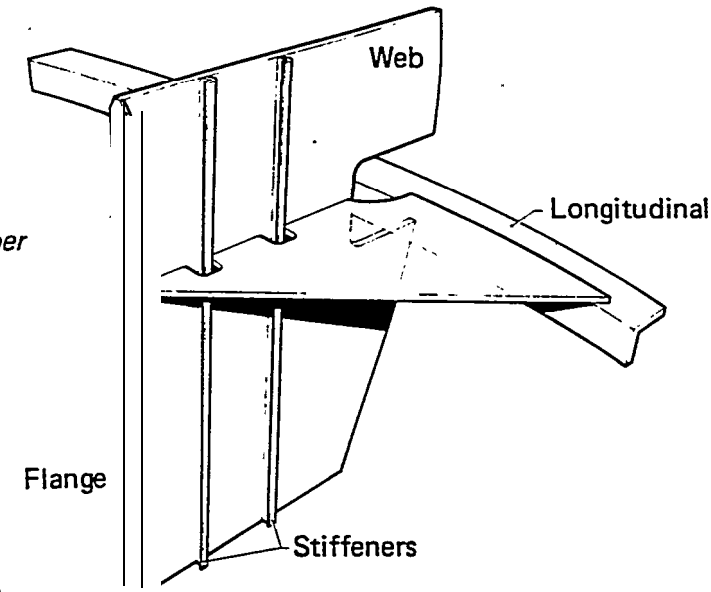
Tripping bracket

Input:

- *Connection code*
- *Longitudinal number*
- *Thickness*
- *Side*
- *Quality*

Result:

The bracket generated and stored

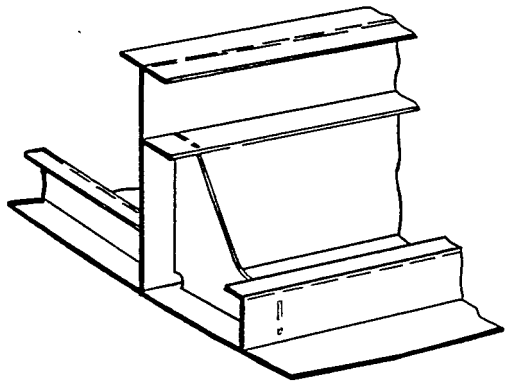


KOCKUMS

Special bracket

INPUT:

- References to longitudinal curve, surrounding panels, profiles etc.
- Some measurements
- Thickness
- Quality

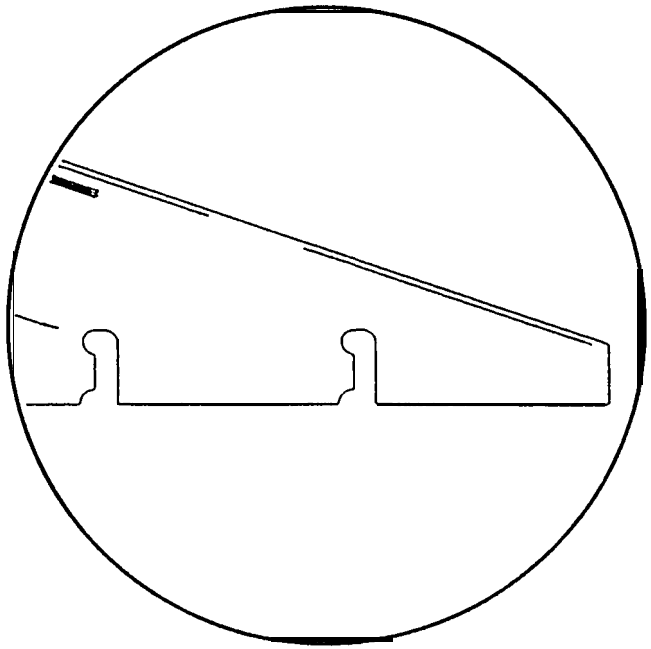


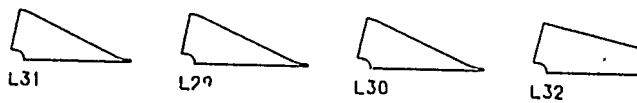
RESULT:

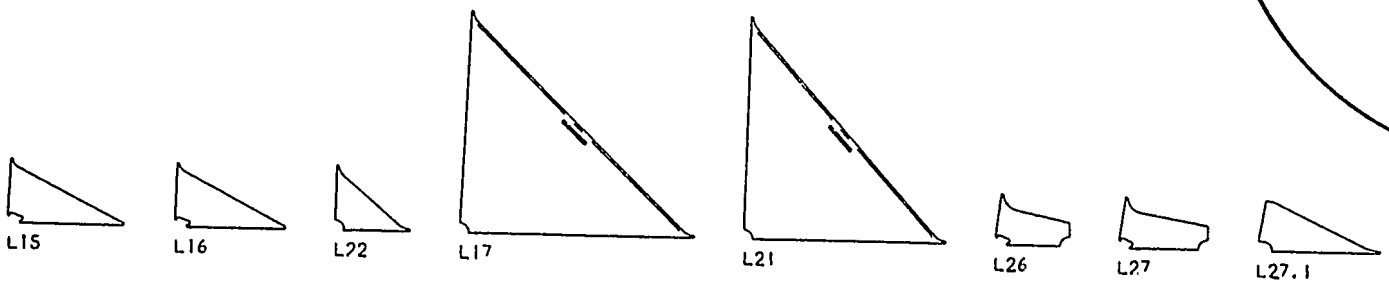
The bracket generated and stored.

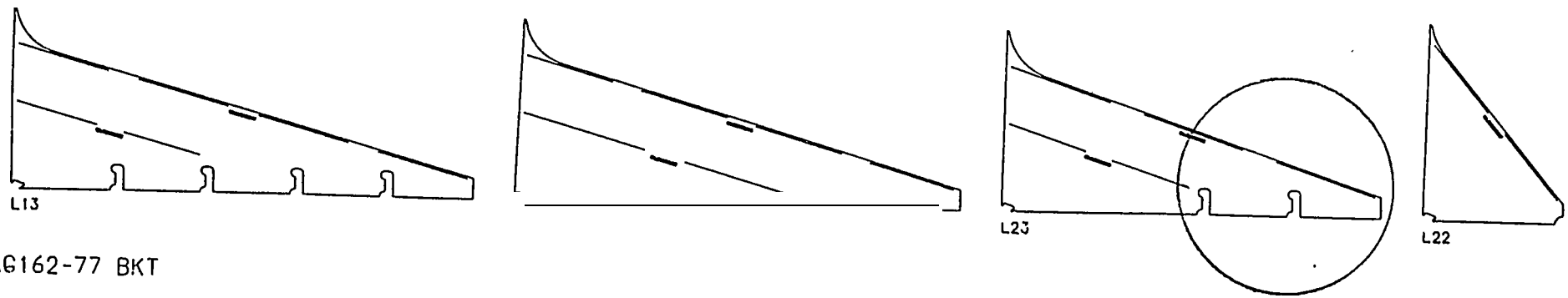
KOCKUMS

Result of structure programming



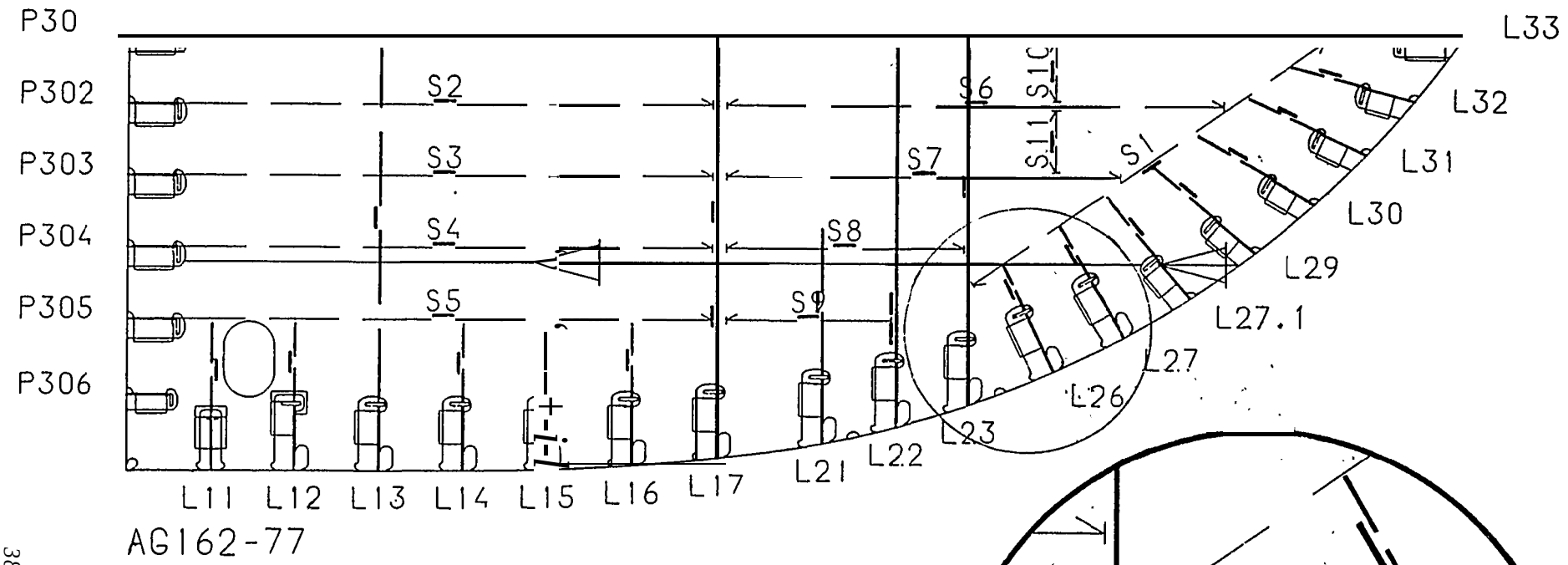


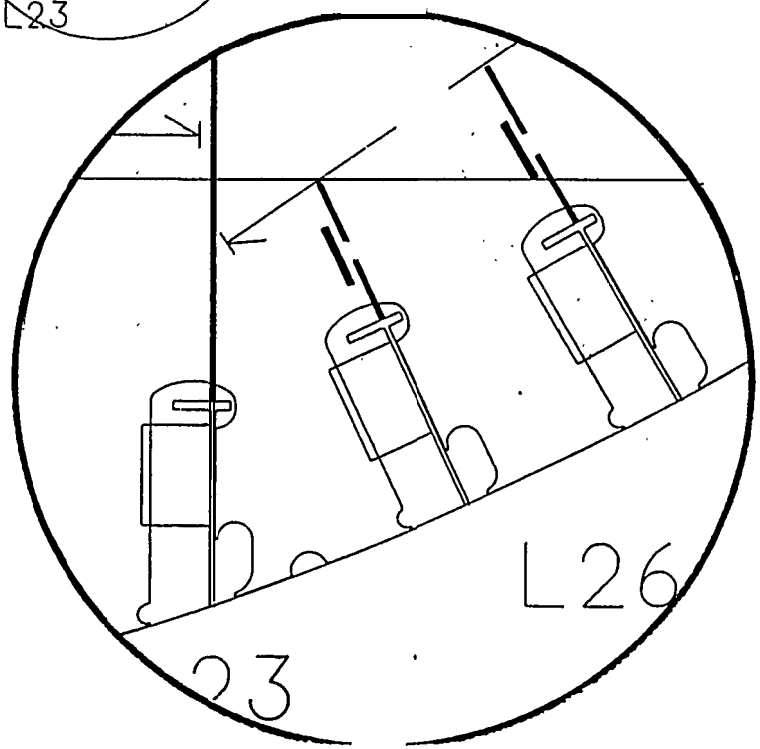




AG162-77 BKT

KOCKUMS

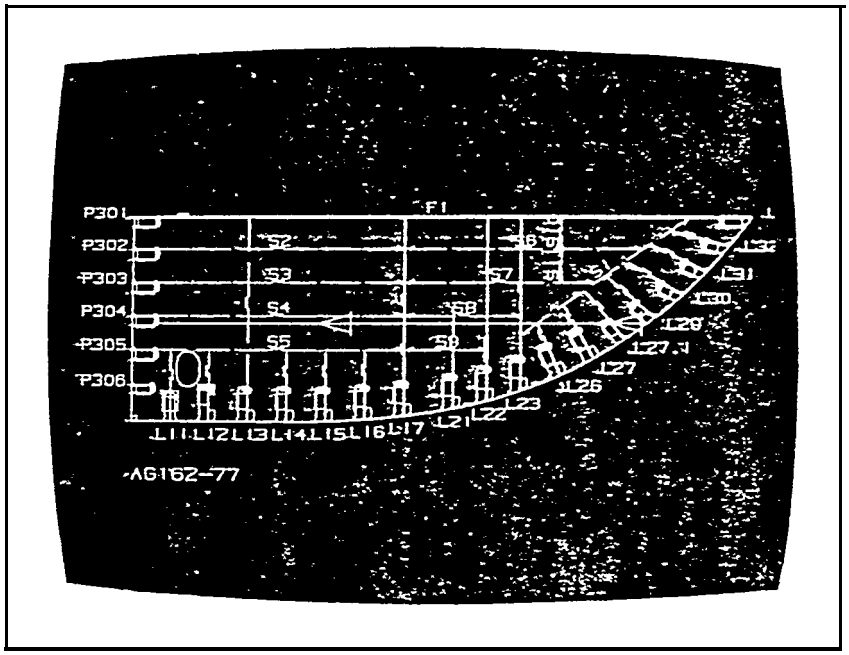




Result of structure programming

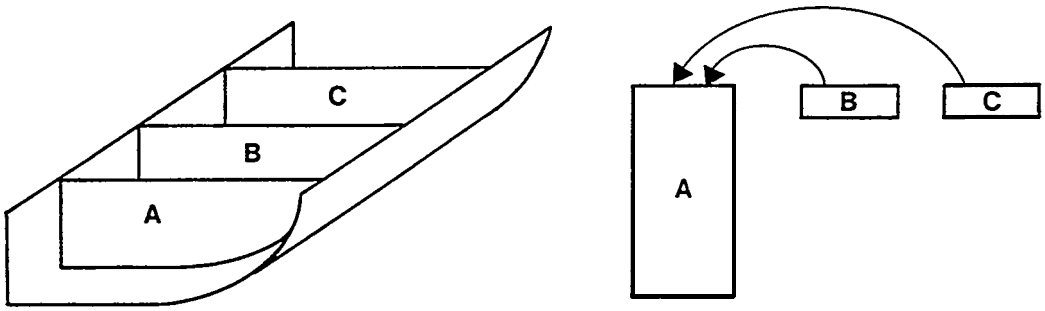
KOCKUMS

Check drawing



KOCKUMS

Identical panels



INPUT:

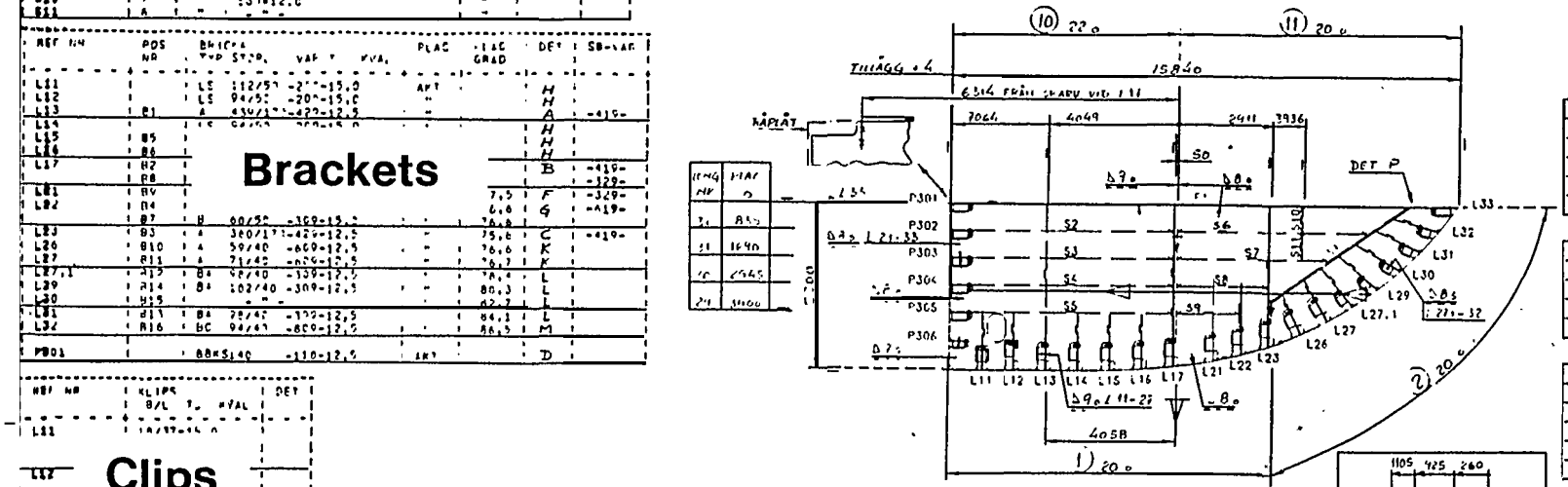
PANEL, 'B', 'C', EQUAL, 'A', X = FR252, FR255;

WORKING DRAWING

Stiffeners

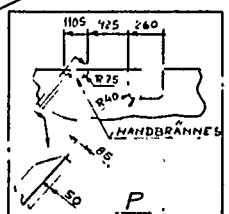
Brackets

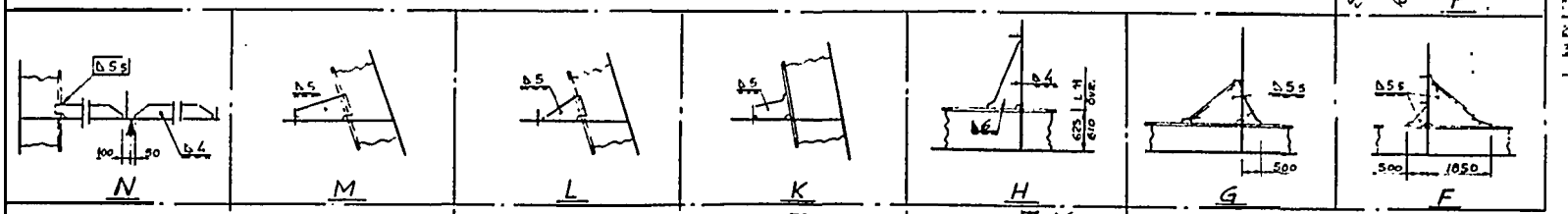
Clips

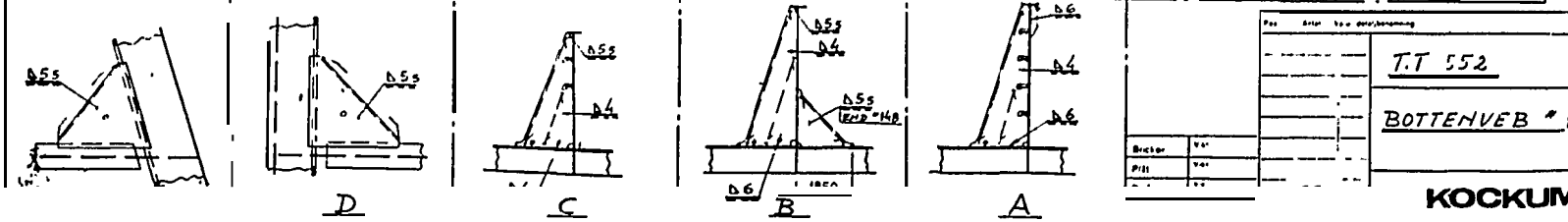


VEB SPT "148

BB SIDA VISAD - SP. LIKN







Detalmarkering

VEBSP "148	162	7	

Förkortningar använda

VEBKAMP "148	120/-/32

Tillkommande rätt av för stend blad

Ändringsanteckningar

SIDPLÅGSN	16/1··
LÅNGSÅ SKOTT	116/3··

1 SETT SOLFJÄLL
2 STAG PLAC PÅ AKTERKANT
3 KLIPS PLAC PÅ FÖRKANT

A42
A4102

T.T 552

BOTTENVEB "148

623 ·1111·

TEL 1683 FORMAT A2 7625 1:100

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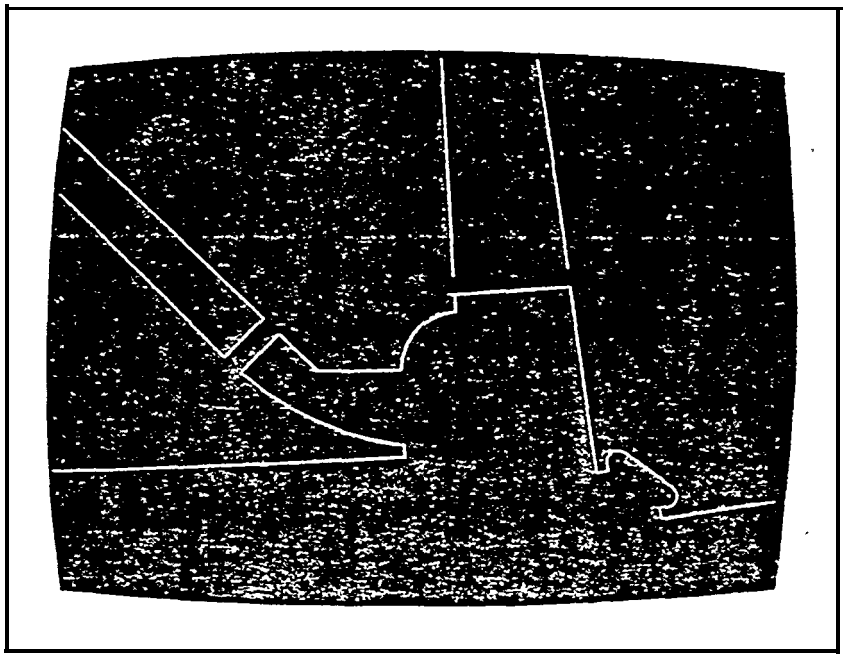
Nesting: burning bridges



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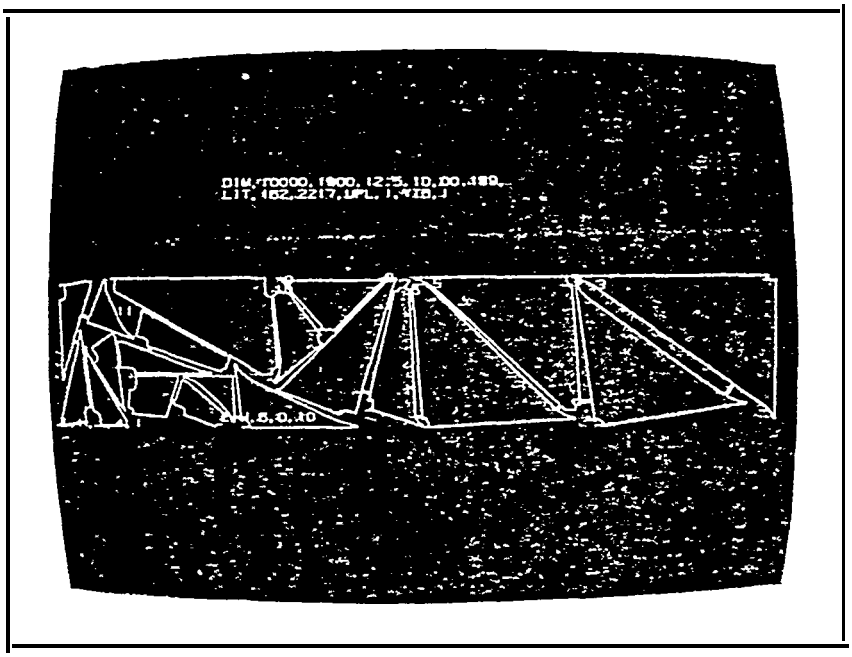
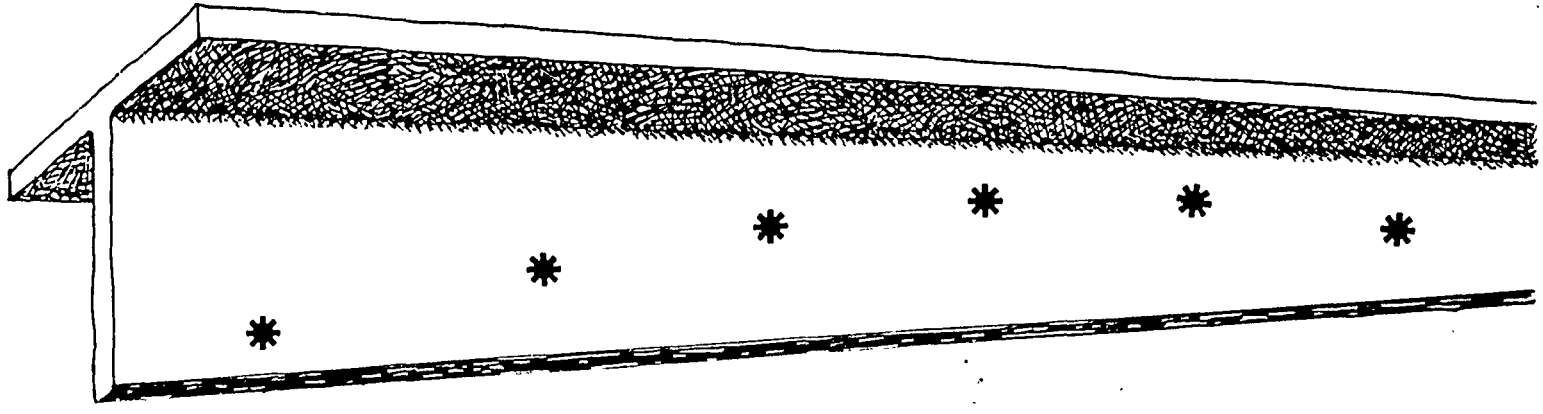
Complete nesting



Longitudinal bending table



KOCKUMS MEKANISKA VERKSTADS AB — MÄRKLISTA FÖR LONGITUDINALER — RITNINGSNR 113/10146/- — KALKYLNR 510-546 — DKNR 113 — VONR 1131 — PLE 24202 — SID 1

TS109A — 1973-09-07

RNR-GNR-LNR	LÄNGD	/ S B / DS	B / AS	B / DS	AS /	VIKT /		TYP	MÄRKES	X N D K A P S D A T A A										FASL	FASF
										A	B	C	R1	R2		V1	V2	V3	V4		
131-1-4	8800	/--	--	/--	1/	1066	/ *1*	31	AKT			14	75			90,4	30	30	90,0		
							/ *2*	31				14	75			90,0	30	30	90,0		
TYP/DIMI	43/660*200*13,5*35,0						/														
						***** H Å L *****															
HE150*75	V=53	U=960,1920,2880,3840,5600,6400,7200,8000																			

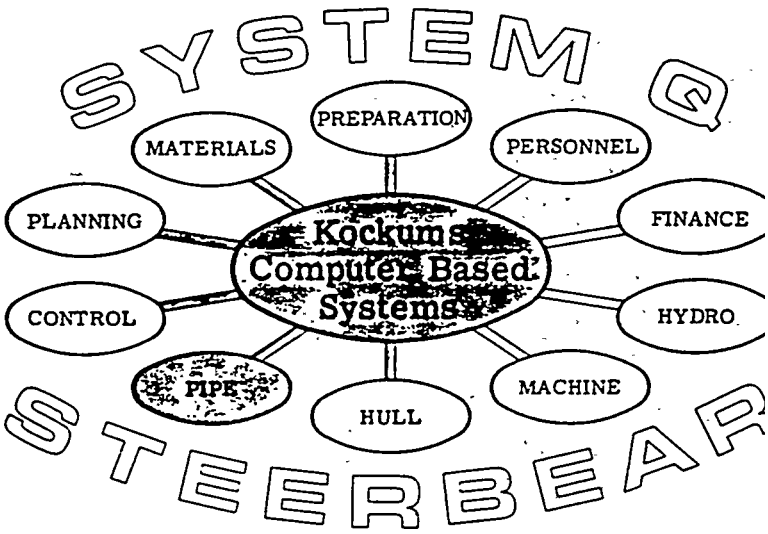
BOCKNINGSTABELL 1

AVST	HUJO	AVST	HUJO	AVST	UUJO	AVST	HUJO
0	459	2500	465	5000	463	7500	4bQ
500	4b2	3000	4b5	5500	462	8000	460
1000	*4b4*	S500	464	6000	462	8500	459
1500	*4b5*	4000	464	b9Q0	461	0797	459
2000	4bS	4500	463	7000	461l		

BOCK NINOST ABEL L2

AVST HOJO	AVST HUJO	AvST HUJD	AVST HUJO

KOCKUMS



- Simplify and rationalize design work
- Check production restrictions on design automatically
- Minimize manual search in standards file
- Automate pipe sketch production
- Simplify changes in standards and design
- Minimize the manual effort to obtain complete production information
- Automate the calculation of cutting lengths, bending angles etc
- Produce automatically NC-tapes for bending machines
- Simplify sister ship handling

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STEERBEAR PIPE
— Main Activities

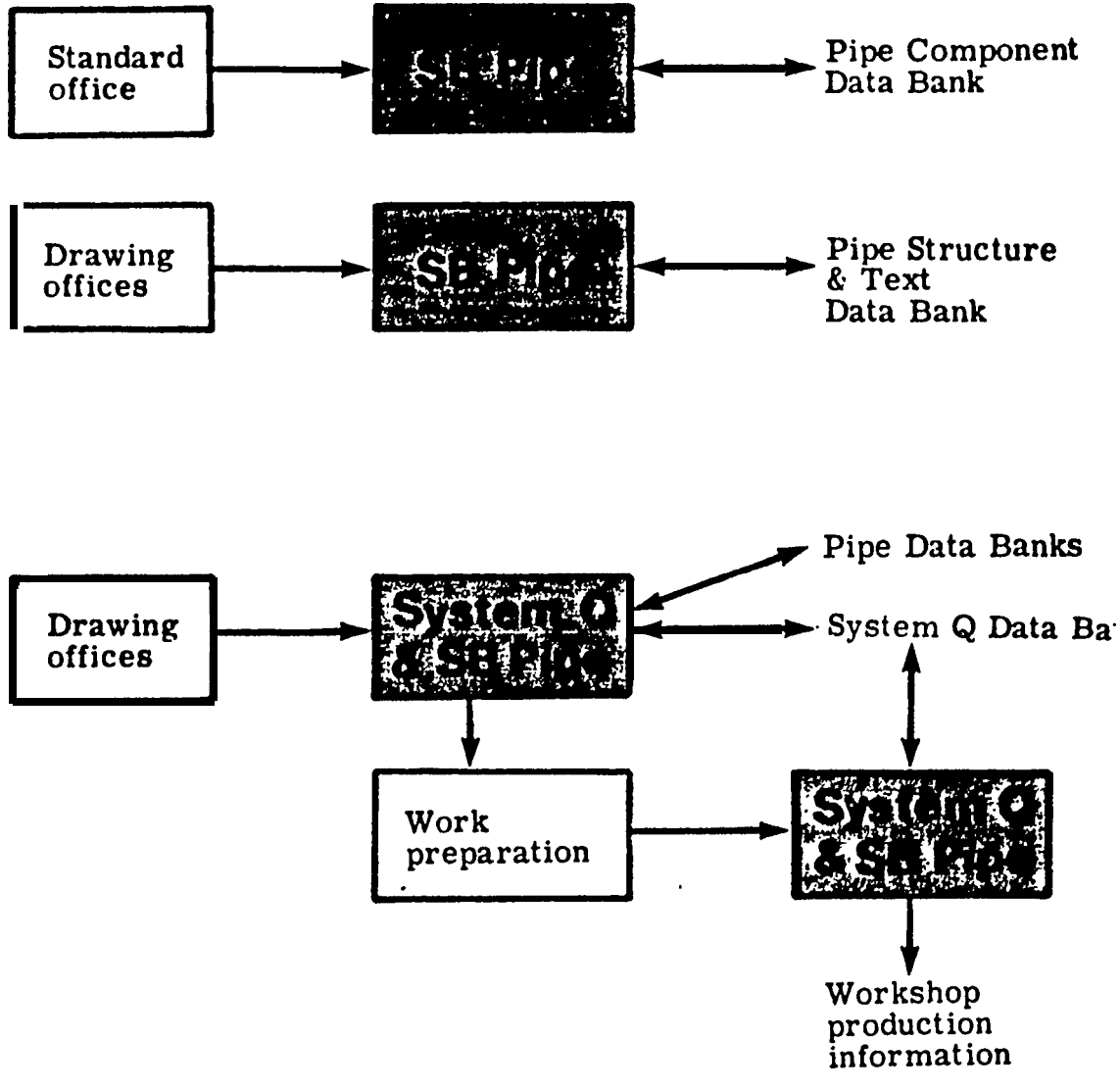
COMPONENT DEFINITION

DESIGN

- Initiation
- Scheme input
- Pipe Geometry Definition

PRODUCTION

- Work preparation information
- Workshop information



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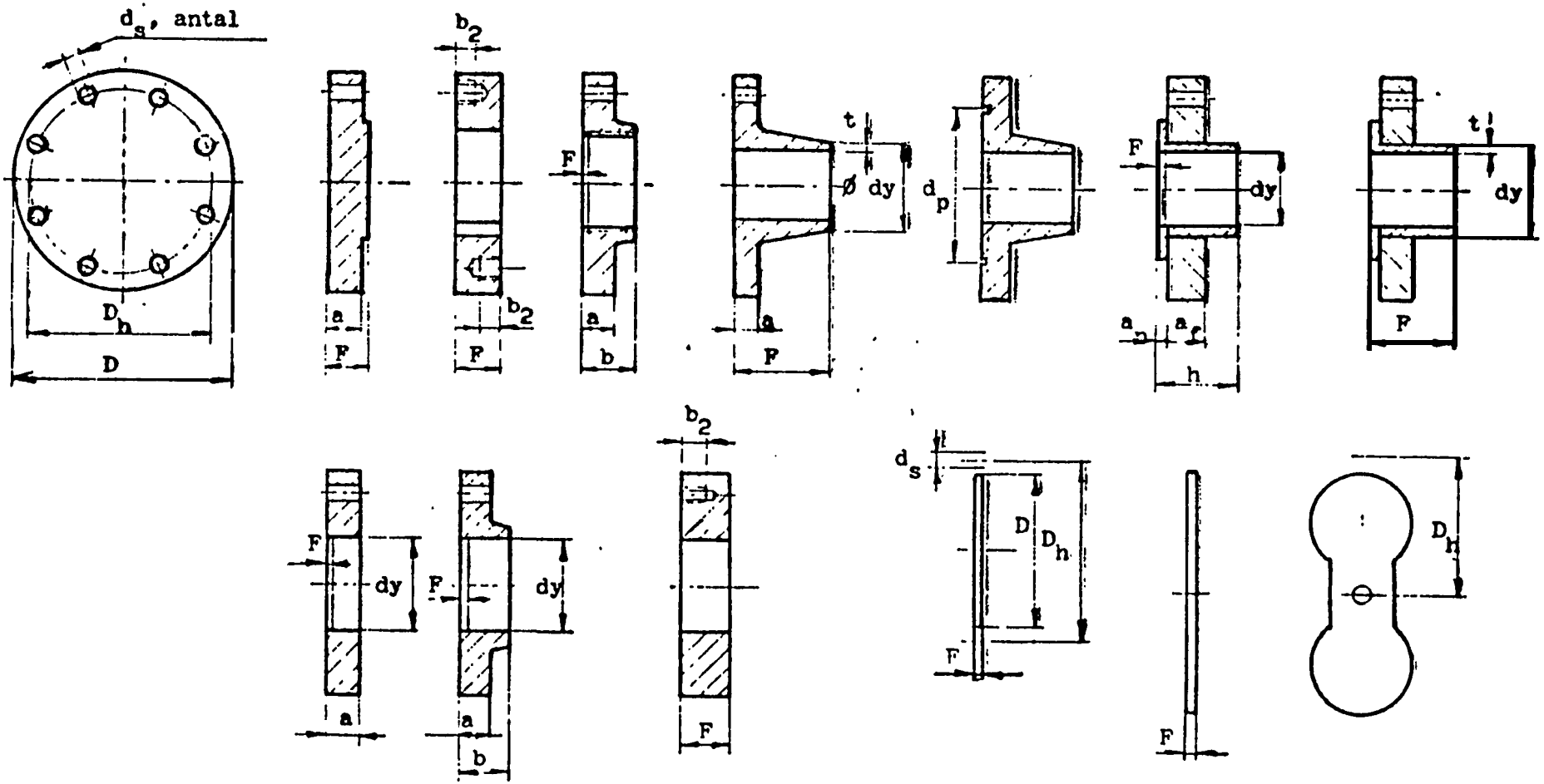
STEERBEAR PIPE
– Stored Flange Standard



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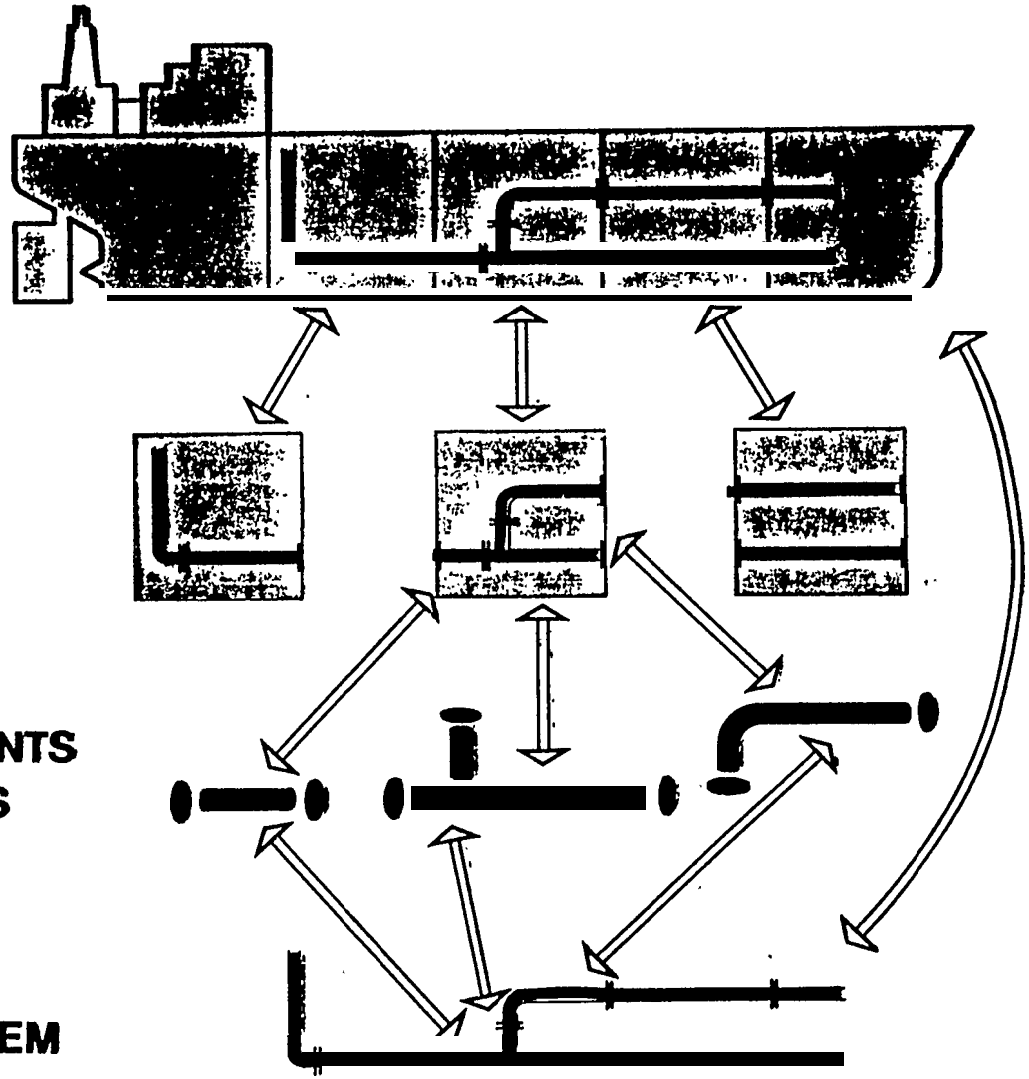
STEERBEAR PIPE
– Data Bank Structure



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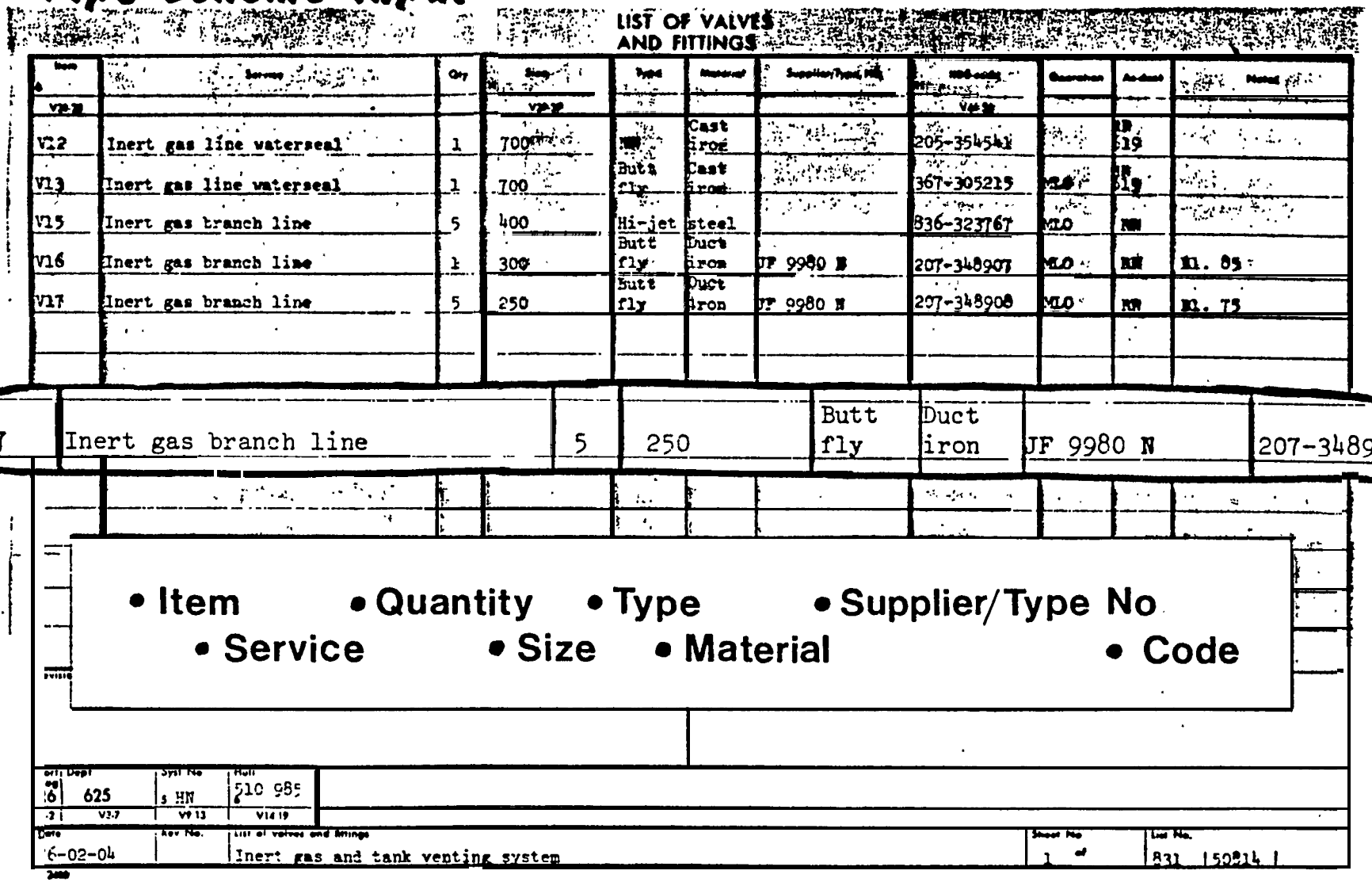
STEERBEAR PIPE

— Pipe Scheme Input



LIST OF VALVES AND FITTINGS

Item	Service	Qty	Size	Type	Material	Supplier/Type No.	Code No.	Connection	Actuator	Noted on
V12	Inert gas line waterseal	1	700		Cast iron		205-354541			
V13	Inert gas line waterseal	1	700	Butt fly	Cast iron		367-305215			
V15	Inert gas branch line	5	400	Hi-jet	steel		836-323767			
V16	Inert gas branch line	1	300	Butt fly	Duct iron	UF 9980 N	207-348907			
V17	Inert gas branch line	5	250	Butt fly	Duct iron	UF 9980 N	207-348908			

V17	Inert gas branch line	5	250	Butt fly	Duct iron	UF 9980 N	207-348908

- Item
- Quantity
- Type
- Supplier/Type No
- Service
- Size
- Material
- Code

Off. Dept	Syst No	Hull
6 625	s HN	510 985
V3-7	V9 13	V14 19

Date	Rev No.	List of valves and fittings	Sheet No	List No.
6-02-04		Inert gas and tank venting system	1 of	831 150814 1

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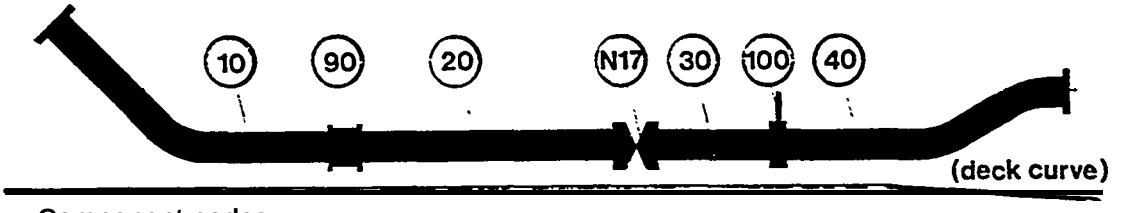
STEERBEAR PIPE
–Pipe Geometry Definition

UHN1- HN1

Position numbers



Component codes

F18	**K43**	**F18**	**F18**	**F18**
		HNV17	**VNR ,233-348733**	
		F18	**F18**	

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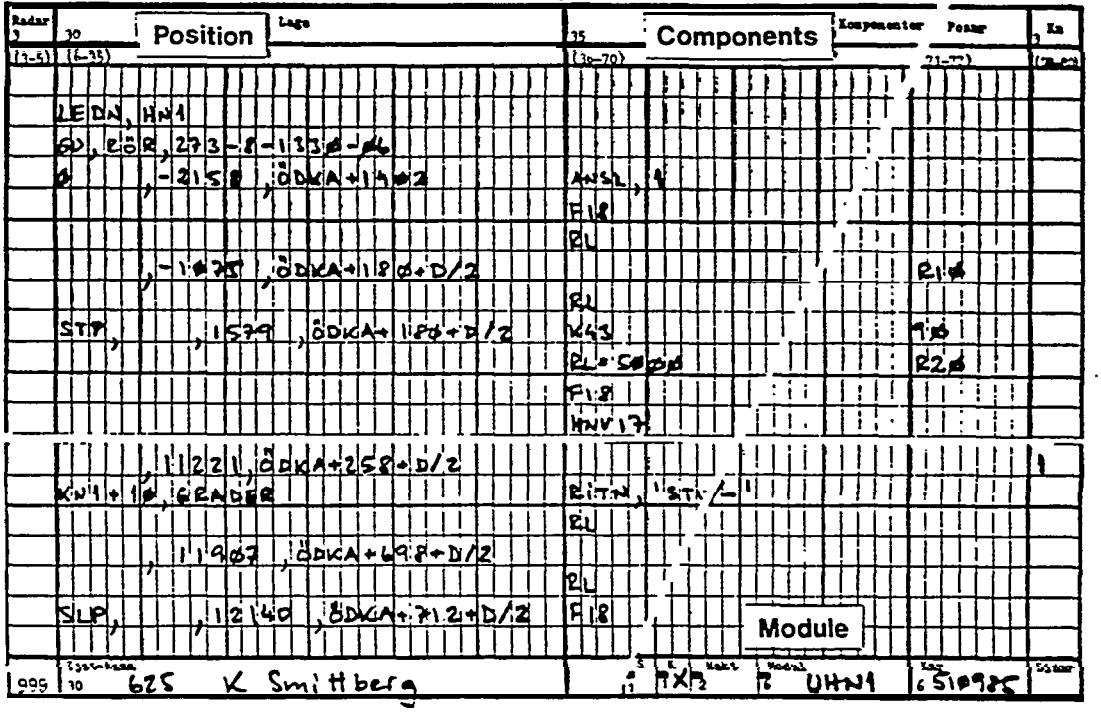
STEERBEAR PIPE –Pipe Geometry Definition



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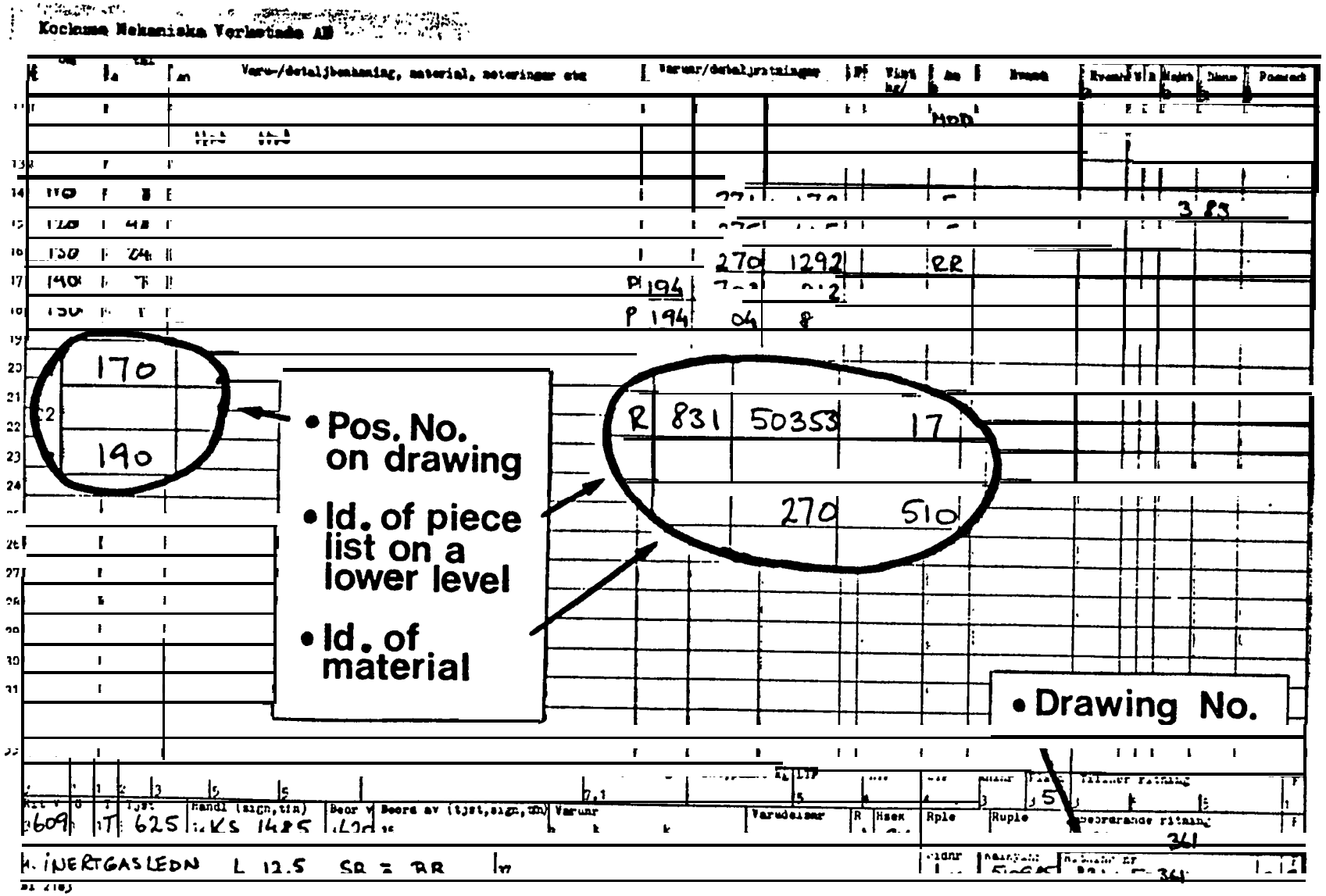
STEERBEAR PIPE
– Piece List Draught



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STEERBEAR PIPE
– Pipe Sketch