OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

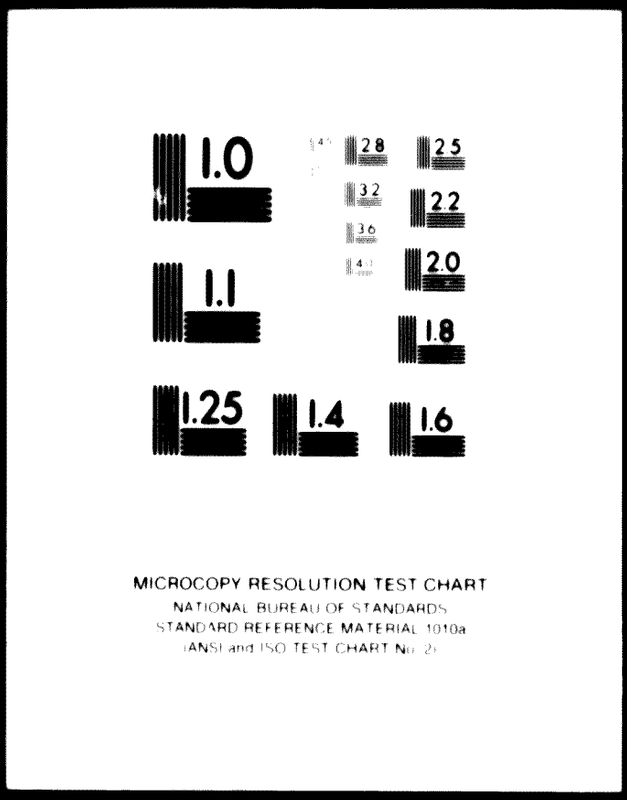
FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org


1.0
1.1
1.25
1.4
1.6
2.8
2.5
3.2
2.2
3.6
2.0
1.8
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS
STANDARD REFERENCE MATERIAL 1010a
(ANSI and ISO TEST CHART No. 2)

MINISTRY OF ECONOMY
Research Center For Industrial
and Trade Development
Tehran - Iran

Survey Report on Proposed Metal Cutting Tool Plant in Iran

By: A. Millward
J. Goodwin
A. Sohanaki
J. Sanandaji

JULY 1972

United Nations Industrial Development Organization

PROJECT NO: IRA-OII-A (SIS)
COUNTRY: IRAN

PROJECT TITLE: Survey Report on Proposed Metal Cutting Tool Plant - Iran.

BY A. Millward, UNIDO Expert-Cutting Tool Production.
J. Goodwin, UNIDO Advisor on Project Evaluation.

COUNTERPARTS: A. Sohanaki
S. Sanandaji

Final Report

Country: IRAN Official: A. Millward

Duration of contract. 4 months-from 21 Feb. 1972 (Extended to 5 months)

Project No. IRA-OII-A(S.I.S.)

Field of work: Cutting Tool Production Expert.

Distribution:

3 copies : Mr. N.A. SIDDIQUI
Chief of Area Section-UNIDO-Vienna

1 copy : Mr. A. MANOS, Chief, Technical
Assistance Unit-Bangkok-Thailand.

1 copy : Mr. A. AGHASSI - Senior Ind.
Dev. Field Adviser - Islamabad Pakistan.

1 copy : Mr. Nessim Shallon.
Resident Representative
U.N. Development Programme, Tehran.

CONTENTS

1. GENERAL

1.1 The expert arrived in Tehran on 23 February 1972 to take up appointment.

1.2 During the first three weeks he was introduced to several administrative staff members of various Government Organizations, and was briefed on the background of the Iranian mechanical engineering industry.

1.3 After consultations between Government officials, it was decided that the expert should be attached to the Research Centre, for Industrial and Trade Development at the Ministry of Economy.

1.4 The expert used the Ministry of Economy as a base until his departure from Iran on July 20, 1972.

1.5 It will be noted that although the original duration of the assignment was for four months only, the expert requested a short extension to enable him to carry out his assignment more to his own personal satisfaction.

The extension was duly granted by the Iranian authorities and approved by U.N.I.D.O.

2. SUMMARY AND CONCLUSIONS

2.1 Following market research, it was concluded, based on estimated market demand, that initially, only seven different categories of cutting tools should be considered for production, covering in all 34 sizes.

2.2 On balance, the siting of a new Metal Cutting Tool Plant would be better attached to the Machine Building Plant at Arak, than at alternative sites.

2.3 The type and number of machines required is set out in detail in the report.

2.4 The pre-feasibility study indicates that a factory established for the manufacture of metal cutting tools in Iran would be potentially viable; and further study, preferably as a joint venture with a foreign partner is recommended.

2.5 The main features of a company to produce cutting tools in the types, quantities and sizes selected are approximately:-

i. Capital cost	67 million Rials
ii. Working capital	42 million Rials
iii. Total floor area	750 sq. metres
iv. Electric Power Loading	435 KW
v. Total employees	100

The cost of heat treatment plant and laboratory facilities are omitted, since it is assumed that they will exist at the site eventually chosen.

3. TERMS OF REFERENCE.

3.1 Make an analysis of requirements and set up a yearly production programme of cutting tools (type and quantity).

3.2 Evaluate the industrial facilities under construction, particularly the Arak Machine Building Plant and the Metallurgical Engineering Plant in Tabriz as a possible site for establishing a metal cutting tool plant.

3.3 Collect all necessary data covering the technological and construction aspects as well as power supply for the future detailed projecting of the plant.

3.4 Train local counterparts.

4. STATEMENT OF OBJECTIVES.

4.1 The assignment of the expert is briefly stated in Section 3, but it was found necessary in order to achieve the eventual aim of evaluating the proposed plant for commercial viability, to include the following investigations;

a) In addition to the type and quantity of tool requirements, it was essential to formulate a range of sizes for eventual manufacture.

b) To enable the UNIDO economic evaluation expert, Mr. J.Goodwin, to assess the commercial viability of the proposed plant, Mr. Millward was requested by the Project Manager to analyse in greater detail several aspects of the technological survey. It was agreed that Mr. Goodwin and Mr. Millward would work in close liaison on this aspect.

4.2 The expert was also expected to train counterpart personnel in metal cutting production techniques to a sufficient standard to enable the National staff to take a major role in the final projecting of the proposed plant.

5. WORK ACCOMPLISHED.

5.1 The work accomplished by the expert is summarized below and given in detail in Sections 6 to 14.

Section 6. Pre-feasibility study (in co-operation with Mr. Goodwin).

" 7. Cutting tool reference book.

" 8. Present cutting tool requirements.

" 9. Future cutting tool requirements.

" 10. Recommendations of cutting tools for indigenous manufacture.

" 11. Evaluation of Metallurgical Engineering Plant, Tabriz.

" 12. Evaluation of Arak Machine Building Plant, Arak.

" 13. Recommended site for metal cutting tool plant.

" 14. Recommended building and construction.

6.- PRE - FEASIBILITY STUDY

6.0 SUMMARY AND RECOMMENDATIONS

6.01 The object of this study was to examine in broad outline whether a factory might be established on a viable basis while marketing the products at prices considered to be acceptable in the context of the Iranian economy.

6.02 The study has the usual limitation of market demand estimates, and although these are the best possible in the circumstances, they are based on sparse information.

6.03 It is shown that the retail prices of the locally manufactured products are likely to be approximately equal to the current prices of imported products.

6.04 It is recommended that, in co-operation with a foreign partner already engaged in the production of cutting tools overseas, a closer technical and economic evaluation be made, with a view to establishing a new industry.

6.10 The Products

6.11 The types of cutting tools to be manufactured, set out below, are those considered to have sufficient domestic demand to warrant production in the initial factory installation.

1. Straight shank twist drills
2. Taper shank twist drills
3. Centre drills

4. Metal slitting saws

5. Metal slitting saws with side chip clearance

6. Parallel hand reamers

7. Parallel shank slot drills

6.12 The object has been to select a limited range of cutting tools and sizes and to plan to meet the total domestic demand for these items, allowing some reserve plant capacity.

6.13 It is envisaged that other cutting tools will be added to this limited list, as demand increases, and that additional production machines and techniques will be introduced from time to time.

6.20 MARKET ANALYSIS

6.21 An initial review of import statistics disclosed that the broad customs classification of "Cutting Tools" covered all cutting tools including such items as chisels, nail extractors and bradawls, and therefore, the import figures had no relevance to the project under investigation.

6.22 An estimation of the total number of machine tools in use in Iran, and research into the requirements of end-users, proved to be a less reliable approach than obtaining from main importers, a statement of their imports of cutting tools.

6.23 Over a period of 12 weeks more than 40 importers and users were visited, from which it emerged that almost the whole of the imports of cutting tools came into the country through three major and three minor import houses.

6.24 The figures quoted by importers were cross-checked as far as possible, and apparent discrepancies referred back, so that the market demand figures presented in this report are as accurate an estimate as possible in the circumstances.

6.25 Particular attention was given to the possible needs of the Metallurgical Engineering Plant at Tabriz, and although the present stock of cutting tools imported with the main plant is programmed to last until 1977, the list of stocks at present at Tabriz, appears to be adequate for the needs of the factory for several years beyond that date.

6.26 The Machine Building Plant at Arak, is unlikely to have a substantial demand for machine cutting tools, due to the nature of the work undertaken there.

6.27 The present cutting tool demand for the year 1972, as set out in Table No. 1, has been derived from a concensus of the information obtained from all sources.

MARKET GROWTH TREND

6.28 It was not possible to obtain from importers, any figures of imports over several years, from which a trend in actual market demand might have been deduced.

6.29 The national growth rate during the period 1968 - 1972 in the metal product group of industries was 15.5%(actual), and a growth rate of 16% is planned for the period 1973 - 1977.

6.30 From import statistics, the overall growth rate in the number of machine tools in use was computed to be 18% in 1972 falling to 13% in 1976.

6.31 The growth rate selected for the purpose of calculating the demand in the year 1979, the reference year used in the pre-feasibility study, was 15% per annum compounded.

6.32 Table No. 2 records the estimated demand in the years 1975 and 1979.

COMPETITION

6.33 The cutting tool demand will not support a second production unit for many years to come and direct competition from other Iranian based factories is not an immediate problem.

6.34 It was been established that the C.I.F. price of imported twist drills is approximately 50% of the retail price of drills in the United Kingdom, and there is a clear danger of imported drills stifling local production unless some form of protection is given in the first few years of the life of a new industry.

DISTRIBUTION CHANNELS

6.35 The existing market is served in the main by three importers, who order, stock, and give credit to dealers and also give credit direct to some users. Their function is not only to serve as an importer but because of the extent of credit given they serve as a source of finance

to both dealers and users. This is not a desirable function for a manufacturing unit but because this trade pattern exists, a local manufacturer would have to make some provision for credit if disruption is to be avoided.

6.36 The possibility exists of appointing importers as main distributors, and so allowing them to provide credit to dealers and users as they do at present.

6.37 The existing approximate price structure using 100 as the CIF figure is:-

C.I.F. price	100
Import tax	2
Price to dealer	150
Price to user	165

6.38 The pre-feasibility study calculations provide for the Company to finance all credits directly.

6.40 BUILDINGS, PRODUCTION PROCESSES AND EQUIPMENT

6.41 The production processes are all primary metal working operations

6.42 All products except the slitting saws, are cut from steel bar, then follows shaping, consisting of several grinding and/or milling operations, marking for identification, heat treatment, inspection and packing. The metal slitting saws are received in the factory as blanks cut and pierced which are shaped by turning, grinding, milling and broaching operations, followed by heat treatment, inspection, and packing.

6.43 The plant required for these operations has been set out in Appendices 'W' and 'X', but it should be noted that provision has not been made for either heat treatment or laboratory facilities, since it has been assumed that the envisaged cutting tool factory will be an adjunct to an existing metal working plant already having these facilities.

6.44 The estimated additional cost of providing heat treatment plant would be approximately 10,000,000 Rials, and although the cost of equipping a laboratory is not known, it is likely to be a substantial amount.

6.45 The proposed overall plant capacity is a compromise between the expected growth in demand, the need to have the capacity to produce initially Iran's total demand of the selected tools, and the desirability from the point of view of training, to commence operations on a single shift basis. All these factors are met by installing

sufficient plant to produce the projected demand on a two shift basis during the fifth year of operation, and the number of machines set out in Appendix 'X' have been calculated on this basis.

6.46 The estimated cost of providing a factory building to the specification set out in Section 14 with provision for administrative offices is Rials 3,000,000.

6.50 MATERIAL REQUIREMENTS

6.51 At the present time, high speed tool steel is not produced in Iran, and it would be necessary to import raw materials from overseas. High speed tool steel is readily available at competitive prices from European countries and from Japan.

6.52 Although the initial annual quantity required in the first year of operation is only approximately 130 tons, at the current CIF price of US $2,500 per ton, this tonnage represents a supply contract well worth competing for.

6.53 The price of US $2,500 per ton is for a tough tool steel alloy containing molybdenum, chromite, and relatively low tungsten content.

6.60 FUEL OIL, ELECTRICITY AND WATER

6.61 Fuel Oil and water are required only in minimal quantities, which would not significantly increase production costs.

6.62 The installed electric motor horse power is 328 H.P. and allowing for a load factor of .7, approximately 600,000 units of electricity would be consumed during the fifth year of operation. Heating and lighting would require an estimated 175,000 units. The price per Kilowatt-hour has been taken as 1.5 Rials.

6.70 LABOUR AND MANAGEMENT

6.71 It is expected that all the necessary technical and managerial skills would rapidly develop in Iran, but particular attention must be given to the training of machine setters of which there will be approximately eight. The training of the machine setters would need to start at the earliest possible date, preferably in the overseas factory of a foreign partner.

6.72 There would be about 83 personnel directly concerned with production, and 9 indirect factory workers. Administrative staff would include a manager, an assistant manager, a secretary - accountant, a part-time chemist, and clerical staff.

6.73 The staff requirements on the sales side will depend on the distribution channels eventually decided upon, but adequate financial coverage has been made in the selling expenses.

6.80 COST OF PROJECT AND CAPITAL STRUCTURE

6.81 The estimated capital cost of the project is set out below:-

	Thousand Rials
1. Land for factory	
8000 square metres at Rs 200 per metre	1600
2. Factory and administrative building	3000
3. Plant and machinery	
a. Imported FOB cost of machinery including spares	41,000
b. Provision for price escalation (15%)	6,150
c. Freight and insurance (5%)	2,050
d. Indigenous equipment	50
e. Internal transport costs	250
f. Power supply, lighting	200
g. Erection charges	200
4. Technical know-how and/or fees	2000
5. Miscellaneous fixed assets	2000
6. Preliminary and promotional expenses	500
7. Pre-operative expenses	2000
8. Contingency (10%)	6100
Capital Cost of Project	67,100
Working capital requirements (Net of bank borrowings)	12,000
Total Cost of Project	79,100

6.82 An indicative capital structure is overleaf.

	Thousand Rials
Equity	32,000
Long Term Loan	47,000
	79,000
Bank Borrowings	30,000
	109,000

6.83 The equity investment of 32,000,000 Rials is in line with the currently accepted practice in Iran, but an equity of 39,000,000 would provide greater financial stability and would be more in line with the debt-equity ratio considered desirable in other countries.

6.90 ESTIMATED COST OF PRODUCTION AND PROFITABILITY

6.91 In preparing the statement of estimated cost of production and profitability, the following assumptions have been made.

(i) The total market demand for the products manufactured will be met on 2 shift operation in the fifth year of production.

(ii) A machine utilization factor of 70% will be reached.

(iii) The CIF cost of raw material is taken at US $2,500 per ton

(iv) Personnel salaries are included at current rates.

(v) Social benefits are taken into account by increasing the cost of personnel by 32%.

(vi) Interest on the long term loan is taken as 9% and on the bank loan as 12%.

(vii) Depreciation has been taken as:-

Land - NIL
Buildings - 5% per annum
Machines - 10% per annum

(viii) A return of 20% on equity investment is projected for the fifth year of operation.

6.92 The calculations show that with a profit margin of 20% on equity capital in the fifth year, it should be possible to sell directly at a retail price, approximately 15% below current prices. To this must be added, about 15% for dealer margin. Allowing for the unavoidable approximation in the estimates, it is safe to say that retail prices should not exceed current retail prices by more than 20%.

6.93 ESTIMATED COST OF PRODUCTION AND PROFITABILITY STATEMENT

IN THOUSAND RIALS

Year Ending 31 December	1975	1976	1977	1978	1979
Production					
Percentage of rated capacity 100% ≡ 2 Shifts	40	46	53	61	70
tons	134	154	177	204	234
Raw Materials	25,700	29,800	34,300	39,500	45,240
Labour	7,600	6,970	7,870	9,230	10,605
Water, Fuel, Power	850	980	1,135	1,310	1,500
Consumable Stores	570	660	760	870	1,000
Repairs Maintenance	100	150	250	400	580
Factory Overheads	900	950	1010	1080	1160
Selling Expenses	20,000	21,200	22,600	24,200	26,000
Administration Overheads	1200	1260	1330	1410	1500
Interest	6900	6900	6900	6900	6900
Depreciation	5140	5140	5140	5140	5140
	68,960	74,010	81,295	90,040	99,625
Sales	60,700	69,800	80,200	92,400	106,025
Operating profit	(8260)	(4210)	(1095)	2360	6400
Approximate Current RETAIL PRICES.	14,200	85,300	98,300	113,000	130,000

7. CUTTING TOOL REFERENCE BOOK.

7.1 To enable a market survey to be executed with accuracy and efficency, the expert compiled a book illustrating the more widely used metal cutting tools, and this is shown in Appendix 'A'.

7.2 The contents of the book were based upon the experts own experience in the mechanical engineering and metal machining industries. The book illustrates 58 of the more commonly used cutting tools and gives over 900 manufacturing sizes.

7.3 The publication proved to be extremely useful, since without the book, the survey would have been long and laborious. The presentation of the book to importers and users of cutting tools, using the visual aid media, often eliminated cutting tool terminological errors, and consequently, more accurate and realistic figures of cutting tool requirements were obtained.

7.4 Should the proposed plant be established, the reference book will assist the designer and detailer of cutting tools as it gives basic sizes and relevant technical data.

8. PRESENT CUTTING TOOL REQUIREMENTS

8.1 On completion of all investigations, the present yearly demand of metal cutting tools is shown in Table 1.

TABLE 1 - PRESENT CUTTING TOOL REQUIREMENTS - 1972

TYPE OF TOOL	BOOK REF.	QUANTITY
CYLINDRICAL CUTTER	M 1	1,430
CYLINDRICAL CUTTER	M 2	20
SIDE AND FACE CUTTER	M 3	650
STAGGERED TOOTH SIDE AND FACE CUTTER	M 4	1,100
SLOTTING CUTTER	M 5	30
METAL SLITTING SAW	M 6	20,000
METAL SLITTING SAW WITH SIDE CHIP CLEARANCE	M 7	25,000
SCREW SLOTTING CUTTER	M 8	NIL
CONVEX CUTTER	M 9	1,130
CONCAVE CUTTER	M 10	1,130
DOUBLE CORNER ROUNDING CUTTER	M 11	500
SINGLE CORNER ROUNDING CUTTER	M 12	1,000
EQUAL ANGLE CUTTER	M 13	NIL
DOUBLE UNEQUAL ANGLE	M 14	NIL
SINGLE ANGLE	M 15	NIL
SHELL END MILL	M 16	50
HOLLOW MILL	M 17	NIL
T SLOT CUTTER	M 18	NIL
WOODRUFF CUTTER	M 19	1,000
PARALLEL SHANK END MILL	M 20	1,000
PARALLEL SHANK SLOT DRILL	M 21	1,000
PARALLEL SHANK SLOT DRILL	M 22	10,000
DOVETAIL CUTTER	M 23	300
INVERTED DOVETAIL CUTTER	M 24	500
CORNER ROUNDING CUTTER	M 25	NIL
BALL NOSED 2 FLUTE SLOT DRILL	M 26	1,000
PARALLEL HAND REAMER	R 1	2,200
LONG FLUTED PARALLEL MACHINE REAMER	R 2	500
MACHINE CHUCKING REAMER	R 3	500
MACHINE JIG REAMER	R 4	NIL
TAPER PIN REAMER	R 5	5,000
ADJUSTABLE HAND REAMER	R 6	NIL
PARALLEL SHANK TWIST DRILL	TD 1	689,728
TAPER SHANK TWIST DRILL	TD 2	14,552
CENTRE DRILL	TD 3	80,000
CARBIDE TIPPED TURNING TOOLS ----------	LT 1 to LT 22	400
MODULE CUTTERS ----------	Not illustrated in book	2,000
CARBIDE TIPS ----------		2,000

9. FUTURE CUTTING TOOL REQUIREMENTS.

9.1 The future requirements of metal cutting tools is dependent upon the growth rate of the metal products group of industries. To establish the possible rate of growth an approach was made from several angles. Firstly, the projected expansion figures for the metal products industries as a whole were examined. Secondly, a study was made of the percentage increase of imported machine tools over the past 10 years, and finally local entrepeneurs were approached on their future expansion programmes.

9.2 After evaluating all the evidence, it appeared that a 15% annual growth rate for metal cutting tool demands seemed both conservative and realistic.

9.3 Table 2 shows the future needs of metal cutting tools based upon the studies undertaken.

9.4 To coincide with the 5th and 6th Development Plan, projected figures of metal cutting tool requirements for 1973, 1977, 1978 and 1982 are given in Table 3.

TABLE 2 - FUTURE CUTTING TOOL REQUIREMENTS

TYPE OF TOOL	BOOK REF.	QUANTITY YEAR 1975	QUANTITY YEAR 1979
CYLINDRICAL CUTTER	M 1	2,173	3,789
CYLINDRICAL CUTTER	M 2	30	53
SIDE AND FACE CUTTER	M 3	988	1,722
STAGGERED TOOTH SIDE AND FACE CUTTER	M 4	1,672	2,915
SLOTTING CUTTER	M 5	45	79
METAL SLITTING SAW	M 6	30,400	53,000
METAL SLITTING SAW WITH SIDE CHIP CLEARANCE	M 7	38,000	66,250
SCREW SLOTTING CUTTER	M 8	-	-
CONVEX CUTTER	M 9	1,717	2,994
CONCAVE CUTTER	M 10	1,717	2,994
DOUBLE CORNER ROUNDING CUTTER	M 11	760	1,325
SINGLE CORNER ROUNDING CUTTER	M 12	1,520	2,650
EQUAL ANGLE CUTTER	M 13	-	-
DOUBLE UNEQUAL ANGLE	M 14	-	-
SINGLE ANGLE	M 15	-	-
SHELL END MILL	M 16	76	132
HOLLOW MILL	M 17	-	-
T SLOT CUTTER	M 18	-	-
WOODRUFF CUTTER	M 19	1,520	2,650
PARALLEL SHANK END MILL	M 20	1,520	2,650
PARALLEL SHANK SLOT DRILL	M 21	1,520	2,650
PARALLEL SHANK SLOT DRILL	M 22	15,200	26,500
DOVETAIL CUTTER	M 23	456	795
INVERTED DOVETAIL CUTTER	M 24	760	1,325
CORNER ROUNDING CUTTER	M 25	-	-
BALL NOSED 2 FLUTE SLOT DRILL	M 26	1,520	2,650
PARALLEL HAND REAMER	R 1	3,344	5,800
LONG FLUTED PARALLEL MACHINE REAMER	R 2	760	1,325
MACHINE CHUCKING REAMER	R 3	760	1,325
MACHINE JIG REAMER	R 4	-	-
TAPER PIN REAMER	R 5	7,600	13,250
ADJUSTABLE HAND REAMER	R 6	-	-
PARALLEL SHANK TWIST DRILL	TD 1	1,048,386	1,827,779
TAPER SHANK TWIST DRILL	TD 2	22,119	38,562
CENTRE DRILL	TD 3	121,600	212,000
CARBIDE TIPPED TURNING TOOLS	LT 1 to 22	608	1,060
MODULE CUTTERS	Not illustrated in book	3,040	5,300
CARBIDE TIPS		3,040	5,300

TABLE 3 - FUTURE CUTTING TOOL REQUIREMENTS

BOOK REF.	YEAR 1973	YEAR 1977	YEAR 1978	YEAR 1982
M 1	1,604	2,874	3,303	5,720
M 2	23	40	46	80
M 3	747	1,306	1,501	2,600
M 4	1,265	2,211	2,541	4,400
M 5	34	60	69	120
M 6	23,000	40,200	46,200	80,000
M 7	28,750	50,250	57,750	100,000
M 8				
M 9	1,299	2,271	2,610	4,520
M 10	1,299	2,271	2,610	4,520
M 11	575	1,005	1,155	2,000
M 12	1,150	2,010	2,310	4,000
M 13				
M 14				
M 15				
M 16	57	100	115	200
M 17				
M 18				
M 19	1,150	2,010	2,310	4,000
M 20	1,150	2,010	2,310	4,000
M 21	1,150	2,010	2,310	4,000
M 22	11,500	20,100	23,100	40,000
M 23	345	603	693	1,200
M 24	575	1,005	1,155	2,000
M 25				
M 26	1,150	2,010	2,310	4,000
R 1	2,530	4,422	5,082	8,800
R 2	575	1,005	1,155	2,000
R 3	575	1,005	1,155	2,000
R 4				
R 5	5,750	10,050	11,550	20,000
R 6				
TD 1	793,187	1,386,353	1,593,271	2,758,912
TD 2	16,734	29,249	33,615	58,208
TD 3	92,000	160,800	184,800	320,000
LT 1 to LT 22	460	804	924	1,600
MODULE CUTTERS	2,300	4,020	4,620	8,000
[illegible] TIPS	2,300	4,020	4,620	8,000

10. RECOMMENDATIONS OF CUTTING TOOLS FOR INDIGENOUS MANUFACTURE.

10.1 For the purpose of establishing the commercial viability of the proposed plant, it is recommended that the initial manufacturing content should comprise of 7 items which are in maximum demand. The selected items cover 34 different sizes and employ a wide range of manufacturing techniques.

10.2 Cutting tools selected for the initial production programme are shown briefly below and are detailed in Appendix 'W' (pages 1 to 8).

Book Ref.	Type of Tool	Sizes
TD1	Straight shank twist drill	3,4,5,6,7,8,9,10,11,12,13,14,15 & 16 m/m dia.
TD2	Taper shank twist drill	13,15,17,19,21,23 & 25 m/m dia.
TD3	Centre drill	3,4,5 & 6 m/m dia.
M6	Metal slitting saw	Average 125 m/m dia. x 3 m/m thick.
M7	Metal slitting saw	Average 150 m/m dia. x 3 m/m thick.
R1	Spiral flute hand reamer	6,12 & 18 m/m dia.
M22	Parallel shank slot drill	5,10,15 & 20 m/m dia.

10.3 Relative technical data for the manufacture of the selected items is given in Appendix 'A', also a list of machinery and equipment to be purchased to enable manufacture is shown in Appendix 'X'. In addition, illustrations of machinery/equipment are shown in Appendices 'B','C','D','E','F','G','H','J','K','L','M','N','O','P','Q', 'R','S','T','U' and 'V'

10.4 Regarding selection of sizes for manufacture, it has not been possible to ascertain these with any degree of accuracy from importers.

The majority of importers, merely gave block figures of the selected 7 items-irrespective of sizes. The expert had therefore to apply his engineering experience to establish a reasonable consumption of each range of sizes.

11. EVALUATION ON METALLURGICAL PLANT - TABRIZ

11.1 The expert accompanied by his counterpart paid a visit in late April to the Metallurgical Engineering Plant at Tabriz for evaluation purposes.

11.2 All aspects of training and production facilities were studied in detail and in consequence, the expert came to the following conclusions.

a) To establish the content of future operational skills required for the proposed new plant, a detailed study was made of the training section. The training course was well planned, but it was felt, that it would be advantageous to the student, if the practical content of the course could be broadened in scope.

b) Related equipment to metal cutting tool production, such as physical laboratory facilities, heat treatment equipment and metrology apparatus, although in the main already existing, for the purpose of a new metal cutting tool plant, additional equipment may be necessary.

c) Bar products being produced at Tabriz appeared to be of satisfactory standard.

Some difficulties now experienced in the foundry will no doubt be rectified when the new building is completed.

11.3 The site was large enough to accomodate the new plant and electrical power was adequate to meet the demands of the proposed cutting tool factory.

12. EVALUATION OF ARAK MACHINE BUILDING PLANT.

12.1 The Machine Building Plant at Arak was visited on May 7 for evaluation.

12.2 In common with Tabriz, all aspects of training, production and the siting of the new plant there, were investigated. The experts comments are as follows:-

a) The training section was satisfactory. The duration of the course was for 2 years and training methodology was well planned.

b) The supervisory staff appeared to be competent and administration throughout the plant appeared efficient.

c) Ancillary services at the plant, such as heat-treatment furnaces, forging equipment and physical laboratory for quality control were of a satisfactory standard.

d) The site could easily accomodate the new plant and electrical power was adequate.

13. RECOMMENDED SITE FOR METAL CUTTING TOOL PLANT

13.1 After evaluation of the two suggested sites for the new metal cutting tool production plant, it is the experts opinion that the new plant should be attached to the Machine Building Plant at Arak.

13.2 The main reasons for this decision are as follows:-

a) Adequate heat-treatment facilities for cutting tool production are installed.

b) Forging facilities are adequate for the eventual preparation of cutting tool blanks.

c) A satisfactory physical laboratory for quality control is existing.

d) Existing production planning at the plant appeared to be of good standard.

e) Metrology facilities are adequate to produce an accurate and good quality product.

f) Training school graduates should have a well rounded knowledge of engineering.

14. RECOMMENDED BUILDING AND CONSTRUCTION

14.1 It is estimated that a factory area of 750 square metres will be required for the first stage of the factory. A steel framed portal roof construction having brick walls, corrugated asbestos roofing and a 150 m/m thick reinforced concrete floor, is proposed. The construction should provide for a temporary wall on one side; with adequate space outside for possible extension.

15. GOVERNMENT SUPPORT

15.1 The Ministry of Economy, and in particular the Ministry's Research Centre for Industrial and Trade Development gave every assistance to the expert during his assignment.

15.2 A national counterpart was provided, Mr. S. Sanandaji of the Mechanical Research Centre of the Ministry of Economy to assist the expert on a part-time basis. The counterpart accompanied the expert during his visits to local entrepreneurs, also to the Metallurgical Engineering Plant - Tabriz and to the Arak Machine Building Plant at Arak.

15.3 During the term of the assignment, the counterpart received instruction in the techniques and technological data used in the manufacture of metal cutting tools.

15.4 It is the opinion of the expert that Mr. Sanandaji has acquired sufficient knowledge of the industry to provide a lead in the final projecting of the plant.

16. ACKNOWLEDGEMENTS.

16.1 In conclusion, the expert would like to acknowledge the undermentioned personnel for help extended to him during his assignment at the duty station.

Dr. Abu-el-Haj (Project Manager) U.N.I.D.O.

Mr. R. Whiteman (Assistant Programme Officer) U.N.D.P. Headquarters - Tehran.

Dr. Ghaffarzade, Mr. Sohanaki and Mr. Sanandaji of the Ministry of Economy.

16.2 The expert also wishes to thank Miss Mostofi of the Ministry of Economy for supplying adequate secretarial assistance.

16.3 Mr. Millward also greatly appreciates the assistance extended to him by Mr. J. Goodwin (U.N.I.D.O. economic evaluation expert attached to the project) for his valuable contribution in assessing the commercial viability of the proposed project.

17. COMMENTARY.

17.1 The processes recommended to produce other than twist drills are those usually used, but in the manufacture of twist drills, three methods of production should be considered.

The first method is to insert the flute by grinding, using hardened bar as raw material. This technique has proved successful on fluting twist drills up to 10 m/m diameter. Although material wastage in the grinding operation is unavoidable, this method eliminates heat-treatment and the reject rate is virtually nil.

The second method is to produce the flute by a milling operation using annealed bar as the raw material. In common with flute grinding, material wastage is unavoidable but a high quality product is obtained, and the reject rate is negligible. Finally a method of forging the flute from annealed bar has recently been developed. The principle is to exert pressure on a hot billet using a specially designed machine to form the flute. The advantage of this method is the low wastage of material, but experience has shown that malformation of the flute often occurs during the process and occasionally material cracks have been observed. In consequence, the reject rate is fairly high, particularly when producing drills in excess of 8 m/m diameter.

After evaluating the 3 methods of production it is recommended that flutes in twist drills from 3 to 10 m/m diameter should be produced by the grinding process. The development of automatic machines for this method of twist drill fluting, has proved economical and its application produces a high quality product.

The fluting of drills over 10 m/m diameter is recommended to be performed by a milling operation. Efficient machinery which produces a high quality drill, is now available for flute milling, and although material wastage is unavoidable, the reject rate is low. Although the forging technique to produce the flute is quicker, this method of manufacture is still being developed, consequently, fluting by forging cannot be recommended at present. However, the process of forging the twist drill flute should be reviewed periodically as modern technology progresses in this direction.

17.2 The possibility of the indigenous manufacture of Taps and Dies was given consideration. It was felt that owing to the highly specialized skills required for operating and setting the sophisticated machinery involved for production, it would be inadvisable at present, to contemplate their manufacture. However, with the increasing skilled labour force graduating from the training schools, the possibility of manufacturing Taps and Dies should be reviewed periodically. The expert feels that the granting of an overseas fellowship by the U.N., to enable an Iranian engineer to study the techniques of cutting tool manufacture, should be considered.

17.3 Although the yearly demand for Module cutters is quite small, consideration was also given to the possibility of manufacturing these items. It was found however, considering the capital cost of equipment necessary for production, in relation to the demand, the manufacture of Module cutters would not be commercially viable.

17.4 The grinding of tungsten based carbide tips from imported steel may be considered at a later date, as may be the holders for tungsten steel tips, which are manufactured from high carbon steel.

17.5 Manufacture of H.H.S. tool bits and brazed on tools could possibly be undertaken without heavy additional capital expenditure, using imported raw materials. However, the extent of Iranian work content would be small, and it is recommended that manufacture be reviewed once the initial production programme is satisfactorily met.

17.6 A number of quotations for molybdenum high speed steel used in the manufacture of cutting tools were considered. Bohler Steels of Austria and Hitachi Special Steel Manufacturing Co. of Japan are both acceptable sources of supply.

APPENDICES.

A. CUTTING TOOL REFERENCE BOOK

B. CUT - OFF MACHINE

C. CUTTER & TOOL GRINDING MACHINE

D. FLUTE GRINDING MACHINE

E. POINT GRINDER

F. CENTRELESS GRINDER

G. MARKING MACHINE

H. FLUTE MILLER

J. FLUTE MILLER

K. PRODUCTION CYLINDRICAL GRINDER

L. AUTOMATIC BAR MACHINE

M. DRILL INSPECTION UNIT

N. AUTOMATIC BAR MACHINE

O. BROACHING MACHINE

P. POINT GRINDER

Q. CHUCKING CAPSTAN

R. INTERNAL GRINDER

S. SURFACE GRINDER

T. CENTRE LATHE

U. UNIVERSAL MILLER

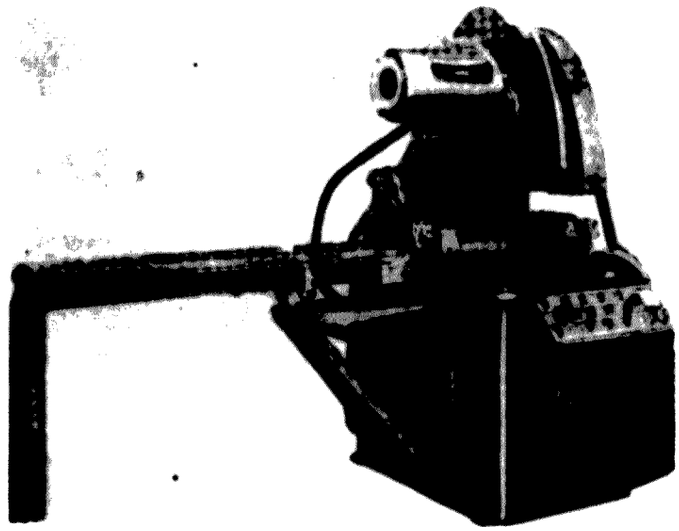
V. PLAIN MILLER

W. PRODUCTION SCHEDULES

X. MACHINERY REQUIREMENTS

APPENDIX 'B'

HIGH SPEED CUT-OFF MACHINES



MODEL M120

BIRKETT CUTMASTER LTD
HIGHTOWN ROAD, CLECKHEATON, YORKSHIRE, ENGLAND

APPENDIX 'C'

CUTTER AND TOOL GRINDING MACHINE

MODEL 311

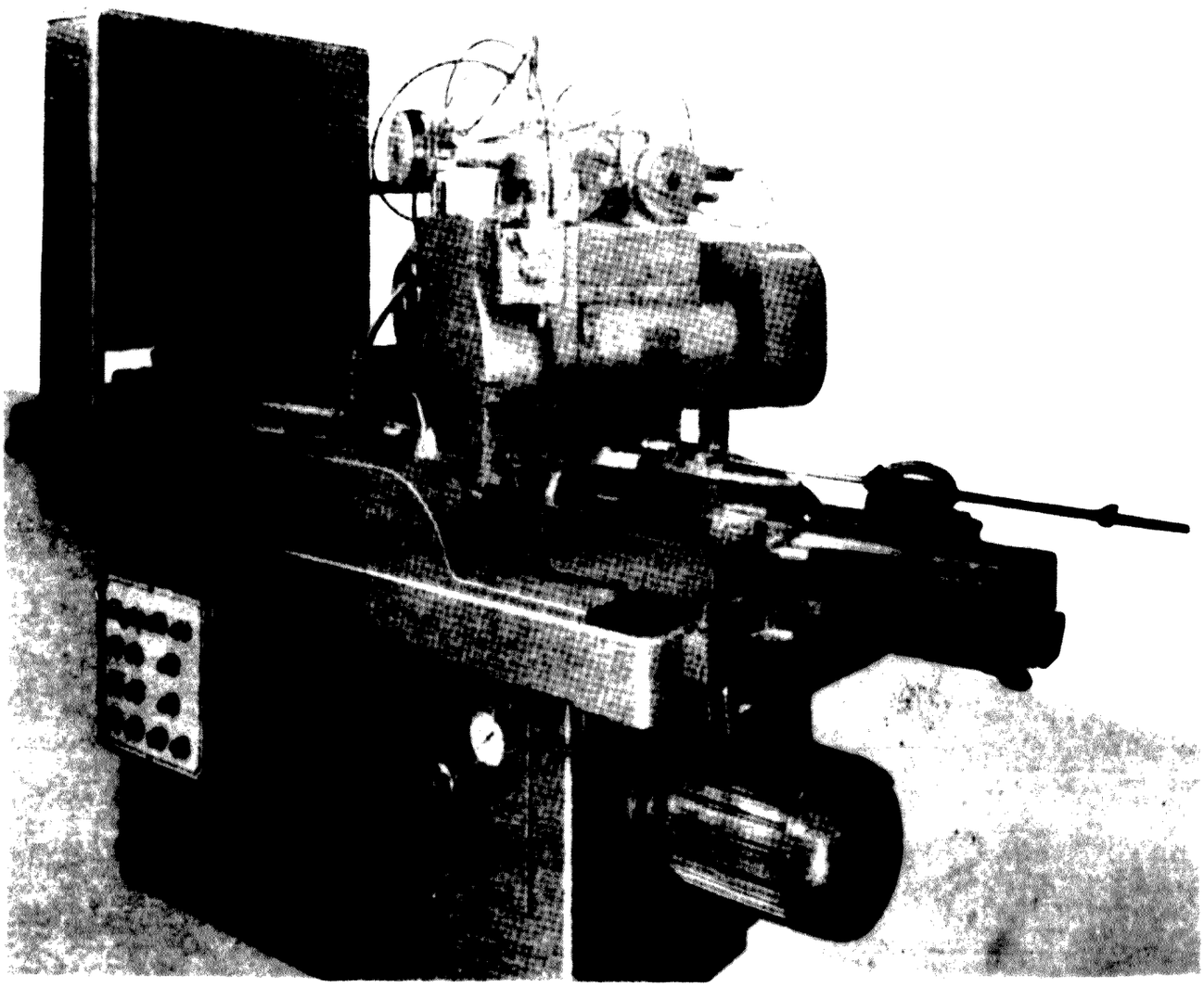
A. A. JONES & SHIPMAN LTD

LEICESTER-ENGLAND

APPENDIX 'D'

Fully Automatic

for DRILLS

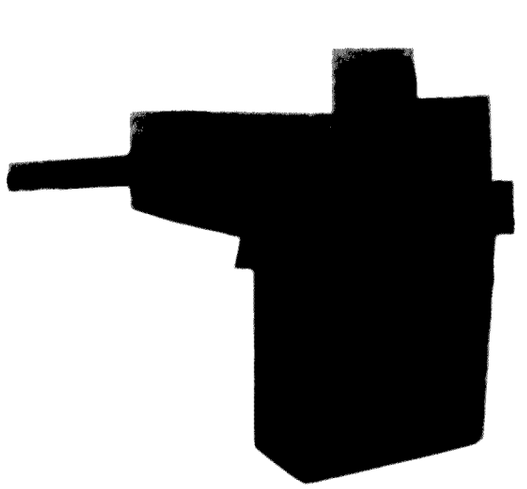


MODELS ADFG 400 & ADFG 250

[redacted] & BROWN (Machine Tools) [redacted]
[redacted] BIGGLESWADE · BEDFORD[redacted]

APPENDIX 'E'

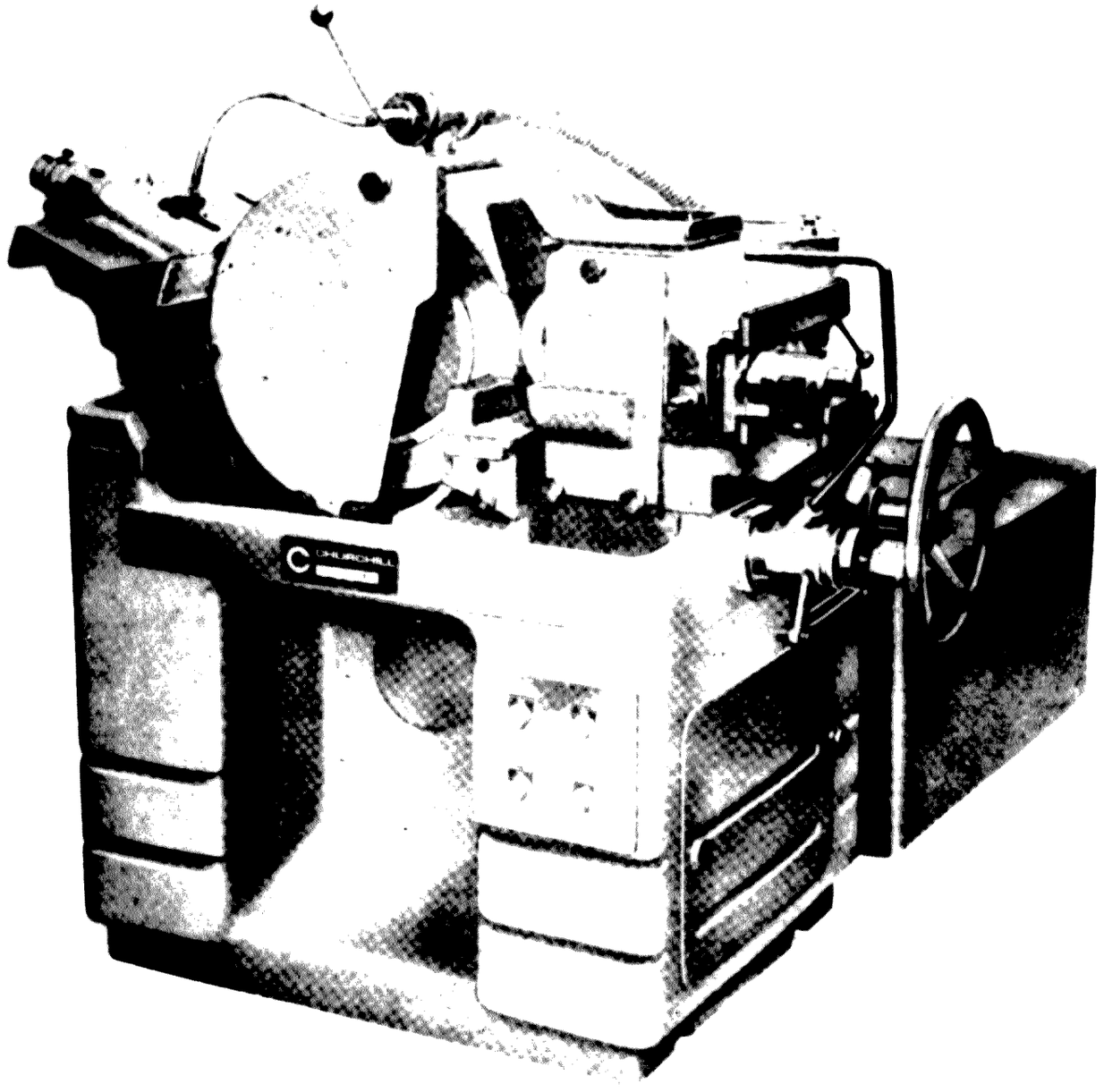
HUNT DG100 DRILL POINT GRINDER



CHARLES CHURCHILL LTD
P.O. BOX 38, FLETCHAMSTEAD HIGHWAY, COVENTRY
ENGLAND

APPENDIX 'F'

MODEL NO.1
CENTRELESS
GRINDING MACHINE

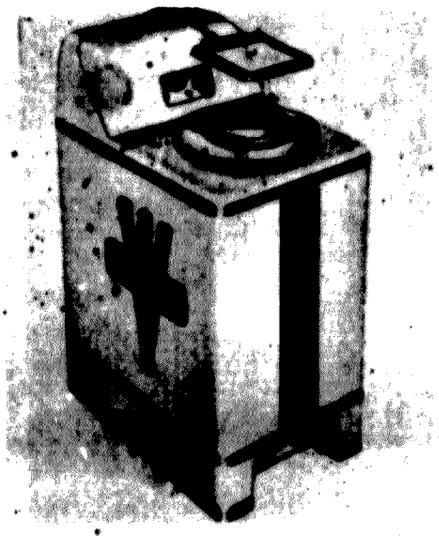


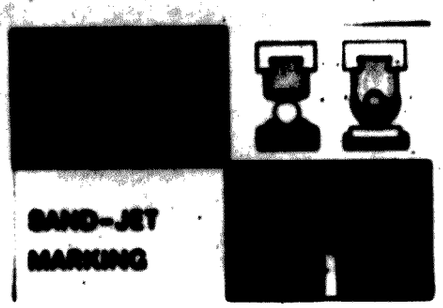
THE CHURCHILL MACHINE TOOL COMPANY LIMITED

BROADHEATH · ALTRINCHAM CHESHIRE · TEL 061-928 3262 TELEX 66 662

APPENDIX 'G'

MARKING MACHINES



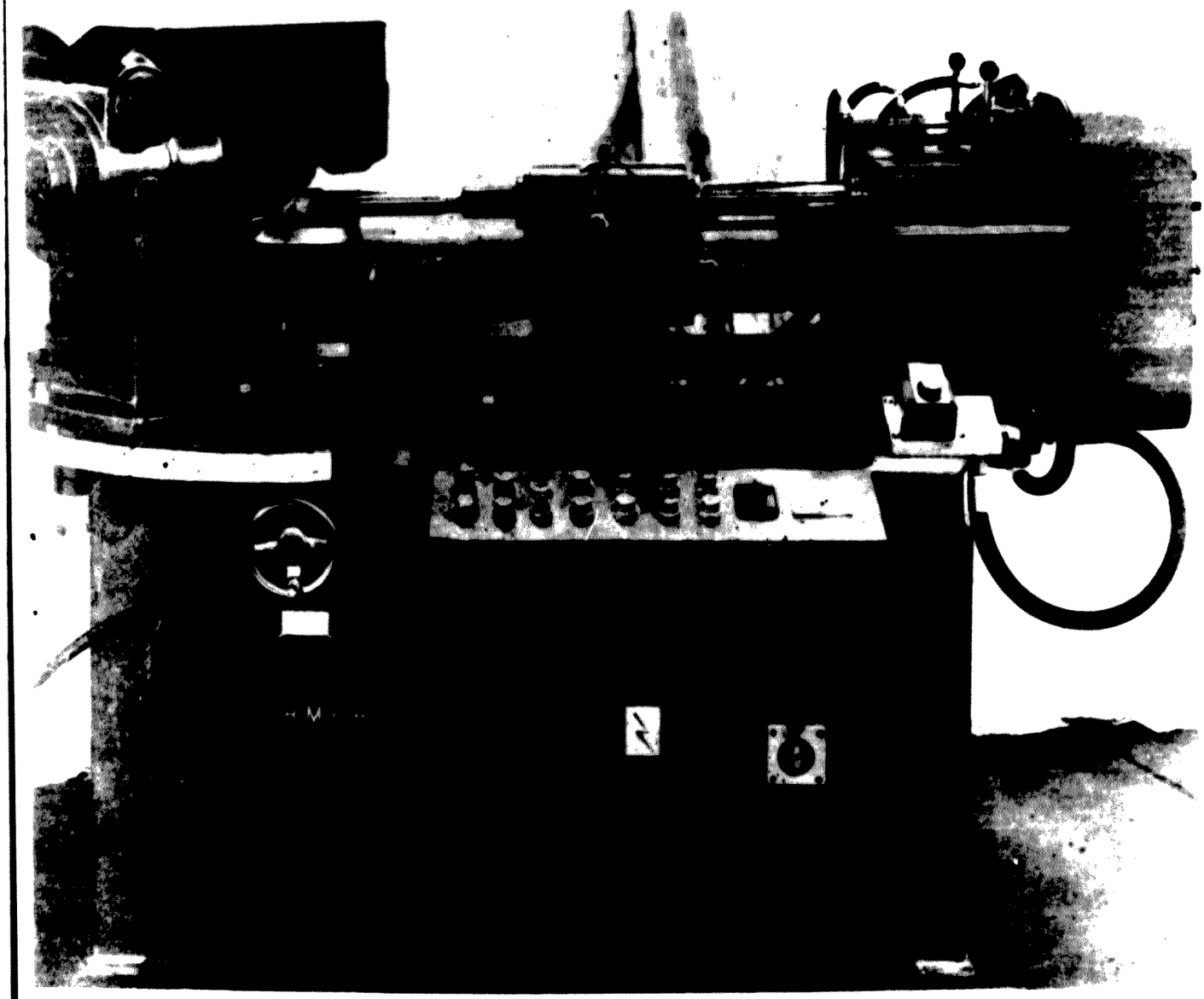


FUNDITOR LIMITED

WEMBLEY-ENGLAND

APPENDIX 'H'

FLUTE MILLER

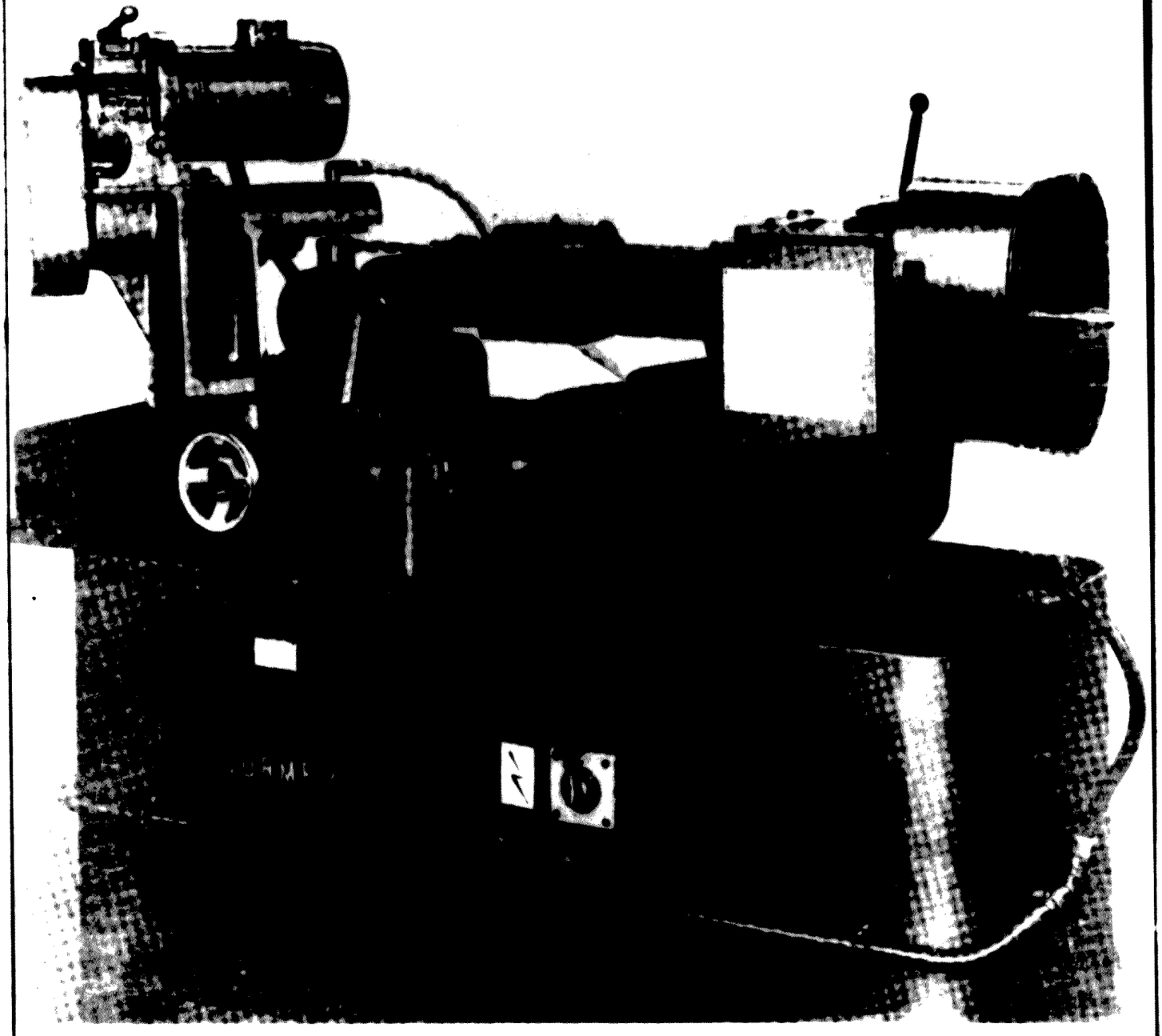


MODEL 181

THE SHEFFIELD TWIST DRILL & STEEL CO LTD
MACHINE TOOL DIVISION
DORMER WORKS, WOODEND, WORKSOP, NOTTS, ENGLAND

APPENDIX 'J'

FLUTE MILLER

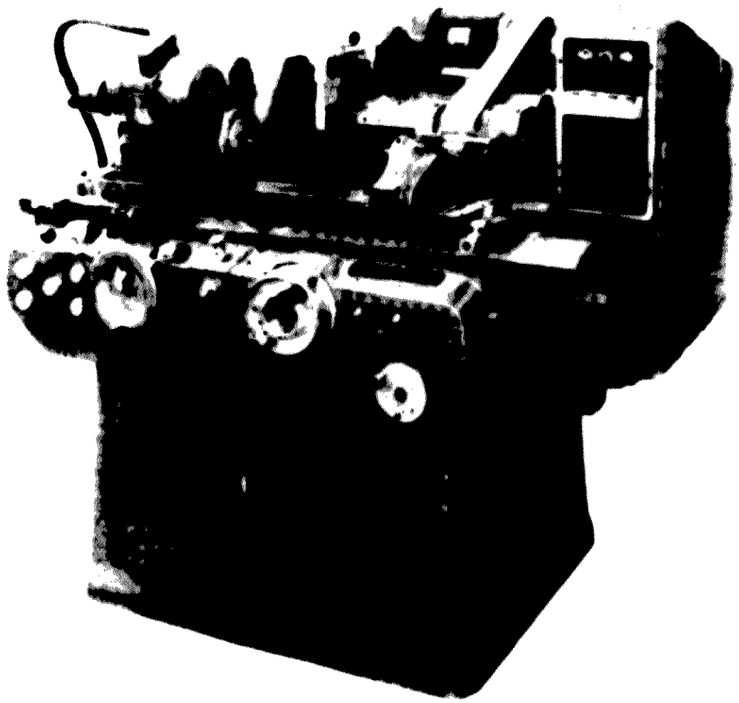


MODEL 115

THE SHEFFIELD TWIST DRILL & STEEL CO LTD
MACHINE TOOL DIVISION
[illegible] WORKS WOODEND WORKSOP NOTTS ENGLAND

APPENDIX "A"

HIGH PRECISION PRODUCTION CYLINDRICAL GRINDER

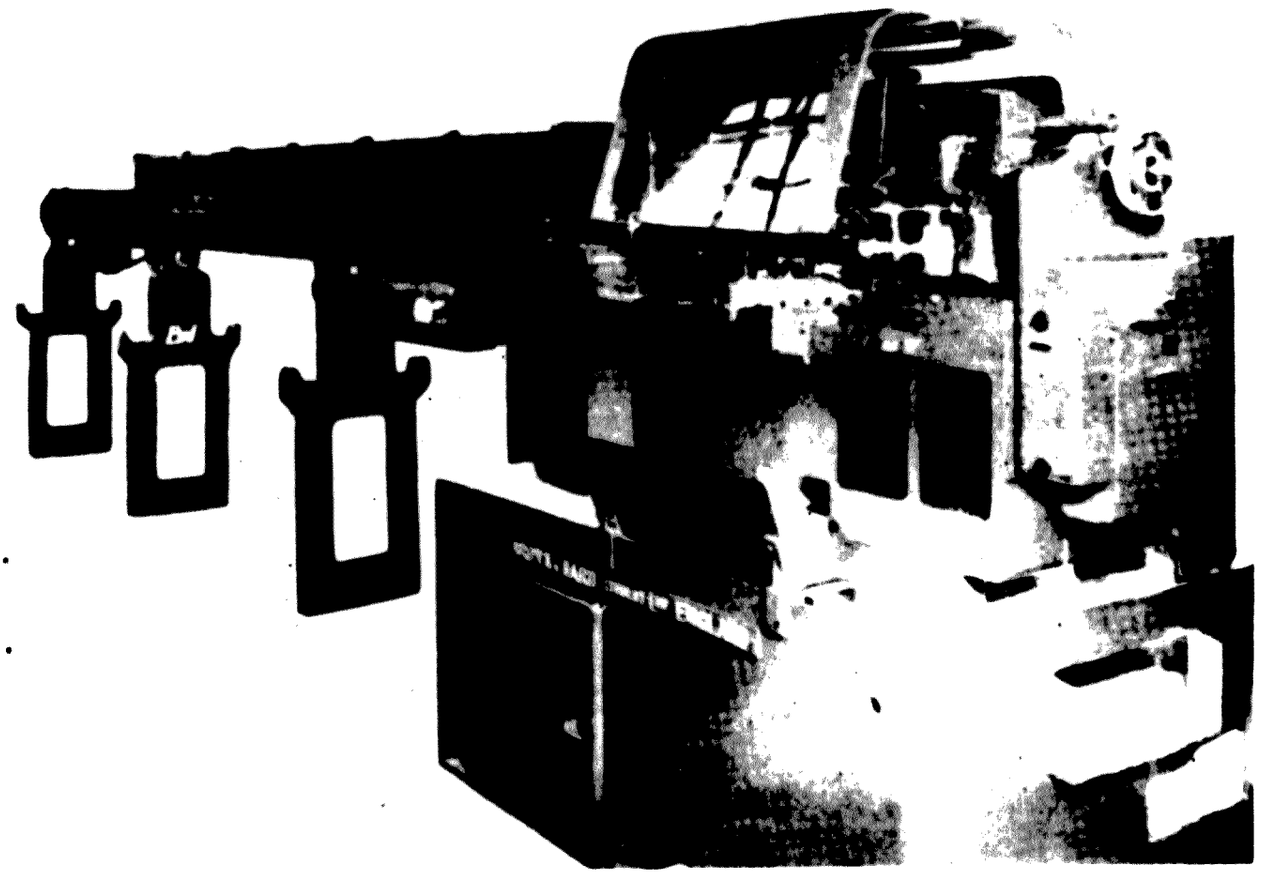


MODEL 107 M

A. A. JONES & SHIPMAN LTD

LEICESTER - ENGLAND

AUTOMATIC BAR MACHINE

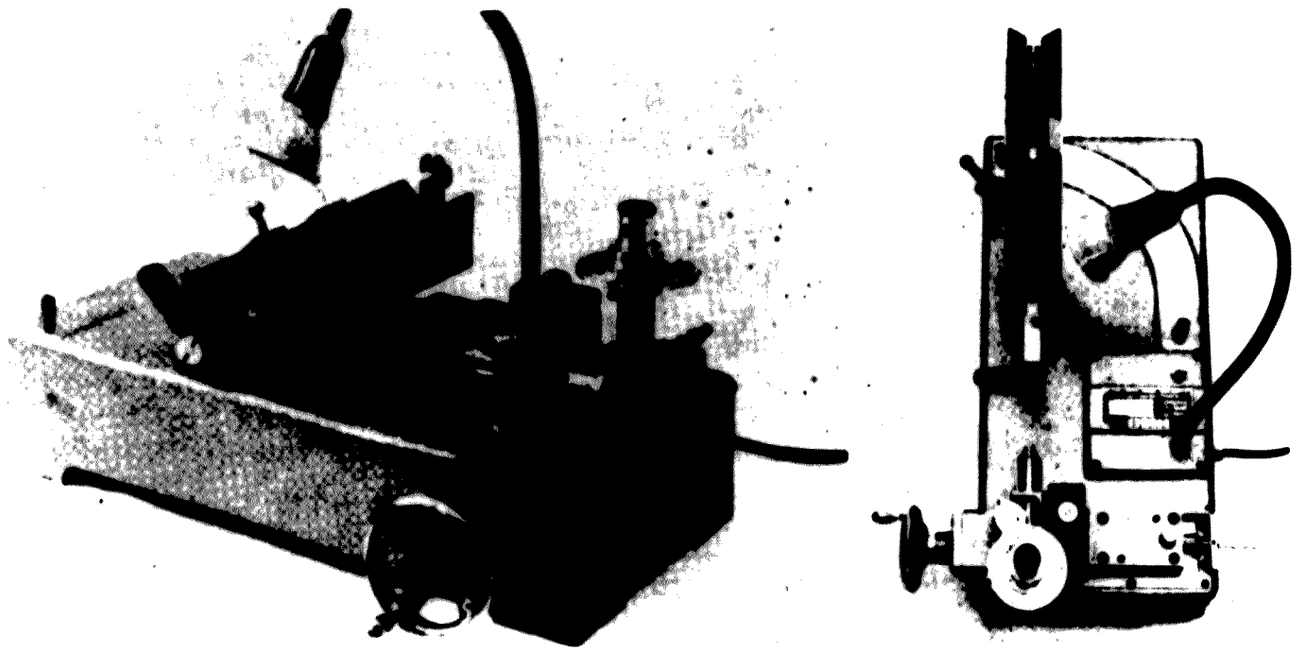


Model H

BROWN & WARD (TOOLS) LTD

WALSALL ENGLAND

[illegible] Drill Inspection Unit

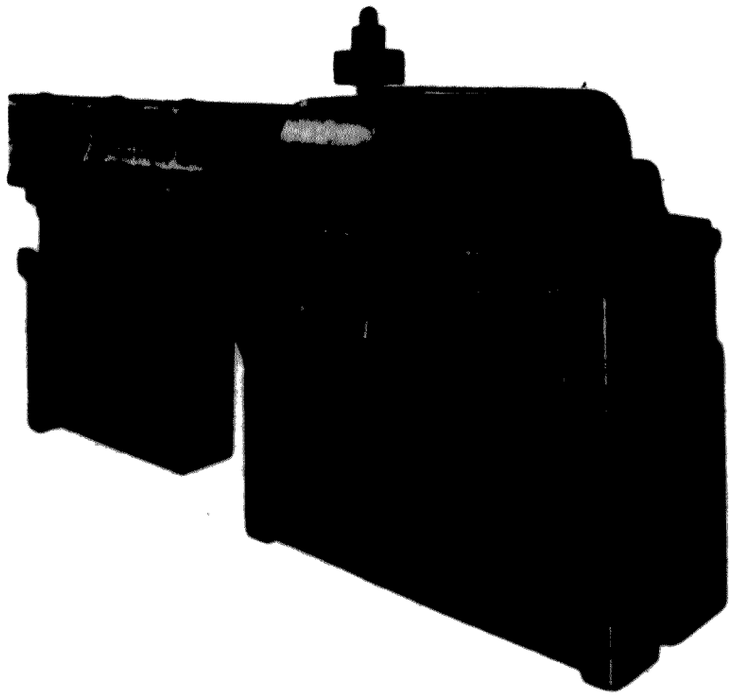


THE SHEFFIELD TWIST DRILL & STEEL CO LTD
MACHINE TOOL DIVISION
DORMER WORKS, WOODEND, WORKSOP, NOTTS, ENGLAND

APPENDIX 'M'

SINGLE SPINDLE

AUTOMATIC BAR MACHINE



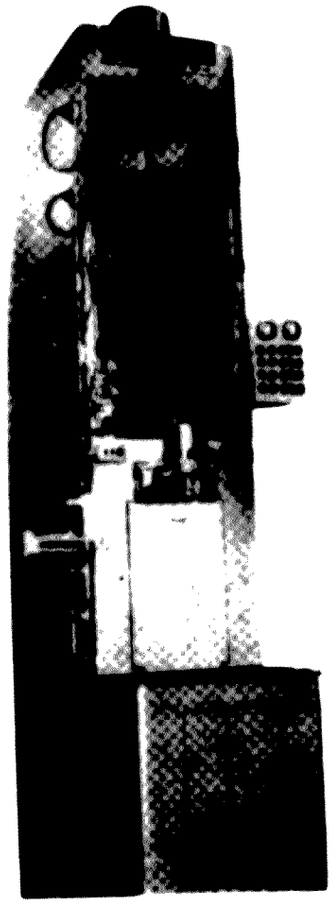
375 SERIES

BROWN AND WARD

WALSALL-ENGLAND.

APPENDIX "O"

Universal Vertical Broaching Machine



MODEL 1042-V

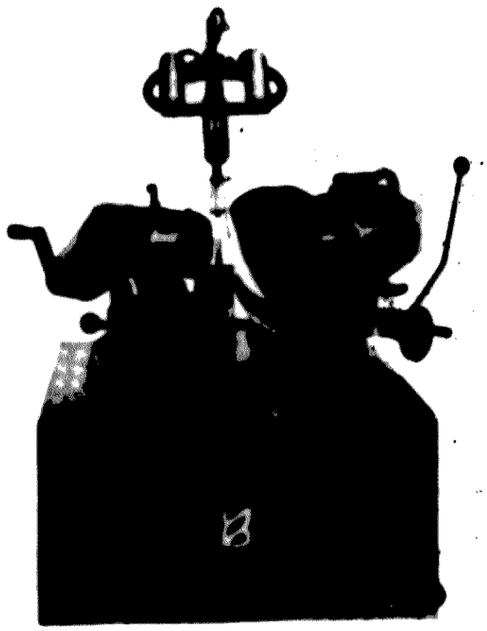
B.S.A. LTD.

BIRMINGHAM

ENGLAND

APPENDIX 'P'

DRILL GRINDER

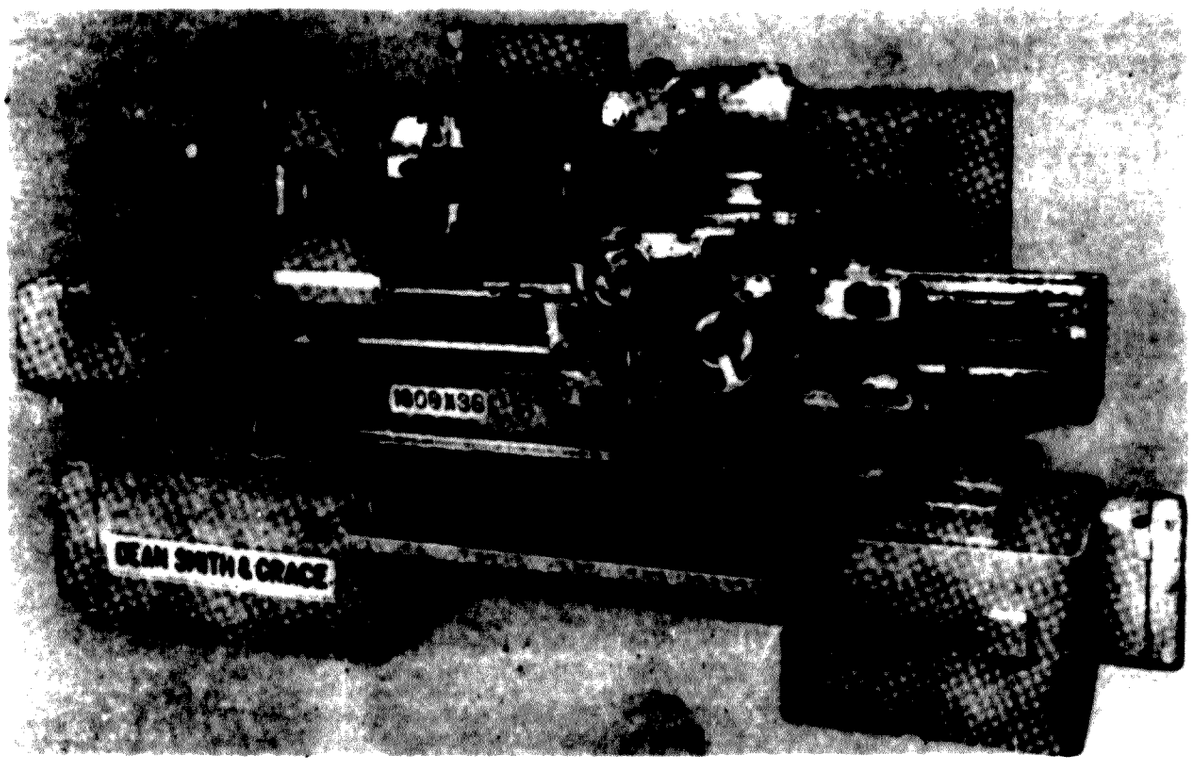


MODEL ZB 25

BRIERLEY LIMITED, Z.
Ferry Farm Road, Llandudno Junction,
North Wales - U.K

APPENDIX 'G'

CHUCKING CAPSTAN

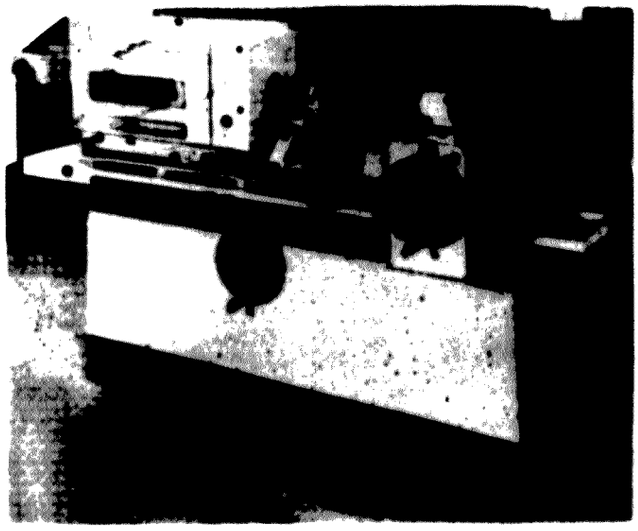


MODEL 1609 CT

Dean Smith and Grace Ltd

Keighley, Yorkshire
England

INTERNAL GRINDING MACHINE



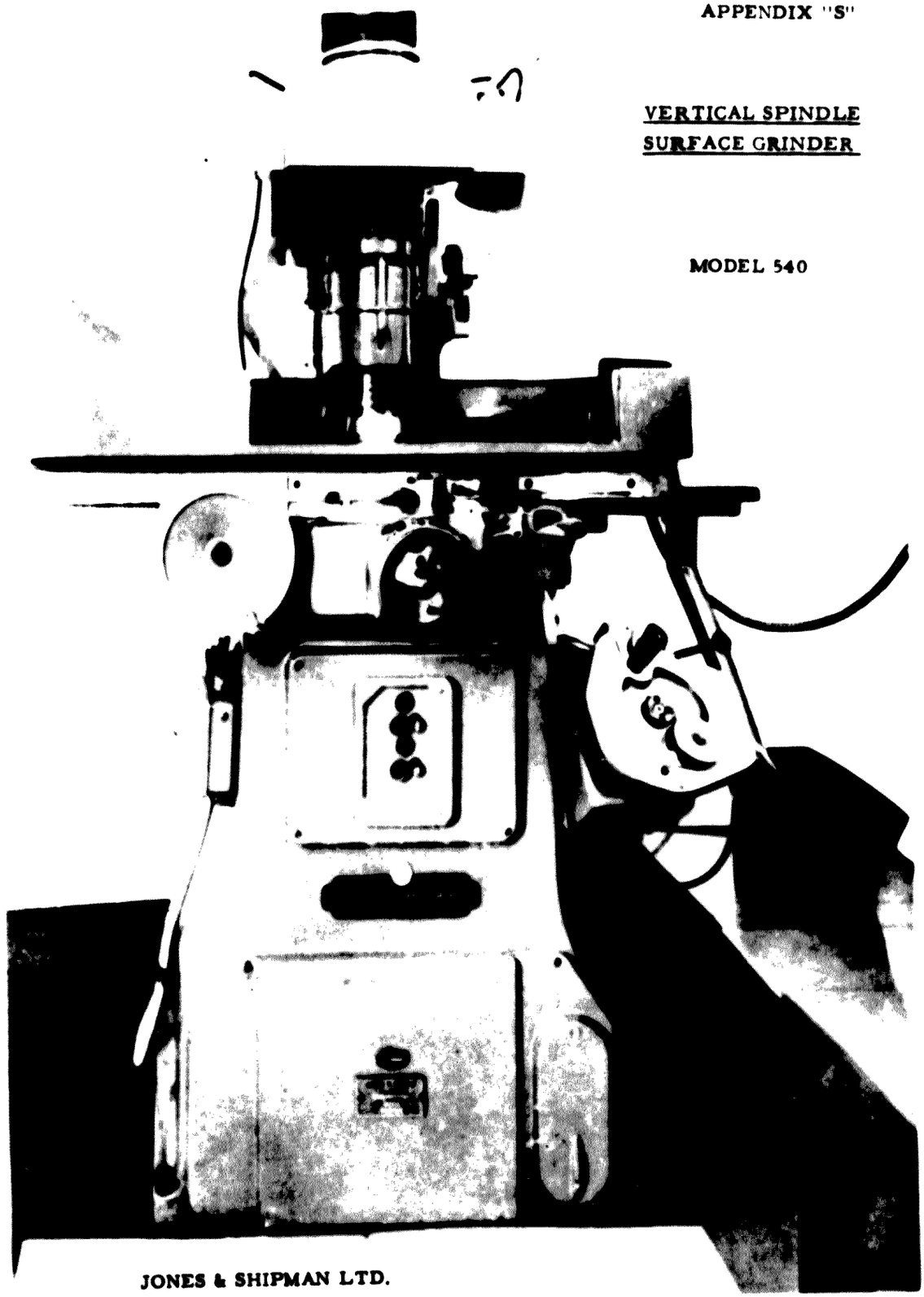
MODEL HAA

THE CHURCHILL MACHINE TOOL CO LTD
BROADHEATH, ALTRINCHAM, CHESHIRE, ENGLAND

APPENDIX "S"

VERTICAL SPINDLE SURFACE GRINDER

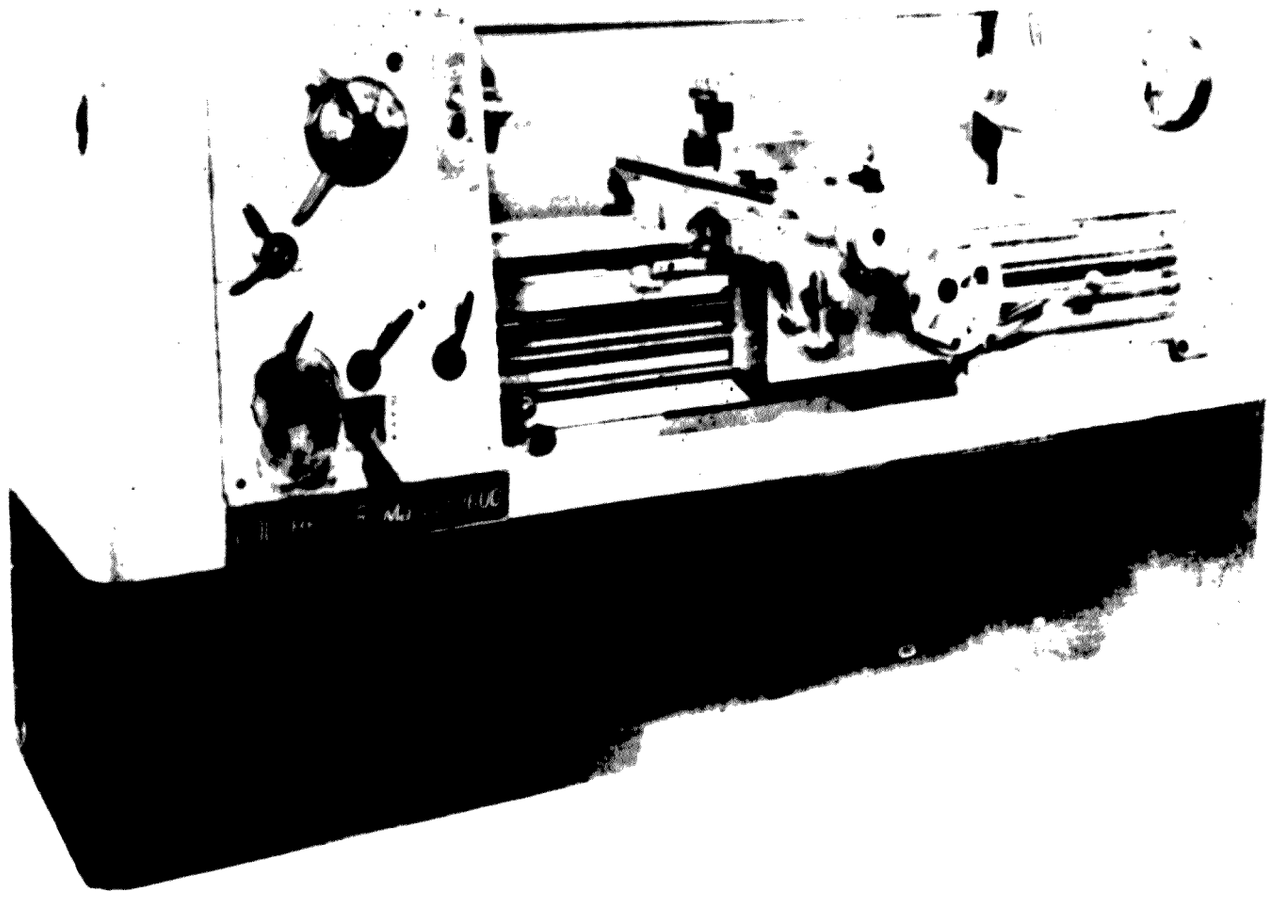
MODEL 540



JONES & SHIPMAN LTD.
LEIZESTER - ENGLAND

APPENDIX 'T'

CENTRE-LATHE

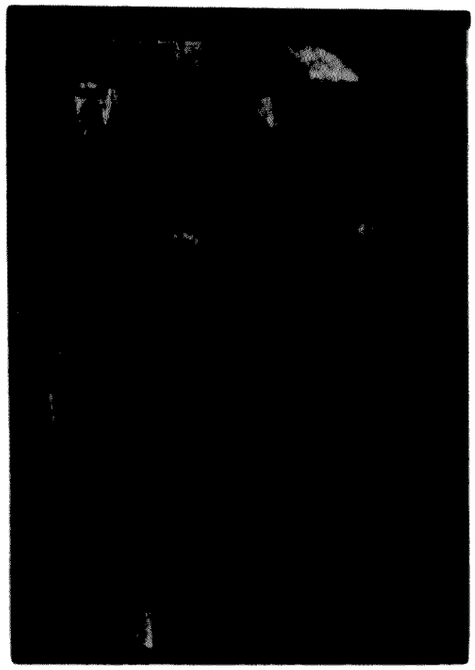


MASCOT1600

THE COLCHESTER LATHE CO LTD
COLCHESTER, ESSEX, ENGLAND

APPENDIX 'U'

UNIVERSAL MILLER

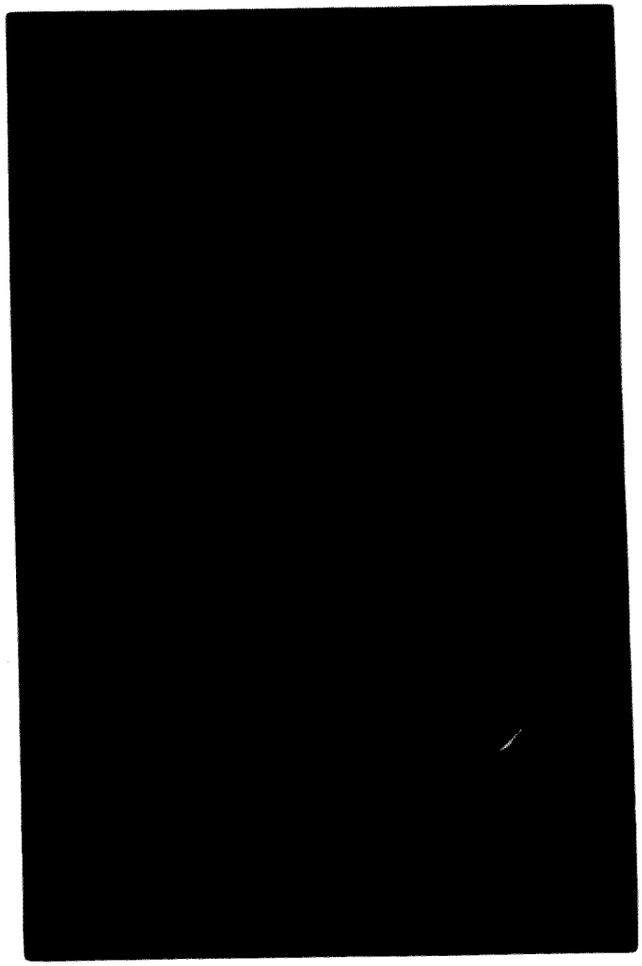


DEL 2

ADCOCK & SHIPLEY (SALES) LTD
P.O. BOX 22, FOREST ROAD, LEICESTER, ENGLAND

APPENDIX 'V'

PLAIN MILLER



MODEL 1ES–M

ADCOCK & SHIPLEY (SALES) LTD
P.O. BOX 22, FOREST ROAD, LEICESTER, ENGLAND

CUTTING TOOL & EQUIPMENT REQUIREMENTS FOR YEAR 1979 - ASSUMING 15% P.A. GROWTH RATE (BASIC YEAR 1971)

(70% MACHINE UTILIZATION)

PRODUCT & BOOK REF.	TOTAL QUANTITY REQ'D.	RAW MATERIAL	SIZE & BREAKDOWN m/m	%	QUANTITY OF EACH SIZE	TOTAL WEIGHT OF ENTIRE QUANTITY (Kgs)	TOTAL MAN/HRS FOR ENTIRE PRODUCTION DIRECT LABOUR	TYPE OF MACHINES/EQUIPMENT REQUIRED FOR ENTIRE PRODUCTION (2 SHIFT SYSTEM)
Straight Shank Twist Drill T. D. 1.	1,279,446	HARDENED BAR (HSS)	3 - 10		127,944	40,067	73,111	Cut - off Machine (Appendix 'B') Flute Grinder (Appendix 'D') Model ADFG 250 Flute Grinder (Appendix 'D') Model ADFG 400 Drill Point Grinder (Appendix 'E') Drill Point Grinder (Appendix 'P') Centreless Grinding Machine (Appendix 'F') Drill Inspection Unit (Appendix 'M') Cutter and Tool Grinding Machine (Appendix 'C') Marking Machine (Appendix 'G')
			4 - 10		127,944			
			5 - 15		191,916			
			6 - 15		191,916			
			7 - 15		191,916			
			8 - 15		191,916			
			9 - 10		127,944			
			10 - 10		127,944			

CUTTING TOOL & EQUIPMENT REQUIREMENTS FOR YEAR 1979-ASSUMING 15% P.A. GROWTH RATE (BASIC YEAR 1972)

(70% MACHINE UTILIZATION)

PRODUCT & BOOK REF.	TOTAL QUANTITY REQ'D.	RAW MATERIAL	SIZE & BREAKDOWN m/m	%	QUANTITY OF EACH SIZE	TOTAL WEIGHT OF ENTIRE QUANTITY (Kg.)	TOTAL MAN/HRS FOR ENTIRE PRODUCTION DIRECT LABOUR	TYPE OF MACHINES/EQUIPMENT REQUIRED FOR ENTIRE PRODUCTION (2 SHIFT SYSTEM)
Straight Shank Twist Drill	548,334	FREE MACHINING BAR (H.S.S.)	11 - 20		109,666	95,630	23,794	Flute Miller (Appendix 'H')
			12 - 25		137,072			Prod. Cylindrical Grinder (Appendix 'K')
T.			13 - 20		109,666			Drill Point Grinder (Appendix 'E')
D.			14 - 15		82,249			Marking Machine (Appendix 'G')
1.			15 - 10		54,833			
			16 - 10		54,833			

CUTTING TOOL & EQUIPMENT REQUIREMENTS FOR YEAR 1979-ASSUMING 15% P.A. GROWTH RATE (BASIC YEAR 1972) APPENDIX 'F'

(70% MACHINE UTILIZATION)

PRODUCT & BOOK REF.	TOTAL QUANTITY REQ'D.	RAW MATERIAL	SIZE & BREAKDOWN m/m	%	QUANTITY OF EACH SIZE	TOTAL WEIGHT OF ENTIRE QUANTITY (Kg.)	TOTAL MAN/HRS FOR ENTIRE PRODUCTION DIRECT LABOUR	TYPE OF MACHINES/EQUIPMENT REQUIRED FOR ENTIRE PRODUCTION (2 SHIFT SYSTEM)
Taper Shank Twist Drill T. D. 2.	38,962	FREE MACHINING BAR (E.S.S.)	13 - 30		11,568	15,851	9,181	Automatic Bar Machine (Appendix 'L') Model H Flute Miller (Appendix 'J') Model 115 Marking Machine (Appendix 'G') Prod. Cylindrical Grinder (Appendix 'E') Drill Point Grinder (Appendix 'P') Universal Miller (Appendix 'U') Plain Miller (Appendix 'V')
			15 - 20		7,712			
			17 - 15		5,784			
			19 - 15		5,784			
			21 - 12½		4,820			
			23 - 5		1,928			
			25 - 2½		964			

CUTTING TOOL & EQUIPMENT REQUIREMENTS FOR YEAR 1979 ASSUMING 15% P.A. GROWTH RATE (BASIC YEAR 1972) APPENDIX 'B'

(70% MACHINE UTILIZATION) Page - 4 -

PRODUCT & BOOK REF.	TOTAL QUANTITY REQ'D.	RAW MATERIAL	SIZE & BREAKDOWN m/m	QUANTITY OF EACH SIZE	TOTAL WEIGHT OF ENTIRE QUANTITY (Kg.)	TOTAL MAN/HRS FOR ENTIRE PRODUCTION DIRECT LABOUR	TYPE OF MACHINES/EQUIPMENT REQUIRED FOR ENTIRE PRODUCTION (2 SHIFT SYSTEM)
Centre Drill T. D. 3.	212,000	FREE MACHINING BAR (E.S.S.)	3 - 40	84,800	16,891	1,001	Automatic Bar Machine (Appendix 'H') Model 395 Universal Miller (Appendix 'E') Centreless Grinding Machine (Appendix 'F') Drill Point Grinder (Appendix 'P') Marking Machine (Appendix 'S')
			4 - 30	63,600			
			5 - 20	42,400			
			6 - 10	21,200			

CUTTING TOOL & EQUIPMENT REQUIREMENTS FOR YEAR 1979 ASSUMING 15% P.A. GROWTH RATE (BASIC YEAR 1972) APPENDIX 'J'

(70% MACHINE UTILIZATION) Page - 5 -

PRODUCT & BOOK REF.	TOTAL QUANTITY REQ'D.	RAW MATERIAL	SIZE & BREAKDOWN m/m %	QUANTITY OF EACH SIZE	TOTAL WEIGHT OF ENTIRE QUANTITY (Kg.)	TOTAL MAN/HRS FOR ENTIRE PRODUCTION DIRECT LABOUR	TYPE OF MACHINES/EQUIPMENT REQUIRED FOR ENTIRE PRODUCTION (2 SHIFT SYSTEM)
Metal Slitting Saw M. 6.	33,000	PIERCED BLANKS (H.S.S.)	AVERAGE 125 m/m DIA. x 3 m/m THICK	NOT APPLICABLE	21,079	1,261	Checking Capstan (Appendix 'Q') Surface Grinder (Appendix 'S') Universal Miller (Appendix 'U') Vertical Broaching Machine (Appendix 'O') Cutter and Tool Grinding Machine (Appendix 'C') Internal Grinder (Appendix 'B') Centre Lathe (Appendix 'P') Marking Machine (Appendix 'G')

CUTTING TOOL & EQUIPMENT REQUIREMENTS FOR YEAR 1979-ASSUMING 15% P.A. GROWTH RATE (BASIC YEAR 1972)

(20% MACHINE UTILIZATION)

PRODUCT & BOOK REF.	TOTAL QUANTITY REQ'D.	RAW MATERIAL	SIZE & BREAKDOWN " / "	QUANTITY OF EACH SIZE	TOTAL WEIGHT OF ENTIRE QUANTITY (Kgs.)	TOTAL MAN/HRS FOR ENTIRE PRODUCTION DIRECT LABOUR	TYPE OF MACHINES/EQUIPMENT REQUIRED FOR ENTIRE PRODUCTION (2 SHIFT SYSTEM)
Metal Slitting Saw With Side Chip Clearance M. 7.	66,250	PIERCED BLANKS (H.S.S.)	AVERAGE 150 " / " DIA. x 3 " / " THICK	NOT APPLICABLE	45,200	9,464	Chucking Capstan (Appendix 'Q') Surface Grinder (Appendix 'S') Universal Miller (Appendix 'U') Vertical Broaching Machine (Appendix 'O') Cutter and Tool Grinding Machine (Appendix 'C') Internal Grinder (Appendix 'I') Marking Machine (Appendix 'G') Centre Lathe (Appendix 'T')

CUTTING TOOL & EQUIPMENT REQUIREMENTS FOR YEAR 1979-ASSUMING 15% P.A. GROWTH RATE (BASIC YEAR 1972)

(70% MACHINE UTILISATION)

PRODUCT & BOOK REF.	TOTAL QUANTITY REQ'D.	RAW MATERIAL	SIZE & BREAKDOWN m/m	QUANTITY OF EACH SIZE	TOTAL WEIGHT OF ENTIRE QUANTITY (Kg.)	TOTAL MAN/HRS FOR ENTIRE PRODUCTION DIRECT LABOUR	TYPE OF MACHINES/EQUIPMENT REQUIRED FOR ENTIRE PRODUCTION (2 SHIFT SYSTEM)
Parallel Hand. Reamer R. 1.	5,800	FREE MACHINING BAR (E.S.S.)	6 - 30	1,740	1,139	1,657	Automatic Bar Machine (Appendix 'L') Model E Universal Miller (Appendix 'U') Plain Miller (Appendix 'V') Cutter and Tool Grinding Machine (Appendix 'C') Production Cylindrical Grinder (Appendix 'K') Marking Machine (Appendix 'G')
			12 - 40	2,320			
			18 - 30	1,740			

CUTTING TOOL & EQUIPMENT REQUIREMENTS FOR YEAR 1979-ASSUMING 15% P.A. GROWTH RATE (BASIC YEAR 1972)

(72% MACHINE UTILIZATION)

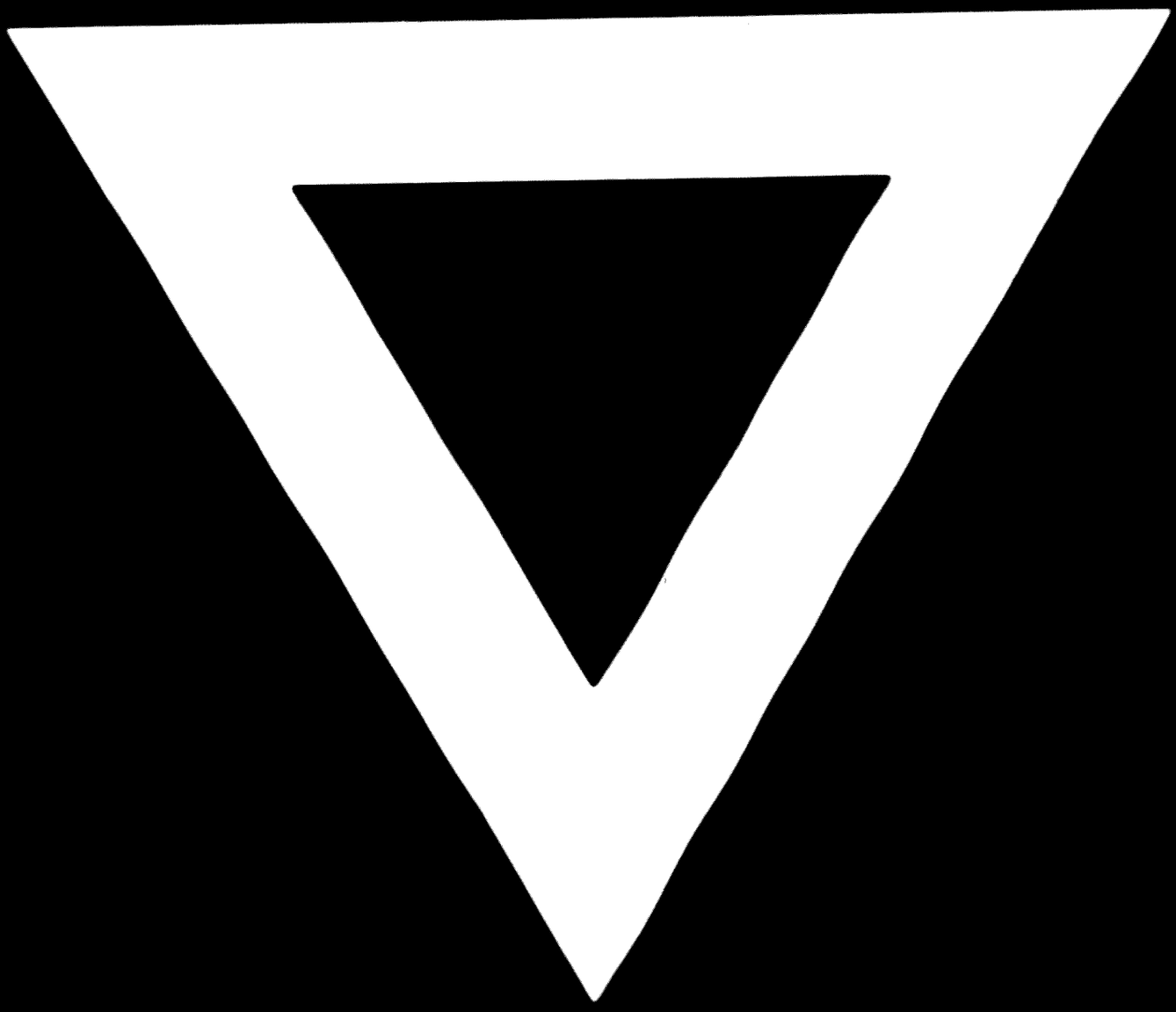
PRODUCT & BOOK REF.	TOTAL QUANTITY REQ'D.	RAW MATERIAL	SIZE & BREAKDOWN B/M S	QUANTITY OF EACH SIZE	TOTAL WEIGHT OF ENTIRE QUANTITY (LBS.)	TOTAL MAN/HRS FOR ENTIRE PRODUCTION DIRECT LABOUR	TYPE OF MACHINES/EQUIPMENT REQUIRED FOR ENTIRE PRODUCTION (2 SHIFT SYSTEM)
Parallel Shank Slot Drill M. 22	26,900	FREE MACHINING BAR (U.S.S.)	5 - 10	2,690	2,388	3,786	Automatic Bar Machine (Appendix 'L') Model E Universal Miller (Appendix 'B') Cutter and Tool Grinding Machine (Appendix 'C') Production Cylindrical Grinder (Appendix 'K') Marking Machine (Appendix 'G')
			10 - 40	10,600			
			15 - 40	10,600			
			20 - 10	2,690			

APPENDIX 'X'

APPENDIX	TYPE OF MACHINE/EQUIPMENT	NO. REQ'D.	MODEL	EQUIPMENT COST F.O.B. INCLUDING ANCILLARY ITEMS £	TOTAL COST OF SPARES £	TOTAL COST OF EQUIPMENT F.O.B. VALUE £	TOTAL COST OF BUYING EQUIPMENT (INCLUDING SPARES)	TOTAL FLOOR SPACE FOR BUYING EQUIPMENT INCLUDING GANGING AREA	TOTAL NO. REQ'D. FOR BUYING EQUIPMENT
B	CUT-OFF MACHINE	1	H 120	2,100	50	2,100			
C	CUTTER & TOOL GRINDING MACHINE	4	311	3,000	200	12,000			
D	FLUTE GRINDER	6	ABF6400	7,500	200	45,000			
D	FLUTE GRINDER	2	ABF8250	5,000	60	10,000			
E	DRILL POINT GRINDER	4	DB 100	2,586	166	10,344			
F	CONTROLLED GRINDING MACHINE	2	Mod 1	6,500	200	13,000			
G	MARKING MACHINE	1	SAND JET	300	20	300			
G	MARKING MACHINE	1	ROLL	300	20	300			
H	FLUTE MILLER	6	181	5,991	256	35,946			
J	FLUTE MILLER	2	919	8,310	188	4,620			
K	PROD. CYLINDRICAL GRINDER	3	107 H	5,000	50	15,000			
L	AUTOMATIC BAR MACHINE	2	H	8,000	50	16,000			
M	DRILL INSPECTION UNIT	1	94	200	20	200			
N	AUTOMATIC BAR MACHINE	1	375	4,000	50	4,000			
O	VERTICAL BROACHING MACHINE	1	10A2	6,000	100	6,000			
P	DRILL POINT GRINDER	4	DB 25	584	64	2,336			
Q	CHUCKING CAPSTAN	1	160908	4,158	42	4,158			
R	INTERNAL GRINDER	1	HAA	4,000	30	4,000			
S	SURFACE GRINDER	1	VERTICAL SPINDLE	5,000	100	5,000			
T	CENTRE LATHE	1	1600	1,918	82	1,918			
U	UNIVERSAL MILLER	2	2H	6,000	50	12,000			
V	PLAIN MILLER	1	IHBM	2,000	50	2,000			

[redacted] £ 208,200 (Rs. 41,640,000) [redacted] sq. metres [redacted]

C-614



85.01.21
AD.86.07
ILL5.5+10