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# Development of Metalworking Industries in Developing Countries

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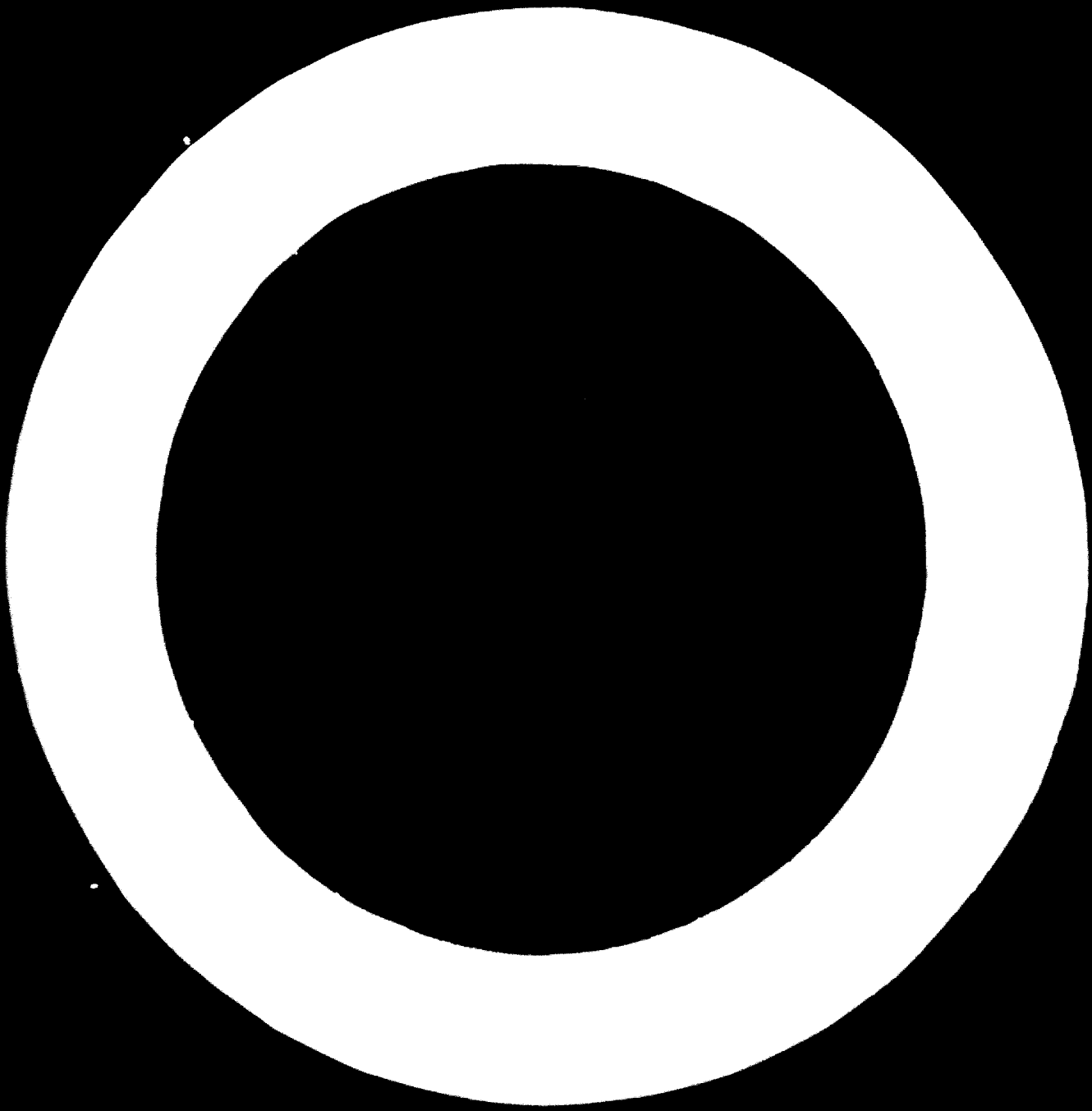

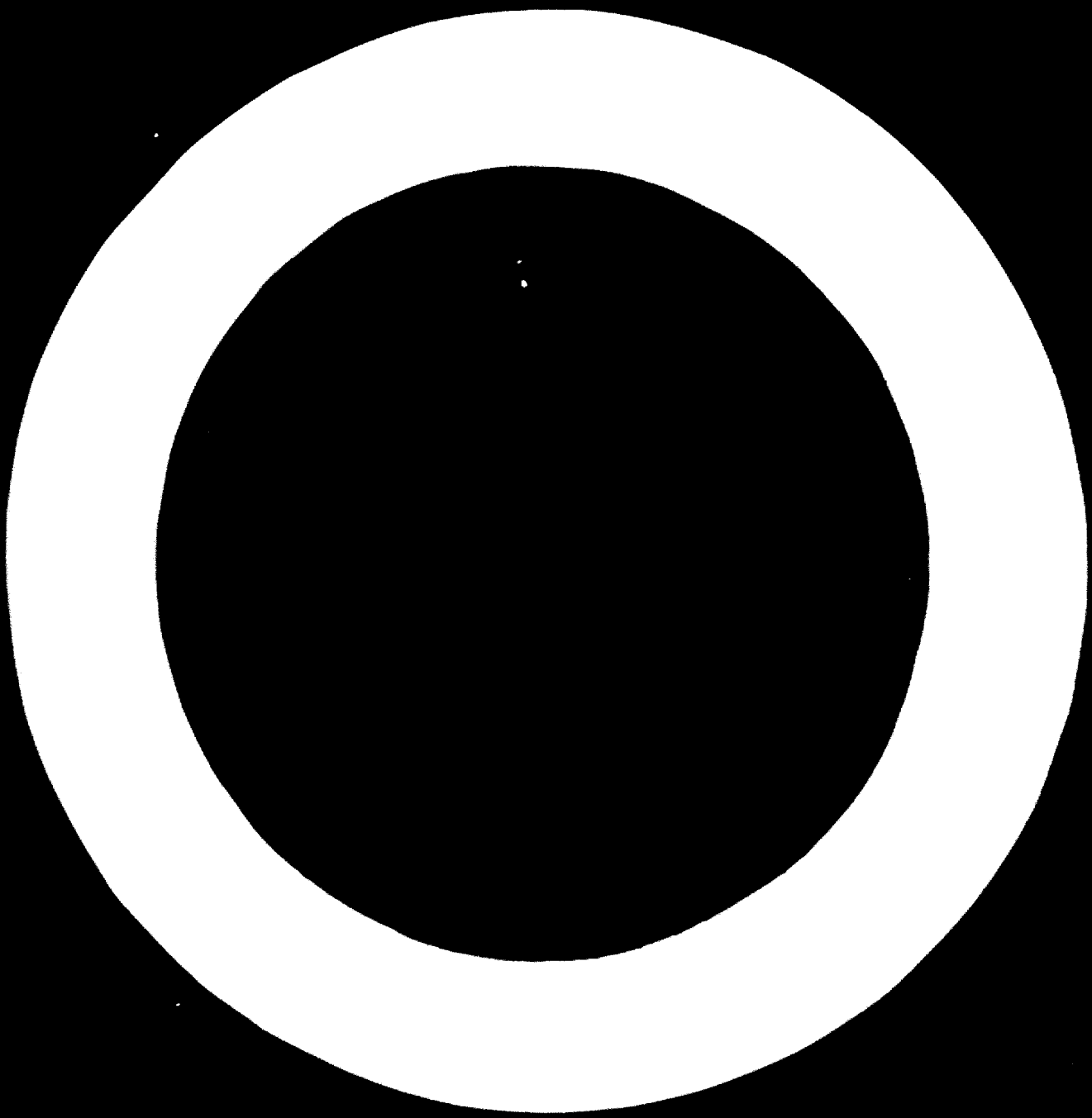

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# BASIC PROBLEMS IN THE EFFICIENT SELECTION OF METALWORKING MACHINES FOR DEVELOPING COUNTRIES

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## INTRODUCTION

During recent years, the developing countries, which have chosen an independent path of development, have been expanding their industrial production and establishing large, modern plants and factories, both through their own efforts and with assistance from abroad.

The developing countries of Africa, Asia and Latin America currently cover most of their needs for metalworking machines by imports from other countries, with only a small number of machines being manufactured in certain of these countries, e.g., Argentina, Brazil and India. The developing countries should solve the urgent problem of organizing national metalworking machine industries in at least some countries, as well as the problem of efficiently selecting machines for importation. It is very important, if one considers that the machine-tool industry is the key branch of the machine-building industry, i.e., its base in manufacturing modern machines, equipment, tools and many other products for industry, transport and agriculture.

Statistical data on production, imports and exports of metalworking machines have been used to define the problems of the rational selection of types of metalworking machines according to the levels of development achieved and the needs of developing countries in Asia, Africa and Latin America during recent years.

## I. ECONOMIC SITUATION AND REQUIREMENTS OF METALWORKING MACHINES IN SELECTED DEVELOPING COUNTRIES

Analysis of the economic situation of selected African, Asian and Latin American countries shows that these countries have large potentialities for the creation and development of national metalworking, machine-building and machine-tool industries.

### A. *African countries*

The population of Africa is 250 million, of which 230 million constitute the population of independent countries. The density of population ranges from two to ten people per square kilometre.

The process of creating economic independence is going on in Africa in very complicated conditions. The unfavourable conditions in the world markets have exerted an influence upon the industrial development of African countries, where the pace remains slow. With the existing pace of growth of industrial production, it is impossible to get free within a short period of time from economic backwardness and to liquidate the gap in the levels of development, as compared with the countries with high industrial development.

The low level of industrial production is expressed in the national incomes of African countries where only 14 per cent is used for industry, including 4 per cent for mining industry and 10 per cent for processing industries.

The share of industry in national income ranges from 24 per cent in Morocco and 19 per cent in the Democratic Republic of the Congo to 3 per cent in Nigeria.

During the last two years, no essential improvements have occurred in the mining industry. The yield of almost all minerals (except oil) has remained at the same level. As for the oil yield in Africa for 1962/1963, the annual gain amounted to about 60 per cent, most of which is owing to the development of oil industry.

The construction of steel plants has been undertaken in Algeria, Morocco and Nigeria. The developing economy of Africa annually increases the demand for ferrous metals and for products made from them.

Wide perspectives are open for the development of the chemical industry, in particular, in the field of fertilizer production. Many branches have successfully developed their own manufacture; agriculture, however, still maintains the colonial structure.

The development of the iron and steel industry forms the basis for the metalworking industries, which today meet only 5 per cent of the demand for metal products in Africa.

Among the African countries, it is expedient to study the development of the metalworking industries in Algeria, Cameroon, the Congo (Brazzaville), the Congo (Democratic Republic of), Ghana, Guinea, the Ivory Coast, Mali, Morocco, the Sudan, the United Arab Republic and the United Republic of Tanzania.

*Algeria.* The processing industry has had little development in Algeria. In the metallurgical and machine-building industries some small enterprises are operating, e.g., a tube mill, a car-building plant, two motor-car factories, an agricultural machinery factory and a tractor plant.

Analysis of the data on imports for the past three years shows that Algerian requirements of metalworking machine tools will be no less than 2,500 pieces for the period 1966–1970. It seems expedient to provide for the designing and construction of a machine-tool plant to satisfy the demands of the metalworking industries.

*Cameroon.* Processing branches of industry have been created in Cameroon. Among them are a factory

for manufacturing aluminium sheets and billets, a plant for manufacturing sheet aluminium rolled from billets, a factory manufacturing plastic packages for agricultural products, a factory for manufacturing plastic, rubber and leather shoes, a perfume factory, meat and fish canneries and a knitted-goods factory. These branches of industry require the establishment of repair shops for manufacturing spare parts, which, in turn, will require the importation of machines.

*Democratic Republic of the Congo.* Metalworking industries are only slightly developed. According to Customs data for 1963, imports of metalworking machine tools amounted to 336 pieces with a value of £779,000. Because of the planned development of metalworking industries in the Democratic Republic of the Congo, metalworking machine tools will have to be imported.

*Ghana.* Different branches of industry have been created in Ghana: a nail-making factory; a tyre factory, a glass-works and a factory for the manufacture of polyethylene, production of steel and rolled steel, a house-building plant, a rolled-aluminium plant etc. The mechanization of agriculture and the extension of the country's industrialization make necessary the replenishment of metalworking machine stock.

It is expedient to provide for the development of the repair factory under design for manufacturing metalworking machine tools and to provide also for the importation of machines.

*Guinea.* The processing industry is only beginning its development in Guinea. The development of industrial production and the cultivation of farm crops in Guinea is facing a problem concerning the necessity of expanding the use of machine tools. In the past, Guinea has satisfied its needs for metalworking machine tools by imports, the purchases being small.

For the period 1966–1970, the Guinean demand for metalworking machine tools should increase slightly.

*The Ivory Coast.* There are metalworking industries producing, e.g., bicycles and radio receivers. This fact makes it necessary to keep metal-cutting equipment at the proper level and to select machine tools for stock.

On the basis of analysis of imports, the existing industrial enterprises of the Ivory Coast will require various metalworking machine tools in the period 1966–1970.

*Mali.* The construction of oil-mills, slaughter-houses, flour-mills, cotton-cleaning plants, a tobacco factory, a textile factory etc. is planned. Enterprises of the processing industry will be constructed, mainly through foreign assistance. At the current time in Mali, the restoration and expansion of the country's vehicle fleet is being undertaken.

According to the Customs data for 1963, Mali imported machine tools.

Measures taken by Mali with regard to agricultural techniques, as well as in the expansion of the power and transport base, will require increasing purchases of metalworking machines.

*Morocco.* The large-scale development of the Moroccan economy and industry needs its complex unity. The absence of national machine tool and metalworking industries impedes the development of the existing branches of industry and agriculture.

According to the Customs statistics for 1963, Morocco imported 696 metalworking machines having a value of $980,000. In the future, Morocco should continue to import machines.

It seems expedient to arrange the manufacture of turning, drilling, planing and milling machines in Morocco.

*Sudan.* The industry is developed very slightly. In the future, however, all types of manufacturing will be increased. In particular, the Sudan has great possibilities for the development of a mining industry.

Despite the low development of metalworking industries, the Sudan imports metalworking machines, which are required for domestic industry and repair establishments.

According to the Customs data for 1963, the Sudan imported 325 machines having a value of $443,000.

For the period 1966–1970, the Sudan will need to continue importing machines.

*United Arab Republic.* Much work is being done towards the development of national branches of the machine-building and metalworking industries.

In recent years, imports of machines have amounted to more than 700 pieces per annum.

Due to the considerable growth of the economy as a whole, as well as the growth of the machine-building and metalworking industries in the country, the demand for metalworking machines will be increased. For the period 1966–1970, it will be necessary for the United Arab Republic to import metalworking machines.

In order to develop the machine-building and metal-cutting industries in the United Arab Republic, it is necessary to create industries for manufacturing turning drilling and milling machines, shapers, etc.

*United Republic of Tanzania.* The development of metalworking industries is low. The industrial share of Tanganyika in the national product is small, about 10 per cent. In accordance with an agreement in Nairobi, Tanganyika has received orders for the further production and deliveries to Kenya and Uganda of some types of equipment (lorry assembling, radio-receiver assembling, manufacture of tyres and inner tubes for motor-cars). The economy of Zanzibar is only slightly developed. The working industry of Zanzibar is represented by small oil-mills, rice-cleaning mills etc. According to the statistics, the United Republic of Tanzania imports a small quantity of machine tools.

Assuming that measures planned by the country for industrialization will be realized and taking into account the level of industrial development already achieved in Tanganyika, it will be necessary to import machines during the period 1966–1970.

### *General conclusions and proposals for African countries*

The basis of modern industry cannot be successfully developed in Africa without the creation of national machine-building industries.

The development of the iron and steel industry has provided the basis for metalworking industries, which might satisfy the demands of Africa for metal products.

Despite the delay in the development of machine tool and metalworking industries in African countries, during the period 1966–1970, imports of metalworking machines will be required.

Furthermore, for the developing economy of the African countries, it will be necessary to build factories for manufacturing turning, drilling, milling, shaping, portable and boring machines in Algeria, Morocco and the United Arab Republic.

For those African countries in which the creation of national branches of machine-tool and metalworking industries is considered necessary, the development of casting, forging, die stamping, fastening and completing products, as well as of tool manufacturing, should be provided for.

Special attention should be drawn to the organization of training of national staffs in machine manufacturing and the planning of production processes.

### B. *Asian countries*

Asia has both the greatest land area and the largest population – 1,500 million – in the world. The density of population varies from four to 155 persons per square kilometre. It is of interest to review the development of economics in the metalworking industries of several Asian countries: Afghanistan, Burma, Cambodia, India, Indonesia, Iran, Iraq, Israel, Lebanon, Pakistan, the Philippines and Yemen.

*Afghanistan.* There are no special metalworking industries in Afghanistan. However, the developing economy in this country, including agriculture, will require the setting-up of repair and maintenance workshops to keep the existing branches of industry in a proper state.

If one assumes that the requirements for repair facilities and domestic industries will remain at the 1963 level, by the end of 1970 Afghanistan will be in need of various metalworking machines. As this country is not prepared for the organization of machine tool manufacturing, the demand for them should be covered by imports.

*Burma.* The growth of capital investments for the development of industrial and agricultural production is being projected in Burma. This will require the maintenance of the major means of production in a highly efficient condition and the replenishment or replacement of equipment necessary for repair shops. The development of the oil and ore industries will be accompanied by the introduction of various machines and equipment, which will naturally necessitate the systematic supply of these fields of industry with metalworking machines for manufacturing spare parts or replacements of used units or parts.

Statistics show that the purchases of machines by this country have not tended towards an increase. During the last three years, imports of machine tools totalled 261 pieces.

As for the next five years, the country will not be able to create its own base for manufacturing metalworking machines: requirements of these machines will be covered by imports. For the period 1966–1970, Burmese industry will require mainly metalworking machines of the universal type.

*Cambodia.* Equipment at existing enterprises in Cambodia should be maintained at the proper level. Repair shops should be set up, and operating shops and individual facilities should be supplied with machine tools. It will, therefore, be necessary for Cambodia to import metal-cutting machine tools during the period 1966–1970.

*India.* The wide development of industries, particularly of machine-building and metalworking industries, is being planned in India. This requires systematic replenishment of the stock of metalworking machines. Indian planning organizations estimate the need in machine tools to amount to 250 million rupees, or about 50,000 machines, per annum. Estimates of the demands for the past five years, however, have not covered all the requirements of the Indian economy.

Thus, it is clear that it will be necessary to develop seriously an Indian machine-tool industry, as well as to maintain a large percentage of imports of such equipment.

*Indonesia.* Provision has been made for the development of the iron and steel industry, the organization of machine-building production, the manufacture of machines for agriculture, light industry and the fabrication of spare parts.

There is no national base for the manufacture of metalworking machine tools. The need for machine tools in Indonesia is being satisfied mainly by means of imports. Analysis of import data has shown that Indonesia does not expand its machine stock, restricting itself to imports of machine tools in small quantities, and does not arrange to have its own base for machine-tool manufacturing.

When comparing the economy of Indonesia with the economy of India and their similar trends in the development of industrialization, it is necessary to draw attention to the necessity of developing a national machine-tool industry for manufacturing turning, drilling and other machine tools.

To meet the requirements of the Indonesian economy, it will be necessary to import various metalworking machines during the period 1966–1970.

*Iran.* Development of power bases is expected in Iran. Furthermore, there are a number of motor-car assembly plants and other factories. Thus, it is necessary to expand the network of various repair units and to maintain working equipment on the proper scale.

Analysis of imports of metal-cutting machines shows that Iran will need to continue to import these machines.

*Iraq.* Further development of the oil industry, as well as of some individual branches of domestic industry, is being planned in Iraq.

*Israel.* Enterprises in the metalworking industry are being actively developed in Israel.

A prominent place in the country's industrial and economic development is given to the iron and steel, electrical-engineering, textile and chemical industries, as well as to other branches of industry.

According to the data of experts and to Customs statistics, replenishment of the stock of metalworking machines in Israel is covered by imports. In 1963, Israel

imported 624 machine tools. Metalworking industrial branches in Israel will require universal metalworking machines of various designations.

*Lebanon.* General development of the economy of Lebanon is being planned. This will require the setting-up of repair shops and the maintenance of transport and domestic shops at the required level. Requirements during the period 1966–1970 will be handled by imports.

*Pakistan.* Considerable development of the economy and, particularly, of the metalworking industry, is being planned in Pakistan. The maintenance of existing industrial enterprises at the proper level will require the supplement of the stock of metalworking machines in the country. Analysis of statistical data shows that Pakistan imports 1,200–1,550 machine tools *per annum*. In the period 1966–1970, the importation of machine tools will be mainly continued. It seems to be expedient in Pakistan to provide the base for the development of national machine tool industry for the manufacture of turning, drilling, planing and other machine tools.

*Philippines.* There is no national machine-tool industry in the Philippines. The metalworking industries meet the demand for machine tools through imports. In the period 1966–1970, the needs of various branches of industry for metalworking machine tools will be satisfied by imports.

*Yemen.* There are semi-primitive workshops in Yemen, and development of the textile industry and energetic system is being planned. Improvements in agriculture will certainly require an intensification of the production of spare parts, which will, in turn, require the expansion of a repair shop system. These machine-tool requirements could normally be met in the coming five-year period by means of imports.

*General conclusions and proposals for developing countries of Asia*

The analysis of data on imports of metalworking machine tools into the above-mentioned Asian countries for the past three years shows their tendency towards the development of national machine-tool and metalworking industries in order to achieve economic independence.

To satisfy the growing needs of the metalworking industries in these twelve Asian countries alone, the purchase of imported machines will be required.

High-quality automatic machine tools and semi-automatic broaching and other machine tools are required for the developing economy of India.

A considerable quantity of marketable small and medium-size machine tools might be manufactured in India, Indonesia and Pakistan. For this purpose, it seems to be expedient to create additional establishments for manufacturing metalworking machine tools in these countries.

The development of national manufacture of metalworking machines and of other branches of the machine-tool industry in Asian countries will require an examination of the problems concerning the setting-up and expansion of enterprises for manufacturing castings, forgings, die stampings, fastening and other outfits, as well as tools and processing equipment.

In order to use more effectively the imported equipment delivered to the Asian countries and particularly to introduce modern methods of organization and planning of production, it will be of great importance to train national personnel, both workers and engineers, who could independently direct the development of metalworking branches and of the machine-building industry in their countries.

### C. *Latin American countries*

In Latin America, there are twenty politically independent States. The total area of Latin America is over 20 million square kilometres, and the population is over 250 million.

The Latin American countries are still less developed economically, despite the growing capital investments, both foreign and domestic, in industry and agriculture.

The development of industry in Latin America, as a whole, is rather poor. While this continent has 7 per cent of the population of the free-enterprise economies, its share in the production of such countries is only 5 per cent.

More than one-third of the continent's population lives in Brazil, the largest country of the continent; about two-thirds live in Argentina, Brazil and Mexico. The Brazilian share in the gross production of all Latin American countries is 40 to 45 per cent and that of Argentina, Brazil, Chile and Mexico is about 75 per cent.

Latin America far exceeds the countries of Asia and Africa in the degree of its industrial development. The total amount of wage labour in Latin America is over 50 per cent of the population, which is one-third more than in Asia and twice as much as in Africa.

Beginning with the early 1950s, an over-balance has been served in the favour of industrial production in the correlation between the industry and agriculture.

During the first post-war years, 57 per cent of all gainfully employed persons were engaged in agriculture; in 1960, only 47 per cent were so employed. The percentage of urban population supporting themselves by income from industry, utilities and trade amounts to 50 per cent in Mexico, 61 per cent in Venezuela, 66 per cent in Chile, 68 per cent in Argentina and 71 per cent in Uruguay.

The post-war period of development of the leading countries of Latin America is characterized by the following general changes:

(*a*) The change in correlation between the extractive and processing branches of industry, in the latter's favour;

(*b*) The increasing share of new branches of production;

(*c*) The growing role of electrical engineering, machine building and the chemical industry;

(*d*) The development of specialization and co-operation in industry.

The industrialization process in the Latin American countries becomes manifest when one considers the rapid growth of the processing branches of industry. The share

of the processing industries in the gross national product is four times as much as the share of mining branches. In 1963, the entire industrial production of Latin America was estimated to amount to $30 million.

The branches of heavy industry are developing in Latin America more rapidly than are light industries. The production of light industries during the period 1953–1963 increased 1.5 times and the production of heavy industries increased twofold. The production of pig-iron and steel did not exceed 370,000 tons in 1937, being concentrated only in Brazil and Mexico. According to data of 1962, the production of pig-iron amounted to 2.9 million tons and that of steel, to 5.8 million tons. At the current time, there are iron and steel industries in Argentina, Brazil, El Salvador, Chile, Colombia, Mexico, Peru, Uruguay and Venezuela. The number of steel plants in Latin America, as a whole, was forty-four in 1962, the total investments in this branch of industry exceeding $1,000 million.

The countries of Latin America are producing domestic appliances, radio receivers, television receivers, sewing-machines, electric generators, boilers for industrial use, hydraulic presses, lifting and handling equipment, road-building machines, railway cars, motor-cars and equipment for the textile, food and pulp and paper industries. In 1958, in Brazil alone, there were 4,362 machine-building plants employing 273,600 people.

The motor-car industry has become comparatively well developed. Brazil has completely stopped importing motor-cars. The motor-car industry of Argentina produces twenty-eight models of passenger motor-cars and nineteen models of lorries. The motor-car industry is growing in Colombia, Mexico, Peru, Uruguay and Venezuela.

The progress and changes in the structure of the processing industries in the Latin American countries are connected with the appearance and expansion of the machine-tool industry.

Of great significance for technical progress is the growing role of the chemical industry. Even such rapidly developing branches of industry as iron and steel, and metalworking are left behind by the growth rates of the chemical industry. Chemical products account for 12 per cent of the entire production of Latin America: of that percentage, one-third is produced by Brazil and one-fourth by Argentina.

The development of heavy industries (iron and steel, machine building, motor-cars, oil and chemicals, ship-building) has caused the noticeable growth in number and significance of enterprises with more than 500, or more than 1,000 employees. In Brazil, by the beginning of 1961 there were 170 enterprises which employed over 1,000 people. They accounted only for 0.15 per cent of the total number of industrial enterprises, but concentrated 17.5 per cent of all persons working in industry. Brazil now has over fifty enterprises in the steel-melting industry.

In 1959, eleven motor-car plants were employing a total of 70,000 people, and in 1961 the number of employees exceeded 100,000. The high concentration of production is characteristic of Chile; it involves all sides of the economy. In Chile, there are eleven groups which exercise control over two-thirds of the capital of all joint stock companies of the country.

The growth of industry in Latin America has increased the number of the working class and has led to concentration of labour at the large plants. More than two-fifths of proletariat (over 13 million people) are workers engaged in industry, construction and transport.

In 1960 the Latin American countries purchased over 5 per cent of the machine tools on the world market. Argentina and Brazil were the main consumers and, partially, local manufacturers of machine tools. In view of the current demand, the consumption of machine tools for the industrial development of Latin America will increase to £94 million in 1970.

Of the Latin American countries, the development of metalworking industries should be considered in Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Mexico, Peru, Uruguay and Venezuela.

*Argentina.* The industrial development of Argentina is, to a considerable degree, associated with the intensive expansion of foreign capital and of that of the United States of America, in particular.

According to the Customs data for 1963, Argentina imported 3,331 machine tools for $25,551,000.

The analysis of import deliveries of machine tools testifies to the fact that the United States of America supplies a considerable number of machine tools, their cost being much higher than the machine tools supplied by the competing countries. The machine-building industry being developed in Argentina covers a short nomenclature of ordinary kinds of machine tools.

A great number of machine tools will have to be imported into Argentina within the next five years.

Furthermore, the machine-building industry of Argentina can fabricate the machine tools for its own needs. Since the demand for machine tools in the country will increase, it is expedient to provide for further development of the national machine-building industry.

*Bolivia.* The processing industry of Bolivia accounts for 12 per cent of the national production; less than 8 per cent of the gainfully employed population is working in it. A considerable part of the national consumption of the most significant products is imported.

Bolivia accounts for 10 per cent of the world tin production. Under one of the plans, mining of zinc and iron-ore is projected in Bolivia.

The processing industries of the country are practically not developing. The small requirement of Bolivia for metalworking machines is mainly met by imports from Argentina and Brazil, and partially from other free enterprise economies. For the period from 1966 to 1970, various imported machine tools will be required for Bolivia.

*Brazil.* This is one of the most developed industrial countries of Latin America. It holds first place in the volume of industrial production among the Latin American countries. The old traditional branches (food and textile industries) have the maximum share in the processing industries of Brazil, as in most other Latin American countries.

During recent years, an increase was observed in the share of the basic branches of heavy industry, i.e., the iron and steel, machine-building and chemical industries.

It is necessary to note the development of machine tools fabrication in Brazil. However, such development concerns only the production of simple machine tools for small metalworking establishments for repair workshops of textile and food industries. As for compound machine tools, Brazil imports them from the Federal Republic of Germany, Sweden and the United States of America.

The changes in the structure of various processing industries of Brazil are associated with the setting-up and further development of the machine-tool industry. The development of a machine-tool industry in Brazil is a result of its being supported by some firms from the Federal Republic of Germany and Sweden, which are establishing the machine tool plants in that country, where a number of their own machine-tool companies have been established.

Analysis of statistical data indicates that Brazil will require a considerable number of machine tools during the period 1966–1970.

The Brazilian machine-tool industry is able partially to provide for the national metalworking industries and to allot a portion of the tools to be exported to the other countries of Latin America and to Africa.

To meet the growing demand for machine tools, it appears to be expedient to set up in Brazil additional establishments for manufacturing metalworking tools.

*Chile.* One of the developed countries of Latin America is Chile. The most developed branch of Chilean economy is the mining industry, mainly the mining of copper, iron-ore and saltpetre.

The share of processing industries in the gross national output accounts for nearly 25 per cent. At the current time, there are about forty branches, but the majority of them are poorly developed. The iron and steel industry and metalworking industries are just beginning.

The machine-building industry is poorly developed. There is no machine-tool industry, and the chemical industry is practically unavailable. Slight development is observed in motor-car assembly and in the pulp and paper industry.

The economic development programme provides for an increase of 76.2 per cent in the output of processing industries.

During recent years, metalworking machine tools valued at £537,000 have been imported into Chile. The greater part of these machines was imported from the United States of America (45 per cent) and from the Federal Republic of Germany (38 per cent). Chile purchased drilling, boring, grinding, turning, milling, planing, gear-milling and other machines.

According to Customs data for 1963, Chile imported 214 machine tools valued at $399,000. Requirements of the growing economy of Chile will be met by imports during the period 1966–1970.

*Colombia.* Substantial capital investments are being allotted for the processing industries in Colombia. To develop the machine-building industry, it is planned to establish a machine-building plant in Bucaromang. The plant will produce parts for railway equipment and for agricultural machinery. The construction of a tractor and diesel-engine plant is under design. A number of motor-car assembly plants are planned. During recent years, one-third of imports into Bolivia came from the United States of America. Imported metalworking machine tools are mainly those for drilling, boring, grinding, turning, milling, planing and gear milling.

According to the Customs data for 1963, Colombia imported 404 machine tools at a cost of $530,000. In the period 1966–1970, the Colombia economy will be in need of imported metalworking machine tools.

*Ecuador.* The development of industry is poor in Ecuador. Its share in the gross output of the country comes to 18 per cent, with 15.8 per cent of it deriving from processing industries.

Processing industries are mainly represented by small industrial establishments which are chiefly engaged in processing the local agricultural raw materials and in manufacturing consumer goods.

During recent years, growth has been observed in the branches producing synthetic materials.

According to import data for 1963, the Federal Republic of Germany was supplier of metalworking machine tools to Ecuador. During the period 1961–1963, it supplied machine-tool equipment amounting to $56,900; the shipments were mainly small-size equipment.

Machine-tool requirements in 1966–1970 will be met by imports.

*Mexico.* The processing industries are first in the manufacturing sector of the national product. Metalworking, fabrication of metal products and the chemical and rubber industries in Mexico account for 58 to 95 per cent of the total volume of products manufactured.

The rapidly growing industrial production imposes a high level of demand for metalworking machine tools. At the current time, provision is being made for the development of the machine-tool industry in Mexico. During recent years, 66 per cent of the imported machine tools came from the United States of America.

The imported metalworking machines are mainly drilling, boring, grinding, turning, milling, planing, gear-milling and other machine tools.

According to the Customs data for 1963, machine tools imported into Mexico totalled 2,435 pieces.

The metalworking industries in Mexico will continue to require imported metalworking machine tools.

It seems to be necessary to provide for the designing and establishment of a national branch of the machine-tool industry in Mexico, in order to produce machine tools for different purposes.

*Peru.* The mining and non-ferrous industry is greatly developed in Peru. Repair workshops account for the greater part of the metalworking industries.

During recent years, metalworking machine tools valued at £344,000 have been imported into Peru. At the current time, Peru is developing its light industries, which makes it necessary to import machine tools for equipping new factories.

The import list of metalworking machine tools includes

different types of drilling, boring, grinding, turning, milling, planing, gear-milling and other machine tools.

According to Customs data for 1963, Peru imported 534 machine tools at a cost of $721,000. The Peruvian requirements for machine tools during the period 1966–1970 will be mainly met by imports.

*Uruguay.* A small quantity of machine-tools is used by Uruguay. In 1960, imports of metalworking machine tools amounted to £94,000. The machine tools were mainly from the Federal Republic of Germany, Italy and the United States of America.

The growth of the motor-car industry will be accompanied by an increased demand for machine tools. The *Customs Statistics Journal* for 1963 shows that Uruguay imported 110 machine tools from the Federal Republic of Germany for $145,000. Approximately the same level of requirement in machine tools will prevail in Uruguay during the period 1966–1970.

*Venezuela.* Processing industries account for 17 per cent of the national production of Venezuela. Metalworking plants are being built in Carabobo and Lara. In 1958, the steel plant was put into operation with a planned production of 650,000 tons of steel.

During recent years, imports of machine tools have amounted to £940,000, with one third of the imports coming from the Federal Republic of Germany, the United Kingdom of Great Britain and Northern Ireland, and the United States of America. With the expansion of production, the demand for machine tools will be met by imports.

*General conclusions and proposals for Latin American countries*

The industrial development of the Latin American countries far exceeds that of African and Asian countries.

The process of industrialization in the Latin American countries is accompanied by rapid growth in the processing branches. The development of heavy industry, e.g., motor-car production and machine tool manufacture, will require the importation of a considerable number of machine tools.

In addition, the expansion of national branches of the machine-tool industry will be required in Argentina, Brazil and Mexico.

The creation and development of national machine-tool industries in the Latin American countries will also require that particular attention should be given to the training of national cadres of workers, engineers and other employees who could master the minimum technical knowledge in their practical work of creating machine tools and in the field of organization and planning of production for this branch of machine building.

It will be necessary to provide for the setting-up of specialized plants for manufacturing castings, forgings, stampings and other completing parts.

## II. Development of National Production of Metalworking Machine Tools and Efficient Selection of Machine Stock

The foregoing analysis of the economic situation in selected countries of Africa, Asia and Latin America shows that those countries are working on the development of branches of national production which can provide for them equality in international economic relations.

The weakest point in the countries discussed is the absence of an all-round association between the development of the raw material and processing branches of industry.

Support of the principle of equality in international economic relations is possible through the availability of an industrial base, particularly the expansion of metalworking industries, the setting-up of manufacture of metalworking machine tools and the correct selection of machines for the machine-tool stock in individual developing countries. The development of industrialization in each country is closely connected with the production of machine tools. In this connexion, it should be particularly noted that the machine tool industry is the key branch of machine building: its basis in manufacturing up-to-date machinery, equipment, tools and all other products for industry, transport and agriculture.

Metalworking machine tools are machines required for the creation of various machines, equipment and modern technical means in all fields of economy of a country which has begun to industrialize.

According to the established trade ties, the developing countries of Africa, Asia and Latin America continue to meet their requirements of machine tools, which are insignificant for the time being, by imports.

The requirement of the metalworking industries of these countries accounts for less than 10 per cent of the world requirements of machine tools.

When embarking on the path of independent economic and industrial development, the developing countries are faced with the immediate tasks of setting up national production of machine tools, correctly selecting the types of machine tools to be imported, providing proper maintenance and keeping the stock of machines at the level of the more industrialized countries.

The index for the level of the industrial development of each country is the ratio of the manufacturing of machinery and other equipment to the total scope of manufacturing production in the country. It should be noted that in the most highly industrialized countries the share of the products of the metalworking industries in the total fabricated production amounts to 22 to 40 per cent, while in the developing countries, it is only 1 to 5 per cent. Therefore, the degree of industrialization and the technological progress are closely connected with the level of the national machine-tool industry, as it is the core of machine-building production.

### A. *Importance of additional development and specialization of metalworking industries in developing countries*

To establish national machine-tool industries in the developing countries of Africa, Asia and Latin America, it is necessary to study the specific features of their economies and, particularly, to determine the scope of production and fix the most significant and required types and sizes of machine tools. The great significance in the development of the machine-tool industry is also con-

firmed by the fact that ten years ago no more than fifteen countries in the world were engaged in producing machine tools, while at the present time, the number of these countries is doubled.

In 1964, more than 50 per cent of the total world production of metalworking machine tools were fabricated in the Federal Republic of Germany, the Union of Soviet Socialist Republics and the United States of America, and the ten largest countries of the world manufactured 90 per cent of world production, with the remaining 10 per cent being produced by twenty other countries.

It is of interest to note that some developing countries had begun to produce metalworking machine tools. However, the share of this production in world production amounted to only 3.6 per cent. Of this amount, 0.6 per cent was produced by India, another 0.6 per cent by Argentina and slightly more than 0.5 per cent by Brazil.

Another important index of the level of industrial development is the *per capita* production of machine tools. According to United Nations data, machine-tool production *per capita* amounted to: $22.40 in Switzerland; $15.20 in the Federal Republic of Germany; $10.30 in Czechoslovakia; $9.70 in Eastern Germany; $7.10 in the United Kingdom; $4.60 in the United States of America; $2.90 in Japan; $1.20 in Argentina; $0.31 in Brazil; and under $0.06 in India.

In the machine-tool industry there are many standard types and sizes which it is not always profitable to manufacture in one country. It is the branch of machine-building in which there is a great field of action in the organization of the most efficient exchange between all countries of the world. Thus, for example, in the period 1955–1960, exports of machine tools accounted for 7.16 per cent of total world production, while manufactures increased by only 35.1 per cent.

In 1960, the exportation of metalworking machine tools involved more than sixty countries of the world, and nearly 50 per cent of the volume was used by industrially developed countries.

Imports of machine tools into the developing countries in 1960 amounted to 2.7 per cent of total world exports. Of this share, Brazil purchased 4.3 per cent; Argentina, 3.9 per cent; India, 3.9 per cent; and Mexico, 1.5 per cent.

Due to the poor development of industry in the countries of Africa, Asia, and Latin America, the requirement of machine tools in these countries still remains insignificant. The principal consumers of machine tools are still thirty-four industrially developed countries which cover 9.4 per cent of the world requirement, with the share of the developing countries accounting for only 3 per cent. Ten principal consumers, who are also the principal manufacturers, utilize 80 per cent of the world requirement of machine tools. Thus, for example, for the last five years the consumption of machine tools in the industrially developed countries of Europe was sixteen times as much as that in the countries of Asia during the same period.

The average annual *per capita* consumption of metalworking machine tools in the period 1958–1962 amounted to: $4.64 in twelve free-enterprise economies of Europe; $2.96 in North America; $2.83 in Eastern Europe; $0.68 in Latin America; $0.27 in Asia and $0.1 in Africa. The world average annual *per capita* was $1.20 during those years.

The developing countries do not occupy any significant place in the world machine-tool market. Exports of machine tools by these countries amounts to 0.03 per cent of total world exports. The annual imports of machine tools into the developing countries is negligible, compared with the industrially developed countries. For example, imports were equal to less than one-seventh to Latin America, one-ninth to Asia and one-twenty-seventh to Africa.

While carrying out industrialization in the developing countries, particularly in its initial stage, it is equally important – along with completing the stock of metalworking machines by importation and the setting-up of the national production of machine tools – to organize efficiently co-operation in the metalworking industries, for which purpose it is necessary to provide for the establishment of certain shops or plants which are capable of fabricating the products and parts for various enterprises.

It appears to be very important to organize properly the specialization in metalworking industries, particularly in manufacturing the normalized fastenings, tools, forgings, castings and die stampings.

The principal thing for each developing country of Africa, Asia and Latin America is the correct organization of training for the national cadres of workers, designers and technologists.

These, as well as other issues, should be given proper care in the developing countries in the process of creating their national machine tool and metalworking branches of industry.

It seems to be expedient, beginning with 1966, to hold international seminars at which there can be discussions of the practical issues concerning the development of national machine-tool industries in the developing countries. It would be desirable to hold seminars in Argentina or Brazil for the countries of Latin America, in India for the Asian countries and in the United Arab Republic for the countries of Africa.

The most efficient form of assistance in the development of metalworking industries in the countries of Africa, Asia, and Latin America could be the completion of the number of branches in those countries through the provision of machine tools which should be removed from production in the industrially developed countries, due to changes in the technological processes. Such machine tools could be supplied to the developing countries on the terms of payment which were most beneficial for them.

The planned development of national enterprises for manufacturing metalworking machines, with a mutual understanding, could be accomplished in the case of wide co-operation between individual countries, taking into consideration the community interests and location. Thus for example, in Latin America, the setting-up of enterprises for manufacturing machine tools could be realized

on the basis of broad co-operation and proper specialization of the production. Similar problems of mutual co-ordination for the creation of national machine-tool industries in certain countries of these continents could be solved by the African and Asian countries.

The Soviet Union is going to continue to render economic and technical assistance to the developing countries in their independent economic and political development, particularly in creating metal-working industries and in setting up national machine-building and machine-tool industries.

The main factor affecting the national economy of all developing countries is the preparation of plans, that is, the programme of economic development. The method of planning is all-embracing in the State sector of the economy of developing countries.

In the more industrialized of the developing countries — for example, in India — it seems to be important also to establish certain ties not only with the State sector, but also with the private one.

The first measure to be taken with regard to setting up the machine-tool industry should be the designing and establishment of plants and factories for the manufacture of machine tools, the broader issuing of licences and the conclusion of technical-aid agreements.

When organizing technical assistance, it seems to be necessary to provide for the supply of certain parts and units for machine tools which are produced in accordance with licences.

In the next five to seven years, of great importance to India is the increased help in the growth of the machine-building and machine-tool industries.

During the next five years in the United Arab Republic, it is also necessary to direct efforts towards growth in the machine-building industry and towards the creation of a national machine-tool industry.

## B. *Efficient selection of machine tools an aid to rapid industrialization and better production*

The analysis of the economic situation in the countries of Africa, Asia, and Latin America indicates that the level of development of metalworking industries in these countries still remains low. However, there are quite great potentialities for creating machine-building industries in these countries.

During the last three or four years, the countries of Africa, Asia and Latin America have been supplied with simple types of drilling, turning, grinding, milling, boring, planing and shaping, cutting-off and other machines.

According to the *Customs Statistics Journal*, 40,800 various machine tools were supplied in these countries in 1963; the value of the tools was $188,408,000.

In connexion with the level achieved and the requirements of metalworking industries, the urgent problem in the planned development of the economy in the developing countries is the selection and fixing of the types of metalworking machine tools which are to be imported and those which are to be produced domestically.

Recommendations with regard to imports of metal-working machine tools for the countries of Africa, Asia and Latin America set forth the approximate data on the eight most important types, including drilling, boring, grinding, turning, milling, planing and shaping, gear-cutting and cutting-off-machines. Brief specifications are given for these types of machine tools.

### 1. *Drilling machines*

In the technology of metal-working industry of the developing countries, a considerable number of drilling machines will be required. This group includes bench drilling machines with a maximum drilling diameter of 1.5 to 12 mm, single-spindle upright drilling machines with a maximum drilling diameter of 18 to 75 mm and radial drilling machines with a maximum drilling diameter of 25 to 50 mm.

The demand for ordinary drilling machines can be increased or reduced, depending upon the nature of production (use of automatic units or automatic lines). The share of drilling machines is considerable in the general technological process in all countries of the world.

### 2. *Boring machines*

Boring machines compete with drilling machines in technological purposes, providing the finer machining of holes, and partially, with milling machines for the machining of planes. According to demand data in 1960, boring machines accounted for 6.2 to 11.5 per cent of the total number of exported machines. In the world trade, the share of the boring machines amounted to 7.1 per cent of all purchases in 1951, 8.8 per cent in 1954 and 9.4 per cent in 1958. The share of boring machines in the technological process in metalworking industries was 4 per cent.

In the developing countries which already have or plan to establish metalworking industries, maximum use will be made of boring machines with a spindle diameter of 60 to 111 mm and portable diamond-and carbide tool-boring machines with a diameter of 125 mm for cylinder boring.

### 3. *Grinding machines*

Grinding machines include a universal plain grinder with a maximum diameter of workpiece not exceeding 500 mm, an internal grinder with maximum diameter of workpiece not exceeding 100 mm, a flat-surface grinder with table size 300 × 1000 mm, sharpening grinders of the universal type, rough grinders with a wheel diameter of 100 to 500 mm, honing machines with a honing diameter of 20 to 200 mm, finishing grinders with a disc diameter of 200 to 450 mm, polishing grinders with a wheel diameter of 300 to 400 mm etc.

According to experts' opinion, by 1970 the share of grinding machines on the market will account for over 11 per cent of the total number of machines purchased. The share of grinding machines in the general scope of deliveries is expected to be increased, having in view the advanced technique of abrasive machining of parts in the development of new technological processes of production.

4. *Turning lathes*

Turning lathes remains one of the important groups in the technological complex of metalworking industries, and up to 1970 they will account for a great share in the purchasing structure for machine tools. The metalworking industries of developing countries will mainly require lathes with a workpiece diameter not exceeding 400 mm, fully automatic thread-cutting lathes for turning woodscrews of 1.5 to 10 mm diameter, engine, stud and nut lathes. Turret lathes with a bar diameter of 12 to 60 mm and chucking lathes with a workpiece diameter of 500 to 800 mm may be required. The demand for lathes in 1960 accounted for 19.5 per cent to 27 per cent of the total requirement of all machines. In 1961, the United Kingdom exported 27.1 per cent of the lathes, including 10 per cent of the turret lathes, 3.3 per cent of the thread-cutting and screw-cutting lathes, and 13.8 per cent of the other lathes of the total export of machine tools of this country.

The Indian machine-building industry will require large, heavy lathes with a workpiece diameter not exceeding 2,500 mm, as well as others.

5. *Milling machines*

Milling machines account for a great share in the technological stock of metalworking enterprises. The demand for milling machines still remains low in spite of favourable market fluctuations. Thus, in 1951 milling machines accounted for 11.8 per cent of total purchases; in 1954 this share was 15.4 per cent and in 1960 it was 10.3 per cent. Purchases of milling machines in 1967 and 1970 are expected to be 9.9 and 9.5 per cent, respectively, of total purchases. Some changes may take place due to the broad development of broaching and outfit milling machines. Of the total demand for machine tools in 1960, the demand for milling machines amounted to 11.8 per cent in the United States of America, 10.3 per cent in the United Kingdom and 8.3 per cent in the Federal Republic of Germany.

This level of demand with slight changes may remain in the developing countries of Africa, Asia and Latin America. To provide for the metalworking branches of these countries, it will be necessary to have horizontal milling machines with tables which are 250 × 1,000 mm and 400 × 1,600 mm in size; vertical milling machines, universal machines, single-upright horizontal plano-milling machines with tables which are 800 × 2,000 mm, engraving machines with tables 200 × 320 mm, bracket milling machines and others.

6. *Gear-working machines*

Gear-working machines are used in all branches of machine building, but their share is, comparatively speaking, not large. It is necessary to bear in mind that the demand for gear-working machines may fluctuate, depending upon the mastering of new technological processes of gear rolling or die stamping instead of milling or planing. In 1960, the share of gear-working machines in total imports of machines amounted to 4.1 per cent in the Federal Republic of Germany, 3 per cent in the United Kingdom and 2.7 per cent in the United States of America.

The developing metalworking industries in the countries of Africa, Asia and Latin America will require, among others, gear-milling machines for cylinder gears whose diameter does not exceed 800 mm, gear-slotting machines for cylinder gears not exceeding 800 mm in diameter; gear-shaping machines for straight-bevel gears with a diameter not exceeding 800 mm; and gear-tooth-chamfering machines for cylinder gears with a diameter not exceeding 800 mm.

7. *Shaping, planing and slotting machines*

Shaping, planing and slotting machines have only a small place in the total technological stock of the metalworking industries. However, such machines are required for machine-building industries, and they will be required particularly in the developing countries. In 1960, purchases of these machines amounted to 3.5 per cent of total purchases by the Federal Republic of Germany and to 2.7 per cent of the total for the United Kingdom. The share of the planing and slotting machines in the total stock of metalworking machines comes to 2–3 per cent. The recommended machine tools in this group are shapers with piston stroke not exceeding 700 mm, open-side planers having tables 1,000 × 3,000 mm in size, slotting machines with maximum ram travel of 100 to 500 mm and others.

8. *Cutting-off machines*

Cutting-off machines are required in the metalworking industries for the cutting-off of metal. It is expected that the developing countries will be in need of hack-sawing machines and cutting-off millers with saw diameters of 350 to 1,000 mm.

### C. *Machine-tool requirements of India*

To meet the requirements of the Indian market it is recommended to provide the following:

(a) ***Full and semi-automatic lathes*** for turning woodscrews with diameters of 1.5 to 10 mm and fully automatic bar lathes for bars with maximum diameters of 25 mm, 40 mm;

(b) ***Broaching machines***, both horizontal and vertical, with loads of 5 to 40 tons;

(c) ***Turret lathes*** for bar diameters of 12 to 800 mm and chucking lathes with workpiece diameters of 500 to 630 mm;

(d) ***Screw-milling machines*** for short male and female screws with diameters of 100 to 140 mm and 200 mm, and workpiece lengths of 500 to 900 mm. For milling long screws with diameters of 100 to 110 mm, the distance between centres should be 500 to 1,500 mm.

Proceeding from the mean level of metalworking industries in the developing countries, the Soviet Union is capable of organizing, in the form of assistance by drawing up the corresponding agreements, the deliveries of 112 standard types and dimensions of machine-working machines to these countries during the period 1966–1970, to meet various technological requirements (see annex to this report). Furthermore, the Soviet Union can

also supply other machine tools to fill orders of individual countries.

### III. Projected Development of Metalworking Industries in Developing Countries' Increased Demand for Machine Tools

According to experts' estimations, the demand for metalworking machines will amount to £1,400 million by 1967, excluding the centrally-planned economies countries, i.e. 79 per cent above the 1960 level. This increase takes into account the planned expansion of metalworking industries in all countries of the world.

According to the same estimate, in order to satisfy the growing market for machine tools in the metalworking industries, it will be necessary to increase imports of machine tools to £370 million in 1967, as compared with £238 million in 1960. By 1970, the total demand of the free-enterprise economies will exceed £1,700 million, i.e. it will be twofold, compared with the level of 1960, and imports will amount to over £400 million.

The rapid development of the metalworking branches of industry is based on the fact that during the twelve-year period from 1948 to 1960 the annual rate of growth in the manufacturing of metal products averaged 7.9 per cent in the free-enterprise economies.

India currently imports a great number of machine tools to develop its domestic machine-building and machine-tool industries. In 1960, imports of machine tools into India amounted to £12.2 million (5.1 per cent of world imports), the requirement being £16.4 million (2.1 per cent of world consumption). By 1967, the machine-tool requirements of various metalworking industries will make up 3 per cent of the world requirements, and imports will amount to 4 per cent of the world imports. It is estimated that by 1970 the requirements will increase fourfold, as compared with the imports at the current time. Argentina and Brazil will also become large consumers of machine tools in the coming years, according to the same experts' estimation.

South and Central America purchased more than 5 per cent of the machine tools on the world market in 1960. The requirements of Latin American countries will increase to £73 million in 1967 and to £94 million in 1970, assuming stability of the demand for machine tools.

The experts noted that large regions of Africa, the Middle East and South-Eastern Asia purchase a small volume of machine tools, and their share will remain insignificant up to 1970.

Since Argentina, Brazil and India are planning to develop their domestic machine-tool industries, an opinion has been expressed that these countries may reduce their imports of machine tools; it is impossible to agree with this opinion.

The machine-tool requirements of the countries of Africa, Asia and Latin America for the period from 1967 to 1970 is estimated by the experts to be £733 million, i.e., over 500,000 machine tools, with imports amounting to £277 million, i.e. over 205,000 machine tools, as may be seen from the following data:

Machine-tool requirements and imports by developing countries, 1967 and 1970

| Description of continents | 1967 | | 1970 | |
|---|---|---|---|---|
| | Requirement | Imports | Requirement | Imports |
| Latin America | 73.0 / 68.8 | 46.0 / 43.0 | 94.0 / 88.8 | 53.0 / 50.0 |
| Far East | 208.0 / 74.6 | 59.0 / 21.2 | 270.0 / 96.9 | 60.0 / 21.6 |
| Africa[a] | 8.0 / 15.3 | 8.0 / 15.3 | 8.0 / 15.3 | 8.0 / 15.3 |
| Middle East | 6.0 / 6.2 | 6.0 / 6.2 | 7.0 / 7.2 | 7.0 / 7.2 |
| India | 44.0 / 39.2 | 15.0 / 12.9 | 65.0 / 58.8 | 15.0 / 0.219 |
| Total for Africa, Asia and Latin America | 339.0 / 204.1 | 134.0 / 98.6 | 444.0 / 257.0 | 143.0 / 107.0 |

*Note:* The numerator – millions of sterling pounds, the denominator – thousands of pieces of machine tools.
[a] Excluding the United Arab Republic.

According to the experts' data, the world production of metalworking machines and forging and press machinery increased from $4,300 million to $4,700 million, i.e. by 6 per cent, during the last two years.

Excluding 20 per cent of the cost of forge and press machinery from these amounts, the production of machine tools in all twenty-seven countries engaged in the manufacture of machine tools accounted for $3,540

million in 1963 and $3,760 million in 1964 – an increase of 5.6 per cent. The mean cost of one machine tool in the United States of America increased from $4,090 to $5,770 in 1963, as compared with 1962, i.e., it became 1.4 times as much; and it increased from $5,770 to $5,870 in 1964, as compared with 1963, i.e., a rise of 1.7 per cent.

The analysis of mean prices shows that in 1963 the mean world price of one machine tool was $5,902; being $5,560 in the countries of the North America, i.e., 6.1 per cent cheaper; $6,387 in the European free-enterprise economies, i.e., 8.1 per cent more expensive; $12,904 in the European centrally planned economies, i.e., 2.2 times as much; $4,240 in the countries of Latin America, i.e., 28 per cent cheaper; $3,880 in Asia, i.e., 35 per cent cheaper; $2,090 in Africa, i.e., 60 per cent cheaper; $11,139 in the countries of the Far East, i.e., 1.9 times more expensive; and $17,290 in Japan, i.e., almost three times as much.

Such correlation of prices testifies to the fact that the developing countries of Africa, Asia and Latin America were supplied with more light-weight and less complicated machine tools. Thus, for example, the mean weight of lathes exported from the United States of America in 1963 was 1.37 tons, with the mean world weight of machine tool of this group being 2.57 tons.

Taking into consideration the development of techniques and assuming $6,000 as the highest world mean price of one machine tool, the world manufacture of metalworking machine tools amounts to 590,000 pieces in 1963 and 623,000 pieces in 1964, the increase being 6.6 per cent. It should be noted that the USSR and the United States of America manufacture more than 50 per cent, by quantity, of the total number produced in the world. Assuming the mean annual rate of growth to be 5 per cent, the world production of metalworking machine tools will increase to 750,000–780,000 pieces in 1970.

During the period 1966–1970, purchases of machine tools for the developing economies and metalworking branches of industry in the countries of Africa, Asia and Latin America will account for not more than 40 per cent of the current world annual production, and it will account for a little more than 5 per cent of the world production during that five years, as the preliminary data read.

## IV. Major problems of developing countries in meeting machine-tool requirements, establishing plants and training personnel

To provide the developing countries of Africa, Asia and Latin America with metalworking machine tools, it appears to be expedient for those countries which are members of the United Nations and which produce metalworking machine tools to consider the preliminary calculation of machine-tool requirements and to find the ways and means for their provision.

Of particular importance is the problem of training staffs of engineers and workers for the national machine-tool industries in some developing countries.

In this connexion, in order to use most effectively the machine-tool equipment imported for work in the developing countries of Africa, Asia and Latin America, the Soviet Union would pledge itself to train the national staffs of workers in the efficient control of machine tools and in the correct technical service, both on the job and at the specially arranged training courses and seminars, depending upon local conditions.

Lathes and drilling, milling, planing and cutting-off machines, as well as some boring, grinding, fully automatic, broaching, large-size and heavy general-purpose machine tools could be supplied by the Soviet Union to the countries of Africa, Asia and Latin America during the period 1966–1970.

In connexion with the level achieved, the requirements of the metalworking industry and the outlined increase in national production in the developing countries of Africa, Asia and Latin America the necessity arises to create and develop machine-tool building industries in the ten most highly industrialized countries of these continents.

Economic and technical assistance should be rendered to the developing countries in designing, construction, training of personnel and procurement of technological-process equipment. Recommendations on certain types of machine tools can be considered during the practical co-ordination of design assignments for the machine-tool works.

When considering the issues concerning the possibility of development of national branches of the metalworking industry and of the machine-tool branch, in particular, it is necessary to envisage the creation of foundries, the manufacture of forgings and the provision of electrical equipment, bearings and other completing products.

The establishment of facilities to fabricate grinding machines for general purposes is closely connected with the necessity of creating a national industry for the production of abrasive materials.

No machine-tool production is available in the metalworking branches of industry being set up in the developing countries. The available stock of metalworking machines mainly comprises cutting and measuring tools, and even simple auxiliary technological-process equipment is imported from abroad.

Since the planned development of metalworking industries is impossible without tool production in the country, it is considered extremely advisable to provide for the design and construction in these countries of tool-making plants for fabricating cutting and measuring tools, lathe chuckings, all types of cutters, keys, jaw vices, files, centres and other running auxiliary tools.

For the composite development of metalworking industries, it is necessary to provide uncomplicated forging and press equipment – mechanical presses with pressures up to 100 tons, punch presses, plate shears and hammers with weight of drop parts up to 100 kg—as well as woodworking equipment in countries which are rich in forests and woods.

According to the experts' opinion, the distribution of the required tools by specific gravity of machine tools is characterized by the following percentage:

(*a*) Cutting tools, 40 per cent;
(*b*) Chuckings, jibs and grips, 22 per cent;
(*c*) Gauges and other measuring tools, 8 per cent;
(*d*) Other tools, 30 per cent.

The requirements for such tools are closely connected with the stock of operating metalworking machine tools. To provide the unique technological processes used in metalworking industries it will be necessary to purchase tools.

At the current time, the matter of great importance is the extension of the economic co-operation of the Soviet Union with the developing countries by means of strengthening the trade relations and rendering to them the economic and technical assistance needed in consolidating their economies and creating national industries, establishing scientific research and design offices, as well as in training specialists and skilled workers.

## *Annex*

### Various types of metalworking machines produced in the Union of Soviet Socialist Republics

| *Sl. No.* | *Description of machine tools and brief specifications* |
|---|---|
| | ***Turning lathes*** |
| 1. | Screw-cutting lathe: diameter of workpiece, 250 mm; distance between centres, 500 mm |
| 2. | Screw-cutting lathe: diameter of workpiece, 320 mm; distance between centres, 710 mm |
| 3. | Screw-cutting lathe: diameter of workpiece, 400 mm; distance between centres, 710, 1,000 and 1,400 mm |
| 4. | Screw-cutting lathe: diameter of workpiece, 500 mm; distance between centres, 1,000, 1,400, 2,000 mm |
| 5. | Screw-cutting lathe: diameter of workpiece, 400 mm; distance between centres, 900, 1,400 mm |
| 6. | Screw-cutting lathe: diameter of workpiece, 630 mm; distance between centres, 1,400, 2,800 mm |
| 7. | Compound engine lathe: diameter of workpiece, 450 mm; distance between centres, 1,100 mm |
| 8. | Single-upright turning and boring lathe: maximum diameter of workpiece, 1,250 mm; maximum height, 1,000 mm |
| | ***Automatic single-spindle bar turret lathes*** |
| 9. | Automatic single-spindle bar turret lathe: maximum diameter of bar, 12 mm |
| 10. | Automatic single-spindle bar turret lathe: maximum diameter of bar, 18 mm |
| 11. | Automatic single-spindle bar turret lathe: maximum diameter of bar, 24 mm |
| 12. | Automatic single-spindle bar turret lathe: maximum diameter of bar, 40 mm |
| 13. | Bar turret lathe with lateral axis of rotation of turret: maximum diameter of bar, 25 mm |
| 14. | Turret lathe: maximum diameter of bar, 25 mm |
| 15. | Turret lathe with longitudinal axis of rotation of turret: maximum diameter of bar, 25 mm |
| 16. | Turret lathe: maximum diameter of bar, 40 mm |
| 17. | Chucking turret lathe with lateral axis of rotation of turret: diameter of workpiece, 500 mm |
| | ***Upright drilling machines*** |
| 18. | Universal single-spindle upright drilling machine: maximum diameter of drilling, 18 mm |
| 19. | Universal single-spindle upright drilling machine: maximum diameter of drilling, 25 mm |
| 20. | Universal single-spindle upright drilling machine; two models; maximum diameter of drilling, 35 mm |
| 21. | Universal single-spindle upright drilling machine: two models; maximum diameter of drilling, 50 mm |
| 22. | Universal single-spindle upright drilling machine: maximum diameter of drilling, 75 mm |
| | ***Radial drilling machines*** |
| 23. | Radial drilling machine: maximum diameter of drilling, 25 mm |
| 24. | Radial drilling machine: two models; maximum diameter of drilling, 35 mm |
| 25. | Radial drilling machine: maximum diameter of drilling, 55 mm |
| | ***Boring machines*** |
| 26. | Boring machine with steady front-rest, turn-table and chucking with radial carriage; diameter of spindle, 80 mm; table size, 800 × 1,000 mm |
| | ***Jig-boring machines*** |
| 27. | Single-upright fine-boring machine: table working surface, 280 × 560 mm |
| | ***Plain-grinding machines*** |
| 28. | Universal plain grinding machine: maximum diameter of workpiece, 100 mm; maximum length, 150 mm |
| 29. | Universal plain grinding machine: maximum diameter of workpiece, 140 mm; length, 250 mm |
| 30. | Universal plain grinding machine: maximum diameter of workpiece, 200 mm; length, 500 mm |
| 31. | Universal plain grinding machine: maximum diameter of workpiece, 280 mm; length, 700 1,400 mm |

Sl. No. | Description of machine tools and brief specifications

*Plain-grinding machines*

32. Universal plain grinding machine: maximum diameter of workpiece, 400 mm; length, 1,000, 2,000 mm
33. Universal plain grinding machine: maximum diameter of workpiece, 140 mm; length, 500 mm
34. Universal plain grinding machine: diameter of workpiece, 200 mm; length, 700 mm
35. Universal plain grinding machine: diameter of workpiece, 280 mm; length, 1,000 mm
36. Universal plain grinding machine: diameter of workpiece, 400 mm; length, 1,400, 2,000, 2,800 mm
37. Camshaft grinding machine: working diameter, 120 mm; length, 1,250 mm
38. Crankshaft and crankpin grinding machine: working diameter, 560 mm; length, 1,600 mm

*Internal grinding machines*

39. Universal internal grinding machine: diameter of hole, 50 mm
40. Universal internal grinding machine: diameter of hole, 1,000 mm
41. Universal internal grinding machine: diameter of hole, 200 mm
42. Universal internal grinding machine: diameter of hole, 400 mm

*Flat-surface grinding machines*

43. Flat-surface grinding machine of high accuracy with compound rectangular table and horizontal spindle: table size, 200 × 630 mm
44. Flat-surface grinding machine of higher accuracy with rectangular table and horizontal spindle: table size, 320 × 1,000 mm
45. Flat-surface grinding machine with rectangular table and vertical spindle: table size, 320 × 300 mm
46. Flat-surface grinding machine of higher accuracy with round table and horizontal spindle: diameter of table, 400 mm
47. Flat-surface grinding machine with travelling round table and vertical spindle: diameter of table, 800 mm

*Sharpening and rough-grinding machines*

48. Sharpening and grinding machine: double-sided; diameter of wheel, 300 mm

*Honing machines*

49. Upright honing machine: diameter of honing, 165 mm; stroke, 500 mm

*Sharpeners and grinders*

50. Sharpener: diameter of workpiece, 100 mm; length, 250 mm
51. Sharpener: diameter of workpiece, 250 mm; length, 630 mm
52. Cutter grinder of higher accuracy: height, 25 mm
53. Semi-automatic drill grinder: diameter of drill, 12–80 mm

*Gear-cutting machines*

54. Semi-automatic gear-milling machine of higher accuracy: diameter of wheel machined, 50 mm; module, 1 mm
55. Semi-automatic gear-milling machine of higher accuracy: diameter of wheel machined, 80 mm; module, 1 mm
56. Gear-milling machine: diameter of wheel machined, 200 mm; module, 3 mm
57. Gear-milling machine: diameter of wheel machined, 320 mm; module, 6 mm
58. Gear-milling machine of higher accuracy: diameter of wheel machined, 500 mm; module, 6 mm
59. Gear-milling machine: diameter of wheel machined, 800 mm; module, 6 mm
60. Vertical gear-shaping machine: diameter of wheel machined, 80 mm; module, 1 mm
61. Vertical gear-shaping machine: diamteer of wheel machined, 200 mm; module, 4 mm
62. Vertical gear-shaping machine: diameter of wheel machined, 500 mm; module, 6 mm
63. Semi-automatic vertical gear-shaping machine: diameter of wheel machined, 800 mm; module, 12 mm
64. Semi-automatic spline-surface milling machine: diameter, 150 mm; module, 6 mm; length of workpiece, 700, 1,500, 2,000 mm
65. Semi-automatic gear-shaving machine: diameter of wheel, 125 mm; module, 1.5 mm
66. Semi-automatic gear-shaving machine: diameter of wheel, 320 mm; module, 6 mm
67. Semi-automatic gear-tooth chamfering machine with vertical axis of workpiece: diameter of wheel, 320 mm; module, 6 mm

*Milling machines*

68. Bracket plain milling machine: table size, 200 × 800 mm
69. Bracket plain milling machine: table size, 250 × 100 mm
70. Bracket plain milling machine: table size, 320 × 1,250 mm
71. Bracket plain milling machine: table size, 400 × 1,600 mm
72. Bracket vertical milling machine: 200 × 800 mm
73. Bracket vertical milling machine: table size, 250 × 1,000 mm
74. Bracket vertical milling machine with turning spindle head: table size, 320 × 1,250 mm
75. Bracket vertical milling machine with turning spindle head: table size, 320 × 1,250 mm; module, 2

| Sl. No. | Description of machine tools and brief specifications |
|---|---|

*Milling machine*

76. Bracket vertical milling machine with turning spindle head: table size, 400 – 1,600 mm
77. Vertical milling machine without bracket: table size, 630 – 1,600 mm
78. Bracket plain milling machine with turn-table (universal): table size, 200 – 800 mm
79. Bracket plain milling machine with turn-table (universal): table size, 250 – 1,000 mm
80. Bracket plain milling machine with turn-table (universal): table size, 400 – 1,600 mm
81. General-purpose tool milling machine: table size, 200 – 630 mm
82. General-purpose milling machine with turning head: table size, 200 – 800 mm
83. General-purpose milling machine with turning head: table size, 250 – 1,000 mm
84. General-purpose milling machine with turning head: table size, 320 – 1,250 mm
85. General-purpose milling machine with turning head: table size, 400 – 1,600 mm
86. Single-upright horizontal plano-milling machine: table size, 500 – 1,000 mm
87. Single-upright horizontal plano-milling machine with bracket cross-piece with vertical and horizontal spindle: table size, 630 – 2,000 mm
88. Single-upright horizontal plano-milling machine with bracket cross-piece with vertical and horizontal spindle: table size, 800 – 3,000 mm
89. Single-upright horizontal plano-milling machine with bracket cross-piece with vertical and horizontal spindle: table size, 1,000 – 4,000 mm
90. Horizontal plano-milling double-upright machine with two horizontal spindles: table size, 500 – 1,600 mm
91. Horizontal plano-milling double-upright machine with vertical and two horizontal spindles: table size, 630 – 2,000 mm
92. Horizontal plano-milling double-upright machine with vertical and two horizontal spindles: table size, 800 – 3,000 mm
93. Two-dimensional pantograph engraving machine: table size, 200 – 320 mm
94. Three-dimensional pantograph engraving machine: table size, 200 – 320 mm

*Shaping and planing machines*

95. Open-side planer: table size, 900 × 3,000 mm
96. Open-side planer: table size, 1,120 × 4,000 mm
97. Double-column planer: table size, 900 – 3,000 mm
98. Double-column planer: table size, 1,120 – 4,000 mm
99. Power-operated shaping machine: table size, 200 – 200 mm
100. Power-operated shaping machine: table size, 280 – 320 mm
101. Power-operated shaping machine: table size, 360 – 500 mm
102. Power-operated shaping machine: table size, 450 – 700 mm

*Slotting machines*

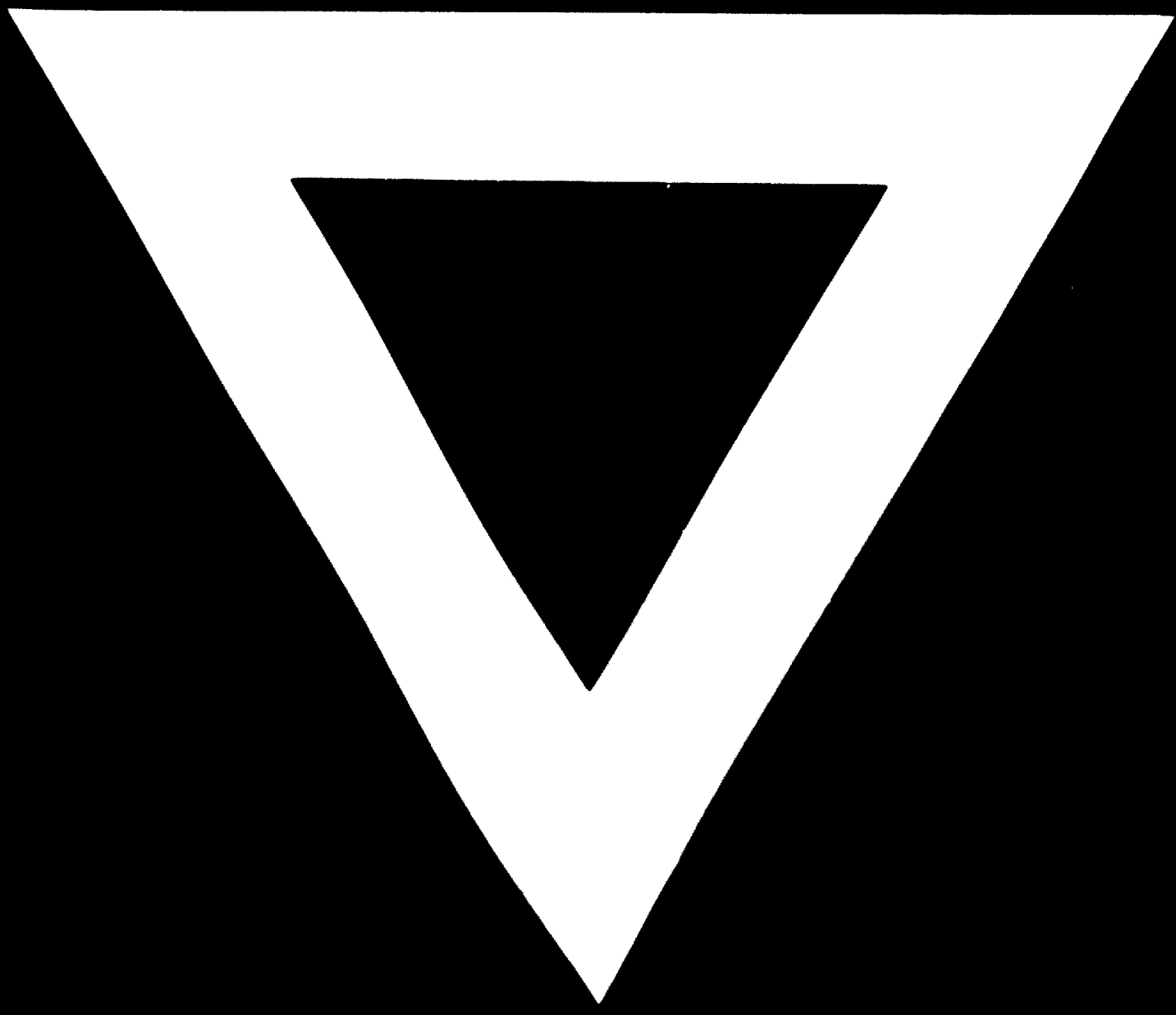
103. Power-operated slotting machine: ram travel, 100 mm
104. Power-operated slotting machine: ram travel, 200 mm
105. Die-shaping machine: piston stroke, 100 mm

*Bolt-threading and nut-tapping machines*

106. Semi-automatic bolt-threading machine: maximum pitch diameter, M40
107. Fully automatic nut-tapping machine with hook top (twin-spindle): pitch diameter, M12
108. Fully automatic nut-tapping machine with hook top (twin-spindle): pitch diameter, M16
109. Fully automatic nut-tapping machine with hook top (twin-spindle): pitch diameter, M24

*Cutting-off machines*

110. Hack-sawing machine: maximum diameter of sawing, 250 mm
111. Band cutting-off machine: saw diameter, 250 mm
112. Semi-automatic cutting-off machine: saw diameter, 240–710 mm



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