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A SURVEY OF THE DEVELOPMENT OF MACHINE TOOL PRODUCTION IN BULGARIA [1]

by

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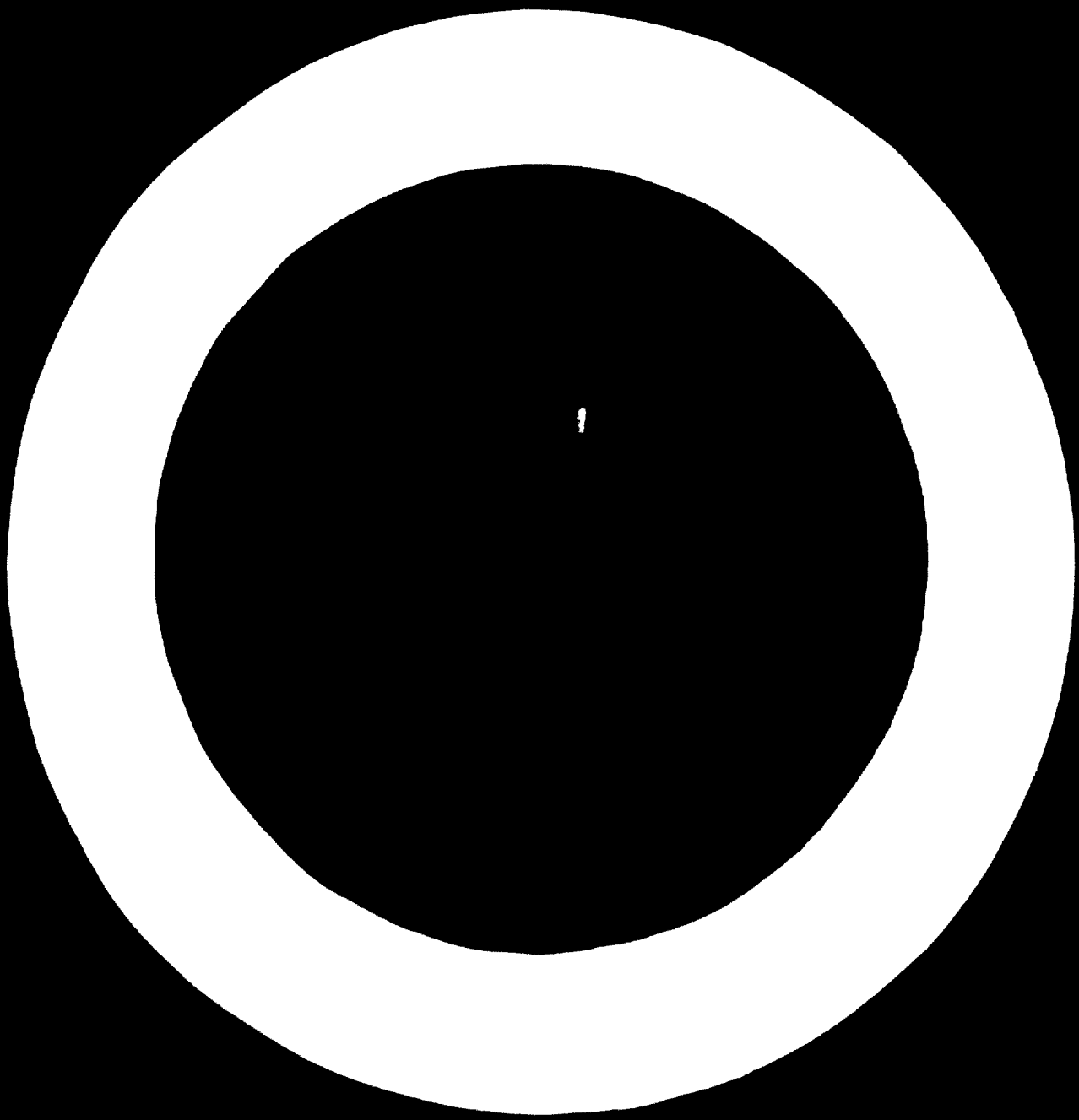

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[illegible] Bulgaria [illegible]

[illegible] million leva, which [illegible] shows a 3[illegible]fold increase. [illegible] national income is secured by industry, while its share in [illegible] only about 19%. Today the Bulgarian industry produces within [illegible] days alone the amount it used to produce during the whole of 1939.

The inner structure of industry has also improved. Machine building, power generation, chemical industry showed a more rapid rate of development. Their relative share in the total industrial output during 1970 reached the level of 41,2%.

Machine building in Bulgaria shows an exceptionally rapid rate of growth. The total output of machines in 1965 amounted to 1180 million leva, in 1970 - to 2620 million leva, while in 1975 it must reach the target of 5625 million leva. It doubles every five years and this speaks of its highly dynamic development. There are 440 machine building plants and enterprises in this country today with more than 250 000 men working in them. Nowedays machine building and metal processing takes about 20% of the total industrial product. The relative share of the machines in the total trade turnover of the country jumped up from 2.6% in 1955 to 29.1% in 1970 and is envisaged to reach the target of 45% by the end of the sixth Five Year Economic Plan of the country.

Radioelectronics, telecommunication, apparatus industry, material handling equipment, ship building and others show a particularly

rapid pace of progress. In the structure of machine building industry constantly new perfection with a clear trend for the production of single machines over to machine systems, systems of devices, systems of machines. A typical case of growth is also exhibited by the manufacturing of metal working facilities like computers, automatic control devices, electronic elements, control equipment and radio electronics, electric trucks, engine trucks and electric forklifts, cars, tractors and ships.

The development of the production of the above said items depend to a significant extent upon the number of machine tools in use, upon their technical condition and upon their further development.

A survey, though very short, of the past development of the "metal working machine" branch as well as an analysis of its present state, will give a clear idea about the experience gained in Bulgaria so far.

As a matter of fact, the real development of the machine tool industry in this country began after the nationalization of industry in 1949. Upon the joint stock of several small private enterprises in Sofia the State Engineering Plant was set up, which later on took the name of Machine Tool Works-Sofia. Another plant was set up in the town of Gabrovo under the name of "Cutting Tool Works". Still another enterprise was established under the name of "Press and Forging machine Works" in the town of Pleven. A wood-cutting machine plant was built in the town of Troyn, which later on was transformed into a machine tool plant.

The initial production started with very simple machine tools, which were on great demand in the country. These machines were universal lathes, milling machines, drilling machines, cut-off machines, shaping machines, etc. Somewhat later, following 1958, against the general background of machine building development in this country

[illegible] improvement [illegible] to the machine tools in relation [illegible] [illegible] accuracy, their variety in types and models [illegible] and their quality was sharply improved.

Papers and drawings until 1953 were based on borrowed designs and ideas. This initial method of building new machines was utterly right for the time being.

Towards 1954 the experience accumulated and the constantly growing production possibilities permitted to enter into a new stage of expedient designing of single machines and machine ranges, that were able to meet the requirements of that time. The work on making our own designs pressed on in its development with the following advantages to the method of borrowing others' ideas.

1.The home made design has its individuality, name and value.

2.No matter how good the borrowed design might be at the moment it is more than certain that it has already grown old to a certain extent.

3.An all-embracing designing provides possibilities to catch up with contemporary standards with a jump.

4.Self-designed machines acquire a typical style while borrowing hampers style formation and production traditions.

5.Home designing takes into account the technological facilities of the local production.

On the basis of the technical experience hitherto gained and the availability of trained workers and managers, in view of the material and technical equipment, some new production enterprises and research establishments were built in 1962. Such were the "Metalik" plant in the town of Pazardjik, The machine Tool Plant in Kazanlak Machine Tool Accessory Plant in Stara Zagora, the Machine Tool Plant in Silistra a[illegible] Rousse, as well as the Research Institute in Sofia.

In 1964-65 a new type of managing organization was introduced

based on the specific character of each industrial branch. Thus the State Business Corporations (Trusts) were established aimed at achieving an optimum degree of concentration and specialization as a precondition for highly effective economic activity and securing the necessary scale of research development, forecasting, market surveying, centralization of capital investments, etc. The building of new plants continued after the drawings of "Machinoelectroproject" design bureau with the active participation of specialists from the Corporation. Some drawings for new plants were prepared in the USSR and the GDR. In parallel with the design work the training of the new personnel was going on. Future workers were trained at some of the home leading plants and some plants abroad.

For the time being the branch of metal-cutting machine tools incorporates 26 plants, two research institutes and two technical development bases. They include:

- Machine tool enterprises
- Press and forging machine enterprises
- Cutting tool and measuring instrument establishments
- Machine tool accessory plants.
- Wood-cutting machines
- Centralized foundries
- Institutes for research and development work, united into a Research Center with a total number of workers and employees of nearly 15000 people.

The following types of machine tools are currently produced in Bulgaria.

-Lathes: unversal, mono-spindle automatic, turret, production, face, particularly accurate chuck and center lathes, such with normal programme control, kinematic and numerical control

-Drilling machines and boring machines: pillar drills, bench

drills, radial and horizontal drill- and boring machines.

-Milling machines: Universal bracket(knee) milling machines, horizontal and vertical milling machines, tool milling machines, plano-milling machines.

-Grinding machines: Cylinder grinding, universal and production Surface grinding with horizontal spindel, production and universal, tool grinders and special purpose.

-Shaping machines.

-Thread cutting machines

-Cut-off machines: Bow-type, band-Type, abrasive disc

-Unitized and special purpose machines and transfer lines

-Some types of electro-chemical and electro-physical processing machines.

-Special machines for tool production.

-Fixtures and devices.

-Tools and instruments.

-Eccentric presses of 16 to 160 tons, crank presses of 100 to 250 tons, hydraulic assembling presses 2,5 to 63 tons, hydro-mechanical screw presses 125 to 600 tons, air operated hammers 63-400 kg. etc.

The technical parameters of these machines meet the latest requirements and are equal to same types produced in the developed countries.

A good deal of work is done in this country to improve the quality, the accuracy and technical resources of the machine tools A part of the responsible components in the lathes and the grinding machines are made in the special "Meehanite" cast iron through license. The guideways are hardened. New type of rugged spindles have been developed on precision bearings in cooperation with the Swidish SKF Company, resulting in augmented static and dynamic

st bility. With sel t t the internati n l st nd rd f radi l st tic stability i 12,5 $\frac{kg}{mk}$ ind x fe ture stability ra f 3,2 $\frac{kg}{mk}$. This property secure f r our machines the bility to retain their initi l ccuracy i the c rse of five and t n years provide they re operated n rm lly nd pr perly.

The new press nd forging machines, cut-off machines, l thes, drilling machines, milling machines and others developed during the l st few years re built on the unitive principle. The basic units of the different types of machines are unified. Thus f r inst nce the ranges of prop rti n lled, utom tic fac nd t ret l thes feature 83% unific tion, while the unific tion in the "Proslav" r nge of l thes is 86%. This or nizes b tch pr duction and wide variety of types and sizes f given kind of machine.

New enterprises specializing in the pr ductio of jigs, fixtures devices, t ls and instr ments are rapidly gr ing in capacity. The degree of equipping is also growing both for the currently produced and for the newly developed machines. Unified and typified units, parts and fixtures are produced not only to meet home demand but export needs, too. Some of the machine equipment items are the quick mechanical, hydraulic and electric chucks, quick-change tool holders and others. The number of the used hydraulic copying devices hydraulic and air devices for the tailstock quill operation, mechanized feeding and longitudinal stops, turrets on additional carriages, blank feeders on presses and cut-off-machines, is constantly growing

The above said additional equipment provided for the various machine tools increase their productivity by and average of 40%, while separate machines show a 2-fold and greater increase.

The incoming Five-Year plan 1971-75 envisages an increase of the total industrial output by 3,4 times. This can only come true thanks to the consistently applied basic principle of organisation-

setting up

- Plants specialising in unified part production
- Plants specializing in the production of units and devices
- Plants specialising in assembly operations.

Separate plants specialise in the production of typified components, units and others like shafts, axles, gear wheels, etc. The concentrated production of typified components and units provides for rational use of most up-to-date processing methods, the flexible transfer lines included, which inevitably leads to a drastic cut in production costs. In result of this unit and part production specialisation the joint production will grow up in extent considerably by 1975 and that not only within the framework of the Machine Tool Corporation, but also out of it. The total amount of joint production is expected to grow up by 1975 as compared with 1970 at least 3,5 times. A considerable part of the joint production will be fulfilled by the specialising plants of the Machine Tool Corporation - about 25% of the total internal joint production. On the other hand the internal joint production alone will grow up from 29% (1970) to 68% (1975).

Production cooperation out of the limits of the Machine Tool Corporation will follow two lines - in the country and out of the country. The main share here will fall on fixtures and devices, castings and forgings. The Machine Tool Corporation carries joint production with more than 15 specialising unions like "Elprom", "Elprom", "Heavy Machine Building", "Balkancar", "Metal casting" etc relating to electric motors, switch boards, wiring, apperatus, electronics, hydraulics and pneumatics, etc.

Items imported include relays, commutators, electronic elements, hydraulic elements, pneumatic elements and the like.

The productivity of the machines is also increased by way of

cutting down handling time and bringing them to the stage of semi-atomata or even full automata through using programme control systems, etc. The cut-off machines with automatic feeders, the presses with automatic feeders, the electro-copying shaping machine, the SP403 production lathe and others may be taken as an example in this respect.

This stage of automation makes it possible for such machines to be incorporated in transfer lines provided that suitable automatic loading and unloading devices are provisioned.

The next step for the further automation of the machine tools is the designing of programme controlled machine tools. For the time being programme controlled machines constitute approximately 1% of the shop floor machines in the developed countries, but a clear tendency is in sight of this percentage being increased in the next few years.

In this connection as early as 1964 the Machine Tool Plant-Sofia and the Reasearch Institute embarked on developing specially designed machines for programme control and this was the begining of a wide-ranging development programme.

Kinematic and numerical control systems started to be developed in an effort to tackle the problems of automation in medium and small batch production as well as in job production. Kinematic programme control devices are provided for the CE 061 and CE081 mono-spindle semi-automatic lathes, the CP101 and CP501 semi-automatic turret lathes and the SP403, SP503 automatised versions of the "Preslav" lathes. The CE081, CP101, CE061, CP501 and others are now in regular production. The ACP-200 programme controlled, (To SKF drawings) automatic turret lathe is now in its initial run.

Problems engendered by mass production are chiefly tackled by unitised machines and transfer lines. The unitised machines produce

to the Machine Tool Plant - Sofia are furnished with [illegible] trol units, distinguished for their highly [illegible] relay [illegible] tion circuits, the reliable function of which guarantees flawless work of the machines.

The production [illegible] is fully engaged and has considerable experience behind. Eversince 1960 [illegible] unitized and 140 special purpose machines have been built and put into operation. A transfer line is further also in use. All necessary papers for these machines have duely been prepared including the normalized units like the feeding tables, the indexing tables, etc. More than 400 types of normalised groups and units interlocked in a complete electro-mechanical system, have been developed by the specialising base in Sofia They are the adequate base for the building of the unitised machine and transfer lines designed in Bulgaria.

The unitised machines and transfer lines built so far have prevailingly been designed for the electric, car, electric truck, refrigirator and farming machine industries. Railway transport also uses them . They are also used for the production of machine tool accessories.

Now the designing of unitised machines is mainly directed to providing suitable equipment for machining whole families of parts by means of easy and quick change of the set-up. The first developments in this direction concern more complicated machine frame components like speed gear boxes, feed gear boxes, etc. requiring highly labour consuming operations on precise surfaces and holes.

The major user of machine tools and cutting tools in this country appears to be the "Machine building" branch of industry for it swallows more than 60% of the produced at home and imported machines and tools. The rest of the machines go to the service and repair shops of other industrial branches like house building, transport, agriculture, communal services, etc.

The chief user of machine tools in Bulgaria - the machine building industry - is characterized by job and small batch production covering about 70% of the total machine output. Therefore it is the character of the machine building industry, that influences to a great extent the structure of the machine tool production and machin tool import, their degree of automation and other quality parameters

In this respect the numerically controlled machines will ever increasingly draw the attention upon themselves.

In accordance with the international practice and the adopted classification by the Council for Mutual Economic Assistance of the socialist countries, the numerically controlled machines are subdevided into machines with numerical positioning, machines with straight line control and machines with continuous path control.

The drilling machine with turret head and coordinate table which is now being developed will be equipped with a system of numerical positioning.

At the same time a face lathe from the CE range is being developed for straight line control system.

In accordance with the prospective production plan of the Machine Tool Corporation all lathes of the CE and CP ranges, the horisontal drilling machines of the PI range, the machine centers for drilling, boring and milling operations and some of the knee-milling machines will also be equipped with straight line control systems.

Some lathes of the "Preslav" range will be equipped with continuous path control systems as well as the vertical versions of the new range of knee milling machines and face lathes of the CE and CP ranges according to the home needs and the demand abroad.

The group of „machine centers" is represented by PRS02 machine on the Machine Tool Corporation production programme.

On the other hand the constant technical changes, the perfectin

of the production processes taken as a whole, make it necessary to use more flexible means for the production of machine parts. In this connection, namely, the machine systems come under discussion. It is these machine systems that can produce the component's families.

In this respect the Tenth Congress of the Bulgarian Communist Party set up a basic task: " To go from the production of single machines over to the production of systems of machines, systems of appliances, systems of means of automation".

The main task of the Machine Tool Corporation during the new Five-Year Plan period will be to ensure the development and the production of machine systems, transfer lines, highly automatized machine tools. This will help solve complex problems of the production processes in machine building with the most active participatk of digital computers.

Concentrated production of axles, shafts, gear wheels, spindles and other rotary parts in steel allows the use of two machine systems controlled by a single digital computer:

-One for rotary components held in a chuck as flanges, gear wheels, etc.(SM-RPD-01)

-The other for components held between centers: shaft, axles, spindles, etc. (SM RZD-01)

A machine system will also be installed for machining big prismatic components (CM PKD-01) for castings ofgear boxes, feed boxes,e A considerable part of the development and production facilities of the "Systems of control automation, computing equipment and automation means" State Business Corporation like the "Electronic" plant in Sofia, Central Institute of Computer equipment, Instrument Research Institute, etc. is engaged According to a special government program a very close colaboration is to be established during the development and the production of individual systems for numerical programme

control of machine tools, systems for direct computer control of machine tools and in securing the necessary mathematical facilities and others. Joint work is established also in the sphere of management and production automation.

Due to the specific character of the Machine Tool building one of its typical features is the necessity of well trained personnel and skilled workers in various professional lines. Of particular imprortance are the programme setters, while the people from the maintenance and operational services have to deal with highly productive machines. The structure of the employed personnel is constantly improving. Thus for instance the relative number of gymnasium and university trained technicians to shop floor workers by 1.I.71 amounted to 60.2 per 1000 for the university trainees and 97.1 per 1000 for the gymnasium ones. 23% of the workers in 1971 have secondary school training and 77% primary. The average skill grade in Machine Tool Corporation is 4,60 - the highest within the framework of the Ministry of Machine Building. A system of 8 degrees has been adopted, the first being the lowest.

The main responsibility for training new workers falls with the Corporation Management. The system of professional training comprises:

Three-year technical professional schools financially run by the respective plants and methodically by the Ministry of Education. The trainees graduate from these schools with a degree of secondary school and are qualified for the 3-5 skill grade provided they pass through the examinations successfully. The Machine Tool Corporation runs 7 such schools with 600-700 alumni annually. About 50% of the graduates go to plants out of the system of the Machine Tool Corporation. About 40% are scholarship students while those trained for the heavy professions of foundrymen, heat treatment, forging enjoy

full boarding facilities. [illegible]
the obligation to work in those plants they are appointed to in the course of three years after graduation. The costs of the schools are taken up by the state budget.

In addition to the schools just described, the workers may also improve their skill by following 3 or 6 month payed courses.

Qualification courses may be followed either after work or instead of work.

Still further apprentice workers may follow their training under the supervision of highly skilled masters. Not more than 15% of the beginners are trained in this way and the tendency is to eliminate it altogether.

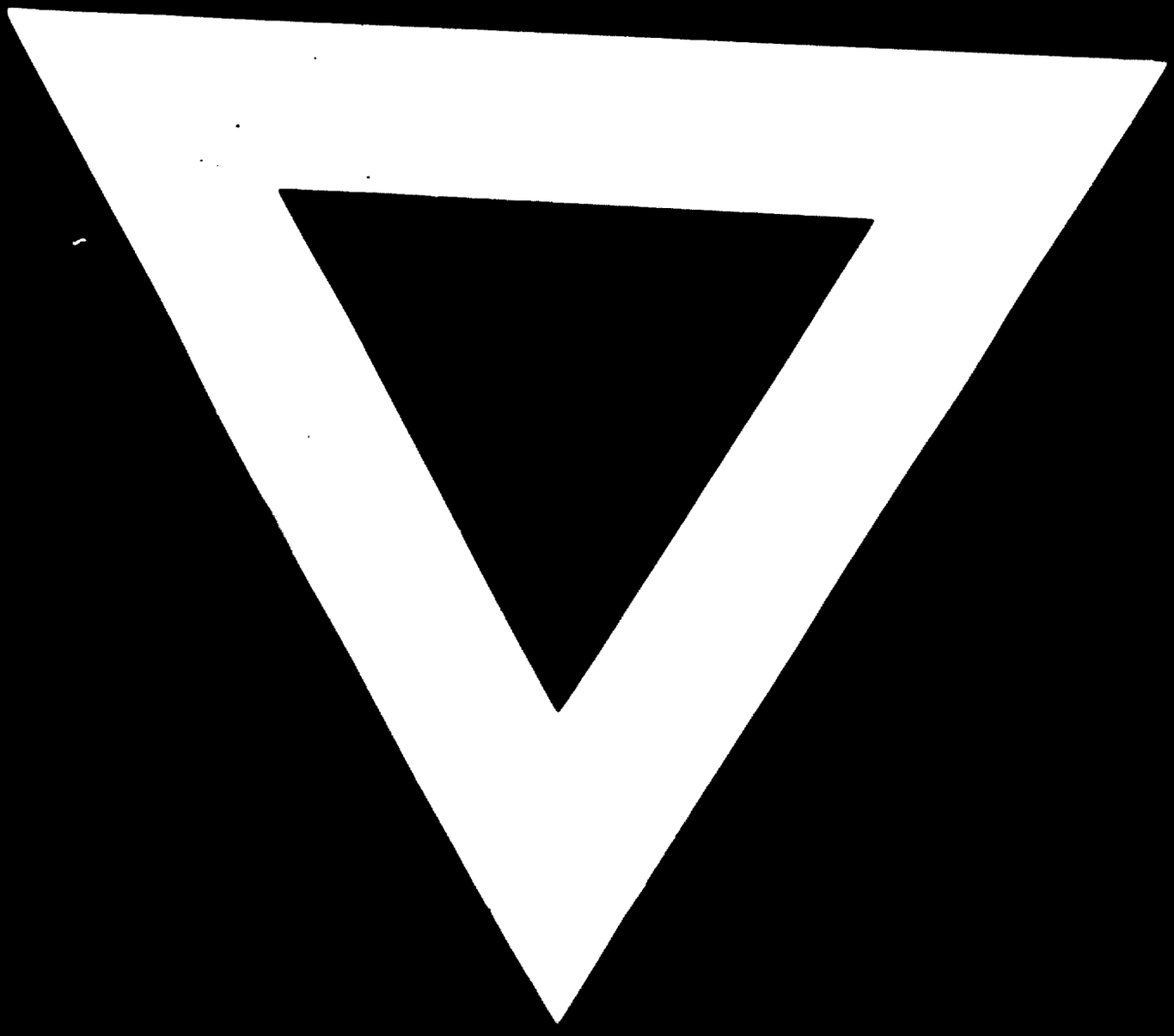
The results thus far achieved do not meet the quantity and quality requirements of this industrial sub-branch. This has made it necessary to work out a comprehensive programme envisaging the build-up of a modern material and technical basis and training facilities. Special attention is devoted to the training of operators, setters and programme control managers attending the highly efficient programme-controlled machines. A special central training base has been established where people not only from the Machine Tool Corporation are trained, but also such coming from the plants of the users of these machines. This training center investigates the new possibilities and ensures the most efficient application of the new highly productive machines throughout the other sub-branches of the machine building industry.

The products of the Bulgarian Machine Tool Corporation are known in more than 60 countries throughout the world. About 40% of the total industrial output is exported. The socialist countries, the countries of western Europe, Asia, Africa and South America have already opened their markets for the Bulgarian machine tools.

The export itself is dealt with by a specializing foreign trading organization "Machinoexport"-Sofia. Special stress is laid on export activities for the running economic plan period up to 1975 during which the amount of export is expected to increase two times. A big share in this respect has the participation of Bulgaria in the international distribution of labour established among the countries participating in the Mutual Economic Assistance Agreemant and in the first place the close cooperation with the Soviet Union in the field of unitized and special-purpose machines designed for long run production. A close cooperation is also to be noted with GDR particularly in the field of automation of small and medium batch production by means of numerical control systems.

The Machine Tool Corporation cooperates in its activities also with some companies in FGR, England and France.

The evergrowing participation of our country in the international distribution of labour on the principle of socialist integration is a necessary condition and a guarantee for the successful fulfilment of the enormous tasks before us yet to be tackled.



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