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AUTOMOBILES AND COMPUTERS IN CZECHOSLOVAKIA

by

Š. Kotoč

CSSR

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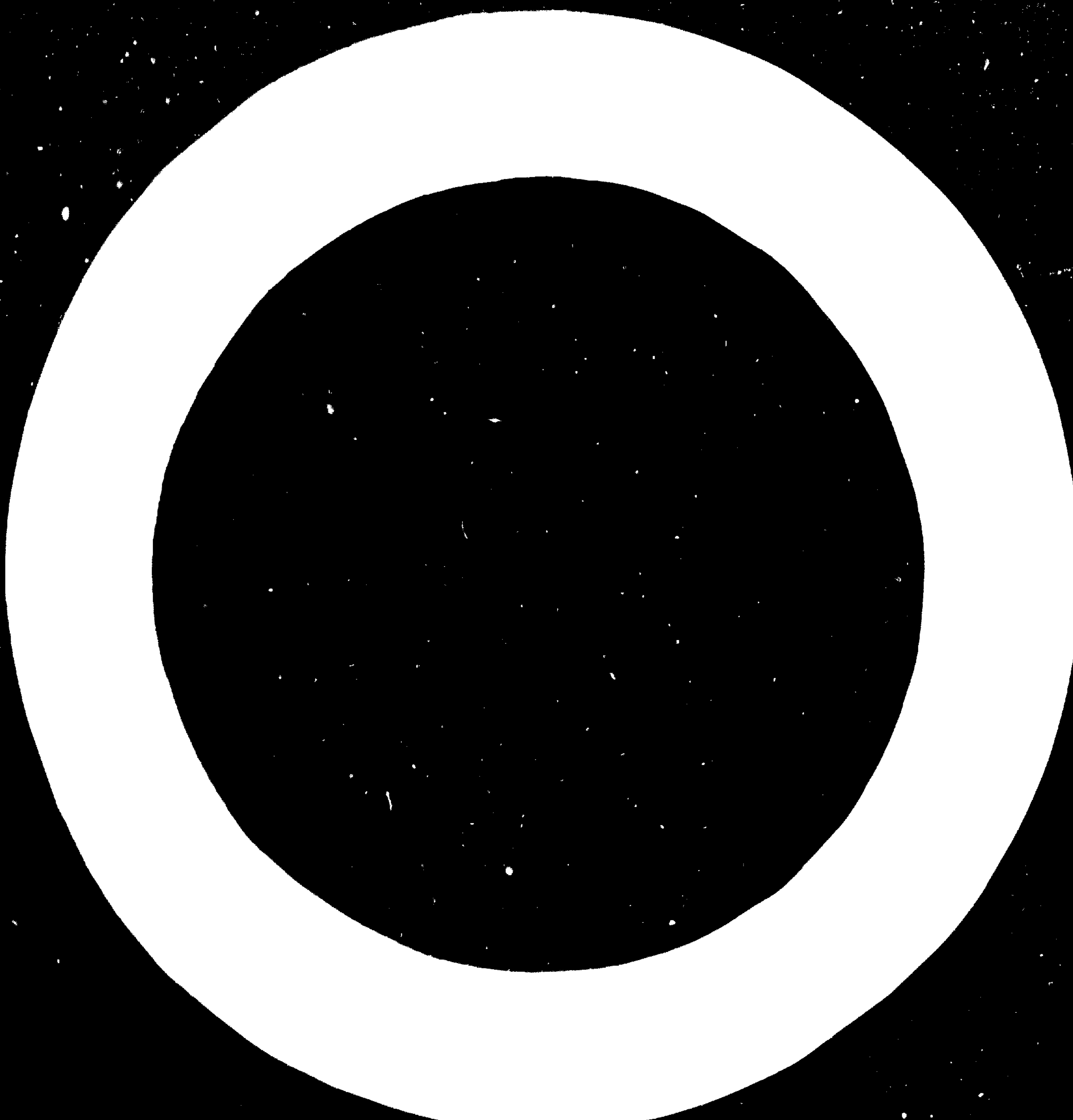

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Introduction

The aim pursued by this contribution should consist in working out a summary information on the interesting assignments that are being worked at in the ČAZ /Czechoslovak Automobile Works/ trust in connection with the utilization of automatic computers.

The fulfilment of the requirements involved in such an objective has become, by this time, an extremely difficult task that would call for a systematic and extensive study and research. Five years ago such a summarized information could have been compiled within a few hours. Meanwhile, I am not in possession of the necessary extent of information to-day, that is, not even from the Motor Car Research Institute of which I am a superintendent in the field of applications of computation techniques. I am obliged to state that in handling this particular problem I have not availed myself up to the present of any means of mechanization or automation and thus this kind of summary information appears to be an increasingly elusive goal as the time goes on. This fact, however, worries me only to a certain extent, because it is only partially due to my falling short of my objective. The principal reason that accounts for this deficiency is undoubtedly the ever-increasing and more intense pursuit of this particular kind of work and an increasing penetration of automatic computers into all fields of activities in our motor vehicle trust.

Up to the present we have not yet built up a centralized system of information on the projects and programmes in the field of motor vehicles. Such a system will probably be introduced in this country next year. The problem will, however, consist not only in a technique of information facilities, but, as usual, in our having to request relatively precise information from the workers who are engaged in the solution of these problems and have to work under extremely difficult conditions that are typical of a stage where new and unorthodox forms of work are introduced which call for organizational changes. We are, at the same time, fully aware of the importance of information precisely in this field. As a matter of fact, even minor results and data on application of automatic computers are of great consequence because they may progressively open up prospect for further suitable applications in the different spheres of development and investigation of products, as well as in the control and administration of enterprises.

The complex of problems associated with the introduction of automatic computers in the ČAZ trust and ultimately in the entire economy of Czechoslovakia features the following typical aspects:

- the technically perfect modern systems of automatic computers are traditionally inaccessible,
- those automatic computers which are accessible have either an imperfect programming equipment /software/, or such an equipment is non-existent,
- the programmers and technicians are faced with too large numbers of types of both basic and peripheral units.

In many instances the situation is rendered difficult by 90-column systems of punched cards which had been introduced earlier and make it impossible to gear up this system to computation techniques of a higher order. In computing centres the function of a programmer is that which is most frequently encountered. The vital issue does not consist in an application of optimum projects and complexes, but in a formulation and a systematic modification of the programmes. These programmes have to be modified not only for their improvement, but also for modification of an automatic computer. A relatively experienced programmer has been handling, during the five to eight years of his professional activities, several types of automatic computers and has been obliged to carry out the programming in a mechanical code or an auto-code. Every time he has to switch over to a new type of computer,

his previous work and experience acquired in his former activities are adversely affected. This is the greatest drawback of our work in this field and we find only little comfort in the fact that not even in many of the modern and world-renowned computers is it possible to transfer programmes formulated, for instance, in the FORTRAN or ALGOL symbolic languages without modifications. The fact alone that the work of our programmers and analysts has not come to a stalemate under these conditions, but, on the contrary, there is recorded a systematic extension of these activities, evidences that, in spite of all the difficulties encountered, the work with automatic computers is undoubtedly a very interesting one and that extraordinary results must have already been achieved.

On hand of the information available to me to-day on the state of project and programming activities in the different enterprises, I shall attempt to set up the following sequence of the establishments involved according to the respective degrees of extension and perfection of their activities:

engineering and scientifically-technical computations	production planning	economic assignments, administration etc.
ÚVMV	PRAGA	MOTOTECHNA
PAL Kroměříž	ČZM	ÚVMV
TATRA	TATRA	ČZM
PRAGA	AZNP	
AZNP	MOTOR Č.Budějovice	
AZNP	AZL	
MOTOR Č.BUDĚJOVICE		
ČZM		

The criterion adopted in this assessment is the enterprises' own creative work insofar it is known to me that the assignments handled have been carried on up to a final realisation on the firm's own or on another establishment's automatic computer. A realisation may be understood as a routine utilization of the programmes. The other enterprises that form part of the ČAZ trust either have punched card equipment or only recently have begun to acquaint themselves with punched card techniques or with automatic computers.

By this time, automatic computers have been installed in the following enterprises of the ČAZ trust: ČZM /since 1965/ and in ÚVMV /since [illegible]/, in both instances they are the Minsk 22 types. For 1968 there are scheduled for installation medium-sized automatic computers in the establishments of Mototechna, AZNP and probably also in TATRA.

In this contribution I shall endeavour to give more detailed information particularly on the projects and programmes worked out in ÚVMV. They are largely concerned with engineering and technical computations.

I. Departmental Computing Centre in the Motor Car Research Institute

Following several years of experience in the use of alien automatic computers, a Departmental Computing Centre for handling research, development and subordinate economic problems was established in the Motor Car Research Institute. Since 196[illegible] this Centre is equipped with a MEDA analog computer and since 1966 with the Minsk 22 computer. In 1967 the centre accomplished the development of its own analog-to-digital converter - diagram - punched tape.

The equipment of the centre is scheduled to be further improved by an installation for processing the data stored by testing departments and for automation of processing of

the data associated with the operation of an enterprise /agenda, planning, management/. The centre would be intersted in acquiring a simultaneous system with an extensive potential for research and development computations and, at the same time, capable of meeting the requirements of an automation of the establishment's operation and of control of production processes /testing laboratories, technology/. The centre's activities are also concerned with tie-ups between computation and reprographic techniques /numerical systems, catalogues, microfilm/.

The work carried out by the departmental computing centre is primarily focussed upon theoretical research consisting in an improvement and application of new computation methods and programmes for automatic computers. These activities are related to the solution of assignments by a substantially more perfect computation technique than the traditional slide rule for which the well-known computation methods had been evolved for many decades. While the assignments are handled in such a way, their theoretical aspects are extended and rendered more precise, while new essential knowledge is acquired all along.

The engineering development of the motor car industry calls, as we all know, for profoundly conceived solution of theoretical and experimental tasks related to a number of scientific disciplines. When analogous problems are compared to those associated with railway, aviation and waterway transport units it is found that the conditions under which motorvehicles operate are essentially more complex and far less stabilized. A mathematical model of a run of a motor vehicle on a roadway has therefore to take into account the characteristics of the engine, of the transmission organs and of a number of other factors at any speed and change of the vehicle's load. A mathematical model of the thermal circulation of a vehicle's internal combustion turbine has to furnish, even while the complexity of the circulation is known, a perfect forecast of the properties of a turbine made up of preselected structural elements, under real variable conditions of operation.

Up to the present the best application has been found in the Motor Car Research Institute for digital computers /SAPO, URAL 1, 2, ZUSE 23, NE - 803, N - 503, ICT 1905, MINSK 22/. From the analog computers the MEDA, MEDA T 40 and NADAC systems have been used.

II. Specification of the Programmes Worked out in the ÚVMV /Motor Car Research/ Institute

The following more extensive assignments have been handled in the ÚVMV on analog computers:

- modelling of the injection law of an injection system according to the Vogel method /Ing. L.Fabián CSc, Ing. Z.Kurz/
- braking of a semi-trailer set /Ing. Kubricht, Ing. R.Dlouhý/
- stability of a vehicle running under a side wind /Ing. M.Apetaur, Ing. J. Panuš/
- braking of a semi-trailer and trailer set /Ing. Kubricht, Ing. J. Panuš/.

For the Minsk 22 computer the following programmes of interest have been worked out:

- SAM, a system of symbolic addressing for scientific and technical computations, MX A1-MV /prom.mat. J. John/
- correlation coefficient, MX H 2-MV /programmer J.Voldřich/
- evaluation of statistical tests of interference suppression in vehicles, MX H7-MV /J. Voldřich/
- evaluation of noise level tests, MX H 8-MV /L.Štorková/
- inversion of triangular matrices to the order of 2000, MX J6-MV /Ing. J. Motyčka/
- interpolation of the function of n variables, stand.subprogramme MX J8-MV /prom. mat.J. John/
- common point of two plane curves, stand. subprogramme MX

J9-MV /prom.mat.J. John/

- computation of intergrals of the type b/x/ dx, b/x/ cos xdx, b /x/ sin xdx stand.subprogramme MX J10-MV /prom.mat. J.John/
- harmonic analysis and synthesis from a table, MX J11-MV /Ing. Š. Kotoč CSc, L. Štorková/
- general programme of arrangement of a triangular matrix from punched cards of 90 col., MX M2 -MV /Ing. J. Motyčka/
- matrix model of the ČAZ trust, basic set of programmes, MX M3-MV /Ing. J. Motyčka/
- arrangement of data on 4 magnetic tapes according to a code, MX Q1-MV /Ing. J. Motyčka/
- arrangement of data on 4 magnet. tapes by the "merging" method, MX Q2-MV /Ing. J. Motyčka/
- conversion of 90-col. punched tapes, MV Q3-MV /Ing. J.Motyčka/
- textual or numerical excerpt from the contents of 90-column punched cards made upon a 5-track punched tape MX Q7-MV /Ing. F.Pik, J. Stránský/
- agenda associated with claims and complaints in an automobile factory, MX L9-MV /Ing. B.Kurz, prom.mat.J.John, Ing. F.Opička/
- ordering of data in an operative memory, MX M10-MV stand. subprogramme /prom.mat. J.John/
- output of numbers and textual information, stand.subroutines MX T2, 3, 5, 6, 8, 9, 13, 14-MV
- input of numbers and text, stand.subroutines MX T10-MV /Ing. F. Opička/
- velocity and acceleration of the stroke curve of a cam, MX Y7-MV /Ing. Š.Kotoč CSc/
- continuous six-element cams, MX Y10-MV /Ing. Š.Kotoč CSc, prom.mat.J.John/

- running characteristics of a vehicle, MX Y11-MV /Ing.F.Opička/
- general-type differential hydromechanical gear case, MX Y14-MV /Ing. A.Hau, Ing. B.Kurz/
- hydrodynamic converter, MX Y15-MV /Ing. A.Hau, Ing. B. Kurz/
- three-stage differential hydromechanical gear case MX Y 16-MV /Ing.A.Hau, Ing. B.Kurz/
- two-stage, three-phase differential gear case /MX Y17-MV /Ing. A.Hau, Ing. B.Kurz/
- converter, computation and identification of coefficients, MX Y18-MV /Ing. A.Hau, Ing.B. Kurz/
- computation of external gear teeth, MX Y20-MV /doc.Č.Šalamoun, Ing. B.Kurz/, prom. mat. J. John/
- model of the run of a vehicle, MX Y21-MV /Ing. F.Opička/
- evaluation of the tests of an internal combustion turbine with a computation of the thermal circulation, MX Y 22-MV /Ing. B. Kurz/
- differential gear case, MX Z1-MV /Ing. A.Hau, Ing. B. Kurz/
- thermal circulation of an internal combustion turbine in a point of design MX Z3-MV /Ing. B.Kurz/
- balanced operation and load application characteristics of internal combustion turbines mounted in vehicles, MX Z4-MV /Ing. B.Kurz/
- indicator diagram of a supercharged gasoline engine MX Z5-MV /Ing. Richter, Ing.B.Kurz, D.Kaupičková/
- analysis of the thermal circulation of the M 601-A engine on hand of measurements, MX Y 23-MV /Ing.B.Kurz/
- synthesis of a cam, MX Y24-MV /Ing. Š.Koteš CSc, prom.mat. J.John/
- torsional vibrations of an unbranched torsional system, MX Y25-MV /Ing. K.Bébr/

- attest /test chart/ of a cam, MX Y27-MV /Ing.Š Koteš CSc, Ing.P. Trejbal/
- a stroke according to a cam's geometry, MX Y 28-MV /Ing.Š.Koteš CSc, Ing. F.Pík, prom.mat. J. John/
- evaluation of the indicator diagram of a compression ignition engine, MX Y29-MV /Ing. R.Dlouhy/
- computation of the limits of the bouncing of a vehicle's wheel while riding over an uneven road surface, MX Y 32-MV /Ing. J. Mackerle, prom.mat. J. John/
- internal planetary gear wheel teeth, MX Y 33-MV /doc.Č. Šalamoun, prom.mat. J.John, B. Kechtnerová/
- torsional vibrations of a branched-out torsional system, MX X34-MV /Ing. K.Bébr/
- analysis of the tests of a supercharged compression ignition engine, MX Y35-MV /Ing. R.Dlouhy/
- dynamics of a valve gear with a correction of the cam shape, MX Y36-MV /Ing.Š.Koteš CSc., K. Neprašová/
- polar diagram of the load acting upon the bearings of an internal combustion engine, MX Y37-MV /Ing.K.Bébr/
- transformation of tangential and polar coordinates, MX Y39-MV /Ing. Š. Koteš CSc, J.Steiner/
- reproduction of the shape of a motor car body by a recorder, MX Y40-MV /S.Baštová/
- mathematical model of a headlight, IC Y1-MV /ing. Š.Koteš CSc, K. Neprašová, computer ICT 1905/
- computation of the frame of a motor vehicle, MX Y41-MV /Ing. Hrdlička, K.Nepraśová/.

The centre plans the elaboration of the following research and development assignments of interest: computation of bevel and hypoid gear teeth, digital model of an injection system with the determination of a suitable configuration of the cam, a model of directional stability of the run of sets of vehicles, hydrodynamic computations of plain bearings, dynamics of an elastic crank mechanism, dynamics of a valve gear fitted with a chain drive.

III. Description of Selected Programmes and Computation Methods of the Motor Car Research Institute /MCRI/

Evaluation of the Indicator Diagram of a Compression Ignition Engine by a Computer /Ing. R.Dlouhý/

The programme MN Y29-M/ tests an appointed indicator diagram for the development of heat liberation and for a perfection of the combustion process on head of modern methods of computation. The resultant table contains, with a 0.5-deg step, the following quantities: pressure and temperature of combustion products in the cylinder, the heat developed and the proportional amount of fuel burned.

Polar Diagrams of the Loads Acting on the Bearings of an Internal Combustion Engine /Ing.K. Pébr/

The programme MX Y37-MV is set up for solution of the development of the loads acting upon the connecting rod and the main bearings of an internal combustion engine. It is applicable for computation of both in-line and V-type engines for all conventional arrangements of cranks and connecting rods.

The load of the main bearings is solved by an approximative method in which a statically indeterminate crankshaft is divided into statically determinate sections /in each instance from one main bearing to the next/ which are then computed separately. The resultant reactions in the main bearings are then summed up.

The sources of load acting upon the bearings are assumed to be the forces generated by gas pressure inside the cylinders,

the forces of inertia of the sliding masses of the piston and the connecting rod end, finally, the forces of inertia generated by the rotating masses of the connecting rod and the crankshaft.

The input quantities for the computation are the dimensions and the layout of the crank mechanism and the masses of each of the component parts, the dimensions of the bearings and the development of gas pressure in the cylinder in a dependence of the angle of setting of the crankshaft /indicator diagram/. The results are obtained in form of tables containing the magnitude of the bearing load vector and its direction for the entire cycle of bearing load and for the given angle. There are also printed out the mean values of bearing load. The computation lasts several minutes.

When an output coordinate recorder is used, the resultant diagram shown in Fig.1 is obtained.

Computation of the Load Carrying Capacity of Plain Bearings Computation of the Trajectory of the Journal Centre in a Plain Bearing Subject to a Dynamic Load /Ing. K.Pébr/

For the computation there has been used the J.Holland method that follows the displacement of the journal centre in the course of one cycle of load application to the bearing. At the same time, the programme solves the Reynolds equations of pressure development in a film of lubricant on hand of a known development of the load and of known properties of a fluid. The computation is carried out for one whole cycle of load application to a bearing and as a result there are obtained, in addition to the data on a displacement of the journal centre, also the data on the convenience of the bearing for the given load.

The programme can be made use of particularly in internal combustion engines with dynamically pronounced loads of the main and the big end bearings. The programme will be supplemented for a computation of the amount of lubricating fluid and its heat-up in a bearing.

When an output coordinate recorder is used, the resultant diagram shown in Fig.1 is obtained.

Computation of the Load Carrying Capacity of Plain Bearings
Computation of the Trajectory of the Journal Centre in a Plain Bearing Subject to a Dynamic Load /Ing. K. Bébr/

For the computation there has been used the J. Holland method that follows the displacement of the journal centre in the course of one cycle of load application to the bearing. At the same time, the programme solves the Reynolds equations of pressure development in a film of lubricant on hand of a known development of the load and of known properties of a fluid. The computation is carried out for one whole cycle of load application to a bearing and as a result there are obtained, in addition to the data on a displacement of the journal centre, also the data on the convenience of the bearing for the given load.

The programme can be made use of particularly in internal combustion engines with dynamically pronounced loads of the main and the big end bearing. The programme will be supplemented for a computation of the amount of lubricating fluid and its heat-up in a bearing.

When an output end recorder is used, the resulting diagram shown in Fig.2 is obtained.

Computation of Torsional Vibrations of an Unbranched and a Branched-out Torsional System /Ing. K.Bébr/

The object of the computation are the deflections of the individual elements of a system as well as the shearing stresses between the masses at selected locations. The programme has been set up primarily for computations of combustion engines

and from this point of view there was determined a method of harmonic analysis of exciting moments and damping effects. The programme enables computations of both in-line and V-type engines.

An authentic system is substituted for the computation by a system of absolutely rigid discs /masses/ of known moments of inertia, connected by weightless members of a torsional elasticity and known rigidity. Each of the masses of the basic system may be excited by an external moment and damped – it is possible to respect material friction in torsionally yielding members.
To each one of the masses of the basic system there may be associated two branching-out systems. At the front end of the system there can be respected the connection of a torsional vibration damper through any kind of linear coupling. The programme MK [illegible]-PV assumes that the exciting moments which act upon the different masses are specified in form of sine and cosine components, or the programme itself carries out a harmonic analysis. For any case of the system the programme is capable of determining the most pronounced harmonic components of the deflections and the amounts of shearing stress and of carrying out a harmonic synthesis. In addition to a computation of forced torsional vibrations, the programme also solves the system's natural vibrations.

The resulting tables contain the above quantities as computed for each selected speed of rotation of the shaft.

Programmes for the MINSK 22 Computer Associated to the Problems of Design and Check-up of Perfection of the Manufacture of Cams

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/Ing. Š.Kotoč CSc/

During these recent years the workers of MCRI have handled a number of both theoretical and experimental assignments associated to injection and valve gear cams.

The experience acquired in this work made it possible to work out methodical procedures and programmes for an automatic digital computer, particularly those related to the following problems:

1/ Computation of the position of a valve tappet according to a MCRI method. By this method it is possible to determine trajectories with both continuous and non-continuous development of the acceleration. When compared to the well-known method worked out by D. Kurz, Daimler Benz, this method shows certain improvements particularly in that a positive loop of acceleration may include, in the region of its apex, also a section of y" = const of any /even a zero/ length, and, in addition to this, the method makes possible a selection of the necessary unsymmetricalness of this loop up to discontinuous configurations. The sections are assigned in a way similar to that [illegible] by D.Kurz, they are, however, six in total, including an entering tapered section for the flank of the cam. Some of the sections may also be equivalent to zero, the rest of the parameters are identical.
The table of results contains values of an angle stepped-off at 0.5 intervals, the stroke /[illegible] for a check-up/, five times the stroke for manufacture of the cam, the velocity, the acceleration and the third derivation in mm, the fullness beginning with the end point of the theoretical entering section and, finally, the radius of curvature of the contour curve. In Fig. 3 there are shown the basic configurations of an acceleration diagram that can be obtained by this method. In Fig.4 there is a summary diagram of computation results of one of the concrete alternatives.

2/ Computation of the displacement of the valve tappet in a geometric assignment of a cam.

The contour curve may be plotted for a cam on hand of the base circle and of combinations of [illegible] tangents of concave and convex arcs tied up to one another in any way whatever. Ahead of a tangent or a concave arc there may be situated, for instance, also an approach /entering/ arc. The following well-known purposeful combinations may be adopted: entering arc, concave arc, smaller convex arc /used to achieve, for instance, a constant velocity within the required span of an angle/ and an apex arc. We shall also assign the maximum throw and some of the arcs, while the others are determined in the course of the computation. As a result there will be obtained a completion of the geometric assignment and a uniform table of results analogous to that under 1. In all computations of cams the valve tappet may be envisaged as fitted with a cam roller.

3/ Computation of the tappet displacement by a synthesis according to an assigned development of the velocity, the acceleration or only of the throw /in this instance it is necessary to "condense" the few known points/. A designer draws the requisite curve of acceleration, with a subsequent read-out and punching of a number of points of significance. Next a computer plots polynoms through the assigned points and works them up so as to be able to print out, as a result, a uniform output table independent from the way in which the task has been assigned. It is usually necessary, on hand of the resultant curve of the velocity /acceleration/ or on hand of the maximum throw prescribed, to make a correction of the original assignment, until a satisfactory solution has been reached. This is an original method of the MCRI.

4/ Computations of tappet displacement with a correction of the input assignment for valve gear dynamics. The correction is carried out according to a MCRI method which consists in finding a position of the point of inflection /in addition to other shaped elements of a cam/ with which the cam will be found to operate most satisfactorily from the points of view of the dynamics and of its working life. The convenience from a point of view of the dynamics of the valve gear is progressively being solved with the help of a reserve between the characteristic of a non-vibrating spring and the "authentic" acceleration of a valve. This assignment is solved with a view to the rigidity, the vibrations and the damping of a valve gear. On the other hand, the convenience from a point of view of the working life is tested with the help of the radius of curvature at the apex of the cam. Between these two conditions it is possible to choose a sort of compromise in the solution by means of what is called a priority factor the values of which range from 0 to 1.0 /with k = 0 the machine places the point of inflection upon the site for which the assigned radius of curvature at the apex has been obtained/ and with the help of the established minimum permissible amount of curvature at the apex.

The cam which results from these considerations has a smooth surface and the valve gear has a continuous acceleration development. There is, however, not excluded even the adoption of a discontinuous initial shape insofar it will be necessary to achieve, for instance, an abnormal fullness. As input information there may also serve only a table of the throw curve. The resulting cam, provided it has been designed for the maximum speed of rotation of the mechanism, will ensure a perfect operation of the valve gear also at all lower speeds of rotation and without any hazard of resonance /which is not excluded, for instance, by the well-known method by W.M.Dudley/. At the same time, the cam is relatively little sensitive to imperfections of the manufacture of the valve gear elements as well as to certain design conditions existing in the valve gear /different rigidity of the marginal and the central supports, cantilever mounting of the rocker arms in etc/, as well as to imperfection of the manufacture of the cam itself. The method makes

it possible for a designer to avail himself of his experience in order, for instance, to influence such important elements of a cam as the entrace and run-out sections from the point of view of heat transmission into the valve, marginal impacts etc.

5/ <u>Transformation of polar and tangential coordinates, transformation of the coordinates of equidistance on hand of differential geometry of curves.</u>
A total of 6 potential cases are involved: transformation of polar coordinates into tangential ones, of tangential coordinates into polar ones, of polar into polar ones /tangential ones need not be transformed into one another/ and, finally, transformation for determination of a machining allowance and for measurement. These computations are necessary, for instance, for determination of the trajectory of the centre of a grinding wheel /a milling cutter/ having a dimension different from that of a tappet roller or from its original size. In this way the contour curve of a cam can be determined, too. Both the input and the output data are assigned by tables of the original or transformed coordinates. This is an original method worked out by the MCRI.

6/ Harmonic analysis and synthesis of a throw or another curve assigned by a table. The programme may be utilized, among other applications, for correction of the throw curve according to Feldinger with regard to the vibrations of a spring.

7/ Evaluation of the perfection of manufacture of a cam on hand of measurements of the throw taken by a Zeiss optical instrument. Following an evaluation according to this original method of the MCRI, the computer prints out tables which contain the following data:
- input data on the cam /numbers of the engine, the shaft etc./
- data on the deflection of a free shaft clamped in position

on an optical bench, as ascertained by measurements

- a table of throw coordinates found by measurements, the first and the second derivation
- information on the shaft deflection at the point where a cam is situated and the corresponding angle
- a table of a regression curve of a throw and its first two derivations following an elimination of the shaft deflection upon the measurements
- information on the situation of the cam apex on hand of the first analysis of the first derivation of a regression curve of the throw
- a table of the regression curve from the second derivation of a throw which has been corrected with a view to the deflection of a free shaft /in order to be able to make a statistical evaluation of the surface finish/
- standard deviation from the second derivation of the throw, separately for the throw section and for the entire surface of the cam
- a comparison of the required shape of the cam /where it is specified by a workshop drawing / with the regression curve of a throw, departures
- the names of the workers who are responsible for the measurements, the preparation of data and the computation.

The above computations are already currently carried out with a satisfactory accuracy and check-up. The derivation of the throw curve are, for instance, determined even in the computations as specified under 1/ not from equations, but numerically on hand of printed-out values. This practice makes it possible to achieve a particularly high accuracy.

The costs of the computations are relatively very low, except those carried out as specified under 4/. When dynamic computations are carried out, the main cost item - the machine time of the Minsk 22 computer, is extended to several hours. Input data may be handed over to the centre by a letter or by teletype, it being also possible to make arrangements for personal consultation.

The MCRI can also manufacture mated cams for a contouring grinder on hand of the tables compiled by computation. It is possible to contemplate a potential periodical following-up of the perfection to which camshafts are manufactured; the MCRI can take charge of this service on behalf of the firms interested.

Programme for Computation of Gear Meshes /Ing. E. Kurz/

The programme NX Y20-MV was set up to cater to the requirements of the development design bureau of the PRAGA national enterprise /a plant that specialises in the manufacture of automobile gear boxes/. The computation method and the block diagram were worked out by Doc. Ing. Čestmír Falc-moun, a worker of the Faculty of Mechanical Engineering of the Prague Czech High Technical School in cooperation with the technicians working in the PRAGA development design bureau. Programming for the MINSK 22 machine was carried out by the workers of the Experimental Computing Centre of the MCRI. The first programme was drawn up and used for computation of two mating gears, one of a spur and the other of a helical type. It was afterwards redesigned so as to make a single programme encompass also a gear train with an internal mesh /again a mesh of spur and helical gears/.

The programme is envisaged to obtain a complete geometrical and strength computation, including some additional indices and reference dimensions. The flexure and crushing computation that has been adopted essentially conforms to the method used in the DIN standard specification.

The input values for computation on an automatic computer are the following ones: numbers of teeth, normal module, normal pressure angle, angle of inclination of teeth, width of tooth, main relative dimensions of teeth. In addition to this there is prescribed one of the following quantities: sum of unit corrections, centre-to-centre distance, rolling pressure angle. In the next group of input data there is assigned either the correction of one gear or the requirement of a definite specific ratio of slips or the requirement of a definite ratio of flexural stresses. In addition to this it is possible to prescribe a position of an abscissa of mesh on the straight line of mesh /by means of this it is possible to obtain, for instance, a two-pair mesh in a pole of the gear teeth or a displacement of the entire abscissa of mesh along of the pole/. There follow other input values: tool parameters for which it is envisaged that each of the two gears may be machined /independent from the other one/ by a rack-type tool /a MAAG-type rack shaper or a hob, either a plain or a protuberant one/, or by a gear shaper tool /a Fellows type pinion-shaped cutter/. The input values are concluded in this enumeration by those of the moment and the angular velocity corresponding to one of the two gears, by the coefficients of adjustment [illegible] and the data related to the computation of the checking dimensions.

The output table coming from the automatic computer is divided into 7 autonomous sections of which only some can be demanded. The first two sections, called "Principal Parameters" and "Dimensions" determine all values of a geometric computation, including an elimination of the interferences that have sprung up; next to this, they determine the time of mesh of an involute and a helix.

The third section of the output is termed "Qualitative Indices" and indicates the following values for all characteristic points situated upon the abscissa of mesh: position respectively of the pole, angles of pressure, specific velocities of slip, specific slips and their ratios, coefficients of shape for determination of contact stresses, coefficients of shape for criteria of seizure according to Alleman-[illegible] and according to Niemann; the coefficients of minimum and maximum lengths of the abscissae of contact; the coefficients of shape for flexure and their proportion.

Section four contains velocity and force relations.

Section five contains the resulting values obtained in a computation of gears for flexure and crushing.

Section six contains the check-up dimensions, that is, the dimension across the teeth and the checking dimensions associated with the use of gauging rollers and balls.

<u>Computation of the [illegible] and the [illegible] Characteristics of</u> Transportation Units /motor vehicles and vehicle sets/.
/Ing. F.Opička/

The programme [illegible] Y21-MV works up data on a vehicle /dependence of the torque and the efficiency on the speed of rotation and load of the engine, to converter, the gear case and the transmission organs, together with other quantities/, the same as data on the costs of fuel and lubricants, on depreciations, wages of the personnel manning the vehicles and data concerned with roads /profile, speed limitations, case of the traffic signs/.

The programme solves systems of equations which express the assigned conditions in such a way that the model vehicle covers, for instance, a section of the route which precedes an upgrade with an acceleration, insofar this satisfies the condition of minimum operation costs or the condition of according a minimum tie of transportation.

By means of the programme it is possible to test a designed motor vehicle under the conditions that have been selected, these conditions being determined by the state of the vehicle, the route and the traffic flow. Such a computation may be more objective and exact than an experiment which is affected by errors of measurement and by variable conditions under which the tests are conducted. The criteria adopted in the solution of the task are

- transportation costs
- time of transportation.

In accordance with these criteria the computation can be focussed upon the following objectives of interest:

a/ a test of the time of run and of the costs of transportation of cargo for a given motor vehicle or set of vehicles. A test of acceleration on a given route. A test of a vehicle under standard conditions;

b/ a search for convenient characteristics of the motor vehicle investigated in its design stage /a road or railway vehicle, an aircraft or a vessel/, that is, the selection of a convenient engine, of speed stage or of the entire complex of the transmission organs. The assigned section of the track is run with the selected characteristics of the vehicle or of vehicle sets and according to the results obtained the most favourable alternative is determined,

c/ computation of graphs;

d/ selection of the most convenient route. The assigned vehicle "covers" a number of alternative routes selected to this end and according to the results of the test the most convenient route is then identified.

The costs involved in a computation of a medium extension including the preparation of data do not exceed 15,000 Czechoslovak crowns. When the computation is repeated with changed input data, the costs are reasonably lower.

Mathematical Model of the Thermal Circulation of an Internal Combustion Turbine /Turbo-set/. /Ing. B.Kurz/

The model is set up on hand of physical properties of the working medium the condition of which is followed up from the situation at which it enters the compressor up to its final exit through the exhaust. In a generalized case the working medium is subject to processes at its entrance into the compressor, to several stages of subsequent compression, to intermediate cooling /up to seven times the original temperature/, to an elevation of the temperature and to chemical reactions in the combustion chamber, to several stages of expansion in the turbines and, finally, to a regeneration and to processes

which take place in the exit tract. At each stage of an internal combustion turbine the influence which acts upon the state of the working medium is expressed by equations and by loss factors, or even by changes of the volume; these phenomena are then computed to a sufficient accuracy either by a direct method or with a progressive approximation. In the computation there are included factors such as the influence of the temperature and of the chemical composition of the working medium /later on also the influence of the pressure/ upon its specific heat within the given section of the through-flow route.

As a result of the computation there are obtained overall parameters of the computed circulation /specific output, efficiencies, consumption of fuel/ and, in addition to this, the temperatures, pressures and compositions of the working medium at each point of the through-flow route of the internal combustion turbine /turbo-set/, insofar this one is identified by the corresponding loss or other factors as a part of the variant assignment.

Most frequently the circulation is computed with a systematic change of the degree of compression or of the maximum temperature of the circulation in order to find an optimum, or for an investigation of the influence of one or another factor upon the energetic balance /influence of the outside conditions, of a loss of the amount of the medium due to leakage or to its extraction, the influence of the efficiency of the throughflow parts such as compressors, turbines and combustion chambers, the influence of the intercooling and the regeneration stage, the influence of mechanical losses etc./. By a computation it is possible to find the most passable way towards the effect in view and to acquire the necessary documents for project and development work and, where necessary, for further modernization of an internal combustion turbine.

The MX 24.MV programme is aimed at circulation systems of internal combustion turbines fitted to vehicles or of other kinds of turbines for various applications /single-and double-flow aircraft turbines, energetic sets/ particularly at the design stage. There it is possible to feed to a computer complete characterization of the through-flow sections in a dependence on the load, it is possible to acquire characteristic properties of the whole internal combustion turbine even in its operation under partial load. A turbine fitted to a vehicle may have from one to three shafts, with regeneration or without it, with potential use of intercooling and inter-stage combustion. An energetic turbo-set may have as many as ten stages.

Mathematical Model of a Headlamp and of Simpler Lighting Fixtures

Basic information on a programme for computation on an automatic computer that still requires additional improvement.
/Ing. Š. Kotoč CSc, K. Neprašová/

A set of programmes IC M1-MV consists of three basic parts:

- light generator
- block of the passage of a beam through shaped cover glass

The programme for computation of a light generator is aimed at a simulation, as true as possible, of the operation of a system consisting of an incandescent filament - a diaphragm - a mirror - a testing wall /screen/. The beam /an elementary three-dimensional cone of light/ issues from the filament, and in a rectilinear propagation may make contact with diaphragms or with a mirror from which it may be reflected ten times as a maximum, with a corresponding loss of intensity in accordence with the assigned dependences of losses on the angle of incidence. From each point assumed to be situated upon the filament there issues a bundle of rays /cones/ in

all directions. For the computation there is envisaged a certain number of an infinite number of beams /cones/ according to a three-dimensional step that can be selected. For instance, in a step of 0.5 - 1.0° there is involved a number of about 165,000 beams /cones/ issuing from a single point upon an incandescent luminous filament. In the computation there will be followed the travel of each beam from its origin upon the filament up to its reflections on a system of diaphragms and a mirror or possibly up to its complete disappearance following a multiple reflection or a passage through an aperture for a bulb/, the same as a passage of the beam through an optical system of prisms, lenses and planes which form the assigned design of the cover glass and, finally, the incidence of this beam upon a test screen.

The position and the configuration of the filament are arbitrary and may be assigned by as many as 100 points to each of which there correspond three coordinates.

The diaphragms may be assigned also in the form of a wellknown diaphragm for dimmed light in an automobile bulb. According to a drawing the configuration of a diaphragm may be expressed by equations and limiting data that are incorporated in the respective subprogramme. The form of a mirror envisaged in the main programme is a paraboloid of revolution determined by the assigned values of focal distance, the size of the aperture for the bulb /or of a plane in the bulb which does not reflect light/ and the outside diameter of the mirror. It is also possible to use a programme for another configuration of the mirror /cylindrical or elliptical paraboloid, a plane etc./.

In the passage of a light beam through the cover glass of the headlamp there are taken into account the shape of the glass and the design of its interior surface. In addition to this there are respected the optical laws of reflection and refraction of a light beam at the interface of two different media. The design of the cover glass is specified in the working drawing from which the dimensions are adopted as constants and coefficients for systems of equations and for a block of the programme for solution of the passage of a beam of light through the glass. The programme respects each geometric element of the glass assigned by the drawing and having an influence on the illumination of the test screen.

The author of the assignment may request only the illumination of a certain section of the cover glass by the rays which make their incidence upon the glass from the mirror /or direct from the filament/. He may also request an optimalization of a certain element of the design, such as the angle of one or several prisms or the disposition of the prism itself upon the glass. The prisms need not have only an elementary surface /a cone, a flat surface, a sphere/. In the computation there may be included also more complex configurations that can be assigned by a drawing without the use of a table of coordinates.

The result of the computation, that is, the illumination of the test screen, is restered in form of a television image.

The test screen is defined for the computation by the distance from the mirror, the size and the position of the centre respectively of the mirror axis. As the line-by-line high speed printing-out device of a computer has only about 120 symbols per line, the raster of the test screen is divided into zones. For instance, if it is desired to raster a surface area of 10 x 10 m by the area of one elementary land of 1 cm^2, the raster can be made up of zones or strips of 1.2 x 10 m /relatively, because to one land or spot there corresponds one type of the printing-out device/, that is, of nine such zones or strips. Under these conditions there is one million of such lands or spots. A television image also is formed on the screen by composition of spots illuminated by a beam of electrons /their approximate number is 400.000/. The dimensions of the raster of a test screen are arbitrary;

this may be a rectangle of 100 x 2000 m or 50 x 100 m; this depends on a selection of the dimensions, or on the dimensions which are called for. The strips thus obtained /insofar the raster of the test screen is not printed out at once/ can be stuck together and thus a general picture of the illumination effect is obtained.

On each elementary area or spot there is accumulated the energy of the impacting rays. Where a relative raster is wanted the resultant energy of the individual elementary spots is divided into a maximum energy that has come into existence upon them. The computer prints out the results in such a way that it associates to each elementary spot according to its energy an alpha-numerical symbol corresponding to the assigned or used key. If necessary, an isolux map can then be plotted by connecting, by a line, e.g. all the letters "M" /the spots which receive a minimum of illumination/, symbols " , " /the spots with a maximum of illumination/ etc.

By a mathematical model and by the MCAI programmes it is possible to solve also all simpler lighting fixtures and systems than an automobile headlamp for dimmed light. They can be used, for instance, for the computation of utility lighting fixtures with simple types of cover glasses or without them, of lasers, parabolic antennae etc.

The computation of an entire system is relatively demanding as regards the machine time of an automatic computer. For the time being the ICT 1905 computer is used. When only a specific section of a design with negligible systematic modification of the construction is handled on a cover glass, a solution in this way is less costly and more expedient than an experimental approach. The basic complex of programmes was put into operation for the first time in April, 1967.

The descriptions of the last three programmes serve to illustrate the activities of the Departmental Computing Centre in the field of economic and administrative computations.

Processing of a Complex of Data of an Automobile Factory on Claims and Complaints /Ing.B.Kurz/

The MX Q1-MV programme serves to replace manual check-up on the correctness of time standards in the reports about claims and complaints, the looking-up of prices in a spare part catalogue, the summation of costs and times of the individual reports, volumes and for specific time intervals, the conversion of hourly rates to units of currency of the different countries, the deduction of discounts, duty fees, freightage, the drawing-up of invoices and notes of credit.

The external memories of a computer contain the following data:

- catalogues of spare parts numbered according to the designations used by the motor car factory and by Mototechna spare part service, with specifications of prices,
- specification of time standards set up for the different operations and the cost standards for operations carried out in a contractual repair shop,
- specification of the coefficients of conversion of the different countries and repair shops with textual data on the names of the countries, addresses of the repair shops and banking connections,
- specification of cooperating subcontractors.

On hand of the input data adopted from a volume of reports on claims and complaints for the given lapse of time, the programme draws up notes of credit for individual repair shops and for Motokov, as well as invoices to cooperating subcontractors.

For one specific period the machine carries out summarized analyses of the costs associated with the claims and complaints according to the repair shops from the different countries and home territories, as well as according to the complexes, categories and subordinate categories and spare parts - in a global form and individually for each country and territory of national repair shops. The costs are detailed for each tenthousand series of engines and continually summarized. Where necessary, the machine draws up a review of the incidence of the different time standards and spare parts in the processed complex of input data. It is also possible to print out a detailed set-up of the different items of claim reports, including sums of the costs of wages and materials according to repair shops, complexes, groups and sub-groups.

Subsequent processing of invoices from a computer by the competent department consists in technical and subject check-up and in having track of the terms of guarantee prior to an input of the data into the computer.

The analysis and surveys printed out by a computer are important for identification and correction of the causes of those defects which are the source of a maximum of claims and complaints for a given lapse of time.

Processing of Scientific, Technical and Economic Information by the Minsk 22 Computer /Ing.R.Žižka/

Between 1967 and 1968 the following complexes of information were processed in the MCRI with the help of the Minsk 22 automatic computer:

- bibliographic researches of the MCRI for the 1958-1966 period
- an IDC excerpt for the automobile branch
- MCRI research reports for 1958-1966
- a bulletin of the documentation department

The basic part of the publication "Bibliographic research worked out by the MCRI for 1958-1966" contains the names of the subjects in an arrangement according to identification numbers. In the second part - a register of permutations /[illegible] permutations/ there are alphabetically ordered the significant /key/ words from the titles of the subjects in such a way as to place the key word always in the middle of the line. The rest of the words which make up the context either precede or follow the key word up to a total extent of 60 symbols. The processing was carried out on the Minsk 22 computer through an application of the Ardis Bibliographical programme issued by the Evaluation [illegible] in Prague. Contrary to the original KWIC /Key-Word-In-Context/ method, the key words are pointed out in anticipation. It is thus possible to have one word, which [illegible] of the context figures as a significant one and, consequently, undergoes a permutation in the register, without permutation for a second time in a different context as one which this time is of no consequence.

The second publication "UDC [illegible]" is the first attempt at applying the KWIC method to an UDC register. The advantage of this method should consist in this connection in aiding an associative recalling of other classification codes."

The main section of the publication contains recordings of the individual classification codes arranged according to the IDC system. The records contain consecutive numbers /which total 1338/ numbers of consecutive or continuous search subjects, the texts supplemented in accordance with the NCRI practice and formulated for the KWIC method, numerical identification symbols /code numbers/ of the IDC and references to other associated IDC, or more detailed explanations of the subject words. The second part is formed by a register of significant key words which are ordered alphabetically and placed each time midway of the line. The third and last part of the publication is a list of numerically ordered continuous bibliographic searches.

The third publication called "NCRI Research Reports" was worked out on the computer through a MINSK-ARDIS set of programmes. The [illegible] section consists of a list of the research reports. The second part has been compiled by a computer and forms an alphabetical register of the KWIC type with cyclic permutations of the key words. The title of each report appears on the average four times in the register. The third part of this publication is an

authors' register with a statistical supplement on the number of reports issued by the author.

The fourth part of the publication "Documentation Bulletin" was also worked out by the MINSK-ARDIS programme. It consists of a basic part of 13 registers and of a supplementary statistic. The documentation records contain, among other information, bibliographic data, data on authors, a Czech title of every processed source of information and an annotation supplemented by an information on the arrangement and illustrative material of the source of information /the number of figures, diagrams and pages/. Of the total of 13 registers of the Bulletin there may be referred to, as those of greatest interest, the registers of authors and firms, a register of titles in the Czech language, of standard specifications, patents etc.

These registers are intended to replace card files.

Mechanical processing of the Documentation Bulletin serves to furnish rapidly the most accomplished review on the bibliographic material in possession of the NCRI and, thereby, to afford their maximum utilization.

Computation of a Structural Model of the ČAZ /Československé automobilové závody - Czechoslovak Automobile Works/ Trust
/Ing. J. Metycka/

The programme is envisaged to meet the requirements of structural analysis that reproduces starting conditions and planned changes of an economic system by means of checkerboard balances and a matrix calculus. In a matrix model there are represented the basic quantitative relationships among production, cooperation and consumption /marketing/. Subordinate changes of the tie-ups are reflected as a chain of events through the entire system and their interpretation is accomplished through structural analysis equations.

In the building-up of a basic model of departmental /sectional/ management it is possible to represent a complex of economic relationships in the items of constructional and technological break-down of a production matrix. The individual items are formed by branches or groups of products.

In addition to a basic production matrix with economic relationships in a financial formulation there is associated to the model a system of supplementary matrices which represent linear relationships in costs, consumption of materials and in the demand for personnel. The planned changes of the basic relationships in production activities are then reflected into the other indices of costs, material usage and demand for manpower.

One prerequisite of an application of the computation procedure is a set-up of a basic model of production economic units /organizations as a representation of both the intrinsic and the marketing relationships for a specific lapse of time, usually for one year. On hand of such a matrix model it is then possible to compute variants of the plan for the coming year by an establishment of total amounts of production for production sectors and categories of products /vector x/, whereupon with the help of structural equations there are located the tie-ups between a planned matrix model and the sales outlets, or the sales demands are determined /vector y/ and the total amount of production with its distribution within the structure are established by computation.

The programme can be made use of for computations of structural analysis also at other levels, such as those of economic organization units or with a view to the organizational disposition of the model according to production units. A basic production model may have 300 items, the supplementary models may have 200 items. The programme has been verified on a model of the general management of the Czechoslovak Automobile Works.

Among other subjects that have been dealt with in the Departmental Computing Centre of the MDRI in the sphere of data processing there may be quoted the following ones:

- computation of annual participation by quotas in the economic results of the research Institute's activities,
- registration of fixed assets,
- computation of the gross receipts of the general management,
- statistical returns of wages for the motor vehicle trust,
- statistics of the agendas of the ministry.

Concepts and Attitudes of Trust and Enterprises to an Information System

The enterprises and organizations which form part of the Czechoslovak automobile industry are aware of the fact that one fundamental prerequisite of an improvement of the standards of management and decisions is the creation and application of an intergrated system of information in the enterprises. In view of this, all enterprises that make up the trust endeavour by this time to handle the problems associated with building-up of at least their own internal system of information in accordance with their own specific conditions. For certain selected sectors of their activities they conduct an analysis of the sources and origin of information, its flow from one work station to another, its subsequent processing and utilization for the needs of management, planning and decision-making.

Within each enterprise great pains are taken in order to solve the problems associated with the gathering and primary identification of the data in a form acceptable for mechanized processing, particularly by automatic computers. As regards punched card inputs certain difficulties are caused by the existence of two types of cards, that is of those with 80 and 90 columns, the same as the quality of the cardboard used which does not make it possible to use equipment with

higher speeds of scanning. In view of the laborious manufacture of punched cards, particularly of those containing data which are recorded once for all, attention is paid also to an automatic recording of the data in the initial stage of their acquisition through a combination of a typewriter, an adding and an accounting machine with a tape punching machine. A team of specialists headed by experts from the general management of the ČZM are at work upon a systematic evaluation of a system of [illegible] for the different spheres of the activities displayed by the enterprises under the specific local conditions of this country. It is endeavoured to solve the problem according to the principle of: -decentralized collection of data with
-centralized processing of data and
-decentralized decision-making.

In the building-up of an information system and in the automation of its processing the greatest advancements have been recorded by the ČZM /Czech Motor Cycle Works/ Strakonice and the Praga Works.

ČZM Strakonice /Ing. F.Fušák/, aided by its relatively extensive punched card computing centre and a centre equipped with a Minks 22 computer, are noted for their pursuits of automation in a wide range of problems and assignments under conditions where the activities of the production enterprise cover a multitude of various types of production from single-part manufacture through small batch production up to quantity and foundry production. The enterprise endeavours with notable success to solve and verify projects belonging also to economic, commercial and technical spheres, with utilization of what is called network-type planning. This enterprise is known for some time by its breakthrough work in the field of organization and in the building-up of an information system. The principal asset of this kind of work

is undoubtedly the rapidity with which the documents are processed according to verified programmes, together with a high operational efficiency of control and management. The issues involved are, for instance, a reflection of the changes in a plan of demand for spare parts when the final production assortment is modified, or the impact of price modifications upon the plan of material and technical supply and in product calculations, the [illegible] of capacity projects for various alternatives of production [illegible], the impact of modifications of production plans upon the demand for tools and utensils etc.

In the PRAGA national enterprise /Ing. J. [illegible]/ there has been worked out a whole system of programmes for computation of a production plan. The [illegible] involved are a statistical computation of the plan in pieces, appraisal by individual costs of wages and materials and a computation of the necessary capacities of machines or [illegible]. In view of the importance of these investigations, a few details will be given below:

The input setups contain both analytic and synthetic indices /such as the costs specified according to parts and production departments and a table of time and task wages and production man-hours for the entire production volume according to production and economic departments etc./.

The system of production planning is appropriate for adoption by enterprises with medium-sized production runs in which relatively intricate products are turned out /one concrete potential application: an engine-clutch-gear case set of a truck/ the structure of which is specified in a parts list of the product.

The system of programmes has been worked out for the Minsk 22 computer. As a result of its technical parameters, the following limitations of the programmes become necessary:
- the maximum number of parts list tie-ups for one product amounts to 4092

- the maximum number of different parts in one product amounts to 1188
- the number of different products is not subject to any limitations, the existing programmes, however, permit 19 products as a maximum

The input information for a computation is made up of basic complexes of data and by variables.

The basic complexes of data are the parts lists of the products, technical and economic performance standards, technical and economic material standards.

The indispensable information contained in the sentences of the individual sets:

parts lists for a lower part
a higher part
pieces
parent department
basic product number
indication of a modification

Explanatory note to the "indication of a modification" concept: this is the disposition of parts lists for a modified version /that is, for versions of the product which are only slightly different from the standard version/. This disposition can be simplified by a method of reference to the standard version and an enumeration of the parts which either figure as additional elements in a modified version /plus elements/ or will be missing in it /minus elements/, when compared to the basic version. The basic version enters meanwhile the modified version with all its lower parts, but not as a unit. This fact has to be communicated to the computer through a designation of the modifying relationship on a punched card of the corresponding parts list make-up.

In each sentence of the parts list make-up there is characterized only a tie-up between a lower and an immediately higher part; it is not necessary to designate the degree of assembly.

The technical and economic performance standards are the

following ones: number of part
operation
department
work station
number of machines attended
tariff class
piece time
crowns /piece /wages/

There are the following material technical and economic standards:

number of part
operation
department
stock item
number of uniform branch classification
key of stock unit /pieces, 10 pcs, 100 pcs, litres, kg etc/
prices per stock unit
physical consumption

Variable information comprises:

a/ sales demands designed by a number of a final part or a spare part and by numbers of piece planned in the time intervals scheduled

b/ time assets of the different periods, special names of set-ups, losses according to work stations and average sur-plus performances according to departments.

The above basic sets of information also enable the working out of intrabudget price lists corresponding to the different reduction or economic departments in the following items:

the department's own wages
total of wages
total of materials

total overhead differentiated according to departments

total price of a part at the stage of a specific operation

There are further worked up in the programme aggregate performance standards corresponding to selected parts /representative parts/ and also reflecting the make-up of the labour-costs according to production departments.

In the sphere of materials there is obtained at the output of the computer a review of the material input subdivided into metallurgical materials, parts acquired from subcontractors and engineering metallurgy /cooperation/.

The output set-ups are substantially variable and thereby make possible various aspects and analyses according to any variant that has been selected. There exists also a number of programmes for check-up of the basic set-ups and various surveys and summaries of these set-ups.

Maintenance of the basic set-ups is carried out with the help of punched cards in which old information is left out and new information entered. On the modified set-ups there is worked out a checking extract and, in TEN-M and TEN-V /technical and economic standards of material and performance/ also an extract from the basic set-up in the modified items after the modifications have been effected.

The entire system is readily adaptable and safeguarded from numerous potential errors.

From other systems of a general applicability there should be made reference to a system of records kept on fixed assets which deals with both accounting /analytical and synthetic/ and technical evidence of fixed assets. This system is made use of also by other enterprises.

The work pursued in the AZNP /Automobile Works/ Mladá Boleslav is primarily focussed upon the following items: stock administration, marketing, operational planning, material and technical supply, handling of claims and

complaints for the commercial and technical service department, tooling and personnel agenda.

Of a similar extension is the work carried out in the national enterprises of Tatra Kopřivnice, Avia Letňany and Motor České Budějovice. Extensive work on automation in the system of store administration is conducted by the Mototechna national enterprise on a nation-wide scale.

An investigation conducted in the enterprises which form part of the ČAZ trust shows that the different subordinate agendas will be processed with the help of an automatic computer in approximately the following order:

- technical and economic performance standards
- fixed assets
- placing of orders for production and production capacities
- technical and economic material standards
- sales /marketing/
- design and technology
- wages and salaries
- general accounting
- material and technical supply
- records kept on production
- personnel agenda
- agenda associated with the incidence of rejects in production
- tooling

The enterprises that form part of the ČAZ trust have learned from their own experience that the adoption of an automatic computer involves a number of positive effects which either can or cannot be characterized by figures. From the latter group there ought to be mentioned:

- the acquisition of sufficient, more exact and reliable information for control and management,

- faster processing of such information;
- the possibility of releasing leading executives from administrative activities which have thus become unnecessary,
- a rise of the general standards of the culture of management

The positive effects which can be expressed in numbers are high in spite of the substantial costs involved in the acquisition of a computer in the initial stage. The adoption of an automatic computer implies, in the first place, the following advantages:
- reduction of the volume of in-process products
- reduction of the amount of floating assets
- reduction of down times in production
- reduction of the labour input into the products
- shortening of the cycle of technical preparation of production
- reduction of the percentage of rejects
- reduction of abnormal supplies of materials and finished products
- reduction of normative supplies etc.

Progressive acquisition of experience from realization of the first more or less comprehensive programmes shows that in the trust of Czechoslovak automobile factories there exist the necessary prerequisites for overcoming the initial difficulties in the adoption of modern computing techniques and that these techniques will prove to be one of the most important contributions towards an improvement of the economic efficiency of management and control in this country s new economic and political conditions.

Prague, Sept. 23, 1968

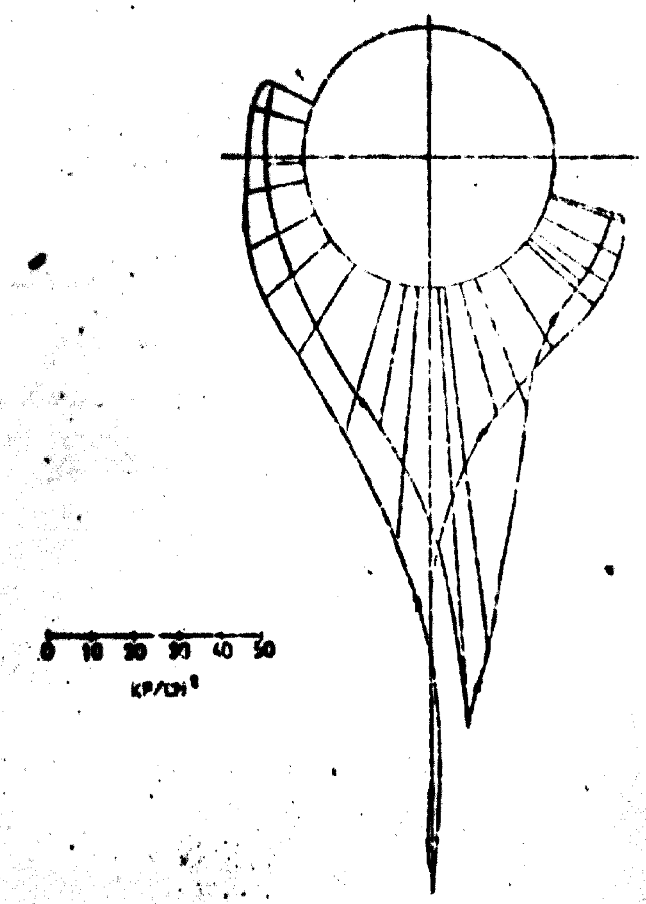


Fig.1.

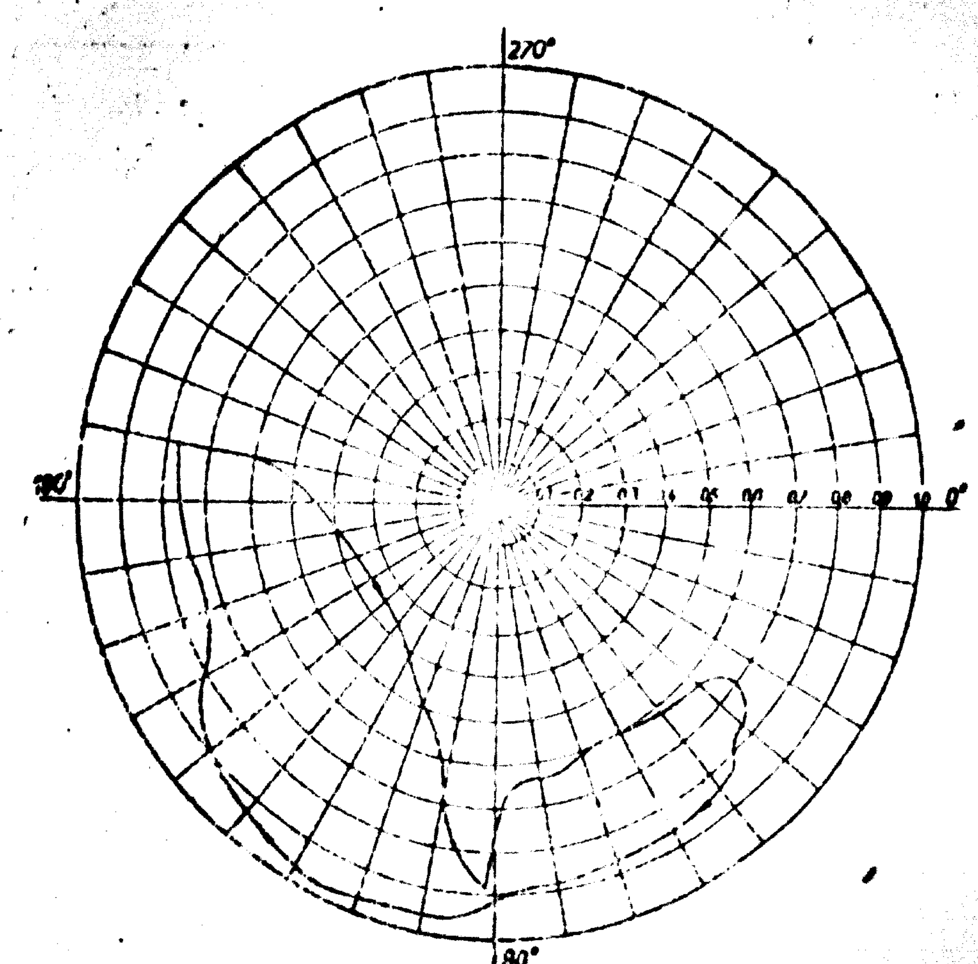


Fig.2.

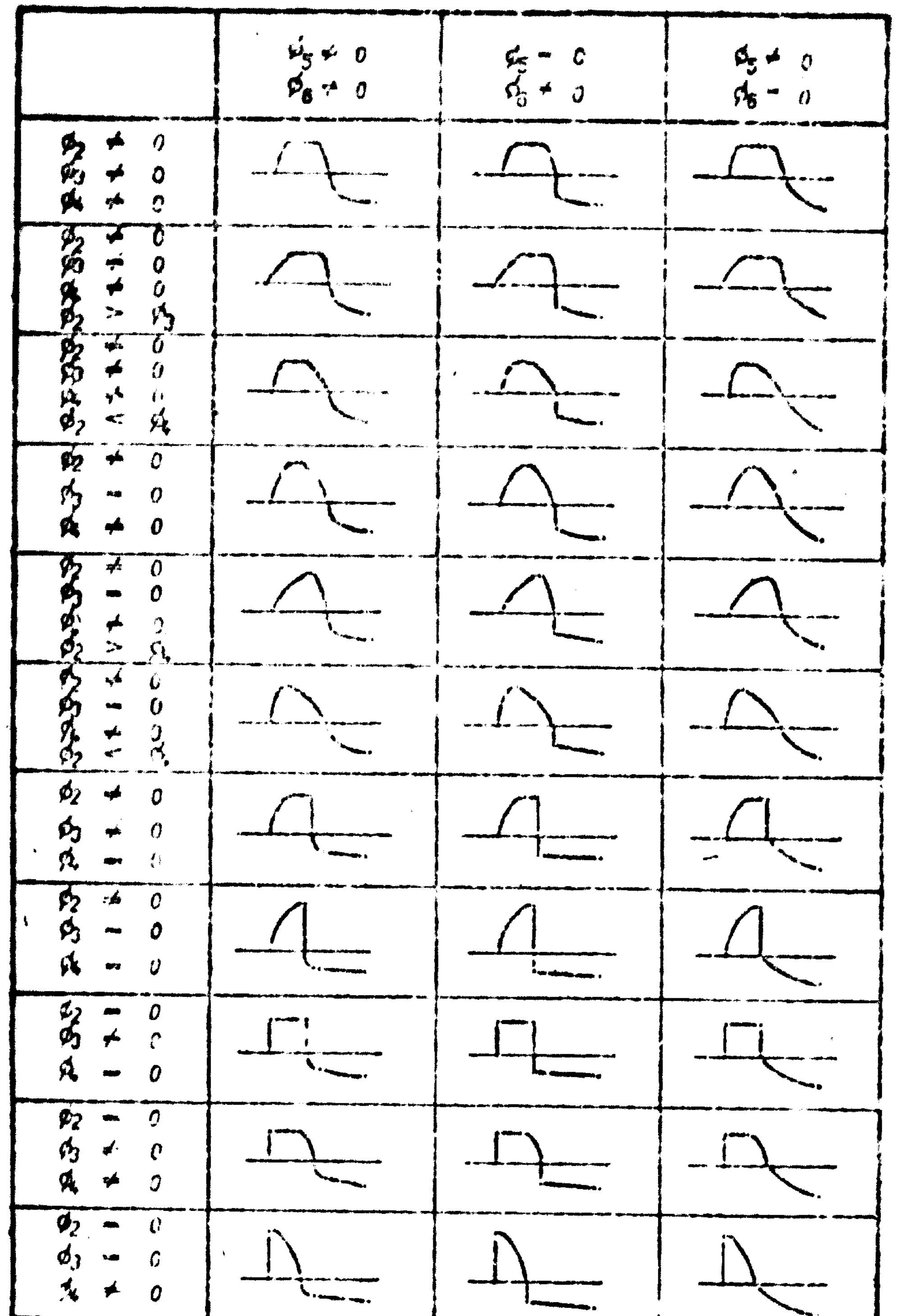
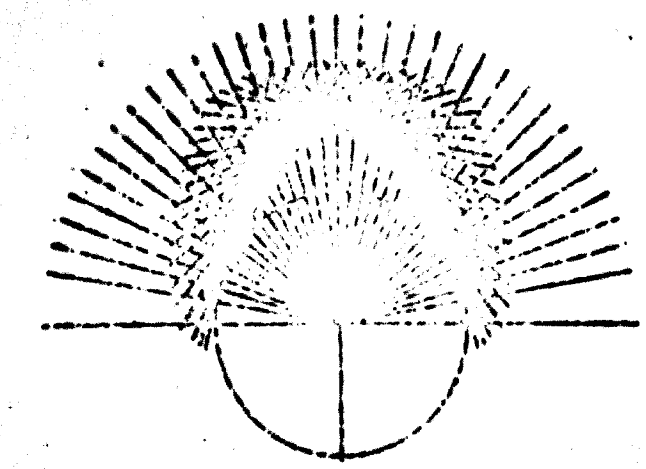
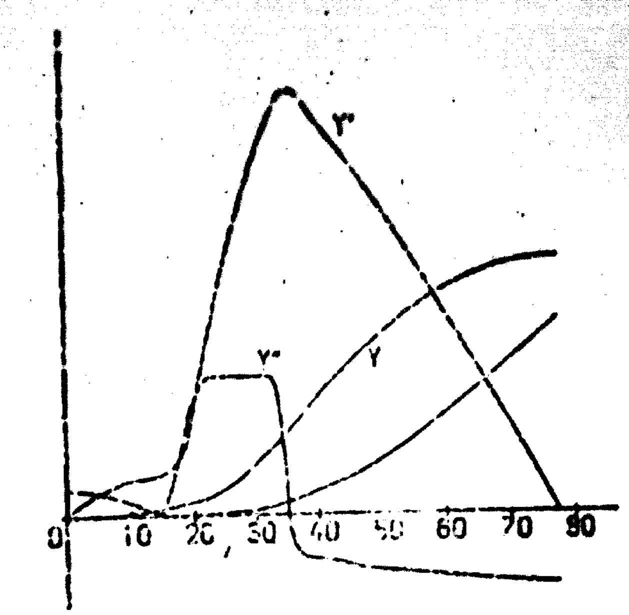

φ5 ≠ 0 φ6 ≠ 0
φ5 = 0 φ6 ≠ 0
φ5 ≠ 0 φ6 = 0
φ2 ≠ 0 φ3 ≠ 0 φ4 ≠ 0
φ2 ≠ 0 φ3 ≠ 0 φ4 ≠ 0 φ2 > φ3
φ2 ≠ 0 φ3 ≠ 0 φ4 ≠ 0 φ2 < φ4
φ2 ≠ 0 φ3 = 0 φ4 ≠ 0
φ2 ≠ 0 φ3 = 0 φ4 ≠ 0 φ2 > φ4
φ2 ≠ 0 φ3 = 0 φ4 ≠ 0 φ2 < φ4
φ2 ≠ 0 φ3 ≠ 0 φ4 = 0
φ2 ≠ 0 φ3 = 0 φ4 = 0
φ2 = 0 φ3 ≠ 0 φ4 = 0
φ2 = 0 φ3 ≠ 0 φ4 ≠ 0
φ2 = 0 φ3 = 0 φ4 ≠ 0

Fig. 3.




Y'
Y''
Y
0
10
20
30
40
50
60
70
80

26. 1. 72