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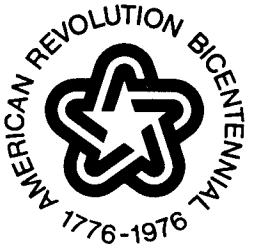
EAST EUROPE

TRANSLATIONS ON EASTERN EUROPE

SCIENTIFIC AFFAIRS

No. 529



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YUGOSLAVIA

USE OF COMPUTERS FOR MILITARY PURPOSES DISCUSSED

Sofia VOENNA TEKHNIKA in Bulgarian No 8, 1976 pp 5-6

[Article by Docent Col Khristo Kalamov, candidate of military sciences: "Computers in Military Engineering Practice"]

[Text] The engineering-technical personnel of the Bulgarian People's Army carries out important tasks related to the operation, repairs and storage of complex equipment and armaments and their maintenance in constant combat readiness. Along with this, military engineers must elaborate theoretically and apply practically a number of questions affecting, above all, the optimal operation of equipment and armaments under our conditions. The solution of such problems quite frequently calls for voluminous computation operations which take a great deal of time and efforts needed for purposeful creative activities.

Computers, whose utilization in all realms of human activities is acquiring an ever broader scope, are a valuable aid of the military engineer engaged in labor intensive computations. Their advantages are numerous. Above all, solution time is sharply reduced. Practical experience has shown that problems requiring several months of work, even with utilization of mechanization facilities, can be resolved in no more than a few days with computers. Computer solutions are distinguished by their great accuracy and it is precisely such accuracy that plays a primary role in resolving certain problems. Thus for example, computer computations of armament strength qualities enable us to determine the level of stress of a considerably larger number of points compared with "manual" computations. It is entirely clear that this considerably facilitates and simplifies design without reducing strength, saving manpower and materials. Use of computers increases the possibility to optimize processes thanks to acquired experience and packets of programs which the military engineer may have at his disposal. Computer mathematical support contains standard programs for the solution of

complex mathematical problems. Some computers have programs for the solution of systems of linear algebraic equations of up to 55 series inclusive, complex definite integrals, and so on.

Effective work with computers requires additional knowledge and a certain experience. The person must have a clear idea of the problems to be resolved before turning to the machine. He must know what to demand of it, the way in which it could yield results, and how to use them. A computer could carry out the intent and the order of a person while the person may understand the results of its work provided that they have a commonly understood language. By language we mean a set of basic symbols and a system of rules for alining them in proper expressions which have been given a specific meaning in advance.

In our view it would be expedient for military engineers to apply two methods in the use of computers. The first calls for setting up collectives of specialist engineers in the field under study and of programers. The obligation of the specialist engineers is to elaborate a mathematical algorithm,[1] draw up the program[2] of the problem, and resolve it with the computer. This method used in resolving engineering and technical problems is convenient and justifiable economically in the case of major projects carried out by large collectives. Specialization in covering the stages in the solution of the problem has a positive influence on the time and quality of solutions.

According to the second method, the military engineer elaborates, himself, both the algorithm and the program of the problem, i.e., he establishes direct contact with the machine. To this effect he must study the foundations of algorithmic languages[3] to be used for the programing in order to be able successfully to draw up programs of low and medium complexity. Consequently, initially the engineer will have to devote considerably greater efforts to study programing. Subsequently however, he would be able to resolve various problems in his field with sufficient confidence without depending on the programers. Bearing in mind the nature of the problems resolved by military engineers, it would be expedient to study the "Avtokod Inzhener" and "Fortran" languages. Both are convenient for programing problems of a clearly manifested formula type. They consist of a set of instructions for implementing the program algorithm. These languages are structurally simple. They can be easily learned by the engineering-technical personnel of the Bulgarian People's Army and other military specialists and applied in the solution of one or another problem. They are studied independently with the help of existing publications or at short courses (30 - 40 hours).

The algorithmic languages "Avtokod Inzhener" and "Fortran" consist of basic symbols and elements. The symbols are the basic structural units of the languages. The elements include figures, variables, mass data,

functions, and instructions. The basic symbols, figures, variables, mass data and functions describe the values included in the resolved problems and indicate the operations they are subjected. The instructions indicate the operations to be carried out by the computer. In terms of purpose, the instructions may be divided into the following groups: data input and location; organization of formula computation; computing process control; information retrieval for printout; subprograms, and others.

Quite frequently the military engineer must make computations based on an individual formula containing unknown variables. The computations are made for each value of the variable quantity, i.e., the formula is computed as many times as there are variables. Such processes are described as cyclical. For example, the time for the evacuation of tank equipment is computed according to the formula:

$$t = \frac{NS1}{nVcpP}$$

in which t is evacuation time; N is the number of machines to be evacuated;

S is the coefficient determining the number of tractors per evacuation;
1 is the evacuation arm;

n is the number of tractors participating in the evacuation;

Vcp is the average evacuation speed;

P is the net evacuation time counting coefficient.

Should the arguments of the function have a single value, the solution could be obtained quickly and without computer use. Assuming, however, that some of them have more than one value, it would be expedient to draw up a computer solution program. Thus for example, if the evacuation arm (1) ranges from 5 to 15 kilometers with a 0.5 kilometer step and with use of a different number of tractors (n = 7; 11; 13; 15; and 17), the following program may be set up with the help of the "Avtokod Inzhener" language for the Minsk-22 computer:

Example 1. PROGRAM ⌴ FOR ⌴ COMPUTING ⌴ OF THE ⌴ TIME ⌴ FOR EVACUATION X

```
1. VVOD ⌴ N,S,V,P,N1(5) X
2. VBICH ⌴ T = (N.S.L1):(N1 |I| . V.P) X
   VBICH ⌴ N2 = N 1 |I| X
   NAP ⌴ TABL ⌴ 2 ⌴ 3NA ⌴ 15 ⌴ N2.15 ⌴ L1, 15 ⌴ T
   POV ⌴ 2 ⌴ I = 1 ⌴ (1).5 X
   POV ⌴ 2 ⌴ L1 = 5 ⌴ (0.5) ⌴ (=15 X )
   KON ⌴ X
   NACH ⌴ 1 X
```

Remark: For program considerations n was replaced by N1, L by L1 and V_{cp} by V.

This program enables us to obtain 105 solutions from which we could select the most suitable for the specific evacuation circumstances in the course of combat operations. The same problem, programed with the Fortran algorithm language, using computer EC1020 will be as follows:

Example 2.

```
DIMENSION M(5)
READ (1,101) R1, S, R2, V, P, M(5)
101 FORMAT (5F8.2,515)
    R2 = 5
  4 I = 1
   3 T = (R1*S*R2)/(M(I)*V*P)
    WRITE (2,102)R2, M(I), T
102 FORMAT (1H, 5X, F8.2, 10X, I 5,10X, F8.2)
    I = 1 + 1
    IF (I.LE.5) GO TO 3
    R2 = R2 + 0.5
    IF ( R2 - 15) 4,4,5
  5 CONTINUE
    STOP
    END
```

Remark: For programing considerations, n was replaced by M; N was replaced by R1, and 1 was replaced by R2.

These and far more complex problems are encountered constantly in military engineering practice, particularly in computing equipment parts and assemblies. In some problems the functions depend on several arguments as a result of which double, triple, and other cycles may be set up, while solutions come in the hundreds or even thousands. One such problem is given in the following example:

Drawing a diagram of a directional antenna on the level E using the correlation:

$$Z = \cos F \frac{\sin \frac{mb}{2} \sin F}{\frac{mb}{2} \sin F};$$

$m = \frac{2\ Pi}{g}$; B= 5,6; 10,1; 13,8; 20,2; 31,9; 41,5; 51,3; 61,5;

$H \leq F \leq \frac{Pi}{2}$; $H = \frac{Pi}{20}$; g = 3,2(0,2)7,4,

in which g is the wavelength; F is the axis angle; H is the step; b is the aerial diameter.

In order to make the diagram, all values for Z must be computed, i.e., with the given values for g, b, and F, the formula must be computed 1760 times. It is clear that this would require a tremendous amount of work and time. This problem can be resolved easily and quickly with a computer, making the following program using the Fortran algorithm language:

Example 3. PROGRAM FOR THE COMPUTATION OF A DIRECTIONAL ANTENNA

```
    DIMENSION B (8)
    READ (1,103) B(8)
103 FORMAT (F8.2)
    P = 3.14159
    H = P/20.0
    H1 = P/2.0
    G = 3.2
   51 = 1
   3F = H
   1Y = P*B(I)/G*SIN(F)
    Z = COS(F)*SIN(Y)/Y
    WRITE (2,104)F, B(1), G,Z
104 FORMAT (1H, 20 X, F8.2, 10X, F6.2, 10X,
    F8.2, 10X, F10.4)
    F= F + H
    IF(F-H1)1,1,2
   2I = I + 1
    IF (I - 8)3,3,4
   4G = G + 0.2
    IF (G-7)5,5,6
  6CONTINUE
    STOP
    END
```

Algorithm languages could be successfully used not only by the engineering and technical personnel but by military specialists in various fields as well. Thus for example, officers working in fire theory have the possibility to resolve many problems with minimal efforts and time. Algorithmic languages acquire a broad range of use in studies in the

fields of communications and radar. A number of computations on the use and repair of armaments and equipment must be made with the help of computers. This also applies to studies on rear line problems, protection of troops from mass destruction weapons, antiaircraft protection of targets, and so on. For this purpose the respective specialists must acquire a certain knowledge in the use of computers for the solution of daily practical problems, thus saving a great deal of efforts and time for creative work and contributing to the faster development of their branches of military science.

5003
CSO: 2202

MAINTENANCE OF VARIOUS FIREARMS EXAMINED

Sofia VOENNA TEKHNIKA in Bulgarian No 8, 1976 p 7

[Article by Col Kali Taushanov: "How To Extend the 'Life' of a Firearm"]

[Text] Several changes occur in the technical condition of a firearm in the course of its proper use. Such changes are natural. They are taken into consideration in its design and are reflected in the operational documents. The documents also indicate the necessary measures for maintaining and insuring the impeccable work of the systems under different conditions. The proper knowledge and observance of the regulations for maintenance, storage and combat work would substantially extend the "life" of the firearm.

After a certain number of rounds (which, in peacetime, are rarely reached by the individual weapon), the chromium lining in the barrel may crack. A gridlike wear may develop. These may be followed by the crumbling of the chromium, particularly in the hind and muzzle parts of the barrel. For awhile, such changes have no influence on the combat or official characteristics of the weapon. However, they require greater care -- a more careful cleaning of the barrel with the more complete removal of the gunpowder deposit. Unless properly cleaned, it penetrates between the chromium cracks, reaching the unprotected metal. In these areas, rust and deep canals may appear. The erosion of the chromium lining of the breach chamber is particularly dangerous. This is the reason for difficulties in the extraction of the shell and for delays. The erosion of the chromium in some parts of the barrel may be the reason for powder gases to go through the barrel and the bullet and the development of a great disparity in power gas pressure, drop of the initial velocity of the bullet, and worsened accuracy.

Changes in the technical condition of the weapon caused by improper use are particularly undesirable.

In the course of dry run training for siting and smooth pressing of the trigger, after cocking and checking the interaction of the firing pin mechanism of the weapon with a percussion pin (Kalashnikov submachine gun, and TT and Makarov pistols), training cartridges must always be used. They protect the firing pin from dulling and breaking and the bolt from a direct strike on the muzzle end face (the bolt hits the bottom of the cartridge while the nipple hits the soft part of the primer). Failure to use training cartridges in practicing with PKT machineguns may result in a break of the barrel's thrust ring, making the barrel prematurely unusable.

The empty striking with a RPG grenade launcher is particularly harmful if the percussion hammer is not hand-supported. This is a reason for the breaking of the nipple and for severe battering and crushing of the hammer nipple.

Firing with uncleaned bore may widen the barrel. The barrel of carbines, submachine guns, and machineguns may be widened without metal protrusion on the external walls of the barrel, provided that the weapon meets normal combat requirements. However, such arms require constant care. The chromium lining of the barrel bore has cracked wherever the protrusion has occurred. The appearance of rust with deep cavities is inevitable. The accuracy of such weapons must be periodically checked and brought to normal.

Accuracy is adversely affected by the violation of some barrel-cleaning rules: improper assembling of the ramrod, nonuse of the muzzle guard (in the case of Kalashnikov submachine gun or a pierced bullet head for machine guns), or use of a faulty ramrod or improper wiping. This wears out the muzzle end face, hurts the chromium bore lining, leads to the battering of the muzzle end face, and in the final account, worsens accuracy.

In the course of training and combat handling of the weapon, particularly in meeting various norms for occupying or abandoning combat vehicles, or disassembling and assembling, it is very important to protect the weapon from blows. In the opposite case, battering, cracks, crushing or battering the magazine, breaking of parts, and others, are possible. Such irregularities may not be removed by the soldier, requiring the intervention of a specialist from the repair arm of the unit.

In the course of fire practice, the fire system must be observed strictly. Continuous fire with an automatic weapon in short bursts should not exceed 8 to 10 rounds, or 25 - 30 rounds for long bursts. Should the fire be intensive (particularly with machineguns), with 500 rounds, the regular barrel must be mandatorily replaced with the spare one.

The normal firing system protects the barrel from overheating and premature wear, retaining its ballistic characteristics.

The proper selection of the proper rate changer is of great importance in machinegun fire. Firing with a larger changer bore creates a strong blow against the sliding system of the hind barrel box stop and damages it. This is the usual reason for its cracking in the case of PKT machineguns mounted on training-combat tanks.

The wrong choice of a rate changer may cause a delay in machinegun firing, particularly if dirty or fired under wintertime conditions. In order to avoid such stops, up to 3000 rounds must be fired with changer "3"; after 3000 rounds, changer "2" should be used, and after 5000 to 6000 rounds, changer "1" should be used. The good gunner must be able to detect by ear any abnormal work of the sliding machinegun system.

Of great importance to its normal operation is for the block arm, the block, and the internal side of the barrel box to be finely and evenly lubricated with GOY-54 or AU spindle oil lubricant, and in winter-time conditions, to operate several times by hand the sliding system in advance.

Also important is precise registration of the number of rounds fired by each machinegun or grenade launcher. Why is it that occasionally this question is underestimated? It is because its role is not understood. Yet it is of great importance to the precise study of the qualitative condition of the weapon. The absence of such records hinders specialists in planning necessary repairs. In the case of machinegun breakdowns, the repairmen have difficulties in determining rapidly irregularities and wornout parts and mechanisms and the reasons for them. A precise record of rounds fired would indicate which assembly should be repaired and what type of repair is to be made -- -- medium or capital. The life span of each machinegun could be extended several hundred percent if it is repaired periodically, each 25,000 - 30,000 rounds.

The technical condition of the weapon largely depends on its prompt and skillful servicing. It is commonly known that before and after each class (guard duty), the weapon must be cleaned and freshly lubricated. In order to prevent damages during the cleaning, dismantling and assembling regulations must be observed strictly. Frequent and total dismantling should be avoided. No great strength should be used in dismantling and putting together the individual assemblies and mechanisms. The dismantling of the complex mechanisms should take place under the skillful guidance of the commander or service specialist.

The weapon must be cleaned only with good quality materials. The parts on which gunpowder gases act must be cleaned with a RCHS solution. Its components dissolve the salts in the powder residue and contribute to removal of the copper from the barrel. Cleaning with RCHS should take place prior to lubrication of the parts. The lubricated parts should not be cleaned with it, for the oil does not allow the RCHS water solution to reach the metal. RCHS is suitable only if the chemicals have been hermetically sealed and the solution has been prepared immediately prior to the cleaning of the weapon. RCHS prepared in advance but kept in a tightly sealed container may be used.

Use of abrasive materials for removal of the residue and rust may make the weapon unusable. Their use removes a layer of metal from the parts and increases (decreases) certain dimensions. For example, if the clearing between the tube of the rate changer and the gas piston of the Kalashnikov submachinegun shows a 0.2 millimeter diameter difference, a new bigger piston should be installed. Use of materials not stipulated in the service manual (NSD) is both undesirable and inadmissible.

Particular attention should be paid in assembling the weapon. Improper placement of the parts or hitting them may create battering, twisting, breaking, or damaging of entire mechanisms. It is necessary to check the numbers of the parts to see whether or not they coincide with the basic number (barrel box number). Installing parts from another weapon with other numbers could increase some gaps and create jamming or other irregularities which would adversely affect the normal work of weapon assemblies and mechanisms.

Knowledge of the structure of a specific weapon and strict observance of its operational characteristics are guarantees for impeccable work and for extension of its "life span."

5003
CSO: 2202

TRANSMISSION AND BRAKING SYSTEMS OF MT-LB TRACTOR DESCRIBED

Sofia VOENNA TEKHNIKA in Bulgarian No 8, 1976 pp 14-16

[Article by Docent Engineer Col Ferdinand Yotsov, candidate of technical sciences: "Combined Work of Main Transmission and Brakes of the Multiple Purpose MT-LB Tractor"]

[Text] The main transmission of the multiple purpose tractor may be described most generally as the double switching on of power, normal and lowered transmission sequence, and the existence of a turning planetary-friction mechanism. In addition to structural specifics, some of the characteristics in its work are related to the work of the brakes.

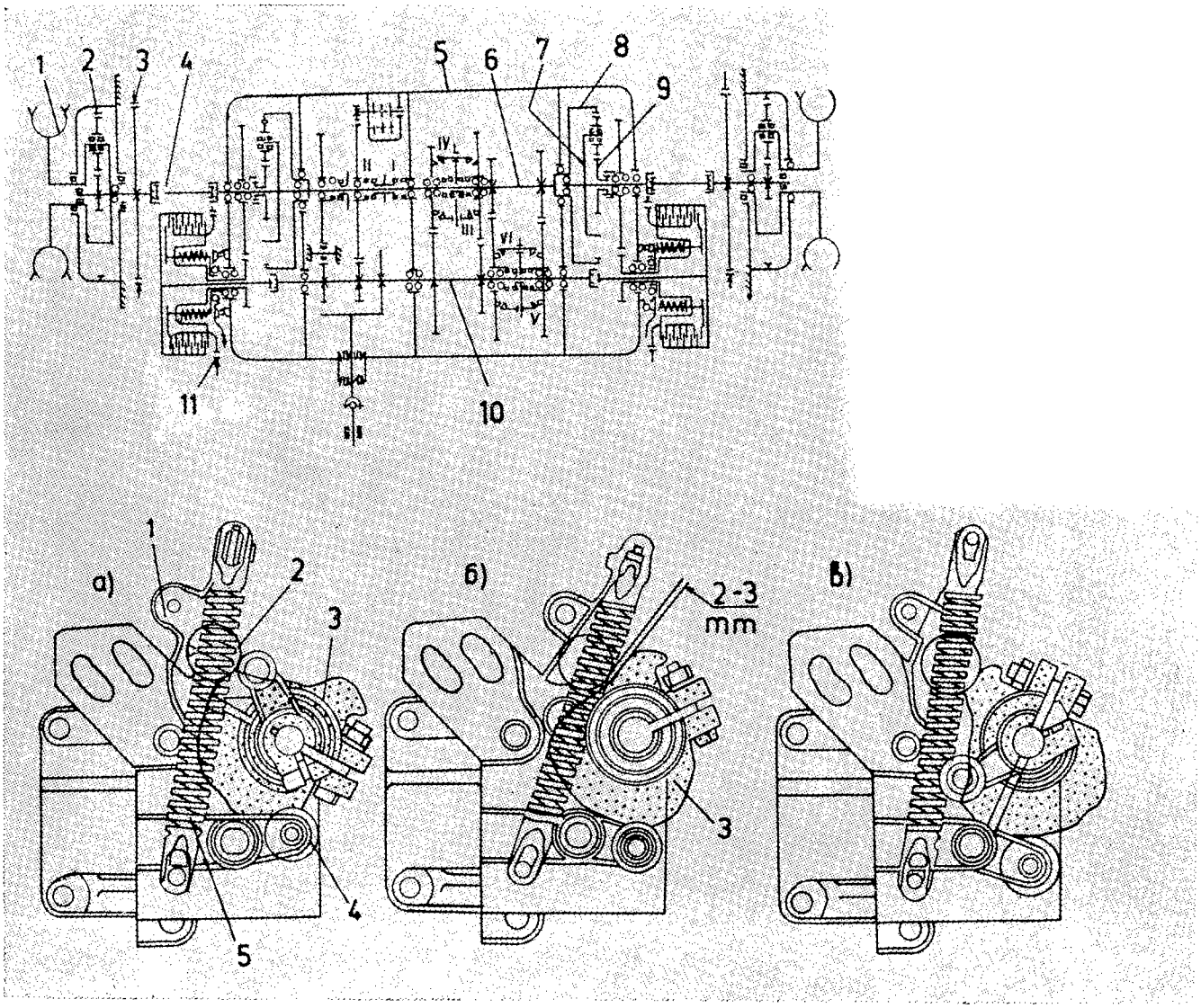
Even though not substantially different from the structural viewpoint, both type brakes (main and turning mechanism) have a qualitatively different relationship with the main transmission and the "behavior" of the tractor in different conditions.

Acting on the drums linked with the cogwheels of the side transmissions, the main brakes are used mainly to reduce the speed, to stop, and to restrain the tractor a long a slope, and to restrain one of the tracks should a drastic change in direction become necessary.

These brakes are activated by two independent drives -- pneumatic and mechanical. The first is controlled with the help of a foot pedal and acts simultaneously on left and right side brakes. Unlike it, the mechanical drive is linked with the drive of the brakes of the turning mechanisms and is activated by the control levers.

The brakes of the turning mechanisms act on the drums linked with the cogwheels of the planetary main transmission trains (Figure 1). They are used to control the tractor and reduce the gears in the transmission

Figure 1. Main Transmission



a. b. c.

Figure 3: Cam Position. a. In neutral. b. First position. c. Second position of control levers.

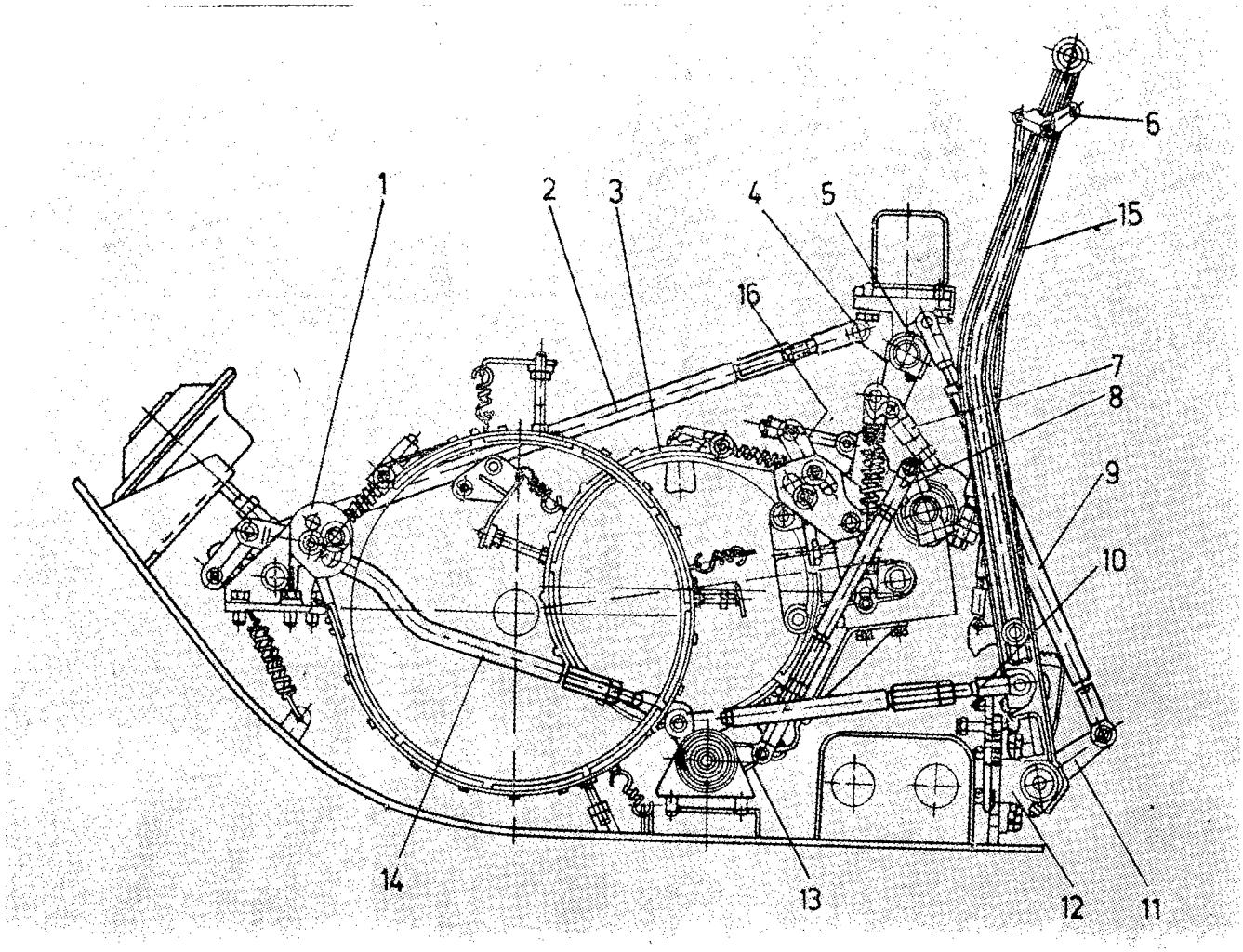


Figure 2: Brake Drive

box. They are activated with the help of levers 15 (Figure 2) of the mechanical drive. The shaped cam 3 (Figure 3) plays very essential role in the work of this drive (for each separate brake). The special shape of this cam makes possible the positioning of control levers in a starting and first position and a specific sequence for disengaging and engaging side frictions and brakes.

The characteristics of the combined work of the main transmission and the brakes are related mainly to the location of the lever for engaging the transmissions and control levers of the tractor. Here two aspects are characteristic. The first is related to the case in which the lever for the engagement of the transmissions is in neutral, while the control levers are in a starting position. Roller 2 of lever 1 (Figure 3a) for engaging and disengaging the turning brakes is in the upper, while roller 4 for the disengagement of the friction is in the lower cam housing. In this position the side frictions are engaged, while the brakes are disengaged. Through the transmission shaft 10 (Figure 1), the engine torque is transmitted to the radial cogwheels 9 which turn the satellites of the planetary trains. In turn, the satellites try to turn both the pinion carriers 7 and the epicyclical cogwheels 8. Because of the higher track resistance, the steering arms remain fixed. Only the epicyclical wheels turn, while the main shaft 6 idles. The tractor remains in a fixed position.

The case is different if one of the machine control levers (the right one, for example) is switched to first from initial position. Through a lever and rod system 11, 9, 5 and 7 (Figure 2), cam 3 (Figure 3b) turns counterclockwise. Roller 4 comes out of its bed and, through the rod, disengages the side friction. Roller 2 of lever 1 also leaves its bed and falls into the cam recess. Under the effect of springs 5, lever 1 turns clockwise and through rod 16 (Figure 2) engages the brake of the turning mechanism. The main brake remains disengaged. In this case the tractor turns toward the disengaged friction, while the position of the turning center depends on the track resistance.

When the resistance moments of both tracks are equal, the torque is transmitted only to the radial cogwheel of the (in this case) disengaged left friction. This turns the satellites, which, in turn, turn the train and the epicyclical cogwheel. Due to the fact that in terms of the epicycle the satellites are intermediary cogwheels, its rotation changes, which also changes the direction of the rotation of the main shaft. The two trains and tracks turn in opposite directions and the tractor turns around its geometric center with a radius equalling one-half of the track width.

Should the track resistance with an engaged friction (left) be higher, the steering arm of the left planetary train remains motionless. The epicyclical cogwheel and, with it, the main shaft turn in the opposite direction. The tractor begins to turn "backwards" around the geometric center of the greater resistance track. The turning radius will be equal to the width of the tracks.

Should the resistance of the track linked with the disengaged friction be higher, the main shaft will remain motionless. The satellites will turn the steering arm of the left planetary train and the tractor will turn "forward" around the geometric center of the disengaged track. In this case again, the turning radius will be equal to the width of the tracks.

Knowledge of such characteristics is of rather substantial importance both in terms of changing the position of the tractor on the spot and the adoption of safety measures in handling the controls.

The other aspect pertains to cases in which the transmission is in the transmission box, while the control levers are in one of the three possible positions: neutral, first or second.

Should the levers be in starting position, the side frictions are engaged while the brakes are disengaged. The power (other than in first gear) is transmitted two ways. The first (main) consists of a transmission shaft, twin locked cogwheels for the corresponding transmission, a main shaft, and epicyclical cogwheels. The second (supplementary) consists of a transmission shaft, side frictions and radial cogwheels. When the two power flows combine, the arms, and through them, the driving wheels of the tracks gain a certain rotation speed and the tractor moves with normal gear shifts.

Two characteristics exist in this case: in engaging in reverse, and in low gear. In the first case, the main power flow goes through the intermediary reverse cogwheel, as a result of which the direction in which the main shaft rotates becomes the opposite. The epicyclical and radial cogwheels turn in the opposite direction. The satellites, rotating around their axles, shift their centers along the direction of the rotation of the epicyclical wheels, whose rotation speed exceeds that of the radial cogwheels. The tractor moves in reverse. In this case, placing one of the levers in position 1 would increase the speed of the arm (of the planetary train with disengaged friction) and, together with it, the speed of track rotation. In this way the tractor begins to turn in the direction of the engaged friction. That is how, in reverse, a left turn is made possible by the right, and a right by the left control lever.

Engaging in low gear blocks the main shaft. The power is transmitted only along the additional flow.

Should the levers be moved from neutral to first position in an engaged transmission, the side frictions are disengaged while the brakes of the turning mechanism are engaged. The position of the main brakes remains unchanged. Power is transmitted only along the main flow. Turning around its axles (under the influence of the epicycles) the satellites turn around the restrained radial cogwheels, turning the steering arms. Due to the fact that the satellites are influenced only by the epicycles, their rotation speed is lower compared with the work in a normal gear shift. In this situation the tractor moves in a straight line with reduced front transmission and accelerated reverse, and stops when the low gear is engaged.

In the case that only one of the levers is in first position while the other is left in its starting position, the tractor turns in the direction of the first position lever with radius consistent with the corresponding gear.

Placing the levers in second position triggers additional changes (Figure 3c) in the position of the cam. Here the roller for the disengagement of the side friction changes along the cam with a permanent radius as a result of which the frictions remain disengaged. With the help of roller 2, the cam hump turns lever 1 in a counterclockwise direction. The power of springs 5 is overcome and the turning mechanism brakes are disengaged. Taking off the slack between the transmission elements, the power is transmitted to the levers of the main brakes as a result of which they are engaged. Should this be done simultaneously for the left and right brakes, the tractor will stop suddenly. Should one of the levers be in the starting while the other in second position, the tractor will turn around the restrained track.

We could state in conclusion that knowledge of such characteristics will contribute to the effective utilization of the tractor in providing various traction efforts, high speed, and high maneuverability under different terrain conditions.

5003
CSO: 2202

BULGARIAN CASSETTE RECORDER DESCRIBED

Sofia RADIO, TELEVIZIYA, ELEKTRONIKA in Bulgarian No 5, 1976 pp 26-28

[Article by Engineer Bogomil Iv. Bozhinov, and Engineer Todor K. Todorov: "Ogosta Cassette Recorder"]

[Text] The designers of the Elektroakustika Plant, Mikhaylovgrad, have developed and submitted for production the first Bulgarian made Ogosta cassette recorder. The tape recorder has good technical and operational parameters and a modern design.

Basic Technical Data:

Tape movement speed -- 4.76 centimeters per second $\pm$ 3 percent

Detonation coefficient -- $\leq$ 0.6 percent

Initial power -- $\geq$ 0.5 W

Nominal load resistance -- 8 Ω

Input:

Microphone $\leq$1 mV/2k Ω
Radio $\leq$10 mV/25 k Ω
Record player and tape recorder $\leq$ 300 mV/500 k Ω

Frequency characteristic 80 $\div$ 8000 Hz

Nonlinear distortion coefficient $\leq$ 4 percent

Background level $\leq$ 37 dB

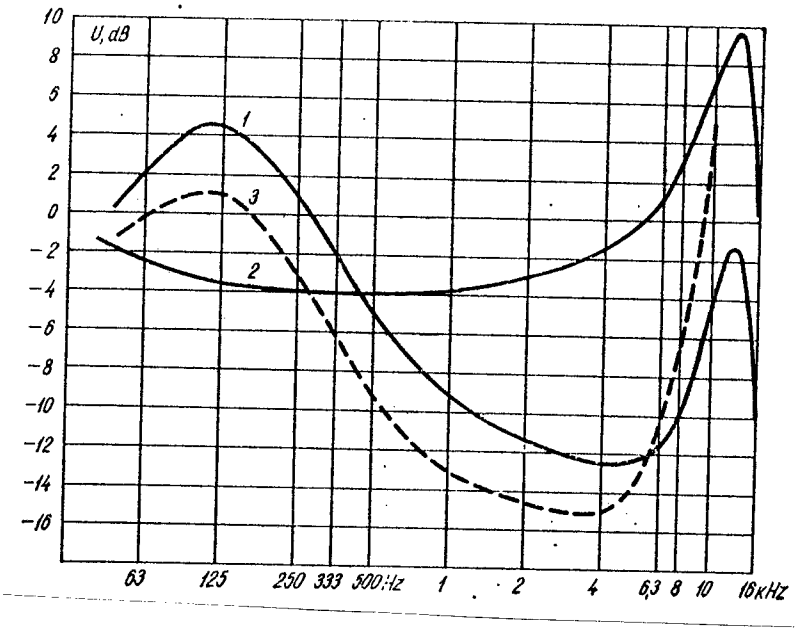


Figure 1.

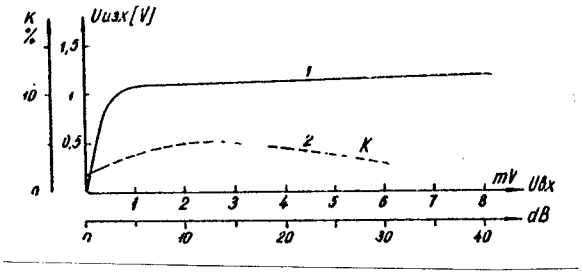


Figure 2.

The cassette recorder is for general, mainly consumer, use. It is used in recording and reproducing tape recordings on SS type cassettes. It has combined power (220 volts or batteries).

The power circuit of the recorder is given in Figure 3.

The preamplifier part has three transistors; the last two (T_{12} and T_{13}) are galvanically linked and provide the classical amplifying structure used in tape recorders. Resistor R_8 provides a tension feedback which leads to high stability of the amplification coefficient in terms of temperature changes and parameter differences. The P_4 trimmer-potentiometer makes it possible to build in transistors with different amplification β and makes possible the easy tuning of the amplification structure in order to obtain minimal nonlinear distortion.

The necessary frequency corrections in recording and reproduction are achieved through suitably connected R, L and C links and with the observance of standard time constants based on Bulgarian state standards. The bobbin L_1 has a 1.3 mH induction and, together with C_{12}, forms a serial pulsating circle which is tuned in resonance at 12.5 kHz. This makes it possible to eliminate noises from frequencies outside the frequency band of the tape recorder and to obtain a frequency characteristic of the recording track -- reproduction with an unevenness lesser than 4 decibels to a frequency of 10 kHz.

Figure 1 provides the frequency characteristics in recording and reproduction. Curve 1 is the frequency characteristic of the amplifier in a reproduction regimen; curve 2 is in the recording regimen, while curve 3 is in the recording-reproduction regimen .

The recording level is automatically controlled through a built-in compressor system. The compression of the signal dynamics is based on a control of the direct current system of the T_{12}, controlled through direct tension obtained by correcting the signal taken from the pre-amplifier lead. Resistors R_9 and R_{10} and diode D_1 are the threshold for activation of the 600 mV compressor for the "microphone" input. The necessary time constant of the compressor is achieved through the condensor C_9. Diodes D_2 and D_3 operate in the linear part of their characteristics so that the tension-controlling T_2 is proportional to the alternating current signal.

A "line" with a level higher than 250 mV and an overall coefficient of nonlinear distortion $k \leq 5$ percent is taken through R_9 and R_{10}.

Figure 2 offers the characteristics of the compressor. Curve 1 is the correlation between the output and the input tension, while curve 2 is the correlation between nonlinear distortions k (%) and the input signal.

In some of the recorders (first series), the T_{12} - T_{13} transistor couple is achieved with a hybrid integral circuit of the 1306 type (2 UP01A).

The chosen tone correction system is maximally simple, and makes possible corrections at low and high frequencies exceeding 10 decibels.

The power amplifier is based on the popular nontransformer system with transistors with supplementing symmetry AC127 and AC128.

The sinusoidal signal in a dynamic system is made symmetrical through the P_3 trimmer and a minimum of nonlinear distortions has been achieved. The R_{30} thermoresistor provides the temperature compensation of the initial current (at rest) I_{co}.

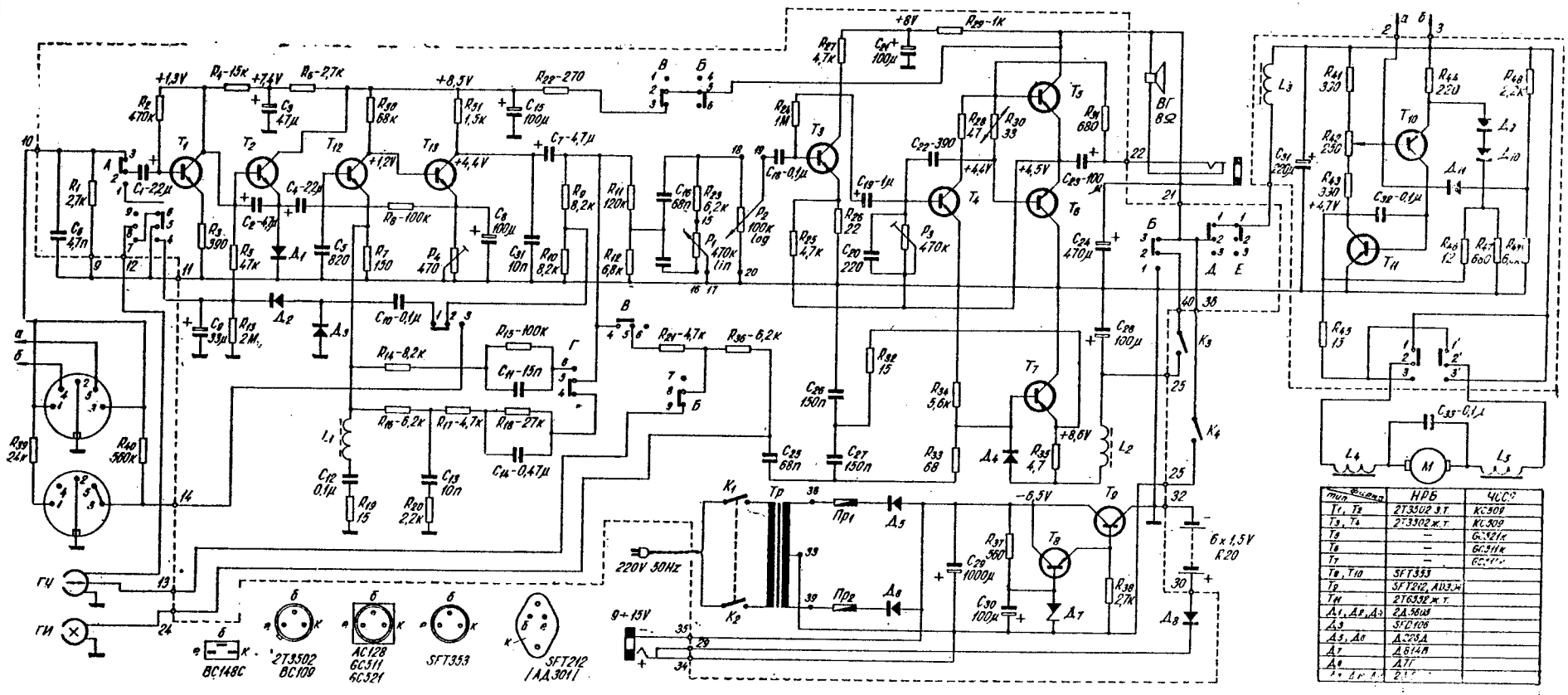
The high frequency generator is based on the classical 3 point system. The generated pulsations have a frequency of about 55 kHz.

The constant tape motion speed is 4.76 centimeters per second $\pm$ 3 percent, achieved through utilization of a sequential-parallel stabilizer of the DC electric motor revolutions. The system of L_4, C_{33}, and L_5 elements forms the filtering group which suppresses the noises characteristic of the electric motor.

The power supply is standard: from the grid through a stabilized ninefold current rectifier or with the help of batteries with 1.5 V R20 elements -- 6 -- or a 9 - 15 volt battery. D_8 diode enables the recorder to be powered by an accumulator without removal of the batteries.

A characteristic feature of the recorder is its possibility for acoustic control of the recorded signal.

The head used is of the general purpose type DF 1A/197 produced by the Photovox company in Turin (Italy) or MK12 produced by the magnetic head plant in Razlog. Its frequency characteristics are shown in Figure 4 in which curve 1 is the characteristic of the head in a reproduction regimen; curve 2 is in the recording-reproduction regimen. In the course of use, due to the inevitable wear, the general purpose head should be replaced. A characteristic feature in replacing it is the fact that the necessary level of the magnetizing current for the different heads is different and is selected through R_{36} on the basis of the level at high frequencies and nonlinear recording distortions. From the viewpoint of quality recording, the nonlinear distortions of the recorded



тип элемента	НРБ	ЧССР
Т1, Т2	2Т3502 Э.Т.	КС509
Т3, Т4	2Т3502 Ж.Т.	КС309
Т5	–	ГС521К
Т6	–	ГС511К
Т7	–	ГС521К
Т8, Т10	SFT353	
Т9	SFT212, АД301Ж	
Т11	2Т6352 Ж.Т.	
Д1, Д2, Д3	2Д.5608	
Д4	Д106	
Д5, Д6	Д223А	
Д7	Д814Л	
Д8	Д7Г	
Д9, Д10, Д11	Д7Г	

Figure 3.

signal should not exceed 3.5 percent. The necessary level of the recorded signal could be achieved through selected R_{21}.

A good erasure (with a residual level of under 50 decibels) requires the proper tuning of the erasing head, so that it may have a good contact with the tape and cover the entire track. This head also wears down after lengthy use and the already mentioned recommendations must be observed in replacing it. The recorder uses an erasing head type CM1A/438 produced by the Photovox company in Turin (Italy) or MKI produced by the magnetic heads plant in Razlog.

In order to eliminate the influence of the grid transformer and other disturbance factors, an inductor with a 16 μH induction is placed on the screening of the conductor (TChP) linking the amplifier with the general purpose head and the common head lead. Through suitable orientation of the inductor in space, a minimum ground level of $\leq$ 37 dB has been reached. The speed of tape movement is controlled through R_{42}. The stroboscopic discus on the flywheel of the tape driving mechanism is observed on the electric light of the circuit (50 Hz).

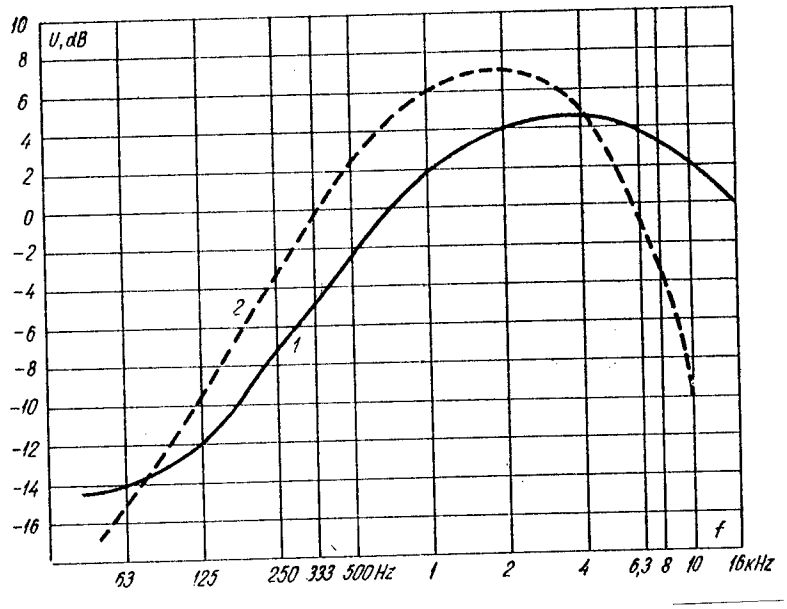


Figure 4.

5003
CSO: 2202

DETAILS ON DATA PROCESSING, ELECTRONICS EQUIPMENT AT SPRING 1976 LEIPZIG FAIR

Devices of Office-Machine and Data Processing Technology

East Berlin FEINGERAETE TECHNIK in German Jul 76 pp 333-335

/Article by Dr Eng L. Boehmey, Dresden Technical University, Computer Center/

/Text/ Firms which already have an international reputation as well as new firms and trade associations demonstrated, in their offerings, the state and developmental trends of systems, devices, components, as well as of the associated system documentation, for the more or less automated acquisition, processing, and evaluation of data from all areas of business, science, and technology.

Off-line systems dominated data acquisition; paper tape, paper-tape cards, punched cards, punched i.d. cards, and punched labels dominate as the primary data media, as they have done previously. But they are being supplemented and partially replaced, to an increasing extent, by 1/8" magnetic tape cassettes, 1/2" magnetic tape, disks, and other data media which at this time have not yet become internationally standardized. To check the correctness of the acquired data, solution methods whose organization has proven itself in the past are generally retained or perfected. Numerous firms, however, also present new device-technical possibilities which help to reduce the noisy printing devices and check-locations of the secondary peripheral equipment: noiseless numerical and alpha-numerical (display screen) indicators of various capacities, mark readers, coding strips on labels or documents, up to character readers for (usually standardized) writing in a line of a document. All the devices required for this have in mind widespread and sometimes specific applications, e.g. electronic cash registers in commerce, bank window systems, collection systems for production-and measurement-data. For such device systems, on-line connection to at least one particular central computer is frequently recommended and is supported by the most varied software supplies from the manufacturers.

The dominating position of terminals and data processing terminal equipment of the most varied kind was underscored at the LFM (Leipzig Spring Fair) 1976 by the fact that relatively few exhibitors displayed complete EDP systems in actual operation. Rather, communication between an exhibitor terminal and a sometimes far removed computer installation was demonstrated to the visitors. (Remote data transmission with 1200 bits per second, over the telephone lines of the German Postal System.) The roads opening in remote data processing were thus clearly indicated. Nearly all the demonstrated central units have the typical characteristics of the third generation of electronic data processing systems. This was made clear through

- improved performance parameters (storage capacity, computer speed, connection of peripheral devices),

- integrated electronics (with the resulting, sometimes considerably reduced dimensions, energy requirements, air conditioning requirements, etc., as well as increased reliability) and

- extensive software support (numerous problem-oriented languages, special compilers, data-bank systems, machine- and problem-oriented system documents).

Peripheral equipment is delineated more and more clearly, on the one hand, by international efforts at standardization, and, on the other hand, by various designs of interfaces, data media, transmission paths, devices and their operating conditions, which are adapted to specific use conditions. Large complexes of electronic measurement technology, microfilm technology, numerous production processes, transportation and storage systems, library-, publishing-, and traffic-problems, and much else can also be seen included here!

In addition to these "large" systems, nearly all countries offer certain process-, mini-, desktop-, and pocket-computers, specific components down to the integrated microprocessor, memory component groups and test devices for RAM, ROM, and PROM, data media of all types, as well as extensive accessories in the sense of "tertiary peripheral equipment". In the area of writing and office technology, it was remarkable that much attention is being paid to more extensively automated text processing which retains the representative and individual format of the documents as well as to partially automated and very powerful office duplicating technology.

The CEMA (Council for Economic Mutual Assistance) has already in the past seen the results of economic integration in the form of ESER (Uniform Electron Data Processing System). These results will in the future also penetrate to minicomputers. They already became apparent at the LFM '76, in the series of powerful pocket-computers "konkret", which was jointly developed and produced by the USSR and the GDR. The offering of devices

was completed through an increased offering of licenses for technologies, constructions, and programs.

By way of two component-complexes of the LFM '76, it shall be shown with what novel physical-technical solutions, processes, components, materials, etc., the manufacturers meet the manifold requirements of the users for device profitability, by increasing their reliability, speed, capacity, universality, compatibility, etc.:

Complex 1

A worldwide differentiation process is occurring in the complex of writing and printing technology:

The mechanical type print is asserting its leading position through numerous novel constructions:

- With the alphanumeric editing and correspondence typewriter: A trend towards quickly interchangeable compact type media with adjustment mechanisms which can be controlled manually through a keyboard or electronically;

- With line printers: Improvement of the writing image, increase in the speed, the number of printable characters, the number of readable copies, as well as of service life;

- With the numerical output printer for short lines: Small dimensions, low weight, low costs with good printing quality and high speed (Figure 1).

The mechanical matrix printer has further confirmed its position in serial print output, because numerous solution variants permit an optimal adaptation of the printing mechanism to electronic and use conditions, e.g. the choice of various printing sizes, cursive printing, diagram displays (plots), low noise, sometimes a large symbol inventory, a clean printing image, and sometimes more than 300 characters per second, for backwards and forwards printing, with two printing heads. Among the numerous non-mechanical printing processes, only a few - among them thermographic and photographic - are worth mentioning. The upbeat was given in Leipzig for the extremely rapid paperless print output on microfilm or microfiche within the framework of ESER (Figure 3). A bridge was thus erected towards microdocumentation of other documents within the framework of the EMS (Uniform Microfilm System); this step should be of great significance for the future organization of office and filing work.

Complex 2

For external storage of programs and data, optimal solutions must be created for all device systems, with respect to capacitance, speed, and

price. These solutions must be accompanied by falling costs for the central unit and by growing user requirements. For this purpose, magneto-mechanical memories continue to offer the most favorable presuppositions. Several manufacturers (including the VEB (State Enterprise) Combine Zentronik with its new booking and invoicing machine daro 1720, Figure 4) exhibited drives for two, three, or four floppy disks, which are particularly appropriate for the performance level of minicomputers. The data medium here is a plastic film coated on one or both sides and well protected inside a cheap cassette. It has a diameter of about 19 cm. It is divided e.g. into 77 sectorized concentric tracks, and, like a larger magnetic disk, it is used to store up to a maximum of about 0.5 Mbytes. In addition to floppy disk memories, small magnetic disk memories were presented for the first time, each of these had a fixed magnetic disk and another removable one in a cassette. The capacity was max. 10 Mbytes. Within the ESER, the 29 Mbyte replaceable disk memory was presented. Numerous devices for data acquisition and for external storage on 1/8" magnetic tape cassettes or 1/2" magnetic tapes were exhibited as new or sometimes with significantly improved parameters, e.g. the magnetic tape storage unit ES 5017-02, which was developed in the USSR and produced by the VEG Carl Zeiss JENA.

Among the exhibitors from the GDR and from the CEMA, the following, among others, were conspicuous:

From the VEB Combine Robotron:

1. EDVA ES 1040, with familiar as well as with new or improved devices of primary peripheral equipment

   - Magnetic tape memory ES 5017-02 (64 kbyte/s, USSR/GDR) and ES 5022 (128 kbyte/s, CSSR) with control units for one or two simultaneous drives;

   - Interchangeable disk memory ES 5061 (29 Mbyte per batch, VRB (People's Republic of Bulgaria)), connected through the 2-channel control unit ES 5561 (VRB);

   - Punched card reader ES 6016 (1000 punched cards/min, CSSR);

   - Card puncher ES 7012 (250 punched cards/min, USSR) and ES 7014 (120 punched cards/min, CSSR);

   - Line printer ES 7033 (84 characters, 1200 lines/min, VRP (Polish People's Republic));

   - Microfilm output device ES 7602 (100,000 characters/s, or 5 microfiche/min, GDR);

- Subscriber central AP 64, consisting of 2 display screen devices "Videoton 340" (UVR (Hungarian People's Republic)) and a series printer daro 1156 (Figure 2), connected over 2 modems ES 8006 and the multiplex control unit MPD 4 (ES 8404, GDR).

Both DOS/ES and OS/ES are available as operating systems. An information system concerning system documentation and licenses of the combine was demonstrated.

2. The minicomputer system ROBOTRON 4201 (Figure 5) has a greater connection capability for peripheral equipment than the KRS 4200; it was presented with, among other things, the magnetic tape cassette storage unit daro 1250/2 (90,000 characters per tape), the compact, ESER compatible magnetic tape memory MBE 4000 (4 drives in 2 housings, VRB), as well as with magnetic drum memories PBB-204-2 (about 100,000 16-bit words per drum).

3. Furthermore, the process computer system PRS 4000 (Figure 6), the automated microfilm reading unit ALG for a microfiche-cassette file, as well as the powerful black-and-white portable television "Kombivision" were demonstrated.

From the VEB Combine Zentronik:

1. Office typewriters, writing-, booking-, and organizing-machines (Figure 7) in connection with numerous applications and program examples, among them the universal booking and invoicing machine daro 1720 (Figure 4) with micro- and macro-program memory, the magnetic ledger card attachment to the matrix printer daro 1156 (Figure 2), and a connection capability for floppy disk or puncher.

2. Proven and in part further developed data acquisition and processing devices, e.g. the system daro 1600, the build-in punched card reader daro 1220 (160 punched cards/min), the punched card/punched id. card puncher daro 1225-4 (6 characters/s) and the magnetic tape-cassette storage unit daro 1250-1 or -2 for sequential recording and reproduction (200 characters/s).

3. Devices of medium data technology, among them the KDVA (minicomputer system) daro 1840 with extended peripheral equipment, the computer system daro 8205 Z with numerous examples of application.

The USSR was represented with numerous ESER device systems, among others with the models of the large EDP system ES 1050. The EDP system ES 1022 was announced as a rapid successor of the ES 1020. Devices were announced for graphic output as well as other examples of computer technology.

The CSSR exhibited not only powerful paper tape and punched card devices of primary and secondary peripheral equipment but also, among other things, the paper-tape controlled drawing table "Digigraf 1612" (ES 7054), the analog computer MEDA, as well as rapid driving groups for device construction (step motor and linear motors).

The VRB placed its magneto-motor memory for ESER into a central position. The VRP especially emphasized its paper tape reader and puncher, the matrix printer DCM-180, the line printer ES 7033, as well as other ESER peripheral devices. These are being used for the EDP system 1032 (up to 1028k bytes main storage capacity) as well as for the ODRA series.

The programmable terminal "Videoton VTS 56100" of the UVR was coupled through a telephone line with an EDP system ES 1010 in Frankfurt/Oder. It contains the subscriber centrals AP 50, AP 62, or AP 70. With maximum equipment, it contains a display screen system VT 340 with a 600/1200 bits per second modem, a matrix printer, magnetic tape cassettes, paper tape readers, an input keyboard, and an operating console. The minicomputer 1005 was shown as a prototype for the banking business. Among other things, it controls a bankbook printer.

There are various levels in the performance parameters and functions of indicating, printing, and sometimes programmable desk computers as well as pocket computers for economic and scientific-technical tasks. These come from the CEMA states, e.g. the "Elka" series (VRB), "Hunor" (UVR), "Digitron" (Socialist Federated Republic of Yogoslavia), or "Konkret" (GDR/USSR). For example, the pocket computer "Konkret 600" is a powerful model from the USSR based on integrated MOS circuits. In addition to the four basic arithmetic operations and memory for constants, it controls the functions $1/x$, $x^{1/2}$, log x, ln x, e^x, xy, sin x, cos x, tan x, including the inversion function as well as operand exchange. In the hand of the engineer, it is therefore far superior to every modern sliderule.

Progress in Electromechanical Sensors

East Berlin FEINGERAETE TECHNIK in German Aug 76 p 379

/Article by Dr Eng G. Pfeifer, Dresden Technical University, Information Technology Section/

/Text/ 1. Developmental Trends

In the area of electromechanical pressure-measurement transducers, integrated piezo-resistive pressure transducers with diffused wire strain gauges or with an hetero-epitaxial structure have already been shown in recent years. The international offerings of such pressure transducers

have stabilized. But pressure sensors with sputtered metal wire strain gauges were also exhibited. Sensors for industrial application now already attain an accuracy classification of 0.2.

The frequent utilization of these types of transducers in pressure sensors for medical applications as well as for laboratory use is remarkable. The reason for this lies in the small dimensions that can be achieved.

In the area of electromechanical force measurement transducers, progress was made in the measurement of small forces as far as 30 N. This progress was achieved by applying the electrodynamical force compensation procedure and the procedure involving changes in the proper frequencies of strings. Small calibratable precision scales were exhibited, which work with these procedures. With the force compensation procedure, errors of about $1 \cdot 10^{-5}$ can be achieved for linearity, hysteresis, and reproducibility. The temperature error of the zero-point and of the transmission factor lie at about $5 \cdot 10^{-6}/K$. Start-up times do not exceed 2 s.

With acceleration sensors, the offerings of past years were dominant. Piezo-resistive sensors with integrated wire strain gauges and with an integrated amplifier were novel.

2. Electromechanical force-, pressure-, and acceleration-sensors from the GDR and other Socialist countries

The GDR's offering of pressure-, force-, and acceleration-sensors could be seen at the collective stand of the VEB Measurement Electronics. It included the assortment of past years without change.

In the Soviet collective exhibition, not only conventional pressure sensors but also the overpressure measurement transducer BPS-36 could be seen. The integrated piezo-resistive pressure transducer of the "Kristall" type is located in the sensor. It has a wire strain gauge of the hetero-epitaxial technology (Figures 1 and 2). This sensor was extensively described in (1), and has already been shown in previous years at the Leipzig Spring Fair.

The electronic scale system "Tensipond" was again exhibited at the collective stand of the Hungarian People's Republic. The relative measurement uncertainty lies in the area of 0.5% to 1%. Individual load cells or precision load cells are not being offered.

The CSSR exhibited pressure sensors of conventional technology.

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Devices and Equipment of Electronics Technology

East Berlin FEINGERAETE TECHNIK in German Aug 76 p 380

/Article by Eng W. Hinueber, Dresden Technical University, Electronics and Fine Device Technology Section/

/Text/ 1. General Considerations

Even though the possibilities of monolithic technology are expanding, the offering of hybrid circuits has increased compared to 1975 on the part of the manufacturing firms and with respect to the scope of components offered. Especially the offering of thick-film integrated circuits and components has here also considerably risen in the CEMA countries. Examples of this are the offerings of multi-chip hybrid components by the People's Republic of Poland (Unitra), and of passive components with thick-film technology by the GDR (Hermsdorf Ceramic Works, Dorfhain), the Hungarian People's Republic (Hiki), and the Socialist Federative Republic of Yugoslavia (Ljubljana). Expanded offerings are also to be noted for components produced by monolithic technology. This expansion is based on the utilization of LSI-circuits and on the increase of packing density. Both of these directions are reflected in the novel and further development of technical equipment.

2. Developmental Trends

The development of hybrid technology is determined particulary by

- extended technological possibilities for thick-film and thin-film technology,

- extended offering of coating systems for thick-film technology,

- increase of the variability, which is essentially determined by the growing offering of monolithic IC's,

- increased requirements for monolithic technology,

and not least at all by economy. The application of thick-film technology here dominates in the production of components to an ever increasing extent. This is based on its significantly cheaper equipment costs as compared to thin-film technology and on the more price-favorable production of manufacturing runs of medium lot size ($\geq$5,000).

The adjustment of thick-film resistance networks is effected almost exclusively by lasers, because of their advantage in digital programmability.

Development in the monolithic sector on the one hand forces the manufacturer of hybrid components to become more and more flexible, and on the other hand forces the device manufacturer to develop further his automatic device systems for the production of monolithic components.

The degree of integration on printed circuit boards also rose considerably through the increased utilization of hybrid and monolithic components. The effort required for testing thereby increases, and this is reflected in a multitude of semi-automatic and fully automatic test systems.

Novel developments of devices and systems more and more utilize self-contained modules, which can selectively be coupled together into various systems. Among the equipment offerings, those for producing monolithic components dominated. In addition, equipment for assembling printed circuits and for mounting components was also exhibited. New principles of method and new constructive solutions could not be seen in the technological equipment.

3. Selected Examples of Devices

In accord with the trend toward ever greater component integration and toward automation of production runs, the VEB Elektromat Dresden exhibited a further development of its familiar alignment and illumination equipment, in the form of the automatic JUB 2108. This device permits illumination of substrates up to a diameter of 76 mm. The productivity of this device goes up to 150 substrate/h, with an illumination period of 5 s.

A further development in this area was also shown by the VEB Carl Zeiss JENA, with its JUB PM 80. Like its predecessor type PM 50, it works according to the projection-optical principle, and it excludes wear of the overlay. Since this device is suitable not only for illuminating substrates up to a diameter of 80 mm, but also for illuminating square substrates up to 91 mm x 91 mm, photomasks and working overlays can be produced with it, so that additional technological equipment is no longer necessary. The VEB Radio and Telecommunications Technology, Measurement Electronics "Otto Schoen" Dresden, exhibited a numerically controlled test stand for printed circuit boards. Using card inserts from the standard interface SI 2.2 and SIM 101 for measurement technology, it can be built up in modular fashion as a component of the device system for automatically measuring electrical quantities and for processing the measured values.

The Soviet Union exhibited a broad offering of technological equipment. The laser welding system "Quant-12", which was distinguished by a gold medal, should be especially emphasized. The Nd-YAG laser serves to seam-

weld metals with minimal deformation of the welding location. It affords a working speed up to 150 mm/min. The diameter of the hot spot can be adjusted from 0.25 mm to 1 mm. The minimum pulse energy is 3 J, with pulse times from 1.5 ms to 4 ms and with pulse sequence frequencies up to 20 Hz.

The People's Republic of Poland exhibited the assembly station for printed circuit boards PME-R-031. This assembly table is especially suitable for small scale production. Projection of the assembly station is through a matrix from the underside of the printed circuit board. The maximum size of printed circuit board that can be processed is 200 mm x 300 mm. The assembly station can store up to 40 different components. An assembly table with still projection as well as a numerically controlled automatic assembly machine for discrete components, made of flanges, are both under development.

The Hungarian People's Republic exhibited an automatic measuring device for thick-film resistance potentiometers. This device was developed in collaboration with the VEB Electronic Components Dorfhain. This device tests 5,000 substrates/h, with a classification accuracy of 0.1%, in the range from 10 Ω to 10 MΩ . It has a digital display. It has 12 measurable parameters and 10 categories. Equipment for producing thick-film integrated circuits was further offered, beginning with the production of masks through a pneumatic screen tensioning device, precision screen printing device, predrying ovens and four-zone ovens and an automatic sand-blasting adjustment machine up to hot-tinning equipment and to the chip gluing bonder.

Minicomputers and Process Computers

East Berlin FEINGERAETE TECHNIK in German Sep 76 pp 427-428

/Article by Eng. P. Kowollik, VEB Robotron, Research and Technology Center/

/Text/ Developmental Trends

Evaluation of this year's Leipzig Spring Fair confirms the following trends in the development and application of minicomputers and process computers:

1. The availability of compact minicomputers and recently also the introduction of microprocessor technology is accelerating the integration of computer technology into devices and systems of measurement, test, control, and regulation technology. For this trend to accelerate it is furthermore presupposed that international standards will be introduced in the constructive solutions of container technology and in the interfaces between computers and peripheral devices. The device-

producing industry is increasingly offering problem-oriented solutions consisting of intermeshing device technology and system supports. Inasmuch as the device manufacturers are not simultaneously computer manufacturers, OEM[1] computers (computers made available exclusively for resale) are almost exclusively used as the central item in the device system.

Several characteristic examples of the integration of computer technology into complex devices were demonstrated at the LFM 1976 inter alia by multi-channel analyzer devices, spectrometers and photometers of universal application, gas-chromatographic terminals, microdensitometers, colorimeters, as well as image processing and evaluation systems.

In this connection should be mentioned the growing significance of CAMAC as a modular device system for data acquisition and processing in research and industry. The extensive standardization of the logical, electrical, and mechanical conditions of this system promotes worldwide expansion of this technology.

2. In the area of minicomputer technology, it is clear that the leading firms are supplementing existing model series by new models in the lower as well as in the upper performance range while retaining general compatibility. At the same time, the offering of peripheral equipment at various levels of performance is being expanded, and machine-oriented system supports are in process of being completed.

3. The leading device and computer manufacturers are very intensively occupied with the application of highly integrated microprocessor[2] and semiconductor memory components to control and computer technology. However, the introduction of universal microcomputers into the model inventory of the computer firms is hesitant in its development. This development, however, will increase in subsequent years to the extent that the capability of the microcomputer achieves that of the modern minicomputer (cycle time $\leq 1.2\ \mu s$).

On the other hand, the application of microprocessor technology is asserting itself much more quickly in the replacement of conventional controls, in the control of particular devices, also including peripheral devices of computer technology, as a central item in problem-oriented microcomputers and particularly in intelligent terminals. Microprocessor technology is used throughout in programmable keyboard-oriented desktop computers. The rich offering of these computers also contains devices with the capability of being connected to peripheral equipment for the acquisition of measured values.

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1) OEM Original Equipment Manufacturer.
2) 8 bit and 16 bit word length

4. The completion of the assortment of peripheral devices for minicomputers is distinguished by the following trend: For data acquisition, magnetic tape cassette devices (0.15 inch tape width) and floppy disks are being utilized to an increasing extent. Optical document readers - mark readers, character readers - are attaining growing significance. The matrix printer has quite generally established itself as a device in the performance range of 20 ... 180 characters/s per printing head. Non-mechanical printers (thermal, electrostatic) are at this time primarily still being used for desktop computers and as copying devices for display units. The wider utilization of external memories with new operating principles, such as the CCD-memories[3] and the domain memories[4] are forecast only for the beginning of the 80's.

In the device technology of process input/output equipment, the increase of modularity is a prime objective, in order to effect economic adaptable solutions, especially price-favorable minimum configurations. Here the international standardization of interfaces plays a major role (e.g. IEG-standard, serial CAMAC interface). In this connection, the introduction of microprocessor technology will form the presupposition for the construction of spatially decentralized systems for the acquisition and processing of measured data. These systems will have a series of tie-points under the control of microcomputers and will be remotely coupled with central process computers. The utilization of process computers for technical control tasks can be regarded as economically sensible when they extend to about 20 control circuits.

5. The technology of communication devices for the man-machine process is stamped almost exclusively by display technology. Price-favorable alphanumeric devices are being offered, and to an increasing extent also color displays with quasi-graphic presentation (alphanumeric characters extended by additional symbols or symbol elements), as well as complex computer-controlled graphic display systems. The plasma display is here making an appearance as a new working principle, initially as a single-color display unit.

Device Offerings

The combines ROBOTRON and ZENTRONIK exhibited complete EDP installations and minicomputer systems. The progressing socialist integration was here impressively demonstrated, in the ESER as well as in the area of minicomputer and process computer technology. At the stand of the VEB Appliance and Regulator Works Teltow, the minicomputer system ROBOTRON 4201 (Figure 1) was exhibited within the context of its utilization in gas chromatography. It is the successor of the KRS ROBOTRON 4200.

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3) Charge coupled devices
4) Memories on the basis of magnetic thin films

Among other things, it offers a significant expansion in its capability for connecting peripheral devices. In this connection, a minimum project variant of the process input/output device URSADAT 4010 was used in a console 800 mm x 800 mm x 600 mm.

Within the complex of offerings from the Association of State Enterprises Communications and Measurement Technology was offered the "universal system for the acquisition of measured data, from products of the ESDM 31 with KRS ROBOTRON 4200." The display unit VIDEOTON 340 with the daro 1156 printer as a copy device was connected as a communication device. The fixed head disk memory unit FPSE 4000 (Figure 2) of the firm MOM (UVR) was a novelty in the ROBOTRON computer system. It has a storage capacity of (2 • 960) K byte (max. 4 drives possible). The magnetic tape unit MBE 4000 with its 4 ISOT 5003 drives (Figure 3) was offered in an ORZ (Organization and Computer Center) configuration of the KRS ROBOTRON 4201. The combine ZENTRONIK exhibited the daro 1602, which is a partial system solution toward computer-supported operative production monitoring.

In the collective exhibit of the USSR, the utilization of the M 7000 computer from the ASWT series was demonstrated in the context of a dispatcher system for traffic operations.

The exhibitors from the VRP and UVR concentrated on presenting minicomputer systems for scientific-technical and economic calculations (MERA 300, VIDEOTON 70), as well as intelligent terminals (VIDEOTON 56 100). NSW (non-socialist monetary area) firms primarily exhibited particular devices of minicomputer peripheral equipment destined for the OEM market.

Temperature Measurement Technology

East Berlin FEINGERAETE TECHNIK in German Sep 76 p 428

/Text/ In the area of temperature-measurement technology, the well-known working principles (temperature-dependent changes in length, volume, pressure, and resistance, as well as the thermoelectric effect) now as before form the basis for determining this measured quantity. The developmental trends are directed towards the constructive improvement of measurement sensors as well as towards the technical perfecting of secondary devices.

The following could particularly be noted:

- Miniaturization of the measurement sensors

- Improvement of their dynamic behavior

- Increase of the sensitivity and reliability of secondary devices

- Increasing digitalization of the display of measured values.

In connection with the new working principles, e.g. the frequency-temperature dependence of the quartz thermometer, economically effective device variants are not yet being offered, and they do not yet find broad application in temperature-measurement technology. Because of the increasing scientific-technical penetration of production processes, the requirements and the demand for precision temperature measurement devices are increasing. The VEB Thermometer Factory Geraberg took account of this trend, with its development of mercury-glass thermometer reference normals. These were for the first time exhibited at the LFM 1976 and were distinguished with a gold medal. With these reference normals, it is possible to execute temperature measurements in the range from -58°C to +610°C, with a measurement tolerance of ±0.002 K to ±0.2K. The reference normals can be certified by the ASMW (Standardization, Measurement, and Commodity Testing Office) as normals of first and second order (Table).

The thermometers were manufactured as enclosed scale thermometers for a temperature range up to 400°C, and in rod form for the range above 400°C. They have a uniform length of 480 mm x 10 mm. In the temperature range between 0°C and 100°C, the reference normals approach the performance limit of precision platinum resistance thermometers with respect to their stability and their achievable measurement tolerance.

The People's Republic of Hungary for the first time exhibited at the Fair a digital thermometer, Type 1013, with a measurement range from 0°C to 100°C, four-digit temperature indication, resolution to 0.01 K, and a platinum resistance temperature sensor.

Table: Technical Measurement Data

Temperaturbereich (1) in °C	kleinster Skalenwert (2) in K	Anzeigebereich (3) in K	Meßunsicherheit für Normale 1. Ordnung (P = 95%) (4) in K	Meßunsicherheit für Normale 2. Ordnung (P = 95%) (5) in K
− 55 bis − 5	0,02	10	±0,02	±0,05
− 5 bis + 60	0,02	10	±0,005	±0,01
+ 60 bis +100	0,02	10	±0,01	±0,02
+100 bis +200	0,05	20	±0,02	±0,10
+200 bis +300	0,05	20	±0,05	±0,20
+300 bis +500	0,10	50	±0,10	±0,20
+500 bis +600	0,20	50	±0,20	±0,40

1. Temperature range in °C
2. Smallest scale value in K
3. Indication range in K
4. Measurement tolerance for normals of the first order (P = 95%) in K
5. Measurement tolerance for normals of the second order (P = 95%) in K

8438
CSO: 2302

BRIEFS

TRANSPORT OF ISOTOPES--All isotope shipments are handled by a six-man brigade which has been working together for 10 years. Only they are authorized to deal with the transport of radioactive materials. They take radioactive materials to the Central Physics Research Institute and in turn deliver preparations from the Institute to various parts of the country. The brigade's job includes burying used radioactive materials in lead containers at a depth of 10 meters at the Solymar "nuclear cemetery." The brigade is given police escort, and its vehicle receives right of way on all its trips: to the stations, to the airport, etc. All members of the brigade are required to undergo a complete physical examination semi-annually. Their wages are 10 percent higher than those of other [shipping] workers. [Budapest HETFOI HIREK in Hungarian 1 Nov 76 p 5]

CSO: 2502

CHOLINESTERASE INHIBITION BY HIGHLY TOXIC O-ETHYL-S-(2-DIISOPROPYLAMINOETHYL) METHYLPHOSPHONOTHIOATE AND REACTIVATION BY VARIOUS PYRIDINIUM ALDOXIMES

Zagreb ACTA PHARMACEUTICA JUGOSLAVICA in English No 3, 1976 pp 233-238

[Article by Matej Maksimovic, Military Technical Institute, Belgrade;
received 15 May 1976]

[Text]

The kinetics of inhibition of purified AChE and SChE and rat diaphragm ChE by O-ethyl-S-(2-diisopropylaminoethyl) methylphosphonothioate (VX) have been investigated, and bimolecular rate constants (k_i) were determined. The rate of AChE inhibition ($68.0 \cdot 10^5\ M^{-1}min^{-1}$) was significantly faster than of SChE ($1.9 \cdot 10^5\ M^{-1}min^{-1}$) or rat diaphragm ChE inhibition ($0.9 \cdot 10^5\ M^{-1}\ min^{-1}$). Activation energies of inhibitor binding to AChE and SChE were almost the same (9.8 and 9.91 Kcal mol^{-1}). The inhibited rat diaphragm ChE was reactivated using seven oximes: PAM-Cl, Toxogonin, TMB-4, HS-3, HS-6, HS-7 and N,N'-trimethylene [(4-hydroxyiminoformylpyridinium)-N-methylmorpholinium] dibromide. The results of this study show that ChE inhibition as a function of phosphorylation by O-ethyl-S-(2-diisopropylaminoethyl) methylphosphonothioate, may be removed in the best way by treatment with oximes. The most potent reactivator was TMB-4, and the reactivation rate constants (k_r) varied from $4.45 \cdot 10^2\ M^{-1}min^{-1}$ (PAM-Cl) to $82.35 \cdot 10^2\ M^{-1}min^{-1}$ (TMB-4).

The derivatives of thiophosphonic acid are very potent anticholinesterase agents (1,2). Because of their toxicity and other physico-chemical properties compounds of this type may be used as chemical weapons (3). Slowenes, cholinesterases inhibited by this group of organophosphorus compounds can be reactivated with good success by many oximes of various structure (4—7).

O-ethyl-S-(2-diisopropylaminoethyl) methylphosphonothioate (VX) (8,9) is a new and highly active member of the organophosphorus anticholinesterase series, and therefore reactivation of cholinesterase inhibited by this potent alkylthiophosphate is of special interest.

The present work is concerned with the study of reactivating effects of seven oximes from the pyridine series, using rat diaphragm cholinesterase (ChE) inhibited by O-ethyl-S-(2-diisopropylaminoethyl) methylphosphonothioate. The rat diaphragm is a suitable preparation for studies of neuromuscular transmission. The degree to which this organ is impaired in its function is related to the general condition of the animal (10). Hence a study of the kinetic parameters of reactivation of phosphorylated enzyme in this tissue is important for comparison with actual therapeutic results.

The following compounds were used as reactivators (Fig. 1): PAM-Cl: N--methyl-(2-hydroxyiminoformyl-pyridinium) chloride; TMB-4: N,N'trimethylene--*bis*-(4-hydroxyiminoformyl-pyridinium) dichloride; Toxogonin: N,N'-dimethylether-*bis*-(4-hydroxyiminoformyl-pyridinium) dichloride; HS-3: N,N'dimethylether [(2-hydroxyiminoformylpyridinium)-4-hydroxyiminoformylpyridinium] dichloride; HS-6: N,N'-dimethylether[(2-hydroxyiminoformypyridinium)-3-carboxaminopyridinium]dichloride; HS-7: N,N'-trimethylene [(4-hydroxyiminoformylpyridinium)-3-carboxaminopyridinium] dibromide; and »oxime XIII«: N,N'--trimethylene [(4-hydroxyiminoformylpyridinium)-N-methylmorpholinium] dibromide (11). The first three oximes are the best reactivators known, which are currently used in human therapy of organophosphorus intoxications (12).

Kinetics of inhibition of rat diaphragm ChE have been followed in parallel with analogous measurements on purified acetylcholinesterase (AChE) and serum cholinesterase (SChE).

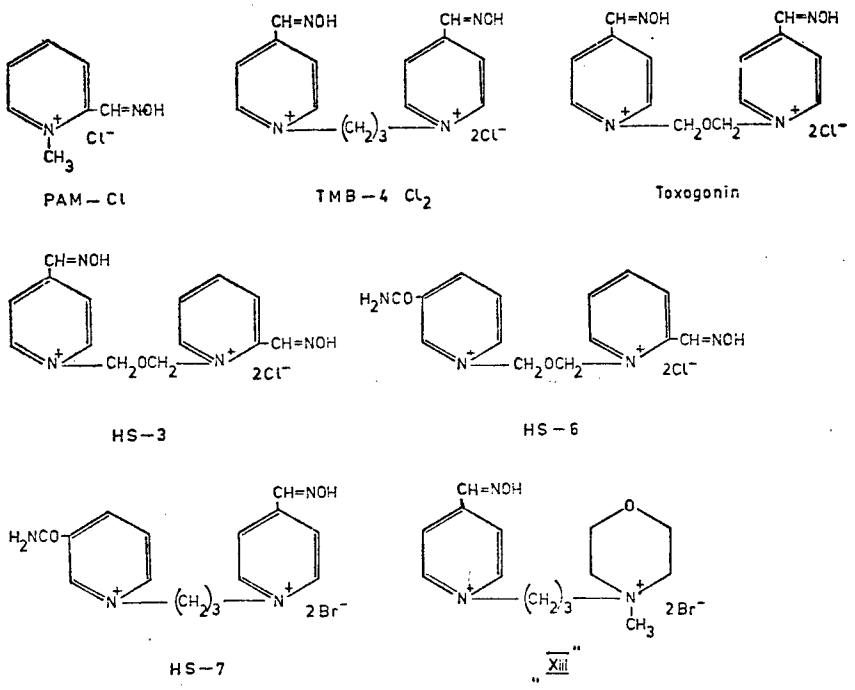

Fig. 1. Structural formulae of the pyridinium oximes used as reactivators.

MATERIAL AND METHODS

Enzymes. — Purified bovine red blood cell AChE (Winthrop Lab.) and horse SChE (Schuhardt) were dissolved in 0.1 M phosphate buffer (pH 7.0) to give 1 or 4 micrograms of enzyme preparations in 3 ml of buffer, respectively. Rat diaphragms were dissected, the central tendineous part *(pars tendinea)* and the dorsal crura were rejected, and only the remaining part *(pars muscularis)* was used (13). The tissue was homogenized in Krebs-Ringer solution to give a concentration of 20 mg tissue/ml. After centrifugation (3.500 rpm), a portion of 0.4 ml of clear supernatant was placed in a 10-mm optical cell, diluted to 3 ml with 0.1 M phosphate buffer, and this solution was used for kinetic measurements.

O-ethyl-S-(2-diisopropylaminoethyl) methylphosphonothioate was of 98% purity. All solutions of this compound were made with analytically pure propanol-2.

Oximes. — PAM-Cl, Toxogonin and TMB-4 were prepared by Ing. M. Milojević in this laboratory and HS-3, HS-6, HS-7 and »XIII« were kindly supplied by Dr. Z. Binenfeld from the Research Institute of »Bosnalijek«, Sarajevo.

Cholinesterase inhibition. — Enzyme activities, both in the presence and in the absence of inhibitor, were continuously monitored by Ellman's method (14). The measurements were made at 25 °C, with a thermostated Ratio Recording Spectrophotometer Beckman DK-2A. The substrates were acetylthiocholine iodide (for AChE and rat diaphragm ChE) or butyrylthiocholine iodide (for SChE), in final concentrations of 5.4 mM each. The inhibition rate constant (k_i) was calculated from Aldridge's equation (15). Each inhibitor was tested in 2 to 4 different concentrations, and corresponding times, required for inhibition, varied from 5 to 15 minutes. Even with large excess of inhibitor, its solvent, propanol-2, never exceeded a final concentration of 0.63 per cent (by vol.), which had no effect upon the rate of inhibition.

Preparation of phosphonylated rat diaphragm ChE and reactivation. — The dissected organs were divided into hemidiaphragms and always left-side parts were used as controls (normal enzyme activity) in rate constant calculations. The right-side hemidiaphragms were incubated for at least five minutes with Krebs-Ringer phosphate containing the inhibitor in large excess ($1 \cdot 10^{-5}$M per organ), at 25 °C, then washed several times with 20-ml portions of inhibitor-free medium at room temperature, and homogenised and centrifuged as described above. Inhibition of ChE activity in the supernatants was practically complete. The supernatant from one hemidiaphragm was used in a reactivation experiment with one reactivating agent: 0.4 ml of supernatant (= 8 mg of tissue) was incubated with 0.1 M phosphate buffer, pH 7.0, containing a suitable amount of reactivator, and 5.4 mM substrate (acetylthiocholine iodide) in a total volume of 3.0 ml, in a 10-mm optical cell placed into the thermostated (25 °C) compartment of the spectrophotometer. The course of reactivation, that is, of substrate hydrolysis, was followed as described in the preceding paragraph, against a blank containing 0.4 ml of supernatant and all other components except the reactivator. Reactivation rate constants (k_r) were calculated according to Shein *et al.* (16).

RESULTS AND DISCUSSION

The results obtained by inhibition experiments (Table I) indicate that O--ethyl-S-(2-diisopropylaminoethyl) methylphosphonothioate has a very high affinity for cholinesterases.

TABLE I

Kinetic rate constants of inhibition (k_i) of purified AChE and SChE and rat diaphragm ChE by O-ethyl--S-(2-diisopropylaminoethyl) methylphosphonothioate, determined at 25 °C and pH 7.0

Enzyme	$k_i \cdot 10^5 \pm$ S. E. M.* ($M^{-1}min^{-1}$)
AChE	68,0 ± 3.7
SChE	1.9 ± 0.08
Rat diaphragm ChE	0.9 ± 0.05

*N = 11.

The highest inhibition rate constant was observed with AChE, and the lowest with rat diaphragm ChE, probably because of insufficient purity of this enzyme preparation.

A comparison of these results with data reported in the literature is extremely difficult, since most studies have either used other derivatives of thiophosphonic acid, or expressed affinity of the inhibitor for cholinesterases as values of I_{50}, or both. However, some kinetic data on thiophosphonates, which have been obtained, *e. g.* those by Patočka and Bajgar (17) for the inhibition of AChE and SChE by O-isopropyl-S-(2-diisopropylaminoethyl) methylphosphonothioate (pH 8.0, 20 °C), are suitable for comparison. The k_i values given by these authors are $2.08 \cdot 10^6$ and $5.60 \cdot 10^6$ for AChE and SChE, respectively. With O-ethyl-S-(2-dimethylaminoethyl) methylphosphonothioate (18) the k_i for AChE is given as $6.62 \cdot 10^6$ (pH 8.0, 25 °C), and we (2) have previously reported k_i values $0.4 \cdot 10^5$ to $12.7 \cdot 10^5$ for AChE and $0.3 \cdot 10^5$ to $12.3 \cdot 10^5$ for SChE (pH 7.0, 25 °C), inhibited by representatives of the O-alkyl-S-(2-dimethylaminoethyl) methylphosphonothioate series.

TABLE II

Bimolecular rate constants of reactivation (k_r) of rat diaphragm ChE inhibited by O-ethyl-S-(2-diisopropylaminoethyl) methylphosphonothioate (pH 7.0, 25 °C)

Oxime	$k_r \cdot 10^2 \pm$ S. E. M.* ($M^{-1}min^{-1}$)	Relative efficiency (PAM chloride: 1.0)
PAM-Cl	4,45 ± 0.23	1
HS-6	13.9 ± 0.58	3.1
Toxogonin	16.05 ± 0.79	3,6
HS-3	34.5 ± 1.87	7.7
»XIII«	45.15 ± 2.99	10.1
HS-7	51.9 ± 4.02	11.6
TMB-4	82.35 ± 6.16	18.5

*N = 8.

The high affinity of the inhibitor now studied toward both enzymes, AChE and SChE, can be accounted for by a certain structural similarity to acetylcholine, which may be the main reason for the high toxicity of this inhibitor. The activation energy (E) for the reaction of inhibitor with AChE (9.8 ± 0.58 kcal mol^{-1}) is almost the same as for that with SChE (9.91 ± 0.56 kcal mol^{-1}).

The results of *in-vitro* studies of reactivation of rat diaphragm ChE inhibited by O-ethyl-S-(2-diisopropylaminoethyl) methylphosphonothioate are given in Table II. In general, one can see that all *bis*-pyridinium oximes, including »oxime XIII« are markedly more effective reactivating agents than PAM-Cl.

TMB-4 was the most potent reactivator. Compounds HS-3, HS-6, as well as Toxogonin and PAM-Cl, had less than 50 per cent of the efficiency of TMB-4. Compounds HS-7 and »oxime XIII« had more than 50 per cent of the activity of TMB-4.

Regarding the structure-activity relationships of the seven oximes investigated it can be said that, primarily, the reactivating properties may be increased or diminished by the introduction of substituents at various positions of the pyridine rings, and by varying the character of the chain between the two rings of the *bis*-quaternary compounds (19—23). With trimethylene derivatives (TMB-4, HS-7 and »XIII«), the best reactivating effect is obtained introducing two oxime groups in position *4* (21). With the remaining *bis*-pyridinium derivatives studied (Toxogonin, HS-3 and HS-6), introduction of an ether oxygen into the bridge decreases the reactivating potency. The least potent *bis*-pyridinium reactivating agent, HS-6, is not indeed a practical reactivator of ChE, but it protects AChE against inactivation by certain organophosphorus compounds (23). On the other hand, introduction of oxime groups in position *2* and *4* (HS-3) of the two pyridine rings, respectively, gives a maximum rate of reactivation when these rings are linked by an oxydimethylene grouping. An examination of the analogous trimethylene *bis*-oxime should be most interesting.

This study confirms previous literature reports (4, 6, 24) stressing the superiority of TMB-4 in reactivation of cholinesterases inhibited by derivatives of thiophosphonic acid, although it was made under different experimental conditions. However, reactivators are ultimately meant as therapeutic agents. Unfortunately the strongest reactivator, TMB-4, is considerably toxic and might conveniently be replaced by less toxic reactivators. Several of the oximes examined in this paper (*e. g.* »XIII«) (11) are considerably less toxic than TMB-4, and are, threfore, likely candidate antidotes against anticholinesterase poisoning.

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