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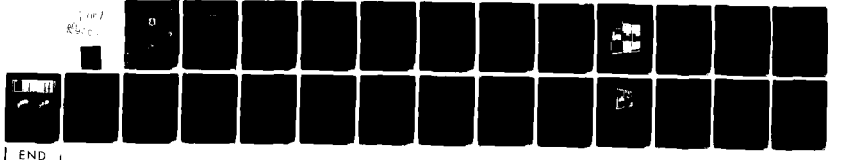

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FOREIGN TECHNOLOGY DIVISION

TELECOMMUTATION EQUIPMENT PRODUCED
BY TELKOM-ZWUT PLANTS

by

Eugeniusz Taras

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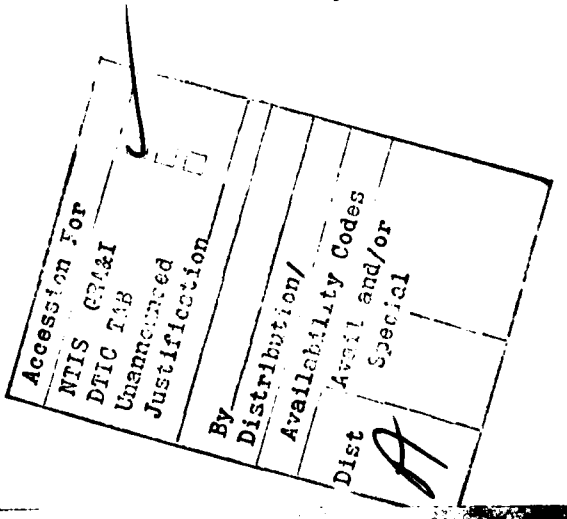
Telecommutation Equipment Produced by TELKOM-ZWUT Plants

by Eugeniusz Taras

The production of telecommutation equipment at the TELKOM-ZWUT Telephone Equipment Manufacturing Plants has a long and rich tradition. Its beginnings coincide with the Polosh government's recovery of independence and in 1968 the 50-year existence of the Plants was solemnly observed.

Before the outbreak of WW II the Plants, then known as Government Tele- and Radiotechnical Plants, were located in Warsaw at 341 Grochowska Street. About 4,000 people were employed at the modernly equipped buildings. Produced at that time were:

- equipment for local exchange of the Strowger 32A system (together with elevated-rotary selector switches 32A) licensed by the British firm Automatic Telephone Manufacturing
- equipment for manual cord and cordless trunk exchanges
- equipment for manual and automatic private branch exchanges
- telephone apparatus for a system of local and central battery, Morse and Hughes telegraph apparatus
- broadcast receivers
- signalling equipment



- army communication equipment--field apparatus, switchboards, radiostations, and the like. The working out and manufacture of a cordless trunk exchange for the Warsaw Telecommunications Office must be credited to the great success of the Plants.

It should also be noted that a fact worthy of attention is the manufacture of 5 units of prototype teletypes of Polish construction.

The war brought complete ruin to the Plants. Provisionally rebuilt, they began production practically the next day after the occupation forces were driven out. They returned to the prewar production profile and after industry was reorganized in 1949 automatic telephone exchange equipment was recognized as the Plants' domain of activity. Their name was also changed to the present one. In 1959 the Plants moved to new quarters at 11 Zupnicza Street. From that moment they specialized in the production of automatic telephone exchange equipment, initially for the Strowger 32A system, and since 1956--its variant 32AB. Manufactured also are manual cord and cordless trunk exchanges as well as a varied set of private branch systems. From the mid 60's they undertook production of local exchange equipment for the domestic MCA system with the WK-610 crossbar switch of their own construction. They also put into production cross rural exchanges and a wide assortment of private branch exchanges.

After 1970 government factors decided achieving considerable acceleration in the development of telecommunication in Poland. Among others, in consideration of the considerable delay in the country's telephonization, new TELKOM-ZWUT Plants were built on Chodakowska Street which are to make possible the manufacture, in 1980, of equipment which will have the equivalent of 600,000 comparable numbers. Also, a license was bought from the French firms Le Materiel Téléphonique and Compagnie Générale des Constructions Téléphoniques to produce automatic a exchange equipment for the Pentaconta system including:

- local exchanges PC 1000 C
- rural exchanges PC 32
- trunk exchanges GCI
- local-trunk exchanges LNI
- private branch exchanges 5 B, 7 E, 18 E and PC 1000.

Presently the Plants produce equipment in quantity which approximates the equivalent in of 150,000 actual numbers, in which individual products have the following part:

- Strowger 32AB system local exchanges about 34%
- MCA system local exchanges about 26%
- rural KW exchanges about 3%
- private branch exchanges with moving selector switches about 9%

- private branch exchanges with crossbar switches about 10%.

The rest of the production is made of equipment for manual trunk exchanges, WK 610 crossbar switches and C-11 relays, also equipment for Pentaconta local and trunk exchanges.

The design of the production plan of the TELKOM-ZWUT Plants for the years 1976-1980 forecasts that at the end of this period they will be producing over 600,000 equivalent numbers of Pentaconta equipment of which:

- local PC 1000 C exchanges--over 200,000 NNP
- rural PC 32 exchanges--about 30,000 NNP
- GCI trunk exchanges--about 30,000 NNP
- private branch exchanges--about 350,000 NNP

The remaining production of the TELKOM-ZWUT Plants will consist of installation fittings for Pentaconta exchanges and interchangeable parts.

STROWGER 32 AB SYSTEM LOCAL EXCHANGES

These exchanges operate in large city networks as main district, tandem, and terminal (satellite) exchanges. They can collaborate with moving exchanges or the cross local exchanges of various systems, as well as with manual and automatic trunk exchanges and with commutation stages "city-city."

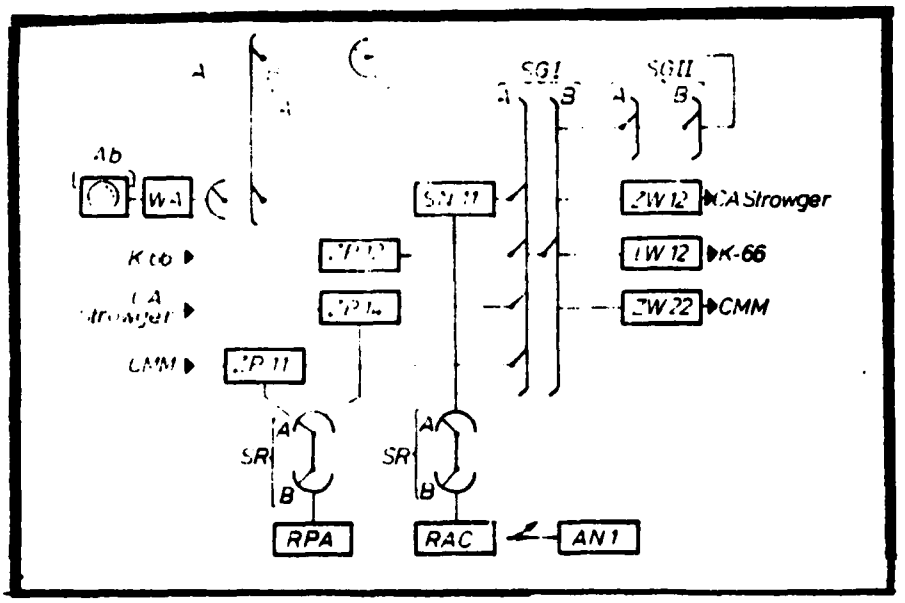


Fig. 1. Circuit diagram of K-661 local exchange--central: Ab-subscriber apparatus, AN-analyzer, LW-line mouthpiece, RAC-subscriber register, RPA-entry register, SA-subscriber stage, EG-group stage, SR-registration stage, ZP-line entry group, ZW-line exit group

Here are the characteristic features of the Strowger 32 AB exchange:

- supply voltage 50 ±2 V

- charging of calls by using a meter battery (with grounded negative pole) single or multiple (system of "scattered pulses")

- basic commutation elements: elevated-rotary selector switch 32 AB type 10 x 20 and telephone relays B-1 and B-2

- exchange system fundamentally non-register, with the exception of district toll exchanges and some types of terminal exchanges in which control systems are used (called differentiating relay groups), similar to registers

- basic commutation organs are 200 final finders, 200 standard and PBX final selector switches and 10/20 group selectors with a battery and insulation test

- call regulation occurs directly except for district exchanges; selector pulses should have a frequency of 10±1 Hz and pulse coefficient of 2

- collaboration with other exchanges takes place by a direct current line (2 x 750Ω and 200 kΩ or alternating current 50 Hz (1600 Ω) or by carrier current circuits (resistance of signalling wire to 500 Ω)

- automatic trunk connections are metered many times on the basis of a charge, designated by the differentiating equipment of the output line set of the output exchange, or by charge pulses received along conversation wires from "city-city" stage systems or ACMM

- collaboration with manual trunk exchange by using groups of call and tie wires

- exchanges are adapted to offer trunk connections

- disconnection of connections depends on the caller except for connections with manual CMM and some special services

Equipment for Strowger 32 AB exchange is mounted on racks 3200 or 2600 mm. high and 1370 mm. wide. Finish and wiring is adapted to the demands of a moderate climate.

MCA SYSTEM LOCAL EXCHANGES

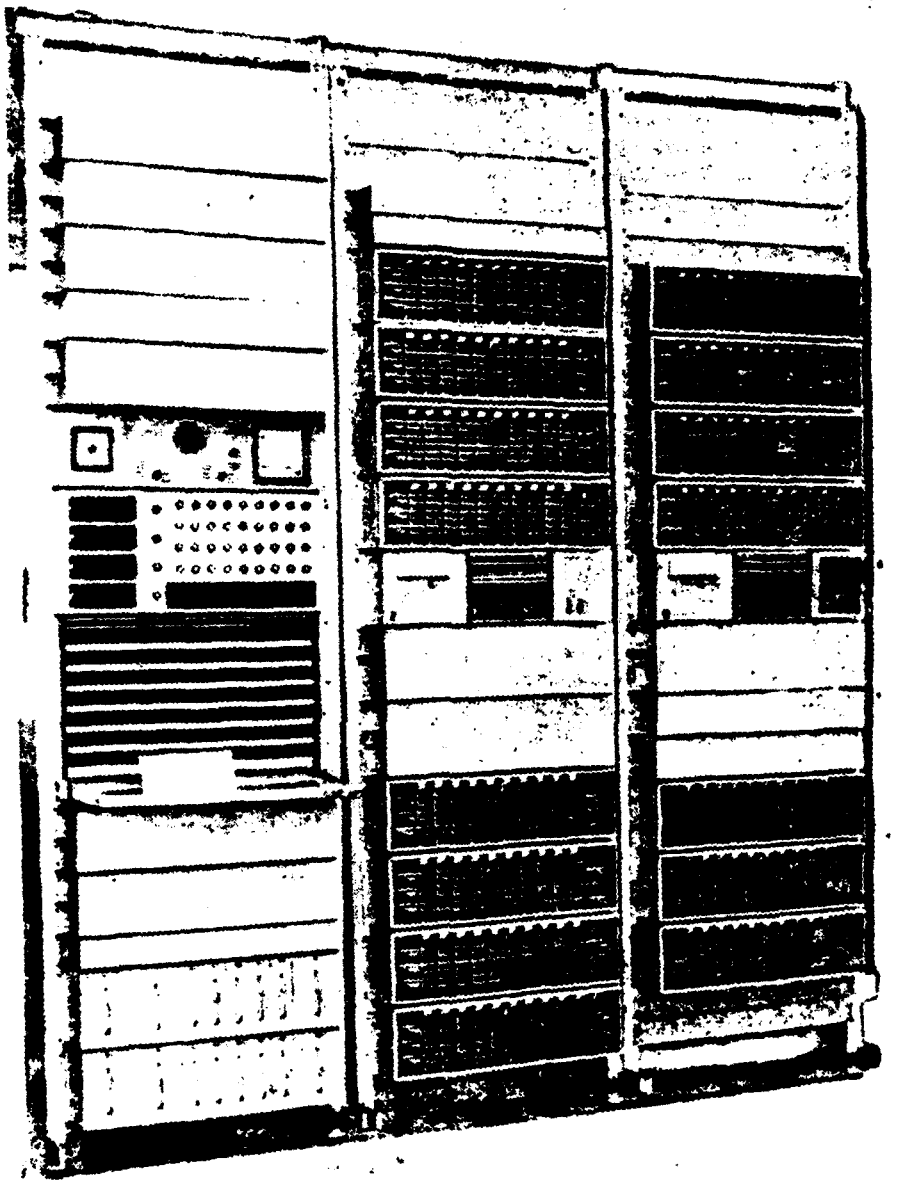


Fig. 2. View of MCA local exchange racks.

These exchanges are designated for the building of new and development of old large-city networks, in which they can operate as central, district, tandem and terminal exchanges. Depending on the nature of the network for which they are designated, differentiated are:

- K-660 exchanges--for homogeneous and remote MCA networks
- K-661 exchanges--for development of Strowger system network
- K-662 exchanges--for networks built from OS machine system exchanges.

MCA system exchanges are built of original commutation elements produced domestically: crossbar switches WK-610 10 x 20 x 6 and 10 x 12 x 12 of telephone relays C-11 (10^8 functions, to 24 contact springs, Ag contact points). MCA exchanges can collaborate both with cross exchanges and moving exchanges of various systems.

Here are the characteristic features of the MCA exchange:

- supply voltage 60 $\pm$6 V
- the commutation part is built of multisection stages (subscriber and group), whose component parts are blocks of average capacity, regulated by block markers
- control of internal and outgoing calls takes place with the help of subscriber registers

- calls coming from moving exchanges are service by incoming registers adapted for receiving signals of decadal code

- subscriber and incoming records receive selector pulses having a frequency of 10 ± 2 Hz and dialing factor of 1-4

- collaboration of registers with markers of group and subscriber stage of the MCA exchange and the exchange of the collaborators takes place by a variable mark code, while with the moving exchanges:

Strowger--by decadal code

OS--by pulse code, used for the exchange of this system

- collaboration with other exchanges occurs by using a direct current circuit:

MCA--by variable mark code 2 x 1500 Ω and 100 k Ω

Strowger--by decadal code: 2 x 750 Ω and 200 k Ω

OS--by pulse code: 2 x 600 Ω or 3 x 600 Ω and 250 k Ω

- outgoing local and trunk calls are metered based on the charge designated by the register of the outgoing exchange; the "scattered impulse" system is used and trunk calls are charged by using meter impulses relayed from ACMM along call wires of an interexchange line

- collaboration with a manual trunk exchange occurs with the help of call and tie lines; MCA exchanges are adapted to offer trunk calls

- call disconnection depends principally on the calling subscriber.

MCA exchanges are comprised of:

- racks of irreplaceable units 2634 mm. high, 760 mm. wide and 425 mm. wide

- racks of replaceable units 2634 mm. high, 890 mm. wide and 425 mm. deep.

The quality of the equipment enables it to be installed in closed quarters in a moderate climate.

PENTACONTA SYSTEM LOCAL EXCHANGES

Equipment for Pentaconta automatic local exchanges, produced in many countries of the world, has been manufactured by the TELKOM-ZWUT Plants since 1974.

The Pentaconta 1000 C local exchanges lend themselves particularly well in the building of great large-city multi-exchange systems as central, district, tandem, and terminal exchanges. To simplify production and design PC 1000 C exchanges have a modular structure, foreseeing certain limited number of typical tasks. The basic commutation elements of Pentaconta exchanges are:

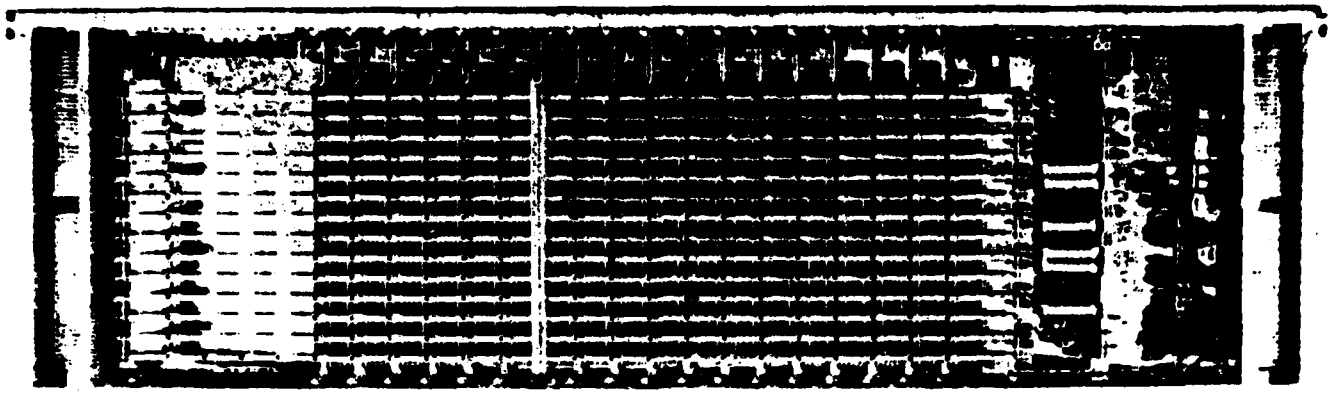


Figure 3. Pentaconta crossbar switch-equipment incomplete.

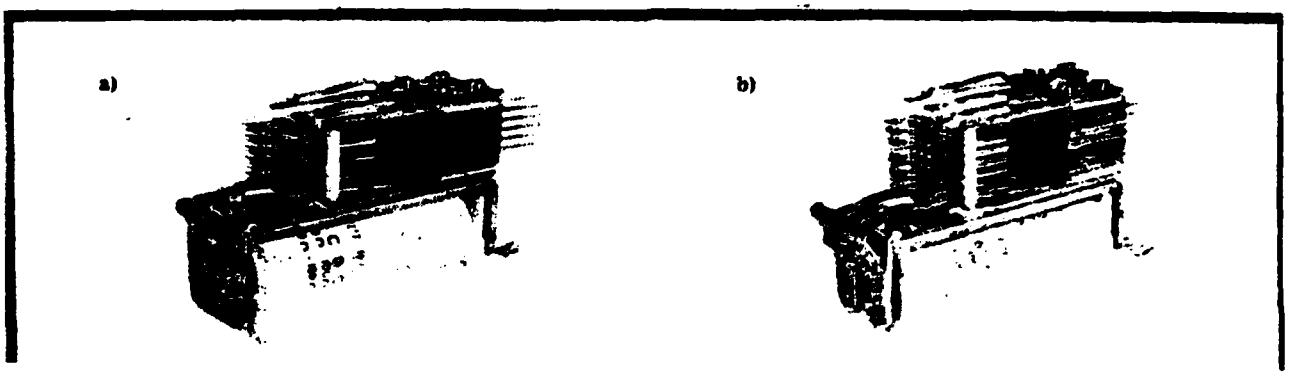


Figure 4. Standard Pentacosta relays: a) round; b) oval.

- Pentaconta crossbar switches (so-called "large") characterized by a large number of bridges (to 22) and a large capacity (28, 52 or 74 openings)

- standard Pentaconta relays (round and oval) having a large number of contact springs. These elements are adapted for wire-wrap connections instead of the traditional soldered connections.

The characteristic features of the Pentaconta 1000 C local exchanges are given below:

- supply voltage 48 ±4 V

- commutation stages (line and group) are built of blocks with large capacity: line stage has 1036 openings, and the group--2080 openings, controlled by block markers

- control of course of connections is done by registers: subscriber (internal and outgoing traffic) and incoming (incoming traffic); in exchanges with smaller capacity the subscriber registers fill the role of incoming registers

- decadal code signals received by subscriber registers can have a frequency of 8-18 Hz and an impulse factor of 0.5-2.7 or 8-22 Hz and 1

- incoming registers receive the decadal code signals with a frequency of 9-11 Hz and impulse factor of 1.7-2.3

- collaboration of registers with markers of their own exchange and with outgoing line groups takes place by a direct current code "2 from 5" using by-pass signal paths:

* preselection (preliminary selection)--category of calling subscriber

* group selection (group selection)--number of desired direction

* line selection (line selection)--number of called subscriber

* charge--type of charge

- collaboration of subscriber registers with incoming registers of collaborating exchanges takes place:

* by multifrequency code "2 from 6" MFC R. 2 (Pentaconta and other exchanges)

* by decadal code (Strowger, MCA and other exchanges)

- collaboration of Pentaconta 1000 C exchange with other exchanges takes place by using direct current circuits (2 x 1500 Ω), alternate current circuit 50 Hz and carrier current circuits with emitted signal frequency

- outgoing calls are charged many times on the basis of the charge set by a computer ("scattered impulse" system) whereby trunk calls can be billed thanks to billing signals received from ACMM along conversation circuit wires

- call disconnection is basically optional on all sides.

PC 1000 C exchange equipment, so-called frames (selector and relay) is mounted on racks 3470 mm. high. Racks of other heights may be used: 3070 mm., 2670 mm., etc. The remaining frame measurements are the following: 1340 x 390, 1340 x 235 and 1050 x 390. Connections are made by

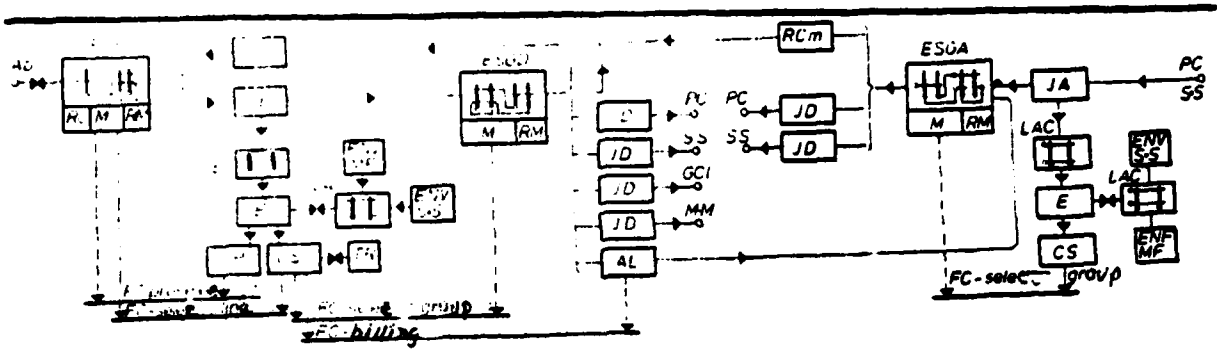


Fig. 5. Block diagram of Pentaconta 1000 C local exchange: Ab-subscriber apparatus, Al-internal connecting group (alimenteur local), CE-register finder (chercheur d'enregistreurs), CP-preselection coupler (coupleur de présélection), CS-selection coupler (coupleur de séléction), E-register (enregistreur), ENV MF-multifrequency transmitter MFC (envoyeur multifréquence), ENV S x S decodal transmitter (envoyeur décimal), ESGA-incoming group stage (éléments de séléction de groupe arrivée), ESGD-outgoing group stage (éléments de séléction départ), ESL-subscriber line stage (éléments de séléction de lignes), FC-signal path (faisceau cond'arrivée), JD-outgoing line group (joncteur de départ), JE-register group (joncteur d'enregistreur), LAC-transmitter coupler (link accès), M-marker (marqueur), M-M-"city-city", PC-Pentaconta, RM-marking relays (relais de marquage), S x S-"step by step"-exchange with step control, TR-computer (traducteur)

*GCI-large intercity exchange (grande centrale interurbaine), JA-incoming line group (joncteur d'arrivée).

the wire-wrap method both during manufacture and installation.

A variation of the Pentaconta 1000 C are the mobile exchanges with a capacity of 740 NN and simplified assembly. These exchanges are scheduled as terminal (satellite) exchanges and Strowger and Pentaconta central and district exchanges. They can be installed for a temporary period until a permanent exchange is built.

RURAL EXCHANGES

The TELKOM-ZWUT Plants presently manufacture type KW rural exchanges based on the WK-610 crossbar switch and C-11 relay, and are preparing to start production in 1978 of PC-32 exchanges based on a Pentaconta selector switch (so-called "small," type 10 x 7) and standard Pentaconta relays.

Rural KW exchanges are divided into two variations:

* terminal exchanges with 32-200 NN capacity

* tandem exchanges to which terminal exchanges are joined (to 2000 NN); tandem exchanges collaborate with local exchanges.

Interchange connections are made by direct current circuits, alternating current 50 Hz circuits and carrier current circuits. Interregister signalling is based on multifrequency MFC R. 2 and decadal code.

PC 32 rural exchanges are characterized by a wide capacity range: from several tens to several thousands NN. They can collaborate with local exchanges of register systems (like Pentaconta) and step ones (like Strowger). Interregister signalling is based on MFC R. 2 and decadal code, as is similar for KW exchanges.

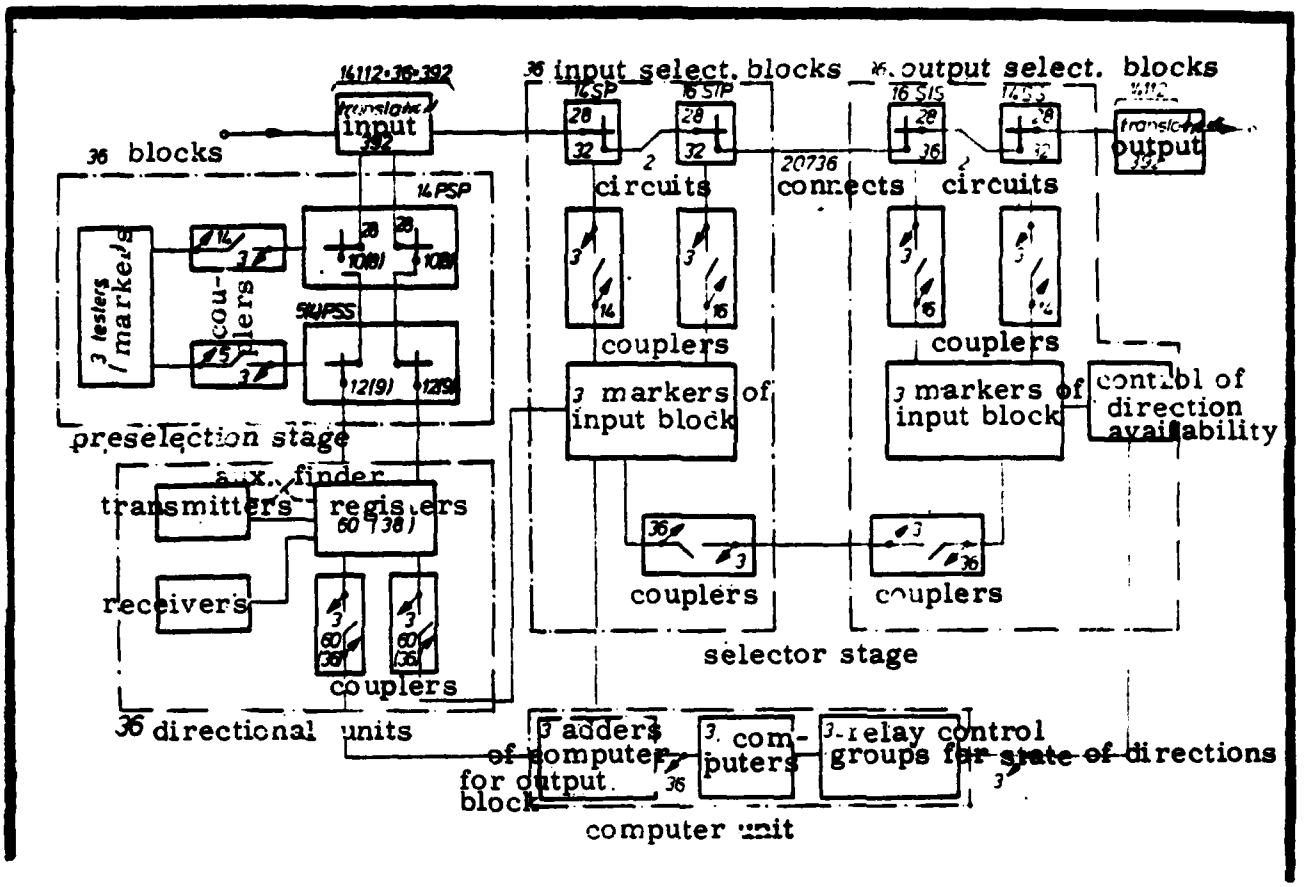


Figure 6. Block diagram of GCI trunk exchanges.

LARGE AUTOMATIC GCI TRUNK EXCHANGE

GCI trunk exchanges can function in automatic trunk networks as junction, collector, and terminal exchanges.

The commutation stage of the GCI exchange has a modular structure. 392 incoming wires and 392 outgoing wires can be added to each module.

A maximum equipped commutation stage is composed of 36 modules which makes it possible to add to the GCI exchange 14, 112 incoming wires and the same number of outgoing ones.

The structure of the stage is in 4 sections. The stage ensures a double circuit commutation.

The module (block) ensures maximum access to 64 directions, while the fully equipped stage--up to 100 directions averaging about 14 lines. The density of transacted telephone traffic amounts to 10,000-11,000 erlangs.

The GCI exchange takes care of the automatic outgoing, incoming and transit trunk traffic of the numerical zone serviced. It can also serve semi-automatic traffic.

Connections with other trunk exchanges are executed with the help of double line circuits. Line signalling rests on the use of ultraband frequency of 3825 Hz, while the interregister signalling--on the MFC R. 2 code.

Local distant exchanges are jointd to the GCI exchange in a similar manner, and close exchanges--by using one-line circuits with direct or alternating current of 50 Hz. Interregister signalling rests on the MFC R. 2 code or decadal code.

Charge signals are relayed to close local exchanges along wires of call lines. Charge signals of international calls are relayed similarly.

The supply voltage is 48 $\pm$4 V.

The fundamental structural elements are Pentaconta selector switches ("large") and standard Pentaconta relays.

Construction of the equipment (frames and racks) is analogous to the construction of the Pentaconta 1000 C exchanges.

LNI INTEGRATED EXCHANGES

Integrated local-trunk LNI exchanges in numerical zones will fill the role of local exchanges, intrazonal transit exchanges and trunk transit exchanges. These exchanges will facilitate local and transit traffic and outgoing, incoming and transit trunk traffic.

LNI exchanges are anticipated to collaborate with local exchanges with MFC R. 2 and decadal register signalling as well as with GCI and LNI exchanges having MFC R. 2 signalling.

Connections with local exchanges are single line (direct and alternating current 50 Hz, carrier current circuits), and with trunk exchanges--four-wire. Local calls are switched through an LNI exchange on a single line, and trunk calls--four-wire. In connection with this in the construction of a group stage four-wire commutation is taken into account.

Billing of trunk calls takes place on subscriber computers. Billing signals will be given to the collaborating local exchanges along call wires of interexchange circuits.

Supply voltage is 48 ±4 V.

The structural elements and construction of the equipment are analogous as for other Pentaconta system exchanges.

SUBSCRIBER EXCHANGES

The TELKOM-ZWUT Plants produce a wide assortment of subscriber exchanges based on WK-610 crossbar switches and C-11 relays. To the latest of the Plant's achievements in this field belongs a special subscriber exchange, so-called railroad, having a 30/60 capacity, designed to service internal telephone traffic, mail (going to and coming from a public utility network) and resort traffic (outgoing, incoming and transit) of a railroad station. Railroad exchange CK-30/60 - after completing small simplifications - can operate as a regular subscriber exchange since it has all of its properties.

The supply voltage is 60 ±6 V.

These circuits can be joined to the exchange:

- subscriber: 2 x 600 Ω , 20 k Ω
- mail: 2 x 500 Ω , 40 k Ω
- railroad cable induction: 2 x 2000 Ω , 50 k Ω
- railroad overhead induction: 2 x 2 kΩ , 10 k Ω
- railroad carrier channels: resistance of signalling wire to 500 Ω
- railroad station: to 10 MB-10 telephone sets of additional high resistance bells

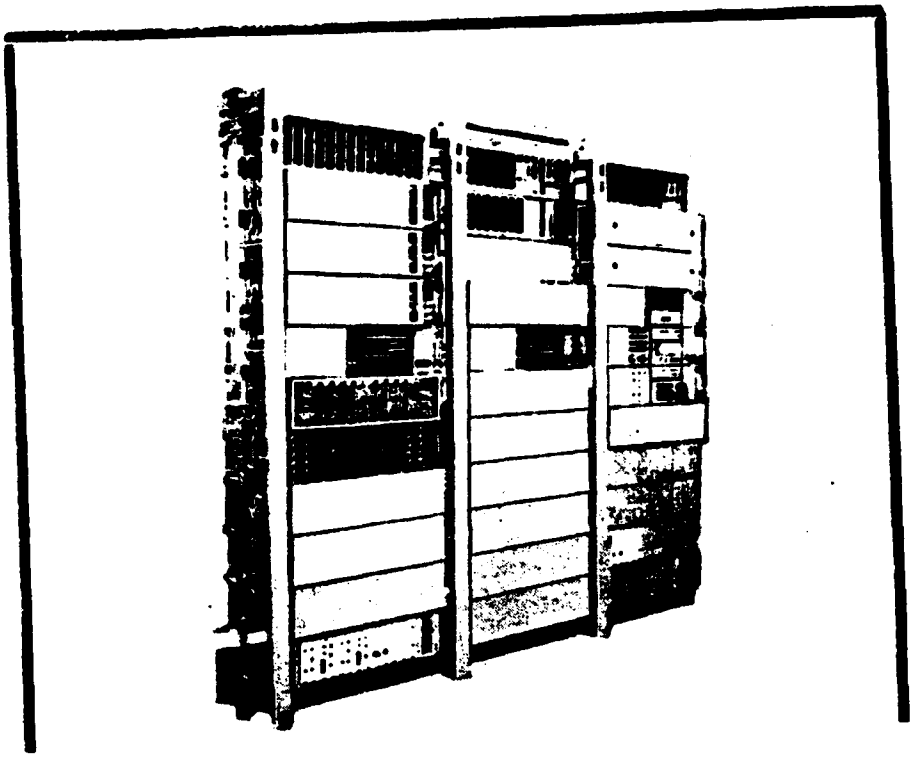


Fig. 7. Railroad exchange CK-30/60

The exchange is equipped with three racks. The first rack contains common exchange equipment including:

- signal equipment (rotating machines)
- common marker
- 3 subscriber registers
- 3 incoming registers
- couplers and other equipment

The second and third racks have equipment designed to service 32 NN sibscriber groups, composed of:

- subscriber equipment (32)

- commutation stage, constructed of three selector switches

- 8 translations, whose required use can be semiautomatic mail, automatic mail, railroad induction, or railroad carrier or railroad station.

Numeration of subscriber lines is two-digit: 12-29 and 41-69 (11 and 77--service numbers); access to mail network ensures the digit 0 and directions of the railroad network have one- and two-digit numeration: 8 and 9 and 71-76, 78-79 and 70, and also if necessary 80-89 and 90-99.

Incoming mail traffic can be facilitated semiautomatically or automatically. Resort telephone traffic is realized automatically with the possibility of passing to semiautomatic traffic.

The exchange ensures all facilities offered by subscriber exchanges.

The exchange equipment is located in 3 racks measuring: height-2180 mm., width-800 mm., depth-360 mm.

The racks--compatible with contemporary trands in the area of subscriber exchange construction--are housed. The equipment is located on both sides of the racks, and access is ensured by removing the housing. Thanks to this construction the CK-30/60 exchanges can be installed even in locations having the most difficult climate conditions.

The production schedule states that from 1976 production of Pentaconta subscriber exchanges begins. Production of the following types is foreseen:

* 5 B with a capacity of 22 NN

* 7 E with a capacity of 50-150 NN

*18 E with a capacity of 100-800 NN

* PC-1000 with a capacity of 600-several thousand NN.

Supply voltage of Pentaconta subscriber exchanges is 44-56 V.

The basic commutation elements are standard Pentaconta selector switches and relays.

Subscriber lines can have resistance to 2 x 500 Ω, while telephone sets-dials with a frequency of 10 $\pm$2 Hz.

The exchanges ensure the subscribers of additional technical-service possibilities, such as return calls, auto-transfer, calling of operator, etc.

Collaboration with the local exchange is basically semiautomatic; for exchanges with a greater capacity automatic collaboration is also foreseen.

With regard to the possibility of using subscriber public network services there are 5 privileged classes.

The exchange equipment fits into steel cabinets (5B, 7E, and 18E) or into racks similar to the Pentaconta 1000 C (Pentaconta 1000) racks. Similarly, as in the Pentaconta remaining equipment, wrapped connections are used.

The manner of making the equipment makes it possible to install Pentaconta subscriber exchanges even under difficult climate conditions.

Photos by E. Cmoch