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A CONCEPT OF A MEASURING AND ALARMING NETWORK FOR POWER OBJECTS

The measuring and alarming network has been worked out for such power objects as thermal-electric and electric power stations. The concept is based on experimental telemetric system, being implanted in the electric power station Turów. The network — because of its tasks — has a star-shaped structure. Various control methods of measuring information inflow, and protection of measuring information and calling in signal against inferences have been discussed. Block diagrams of a typical measuring point and supervisory centre presented in the paper have been used in discussion of the structure and operation principles of the network systems.

1. INTRODUCTION

A prototype of a telemetric system for the measurements of pollution in ground layers of the atmosphere surrounding power objects has been constructed in the Institute of Automatics of Power Systems [1]. This system is now being tested in the region surrounding one of Lower Silesia power stations. The preliminary experience allowed to work out a concept of a measuring and alarming network for the measurements of pollution in the atmosphere surrounding typical power objects, such as thermal-electric and electric power stations [2]. The telemetric system has been intended for experimental purposes, hence it allows to measure many parameters, and the number of field measuring points may ammount to 32. The concept discussed below provides a network much simplified in this respect. The reduction of the number of field measuring points as well as of the parameters measured was possible due to the experience acquired, and to the analysis of typical networks existing in other countries.

2. ORGANIZATION OF THE NETWORK

The measuring and alarming network includes the field measuring points situated around the given object in selected places, and a supervisory centre, located usually within the given object. The network is used for the measurement of defined physical parameters (concentration of sulphur dioxide, dusting, etc) and of selected meteorological parameters, as well as to transmission of results obtained in separate field measuring points to the

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supervisory centre. Because of its specific task the structure of the network is star-shaped (Fig. 1).

To receive the results of measurements, a calling signal is sent by the supervisory centre to each field measuring point separately. Each point has its own number, and as soon as the conformity of the call signal is checked, transmission of the measuring information to the supervisory centre is initiated. The results obtained in each field measuring point are processed, encoded and thereupon sent to the supervisor centre. In the latter the information is decoded, transmitted to the teletype and written in digital form.

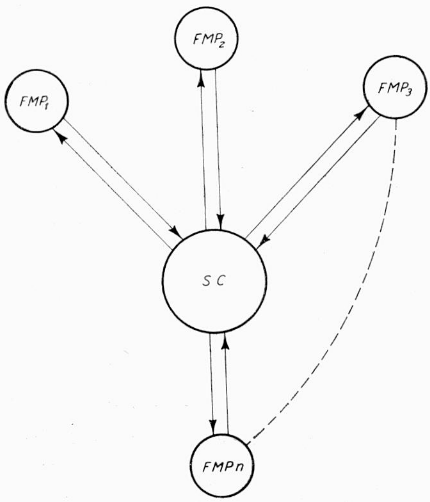

Fig. 1. Structure of measuring and alarming network

SC — supervisory centre, *FMP* — field measuring point, *n* — number of field measuring points

Rys. 1. Struktura sieci pomiarowo-alarmowej

SC — centralny ośrodek dyspozycyjny, *FMP* — stacja pomiarowo-alarmowa; *n* — liczba stacji pomiarowo-alarmowych

In case when the value of the measured quantity exceeds the established alarming value the dispatcher is alarmed by optical or acoustical signalization. Optical signalization indicates on a situation panel of the field measuring point in which the measured value exceeds the alarm value.

The inflow of measuring information from the particular field measuring stations is controlled by a dispatcher. This information can be transmitted after the following variants:

a) cyclically, according to the order established,

b) from an arbitrary point, selected by the dispatcher.

Under normal condition the first variant is usually employed. If, however, the information from the given field measuring point is to be obtained quickly the dispatcher stops cyclical operation, and by pressing the key he calls out the required field measuring point.

For the sake of simplicity both in structure and service of the network, the supervisory centre is not supposed to be equipped with a computing centre and a digital computer. Nevertheless, according to the solution suggested either the cooperation with a computer centre is possible or the measuring information can be transmitted to the centre of a higher rank which accumulates the data from a number of measuring and alarming stations.

Bearing in mind the possible interferences of transmission signals occurring on the areas within the network attention has been paid to the encoding of the transmitted information. The suggested encoding method allows a considerable increase of data transmission fidelity in the network.

Both the measuring information, transmitted from the separate field measuring points to the supervisory centre, and the calling signal sent from the field points to the supervisory centre have a discrete character. The measurement result of one measured value constitutes a unit (block) of measuring information consisting of 16 bits, in form of four tetrades of binary-decimal cod with weights 8421. The first tetrade defines the number of the magnitude measured, and the next three tetrades define its value. Calling information is constituted by a four-bit signal of the number of the measuring field point required, given also in *BCD* code with weights 8421. In order to protect the measuring information and calling information against the error, the correcting cyclic codes will be used.

The network will consist of at most 8 field measuring points. In each point 4 magnitudes can be measured. A complete measuring information will be transmitted cyclically at every one hour. The period of the cycle can be altered.

3. TELECOMMUNICATION NETWORK

Telecommunication network between separate field measuring points and supervisory centre can be realized in form of either a cable or radiocommunication network.

The choice of the kind of communication depends on the possibilities existing the area on which this network is to be located. If a cable communication is at the disposal then it is recommended to install a cable network. Required channels can be made available by the ministries of communication, mining, power, or others. If, however, the area is not developed then radio-communication network should be used.

From the preliminary analysis of costs and demands for frequency it follows that in case of cable communication systems with carrying channels, and in case of radio-communication simplex radio-telephones should be used. In both the cases the realization of communication network can be based on devices produced in this country.

4. STRUCTURE OF A FIELD MEASURING AND ALARMING POINT

The description of the structure and operation of a typical measuring and alarming field point will be based on block diagram shown in Fig. 2.

Supervisory centre sends a calling signal to the field measuring point. This signal is conveyed from a transmission block *TB* to the decoder-register unit *DR*, which examines the fidelity of the calling information. In case of the eventual error the calling information

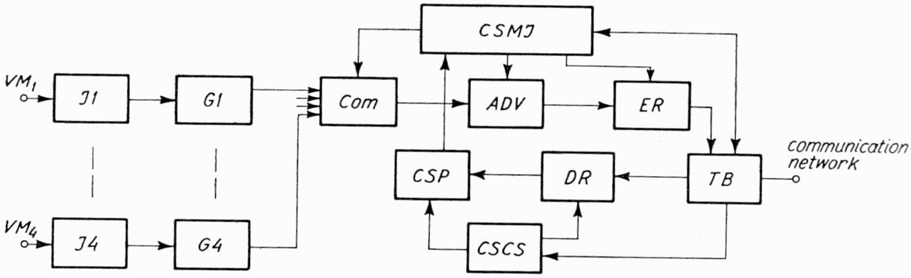

Fig. 2. Block diagram of measuring and alarming network

VM — value measured, *I* — indicator, *G* — converter, *Com* — commutator, *ADV* — analogue and digital converter, *ER* — encorder-register *TB* — transmission block, *DR* — dicoder register, *CSP* — calling signal receiver, *CSMI* — control set of measuring information sending unit, *CSCS* — control set of calling receiver unit

Rys. 2. Schemat blokowy stacji pomiarowo-alarmowej

VM — wielkość mierzona, *I* — czujnik, *G* — przetwornik, *Com* — komutator, *ADV* — konwertor analogowo-cyfrowy, *ER* — rejestr-koder, *TB* — blok transmisyjny, *DR* — dekader-rejestr, *CSP* — odbiornik sygnału wywołania, *CSMI* — blok sterowania zespołu nadawania, *CSCS* — blok sterowania zespołu odbiorczego sygnału wywołania

is corrected in the decoder. Thereupon the signal is transmitted to the receiver of the calling signal *CSR* in which the conformity of the number sent by the supervisory centre with the number of the measuring point is checked out. If this conformity is stated, the signal is transmitted from the block *CSP* to the block *CSMI*, which controls the unit transmitting the measuring information. This block puts in motion the process of transmission of measuring information to the supervisory centre.

The block *CSCS* ensures a proper operation of the unit receiving the calling signal of the field measuring point.

The established physical magnitudes $VM_1 \dots VM_4$ are measured in the field measuring point by means of pickups $P_1 \dots P_4$. The pickups convert the values of the measured magnitudes into proportional electrical signals.

Converters $C_1 \dots C_4$ convert these signals into standard output signals, given to the input of commutator *Com*, which in turn, gives it consecutively to the analog-to-digital converter *ADV*, whence the measured value is given in digital form to the encoder-register unit *ER*, which receives also from the control unit *CSMI* the number of the measured physical magnitude. The encoding of the received measuring information takes place in the block *ER*, by adding redundancy positions to information positions in order to protect the produced code word against error in the course of transmission.

5. STRUCTURE OF THE SUPERVISORY CENTRE

Structure and the operation of the supervisory centre can be discussed by means of schematic representation given in Fig. 3.

Two ways of the network operation, mentioned in section 2 can be chosen alternatively by means of keys present in the calling unit *CU*. After having chosen a "cyclical operation" the system begins a cyclical transmission of calling information to the field

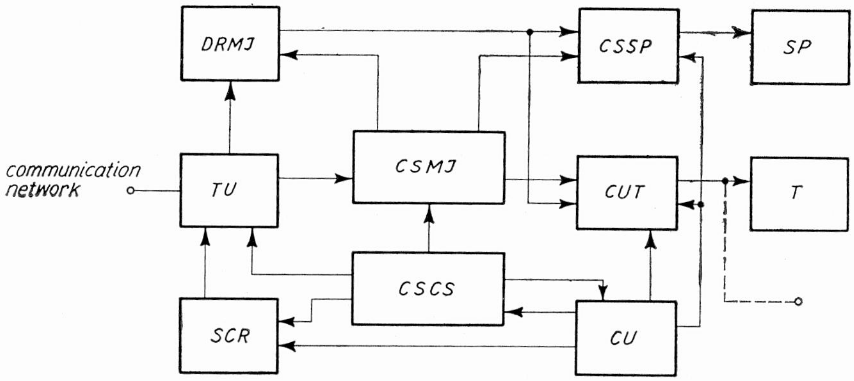

Fig. 3. Block diagram of the supervisory centre

CU – calling unit, *SCR* – sending coder-register of calling unit, *CSCS* – central set of calling signal sending unit, *TU* – transmission unit, *DRMI* – dicoder-register of measuring information *CSMI* – control set of measuring information receiving unit, *CSSP* – control set of situation panel, *SP* – situation panel, *CUT* – control unit of teletype, *T* – teletype

Rys. 3. Schemat blokowy centralnego ośrodka dyspozycyjnego

CU – blok wywołania, *SCR* – koder-rejestr nadawczy sygnału wywołania, *CSCS* – blok sterowania zespołu nadawczego sygnału wywoławczego, *TU* – blok transmisyjny, *DRMI* – dekoder-rejestr odbiorczy informacji pomiarowej, *CSMI* – blok sterowania zespołu odbiorczego informacji pomiarowej, *CSSP* – blok sterowania planszą sytuacyjną, *SP* – plansza sytuacyjna, *CUT* – blok sterowania dalekopisem, *T* – dalekopis

measuring and alarming points, and then the reception of measuring information from the field measuring points called consecutively, then the decoding of information and its writting on the teletype *T*.

In the calling unit *CU* the numbers of field measuring points called consecutively, are produced. So, the calling number of the first field measuring point goes to the encoder--register system *SCR*, here it is encoded and transmitted to the transmission unit *TU*.

By means of telecommunication network the signal is transmitted to the measuring and alarming field points. The task of the first station is to state the conformity of the number sent, and then to convey the measuring information to the supervisory centre. The consecutive stations are called out in similar way.

The same signal which is transmitted from the block *CU* to the block *SCR* is simultaneously sent to the block *CUT* controlling the teletype and to the block *CSSP* controlling the monitoring panel. Block *CSCS* controls the operation of the unit sending the calling signal.

Measuring information called out from the station passes to the transmission unit *TU* and is conveyed to the decoder-register unit *DRMJ* in order to examine the fidelity of the information received. The decoded information is transferred to the block *CUT* controlling the teletype, where it is converted into teletype code and then printed on the teletype *T*.

The actual data, measurement hour, station number and then numbers and values of the measured magnitudes are each time registered by the teletype. Information printed on the teletype can be also sent parallelly to the teletype network in form of standard teletype signals.

Supervisory centre is also equipped with a situation panel *SP*, controlled by the block *CSSP*. This block possesses a detecting unit with a modelled alarming value of the selected value under measurements.

6. FINAL REMARKS

The measuring and alarming network discussed in the present paper is based on digital technology and allows to apply typical units used in computer science, as well as to register the results in digital form. The network is adopted to the cooperation with a computer.

The number of stations, their localization, the physical and meteorogical parameters which should be measured, will be determined for each station separately, depending on meteorological conditions, and on the kind and number of plants situated within the region considered.

The network can be extended without changing the way of its operation.

KONCEPCJA ZUNIFIKOWANEJ SIECI POMIAROWO-ALARMOWEJ DLA OBIEKTÓW ENERGETYCZNYCH

W pracy przedstawiono koncepcję sieci pomiarowo-alarmowej dla obiektów energetycznych, takich jak elektrownie lub elektrociepłownie. Koncepcja oparta jest na doświadczalnym systemie telemetrycznym, wdrażanym w elektrowni Turów.

Sieć ma, ze względu na swoje zadania, strukturę gwiaździstą. Omówiono organizację sieci, sposoby kierowania strumieniem informacji pomiarowej oraz zabezpieczeniem przed zakłóceniami przesyłanej informacji pomiarowej i wywoławczej. Podano schematy blokowe typowej terenowej stacji pomiarowej i centralnego ośrodka dyspozycyjnego i na tej podstawie omówiono struktury i sposoby działania tych układów sieci.

KONZEPTION DES UNIFIZIERTEN MESS- UND ALARMNETZES FÜR ENERGETISCHE OBJEKTE

In der Arbeit wird die Konzeption des Mess- und Alarmnetzes für energetische Objekte sowie: Kraftwerke oder Heizkraftwerke, dargestellt. Die Konzeption wird auf dem experimentellen, telemetrischen System gestützt und in Kraftwerk Turów eingesetzt.

Das Netz hat, in Hinsicht auf die Aufgabe, eine gestirnte Struktur. Es wird Netzorganisation, Leitungsweise des Messinformationstromes und Schutzeinrichtung gegen Störung der übertragenden Mess- und Anrufinformation, besprochen. Es wurden die Blockschemen einer typischen, geländegängigen Mess-tation und des zentralen Dispatscherzentrums angegeben. Anhand dessen werden Strukturen und Wirkungsweisen der Netzsystemen besprochen.

КОНЦЕПЦИЯ УНИФИЦИРОВАННОЙ ИЗМЕРИТЕЛЬНО-СИГНАЛИЗАЦИОННОЙ СЕТИ ДЛЯ ЭНЕРГЕТИЧЕСКИХ ОБЬЕКТОВ

Изложена концепция измерительно-сигнализационной сети для энергетических объектов, таких как электростанции и теплоцентрали. Она основана на экспериментальной телеметрической системе, внедряемой на электростанции „Турув". В соответствии со своими задачами сеть получила звездообразную структуру. Обсуждены организация сети, способы управления потоком информации от измерений и защитой от возмущений передаваемой измерительной и позывной информаций. Приведены блок-схемы типичной, работающей на местности измерительной установки и центральной диспетчерской базы. На такой, именно, основе обсуждены стружтуры и способы действия этих схем сети.

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