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CENTRAL INTELLIGENCE AGENCY
INFORMATION FROM
FOREIGN DOCUMENTS OR RADIO BROADCASTS

REPORT

CD NO.

STAT

COUNTRY	USSR	DATE OF INFORMATION	1951
SUBJECT	Scientific - Electronics, television, radio		
HOW PUBLISHED	Monthly periodical	DATE DIST.	17 Dec 1952
WHERE PUBLISHED	Moscow	NO. OF PAGES	6
DATE PUBLISHED	Aug 1952		
LANGUAGE	Russian	SUPPLEMENT TO REPORT NO.	

THIS IS UNEVALUATED INFORMATION

SOURCE Radio, No 8, 1952, pp 5-11.

SOVIET RADIO ENGINEERING IN 1951

Academician A. I. Berg

Radio Communications and Radio Broadcasting

The huge land area of the Soviet Union requires the continuous improvement of radio communications. The frequency-shift keying system was introduced in intra-oblast radio communications lines in 1951. The first series of simplified equipment which will make it possible to convert intra-oblast communications to a single-channel frequency telegraphy system was produced. This equipment will improve the quality of operation and will permit the use of teletype.

In 1951, the industry completed the development of new radio broadcast transmitters which use a new series of electron tubes with the cathodes supplied by ac. Special thyratron rectifiers supplying the plates of the tubes will increase tube life. Automatic devices replacing fuses will cut down interruptions in station operation. All this will reduce the cost of operating transmitters.

The crowded radio broadcast spectrum imposes very severe requirements for frequency stability of the modern radio broadcast transmitter. Great progress was made last year in frequency stabilization. New exciters were developed for all the broadcast bands which provide frequency stability better than that required by international norms. A group in the Scientific Research Institute of Communications headed by V. K. Solntsev has developed new models of quartz resonators for the entire frequency band.

An instrument for measuring and checking frequencies of radio stations with amplitude and frequency modulation up to 60 Mc with an accuracy of $\pm 1 \cdot 10^{-7}$ was developed. Technical control points of the Ministry of Communications being equipped with these instruments in 1952. The secondary frequency standard which is a part of this instrument is also being used by itself in many branches of science and engineering.

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Engineer V. M. Vol'f has developed a new instrument for measuring nonlinear distortion during transmission. This had not been done previously either in the USSR or abroad. The rejector filters used in the device take out a narrow band of 50-100 cps from the modulating spectrum. The distortion of transmission is figured from the intensity of the harmonics appearing at the output of the transmitter in this narrow frequency band.

New equipment put into operation in wire interurban trunk lines will provide high-quality transmission of central broadcasting programs on all the trunk lines from Moscow to a number of cities and thus will considerably improve union and republic broadcasting.

The Institute of Radio Reception and Acoustics, Ministry of the Communications Equipment Industry, (IRPA, MPSS) has developed new types of microphones with high-quality indices. One of these microphones, designed for speech amplification, has a special directional characteristic which reduces acoustic feedback. In 1951, the Ministry of Communications developed an original studio microphone which is a combination of the velocity and dynamic types. It has adjustable directivity, high sensitivity, good frequency response, and a comparatively low noise level.

The network of radio receivers grows steadily from year to year, and in 1951 the industry increased receiver production eight times in comparison with 1940. The workers of the MPSS have given a great deal of attention in the last year to improving the quality of receiving equipment. A state standard for radio broadcast receivers was approved in 1951. In connection with this standard, improvements were introduced in a number of receivers produced by industry. In particular, economical one-volt miniature tubes were used in the new model of the Rodina kolkhoz receiver. The filament power drain was halved in comparison with the old model (Rodina-47 and is now only 0.5 w. The receiver is battery-operated.

The simple economical Tula receiver is still being produced for use in nonelectrified regions. This two-tube receiver weighs only 1.7 kg, draws 150 mw filament power, and 0.27 w plate power.

Production of the cheap mass-produced Moskvich receiver continues. The Rodina and Moskvich receivers are popular and the demand for them is great. A new type of power supply, a thermogenerator, has been developed for the Rodina receiver in the Ministry of Communications. It produces electric power by using the heat of an ordinary kerosene lamp or any other source of thermal energy.

Research is being conducted to improve the quality of sound in small receivers, where small loudspeakers must be used. For example, good reproduction of the low frequencies, starting with 100 cps, has been obtained in the Moskvich receiver.

In addition to the first-class Latvia broadcast receiver produced by industry, a new receiver of the same class using single-ended tubes was developed in 1951. Its input is designed for connection to an interference-protected two-conductor antenna leadin. A noiseless tuning system is used in the set.

The assortment of ceramic radio parts has been increased and their quality improved through the work of a group of scientists and designers headed by Professor N. P. Bogoroditskiy, Stalin Prize winner. The use of metallized paper has considerably improved the quality of paper capacitors; in addition, they can be made two to three times smaller. These new capacitors have the very valuable property of sealing themselves after a breakdown.

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The new composition resistors developed by B. A. Bochkarev, Stalin Prize winner, have good electrical characteristics and are only one fifth as large as the well-known carbon resistors.

Research in materials has led to the development of a new type of magnetic ferroceramic materials, the ferrites. Oxides of iron, zinc, nickel, and other metals are the raw materials for the production of ferrites. The magnetic permeability of ferrites may vary from 10 to 2,000, depending on the raw material and the production technology. The resistivity of ferrites is millions of times greater than that of soft magnetic materials. The use of ferrites permits a new approach to the design of radio equipment and simplifies the development of high-frequency magnetic amplifiers, i-f transformers, transformers and chokes for television and broadcast receivers, tuning circuits, etc. By using the change in magnetic permeability of a ferrite core produced by the field of a permanent magnet, Engineer N. I. Oblezov has developed a tuning circuit for a cheap receiver which covers the medium- and long-wave broadcast bands without any changes in the oscillatory circuits.

The use of ultrashort waves holds great promise for the development of high-quality multiprogram broadcasting for the larger cultural and industrial centers.

The problem of industrial noise is closely connected with the quality of radio broadcasting. At present the use of radio engineering methods in all branches of the economy and in science and engineering has reached such proportions that a number of organizational and technical measures must be carried out to ensure normal operation of equipment for radio communications, radio broadcasting, and television. A year ago, the government adopted a resolution which defined the plan and the main methods for preventing any further increase in the industrial noise level. Radio specialists and radio amateurs and the radio engineering press must participate actively in checking and developing methods for combating radio interference and in developing simple, reliable instruments for detecting interference and measuring noise levels.

Wire Radiofication

In 1951, the number of subscriber loudspeakers increased by more than 30% for the country as a whole and by almost 193% for rural localities. In concentrating on the problems of rural radiofication, radio industry and radiofication workers have been concerned primarily with the development of cheap economical equipment and power supplies for this equipment. Production of the new center of the KRU-10 type with output power of 10 w has begun. Operating experience with the Type KRU-2 amplifying unit was used in designing the KRU-10. The latter center is intended for large (combined) kolkhozes. It consists of a receiving-amplifying unit and a separate supply unit. The equipment is very economical, since a special wind-electric power unit, the VE-2, was developed for it. The storage batteries of the center can also be charged from the lighting circuit.

A set of equipment which can be supplied and remotely controlled from the rayon center through intrarayon telephone wires at distances up to 30-40 km has been developed for regions which are still not electrified. The programs are transmitted by high-frequency currents.

Radiofication workers have given a great deal of attention to the development of the underground cable net which replaces overhead lines. Cables with vinyl chloride insulation are used in this work. Methods have been found which permit such cable lines to be laid up to 50 km in length. To mechanize cable-laying work, several types of cable-laying machines have been developed, along with special pliers for splicing cables.

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Wire broadcasting equipment which provides high program quality is being introduced in the large cities. Production of instruments for remotely controlled substations of wire broadcasting systems has been organized. A unit for multiprogram broadcasting along wire broadcasting networks has been developed and will be put into experimental operation this year.

The MPSS also developed a new improved wire broadcasting receiver in 1951.

Television

The experience gained in building the Moscow Television Center and in modernizing the Leningrad Television Center has made possible the comparatively rapid development of first-class equipment for the Kiev Television Center, which began regular experimental transmissions in 1951. The Moscow and Leningrad centers have also been supplied with new equipment. In 1951, new synch generators, new sensitive transmitting tubes, test and measuring equipment, etc., were tested at these centers.

The experience accumulated by the Moscow Television Center in television transmissions from theaters, stadiums, and from squares has emphasized the need for constructing permanent relay points for simultaneous service of a group of entertainment enterprises.

In 1951, the industry completed the design of a mobile television station which is mounted in two specially equipped Type ZIS-155 busses. The equipment for video transmission is located in one of these busses, while the other houses the equipment for sound accompaniment and operational radio communications. The highly sensitive transmitting tubes with double-sided targets proposed by Professor G. V. Braude are used in the television cameras of the mobile stations.

In the last year, a group of radio industry specialists under the direction of Engineer P. Ye. Kodess, Stalin Prize winner, completed the development of a standard compact, simple, and economical television center which is intended for installation in capitals of union republics and in large oblast centers. This standard center will be equipped for both studio and field transmissions. Transmitting tubes with image transfer proposed by Professors P. V. Shmakov and P. V. Timofeyev will be used in the television cameras of the center. These tubes permit transmission under average illuminations and provide an effective signal-to-noise ratio of at least 15 db. The center will use an AM video transmitter and an FM sound transmitter.

The experimental work of the Ministry of Communications on relaying television programs on interurban cables has proceeded successfully. In the future, relaying of television programs can be organized in any town where such trunk lines pass through and where there are amplifying points.

A great deal of attention was given to increasing the quality of new television receivers being developed and produced. A new model of a television receiver was developed which has electrostatic deflection and focusing of the electron beam in the Kinescope. The receiver uses a superheterodyne circuit and has 17 tubes. The sound channel i-f is obtained by beating the video and sound carriers against each other. The receiver sensitivity is about one mv and the screen diameter is 175 mm. The use of a kinescope with electrostatic deflection simplied the receiver design considerably, reduced its weight to 18 kg (almost 10 kg less than the KVN-49), reduced the power drawn to 150 w, simplified control, and considerably reduced the level of interference created by radio broadcast receivers.

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Considerable work was also done in 1951 on the development of models of large-screen television receivers. For example, an 18-tube receiver with a tube having a screen diameter of 230 mm was developed. It uses a superheterodyne circuit and comes in two types, i.e., combined with a multiband broadcast receiver and without this receiver. In addition, an experimental unit with screen dimensions of 3 x 4 m was developed this is a prototype of future installations for clubs, sanatoria, and other public places.

The television receivers produced up to the present time create considerable interference with radio broadcast reception. This interference was reduced more than ten-fold by a number of simple measures (shielding the sides of the cabinet and come circuits in the receiver and installing filters in the supply circuits).

The problem of collective television antennas and combined antennas for television and radio reception has taken on a new importance in connection with the extensive building program now under way, with particular reference to the construction of high buildings. A collective antenna unit to serve 200 television receivers was developed last year. This unit consists of the antenna itself, the amplifying unit, and the distribution network. The distribution network is designed to pass the frequency band from 48 to 84 Mc and the amplifier is designed to pass one of the three television programs. In the event of simultaneous transmission of two television programs, the possibility of installing an amplifier for the second program has been provided for. A model of a collective antenna without an amplifier which does not require special maintenance has also been produced. Up to 100 television receivers can be connected to it. Tests of this antenna have shown that it can be used at distances up to 10 km from the television center.

In 1908 Engineer A. A. Adamian, Baku, proposed a mechanical color system with alternate transmission of colors. In 1925, he submitted a second proposal which represented a considerable improvement over his first. In 1951, successful experiments in color television transmission were carried out in one of the institutes of the MPSS under the direction of Professor V. K. Kreytser, Stalin Prize winner. These experiments constituted a further development of Adamian's ideas.

New Methods of Labor Organization, Efficiency, Invention, and Exchange of Experience

The extensive development of efficiency-consciousness and inventiveness and the continuing union of science and production are the mainstays of further technical progress. In 1951, more than 30,000 efficiency suggestions were introduced by engineers and technicians, leading Stakhanovites and communications workers, workers in radio communications, radio broadcasting, radiofication, and electric communications enterprises. A new form of efficiency work, i.e., the organization of complex brigades, uniting engineers, technicians, and leading workers, is becoming widespread. The most valuable suggestions were worked out by such brigades.

Deserving of attention was the work of a complex brigade at one of the powerful radio stations. This brigade developed a device which quenches almost instantaneously the hf arc arising in overvoltages. Scientific workers and engineers of scientific research institutes also cooperate in working out such suggestions. They actually implement the cooperation of scientific research and educational institutions with the operational and production enterprises.

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The suggestion of Engineer A. A. Voyevodin, who developed a light mast antenna, is among the more interesting of the individual proposals. This mast antenna is very strong and durable but weighs only one sixth to one eighth as much as other designs. These antennas were installed at several radio stations in 1951.

The periodicals Radiotekhnika, Radio, Vestnik Svyazi, and Sovetskiy Svyazist play an important role in exchange of experience and in propagandizing the priority of Soviet science. Unfortunately, the sections on criticism and bibliography have been poorly represented in these periodicals. The further progress of radio engineering requires promotion of discussion on many problems in radio publications.

The utilization of the decimeter and centimeter bands, the development of television, radar, radio navigation, the appearance of such new fields as radio astronomy, the development of pulse techniques, and the introduction of new vacuum-tube instruments, parts, and materials has greatly increased the radio engineering glossary. Despite this, the effort on systematic standarization of terminology and on the coining of new scientific definitions has been weak and disorganized. The standards produced previously are incomplete and partially obsolete. All this has led to the penetration of unfortunate terms and synonyms, and unnecessary foreign terms into the radio engineering glossary. In 1951, the All-Union Council of Radio Physics and Radio Engineering began an extensive program on the clarification of radio engineering terminology. By request of the council, a vocabulary of terms in radio engineering, radio physics, and electronics was drawn up. This work is being continued this year and the Academy of Sciences' Commission on Terminology is participating in it. It is quite obvious that these organizations will not be able to cope with this difficult task without the generous cooperation of everyone connected with these fields.

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