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AUTOMATIC ANALYZERS AND SIGNAL INDICATORS OF TOXIC AND DANGEROU--ETC(U)
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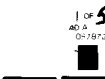

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AUTOMATIC ANALYZERS AND SIGNAL INDICATORS OF TOXIC AND DANGEROUSLY EXPLOSIVE SUBSTANCES IN AIR

By

E. N. Iovenko

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By: E. N. Iovenko

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PREPARED BY:

TRANSLATION DIVISION
FOREIGN TECHNOLOGY DIVISION
WP-AFB, OHIO.

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U. S. BOARD ON GEOGRAPHIC NAMES TRANSLITERATION SYSTEM

Block	Italic	Transliteration	Block	Italic	Transliteration
А а	*А а*	A, a	Р р	*Р р*	R, r
Б б	*Б б*	B, b	С с	*С с*	S, s
В в	*В в*	V, v	Т т	*Т т*	T, t
Г г	*Г г*	G, g	У у	*У у*	U, u
Д д	*Д д*	D, d	Ф ф	*Ф ф*	F, f
Е е	*Е е*	Ye, ye; E, e*	Х х	*Х х*	Kh, kh
Ж ж	*Ж ж*	Zh, zh	Ц ц	*Ц ц*	Ts, ts
З з	*З з*	Z, z	Ч ч	*Ч ч*	Ch, ch
И и	*И и*	I, i	Ш ш	*Ш ш*	Sh, sh
Й й	*Й й*	Y, y	Щ щ	*Щ щ*	Shch, shch
К к	*К к*	K, k	Ъ ъ	*Ъ ъ*	"
Л л	*Л л*	L, l	Ы ы	*Ы ы*	Y, y
М м	*М м*	M, m	Ь ь	*Ь ь*	'
Н н	*Н н*	N, n	Э э	*Э э*	E, e
О о	*О о*	O, o	Ю ю	*Ю ю*	Yu, yu
П п	*П п*	P, p	Я я	*Я я*	Ya, ya

*ye initially, after vowels, and after ъ, ь; e elsewhere.
When written as ё in Russian, transliterate as yё or ё.

RUSSIAN AND ENGLISH TRIGONOMETRIC FUNCTIONS

Russian	English	Russian	English	Russian	English
sin	sin	sh	sinh	arc sh	$\sinh^{-1}$
cos	cos	ch	cosh	arc ch	$\cosh^{-1}$
tg	tan	th	tanh	arc th	$\tanh^{-1}$
ctg	cot	cth	coth	arc cth	$\coth^{-1}$
sec	sec	sch	sech	arc sch	sech^{-1}
cosec	csc	csch	csch	arc csch	csch^{-1}

Russian	English
rot	curl
lg	log

AUTOMATIC ANALYZERS AND SIGNAL INDICATORS OF TOXIC AND DANGEROUSLY EXPLOSIVE SUBSTANCES IN AIR.

E. N. Iovenko.

In the book are given basic concepts and definitions, utilized in the field of automatic gas analysis, forms of the performance of instruments, fundamental rules of selection, installation and exploitation of automatic gas analyzers and gas signal indicators; they are described the Soviet instruments of the control/checking of air and auxilople to them, their technical and operating characteristics, they are led the data about some foreign instruments, operated on enterprises in our country.

The book is intended for the technical-engineering workers of the chemical, petrochemical and oil refineries, and also it can be useful for the wide circle of those, who are interested in questions of the automatic analysis of air in industrial rooms.

Pages 3-4 No Typing.

PREFACE.

In the proposed work is generalized and systematized the encountered in different literary sources information about the contemporary instruments or the automatic analysis of air.

In the book together with the description of the instruments of series production is connected the description of instruments, produced by short runs, which are located in the stage of modification and modernization, and also instruments no longer produced, but being basic machines for developing new instruments.

Furthermore, in the book are given the descriptions of some instruments of the foreign firms which are operated in the chemical and petroleum enterprises of our country.

The generalized in the book material will allow the reader to obtain presentation/concept about the state of development and production of the instruments of the automatic analysis of the air medium of industrial rooms, to rate/estimate the technical capabilities of the existing instruments and the degree of their

compliance to contemporary requirements.

In contrast to the previously left books according to gas analysis, in this book the instruments are systematized not according to the methods of analysis, placed as their basis, but according to designation/purpose, which will facilitate to the reader obtaining information about instruments for the analysis of the specific air medium.

Page 6.

The description of technical and operating characteristics of instruments and auxilople to them precede the presentation of basic concepts and definitions, used in the field of the automatic analysis of air, the description of the forms of the performance of instruments, and also recommendation by choice, installation and exploitation of automatic ones analyzer and signal indicator. The presentation of this material is dictated by the tendency to raise the practical value of the entire book as a whole.

The book is intended for that in order to render practical by aid to technical-engineering workers in selection and exploitation of the resources of the automatic analysis of air medium.

INTRODUCTION.

The special feature/peculiarity of chemical and petroleum productions in contrast to the productions of many other branches of industry is the wide utilization of explosion- and flammable, and also highly toxic substances, which conditions the possibility of the appearance of dangerous concentrations of the substances indicated in air of industrial rooms. Therefore one of the fundamental problems of safety engineering in chemical industry is fight with air pollution.

The permission of this problem is bonded with the need of determining the content in air of toxic and dangerously explosive substances. The analysis of air makes it possible to reveal/detect the excess of the permissible concentration and thereby to in proper time take the effective measures, which ensure decrease in the gas concentration, averting blasts and poisoning in production.

At the disposal of the workers of safety, of doctors technique of industrial enterprises and hygienists, who are occupied by the investigation of air and by the development of measures for dealing with its pollution, must be the corresponding methods and

instruments.

At present in industry are used three basic groups of the methods of determining the concentrations of toxic and dangerously explosive substances in air of the industrial rooms: laboratory, express and automatic.

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The laboratory (analytical) methods of the control/checking of air are characterized by high accuracy and are irreplaceable for performing of deepened work on the study of working conditions on enterprises during establishment maximum permissible substance concentrations. However, these methods are insufficiently operational, since the sampling of air and the fulfillment of analyses require the high expenditures of the time (in certain cases analysis lasts more than two hours). However, the time of the development of emergency situation in many chemical production is measured by seconds or even fractions of second.

The express methods of determining the concentrations of toxic gases and vapors in air with the aid of indicator tubes are simple and reliable, give sufficiently accurate results, they possess specificity and require comparatively small expenditures of time

(from 2 to 10 min) for conducting of analysis.

However, the laboratory and express methods of analysis do not make it possible to continuously and automatically control the cleanliness of air, and consequently, entirely they do not satisfy the requirements of the contemporary automated productions. The instruments, created on the basis of these methods, cannot be used in automatic protective systems and signaling. Meanwhile the trend of development chemical and other branches of industry poses the new problem before safety engineering - wide utilization of integrated automatic protective systems.

The automatic methods of the analysis of air are most effective for the solution of the problem indicated. The instruments whose effect/action is based on these methods, provide speed and continuity, high accuracy and objectivity of the results of analysis.

The automatically operating instruments can be successfully used as the sensors, which fix the presence of toxic and dangerously explosive concentrations in air of industrial rooms during the creation of integrated protective systems.

The first automatic gas analyzers appeared in the Soviet Union in the 20's. But already in the thirties M. M. Faynberg most

completely presented principles of the theory of automatic gas analyzers and were developed the first Soviet instruments of the automatic analysis of air, using a thermochemical method of analysis.

From the automatic methods of the analysis of air great practical use/application found the thermochemical and photocolorimetric methods of analysis.

The thermochemical method of analysis is based on the utilization thermal usefulness of the reaction of oxidation (burning), determined component in the presence of catalyst.

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At present thermochemical gas analyzers compose the vast and important group of the instruments of the automatic analysis of air.

Are known and are developed/processed two in principle and structurally/constructurally different groups of thermochemical gas analyzers, moreover the degree of mastery/adoption and the field of application as the nomenclature of the instruments of each of the groups, are different.

In the instruments of the first group the burning occurs on the

catalytically active platinum filament, which is simultaneously temperature detector. The instruments of this group are simple in construction/design, differ in terms of the simplicity of adjustment and in terms of speed the effects/actions. Shortcoming of these instruments is a comparatively high error of measurement, low sensitivity and selectivity, and also high sensitivity of platinum to catalytic poisons[1].

FOOTNOTE [1]. The substances whose effect on catalyst causes decrease or full/total/complete cessation of its catalytic action, are called "catalytic poisons", and very process of the effect - "poisoning". ENDFOOTNOTE.

The latter fact limits the field of application of instruments of this type.

In the thermochemical gas analyzers of the second group the catalytic oxidation of the determined component occurs in the layer of the solid granulated catalyst in transit through it of the analyzed gas-air mixture, and the useful thermal effect of reaction is measured by the thermosensitive element/cell, placed into catalyst. Gas analyzers with bulk catalyst possess the following advantages in comparison with the gas analyzers, which have the platinum filament.

a) by higher sensitivity, since bulk catalyst has more developed surface of contacting, than the platinum filament (completeness of reaction on it is above);

b) by large selectivity during the analysis of one combustible gas in the presence of another gas, which allows during the selection of the corresponding catalyst, its quantity and temperature conditions of reaction to use one type of gas analyzer for determining different gases.

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Speaking about the large selectivity of the thermochemical gas analyzers of the second group, it should be noted that the instruments of the first group possess less important merit determining the degree of their universality, namely: by the variation of the temperature of the incandescence of temperature detector (platinum filament) it is possible to selectively determine different combustible gases and vapors in the analyzed mixture. In other words, thermochemical method and created on its base instruments are in practice universal with the only limitation, that their applicability is determined either by the substances which

poison catalyst (for instruments with platinum filament), or possibility of selecting the corresponding type of catalyst (for instruments with bulk catalyst). This advantage of the thermochemical method of analysis predetermined its priority development among other methods of the automatic analysis of air.

One of the earliest constructions/designs of thermochemical gas analyzers with platinum filament is developed by M. M. Faynberg semi-automatic gas analyzer PGF-1, intended for determining methane concentrations, carbon monoxide, hydrogen and some other gases and vapors, which are contained in air simultaneously. By main disadvantage in the first version of instrument was the impossibility of its use in the dangerously explosive medium (instrument did not have elements/cells of blast shield), and also the impossibility of determination it vapors of leaded gasolines and some other products, poisoning catalyst.

In the new modifications of instrument (PGF2M1-I1A, PGF2M1-I3G, PGF2M1-I4A) in explosion-proof performance is used the filter, which absorbs poisoning the catalyst (platinum) substance. This made it possible to expand the nomenclature of the determined substances and the field of application of instruments.

Instruments of this type, for the first time applied in

mines/shafts as the indicators of the dangerously explosive concentrations of methane, at present widely are used in chemical, petrochemical and other branches of industry for determining of many combustible gases and vapors in air of industrial rooms.

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Special practical interest are of those developed more lately on the principle of gas-analyzer PGF instruments SGG2M, SVK-3M1, automatically signalling achievement in air of the dangerous concentration of combustible gases and vapors whose use/application makes it possible to considerably expand the nomenclature of the determined substances. Besides this, on the basis of instrument PGF was developed a number of devices, intended for the periodic indication of the sub-explosive concentrations of combustible substances in air (IVK-1, IVP-1, PIV-1. The latter/last development, carried out on the basis of this method, is the base construction/design of thermo-chemical signal indicator (STKh), with the aid of which it is possible to determine almost all combustible gases and vapors capable of forming in air dangerously explosive concentrations, with exception of the connections, which poison the catalysts of platinum group.

Instruments with bulk catalyst underwent very limited

development. Are known altogether only the single developments of instruments of this type (ТИ2102, ИИ2104), the intended for determining the toxic concentrations of carbon monoxide in air, and existing in the form models or experimental samples suitable for series production.

Photocolorimeteric method found widest application during the development of the instruments, intended for determining the microconcentrations of toxic substances in air.

In the instruments, based on the photocolorimetric method of analysis, is used the colored selective reaction between the indicator in solution or on tape and the component of gas-air mixture whose concentration is determined. Moreover the measure for the concentration of the determined component is the intensity of coloring generating as a result of reaction complexes.

Advantages of the photocolorimetric method of analysis - high sensitivity, selectivity and universality. The high sensitivity of method is caused by the possibility to accumulate the painted product of chemical interaction in solution or on tape. The sensitivity of method sharply falls in the measurement of concentrations into several percents by volume and it is above.

The selectivity of photocolorimetric method is explained by the fact that for a significant number of determined gases and vapors, with the known composition of the undetermined blending agents, can be selected the specific color reactions.

The nomenclature of the substances, determined by this method, is very wide, and therefore photocolorimetric gas-analyzers belong to all-purpose instruments.

In practice with the development/detection of the possibility of applying the photocolorimetric gas analyzers for determining different substances decisive is the selection of the corresponding reagent, which gives specific color reaction with the determined component and selection of the mode/conditions of the work of instrument.

There are two types of photocolorimetric gas analyzers, in principle distinct in the design concept and in operating principle.

In some gas analyzers, called photocolorimetric liquid, the reaction occurs in solution, and the concentration of the determined component is measured according to the light absorption of solution.

The advantage of instruments of this type is the higher accuracy of measurement (fundamental given error of approximately 5o/o) and the possibility of applying the indicator solutions in which are included the concentrated acids, which is especially important for the analysis of the microconcentrations of substances, chemically low-activity under normal conditions (hydrocarbons, terpenes and some other organic products).

Main disadvantage in the liquid photocolorimetric gas analyzers, which impedes their exploitation under production conditions, is complexity and unwieldiness of construction/design, caused by the presence of the series/number of mechanisms (pumps, dosing devices of solution, engines, valves, change-over switches, etc.), which ensure motion and reaction of the participating in reaction components (gas-liquid). The deficiency indicated predetermined the limitedness of development and use/application of liquid gas analyzers.

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Up to now there is no satisfactory model of the sufficiently simple, reliable and inexpensively gas-liquid instrument which would be released by in series Soviet instrument-making industry. In the literature [1-3] it is possible to encounter the description of altogether only of several constructions/designs of the liquid

photocolorimeters, intended for determining the microconcentrations of oxides of nitrogen (FK4501, FK4502 and etc.) hydrogen sulfide (FK5601) and some other gases. The development of these instruments ended by output prototypes, not led to series production, or by issue of the short runs of special designation/purpose. Meanwhile the modern constructions/designs of liquid photocolorimetric gas analyzers are necessary, since by the force of the specific special features/peculiarities of the utilized method they would make it possible to expand the field of application of these instruments to a large number of organic substances which are not determined with the aid of another type of instruments.

In the gas analyzers, called photocolorimetric strip/tape, the reaction occurs on the layer of textile or paper tape, and the concentration of the determined component is measured according to weakening of the luminous flux, reflected from the section of the indicator tape, which changed its coloring as a result of chemical interaction with the determined component.

Depending on the physicochemical properties of indicator - reagent it can be brought in to tape - base either previously, in the process its special (dry indicator tape), or it is direct before its photocolorimetry (wet indicator tape).

The use/application of an indicator tape, especially dry, makes it possible to simplify the construction/design of instruments, to decrease their clearance and weight, to remove brittle parts and thereby to raise operating instrument accuracy.

Besides this, strip/tape photocolorimetric gas analyzers possess considerably greater sensitivity in comparison with liquid instruments. Thus, for instance, threshold of response of strip/tape and liquid gas analyzers is respectively on hydrogen sulfide 0.0002 and 0.02 mg/l, on the dioxide or nitrogen 0.001 and 0.01 mg/l [3].

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An essential deficiency in the strip/tape gas analyzers is the significant error of measurement which is caused in essence by the heterogeneity of the material of tape and its saturation, and also by error in the chemical check analysis during the calibration of instrument.

However, if we consider the advantages of strip/tape photocolorimetric gas analyzers and the fact that during the checking of the cleanliness of air of the industrial rooms is permitted a comparatively large error of measurement[1], then it is possible to consider completely worthwhile preferred development and

use/application of these instruments for indication and signaling of the maximum permissible concentrations of toxic gases and vapors in air of industrial rooms.

FOOTNOTE 1. According to the solution of the International symposium, which was taking place in Prague in 1959 and dedicated to a question about the greatest permissible content of toxic substances in air of industrial rooms, relative error during the determination of these substances must not exceed ±20o/o. ENDFOOTNOTE.

In latter/last decade strip/tape photocolorimetric gas analyzers underwent significant development.

The first instruments of this type were created on the basis of the utilization of an indicator tape, moistened from dropping bottle directly before photocolorimetry (FL6801, FKG-3 and etc.).

Subsequently were perfected the measuring circuits of these instruments, was expanded the field of application of the developed modifications and were created universal strip/tape photocolorimeters intended for measuring small concentrations of most varied gases and vapors in air.

One of the recent designs of instruments with wet indicator tape

is the universal photocolorimetric gas analyzer FL5501. Utilization in this instrument of two-photoelement measuring circuit with the electric of compensations (instead of the optical) made it possible to simplify the construction/design of instrument and to reduce the process/operations, bonded with its adjustment.

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Further development of strip/tape photocolorimetric gas analyzers is the creation of the instruments, in which is used dry indicator tape. Instruments of this type differ, first of all, in terms of simplicity of construction/design since in them they are not necessary the devices, which ensure the reserve of the indicator solution, or its dosage and supply to tape in the specific program.

On the basis of this method is created a number of devices, including the base construction/design of phctocolorimetric gas analyzer with the dry indicator tape (FGTs), that has several modifications (FGTs-1V, FGTs-1Ye, FGTs-2, FGTs-3, FGTs-4).

The construction/design of these instruments does not provide for their universality - the possibility of determination by one and the same instrument of the concentrations of different gases and vapors.

This deficiency is caused to a considerable degree by the absence of the procedures of the photocolorimetric analysis (specific reactions) of many substances, which are contained in air.

In the instruments of the automatic analysis of air are used also thermo-conductometry and electroconductometric methods.

The thermo-conductometry method of analysis is based on a change of the heat conductivity of the analyzed mixture in dependence on the content in it of the determined component. Main disadvantage in these instruments consists in the fact that they equally react to all gases, which have close in the value of heat conductivity. Therefore the field of application of thermo-conductometry gas analyzers is very limited and is reduced in essence to the analysis of two-component mixtures or multicomponent ones, all whose components, except determined, possess approximately identical heat conductivity, and the heat conductivity of the determined component considerably differs.

Main disadvantage in the thermo-conductometry gas analyzers - increased sensitivity to a change in the ambient conditions, in consequence of which these instruments possess significant additional

errors.

However, as showed the results of works [3-4-5], these deficiencies can be removed, if to use different methods of increasing the selectivity of instruments, and also more advanced compensation measuring circuits.

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Contemporary thermo-conductometry gas analyzers, as a rule, are characterized by high reliability, minimum number of auxilople and simplicity of the construction/design, which does not require the qualified maintenance/servicing.

At present developed several types and modifications of these instruments, intended for uninterrupted (TP1116M, etc.) and periodic (TP1123) the determinations of the content of hydrogen and air of industrial rooms. Moreover almost all these instruments are released in series.

The electroconductometric method of analysis is based on the dependence of the specific conductivity of the solution of electrolyte on the concentration of the determined component, absorbed by this solution from the analyzed mixture.

Method is characterized by the high sensitivity, which makes it possible to measure the microconcentrations and even tracks of some gases.

However, due to non-selectivity of the method and some other deficiencies it did not have extensive application. Are developed only semiautomatic laboratory installations (KU-1, KU-3) for determining of concentrations CO_2, CO and vapors of gasoline in air. An increase in the selectivity and the decrease of the inertness of electroconductometers will make it possible, apparently, to create the automatic instruments, which correspond to contemporary technical requirements.

Together with the classical methods of the automatic analysis of air obtained use/application the methods, based on the newest achievements of different branches of science and engineering, in particular ionization, optical, Coulomb polarographic (variety of electrochemical ones), magnetic, etc.

Special interest are of the ionization and Coulomb polarographic methods, which give positive results during the determination of microconcentrations.

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The ionization method of gas analysis is based on the dependence of the strength of ion current, which appears with the ionization of the analyzed mixture, from the content in this mixture of the determined component. From the existing methods of the ionization of the analyzed mixture (ionization by flame, by the glowing discharge, photoionization, ionization by radioactive radiation, etc.) great use/application during the development of the instruments of the analysis of air obtained ionization by flame and ionization by radioactive radiation.

The gas analyzers, which use ionization methods of analysis, have high sensitivity, they are simple by construction/design and it is almost inertia-free (inertness of measurement less than one second). However, as a result of small selectivity ionization gas analyzers were not widely applied. Only in recent years as a result of great experimental works are created prototypes of the flame-ionization gas analyzer (" Gamma-1" and of its modification), which makes it possible to determine the content of toxic organic matter in air of industrial rooms.

As showed the results of work [6], the effective method of an improvement in selectivity and sensitivity of the ionization method of analysis is the translation/conversion of the determined component into the aerosol which causes a considerably greater change in the ion current, than gases and vapors. At present there are instruments, based on this principle and intended for determining the harmful substances in air (" Sigma 1" and its modification), but in series they are not released.

Coulomb polarographic method is used comparatively recently. The operating principle of Coulomb polarographic gas analyzers is based on the measurement of the saturated electric current, which appears during the electrolysis of the solution which contains the determined substance, which is electrochemical depolarizer.

The first prototypes of the Soviet Coulomb polarographic gas analyzer (GKP-1), intended for determining sulfurous anhydride in atmospheric air, were developed during the years 1965-1966. During the subsequent years was carried out the theoretical and experimental study of the possibilities of Coulomb polarographic method, which showed that by this method it is possible to analyze almost all toxic substances, which were being encountered in the practice of chemical production, in the ranges of concentrations from $1 \cdot 10^{-7}$ to 100 mg/m^3).

The creation of the new constructions/designs of Coulomb polarographic gas analyzers, the expansion of the field of their use/application and bringing/finishing to series production is the main trend of the research and designing, conducted at present.

The optical methods of gas analysis of their nature are among of most selective ones and sensitive ones. They are based on the utilization of a dependence of change in one of the optical properties of the analyzed mixture (optical density, refractive index, spectral absorption, spectrum radiation/emission, etc.) from the concentration of the determined component.

Optical gas analyzers possess high metrological data, but with exception of transferable interferometers it is structurally/constructurally complex and bulky.

Are known the separate types of interferometers (GIK-1, IGA, etc.), and also gas analyzers of the infrared (GIP-7, GIP-14-7) and ultraviolet (IKRP-445, IKRP-446) absorption, intended for the analysis of air in industrial rooms. Are in series released only

interferometers, whereas the remaining types of instruments either are released in the form prototypes or they do not satisfy the requirements of industry and require the appropriate modification.

In spite of some achievements in the region of analytical instrument building, gas analyzers and signal indicators, intended for the checking of air in industrial rooms, thus far it is still insufficient both according to nomenclature and in a quantity.

In industry continue to predominate the manual (express) and laboratory methods of the analysis of air. About this testify the data, obtained in some enterprises which must become experimental-demonstration on level of automation.

So, at the Voronezh plant of synthetic rubber from a total number of points of selection, at which is conducted the analysis of air, by automatic gas analyzers it is equipped only by 3.5o/o, but at the Severodnetsk chemical combine where it is expedient to automate 60o/o of analyses, it is automated only by 13o/o [7].

The analysis of the requirement for instruments it attests to the fact that for chemical industry are necessary in essence (about 85o/o) the transferable and stationary instruments for explosion proof performance, moreover the requirement for stationary

instruments almost four times more than in transferable ones.

Fundamental requirement compose analyzers and signal indicators; indicators are required in a very small quantity.

As a whole for the chemical, petrochemical and petroleum refining industry is required the development of instruments more than to 300 toxic and dangerously explosive substances.

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The variety of chemical products, the possibility of the appearance of gases and vapors in air of industrial rooms in different combinations and proportions require the creation of the standardized system of instruments.

The existing up to now practice of design to a considerable degree is characterized by the insufficient use/application of principles of unification, which leads to the creation of the instruments of individual constructions/designs and creates difficulty in the mastery/adoption of the production of new instruments.

At the present time is initiated the work on the creation of the

standardized system of signal indicators and analyzers, based on the thermochemical and photocolorimetric methods of measurement. Each branch of standardized system will be the normal series/number of the typical dimensions of basic machines, models and modifications, including stationary analyzers, stationary and transferable signal indicators and transferable indicators.

Unification, as one of the stages of standardization, will make it possible to considerably reduce the periods of development and mastery/adoption of new models, and to also lower the expenditures of resources for development and production of new instruments.

The technical perfection of the enterprises of chemical industry conditions an increase in the requirement for instruments and simultaneously imposes the increased requirements on the quality of the instruments of the automatic analysis of air.

Until automatic gas analyzers were used for purposes of checking during manual control of production, the technical specifications, imposed on them, were low. The role of gas analyzer was passive, but errors and malfunctions did not entail heavy consequences. When these instruments began to be used in the systems of automatic protection and signaling, and also in the automatic control systems, serving purposes of safety engineering, requirements for their reliability

and accuracy grew considerably, since in this case of failure of the instrument, checking the appearance of a dangerous concentration, can lead to blast or poisoning of people, and the false response of block-signal system, caused by this instrument, as a rule, entails large material damage.

Operating conditions of instruments with transition/junction from the partial automation of productions to complex are significantly stiffened. On chemical enterprises is reduced the number of service personnel, and in connection with this servicing of instruments must be minimum. Furthermore, in the majority of contemporary chemical production periodic processes are replaced by uninterrupted ones. Consequently, and protective systems and signaling (but it means, and their sensors - gas signal indicators) must smoothly work during long time (to several thousand hours).

Until recently to automatic gas analysis technique, and in particular for the instruments of the analysis of air, were imposed requirements of the determination of any component in comparatively simple gas-air mixtures. Now, with production of complex organic compounds and synthetic materials, in air of industrial rooms the simultaneous possible presence of several (or a large number) chemical substances, their concentrations can continuously be changed.

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Under these conditions are necessary the instruments of the general-purpose use/application, which allow/assume, as a rule, change in the composition or the uncontrollable part of the analyzed mixture over wide limits, i.e., possessing the increased selectivity.

Not smaller requirements are presented also to metrological characteristics of the instruments of the automatic analysis of air. The very important characteristic, which is determining the possibility of applying gas analyzer for specific case of exploitation, especially for determining the microconcentrations of toxic substances in air, is sensitivity or, is more accurate, the threshold of response of instrument.

Thus, the fundamental requirements, presented by industry to the instruments of the automatic analysis of air, these are maximum simplicity of construction/design, reliability, universality, increased selectivity, sensitivity and accuracy, capacity long time to work under different production conditions.

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1. Automatic analysis of air.

1.1. Approximate functional diagram of automatic gas-analytic instrument (installation).

The determination of the content in air of industrial enterprises in the harmful for health industrial enterprises of harmful ones for health and dangerously explosive admixtures/impurities is the independent section of the gas analysis, which places with its task the measurement of the concentration of separate components in the analyzed gaseous mixture.

Automatic gas analysis, in particular the analysis of air, is the totality of process/operations (stages), provided for by gas analysis and accomplished by a gas-analytic instrument automatically, without the participation of man.

In this case the term gas-analytic instrument is generalizing for the following group of instruments:

gas analyzers - the measuring instruments, intended for investigation and establishment of the qualitative and (or)

quantitative composition of the analyzed gaseous mixture [1];

Gas signal indicators - the instruments, which accomplish/realize only a signaling about the achievement of the preestablished value of the concentration of the analyzed component (or their sum) and not intended for quantitative evaluation of the factual value of concentration to or after the moment of operation of signal indicator.

FOOTNOTE [1]. They can possess simultaneously the signs of gas signal indicator. ENDFOOTNOTE.

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During the appropriate construction/design the instrument can signal about the achievement of several values of the concentration;

Gas indicators - instruments, intended for the detection of the analyzed component (or their group) and of the signalling upon reaching values of the concentration of this component, equal to the threshold of response of this instrument.

Automatic instruments consist of blocks and assemblies, functionally connected and united into the single complex gas-analytic system, of which automatically are selected/taken the tests/samples of the analyzed gaseous mixture, occurs strictly analysis, fixation of the results of analysis, and also distance of the analyzed test/sample from instrument.

In semiautomatic instruments the sampling and its distance are fulfilled by hand, but strictly analysis and fixation of the results of analysis - automatically.

The approximate block diagram of the gas-analytic system is represented in Fig. 1.

The basic functional link of gas-analytic instrument is the sensor, in which depending on the composition of the test/sample of gas appears and is formed/shaped the output signal (current, voltage), proportional to the concentration of the analyzed component. The output sensor signal is amplified (it transforms itself) and enters the secondary instrument where occurs measurement and fixation of the value or signal.

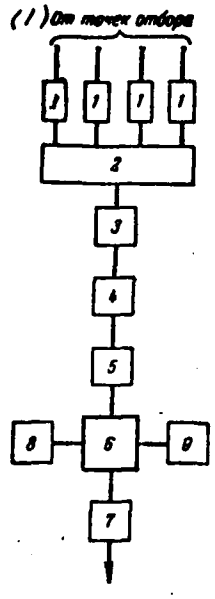

Fig. 1. Approximate functional diagram of the gas-analytic installation. 1 - purification and drying devices; 2 - gas-distributing device; 3 - special purification device; 4 - device, which stabilizes the flow rate; 5 - device for the control of the expenditure/consumption; 6 - sensor; 7 - sucking device (stimulus of expenditure/consumption); 8 - power supply unit; 9 - secondary instrument.

Key: (1). From the points of selection.

Sensor, block of amplification and meter (secondary instrument) are supplied usually from the stabilized supply of power (power supply unit). As the secondary instruments of gas analyzers are used (with insignificant changes in electric circuit) typical automatic electron comparators, potentiometers and balanced bridges. These instruments can be simultaneously showing and recording, they can have two- and three-position controlling (signal) devices, utilized for the delivery of the commands to the signaling systems and control (protective system). The totality of the examined functional links (sensor, meter of output signals and power supply unit) is the assembly of automatic gas-analytic instrument.

For the normal work of automatic gas analyzers the analyzed mixture of gases, which enters the input of sensor, must have the specific physicochemical parameters. Divergence from the required parameters brings, as a rule, either to increasing the error in the analysis or to the fact that conducting analysis becomes generally impossible.

The preparation of gas for analysis perform so-called auxilople. They include, first of all, the resources of the sampling, its cleaning/purification from the mechanical impurities and moisture, resource of the transport of test/sample to sensor, and also control device and stabilization of expenditure/consumption and pressure of

the analyzed gaseous mixture. In certain cases it comes, furthermore, to resort to the special devices, intended for the chemical purification of gaseous mixture from the which mix determination or agressive admixtures/impurities; to the gas-distributing devices, which make it possible to produce sampling from several points (rooms), and also to the diluting devices, used if necessary of expanding the range of the measurement of gas analyzer.

The enumeration of auxilople, which complete one or another type of gas-aralytic instrument can be determined only after studying of the specific conditions for analysis and operating this instrument.

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The quality of the work of auxilople and their correct selection in large measure determine the quality of the work of an entire gas-analytic installation, which is the totality of the assembly of gas-analytic instrument and set/dialing of auxilople.

1.2. Basic concepts and definitions, used in the region of automatic gas analysis.

The analyzed mixture - mixture of gases and vapors which must be analyzed, i.e., it is determined its qualitative and (or)

quantitative composition or in which must be determined concentration of its separate components.

The determined component - component or sum of several components, which form part of the analyzed mixture, presence or quantitative content of which is determined by gas-analytic instrument.

Test/sample of the analyzed gas - portion of gas, cyclically or continuously selected/taken by sampling device from the limited space (room or its individual section) for the analysis, performed by gas-analytic instrument.

Control (calibration) mixture of gases - artificially prepared gaseous mixture with known qualitative and quantitative composition, utilized for calibration and checking/verifying the gas-analytic instruments.

The concentration of the determined component - quantity of determined component, which is contained per unit of volume of the analyzed mixture of gases.

In the practice of the determination of the concentration of toxic and dangerously explosive substances in air of the production

rooms distinguish the concentrations as normal and saturated.

Normal concentrations these are such concentrations of the toxic or dangerously explosive substances in air, with which is excluded the possibility of blast or poisoning in production.

Limiting concentrations they are respectively: for toxic substances - maximum permissible concentration, (PDK), for dangerously explosive ones - the maximum permissible explosion proof concentration (PDVK).

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The state sanitary supervision of the USSR establishes/installs necessary for all branches industries of the norm of the maximum permissible content of harmful substances (vapors, gases and dust) in air of the working zone of the industrial rooms (see appendix 1).

The maximum permissible concentration - such concentration of toxic substances, which are contained in air of industrial rooms, which under the daily influence during unlimitedly prolonged time cannot cause in the working occupational diseases or any divergences from normal state, detected by contemporary means of investigation [8].

Smallest and is greatest, concentration of the combustible and (or) dangerously explosive substances in air, in interval of which can occur the ignition or the blast of this mixture from its contact with the source of ignition, they are called with respect to lower (NPV) and upper (VPV) concentration inflammability limits, but an interval between them - regions of ignition.

Is the maximum permissible explosion proof of concentration (PDVK) of vapors and gases with work with the use/application of a fire/light and sparking instrument - concentration which does not exceed 5o/o of value of the lower inflammability limit of this vapor or gas in air [9].

The usually maximum permissible concentrations are expressed in milligrams to cubic meter (mg/m³), in milligrams per liter (mg/l) and less often - in grams to the cubic meter (g/m³) of the air; dangerously explosive - in the percents by volume (Vol. o/o).

In the literature, especially in foreign, frequently is encountered the expression of substance concentration in parts to millions rrf, or, which is the same thing, the content of substance in milliliters to the cubic meter of air.

The limits of the measurement of gas analyzer - small and great value of the concentrations of the determined component within limits of which the instrument accomplishes/realizes a measurement with an error that not exceeding the given one.

Range of measurement - interval of the values of the concentration of determined component, close to margins of measurement of gas analyzer.

The automatic gas analyzers, intended for a work in two or more different ranges of the concentrations, limited each by the specific pair of the numerical values of the lower and upper limits of measurement, are called multirange.

Distinguish also zero (lower limit of measurement is equal to 0) and suppressed zero (lower limit of measurement is different from 0) ranges measurements.

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Common absolute reading error of gas-analytic instrument - totality of its fundamental error and series/number of the additional

particular errors, which characterize the stability of instrument to various kinds to effects, under operating conditions.

Fundamental absolute error - the common absolute reading error of gas analyzer, determined under standard conditions of this operation.

The fundamental given error - the fundamental absolute error, in reference to the range of the measurement of instrument and expressed in percentages of this range

$$\delta_0 = \frac{П - C}{C_1 - C_2} \cdot 100$$

where П - readings with the transmission of control gaseous mixture, Vol. o/o content of the determined component;

C - actual content of the determined component in control gaseous mixture, Vol. o/o (according to specifications to this mixture);

П—C - fundamental absolute reading error of the instrument;

C_1 - the upper limit of the measurement of gas analyzer, Vol. o/o;

C_2 - lower limit of the measurement of gas analyzer, Vol. o/o;

C_1-C_2 - range of the measurement of gas analyzer, Vol. o/o.

The value of a fundamental error of gas analyzer is determined under the following normal (calibrated) conditions for its exploitation;

Ambient temperature of 20±2°C;

Relative humidity of environment 30-80o/o;

Atmospheric pressure 745±25 mm Hg (99.3±3.3 kN/m²);

Supply voltage within limits of ±10o/o from the nominal value of line voltage of feed (220, 127 V);

Frequency in limits of ±1o/o from nominal value (50 Hz);

The composition and the parameters of the analyzed gas (temperature, pressure, humidity, expenditure/consumption, concentrations of immeasurable components, etc.) must correspond to

calibration ones and they must not cause additional errors.

Additional absolute error - change in the readings, caused by the divergence of value of one of the environmental factors from the nominal value, which corresponds to standard conditions for the exploitation of instrument, under which is determined fundamental error of its readings.

The additional given error - the additional absolute error, in reference to the range of the measurement of instrument and expressed in percentages of this range.

From a large number of factors, which call additional errors, are standardized only those, that have vital importance for the selected method of analysis and for the given construction/design of instrument.

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Additional errors are standardized separately for each of the influencing factors. Most frequently are indicated the errors, which appear from the change:

environmental parameters (temperature, atmospheric pressure,

relative humidity);

the parameters of the analyzed gaseous mixture (temperature, pressure, expenditure/consumption through the sensor, the contents of undefined components);

the parameters of the network/grid of feed (voltage, frequency).

Under operating conditions under the simultaneous influence of several factors appears summary quadratic additional error $\Delta_{\text{сум}}$, which is defined as square root from the sum of the squares of corresponding particular additional errors δ_i. For contemporary automatic and semiautomatic gas analyzers, according to GOST [All-union State Standard] 13320-67 [10], the standardized value of particular additional errors (by each individually) must not exceed half of the absolute value of the fundamental given error.

In this case the value of summary quadratic additional error must comprise not more than 1.2 values of the fundamental given error:

$$\Delta_{\text{сум}} = \sqrt{\delta_1^2 + \delta_2^2 + \ldots + \delta_n^2} \leqslant 1{,}2\delta_0$$

Class of instrument accuracy - characteristic of instrument,

which uses for the evaluation/estimate of its precision possibilities, numerically equal to the absolute value of the established/installed for this instrument fundamental given error and which is determining the maximum permissible values of many metrological indices of instrument.

Sensitivity of gas-analytic instrument - relation of the displacement/movement of the indicator of measuring unit (arrow/pointer, foil) and to the change in the concentration of the determined component, which caused this displacement/movement.

Threshold of response - small change in the value of the concentration of the determined component, capable of causing a least change of reading the measuring instrument.

Time lag of readings of gas analyzer (inertness) - the time, which passed from the moment/torque of changing the value of the concentration of the determined component at the input into the sensor of gas analyzer (input signal to the moment/torque of the establishment of the readings, which corresponds to the value of this concentration, with precision within the limits of fundamental error.

The inertness of readings of gas analyzer is the important characteristic, very which is frequently determining the possibility

of applying the gas analyzer in this specific case, especially during utilization in automatic control systems or in the systems of emergency protection system and signaling.

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Time it began reactions - time interval from the time of a change in the concentration of the determined component at the input into the sensor of gas analyzer to the moment/torque of the beginning of a charge in the output sensor signal.

Depending on the time of the beginning of reaction gas analyzers can be divided into three basic groups:

(1) Группа	1	2	3
(2) Время начала реагирования, сек	(3) до 10	10—30	(4) свыше 30

Key: (1). Group. (2). Time began reactions, s. (3). to. (4). it is more than.

Starting time - time interval from the moment/torque of the fulfillment by the operating personnel of all periodic servicing on the preparation of gas-analytic instrument for exploitation to the moment/torque of the establishment of his permanent output signal.

1.3. Forms of the performance of gas-analytic instruments.

According to a number of separate blocks, which generate in totality the assembly or gas-analytic instrument and which perform the specific fundamental and auxiliary process/operations of gas analysis, all automatic gas-analytic instruments subdivide as follows:

monoblock - structurally/constructurally carried out in one housing, general/common/total for all functional links, entering the assembly of the instrument;

multiblock - structurally/constructurally carried out in two or more separately assembled housings, in each of which are included one or several functional links, making up the assembly of instrument.

Depending on the possibility of displacement/movement during exploitation automatic gas-analytic instruments can be stationary and transferable.

By the character or mounting are distinguished the following forms of structural-assembling performance of the stationary

gas-analytic instruments:

wall - foreseeing the mounting of instrument on the wall of the room;

frame - a joint mounting of all functional links of gas-analytic instruments of auxilople on metallic girder frame, intended for the individual mounting;

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panel - providing the mounting of instrument on the panel of the vertical panel, intended for a mounting on it of KIP and control instruments;

cabinet - characteristic that the instrument is structurally/constructurally mounted on cabinet type panel.

Depending on that, for what operating conditions is intended one or another the instrument, there are two basic groups of the performance of the automatic gas-analytic instruments: the instruments of normal performance and the instruments of special performance.

The instruments of normal performance are intended for a work in industrial rooms with standard conditions for the exploitation; to them are not presented special requirements in the ratio of their stability to different kinds of external agents.

For protection from the effect of harmful factors on the work of gas-analytic instruments are provided for different forms of the special design concept of these instruments [10], caused by specific (different from normal ones) operating conditions.

Stability to the effect of different factors of the environment provide the following forms of performance:

that dustproofed - foreseeing protection from the penetration of dust from surrounding air inside the housing of instrument with the blowing of it under certain conditions, also, during preset time by air of the specific dustiness;

splashproof - foreseeing protection from the penetration of the splashing of water from the surrounding spaces inside housing instrument with polishing of it under certain conditions, also, during preset time by rain of the prescribed/assigned intensity;

that water-proofed - foreseeing protection from penetration

inside the housing of the instrument of water with its drenching outside by the water jet or the prescribed/assigned pressure head from the prescribed/assigned distance during the specific time;

waterproofed - foreseeing protection from penetration inside the housing of the instrument or water during its immersion into water at the prescribed/assigned depth during the specific time.

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tropical - ensuring normal effect/action of instrument under conditions of the tropical climate of the specific type (moist or dry);

airtight - design concept, which ensures the specific strength and the density (tightness) of housing, adjusted by the testing by outside hydraulic and within by the pneumatic pressure of the assigned magnitude;

corrosion-resistant - foreseeing protection from the which destroys effects specific corrosive gas or group of gases found in surrounding air (in the analyzed mixture of gases) in the limits of the prescribed/assigned range by gas concentration.

Depending on stability to mecnanical effects are distinguished the instruments by their design concept:

Vibration-resistant - operating fitly under conditions for the induced vibration of the prescribed/assigned form and duration, the characterized by the specific range frequencies and amplitudes (accelerations);

vibration-proof - working fitly after the effect of the vibration of the prescribed/assigned form and duration;

shaking-resistant - operating fitly under conditions of the induced shaker, characterized by specific ranges of the average/mean values of frequencies and accelerations, and also by duration of the effect;

shake-proof - working fitly after the effect of the shaker of the prescribed/assigned form and duration;

shock resistant - fitly working after the effect of the shock jolts, characterized by that determined range of the values of their quantity, frequency, accelerations (energy of impacts) and duration.

There is also design concept of the gas-analytic instruments,

which ensures their stability to the effect of electromagnetic and radioactive emissions.

The large subgroup of the gas-analytic instruments of special performance present the explosion-proof instruments whose design concept provides safety from use/application in dangerously explosive rooms.

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These instruments depending on the level of blast shield are subdivided into the following groups:

1) the instruments of increased reliability against blast - the design concept provides for resources and measures, which impede the onset of sparks, of electric arcs and heating, and provides blast shield only in the mode/conditions of their normal operation;

2) explosion proof instruments - the design concept provides for protective measures from the blast of the surrounding dangerously explosive gas-, vapor- and dusty mixture as a result of the actions of sparks, of electric arcs or heated surfaces with normal operation and during the probable damages;

3) the instruments, explosion proof with any numbers of damages, the design concept provide for protective measures from the effect/action of sparks or electric arcs with normal operation and with the unlimited number of damages of any elements/cells with exception of the protective elements of sparkproof systems.

Depending on level the blast shields, and also the explosion hazard of the medium for which this instrument is acknowledged explosion-proof, the "rules of the preparation/manufacture of explosion-proof and mining electrical equipment" (PIVRE) establish/install the following conventional designations of the performance of instruments.

In the first place is placed the letter, which designates the level of the blast shield:

the increased reliability

against blast..... H

is explosion proof..... B

explosion proof during any damages ... O.

Further as sign of the level of blast shield is indicated (in the second place the highest category and (in the third place) the highest group of the dangerously explosive mixture for which this instrument is acknowledged explosion-proof (see appendix 2).

Thus, for instance, instrument, which has "explosion proof" performance for the substances of the 3rd category of group T4 will have an index of blast shield B3T4, performance of "increased reliability against blast" for the substances of the 4th category of group T3-H4T3 and so forth.

In explosion-proof performance are usually released only the sensors and auxilople to gas analyzers and gas indicator. Electrical units and secondary instruments nave most frequently general-purpose performance and are established/installed in explosion proof rooms.

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1.4. Safety evaluation and reliability of automatic gas analyzers and gas indicators.

In fire and dangerously explosive productions the safety of the instruments of automation plays very important role. As is known,, so that would occur the blast, is necessary, first of all, the presence

in air of the dangerous concentration of vapors and gases. However, in the gassed room blast can occur only upon the appearance of a source of ignition - electric discharge (friend, spark), incandescent to dangerous temperatures contacts, etc.

Therefore the safety of instruments must be rated/estimated, first of all, by the probability of the occurence of blast or ignition under the normal or emergency conditions for their exploitation.

From this point of view all instruments can be divided into two groups:

instruments without the use/application of the electric energy;

instruments with the use/application of electric energy.

The instruments of the first group are absolutely safe, since cannot be reason the appearances of sources of ignition.

The automatic gas analyzers in question and gas indicators with small exception are related to the instruments, which work with the use/application of the electric energy.

The instruments of this group depending on the degree of safety are subdivided into usual ones and explosion-proof ones [10]. Instruments usual (general-purpose performance) almost always can be the reason for blast under conditions for dangerously explosive productions. Therefore their use/application in dangerously explosive rooms is not allowed/assumed (PUE, Chapter VII-3).

As an exception is allowed/assumed the installation of the sensors of the instruments of normal performance in dangerously explosive rooms under the condition for their arrangement within the airtight cabinets, air-blown or inert gas under overpressure with its overshoot in the atmosphere beyond the limits of dangerously explosive room (PUE, Chapter VII-3/27).

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The degree of the safety of explosion-proof instruments is caused by their, first of all, design concept, which ensures the appropriate protection or the establishment of safe parameters of the used in them electrical energy in accordance with the requirements of the existing PIVRE [11]. Therefore the evaluation/estimate of the degree of the safety of these instruments is reduced to the evaluation/estimate of their design concept, which allows (or not making it possible) to use an instrument in dangerously explosive

rooms of the corresponding class.

Table 1 gives the safety evaluation of automatic and semiautomatic gas analyzers and gas indicators of explosion-proof performance depending on the form of performance with the indication of the class of room, and also categories and group of the inflammability of the dangerously explosive media, in which is allowed/assumed the use/application of these instruments.

During the exploitation of automatic gas analyzers and gas indicators together with safety less important value has reliability of these instruments which is caused by their mainly reliability.

By reliability is understood the property of instrument (device) to retain fitness for work during the prescribed/assigned time interval under certain conditions of exploitation.

The reliability of instruments is defined by the time of the failure-free operation T or as accept it to call, by operation time by malfunctions and by rate of failures λ, which are connected with the following dependence:

$$\lambda = \frac{1}{T}.$$

The evaluation/estimate of instrument accuracy, in particular,

automatic gas analyzers and gas indicators bears probabilistic character, since the fundamental indices of reliability are values accidental, and the methods of their determination are based on collection and processing of statistical information.

The collection of statistical material for determining reliability is accomplished/realized directly during the normal exploitation of instruments (controlled exploitation) or by the bench tests by a the manufacturer under conditions, stipulated in the certificate of this instrument.

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Over a number of years some specialized organizations as, for example, special design bureau of the analytical instrument manufacture (SKBAP) of the Academy of Sciences of the USSR experimental design office of the automation (OKBA) of ministry chemical industry of the USSR, etc., investigate the instrument accuracy and resources of automation. As a result of works [5, 14, 15, 16, 17] conducted is accumulated the material, which makes it possible tentatively to judge about the degree of reliability of the separate types of automatic and semiautomatic gas analyzers and gas indicators used for determining the toxic and dangerously explosive substances in air of industrial rooms. the fundamental information

about reliability level of these instruments, borrowed from the works pointed out above, taking into account the data of controlled operation of some instruments, conducted by All-Union scientific research institute safety engineering in chemical industry (VNIITBKhP), is given in Table 2. These data are related only to the failures, revealed in the process of the work of instruments on the spot of installation (under operating conditions) and they do not consider the concealed/latent (metrological) failures, occurring due to the excess of the permissible errors of measurement and revealed/detected only while conducting of planned checks/verifications and repairs.

For many instruments the large part of the failures falls in the fraction/portion of metrological failures. Therefore the given data are somewhat high.

Table 1. the fundamental data, which are determining the field of application of automatic gas analyzers, gas indicators and indicators in the explosive shielded performance.

(1) Тип прибора	(2) Уровень взрывозащиты	(3) Вид взрывозащиты	(4) Условное обозначение	
			(7) согласно ПИВЭ	(7) согласно ПИВРЭ
ПГФ2М1	(10) Взрывобезопасный	(11) Искробезопасность со взрывонепроницаемыми элементами	ИIА/метан (12) (14) ИЗГ/серный эфир И4А/водород (15)	B1T1-И, В B3T4-И, В B4aT1-И, В
ИВК-1	(13) То же	То же (3)	ИЗГ/серный эфир (4)	B3T4-И, В
ИВП-1	»	»	ИЗГ-И4А	B3T4-B4aT1-И, В
ПИВ-1	(16)	» (17)	И2Г	B2T4-И, В
СГГ2М	Взрывобезопасный (датчик)	Взрывонепроницаемая оболочка	В2Б	B2T3-B
			В3Г	B3T4-B
			В4Б	B4T2-B
СВК-3М1	То же (13)	То же (3)	В3Г-В4А	B3T4-B4aT1-B
ФГЦ	»	Искробезопасность	ИО/сероуглерод (23)	B4T5-И
«Гамма-1» (19)	»	Взрывопроницаемая оболочка	В3Г-В4А	B3T4-B4aT1-B
«Сигма-1» (20)	»	Взрывонепроницаемая оболочка с искробезопасными элементами (21)	В3Г-В4А, И	B3T4-B4aT1-B, И
			серный эфир, водород (22)	

Table 1 (cont.)

(5) Класс помещения					(6) Взрывоопасные смеси									
					(8) Категория					(9) Группа				
B-I	B-Ia	B-Iб	B-II	B-IIa	1	2	3	4 а	4 б	T1	T2	T3	T4	T5
+	+	+	+	+	+					+				
+	+	+	+	+		+	+				+	+	+	
+	+	+	+	+				+		+				
+	+				+	+	+			+	+	+	+	
+	+	+	+	+	+	+	+	+		+	+	+	+	
+	+	+	+	+	+	+				+	+	+		
+	+	+			+	+	+			+	+	+	+	
+	+	+						+	+	+	+			
+	+	+	+		+	+	+	+		+	+	+	+	
+	+				+	+	+	+	+	+	+	+	+	+
+	+	+	+		+	+	+			+	+	+	+	
	+				+	+	+	+		+	+	+	+	

Notes: 1. Table is comprised in accordance with requirements of PIVE (section II) [12], PIVRE (Chapter 1.2, 1.3) [11] and of PUE (Chapter VII-3) [13].

2. Conventional designations according to PIVE is accepted in dependence on form of blast shield and the highest category and group in dangerously explosive mixture for which this instrument is acknowledged explosion-proof. The conventional designations according to PIVRE is received in dependence on the level of blast shield and as the highest of categories and group in the dangerously explosive

mixture for which this instrument is acknowledged by explosive shielded, and the form of blast shield is indicated separately.

3. Sign "+" showed class of room medium (category for which this instrument is intended.

4. Categories of dangerously explosive mixtures indicated are limited by enumeration of substances, to which calibrates itself this instrument.

Key: (1). Type of instrument. (2). level of blast shield. (3). Form of blast shield. (4). conventional designations. (5). Class of room. (6). Dangerously explosive mixtures. (7). accordingly. (8). Category. (9). Group. (10). Explosion proof. (11). spark safety with explosive-nonexplosive elements/cells. (12). methane. (13). Then. (14). sulfur ether. (15). hydrogen. (16). Explosion proof (sensor). (17). Explosion-impermeable shell. (18). Spark safety. (19). Gamma. (20). Sigma-1. (21). Explosive-impenetrable shell with sparkproof elements/cells. (22). sulfur ether, hydrogen. (23). carbon disulfide.

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Furthermore, the given by different researchers values of the parameters of the reliability of one and the same types of instruments are not identical, what is explained, first of all by deficiencies in the very method of study - the method of controlled exploitation (difficulty of organizing the regular collection of full/total/complete and reliable information, difference in the conditions for the work of instruments on enterprises, etc.).

To reason indicated strength the recommended evaluations/estimates of the parameters of the reliability of the separate types of instruments, led in Table 2, can be used only as tentative.

Table 2. Indices of the reliability of automatic gas analyzers, gas signal devices and indicators [5, 14].

(1) Тип прибора	(2) Средние значения параметров безотказности	
	(3) интенсивность потока отказов λ, 1/ч	(4) наработка на отказ T, ч
ПГФ2М1	$3,8 \cdot 10^{-6}$	26000
СГГ2М	$43 \cdot 10^{-5}$	2300
СВК-3М1	$12,8 \cdot 10^{-6}$	7800
ТП1116М	$21,2 \cdot 10^{-5}$	4700
ФКГ-2	$91 \cdot 10^{-6}$	1100
ФКГ-3	$28 \cdot 10^{-6}$	3570
ФГЦ	$10,7 \cdot 10^{-4}$	930
ФЛ5501	$19,2 \cdot 10^{-4}$	520
(5). Сигма-1 [1]	$83 \cdot 10^{-6}$	1200
(6). Гамма-1 [1]	$10 \cdot 10^{-4}$	1000

Key: (1). Type of instrument. (2). Average/mean values of parameters of reliability. (3). intensity of flow of failures λ, 1/h. (4). working to failure T, h. (5). Sigma -1 [1].

FOOTNOTE [1]. Are given the data of bench tests. ENDFOOTNOTE.

(6). Gamma-1 [1].

1.5. Selection, installation and operating condition of automatic gas analyzers and gas signaling devices.

Taking into account the specific ones of working conditions of the chemical and petroleum refining productions, and also the increased fire and explosion hazard of the separate processes of

these productions, it is necessary with special attention to be related to the selection of the instruments of automatic check and protection and, in particular, to the selection of automatic gas analyzers and gas signaling devices for determining the toxic and dangerously explosive substances in air of industrial rooms.

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When selecting and setting up of these instruments one should, first of all, track the conformity of the form of the performance of instrument to the conditions in which it will work (see 1.3 the "Forms of the performance of gas-analytic instruments"). The instruments, which one must establish/install in dangerously explosive rooms, must be in the explosion-proof performance, which corresponds to those categories and groups of the dangerously explosive mixtures which can be formed in this room (see 1.4 "Safety evaluations and reliability of automatic gas analyzers and gas signal devices"). For the correct selection of gas analyzer and its completing auxilople it is necessary to have information in the space of the questionnaire (see Appendix 3), where are indicated the designation of the measured component, the full/total/complete composition of the analyzed gas-air mixture, the limits of measurement, permitted an error of measurement and time lag, characteristic of the place of the sampling of air, setting up of

sensor and secondary instrument, etc. When selecting the scales of device one should be guided by the data about the limiting concentrations of the determined component in air of the working zone of the industrial rooms (see Appendix 1).

As a rule, measurements at the very beginning of the scale do not make, since is the nearer operating point at the beginning of the scale, the greater the error of measurement. Therefore the scale is selected in such a way that the value of operating point (signalled or controllable/controlled/inspected value of concentration) it would be located in zone, close to 2/3 upper values of the scale. When selecting of gas analyzer (gas signal device), necessary as the sensor of the system of automatic protection and signaling, it is necessary to keep in mind that the signaling systems of concentrations of combustible gases sufficient for explosion and vapors must put out signal with the concentration of these substances in air in limits of 5-50o/o from NPV, but toxic - with the concentration, equal to PDK.

During the setting up of automatic gas analyzers and gas signal devices, and also auxilople to them in industrial shops it is necessary to consider rules and requirements, caused by the design special features/peculiarities of these instruments and by the specific character of their exploitation under these production

conditions.

Page 38.

Setting up and servicing of gas analyzers must be accomplished/realized in accordance with assembling-operating instructions applied to each instrument. Besides the specific conditions, stipulated in assembling-operating instructions, there are general considerations, which should be been guided during setting up, mounting and exploitation of automatic gas analyzers and gas signal devices. Let us point out some of them.

1. Automatic instruments for control/checking in air of concentrations of gases and vapors sufficient for explosion it is necessary establish in all rooms where is possible liberation/isolation of combustible gases and vapors of inflammable liquids.

In those rooms where is possible the liberation/isolation of vapors and gases of sulfurous, chloride, cyanide and phosphoric connections, instead of gas signal devices of combustible concentrations it is necessary to establish/install gas signal devices PDK. This is caused by the fact that gas signal devices of of pre-explosion concentrations (predominantly thermochemical) go out of

order due to poisoning of platinum catalyst by sulfurous, chloride, cyanide and phosphoric connections in the concentrations higher than PDK.

In the rooms where are established/installed the gas analyzers (or gas signal devices) of PDK of toxic substances in air, instruments for determining the preexplosive dangerous concentrations of these substances, as a rule, are not established/installed.

2. Automatic devices for monitoring of content of toxic substances in air must be placed in all rooms where is possible liberation/isolation of harmful vapors and gases, indicated in SN 245-63 (including additions to them).

3. Test/sample of air for determining concentrations of toxic substances should be selected/taken in rooms at work sites at height of 1.5-1.7 m. In this case it is necessary to establish/install not less than one sensor to every 200 m^2 of the area of room [18].

4. Sampling devices of gas analyzers of gas signal devices of preexplosive concentrations should be placed in region of most probable sources of gas evolutiones.

Along height their rooms arrange/locate, taking into account the vapor density and gases (it is compulsory to correct for temperature). For industrial rooms with small heat evolution it is possible to recommend the following arrangement/position of the points of sampling:

with liberation/isolation of light gases with density on the basis of air less than 1 - at the height of 0.5-0.7 m above the source;

with gas evolution with the density on the basis of air, equal to 1, but not more than 1.5, at the height of source or it is lower than the source not more than on 0.6-0.7 m;

with gas evolution and vapors with the density on the basis of air of more than 1.5 - at the height not more than 0.5 m above the floor/sex.

5. Sampling of tube in place of sampling of air must be finished with those turned downward funnel of diameters not less than 100 mm.

6. Distance from site of installation of sampling device to site

of installation of sensor must be shortest for safeguard of smallest instrument lag.

7. Sensor of gas analyzer must be established/installed on stable foundation and shielded from vibrations and jolts. As a rule, sensor is assembled on the special panel, adjusted near from the place of sampling. Here, on the panel of sensor or near from it on the special framework, are assembled some auxilople (power supply unit, filters, stimulus of expenditure/consumption, etc.).

With the significant liberations/isolations of dust in room or in the case of the danger of mechanical damage the sensor should be assembled in cabinet type panel. The panel of sensor should be established/installed in the places of convenient ones for maintenance/servicing and repairs. The temperature in the site of installation of sensors must be from 5 to 50°C, and relative humidity - from 30 to 80o/o.

8. Gas line, which supplies analyzed gas-air mixture from point of selection to sensor of gas analyzer, must be airtight and prevented from choking. The mounting of gas line must allow for its purging, and also periodic cleanup of gas-bleeding felling without its dismantling.

9. Material of tubes, armature, adapters and other elements/cells of tube route must possess corrosion resistance to effect of analyzed and environment.

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Gas line from sampling device to sensor in the majority of the cases is prepared from seamless small tubes made of the carbide and stainless steel, and in certain cases - from copper small tubes. The sizes/dimensions of the gas-feeding tubes (diameter and wall thickness) are determined by the construction/design of connecting pipes and by the technical specifications, imposed on gas analyzer and to an entire gas-analytic setting up (for example, the permissible time lag, the expenditure/consumption of the analyzed gas-air mixture, etc.).

The use/application of small-diameter tubes (less than 8 mm) is not recommended, since the decrease of diameter can lead to choking of tubes and to an increase in the instrument lag. Recently for the binding of separate blocks, and for transporting tests/samples also use extensively the nonmetallic ones of the tube: polyethylene, polychlorovinyl, etc. The use/application of plastic tubes instead of the metallic ones is preferable especially under conditions of agressive media (transported on conduits/manifolds and that

surrounding), in damp/crude rooms, and also in the presence of vibrations and jolts. Polyethylene tubes one should use for outer (in the open air) and internal (in rooms) wirings; polychlorovinly - for interior wirings and for wiring in panels and boards.

10. Used as secondary instruments to gas analyzers electron potentiometers, comparators and balanced bridges can be assembled either on general/common/total panels of instruments of technological monitoring and automatic control or on separate panels. In this case it is necessary to keep in mind that these instruments can be referred from sensors to the limited distance, which makes it possible to observe of readings during adjustment and adjustment of gas analyzers. The conditions for mounting and exploiting the secondary instruments usually are specified in appropriate assembling-operating instructions to these instruments.

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2. Gas analyzers, gas signal devices and indicators for determining the dangerously explosive and combustible substances in air.

2.1. Instruments for determining hydrogen.

For determining hydrogen in air of industrial rooms are used, first of all, the staticnary automatic gas analyzer of TP1116M and transferable gas analyzer TP1123.

Besides these instruments for determining hydrogen it is possible to use: a signal indicator of combustible gases SG2M-V4B, a signal indicator SVK-3M1, transferable analyzer of PGF2M1-I4A, transferable indicator IVP-1 (described in section 2.4.,) and gas detector interference GIK-1, described in section 2.2.

Stationary automatic gas analyzer of TP1116M.

Instrument is developed by SKB of the analytical instrument manufacture of the AS USSR and is released by the series Vyra plant of gas analyzers.

Designation/purpose. Gas analyzer is intended for the continuous automatic measurement of the content of hydrogen in multicomponent gaseous mixtures, and also in air of industrial rooms.

Operating principle. The effect/action of gas analyzer is based on the utilization of a dependence of the heat conductivity of the analyzed mixture on the content in it of hydrogen, since the heat conductivity of hydrogen considerably higher than heat conductivity of each other, unmeasurable components.

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In gas analyzer is applied a compensation-bridge measuring circuit, which consists of two bridges - worker and comparative. The relation of two voltages, which appear in the diagonals of these bridges, is supplied to the input of the electron indicating device.

Structural-assembly performance. A gas analyzer has the water-proofed, shock-vibration-proof performance and it is explosive-shielded through the gas circuit. The construction/design of gas analyzer provides its normal operation with prolonged inclinations/slopes on angle 15°, and also after output from short-time inclinations/slopes to angle to 45°.

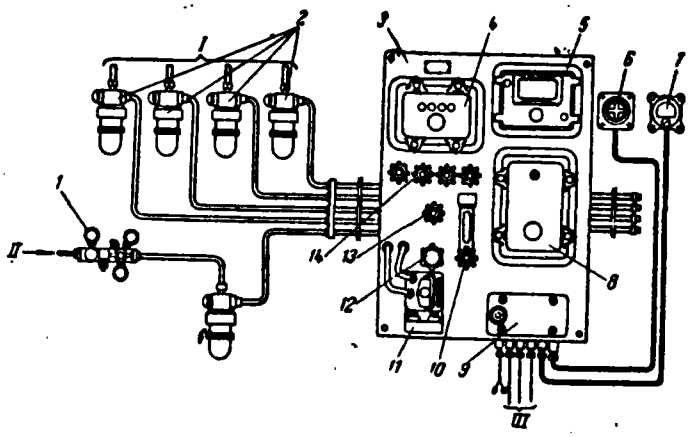

Fig. 2. Gas analyzer of TP1116M. 1 - pressure reducer; 2 - containers for the condensate; 3 - panel of the gas analyzer; 4 - distributing block; 5 - electron indicating device; 6 - four-valve signal panel; 7 - doubling instrument; 8 - sensor; 9 - the junction box; 10 - rotameter with filter; 11 - stimulus of the flow rate; 12 - blocking and regulating valve/gate; 13 - valve change-over switch; 14 - control filters; I - from the points of the selection of analyzed mixture; II - compressed air; III - to signalling device.

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Into the assembly of gas analyzer enter: the gas analyzer of TP1116M on panel with the mounted on it blocks (receiver, electron indicating device EK-1, distributing block RB-3, control filters - 4

pieces, rotameter with filter, valve/gate steaming-controlling VR-2, valve/gate - switch, choke/throttle, stimulus of flow rate PR-8, fire wall - 9 pieces); containers for a condensate - 5 pieces, doubling indicating device GTG-1, signal panel four-valve, air reductor VR-0.5.

Auxilople are selected according to the data of questionnaire and are supplied additionally together with gas analyzer. All blocks and nodes of instrument, entering the assembly of gas analyzer, with exception of outside devices (containers for a condensate, the doubling indicating device, the signal panel of four-valve and air reductor), are mounted on the panel-type board. The arrangement of blocks and auxiliary nodes on the panel of gas analyzer is shown in Fig. 2, there is depicted the diagram of external gas and electrical connections of gas analyzer, in accordance with which is produced the mounting.

Fundamental technical and performance data.

Range of measurement, Vol. o/o ... 0-6.

Threshold of response, Vol. o/o ... 0.1.

Fundamental error, o/o from the range of the measurement ... ±2.5

Additional errors do not exceed the following values (in the Vol. o/o concentration of hydrogen):

from a change in the ambient temperature for each of 10°C ... +-0.1.

from a change in the relative humidity of the analyzed mixture from 45 to 98o/o at an ambient temperature to 50°C ... +-0.6.

from a change in the supply voltage on +-13V from 127V ...±0.1.

Parameters of the analyzed mixture

temperature, °C ... 5-50.

atmospheric pressure, mm Hg (kN/m²) ... 720-920 (96-123).

relative humidity, o/o ... 45-98.

flow rate, l/h ... 90.

Starting time, min ... 5.

Time lag of readings of gas analyzer, min ... 1.

Duration of measurment in one point (with the automatic changeover), min ... 2.

The limits of the adjustable values of hydrogen concentrations upon reaching of which occurs the wear of stations of the electron indicating device, Vol. c/o ... 0.2-0.5; 1.2-1.7; 2.5-3.0.

Supply voltage at the frequency of 50 Hz, V ... 127.

Required power, W ... 200.

Clearance of the panel of gas analyzer, mm ... 530x735x240.

Weight, kg

the assembly of gas analyzer on panel ... 55.

full/total/complete assembly with outside device ... 70.

Gas analyzer it provides:

uninterrupted air bleed for analysis alternately of four points (rooms) with the automatic changeover of the points of the selection;

air bleed from one of the points, connected by hand (with the connected distributor) during the unlimited time;

the wear of the signal system of the electron indicating device upon reaching in that analyzed of air of one of the three rating values of hydrogen concentration;

the redundancy of readings at a distance with the outside indicating device with the simultaneous light signaling of the number of the point of the selection of the analyzed mixture.

Mounting conditions and mounting. Gas analyzer must be established/installed in explosion proof room with the following environmental parameters:

temperature, °C ... 5-40.

relative humidity, o/o ... to 98.

Panel with gas analyzer is not recommended to establish/install near the powerful/thick sources of variable electron-magnetic fields (electric motors, transformers, etc.). For checking zero gas analyzers must be provided for the feed line of pure air from main line or from tank/balloon.

Maximum length of the line of communications:

from the point of the selection of the analyzed mixture to the panel of gas analyzer, m ... 25.

from panel to the doubling instrument, m ... 100.

Light signal panel should be established/installed about the doubling instrument taking into account the need for simultaneous observation of dial face and signal lamps of signal panel.

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Transferable gas analyzer TP1123.

Instrument (Fig. 3) is developed by SKB of the analytical

instrument manufacture o. ue AS USSR (Leningrad) and is released by the series Yyva plant or gas analyzers.

Designation/purpose. Gas analyzer is intended for incidental measuring of the content or hydrogen in gas-air mixtures, including - in air of industrial rocms.

Operating principle. The effect/action of gas analyzer is based on heat conductivity. Is applied two-bridge compensation comparative measuring circuit. The measurement of the content of hydrogen in the analyzed mixture (air) is reduced to the comparison of voltage in the diagonal of working bridge with voltage in the diagonal of comparative bridge. The comparison (balancing) of voltages is produced by hand by displacing the wiper/slide of rheochord.

The moment/torque of equilibrium is fixed/recorded on galvanometer. With the wiper/slide of rheochord is bonded the scale, graduated in the percentages of hydrogen, according to which at moment/torque the equilibria or diagram take a reading of hydrogen concentration.

Structural-assembling performance. Gas analyzer is vibration-proof, shock resistant, splashproof.

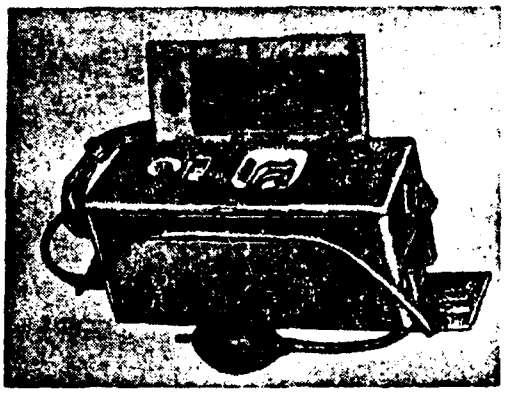

Fig. 3. Gas analyzer TP1123.

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According to the degree of blast shield the instrument has normal performance with sparkproof input and is intended for a work in explosion-proof rooms. Instrument TP1123 can also be released in tropical performance (modification TP1123-T). Gas analyzer is supplied from the self-contained source of direct current (dry batteries) or from the net of alternating current through plug (power supply unit), which has the connecting cable with a length of 5 m.

Into the assembly of gas analyzer enter: the gas analyzer, power supply unit (plug), assembly of interchangeable dry batteries of the type "Saturn" (for TP1123) or type "Mars" (for TP1123-T). All nodes

of gas analyzer are mounted in the steel housing, closed from above by duralumin panel and general/common/total cover/cap (see Fig. 3). For the transference of instrument is used the belt, fixed to housings.

Fundamental technical and performance data.

Range of measurement, Vol. o/o ... 0-4.

Threshold of response, Vol. o/o ... 0.05.

Fundamental error, Vol. o/o

with feed from dry batteries ... +-0.15.

with feed from the net of single-phase alternating current ... +-0.2.

Additional error do not exceed the following values (Vol. o/o concentration of hydrogen):

from a change in the ambient temperature for each of 10°C (to 50°C) ... +-0.1.

from a change in the relative humidity of the analyzed gaseous mixture from 70 to 98o/o at an ambient temperature to 50°C ... +-0.2.

from a change in the content of immeasurable components within the prescribed/assigned limits ... +-0.15.

from a change in the supply voltage on +-0.5V from 2.5V with the feed of instrument from dry batteries ... +-0.2.

from a change in the supply voltage on +-6.5V from 127V with the feed of instrument from the net of single-phase alternating current ... +-0.1.

Parameters of the analyzed mixture

temperature, °C

for TP1123 ... 5-50.

for TP 1123-T ... from -10 to 55.

atmospheric pressure, mm Hg (kN/m²) ... 700-900 (93-120).

relative humidity, o/o ... 70-98.

Environmental parameters

temperature, °C ... 5-50.

relative humidity, o/o ... to 98.

Duration of one measurment, min ... 2.

Number of measurments without the overcharge of dry cells ... 400.

Supply voltage, V.

from batteries of the type of "Saturn" ... 2.5+-0.5.

from the net of alternating current at the frequency of 50 Hz ... 127.

Clearance, mm ... 254x100x135.

Weight of gas analyzer (without plug), kg ... 3.8.

Weight of full/total/complete assembly, kg ... 8.3.

2.2. Instruments for determining methane.

For determining methane use the transferable gas analyzer TKh2301, transferable gas detectors GMT-3 and GIK-1, and also interference gas analyzer IGA, described below, and also the signal indicator of the combustible gases of SGG2M—V2B, signal indicator SVK-3M1, transferable gas analyzer of PGF2M1-I1A and transferable indicator IVP-1 (described in section 2.4).

Portable gas analyzer TKh2301.

Instrument is developed by SKB of the analytical instrument manufacture of the AS USSR (Leningrad) and in connection with creation on its basis of the more advanced constructions/designs the industry is not released.

Designation/purpose. Gas analyzer is intended for the incidental determination of methane concentration in air of industrial rooms. It can be used for the analysis of the content in air of the dangerously explosive concentrations (to 5o/o) of hydrogen, combustible gases and

vapors.

Operating principle. The effect/action of instrument is based on the determination of the thermal effect of the reaction of oxidation (combustion) of methane on the catalytically active platinum filament, which is actuating arm or the unbalanced measuring bridge. During analysis methane, which is contained in air, burns on the platinum filament of working shoulder element/cell, the temperature of filament in this case is raised and its resistor/resistance is increased. As a result of this is disturbed bridge balance and in its measuring diagonal appears the current whose value is proportional to methane concentration. The current of unbalance is measured by millivoltmeter, connected in the diagonal of bridge.

Structural-assembling performance. Gas analyzer explosive-impenetrable. Into the assembly of instrument enters the gas analyzer and the special filter, which uses for cleaning dust, dioxide of carbon and sulfides from analyzed mixture. The feed of gas analyzer is accomplished/realized from dry battery. Structurally/constructurally instrument is made in metal housing with hinged/reversible cover/cap.

To housing is attached the belt for the transference of instrument. On the face of panel are arranged/located the control knobs and indicating device.

Fundamental technical and performance data.

Ranges of measurement, vol. o/o ... 0-2.5; 0-5.

Threshold of response, vol. o/o ... 0.05.

Fundamental error, o/o from the range of the measurement ... +-4.

Duration of one measurment, min ... 0.5.

Clearance, mm ... 180x150x200.

Weight, kg ... 4.

Transferable gas detector GMT-3.

Instrument is developed MakNII (Makeyev scientific research institute); by industry it was not in series released.

Designation/purpose. Gas detector is intended for the episodic

determination of methane concentration in mine productions/consumptions/generations, and alsc in air of industrial rooms.

Operating principle. The effect/action of instrument is based on the comparison of the heat conductivity of methane (analyzed mixture) and pure air. In instrument is applied the bridge measuring circuit, which consists of two measuring and two comparative shoulder elements/cells. The analyzed mixture they suck through the channels in which are placed measuring shoulder elements/cells. The temperature of measuring elements/cells in this case decreases as a result of the fact that metnane has greater heat conductivity than air, which is located in other two channels; the differently heated measuring and comparative elements/cells will have different resistors/resistances. A difference in the resistors/resistances is proportional to the content of metnane in air and is measured by galvanometer.

Structural- assembling performance. Gas detector consists of following basic parts; the rubber bulb (pump), the absorber of the dioxide of carbon and water vapors, block of shoulder elements/cells, galvanometer, rheostat with rheochord, change-over switch and dry battery. All parts of instrument are placed in metal housing with the opened/disclosed cover/cap. To housing is attached the belt for the

transference of instrument. On the face of panel are arranged/located galvanometer, connecting pipes or input and output of that analyzed mixture, handle of rheostat and handle of change-over switch.

Fundamental technical and performance data.

Range of measurement, Vol. o/o ... 0-15.

Threshold of response, Vol. o/o ... 0.1.

Fundamental error, Vol. o/o ... +-0.3.

Duration of one measurment, min ... 1-2.

Clearance, mm ... 230x180x135.

Weight, kg ... 5.

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Transferable gas detector (interferometer) GIK-1.

Instrument (Fig. 4) is developed by VostNII (Ufa) and is released by the series experimental design office of automation

(OKBA).

Designation/purpose. Gas detector is intended for the periodic determination of methane concentrations, hydrogen and carbon dioxide in firedamp it is direct in mine workings. With the aid of instrument it is possible to measure the concentrations of the determined components with their separate and simultaneous presence in firedamp.

Operating principle. The effect/action of instrument is based on the measurement of the difference between the refractive indices of the light/world of the analyzed mixture (firedamp) and pure atmospheric air. This difference is determined quantitatively from the displacement of interference fringes of their relatively initial (zero) position.

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AUTOMATIC ANALYZERS AND SIGNAL INDICATORS OF TOXIC AND DANGEROU--ETC(U)
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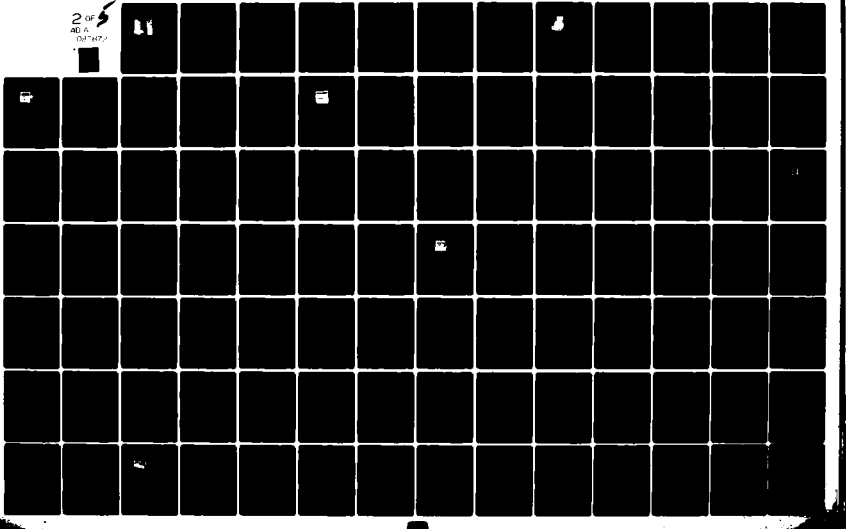

Fig. 4.

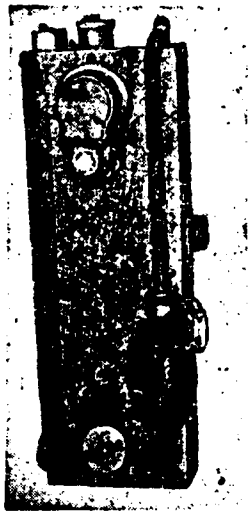

Fig. 5.

Fig. 4. Gas detector GIK-1.

Fig. 5. Gas analyzer IGA.

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The amount of the displacement or spectrum is proportional to the value of the refractive index of the analyzed mixture, which in turn, is proportional to the percentage of methane, hydrogen or carbon dioxide in this mixture. The refractive indices of light/world

compare with the passage of the coherent rays/beams through the standard and measuring channels of the air-gas chamber/camera of interferometer, filled with respectively pure air and analyzed gas-air mixture. In contrast to the previously existing interferometers the instrument GIK-1 is equipped with the new reference system, which makes it possible to simplify the calculation of the concentration of the determined components and to reduce the time of measurment.

Structural-assembling performance. Gas detector has mining sparkproof performance. The instrument, which is the flat/plane, poured from silumin quadrangular case, is placed into special case and is transferred on shoulder strap.

Into the assembly of gas detector enter: the gas detector, the case of instrument, the rubber bulb (pump), rubber tube.

Gas detector is supplied from dry battery.

Fundamental technical and performance data.

Ranges of measurement, Vol. o/o

methane ... 0-3.

hydrogen ... 0-2.

the dioxide of carbon ... 0-1.

Fundamental error, o/o from the range of the measurement ... +-5.

Duration of one measurment, min ... 1.

Clearance, mm ... 245x135x75.

Weight, kg ... 2.2.

Interference gas analyzer IGA.

Instrument (Fig. 5) is developed by TsNIL VGSCh of Kuzbass and is released in series Novosibirsk Instrument Making Plant.

Designation/purpose. Gas analyzer designed for the incidental determination of the concentration of methane, dioxide of carbon and oxygen in firedamp.

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With the aid of instrument it is possible to determine all three gases with their simultaneous presence in firedamp.

Operating principle. The effect/action of instrument is based on the phenomenon of the shift of interference fringes as a result of a change in the composition of the analyzed gaseous mixture (see the "Operating principle" of gas detector GIK-1).

Structural-assembling performance. A gas analyzer has mining, sparkproof performance. Into the assembly of gas analyzer enter: the gas analyzer, the case of instrument, the rubber bulb (pump), absorption tubes with the activated carbon (5 pieces).

Absorption tube serves for absorbing methane from the analyzed mixture in the case of determining oxygen concentration. Repeated use of absorption tube is possible only after purging by its pure air.

All nodes of gas analyzer are arranged/located in flat/plane silumin case. Instrument is placed into special case and is transferred on belt.

Fundamental technical and performance data.

Ranges of measurement, Vol. o/o

methane ... 0-6.

the dioxide of carbon ... 0-6.

oxygen ... 5-20.9.

Fundamental error, Vol. o/o +-0.3.

Environmental parameters

temperature, °C ... 10-30.

atmospheric pressure, mm Hg (kN/m^2) ... 720-800 (96-107).

Clearance, mm ... 135x82x320.

Weight, kg ... 2.2.

2.3. Instruments for determining vapors of fuel oils.

For determining the concentration of vapors of some fuel oils in air of industrial rooms use a transferable gas analyzer GB-3 and transferable indicators IVK-1 and PIV-1, described in this section.

Furthermore, the concentration of vapors of some fuel oils can be determined with the aid of the signal indicator of the combustible gases of SGG2MV2B, signal indicator SVK-3M1, transferable gas analyzer of PGF2M1-I1A and transferable indicator IVP-1, described in section 2.4.

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Transferable gas analyzer GB-3.

Instrument (Fig. 6) is developed VNIIOT [ВНИИОТ - All-Union Scientific Research Institute of Work Safety of the VTsSPS] VTsSPS [ВЦСПС - All-Union CentralTrade-Union Council] and is released in series Vyra plant of gas analyzers.

Designation/purpose. Gas analyzer is intended for periodic determination in air of vapors of the gasoline, which contains the additions of ethyl fluid, also, without them. Presence in the analyzed air besides vapors of gasoline of any other combustible vapors and gases decreases the accuracy of measurement.

Operating principle. The effect/action of instrument is based on the measurement of thermal effect of the reaction of oxidation (burning) of vapors of gasoline on the catalytically active platinum filament, which is one of the arms of unbalanced measuring bridge. Burning on the surface of platinum filament, the vapors of gasoline change the initial temperature of filament and its electrical resistance, which in the final analysis leads to the disequilibrium of measuring bridge and appearance in the diagonal of the bridge of the current whose value is proportional to the concentration of vapors of gasoline in the analyzed mixture.

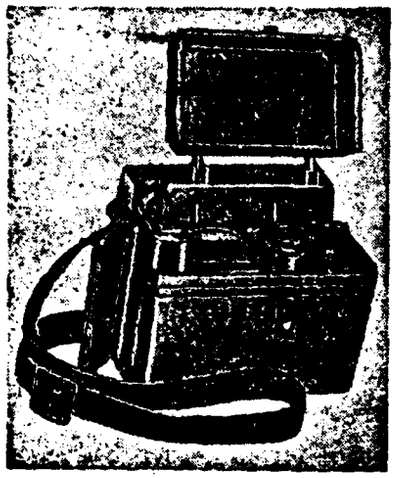

Fig. 6. Gas analyzer GB-3.

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Structural-assembling performance. Gas analyzer GB-3 is released in the explosive-impenetrable performance. It is to poured silumin housing with the hinged/reversible cover/cap under which on panel are arranged/located the control knobs and indicating device. To housing is attached the belt for the transference of instrument.

Into set of gas analyzer enter: gas analyzer and two filtering patrons, used for absorbing vapors of tetraethyl lead, the dioxides of carbon and sulfides.

Fundamental technical and performance data.

Ranges of measurement, g/m³ ... 0-30; 0-150.

Fundamental error, o/o from the range of the measurement ... +-7.

Environmental parameters

temperature, °C ... from -20 to 30.

relative humidity, o/o ... 25-95.

Feed from two alkaline batteries of the type KN-10.

Clearance, mm ... 155x206x165.

Weight, kg ... 4.5.

Transferable indicator of dangerously explosive concentrations IVK-1.

Instrument (Fig. 7) is developed and is released in series experimental design office of automation (OKBA).

Designation/purpose. Indicator is intended for the incidental

indication of pre-explosive, concentrations of vapors of fuel oils and their mixtures in the atmosphere of the closed rooms and capacitance.

Operating principle. The effect/action instrument is based on the determination of the thermal effect of the reaction of oxidation (burning) of vapors of fuel oils on catalytically active platinum filament. In instrument is applied the schematic of the unbalanced bridge (it is analogous with instrument GB-3).

Structural-assembling performance. Indicator is released in sparkproof performance with the explosive-impenetrable elements/cells; the index or explosive-protection - IZG (sulfur ether/ester) (VZT-I, V).[1]

FOOTNOTE [1]. Here and throughout in brackets is shown new conventional designations of the blast shield or instrument in accordance with PIVRE. ENDFOOTNOTE.

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Instrument is placed in plastic housing with the hinged/reversible cover/cap under which on panel are arranged/located the control knobs and indicating device. On housing is attached the belt for the

transference of instrument. Into the assembly of indicator enter: the indicator, filter FEB, filter air, hose rubber (5 m).

Filter FEB is used with the indication of leaded gasolines and vapors of fuel oils, which contain sulfides in a quantity of 0.5-1.0 mg/l.

Fundamental technical and performance data

Environmental parameters

temperature, °C ... from -10 to 50.

relative humidity, o/o ... to 80.

atmospheric pressure, mm Hg (kN/m²) ... 750+-30 (100+-4).

Is permitted the utilization of an indicator in low-temperature conditions to -40°C.

Time lag of readings of indicator, s ... 1-2.

Initial voltage of supply (from dry batteries of the type KBS-L-0.5), V ... 3.7.

Clearance, mm ... 204x132x100.

Weight, kg ... 3.

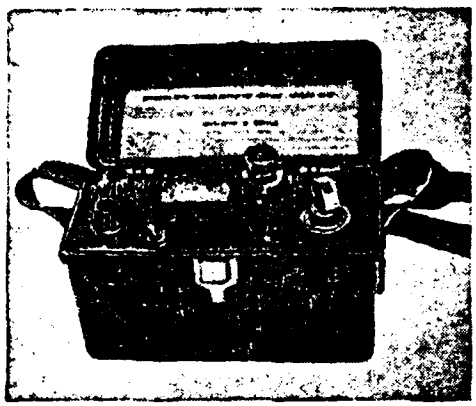

Fig. 7. Indicator IVK-1.

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Instrument is calculated for the indication of the pre-explosive (signal) concentrations (in o/o from NPV) of vapors of the following fuel oils:

(1) Бензин Б-70 . . .	13,5	(4) Топливо Т-1 . . .	27
(1) Бензин А-72 . . .	14	(4) Топливо ТС-1 . .	32
(1) Бензин А-66 . . .	14,5	(5) Уайт-спирит . . .	35,5
(1) Бензин Б95/130 .	15	(6) Смесь паров выше-указанных топлив	30
(2) Керосин	17,3		
(3) Сырая нефть . . .	6,5		

Key: (1). gasoline. (2). Kerosene. (3). Petroleum crude. (4). Fuel/propellant. (5). Mineral spirits. (6). Mixture of vapors of fuels/propellants pointed out above.

At the values of the concentrations of the determined components indicated the arrow/pointer of indicating device is established/installed in the beginning of the signal zone, colored red.

A fundamental error in the indicator on standard mixture (gasoline A-72) does not exceed +-30o/o, and an error of measurement of indicator on other single components must not exceed +-40o/o of signal concentration. Error with the indication of the mixture of several components of vapors of fuel oils is located within the limits from +75o/o to -85o/o relative to signal point.

Transferable indicator PIV-1.

Instrument PIV-1 (Fig. 8) it is developed by the experimental design office of automation (OKBA).

Designation/purpose. Indicator is intended for monitoring and signaling about the pre-explosive concentrations of combustible gases and vapors, and also their mixtures in air of the closed rooms. Indicator can be used with coloring works in the closed rooms and in the enterprises, bonded with production or use/application of solvents.

Operating principle. The effect/action of instrument is based on the thermochemical method of the analysis (see "Operating principle" of indicator IVK-1). In contrast to analogous designs of instruments (IVK-1, GB-3, etc.) in indicator PIV-1 the analyzed gaseous mixture is supplied to sensing element with free convection.

Structural- assembling performance. Instrument has spark-proof performance with the explosive-impenetrable elements/cells, index of blast shield I2G (V2T4-I,V).

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Indicator consists of sensor, unit of adjustments, relay assembly, power supply unit, electronic component, measuring instrument and dynamics which are mounted in aluminum housing. On front/leading panel they are located knob/button the "current", measuring instrument, knobs/arms/handles of the potentiometers "zero-setting" and "setting of current", which are closed by cover/cap. Besides in addition to this on the front/leading panel of indicator they are located toggle switch "connected" and knob/button the "discharge/break of signal". On the upper lid of indicator are placed the bulbs "signal" and "inclusively", which are closed with light-diffusers of fiberglass. In the lower cover/cap of indicator is located the section for the power supply unit, which consists of five, connected in series, storage batteries/accumulators of the type KPGK-10D. Indicator is equipped with the device, which feeds sound and indicating light (discontinuous) "malfunction" with the burn-out of shoulder sensing element of measuring bridge.

Fundamental technical and performance data.

Environmental parameters.

temperature, °C:. from -10 to +50.

relative humidity, o/o:. 30-80 [1].

FOOTNOTE [1]. Sometimes it is allowed/assumed to 98o/o. ENDFOOTNOTE.

atmospheric pressure, mm Hg (kN/m²):. 750+-30 (100+-4).

The time of continuous operation without the recharging of storage batteries/accumulators, h, is not less ... 8.

Signal lag, min ... 1.

Clearance, mm:. 275x110x225.

Weight, kg ... 5.5.

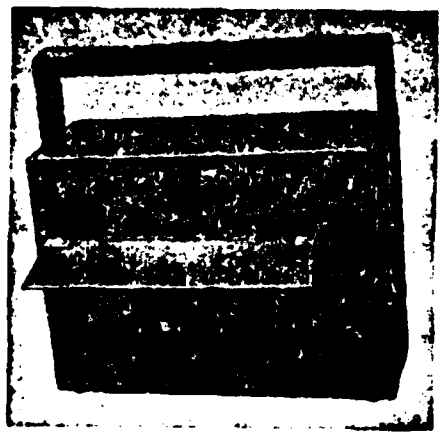

Fig. 8. Indicator PIV-1.

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Instrument is calculated for the indication of the $\overset{pre.}{\wedge}$-explosive concentrations of the following combustible substances:

	(1) Диапазон индикации, объемн. %		(1) Диапазон индикации, объемн. %
(2) Амилацетат	0,05—0,5	(9) Растворитель № 648	0,08—0,83
(3) Ацетон	0,1—1,1	(10) Разжижитель Р-5	0,09—0,92
(4) Бензин	0,04—0,38	(11) Сольвент-нафта	0,07—0,65
(5) Бутилацетат	0,1—1,1	(12) Сольвент-каменноугольный	2,9—28,5 мг/л (13)
(6) Бутиловый спирт	0,09—0,85	(14) Толуол	0,07—0,66
(7) Ксилол	0,06—0,55	(15) Уайт-спирит	0,05—0,45
(8) Растворитель Р-4	0,08—0,83	(16) Циклогексанон	0,05—0,46
(9) Растворитель № 646	0,08—0,8	(17) Этиловый спирт	0,2—1,8
		(18) Этилцеллозольв	0,1—1,3

Key: (1). Indication range of Vol. ones o/o. (2). Amylacetate. (3).

Acetone. (4). Gasoline. (5). Butyl acetate. (6). Butyl alcohol. (7). Xylene. (8). Solvent. (9). Thinner. (10). Solvent naphtha. (11). Solvent-coal. (12). mg/l. (13). Toluene. (14). Mineral spirits. (15). Cyclohexanone. (16). Ethyl alcohol. (17). Ethyl cellosolve.

With the content in the analyzed mixture of the combustible gases indicated, vapors and their mixtures in the range of concentrations 5-50o/o NPV the indicator puts out the signal of "concentration" (uninterrupted sound signal and even glow of signal lamp).

2.4. Instruments for determining combustible gases, vapors and their mixtures.

The instruments of this group because of their universality make it possible to determine in air of the industrial rooms of the concentration of a large quantity of different combustible gases, vapors and their mixtures.

Widest application for these purposes found those described in this section the stationary automatic gas analyzer MN3001M, the signal indicator of combustible gases SGG2M, signal indicator SVK-3M1 and transferable gas analyzer PGF2M1.

To this group of instruments should be also related transferable indicators IVP-1 (see below) and PIV-1, described in section 2.3.

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Automatic stationary gas analyzer MN3001M.

Instrument is developed and is released serially by the Vyruskiy plant of gas analyzers.

Designation/purpose. Gas analyzer is intended for the uninterrupted automatic determination of concentration of one or sum of the concentrations of several combustible substances (gases or vapors) in air of industrial rooms and signaling about the achievement of two prescribed/assigned limits of the measured value.

In the analyzed mixture simultaneously there can be vapors (or gases) one or several combustible substances with spontaneous ignition temperature not above 500 °C under the condition for the permanent relationship/ratio of concentrations over entire range of measurement. In the measurement of the content of several substances in the analyzed mixture the gas analyzer shows the sum of the concentrations of these substances.

Operating principle. The effect/action of gas analyzer is based on the measurement of oxygen, spent during the combustion of gases or vapors of the combustible substances, which are contained in the analyzed mixture. For measuring oxygen are used its thermomagnetic properties, in terms of which it considerably differs from other gases.

The magnetic susceptibility of paramagnetic gases decreases with the increase in temperature. The molecules of gas, are been located about the hot body, arranged/located in magnetic field, partially lose their magnetic properties and are pushed out of the magnetic field more by "cold" molecules. The temperature of "cold" molecules is raised with their approximation/approach to hot body, and they, in turn, are pushed out of magnetic field by the already cooled molecules. So there develop the convection currents (thermomagnetic convection or "magnetic wind"), which call a change in the temperature of hot body (sensing element). The oscillations/vibrations of the temperature of sensing element affect its electrical resistance whose value characterizes oxygen concentration in mixture, which is changed in dependence on a quantity of burnt combustible substances.

In gas analyzer is applied compensation-bridge measuring circuit, which consists of two unbalanced bridges - worker (made on base thermomagnetic method), through which is passed the analyzed gaseous mixture before and after the furnace of combustion, and comparative (made on base method of heat conductivity), two contradictory of arm of which are filled with air, but two others - by mixture 50o/o carbon dioxide and 50o/o of air.

The change of oxygen concentration in mixture, which occurs due to the combustion of the analyzed combustible substances, is converted in receiver in the voltage of alternating current, removed from the measuring diagonals of these bridges.

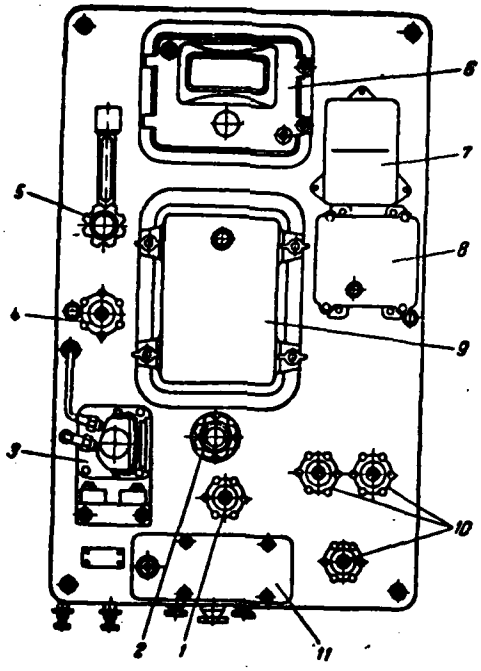

Fig. 9. Gas analyzer of *MN3001M*. The arrangement of units and auxiliary nodes on the panel of the gas analyzer: 1 - valve-change-over switch; 2 - filter- control room with the choke/throttle; 3 - stimulus of the flow rate; 4 - blocking and regulating valve/gate; 5 - rotameter with the filter; 6 - electron indicating device; 7 - furnace of the combustion; 8 - transformer; 9 - sensor; 10 - valves/gates of the cooler; 11 - the junction box.

The relation of two voltages, which is changed in dependence on oxygen concentration in the analyzed gas is measured by the electron indicating device whose scale is graduated in g/m³ of the determined component (or their sum).

Structural-assembling performance. Gas analyzer is released in the general-purpose (not explosion-proof) performance and has a blast shield through the gas circuit for mixtures to the category indicated. Into the assembly of gas analyzer enter: the panel, sensor, electron indicating device EK-1, furnace of combustion, transformer with signal lamp, cooler, rotameter with filter, valve-change-over switch, which is blocking and regulating valve/gate, junction box, fire wall - 7 pieces, filter the control with choke/throttle, stimulus of the expenditure PR-8, voltage regulator S-0, 09T.

In assembly with gas analyzer can be supplied the unit of distributing gas RB-3 for the sampling of the analyzed mixture of four points (rooms). All units and nodes of gas analyzer (with exception of voltage regulator) are mounted on the general/common/total panel (Fig. 9), intended for a wall mounting on the special framework.

Fundamental technical and performance data.

Range of measurement:. from 0 to 1.2o/o of the volume concentration, equivalent to the mixture or butane with air [1].

FOOTNOTE [1]. Equivalent mixture-mixture, equivalent according to its properties (lying at the basis of the method of measurement) of the analyzed gaseous mixture with the appropriate concentrations. ENDFOOTNOTE.

Threshold of response, Vol. o/o ... +-0.05.

Fundamental error, o/o volumetric concentration of butane ... 0.08.

Additional errors do not exceed the following values (in the Vol. o/o concentration of butane):

from a change in the expenditure of the analyzed mixture for +-0.1 l/min ... +-0.06.

from a change in the pressure of the analyzed mixture on 0.13 kg/cm^2 (12.75 kN/m^2) from 1 kg/cm^2 (98 kN/m^2) ... +-0.07.

from a change in the ambient temperature for each of 10 °C in

the range of 5-50 °C ... +-0.04.

from a change in the supply voltage on +-13 V from 127 V ... +-0.05.

Flow rate of analyzed gaseous mixture, l/h ... 42.

Time began reactions, s ... 30.

The starting time, h, is not more than ... 1.

Time lag of readings of gas analyzer, min ... 1.

Closing/shorting and interrupting the contacts of signaling upon reaching of two prescribed/assigned values of concentration ... is provided with the accuracy of fundamental error.

Supply voltage with frequency 50 Hz, V ... 127.

Required power, W, not more than ... 250.

Clearance of the panel of gas analyzer, mm ... 500x810x270.

Weight of the assembly of gas analyzer (on panel), kg.

without the unit of distributing gas ... 64.

with the unit of distributing gas ... 82.

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Mounting conditions and mounting. Gas analyzer must be established/installed in explosion proof room with the following environmental parameters:

temperature, °C ... 5-50.

relative humidity, o/o ... to 80.

Panel with the units of gas analyzer is not recommended to establish/install near the powerful/thick sources of variable electromagnetic fields (electric motors, transformers, etc.). External gas and electrical connections are assembled in accordance with the diagrams, shown in Fig. 10 and 11.

Stationary automatic signal indicator of combustible gases SGG2M.

Instrument is developed and is released by the in series experimental design office or automation (OKBA).

Designation/purpose. Signal indicator is intended for determining of combustible gases, vapors and their mixtures in air of the closed rooms. With the content in air of combustible gas (or vapor) in quantity 20o/o or lower inflammability limit (NPV) operates/wears the signalling device of instrument, which warns about the presence of the dangerous concentration of combustible gas (or vapor).

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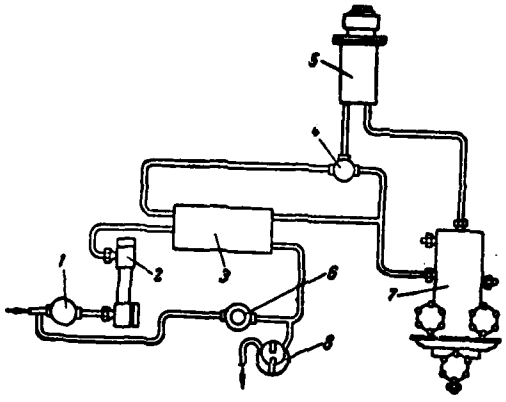

Fig. 10.

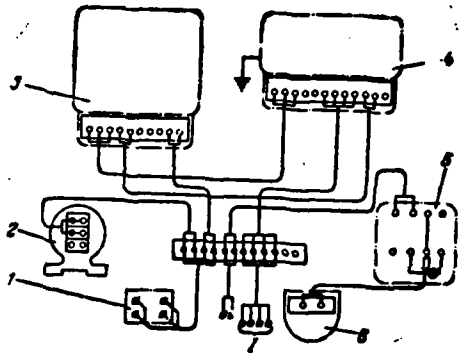

Fig. 11.

Fig. 10. Gas analyzer MN3001M. Diagram of external gas connections. 1 - valve/gate being blocking and regulating; 2 - rotameter with the filter; 3 - thermomagnetic sensor; 4 - valve/gate the change-over switch; 5 - furnace of the combustion; 6 - choke/throttle; 7 - cooler; 8 - stimulus of flow rate.

Fig. 11. Gas analyzer MN3001M. The diagram of the external electrical connections: 1 - voltage regulator; 2 - stimulus of the flow rate; 3 - sensor; 4 - electron indicating device; 5 - transformer; 6 - furnace of the combustion; I - to signalling device.

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With the smaller concentration of combustible substances (less than 20o/o NPV) the instrument works as indicator.

Operating principle. The effect/action of instrument is based on the determination of the heat of combustion of combustible gases and vapor on the catalytically active platinum spiral, which is one of the arms (by worker) of the unbalanced measuring bridge. In transit through the sensor of signal indicator the containing in air determined component (combustible gas or vapor) burns on working shoulder element/cell. In this case the temperature of platinum spiral is raised, and its resistor/resistance is increased, as a result of which is disturbed bridge balance. In the measuring diagonal of bridge appears the current, proportional in the value of the concentration of the determined component. Electric signal from measuring bridge is supplied to secondary instrument.

Structural-assembling performance. Into the assembly of signal indicator enter: the sensor, the unit of electric power supply, a secondary instrument of the type EPV2-11A, filter FEB-1 (for the instruments, calibrated to leaded gasoline). Signal indicator can be additionally completed by the gas suction device of the type VEZh (air removal jet) and by the panel of gas supply PPG-1.

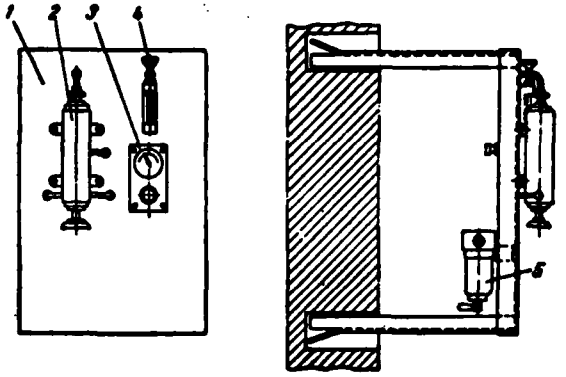

Fig. 12. Unit of the sensor of signal indicator SGG2M on wall. 1 - panel the panel small/miniature; 2 - sensor; 3 - control panel PDU-A; 4 - rotameter RS-3A; 5 - filter of air FV-10.

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The sensor of signal indicator SGG2M has the explosive-impenetrable performance. Depending on category and group of the explosion hazard of the determined components the sensor is released in three modifications: SGG2M -V2B, SGG2M -V3G, SGG2M -V4B. The modifications of the sensor differ from one another only by the width of the slits of explosion-resistant devices.

The sensor of signal indicator is assembled on the special panel which with the aid of framework is fastened to wall (Fig. 12). The unit of electric power supply is prepared with dust- and spatterproof. According to the degree of explosion-proof character

the unit of electric power supply and secondary instrument are made in the general-purpose (not explosion-proof) performance and are intended for an attendant mounting.

Fundamental technical and performance data.

Fundamental error, o/o from signal concentration [1] ... +5 -10.

FOOTNOTE [1]. For acetic acid fundamental error is from +5 to -20o/o. ENDFOOTNOTE.

Parameters of analyzed mixture:

temperature, °C ... from -10 to 40.

relative humidity, o/o ... 40-80.

rarefaction/evacuation (in gas-bleeding tube), mm H_2O (N/m^2), is not less ... 5 (50).

flow rate, l/h ... 12-20.

Threshold of response, o/o from signal concentration ... 10.

Signal lag (without taking into account time lag due to the gas-feeding line), s

for air-steam mixtures, is not more than ... 50.

for gas-air mixtures, it is not more than ... 30.

The power of the signalling device

on direct current with voltage to 220 V with inductive load 2 Hz, W, is not more than ... 50.

on alternating current with voltage 220 V, W, it is not more than ... 500.

Supply voltage at the frequency of 50 Hz, V ... 220.

Required power, W, not more than ... 100.

Clearance, mm

sensor ... 302x188x128.

the unit of electric power supply ... 402x286x260.

secondary instrument ... 457x332x235.

Weight, kg

sensor ... 3,4.

the unit of electric power supply ... 7.

secondary instrument ... 25.

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Instrument switches on signal upon reaching of the so-called signal concentrations (20o/o of NPV) of the following components (in the Vol. ones o/o):

СГТ2М-В2Б

(1) Метан	1,0
(3) Пропан	0,5
(5) Пропилен	0,4
(7) Бутилен	0,32
(9) Метиловый спирт	1,1
(11) Этиловый спирт	0,6
(13) Бутиловый спирт	0,39
(15) Изопропиловый спирт	0,5
(17) Бензол	0,22
(18) Толуол	0,3
(21) Стирол	0,22
(23) Изопропилбензол	0,12
(25) Альфаметилстирол	0,16
(27) Сильван	0,3
(29) Циклогексанон	0,19
(31) Нитрил акриловой кислоты	0,55
(33) Метилакрилат	0,19
(35) Этилацетат	0,44
(36) Растворители магнитного лака (толуол, ацетон и бутилацетат в соотношении 60:20:20)	0,36

СГТ2М-В3Г

(2) Коксовый газ	0,8
(4) Этилен	0,6
(6) Окись этилена	0,6
(8) Дивинил	0,3
(10) Диэтиловый эфир	0,4
(12) Винилацетат	0,5
(14) Бутилакрилат	0,18
(16) Бензин Б-70	0,2
(19) Бензин Б-91/115	0,2
(20) Бензин «Калоша»	7,7 мг/л
(22) Керосин Т-1	20 мг/л
(24) Ацетон	0,4
(26) Циклогексан	0,26
(28) Циклогексанол	0,25
(30) Ацетальдегид	0,73
(32) Смесь этилового спирта и толуола	0,32
(34) Уксусная кислота	1,2*

СГТ2М-В4Б

(37) Водород	0,8
(39) Ацетилен	0,5

Key: (1). Methane. (2). Coke gas. (3). Propane. (4). Ethylene. (5). Propylene. (6). Ethylene oxide. (7). Butylene. (8). Divinyl. (9). Methyl alcohol. (10). Diethyl ether. (11). Ethyl alcohol. (12). Vinyl acetate. (13). Butyl alcohol. (14). Butylacrylate. (15). Isopropyl alcohol. (16). Gasoline. (17). Benzene. (18). Toluene. (19). Gasoline "Kaloshа". (20). mg/l. (21). Styrene. (22). Kerosene T-1. (23). Isopropylene benzene. (24). Acetone. (25). Alpha methyl styrol. (26). Cyclohexane. (27). Sylvan. (28). Cyclohexanol. (29). Cyclohexanone. (30). Acetaldehyde. (31). Nitrile of acrylic acid. (32). Mixture of ethyl alcohol and toluene. (33). Methylacrylate. (34). Acetic acid ... 1.2 *.

FOOTNOTE [1]. 40o/o of lower inflammability limit. ENDFOOTNOTE.

(35). Ethyl acetate. (36). Solvents of magnetic varnish (toluene, acetone and butyl acetate in ratio. (37). Hydrogen. (38). Acetylene.

Signal indicator calibrates itself by producer to one of enumerated combustible vapor and gases or to the mixture, which has the permanent relationship/ratio or components [1].

FOOTNOTE [1]. In work [19] A. I. Kvasov recommends the procedure of calibration and testing or a signal indicator of the type SGG2M, which makes it possible to use it for the monitoring of air of industrial rooms, of the containing the mixture several combustible vapors (or gases) with the arbitrarily changing in time relationship/ratio of components. The proposed procedure of calibration does not require in the majority of the cases of complex equipment, high qualification or the specialists and can be realized (with sufficient for practical targets accuracy) by any enterprise, which contains laboratory of KIP. ENDFOOTNOTE.

Mounting conditions and mounting. The sensor of signal indicator (any of the modifications) is established either directly in the room where is possible the onset or the dangerously explosive concentrations of combustible gases and vapors (see Table 1), or it

is connected with this room by the gas-feeding communication.

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Signal indicator normally works in the following environmental parameters:

temperature, °C ... from -10 to 40.

relative humidity, o/o ... 80.

atmospheric pressure, mm Hg (kN/m²) ... 750+-30 (100+-4).

Is not allowed/assumed the setting up of sensor in the strongly dusty rooms and in the rooms, which contain vapors of acids and alkalis. For the work of signal indicator is necessary the main line of the compressed air with pressure 2-10 kg/cm². The unit of electric power supply and secondary instrument are established/installed in nonexplosive room. The mounting of the external gas and electrical connections of signal indicator is produced in accordance with the diagrams, given in Fig. 13 and 14. The distance between sensor and unit of electric power supply must not exceed 80 m.

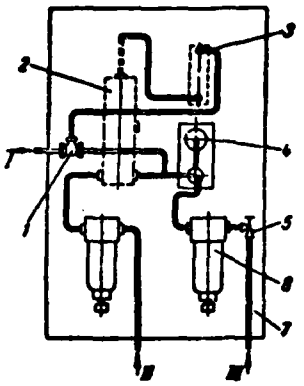

Fig. 13.

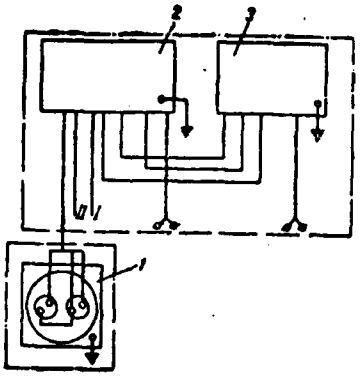

Fig. 14.

Fig. 13. Signal indicator SGG2M. Diagram of external gas connections. 1 - air ejector; 2 - sensor; 3 - rotameter; 4 - control panel; 5 - valve/gate; 6 - filter of the air; 7 - panel of the sensor; I - discharge/break in the atmosphere; II - analyzed gaseous mixture; III - compressed air.

Fig. 14. Signal indicator SGG2M. Diagram of external electrical connections. 1 - sensor; 2 - power supply unit; 3 - secondary instrument; I - chain of the emergency signal; II - chain of alarm signal.

Stationary automatic signal indicator SVK-3M1.

Instrument is developed by the experimental design office of automation (OKBA) and since 1971 is released by the in series Smolensk plant of the means of automation.

Designation/purpose. Signal indicator is intended for uninterrupted automatic determination and signaling about presence in air of the closed rooms of the pre-explosive concentrations of combustible gases, vapors and their mixtures. With the concentration of the defined component or less than alarm works as indicator.

Operating principle. The effect/action of instrument is based on the determination of the thermal effect of the reaction of oxidation (combustion) of combustible substances on catalytically active oxide of aluminum. As a result of this on the platinum spiral, wound on small cylinder from oxide of aluminum, is separated/liberated an additional quantity of heat, the resistor/resistance of spiral is increased also in the measuring diagonal of bridge appears the potential difference whose value is proportional to the concentration of the determined component.

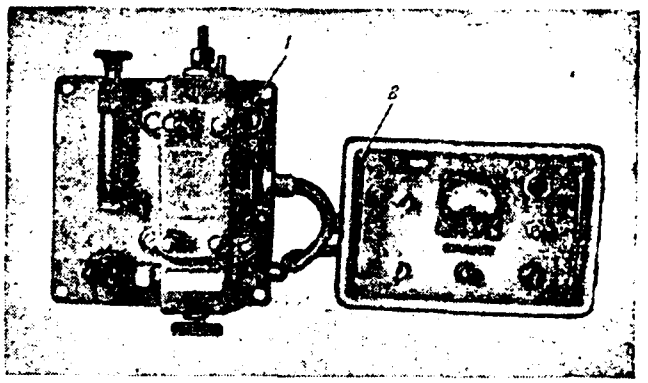

Fig. 15. Sensor (1) and unit of electric power supply (2) of signal indicator SVK-3M1.

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According to the scale of the measuring instrument, built in into the unit of electric power supply, they visually control a change of the concentration of the determined component in the site of installation of sensor to the moment/torque of delivering the signal "concentration".

Structural-assembling performance. Signal indicator (Fig. 15) consists of two units: sensor unit (sensor, rotameter RS-3A, air removal jet VEZh-2, filter of air FV-10, pressure reducer RDV-5M) and unit of electric power supply. All nodes of the sensor unit are

mounted on special panel, which with the aid of brackets is fastened to the wall (it is analogous with instrument SGG2M). The sensor of signal indicator has explosion-inpenetrable performance V3G-V4A (V3T4-V4aT1-V). The unit or electric power supply is mounted on box type chassis/landing gear with the front/leading panel, on which are arranged/located the control knobs and measuring instrument. The unit of electric power supply has the general-purpose (not explosion-proof) performance and is intended for an attendant mounting. Signal indicator is equipped with the device, signalling "malfunction" with the burn-out of sensing element or the break of the feed circuit of sensor.

Fundamental technical and performance data.

Parameters of the analyzed mixture

temperature, °C ... 5-40.

relative humidity, o/o ... 30-90.

atmospheric pressure, mm Hg (kN/m²) ... 650-780. (87-104)

flow rate, l/h ... 16+-1.5.

Signal lag, s ... 30.

Supply voltage at the frequency of 50 Hz, V ... 220.

Required power, W ... 50.

Clearance, mm

sensor unit ... 285x225x240.

the unit of electric power supply ... 332x160x275.

Weight, kg

sensor unit ... 6.

the unit of electric power supply ... 8.

Signal indicator puts out signal "concentration" upon reaching at the analyzed mixture or the signal concentration of the determined component, which lies in the range 5-50o/o NPV.

Instrument SVK-3M1 supplies impulse/momentum/pulse on the start of signalling device at the following values of the concentrations (in the Vol. ones o/o) of the determined components:

(1) Акрилонитрил	0,15—1,5	(2) Коксовый газ	0,2—2,2
(3) Акролеин	0,15—1,4	(4) Ксилол	0,06—0,55
(5) Аллиловый спирт	0,13—1,25	(6) Метан	0,25—2,5
(7) Амиловый спирт	0,06—0,6	(8) Метилакрилат	0,06—0,6
(9) Ацетальдегид	0,2—2	(10) Метилаль	0,15—1,48
(11) Ацетилен	0,13—1,25	(12) Метиламин	0,25—2,45
(13) Ацетон	0,1—1,1	(14) Метилацетат	0,18—1,8
(15) Бензин А-66	0,04—0,38	(16) Метилметакрилат	0,08—0,75
Бензин А-72	0,07—0,73	(17) Метиловый спирт	0,3—3
Бензин Б-70	0,04—0,39	(18) Метилформиат	0,2—2,2
Бензин Б-95/130	0,05—0,49	(19) Метилэтилкетон	0,1—0,95
(20) Бензин «Калоша»	0,05—0,55	(21) Окись углерода	0,63—6,25
(22) Бензол	0,07—0,7	(23) Окись этилена	0,15—1,5
(24) Бутан	0,1—0,9	(25) Пентан	0,08—0,75
(26) Бутилацетат	0,1—1,1	(27) Пропан	0,1—1,05
(28) Бутилен	0,08—0,8	(29) Пропилацетат	0,09—0,9
(30) Бутиловый спирт	0,09—0,85	(31) Пропилен	0,1—1,1
(32) Винилацетат	0,13—1,25	(33) Пропиловый спирт	0,1—1,05
(34) Водород	0,2—2	(35) Пропилформиат	0,12—1,18
(36) Водяной газ	0,3—3	(37) Скипидар	0,04—0,4
(38) н-Гексан	0,06—0,6	(39) Сольвент-каменно-угольный	2,9—28 мг/л (39 стр.)
(40) Гептан	0,06—0,55		
(41) Дивинил	0,1—1	(42) Сольвент-нафта	0,07—0,65
(43) Диизопропиловый эфир	0,07—0,7	(44) Толуол	0,07—0,65
(46) Диметилдиоксан	0,1—0,96	(45) Топливо Т-1	0,05—0,45
(48) Диоксан	0,09—0,93	(47) Триметилкарбинол	0,28—2,75
(50) Диэтиламин	0,1—1,1	(49) Триэтиламин	0,08—0,75
(52) Диэтиловый эфир	0,09—0,85	(51) Уайт-спирит	0,07—0,7
(54) Изобутан	0,09—0,9	(53) Уксусная кислота	0,17—1,65
(56) Изобутилен	0,09—0,9	(55) Фурфурол	0,09—0,9
(58) Изобутиловый спирт	0,09—0,9	(57) Циклогексан	0,06—0,6
(61) Изопентан	0,07—0,65	(59) Этан	0,15—1,45
(63) Изопрен	0,09—0,85	(60) Этилацетат	0,18—1,75
(65) Изопропиловый спирт	0,1—1	(62) Этилен	0,15—1,5
		(64) Этиловый спирт	0,18—1,8

Key: (1). Acrylonitrile. (2). Coke gas. (3). Acrolein. (4). Xylene. (5). Allyl alcohol. (6). Methane. (7). Amyl alcohol. (8). Methylacrylate. (9). Acetaldenyde. (10). Methylal. (11). Acetylene. (12). Methylamine. (13). Acetone. (14). Methyl acetate. (15). Gasoline. (16). Methylmethacrylate. (17). Methyl alcohol. (18).

Methylformate. (19). Methylethylketone. (20). Gasoline "Kaloshа". (21). Carbon monoxide. (22). Benzene. (23). Ethylene oxide. (24). Butane. (25). Pentane. (26). Butyl acetate. (27). Propane. (28). Butylene. (29). Propylacetate. (30). Butyl alcohol. (31). Propylene. (32). Vinyl acetate. (33). Propyl alcohol. (34). Hydrogen. (35). propylformat. (36). Water gas. (37). Turpentine. (38). *n*-Hexane. (39). Solvent-coal. (39a). mg/l. (40). Heptane. (41). Divinyl. (42). Solvent naphtha. (43). Diisopropyl ether. (44). Toluene. (45). Fuel/propellant T-1. (46). Dimethyldioxane. (47). Trimethylcarbinol. (48). Dioxane. (49). Triethylamine. (50). Diethylamine. (51). White-sprit. (52). Diethyl ether. (53). Acetic acid. (54). Isobutane. (55). Furfural. (56). Isobutylene. (57). Cyclohexane. (58). Isobutyl alcohol. (59). Ethane. (60). Ethylacetate. (61). Isopentane. (62). Ethylene. (63). Isoprene. (64). Ethyl alcohol. (65). Isopropyl alcohol.

Signal indicator is calibrated on the equivalent mixture of hydrogen in by air. Upon request it can calibrate itself according to any other substance, indicated above.

Mounting conditions and mounting. Sensor unit is established directly in the room where it is necessary to control the pre-explosive concentrations of combustible gases, vapors and their mixtures in air (see pg. 89).

Signal indicator normally works in the following environmental parameters:

temperature, °C ... 5-40.

relative humidity, o/o ... 30-90.

atmospheric pressure, mm Hg (kN/m²) ... 600-800 (80-106).

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The unit of electric power supply is established in explosion proof room. Maximum distance from sensor unit to the unit of electric power supply must not exceed 500 m. The binding of the gas schematic of sensor unit is produced in accordance with the diagram, represented in Fig. 16. External electrical connections from sensor unit to the unit of the electric power supply of arranged according to the diagram, represented in Fig. 17.

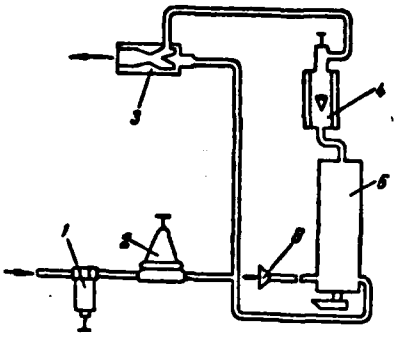

Fig. 16.

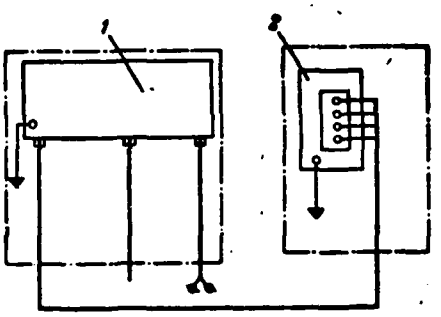

Fig. 17.

Fig. 16. Signal indicator SVK-3M1. Diagram of external gas connections. 1 - filter; 2 - pressure reducer; 3 - air removal jet; 4 - rotameter; 5 - sensor; 6 - sampling funnel.

Fig. 17. Signal indicator SVK-3M1. Diagram of external electrical connections. 1 - unit of the electric power supply; 2 - sensor unit; I - to system, signaling and protection.

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Transferable gas analyzer PGP2M1.

Instrument (Fig. 18) is developed and is released by the in series experimental design office of automation (OKBA).

Designation/purpose. Gas analyzer is intended for the incidental determination of the concentrations of combustible gases and vapors in air of industrial rooms.

Operating principle. The effect/action of instrument is based on the determination of the thermal effect of the reaction of oxidation (combustion) of combustible gases and vapors on the catalytically active platinum spiral, which is one of the arms of the unbalanced measuring bridge. While conducting of analysis the determined component (combustible gas or vapor), which is contained in the analyzed medium, burns on the platinum spiral of the working shoulder element/cell; the temperature of spiral in this case is raised and is increased its resistor/resistance. As a result of this is disturbed bridge balance and in its measuring diagonal appears the current whose value is proportional to the concentration of the determined component. The current of unbalance is supplied to indicating device (millivoltmeter).

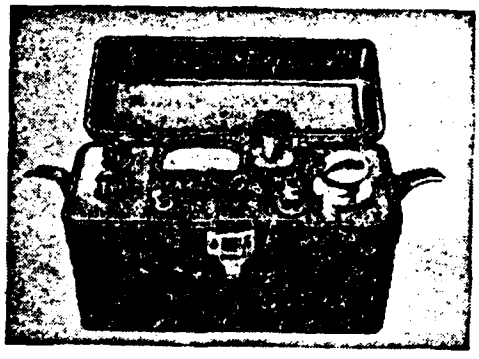

Fig. 18. Gas analyzer PGF2M1.

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Structural-assembling performance. Depending on the degree of explosion-proof character the instrument is made in the following modifications which are caused by category and group of the explosion hazard of the determined components:

ПГФ2М1	(1) Общепромышленное исполнение
ПГФ2М1—(2) И1А / метан (В1Т1-И, В)	(3) Искробезопасное исполнение со взрывонепроницаемыми элементами
ПГФ2М1—(5) ИЗГ / серный эфир (В3Т4-И, В)	(4) То же
ПГФ2М1—(6) И4А / водород (В4аТ1-И, В)	»

Key: (1). General-purpose performance. (2). methane. (3). Sparkproof performance with explosion-inpenetrable elements/cells. (4). sulfur

ether. (5). Same. (6). nydrogen.

The modifications of the instrument it is structural/constructural of differ between themselves only by the width of the slit of explosion-resistant devices. Into the assembly of gas analyzer enter: the gas analyzer PGF2M1 (one of the modifications), filter gas, filter FEB (only for the instruments of those calibrated to leaded gasoline).

Gas analyzer is placed in plastic housing with the hinged/reversible cover/cap under which on panel are arranged/located the control knobs and indicating device. On housing is attached the belt for the transference of instrument.

Fundamental technical and performance data.

Environmental parameters.

temperature, °C ... from -20 to 40.

relative humidity, o/o ... to 80.

Threshold of response, o/o from the lower limit of measured concentrations ... 50.

Time lag of readings of gas analyzer, s ... 30-40.

Voltage of supply (from dry batteries of the type KBS-L-0.5), V ... 3,7.

Clearance, mm ... 204x132x100.

Weight, kg ... 3.

The enumeration of the determined components, the ranges of the measurement of their concentrations and the permissible errors of measurement are shown in Table 3.

During the evaluation/estimate of the degree of the explosion hazard gas- or steam-air medium frequently appears need in the determination of the concentrations of combustible substances in the range of the upper limit of explodability. In this respect definite interest is of the developed by engineers V. K. Kovalev and V. I. Gol'shteyn [20] method of measurement of the concentrations of vapors of gasoline of above 80 mg/l, with the utilization of a gas analyzer PGP2M1 - IZG/ethyl ether.

An error of measurement of the concentrations of vapors of gasoline in the range 80-600 mg/l in this manner does not exceed +-30 mg/l.

As a result carried out by Kharkov branch of OKBA of work [21] it is explained that gas analyzer PGF2MI - IZG/ethyl ether/ester can be used for determination in air of the industrial rooms of benzene, and also mixtures: by alcohol-acetone in relationship/ratio 6:1 and alcohol- xylol in relationship/ratio 8:1 without any remodellings and additional calibrations of instrument.

Table 3. Characteristic of the modifications of instrument PGF2M1.

(a) Определяемый компонент	(b) Положение переключателя диапазонов	(c) Диапазоны измерения, объемн. %	(d) Погрешность, объемн. %
	ПГФ2М1-И1А		
Метан	I	0,37—1,2	±0,15
	II	1,2—4,2	±0,5
	ПГФ2М1-И3Г		
Пропан	I	0,1—0,4	±0,1
	II	0,4—2,0	±0,3
Этилен	I	0,05—0,25	±0,05
	II	0,25—2,0	±0,25
Этиловый спирт	I	0,2—0,65	±0,15
	II	0,65—3,7	±0,5
Диэтиловый эфир	I	0,08—0,4	±0,05
	II	0,4—2,2	±0,2
Бензин Б-70	I	2,5—12,5 мг/л	±2 мг/л
	II	12,5—80 мг/л	±12,5 мг/л
Этилированный бензин Б-95/130	I	2,5—12,5 мг/л	±2 мг/л
	II	12,5—80 мг/л	±12 мг/л
Коксовый газ	I	0,2—1,0	±0,1
	II	1,0—4,0	±0,5
Пропилен	I	0,06—0,3	±0,05
	II	0,3—1,7	±0,25
Метиловый спирт	I	0,35—1,1	±0,2
	II	1,1—5,5	±1,0
	ПГФ2М1-И4А		
Водород	I	0,2—0,6	±0,1
	II	0,6—3,7	±0,5
	ПГФ2М (нормальное исполнение)[*]		
Топливо Т-1	I	0—40 мг/л	±10 мг/л

Key: (a). Determined component. (b). Position of band selector. (c). Ranges of measurement, Vol. o/o. (d). Error, Vol. o/o. (1). Methane. (2). Propane. (3). Ethylene. (4). Ethyl alcohol. (5). Diethyl ether. (6). Gasoline B-70. (7). mg/l. (8). Leaded gasoline B-95/130. (9). Coke gas. (10). Propylene. (11). Methyl alcohol. (12). Hydrogen. (13). PGF2M (normal performance) [*].

[*]. At present it is not released. ENDFOOTNOTE

[illegible]

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Are given below the concentrations of the determined components depending on the readings and position of band selector:

(1) Определяемый компонент (смесь)	(2) Положение переключателя диапазонов	(3) Деления шкалы прибора и соответствующая концентрация (в объем.%) 1	2	3	4	5	(4) Погрешность измерения, объемн.%
Бензол (5)	I	0,05	0,10	0,15	0,20	0,25	±0,05
	II	0,25	0,50	0,75	1,00	1,25	±0,26
Спиртоацетоновая смесь (6)	I	0,10	0,19	0,29	0,38	0,48	±0,15
	II	0,48	0,95	1,43	1,90	2,38	±0,55
Спиртоксилоловая смесь (7)	I	0,10	0,19	0,29	0,38	0,48	±0,015
	II	0,48	0,95	1,43	1,90	2,38	±0,55

Key: (1). Determined component (mixture). (2). Position of band selector. (3). Scale divisions of instrument and corresponding concentration (in vol. o/o). (4). Error of measurement, Vol., o/o. (5). Benzene. (6). Alcohol-acetone mixture. (7). alcohol-xylol mixture.

Gas analyzer calibrates itself by producer to one of the components pointed out above. In instrument are provided for two limits of measurement. For the translation/conversion of instrument from one limit of measurement to another is a change-over switch.

Transferable indicator IVP-1.

Instrument (Fig. 19) is developed by the experimental design office of automation (OKBA).

Designation/purpose. Indicator is intended for the incidental indication of the pre-explosive concentrations of combustible gases, vapors and their mixtures in air of industrial rooms and in the closed capacitance.

Operating principle. The effect/action of instrument is based on the thermochemical method of the analysis (see "Operating principle" of indicator IVK-1).

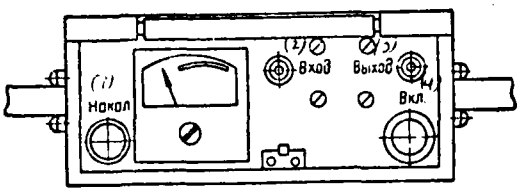

Fig. 19. Indicator IVP-1 (front panel).

Key: (1). Incandescence. (2). Input. (3). Output. (4). Vkl.

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Structural-assembling performance. instrument has sparkproof performance with the explosive-impenetrable elements/cells; the index of blast shield IZG-I4A (V3T4-V4aT1-I, V). Indicator consists of the sensor unit, of rubber bulb, measuring instrument and supply of power which are mounted in plastic housing.

In the lower part of the housing of indicator is provided for the section for the power supply, which consists of three series-connected batteries of type 373 "Mars". There also it cut off for storing the bulb, which is solidly connected with sensor unit.

Indicator is equipped with the filter FEB, which is used in the

case of the content in the analyzed mixture of sulfides and leaded gasolines (tetraethyl lead) in a quantity to 1 mg/ℓ.

Fundamental technical and performance data.

Environmental parameters

temperature, °C ... from -20 to 50

relative humidity, o/o ... 30-80 [1]

atmospheric pressure, mm Hg (kN/m²) ... 620-820 (83-108).

Time lag of readings of indicator, s ... 1-2.

Clearance, mm ... 204x80x122.

Weight, kg ... 3.

FOOTNOTE [1]. Sometimes it is allowed/assumed to 98o/o. ENDFOOTNOTE.

Instrument indexes/identifies the pre-explosive concentrations (in Vol. o/o) of combustible substances in the following ranges:

Allyl alcohol ... 0.13-1.25.

Acrolein ... 0.15-1.4.

Acrylonitrile ... 0.15-1.5.

Acetone ... 0.1-1.1.

Acetaldehyde ... 0.2-2.

Butane ... 0.1-0.9.

Butylene ... 0.08-0.8.

Gasoline B-70 ... 0.04-0.39.

Gasoline B-95/130 ... 0.05-0.49.

Gasoline A-72 ... 0.07-0.73.

Gasoline A-66 ... 0.04-0.38.

Gasoline "Kaloshd" ... 0.05-0.55.

Benzene ... 0.07-0.7.

Butyl alcohol ... 0.09-0.85.

Hydrogen ... 0.2-1.6.

Vinyl acetate ... 0.13-1.25.

Water gas ... 0.3-3.

Heptane ... 0.06-0.55.

n-Hexane ... 0.06-0.6.

Divinyl ... 0.1-1.

Diethyl ether ... 0.09-0.85.

Diethyl ether/ester ... 0.07-0.7.

Dioxane ... 0.09-0.93.

Diethylamine ... 0.1-1.1.

Dimethyldioxane ... 0.1-0.96.

Isobutylene ... 0.09-0.9.

Isobutane ... 0.09-0.9.

Isoprene ... 0.09-0.9.

Isopentane ... 0.07-0.65.

Isopropyl alcohol ... 0.1-1.

Isobutyl alcohol ... 0.09-0.9.

Coke gas ... 0.2-2.2.

Methyl alcohol ... 0.3-3.

Methyl acetate ... 0.18-1.8.

Methylformate ... 0.2-2.2.

Methylmethacrylate ... 0.08-0.75.

Methane ... 0.25-2.5.

Methylacrylate ... 0.06-0.6.

Methylal ... 0.15-1.48.

Methylethylketone ... 0.1-0.95.

Carbon monoxide ... 0.63-6.25.

Propane ... 0.1-1.05.

Propylene ... 0.1-1.1.

Propyl alcohol ... 0.1-1.05.

Pentane ... 0.08-0.75.

Propyl acetate ... 0.09-0.9.

Propyl forminate ... 0.12-1.18.

Solvent-naphtha ... 0.07-0.65.

Solvent coal ... 2.9-28 mg/l.

Fuel/propellant T-1 ... 0.05-0.45.

Toluene ... 0.07-0.65.

Triethylamine ... 0.08-0.75.

Trimethylcarbinol ... 0.28-2.75.

Mineral spirits ... 0.07-0.7.

Acetic acid ... 0.17-1.65.

Cyclohexane ... 0.06-0.6.

Cyclohexanone ... 0.05-0.46.

Cyclohexanol ... 0.08-0.75.

Ethane ... 0.15-1.45.

Ethylene: 0.15-1.5.

Ethyl alcohol ... 0.18-1.8.

Ethylacetate ... 0.18-1.75.

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Indicator puts out the signal (arrow/pointer of measuring instrument enters into the signal zone of the scale) about presence in the analyzed medium of combustible gases, vapors and their mixtures in the range of concentrations 5-50o/o NPV. On hydrogen-air mixture the indicator puts out signal in the range 5-40o/o NPV.

3. Gas analyzers and gas signal devices for determining the toxic substances in air.

3.1. Instruments for determining carbon monoxide.

This group of instruments includes: stationary automatic gas analyzers TKh2102, TKh2104 and GIP-7; the stationary automatic sensor of carbon monoxide FL2101 and the transferable gas detector of carbon monoxide.

For determining the microconcentrations of carbon monoxide in air of industrial rooms can be also used the conductometry device KU-3, described in section 3.3.

Stationary automatic gas analyzer TKh2102.

Instrument is developed by SKB of the analytical instrument manufacture of the AS USSR and is one of the modifications of instruments of this type, created in the process of the search of the most modern construction/design of thermochemical gas

analyzer (with bulk catalyst) for determining the toxic concentrations of carbon monoxide in air [1].

FOOTNOTE [1]. SKB of the analytical instrument manufacture is developed of 3 modifications of thermochemical gas analyzer for the uninterrupted automatic check of the content in air of carbon monoxide. Two of them - TKh2102 and TKh2104 are examined in this work, The third modification - transferable gas analyzer-signal indicator TKh2103 - does not have any vital differences from two preceding. Fundamental technical and operating characteristics of this instrument:

range of measurement, mg/m^3 ... 0-1800.

Fundamental error, o/o of upper limit of the measurement ... +-10.

Time began reactions, s ... 20.

Time lag, min ... 5.

Supply voltage, V

from the net of alternating current at the frequency of 50 Hz ... 127/220.

from the source of direct current ... 24.

Required power, W ... 120.

Weight of gas analyzer-signal indicator, kg ... 18. ENDFOOTNOTE

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Designation/purpose. Gas analyzer is intended for continuous automatic measurement and recording the content of carbon monoxide in air of industrial rooms. Instrument is equipped with telecommand about the achievement of the prescribed/assigned limit of the concentration of the determined component.

Operating principle. The effect/action of instrument is based on the measurement of the thermal effect, which appears during the catalytic oxidation of carbon monoxide to dioxide on bulk catalyst - hopcalite, which is mixture 60o/o of active manganese dioxide and 40o/o of copper oxide. Thermal effect is measured via the comparison of the value of the resistor/resistance of two copper electric thermometers, placed into reaction chamber (one - in the flow of the cold analyzed mixture, another - in the flow of the analyzed mixture,

heated due to reaction) and being the active arms of nonequilibrium measuring bridge.

Structural-assembling performance. Into the assembly of gas analyzer enter: the sensor unit, electron showing and recording instrument EPD-17, voltage regulator, unit of chemical filters.

The sensor of gas analyzer is mounted in steel welded housing with hinged/reversible cover/cap. On the lower wall of housing are arranged/located stuffing box conclusions for wires. In the lower part of the housing of sensor are established/installed intake chamber, flow meter with control filter, zero rheostat, tap selector and terminal block. In upper part are established/installed the fan blower with electric motor and flow regulator and the signal lamp of the fitness of instrument. Sensor and secondary instrument are made in the general-purpose (not explosion-proof) performance.

Fundamental technical and performance data.

Range of measurement, mg/m^3 ... 0-6300.

Fundamental error, o/o from the upper limit of the measurement ... +-5.

Additional error from a change in the ambient temperature, o/o from the upper limit of measurement, is not more than ... +-5.

Threshold of response, mg/m³ ... 150.

Starting time, min ... 15.

The time lag of readings, min, is not more than ... 4-5.

Supply voltage at the frequency of 50 Hz, V ... 127.

Required power, W ... 300.

Clearance of sensor, mm ... 300x480x135.

Weight of entire assembly of gas analyzer, kg ... 32.

Mounting conditions and mounting. The sensor of gas analyzer and secondary instrument must be established/installed in dangerously explosive room.

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Stationary automatic gas analyzer TKh2104.

Instrument is developed by SKB of the analytical instrument manufacture of the AS USSR and was released by the series Vyru by plant of gas analyzers.

Designation/purpose. Gas analyzer is intended for the continuous automatic measurement of the content of carbon monoxide in air of industrial rooms. Gas analyzer is equipped with telecommand about the achievement of the prescribed/assigned limit of the concentration of carbon monoxide.

Operating principle. The effect/action of gas analyzer is based on the thermochemical method of the analysis (see "Principle of action" of gas analyzer TKh2102).

Structural-assembling performance. Into the assembly of gas analyzer enter: the sensor, the electron indicating device (EK-1), attachment to the stimulus of flow rate, filter, tap selector, rotameter, valve/gate locking.

The sensor of gas analyzer is mounted in flat/plane right angled welded housing and is intended for a mounting on panel or on frame.

According to the degree of explosion-proof character the sensor and secondary instrument are made in the general-purpose (non explosion-proof) performance.

Fundamental technical and performance data.

Ranges of measurement, mg/m³ ... 0-100, 100-1000.

Fundamental error for each range of measurements, o/o from the upper limit of measurements +-5.

Summary quadratic additional error for each range of measurements, o/o from the upper limit of the measurements ... +-5.

Threshold of response, mg/m³ ... 10.

Parameters of the analyzed mixture

temperature, °C ... 5-50.

relative humidity, o/o ... to 95.

atmospheric pressure, mm Hg (kN/m²) ... 720-920 (96-122)

consumption t/h, ... 480.

Starting time, min ... 20-25.

Time began reactions, s ... 30.

Time lag of readings, min ... 4-5.

Supply voltage at the frequency of 50 Hz, V ... 127.

Required power, W ... 300.

Clearance of sensor, mm ... 302x480x135.

Weight, kg

sensor ... 10.

entire assembly of gas analyzer ... 33.

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Mounting conditions and mounting. The sensor and all units (with exception of secondary instrument) are assembled on panel either in

overall frame, which are established/installed in the same room, where is produced the selection of the analyzed mixture, or in adjacent with it room with the following environmental parameters:

temperature, by °C ... 5-45

relative humidity, o/o ... to 95.

Sensor and electronic device must be assembled at smallest possible distance from each other. The external gas and electrical connections of gas analyzer are assembled in accordance with diagram (Fig. 20).

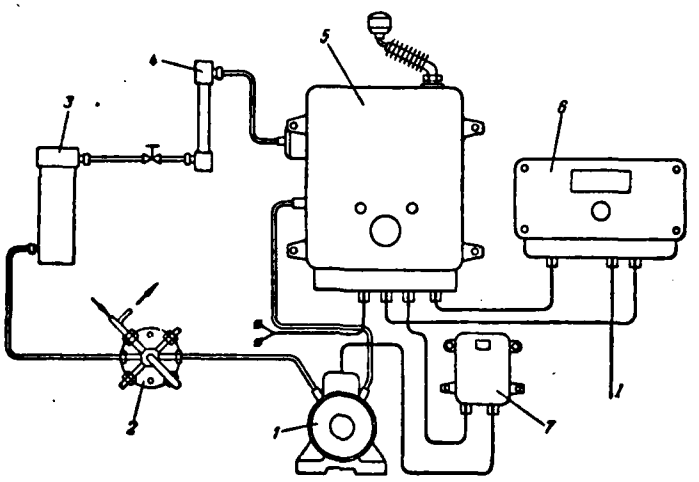

Fig. 20. Gas analyzer TKh2104. The diagram of the external gas and electrical connections: 1 - stimulus of the flow rate; 2- tap selector; 3 - filter; 4 - rotameter; 5 - sensor; 6 - secondary instrument; 7 - attachment to the stimulus of the flow rate; I - to signalling device.

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Stationary automatic gas analyzer GIP-7.

Instrument is developed by the experimental design office of automation (OKBA). Non-current for modification 1.

FOOTNOTE [1]. On the basis of gas analyzer GIP-7 in OKBA is developed/processed the gas analyzer GIP-14-7, intended for determining carbon monoxide in air in the range of concentrations 0-630 mg/m^3. ENDFOOTNOTE.

Designation/purpose. Gas analyzer is intended for continuous automatic measurement and recording the content of carbon monoxide, dioxide of carbon, methane and ammonia in technological gaseous mixtures, and also carbon monoxide in air of industrial rooms. Instrument is equipped with telecommand about the achievement of the prescribed/assigned values of the concentration of the determined component.

Operating principle. The effect/action of instrument is based on selective absorption (in the specific part of the spectrum) of infrared radiation by the determined component. The source of infrared radiation are two Nichrome spirals, heated by electric current. The flows of infrared radiation from the heated spirals, being interrupted/broken by special obturator/shutter, are passed through two in parallel established/installed cuvettes one of which (worker) is filled with the analyzed gaseous mixture, and another (comparative) - by air.

If in the analyzed gaseous mixture is present the determined

component, occurs weakening radiation flux in working cuvette due to the absorption of the counterpart of the spectrum by the determined component. The degree of radiation absorption depends on concentration of the determined component in the analyzed mixture. In the airtight comparative cuvette, filled with pure air, the radiation absorption does not occur. Thus, the working and comparative cuvettes leave radiant fluxes a difference in intensities of which is measured by compensation method.

Structural-assembling performance. Instrument GIP-7 is prepared on the basis of an electron potentiometer of the type EPD. Into the assembly of instrument enter the sensor of gas analyzer with the recording showing device and voltage regulator (SNÉ-0, 09-120). Additionally into the assembly of gas analyzer they can enter: secondary (outside) instrument (EPD, EPP, PS), air removal jet of the type VEZh, panel of the air supply of the type PPV-1 with filter FV-10.

In the housing of sensor are arranged/located the emitters, the unit of obturator/shutter with motor and photosensitive device of rectifier, the unit of cuvettes, radiation detector, preamplifier, comparative and compensation shutters/valves with the systems of kinematic draft, reversible geared engine, synchronous geared engine for rotating the diagrams, motor generator of feedback, power supply

unit, terminal amplifier and filter. On the left wall of the housing of sensor are located the connecting pipes for input and yield of the analyzed gaseous mixture.

Sensor is made in the general-purpose (not explosion-proof) performance.

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Fundamental technical and performance data.

Range of measurement, mg/m³ ... 0-630.

Fundamental error, o/o from the range of the measurement ... +-10.

Additional error from a change in the temperature on 1 °C, o/o from the range of the measurement ... +-1.

Threshold of response, mg/m³ ... 30.

Parameters of the analyzed mixture

temperature, °C ... 10-40.

relative humidity, o/o ... to 80.

atmospheric pressure, mm Hg (кN/m²) ... 760+-10 (101+-1.3).

flow rate, L/h ... 50+-20.

The time lag of readings of gas analyzer (without taking into account time lag due to the gas-feeding line), s, is not more than ... 40.

Supply voltage at the frequency of 50 Hz, V ... 220.

Required power, W, not more than ... 100.

Clearance, mm ... 292x420x506.

Weight, kg ... 45.

Mounting conditions and mounting. The sensor of the gas analyzer was placed in explosion proof room is assembled on panel. Gas analyzer normally works in the following environmental parameters:

temperature, by °C ... 20+-2.

relative humidity, o/o ... to 80.

atmospheric pressure, mm Hg (kN/m²) ... 760+-10 (101+-1.3).

The analyzed gaseous mixture must not contain agressive admixtures/impurities (hydrogen sulfide not more than 0.001 g/nm³), dust and components, which are condensed at temperature lower than 30°C.

Stationary automatic sensor of carbon monoxide FL2101.

Instrument is developed by SKB of the analytical instrument manufacture of the AS USSR and is released by the in series Smolensk plant of the means of automation. [91] Designation/purpose. Sensor is intended for the continuous automatic measurement of the content of carbon monoxide in air of industrial rooms and has the standardized output signal of direct current in limits from 0 to 10 V, proportional to the concentration of carbon monoxide and that calculated for load (connection of the secondary instrument, not entering the assembly) not less than 10 kiloohm.

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Operating principle. The effect/action of gas analyzer based on

the photometric method of measurement consists in the comparison of the value of the luminous flux, reflected from dyed as a result of color reaction spot on indicator tape with the value of standard luminous flux.

Structural-assembling performance. The assembly of instrument consists of sensor and panel or auxilople. Sensor has the water-proofed, vibration-proof and shock resistant performance. According to the degree of explosion-proof character the sensor is made in the general-purpose (not explosion-proof) performance.

Fundamental technical and performance data.

Range of measurement, mg/m^3, (V) ... 0-30 (0-10).

Fundamental error, o/o from the upper limit of the measurement (V) ...+-15 (1, 5).

Threshold of response, mg/m^3 ... 5.

Parameters of the analyzed mixture

temperature, ^{o}C ... 5-50.

relative humidity, o/o ... 45-98.

atmospheric pressure, mm Hg (kN/m²) ... 690-860 (90-114).

flow rate, l/h ... 30+-1.5.

The starting time, h ... is not more than 1.

Signal lag, min ... is not more than 20.

Supply voltage at the frequency of 400 Hz, V ... 220.

Required power, W ... not more than 200.

Clearance, mm

sensor ... 380x260x260.

the panel of auxiliary ... 370x350x340.

Weight of assembly, kg ... 43.

Mounting conditions and mounting. The sensor of gas analyzer is established/installed in explosive-not dangerous room. Distance from

the place of selection of the analyzed mixture to sensor must not exceed 5 m along the length of gas line. Instrument can work under conditions of prolonged inclinations/slopes on angle to 45°.

With work under conditions of the increased humidity and temperature for 1000 h the works the panel of auxilople replace.

Transferable gas detector of carbon monoxide.

Instrument is developed by MakNII, in series it was not released.

Designation/purpose. Gas detector is intended for determining the concentration of carbon monoxide in mining atmosphere.

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Operating principle. The effect/action of instrument is based on the thermochemical method of the analysis (see "Operating principle" of gas analyzer TKh2102).

A quantity of separating heat (due to the oxidation reaction) is fixed/recorded with the thermopile from the iron-constantan thermocouples, to which is connected the galvanometer. For the

numerical determination of the concentration of carbon monoxide they put to use the table, placed on the cover/cap of instrument. To the numerical significance of a deviation of the arrow/pointer of galvanometer corresponds the specific concentration of carbon monoxide.

Structural-assembling performance. Gas detector consists of the following parts: hand pump with dustproof filter, air collector by the capacitance of 0.4 ℓ, air cocks, columns from carbogel for the drying of the analyzed mixture of moisture, reaction chamber with hopcalite and thermopile, rotameter and galvanometer with change-over switch. All nodes of instrument (with exception of pump) are placed into the metallic case to which is attached the belt for a transference device.

Main technical and performance data.

Range of measurement, mg/m³ ... 0-2500.

Fundamental error, o/o from the upper limit of measurement ... ± 1.

Threshold of response, mg/m³ ... 12.5.

Duration of one measurment, min ... about 5.

Clearance, mm ... 222x134x149.

Weight, kg ... not more than 4.5.

3.2. Instruments for determining ammonia [1].

FOOTNOTE [1]. On the basis carried out by Voronezh branch of OKBA study on the expansion of sphere to the tonic of the instruments, developed by OKBA, it is recommended to determine the content ammonia in air in the limits of 0-0.04 mg/l and 0-0.4 mg/l also by gas analyzer FKG-2, intended for determining hydrogen sulfide in air and technolcgical gaseous mixtures (see "Instruments for determining hydrogen sulfide"). As sensitive indicator one should use the cloth tape, saturated with the 5,8o/o alcoholic solution of bromphenolic blue water-soluble. In work [22] is in detail described the procedure of the calibration of instrument, are given calibration curves, and are also shown the parameters, which are determining the mode/conditions of the work of instrument. ENDFOOTNOTE.

For determining ammonia in air of industrial rooms can be used the automatic gas analyzers of FGTs-4, "Sigma-1" and FL5501.

In connection with the fact that these instruments are related to the group of universal ones, their description is given in section 3.16.

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3.3. Instrument for determining vapors of gasoline.

Conductometry device KU-3 [1].

FOOTNOTE [1]. Instrument is developed on base the previously created conductometry device KU-1 and differs from it in terms of the improved technical and operating characteristics, in particular instrument sensitivity is increased 5 times, the time, necessary for analysis, is abbreviated/reduced 1.5 times, weight is reduced 2.2 times. In contrast to the device KU-1, the instrument KU-3 is mounted in one housing. ENDFOOTNOTE.

Instrument (Fig. 21) is developed and is released by short runs experimental workshop of SKB VNIIOT of VTsSPS.

Designation/purpose. Of device is intended for the continuous measurements of the concentration of carbon monoxide, dioxide of carbon and vapors of gasoline in air under laboratory and production

conditions.

Operating principle. The effect/action of instrument is based on the measurement of a change in the electroconduccivity of the solution of the sodium hydroxide during the absorption by it of carbon dioxide. In the basis of the method of determining the change of the electroconductivity in this diagram is placed the principle of the measurement of current strength, passing through the electrolyte with the prescribed/assigned voltage.

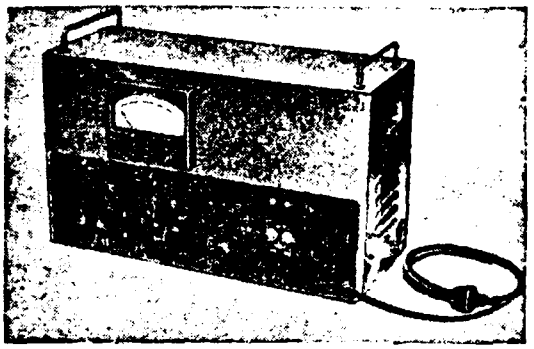

Fig. 21. Conductometry device KU-3.

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By the determination of carbon monoxide and vapors of gasoline is produced their preliminary oxidation to carbon dioxide by special reagents. Differential electrical measuring diagram makes it possible to determine concentration in all ranges of measurement with one and the same ones by electrolytic cells and solution of the alkali of one concentration.

Structural-assembling performance. All nodes and elements/cells of instrument are mounted in one housing, to front/leading panel of which is carried out measuring instrument (micro-ammeter) and control knobs. Instrument is intended for intallation laboratory bench or on the special framework (brackets). Instrument is made in

the general-purpose (not explosion-proof) performance.

Fundamental technical and perrormance data.

Ranges of measurement, mg/m^3

carbon monoxide ... 0-50, 0-500, 0-1500

carbon dioxide ... 0-500, 0-2500

Vapors of gasoline ... 0-750.

Fundamental error for each range or measurement, o/o from the upper limit of the measurement ... +-5.

Parameters of the analyzed mixture

temperature, °C ... 15-25.

relative humidity, o/o ... to 80.

Duration of one measurment, min:.

during the determination or the dioxide of carbon ... 3.

during the determination of carbon monoxide and vapors of gasoline ... 7.

Supply voltage at the frequency of 50 Hz, V ... 127/220.

Required power, W ... 100.

Clearance, mm ... 200x480x310.

Weight, kg ... 14.

3.4. Instrument for determining vapors of benzene and its derivatives.

Stationary automatic gas analyzer "Gamma-1".

Instrument is developed and is released (by short runs) by the experimental design office of automation (OKBA).

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Designation/purpose. Gas analyzer is intended for determining

vapors of toxic organic matter in air of industrial placements and supplies of signal with the excess of the prescribed/assigned value of the concentration of the determined component (or the mixture of several components). In particular, gas analyzer can be used for determining of benzene and sum of benzene and its derivatives in air.

Operating principle. The effect/action of gas analyzer is based on the utilization of a process of the ionization of the molecules of organic matter in the flame of hydrogen.

Gauge element is the cell or sensor, which is ionization chamber with two measuring electrodes. The potential difference, created between measuring electrodes by the external voltage source, forms electric field.

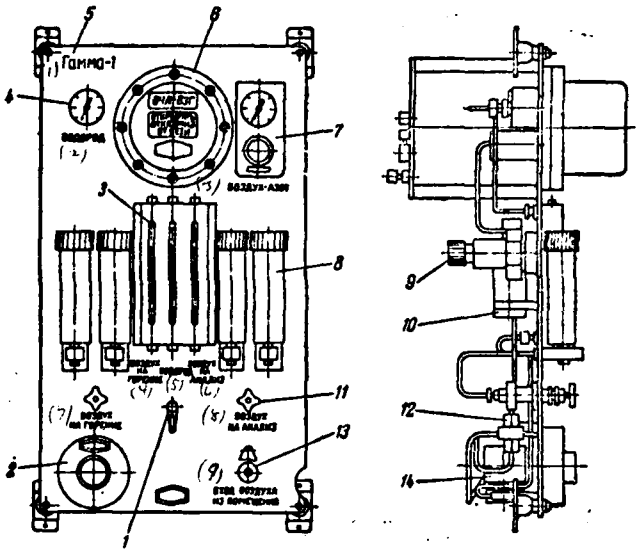

Fig. 22. Gas analyzer "Gamma-1". Arrangement of separate nodes on the panel of sensor. 1 - tap/crane or the threeway; 2- flow regulator of the gas; 3 - unit of the rotameters; 4 - mancmeter; 5 - panel; 6 - sensor; 7 - control panel; 8 - filters for cleaning organic matter from gas flows (4 pieces - 1 stand-by); 9 - pressure regulator; 10 - filter of the air; 11 - valve/gate, 12, 13 - filters for cleaning/purification of the air, sucked to rcoms, from the dust; 14 - stimulus of flow rate.

Key: (1). Gamma. (2). hydrogen (3). air- nitrogen. (4). air for combustion. (5). hydrogen. (6). air for analysis. (7). air for combustion. (8). air for analysis. (9). air input from premises.

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In the absence in the analyzed mixture of organic matter the flame in cell possesses very low electroconductivity. Appearance in the analyzed mixture of organic matter and their subsequent ionization in hydrogen flame leads to snarp increase of the electroconductivity of flame and corresponding increase in the ionization current between measuring electrodes. A change in the ionization current is proportional to a quantity of organic matter, which enter the cell with the analyzed flow per unit time. The ionization current of sensor is measured according to a voltage drop across measuring resistor/resistance with the aid of secondary instrument.

Structural-assembling performance. Into the assembly of gas analyzer enter: the unit PD (panel with sensor and elements/cells of shaping and preparation of gas flows), unit PVZ (transformer high-impedance), electron potentiometer, cable uniting.

The sensor unit of gas analyzer (unit PD) is released in the explosive-impenetrable performance V3G-V4A (V3T4-V4aT1-V). Sensor and all auxilople are assembled on the special panel, intended for setting up on panel (the flush mounting), or on the special

framework. Unit PVZ is mounted in a dust--splashproof housing. Unit PVZ and electron potentiometer have the general-purpose (not explosion-poof) performance and are assembled on panel. The arrangement of nodes on the panel of the sensor of gas analyzer is shown in Fig. 22.

Fundamental technical and performance data.

Parameters of the analyzed mixture.

temperature, °C ... 5-40.

relative humidity, o/o ... to 80.

flow rate, l/h ... 3.

Time it began reactions, min ... 1.

The time lag of readings of gas analyzer, min, is not more than ... 3.

Supply voltage at the frequency of 50 Hz, V ... 220.

Required power, W ... 100.

Clearance, mm.

Unit PD ... 380x725x353.

Unit PVZ ... 160x290x360.

Weight, kg.

Unit PD ... 30.

Unit PVZ ... 15.

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Depending on the determined component the gas analyzer "Gamma-1" is released in different modifications. The enumeration of the determined components, the ranges of the measurement of their concentrations and fundamental errors of measurement are shown in Table 4.

Gas analyzer calibrates itself by producer according to the equivalent mixture of benzene with air.

Mounting conditions and mounting. The panel of sensor can be established/installed directly in the place from selection of test/sample in dangerously explosive rooms. Unit PD is assembled on panel or on special U-shaped strut. Unit must be established/installed in strictly vertical position.

Environmental parameters in the site of installation of unit PD must be located in the following limits:

temperature, by °C ... 5-40.

relative humidity, o/o ... to 80.

Unit PVZ and secondary device place in explosion proof room at a distance to 100 m from the panel of sensor. Distance from unit PVZ to secondary instrument must be not more than three meters. Unit PVZ and secondary device place in general/common/total panel.

Environmental parameters in place of installation of unit PVZ and secondary instrument must be:

temperature, °C ... 10-35.

relative humidity, o/o ... to 80.

Table 4. Characteristics of the modifications of gas analyzer "Gamma".

Модификация прибора	Определяемый компонент	Диапазоны измерения, мг/м³	Погрешность измерения, % от диапазона измерения
Гамма-1А . . .	Бензол	0—100	±10
Гамма-1Б . . .	Стирол	0—75	±10
Гамма-1В . . .	»	0—25	±15
Гамма-1Д . . .	Толуол	0—150	±10
Гамма-2А . . .	Хлорвинил	0—150	±15
СДКІА[1] . . .	Хлорбензол	Порог срабатывания при концентрации 12 мг/л	Точность порога срабатывания 10,2—13,8 мг/л

---

1. The signal indicator of pre-explosive concentrations has another completeness (panel with sensor and meter).

Key: (1). Modification of instrument. (2). Determined component. (3). Ranges of measurement, mg/m³. (4). Error of measurement, o/o from range of measurement. (5). Gamma. (6). Benzene. (7). Styrene. (8). Toluene. (9). Vinyl chloride. (10). Chlorobenzene. (11). Threshold of wear with concentration 12 mg/l. (12). Accuracy of threshold of wear 10.2-13.8 mg/l.

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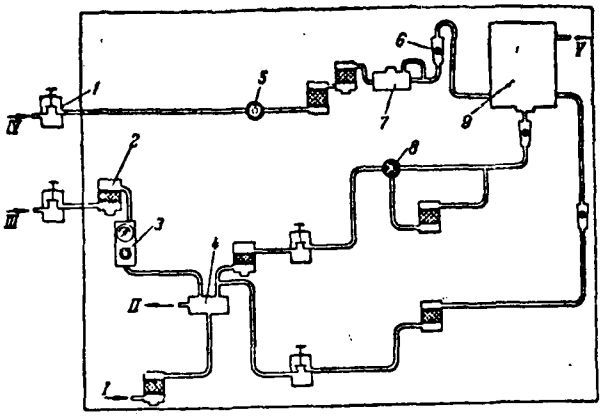

Fig. 23. Gas analyzer "Gamma-1". Diagrams of external gas connections (unit PD). 1 - valve/gate (4 pieces); 2 - filter (7 pieces); 3 - control panel; 4 - stimulus of the flow rate; 5 - reductor; 6 - rotameter (3 pieces); 7 - flow regulator; 8 - tap/crane of the threeway; 9 - cell of the sensor; I - analyzed gaseous mixture; II - discharge/break of compressed air or nitrogen; III - compressed air or nitrogen; IV - hydrogen; V - discharge/break of the products of burning.

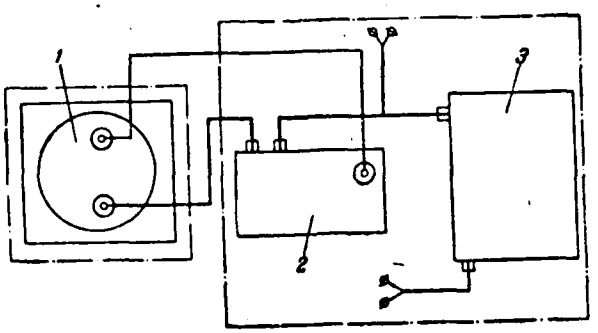

Fig. 24. Gas analyzer "Gamma-1". The diagram of the external electrical connections: 1 - sensor; 2 - converter high-ohm ; 3 - electron potentiometer.

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To unit PD besides the bleed line of the analyzed mixture must be conducted/supplied the line of the compressed air (pressure 2-10 kg/cm²) and the line of hydrogen (pressure 2-10 kg/cm²). In the absence in the site of installation of unit PD of the line of technical hydrogen can be used the tank/balloon with hydrogen. Air and hydrogen must be purified from dust, moisture, oil and organic impurities. For simplification in the exploitation of instrument as air for maintaining the burning can be used analyze the air, preliminarily purified from organic impurities.

AD-A087 872 FOREIGN TECHNOLOGY DIV WRIGHT-PATTERSON AFB OH F/G 13/2
AUTOMATIC ANALYZERS AND SIGNAL INDICATORS OF TOXIC AND DANGEROU--ETC(U)
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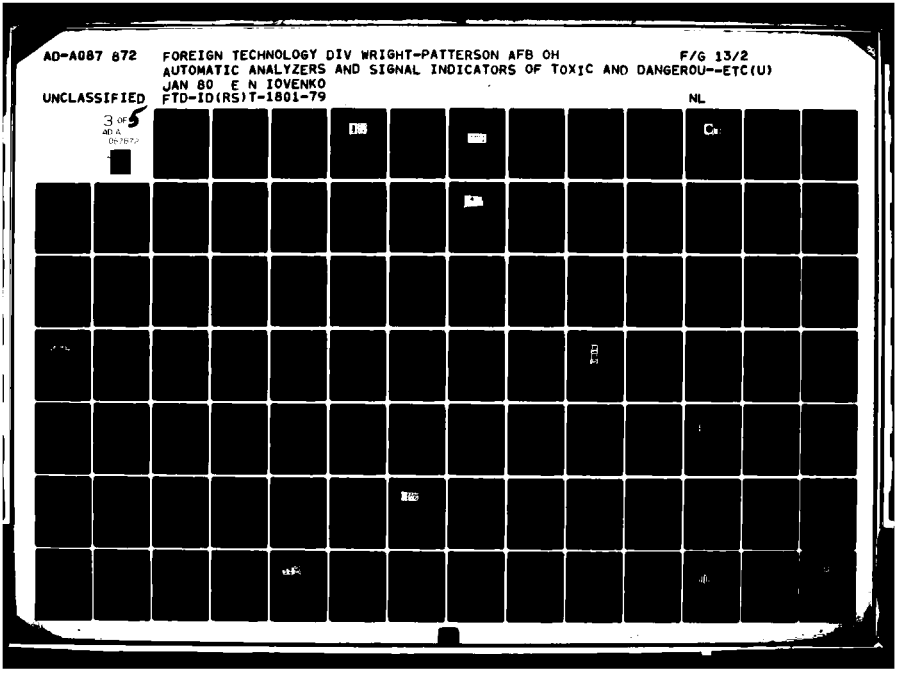

The gas and electrical connections of gas analyzer are assembled in accordance with the diagrams, given in Fig. 23 and 24.

3.5. Instruments for determining nitrogen oxides.

The presence of nitrogen oxides in air of industrial rooms is determined with the aid of the stationary automatic gas analyzer FK-0060, described in this section, and also gas analyzers "Sigma 1" and FL 5501, described in section 3.16.

To this group of instruments should be also related liquid photocolorimetric gas analyzers FK4501 and FK 4502, the developed by SKB analytical instrument manufacture of the AS USSR and intended for the cyclic determination of microconcentrations with respect to FK4501 - oxides of nitrogen ($NO+NO_2$) and FK4502 - nitrogen dioxide in air of industrial rooms. Gas analyzers do not have the vital differences between themselves and are characterized by the following indices:

Range of measurement, mg/m^3

FK 4501 ... 0-5.

FK 4502 ... 0-10.

Fundamental error, o/o from the upper limit of the measurement ... +-10.

Time lag of readings of gas analyzer, min ... 5.

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Stationary automatic gas signal analyzer FK-0060.

Instrument is developed by the design office of the analytical instrument manufacture of plant "Kievpribor."

Designation/purpose. Gas signal analyzer is intended for the signaling of the presence in air of industrial, storage and other rooms of the toxic concentrations of nitrogen oxides.

Operating principle. The effect/action gas signal analyzer is based on a change in the optical density dry, pre-impregnated with reagent, indicator tape under the effect/action of nitrogen oxides, which are found in the analyzed air.

The concentration of nitrogen oxides is measured via the

comparison of the illumination of comparative and worker of photocells, the illumination of the latter depending on a change in the optical density of indicator belt.

The photoelectric schematic of instrument operates/wears, when the optical density of belt reaches the given one during adjustment. Diagram they tune on the standard, which is the interchangeable light filter in the channel of comparative photocell. As a result of wearing the photoelectric diagram is included the light and sound communication, which notifies about the toxic concentrations of nitrogen oxides in air.

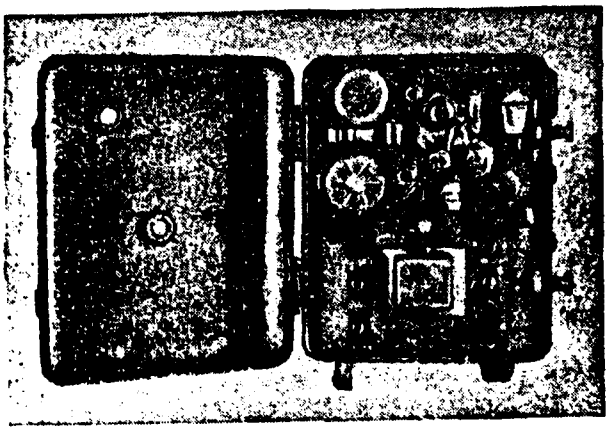

Fig. 25. Sensor gas signal analyzer FK-0060 with the open cover/cap.

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Structural-assembliny performance. Into the assembly of gas signal analyzer enter: the sensor and control panel. The sensor of gas signal analyzer (Fig. 25) is made in the dust-splashproof performance. Control panel is depicted in Fig. 26.

Fundamental technical and performance data.

Parameters of the analyzed mixture

temperature, °C ... from -40 to 30

flow rate, l/h ... 60.

Supply voltage at the frequency of 50 Hz, V ... 220.

Required power, W ... 100.

Clearance, mm

the sensor ... 410x315x200

of control panel ... 260x250x140.

Weight of the assembly of gas signal analyzer, kg ... 20.

Instrument FK-0060 determines the concentration of nitrogen oxides in the analyzed air on one of the three ranges and puts out signal about the achievement of the established/installed concentration. Are given below the ranges of the signal concentrations of the determined component and triggering time of the signalling device of gas signal analyzer:

(1) Предел переключения	(2) Интервал времени срабатывания	(3) Диапазоны сигнальных концентраций, мг/м³
1	(4) От 0 до 10±5 сек	(5) От 100 и выше
2	(6) От 10±5 сек до 3±1 мин.	(7) От 100 до 5
3	(8) От 3±1 мин до 10±3 мин.	(9) От 5 до 1,8

Key: (1). Limit of switching. (2). Time interval of wear. (3). Ranges of signal concentrations, $мг/м^3$. (4). From 0 to 10+-5 s. (5). From 100 it is above. (6). From 10+-5 s to 3+-1 min. (7). From 100 to 5. (8). From 3+-1 min to 10+-3 min. (9). From 5 to 1.8.

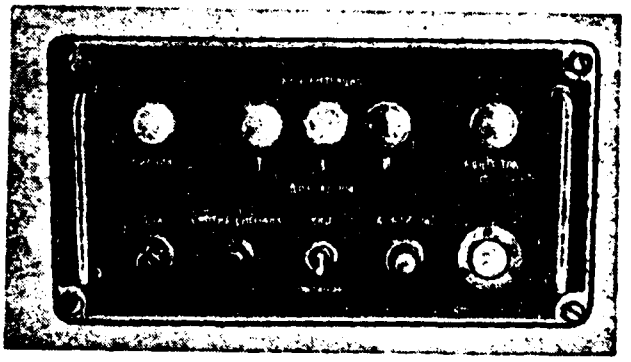

Fig. 26. Control panel of gas signal analyzer FK-0060 (front panel).

Mounting conditions and mounting. The sensor of gas indicator is installed directly in the room, from which is selected/taken the air for analysis. Instrument it is operational at an ambient temperature from -40 to 30°C and during the removal of sensor from control panel up to distance to 200 m.

3.6. Instruments for determining mercury vapor.

The presence of mercury vapor in air of industrial enterprises is determined with the aid of the stationary automatic meters of the concentration of mercury vapors IKRP-445 and transferable gas analyzers OP8301.

Stationary automatic meter of the concentration of mercury vapors IKRP-445.

Instrument is developed by design office "Tsvetmatavtomatika" (KB TsMA) and is the base construction/design of the subsequent developments of instruments of this type.

On the basis of instrument IKRP-445 of the KB TsMA together with the institute of the hygiene of work and occupational diseases of the AMS USSR is developed automatic stationary gas analyzer IKRP-446 and portable instrument IKRP-450.

(1) Основные характеристики приборов

(2)	ИКРП-446	ИКРП-450
Диапазоны измерения, *мг/м³*	0,002—0,06	0,002—0,3 0,01—0,1 0,05—0,6
(3) Основная погрешность, % от верхнего предела измерения	±5	±5
(4) Запаздывание показаний, *сек*	20	20

(5) Опытная партия приборов выпущена Московским электромеханическим заводом.

Key: (1). Fundamental characteristics of instruments. (2). Ranges of measurement, mg/m³. (3). Fundamental error, o/o from upper limit of measurement. (4). Time lag of readings, s. (5). Test batch of instruments is released by Moscow electrical engineering plant.

Designation/purpose. Gas analyzer is intended for continuous automatic measurement and recording the concentration of mercury vapors in air of industrial rooms and signaling and excess of the prescribed/assigned values.

Operating principle.

The effect/action of instrument is based on the measurement of selective absorption by the mercury vapors of ultraviolet radiation. As the source of radiation serves glow-discharge mercury-vapor lamp. As receiver is applied maynesium photocell.

The analyzed gaseous mixture is passed through block-cuvettes, which is divided into two equal cuvettes: the worker (on which is passed the analyzed mixture) and comparative (hermetically sealed and containing pure air). With the aid of photomodulator from mercury luminous gas lamp alternately passes through both cuvettes and it falls to photocell. Upon appearance in the analyzed mixture of mercury vapors the luminous absorption in working cuvette sharply increases/grows, the equilibrium of the luminous fluxes, which fall to photocell, is disturbed, as a result of which appears variable component in the luminous flux and the current of photocell. In instrument is applied compensation measuring circuit.

Structural-assembling performance. Instrument (Fig. 27) is designed on the basis of the electron recording bridge of the type EMD-212 in housing of which are mounted electron and measuring instrument units.

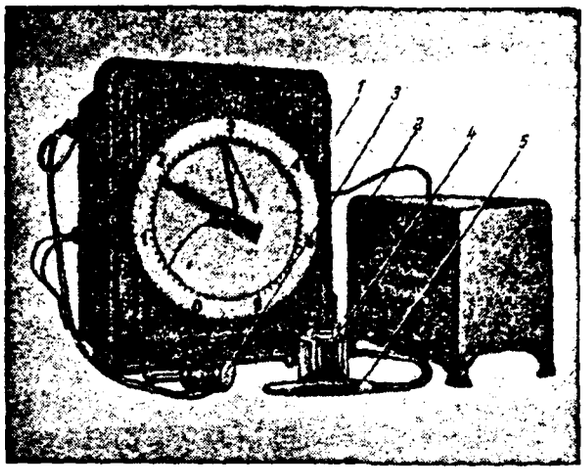

Fig. 27. Gas analyzer IKRP-445 (the general view of assembly): 1 - electron bridge; 2 - pump; 3 - sampler; 4 - standard source of the mercury vapors; 5 - filter for cleaning mercury vapor from air.

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Into assembly gas analyzer enter: electron bridge EMD-212, pump (compressor of the type KVM-8), sampler, standard source of mercury vapors and filter for cleaning mercury vapor from air.

With it is carried out in the general-purpose (nonexplosion-protected) performance.

Fundamental technical and performance data.

Range of measurement, mg/m³ ... 0.01-0.6.

Fundamental error, o/o from the upper limit of the measurement ... by ±10.

Threshold of response, mg/m³ ... 0.01.

Time lag of readings gas analyzer, s ... 10.

Supply voltage at the frequency of 50 Hz, into ... 220.

Required power, W ... 200.

Weight of assembly gas analyzer, kg ... 30.

Transferable gas analyzer OP8301.

Instrument is developed by SKB of the analytical instrument manufacture of the AS USSR; by industry it is not released.

Designation/purpose. Gas analyzer is intended for continuous automatic measurement and recording the concentration of mercury

vapor in air of industrial rooms.

Operating principle. The effect/action of instrument is based on the phenomenon of absorption by the mercury vapors of ultraviolet radiation in with specific, the only with it, the part of the spectrum.

In contrast to the analogous in operating principle of instrument IKRP-445 in gas analyzer OP8301 gaseous mixture is supplied to analysis with free convection.

Structural-assembling performance. Instrument is carried out in the general-purpose (nonexplosive-protected) performance. All nodes are mounted in portable metal housing. Despite the fact that the gas analyzer is portable instrument, it can be connected with the aid of the built-in rheochord to secondary recording instrument, entering the assembly of gas analyzer. In this case is provided remote the redundancy and record of readings of portable instrument.

Fundamental technical and performance data.

Range of measurement, mg/m^3 ... 0-0.1.

Fundamental error, o/o from the upper limit of the measurement ...

±10.

Threshold of response, mg/m³ ... 0.01.

Time lag of readings of gas analyzer, s ... 30.

Environmental parameters

temperature, °C ... 10-50.

relative humidity, o/o ... to 80.

Supply voltage at the frequency of 50 Hz, V ... 127.

consumed power, W ... 250.

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3.7. Instruments for determining hydrogen sulfide.

For determining the concentration of hydrogen sulfide in air of industrial rooms are used stationary automatic gas analyzers FK5601 and FKG-2 whose description is given in this section, and also universal stationary automatic gas analyzers FL5501 and FGTs,

described in pt. 3.16.

Stationary automatic gas analyzer FK5601.

Instrument is developed by SKB of the analytical instrument manufacture of the AS USSR; by industry it is not released.

designation/purpose. Gas analyzer is intended for the continuous automatic measurement of hydrogen sulfide concentration in air of industrial rooms and signaling about the excess of its maximum permissible value.

Operating principle. The effect/action of instrument is based on the photocolorimetry of the indicator solution[1], which changed its coloring as a result of chemical interaction with hydrogen sulfide, which are located in the analyzed mixture.

FOOTNOTE [1]. Composition of indicator solution (on 1 l of the distilled water), g:

molybdic oxide of ammonium ... 5.

sulfate ammonium ... 2, 5.

sulfuric acid ... 9, 2. ENDFOOTNOTE.

In instrument is applied the differential null circuit of measurement with two photocells and with the optical compensation photoelectric current.

In the absence in the analyzed mixture of hydrogen sulfide the intensity of the luminous fluxes (passed preliminarily respectively through working and comparative cuvettes), which fall to working and comparative photocells, will be identical, and consequently, in metering circuit of signal it will not be. Appearance in the analyzed mixture of hydrogen sulfide produces change in the intensity of coloring the indicator solution in working cuvette and, consequently, also the value of the luminous flux, which falls to working photocell. Appearing in this case difference in the intensities of the luminous fluxes, which fall to photocells, causes the appearance of the corresponding difference in the photoelectric currents - voltage of unbalance, proportional to hydrogen sulfide concentration in the analyzed gaseous mixture.

Structural-assembling performance. Into the assembly of gas analyzer enter: voltage regulator EPA-15, transformer, block of supplying the solution, sensor of gas analyzer and block of supply to the analyzed gaseous mixture. Additionally into assembly can enter

secondary instrument - electron potentiometer of the type EPD-07.

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The block of supplying the solution is the metallic cabinet, which consists of two sections, of which are placed the carboys for a working solution, bimetallic temperature controller and electric heaters for maintaining the permanent temperature of solution.

In the cover/cap of gas analyzer is inspection window for observation according to the scale of readings and opening/aperture for the installation of the signal lamp whose burning in the process of work characterizes the fitness of gas analyzer. Sensor is carried out in the general-purpose (nonexplosion-protected) performance.

Fundamental technical and performance data.

Range of measurement, mg/m^3 ... 0-20.

Signal concentration, mg/m^3 ... 10.

Fundamental error, o/o from the range of the measurement ... by $\pm$10.

Threshold of response, mg/m^3 ... 1.

Expenditure/consumption of analyzed gaseous mixture, l/h ... 12.

Expenditure/consumption of indicator solution, l/h ... 0.3.

Time lag of readings of gas analyzer, min ... 3.

Supply voltage at the frequency of 50 Hz, V ... 127.

Required power, W ... 150.

Mounting conditions and mounting. Gas analyzer (sensor and auxilople) is intended for a wall mounting or during special construction/design (frame) and can be established/installed only in explosion proof room with tne rollowing environmental parameters:

temperature, by °C ... 10-20.

relative humidity, o/o ... to 80.

Stationary automatic gas analyzer FKG-2.

Instrument is developed and is released by the in series

developmental office of automation (OKBA).

Designation/purpose. Gas analyzer is intended for continuous automatic measurement and recording the content of hydrogen sulfide in technological gaseous mixtures after sulfur removal, and also in air of the shops of the production of synthetic fiber.

Operating principle. The effect/action of gas analyzer is based on the photometric measurement of the dry indicator tape[1], which changes its coloring during reaction with hydrogen sulfide.

FOOTNOTE [1]. Composition of indicator solution for the saturation of cloth (cotton) tape, Vol. o/o:

acetic lead (analytically-pure) ... 20.

glycerin ... 12.

acetic acid (chemically pure) ... 0.2.

the distilled water ... 67.8. ENDFOOTNOTE.

The luminous fluxes from the lighting tube through converging lenses are directed for the moving/driving indicator tape and for immobile reference sample and, being reflected from them, they fall to the light sensitive layer of photoresistors. Photoresistors (worker and comparative) are connected into bridge measuring circuit.

In the absence in the analyzed mixture of hydrogen sulfide intensity of the falling/incident to photoresistors luminous fluxes and appearing in this case photoelectric currents are identical and in diagonal of bridge is absent measuring signal. Appearance in the analyzed mixture of hydrogen sulfide causes the appropriate change in the intensity of coloring indicator tape and, consequently, also the value of the luminous flux, reflected from indicator tape to working photoresistor. Appearing in this case signal in the diagonal of bridge is proportional to the concentration of the determined component.

Construction-assembling performance. Instrument is carried out in the general-purpose (non-explosion-protected) performance.

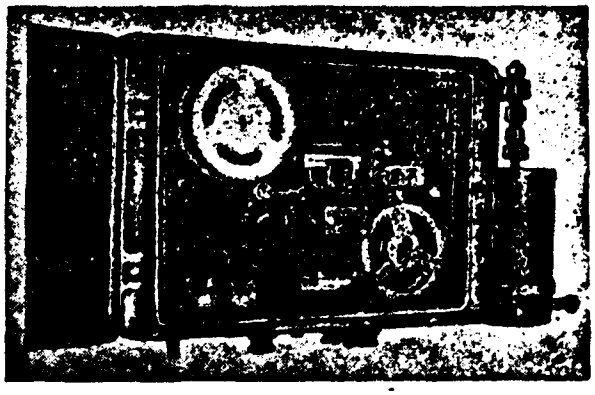

Fig. 28. Sensor of gas analyzer FKG-2 with the open cover/cap.

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Into the assembly of gas analyzer enter: the sensor, electronic relay ElR-1, voltage regulator S-0.09, secondary instrument EPD-12, pressure relay RlD-1, control panel PDU-A, of timer Ye-52, filter of air FV-10.

On special order in assembly with gas analyzer are supplied: the installation for the saturation of indicator tape UPL-1, moisture separator V-01, stimulus of expenditure/consumption PNG-1. The housing of sensor is made in dust-splashproof version and continuously is blasted by pure air or by nitrogen. In the case of the cessation of the supply of pure air into the housing of sensor is provided for the device, which disconnects the supply of electric

power supply into sensor. The construction/design of sensor provides for its mounting on panel or on bracket. The general view of the sensor of gas analyzer with the open cover/cap is shown in Fig. 28.

Fundamental technical and performance data.

Range of measurement, mg/m³ ... 0-30.

Fundamental error, o/o from the upper limit of the measurement ... ±10.

Additional errors do not exceed the following values (o/o from the upper limit of measurement):

from the measurement of the ambient temperature for each of 10°C in interval of 10-35°C ... ±2.

from a barometric change on every 10 mm Hg in the range 720-770 mm Hg (96-100 kN/m²) ... ±2.

from a change in the supply voltage on ±10o/o from 220 V ... ±1.5.

Threshold of sensitivity, mg/m³ ... 5.

Parameters of the analyzed mixture

temperature, °C ... 10-40.

relative humidity, o/o ... 30-80.

expenditure/consumption, l/h ... 12.

Speed of the motion of indicator tape, mm/min ... 6±0.2.

Time it began reactions, min ... 5.

Supply voltage at the frequency of 50 Hz, V ... 220.

Required power, W ... 300.

Clearance of sensor, mm ... 430x315x175.

Weight of sensor, kg ... 22.

Weight of entire assembly, kg ... 76.

Mounting conditions and mounting. The sensor of gas analyzer is installed in explosion proof room with the following environmental parameters:

temperature, °C ... 10-35.

relative humidity, o/o ... to 80.

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For decreasing the time lag the sensor of gas analyzer must be established/installed near the point of the selection of the analyzed mixture. The sensor of gas analyzer is assembled on panel or bracket at a distance not less than 0.5 m from wall and 1.5 m of floor/sex. Gas lines are assembled in accordance with the diagram of gas connections, represented in Fig. 29. For the purging of the housing of sensor must be conducted/supplied the line of the compressed air or nitrogen.

The binding of the stimulus of expenditure/consumption is fulfilled in accordance with the diagram of mounting PNG-1.

Secondary instrument is assembled on general/common/total panel. Pressure relays, voltage regulator, electronic relay and timer can be

established/installed separately. The length of line between the sensor and the secondary instrument must not exceed 100 m. The mounting of electric lines they conduct according to the diagram of external electrical connections (Fig. 30).

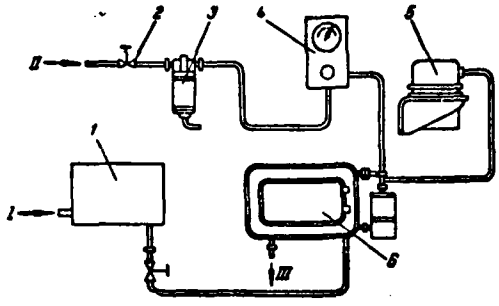

Fig. 29. Gas analyzer FKG-2. The diagram of external gas connections: 1 - stimulus of the flow rate; 2 - valve/gate; 3 - filter of the air; 4 - control panel; 5 - pressure relay; 6 - sensor; I - analyzed gaseous mixture; II - compressed air (nitrogen); III - discharge/break of gas.

3.8. Instruments for determining sulfurous anhydride.

For determining sulfurous annydride in air of industrial rooms are used the described below stationary automatic gas analyzer GKP-1 and the stationary automatic gas analyzer FL5501 **whose description is given in pt.** 3.16.

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Stationary automatic gas analyzer GKP-1.

Instrument is developed and is released by short runs by the experimental design office of automation (OKBA)[1].

FOOTNOTE [1]. In the experimental design office of automation is developed/processed also the instrument GKP-2 for determining sulfurous anhydride in air with the limits of measurement 0-30 mg/m^3. ENDFOOTNOTE.

Designation/purpose. Gas analyzer is intended for continuous automatic measurement and recording the content of sulfurous anhydride in atmospheric air.

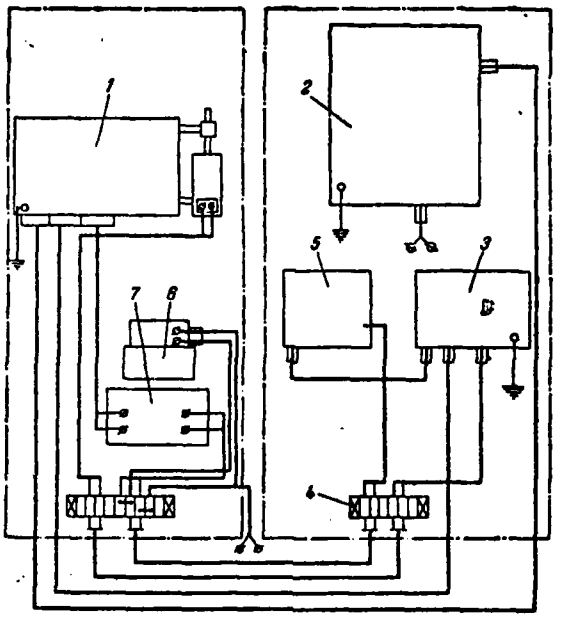

Fig. 30. Gas analyzer FKG-2. The diagram of the external electrical connections: 1 - sensor; 2 - electron potentiometer; 3 - electronic relay; 4 - rack of terminals/grippers, switching; 5 - timer; 6 - pressure relay; 7 - voltage regulator.

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A relatively larger quantity of oxides of nitrogen (to 18 mg/m^3), hydrogen sulfide (to 0.1 mg/m^3), hydrocarbons (to 200 mg/m^3), chlorines and other admixtures/impurities (undefined components) in the analyzed mixture does not prevent the measurement of the

concentration of the determined component with the accuracy of fundamental error. According to agreement with producer the gas analyzer GKP-1 can be used for determining sulfurous anhydride in air of industrial rooms.

Operating principle. The effect/action of gas analyzer is based on the measurement of the saturated electric current, which appears during the electrolysis of the solution which contains the determined substance, which is electrochemical depolarizer.

The analyzed mixture with the aid of the stimulus of flow rate is supplied through the sampling device into electrochemical cell. The sulfurous anhydride, which is contained in the analyzed mixture, reacts with iodine to hydrogen iodide which then is electroplated on measuring electrode, moreover the value of electric current is the measure for the concentration of the determined component.

Structural-assembling performance. Gas analyzer is not explosion-proof. Into the assembly of gas analyzer enter: the sensor, control panel, secondary instrument (potentiometer of the type PSR), voltage regulator S-0.09, cable, reagents.

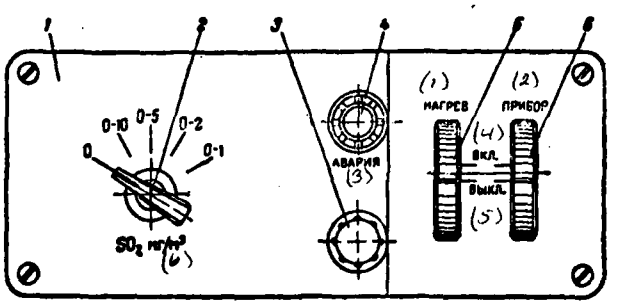

Fig. 31. Gas analyzer GKP-1. Control panel (front panel): 1 - panel; 2 - selector knob of the ranges; 3 - safety device/fuse; 4 - signal lamp of the divergence of the gas flow from the given one; 5 - knob/arm/handle of the start of the heating; 6 - knob/arm/handle of the start of instrument.

Key: (1). Heating. (2). Instrument. (3). Emergency. (4). Vkl. (5). Off. (6). mg/m^3.

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The sensor of gas analyzer installed in housing made from glass-fiber-reinforced plastic with thermal insulation layer from foamed plastic. The elements of the network of sensor, with exception of gas-bleeding device, are mounted on sliding carriage, and control panel (Fig. 31) - in aluminum housing with the detachable front panel on which are arranged/located measuring range changeover switch and

other control knobs of the work of instrument.

Fundamental technical and performance data.

Range of measurement, mg/m³ ... of 0-1; 0-2; 0-5; 0-10.

Scaling factor K_n, mg/m³ ... 0.01; 0.02; 0.05; 0.1.

Fundamental error, o/o from the upper limit of the measurement ... by ±6.

Threshold of response, mg/m³ ... 0.03.

the parameters of the analyzed mixture:

temperature, °C ... from -40 to 40.

relative humidity, o/o ... 10-95.

flow rate, l/h ... 50.

Time it began reactions, min ... 5.

Time lag of readings of gas analyzer, min ... 15.

Supply voltage at the frequency of 50 Hz, V ... 220.

Required power, W ... 100.

Clearance, mm

sensor ... 365x236x320.

control panel ... 114x90x230.

Weight, kg

sensor ... 8.

control panel ... 1.

Mounting conditions and mounting. The sensor of gas analyzer is installed directly in the place of the selection of the analyzed mixture (in cabinet) and with the aid of plug couplings is connected with control panel [see the diagram of electrical connections (Fig. 32)]. The gas connections of sensor are made from Teflon tube in accordance with the diagram, represented in Fig. 33. In the site of

installation of sensor the environmental parameters must be within the following limits:

the temperature, °C ... -40 to 40.

relative humidity, o/o ... 10-95.

Control panel, stabilizer and secondary instrument are installed in a room with the following environmental parameters:

temperature, °C ... 5-40.

relative humidity, o/o ... to 80.

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Secondary instrument can be distant from sensor up to distance to 500 m.

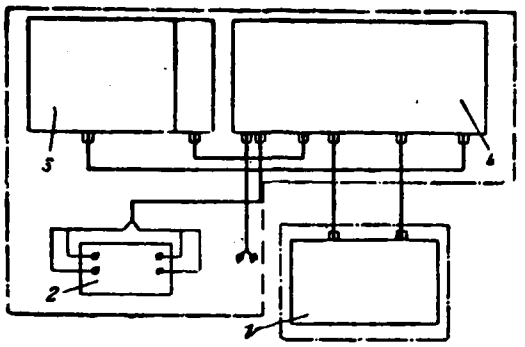

Fig. 32. Gas analyzer GKP-1. The diagram of the external electrical connections: 1 - sensor; 2 - voltage regulator; 3 - secondary instrument; 4 - control panel.

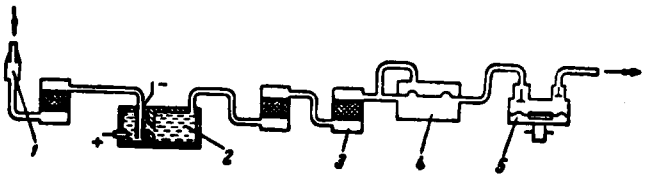

Fig. 33. Gas analyzer GKP-1. The diagram of gas connections: 1 - gas-bleeding device; 2 - cell electrochemical; 3 - filters of the rough and fine purification; 4 - signal indicator of the flow of gas SRG-5; 5 - stimulus of flow rate PRG-4.

3.9. Instrument for determining hydrocyanic acid.

For determining the microconcentrations of hydrocyanic acid in

air of industrial rooms can be used universal stationary automatic gas analyzer FGTs, described in pt. 3.16.

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3.10. Instruments for determining the phosgene.

For determining the microconcentrations of phosgene in air of industrial rooms is intended stationary automatic gas analyzer GSF-3.

For these purposes can be also used universal stationary automatic gas analyzer FGTs, described in pt. 3.16.

Stationary automatic gas analyzer GSF-3.

Instrument is developed and he was in series released by the experimental design office of automation (OKBA). In 1969 it was taken out of production.

Designation/purpose. Gas indicator is intended for a signaling about the presence in air of the industrial rooms of the maximum permissible concentration of phosgene.

Operating principle. The effect/action of gas indicator is based

on the measurement of time during which coloring the scanned photometrically dry indicator tape[1] during reaction with phosgene reaches the specific intensity, also, on the comparison of this time with the prescribed/assigned standard, equal to the cycle time of timer.

FOOTNOTE [1]. Composition of indicator solution for the saturation of one plate holder (20 m) of cloth tape (in 100 ml, benzene), g:

γ-benzylpyridine ... 4.

N-benzylanyline ... 1. ENDFOOTNOTE.

The function of timer performs the engine, kinematically bonded through reducer and cam with microswitch. The signalling device of instrument is included, when the time of the achievement of prescribed/assigned to intensity coloring of indicator tape less than or equal to to the cycle time of timer, which corresponds to phosgene concentration in air, greater or equal to PDK.

Structural-assembling performance. Into the assembly of gas indicator enter: the sensor, voltage regulator $\frac{S}{K}$-0.09, control panel PDU-A, filter of air FV-10, air removal jet VEZh-2, rotameter RS-3A, electromagnetic relay MKU-48, knob/button with no [normally open]

contact, knob/button with nc [normally closed] contact, needle valve. For recording the dangerous concentrations of phosgene in time instrument they complete by the recording voltmeter. Its to connect to diagram in this case is must in parallel with indicating relay. Housing of the sensor of poured from Silumin. All nodes and elements/cells of sensor are arranged on two panels which are placed into the housing, constantly blown by pure air or nitrogen (for retaining/preserving/maintaining the sensitivity of indicator tape). The sensor of gas indicator in the general industrial version is assembled on panel.

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Fundamental technical and performance data.

Signal concentration, mg/m^3 ... 0.5.

Fundamental error, o/o from signal concentration ... $\pm$20.

As the signalling device of instrument can be used any electrolytic device (light, sonic, etc.) with voltage 12/220 V and in required power to 500 W.

Parameters of the analyzed mixture

temperature, °C ... 10-35.

relative humidity, o/o ... to 80.

Signal lag (without taking into account time lag due to the gas-feeding line), min ... 8.

Supply voltage at the frequency of 50 Hz, V ... 220.

Required power, W ... 75.

Clearance of sensor, mm ... 430x320x262.

Weight of sensor, kg ... 17.5.

Mounting conditions and mounting. Instrument is calculated for exploitation in explosion proof rooms in the following environmental parameters:

temperature, °C ... 10-35.

relative humidity, o/o ... to 80.

All blocks of gas indicator are assembled on the panel, installed at a distance not more than 100 m from the point of the sampling of the analyzed gas. For the purging of the housing of sensor and feed of ejector must be conducted/supplied the line of the compressed air (or nitrogen) by pressure 2-10 kg/cm^2 with flow rate not more than 2 m^3/h.

3.11. Instruments for determining chlorine.

For determination and recording chlorine concentration in air of industrial rooms use stationary automatic gas analyzers FKG-3 and AGL-2, described below.

For determining the microconcentrations of chlorine can be also used universal stationary automatic gas analyzer FL5501, described in pt. 3.16.

Stationary automatic gas analyzer FKG-3.

Instrument is developed and is released by the in series developmental office of automation (OKBA).

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Designation/purpose. Gas analyzer is intended for continuous automatic measurement and recording the tracks of chlorine in air of industrial rooms.

Operating principle. The effect/action of gas analyzer is based on the photometric measurement of the wet indicator tape[1], which changes its coloring during reaction with chlorine.

FOOTNOTE [1]. Composition of indicator solution for saturation with cloth (cotton), tape, o/o Vol.:

acetate of sodium ... 5.

iodide cadmium ... 5.

starch (soluble) ... 1.

the distilled water ... 89. ENDFOOTNOTE.

Photoresistors (working and comparative) are connected on differential circuit with direct reading. In the absence of chlorine in air the intensity of the falling/incident to photoresistors

luminous fluxes is identical and the arrow/pointer of secondary instrument will cost on zero.

Appearance in air of chlorine causes the appropriate change in the intensity of coloring indicator tape and, consequently, also the value of the luminous flux, reflected from indicator tape to working photoresistor. Appearing in this case difference in the intensities of the luminous fluxes, which fall to photoresistors, causes the appearance of the corresponding difference in the photoelectric currents - voltage of unbalance, proportional to the concentration of the determined component.

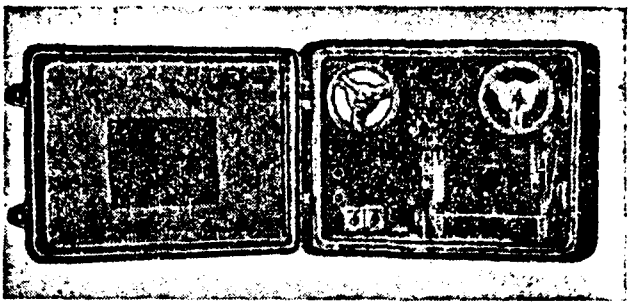

Fig. 34. Sensor of gas analyzer PKG-3 with the open cover/cap.

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This voltage is measured by secondary instrument.

Structural-assembling performance. Into the assembly of gas analyzer enter: the sensor, voltage regulator S-0.09, secondary instrument of the type EPD, block of gas supply BPG-2, control panel PDU-A, filter of air FV-10. housing of sensor is dust- and splash-proof. All sensor units with exception of the transformer, established/installed on rear wall, are arranged/located on the removing itself panel.

The nodes of the block of gas supply (stimulus of flow rate, rotameter and pressure regulator) are mounted in metal housing. The construction/design of sensor and block of gas supply provides for

their mounting on panel or on the special framework. Sensor with the open cover/cap is depicted in Fig. 34.

Fundamental technical and performance data.

Range of measurement, mg/m³ ... 0-2.

Fundamental error, o/o from the upper limit of the measurement by ±20.

Additional errors do not exceed the following values (o/o from the upper limit of measurement):

from a change in the flow rate of the analyzed mixture per ±4o/o from 60 l/h ... ±4.

from a change in the ambient temperature for each of 5°C in interval of 10-35°C ... ±5.

from the change of barometric pressure for every 10 mm Hg in the range of 720-780 mm Hg ... ±2.

from the change in supply voltage by ±10% from 220 V ... ±1.5.

Threshold of response, mg/m³ ... 0.25.

Parameters of the analyzed mixture:

temperature, °C ... 10-35.

relative humidity, o/o ... to 80.

atmospheric pressure, mm Hg (κN/m²) ... 720-780 (96-102).

flow rate, l/h ... 60.

Time it began reactions, min ... 3.5.

Time lag of readings of gas analyzer, min ... 10.

Speed of the motion of indicator tape, mm/min ... 6±0.6.

Supply voltage at the frequency of 50 Hz, V ... 220.

Required power, W ... 100.

Clearance of sensor, mm ... 422x331x175.

Weight of sensor, kg ... 18.5.

Weight of entire assembly of gas analyzer, kg ... 47.

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Mounting conditions and mounting. Sensor and block of gas supply are assembled on panel or on the bracket, installed in explosion proof room with the following environmental parameters:

temperature, °C ... 10-35.

relative humidity, o/o ... to 80.

Secondary instrument is assembled on general/common/total panel. Voltage regulator can be established/installed separately.

The length of the line of communications between the sensor and the secondary instrument must be not more than 10 m.

The external gas and electrical connections of gas analyzer it is assembled in accordance with diagram (Fig. 35).

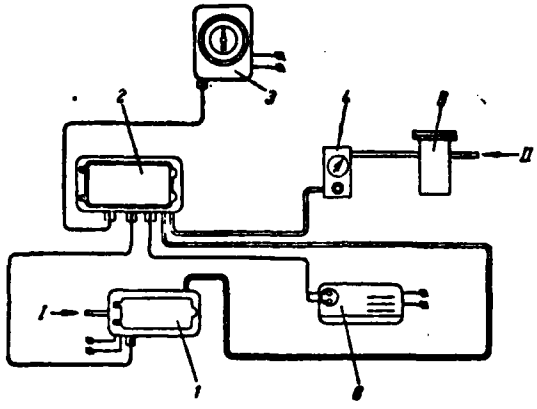

Fig. 35. Gas analyzer FKG-3. The diagram of the external gas and electrical connections: 1 - block of gas supply; 2 - sensor; 3 - secondary instrument; 4 - control panel; 5 - filter of the air; 6 - voltage regulator; I - analyzed gaseous mixture; II - compressed air.

Stationary automatic gas analyzer AGL-2.

Instrument is developed and was released by short runs experimental workshop SKB VNIIOT [All-Union Scientific Research Institute of Work Safety of the VTsSPS] of VTsSPS [All-Union CentralTrade-Union Council]. Non-current for modification.

Designation/purpose. Gas analyzer is intended for continuous (cyclic) automatic measurement and recording chlorine concentration in air of industrial rooms.

Operating principle. The effect/action of gas analyzer is based on linear-coloristic method of determining gas concentrations in air.

In the narrow section, situated across paper tape, is applied a solution of reagent[1], and then above the surface of this section along special channel is broached with given speed the specific space of the analyzed mixture.

FOOTNOTE [1]. For the scale 0-20 mg/m^3 is used the indicator solution of the following composition: 100 ml of the distilled water; 0.05 g of o-Tolidine (fundamental, pure) 0.50 g of citric acid (chemically pure) and 10 g of potassium bromide (chemically pure). ENDFOOTNOTE.

As a result of the reaction of the determined component with reagent on the surface of tape is formed the painted track in the form of the line whose length is proportional to the concentration of the determined component.

Reference grid on tape makes it possible to determine a change of chlorine concentration in time.

Structural-assembling performance. Instrument is carried out in the general-purpose (nonexplosion-proof) performance. Into the assembly of gas analyzer enter: the gas analyzer AGL-2, coupling cable and reagents. All nodes and elements/cells of gas analyzer are mounted in one metal housing, intended for a mounting on panel or on the special framework (frame, bracket).

Fundamental technical and performance data.

Range of measurement, mg/m^3 ... 0-20.

Fundamental error, o/o from the upper limit of the measurement ... $\pm$5.

Threshold of response, mg/m^3 ... 1.

Flow rate of analyzed mixture, min ... 1.

Duration of cycle, min ... 3.

Speed of the motion of indicator tape, mm/min ... 1.

Supply voltage at the frequency of 50 Hz, V ... 220.

Required power, W ... 40.

Clearance, mm ... 130x290x338.

Weight, kg ... 8.

3.12. Instrument d14 the determination of Freon-12.

Stationary automatic of gas analyzer FL6801.

Instrument is developed by SKB of the analytical instrument manufacture of the AS USSR and is released by the in series Smolensk plant of the resources of automation.

Designation/purpose. Gas analyzer is intended for the continuous (cyclic) automatic measurement of microconcentrations Freon-12 in the air.

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Operating principle. The effect/action of instrument is based on the photometric measurement of the dry paper indicator tape, which

changes its coloring as a result of reaction with products of the thermal decomposition of Freon-12, obtained in the electric furnace of resolution. Gas analyzer works according to closed system - the analyzed gaseous mixture is abstracted/removed into the same room, from which is selected the test/sample.

As measuring in instrument is used optical two-channel diagram with electric compensation.

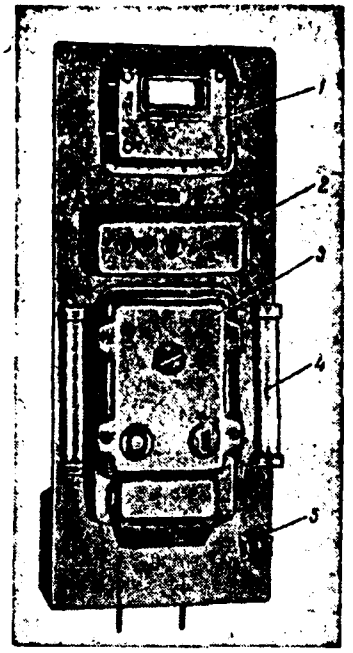

Fig. 36. Gas analyzer FL6801. The arrangement of blocks and auxiliary nodes on the panel: 1 - secondary instrument; 2 - junction box; 3 - sensor; 4 - chemical filter (2 pieces); 5 - blocking and regulating valve/gate.

Page 113.

Structural-assembling performance. Gas analyzer is released in the water-proofed, vibration-proof and shock resistant performance. The construction/design of gas analyzer provides its normal operation with prolonged inclinations/slopes on angle of 15° to any side, and

also after output from short-time inclinations to angle to 45°.

Into the assembly of gas analyzer enter: the sensor, electron indicating device EK-1, stimulus or flow rate, junction box, chemical filters - 2 pieces and blocking and regulating valve/gate. Additionally (if necessary) into the assembly of gas analyzer can enter the block of distributing gas RB-5 and the outside panel for the teletransmission of readings.

All blocks and nodes of gas analyzer (except block RB-5 and outside panel) are mounted on general/common/total panel switchboard (Fig. 36). In the cover/cap of the sensor of gas analyzer, which emerges on the face of panel, are inspection holes of rotameter and of signal about spending or break of indicator tape. On the cover/cap of junction box, also emerging on face panel, is placed the toggle switch for the start of gas analyzer.

Portable panel for the teletransmission of readings is the shield on which are established/installed: the indicating device, which doubles readings of fundamental electronic device, device (neon tube/lamp), which signals about spending or break of tape in the sensor of gas analyzer, and four-valve signal panel, intended for the redundancy of the indicating lights of the block of distributing gas about the ordinal point of the selection of the analyzed gaseous

mixture.

Fundamental technical and performance data.

Range of measurement, mg/m³ ... 0-500.

Fundamental error, o/o from the upper limit of the measurement ... by ±10.

Threshold of response, mg/m³ ... 25.

Parameters of the analyzed mixture

temperature, °C ... from -10, to 50.

relative humidity, o/o ... 30-98.

atmospheric pressure, mm Hg (kN/m²) ... 680-920 (90-122).

flow rate, l/h ... 60.

Duration of one cycle of analysis, min ¹ ... 5, 10, 15.

FOOTNOTE: the duration of cycle is established with the aid of the

change gears. ENDFOOTNOTE.

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Starting time, min ... 30.

Time of continuous operation without the change of tape (during cycle 5 min), h ... 39-50.

Supply voltage at the frequency of 50 Hz, V ... 127/220.

Required power, W ... 200.

Overall dimensions of the panel of gas analyzer, mm ... 400x935x285.

Weight of the assembly of gas analyzer on panel, kg ... 69.

Instrument performs the following process/operations:

automatically selects/takes air for analysis consecutively/serially of four different points (rooms);

it remotely transmits readings with the indication of the points of the selection;

it signals about the spending of the indicator tape;

puts out impulse/momentum/pulse into the signaling system about the achievement of the established/installed limits of the concentration of determined component in air.

Mounting conditions and mounting.

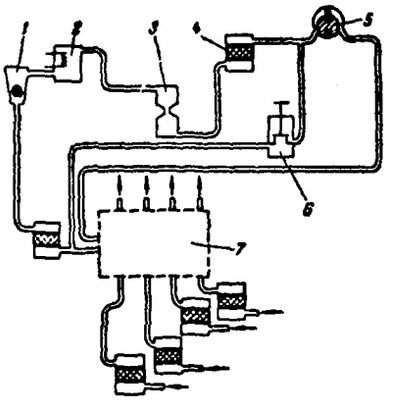

Fig. 37. Gas analyzer FL6801. The diagram of external gas connections: 1 - rotameter; 2 - furnace of the resolution; 3 - the reaction chamber; 4 - filter (6 pieces); 5 - stimulus of the flow rate; 6 - blocking and regulating valve/gate; 7 - block of distributing gas.

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Gas analyzer and its separate blocks are installed in explosion proof room with the following environmental parameters:

temperature, °C ... 5-50.

relative humidity, o/o ... 30-98.

Distance from the place or sampling for analysis to sensor can comprise to 25 m along the length of gas line. The block of distributing gas is installed in immediate proximity of panel, and the panel for the teletransmission of readings can be referred to distance to 100 m. Gas connections are assembled on diagram (Fig. 37). The schematic of the external electrical connections of gas analyzer is given in Fig. 38.

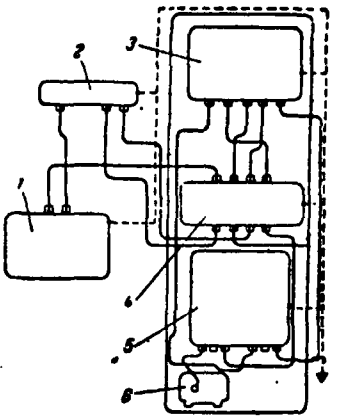

Fig. 38. Gas analyzer FL6801. The diagram of the external electrical connections: 1 - block of distributing the gas; 2 - outside panel; 3 - electron indicating device; 4 - junction box; 5 - sensor; 6 - stimulus of flow rate.

3.13. Instrument for determining carbonyl of nickel.

Stationary automatic gas analyzer UP8101.

Instrument is developed and is released by SKB of the analytical instrument manufacture of the AS USSR.

Designation/purpose. Gas analyzer is intended for the continuous automatic measurement of the microconcentrations of vapors of carbonyl of nickel in air of industrial rooms.

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Operating principle. The effect/action of instrument is based on selective absorption by the vapors of carbonyl of nickel of the ultraviolet rays (see the "operating principle" of gas analyzer IKRP-445).

For increasing the selectivity in gas analyzer is applied luminescence transformer - phosphor L-27 and light filter KS-2 for the liberation/isolation of ultraviolet section from entire radiation spectrum of source (mercury-vapor lamp) and its conversion into visible radiation.

In instrument is applied measuring circuit with the zero optical compensation photoelectric current.

A structural-assembling performance. All blocks and nodes of gas analyzer are mounted in metal housing with the opened/disclosed front/leading door, on inside of which is arranged/located measuring instrument unit, power transformer and vibrator for the modulation of

the luminous flux. Within housing, above, is placed the block of distributing gas RB-5 with filters, below - the chamber/camera of destruction (resolution of carbonyl nickel at temperature to 300°C), intended for cleaning vapors of carbonyl of nickel and supply from analyzed gaseous its supply into comparative cuvette, stimulus of the flow rate PR-3, filter for the collecting of the isolated in chamber/camera decomposition of nickel, blocking and regulating valve/gate and fan for cooling the internal cavity of housing.

To the front panel of the housing of gas analyzer is carried out electron showing and recording instrument DSR1-07, under which is located the light signal panel, which signals about the chamber operation of decomposition.

Fundamental technical and performance data.

Range of measurement, mg/m³ ... 0-10

Fundamental error, o/o from the upper limit of measurement ... ±20

Threshold of response, mg/m³ ... 1

Flow rate of analyzed gaseous mixture, l/h ... 600

Supply voltage at the frequency of 50 Hz, into ... 220

Required power, W ... 400

Clearance of the panel of gas analyzer, mm ... 700x1750x450

Weight of the assembly of gas analyzer, kg ... 300.

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Instrument performs automatic air bleed for analysis consecutively/serially of four different points (rooms), and also it signals about the achievement of the prescribed/assigned limit of the concentrations of the determined component.

Mounting conditions and mounting. Gas analyzer is established/installed in explosion proof room with the following environmental parameters:

temperature, by °C ... 15-35

relative humidity, o/o ... to 80

Distance from the place of sampling for analysis to gas analyzer

must not exceed 50 m along the length of gas line.

Gas connections are assembled in accordance with diagram (Fig. 39).

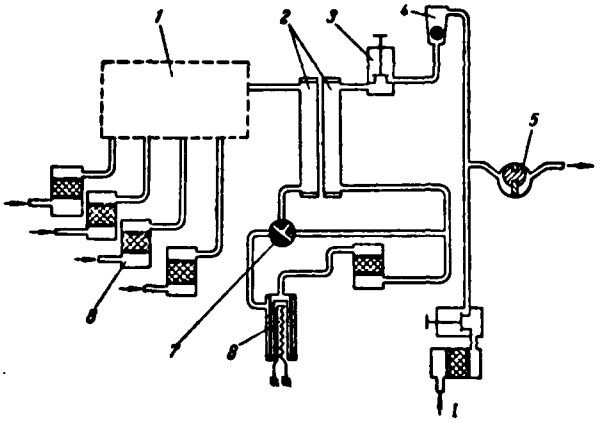

Fig. 39. Gas analyzer UF81-10. Diagram of gas connections. 1 - block of distributing the gas; 2 - working and comparative cuvettes; 3 - shut-off controlling valve/gate (2 pieces); 4 - rotameter; 5 - stimulus of the flow rate; 6 - chamber/camera of the resolution; 7 - gas change-over switch; 8 - filter (6 pieces). I - air suction for the safeguard of a normal operation of the stimulus of flow rate.

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3.14. Instrument for determining ozone[1].

FOOTNOTE [1]. OKBA develops/processes stationary ultra-violet gas analyzer GUP-2V, intended for determining ozone in air in the range of the concentrations of 0-10 Vol. ones o/o. ENDFOOTNOTE.

For determining ozone concentration in air of industrial rooms it is possible to use a universal stationary automatic gas analyzer FL5501, described in pt. 3.16.

3.15. Instrument for determining hydrogen chloride.

The presence of hydrogen chloride in air of industrial rooms can be determined with the aid of the stationary automatic gas analyzer "Sigma 1", described in pt. 3.16.

3.16. Instruments for determining several harmful substances (all-purpose instruments).

This group of instruments includes: stationary automatic gas analyzers FL5501, FGTs and "Sigma 1".

Stationary automatic gas analyzer FL5501[1].

FOOTNOTE [1]. Toward the end of 1972 the Smolensk plant of the resources of automation will master the issue of the modernized photometers FL5501L with the standardized output signal, which will make possible to use it in the automatic control systems and control. ENDFOOTNOTE.

Instrument (Fig. 40) is developed by SKB of the analytical instrument manufacture of the AS USSR and is released by the in series Smolensk plant of the resources of automation.

Designation/purpose. Gas analyzer is intended for automatic continuous (cyclic) or periodic measurement and recording the microconcentrations of different gases and vapors (nitrogen oxides, hydrogen sulfide, sulfurous anhydride, ammonia, chlorine, ozone, etc.) in air-gas media.

The use/application of an instrument depends virtually on the selection of the color reactions of the determined components to the impregnating composition of indicator tape and selection of the mode/conditions of the work of gas analyzer. These investigations can perform qualified factory chemical laboratories.

The operating principle of gas analyzer is based on the photometric method of measurement and consists in the comparison of the value of the luminous flux, reflected from that painted as a result of reacting the spot on wet indicator tape, with the value of standard luminous flux. A difference in the luminous fluxes is converted by photoelectric diagram into the electric signal which is supplied to the input of the electron showing and recording measuring instrument.

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Indicator composition will be brought in to paper tape in the process of analysis. The cyclic recurrence of the work of instrument (deposition of indicator composition, displacement/movement of tape, supply to the analyzed mixture, measurement) is provided by special programmer.

In instrument is provided for the possibility of the setting up of different duration of the cycle of analysis depending on reaction rate on tape.

In gas analyzer is applied optical two-channel measuring circuit with electric compensation.

Is structural/constructural - assembling performance. Instrument is carried out in the general-purpose (non-explosion-proof) performance. Into the assembly of gas analyzer enter: the sensor, electron recording instrument MSR-1-11, stimulus of flow rate, change-over switch gas, filter chemical, valve/gate being blocking and regulating, panel panel, assembly of rotameters and interchangeable gears of programmer. All blocks, entering the gas analyzer, are mounted on the panel-type board, intended for the wall mounting (see Fig. 40).

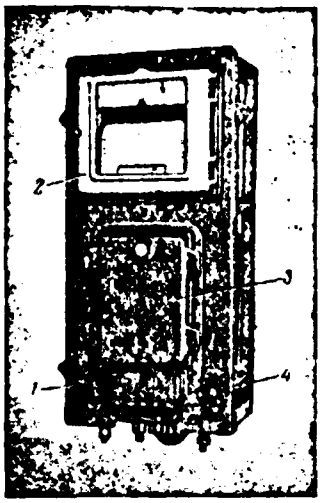

Fig. 40. Gas analyzer FL5501. The arrangement of blocks and auxiliary nodes on the panel: 1 - gas change-over switch; 2 - secondary instrument; 3 - sensor; 4 - valve/gate being blocking and regulating.

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Fundamental technical and performance data.

Number of conventional scale divisions of secondary instrument ... 100

Fundamental error, o/o from the upper limit of the measurement (during check on reference point) ... by ±10

Summary quadratic additional error from a change in the supply voltage on ±5o/o from 127V and ambient temperature from 5 to 40°C (during check on reference point), o/o from the upper limits of measurement ... ±10

Parameters of the analyzed mixture

temperature, °C ... 5-50

relative humidity, o/o ... 30-80

flow rate, l/h ... 9; 30; 60

Starting time, lin ... 30

Time lag of readings of gas analyzer, min ... 20

Duration of one cycle of analysis, min ... 2.5, 5; 10

Duration of the uninterrupted work of instrument without the change of tape and indicator solution (during cycle - 5 min), h ... 150

Supply voltage at the frequency of 50 Hz, into ... 127

Required power, W ... 150

Clearance of the panel of gas analyzer, mm ... 840x429x404

Weight of the assembly of gas analyzer, kg ... 80.

Instrument is released without calibration to the specific measured component and must calibrate itself in consumer for each specific case.

Instrument can be connected to the signaling system about the achievement of the rating value or the concentration of the determined component in the limits of the range of measurement. For utilization in automatic control systems to gas analyzer can be connected the outside doubling instrument.

The range of the measurement of the determined component (replacement of the arbitrary units of the scale of secondary instrument by prescribed/assigned unity of concentration), the speed of the passage of the analyzed gaseous mixture and the duration of one cycle of measurement are established/installed for each determined component in the process of calibrating the instrument. Table 5 shows the compositions of indicator solutions and the mode/conditions of the photocolorimetric determination of the content

of some substances in air with the aid of instrument FL5501.

Mounting conditions and mounting. Gas analyzer must be established/installed in explosion proof room with the following environmental parameters:

temperature, by °C ... 5-50

relative humidity, o/o ... to 80.

Panel with gas analyzer is not recommended to establish/install near the powerful/thick sources of variable electromagnetic fields (electric motors, transformers, etc.). Panel is intended for a wall mounting and must be established/installed on brackets.

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Table 5. Compositions of indicator solutions and modes/conditions of photocolorimetry.

(1) Определяемый компонент	(2) Диапазон измерения, мг/м³	(3) Порог чувствительности, мг/м³	(4) Состав индикаторного раствора	(5) Расход индикаторного раствора (на 1 цикл), мл	(6) Расход анализируемой газовой смеси, л/ч	(7) Продолжительность одного цикла измерения, мин
Аммиак (8)	0—10	1	0,1 г (9) бромкрезолпурпурного в 200 мл 20% водного раствора этилового спирта	0,02	9	2,5
Двуокись (10) азота	0—5	0,1	1 г 2,5-дисульфокислоты анилина, 0,5 г α-нафтилэтилендиамина дихлоргидрата, 10 мл глицерина в 100 мл (11) воды	0,025	9	2,5—5
Озон (12)	0—0,5	0,025	100 мл 1% водного раствора крахмала, 1 г (13) едкого калия, 1 г сульфаминовой кислоты и 5 г иодистого калия	0,03	30	5
Сернистый (14) ангидрид	0—20	1	2 г иодноватокислого калия в 1,36 г (15) однозамещенного фосфорнокислого калия, 2,56 г фосфорнокислого натрия и 15 мл глицерина в 100 мл воды	0,025	15	5
Сероводород (16)	0—10 0—1	0,1	2 г (17) уксуснокислого свинца в 100 мл 1% раствора уксусной кислоты с добавлением 10 мл глицерина	0,03—0,04	30	2,5—5
Хлор (18)	0—5	0,5	0,5 г о-толидина в 100 мл этилового спирта (19)	0,03—0,04	15—30	0,5

Key: (1). Determined component. (2). Range of measurement, mg/m³. (3). Threshold of response, mg/m³. (4). Composition of indicator solution. (5). Expenditure of indicator solution (for 1 cycle), ml. (6). Expenditure of analyzed gaseous mixture, l/h. (7). Duration of one cycle of measurement, min. (8). Ammonia. (9). 0.1 g bromcresol purple in 200 ml 20o/o of aqueous solution ethyl alcohol. (10). Nitrogen dioxide. (11). 1 g 2.5- disulfonic acid of aniline, 0.5 g of α-naphthylethylenediamine of dihydrochloride, 10 ml of glycerin in

100 ml of water. (12). Ozone. (13). 100 ml 1o/o of aqueous solution of starch, 1 g of potassium hydroxide, 1 g of sulfamic acid and 5 g of potassium iodide. (14). Sulfurous anhydride. (15). 2 g of iodate potassium in 1.36 g of monosubstituted potassium phosphate, 2.56 g of phosphate sodium and 15 ml of glycerin in 100 ml of water. (16). Hydrogen sulfide. (17). 2 g of acetate lead in 100 ml 1o/o solution of acetic acid with addition 10 ml of glycerin. (18). Chlorine. (19). 0.5 g of o-Tolidine in 100 ml of ethyl alcohol.

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The gas lines of gas analyzer are assembled in accordance with diagram (Fig. 41), external electrical connections - according to the diagram, shown in Fig. 42.

Stationary automatic gas analyzer FGTs.

Instrument is developed and is released by the in series experimental-konstrukorskim office of automation (OKBA).

Designation/purpose. Gas analyzer is intended for continuous (cyclic) automatic measurement and recording the concentration of different toxic gases and vapors (hydrogen sulfide, phosgene, hydrocyanic acid, ammonia, etc.) in technological gaseous mixtures, and also in air of industrial rooms.

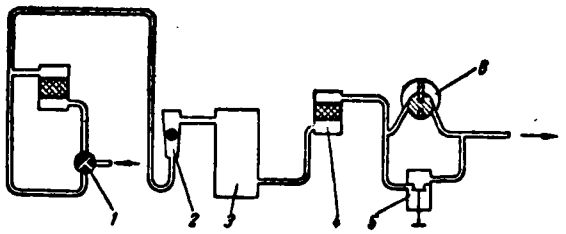

Fig. 41. Gas analyzer FL5501. The diagram of gas connections: 1 - gas change-over switch; 2 - rotameter; 3 - the reaction chamber; 4 - filter (2 pieces); 5 - blocking and regulating valve/gate; 6 - stimulus of flow rate.

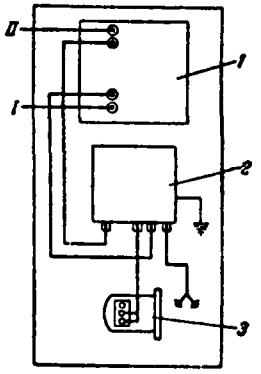

Fig. 42. Gas analyzer FL5501. The diagram of the external electrical connections: 1 - secondary instrument; 2 - sensor; 3 - stimulus of the flow rate; I - to the signalling device; II - to the doubling instrument.

Instrument is equipped with the signalling device, which signals about the achievement of the prescribed/assigned value of the determined component.

The operating principle of gas analyzer is based on the comparison of the value of the luminous flux, reflected from that painted as a result of reacting the spot on dry indicator tape, with the value of standard luminous flux.

The signal of electric unbalance, which appears with a difference in the luminous fluxes (if in air is present the determined component) is amplified and enters the secondary instrument. The cyclic recurrence of the work of instrument is provided by special command device.

A structural-assembling performance. Into the assembly of gas analyzer enter: the sensor, power supply unit, secondary instrument of the type PRBI, control panel PDU-A (2 pieces), filter of air FV-10 (2 pieces), filter control room, valve/gate acicular V3-2, rotameter RS-3A.

Notes: 1. Gas analyzer is supplied during issue with indicator tape in the quantity, sufficient for the uninterrupted work of instrument in the course of three months (storage life of tape). For

the subsequent delivery of indicator tape for additional charge is necessary the declaration of consumer.

2. Modifications of gas analyzer, designed for gas flow through instrument are less than 20 l/h, by rotameters RS-3A they are not completed.

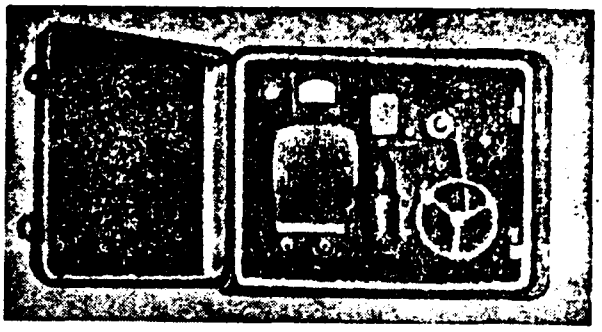

Fig. 43. Sensor is gas analyzer PGTs with the open cover/cap.

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The sensor of gas analyzer has dust- and spatterproof, sparkproof performance with the index of the blast shield IO/carbon disulfide (V4T5-I). The general view of sensor with the open cover/cap is depicted in Fig. 43. On the face of the panel of sensor are arranged/located: the photo unit, the assembly of depressurization, airtight plate holder with indicator tape, takeup reel and monitoring instrument. Here are located the knobs/arms/handles of potentiometers "Setting up of the scale" and "Zero-setting". The block or electric power supply is mounted in dust- and spatterproof housing. According to the degree of blast shield the block of electric power supply and secondary instrument are carried out in the general-purpose (non-explosion proof) model.

All units of gas analyzer are intended for an attendant mounting.

Depending on the determined component and the range of the measurement of its concentrations are released the modifications of the instrument (see Table 6).

The design concept of the power supply units of separate modifications is determined by different duration of the cycle of instrument that it is achieved by gear reduction of reductor of the master switch of power supply unit.

Fundamental technical and performance data.

Fundamental error, o/o from the upper limit of the measurement ... by ±20

Additional errors do not exceed the following values (o/o from the upper limit of measurement):

from a change in the ambient temperature for each of 10°C in range from 20 to 50°C ... ±10

from a change in the supply voltage on +10o/o from 220V ... ±6

The parameters of the analyzed mixture

temperature, °C ... 5-50

relative humidity, o/o ... to 80

The expenditure of indicator tape (for one cycle), mm ... 10

The time lag of readings of gas analyzer ... does not exceed 2 cycles.

Supply voltage at the frequency of 50 Hz, into ... 220

Required power, W ... 100

Clearance, mm

the sensor ... 404x286x164

of power supply unit ... 404x286x164

Weight of entire assembly of gas analyzer, kg ... 70.

The determined components, the ranges of the measurement of their concentrations, the compositions of indicator solutions for the special saturation of satin paper tape and the mode/conditions of photometric measurement for different modifications of gas analyzer are given in Table 6.

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Table 6. Characteristic of the modifications of gas analyzers FGTs.

(1) Модификация прибора	(2) Определяемый компонент	(3) Диапазон измерения, мг/м³	(4) Порог чувствительности, мг/м³	(5) Состав индикаторного раствора	(6) Расход анализируемой газовой смеси, л/ч	(7) Продолжительность одного цикла измерения, мин
ФГЦ-1В ФГЦ-1Е	Сероводород (8) Сероводород (8)	0—10 0—30	0,1	200 г (9) свинца уксуснокислого, 74,5 мл глицерина дистиллата высшего сорта, 1,9 мл ледяной уксусной кислоты в 400 мл дистиллированной воды	6 2	5 5
ФГЦ-2	Фосген (10)	0—0,5	0,1	4 г (11) 4-нитробензил-γ-пиридин 1 г N-бензиланилина в 100 мл бензола	120	4
ФГЦ-3	(12) Синильная кислота	0—0,5	0,08	10 г (13) п-нитробензальдегида, 5 г натрия тетраборнокислого в 280 мл метанола с добавлением 60 мл диэтиленгликоля	90	4
ФГЦ-4	Аммиак (14)	0—20	1	1,5 г (15) бромфенолового синего в 100 мл этилового спирта с добавлением 100 мл дистиллированной воды	2	5

Key: (1). Modification of instrument. (2). Determined component. (3). Range of measurement, mg/m³. (4). Threshold of response, mg/m³. (5). Composition of indicator solution. (6). Flow rate of analyzed gaseous mixture, l/h. (7). Duration of one cycle of measurement, min. (8). Hydrogen sulfide. (9). 200 g of lead of acetate, 74.5 ml of glycerin of distillate of highest type, 1.9 ml of glacial acetic acid in 400 ml of distilled water. (10). Phosgene. (11). 4 g of 4-nitrobenzyl-γ-pyridine 1 g of N-benzylaniline in 100 ml of benzene. (12). Hydrocyanic acid. (13). 10 g of n-nitrobenzaldehyde, 5 g of

sodium of tetraborate in 280 ml methanol with addition 60 ml of diethylene glycol. (14). Ammonia. (15). 1.5 g of bromphenolic blue in 100 ml ethyl alcohol with addition 100 ml of distilled water.

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Mounting conditions and mounting. The sensor of gas analyzer and relating to it auxilople assemble on the panel, adjusted directly in the room where it is necessary to control concentration of the determined component in air.

Sparkproof performance of sensor gives the possibility to establish/install it in the rooms of all classes, in which is possible the formation of the dangerously explosive vapor- and gas-air mixtures of the corresponding categories and groups (see Table 1).

Power supply unit and secondary instrument assemble on the general/common/total panel, adjusted in nonexplosive room.

In the sites of installation of gas analyzer the parameters, the environments must be within the following limits:

the temperature, °C ... 5-50

relative humidity, o/o 30-80

atmospheric pressure, mm dg (kN/m^2) ... 680-780 (92-104).

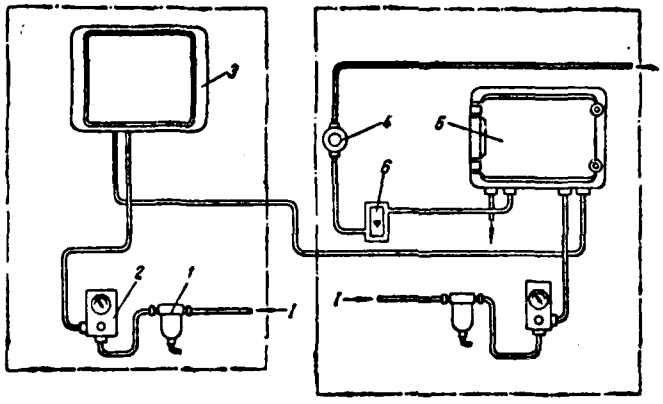

Fig. 44. Gas analyzer FGIs. The diagram of external gas connections: 1 - filter of air (2 pieces); 2 - control panel (2 pieces); 3 - power supply unit; 4 - filter the control room; 5 - sensor; 6 - rotameter; I - compressed air.

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The distance between sensor and power supply unit with secondary instrument must not exceed 300 m. One should not establish/install the units of gas analyzer near the powerful/thick sources of ac fields (electrical motors, transformers, etc.). For the work of gas analyzer necessary are the compressed air (nitrogen) by pressure 2-10 kg/cm^2. Gas and aerial lines of gas analyzer are assembled in accordance with diagram (Fig. 44).

The intermodule connections of the electric chains of gas analyzer are performed from the cable through the plugs of units in accordance with the diagrams of external electrical connections (Fig. 45).

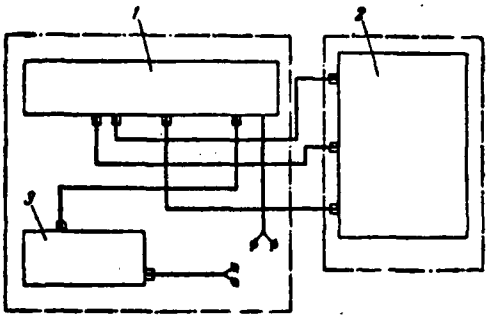

Fig. 45. Gas analyzer FGTs. The diagram of the external electrical connections: 1 - power supply unit; 2 - sensor; 3 - secondary instrument.

Stationary automatic gas analyzer "Sigma 1".

Instrument is developed and is released by short runs by the experimental design office of automation (OKBA).

Designation/purpose. Gas analyzer is intended for continuous automatic measurement and recording the concentrations of different toxic gases and vapors (ammonia, nitrogen oxides, hydrogen chloride, etc.), and also their mixtures in air of industrial rooms. Instrument can be applied virtually for determining the concentration of any gases and vapors, capable of forming aerosols with reaction with the appropriate chemical reagents.

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Operating principle. The effect/action of gas analyzer is based on the selective translation/conversion of the determined component into aerosol state during its reaction with auxiliary chemical reagent with the subsequent detection of aerosol particles in ionization chamber. By the source of the ionizing radiation/emission serves standard airtight β-ray emitter ^{90}Sr - ^{90}Y as activity to 20 mCi.

To the electrodes of chamber/camera is applied the permanent stabilized voltage. The containing in the analyzed mixture determined components enter into chemical reaction with the vapors of auxiliary reagent. As a result of reaction is formed the substance with the low pressure of the saturated steams which is condensed with the formation of aerosol particles. Air with suspended particles, passing through the working volume of chamber/camera, causes the decrease of ionization current. In this case a change in the strength of ionization current of chamber/camera proportional to the concentration of aerosol particles is the measure for the concentration of the determined component.

A structural-assembling performance. Into make-up of gas analyzer enter: the sensor with an aerosol-ionization chamber/camera

(unit SK), the control unit and signalings (unit US), unit of the meter of ionization currents (unit IIT-2), stimulus of the flow of gas (unit BPG-6), secondary instrument of the type EPD.

On special requirement into unit SK additionally can be built in the signal indicator of the flow of a gas of the type SRG-5. The housing of sensor is the welded construction whose internal cavity is divided in the explosive-impenetrable and sparkproof sections. The sensor of gas analyzer has the explosive-impenetrable performance with sparkproof elements/cells - VEG-V4A I/ethyl ether/hydrogen (V3T4-V4AT1-V, I). Remaining electric units according to the degree of blast shield have the general-purpose (non-explosion proof) model. Instrument is released in different modifications depending on character and quantity of controllable/controlled/inspected components.

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Units IIT-2 and US have the standardize poured silumin housings of the type KL-1, carried out in the dust-splashproof performance. Nodes and elements/cells of both units are mounted on intramodular panels.

The construction/design of the sensor of gas analyzer and

stimulus of the flow of gas (BPG-6) provides for their mounting on the special framework (strut or frame). Units IIT-2, US and secondary instrument are intended for an attendant mounting.

The general view of entire assembly of gas analyzer (except secondary instrument) is shown in Fig. 46.

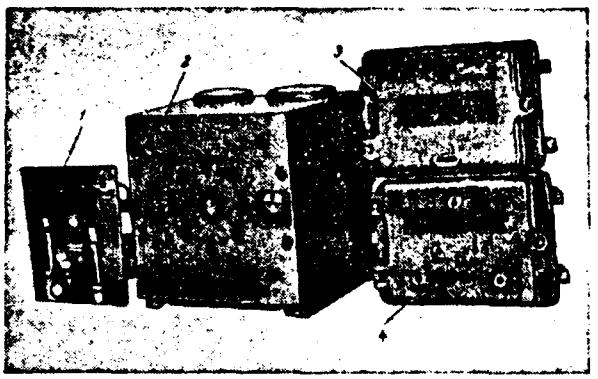

Fig. 46. Gas analyzer "Sigma-1" (without secondary instrument): 1 - stimulus of the flow rate; 2 - sensor; 3 - unit of the meter of the ionization currents; 4 - unit of control and signaling.

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Fundamental technical and performance data.

Fundamental error, o/o from the range of the measurement ... by ±10-20

With the simultaneous presence of several determined components in the analyzed mixture of scale division correspond to their summary content, expressed in mg/l.

Supply voltage at the frequency of 50 Hz, into ... 220

Required power, W ... 400

Clearance, mm:

the sensor ... 300x370x350

of the unit of control and signaling ... 300x200x170

the unit of the meter of ionization currents ... 300x200x200

Weight, kg:

the sensor ... 70

of the unit of control and signalling ... 6

of the unit of the meter of ionization currents ... 8.

Determined components: hydrogen chloride, ammonia, nitrogen oxides.

Depending on designation/purpose the gas analyzer calibrates

itself to different ranges of measurement from 1 to 10 PDK of the determined component. Furthermore, gas analyzers can be calibrated to other gases and vapors, which relate to volatile acids and foundations[1].

FOOTNOTE [1]. As a result of the carried out by OKBA prospecting work is determined the approximate enumeration of the substances whose concentrations in air can be determined by an aerosol-ionization method (on the basis of gas analyzer "Sigma 1"). This is - chlorine, hydrogen fluoride, hydrocyanic acid, sulfurous anhydride, dimethylamine, triethylamine, aniline, dichloroethane, phosgene, carbonyl of nickel, etc. ENDFOOTNOTE.

Mounting conditions and mounting. The sensor of gas analyzer can be established/installed in the dangerously explosive rooms of class V-IA, where is possible the formation of the dangerously explosive mixtures of the corresponding categories and groups, indicated in Table 1. Sensor and unit BPG-6 install in special strut directly in the place of the sampling of the analyzed mixture. Unit BPG-6 they place not more than on 0.5 m of unit SK. Unit IIT-2, US and secondary instrument place on the panel, adjusted in explosion proof room at a distance not more than 300 m from sensor.

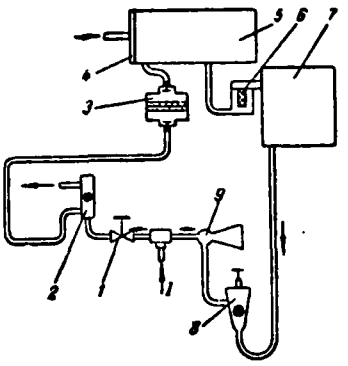

Fig. 47. Gas analyzer "Sigma-I". Diagram of gas connections (unit SK). 1 - valve/gate acicular; 2 - rotameter; 3 - mixer of the reagent; 4 - filter of the dust; 5 - ionization chamber; 6 - filter aerosol; 7 - signal indicator of the gas flow; 8 - rotameter; 9 - air removal jet; I - compressed air.

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Environmental parameters in the site of installation of gas analyzer must be within the following limits:

the temperature, °C ... 10-35

relative humidity, o/o ... 30-80

atmospheric pressure, mm Hg (kN/m²) ... 720-770 (96-103).

For the work of gas analyzer is necessary the line of the compressed air (nitrogen) by pressure 2-10 kg/cm².

The connection of the elements of the gas network of sensor (unit SK) is shown in Fig. 47. The schematic of the external electrical connections of gas analyzer is represented in Fig. 48.

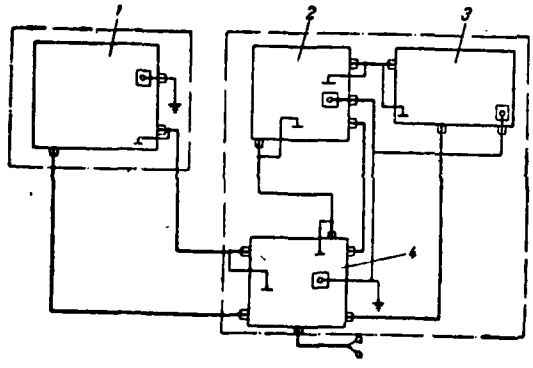

Fig. 48. Gas analyzer "Sigma-I". The diagram of the external electrical connections: 1 - sensor; 2 - the electrometric amplifier; 3 - secondary instrument; 4 - unit of control and signaling.

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4. Auxilople to gas analyzers and gas signal indicators.

Auxilople according to the performed by them functions are subdivided into the following basic groups: gas-bleeding devices, purification devices, control devices and flow-rate controls and pressures, stimuli of flow rate, gas-distributing devices, package units (units of auxilople) and other special devices.

Each group of auxilople can have several varieties depending on the presented to them requirements which in turn, are determined by different operating conditions of gas analyzers.

Are examined below constructions/designs and fundamental technical specifications of some most characteristic auxilople to the automatic instruments of the analysis of air in industrial locations.

4.1. Purification devices.

Gas-scrubbing devices of GOU-1M and GOU-2.

GOU-1M gas-scrubbing device (Fig. 49) is intended for drying and cleaning hydrogen sulfide from supplied to gas analyzer gas and fog of alkali by solid absorbers.

GOU-2 gas-scrubbing device (Fig. 50) is intended for the drying of the supplied to gas analyzer gas and his cleaning/purification from fog of sulfuric acid, chlorine, ammonia and tracks of sulfur dioxide by liquid absorbers.

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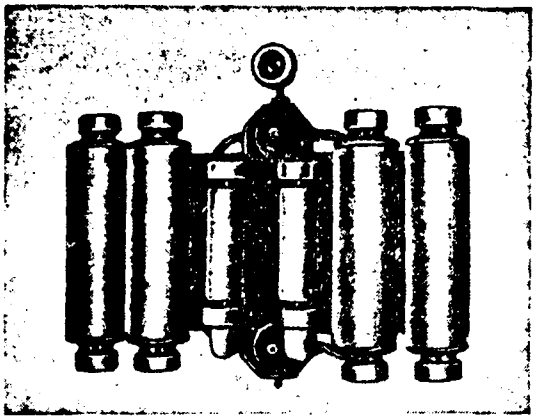

Fig. 49.

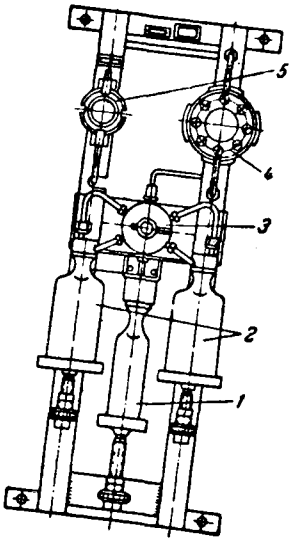

Fig. 50.

Fig. 49. GOU-1M gas-scrubbing device.

Fig. 50. GOU-2 gas-scrubbing device. 1 - bottle for the collection of the condensate; 2 - bottle for the liquid absorbers; 3 - tap/crane; 4 - filter with the solid absorber; 5 - filter control room.

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The devices of GOU-1M and GOU-2 are released by the in series experimental design office of automation (OKBA).

Fundamental technical specifications.

	GOU -1M	GOU -2
(1) Температура газа, подаваемого в газоочистительное устройство, °С	10—45	5—45
(2) Давление газа перед газоочистным устройством, кгс/см² (кН/м²)	0,1 (10)	±0,1 (±10)
(3) Расход газа, л/ч	14—200	200
(4) Перепад давления в газоочистном устройстве, мм вод. ст.,		
при расходе 14 л/ч	50	—
при расходе 200 л/ч	150	200
(6) Запаздывание показаний газоанализатора из-за газоочистного устройства, мин		
при расходе 14 л/ч, не более	5	—
при расходе 200 л/ч, не более	0,3	0,3
(8) Вес, кгс	11,5	15,5

Key: (1). Temperature of the gas, supplied to gas-purifying device, °C. (2). Gas pressure before gas-scrubbing device, kg/cm² (kN/m²). (3). Flow of gas, l/h. (4). Pressure differential in gas-scrubbing device, mm water. cm. (5). with flow rate. (6). Delay of reading of gas analyzer because of gas-purifying device, min. (7). l/h, are not more. (8). Weight, kg.

Filter control FK.

Filter (Fig. 51) is intended for the control/checking of the cleanliness of gaseous mixture and its cleaning/purification from the mechanical impurities. By the filtering element/cell of control room filter is flannel.

It is released by the in series Smolensk plant of the resources of automation.

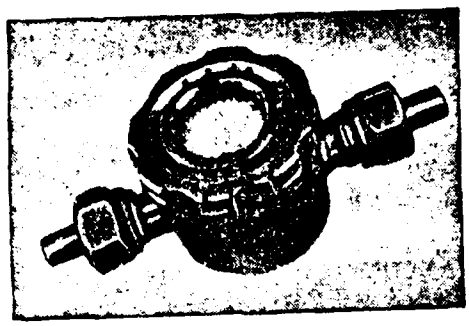

Fig. 51. Filter control FK.

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Fundamental technical specifications.

Flow of gas, l/h ... to 600.

Ambient temperature, °C ... 10-30.

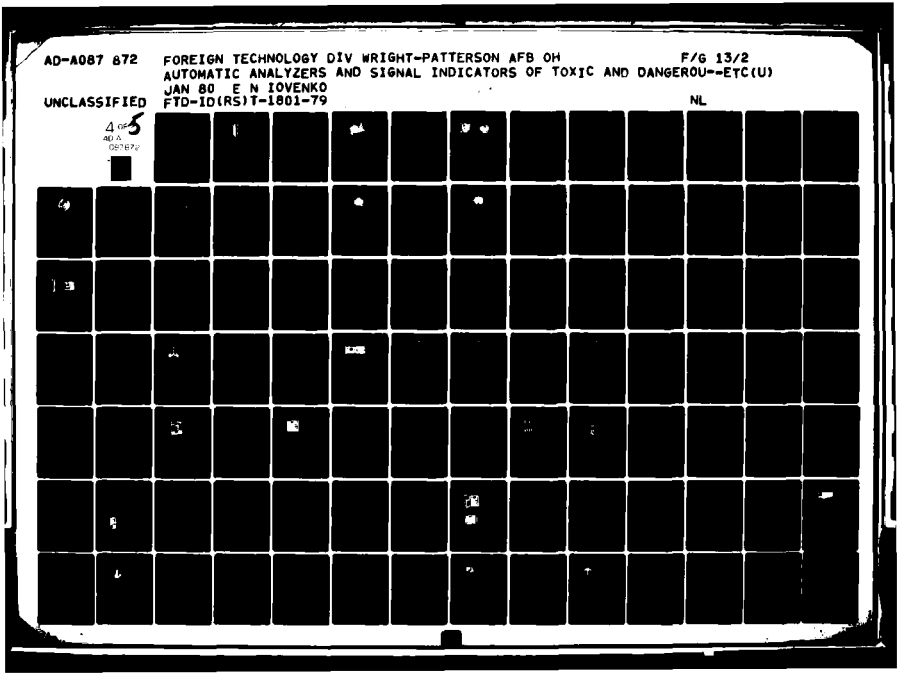
Clearance, mm ... 120x56x45.

Weight, kg ... 0.5.

Filter of air FV-10.

Filter (Fig. 52) is intended for recleaning from moisture, oil

AD-A087 872 FOREIGN TECHNOLOGY DIV WRIGHT-PATTERSON AFB OH F/G 13/2
AUTOMATIC ANALYZERS AND SIGNAL INDICATORS OF TOXIC AND DANGEROU--ETC(U)
JAN 80 E N IOVENKO
UNCLASSIFIED FTD-ID(RS)T-1801-79 NL



and dust of the compressed air which can be used for the ejection of the analyzed gaseous mixture, ventilation of the housing of sensor gas analyzer or for the feed of different pressure-operated devices.

It is released by in series Baku Instrument building plant.

Fundamental technical specifications.

Air pressure, passing through the filter kgf/cm^2 (kN/m^2)... 3-10. (300-1000).

Flow of air, l/h ... to 1000.

The pressure differential on filter, kg/cm^2 (kN/m^2), is not less:..0.5 (50).

Clearance, mm ... 165x118x67.

Weight, kg ... 0.8.

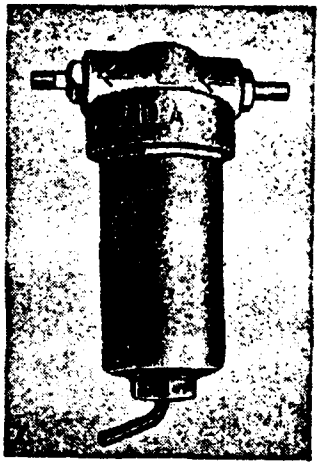


Fig. 52. Filter of air FV-10.

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4.2. Stimuli of flow rate.

Stimuli of flow rate PR-3, PR-7, PR-8, PR-11 and PR 12.

Stimuli are intended for the safeguard of the necessary flow rate of the analyzed gaseous mixture within the gas analyzer and are established/installed in the gas diagram within the gas analyzer. In them are used rotary pumps with drive from asynchronous electric motor.

The stimuli of flow rate PR-3, PR-7, PR-11 and PR 12 are used

during the analysis of the gaseous mixtures, which do not contain agressive admixtures/impurities, but the PR-8 is intended for the mixtures which can contain agressive admixtures/impurities.

Stimuli PR-11 and PR-12 have the vibration-proof, shock resistant and water-proofed performance, they (as the PR-8) normally they work under conditions of swing and inclinations/slopes on angle to 45°.

The victors of flow rate are intended for a work in the following environmental parameters:

temperature, °C ... 5-50.

relative humidity, o/o ... to 98.

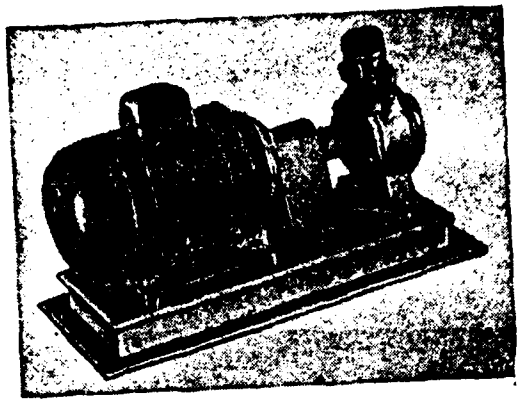

Fig. 53. Stimulus of flow rate PR-3.

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Fundamental technical specifications of the stimulus of flow rate PR-3 (Fig. 53).

The rarefaction/evacuation in the place of sampling, created with the flow rate of gaseous mixture 600 l/h, kg/cm² (kN/m²), is not less ... 0.3 (30).

Productivity with the discharge 30 mm water. see, l/h, not less ... 1200.

Supply voltage at the frequency of 50 Hz, V ... 220/380.

Required power, W ... 120.

Clearance, mm ... 370x200x204.

Weight, kg ... 12.

It is released by the in series Smolensk plant of the resources of automation.

Fundamental technical specifications of the stimuli of flow rate PR-7 (Fig. 54) and the PR-8 (Fig. 55).

	PR-7	PR-8
(1) Разрежение в месте отбора пробы, создаваемое при расходе газовой смеси 180 *л/ч*, *кгс/м²* (*кн/м²*), не менее	0,15 (15)	0,15 (15)
(2) Производительность при разряжении 10 *мм вод. ст.*, *л/ч*, не менее . .	270	270
(3) Напряжение питания при частоте 50 *гц*, *в*	127	127
(4) Потребляемая мощность, *вт*	6,7	6,7
(5) Габариты, *мм*	196×135×150	185×106×129
(6) Вес, *кгс*	6	4,3

Key: (1). The rarefaction/evacuation in the place of sampling, created with the flow rate of gaseous mixture 180 l/h, kg/cm² (kN/m²), is not less. (2). Productivity with discharge 10 mm of water. Cm l/h, it is not less. (3). Supply voltage at frequency of 50 Hz, V. (4). Required power, W (5). Clearance, mm. (6). Weight, kg.

They are released by the in series Vyrusk plant of gas analyzers and by the Smolensk plant of the resources of automatic equipment.

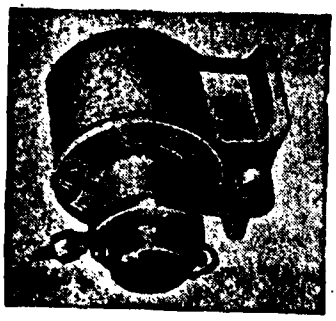

Fig. 54.

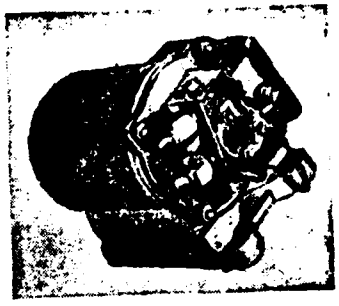

Fig. 55.

Fig. 54. Stimulus of flow rate PR-7.

Fig. 55. Stimulus of flow rate PR-8.

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Fundamental technical specifications of the stimuli of flow rate PR-11 and PR-12.

	ПР-11	ПР-12
(1) Разрежение в месте отбора пробы, *кгс/см²* (*кн/м²*), создаваемое при расходе газовой смеси		
150 (2) *л/ч*, не менее	0,3 (30)	—
42 *л/ч*, не менее	—	0,03 (3)
(5) Напряжение питания при частоте 400 *гц*, *в*	220	220
(4) Потребляемая мощность, *вт*	110	65
(7) Габариты, *мм*	248×172×108	120×160×175
(6) Вес, *кгс*	4,5	2,8

Key: (1). Rarefaction/evacuation in the place of the sampling, kg/cm² (kN/m²), created with the flow rate of gas mixture. (2). ℓ/h, are not

less. (3). Supply voltage at frequency of 400 Hz, V. (4). Required power, W. (5). Clearance, mm. (6). Weight, kg.

Delivery pump of gas pneumatic PNG-1.

The delivery pump of gas is intended for supplying the test/sample of the analyzed gaseous mixture into the sensor of gas analyzer. Delivery pump is membrane/diaphragm type explosion proof pump with the pneumatic drive and is established/installed in dangerously explosive rooms in the following environmental parameters:

temperature, °C ... 5-45.

relative humidity, o/o ... to 80.

Delivery pump can be used for the gases, not corrosive of the materials from which the manufactured parts of delivery pump, contacting with gaseous medium (steel Kh18N9T and teflon). Delivery pump is established/installed before the gas analyzer according to the diagram of gas connections, represented in Fig. 56.

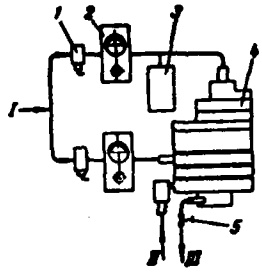

Fig. 56. Delivery pump of gas pneumatic PNG-1. The diagram of the gas connections: 1 - filter of air FV-10; 2 - control panel PDU-2; 3 - damping capacity (not less tnan 10 l.); 4 - pneumatic delivery pump of the gas ; 5 - valve/gate; I - compressed air; II - input of the gas; III - yield of gas into gas analyzer.

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It is released in series b/ experimental design office of automation (OKBA).

Fundamental technical specifications.

Productivity of delivery pump, l/h ... 200.

Pressure on output, kg/cm² (kN/m²).

during rarefaction/evacuation in the place of sampling 0.1

kg/cm² ... 0.15 (15).

at atmospheric pressure in the place of sampling ... 0.3 (30).

Pressure of the compressed air for the feed of pneumatic actuator, kg/cm² (kN/m²).

for an amplifier ... 2+-0.2 (200+-20).

for a generator ... 1.1+-0.1 (110+-10).

General/common/total flow rate of air, which ensures the work of drive, ₹/h ... 3000.

Clearance, mm ... 300x150x160.

Weight, kg ... 5.

Air removal jet VEZh.

Ejector is intended for the suction of the analyzed mixture through the gas analyzer. Ejector is released in two modifications: VEZh-1 (with housing from brass LS-59-1) and VEZh-2 (with the housing made of steel Kh18N9 and Kn18N9T). For the work of ejector necessary

are the compressed air by pressure 1.5 kg/cm^2. If the sucked gases form with air combustible or dangerously explosive mixtures, air should be replaced nitrogen. Ejector is installed after the sensor of gas analyzer and they connect up gas line according to the diagram, indicated in Fig. 57.

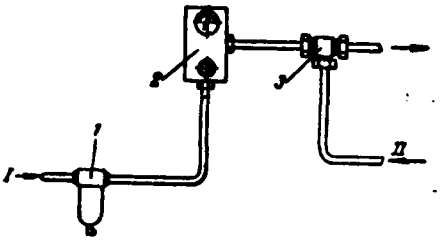

Fig. 57. Air removal jet VEZh. The diagram of the gas connections: 1 - filter of the air; 2 - control panel; 3 - air ejector; I - compressed air; II - from the sensor of gas analyzer.

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Completely with ejector are supplied: control panel PDU-A and filter of air FV-10.

It is released by the in series by experimental design office of automation (OKBA).

Fundamental technical specifications.

Flow of gas, l/h ... 200.

Rarefaction/evacuation in gas line, provided by ejector, kg/cm² (kN/m²) ... 0.08 (8).

Clearance, mm ... 105x65x27.

Weight, kg ... 0.3.

4.3. Regulators and indicators of flow rate.

Flow regulator of gas RRG-1.

Flow regulator (Fig. 5d) is intended for the stabilization of the prescribed/assigned flow rate of the agressive time in the line of its supply to gas analyzer,

Fig. 58. Flow regulator of gas RRG-1.

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Regulator is prepared in two modifications: RRG-1A and RRG-1B. Flow regulator RRG-1A is intended for the gases, which do not destroy steel Kh18N9T, alloys K40NKhM, N36KhT10M8 and polyethylene. Regulator is calculated for work under dangerously explosive conditions at an ambient temperature from 5 to 50°C and relative humidity to 80o/o. Regulator is assembled on panel or panel near the instrument, in assembly with which it works.

It is released in series by plant "Teplopribor" (Ulan-Ude).

Fundamental technical specifications.

Limits of the adjustment of flow rate (by air), l/h ... 1-200.

Tuning precision of flow rate, o/o ... +-2.

Temperature of gas at the input into regulator, °C ... 5-45.

Gas pressure on input into regulator, kg/cm² ... 0.2-(-0.05).

←Minimum pressure differential in regulator, kg/cm² (kN/m²) ... 0.025 (2.5).

Change in the gas flow, o/o.

with a change in the pressure to regulator on every 0.05 kg/cm² ... +-1.

with a change in the ambient temperature and gas for each of 5 °C in interval of 5-45°C ... +-2.

Clearance, mm ... 106x108.

←Weight, kg ... 1.9.

Flow regulator of gas RRGPM-2.

Regulator (Fig. 50) is intended for the stabilization of the prescribed/assigned gas flow, not corrosive of the materials from which it is prepared.

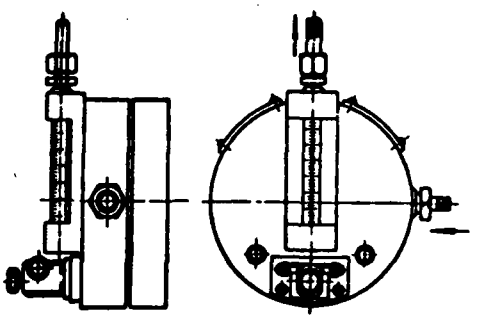

Fig. 59. Flow regulator of gas RRGPN-2.

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Regulator is released in the general-purpose (non-explosion proof) model and is established/installed in explosion proof rooms with ambient temperature from 10 to 50°C with relative atmospheric humidity not more than 80o/o. Regulator is assembled on panel or panel near the instrument, in assembly with which it works.

It is released by the in series by experimental design office of automation (OKBA).

Fundamental technical specifications.

Limits of the adjustment of flow rate (by air), l/h ... 2-20.

Temperature of gas at the input into regulator, °C ... 10-50.

Pressure of gas, kg/cm² (kN/m²).

At the input into regulator ... 0.2 (20).

at output from regulator ... 0.1 (10).

Minimum pressure differential in regulator, kg/cm² (kN/m²) ... 0.05 (5).

Change in the gas flow, o/o:

with a change in the pressure to regulator on +-25o/o from 0.2 kg/cm² ... +-0.5.

with a change in the ambient temperature and gas for each of +-5°C in interval of 10-50°C ... +-2.

Clearance, mm ... 210x140x125.

Weight, kg ... 4.

Flow regulator RR-4.

Regulator (Fig. 60) is intended for stabilization of the flow of the analyzed gas through the gas analyzer. Regulator normally works in the following environmental parameters:

temperature, °C ... 5-50.

relative humidity, o/o ... to 80.

atmospheric pressure, mm Hg (kN/m²) ... 750+-30 (100+-4).

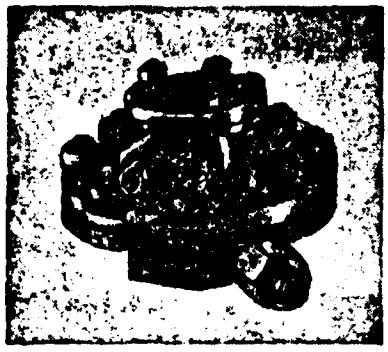

Fig. 60. Flow regulator of gas RR-4.

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It is released by in series Smolensk plant of the resources of automation.

Fundamental technical specifications.

Value of adjustable flow rate, 1/n ... 30.

Tuning precision of flow rate, o/o ... +-5.

Temperature of gas at the input into regulator, °C ... 5-50.

Gas pressure on input into regulator, kg/cm² (kN/m²) ... 0.2-2 (20-200).

The pressure differential in regulator, kg/cm² (kN/m²) ... to 0.15 (15).

Clearance, mm ... 155x112x77.

Weight, kg ... 1.8.

Ratio regulator of gas flows RSG-3.

Regulator (Fig. 61) is intended for the automatic stabilization of the relationship/ratio of the flow rates of two different flows of gases during the supplying to their mixture into gas analyzer. Regulator can be used for expanding the scale of gas analyzers due to the dilution of the analyzed gas strictly established/installed proportional quantities of gas of diluent and for the automatic preparation of gas mixtures with the maintenance of the permanent relationship/ratio of the flow rates of two components of this mixture, relationship value can have several prescribed/assigned values.

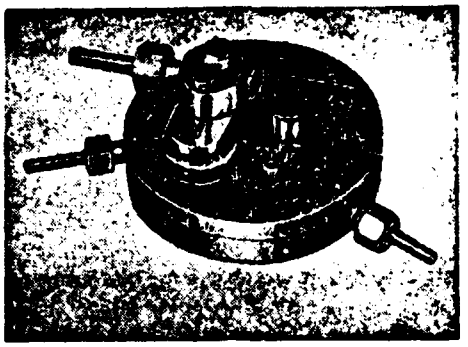

Fig. 61. Ratio regulator of gas flows RGS-3.

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Regulator has a set/dialing of the calibrated chokes/throttles, which gives the possibility to obtain twenty different relationships/ratios to change the flow rate of mixture per each of the relationships/ratios 0.9-1.1 times. Regulator is made from corrosion-resistant materials and can be used for agressive gases. Regulator can work in the following environmental parameters:

temperature, °C ... 5-45.

relative humidity, o/o ... to 80.

Regulator is assembled on panel or panel near the sensor of gas analyzer.

It is released of special order by the experimental design office of automation (OKBA).

Fundamental technical specifications.

Pressure of analyzed gas on input into regulator, kg/cm² (kN/m²) ... 0.04 - 0.15 (4.15).

Minimum pressure differential in regulator, kg/cm² (kN/m²) ... 0.035 (3.5).

Maximally possible error in the maintenance of the prescribed/assigned relationship/ratio of flow rates due to the static error for regulator, o/o ... +-1.

Clearance, mm ... 120x152x196.

Control panel PDU-A.

It is released by the in series Baku Instrument Making Plant.

It is intended for the feed of pneumatic devices by the

compressed air of the prescribed/assigned pressure or for remote control of actuating mechanisms. Panel provides a smooth change of the pressure at output within the limits of 0-1.5 kg/cm^2.

Control panel (Fig. 62) is structural/design assembly on the general/common/total panel of the pressure reducer of air and manometer.

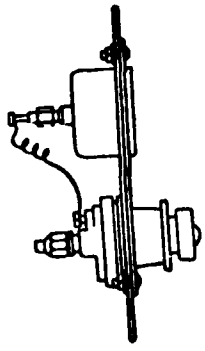

Fig. 62. Control panel PDU-A.

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For the feed of panel necessary are the dry, purified air by pressure from 2 to 10 kg/cm² with the air flow rate to 1000 l/h. Panel is intended for a panel mounting. Fastenings are supplied completely with panel.

Clearance, mm ... 136x112x76.

Weight, kg ... 0.6.

Indicator of flow rate RI-2.

Indicator is intended for the control/checking of the flow rate of gaseous mixtures at atmospheric pressure in system.

It is released by the in series Smolensk plant of the resources of automation.

Fundamental technical specifications.

Controllable/controlled/inspected flow rate (with the temperature of gas and or environment of 20+-5°C and atmospheric pressure), l/h ... 30.

Clearance, mm ... 160x55x28

Weight, kg ... 0.3.

Rotameter glass RS-3A.

Rotameter (Fig. 63) is intended for measuring of stable or smoothly changing flows of the noncrystallizing liquids and gases, neutral relative to glass, materials of float and internal armature.

Fundamental technical specifications.

Ranges of the measurement of flow rate (by air) depending on the

material of float, m^3/g.

ebonite ... 0.006-0.06.

duralumin anodized ... 0.01-0.1.

steel of 1KH18N9T... 0.025-0.160 0.04-0.25

Maximum permissible operating pressure, kg/cm^2 (kN/m^2).

for a liquid ... 6 (600).

for gas ... 4 (400).

Weight, kg ... 0.5.

4.4. Gas-distributing devices (Gas change-over switches).

Unit of distributing gas RB-3.

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Unit is intended for the automatic consecutive selection (when in assembly the gas analyzer or the stimulus of flow rate is

present,) of the tests/samples of the analyzed mixture of four points of one or several rooms and return of this mixture after analysis into the point of selection.

The unit of distributing gas is released in two modifications RB-3 and RB-3A-D.

Unit RB-3 (Fig. 64) is intended for the gaseous mixtures, which do not contain agressive admixtures/impurities. Units RB-3A-D are intended for the agressive gaseous mixtures, which contain oxides of nitrogen or vapor of different fuels/propellants in limits to 40 mg/l. Units for propellant vapors are subdivided into RB-3V, RB-3G, RB-3D have the appropriate blast shield through the gas circuit depending on propellant composition.

Into the assembly of the unit of distributing gas enter: the unit of distribution, filter control room (4 pieces), fire barriers (8 pieces for modifications RB-3A-D), panel.

The unit of distributing gas normally works in the following parameters of gaseous mixture and surrounding air:

temperature, by °C. ..5-50.
relative humidity, o/o ... to 98.
Instrument can also work under conditions of swing and inclination/slope on angle to 45°.

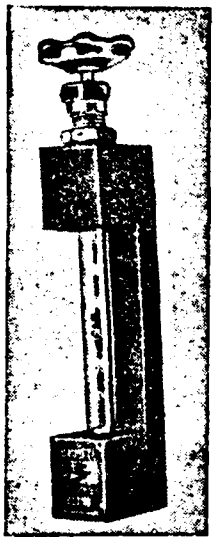

Fig. 63.

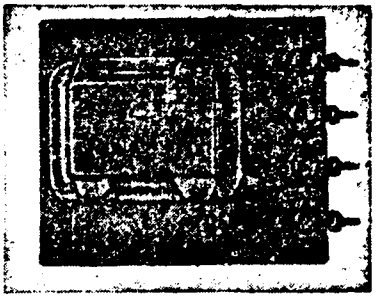

Fig. 64.

Fig. 63. Rotameter glass RS-3A.

Fig. 64. Unit of distributing gas RB-3.

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All units have the vibration-proof, shock resistant, water-proofed performance. The electric circuit of the unit of distributing gas (Fig. 65), consists of the chains of electric motor and signal lamps of the points of selection. Upon firing of engine (by switch KV-2) gaseous mixture is selected/taken automatically from each of four

points with the prescribed/assigned cycle time.

For the permanent selection of gaseous mixture in one source the engine is disconnected, and the signal lamp, bonded with this point, remains connected all the time of the selection of gaseous mixture.

To unit can be connected the remote signalling device, which indicates the number of the point of sampling at given moment/torque. Signalling device (for example, four-valve signal panel) is connected to the output terminals of terminal block K_1 (see Fig. 65).

It is released by the in series Vyrusk plant of gas analyzers[1].

FOOTNOTE [1]. This plant releases the unit of distributing gas RB-5 in two modifications; RB-5 and RB-5A, intended for a work under the same conditions as respectively units RB-3 and RB-3A and having analogous design concept.

In contrast to unit RB-3 in unit RB-5 duration from boron of test/sample at one point with the automatic changeover - 2 min. ENDFOOTNOTE.

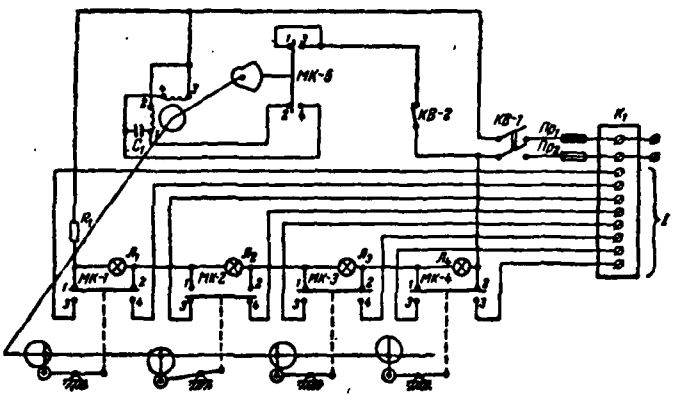

Fig. 65. Electric circuit of the unit of distributing gas RB-3: I - to the contacts of signalling device.

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Fundamental technical specifications.

Duration of selection from one point with automatic changeover, min ... 3.

The complete cycle of selection from 4 points, min ... 12.

● The resistor/resistance of gas pulley tackle with the flow rate of gaseous mixture 210 ~~₹~~ l/h, mm ~~of~~ H_2O (kN/m²)

for modification RB-3, not more than ... 160 (1.6).

for modification RB-3A-D it is not more than ... 240 (2.4).

Supply voltage with frequent of 50 Hz, V ... 127.

Required power, W, not more than ... 15.

Weight of unit on panel, kg ... 18.

Change-over switch gas GP-1.

Change-over switch is intended for automatic consecutive supply (when in assembly the gas analyzer of the stimulus of flow rate is present) of the tests/samples of the analyzed gaseous mixture of six technological points or industrial placements to one gas analyzer with preliminary purging of bleed line before its connection.

Change-over switch gas (Fig. 66) has the explosive-impenetrable performance V3G and can be established/installed in the rooms of class V-Iа. Change-over switch normally works at the following values of the parameters of the gaseous mixture and the environment:

temperature, °C ... 5-50

relative humidity, o/o ... to 80.

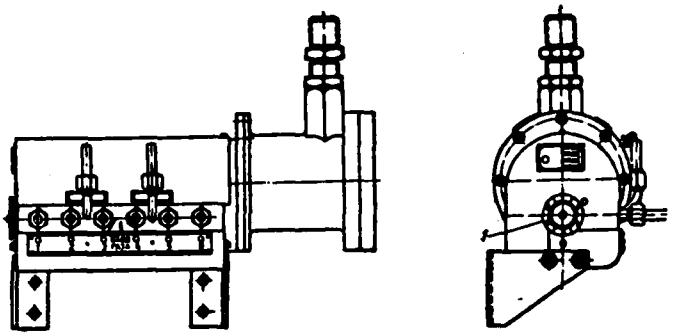

Fig. 66. Change-over switch gas GP-1: 1 - disk with the numerals, which correspond to the number of working valve (point of selection). Key: (1) Gas input

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Change-over switch can work in the media, not corrosive of the materials from which is prepared the instrument (steel Kh18N9T, rubber of brand 205 and polychlorovinyl plastic material).

The number of the point of selection at each moment/torque is determined from plank I with the numerals (see Fig. 66). Numeral, which is located against arrow/pointer on jacket, corresponds to the number of the working valve (point of selection) of that opened at given moment/torque.

Gas change-over switch is assembled on panel.

It is released by the in series experimental design office of automation (OKBA).

Fundamental technical specifications.

Maximum pressure (rarefaction/evacuation) of gas on input into change-over switch, kg/cm² (kN/m²) ... 0.15 (15).

Maximum gas flow from each point, l/h ... 200.

Operate time of each working valve, s ... 60.

The pressure differential in valves, kg/cm² (kN/m²) ... 0.005 (0.5).

The complete cycle of selection in six points, min ... 6.

Supply voltage at the frequency of 50 Hz, V ... 220.

Required power, W ... 12.

Clearance, mm ... 390x360x189.

Weight, kg ... 10.

Change-over switch pneumatic tne PP-8.

Change-over switch is intended for the consecutive automatic connection of eight points of the selection of the analyzed gaseous mixture to sensor of gas analyzer with the preliminary purging of bleed line before its connection. With the aid of knobs/buttons on panel at any time it is possible to stop the cycle of run at the necessary point, to begin it again with this or any other point, and to also reduce the number of bypassed points from eight to two.

Change-over switch pneumatic consists of two units: pneumatic bypassing device UMO-8 and unit of pneumatic valves KP-8. The unit of the bypassing device is equipped with the signal indicator, which indicates the reference number of the working line (point of selection).

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Pneumatic change-over switch PP-8 is explosion proof device and can be used in dangerously explosive rooms. Change-over switch normally works at the following values of environmental parameters:

temperature, °C ... 5-50.

relative humidity, o/o ... to 80.

Change-over switch can work in the media, not bringing about the corrosion of the materials from which are prepared the valves (steel Kh18N9T, teflon, polychlorovinyl plastic material).

For the work of pneumatic bypassing device of change-over switch necessary are the compressed air by pressure 1.4 kg/cm^2. The overall diagram of the gas connections of the change-over switch of pneumatic the PP-8 is shown in Fig. 67.

It is released of special-order by the experimental design office of automation (OKBA).

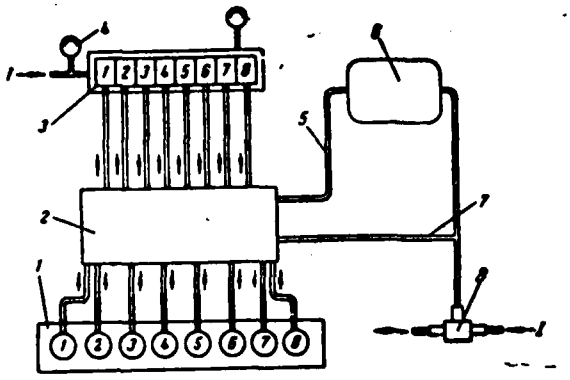

Fig. 67. The overall diagram of the gas connections of the change-over switch of pneumatic tne PP-8: 1 - point of the selection; 2 - unit of the pneumatic valves; 3 - pneumatic bypassing device; 4 - manometer (2 pieces); 5 - line of the supply of test sample; 6 - gas analyzer; 7 - line of the purging; 8 - air removal jet; I - compressed air.

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Fundamental technical specifications.

Gas pressure at the input into valves KP-8, kg/cm² (kN/m²) ... from -0.1 (10) to 0.3 (30).

Maximum gas flow from each point, l/h ... 200.

Duration of selection from one point with automatic changeover, min ... 0.75-5.

The complete cycle of selection from eight points, min...6-40.

Maximum distance, m

from the bypassing device to the unit of valves ... 300.

from the place of sampling to the unit of valves ... 50.

Clearance, mm

the pneumatic bypassing devices UMO-8 ... 320x240x535.

the unit of pneumatic valves KP-8 ... 225x216x103.

Weight of pneumatic bypassing device, kg ... 35.

4.5. Units of auxiliary devices (package units).

Units of adjustment and filtration B-1, B-3, B-4, B-5, B-7, B-8.

Units are intended for control and control of the flow rate of

the analyzed gaseous mixture, drying, cleaning/purification from agressive admixtures/impurities and checking of the cleanliness of gas, supplied to gas analyzer.

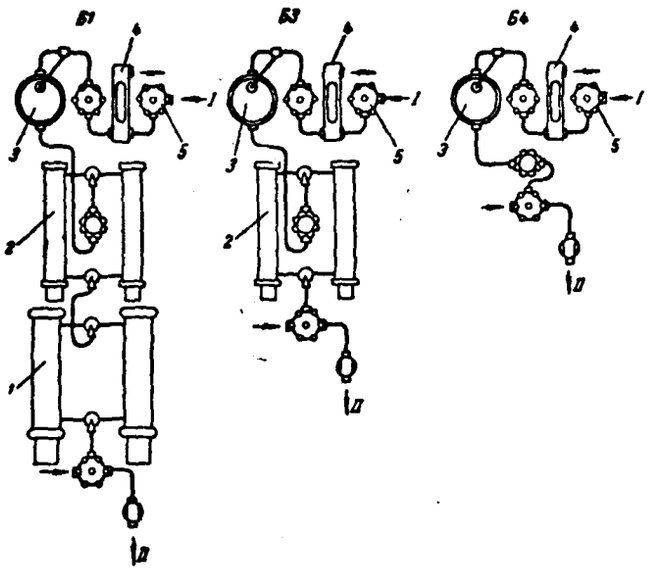

Fig. 68. Units of adjustment and filtration B-1, B-3 and B-4. The diagrams of gas connections: 1 - filters chemical; 2 - filter-driers; 3 - flow regulator; 4 - rotameter; 5 - valve/gate; I - supply to the control mixture; II - discharge/break of gas.

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Units B-1 and B-5 are used in systems with the moist gases, which contain the agressive admixtures/impurities; units B-3 and B-7 - in systems with moist gases without the agressive admixtures/impurities; units B-4 and B-8 - in systems with dry gases without agressive admixtures/impurities. The diagrams of gas connections of the separate elements/cells of units B-1, B-3 and

B-4 are shown in Fig. 68. All units are intended for a work at an ambient temperature from 10 to 30°C. Error in the flow-rate control of gas mixture +-20o/o. The fundamental characteristics of gaseous mixture before and after the units of adjustment and filtration are given in Table 7.

Table 7. Characteristic of gaseous mixture before and after the units of adjustment and filtration.

(1) Тип блока	(2) Содержание агрессивных примесей, г/м³		(3) Влагосодержание, г/м³		(4) Избыточное давление (разрежение), кгс/см²	(5) Плотность, кг/м³	(6) Номинальный расход газовой смеси, л/мин
	(7) на входе	(8) на выходе	(9) на входе	(10) на выходе			
Б-1	15	0,01	30	0,5	0,06—0,2	0,2—1,5	0,5; 0,7
Б-3	0,01						
Б-4							
Б-5	15	0,001	30	0,5	—0,02—0,02		
Б-7	0,001						
Б-8			0,5				

Key: (1). Type of unit. (2). Content of aggressive admixtures/impurities, g/m³. (3). Water content, g/m³. (4). Overpressure (rarefaction/evacuation), kg/cm². (5). Density, kg/m³. (6). Nominal flow rate of gaseous mixture, l/min. (7). at input. (8). at output.

Clearance and weight of units are shown below:

(1) Тип блока	(2) Габариты, мм	(3) Вес, кг
Б-1	1050×330×180	26
Б-3	720×330×182	22
Б-4	486×330×182	19
Б-5	995×295×167	23
Б-7	715×295×167	19
Б-8	317×295×167	16

Key: (1). Type of unit. (2). Clearance, mm. (3). Weight, kg.

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Units are released by the in series by Vyrusk plant of gas analyzers and by the Smolensk plant of the resources of automation.

Unit of control/checking B-12.

Unit B-12 (Fig. 69) is intended for checking and controlling flow of the analyzed gaseous mixture, and also the checking of its cleanliness. The unit of checking is used for a work with the dry pure/clean gaseous mixtures, which do not contain agressive and mechanical impurities, at a stable pressure in system.

It is released by the in series Vyrusk plant of gas analyzers and by the Smolensk plant of the resources of automation.

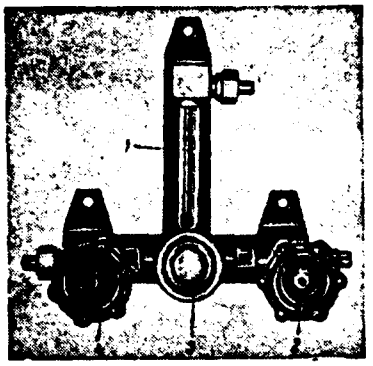

Fig. 69. The unit of checking B-12: 1 - rotameter; 2 - valve/gate locking; 3 - filter the control room; 4 - valve/gate, blocking and regulating.

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Fundamental technical specifications.

Error in the flow-rate control, o/o ... +-20.

Nominal flow rate of the gaseous mixture through unit, l/h ... 18-120.

Operating pressure, kg/cm² (kN/m²)

with work in closed system ... to 4 (392).

with work on discharge/break in the atmosphere ... to 0.5 (49).

Temperature of gaseous mixture and environment, °C ... 10-30.

Weight, kg ... 2.5.

Unit of gas supply BPG-2.

Unit BPG-2 (Fig. 70) is intended for the selection of the analyzed mixture from placement and its supply with the constant velocity into the sensor of gas analyzer. Unit consists of filter, electrovibration pump, regulator of pressure and the indicator of flow rate. All nodes are placed in the casting, intended for an attendant or wall mounting. Instrument has the general-purpose (non-explosion proof) performance. The unit of gas supply normally works with following parameters of the environment:

temperature, °C ... 10-45.

relative humidity, o/o ... to 80.

It is released of special order by the experimental design

office of automation (OKBA).

Fundamental technical specifications.

Limits of the adjustable flow rate of gaseous mixture, l/h ... 20-60.

Parameters of the analyzed mixture

temperature, °C ... 10-45.

relative humidity, o/o ... to 80.

Supply voltage with frequent of 50 Hz, V ... 220.

Required power, W ... 5.

Clearance, mm ... 320x220x144.

Weight, kg ... 4.

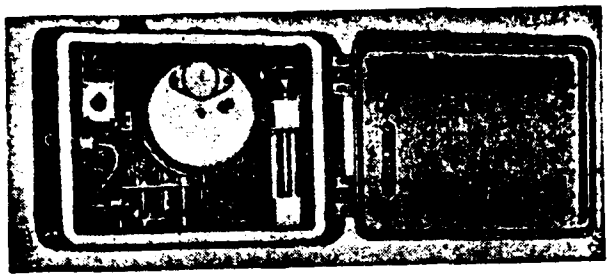

Fig. 70. Unit of gas supply BPG-2 with the open cover/cap.

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4.6. Other auxilople.

Installation for saturation and drying of the indicator tape of gas analyzer UPL-1M.

Installation UPL-1M (Fig. 71) is intended for the preparation of indicator tape for use/application in photocolorimetric gas analyzers FKG-2, FKG-3, GSP-3, etc. The preparation of tape consists of its saturation in the appropriate solutions and the subsequent drying in heating device.

Installation can work in explosion proof room with the following environmental parameters:

temperature, °C ... 10-40.

relative humidity, o/o ... to 80.

The electrical connections of installation are assembled in accordance with the diagram, given in Fig. 72.

It is released by the in series experimental design office of automation (OKBA).

Fundamental technical specifications.

Width of belt, mm ... 13.

Speed of the motion of tape, mm/min ... 30.

The absolute humidity of the dried tape, o/o ... 5.

The temperature, provided by heating device, °C ... 50.

Supply voltage with frequent of 50 Hz, V ... 220.

Power of heating device, W ... 240.

All installations, kg ... 15.

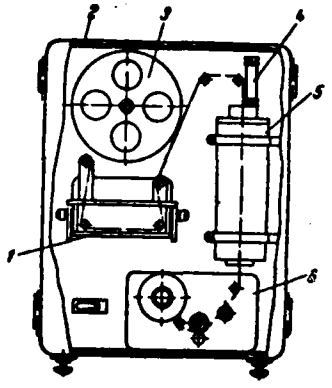

Fig. 71. Installation UPL-1M; 1 - bath with solution for the saturation; 2 - housing; 3 - tape drum; 4 - the contacting thermometer; 5 - electrical heating device; 6 - tape-drive mechanism.

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Machine, tape-impregnating, MLP-2.

Machine is intended for the preparation of indicator tape for gas analyzers. The preparation of tape consists of its saturation in indicator solutions and subsequent drying and coil/winding of the reel/cylinders of the established/installed size/dimension to spools. Machine operates automatically (periodically) and can be used for saturation with the indicator solutions, not agressive to polyethylene, fluoroplast, polyvinyl chloride plastic and organic glass.

Machine can work in explosion proof rooms with the following environmental parameters:

temperature, °C ... 10-60.

relative humidity, o/o ... to 80.

Tape-impregnating machine consists of installations UPL-3 for the saturation of tape and electron relay ElR-1. In machine is provided for the possibility to change in sufficiently wide speed range of broaching tape, duration and temperature of its drying.

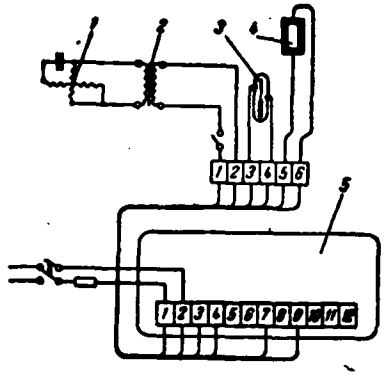

Fig. 72. The schematic of the electrical connections of installation UPL-1M: 1 - electric motor; 2 - transformer; 3 - the contacting thermometer; 4 - heating device; 5 - electronic relay.

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IT is released by the in series experimental design office of automation (OKBA).

Fundamental technical specifications.

Width of belt, mm ... 13-22.

Rate of broaching belt, cm/min ... 10-20.

The temperature, provided by heating device, °C ... 25-65.

Accuracy of thermostatic control of air flow, °C ... +-1.

Air pressure on input into drier, kg/cm² (kN/m²) ... to 0.05 (5).

Warm-up period of machine, min ... 15.

Supply voltage at the frequency of 50 Hz, V ... 220.

Required power, W ... 250.

Clearance UPL-3, mm ... 345x240x505.

Weight of machine, kg ... 23.

Installation for the preparation of gaseous mixtures UPGS-1.

Installation UPGS-1 is standard and is intended for preparation by the static method of the compatible explosion proof binary gaseous mixtures of the prescribed/assigned composition, utilized for individual calibration and dial test of the automatic gas analyzers the operating principle of which provides the retention/preservation/maintaining the composition of the mixture,

which enters the sensor. Prepared gas mixture must not interact with the material from which is prepared the installation.

Installation UPGS-1 can be used during the calibration of gas analyzers at all stages of their development, with certification at the stage of issue, and also shops KIP for checking the correctness of readings of analyzers.

In the assembly of the installation enter: containers glass ones to 2 and to 20 ml (on 4 pieces), ballast capacities to 50 and to 240 ml, stimulus of the gas flow and attachment for calibrating the total volume.

The material of all fundamental assemblies and connections of installation - glass and fluoroplast, which reduces to minimum the sorption and the reaction of these materials with the components of mixture.

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Installation, portable, for the periodic effect/action. All elements/cells of installation are stacked in wooden case with knob/arm/handle. The presence in installation of four doubled and preliminarily calibrated containers for the determined component and

two for ballast gas, and also the utilization of dual dilution makes it possible to simultaneously compose four different mixtures with the concentrations of analyzed component 25, 50, 75 and 100o/o of the scale range of the calibrated instrument.

The process of the preparation of gaseous mixtures consists into the following. In one of the calibrated fitted capacities they select/take the determined component, equalize pressure with atmospheric, blow entire line by gas - diluent, they close diagram to sensor and forcedly is agitated itself the obtained mixture in closed volume.

The ratio of the volume of the determined gas (component), led to standard conditions, to the total calibrated volume is the measure for concentration.

It is released of special order by the experimental design office of automation (OKBA).

Fundamental technical specifications.

Range of the prepared concentrations, Vol. o/o

during the first dilution ... 0.5-73.

during the second dilution ... 0.003-53.

An error in the prepared mixtures does not exceed, o/o

during the first dilution ... +-0.5.

during the second dilution ... +-1.

Voltage of supply (pump) with frequency 50 Hz, V ... 220.

Clearance of case, mm ... 490x470x150.

Weight, kg ... 7.

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5. Instruments and auxilopie, produced by foreign firms.

In section are led technical and operating characteristics of automatic gas analyzers and auxiliopie to them, produced by the leading firms of the FRG and USA, and operated by some enterprises of chemical and petrochemical industry, for the monitoring of the air

medium of industrial rooms.

Gas analyzers Uras 1 and Uras 2.

Instruments are intended for the continuous automatic measurement of the content of different by two- and polyatomic gases and vapors, including sulfurous and chlorine connections in entire range of concentrations from 0 to 100 Vol. o/o (for vapors from 0 to saturation) in technological mixtures, and also in air of industrial rooms. Gas analyzers cannot be applied for measuring the concentration of the diatomic gases which do not have an absorption band in infrared spectrum N_2, O_2, H_2, Cl_2, etc.

The operating principle of gas analyzers is based on the property of heteroatomic gases (consisting of different forms atoms) to absorb infrared rays in specific, specific for each gas spectrum bands.

The flows of infrared rays from emitter pass simultaneously through working and comparative chambers/cameras. Comparative chamber/camera is filled with nitrogen, which does not absorb infrared rays.

Through the working chamber flows/occurs/lasts the analyzed gaseous mixture, which partially absorbs the flow of infrared rays. In passing by both chambers/cameras, flows fall into radiation detector. Difference in the intensity of two flows (through working and comparative chambers/cameras), that depends on the concentration of the determined component, is established/installed by radiation detector and is converted into the electric measured value, supplied to secondary instrument.

The chambers/cameras of gas analyzer are prepared from gilded glass, most important parts - made of aluminum and stainless chrome-nickel steel. This makes it possible to use instruments for the analysis of aggressive gases.

All nodes and units of gas analyzer Uras1 (Fig. 73) are mounted in the dust-splashproof jacket from light metal with the closing door. On the upper side of jacket are located four stuffing-boxs seal for the inlet/introduction of electric cables, on lower - uniting pipelines for delivery and removal/outlet of the analyzed gas. In the gas analyzer Uras 2 (Fig. 74) in contrast to Uras 1 is provided for three-dimensional/space separation of gas-analytic and electrics.

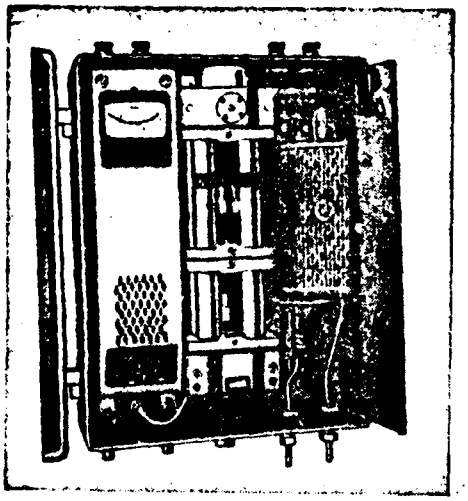

Fig. 73. Gas analyzer Uras 1 with the open cover/cap.

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They are found in one housing, but they are divided by partition and have the separate screwed on covers/caps (panel). In the lower part of the housing is located the gas-analytic system of instrument, in upper are located the amplifier, dial instrument and other electric assemblies.

Firm "Hartmann and Braun" developed the special version of instrument Uras 2 explosion proof performances. In this instrument gas and electrics are also divided and arranged/located in two airtight containers (Fig. 75). Is to the left arranged/located

gas-analytic part, to the right - electric, in the middle part is built in the indicator. Gas analyzers are intended for a wall mounting or panel.

Producer: firm "Hartmann and Braun" (FRG).

Fundamental technical specifications.

Fundamental error, o/o from the range of the measurement ... +-3.

Time began controls, s ... 0.6.

Time lag of readings of gas analyzer, s ... 10.

Threshold of response, o/o of the upper limit of the measurement ... 0.5.

Permissible temperature of that surrounding medium, °C:

gas analyzer Uras 1 ... 10-35.

gas analyzer Uras 2 ... 10-45.

The flow rate of analyzed gaseous mixture (are possible other flow rates), l/h ... 30 or 60.

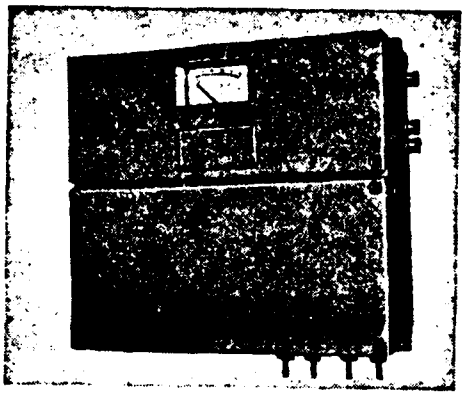

Fig. 74. Gas analyzer Uras 2.

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Pressure of analyzed mixture (excess), kg/cm² (kN/m²) ... 0.02-1 (2-98).

Supply voltage at the frequency of 50 Hz, V ... 220.

Required power, W

gas analyzer Uras 1 ... 225.

gas analyzer Uras 2 ... 100.

Weight of gas analyzer, kg

Uras 1 ... 25.

Uras 2 ... 31.5.

Instruments Uras 1 and **Uras** 2 have the **minimum ranges of the measurement** of concentrations (into Vol. o/o) for the following **determined components:**

	Uras 1	Uras 2
(1) Аммиак	0—0,1	0—0,1
(2) Ацетальдегид	0—0,25	0—0,1
(3) Ацетилен	0—0,02	0—0,05
(4) Ацетон	—	0—0,04
(5) Бензол	0—0,06 (7)	0—0,03 (7)
(6) Бензин	0—1,0 г/м³	0—0,5 г/м³
(8) Бутан	0—0,02	0—0,02
(9) Гексан	0—0,03	0—0,01
(10) Гептан	0—0,02	0—0,01
(11) Двуокись углерода	0—0,005	0—0,005
(12) Закись азота	0—0,05	0—0,005
(13) Метан	0—0,02	0—0,02
(14) Метанол	0—0,07	0—0,07
(15) Метиленхлорид	0—0,1	0—0,1
(16) Окись углерода	0—0,01	0—0,01 (15)
(17) Пары растворителей	—	по особому требованию
(19) Пропан	0—0,02	0—0,02
(20) Пропилен	0—0,2	0—0,2
(21) Сернистый ангидрид	0—0,02	0—0,02
(22) Синильная кислота	0—0,5	0—0,05
(23) Сероуглерод	0—0,015 (3)	0—0,015 (2)
(24) Толуол	0—2,0 г/м³	0—2,0 г/м³ (18)
(25) Трихлорэтилен	—	по особому требованию
(26) Хлористый водород	0—0,2	0—0,1
(27) Этан	0—0,02	0—0,02
(28) Этилен	0—0,2	0—0,2
(29) Этиловый спирт	0—0,1	0—0,1

Key: (1). Ammonia. (2). Acetaldehyde. (3). Acetylene. (4). Acetone. (5). Benzene. (6). Gasoline. (7). g/m³. (8). Butane. (9). Hexane. (10). Heptane. (11). Carbon dioxide. (12). Nitrous oxide. (13).

Methane. (14). Methanol. (15). Methylene chloride. (16). Carbon monoxide. (17). Vapors of solvents. (18). on special requirement. (19). Propane. (20). Propylene. (21). Sulfur anhydride. (22). Hydrocyanic acid. (23). Carbon disulfide. (24). Toluene. (25). Trichloroethylene. (26). Hydrogen chloride. (27). Ethane. (28). Ethylene. (29). Ethyl alcohol.

Greatest range of the measurements: 0-100 Vol. o/o, for vapors - from 0 to saturation. Are possible also the limits of measurement with suppressed zero (for example, 60-70 Vol. o/o). Maximum suppression 6:1.

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Transition/junction from one determined component to another and in accordance with one range of measurement to another is feasible in the case of replacing the separate nodes of instrument. Thus, for instance, replacing measuring cuvettes (chamber/camera), it is possible to change to another range of measurement, and replacing receiver, it is possible to switch over to the determination of the concentration of another component.

Gas analyzer Unor 2.

Instrument is intended for the continuous automatic measurement of the concentration of carbon monoxide, dioxide of carbon or methane in different gaseous mixtures, and also in air of industrial premises in entire range of concentrations from 0 to 100 Vol. o/o.

The operating principle of gas analyzer (Fig. 76) is based on measurement of the value of absorption determined by component of radiation in the infrared region of spectrum. A difference in the spectra of absorption of different gases gives the possibility to conduct selective analysis one component in complex gaseous mixtures independent of a change in the concentrations of undefined components.

The housing of instrument is prepared from sheet steel. Units and nodes of instrument are arranged/located on the reverse side of the removing itself panel. On the front side of panel are established/installed the knobs/buttons for zero adjustment and instrument sensitivity. Entire the optical part of the gas analyzer is located in airtight chamber/camera. Power supply unit and amplifier are carried out in the form of printed circuit on semiconductors.

In gas analyzer there is a manual change-over switch of points of the selection of the analyzed mixture. In assembly with gas analyzer is used secondary recorder with signal (controlling) device.

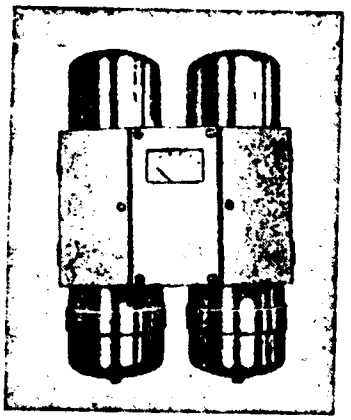

Fig. 75. Gas analyzer Uras 2 (explosion proof model).

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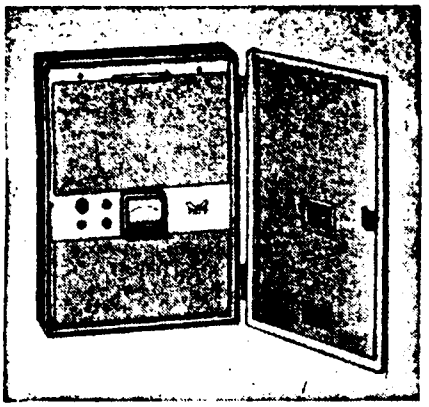

Fig. 76. Gas analyzer Unor 2 with open door.

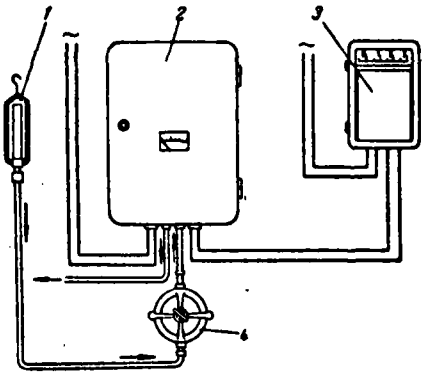

Fig. 77. Schematic of external gas and electrical connections of gas analyzer Unor 2: 1 - gas-bleeding device; 2 - gas analyzer; 3 - secondary recorder; 4 - filter.

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Gas analyzer is assembled on wall. All gas and electric connections are produced in the lower part of the instrument. Fig. 77 depicts interconnection diagram of gas analyzer in the case of its use/application for the analysis of air in industrial rooms. In the place of the selection of the analyzed mixture are hung out the special gas-bleeding devices, which consist of corrosion-resistant meshed housing and built in into it ceramic filter.

Producer: firm "Mainak" (FRG).

Fundamental technical data

Fundamental error, o/o from the range of the measurement ... by ±2.

Time began reactions, s, it is not less ... 1.

Expenditure/consumption of analyzed gaseous mixture, l/h ... 30.

Supply voltage at the frequency of 50 Hz, V ... 220.

Required power, W ... 20.

Clearance, mm ... 370x510x200.

Weight, kg ... 22.

Instrument is calculated for following ranges of the measurement of the concentration (in vol. %) of the determined components:

(1) Окись углерода	0—0,01; 0—0,03; 0—0,3; 0—1; 0—10, 0—40; 0—100
(2) Двуокись углерода	0—0,005 0—1; 0—5; 0—10, 0—20
(3) Метан	0—0,01; 0—0,1; 0—1; 0—3, 0—10, 0—100

Key: (1). Carbon monoxide. (2). Carbon dioxide. (3). Methane.

On the demand of customer the gas analyzer can be calibrated for determining of propane, butane, oxide of nitrogen and some other gases.

Gas analyzer CGCOG.

Instrument CGCOG is intended for the continuous automatic measurement of the sanitary concentrations of carbon monoxide in air of industrial rooms and signaling about the achievement of the limiting values of the determined component.

The operating principle of instrument is based on the acousto-optical method of analysis. The schematic diagram of

instrument is analogous the schematic of instruments of the type Uras (see the operating principle of gas analyzers Uras 1 and Uras 2).

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Instrument is usually calculated for one point of the selection of the analyzed mixture; however, at will of customer it can be completed by special gas-distributing device to three points of selection with three-tube signal signal panel for the indication of the point of selection. Possibly also connection to the instrument of siren or bell.

The housing of instrument is prepared from steel plate. Within housing, to plate/slab are fastened all instrument units. In upper part is established/installed the indicating device with signalling device and two tubes: green (normal work of instrument) and red (excess of the parameter). Besides the built in instrument is possible the connection of other two instruments. Fig. 78 depicts interconnection diagram of the units of gas analyzer with the selection of the analyzed mixture at three points (rooms). The mounting of gas analyzer is wall.

Producer: firm "Hartmann and Braun" (FRG).

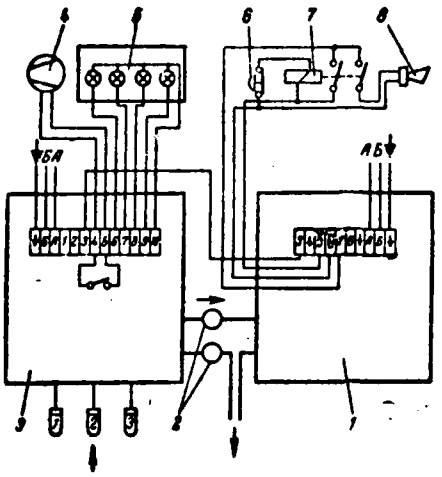

Fig. 78. Interconnection diagram of gas analyzer CGCOG (for three points of selection): 1 - gas analyzer; 2 - diaphragm pumps; 3 - gas-bleeding device; 4 - fan; 5 - signal signal panel; 6 - push-button switch; 7 - auxiliary relay; 8 - siren.

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Basic technical data.

Ranges of measurement, Vol. o/o ... 0-10; 0-20.

Threshold of response, o/o from the upper limit of the measurement ... by 0.5.

The time lag of readings of gas analyzer, s, is not more than ... 10.

Expenditure/consumption of analyzed gaseous mixture, l/h ... 60.

Ambient temperature, °C ... from -10 to 40.

Supply voltage at the frequency of 50 Hz, V ... 220.

Required power, W ... 100.

Clearance, mm ... 920x600x320.

Weight, kg ... 75.

Gas analyzers Picoflux L and Picoflux E.

Instruments are intended for the uninterrupted detection of the tracks of sulfurous anhydride (Picoflux L), dioxide of nitrogen, chlorine and hydrogen sulfide (Picoflux E) in air of industrial rooms.

The operating principle of instrument Picoflux L is based on an electro-conductometry method of analysis and is reduced to the measurement of the specific conductivity of liquid, in which is

dissolved the determined component, which changes during dissolution into ions, i.e., generating the solution of electrolyte. an increase of the quantity of ions in liquid increases its electroconductivity which serves as the measure of a quantity of dissolved gas and, consequently, also its concentration in the analyzed gaseous mixture.

The fundamental condition for the precise measurement of the concentration of the determined component with the aid of gas analyzer Picoflux L is the preliminary purification of the analyzed mixture from the immeasurable, which mix determination components (especially from ammonia and hydrogen chloride) with the aid of selective filters.

Fig. 79. Gas analyzer Picoflux.

The maximum accuracy of measurement is achieved also by the use/application of a special system of thermostatic control of conductivity cells. In instrument Picoflux E is used electrochemical effect. Here also the direct flow of gas reacts with the direct flow of reaction solution. As the elements/cells of measurement and comparison (arranged/located before and after the zone of reaction) serve divided from each other by diaphragm reference electrodes. As a result of the assorted composition of the solutions, which take place through both elements/cells, appears the galvanic current, proportional to the concentration of the determined component.

Structurally/constructurally gas analyzer Picoflux (both modifications) (Fig. 79) is two housings, prepared from sheet steel and attached on general/common/total strut. Both parts are closed by doors. In upper part is arranged/located the sensor, below - secondary instrument. As secondary the instrument is used compensation chart-recording instrument to three points. Additionally with gas analyzer (any modifications) can be supplied the integrator which registers on the built-in printer the average/mean output values of the measurement in 10 or 30 min.

Producer: firm "Hartmann and Braun" (FRG).

Basic technical data.

Ranges of measurement, mg/m³.

gas analyzer Picoflux L.

sulfurous anhydride ... or 0-1; 0-2.5; 0-5.

gas analyzer Picoflux E.

the dioxide of nitrogen ... of 0-1.

chlorine ... of 0-1.

hydrogen sulfide ... of 0-1.

Fundamental error, o/o from the range of measurement ... ±5.

Additional error, o/o from the range of measurement.

from a change in the temperature of the analyzed mixture on 1°C (from that permitted), it is not more than ... 2.

from a change in the pressure of the analyzed mixture on 10 mm

Hg (from 760 mm Hg) ... 1.

Threshold of response, o/o from the upper limit of the measurement ... by +1.

Permissible ambient temperature, °C ... from -3 to 32.

Expenditure/consumption of analyzed gaseous mixture, l/h ... 50.

Supply voltage at the frequency of 50 Hz, V ... 220.

the required power, W ... 130.

clearance, mm.

sensor ... 480x640x450.

secondary instrument ... 480x380x450.

the weight of sensor, kg.

without filling ... with 45.

with filling ... with 63.

the weight of secondary instrument, kg ... 40.

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Gas analyzers Caldos 2 and Caldos 3.

Instruments are intended for the continuous automatic measurement of the content of hydrogen, dioxide of carbon, sulfurous anhydride and ammonia in technological gaseous mixtures, and also in air of industrial rooms.

Operating principle gas analyzer is based on the dependence of the heat conductivity of the analyzed mixture (air) from the content in it of hydrogen, since the heat conductivity of the latter considerably exceeds the heat conductivity of other immeasurable blending agents.

In instruments is used the schematic of measuring direct-current bridge. Sensing elements, washed by the analyzed gaseous mixture, are connected into contradictory ratio arms, and two another arm are formed by sensing elements, washed by comparative gas.

Depending on the composition of the analyzed mixture the gas analyzers can be released with the simple or differential circuit of measurement.

If under operating conditions occur insignificant changes in the composition of the uncontrollable part of the analyzed mixture, then in the composition of calibration mixtures is considered the average content of each of the immeasurable components.

In the case of the analysis of the multicomponent gaseous mixtures of variable composition in gas analyzers is used differential measuring circuit with two independent flows of the compared gases. In accordance with this into the assembly of gas analyzer enters either the furnace of combustion or filter with chemical absorber. Gas analyzer Caldos 2 (Fig. 80) is used for the analysis of nonagressive media. Unlike it, instrument Caldos 3 (Fig. 81) possesses increased corrosion resistance, which makes it possible to use it for the analysis of any agressive gases, including chlorine and its derivatives. Instrument Caldos 3 has explosion proof performance.

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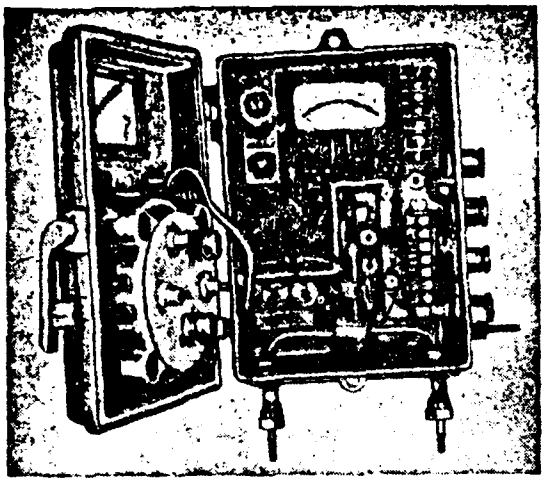

Fig. 80. Gas analyzer Caldos 2 with open door.

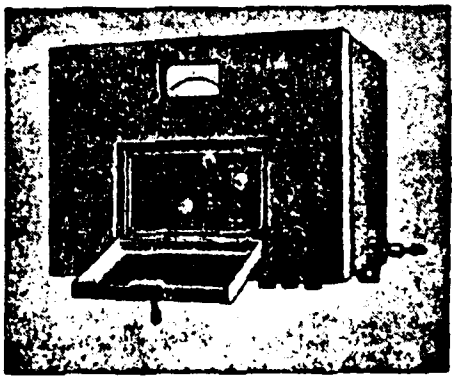

Fig. 81. Gas analyzer Caldos 3.

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Structurally/constructurally gas analyzer Callos 2 is placed in

the poured pig iron housing with the closing door and is intended for a wall mounting; Caldos 3 is arranged in housing from light metal with the airtightly closing door it is assembled on wall or panel.

the producer: firm "Hartmann and Braun" (FRG).

Basic technical data.

Minimum ranges of measurement, Vol. o/o.

hydrogen ... 0-0.5.

the dioxide of carbon ... 0-5.

sulfurous anhydride ... 0-1.5.

ammonia ... of 0-1.

Fundamental error, o/o from the range of the measurement ... by ±2.

Threshold of response, o/o from the upper limit of of measurement ... 1.

Time began reactions, s ... 2.

Permissible ambient temperature and analyzed mixture, °C.

Caldos 2 ... 0-35.

Caldos 3 ... 0-40.

Expenditure/consumption of analyzed gaseous mixture, l/h ... 30 or 60.

Supply voltage, V.

from network/grid at the frequency of 48-62 Hz ... 220.

from storage batteries/accumulators ... 12.

Required power (without secondary instrument), W.

Caldos 2 ... 18.5.

Caldos 3 ... 28.5.

Clearance, mm.

Caldos 2 ... 215x155x295.

Caldos 3 ... 384x245x288.

Weight, kg.

Caldos 2 ... 14.5.

Caldos 3 ... 21.5.

Gas analyzers Caldos are released to different limits of the measurement of the determined components in the range of concentrations from 0 to 100 Vol. ones o/o. Can also be released instruments with suppressed zero (for example, 98-100 Vol. o/o, 20-60 Vol. o/o and so forth) and two-limit.

Gas analyzer Lira (model 300).

Instrument (Fig. 82) is intended for the continuous automatic measurement of the concentration of carbon monoxide, methane, ammonia and some other gases and vapors in air of industrial rooms.

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The operating principle of gas analyzer is based on the acousto-optical method of the analysis (see the operating principle of instruments Uras and Unor 2).

Gas analyzer has vibration-proof performance and is assembled on panel.

Manufacturer: firm "MSA" (USA).

Basic technical data.

Ranges of measurement, Vol. o/o.

carbon monoxide ... 0-0.2; 0-1; 0-10.

the dioxide of carbon ... 0-0.2; 0-10; 0-100.

methane ... of 0-1; 0-20; 0-50.

ethane ... 0-2; 0-4; 0-100.

ethylene ... 0-10; 0-20; 0-50.

ammonium ... 0-0.3; 0-1; 0-5.

cyclohexane ... 0-3; 0-5; 0-7.5.

methylene-chloride ... 0-100.

sulfur dioxide ... 0-5; 0-20.

Fundamental error, o/o from the range of the measurement ... by ±2.

Supply voltage, V ... 110.

Required power, W ... 60.

Clearance, mm ... 516x2o5x203.

Automatic gas change-over switch.

Change-over switch (Fig. 83) is intended for the automatic consecutive selection of the analyzed mixture at six points (rooms). Automatic gas change-over switch has the rotating shutter/valve, powered by the synchroncus motor through the reductor.

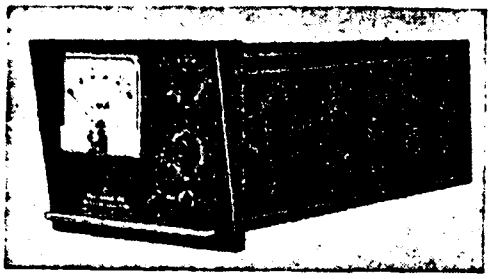

Fig. 82. Gas analyzer Lira (model 300).

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With the aid of reductor is established the necessary duration of selection at one point. The indicator of the numbers of the points of selection is arranged/located on the face of the cover/cap of gas change-over switch. The diagram of gas change-over switch can be changed in such a way as to obtain two-, three- or six-position change-over switch.

Gas change-over switch is released two types: A (six inputs and one output) and P (six inputs even two outputs). In a change-over switch of the type A the choice conduits/manifolds, not bonded with analyzer, are cut off. Consequently, the analyzed gaseous mixture stands too long in unusable conduits/manifolds. As a result of this during switching for the following point of selection appears additional time lag. This time lag can be excluded, after

establishing the regulator of overpressure directly before the gas change-over switch.

Type P has two gas tubing; through the first tubing one point of selection is connected with gas analyzer, remaining points are connected with the second tubing, to which is connected the suction pump. As a result of this immediately after switching to gas analyzer from change-over switch comes fresh gaseous mixture.

The contacts of control and synchronization give in necessary time impulse/momentum/pulse on the inclusion/connection of the process/operation of recording on six-point chart-recording instrument. With the connection of chart-recording instrument to the gas switch the period of its switching must be matched with the sequence of the points of chart-recording instrument.

In gas change-over switch can be also built in the contacts of the outside light signal panel, which shows, what point of selection is connected to gas analyzer at the given moment/torque.

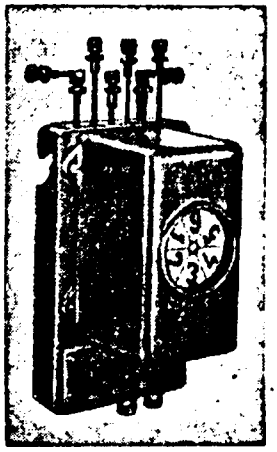

Fig. 83. Automatic gas change-over switch.

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During anticorrosive performance gas change-over switch is prepared from the stainless steel.

The mounting of change-over switch is wall.

Producer: firm "Hartmann and Braun" (FRG).

Basic technical data.

Maximum quantity of points of selection ... 6.

Duration of selection from one point, min ... 0.5-8.

Maximum pressure of gas (excess), kg/cm² (kN/m²) ... 0.05 (5).

Flow of gas, l/h ... 100.

Supply voltage at the frequency of 50 Hz, V ... 220.

Required power, W ... 20.

Clearance, mm ... 270x460x185.

Weight of gas change-over switch, kg.

without the contacts of light signal panel ... 7.

with the contacts of light signal panel ... 7.8.

Filter membrane/diaphragm.

Membrane filter (Fig. 84) is intended for the recleaning of gaseous mixture from the mecnanical impurities.

The housing of filter is prepared from gray cast iron and the

internal surface of housing is covered with varnish. The membrane/diaphragm is located between two pig iron plates which are fastenned by wing nut. Material of the membrane/diaphragm: fiberglass fabric (usual performance) or polystyrene (anticorrosive performance). Mount of filter is wall.

Producer: firm "Hartmann and Braun" (FRG).

Basic technical data.

Capacity, l/h ... 30 ... 60 ... 90.

Duration of delay, s ... 3.9 ... 2.0 ... 1.5.

Drop/jump in the pressure mm H_2O (kN/m^2) ... 2(20) ... 3(30) ... 5(50).

Clearance, mm ... 295x200x230.

Weight, kg ... 3.5.

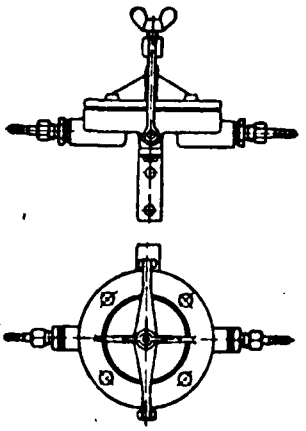

Fig. 84. Filter is membrane/diaphragm.

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Pump, membrane/diaphragm.

Pump (Fig. 85) is intended for supplying the test/sample of gaseous mixture for analysis (into the sensor of gas analyzer) and it is used when the pressure of the analyzed mixture in the place of sampling is less than 250 mm H_2O (for gas analyzers Caldos and Uras) or less than 500 mm H_2O (for gas analyzers Picoflux). The membrane/diaphragm is given in motion by electromagnet with the frequency of the network/grid of electric power supply. Quantities of supplied gas it is regulated with the aid of magnetic connections. Pump is explosion-proof and is assembled on wall or panel.

Producer: firm "Hartmann and Braun" (FRG).

Basic technical data.

Capacity, l/h ... 30 ... 60 ... 90.

Duration of delay, s ... 0.9 ... 0.7 ... 0.6.

Drop/jump in pressure, mm H_2O (kN/m^2) ... 4(40) ... 11(110) ... 18(180).

Ambient temperature, °C ... from -10 to 45.

Supply voltage at the frequency of 50-60 Hz, V ... 220; 115; 24.

Required power (depending on productivity), W ... 2.5-11.

Clearance, mm ... 245x90x165.

Weight, kg ... 3.

Flowmeter.

Flowmeter (Fig. 86) is intended for the adjustment of the expenditure of gaseous mixture, which enters for analysis. With the aid of the needle valve, built in into flowmeter, is established/installed the required flow of gas - 30 l/h or 60 l/h.

Flowmeter works according to the principle of float.

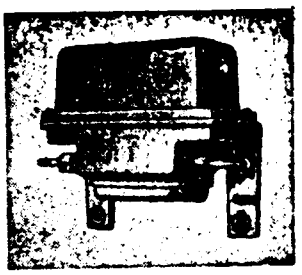

Fig. 85. Pump is membrane/diaphragm.

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Operating against gravitational force, gas taking place rises small ball/sphere (float) which moves in slightly conical glass tube with calibrated markers 25, 30 and 35 or 50, 60 and 70 l/h. Measuring glass tube is placed into the transparent protective jacket, prepared from macro-bosom. The second needle valve with connecting pipe serves for the connection of control or "zero" gas. The housing of flowmeter is prepared from plastic, needle valves - made of the stainless steel.

Producer: firm "Hartmann and Braun" (FRG).

Basic technical data.

Capacity, l/h ... 30 ... 60.

Duration of delay, s ... 1.3 ... 0.8.

Drop/jump in pressure, mm H_2O (kN/m^2) ... 3(30) ... 12(120).

Weight of flowmeter, kg ... 1.1.

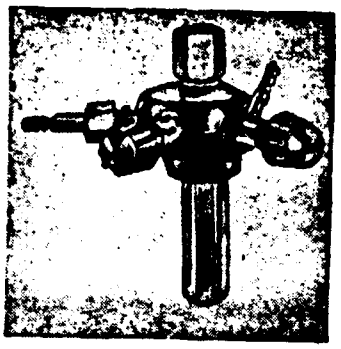

Fig. 86. Flowmeter.

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Appendix 1. Dangerously explosive and maximum permissible concentrations of some gases and vapors.

(1) Вещество	ПДК, (2) мг/м³	(3) Область воспламенения	
		ЧПВ	ВПВ
		(4) объемн. %	(4) объемн. %
(5) Акриловая кислота	5	1,9	5,4
(6) Акрилонитрил	0,5	3	17
(7) Акролеин	0,7	2,8	31,0
(8) Аллиловый спирт	—	2,5	18,0
(9) Амилацетат	100	1,0	7,5
(10) Амиловый спирт	100	1,2	10
(11) Аммиак	20	15,0	28,0
(12) Ацетальдегид	5	4	55
(13) Ацетилен	—	2,5	81,0
(14) Ацетон	200	2,2	13,0
(15) Бензин-растворитель (в пересчете на С)	300	0,76	5,16
(16) Бензин-топливный-сланцевый крекинг и др. (в пересчете на С)	100	0,98	5,48
(17) Бензол	5	1,4	7,1
(18) Бутан	300	1,8	9,1
(19) Бутилакрилат	10	1	7,4
(20) Бутилацетат	200	2,2	14,7
(21) Бутилен	300	1,6	9,4
(22) Бутиловый спирт	10	1,7	12
(23) Винилацетат	10	2,5	17,5
(24) Водород	—	4,0	75,0
(25) Водяной газ	—	6,0	72,0
(26) н-Гексан	—	1,2	7,5
(27) Гептан	300	1,1	6,7
(28) Гидразин-гидрат	0,1	—	—
(29) Дивинил	100	2	11,5
(30) Диизопропиловый эфир	—	1,4	7,9
(31) Диметиламин	1	2,8	14,4
(32) Диметилдиоксан	10	1,92	—
(33) Диметиловый эфир	—	3,4	18,1
(34) Диоксан	10	1,87	23,41
(35) Дихлорэтан	10	6,2	16
(36) Диэтиламин	30	2,2	14,9
(37) Диэтилбензол	10	—	—
(38) Диэтиловый эфир	300	1,7	49,0
(39) Изобутан	—	1,8	8,4

(1) Вещество	(2) ПДК, мг/м³	(3) Область воспламенения	
		НПВ (4) объемн. %	ВПВ (4) объемн. %
(40) Изобутилен	100	1,8	9,6
(41) Изобутиловый спирт	—	1,84	7,3
(42) Изопентан	—	1,3	7,6
(43) Изопрен	40	1,7	11,5
(44) Изопропилбензол	50	0,88	6,5
(45) Изопропиловый спирт	—	2,0	12,0
(46) Керосин (в пересчете на С)	300	1,4	7,5
(47) Коксовый газ	—	4,4	34,0
(48) Ксилол	50	1,1	5,6
(49) Метан	300	5	15
(50) Метилаль	—	2,95	—
(51) Метиламин	5	4,9	20,8
(52) Метилакрилат	20	1,2	13
(53) Метилацетат	100	3,6	12,8
(54) Метиловый спирт	5	6,0	34,7
(55) Метилэтилкетон	200	1,9	10,0
(56) Метилформиат	—	4,4	23
(57) Нафталин	20	0,37	6,9
(58) Озон	0,1	—	—
(59) Окислы азота (в пересчете на N_2O_5)	5,0	—	—
(60) Окись углерода	20	12,5	74
(61) Окись этилена	1	3,0	80,0
(62) Пентан	300	1,4	7,8
(63) Пропан	300	2,1	9,5
(64) Пропилацетат	200	1,8	8,0
(65) Пропилен	300	2,2	10,2
(66) Пропиловый спирт	200	2,1	13,5
(67) Пропилформиат	—	2,36	7,75
(68) Растворители: Р-4	—	1,65	—
№ 646	—	1,6	—
№ 648	—	1,65	—
(69) Растворитель Р5	—	1,83	—
(70) Ртуть металлическая	0,01	—	—
(71) Сернистый ангидрид	10	—	—
(72) Сероводород	10	4,3	46,0
(73) Сероуглерод	10	1,0	50,0
(74) Сильван	1,0	—	—
(75) Синильная кислота	0,3	5,6	40
(76) Скипидар	300	0,8	—
(77) Сольвент-нафта	100	1,3	8,0

(1) Вещество	(2) ПДК, мг/м³	(3) Область воспламенения	
		НПВ	ВПВ
		(4) объемн. %	(4) объемн. %
(75) Стирол	5	1,1	5,2
(76) Сырая нефть	300	1,1	6,4
(80) Толуол	50	1,3	6,7
(81) Топливо Т-1	—	0,9	—
(82) Топливо ТС-1	—	0,71	—
(83) Триметилкарбинол	—	5,5	—
(84) Триэтиламин	10	1,5	6,1
(85) Уайт-спирит (в пересчете на С)	300	1,4	6,0
(86) Уксусная кислота	5	3,3	22,0
(87) Формальдегид	0,5	7,0	73,0
(88) Фосген	0,5	—	—
(89) Фурфурол	10	1,8	3,4
(90) Хлор	1	5,0	87,0
(91) Хлорбензол	50	1,3	7,1
(92) Хлористый водород и соляная кислота (в пересчете на HCl)	5	—	—
(93) Циклогексан	80	1,2	10,6
(94) Циклогексанол	—	1,5	11,1
(95) Циклогексанон	10	0,92	3,5
(96) Этан	300	2,9	15
(97) Этиламин	—	5,5	17
(98) Этилацетат	200	3,5	16,8
(99) Этилбензол	—	0,9	3,9
(100) Этилен	300	3	32
(101) Этиловый спирт	1000	3,6	19,0

Note. During the composition of present material were used the data included in SN 245-63 "maximum permissible concentrations of harmful gases, vapors, dust and other aerosols in air of the working zone of industrial rooms" and all subsequent additions to them, and also data of the manual "Fire danger of substances and materials, used in chemical industry", under the general/common/total editorship of I. V. Riabov, ed. "chemistry", 1970.

Key: (1). Substance. (2). mg/m³. (3). Region of ignition. (4). Vol. (5). Acrylic acid. (6). Acrylonitrile. (7). Acrolein. (8). Allyl alcohol. (9). Amylacetate. (10). Amyl alcohol. (11). Ammonia. (12). Acetaldehyde. (13). Acetylene. (14). Acetone. (15). Gasoline-solvent (recalculated to C). (16). Gasoline-fuel-shale cracking, etc. (recalculated to C). (17). Benzene. (18). Butane. (19). Butylacrylate. (20). Butyl acetate. (21). Butylene. (22). Butyl alcohol. (23). Vinyl acetate. (24). Hydrogen. (25). Water gas. (26). n-Hexane. (27). Heptane. (28). Hydrazine-hydrate. (29). Divinyl. (30). Diisopropyl ether/ester. (31). Dimethylamine. (32). Dimethyldioxane. (33). Dimethyl ether/ester. (34). Dioxane. (35). Dichloroethane. (36). Diethylamine. (37). Diethylbenzene. (38). Diethyl ether. (39). Isobutane. (40). Isobutylene. (41). Isobutyl alconol. (42). Isopentane. (43). Isoprene. (44). Isopropyl benzene. (45). Isopropyl alcohol. (46). Kerosene (recalculated to C). (47).

AD-A087 872 FOREIGN TECHNOLOGY DIV WRIGHT-PATTERSON AFB OH F/G 13/2
AUTOMATIC ANALYZERS AND SIGNAL INDICATORS OF TOXIC AND DANGEROU--ETC(U)
JAN 80 E N IOVENKO
UNCLASSIFIED FTD-ID(RS)T-1801-79 NL

5 OF 5
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Coke gas. (48). Xylene. (50). Metnylal. (51). Methylamine. (52). Methylacrylate. (53). Methyl acetate. (54). Methyl alcohol. (55). Methylethylketone. (56). Methylformate. (57). Naphthalene. (58). Ozone. (59). Oxides of nitrogen (recalculated to N_2O_5). (60). Carbon monoxide. (61). Ethylene oxide. (62). Pentane. (63). Propane. (64). Propylacetate. (65). Propylene. (66). Propyl alcohol. (67). Propylformate. (68). Solvents. (69). Solvent 5. (70). Mercury metallic. (71). Sulfurous anhydride. (72). Hydrogen sulfide. (73). Carbon disulfide. (74). α-Metnylfuran. (75). Hydrocyanic acid. (76). Turpentine. (77). Solvent naphtha. (78). Styrene. (79). Petroleum crude. (80). Toluene. (81). Fuel/propellant T-1. (82). Fuel/propellant TS-1. (83). Trimetnylcarbinol. (84). Triethylamine. (85). Mineral spirits (recalculated to C). (86). Acetic acid. (87). Formaldehyde. (88). Phosgene. (89). Furfural. (90). Chlorine. (91). Chlorobenzene. (92). Hydrogen chloride and hydrochloric acid (recalculated to HCl). (93). Cyclonexane. (94). Cyclohexanol. (95). Cyclohexanone. (96). Etnane. (97). Ethylamine. (98). Ethylacetate. (99). Ethylbenzene. (100). Ethylene. (101). Ethyl alcohol.

FOOTNOTE [1]. At 100°C. ENDFOOTNOTE.

Pages 180-181. Appendix 2. Distribution of some dangerously explosive mixtures (with air) of categories and groups of explosion hazard (as of on 1 January, 1971).

(1) Категория взрыво-опасной смеси	(2) Группа взрывоопасной смеси				
	T1	T2	T3	T4	T5
	(3) Наименование веществ, образующих взрывоопасную смесь с воздухом				
(4)	Аллил хлористый, аммиак, ацетонитрил, винилиден хлористый, дихлорэтан, изобутилен, кислота уксусная, метан, метилацетат, метилстирол, метил хлористый, метилхлорформиат, метилфенилдихлорсилан	(5) Алкилбензол ГОСТ 7166—54, амилацетат, ангидрид уксусный, винилацетат, винилиден фтористый, диизопропилэфир, изопрен, изопропиламин, кислота пропионовая, метилметакрилат, метилтрихлорсилан, метилхлорметилдихлорсилан, пропиламин	(6) Полиэфир ТГМ-3, растворитель № 651 (ТУ МХП 4517—56), скипидар, спирт амиловый, уайт-спирит, циклогексан, этилдихлортиофосфат		
	(7) Растворители: Р-5 (ТУ МХП 2191—50) РС-1 (ТУ МХП 1761—52) Р-4 (ГОСТ 7827—55) РЭ-1 (ТУ МХП КУ 376—54)	(8) Растворители: № 646 (ГОСТ 5630—51) № 647 (ГОСТ 4005—48) № 648 (ГОСТ 4006—48) № 649 (ТУ МХП 1812—48) РДВ (ГОСТ 4399—40) РКБ-1 (ТУ МХП 2513—53) РКБ-2 (РТУМ 2 СНХП (109—58) РС-2 (ТУ МХП 1763—52) Р-40			
(18)	Сольвент каменноугольный, трифторхлорпропан, трифторпропан, трифторэтан, трифторхлорэтилен, фенилтрихлорсилан, циклогексанон	(9) Спирты: (13) Бутиловый (третичный), изоамиловый, изобутиловый, изопропиловый (10) Трифторпропилметилдихлорсилан, хлорметилтрихлорсилан, γ-хлорпропилтрихлорсилан, этилендиацетат			
2	(12) Ацетон, бензин Б-100, бензол, винил хлористый, газ доменный, диэтиламин, изобутан, изопропилбензол, ксилол, нафталин, окись углерода, пиридин, пропан, стирол, толуол, триэтиламин, хлорбензол, циклопентадиен, этан, этил хлористый, этилбензол, эфир диизопропиловый	(13) Бензин Б-95/130, бутан, бутилацетат, винилэфир, диметиламин, диметилдихлорсилан, диоксан, диэтилдихлорсилан, изопентан, кислота акриловая, метилакрилат, метиламин, метилвинилдихлорсилан, метилфуран, нитрил акриловой кислоты, нитроциклогексан, пентан, пропилен (16) Спирты: бутиловый, метиловый, этиловый (17) Триметилхлорсилан, фуран, фурфурол, этилацетат	(14) Аминопропилтриэтоксисилан, бензин А-66, бензин А-72, бензин А-76, бензин Б-70, бензин «калоша», бензин с октановым числом 85—54, бензин экстракционный МРТУ 12Н-20—63, бутилметакрилат, гексан, «гептил», дипропиламин, изооктилен, керосин гидрировзный с трибутилфосфатом, керосин тракторный ГОСТ 1842—52, нефть сырая ромашкинская, «Сольвент», тетрагидрофуран, тетраэтоксисилан, топливо дизельное (зимнее), топливо Т-1, топливо ТС-1, триметилфенил, триэтоксисилан, формальгликоль γ-хлорпропилтриэтоксисилан, этилмеркаптан, этилцеллозольв	(15) Ацетальдегид, дибутиловый эфир, диэтиловый эфир, этиленгликоль	—
3	(18) Коксовый газ (метана 40%, водорода 60%), светильный газ, этилен	(19) Окись этилена, окись пропилена, этилтрихлорсилан	(20) Винилтрихлорсилан, этилдихлорсилан	(21) Диэтиловый (серный) эфир	—
4	(22) а) Водород, водяной газ б)	(23) Ацетилен, метилдихлорсилан	(24) Сероводород Тиодорсилан (25)	—	(26) Сероуглерод

Key: (1). Category of explosive mixture. (2). Group of dangerously explosive mixture. (3). Designation of substances, which generate dangerously explosive mixture with air. (4). Allyl chloride, ammonia, acetonitrile, vinylidene chloride, dichloroethane, isobutylene, acid acetic, methane, methyl acetate, methyl styrene, methyl chloride, methylchloroformate, methylphenyldichlorosilane. (5). Alkylbenzene GOST 7166-54, amylacetate, anhydride acetic vinyl acetate, vinylidene fluoride, diisopropylamine, isoprene, isopropylamine, acid propionic, methyl methacrylate, methyltrichlorosilane, methylchloromethyldichlorosilane, propylamine. (6). Polyester/polyether TGM-Z, solvent No 651 (TU MKhP 4537-56), turpentine, alcohol amyl, mineral spirits, cyclohexane, ethyldichlorothiophosphate. (7). Solvents. (8). Solvent coal, trifluorochloropropane, trifluoropropane, trifluoroethane, trifluorochloroethylene, phenyltrichlorosilane, cyclohexanone. (9). Alcohols. (10). Butyl (tertiary), isoamyl, isobutyl, isopropyl. (11). Trifluoropropylmethyldichlorosilane, chloromethyltrichlorosilane, γ-chloropropyltrichlorosilane, ethylidenediacetate. (12). Acetone, gasoline B-100, benzene, vinyl chloride, blast-furnace gas, diethylamine, isobutane, isopropyl benzene, xylene, naphthalene. carbon monoxide, pyridine, propane, styrene, toluene, triethylamine, chlorobenzene, cyclopentadiene, etnane, ethyl chloride, ethylbenzene, ether/ester diisopropyl. (13). Gasoline B-95/130, butane, butyl

acetate, divinyl, dimethylamine, dimethyldichlorosilane, dioxane, diethyldichlorosilane, isopentane, acid acrylic, methylacrylate, methylamine, methylvinyldichlorosilane, methylfuran, nitrile of acrylic acid, nitro cyclonexane, pentane, propylene. (14). Aminopropyltriethoxysilane, gasoline A-66, gasoline A-72, gasoline A-76, gasoline B-70, gasoline "Kalosha", gasoline with octane number 50-54, extraction gasoline MRTU 12N-20-63, butyl methacrylate, hexane, "heptyl", dipropylamine, isooctylene, kerosene hydrogenated from tributylphosphate, kerosene tractor GOST 1842-52, crude oil romashkinsk, "Samin", tetrahydrofuran, tetraethoxysilane, fuel/propellant diesel (are winter, fuel/propellant T-1, fuel/propellant TS-1, trimethylamine, triethoxysilane, ethyleneglycol formal, γ-chloropropyltriethoxysilane, ethyl mercaptan, ethyl cellosolve. (15). Acetaldehyde, dibutyl ether/ester, diethyl ether, ethylene glycol. (16). Alcohols: butyl, methyl, ethyl. (17). Trimethylchlorosilane, furan, furfural, ethylacetate. (18). Coke gas (methane 40o/o, hydrogen 60o/o), illuminating gas, ethylene. (19). Oxide of ethylene, oxide of propylene, ethyltrichlorosilane. (20). Vinyltrichlorosilane, ethyldichlorosilane. (21). Diethyl (sulfuric) ether. (22). Hydrogen, water gas. (23). Acetylene, methyldichlorosilane. (24). Hydrogen sulfide. (25). Trichlorosilane. (26). Carbon disulfide.

Pages 182-184.

Appendix 3.

Form UOD-5.

Questionnaire No:.

For order _____

(designation and top of the ordered analyzer of liquid or gas).

Position No _____ Specification No _____.

Questionnaire is technical and juridical document for the order of the instruments of series production, signs by the leader of an enterprise-customer it is completed by press/printing.

Two samples of questionnaire are directed to supplier, Copy is stored in customer and in an organization-compiler of specification.

On all questions are given the accurate and being all-inclusive responses/answers. With imprecise and incomplete filling of questionnaire or nonobservance of the conditions, stipulated in reference materials of manufacturing plant, the order is not

fulfilled.

1. Customer _____

2. Postal and telegraphic address and telephone of customer

_____

_____

3. Quantity of instruments (assemblies), that are subject to preparation/manufacture according to present questionnaire

_____

4. Analyzed component (or sum of blending agents

_____

5. Process of production (and its periodicity), technological point of gas bleed or liquid to analysis _____

_____

6. Normal concentration (in o/o by space, mg/l, g/m^3, pH, sym/cm, units of optimum density, etc.) of analyzed component (or sum of components, its oscillation/vibration and periodicity of extreme values, change in concentration of analyzed component (smooth, intermittent _____

_____

7. Dial face with indication of dimensionality _____

8. Full/total/complete composition of mixture (with indication of dimensionality), involving microcontaminants and possible oscillations/vibrations of concentration of immeasurable components (for multicomponent mixture it is indicated average/mean composition and limits of change in each component); capability of mixture for skinning _____

_____

9. Viscosity/ductility/toughness of medium (poise), density (kg/m^3) _____

10. Humidity of gas (to gas admix) with indication of dimensionality _____

11. Gas content in liquid _____

12. Mechanical impurities (dust, resin, oil and others in analyzed mixture, their character and content (with indication of dimensionality). Presence of the bubbles of gas and air in liquid

_____

_____

13. Absolute pressure of mixture and its oscillation/vibration in place of selection _____ kg/cm².

14. Absolute pressure of mixture at input into instrument _____ kg/cm².

15. Temperature of mixture and its oscillation/vibration in place of selection _____ of °C.

16. Temperature of mixture at input into instrument, _____ °C.

17. Temperature, pressure and humidity of surrounding air in site of installation of sensor and their oscillation/vibration.

_____

18. direction of mixture after analyzer (in the atmosphere, into container with pressure P=, return into technological line with drop/jump in pressure between point of selection and place of discharge/break ΔP=) _____

_____

19. Composition environments in site of installation of sensor

_____

20. Mode of operation of analyzer (periodic or uninterrupted effect/action, interchangeability of work, stationary or transferable) _____

_____

21. Parameters of power line (voltage, frequency, pressure of compressed air and others and their oscillation/vibration _____

_____

22. Distance between sensor and secondary instrument on path of cable laying _____

23. Distance between sensor and place of selection of mixture on path of pipe laying _____

24. Presence of auxilople (cleansing, that cool, that reduce and others for analyzed mixture in place of selection _____

_____

_____

25. Category and group of explosion hazard of mixture and class of room in site of installation of sensor, secondary instrument,

power supply unit _____

_____

_____

26. Character of output sensor signal and its parameters (it is filled with delivery of sensor witnout secondary instrument) _____

_____

27. Type of sensor (flowing, immersion, float) _____

_____

28. Model (modification and necessary quantity of secondary instruments to one sensor _____

_____

29. Additional devices for assembly of instrument (cooler, pressure reducer, filter, stimulus of expenditure/consumption, etc.)

_____

_____piece.

(type) (quantity).

30. presence near instrumentation of electromagnetic fields with indication of voltage of field _____

_____

31. performance _____

32. Additional information about specificity of conditions of operation of device (what metals are not admitted in contact with analyzed medium; fitness or sensor for check and adjustment of readings, etc.) _____

_____

33. Designation of organization, which filled questionnaire, office and surname of compiler, his official address, telephone

_____

_____

_____

the signature of the leader of enterprise

_____

"___" _____ 19___ g.

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