1 DESIGNATION

1.1 Reference Instrument УКП-5 (further as Instrument) is designed to check self-contained oxygen breathing apparatus (further as respirator) and its components.

1.2 The Instrument can cheek the following parameters of a respirator:

– airway system air-tightness with positive pressure and with vacuum gauge pressure;

– the reducer assembly steady feed of oxygen;

– the relief valve opening pressure;

– vacuum-gauge pressure of the lung-governed valve opening;

– vacuum-gauge pressure at which lung-governed valve controls a designed feed of oxygen;

– feed of oxygen by the by-pass valve.

The Instrument can cheek the following parameters of respirator components:

– feed of oxygen by by-pass and lung-governed valves;

– air tightness of the regenerative cartridge and cooler;

– the relief valve opening pressure of the reducer assembly.

1.3 Instrument is designed to be used under the following conditions:

– in ambient air temperatures of 10 to 40 °C;

– in relative humidity of 30 to 80 %;

– at atmospheric pressure of 760 to 1040 hPa (of 570 to 780 mm Hg);

– upright position only.

2 TECHNICAL DATA

2.1 Upper limit of measured positive and vacuum-gauge pressure, Pa 1000

2.2 Scale division value of the pressure gauge, Pa 10

2.3 Pressure gauge accuracy rating, Pa 2,5

2.4 Pressure gauge sensitivity threshold, Pa, less than 5

2.5 Feed of oxygen, measured with flowmeter, 1/min, within the limits 0,6 to 2,0

2.6 Flowmeter accuracy rating	4.0
2.7 Air consumption, measured with flow tube, 1/min:	
– upper float	10
– lower float	60, 70, 90; 100; 150
2.8 Limit tolerance of the flow tube, deviation from data-sheet value,%	±10
2.9 Maximum discharging and suction flow of the ejector, 1/min, more than	150
2.10 Maximum positive and vacuum-gauge pressure of the elector, Pa, more than	5880
2.11 Oxygen cylinder capacity at a pressure of 20 MPa	400
2.12 Dimensions, mm	450x250x198
2.13 Weight of the fully charged Instrument, kg, max:	14

3 CONSTRUCTION AND PERFORMANCE

3.1 General construction

3.1.1 Instrument consists of pressure gauge-flowmeter and flow tube designed to cheek the parameters of a respirator. The Instrument also includes the system designed to produce an air flow by the ejection of the compressed oxygen. The system comprises a cylinder with a cylinder valve, reducer assembly, high pressure tube, oxygen pressure gauge, ejector and ejector cock.

3.1.2 The Instrument units ire housed in, a rectangular metal casing with a handle 10 (see Fig. 1). The right wall of the casing has openings for the handwheel of the cylinder valve and a pipe connection of the pressure gauge-flowmeter. The left wall has the collector pipe connection 5 for coupling a respirator with the Instrument tube pipe connection 4, designed for connection with a respirator feed-gear. All three pipe connections are plugged when not in use.

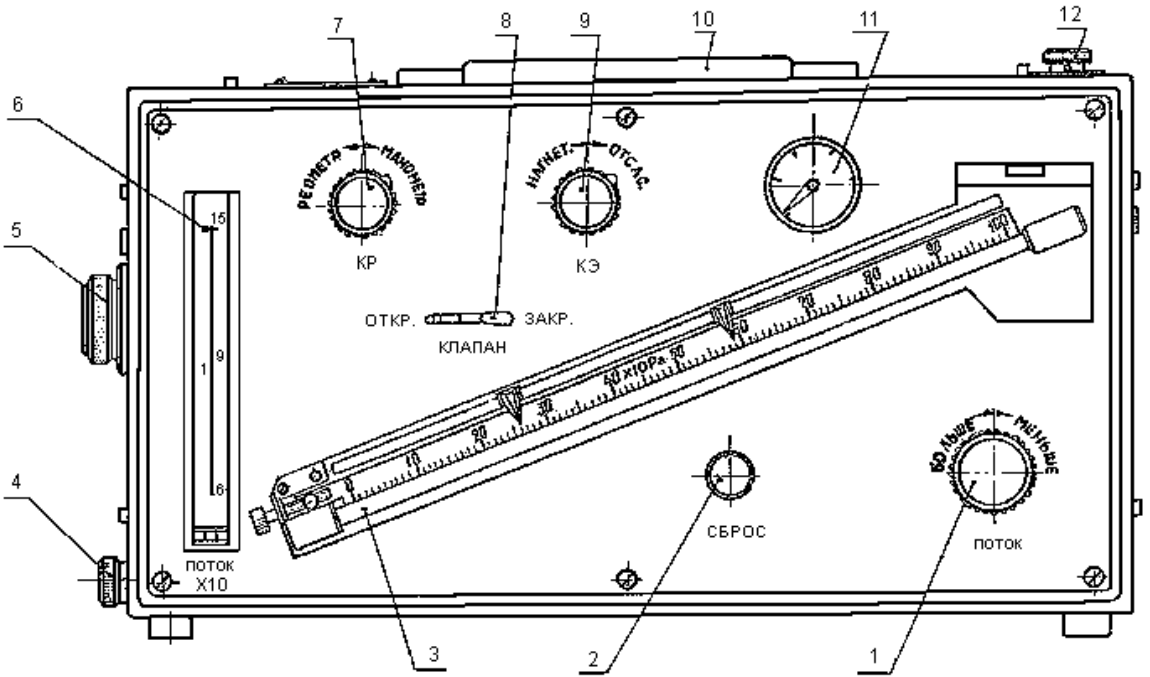

Fig. 1. The face panel (with a cover removed):

1 – handwheel of the reducer valve; 2 – handwheel of the relief valve; 3 – pressure gauge-flowmeter; 4 – flaw tube pipe connection; 5 – collector pipe connection; 6 – flow tube; 7 – handwheel of the flow tape-cock; 8 – valve lever head; 9 – hand-wheel of the ejector cock; 10 – handle; 11 – oxygen pressure gauge; 12 – adjusting

The face panel bears pressure gauge-flowmeter 3, valve lever head 8 and handwheels of:

1– reducer assembly;

2– relief valve;

7 – flowmeter cock;

9 – distributor cock.

There are also holes for the flow tube 6 and oxygen pressure-gauge 11. The face panel is protected by a cover when not in use.

There is a pressure gauge-flowmeter adjusting head 12 on the top of the casing.

The casing (Fig. 2) holds two liter capacity oxygen cylinder 15, reducer assembly 16, ejector 17, top and bottom tanks 19 and 13 of the pressure gauge-flowmeter, pipe connection 10 of the pressure gauge-flowmeter, oxygen pressure gauge 11, distributor with pressure gauge cook 20 and ejector cock 21, valve 22, flowmeter cock 24 with dosing pipe connection 23, collector 25, flow tube 6 and relief valve 14. Almost all units are mounted on the back of the face panel. The airway connections are of rubber high pressure hoses.

There is a back cover to make the access to the main Units inside the casing.

There is a pocket fixed to the inner surface of the back cover for spare parts and accessories.

3.2 Principle of operation

Figs. 3 and 4 show the diagram of the Instrument. Air flow is formed and adjusted by oxygen feed valve 26. Oxygen is supplied from cylinder 15 through reducer assembly 16 to the ejector discharge nozzle 17. The pressure in the cylinder is monitored by oxygen pressure gauge 11 with the valve opened.

Air flow direction (compression onto a system being checked or suction from it) depends upon an ejector cock 2.1 position. If the cock is in the «НАГНЕТАНИЕ» position (Fig. 3), the ejector is sucking in atmospheric air through the headpiece of the ejector 21 cock and compressing air oxygen mixture through the bottommost of the cock, through flow tube 6 and again through the ejector cook (top and bottom parts) into the system being checked, provided that the valve 21 is opened. If the ejector cock is in the «ОТСАСЫВАНИЕ»

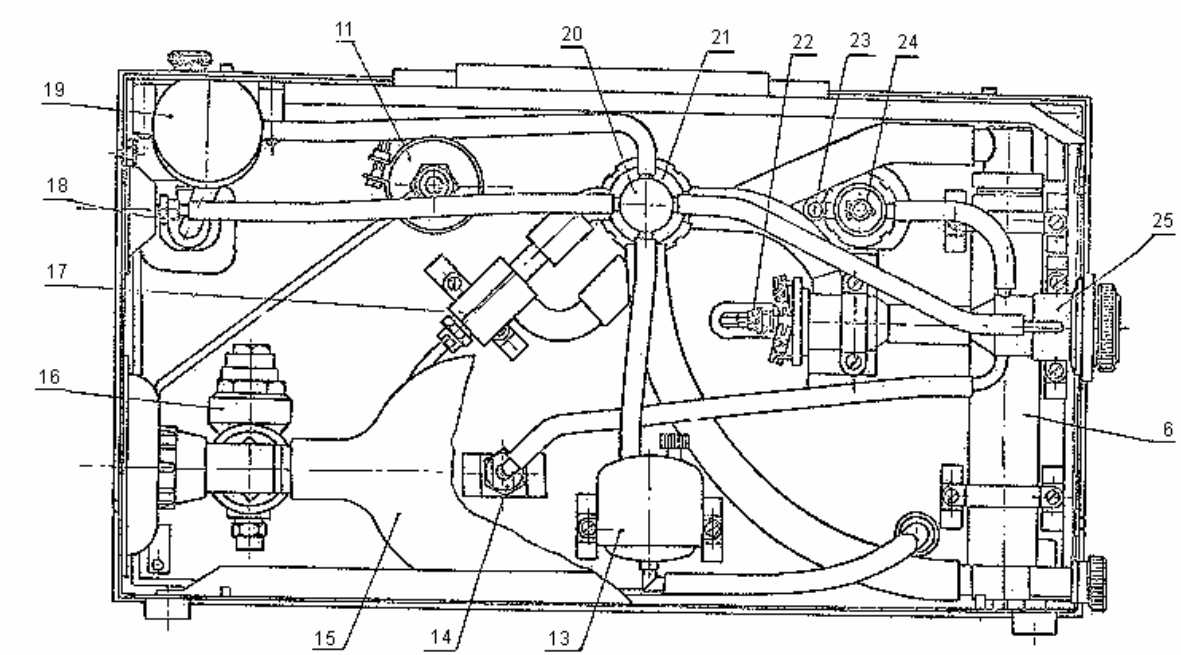

Fig. 2. Back view of the Instrument (without back cover)

6 – flow tube; 11 - oxygen pressure gauge; 13 – bottom tank; 14 – relief valve; 15 – cylinder; 16 – reducer assembly; 17 – ejector; 18 – connection pipe of the pressure gauge-flowmeter; 19 – top tank; 20, 21 – distributor; 22 – valve; 23 – dosing pipe connection; 24 – flow tube cock; 25 – collector.

position (Fig. 4), ejector is sucking a gas-mixture from a system being checked through the valve, bottommost of the ejector cock, flow tube and the ejector cock headpiece. The gas mixture is ejected through the ejector bottommost and headpiece of the cook into the atmosphere; A value of compressed or sucked flow is determined by the flow tube.

Pressure gauge cock 20 is jointed with the ejector cock 21. If ejector cock is in «НАГНЕТАНИЕ» or «ОТСАСЫВАНИЕ» position, pressure gauge-flowmeter3shows positive or vacuum gauge pressure respectively.

While checking the Instrument (with a plugged pipe connection) or respirator airtightness, the latter is fitted to the pipe connection 5, the valve 22 is shut. Relief valve 14 and flow tube cock 24 should be shut during checking. Relief valve is intended for smooth pressure reduction in a tested system up to a specified value.

To check the steady oxygen feed open the flow tube cock, shut the valve and switch the pressure supply cock into position as if the Instrument worked in the compression mode. A pressure drop measured by pressure gauge-flowmeter corresponds to the tabular value of the oxygen flow, which is exhausted into the atmosphere through the flow tube cook and dosing pipe connection

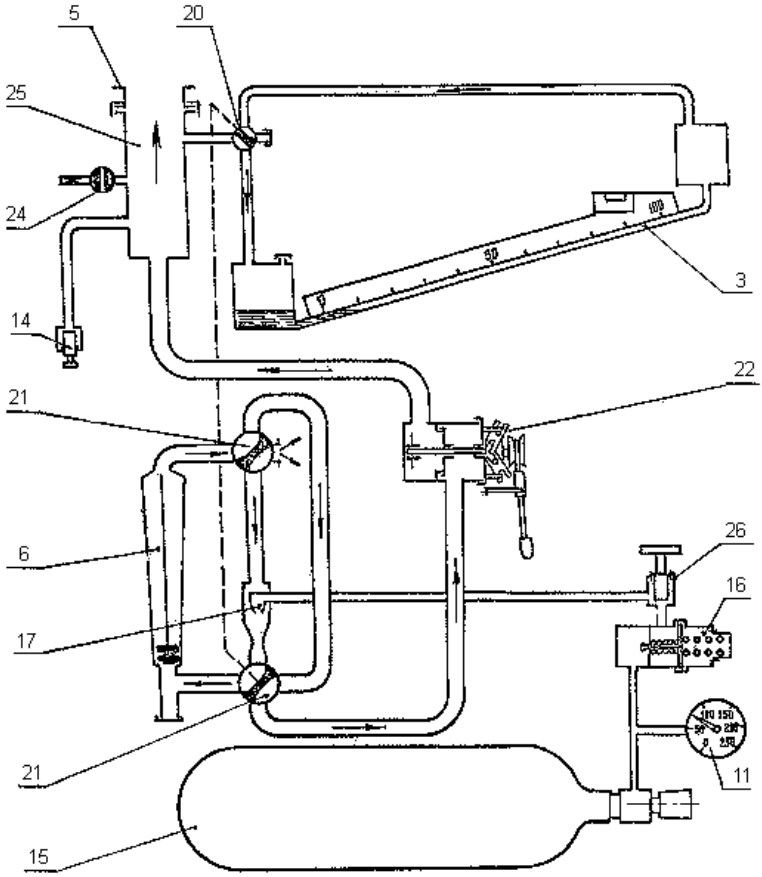

Fig. 3. Diagram of the Instrument (compression)

3 – pressure gauge-flowmeter collector; 6 – flow tube; 11 – relief valve;
15 – cylinder; 16 – reducer assembly; 17 – ejector; 20 – pressure gauge valve;
24 – flow tube; 25 – collector; 26 – reducer assembly valve

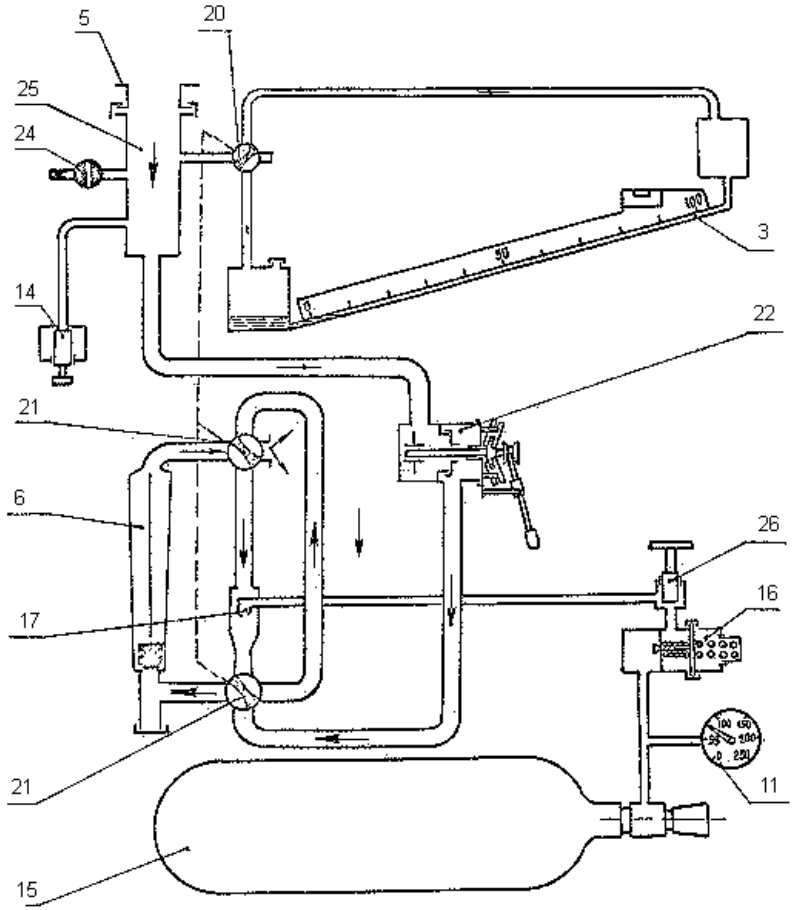

Fig. 4. Diagram of the Instrument (suction)

3 – pressure gauge-flowmeter; 5 – pipe connection of collector;
6 – flow tube; 11 – oxygen pressure gauge; 14 – relief valve;
15 – cylinder; 16 – reducer; 17 – ejector; 20 – pressure gauge cock;
21 – ejector cock; 22 – valve; 24 – flow tube cock; 25 – collector;
26 – reducer valve.

For convenience the scale of the pressure gauge-flowmeter has marks of admissible deviations during performance of a lung-governed valve or relief valve at 100 to 300 Pa and for respirator airtightness test at 750 to 800 Pa.

3.3 Construction and performance of the component parts

3.3.1 Pressure gauge-flowmeter (Fig. 5) is designed to measure positive or vacuum pressure, maximum 1000 Pa and oxygen feed in the range of 0.6 to 2.0 l/min.

Pressure gauge-flowmeter consists of measuring tube 27, scale 28, top 19 and bottom 13 tanks, pressure gauge cock 20, flowmeter cock 24 and dosing pipe connection 23, coupled with each other and with the Instrument collector by rubber hoses.

Pressure gauge cock is designed to switch pressure gauge-flowmeter to measure either positive or vacuum pressure. Depending on the cook position one tank of the pressure gauge-flowmeter is coupled with the collector, and the other with a plug through pipe connection 18 is opened to ambient atmosphere.

Flowmeter cock switches pressure gauge-flowmeter to measure either pressure or oxygen consumption. If the flowmeter cock is opened, oxygen fed to the collector past s through the cook and dosing pipe connection 23 into the ambient atmosphere. If pipe connection 18 is opened and pressure gauge cock is in such position as during positive pressure measurement, pressure gauge-flowmeter displays a pressure drop at the inlet and outlet of the pipe connection in Pa.

Oxygen consumption displayed by pressure gauge-flowmeter is read on the Instrument diagram in 1/min. The measuring tube and the scale of the pressure gauge-flowmeter are fixed to a lever with level 32 and adjusting head 33, which helps to adjust the proper angle of the tube. The scale of the pressure gauge-flowmeter has a screw 30, which can shift it along the flowmeter tube and two pointers 29 for marking admissible deviations while measuring oxygen consumption. The bottom tank has pipe connection 31, designed to fill the pressure gauge-flowmeter with pumping liquid.

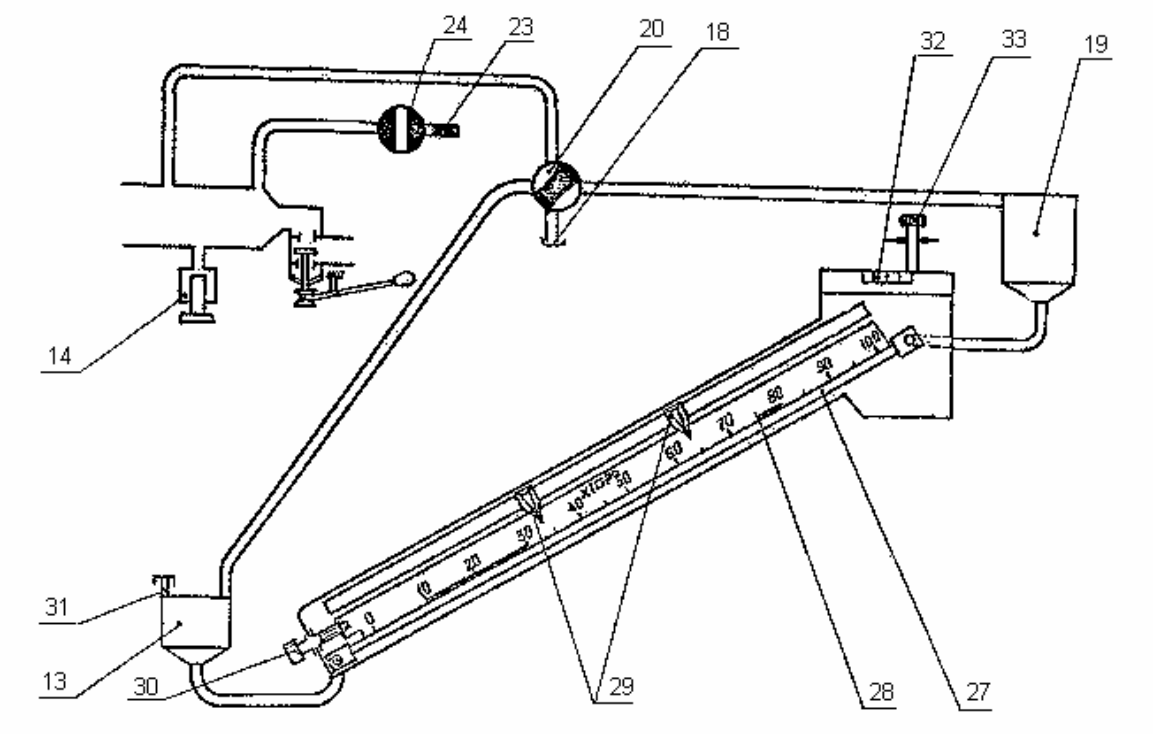

Fig. 5. Block-diagram of the pressure gauge-flowmeter:

13 – bottom tank; 14 – relief valve; 18 – pipe connection of pressure gauge-flowmeter; 19 – top tank; 20 – flow tube cock; 23 – dosing pipe connection; 24 – flow tube cock; 27 – measuring tube; 28 – scale; 29 – pointer; 30 – adjusting screw; 31 – pipe connection; 32 – level; 33 – adjusting head.

3.3.2 Flow tube (Fig. 6) is designed to monitor gas flow from ejector or oxygen feed system of a respirator being tested.

Rotameter type flow tube comprises tube 35, two floats: upper float 36 (of black colour), and lower float 37 (of red colour) moving along the axial carrier in the tube; and two branch pipes: top 34 and bottom 38. The bottom branch pipe is T-joint, one of the branches of which serves as a pipe connection 4, to which a respirator feed-gear is connected. While checking a respirator as an assembly the pipe connection is plugged.

The surface of the measuring tube bears a straight line and rives marks corresponding to predetermined consumption values. If the up-per(black) float reaches the black mark 1, it means that consumption is 10 1/min; if the lower (red) float reaches the red marks 6, 7, 9, 10 and 15, it means that consumption is 60, 79, 90,100 and 150 1/min. correspondingly.

3.3.3 Reducer assembly (Fig. 7) is designed to reduce unsteady high pressure oxygen flow from cylinder to a steady oxygen flow 1.2 MPa in an ejector. The Instrument employs a diaphragm type reversible reducer (valve is pressed by oxygen flow).

Reducer comprises a reducer valve 45 fixed by screw in a body 44 seat, diaphragm 46, cap 48, spring 49, two plates: pressure plate 47 and centre plate 50, adjusting screw 51, lockscrew 52. Reducer has safety valve 55 and discharge valve with a stem 39, pipe connection 42, gland nut 43 and packing ring 40.

Reducer body has a foot 54 with a coupling nut 53 for a cylinder connection, outlet pipe connection 56 for an ejector connection and pipe connection 57 for an oxygen pressure gauge connection. Male thread of a pipe connection 42 and lock-nut 41 are intended to fix the reducer assembly to the Instrument panel.

Discharge valve stem is brought out to the face panel and 13 controlled by a handwheel 1. While rotating the handwheel counterclockwise the stem is being screwed out, the valve is being withdrawn from the seating thus oxygen feed of the ejector is enhanced. Rotation the handwheel clockwise oxygen feed is reduced.

3.3.4 The valve (Fig. 8) cuts off the ejector from a system being tested and makes it airtight during measurements being performed by pressure gauge-flowmeter.

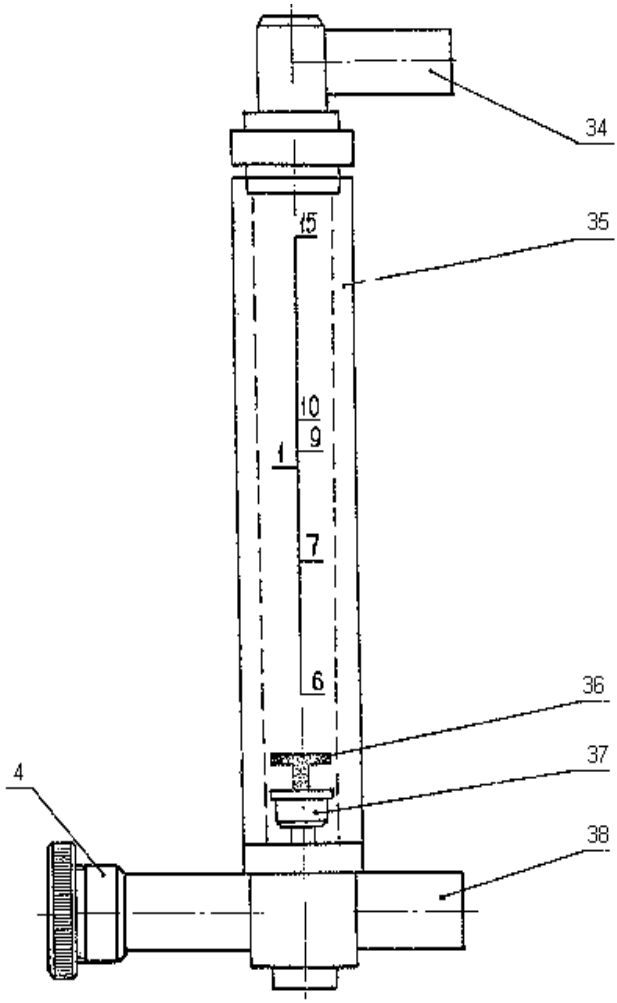

Fig. 6. Flow tube:

4 – pipe connection; 34 – top branch pipe; 35 – tube; 36 – upper float; 37 – lower float; 38 – bottom branch pipe

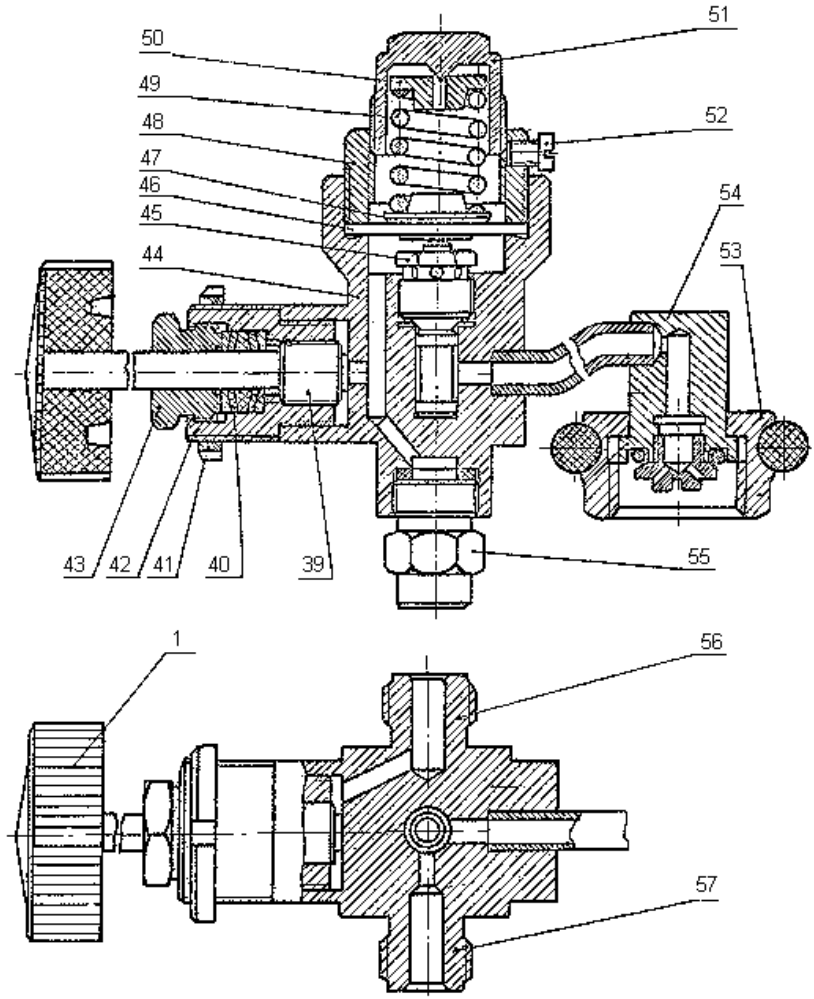

Fig. 7. Reducer assembly:

1 – handwheel; 39 – stem; 40 – packing ring; 41 – lock-nut; 42 – pipe connection; 43 – gland nut; 44 – body; 45 – reducer valve; 46 – diaphragm; 47 – pressure plate; 48 – cap; 49 – spring; 50 – centre plate; 51 – adjusting screw; 52 – lock-screw; 53 – nut; 54 – foot; 55 – safety valve; 56 – outlet pipe connection; 57 – pipe connection

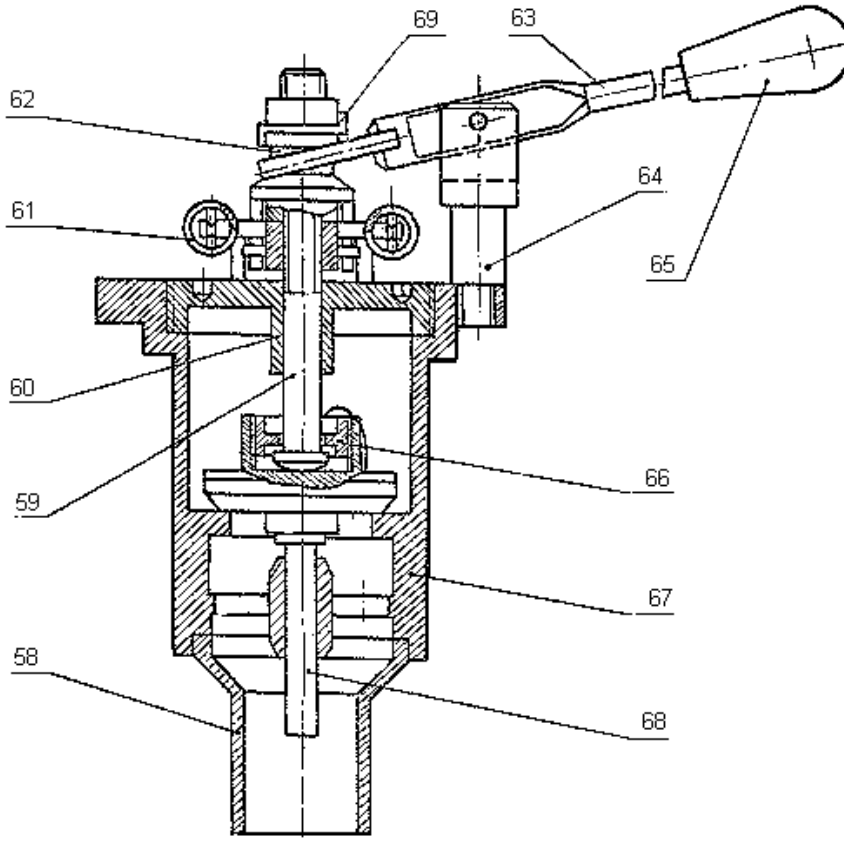

Fig. 8. Valve

58 – pipe connection; 59 – stem; 60 – guide; 61 – switching device; 62 – nut; 63 – lever; 64 – fixed member; 65 – lever head; 66 – bushing; 67 – body; 68 – valve; 69 – lock washer

The valve consists of body 67 with pipe connection 58 and bleed; valve 68 is connected with the stem 59 and bushing 66 and screwed to the stem switching device 61, fixing the valve in opened or closed position. Lever 63 moves the stem along the guide 60. It is clamped by the fixed member 64 on the valve body. The lever controls the stem through the nut 62, which together with switching device is fixed to the stem by lock washer 69 in position which ensures equivalent angles with the valve opened and closed. If the lever head moves rightward the stem shifts leftward and presses the valve to the seating; if the lever head moves leftward, the stem withdraws the valve from the seating through the bushing 66.

3.3.5 The distributor (Fig. 9) is an embodiment of two cocks: ejector cock and pressure gauge cock. Distributor comprises body 76 and a plug 75 with two stems. The upper bears the handwheel 9, and the lower spring 73, thus they hold the plug in the body with washers 72 and 81 and cotter pin 84. The handwheel is damped to the stem by a screw 78 and a spring 79, rotation angle of the plug is limited by pins 77. There are ten radial openings forming three tiers. Opening A admits the ambient air in and the other openings have tubes soldered in: five tubes 80 (in the two upper tiers) are of larger diameter and four tubes 87 are of smaller diameter (in the lowest tier).

The upper portion of the distributor acts as an ejector cock. Tubes 80 couple inlet and outlet ejector orifices, upper and lower pipe connection of the flow tube end the valve (see Figs 3 and 4).

The lower part is a pressure gauge cook. The tubes 87 couple the top and bottom tanks of the pressure gauge-flowmeter collector and outlet pipe connection of the pressure gauge-flowmeter.

The top body edge has male thread intended for mounting of the cock to the Instrument panel (with subsequent fixing by a rotating ring).

If the handwheel is in «НАГНЕТАНИЕ» position the ejector compresses the air into the system which is coupled with the bottom tank of the pressure gauge-flowmeter, then pressure gauge measures positive pressure.

If the handwheel is in «ОТСАСЫВАНИЕ» position the ejector sucks air from the system which is coupled with the top tank of the pressure gauge-flowmeter, indicating vacuum gauge pressure.

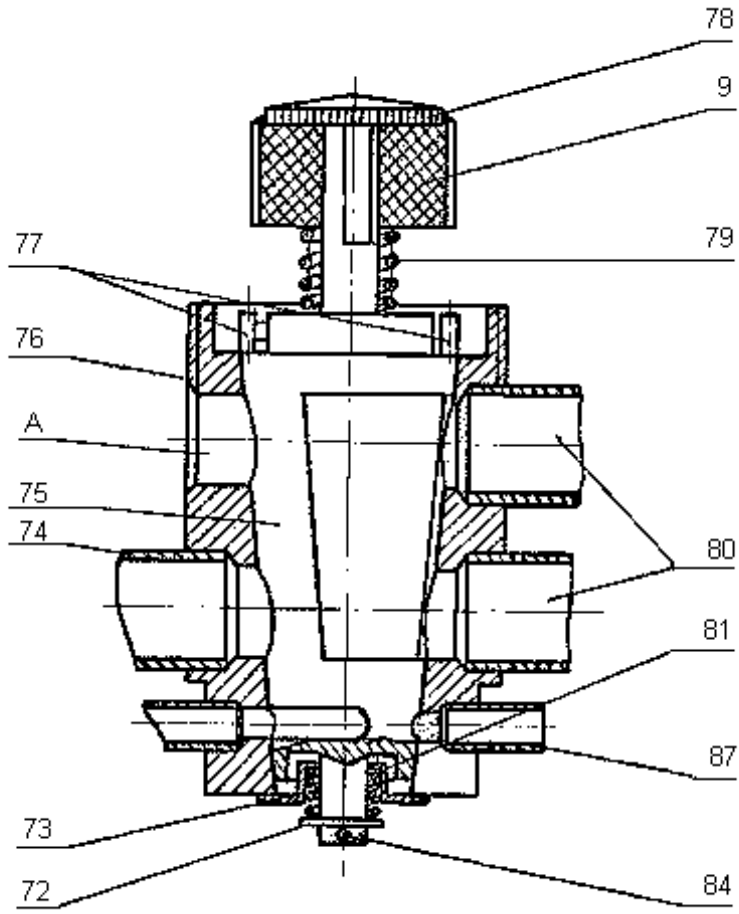

Fig. 9. Distributor:

9 – handwheel; 73,79 – springs; 72 – washer; 74, 80 – pipes; 75 – plug; 76 – cock body; 77 – pin; 7 8 – screw; 81 – washer; 84 – cotter pin; 87 – branch pipe; A – opening

4 OPERATING INSTRUCTIONS

4.1 Putting into operation

Before putting the Instrument into operation make visual inspection, check the spare parts availability according to section 2 of the Instrument certificate.

4.1.2 Place the Instrument horizontally and remove the front cover. For that purpose press the bottom lock buttons on the side walls of the Instrument With your forefingers, push the bottom part of the cover toward yourself and jerk it upward.

4.1.3 Remove the back cover. For that purpose press the upper look buttons on the side walls with your forefingers, push the top part of the cover toward yourself and jerk it. Make an inspection of the Instrument; make sure in its good working condition and availability of the accessories.

4.1.4 Open the bracing band lock of the oxygen cylinder , unscrew the coupling nut, remove the cylinder, charge it with medically pure oxygen to a pressure of (20±1) MPa and then replace the cylinder into the Instrument.

4.1.5 Place the lever «КЛАПАН» into «ЗАКР.» position, rotate the handwheel «ПОТОК» into «МЕНЬШЕ» direction against the stop, open the cylinder valve and read the pressure from the oxygen pressure gauge.

4.1.6 Cheek the airtightness of the Instrument oxygen-feeder (oxygen cylinder-reducer assembly-oxygen pressure gauge).

Rotate the handwheel «ПОТОК» into «МЕНЬШЕ» position against the stop, open the cylinder Valve and read the pressure gauge.

If the pressure drop is less than 5 MPa per minute, the system is airtight.

If the oxygen-feeder is not airtight, detect a leakage with a smoldering wick and correct it.

4.1.7 Cheek the working condition of the Instrument ejector. Remove the plug out of the collector pipe connection, switch into «КЛАПАН» lever into «ОТКР.» position, КР handwheel into «МАНОМЕТР» position, КЭ handwheel into «НАГНЕТ.» position, rotate handwheel «ПОТОК» into «МЕНЬШЕ» direction against a stop. Open the cylinder valve and rotating the handwheel in the «БОЛЬШЕ» direction produce air flows in such a consequence that the flow tube

floats reach the following marks on the scale:

– the upper (black)float – mark 1;

– the lower(red) float – marks 6, 9, 10 and 15.

The float position against every mark should be stable.

Rotate the КЭ handwheel into «ОТСАС.» position and check the Instrument in suction mode following the above mentioned procedure.

Adjust the tube of pressure gauge-flowmeter according to the level, i.e. place the level air bubble between the two centre marks by rotation of the adjusting head.

Open the pipe connection of the pressure gauge-flowmeter (unscrew the plug), put off the pipe connection plug of the bottom tank and fill working fluid into pressure gauge-flowmeter with a rubber vessel. The fluid must reach a zero mark while the level bubble should be in the centre level position. Pressure gauge-flowmeter is filled in with ethyl alcohol with density (0.85±0.005) g/cm3 at temperature of 20 oC. Density and volume fraction values at temperatures from 10 to 40 oC are enlisted in a Table (see supplement 1).

There should be adequate spaces between the extreme end of the tube and marks (00 and 100) while filling in liquid into the pressure gauge-flowmeter. The final adjustment of the zero mark is performed by scale shifting with the help of the screw. Plug pipe connection of the bottom tank.

4.1.10 Plug the collector pipe connection and check the tightness of the pressure gauge-flowmeter. For that purpose place the lever «КЛАПАН» into the «ОТКР.» position, КР handwheel cock into «МАНОМЕТР» position and КЭ handwheel into «НАГНЕТ.» position.

«ПОТОК» handwheel should be rotated into «МЕНЬШЕ» direction against a stop while pipe connection of the pressure gauge-flowmeter should be opened.

Open the cylinder valve and by rotating «ПОТОК» handwheel smoothly in «БОЛЬШЕ» direction increase the pressure in the system being tested up to 1000 Pa and switch the «КЛАПАН» lever into «ЗАКР» position rapidly. If a pressure is higher than specified reduce it by the relief valve.

Rotate the «ПОТОК» handwheel in «МЕНЬШЕ» direction against a stop and control the liquid level in the tube of pressure gauge-flowmeter.

If liquid level in the tube does not excess over 5 Pa per 1 minute, the system being checked is airtight.

4.1.11 Having completed the check, close the cylinder valve, switch «КЛАПАН» lever into «ОТКР.» position and by rotation of the «ПОТОК» handwheel in «БОЛЬШЕ» direction release oxygen from high pressure system (control the oxygen pressure gauge) and then rotate the handwheel in «МЕНЬШЕ» direction against a stop. Switch КР handwheel into «МАНОМЕТР» position. Plug the pipe connections of the collector, flow tube and pressure gauge. Check the Instrument complete set, put all the accessories into a pocket on the back cover, replace both covers, push in the handwheel of the cylinder shut-off valve.

4.2 Application

4.2.1 Apply pressure gauge-flowmeter at constant ambient air temperature. Tolerable rate of temperature change while measuring should not exceed ±0.5 oC per hour.

4.2.2 While checking a respirator or its components connected to the collector pipe connection, pipe connection of the flow tube should be plugged.

4.2.3 Pipe connection of the pressure gauge-flowmeter should be opened only while measuring pressure up to ±1000 Pa or with oxygen feed not more than 2 l/min. Otherwise pipe connection should be plugged.

4.2.4 Flowmeter cock should be opened only while measuring oxygen flow with flowmeter, otherwise it should be closed.

4.2.5 Cylinder valve is being opened the «ПОТОК» handwheel should be rotated in «МЕНЬШЕ» direction against a stop. If the cylinder valve is opened, expand the flow by smooth rotation of the handwheel in «БОЛЬШЕ» direction.

4.2.6 To compress air into a system being checked, switch «КЛАПАН» lever into «ОТКР.» position., КР handwheel into «МАНОМЕТР» position, КЗ handwheel into «НАГНЕТ.» position, «ПОТОК» hand-wheel rotate in «МЕНЬШЕ» direction against a stop. Open the cylinder valve and expand a flow to a predetermined value by rotation of the handwheel in «БОЛЬШЕ» direction. While, the system is being filled read the pressure gauge.

4.2.7 To suck air from a system switch «КЛАПАН» lever into «ОТКР.» position, КР handwheel into «МАНОМЕТР» position КЭ handwheel into «ОТСАС.» position, rotate «ПОТОК» handwheel in «МЕНЬШЕ» direction against a stop. Open the cylinder valve and expand a flow to a predetermined value by rotation in «БОЛЬШЕ» direction, read the pressure gauge during the procedure.

4.2.8 Но measure oxygen consumption by the flowmeter switch the «КЛАПАН» lever to «ЗАКР» position, КР handwheel to «РЕОМЕТР» position, КР handwheel to «НАГНЕТ.» position, rotate the «ПОТОК» handwheel in «МЕНЬШЕ» direction against a stop.

Measure oxygen consumption. The values measured by the flowmeter in pascals reduce to normal conditions by division into β coefficient, which corrects for change in flowmeter readings depending upon temperature and pressure. According to the Instrument diagram define oxygen consumption corresponding to defined pressure drop value. Coefficient β is derived from the formula:

$$\beta = \alpha \cdot k \qquad (1)$$

where α – coefficient corresponding for temperature influence upon working fluid state in flowmeter (see supplement 2);

k – coefficient correcting for temperature and pressure influence upon a gas State measured by the flowmeter

$$k = \frac{1013 \cdot (273 + t)}{293 \cdot (B + H)}, \qquad (2)$$

where t – inside temperature, ^{o}C;

B – atmospheric pressure, hPa;

H – flowmeter readings, hPa.

To compare the measured oxygen consumption with predetermined one, according to the diagram, define a pressure drop, which corresponds to the measured consumption, multiply it by β coefficient defined for temperature and pressure of the location and then place the pointer to a corresponding mark. While measuring the consumption, fluid meniscus should be against the pointer.

4.2.9 To determine controls position on the Instrument face use Table 1.

Table 1

Type of operation	***Controls position on the face panel***			
	КЛАПАН	***КР***	***КЭ***	***ПОТОК***
Compression of the air into a system	ОТКР.	МАНОМЕТР	НАГНЕТ.	БОЛЬШЕ
Suction of the air from a system	ОТКР.	МАНОМЕТР	ОТСАС.	БОЛЬШЕ
Airtightness check: positive pressure vacuum gauge pressure	ЗАКР. ЗАКР.	МАНQМЕТР МАНОМЕТР	НАГНЕТ ОТСАС.	МЕНЬШЕ МЕНЬШЕ
Measuring of consumption by flowmeter	ЗАКР.	РЕОМЕТР	НАГНЕТ.	МЕНЬШЕ
Measuring by flew supplied through flowmeter pipe connection	ЗАКР.	Any	ОТСАС.	МЕНЬШЕ
Suction of air through flowmeter pipe connection	ЗАКР.	Any	ОТСАС.	БОЛЬШЕ
Idle	ОТКР.	МАНОМЕТР	Any	МЕНЬШЕ

5 SAFETY PRECAUTIOUS

5.1 Before getting to work with the Instrument wash your hands with soap and degrease the Instrument.

5.2 Do not allow grease and oil getting in oxygen feed-gear of the Instrument.

5.3 Do net install oxygen cylinder with exhausted storage life.

5.4 Do not atop leakage white the oxygen feed-gear is under pressure.

6 PRESTARTIONG PROCEDURE

6.1 Level the Instrument, remove the front cover and check pressure in oxygen cylinder. If needed raise the pressure up to (20±1) MPa. Check the oxygen feed-gear airtightness.

6.2 Level pressure gauge-flowmeter, unplug pipe connections of collector and pressure gauge flowmeter. Then shift the scale along the tube until zero mark coincides with lower meniscus of liquid. Sop off the liquid level, if needed.

6.3 Prior to testing a respirator connect tae pipe connection with oval flange to collector pipe connection. If it is cumbersome to connect a respirator being tested to the rigidly fixed pipe connection, connect the latter to the Instrument by a flexible tube (available in Spare parts set). Plug the pipe connection outlet. Check the system airtightness as in 4.1.10. Prior to testing a respirator with a mask, the Instrument airtightness should be checked jointly with a hose connecting mask with the Instrument.

6.4 Check the Instrument airtightness jointly with connecting hoses used for testing a respirator or its components.

6.5 Having checked airtightness of the Instrument switch «КЛАПАН» lever into «ОТКР.» position, unplug the hose and connect it to a respirator or its component part being tested.

6.6 Prior to testing a respirator, limit with adjustable pointers on the scale a tolerable changing of regular oxygen feed from a reducer assembly, taking into

account unsteady atmospheric pressure and ambient air temperature.

First, determine flowmeter readings from nomographs, they should adhere to specified consumption tolerances (e.g. 1.3 and 1.5. l/min for steady supply (1.4±0.1 l/min). On every nomograph locate intersection coordinate point of indoor temperature and atmospheric pressure and find out pressure drop of a zone in which the point is located (all zones are diagonally arranged). Set the scale pointers of pressure gauge flowmeter against known pressure drop values.

6.7 Provided that the Instrument is used in the same climatic conditions it is allowed to check steady oxygen feed with one and the same position of the scale pointers of the pressure gauge-flowmeter. In such a case annual minimum and maximum temperatures and atmospheric pressure should be known beforehand. Find out pressure drop from nomograph at maximum temperature and of minimum pressure for lower limit of steady oxygen feed, and from the upper limit nomograph find out pressure drop at minimum temperature and at maximum pressure. Subsequently place the pointers against the corresponding scale marks of the flowmeter then fix them or note the found values on the nomograph.

The limited zone of the flowmeter readings somewhat restricts admissible deviation of the steady oxygen feed from the predetermined values and makes a daily routine (temperature and pressure measurements, nomographs usage, applications of corrections) excluded.

7 PERFORMANCE AMD METHOD OF OPERATION

7.1 Checking of the respirator assembly.

7.1.1 During checking procedure of a respirator use its Specifications and Operating Instructions. Checking of a respirator should be in the outlined sequence.

7.1.2 The respirator checking procedure should be started with checking it for leak-tightness under positive pressure.

Switch the КР flywheel into «МАНОМЕТР» position, КЭ flywheel into «НАГНЕТ.» position, «КЛАПАН» lever into «ОТКР.» position, «ПОТОК»

flywheel rotate in «БОЛЬШЕ» direction against a atop, open the cylinder valve and by rotation of the "ПОТОК " flywheel in «МЕНЬШЕ» direction develop a positive pressure in the apparatus. Make a swift switch of the «КЛАПАН» lever into «ЗАКР.» position, next rotate the «ПОТОК» flywheel into «МЕНЬШЕ» direction against a stop. If positive pressure is too high, release the excess pressure either through the flowmeter cock or through the relief valve. Measure a tightness level of the system by speed of pressure changing in it.

7.1.3 Check the steady oxygen feed value. Switch КР flywheel into «РЕОМЕТР» position and watch the liquid meniscus in the measuring tube to be in the zone limited by pointers.

7.1.4 Check the relief valve opening pressure. Switch КР flywheel into "МАНОМЕТР" position. Watch over the pressure gaugeflowmeter readings.

7.1.5 Check the opening pressure of the lung-governed valve. Switch «КЛАПАН» lever into «ОТКР.» position, and КЭ flywheel into «ОТСАС.» position. Adjust the air suction rate at 10 1/min. and watch over the pressure gauge-flowmeter readings.

7.1.6 Check a respirator leak tightness under vacuum gauge pressure.

Make the air suction, as in 7.1.5, to a given value and switch «КЛАПАН» lever swiftly into «ЗАКР.» position, then rotate «ПОТОК» flywheel in «МЕНЬШЕ» direction against a stop. If needed adjust the pressure by the relief valve and evaluate the level of the respirator leak tightness.

7.7.7 Check the oxygen flow rate of the lung-governed valve. Make the air suction, as in 7.1.5. from the breathing apparatus circuits. Increase a flow rate of the air being sucked to a given value, by the flow tube readings and pressure in the circuits by pressure gauge-flowmeter readings.

7.7.8 Check the by-pass valve oxygen supply.

The face panel controls positions should be as in 7.1.5. Pipe connection of pressure gauge-flowmeter should be plugged, and «ПОТОК» flywheel should rest in «МЕНЬШЕ» position. Push the by-pass valve button and observe the flow tube to determine the flow rate.

7.2 Respirator components check

7.2.1 Checking of the lung-governed oxygen supply or that of a by-pass devorced from breathing apparatus.

Connect an oxygen feed-gear and a cylinder to the pipe connection of the flow tube. Switch K3 flywheel into «OTCAC.» position, valve lever into «3AKP.» position, and «ПОТОК» flywheel rotate in «МЕНЬШЕ» direction against a stop.

To check the by-pass valve of oxygen supply push the valve button and observe the flow tube to determine the oxygen flow rate. To check the lung-governed Valve rotate «ПОТОК» flywheel in «БОЛЬШЕ» direction while cylinder valves of the Instrument and the respirator are opened, and develop an oxygen flow (according to flow tube) adequate to the lung-governed valve supply of a tested respirator. If you fail to develop a specified flow by having rotated «ПОТОК» flywheel in «БОЛЬШЕ» direction against a stop, it means that lung-governed valve does not provide the Instrument with the specified oxygen supply.

7.2.2. Checking the respirator gas circuit component parts for leak tightness.

Make a component part of a respirator and the collector pipe connection with the branch pipe. Teak tightness check of component parts is adequate to check of respirator leak tightness (see 7.1.2).

8 TROUBLE SHOOTING

Table 8

Fault	***Cause***	***Remedy***
1. Instrument leaks under excessive pres sure	The feed-gear connections are not tight	Examine the connections and tighten the coupling nuts. Examine the gaskets and replace them if necessary
	Cylinder valve joint with the reducer assembly foot is loose	Disconnect the cylinder from the Instrument examine the rubber packing ring and replace it if necessary
	Reducer assembly is mat leak tight	Dismantle the reducer assembly chamber and tighten the valve by screwing it. If it's of no help, replace the valve
	The reducer discharge valve is not leak tight	Replace the valve insert
2. Pressure gauge flowmeter is not leak tight	The connection device nuts are not tight, the oval pipe connection and pipe connection of the pressure-flowmeter bottom tank are not properly plugged	Examine the gasket and tighten the coupling nuts, plug the oval pip connection and bottom tank pip connection tightly. Replace the gasket, ring or nut if necessary
	Shut-off valve is not leak tight	Dismantle the valve and examine it, adjust the switching device position on the valve stem, as in 9.5., if necessary. Grind in the seating or replace the valve
	Pressure gauge cock is not leak tight	Dismantle and examine the pressure gauge cock, grind in and lubricate it if necessary

Table 8 continued

Fault	*Cause*	*Remedy*
	Flowmeter cock is not leak tight	Dismantle and examine the distributor cock, grind it if necessary and lubricate it.
	Rubber hoses are loosely connected to the branch pipes or they are damaged	Examine the rubber hoses system, check the joints, remove the damaged hose
3. The liquid is moving slowly along pressure gauge-flowmeter tube	The pressure gauge-flowmeter orifices are chocked	Examine the rubber hoses, glass tube and pressure gauge-flowmeter orifices. Scavenge the orifices or replace the rubber hoses
	The pressure gauge glass tube choked the orifice	Examine the tube position, shift it and free the orifice.

9 MAINTENANCE

9.1 Keep the Instrument off damage, especially glass parts: pressure gauge-flowmeter measuring tube and level vial.

9.2 Control the connecting rubber hoses condition of the Instrument, replace if necessary.

9.3 Control the cocks condition: the distributor cock and the flowmeter cock; do not let the grinding occur, lubricate it twice a year with ЦИАТИМ-221, or ЦИАТИМ-201. Lubricants, prior to it remove a layer of the used lubricant with the alcohol wet wad.

To dismantle the distributor cock (Fig. 9) press the handwheel 9 towards the face panel, compressing the spring 79 and releasing screw 78, unscrew the bolt and take the handwheel and spring off from the stem. Disconnect the cook body from

the face panel (unscrew the stop screw, next the cock body from the seating) and dismantle the cock. Disconnect the flowmeter cock from the reducer assembly in the same manner.

Assembly of the cocks is the reverse of disassembly.

9.4 Mind that the measuring tube of the pressure gauge-flowmeter and the filling liquid be clear.

To remove the pressure gauge-flowmeter tube put the rubber hoses off the bleeds 88 (Fig.10), unscrew the nuts 89, disconnect the pressure gauge-flowmeter, unscrew the nuts 90, disconnect the scale panel 91 from the bleeds and the bleeds from tube 93. It is approved to clean the tube with cotton applied on a wire. The cleaned tube is washed by distilled water, dried or sponged with cotton. Mind not to leave the cotton naps on the inside tube walls.

Control the packing rings 92 availability in bleeds while reassembling. The tube ends should enter the bleed orifices to the same deepness and not block the channels to the top and bottom tanks.

9.5 Check the adjustment of the switching device of the shutoff valve. The valve should be fixed firmly in both positions and ensure leak tightness of the system being checked in «ЗАКР.» position. If the clutch 62 position is properly adjusted (see Fig. 8) on stem 59, there should be a clearance between the guide plane 60 and lever webs of the switching device 61. The clearance is detected with a strip of paper (with the valve shut a strip of paper should enter the clearance loosely).

To adjust the clutch position on the stem the valve lever should be switched into "ОТКР.» position, the clutch look-nut should be slacked and the clutch should be shifted on the thread in the desired direction and subsequently secure it with the look-nut.

9.6 Instrument should be tested by metrology service annually, according to section 10.

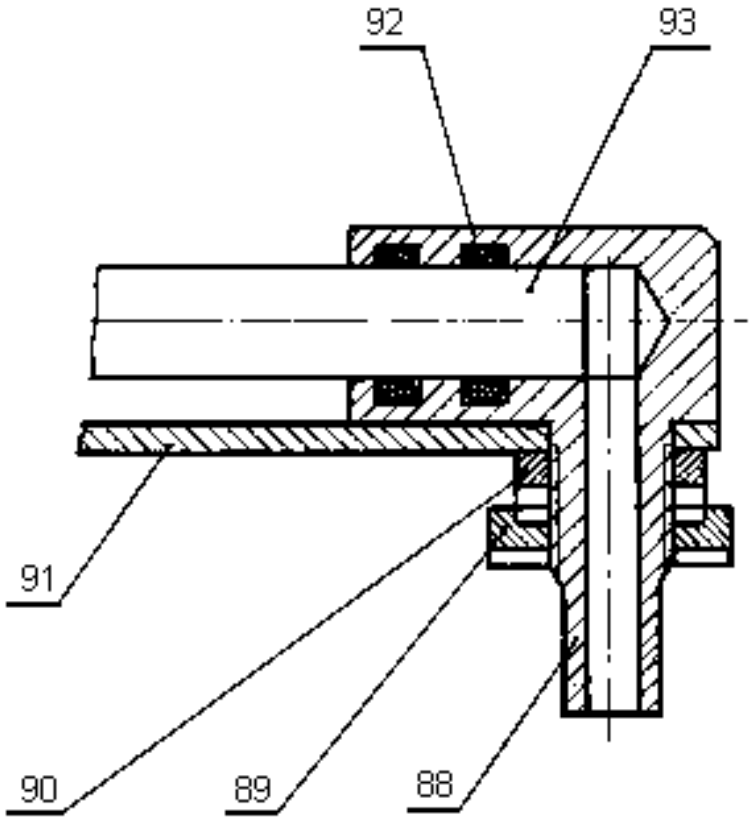

Fig. 10. Pressure gauge-flowmeter (attachment system):

88 – bleed; 09, 90 – nuts; 91 – scale panel; 92 – packing ring; 93 – measuring tube

10 THE INSTRUMENT CALIBRATION

10.1 Types of calibration

Periodic calibration of an Instrument in use or being stored embraces visual inspection and a check for the main error of the pressure gauge, flowmeter and flow-tube. Besides, ejector output and created pressure should be measured after each repair.

10.2 Means of calibration

For calibration use the following:

Oxygen cylinder with a valve;

Domestic barometer БК – 55;

Springy clamp for rubber tubes;

Screw clamp for rubber tubes;

Three – or five-fold magnifier.

Vacuum gauge with accuracy higher than 2.5 and upper limit of the range higher than 6 kPa;

Liquid column micropressure gauge МТВ type, with accuracy 0.06 and upper limit of the range 1600 Pa, other type of micropressure gauge is tolerated with accuracy higher than 0.5 and upper limit of the range higher 1000 Pa;

Special rubber plug No 24 with axial hole and a rigid tube inserted in it, designed for coupling of the rubber tubes: 6x2 and 10x3.

Reducer БКД-25 or an oxygen reducer of other type, which gives an oxygen consumption of 0 to 2.4 1/min., with smooth adjustment of oxygen consumption;

Rotameter of РМ type with the accuracy higher than – 2.5 % and upper limit of range 1.6 cu.m/h of air;

Rotameter of РМ type with accuracy higher than – 2.5 % and upper limit of range 10 cu. m/h of air;

Stopwatch СД Ппр-1-3-000 or a stopwatch of other type with the analogue dial, scale and accuracy is tolerated;

Sprinkler with soft point, type A No 1;

Drum type counter ГСБ-400 with accuracy rating 1.0;

ТЛ 44-А2 or other type of thermometer with the measurement range from 0 to +50 °С and scale factor of 0.1 °С;

T-joint for rubber pipes connection 6x1.5;

Corrugated tube with pipe connection for coupling with the Instrument pipe connection and bleed Ø6 mm, which is located closer than 20 mm from pipe connection at an angle of 90°;

Rubber medical pipe, type 36.0 x 2.0;

Rubber medical pipe, type 310 x 3;

Tube ДКРНМ 6х1 хх or М6х1 Л63.

10.3 Calibration conditions and preparations for 7

10.3.1 While calibrating, observe the following conditions:

While defining the main error of the pressure gauge and flowmeter, the ambient temperature should be (20-5) °С; temperature deviations should be within i 1°С, a temperature drop should not exceed 0.5 °С per hour; pressure change should be within 5 Pa;

The other adjusting is performed at temperatures from 10 to 40 °С.

10.3.2 Preceding the calibration starting, arrange the following:

Actuate the Instrument as in items 6.1 and 6.2.

Insert a rubber plug with a rubber tube into the collector's pipe connection and connect a sprinkler (rubber vessel) to a rubber pipe;

Put the «Клапан»" lever into «ЗАКР.» position, hand-wheel КР into «МАНОМЕТР» position, handwheel КВ into «НАГНЕТ.» position, rotate the ПОТОК handwheel into «МЕНЬШЕ» direction until a stop (pressure gauge-flowmeter pipe connection should be opened);

Create a positive pressure 1000 Pa in the system with a sprinkler, pinch a rubber tube and, observing the meniscus position in the measuring tube, test air-tightness of the pressure gauge-flow-meter system.

The Instrument is considered to be airtight if five minutes of endurance give a pressure drop less than 5 Pa.

10.3.3 Having established the test se^-up to measure an Instrument response, test its airtightness altogether.

10.4 The Test

10.4.1 The test includes visual inspection and performance check, definition of the metrological characteristics and an Instrument's response.

10.4.2 Make visual inspection of the Instrument and make sure that J

The spare parts have no flaws;

The cover locks function smoothly;

The metal parts of the Instrument have coating proof against atmospheric corrosion;

The ejector cocks and reducer handwheels rotate smoothly, the shut-off valve lever switches smoothly and locks easily in both positions;

The measuring tubes of the pressure-gauge-flowmeter are straight and transparent, without flaws which make the reading difficult;

The marks, letters and figures of pressure-gauge, flowmeter and panel scales are well defined;

Adjusting head of the pressure gauge-flowmeter fixes the panel and measuring tube at a specified angle to the horizontal plane (by a level);

The Instrument has a marking table with:

Instrument name: УКП-5;

Serial number of the Instrument;

Accuracy rate: Instrument – 2.5 flowmeter – 4.0;

Year of production.

10.4.3 During the Instrument check, test the ejector unit serviceability.

Create the compressed and sucked off flows to make the flowmeter floats stop in succession against specified marks of the measuring tube: upper (black) float – against the black mark 1; the lower (red) – against the red marks 6, 7, 9, 10 and 15 correspondingly. Every float position against a specified mark should be stable.

10.4.4 The main error is defined by comparison of the pressure gauge readings of the Instrument being tested and readings of the control micro-pressure gauge at positive and vacuum gauge pressure.

10.4.5 To define a pressure gauge error at positive pressure establish the test set-up as shown in Fig. 11. Set the handwheel of KP unit into «МАНОМЕТР» position, КЭ handwheel into «НАГНЕТ» position, and «КЛАПАН» lever into «ЗАКР.» position. The pressure-gauge flowmeter pipe connection should be opened. Then, release clamp 2 and feeding the air into the system through the side orifice of the T-joint 5, create positive pressure in series; 200, 400, 600, 800 and 1000 Pa. The readings are taken from the control micro-pressure gauge. Simultaneously read every created pressure value of the pressure gauge being tested, with the accuracy higher than 2.5 Pa.

Take the readings twice: while boosting the pressure and while releasing it. The error and difference of readings between boosting values and releasing values should be within 25 Pa.

10.4.6 To define a pressure gauge error at vacuum-gauge pressure switch the micro-pressure gauge (see Fig. 11) to vacuum-gauge pressure position. If controls of an Instrument being tested are in such positions as described in item 10.4.5, set КЭ handwheel into «ОТСАС.» position. Create vacuum-gauge pressure in series 200, 400, 600, 800 and 1000 Pa, read the pressure gauge while boosting and while releasing the pressure, at the marks being tested, with accuracy higher than 2.5 Pa.

The error and difference of readings between boosting values and releasing values should be within 25 Pa.

10.4.7 The main error of the flowmeter is defined by the flow rate, measured by the flowmeter in question, compared to the real flow rate values, measured by a control gas meter in normal conditions.

10.4.8 To define main error of the flowmeter, establish the test set-up as shown in Fig. 12, set the «КЛАПАН» lever into «ЗАКР.» position and KP handwheel into «РЕОМЕТР» position, К3 handwheel into «НАГНЕТ.» position. The pipe connection of the pressure gauge flowmeter should be opened. Define pressure drops by the Instrument charter which correspond to the following oxygen flow rates: 0,6; 1.0; 1,3; 1-5; 2.0 l/min, and correct it for the given heat condition multiplying by coefficient β, as was said above (see item 4.2.8).

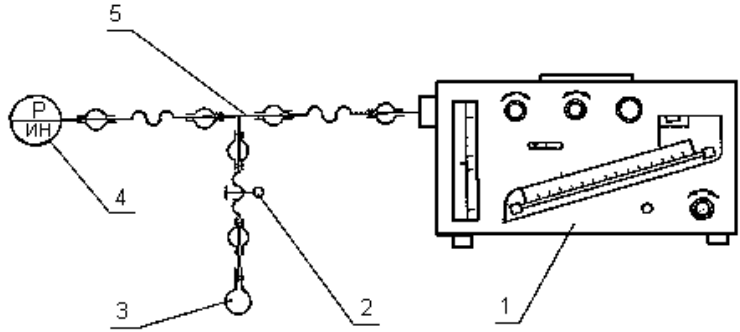

Fig. 11. A test set-up for defining of the pressure-gauge error;
1 – Instrument УКП-5; 2 – spring clamp; 3 – sprinkler;
4 – micro-pressure gauge; 5 – T-joint

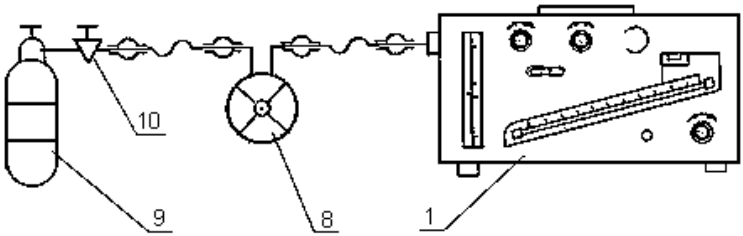

Fig. 12. A test set-up for defining of the flowmeter error:
1 – Instrument УКП-5; 8 – drum gas meter;
9 – pressure cylinder with a valve; 10 – reducer

Open the oxygen cylinder 9 valve and adjust the oxygen flow rate by the reducer 10 in such a manner that the alcohol meniscus in the flowmeter measuring tube stopped against a mark corresponding to the oxygen flow rate of 0.6 l/min. at the given test conditions. Define the real oxygen flow rate by the gas meter 8 with accuracy higher than 0.01 l/min. Measure the oxygen volume passing through the gas meter in time space enough for the counter point to make nearly one cycle, but more than three minutes.

Check all the marks which correspond the given flow rates by the described above method. Every mark should be checked twice: during forward sequence of the marks being checked (at a slow increasing of the flow rate being measured) and during backward one.

Values, measured by a gas meter, should be corrected for the normal conditions according to the formula:

$$V_o = \frac{V_t}{K}, \qquad (3)$$

where ***Vo*** – oxygen volume passing through the gas meter per 1 minute, corrected for the normal conditions: 20 °C, 1013 hPa, l;

Vt – oxygen volume passing through the gas meter per 1 minute in changed conditions, l;

K – coefficient, which takes into account temperature and pressure influence on the state of the measured gas (see item 4.2.8).

The error and difference of readings between forward and backward sequences should be learn than 0.08 l/min. (4 % of the upper measuring limit).

10.4.9 The flowmeter error is defined by the nominal oxygen flow rates, corresponding to the specified flowmeter float positions, compared to the flow rates, measured by a control rotameter in suction mode.

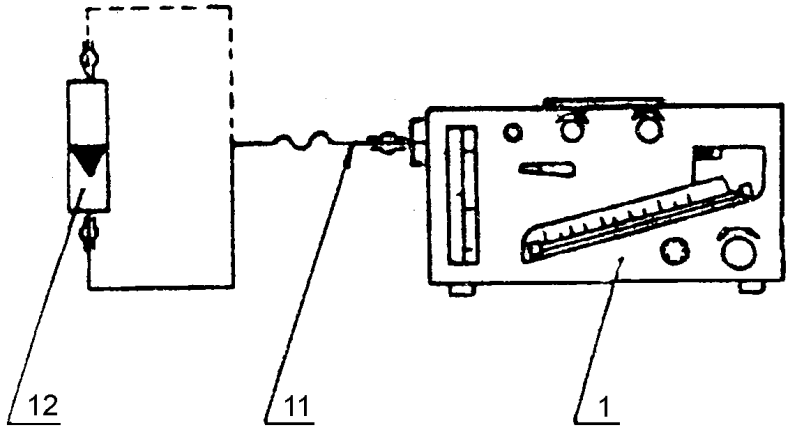

Fig. 13. Test set-up for defining of the flowmeter error:
1 – УКП-5 - Instrument; 11 – pipe with connection pipe; 12 – rotameter

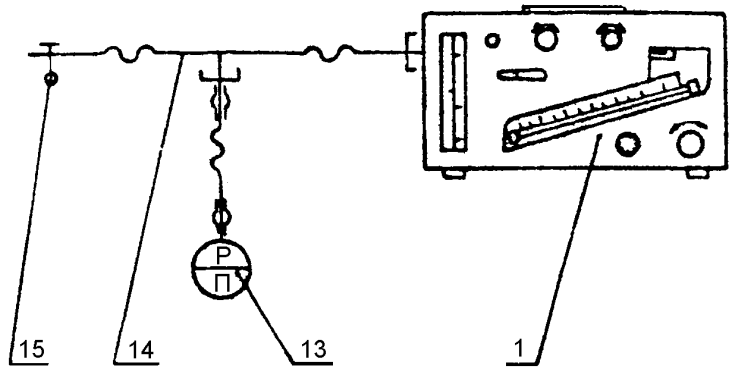

Fig. 14. Test set-up of the ejector outputs
1 – УКП-5 Instrument; 13 – compound pr«tenure and vacuum gauge;
14 – a pipe with a tap; 5 – screw clamp

10.4.10 To define the flowmeter error, couple a rotameter with the Instrument's pipe connection, as shown in Fig. 13. Set the «КЛАПАН» lever into «ОТКР.» position, КР handwheel into «МАНОМЕТР» position, КЭ handwheel into «ОТСАС.» position and «ПОТОК» hand-wheel rotate into «МЕНЬШЕ» direction against a stop. Pipe connection of the pressure gauge flowmeter should be shut. Open the cylinder valve and create such a flow in the Instrument by the «ПОТОК» handwheel rotation, that the upper (black) flowmeter float should stop against the black mark. Define the flow rate by a rotameter with accuracy higher than 0.1 l/min. Increase the flow in such a way, that the lower (red) flowmeter float stops against marks 6, 7, 9, 10 and 15 (change rotameter if needed). Every flow rate define by a rotameter with accuracy higher than 1 1/min. The error should be less than 10 % of the nominal flow rate value.

10.4.11 To define the ejector capabilities connect a compound pressure and vacuum gauge to the Instrument pipe connection with upper limit of the range ±6000 Pa. If controls are in positions as instructed in item 10.4.10 create positive pressure of 5880 Pa in the air system by the «ПОТОК» handwheel rotation toward БОЛЬШЕ position. The pressure is measured by a compound pressure and vacuum gauge. Then set КЭ handwheel into «ОТСАС.» position and create corresponding vacuum gauge pressure.

Ejector unit should provide positive and vacuum gauge pressure of more than 5880 Pa in a system being tested.

10.4.12 To check the ejector output establish the test set-up shown in Fig. 14. Set the panel controls as described in item 10.4.10 and create a maximum flow. Reduce a cross section of the tube by a screw clamp 15 to establish the pressure of 2000 Pa, in the system being checked and read the flowmeter. The pressure is controlled by a vacuum gauge 13. Тнет set КЭ handwheel into «НАГНЕТ.» position and repeat the operation.

The maximum flow, created by the ejector in the mode of compression and suction and resistance of 2000 Pa, should be more than 150 1/min.

10.5 Processing of the results

10.5.1 The main error of the pressure gauge ***δм*** (see items 10.4.5, 10.4.6) is calculated with accuracy higher than 0.1 % from the formula:

$$\delta_{м} = \frac{\Delta_{м}}{H_{пр}} \cdot 100\%, \qquad (4)$$

where **Δm** – maximal pressure gauge deviation of the measured value from the real value of positive and vacuum gauge pressures, measured by a control micro-pressure gauge, Pa;

Hпр – upper limit of the pressure gauge range, Pa (*Hпр* – 1000 Pa).

10.5.2 The maim error of the reometer δp (see item 10.4.8) is calculated with accuracy higher than 0.1 % from the formula:

$$\delta_{p} = \frac{\Delta_{p}}{V_{пр}} \cdot 100\%, \qquad (5)$$

where ***Δp*** – maximal reometer deviation from the real flow rate;
measured by a gas meter, 1/min;

Vпр – upper limit of the reometer range, 1/min (*Vпр* = 2 1/min).

10.5.3 The flowmeter error ***δpc*** (see item 10.4.10) is calculated with accuracy higher than 1 % from the formula:

$$\delta_{pc} = \frac{\Delta_{pc}}{Q_{н}} \cdot 100\%, \qquad (6)$$

where ***Δpc*** – flowmeter deviation from the real flow rate value, measured by the rotameter, 1/min;

Qн – nominal flow rate value for a mark-being checked, 1/min.

10.6 Presentation of the results

10.6.1 The Instrument, which meets the requirements of the present Instruction, is supplied with a certificate of calibration by the meteorology service.

10.6.2 The Instrument which does not meat the requirements of the present Instruction is not allowed to use.

10.7 For conversion values in ram Hg into hPa, in a course of measuring pressure by different types of barometers, use Supplement 3.

11 STORAGE

11.1 The Reference Instrument should be stored in dry location at temperatures from 5 to 40 °C and relative humidity from 30 to 80 %, away from the flammable materials and materials promoting the metal corrosion. It should be placed at a distance of more than 1 m from heating device.

The location air should not contain airborn dust and corrosive impurities or fumes and gases.

11.2 When the Instrument is stored its controls should he in position as suggested in 4.1.11.

11.3 When the instrument is to be stored for a long time, release the liquid from the pressure gauge-flowmeter and the cylinder from oxygen.

12 TRANSPORTION

12.1 The Instrument should he transported in boxes or in shook-absorbing cells in upright position (with the handle upward).

12.2 The Instrument should be transported by any vehicle protected from ambient humidity and from mechanical injury.

12.3 If the Instrument being transported is charged, the controls on the face panel should be as suggested in 4.1.11.

SUPPLEMENT 1

Density values for an ethyl alcohol solution and alcohol volume fraction in the solution (fraction of total mass is 77.33 %) at different temperatures

Temperature, °C	***Density, °C***	***Volume, fraction***	***Temperature, °C***	***Density, g/cm³***	***Volume, fraction %***
10	0,858	80,2	25	0,846	84,7
11	0,858	80,5	26	0,845	85,0
12	0,857	80,3	27	0,844	85,3
13	0,856	81,1	28	0,843	85,6
14	0,855	81,4	29	0,842	85,9
15	0,854	81,7	30	0,841	86,2
16	0,853	82,0	31	0,840	86,5
17	0,853	82,3	32	0,840	86,8
18	0,852	82,6	33	0,839	87,1
19	0,851	82,9	34	0,838	87,4
20	0,850	83,2	35	0,837	87,6
21	0,849	83,5	36	0,836	87,9
22	0,848	83,8	37	0,835	88,2
23	0,847	84,1	38	0,834	88,5
24	0,847	84,4	39	0.833	88,7

Note. Admissible deviation from the values given in table:

density ±0.005 g/cm3;

volume fraction – 1.5 %.

SUPPLEMENT 2

Coefficient/values correcting temperature influence on the flowmeter working state (alcohol-water solution with the fraction of total mass 77.33 %)

Temperature, °C	***α***	***Temperature, °C***	***α***	***Temperature, °C***	***α***

SUPPLEMENT 3

Pressure values in hPa and mm Hg

hPa	***mm Hg***	***hPa***	***mm Hg***	***hPa***	***mm Hg***	***hPa***	***mm Hg***	***hPa***	***mm Hg***	***hPa***	***mm Hg***

CONTENTS

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