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FOREIGN TECHNOLOGY DIVISION

RADIO ENGINEERING SYSTEM OF SHORT-RANGE NAVIGATION.
RSBN-2

by

Ye. M. Yakovlev, A. N. Klepikov,
et al.

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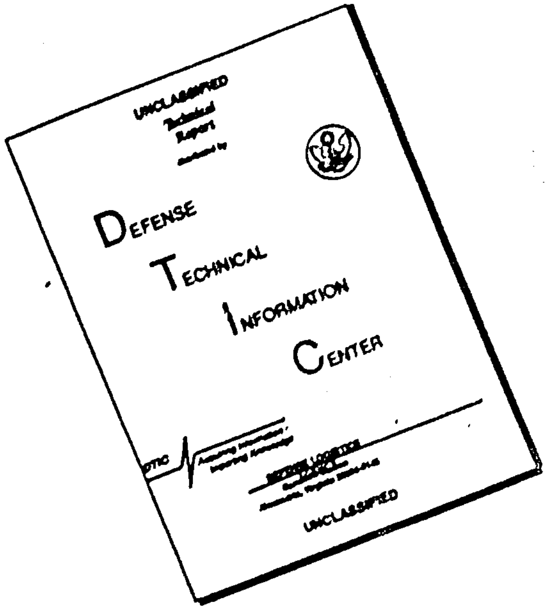

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RADIO ENGINEERING SYSTEM OF SHORT-RANGE NAVIGATION. RSBN-2

By: Ye. M. Yakovlev, A. N. Klepikov, et al.

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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. The use of diacritical marks is preferred, but such marks may be omitted when expediency dictates.

GREEK ALPHABET

Alpha	Α	α	α	Nu	Ν	ν	
Beta	Β	β		Xi	Ξ	ξ	
Gamma	Γ	γ		Omicron	Ο	ο	
Delta	Δ	δ		Pi	Π	π	
Epsilon	Ε	ε	ϵ	Rho	Ρ	ρ	ϱ
Zeta	Ζ	ζ		Sigma	Σ	σ	ς
Eta	Η	η		Tau	Τ	τ	
Theta	Θ	θ	ϑ	Upsilon	Τ	υ	
Iota	Ι	ι		Phi	Φ	φ	ϕ
Kappa	Κ	ϰ	κ κ	Chi	Χ	χ	
Lambda	Λ	λ		Psi	Ψ	ψ	
Mu	Μ	μ		Omega	Ω	ω	

RUSSIAN AND ENGLISH TRIGONOMETRIC FUNCTIONS

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

Russian	English
rot	curl
lg	log

GRAPHICS DISCLAIMER

All figures, graphics, tables, equations, etc. merged into this translation were extracted from the best quality copy available.

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SUBJECT CODE 214D

Pages 1-29.

RADIO ENGINEERING SYSTEM OF SHORT-RANGE NAVIGATION. RSBN-2. Is affirmed UUZ [99sp4 - Administration of Educational Institutions] the IGA of the USSR as textbook for the technical schools of the civil aviation.

Pages 1-29.

Page 2.

Radio engineering system of the short-range navigation of RSBN-2. Yakovlev Ye. M., Klepikov, A. N., Shteynberg, A. L., Morgukov, L. F., Fedorov, I. K. Publishing house the "transport", of 1971, page 1-220.

In the book are set forth designation/purpose the composition and the operating principle of system RSBN-2, is given detailed description of the schematic diagrams of all devices and blocks of ground-based radio beacon. Is given the short information about aircraft equipment of system RSBN-2, are illuminated the operating principles of individual blocks and also the interaction of ground-based and aircraft equipment.

The book is intended as textbook for air technical school of the special service of the civil aviation. It can be used by technical personnel of civil aviation, VVS [99sp03 - Air Force] and DOSAAF [99sp06 - All-union Voluntary Society for Assistance to the Army, Air force, and Navy. Fig. 167, Table 1.

Page 3. Chapter 1.

GENERAL INFORMATION. [redacted] Purpose and technical specification.

The radio engineering system of the short-range navigation of RSBN-2 is intended for setting up in airports and on the aircraft of the civil aviation. It provides piloting in complex meteorological conditions with the day and at night.

System RSBN-2 consists of the ground-based omnidirectional azimuth-ranging radio beacon and the aircraft equipment, which make it possible to determine on aircraft the current polar coordinates - azimuth and slant range relative to the site of installation of radio beacon. Data, obtained by the aid of system RSBN-2 measured are continuous with high accuracy, and also the data on height/altitude, rate and the course of aircraft, determined on the corresponding instruments, they make it possible to crew to solve the following piloting and navigational problems:

air navigation in any rectilinear direction (azimuth), passing through the point of setting radio beaccn, and also on the orbit of an arbitrary radius on the limits of the range cf system;

air navigation on any rectilinear route, nct passing through the pcint cf setting radio beacon, with the aid of computer (SRP);

recovery to grcund-based reference pcints with the indication of approach and torque/moment cf the flight/span cf each reference pcint;

the drive of aircraft into point it began decreases with cloud penetraticn cn that which was assigned for this aircraft type of trajectory;

continuous position finding cf aircraft frcm the obtained instantaneous values of azimuth and slant range;

crosstalk of the call signals of radio beacon, coded on Morse code.

On radio beacon there is a plan-position indicator (PPI) and connected VHF- radio station RSIU-4. On PPI dispatchers or technical personnel can determine the polar coordinates of the aircraft, which work with this radio beacon, and realize their individual recognition, but with the aid of the radiostation RSIU-4 carry out two-way VHF-communication/connection with aircraft.

In system RSBN-2, is provided the simultaneous transmission:

in direction aircraft - the earth/ground: inquiring range-finders signal [1], response signals to ground-based NKO [99sp3 - People's Commisariat of Defense], the identification signals of aircraft;

in direction the earth/ground - the aircraft: the azimuth signals of omnidirectional radio beacon, supporting/reference signals "35" and "36", of response of range-finders signal, two-degree (identification) signals of radio beacon.

FOOTNOTE [1]. Here and throughout hearth by "signals" are implied the momentum/impulse/pulses of high and intermediate frequency (radiopulses). ENDFOOTNOTE.

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All transmitters and the heterodynes of receivers have the quartz-crystal control of carrier frequencies, which makes it possible to produce untuned communication/connection, the rapid and reliable exchange of frequency channels in flight.

Transmitter P-200M of azimuth signals works in the mode of continuous emission/radiation, while transmitter P-20A - in pulsed operation (both on the same frequency channels). The separate transmission of reference signals "35" and "36" is provided with the aid of two-pulse code.

Transmitter P-20D of the repeater of range finder operates on a pulsed basis at frequencies of those occupying band 28 MHz.

The inquisitor of range (SZD) issues the inquiring ranging, response indicator and unique signals of aircraft on one of the frequency-code channels of system. The aircraft receptor of range-finders signal has a band, necessary for the undistorted reception of the signals, emitted transmitter P-20D.

For the separation of the signals of the radio beacons, which work at adjacent frequencies, is utilized three-pulse coding. In this case, the frequencies of unique codes are spread not less than to four frequency channels. The alternation of four records makes it possible to avoid mutual interferences on adjacent frequency channels.

Key: (1). The performance data of radic beacon. (2). passability/trafficability, km/h. (3) 25 on the ground roads of the improved coating. (4). Weight of auto, kgf. (5) the power plant of PES-6, kg. (6). Overall sizes, mm. (7) in march position. (8) in operating position. (9). Consumption from grid/network 50 Hz, 220/380 in, kVA. (10). Consumption from grid/network 400 Hz, 208 in, kVA. (11) maximum. (12) minimum. (13). Fuel/propellant: for an auto. (14) diesel (GOST [99sp04 - All-union State Standard] 4749-49) or tractor (GOST 305-42), the reserve mobile fuel - - 400 kgf, the consumption of fuel/propellant - 145 kgf on 100 km. (15) for the diesel-electric aggregates of power station PES-6. (16) diesel (GOST 4749-49) or tractor GOST 305-42), the reserve of the conveyed fuel 390 kgf, of consumption for 1 h works at the nominal power 17 kgf.

Content of equipment.

The instrumentation of system RSEN-2 is divided into ground-based and aircraft. Ground equipment is installed in apparatus cabin and the mobile power plant PES-6. This instrumentation is called and ground radio beacon (Fig. 1.2) and is designated by RSBN 2i.

Radio beacon is placed on the tractor KRAZ-22G by two-axis the trailer ANL in which is mounted the power plant PES-6. During transporation, entire rigging and spare property is placed on trailer ANL.

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Fig. 1. Ground-based radio beacon in moving position.

Fig. 2. Grcund-based radic beacon in expanded/scanned position.

In apparatus bay are placed the equipment for omnidirectional azimuth radio beacon and repeater of range finder, PPI, monitoring-measuring equipment, the radio station RSIU-4 electrical equipment.

Equipment for the omnidirectional azimuth radio beacon of system BSBN-2 consists of:

transmitting antenna with the narrow-beam radiation characteristic in the horizontal plane, which rotates at a rate of 100 r/min;

the transmitting antenna with the nondirectional radiation characteristic in horizontal plane;

the transmitter of P-200M, working in mode/conditions continuous generation and powering antenna with narrow radiation pattern in horizontal plane;

the transmitter of P-10A, which operates on a pulsed basis and powering antenna with nondirected radiation characteristic in horizontal plane by reference signals "35" and "36".

Page 6.

The equipment of repeater of range finder includes:

the receiving antennas of the upper and lower angles;

ground-based receptor (NPU), providing the reception of the signals of inquisitors, decoding, constant delay, the automatic limitation of the charging of the transmitter of P-20D the delivery of signals from aircraft on PPI;

the transmitting antenna system of the repeater of range finder in nondirected radiation characteristic in horizontal plane transmitter P-20D which operates on a pulsed basis, provides the coding of the inquiring signals, obtained from receptor, it develops unique signals of radio beacon and feeds antenna with nondirected radiation characteristic in horizontal plane.

In the assembly of the aircraft equipment, designated RSBN 2s, they enter:

antenna systems;

SZD;

the aircraft sensing transducer of azimuth and range (decay), that accepts azimuth and reference signals, the response signals of the ground-based transmitter of the repeater of range finder and inquiring indicator signals;

bearing unit (BA), automatically measuring the azimuth;

range unit (BD), automatically measuring the range and having the device of the programmed decrease ir the aircraft from any height/altitudes, which indicates to crew the predetermined trajectory of flight and output/yield tc the glide path of landing beaccn;

control panels one of which is established/installed in pilot (ShchU), and another - in navigator (ShchUSh) intended for a control cf aircraft equipment of system;

the directly reading instruments cf ranges and azimuth some of which is established/installed in pilot (PPDA) a another - in navigator (PPDA-Sh), that identify/index and counting off the azimuth and the range of aircraft relative to radio beacon;

the combined flight instruments (KPP-M), which have the vertical and horizontal arrow/pointers, intended for pilcting in the mode/conditions of zero-driving, and also for instrument landing but to the beacons of PRMG-4 or SP-50;

the computer, which consists of the units of control (BU) and of final adjustment (side-locking), that ensure flight in the specified track of any direction.

Operating principle.

Azimuth determination of aircraft relative to ground-based radio beacon. This determination is realized by the measurement of the time interval between the moment of reading, identical for all aircraft which are located in the zone of action of radio beacon, and the torque/moment of the reception of azimuth signal by each of them individually.

In aircraft equipment RSBN 2s (Fig. 3) azimuth signal is form/shaped during irradiation of aircraft by the antenna A-1 (Fig. 4) which is powered from the transmitter P-200 m of continuous emission/radiation.

The evenly revolving antenna A-1 has narrow radiation pattern in horizontal plane. for raising the accuracy of reading of azimuth, the rotator is stabilized.

The momentum/impulse/pulse, which determines reference point in aircraft equipment is form/shaped into that torque/moment, when the middle of failure between the lobes of the antenna radiation pattern A-1 is directed strictly toward true north. Is realized this as follows.

Fig. 3. Simplified block diagram of installed equipment.

Key: (1). Decoder of supporting/reference signals. (2). Receiver. (3). Block of the measurement of azimuth. (4). Indicator. (5). Adapter.

Fig. 4. Simplified is unit the diagram of ground-based radio beacon.

Key: (1). Directional antenna. (2) sensor "supporting/reference 35". (3) azimuth transmitter P-200M. (4) the transmitter of reference signals P-20A.

Cn the axis of antenna immobly are fastened the disks, which rotate together by it. In the circumference of disks, are evenly arranged magnetic inserts with the aid of which they are formed the momentum/impulse/pulses, conditionally named by supporting/reference pulses "35" and "36". These momentum/impulse/pulses simulate transmitter P-20A. They are emitted by the antenna of A-2, which has the nondirectional radiation characteristic in horizontal plane.

The sensors of reference momentum/impulse/pulses "35" and "36" are established/installed so that in the direction of the middle of failure of the antenna radiation pattern A-1 in north momentum/impulse/pulses "35" coincide with momentum/impulse/pulses "36". This coincidence subsequently we will call northern agreement, and the momentum/impulse/pulse, which is obtained as a result of this of agreement, northern. Northern momentum/impulse/pulse serves as beginning for the reading of azimuth. Thus, the time interval between northern agreement and the torque/moment of the reception of the azimuth signal of the pencil-beam antenna is proportional to the azimuth of aircraft relative to radio beacon.

The reference and azimuth signals, accepted by aircraft receptor and decoded, are supplied to the measuring unit of azimuth.

The time diagrams, which elucidate the principle of the measurement of azimuth, are shown in Fig. 5. The time interval between the northern and the azimuth momentum/impulse/pulses of aaaaa is utilized for the rough measurement of azimuth, but the interval between the azimuth and the nearest the supporting/reference "36" by momentum/impulse/pulses of aaaaaaa - for precision measurement.

Azimuth on aircraft is measured as follows (Fig. 6). In the time/temporary modulator of rough azimuth determination during the agreement of reference pulses "35" "36" are developed the strobe pulses. With the aid of phase converter FG rough azimuth determination it is realized the smooth shift/shear of strobe pulses to agreement with azimuth. This operating mode of is called search. In the case of the time/temporary disagreement/mismatch between selector and azimuth momentum/impulse/pulses in discriminator, is developed the error voltage. This voltage through the amplifier affects the electric motor m, connected through the reducer with phase inverter FG.

Electric motor m sets into phase inverter FG, as a result of which the phase of strobe pulses smoothly changes to agreement with the phase azimuth. During the complete belt agreement of these voltage pulses, of error on the output of discriminator becomes equal to zero. As a result of this, occurs the automatic changeover of diagram from search mode into the mode/conditions of tracking.

Work in the mode/conditions of tracking occurs analogously. Azimuth momentum/impulse/pulses are compared in time with the reference pulses "36", smooth shift/shear of which is done with the aid of phase inverter FT the precision determination of azimuth. System automatically balasisiruyetsya with zero error voltage, since the angle of rotation of axes corresponds to the measured azimuth.

Fig. 5. The time diagrams of the input signals: a) supporting/reference signals "36"; b) reference signals "35"; c) azimuth signals.

Key: (1) anta.

Fig. 6. Block diagram of the measurement of the azimuth on of aircraft.

Key: (1). Azimuth signal. (2). Reference signal "35". (3). Time/temporary modulation of rough azimuth determination. (4). Switching circuit of mode/conditions. (5). Time/temporary modulation of the precision determination of azimuth. (6). Time/temporary discriminator. (7). Voltage amplifier of the error signal.

Phase inverters FG and FT are connected between themselves by reducer with relation 1:36. one turn of the axis of phase inverter FT is 10° rotation of axis of phase converter FG. Eecause of this diplex method of the measurement of azimuth, is reached high accuracy.

Reducer has selsyn transmitters with the aid of which the angle cf rotation of its cutput axes transmits tc the directly reading instrument of range and azimuth, the urits cf control and final adjustment, computer.

Ranging of aircraft relative tc grcund-based radio beacon. The range is determined by pulse method by the measurement of the total propagation time of inquiring signal frcm aircraft to radio beacon and response signal from radio beacon tc aircraft. This time proportionally measured cf the premise/impulses which start SZD 2. SZD at frequencies, stabilized by quartz, is sent through antenna-feeder system 3, 12 pairs of momentum/impulse/pulses. The interval between momentum/impulse/pulses is assigned by encoder 4, which are located into SZD. Signals frcm aircraft are accepted NPU 6, that has all-directional antenna 5. Decoder 7 passes the only pairs cf the momentum/impulse/pulses the distance between which was determined and preestablished by the encoder cf SZD.

The decoded momentum/impulse/pulses pass through the unit 15 limitations of charging, balancing delay line 8 of transmitter 10 repeater of range finder. This transmitter works at frequencies, stabilized by quartz, and it has encoder 9 with four pairs of impulse codes.

Pulse signals are emitted by omnidirectional antenna 11 of the transmitter of the repeater of range finder and are received as slave unit 13. receiver has at output/yield decoder 14, that passes the pairs of momentum/impulse/pulses with the interval, assigned as encoder.

Fig. 7. Diagram of radio distance gauge.

Key: (1). Aircraft channel. (2). Measuring circuit of radio distance gauge. (3). Encoder. (4). Decoder. (5). Ground-based channel. (6). Balancing delay line. (7). Unit iz.

The decoded reciprocal momentum/impulse/pulses approach measuring circuit 1 in which automatically and continuously is measured the time between the sending of starting momentum/impulse/pulses and the momentum/impulse/pulses of answer/response. The measured time is identify/indexed in kilometers to PPDA.

Ranging and azimuth on ground-based plan position indicator. According to ground-based PPI are determined the azimuth and the range aircraft that work with this radio beacon, and also is realized their individual designation. Is provided this as follows. On one of the disks, which rotate synchronously with azimuth are evenly placed 180 inserts with the aid of which through each 2° rotation antenna sends off momentum/impulse/pulse. These two-degree pulses, or momentum/impulse/pulses 180, modulate transmitter P-20D and simultaneously start scanning/sweep PPI.

From the output/yield of the transmitter of P-20D, two-degree momentum/impulse/pulses, or as them still call, inquiring indicator momentum/impulse/pulses, are supplied to the omnidirectional antenna, they are emitted and are accepted by aircraft receiver. In aircraft equipment the special diagram of the isolation of two-degree momentum/impulse/pulses selects that from them, that is accepted immediately after the irradiation of aircraft by the directional azimuth antenna. The chosen momentum/impulse/pulse starts the SZD, which transmits to the earth response signal. This signal is received as the omnidirectional receiving antenna of the upper or lower angles, it approaches NPU, whence it is supplied on the PPI, at screen of which appears brightness mark. The distance of mark from the center of tube is proportional to distance of aircraft, and the angular position of mark corresponds to the azimuth of aircraft.

For the facilitation of coordinate determination of aircraft on PPI, are calibration range marks and azimuth, obtained from the special diagram which is started simultaneously with scanning/sweep.

In the work of the transmitter of the plane radio of RSIU-4, is included two's complement, thanks to which the mark of aircraft on PPI bifurcates itself how is provided its individuality of identification.

For the transmission of the identification signals of radio beacon, are utilized the three-pulse premise/impulses of the demand of indication. one of the momentum/impulse/pulses of each premise/impulse is switched so that is cbtained the two-letter code of recognition coded on Morse code.

Construction.

For setting directed azimuth the antenna and its drive of chassis/landing gear of the auto cf KRAZ-221G, is increased on 0.5 m. Here are placed the column of the drive of azimuth antenna and the unit of the fundamental machines, and are also fastened two hoists cne of which serves for lift and the settling cf the mast of the receiving antenna of low angles and the other - for lift and the settling spare track.

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On the shaft of the starter motor of the cclumn of the drive is fastened azimuthal antenna. For a decrease in the aerodynamic lcadings, the antenna rotates within "tent" - wind shield. The roof of wind shield consists of the metal frame, covered on top by canvas.

Side walls of wind shield are made from the light panels of the foam whose dielectric properties do not exert a substantial influence on radiaticn pattern and the power, emitted azimuth antenna.

For warming the body between external and internal circuits and also in sex/floor is packed the foam.

Eody has two tear: worker - starbcard in the course of auto and emergency - with left, two window with blinds. From starboard next to dccr is arranged cable panel. On the frcnt/leading external wall of body in the separate cabinets are mcunted storage batteries ZST-98 - cn five in each cabinet. Above driver's catin in cabinet, are arranged two fan for the blcwout of the cermet tutes of transmitters and one fan for the blowout of equipment in the cabinets of the frcnt/leading wall of body. In this same cabinet is established/installed the converter PC-500 for the feed of the radio staticn of RSIU-4. The blowout of equipment of the rear wall of body and cabinet cf feed is realized by the fan, strengthened to the rear wall cf body. The air, which ccols equipment, is cleanned of dust by the filters, placed of the air intakes of fan.

For the preservation/retention/maintaining of the normal operating temperature in body, are three exhaust fans one of which is arranged on the front/leading wall of body, and two others - on rear. Between the blown off/out cabinets and the walls of body, are mounted distributive duct with opening/apertures. In winter equipment is blown off/out by the air, gathered from the body through the windows of front/leading and rear walls. The shutter/valves of the windows of front wall, which control air supply, are connected by lever, which are located under ceiling.

For the connection of antennas to equipment on front/leading and rear walls outside body under fans, are established/installed antenna input/introductions. To front/leading antenna input/introduction are conducted: cable RKK-5/18 from receiving antenna, two cable of RKK-5/18 from the transmitting antennas the cables of light enclosure/protection receiving and transmitting antennas. To antenna input/introduction on the rear wall of body, are conducted two cable of RK-1 the cable of feed from extension receiver, the cables of RKK-5/18 from the antennas, arrange/located on trailer, and cable BKG-10 from the revolving transition of azimuth antenna and to the meter of the passage power of the transmitter of P-200M.

For the connection/inclusion of the portable control panel of the radio station of RSIU-4, smokestack fan and portable light outside body, are special couplings.

On front wall of the bodies are placed to the left racks of transmitters, P-200M, P-20D, P-20A, responder's ground-based receiver (NPO). In right to angle is established/installed the section with furnace, water storage tank and by cabinet for firewood.

Of rear wall are arranged from right to left the cabinets PPI, the radio station of RSIU-4, of supervisory equipment (kA), of NPU, roll control of antenna (UVA). On the cabinet of the radio station of RSPU-4, are established/installed portable oscillographs.

Of the right wall of body, is located the cabinet of feed (ethyl alcohol) above which is mounted the meter of the passage power of the transmitter of P-200M. Meter passage power connect with the which rotates transition of the azimuth antenna through the filter by the cable of RKG-10.

Fig. 8. Antenna-feeder devices: ---, and ---, phase converters: f_1 - f_1 - HF- filters.

Key: (1). Antenna of reference signals "35" and "36". (2). Antenna of the repeater of rangefinder. (3). Azimuth antenna. (4). Antenna of lower angles. (5). Antenna of the upper angles. (6). Drive. (7). Revolving transition.

On the right wall of body are placed fire extinguisher OU-2, siren RVS-24, telephone TAN-6, hanger and two collapsible chairs. On by virgin to the wall of the body is fastened the hinged/reversible stand (on emergency door) of sconce for the illumination of this stand, the case of first-aid kit, folding skadanoy chair and the field telephone TAN-43. Cabinet with instruments and operator's chair are fixed on the sex/floor of body.

In the middle of the sex/floor of body, is made the hatch with the removable cover where are packed transient (repair) cables, smokestack fan, cabinet with removable lights, units II spare parts of the radio station of RSIU-4, etc.

On the outside of body have four cabinet for the laying of the spare equipment which is utilized with the scanning of radio beacon. Chapter II.

ANTENNA FEEDER UNITS.

For providing a simultaneous operation of three channels of communication/connection the "earth/ground - aircraft", two communication channels of communication "aircraft - the earth/ground", the works of supervisory equipment and radio station RSIU-4 in the instrumentation RSBN 2i are utilized the following antenna feeder units (Fig. 8):

the directional antenna of transmitter P-200 m (azimuth antenna);

the omnidirectional antenna of transmitter P-20A (antenna of reference signals "35" and "36"):

the omnidirectional antenna of transmitter P-20D of the repeater of range finder (antenna of the repeater of range finder):

the ceiving antennas NPU and PPC;

the parabolic receiving antenna of control mobile station (KVP), the picking up signal of transmitter P-200M;

the horn antenna KVF, which picks up signal of transmitters E-20A and of P-20D;

the discone antenna of the radic station cf RSIU-4.

Fig. 9. Azimuth antenna.

Fig. 10. Diagram of the directivity of the azimuthal antenna: a) in horizontal plane; b) in vertical plane.

Key: (1). Individual diagrams.

Antenna of the transmitter P-200M.

This antenna is intended for the formation of azimuth signal. In horizontal plane it has two-lobe radiation pattern, while in vertical - it provides visual range within limits from 0 to 45°.

Antenna is the truncated paraboloid of rotation 4.5 X 1.6 m in size/dimension with three antiphase irradiators, placed on vertical line (Fig. 9).

Approximately 50o/o of power of the transmitter of P-200M will be feed/conducted to the upper irradiator A (Fig. 10), and into average b and lower into irradiators - on 25o/o. This power distribution is provided by coaxial type divider/denominator. The lengths of the cables, which go from the divider/denominator of power to separate irradiator, are selected by such, that occurs the following phasing of the field currents of the resonators: A-90°, B-0°, V-270°. The selection of the phases of the field currents of irradiators makes it possible to attenuate/weaken the interference minimums, caused by the separation of irradiators on vertical line, and to even the resulting radiation pattern in vertical plane.

For a decrease in the aerodynamic drag, the reflecting surface antenna is carried out in the form of grid. The area of opening/apertures is 80-85o/o of entire surface.

The principle of the formation of radiation pattern in horizontal and vertical planes is based on the property parabolic antenna which entails the fact that if we displace point irradiator relative to the focal axis of reflector, then the form/shaped ray/beam is deflected to opposite side to the angle, proportional to this displacement.

During small displacement of emitter, the value of angle θ the deviation of the maximum of diagram it is possible to determine by formula where h is displacement of the irradiator: f - focal distance.

Fig. 11. Dcuble-slotted irradiator and the structure of the fields: a) the general view of irradiator; b) the fcrm cf irradiator along the ncrmal to Howe's plane; 1 - the electric field of resonator; 2 - magnetic power lines; 3 - surface currents.

If we use antiphase irradiator and to place its it is symmetrical relative to the vertical focal plane, then the resulting radiation pattern will have two lug/lobe with the zero value of field in the direction of this plane (see Fig. 10a).

In order more accurately to determine the position of the electrical axis of azimuth antenna and to raise the accuracy of the measurement of azimuth on aircraft, it is necessary to have the acute/sharp minimum of radiation pattern. The sharpness of the minimum depends on the slope/transconductance of the internal fronts of lug/lobes and it reaches the maximum value at the intersection of individual radiation patterns at the level 0.7 (shown broken line in Fig. 10a).

The principle of the formation of radiation pattern in vertical plane is explained by Fig. 10b. By broken lines are shown the approximate individual radiation patterns, obtained during irradiation of reflector by separate irradiators, and the approximate resultant radiation pattern.

For a decrease in the ground effect or the formation of the radiation pattern, decrease in the dead space and weakening of the interference minimums, the antenna is inclined to 15° upward. To completely eliminate ground effects is impossible; therefore approximately at an angle of 2°, is created the minimum, caused by the interference of straight line and reflected ray/beams.

Thus, the system of three diverse on vertical line antiphase irradiators together with reflector provides double-lobe radiation pattern in horizontal plane and initial radiation pattern in vertical.

Antiphase to irradiate is the rectangular resonator, in which are gashed rectangular parallel slots (Fig. 11a).

The excitation of resonator is realized by the stub, introduced through the opening/aperture in the center of the large wall of resonator and position on line perpendicular to plane XOY (Fig. 11b).

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The fundamental magnetic (electrical) fluctuation, which possesses the lowest frequency and the simplest structure, has the following components:

where the aaaaa - the projection of the amplitude value of electric intensity for Z-axis; aaaaaa - the projection of the maximum value of the amplitude of electric intensity for Z-axis; aaaaaaaaaa - the projection of the amplitude values of the strength magnetic field on the axis X and Y; the aaaaaaa of the projection of the maximum values of amplitude of strengths of the magnetic field of axis X and Y; a, b

- the size/dimensions of resonator along the axes X and Y respectively.

this field is called a field of the type of aaaaaaaaaaaaa.

In the case in question the electric field has a only one longitudinal component aaaaa. It maximally in the middle of resonator (direct/straight aaaaaaaaaaa and aaaaaaaaaa coinciding with the axis of stub), but to directions to upper and lower, right and left walls decreases according to sinusoidal law. The electrical lines of force are straight lines, that go from remote wall to near. Magnetic power, the lines are closed curves. The planes in which it are arranged, parallel to the near and remote walls of resonator.

magnetic field equal to zero into the middle of resonator (direct/straight aaaaaaaaaaaaaaaaaaaaa) and reaches maximum value of its walls. Value both electrical and magnetic zerooes does not depend on coordinate z.

The value of resonance frequency fcr the fluctuation of the aaaaaaa of aaaaaaaa depends cn size/dimensicns cf resonator (a = 250 mm, b = 210 mm, 1 = 110 mm) and is determined from formula

where the aaaaa is an electrical penetrability;

aaaaaa - magnetic penetrability.

Surface currents 3 in near and remote vertical walls at each point in time are equal in magnitude and flcw relative to node K to cpposite sides.

The places of the arrangement/permutation cf slots on the walls of cavity rescnator are selected, cn the strength of the following considerations. one of the widespread forms of slot antenna is the antenna in the form of half-wave slot. For obtaining antiphase slotted irradiator, the slots are arranged symmetrically relative to stub - cavity driver. During this excitation of resonator, the power, emitted by slots, are identical.

The most intense excitation of slots is achieved by their location in the places of the greatest density of surface currents (conduction currents) on the internal walls of resonator and so that these currents would intersect slot at the angles, close to straight lines. Conduction currents on the internal walls of resonator are closed through fir trees in the form of bias currents.

The distribution of voltage along the length of resonant slot has sinusoidal character with antinode in the middle.

The coaxial divider/denominator of power is crest-like coaxial distributor with the different input resistor/resistances of removal/outlets.

The entry impedance of aaaaaaa is determined by the wave resistance of removal/outlets ρ and load impedance of aaaaaaa connected to it.

The loads of removal/outlets are the resonators; therefore

. end section.

Fig. 12. Rotating junction and its electrical circuit.

Key: (1). Inner lead. (2). Outer lead.

The power level P in removal/outlets is determined from formulas

where U - the voltage/stress, fed to removal/outlet.

In order that power P_1 would be 2 times more than power P_2, wave impedance ρ_2 is taken aaaaa times more than ρ_1.

The revolving transition provides the possibility of the rotation of one part of the coaxial line relative to another without the breakdown of conditions of transmission of electromagnetic energy. These conditions are not disrupted, if in the revolving transition are applied the line elements of transmission with the axial symmetry of an electromagnetic field of the type by the fact.

In system PSBN-2 is utilized the contactless (choking) coaxial revolving transition, in which galvanic contact is replaced by more reliable electrical short circuiting in high frequency (Fig. 12).

Short circuit is produced because of the application/use of the short-circuited half-wave line, connected in series in the external wire of coaxial feeder (point a, b), and the extended 1/4-wave cut (H.f.- throttle/choke) in indoor wiring (point d, e).

The grinding itself joint (points c, d) in the external wire of coaxial line, is carried out at a distance aaaaaaa from shortcircuited end/lead. In this place the amplitude of current is close to zero; therefore losses for heating and emission/radiation are small. Change resistor/resistance in this place with the function of the grinding itself joint does not exert a substantial influence on the work of the revolving coupling.

Antennas of transmitters P-20A and of P-20D.

The difference between these antennas entails the fact that the diameter of the circular emitter of the antenna of the repeater of range finder is somewhat less than the diameter of the emitter of the antenna of reference signals, since transmitter frequency of P-20D is higher than the transmitter frequency of P-20A. Therefore minutely let us examine only the antenna of reference signals (Fig. 13). This antenna is a vertical series of nine circular emitters, which ensure nondirectional emission/radiation in horizontal plane during the horizontal polarization of field. Circular emitter consists of three diverse in circumference curved half-wave dipoles which are connected with the aid of probe with the inner wire of coaxial feeder.

For an increase in the range of system, and also for obtaining continuous visual range with angle of elevation the antenna radiation pattern on vertical plane has a form, shown in Fig. 13b. This is achieved by the application/use of a vertical series of circular emitters, by the selection of phases and amplitude of the feed currents and by the application/use of a screen.

Fig. 13. Transmitting antenna of the reference signals: a) electric circuit; b) radiation pattern in vertical plane; c) circular emitter and its vibrator; d) the general view of antenna.

The diagram of the feed of circular emitters 1-9 antennas of reference signals and power distribution are shown in Fig. 13a. From the figure one can see that to all emitters, except the fifth, will be feed/conducted the identical power. The even distribution of power is realized by a divider/denominator Tr of the transformer type, and its supply to emitters is conducted with the aid of cables RK-1. If cables have identical length, then all emitters are supplied cophasally and in the absence of ground effect the maximum of radiation pattern is arranged horizontally. However, since the middle of a vertical series of antenna is arrange/located approximately on height/altitude 6.5 m, then on the formation of diagram have an effect the signals, reflected from the earth/ground. Therefore field acquires the interference structure, which is characterized by the presence of the maximums and minimums.

For the weakening of minimums and obtaining continuous visual range in vertical plane, the maximum of diagram is directed not horizontally but at an angle of 5°. For this, the second cable is shortened on 15-16 mm, the third to 30-32 mm, the fourth to 45-48 mm etc. This leads to increased the strength of field in the minimums of diagram.

The examined series of eight circular emitters (with the exception of the fifth) provides shaping of continuous visual range in vertical plane at small angles of elevation.

For the overlap of visual range at wide angles of elevation and for obtaining low dead space serves the fifth circular emitter of the arranged/located above the screen at height/altitude λ/4. To this emitter is fed approximately half of all power applied to antenna. The division of power between the fifth emitter and the others is done by a coaxial divider, while power supply to the fifth emitter and transformer - by cables RK-3.

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All emitters are included into pressurized/sealed cylindrical plexiglas cover which shields them from moisture, dust, etc.

High-frequency energy from transmitter P-20A will be feed/conducted to antenna with the aid of the cable RKK-5/18 through the continuous-power meter IPM-2I and the phase inverter which makes it possible to improve traveling-wave ratio (KBV).

Antennas NPU and NPO.

The receiving antennas NPU have the nondirectional diagram in horizontal plane and continuous visual range in vertical plane at small and wide angles of elevation (within limits from 0 to 65°), providing the reception of signals SZD.

Obtaining continuous visual range in vertical plane is achieved by the application/use of two antennas, i.e., by fundamental (antenna of lower angles) and auxiliary (antenna of the upper angles). Fundamental receiving antenna 1 (Fig. 14) provides the overlap of zone in vertical plane at small angles of elevation and serves for the reception of interrogating signals from aircraft, which are located at large distances, while auxiliary 2 - for the overlap of zone at the wide angles of elevation and smoothing of the interference minimums.

The operating principle of antennas is analogous to the principle of the work of the transmitting antennas of reference signals and repeater of range finder.

The fundamental antenna is a vertical series of seven circular emitters. The center of this series is located on height/altitude 9.8 m. The maximum of the emission/radiation of antenna is directed horizontally, which provides the reliability of the reception of the signals, which come in at small angles. However, because of the signals, reflected from the earth/ground, are created the deep interference minimums, which overlap interference maximums of the radiation pattern of supplementary antenna.

Supplementary antenna consists of five the same as the whisker of the fundamental antenna, circular emitters, but under the third emitter at a distance, approximately equal to the fourth of wavelength, is arranged the metallic screen, which makes it possible to decrease the dead space and to create visual range at wide angles of elevation. The height/altitude of supplementary antenna is selected from the conditions of the overlap of the interference minimums of the radiation pattern of the fundamental antenna.

Feeder systems within antennas are made from the cable RK-1, and the fundamental feeders, which connect antennas with receivers, from the cable RKK-5/18, which possesses small attenuation in decimeter wave band. In the circuit of the fundamental feeders, are included the surge absorbers.

The receiving antennas NPO in their operating principle and construction are analogous to the antennas NPU and differ only in terms of amount of circular emitters.

Fundamental antenna 1 (Fig. 15) is the vertical series of 10 circular emitters whose middle is established/installed on height/altitude 8.2 m and serves for the reception of signals, arriving at small angles to the horizon. Antenna overlaps visual range in vertical plane from 0 to 15° with the first interference minimums at angles of 1°17' and 2°35', which are overlapped by the interference maximums of supplementary antenna.

Supplementary antenna 2 consists of nine circular emitters. The middle emitter is located on height/altitude 6.2 m. Under the upper emitter, at a distance equal to 1/4 wavelength, is established/installed the screen.

Fig. 14. Fundamental and supplementary antenna of the NPU: a) the general view of antennas; b) the resulting radiation pattern in vertical plane.

Fig. 15. Fundamental and supplementary antenna of the NPO: a) the general view of antennas; b) the resulting radiation pattern in vertical plane.

Fig. 16. Diagrams of the directivity of the antennas of the radio beacon: 1 - the azimuth antenna; 2 - the antenna of transmitter P-20A; 3 - the antenna of the transmitter P-20D; 4 - antennas NPU; 5 - the resulting visual range of radio beacon.

The very important operational characteristic of the ground-based equipment of azimuth-ranging system is the zone of the coverage which characterizes the possibilities of using a system for providing air navigation at different height/altitudes.

At high altitudes the interference minimums of the radiation patterns of separate antennas (Fig. 16) create the space in which the system does not assure air navigation. These minimums are somewhat displaced relative to each other. Because of this the space, in which the system does not provide air navigation, somewhat increases.

During the mass use of a system RSBN-2 for the air navigation of the visual range of radio beacons, they must be uniform, which requires the fine adjustment of antenna systems at plant.

The resulting visual range depends on the state of antenna feeder units and connecting contacts. Power supply must be conducted only by those cables which were utilized in the process of the liquid of antenna systems at plant and they are located in the assembly of station.

The replacement of the cables of high frequency and the disturbance/breakdown of contacts can cause changes in energy distribution, which substantially shows up in the form of the radiation patterns of separate antennas, it brings to appeared new interference minimums and to an increase in the zones of the uncertain indication.

Chapter III.

TRANSMITTERS. Transmitter P-200M.

This transmitter (Fig. 17) is intended for the generation of continuous high-frequency oscillations in decimeter wave band which are utilized for the creation of azimuth signals.

Fig. 17. The cabinet of transmitter P-200M: 1 - high-voltage rectifier block; 2 - control unit of rectifier; 3 - five-stage exciter block; 4 - frequency-multiplier block; 5 - power amplifier block.

Functional diagram. Transmitter (Fig. 18) includes:

the block of five-stage driver;

the block of frequency multiplier;

the unit of power amplifier;

the control unit of rectifier +350 V;

the unit of high-voltage rectifier;

the unit of the meter of passage power.

The unit of the five-stage driver of destination for producing fluctuations of forty record/fixed and quartz-stabilized frequencies which are obtained after 36-fold frequency multiplication. This unit consists of the master oscillator, two cascade/stages of the frequency triplers, cascade/stage of the power amplifier and output stage of the frequency doubler. From the output/yield of the unit of five-stage driver, the power is supplied to the input of the unit of frequency multipliers.

The unit of frequency multipliers is intended for subsequent frequency multiplication and contains two cascade/stage. Fluctuations from the output/yield of the second doubler are supplied to the input of the unit of power amplifier.

The unit of power amplifier amplifies the fluctuation of the waves of decimeter range.

The unit of the meter of passage power measures the power of the oscillations, which enter from the power amplifier to the antenna, the oscillation frequency and coefficients of standing and traveling waves, in terms of values of which it is possible to judge the agreement of the output resistance of transmitter and input antenna resistance.

The control unit by rectifier + 350 V is intended for switching on and disconnection of transmitter, it monitors its work, and also feeds the anode and shielding circuits of the unit of five-stage driver. The unit of high-voltage rectifier feeds the anode circuits of the fifth - the eighth the cascade/stages of transmitter, by direct current with voltage/stress +1250 V and +1700 V.

For plate cooling of the tubes of transmitter and their protection from overheating provided forced-air cooling. Cold air is supplied from the fan through special air ducts.

Unit of five-stage driver.

The master oscillator (first cascade/stage) is assembled on tube L_1 (6N6S) and it has crystal control. The equivalent diagram of this generator can be reduced to a capacitive three-point circuit with common/general/total anode (Fig. 20). Since the plate circuit L_5C_{11} (see Fig. 19) of the generator is tuned to the second harmonic of the crystal frequency, for the first harmonic its resistor/resistance can be disregarded.

Fig. 18. Functional circuit of transmitter P-200M.

Key: (1). Unit of five-stage driver. (2). Unit of frequency multipliers. (3). Master oscillator. (4). Tripler. (5). Amplifier. (6). Doubler. (7). Doubler. (8). Cooling unit. (9). Control unit of rectifier. (10). High-voltage rectifier unit. (11). Unit of the meter of passage power IPM-1K. (12). Unit of power amplifier. (13). To azimuth antenna.

Capacitor C_7 turns out to be that connected between the control grid and the cathode, because the shielding grid in high frequency has a potential of cathode.

Capacitive three-point circuit is formed as follows. On the section between the anode and the control electrode, is included the quartz, equivalent resistance of which has inductive character, and between sections control electrode - cathode and the anode - cathode are included condenser/capacitor C_7 and duct L_4C_8. The equivalent resistance of duct has capacitive character, since it is tuned to a frequency of aaaaaaa. Condenser/capacitor C_7 and cathode circuit L_4C_8 serve for the creation of positive feedback.

The diagram with the incorporation of the quartz between the anode and the control electrode provides more stable work as compared with the diagram where the quartz is included between the control electrode and the cathode, because the frequency stability of crystal oscillator to a considerable degree depends on the lamp's internal capacitance/capacity, connected in parallel to quartz.

In the anode circuit of tube for providing excitation of oscillations over a wide range of frequencies without the retuning of ducts, is applied the band-pass filter, which consists of two connected oscillatory circuits L_5C_{11} and L_6C_{14}. This system of ducts is inclined to the quadratic component of crystal frequency; therefore generator performs simultaneously two functions: the master oscillator and doubler of frequency. Coupled circuits are tuned to the second harmonic with the aid of magnetite cores.

In the master oscillator for the increasing of frequency stability applied series powering of the anode. Voltage on the anode of tube is supplied through resistor/resistance R_4 and oscillatory circuit L_5C_{11} from this same rectifier through the extinguishing resistor/resistance R_3 which is shunted by condenser/capacitor C_{12}. Displacement to control electrode is supplied because of the drop of voltage on resistor/resistance R_2 in transit through it of grid currents. Filament voltage 6.3 v on the master oscillator is supplied from the in parallel connected windings of the transformer Tr_1.

For the increase of frequency stability with the variations of the temperature of surrounding air in the master oscillator, use the thermostat into which are placed six crystals of operating range. The selection of the necessary quartz is realized by switch B_1 -

"Channels". During the installation of switch into one of the six positions on the winding of relay, is supplied the voltage + 27 in.

Fig. 19. Basic schematic the unit of five-stage driver.

Key: (1). Frequency doubler. (2). Off. (3). Control/checking of the current of cascade/stages. (4) Ground. (5) Blanking signal. (6) Blocking. (7). Channels.

Relay will actuate/operate and by its closing contacts 1-2 will connect quartz to the control electrode of the tube of the master oscillator, but by circuit closing contacts 3-4 it supplies voltage + 27 v on the tube LN, which will inflame, signalling about the connection of quartz. Condenser/capacitors C_1-C_6, connected in parallel to the windings of relay P_1-P_6, remove the sparking between the contacts of switch B_1.

The temperature in thermostat is supported by constant within the limits of 70 1.5°C using a heater. The heater is fed by alternating voltage 30 V through the breaking contacts 1-2 of relay P_7 and a heat regulator. Tube LN_8 - "thermostat on" signals, that heating is turned on.

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Fig. 20. Equivalent diagram of the master oscillator.

Key: (1). Quartz.

The work of temperature control entails the following. When the temperature in thermostat reaches the maximum value (70 + 1.5°C), the mercury column of temperature control drops, closes contacts 1-2 and creates the circuit of the powering of relay P_7. Relay P_7 will actuate/operate and will disconnect contacts 1-2, which will ensure the disconnection/cutoff of the power of heater. Tube LN_8 goes out. When the temperature in thermostat decreases and achieves minimum value (70-1.5°C), the mercury column of temperature control will be drop/omitted and will break the circuit of the powering of relay P_7, which by its breaking contact 1-2 will include/connect heater.

The second cascade/stage (first frequency tripler) is carried out on tube L_2 (6P6S). Excitation voltage on the control electrode of tube is supplied from duct L_6C_{14} through condenser/capacitor C_{13}. The plate circuit of the second cascade/stage consists of inductance L_7 and condenser/capacitor C_{18}. Because of the powerful inductive coupling of this circuit with input circuit L_7C_{20} the third cascade/stage upon the exchange of quartzes is not required the retuning of the output circuit which is inclined to the sixth harmonic of crystal frequency or the third harmonic of input signal.

The control/checking of tuning is realized from the value of the anode current of the second cascade/stage, measured by the instruments IP_1 during the position 2 of switch B_2 - the "Control/checking of stage". The resistor/resistance R_8 is shunt to the instrument of IP_1.

Anode feed of tube L_2 from rectifier +350 V consecutive: through resistor/resistance R_8, shunted by condenser/capacitor C_{17}, and plate circuit L_7C_{18}. Screen-grid voltage is supplied from the same rectifier through resistor/resistance R_7, shunted by capacitor C_{16}. To this grid through the cable, is connected the anode of the tube of the L_{30} of the encoder of the cabinet of NPU. Tube L_{30}, being open/disclosed, shunts screen grid and ceases oscillating process in the second cascade/stage (see the description of the diagram of encoder).

Displacement to the control electrode of tube L_2 is supplied because of a voltage drop across resistor/resistance R_6 in transit through it of the full current of tube. Resistor/resistance R_6 is shunted by capacitor C_{15}. Feed of filament of incandescence of tube is realized by voltage 6.3 v from transformer Tr_1.

The third cascade/stage (second tripler) is assembled by push-pull circuit on tube L_3 (GU-32). Input circuit consists of the inductance coil L_7 and of capacitor C_{20}. The midpoint of inductance coil L_7 is grounded through resistor/resistance R_9 and capacitor C_{19}.

Output circuit is carried out in the form of the two-wire circuit, briefly locked at end/lead. The length of line is selected taking into account capacitance of anode-cathode and alternating/variable capacitor C_{23} with the aid of which is realized the tuning of cascade/stage. Tuning is monitored from the readings of IP_1 in the position of 3 switches B_2.

To the anodes of tube L_3, the feed is supplied from rectifier +350 v through H.f.-throttle/choke L_{14} and the midpoint of the two-wire circuit where is located rf node. Resistor/resistance R_{12} serves as shunt to the milliammeter of the instrument of IP_1. Screen-grid voltage of foot is supplied from rectifier +350 v through the extinguishing resistor/resistance R_{11}, shunted with capacitor C_{34}.

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Bias on the control electrodes of tube L_3 automatic, because of a voltage drop across resistor/resistance R_{10} in transit through it of the full current of tube. This resistor/resistance is shunted by the capacitor of great capacity C_{21}. The feed of the filament of tube is realized by voltage 6.3 v from transformer Tr_1. Communication/connection by the third cascade/stage with the fourth cascade/stage is realized with the aid of capacitors C_{22} and C_{24}.

The fourth cascade/stage is carried out by push-pull circuit on tube L_4 (GU-32) and works in the mode/conditions of amplification.

The input circuit of cascade/stage has inductance L_9 and L_{10} with high reactance in all frequency band. The plate circuit of the cascade/stage consists of inductance L_{12} and capacitor C_{29} with the aid of which is realized the tuning of cascade/stage. Resistor/resistance R_{17} is a shunt to the instrument of the IP_1, which monitors the tuning of cascade/stage. Voltage on the anodes of tube L_4 is supplied from rectifier +350 v through the connected consecutively high-frequencys choke L_{11} and L_{15} and the midpoint of inductance L_{12}, but to screen grid - from the same rectifier through the extinguishing resistor/resistance R_{16}, shunted with capacitor C_{35}. Displacement is obtained because of a voltage drop across resistor/resistances R_{13} and R_{14}, shunted by capacitors C_{26} and C_{27}, in transit through them of grid currents. The voltage of the filament of tube L_4 is remove/taken from transformer Tr_1. The communication/connection of the plate circuit of the fourth cascade/stage with the input circuit of the fifth is inductive.

The fifth cascade/stage (doubler of frequency) is carried out by grounded-grid circuit on cermet tube L_5 (GI-7B). This diagram assures stable operation, i.e., decreases the possibility of self-excitation. Input circuit consists of inductance L_{13}, the alternating/variable capacitor C_{30} and interelectrode capacitance grid - cathode of tube L_5. Input circuit they tune with the aid of capacitor C_{30} and by changing the inductive coupling between L_{13} and L_{12}.

The plate circuit of the cascade/stage consists of the cut of coaxial line, on the one hand by the loaded transfer capacitance of tube, and from by another short-circuited tuning plunger with the aid of which duct they tune for the assigned frequency. The capacitor C_{31} is separating for the direct-current circuits and high-frequency current. The selection of oscillatory power from the plate circuit of the fifth cascade/stage is realized with the aid of the capacitive probe, carried out in the form of stub with disk at end/lead and omitted into the cavity of coaxial line. By the submersion depth of probe it is possible to regulate the value of the take/selected power.

Voltage on the anode of tube L_5 is supplied from rectifier +1250 v through H.f.-throttle/choke L_{16}, shunted with capacitor C_{36}. Filter $L_{16}C_{36}$ removes the parasitic communication/connections through the power supply.

Bias on the control electrode of tube L_5 is formed because of the drop of voltage on resistor/resistance R_{18} in transit through it of the full current of tube. Resistor/resistance R_{18} is variable, which makes it possible to change the operating mode of cascade/stage.

Filament voltage 12.6 V is supplied to tube from transformer Tr_1 through the blocking H.f.-throttle/chokes L_1 and L_2, which removes the passage of high-frequency oscillations in filament circuit. The windings of transformer are connected in series for obtaining necessary voltage of 12.6 V. The resistor/resistance R_{19} is shunt to the instrument of the IP_1, which serves as indicator during the tuning of the fifth cascade/stage.

Constructions. Network elements are assembled on steel L-shaped chassis/landing gear. On the rear wall of chassis/landing gear, is established/installed connector Sh_4, through which to unit will be feed/conducted all feed voltages.

Fig. 21. Unit of the five-stage driver: 1 - the display of the tuning of cascade/stages; 2 - the tube of the control/checking of the selected channel; 3 - commutator switch; 4 - H.f. coupling; 5 - the toggle switch of the start of the lighting of instrument; 6, 8, 10, 11 - the organ/controls of the tuning of cascade/stages; 7 - the cap/cover of inspection hole for the replacement of tube and quartzes; 9 - the knob/button of blocking; 12 - the tube of the control/checking of the work of thermostat; 13 - the switch of the instrument of tuning.

On the front/leading panel of unit (Fig. 21) are arranged the organ/controls of the tuning of control and control/checking of work, there is an inspection hole for the installation of quartzes into thermostat and the replacement of tube L_5. The cap/cover of the inspection hole has electrical interlock of KP_1 and KP_2 (see Fig. 19), which disconnects high voltage with the opening of cap/cover.

The unit of the five-stage driver is installed in the cabinet of the transmitter of P-200M and is fixed in it with the aid of four captive screw/propellers.

Unit of frequency multipliers.

This unit is intended for the frequency multiplication and amplification of h-f oscillations to the value, necessary for the excitation of output unit - power amplifier. Unit consists of the sixth and seventh cascade/stages of frequency multipliers.

Schematic diagram (Fig. 22). The sixth cascade/stage is carried out by diagram with common/general/total grid on the cermet tube of

GI-7B (L_1) and works in the mode/conditions of frequency doubling. The diagram with common/general/total grid provides a good decoupling of input and output circuits, which is especially important in the next-to-last and final stages for the elimination of self-excitation.

Input circuit is formed by the cut of coaxial line and by the input capacitance of tube. Duct is tuned to 36th harmonic of crystal frequency with the aid of capacitive plunger. Excitation voltages from the fifth cascade/stage enter the sixth through h-f cable and through phase inverter PV_1 to the loop of the communication/connection which is arranged in input duct. Phase inverter serves for the agreement of the output resistance of the fifth cascade/stage with the entry impedance of the sixth. It is the coaxial line of the variable length.

Output circuit consists of the cut of coaxial line, on the one hand by the loaded transfer capacitance of tube L_1, and on the other hand shortcircuited capacitive tuning plunger.

Fig. 22. Basic schematic of the unit of frequency multipliers.

Capacitor C_1 divides the circuit of variable and constant components of current. Power take-off from the output circuit of the sixth cascade/stage is realized with the aid of the capacitive probe, carried out in the form of stub with the fastened to its end/lead disk. Probe is lowered in the cavity of coaxial line.

The tuning of cascade/stage is conducted by movement of the plungers and is monitored from the readings of the IP_1, which is included in the cathode circuit of tube L_1 and is shunted by capacitor C_3 for a protection from high-frequency currents.

Anode voltage is supplied from rectifier +1250 v through H.f.-throttle/choke L_5, shunted with capacitor C_5. Filter L_5C_5 eliminates spurious coupling through power supplies with other cascade/stages. Displacement to the sixth cascade/stage automatic. Its value is regulated by variable resistor/resistance R_1, connected in series with the milliammeter of the instrument of IP_1 in the cathode circuit of tube. Excitation voltage from the sixth cascade/stage through the high-frequency cable is supplied on the seventh.

The seventh cascade/stage in diagram and structural fulfillment practically does not differ from the sixth. Input circuit is tuned to 72nd harmonic of crystal frequency, output - to 144th.

Filament voltage 12.6 v on the tubes of the sixth and seventh cascade/stages is supplied from transformer Tr_1 through throttle/chokes L_1, L_2, L_3, L_4, which remove the passage of high-frequency currents in filament circuit. A transformer have three windings: to primary is supplied the current with voltage 208 v and frequency 400 Hz; two secondary windings serve for powering the filaments of the tubes.

Construction. On the front/leading panel of unit (Fig. 23) are arranged the organ/controls of the tuning of the sixth and seventh cascade/stages, instruments IP_1 and IP_2 for the control/checking of the tuning of cascade/stages inspection hole for the exchange of tubes. The cover of inspection hole is equipped by electrical interlock (KP_1 and KP_2, see Fig. 22) for the disconnection of high voltage with the opening of cover.

Fig. 23. Unit of frequency multipliers: 1, 3, 6, 9, 11 - the organ/controls of tuning; 2, 4 - the instruments of the tuning of the sixth and of the seventh cascade/stages respectively: 5, 7 - high-frequency couplings, 8 - the cover of inspection hole for the exchange of tubes; 10 - the knob of blocking; 12 - the toggle switch of the start of the illumination of instruments; 13 - the protective grids of plate circuits.

Fig. 24. Basic schematic of the unit of power amplifier.

Key: (1). Communication/connection. (2). Output/yield. (3). Input. (4). Housing.

In the upper right-hand corner of the front/leading panel of unit is arranged high-frequency coupling "output/yield VIIK" through which is supplied the excitation voltage on the eighth cascade/stage or directly into antenna in the work of radio beacon in the mode of the light rating of emission/radiation.

Unit of power amplifier.

This unit amplifies high-frequency oscillations to the value necessary for the feed of azimuth antenna.

Schematic diagram (Fig. 24). The eighth cascade/stage is assembled by diagram with common/general/total grid on a cermet triode of the type of GS-1B. Input circuit is formed by the cut of coaxial line and by the input capacitance of tube L_1. It is tuned to 144th harmonic of crystal frequency with the aid of capacitive plunger. Excitation voltage from the seventh cascade/stage enters through high-frequency cable to the coupling loop, which is arranged in the cavity of input circuit. Output circuit consists of the cut of coaxial line, on the one hand by the loaded transfer capacitance of tube L_1, and on the other hand - by the capacitive short-circuiting plunger of tuning.

Fig. 25. Unit of power amplifier: 1 - the display of the tuning of unit; 2 - the protective grid of plate circuit; 3, 4, 8 - the organ/controls of the tuning of unit; 5 - h-f coupling; 6 - the cover of inspection hole for the exchange of tubes; 7 - the blocking knob.

Fig. 26. Basic schematic of the unit of the meter of the passage power IPM-1N.

Key: (1). Circuit. (2). Housing. (3). Input. (4). Hz.

power take-off from the output duct is realized with the aid of by a capacitance/capacity of the probe, carried out in the form of stub with disk at end/lead. Value of the tapped power is regulated by the depth of the immersion of capacitive probe into the cavity of duct. The tuning of cascade/stage and the control/checking of cathode cathode current L_1 is realized from the readings of the instrument of IP_1, connected in series with resistor R_1 in the cathode circuit of tube. Instrument IP_1 is shunted by capacitor C_3.

Voltage on the anode of tube L_1 is supplied from rectifier +1700 v through the blocking throttle/choke Dr_1, shunted with capacitor C_5. The anode of tube is d-c insulated from output (anode) circuit by the circular bypass capacitor C_1 with dielectric from porcelain.

Displacement on the grid of tube is obtained because of an incidence/drop in the voltage on variable resistance R_1, connected in the cathode circuit of tube which is d-c insulated from duct by capacitor C_2. Filament voltage on tube comes from transformer transaction. Transformer has two primary windings 1-2 and 2-3. Winding 2-3 is arranged under secondary winding 4-5, while winding 1-2 is separated from the secondary winding by magnetic shunt. Therefore during the passage of current with voltage 208 V and by frequency 400 Hz along winding 2-3 on the secondary winding of transformer will appear voltage 12.6 in, barely depending on the value of the current of load. But if this current is fed to the winding of 1-2 transformers Tr_1, then the voltage will depend greatly on the current of load. During dead short the current of secondary winding will not exceed 8 A.

Fig. 27. Unit of the meter of the passage power: 1- toggle switch of the start of the illumination of instrument; 2 - safety device/fuse; 3 - rule for the measurement of wavelength; 4 - the shielding cap of the light bulb; 5 - measuring meter; 6 - h-f coupling; 7 - the knob/stick of tuning; 8 - nomogram for the calculation of average power.

In the first 4-6 min after the starting/launching of transmitter is included winding 1-2, and winding 2-3 still disconnected, because the filament of tube "cold", its resistor/resistance little and the operating mode of secondary winding is close to the mode/conditions of short circuit. With the warm-up of filament, its resistor/resistance increases, current strength decreases and voltage approaches nominal.

After the function of timing relay, it is included by relay P_1, which by its contacts disconnects winding 1-2 and switches on winding 2-3. in filament circuit, is establish/installed the nominal voltage 12.6 in.

Constiuctions. The unit of power amplifier (Fig. 25) is placed in the upper section of the cabinet of the transmitter P-200M. Network elements are assembled on standard L-shaped chassis/landing gear. On the front/leading panel of unit, are arranged the controls for tuning and adjustment. In right lower to angle there are high-frequency coupling for the connection of the cable with the aid of which the energy is supplied to antenna, the inspection hole for an exchange of tubes whose cap/cover has an interlock (B_2 and B_3, see Fig. 24).

Plate circuit has special shielding cap/covers for a decrease in the strength of H.f.-field in cabin of radio beacon.

Unit of the meter of passage power.

Value determination of passage power is conducted by the measurement of stresses on the cut of coaxial line. Power P in line can be calculated according to formula

where aaaaaaaaaaaaa is the maximum and minimum voltages in line;

ρ is line characteristic.

Voltage from line is remove/taken with the aid of the capacitive probe which is moved along grad line. In this case, are determined the aaaaaaa and the aaaaaaa. The distance between corresponds to the fourth of wavelength. According to the relation of these voltages of aaaaaaaaaa and aaaaaaaaaaa it is possible to judge the coefficients of the traveling (KBV) and standing (KSV) waves, respectively.

Schematic diagram (Fig. 26). The voltage of high frequency with the capacitance/capacity of probe enters the anode of tube L_2 (1D1C) and is detected. Resistor/resistance R_4 closes the circuit of the dc current component of diode. In the cathode circuit of tube L_2, is included the instrument the IP_1 which measures the average current. The upper scale of microammeter is quadratic and corresponds to the average power coefficients. The lower scale uniform serves for determining KBV and KSV. The sensitivity of instruments is regulated with the aid of resistor/resistance R_3. For the stabilization of the initial current of diode during the oscillations of grid/network into filament circuit, between the primary winding of transformer Tr_2 and the secondary winding of transformer Tr_1 is included ballast resistor (tube L_1). The current of ballast resistor depends on the constant value resistor/resistance R_1 and of variable resistance R_2. From the primary winding of transformer Tr_2, is made the removal/outlet to jack G_1 for the supply of gauging voltage on the anode L_2 during the adjustment of the unit of the meter of passage power.

Constructions. The unit of the meter of passage power (Fig. 27) small, with that which is removing itself front/leading panel to which are arranged the instrument IP_2, dial light, the scale for the measurement of the lengths of the will electrical starts and the disconnection of grid/network and the safety device/fuse.

From left side is established/installed h-f coupling for the cable, which goes from transmitter, while with right - high-frequency coupling for the connection of cable to antenna and knob/stick for the movement of capacitive probe along grad line (tuning knob). Within unit are arranged grad line and network elements.

end section.

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Control unit of rectifier +350 in.

Schematic diagram (Fig. 28). Rectifier +350 in is assembled according to bridge circuit on selenium rectifier D_1 (40GD16A). Voltage on rectifying bridge enters from the transformer Tr_1, primary winding of which through the safety device/fuse Pr_2 is connected to grid/network 208 in, 400 Hz (block B_1, terminal 2-3). In parallel to safety device/fuse Pr_2 is included the target/purpose, which consists of resistor/resistance R_7 and the neon tube/lamp NL_2. Neon tube is fired with blowing Pr_2.

Unidirectional voltage is supplied to the filter, employed for the smoothing of pulsations. Pi-section filter consists of throttle/choke Dr_1 and capacitors S_1 and S_2. At the output/yield of filter is a voltage divider R_2-P_4, voltage from which approaches instrument IP_1 in the position of switch V_1 "+350 V". From the second secondary winding of transformer Tr_1 is remove/taken alternating voltage 30 v for the preheating of thermostat.

Transformer Tr_2 serves for the creation of the voltage 6 in, which is utilized for the illumination of all measuring meters in the cabinet of transmitter P-200M. The feed of transformer conducts by current with voltage 208 in, frequency 400 Hz (block P_1, terminal 3-4). In supply-line winding Tr_2 is included the safety device/fuse Pr_1 and circuit R_5. NL_1 for a monitoring of the soundness of safety device/fuse Pr_1.

During the supplying of current with voltage 208 v and frequency

400 Hz wear/operates the relay R_1 but value: 208 in, 400 Hz the terminal emf of couplings P_1-Pr_2 - resistor/resistance R_6 is a diode D_2 - the winding of relay R_1 is a terminal cf 7 couplings P_1 208 in, 400 Hz. To the terminal of 7 couplings P_1 the current with voltage 208 v and frequency 400 Hz enters through the blocking contact of blower, which is closed only in the presence of air flow. This connection of the power of relay R_1 does not allow/assume the supply of high voltage on transmitter without the preliminary start of blower.

Simultaneously with current feed with voltage 208 v and frequency 400 Hz voltage +27 v from the common/general/total rectifier through the terminal of 24 couplings P_2, the safety device/fuse Pr_4 and the terminal of 20 couplings P_2 enters control circuit of transmitter. Page 31.

Fig. 28. The schematic diagram of the block of the administration of rectifier +350 in.

Key: (1). Incandescence. (2). Armature plate. (emf). Work. (4). Illumination. (5). Circuit. (6). Housing. (7). mA. (8). in. (9). Voltage meas. (10). Hz. (11). Max. of relay. (12). Blocking. (13). Illumination. (14). a. Page 32.

After wear/operates relay R_1, safety device/fuse Pr_3, the terminal of 21 couplings P_2, the blocking contacts of the cabinet of transmitter and rectifiers +1250 v even +1700 in, the terminal of 22 couplings P_2 approaches tube LN_2 "blocking is locked". Tube will inflame, if blocking is nowhere disrupted. From terminal 22 voltage +27 in is supplied to the circuit closing contacts of 1-6 relay R_2.

After 4-6 min of timing relay RV wear/operates and by its circuit closing contacts 3-4 supplies feed to the relay R_5, which wear/operates and is self-locked through contacts 5-10. Relay R_5 by contacts 2-7 will de-energize the winding of the feed of the timing relay RV_1.

The contacts of timing relay 5-5 will be closed and they will feed power on relay R_6. R_6 will actuate/operate on the circuit: +27 in the terminal of 24 couplings P_2 is contacts of 1-2 relays R_1 - safety device/fuse Pr_3 is contacts of 2-7 relay R_2 the contacts of 2-7 relay R_3 - the winding of relay R_6 is the earth/ground (-27 c).

The contacts of relay R_6 2-7 and 4-9 will be closed and they will feed feed on relay R_4. Relay R_4 will actuate/operate on the circuit: +27 in the terminal of 24 couplings P_2 is contacts of 1-2 relays R_1 - safety device/fuse is contacts of 2-7 relay R_6 - the winding of relay R_4 is the earth/ground (-27 c).

In this case contacts 1-6 include the circuit of the powering of relay R_2, contacts 5-10 shunt the contacts of 2-7 relay R_2, and contacts 2-7 disrupt the feed circuit of the tube of LN_3 "actuate/operated the maximum protection". Relay R_2 wear/operates on the circuit: +27 in the terminal of 24 couplings P_2 is contacts of 1-2 relays R_1 - safety device/fuse Pr_3 is contacts of 1-6 relay R_4 - the winding of relay R_2 is the earth/ground (-27 c). With this relay R_2 it is self-locked through contacts 5-10. Contacts 2-7 is extended, but this does not affect the work of circuit, since in parallel to them are included the contacts of 5-10 relays R_4.

Through the contacts of 4-9 relay R_6 and the switch V_3 the "start of high voltage" the voltage +27 in is supplied to the windings of three relays, arrange/located in the lower section of the cabinet of transmitter on the circuit: +27 C - is a terminal of 24 couplings P_2 - the contacts of 1-2 relays R_1 are a safety device/fuse Pr_3 - switch V_3 is contacts of 4-9 relay R_6 - the terminal of 19 couplings P_2 is windings of relay R_1, R_3, R_4 - the earth/ground (-27 c). Relays will actuate/operate and will include/connect rectifiers +1250 v even +1700 in. In this case will inflame the tube LN_4 "high voltage included". With this concludes the turn-on transient of rectifiers.

With the overloading of rectifiers +1250 v even +1700 into the relay R_3, connected in the load of rectifiers, wear/operate and it breaks its contacts 2-7. In this case they are disconnect/turned off by relay R_6 and R_4. Simultaneously they are de-energized by relay R_1, R_3, R_4. They disconnect/turn off rectifiers and include tube LN_3 "actuate/operated the maximum protection".

After the elimination of the reason for overloading the inclusion of rectifiers +1250 v even +1700 in can be produced without time element by pushing of knob Kn_2 the "return of the maximum protection". In this case again will actuate/operate the relays R_6 and R_4, which will produce the necessary starts and will extinguish tube IN_3.

Timing relay is shunted knob Kn_1, by pressure which it is possible to include/connect high voltage without the delay of timing relay.

For a signaling about the disconnection of high voltage is provided the equipment/device, which consists of diodes D_3, D_4 and howler. Upon the disappearance of the high voltage of relay R_6 it is disconnected and dumps +27 in by its contacts 4-9 (with the connected switch V_3) from the terminal of 17 couplings P_2, which leads to the start of sound signal (howler). Page 33.

Fig. 29. Control unit of rectifier +350 in: 1, 2, 5, 7, 11 - indicator lights; 8, 10, 13, 15 - predxraniteli; emf - measuring meter; 4 - the toggle switch of the start of the illumination of measuring meter; 6 - the toggle switch of the switch of incandescence, closed by cap/cover; 9 - the knob/button of the return of the maximum protection; 12 - instrument switch; 14 - the toggle switch of the start of high voltage; 16 - the knob/button of the shunting of timing relay. Toggle switch V_4 serves for switching incandescence from mode/conditions "work" into mode/conditions "hardening" in the training/aging of tubes.

In unit there are instruments IP_1 and a switch V_1.

With the aid of switch the voltmeter is connected to the measuring potentiometer of any of the rectifiers.

Constructions. On the front/leading wall of the control unit by rectifier +350 in (Fig. 29) are arranged the cell/elements of control and indication, measuring meter for the checking of the feeding voltages, safety device/fuses.

Unit of high-voltage rectifier.

Schematic diagram (Fig. 30). Unit consists of two series-connected rectifiers +1250 v even +500 in. Voltage on both rectifiers is supplied from one power three-phase transformer Tr_1, which has two secondary windings.

Rectifier +1250 in is assembled on selenium cell/elements D_1 the type 75ED24G according to three-phase bridge circuit. For the smoothing of the pulsations of unidirectional voltage is provided the filter, which is of throttle/choke Dr_1 and capacitor C_1. At the output/yield of rectifier is included divider/denominator R_2-R_7, voltage from which through the terminal of 15 couplings P_5 and the switch V_1 (see Fig. 28) it is supplied to measuring meter IP_1.

Rectifier +500 in is assembled on selenium cell/elements D_2 (see Fig. 30) according to three-phase bridge circuit. At the output/yield of rectifier is included the ripple filter, which consists of throttle/choke Dr_2 and capacitor S_2, and the measuring potentiometer

R_8-R_{13}. Voltage from this potentiometer through the terminal of 14 couplings P_5 and the switch V_1 (see Fig. 28) is supplied to instrument IP_1.

Current with voltage 208 v and frequency 400 Hz through the coupling P_1 (see Fig. 30) and terminals 1-2-3 approaches automatic machine Av_1 (" grid/network"). Rectifiers are switched on by automatic machine Av_1. In this case voltage 208 in 400 Hz approaches the contacts of 1-2 contactors R_1, which wear/operates after that, kA will be include/connected by the timing relay RV_1 (see Fig. 28).

In the circuit of rectifiers +1250 v even +1700 into provided safety device, which consists of resistor/resistance R_{14} (see Fig. 30), through which "grounded" common/general/total minus of rectifiers and overload relay.

Signalling device from resistor/resistance R_{15}, selenium rectifier D_3 and relay R_2 is intended for the prevention/warning of the service personnel about the absence of anode voltage. If the circuit which feeds anode transformer, is exact, then relay R_2 is included by its breaking contact 2-7, 4-9 disrupts circuit +27 v on howler. But if for any reason current with voltage 208 v and frequency 400 Hz is absent, the relay R_2 is disconnect/turned off and includes howler. Page 34.

Fig. 30. The schematic diagram of the block of high-voltage rectifier.

Key: (1). Grid/network. (2). Circuit. (2a). Grid/network. (2b). in. (2c) Hz. (emf). Housing. (4). Signal. (5). Blocking. (6). Illumin. (7). mA. (8). Volt. meas. (9). Max. of relay. In the unit of the rectifier is provided blocking through contacts Kn_1 and Kn_2, which disconnect/turns off high voltage with the opening of cap/cover on the front/leading wall of unit. Unit is arranged in the lower section of the cabinet of the transmitter P-200M.

Transmitters P-20A and P-20D.

Transmitter P-20A is intended for the generation of the reference signals "35" and "36", which together with the signal of the transmitter P-200M, make it possible aboard the aircraft to determine the values of azimuth relative to the site of installation of radio beacon.

Transmitter P-20D is intended for the relay retort of the inquiring signals, which enter from aircraft transmitter. These signals are called reciprocal. They are necessary for determining the instantaneous value of range aboard the aircraft. Furthermore, the transmitter P-20D generates the two-degree signals, which are utilized for the work of the ground-based PPI, on which is superimposed the identification signal, coded in alphabet of Morse code. Transmitters P-20A and P-20D are almost identical in their structural/design and circuit performance.

The transmitters P-20A and P-20D consist of the units of the generators of frequency 1 (Fig. 31), the keying units 2, of the assemblies of the administration of rectifier 11 kV emf, the power supply units of modulators 4, of the units of high-voltage rectifiers 5, of the diplex unit of the automatic frequency control (AFC), of the power supply unit of unit AFC, of phase inverters, diplex unit of the control/checking of frequency (BKCh), of the units of the meters of the passage power IMP-2I, unit of encoder with the power supply unit, sensor unit of reference signals. Page 35.

Fig. 31. Cabinet of the transmitter P-20A.

Fig. 32. Functional transmitter circuit P-20A and P-20D.

Key: (1). Antennas. (2). Unit of the meter of passage power. (emf). Phase inverter. (4). Keying unit. (5). Unit of generator. (6). Unit AFC. (7). Unit of encoder. (8). Sensors. Functional diagram (Fig. 32). Transmitters work as follows. During the rotation of the azimuth antenna of radio beacon four electromagnetic sensors, arrange/located in the column of the drive of this antenna, generate two polar momentum/impulse/pulses. two sensors form/shape reference pulses "35" and "36", the third is intended for obtaining two-degree call momentum/impulse/pulses and the fourth form/shapes momentum/impulse/pulse into the torque/moment of the passage of the middle of failure of the radiation pattern of the azimuth antenna through the direction in true north. Bipolar momentum/impulse/pulses are supplied from electromagnetic sensors to the input of the unit of encoder.

In the unit of encoder are form/shaped, are coded and are distributed the momentum/impulse/pulses, which start transmitters and PPI. From the output/yield of this unit rectangular reference pulses "35" and "36" together with northern momentum/impulse/pulse are supplied to the keying unit of the transmitter P-20A, but two-degree and inquiring - to the keying unit of transmitter P-20D.

The keying units of transmitters form/shape the momentum/impulse/pulses of the high voltage, necessary for the work of high-frequency oscillators. The intensive signals through phase inverters and the unit of the meter of passage power are supplied to antenna and are emitted into space. Phase inverters will match the output resistance of high-frequency oscillator with input antenna resistance. Page 36.

Fig. 33. The schematic diagram of the block of high-frequency oscillator.

Key: (1). Output/yield. (2). Incandescence. (emf). Work. (4). Switching on. (5). Indicator of work AFC. (6). Input. The unit of the meter of passage power monitors the power output of both transmitters, it measures the oscillation frequency, KBV and KSV of the feeders, which supply energy from transmitters to antenna.

Part of the high-frequency energy across the coupler goes to the input of units AFC and of BKCh. Unit AFC supports with constant oscillator frequency and reconstructs them to any of 40 fixed/recorded frequencies. Unit BKCh is intended for the operational inspection of transmitter frequency.

The feed of transmitters is realized from the special units of rectifiers. The control units by rectifiers including disconnect/turn off rectifiers, is monitored their work.

Unit of high-frequency oscillator.

This unit is intended for the generation of high-frequency signals. It includes oscillatory circuits with a cermet triode of the type GI-14B, the coupler of unit AFC, the mechanism of tuning and frequency control.

Schematic diagram (Fig. 33). Oscillator is assembled according to circuit with common/general/total grid. Its input and output circuits are carried out in the form of the cuts of the coaxial line, connected in circuit of grid - the anode and grid is a cathode.

Input oscillatory circuit is formed by inductance in the form of coaxial line (anode-grid tube) and by input capacitance (Fig. 34b) tube (grid - cathode). This duct from one end/lead is closed by the short-circuiting tuning plunger. The cathode of tube is isolate/insulated by direct current from oscillatory circuit by bypass capacitor (Fig. 34a). Page 37.

Fig. 34. Simplified (a) and equivalent (b) schematic of high-frequency oscillator.

Key: (1). Coupling element. (2). Coupling slit of a waveguide. Output oscillatory circuit (grid the anode) is formed by inductance in the form of coaxial line (anode-gr d tube) and by transfer capacitance tube (see Fig. 34b). This duct from one end/lead is closed by the short-circuiting tuning plunger. about to direct current the anode of tube is isolate/insulated from duct with the aid of bypass capacitor (see Fig. 34a), with ceramic dielectric. Capacitors and for high-frequency currents represent low resistor/resistance.

Feedback in circuit is realized through the capacitance/capacity (see Fig. 34b) tube. Since in all working frequency band this capacitance/capacity does not provide the necessary value of feedback, latter is increased because of the fulfillment of special gashes in the grid tube of coaxial line. This communication/connection is equivalent to the connection of supplementary capacitance/capacity in parallel

Power take-off is realized with the aid of the capacitive probe, omitted into the cavity of plate circuit in the location of the grid of tube. The value of the take/selected power is regulated with the aid of knob/stick "communication/connection". Probe connect with coaxial line with high-frequency coupling. High-frequency oscillations enter through the unit of the meter of passage power to antenna.

The coarse adjustment of oscillator of the assigned fixed/recorded frequency conducts by the displacement/movement of anode and cathode plunger, and a precise tuning - with the aid of the iron core, introduced into the cavity of plate circuit.

Retuning from one fixed/recorded frequency to another can be done automatically from unit AFC or by hand with the aid of knob/stick "tuning".

The automatic retuning of oscillator from one frequency to another occurs as follows. During the installation of switch V_1 - "man.-auto" - to the position of "authors" (see Fig. 33) the voltage +27 in it is supplied to the winding of relay R_1 on the circuit: +27 in the terminal of 18 couplings Sh_1 is a switch V_1 - the limit switches KP_1 and KP_2 are a winding of relay R_1 - the terminal of 11 couplings W_1 -27 in. Relay R_1 operates, contacts 1-6, 2-7, 4-9, 5-10 will be closed and three-phase current with voltage 209 v and frequency 400 Hz from coupling Sh_1 through terminals 2, emf, 4 it is supplied to the winding of motor M_1.

The first phase of this current for the feed of electric motor M_1 is supplied on the circuits: the terminal of 2 couplings Sh_1 is the circuit closing contacts of 1-6 relay R_1 - terminal 1 winding of electric motor; the second phase - on the circuit: the terminal emf of couplings Sh_1 is the circuit closing contacts of 4-9 relay R_1 - the breaking contact of 4-5 relay R_2 the terminal of 2 windings of electric motor; the third phase - on the circuit: the terminal of 4 couplings Sh_1 is the circuit closing contacts of 2-7 relay R_1 - the breaking contact of 1-2 relays R_2 are a terminal emf of windings of electric motor.

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Electric motor begins to rotate and moves tuning plungers. The mechanism of the retuning of ducts has two end switches KP_3 and KP_4, with the aid of which are changed over the phases of current, supplied to electric motor. Upon reaching by plunger of one of the end positions the tappet drum presses on the contacts of the end switch KP_3. Contacts are broken, and the circuit of the winding of relay R_2 is closed: +27 C - is a coupling Sh_1 terminal 18 - the winding of relay R_2 the locked contacts KP_4 and KP_3 27 in (earth/ground). Relay R_2 wear/operates and it breaks contact 1-2, 4-5, 7-8, 10-11 it closes contacts 2-3, 5-6, 8-9, 11-12. In this case is changed the order of the alternation of phases and electric motor begins to rotate in the other direction. The contacts of 8-9 relay R_2 block end switch KP_3, providing the work of electric motor M_1 during the displacement of the cam/catch/jaw of the mechanism of retuning from the contacts of the switch KP_3.

Upon reaching by the plunger of the tuning of another end position the cam/catch/jaw of the mechanism of retuning presses on contact KP_4. Relay R_2 is de-energized and restores the initial ordering of the phases of the current of electric motor M_1.

The motion of plungers continues, thus far relay R_1 is located under voltage. The feed of relay R_1 is disconnect/turned off either automatically by unit AFC upon reaching by the plungers of that position, which provides generation at the assigned frequency or by band switch V_1. The search for the required frequency conducts during the motion of the plungers of tuning in both directions.

In order in the case of any malfunction in the mechanism of retuning not to destroy ducts, are established/installed two emergency limit switches KP_1 and KP_2, which remove/take feed from the electric motor of retuning.

For precise frequency control is a special mechanism, which is put into action by electric motor M_2. An electric motor have two windings (excitation and controls). The feed of both windings conducts from unit AFC. Current with voltage 30 v and frequency 400 Hz through the terminals of 9-10 couplings Sh_1 is supplied to excitation winding 2-4, but through terminals 7-8 - to control winding 1-3. Under the action of control voltage the electric motor rotates and through the reducer it changes the submersion depth of iron core (cell/element of the fine tuning of duct).

In order that the cell/element of fine tuning would be located in the mid-position during the automatic search for the required oscillator frequency, on one of the axes of the mechanism of a precise tuning was established/installed the contact disk, which together with the contact KF_7 creates the supplementary feed circuit of relay (+27 C - V_1 - the contacts KN_1 and KN_2 - the winding of relay R_1 - the contacts of 5-10 relays R_1 - KN_7 - 27 c). This makes it possible to move to the plunger of tuning on as much, as occupies contact surface on disk. When disk by its insulating sector breaks the feed circuit of relay R_1, the plungers of tuning they will stop, and the cell/element of fine tuning will be located in the mid-position.

The voltage of anode feed on tube GS-14B (about 12 kV) is supplied from peak transformer, and displacement to the grid of tube - from variable resistance R_1 because of a voltage drop across it during the passage of complete cathode current.

For a monitoring of work of oscillator in the cathode circuit of tube is included the instrument IP_1, protected at high frequency by capacitor S_1.

Construction (Fig. 35). The network elements are assembled on steel chassis/landing gear cf U-shaped construction, on rear wall of which is arranged coupling Sh_1 and high-voltage coupling I_1 (see Fig. 33), the supplying feeding and contrcl voltages. On the front/leading panel of unit are arranged the organ/ccntrcls cf transmitter tuning, high-frequency coupling for the connection cf cscillator for antenna, the displays of the mode/conditions of transmitter, also, with boron cf frequency control. Page 39.

Fig. 35. Unit of the high-frequency oscillator: 1., 2. high-frequency couplings; emf - the indicator of work AFC; 4 - the tube of oscillator; 5 - instrument of the developments of unit; 6, 7. the organ/controls of tuning of unit.

Fig. 36. The schematic diagram of the block of modulator.

Key: (1). Monitoring of modulator driver. (1A). in. (1b). Hz. (1c). [Illegible]. (1d). Circuit. (2). Housing. (emf). Monitoring of starting/launching. (4). Grid/network. The arrow/pointer of the instrument of frequency control is stopped, when oscillator is tuned to the assigned frequency. Remaining time it rotates. For the replacement of the tube GS-14B is an inspection hole. The cap/cover of inspection hole with louver has a blocking KP_5 and KP_6 (see Fig. 33), which disconnects high voltage with the opening of cap/cover.

The unit of oscillator is arranged in the upper part of the cabinet of transmitters and is secured with the aid of four nondropout screw/propellers.

Keying unit.

Schematic diagram (Fig. 36). This unit consists of two-stage modulator driver and the modulator, that simultaneously is power amplifier. The first cascade/stage of modulator driver is assembled on the tube GMI-6 (L_1), both halves of which are included in parallel. This start makes it possible to obtain large power, but together with this can arise parasites in the circuits of tube, which requires the application/use of special measures for their elimination.

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As the plate load of cascade/stage serves the primary winding of transformer transaction.

To the arrival of the trigger pulse of tube L_1 is closed by negative voltage -80 in, by subject on the control electrodes of both of the half of tube from power supply unit through the filter, which consists of resistor/resistance R_{26} and capacitor S_9. Trigger pulses about 100 in amplitude are supplied from encoder to the control electrode of tube L_1 through the terminal of 5 couplings Sh_3 and the capacitor S_1. Tube is blocked, and in the primary winding of transformer appears the voltage pulse, which transmits into the secondary winding of transformer Tr_1.

In the circuit of the screen grid are included the capacitor S_2 and resistor/resistance R_{31}, which compose equalizer. To the arrival of trigger pulse the capacitor S_2 charges itself on the circuit: +400 C - is R_{31} - S_2 -400 v to the supply voltage, which is somewhat greater than that, that is applied to screen grid. At the torque/moment of the blockage of tube the voltage on its screen grid turns out to be that which was increased. Therefore the current through the tube during the passage of leading impulse front in comparison with the current through it during the passage of basic part of the momentum/impulse/pulse will be more, since with the torque/moment of blocking of tube it begins to pass screen current and voltage to decrease because of a voltage drop across resistor/resistance R_{31} and the partial discharge of capacitance/capacity S_2.

Capacitor is discharged on the circuit: S_2-R_4-L_1 - the earth/ground - S_2. Resistor/resistances R_1-R_5, connected in the circuit of the managers, the screen grids and the anode, prevent the onset of parasites. Resistor/resistances R_6 it shunts the secondary winding of transformer Tr_1 and performs the role of damper in the case of the onset of oscillating process through the termination of trigger pulse. The anode and shielding circuits of tube L_1 are supplied from rectifier +400 in, voltage is supplied from the power supply unit of the modulator through the terminal of 2 couplings Sh_1.

From secondary winding peak transformer Tr_1 the positive pulses through the capacitor S_3 are supplied to the control electrodes of tubes L_2 (GMI-6) and L_3 (GMI-6). On tubes L_2 and L_3 is assembled by second cascade/stage of modulator driver. Tubes are included in parallel and to the arrival of trigger pulse are closed by the negative voltage 150 V, sent to the managers of the networks of power supply unit through the decoupling filter, which consists of resistor/resistance R_{27} and the capacitor S_{10}.

The positive trigger pulse about 200 in amplitude is supplied to the control electrodes of the tubes, which trigger themselves for a period of the action of momentum/impulse/pulse. In the primary winding of transformer Tr_2 appears the voltage pulse, which transmits into the secondary winding of transformer Tr_2. The circuit, which consists of capacitor S_{12} resistor/resistance R_{30}, corrects leading impulse front.

The secondary winding of transformer Tr_2 is protected by resistor/resistances R_{17} and R_{18}, which are attenuators.

Resistor/resistance R_{13}, furthermore, is intended for obtaining control voltage n socket G_1 the "monitoring of modulator driver". Resistor/resistances R_7-R_{16} serve for the prevention of parasites.

Feed to the anodes of tube is supplied from rectifier +1500 in the power supply unit of the modulator through the primary winding of transformer Tr_2. Voltage +600 in approaches screen grids from the unit of power through the terminal of 2 couplings Sh_1.

From the secondary winding of transformer Tr_2 the positive pulses across the isolating capacitor S_5 go to the control electrodes of two in parallel connected tubes L_4 (GMI-90) and L_5 (GMI-90), on which is assembled the modulator.

Modulator is constructed according to the circuit of the partial discharge of the capacitance/capacity, which is accumulator of energy. This modulator makes it possible to change over wide limits repetition frequency and pulse duration without any switchings in circuit. Page 41.

Fig. 37. Keying unit. This is especially important for the modulator of the transmitter P-20D, the repetition frequency of trigger pulses of which is changed within limits from 30 to 1500 Hz depending on the number of aircraft, which work in the given torque/moment with radio beacon.

To the arrival of trigger pulse from the modulator driver of tube L_4 and L_5 are closed by negative voltage -700 in, by subject on the control electrodes through the coupling Sh_1, terminal 1 and the filter, which consists of resistor/resistance R_{28} and the capacitor S_{11}. Capacitor S_8 charges itself from high-voltage rectifier to the voltage, close to the supply voltage in the circuit: +9 kV are a coupling I_1 - resistor/resistance R_{22} is a capacitor S_8 - the primary winding of transformer Tr_1 -9 kV.

Positive pulse on the order of 800 in amplitude is supplied to the control electrodes of tubes L_4 and L_5 and triggers them. Anode resistance to direct current becomes small and capacitor S_8 - tube L_4 and L_5 - the earth/ground - the primary winding of the peak transformer Tr_1, arrange/located in the unit of the oscillator of H.f. - capacitor S_8.

During the passage of the current of capacitor discharge S_8 through the primary winding of pulse transformer Tr_1 in its secondary winding appears the momentum/impulse/pulse of positive polarity with voltage of approximately 12 kV.

The capacitance value of capacitor S_8 (0.5 μF) provides an almost constant value of surge voltage on the anode of the tube of the oscillator of the transmitter P-20D during pulse duration, but does not provide this constancy in the transmitter P-20A, since pulse duration, equal to 6 μss, is considerably more the pulse duration of the transmitter P-20D, equal to 1 μs. Therefore for maintaining the constancy of the value of surge voltage on the oscillator of the transmitter P-20A in parallel to capacitance/capacity S_8 is connected the supplementary capacitance/capacity equal to 2 μF.

The circuit which consists of capacitors S_6, S_7 and resistor/resistance R_{29}, corrects leading impulse front. Resistor/resistances R_{19}, R_{21}, R_{22} and R_{25} prevent the onset of parasites.

The feeding voltages on the anodes and the screen grids of tubes are supplied from the power supply unit of modulator, voltage +9 kV on the anodes of tubes - through high-voltage coupling I_1, voltage +1200 v on screen grids - through the terminal of 1 coupling Sh_2. The feed of the filament circuits of modulator driver and modulator is realized from common/general/total transformer Tr_3.

In keying unit on front/leading panel is established/installed the pushbutton automatic machine Av_1, with the aid of which is included and is disconnect/turned off the current with voltage 208 v and frequency 400 Hz, which feeds transmitter.

Constructions. Modulator (Fig. 37) is assembled on standard U-shaped chassis/landing gear, on which are placed all network elements. the pulse transformer of modulator and accumulative capacitance/capacity are established/installed in the cabinet of transmitter. Page 42.

Fig. 38. The schematic diagram of the block of control by rectifier 11 kV.

Key: (1). [Illegible]. (2). Circuit.

On the front/leading panel of unit is arranged the automatic machine Av_1 (see Fig. 36) and the sockets G_1-G_3 for the monitoring of the work of modulator with the aid of oscillograph. Keying units is established/installed in the cabinet of transmitter and is attached rendrcpout screw/propellers.

Control unit of rectifier 11 kV.

Schematic diagram (Fig. 38). Three-phase current with voltage 208 v and frequency 400 Hz will be feed/conducted to the control unit through terminals 2, emf, 4 couplings P_1. Furthermore, to the terminal of 16 couplings P_2 is conducted one phase of the current through the contact of blower No. 1, which eliminates the start of transmitters with the switched off blowout of the tubes of oscillator.

Upon switching on automatic machines Av_1 (see Fig. 36) in keying unit the current approaches transformer Tr_1 (see Fig. 38), that feeds the dial lights LN_3 and LN_4.

Illumination is included by toggle switch V_2. In parallel to safety device/fuse Pr_1, is included the circuit, which consists of resistor/resistance R_1 and the neon tube/lamp NL_1, intended for a signaling about the malfunction of safety device/fuse.

Simultaneously current is supplied to the terminals of 8-9 couplings P_1 for the feed of filament transformers, on relay R_1 and the timing relay RV_1. If is included the blowout of the tubes of oscillator, then relay R_1 will actuate/operate and it will feed voltage +27 v from rectifier in control circuit through the safety device/fuse Pr_4 ("control circuit"). Relay R_1 wear/operates on the circuit: 208 in, 400 Hz (terminal of 4 couplings P_1) - resistor/resistance R_3 is a rectifier D_1 - the winding of relay R_1 is a terminal of 16 couplings P_2 - 208 in, 400 Hz closes contacts 1-2. In this case the voltage +27 in enters control circuit. If blocking is locked, then on the circuit: +27 C - the terminal of 21 couplings

P_2 - blocking is a terminal of 22 couplings P_2 - resistor/resistance R_4 is a tube LN_1 "blocking is locked" -27 in, tube "blocking is locked" it is fired, signalling, that the blocking is not disrupted.

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After 3-4 min wear/operates the timing relay RV_1 and through contacts 1-6 supplies voltage +27 v on the terminal of 13 couplings P_2 and of the relay R_2, which, after actuate/operating, it is self-locked through contacts 5-10, disconnect/turns off the feed of the timing relay RV_1 and through contacts 1-6 it provides switching the incandescence of the tube GI-14B in the unit of oscillator. Upon the reclosing of transmitter it is possible to use the knob/button KN_1 in order to shorten the on time of transmitter. Knob/button KN_1 shunts the performing contact of timing relay and simultaneously the closing relay R_6, which, being self-locked through contacts 1-2, supplies voltage +27 v through contacts 3-4 on switch V_1.

The transformer Tr_2, which controls high voltage, has blocking contact KN_2, which is closed during the installation of the minimum voltage. In this case, if switch V_1 the "inclusion of high voltage" costs in position "On", operates relay R_3.

Relay R_3 wear/operates on the circuit: +27 C - are terminals of 21-22 couplings P_2 - blocking is a switch V_1 - contact KN_2 is contacts of 2-7 relay R_4 - the winding of relay R_3-27 in. Relay R_3 wear/operates and shunts by its contacts 7-8 contacts KN_2, which provides the possibility of the adjustment of high voltage to 11 kV. With conta s 2-3 is supplied feed on relay R_5 and foot LN_2 "high voltage is included". Relay supplies feed to variac (transformer Tr_2), the terminal of 15 couplings P_2 and the terminal of 11 couplings P_1. From the terminals of 14-15 couplings P_2 the current with voltage 208 v and frequency 400 Hz approaches the winding of anode transformer (in the diagram is not shown).

The turn-on transient power supplies concludes unit of high voltage 9 kV with the aid of transformer Tr_2.

If in the work of transmitter on any reason occurs the overloading of rectifier 11 kV, then will be include/connected relay R_4. It by contacts 4-9 will disconnect the relay R_3, which will ensure with relay R_5, and the latter will disconnect high voltage.

For the reclosing of voltage 11 kV it is necessary to establish/install transformer Tr_2 to initial position (minimum voltage). The winding of relay R_3 is shunted by capacitor S_3 for an increase in the time constant of circuit, which is necessary for the retarding/deceleration/delay of the start of this relay during the function of the relay of the maximum protection R_4 from random short-term overloadings.

In the circuit of the control unit is provided the device, which signals about disconnection or about the absence of anode voltage. Signalling device consists of howler, relay R_3, selenium rectifier D_2. If relay R_3 is de-energized (it in this case will disconnect high voltage), then through its contacts 1-2, selenium rectifiers D_2, D_3 and the terminal of 17 couplings P_2 will be include/connected sound communication (howler).

Constructions. On front/leading wall (Fig. 39) are arranged the cell/elements of control and direction. Unit is established/installed in the cabinet of transmitter.

Power supply unit of modulator.

This unit provides modulator with the necessary feeding voltages: -600--700 in, -100--150 in, -50--100 in, +400 in, +600 in, +1200 in, +1500 in.

Schematic diagram (Fig. 40). Voltages 600--700 in, -100--150 in, -50--100 in provide the rectifier, assembled according to bridge circuit and which consists of transformer Tr_1, selenium rectifier D_1 and pi-section filter. Filter consists of capacitors S_1 and S_2, low-frequency throttle/choke Dr_1 and resistor/resistance R_4. Resistor/resistance R_1 is selected in the process of transmitter tuning during the adjustment of voltage 700 in. Page 44.

Fig. 39. Control unit of rectifier 11 kV: 1. , 2. measuring meters; emf - the toggle switch of the start of illumination; 4 - the tube of the monitoring of the completeness of safety device/fuse; 5, 9, 11, 12. safety device/fuses; 6 - the tube of the signaling of blocking; 7 - the adjustment knob of high voltage; 8 - the toggle switch of the disconnection of high voltage; 10 - the knob/button of the shunting of timing relay. At the output/yield of rectifier -700 in are connected the voltage dividers. The divider/denominator, which consists of resistor/resistances R_8, R_{10}, R_{11}, is intended for obtaining the voltage within limits -600-700 in. Resistor/resistance R_9 included in parallel R_8 serves as shunt for the measuring meter IP_1, with the aid of which is monitored the stress level - 700 in. The divider/denominator is, which consists of resistor/resistances R_{12}, R_{13}, R_{14}, R_{15}, R_{17}, R_{18}, is designed for obtaining the voltage -100--150 in whose value is regulated with the aid of potentiometer R_{13} according to the instrument IP_1. As shunt for an instrument serves potentiometer R_{16}, R_{17}, R_{18}. The divider/denominator, which consists of resistor/resistances R_{19}, R_{20}, R_{21}, R_{22}, R_{23}, R_{24}, R_{25}, is intended for obtaining the voltage 10--100 in whose value is establish/installed with the aid of potentiometer R_{20} according to the instrument IP_1. As shunt for an instrument serves resistor/resistance R_{24}.

Current with voltage 208 v and frequency 400 Hz is supplied to transformer Tr_1 from terminals 4 and 5 couplings P_1 through the safety device/fuse Pr_2. For the protection of transmitter in the case of the malfunction of rectifier in parallel to the load of rectifier is included the circuit, which consists of relay R_1 and resistor/resistances R_5, R_6. Relay R_1 wear/operates only in the presence of displacement. By contacts 1-2 it ignites pilot lamp LN_2 "displacement included", while by contacts 3-4 it closes the blocking of the start of high voltage, which creates the circuit of the start of transmitter. Bias voltage is monitored with the aid of the instrument IP_1 with the scale 800 in, which is connected by switch V_1.

Voltages +400, +600. +1200 and +1500 in develop three separate rectifiers, that feed from common/general/total transformer Tr_2. Rectifier +400 in is assembled on selenium cell/elements D_2 on bridge circuit with the pi-section filter, which consists of capacitors S_4 and S_5 throttle/choke Dr_2 and series-connected resistor R_{26}, intended for the adjustment of voltage +400 in. In parallel to rectifier is included potentiometer R_{27}, R_{28}, R_{29}. Rectifier +600 v by circuit and according to operating principle is analogous to rectifier -400 v and is assembled on selenium rectifiers D_3. In its filter enter: throttle/choke Dr_2 the capacitors S_6, S_7 and divider/denominator R_{31},

R_{32}, R_{33}, R_{34}. Rectifier +1200 and +1500 in is assembled according to full-wave circuit on high-voltages rectifier L_1 and L_2 (V1 = 0.1/30) with the filter, which consists of throttle/choke Dr_4 and capacitors S_8 and S_9. Page 45.

Fig. 40. The schematic diagram of the block of the feed of modulator.

Key: (1). Circuit. (2). Housing. (2a). V. (2b). Hz. (2c). mA. (emf). Blocking. (4). illumination. Resistor/resistance R_{40} serves for the adjustment of voltage +1500 in. Voltage +1200 in is remove/taken after the supplementary filter R_{41} and S_{10}. Divider/denominator for the measurement of stresses consists of resistor/resistances R_{26}, R_{37} and R_{38}.

Positive voltages are monitored with the aid of the instrument IP_2 with the scale on 2000 in, which is switched by switch V_2. Supply voltage on rectifiers is supplied through the unit of control with delay 3-4 min, terminals 2, emf couplings P_2 and safety device/fuses Pr_3 and Pr_1.

Constructions. On front/leading panel (Fig. 41) are arranged the organ/controls of the monitoring of the work of rectifiers and the cell/elements of signaling. Unit is established/installed in the cabinet of transmitter and is attached with the aid of the captive screw/propellers.

Units of high-voltage rectifiers.

These units (Figs. 42, 43) are intended for the feed of transmitters P-20A and P-20D. They differ only in terms of fact that the rectifier 11 kV for the transmitter P-20D contains two transformers Tr_1 and Tr_2, which are included between themselves in parallel. Is given below the description of the schematic diagram of rectifier for the transmitter P-20D.

Schematic diagram. Rectifier is assembled by diagram of duplication on high-voltages rectifier L_1 and L_2 (V1-01/30). Transformer Tr_1 has two primary windings, to one of which the voltage completely is supplied immediately after start. On the second shunt winding of feed goes across the voltage regulator Tr_2 that it makes it possible to regulate the voltage, removed from its secondary winding within limits 5-11 kV.

Minus of rectifier is grounded through resistor/resistances R_8 and [illegible]. In parallel to resistor/resistance R_8 is included relay R_4 (relay of the maximum protection) and voltmeter, the arranged/located in unit controls of rectifier 11 kV. Page 46.

Fig. 41. Power supply unit of the modulator: 1 - the dial light of instruments; 2, emf - measuring meters; 4, 7 - instrument switches, 5 - the tube of the checking of the presence of bias voltage; 6 - the toggle switch of the start of the illumination of instruments. Resistor/resistance R_4 shields the control unit from the incidence/impingement of high voltage. The potentiometer, which consists of resistor/resistances R_1-R_6, through resistor/resistance R_7 is connected to voltmeter with the scale on 15 kV. The filaments of kenotrons are supplied from special transformer Tr_3.

Rectifiers 11 kV are arranged in the lower sections of the cabinets of transmitters and are closed by cap/covers. The contacts Kn_1 and Kn_2 disconnect/turn off high voltage with the opening of cap/cover. Control by these rectifiers conducts from the control units.

End section.

Fig. 42. Schematic diagram of rectifier 11 kV P-20D.

Key: (1). Target/purpose. (2). Housing. (2a). in. (2b). Hz. (3). Blocking. (4). Max. protection. (5). Will measure voltage. (6). Neg. voltage.

Fig. 43. Schematic diagram of rectifier 11 kV P-20A.

Key: (1). Circuit. (2). Housing. (2a). in. (2b). Hz. (2c). Blocking. (3). Max. protection. (4). Voltage meas.

Block of automatic frequency control.

This block has two channel, each of which consists of mixer, the IF amplifier (UPCh), of discriminator, expander, of balanced modulator, terminal amplifier, amplifier direct current (UPT) with search relay. Common/general/total for both channels are the heterodyne and the calibrator.

Functional diagram (Fig. 44). Both channels of block AFC - azimuth and ranging - have two operating mode: the mode/conditions of tracking and search mode.

The mode/conditions of tracking is intended for maintaining the frequency of transmitters P-20A and P-20D within the assigned limits. The search mode provides the tuning of high-frequency oscillator in the case of the automatic retuning of transmitter from channel to channel.

The operating principle of block AFC in the mode/conditions of tracking entails the following. The signals of high frequency through the ccupler from the output/yield of high-frequency oscillators are supplied to the mixers of the azimual and ranging channels of block AFCh. Mixers the transfcrmed signals cf high frequency into the signals of intermediate frequency. Simultaneously to mixers is supplied voltage/stress from the hetercdyne, ccmmon/general/total for ranging (DK) and azimuth (AK) channels. Heterodyne generates the stable frequency which is utilized for cbtaining intermediate frequency.

As a result of the displacement cf the oscillations of the high frequency of transmitters and oscillaticns cf heterodyne at the output/yield of mixer, are obtained the signals of the intermediate frequency, which go to the input of the amplifiers which amplify the cbtained signals to the value, necessary fcr the work of discriminator.

In the azimuth channel cf block AFC applied double frequency ccnversicn which is realized with the aid ci supplementary heterodyne and mixer.

Discriminator is intended fcr cbtaining errcr voltage with frequency drift of transmitter beyond margins. From the output/yield of discriminator, the positive pulses of equal amplitudes in the case of the absence of the detuning of the frequency of transmitters and different amplitudes with its detuning are supplied to the expander of momentum/impulse/pulses. Expander converts voltage pulses into direct/constant voltage (error voltage), which is supplied to balanced modulator.

Balanced modulator modulates the fluctuations of carrier frequency 400 Hz by error voltage. The modulated voltage is supplied to the output amplifier of power, and then - to the electric motor of the frequency control of oscillator. During a change in the oscillator frequency at the output/yield of discriminator, appears the error voltage, which controls the electric motor of frequency control.

During a change in the oscillator frequency of high value, when from the output/yield of mixer are remove/taken fluctuations with the frequency, not equal to intermediate, block MT it passes to search mode. In this case at the output/yield of discriminator, is absent the positive voltage, applied on dc amplifier which includes search relay. This relay strongly unbalances modulator, which leads to the connection/inclusion of the electric mctor cf retuning which rotates until frequency at the cutput/yield cf mixer is equal to intermediate and thus far at the output/yield of discriminatcr will not appear positive voltage.

Fig. 44. Functional diagram of block AFC.

Key: (1). Hz. (2). To the electric motor of the tuning of the oscillator of the transmitter of P-20D. (3). Mixer DK. (4). Discriminator. (5). Expander of momentum/impulse/pulses. (6). Balanced modulator. (7). Amplifier. (8). To the electric motor of the retuning of the oscillator of transmitter P-20D. (9). Search relay. (10). Calibrator. (11). Tripler. (12). Doubler. (13). Quartz driver-tripler. (14). Heterodyne. (15). Search relay. (16). Second mixer. (17). in.

Then by search relay disconnects the electric motor of retuning and diagram passes into the mode/conditions of "tracking".

Schematic diagram (Fig. 45). The mixers of azimuth and ranging channels serve for the mixing of frequencies, which simultaneously enter on them from transmitters and quartz heterodynes, and obtaining intermediate frequency.

Each mixer is the coaxial circuit, on the one hand of which is established/installed lighthouse L_6 or L_7 (6S17K), and with opposite - the contact sliding contact with the aid of which the duct is tuned for midband frequency.

In the housing of mixer, are sealed in two plugs. In them enter the cables, which go from heterodyne and output/yield of high-frequency oscillator (H.F.- generator). Cables have at their end/leads coupling disks, which, being immersed in the cavity of duct, regulate the communication/connection of mixer with the heterodyne and of mixer with the output/yield of H.F.-generator. The fluctuations of intermediate frequency are remove/taken from the plate loads of tubes L_6 and L_7.

In filament circuit, are included H.F.- throttle/chokes L_1 and L_2 for the exception/elimination of spurious coupling in high frequency.

The IF amplifier of ranging channel (UPCh-DK) is intended for the amplification of the fluctuations of intermediate frequency to the value, necessary for the work of discriminator, UPCh-DK consists of three cascade/stages of amplification (Fig. 46). The communication/connection of mixer with the first intermediatefrequency stage is transformer. The fluctuations of the intermediate frequency through the coupling F_1 are supplied to the first winding of inductance coil L_1, which will match the output resistance of mixer with the entry impedance of the first intermediatefrequency stage. The second winding of this coil is shunted by resistor/resistance R_2 for the expansion of passband.

Cascade/stage is assembled by the diagram of consecutive anode feed on tube L_1 (6Zh1P). As load serves the duct, which consists of the inductance coil L_4 and of the output capacitance of tube. Anode and screening voltages on tube they are supplied through the filter R_4S_5. Displacement automatic, because of the currents, which pass on the cathode resistor/resistance R_3 which is protected by condenser/capacitor S_3. The voltage of channel is supplied through the filter L_3S_4.

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For the control/checking of the current of the detector of mixer, the voltage from the first winding of inductance coil L_1 through the filter, which consists of H.F.- throttle/chokes L_2, L_{13}, condenser/capacitors S_1, S_2, S_{25} resistor/resistance R_1, approaches instrument IP_1 (see Fig. 45). The intensive fluctuations of intermediate frequency are supplied to the second intermediatefrequency stage, assembled on tube L_2 (6Zh1P, see Fig. 46). The diagrams of the first and second cascade/stage are analogous.

The third intermediatefrequency stage on tube L_3 (6Zh1P) for a decrease in the effect of the amplitude modulation of the voltage of intermediate frequency on the work of discriminator is assembled by diagram with grid-circuit clipping. The resistor/resistance R_8 is limiting. If input voltage does not exceed bias voltage, grid current it is absent and grid voltage it changes in accordance with a change in the input voltage. When input voltage exceeds bias voltage appears the grid current, which creates a voltage drop across resistor/resistance R_8. A further increase in the input voltage virtually does not produce an increase in the grid voltage, which remains constant/invariable and close to zero.

From output circuit (L_8, S_{14} and S_{16}) the fluctuations of the intermediate frequency through the condenser/capacitor S_{15} because of inductive coupling enter the duct of the discriminator.

Discriminator is assembled on tube L_4 (6Kh2P). The duct of the discriminator consists of the inductance coil L_{11} and of capacitors S_{17} and of S_{18}, but its load are the resistor/resistances R_{15} and R_{16}. The capacitors of S_{20} and S_{21} serve for the filtration of high-frequency components. The control voltage through resistor/resistances R_{19} and R_{18} is supplied to the expander of momentum/impulse/pulses.

The feed of the filament of the tube of discriminator is supplied through H.F.- throttle/choke L_{10} and the capacitor S_{19} for the elimination of spurious coupling in high frequency through the power supply. H.f.-throttle/choke L_9 blocks the closing/shorting of the currents of intermediate frequency besides tube L_4 and forms circuit for the dc current component of tube.

Discriminator works thus. Output circuit UPCh and the duct of the discriminator are inclined for intermediate frequency. As a result of the double bond of these ducts on the anodes of foot L_4, simultaneously operate two voltages: through capacitive coupling - alternating voltage U_1 (Fig. 47a) and through inductive coupling - voltage $U_2/2$.

The resulting voltage on the anodes of tube is determined by the vector sum of the voltages:

If detunings no, then a difference in frequencies of the transmitter and heterodyne is equal to intermediate frequency and both ducts are inclined into resonance. The resistor/resistance of the duct of discriminator has active character; therefore the current of aaaaa in it coincides in phase with emf of the mutual induction aaaaaa. This current, flow/lasting over inductance coil L_{11} (see Fig. 46), stresses of the aaaaaa (see Fig. 47), which advances current I_2 by 90°. After dividing the vector of the aaaaa of L_{11} (since inductance coil L_{11} (see Fig. 46) it has the grounded midpoint) and after accumulating geometrically the vectors of aaaaaaaa and aaaaaaaa with the vector of aaaaaa (see Fig. 47), we will obtain the equations of the voltage of aaaaaa and aaaaaa, applied to tube L_4 (see Fig. 46). Consequently, through resistor/resistances R_{15} and the R_{16} will flow/last the equal currents, which create equal positive voltages.

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Fig. 45. Schematic diagram of the block AFC.

Key: (1). Mixer. (2). Input. (3). Calibrator. (4). Housing. (5). in. (6). Output/yield. (7). Current output of cascade/stage. (8). Cont. (9). Cont. the energy level. (10). Preheater. (11). Inclusively incandescing. (12). Control unit. (13). Balance. (14). Search. (15). Control/checking of channels. (16). Capture. (17). Hz. (18). Cont. of turns of motor. (19). Cont. is common/general/total. (20). Housing. (21). Illumination.

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Fig. 46. Fundamental amplifier circuit of the intermediate frequency of the ranging channel of block AFC.

Key: (1). Housing. (2). Output/yield. (3). Control/checking. (4). V.

Fig. 47. The vector diagrams of the stresses of the discriminator: a) detuning is absent; b) detuning positive; c) detuning negative.

Fig. 48. Fundamental amplifier circuit cf the intermediate frequency cf the azimuth channel of block AFC.

Key: (1). Duct of the discriminator. (2). Centrcl/checking. (3). Circuit. (4). Housing. (5). Cutput/yield. (6). Cont. (7). \.

With positive detuning coil L_{11} resistive of inductive character; therefore emf of the mutual induction of aaaaa (see Fig. 47) wattful of aaaaaa, produces in it the current of aaaaa lagging on phase behind aaaaa to angle ϕ. This current, flow/lasting over inductance coil L_{11} (see Fig. 46), creates on it the stress of aaaaa (see Fig. 47), which anticipate/leads to phase current I_2 by 90°.

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After accumulating geometrically vectors $+U_2/2$ and aaaaaaa with vector U_1, let us ascertain that to the anodes of tube L_4 (see Fig. 46) are applied unequal stresses. Consequently, the currents through the halves of tube are not equal and positive stress on resistor/resistance R_{15} more than on resistor/resistance R_{16}.

Analogously discussing, it is possible to show that with negative detuning (Fig. 47c) stress on resistor/resistance R_{16} is more than during resistor/resistance R_{15}.

The IF amplifier of azimuth channel (UPCh-AK) amplifies the fluctuations of intermediate frequency to the value, necessary for the work of discriminator. This amplifier consists of three stages: mixer, heterodyne and discriminator.

The fluctuations of intermediate frequency from mixer are supplied to the first intermediatefrequency stage whose diagram is analcgous to the diagram of UPCh-DK. Intensified with the first cascade/stage stress is supplied to the control electrode of tube L_3 (6Zh1P, Fig. 48) on which is assembled the second mixer. To the suppressor grid of this tube, is supplied the stress of the heterodyne through the capacitor S_{10}. As a result of the mixing of the first intermediate frequency and frequency of heterodyne, is isolated the second intermediate frequency. The fluctuations of intermediate frequency are remove/taken from duct L_7, R_{15}, S_{21} and are supplied to the second IF amplifier, assembled on tube L_4 (6Zh1P).

The second and third (tube L_4, L_5 - 6Zh1P) IF amplifiers and discriminator L_6 (6Kh2P) they work analogous with the appropriate cascade/stages of ranging channel.

The second heterodyne of azimuth channel generates high-frequency oscillations for operational provisions of the second mixer. Heterodyne consists of the master quartz oscillator and the cascade/stage of the frequency multiplication of quartz. Oscillator is assembled on the left half of tube I_1 (6N1P). Quartz is included between grid and cathode of tube. The cascade/stage of multiplication is assembled on the right half of tube L_1 and is inclined to the third harmonic of crystal frequency.

The cascade/stages of ranging and azimuth channels are analogous in diagram; therefore subsequently is given the description of the diagrams only of ranging channel. Channel consists of the expander of momentum/impulse/pulses, of balanced modulator, terminal amplifier and dc amplifier.

The expander of momentum/impulse/pulses converts the positive pulses, which enter from the output/yield of discriminator, into the constant control voltage.

Positive pulse approaches the control electrodes of tube L_2 (6N1P, see Fig. 45). In this case, the capacitors S_2 and S_7, the connected in cathode tubes, charge themselves. At the termination of the action of momentum/impulse/pulse, the capacitors S_2 and S_7 begin to be discharged on the circuit: S_2-R_{11}-R_{20} - the earth/ground - S_2 and on the circuit: S_7-R_{13}-R_{16} - the earth/ground S_7. The time constants of discharge circuit S_2 (R_{11} + R_{20}) and S_7 (R_{13}-R_{16}) are fitted so that the capacitors are discharged not more than to 0.1-0.2o/o of aaaaaa, therefore, from resistor/resistances R_{16} and R_{20} it is remove/taken almost direct/constant voltage. In order that would not affect the random overshoots of voltage, caused by the jumps of oscillator frequency, in parallel to resistor/resistances R_{11} and R_{13} were included capacitors S_3 and S_6.

Voltage on the anodes of the tube of expander is supplied from voltage divider, which consists of fixed resistors R_{10}, R_{14} and potentiometer R_{60} whose spline is derived on front/leading panel with writing "Balance D". With the aid of potentiometer R_{60} it is possible to balance the initial currents of triodes, and resistor/resistance R_{10} and R_{14} together with capacitors S_4 and S_5 they are decoupling filter.

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The balanced modulator of ranging channel changes phase and the amplitude of the stress of frequency 400 Hz in accordance with a change in the stress, which enters from expander.

Modulator is assembled on tube L_3 (6P1P). Displacement to the control electrodes of balanced modulator is supplied automatically because of a voltage drop across the common/general/total for both triodes resistor/resistance R_{19}, shunted with capacitor S_8. The plate loads of tube L_3 are the resistor/resistances R_{17} and R_{18}, from which the voltage of the signal through capacitors S_9 and the S_{10} is supplied to transformer Tr_1. Transformer has the grounded midpoint. Thus, its windings are included towards each other.

To the cathodes of tube L_3 from the special winding of power transformer, is supplied modulated voltage 8 v with frequency 400 Hz, which through resistor/resistances R_6 and R_{20} is applied in phase to the grids of tube.

Voltage 400 Hz frequency is modulated by the error voltage, which is remove/taken from resistor/resistances R_{16} and R_{20}. In the absence of error, i.e., when the voltages, applied to the grids of tube L_3, are equal, on plate loads are isolated the voltages 400 Hz frequency, equal in phase and amplitude. During the supplying from the plate loads of balanced modulator to primary winding transformer Tr_1 equal in phase and amplitude voltages they average out, but voltage on the secondary winding of conversion transformer Tr_2 is absent.

When the error of voltage is present,, applied on the grids of tube L_3, are not equal. The currents through tube are not also equal and therefore voltages from plate loads they are remove/taken with different amplitude. In the secondary winding of transformer Tr_1, will appear the voltage with the amplitude, equal to a voltage difference on the halves of primary winding. The phase of this voltage depends on that, to which half of primary winding applied larger voltage. The resulting voltage approaches terminal amplifier.

The terminal amplifier of ranging channel amplifies error voltage according to power up to the value, necessary for the work of the electric motor of the mechanism of retuning.

Amplifier is carried out on tubes L_4 (6P6S) and L_5 (6P6S) by push-pull transformer diagram. Voltage from balanced modulator to the grids of amplifier enters through the secondary winding of transformer Tr_1. To the grids of bias tubes, is supplied from the rectifier of block AFC - 105 in. Amplifier is assembled by the diagram of consecutive anode feed. As the plate load of amplifier serves the primary winding of the transformer Tr_2, from secondary winding of which the voltage is supplied to the electric motor of the mechanism of retuning.

The dc amplifier of ranging channel controls the relay R_1, which converts diagram from the mode/conditions of "search" into the mode/conditions of "capture". Amplifier is assembled on tube L_1 (6N1P). In the absence of positive error voltage on the right half of tube L_1, it is closed by the positive voltage, applied on its cathode from divider/denominator R_1, R_2, R_3 which is included at the output/yield of rectifier +300 in.

Positive voltage from the plate load of the right half of tube L_1 through resistor/resistance R_4, which enters in voltage divider

R_4, R_5, R_6, goes to the grid of the left half of tube. To potentiometer R_6, protected by capacitor S_1, is supplied negative voltage -105 in. The wiper is established/installed at this position in which the grid voltage of the left half of tube is close to zero. In this case it is completely opened. As its load serves the winding of the relay R_1 which is included and by contacts 4-5 switches on tube LN_1 "search" and the electric motor of retuning, and also it disconnect/turns off tube LN_2 "capture", breaking contact 3-4. The contacts by 6-7 relay R_1 connect the grid of the left half of the tube of balanced modulator with the earth/ground, which leads to the sharp imbalance of modulator, as a result of which the electric motor of the tuning of oscillator begins to rotate.

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The rotation of the electric motor of tuning occurs until the frequency, generated by transmitter, approaches itself that which was assigned so, in order to isolated at the output/yield of the mixer of oscillation with the intermediate frequency of channel into the band of capture of discriminator. Then on the cathode of the left half of tube L_2 appears positive voltage. This voltage through resistor/resistance R_9 approaches the grid of the right half of tube

L_1. Tube triggers itself, voltage on its anode will give, and on the grid of the left half of tube it becomes negative and it is cut off. Relay P_1 switches on the electric motor of retuning, it switches on tube "capture" and disconnects the grid of the left half of the tube of balanced modulator from the earth/ground. Diagram passes to the mode/conditions of "tracking". The electric motor of tuning changes the oscillator frequency of transmitter until intermediate frequency becomes equal tuning frequencies of discriminator, whereupon the electric motor is stopped.

Heterodyne (Fig. 49) it oscillate of the high-stability frequency which is supplied to the mixers of the azimuth and ranging channels of block AFC. The oscillation frequency of heterodyne corresponds to 162-1 crystal harmonics.

Heterodyne consists of the master quartz oscillator and the cascade/stages of frequency multiplication. The master oscillator is assembled on the left half of tube L_1 (6N1P) with the quartz, connected between the grid and the cathode. In the anode circuit of tube, are consecutively included two duct: duct L_1, S_3, inclined to the fundamental harmonic of the oscillation frequency of quartz, and duct L_2, S_6, inclined to the third harmonic of the oscillation frequency of quartz. Therefore the master oscillator simultaneously performs the role of tripler.

The equivalent diagram of the master oscillator is inductive Hartley oscillator circuit. The capacitance/capacity of communication/connection is the capacitor S_1, connected between anode and grid of tube. Resistor/resistances R_2 and R_3 are leakage resistance of the grid of the left half of tube L_1. Resistor/resistance R_4 and shunting capacitor S_5 compose the circuit of automatic displacement. Voltage with the frequency of third crystal harmonics from the master oscillator through the band-pass filter L_2, S_6, L_3, S_7 is supplied to the second cascade/stage.

The second cascade/stage is assembled on the right half of tube L_1 as tripler. Plate circuit L_4, S_{11} are inclined to the ninth harmonic of crystal frequency. The resistor/resistance R_5, shunted with capacitor S_9, provides automatic displacement.

The third cascade/stage (doubler) is carried out on tube L_2 (6N1P). As plate load serves duct L_6, the S_{19}, inclined on 18-th harmonic of crystal frequency. The voltage of 18-1 harmonics from symmetrical input circuit is supplied to both grids of the fourth cascade/stage.

The fourth cascade/stage (tripler) is assembled on tube L_3 (6N1P) by the double diagram which provides the suppression of even harmonics. As the plate load of cascade/stage serves duct L_{10}, the aaaaaaaaaaa, carried out in the form of the symmetrical short-circuited line which is inductively connected with the analogous line, connected in grid circuit - the cathode of output stage.

Output stage is assembled on tube L_4 (lighthouse triode 6S5D) by diagram with common/general/total grid. As the plate load of cascade/stage serves the coaxial line, inclined on 162-th harmonic of crystal frequency. The tuning of cascade/stage is conducted by the displacement/movement of plunger over the maximum of cathode current over the instrument of the IP_1, voltage on which is supplied from resistor/resistance R_{18}, connected in the cathode of tube L_4. The tuning of cascade/stage is realized by the capacitance/capacity, one of plates of which is fastened on the indoor wiring of coaxial line, and the second, movable, is connected with the aid of gear with the mechanism of tuning.

Fig. 49. Schematic diagram of the heterodyne of block AFCh.

Key: (1). cascade/stage. (2). Thermostat. (3). Tuning. (4). Designation. (5). Housing. (6). in. (7). Current of heterod. (8). Therm. control.

Filament voltage enters through H.F.- throttle/chokes L_{13} and L_{14}, the capacitor S_{26}, which protects output stage from the penetration of high-frequency currents in value incandescence.

Anode feed to all cascade/stages of heterodyne is supplied from rectifier +300 v through filters of the type RC, and to the fourth and fifth cascade/stages - through the supplementary H.F.- throttle/chokes L_9, L_{12} and the capacitors of S_{23}, S_{27}.

The retuning of the frequency of heterodyne is conducted by switching quartzes. The commutation of quartzes occurs with the aid of switch V_1 "switching channels" and six relay R_1-R_6. The ducts of all cascade/stages of multiplication are carried out in the form of the band-passs filter, which ensure the possibility of the work of heterodyne over a wide range of frequencies without tuning. Working quartzes of heterodyne for an increase in the frequency stability are placed into the thermostat whose work is analogous to the work of the thermostat of the five-stage driver of the transmitter of P-200M. The power output of heterodyne is not less than 30 mW.

Calibrator is intended for the control/checking of the frequency of the duct of discriminators UPCh of azimuth and ranging channels. Calibrator is the quartz heterodyne, which consists of the master oscillator and the cascade/stage of the trebling of frequency. Heterodyne is assembled on the left half of tube L_8 (6N1P, see Fig. 45). Quartz is included between the grid and the anode. The cascade/stage of multiplication is assembled on the right half of twin triode L_8.

Because of the sufficiently large amplitude of the sixth harmonic of crystal frequency on the plate load of tripler, the calibrator has the only one output/yield, employed for calibrating the frequency of the discriminators of azimuth and ranging channels.

The control/checking of the work of block AFC is realized by an instrument of the IP_1, which is switched by switches V_3 and V_4. Switch V_3 has two position of "A" and "d", switch V_4 is three positions. In position the "current heter. output stage" is measured the current of the output stage of heterodyne; at the second position "current is placed. " - the current of the detector of mixer, in this case is included the supplementary resistor/resistance R_{271}; in the third position "balance" - the voltage on the electric motor of retuning. The resistor/resistance R_{59} is supplementary resistor/resistance to the instrument of the IP_1, voltage on which in this position V_4 is supplied through the diode D_1.

Constructions. Block (Fig. 50) is arranged in the cabinet of supervisory equipment. All network elements are carried out in the form of the separate functional rules, established/installed on L-shaped chassis/landing gear. On the front panel of block, are placed the cell/elements of the control/checking of control and tuning. In block is established/installed the common/general/total filament transformer Tr_5, which has five windings: primary to voltage 208 v with frequency 400 Hz and four secondary.

Fig. 50. Block AFC: 1 - measuring meter; 2, 8 - high-frequency couplings; 3, 7 - the knob/button of the control/checking of the balance of channels; 4 - commutator switch; 5 - the knob/stick of the tuning of heterodyne; 6 - instrument switch.

Each secondary winding provides voltage 6.3 v with the current of load 2.5 a. All windings are connected in parallel between themselves.

Power unit of unit AFC.

This unit provides unit AFC with the following stresses: +300, +150, 105 in direct current even 30, 8 and 6 in alternating current 400 Hz frequency.

Schematic diagram. Positive stress +300 and +150 in issues rectifier D_1 (Fig. 51), assembled by single-phase bridge circuit on selenium cell/elements. Output voltage is stabilized with the aid of the electronic regulator which consists of tube L_6 (SG4S), amplifier tube L_7 (6Zh8), current-regulating tubes L_1-L_5 (6N13S) and resistor/resistances R_{22}-R_{29}. With the aid of resistor/resistances R_2 and R_{26}, is regulated the stabilization factor, while with the aid of resistor/resistance R_{28} - the output voltage of stabilizer +300 in.

Voltage +150 in is obtained with the aid of tubes L_8 (SG4S) and

L_9 (SG4S), feed to which is supplied frcm rectifier +300 v through the terminal of 13 couplings P_2. Terminals 13 and 14 couplings P_2 are connected only with the placed in place unit AFC. By this tubes L_8 and L_9 are protected frcm overloading with idling.

Voltage -105 in is obtained with the aid cf the rectifier, assembled on single-phase bridge circuit on selenium cell/element D_2 and capacitors S_4 and S_5. In parallel to rectifier is included tube I_{10} (SG3S) with ballast resistance R_{42}.

All DC voltages are monitored with the aid of the instrument of IP_1 with the scale on 500 in. Instrument is cornected to the appropriate circuits with the aid of switch V_2 and has a dial light, which is included by switch V_3.

Transformer Tr_2, besides voltage on rectifier, gives of two alterrating voltage 30 and 6 v with frequency 400 Hz which are supplied respectively to terminals 8, 9 and 1-10 couplings P_1. Voltage on power unit is supplied with the aid of switch V_1.

Fig. 51. The schematic diagram of the block of the feed of unit AFC.

Key: (1). Circuit. (2). Housing. (3). in. (4). Hz. (5). illumination.

Fig. 52. Power unit of unit AFC: 1 - the dial light of measuring meter; 2 - measuring meter; 3 - the toggle switch of the connection/inclusion of illumination; 4 - power switch; 5 - the tube of the control/checking of the [illegible] of safety device/fuses; 6 - safety device/fuses; 7 - the switch of the measuring instrument.

Construction (Fig. 52). Unit is assembled on standard L-shaped chassis/landing gear on which are mounted all network elements of rectifiers. On the front/leading panel of unit, are arranged measuring meter, the safety device/fuses and the toggle switches of control of rectifier.

End section.

Fig. 53. The schematic diagram of the block fcr measring the passage power of IPM-2I.

Key: (1). Input. (2). Output/yield. (3). Circuit. (4). Housing.

Unit of the meter of passage power.

This unit has azimuth and ranging channels. The Principle of the work of the unit of IPM-2I the same as of the unit of the IPM-1N which was described above.

Schematic diagram (Fig. 53). The high-frequency pulses of the transmitter of P-20D from capacitive probe approach the anode of tube L_1 (2D1S), they are detected and charge capacitor S_3 up to the a certain value of surge voltage. The time constant of charge of capacitor S_3 is determined by the anode resistance L_1 and of size capacitance of capacitor S_3. Resistor/resistance R_1 creates the circuit constant component of cathode current I_1.

One or the other grad line is connected to diagram with the aid of switch B_1, which has two position: "channel A" and "channel d". During setting switch B_1 at position "channel d" the grad line of the transmitter of P-20D is connected to the cathode follower, assembled on the left half of tube L_3 (6N8S). Cathode repeater divides the circuits of detection and accumulation of momentum/impulse/pulses.

With connection to measuring circuit, the capacitor S_3 begins to be discharged on the circuit: S_3-V_1-R_3 - the earth/ground - S_3. Since the time constant of charge is much lower than the time constant of discharge, pulse duration, which enters the grid of the left half of tube, is somewhat more than 1 μs.

From the cathode load R_5 tube L_3 the stretched momentum/impulse/pulse approaches the diagram of accumulation, assembled on tube L_4 ('X'S). In the cathode circuit of tube L_4, is included storage circuit S_7, R_7. The time constant of the charge of tank S_7 is determined by the output resistance of cathode repeater (left half of tube L_3) by anode resistance L_4 and by capacitance value S_7. Time constant must be possibly lesser for obtaining the maximum amplitude of the charge of tank for the transit time of momentum/impulse/pulse.

Capacitor discharge S_7 occurs through resistor/resistance R_7, which for the purpose of obtaining sufficient time constant of discharge is selected large. Resistor/resistance R_8 between the cathode of tube L_4 and the grid of tube L_5 (6N8S) limits grid currents.

Fig. 54. Unit of the meter of the passage power of IPM-2I: 1.5 - high-frequency couplings; 2 - high-frequency diode; 3 - to measuring line; 4 - the shielding cover of dial light; 6, 14 - tuning knob; 7 - measuring meter; 8 - the toggle switch of the illumination of grid/network; 9 - the toggle switch of the connection/inclusion of output/yield to oscillograph; 10 - the knob/stick of the setting up of "zero" of instrument; 11 - the toggle switch of the channel switcher; 12 - control socket; 13 - circuit breaker.

In order to stabilize the position of zero of instrument, balance amplifier is constructed but to diagram with autocompensation, for which are used tube L_3 and L_5. On the left halves of these tubes, are assembled the amplifier stages, the right halves of tubes provide autocompensation.

With the aid of resistor/resistance R_{21} realizes the initial balance of amplifier by the adjustment of the current through the right half of tube L_3. Thereby is regulated grid voltage of the right half of the tube of the balance of amplifier assembled on tube L_5.

In the cathode circuit of tube L_5, is included measuring meter the IP_1 whose calibration is conducted with the aid of resistor/resistances R_{11}, R_{13} and R_{16}. By potentiometer R_{11} is establish/installed "zero" of instrument, and by potentiometers R_{13} and R_{16} correct measurement ranges.

The feed of the anode circuits of output meter is conducted from the rectifier assembled by two-half-period diagram. Filter (Dp_1, C_{11} and C_{15}) - L-shaped. At the output/yield of rectifier, is a voltage regulator, consisting of two series-connected tubes L_6, L_7 (SG2S) and the ballast resistance R_{18}.

For the stabilization of "zero" of measuring meter during a change in the filament currents during a change in the line voltage, is included the ballast resistor (tube I_9, 1B10-17). For the setting up of the rated current of ballast resistor parallel to the primary winding of transformer Tp_1 are included variable resistances R_{19} and R_{20}. The secondary winding of transformer Tp_2 is included consecutively with the primary winding of transformer Tp_1.

Constructions. Unit (Fig. 54) is placed in the upper part of the cabinet NNO. On the front/leading panel of unit, are arranged: the measuring meter, which has two scales: upper quadratic - for the reading of power and lower smooth for measurement of KSV and the KBV of feeders, the organ/controls of adjustment and control.

Phase converter will match the output resistance of transmitter with input resistance of antenna so that --------------.

Fig. 55. Functional diagram of BKC.

Key: (1). Azimuth channel. (2). Mixer. (3). Narrow-band cascade. (4). Detector. (5). Cathode repeater. (6). Input. (7). Heterodyne. (8). Local Heterodine. (9). Calibrator. (10). Measuring meter. (11). Pack detector. (12). Ranging channel. (13). Local heterodyne

It is established/installed between the cutput/yield of high-frequency oscillator and the unit cf the meter of passage power. Phase inverter is the cut of the coaxial line whose length can change in some limits with the aid of special mechanism.

Unit cf the control/checking of frequency.

This unit monitors the frequencies for which are inclined the transmitters P-20A and P-20D, the frequency spectra of these transmitters, and also it serves as indicator with the tuning of transmitters with the aid of phase inverters in the case of the "jumping" cf frequency.

The unit of the control/checking cf frequency consists of the mixers of azimuth and ranging channel, second mixer of azimuth channel, IF amplifiers of these channels, peak detector, heterodyne, calibrator.

Functional diagram (Fig. 55) it contains the azimuth and ranging channels which are intended for the control/checking of frequencies cf the transmitters P-20A and P-20D respectively.

The operating principle of the unit cf control/checking consists cf the following. To the input of the mixers cf the azimuth and ranging channels through the coupler, are supplied simultaneously the high-frequency oscillations: from the output/yield of the transmitter P-20A or P-20D and from the common/general/total for both channels heterodyne, stabilized by quartz. As a result cf the mixing of these oscillations at the output/yield of mixer, is obtained the voltage of intermediate frequency, which is supplied tc IF amplifier. This voltage is amplified by the first intermediatefrequency stage and is converted into the voltage cf lower intermediate frequency in the second cascade/stage, for which to suppressor grid tube of the second cascade/stage, it is supplied voltage from the local oscillator whose frequency is stabilized by quartz. The signals cf intermediate frequency are amplified and are supplied tc narrow-band intermediatefrequency stage and further tc detector. At the output/yield of detector, the pulse amplitude will be maximum, when transmitter frequency corresponds that which was assigned; with the detuning of transmitters, its amplitude decreases.

Momentum/impulse/pulses from the output/yield of detector are supplied to the cathode follower, from output/yield of which they approach the monitoring jacks G_1 and G_2, arrange/located on the front/leading channels of unit. These sockets are intended for the visual test of momentum/impulse/pulses with the aid of oscillograph. Simultaneously momentum/impulse/pulses from cathode follower are supplied to the peak detector through the circuits of commutation.

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Direct/constant voltage from the output/yield of peak detector approaches the measuring instrument, thus far readings of which are proportional to pulse amplitude.

For checking the correctness of the tuning of UNCh-AK and UNCh-DK for intermediate frequency into BKCh, is assembled the separate calibrator, which is self-excited oscillator with consecutive multiplication of frequency. Voltage 15 MHz frequency with the aid of cables approaches UNC. The powering of the unit of the control/checking of frequency is realized from separate rectifier.

Schematic diagram (Fig. 56). The mixers are the input cascade/stages of unit and serve for the mixing of the oscillations, applied from transmitters, with the oscillations of the local oscillator for the purpose of obtaining the voltage of intermediate frequency.

Each mixer is carried out in the form of the coaxial line in which is established/installed lighthouse triode 6S17K (L_6 or L_7). On the housing of mixer against each other are placed two plugs with clamp grippers. In plugs enter cable ends with coupling disks. At the opposite from tube end/lead of the coaxial line, is placed the short-circuiting tuning plunger, which is establish/installed in the position, which corresponds to tuning for midband frequency. The signal of intermediate frequency is remove/taken from the plate load of tube with the aid of switch jaw contact. The structural/design tank between coaxial line and the anode-grid switch jaw contact shunts input UPCh in high frequency. H.f.-throttle/chokes L_2, L_3 and the capacitors of S_{19}, S_{20} in the filament circuits of the tubes of mixers protect the circuits of powering from the penetration in them of high-frequency oscillations. The output voltage of intermediate frequency is supplied on the cable of KE_3 and KE_4 to input UPCh.

The amplifier of intermediate frequency amplifies the cscillations of intermediate frequency, it converts them into oscillations with lower intermediate frequency and then into the video pulse whose amplitude depends on the detuning of transmitter relative to the assigned frequency.

The schematic diagrams of UPCh-AK and UPCh-DK (Fig. 57) are completely analogous. The voltage of intermediate frequency from mixer is supplied to the input of the first intermediatefrequency stage, which is assembled on tube L_2 (6Zh1P). The input circuit of cascade/stage is carried out in the form of the duct, which consists of inductance L_3, L_4, the capacitor of S_{12} and resistor/resistance R_8, which is intended for the expansion of the pass-band of input circuit. As the load of cascade/stage serves the system of coupled circuits (L_5, S_{11} and L_6, S_{15}). For expansion of the passbands duct are shunted by resistor/resistances R_{10} and R_{11}. Anode power to tubes is supplied from rectifier +150 v through the decoupling filter R_9S_{10}. Displacement is automatic, because of voltage drop across resistor/resistance R_{12}, shunted by the capacitor of S_{14}. Filament voltage is supplied through the filter Dp_5S_{13}.

Mixer is assembled on tube L_3 (6Zh2P), to control electrode of which will be moved voltage with UPCh, and cn shielding - from the second heterodyne. The vcltage of intermediate frequency is isolated cn duct L_7, S_{17}. The automatic displacement is provided because of the drcp of voltage on resistor/resistance R_{14} which is shunted by the capacitor of S_{20}. Anode voltage is supplied through the filter $R_{13}S_{16}$.

The seccnd heterodyne is assembled cn the left half of tube L_1 (6N3N) by capacitive Hartley oscillator circuit. Throttle/choke Dp_1 insulates cathode from ground in high frequency. In the anode circuit of the left half of tube L_1, is included the band-pass filter (L_1, S_1 and L_2, S_7), inclined to the quadratic compcnent of crystal frequency. the presence of excitation vcltage is monitored in sccket G_1 with the aid of cscillcgraph.

Fig. 56. Schematic diagram of BKCh.

Key: (1). caliber. (2). Circuit. (3). Housing. (4). Mixing current. (5). Pulse circuit. (6). Input. (7). [Illegible] circuit. (8). Intermediate frequency. (9). Output/yield of heterodyne. (10). Illegible.

Fig. 57. Printsinial'naya amplifier circuit of the intermediate frequency of UPCh-DK.

Key: (1). [Illegible]. (2). Input. (3). Circuit. (4). V. (5). Output/yield. (6). Mixing current. (7). Housing.

On the right half of tube L_1 is assembled the detector, load of which is the divider/denominator, which consists of resistor/resistances R_4, R_5.

The voltage of intermediate frequency from injection circuit through the capacitor S_{18} is supplied to the narrow-band amplifier, assembled on tube L_4 (6Zh1P). the load of this cascade/stage is the band-pass filter L_8S_{22} and L_9S_{23}. Voltage from the duct of L_9S_{23} is sent to the detector of video pulses, assembled on the diode D_1, load of which are the resistor/resistance R_{17} and the capacitor S_{24}. Video pulse from the load of the detector across the throttle/choke Dr_8, which decreases the penetration of the fluctuations of intermediate frequency, go to the terminal of 9 couplings Sh_1 and further across switching circuits - to peak detector (see Fig. 56). For the matching of the output resistance of detector UPCh with the entry impedance of peak detector, is applied cathode follower on tube L_3 (6N3P). On both halves of tube L_3, are assembled cathode followers for ranging and azimuth channels. From the cathode loads R_2 and R_3, the video pulses through capacitors S_4, S_5 and resistor/resistances R_1, R_4 approach peak detector.

Peak detector converts the video pulses, which enter its input, into direct/constant voltage, which corresponds to their amplitude. It consists of two identical channels: azimuth and ranging, assembled on tubes L_1 (6Kh2P) and L_2. On tube L_1 are assembled the detectors of both channels. During the action of video pulse, the capacitor S_1, S_2 charge themselves up to peak value on the circuit: R_1 (R_1) L_1 S_1 (S_2) - earth/ground R_1 (R_4). Capacitors are discharged through resistance R_2 and R_3. Voltage from the output/yield of the detector through I-shaped filters R_1S_4 and R_4S_3 is supplied to the input of the cathode follower, output potential of which directly proportional to the amplitude of video pulses.

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Heterodyne (Fig. 58) it generates quartz-stabilizedfrequency which is supplied to the mixers of azimuth and ranging channels for obtaining intermediate frequency.

Heterodyne consists of the crystal assigning oscillator and four cascade/stages of frequency multiplication. It works on any of 40 quartzes which are switched with the aid of switch V_1. For an increase in the frequency stability, the quartzes are established/installed into thermostat.

The master oscillator is assembled on the left half of tube L_1 (6N3P) by inductive Hartley oscillator circuit. In anode circuit is included the duct, which consists of L_2, S_4 and L_3, S_5 which is inclined to the third harmonic of crystal frequency. voltage from duct L_3, S_5 is supplied to the second cascade/stage - tripler.

The second cascade/stage is assembled on the right half of tube L_1. Its load is the duct L_4, S_9 and L_5, S_{12}. Cascade/stage works with the automatic displacement, removed from circuit R_5, S_7. Anode power is supplied from rectifier +300 v through the filter R_9S_{10}.

The third cascade/stage is assembled on tube L_2 (6N1P) and works in the mode/conditions of frequency doubling. As the load of cascade/stage serve ducts L_6, S_{16}, L_7, S_{17}, and L_8, S_{18}. The secondary duct consists of two ducts, because the fourth cascade/stage is assembled by push-pull circuit. Displacement is automatic, because of a voltage drop across resistor/resistance R_{12}, shunted by the capacitor of S_{13}. Anode feed is supplied through the filter $R_{13}S_{14}$.

The fourth cascade/stage is assembled cn tube L_3 (6N1P), it works in the mode/conditions of the trebling of frequency. as the load of cascade/stage serves the duct, carried cut in the form of the two-wire circuit which is inductively connected from another, forming together with tank tube L_4 the input circuit of the fifth cascade/stage.

The fifth cascade/stage is assembled cn tube L_4 by diagram with common/general/total grid on the lighthouse tricde of 6S9D. As the load cf cascade/stage serves the coaxial line, tuned to the third harmonic of crystal frequency. The tuning cf duct is conducted with the aid of the knob/stick, derived to the front/leading panel cf unit.

Output voltage through two cables approaches the input of the mixers of azimuth and ranging channels. The control/checking of the tuning of the first three cascade/stages is conducted in the sockets cf G_1-G_4 with the aid of oscillograph. For the control of the power output of the fifth cascade/stage cathode the tube L_4 through resistor/resistance R_{19} connect with the instrument of IP_1.

Calibrator is intended for checking accuracy the tuning of UPCh-AK and UPCh-DK for intermediate frequency. It consists of two cascade/stages: the generator, stabilized by quartz, and frequency multiplier.

First cascade/stage of the calibrator is assembled on the left half of tube L_4 (6N1P, cm. of Fig. 56) by capacitive Hartley oscillator circuit with the quartz, connected between the anode and the grid. The second cascade/stage (frequency multiplier) is assembled on the right half of tube L_4 and operates in the mode/conditions of the arrangement of frequency. In anode circuit is included the duct, inclined to the third harmonic of crystal frequency. voltage from duct L_1, the S_{13} through the capacitor S_{18} is supplied to high-frequency couplings F_1 and F_2 connected with cables with intermediatefrequency stages.

The circuits of the commutation of BKCh have two switch to five positions. Switch v (see Fig. 56) is intended for the preparation of unit for the work. In position the "balance" is supplied voltage +27 v on relay R_1 in intermediate frequency stages. Relay R_1 wear/operates and by contacts 1-2 disconnects anode power from input cascade/stages, local oscillators and UPCh, but by contacts 3-4 switches circuit for an application of voltage from the calibrator which at this torque/moment is switched off. In this position is conducted the balance of measuring circuits in azimuth and remote channels by the setting up of "zero" of the instrument of IP_1 by potentiometers R_6 and R_9.

Fig. 58. Schematic diagram of the hetercdyne of BKCh.

Key: (1). Circuit. (2). Housing. (3). V. (4). Current of output stages. (5). Thermal circuit. (6). Preheating rub. (7). cascade/stage. (8). Circuit. (9). Mixer.

Switch is set in turn in positions the "work AK" and the "work DK". In this case, consecutively with the instrument of IP_1 are included resistor/resistances R_6, R_7 or R_8, R_9. From these resistor/resistances is remove/taken negative displacement for the compensation constant displacement at the output/yield of peak detector in the absence of signal.

In position "Calibr. AK" is realized checking the tuning of UPCh-AK. Anode voltage is supplied to calibrator. It is included by the relay R_1, which by contacts 1-2 disconnects anode feed from input cascade/stage and the local oscillator of UPCh-AK, but by contacts 3-4 it supplies radio frequency voltage from calibrator on UPCh-AK. Voltage from output/yield UPCh ak through the switch V_1 approaches the input of peak detector, passing cathode follower. In measuring circuit consecutively with instrument IP is included resistor/resistance R_{10} whose value determines instrument sensitivity during checking from the calibrator of azimuth channel.

In position "Calibr. DK" is checked UPCh-DK from calibrator. All processes of the work of diagram are analogous to those above described. The calibration of diagram is conducted with the aid of resistor/resistance R_5. In this case, the switch V_2 must be established/installed at position the "work DK".

In positions "work AK" and the "work DK" calibrator is disconnected, by relay R_1 is de-energized and diagram is put to working order.

Switch V_2 the "monitoring of mode/conditions" has five positions. In position the "heterodyne" is monitored the current of the output stage of heterodyne. In positions the "current of mixer DK" and the "current of mixer AK" are monitored the currents of the mixers of azimuth and ranging channels. In positions the "work AK" and the "work DK" instrument NP_1 is connected to the measuring circuit of azimuth and ranging channels respectively.

Power of BKCh is realized from the network of alternating current with voltage 208 v and frequency 400 Hz which through the toggle switch V_3 and the circuit breaker Pr_2 is supplied to transformers Tr_1 and Tr_2. From the secondary windings of transformers is remove/taken voltage 6.3 v for the powering of the filament circuits of unit. On diodes D_9 and D_{10} is assembled rectifier +27 v for the feed of relay R_1, while on the diodes of D_1-D_8 - plate rectifier of unit. At the output/yield cf the last/latter rectifier, is included the filter, which consists of throttle/chokes Dr_1, cther and capacitors S_{15} and S_{16}. From throttle/choke Dr_2, is remove/taken the vcltage +300 in.

Electronic regulator is assembled cn tubes L_8 (6Zh1P), L_9 (6N13S), L_5 (SG2P). From the output/yield of stabilizer, is remcve/taken the voltage +150 in. From transformer Tr_1, is remove/taken voltage 30 v for the feed of the thermostat of heterodyne.

Constructions. Unit (Fig. 59) is carried cut on L-shaped chassis/landing gear. Cn the front/leading panel of unit, are arranged the instrument IP_1, the dial light of the LN_2 of instrument, switches V_2 - the "monitoring or mode/conditicrs" and V_3, V_1 - "switching quartzes", potentiometers "balance AK". "balance DK" and knob/stick "tuning of heterodyne". There is a dcor for an admission to thermostat and the replacement cf quartzes.

end section.

Fig. 59. Unit of the contrcl/checking cf the frequency: 1 - measuring meter; 2 - the knob/stick cf the tuning of heterodyne; emf - ccmmutator switch; 4 - high-frequency couplings; 5 - instrument switches; 6 - the pctentiometers of the adjustment of balance and sensitivity; 7 - the toggle switch of the start of grid/network. Unit cf encoder.

This unit form/shapes and codes ncrthern, two-degree and reference pulses "35" and "36", entering frcm electromagnetic sensors cclumns of the drive of azimuth antenna, and the reciprocal ranging momentum/impulse/pulses, formed into NFU. From the output/yields of unit the momentum/impulse/pulses are supplied tc the modulators of transmitters P-20A and P-20D, on IKO and NFU.

The unit of encoder has four codes fcr the reference pulses "35" and "36", of reciprocal ranging and twc-degree momentum/impulse/pulses. Switching codes is realized by hand.

Functional diagram in Fig. 60). Channel cf northern momentum/impulse/pulses. For the starting/launching of this channel to the input cf its amplifier-limiter from electromagnetic sensor "north" are supplied bipolar momentum/impulse/pulses 40-50 in amplitude.

The intensive and limited momentum/impulse/pulse approaches the phase invertor, which changes its polarity to positive, and then - to the differentiating circuit for obtaining the momentum/impulse/pulse of short duration. As a result of differentiation is formed negative pulse. The second cascade/stage of amplifier-limiter amplifies and limits the differentiated momentum/impulse/pulse, but phase inverter changes its polarity by positive. From the output/yield of phase invertor the momentum/impulse/pulse is supplied to cathode follower and further on cable - on PPI. Single northern momentum/impulse/pulses from the output/yield of cathode follower take the form, close to rectangular, with duration 10 μss and amplitude of approximately 50 in.

Channel of reference pulses "35". The first cascade/stages of this channel according to circuit (amplifier-limiter, phase inverter, the differentiating circuit, the second amplifier-limiter, phase inverter and cathode follower) are analogous to the cascade/stages of the channel of northern momentum/impulse/pulses with the only difference, that to the input of first amplifier-limiter are supplied the bipolar momentum/impulse/pulses from the electromagnetic sensor of reference pulses "35".

From the output/yield of the cathode follower of the channel of reference pulses "35" the positive pulse approaches delay line for obtaining the bunk of the momentum/impulse/pulses, delayed one relative to another for a period, which corresponds to the code of channel, and further - on amplifier. After amplification the pair of momentum/impulse/pulses is supplied in the diagram, which is common/general/total for the channels of reference pulses "35" and "36". Circuit consists of the multivibrator, which forms momentum/impulse/pulses in duration, amplifier-limiter, amplifier and cathode follower. From the output/yield of cathode impulse repeater are relayed on cable to the modulator of the transmitter P-20A and to NPU for its closing for a period of the emission/radiation of signals by the transmitter P-20A.

the channel of the reference pulses "36" is analogous to the channel of momentum/impulse/pulses "35", but on its input are supplied bipolar momentum/impulse/pulses from the electromagnetic sensor of reference pulses "36".

Output reference pulses "35" and "36", going to modulator of transmitter P-20A and on NPU, take positive polarity and the form, close to rectangular, with amplitude of approximately 100 in.

The channel of two-degree momentum/impulse/pulses is started by bipolar momentum/impulse/pulses from the electromagnetic sensor of two-degree premise/impulses. The first five cascade/stages of this channel are analogous those which were described above and fulfill in circuit the same functions. After the fifth cascade/stage - phase inverter - the positive pulse approaches the blocking oscillator, which develops the positive pulses of the short duration, which are supplied to delay line for obtaining three momentum/impulse/pulses, delayed one relative to another for a period, which corresponds to the code of channel. These three momentum/impulse/pulses are amplified, are form/shaped with multivibrator in duration, then they pass two cascade/stages of amplification and approach the cathode follower, from output/yield of which they are supplied on cable to the starting/launching of the modulator of the transmitter P-20D and for cut-off of NPU for a period of the emission/radiation of signals by transmitter. Page 71.

Fig. 60. Functional diagram of the unit of enccder.

Key: (1). Channel of northern momentum/impulse/pulses. (2). amplifier-limiter. (3) Phase inverter. (4). Differentiating circuit. (5). Cathode repeater. (6). To PPI. (7). Ccmmcn/general/total channel for reference pulses "35" and "36". (8). Amplifier [illegible]. (9). Delay line. (10). Amplifier is mixer. (11). Multivibrator. (12). Amplifier-limiter. (13). Amplifier. (14). Cathcde follower. (15). Channel of reference pulses. (16). Amplifier-limiter. (17). Cascade/stage of agreement. (18). to. (19). Blocking oscillator. (20). Amplifier. (21). Multi-vibrator. (22). Amplifier-limiter. (23). Cathcde follcwer. (24). Cathode follcwer. (25). Manipulator. (26). Channel [illegible] momentum/impulse/pulses. (27). Blocking Generator. (28). Delay line. (29). amplifier-mixer. (30). Multivibrator. (31). Amplifier. (32). Phase inverter. (33). Cathode repeater. (34). Channel cf responding [illegible] momentum/impulse/pulses. (35). Imitator. (36). Phase inverter. (37). the mil6ti-vibrator of the blanking momentum/impulse/pulse. Page 71a.

Fig. 61. The schematic diagram of the block of encoder.

Key: (1). Cascade/stage of coding. (2). Multivibrator of formation. (emf). Amplifier. (4). The output stage of the reference signals of azimuth. (5). Circuit. (6). Housing. (7). V. (8). Hz. (9). Output of signal interrogation unit. (10). coding. (11). Imitator. (12). The output stage of channel. (13). Test stage. (14). Multivibrator of formation. (15). The output stage of the channel of call. (16). Call code keyer. (17). Multivibrator of the blanking momentum/impulse/pulse. (18). The output stage of range channel. (19). Phase inverter. Page 72.

For the formation of the call momentum/impulse/pulses of radio beacon in the form of the points and dash in two-degree channel is established/installed the manipulator, who is included by the special toggle switch, arrange/located on the front/leading panel of unit. Simultaneously from the forming blocking oscillator of channel single momentum/impulse/pulses through the cathode follower approach PPI.

The channel of reciprocal ranging momentum/impulse/pulses is started by inquiring ranging momentum/impulse/pulses by duration 1.5 μss of approximately 50 in amplitude, accepted by NPU. The taken momentum/impulse/pulses start the bloknig-oscillator, generating the momentum/impulse/pulses of the short duration, which are supplied to the delay line, which forms two-pulse code. from the line of pulse delay after preliminary amplification are form/shaped in duration with multivibrator and again approach pre-leave amplifier. the intensive momentum/impulse/pulses are converted into positive in the phase inverter, from output/yield of which across the cathode follower they go to the starting/launching of the modulator of the transmitter P-20D and cut off NPU.

The unit of encoder are another the cascade/stage of agreement, employed for the formation of three-pulse code in the torque/moment of the northern matching of reference pulses "35" and "36", and the imitator, intended for checking of transmitters P-20A and P-20D in cases when azimuth antenna for any reasons does not rotate.

Schematic diagram (Fig. 61, see insert). Channel of northern momentum/impulse/pulses. From electromagnetic sensor the "north" of the column of the drive of antenna momentum/impulse/pulse through the isolating capacitor S_1 is supplied to the control electrode of the left half of tube L_1 (6N2P), the performing the role amplifier-limiter (R_1 - the leakage resistance of tube, R_{214} - the limiting resistor/resistance in grid limiter circuit). The limitation of momentum/impulse/pulse occurs because of grid cathode currents. The plate load of amplifier-limiter is the resistor/resistance R_4. Displacement -4 v to the left half of tube is supplied from rectifier - 210 v through the voltage divider R_3, R_2 (S_2 - blocking capacitance/capacity in bias circuit).

The positive part of the momentum/impulse/pulse triggers the left half of tube L_1. From plate load R_4 is remove/taken the intensive and limiting momentum/impulse/pulse with an amplitude of of approximately 100 v and is supplied through the capacitor S_3 to the grid of the right half of tube L_1 - phase inverter. Tube is cut off and from its plate load R_5 is remove/taken the positive pulse with an amplitude of 80 v and the duration 1 ms, which approaches the differentiating circuit, which consists of capacitor S_4 and resistor/resistance R_7.

The differentiated momentum/impulse/pulse through the capacitor S_6 is supplied to the grid of the left half of tube L_2 (6N1P) - amplifier-limiter. The left half of tube L_2 is closed by negative displacement from divider/denominator R_8, R_{10} (R_9 - the leakage resistance of tube). The positive part of the momentum/impulse/pulse open/discloses the left half of tube and from its plate load R_{12} is remove/taken the negative pulse of short duration 80 in amplitude, which enters through the capacitor S_8 to the grid of the right half of tube L_2. The right half of tube works with zero displacement. negative pulse closes tube and from its plate load it is remove/taken positive pulse of approximately 120 in amplitude. The formed by the forming cascade/stages momentum/impulse/pulse of positive polarity through the capacitor S_9 approaches the cathode follower, made on two in parallel connected triodes of tube L_3 (6N1P).

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Triodes in the absence of momentum/impulse/pulses at the output/yield are cut off by negative voltage 50 intc s vcltage divider R_{15} R_{17} (R_{16} is leakage resistance of tube, capacitor S_{10} - blocking).

After pulse arrival cn grids the tube rests on its cathode load, common/general/total for both of the halves of tube, is formed the positive pulse with an amplitude of of approximately 40 v and the duration 10 μss, which is supplied on cable on PPI. Cathode repeater is necessary for matching of the output resistance of shaping circuit with the resistor/resistance of the cable, cn which is relayed the momentum/impulse/pulse. For the decoupling cf cascade/stages on the circuit of anode power in channel is a filter $R_{11}S_5$.

Channels of reference pulses "35" and "36". Bipolar momentum/impulse/pulse from the sensor cf the reference pulses "35" cf the drive column of the antenna through the coupling Sh_7 and the capacitor S_{11} is supplied to the amplifier-limiter, assembled on the left half cf tube L_4 (6N2P) whose diagram is analogous to the circuit cf the amplifier-limiter of the channel cf northern momentum/impulse/pulses. From the output/yield cf the amplifier-limiter of the signal through the capacitor S_{13} approaches amplifier, the phase inverter,, which works with zero bias and fulfills the same functions, as in the charnel of northern momentum/impulse/pulses. The entering from the output/yield of phase inverter momentum/impulse/pulse is differentiated by the circuit of S_{14}, R_{25}.

The undershoot of momentum/impulse/pulse is limited to diode limiter D_7 and is supplied to the amplifier-limiter, carried out on tube L_5 (6N1P), and then - to cathode follower L_6 (6N1P).

Schematic diagrams these amplifier-limiters and of cathode follower are analogous to the schematics of the same devices of the channel of northern signals.

Positive pulse with an amplitude of stress of 40 v and the duration 10 μss enters through the capacitor S_{23} of the input of the delay line in the LZ-1 on 88 μss, which is utilized for the formation of codes. the removal/outlets of line are derived on the switch of codes. Line is loaded for matched impedance R_{54} in order that it would not be reflected from the dead ending of momentum/impulse/pulses. From the output/yield of the line of LZ-1 they are remove/taken two momentum/impulse/pulses, delayed for a period, which corresponds to the code, established/installed by switch. These momentum/impulse/pulses are supplied to the amplifier-mixer, carried out on tube L_7 (6N1P) and which is two identical amplifiers, assembled on two triodes, which work on one common/general/total anode load R_{40}. To the grids of the triodes through voltage dividers R_{39}, R_{38} and R_{44}, R_{43} given negative bias voltage from rectifier 21C in.

After the admission of positive pulses the tube L_7 triggers itself and from its plate load are remove/taken negative pulses 120 in amplitude.

For the final formation of the coded momentum/impulse/pulses through duration they enter through capacitor S_{29} and resistor/resistance R_{228} for the starting/launching blocked multivibrator, assembled on tube L_8 (6N1P). The required pulse duration of multivibrator is reached by trial and error of the elements.

From plate load R_{52} multivibrator the formed positive pulses through the capacitor S_{31} approach the left (closed) triode of tube L_9 (6N1P), which performs the role of amplifier. From plate load R_{48} tube negative pulse is supplied to the grid of the right triode of the tube L_9, connected through resistor/resistance R_{60} with plus of power supply. After the admission of negative pulse on grid, the triode is closed and on its plate load R_{59} is formed the intensive positive pulse 150 in amplitude, which is supplied to the grid of the matching cascade/stage - cathode follower. From load R_{61} cathode impulse repeater enters through cable for the starting/launching of transmitter N-20A and through resistor/resistance R_{109} to the blockage of receiver.

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The channel of reference pulses "36" on its functional subassemblies is analogous to the channel of reference pulses "35" with the small differences, which includes the following: the right triode of the channel of reference pulses "36", make from to the tube L_{13} (6N2P), works not with zero bias, but with positive; there is no diode limiter D_7; in the channel of reference pulses "36" on the tube L_{13} (6N1P) are assembled two cathode repeaters, from one of which (from resistor/resistance R_{82}) through the capacitor S_{47} the reference pulses "36" are supplied on PPI for the creation of ten-degree markers. From load R_{83} the second cathode impulse repeater are supplied to the delay line in LZ-2, and through the capacitor S_{125} - in the diagram of the formation of the blanking momentum/impulse/pulse.

For correct azimuth determination electromagnetic impulsers "35" and "36" are combined so, in order to at the torque/moment of the passage of the azimuth antenna through the northern direction of the matching of two momentum/impulse/pulses, issued by these sensors. As a result of the addition of reference pulses "35" and "36" at the output/yield of the unit of encoder is form/shaped three-pulse code. For the exception/elimination of an inaccuracy in the pulse pile-up at the torque/moment of agreement, with the sensors of reference pulses "35" and "36" is combined the sensor "north". In this case on encoder come simultaneously three momentum/impulse/pulses: supporting/reference "35" and "36" and northern.

The circuit of encoder during this agreement disconnects the channel of reference pulses "35" and issues the new imitated three-pulse code. Occurs this thus. From load R_4 amplifier, made on tube L_1, the momentum/impulse/pulse cf negative polarity with duration 1 μs through the diode limiter D_3 apprcaches the grid of the left half of the tube L_5, closed by negative vcltage from voltage divider R_{27}, R_{29}. To this same grid is supplied the reference pulse "35" cf positive polarity with duration 20 μss from diode limiter D_7. If both momentum/impulse/pulses come simultanecusly, then positive pulse is shunted and amplifier L_5 not started.

Simultaneously from resistor/resistance R_5 phase inverter L_1 the channel of northern momentum/impulse/pulses is supplied the momentum/impulse/pulse cf pcsitive pclarity with duration 10 μss thrcugh the capacitor S_{120} cn the third grid cf the tube of the L_{31} (6Zh2P) of the cascade/stage of agreement. To the first grid of this tube enters positive reference pulse "36" from the delay line in LZ-2 through the switch V1-V. If momentum/impulse/pulses come simultaneously, from the anode load R_{107} is remove/taken the negative pulse, which across capacitor S_{118} and resistcr/resistance R_{228} goes tc blccked multivibrator L_8 shaping in duration, common/general/total for the channels of reference pulses "35" and "36".

Consequently, from the delay line in LZ-2 are remove/taken three momentum/impulse/pulses: the first - tc the cascade/stage of the agreement of L_{31}, the second and the third - to amplifier-mixer L_{14} (6N1P). three momentum/impulse/pulses start in turn the forming multivibrator, which issues three-pulse code. The interval between the alternating fronts of the first and third momentum/impulse/pulses corresponds to the code of reference pulses "35", and between the leading edges of the second and the third - to the code of reference momentum/impulse/pulses "36".

Channel of two-degree momentum/impulse/pulses. From the two-degree sensor through the coupling Sh_4 and the capacitor S_{63} bipolar momentum/impulse/pulse is supplied to the amplifier-limier assembled on the left half of the tube of L_{17} (6N1P), then - to phase inverter (right half of the tube of L_{17}) and the differentiating circuits S_{65}, R_{119}. The undershoot of momentum/impulse/pulse after differentiation is not passed by diode D_1. The positive part of the differentiated momentum/impulse/pulse approaches the grid of the left half of the tube of L_{18} (6N1P) is blocked by the negative voltage, which enters from divider/denominator R_{121}, R_{123}.

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The negative pulse, removed from plate load R_{124}, through the capacitor S_{68} is supplied to the grid blocked by the right half of the tube of L_{18}, it is amplified and approaches the blocking oscillator, assembled on the tube L_{19} (6N1P) according to circuit with parallel starting/launching (R_{130}, S_{70} - filter in the circuit of anode power, R_{132}, R_{128} - the leakage resistance of the grids of the tube of blocking-oscillator, S_{72} - the reservoir capacitor of blocking oscillator). From the third winding of 2-5 peak transformer Tr_5 bloknig-oscillator is remove/taken the positive pulse with duration 1.5 μss and amplitude 150 in, which through the capacitor S_{73} is supplied to the input of the delay line in LZ-4. From the removal/outlets of this line are remove/taken three momentum/impulse/pulses and are supplied to the grids of the tube of L_{20} (6N1P) of the amplifier-mixer analogous according to mixer circuit amplifier-, assembled on tube L_7. The first momentum/impulse/pulse is supplied through the switch of codes V1-B to the grid of the closed right half of the tube L_{20}, and the second and the third - through diodes D_4 and D_5 - to the grid of the closed left half of the tube of L_{20}.

From plate load R_{137} tube of L_{20} are removed the negative coded pulses with an amplitude of 120 v and are supplied to the anode circuit of the closed multivibrator, assembled on the tube L_{21}

(6N1P), analogous according to circuit tc multivibrator on tube L_8 the channel of referenct momentum/impulse/pulses "35".

The formed in pulse duration through the capacitor S_{83} is sent tc two stages of the amplifiers, made on the tute of L_{22} (6N1P). From plate load R_{156} this tube through the capacitor S_{86} the intensive momentum/impulse/pulses are supplied in the output stage of the channel of two-degree (call) momentum/impulse/pulses. The cathode follcwer of output stage on the tute of L_{23} (6P1P) is closed by voltage - 20 in, by subject on contrcl electrode.

From the cathode follcwer thrcugh the coupling F_5 the momentum/impulse/pulses are relayed on cable tc the modulator of the transmitter cf P-20D, and through resistor/resistance R_{111} and coupling F_6 - to NPU for its clcsing fcr a pericd of the work cf transmitter. Furtnermore, from the third winding of transformer Tr_5 the pcsitive pulses through the capacitcr S_{57} are supplied to cathode follcwer L_{16}, (6N1P), which in the absence cf mcmentum/impulse/pulse is clcsed. From part of load R_{24} cathode repeater the momentum/impulse/pulses are relayed on catle cn PPI for the creaticn cf twc-degree azimuth markers cn screen.

In the channel of two-degree momentum/impulse/pulses enters the manipulator, who forms the call signals of radic beacon by Morse code. The insert/bushings of manipulatcr's disk switch two bunks of contacts. Contacts K_2 switch into cycle/strcke with call the feed circuit of the neon tube/lamp of NL_1 "work", while contacts K_1 - the bias circuit of the right half of the tube of L_{20}, without passing to transmitter P-20D into cycle/stroke with the call of radio beacon one of the momentum/impulse/pulses of three-pulse code. The delivery of the call signals of radio beacon occurs during 15 s. Manipulator's electric motor is powered by alternating current with voltage 26 v and frequency 400 Hz from transformer Tr_1 through resistor/resistance R_{232} and the contacts of switch V_2.

Channel of ranging momentum/impulse/pulses. Accepted NPU inquiring range-finders signal by duration 1.5 μss of approximately 50 in amplitude are supplied through the coupling F_1 and the capacitor S_{89} to blocking oscillator with parallel start assembled on the tube L_{24} (6N1P). The circuit of blocking cscillator is analcgous to the circuit, made on the tube L_{19}. In the circuit of the grid of the left triode of blocking oscillator is included the diode D_6 for the shunting of negative pulses. Blocking cscillator is open/disclosed by the entering positive pulses. In the third winding of its transformer is formed by positive pulses with duration 1.5 μss and amplitude of approximately 150 in.

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The obtained momentum/impulse/pulse transmits to the delay line in LZ-3, analogous earlier described. In the output/yield of the line of pulse delay enter through the capacitors of S_{95} and S_{97} to the grids of the amplifier-mixer, assembled on the tube of L_{25} (6N1P).

The coded momentum/impulse/pulses from load R_{172} amplifier-mixer through resistor/resistance R_{233} and capacitor S_{98} are supplied to the starting/launching of multivibrator made on the tube L_{26} (6N1P). The formed along pulse duration pass through the forming cascade/stage on the tube of L_{27} (6N1P), that consists of two resistance coupled amplifiers and are supplied to the output cathode follower, assembled on the tube L_{28} (6N1P).

The load of cathode follower is the resistor/resistance R_{161}, common/general/total for tubes L_{28} and L_{23}. Momentum/impulse/pulses with amplitude of 100 in duration 2 μss from resistor/resistance R_{161} on cable transmit to coupling P_5 for starting of the transmitter P-20D and through resistor/resistance R_{111} - for coupling P_6 for a black-out effect during the emission/radiation of signals by transmitter.

Channel of the formation of the blanking momentum/impulse/pulse of the transmitter of P-200M. In the unit of encoder enters the cascade/stage of the formation of the blanking momentum/impulse/pulse of the transmitter P-200M during the emission/radiation of the transmitter P-20A.

Reference pulse "35" from load R_{36} cathode follower on tube L_6 and reference pulse "36" from load R_{83} cathode follower on the tube L_{13} through the capacitors S_{114}, S_{115} and diodes D_2, D_3 are supplied for the starting/launching of the multivibrator of the blanking momentum/impulse/pulse on the tube L_{29} (6N1P).

Multivibrator is made according to circuit with cathode coupling. From load R_{237} multivibrator through the capacitor S_{132} the momentum/impulse/pulses approach the grid of the closed phase inverter, assembled on the tube of L_{30} (6N1P). the load of phase inverter is removed into transmitter P-200M.

Imitator. In encoder there is a separate blocking oscillator, assembled on the tube L_{15} (6N1P) and intended for the verification test of transmitters P-20A and P-20D with the stationary azimuth antenna. Bl ing oscillator works in the mode/conditions of self-excitation. Upon the start of toggle switch V_3 is supplied the feed to tube LN_1 "imitator" and displacement to the grids of blocking oscillator. Blocking oscillator develops positive pulses by duration 1.5 μss with following 200 Hz frequency. These momentum/impulse/pulses is obtained for coupling F_4 with engraving "imitator".

By supplying pulses from imitator to the channel of encoder, it is possible to start the transmitters P-20A and P-20D, without including the drive or the azimuth antenna, on which are located electromagnetic sensors.

The incandescence of all tubes of the unit of encoder is realized from two separate transformers Tr_2 and Tr_3.

Construction (Fig. 62). On front panel are derived the couplings for the connection: cables from electromagnetic sensors, cables, but with which are supplied reference pulses "35" and "36" for the starting/launching of the transmitter P-20A and blocking of NPU, cable, on which are supplied inquiring range-finders signal from the NPU, cables, but with which are supplied two-degree and reciprocal ranging momentum/impulse/pulses for the starting/launching of the transmitter of P-20D and closing of the NPU, cables, on which are supplied two-degree, northern and reference "36" momentum/impulse/pulses for creation two- and of the ten-degree markers of azimuth and synchronization. Here are arranged the tubes, indicating the work of the channel of call signals and immitator, the switch of codes, monitoring jacks and the toggle switch of the start if keyer, which is closed by special hatch cover for an admission to the disk of the dialing/set of call signals and for the start of the toggle switch of imitator. Page 77.

Fig. 62. Unit of the encoder: 1. , 3. , 4. , 11. , 12. high-frequency couplings; 2 - socket couplings; 5, 9, 10. monitoring jacks; 6 - the toggle switch of the start of call signals; 7 - commutator switch; 8 - Indicator tubes. On the rear end of the unit is a knife coupling for the connection of unit to the common/general/total cable system of the strut of the cabinet of NPU. unit is inserted into common/general/total framework/body and heels by the captive screw/propellers.

Power supply unit of encoder.

This unit (Fig. 63) issues the following stresses: +250 in direct current (stabilized) for the feed of the anode and shielding circuits of encoder, +200 in direct current for powerng the circuits of the column of the drive of azimuth antenna, -210 in direct current (stabilized) for powering the grid circuits of the unit of encoder.

Upon the inclusion of toggle switch V_1 voltage 208 v with frequency 400 Hz from the cabinet of the feed of the radio beacon through the terminals of 2-3 couplings E_1, closed contacts of toggle switch V_1 and the safety device/fuse PR_1, parallel to which are included resistor/resistance R_3 and neon tube/lamp NL_1, is supplied to the primary windings of transformers Tr_1 and Tr_2, but through the coupling P_1 (terminals 6, 7, and 4, 5 are locked) and the circuit breaker Pr_2, in parallel to which are included resistor/resistance R_{30} and neon tube/lamp NL_2, for the primary winding of transformer Tr_2 the feed of the dial lights of rack of NPU. From the secondary windings of transformers the alternating voltage is sent to rectifiers D_1, D_2 and D_3.

The voltage +250 in provides the rectifier D_1, assembled according to bridge circuit on selenium cell/elements. Voltage is stabilized by electronic regulator. Tubes L_1, L_2 (6N13S) - current-regulating and the tube L_4 (6Zh8) is amplifier of direct current. Tube L_3 (SG2S) stabilizes the reference voltage in the cathode of tube L_4. From the output/yield of voltage regulator through the circuit breaker Pr_3, parallel to which are included resistor/resistance R_{31} and neon tube/lamp NL_3, is sent to the terminal of 14 couplings P_2 for powering anode and screening circuits the unit of encoder. Stabilized voltage of +250 V is sent to the terminal of switch V_2 for a control/checking in terms of the instrument of IP_1. In circuit is provided the adjustment of output voltage on the control electrode of tube L_4. Page 78.

Fig. 63. The schematic diagram of the block of the feed of encoder.

Key: (1). Circuit. (2). Housing. (emf). V. (4). Hz. (5). mA. (6). Lights. Page 79.

Fig. 64. Block of power cf encoder: 1 - the tube for lighting dial face; 2 - measuring meter; emf - the toggle switch of the start of dial light; 4 - the toggle switch of the start cf grid/network; 5 - circuit breaker; 6 - indicator lights; 7 - the switch of measuring instrument. Voltage +200 in is removed frcm the rectifier D_2, assembled not bridge circuit with selenium cell/elements. This voltage it passes through the filter S_4, Dr_1, LS_5 and through the terminal of 16 couplings P_2 is supplied fcr the feed of the column of drive, and also to switch V_2 for a control/checking in terms of the instrument of IP_1.

Negative voltage of -210 v fcr powering the circuits of the unit of the displacement of encoder is obtained frcm the rectifier D_3, assembled but to bridge circuit. The obtained vcltage it passes through the pi-section filter S_6, cthers, S_7 is stabilized by two been connected in series tubes L_5, L_6 (SGZS).

From the output/yield cf rectifier negative voltage is sent to the switch of the instrument of IP_1 and the ccupling P_2 (terminal 18 is connected with terminal 19), from which it is supplied to the unit cf encoder.

Construction (Fig. 64). Unit for powering the encoder is assembled on rectangular chassis/landing gear with front/leading panel. The fundamental cells are placed from above chassis/landing gear, and small parts and installation wires - below. The input and output voltages of rectifiers are supplied through two knife couplings, the arranged/located on rear wall chassis/landing gear.

On front panel are derived the instrument NP_1, tube LN_1 of the illumination of its scale, toggle switch V_3 the start of dial light, safety device/fuses Pr_1, Pr_2, Pr_3, the tube of NL_1, NL_2, NL_3, that fix overheating of circuit breaker, toggle switch V_1 the start of grid/network, potentiometer R_{16} adjustment of voltage +250 in (is derived under slit). Unit is inserted into cabinet of NPU and heels by the captive screw/propellers.

Chapter IV.

GROUND-BASED RECEPTORS.

Ground-based receptors are intended for reception and decoding of signals SZD and of the aircraft responder of range (sodas) with the subsequent isolation/literation and the separation received signals into ranging and indicator. Indicator signals are supplied to the PPI, and ranging - to the starting/launching of the encoder of the transmitter of P-20D. Page 80.

Fig. 65. Cabinet the NPU: 1 - unit ShDA; 2 - unit Lake; emf - unit DZD; 4 - unit KDShP; 5 - receivers hearth; 6 - the unit of the rectifier of encoder; 7 - the unit of the rectifier of receiver.

Fig. 66. Cabinet NPO: 1 - the unit of the meter of passage power; 2 - unit DShO; emf - the unit of portable property; 4 - unit NPO; 5 - the unit of the rectifier of receiver.

Fig. 67. Functional diagram of receptors.

Key: (1). Filter. (2). Output units. (emf). Cabinet. (4). unit. (5). To IKP rack. (6). To transmitter.

In receptor is provided the blanking of signals for the purpose of the suppression of internally-produced noise in the ranging and indicator channels, reflected signals from the ground features, limiting of charging the transmitter P-20D.

Cabinet NPU (Fig. 65) consists of the unit of encoder (ShDA), of the unit of the limitation of charging (Lake), of the unit of a supplementary delay in the range finder (DZD), in the unit of the decoder of receiver (DShP), of two units of the receivers of the responder of range finder (hearth), of the unit of the rectifier of encoder (VShDA), of the unit of the rectifier of receiver (VPOD).

Cabinet NPO (Fig. 66) consists of the unit of decoder (DShO), of the receiver of responder, unit of the rectifier of receiver (VNPO).

Functional diagram (Fig. 67). Inquiring ranging and indicator signals of SZD are received as the antennas of the upper and low angles and are sent through filters to inputs hearth. From units NOD the isolated signals are sent to the input devices, where they are divided into ranging and indicator, and then - into unit Lake. The response indicator and identification signals of sodas are received as omnidirectional antenna and enter NPC. With the input of NPO the signals go into decoder and further along ranging and indicator channels into unit Lake. In unit Lake the signals are store/added up of groups. There is realized the blanking of interferences for all signals, and for ranging, furthermore, conducts the limitation of charging.

From the output/yield of unit Lake the range-finders signal through the unit DZD, where they are delayed on 131.2 μss, approach the unit of encoder (ShDA) for coding and starting of the transmitter P-20D. indicator signals with unit Lake go on PPI for the creation of brightness marks on screen.

end section.

Fig. 68. Functional diagram of unit hearth.

Key: (1-9). Illegible.

Units of the receiver of the responder of range finder.

These units are intended for a separate reception, conversion and the amplification of the signals, accepted by the antennas of the upper and lower angles from sodas by ten frequency channels.

Functional diagram (Fig. 68). High-frequency signal from the receiving antenna through the filter approaches high-frequency amplifier (ultrahigh-frequency), also, from it to crystal mixer. For obtaining on the output/yield of the mixer of the fluctuations of intermediate frequency to it, besides received signal, are supplied continuous high-frequency oscillations from the quartz heterodyne through the filter, which weakens the parasitic harmonics of heterodyne. The frequency of heterodyne is higher than the frequency of received signals upon the value of intermediate frequency.

At the output/yield of mixer, is obtained the signal of intermediate frequency, which enters the unit cf intermediate-frequency preamplifier (PUPCh [99sp04 - intermediate-frequency preamplifier]), and then in fundamental. The intensive signal is supplied to unit DShI. For a monitoring of the currents of mixer and heterodyne, and also of the supply voltagees of unit hearth in diagram are provided the controls value with measuring meter.

Fig. 69. Simplified schematic diagram of the block hearth.

Key: (1-5). Illegible.

Schematic diagram (Fig. 69). The accepted by antenna signal through the coupling of aaaaa is supplied on ultrahigh-frequency, the assembled on tube aaaa (6S9D). The application/use of a tube of 6S9D is caused by the requirement for obtaining high sensitivity. This tube has low inherent noise level. The presence of plate circuit ultrahigh-frequency considerably increases the selectivity of receptor, and also protects the crystal of mixer. Anode and cathode citcuits ultrahigh-frequency are carried out in the form of two volumetric silver-plated cylindrical cavities.

Signal from antenna approaches the cathode citcuit through spring contact. This duct is tuned by plunger and is strongly shunted by the input impedance of a tube and by the resistor/resistance of receiving antenna, which provides the broad-band character of duct.

The intensive signal is isolated in the plate circuit which is tuned into resonance upon the frequency of received signal. With the aid of coupling loop, the signal is remcve/taken from plate circuit and after the cable KB-2 is supplied to the input of crystal mixer. The communication/connection between the mixer and the plate circuit is is very weak. This is necessary in crder that the coupled impedance from the side of crystal mixer does not shunt plate circuit. The available in plate circuit structural/design tank serves for separation of variables and the feed currents of tube L_1. For the creation of automatic displacement to tube L_1, serves circuit R_{15}, C_2. For the creation of automatic displacement to tube L_1, serves circuit R_{15}, C_2. H.f.-throttle/chokes L_1, L_2, L_3 remove feedback in the circuits of feed.

The filament of tube obtains feed from the common/general/total filament transformer of unit hearth, and the ancde of tube - through plug P_4 from the common/general/total rectifier of receiver.

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Crystal mixer is assembled on the germanium diode of D-403V and is the cut of coaxial line. To the input of mixer, are supplied two signal: the taken signal of high frequency with output/yield ultrahigh-frequency the signal of quartz heterodyne. The mixing of these signals and the isolation of the signal of intermediate frequency occurs because of the nonlinearity of the characteristic of diode. For impedance matching of the coupling lcop and internal resistor/resistance of diode in coaxial line, is a transformer in the form of the moved plug from the fluoroplast which supports the KSV of mixer in operating range equal to 2. The dc current component of crystal is closed through the quarter-wave short-circuited line. The current of crystal is monitored according to the instrument of IP_1 on the front/leading panel of unit hearth.

From the output/yield of mixer, the signal of intermediate frequency on the cable of KB-5 is supplied to unit PUPCh through the transient tank C_2 (Fig. 70). The input circuit, which consists of coils L_1' and L_1'', is included by autoinductive diagram. This connection/inclusion is necessary for the decoupling of mixer and input circuit.

The first cascade/stage of unit PUPCh is assembled on tubes L_1, L_2 (6Zh1P) by cascade circuit (first tube works in the mode of triode with the grounded cathode, and the second - in the mode/conditions of triode with grounded grid). This cascade/stage provides the minimum inherent noise level. Furthermore, for a decrease in the level of noises and increase in the stability of the work the diagrams are introduced the grid and anode neutralization of the tubes of cascade/stage. For this purpose, of inductance coil L_4 and L_7 are respectively inclined for intermediate frequency taking into account the tanks of network - - anode of tube L_1 and the anode - cathode of tube L_2. Bias voltage to tubes is supplied by circuits R_1, C_6 and R_6 and R_3, C_9.

The plate load of cascade/stage is the duct, which consists of the coils of inductance L_9 and of the tank of tube L_2. From the plate circuit of tube L_2 through coil L_9, the signal approaches the grid of tube L_3 (6Zh1P).

Fig. 70. Schematic diagram of the block PUPCh.

From the resistor/resistance of plate load R_8 tube L_3 the fluctuation of the intermediate frequency through capacitor C_{15} go to the input of IF amplifier (UPCh). The inductance coil L_{11} in the anode circuit of tube L_3 is the cell/element of agreement. For the elimination of the self-excitation of unit PUPCh in the power circuits are included inductive-capacitance and rheostat-capacitance filters.

The signal intermediate of frequency from the output/yield of unit PUPCh supplied through the coupling $_1$ to the first cascade/stage of unit UPCh (Fig. 71), carried out on tube L_1 (6Zh1P). Cascade/stage has the grid circuit, formed as inductance coil L_1, by wiring capacitance, by the input capacitance of tube, and the plate circuit, which consists of the inductance coil L_3 and of the output capacitance of tube. The intensive signal from plate circuit transmits to the grid circuit of the following cascade/stage of unit UPCh because of inductive coupling between ducts. All cascade/stages of unit UPCh (tube of L_1-L_3-6Zh1P and L_4-6K4P) are carried out by one diagram. In unit UPCh, is provided the manual gain control, which is realized by changing the negative displacement on the grids of tubes L_1 and L_2 (6Zh1P). Displacement is regulated by potentiometer R_{16} (see Fig. 69), derived to the front/leading panel of unit hearth. Range of gain control of approximately 40 dB.

From the plate circuit of the fourth cascade/stage of unit UPCh, the signal of intermediate frequency is supplied to the grid of aperiodic amplifier on tube L_5 (6K4P). The fourth cascade/stage of unit UpCh and aperiodic amplifier are carried out on pentodes with the elongated characteristic for the expansion of the dynamic range of unit UPCh. From the cascade/stage of aneriodicheskogo signal amplifier, of intermediate frequency approaches the diagram of amplitude-frequency detector (AChD), which is utilized for an increase in the selectivity of receptor.

Signal with plate load L_{11} goes to duct C_{23}, C_{28}, C_{39}, L_{12}, inductively connected to circuit C_{24}, C_{40}, C_{41}, L_{13}, and simultaneously to the right half of tube L_6 (6Kh2P), loaded by resistor/resistance R_{23}. To left the half of the diode L_6, loaded by resistance R_{22}, is connected circuits C_{21}, C_{40}, C_{41}, L_{13}. On the loads of diode L_6, are isolated the detected signal of the intermediate frequency U_1 (Fig. 72) and U_2, to with different polarity.

Fig. 71. Schematic diagram of the block UPCh.

Key. (1). Target/purpose. (2). Housing. (3). in. (4). The current of the 2nd is placed. (5). Output of videc.

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Fig. 72. Frequency characteristics of unit UPCh: a) frequency characteristic to AChD; b) frequency characteristic after AChD; c) the curve/graphs, which elucidate the work AChD.

The form of voltage U_1 has one resonance at the frequency of aaaa. The form of voltage U_2 has failure at the resonance frequency of aaaa even two clearly expressed resonances at frequencies f_3 and f_6 in view of the fact that into duct as a result of inductive coupling are introduced the active and reactance. The effective resistance determines failure at resonance frequency, and jet/reactive two resonance at frequencies f_3 and f_6.

The total signal U_1 and U_2 is supplied to the grid of cathode follower L_7 (6Zh1P) (see Fig. 71) through the filtering throttle/choke L_{15}. Figure 72 shows that the edge steepness of the resulting curve considerably increases, due to what is raised the selectivity of the circuit of unit UPCh. For the limitation of the characteristic of amplitude-frequency detector in the circuit of the grid of cathode follower, is included crystal diode D_1 (D-2Ye, see Fig. 71).

From the output/yield of cathode follower, the signal is supplied through the coupling of aaaaa to the input of the unit of DShP. The feed of the anode and shielding circuits of unit UPCh is conducted from separate rectifier. The incandescence of tubes is realized from the transformer of power unit. For the target/purpose of the elimination of the self-excitation of unit UPCh because of the spurious coupling, which appear in the circuits of feed and monitoring, are applied the filtering cells LC and RC.

As already it is mentioned earlier, for obtaining on the output/yield of the mixer of the voltage of intermediate frequency on its input, besides received signal, it is supplied the voltage of high-stability frequency from heterodyne.

For obtaining high-stability fluctuations in heterodyne, is utilized the crystal control. Quartzes are placed into thermostat and work at temperature of +70°C.

Transition from one channel to another is conducted by hand by switching quartzes and tuning of the output circuit of heterodyne. Heterodyne consists of the master oscillator and the cascade/stages of frequency multiplication. The master oscillator (Fig. 73) is assembled on tube L_1 (6N1P) by diagram with quartz, connected between the cathode and the grid, and the capacitive feedback between the anode and the grid through capacitor C_1.

Quartz is connected by one of the relay P_1-P_{10}.

The plate load of generator is the duct L_2, C_4, connected with grid circuit L_3, C_5 the second half of tube L_1 because of reactance-capacity coupling (C_2 is a tank of communication/connection). Both ducts form the band-pass filter, which isolates the third harmonic of crystal frequency. The resistor/resistance R_4 and the capacitor C_3 are the circuit of automatic displacement, resistor/resistance R_2 - by the leakage resistance of grid, resistor/resistance R_3 - by instrument shunt. As the plate load of the second half of tube L_1 serves duct L_4, C_9, inductively connected with grid circuit L_5, C_{12} the multiplier, carried out on tube L_2 (6Zh9P).

Band-pass filter L_4, C_9 and L_5, C_{12} is inclined to the ninth harmonic of crystal frequency.

Fig. 73. Schematic diagram of heterodyne.

Key: (1). Duct of the heterodyne. (2). Manual tuning. (3). Output/yield. (4). Thermostat on 10 quartzes. (5). Circuit. (6). Housing. (7). in. (8). Current output of cascade. (9). Grid current cf the aaaa of cascade. (10). Thermostat circuit. (11). Quartz.

The circuit of the automatic displacement of tube L_2 consists of resistor/resistance R_{12} and capacitor C_{13}.

The sinusoidal fluctuations of the ninth harmonic of crystal frequency are supplied to the grid of tube L_2. In the anode circuit of tube, is included duct L_6, C_{16}, which together with inductively the connected bilateral circuit L_7, C_{17} and L_8, C_{18} forms band-pass filter inclined on 18-th harmonic of the frequency of quartz. The voltage of this frequency is supplied to the grids of the following cascade/stage of the multiplication, assembled by push-pull circuit cn tube L_2 (6P1P) and which works in the mode/conditions of the trebling of frequency. The push-pull circuit provides the suppression of even harmonics. By the load of cascade/stage is the duct L_9 in the form symmetrical short-circuited linin, inductively connected with a similar grid circuit of the following cascade/stage.

Fig. 74. Unit is the hearth: 1 - high-frequency coupling; 2 - the knob/stick of the tuning of heterodyne; 3 - the toggle switch of ~~the~~ start of putting on the scale of measuring meter; 4 - the potentiometer of the adjustment or gain; 5 - measuring meter; 6 - the potentiometer of the adjustment of the current of mixer; 7 - the knob/button of the monitoring of the reverse/inverse resistance of mixer; 8 - the switch of measuring meter; 9 - tone switch; 10, 12 - monitoring jacks; 11 - the tube of the monitoring of the work of thermostat.

Output tripler is carried out on tube L_4 (6S5D) with plate load in the form of the coaxial line, inclined on 162-th harmonic of crystal frequency. For the retuning of output circuit from one frequency to another, is utilized structural/design tank in the form of the peculiar capacitor, one of plates of which is fastened on the indoor wiring of coaxial line, and the second is moved with the aid of the mechanism of tuning, derived to the front/leading panel of unit hearth.

For the expansion of the passband of output stage, its grid circuit is shunted by resistor/resistance R_{18}. This resistor/resistance serves for the creation of automatic displacement.

Protection from the various kinds of feedback is carried out by means of the inclusion into the filament circuits of HF-throttle/chokes L_{12} and L_{13}. For the elimination of self-excitation into anode circuits, are introduced the untying RC-filters.

The effect of a change in the ambient temperature for the oscillation frequency of heterodyne is eliminated by means of the addition to the diagram of the thermostating of quartz. The work of thermostat is described in chapter III.

From the output stage of voltage multiplication, of heterodyne is supplied to the filter, which is narrow-band coaxial cavity. Filter passes the fluctuations only of that frequency for which it is inclined, and all others it attenuate/weakens. The tuning of filter is conducted by changing the submersion depth of coupling element into resonator. The fluctuations of heterodyne with the aid of coupling loop are take/selected from resonator and are supplied to the heterodyne input of mixer.

Construction (Fig. 74). Unit is carried out on rectangular chassis/landing gear on which are mounted the heterodyne with thermostat, IF amplifier, crystal mixer and intermediate-frequency preamplifier.

Unit of heterodyne, PUPCh and UPCh are connected to other devices through knife type adapter sockets and heel to main landing gear with the aid of nondropout screw/propellers.

Fig. 75. Functional diagram of the unit of DShP.

Key: (1). From unit hearth. (2). Amplifier. (3). Amplifier - limiter. (4). Amplifier. (5). Limiter on the minimum. (6). To unit OZ. (7). Cathode follower. (8). Cascade/stage of collision excitation. (9). Cascade/stage of agreement. (10). Cathode repeater. (11). To unit OZ. (12). Indicator of output/yield DK. (13). Line of coding.

On front/leading will sing unit hearth there are the plug of the connection of receiving antenna, the tuning knot of heterodyne, the toggle switch of the start of the illumination of the scale of measuring meter, instrument for the functional check of unit hearth, potentiometer R_{16} "amplification", potentiometer R_2 the "current of mixer", switch B-2 thecontrol of th. modes of unit and feed voltages, knob/button for the monitoring of the back resistance of mixer, switch B-1 "" switching frequencies", tube of the monitoring of the work of thermostat and monitoring jacks. Unit is connected to feeding circuits of the cabinet of the PPU through the special knife couplings, arrange/located in the rear end-type part of the unit.

Unit of the decoder of receiver.

This unit serves for the decoding of the signals, accepted NPU from the aircraft, which work with beacon, and the separate isolation of inquiring ranging and responding indicator momentum/impulse/pulses. Decoder consists of two analogous input devices with the supplementary lines of alternating/variable delay and common/general/total circuits of commutation, monitoring and feed of unit.

Functional diagram (Fig. 75). From the output/yield of unit under shaped pulses, approach the end device of unit the DShP, they are amplified by the first amplifier, they are amplified and are limited on maximum to the second amplifier, and then they are supplied to the third amplifier. From the output of the third amplifier, the formed through pulse amplitude approach the time gate, which consists of open-end line of a delay in the LZ-1 and limiter through the minimum. The selector of narrow pulses suppresses momentum/impulse/pulses by duration less than 0.4 μss.

The output pulses of selector approach the amplifier, in parallel to input of which is connected the locked at dead ending of a delay in the LZ-2, which form/shapes momentum/impulse/pulses in duration. Preliminary fixation of pulse duration, which enter the line of decoding, allows:

to raise code selectivity;

the more full to realize the sensitivity of end device (is provided the possibility of the work of the cascade/stage of agreements in the mode/conditions of the maximum sensitivity);

to shield end device from continuous disturbance and the momentum/impulse/pulses, which overlap code intervals. After formation in duration and amplification, the momentum/impulse/pulses through the matching cascade/stage - cathode follower - are supplied to supplementary delay line of alternating/variable.

Fig. 76. Schematic diagram of end device.

Key: (1). Target/purpose. (2). in. (3). Output/yield. (4). output/yield. (5). Grid. (6). Input. (7). Illegible. (8). Ind. of output. (9). Blanker. (10). Housing.

This line makes it possible to change a delay of the decoded momentum/impulse/pulses in each of the end devices, that provides a precise coincidence in time simultaneously accepted by both units the hearth of signals, with the subsequent their addition in unit OZ.

In passing by through the supplementary delay line, momentum/impulse/pulses approach line LZ-3, where occurs the decoding of the taken momentum/impulse/pulses and their separation into ranging and indicator. These momentum/impulse/pulses after the line of decoding approach the cascade/stages of agreement, and then to the cascade/stages of collision excitation. The formed in the cascade/stages of collision excitation output pulses through the matching cathode followers are supplied to unit OZ.

For a monitoring of pulse advancing through the unit ShDA and their admission into unit OZ in parallel to output/yields "d" of decoder are connected the indicators of the output/yield of "d". The indicators of output/yield - these are the waiting multivibrators, which include the neon tubes whose combustion shows presence at the output/yield of the decoder of ranging momentum/impulse/pulses.

Schematic diagram (Fig. 76). The coded ranging and indicator momentum/impulse/pulses, accepted by unit hearth, through the output coupling P_1 and block capacitor C_1 approach the grid of the first cascade/stage of the video amplifier, assembled on tube L_1 (6K4P) through amplifier circuit during resistor/resistances. Cascade/stage works with automatic displacement (circuit aaaaaaaa). To the second grid of the cascade/stage through capacitor C_{28} from unit OZ, are supplied the negative blanking pulses, which lock cascade/stage for a period of the emission/radiation of signals with the transmitters of P-20A and P-20D.

From plate load R_3 the first video amplifier the momentum/impulse/pulses across block capacitor C_3 go to the grid of the second stage of the amplifier of the limiter on maximum, carried out by amplifier circuit during resistor/resistances with automatic displacement on tube L_2 (6P1P). From the output/yield of the second cascade/stage, the momentum/impulse/pulses, limited on maximum, through capacitor C_4 and resistor/resistance R_8 approach the diagram of the selector of narrow pulses.

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The selection of narrow pulses is utilized for obtaining high code selectivity. Selector consists of the amplifier, made on tube L_3 (6N1P) with the delay lines in the LZ-1 and LZ-2, and the limiter on the minimum on diode D_2. The entering on grid momentum/impulse/pulses of constant amplitude are amplified by the left half of tube L_3. The entering on grid momentum/impulse/pulses of constant amplitude are amplified by the left half of tube L_3. Displacement to tube is remove/taken from potentiometer R_{12}. From plate load R_{11}, the momentum/impulse/pulses are supplied to the selecting cell/element - open-end line. In passing by on line and after being reflected in the same polarity from its extended end/lead, momentum/impulse/pulse again comes to its beginning, delayed on the dual delay factor in the line. Straight line and reflected momentum/impulse/pulses store/add up themselves at input. As a result of addition, is obtained the momentum/impulse/pulse, which is supplied to limiter D_2 on the minimum. Limiter isolates momentum/impulse/pulse only during the agreement input and reflected momentum/impulse/pulses. If the duration of input pulse is shorter than the dual delay in the line, then on output/yield voltage is absent, since input and reflected momentum/impulse/pulses do not overlap each other in time.

Limitation level is regulated by potenticmeter R_{12} changing negative voltage on the anode of diode. Thus, the premise/impulses, which consist of the momentum/impulse/pulses which have a duration, which does not exceed the doubled delay in the line, past the selector narrow pulses do not pass.

In passing by through the limiter D_2, momentum/impulse/pulses across capacitor C_6 go to the grid of the amplifier, assembled on the right half of tube L_3. In parallel to grid is connected the short-circuited delay line in the LZ-2, employed for an impulse shaping in duration for the target/purpose of an increase in the code selectivity of end device. Incoming on the line of pulse delay on the passage of it is reflected off the short-circuited end/lead in a change in the polarity. Straight line and reflected momentum/impulse/pulses are deducted at the input of line, as a result of which is obtained the negative pulse, which does not exceed the doubled delay in the line, and the positive pulse of the same duration. The obtained at input momentum/impulse/pulses approach the amplifier, assembled on the right half of tube L_3, they are amplified and from its plate load R_{13} through capacitor C_7 are supplied to the grid of cathode follower L_4 (6P1P). Displacement to the control electrode of tube is taken from divider/denominator R_{21}, R_{20}. Cathode follower cuts negative pulse and, furthermore, will agree output lamp resistance with the line impedance of unbelted delay.

Fig. 77. The schematic diagram of the block of DShP.

Key: (1). Delay line. (2). Target/purpose. (3). Input of video. (4). Output/yield. (5). in. (6). Housing. (7). Output unit. (8). Target/purpose. (9). Housing. (10). Indic. of output. (11). Indic. of output. (12). Regul. of mixing. (13). Input of video. (14). Tube. (15). Input. (16). Grid. (17). Output/yield. (18). in. (19). Form. (20). Output/yield. (21). Switching codes. (22). Displacement. (23). Housing. (24). Form. (25). illumination. (26). Off.

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From resistor/resistance R_1, cathode impulse repeater through the terminal of 20 couplings P_1 (Fig. 77, see insert), switch B_1, the delay line of an alternating/variable in the LZ-4 and terminal 5 of plug P_1 approach the line of the decoding of LZ-3. The delay line in the LZ-4 has 10 removal/outlets on 0.11 μss. Delay factor is selected during plant adjustment.

Utilized in the unit of the end device of the principle of decoding entails the fact that the momentum/impulse/pulses of code are combined on time with the aid of the delay line in the LZ-3 and trigger the cascade/stage of agreement in two grids. Removal/outlets the linin of delay are switched with the aid of the stud switch of codes, derived to front/leading panel. The switch of codes connects the winding of the corresponding relay on value (see Fig. 77): +27 in power supply - the terminal of 12 couplings P_3 is a knob/button the KP_1 of the switch of codes - the terminal of 13 couplings P_1 end device is a winding of relay - -27 in power supply. Relay connects corresponding to code the removal/outlet of delay line. Relays with even numbers switch indicator codes, and with odd - ranging. Ranging momentum/impulse/pulses enter through capacitor C_{14} (see Fig. 76) and resistor/resistance R_{30} to the first grid of the cascade/stage of agreements, made on tube L_5 (6Zh2P), and through capacitor C_{13} - to the third grid of the cascade/stage of agreements.

The cascade/stage of agreements triggers itself only when both momentum/impulse/pulses on grids come simultaneously. At the output/yield of this cascade/stage, are obtained the momentum/impulse/pulses of the negative polarity, delayed with respect to the first momentum/impulse/pulse of input premise/impulse cn 25.4 0.35 μss. Displacement to the third grid of tube L_5 is remove/taken from divider/denominator R_{28}, R_{27}. Displacement on the first grid of tube L_5 is regulated by potenticmeter R_1, derived to the front/leading panel of unit.

From plate load R_{32} the cascade/stage of agreement negative pulses go to shock-excited oscillator, made on the left half of tube L_6 (6N1P). By the entering pulse tube is cut off in its plate circuit, which consists of the inductance ccil L_2 and of stray capacitances, because of the energy, accumulated during the passage of the current through the tube, appears oscillating process. For the expansion of passband the duct of the shunted by resistor/resistance R_{34}. The removed from plate circuit momentum/impulse/pulses of shock-excited oscillator through the cathode follower, assembled on the right half of tube L_6, are supplied to unit OZ. Cathode follower in the absence of momentum/impulse/pulses is closed by voltage from divider/denominator R_{38}, R_{37}.

From load R_{36} cathode impulse repeater of shock-excited oscillator through capacitor C_{25} are supplied to the grid of the which waits multivibrator, assembled on tube L_9 (6P1P). Multivibrator is made but to diagram with cathode coupling. Parallel to load R_{50} is connected neon indicator light "output/yield d", outlying to the front/leading panel of unit DShP. It burns, when tube is open/disclosed by the incoming momentum/impulse/pulses. The pulse duration of multivibrator is selected so that at the smallest repetition frequency of trigger pulses, equal to 30 Hz, the glow of tube would be well distinguished.

The coded indicator premise/impulses from delay line enter through capacitor C_{20} to the first grid of the cascade/stage of agreements, made on tube L_7 (6Zh2P), and to the second and third grids - through capacitors C_{21} and C_{19} respectively. The cascade/stage of agreement is closed on all grids by the negative voltage, removed from divider/denominators R_{41}, R_{40}, R_{45}, R_{44}, R_{49},

$B_{4,8}$ and wear/operates only in the case when it triggers itself simultaneously on all grids.

Fig. 78. Unit the DShP: 1. , 6. pilot lamps; 2 - the toggle switch of measuring meter; 3 - measuring instrument; 4 - shielding cap; 5 - the toggle switch of the start of the illumination of measuring meter; 7, 13. the potentiometers of the adjustment of displacement; 8, 10. safety device/fuses; 9 - the indicator light of blowing; 11 - the stud switch of courses; 12 - the pilot lamp of the collected code.

In the cascade/stage of matching in parallel to the first grid is connected the diode D_3, which is limiter on the minimum. From plate load R_{46}, the momentum/impulse/pulses approach shock-excited oscillator on the left half of tube L_8 (6N1P), also, from it - to cathode follower on the right half of tube L_8. These cascade/stages are analogous in diagram to cascade/stages on tube L_6. From the load of cathode follower, inductor momentum/impulse/pulses are supplied to the output/yield of the unit of DShP.

Unit DShP obtains feed from the special unit (see Fig. 77), assembled on chassis/landing gear of the unit of DShP. Alternating voltage 6.3 in is remove/taken from separate filament transformer Tr_1. For obtaining direct/constant voltage - 105 in serves the selenium rectifier D_2 with gas stabilizer L_5 (SG-3S).

Direct/constant voltage +250 v for the feed of the anode and shielding circuits is remove/taken from the stabilized selenium rectifier D_1, L_2, L_4 (6N13S), L_3 (6Zh8), L_1 (SG-2S).

Alternating current with voltage 208 v and frequency 400 Hz is supplied from the common/general/total cabinet of the power through the knife coupling P_3 (terminal 2, 3), the safety device/fuse Pr_1 to the primary windings of transformers Tr_1, Tr_2, Tr_3.

Constructions. Unit (Fig. 78) is assembled on rectangular chassis/landing gear. On chassis/landing gear are arranged two unit of end devices, the selenium rectifiers, the transformers of the unit of power, delay line of an alternating/variable in the end devices and the network elements of feed. Electrical mounting is made in the basement of chassis/landing gear.

To the front/leading panel of unit are derived the tubes of IL_1 "output/yield D-1" and IL_2 "output/yield D-2", measuring meter IP_1 with cap covering the dial light of the dial face of IP_1 and toggle switches B_2 switching the controlled/inspected voltages and B_3 the start of the illumination of the dial face of IP_1, potentiometers R_1 "the displacement of aaaaaa "and R_4 - the "displacement of aaaaaa", the stud switch of codes, tube of the monitoring of the collected code, the safety device/fuses of PR_1 during feed circuit 208 in, 100 Hz and Pr_2 during the circuit of anode feed, tube the NL_3 of the monitoring of blowing. Unit is inserted into cabinet NNU and is fastened nondrop-out screw/propellers.

Fig. 79. Functional diagram of BOZ.

Key: (1). Ranging channel. (2). Cascade/stage of addition. (emf). Cascade/stage of blanking DK. (4). Oscillator of impact excitation. (5). Cathode follower. (6). Output/yield. (7). Input. (8). From. (9). Cascade/stage of the limitation of charging. (10). Cathode follower. (11). Channel of the blanking of internally-produced noise and limitation of charging. (12). Oscillator of pilot lamp. (13). Counting circuit. (14). Cascade/stage of addition. (15). Amplifier. (16). Blanking signal to the unit of DShP. (17). Cathode follower. (18). Indicator channel. Unit of the limitation of charging.

This unit serves for the addition of the decoded ranging and indicator momentum/impulse/pulses, which come in from units DShP and DShO, for the suppression of internally-produced noise (from the transmitters of radio beacon) and of limitation of charging the transmitter P-20D. Page 95.

Fig. 80. Schematic diagram BOZ.

Key: (1). Charging is output/yield. (2). Input. (emf). Illegible. (4). Limitation. (5). Control/checking. (6). Output/yield. (7). Target/purpose. (8). Input. (9). Output/yield. (10). Illumination. (11). Off. (12). Form. (13). Illegible. (14). in. From the output/yield of unit are removed the trigger pulses on unit ShDA, indicator momentum/impulse/pulses on PPI and blanking - for the closing of units DShP and DShO for a period of the emission/radiation of transmitters.

The blanking (closing) of the decoders of receivers for a period of the emission/radiation of signals by transmitters is necessary for the exception/elimination of the penetration of the false trigger pulses on the encoder of the transmitter P-20D and appearance of false markers on screen PPI.

The limitation of charging the transmitter P-20D is introduced for the prevention of its overloadings if the number of aircraft, which work with radio beacon, exceeds the permissible amount. The cascade/stage of the limitation of charging "cuts out" part of the incoming momentum/impulse/pulses, proportional to the amount of g-force, and it supports with almost constant the medium frequency of the demand of range-finders signal. As a result of this the medium frequency of obtaining the answer/responses by any of the requesting aircraft will be less than the interrogation frequency to the value, proportional to the overloading of the transmitter P-20D.

The functional diagram (Fig. 79) contains the channels: ranging, indicator, the blanking of internally-produced noise and limitation of charging the transmitter P-20D.

Ranging channel is intended for the addition of the ranging momentum/impulse/pulses, sent from the units of decoders NPO and NPU, formation of reciprocal ranging momentum/impulse/pulse, indication of the passage of ranging momentum/impulse/pulses and reading of their average repetition frequency at input or output/yield of unit, and also blanking for the purpose of the suppression of internally-produced noise and limitation of charging.

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The formed ranging momentum/impulse/pulses D-1, D-2, D-3 from units DShP and DShO stumble to the cascade/stage of addition, but after it [to the cascade/stage of blanking dripped "d" and counting circuit. To the cascade/stage of blanking from the channel of the blanking of the internally-produced noise through the cathode follower and the cascade/stage of the limitation of charging are supplied the blanking momentum/impulse/pulses. In passing by the cascade/stage of blanking, ranging momentum/impulse/pulses are supplied to shock-excited oscillator, from output/yield of which the momentum/impulse/pulses through the cathode follower enter unit DZD. Furthermore, the momentum/impulse/pulses from cathode follower are headed for counting circuit and the cascade/stage of the indication of the passage of ranging momentum/impulse/pulses.

Indicator channel is intended for the addition of the decoded reciprocal momentum/impulse/pulses for a ground-based indication, which enter from the units of decoders NPU and but also the delivery of indicator momentum/impulse/pulse PPI.

From the units of decoders NPU and of NPO the reciprocal indicator momentum/impulse/pulses I-1, I-2, I-3 are summarized in the cascade/stage of addition and then through the output cathode follower are supplied on cable on PPI.

The channel of the blanking of internally-produced noise and limitation of charging is intended for the creation of the blanking momentum/impulse/pulses, which lock ranging channel and the units of decoders NPU and of NPO for a period of the emission/radiation of transmitters P-20A and P-20D. The suppressor pulses ZS-1 and ZS-2 from the unit ShDA approach the cascade/stage of addition. The resulting momentum/impulse/pulse is amplified and is supplied to the cascade/stage of the addition of the blanking momentum/impulse/pulses, and then - on the cascade/stage of the blanking of the channel of "d" for its closing.

The same resulting momentum/impulse/pulse is supplied from the cascade/stage of addition to another output amplifier stage, from which receives the blanking negative pulse for the closing of the units of decoders NPU and NPO. The cascade/stage of the limitation of charging form/shapes the blanking momentum/impulse/pulses.

Schematic diagram (Fig. 80). Ranging channel. The decoded ranging momentum/impulse/pulses from the unit of the decoder of NPU through the transient coupling PN2-2 (terminal 15, 16) and from the unit of the decoder of the NPO through the adapter socket PN2-3 (terminal 24) approach the cascade/stage of addition, assembled on three germanium diodes D_1, D_2, D_3. Diodes are loaded for the common/general/total load R_2. The utilized circuit does not give the total addition of the simultaneously incoming momentum/impulse/pulses. In the case of the simultaneous arrival of two or three momentum/impulse/pulses on load R_2 is isolated only greatest on the basis of pulse amplitude, since for remaining signals (smaller in amplitude) diodes turn out to be closed.

From the load of the cascade/stage of addition positive ranging momentum/impulse/pulses through capacitc C_{23} will be feed/conducted to the control electrode of the cascade/stage of the blanking, made on the tube L_{13} (6Zh2P). The cascade/stage of blocking on control electrode as the negative voltage, removed from divider/denominator R_{59}, R_{60} has bullet potential on the third grid. To the third grid of tube from the cascade/stages of addition and limitation of charging are supplied the blanking momentum/impulse/pulses. In connection with the fact that the repetition frequency of the ranging and blanking momentum/impulse/pulses, which enter on both grids, and also the duration of the blanking momentum/impulse/pulses can change over wide limits, and consequently, will be changed the parameters of output pulses, into the circuit of cascade/stage is introduced the fixation of the grid mode/conditions of tube. Fixation of the mode/conditions of tube on the first and third grids is provided by connection to the grid resistors R_{57} and R_{58} diodes D_5 and D_6, through which are discharged the block capacitors in the pulse separations.

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During the absence of the blanking momentum/impulse/pulses on the third grid, the tube L_{13} works as usual amplifier. Entering the [illegible] grid negative pulse cuts off cascade/stage, thereby not passing ranging momentum/impulse/pulses on the output/yield of channel.

From the plate load of cascade/stage R_{61} the momentum/impulse/pulses across capacitor C_{25} go to the start of oscillator with collision excitation. Oscillator is made on the left half of the tube L_{14} (6N1P). The plate load of cascade/stage is the duct, which consists of inductance coil L_1, the wiring capacitances and coil capacitance L_1. Duct is shunted by resistor/resistance R_{63}, which suppresses free oscillations in duct, making it aperiodic.

The entering momentum/impulse/pulse cuts off the left half of the tube L_{14} and in plate circuit they appear natural oscillations, whereupon the first positive half-period of oscillations is supported by a sharp decrease in the anode cathode current, and negative half-period is suppressed by by-passing resistor/resistance R_{63} and the tube, which is open/disclosed after completion of the action of the entering momentum/impulse/pulse.

For the limitation of the amplitude of the appearing in duct momentum/impulse/pulse into circuit is introduced negative current feedback through the cathode resistor/resistance R_{64}. The obtained momentum/impulse/pulses from the plate circuit through capacitor C_{28} approach the grid of the cathode follower, assembled on the right half of the tube L_{14} and closed by the negative voltage, which is removed from divider/denominator R_{67}, R_{68}. Cathode follower is applied for the agreement of the high output resistance of shock-excited oscillator with the low resistor/resistance of the cable, which transmits output ranging momentum/impulse/pulses on unit DZD.

For a monitoring of the passage of ranging momentum/impulse/pulses into the circuit of unit Lake is introduced the special indicator cascade/stage, made on the tube L_{18} (6N1P) according to the circuit of the waiting multivibrator with cathode coupling. In parallel to the load of cascade/stage R_{89} is connected indicator light NL_1 "output/yield d", established/installed on the front/leading panel of unit Lake and burning at the torque/moment of the admission of ranging momentum/impulse/pulse. The pulse duration of multivibrator is establish/installed so that at the nominal pulse repetition rate, equal to 30 Hz, the glow of tube would be is well distinguished.

The counting circuit, introduced into ranging channel, serves for the measurement of the average pulse repetition rates at the input into unit Lake and output/yield from it. Ranging momentum/impulse/pulses from the cascade/stage of addition (during the monitoring of the frequency of input pulses) or from output cathode follower (during the monitoring of the frequency of output pulses) are supplied through switch B_1 "input- output/yield" and capacitor C_1 to the grid of the left half of tube L_1 (6N1P), closed by negative voltage from divider/denominator R_4. R_5.

The incoming positive ranging momentum/impulse/pulses trigger cascade/stage, also, on load R_6, common/general/total with the load of the expanding multivibrator, assembled on tube L_2 (6N1P), appears the negative pulse, which through capacitor C_4 is supplied to the grid of the right half of tube L_2, activating of multivibrator. From load R_{10} this half of the tube, opened in the absence of momentum/impulse/pulse, is removed the positive pulse and is supplied through capacitor C_3 to the grid of the closed in the absence momentum/impulse/pulse of the cathode follower, assembled on the right half of tube L_1. Negative grid voltage of cathode follower is supplied from divider/denominator R_8, R_6. In parallel to load R_7 cathode follower is included instrument IP_1, which measures the average current, which takes place through the tube. Value of the current is proportional to the number of momentum/impulse/pulses, which enter the cathode follower per unit time.

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Indicator channel. The indicator momentum/impulse/pulses I-1, I--2, I-3, that enter from the unit of the decoder of the NPU through the coupling PN2-2 (terminal 13, 14) and the contacts of relay R_4, and also from the unit of the decoder of the NPO through junction PN2-3 and the breaking contact of relay R_2, are supplied to the cascade/stage of addition. This cascade/stage consists of three diodes D_3, D_4, D_6, working on one common/general/total load R_1. The circuit provides the nontotal addition of signals as in ranging channel.

From load R_1 of cascade/stage indicator momentum/impulse/pulses through capacitor C_{32} and resistor/resistance R_{63} pass to the grid of cathode follower, while from its load R_{66} they are supplied on cable to the output terminal of 9 couplings PN2-2 and further - on PPI. Relays P_1 and P_2 serve for providing the separate indication of the aircraft, which work according to the fundamental and simplified version.

Channel of the blanking of internally-produced noise and limitation of charging. Suppressor pulses (ZS-1, ZS-2) from the unit of the ShDA through the coupling PN2-2 (terminal 10, 11) approach the cascade/stage of addition, made on the tube L_{12} (6X2P). Cascade/stage works on one common/general/total load R_{56} and is assembled according to the circuit of the nontotal addition. Suppressor pulses, passing through the summing cascade/stage, are isolated on the load of cascade/stage and from it through capacitor C_{21} they are supplied to the closed output amplifier, assembled on the left half of the tube L_{11} (6N1P) and the right half of the tube L_{17} (6N1P), which are included in parallel.

To the control electrodes of tubes given negative displacement from divider/denominator R_{62}, R_{64}. In the circuit of cascade/stage is utilized the fixation of the mode/conditions of tube on the first grid because of start in parallel to the grid resistor of the diode D_{10}, which abstract/removes charges from block capacitor, thereby providing with constant the potential of grid independent of frequency and duration of the incoming momentum/impulse/pulses.

From the plate load of amplifier R_{46} the negative pulses across capacitor C_{20} and the coupling PN2-3 (terminal 10, 21) go to the third grids of the video amplifiers of the units of decoders NPU and NPO, cutting off them for a period of the emission/radiation of signals by the transmitters P-20A and P-20D.

Furthermore, from load R_{56} cascade/stage cf addition the suppressor pulses are supplied to closed with negative voltage from divider/denominator R_{82}, R_{84} the amplifier, made on the right half of the tube L_{11} with fixation of the mode/conditicns of grid by the diode D_{10}. Momentum/impulse/pulses are amplified and from the load of cascade/stage R_{58} through capacitor C_{18} approach the grid of the cathode follower, assembled on the right half of the tube L_{10} (6N1P).

Cathode follower works with positive vcltage on control electrode because of the connection of grid resistor R_{93} to plus of power supply.

The obtained on load R_{45} momentum/impulse/pulses pass circuit R_{44}, C_{24} and are sent to the third grid of the cascade/stage of the blanking of ranging channel, cutting off it for a period of the emission/radiation of transmitters P-20A and P20D.

The cascade/stage of the formation of the tlanking momentum/impulse/pulses of the limitation of charging is assembled on the left half of the tube L_{10}. Into the cathode circuit of the cascade/stage through divider/denominatcr R_{53}, R_{52}, R_{15} given negative voltage from the unit of rectifier 11 kV of the transmitter P-20D. The plate load of cascade/stage is the resistor/resistance R_{57} - the grid resistor of the cascade/stage of blanking. To the control electrode of the cascade/stage through resistor/resistance R_{48} is given the voltage - 105 in. The mode/conditions of tube is selected by a change in the voltage on cathode by potentiometer R_{52} the "limitation of charging" so that during normal charging the transmitter P-20D the cascade/stage is closed.

An increase in the charging decreases the negative supply voltage of the transmitter P-20D, which is supplied to the circuit of the cathode of cascade/stage. Upon reaching of negative voltage on the cathode of the level of limitation, the cascade/stage is open/disclosed and from resistor/resistance R_{57} is removed negative momentum/impulse/pulse, which closes the cascade/stage of the blanking of ranging channel. In anode value cascade/stage there is toggle switch B_2, which includes the cascade/stage of the limitation of charging. Page 99.

Fig. 81. Unit Lake: 1 - the toggle switch cf the start of the mode/conditions of the limitation of charging; 2 - measuring meter; emf - the toggle switch of switching measuring meter; 4 - the toggle switch of switching the illumination of the scale of measuring meter; 5, 6, 7, 8, 9, 11, 12, 13, 14 - monitoring jacks; 10 - indicator light. Constructions. Unit (Fig. 81) is assembled on rectangular chassis/landing gear. The electrical mcunting of unit is made in the basement of chassis/landing gear. All supply vcltagees, the input and output signals of unit are supplied through twc knife couplings, the arranged/located from the back chassis/landing gear.

On the front/leading panel of unit are arranged toggle switch B_2 switching on of the limitation of charging, the instrument IP_1, which measures the medium frequency of pulse advancing, toggle switch B_3 start of the illumination of the instrument IP_1, toggle switch B_1, which changes over counting circuit to input or output/yield, the indicator light NL_1, which signals abcut the passage of ranging momentum/impulse/pulses through the unit Lake, monitoring jacks for checking momentum/impulse/pulses along cscillcgraph.

Unit of a supplementary delay in the range finder.

This unit serves for a delay in the decoded interrogation pulse on the value, equal to the initial delay in the phantastron of the aircraft measuring unit of azimuth. Delay factor (131.2 μss) is reached because of the application/use of an ultrasonic delay line.

Functional diagram (Fig. 82). Momentum/impulse/pulses from unit Lake approach the series-connected the variable delay lines in the unit DZD. The first and third delay lines (on 0.3 μss and 2 μss) are intended for the adjustment of common/general/total delay during zero-setting of range. The second delay line (on 1 μs) it serves for the compensation for the scatter of the ratings of delay lines.

Since to transmit momentum/impulse/pulses through the ultrasonic delay line without considerable distortions is impossible, them they convert into signals. To avoid distortions the signal carrier frequency is selected of the calculation of the formation of each of them not less than seven times by the periods of high-frequency oscillations.

In the output/yield of the third line of pulse delay approach the driver, which cons'sts of video amplifier and shock-excited oscillator. The unit of driver converts momentum/impulse/pulses into the radio pulses, which are necessary for excitation of ultrasonic delay line.

The obtained in shock-excited oscillator signals are supplied to ultrasonic delay line, where they are delayed on 129.5 μss. In passing by this delay line, signals considerably they are attenuate/weakened. For the compensation for line loss the signals approach four-stage amplifier. Then they are detected, and the obtained momentum/impulse/pulses are supplied to two-stage video amplifier with cathode efficiency. From the output/yield of the unit DZD the momentum/impulse/pulses enter unit ShDA.

Schematic diagram (Fig. 83, see insert). From unit Lake the momentum/impulse/pulses through the knife junction P_4 (terminal 16) are supplied to variable delay lines on 0.3 μss, 1 μs even 2 μss. These lines are ten-link low-pass filters with T-shaped cells and removal/outlets from each cell. Delay line of 2 μss is formed of two lines with delay on 1 μs each. Page 100.

Fig. 82. Functional diagram of the unit DZD.

Key: (1). Driver. (2). Input. (3-4). Illegible. (5) electrical line delay τ = 2 μss. (6). Video amplifier. (7). Shock-excited oscillator. (8). Output/yield. (9). Video amplifier with cathode efficiency. (10). Amplifier of radio pulses with detector. (11). Delay line τ = 129.5 μss. (12). Amplifier. The cells of delay lines are changed over with the aid of switches B_1 the "range-zero calibration" - "accurately" and B_2 the "range-zero calibration" - "roughly", derived on the front/leading panel of unit. The series connection of delay lines makes it possible to accurately fit the delay in unit, which is by 131.2 μss.

For the suppression of reflections from the dead endings of delay are loaded for resistor/resistances R_{33}, R_{34}, R_{35}, equal to wave impedance. From the lines of pulse delays through cable approach the video amplifier, assembled on tube L_7 (6N1P) according to amplifier circuit, during resistor/resistances. Displacement is supplied from divider/denominator R_{24}, R_{23}. From plate load the momentum/impulse/pulses across capacitor C_{24} go to the grid of the cathode follower, made on the left half of tube L_8 (6N1P), and they cut off it.

On the right half of tube L_8 is assembled the shock-excited oscillator according to autoinductive oscillator circuit self-excited. The duct of oscillator L_7 is inclined at frequencies 15 + 0.5 MHz. The load of cathode follower is connected in parallel to the duct of oscillator and will shunt it, preventing the self-excitation of oscillator.

The incoming momentum/impulse/pulses cut off cathode follower. Its output resistance sharply increases. the shunting of the duct of oscillator it decreases, and it is self-excited at frequencies, which corresponds to the tuning of duct L_7.

The duration of the signals of oscillator corresponds to pulse duration at the input of the unit DZD. Signals are removed from the secondary winding of the matching duct L_6, connected in anode circuit, and they are supplied to the input of the ultrasonic delay line in the LZ-5.

The operating principle of ultrasonic delay line is comprised in the fact that the electrical oscillations are converted into mechanical ultrasonic, which are propagated in this line along broken trajectory, being repeatedly reflected from the faces of line. At the output/yield of line mechanical ultrasonic vibrations again are converted into electrical. Because of the large path, which passes by ultrasonic vibrations in delay line, and to multiple reflections the signals at the output/yield of line are obtained the delayed to 129.5 μss and strongly weakened.

In the output/yield of the ultrasonic line of signal delay approach the grid of the first cascade/stage of amplification, is assembled to tube L_1 (6Zh1P). The plate load of cascade/stage is the coupled circuit L_1. Page 100a.

Fig. 83. The schematic diagram of the block DZD.

Key: (1). Amplifier. (2). Circuit. (emf). Housing. (4). Videos. (5). Illegible. (6). Driver.

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Fig. 84. Unit DZD: 1. , 3. control sockets; 2 - the potentiometer of the amplitude control of output/yield; 4 - the switch of fine adjustment the bullet of range; 5 - the switch of the rough range-zero calibration. Cascade/stage works with automatic displacement. The signals, obtained in the plate circuit of tube L_1, transmit to the grid circuit of the second cascade/stage of the amplification, assembled on tube L_2 (6Zh1P) according to analogous circuit. Displacement to the second cascade/stage is removed from divider/denominator R_{31}, R_{32}. A change in the displacement on the grid of tube changes the amplitude of output signals. From the output/yield of the second cascade/stage the signals approach the third, and then to the fourth the cascade/stages of amplification, which work with automatic displacement. The common/general/total amplifier gain of signals is not less than 69 dB.

The intensive signals from the fourth cascade/stage are supplied to detector D_1 (D-2Ye), which converts them into momentum/impulse/pulses. From the load of detector the momentum/impulse/pulses through capacitor C_{14} approach the grid of the video amplifier, assembled on tube L_5 (6P1P) according to circuit with load in cathode. Displacement to tube is removed from divider/denominator R_{20}, R_{27}, R_{15}. The intensified by the first cascade/stage momentum/impulse/pulses are supplied through capacitor

C_{17} to the grid of the closed in the absence signal of cathode follower on tube L_6 (6P1P). From load R_{19} pulses through cable they approach unit ShDA.

Unit DZD obtains feed from the common/general/total rectifier of unit the hearth through the terminals of knife coupling P_2. In the filament circuits of amplifiers are included the decoupling filters of the type "LC "for the elimination of its self-excitation.

Constructions. Unit is assembled on rectangular chassis/landing gear (Fig. 84), in which are installed the driver, ultrasonic delay line, variable delay lines and the cascade/stages of amplification. The electrical mounting of unit is made in the basement of chassis/landing gear.

On the front/leading panel of unit are placed potentiometer R_{31} the "amplitude of output/yield", switches B_1, B_2 and monitoring jacks.

The input and output pulses of unit, and also supply voltage enter through the burnt couplings, arrange/located from the back. Unit is inserted into cabinet of NPU and is fastened nondropout screw/propellers.

power supply unit of ground-based receptor.

Schematic diagram (Fig. 85). The feed of units hearth, DZD, OZ of the cabinet of NPU conducts from the separate unit VPOD.

From the output/yield of the unit VPOD is taken direct/constant voltage +300 v with current 130 mA, stabilized direct/constant voltages +250 v with current 300 mA, +125 v with current 270 mA, -105 v with current 20 mA.

Rectifier obtains feed from common mains of radio beacon (208 in, 400 Hz) on value; coupling P_1 (terminal 2, emf) the contacts of the toggle switch of the switching on of mains of unit B_3 are the safety device/fuse PR_1, shunted by resistor/resistance R_{55} with neon tube NL_1 - the primary windings of transformers Tr_1, Tr_2. Furthermore, after toggle switch B_3 the current with voltage 208 v and frequency 400 Hz through the coupling P_1 (terminal 4, 5) is supplied to the primary windings of the filament transformers, arrange/located in the units DZD, OZ, DShP, and power transformers Tr_2, Tr_3, the arranged/located in unit DShP. Page 102.

Fig. 85. The schematic diagram of the block VPOC.

Key: (1). Regulation. (2). Circuit. (emf). Housing. (4). Hz. (6). Mains.

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Fig. 86. Unit VPOD: 1 - switches, mains; 2 - the tube of the monitoring of completeness of circuit-breakers; emf - safety device/fuses. Direct/constant voltage +300 in is removed from the selenium rectifier D_4, made according to bridge circuit. This voltage is filtered by pi-section filter C_{17}, Dr_3, C_{18} and through the coupling P_1 (terminal 7) is supplied for the feed of the anode and shielding circuits of units hearth and Lake.

Voltage +250 in direct current provides the selenium rectifier D_1, assembled according to bridge circuit. Voltage is stabilized by the electronic regulator, at whose tubes L_1, L_2, L_3 (6N13S) - controlling, and tube L_4 (6Zh4) - is amplifier. For providing a constant reference voltage into the cathode circuit of tube L_4 is included the stabilitron tube L_5 (SG-3S).

The output voltage of stabilizer is regulated by potentiometer R_{20} (by change in the potential of the control electrode of tube L_4). Stabilization factor is regulated by potentiometer R_2.

Voltage +250 v through the safety device/fuse Pr_2, shunted by circuit from resistor/resistance R_{56} and by the neon tube/lamp NL_2

coupling P_1 (terminal 8) enters units hearth, DZD and Lake for the feed of the anode and shielding circuits, where is required the high stability of the feeding voltages.

From the selenium rectifier D_2, assembled according to bridge circuit, is removed direct/constant voltage +125 in. This voltage it passes through filter C_7, Dr_1, C_8 in the diagram of electronic regulator. Stabilizer is assembled on control tubes L_6, L_7 (6N13S), amplifier L_8 (6Zh4) and stabilitron tubes L_9 (SG-4S), L_{10} (SG-3S), which ensure reference voltage on the cathode of tube L_8.

Potentiometer R_{39} within small limits regulates output voltage +125 in. Stabilized voltage through the safety device/fuse Pr_3, in parallel to which is included circuit, which consists of resistor/resistance R_{57} and neon tube NL_3, which fixes blowing, and the terminal of 9 couplings P_1 will be feed/conducted into the units of NPU for powering anode and screening circuits.

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Rectifier D_3 serves for obtaining direct/constant voltage 105 in, stabilized tube L_{11} (SG-3S). The rectifier is made according to bridge circuit with ripple filter C_{14}, Dr_2, C_{15} supplies through terminal 6 coupling P_1 the grid circuits of NPU. From this same rectifier obtains feed two-stage supporting/reference stabilizer made on tubes L_9, L_{10}.

Constructions. Unit VPOD (Fig. 86) is assembled on rectangular chassis/landing gear. The electrical mounting of unit is made in the basement of chassis/landing gear. Transformers, selenium rectifiers, capacitors and tubes are placed from above chassis/landing gear.

On front/leading panel are arranged the power switch B_3, of the tube NL_1, NL_2, NP_3 of the monitoring of the completeness of safety device/fuses, safety device/fuses Pr_1, Pr_2, Pr_3, the shutter/valves of potentiometers R_{20} and R_{39}. On rear wall are arranged knife couplings, through which the unit is connected with other units of the cabinet of NPU. Unit is inserted into cabinet NPU and is fastened with the captive screw/propellers.

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