50X1-HUM

Next 1 Page(s) In Document Denied

BRIEF DESCRIPTION OF THE "L-1" APPARATUS

(Working Dummy Model of a Radar Set for Air Target Observation)

Contents

I. Description and Purpose

II. Brief Data on the Apparatus

III. Components of the Apparatus

IV. Construction of the Apparatus

V. Brief Explanation of Kinematic and Electrical Systems' Operation

VI. How to Use the Apparatus

VII. Instructions for Adjusting the Apparatus

VIII. Repair and Replacement of Parts and Assemblies

IX. Storage and Transport

Specifications for Electrical Elements

Appendices [missing from original document]

a. Kinematic System

b. Electrical System

c. Wiring Diagram (2 pages)

d. Photographs (No 1 to No 21)

e. Four reserve diagrams

SECRET

50X1-HUM

I. Definition and Purpose

The L-1 apparatus is a visual training aid, a working dummy model of a radar set for air target observation. Its uses are twofold:

a. For demonstration, in training, of radar methods of determining the polar coordinates of an air target; i.e., range, azimuth, and angle of target position([illegible]).

b. For demonstrating the operation of a block-diagram of the device being imitated, together with a cathode ray tube used as a recorder.

The apparatus is designed for use in laboratories and permanent training installations.

II. Brief Data on the Apparatus

a. Operating Voltage	110/220
b. Motor power	one 20-watt or two 10-watt motors
c. Power demand for apparatus	150 watts
d. Operating voltage of bulb dummies	3.5 v
e. Operating voltage of bulb dummy of CR-tube	6 v
f. Weight of apparatus w/o case	55 kg
g. Weight w/ case	105 kg
h. External dimensions of apparatus with antenna and model plane removed	1100 x 830 x 330 mm
i. External dimensions of case	1200 x 1000 x 400 mm

III. Components of the Apparatus

Item of Unit	Quantity
a. L-1 apparatus	1
b. Model plane with stand	1
c. Antenna with electric bulb	1
d. Protective cover for CR-tube	1
e. Mirror, plane w/ bracket	1
f. Connection cable w/ socket and plug	1
g. Oil can	1

SECRET

SECRET

h.	Hood	1
i.	Instruction book	1
j.	Certificate	1
k.	Case	1
l.	Spare parts (cf. photo)	
	1. Cam for horizontal adjustment (253)	1
	2. Cam for first vertical impulse (252)	1
	3. Cam for second vertical impulse (256)	1
	4. Lever-arm assembly for turning mirror on horizontal axis (266; 268)	1
	5. Levers for turning mirror on vertical axis; one assembly (286-289)	4
	6. Horizontal axle for operating rods (277)	1
	7. Mirror for horizontal sweep (293)	1
	8. Mirror for vertical sweep (285)	1
	9. Springs for horizontal and vertical sweep mirrors and cam levers (283, 292, 372, 374, 375)	5
	10. Contacts for contact device w/ springs (240)	8
	11. Two-amp fuses	2
	12. Incandescent bulbs, 3.8 v, 0.07 a	206
	13. Incandescent bulbs, 6 v, 5 a (100)	3

IV. Construction of the Apparatus (cf. photo 1)

The apparatus consists of a housing containing mechanical, optical and electrical units. The upper horizontal panel holds the following dummy radar set equipment:

a. Main elements of the set connected by conduit with a schematic representation of the character of the pulses which they carry.

b. Cathode-ray tube used as a recorder with current paths represented by light. The CR tube includes the following dummy devices: cathode (102); grid (103); focusing and accelerating anodes (104, 105); conduit from vertical sweep plate (108); conduits from horizontal sweep plate (106, 107, 109); and a screen with scales of distance and rate of radiowave propagation.

c. Antenna (313) with wire mockup of radiation zone (314) and scales

for angular height (315) and azimuth (322).

d. Model plane target mounted on stand (377) movable along a groove with scales for distance and rate of radiowave propagation (6045, 6046).

e. Table: rate of radiowave propagation relative to distance (6026).

A mirror (6600) is situated in front of the CR tube screen to facilitate screen observation.

Labeled controls for operating the model are fitted on the face panel of the apparatus (cf. photo 2).

Principal units inside the housing are as follows: (photo 3)

Antenna with socket holder (2000)

Control rack with slide (3000) for adjusting model stand.

Mirror assembly (1000)

Driving gear (4000)

Contact device for illuminated current path (4600)

Dummy CR projector (5000)

Panel with contacts and locking disc on manual drive axle (147)

110/220-v transformer (111) with fuses (119) and changeover switch (112)

Multiple cutout switch (8600)

Contacts, potentiometers, contact block with 34 clamp terminals.

On the inside of the horizontal panel (photo 4) are the housings for the illuminated current pulse channels with 101 bulbs and the necessary wiring (see assembly circuit diagram).

Antenna Assembly (cf photo 5)

The antenna assembly is designed for up-down and right-left adjustment for shifting of the target plane to various distances from the antenna, and for synchronous transmission of functions of the motions indicated to the mirror assembly.

The antenna assembly consists of the following:

Housing for mechanical unit

Controls (3000) for moving target plane

Cam (309) for antenna elevation

Cam (324) for 360-degree azimuth adjustment

for angular height (315) and azimuth (322).

d. Model plane target mounted on stand (377) movable along a groove with scales for distance and rate of radiowave propagation (6045, 6046).

e. Table: rate of radiowave propagation relative to distance (6026).

A mirror (6600) is situated in front of the CR tube screen to facilitate screen observation.

Labeled controls for operating the model are fitted on the face panel of the apparatus (cf. photo 2).

Principal units inside the housing are as follows: (photo 3)

Antenna with socket holder (2000)

Control rack with slide (3000) for adjusting model stand.

Mirror assembly (1000)

Driving gear (4000)

Contact device for illuminated current path (4600)

Dummy CR projector (5000)

Panel with contacts and locking disc on manual drive axle (147)

110/220-v transformer (111) with fuses (119) and changeover switch (112)

Multiple cutout switch (8600)

Contacts, potentiometers, contact block with 34 clamp terminals.

On the inside of the horizontal panel (photo 4) are the housings for the illuminated current pulse channels with 101 bulbs and the necessary wiring (see assembly circuit diagram).

Antenna Assembly (cf photo 5)

The antenna assembly is designed for up-down and right-left adjustment for shifting of the target plane to various distances from the antenna, and for synchronous transmission of functions of the motions indicated to the mirror assembly.

The antenna assembly consists of the following:

Housing for mechanical unit

Controls (3000) for moving target plane

Cam (309) for antenna elevation

Cam (324) for 360-degree azimuth adjustment

Conoid (308) for 0 - 90-degree vertical correction of antenna and for changes in antenna-target distance of 10 - 200 km.

Slide block (338) with Y-bracket (339) for shifting conoid (308) during motion of target plane, and cable (238) connected with mirror unit.

Correcting systems with two rods (340, 341) attached to the end of a double-arm lever (342) (of kinematic diagram) which is cable-connected with the mirror unit.

Mirror Unit (of photo 6 and kinematic diagram)

The mechanical part of the unit is mounted on a base consisting of two plates fastened to a table.

Simulation of sweep is accomplished by using the two mirrors 285, 293.

Mirror 293, turning on a vertical axis and representing horizontal sweep, reflects a beam from projector 5000 to mirror 285.

Mirror 285, turning on a horizontal axis and representing vertical sweep, reflects the beam onto the CR tube (376) screen.

The mirrors are turned by means of cam discs synchronized with the master elements of the antenna unit. The cam motion is transmitted to mirror 293 by levers 286-289 and to mirror 285 through levers 266 and 268.

The cams are actuated by levers cable connected with the horizontal and vertical sweep knobs on the control board.

Lever 260 is connected with the two-arm lever of the antenna unit's correcting device.

A shield-vane is connected with the "blanking" shaft (224, shield vane designation is 219) and serves to break the ligh beam on the return path to the screen. It "dissipates" upon simulated increasing of the voltage on the "grid" of the CR tube; i.e., it operates as a "blocking grid".

A contact device (4600) assures simulation of the passage of electrical pulses through the flashing bulbs in the block-diagram channels.

A potentiometer 154/155 on the axle of the contact device assures simulation of the voltage variations in conduit 106/107 leading to the horizontal sweep plate.

Electrical and mechanical drives are on the left side of the mirror assembly.

The electrical drive consists of two 10-watt motors (110) (or one 20-watt motor) and a conical transmission with automatic friction coupling (204) to the main axle. The coupling is needed to turn the main axle from the manually operated drive independent of the coupling with the electric motor.

The mechanical drive consists of a crank (206) located on the control board, a shaft (207) and a conical transmission to the main axle. A disc (359) is mounted on shaft 207 and closes the contacts (147) for the illuminated current path when the apparatus is running off of the electric motor.

When the apparatus is operated manually the contacts are disconnected. In this case each contact is closed in its order owing to the advantage of being able to carry out the entire cycle of operation in slow motion.

Time contacts 145/146 are used to assure full lighting of the bulbs during motor operation, and all contacts are closed since on-off contact at motor-operating speed is too brief for the filament to glow sufficiently.

Electron Beam Projector (5000) (cf photo 7)

The rear part of the projector has a chamber (356) containing a cartridge with a 6-volt 30-watt automobile bulb (100) with a point source of light. A diphragm with a small center aperture is placed in front of the bulb. The front part of the projector has a movable head (365) with projection lens. The movable head is cable-connected with the "focusing" knob and serves to focus the light spot on the screen. The lever which moves the head is connected with the sliding contact of a rheostat (153) which governs the light-simulated conduit-voltage variations and the voltage variations in the focusing anode (104) of the tube.

V. Brief Description of Kinematic and Electrical Systems' Operation

The three coordinates of the target plane are determined by manipulation of the following controls: 301 - "antenna elevation" - angular height of target, computed on the antenna's vertical scale; 316 - "antenna rotation" - target azimuth, computed on the horizontal limb; 325 - "range" - computed on the distance/rate-of-radiowave-propagation scale.

50X1-HUM

The kinematic process runs as follows: "antenna elevation" knob (by means of a worm gear) causes axle 307 to rotate with cam 309 which, via a rack-and-pinion (311) raises the "radiation zone" mockup. Conoid 308 (cf photo 5) rotates at the same time.

Manipulation of the "rotation" knob activates gears 319 and 320, rotating the antenna mechanism, and a bushing (323), rotating cam 324. Two levers (340,341) are clamped to cam 324 and to conoid 308. Clearance between cam/conoid and the levers is so set that either the cam or the conoid, determining azimuth or angular height and range, can rotate without interfering with rack 343. Only when cam and conoid are in proper position and levers 340 and 341 are disconnected (i.e., when the target plane is in the radiation zone) does rack 343 advance. In this case the voltage for the plane light and for reception pulses is transmitted over contact 132 to a rotary switch.

The "range" control activates cable drum 332 to move the plane slide 335, and due to worm gear 338 the motion of rack 343 is transferred by hammer-shaped lever 345 (relative to the range) to a frame (346) which pulls cable 264. At the same time conoid 308 is moved on its axis by Y-bracket 339 so that lever 340 is disconnected when the plane is within the radiation zone. The conoid covers operation of the mechanism for ranges up to 150 km. When the "range" control is manipulated the motor has to operate in order to minimize friction errors and clearances between parts, assure true operation of the differential, and in order that the rotary switch contacts are set mechanically to the same side (they sometimes become bent).

The main axle of the mechanism may be driven by motor 110, or manually from control 206 through gears 226 and 227. Gears 227 and 231 are parts of the differential whose planetary is set at a definite angle by the rotation of the cable wheel (237) (consequently, of axle 236 also) activated by range cable 238.

The differential gear 231 is displaced, with respect to 227, at an angle (2a) of the deflection angle (a) of the planetary axis. Gear

231 rotates in the opposite direction from 227; gear 232 causes synchronous rotation of gear 233 with the main axle (212), but 233 is displaced at angle 2a which is dependent upon range. Gear 233 is connected by brushing 234 with contact disc 143 whenever contact disc 141 connects firmly with the main axle 212. Disc 141 with its four spring contacts at 90-degree intervals around the disc, picks up light impulses from disc 241 which serves to produce the simulated course of the radiated and reflected pulses.

The contacts on 241, touching the corresponding spring contacts (240) on 141 cause current to be put through to the lights in the channels representing the basic elements of the radar set, and into the vertical sweep plate conduit resulting in aerial flashing of light group 171-182 and 197. Disc 141 rotates through 17 degrees to cover the entire cycle. Order of light flashes is 171, 172-182; 183 (antenna) and 197 (vertical sweep plate) flash simultaneously. Discs 142 and 141 are constructed alike.

Contact disc 142 , displaced by the differential mechanism at an angle 2a with respect to 141, dependent upon range picks up time-staggered pulses from 241. These pulses are transmitted to the circuit for the other lights of the vertical sweep plate and other channels, with light 183 (antenna) burning first, then 186-196, followed by the vertical sweep plate light. As the current lights 197 the point of light on the screen reaches its maximum in altitude.

A reducer 242-246 inside the contact device turns contact 142 of the plane light to angle a. Cylindrical gear 242 attaches to axle 212. Axle 244 with gears 243-245 is attached to contact disc 143. Cylindrical gear 246 with a contact spring rotates on 212. Contact 142 closes at half the time interval between the first and second flashes of the antenna light. The construction assures operation of the contact only at ranges over 10 km. Contacts 144 and the contact sections of the rings of disc 141 serve to simulate attenuation of the cathode ray and voltage variations on the "grid" at the time of "blanking".

Electron beam sweep simulation works as follows:

Cam 252 activated from the main axle by gears 227 and 250, raises one end of throw-over lever 266 causing the other end to strike disc 281 which is on the axle of mirror 285. Turning of axle 277 moves mirror 285 and raises the light beam. This creates the primary impulse of the transmitting element on the screen of the apparatus. The second impulse cam, set by gears 231 and 254 at a certain angle relative to cam 252 (position dependent upon range) is rotated, and via throw-over lever 268 produces the secondary declination of the vertical sweep mirror, which brings about the appearance on the screen of the second reflected impulse. Spring 283 returns the mirror to its original position.

The magnitude of the secondary impulse, or impulse of reception (of the radiowave reflected from the plane) is posed by the position of axle 255, cam 256.

Levers 286-289 activated by cam 253 on axle 251 control mirror 293 for horizontal sweep. The swing of the mirror depends on the adjustment of hammer-shaped lever 287 which is set by lever system 295-297, and cable 298 by means of the horizontal sweep control 299.

Manual operation of the apparatus slows up the process so that the function of the individual elements may be observed. For general demonstration of the functions of a radar set, the motor is used and the speed is properly set by control 305.

VI. How to Use the Apparatus

This section comprises a group of instructions of a general nature dealing with the care and handling of the apparatus; e.g., don't tip the apparatus, don't subject the apparatus to sudden movement or impact, don't force the controls, don't touch manual controls when motor is running, do not attempt to adjust antenna drive or mirror unit unless absolutely necessary, lubricate frequently, check motor brush wear, check clean and lubricate apparatus every three months when not in use, use on AC circuit only, 220 volts, turn brightness and focusing knobs to obtain proper brightness and focus, vary operational procedure only after complete

familiarization with the apparatus, etc.]

VII. Instructions for Adjusting the Apparatus

[This is a "manual" section giving instructions on how to set up the various parts of the apparatus "by the numbers". It is divided into the following sections: Conoid 308 and cam 309; Antenna 313; Mirrors; Light beam; Horizontal sweep control; Vertical sweep control; Range control; Shield vane; Contact disc 143; Spring contact 142; Contact disc of transmitting element; Grid; Potentiometer; Focus; Switch for grid illumination channel; Horizontal sweep; Vertical Sweep; Contact 132; Distribution shaft 210; Switch 147; Motor rpm control.]

VIII. Repair and Replacement of Parts and Assemblies

[States that repairs are to be made only by experienced specialists under the supervision of an engineer. Lists precautions to be taken such as comparison of parts numbers, test repair by manual operation, etc. and gives a list of simple defects such as unlit lamps, and corrective measures.]

IX. Storage and Transport

The apparatus is stored in its case in horizontal position in accordance with the markings on the case. Storage must be in a dry place where the temperature is stable.

In the case of prolonged storage a non-acid lubricant (technical vaseline) must be used. Nickeled parts should also be lubricated in this event.

Out of its case, the apparatus may be carried in horizontal position by two men; when cased, by four men.

Specifications for Electrical Elements

Serial	Designation	Key to Diagram	Quantity	Spec.
1.	Distributing wires, marked on cloth tags, passing through 34-conductor contact blocks (at antenna unit on left wall of housing)	1-78	78	
2.	2-conductor metric cable, rubber insulated with plug and connector	81	1	
3.	light bulb	100	1	6 v, 5 a

50X1-HUM

4.	light bulbs for illuminating main units	101	16	3.8 v, 0.07 a
5.	light bulbs for:			
	cathode and its channel	102	3	do
	grid and its channel	103	5	do
	first anode and its channel	104	8	do
	second anode and its channel	105	10	do
	horizontal sweep (blue impulse) slow elevation	106	9	do
	horizontal sweep, return, rapid elevation	107	9	do
	cathode ray	108	3	do
	horizontal sweep plate ground	109	4	do
6.	AC electric motor	110	1 or 2	220 v, 20 w 220 v, 10 w
7.	power transformer	111	1	primary 110/220 secondary 220/0.2 a, 7 v/5 a , 3.5 v/7 a.
8.	distributor to transformer	112	1	
9.	fuse, 2a			
10.	master switch	120	1	
11.	multiple crossover with contacts 121-127	8600	1	
12.	contact, activated by manual horizontal sweep drive 299	128		
13.	contacts activated by manual "blanking" drive 224	129-130		
14.	contact activated by manual vertical sweep drive 275	131		
15.	contact activated by rack 343 of antenna unit 2000	132		
16.	rotating contact disc w/ 4 contacts (spring) for impulse from transmitting element	141		
17.	rotating spring contact for plane bulb connection	142		
18.	same as 16, for receiving 2nd pulse	143		
19.	3 contacts to 16 (disc 141) for conduit "x" of grid 103 and cathode ray 108	144		
20.	contacts to main axle	145,146		
21.	distributor activated by manual drive 206	147		
22.	potentiometer with cutout activated by "brightness" control 364	151		R - 1 ohm
23.	same as 22	152		R - 10 ohms
24.	potentiometer activated by "focus" control 349	153		
25.	potentiometer activated by main axle 212	154,155		R - 2x12 ohms
26.	potentiometer with cutout activated by "motor" control 365	156		R - 800 ohms
27.	potentiometer with cutout activated by "brightness control 364	157		R - 20 ohms

28. light bulbs, serial flash on manual drive (distributing discs 141, 143), simultaneous flash on motor drive (cutouts 145,147) same as 4

There are as follows:

171	2
172	2
174	4
175	2
178	2
181	2
183	2
190	2
173-197 inc.	1 each

Contributors to this description were D. K. Ratmirov, L. I. Ivchenko, I. N. Polevin, and I. V. Baschestnyy

Late changes in the electrical system:

To lengthen service life of the 3.8-volt bulbs, put a 0.15-ohm resistance in the 3.55-volt circuit. This will reduce bulb-feed voltage to 3.0 volts.
Wire material: constantan, 1-mm diameter, length, 230 mm.

-END-