UNEDITED ROUGH DRAFT TRANSLATION

THE FGS 392-TYPE RADAR EQUIPMENT FOR SHIPS

BY: Author Unknown

English Pages: 25

SOURCE: Schiffs-Radaranlage FGS-392 (KSA-3), VEB Funkwerk, Berlin, pp. 1-20

The FGS 392-Type Radar Equipment for Ships.

Principal Mode of Operation

To facilitate ship navigation during poor-visibility weather, ship radar equipment is available for sea-going vessels which produces a map-like picture of the ship's surroundings wherefrom direction and distance of obstacles, e. g. ships, drifting icebergs, islands or ship lane markers can be determined. At the same time, the ship's position forms the center of the picture.

In ~~order~~ to achieve this panoramic view, high-frequency electromagnetic waves are reflected from an impulse-keyed transmitter via a directional antenna. They disperse in a similar manner as light waves and possess ~~the~~ characteristics that they reflect upon hitting objects (targets). The equipment's range is limited by the optical visibility, thus largely dependent upon the position of the directional antenna.

When transmitting, a horn emitter emits the impulses which come from the transmitter against a parabolic reflector which in turn beams them directionally. Reflected impulses are picked-up by the same parabolic reflector and guided via the horn emitter to a receiver aerial and finally made visible on the screen of an electron-beam tube.

The distance between the measuring point and object is determined by calculating the time required by an emitted impulse signal to travel from the measuring point to the object and back. The impulse emitted by the transmitter and received directly by the receiving part is employed for control of reflection time.

Technical Specifications:

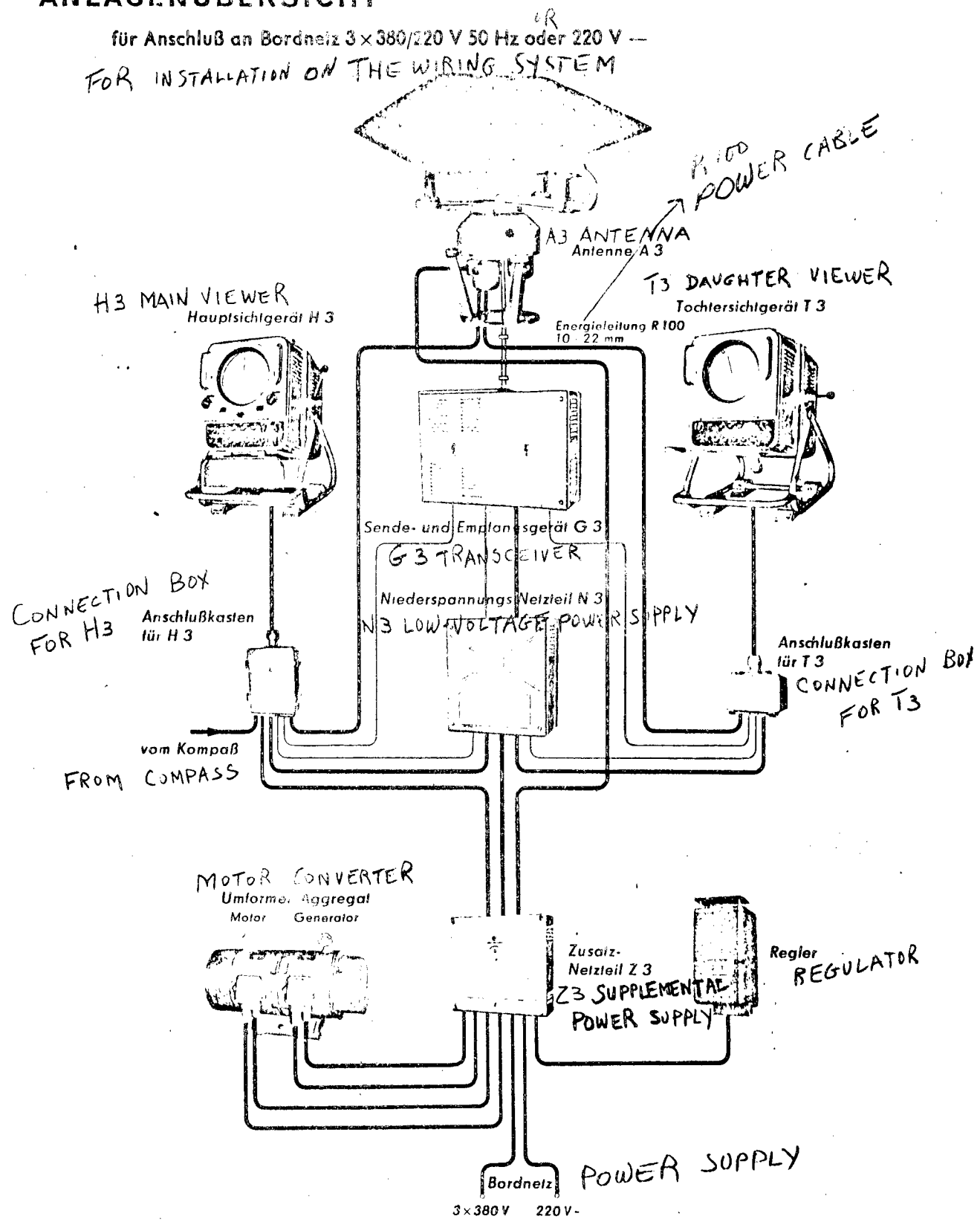
Maximum range	24 sm
Impulse output	approx. 40 kw

EQUIPMENT DIAGRAM

ANLAGENÜBERSICHT

für Anschluß an Bordnetz 3 × 380/220 V 50 Hz oder 220 V —

FOR INSTALLATION ON THE WIRING SYSTEM



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Resolving properties

close-range resolving approx. 60 m

radial " " 40 m

angle " " 2°

Charging rate 1,5 kVA

Weight of equipment, without daughter viewer and power supply approx. 150 kg

Weight of daughter viewer approx. 40 kg

Weight of power supply approx. 120 kg

A 3 Directional Beam Antenna

Rate of revolution 20 rpm

Directive-antenna effect

horizontal 2° half width

vertical 20° half width

Minor lobe damping 28 db

Operation

Polyphase flange induction motor 220/380 V 50 cycles per second

or DC flange motor 220 V

Transmitter and Receiver

Transmitter:

Frequency 9375 megacycle per second (3,2 cm)

Control Impulse control

Impulse frequency 2000 cycles per second

Impulse duration 0.2 microsecond

Impulse performace 40 kw

Transmitting tube magnetron 730

Magnet induction in the air gap 5500 G

Starting delay 3 minutes

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Phantom Circuit Part

Tubular conductor cross section (internal measurement) 10.16 x 22.86 mm

with transition to 12.6 x 28.5 mm

Wave length in tubular conductor approx. 44.8 mm

Receiver blocking tube 1 B 24

Preionized current 150 microamperes

Transmitter blocking tube 1 B 24

Circuit parallel to power cable

Power cable (antenna cable)

Tubular conductor Ms 63 high-frequency rectangular tubular conductor

DIN 47.302 (power cable)

Nominal size 22 x 10' tolerance $\pm$ 0.08

Connections throttle flange

Sealing rubber gaskets and Perfol 0.2 mm

Receiver part

Sensitivity 15 d B

Frequency changer

Oscillator tube reflexklystron 723 A/B (2 K 25)

Mixed crystalls OA 513 or 1 N 23 B equipped with 1 pair

Mix damping $<$10 d B

Intermediate frequency. 45 megacycles

Driver stage

Driving pulses approx. 0.2 microseconds

Drive tubes 1 x EY 81

1 X ECL 81

1 X SRS 4452

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Keying stage

Keying pulse 10...12 kv

Tubes 1 X SRS 454

12 kv High-voltage power supply

Rectifiers: selenium rectifier B 1000/375-0.01

Sea interference elimination

Intermediate Frequency Amplifier

Band width 10 megacycles

Sensitivity 2...2,5 kTo

Input resistance 2 X 250 ohm

Output resistance 150 ohm

Tubes 1 X ECC 84

5 X EF 80

The H3 Main Viewer

Screen diameter 9"

Screen setting I 0.75 sm

II 1.5 sm

III 3.0 sm

IV 6.0 sm

V 12.0 sm

VI 24.0 sm

Tripping impulse frequency approx. 2000 cps

Sweep amplitude correction adjustable

Range 0 - 24 sm

Screen setting "ship ahead" or "north"

Zero point displacement

horizontal and vertical ± 6mm

Deflection coil revolutions 20 rpm synchronized with the antenna

Tubes

Sweep generator	1 X ECC 81
	1 X EL 81
Intemediate frequency terminal amplifier	2 X EF 80
Video amplifier	1 X EF 80
Marking frequency changer	1 X ECC 82
Input blocking oscillator	1 X ECC 81
Multi-vibrator	2 X EF 80
	1 X ECC 82
Limiting phase (stage)	1 X ECC 81
Range finder	2 X EF 80
	1 X EAA 91
	1 X ECC 81
Advance mark indicator	1 X EF 80
	1 X EC 92
North mark indicator	1 X ECC 81
	1 X EF 80
Focusing tube	1 X EL 84
Picture tube	B 23 M 2 DN (night illum. screen)
High-voltage part	2 X EY 51

The T 3 Daughter Viewer

Screen diameter	9"
Screen setting I	0.75 sm
" " II	1,5 sm
" " III	3,0 sm
" " IV	6.0 sm

Screen setting V 12.0 sm

" " VI 24.0 sm

Tripping impulse frequency approx. 2000 cps

Sweep amplitude change balanceable

Distance range 0 - 24 sm

Screen setting "ship ahead"

Zero point displacement horizontal and vertical ± 5 mm

Deflection coil revolutions 20 rpm synchronized with the antenna

Tubes:

Intermediate flrequency amplifier 2 X EF 80

Video amplifier 1 X EF 80

1 X EL 83

Limiting phase (stage) 1 X ECC 81

Range finder 2 X ECC 81

Sweep generator 1 X E(C)F 82

1 X EL 81

Multi-vibrator 1 X EC(F) 82

1 X ECF 82

Line mixing tube 1 X ECC 82

Advance mark indicator 1 X ECF 82

Focusing tube 1 X EL 84

Picture tube 1 X B 23 M 1 DN (luminous screen)

High-voltage power supply 2 X EY 51

Low-voltage power supply

2 X EL 81

1 X EF 80

2 X STR 85/10

Installation components

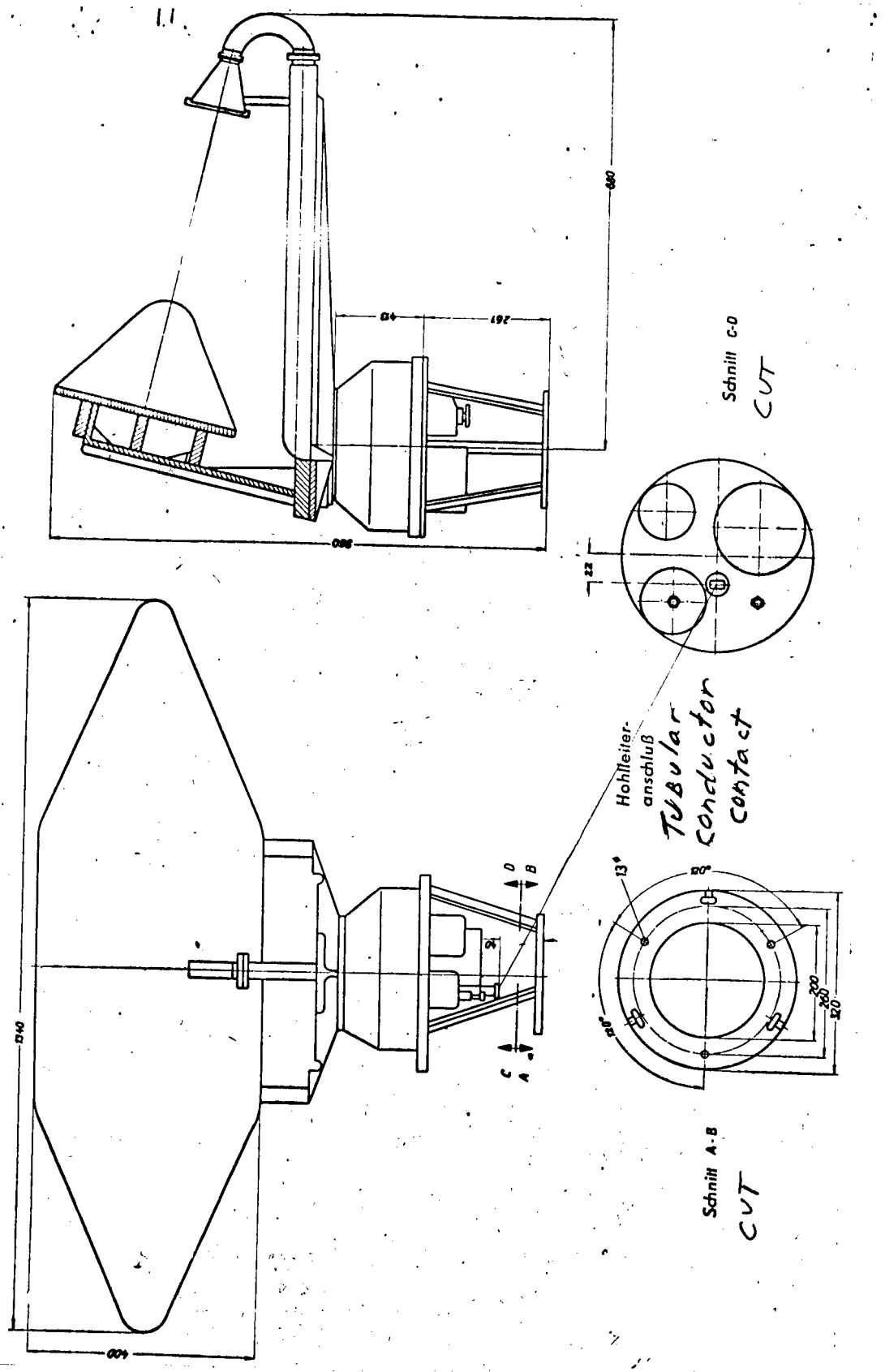
The following components are part of a complete FGS 392-type ship radar installation:

1. A 3-type directional beam antenna
2. G 3-type transmitter and receiver
3. H 3-type main viewer
4. connection box for H 3
5. T 3-type daughter viewer
6. connection box for T 3
7. N 3-type low-voltage power supply
8. power supply

The following synoptic table indicates what type ship radar installation should be selected for available voltage and compass:

Voltage	Description	Type of gyrostatic compass	Type
220/380 V rotary current	Main viewer and daughter viewer	FWK-compass 50 cps 2°	1420.8 F 1
		Course-3 resp. 4-compass 50 cps 1°	1420.8 F 2
		Amur-compass 500 cps 1°	1420.8 F 3
	Main viewer	FWK-compass 50 cps 2°	1420.8 F 4
		Course-3 resp. 4-compass 50 cps 1°	1420.8 F 5
		Amur-compass 500 cps 1°	1420.8 F 6
Direct current 220 V	Main viewer and daughter viewer	FWK-compass 50 cps 2°	1420.8 F 7
		Course-3 resp. 4-compass 50 cps 1°	1420.8 F 8
		Amur-compass 500 cps 1°	1420.8 F 9
	Main viewer	FWK-compass 50 cps 2°	1420.8 F 10
		Course-3 resp. 4-compass 50 cps 1°	1420.8 F 11
		Amur-compass 500 cps 1°	1420.8 F 12

Directional beam antenna (dimensions), weight approx. 31 kg



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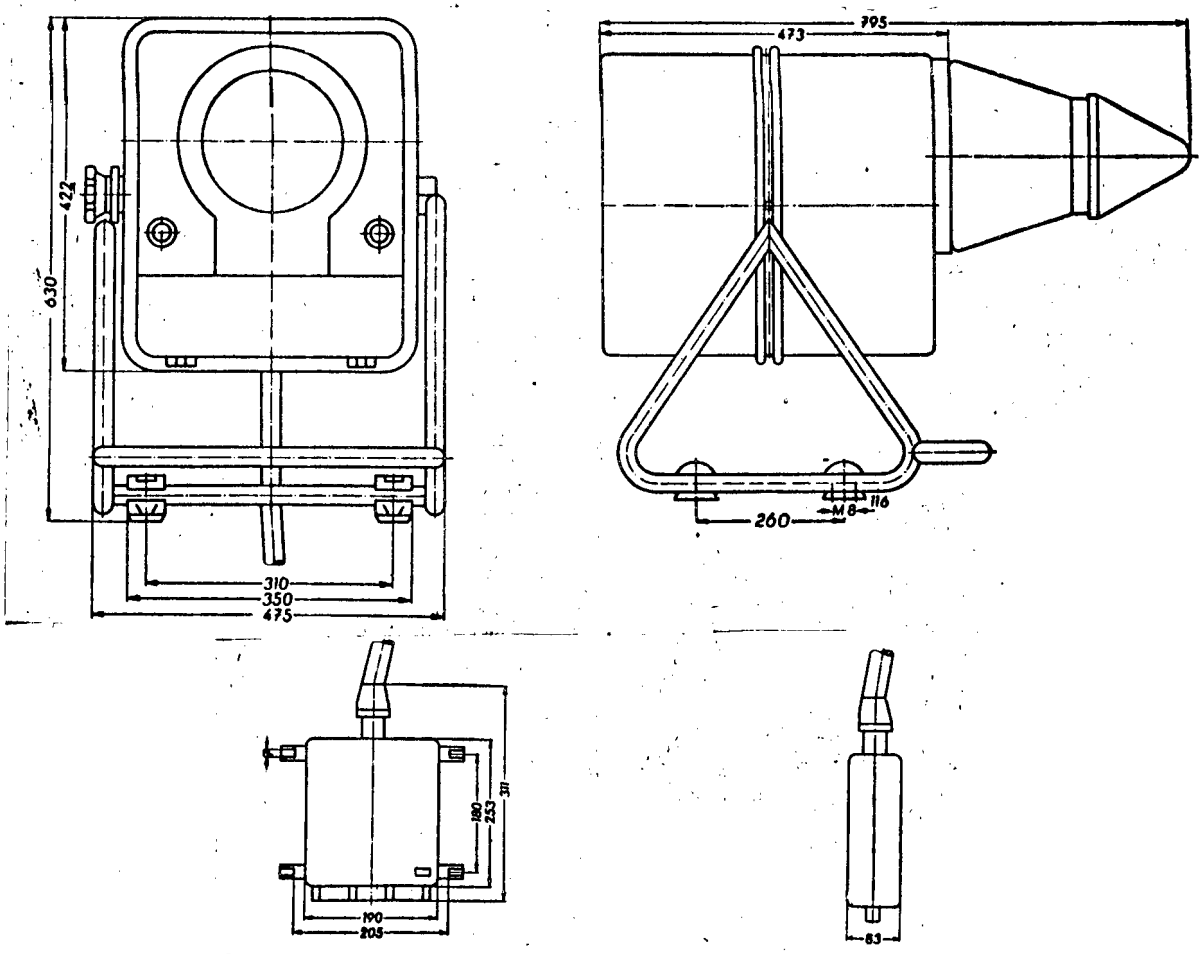
Main viewer (dimensions) weight approx. 43 kg



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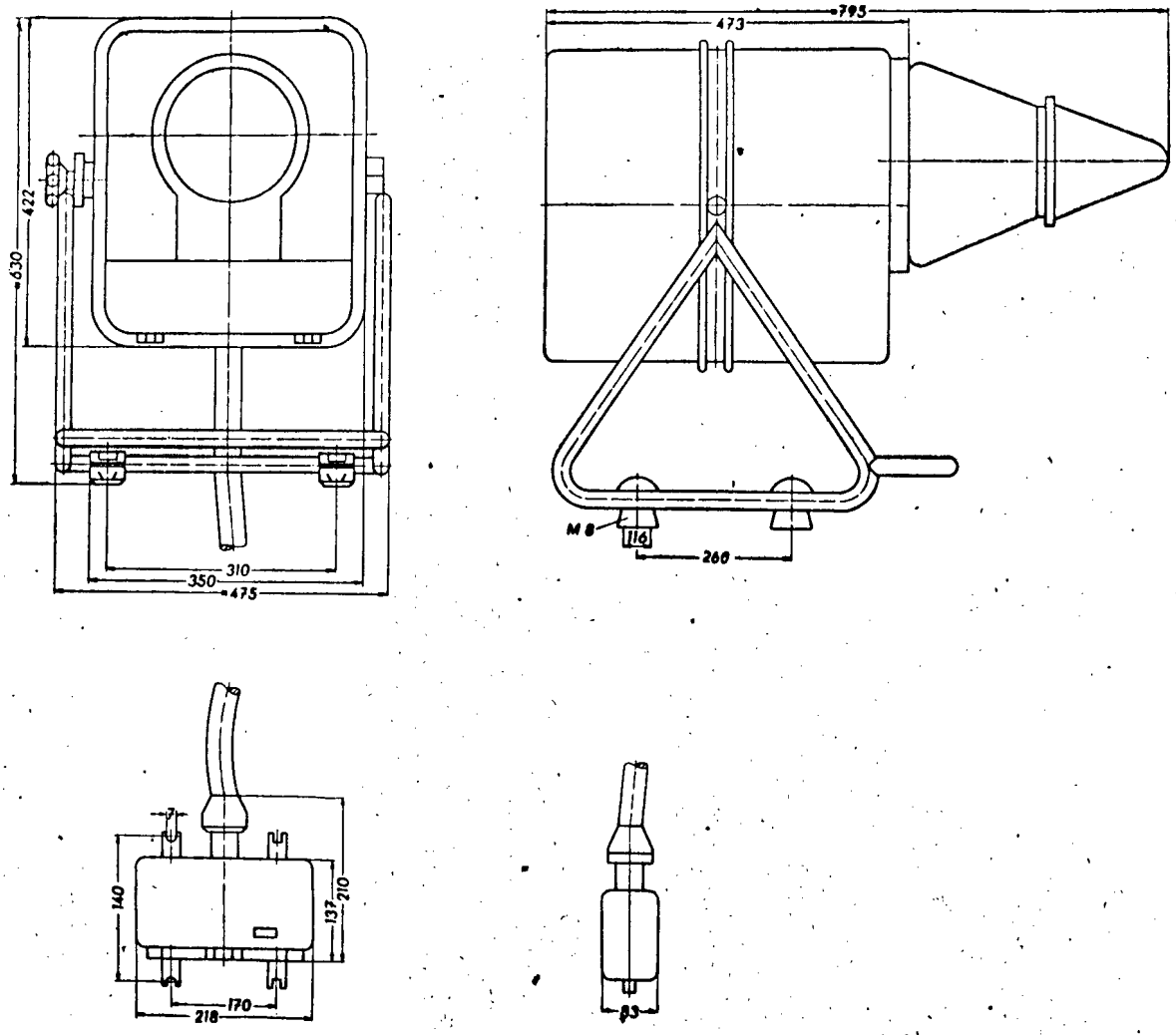
Daughter viewer (dimensions) weight approx. 41 kg



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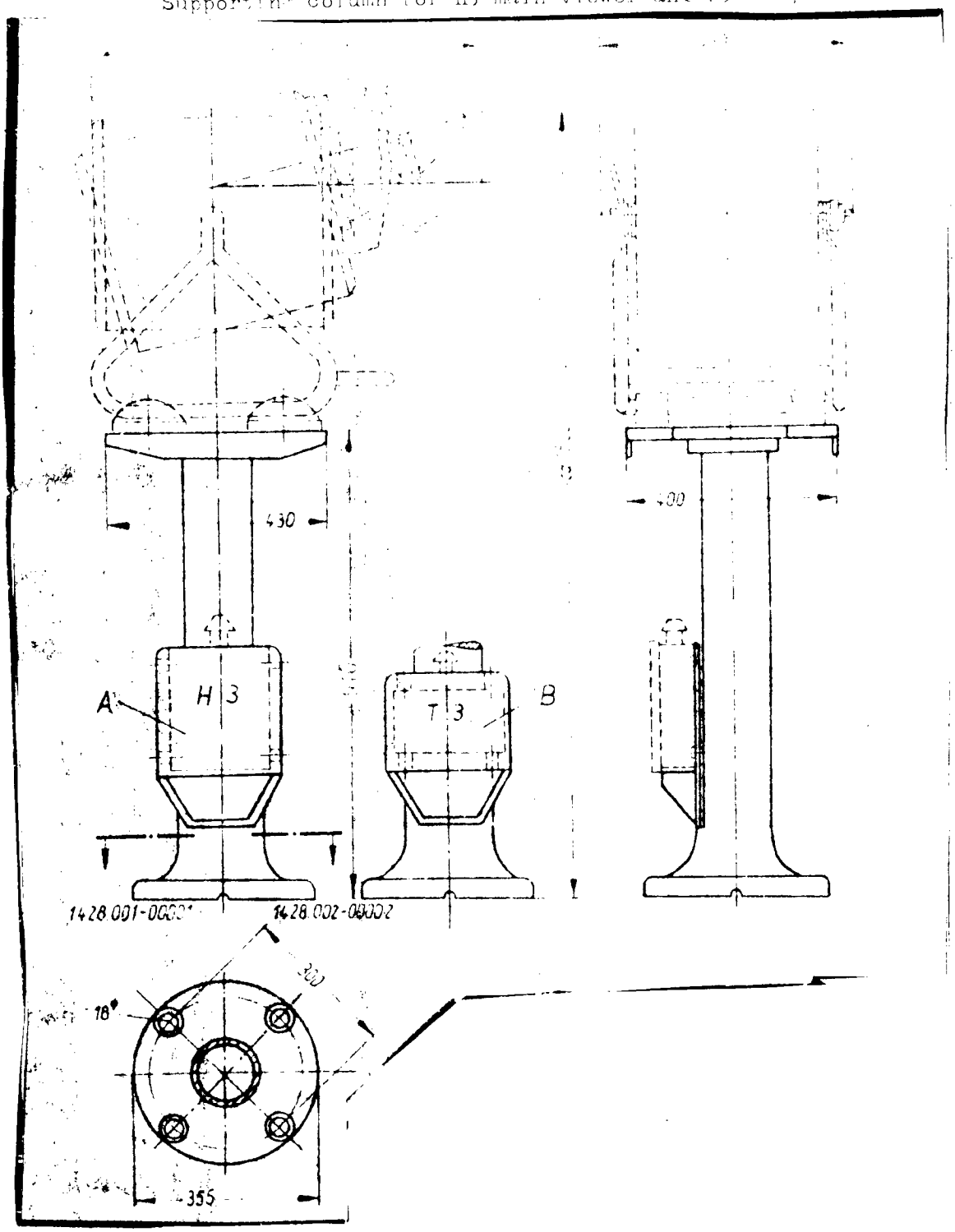
Supporting column for H3 main viewer and T3 daughter viewer



A - column for H 3 main viewer - column for T 3 daughter viewer

If needed it is possible

~~In case of requirement, the possibility exists~~ to supply one each support column for the H 3 main viewer and T 3 daughter viewer.

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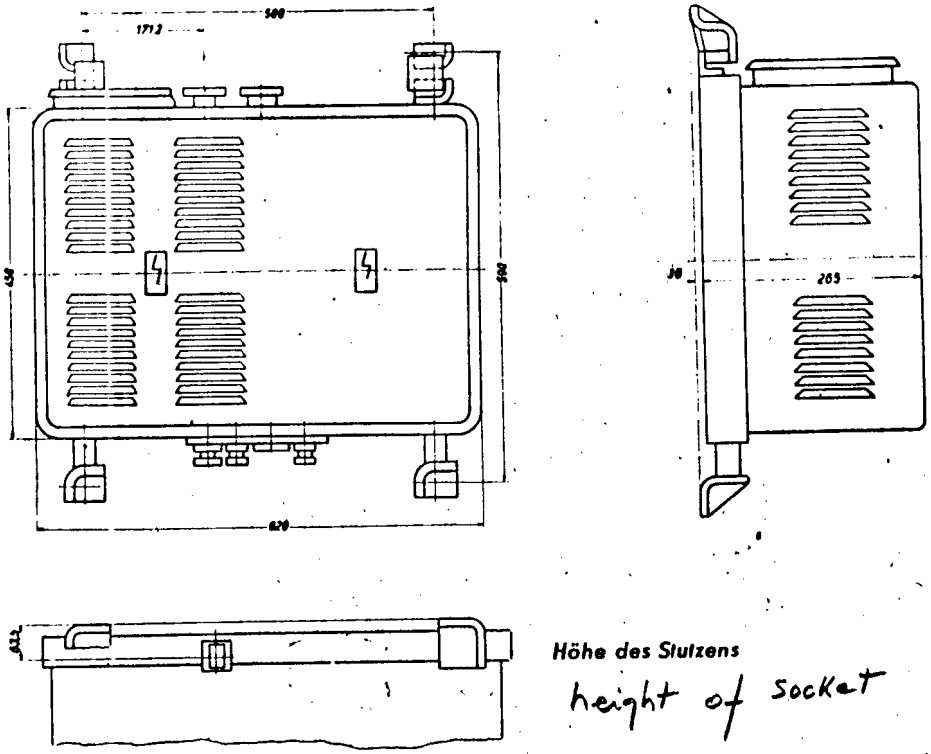
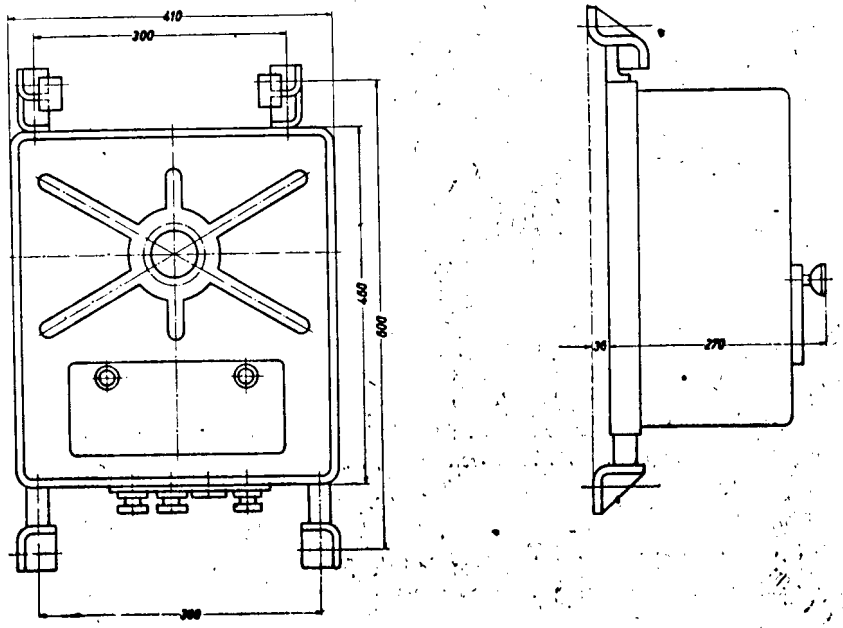
G 3 Transmitter and receiver (dimensions) weight approx. 45 kg



N 3
Low-voltage power supply weight approx. 23 kg



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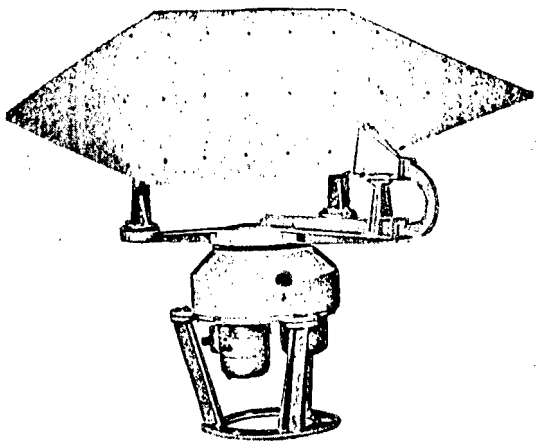
Erecting the FGS 392-type ship radar installation.

A-3 Directional Beam Antenna.

The antenna is composed of the parabolic reflector, antenna column, gear case and the driving motor. The antenna is shaped like a cylinder parabolic reflector with a horn emitter mounted in the focal point. The opening of the horn emitter is covered with polystyrol sheet which prevents the intrusion of moisture and foreign objects. During transmission, the horn emitter emits the impulses which come from the transmitter against the reflector which in turn emits them directionally and coned. During reception, the echo impulses absorbed by the reflector are fed to the horn emitter and transmitted to the receiver.



directional beam antenna with gear box

For a good all-around view the rotational antenna must be set-up in such a manner that the emitted high-frequency power is not adversely affected by interfering superstructures or reflectors.

A rectangular tubular conductor (inside measures: 10.16 X 22.86 mm) is utilized for transmission of power between transmitter and receiver. Power connection between the rotating antenna and stationary power cable is made by a swiveling link housed in the gear box.

The gear box also houses a tachometer for transmitting the number of revolutions to a tachometer in the viewer and a snap switch. The driving motor is flanged from

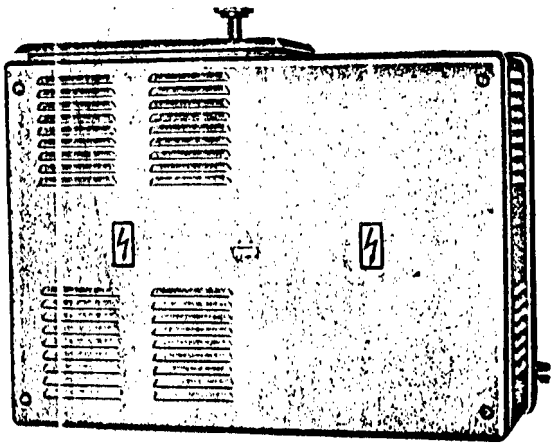
the outside to the transmission gear.

The tachometer effects the synchronization between the antenna and the deflection coil in the viewer. One snap switch serves for synchronization of the independent time control. The second snap switch effects the signaling of the forward direction on the screen of the viewer, ~~the forward direction marking~~. The snap switch is closed when the directional beam is located parallel to the ship's longitudinal axle. ~~In order that~~ To assure this directional indication ~~is assured~~, the antenna reflector must be aligned exactly according to the ship's longitudinal axle when same is installed. A fine adjustment of the forward contact ($\pm 5^{\circ}$) is possible from the outside.

Power connection between the tachometer, the two switch contacts "synchronization" and "ahead" which are housed in the antenna block and the main viewer is established by a cable having 9 leads. The driving motor is fed by a special cable. If a daughter viewer is used, a cable with 7 leads connects same with the antenna block.

A main switch on the viewer turns off and on the driving motor. By means of gears the motor drives the reflector carrier and the two snap switches 20 rpm and the tachometer 360 rpm.

the G 3 Transmitter and Receiver.

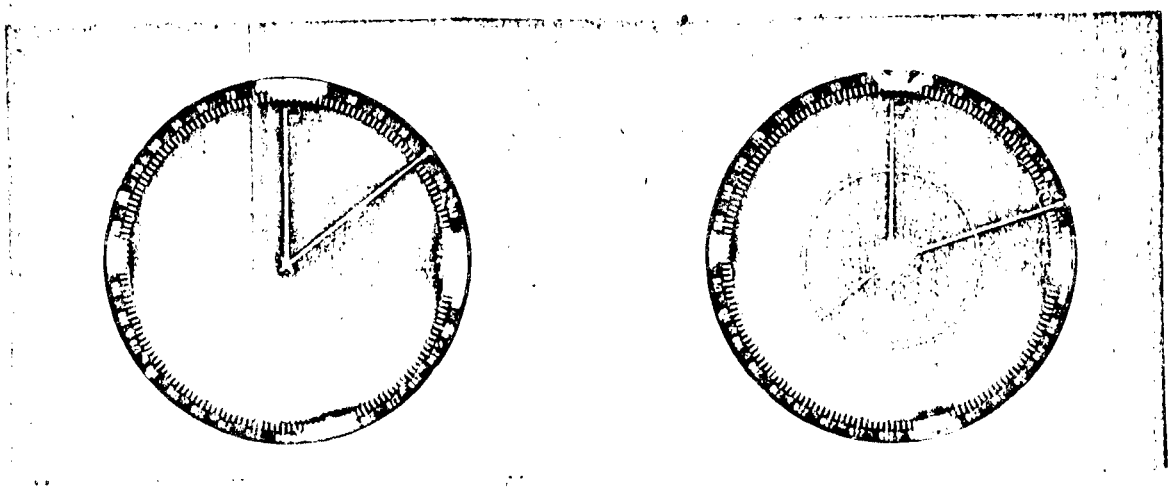


Individual assemblies are mounted on a chassis and covered by a sheet-metal casing which protects them against jets of water. Transmitter and receiver

are separated by a shielding screen. Upon removing the sheet-metal casing the feeding voltage and high voltage are automatically shut-off and the high-voltage condenser discharged. Modulation stage Magnetron transmitter and the common transmitting and receiving unit are mounted stationary on the chassis while the exciter, 12 kv power supply, intermediate frequency amplifier and seaway interference eliminator form their own assemblies. Power connection is effected via terminal strips and high-frequency plugs.

The H 3 -type Main Viewer (See page 15a for insert)

This viewer is built in table model form and traversely bedded in a tubular steel frame so that the height of the picture tube can be adjusted to the body height of the observer. The assembly elements are mounted on both sides to a cast steel frame and covered with one hood each. After removing the front hood as well as another fastening ring the picture tube can easily be extracted. The necessary operating levers are located on the front side. Two computers serve for indicating the compass course and range indication of the adjustable range finder. Control of the entire installation is effected by the band switch of the main viewer.



Forward indicator with compass course indication

Forward indicator with compass course indication and range ring

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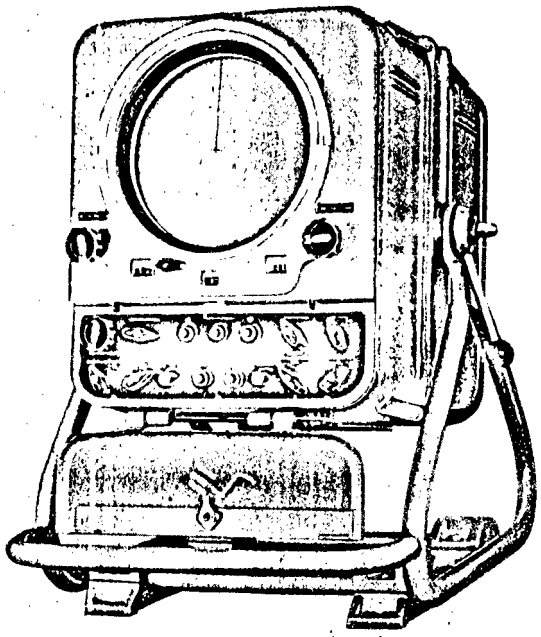

The H 3 type Main Viewer

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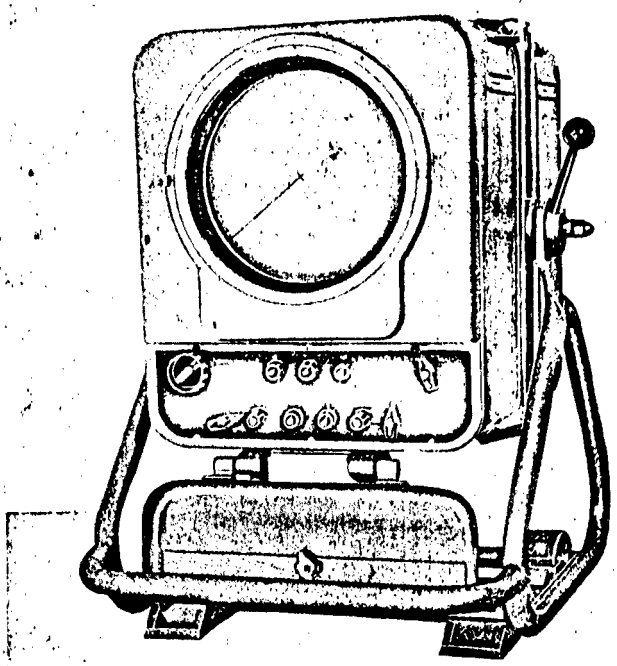
The T 3-type Daughter Viewer

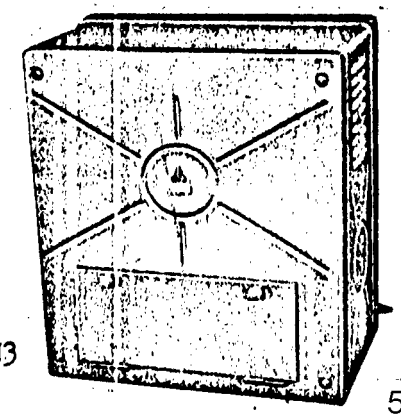
All cable junctions terminate in a junction box related to the main viewer. Construction is similar to the main viewer. The daughter viewer has its own electronically controlled power supply, however, no contact is provided for a gyrostatic compass. Thus indication for the north indicator is absent.



T 3 - type daughter viewer

In place of the adjustable ragne finder on the main viewer, the daughter viewer is equipped with stationary range rings, generated by an indicator generator.

N 3-type Low-voltage Power Supply



Low-voltage Power Supply N3

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The power-supply unit is supplied with 110 V/500 cps power by the transformer and supplies the G 3 transmitter and receiver as well as the main viewer with every type of operational power except high voltage. By turning the band switch in the main viewer to the "readiness" position the transformer engages the power supply for the entire installation and its output voltage is fed via cables to the low-voltage power supply unit.

Power Supply

The transformer supplies the power requirement for the entire installation which is approx. 1 kv-a.

During voltage fluctuation in power supply, the generator voltage of the transformer required for the operation of the installation is regulated by a carbon pressure regulator with tolerances of ± 2%. The turning on and off of the installation is accomplished by the main switch located in the front of the main viewer. According to available voltage, power is supplied by the following equipment:

220 V (110 V upon request)

Transformer: single housing trasnformer GEUB 2 - 300 B/500

Delivered by: FIMAG

Marine automatic starter MGSA 1 (220 V)

Mfg. by: VEB Schaltgeraetewerk Dresden

Carbon pressure regulator 56/31 (220 V separate excitation)

Mfg. by: VEB Fahrzeugausruestung Berlin

1499.12 A 1 -type junction box

Mfg. by: VEB Funkwerk Koepenick

Voltage: 3 X 220 V/50 cps or 3 X 380 V /50 cps

Transformer: DEUB 2 - 300 B/500-type single housing transformer

Mfg. by: FIMAG

56/31-type carbon pressure regulator (220 V separate excitation)

Mfg. by: VEB Fahrzeugausruestung Berlin

1491, 93 A 1 -type suplemental power-supply unit

Mfg. by: VEB Funkwerk Koepenick

On orders from abroad the complete power supply will be delivered upon customer's request. On domestic orders parts of the power supply unit are not delivered by the manufacturing source. Procurement is possible from the VEB Fernmelde-Anlagebau

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Rostock upon purchase of a complete installation or through direct purchases at listed manufacturing outlets.

Operation of the FGS 392-type Ship Radar Installation

Main Generator.

The main generator generates power synchronized pulse sequences of 2000 cps for the operation of transmitter and viewers. It delivers a delayed positive control pulse to the exciter and another undelayed one to the input blocking oscillator of the viewers both of whom are adjustable to the pulse timing.

Exciting Stage

The exciting stage is operated as a blocking oscillator and converts the impulse from the main generator to a rectangular impulse. Impulse width is determined by pulse timing series. A rectangular impulse for control of the modulation tube is neutralized via the condenser from the tertiary winding and another impulse is removed from a voltage divider for the seaway interference eliminator.

Modulation Stage

The rectangular impulse coming from the exciting stage opens the modulation tube so that the connecting condenser which is charged with anode voltage can discharge itself via the magnetron. The condenser charges itself again to the anode voltage during the impulse break

Magnetron Transmitter

The magnetron begins to oscillate when the impulse voltage on its cathode reaches a certain value and delivers for the duration of the modulation impulse a high-frequency impulse via the simultaneous part to the antenna wherefrom it is then emitted directionally.

Composite Section

The composite section is an automatically operating antenna switch which makes it possible to join the transmitter and receiver to a common antenna.

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~~blocks~~ for the duration of the transmitting impulse entry to the mixer head in the intermediate frequency amplifier ~~in order~~ that the sensitive mixed crystals in the mixer head are not destroyed. During reception the antenna switch prevents that a significant part of the receiving power does not reach the transmitter and thus ~~is~~ lost for the receiver.

Oscillation power of approx. 1 Mw per mixed crystal must be set. Upon verification the instrument of the testing outfit must indicate approx. 35 micro-angstrom. The testing outfit is located in the accessory pack.

Receiver Part

The high-frequency impulse reflected from the object is again picked up by the antenna and reaches the entry to the mixer head in the intermediate frequency amplifier via the antenna switch. By superposition of the auxiliary frequency generated in the oscillator (klystron) an intermediate frequency of 45 Mc is produced at the mixed crystals, which is inductively coupled to the intermediate frequency amplifier. ~~After~~ amplification, ~~same~~ reaches via a 150 ohm cable, the inlet of the 2-stage intermediate frequency terminal amplifier in the viewer.

Seaway Interference Eliminator

This device reduces reception sensitivity for echoes from nearby to the point where echo impulses, strongly reflected by the seaway in the antenna proximity zone, do not project interfering images on the screen. The switch - sharpening of seaway - located on the viewer puts this device into operation.

The Intermediate Frequency Terminal Amplifier

Once again amplifies the impulse and after demodulation the impulse is coupled via a switchable time constant on the control grid of the first tube of the video amplifier. When switching on the rain deblurring switch, the time constant is reversed by a relay.

The Two-Stage Video Amplifier

is equipped with a throttle lift for increasing the upper cutoff fre-

quency (10 megacycle). Signals from the range finder and north indicator are mixed at the anode resistance of the second video amplifier tube. Amplified impulses are conducted to the picture tube cathode. Its zero level is kept on a voltage corresponding to the brightness of the background by a zero level diode.

Background Brightness

and picture contrast can be regulated. Indicator brightness can be adjusted at the cathode resistance of the line mixing tube.

The input blocking oscillator excited by the positive control pulse of the main generator, transmits a negative impulse to the galvanically regenerated multivibrator.

The Multivibrator

delivers a negative rectangular impulse to the sweep generator as well as a positive rectangular impulse to the Wehnelt-cylinder if the picture tube and to the third grid of the Miller-integrator in the range finder.

The Sweep Generator

sends a current impulse through the deflection coil of the picture tube. This current impulse deflects the light spot on the screen radially from the center point to the outside. Deflected coils rotate synchronized and inphase with the directional beam antenna around the picture tube, so that the flash point is always deflected into the direction which corresponds to the instantaneous directional beam of the antenna.

The Range Finder

can compute exact distance of an object. A measuring impulse is transmitted to the line mixing tube by the range finder at a suitable time ratio after the start of each tripping impulse. These impulses are visible on the screen as a bright concentric circle.

The Forward Mark Indicator

is operated by the "forward contact" in the antenna gear and controlled

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by the emitted impulse of the input blocking oscillator. The forward mark-rectangular impulse is at that time passed to the line mixing tubes. The brightness of the forward mark can be adjusted.

The North Mark Indicator

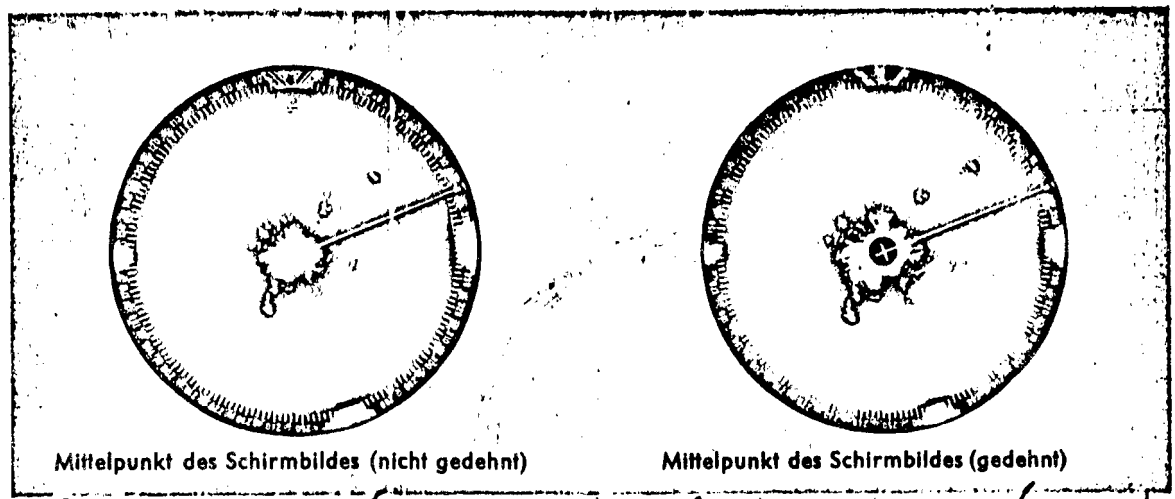
is controlled parallel to the forward mark indicator by the emitting impulse of the input blocking oscillator and actuated by a trip cam in the gear. Together with the blocking oscillator it delivers during a one only time-base period a continuous sequence of short impulses which are passed on to the line mixing tubes.

Focusing

An electromagnetic lens serves for focusing the cathode ray of the picture tube. Grid current control for the focusing - variable mutual tube is performed by a potentiometer from the front plate and consequently the stabilization of current for the focusing coil is effected.

The Center of the Screen

can be adjusted either vertically or horizontally for approx. 8 mm. The center point can be expanded up to 15 mm into all directions in order to be able to still accurately measure the azimuth of targets which lie closely together in the antenna-proximity zone.



Center of screen (not expanded) Center of screen (expanded)

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AC Rotating Indicator System

One of the most important conditions for the formation of an authentic screen image is that the directional beam antenna and the deflection coil rotate synchronized and inphase. This synchronization is achieved by AC rotating indicators. A rotation indicator is located in the antenna gear which **electrically** conveys antenna rotations to a rotation indicator receiver in the viewer. This roation indicator in turn rotates via a gear the reflection coil of the picture tube, facilitating same to rotate synchronized with the antenna.

The inphase condition between the direction of the antenna beam and the deflection device of the coil is set automatically with the aid of a relay, a cam switch and a synchronized contact.

Another AC rotating indicator system effects the north orientation of the screen image. A rotating indicator receiver located in the viewer can be connected to a rotating indicator of an optional gyrocompass installation and thus act as a secondary compass. The main compass always stabilizes the screen image in the northern position independent of the ship's course. The utilized rotation indicator receiver type is dependent on the rotation indicator utilized in the gyrocompass.

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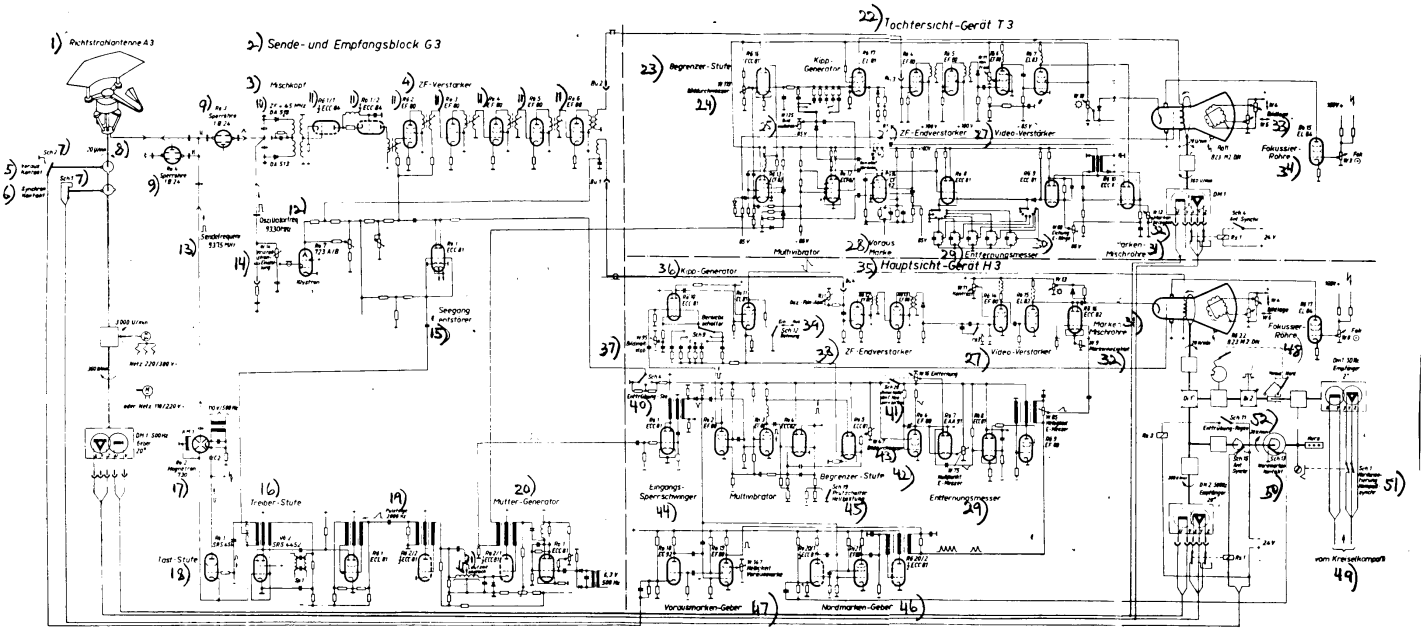
circuit diagram

PRINZIPSCHALTBILD



HINWEISE FÜR DIE BESTELLUNG

suggestions for ordering

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Glossary for Cirucit Diagram

1) A3 Directional beam antenna
2) G3 Receiver and transmitter
3) Mixer head
4) Intermediate freuqency amplifier
5) Forward contact
6) Synchronized contact
7) Switch
8) rpm
9) tube 3 - blocking tube
10) intermediate frequency
11) tubes
12)oscillator frequency
13) transmitting frequency
14) crystal current - position
15) seaway interference eliminator
16) drive stage
17) magnetron
18) modulation stage
19) pulse sequence
20) main generator
21) transition time balancing
22) T3 daughter viewer
23) limitation stage
24) picture diameter
25) picture measurement
26) intemediate frequency amplifier
27) video amplifier
28) forward indicator
29) range finder
30) calibration E-rings
31) line mixing tube
32) line brightness
33) image position
34) focusing tube
35) H3 main viewer
36) sweep generator
37) picture measurement
38) intermediate frequency terminal amplif.
39) in - out expansion
40) sharpening of minimum (sea)
41) circuit breaker for E-meter
42) limitation stage
43) picture diameter
44) input blocking oscillator
45) test switch, brightness stage
46) North line indicator
47) forward indicator
48) focusing tube
49) from gyrocompass
50) North line contact
51) North orientation compass synchronized
52) sharpening of minimum (rain)

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Suggestions for Ordering

The following information must be submitted when ordering a ship radar installation:

1. available voltage
2. whether a daughter viewer is desired or not
3. what roation indicator receiver type is required in case an optional gyrocompass will be connected

We reserve the right to make any changes necessary due to continued technical research.

Please contact VEB Funkwerk Koepenick for further information of interest particularly about the various applicability of the set as well as its uses. You will receive individual attention from our experts.

Export Informations:

Deutscher Innen - und Aussenhandel (German Domestic and Foreign Trade)

Elektrotechnik (electrotechnology)

Berlin N 4, Chausseestrasse 110 - 112 - Cable address: Diaelektro Berlin

Procurement within the DDR:

VEB Fernmelde-Anlagebau Rostock

Rostock/Mecklenburg, Friedrich-Engels Strasse 28

Phone: Rostock 7171 - teletype: 013-243 - wire: Erfteanlagen Rostock

Our Production Program

Electric Measuring Devices

of highest precision for all purpose sinus, impulse and centimeter measuring technology.

Transmitting Installations

for radio, UHF, television and commercial use.

Ship radio and Navigational Equipment

ship transmitter, emergency transmitter, goniometer (direction finder), distress and alarm devices, ship radar installation.

Gyrocompass Installations

Hydro-acoustic Installations

sonic altimeter, echographs, horizontal-vertical sonic altimeter.

Navigational devices

machine telegraph installations and installations for voice communications and reception. Control equipment with indicators at the control station and speed indicators.