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MINISTRY OF SUPPLY

The Siemens-L G W Kurssteuerung K 12

The Siemens-LGW. Course Controller
K. 12

by

Siemens

September 1940

TRANSLATED AND ISSUED BY

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TECHNICAL INFORMATION BUREAU

FOR

CHIEF SCIENTIST

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3.10

UNCLASSIFIED

The Siemens - LGW, Course Controller K. 12.

Siemens LGW, Hakenfelde, Berlin

September, 1940

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- I. General functional description.

The Siemens Course Controller K.12 operates like the course controller K.4, at present in large scale production, by means of electrical direction transmitters and electro-hydraulic amplifiers.

In relation to a directionally stabilised gyro, monitored by a remote compass, the course changes of the aircraft are detected by a bolometer and converted to a proportional rudder movement by a magnetic amplifier and an electrically controlled hydraulic rudder servo motor.

The rotational speed of the aircraft is measured in the usual manner by a turn indicator and used in the controller from a potentiometer pick-off for damping. This apparatus will be subsequently referred to as the damping gyro.

Any course changes which may be required are made by means of a direction transmitter, usually situated on the control column, which adjusts the datum of the course gyro by means of the course motor.

In contrast to the constructional form of the course controller K.4 separate units have been chosen for the rudder servo motor, the damping gyro and the inverter, as this ensures, particularly in modern small and medium aircraft an appreciable simplification in the installation compared to the block construction of the K.4 - controller. The equipment is arranged in individual units which may be installed separately and independently of each other.

The pick-off of the course error angle, the rate of turn and the rudder angle (feed-back) is electrical. These impulses are amplified and suitably mixed in a magnetic amplifier operating on the principle of the permagnetised choke coil. The resultant value is transmitted to a coil system situated in the rudder servo. This coil system operates a pre-setting valve, which permits pressure oil, supplied by a pump, to be supplied to the appropriate side of the working piston (see drawing No. 77 Ig - W b 53). The movement of the working piston produces a rotation of the output axis, and hence the rudder position is adjusted by means of the output

crank. The rudder angle, as stated previously, is set from the rudder servo by means of a potentiometer in an electrical comparison circuit so that it effectively opposes the impulses from the course gyro and the damping gyro and thus provides the input to the magnetic amplifier. This arrangement ensures that a movement of control coil system occurs only until a balance is produced between the direction transmitter impulses and the feed-back impulses. Thus a definite rudder movement takes place for a definite angular error in course.

During a curved flight caused by the direction transmitter the curvature voltage of the course motor, which is proportional to the rate of turn of the aircraft, is used to compensate for the steady current produced by the rate gyro. This is arranged, by means of the magnetic amplifier, by applying the armature voltage of the course motor to the fourth input winding, so that it effectively opposes the damping gyro impulse.

II. Brief details of equipment.

1. Signal transmitters.

- (a) Course gyro LKU 4 with course indicator LKZ 3
- (b) Damping gyro LDK 1/1
- (c) One handed direction transmitter LRg 12.

2. Mixer LMK 12.

3. Rudder, servo motor LRM 12.

4. Ancilliary equipment.

- (a) Main switch ISch 4 ü
- (b) Automatic switch Laut 6 and Laut 15.
- (c) Inverters GDU 70/25 - 70/23 K.

1a. Course gyro LKU 4 with course indicator LKZ 3.

Both these items correspond to those used in the course controller K4 and a knowledge of them will therefore be assumed. In the arrangement supplied to the German Air Force the course gyro is controlled from a Patin master compass. Obviously, if required, the Siemens compass may also be used. Details of this equipment are also omitted from this brief description as the items are common to the course controller K4.

1b. Damping gyro LDK 1/1.

The damping gyro measures the rate of turn of the aircraft about its principal axis by means of a spring restrained gyro. A new constructional form of ball gyro is used, whose precessional torque, proportional to the rate of turn, is balanced by the restraining spring. The resulting movement is transferred by a potentiometer to an electrical control valve. The equipment incorporates eddy-current damping; the two magnet windings together with the potentiometer are connected in a bridge circuit, in whose diagonal the input winding of the magnetic amplifier is situated.

1c. One-handed direction transmitter LRg 12.

The one-handed direction transmitter LRg 12 controls the course motor, in a manner similar to the direction transmitter LRg 9 produced for the course controller K4, to give two selected rates of turn in each direction. In addition it contains a switch, to facilitate the coupling in and out of the apparatus, which operates the coupling valve in the rudder servo.

2. Mixer LMK 12.

The principal component of the mixer is the magnetic amplifier, its function being to amplify and mix the control impulses. As shown in the circuit diagram 77-1 - S2 124.02 the control values from the course gyro and the damping gyro are connected, as explained, in opposition to the amplifier input points 1 and 2. The control impulses for feed-back and from the course motor (armature voltage to compensate for the damping gyro impulses during curved flight) are fed to the inputs 3 and 2. The resultant of these curves is amplified and transmitted to the control coil on the rudder servo. Alternating current is led to the mixing amplifier through a voltage divider. In general the mixer contains pre-set

resistances to adjust the control strength of similar impulses and in addition the supplementary resistances for the various bridge circuits. The pre-resistances for one or two course indicators and the comparison resistances for the magnetic amplifier are also included.

3. Rudder servo motor LRii 12.

The rudder servo motor is an electrically operated hydraulic load amplifier. The two windings of the control coil lie in the field of a separately excited magnet and when control currents are applied, they operate the adjusting needle of a controlling valve. This again supplies, as explained, the pressure oil from the pump to the appropriate side of the operating piston. The movement of the piston is converted by a crank drive into a rotational motion of the output axis. In contrast to the arrangement of the pre-controlled valve in the rudder controller K40 a constructive measure has been introduced to ensure that in the null position of the valve it is no longer necessary for the pump to operate against the full working pressure. This means that the power requirements of the servo for no control are only about 90 to 100 watts. The maximum output torque is, as in the rudder servo K40, 18 mkg. In this case the rudder servo requires about 250 watts. The angle of the output crank relative to the null position is, as previously explained, picked-off by a potentiometer and used as a fed-back impulse in the mixer.

The rudder servo unit is completely enclosed and arranged with a spring compartment which permits variations in the volume of the oil to take place during temperature changes.

The rudder servo, is coupled and uncoupled by a coupling valve. This produces a variable oil short circuit path between the two sides of the operating chambers. The sealing is produced by means of an electro magnet whose operation breaks the connection between the two cylinders. In this condition the servo is coupled, and the operating piston responds to the control impulses.

The working pressure of the oil is limited by a safety valve to 25 atmospheres.

Suppression is provided in the rudder servo to the latest DVL requirements.

4a. Main switch LSch 4 U.

Functionally the main switch is unnecessary in the course controller K12 but it has been retained in order to ensure an absolute similarity of operation with the course controller K4. Thus it is unnecessary for flying personnel to be given a conversion course.

4b. Automatic switches Laut 5 and Laut 15.

The production version of the Siemens automatic switch for maximum currents of 6 and 15 amps is used for switching on and automatic switching off.

4c. Inverter GDU 70/25 - 70/23K.

The inverter is a motor generator which supplies a poly-phase current of 36 volts, 500 cycles, with a nominal power of 50 volt amps. It has been designed to supply the requirements of the course controller K12 and is required because of the existence of a poly-phase network. Suppression of the equipment to the latest DVL requirements is also provided.

III. Power requirements and weights.

| Quantity | Unit | Type | Weight (Kg) | Direct current steady load requirements. (watts) | Alternating Poly-phase current steady load requirements (V.) (watts) | | | |
|----------|----------------------------------|----------------------|-------------|--|--|----|----|------|
| | | | | | 25 | 9 | 22 | 7.5 |
| 1 | Course gyro | LKa 4 | 2.25 | 8 | 25 | 9 | 22 | 7.5 |
| 1 | Course motor | LKMo | 0.52 | — | — | — | — | — |
| 1 | Course Indicator | LKz 3 | 0.36 | — | — | — | — | — |
| 1 | One-handed direction transmitter | LRg 12 | 0.10 | — | — | — | — | — |
| 1 | Damping gyro | LDK 1/1 | 0.60 | 4 | — | 6 | 4 | — |
| 1 | Mixer | LMK 12 | 1.20 | — | 4 | 4 | — | — |
| 1 | Rudder servo | LRM 12 | 10.30 | 100/250 max | — | — | — | — |
| 1 | Output crank | LKR | 0.74 | — | — | — | — | — |
| 1 | Inverted | EDU 70/25 -70/23K | 2.10 | 70 | — | — | — | — |
| 1 | Main switch | LSch 4ii | 0.35 | — | — | — | — | — |
| 1 | Automatic switch | Laut 15 | 0.15 | — | — | — | — | — |
| 2 | Automatic switch | Laut 6 | 0.30 | — | — | — | — | — |
| | | | 18.97 | 188/338 max | 29 | 13 | 28 | 11.5 |
| 1 | Patin remote compass | | 3.60 | | | | | |
| 1 | Patin compass repeater | | 1.20 | | | | | |
| | | | 23.77 | | | | | |

IV. Installation, adjustment and operation.

Installation.

The installation of the controller offers a number of advantages compared with the present installation of the controller Kd.

1. The units have become smaller and lighter and hence particularly where space is restricted, are more readily installable.
2. The very small and light damping gyro may be readily installed in a technically satisfactory position (chiefly, well away from a fuselage node of oscillation).
3. As the rudder servo no longer contains the damping gyro it is no longer necessary to impose rigid conditions on the stiffness of its foundations. It is necessary only to ensure adequate strength.
4. The rudder servo is completely enclosed and is installable in any attitude.

Adjustment.

All adjustments are made by the setting of resistances adjacent to the mixer.

The setting of the circuit magnitudes of the course -, damping gyro - and feed-back - impulses occurs by fixing suitable resistances in the appropriate amplifier input leads. These adjusting resistances are collected together on a completely interchangeable socket-connected strip. The connection for the adjusting equipment may be made at positions on this strip, and by this means the circuit values and their directional sense may be established. It is necessary to adjust these values once only for a given type of aircraft. The resistances then have constant values for this type.

For individual installation only the zero point of the control, the rotational speed of the course motor and its associated turn signal need be adjusted. The former is made with the help of the tuning resistance, which is connected, with the feed-back potentiometer, in a bridge circuit, the latter by adjustment of the appropriate pre-resistance.

Operation.

The switching on operation is made by the following hand operation in the sequence given.

1. Switch on all automatics.
2. Move the main switch to position 2.
3. Set the course gyro.
4. Couple up the equipment by operating the coupling switch in the one-handed direction transmitter LRg12.

After the first operation an interval of about one minute should elapse to allow the gyro to run up to speed.

The equipment is switched off by reversing the above sequence.

V Safety measures.

By combining in the one-handed direction transmitter LRg 12 the direction transmitter and coupling switch a very rapid uncoupling may be obtained in an emergency. Any hand switch of the normally inaccessible setting knob on the course gyro or the main switch is unacceptable. At the same time the equipment may obviously also be uncoupled by operating these switches.

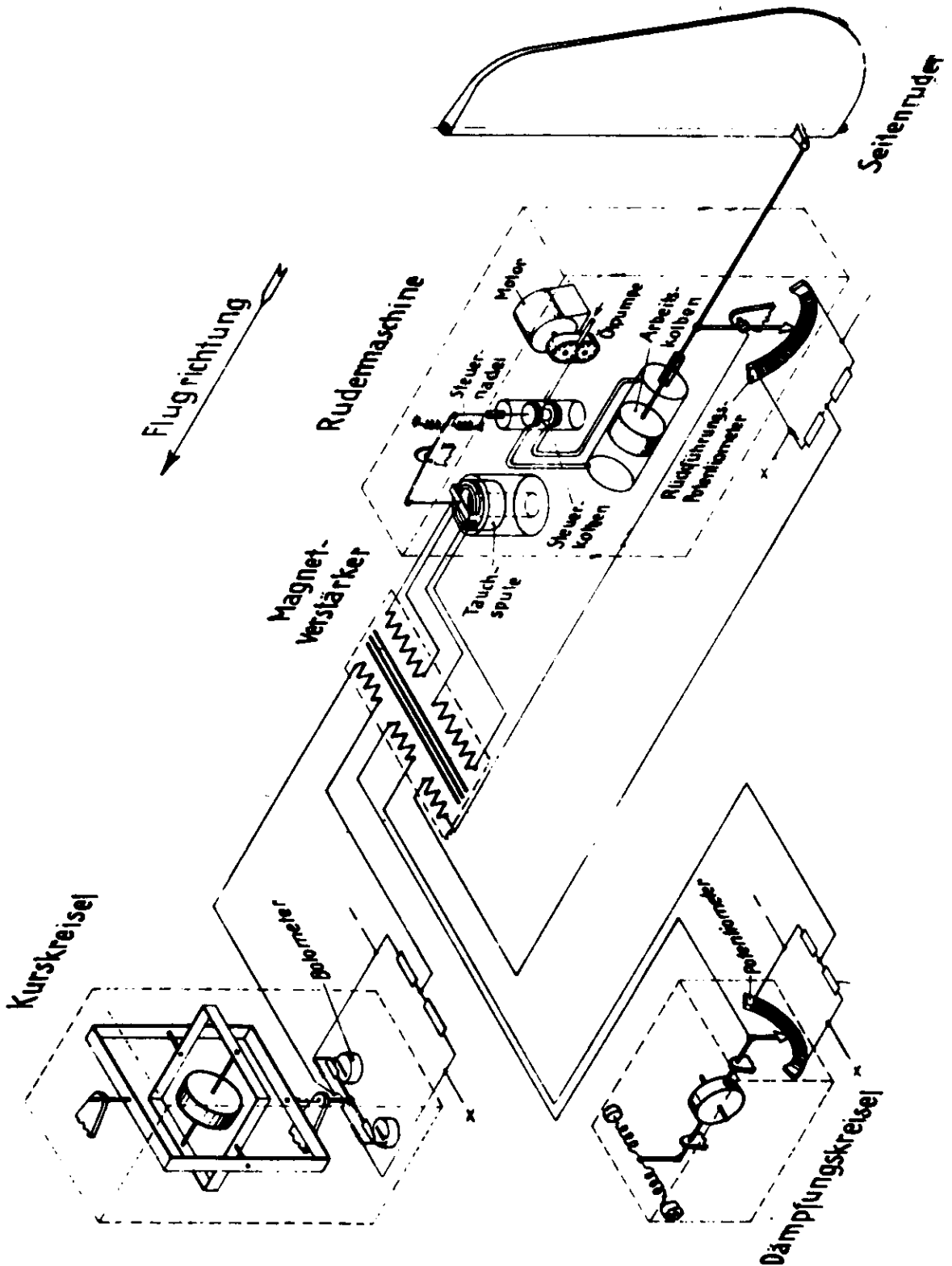
The further possibility exists of violently overcoming the controller. The armature in the coupling valve pulls off as soon as the load acting upon it from the oil pressure overcomes the pull of the magnet. This causes the oil short circuit between the two sides of the cylinder and the piston may move freely.

In addition to these possibilities an emergency lever is provided, as in the controller K.4, which mechanically separates the rudder link and the rudder servo output drive.

These measures ensure that if, for example, the controller is damaged by enemy action it is possible to return to manual control.

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" 7. Dimensional drawing: damping gyro.
" 8. Dimensional drawing: direction transmitter.
" 9. Dimensional drawing: mixer.
" 10. Dimensional drawing: rudder servo.
" 11. Dimensional drawing: main switch.
" 12. Dimensional drawing: automatic switch series 6 to 30 amps.
" 13. Dimensional drawing: inverter.



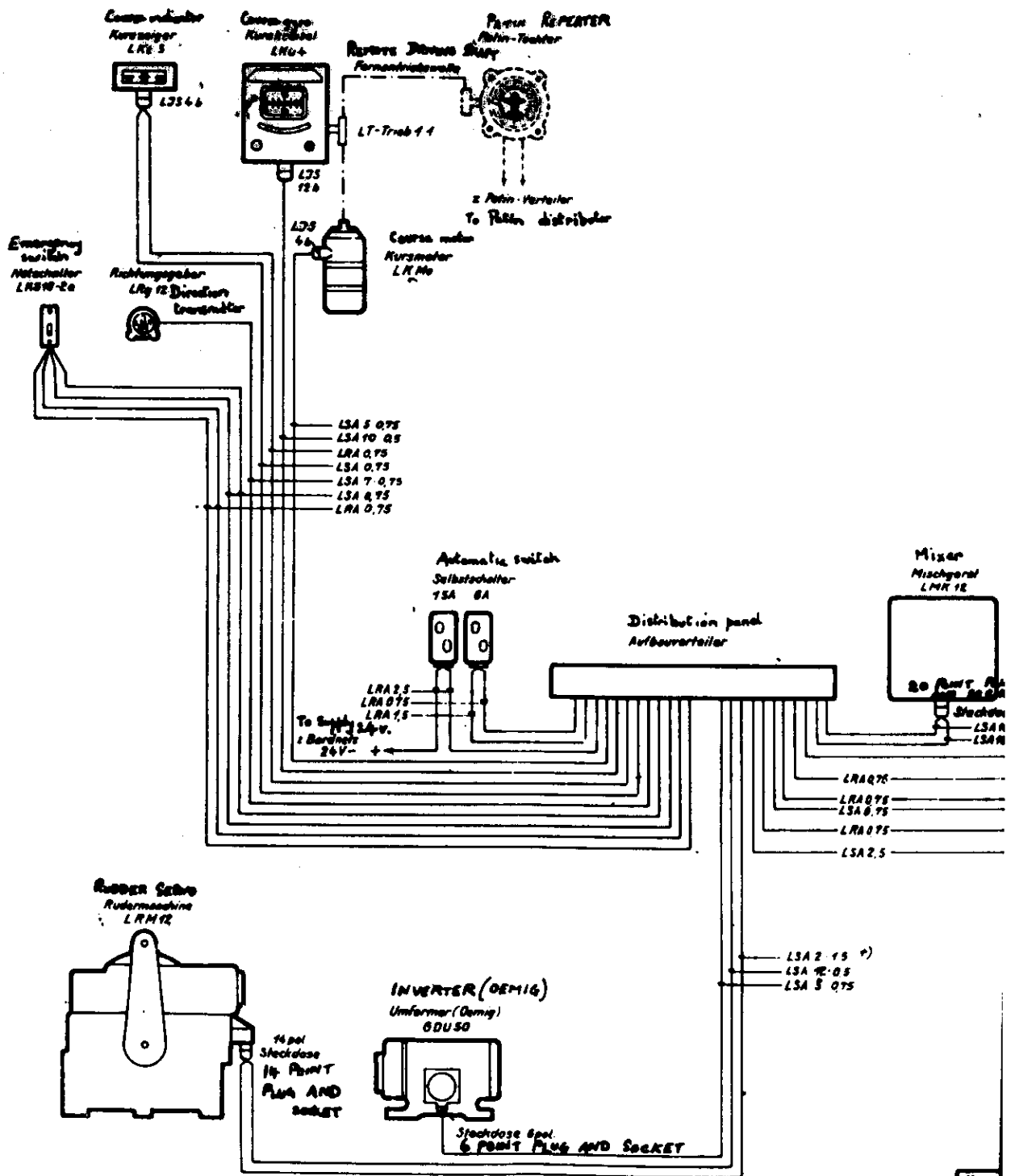
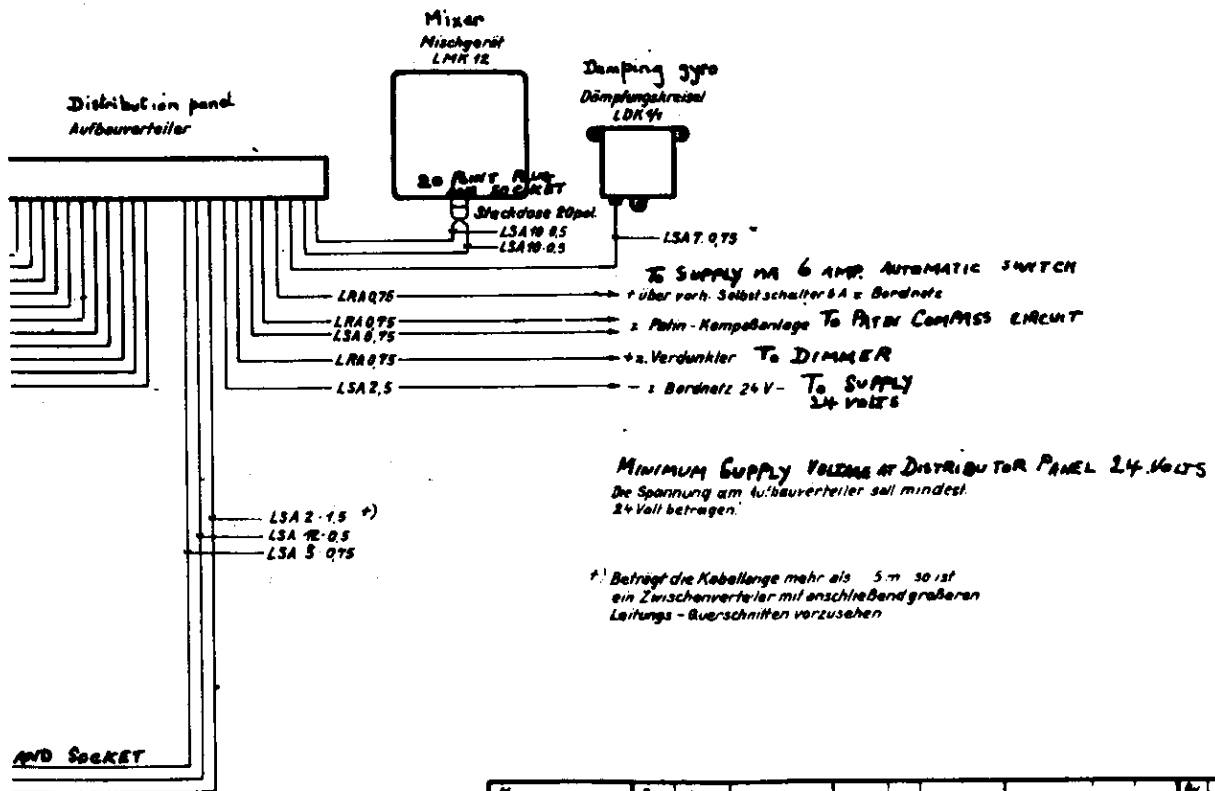


FIGURE 2. COURSE CONTROLLER K12: General arrangement

14
 The 20 point
 plug and socket
 assembly is
 shown in
 detail on
 page 10
 of the
 manual
 for the
 course controller
 K12.

TEK

Wider



WILLER K12: General arrangement

| № | Tag | Name | | | | | | | | | | | | | | | | | | |
|---|------------|-------|----|--|--|--|--|--|--|---------------------------|--|--|--|--|--|--|--|--|--|--|
| Die Zeichnung ist | Gezeichnet | 6 754 | 73 | | | | | | | | | | | | | | | | | |
| von | Gezeichnet | | | | | | | | | | | | | | | | | | | |
| von | Gezeichnet | | | | | | | | | | | | | | | | | | | |
| Kurssteuerung K12 | | | | | | | | | | 77 Lg 1-S 2 124.01 | | | | | | | | | | |
| Geräteübersicht | | | | | | | | | | | | | | | | | | | | |
| Siemens Apparate u. Maschinen G.m.b.H. Luftfahrtgerätekwerk | | | | | | | | | | | | | | | | | | | | |

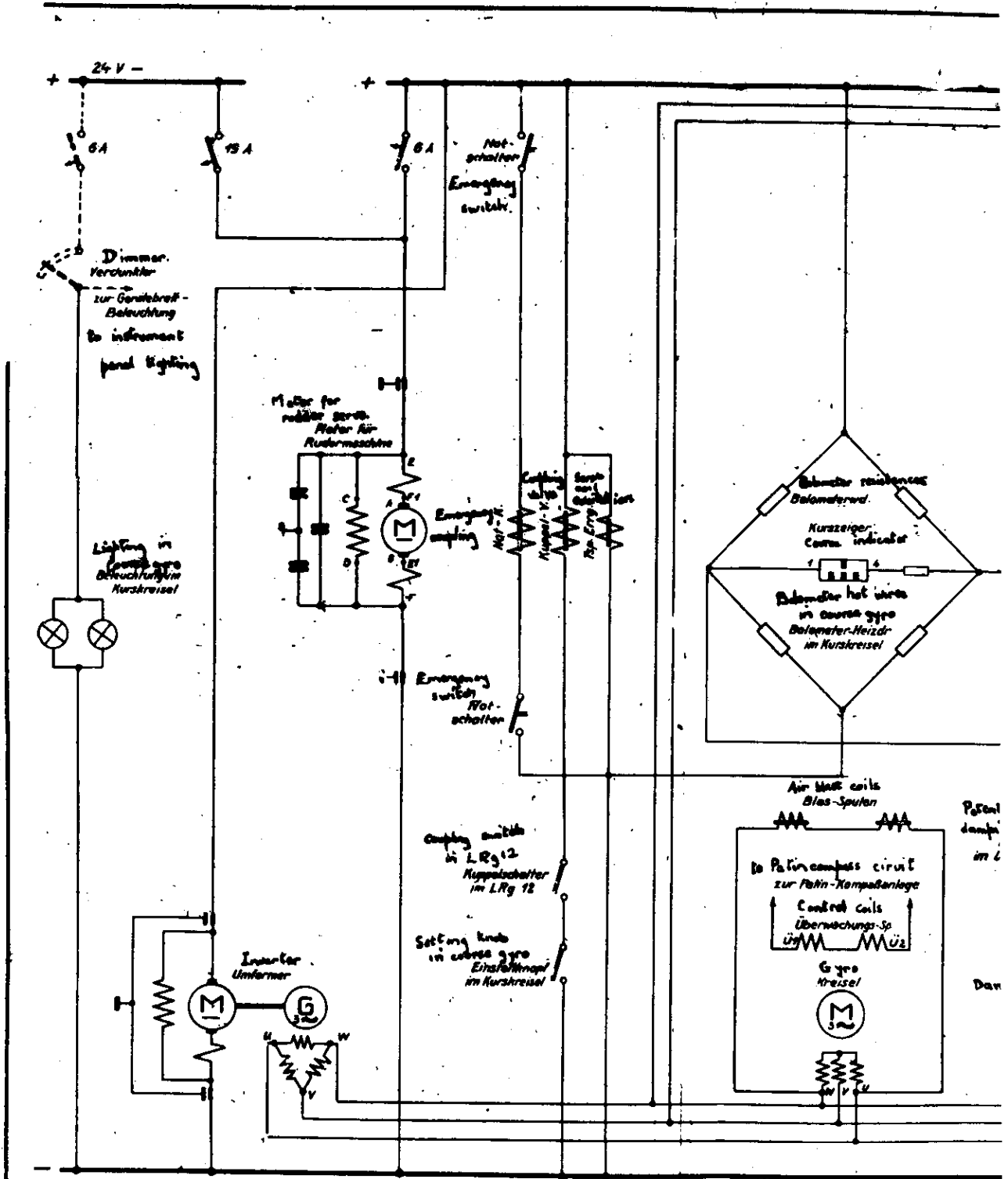
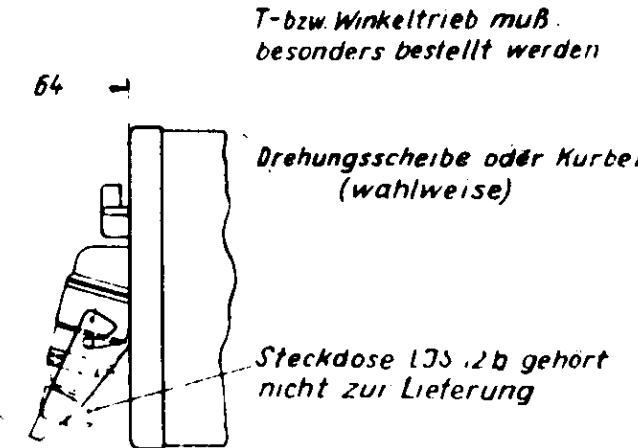
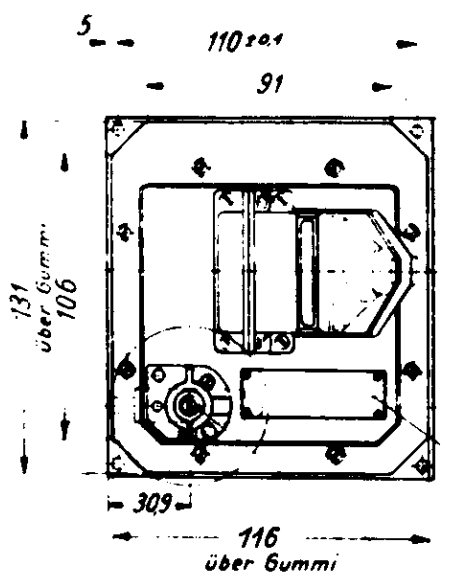
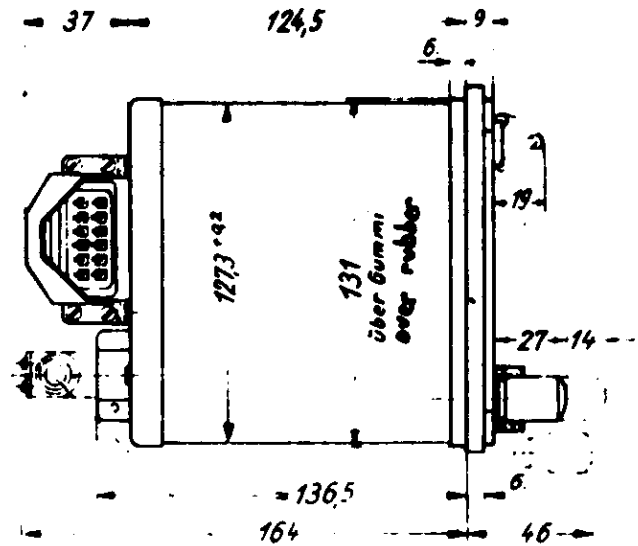
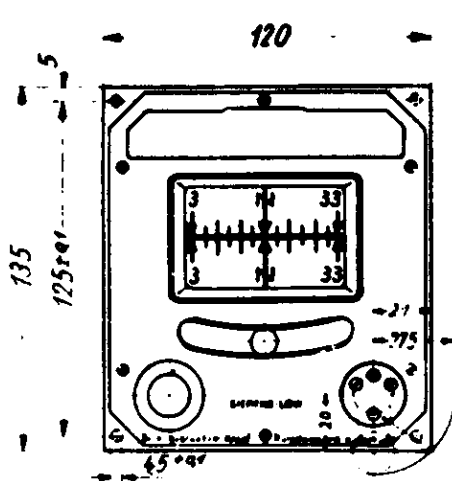


FIGURE 3 COURSE CONTROLLER K
CIRCUIT DIAGRAM

Maße in mm



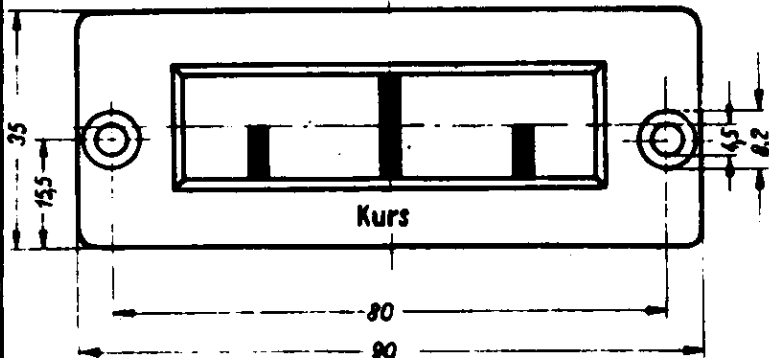
Geräteschild

Antrieb zum Anschluß der Fernantriebswelle
 nur 5 Bedart gerade über Zwischenlager
 oder über T- bzw Winkeltrieb
 (gehören nicht zur Lieferung)

Gewicht: ca 2,25 kg
 Maßstab: 1 : 2,5

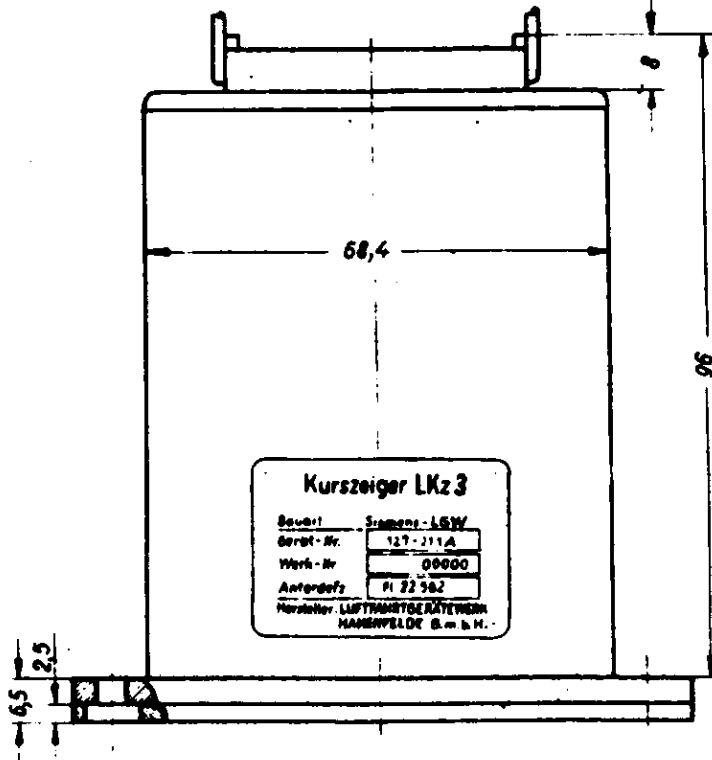
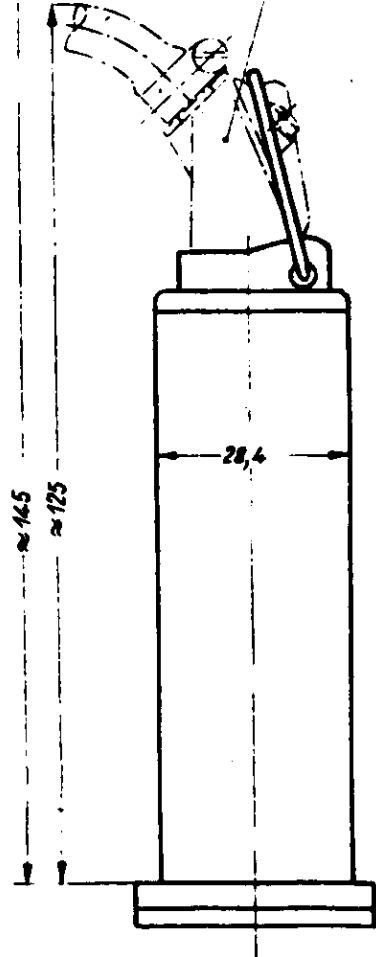
Werkstoff:
 Gehäuse: Leichtmetall

Made in mm



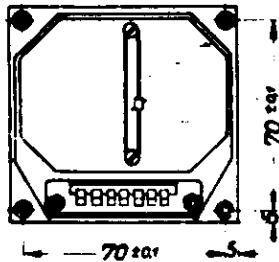
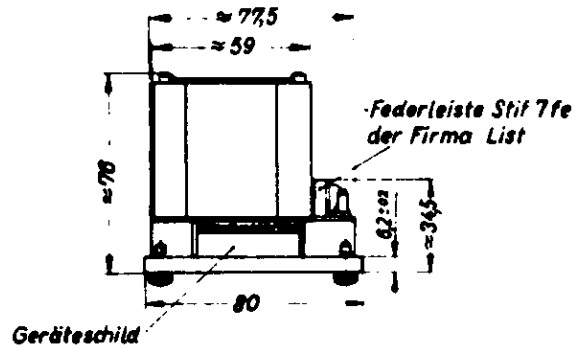
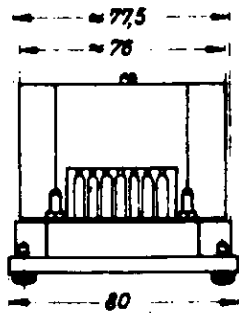
Erforderlicher Abstand zum Einsetzen bzw. Herausnehmen der Steckdose

Instrumentensteckdose LIS 2b
 (gehört nicht zur Lieferung)



Werkstoff:
 Frontplatte: Leichtmetall
 Gehäusemantel: magn. Weicheisen

Maßstab: 1:1
 Gewicht: ≈ 0,37 kg



*Zum Einbau erforderlich, jedoch
 nicht zum Lieferumfang gehörig:*
 1 Gehäuse für Dämpfungskreisel 127-329 A Fl 22547
 oder
 1 Gehäuse für Dämpfungskreiselsatz 127-317A
 Fl 22527

Maßstab: 1:2,5
Gewicht: 0,555 kg

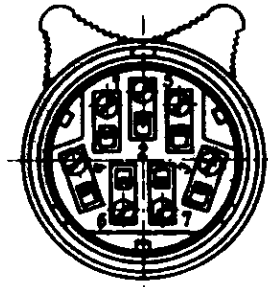
Werkstoff:
 Gehäuse: Leichtmetall

30.1.42 *Wagner Bk*

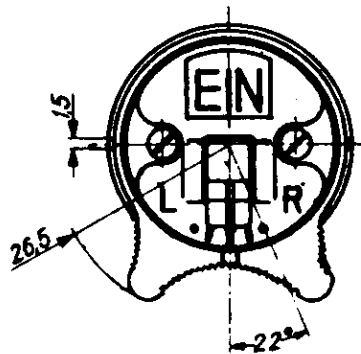
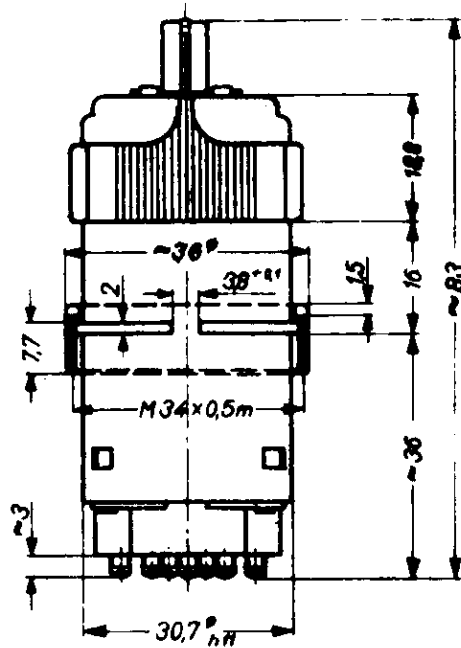
LZ 821 12.2.42 *Jk*

02408

Maße in mm



Anschlüsse 1 bis 7
für Leitungen 0,75mm²



Maßstab : 1:1
 Gewicht : ~0,115 kg

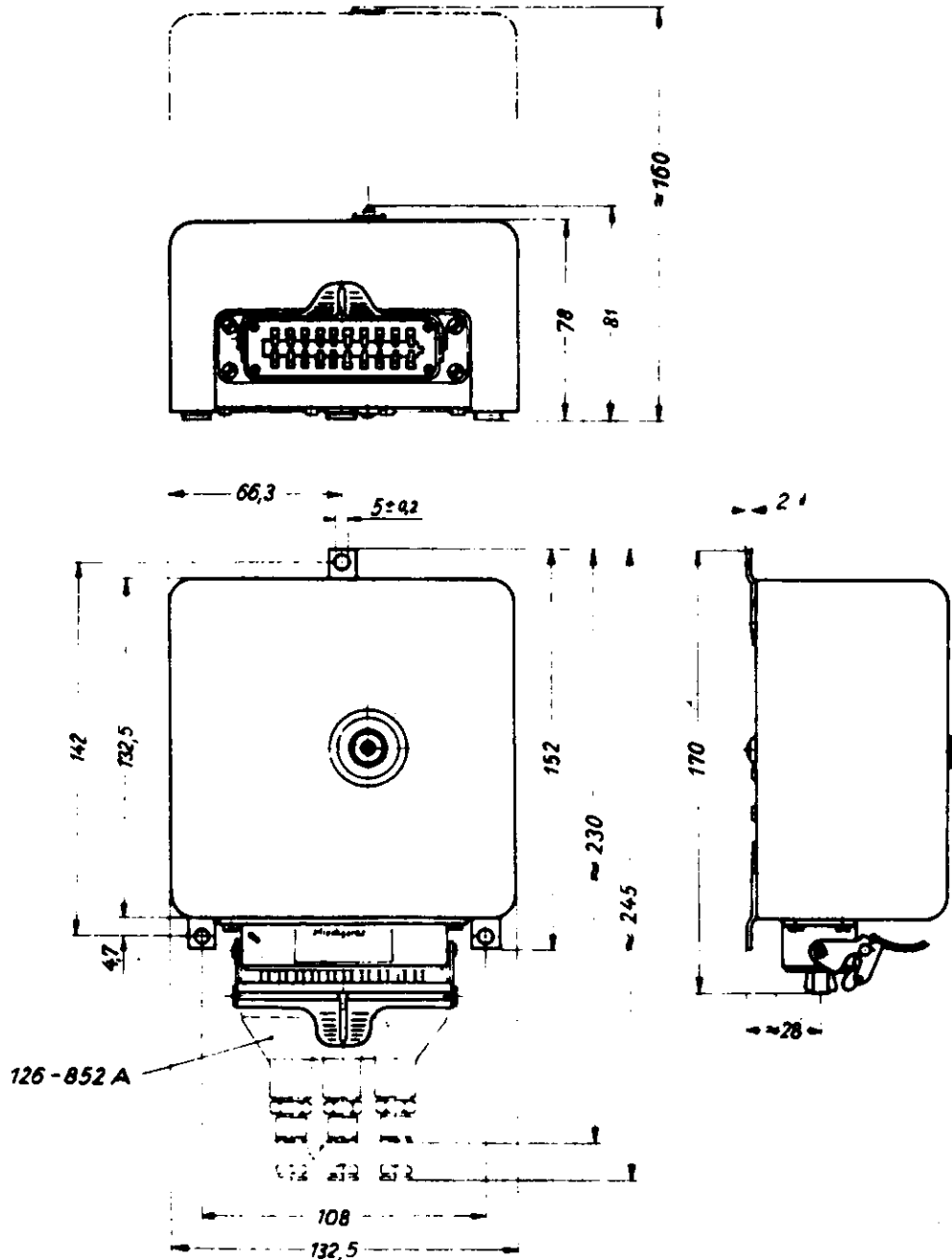
Werkstoff :
 Gehäuse : Leichtmetall

28.8.41 Oe. *Fu Hgt.*

LZ 569 29.8.41 *Hgt.*

02 406

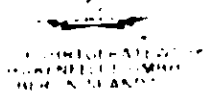
Maße in mm



Zum Einbau erforderlich, jedoch
 nicht zum Lieferumfang gehörig:
 eine 20-pol Steckdose 126-852A FI 32113-1
 ein Zusatzgerät zum Mischgerät 127-347
 (Ausführung je nach Flugzeugtype)

Gewicht \approx 12 kg
 Maßstab 1:2,5

Werkstoff
 Gehäuse: Leichtmetall



Maßblatt
Rudermaschine

Baumuster LÄM 12
Zeichnungs-Nr.
32 Flug 1880

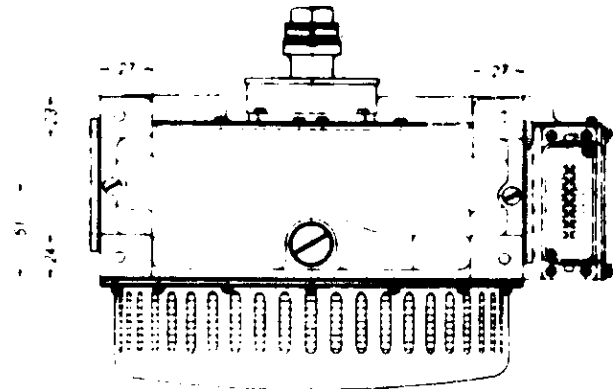
Maße in mm

Hierzu: Einbauanweisung 77Lg1 Eb110

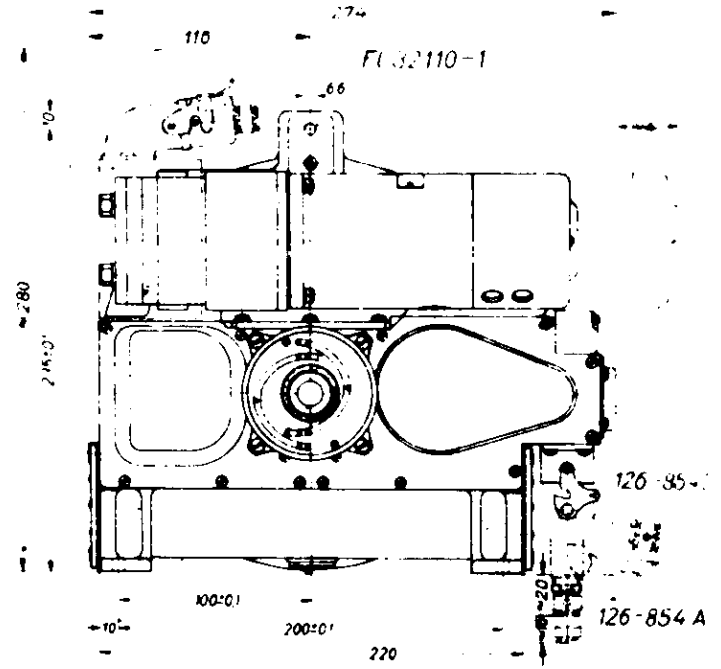
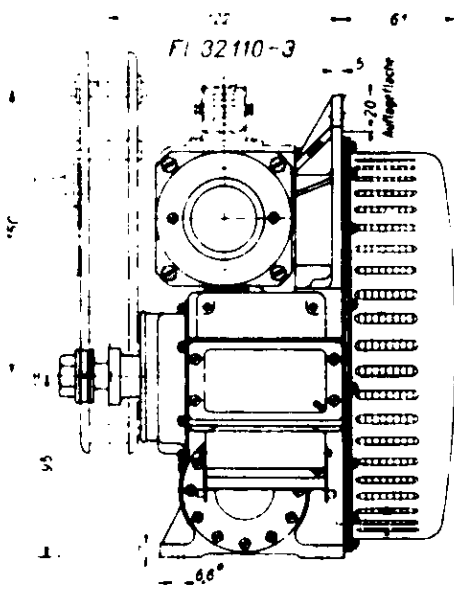
Bei Bedarf ist Zusatz-Heizung
gesondert zu bestellen

Angriffspunkt für
Rudergestänge

bei Verwendung von
LKRr oder LKRl



Zusatz-Heizung



Bei Verwendung
von LÄH 12

Zum Einbau erforderlich, jedoch nicht zum Lieferumfang gehörig:

| Stück | Benennung | Baumuster | Gerät-Nr | Ant-Zeichen | Maßblatt |
|--------|---|-----------|------------|-------------|----------|
| 1 | 14-pol Steckdose | — | 126-854 A | FI 32111-1 | — |
| oder 1 | 14-pol Steckdose | — | 126-854 B | FI 32111-2 | — |
| 1 | Kupplungshebel mit elektr. Notkupplung | LÄH 12 | 127-328 A | FI 22 539 | 02 450 |
| oder 1 | Abtriebshebel rechts mit mechn. Notauslösung | LKRr | 127-221.15 | FI 22 575-1 | 02 366 |
| oder 1 | Abtriebshebel links mit mechn. Notauslösung | LKRl | 127-221.12 | FI 22 575-2 | 02 367 |

Nennspannung: 24V —
Drehmoment am Abtriebshebel: 18mkg

Maßstab: 1:25
Gewicht: 11,5 kg (mit Ölwanne)

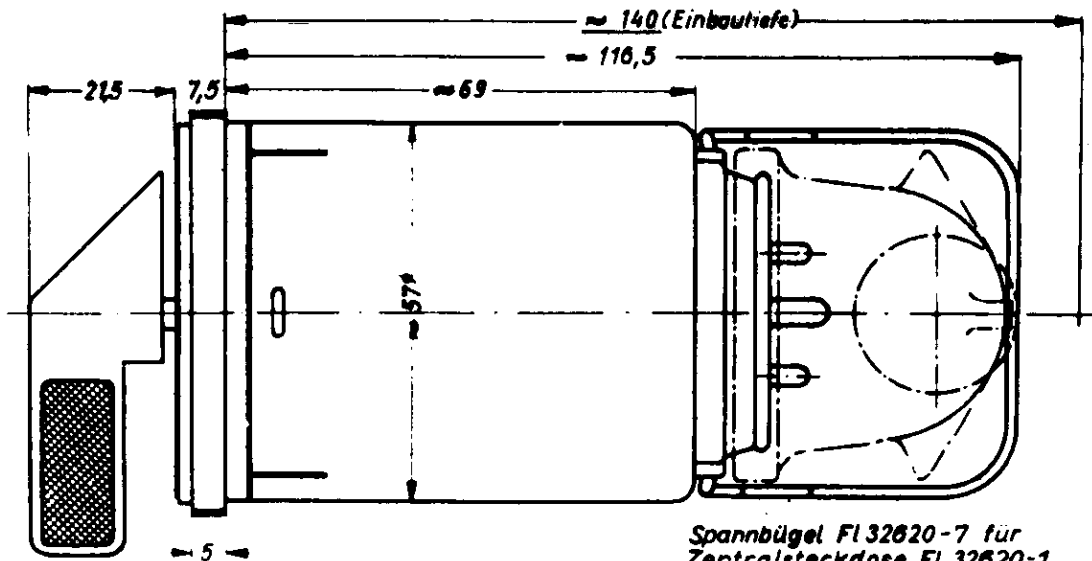
Werkstoff:
Gehäuse: Leichtmetall

29 12 41 0e. *pu*

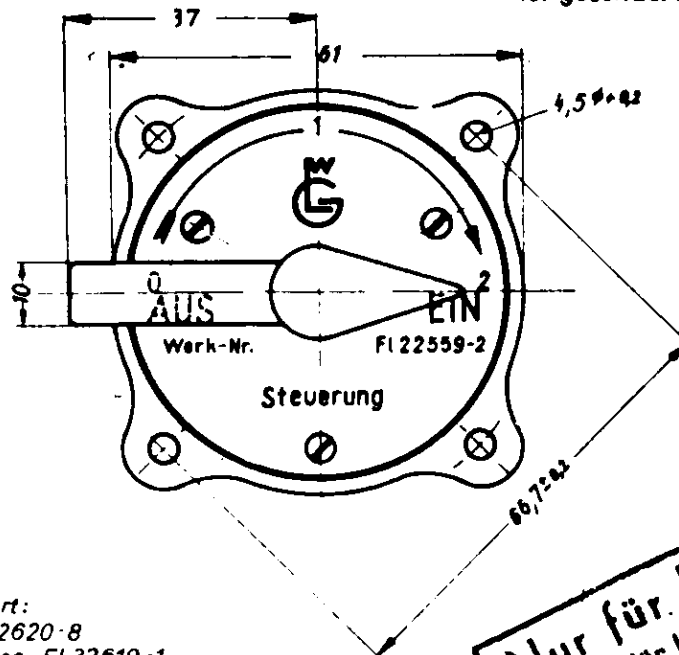
L7 784 20 142 *2*

02 376

Maße in mm



Spannbügel Fl 32620-7 für
 Zentralsteckdose Fl 32620-1
 ist gesondert anzufordern



Zur Lieferung gehört:
 1 Spannbügel Fl 32620-8
 für Winkelsteckdose Fl 32619-1

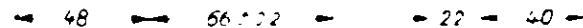
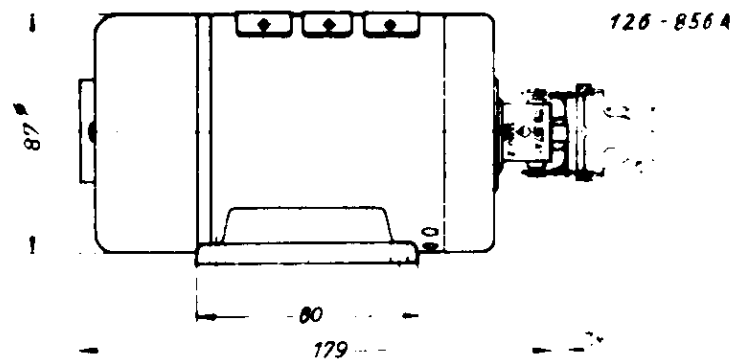
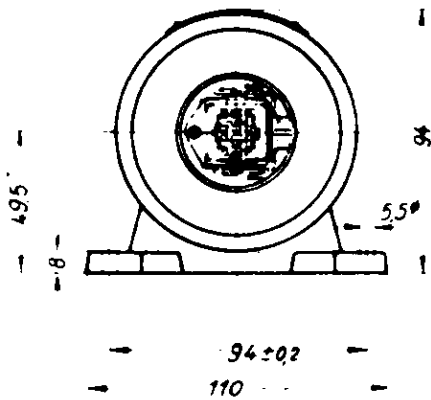
Schaltstellung:
 Stellung 0: Anlage aus
 - 1: Drehstrom-Umformer ein
 - 2: Steuerung aufgekuppelt

Gewicht etwa 0,33 kg
 Maßstab: 1:1

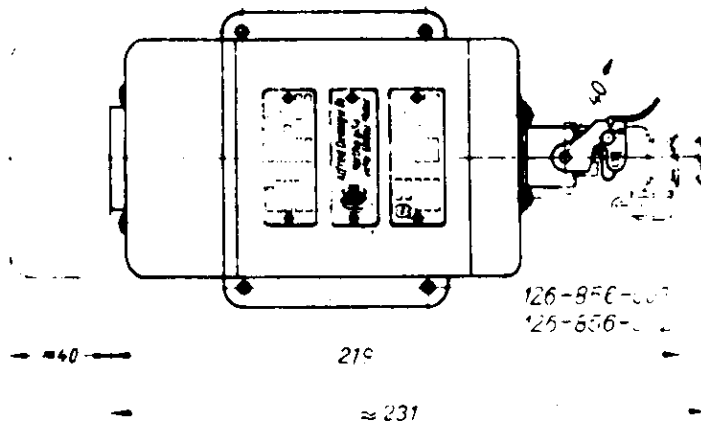
Werkstoff:
 Behäuser Leichtmetall

Nur für Projekt!
 Nicht für Konstruktion

Maße in mm



Zum Einbau erforderlich, jedoch
 nicht zum Lieferumfang gehörig:
 6-pol. Steckdose 126-856 A -
 FI 32 110-1
 oder Abgewinkeltes Steckgehäuse
 126-856-U03 FI 32 110-7
 mit 6-pol. Steckdoseneinsatz
 126-856-U02 FI 32 110-9



Technische Angaben

| Motor | Generator |
|-----------------------|---|
| Spannung: 27 V - | Spannung: 3 × 36 V, 500 Hz |
| Strom: 3 A | Strom: 0,8 A |
| Drehzahl: 7.500 U/min | Leistung: 32,5 W, Leistungsfaktor: $\cos \gamma = 0,65$ |

Gewicht 20kg
 Maßstab 1:2,5

Werkstoff
 Gehäuse, Leichtmetall

