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SECRET MILITARY MATTER

CIPHER ATTACHMENT 42 FOR THE TELEPRINTER [SZ42]

[Schluesselzusatz 42 zum Fernschreiber]

Volume I

Provisional Descriptions

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This is a secret document in the sense of Paragraph 88 of the German Penal Code (edition of 24 April 1944). Misuse will be punished according to the provisions of this law, insofar as other penalties do not come into question.

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I. Purpose and use of the device.

This device is for enciphering and deciphering telegraphic messages sent and received by teletype with a five element alphabet. Each station requires:

- 1 teleprinter (mechanical type)
- 1 cipher attachment 42.

The low voltage supply for the telegraphic side is provided by the nearest electrical circuit or from a Fernschreibanschlussgeraet\*. The local circuit between the teleprinter and the cipher attachment 42 is fed by the latter.

In any event 50 cycle 220 volt AC is required for the motor and the local\*\* AC supply. This can be obtained from any source of alternate current between 90 and 240 volts by introducing into the line the Fernschreibanschlussgeraet and setting it for 220 volts.

Messages are written out on the teleprinter at the sending end in plain text and after encipherment by cipher attachment 42 are sent out in cipher form over the land line or through the air; at the receiving end they are received by cipher attachment 42 which now serves for decipherment, deciphered and passed on to the local teleprinter. Transmission in the opposite direction results in corresponding fashion. The devices are so arranged that alternating communication between the two stations is possible using a monitoring tape at the sending station, and without any particular switching from "send" to "receive" an interruption may be flashed from the receiving station to the sending station.

II. Description of the device.A. Mechanical structure.

SZ42 contains under a common hood a telegraphic part which undertakes the reception of plain text, the holding back of the same, and -- after encipherment -- the sending

\* Fernschreibanschlussgeraet (FA-Geraet) seems to be, or to include, a voltage transformer and regulator such that with an input of 90 - 250 volt ac the output (indicated by setting) is constant at 220 volt ac.

\*\* Local current or circuit is that used either between the teleprinter and the cipher attachment or on circuits within the cipher attachment, in contrast to current and circuits involved in transmission to another station.

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out of the text in enciphered form. To make possible the independent use of the reverse process two receiving parts are provided, but only one mechanical sender is included. It is associated to the proper direction by a switch relay. The base contains all elements involved with current supply, connecting cables, sockets, and the operating switch.

The cipher unit, which has been developed as a removable, constantly locked construction part and as such can be mounted and tested independently, consists essentially of 12 wheels with lugs, some of which are driven forward regularly while some are driven intermittently. This produces the so-called mixed text [running key] which serves for encipherment or decipherment of the message text.

#### B. Upper part.

On a common base plate are mounted the motor with governor and spark suppressors, the two receiver shafts (horizontal position) with the receiver magnet systems, range finder assembly [Teilkreisanordnungen], the selector cam assembly [Wahldaumenbuchsen] and the other selector units, which in last analysis affect the setting of the receiving magnet contacts.

The drive of the sender shaft results from the left receiver shaft. Aside from a sender coupling and the drive gear wheel for the set of cipher wheels it carries the set of sender contacts, which with the aid of the cam controlled contacts provides for sending out the enciphered (or the plain) text. The spark suppressors and static suppressors are located in the same plastic case on the under side of the base plate.

In the middle of the front in a common container are mounted the dc milliammeter and the tachometer. The milliammeter with the aid of the switch key serves for occasional testing of voltage and polarity of both the local and outside circuit. The tachometer shows continuously the revolutions of the machine. It is driven by the right receiver axle. The four contact connector board visible on the base plate at the left rear serves for carrying current for illumination of the hood. On the lower side of the mounting plate are attached the governor resistors and spark suppressors. The soldering lug connector strip attached to the front side of the case of the spark suppressors has on its left edge a detachable metal connector. This serves to disconnect spark and static suppressors when making exact measurement of sender distortion, since by their electrical properties these would vitiate any exact measurement of distortion.



All wires of the upper part are collected in two cables at the left and right and from here part lead to the contact bar for the set of cipher wheels, part to the base.

The motor (enlarged teleprinter type MUN 608/42, 220 volt 50 cycle 50 watt 1500 rpm), wired as a heavy current motor [Hauptstrommotor].

Its speed is controlled by a centrifugal governor with an exactitude of  $\pm \frac{1}{2}\%$  by a periodical shorting of a resistor by the contact of a centrifugal governor. The governor consists of a casing which rotates with the motor with a rocker arm and spiral springs, the stationary governor contacts with their spark suppressors and a setting bar, which works through two gears [Übersetzungen] and ends at the front edge of the upper part in a knob. By turning this knob with the motor running the speed can be changed. Turning to the right increases speed, to the left decreases speed. The proper speed is attained when the indicator of the tachometer is on 0%.

The two carbon brushes of the motor are in the left bearing shield. The set of governor contacts and the gears of the setting bar are protected by a cap near which are mounted the spark suppressors consisting of two choke coils and a condenser.

On each side of the motor shaft is a (13 tooth) worm gear which provides the drive for both receiver shafts. These carry -- taken from back to front -- the worm gear wheel (Turbax, 42 teeth), the rear ball bearing, the forward ball bearing, and the receiver selector switch with its stop, which can revolve with the shaft by means of felt friction couplings and a coupling spring. The left receiver shaft has also a steel gear wheel to drive the sender and the right shaft has a turbax wheel to drive the tachometer.

Other selector units, such as range finder assembly [Teilkreisanordnung], swords, control levers, intermediate levers, contact levers for activation of the receiver magnet contacts, are attached to the common receiver magnet plate, which also holds the receiver magnet with its armature. Each of the receiver magnet contacts is enclosed in an airtight box (Emf and Emo).

The steps in reception, selection, and setting of the individual impulses of a letter are the same as with the Lorenz teleprinter and are assumed to be known. (The only difference is in the manner of numbering the selector units: In cipher attachment 42 -- viewed from the front -- the selector and setting elements nearest the front belong to the fifth impulse, the elements furthest back to the first impulse.)



When the device is switched on, with the receipt of the start pulse the multi circuit selector switch on the receiver shaft is carried along for one revolution. During this revolution the five impulses which are received successively are registered by the armature positions of the receiver magnet, held back by the swords and conducted through the setting bars to the five receiver magnet contacts, in which they are held for a definite period for further functions. With the arrival of the stop pulse the multi circuit selector switch is stopped again and the entire receiver system brought to rest. On the multi circuit selector switch there is, aside from the five tips which activate the control levers of the selector arms in a definite sequence, still a sixth tip which approximately at the time of reception of the third letter-impulse through the coupling activation lever and the uncoupler releases the coupling of the sender shaft, setting it free for one revolution. This control results through a coupling bar, which can be activated by the left or the right receiver magnet system. Through an intermediate lever it engages the gear coupling which serves to drive the sender.

The sender is mounted in a cast frame and consists in detail of the following parts:

The cam assembly [Nockenbuchse], which undertakes the control of the sending contacts, the start-stop-contact and the auxiliary contact,

the control levers with their bearings and the sets of springs,

the gear coupling, the coupling-spring and uncoupling arm,

the cam-wheel with the pressure-lever for the coupling zero-position or zero-setting, and

the drive-wheel for the set of cipher wheels.

Moreover, this cast frame contains the two ball bearings which are protected on both sides by dust caps against the intrusion of foreign matter. To provide all of the sending cams with sufficient oil in small quantities the inner side of the protecting cap contains a comb-shaped oil felt whose teeth touch the surface of the cams and so provide for a constant supply of oil. Replenishment of oil is through an oil hole in the cover and permits introducing a relatively large supply for a considerable period of time. Moreover, the felt rings, which are introduced between the individual cam wheels, take up a further supply of oil.

On the right side of the upper part are three switch relays mounted under a common hood in the so-called switch and relay box in the lower part of which is the switch for the plain text limitation [Klartextfunktion]. The switch



itself is only accessible after unscrewing the cover plate marked "KT-Schalter." Behind the governor is a fourth (delaying) relay which is required for holding back [impulses from] the plain text limitation.

The coupling zero-setting consists of the above named cam wheel on whose circumference runs a lever with a roller in the end, which is constantly held up by the tension of a spring. This arrangement is intended to assist the relays of the gear wheel coupling at the close of the revolution of the sender shaft in that, before the final release of the teeth the forward moving coupling part experiences an auxiliary acceleration by the spring which is pulled by the cam wheel.

The base plate of the upper part rests on a four-legged frame which is screwed to the base and contains the wiring as well as the plug board for the cipher unit. This serves for connecting all circuits with the cipher unit, the back side of which has the jack board correspondingly arranged.

The gear ratios between motor shaft, receiver shaft, and sender shaft are so selected that with a speed of the motor of 1500 rpm the receiver shaft makes 464 rpm and the sender shaft 8 rpm. These ratios correspond exactly to those customary in teleprinters and therefore guarantee the same leeway in start-stop operation as is found in teleprinters.

#### C. Base.

The base serves to hold the upper part and the cipher unit. The upper part is rigidly screwed to the base, the cipher unit is mounted on two rails so that it can be taken out. On the front side of the base is the operating switch for the entire apparatus, "Ein" and "Aus" [On - Off]. In the base itself are housed the different cable elements.

A common transformer, whose primary side is protected by a fuse, feeds on the secondary side two sets of dry rectifiers: one, for the supply of the telegraphic circuit, with special smoothing of the direct current by a choke, a capacitor and a load resistor, and the second, whose curve is smoothed out only by a capacitor, for energizing the relay circuits.

The variable resistor (rheostat), which can be set externally with a screw driver, serves for exact adjustment of the local voltage. Also built in are the heavy voltage cable, which supplies the power, the low voltage lead which connects with the land line or antenna [Fernleitungsanschluss], as well as high and low voltage sockets to receive corresponding connections from the local tele-



printer. The left and the right side of the base are shaped to make convenient handles for moving the apparatus. The inner part of the base which contains the above-mentioned switch elements can be closed airtight by a plate.

#### D. Cipher unit.

For security reasons the removable cipher unit is always encased. It can only be taken out after opening the front hinged cover (Zeiss-Ikon safety lock) and removing two lock screws at the left and right front. As most important parts there are united in this:

The 12 wheels with lugs which are arranged symmetrically with one another, two and two; the drive gears [Antriebsvorgelege] on the left side;

The control and blocking devices for the cipher wheels and the key contacts;

The plate with set of springs which carries all contacts and a mixing relay and which can be closed airtight by a cover;

The switch magnet UM, which with the operating switch set on "Aus" becomes active, and occasions two revolutions of the set of cam wheels with simultaneous activation of the unblocking levers;

The switch magnet KM with armature and intermediate lever, which can -- depending upon the plain text limitation -- affect the working of the drive mechanism;

And on the back the jack board connecting with the circuits of the upper part and those of the base.

The cipher wheels serve to control the cipher contacts through a control lever; they are driven by a set of gears [Zahnradvorgelege] and with the transmission of each letter usually move forward one step. All cipher wheels are divided up differently. The lugs are mounted movably and can be set by hand or with the lug stylus in one of two limit positions in which they are held by a stop [Rast]. Beside the lugs on a number band are the corresponding numbers of the steps.

For the choice of a definite initial position the wheel with the lugs can be turned relative to the driving part by using the finger wheel, which is firmly attached to the lug wheel, until in the window of the cover the desired number appears.

Such a cipher element consists in detail of the following construction parts:



The finger wheel,

The lug spring holding ring [Nockenfederhalterring], which clips in position all the stop springs,

The drive gear with the ball stop envelope [Kugelarsthuelse] and the blocking wheel [Sperrrad], which serves to eliminate temporarily the constant drive of part of the cipher wheels.

To limit the lugs in their sidewise position there is a [beveled] lug stop ring. The lug rings hold all lugs with spring stops [Rastfedern] and ball stops [Rastkugeln], the disc has on its outer edge the number band, in the interior is the wheel stop [Rastrad], in which the stop ball engages. All lugs are mounted on a wire ring so that they can turn. The entire arrangement is attached to the shaft by a bushing.

In all there are 12 such cipher wheels concerned with the encipherment of the five letter-impulses and, to be sure, the wheels 8 (41), 9 (31), 10 (29), 11 (26), and 12 (23), which are always moved forward one step with the transmission of each letter, and wheels 1 (59), 2 (53), 3 (51), 4 (47), and 5 (43) which generally participate in the forward motion but can be checked temporarily depending on the functions of wheels 6 (37) and 7 (61). In this way -- depending upon the setting of the lugs and the initial position selected for the 12 wheels -- with each advance of one step five different impulses ("Strom- or "Kein- Stromschritte") [+] or [-] are produced which are used for mixing with the five plain text impulses. Corresponding to the unique determination of the start-stop teleprinter, these plain text impulses come in one after the other at a speed of 50 bauds (7.14 symbols per second = 7 pulses per letter). By a corresponding selection of the drive ratios and the displacement of the contact controlling cam wheels with regard to one another, provision is made that this "Mischtext" [running key] is likewise produced at the same speed and with the same timing sequence. This timing displacement of the control and blocking functions with respect to one another permits putting the activation, for instance, of individual contacts in those time intervals in which they are not used for encipherment whereby the consequences of recoil phenomena and slight mechanical tolerances are rendered innocuous.

# 1. Lug controlled cipher functions.

The five cipher wheels of the uninterruptedly advancing cipher alphabet [Spaltencaesar = "Chi" wheels] which are located in the right side of the cipher unit and are divided into steps 41, 31, 29, 26, 23, control, in exactly the same fashion as the five cipher wheels on the left side



belonging to the irregularly moving alphabet [Spring-caesar = "Psi" wheels] with the steps 43, 47, 51, 53, 59, through contact levers the sets of contact springs mounted on a special plate. To each cipher wheel is associated a contact lever which under pressure of the spiral spring reads with its left arm by means of a roller the position of the lugs and with the contact surfaces of its right arm activates a pin which in turn controls the associated set of springs. If the roller finds a lug the tips of the moving springs are raised by the intervening pin; if no lug is present the moving spring remains at rest and the control lever is then held in its lowest position by a stop.

The command to hold up or to release the five Spr[ing] [Psi] wheels is produced through mechanical action by the lug setting of the two central cipher wheels with 61 and 37 steps respectively, which will be described later. In explanation of the process of blocking the Psi wheels (N 46312) it is enough for the moment to assume that a blocking lever shaft carrying five blocking levers moves a few degrees to one or the other of two possible end positions according to whether a hold-up or a forward step is to result. It operates, by two rocker arms [Ausweichglied] (3) under spring tension from either side, the actual blocking lever which is brought into engagement with the striking lever. This striking lever has on its left extension the actual blocking piece (1) which engages the blocking wheel. This is rigidly attached to the lug element [cipher wheel]. If, for example, the blocking lever shaft is turned very slightly clockwise so that the blocking lever itself stands in contact with the nose of the striking lever, then with a half revolution of the blocking cam in spite of raising the striking lever nothing is changed, so that the locking of its lefthand, half-rigidly-jointed-on extension with the blocking wheel is not released. If, meanwhile, movement of the blocking lever shaft results in the opposite direction, i.e. counter-clockwise, then the blocking lever under the influence of the spring tensioned rocker arms endeavors to escape to the right and to break the locking. When the cam begins its next half revolution with the transmission of the following letter then the locking is released, the blocking-piece is raised from the blocking wheel, and the cipher wheel rigidly connected to the locking wheel takes part in the forward movement, i.e. makes one step. By corresponding timing-displacement between the turning of the blocking lever shaft and the movement of the blocking cam, provision is made that the command to hold up or release the cipher wheels is stored for a brief time in the two rocker arms [Ausweichglied] which control the blocking lever until the blocking cam arrives at its highest point and checks whether there is to result a locking between the blocking lever and the striking lever or whether one already existing is to be done away with. Due to this timing storage between the announcement and the execution of the order, an extremely short time is required for the actual work of blocking or unblocking.

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belonging to the irregularly moving alphabet [Spring-caesar = "Psi" wheels] with the steps 43, 47, 51, 53, 59, through contact levers the sets of contact springs mounted on a special plate. To each cipher wheel is associated a contact lever which under pressure of the spiral spring reads with its left arm by means of a roller the position of the lugs and with the contact surfaces of its right arm activates a pin which in turn controls the associated set of springs. If the roller finds a lug the tips of the moving springs are raised by the intervening pin; if no lug is present the moving spring remains at rest and the control lever is then held in its lowest position by a stop.

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As mentioned, for control of the Spri [Psi] wheels there is responsible among other things an arrangement consisting of the two central cipher wheels No. 6 and 7 [motor wheels] (61 and 37) and their common control arrangement. The manner in which they work is shown schematically in figure N46153. On the left side of the figure are the two above mentioned lug wheels while on the right side of the figure the blocking lever shaft is indicated on which are rigidly mounted the blocking levers 1 to 5 and the control lever, while the foremost blocking lever rests on it with a ball bearing and so can execute its movements independent of it.

The 61 wheel, like the 5 Chi wheels, always participates in the revolution, i.e., it moves forward one step with the passage of each letter. According to its lug setting the contact lever whose roller reads the lugs will move a push bar to the right or to the left. This movement is stored in the two spring tensioned rocker arms of the foremost blocking lever. If, for example, when a lug is present the intermediate lever moves to the right so that the blocking lever is under corresponding advance tension, then, when the revolution of the cam 30 begins, its engagement with the appropriate blocking mechanism is released, this is drawn upward under the influence of spring and its left extension is drawn down, whereby the blocking piece no longer engages the blocking wheel of the 37 wheel, so that this is freed for the next step and can take part in the movement. In this way the motion of the 37 wheel is controlled in agreement with the lug setting of the 61 wheel, i.e. the 37 wheel is held back or released.

The 37 wheel is responsible by its motion and corresponding to its lug setting for the setting of the blocking lever shaft. Here again through a contact lever the path of the lugs is read and the turning of the blocking lever shaft a slight degree to one of its two final positions is accomplished by means of a device to be described in the following.

If, for example, the lug reader of the 37 wheel hits on a lug then the left arm of the selector lever [Wahlhebel] moves under the influence of the tension spring [Zugfeder], its right arm locks with the pressure lever [Druckhebel] so that under the influence of cam 26 and the pressure lever the tip of the release lever is raised against the tension of both spiral springs, thereby an advance tension toward the left is imparted to the control lever, which, however, leads to no movement so long as its tip is firmly locked with the blocking mechanism 2. Cam 28 now releases the control lever for a brief period as each letter passes through so that, in the case described, it escapes to the left and locks in the left hand notch. In this way the blocking lever shaft, which is rigidly attached to it, is



turned to the left. Thus the blocking levers 1 to 5, which in figure 46153 are only indicated, are put under advance tension to the left in the manner described more fully in figure 46132 and then exercise their actual blocking function when the appropriate blocking cams activate them one after the other. In this way the blocking and release of the Spri [Psi] wheels is accomplished in the same timing sequence as the motion of the Spa [Chi] wheels so that the two cipher wheels belonging to the same letter impulse execute their movements at exactly the same time.

## 2. Zero setting and the unblocking bars (W46332)

Independent of this control of the Psi blocking which results from the two command wheels [motor wheels] via the blocking lever shaft, provision must be made that after the transmission of an enciphered message has been completed the blocking commands stored in the different storage organs may be eliminated and if necessary the mechanical blocking of the Spri [Psi] wheels which may exist be released so as to make possible a new setting before starting the next message. Both these things occur dependent upon the position of the main switch, "Aus" "Ein". The elimination of blocking commands already prepared is secured by continuing the movement of the entire cipher set two steps. This is achieved when the operating switch is thrown from Ein to Aus by temporary shortcircuiting of EMO for a precisely limited time in that the switching magnet UM is energized. This attracts its armature and closes the contact um. The disengaging lever when attracted immediately comes into contact with the blocking latch [Klinke]. In this way contact um remains closed and the control cam has completed a half revolution. Only then is the latch released again and the contact um opened. By dropping the armature of EMO in the usual mechanical manner this time suffices to start the sender in the usual mechanical manner and thus impart to the entire cipher mechanism a forward movement of two steps. At the same time in switching from Ein to Aus through the attraction of the armature of UM, any existing blocking of the Psi wheels is released. Cam 32 and its cam lever move through the blocking bars a push bar which with the unblocking finger grips the nose of a blocking latch. Since this process has to be executed simultaneously for all five Psi wheels and one motion wheel, there is connected with the push bar by means of a joint a rocker bar, which rests on two ball bearings and extends across the width of the six cipher wheels to be released and to which are rigidly fastened the individual unblocking fingers. This blocking device through an angular extension [Ansatz] operates a further unblocking lever whose purpose is to release any existing blocking between the selector lever and the pressure bar. In this way the blocking conditions in the two control wheels for the Spri [Psi]

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wheels which may have existed at the end of a message are wiped out; moreover the blocking lever shaft which determines the control of the individual blocking levers for the six cipher wheels likewise is moved into a "free" position whereupon the cipher wheels are released one after the other by the successive effects of the five blocking cams.

### 3. Disturber Functions of the Spri /Psi/ Wheels (N 47001)

To extend the compulsory cycle of the Psi wheels as fixed by the lug setting of the motion wheels, i.e., to render unauthorized decipherment more difficult by adding new disturber functions, two so-called disturber functions have been provided of which one - the local disturber function - is derived from the lug setting of one Psi and one Chi wheel, the other - the so-called plain text function - is related to the polarity of the plain text [impulse] being transmitted and is added to the local disturber function.

#### (a) Local disturber function: /Psi 1 Chi 2 limitation/

For this purpose the lug setting of wheel 1 (the Psi wheel for the first impulse) and the lug setting of wheel 9 (Chi wheel for the second impulse) are compared and any identity is determined in the mixing relay. This relay is on the lower side of the plate for the spring contacts, where the spark suppressors for its control contacts are also located. This relay activates a switching magnet KM whose armature influences the selector lever mentioned in drawing 46332. This occurs in the manner indicated in detail in drawing N47001, in that, when the armature is attracted, the locking of the selector lever with the pressure lever can be released. In this way the compulsory control of the Spri /Psi/ wheels as determined by the lug setting of the motor wheels is interfered with in that a blocking command, which happens to be present at any given moment, can be cancelled through the K magnet by lifting the selector lever.

#### (b) Plain text function (plain text limitation): /KT-Funktion/

The control of the Spri /Psi/ wheels has thus far been dependent on the lug setting of the motor wheels (61 and 37 wheels) and likewise dependent on the lug setting of the first Psi and the second Chi wheel. The sequence of commands resulting is therefore entirely determined by the cipher wheels and is compulsory. If, in order to render unauthorized decipherment more difficult, it is desired to expand this rigid sequence of commands for control of the selector lever by a function



not derived from constants in the device, then the so-called plain text limitation is switched in. Its effect depends on the polarity of the individual letter impulse which is being enciphered at the moment and consists in supplementary introduction of the condition of the fifth impulse (whether + or -) into the circuit controlling the K magnet. Its effect consists, therefore, in cancelling under given conditions a stop command which is given by the motor wheels to the Spri [Psi] wheels. By the aid of the KT switch located in the switch and relay box at the right side of the upper part, this can be switched on or off. This switch is only accessible after opening its cover plate. Its purely electrical operation will be described later under IIID2b.

#### E. Hood

The whole apparatus is protected by a hood. On the front it has two windows with the inscription EIN and AUS, of which the one corresponding to the position of the operating switch is illuminated. For servicing the cipher unit, there is a large hinged window in the front covered with celluloid. The left and right side-walls have a series of vents which are repeated in the side of the hinged cover. In the front of the cover is an indentation to serve as a handle for opening it. The cover and hinged window, when closed, are held in place by a ball catch [Kugelrast]. The rear wall and cover of the hood are lined with sheets of felt to deaden sound, and these sheets are held in place by steel wires. Aside from the two lamps for the windows marking switch position EIN and AUS, three other lamps are mounted in the interior of the hood across the width of the cipher unit; these burn when the machine is in operation and light up the cipher bank evenly to facilitate setting the wheels. The leads for this circuit are through a four-part contact in the left wall of the hood which engages the corresponding contacts in the upper part. The hood is attached to the apparatus by four thumb screws which are tightened after the hood is in place.

### III. Description of wiring (wiring diagram N46292 and details N46801)

#### A. Drive

The drive for the mechanical functions of the apparatus is by a motor which is built as a 'collector' (induction) motor for connection to 220 volt alternating current. The collector motor is wired as a heavy current motor. For reasons of spark disturbance the winding [Wicklung] is divided into two halves which lie symmetrical to the armature. With the aid of a three pole jack



connection is made with the high voltage supply and the ground. The third conductor is grounded to the casing of the apparatus. The motor has a filter [Entstoerfilter] III which consists of two high frequency chokes and two condensers  $C_2$  and  $C_3$  each of 0.1 mf, with middle connection grounded to the casing. The contact of the centrifugal governor influences the governor resistor ( $W_1 = 1 k^0$ ) is located in the motor field [Motorstromkreis] and thus controls the speed of the motor shaft with a precision of about  $\pm 0.2\%$ . In the leads to the governor contact are the high frequency chokes  $Dr_1$  and  $Dr_2$  and parallel to them the condenser  $C_1$  with 0.5 mf. At points R and T there is the connecting socket for the teleprinter. At the same points is the primary coil of the high voltage transformer for current supply.

#### B. Local current supply

The primary side of this transformer is protected by a fuse Si (500 ma). On the secondary side there is produced 24 volt ac to feed the lights of the hood (3 Soffittenlampen = ?) and those for the red and green windows (one bulb each) which show the position of the operating switch ( $Sch_{VI}$ ). From a second coil [Wicklung] alternating current is taken which through a selenium rectifier and a capacitor of 50 mf at points 3 and 4 produces about a 70 volt dc which serves to operate all relay and switching circuits. The maximum permissible uninterrupted consumption is 0.6 amps.

In the third coil via a corresponding selenium rectifier, a smoothing choke and a capacitor of 8 mf at points 1 and 2 is developed dc current feeding the telegraphic circuit (about 100 volts, maximum 125 ma).

#### C. Telegraphic circuits

Cipher attachment 42 is connected locally to a teleprinter through the "socket for teleprinter" to whose rings a and c is attached the two wire, single phase lead [Zweidraht-Einfach-Stromleitung] (there is a short circuit connection between a<sub>1</sub> and c as well as between b and w<sub>2</sub>). Connection with the teleprinter is established with the aid of a four-pole low-voltage plug ZB 32, to points a and c of which the two wire lead is attached.

If the teleprinter and the land line are connected up, then with the operating switch on "Aus" the following path is established: the line connection at points a and c of the four-conductor connecting cord passes over the activated contacts I and II of the above mentioned switch to the socket and to the teleprinter itself. Its feed is from the distant station line (power source of the transmission line [Vermittlung] or of the subscriber's buss



[Teilnehmeranschlusschiene]). The polarity and voltage can be read from the same dc milliammeter by pressing the key T. This condition completes the auxiliary circuit from the telegraphic rectifier point 1 via the resistor  $W_5$  ( $3k^0$ ), contact V, EMF, contact IV, EMO, stop contact of the sender to point 2. By this the armatures of both receiving magnet systems are held attracted. Upon throwing the operating switch to Ein the teleprinter is linked up in series with EMO via contacts IV and V and the local telegraphic source of current. The dc instrument now shows, when the button is pressed, the polarity and voltage of the local current. This can be set by the aid of resistor  $W_5$  to the standard value of 40 ma. The line is now directly connected with EMF via contacts I and II of the operating switch, which gets its current from the line. When, with distant station switch on, there is a negative voltage at point a relative to point c, then the switching from Aus to Ein proceeds without any interruption of the current, i.e., without the armature of the receiving magnet dropping temporarily. (When starting to operate attention must be given to this. If necessary, the two connecting wires of the two wire lead are to be reversed!)

Whereas with the operating switch on "Aus" direct teleprinter traffic between the local station and the distant station can be carried on in plain text in either direction (the red window "Aus" is illuminated), when the switch is on "Ein" (green window) the cipher attachment 42 is switched in and ready to operate.

1. Sending teletype impulses from the teleprinter to the wire through cipher attachment 42  
(Timing diagram 1) N46032

As soon as any impulse groups are sent out by the local teleprinter, the armature of EMO is caused to drop. The five letter-impulses are stored via the swords in contacts  $emf_1$  to  $emf_5$  and held ready for sending out over the line. Meanwhile, by a special cam of the multi circuit selector switch of EMO, contact ur has been closed which causes relays UR I and UR II to operate. These relays are held operated for a definite time by  $ur^{18}$ . In this way the sender contact arrangement is switched to the line side by operating contacts 2 - 4 and 5 - 6 of UR I. To avoid interruption of the current before the actual switching, contact  $ur^{11}$  is closed, and when the switching is completed contact  $ur^{17}$  is opened. By the switching in of the sender distributor, which results mechanically at the expiration of a definite time, there are now transmitted to the line the start-stop impulses and the five letter-impulses from contacts 1 to 5. They pass through the winding of EMF and activate its armature as well as contacts  $emo_1$  to  $emo_5$ . These, however, are switched off by the switch contacts of UR II



which likewise has become active. Meanwhile the receiver multi circuit selector switch Empfangsdaumenbuchse has finished its revolution and contact ur which is controlled by its special cam has been opened again. The relays UR I and UR II, however, still remain operated since previously the auxiliary contact hk on the sending shaft has been transferred umgelegt and the relays are now held through ur<sup>13</sup>. Shortly before completion of the sender revolution hk opens whereupon relays UR I and UR II drop, the sender is switched from the line circuit to the local circuit once more in reverse sequence and with the aid of relay UR II contacts emo<sub>1</sub> to emo<sub>5</sub> are again linked to the sending contacts 1 to 5.

2. Reception of teletype impulses from the line to the local teleprinter through cipher attachment 42

This goes on without influence of switch relays since the sender distributor in rest position is connected to the local side necessary for this direction of traffic. The impulses arriving from the line activate the armature of EMF, which through the selector swords stores the letter in contacts emo<sub>1</sub> to emo<sub>5</sub> ready to send out again. By the revolution of the multi circuit selector switch of EMF after a definite time the sender distributor is started mechanically and now sends the impulses through EMO to the receiver magnet of the local teleprinter. Again the working of EMO and the setting of its pertinent contacts emf<sub>1</sub> to emf<sub>5</sub> is without effect because these are switched off by relay UR II which is dropped.

3. Switching off and "two revolutions" (Timing diagram 2) N46032

After conclusion of the message, cipher attachment 42 is switched off by turning the main switch to Aus and the local teleprinter is again connected directly with the line. In order to dispose of any control impulses stored in the cipher circuits it is necessary to cause the enciphering unit (cam shafts) to make a double revolution. This occurs as follows: by turning the main switch to "Aus" the power magnet UM is energized through contact Sch III, which closes its contact um. In this way the receiving system EMO is shorted. Its armature drops, the multi circuit selector switch begins its first revolution. At the expiration of a definite time the sender is engaged mechanically as usual and being rigidly attached to the set of cipher wheels causes these to move. After the multi circuit selector switch has completed its first revolution and, due to the receiver magnet EMO which is still shorted, has begun its second revolution, the cam wheels mechanically open contact um and the shorting to EMO is released. Thereupon the receiver multi selector switch Empfangsdaumenbuchse completes its second revolution and stops.



If now at the beginning of a new message the operating switch is thrown to Ein, the magnet UM is without current, which remains without any effect since its contact um has already been opened mechanically. By the breaking of the shorting to EMO which is caused by the cam wheel shaft only at the beginning of the second revolution of its multi circuit selector switch, the necessary double revolution and with this the two revolutions of the selector switch and also that of the sender and the movement of the cipher wheels is achieved.

#### D. Encipherment circuits

##### 1. The lug-controlled cipher function

Encipherment and decipherment of the five telegraphic impulses is by contacts  $spa_1$  to  $spa_5$ ,  $spri_1$  to  $spri_5$ , which are connected in the manner indicated in the diagram. These contacts are controlled by the cipher wheels, which are generally moved one step with the transmission of each letter. The setting of these contacts results successively (?) with a timing displacement with respect to the activation of the sending contacts such that no false sending can occur through recoil phenomena, etc. (see section on "Abwicklung").

Contacts  $ur^{II}_1$  to  $ur^{II}_5$  assume the desired position immediately after the receipt of the symbol begins, i.e., upon reception from the local teleprinter and the activation of UR II a circuit is prepared for contacts  $emf_1$  to  $emf_5$  whereas when receiving from the line, in which case relay UR II remains released, a path is prepared for contacts  $emo_1$  to  $emo_5$ . Contacts  $spa_1$  to  $spa_5$  are controlled by five separate wheels with movable lugs which are moved forward one step with the passage of each letter. Contacts  $spri_1$  to  $spri_5$  are also influenced by five other wheels with lugs which are moved forward in irregular steps by the effect of two motor wheels. By the combined effect the individual plain text impulses, as soon as they are stored in contacts  $emf_1$  to  $emf_5$ , are altered according to the encipherment. In the reverse process of decipherment the stored enciphered impulses present in the position of contacts  $emo_1$  to  $emo_5$  are deciphered by an exactly similar influence of contacts  $spa_1$  to  $spa_5$  and  $spri_1$  to  $spri_5$ . Following this encipherment or decipherment the altered impulses are sent out in succession by contacts 1 to 5 of the sender, whereby, as already mentioned, the time displacement of the contact activation with respect to sending avoids disturbances in the typing.

##### 2. Disturber functions of the Psi wheels /Spring-caesar/:

To render unauthorized decipherment still more difficult, two additional factors are provided for the irregular movement of the  $spri$  /Psi/ wheels.



- (a) A local disturber function and
- (b) the so-called plain text limitation.

(a) The local disturber function

As described under D1 the movement of the Psi wheels is normally determined by the 61 and 37 wheels and their lug settings. This drive mechanism yields as final result commands in irregular sequence for temporary holding up of movement of the five spri Psi wheels. The local disturber function consists in cancelling such a stop command for the Psi wheels 1 to 5 and is made dependent upon the lug setting of wheel 1 (Psi 1) and wheel 9 (Chi 2) existing at the moment. These two wheels have in addition to the above described contacts for encipherment of the plain text impulses an additional Morse contact which is controlled in the same manner as the enciphering contacts. These contacts check whether at a given moment Psi 1 and Chi 2 have a lug up or not. Corresponding to the existing lug setting these two contacts are activated and in the usual electrical mixture the coil of a mixing relay MR is excited according to whether or not a lug is up on both wheels. If both are the same, MR is not excited. This relay has only one Morse contact by which a power magnet KM is controlled whose armature mechanically suppresses any stop command that happens to be present and causes the Psi wheels to move with this letter. In this way there is added to the motor wheels as a further source of control for the rhythm of the Psi wheels the mixture of the lug setting of the first Psi and second Chi wheels. In this way there results, aside from a lengthening of the period of the Psi wheels, an increase in the difficulty of unauthorized decipherment since now no unique association of the different control sources for the blocking of the Psi wheels exists.

(b) Plain text limitation /Klartextfunktion/

Aside from this lug setting factor for the movement of the Psi wheels a further arbitrary influence can be introduced by switching on a so-called "plain text limitation" so that then the movement of the Psi wheels depends upon the fifth impulse of the plain text letter to be enciphered as well as upon the lug settings of Psi 1 and Chi 2. A special contact emfk tests the polarity of the fifth impulse of the letter to be enciphered (or the one which has just been deciphered) and determines whether it is + or -. For the comparison, contact mr is used which is mixed with the first named contact in the usual fashion. From the four possibilities there arise thus in each case two conditions in which a stop command for the Psi wheels produced by the motion wheels may be suppressed. If, for example, the fifth impulse of the letter to be worked on is - and at the same time the relay MR is dropped, the stop command for Psi wheels 1 to 5 produced



mechanically by the motor wheels by excitement of KM is cancelled. The same occurs if the fifth impulse of the plain text letter is + and relay MR is operated.

If we observe a cipher attachment 42 working with the plain text function enciphering and another working with it deciphering, the following is to be noted:

On the enciphering side the plain text is available immediately after receipt of the letter impulses from the local teleprinter and the criterion of the polarity of its fifth impulse is immediately available. On the deciphering side, however, this is only available after running through the entire attachment as it is ready to be sent out deciphered to the local teleprinter for printing. Moreover, it is to be noted that the influence on the movement of the Psi wheels is only possible at a third, still later period of time, namely when working upon the next following letter. From these timing conditions results the necessity of providing a device which will store up the criteria available at different times and hold them ready for action at a still later time when this condition will remain in force until the arrival of the following commands.

This supplemental device consists of the switch relay UR III and the delaying relay VR, the cam controlled contact arrangement VN with the mechanically operated contact vk and the magnet KM, whose armature mechanically affects the control of the Psi wheels. Furthermore, there is a switch KT which when thrown on causes the plain text limitation to function in collaboration with the lug setting of Psi 1 and Chi 2, whereas with MR dropped, only the auxiliary effect of Psi 1 and Chi 2 is operated. Since the effect of the wiring is different when sending and receiving for the above-mentioned reasons, the circuits for these cases are given separately in the wiring diagram described in the following; the upper part shows the apparatus with the plain text limitation switched on in both possible directions, receiving and sending. Since the criterion of the plain text limitation becomes effective later on the receiving side than on the sending side, the receiving side requires no storage device. Here the effect of the switching is as follows: Relay UR III, which is controlled in the same way as relays UR I and UR II (see 3a and b), remains unoperated during the entire receiving process. The position of contact emfk, which represents the polarity of the fifth impulse of the letter which is deciphered and sent out to the local teleprinter is compared in the usual way with the position of contact mr and their combined effect transmitted to the coil of KM and its armature, which when attracted cancels any momentarily existing stop order for the Psi wheels.



As soon as sending is begun, UR III operates and through  $ur^{III}2$  causes relay VR to operate if cam VN activates contact set vk correspondingly. After reaching rest position of VN, VR is operated and locks through its contact  $vr_3$ . This condition, however, only occurs if EMC is without current. With VR and UR III operated there arises, independent of further activation of emfk, for KM a circuit from + by way of mr,  $ur^{III}3$ ,  $vr_1$ , to - so that KM is influenced according to the position of mr. This condition remains until at passage of the next letter cam VN makes its next revolution and thus influences VR. If RMO  $\square$  has current, then by the activation of vk the relay is dropped whereby  $vr_1$  and  $vr_2$  take the opposite position. In case mr has not changed its position, KM now drops. In this way the joint effect of emfk and mr is transmitted to KM despite the different points in time at which these two contacts are controlled and the armature of KM at the appropriate third point in time mechanically engages the Psi wheels.

If switch KT is thrown to position "Ohne" (Diagram: apparatus without plain text limitation), then the effect of emfk through  $kt_1$  is switched off and the operation of UR III, which would occur in the sending direction, is suppressed by  $kt_2$ . The resulting circuit from -  $kt_1$ ,  $ur^{III}2$ ,  $vr_2$ , mr KM, to + is therefore valid for both operating directions and controls KM dependent upon mr, this in turn is dependent through MR upon Psi 1 and Chi 2.

Plain text limitation with change of direction  
(2 timing diagrams) N46382, N46392

From the preceding statements it can be seen that the criterion arising from the fifth plain text impulse and Chi 2 for the movement of Psi 1 to Psi 5 is stored up due to the fact that the plain text letter appears at different times on the sending and receiving sides, and its effect is exerted as the next letter passes through. Through the difference in registration on the sending and receiving side and through the postponement of the effect to the following symbol, it should be noted that when the direction is changed (sender becomes receiver or vice versa) there is no disagreement in the stored commands between the sending and receiving apparatus. Therefore we must study separately the cases in which, when the direction is changed, the polarity of the fifth impulse of the first letter of the text sent in the new direction is the same as or opposite to that of the fifth impulse of the last letter sent in the former direction. There are all told four cases, two where the change of direction results without any change in sign (the fifth impulse of both letters is + or -) and two others, in which when the direction is changed there is also a change of sign (last letter +, first letter - or vice versa). Timing diagram 3 shows the two possible cases of change of direction without change of sign of



emfk. In their time sequence are represented the position of contact emfk, the polarity of VR, the current in the coil KM, and the period of registration W. This represents the period of time in which the armature of KM can cancel a stop command for Psi 1 to Psi 5 which happens to be present. At other times such a command [cancellation] is not possible due to the fact that the steps necessary for moving the Psi wheels have already been started. In any case the start is from the basic position which is set when the cipher attachment 42 is switched on, i.e., in the position where after previous double revolution all commands still stored up from the previous message have been eliminated. To show clearly the influence of the selector lever W on the movement of the Psi wheels, two letters are sent through each time and, to be sure, it is the same letter repeated. For simplification the position of mr remains the same (position "lug"). In diagram 4 the same circumstances are studied when the change of direction is accompanied by a change of sign.

3. Change of direction without change of sign.  
Sending in both directions with "current" [+]

Starting from the basic position which the apparatus assumes after the double revolution and throwing the switch to Ein, the apparatus sends one letter with fifth impulse plus. Remembering that UR III has operated, VR, however, due to the position of emfk, cannot be excited, KM remains without current. On the sending side the functions therefore remain unchanged from what they were at the close of the double revolution. The same is true on the receiving side where KM, with UR and VR down, gets no current due to the position of emfk. This is not changed by sending of the second letter which, as mentioned, is identical with the first. If now the former receiver is used for sending and the former sender for receiving, no change with relation to the basic position of the double revolution occurs so that the resulting picture remains the same.

Sending in both directions with "no current"

The relations change as soon as, after assuming the basic position, a letter is sent out with fifth impulse negative. On the sending side shortly after the beginning of revolution of EMO the appropriate emfk transfers over. Since UR has operated, VR is switched in and through its coil I is excited depending upon cam VN and held by  $vr_3$ . However, this only occurs when activated by cam VN. At this moment KM gets current through -  $vr_1$ ,  $ur_{III}^3$ ,  $mr$ ,  $KM$ ,  $+$ . This condition remains for the following letter. However, it comes too late to fall within the registration time of selector lever W. On the receiving side the plain text whose fifth impulse this time is negative, is produced almost at the end of the passage through the machine.



Corresponding to the wiring diagram (receiving) KM receives current when emfk is thrown over, through  $kt_1$  and closed  $ur_{III2}$  as well as  $vr_2$  and  $mr$ . Here again the procedure results later at the time of registration for selector lever W. This condition, however, remains for the following letter. If this is like the one sent first, no change in the position of emfk occurs. Only selector switch W is activated by the armature of KM which is attracted in both the sender and the receiver and causes the cancellation of any stop command for the Psi wheels which may possibly be present. If now the role of sender and receiver is reversed whereby again the same letter is sent twice, the position of emfk on the sending side remains unchanged. Upon excitement of UR III and with the throwing of  $ur_{III2}$  KM first drops and is checked in this position by the selector lever. After cam VN has activated contact vk, through the circuit determined VR is excited and KM receives current through  $vr_1$  etc. This condition is held. On the new receiving side emfk likewise remains unchanged. VR remains operated for the moment. KM, however, immediately drops, whereupon KM comes again so that with the sending of the second letter in this direction the selector lever is thrown over.

4. Change of direction with change of sign.  
Sending with fifth impulse positive.

Here before the change of direction we have the same conditions as in figure 3 paragraph 1. As soon as the direction has changed and a letter is sent with negative fifth impulse on the new sending side, first emfk is transferred whereupon as usual VR and KM are later energized; too late for registration of the selector lever, however, they are held over for the following letter. On the receiving side the transferring of emfk, due to the last plain text letter produced, results later, whereby KM receives current and this effect remains. Upon sending out the second letter in the same direction the conditions remain, only the armature of KM makes its contact within the prescribed registration time.

Sending with fifth impulse negative

Starting from the basic position after double revolution on the sending side emfk is immediately transferred whereupon VR and KM are later energized in the usual sequence. On the receiving side the transferring of emfk occurs almost at the end of the process, whereby KM remains operated at the sending of the second letter in the same direction, the interference with the movement of the Psi wheels results equally from both sides.

With change of direction and change of sign (sending with fifth impulse plus) KM drops first, since VR was down, then emfk transfers. This state cannot energize VR, so

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that now action of the selector lever is prepared and exercised upon the second letter. On the receiving side due to VR being operated ( $vr_2$  open) KM drops first. After completion of the corresponding decipherment the emfk transfers whereupon through VR, operation of KM is prevented. Upon the arrival of the second letter the same conditions remain and on the sending and receiving side there is no effect upon the drive of the Psi wheels.

By considering individually the four possible cases with change of direction we have shown that on the basis of the collaboration of emfk, VR, VN, and UR III there always results a symmetrical influence on the motion of the Psi wheels on sending and receiving side after change of direction. For a better understanding of the interaction of the mechanical and the electrical functions which are involved in the sending and receiving processes, these are represented once again in two function diagrams (separately for sender and receiver) with a timing relation.

Function diagram sender (figures 1 to 15): N46094

For encipherment in sending out a letter the following functions come into play:

Fig. 1: The process is begun by sending the start-pulse, with five letter-pulses and the stop-pulse from the sender contacts of the local teleprinter.

Fig. 2: With this the armature of EMO drops, the multi circuit selector switch begins its one time revolution and the EMO cam mounted on it activates contact ur.

Fig. 3: With the aid of the auxiliary contact hk, located on the sender control bushing, the circuit is prepared for the relays UR I, UR II, and UR III (the last only with plain text limitation), as shown in figure 4, contact ur<sub>1</sub> is closed. By this the cam control sender of the encipherment device is connected to the line.

Fig. 5: Meanwhile the letter-pulses have been stored in the contacts of the receiver magnet system EMO, corresponding to the mechanical function of the impulses 1 to 5 one after the other.

Fig. 6: In the same rhythm contacts 1 to 5 of the Chi wheels are controlled, i.e., are already prepared for pulses 1 to 3 when the apparatus is put into operation.

Fig. 7: In exactly parallel fashion runs the control of contacts 1 to 5 of the Psi wheels.

Fig. 8: Meanwhile the sender cam assembly has started and with its contacts 1 to 5 and the stop cam sends out



in succession the start pulse, the 5 enciphered letter-pulses and the stop pulse. Thereby the encipherment contacts have impulses 4 and 5 of the letter just being enciphered and impulses 1 to 3 of the following letter are set up. This occurs according to the timing development for each impulse only in the time periods which lie in the middle between the switching points of the control.

Fig. 9a,b: Synchronized with the Chi and Psi contacts of figures 6 and 7 the two contacts  $spa_2$  and  $spri_1$  are controlled, which together influence the coil of MR (figure 15) and through mr represent the local disturber function, inasmuch as they control the circuit of KM.

Fig. 10: The armature of this magnet at definite times breaks the latching of the pressure lever and so suppresses a stop command for the movement of the Psi wheels.

When the plain text limitation is switched on, contact emfk, which represents the polarity of the fifth impulse of the plain text letter about to be enciphered, is added for mixing with contact mr. Since the plain text is immediately available on the sending side, the state of the fifth impulse has to be stored. This is effected by a mechanical activation of contacts vk by cam VN, whereby as shown in figure 12 relay VR is operated. In the same way the effect of contacts  $spa_2$  and  $spri_1$  (figure 13a,b) controls through MR with its contact mr (figure 15) the coil of KM. The armature developed as a selector lever then tests in the manner indicated in figure 14 the movement of the Psi wheels.

Fig. 15: The timing of the energizing of MR, as indicated in figure 15, is the same whether operating with or without the plain text limitation.

#### Function Diagram receiver (figures 1 to 10): N46104

The teleprinter impulses coming in over the wire for decipherment arrive first at the receiving magnet system EMP (figure 1), in which they are stored up in contacts 1 to 5 for the period of decipherment. Exactly parallel in timing is the activation of the contacts of the Chi wheels (figure 2) and of the lug controlled Psi contacts (Figure 3), which are again prepared for impulse numbers 1 to 3. At the expiration of a definite time the cam controlled sender begins its revolution and with its contacts 1 to 5 and its stop cam sends out the start-pulse, the five letter-pulses and the stop-pulse to be recorded as plain text letter in the local teleprinter. The two auxiliary contacts for the local disturber function,  $spa_2$  and  $spri_1$  (figure 5a,b) are controlled in exactly the same rhythm as the spa and spri contacts and



control through MR (figure 10) with its contacts mr the magnet KM, whose armature in the form of a selector lever (figure 6) influences the pressure lever for the movement of the Psi wheels. As soon as KT is switched on, the fifth impulse of the plain text letter appears when the deciphered text is sent to the local teleprinter (figure 7) in a special contact K<sub>1</sub>, which is controlled in the same manner as contact number 5. This then, corresponding to the wiring, is added to the effect of contacts spa<sub>2</sub> and spr<sub>1</sub> (figure 8a,b). Together these work directly or through the mixing relay MR (figure 10) upon the switching magnet KM, whose armature, as shown in figure 9, makes a contact with the control of the Psi wheels. The periods of activation of MR (figure 10) hold true whether used with or without the plain text limitation.

#### IV. Accessories.

- A. Message table:  
Purpose and use. See the key instructions for SZ 42.
- B. Case for transportation and safekeeping:  
Description and rules for packing.

The armored case supplied with the apparatus "Werner 101b" serves the two following purposes:

1. Serves for transportation of the apparatus.
2. Protects the apparatus during relatively long pauses in operation against unauthorized interference or tampering.

For transportation of the apparatus there are provided in the base two slots which fit on two rails to be found in the case. When the machine is thus placed in the armored case and pushed back until it stops, and bolted and fastened by the bar, then after locking the two doors the apparatus is ready for transportation.

For protecting the apparatus during operating pauses provision is made for leading the cables of SZ 42 and the teleprinter through an opening in the back wall so that the apparatus may be operated in the case and if necessary protected from unauthorized tampering during longer pauses by locking the doors of the case.

In the side walls of the case there are two grips so that the apparatus may be carried conveniently by four men. The bar which keeps the apparatus in place in the case is latched in horizontal position by a double ball catch so that unlatching is impossible even in case of considerable shaking. In its vertical position the bar



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is also held by a latch. The lid [Klappe] in the rear wall, which when open allows the lead cords to be carried through, is held in place by a ball latch when closed. The doors are held locked by a safety lock, and two bolts guarantee security. The lock cover disc guards against any dust entering the lock mechanism during transport.

In the frame which is attached to the inner side of the left door are the packing regulations, which are to be observed and which provide in particular the following:

1. Case to be unlocked and both doors opened wide.
2. The guard bar is to be pushed up to the left and latched securely.
3. Check whether the lid in the back wall has been closed.
4. Throw the switch of the apparatus to "Aus."
5. The high and low voltage cables of the local teleprinter are to be removed from the cipher apparatus.
6. High and low voltage plugs of the cipher device are to be removed from the switch sockets, the connecting cables are to be laid over the hood toward the front, around the handle of the front window and back over the hood. (See picture on packing regulations.) Both plugs are then to be inserted in the sockets in the rear of the apparatus.
7. Check the four thumb screws which fasten the hood to make sure they are screwed tight. See that the window is properly closed.
8. Two men take hold of the apparatus by the grips in the base and slowly push it into the case until it stops.
9. Then the bar is to be pulled down to the right and firmly latched.
10. The message table is to be slipped into the case alongside the apparatus and at its left.
11. The felt pad supplied with the apparatus is to be laid flat across the front and the edges tucked in neatly.
12. Then the two doors are to be closed. The armored case is locked by applying light pressure to the edge of the door and turning the key once.

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(After withdrawing the key see that the dust cover is in place over the key hole.)

On the inner side of the right hand door in a frame with a hold spring is the accessories box.

It contains:

- 6 nut drivers (wrenches)
- 2 styluses for lug setting
- 4 carbon brushes for motor
- 4 Soffitten lamps (24 volt) for illumination of hood
- 10 Wickmann fuses 0.500 amp.

Oils and greases as well as two oil cans for care of the apparatus are supplied separately.

Warning:

For locking the cipher section two keys are supplied with the same inscription. A number corresponds to that engraved in the cover disk of the lock.

For the armored case three keys are supplied. The numbers of these keys are stamped in the upper right edge of the transportation case.

\* \* \* \* \*

List of drawings of the mechanical and electrical details of SZ 42

- 1) N 46312 Blocking mechanism for the Ps wheels.
- 2) N 46153 The operation of the motor wheels, blocked position.
- 3) N 46332 Operation of the release bar.
- 4) N 47001 Operation of the switching magnet for the disturber functions of the Psi wheels.
- 5) N 46292 Basic wiring of SZ 42.
- 6) N 46801 Detail of wiring for the local disturber function of the Psi wheels.
- 7) N 46032 (Fig. 1) Activation of UR in sending.  
(Fig. 2) Switching procedure for double revolution.
- 8) N 46392 (Fig. 3) Change of direction without change of sign in the plain text letter.

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- 9) N 46382 (Fig. 4) Change of direction with change of sign in the plain text letter.
- 10) N 46094 Function diagram of the sender (SZ 42).
- 11) N 46104 Function diagram of the receiver (SZ 42).

Translated by Dr. Ray W. Pettengill  
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